25-30 January 2009 · Centre de Congrès Acropolis · Nice, France

Window on the Promenade des Anglais, Nice; 1938. Dufy, Raoul (1877-1953) Oil on canvas, 18 1/8 x 15 1/16 inches (46 x 38.3 cm). The Samuel S. White 3rd and Vera White Collection, 1967. Location: Philadelphia Museum of Art, Philadelphia, Pennsylvania, U.S.A. Photo Credit : The Philadelphia Museum of Art / Art Resource, NY

A Cruise Through Nice Waters!

ASLO Aquatic Sciences Meeting 2009

Meeting Abstracts

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ville de Nice

Nice Côte d'Azur

Schedule Overview

MONDAY

Room	Athena	Hermes	Med I	Med II	Med III	Thalie	Erato	Euterpe	Uranie	Calliope	Clio	Room
08:00 - 10:00	AWARDS & PLENARY ADDRESS											08:00 - 10:00
10:00 - 10:30	BREAK											10:00 - 10:30
10:30												10:30
10:45												10:45
11:00	012	GS07	025	053	031	047	042	072	039	023	010	11:00
11:15												11:15
11:30												11:30
11:45												11:45
12:00												12:00
12:15												12:15
12:30 - 14:30	LUNCH											12:30 - 14:30
14:30												14:30
14:45												14:45
15:00	012 con't	GS07 con't	025 con't	053 con't	031 con't	014	042 con't	072 con't	067	023 con't	010 con't	15:00
15:15												15:15
15:30												15:30
15:45												15:45
16:00 - 16:30	BREAK											16:00 - 16:30
16:30												16:30
16:45												16:45
17:00	012 con't	015	089	053 con't	031 con't	014 con't	042 con't	072 con't	067 con't	023 con't	010 con't	17:00
17:15												17:15
17:30												17:30
17:45												17:45

TUESDAY

Room	Athena	Hermes	Med I	Med II	Med III	Thalie	Erato	Euterpe	Uranie	Calliope	Clio	Room
08:00 - 10:00	AWARDS & PLENARY ADDRESS											08:00 - 10:00
10:00 - 10:30	BREAK											10:00 - 10:30
10:30												10:30
10:45												10:45
11:00	101	054	GS08	008	GS05	001	069	053 con't	064	048	035	11:00
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11:30												11:30
11:45												11:45
12:00												12:00
12:15												12:15
12:30 - 14:30	LUNCH											12:30 - 14:30
14:30												14:30
14:45												14:45
15:00	101 con't	054 con't	GS08 con't	008 con't	062	022	069 con't	092	064 con't	048 con't	044	15:00
15:15												15:15
15:30												15:30
15:45												15:45
16:00 - 16:30	BREAK											16:00 - 16:30
16:30												16:30
16:45												16:45
17:00	057	054 con't	GS08 con't	051	062 con't	022 con't	069 con't	092 con't	064 con't	011	044 con't	17:00
17:15												17:15
17:30												17:30
17:45												17:45

WEDNESDAY

Room	Athena	Hermes	Med I	Med II	Med III	Thalie	Erato	Euterpe	Uranie	Calliope	Clio	Room
08:30 - 10:00	AWARDS & PLENARY ADDRESS											08:30 - 10:00
10:00 - 10:30	BREAK											10:00 - 10:30
10:30												10:30
10:45												10:45
11:00	021	065	100	007	107	070	019	093	003	024	077	11:00
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12:30 - 14:30	LUNCH											12:30 - 14:30
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15:45												15:45
16:00 - 16:30	BREAK											16:00 - 16:30
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16:45												16:45
17:00	GS06	065 con't	100 con't	043 con't	018 con't	032 con't	084	091 con't	003 con't	020 con't	077 con't	17:00
17:15												17:15
17:30												17:30
17:45												17:45

THURSDAY

Room	Athena	Hermes	Med I	Med II	Med III	Thalie	Erato	Euterpe	Uranie	Calliope	Clio	Room
08:30 - 10:00	AWARDS & PLENARY ADDRESS											08:30 - 10:00
10:00 - 10:30	BREAK											10:00 - 10:30
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10:45												10:45
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15:45												15:45
16:00 - 16:30	BREAK											16:00 - 16:30
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16:45												16:45
17:00	045 con't	033	058 con't	079	099 con't	059 con't	GS03	082 con't	056 con't	098 con't	046 con't	17:00
17:15												17:15
17:30												17:30
17:45												17:45

FRIDAY

Room	Athena	Hermes	Med I	Med II	Med III	Thalie	Erato	Euterpe	Uranie	Calliope	Clio	Room
08:30 - 10:00	AWARDS & PLENARY ADDRESS											08:30 - 10:00
10:00 - 10:30	BREAK											10:00 - 10:30
10:30												10:30
10:45												10:45
11:00	102	040	005	068	097	004	017	073	GS03 con't	029	052	11:00
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12:30 - 14:30	LUNCH											12:30 - 14:30
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16:00 - 16:30	BREAK											16:00 - 16:30
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17:00	026	040 con't	009 con't	066 con't	081 con't	028 con't	004 con't	073 con't	078 con't	029 con't	041 con't	17:00
17:15												17:15
17:30												17:30
17:45												17:45

A CRUISE THROUGH NICE WATERS!

ASLO Aquatic Sciences Meeting 2009

Contents

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COUPLING THE CONTINENTS WITH THE OCEAN THROUGH THE LARGEST RIVERS – THE FATE OF DISSOLVED ORGANIC MATTER (DOM)

Which proportion of DOM reaching the ocean is eventually photochemically or biologically degradable? How much riverine DOM contributes to the heterotrophic production in coastal ocean? We address these questions by sampling the biggest rivers (e.g., Amazon, Lena, Mississippi, Yangtze) exporting >1/3 of DOM to the ocean. We hypothesize that photochemistry plays a major role in the decomposition of riverine DOM in the ocean. The photochemical and biological reactivity of riverine DOM in an oceanic matrix is assessed in laboratory in order to obtain modeling parameters for the photochemical and biological decomposition of DOM. These model parameters are applied to the environmental conditions of each river plume to quantify the rates of photochemical and biological decomposition in the coastal ocean. With this approach we determine the utilization rates of carbon and nutrients (e.g., N, P, iron) bound in the continental DOM. Our study will benefit from collaboration and allows opportunities for assessing global fluxes between the continents and the ocean. We warmly invite researchers interested in the export of matter from the continents to the ocean to join our effort.

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SPATIO-TEMPORAL VARIATION OF POTENTIALLY HARMFUL ALGAE BLOOMS IN SOUTH-EAST COASTAL SHALLOW WATERS OF THE IBERIAN PENINSULA

The spatio-temporal variation of potentially harmful phytoplankton cells was measured on 74 beaches along summer for three years (2006-2008) in the SE coast of Spain. This area includes the larges coastal lagoon of the Iberian Peninsula, the Mar Menor. A total of 647 samples, taken in beaches covering 350 Km of coast were analyzed. A total of 11 potentially toxic taxonomic groups were recorded. The geographical distribution shows a relationship between the spatial distribution and the density of these groups to runoff from watercourses, especially in the lagoon, and areas of low turbulence. The results show a clear pattern defined by nutrients and turbulence as major factor driving harmful algae blooms in the area.

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SPRING BLOOM SUCCESSION OF CILIATE COMMUNITIES IN RESPONSE TO WINTER WARMING

Phytoplankton spring blooms are major drivers of heterotrophic processes in the plankton and autotrophic biomass peaks are usually followed instantaneously by fast-growing microzooplankton. Global warming is expected to alter plankton spring succession by accelerating heterotrophic processes more than autotrophic processes leading to a mismatch between food demand and supply. Within this study different degrees of winter warming were simulated during three consecutive years and its potential effects on ciliate succession patterns during spring were assessed. By using indoor mesocosms filled with unfiltered water from Kiel Bight, natural light and four different temperature regimes, phytoplankton spring blooms were induced and the thermal responses of ciliates were quantified. Two distinct ciliate assemblages, a pre-spring and a spring bloom assemblage could be detected while their formation was strongly temperature-dependent. Instantaneous numerical responses of ciliates to increasing food concentrations showed a strong acceleration by temperature and elevated temperatures shortened the time span between phytoplankton bloom and ciliate biomass peaks. Overall, this mesocosms study gives further evidence that warming trends can strongly affect auto- and heterotrophic plankton communities leading to mismatch situations during spring succession.

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FREE-CHOICE LEARNING OPPORTUNITIES IN MICROBIAL OCEANOGRAPHY

The Center for Microbial Oceanography: Research and Education (C-MORE) is a recently established NSF-funded Science and Technology Center, comprised of six partner institutions and headquartered at the University of Hawaii. The C-MORE education and outreach program is focused on increasing scientific literacy in microbial oceanography. C-MORE offers a variety of programs to enhance scientific literacy in microbial oceanography, including several free choice-learning opportunities. For example, C-MORE provides online resources, public lecture series, an educational brochure on the key concepts of microbial oceanography, children's programs and exhibits at public venues, high profile documentaries, as well as professional development opportunities for educators. The majority of these programs encourage and facilitate the exchange of ideas between scientists, educators, and the general public by producing opportunities for these groups to interface in a creative and engaging manner.

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Baker, A., University of East Anglia, Norwich, United Kingdom,

DUST INPUTS TO THE (SUB-) TROPICAL NORTH ATLANTIC OCEAN; INFLUENCE ON OCEAN BIOGEOCHEMISTRY

The (sub)-tropical North Atlantic receives high dust inputs, originating in the Sahara. This presentation will discuss findings from the January-February 2008 UK-SOLAS cruise. The cruise was undertaken in winter, when dust inputs to the ocean are enhanced due to strong northeasterly tradewinds bringing dust from NW Africa and a more southerly position of the intertropical convergence zone (ca. 5-10°N). The nutrient concentrations in the study region were at nanomolar levels (nitrate 3-260 nM; phosphate 2-99 nM). Two major dust events were encountered during the cruise, resulting in a enhanced supply of Fe, Al and N to the surface waters. Enhanced surface water dissolved Al (up to 50 nM) and Fe (up to 0.37 nM) concentrations were observed in regions subjected to enhanced dust inputs. The dust inputs did not yield important changes in the bacterial community structure or their productivity. The dust inputs however had a strong influence on nitrogen fixation (diazotrophy), with the oligotrophic waters of the study regions showing enhanced levels of diazotrophy. The diazotrophs have high iron requirements which are met by the supply of atmospheric iron.

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THE ROUND SARDINE (*SARDINELLA AURITA*) STOCK ON WESTERN VENEZUELAN COAST: ITS RELATIONSHIP WITH HYDROLOGICAL CONDITIONS.

The most important sardine species in Venezuelan coasts for ecological and economic reasons is *Sardinella aurita*. Its distribution and the distribution of associated small pelagic species, as well as their relation with environmental conditions (especially the presence and intensity of local upwelling) were studied through acoustic surveys, hydrologic profiles with CTD and satellite imageries between 1995 and 2000. High values of acoustic density (proxy of pelagic fish biomass) were registered in waters with sea surface temperature between 20.2 and 28°C depending on the time of the year and location with respect to the coast. During some cruises, fish concentrated towards the coast and in others, they moved offshore. Since *S. aurita* is able to form aggregations at different depths, the depth of sardine schools were analyzed in relation to temperature, salinity and fluorescence profiles. The results showed that environmental conditions in the water column, as well as the thermocline location, were significant on sardine vertical distribution. In general, sardine biomass was found between 5 and 30 m, although there were some schools found up to 60 m deep.

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DIFFUSIVITIES IN THE FLOW ENVIRONMENTS AROUND FRESHWATER MACROPHYTES OF DIFFERING LEAF MORPHOLOGY

Flow environment around three macrophyte species, *Vallisneria americana* (linear-bladed), *Elodea canadensis* (whorled), *Ceratophyllum demersum* (dissected) and a circular cylinder (physical model) were examined at velocities of 1.3 – 11 cms^{-1} using light induced fluorometry. Under slow flow (< 5 cms^{-1}), filamentous loops of dye were observed attached to a leaf of *Vallisneria*, the individual leaf whorls of *Elodea*, and the individual leaf segments of *Ceratophyllum*. Turbulent eddies and flow separation on the leaf margins were observed downstream of all species at velocities > 8 cms^{-1}. Diffusivities (K) were on the order of 10^{-4} m^2s^{-1} and were greater in vertical (K_z) than in horizontal planes (K_x). The ranking of K_x and K_z was *Vallisneria* > cylinder > *Elodea* > *Ceratophyllum*, which appears to be related to the complexity of leaf morphologies among the macrophyte species. Moreover, the relationship of K vs. Re (Reynolds numbers) is consistent with published field and laboratory studies. These results suggest that fluid-morphological interactions are important for freshwater macrophytes.

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ISOPRENE BIODEGRADATION IN MARINE AND ESTUARINE ENVIRONMENTS

Isoprene is a volatile organic compound emitted mainly by plants and phytoplankton that affects climate in numerous ways. Terrestrial sources of isoprene have been well studied and degradation by heterotrophic bacteria is known. Isoprene production by marine phytoplankton may be greater than previously thought, and to date no marine isoprene degraders have been found. Isoprene enrichment cultures were prepared with water and sediments from different marine and estuarine locations, and isoprene degradation measured by gas chromatography. Several isolates were obtained from these enrichments and bacterial communities were analyzed by DGGE and 454-pyrosequencing of 16S rRNA genes. Isoprene was degraded in samples from several temperate and tropical sites, showing that marine isoprene biodegradation is a global phenomenon. Sequence analysis from DGGE gels and isolates growing on isoprene revealed Actinobacteria, Alphaproteobacteria and Bacteroidetes as widespread groups of marine isoprene-degraders. This is the first report showing the potential for isoprene degradation in marine and coastal environments. The discovery of isoprene's missing marine sink will enable more robust predictions of the flux of this abundant and climate-altering hydrocarbon.

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DIATOM FLOATATION AT THE ONSET OF THE SPRING PHYTOPLANKTON BLOOM

We have used a new type of sediment trap to test the buoyancy properties of diatoms during the triggering phase of the Spring Phytoplankton Bloom (SPB). Diatoms shifted from a sinking pattern before the bloom, while their populations were not growing, to a neutrally buoyant pattern during bloom development, when calm conditions prevailed, light was abundant and phytoplankton were growing actively. This shift was mainly due to the upward motion of centric diatoms during the growth phase. Our field experiment confirms laboratory experiments and field observations showing that diatoms, the paradigm of sinking phytoplankton, approach neutral buoyancy when conditions are adequate for growth. Thus, diatoms float opportunistically, a fact that is overlooked in most phytoplankton dynamics and SPB models that are used to predict the impact of climate change on pelagic ecosystems.

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CHANGES IN TEMPERATURE AND PRECIPITATION REGIMES ALTER THE ORGANIC CARBON DYNAMICS IN FRESHWATER ECOSYSTEMS

1. Global change is increasing both surface temperature and hydrologic cycle activity. Such changes in the temperature and flow regime may have major implications in freshwater ecosystems, and in particular, in the role of river networks in the global C cycle. 2. Main goals of this study were: (i) to study the interplay between flow and thermal regime on the stream organic C dynamics, and (ii) to explore the relative role of lotic and lentic compartments in the processing of organic C in the river network. 3. Organic C dynamics (transport, retention and evasion after processing) were simulated in different scenarios resulting from the combination of 3 flow regimes, 3 temperature regimes and 3 different configurations of the river network (33 = 27 scenarios). 4. Results indicate that increasing variability of flow regime reduced the ratio processed / exported organic C from river networks, that changes in both regimes increased the relative contribution of lentic habitats to the entire river network in terms of organic C processing, and that the changes in the flow regime were the most relevant.

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MOLECULAR MECHANISM UNDERLYING THE PLASTIC RESPONSE OF SEA URCHIN LARVAL FEEDING STRUCTURE TO FOOD AVAILABILITY

Climate change is broadly producing disconnects between predator and prey cycles. For marine benthic invertebrates, spawning is often timed to coincide with phytoplankton blooms. Observed phenotypic plasticity in feeding structure may help sea urchin larvae to cope with changes in food availability caused by timing mismatches. We hypothesize that sensors in the arms of pre-feeding sea urchin larvae can initiate ectoderm/mesenchyme signaling to adjust the size of the feeding apparatus (length of arms) to optimize expected food intake versus expenditure of maternal energetic stores. We are interested in identifying the molecular mechanism by which the environmental stimulus is translated into changes in mineralization rate and cell proliferation in the larval arms. A screen of pharmaceuticals targeted to known sea urchin neurotransmitters revealed that dopaminergic neurons are involved in regulating arm growth in pre-feeding larvae. Perturbation of dopaminergic function recapitulated phenotypic differences observed in larvae reared in high and no/low food treatments. Microarray analyses and timed gene knockout studies will further identify and test the role of transcription factors and signaling molecules involved in translating food availability into feeding structure outgrowth.

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NEMATODES VS MACROFAUNA ASSEMBLAGES ALONG AN ESTUARINE GRADIENT (MONDEGO ESTUARY, PORTUGAL)

The spatial distribution of the nematodes and macrofauna communities in the subtidal sediments along the estuarine gradient in the Mondego estuary was studied. The main purpose was to see if both nematodes and macrofauna assemblages were able to simultaneously characterise a priori defined estuarine stretches. Spatial distribution of nematode assemblages followed the estuarine gradients, allowing distinguishing: the freshwater and oligohaline sections, characterised by the presence of freshwater nematodes, low density and diversity; the Mesohaline section, where density and diversity were also low and the Polyhaline and Euhaline sections, with the highest density and diversity. Significant differences in macrofauna density were also obtained; the highest values were obtained in the euhaline and mesohaline areas. The euhaline stations presented higher species richness, while the freshwater section registered the lower values. The Shannon-Wiener index revealed significant differences between estuarine sections, in both estuaries, and community assemblages. From the management point of view, knowing the behaviour of both communities (nematodes and macrofauna) along the estuarine gradient gave interesting clues, namely regarding the cost and effort effectiveness of ecological quality status assessment in transitional systems.

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ASEXUAL PROPAGATION INFLUENCING JELLYFISH BLOOMS?

Mass occurrences of medusae can be found increasingly all over the world's oceans. The subjects of most studies on reasons for the blooms are the medusae. Different amounts of medusae are produced in the process of strobilation. This process is dependent on different factors (e.g. Chen and Ding 1983, Hernroth and Gröndahl 1985, Holst 2008, Loeb 1973, Stampar et al. 2008). But there is another factor which does not get the appropriate attention in research yet, the basis for the production of strobilae: the polyps. Polyps are able to enlarge their populations by many types of asexual reproduction using smallest amounts of tissue. The scyphozoan species *Sanderia malayensis* for instance shows a variety of types of asexual reproduction previously unknown. These new findings recently enabled the establishment of a new classification of asexual reproduction in Scyphozoa (Adler and Jarms in preparation). *Sanderia malayensis* is distributed in the indo-pacific region, but keeps spreading out to its temperature boundaries. Using its special abilities in asexual reproduction, *Sanderia* ensures both its survival and dispersal very effectively. Due to global warming, we have to face further dispersal of the species beyond indo-pacific regions and more mass occurrences as already seen e.g. in the Yangtze-estuary in 2004 (Xian et al. 2005).

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PERIODIC FLOODING RESTRAINS LOCAL SUCCESSION OF MICROPHYTOBENTHOS IN FLOODPLAIN LAKES

Periodic flooding of river floodplains and connectivity of floodplain lakes and rivers is suggested to interfere with the succession of microphytobenthos. To analyse this we: 1. studied the impact of flooding on the relationship between irradiance level (depth) and microphytobenthic community composition; 2. sampled three lakes with different connection-disconnection patterns; and 3. studied seasonal variation in community composition in one floodplain lake subjected to several flooding events. Shortly after flooding and subsequent connection of floodplain lakes, microphytobenthic communities showed a uniform species composition. Disconnection of the lakes was followed by a succession of species according to local environmental conditions. However, assemblages were often set back before outgrowth of local species or divergence of community composition became prominent. It is therefore concluded that flooding and the associated connection-disconnection regime of floodplain waters overrule the selective effects of local environmental parameters.

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HIERARCHY RESPONSES TO CLIMATE CHANGE? THRESHOLDS AND REGIME SHIFTS IN LAKES

With growing concerns of present global warming, we examined potential lake ecosystem responses, natural hierarchy responses, and possible shifts among abiotic and biotic system components. Specifically, we analyzed decadal data collected from Müggelsee, a lake in Berlin, Germany, for climate induced abiotic and biotic changes, their timing and type, and classified them as abrupt permanent, gradual permanent, abrupt temporary, or monotonic. We further categorized parameter changes as a function of system hierarchy, including lake physics (ice, temperature, stratification), nutrients, plankton, and levels of integration (i.e. species, taxonomical groups, total plankton). Contrary to current theory, data suggests abrupt responses did not occur in a hierarchy-dependent manner, nor was a clear pattern observed among taxonomical system based categories. Abrupt permanent changes were the most prominent response pattern observed, suggesting they may be driven by surpassed thresholds, as noted in previous case studies. Gradual changes coincided with affected abiotic parameters spanning an expansive time range. Nevertheless, the complexity of response patterns at the single system level manifested clear chronological regime shifts in abiotic and biotic parameters in spring and, to a lesser extent, in summer.

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THE NEED, APPLICATION AND RESULTS OF MICROALGAL BIOMASS ANALYSIS TO STUDY CARBON FLUX AND ITS CONTROL UNDER GROWTH AND STRESS CONDITIONS FOR BIOFUELS

Despite considerable accumulated data and collective know-how, the industrial production of alternative energy sources from algae is still predominantly hampered by limited biological knowledge focused on the metabolism and control of storage carbohydrates and lipids. A better working understanding needs to be developed and implemented to account for carbon flux from CO2 into protein, carbohydrate and lipid. This acquaintance should ideally be based on a general methodology for an accurate determination of total macromolecular classes in biomass, independent of the organism species and its physiological status. Such an approach is described, in which fresh algal biomass is hydrolyzed in acid releasing sugar monomers as well as free fatty acids and sterols that are further determined by colorimetry. The rapid method has been validated against independent procedures and optimized to account for significant cross-reactivity among species. Preliminary analysis of algal cultures under various conditions indicate an increase of the total lipid:carbohydrate ratio upon nitrogen depletion and/or increase in light intensity, or other abiotic stresses. The procedure is well suited for routine screening purposes, and data acquisition for preliminary analysis of carbon fluxes.

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TIME SERIES OBSERVATION OF BIOLOGICAL PRODUCTIVITY AT 43°N, 14°E IN THE WESTERN HOKKAIDO COAST, ISHIKARI BAY, JAPAN.

As part of an on going study on the dynamics of primary production process in the Ishikari Bay, Japan, time series measurements of biological productivity and several biogeochemical parameters were made at 43°N, 141°E in the northwestern North Pacific from September, 2007 to December, 2007. Biological productivity was classified as “high biomass” and “low biomass” season when (Chl *a*) concentration is >3.0 μg l^{-1} and <3.0 μg l^{-1}, respectively. Temperature average value changed from 8.4 °C in low biomass to 18.4 °C in high biomass season. During high phytoplankton biomass season, there was a corresponding decrease in dissolved inorganic nitrogen (DIN), phosphate and silicate mean concentration from 10.57 μm, 0.44 μm and 14.06 μm observed during low biomass to 2.52 μm, 0.14 μm and 5.06 μm, respectively. Phytoplankton biomass ((Chl *a*)) and primary productivity mean values was 6.92 μg l^{-1} and 36.12 μg C l^{-1} d^{-1} , respectively, in high biomass season. In the high biomass season, Micro-size percentage contribution to total phytoplankton biomass and primary productivity were (84%) and (85%), respectively. This result shows that biological productivity has a distinct seasonal variation in an oligotrophic coastal subarctic system.

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BACTERIAL AND ARCHAEAL DYNAMICS IN PHYLOGENY AND FUNCTION IN THE NORTH ATLANTIC DEEP WATERS: LINKING LARGE-SCALE CIRCULATION PATTERNS TO MICROBIAL OCEANOGRAPHY

The diversity and specific functional aspects linked to the N cycle of the bacterio- and archaeoplankton were investigated in the major deep water masses of the North Atlantic following the main driver of the thermohaline circulation, the North Atlantic Deep Water, from 65°N to 5°S. The phylogenetic composition of Bacteria and Archaea is not only depth-dependent but, specific water masses harbor specific prokaryotic communities. The specific composition of these communities in a particular water mass is maintained even over large distances. The distribution of archaeal and bacterial amoA genes were also determined. Archaeal amoA copy numbers decreased drastically with depth especially in the eastern subtropical Atlantic. This coincides with the lower nutrient concentration of the deep waters in the southern parts of the North Atlantic and the older age of the deep-water masses there. These data demonstrate that the diversity and potential nitrification activity are closely linked to the hydrology and chemical characteristics of the major water masses in the North Atlantic.

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A METHOD FOR COASTAL BUOYANT PLUMES DETECTION AND CLASSIFICATION FROM HYDROGRAPHIC DATA IN THE WESTERN COAST OF GALICIA (NW SPAIN)

A method for coastal buoyant plumes classification from observed TS data was developed. Data were obtained by means of an intensive 47 weekly sampling, from 15 CTD stations in two zonal transects perpendicular to the southwestern coast of Galicia. In this area, Western Iberian Buoyant Plume (WIBP) has ecological importance because it acts as a biogeochemical retention mechanism. A routine in MATLAB® was programmed to detect and characterize these plumes according with the location of the salinity front, either shallow or deep. An estimation of their dimensions at surface and at the bottom (y_s and y_b) was made. Using these new parameters, we classified buoyant plumes, according to Yankowsky (1997) criteria into surface, bottom or intermediate buoyant plumes. Finally, to validate our method, we compared MATLAB® theoretical results against observed examples. Most of these plumes throughout this year were classified as superficial and only few cases were characterized as intermediate.

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RESPONSE OF COASTAL ANTARCTIC PHYTOPLANKTON TO SOLAR RADIATION AND NUTRIENT MANIPULATION: AN IN SITU MESOCOSM EXPERIMENT

Increasing warming in Antarctica is affecting principally coastal and continental/ice margin areas. Coastal areas, despite the HNLC situation of Antarctic waters, are often iron rich and susceptible to develop large phytoplankton blooms, which are not yet predictable. We have tested the role of solar irradiance and nutrient inputs on phytoplankton bloom formation in Antarctic coastal waters by performing a large-scale, in situ, mesocosm experiment in Sur Bay (Livingston Island, South Shetlands, Antarctica). Phytoplankton growth, nutrient use and biomass development remained low at reduced light and at ambient irradiances, and increased greatly (> 30 fold) to yield large phytoplankton blooms in response to moderate shading. Nutrient additions (ammonium) greatly stimulated (> one order-of-magnitude) phytoplankton growth, biomass, and nutrient use at ambient irradiances, and lead to a decline in the specific UV absorption by MAAs, indicative of an alleviation from stress derived from high UV and irradiance. These results suggest a narrow window of irradiance where phytoplankton could develop blooms in the coastal Antarctica.

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CYANOBACTERIAL INDOLE-3-ACETIC ACID

Cyanobacteria are well known for their ability to produce secondary metabolites including phytohormones such as auxins. Indole-3-acetic acid (IAA) is the most studied plant growth regulator. Cyanobacteria synthesizing IAA were isolated from rhizosphere and identified by ribotyping. We used Salkowski's method for the screening of IAA producing cyanobacteria. IAA-like compounds were released by two unicellular cyanobacteria (identified as *Synechocystis* sp. and *Chroococcidiopsis* sp.) and two filamentous strains (identified as *Leptolyngbya* sp. and *Arthrospira* sp.). The IAA was further confirmed by HPLC. Arthrospira sp. produced the highest amount of IAA (0.2 mg ml^{-1}). IAA was produced only after addition of IAA precursor tryptophan, suggesting the involvement of the tryptophan-dependent pathway. The amount of IAA in the supernatant increased with cultivation duration (maximum after 5 weeks) and with tryptophan concentration (maximum at 1.5 mg ml^{-1}). Application of culture supernatant containing IAA to the *Pisum sativum* seeds decreased the root length while shoot length and number of roots increased.

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NIR REFLECTANCE AND ITS APPLICATION TO FLUORESCENCE, CHLOROPHYLL AND ALGAL BLOOM COASTAL WATER RETRIEVALS

In open ocean waters, with low [Chl] and turbidity, the height of the NIR reflectance peak above the baseline, dominated by its fluorescence component, has proved effective for chlorophyll fluorescence height (FLH) retrievals. In the more complex conditions typical of coastal waters, extensive parametric studies by us, including Hydrolight simulations, and hyper spectral field measurements (Satlantic, GER, AC-S, WET Labs) as well as sampling, in the Chesapeake, Georgia and Long Island, examination of NIR reflectance as a function of CDOM absorption, chlorophyll and mineral scattering/absorption, showed that as [Chl] and mineral concentrations increase, the NIR peak can be increasingly accounted for by elastic scattering, from chlorophyll and minerals, which is modulated by the confluence of rapidly changing chlorophyll and water absorption spectra, while the contribution of chlorophyll fluorescence becomes relatively insignificant. This improved understanding of NIR reflectance features, is shown to be effective, not only for defining better the range of FLH applicability, but also for the use of MODIS and MERIS band measurements in ratio algorithms for [Chl] and algal bloom retrievals, with minimal spectral interference from CDOM and minerals components.

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BIOAVAILABILITY OF RIVER DISSOLVED ORGANIC MATERIAL TO PHYTOPLANKTON IN THE GULF OF RIGA, BALTIC SEA

The marine areas directly influenced by discharges of large rivers are comparatively more productive than offshore areas. Mostly this is due to large amounts of dissolved inorganic nutrients brought by rivers to marine ecosystem. However, along with dissolved inorganic nutrients rivers caries also large amounts of dissolved organic substances some of which might be used by phytoplankton. The aim of this study was to run the mesocosm experiments to observe summer and autumn phytoplankton community response to enrichment by river dissolved organic substances divided in three molecular size classes – between 5 - 100; 100 – 1000 and larger than 1000 daltons. Several species and their groups of the summer and autumn phytoplankton communities responded well to treatments by dissolved organic substances. Small Cyanobacteria and Monoraphidium contortum were responding to almost all size groups of added organic material during both experiments. Oocystis spp. characteristic for summer and Chaetoceros wighamii, Cyclotella spp., Thalassiosira baltica for autumn responded to treatment by two and three size classes of organic substances, respectively, while Merismopedia spp. obviously shifted from one food source to another during summer experiment.

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BENTHIC NUTRIENT CYCLING IN THE DANUBE-INFLUENCED COASTAL ZONE

Benthic nutrient fluxes and benthic metabolism were measured in the coastal zone influenced by the Danube river. The results from sediment core incubations during SESAME project October 2007 cruise yield information on the spatial heterogeneity of benthic nutrient cycling and carbon sequestration with respect to proximity to the mouth of each of the three main branches of Danube (Kilia, Sulina, St George). Benthic oxygen consumption rates were higher at the prodelta off St. George branch (65.8 mmol m-2 d-1) than at the delta front areas (15.4 - 34.4 mmol m-2 d-1). On the other hand, benthic phosphate (0.05 - 0.39 mmol m-2 d-1) and ammonia (0.11 - 4.73 mmol m-2 d-1) recycling peaked in front of the mouths of Kilia and St George branches, respectively. The release of ammonia negatively correlated with benthic metabolism but positively with silicate fluxes, indicating that recycling of fresh and recently settled particulate material occurs at the end of the summer. This information is discussed in the light of data on pore-water profiles, sediment accumulation rates and the isotopic signature of sediment organic matter.

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NON-LINEAR EFFECTS OF WATER CLARITY ON FOOD WEB STRUCTURE – THEORY AND EVIDENCE.

Analyses of observed regime shifts in marine ecosystems are commonly restricted to environmental variables that have been monitored for some time such as temperature, stratification, and nutrients. The general lack of time-series of optical properties makes these less accessible for such analyses. Observations of Secchi depth and optical proxies, however, suggest slow but persistent multi-decadal darkening of certain coastal ecosystems. Here I present theoretical and observational evidence that such changes might cause non-linear effects on marine food web structure and therefore need to be addressed in analyses of past and future regime shifts.

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SEASONALITY OF PHYTOPLANKTON IN THE COASTAL WATER OF OMAN IN RELATION TO MONSOON WINDS

In order to understand the seasonal and interannual changes associated with monsoonal forcing, monthly measurements of sea surface temperature, salinity, nutrients, oxygen concentration, chlorophyll a, phyto- and mesozooplankton samples were carried out from February 2004 and onwards, at two stations on the southern coast of the Gulf of Oman. and one in the Arabian Sea (Masirah Island). Timing and the amplitude of the chlorophyll a seasonal peak exhibited gradual changes over years. Highest abundance of phytoplankton was associated with the south-west monsoon season. It was hypothesized that the shift of chlorophyll and phytoplankton biomass maxima might be rested on inter-annual differences in the structure and timing of seasonal cycles of nutrients. On the other hand, the mesoscale variability (in the form of eddies) markedly impacted monthly variation of planktonic communities and environmental characteristics. An issue of interaction of spatial and temporal variability was discussed

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IMPACT OF WIND STRESS CURL ON THE PRIMARY PRODUCTION IN UPWELLING SYSTEMS

Upwelling systems are primarily controlled by alongshore wind stress and nearshore wind stress curl mean and variability. A regional model is used to determine in what extent the primary production in the Peru Current System can be driven by the spatio-temporal structure of wind forcings. Atmospheric forcings that differ in spatial resolution and in the length of the time period considered are found to produce significantly different mean surface chlorophyll distribution and subsurface circulation in key subregions. We show that strongly negative nearshore wind stress curl can control the spatial structure of the alongshore poleward undercurrent which brings nutrient-rich waters to be upwelled, hence generating a productive zone similar to satellite observations. The biological response to local wind stress variability at intraseasonal to interannual timescales is also investigated. A burst in the wind can induce a vertical displacement of the nutricline and modify nutrient input into the euphotic zone, as well as a deepening of the mixed-layer depth and increase in dilution and light limitation. These two mechanisms, leading to opposite impact on the coastal productivity are investigated and quantified.

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THE ROLE OF ARCTIC ZOOPLANKTON IN BIOGEOCHEMICAL CYCLES: SUMMER RESPIRATION AND AMMONIA AND PHOSPHORUS RECLICLING RATES.

The carbon respiratory demands of Arctic zooplankton as well as their contribution to N and P regeneration were studied during July 2007 in a transect along the Greenland current, plus a grid of stations near the Svalbard islands, coinciding with a widespread and intense *Phaeocystis* bloom. Changes in dissolved oxygen concentration in the incubation experiments were continuously measured using Optodes®, and the NH_4-N and PO_4-P excretion rates were obtained by difference between initial and final concentration in experimental and control flasks. The average specific C losses and PO_4-P excretion rates were similar to previously reported data for Arctic zooplankton, whereas the NH_4-N excretion rates were higher by a factor of 3. However, the corresponding metabolic atomic quotients almost coincided with the average Redfield's stoichiometric ratios. The metabolic requirements of zooplankton in terms of C, and their contribution to nutrient regeneration by excretion, as well as the high N excretion rates observed are discussed in relation to the different trophic and hydrographic characteristics of the studied area.

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HIGH RATES OF DARK BICARBONATE FIXATION BY ARCTIC BACTERIA IN SEAWATER DILUTION CULTURES

Non-photosynthetic CO_2 uptake by microorganisms remains a poorly explored flux in microbial carbon processing, even if, essentially, all microbes are capable of CO_2 assimilation. While inorganic carbon represents the only carbon source for chemoautotrophic organisms, heterotrophs can incorporate it through anaplerotic reactions. The very few studies that have assessed rates of anaplerotic CO_2 fixation concluded that, generally, it constituted a minor carbon source (1-8% of cell carbon). Here, we show high rates of dark bicarbonate fixation (equaling rates of heterotrophic production) by arctic bacteria growing on 4-months aged seawater dilution cultures. Heterotrophic members of Gammaproteobacteria dominated the community in the enrichments as analyzed by 16S rRNA gene cloning and sequencing. Both Gamma- and Betaproteobacteria were detected as highly active in bicarbonate and leucine uptake (around 25% of active cells) by combined microautoradiography and fluorescence in situ hybridization. The addition of ammonium significantly enhanced the rates of dark CO_2 fixation in some of the dilution cultures. Our results suggest that CO_2 fixation by potential heterotrophs could be more relevant than currently assumed under organic carbon limitation in the Arctic Ocean.

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ASSESSING CELL VIABILITY IN ARCTIC ICE ALGAE COMMUNITIES

Cell viability in ice algae was quantified during spring 2008 in the Canadian Beaufort Sea during the CFL project. Percentages of live and dead cells were estimated using two different methods: a staining method (BacLight Kit) and an enzymatic cell digestion assay (non-staining). Temporal changes in the cell viability of ice algae were studied over 6 days. The influence of light was examined by comparing light and dark-exposed samples. The influence of temperature was tested by exposing ice algae samples to two different temperatures. Decreased viability was observed in the samples exposed to a higher temperature and darkness. This preliminary study will enable us to better understand the influence of light and temperature on the viability of ice algae in a changing Arctic.

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THE SPECIATION OF TRACE METALS POST EMILIANIA HUXLEYI BLOOM 2005-2006.

The aim of the study was to determine the trace metal speciation in samples collected post a natural *Emiliania huxleyi* bloom event in the Western English Channel. Virus and plankton abundances, the concentrations of trace metals (Cu, Co, Ni,) and other relevant parameters were measured in depth profiles. During the 2005 survey, chlorophyll *a* concentrations ranged from 0.03 to 3.45 μg L^{-1} and higher concentration were observed during the 2006 survey, reaching a maximum of 3.70 μg L^{-1}.Total dissolved Cu concentrations ranged between 1.87-3.73 nM in 2005, and between 2.11- 4.43 nM in 2006. All results indicated that ligand concentrations (3.62-5.98 nM in 2005, 6.10-9.76 nM in 2006) exceeded total dissolved Cu concentration. Copper organic ligand in both surveys presented high conditional stability constants (Log KCuL 12.20-13.77 M), which is characteristic of the strong Cu-binding L1 ligand class. The Cu^{2+} concentration range was higher in 2005 (0.14-1.69 pM) than in 2006 (0.01-0.73 pM), when a slightly higher ligand concentrations was observed. The average surface Ni values in the surveys were 3.99 nM for 2005 and 3.23 nM for 2006. Total dissolved Co ranged between 0.12-0.22 nM in 2005, and between 0.16-0.45 nM in 2006. Comparison between metal speciation in the culture experiments and findings of coastal surveys will be discussed.

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COMBINED NUTRIENT TOXICANT EFFECTS ON MEIO- AND MACROFAUNAL GRAZING IN SHALLOW-WATER SEDIMENT SYSTEMS

Shallow-water sediments are exposed simultaneously to several human-induced stressors, e.g. increased nutrient load and toxicants. Previous outdoor experiments, with intact sediment, studying the effects of toxicants alone or in combination with nutrient enrichment, showed that effects of toxicants (an antifouling substance or a PAH) depend on nutrient status. The finding that toxicants increased algal biomass after a few weeks, suggested possible indirect toxicant effects mediated through grazers. Since grazing rates were not measured in these previous outdoor experiments, we studied the combined nutrient+toxicant effects on meiofaunal and macrofaunal (*Hydrobia*) grazing rates in subsequent laboratory experiments. We found that the toxicants affected faunal grazing rates and that there was a nutrient–toxicant interaction. Our laboratory experiments support the hypothesis that indirect effects can be mediated through top-down control, showing that indirect toxicant effects can be as important as direct effects of a toxicant. Moreover, nutrient status has to be considered when predicting toxicant effects on shallow-water sediment communities.

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SEASONAL DISTRIBUTION AND SUCCESSION OF DOMINANT PHYTOPLANKTON GROUPS IN THE GLOBAL OCEAN FROM PHYSAT

Phytoplankton plays an important role in the global carbon cycle via the photosynthesis process. However, the efficiency of this "biological pump of carbon" depends on the nature of the phytoplankton. Most recent numerical models used to estimate the marine biological pump managed to represent the main phytoplankton groups. Monitoring spatial and temporal variations of the distribution of phytoplankton groups at the global scale is thus of critical importance. Recently, an algorithm, called PHYSAT, has been developed to detect major dominant phytoplankton groups from anomalies of the marine signal measured by ocean color satellites. For the moment, this method allows to identify nanoeucaryotes, Prochlorococcus, Synechococcus, diatoms and phaeocystis-like. The last version of PHYSAT was used to process daily global SeaWiFS GAC data between 1998 and 2007. PHYSAT observations as well as a validation part from in-situ data will be shown at the global scale over this period, as a monthly climatology. PHYSAT observations for three regions of particular interest (the Southern Ocean, the North Atlantic, and the Equatorial Pacific) will be shown in addition to the global monthly climatology.

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HETEROGENEITY OF BACTERIAL COMMUNITIES ASSOCIATED WITH STREAMBED SUBSTRATES UNDER VARYING WATER FLOW CONDITIONS

In Mediterranean intermittent streams, the variable exposure of water to biochemically-reactive benthic substrates affects the overall nutrient dynamics. However, little is known on how the hydrologic variability modifies the benthic microbial community and thus the nutrient assimilation, retention and mineralization. In this study, we analyzed the bacterial community composition and diversity at small spatial scale in sediment and leaf litter exposed to different water flow conditions. Samples were collected in the intermittent stream Cremera (Formello, Italy) from areas with slow- and fast-flowing waters, from isolated pools and from the dry bank. Community composition was analyzed by fluorescence in situ hybridization (CARD-FISH) and fingerprinting techniques (T-RFLP). Alpha- and beta-Proteobacteria dominated the community associated with sediments in all sites except pools. The communities associated with substrates having the highest organic matter content (i.e. sediments in pools and leaf litter) were widely distributed among the analyzed clusters. The differences observed within bacterial communities in term of abundance and composition could contribute to better modelling temporal and spatial patterns of dissolved nutrients in lotic systems under hydrologic intermittency.

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THE INTERNATIONAL CENSUS OF MARINE MICROBES (ICOMM): UNVEILING THE OCEAN'S HIDDEN MAJORITY THROUGH COMMUNITY 454 TAG PYROSEQUENCING

ICoMM is part of the Census of Marine Life Program that seeks to determine the diversity, distribution and abundance of microbes in the ocean. In collaboration with an international community of marine microbiologists, ICoMM has forged a large-scale effort to characterize microbial diversity in the sea through massively-parallel, 454-based sequencing of hypervariable regions of the SSU rRNA genes of bacteria, archaea and microbial eukaryotes. Sequencing is underway on 52 separate projects from environments including deep and shallow hydrothermal vent systems, polar regions, coastal and estuarine environments, the open ocean, the deep biosphere, oxygen minimum zones, corals and 8 of the 13 aquatic US Long Term Ecological Research Sites. ICoMM is simultaneously collecting data on environmental parameters that characterize all sampling sites and making these available through its affiliated website VAMPS (http://vamps.mbl.edu) that provides the ICoMM community with tools for comparing similarities and differences in the composition of microbial populations. To date, ICoMM has generated over 10 million tags. Analyses underway integrating diversity data with contextual information should inform us about the interplay between microbial mediated activities and oceanic processes.

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HABITAT SELECTION AT LIFE'S EXTREMES

Biotic (e.g. competition) and abiotic (habitat filtering) forces play a part in shaping microbial community structure in nature. Habitat selection predicts the co-occurrence of closely related taxa, while competition predicts the presence of more distantly related ones. If Hubbell's neutral assembly process were at work, chance and dispersal would diminish patterns of relatedness. Extreme environments provide an opportunity to test the relative importance of competition, habitat filtering and neutral assembly processes in shaping microbial community structure. Studies that quantitatively examine bacterial community structure within a phylogenetic framework are becoming more common. However, studies that consider microbial community structure at the level of all three domains of life (Bacteria, Archaea and Eukarya) are still rare. Do common forces operate across all domains of life within a given habitat? The Rio Tinto in southwestern Spain provides an opportunity to explore the question of community structuring both within and between life's domains. A study from the Rio Tinto that explores the relationship between environmental parameters and microbial community diversity across the three domains of life provides a means of addressing this question.

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EUTROPHICATION IN THE BALTIC SEA: CLASSIFICATION AND CONFIDENCE ASSESSMENT

Large parts of the Baltic Sea are classified as "eutrophication problem areas". Typical eutrophication signals are harmful algae blooms (often cyanobacteria), short lived filamentous algae washed upon the shores, reduced depth distribution of submerged aquatic vegetation, bottom waters depleted of oxygen, as well as kills of benthic invertebrates and fish. This has for decades motivated Baltic Sea states to implement nutrient management plans, and recently the states adopted the HELCOM Baltic Sea Action Plan which involves a full cooperation model for sharing nutrient reductions. This presentation will summarise the results of the HELCOM integrated thematic assessment of eutrophication status in the Baltic Sea with focus on causes, effects, and classification of eutrophication status in different parts of the Baltic Sea. Special focus will be put on the HELCOM Eutrophication Assessment Tool (HEAT) for eutrophication status assessment. HEAT provides both a Baltic Sea-wide harmonised classification of eutrophication status and an indirect assessment of the confidence/uncertainty of the eutrophication status assessment. The HELCOM integrated thematic assessment of eutrophication is intended to serve as an instrument providing guidance for and potentially also strengthening the implementation of the HELCOM Baltic Sea Action Plan.

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DISENTANGLING SESTON STOICHIOMETRY BY GENERALIZED LINEAR MODELS

Seston samples are known to be complex mixtures of autotrophic, heterotropic, and detrital particles, blurring the interpretation of the underlying stoichiometric signal. The autotrophic component of seston stoichiometry may be isolated by using chlorophyll or other proxies for algal biomass as covariate in regression analysis. Log-transformation is often used to stabilize variances in heteroscedastic seston data, unfortunately with the side effect of also changing the interpretation the regression coefficients. Generalized linear models with gamma distributed noise and identity link allow identification of autotrophic and non-autotrophic seston components also in highly heteroscedastic data. We demonstrate the applicability of this technique on a large seston data set from the NE Baltic Sea, and how it can be used to identify seasonal and spatial signals in seston composition, as well as general seston stoichiometry responses to nutrient enrichment.

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TRACKING THE FATE OF CARBON AND NITROGEN IN A SHALLOW PHOTIC COASTAL LAGOON

Shallow coastal bays are thought to play an important role in the delivery of carbon and nitrogen from land to the coastal ocean. Because of their location on the land margin, these shallow systems often suffer from eutrophication, due to nitrogen loading from adjacent watersheds. Sediment processes moderate ecosystem responses to nutrient enrichment due to production by benthic autotrophs, including both benthic microalgae (BMA) and ephemeral macroalgae, as well as heterotrophic bacteria. We will describe use of a novel perfusionator system, which allows introduction of labeled inorganic nutrients through either sediment pore water or overlying water to mesocosms at rates comparable to in situ N loads. We investigated uptake and retention of 13C and 15N by both BMA and bulk sediments in mesocosms with the following treatments: (1) ambient light vs. dark; (2) presence vs. absence of macroalgae; (3) introduction of isotopes from porewater vs. water column. Labeling took place for two weeks, followed by continuous addition of non-labeled nutrients for four weeks. Results demonstrated long-term retention of N and somewhat less of C over the 4-week period.

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DETERMINING THE CONSEQUENCES OF ANTHROPOGENIC PERTURBATIONS FOR ESTUARINE FISHERIES RESOURCES USING STABLE ISOTOPES – AN EXAMPLE FROM LAKE MELVILLE, CANADA.

The environmental consequences of human activities for renewable marine resources in estuaries are complex. Hydrological regime modifications may alter estuarine productivity, carbon flow through the foodweb and habitat availability for resident and migratory populations. Here we present a study of Lake Melville, Labrador to demonstrate the use of stable isotopes to characterize both carbon sources and fish habitat in this estuary of the Churchill River. Salmonids provide end member stable isotope referents for freshwater, estuarine and marine consumers. Brook and lake trout from the Churchill River, sea trout and Atlantic salmon from the food fishery in Lake Melville have stable isotopic signatures reflecting littoral-freshwater, pelagic-freshwater, estuarine and marine habitat use, respectively. Smelt, a principal prey for sea trout and ring seals, link the lower food web to fisheries resources of Lake Melville and support a winter fishery. Ring seals are a traditional food for the coastal peoples of Labrador. Results of the study will be used to explore effects on estuarine fisheries resources of modified freshwater inflow resulting from a proposed hydroelectric project on the Churchill River.

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REGIONAL CARBON BURIAL IN SW GREENLAND – A SIGNIFICANT ROLE FOR LAKES?

Estimates of regional carbon cycling in the Arctic have focussed on terrestrial ecosystems because of the large carbon stores in tundra soils. Although lakes may contain less carbon than surrounding sedge tundra they are important for the processing of catchment-derived carbon. The Kangerlussuaq area of SW Greenland, a glacially-scoured landscape contains thousands of lakes (comprising nearly 15% of the land area). In contrast to areas of sedge tundra with thicker soils, the terrestrial vegetation around Kangerlussuaq is dominated by dwarf shrub tundra and soils are thin. Moreover, vegetation and soil cover is patchy due to low effective precipitation. To determine whether lakes make a substantial contribution to the regional C-budget, carbon storage and mean accumulation rates for the last 150 and 8000 years were estimated for 12 lakes using palaeolimnological methods (210-Pb and 14-C dating). Sediment-derived burial rates were compared with contemporary sediment trap C-fluxes. A comparison of the upscaled estimates of lake and soil carbon content suggests that lakes are an important component of the regional carbon budget: the mean Holocene C burden for lakes is 40 kg C m^2.

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ECOLOGICAL RESPONSE OF UPLAND LAKES IN IRELAND TO MULTIPLE STRESSORS: PALAEOLIMNOLOGICAL PERSPECTIVES

Afforestation has been promoted as an alternative to extensive agriculture in upland regions of Ireland but ploughing, fertilization and planting on organic moorland soils is likely have considerable effects on ecologically sensitive upland lakes. These lakes are also subject to changing sulphate deposition, DOC losses and temperatures. Given the lack of monitoring predating the initial afforestation in 1950s, it is difficult to evaluate how these multiple stressors impact on oligotrophic upland lakes. To define the extent of these impacts for a series of upland lakes in northwest Ireland, covering a gradient from complete catchment afforestation to control sites with no planting, we took sediment cores and used a range of palaeolimnological techniques (diatom and HPLC pigment analyses, 210-Pb dating, near-infrared spectroscopy and aquatic macrofossils) to describe recent trends in diatom diversity, dry mass accumulation rates, algal biomass, DOC and changes in macrophyte cover. These were coupled with forestry planting and fertilization histories, regional climate data and analyzed using redundancy analysis to determine the significant drivers of the observed ecological change.

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PLANKTON COMMUNITY STRUCTURE, BIOGEOCHEMICAL CYCLES AND CARBON EXPORT IN THE OCEAN: AN EVOLVING PARADIGM

The basic paradigm for the relationship between plankton community structure and ocean biogeochemistry was articulated by pioneers of marine ecosystem modelling such as Gordon Riley and John Steele, namely nutrients and light driving primary production, regeneration by grazers and export to the deep ocean being balanced by nutrient input. The earliest (simple) models did remarkably well at capturing bloom dynamics and seasonal cycles of phytoplankton. Yet, the link to export has been, and remains, notoriously uncertain. The interaction between plankton community structure, marine biogeochemistry and export is complex. Unravelling this complexity has led to a continually evolving paradigm, progressively including factors such as the microbial loop, size structure, multiple nutrients, plankton functional types, ballast minerals, etc. Mathematics is the language of science, thus emphasizing the need to convert these concepts into mathematical form, demonstrating quantitative understanding and laying

the foundations for prediction. In this context, just how good are our models for relating plankton community structure, biogeochemical cycles and carbon export in the ocean?

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TEMPORAL SHIFTS IN COMPOSITION AND DIVERSITY OF BALTIC SEA BACTERIOPLANKTON: ENVIRONMENTAL DRIVERS FOR POPULATION DYNAMICS AT CONTRASTING TAXONOMIC RESOLUTION

Variation in ecological traits causes bacterial groups and populations to respond in contrasting ways to environmental drivers. Learning about this will help us understand the function and control of individual populations in complex ecosystems. We used 454-based pyrosequencing of the hypervariable region V6 of 16S rRNA to study temporal shifts in a Baltic Sea bacterial community and link community changes to biological and chemical structuring factors. Surface samples were collected from May-October at the Landsort Deep. The analysis rendered on average 20000 sequence reads for each of the eight seasonal samples analyzed, providing the first detailed description of Baltic Sea bacterial communities. Sequences were binned into operational taxonomic units (OTUs) and phylogenetically annotated using an in-house developed bioinformatics pipeline. The communities were generally dominated by Actinobacteria, Alpha-Proteobacteria, Bacteroidetes and Cyanobacteria. Community composition varied dramatically over time supporting the idea of strong temporal shifts in pelagic communities; 50% of the OTUs (at 5% sequence similarity level in region V6), were found in only one sample whereas only 2% were detected throughout the sampling period. Variations in overall community structure and in individual taxonomic groups were correlated with changes in temperature and phytoplankton (Chlorophyll a) concentrations.

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DECREASE IN THE CONCENTRATION IN BLUEFIN TUNA BY BREEDING FISHES WITH LOW MERCURY LEVELS

The purpose of this study was to reduce the mercury level of cultured bluefin tuna by feeding bait with lower mercury levels. The control group was fed spotted chub mackerel, whose mercury concentration is 0.052 ppm, and the test group was fed horse mackerel (0.016 ppm) and Japanese sand lance (0.037 ppm). Breeding continued for 18 months (test group) and 19 months (control group). During the feeding period, in the test group, the mercury concentration increased from 0.25 to 0.55 ppm, corresponding to a weight increase from 5.0 to 40.0 kg. In contrast, in the test group, the mercury concentration was less than 0.30 ppm in all parts of the muscle, and there were no significant increases in mercury concentration in spite of increases in body weight. Feeding of horse mackerel can decrease the mercury level of cultured bluefin tuna. The mercury concentration in the resulting cultured tuna is lower than the strict standard of Japan, and the present study is the first report of production of bluefin tuna with such a low level of mercury.

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NEW AND INNOVATIVE METHODS FOR MONITORING ECOLOGICAL CHANGES ASSOCIATED WITH AQUACULTURE

One of the characteristic features of traditional aquaculture systems such as finfish net pens or shellfish gear is that they are spatially static and wastes emitted by the cultured organisms may have cumulative effects on the surrounding environment. Aquaculture sites are generally monitored to ensure that these effects (water quality or benthos) do not exceed environmental quality standards. These standards are based on a suite of chemical and biological variables that have been adopted and adapted from coastal or estuarine regulatory agencies, and in some cases, the standards are neither appropriate nor sufficient to determine impacts to the relevant ecosystem. This presentation will review the pros and cons of accepted standards and will explore several new tools that have been developed recently for use in environmental impact assessment and monitoring of aquaculture leases. Improved understanding of the environmental implications of human activities should bring us closer to an "ecosystem approach" toward management of our coastal and marine resources.

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CAN EUTROPHIC FISHPONDS RESPOND TO THE WATER FRAMEWORK DIRECTIVE REQUIREMENTS? FIRST ANSWER ACCORDING TO THE BIODIVERSITY OF MACROINVERTEBRATES AND DRAGONFLIES

The Dombes region (France) is characterised by about 1100 fishponds located in an agricultural area. Traditional practices are based on alternation of fish farming and crop farming in the ponds which range from eutrophic to hyper-eutrophic. These ecosystems belong to the heavily modified or artificial waterbodies defined by the Water Framework Directive and thus, they must reach a good ecological status in 2015. However, there is a need to define both appropriate indicators of water and biodiversity quality, and conditions reference for these particular ecosystems. A research project started in 2007, measuring local and regional environmental variables (e.g. water physico-chemistry, land use around the ponds) and biodiversity (from phytoplankton to ducks and amphibians). The results presented here concern the biodiversity of both dragonflies (57 ponds) and aquatic macroinvertebrates (in a subset of ponds). The use of Generalized Additive Models allowed to link the observed differences in species richness with ponds characteristics, and underlined the important impact of both local (e.g. water and sediment characteristics) and regional (e.g. percentage of forest in the watershed) variables.

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IN SITU MEASUREMENTS OF PHYTOPLANKTON SIZE DISTRIBUTION BY LASER-SCATTERING PARTICLE ANALYZER

Size distribution is an important issue in the physiology and ecology of phytoplankton. Cell size is an indicator of metabolism and growth, and it plays a key role in the life cycle of phytoplankton species. In the present study, we use a laser-scattering particle analyzer (LISST-100X) to assess changes in size distribution of the noxious species *Alexandrium taylori* (Dinophyceae) during a high-biomass bloom in two Mediterranean beaches. Previously, we develop a size-fraction method to discriminate phytoplankton species and groups present in the natural community, and we quantify their abundance. LISST-100X measurements of cultures in the laboratory as well as field recordings are validated to simultaneous microscopic counts. The results obtained demonstrate the accuracy of the instrument's measurements. Further, we present in situ growth rates of *Alexandrium taylori* estimated from the changes in cell size distribution measured by the LISST-100X, assuming that variations in cell size are indicative of cell division.

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MODELLING OF MIGRATION AND DISTRUCTION PROCESSES AT AIR-WATER INTERFACE FOR BATTLE POISONS

In present still remains actual question of the ecological safety connected with the chemical weapon sinking in Baltic Sea. In earlier published models of migration and transformation battle poisons (BP) in the sea environment it is considered that all BP are quickly dissolved in sea water and are exposed to hydrolysis and its products are utilized by heterotrophic bacteria. To construct adequate model of migration and destruction processes, it is necessary to consider variety of the natural factors displaying joint influence on behavior of an impurity of hydrophysical, physical and chemical and biological processes. Besides, to increase of reliability of forecasting it is necessary to use nonlinear models of transformation of an organic impurity in water as such approach allows predicting behavior of a mixture of organic connections with various half-life periods. Yperite and lewisite are main BP and because of their surface-active properties are collected in a water-air microlayer. Besides, these substances are a part of an organic film on a surface of the weighed particles, dissolved with the oil and chlorinated hydrocarbons. In turn, the tabun and sarin, as well as other water-soluble organic matters, also can concentrate in a surface microlayer due to general properties of such structure. So it would be useful make destruction influence on BP in air-water system according to this model.

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ORGANIC LOADING IMPACT ON COMMUNITY METABOLISM AND NUTRIENT FLUXES IN MEDITERRANEAN SEAGRASS (*POSIDONIA OCEANICA*) MEADOWS

Fish farming impact on the seasonal carbon and nutrient fluxes of the seagrass *Posidonia oceanica* was assessed in the Aegean Sea (Greece), using in situ incubations, in order to detect changes in community metabolism with organic loading of the meadow. Net community production (NCP), respiration (R) and gross primary production (GPP) at the impacted community decreased by 60%, 34% and 44%, respectively, compared to those at the pristine one. NCP decreased with decreasing shoot density and increasing sedimentation measured under the fish cages. Organic loading induced DOC release by 204%, DON by 1639%, NH_4 by 122% and NO_3 by 26%, in respect to the pristine community, while it shifted the community from sink of DOP and DIP at the pristine to source at the impacted community, on annual basis. Organic loading altered ecosystem state by lowering the productivity and by enhancing nutrient release and eventually shifting sediments from sinks to sources of nutrients.

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AN EXPERIMENTAL AND GENOMIC APPROACH TO INVESTIGATING GRAZING RESISTANCE IN SYNECHOCOCCUS

Synechococcus is an important contributor to carbon fixation in marine systems, yet rates at which these organisms are consumed and factors regulating grazer interactions are poorly understood. Our study combines grazing experiments with genomic analyses to explore mechanisms of grazing resistance and further elucidate *Synechococcus*:grazer dynamics. Grazing experiments were conducted using *Synechococcus* (WH8102, CC9605, CC9311, CC9902) with marine flagellates (*Oxyrrhis*, *Goniomonas*) and a ciliate (*Eutintinnis*) as grazers. Flagellates exhibited distinct differences in ingestion rates, proportion of population feeding, and survival among different *Synechococcus* strains. Grazing and growth rates were highest on CC9311, while the lowest rates and percentage feeding were observed for 9605. *Goniomonas* grew well on all strains of *Synechococcus*, while *Oxyrrhis* only grew well on CC9311, suggesting that the value of *Synechococcus* as a food source may depend upon both the grazer and the strain of *Synechococcus* being consumed. Current grazing experiments are utilizing strains of *Synechococcus* whose whole genome sequences are known in order to relate genetic components to grazing resistance. Our study provides insight into the complex dynamics shaping grazer interactions in marine microbial food webs.

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CARBON AND NITROGEN DYNAMICS WITHIN A FLOODPLAIN MOSAIC

Denitrification in floodplain soils can dramatically reduce river nitrate loads. Especially where carbon availability limits denitrification, organic matter from terrestrial plants may be a key energy source for denitrifying bacteria. We investigated vegetation type as a possible driver of spatial variability in denitrification rates across the Nyack Floodplain of the Middle Fork Flathead River in Montana. We sampled soil from 4-5 depths in 13 soil pits located in forest stands, meadows, and gravel bars. We assayed denitrification potentials, KCl-extractable N, water-extractable C, C bioavailability, and total C and N. Denitrification at most sites was co-limited by C and N, confirming the joint importance of primary productivity and N supply. Denitrification potentials were below detection limits for soils below 30cm except for a few unusually fine-textured soils near the water table (1-3m depth). In the top 10cm at each site, we found the highest denitrification potentials and N and C concentrations at forested sites, followed by grassy sites and finally gravel bar sites. We conclude that plant cover is a useful predictor of C and N dynamics at Nyack Floodplain.

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VARIATION OF THE PLANKTON METABOLIC BALANCE FROM THE MARGIN TO THE CENTER OF THE OLIGOTROPHIC NORTH ATLANTIC SUBTROPICAL GYRE

Discussions about the magnitude of the plankton photosynthesis to respiration balance in the open ocean have led to some questions e.g. is community metabolism controlled by primary production? how does P:R relationship vary within and between biogeographic provinces? To study these questions, a cruise was carried out on October-November 2006, consisting in a 7-stations transect across the eastern part of the North Atlantic Subtropical Gyre (14°W-34°N to 26°W-36°N), followed by two 8-days lagrangian samplings, one in the centre and the other in the eastern margin of the Gyre. Our hypothesis was that, given the influence of allochthonous organic matter on the heterotrophic component of plankton communities, a gradient of respiration and metabolic balance should be coupled to the expected decrease in availability of external organic matter towards the centre of the gyre. Our results confirm the prevalence of net heterotrophy in the marginal area of the gyre, whereas the central area presented a balanced community metabolism. Differences in the snapshot (transect) vs. integrative (lagrangian) approaches highlight the importance of temporal dynamics on the understanding of geographical patterns of community metabolism.

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DMSP AND DMS PRODUCTION IN THE FACE OF INDUCED PHOTOINHIBITION IN NATURAL PHYTOPLANKTON COMMUNITIES

Enhanced production of dimethyl sulphide (DMS) from dimethylsulphoniopropionate (DMSP), under conditions that promote physiological stress in phytoplankton, may stem from the physiological role of DMSP as either a source of antioxidants or a metabolic overflow mechanism. In order to address this issue in the natural environment, Tropical Atlantic waters were incubated in varied light regimes to replicate near-surface or deeper environments and with or without exclusion of UV wavelengths. Fluorescence arising from photosystem II (PSII) was used to assess photosynthetic electron transfer rates, degrees of photo-inhibition and potential photo-oxidative stress related to the varying light and UV regimes. Changes in specific concentrations and production rates of DMSP and DMS are compared to measurements to quantify the activity of alternative photo-protective mechanisms used by phytoplankton. These include xanthophyll cycle pigment ratios and the capacity for repair of photosystem II. A modelling approach will be used to discuss the relationship between a photo-physiological role that drives DMSP synthesis and the concentrations of DMS in the open ocean.

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DIFFERENCES IN PLANKTON COMMUNITY STRUCTURE AND CARBON CYCLING ALONG A CLIMATE GRADIENT FROM THE GREENLAND ICE SHEET TO OFFSHORE WATERS

Huge differences in plankton community structures and biomasses are observed along a climate gradient from the Greenland Ice Sheet to offshore waters at the West Greenland coast. The offshore region has a high biomass of copepods dominated by Calanus spp., which are capable of consuming 55% of the daily primary production. Close to the Greenland Ice Sheet copepod biomasses are significant lower and dominated by smaller copepod species (Pseudocalanus spp. Metridia longa and Microsetalla spp.). In this region copepods are capable of consuming only 4 % of the daily primary production. Protozooplankton accounts for 20-38% of the carbon turnover in the offshore and inland areas. However, protozooplankton like copepods has low ability to turn over the primary production close to the Ice Sheet. Increased run of from the Greenland Ice Sheet due to global warming could displace the existing climate gradient. This would have a profound influence on the future plankton community structure as well as the energy transfer to higher trophic levels in Arctic coastal ecosystems.

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SEDIMENT & NUTRIENT TRANSFER FROM AGRICULTURAL LAND: PROCESS INSIGHTS FROM LABORATORY SIMULATIONS AND FIELD EXPERIMENTATION

Sediment and sediment-associated nutrients play a pivotal role in influencing water quality and biodiversity. Agriculture is thought to be responsible for 50% of the sediments found in surface waters, and this, coupled with the requirements of the EU Water Framework Directive, has made understanding and predicting the movement of these diffuse inputs from land to water increasingly important. Laboratory rainfall simulation experiments were undertaken in triplicate on 3%, 6%, and 9% slopes. Previous studies, which generally examined steeper slopes, observed an increase in sediment transfer with increasing slope. However, examination of 3%-9% slopes, which are more representative of agricultural landscapes, indicates a slope threshold exists between 3% and 6%, below which sediment transfer is higher. The higher sediment transfer is related to different processes as a consequence of increased water ponding and reduces as the system moves towards steady-state. The particle size distribution and nutrient content of the sediment was also measured. These results provide insights into the dominant sediment and nutrient transfer processes occurring on agricultural land. This process understanding is then applied to samples taken from field plots.

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IN SITU ABUNDANCE AND SEASONALITY OF VERRUCOMICROBIA SUBGROUPS IN A HUMIC LAKE

Since the past decade, molecular tools provided ecologists insights into microbial communities in nature. The dominant microbial players have been identified in both terrestrial and aquatic habitats, however, several microbes have been missed using approaches based on conventional primers and probes or only found by chance due to unspecific bindings. For example, the general bacterial probe EUB338 commonly used for FISH does not target *Planctomycetes* and *Verrucomicrobia*. Therefore, two further probes were later introduced supplementing probe EUB338. However, quantitative data on *Verrucomicrobia* in nature are still rare and mostly PCR biased. Isolates use different carbon compounds, e.g. various sugars or methane. Here, we report on the seasonality of *Verrucomicrobia* subgroups in waters of the humic lake Fuchskuhle (Germany) studied by FISH and CARD-FISH. Using group-specific probes for *Verrucomicrobia*, between 0.2% and at least 9% of all cells accounted for this group. Detailed analysis with newly designed subgroup-specific probes revealed the presence of three subgroups: *Verrucomicrobia-Prosthecobacter*, *Opitutus* and probably *Xiphinematobacter* like species. Their seasonal variability will be discussed with respect to the well studied lake's hydrogeology, biogeochemistry and microbial community.

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TWO DISTINCT MECHANISMS OF LAKE HYDROLOGICAL AND CHEMICAL CHANGE ALONG THE ARCTIC COASTAL PLAIN, ALASKA

Abundant thermokarst lakes of the arctic coastal plain are susceptible to changes in summer water balance and storm surge flooding. Both lake change mechanisms may be enhanced by of longer ice-free summers. We present evidence from a lake-rich area along the Beaufort Sea coast, Alaska that lake salinity is increasing both progressively and episodically by two distinct mechanisms. Specific conductance synoptically sampled in the late summer increased consistently by 35% from 2004 to 2008 and 44% since 1977, suggesting widening evaporation to precipitation imbalance. During this same period, at least 7% of lakes became exposed to periodic seawater flooding because of accelerated erosion coupled to more effective storms creating inland surges. We hypothesize that both mechanisms of lake change are occuring primarily because of a seasonal increase in ice-free conditions both inland and offshore. Local ice-free duration of lakes has increased by 15 days since 1970 and the decline in Arctic sea-ice extent is well recognized. The consequences of these distinct lake change mechanisms are discussed in terms of wildlife habitat, water supply, lake-ice dynamics, and climate feedbacks.

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LONGITUDINAL DEVELOPMENT OF CHLOROPHYLL AND PHYTOPLANKTON ASSEMBLAGES IN A REGULATED LARGE RIVER (THE EBRO RIVER)

The distribution of chlorophyll and phytoplankton communities were compared to nutrient concentrations and hydrological parameters along the main stretch of the river Ebro. A progressive increase in planktonic chlorophyll was observed from the upper reaches to the middle section of the river. Chlorophyll reached a maximum (60-80 microg L-1) in the meandering section (downstream of the city of Zaragoza), where nutrient inputs (both N and P) and residence time of water are very high. In this meandering section phytoplankton assemblages consisted of large centric diatoms and Scenedesmus sp. pl. These longitudinal patterns were interrupted by the presence of three large reservoirs in the lower section of the river. In the section below the reservoirs, the shorter residence water time, the presence of invasive zebra mussel, and the massive macrophyte development may explain the historical decrease in chlorophyll-a (from 20-45 microg L-1 in the 1990s to the present 2-5 microg L-1). Phytoplankton densities were extremely poor in this section of the river, where large colonial Coelastrum sp. pl. and Pediastrum sp. pl. were the most characteristic taxa.

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HYDRODYNAMIC CHARACTERISTICS DURING A *KARLODINIUM VENEFICUM* BLOOM IN ALFACS BAY (EBRE DELTA, NW MEDITERRANEAN)

Laboratory experiments have shown the particular biological responses of many dinoflagellate species to small-scale turbulence. However, the relevance of these observations has been rarely tested in the field. In this work we characterized the environmental physical conditions during a bloom of the ichthyotoxic dinoflagellate *Karlodinium veneficum* occurred on June-July 2007 in Alfacs Bay, an aquacultural site. Over the bloom event, velocity data were almost continuously recorded by a 2MHz acoustic Doppler current profiler deployed on a fixed station (6 m depth). Additional physical (using a CTD and a SCAMP microstructure probe) and biological (chlorophyll concentration, phytoplankton species composition) parameters were obtained from several sampling points. Meteorological data were provided by a nearby station. Along the bloom, *K. veneficum* reached maximum concentrations of ca. $1.5x10^6$ cell•L^{-1}. In general, the water conditions were highly dynamic, with homogeneous profiles of low turbulent kinetic energy dissipation rates and shear conditions (average ranges: 10^{-9} cm^2•s^{-3} and 0.05 s^{-1}, respectively). This physical environment likely allowed *K. veneficum* to maintain a preferential distribution at 4 – 5 m depth, where light intensity levels (ca. 200 μmol•m^2•s^{-1}) allowed its optimal growth.

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PRODUCTION, CHARACTERISATION AND NOVEL ROLES OF SEA-ICE DIATOM EXOPOLYMERS (EPS)

Sea ice at its maximum extent covers over 13% of the Earth's surface area. The major primary producers within sea ice are diatoms, predominantly pennate taxa. Ability to produce extracellular mucilages (EPS) is a typical characteristic of many species of pennate diatoms. EPS is increasingly recognised as an important component of aquatic systems; however, there has been no systematic investigation of the rates of production, chemical composition and potential function of this diatom-derived EPS within the sea ice matrix. Brine and ice core samples were collected during The Sea Ice Physics and Ecosystems Experiment (SIPEX) expedition around Eastern Antarctica between 110ºand 130ºE from September to October 2007 with associated biotic and abiotic environmental parameters such as, temperature, salinity, DOC, Chl a and nutrients. We compared EPS abundance and monosaccharide composition and found distinct monosaccharide pattern in carbohydrates from both Brine and Ice cores. Uronic acids comprised <15% of total amount of carbohydrates. EPS produced in situ in the Antarctic Ocean showed a degree of comparibility with EPS produced using culture of the sea ice diatom, F.cylindrus and F.curta under defined conditions

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THE VARIATIONS OF BACTERIOPLAKTON IN A STRATIFIED INLAND SEA

The Sea of Marmara is an inland sea connecting world's two oceanographically distinct seas, the Black Sea and the Mediterranean Sea. The seasonally collected bacterioplankton data were compared using 16S rRNA sequencing technique. The alpha and gamma Proteobacteria groups were the most abundant groups among the cultivable species in the area. The lower layer waters of the Sea of Marmara had the highest variations of isolates and 57% of them were below 100 m, whereas 42% was below 350 m and 16% were below 1000 m. Although the physical parameters remained constant below 350 m, the biochemical parameters including the nutrients and dissolved oxygen varied greatly which might have played important role on the variations of the species composition. Comparison between seasons showed that the highest diversity at the upper layer was obtained in March 2006, following a spring phytoplankton bloom where the carbon concentrations significantly increased. These data clearly showed that the bacterioplankton species in the Sea of Marmara vary both in temporal and spatial scale, mostly driven by environmental conditions.

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PRELIMINARY RESULTS ON THE CONTRIBUTION OF *AURELIA AURITA* TO RESPIRATION AND NUTRIENT RECYCLING IN A PLANKTON COMMUNITY OF THE ADRIATIC SEA

Aurelia aurita is one of the most common scyphozoan species originating massive proliferations in the Mediterranean Sea. It appears in specially high numbers near the Adriatic coasts in spring. In spite the frequency and marked seasonality of *A. aurita* coastal swarms, little has been done about the possible impacts these blooms may have in marine ecosystems. In situ and laboratory experiments were conducted in two different areas of the Adriatic Sea in an attempt to assess the contribution of this species to respiration and nutrient recycling in the planktonic community. Mljet lake in Croatia was chosen for the in situ experiments where respiration and excretion rates were studied at different depths and light exposures. Laboratory experiments were performed in filtered sea water and simulated under-thermocline conditions at the Marine Biology Station in Piran-Slovenia. We report here some of the preliminary results of this study.

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FIRST EVALUATION OF JELLYFISH SWARMS ON THE BALEARIC SEA (NORTHWESTER MEDITERRANEAN)

In the Northwestern Mediterranean populations of jellyfish have increased considerably during the last years. Despite its importance due to its impact on tourism, fishery and industry, in the Spanish Mediterranean, there has been no study evaluating the presence of jellyfish in open waters. Balearic coasts were identified as a sensible area for the arrival of jellyfish swarms, which presumably are dragged from open water by certain factors, such as wind and currents. Thus, the evaluation of swarms in open sea is critical (1) to understand the dynamics of jellyfish arrival to the coast, and (2) in order to predict their occurrence on the coast. This first evaluation was done along the Balearic sea on board the Greenpeace vessel "Artic Sunrise". Records were obtained through observations from board and through aerial recognition from an helicopter provided by the "Artic Sunrise". We identified different jellyfish swarms along the studied zone, data of their area and abundances were collected. The vicinity of Menorca island and the southern region of Mallorca island were identified as a "hot-spot" areas for jellyfish swarms.

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IS THERE A UNIVERSAL RELATIONSHIP BETWEEN PHYTOPLANKTON SPECIFIC GROWTH RATE AND TEMPERATURE?

The Metabolic Theory of Ecology (MTE) proposes that the rates of processes driven by photosynthesis respond to temperature with an average activation energy (E_A) of 0.32 eV. This potential ecological law could enable predictions of ecosystem functional responses to environmental change. Here, we use meta-analysis to test this prediction using phytoplankton specific growth rate data. To aid mechanistic understanding, our literature-derived database comprised 30 thermal responses of single species under controlled environmental conditions, and we corrected for cell size and light climate between datasets. To reduce further the effects of confounding variables (e.g. nutrient supply), we used quantile regression to examine the multi-species response of maximum specific growth rate. We also calculated mean activation energies within species. We found that mean E_A was higher than 0.32 both among species (0.48 eV) and within species (0.46 eV), leading to predicted growth rate with a 10 °C temperature increase that is about 25% higher than expected from the MTE. We also found considerable variability in the thermal sensitivity of specific growth rate, and show that much of this is explicable by resource availability.

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PAST AND PRESENT IDEAS ON THE NATURE AND IMPORTANCE OF OCEAN-REEF COUPLING.

This talk is an invited "tutorial" in ocean-reef coupling; the overall objective is to provide a basic understanding of the issues and lend insight into important directions and approaches for research. I will first present a brief summary of past ideas and key findings on ocean-reef coupling. I will then review different approaches and techniques at both organismic and community scales, trying to identify some commonality. Ocean-reef coupling can be discussed in terms of physical characteristics of the water such as temperature, salinity, dissolved inorganic carbon, oxygen, optical clarity, waves, currents, storms, as well as biological properties such as nutrients, phytoplankton composition, dissolved organic matter detritus and even diversity. The talk will end with a brief discussion of critical directions, hypotheses and techniques to evaluate the importance of ocean-reef coupling in shaping coral reef communities.

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IMPORTANCE OF TERRESTRIAL ORGANIC MATTER IN A TROPICAL ESTUARINE FOOD WEB

The relative importance of terrestrial organic matter (OM) to a tropical pelagic estuarine food web was examined using carbon and nitrogen stable isotope signature analyses of OM sources, zooplankton, and juvenile fishes. Over one year, dominate zooplankton taxonomic groups, 50-500μm and ≥500 μm bulk zooplankton samples, and fishes of recreational and economical importance were collected from three sites within Hilo Bay, Hawaii, USA, during both periods of high and low river flow. Terrestrial OM was found to have minimal contribution (< 20%) to the diets of estuarine consumers, regardless of distance from rivers and river flow rates. Results showed that despite large inputs of terrestrial OM to the estuary, pelagic food webs were primarily supported by estuarine primary production (>60%). Although this study suggests that Hilo Bay's pelagic food web may not be directly affected by changes in terrestrial OM inputs to the estuary, riverine inputs of nutrients are indirectly supporting it through stimulation of estuarine primary production.

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THE ADAPTIVE PHOSPHATE UPTAKE BEHAVIOR OF PHYTOPLANKTON REFLECTS INFORMATION PROCESSING

Phosphate deficient phytoplankton communities have the short-term capability of physiological adaptive phosphate uptake behavior during environmental resource fluctuations. The kinetic alterations were evaluated by two parameters of the flow-force relationship: L_p that reflects the activity of phytoplankton uptake systems, and a threshold concentration ($[P_e]_A$) where net phosphate incorporation ceases. The adaptive responses consisted in a gradual L_p decrease and $[P_e]_A$ increase. This response was triggered by a persistent exposure time of organisms to external phosphate concentrations before exhausting the nutrient storing capacity. This diminution of acquired phosphate, however, resulted in a higher growth rate. It results in uniform uptake kinetics in which individual species developed a coherent uptake behavior with respect to $[P_e]_A$. This adaptation is lasting for several hours and characterized by a linear relationship of uptake rates and the logarithm of external phosphate over an extended concentration range. The coherent adaptive response of phytoplankton is achieved by self-referential features, which becomes fundamental for species coexistence. The adaptive response of phytoplankton to distinct pulse patterns is understood as information processing by the microorganisms in a highly fluctuating environment.

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BREAKING THE GRASS CEILING: THE IMPORTANCE OF CANOPY UNDERSTORY IN SEAGRASS NUTRIENT DYNAMICS

Though often viewed from a 'grass' perspective, seagrass canopies range from simple grass dominated meadows to complex systems with diverse, space-filling understories composed of macro-algae, invertebrates, and microphytobenthos. The presence and composition of this understory has implications for benthic/pelagic exchange of nutrients. Together, the canopy and understory reduce the velocity and turbulence of flow penetrating the canopy and act as direct sinks for nutrients. Here, we use naturally occurring canopies to: characterize the distribution of biomass, leaf area, and volume of organisms; measure flow and flow penetration into the canopy under different flow regimes; calculate component-specific uptake rates in response to local flow conditions, and map total N uptake against the vertical distribution of biomass and flow within the community. Results indicate that turbulence averaged over the height of individual components best predicts uptake rates for individual components of the canopy. Further, flow conditions in the overlying water influence the distribution of uptake among community members. These results have implications for large-scale nutrient processes and food web dynamics in shallow coastal systems.

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CHANGING MEDITERRANEAN SEA– AN ACIDIFICATION APPROACH THROUGH NUMERICAL MODELLING AND LABORATORY EXPERIMENTS

Changing seawater pH is likely to have a major impact on the biogeochemistry of certain ecosystems with resulting changes on the marine sources of climatically active gases such as dimethyl sulphide (DMS). We present efforts to investigate the link between increasing pCO2, possible phytoplankton physiological changes, bacterial production and abundance and DMS/DMSP concentrations. Oceanic acidification and pH reduction effects, on both ecosystem and functional group level, are being presented through a combination of numerical modelling and laboratory experimental work that both focus on the Eastern Mediterranean Sea; an area characterised by extreme oligotrophy and phosphorus limitation. Recent pCO2 measurements in the area indicate undersaturated surface seawater with respect to atmospheric pCO2, throughout the year. Prediction of ecosystem responses is attempted through model simulations that use an ecological model, ERSEM, linked to HALTAFALL, a well established model code covering the carbonate system. Functional group responses are being tested through on going targeted experimental work. Such CO2 enrichment experiments include investigations of laboratory cultures and natural microbial assemblages. This work is being carried out under the scientific umbrella of the EU project SESAME.

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HOW DOES THE CONNECTIVITY BETWEEN POPULATIONS MEDIATE RANGE LIMITS OF MARINE INVERTEBRATES? A CASE STUDY IN THE NE ATLANTIC.

For bentho-pelagic organisms, larval dispersal is the major way to connect distant populations within a metapopulation. It then plays a crucial role in the distribution range of marine species and the boundaries of biogeographic provinces. The present work explores the variability of dispersal and connectivity among marine invertebrate metapopulations along the French Atlantic coast (NE Atlantic), through a transition zone between the Boreal and Lusitanian biogeographic provinces. A coupled bio-physical model was used to track larval trajectories under realistic hydroclimatic forcings and for several life history traits (spawning period, planktonic larval duration, larval behavior). Connectivity matrices between 16 populations were calculated. The results allowed to identify the biological properties and environmental conditions that would allow connectivity through the biogeographic transition. The model outputs were then compared with *in situ* data on the vertical and horizontal distributions of the larvae of two polychaete species: *Owenia fusiformis* and *Pectinaria koreni*, for which distinct evolutionary lineages have been reported on both sides of the transition zone.

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THINK SMALL: MICROSCALE BIOGEOCHEMISTRY AND GLOBAL CHANGE

Microbes play major roles in the ocean's foodweb and carbon cycle. A challenge for the future is to understand in situ functioning and a framework to predict the microbial response to global change. We require direct studies of microscale processes at the mechanistic level, and to scale them to ocean basin scale dynamics. I will discuss progress and prospect in this research direction and Fereidoun Rassoulzadegan's contributions to it.

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TRANSIENT RESPONSE IN THE SWIMMING BEHAVIOUR OF MOON JELLYFISH UPON CONTROLLED ILLUMINATION STUDIED BY THE FREQUENCY DOMAIN VIDEO IMAGE ANALYSIS

Even though a moon jellyfish, i.e. *Aurelia aurita*, has ocellus, each at their 8 marginal sense organs, the reported pulsation and migration behaviors against light are rather varied and uncertain so far. Change in the pulsation has been mostly referred to the 1 min average rate irrespective of the adaptation for prolonged stimulation nor the instantaneous responses. In order to understand the behavior of the jellyfish upon light or darkness the authors focused on their temporal responses to light-ON and/or light-OFF by using video image analysis. Time course of the recorded cross-sectional area of medusae clearly showed their swimming and pulsation behavior. The serial data was found, based on FFT and reverse FFT, to be dissolved into the bell pulsation, migration and the turning of its body axis. Thus the present method was utilized to identify and to evaluate how external stimuli affects the specific components of the motion, and the observation will be carefully discussed also with respect to the relation among the direction of the light shed, gravity and the response of medusae.

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RELATIVE IMPORTANCE OF TROPHIC INTERACTIONS AND NUTRIENT ENRICHMENT IN SEAGRASS ECOSYSTEMS ALONG A SALINITY GRADIENT FROM THE BALTIC TO THE NORTH SEA.

The interaction of eutrophication and predation in structuring seagrass *Zostera marina* L. was assessed in a field experiment in three regions along an estuarine gradient from Southern Finland to the Skagerrak areas of the Swedish west coast. All regions are considered being equally eutrophied and overfished. Using transplanted eelgrass nutrient level and predator abundance was manipulated in a full-factorial cage-experiment. Interregional differences showed seagrass growth to decrease with salinity being only 20 % of full saline growth. A cascade was observed as response to predator treatments, but only in the Skagerrak seagrass. Small predators resulted in significantly lower biomass of larger mesograzers and higher biomass of smaller amphipods and gastropods and filamentous algae especially in nutrient treatments. These algae, in turn, resulted in decreased growth of seagrass. In the Baltic larger mesograzers dominated and in the experiments the only effect observed was that nutrient enrichment was immediately transferred presumably via algae to even higher biomass of these grazers. Presence or absence of smaller predators may explain this interregional difference in response to eutrophication and overfishing.

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INTERSPECIFIC DIFFERENCES IN SILICIFICATION OF RESIDENT DIATOM SPECIES CAUSE INTEREGIONAL DIFFERENCES IN SI AND C EXPORT

Ocean iron fertilization proposals and biogeochemical models assume that diatoms facilitate the export of organic carbon to the same degree across the ocean. We use single-cell analyses to show that diatom species in the Antarctic Zone of the Southern Ocean are more silicified than those from the Eastern Equatorial Pacific by a factor of 5-10. The resulting differences predicted for diatom sinking and frustule dissolution rates are large enough to explain why the proportion of organic carbon production exported to depth in the two regions differs by a factor of 3-10. The interregional differences in silicification are the result of species specific differences in silica content rather than physiology. The prevailing temperature, silicic acid concentration and predation regimes appear to favor more silicified species that promote export of carbon and silicon in the Southern Ocean, while preventing silicified species from becoming abundant in the EEP. Because silicification varies by an order of magnitude among species, such ecological filters can generate more variability in cellular silicification, and in the rates of related biogeochemical processes, than is possible through physiology alone.

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DECADAL SIMULATIONS OF A SIZE-RESOLVED PELAGIC ECOSYSTEM MODEL

A size-resolved pelagic ecosystem model has been developed using descriptions of physical limits to biological processes and allometric relationships to determine physiological rates. In particular, the diet of predators is based on size-ranges, allowing the number of size-classes to be altered without changing the underlying model equations or parameters. Numerical experiments have shown that configurations with increasing number of size-classes converge, demonstrating that the model resolves size. In this talk, the behaviour of the model is investigated over decadal times scale to understand steady-state behaviour. The model is configured for a high-latitude mixed layer, which places a strong seasonal forcing on the model. After highly sensitive behaviour to initial conditions for up to 10 years, the model settles into a stable oscillation. The properties of this stable oscillation are investigated, and, in particular, the sensitivity to the number of size-classes quantified.

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ESTIMATION OF ATMOSPHERIC SOLUBLE IRON INPUTS TO THE ATLANTIC OCEAN (50N TO 50S) BASED ON FIELD MEASUREMENTS OF DRY AND WET DEPOSITION

Atmospheric inputs of iron from mineral dust and other sources play a significant role in the supply of iron to photosynthetic organisms in the ocean. Although dust flux to the ocean can be estimated using data from island monitoring sites, these sites are too widely dispersed to give reliable information on spatial heterogeneities in dust supply. This paper will report our initial estimates of atmospheric soluble iron flux to the Atlantic based on the collection of dry and wet deposition samples during 10 long transect cruises between October 2000 and November 2005. The dry flux estimate is obtained by combining data from aerosol samples with a climatology of air mass types over the region, while the wet flux estimate is produced using rainwater iron concentrations and modelled rainfall fields. For the aerosol samples soluble iron was determined after leaching at pH 4.7. We consider that this approach yields a maximum atmospherically available iron estimate, but this atmospheric soluble iron flux will be altered after deposition according to the conditions prevailing in the receiving waters.

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TRACING SEWAGE INPUTS TO CORAL REEFS: AN EXAMPLE FROM THE MESO-AMERICAN BARRIER REEF

Developing nations are challenged with balancing economic growth and environmental health. Fueled by tourism, the Mexican state of Quintana Roo is among the most rapidly developing coastlines on Earth. Despite the industry's reliance on the services coral reefs afford, little is known about the impacts of development. Specifically, sewage contamination to local aquifers is an emerging issue. Wastewater treatment systems are rare and generally remove solids while discharging high concentrations of nutrients and bacteria. These discharges pose a threat to reef corals, arguably the keystone to the tourism industry. Here, we utilize cost-effective monitoring tools (stable isotope analyses and *Enterococcus* assays) to test for the presence of sewage-derived nitrogen in groundwater inputs to coastal marine waters proximal to developed and undeveloped localities in Quintana Roo. $\delta^{15}N$ values of the sea fan coral *Gorgonia ventalina* sampled from developed areas were enriched (up to 3.6 ‰) relative to undeveloped areas. Furthermore, $\delta^{15}N$ values from corals sampled along a transect parallel to shore were correlated with *Enterococcus* counts, suggesting that the source of nitrogen assimilated by these corals was of human origin, and not a result of denitrification. We stress that these metrics provide a means to link development to ecosystem decline in regions where traditional water quality monitoring is not feasible.

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HERBIVORE IMPACT ON FRESHWATER MACROPHYTES: PLANT STOICHIOMETRY AND PALATABILITY ALONG AN ENVIRONMENTAL GRADIENT

The importance of herbivory as a factor that limits macrophyte abundance and species composition is still debated. Freshwater macrophytes are descendants from terrestrial plants, they combine vascular plant properties with the demands of an aquatic lifestyle. I compared the proportion of herbivore consumption on freshwater macrophytes relative to aquatic algae and terrestrial vascular plants from a stoichiometric perspective. My database of measurements of C:N ratio's in submerged macrophytes shows that median C:N ratio's are higher than those of algae and lower than in terrestrial vascular plants. A review of published vertebrate herbivore exclosure studies shows a similar result for the proportion herbivory, e.g. the proportion consumption is higher than on terrestrial plants and lower than on aquatic algae. I conclude that herbivory should be generally quantitatively more important on macrophytes than on terrestrial plants and that there is a (cor)relation between the plant C:N ratio and proportion consumption by herbivores. I subsequently tested whether this relationship also exists at a smaller scale: does increased nutrient availability in the environment lead to higher plant nutrient concentration and higher plant palatability?

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TRADE-OFFS RELATED TO AQUATIC PLANT-GROWTH STRATEGIES: HOW TO MAXIMIZE LIGHT INTERCEPTION WHILE MINIMIZING DRAG?

Macrophytes in running waters experience a highly dynamic and harsh environment. To avoid breakage plants have to reduce the experienced drag force. Plants have various strategies to cope with mechanical forces. In these experiments the trade-off between minimizing drag and maximizing leaf area for different growth strategies were assessed. For emerged species, drag (in N m^{-2}) was three to four times higher (28 N m^{-2}) than for submerged species. To account for leaf versatility, leaves were removed and their effect on drag and reconfiguration were investigated. From our results it was seen that 60% of the drag is generated by the leaves. When the ratio photosynthetic surface versus total drag (cm^2 N^{-1}) was plotted in function of stream velocity three significant groups were detected. The first group, with *S. erectum*, was characterised by a high ratio at velocities beneath 0.1 ms^{-1}. With increasing velocity submerged species reduced their drag due to their ability to reconfigure. Within these submerged species a clear distinction was seen between those concentrating their leaf area on or just beneath the water surface and those with evenly distributed biomass.

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EFFECT OF THREE DIATOM-DERIVED POLYUNSATURATED ALDEHYDES ON NATURAL BACTERIAL COMMUNITIES

Some diatoms are known to produce polyunsaturated aldehydes (PUAs) upon disruption of their cell membrane by grazing or cell lysis. Bacteria live in strict contact with diatoms at sea and are therefore presumably exposed to the chemicals they release. However, the nature of this interaction still remains poorly understood. We tested the effects of three PUAs and a mix of two on two different natural communities of bacteria from the Mediterranean Sea. One site, along the northern Spanish coast, was sampled in May. The other, along the Italian coast of the Northern Adriatic Sea, was sampled during a diatom bloom. In both cases, no or little effect on cell concentration or total bacterial production was observed when compared to the control. Only slight modifications of community composition (CARD-FISH) were observed, while metabolic activity (Mar-CARD-FISH) indicated a group-specific reaction to the PUAs inoculated, with Roseobacter the most affected and Gammaproteobacteria the least. Hence, PUAs appear to determine community composition directly by favouring some bacterial group, or indirectly, by slowing down some others. This has implications for the diversity of bacterial communities when diatoms are present.

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IS CLIMATE CHANGE THE MAIN DRIVER OF CURRENT COMMUNITY AND LANDSCAPE CHANGES IN THE MEDITERRANEAN SEA?

Mass mortalities and spread of alien species are severely affecting shallow (above 70 meters depth) Mediterranean assemblages. These disturbances have been often related to climate change. However, and regarding the high variety of anthropic and natural pressures that are currently suffering most Mediterranean communities and the lack of long (>20 years) term monitorings and scientific data, we contend that it is difficult to unequivocally relate mass mortalities and alien species spread with climate change. Anthropic pressures such as overfishing, pollution or habitat destruction are greatly affecting not only communities and landscapes but they are also modifying the relationships between species and between species and environment, facilitating the introduction of alien species or increasing the probability of mass mortality events.

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BACTERIAL COMMUNITIES ASSOCIATED WITH THE MEDITERRANEAN GORGONIAN PARAMURICEA CLAVATA

Large-scale disease outbreaks in Paramuricea clavata and other gorgonian species have recently occurred in the northwestern Mediterranean. The environmental driver of these events was an increase in seawater temperature during climatic anomalies in summer. From diseased P. clavata colonies, we previously isolated a Vibrio strain that showed thermodependent virulence, demonstrating that pathogenic microbes are associated to gorgonian mortalities. The composition and dynamics of the natural microbial communities living in association with P. clavata are unknown. The aim of the present study is to establish a baseline for diversity and abundance of associated bacteria. These data will be used to investigate changes in the normal microbiota at elevated temperature and to test specific hypothesis about factors leading to pathogen development and disease during anomalies. Preliminary data obtained by culture-independent techniques indicate that bacterial communities from geographically remote populations of P. clavata are similar, while observed seasonal changes in bacterial assemblages suggest that environmental factors could influence their composition. As part of the multidisciplinary Medchange program, this work will contribute to provide a better understanding of marine ecological responses to climate change.

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LOW FOOD P:C DECREASES ANTIOXIDANT RESPONSE TO UVR IN ZOOPLANKTON

Stoichiometric constraints are important in regulating organism growth and nutrient cycling in food webs. Considering the importance of C:N:P stoichiometry in protein-synthesis, UVR antioxidant enzymes would be also affected by food quality. We analyze this effect in a laboratory experiment with *Daphnia commutata*, examining the effect of food C:P ratio on the response of antioxidant enzymes to UVR. Neonates were reared in three different C:P ratio *Chlamydomonas reinhardtii* cultures, and then a subsample of each treatment exposed to ultraviolet radiation (UVA340) in order to analyze if these stoichiometric constraints limit enzymatic defenses against oxidative stress cause by UVR. After 12 days the C:P ratio of the *Daphnia* reared in the lowest food quality was significantly higher than that of individuals reared in good quality food. Total Glutathione S-Transferases (GST) and Catalase (CAT) showed higher activities in UVR exposed treatments, however, in all cases resulted in an inverse relationship with food C:P ratio. Thus, food quality (in terms of elemental ratios) imposes another bottleneck for zooplankton grazers, since UVR would interact with food quality affecting fitness.

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PREDOMINANT OF FREE EXTRACELLULAR ENZYMATIC ACTIVITY IN THE DARK CENTRAL ATLANTIC OCEAN

The distribution of prokaryotic abundance (PA), prokaryotic heterotrophic production (PHP), and suspended particulate (POM), as well as total and dissolved extracellular alpha- and beta-glucosidase (AGase and BGase), leucine aminopeptidase (LAPase), and alkaline phosphatase (APase) activities were determined in the meso- and bathypelagic waters of the (sub)tropical Atlantic. PHP decreased by three orders of magnitude from the lower euphotic zone to the bathypelagic waters, PA and cell-specific PHP only by one order of magnitude. The contribution of dissolved to total extracellular enzymatic activity (EEA) increased with depth for all enzymes ranging between 54-100%, 56-100%, 65-100%, 59-97% for AGase, BGase, LAPase and APase, respectively. Profiles of LAPase and APase kinetics for the total and dissolved fractions were also obtained. The kinetic parameters (Vmax and Km) of dissolved and total LAPase and of APase were similar throughout the water column, suggesting a similar origin for the dissolved and particulate EEA. Significant correlations were found between the free and total EEA with prokaryotic production and the POM pool. Our results might indicate that microbial activity in the dark ocean might be more bound to particulate and colloidal material than hitherto assumed.

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INFLUENCE OF THE STRESS LEVEL OF THE MARINE ECOSYSTEM IN THE BACTERIAL GROWTH EFFICIENCY (BGE)

Chemoorganotrophic aerobic prokaryotes play a key role in energy and carbon cycling in marine ecosystems: they consume dissolved organic matter (DOM) at the same time that produce new biomass (POM) and respire organic carbon to carbon dioxide to obtain energy. BGE summarizes all these activities and gives information about the prokaryote physiological situation. Any factor influencing the characteristics of the ecosystem may cause a stress level which in turn will affect BGE and consequently the global carbon cycling. The aim of this study was to analyze the influence in the BGE of two factors that provoke stress in the system: the quantity of prokaryotic biomass and the nature of the DOM. Different stress levels in seawater microcosms were obtained by changing the bacterioplanktonic biomass as well as by supplementing the natural DOM in the system with DOM generated under conditions of strong grazing pressure by bacterivorous protists. We observed that increased ecosystem stress results in a drop of the bacterial growth efficiency, mainly because the prokaryotes divert a higher fraction of the incorporated carbon towards respiratory processes.

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PLANKTONIC GROWTH AND GRAZING IN THE COLUMBIA RIVER PLUME REGION: A BIOPHYSICAL MODEL STUDY

A four-box model of planktonic nutrient cycling was coupled to a high-resolution hindcast circulation model of the Oregon-Washington coast, to assess the role of the Columbia River plume in shaping regional-scale patterns of phytoplankton biomass and productivity. The ecosystem model tracks nitrogen in four phases: dissolved nutrients, phytoplankton biomass, zooplankton biomass, and detritus. Model parameters were chosen using observations from two cruises in 2004 and 2005 conducted as part of the RISE (River Influences on Shelf Ecosystems) program. In particular, community growth and grazing rates from 26 microzooplankton dilution experiments were used, in conjunction with analytical equilibrium solutions to the model equations, to diagnose key rate parameters. The result is a simple model that reproduces both stocks (of nutrients, phytoplankton, and zooplankton) and rates (of phytoplankton growth and microzooplankton grazing) simultaneously. Transient plume circulation processes are found to modulate the Washington-Oregon upwelling system in two ways. First, the presence of the plume shifts primary production to deeper water: under weak-to-moderate upwelling winds, 20% less primary production is seen on the inner shelf and 10-20% more is seen past the 100 m isobath. Second, increased retention in the along-coast direction causes a net shift toward older communities and increased micrograzer impact, both north and south of the river mouth.

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TRACE ELEMENTS PROFILES IN CALCITIC BIVALVE SHELLS AS HIGH FREQUENCY ARCHIVES: A "SCALLOP WATCH" OF BIOGEOCHEMICAL PROCESSES AT THE SEDIMENT WATER INTERFACE?

Coastal biogeochemical processes were recently investigated through chronological records of trace elements archived in bivalve shells. The Great Scallop Pecten maximus (L.) presents the particularity to form a daily and distinct calcite stria on its shells. Direct quantitative microanalyses of trace elements within these striae (LA-ICPMS) allowed the definition of trace element profiles accurately time-assigned. Scallops from temperate coastal sites and over a 7-year period were examined for their trace element profiles. Most of shell profiles revealed a steady background content (Co, Cu, Pb,...), supposed to be related to seawater composition and thermodynamic constants (Ks). Shell profiles of Mn, Mo and Ba exhibited a steady background punctuated by specific episodic enrichments. These events were supposed to be associated to seasonal and biogeochemical processes: continental inputs and benthic eutrophication for Mn, rather a direct or indirect influence of spring and summer pelagic biogenic processes for, respectively, Mo and Ba. A better understanding of these processes would promote the "scallop shell watch" as a new high frequency biosensor providing a unique assessment of coastal environmental changes over short and long time scale.

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ENVIRONMENTAL FORCING OF PHYTOPLANKTON IN A SEMI-ARID ESTUARY (GUADIANA ESTUARY, SW IBERIA): A DECADAL STUDY OF ANTHROPOGENIC AND CLIMATIC INFLUENCES

Phytoplankton is the dominant primary producer in aquatic ecosystems and is also extensively used as a gauge of ecological condition and change. This study aimed to describe estuarine phytoplankton seasonal and interannual variability over a 10-year period (1996-2005) in the Guadiana estuary and its environmental drivers. This estuary has been affected by increasing anthropogenic perturbations and by climate change in the last decades. Phytoplankton exhibited seasonal patterns indicating sustained light limitation, particularly with increased sediment load during Alqueva dam construction. Occasional periods of potential nutrient limitation (N and Si) occurred associated with phytoplankton bimodal cycles, but dam construction increased Si load due to increased flooded land area. Periods without nutrient limitation were usually associated to phytoplankton unimodal cycles, with summer blooms. Interannual variability of phytoplankton biomass exhibited a declining trend (1997-1999), followed by an increase (2000-2001) due to changes in light availability mostly induced by dam construction, then a declining trend (2001-2005) influenced also by nutrient limitation. North Atlantic Oscillation index was inversely related to water temperature, but had no apparent effect on phytoplankton in view of severe light limitation.

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STRUCTURAL ANALYSES OF SUMMER PHYTOPLANKTON AS INDICATOR OF WATER QUALITY IN LATVIAN EUTROFIC – HYPERTROFIC LAKES

During last five years EU Water Framework Directive 2000/60/EC is being intensively implemented and this process changes all monitoring system. Based on the Regulations issued by the Cabinet of Ministers (Nr.858), species composition and biomass are one of the main indicators of ecological situation in Latvian lakes. Therefore the main aim of the work was to determine water quality and appraise current ecological situation using the phytoplankton structure in the eutrophic-hypertrophic Lakes Lielais and Mazais Baltezers during the summer period 2002-2007. Coastal zone of L. and M. Baltezers characterizes with intensive housing that increases anthropogenic load. This results in high concentration of total dissolved nitrogen and phosphorus. During the period 2002-2007 analyse of phytoplankton summer community structure shows high biomass concentration (max. 18-22 mg/l). Cyanobacteria are among dominant phytoplankton division in the Lakes M. and L Baltezers, composing 50-90 % of the total phytoplankton biomass, diatoms subdominate in the Lake L. Baltezers as well. High number of potentially toxic cyanobacteria species appears in both lakes, producing significant amount of microcystin (max.11 μg/l). Specific weights of other taxonomical groups are insignificant.

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PSEUDO-NITZSCHIA AND DOMOIC ACID IN NATURALLY IRON-ENRICHED AND IRON-POOR AREAS OF THE SUBARCTIC PACIFIC

Although some cosmopolitan species of *Pseudo-nitzschia* are known to produce the neurotoxin domoic acid (DA) in coastal environments, little is known about the ability of these or of truly oceanic species to produce DA *in situ* in oceanic regions. Here we present data on cellular DA quotas measured in the subarctic Pacific with both iron-limited and naturally iron-enriched regions. Densities of *Pseudo-nitzschia* in the oceanic water samples were modest and DA levels low, as expected for the comparatively small cells that dominate oceanic populations. DA cell quotas reported here are at the lower to middle range of those measured *in situ* in natural populations from coastal environments. The variability in cell toxin levels among sites likely reflects both differences among species mixes and environmental growth conditions. Such toxin data are needed to predict whether local *Pseudo-nitzschia*, which respond rapidly to iron enrichment, could possibly – due to heightened abundance - generate DA levels that threaten ecosystems upon artificially iron enrichment, a geo-engineering remedy proposed to reduce atmospheric CO2 levels and hence reduce global warming.

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A NOVEL TECHNIQUE TO ESTIMATE PRIMARY PRODUCTION DIRECTLY FROM EARTH OBSERVATION DATA: AN INHERENT OPTICAL PROPERTY APPROACH

Primary production (PP) models traditionally include parameterisation of chlorophyll-a, but estimates from such models can be complicated in Case 2 regions. In such regions, chlorophyll-a estimated from satellite global algorithms may be impaired by high concentrations of non-phytoplankton substances such as suspended sediment or coloured dissolved organic matter (CDOM). A novel approach to modelling PP from Earth Observation data is presented, based on Inherent Optical Properties (IOPs). The model is a triple integral of wavelength, depth and day length and uses modelled global fields of absorption, $a(\lambda)$ and backscatter, $b_b(\lambda)$, both primary IOPs, to determine the light field. Global fields of the secondary IOP $a_{ph}(\lambda)$, removes the requirement for algorithm-derived chlorophyll-a. Global yearly PP is estimated to be around 85 Gt C y^{-1} which, although at the higher end of the range of PP model estimates, is explained by possible overestimation of $a_{ph}(\lambda)$ in the open ocean from the semi-analytical IOP inversion model. The IOP-PP model is shown to perform very differently in coastal areas known for high sediment and CDOM; coastal PP estimates are lower than chlorophyll-a based estimates.

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HIGH VARIABILITY OF THE EXO-METABOLOME OF INTACT DIATOMS SUGGESTS POSSIBLE RELEASE OF INFOCHEMICALS

We studied water-borne metabolites released by diatoms over the entire development of a culture. A high throughput enrichment procedure for metabolites released by intact diatom cells from the medium was developed. Metabolic profiling based on rapid mass spectrometric methods generated large scale data sets that could be evaluated by principal component analysis. Investigation of monocultures of *Skeletonema marinoi*, *Stephanopyxis turris* and *Thalassiosira pseudonana* revealed a staged metabolite release dependant on the growth phases of the cultures. A complex and variable pattern of specific metabolites was detected for each species. To verify if diatom exudates influence the growth of competitors, we set up a co-culturing where different diatom species were in chemical but not in physical contact. We observed differences in growth rates and physiology of diatoms that grew under the influence of metabolites released from another species, which suggests a role of these metabolites as allelochemicals. These results demonstrate that hitherto unrecognized multifaceted chemical processes might have a major impact on species interactions in plankton.

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USE OF THE PDMPO FLUORESCENT PROBE TO SORT DIATOM CELLS

Separation of phytoplankton populations from a mixed assemblage is needed for a variety of studies including cultivation, chemical composition, cell activity and physiology, and genetic makeup. Size fractionation by filtration often disrupts fragile cells and plankton classes are not reliably separated by size alone. We developed a procedure to sort phytoplankton groups using high speed cell sorting based on incubation with the fluorescence probe PDMPO. Natural phytoplankton populations from Boothbay Harbor (ME, USA) were incubated under different incubation times, conditions and preservation methods. Preserved samples showed less fluorescence than the fresh-prepared slides. To sort PDMPO-positive cells from natural communities, samples were incubated for 24 h with PDMPO and then sorted using high speed sorters (Cytomation MoFlo and Cytopeia InFlux). High and low-PDMPO populations were separated by sorting and then examined by epifluorescence microscopy. The high-PDMPO sort was composed primarily of diatoms. Experiments developed in a cruise across the South Atlantic Ocean showed similar results, but some flagellates were occasionally observed in High-PDMPO populations. We believe that this method shows great potential in the separation of diatoms from mixed plankton communities.

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SEASONAL VARIATION OF PHYTOPLANKTON CARBON AND NITROGEN STABLE ISOTOPE RATIOS AND ZOOPLANKTON FEEDING SELECTIVITY IN AN IRISH MESOTROPHIC LAKE

In humic Lough Melvin, eutrophication may be altering the carbon base of the foodweb. To determine seasonal reliance of zooplankton on autochthonous carbon (C), stable isotope ratios of C and nitrogen ($\delta^{13}C$ & $\delta^{15}N$) were tracked over one year. Annually the dominant zooplankton genera were reliant on allochthonous organic C: *Arctodiaptomus* (50%), *Eudiaptomus* (44%) *Cyclops* (46%) and *Daphnia* (53%). Appreciable autochthony commenced with the April diatom bloom but allochthony increased from July when high catchment inputs of more labile dissolved organic C (DOC) favoured heterotrophic bacterial production. Summer enrichment of phytoplankton $\delta^{13}C$ reflected ^{13}C enrichment of dissolved inorganic C but phytoplankton $\delta^{15}N$ declined despite the absence of nitrogen-fixing species. Copepod $\delta^{15}N$ were high indicating several masked trophic levels and a capacity to feed more selectively and on larger prey, whereas *Daphnia* functioned as a low order consumer, being largely dependent on the ambient concentration of small prey items. Low autochthony in this polymictic Irish lake, despite lake phosphorus of 30 μg P L^{-1}, may reflect light limitation of phytoplankton by humic substances given that DOC exceeds 10 mg L^{-1}.

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INTENSIFIED OCEAN ACIDIFICATION IN OXYGEN MINIMUM ZONES: AMPLIFIED STRESS FOR DEEP-SEA ECOSYSTEMS

Although ocean acidification has reduced the pH of surface waters by ~0.1 units, the upper ocean is largely buffered by its high carbonate ion levels. In contrast, most carbonate in oxygen minimum zones has been titrated by respiratory CO2, thereby reducing the buffering capacity of those waters. Added anthropogenic CO2 in OMZs will therefore cause a much larger shift in ocean pH and pCO2 than would be observed in the upper ocean. Under an atmosphere of 700 ppm CO2, upper ocean pH may fall by 0.3-0.4 units and pCO2 will increase by ~500+ ppm. In OMZ waters, pH could drop by 0.5+ units and pCO2 could increase by 3000+ ppm. Intensified ocean acidification in OMZ sea waters will amplify physiological stress for deep-sea animals. In addition to compromising the calcification rates of corals and other taxa with carbonate skeletal elements, elevated pCO2 will increase respiratory stress, acidosis, and metabolic depression for a variety of deep-sea animals. Tolerance to environmental hypercapnia may have influenced observed distribution patterns for deep-sea organisms, and is almost certain to influence deep-sea ecosystems in the future.

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PATTERNS IN MACROZOOBENTHOS DENSITIES AND COMMUNITY COMPOSITION ALONG A GRADIENT OF TOTAL PHOSPHORUS AND DISSOLVED ORGANIC CARBON

In lake ecosystems, macroinvertebrate community composition is closely linked to environmental conditions. However, studies how environmental disturbances caused by human activity affect macroinvertebrates are scarce. In particular, little is known about the impact of eutrophication and an increased input of dissolved organic carbon (DOC) on macroinvertebrate assemblages. An increase in nutrient loading will most likely shift benthic to pelagic production. DOC provides a major energy source for bacteria in aquatic food webs and its mobilization into bacterial biomass is likely transferred to higher trophic levels. In this study, we compared benthic macroinvertebrate densities and community composition of eight lakes in central Sweden. The lakes were selected along a gradient of total phosphorus (TP) and DOC. Within lakes, macroinvertebrate densities and species richness increased with decreasing depth. Across lakes, depth-specific patterns were sustained, but densities and community composition differed considerably along the gradient of TP and DOC, indicating that macroinvertebrate assemblages are affected by environmental disturbances. These contrasting benthic macroinvertebrate communities might have significant impacts on benthic food webs and the transfer of energy and nutrients to the pelagic.

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DO PLEUSTOPHYTES ENHANCE CH4 EMISSION TO THE ATMOSPHERE?

In shallow freshwater environments of the Po River Plain (Northern Italy) nutrient availability stimulates eutrophication processes with phytoplankton blooms followed by the progressive disappearance of submerged aquatic vegetation (SAV), often replaced by floating leaved macrophyets (FLM). Under high nutrient loadings, FLM spread over the whole water surface forming dense and thick monospecific mats. We measured dissolved gas (O2, CO2 and CH4) concentrations and fluxes across the sediment-water and water-atmosphere interfaces with both intact cores and static chambers incubation in different aquatic environments with SAV and FLM. The shift of the location of primary producers from the sediment-water to the water-atmosphere interfaces does not result in different rates of C fixation, but in different pathways and fate of O2 and CO2. Dense stands of FLM promote organic enrichment and anoxia in both water column and sediment, whit release of CH4 to the atmosphere, whilst CH4 fluxes are strongly attenuated by SAV, probably due to root-associated methanotrophy. The shift from SAV to FLM has to be considered as a further source of CH4 emission to the atmosphere.

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WHAT REGULATES SPATIAL GRADIENTS IN MARINE PHYTOPLANKTON DIVERSITY?

We develop a three-dimensional, self-assembling model of global marine phytoplankton communities. When initialized randomly with many tens of plausible phytoplankton physiologies, the trait-based model shows an equator-to-pole decrease in the diversity of phytoplankton species. This pattern is common to many marine and terrestrial taxa. Regions of enhanced phytoplankton diversity also occur in association with areas of energetic flow including western boundary currents. In the trait-based model, the most abundant phytoplankton types in stable, warm waters tend to have similar, low R* values, which indicates their strong ability to compete for scarce nutrients in these regions. We use a highly idealized, zero-dimensional model to illustrate and interpret the mechanisms causing the meridional diversity gradient in terms of the variability of the marine environment. We demonstrate that in oligotrophic conditions there are very long competitive exclusion timescales (hundreds to thousands of years) for organisms with similar and low R* values if temporal variability in resource supply is either long (inter-annual or longer) or short (comparable to the growth period or shorter). Conversely, variability in resource supply with seasonal timescales leads to rapid competitive exclusion. We argue that these contrasting regimes--competitive exclusion in high latitudes vs. coexistence in low latitudes--may explain the meridional phytoplankton diversity gradient.

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FOOD WEB C AND N STABLE ISOTOPE VARIABILITY IN HIGH MOUNTAIN LAKES THROUGHOUT AN ALTITUDINAL GRADIENT

High mountain lakes are increasingly used as sentinels of present Global Change. Understanding C and N flow through their food webs (with e.g. C-N stable isotopes) becomes necessary to interpret observations on past and present changes. We present the results from four Pyrenean lakes, encompassing an elevation gradient of 1,068 m. No major differences were found in food web taxonomic composition. However, a large variability was found in $\delta^{13}C$ and $\delta^{15}N$ within food web primary carbon sources. A gradation from benthos to plankton was found for $\delta^{13}C$. Bottom organisms from lakes below tree-line were ^{15}N depleted in comparison to littoral comparable organisms. These C and N differences propagated up to brown trout individuals, indicating a specialization in littoral or bottom preys. Altitudinally, $\delta^{15}N$ increased in all compartments. Brown trout $\delta^{13}C$ and $\delta^{15}N$ were positively correlated within a lake, and the slope of the regression decreased with lake altitude. The existence of within-lake (littoral/bottom) and altitudinal patterns in $\delta^{15}N$ without major changes in food web structure, suggest that $\delta^{15}N$ signatures are suitable for monitoring Global Change effects in mountain systems.

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NOVEL

Toxic Cyanobacterial blooms are a matter of growing concern for water quality. Nutrient availability is an important factor affecting the dynamics of phytoplankton blooms; many organisms respond to inorganic phosphate (Pi) limitation by enhancing external alkaline phosphatase (AP) activity. Here we show that *Aphanizomenon ovalisporum* which produces the hepatotoxin Cylindrospermopsin (CYN) recruits other organisms to supply its Pi needs. *A. ovalisporum* responds to removal of external Pi by fast induction of genes essential for CYN production, high affinity Pi uptake system and AP. In contrast, AP activity is observed only after 7 days during which it consumes the internal Pi. Treatments of *Chlamydomonas reinhardtii* (and *Chlorella sp.*) with *A. ovalisporum* spent media or with CYN, led to a typical Pi limitation response and a significant rise in the AP activity in these organisms, despite the fact that they were not Pi limited. The suggested role of CYN may explain the observed rise in AP activity in the water body despite the high Pi quota within the *A. ovalisporum* cells and a mechanism of forming massive blooms despite limiting Pi conditions.

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TRANSPERANT EXOPOLYMER PARTICLES (TEP) IN THE EASTERN MEDITERRANEAN SEA

TEP concentrations in the ultra-oligotrophic eastern Mediterranean were monitored monthly, concomitantly with biological, physical and chemical parameters at a shallow coastal station above the continental shelf and at a deep pelagic station. Additionally, a summer east to west transect was conducted between Israel and Crete. The distribution and abundance of TEP was examined in relation to the physical, chemical, and biological characteristics (micro and pico phytoplankton communities). From February through June 2008, TEP concentrations (integrated to 300 m) ranged from 12.9 to 35.6 mg Xanthan equivalents m-2 and 17.3 to 24.4 mg Xanthan equivalents m-2 at the shallow and pelagic stations, respectively. In winter, when the water column was mixed, TEP, Chl a concentration, and alkaline phosphatase (APA) activities (indicative of physiological P-status) were uniform throughout the water column. From April-June (stratified water column) TEP concentrations and APA were low in the deep chlorophyll maximum (~ 120m). We discuss the distribution and significance of TEP in relation to water mass characteristics and physiological status of the micro-phytoplankton in this ultra-oligotrophic environment.

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APPLICATION OF BIOMASS SPECTRUM THEORIES TO THE MESOZOOPLANKTON COMMUNITY IN A REGION OF THE POLAR FRONT

Mesoscale physical processes and their impacts on foodweb dynamics at the Polar Front southeast of Hopen island, Barents Sea, were studied 3 times during the IPY-NESSAR project: once in autumn 2007 (July/August) and twice in spring 2008 (May 2-5 and May 10-13). The spatial and temporal distributions of hydrography and mesozooplankton were measured using a towed instrument platform equipped with a Laser Optical Plankton Counter (LOPC), a CTD and a fluorometer (F). Discrete water and zooplankton net samples were collected to compare with and interpret the LOPC-CTD-F data. The mesoscale distribution and evolution of zooplankton biomass spectra indicates the interaction between water masses, physical advection and retention, and different zooplankton communities. The biovolume spectra of the mesozooplankton communities during the different seasons shows the seasonal evolution of growth, mortality and community structures. In situ growth and mortality are being computed based on biomass spectrum theory. The slope of the spectra obtained from spring and autumn is discussed with regard to trophic levels in the system.

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NUTRITION OF THE INVASIVE FRESHWATER BIVALVE *CORBICULA FLUMINEA*: ROLE OF ESSENTIAL LIPIDS

Experiments with marine bivalves suggest that the ability to synthesize long chain polyunsaturated fatty acids (PUFAs) and sterols de novo is generally low or absent among bivalve species, which implies that a dietary supply of these lipids is essential for growth and reproduction. Here standardized growth experiments were conducted with the freshwater bivalve *Corbicula fluminea* to assess potential effects of dietary lipids on the performance of this invasive species. Our data suggest that cyanobacteria, as prokaryotic organisms, are a poor food source due to the absence of PUFAs and sterols, whereas eukaryotic algae, containing high amounts of long chain PUFAs and phytosterols, are a superior food for *C. fluminea*. Results obtained might contribute to our understanding of invasion patterns of *C. fluminea*.

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HOW REACTIVE IS COLLOIDAL IRON IN A HIGH-DOC, HIGH-IRON COASTAL SYSTEM?

The black-water rivers of northern Europe are an important source of soluble and colloidal DOM to the receiving coastal waters where this DOM directly affects the physicochemical forms and biological availability of trace elements. In this study, competitive ligand exchange-adsorptive cathodic stripping voltammetry (CLE-ACSV) was used to quantify the total (liberated by acidification and/or digestion) and reactive (labile and/or electrochemically active) pools of soluble (< 5000 kDa) and colloidal iron (5000 kDa - 0.4 µm) in a coastal system of the north of Scotland. Spatial variations in total colloidal iron measured over the salinity range 29.3-34.4 closely followed those of total "dissolved" iron (50-400 nM). Total soluble iron variations were totally uncoupled with the above. The total iron concentrations in each fraction were as much governed by sampling site location as by salinity. By contrast, the concentrations of kinetically labile and humic-complexed iron occurring in either the soluble or colloidal fraction turned out to vary linearly with salinity. We suggest that the presence of a kinetically inert but highly variable colloidal form of iron is the reason for these apparent discrepancies.

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INCREASING DOMINANCE OF TWO ALLOCHTHONOUS GELATINOUS ZOOPLANKTON SPECIES IN THE ADRIATIC SEA: A POSSIBLE RELATIONSHIP WITH HYDROCLIMATIC CHANGES

Hydromedusae Niobia dendrotentaculata and thaliacea Thalia orientalis, newly observed in the Adriatic, were recorded as dominant species in August 2006 and January 2008, respectively. Niobia dendrotentaculata with 11.2 ind./m3 made 44% of the total number of hydromedusae in the coastal area of the South Adriatic. Previously predominant (> 70%) hydromedusas in the coastal part of the South Adriatic Aglaura hemistoma contributed 38% to total number in August 2006. Similar, Thalia orientalis has replaced (with more than 55% individuals in total thaliacean) its formerly dominant congener Thalia democratica in the coastal and open south Adriatic water in January 2008. These faunal changes follow changes in zooplankton community structure recorded from 1995 in the Adriatic Sea. This coincides with - and perhaps partly are owed to - documented circulation changes in the Eastern Mediterranean, the proximate source of southern Adriatic water. Such hydrological changes were associated to large-scale hydroclimatic fluctuations, i.e. the North Atlantic Oscillation (NAO).

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CONTRIBUTION OF INDONESIAN PEAT-DRAINING RIVERS TO THE RIVERINE EXPORT OF DISSOLVED ORGANIC CARBON INTO THE OCEAN

Indonesian peat soils store approximately 3% of the global soil carbon (26-50 Gt) which, in their original state, sequestered as much organic carbon (10-30 Tg C yr-1) as the global deep sea sediments. Today approximately 45% of the former Indonesian peat swamp forest has been lost and the disturbed peat lands turned into CO2 sources. Here we determined DOC discharges from three Indonesian peat-draining rivers. The area normalized DOC exports (yields) of these three rivers are among the highest reported worldwide and exceed even those of classical blackwater rivers like the Rio Negro. DOC export rates extrapolated to the Indonesian peat lands suggest that the DOC export with ~20 Tg C yr-1 is as high as that from mangroves worldwide and even comparable to the export from the Amazon. A still not quantified part of the DOC that is discharged from the peat-draining rivers into the coastal ocean seems to be adsorbed to clay minerals and is most likely exported to the sediments.

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MULTIGENE PHYLOGENY OF THE SCYPHOZOAN JELLYFISH (CNIDARIA: SCYPHOZOA): CONCORDANCE WITH MORPHOLOGICAL DIFFERENTIATION AND FAMILY-LEVEL SYSTEMATIC REVISION

The cnidarian class Scyphozoa is composed of approximately 200 species of pelagic jellyfish inhabiting all regions of the marine realm (open ocean, coastal, estuarine and deep sea). Many scyphozoans periodically form dense blooms or aggregations, with well-known impacts on fisheries, commerce and tourism, and recent evidence indicates that worldwide intensity of jellyfish blooms may be increasing. However, taxonomic knowledge of this group has been in flux over the past decade, with molecular studies indicating more species than were previously described. At higher taxonomic levels (Order, Family, etc.), morphological and molecular studies based on one or two genetic regions have shown general agreement in their taxonomic conclusions. Because greater molecular coverage often leads to better phylogenetic precision, we have conducted the most complete phylogenetic study to date of the Scyphozoa using multiple nuclear and mitochondrial genetic regions. Results are generally concordant with morphology, but also indicate that family-level systematic revision is likely necessary. More importantly, our phylogenetic hypotheses serve as a context for comparative studies to understand the evolution of morphology, ecology and behavior (bloom forming, invasiveness, etc.) within the Scyphozoa.

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DIFFERENTIAL GROWTH AND RESPONSE TO NUTRIENT AMENDMENTS BETWEEN BACTERIOPLANKTON GROUPS IN THE HNLC SUBARCTIC NORTHEASTERN PACIFIC OCEAN

Free-living pelagic heterotrophic prokaryotes are an ecologically-important component of planktonic ecosystems. Flow cytometry combined with nucleic acid stains has identified two subcommunities of cells; high nucleic acid (HNA) and low nucleic acid (LNA) cell groups. We examined the factors that control the growth of these prokaryote subcommunities in High Nitrate Low Chlorophyll (HNLC) waters of the Northeastern Subarctic Pacific Ocean. Nutrient amendments were combined with dilution experiments to estimate how nutrient supply (organic carbon & iron) and grazing controlled the growth of heterotrophic prokaryotes. The growth rate of the entire prokaryotic community, and both HNA and LNA cells, increased significantly with dilution (from <1 to >2 division d^{-1}), suggesting that grazing or other density-dependent factors exert dominant control over the net growth of heterotrophic prokaryotes. Nutrient amendments had no consistent overall effect of the growth rates of the prokaryotic community, yet iron amendments appeared to stimulate the growth of the LNA cells, while glucose enhanced the growth of the HNA group. These findings indicate that episodic iron inputs to HNLC waters may generate time-dependent reverberations in the prokaryotic community structure.

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DIURNAL FLUCTUATIONS IN PHOTOSYNTHETIC PARAMETERS IN MASS CULTURES OF *NANNOCHLOROPSIS*: COMPARISONS BETWEEN A VERTICAL BIOREACTOR AND A RACEWAY POND

Outdoor algal mass cultures are exposed to diurnal fluctuations in solar photon flux and temperature. These fluctuations affect the metabolic activities of the cultures which impose circadian changes in various physicochemical parameters such as, pH and CO2. concentration. In order to understand how algae in two commonly used mass culture systems respond to such daily environmental changes we compared photosynthetic activity of *Nannochloropsis* (a marine eustigmatophyte) grown in a vertical photo-bioreactor (VPBR) and a raceway pond (RP). Temperature and pH changes in the RP were more muted than in the VPBR. Both VPBR and RP cultures showed significant declines in both maximum photosynthetic yield (Fv/Fm) and effective quantum yield (Fv′/Fm′) during the day. Cultures in the RP exhibited lower maximum rates of electron transport, higher alpha and lower respiration rates than did the VPBR, reflecting the greater shade adaptation (longer path length for light) in the former system. Both the VPBR and RP systems showed diurnal changes in PSI vs PSII activity and in OJIP induction curves. The capacity of cultures to recover from stress will also be discussed.

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INTEGRATED ASSESSMENT OF CHEMICAL AND RADIOLOGICAL ECOTOXICITY OF DEPLETED, NATURAL AND ENRICHED URANIUM IN FRESHWATER ECOSYSTEMS

Uranium (U) presents a unique challenge for ecological risk assessments because it induces both chemical and radiological toxicity. We present a method to assess the ecotoxicological impact from these two modes of toxicity of different U isotopic compositions (depleted, enriched, and natural U) in freshwater ecosystems. We derived chemical (3.2 µg/l) and radiological (10 µGy/h) benchmarks from chronic toxicity data using Species Sensitivity Distributions, and determined the level of the radiological protectiveness of the chemical benchmark (and vice versa) for the various isotopic compositions of U. Results show that the percentage of species radiologically protected by the chemical benchmark decreases with increasing 235-U enrichment such that the chemical benchmark is not protective for freshwater ecosystems radiologically exposed to highly enriched U, or to natural U in secular equilibrium. These results are relevant to the ongoing development of freshwater quality criteria for radionuclides associated with nuclear applications of U exploitation, and highlight the need for further research on the speciation, bioavailability and toxicity of U under different environmental conditions.

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LIPIDS DYNAMIC WITHIN MICROBIAL FOOD WEBS: A KEY FACTOR DETERMINING METAZOAN PRODUCTION

Because the trophic transfer of polyunsaturated fatty acids from aquatic to terrestrial food webs is important for humans beings, food webs studies often focus on efficient metazoan food chains. However especially in marine pelagic ecosystems it appears that heterotrophic protists often occupy the position of dominant primary consumers in aquatic systems. Multiple trophic transfers within microbial food webs lead to substantial carbon losses and the efficiency of trophic transfer of primary production to metazooplankton via protists is highly dependent on the number of predatory interactions among microconsumers .The efficiency of trophic transfer also depends on whether the quality of food for consumption at the next trophic level is enhanced (i.e trophic upgrading). In food chains, energy dissipates rapidly through trophic transfer processes so trophic upgrading can not ultimately counteract carbon losses. In systems where producers are dominated by prokaryotic picoplankton which can not substain metazoan production, the heterotrophic protists constitute a necessary biosynthetic step and provide essential lipid compounds for higher trophic levels.

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PORE WATER DISCHARGE CONTROLS NUTRIENT CYCLING IN TIDAL FLAT AREAS

In the southern North Sea, a large tidal flat area extends between the coastline and a chain of barrier islands. These barrier islands are separated by tidal inlets enabling water exchange between the tidal flat area and the North Sea. In the tidal inlet between Spiekeroog and Langeoog Island, nutrients are measured hourly at a permanent time series station. Silica concentrations show a tidal cyclicity with highest concentrations during low tide. These increasing concentrations during low tide could either be due to fresh water inflow and/or to submarine groundwater discharge. Radium isotopes were used to quantify fluxes and associated nutrient input. Fresh water inflow was found to be a minor nutrient source to the tidal flat area. In contrast, pore water flow enriches the tidal channels in radium and nutrients. It is estimated that up to 1.2⋅10^6 m^3 pore water are released each tidal cycle suggesting that 1-3% of the water in the tidal channels at low tide is pore water released from tidal flat sediments. Thus, these tidal flats are a significant nutrient source to the North Sea.

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A FRESH LOOK AT THE NUTRIENT CYCLING IN THE OLIGOTROPHIC OCEAN

An alternative framework for the description and analysis of the vertical nutrient cycling in oligotrophic waters is proposed. Instead of the usual distinction between euphotic and aphotic zones (i.e., with and without net primary production), the new concept assumes a three-layer system featuring the subsurface production remineralization layer (SPRL) between the base of the surface mixed layer (SML) and the nutrient maximum at about 1000-1200 m depth. The new approach leads to revised definitions of the terms new and regenerated production, as well as export into the deep ocean, which are more adequate to characterize the biological pump in the oligotrophic ocean. One of the immediate conclusions is that the steady state nitrate export from the SPRL is fully determined by the sum of atmospheric deposition of nitrogen and N_2-fixation. This means that the magnitude of primary production by non-diazotrophic phytoplankton is irrelevant for export into the deep ocean; biological processes are, however, crucial in determining size, shape and density of sinking particles and the remineralization rate of detritus.

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FUNKTIONAL DIVERSITY IN PHYTOPLANKTON COMMUNITIES

During the last decade an increasing number of programs have been started to record the diversity of life in various ecosystems and to disentangle how biodiversity per se affects processes in the biosphere, such as carbon or nutrient cycling. Many experimental studies and theoretical considerations showed an overall positive diversity-effect on a variety of ecosystem functions. However the underlying mechanisms remain unclear since such positive correlations can be explained either by complementary resource use ("complementarity effect") or by the dominance of one species ("selection effect"). Moreover different measures of diversity, such as species richness or the diversity of traits ("functional diversity") may influence the results. In a laboratory experiment with 22 phytoplankton strains we set up different algal communities in a gradient of a priori defined diversity in order to compare the effects of functional to species diversity. Furthermore we examined the relative effects of "complementarity" and "selection" in our communities. The observed diversity-effects were dependent on the algal classes and in general stronger in a functional diversity approach.

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PATTERNS OF SPATIAL AND TEMPORAL DYNAMICS OF PROTISTAN COMMUNITIES IN AN ANOXIC WATER COLUMN (FRAMVAREN FJORD, NORWAY)

Multiple studies based either on morphological investigation or on the application of molecular tools revealed that the composition of protistan communities in anoxic waters is dynamic over spatial and seasonal scales. Variations in local community patterns are assumed to reflect changes in environmental conditions, even though the identification of responsible key parameters is difficult. By investigating the composition of three distinct protistan communities along a vertical O_2/H_2S gradient in the Framvaren Fjord (Norway) we tried to make out abiotic and/or biotic factors shaping community composition. Sampling and collection of contextual data was conducted at different sampling sites within the fjord as well as in different seasons. Community patterns were determined by T-RFLP and tested for correlation with e.g. oxygen or hydrogen sulphide concentrations, or composition of prokaryotic communities. While protistan communities displayed no clear correlation to any of the considered abiotic parameters, the composition of prokaryotic communities reflected the redox regime. We hypothesize that the variation within protistan communities is at least in parts due to biotic factors and mirrors changes in prokaryotic communities, as a result of prey-predator relationships.

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INITIAL RESULTS FROM THE DMS-GO INITIATIVE TO PRODUCE A NEW GLOBAL SURFACE-OCEAN DMS CLIMATOLOGY

It has been postulated that the biogenic trace gas, dimethylsulphide (DMS), may play a role in the regulation of climate. As part of the assessment of this hypothesis, it is important to quantify the global flux of DMS across the air-sea interface. A decade ago, Jamie Kettle compiled a database of available surface measurements (~15,000 data points), and used them to create global DMS concentration and flux climatologies with seasonal variability (Kettle et al. 1999). The significance of this work to the scientific community is easily demonstrated by the number of citations it has received (210 to date). However, since this landmark publication, the online database has grown substantially to ~40,000 data points, with increased spatial and temporal coverage. Working with the SOLAS Integration Project (http://www.bodc.ac.uk/solas_integration/) and COST Action 735 (http://www.cost-735.org/), DMS-GO (DiMethylSulfide concentrations and emission fluxes in the Global Ocean) is an initiative to produce new DMS climatologies from the updated database. We will present and discuss the initial results from this project, with particular emphasis on the implications of its conclusions.

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SPATIO-TEMPORAL VARIABILITY OF VIRUSES FROM PRASINOPHYTE PLANCTONIC ALGAE IN THE NORTH WEST MEDITERRANEAN SEA

Viruses are increasingly recognized to be major regulators of picophytoplanktonic populations. In the Mediterranean Sea, Mamiellales green algae are the most abundant and widespread representatives of the Prasinophyceae, especially the three genera Bathycoccus, Micromonas and Ostreococcus. We showed that Phycodnaviridae currently occurs in these algae in the Mediterranean Sea and coastal lagoons. Several methods (growth on solid medium, Fish, cytometry, phylogenetic analyses…) were used to study the diversity of viruses infecting different Ostreococcus strains in a spatio-temporal manner. Viruses were characterized and identified via the partial sequencing of the DNA polymerase gene. We isolated twenty-seven new viral strains from five different host strains. Furthermore, since 2007, time series were carried out to quantify hosts and associated viruses. We thus monitored abundance, diversity and polymorphism of algal hosts and their viruses. This study brings some insights about the evolutionary history of the picoalgal-virus system and the factors controlling these interactions.

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BACTERIAL COMMUNITIES IN MARINE BIOFILM GROWING ON ARTIFICIAL SUBSTRATA IN DEEP SEA WATERS OF THE EASTERN MEDITERRANEAN SEA

In this study terminal-restriction fragment length polymorphism (T-RFLP) fingerprinting was used to analyze the community structure of bacteria growing in biofilms attached to different types of artificial substratum deployed in the deep sea waters of the Hellenic Trench (Ionian Sea). This area is characterized by small temperature fluctuations between the deep-water layers. As a consequence, it seems relevant to examine possible variations in the community structure of bacteria with regard to depth and substratum, as other environmental factors probably determine depth zonation of bacteria. In order to test if depth and type of substratum can affect the biofilm formation and its structure in terms of bacterial communities in deep-sea biofilms, an innovative experimental device with five different types of artificial substratum (titanium, aluminum, glass, limestone and shale) were deployed for a six month period at four different depths (4500, 3500, 2500 and 1500m) at the Hellenic Trench. The analyses of 64 T-RFLP-electropherograms displayed differences among depths and thus indicate that within one deep-sea water layer the physical nature of surfaces affects the settlement of bacteria as shown in coastal areas

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MODELLING THE BIOGEOCHEMICAL CYCLES IN THE MEDITERRANEAN SEA

The Mediterranean Sea is generally regarded as the best site to understand the interactions between the climate, the biogeochemical cycles as well as the marine ecosystems (Béthoux et al., 1999), because of its short turnover time of water and zones of deep water formation. Many studies have observed physical modifications (Rother and al., 1998) as well as biological ones (Marty and Chiavérini, 2002) which could be partially explained by climatic changes (Béthoux et al., 2001). It appears hence necessary to evaluate the impact of climate anomalies on biogeochemical fluxes in the Mediterranean Sea. To this end, I am adapting the biogeochemical model of the global ocean (LOCH) developed by Mouchet et François (1996) and coupling it to the GHER 3D circulation model of the Mediterranean Sea (Beckers et al., 2002). The biogeochemical module contains 9 states variables (2 groups of phytoplankton, silicate, biogenic silica, phosphorus, alkalinity, dissolved inorganic carbon, dissolved and particulate organic matter). We run the model forced with climatological forcing in order to reproduce the seasonal distribution of the biogeochemical fluxes over the whole Mediterranean Sea. The results will be presented and discussed. We also compare the distribution of pCO2 obtained with the model to in situ pCO2 data in different sampling stations of the Mediterranean Sea (e.g Dyfamed).

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ALTERATION OF OCEANIC NITRIFICATION UNDER ELEVATED CARBON DIOXIDE CONCENTRATIONS

Dissolution of anthropogenic carbon dioxide (CO_2) in the ocean reduces pH, alters carbonate chemistry, and also represents a potential resource for a broad spectrum of marine microorganisms that fix inorganic carbon. These bacteria and archaea drive global biogeochemical cycles of carbon and nitrogen, yet their responses to increased pCO_2 and reduced pH remain largely undocumented. Here we show that elevated pCO_2 may alter nitrification rates and populations of nitrifying microorganisms in the ocean. Multiple experiments were performed in the Sargasso Sea and Southern California Bight under glacial maximum (193 ppm), present day (390 ppm), and projected (750 ppm) pCO_2 concentrations, over time scales from hours to days, and at depths of 45-240 m. In the majority of experiments, populations of ammonia-oxidizing archaea and bacteria decreased by 40-80% under elevated pCO_2, and this reduction became more pronounced with exposure over time. Nitrification rates were measured with isotopically-labeled nitrogen and also showed significant responses to changes in pCO_2. These findings suggest that projected increases in pCO_2 and subsequent decreases in pH may affect microbial community structure and biogeochemistry in the sea.

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EFFECTS OF NITROGEN SOURCE AND THE LIGHT:DARK CYCLE ON GROWTH AND GENE EXPRESSION ASSOCIATED WITH THE UREA CYCLE IN THALASSIOSIRA PSEUDONANA

Whole genome sequence analysis indicates that diatoms possess a complete urea cycle. The specific function of the urea cycle in diatoms is unknown, but it has been hypothesized to connect several vital cellular pathways to one another including carbon fixation, energy storage and photorespiration. The planktonic diatom Thalassiosira pseudonana was grown in steady state on three nitrogen sources (urea, nitrate, ammonium) under a light:dark cycle. Growth rates and variable fluorescence were monitored, and differential gene expression of three key genes (CPSIII, URE, CK) associated with N-metabolism and the urea cycle was measured using quantitative PCR. Cells grew at similar rates on ammonium and nitrate; however, growth on urea was significantly elevated. Our gene expression results indicate that the first gene in the urea cycle pathway (CPSIII) is up regulated during the dark cycle relative to the light cycle. Additionally, the expression data for each gene varied based on N source. These results help clarify the function of the urea cycle in T. pseudonana, and they suggest a connection between the urea cycle and metabolic processes that occur in the dark.

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STREAM DRYING IN THE IBERIAN PENINSULA AND CONSEQUENCES FOR FISH ASSEMBLAGES

Excessive freshwater abstraction impairs the capacity of streams to support native biota. We investigated the flow regime and related variables in six river basins of the Iberian Peninsula and show that they have been strongly altered, with negative trends for flow and aquifer levels during the 20th century. We observed lower flows and higher frequency of stream-drying than those predicted by the official hydrological model used in this region. We also observed dry conditions for some streams predicted by the model to be permanently flowing. Meanwhile, there has been no decrease in precipitation. We investigated the fish assemblage of a stream in one of these river basins (Tordera) for six years and show that sites more affected by water abstraction display significant differences in four fish metrics (catch per unit effort, number of benthic species, number of intolerant species and proportional abundance of intolerant individuals). We discuss the utility of these metrics in assessing impacts of water abstraction and point out the

need for detailed characterization of the natural flow regime (and hence drought events) prior to the application of biotic indices in streams severely affected by water abstraction. In particular, in cases of artificially dry streams, it is more appropriate for regulatory agencies to assign index scores that reflect impairment than to assign "missing" scores, as is customary for Iberian streams.

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SHORT LIVED RADIONUCLIDES AS TRACERS OF PARTICLE FLUX IN THE OCEANS: A LOOK TOWARDS THE FUTURE

Measuring what controls the magnitude, timing, and depth of surface water particle export in marine systems is a difficult task and the focus of a multitude of current research programs. Over the past several decades, short lived radionuclide pairs, such as ^{234}Th:^{238}U, and more recently ^{210}Po:^{210}Pb, have been used to examine particle export on timescales of a few days to months. The models used to convert radioactive daughter deficits to fluxes of carbon, nitrogen, and other elements are relatively simple and empirically derived, with little knowledge required of the underlying controlling mechanisms. While great strides have been made in understanding the "black box" steady state approach used to estimate particle flux, there is still much to be learned and explored when applying a more complete model. This tutorial will highlight current applications that increasingly incorporate non-steady state and physical processes and the combination of mutiple isotope pairs for delineating specific time periods and flux constituents.

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OBSERVING AND INTEGRATING DEEP CHLOROPHYLL MAXIMUM OF THE METALIMNETIC CYANOBACTERIA *P.RUBESCENS* FROM SINGLE POINT MEASUREMENTS

The research program Proliphyc aims at developing autonomous monitoring buoys and expert-system for the detection, characterization and early-warning of potentially toxic algal blooms. Semi-continuous measurements (4/hour) of CTD, oxygen and fluorescence were performed since July 2007 by a prototype at 15m depth in a large subalpine lake to study the annual cycle of the metalimnetic cyanobacteria *Planktothrix rubescens*. Internal waves were the primary drivers of variability for all parameters, inducing daily variations in summer larger than annual ones. A new method was developed to decipher biological and geochemical dynamics in such highly variable environments. Statistical and spectral analysis were first conducted to determine the times scales of the main physical forcing (3-4 days). Property-temperature representation over this period provided a "mean image", integrative of vertical oscillations and horizontal transfers. This original concept allows new qualitative and quantitative interpretation of continuous measurements that highlights ecosystem functioning. Documenting conductivity and oxygen vertical gradients in the metalimnon and peak distribution of chla, feed-back on observation strategy was also provided. Finally, *P.rubescens* deep chlorophyll maximum dynamics at short and inter annual scale was examined.

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WHAT HAVE WE LEARNED ABOUT THE PHYSIOLOGY OF DINOFLAGELLATES UNDER SMALL SCALE TURBULENCE?

We will review the literature about laboratory studies of the physiological responses of dinoflagellates to small-scale turbulence. Relevant observations include: 1) changes in the morphology and cellular volume, 2) alterations of the cellular content of DNA, toxins or DMSP, 3) modifications of the cell division and live cycles (cyst formation) and of motility patterns, 4) interferences with predator-prey and parasite-host interactions, and 5) cell death. Altogether, these results point to the particular sensitivity of dinoflagellates to small-scale turbulence. One challenge now is to understand the fundamental mechanisms of the responses of dinoflagellates to turbulence, which requires an intensification of studies with sophisticated laboratory methodologies. Other challenges are to ascertain to what extent experimental laboratory designs and setups approximate natural conditions and how the physiological capacities of the organisms interact with other biological factors, environmental forcings and water circulation at a variety of spatio-temporal scales, to determine the dynamics of dinoflagellate populations in nature.

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EXTENDING OUR ECOLOGICAL VIEW OF INTERACTIONS BETWEEN BACTERIVORY AND BACTERIOLYSIS IN MESOTROPHIC VS. OLIGOTROPHIC CONDITIONS

Bacterivory and bacteriolysis are key biological processes while studying aquatic microbial functioning but they are still poorly known in freshwaters. We used a size-fractionation approach (to manipulate the grazing pressure) in order to examine the fate of viral and prokaryotic standing stocks and functions, as well as the potential nutrient release and bacterial carbon demand. Samples originated from two lakes (mesotrophic vs. oligotrophic), two different periods of the year (winter vs. summer) and two contrasting depths (2 vs. 50 m). The presence of the bacterivores caused a substantial increase in both bacterial and viral production and abundance within less than 48h, supporting the hypothesis of synergistic interactions between grazers and viruses. The intense bacterial and viral activities observed during experiments were going with the modification and enhancement of specific DOM fluorescence intensity as revealed throughout the use of high resolution fluorescent spectroscopy, but only in the mesotrophic lake. Viral production exceeded viral decay, resulting in the net increase of viral abundance recorded during the experiments and this production seemed to be amplified with the trophic status, under favourable environmental conditions. Such an unbalance was accented by the presence of bacterivores, suggesting that the latter could stimulate the lytic cycle. In fine, the viral-induced carbon released could represent up to 40% of the bacterial carbon demand.

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EDDY CORRELATION MEASUREMENTS AND MATHEMATICAL MODELING OF BENTHIC OXYGEN EXCHANGE DYNAMICS

The eddy correlation technique can record undisturbed oxygen fluxes across the sediment-water interface and can capture dynamic flux variations with time scales down to 10 min. Some of these dynamic changes are linked to chances in light, current velocity, and wave action, but often flux variations follow a complex pattern that is more difficult to decode. In this presentation, we combine eddy correlation flux measurements with two-dimensional mathematical modeling of oxygen transport and oxygen consuming biogeochemical processes in sediments. This joined approach allows us to gain further insights into dynamic sequences of measured oxygen fluxes, their controls and their time scales. The focus will be on shallow-water sediments that are highly permeable and thus allow current and wave-driven porewater flushing of the upper sediment layers. This advective transport that is many times more effective than molecular diffusion that usually dominates cohesive muddy sediments, can radically alter biogeochemical cycling in permeable sediments.

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HIGH SALINITY SHELF WATER SIGNATURE IN THE NEW FORMED AABW NEAR CAPE ADARE: IMPLICATIONS FOR DARK OCEAN ECOSYSTEMS

In the Pacific sector, High Salinity Shelf Water (HSSW) is a key constituent of the Antarctic Bottom Water (AABW) that plays an important role in ventilating the global deep ocean. HSSW is formed by brine release during sea ice formation when katabatic wind produces important polynya phenomena mainly in southern Victoria Land near Terra Nova Bay (TNB). HSSW fill-up the whole Drygalsky basin as bottom water, dense enough to flow northward and trigger downslope processes to the abyssal depths near C. Adare region. During February 2006, within the XXI° PNRA expedition, CLIMA &

PolarDOVE Projects, a benthic boundary layer mooring was deployed off the Cape Adare at 2300 meter depth. At the same time few transects of the shelf break were carried out in order to have a snapshot of the shelf-slope system behaviour. The mooring was recovered successfully in January 2008 given us the opportunity to have a two year long time series of the evolution of the bottom boundary layer during IPY period. The biological determinations showed a clear signal of high metabolic processes within the HSSW, at the same the 2 year long T-S-currents analysis of the benthic boundary layer allows us to make some hypothesis of dark ecosystem functioning.

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INVASION OF ELODEA CANADENSIS IN LAKE STEINSFJORD (S-E NORWAY) AND LONG TERM IMPLICATIONS FOR BIODIVERSITY, WATERFOWL AND LAKE PRODUCTIVITY

Elodea canadensis quickly became dominant in Lake Steinsfjord since its appearance in 1976-80 and still dominated the macrophyte community in 2004. However, after the peak in 1984, the covered area as well as the biomass and shoot length declined gradually towards 2004. In the first years after the invasion the break down of Elodea stands resulted in leakage of nutrients to the water, which eutrophicated the lake. However, this effect disappeared after a few years. The large stands of Elodea attracted waterfowls in large quantities, and in the mid nineties approx. 800 swans were counted in late summer and autumn. The nutrient from waterfowl faeces increased the eutrophication again and toxic cyaobacteria developed. However, extensive bird grazing and P-depletion of the littoral sediments after years with massive growth decreased the stands of Elodea, which became less accessible for the waterfowl. The amount of waterfowls decreased and the lake became less productive. Species richness of aquatic macrophytes has not changed significantly since the earliest surveys. However, the species composition changed remarkably due to the Elodea invasion.

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IMPACT OF MESOZOOPLANKTON, STRATIFICATION AND TEMPERATURE ON SPRING PLANKTON DYNAMICS – A MESOCOSM EXPERIMENT

Global warming is expected to affect light- and temperature-dependent biological processes differently and may have its strongest impact on lake plankton in spring, when light availability and temperatures change rapidly with the onset of stratification. In deep lakes water temperature and the timing and depth of stratification influence seasonal events such as the phytoplankton spring bloom, and the subsequent clearwater phase and mesozooplankton peak. The mechanisms determining the timing and biomass levels during these events are not well understood. Particularly, little is known about the relative roles of micro- vs. mesozooplankton grazing. We experimentally investigated the impacts of mesozooplankton grazing (Daphnia present/absent) on spring succession under different scenarios of stratification depth and water temperature. Increased water temperature shifted all spring events forward leading to earlier phytoplankton peaks, clearwater phases and Daphnia peaks. The magnitudes of the phytoplankton and Daphnia peaks decreased with stratification depth. While the magnitudes of the phytoplankton peaks were similar in Daphnia-present and -absent treatments, phytoplankton biomass at the clearwater stage was much lower in presence of Daphnia, suggesting a relatively weaker impact of ciliate grazing on phytoplankton dynamics.

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AGING OF ALLOCHTHONOUS ORGANIC CARBON REGULATES BACTERIAL PRODUCTION IN UNPRODUCTIVE BOREAL LAKES

Allochthonous dissolved organic carbon (DOC) is an important carbon source for bacterial production (BP) in humic lakes. Here we show that BP can be a function of, and decreases with, the aging of allochthonous DOC in the aquatic environment. During a seasonal cycle, bacterial bioassays coupled to calculations of average aquatic DOC age (the time span from soil discharge to observation) were performed with water from the inlets and outlets of two unproductive Swedish lakes. BP and bacterial growth efficiency (BGE) during 7-day bioassays decreased with increasing average aquatic DOC age. Parallel to the declines in BP and BGE there was a rise in specific UV absorbance at the wavelength of 254 nm (SUVA254) indicating that decreasing BP and BGE were connected to a shift to a more aromatic and recalcitrant DOC pool. The results suggest that hydrological variability in combination with lake size and temperature have large influence on pelagic BP in lakes with high input of terrigenous DOC.

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INTER-COMPARISON OF ZOOPLANKTON TIME SERIES AT SIX STATIONS IN THE MEDITERRANEAN

In the framework of SESAME, an inter-comparison study of long (≥ 10 years) Mediterranean mesozooplankton time series is carried out. At present, six time series of mesozooplankton abundance, located in Balearic, Ligurian, Tyrrhenian, Adriatic and Aegean Sea have been collected. Time series differ in length (periods from 10 to 40 years), taxonomic resolution (species or group), sampling nets (200 to 330 µm mesh size), and sampling frequency (week to season). Along with zooplankton data, hydrology was characterized by in situ data of temperature, salinity and Chla. Focusing on four main taxonomic group (copepods, chaetognaths, appendicularians and cladocerans), series of abundances were analyzed to detect trends, discontinuities and main modes of variability. Results are discussed with respect to local and regional climate.

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A NOVEL APPROACH TO ESTIMATE BACTERIAL GROWTH EFFICIENCY: THE INSTANCE OF LAKE KINNERET, 2001-2007

Semi-annual, averaged values of photosynthetic carbon fixation (PFC), community respiration (CR), bacterial productivity (BP), measured bi-weekly or monthly were used to obtain long-term estimates of bacterial growth efficiency (BGE) in Lake Kinneret. We posited that CR = phytoplankton (PR) + bacterial (BR) + zooplankton (ZR) respiration; also Gross Primary Production (GPP) =1.6 PCF and PR = 0.3 GPP (results from independent experimental series). ZR was determined by multiplying zooplankton biomass with published respiration rates for the major zooplankton groups. These data allowed us to calculate BR and consequently BGE, as BP/(BR+BP). BGE on sampling dates fluctuated widely (15% to 95%) but semi-annual BGE varied only from 27% to 55%, averaging 40(±7)% overall from 2001 through 2007. Similar BGE were obtained if we assumed that BR =2ZR or 3ZR. We suggest that realistic estimates of BGE suitable for budget calculations and ecological modeling in aquatic systems can only be achieved by using relatively long-term averages in order to obviate sharp fluctuations of BGE caused by transient environmental perturbations.

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NITROGEN FIXATION IN THE EASTERN MEDITERRANEAN SEA.

Nitrogen fixation has been suggested to contribute greatly to the N cycle in the ultra-oligotrophic eastern Mediterranean. We monitored routine stations in an east-west transect from the coast of Israel from 2005 through 2007 to identify and quantify the organisms responsible for nitrogen-fixation (diazotrophs) in the Levantine basin.

Phylogenetic analyses of the *nifH* genes studied by RT-PCR showed differential patterns in the genetic potential for nitrogen-fixation (DNA) versus organisms that were actively expressing *nifH* genes (RNA). The high diversity of *nifH* genes found is extensive and includes members from three different *nifH* clusters (I, II and III). An abundant diazotroph was the endosymbiotic cyanobacterium *Richelia intracellularis* which resides within diatoms such as *Rhizosolenia spp.* and *Hemiaulus spp.* High diversity of *nifH* contrasted with very low measured rates of nitrogen fixation, averaging ~ 1 nmol N L-1d-1 for all size fractions and depths. The lack of any observable large scale diazotroph blooms may result from the P-starved conditions affecting organisms in the Levantine basin.

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A NEW PHOTOBIOREACTOR MODEL DEALING WITH NITROGEN LIMITATION

Active researches are aiming at using microalgae and cyanobacteria to produce renewable energy. Extracting the lipid fraction from this biomass is one of the possibilities which are actively investigated. However, the continuous culture of algae is not straightforward and suffers from many limitations, so that there is a strong need for optimization and regulation approaches to run photobioreactors on the long term. Existing models of photobioreactors able to calculate the productivity from the light attenuation consider that growth is light-limited. However, nitrogen starvation is known to enhance the lipid production, and can significantly increase the lipid productivity. In such N-limited cultures, pigment and thus the absorption properties of the algae are not only light-dependent. We present a simple model, adapted from the Droop model, which takes into account both the photoacclimation to light and the chlorophyll decrease due to nitrogen limitation. This model can thus predict the chlorophyll in the photobioreactor and light attenuation. The resulting biomass productivity can then be simply computed and optimized. This model is validated with data from Isochrysis galbana grown under light-dark cycles.

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ASSESSING THE IMPACTS OF MANUFACTURED NANOMATERIALS ON AQUATIC MICROBIAL COMMUNITY STRUCTURE AND FUNCTION

Over the past decade there has been exponental growth in the development of new nanotechnologies, leading to rapid increases in the variety and production of manufactured nanomaterials (materials with at least one dimension under 100nm). Because of their nanosize, many of these novel materials possess enhanced or unique catalytic, conductive or optical properties. These attributes generate concern about the fate and environmental impact of these novel compounds in the environment. Here, I present the framework of the recently established Center for Environmental Impacts of Nanomaterials (CEINT) for assessing the environmental risks for manufactured nanomaterials. I will show the first results from laboratory assays examining the effects of silver nanomaterials on microbial activity and community structure in freshwater sediments. In early work we are examining how microbial biomass (measured by substrate induced respiration) and rates of C mineralization are affected by: dosing; b) silver nanoparticle size (4nm, 30nm, 100nm); and sediment organic matter content.

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MIXOTROPHIC PROTISTS IN AQUATIC SYSTEMS: WHEN DO THEY OCCUR?

Mixotrophy (photoautotrophy combined with phagotrophy) among protists and its potential importance for the carbon transfer in aquatic environments has long been known. But despite a wealth of laboratory and field studies, mostly focusing on the effect of abiotic parameters or food supply on their abundance, we still lack a complete understanding of the factors that determine the occurrence and diversity of mixotrophic ciliates and flagellates and their contribution to the ecosystem function. Our approach is more community-oriented. We investigated the effect of the composition of the entire planktonic community (prokaryotes, protists and metazooplankton) on the abundance and diversity of mixotrophic protists and their relative contribution to primary production and comsumption in a range of water bodies near Salzburg (A). In addition, we conducted laboratory experiments aiming at competition among different mixotrophic ciliates and their vulnerability to grazing from zooplankton. Our results indicated higher numbers of mixotrophic nanoflagellates when the zooplankton community was dominated by rotifers, compared to Daphnia-dominated systems. Mixotrophic ciliates appear to respond to abiotic factors (water temperature, light field) more strongly than to community-level effects.

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BIOTURBATION ENHANCES MICROBIAL DIVERSITY AND ECOSYSTEM PERFORMANCE

Bioturbation is known to influence benthic ecosystem functioning throughout the world ocean. Deep burrowing macrofauna species not only enhance the sediment-water interface, but also create biogeochemical reaction zones ('hot spots') associated with their burrows and burrowing behavior. In this study, we focused on mapping the subsurface reaction zones linked to the bioturbation activity of a thalassinid shrimp (*Neotrypaea californiensis*) in a coastal lagoon (Catalina Island, CA, U.S.A). We conducted detailed field and laboratory studies to assess the biogeochemical processes (sulfate reduction, nitrogen fixation, iron cycling) as well as the microbial diversity (using the community fingerprinting approach ARISA) associated with individual burrow structures. Our goal was to evaluate the effect of these microniches on benthic microbial diversity and ecosystem performance. Results indicate a clear impact of geochemical parameters on microbial diversity patterns and an increase of microbial activity within 'hot spots' that are up to three orders of magnitude higher than in the immediate surrounding sediment. We will evaluate the ecological significance of this bioturbation-induced patchwork of microbial processes for the entire benthic ecosystem at the investigated site.

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SENSING AND EXPLAINING MICROBIAL DYNAMICS AT DIURNAL TO SEASONAL TIMESCALES

An increasing number of recent studies relying on high-frequency environmental observation systems and high-throughput analyses of microbial response-variables have highlighted the dynamic properties of microbial community composition and function at scales that may range from episodic disturbance events to more predictable and long-term changes driven by radiation, climate and other gradual environmental changes. Using data from mainly freshwater ecosystems, this tutorial will address and review our current understanding of the frequency and amplitude of intrinsically and extrinsically-driven temporal changes in: (i) overall microbial community composition, (ii) individual microbial populations and phylogenetic groups, and (iii) microorganism-mediated biogeochemical processes. The major drivers behind these changes and the relevance of contrasting timescales for understanding the different dynamic properties of microbial communities will be reviewed and the need for high-frequency environmental sensors, adaptive sampling strategies and coordinated research programs will be discussed.

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DIFFERENCES OF EPILIMNETIC AND HYPOLIMNETIC PROKARYOTIC ASSEMBLAGES IN A DEEP HOLO-OLIGOMICTIC LAKE

The increase of hypolimnetic temperature, due to global warming, will likely determine a decrease of overturns and of winter mixing depth in deep oligomictic lakes. The consequent rise in separation of epi and hypolimnetic waters could possibly change the microbial diversity between the two zones. We evaluated the bacterial diversity in epi and hypolimnetic waters of Lake Maggiore, a large deep holo-oligotrophic lake in Northern Italy. We compared abundance, morphology, activity and genetic features of bacteria in the two zones. The average cellular volume of bacteria in epilimnium resulted significantly lower that in hypolimnium (t-test, $P<0.001$). The mean bacterial carbon production from [^{14}C]-Leucine uptake was 0.38 and 0.06 µg C l^{-1} h^{-1} in epilimnetic and hypolimnetic waters, respectively. The Denaturating Gradient Gel Electrophoresis (DGGE) profile showed a high genetic diversity between the two zones particularly in late summer. The analysis of samples with CAtalyzed Reporter Deposition- Fluorescence In Situ Hybridization (CARD-FISH) showed a remarkable increase of the percentage of *Archaea* on total DAPI counts, from surface to deep waters.

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EFFECT OF WATER LEVEL STABILITY IN WETLANDS ON PARASITES OF JUVENILE YELLOW PERCH

A number of wetlands have been constructed worldwide to compensate for loss of natural wetlands. Some are permanently flooded due to the presence of ditches which contrast with natural seasonally flooded wetlands. The objective of our study was to examine the effects of water level control on recruitment of parasites by juveniles yellow perch. We compared the parasite communities of juvenile perch captured in two permanently flooded wetlands (managed) with those from two seasonally flooded wetlands (natural). We observed a high similarity within and a low similarity between each type of wetland in the parasite communities of perch. Parasite diversity and species richness were higher in natural than managed wetlands. A striking difference between natural and managed wetlands was the absence of glochidia and of parasites that include sphaerid clams in their life cycle in managed wetlands. There was a low number of trematode taxa that include snails and birds in their life cycle in perch from both managed wetlands. Our study suggests that water level stabilization in wetlands results in reduced biodiversity and compromises food web structure and function.

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MACROPHYTE COMMUNITIES ASSESSMENT ON LAKES AND WATER FRAMEWORK DIRECTIVE (WFD) – DEVELOPMENT AND FIRST APPLICATION OF A STANDARDIZED SAMPLING METHOD IN FRANCE

Regarded as a biological quality element by the WFD, macrophytes are currently used for the assessment and the classification of the ecological status of 172 lakes in France. Over the past decades, aquatic vegetation from French waterbodies has been studied in order to characterize the community structure and improve the management of invasive alien species. Various sampling protocols have been used, and the comparability between the data obtained at the national scale was quite difficult. In the context of the implementation of the WFD, we developed a standardized sampling method optimising the macrophyte communities assessment. Compliant with European standards, this protocol was tested on 8 lakes corresponding to 8 different national types distributed on the whole French territory and has been used to assess the ecological status of 46 others French lakes since then. After a critical analysis of this protocol compared to previous French protocols and other sampling methods used in other European countries, we propose a first analysis of results of the implementation of this protocol on several French lakes.

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SYMBIOSIS-DEPENDENT EXPRESSION OF A P-TYPE H+-ATPASE GENE IN A CORAL-DINOFLAGELLATE ASSOCIATION

Besides a free-living form, dinoflagellates from the genus *Symbiodinium* (commonly named zooxanthellae) are also able to establish a phototrophic endosymbiosis with most scleractinian corals. This association underpins the formation and maintenance of the coral reef ecosystem. Due to the low level of CO_2 in seawater, many marine phototrophs have developed CO_2-concentrating mechanisms (CCM). Previous studies from our lab showed that CCM also occurs in symbiotic corals and their endosymbiotic zooxanthellae. Using a pharmacological approach, these studies have demonstrated specific mechanisms in cultured and *in hospite* zooxanthellae. In the present study, we report the cloning and sequencing of a P-type H^+-ATPase belonging to zooxanthellae and sharing several features with both fungal and plant groups of H^+-ATPases. This protein is only expressed when the symbiont is engaged in a symbiotic relationship and may be involved in CCM by mediating bicarbonate (HCO_3^-) dehydration for CO_2 supply to photosynthesis. This gene is the first symbiotic-dependent gene described in zooxanthellae and could be used as a biomarker to assess the shift in symbiont physiology during symbiosis establishment or coral bleaching events.

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THE MEDITERRANEAN SEA: A CASE STUDY FOR CLIMATIC AND ENVIRONMENTAL CHANGES

The well known Mediterranean physical functioning is driven by heat, water and salt budgets. Resulting homogeneity of deep waters allows determination of its geochemistry depending, through biological activity, on Atlantic input and mainly on atmospheric and terrestrial discharges. Before the closing of Ashwan High dam in the 1970s, the Mediterranean terrestrial watershed was twice greater than the sea surface. Geochemistry budgets determined peculiarities : e.g.; for marine productivity, importance of terrestrial inputs of phosphorus (about 80%), nitrogen fixation probably driven by diatoms ecosystem, and resulting molar ratio N/P of about 22 to 24, driving to high carbon sequestration. The short residence times of deep waters, from 15 years in the Algero-Provençal Basin to about 50 years in the eastern Mediterranean, allow the evidence of climatic changes (through temperature and salinity) and geochemical changes (through lead, phosphorus, nitrogen...). These marine changes may be used to quantify and survey at sea scale the climatic and environmental changes resulting from the anthropic activities, with consequences on the marine ecosystem, and may be compared to socio-economic data acquired on the watershed.

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VIRUS-PROKARYOTE INTERACTIONS ALONG A FULL SALINITY GRADIENT

Virus-prokaryote interactions were investigated in four natural sites in Senegal (West Africa) covering a salinity gradient from freshwater to salt saturation (370‰). Remarkably, both communities showed spectacular physiological, genetic, and morphological adjustments to resist and adapt to the highest levels of salinity. Viral and bacterial stocks greatly increased beyond 250‰, along with the emergence of (i) highly active square Archea (presumably Haloquadraton walsbyi), and of (ii) viral particles of irregular structure (predominantly lemon shaped and filamentous morphotypes). Viral life strategies also showed some salinity driven dependence, switching from a prevalence of lytic to lysogenic stages of infection in the upper salinity ranges. Interestingly, the fraction of lysogenized cells was positively correlated with the proportion of square Archeae, implying that the majority of haloarcheophages are temperate rather than virulent. Overall, the extraordinary abundance of viruses in hypersaline systems (up to billions of particles per millilitre) appears to be partly explained by their high stability and specific properties to persist, accumulate and proliferate in these harsh habitats.

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BIOGEOGRAPHY OF PHOTOSYNTHETIC STRATEGY IN MARINE PHYTOPLANKTON

Photosynthetic light-harvesting (LH) proteins are the mechanism by which energy enters the marine ecosystem; using the Global Ocean Sampling (GOS) data, we mapped the biogeography of these genes in the marine oxyphotobacteria *Prochlorococcus* and *Synechococcus* on ocean-basin scales and show that an environmental gradient exists in which chlorophyll concentration is correlated to variability of LH protein type. We define three functionally distinct types of LH genes in marine oxyphotobacteria: (1) the phycobilisome (PBS) genes of *Synechococcus*; (2) the *pcb* genes of *Prochlorococcus*; and (3) the iron-stress-induced genes (*isiA*) present in some marine *Synechococcus* (sometimes referred to as *pcbD*). Importantly, *isiA* is found in the iron-limited, high-nutrient low-chlorophyll (HNLC) region of the equatorial Pacific. This observation confirms the ecological importance of *isiA* in enabling marine *Synechococcus* to acclimate to iron limitation and suggests that the presence of this gene can be used as a natural biomarker for iron limitation in oceanic environments.

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BACTERIA-MEDIATED DECOMPOSITION OF BIOMOLECULES CONTAINED WITHIN COPEPOD CARCASSES

Zooplankton carcasses have been observed in both freshwater and marine environments, but their ecological significance has been largely unexplored. Carcasses represent potentially rich bacterial substrates and vehicles for vertical transport of organic matter. We studied bacterial utilization of different biomolecules within copepod carcasses. Carcass-associated bacteria exhibited higher abundances, protease and lipase activities than free-living bacteria. Carcass-associated cell specific lipase and protease activity peaked within 16 hours, while bacterial abundance peaked after 24 hours. Copepods lost over 70% of their protein content within eight hours after death, presumably due to bacterial consumption and leakage. Our results suggest that labile components of a copepod carcass may be consumed by heterotrophic bacteria and retained within the surface water, preventing transport of nutritionally rich material to depth, even within shallow systems.

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A MATTER OF LIFE OR DEATH? CELLULAR MECHANISMS REGULATING PHYTOPLANKTON MORTALITY

Recent discoveries of cellular mechanisms regulating phytoplankton death highlight loss processes independent of grazing and help explain how an average of 50% of global primary production flows through microbial foodwebs. Now recognized as a fundamental mortality mechanism in evolutionary diverse aquatic microbes, autocatalytic programmed cell death (PCD) is triggered by a variety of adverse stresses, including nutrient deprivation, allelopathy, and viral infection. The coherence of physiological, biochemical, and genetic evidence in diverse prokaryotic and eukaryotic phytoplankton lineages suggests that PCD has deeply rooted origins and possesses a core set of death proteins. Furthermore, its observed connection with transparent exopolymeric particle production and aggregate formation suggests a mechanistic role in the vertical flux of organic matter. Given that phytoplankton sense environmental cues and activate PCD via cell signalling pathways, chemical signals appear to play a heretofore unappreciated role in mediating cell fate and influencing large scale processes. Recent advances in genomics and genetic tools are providing key insight into cellular strategies employed by phytoplankton when interacting with their changing environment and allow us to interpret bloom dynamics in a novel context.

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HIGH ABUNDANCE OF DIAZOTROPHIC PICO-CYANOBACTERIA ALONG NUTRIENT GRADIENTS IN PACIFIC WATERS (COASTAL AND OCEANIC)

It is now more and more recognized that the unicellular diazotrophic cyanobacteria play an important role in marine nitrogen and carbon cycles, although these organisms are still not taken into account in global biogeochemical budgets and models. In this study we quantified unicellular diazotrophic cyanobacteria ($UCYN_2$-FIX lineage) using specific whole cell hybridization technique (TSA-FISH) within picoplanktonic, nanoplanctonic and larger size fractions. Surprisingly a significant population of diazotrophic pico-cyanobacteria was discovered in every size fractions and over a large range of nutrient concentrations. These diazotrophs were numerically dominated the $UCYN_2$-FIX community at 97% and 98% in coastal and oceanic environments respectively. In these environments N_2-fixation from the < 10µm size fraction contributed to 74% of total N_2-fixation. Along the oceanic equatorial transect diazotrophy could explain from 0.8% to 50% of the net and new primary production in the Pacific HNLC and oligotrophic warm pool waters, respectively. Further work should be done to identify this new population of diazotrophs, and it will be important to better characterize the contribution of each group of diazotrophs to global N_2-fixation.

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SPATIAL GRADIENTS IN MICROBIAL BIODIVERSITY OF ARCTIC OCEAN SEDIMENTS: FROM SHELF TO DEEP SEA

The identification of spatial patterns and of the factors influencing them is fundamental to the understanding of microbial ecology and biogeography. In this study we used a well-characterized set of sediment samples from the Arctic Ocean to address these questions. The samples covered three transects in the Laptev Sea that extend from the shelf to the deep sea (Boetius & Damm, 1998, Deep-Sea Research I). Patterns of microbial diversity were assessed along the transects as well as along vertical profiles in the surface sediments, covering sediment depths of 0-1, 1-2 and 4-5 cm, using the fingerprinting method Automated Ribosomal Intergenic Spacer Analysis (ARISA). Non-metric multidimensional scaling and analysis of similarity showed that differences in microbial community patterns were correlated with water depth. The factors "geographic location", "water depth" and "sediment depth" were combined with a set of biogeochemical parameters, and further analyzed via constrained ordination methods and variation partitioning. The main drivers of beta diversity were therefore determined which will help to describe the response patterns of microbial communities to environmental and spatial changes.

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EFFECT OF CO_2 ON THE PROPERTIES AND SINKING VELOCITIY OF AGGREGATES OF THE COCCOLITHOPHORE EMILIANIA HUXLEYI

Coccolithophores play an important role for organic matter export due to the production of the mineral calcite which can act as ballast for organic matter. Recent studies indicated that calcification in coccolithophores may be affected by changes in the seawater carbonate system. We investigated the influence of CO_2 on the aggregation and sinking behaviour of the coccolithophore *Emiliania huxleyi* (PML 92/11) during a laboratory experiment. The coccolithophores were grown under glacial, present and future CO_2 conditions. Aggregation of the cells was promoted using the roller table approach of Shanks and Edmondson (1989). Size and settling velocity of aggregates were determined during the incubation using video image analysis. The aggregates were analysed for mass, bacterial abundance, particulate organic and inorganic carbon (POC, PIC). The results show that CO_2 induced changes in the PIC to POC ratio influence the sinking velocity and properties of aggregates of *Emiliania huxleyi*. The amount of calcite in aggregates is crucial for the degree of ballasting effect. Our findings suggest a reduced vertical export of organic matter in the ocean, if CO_2 in the atmosphere further increases.

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COOPERATIVE RESEARCH ON DISTRIBUTION AND HABITAT USE OF SPERM WHALES AND OTHER MARINE MAMMALS IN THE EASTERN TROPICAL PACIFIC

In Sept-Oct 2008, we began fieldwork to study the impact of regime change from El Viejo (El Niño dominated conditions of the last 20 years) to La Vieja (anticipated La Niña dominated conditions) on sperm whales and other marine mammals between Ecuador and the Galápagos Islands. Daniel Palacios, Hal Whitehead, and others who surveyed sperm whales at the Galapagos in the 1990s believe many individuals left following the very strong El Niño of 1997-1998, but they also hypothesized sperm whales might return when La Niña dominated conditions return to the Galápagos. Marine mammal observers riding Guayaquil-Galápagos cruises on the Ecuador Navy ship R/V Orion offer the opportunity to test how regime change impacts whale distribution. This poster summarizes our 2008 marine mammal sightings and their habitat correlations with satellite altimetry and ocean color. Our long-term vision is this collaboration for ecosystem-based research will extend to future work from coastal vessel(s) in the Galápagos as well as on the R/V Orion cruises. INOCAR has a coastal vessel (M/V Rigel) which they intend to operate for fieldwork in the Galapagos to supplement the Guayaquil to Galápagos cruises on their 230-foot R/V Orion. One of us (JEO) and two other graduate students participated in a cruise on M/V Rigel in summer 2007 in which they documented the presence of sperm whales west of Fernandina Island; we expect M/V Rigel cruises might continue summers 2009 and 2010.

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ASSESSMENT OF TOXIC ALGAL THREAT (MICROCYSTIN) IN FLORIDA LAKES

Assessment of microcystin in 187 Florida lakes was completed during January-December 2006. Annual average microcystin concentrations of the 187 Florida lakes ranged from non-detectable (< 0.1 µg L^{-1}) to 12 µg L^{-1}. Of the 862 individual water samples collected from the 187 lakes, microcystin concentrations ranged from non-detectable to 32 µg L^{-1}. Only 7 % of the individual samples exceeded the World Health Organization (WHO) drinking water standard of 1 µg L^{-1}. Three individual water samples (0.3 %) exceeded the WHO recreational standard of 20 µg L^{-1}. Using chlorophyll concentrations and Secchi depth measurements, tables were constructed to predict the probability that microcystin concentrations would exceed the WHO standards in Florida lakes. A study of six hypereutrophic lakes (Harris Chain of Lakes, Lake County, Florida) completed during September 2006-August 2007 showed 40% of these samples were above 1 µg L^{-1}; none exceeded 20 µg L^{-1}. Consequently, microcystin concentrations did not seem to pose a significant threat to Floridians as lakes are typically not used for drinking water and the recreational standard was seldom exceeded.

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METHODOLOGICAL ADVANCES IN THE MEASUREMENT OF CARBON DIOXIDE IN SURFACE WATERS

Although the determination of CO2 concentrations in surface waters is a fundamental measurement in limnology, much of what we know about CO2 is inferred from indirect measurements. Although the headspace method now provides a routine, simple and direct method for measuring free CO2, there is a need for an in situ method to make continuous, high frequency measurements of CO2 concentrations. Here we present a new, logger based method, which uses an in-stream NDIR sensor. We compare its performance with other methods and demonstrate its use in boreal, temperate and tropical aquatic systems. A further advance has been in the direct measurement of the isotopic composition of CO2 released from water surfaces. In the past evasion del13C-CO2 and 14C-CO2 have been inferred indirectly from DIC. We present a new method based on a combination of floating chamber and molecular sieve, which allows CO2 to be captured directly for isotopic analysis. The headspace method, in-stream sensor and molecular sieve-based method now provide direct tools to improve our understanding of the processes that control CO2 concentrations in aquatic systems.

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DETECTING AND IDENTIFYING MICROBIAL COMMUNITIES WITH A REMOTE, IN SITU SENSOR, THE ENVIRONMENTAL SAMPLE PROCESSOR.

Discerning the impact of microbial communities on geochemical cycling requires identification of organisms, genes, or gene products within an environmental context. To that end, we have developed the Environmental Sample Processor (ESP; http://www.mbari.org/esp/), which employs wet chemistry molecular analytical techniques to autonomously assess the presence and abundance of specific organisms, their genes and/or metabolites. The ESP instrument provides in situ and near real time identification of microbial species. Current detection chemistries rely on low-density DNA probe and protein arrays; we have recently added a reusable solid-phase extraction column for purifying nucleic acids and a real-time PCR module. This qPCR capability is the result of a unique fluidic handling system on the ESP and allows the use of a variety of PCR master mixes and primer/probe combinations. We will present an update on progress towards fielding a PCR-enabled ESP, along with an outline for plans for its use in coastal and oligotrophic oceanic regimes.

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DAYLENGTH AND MICROALGAL GROWTH: A GENERAL MODEL

At mid and high latitudes daylength exerts a strong influence on the seasonal variation in microalgal specific growth rates (μ). However, despite the importance of the relationship between microalgal μ and daylength there is a lack of consensus regarding the most suitable model to use. Consequently, many comparative studies adopt a linear relationship when extrapolating from microalgal growth at one daylength to another. Here, we used a meta-analytical approach (54 responses), together with information theory, to investigate the shape of the microalgal specific growth response to daylength. Our results indicate that this relationship is well described by a modified 3-parameter rectangular hyperbolic (Michaelis-Menten type) model. The linear model was a poor predictor of the data, and we show that linear extrapolation of growth rates (i.e., assuming 24 h as 100%, 12 h as 50%) will lead to growth rate underestimates and overestimates of up to 25% and 65% respectively. This general model of microalgal growth in response to daylength will be useful in large-scale comparative studies where there is a need to normalize growth rates to a standard daylength.

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COUPLED COMMUNITY SIZE SPECTRA:DATA AND MODEL

We present a model describing the dynamics of coupled community size spectra, to explain how coupling of predator and detritivore communities affects the scaling of log abundance versus log body mass. The model captures the trophic interactions and recycling of material that occur in many aquatic ecosystems; focusing on the transfer of energy from a fixed plankton resource to larger sized organisms (i.e. fish predators and benthic detritivores). Model simulations demonstrate that the biological processes underlying growth and mortality in the two distinct size spectra lead to patterns consistent with data. Slopes of size spectra were steeper and growth rates faster for predators compared to detritivores. Size spectra were truncated when primary production was too low for predators and when detritivores experienced predation pressure. The approach also allows us to assess the effects of external sources of mortality (e.g. harvesting). Removal of large predators resulted in steeper predator spectra and increases in their prey (small fish and detritivores). The model predictions are consistent with observed patterns of exploited ecosystems.

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A MULTI-GENE MOLECULAR PHYLOGENY OF CALANOID COPEPODS WITH CONSIDERATION OF THE GEOLOGICAL AND ENVIRONMENTAL HISTORY OF THE OCEANS

Calanoid copepods – the most speciose and successful zooplankton group – may have invaded the pelagic realm multiple times, with secondary return to the benthos, during 500 million years of evolution. The phylogenetic history of the calanoids has been re-interpreted in terms of the geological history of the oceans and hypothesized resultant environmental conditions, as well as possible morphological and functional innovations. Hypotheses of the benthic origins, pelagic invasions, and timing of radiation/extinction events may be examined using molecular phylogenetic analysis. In this study, DNA sequences for several independently-evolving genes were used to reconstruct the phylogenetic relationships of calanoid copepod families and genera. The molecular phylogeny was used to evaluate patterns of species diversity and occurrences of morphological and functional innovations in light of the geological and environmental history of the oceans.

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COMPARING REGIME SHIFT DETECTION METHODS BASED ON LONG-TERM DATASETS

In recent years, several publications addressed the identification and understanding of regime shifts in various marine ecosystems. However, no common approach has been found to define and identify regime shifts and reveal the functional response to key drivers. Here we present different ordination and regime shift methods to discuss and test for the most appropriate design for the detection of abrupt changes and their key drivers. All methods were applied to a unique dataset from the Central Baltic Sea covering 30 years and encompassing over 60 variables from physics to plankton and key fish species. Two regime shifts could be clearly identified by each of the methods. However, the specific time of the tipping point differs and we discuss advantages and drawbacks of the various approaches. Based on our example, we propose an easy-to-use combination of methods to (1) objectively identify and test for regime shifts in marine ecosystems, i.e. including abiotic and biotic features, and (2) to analyse the underlying processes and by this identify the ecosystem drivers and indicators and, if possible, early warning signals.

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THE INVASION OF LAKES BY GONYOSTOMUM SEMEN – AN INDICATOR FOR CLIMATE CHANGE?

Gonyostomum semen (G.) is an invasive flagellate that has rapidly increased its distribution and abundance in lakes in Northern Europe during the last decades. It can form intensive blooms that can be harmful to humans by causing skin irritation and allergic reactions. Previous and our own preliminary studies have pointed out that high DOC (> 10 mg DOC l-1) and high total phosphorus concentrations (> 30 μg l-1) are favorable for the development of G. Since DOC concentrations have increased in many regions of Northern Europe, probably due to climatic changes, the increase in the distribution and abundance of G. could be a result of climatic changes. Our results support the close relationship between climatic changes and the occurrence of G. since it increased particularly in October when water temperatures have increased over time. We conducted laboratory experiments that confirm that growth of G. is limited by temperatures below 10°C. If the time span of temperatures above 10°C is extended due to global warming, we can expect a prolongation of periods when G. can cause negative socio-economic and ecological effects.

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IODINE SPECIATION IN THE ATLANTIC SECTOR OF THE SOUTHERN OCEAN

Iodine is potentially a key element for climate change as iodine emissions from the ocean strongly influence the formation of new aerosol particles. The source and mechanism of iodine emissions from the ocean is poorly understood as are other aspects of iodine cycling in seawater. The biogeochemistry of iodide in the waters of the Atlantic sector of the Southern Ocean was investigated during the Polarstern cruise ANTXXIV-3 (GEOTRACES). Iodide profiles showed a maximum at the surface and concentrations declined towards depth. Highest iodide concentrations were found within the euphotic zone and were frequently associated with the chlorophyll-a maximum. Thus it is obvious that the formation of iodide is influenced in part by biological processes. Complementary laboratory experiments revealed that Antarctic diatoms can facilitate the reduction of iodate to iodide. All species tested produced iodide and showed an exponential increase over time. The iodide production rates were in the range of 0.02 - 0.8 nmol/ μg chl-a/ day and iodide levels peaked at the end of the stationary growth phase, suggesting that the iodide production mechanism is connected to cell senescence.

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VERTICAL VIDEO PROFILES OF PARTICLES FROM 100 TO 6000 M ACROSS THE TROPICAL ATLANTIC FROM BRAZIL TO AFRICA

Sinking particles are important vehicles for carbon fixed in surface waters to reach the deep sea where residence times are long and biological processes are slow. These particles consist of plankton carcasses, marine snow and fecal pellets of larger zooplankton. There are relatively few data on the relative abundance and morphology of these sinking particles in the water column, particularly in meso- and bathypelagic environments. During a recent research cruise, we determined particle distributions in the water column between 100 and 6000 m in a transect across the tropical Atlantic from Brazil, through the Romanche Fracture Zone (one of the deepest locations in the Atlantic) to the Cape Verde Islands using a simple video camera and newly designed image analysis software. Distinct particle abundance peaks were found in the oxygen minimum zone in the equatorial upwelling region, and inside the Romanche Fracture Zone between 3000 and 6000 m. The origins of the high particle loads inside the valley are unknown, but may be the result of resuspension from the canyon walls due to the strong bidirectional currents found there.

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WHAT CONTROLS DMSP SYNTHESIS AND BREAKDOWN IN EMILIANIA HUXLEYI?

The ocean is the dominant source of dimethylsulphide (DMS) and the sea-to-air flux of this sulphur trace gas is hypothesised to drive a feedback loop between plankton and climate. Synthesis of the major DMS precursor dimethylsulphoniopropionate (DMSP) by marine algae is fundamental for the biogeochemical cycle of DMS. However, despite a great deal of research, current understanding of the pathway between sulphur uptake and DMS production is far from complete. The overall aim of our project is to advance knowledge of the controls on DMSP synthesis and breakdown by the coccolithophore Emiliania huxleyi using biochemical and molecular tools (i.e. proteomics, transcriptomics, metabolomics). As an initial step we are looking for conditions that lead to rapid changes in DMSP synthesis. Cultures were grown in media with variable sulphate concentrations (with no change in ionic strength). The results demonstrate that cell growth rate and intracellular DMSP concentration decreases under low sulphate conditions. In ongoing experiments we are looking at how adding different forms of sulphur back to sulphate-limited cultures alters the production of sulphur metabolites including DMSP.

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THE OCEAN FLOOR BIOGEOCHEMICAL DATABASE.A SYNTHESIS OF EXISTING DATA ON ORGANIC MATTER PROCESSING IN MARINE SEDIMENTS

There is great interest in the processes controlling the processing of organic matter within marine sediments, because decomposition fuels the benthic ecosystem and burial depletes the active carbon reservoirs of the ocean. A key factor controlling the mineralization of organic matter is thought to be the presence of macrofauna in sediments. In recent years, a number of case studies have shown that bioturbation, and particularly bio-irrigation, increases the oxygen uptake, and hence the mineralization in the sediment. However do macrofauna influence carbon processing on a global scale? To answer this question, we are currently compiling the existing biogeochemical data that link macrofauna to organic matter processing into one database. Targeted process parameters include bioturbation (e.g., biodiffusion coefficients based on radio-nuclides), bio-irrigation (e.g., total and diffusive sediment oxygen uptake), and OM mineralization and burial (e.g., OM input, burial velocity, and decay rate constant). This database is examined with explorative statistics and regression analysis. Preliminary results suggest that such analysis could provide quantitative insight into the effects of burrowing organisms on OM processing on a global scale.

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NOVEL ASPECTS OF DIMETHYLSULFIDE METABOLISM IN *ALPHA*- AND *GAMMAPROTEOBACTERIA*

Bacterial metabolism of dimethylsulfide (DMS) is recognised as a major sink of the compound in the marine environment but is poorly understood. Marine DMS-oxidizing bacteria have been studied - *Methylophaga thiooxidans* (*Gammaproteobacteria*) and *Sagittula stellata* (*Alphaproteobacteria*). Relatives of *M. thiooxidans* have been demonstrated to be among the dominant DMS-oxidizing *Bacteria* during phytoplankton blooms using stable-isotope probing (SIP) methodology. *M. thiooxidans* assimilates carbon from DMS and oxidises the DMS sulfur via a novel pathway to tetrathionate ($S_4O_6^{2-}$). In addition to being a demonstration of a novel previously unrecognised fate of DMS sulfur, this is also the first reported microbial production of a polythionate from any organosulfur compound. Oxidation of DMS to dimethylsulfoxide (DMSO) has recently been suggested as another important DMS sink. *S. stellata* has been shown to oxidize DMS stoichiometrically to DMSO during heterotrophic growth in fructose- and succinate-limited chemostats with an associated increase in yield (Y_{max}). This is indicative of the use of DMS as an auxiliary energy source by a marine heterotroph and potentially represents an important biological pathway of DMSO formation in seawater.

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ECOLOGICAL CONSIDERATIONS IN RENEWABLE WAVE ENERGY DEVELOPMENT IN THE PACIFIC NORTHWEST

Ocean wave energy can provide clean and renewable power in many parts of the world. In the US Pacific Northwest, consistent and predictable wave energy produced across the long fetch of the North Pacific is a good match with the necessary coastal infrastructure and the demand for electrical power. Accordingly, the move to develop wave energy has been proceeding rapidly, with governmental stimulus and interest by industry. As the technology develops, we must understand the potential environmental effects from construction through operation to ultimate decommissioning. Environmental effects can range from changes to the physical environment (e.g., sand transport or currents) to ecosystem changes (fish and benthic community composition) to direct impacts (effects on migratory corridors for fish and marine mammals, collision or entanglement with devices). Baseline information, appropriate monitoring, and mitigation of potential effects (through wave energy facility siting and modification of conversion devices) will all play a role in development of this new, renewable energy resource.

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STOICHIOMETRIC CONSTRAINTS IN A CHANGING WORLD

In recent years it has become very clear that the nutrient stoichiometry of algal food plays a major role in determining its quality as food for higher trophic levels. Many experiments have been carried out showing that especially algae with high carbon to phosphorus or high carbon to nitrogen ratios are not a good food source for zooplankters. The relative availability of light and nutrients has been identified as one of the major factors steering nutrient stoichiometry of algae. Up until recently the changing global environment has not been considered as a factor influencing nutrient stoichiometry in primary producers and through this secondary production. Here, we will present data on the change of nutrients ratios at the Helgoland Roads long-term sampling station and discuss the possible implications these changes will have had and are likely to have in future.

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CO2 LEAKAGE IN THE DEEP OCEAN AND ITS EFFECT ON BIOTA AND BIOGEOCHEMISTRY – LESSONS FROM NATURAL ANALOGUES ON CO2 DISPOSAL IN THE OCEAN

One of the future strategies to deal with excess CO2 in the atmosphere is its disposal and storage in the ocean. The environmental risks of this mitigation strategy are not well constrained. Critical questions to any disposal scenario are as to the tipping points at which endemic species are affected by increasing pCO2 and decreasing pH, and as to the threshold for CO2 leakage from the seafloor to prevent negative effects on biodiversity and ecosystem services. During a recent expedition to the Okinawa Trough we have investigated the potential effects of natural CO2 leakage on deep-water benthic ecosystems at 1350 m water depth. At the Yonaguni Knoll vent system, volcanic CO2 emissions lower the pH of the bottom water to 7.2, with dramatic effects on megafauna distribution and composition. Furthermore, subsurface accumulations of liquid CO2 cause a decrease in pH down to pH 4.5 in the ocean seafloor, altering considerably biogeochemical processes in the sediments and affecting microbial communities. This presentation discusses direct and indirect effects of CO2 accumulation and leakage on deep-water ecosystems and relevant biogeochemical processes.

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EFFECTS OF SEVERAL ANTIBIOTICS ON RIVER BACTERIOPLANKTON COMMUNITIES AND ANTIBIOTIC RESISTANCE IN DIFFERENT E. COLI STRAINS ISOLATED FROM FOGLIA RIVER (ITALY).

Bacteria can adapt to human-induced factors in the environment, acquiring features that allow them to survive. The large use of antibiotics in medical practice and their release in the environment caused a selective pressure on bacteria, which determined the development of antibiotic resistance, enhanced by horizontal gene transfer among bacteria. This phenomenon may influence seasonal and geographic microorganism distribution in aquatic ecosystems. The effect of six antibiotics (ampicillin, gentamicin, kanamycin, a mix of streptomycin and penicillin, chloramphenicol and nalidixic acid) and a mix of all of them was tested on the bacterioplankton community at two sampling sites (river-head and river mouth) in Foglia river. Changes in cell viability, cell abundance and community composition were assessed by Flow Cytometry and CARD-FISH. Because of pollution of Foglia river and high presence of E. coli especially in the river mouth (up to 2,9 E+05 CFU/100 mL as reported by ARPAM) we tested the occurrence of antibiotic resistance in different E. coli strains isolated from water. Preliminary results showed a marked resistance towards ampicillin, chloramphenicol and streptomycin-penicillin in some of the strains analysed.

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ABUNDANCE OF DIAZOTROPHIC MICROORGANISMS AND NITROGENASE GENE (*NIFH*) EXPRESSION IN THE MEKONG RIVER PLUME DURING INTERMONSOON

Quantitative polymerase chain reaction (qPCR) and reverse-transcription qPCR approaches were used to investigate the horizontal distribution and activity of eight nitrogen-fixing microorganisms (diazotrophs) in surface waters off the Mekong River mouth in the South China Sea (SCS) in April 2007. The study coincided with intermonsoon and the river's lowest annual outflow. Sampling stations covered a gradient from eutrophic estuarine- to oligotrophic marine conditions (14-34 PSU). Highest abundances of all detected *nifH* phylotypes and greatest *nifH* transcription were observed at stations with salinities >32 and lowest turbidity and nutrient concentrations. *Trichodesmium* was the most abundant diazotroph with $2x10^5$ gene copies L^{-1}, but the *Rhizosolenia-Richelia* symbiosis displayed greatest *nifH* expression (up to $2x10^6$ transcripts L^{-1}). Unicellular cyanobacterial groups B and C and a γProteobacterium were detected at a few stations furthest offshore and all actively expressed the *nifH* gene. The cyanobacterial symbiont *Calothrix*, group A unicells, and a γProteobacterial diazotroph previously found in the SCS were not detected at any station. Our results show that riverine nutrients in the Mekong River plume set favorable conditions for diazotrophs and cyanobionts in particular.

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INFLUENCE OF WATER LEVEL FLUCTUATIONS ON BIOMASS AND PRIMARY PRODUCTION OF MICROPHYTOBENTHOS AND THEIR ROLE IN THE CARBON CYCLING IN FLUVIAL LANDSCAPES

Today many European rivers are disconnected from their former floodplains and the hydrological interactions are disturbed. Therefore, especially during low flow periods, the importance of shore line and in-stream zones for nutrient cycling and the in river productivity increases. In these areas an important source and basis for the riverine food web is provided by microphytobenthos. Several control factors for microphytobenthos are known, but less on their impacts for these benthic algal communities in large rivers and their adjacent aquatic areas. Water level fluctuations and light availability modify the development of microphytobenthos. The lowering of the water level causes desiccation stress for phytobenthic communities and suppresses growth and increases mortality. The aim of this study was to determine the potential role of microphytobenthos in the carbon cycle for a fluvial landscape. The second aim was to show how short-term desiccation stress influences the production potential of the phytobenthic community and therefore also the carbon cycling.

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EARTH'S LIVING OCEAN: FUTURE RETRIEVALS FOR OCEAN CHEMISTRY AND BIOLOGY FROM SPACE

For thirty years, the international ocean research community has made a vast array of discoveries using sustained, global, space-based data that allow estimation of ocean biological and biogeochemical properties. The findings enabled advances in global and regional carbon cycle science, ocean ecology, and helped to define the role of the oceans in Earth's climate. As our knowledge of the complex relationship between ocean biogeochemistry and global climate expands, new questions have arisen that require ocean color remote sensing data to move beyond chl-a, and provide a wider variety of data products such as particulate organic carbon concentration and particle size distribution. In addition, new, non-ocean color sensors, such as Calipso and Aquarius, may provide these key data and allow estimates of total column atmospheric CO2 concentrations, ocean salinity, and, potentially, surface CO2 concentrations. NASA continues to develop such new observational requirements for its future missions with the goal of achieving a more mechanistic understanding of phytoplankton physiology, habitat health, and carbon fluxes as we move from the laboratory to the global context of Earth's biosphere.

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A NEW CHEMOSTAT SYSTEM TO INVESTIGATE COMBINED TEMPERATURE AND CO_2 EFFECTS ON MARINE PHYTOPLANKTON SPECIES

In order to better understand the consequences of global change on marine plankton and biogeochemical cycling we established a new continuous culture facility that enables the investigation of combined temperature and CO_2 effects. The facility consists of five independent chemostats to cultivate algae in physiological steady-state under a controlled temperature, pCO_2, nutrient and light regime. Each chemostat is surrounded by a water jacket that controls temperature within a deviation of 0.2°C. In the incubators, the cultures are continuously aerated with gas of preset CO_2 concentrations. Distinct pCO_2 conditions, ranging from 0 to more than 5000 µatm (± <1.8%) can be created using a two-step CO_2 regulation system. To test the stability of the system and to asses the suitability for investigation of temperature and CO_2 effects on phytoplankton, we followed the growth of a calcifying strain of *Emiliania huxleyi* under three different CO_2 concentrations (180, 380 and 750 µatm) and two different temperatures (14°C and 18°C) simulating glacial, present day and future climate conditions. We will discuss the suitability of this system to investigate different scenarios of ocean warming and acidification.

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RECENT BENTHIC FORAMINIFERA IN PARALIC ENVIRONMENTS: CETINA AND NERETVA RIVER MOUTHS, ADRIATIC SEA, CROATIA

Benthic foraminifera are a major component of marine communities. They have ability to tolerate a broad range of environmental conditions. Dominant species have been determined, diversity indices and foraminiferal density were calculated in surface sediments from two karstic river mouths located at east coast of the Adriatic Sea: the Cetina Estuary (CE, outer estuary, depth 30 m) and the Neretva Delta (ND, prodelta, depth 32 m). Both assemblages are dominated by *Bulimina*, *Haynesina*, *Ammonia* and *Elphidium* genera. However, these genera comprise only 37 % at CE and 70.8 % at ND of total foraminiferal assemblages. At station CE, Fisher α index reaches value of 30.83 and foraminiferal density is 860 specimens per 1 g of dry sediment. On the other hand, at station ND, α index is very low (2.72) and foraminiferal density is 36.8 specimens per 1 g of dry sediment, also. We presume that the difference between foraminiferal assemblages is result of higher river influence at Neretva Delta area.

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CARBON CYCLING IN THE MIXOLIMNION OF LAKE KIVU (EAST AFRICA)

Lake Kivu is situated in the Western Rift Valley, and has unique limnological characteristics, as temperature and salinity increase with depth, due to bottom geothermal inputs. Due to its permanent meromictic nature, CH4 and CO2 concentrations are extremely high in Lake Kivu's bottom anoxic waters, similar to other “killer lakes” such lake Nyos in Cameroon. We obtained a data-set of inorganic carbon (pCO2, pH, TA, DIC, DIC stable isotopes), CH4, inorganic nutrients, organic carbon, bacterial production, and primary production in the mixolimnion of lake Kivu during the rainy season (March 2007), the late dry season (September 2007) and the mid dry season (June 2008). We show that the surface waters of lake Kivu were a source of CO2 and CH4 to the atmosphere albeit that the mixolimnion was net autotrophic at the community level, based on DIC mass balance budgets, sediment trap data and measurements of bacterial production and primary production. This rather unique situation is related to the important magmatic sources of CO2 in the bottom of the lake.

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LONG-TERM (1989-2007) RECOVERY OF BENTHIC AND FISH FAUNA, AFTER URBAN AND INDUSTRIAL DISCHARGES REMOVAL WITHIN A BASQUE ESTUARY (NORTHERN SPAIN)

The Nervión estuary (Basque Country, northern Spain) received high pollutant loads until the end of the 1990's. As a consequence, depending on the stretch within the estuary, the magnitude of the load, the morphological structure of the water body, residence times, etc., some parts of the estuary were azoic over a number of years. Water treatment in this estuary started in the late 1980s. Most of the engineering works within this particular estuary finished in 2000, when biological water treatment commenced; this coincided with a clear recovery in the physico-chemical, benthic and fish elements. This study extends from 1989 to 2007, and the positive trends observed in the sediment quality and the benthic status (sensu the Water Framework Directive) are due mainly to a reduction, in recent years, of nutrient discharges and an increase in dissolved oxygen; in some cases, from anoxic or hypoxic situations, to well-oxygenated bottom layers. For the most impacted stretches within the estuary, recovery takes 8-10 years to achieve a good benthic status. Data from this area shows that fish recovery depends on benthic recolonisation, being posteriorly detected the recovery in aquatic birds. This contribution shows an evolution of the estuarine quality, using integrative methodologies in assessing the status, including different compartments of the system, such as sediment, benthos, fishes, and aquatic birds.

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INTERANNUAL VARIATION OF THE MEDITERRANEAN SEA OLIGOTHROPHY: A POTENTIAL LINK TO CLIMATE CHANGE INDICES

The Mediterranean Basin, which is subject to both climate change and increasing anthropogenic inputs, is an appropriate test area for observing the evolution of algal biomass on a long-term basis. With more than 10 years of satellite ocean color measurements, SeaWiFS data allow us to evaluate interannual variations of sea surface chlorophyll concentrations. The study focus on the areal extent of extremely oligothrophic surface waters which are characterised by low chlorophyll concentrations and mainly found in the eastern Mediterranean basin. As an oligothrophic indicator, we used low chlorophyll concentration indices to study links between Mediterranean Sea biogeochemical processes and several large-scale indices of climate variability. We exploited monthly time series of well-known climate indices in order to attempt to evaluate to what extent climate anomalies from other basins may influence the Mediterranean Sea.

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CHEMOAUTOTROPHY RATES AND ACTIVE ORGANISMS IN MARINE SEDIMENTS BY 13C-BICARBONATE LABELING OF LIPID BIOMARKERS

Although chemoautotrophy is an important energy source in extreme ecosystems such as hydrothermal vents, it may also be an important process in normal marine sediments. In these sediments, chemoautotrophy is mainly driven by reoxidation of products formed during anaerobic mineralization such as sulfides and ammonium. We have studied chemoautotrophy in several coastal sediments by measuring dark-fixation of 13C-bicarbonate into lipid biomarkers (PLFA). Related to the sulfide chemistry of the sediments, label distribution in PLFA was clearly different between sediments indicating the activity of different chemoautotrophic bacteria. Label incorporation was restricted to the oxic and upper anoxic layer of the sediment. However, especially at low free-sulfide sites there was a considerable anaerobic activity possibly by organisms related to sulfate reducing bacteria, which explained up to half of the total chemoautotrophy. Estimated rates of total chemoautotrophy were very high and about 20% of the carbon mineralization was refixed by chemoautotrophs. Our results suggest that chemoautotrophy is a major - though highly understudied - process in coastal sediments and that chemoautotrophic bacteria are an important component of the microbial food web.

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GLOBAL ANALYSIS OF PHYTOPLANKTON PHYSIOLOGY USING SATELLITE CHLOROPHYLL FLUORESCENCE

Chlorophyll fluorescence from surface ocean phytoplankton has been monitored from space since 2002. Here we provide a global analysis of these data and show that the three primary factors influencing fluorescence distributions are phytoplankton pigment concentrations, pigment-packaging effects on light absorption efficiencies, and a globally-expressed physiological response aimed at protecting photosynthesis from high-light damage. Adjusting satellite fluorescencedata for these three factors, we derive global distributions of fluorescence quantum yields that reveal additional information on phytoplankton physiology and appear particularly sensitive to iron-stress conditions. Our resultsidentify satellite fluorescence observations as an important new global tool for resolving climate-phytoplankton interactions, testing nutrient-stress predictions of ocean ecosystem models, detecting phytoplankton responses to iron enrichments, and improving estimates of ocean photosynthesis

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MODELING LONG TERM PRIMARY PRODUCTION IN LAKES

Phytoplankton primary production is a key parameter to characterize the trophic state of lakes or oceans. In this study we have devised a numerical interpolation model, the P-E-equations of which are based on Platt's models partly modified to our purposes. 1. We present and discuss numerical interpolative calculation models which are based on different sets of environmental parameters (such as PAR, UV-A and temperature) that enable the estimation of monthly and annual primary production calculated from different sampling frequencies (from 4 day intervals to monthly intervals). Advantages and disadvantages of including UV-A and temperature, besides PAR, into the interpolation model are discussed by applying statistical tools. Estimates are given about optimal sampling frequencies, which still allow a reliable estimation of annual primary production in oligo-mesotrophic Lake Lucerne. 2. We present a method that allows describing the seasonal time course of primary production with a reasonable resolution and reliability. For this purpose we investigate and discuss short term changes (within days) of primary production key parameters (such as chlorophyll standing crop, and the production coefficients ANmax, α and ß).

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FAUNAL RECRUITMENT AND COLONIZATION PATTERNS IN SEAGRASS LANDSCAPES

The influence of seagrass landscape attributes on settlement and mobility of animals is poorly understood. To study faunal settlement, invertebrates (>125 μm) were collected in recruitment traps at five occasions over three months in continuous seagrass, seagrass patches and in bare sand. To study macrofaunal (>500 μm) colonization, artificial seagrass units (ASUs) were deployed for one, three and nine days at the interior and edge of continuous vegetation, and in bare sand at two sites, respectively. Both studies were carried out in the Baltic Sea. Traps collected totally 40 taxa, with non-significant habitat effects on species richness. Total number of recruits showed strong, largely wind-driven, temporal variability. Specifically, on three out of five occasions, lower numbers were recorded in continuous seagrass compared to small patches and bare sand. Colonization of ASUs was rapid, showing strong, but often site and time-specific effects of ASU location, on community variables. Species and individual-level animal responses further suggests, that seagrass landscapes are highly dynamic environments, characterized by site, time and species-specific effects of landscape attributes on animal recruitment and mobility.

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METHANE AND ORGANIC MATTER AS SOURCES FOR EXCESS CARBON DIOXIDE IN TEMPERATE INTERTIDAL SURFACE SEDIMENTS: BIOGEOCHEMICAL AND STABLE ISOTOPE EVIDENCE

Reduced organic carbon as DOC or methane can be oxidized in marine sediments forming carbon dioxide (DIC). Both, carbon dioxide and methane are strong green-house gases that may be released from intertidal surface sediments into the bottom waters or the atmosphere. The carbon isotopic composition of DIC is used here to identify the sources and key reactions in the carbon-sulfur cycle of a temperate intertidal system. Pore waters and surface sediments from the intertidal of the Wadden Sea, North Sea, have been analyzed on a seasonal base for a number of (bio)geochemical parameters as, for instance, the contents and isotope composition of TOC, TIC, DIC, methane, SRR, sulfate, sulfide, pyrite, and AVS. It is found, that below sands with reduced surfaces, the isotopic composition of DIC can reach isotope values as low as -36 permil indicating biogenic methane (-60 to-70 permil) as an important DIC source via AOM. DIC is much heavier below sands with oxidized surfaces, mixed, and muddy sediments, where oxidation of DOC as electron donor using oxygen and sulfate dominate. Seasonal changes are linked to microbial activity variations.

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PHYTOPLANKTON AND TURBULENCE: ARE WE EXPECTING TOO MUCH FROM MODELS? AN ENGINEER'S VIEW STARTING FROM FIRST PRINCIPLES

When trying to understand if some specific traits of various phytoplankton species, such as a given shape of a specific density ratio, are somehow linked to the necessity of living in a turbulent environment, we try to model the departure from the pure Stokes flow that such traits could generate. For example, a relatively small inertia may allow phytoplankton particles to depart from purely passive trajectories and concentrate to specific regions of high or low strains. Modelling studies are usually made using simplified equations for the motion of the particles within quite complex representations of the turbulent motions, as given by Large Eddy Simulations and Direct Numeric Simulations of turbulence. On the basis of my experience on the use of these approaches, starting from first principles, that is from the Navier Stokes equations of motion, and discussing under which simplifying assumptions such modelling tools have been obtained, I argue that models currently used are probably not adapt to predict the very small departure from Stokes flow that may cause an effect of turbulence on phytoplankton.

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CHARACTERIZATION OF POPULATION GENETIC STRUCTURE OF CYSTOSEIRA AMENTACEA VAR. STRICTA (PHAEOPHYCEAE) FROM THE FRENCH MEDITERRANEAN COAST.

Cystoseira algal communities (Fucales, Phaeophyceae) are considered as the final stage (climax) in a succession of photophilous algal communities, and are therefore a good indicator of the "ecological quality" of the coastal ecosystem. They play an important role in the structuration of the biodiversity on rocky substrates. Cystoseira amentacea var. stricta is endemic to the Mediterranean and is located in the eulittoral zone. They are found mainly along the exposed sites and populations along the coast are fragmented. The reproductive characteristics of this species makes long-distance dispersal difficult, so the connectivity between the populations seems low. Recent studies report a regression of the populations, probably due to anthropogenic disturbances. To assess the connectivity between the populations and their potentiality to be maintained in the long term, we study the genetic structure of the populations, and the gene flow between them. These issues are addressed using genetic markers: nuclear microsatellites. For the moment, 5 microsatellite loci have been found and are currently tested for the species studied.

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VIRAL VERSUS GRAZING CONTROL OF PHYTOPLANKTON AND BACTERIAL BIOMASS IN THE RHONE RIVER PLUME (NORTH-WESTERN MEDITERRANEAN SEA)

Besides grazing, viral lysis is a major cause of microbial mortality in various ecosystems. Therefore, we explored the importance of grazing vs. lysis in controlling phytoplankton and bacterial biomass in the Rhône River plume from experiments carried out during May 2008. Estimates of viral- and microzooplankton grazing-induced phytoplankton mortality, derived in three experiments through a modified dilution approach, revealed similar turnover rates of the chlorophyll-a standing stocks (3, 21 and 43% dialy vs. 3, 27 and 39% daily, respectively). Estimates of viral vs. grazing induced bacterial mortality (frequency of infected cells and selective inhibitor method) are currently in process. So far, using transmission electron microscopy, we scored a number of vibrio-shape prokaryotes (containing > 5 intracellular viruses) as infected (range: 8 - 26/cell) assuming they are subsequently lysed. Whether cells are grazed or lysed has different biogeochemical consequences; grazed cells are transferred onto higher trophic levels, whereas lysed cells fuel the regeneration of nutrients and recycling of carbon. In particular, viral lysis is an important source of dissolved organic matter (DOM) what in turn is available for bacterial uptake. Our study indicates the importance of viral-mediated loss processes in the study area and we certainly need to consider them in nutrient and energy cycle based budgets.

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MERCURY SPECIES REACTIVITY AND EXCHANGES AT THE SEDIMENT/WATER, SEDIMENT/AIR AND WATER/AIR INTERFACES OF A TIDAL BAY (ARCACHON, FRANCE)

The fate of mercury (Hg) species at aquatic interfaces is important for Hg transport, residence time, and bioaccumulation in the aquatic food web. The production of gaseous Hg, via the reduction of inorganic Hg, favors the removal of a labile reactant which in turn promotes Hg methylation. In this study, inter-tidal and seasonal variability of the Hg species exchanges at the natural interfaces of the Arcachon Bay were investigated. For the first time, flux intensities at all interfaces were determined and compared. Gaseous Hg fluxes at the sediment-air interface show that sunlight radiations and sediment temperature are key parameters that govern its evasion from intertidal sediment to the overlying atmosphere. Benthic fluxes of gaseous, dissolved inorganic and methyl Hg were highly variable and differed between seasons by two orders of magnitude. Fluxes are mainly driven by redox conditions, biological activity or water concentrations. In the Arcachon Bay, inter-tidal ecosystems are suggested to play a major role for Hg exchange between the different compartments and to promote a significant evasion of mercury at the sediment-air interface.

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DEVELOPMENT OF A DYNAMICAL MODEL FOR COLIMITATION WITH NITROGEN AND PHOSPHORUS IN CONTINUOUS MICROALGAL CULTURES

Accurate modelling algal growth in situation of colimitation is a key issue especially for predicting phytoplanktonic blooms in areas where two nutrients are in suboptimal concentrations. The usual models developed for natural ecosystems are generally relying either on a multiplicative law where the growth is the product of two terms representing each limitation, or on a minimum principle where the limiting substrate is assumed to drive the algal growth (Saito et al. 2008). The developed model relies on the basis of the quota-based Droop model (Droop, 1983). It assumes a minimum law for the growth rate, on the basis of the quota of the two limiting nutrients (here nitrogen and phosphorus). The uptake rates were modified compared to the Droop model, in order to inhibit the uptake when large quota values are reached, and to account for interactions between the two nutrients at the acquisition level. Experiments were carried out with *Isochrysis affinis galbana* grown in chemostat with either nitrogen or phosphorus limiting. The simulations qualitatively reproduce the experimental data and the model proposes new theoretical insights for describing colimitation.

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DISTRIBUTION AND CYCLING OF CARBON IN THE TANA RIVER BASIN (KENYA), FROM HEADWATERS TO THE TANA RIVER DELTA

The Tana river represents the largest river basin in Kenya (~120,000 km²). We conducted a dry season survey in headwater streams and along the main river, analysing a wide suite of biogeochemical parameters (concentrations and stable isotope composition of POC, DOC, DIC, and O2, as well as general physico-chemical measurements, nutrients, methane, and pigments). Biogeochemical signatures in headwater streams were highly variable, with some organic carbon characteristics in the water column clearly correlated to those in surface soils. Along the middle and lower river course (>600 km), TSM concentrations increased almost 20-fold despite the absence of tributary inputs, indicating important resuspension of internally stored sediment. These inputs were characterized by a decreased and more 14C-depleted OC content, suggesting selective degradation of more recent material during sediment retention. Masinga Dam (a large reservoir on the upper river) showed a strong retention of nutrients and an uncoupling of DOC and POC: while DOC pools and d13C signatures were similar above, in and below Masinga, the POC pool in Masinga was drastically different, being dominated by 13C-depleted phytoplankton with a distinct pigment composition.

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UP-SCALING PLANT GROWTH STRATEGIES TO LANDSCAPE EVOLUTION: COMPARING FLUME, BASIN AND MODELING RESULTS

Biophysical interactions between organisms and hydrodynamic forces are a main determinant of the geomorphology of intertidal areas. Especially vascular plants can have striking effects on the intertidal landscape. However, plants can vary greatly in morphology by having a different shape, density or stiffness. We study how the interaction between plant morphology and hydrodynamic forces affects the morphological development of intertidal areas. For a range of intertidal vegetations, we carried out a series of studies in a 0.6 m wide flume, in a 16 m wide basin and extrapolated these results to the landscape level by hydrodynamic modeling with Delft-3D. Our results on contrasting vegetation types clearly demonstrate that differences in plant morphology cause profound differences in hydrodynamic patterns (flume and basin) and sediment dynamics (flume). Moreover, the basin studies on vegetation patches revealed some unexpected flow patterns. Up-scaling by modelling shows that these differences have major impact on the landscape formation. Overall, present results show that species-specific characteristics like shoot stiffness and vegetation density are highly important for long-term large-scale landscape evolution.

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CULTURE OPTIMIZATION FOR THE EMERGING ZOOPLANKTONIC MODEL ORGANISM OIKOPLEURA DIOICA.

The urochordate *Oikopleura dioica* is emerging as a novel model organism with considerable promise in cross-disciplinary research ranging from marine ecology to chordate development, genetics and evolution. Recently, it has been shown that urochordates, not cephalochordates, are the closest living relatives to the vertebrates. For a chordate, *O. dioica* has an exceptionally short life cycle (6 days at 15°C) with high fecundity (> 300 eggs per female). These life history features permit quick response to favourable conditions as well as synchronized culture and studies through numerous generations. The small organism (< 1mm adult) remains fully transparent throughout its life cycle, greatly facilitating experimental investigation. Despite its evolutionary position, at about 70 Mb, *O. dioica* has one of the smallest known metazoan genomes with .high gene density (one gene per 4-5 kb). Here, we present data on feeding regimes, spawn densities and dilutions, and seawater treatment, leading to optimization of a detailed culture protocol. Combining this with recent technical improvements in culture methods now permit reliable long-term maintenance of the animal, allowing continuous, uninterrupted production of source material for experimentation.

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SYMBIOSIS IN THE HYDROTHERMAL VENT MUSSEL BATHYMODIOLUS AZORICUS: IS HOST GENE EXPRESSION RELATED TO ITS METHANOTROPHIC & SULFIDE-OXIDIZING BACTERIAL SYMBIONTS

Deep-sea mussels of the genus *Bathymodiolus* are distributed worldwide both at cold seeps and hydrothermal vents. The species *B. azoricus* dominates communities from hydrothermal vent sites of the Mid-Atlantic Ridge, South of Azores and it has developed a dual endosymbiosis with both methanotrophic (MOX) and sulfide-oxidizing (SOX) bacteria housed inside specialized gill cells. Few studies have investigated the metabolism of the host at a molecular level, such as the description of genes involved in symbiosis establishment and/or relation with bacteria (nutrient exchanges, regulation of bacterial proliferation, etc.). We used a subtractive hybridization approach to identify regulated genes in *B. azoricus* as a function of bacteria quantity and metabolism (MOX/SOX). We identified and analyzed the expression of genes involved in calcium regulation (calmodulin, calreticulin), CO2 metabolism (carbonic anhydrase), stress protein (HSP70 and 90), immune system (phospholipase) and numerous as yet unidentified genes in relation with the nature and extent of symbiosis.

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PRESSURE EFFECT ON DEGRADATION OF ORGANIC MATTER BY DEEP-SEA PROKARYOTES COMMUNITIES

The interactions between prokaryotes and marine dissolved organic matter (DOM), one of the largest active reservoirs of organic carbon, play a major role in the global carbon cycle. DOM is (technically) divided into high molecular weight (HMW-DOM) (than prokaryotes must hydrolyze via ectoenzymatic activity to assimilate it) and low molecular weight (LMW-DOM) size classes. A large part of the HMW-DOM is composed by carbohydrates (50-70% of HMW-DOM). In the framework of the ANR POTES (Pressure effect On marine prokaryoTES) program, we synthesized exopolysaccharides radiolabeled with tritium (^{3}H-EPS) and incubated it with deep-sea samples of DYFAMED site (NW Mediterranean Sea) under in situ pressure conditions to estimate the deep-sea capacity to degrade HMW-DOM. We also examined ^{3}H-Glucose assimilation rates and prokaryotic production (^{3}H-Leucine). Degradation rates were higher under in situ pressure than at atmospheric conditions. These first results suggested also that EPS may sustain prokaryotic production in the deep-sea waters.

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TOLERANCE OF FRESH- AND SEAWATER VIRIO- AND BACTERIOPLANKTON TO CHANGES OF SALINITY

Comprehensive data on the fundamental niche of virio- and bacterioplankton are rare but essential to assess their persistence and coexistence over time and space, especially for estuarine communities that undergo large and brutal changes in environmental factors such as salinity. We experimentally explored salinity tolerance of estuarine communities to assess whether (i) viruses have a distinct larger salinity tolerance than their bacterial hosts, and (ii) if contact is possible between freshwater viruses and marine bacteria, and vice versa. Both fresh- and seawater viral and bacterial communities from the end-members of the Firehenenana estuary (Madagascar) were gradually salted or desalinated. Changes in bacterial abundance, physiology and diversity were followed over 48 hours. Freshwater viral and bacterial communities were more tolerant than their marine counterparts to changes in salinity. Viruses from both fresh and marine waters were less tolerant than their bacterial hosts. Bacterial phylogenetic groups were differently affected by salinity changes. Overall, our results suggest that probability of contact between virus and bacteria is more likely between freshwater viruses and salty bacteria than the contrary.

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IN CONTRAST TO PELAGIC SYSTEMS, SALT MARSH SEDIMENT MICROBIAL COMMUNITIES SHOW REMARKABLE SIMILARITIES AMONG SEASONS, LOCATIONS, AND DISTURBANCE REGIMES

Salt marshes form a critical boundary between terrestrial and aquatic biospheres and filter many human-derived pollutants that enter the coastal zone. Much of the filtering capacity of these sediments can be attributed to the prokaryotes that reside therein. In this study we use massively parallel tag sequencing to examine the distribution and community composition of salt marsh microbes and their response to environmental perturbation. We collected DNA from sediments in Spartina alterniflora habitats in several salt marshes, some of which had been exposed to large inputs of nitrogenous fertilizers. We sequenced hundreds of thousands of tags from environmental samples using a Roche Genome Sequencer FLX system. Our data indicate that marsh sediment microbial communities have remarkably similar taxonomies when sampled at local scales and within-marsh similarities are maintained throughout the growing season. Furthermore different salt marshes exposed to elevated concentrations of nitrogen show little divergence in their community composition when compared with untreated control marshes. These results stand in sharp contrast to aquatic systems that show synchronous shifts in communities over time and with changing environmental conditions.

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REVEALING THE MOLECULAR SECRETS OF DIATOMS THROUGH WHOLE GENOME SEQUENCE ANALYSIS

The genome sequence of the marine centric diatom Thalassiosira pseudonana was reported in 2004, and revealed a wealth of novel information about diatom biology, ecology and evolution.The marine pennate diatom Phaeodactylum tricornutum is the second diatom for which a whole genome sequence has now been generated. We have performed detailed comparisons of the two diatom genomes in an attempt to clarify evolutionary origins and functional significance of their gene complements. In spite of the fact that the pennate and centric lineages have only been diverging for 90 million years, their genome structures are dramatically different and a substantial fraction of genes (~40%) are not shared by these representatives of the two lineages. Analysis of molecular divergence compared with yeasts and metazoans reveals rapid rates of gene diversification in diatoms. Contributing factors include selective gene family expansions, differential losses and gains of genes and introns, and differential mobilization of transposable elements. Most significantly, we found the unprecedented presence of hundreds of genes from bacteria. The ancient origins of these gene transfers are testified by the finding that more than 300 are found in both diatoms, and many are likely to provide novel possibilities for metabolite management and for perception of environmental signals. These findings go a long way toward explaining the incredible diversity and success of the diatoms in contemporary oceans.

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DISSOLVED COBALT DISTRIBUTION AND ITS ORGANIC SPECIATION IN THE ATLANTIC SECTOR OF THE SOUTHERN OCEAN DURING THE BONUS-GOODHOPE CRUISE (IPY-GEOTRACES)

In open-ocean waters, dissolved cobalt concentrations are low, typically in the nanomolar to picomolar range. It is kown that cobalt is involved in biochemical functions such as the carbonic anhydrase and the vitamin B12 in marine microorganisms. Studies using electrochemical techniques have demonstrated that in surface seawater most of the cobalt is chelated by strong metal-binding organics ligands. Determining dissolved cobalt and its organic speciation brought us interesting data to confront with other biogeochemical and physical parameters, allowing us to better constrain the biogeochemical cycle of this element. Here we present the preliminary results of the analysis of cobalt speciation and dissolved cobalt distributions from samples collected during the BONUS-GOODHOPE cruise between South Africa and the Weddell gyre. The cruise track crossed several frontal systems of the Antarctic Circumpolar current (ACC) giving us five deep profiles respectively sampled in Subtropical, Subantarctic, Polar, Southern ACC and the southern boundary of the ACC. We discuss cobalt biogeochemistry cycle along the BONUS-GOODHOPE transect in the light of biogeochemical and physical parameters such as macronutrients, chlorophyll and mass water characteristics.

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ENVIRONMENTAL CONTROL OF PHYTOPLANKTON FUNCTIONAL GROUPS – WHAT DO WE KNOW?

In the last decade there has been an increasing awareness of the relationship between key phytoplankton groups and their pivotal role in the biogeochemical cycles of a range of elements – e.g. coccolithophores and Sulfur and Carbon. Other key groups include diatoms, Phaeocystis spp., Nitrogen fixers, and cyanobacteria. We now have a relatively good understanding of the biogeography of each algal functional group and their interactions with different biogeochemical cycles. However, what is less clear are the environmental factors that determine bottom-up control on each of these phytoplankton groups. Developing a mechanistic understanding of what factor(s) control the functioning of each group is needed before we can determine how climate change will impact phytoplankton community structure in the open ocean, and what the likely sign and magnitude of any feedback(s) resulting from climate-change mediated floristic shifts. Here, I will explore the current status of our understanding using a range of approaches – from perturbation and lab culture experiments, to lessons from climate variability time-series and modelling studies.

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ORGANIC MATTER EXPORT IN THE OCEAN, NOW AND IN THE FUTURE

The downward export of both dissolved (DOC) and particulate (POC) organic matter represent a major conduit for carbon into the ocean's interior. Future changes in both the magnitude and relative proportion of DOC and POC export potentially represent significant feedbacks to climate change. In this tutorial, I will appraise our current understanding of the factors that set export out of the surface ocean, and modify export flux in subsurface and deep ocean strata. I will then attempt to link current projections, on how ocean properties will alter due to climate change, from coupled ocean atmosphere models with embedded biogeochemistry, with our contemporary understanding of the drivers of both POC and DOC export. By linking these themes I will provide a ranking of the certainties and uncertainties that exist in describing the physical and biological transport of carbon into the deep ocean and how it will alter in the future.

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GEOTRACES IN THE INTERNATIONAL POLAR YEAR: AN OVERVIEW.

The international GEOTRACES program has its flying start in the International Polar Year. The unique quasi-synopsis of IPY-cruises with GEOTRACES issues in the Arctic (D/NL Polarstern ; Spain-ATOS ; Japan-Geotraces; and upcoming CAN-Geotraces) and Southern Ocean (FR-Bonus Goodhope ; NL/D-Zero & Drake ; Australian-SR3 and SAZ-SENSE ; American-IS6 CLIVAR ; Japan-Geotraces ; and upcoming Spain-ATOS 2) has the potential to provide new insights into a wide range of ocean processes and dynamics in Polar Oceans. An overview of these cruises and preliminary results will be presented, keeping with the IPY-GEOTRACES cluster (IPY #35 ; H. de Baar). Moreover the intercalibration efforts during the IPY-GEOTRACES program will be introduced.

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AN OVERVIEW OF THE BIOGEOCHEMICAL FEATURES OF THE SOUTHERN OCEAN DURING THE INTERNATIONAL POLAR YEAR

IIn the framework of the IPY (ICED, GEOTRACES & CASO), several multidisciplinary cruises took place in the Southern Ocean (France: Bonus Goodhope; The Netherlands/Germany: Zero & Drake ; Germany ANT-XXIV/2: ; Australia: SR3, SAZ-SENSE and SIPEX ; USA: IS6 CLIVAR). The quasi-synopticity of these cruises has the potential to provide a unique picture of the biogeochemical functioning of the Southern Ocean. A brief overview of the preliminary biogeochemical features in the Southern Ocean during the International Polar Year will be presented.

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GLOBAL OBSERVATION OF DIFFERENT PHYTOPLANKTON GROUPS USING PHYTODOAS ON REMOTE SENSING DATA FROM SCIAMACHY AND GOME-2 DATA

In order to understand the marine phytoplankton's role in the global marine ecosystem, it is necessary to derive global information on the distribution of major functional phytoplankton types (PFT) in the world oceans. So far only the dominant PFTs can be analysed from ocean color sensors such as CZCS, SeaWiFS, MODIS or MERIS. In our study we use PhytoDOAS, a method of Differential Optical Absorption Spectroscopy (DOAS) specialized for phytoplankton, to retrieve the absorption spectra and concentrations of various phytoplankton groups from high spectrally resolved satellite data of SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric Cartography) on ENVISAT and GOME-2 (Global Ozone Measurement Experiment 2) on Meteosat. In-situ measured phytoplankton absorption spectra were used to identify these characteristic absorption spectra in SCIAMACHY data in the range of 430-500 and 530-590 nm. Pigment concentrations of in situ measurements were used to validate the satellite data, which showed a good agreement with the collocated in-situ measurements and with the NASA Ocean Biogeochemical Model. Results are of great importance for global modelling of marine ecosystems and climate change studies.

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DISTRIBUTION AND TRANSFER OF ELEMENTS IN A COASTAL BALTIC ECOSYSTEM – A STOICHIOMETRIC APPROACH

The fate and distribution of elements in an ecosystem depends on biological processes, such as uptake and elimination, respiration, photosynthesis and predation. Element transport is thus related to the flow of energy in the ecosystem and element fate depends on whether or not they are biologically essential, or if they are chemically similar to essential elements. Here we describe the ecological stoichiometry of 48 elements in and between all major functional components of a coastal Baltic Sea ecosystem. The aim

was to better understand the ecological properties and processes that govern uptake and transfer different elements. We first calculated the pools and fluxes of C in a coastal area using spatial data of organism distributions, and mass balance and ecosystem modelling. We then extrapolated these models to other elements using stoichiometric relationships with C (element : C ratios) obtained from our own field studies. The results show the importance of considering organism-specific, as well as element-specific, processes when studying element transport in ecosystems.

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ADAPTIVE DYNAMICS OF PHYTOPLANKTON STOICHIOMETRY: EVOLUTIONARY STABILITY AND NONEQUILIBRIUM COEXISTENCE UNDER SELECTIVE PREDATION

Natural waters host a rich diversity of plankton populations involved in numerous species interactions, including competition and predation. Here, we use models based on the emerging field of adaptive dynamics to understand the evolutionary implications of resource competition and selective predation on plankton community structure. To this end, we investigate the adaptive evolution of phytoplankton stoichiometry in the presence of competition and predation; and inquire which evolutionary conditions favor phytoplankton species coexistence. Assuming trade-offs in nutrient stoichiometry between phytoplankton competitive ability and susceptibility to predation, we find that selection for phytoplankton growth may be countered by selection against predation. The two selective pressures lead to convergence towards evolutionarily stable strategies. Depending on whether trade-offs are explicit or emerging from the community dynamics, nonequilibrium coexistence or alternative states can ensue. These model results will be confronted with empirical evidence, and shed new light on the evolutionary forces underlying Hutchinson's plankton paradox.

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MODELLING THE EFFECT OF A DYNAMIC DIFFUSIVE BOUNDARY LAYER ON PORE-WATER SOLUTES

We used a reaction-transport model to identify the different effects of the diffusive boundary layer (DBL) on solute dynamics. The model was calibrated with in-situ micro profiles of oxygen and nitrate from Lake Alpnach. This perialpine lake shows strong seiche-driven bottom boundary layer dynamics. An expansion of the DBL thickness in the model from 0.25 to 1.5 mm decreased the oxygen uptake into the sediment from 15 to 9.5 mmol m^{-2} d^{-1}. Reoxidation of iron and manganese in the sediment slowed down by up to 38 % when a DBL thickness of 2 mm was imposed. Processes in the deeper layers of the sediment which are inhibited by the presence of oxygen showed a low sensitivity to a changing DBL thickness. Denitrification rates were reduced by only 11 % when the DBL thickness was extended to 2 mm. This limited effect of a stronger transport resistance was a result of faster denitrification close to the sediment due to limited penetration of oxygen.

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THE BACTERIAL COMMUNITY OF MARINE COPEPODS

Marine zooplankters, such as copepods, can be associated with large numbers of bacteria. Some of them are attached to copepods' surface, others are associated with their intestine (and faecal pellets). General conclusions concerning the identity and specificity of these bacteria are difficult since the majority of the published studies focussed on cultivable bacteria only. Hence, to date little is known about the structure of this particular bacterial community. For example, the specificity of the copepod-bacteria interactions is unclear, and also the role and function of these bacteria, i.e. whether they are symbiotic, commensalic or parasitic needs further elucidation. As a result, the seasonal dynamics of this association is completely unknown. To shed more light on these particular eu/prokaryotic consortia, zooplankton samples were taken from the long-term sampling station Helgoland Roads (North Sea) during two seasonal cycles. Bacterial DNA was isolated from different copepod genera and analysed by PCR-DGGE (denaturing-gel-gradient-electrophoresis) and subsequent analysis of sequenced DGGE-bands. The community structure of different copepod species/genera and between samples of different seasons was analysed by multivariate statistics. Results of this study will be presented.

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A STABLE ISOTOPE APPROACH TO IMPROVE CALCULATIONS OF CONSUMER-RESOURCE NUTRIENT IMBALANCES

Stoichiometric theory predicts that the nutritional quality of a resource can constrain consumer growth when resource's elemental content does not match the consumer's nutritional demand. Potential growth limitations arising from nutrient deficient food are evaluated by calculating consumer-resource imbalances as the difference between the elemental composition of a consumer and its food. For macroinvertebrates, the potential food is mostly inferred from their functional feeding group (FFG) affiliation, e.g. periphyton if the consumer is classified as a grazer. However, consumers may assimilate nutrients from more than one resource, resulting in biased elemental imbalances if food elemental composition is not considered as a weighted combination of the elemental composition of each food resource. We present a method to calculate the elemental composition of a food mixture based on the contribution of food resources to the diet using stable isotopes, mixing model analysis and the elemental composition of the individual resources. By comparing this approach with the FFG approach, we show that the FFG approach over- or underestimates elemental imbalances and demonstrate that stable isotope analyses can be used to complement stoichiometric analyses.

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DYNAMICS OF THE RARE BIOSPHERE IN CARBONATE CHIMNEYS SPANNING A THOUSAND YEARS OF THE LOST CITY HYDROTHERMAL FIELD

The Lost City hydrothermal field, an ultramafic-hosted system located 15 km from the mid-Atlantic ridge, has experienced at least 30,000 years of hydrothermal activity, and the microbial communities of its carbonate chimneys are dominated by only a few taxa. Pyrosequencing of archaeal and bacterial 16S rRNA V6 tags of carbonate chimney samples ranging in age from 30 – 1100 years revealed successional changes in microbial diversity and community composition. The same major taxonomic groups composed of clusters of many similar sequences tended to dominate all samples regardless of age. Samples differed greatly, however, with respect to which individual sequence types dominated each taxonomic cluster. This unexpected micro-diversity in 16S rRNA sequence most likely represents niche-differentiation among species within the same genus or strains within a species. Each species or strain may be pre-adapted to a particular geochemical regime and able to quickly increase in abundance from extremely rare to the most dominant taxon when conditions allow. This dataset offers an unprecedented opportunity to study the dynamics of a microbial ecosystem over a thousand year time scale.

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THE CHEMICAL ECOLOGY OF DMSP AND RELATED COMPOUNDS IN TROPHIC INTERACTIONS

The climatically relevant marine trace gas, dimethylsulphide (DMS) is produced from its algal precursor dimethylsulphoniopropionate (DMSP) following microzooplankton grazing. Previous studies showed that DMSP and DMS can elicit behavioural responses in a range of marine organisms. For example, the heterotrophic dinoflagellate *Oxyrrhis marina* avoids high DMS-producing phytoplankton prey and microzooplankton grazing is reduced following bulk additions of DMSP. However, our capillary chemotaxis assays with *O. marina* indicated positive chemotaxis towards gradients of 100 nM to 1 mM DMSP. Data from flow cytometry experiments using phytoplankton with different DMS production rates indicated that *Oxyrrhis marina* may in fact selectively graze on high DMS-producing strains of *Emiliania huxleyi*. Through a range of behavioural experiments and grazing trials we explored the effects of DMSP and its cleavage product DMS in shaping interactions between phytoplankton, microzooplankton and copepods. Our results suggest both chemicals may play complex yet crucial roles in mediating interactions between different marine trophic levels.

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NITROGEN, HYPOXIA AND FISHES: MOVING BEYOND FISHERIES DATA TO UNDERSTAND EFFECTS ON UPPER TROPHIC LEVELS IN ESTUARIES AND SEMI-ENCLOSED SEAS

Cross-system comparisons of nitrogen loads, hypoxia and fisheries landings provide useful insight into anthropogenic effects on important coastal ecosystems at the whole-system scale. Our data suggest a strong relationship between nitrogen loads and both total fisheries landings and the dockside value of fisheries. Because of compensatory mechanisms inherent in both fisheries and the behavior of affected organisms, large-scale relationships between nitrogen loadings and fisheries landings are not strongly altered by the spatial extent of hypoxia. Separating effects of hypoxia and nutrient enrichment provides insight into the ways that these stressors affect fisheries alone and in combination. However, understanding assemblage level effects of nitrogen and hypoxia on actual abundances requires moving beyond fisheries data that reflect regulations, traditions and effort as well as abundances of target species. A new program, in which we invite participation, is seeking to use model predictions of fish and shellfish biomasses in cross-system comparisons to better understand the effects of multiple anthropogenic stressors on upper trophic level assemblages in estuaries, semi-enclosed and coastal seas.

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ARE BACTERIVORES TEMPTED TO EAT VEG? OUTCOMES FROM GRAZING EXPERIMENTS WITH NANOFLAGELLATES FED ON AUTOTROPHIC PICOPLANKTON (APP) PREY

APP forms the smallest size fraction of phytoplankton and is an important component of microbial food webs. In Lake Vesijärvi, a clear-water lake in Southern Finland, APP is responsible for up to 55% of primary production. Moreover, in spring the peak of APP abundance coincides with the high density of heterotrophic nanoflagellates (HNF). Our laboratory experiment was intended to illustrate the role of HNFs as grazers of APP in early spring at the time when water temperature is still low. Three different types of HNF predators were fed with one type of prey (the rod-shaped unicellular picoalgae *Choricystis* sp.). As model predators we used *Rhynchomonas* sp. and *Bodo saltans* and compared their performance with the culture of small (< 10 μm) HNF obtained from Lake Vesijärvi. Grazing impact of HNF revealed a positive correlation with the APP density; this result was especially clear with natural HNF assemblages. However, the predator-prey interaction observed in course of experiments was not strong enough to be considered as the main regulatory mechanism of APP abundance at the time of low water temperatures.

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ASSESSING THE ACCURACY OF REMOTE SENSING OF PHYTOPLANKTON FUNCTIONAL TYPES

Recent bio-optical and ecological methods have been established that use satellite data to differentiate between certain phytoplankton functional types (PFTs) e.g. Sathyendranath et al. (2004); Alvain et al. (2005, 2008); Uitz et al. (2006); Devred et al. (2006); Ciotti and Bricaud (2006); Aiken et al. (2007); Raitsos et al. (2008); and Hirata et al. (2008). Applying these techiques to SeaWiFS ocean colour data allows us to view the changes in phytoplankton communities over the past decade, understand how they are adapting to climate trends and how this is influencing the carbon cycle on a global scale. These satellite PFT approachs can also be used as a validation tool for ecosystem models. However, in order to confidently use these products it is essential we know their limits and their accuracy. This study tests these PFT satellite techniques by applying them to a long-term ocean colour dataset from the SeaWiFS project, and compares the output to in situ phytoplankton size class data from a wide range of spatial regions over the past decade, in order to assess the accuracy of these approaches.

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LONG-TERM VARIATIONS OF ABSORPTION BY PHYTOPLANKTON AND COLORED DETRITAL MATTER AT THE GLOBAL AND REGIONAL SCALES, AS DERIVED FROM THE SEAWIFS TIME SERIES

A procedure has been recently proposed (Ciotti and Bricaud, 2006) to retrieve the spectral absorption coefficients of phytoplankton and colored detrital matter (CDM) from satellite radiance measurements. This procedure is the first one to also provide a size parameter for phytoplankton (Sf), based on the shape of the retrieved algal absorption spectrum, as well as the spectral slope for CDM absorption. This method has been applied to the presently available time series of SeaWiFS observations (september 1997 to 2008). The spatial-temporal variations of absorption coefficients of phytoplankton, CDM (which are an index of the CDM content of waters), and Sf, are presented over this period, at the global scale and for selected oceanic areas. The observed trends are discussed, in particular in relation to those observed for algal biomass.

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IMPACT AND RECOVERY TIME OF PHYTOPLANKTON BIOMASS AFTER MAJOR STORM IN SEPARATE ZONES OF FLORIDA BAY, USA.

Phytoplankton biomass (CHLa) in coastal and estuarine waters display a continuum of seasonal patterns dictated by global and local climatic settings, site-specific phytoplankton assemblages, nutrient loads and basin characteristics. Being a compound response it complicates the signal extraction due to climate change. Storms and hurricanes frequently impact Florida Bay (FB) and the reaction to conditions imposed by hurricanes is a sudden increase in CHLa, and the development of a new CHLa seasonality. We explored storm-induced changes using monthly water quality data (1991-2007), and applied factor analysis-hierarchical clustering to subdivide FB into six zones having distinct water quality and phytoplankton communities. Nutrient and CHLa time series were transformed into z-scores cumulative sum charts and dates of hurricane landfalls (1992-2007) were overlaid onto the charts. Magnitude of hurricane impacts (MI) on CHLa and time to return to pre-hurricane concentrations (RT) were measured. Finally, the MI:RT ratio which is constant for each event across FB was used for predicting spatial and temporal hurricane effects to be screened before extracting global climatic signals.

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ARTIFICIAL REEFS ENHANCE FISH PRODUCTION IN RESIDENTIAL CANALS

Artificial reefs deployed into canals on Australia's Gold Coast were sampled quantitatively alongside soft-sediment controls and existing piers. Few fish were present at controls before and after reef deployment. Densities of fish at reefs increased from zero to appreciable levels within three months. Increases in the abundance of a common species, the bream (*Monodactylus argenteus*), at reefs did not occur at the expense of pier abundances, suggesting increased overall production at this location. We tested whether provision of food was a mechanism by which reefs might support increased fish production. Stable isotope ratios of bream differed between reefs and piers. Isotope analysis showed that bream on reefs obtained nutrition mainly from epibenthic animals attached to the reef. Stomach content analyses confirmed consumption of epibenthic animals such as barnacles, but also showed an ontogenetic shift in diet from the very young juveniles on piers to the older, larger fish on reefs. The combination of fish occurrences, size distributions and feeding activity indicate that artificial reefs go beyond mere attraction of fish and actually enhance fish production in canals.

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STUDY OF THE BIOTIC TRANSFORMATIONS OF ORGANOTIN COMPOUNDS BY ANAEROBIC BACTERIA USING ISOTOPICALLY LABELLED TRACERS

Organotin pollutants widespread in aquatic environments tend to accumulate in surface sediments. The response of anaerobic micro-organisms in such environment may alter the bioavailability, toxicity and degradation of organotin which depends on the identity and the number of organic chains attached to the heteroatom. Studies on the biological alkylation and/or de-alkylation processes of these compounds under oxic/anoxic conditions are of primary importance to investigate their ecotoxicological impact at the sediment water interface. For this purpose, pure bacterial cultures isolated from contaminated sediments were incubated in anoxic conditions with stable enriched butyltin species. The experimental design and the high selectivity and sensitivity of isotopically deconvoluted gas chromatography - inductively coupled plasma - mass spectrometry (GC-ICP-MS) measurements permitted to identify accurately methylation and debutylation capability of different bacterial strains at natural concentration levels. Results evidenced the debutylation role of Pseudomonas strains in oxic and anoxic conditions whereas Chlorella and Alcaligenes strains exhibited higher debutylation patterns in oxic conditions. The overall set of experiments has also re-assessed the potential role of such bacteria for the endogenous production of organotin compounds via methylation pathways.

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PERSISTENCE OF ZOOPLANKTON DIEL VERTICAL MIGRATION THROUGH THE ARCTIC WINTER, AND IMPLICATIONS FOR CARBON FLUX

Vertical migration behaviour by zooplankton drives the 'biological pump' that draws atmospheric CO2 into the ocean interior. The day/night light cycle is the proximate cause of diel vertical migration (DVM), so this behaviour is presumed to cease in the perpetual darkness of Arctic winter. Here we report observations by moored acoustic Doppler current profilers off Svalbard that show DVM continuing throughout the polar night. DVM persisted in open water and under sea ice, but was more intense in open water. The predicted reductions in Arctic sea ice thickness and extent may lead to increased DVM activity and consequently to increased carbon flux.

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RELATIVE BIOAVAILABILITY OF DISSOLVED ORGANIC PHOSPHORUS (DOP) VERSUS PHOSPHATE (PO4) IN FE-RICH COASTAL SEDIMENTS

Labile iron-oxyhydroxides typically have associated with them significant quantities of sorbed phosphate, resulting in coupled iron (Fe)–phosphate (PO4) cycling in aquatic systems. A study conducted in a coastal pond adjacent to Kaneohe Bay, Hawaii reveals decoupling of Fe and PO4 due to high levels of iron-oxyhydroxides in sediments. Coastal tropical island sediments, such as those found in the Hawaiian Islands, contain large quantities of reactive terrestrial iron-oxyhydroxides. We observe sediment porewaters devoid of PO4 as a consequence of extreme adsorption onto abundant iron-oxyhydroxides. In contrast, there is a build-up of dissolved organic phosphorus (DOP) in pore waters, suggesting that DOP is less efficiently sorbed onto iron-oxyhydroxides than PO4. Differential sorption of PO4 versus DOP in these sediments may result in greater mobility of DOP relative to PO4, and support an enhanced DOP benthic flux relative to PO4. DOP may thus play a disproportionately important role in supporting primary production in waters overlying iron-rich sediments in this type of coastal environment.

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USE OF 15N AND 13C TRACERS TO DETERMINE THE EFFECTS OF LIGHT, TEMPERATURE AND DIN LEVELS ON THE N AND C UPTAKE OF FRESHWATER MACROPHYTES

In order to identify major environmental factors controlling inorganic nitrogen and carbon uptake by freshwater macrophyte species, we performed incubation experiments of macrophyte specimens in the presence of 15N-ammonium or -nitrate, and 13C-bicarbonate. Experiments where performed in specially designed whole plant incubators, which allow the isolation of the water-shoot phase from the sediment-root phase of specimens. The incubators where placed in a thermostatic cabinet with controlled light and temperature. Results showed that the 2 tested macrophyte species (Potamogeton natans and Callitriche platycarpa) had a preference for ammonium. Major factors controlling the N uptake are ammonium concentration and temperature, while major factors affecting C uptake are light and temperature. Additionally we could demonstrate that macrophytes used excess amounts of ammonium compared to biomass needs, while they were unable to satisfy their N needs with nitrate as only DIN source.

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TRACING NITROGEN AND CARBON FLOWS ACROSS THE SOUTHERN NORTH SEA

The North Sea receives extensive inputs of nitrogen from offshore sources augmented by inputs from terrestrial sources. To maintain the health of this economically important shelf sea the effective management of nutrient input is essential. UK derived nutrients enter the southern North Sea via the Thames, Wash and Humber estuaries, which coalesce to form the East Anglian Plume, transporting nutrients towards continental Europe. The nature and extent of this transport is difficult to quantify within the complex dynamics of the North Sea. Sampling was undertaken from 2006-2007 to study natural isotopic variations in nitrogen ($\delta^{15}N$-NH_4^+, $\delta^{15}N$-NO_3^-, $\delta^{15}N$-PON) to identify sources and transformations of nitrogen. To provide additional constraints on natural processes, $\delta^{13}C$-POC and $\delta^{18}O$-NO_3^- were also studied. Results for this suite of isotopic tracers, along with nutrient and hydrographic data, are used to identify the transport and transformations of nitrogen across the southern North Sea. Results include the clear identification of the East Anglian plume as a feature in both $\delta^{15}N$ and $\delta^{13}C$ associated with higher NO_3^- concentrations and lower salinity. Mechanisms regulating this will be considered.

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A SIMPLE ASSILIMATIVE CAPACITY MODEL FOR RIA FORMOSA (PORTUGAL): AN ADAPTATION OF THE DYNAMIC CSTT MODEL

Ria Formosa is a lagoon in the south of Portugal which is cut off from the normal circulation of coastal waters and has several anthropogenic activities that can lead to an increase in nutrients and potentially to eutrophication. A dynamic version of the CSTT model has been developed coupling the benthic and pelagic components of the system to assess its assimilative capacity. The model predicts a large biomass of microbenthic algae, which strongly influences the pelagic chlorophyll concentration by re-suspension. However, algae concentrations in the water column are relatively small due to the high flushing rate of the lagoon. A complete dataset was collected during 2006-2008 and showed, through a Fourier analysis, that the seasonal cycles of phytoplankton are influenced by microphytobenthos. The model is being used to explore the pelagic-benthic interaction during nutrient enrichment events. Sediments may act as sinks for nutrients, with a rapid uptake and as a source for chlorophyll. Therefore, we recommend the evaluation of the benthic component for the management of shallow systems.

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PHOSPHATE UPTAKE, STORAGE AND RELEASE BY LARGE MARINE SULFUR BACTERIA IN COASTAL UPWELLING AREAS

Marine sediments of coastal upwelling areas, which are the main areas of modern phosphogenesis, are densely populated by large nitrate-storing sulfur bacteria of the genera *Beggiatoa*, *Thioploca* and *Thiomargarita*. These bacteria can accumulate polyphosphate and release phosphate periodically resulting in phosphate peaks in the sediment and rapid apatite formation. The uptake, storage and release of phosphate are studied on a culture of marine *Beggiatoa*, grown in a sulfide/oxygen gradient medium. Under oxic growth conditions phosphate profiles show uptake of phosphate in the bacterial mat. The accumulation of polyphosphate within filaments of *Beggiatoa* is demonstrated by staining with 4',6-Diamidino-2-Phenylindole (DAPI) and toluidine blue. When culture conditions are changed to anoxia, increasing fluxes of sulfide result in an increase of phosphate release by polyphospate breakdown. Anoxic conditions at low sulfide fluxes and high concentrations of volatile fatty acids do not induce phosphate release. This finding is in contrast to the current concept of bacterial polyphosphate usage, deriving from the study of fresh water bacteria, but it provides an explanation for the modern and ancient formation of phosphorus rich layers in sulfidic sediments.

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AUTOTROPHIC VERSUS HETEROTROPHIC NITROGEN UPTAKE – WHO IS DOING WHAT?

Whether a given form of nitrogen fuels the production of autotrophic versus heterotrophic biomass has important implications for the fate of the nitrogen and the carbon associated with it. Traditionally, size fractionation has been used to separate phytoplankton from bacteria but the separation is not exact and results can be difficult to interpret. We have used two N15 tracer approaches to distinguish phytoplankton from bacterial uptake – flow cytometric sorting targeting phytoplankton and stable isotope probing targeting bacteria. In a cross system comparison the flow cytometric approach showed that traditional filtration methods (i.e. use of GF/F filters) overestimate phytoplankton nitrogen uptake rates by up to a factor of 2.2. Stable isotope probing results from the Orinoco River plume indicate that AlphaProteobacteria are responsible for a significant amount of nitrogen uptake and that the ability of different groups to take up ammonium and nitrate varies with depth. These new approaches hold great promise to define the active microbial fraction and will allow us to relate microbial community structure to function in marine and other ecosystems.

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FRENCH ENDEMIC AQUATIC INVERTEBRATE BIODIVERSITY: IMPORTANCE OF THE PYRENEAN ALPINE ZONE AND ISSUES FOR CONSERVATION

Despite the potential status of many European alpine regions as aquatic biodiversity 'hotspots', freshwater species from these areas remain underrepresented in conservation policy. In this study we examined the distribution, diversity and habitat preferences of

17 endemic mayflies, stoneflies and caddisflies from 600 sites across southwest France. Our aims were to highlight the unique freshwater biodiversity resources of the Pyrénées relative to surrounding lowlands, and to illustrate the wider need for mountain freshwater conservation policies. Our results showed that streams of the French Pyrénées are of key importance for endemic aquatic invertebrate biodiversity relative to other running waters in southwest France. Some species were found to have very restricted local distributions, with nine recorded from <20 sites and two from only 10 sites. Endemic species richness peaked at ~1800m suggesting the contemporary treeline ecotone may be a key location for directing conservation efforts. Despite the global uniqueness of these aquatic invertebrates, none of them currently have any specific conservation status. New conservation policies for Pyrenean freshwater ecosystems need to be developed as a priority due to the relative rarity (global, and in many cases local) of many aquatic species in these areas, growing threats to their existence (habitat modification, hydrological change), and to recognise their importance in food webs that may include other rare species.

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USING GENE EXPRESSION AND BIOGEOCHEMICAL MEASUREMENTS TO UNDERSTAND CONTROLS ON ESTUARINE SEDIMENT NITROGEN CYCLING PROCESSES

By coupling molecular techniques with biogeochemical measurements, we can begin to understand how microbial community composition and activity influence the nitrogen (N) cycle in estuarine ecosystems. Recently, N_2-flux measurements in Narragansett Bay (RI, USA) sediments revealed a switch from net denitrification to net nitrogen fixation. Experimental manipulations of marine mesocosms are being used to test the hypothesis that the amount and/or timing of organic matter deposition to sediments controls whether the microbial communities denitrify or fix N. Since sediment N-cycling communities are extremely diverse, we have targeted expressed genes to identify the microbes that are active N-fixers and denitrifiers. In the N-fixing mesocosms, the *nifH* gene is expressed from microbes related to sulfur and sulfate reducers. We have also seen expression of denitrification genes (*nirS*) in tanks that are a net sink for N. Using quantitative PCR and RT-PCR, we can follow the changes in microbial diversity and activity over time and under different conditions, so we will be better able to predict how the ecosystem may respond to environmental changes.

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COMPARATIVE FUNCTIONAL DIVERSITY OF PHYTOPLANKTON AND PHYSICAL PROPERTIES AT 10 STATIONS ALONG A TRANS-MEDITERRANEAN TRANSECT

Picoplankton assemblage as revealed by flow cytometry analysis coupled with HPLC pigment analysis with chemotaxonomic data processed by ChemTax have been compared at 10 stations along a trans-Mediterranean transect in June 2007. Key differences between the stations were the depth of the mixed layer and the depth of the DCM, which were shallower and deeper in the Eastern basin, respectively. Hydrological properties and the trophic state of the water masses appear to significantly affect the contribution of picoplankton fraction to total biomass (between 40 and 80 %), the chemotaxonomic pigment diversity as well as the photophysiological state of the phytoplankton community. Prochlorochoccus was missing from the Alboran and the Ligurian Sea, where, instead, Synechococcus showed a surface peak in concentrations. In general, Prochlorococcus showed a deep peak above the DCM. Coupling flow cytometry and HPLC data we estimated the cell dvchla content of Prochlorococcus to range between 0.25 and 1.51 fg dvchla.cell-1, depending on depth and therefore light. The cell zeaxanhin content of Synechococcus was 1.40 and 1.00 fg.cell-1 in the Western and Eastern basins, respectively.

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PHOTOACCLIMATION CAPACITY AND ECOLOGICAL NICHE PROPERTIES OF SIX PHYTOPLANKTON SPECIES

Photoprotective capacities of six nano and pico-algae belonging to different taxonomical groups with different combinations of light-harvesting complexes and xanthophyll-cycle pigments are compared. The aim of this study was to test the hypothesis that the xanthophyll cycle development can be considered as a functional trait in algae. Lipophylic pigments, quantum yield of fluorescence and NPQ were frequently measured during a progressive light increase from 40 to 400 µmol.photons.m-2.s-1. The observed photoresponse in the six species presented a high variability with a different activation and kinetics of the xanthophyll cycle revealing that the capacity of photoprotection differs between species. The photosynthesis regulation and photoprotective capacity appear to be strongly related to the photoadaptation state of the cells suggesting a relationship between the photophysiological properties to the biology and/or ecology of these algae. The xanthophyll cycle is proposed as a functional trait of algae, with three defined functional groups: the high light-growing species, the low light-growing species and the variable light-growing species.

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THE HISTORICAL AND PALEOECOLOGICAL RECORD OF LAND USE AND ESTUARINE EUTROPHICATION: THE IMPORTANCE OF NITROGEN

Organisms and chemicals preserved in Chesapeake Bay sediment cores in mid-Atlantic USA show changes in the estuarine ecosystem related to colonial land use beginning in the 17th century, with the most significant changes occurring since the mid-20th century. Prior to European settlement, the watershed drained by the Chesapeake consisted of a diversity of forests, coastal marshes, floodplains and inland wetlands many of which were created by beavers. With the extermination of the beaver in the mid 18th century and draining of wetlands for arable land, the system lost much of its potential for denitrifcation. At the same time, nitrogen made available by natural biological fixation increased with crop rotation. Animal and human waste, natural and synthetic fertilizers, and more recently emissions from cars and power plants also increased nitrogen loads. Over the last 200 years, the paleoecological record shows an increase in anoxia in the mesohaline estuary, as nitrogen inputs increased, accompanied by a shift from benthic to planktonic autotrophs. The historical records of the decline in fish and shellfish harvests show similar trends, also exacerbated by overharvesting.

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SCALING RATES OF WATER COLUMN, BENTHIC, AND SYSTEM METABOLISM AS A FUNCTION OF DEPTH AND WATER QUALITY IN SHALLOW PHOTIC ECOSYSTEMS

Benthic microalgae have the potential to sequester enough nutrients to mediate the negative consequences of watershed loading. As loads increase, however, phytoplankton may be able to overcome this buffer, resulting in large blooms. These blooms together with sediments and colored dissolved organic matter (CDOM) have the potential to reduce light penetration and shift dominance from benthic to pelagic production, with negative consequences to water quality and ecosystem function. We measured water and sediment photosynthesis-irradiance curves along the New River Estuary, NC and combined estimates of production and respiration with hourly light records to scale up to daily rates and compute net ecosystem metabolism. Following development of a regression model to predict light attenuation as a function of optical properties, we tested the effect of proportional changes in chlorophyll, turbidity, and CDOM on the metabolic balance of the estuary. Metabolic rates and overall balance were a function of location along the estuarine gradient and were highly sensitive to system depth. Changes in optical properties have the potential to alter metabolic rates in this system as well as the overall metabolic balance.

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IRON LIMITATION INCREASES THE INTRACELLULAR CONCENTRATION OF DMSP AND DMSO OF THE MARINE DIATOM THALASSIOSIRA OCEANICA

The climatically active gas DMS (dimethylsulfide) is derived from enzymatic cleavage of the algal metabolite DMSP (dimethylsulfoniopropionate). DMSP, DMS and the oxidation product DMSO (dimethylsulfoxide) have been proposed to function as antioxidants that protect marine phytoplankton from oxidative stress, such as that arising from nutrient limitation. Iron limits phytoplankton growth in ~40% of the ocean, and iron inputs to ocean waters promote the growth of diatoms, which are thought to produce only low amounts of DMSP and DMS. In culture experiments with the oceanic diatom Thalassiosira oceanica we found that iron limitation of growth rate increased the intracellular concentration of DMSP from 3.7 to 33.7 mM and that of DMSO from 0.8 to 3.9 mM, but it had no effect on DMS production. The reaction of DMSP with the hydroxyl radicals (released during oxidative stress) produces DMSO, which further reacts with and removes these toxic radicals. The increase in DMSP and DMSO under iron limitation provides further support to the antioxidant hypothesis. It also suggests that the role of diatoms in the DMS cycle may need to be reexamined.

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INTERACTION OF THE INVASIVE RED ALGA *GRACILARIA VERMICULOPHYLLA* WITH NATIVE *FUCUS VESICULOSUS* IN THE BALTIC SEA

In the SW Baltic Sea the recently introduced perennial red alga *Gracilaria vermiculophylla* preferentially grows in environments that have so far been dominated by the rockweed *Fucus vesiculosus*. Here we present evidence from outdoor-, mesocosm- and laboratory-experiments that *Gracilaria* has the potential to change these *Fucus* habitats through several different mechanisms: Due to allelopathic inhibition the settlement success of *Fucus* zygotes is reduced when *Gracilaria* is present. Further, *Gracilaria* represents a preferred refuge for mesograzers, in particular in winter and spring. These nonetheless preferentially feed on *Fucus*, which results in reduced survival of *Fucus* juveniles and in reduced net growth of *Fucus* adults when *Gracilaria* is present. Finally, *Gracilaria* forms mats which may overgrow *Fucus*, causing a reduction of light and nutrient resources and reduced growth in summer. A future decline of *Fucus* communities in sheltered environments of the Baltic due to further spreading of *Gracilaria* appears as possible, but at the same time *Gracilaria* may deliver at least some of the ecological services that have so far been provided by *Fucus*.

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INVERSE KINETIC ISOTOPE FRACTIONATION OF BACTERIAL NITRITE OXIDATION

Natural abundance isotopic measurements of dissolved nitrate and nitrite provide unique tracers of nitrogen biogeochemical cycling in the ocean. In order to interpret the natural abundance isotope ratios of these species, the isotope effects of the processes that affect nitrate and nitrite are needed. Bacterial nitrite oxidation is known to be an important process for cycling nitrite in the ocean, and may play an important role in retention of fixed nitrogen in oxygen minimum zones. In this study, we have measured the N and O kinetic isotope effects for this process. Applying recently developed analytical tools, we have shown that 3 genera of marine nitrite oxidizing bacteria: *Nitrobacter*, *Nitrospira*, and *Nitrococcus*, all exhibit *inverse* kinetic isotope fractionation for both isotopes. In these experiments, the ^{15}N inverse isotope effect is always greater in magnitude than the ^{18}O isotope effect. Although inverse kinetic isotope fractionation is rare, these results can be understood on a theoretical basis. These findings will greatly aid our interpretation of natural abundance nitrogen and oxygen isotopes.

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SOURCES OF IRON- AND COPPER-BINDING LIGANDS IN NATURAL SEAWATER: RESULTS OF INCUBATION EXPERIMENTS FROM DISTINCT MARINE SYSTEMS

Trace metal clean incubation experiments were conducted in high nutrient low chlorophyll water from the Southern Ocean, and in moderate nutrient low chlorophyll and oligotrophic waters from Southern California and the Eastern Tropical North Pacific. The speciation of dissolved iron and copper through the incubations was investigated using competitive ligand exchange-adsorptive cathodic stripping voltammetry (CLE-ACSV) with the added ligand salicylaldoxime. Results detail the extent of production of iron-binding and/or copper-binding ligands under the distinct conditions of the unamended incubation waters as well as from inorganic nutrient-amended or iron-amended incubations. As stronger iron-binding ligands were predominantly produced in the light bottles of iron-limited incubations and copper-binding ligand production was also observed in some bottles, trends in the speciation of iron and copper were assessed in terms of light and dark treatments, nutrients, chlorophyll a, and phytoplankton and bacterial characteristics. The contribution of the bacterial community was specifically addressed in complementary incubations of whole and 1 μ m filtered waters from the Eastern Tropical North Pacific.

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LIVING ASSEMBLAGES FROM THE "DEAD ZONE" AND "NATURALLY OCCURRING" HYPOXIC ZONES

"Dead" or hypoxic zones are defined as the seafloor and the water column immediately above the it with oxygen concentrations of less than 2 mg/l. Such low oxygen concentrations result from the aerobic decay of organic debris from locally–elevated primary production that is fueled by anthropogenic nutrient inputs to the coastal ocean (e.g. fertilizer runoff). Other benthic environments with persistent hypoxia unrelated to human activities have been known for decades as well. Silled basins and cold seeps are examples of "natural" hypoxic regions. Using microscopy, we have documented disparate but diverse symbioses-dominated assemblages of protists and nematodes from all three of these hypoxic environments. The "dead zone" in the Gulf of Mexico is dominated by flagellates and ciliates. Monterey Bay cold seeps, while hosting biomass roughly equivalent to that from the "dead zone", had assemblages dominated by nematodes. The meiofaunal assemblage from Santa Barbara Basin was approximately an order of magnitude higher in biomass and was dominated by foraminifera. In all three hypoxic environments, symbioses were a prominent component of the meiofaunal assemblage

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MICROBES INVOLVED IN OXIDATION OF EXTREMELY HIGH METHANE CONCENTRATIONS IN LAKE KIVU

Meromictic Lake Kivu in East Central Africa is a lake with extremely high concentrations of dissolved methane and carbon dioxide in the hypolimnion. Methane concentrations are high enough for commercial exploitation, on the other hand rising gas concentrations create worries about potential catastrophic gas eruptions.
We have investigated the microbial community in Lake Kivu, with an emphasis on the methane oxidizing populations. Stable isotope measurements, modelling and microbial analysis indicate that aerobic methane oxidation is the dominant process for methane oxidation in the lake. Anaerobic methane oxidation probably contributes less than 10% to the total methane oxidation, and appears to occur in conjunction with sulphate reduction. Analysis of the pmoA and mcrA genes revealed the presence of methane oxidizing populations. The aerobic methane oxidizing population located in the oxycline appears to be dominated by Type I methanotrophs. In contrast, we did not find any of the known subgroups of anaerobic methane oxidizers (ANME). However there are three novel clusters of mcrA genes, that indicate the presence of new groups of either ANME or methanogenic archaea in the anoxic water column.

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THE EFFECT OF SEASONAL HYPOXIA TREND IN THE CHESAPEAKE BAY ON ITS TRIBUTARIES

The Chesapeake Bay has been one of most studied systems relative to hypoxia in the United States. Although hypoxia is a natural occurring event, its presence in coastal systems, such as the Chesapeake Bay, has become an increasing trend. Research has suggested that nutrient loading from land runoff, enhanced by human activities, has catalyzed this trend in the mainstem of the bay. In recent years, hypoxic volume of the bay has increased and has expanded into the bay tributary system causing adverse affects on the surrounding ecosystem. The purpose of this study is to examine the extent of the hypoxia phenomenon in the Choptank River and determine if this trend is a by-product of hypoxia in the mainstem bay or contributes to the mainstem hypoxic volume increase in. Data collected in 2001-2008 by the Chesapeake Bay Monitoring Program and the MAST program (clarify what MAST stands for) are analyzed to gain an understanding of mainstem and Choptank River hydrographic parameters as well as chlorophyll and nitrogen concentrations. These data are evaluated using time series analysis techniques and computer modeling. Results present here are a product of an undergraduate research experience at the University of Maryland Center for Environmental Sciences Horn Point Laboratory and Hampton University.

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ORIGIN AND FATE OF TERRESTRIAL AND MARINE ORGANIC MATTER OFF THE RHÔNE RIVER : SPATIAL AND SEASONAL VARIATIONS (GULF OF LIONS, FRANCE)

Organic matter (OM) inputs from both terrestrial and marine origin represent the two main sources of organic supply in the coastal zone. Studies on the Rhône river organic inputs and the fate of OM in the river prodelta provide informations on the transport,d eposition,regeneration and burial processes.Spatio-temporal variability is a crucial issue for the benthic environment understanding which has been tackled using the following strategy: - Spatial variations based on 20 sediment stations located off the Rhône river in a radius of 15 miles. - Temporal variations investigated during three cruises performed in April 2007, September 2007 and May 2008. Three main groups of biogeochemical parameters have been utilized in order to assess the budget of recycling/burial and the dynamical processes which drive this budget in marine sediments. - For the origin of OM : ∂13C, ∂15N, specific fatty acids, pigments - For quantification and characterization of organic compounds : OC, N, and the biochemical classes (lipids,carbohydrates, protids) - For relation with infaunal ecosystem, estimation of the labile fraction (total and enzymatically hydrolyzable amino acids.

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RESEARCH AND MONITORING AT THE MISSION-ARANSAS NATIONAL ESTUARINE RESEARCH RESERVE: FOCUS ON CLIMATE CHANGE AND HARMFUL ALGAL BLOOMS

The Mission-Aransas National Estuarine Research Reserve (MANERR) on the south coast of Texas is the newest member of a nationwide system of 27 estuarine research reserves in the USA. MANERR contains over 75000 hectares of terrestrial, wetland and marine habitats. We have established five permanent hydrographic monitoring stations within the reserve along a salinity gradient from the freshwater inflow of the Aransas River to the seawater exchange pass to the open Gulf of Mexico. These stations provide continuous, real time information on temperature, salinity, pH, turbidity, dissolved oxygen, chlorophyll and water level. This monitoring data will allow us to address issues of climate change along the subtropical south Texas coast. We are observing northward range extensions of tropical fauna and flora within MANERR. We are also supporting monitoring efforts for harmful algal bloom detection. These efforts have detected a new species of dinoflagellate previously unknown in this region and detected the first large-scale bloom of *Dinophysis acuminata* along the coast of Texas, resulting in the first closure of oyster beds due to the detection of DSP toxins.

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PROXY CLIMATIC INDICES AS INDICATORS OF CLIMATE VARIABILITY. HOW DO THEY AFFECT MARINE SPECIES?

Previous works has developed proxy indices for different areas with the objective of explaining changes in other variables (sea surface temperature, rainfall, dew point,...). Most of them show a latitudinal variability of atmospheric pressure dipoles. The present work attempt to build up a climatic index for the North East Atlantic Ocean that explains the longitudinal movements of the Azores High and how it may affect the behaviour of different marine species. This has been done using an Eulerian approach and statistical analyses. The evaluation period goes from 1899 to 2008. This kind of studies can give an idea of how the climate change may disturb marine populations.

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MAGNITUDE AND VARIABILITY OF NITROGEN FLUXES FROM MARINE AND FRESH SGD SOURCES

Intercomparison studies of submarine groundwater discharge (SGD) reveal a high degree of geographical variability in the magnitude of fresh and marine sources of SGD, and new nitrogen inputs from SGD must account for this source variability. Factors contributing to these differences include geology, coastal aquifer type/size, groundwater recharge/consumption rates, tides, waves, and bio-irrigation. Fresh, or terrestrially derived, groundwater can range from less than 1% to as high as about 70% of the total discharge observed, depending upon location. Additionally fresh groundwater discharge usually diminishes to minimal rates within a few meters of the shoreline, indicating the zone of new nitrogen input is small. In a coastal lagoon, nitrogen fluxes were estimated from a nearshore piezometer transect across the seepage face and at four randomly distributed marine endmember sites beyond the zone of fresh water influence. Most dissolved inorganic nitrogen is present as NH_4 in the shoreline subterranean estuary zone where N fluxes were about 1.8 mM/m2/day. In the marine dominated zone beyond the fresh seepage face, irrigating processes enhance porewater NH_4 fluxes as high as 26 mM/m2/day.

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INBREEDING DEPRESSION VARIES WITH INVESTMENT IN SEX IN *DAPHNIA PULICARIA*

In facultative parthenogens recessive mutations that accumulate during the asexual phase can be unmasked following sexual reproduction. Longer periods of asexual reproduction should increase the accumulation of deleterious mutations within individuals, and reduce population-level genetic diversity via competition. We quantified the level of inbreeding depression in five populations of *Daphnia pulicaria* that vary in sex investment. We compared the viability of sexual eggs collected from the field to those that were produced in the laboratory by mating mothers to their genetically-identical sons. Inbreeding reduced the hatching fraction of eggs on average 20%. We raised multiple families (mother, field-produced daughter, lab-produced daughter) on high food and estimated the fitness reduction in both sexually-produced offspring relative to the maternal genotype. Inbred individuals had lower fitness than either their mothers or field-produced siblings. The magnitude of fitness reduction in inbred offspring increased as population-level investment in sex decreased. However, there was less of a fitness reduction following sex in the field-produced daughters, suggesting that many field-collected mothers had mated with a genotype other than their own.

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THE EFFECT OF UPWELLING ON SHORT TERM VARIABILITY IN SEDIMENT BIOGEOCHEMISTRY IN A SMALL CALIFORNIA ESTUARY, ELKHORN SLOUGH, CA, USA

We examined short term variability in sediment microbial processes during an upwelling event. Potential nitrification, nitrifier community composition, pore water nutrients, solid phase iron and pore water sulfide concentrations were measured at three locations in Elkhorn Slough, CA. Fog associated with upwelling in Monterey Bay reduced photosynthetically active radiation in Elkhorn Slough which led to an increased duration of hypoxia in the water column as upwelling intensified. Solid phase $Fe3+$ and potential nitrification rates declined while pore water sulfide increased over this period. While potential nitrification rates from this study are lower than rates from estuaries that do not go hypoxic or anoxic, nitrifiers in Elkhorn Slough appear to be capable of adjusting to changing environmental conditions, specifically being able to tolerate low levels of sulfide. Different members of the nitrifying community - either ammonia oxidizing bacteria or ammonia oxidizing archaea - may be responsible for nitrification under different environmental conditions. Eutrophic, shallow estuaries like Elkhorn Slough are delicately poised such that their sediment biogeochemistry responds quickly to relatively small changes in the light environment

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IMPACTS OF MICRO- AND NANOGRAZERS ON PHYTOPLANKTON IN NW MEDITERRANEAN COASTAL WATERS

We studied the relevance of metazoan microzooplankton, and protozoan micro- and nanograzers as consumers of phytoplankton in NW Mediterranean coastal waters along a seasonal cycle (September 2005-2006). We conducted 11 standard and < 10 µm size-fractionated dilution experiments, and grazing incubations with metazoan microzooplankton (50-200 µm). On annual average, protistan grazers consumed 40% of the total phytoplankton standing stock per day (range 9-83%), and metazoan microzooplankton 7% (range 0-18%). Grazing impact on > 10 µm cells was only significant in 5 out of 11 experiments, mostly during the warmer period (average impact of 33% of the > 10 µm standing stock consumed daily for the whole microzooplankton community, range 0-130%). The data suggest the coastal NW Mediterranean is a system in which microzooplankton (> 10 µm organisms) weakly control the primary producers during the cold season (winter and most autumn), switch to nano-sized heterotrophic prey during spring, partially suppressing the impact of this group on phytoplankton, and finally they are replaced by nanograzers during the warmer months (end of summer period), heavily impacting the dominant small primary producers.

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ENGINEERED OCEAN CARBON STORAGE: BENEFITS AND COSTS

Various schemes have been proposed to engineer an increase in ocean carbon storage with the intent of either diminishing atmospheric carbon dioxide concentrations or allowing use of additional fossil fuel carbon. These proposals include direct injection of purified and compressed CO_2 into the ocean, fertilization of the ocean with iron or other nutrients, acceleration of carbonate weathering processes, and engineered confinement of carbon dioxide on the sea floor. Benefits claimed usually relate to diminished economic costs of carbon storage, diminished effects of climate or chemistry changes on marine ecosystems, and/or enhancement of fisheries. Costs claimed usually relate to economic costs, potential environmental damage, and costs associated with the interaction of ocean storage options and broader socio-political systems. Decisions are made difficult because of competing claims on a global commons, with different parties having different perceptions and stressing different interests. Decision-making difficulties are compounded by the high degree of uncertainty involved, which in turn is in part dependent upon our limited understanding of marine biogeochemical systems and the potential impact of various human activities on those systems. Science can help us to understand the facts; facts, when combined with values, can help us to determine what might be wise.

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COMPOUND SPECIFIC Δ13C AND Δ15N AMINO ACID SIGNATURES IN TOTAL OCEANIC DISSOLVED ORGANIC NITROGEN (DON): A NEW APPROACH AND INITIAL RESULTS

One of the largest reservoirs of organic nitrogen (N) and reduced carbon (C) on earth exist in the subsurface ocean water column as detrital dissolved organic material (DOM), however its cycling, composition, and reasons for long-term preservation remain poorly constrained. Compound specific δ13C and δ15N amino acid (AA) analysis has emerged as a powerful new approach to elucidate organic nitrogen source and cycling, as AA represent the main identifiable component of organic N in DOM. Due to analytical limitations this approach has so far focused only on characterization of the high molecular weight fraction (HMW-DOM), and early results have suggested provocative hypotheses about DOM preservation. However, HMW-DOM represents only 10-30% of the total, and is believed generally more dynamic and less degraded. Major analytical issues for total DOM include large sample requirements, the need for desalting, and high levels of unknown interfering compounds. Here we present a new method to analyze compound specific AA isotopes in total DOM, and describe the first comparison between AA isotope patterns in total oceanic DOM versus HMW-DOM from the Californian Current.

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DIVERSITY OF THE ITS-1 OPERON AND PHOTOSYNTHETIC TRAITS OF ANDEAN FRESHWATER PICOCYANOBACTERIA

In ultraoligotrophic North Patagonian Andean lakes picocyanobacteria (Pcy) are the dominant picophytoplankters comprising 50% of the total primary production and 30% of autotrophic biomass, as average in the water column. Automated rRNA Intergenic Spacer Analysis (ARISA) was used to study the structure and the diversity of Pcy community in six of these lakes. We investigated the relationships among the Operational Taxonomic Units (OTUs) and the photosynthetic characteristics of Pcy assemblages. The six lakes clustered into two main groups mirroring their history after the Last Glacial Maximum. About 50% of significant ARISA fragments appeared to be site specific, others displayed cosmopolitan distribution. The relative DNA fluorescence of one OTU was significantly related to chlorophyll specific production. The variation of the photosynthetic traits of the two clusters characterized by different OTU diversity is consistent with the hypothesis that the ITS-1 sequence of Pcy define functionally differentiated groups. Clone libraries approach coupled with ITS-1 analyses was used to obtain phylogenetic information of ARISA fragments and an ITS-1 phylogenetic tree was inferred using marine and freshwater picocyanobacteria published sequences.

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INVESTIGATING SEA-ICE DYNAMICS IN THE ARCTIC OCEAN USING BE-7 AS A TRACER

Sea-ice is a key feature of the Arctic Ocean. From its formation until melting, sea-ice undergoes chemical, physical and structural processes. During its lifespan, it acts as a temporal buffer, accumulating chemical species and particles from the atmosphere as well as from the surface waters and the sea floor in coastal areas. Drifting sea-ice thus becomes an important transport agent for solid material and chemical species which are subsequently released into the underlying water column during melting. This discharge occurs on a relatively short timescale, enhancing sedimentation rates and biological productivity in ice ablation areas. Be-7 is a cosmogenic, particle-reactive radionuclide with a short-life of 54 days. These characteristics make it appropriate for use as a tracer of sea-ice transit times and the dynamics that govern the incorporation, transport, accumulation and redistribution of chemical species and material by sea ice. Tracers such as Be-7 may be even more useful in the foreseen changing conditions of the Arctic Ocean. Here we present an overview of Be-7 in sea-ice, surface water, sub-ice water, sea-ice sediments, aerosols and precipitation along the Transpolar-Drift.

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DENSITY-DEPENDENT HABITAT SELECTION IN JUVENILE ENGLISH SOLE (PLEURONECTES VETULUS)

The contribution of nursery habitats to adult recruitment of marine fish depends on the physical qualities of the habitat as well as intraspecifc behavioral interactions, which may be density-dependent. Density-dependent habitat selection (DDHS) was examined in juvenile English sole, found in estuarine nurseries at high densities, and compared to that of northern rock sole which occur at low densities in coastal nurseries and exhibit DDHS. DDHS was hypothesized to be similar between the two species, but would be initiated at higher densities in English sole. Trials were conducted over seven density treatments (0.4, 0.8, 1.5, 3.0, 6.1, 12.2, 18.6, and 23.8 fish m^{-2}) during which fish were given equal access to a preferred sandy habitat and a less-preferred pebble habitat. Low-densities of English sole (0.4-1.5 fish m^{-2}) showed little habitat preference, use of the less-preferred pebble habitat decreased with increasing density up to 3.0 fish m^{-2} where DDHS initiated and pebble use increased from 30 to 50% with density. This pattern remained even under predation pressure. Initiation of DDHS and the lack of habitat preference at low densities may indicate that English sole perceive conspecifics as indicative of habitat quality.

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AUTOMATED CONTINUOUS ANALYSIS OF PHYTOPLANKTON COMMUNITY COMPOSITION BY IMAGING FLOWCYTOBOT REVEALS BLOOM DYNAMICS AND PROVIDES EARLY WARNING OF A HAB EVENT

Imaging FlowCytobot (IFCB) combines video and flow cytometric technology to capture high resolution (1 μm) images for plankton identification and to measure chlorophyll fluorescence associated with each image. Organisms ranging from ~10 to >100 μm can be identified often to genus and, in some cases, to species. Since its installation at UT-Marine Sciences Institute Pier Laboratory (Port Aransas, TX) in September 2007, IFCB has provided nearly continuous data. Automated image classification, involving extraction of image features and supervised machine learning algorithms, has revealed a dynamic phytoplankton community composition characterized by rapid fluctuations in abundance by a series of taxonomic groups. In early February 2008, *Dinophysis* were detected (1-5 per mL) and by late February estimates were >100 per mL. Retrospective analysis of this time series has revealed the occurrence of prey species (*Myrionecta rubra*) prior to bloom initiation. Results have demonstrated that continuous and automated methods for monitoring coastal waters enhance our ability to monitor the abundance of individual phytoplankton taxa at temporal scales relevant for better understanding of community dynamics, predator-prey interactions and prediction of harmful algal blooms.

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IMPACT OF A MESOSCALE EDDY ON THE STRUCTURE OF THE TROPHIC FOODWEB IN THE GULF OF LIONS (NW MEDITERRANEAN)

The purpose of this study, carried out in the context of the LATEX programme, is to examine the biogeochemical properties of mesoscale eddies in the Gulf of Lions (NW Mediterranean) and study their impact on the structure of the plankton community. These structures were previously identified using wavelet analysis on the outputs of a 3-dimensional hydrodynamic model, Symphonie. By adding to Symphonie a multi-nutrient, multi-functional groups of plankton, biogeochemical model, ECO3-NWMED, we analyse the biogeochemical activity within these eddies. The ouputs of the coupled model are compared to several different types of datasets (SeaWiFS images, in situ data) in order to fully verify its realism. A study of an anti-cyclonic eddy indicates a downwelling phenomenon which can be observed using various biogeochemical tracers such as nutrients, phytoplankton and bacteria. Decreasing concentrations of phytoplankton biomass throughout the period of the anticyclone are predicted and can be explained by predation by zooplankton and reduced availability of phosphate. At the end of the eddy episode, we observe various biogeochemical tracers rising up to the thermocline on the edge of the eddy.

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RESUSPENSION CREATED BY BEDLOAD TRANSPORT OF UNATTACHED MACROALGAE

Earlier studies have quantified that plant bound transport in shallow lagoons and estuaries periodically may be the dominating nutrient transport form. In some of these field studies turbidity increased when plant transport increased. The hypothesis in this study is that macroalgae resuspend surface sediment while drifting. To improve the understanding of this ballistic effect of moving plants on the sediment surface, controlled annular flume experiments were performed. Plant transport was measured together with turbidity and suspended particulate matter during increasing water currents. In all experiments the plant induced sediment erosion started earlier than at bare bottoms. The turbidity increased when the plants started to move (2-4 cm s-1). Depending on the plant type the turbidity increased from a background concentration of 7-10 mg SPM l-1 to 30-50 mg SPM l-1 for Ulva lactuca, Chaetomorpha linum and Cladophora sp., while the more rigid macroalgae like Fucus vesiculosus and Condus crispus caused much higher turbidities (50-150 mg SPM l-1). This phenomena may explain the appearance of turbid waters in estuaries and lagoons in the absence of wind and wave action.

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TAXONOMIC AND FUNCTIONAL LOCAL RICHNESS FIND SATURATION OVER TIME IN MARINE FOULING COMMUNITIES – A GLOBAL PERSPECTIVE

The shape of the local-regional richness relationship has frequently been used to examine the contribution of regional processes on local assemblages for different habitats, taxonomic groups or spatial scales. We investigate this relationship using a new concept. We report a large-scale experiment in marine hard-bottom assemblages growing on artificial substratum highly replicated at eight different bio-geographic regions. At four different successional ages (2, 4, 6 and 8 months) we have inventoried the percent cover of all sessile species present in our experimental units, the availability of resources (measured as percentage cover of unoccupied substratum) and functional richness. The shape of the relationship between local and regional diversity depended on successional stage, and the dimension of diversity considered, i.e. taxonomical versus functional richness. Both species richness and functional richness shifted from unsaturated to saturated during succession, but species richness reached saturation faster than functional richness. Younger and unsaturated communities were not constrained by the availability of substratum while older and saturated assemblages were. Moreover, multivariate analysis determined that regional richness was not a primary factor affecting local fouling assemblages during succession.

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A DIRECT COMPARISON OF BACTERIAL RESPONSE TO A VARIETY OF PHYTOPLANKTON PRODUCED DOM VIA EXUDATION AND LYSIS

Variability in phytoplankton lineage dominance is known to occur spatially and temporally. We sought to compare the bacterial response to DOM produced by five phytoplankton mono-cultures grown in environmentally relevant conditions. DOM production was most notable after the transition to nitrate deplete conditions. DOM was harvested from each culture and cell pellets were also collected by gentle centrifugation and lysed to produce an algal lysate DOM (AL-DOM). Dark DOM remineralization experiments were conducted in which natural assemblages of bacterioplankton were amended with DOM from direct exudation or AL-DOM at comparable carbon concentrations. We observed a 3-4X higher cell density and specific growth rate on AL-DOM compared to DOM exudates. Bacterial cell densities and specific growth rates were also greatest on Phaeocystis and Lingulodinium derived DOM compared to Chaetoceros, Tetraselmis and Cruciplacolithus derived DOM. Here we will also discuss the percent bioavailability of DOM to bacteria, the efficiency at which they utilized the DOM and how phytoplankton lineage as well as DOM type, exuded versus AL-DOM , impacted the community structure of the bacteria.

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FATE AND TRANSFORMATION THROUGH TIDAL ESTUARIES OF BIOGENIC MATERIAL ORIGINATING FROM CONTINENTAL WATERS: COMPARISON OF THREE ESTUARIES OF THE ARCACHON BAY

The Arcachon lagoon is a preserved site, but eutrophication may develop as a consequence of low buffer capacity and slow turnover of waters inside the lagoon. The aim of this study was to determine the fate and transformation of N, P, and C compounds between river mouths and the lagoon, in order to better describe their dynamics. Macrotidal estuaries of three small rivers were compared. The largest river is a source of nitrate and forms a delta. The second is also a source of nitrate but it is a small stream well open to lagoon waters. The third is a source of ammonia. It is small and protected by dams. We have measured the distribution of nitrate, ammonia, dissolved inorganic phosphorus, dissolved organic nitrogen and phosphorus, particulate organic carbon, nitrogen and phosphorus, loosely bound phosphorus (LBP), δ13C and δ15N. We observed that oxidation of ammonia to nitrate occurs within the estuaries rather than upstream, because of the longer residence time of estuaries waters River nitrate is conservative. Organic P and LBP are the main forms of easily bioavailable phosphorus.

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KINETIC CHARACTERIZATION OF ORGANIC LIGANDS COMPLEXING METALS IN COASTAL MARINE ENVIRONMENTS

Measurements carried out by Anodic Stripping Voltammetry to study metal complexation is one operational approach discriminating inert forms and labile forms of metals from the thermodynamic and overall kinetic point of view. There are evidences that marine organic ligands of trace metals may have different characteristics on the base of kinetic properties. Effects of kinetic lability on complexing capacity and conditional stability constants were considered and one model was developed to estimate the backward kinetic constant and the conditional stability constant of complexes. The model was used to study the kinetic lability of organic complexes of cadmium and zinc in coastal marine water of the Adriatic sea. The complexing capacity of cadmium was 2.4 ± 0.3 nmol/L, the conditional stability constant and the backward kinetic constant were $K'=2.2 \pm 0.1$ $(nmol/L)^{-1}$ and $k_{b'} = 6.8 \pm 2.9\ s^{-1}$ respectively. The complexing capacity of zinc was 31 ± 3 nmol/L, the conditional stability constant and the backward kinetic constant were 2.7 ± 0.1 $(nmol/L)^{-1}$ and $k_b = 0.62 \pm 0.26\ s^{-1}$ respectively.

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CAUSES OF THE VARIABILITY IN PRIMARY PRODUCTION IN CARLINGFORD LOUGH

The aim of this work was to create a method for obtaining reliable estimates of annual production (gross and net) from monitoring in coastal waters, combining observations and mathematical modelling, to use as indicators of ecosystem vigour in the management of ecosystem health. The study site was Carlingford Lough, opening into the Irish Sea. Photosynthesis-irradiance curves were determined from ^{14}C uptake in a light-gradient incubator, and respiration was measured by oxygen consumption in the dark. Daily column production was then calculated from light penetration and chlorophyll concentration. A truncated Fourier series (TFS) was used to interpolate the daily estimates, and explained 67% of the variability in gross primary production (GPP). A Monte Carlo method, employing the TFS and residual error, was used to estimate GPP as 207 gC/m^2y with 95% confidence limits at 186 and 228. The paper will explore causes of the seasonal variation (captured by the TFS) and the residual error, some of which can be explained by environmental variables such as chlorophyll standing stock and nutrient concentration.

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SEASONAL VARIATIONS OF SILICON ISOTOPES IN RIVERS: IMPACT OF LAND-USE AND OTHER BIOGEOCHEMICAL PROCESSES

We present silicon isotopic signatures (d30Si) of rivers from the Scheldt basin (Belgium), a watershed under extremely high anthropogenic pressure (agriculture, urbanization, industries). Seasonal variations of d30Si have been measured in the lower Scheldt (from Ghent up to Antwerp) and on its main tributaries. We have also measured d30Si on streams selected on the basis of their location in small sub-basins under contrasted land-uses: forest, cropland and grassland. In the lower Scheldt and in the large tributaries, d30Si are generally heavier when dissolved Si contents are lower, likely resulting from an imprint of diatoms' growth. However the trend is scattered and varies with both season and location suggesting diatom uptake is not the only process controlling d30Si. Tributaries from the eastern watershed are generally isotopically lighter than the western ones and in most streams, d30Si values are lighter in summer, a seasonal feature contrasting with observations in larger rivers. These results will be discussed along with other biogeochemical parameters to assess whether silicon isotopes can be used as a proxy of land-use impact on silicon fluxes.

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FOOD WEB STRUCTURE OF DEEP MEDITERRANEAN COLD SEEPS ASSESSED BY MULTIPLE STABLE ISOTOPES ANALYSIS

Food web structure and functioning of deep ecosystems remain poorly characterised. Cold seeps are continental margins areas where fluids enriched in reduced compounds (methane and sulphide) escape from the seafloor and sustain free-living and symbiotic bacteria activity. In the framework of the HERMES program, we investigated the benthic food web of two cold seeps (the mud volcanoes “Napoli” and “Amsterdam”) located in the deep eastern Mediterranean Sea (2000m depth) at fall 2007. We identified the energy and carbon sources of macroinvertebrates by the use of multiple stable isotope ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) analysis. We determined that virtually all carbon assimilated by consumers of mud volcanoes originate from chemosynthetic pathways, mostly via sulphur-oxidising activity and to a lesser extent via the methanotrophic pathway. However, considering the tubeworm *Lamellibrachia* sp. that exclusively depends on thiotrophically derived carbon, $\delta^{13}C$ data showed that the origin of dissolved inorganic carbon that is fixed by symbiotic bacteria vary on very small spatial scales (< 1m). These results reinforce the interest of multiple stable isotope approach to investigate complex trophic relationships on chemosynthetic ecosystems.

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SEASONAL DYNAMICS OF SAR11 POPULATIONS IN THE EUPHOTIC AND MESOPELAGIC ZONES OF THE NORTHWESTERN SARGASSO SEA

Bacterioplankton belonging to the SAR11 clade of alpha-proteobacteria were counted by fluorescence in situ hybridization (FISH) over eight depths in the surface 300 m at the Bermuda Atlantic Time-series Study site (2003 – 2005). This quantitative, high-resolution time-series data revealed distinct annual patterns of SAR11 clade abundance in both the euphotic and upper mesopelagic (160 – 300 m) zones. Spring and summer maxima in integrated SAR11 stocks within the surface 120 m were reproducibly correlated with seasonal stratification of the water column. SAR11 blooms were also observed in the upper mesopelagic each year following convective overturn. Terminal restriction fragment length polymorphism data generated from a decade of samples collected at the same site were combined with the quantitative FISH data to model the annual dynamics of SAR11 subclade populations. Clear spatial and temporal transitions among the subclades were observed along physical and chemical gradients at this oligotrophic site. The correlation between evolutionary descent and temporal/spatial patterns we describe, confirmed that a minimum of at least three SAR11 ecotypes occupy the Sargasso Sea surface layer, and revealed their population dynamics in unprecedented detail.

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HURRICANE IMPACTS ON SEAGRASSES ALONG FLORIDA'S WEST COAST

Five major storms (Bonnie, Charley, Frances, Ivan, and Jeanne) affected the west coast of Florida in 2004. Charley and Ivan had wind velocities of 150 kph or greater and caused considerable damage. Bonnie, Frances, and Jeanne had lower wind speeds but delivered more rainfall to Florida's West Coast and associated watersheds. Analysis of seagrass maps generated from imagery collected before 2004 and after 2005 showed that storm impacts on seagrasses varied among estuaries. The immediate, physical impacts depended on the path of the storm, wind speeds, and coastline orientation: Charley and Frances caused direct, physical losses in Charlotte Harbor and Steinhatchee. Total seagrass area in Tampa Bay actually increased between 2004 and 2006, despite localized losses. However, heavy rainfall in Florida and Georgia associated with Frances and Jeanne combined with winter rains to cause longer-term impacts on water quality in the Suwannee River Estuary, resulting in complete loss of 1500 ha of seagrasses and thinning of another 1700 ha. We conclude that water quality impacts of storms, especially if they are persistent, can be as damaging as direct physical impacts.

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SIX DEGREES OF SEPARATION: THE COMPOSITION OF THE DEEP CHLOROPHYLL MAXIMUM (DCM) AT THE MID-LAKE REEF COMPLEX (MLRC) IN LAKE MICHIGAN

Lake Michigan zebra mussels (ZM) have now been displaced by quagga mussels (QM) with a much broader range (<6 to >90m). After only three years with QM, dampened seasonal silicate cycling indicated a basin-wide reduction of diatom production. Communities in Lake Michigan shifted from diatom and big cell-dominated to small cell picocyanobacteria-dominated phytoplankton. In the DCM, *Synechococcus* reached populations of 210,000 cells/ml. DCM chlorophyll *a* remained similar (3-4µg/l) but late summer species composition changed dramatically to mostly <3µm cells. After the June 2008 floods in SE Wisconsin, a large volume of water collected throughout the watershed flowed through the rivers into Lake Michigan. Species composition of phytoplankton was temporarily dominated by diatoms in the epilimnion. Chlorophyll *a* concentrations increased several-fold in surface waters during that time and diatom biomass increased from the previous years. *Synechococcus* populations in the DCM were only 25% of the previous years. In 2008, the 1% light level shifted upwards by 10m, providing less radiance to the DCM. Chlorophyll *a* concentrations in the DCM increased by almost 2-fold and was significantly thicker than the previous year.

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EFFECTS OF NUTRIENT LIMITATION ON DIATOM OXYLIPIN PRODUCTION AND COPEPOD REPRODUCTION.

Several studies have shown that marine diatoms produce lipid derived oxygenated compounds (oxylipins) that impair copepod reproduction. Such compounds included polyunsaturated aldehydes (PUAs), fatty acid epoxy alcohols, fatty acid hydroxides and many others, all sharing a similar chemical structure and the same biological effects on copepods and other marine invertebrates. Recently, it has been shown that nutrient limitation increases PUA production in the diatom Skeletonema marinoi. Total cellular PUAs production increases up to 5 times under P-limitation compared to the nutrient-replete control cultures. In order to test whether such nutrient-related differences in oxylipin content of S. marinoi translate into stronger toxic effects on copepods, the copepod Calanus helgolandicus was fed with P-limited S. marinoi. Our results showed that although hatching success in C. helgolandicus decreased similarly with both P-limited and P-replete S. marinoi, P-limitation induced a higher percentage of abnormal nauplii. This may suggest that copepods feeding at the end of the bloom, when the algae are under stress (e.g. due to nutrient limitation), could be more affected than early-bloom grazers.

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MICROBIAL DEGRADATION OF DISSOLVED ORGANIC CARBON IN A COASTAL UPWELLING SYSTEM (NW IBERIAN PENINSULA)

Temporal variation in microbial respiration and dissolved organic carbon (DOC) degradation, has been assessed during an annual cycle in the coastal upwelling system of the Ría de Vigo (NW Iberian Peninsula). Eleven seawater culture experiments were established using filtered (0.2µm) surface seawater inoculated with GF/C filtered water and incubation at a constant temperature (15°C) in the dark for 50 days. DOC and oxygen concentrations were measured together with bacterial production, electron transport system (ETS) activity and Fluorescence DOC (FDOC) throughout the incubations. These measurements were used to calculate bacterial growth efficiency (BGE) and DOC bioavailability (BDOC) and degradation rates. Our results show that the bioavailable DOC was consumed within the first 10 days with low respiration rates; indicating a high quality of the substrate for growth and following high BGE estimates. The experiments further showed that BDOC accounted for 24 ± 6 % (average ± SD) of DOC. Calculations showed that the BDOC was degraded at a rate of 23 ± 9 % d^{-1} suggesting an average half life of 1.4 ± 0.5 days. Calculating the export of BDOC from Ria de Vigo using the average water flushing time (6 days) showed that 27 ± 11 % was exported to adjacent waters and could fuel heterotrophic production. Relation found between DOC and DOM fluorescence suggested that protein and humic-like fluorophores could be used as a proxy of bioavailable and refractory DOC Ría de Vigo.

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NON-ADDITIVE EFFECTS OF UV RADIATION AND NUTRIENT PULSES ON THE DIVERSITY AND FUNCTION OF PRIMARY PRODUCERS

Global climate change is the result of multiple anthropic stressors. However, there is growing uncertainty on the cumulative impacts that multiple stressors exert on ecosystem. Stressors can induce species tolerance resulting in antagonistic responses, while ecological trade-offs generate synergistic responses. We conducted different factorial experiments on short, mid and long temporal scales to determine the interactive effects of UV radiation and nutrient inputs on the elemental composition, growth rates, Chlorophyll a, algal composition and biomass, and primary production. Significant decreases in C:P and N:P ratios in +UVR treatments were found, with UVR x Nutrient antagonistic effects. Strong P-pulses (>30 µgP L-1) resulted in severe UVR damage on algal photosynthetic activity and growth rates over mid-term scales (11days) and on functional and structural algal variables over long-term scales (>2 months), i.e. synergistic interactive effects. The UVR x Nutrient effect on algal diversity was negative antagonistic, with a final loss of mixotrophic species. This may affect ecosystems functioning, particularly in oligotrophic ecosystem, where mixotrophs constitute a by-pass in the C-flux between the microbial loop and grazing chain.

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REGIME SHIFTS IN RINGKØBING FJORD: A MODEL STUDY TO INCREASE PREDICTABILITY AND ANALYSE ECOSYSTEM RESILIENCE

The observation that ecosystems can undergo abrupt shifts between alternative stable states is conceptually accepted but models capable of describing such phenomena are scarce and mostly confined to theoretical studies. The Ringkøbing Fjord is a coastal lagoon where a regime shift was observed in 1996 after changing the sluice-gate practice, manifested through a multitude of ecosystem responses with different dynamics and time lags. Non-linear time series models were developed to describe the interaction between various ecosystem components. The objective was to identify critical threshold values for maintaining the present state and to investigate the ecosystem resilience through stochastic perturbations. The analysis documented three different regime shifts between the components: 1) a salinity threshold allowing clams to settle, 2) salinity thresholds for two different benthic vegetation types, and 3) a flip-flop between nitrogen and phosphorus limitation caused by increased capacity to iron-bind phosphate in the sediments. The model was used to assess different scenarios for managing the lagoon including both the hydraulic control and nutrient discharges.

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INFLUENCE OF SALINITY ON DISTRIBUTION OF CHIRONOMIDS (DIPTERA) IN A FRENCH MEDITERRANEAN COASTAL LAGOON

Chironomus salinarius is a common species in coastal lagoons, where it is likely to swarm and create nuisances for human populations. This species is present in the Bolmon lagoon, a French Mediterranean coastal lagoon under eutrophication. Over the last year, the complex Berre-Bolmon lagoons (South of France) have undergone management change: salinity has increased following the decrease of freshwater input. The population of *C. salinarius* was sampled from June 2007 to June 2008 in 12 sites located in two areas of the Bolmon lagoon. This was conducted in order to evaluate the impact of the salinity increase on chironomid populations. Environmental variables (temperature, dissolved oxygen, sediment organic matter content and grain size) and microbial activities (i.e. hydrolasic activities) will also be considered as additional explanatory factors of chironomid densities and distribution.

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NEW INSIGHTS INTO THE INTERSPECIFIC VARIABILITY IN DMSP PRODUCTION BY DINOFLAGELLATES

Dimethylsulphoniopropionate (DMSP) is the biogenic precursor of the climate-cooling gas dimethylsulphide (DMS). Mostly produced by marine algae, DMSP can potentially be used as a compatible solute, a cryoprotectant, an antioxidant, an overflow metabolite or a chemical defence against grazers. Dinoflagellates are one of the major DMSP-producing phytoplankton groups, but the taxon is rather unique because it ranges over 5 different plastid groups which might be relevant if DMSP is synthesised in chloroplasts as shown for the flowering plant *Wollastonia biflora*. Furthermore, about 50% of dinoflagellates are heterotrophic species that represent a substantial part of the zooplankton biomass. We collated our laboratory data along with published data for this group and this underlines the very high variability in DMSP content between dinoflagellates species. We further examined this data by comparison with a range of biological criteria: plastid-type, toxicity, and phylogeny. We examined DMSP production in one heterotrophic species *Crypthecodinium cohnii* in detail and found evidence for a four-fold increase in DMSP concentration in response to carbon depletion. These results give new insight into the biological role of DMSP in dinoflagellates.

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NITRIFICATION IN THE TROPICAL SPONGE *CHONDRILLA NUCULA*

The tropical sponge *Chondrilla nucula* is a cosmopolitan and abundant species in Caribbean coral reefs. This sponge was previously shown to release nitrate at rates greatly exceeding local water column or sedimentary rates. In the present study, a combination of nitrogen isotope tracer techniques and molecular genetic techniques was used to identify the key microbial players and to elucidate the nitrogen cycle dynamics within this novel biogeochemical habitat. Denaturing gradient gel electrophoresis (DGGE) and sequence analysis of 16S rRNA genes among ten individuals of *C. nucula* showed a stable but diverse bacterial community, including Nitrospira, Cyanobacteria, Acidobacteria, Chloroflexi, Actinobacteria, Bacteroidetes, and Proteobacteria. Two archaeal phylotypes were also detected, as well as archaeal *amoA* genes. Using isotope dilution techniques, we are able to demonstrate concurrent nitrate production and consumption by the sponge community. In addition, surprisingly little decrease of ammonia oxidation was observed upon addition of N-serve (a metabolic inhibitor), or exposure to light. The presence of an active nitrifying assemblage in *C. nucula* makes this sponge an important niche for nutrient and carbon fluxes in shallow coral reef ecosystems.

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TROPHIC CASCADES PROMOTE THRESHOLD-LIKE SHIFTS IN MARINE ECOSYSTEM DYNAMICS

Anthropogenic disturbances inter-twined with climatic changes have a large impact on the upper trophic levels of marine ecosystems, which may cascade down the food-web. The implications of these cascading processes on system function and resilience remain source of intense scientific debate. Using field data covering a 30-year period, we show for the Baltic Sea that the underlying mechanisms of trophic cascades produced a shift in the ecosystem dynamics after the collapse of the top-predator cod. We identified an ecological threshold, corresponding to a planktivore abundance of ~17*10^10 individuals, which separates two ecosystem configurations in which zooplankton dynamics are driven by either climate-controlled hydrographic factors or predation pressure. This study reveals two alternative ecosystem configuration in the Baltic Sea, one cod-dominated and one sprat-dominated, characterized by different ecosystem functioning and whose establishment ultimately depends on the top-predator biomass. The two configurations could represent an example of alternative stable states. The results emphasizes that changes in ecosystem functioning can be a result of variations at the higher trophic levels directly affected by human exploitation, and not merely the consequence of climate changes.

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BLOOM DYNAMICS AND DIATOM SECONDARY METABOLITES DURING WINTER BLOOMS OF SKELETONEMA MARINOI IN THE NORTHERN ADRIATIC (MEDITERRANEAN SEA)

In the northern Adriatic Sea a bloom of Skeletonema marinoi is observed in late winter each year. The onset of the bloom is dependent upon light availability whereas its intensity, in terms of cell concentration, and duration is modulated by nutrient discharges from river runoff and the general climatology of the area. Skeletonema marinoi is a known producer of polyunsaturated aldehydes (PUAs) and other secondary metabolites which affect grazers and also the growth and functioning of surrounding organisms. Total phytoplankton cell lysis rates were higher during the bloom as compared to non-bloom periods. Estimated cell lysis rates were directly correlated to concentrations of dissolved PUAs in the seawater, suggesting a release without grazing and a possible toxic effect on surrounding algae and bacteria, as observed in culture. The percent of apoptotic Skeletonema cells, identified by the TUNEL assay, follows the same trend as cell numbers, immediately preceding the bloom decay. The released PUAs are expected to have a role in regulating community composition of bacteria and phytoplankton and therefore in affecting the diversity and ecosystem functioning of the area.

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USING METABOLIC PARAMETERS TO ASSESS COPEPOD TOLERANCE TO LOW-OXYGEN ENVIRONMENTS IN THE EASTERN TROPICAL PACIFIC

The eastern tropical Pacific has a prominent oxygen minimum zone (OMZ), where mid-water oxygen levels can reach below 5 μmoles O_2 per kg. This location also has high zooplankton diversity, including numerous copepod species of the family Eucalanidae. Three such species include *Subeucalanus subtenuis*, *Rhincalanus cornutus*, and *Eucalanus inermis*, which have distinct vertical distributions in this area. We examined differences in oxygen consumption rates between these three species to determine whether the OMZ affects their vertical distributions. Experiments monitored oxygen consumption at three different initial oxygen concentrations. Weight specific oxygen consumption rates were lowest for *E. inermis* and highest for *S. subtenuis* under oxygen saturated conditions. *S. subtenuis* individuals were found to have very low survival rates in the lowest oxygen treatment, while both *E. inermis* and *R. cornutus* had high survival rates. Respiration measurements indicate that *E. inermis* is better adapted to low-oxygen environments than *S. subtenuis*. *R. cornutus* appears to have an intermediate level of tolerance to hypoxia. Such differences in low-oxygen tolerance likely play a role in influencing the vertical distribution of these copepods.

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GENOTYPIC AND PHENOTYPIC VARIATION AMONG THE THERMO-ACIDOPHILIC ALGAE OF ACID GEOTHERMAL WATERS OF YELLOWSTONE NATIONAL PARK, USA

Order Cyanidiales (Rhodophyta) with 3 unicellular, asexual genera of algae inhabit acidic habitats (pH 0.5 to 4.0) from ~40° to 56°C. Globally these are the only known photosynthetic thermo-acidophiles. In Yellowstone National Park the most abundant morphotype (>140 isolates) is Type IA Galdieria *, a walled unicell forming 4-8 daughter cells internally. However, the nuclear 18S rDNA and chloroplast rbcL gene sequences are identical to Cyanidioschyzon merolae that lacks a wall and divides into two daughter cells. Differences in growth rates with temperature and tolerances to some metals (Al,Hg) and metalloids (As) and to higher pH have now been shown within the Type IA Galdieria-like morphotypes as well as small differences in gene sequences at other loci (e.g. psaA, cytochrome B6/f), and in the nuclear ß tubulin gene. Thus, some Type IA isolates have been differentiated from each other as possible ecotypes, but not from Cyanidioschyzon merolae. In contrast, isolates of Galdieria-like Cyanidiales from Japan, New Zealand, and Iceland are genetically quite distinct from Yellowstone Type IA strains even at the 18S and rbcL loci. * Toplin JA et al. (2008) Appl. Environ. Microbiol. 74: 2822–2833.

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WATER QUALITY IN A SMALL COASTAL RIVER: CONSIDERATIONS TO WATERSHED MANAGEMENT

Land use in coastal areas as increased delivery of nutrients and pollutants in rivers and estuaries, accompanied by upland development, affecting water quality, estuarine habitats and biotic communities. Water quality and river basin management plans that guarantee good ecological status of coastal surface waters and groundwater are issues with priority for the Mondego river basin (Portugal). In this work we propose to: 1) analyse and compare landscape transformation in the past decades in a subwatershed of the Mondego river basin to the history of nutrient loading to affected river and 2) quantify organic and inorganic N, and del15N derived from a sewage treatment plant from outfall to the main river to map the spatial extent of the influence of sewage N in this small water course. Aerial photos will be used to reconstruct patterns of land use and data analysed using a Geographical Information System (GIS). Water quality trends will be assessed from data obtained from regional governmental institutions and bibliography. This study will contribute to understand more about the fate of anthropogenic nutrients and assimilation capacity of coastal zones.

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ECOLOGICAL THRESHOLDS IN HIGH MOUNTAIN LAKES

The species assemblage patterns of diatoms, rotifers, chydorids, planktonic crustaceans and chironomids were studied in 235 high moutanin lakes in Europe. We determined the optimal number of lake clustering (i.e. assemblage types) for each taxonomic group and performed discriminant analyses to investigate the environmental influence on these assemblage patterns. From 17 (rotifers) to 37% (diatoms) of the assemblage structure was accounted for by environmental variables. The significant environmental variables could be grouped into four main general lake features: size, tropho-dynamic status, acid-base balance and ice cover duration. Defining ecological thresholds as values within environmental gradients in which the rate of change in assemblages is accelerated relative to points distant from that threshold, we were able to find specific threshold values for the four general environmental factors: 3 ha for lake area; 0.6 mg l-1 for DOC (i.e. lake trophic status in our alpine lakes); 190 days for ice cover duration and 200 μeq l-1 for ANC. These ecological thresholds have direct applications in establishing lake typologies for environmental quality and biodiversity conservation programmes, and in improving predictions on Global Change impacts.

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GEOGRAPHIC DIFFERENTIATION AND MASS MORTALITIES IN A MEDITERRANEAN SYMBIOTIC GORGONIAN: EUNICELLA SINGULARIS

Over the past decade, the Mediterranean seawaters have undergone important warming events, which led to episodic but massive mortalities of marine invertebrates. Among these, *Eunicella singularis*, the only symbiotic Mediterranean gorgonian, has been particularly affected. However, the observed mortalities varied geographically. Such heterogeneity could be due to a genetic differentiation of the holobionte, even if, unlike tropical corals and despite a broad bathymetric distribution, *Eunicella singularis* harbours only one *Symbiodinium* sub-clade (temperate A). The aim of this work was to find if the heterogeneity in mortality could be linked to geographical and/or bathymetric differentiation of *Eunicella singularis*, either in the host and/or in its Dinoflagellate symbionts. Therefore, we identified 8 microsatellite loci from *Eunicella singularis* and 7 from its symbiont. New loci had to be developed, as it proved impossible to transfer the microsatellites found in other cnidarians and their *Symbiodinium* clades. 156 individuals collected on 4 sites at two depths were genotyped. Differentiation was explored by bayesian analysis. Unexpectedly, the first results show a different geographic and bathymetric structuration for the host and the symbionts.

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THE FATE OF THE RHONE RIVER DELIVERY TO THE COASTAL OCEAN: INVESTIGATING THE SEASONAL PATTERN

Continent/ocean interface zones receive rivers delivery containing organic matter and nutrients that support local primary production. The fate of organic particles at the Rhône river mouth is a complex issue submitted to bio-geochemical and physical processes. Seasonal variations of environmental condition (T, light, hydrology) and organic matter inputs from the river govern degradation, transport and deposit phenomena. Three cruises were performed off the Rhône river to study the export and biogeochemical transformations of particulate inputs and investigate their seasonal variation. In April 2007, September 2007 and May 2008 oxygen profiles were measured in the sediments off the Rhône river mouth using an in situ microprofiler unit. Dark community respiration (DCR), suspended particulate matter (SPM), particulate organic carbon (POC) and dissolved organic carbon (DOC) were measured in bottom water. Mineralization rates varied during the year but displayed a stable spatial distribution: intense degradation of organic matter occurred at the Rhône river mouth and decrease Southwestward with main particle dispersion through local hydrodynamics. Carbon isotopes (d13-C and D14-C) were analysed and confirmed this degradation pattern.

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INTERACTIONS BETWEEN SUBMERGED MACROPHYTES AND BENTHIC CYANOBACTERIA ALONG A GRADIENT OF WATER QUALITY DEGRADATION IN THE ST. LAWRENCE RIVER (QUEBEC, CANADA)

Proliferation of colonial, benthic cyanobacteria (*Gloeotrichia pisum* and *Lyngbya wollei*) has been reported since 2005 in the St. Lawrence River. To assess distribution and interactions of submerged macrophytes and cyanobacteria, we carried out spatial surveys in August 2006-2008 in Lake Saint-Pierre. This large (≈ 300 km^2), shallow fluvial lake of the St. Lawrence River is subjected to heavy nutrient enrichment from tributaries draining farmlands. Macrophyte maximum biomass was observed immediately downstream of the tributaries where nitrogen ad phosphorus concentrations were elevated. Dominance of nitrogen-fixing cyanobacteria was instead favoured by low ammonium and/or nitrate concentrations induced by the slow transit of tributary waters through the dense submerged plant beds. Intense biological activity occurring in these beds results in high nitrogen assimilation by plants and epiphytes and bacterial denitrification. Macrophyte biomass and condition (nitrogen and chlorophyll tissue content) decreased in the presence of the benthic cyanobacteria. The negative interactions between macrophytes and cyanobacteria were strongest in summer 2007 when water levels decreased to record low value. Benthic cyanobacterial proliferation may have a severe impact on macrophyte survival and food-chain structure.

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BLACK CARBON – A NEW PLAYER STRUCTURING MICROBIAL PROCESSES IN MARINE COASTAL WATERS

Black Carbon (BC) represents a refractory and chemically complex product of incomplete combustion of fossil fuel and biomass. Atmospheric BC deposition can be significant in the Bay of Villefranche (France). However, its role for marine microbes is not well studied. Using a model BC and flow cytometry, laser scanning and scanning electron microscopy, we found that viruses and bacteria got adsorbed within hours to black carbon particles and that the abundance of free viruses decreased with BC concentration. In experimental conditions percentage of attached bacteria and viruses varied after 10 hours between 22 - 54 % and 51 - 72 %, respectively, of total abundance. As BC sinks, this could result in an increased removal of microorganisms from surface waters. Bacterial production increased with increasing BC concentration, probably as a combined result of reduced viral lysis rates and use of BC as substrate. Our data suggest that bacteria can use BC as carbon source and that BC can change the interactions between viruses and their hosts. Thus, BC should affect processes in the microbial food web.

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SPATIAL VARIABILITY OF NEUTRAL LIPIDS ALONG THE GREENWICH MERIDIAN IN THE SOUTHERN OCEAN (BONUS-GOODHOPE): PRELIMINARY RESULTS

The efficiency of the biological carbon pump is also depending on the microbial and zooplankton community structure / activity throughout the water column. The composition of the C-export flux can be resolved by studying the spatial variability of specific compounds in suspended matter. During the BONUS-GOODHOPE expedition (Feb.-March 2008, R/V Marion Dufresne), particulate organic matter was sampled with large volume in-situ filtration systems at five stations selected on the basis of their zonal characteristics: S1 and S2 in the STZ, S3 in the SAZ, S4 in the PFZ and S5 in the AZ. In first instance neutral lipids were extracted and analyzed on GC-MS for compound identification and GC-c-IRMS for carbon isotopic composition. We present preliminary results focusing on depth profiles of specific biomarkers characterized as neutral lipids (free fatty acids and sterols) to learn more about components of the plankton community and their degree of preservation throughout the water column. The objective is to determine to what extent variability of ecological and biogeochemical properties of the surface layer and the deeper water column are impacting on C-export and remineralization.

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GROUNDWATER INPUTS TO THE COASTAL ZONE OF SOUTH GALWAY AND CLARE

Groundwater inputs to coastal areas in the form of sub-tidal and/or submarine groundwater discharge can be a significant source of nutrients and contaminants to coastal waters. The occurrences of groundwater inputs along the coast of Galway and Clare on the west coast of Ireland have been mapped. The magnitude of inputs from the karst limestone coast of south Galway and Clare have been calculated and a range of techniques are being employed to measure flow volumes and their variability, and to establish pathways in the coastal zone. In one bay hosting locally important shellfish aquaculture, flow volumes are sufficient to create estuarine conditions throughout the bay. These groundwaters contain high concentrations of nitrate and ammoniacal nitrogen when compared to coastal seawater. They are not currently monitored by any regulatory body at the discharge points. While the levels of nitrate in the groundwater do not exceed drinking water standards they are two orders of magnitude higher than seawater concentrations. The magnitude of the groundwater inputs indicate they pose a eutrophication risk with potential adverse environmental and economic consequences.

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SEXUAL SELECTION IN A PELAGIC COPEPOD

We examine sexual selection in the pelagic copepod *Acartia tonsa*. Sexual selection trough mate choice requires that mates meet frequently enough that males and/or females can afford being choosy, that there is a significant cost of mating (e.g., in terms of lost future opportunities), and that there is individual variability among mates that can be perceived by the sex partner. We show that encounter rates between sexes may be high during large parts of the year, that spermatophore production in males is low (hence, costly), and that there is high individual variability in mate quality, which is related to size: large females produce more eggs than small ones, and large males produce larger spermatophores that, in turn, can sire more offspring than small ones. We finally demonstrate mate choice: males mate preferentially with large females, and females mate preferentially with large males. This is the first demonstration of sexual selection in a planktonic organism

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THE ROLE OF SEA-URCHIN HERBIVORY ON THE INVASIVE ALGAE CAULERPA RACEMOSA AND LOPHOCLADIA LALLEMANDII IN MEDITERRANEAN WATERS.

Caulerpa racemosa and Lophocladia lallemandii are invasive algae threatening biodiversity in several Mediterranean regions. Both species are known for their competitive superiority, probably due to several factors, including limited grazing effects by native herbivores. In this sense, herbivory of C. racemosa and L. lallemandii by native sea-urchin Paracentrotus lividus was investigated in order to assess (1) grazing intensity, (2) colonization control by grazing in non-invaded areas and, (3) effects of grazing on invasion spread. P. lividus preference of invasive species against other palatable native species was studied in situ and at the laboratory by means of choice-feeding experiments, whereas the effects of grazing on invasive species spread was examined by means of field experimental approaches manipulating P.lividus densities. P.lividus was able to consume both invasive species but grazing was not able to reduce invasion on already invaded areas. However, P. lividus grazing limited the spread of C. racemosa to some extent in non-invaded areas, highlighting the importance of herbivory at the very beginning of the invasion.

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WATER SHARING IN WEST AFRICA: THE SMALL RESERVOIRS IN THE VOLTA BASIN.

Water sharing is one of the major challenges regarding the future of freshwater resources. In arid countries, reservoir's building is a frequent strategy to alleviate water shortage. Burkina Faso is the West African country with the highest density of small reservoirs. Most of them lie on the Upper part of the Volta Basin that contributes downstream to the filling of the large Volta Lake in Ghana. Where are small reservoirs? What is their cumulated size? What's their impact on the hydrologic budget of the Volta Basin? In using the most recent official secondary databases, we created a tailor made GIS to combine information and generate a new perspective on the distribution, roles and impacts of small reservoirs in this country. Even an increase by a factor 100 of their number wouldn't generate a significant impact on global runoff. Conversely their scattering sustains significant local benefits (e.g. water availability, fisheries) as it induces adverse consequences (e.g. pollutions, water-borne diseases). Anthropogenic pressures (e.g. population densities, land use) modulate goods and services (water quality, first). A network of dense clusters of reservoirs defines thus a specific geography that (i) highlights the weight of historical traditional leadership, and (ii) allows the identification of hot spots to be urgently managed.

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DEPTH PROFILES OF BACTERIOPLANKTON ASSEMBLAGES AND THEIR ACTIVITIES IN TWO DIFFERENT AREAS OF THE ROSS SEA (ANTARCTICA)

The identification of bacterial community structure has led, since the beginning of the '90s, to the idea that bacterioplankton populations are stratified along the water column and that diverse lineages with mostly unknown phenotypes dominate marine microbial communities. The diversity of depth-related assemblages is also reflected in their patterns of activities as bacteria affiliated to different groups can express different activities in a given ecosystem. We analysed bacterial assemblages (DGGE fingerprinting) and their activities (prokaryotic carbon production, protease, phosphatase, chitinase, beta-glucosidase and lipase activities) in 2 areas in the Ross Sea, differing mainly for their productivity regime: two stations are located in the Terra Nova Bay polynya and two closely to Cape Adare. In every station a pronounced stratification of bacterial assemblages were identified, highlighting epipelagic communities differing substantially from the mesopelagic and the bathypelagic ones. Furthermore, we found a close coupling between given assemblages and their activities stressing how similar communities express similar metabolic requirements reflected in analogous patterns of activity.

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THE CASE FOR DINOFOLAGELLATE POLYETHER TOXINS IN ALLELOCHEMICAL INTERACTIONS IN THE SEA: BIOACTIVITY AND FUNCTION

Marine dinoflagellates represent an ancient lineage of protists that are a rich source of secondary metabolites, including polyether phycotoxins associated with harmful algal blooms (HABs). The pharmacological and toxicological properties of most polyether toxins are well described, but relatively little is known about in situ structural/functional relationships of these secondary metabolites. Based upon their high specific potency, various hypotheses relating to their role in chemical ecology have been advanced - as allelopathic agents against competitors, as pheromones (sexual attractants), and as chemical defence mechanisms against predators. We present here recent advances in understanding the structural-functional relationships of polyether toxins based upon targeted bioassays, molecular genetics and gene expression and the determination of biosynthetic pathways. Comparison of toxin composition among dinoflagellate populations typically reveals a high degree of structural polymorphism and the expression of geographically distinct profiles. Yet current evidence suggests that allelochemical potency of dinoflagellates against other protists is not directly correlated with cell quota of known phycotoxins. A definitive function for known phycotoxins has not yet been attributed, but hypotheses concerning evolutionary significance and chemical ecology are being addressed.

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ASSESING THE CUMULATIVE EFFECT OF NATURAL AND ARTIFICIAL CHEMICAL STRESSORS ON ZOOPLANKTON

With intensive land use and variety of human made chemicals freshwater ecosystems are confronted with increasing amounts of stress factors (e.g. pesticides and cyanotoxins). Moreover, these factors may interfere with infochemicals, e.g. fish kairomones, and influence the induction of defense mechanisms against predators. The combined influences of pesticides (carbaryl) and cyanotoxins (microcystin LR) on zooplankton exposed to infochemicals was investigated. Artificial zooplankton community was established in microcosms in constant light, temperature and food conditions. Throughout experiments animals were exposed to cell bound microcystins at sub-lethal concentrations and kairomones. Part of the vessels was spiked with pesticide. In order to determine the actual concentrations of cyanotoxins and pesticides the HPLC-DAD and LC/MS/MS were used. The preliminary results will show the effects of combined stressors on zooplankton.

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DIVERSITY AND SPATIAL VARIABILITY OF PHYTOPLANKTON IN THE MEDITERRANEAN SEA COUPLING UTERMÖHL COUNTS AND CLONE LIBRARIES

The composition and abundance of phytoplankton was investigated throughout the Mediterranean Sea during an oceanographic cruise carried out in summer 2007 in the framework of the Italian project VECTOR. In addition to the traditional counting method in light microscopy, we used a metagenomic approach (clone libraries of 16S rRNA gene) to describe the diversity of autotrophic eukaryotic assemblages. Phytoplankton concentrations were generally lower than 200 cells ml^{-1} in both the Western and Eastern basins, but higher abundances (up to 900 cells ml^{-1}) were observed in deep chlorophyll maximum (DCM) at some stations. The phytoplankton community was dominated by phytoflagellates, while diatoms were only at times abundant in the DCM. The most abundant eukaryotic 16S rRNA sequences were related to Prymnesiophyceae and Bacillariophyceae. A high number of Pelagophyceae sequences were often found in the DCM samples, while Cryptophyceae, Chrysophyceae and Dictyochophyceae provided minor contributions. A good correspondence in terms of group percentage was found between light microscopy and molecular data, but the latter provided a much higher taxonomic resolution.

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UPPER OCEAN TURBULENCE AND THE BALANCE BETWEEN DIATOMS AND COCCOLITHOPHORIDS IN THE ATLANTIC OCEAN

Over the past ~50 million years, the balance between diatom and coccolithophorid abundance has played a key role in Earth's biogeochemical cycles by controlling the rate of carbon transfer between the atmosphere and the ocean. We have analyzed phytoplankton community composition across latitudinal gradients in the Atlantic Ocean. Our analysis shows that the relative distribution of diatoms and coccolithophorids is correlated with the nutricline depth, a proxy of nutrient supply to the upper mixed layer of the ocean. Coupled atmosphere-ocean general circulation models predict a dramatic reduction in the nutrient supply to the euphotic layer in the coming century as a result of increased thermal stratification. Our results indicate that, by altering phytoplankton community composition, this causal relationship may lead to a decreased role of the biological pump in sequestering atmospheric CO_2, implying a positive feedback in the climate system.

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DOES THE INTERACTION BETWEEN TEMPERATURE AND PESTICIDES CAN CHANGE THE STRUCTURE OF FRESHWATER PHYTOPLANKTON COMMUNITY?

Temperature and presence of pesticides in freshwater systems are two factors that can influence the growth of primary producers. Although both factors have been studied extensively in the last years, the effect of their combination is still misunderstood. In this study, isolated cultures of *Scenedesmus obliquus* (a green algae), *Navicula pelliculosa* (a diatom) and two strains of *Microcystis aeruginosa* (cyanobacteria) were acclimated to three different temperatures and exposed for 72 H to five concentrations of the herbicide atrazine. The growth rate and photosynthetic activity were then obtained by cell counting and by measuring chlorophyll *a* fluorescence emission. The results showed that *M. aeruginosa* was much more affected by atrazine at low temperature (10°C) than the two algal species, but was more resistant than *S. obliquus* when the water temperature was approaching its growth optimum (25°C). The same tendency was obtained in mixed cultures, where the interaction between temperature and atrazine modified differently the phytoplankton ratio leading to a specie dominance. We will finally discuss the possible impact of global warming, combined to agricultural pollution, on the occurrence of cyanobacterial blooms.

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AMOEBOPHRYIDAE (SYNDINIALES), AN IMPORTANT PARASITOID GROUP FOR DINOFLAGELLATES

Syndiniales (Alveolata) are marine parasitoids that infect a wide range of host species, extending from dinoflagellates, ciliates, radiolarians, cercozoans, chaetognaths, copepods, cnidarians, appendicularians, crabs, and even fish eggs. These pathogens obligatory killed their host to accomplish their life cycle. Detected from the sea surface to deep hydrothermal vents, Syndiniales often constituted the majority of the 18S gene sequences retrieved from environmental genetic libraries from marine waters. Among them, Amoebophryidae, (Syndiniales Group II), preferentially infect dinoflagellates, a key component of the marine phytoplankton also responsible for the majority of the toxic red tides. In this study, we will review several recent multidisciplinary approaches employed to study this parasitoid group, and original findings concerning their in situ specificity, their control capacity parasitoids on dinoflagellate host populations both from field observations and by in silico modelisation, and an ingenious mechanism develops by this parasitoid to survive on a long term in close association with its host.

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component of the marine phytoplankton also responsible for the majority of the toxic red tides. In this study, we will review several recent multidisciplinary approaches employed to study this parasitoid group, and original findings concerning their in situ specificity, their control capacity on dinoflagellate host populations both from field observations and by in silico modelisation, and an ingenious mechanism develops by this parasitoid to survive on a long term in close association with its host.

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CLIMATE MODULATION OF UPWELLING-DRIVEN SHELF HYPOXIA IN THE CALIFORNIA CURRENT LARGE MARINE ECOSYSTEM

Eastern boundary upwelling ecosystems (EBUEs) are marked by intensive coupling between atmospheric forcing, circulation, elemental cycling and food-web structure. The development of shelf hypoxia is also common to some but not all EBUEs where enhanced rates of export production and cross-shelf transport of oxygen-poor waters serve as key determinants of ecosystem oxygen budgets. Strong atmosphere-ocean-ecosystem coupling suggests that oxygen dynamics in EBUEs may be particularly sensitive to variations and changes in climate forcing. In the California Current Ecosystem, recent studies have identified the novel emergence of inner-shelf anoxia and the shoaling of offshore hypoxia horizons. Using multi-year measurements from moorings, autonomous underwater gliders and ship-based observing efforts, we show that broad-scale changes in the oxygen content of offshore sourcewaters interact strongly with variations in the strength and temporal characteristics of wind forcing. These findings suggest that the present day distribution of low-oxygen zones across upwelling systems may be dynamic and subject to re-organization with future changes in global climate.

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THE NITROGEN GAS EXCESS IN THE EASTERN TROPICAL NORTH PACIFIC OXYGEN DEFICIENT ZONE

Most water column denitrification occurs in the three main oxygen deficient zones (ODZ) of the world ocean: the Arabian Sea and the eastern tropical North and South Pacific. Current estimates of global water column denitrification rates have almost entirely depended on assumptions of Redfield stoichiometry (e.g. N* [Gruber and Sarmiento 1997]). In this study, we measured N_2:Ar ratios in the ODZ of the eastern tropical north Pacific (ETNP). Since there are no other processes that produce or consume N_2 in the ODZ, its excess above background values can be used to estimate denitrification rates, avoiding assumptions regarding the composition of the respired organic matter and also uncertainties in the nitrogen removal pathways. Recent studies measuring the N_2 excess have indicated that water column denitrification rates calculated using nitrate deficit-type methods could be a substantial underestimate. In the ETNP ODZ, the observed N_2 excess extended from 100 to 1000 m with a maximum of 12.6 μM monatomic N at 300 m, which was coincident with the most ^{15}N-depleted nitrogen gas. This result is comparable to previously determined nitrate deficits at this location. Given the same considerations of the volume and residence time of oxygen deficient waters, a denitrification rate calculated using the N_2 excess in the ETNP would be similar to earlier rates determined by nitrate deficit-type approaches.

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TRANSFER EFFICIENCY ESTIMATION BY USING PREDATOR-PREY SIZE RATIO AND SIZE SPECTRUM

Estimation of transfer efficiency in ecological research is difficult in practice. It is time consuming and highly uncertain, and the estimation of secondary production is often only restricted to large crustaceans. We propose alternative indirect approach to estimate trophic transfer efficiency for the planktonic component in aquatic systems based on estimating the size-spectrum and size-specific trophic level. Following metabolic theory, log(N)=(log(TE)/log(PPMR)-0.75)*log(M), where N is abundance of a biomass class, M is biomass class, TE is trophic transfer efficiency, and PPMR is predator-prey biomass ratio. TE can be estimated if the slope of size-spectrum and the PPMR is known. Biweekly field sampling in a water reservoir is carried out to obtain the PPMR from size fractionated stable isotope analysis and the size spectrum from combination of FlowCAM and microscope measurements. Together with primary production data from C14 radioisotope measurement and other environmental factors (e.g. mixing layer depth and run-off), it provided and explained secondary production dynamics for the whole planktonic community in the water reservoir. Source of uncertainty of these estimates is evaluated.

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OPTIMIZING AUTOMATIC ZOOPLANKTON IDENTIFICATION SYSTEM WITH ZOOSCAN

We propose and evaluate an optimal procedure to automatically classify zooplankton in the west Pacific subtropical ocean with ZOOSCAN and image analysis. Our major goal is to obtain zooplankton community data with minimum human intervention. The procedure includes several levels. First, we determine how many individuals (images) need to be included in a learning set for a specific group (e.g. calanoid copepods) in order to achieve suitable recognition accuracy. Second, we compare the efficacy of watermass-specific and/or season-specific learning sets with that of a universal regional learning set. Third, we examine the improvement of accuracy by human intervention; that is, manually reclassify objects that exhibit a low classification score. We aim to minimize the time spent for training the machines and maximize the taxon-specific accuracy of classification. We evaluate the cost and benefit of different procedures and operational complexity. We currently focus on the East China Sea ecosystem which is subject to various human impacts including pollution as well as construction and damming effects of the Three-Gorge Dam.

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INTERACTION BETWEEN MESOZOOPLANKTON AND MICROBIAL FOODWEB: SPECIES-SPECIFIC FEEDING HABIT OF MESOZOOPALNTKON AND THE IMPACT ON MICROBIAL COMMUNITY

Mesozooplankton can affect microbial food web through direct grazing, and often indirectly through trophic cascade. We analyzed their interactions in coastal marine area of Japan (Uwa Sea, Shikoku Island) of which trophic status is oligo-meso trophic. We estimated feeding habits of common coastal mesozooplankton species including Copepoda (*Temora turbinata, Paracalanus* spp., *Oithona* spp. and *Euterpina acutifrons*), Cladocera (*Penilia avirostris*) and Appendicularia, on microplankton community (ciliates, heterotrophic-nanoflagellates and bacteria). The transparent nalgene bottles (1 L) including each mesozooplankton grazer and natural microplankton community were set up at 5 m depth at the coastal area, and their daily feeding amounts were estimated. All copepods and *P. avirostris* consumed ciliates, but only *T. turbinata* consumed heterotrophic-nanoflagellates. Despite the decrease of ciliates and heterotrophic-nanoflagellates, no change occurred in bacterial abundances. The results suggest species-specific feeding habits of mesozooplankton with different feeding habit of *T. turbinate*, and potential predation impact of mesozoopalnkton on ciliates. However, their impacts through direct grazing and trophic cascade on microbial food web, particularly on bacterial abundance, seem to be weak in a coastal marine area.

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SPATIAL VARIATIONS OF SPECIES COMPOSITION AND DIVERSITY OF DEMERSAL FISH IN EAST CHINA SEA

East China Sea (ECS) is an important fishing ground of eastern Asia. Demersal fishes contributed considerable quantities of the catches and also play important roles in the food webs of ECS continental shelf. In order to understand the community structure of demersal fishes, oceanographic surveys were conducted with beam trawl along 3 transects from inshore to offshore in ECS. 3446 individuals including 70 species were collected. The relationship between species composition and environment and the index of diversity and evenness were analyzed. The results indicated greater variations of species composition between inshore and offshore sites. Goby and tonguefish were dominant at inshore and shallower sites, while crocodile toothfish, grenadiers and flounders were only found at offshore sites. The diversity indices showed the two inshore sites, which located near Chang Jiang and Qiantang River had low diversity but great abundance. The results might because of the organic input from rivers and strong water dynamics accompanied with heavy sediment deposited at Qiangtang River and Chang Jiang estuaries. The distance from estuary has the most influence among all environmental factors.

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DECIPHERING THE SEDIMENTARY RECORD OF URANIUM IN LAKE SEDIMENTS

Uranium enrichments in marine sediments are used to constrain past environmental changes in the ocean but the geochemistry of this element is still poorly understood, particularly in freshwater environment. We have determined the profiles of U as well as those of other geochemical variables in sediment and porewater from two lakes: one perennially oxygenated and the other seasonally anoxic. Modeling the porewater U

profiles with a transport-reaction diagenetic equation indicates that authigenic U never represents more than 3% of its total sedimentary concentration. Consistently, present-day fluxes of dissolved U by diffusion, bioturbation and bioirrigation are negligible compared to deposition flux with settling particles. Comparison of the U and Fe porewater profiles indicates nevertheless that some U is bound to Fe oxyhydroxides. However, U is mostly associated with organic matter, as demonstrated by the correlation between U and Corg in the seasonally anoxic lake sediments and by the similarity of the U:Corg ratio in surface sediment and in diagenetic material collected with Teflon sheets inserted into the sediments of the perennially oxygenated lake. We infer that previously suggested precipitation of UO2(s), U3O7(s) and U3O8(s) in sediments is improbable.

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MOLECULAR DEMONSTRATION OF IN SITU IRON LIMITATION IN TRICHODESMIUM

Trichodesmium spp. are important nitrogen (N) fixing cyanobacteria in the tropical and subtropical oceans, regimes frequently characterized by low iron (Fe) concentrations. There is limited information about the mechanisms and controls of Trichodesmium Fe acquisition and what levels of Fe in the ocean correspond to a reduction in N fixation capabilities. To aid in defining the threshold of Fe required by Trichodesmium in situ, we developed a clade-specific diagnostic for Fe stress using quantitative reverse transcription PCR (qRT-PCR) of the Fe stress response gene isiB, which encodes for flavodoxin a non-Fe containing substitute for ferredoxin. In controlled laboratory experiments with varying levels of Fe and constant EDTA, high gene expression corresponded to specific reductions in N fixation rates in both major phylogenetic clades of Trichodesmium (the T. erythraeum clade and T. tenue clade). Using the thresholds determined in the laboratory experiments, we have assessed Fe limitation of Trichodesmium collected from the Sargasso Sea, equatorial Atlantic Ocean and Western Pacific Warm Pool. We have found evidence of Fe stress in Trichodesmium samples from the Pacific Ocean corresponding to low dissolved Fe concentrations. These data support and refine previous model predictions and demonstrate the in situ importance of the trace metal Fe to the marine N cycle.

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CLIMATE CHANGE AND HUMAN ACTIVITIES AT THE LAND-OCEAN INTERFACE: IMPACTS ON COUPLED GROUNDWATER-SURFACE WATER SYSTEMS

In addition to being a resource for human consumption and agriculture, groundwater is an underappreciated carrier for a wide range of dissolved substances to the coastal zone. As a water resource, groundwater is impacted by anthropogenic inputs and saltwater intrusion, the latter being a function of, for example, withdrawals that exceed recharge or unanticipated climactic events such as extended drought periods or storm surges that overtop the aquifer. As a vector for the oceanic input of chemical and biological contaminants, groundwater has led to nutrient over-enrichment of estuaries, ecosystem-level impacts of pharmaceuticals, and closing of beaches due to harmful levels of bacteria. This tutorial lecture will cover these topics with examples from the recent literature as well as unpublished studies. It will conclude with a discussion of potential future research directions.

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NUTRIENTS RELEASE FROM PERMEABLE SEDIMENT UNDER WAVE FORCING IN THE MEDITERRANEAN SEA

During sedimentation, freshly produced organic matter settles on the seabed. There, it is regenerated by marine heterotrophs, increasing nutrients concentration in the interstitial pore water. These nutrients pools can, however, be made available for pelagic primary production under wave forcing in coastal marine environment. Indeed, wave forcing over shallow permeable sediments acts as a filtration pump of seawater through the upper layer of the seafloor. Nonetheless, the importance of this pump for pore water trapped nutrients release to the water column have not been assessed in the Mediterranean Sea, presumably neglected in comparison to rivers inputs. However, in the present context of climate change, with expected reduced global watershed inputs, marine potential to recycle nutrients to the overlying water needs to be quantified. Our study includes (a) a weekly monitoring of nutrient pore water concentration in permeable sediment of Banyuls Bay, exhibiting the effect of waves pumping and (b) calculations of water exchange and nutrients release due to waves at a regional scale (Gulf of Lions), based on bathymetry, sediment grain size derived permeability and wave climate of the area.

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DIVERSITY OF PROTISTS IN CONTAMINATED GROUNDWATER AND THEIR POTENTIAL ROLE IN STIMULATING BACTERIAL CONTAMINANT BIODEGRADATION IN NUTRIENT-LIMITED SYSTEMS

Heterotrophic protists are important predators of bacteria in virtually all ecosystems, thus influencing structure and function of bacterial communities. While the diversity of bacteria in polluted groundwater has been the subject of extensive research, the presence of protists in this ecosystem has received less attention. This study presents data on the diversity of protist in BTEX and MTBE polluted groundwater and in on-site reactors set up for natural attenuation of the contamination. Protistan communities were compared between different sites by 18S rRNA gene based T-RFLP analysis. Phylogenetic analysis of 18S rRNA gene clone libraries revealed the presence of a wide range of heterotrophic protists. In addition, we tested how protistan grazing may stimulate bacterial contaminant degradation via the recycling of limiting inorganic nutrients in a controlled laboratory experiment containing benzene degrading bacteria, a bicosoecid flagellate and benzene. During the grazing experiment, bacteria consumed three times more benzene than in a control with inactivated protists as a consequence of nitrogen remineralization. Nutrient recycling by bacterivorous protists may thus stimulate growth-coupled bacterial contaminant degradation in nutrient-limited systems such as groundwater.

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DIFFERENTIAL RESPONSES OF INDIGENOUS BACTERIOVORAX RIBOTYPES PREYING ON VIBRIO VULNIFICUS AND VIBRIO PARAHAEMOLYTICUS IN A NATURAL MESOCOSM

Bacteriovorax (*Bx*), previously marine *Bdellovibrio*, are halophilic predatory prokaryotes that prey on susceptible Gram-negative bacteria including *Vibrio vulnificus* and *Vibrio parahaemolyticus*. Evidence suggests that *Bx* plays some role in bacterial mortality. However, to demonstrate this, the most appropriate *Bx* strains must be selected since their predation efficiency varies. The aim of this study was to isolate the most efficient *Bx* strains on *V. vulnificus* and *V. parahaemolyticus* from water samples collected from Apalachicola Bay. Samples were spiked with the two preys respectively to establish laboratory mesocosms. Samples removed at 24 hour intervals were plated for *Bx* and remaining prey cells. *Bx* plaques which indicate the lysis of prey cells were identified by 16S rRNA gene amplification and sequencing which revealed that for *V. vulnificus*, ribotypes IX and X were consistently the most efficient. However, with *V. parahaemolyticus*, shifts with up to six *Bx* ribotypes were observed. This is the first report indicating that different ribotypes of *Bx* may have different prey preferences. This method has potential to identify the most efficient *Bx* in controlling target bacteria in marine systems.

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TOWARDS UNDERSTANDING THE FLUX OF DISSOLVED ORGANIC CARBON (DOC) AND CHROMOPHORIC DISSOLVED ORGANIC MATTER (CDOM) FROM COASTAL WATERSHED TO COASTAL OCEAN

Organic matter is washed out of terrestrial soils in coastal watersheds, brought by steams and rivers to estuaries, and then mixed with coastal seawater. A variety of processes affect this flux in various coastal systems, including land use, precipitation, season, tidal exchange in coastal wetlands, in situ production, and photo/biodegradation. In order to better understand this diversity of processes on temporal scales of hours to seasons and spatial scales from centimeters (vertically) to kilometers, high resolution sampling is required. We have combined monthly discrete sampling, high resolution towed vehicle measurements, mooring data, and remote sensing imagery to investigate the flux of dissolved organic carbon (DOC) and its tracer, chromophoric dissolved organic matter (CDOM), in a variety of coastal watershed and estuarine systems. Lessons learned from observations and models in the Neponset Watershed/Estuary, Hudson Watershed/Estuary, San Francisco Bay, Chesapeake Bay, Mississippi River Plume, and Atchafalaya Estuary will be discussed.

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CAN FE:C RATIOS IN FOOD AFFECT COPEPOD PRODUCTIVITY?

Phytoplankton growth and photosynthesis are Fe-limited over large areas of the ocean, but the influence of Fe stress on mesozooplankton remains largely unstudied. Ecological stoichiometric modeling using literature estimates of Fe quotas and zooplankton physiological rates predicts that marine zooplankton are often Fe-limited in situ. In laboratory experiments designed to test this prediction, the copepod Acartia tonsa had 3-9-fold lower rates of egg production and slower somatic growth when fed Fe-deplete diatoms than when fed Fe-replete diatoms. These effects were not the result of differences in ingestion rates, food quality (other than Fe content) or assimilation of Fe from ingested algal food, and uptake from the dissolved phase contributed little Fe to A. tonsa. Instead, the productivity of A. tonsa in our experiments is determined by Fe:C ratios in food. A generalized stiochiometric model predicts that copepod productivity in Fe-limited regions of the ocean should increase non-linearly in response to increasing Fe supply due to the combined effects of increased food availability and food quality. Such non-linear increases may have large effects on productivity of planktivorous species and C cycling.

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CARBON FLUX IN A SUBTERRANEAN ESTUARY: WHAT DOES SUBMARINE GROUNDWATER DISCHARGE HAVE TO DO WITH IT?

Buried organic matter in coastal sediments has long been considered a carbon sink; however, submarine groundwater discharge (SDG), represented by fresh hypoxic meteoric groundwater and infiltrating oxic seawater source terms, may potentially enhance carbon flux from marine sediments. Biogeochemical studies were conducted to investigate sediment porewater DOC and DIC flux as a function of hydrologic gradients in a coastal lagoon. Natural ^{14}C abundances were used to trace carbon flux at three sites (nearshore – EGN0, at the distal end of the freshwater seepage face – EGN20, and 250 m offshore – EGN39). DOC within the EGN0 mixing gradient was depleted in ^{14}C relative to SOC but at EGN20 and EGN 39 the $DO^{14}C$ and $SO^{14}C$ were essentially the same. In contrast, the $DI^{14}C$ for both EGN0 and EGN20 were significantly depleted relative to the DOC indicating advective DIC input from deeper SOC remineralizaion. The EGN39 $DI^{14}C$ profile was uniform with depth and similar to the ^{14}C of both the DOC and SOC. Collectively these results suggest that the coupled effects of sediment biogeochemistry and SGD hydrologic gradients may significantly alter sediment carbon flux.

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IMPACT OF EASTERN CARIBBEAN CIRCULATION SEASONALITY ON TWO REEF ORGANISMS

The seasonality of the surface circulation of the Eastern Caribbean Sea is mostly forced by the fresh water input from the Amazon and Orinoco rivers. As a consequence, mesoscale activity is strongly increased from August to December. Eddy forcing on the narrow shelf of the north eastern Antilles increases significantly and has a strong impact on coral reef ecosystems. The impact on two reef organisms is presented here. (1) Reef-building coral: genetic analyzes showing that reef-building coral, Acropora palmata, have experienced limited genetic exchange between the western and eastern Caribbean are substantiated by the results of a bio- physical coupled model accounting for larvae life history traits. (2) Grouper: several grouper species form spawning aggregations at the shelf edge of the US Virgin Islands starting in December. Using ADCP current measurements, we show that spawning occurring between January and April is mostly tide driven, and numerical simulations show a limited dispersal. However, in presence of sub-mesoscale coherent features in December numerical simulations show unusual large 'dispersion' pulses.

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FE SPECIATION DURING THE BONUS-GOODHOPE CRUISE

Fe physical (total dissolvable TDFe, dissolved DFe, and soluble SFe) and redox (Fe(III) and Fe(II)) speciation, as well as hydrogen peroxide (H2O2) distributions were investigated in the Sub-tropical South Atlantic and the Southern Ocean from 34 to 57°S during the BONUS-GoodHope cruise (February-March 2008). Depth profiles were sampled at seven Large stations (0-2000 m) and five Super stations (0-4000 m). The highest values of surface DFe (0.720 nM) were observed in the sub-tropical domain, with aeolian input coming from Patagonia or Fe enriched waters coming from the continental margin as possible sources. South of the Sub-tropical front, surface DFe minimum (0.064 nM) corresponded to chlorophyll-a (Chla) maximum. In deep waters, the highest values were measured in the AABW. Fe(II) exhibited high concentrations in the upper 2000m (0.006 – 0.152 nM), with a maximum below Chla maximum suggesting remineralisation processes. DFe concentrations represented 50% of the TDFe and SFe concentrations represented 55% of the DFe. H2O2 decreased exponentially with depth, except at the southernmost stations where high values were still observed at 1000m.

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CHANGES IN BACTERIOPLANKTON COMMUNITY STRUCTURE AND DIVERSITY ALONG A BROAD GRADIENT OF VIRAL LYTIC PRESSURE

We examined whether bacterial community composition and diversity (assessed by the T-RFLP analysis of PCR-amplified 16S rRNA gene fragment) changed in response to the addition of P, virus or P+virus in seawater cultures from surface waters of the Bay of Villefranche (NW Mediterranean). The ratio of viral production to bacterial production was used as an index of viral lytic pressure. In December, the addition of P resulted in a drastic shift in community composition toward the prevalence of a single taxon (OTU57bp), indicating that OTU57bp was competitively superior in P-replete condition. The dominance of OTU57bp diminished in the P+virus treatment, which presumably reflected selective elimination by viruses of the dominant taxon. In contrast, in February, OTU57bp dominated the community in both the P and P+virus treatments, despite high viral lytic pressure in these treatments. Our overall results indicate that bacterial diversity displayed a dome-shaped pattern along a broad gradient of viral lytic pressure, i.e. bacterial diversity was highest when viral induced mortality relative to bacterial growth was at intermediate level.

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EFFECTS OF PHYSICAL AND ECOLOGICAL CONNECTIVITY ON RESILIENCE OF ROCKY SHORE ASSEMBLAGES

Understanding mechanisms that maintain resilience across gradients of biodiversity remains one of the greatest challenges in ecological science. A key problem is the ability to integrate disturbance/recovery dynamics with biodiversity over different space and time scales. Recent advances in theoretical ecology provide a way of linking the relative importance of regional vs local scale processes through the movement of species amongst metacommunities. We applied metacommunity ecology concepts in an experimental study performed on low rocky shore assemblages in the Ligurian Sea. We first assessed the regional and local species diversity along the eastern ligurian coast (about 100 km) to define connectivity between locations and describe spatial patterns in diversity. Accordingly, we designed an experiment to test the hypothesis that resilience to disturbance varies predictably with physical and ecological connectivity to the regional species pool. Our aim is to provide an empirical test and to use the insights gained to develop models and applications for coastal resource management.

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MORPHOMETRICS, MOLECULES, AND ECOLOGY: THE CASE OF TWO CO-OCURRING SPECIES OF MOON JELLYFISH DISTRIBUTED ALONG AN ENVIRONMENTAL GRADIENT IN THE GULF OF MEXICO

The moon jellyfish Aurelia sp. is arguably the most conspicuous gelatinous species along the Gulf of Mexico, where it has increased during over the past 25 years in northern waters, affecting both local zooplankton communities and fisheries. Based on limited molecular data, one species of Aurelia has been recognized for the Gulf of Mexico. However, our observations revealed that two distinct "morphotypes" occurred and that these may possibly be different species. In this study, we used molecular and morphological analyses to identify both "morphotypes" of Aurelia, and combined both methods to understand their ecology. Both "morphotypes" were collected from two locations: Northern (Dauphin Island) and South Eastern Gulf (Florida Keys). Analysis of mitochondrial and nuclear DNA showed significant DNA sequence divergence between the morphotypes, indicative of separation into distinct species. Both species were also morphologically distinct and could be differentiated by univariate and multivariate morphological analysis. Ten morphological features were significantly different between species. In addition, one species showed morphological variation between locations, while the other one did not, suggesting two different ecological strategies between them: specialist and generalist, respectively.

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ABRUPT INCREASE OF TEMPERATURE AND SALINITY IN THE WMDW AT DYFAMED TIME-SERIES STATION (NW MEDITERRANEAN SEA) IN 2006: A RESPONSE TO DECREASING RAINS?

An abrupt increase in temperature (+0.1°C) and salinity (+0.03psu) was recorded in February 2006 in deep waters (2000 m depth) of the NW Mediterranean Sea in the course of monthly cruises of the 12-year time-series DYFAMED which superimposed over the regular increase (0.005 °C y-1, 0.0022 psu y-1) recorded during 1995-2005. It resulted from the winter mixing of the entire water column during winter 2005-2006 which leaded to disappearance of the intermediate water. This intense mixing was initiated by increase of surface salinity linked to deficit of freshwater inputs to the Mediterranean basin during three successive years (2003-2005), associated to decrease in salinity of intermediate waters in preceding year through strong winter convergence. Since climate models predict the increase of dryness in the Mediterranean basin, we suggest that this type of event could be recurrent and go against an enhancement of upper stratification in the Mediterranean Sea. In this respect, the Mediterranean productivity could be maintained or increased as observed in the time series.

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CONTRASTING FEATURES OF CELL DEATH IN RESPONSE TO OXIDATIVE STRESSES IN MARINE AND FRESHWATER CHLOROPHYTE ALGAE

Programmed Cell Death (PCD) in phytoplankton is widely recognized, but details (conserved features, pathways, mechanisms) are lacking and there is little comparative work. PCD is well-characterized in the marine chlorophyte *Dunaliella tertiolecta*, but we have little sequence data; in contrast, we know less about PCD in the freshwater chlorophyte, *Chlamydomonas reinhardtii*, but the genome is sequenced. We compared responses of these species to Reactive Oxygen and Nitrogen Species (ROS, RNS), which are established inducers of oxidative stress and mortality. $NaNO_2$ (a RNS) induced cell death in *C. reinhardtii*, but had no effect on *D. tertiolecta* at concentrations up to 500 mM. In contrast, *D. tertiolecta* underwent cell death on addition of H_2O_2 (a ROS) while *C. reinhardtii* was unaffected up to 1 mM. Morphological hallmarks of PCD and cleavage of substrates specific for cell-death proteases (caspases) were found in both species. However, while caspase homologues (metacaspases) were identified in *C. reinhardtii* sequence, the sources of caspase-like activities in *D. tertiolecta* remain unclear. Interspecific differences imply different signaling, transduction and execution mechanisms and offer the means to explore these features.

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EFFECT OF TEMPERATURE CHANGES ON MARINE ECOSYSTEMS: PREDICTIONS ON DIATOMS GROWTH RATES

Understanding the effects of climate change on marine ecosystems is one of the biggest current issues for ecologists. Phytoplankton plays an important role as the base of the trophic chain, but also as a key component of biogeochemical cycles in the global ocean. Phytoplankton distribution and abundance are closely linked with environmental conditions such as temperature, irradiance and nutrients concentrations. Diatoms are a major component of phytoplankton communities and dominate the export of carbon. It is now established that growth rate increases with increasing temperature. Literature suggests that the temperature dependence of phytoplankton growth rate is either linear or exponential. This work presents a database of diatoms maximum growth rates as a function of temperature (400 data, representing 63 species), which was compiled from both the published literature and new experimental cultures. Temperature ranges from -2 to 30 °;C. Only growth rates obtained in replete conditions of light and nutrients are included. Linear, exponential and optimal functions are fitted to the data. The best fit, obtained with the exponential function, is incorporated into a global marine ecosystem model.

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TRACING MERCURY WITH DEPTH IN A HAWAIIAN PELAGIC ECOSYSTEM

Inter- and intra-specific variations in mercury levels of predatory pelagic fish are of ecological interest and have been previously linked to size, age, trophic position, environmental parameters, and location. Biogeochemical studies report that low-oxygen, deeper waters are sites for enhanced mercury methylation; thus we expect that organisms inhabiting and foraging in these waters will exhibit elevated bioaccumulation as ingestion of mercury from food is the dominant uptake pathway in fish. This study examines total mercury levels in six species of pelagic predatory fishes (Thunnus obesus, T. albacares, Katsuwonus pelamis, Xiphias gladius, Lampris guttatus, Coryphaena hippurus) and numerous representatives of their micronektonic prey from Hawaiian waters. Coupling stomach content and stable isotopic analyses, results indicate that total mercury levels of predators and their prey increase with average depth of occurrence in the water. Diet analysis indicates greater occurrence of higher-mercury containing deeper-water prey organisms in the diets of the deeper dwelling predators. With additional sampling over a larger depth gradient, results from this study may offer predictive value to deducing mercury concentrations in pelagic organisms according to their depth distributions.

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MICROBES IN THE OPEN MEDITERRANEAN SEA: A REVIEW.

The combined efforts of microbial ecologists in the Mediterranean over the past 15 years have provided us with crucial information on the structure of its microbial food webs and the role of micro-organisms in biochemical cycles. The hypothesis of phosphate limitation of primary production in the Mediterranean Sea and the remarkably pronounced west-east gradient of P depletion, have inspired numerous studies. It has been this important work that has made us aware that besides the general aspect of oligotrophy in the Mediterranean, there exist important mesoscale discontinuities that influence the biological processes. In the present review we discuss different studies related with the components of the microbial food webs and the viral shunt in the Mediterranean open sea waters. We try to recognize the main patterns for virus, bacteria and protists abundance and activities along west-east gradients and we discuss gaps in current knowledge and future perspectives. This a contribution to a EUR-OCEANS Integration Project: "Plankton dynamics and food web structure in the open Mediterranean sea". IP I. Siokou HCMR, Greece.

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ROLE OF HETEROTROPHIC PROTISTS IN MICROBIAL WEBS FUNCTIONING: COMPARISON BETWEEN BENTHIC AND PELAGIC DOMAINS IN COASTAL ECOSYSTEMS

Heterotrophic protists are well known to be an essential vector of matter in planktonic food webs. Although heterotrophic protists are present in benthic environment, their role within benthic food webs remains unclear. In the present study, we examined whether heterotrophic protists play the same or different role within pelagic and benthic domains. We based our discussion on studies along different ecosystems, Bay of Biscay, Atlantic coastal ponds or intertidal mudflats. In the pelagos, heterotrophic protists play a role in the microbial loop and microbial food web. The shift between an herbivorous food web to the microbial webs can be due to hydrologic water structure, limitation of nutrients or top-down control. In the mudflat ecosystem (i.e. benthos), the composition of primary producers did not change, the bacteria abundance was high all year and macrozoobenthos is able to ingest picopreys. Heterotrophic protists appeared to be less significant for the benthic food web functioning and the microbial webs are probably influenced by different factors in the benthos compared to the pelagos. Nevertheless, the question on protist role in microbial webs still remains for benthic sandy ecosystems.

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SURVEILLANCE OF THE EUTROPHICATION TRENDS IN THE LAGOON OF VENICE, ITALY

The trophic status of the Lagoon of Venice, one of the largest and most productive Mediterranean lagoons, has experienced in the last decades relevant changes, mainly as a consequence of regulatory and management efforts, which lead to a marked decrease in the high concentrations of ammonia and reactive phosphorous observed in the sixties. Nevertheless, in the last couple of years, macroalgae standing crop reached again alert levels in some lagoon areas were massive proliferations and anoxic conditions were observed in the eighties. This sudden change in the negative trend of macroalgae population was promptly detected by the monitoring system set up by the Venice water authority. This system integrates real-time monitoring of hydrological parameters and periodical field surveys of trophic parameters. As we show in the present work, mathematical models play a key role in extracting useful information from this data set.

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THE VALUE OF WATER MITES (HYDRACHNIDIA) AS INDICATORS OF BIODIVERSITY AND STREAM ECOLOGICAL STATUS: AN EXAMPLE FROM ABRUZZO, CENTRAL ITALY

Current macroinvertebrate-based riverine ecological health assessment procedures in Italy, which exclude water mites, are under revision partly due to perceived poor sensitivity to environmental conditions. Recent (2000-2005) data on water mite distribution in Abruzzo's rivers, which cover all five ecological status classes (I-V) described in current monitoring programs, have been analyzed in relation to stream biodiversity and ecological status. Around ¾ of the known Abruzzo water mite species exhibited a sufficiently clear association to stream ecological status. Approximately ½ of such species were restricted to the least polluted habitats (classes I-II); only a handful species were found in moderately impacted habitats, and none were found in polluted habitats (classes IV-V). Mite taxonomic richness, often high in low-impact habitats, also was related to in-stream non-mite invertebrate diversity. Potential of water mites as bioindicators in running waters is high. General absence from polluted waters, correlation with in-stream biodiversity, and dependence on other invertebrates to complete their complex life cycles also give water mites an uncommon potential as bioindicators of general ecological status, rather than being associated with specific parameters.

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IRON SULFIDE SPECIES IN ANOXIC WATER COLUMN OF MEROMICTIC PAVIN CRATER LAKE (CENTRAL MASSIF, FRANCE)

Sulfur electrochemical speciation techniques were applied to understand the chemistry and cycling of sulfur in a meromictic crater lake, Pavin Lake (France). Using a cathodic stripping cyclic and linear sweep voltammetry technique we aimed to make distinguish between "free" and iron sulfide species in the anoxic deep layer. High determined concentrations (>1000 μM) of dissolved Fe (<0.2 μM) in anoxic water column indicate that Fe is dominant metal involved in sulfur redox cycling and precipitation. Consequently, in anoxic deep layer of Pavin Lake "free" H2Saq was low, and about 80 % of total sulfide detected (<0.2 μm) was in the FeSaq and/or FeSam colloidal form. IAP calculations showed that Pavin Lake water column is saturated with respect to the FeSam phases. Sulfide concentrations were determined parallel by using spectophotometry methylene blue technique. ∑H2S concentrations determined on that way (0.6 μM to 16.7 μM) were substantial higher than H2Saq concentrations determined by voltammetric measurements (0.1 to 3.7 μM). Observed difference in the RSS concentrations between the two methods can be assigned to the presence of FeS dissolved and/or colloidal species.

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THE LONG HOT SUMMERS: EFFECTS OF CLIMATE CHANGE ON GORGONIAN POPULATIONS IN THE GULF OF NAPLES (TYRRHENIAN SEA)

Mass mortality of colonial sessile organisms occurred in the NW Mediterranean almost every year since the unprecedented event in 1999, and gorgonians were among the most sensitive and affected species. Here we report the effects of two mortality events on gorgonian populations, recorded for the first time in the Gulf of Naples (islands of Ischia and Procida, Tyrrhenian Sea) in the years 2003 and 2005, and related to the occurrence of thermal anomalies (heat-waves). The mortality events in both years occurred at the end of August along the first 25 m depth; the damaged species were Paramuricea clavata (mean dead colonies = 28.3%) and Eunicella singularis (22.8%) in 2003, and E. singularis (17.7%) and Eunicella cavolinii (28.6%) in 2005. A survey in summer 2008 revealed different degrees of recovery for both species of Eunicella in different stations, with still high damaged colonies and low juvenile presence in the stations affected both in 2003 and 2005. Such repetitive events may dramatically affect the recovery potential and resilience of these species and alter their population structure, as well as affect the local biodiversity.

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NATURAL SEDIMENTATION DYNAMICS OF MICROCYSTIS POPULATIONS IN MEDITERRANEAN RESERVOIRS.

The cyanobacterial genus *Microcystis* is considered as the main microcystins (cyanotoxins) producer in waterbodies of the Mediterranean area. *Microcystis* natural sedimentation takes place along all *Microcystis* annual cycle, representing in some periods the main mechanism explaining the lost of pelagic populations of *Microcystis*. Furthermore, sedimentation of *Microcystis* colonies could be one of the main inputs of cyanotoxins to the sediments of reservoirs. In order to determine *Microcystis* sedimentation patterns in Mediterranean reservoirs, waterbodies characterised by rapidly changing hydrophysical and meteorological conditions, a sedimentation study in three Spanish Mediterranean reservoirs was carried out. Sediment traps were installed at both epilimnetic and hypolimnetic depths during summer and autumn, in 2006 and 2007. Also, the influence of water temperature, suspended inorganic particles and intracellular microcystin content in sedimentation rates was studied. Preliminary results showed a biphasic sedimentation pattern, with a first stage, during bloom period, characterised by fluctuating low to moderate sedimentation rates related to ecological succession of pelagic populations, and a second period developed after surface bloom disappearance in which the highest sedimentation rates were reached, possibly due to water temperature decline.

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SEASONAL DYNAMICS OF CARBON EXCRETIONS (EPS & TEP) BY PHYTOPLANKTON IN COASTAL MACROTIDAL ECOSYSTEMS OF THE ENGLISH CHANNEL (FRANCE): EFFECTS ON SUCCESSIONS

Phytoplankton generates large amounts of polysaccharides, Exopolymeric substances (EPS) and transparent exopolymeric particles (TEP), which represent a considerable loss of organic carbon. These excretions are involved in aggregation mechanisms which influence blooms sedimentation and zooplankton grazing. Seasonal dynamics of carbon excretions was followed for three years (2006–2008) in two macrotidal coastal ecosystems of the Normand English-Channel. The Bay des Veys is protected from winds while the other site is exposed to dominant winds (west-Cotentin). In the exposed side, the phytoplankton dynamics and carbon excretions did not appear to be related to the nutrients variations, whereas an inverse correlation between the phytoplankton biomass and the silicates concentration were observed in the Bay ($p<0.0001$). The stress generated by the Si limitation led to an increase in TEP production ($p<0.05$) while a decrease of the EPS pool was measured ($p<0.0001$). Under this nutrient stress, phytoplankton excreted more carbon under TEP form than EPS form, which reveals modifications of carbon metabolism excretion pathway and a heterotrophic behavior. This work highlights the effects of excretion on phytoplankton dynamics at various time scales

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SPATIAL DISTRIBUTIONS OF HYPORHEIC ASSEMBLAGES ACROSS A BRAIDED FLOODPLAIN OF A SUB-MEDITERRANEAN RIVER

Braided gravel-bed rivers are highly heterogeneous and complex river-floodplain systems. This complexity is reflected by the dynamic mosaic of habitats that harbour rich invertebrate assemblages. In floodplains, surface heterogeneity is likely to influence the subsurface compartment through surface water-groundwater exchanges, hydrological flowpaths, sediment characteristics and organic matter. Hence, hyporheic and parafluvial zones should be inhabited by diverse faunal assemblages at the floodplain-scale. Sampling at three depths beneath five types of waterbodies across a braided floodplain was conducted to investigate biodiversity patterns of invertebrate assemblages in relation to the environmental conditions. The samples were collected in triplicates in order to consider the within- and between-habitat heterogeneity along the lateral and vertical dimensions. This study will also bring first insights on the composition and distribution of subsurface metazoan in braided rivers of the south-east of France.

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OUTSTANDING *LOBELIA DORTMANNA* IN IRON AMOR

Lobelia dortmanna leads a group of small, highly-valued rosette species that grow on nutrient-poor sand in temperate softwater lakes. *Lobelia* is the only species that exchanges virtually all carbon dioxide and oxygen in photosynthesis and respiration with the sediment across the roots. The ready gas exchange across root surfaces represents, however, a risk to insufficient oxygen supply to the distal root meristems as sediments accumulate organic matter from lake pollution. Thus, root length declines from 10 to 2 cm at modest contents (2.4%) of degradable organic matter. Coatings of oxidized iron on roots in organically enriched sediments reduce radial oxygen loss and divert more oxygen to roots tips. Ongoing field experiments test if iron enrichment of sediments can help survival of rosette species threatened by lake pollution or whether removal of organic surface sediments is required.

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EUTROPHICATION ASSESSMENT FOR EUROPEAN WATERS

Assessment procedures of eutrophication processes, applied in European waters, are compared and combined for a pan European assessment proposal under consideration of assessment procedures for US estuaries and other areas. Harmonised and transparent assessments are essential for the implementation of balanced measures to combat eutrophication. Eutrophication assessment is required under different regimes in Europe covering regional conventions for the protection of the marine environment and directives protecting surface waters. So is the Water Framework Directive applied to all European lakes, rivers, transitional and coastal waters, the OSPAR Comprehensive Procedure for Eutrophication Assessment in the North East Atlantic, the HELCOM Eutrophication Assessment Tool in the Baltic Sea, TRIX in the Mediterranean Sea and the Marine Strategy Framework Directive is covering coastal and offshore waters of the European Union. Selection of assessment parameters, definition of reference conditions, boundary setting (between acceptable and unacceptable status) and implementation of causal relations are presented. Influences of regional environmental processes and monitoring quality on the assessment results are discussed.

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MICROBIAL AND CHEMICAL SIGNATURES OF TRANSIENT EDDIES IN THE NORTH PACIFIC SUBTROPICAL GYRE

Mesoscale ocean dynamics are key drivers of heterogeneity in planktonic metabolism and community structure. Ocean eddies are transient features that may impart distinct biogeochemical and physical changes to watercolumn properties. During the 2008 CMORE "Microbial Oceanography: from Genomes to Biomes" course, we sampled an area north of station ALOHA, located 24N, 158 - 160W, focusing on the waters of a cyclonic and an anticyclonic eddy. Examination of microbiological rate measurements (primary and bacterial production), determinations of plankton biomass, and measurements of bioelemental export fluxes provided insight into the biogeochemical properties of these two features. In general, inorganic N:P ratios were lower in the anti-cyclone, than the cyclone. Despite comparable rates of primary production, mesopelagic particle fluxes were lower in the anticyclone, suggesting elevated rates of remineralization. Sequencing of 16S rRNA gene clone libraries revealed a more diverse bacterial community associated with the cyclone. Despite similarities in upper ocean biogeochemical properties, the observed differences in planktonic diversity suggest the influence of mesoscale physical forcing may be important in controlling short-term variability in microbial community structure.

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THE ECOPHYSIOLOGICAL RELATIONSHIP BETWEEN THE BEHAVIORAL STRATEGIES AND TROPHIC NATURE OF PLANKTONIC FLAGELLATES

Planktonic flagellates are an ecologically important group of motile, eukaryotic microorganisms characterized by a trophic complexity, involving photosynthesis and the uptake of organic nutrients, and a behavioral flexibility, whereby cells are able to actively sense and respond to resources within the environment. Although it is commonly believed that trophic and behavioral strategies combine to facilitate the growth and survival of these organisms, few studies have assessed the ecophysiological relationship between these factors. Therefore, using an integrated behavioral, physiological and theoretical approach, this study investigated this complex relationship in ten, trophically-contrasting and ecologically significant freshwater, estuarine and marine species. A series of behavioral experiments quantified the strength, plasticity and diversity of responses to ecologically representative gradients of substitutable resources (such as light, carbon dioxide, dissolved organic carbon and bacteria). Parallel physiological analyses of photosynthetic ability, multi-factorial growth experiments, and cost-benefit analyses determined if behavioral preferences were physiologically motivated, and clarified their energetic relationship with trophic nature. Finally, results were placed in an ecological context and the functional implications for survival, competition and spatial and temporal distribution are discussed.

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DISPERSION OF (LIGHT) INERTIAL PARTICLES IN STABLY STRATIFIED TURBULENCE

The first part of this contribution focuses on the basic physics of stably stratified turbulence, the dispersion of passive fluid parcels and heavy inertial particles. The second part addresses the dispersion of light inertial particles in isotropic and in stably stratified turbulence by direct numerical simulations. The trajectories of small inertial particles, with densities similar to the fluid density, in turbulent flows can be computed using the Maxey-Riley equation. The importance of the different forces that are acting on the particles is examined, and its relevance for collision processes and particle dispersion will be discussed. The role of the different forces on preferential concentration of light particles will be addressed and compared with those obtained for heavy particles.

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PATTERNS AND SCALES OF PHYTOPLANKTON VARIABILITY IN ESTUARINE-COASTAL ECOSYSTEMS

Multidecadal observations of phytoplankton biomass and community composition have been sustained in dozens of estuaries and nearshore marine ecosystems around the world, but there is no synthesis of these records to search for general patterns of phytoplankton variability at the land-sea interface. We compiled records of phytoplankton biomass (chlorophyll-a) from 90 sites in 47 estuarine-coastal ecosystems, and compared variability at annual, seasonal, and monthly-event scales within and across sites. This analysis reveals a wide range of phytoplankton patterns, including: (1) strongly recurrent seasonal cycles (e.g. Oosterschelde); (2) weak seasonality but high annual variability (e.g. Florida Bay); (3) small variability at all time scales (e.g. Seto Inland Sea); and (4) large variability at all scales (e.g. Puget Sound). This range of patterns is not observed in the open ocean, implying that proximity to land adds complexity to the processes and patterns of phytoplankton variability. We propose a conceptual model to explain this complexity as phytoplankton responses to exogenous forcings originating in the atmosphere, regional oceans and adjacent terrestrial landscapes, and from endogenous biological processes including species interactions and phytoplankton life-stage transitions.

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^{234}TH-DERIVED PARTICULATE ORGANIC CARBON (POC) FLUXES AND MICROBIAL EXTRACELLULAR ENZYMATIC ACTIVITY IN ARCTIC POLYNYAS

Water column ^{234}Th deficits, coupled with measurements of the POC/^{234}Th ratio on filterable particles >70 μm, have been used to estimate late summer POC fluxes in the Laptev Sea (2005) and North Water (2006) Polynyas. POC fluxes at 100 m were generally greater in the North Water Polynya relative to the Laptev. Rates of extracellular enzyme (protease and carbohydrase) activities were determined on particles (1-70 μm and >70 μm) filtered in situ to test the hypothesis that POC fluxes in the Arctic Ocean are related to extracellular enzyme activities. Protease activities were greater than carbohydrase activities in both size fractions and in both polynyas, and correlated positively with particulate N (PN) and POC. Carbohydrase activities correlated with POC and, in the Laptev, with PN. Activities of protease and carbohydrase correlated negatively with POC flux, with lower POC fluxes having higher extracellular enzyme activities. The relationships between POC flux and enzyme activity in the two polynyas did not fall along the same trend however, possibly due to interannual variability or differences in sources of organic matter to the two systems.

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CO-VARIATION OF VIRAL AND BACTERIAL DIVERSITY: EVIDENCE FOR A MASS LYSIS EVENT

The factors inducing lysogenic bacterioplankton in the ocean and its contribution to viral diversity are not well known. Thus, we followed the percentage of lysogenic cells and the diversity of viruses (pulsed field gel electrophoresis, PFGE) and bacteria (16S rRNA gene DGGE) during the development of a spring phytoplankton bloom in the Bay of Villefranche) in situ and in mitomycin C induced samples. From winter onwards the percentage of mitomycin C detectable lysogens had built up to > 20%, but dropped to 5% at the maximum of the bloom and increased again afterwards. At this low detectable lysogeny, a PFGE band, which was typically only found in incubations with mitomycin C, was also found in situ. In addition, bacterial and viral richness was well correlated before and after the height of the bloom but not during the height of the bloom. Together, this suggests a mass lysis events and production of specific viruses. Also, this suggests that lytic viral infection is the main reason for viral diversity, but at times induction can contribute as well.

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DEVELOPPEMENT OF OSTREOPSIS SPP. IN MONACO IN RELATION WITH ENVIRONMENTAL FACTORS

In the Mediterranean Sea, the number of Harmful Algal Blooms increased, with a diversification of the species of microalgae proliferating. Among these species, Ostreopsis spp., a benthic toxic dinoflagellate, makes blooms since 1998 and can cause important healthy problems along the North-Western Mediterranean coasts, especially in the Ligurian Sea. To understand the environmental conditions wich favour the developpement of Ostreopsis spp., we surveyed the evolution of Ostreopsis spp. population in Monaco during the summers 2007 and 2008. In both year, the species was observed through all the summer (from July 02th to September 03th 2007, and from 16th June to 25th August 2008) and we observed an important variability at small scale in the developpement of the algae. In early July 2007, we observed an important bloom (27,7.105 cells.g fw-1 macroalgae) whereas in 2008 the bloom occured in mid-July (6,1.105 cells.g fw-1 macroalgae). Sea water temperatures higher than 22,5 °C and frequency of strong West-wind (>10 Knots) appeared to be possible causes for the bloom of Ostreopsis spp.

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THE NATURE OF FLOW THROUGH PERMEABLE SHELF SANDS BASED ON PORE WATER RADON AND RADIUM PROFILES

Submarine Groundwater Discharge (SGD) represents (1) water recharged above sea level or (2) seawater circulated locally through permeable sediments by flow over rough topography, wave activity, pumping of irrigating macrofauna, and convection. Recent studies have used water column budgets for Ra isotopes to evaluate SGD and calculate nutrient fluxes due to SGD. However, because the scale distances for nutrients may differ from those of the Ra isotopes, it is important to constrain whether SGD calculated from near-shore water column Ra budgets represents local circulation of overlying water through sediments, or regional flow driven by recharge above sea level. This also can define whether nutrient fluxes are driven by remineralization of biogenic material formed in the overlying water, or by transport from adjacent land areas. We have measured profiles of Rn-222 and Ra isotopes (223, 224, 228) in pore waters of permeable sands offshore from Huntington Beach, CA, on multiple occasions, working at the shoreline and at water depths of 5 to 15 m. By also determining the rate that these isotopes emanate from sediments and the Ra adsorption constant, we can evaluate the nature of SGD circulation in this system. Results indicate that nearly all of the SGD is due to local recirculation of overlying water driven by flow over rough topography and macrofaunal irrigation. Ra-228 profiles, coupled with water column budgets, can be used to put constraints on regional vertical flow.

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FLUID INTERACTIONS OF THE LOBATE CTENOPHORE *MNEMIOPSIS LEIDYI*

The lobate ctenophore *Mnemiopsis leidyi* is voracious predator whose distribution has been increasing globally. To begin to understand the mechanistic bases of their predatory impact in pelagic ecosystems, we examined how *M. leidyi* manipulates its surrounding fluid in order to feed. We qualitatively visualized their flow using fluorescene dye and quantified the flow using digital particle image velocimetry (DPIV). Cilia along the ctene rows and auricles create a laminar feeding current that draws fluid between the lobes and toward capture surfaces. The flow is characterized by relatively low velocities and levels of shear. The low levels of shear support the hypothesis that *M. leidyi* is capable of functioning as a stealth predator on adult copepods. We estimated the flux of fluid that passes between the lobes to estimate the maximum clearance rate (fmax) for non-motile particles and we estimated how this increases with the size of the ctenophore. The significance of the fluid interactions of *M. leidyi* on predation are discussed.

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ASSESSING ICHTHYOPLANKTON PREDATION RISK TO RESOLVE PATTERNS AND PROCESSES DUE TO GELATINOUS ZOOPLANKTON FEEDING

Gelatinous zooplankton are widely considered important predators on estuarine and marine zooplankton. While predation on the larger marine zooplankton community may influence distribution of energy and nutrients within the ecosystem, direct predation by 'jellies' on ichthyoplankton (larval fish and fish eggs) may have important implications for recruitment strength and population dynamics of many important marine and estuarine fishes. We estimated ichthyoplankton predation risk by a diverse assemblage of gelatinous zooplankton, primarily ctenophores and medusae, in estuarine and coastal waters of the north central Gulf of Mexico. A spatial risk predation assessment along the main stem of Mobile Bay illustrates the disproportionately important role of estuarine fronts for ichthyoplankton predation. A temporal risk assessment, monthly during 2004-2006, revealed strong seasonal risk for several important fish species. The utility of such predation risk assessments should provide a useful tool for relating stock recruitment strength of fish to predation mortality on early life-history stages.

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WHAT DO VISITORS CHOOSE TO LEARN ABOUT THE TREE OF LIFE AT THE SMITHSONIAN'S NEW OCEAN HALL?

The Smithsonian Institution's National Museum of Natural History just opened a spectacular example of free choice learning opportunities, the Sant Ocean Hall. Among its many exhibits is a prominently positioned entry experience on marine biodiversity. Within this section are two phylogenetic trees of life focused on animal diversity. One can ask, what if anything do visitors learn from the presentation of phylogenetic trees? This question is directly relevant to NSF-sponsored Cnidarian and Poriferan Tree of Life projects, which have commitments to outreach. Significant funds are allocated for research teams to work out evolutionary relationships among different groups of organisms and it is important to know what the public's perceptions of phylogenetic trees are. Between the opening of the Ocean Hall in late September, 2008 and the ASLO meeting, a series of controlled survey questions will be asked of visitors who choose and do not choose to view the phylogenetic trees. These questions attempt to assess: 1) why visitors either choose to view or pass by the Tree of Life; 2) what those who view it take away from the experience; and, 3) whether visitors understand the connection between the phylogenetic tree and the biodiversity entry experience.

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CONSORTIUM FOR OCEAN LEADERSHIP'S FREE CHOICE LEARNING OPPORTUNITIES AS PART OF THE YEAR OF SCIENCE 2009

The Year of Science 2009 provides a tremendous opportunity for engaging the public in science. The events that will take place nationally throughout the year are sponsored by members of the Coalition on the Public Understanding of Science (COPUS), a grassroots effort aimed at engaging the public to increase their understanding and awareness of the nature of science and the important role science plays in our society. The Consortium for Ocean Leadership's Distinguished Lecture Series is just one example of successful programs that offer free-choice learning opportunities that will be part of the Year of Science efforts. Traditionally the lecture series have taken place at Universities for graduate student audiences, but this years' DLS participants will also be presenting to general public and teacher audiences, requiring a different format and emphasis.

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GRAZING CONTROLS THE BALANCE BETWEEN AUTOTROPHIC AND NON AUTOTROPHIC CARBON ACQUISITION BY *ALEXANDRIUM CATENELLA*

Inorganic carbon uptake by the toxic dinoflagellate *Alexandrium catenella* estimated from incorporation of ^{13}C labelled bicarbonate (an estimate of carbon gain by autotrophy) was compared to increases in particulate carbon (PC) that integrate all processes leading to carbon gain by cells (autotrophy, heterotrophy, mixotrophy). During blooms of *Alexandrium catenella* in the field, the ^{13}C technique could account for only 47 % of the increase in PC in conventional 24 hour incubations. Grazing rates obtained from dilution experiments were related significantly and positively to the ratio of PC increases to bicarbonate uptake, indicating that dissolved organic carbon contributes to growth as a direct function of grazing activity. In addition, as grazing rate increased, the contribution of DIC uptake to C based growth decreased in a linear way (from 56 to 33% of total C acquisition) and the contribution of non autotrophic processes increased (from 54 to 67%). Thus grazing appears to closely control the balance between autotrophic and non-autotrophic processes leading to carbon acquisition by natural populations of *A. catenella*.

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MERCURY CONCENTRATIONS IN PACIFIC BLUEFIN TUNA: ARE THEY POTENTIAL INDICATORS OF METHYLMERCURY AVAILABILITY IN THE OCEANS?

Advances in techniques for mercury analysis in fish tissue and in knowledge of migration patterns of bluefin tuna may be useful to assess methylmercury availability in the oceans. Analyses of tissue from Pacific bluefin tuna (*Thunnus orientalis*) indicated that mercury concentrations in white, fast-twitch muscle averaged 6 percent greater than those in red, slow-twitch muscle. Comparison of sampling position indicated that caudal and mid-fork-length samples contained similar amounts of mercury, and that measurements of tissue-mercury concentrations using a direct determination method were precise (1.6 % error). Mercury concentrations in 16 two-year-old fish, captured after transoceanic migrations from spawning areas near Japan and collected off Baja California, averaged 0.50 µg/g ww (SD 0.094). Concentrations in two-year-old fish captured off Baja and raised in coastal pens for 8 months were similar (0.47 µg/g ww, SD 0.078) to those in wild fish and correlated negatively with fish length. Relatively low levels of methylmercury may be expected off Baja where methylmercury flux from rivers and continental shelf sediments are low, and where deep-water upwelling supplies nutrients, but little methylmercury.

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CRYPTIC PHAGES AND LYSOGENIC INFECTIONS IN A FRESHWATER LAKE BACTERIOPLANKTON

In this study, high resolution vertical sampling was conducted in a deep meromictic lake during nine-month period, for evidence of experimentally inducible cryptic phages, i.e. prophages, integrated into the genetic material of bacterioplankton. Temperate viruses responded to mitomycin-C used to induce prophages into lytic cycle. Frequency of lysogenically infected cells (FLC) represented from < 0.1 to 11.5 % of the total abundance of prokaryotic communities. No consistent correlation was found between FLC and the physico-chemical parameters but with the abundances of bacteria and of free-occurring viruses, and with the frequency of lytically infected cells (FIC) which was higher (range < 0.1 to 26 %). These correlations were negatives and FLC was detected at a significant level only from under an apparent threshold bacterial abundance of about 5 x 10^6 cells mL-1. In conjunction with the finding that the potential viral production from spontaneous induction of all lysogens represented less that 2 % of viral lytic production, our study provides empirical indications that lysogeny mainly is a strategy for the maintenance of viral genotypic and phenotypic traits in the environment and can further have significant incidences on the evolutionary ecology of host communities.

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LONG-TERM EVOLUTION OF PTEROPOD POPULATIONS IN THE BAY OF VILLEFRANCHE

Thecosome pteropods (pelagic molluscs) can play an important role in the food web of various ecosystems. They can be an important food source for zooplankton or higher predator such as fishes, whales and birds. They are also significant contributors to the export of carbonate and carbon to the deep ocean. Due to their aragonitic shell, it was shown that pteropods are very sensitive to ocean acidification. Long-term time series of the abundance and distribution on pteropods would provide critical information on the life cycle and response to environmental changes. The Laboratory of Oceanography in Villefranche holds an exceptional collection of plankton samples collected weekly since 1973. A ZooScan, a powerful imaging system, was used to investigate this 30 years time series. The abundance of the two main pteropods (Cavolinia inflexa and Creseis sp.) in the Bay of Villefranche has been reconstructed. These data are used together with a size-weight relationship of the shell and 45Ca calcification data to estimate the aragonite fluxes generated by pteropods.

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ASSESSMENT OF WORLD TRADE CENTER ATTACKS IMPACT ON THE HUDSON RARITAN ESTUARY

The attack on the World Trade Center (WTC) resulted in the destruction of buildings and the release of debris containing a variety of contaminants including heavy metals. An assessment of the Hudson Raritan Estuary (HRE) was performed using data from the National Oceanic and Atmospheric Administration's *National Status and Trends Mussel Watch Program* to determine the environmental impact of the WTC collapse. By using pre-attack and post-attack metal measurements from the blue mussel, *mytilus sp.* we were able to characterize the estuary based on perturbations and spatial variability. Specifically, the measurements allowed the study team to achieve the following: a) compare metal accumulation in the HRE with similar estuaries across the nation; b) detect trends for specific metals in the estuary; c) compare the upper bay to the lower bay; and d) compare pre-attack and post-attack metal concentrations. The results suggest that the collapse of the WTC did not have a significant impact on the surrounding coastal waters in terms of causing an upsurge in heavy metal concentrations.

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THE 'JELLY CARBON PUMP': JELLYFISH BLOOMS RESULT IN A MAJOR MICROBIAL RESPIRATORY SINK OF CARBON IN MARINE SYSTEMS

Large jellyfish blooms of lobate ctenophores (*Mnemiopsis leidyi*) and scyphomedusae (*Chrysaora quinquecirrha*) occur in many coastal areas, including large summer blooms in Chesapeake Bay. High jellyfish biomass coincides with peaks in microbial activity and biomass, but few studies have investigated the potential link between jellyfish blooms and microbial functioning in coastal ecosystems. We measured dissolved organic matter (DOM) production by jellyfish, and the response of free-living bacterioplankton to this C input, in terms of bacterial cell growth, metabolism, and phylogenetic community composition. Both species of jellyfish released large amounts of carbon (C)-rich dissolved organic matter (J-DOM), and bacterioplankton quickly responded with large increases in metabolic activity. Enumeration of prokaryotic phylogenetic groups using fluorescence in situ hybridization (FISH) showed specific bacterial groups were responsible for increased metabolism resulting from jellyfish-generated DOM. Furthermore, decreases in bacterial growth efficiency suggest a shunt of C consumed towards bacterial respiration. In the context of worldwide increases in jellyfish, our results suggest the possibility of major shifts in marine microbial structure and function, and a large bacterial C sink away from higher trophic levels.

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TRACING THE SIGNAL UP THE FOOD WEB: ISOTOPE LABELLING DISTINGUISHES SEAGRASS AND ALGAE AS NITROGEN SOURCES FOR PRAWNS

There is a longstanding debate about the relative importance of macrophytes versus microalgae in freshwater, estuarine and coastal foodwebs. The issue in seagrass meadows is whether fauna derives nutrition mainly from seagrass or its epiphytic microalgae. We used 15N enrichment of seagrass/epiphyte habitat to separate the contribution of these primary sources to the diets of omnivorous animals. In laboratory mesocosms, juvenile tiger prawn nitrogen isotope values (mean 50‰) remained below those of seagrass (107‰) and well below those of algae (412‰) after 24 days. Modeling of nitrogen turnover in prawns (via measured growth rates) confirmed that seagrass was a larger source of nitrogen than algae. The same procedure applied in the wild showed a similar result over 30 days. Prawn isotope values (241‰) matched seagrass (230‰) rather than algae (2718‰) values. Turnover models again showed that seagrass was a more important source of nitrogen. The results contradict the current paradigm that microalgae play a larger role than macrophytes in seagrass foodwebs. Our experiments show that isotope enrichment can effectively trace pathways to mobile fauna.

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ABRUPT ECOSYSTEM SHIFT IN THE MEDITERRANEAN SEA

In this work we analyze the 36-year copepod abundance time series in the Gulf of Trieste, North Adriatic, to investigate its interannual variability, long-term species trends, and phenology. The analysis of the winter sea surface temperature identifies two periods: 1970-1987 and 1988-2005. The second period is characterized by ecosystem-wide changes: the arrival of a new species, the rise or decline of several taxa, and changes in the phenology in several species. In addition, we compare these series with the 27 year mesozooplankton series in Villefranche Bay, western Mediterranean, and also find a step-like change in 1987, which separates two distinct periods, 1967-1986 and 1987-1993. The second period was favorable for gelatinous zooplankton and some copepod species, whereas chaetognathes and summer-autumn copepods decreased. In the same year (1987) abrupt shifts in the North Adriatic are also registered in other trophic levels (from phytoplankton to fish). The synchronicity of events in these separate basins, as well as with other seas, suggests dependence on large scale climate drivers.

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SHIP TO SHORE FREE CHOICE LEARNING WITH THE JOIDES RESOLUTION

The Internet is increasingly where young people go for information, social interaction, and learning. As part of the re-launch of the JOIDES Resolution, the U.S. vessel for scientific ocean drilling, the drilling program's education department will open a new venue for free choice learning opportunities using the ship as a window into real science; it will launch a companion web site, www.joidesresolution.org. This site will take wide advantage of the Internet's capabilities to promote interaction between shipboard scientists and free choice learners on shore. It will feature written, audio and video blogs, a web cam, ship-tracking, interactive games, regular installments of graphic novel stories from the ship, ask-a-scientist opportunities, ideas for implementation in classrooms by teachers, and integration with social networking sites such as Twitter, MySpace and Facebook. Wide promotional efforts will target families, teachers and students, and alert these users to updates as the ship conducts its work on each expedition. Use statistics will be regularly analyzed; these results will be used to adapt the highly interactive site as needed to encourage broader participation.

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MOOSE: AN INTEGRATED MULTI-SITE SYSTEM OF NW MEDITERRANEAN MARINE AND ATMOSPHERIC OBSERVATORIES

Despite intensive research efforts undertaken in the Mediterranean Sea over more than a century, an integrated view of its evolution, viewed in the climate change and anthropogenic pressure, still lacks. In this context, a Mediterranean Ocean Observing System on Environment (MOOSE) has been set up as an interactive, distributed and integrated observatory system of the NW Mediterranean Sea to detect and identify long-term environmental anomalies. It will be based on a multisite system of continental-shelf and deep-sea fixed stations as well as Lagrangian platform network to observe the spatio-temporal variability of processes interacting between the coastal-open ocean and the ocean-atmosphere components. Another target is to build efficient indicators of the health of the NW Mediterranean basin. MOOSE will also provide a large flux of real-time data to facilitate validation of operational oceanographic models. It will supply and maintain long-term time series, the only data sets that allow to evidence climatic trends. Finally, MOOSE project is supported by the Inter-Organization Environment Committee (CIO-E) and INSU to stimulate the national scientific community and European partners for a significant multidisciplinary program.

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ANALYZING SHORELINE CHANGE ALONG COMPLEX COASTLINES: APPROACH AND INTERPRETATIONS

Coastlines are constantly changing due to both natural and anthropogenic forces. Climate change and associated sea level rise will undoubtedly reshape our coasts. No longer are oceanfronts the only concern of short-term shoreline change. Shoreline dynamics along more sheltered estuaries have gained attention and are needed to better understand and protect coastal resources. A transect-based approach is commonly used to quantify shoreline change on linear (i.e., ocean) shorelines; however, due to the complex morphology of most estuarine systems, a point-based approach (50-m spacing) was developed and applied to study the Neuse River Estuary, North Carolina, USA. Shoreline-change rates and additional parameters (i.e., fetch, wave energy, shoreline composition, etc.) were determined at each point using 1958 and 1998 aerial photography and available datasets. The average shoreline change in the study area is -0.24 m/yr, with 88% of the shoreline eroding. The point-based approach allows the application of geostatistical methods to evaluate the dominant forces affecting change. Spatial autocorrelation analysis indicates correlation is minimized at distances greater than 1 km. Shoreline composition and average fetch appear to influence the rate of shoreline change.

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NORTH ATLANTIC DEEP-SEA BENTHIC FORAMINIFERAL BIODIVERSITY IS RELATED TO SEASONALITY OF MEAN ANNUAL PRODUCTIVITY OF THE SURFACE WATERS

Latitudinal gradients in biodiversity exist in both terrestrial and marine environments, but little agreement exists on the mechanisms or ecological causes creating these patterns. Marine biodiversity patterns have been particularly challenging to document, due to the lack of appropriate data sets from ocean basins. We document latitudinal patterns of North Atlantic deep-sea benthic foraminifera and show that seasonality of primary productivity, as estimated from SeaWiFS satellite imagery, has a significant effect on diversity indices. Annual resource stability, reflecting the timing of organic carbon flux and the mode of sedimentation, accounts for these patterns and is an important variable structuring the deep-sea benthic foraminiferal community.

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BACTERIA DIVERSITY AND MORPHOLOGY IN DEEP ULTRAOLIGOTROPHIC ANDEAN LAKES: THE ROLE OF ULTRAVIOLET RADIATION ON VERTICAL DISTRIBUTION

We analysed the bacteria relative diversity by Denaturating Gradient Gel Electrophoresis (DGGE), and the morphological distribution (cocci or rods vs. filaments >7μm) in relation to vertical profiles of different light wavelengths (UVR and PAR), temperature, nutrients, and nanoflagellate and ciliate abundances, in eight ultraoligotrophic Andean lakes (Patagonia, Argentina). The overall bacterial community composition was similar among the lakes and at different depths along the euphotic zone of each lake. Nevertheless the relative proportion of filaments to total bacterial biovolume was higher in upper layers with higher UVR, showing a monotonical decrease with depth. Lakes with lower UVR diffuse extinction coefficient (305 nm) showed a greater proportion of filaments. Statistical analysis showed a strong correlation between UVR and filament proportion while neither nanopredator abundance, nor predation pressure, nor resources (dissolved nutrients) could explain the high proportion of filamentation in the near-surface layers. We propose that UVR plays an important role stimulating bacterial filamentation, particularly in lakes with high UVR penetration like the deep Andean transparent lakes.

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COMPARISON OF DIFFERENT MICROBIAL FOOD WEB FORMULATIONS IN A BIOGEOCHEMICAL MODEL OF INTERMEDIATE COMPLEXITY

Since late seventies microbial food webs have being recognized as fundamental part of biogeochemical cycles in ocean systems, and several numerical models have now been proposed which include more or less detailed representation of matter and energy flows channelled by this ecosystem component. In this study, we analyzed 5 different parametrizations proposed in the last 2 decades, and coupled each of them to an intermediate complexity biogeochemical model of C and P cycles, which was developed for a P-limited zone of the Mediterranean Sea. Each formulation stems from a different point of view, and focus on particular aspects of the system. We compared the global effects of the different formulations on the integrated model performances, captured by primary productivity, phytoplankton versus bacteria competition, P mineralization process and Dissolved Organic Carbon budged. Data requirements for a proper implementation and validation of different schemes, and for choosing the "best representation" are considered too. Results suggest that, given the consistency of actual data set typically available, simpler representations should be preferred.

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THE IMPORTANCE OF A LONG-TERM MONITORING PROGRAM IN THE ASSESSMENT OF BENTHIC RECOVERY TRENDS IN THE TAGUS ESTUARY (PORTUGAL)

A monitoring program of the area where EXPO'98 took place (Tagus estuary, Portugal) was developed during twelve years (1996-2007). Seasonal samples of intertidal macroinvertebrate communities were collected to assess changes related to recovery after major human impacts. Multivariate analyses was used to investigate major trends (i) in the structure of the macroinvertebrate communities and (ii) in the ecological quality assessed using some invertebrate attributes, including biotic indices (density, biomass, richness, diversity, W-Statistic, AMBI). Although seasonal changes occurred for most species, no seasonal aggregation was identified, but ordinations showed a clear separation between two different periods. The first period (1996/2002) was characterized by the occurrence of several anthropogenic interventions in the area and the invertebrate community was dominated by small size annelids. In the second period (2003/2007), a significant increase in density, biomass and richness, and an improvement of the AMBI results were observed, associated with a significant reduction of human pressure. This study demonstrated the importance of long-term datasets in the assessment of benthic recovery trends, which could be misidentified when examining only seasonal or short-term interannual changes.

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ORGANIC CARBON BURIAL AND INTERNAL DYNAMICS IN PRAIRIE POTHOLE LAKES

Small lakes have been recognized as a potentially important organic carbon sink globally. Here we try to answer three questions regarding organic carbon burial in shallow, small wetland lakes (<25 ha): (1) What are the primary sources for the buried material?; (2) What mechanisms facilitate burial efficiency?; and (3) How much organic carbon is buried in these shallow systems? We used stable isotopes and elemental stoichiometry of material collected in the water column and sediments to study two lakes in the southeast portion of the Prairie Pothole Region of North America, one dominated by macrophytes and the other by phytoplankton. Primary production in these two systems is very similar. We found that the primary sources of buried material was of mixed composition with an increased burial of phytoplankton organic carbon since human settlement (ca. 1880 A.D.). The latter trend was most obvious in the phytoplankton-dominated lake where sediment organic matter had a C:N signature of ca. 11-14 (mean 12.1). Both lakes had δ13C isotope ratios most similar to terrestrial organic matter especially downcore. Furthermore, both lakes have had increased the rate of organic matter burial since human settlement by about a factor of 10. Current organic carbon burial rates are approximately 149-265 g C m-2 yr-1. Assuming similar burial rates in small wetland lakes across the Prairie Pothole Region, current burial rates are approximately 4-5 Tg OC per year.

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PHOTOHETEROTROPHIC MICROBES IN THE ARCTIC OCEAN

Photoheterotrophic microbes, which are capable of utilizing dissolved organic materials (DOM) and harvesting light energy, include cyanobacteria (*Synechococcus* and *Prochlorococcus*), aerobic anoxygenic phototrophic (AAP) bacteria, and proteorhodopsin (PR)-containing bacteria. Our knowledge of photoheterotrophic microbes is largely incomplete, especially in high latitude waters such as the Arctic Ocean where photoheterotrophs may have distinct biogeochemical impacts due to extremes in day length and seasonal ice cover. We used flow cytometry, infrared epifluorescence microscopy and quantitative PCR (qPCR) to examine photoheterotroph abundance in coastal Arctic Ocean waters in summer and during winter darkness below the ice. The abundances of AAP bacteria and PR-containing bacteria decreased between summer and winter in parallel with a 4-fold decrease in the total prokaryotic community. In contrast, *Synechococcus* did not decrease in winter, suggesting metabolism supported by organic substrates. qPCR targeting winter and summer clades revealed no substantial shifts in community structure of AAP bacteria and PR-containing bacteria. Our results suggest that photoheterotrophic microbes successfully compete with strict heterotrophs during winter darkness below the ice, but AAP bacteria and PR-containing bacteria are not superior competitors during summer.

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RESUSPENSION EVENTS AND THEIR EFFECTS ON NUTRIENT FLUXES ACROSS THE SEDIMENT-WATER INTERFACE IN THE SOUTHERN NORTH SEA

Traditionally, marine nutrient fluxes and mass balances have been calculated from riverine inputs with little attention paid to benthic inputs. Where sediment-water column nutrient exchange has been evaluated the focus has been on diffusive fluxes and the influence of bioturbation and bioirrigation. However, southern North Sea near bed velocities are often above the critical erosion threshold suggesting that resuspension effects should be also considered in ecosystem modelling. Physical and chemical data were measured during resuspension experiments on southern North Sea sediments ranging from sand to mud. An in-situ annular benthic flume was deployed at various sites and used to characterise the sediment and its physical properties. To compliment the in-situ benthic flume a number of collected box cores were used to determine the change in nutrient flux during resuspension events using a series of ship based experiments. Pore water profiles and diffusive fluxes were also determined on collected cores for comparison. The obtained physical and chemical data will be used in new and existing models to incorporate the impact of resuspension on nutrient release.

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LAKE SEDIMENTS AS ARCHIVES OF ATMOSPHERIC ARSENIC CONTAMINATION

Current emissions of arsenic (As) into the atmosphere are thought to globally increase as a result of human activities but temporal trends at regional scales are not well defined. We have determined the profiles of this redox-sensitive metalloid in dated (210Pb and 137Cs) sediment cores and in sediment porewater from Canadian Shield lakes, where atmospheric deposition is the only input of anthropogenic As. A one-dimensional transport-reaction equation was applied to the porewater As profiles in order to quantify the post-depositional addition or removal of As to the solid phase and estimate the sedimentary As concentrations at the time of deposition. By multiplying these concentrations by sediment mass accumulation rates, variations over the last two centuries in As fluxes at the sediment surface were estimated. The resulting chronological profiles in all lacustrines basins reveal that atmospheric As contamination was at its maximum in the 1950's and significantly decreased since then; such a trend is consistent with the history of specific markers of coal combustion at the same sites.

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A REGIME SHIFT IN A FRESHWATER ESTUARINE ECOSYSTEM RECOVERING FROM HYPEREUTROPHICATION?

After decades of hypereutrophication, with strong hypoxia and elevated ammonia concentrations, water quality in the freshwater part of the Schelde estuary changed rapidly. Average May-Sep oxygen concentrations more than quintupled, from 8% of saturation (1996) to 51% (2007). Ammonium concentrations decreased from a 296 μM May to Sep average (1996) to 16 μM (2007). Average May-Sep chlorophyll a concentrations increased from 15 μg/l (1996) to 178 μg/l (2007). From 2006 oversaturated oxygen concentrations are occasionally observed, caused by algal primary production. We hypothesise that inhibition of primary production and algal growth due to anoxia and/or ammonia toxicity prevented the build-up of algal biomass until a decade ago. We study the steady states and dynamics of a simple mathematical model, including this algal growth inhibition. It displays a regime shift from a heterotroph state to an autotroph state, when ammonia load is reduced below a threshold. At intermediate loads it predicts fluctuations in oxygen concentration in response to discharge peaks. Data and model results are consistent, and thus indicate a possible regime shift from heterotrophy to autotrophy in this ecosystem.

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MOLECULAR ASSESSMENT OF DIATOM COMMUNITY COMPOSITION IN RESPONSE TO NITROGEN POLLUTION AND INCREASED ATMOSPHERIC CO_2

Diatoms are excellent indicators of environmental change and are used to infer climate and land-use changes over a range of temporal and spatial scales. Although anticipated increases in eutrophication and atmospheric CO_2 will likely result in shifts in diatom community composition, little is known about the magnitude of this shift or responses of individual species. We investigated changes in marsh sediment diatom communities in response to nitrogen pollution and elevated CO_2. Plots of brackish marsh were exposed to ambient and elevated porewater NH_4, crossed with ambient and elevated atmospheric CO_2. DNA was extracted from sediments and amplified using diatom-specific primers to produce 18S rRNA clone libraries from each treatment. Restriction fragment length polymorphism (RFLP) analysis revealed that diatom communities consisted of a number of diatom taxa that were common to all treatments, but also included diatoms that may be indicative of their environment. RFLPs will be further analyzed using multivariate statistical tools such as multidimensional scaling and analysis of similarity. Sequence analysis from selected clones will be presented to identify diatoms that may serve as indicators of environmental change.

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GENETIC VARIABILITY AND MOLECULAR PHYLOGENY OF THE GENUS CERATIUM (PLANKTONIC DINOFLAGELLATE) INFERRED FROM SINGLE-CELL ANALYSIS OF ITS RDNA SEQUENCES

Traditionnally, identification based on the morphospecies concept has been used for phytoplankton biodiversity assessments and ecological studies. Recent analyses involving molecular tools have revealed an important unsuspected phylogenetic diversity. Cryptic species have been detected in well characterized, cosmopolitan and ecologically important taxa. Yet, the ecological significance of this diversity is still not fully understood. In this context, the present work, supported by the Aquaparadox project, compares ITS rDNA sequences of 33 "species" of the genus Ceratium, a cosmopolitan and common dinoflagellate genus which both the morphology and ecology has been studied in details, in particular during the XIXth century. Our phylogenetic analyses do not support the monophyly of the subgenera within Ceratium but show that most species form monophyletic groups. Our work also show a clear genetic structure within some Ceratium species and suggests the existence of cryptic or pseudo-cryptic species within this genus. Conversely, the wide infra-specific morphological variations observed for some other species is not echoed by the genetic analyses. These data should enable us clarifying the status of doubtful taxa within the genus Ceratium. More generally, this work will contribute to the evaluation of the ITS rDNA genes as a tool to circumscribe the ideal phytoplankton species and should contribute to a better understanding of evolutionary processes in phytoplankton.

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S-ISOTOPES SHOW THAT DETRITUS SUSTAIN FISH PRODUCTION IN BOREAL LAKES

The importance of dead organic matter (detritus) in supporting top predators such as fish is little appreciated, even though ecologists have long suggested that detritus can be a major nutrient and energy source for food webs. We used sulphur isotopic ratios to show that piscivores and other aquatic animals do indeed depend on detritus in sediments for nutrients. Thus, in several eastern Canadian boreal lakes, benthic insects feeding on sediment had d34S values similar to those measured in sediment, whereas the d34S values of benthic bivalves, which feed mainly on suspended particles, were close to those of sulphate in the water column (as were those of several types of planktonic invertebrates). Using the S-isotopic signatures of benthic and planktonic end members in a mixing model, we estimate that both an invertebrate-feeding fish and a piscivore obtain S from the sedimentary microbial food web (means of 60% and 20%, respectively). We conclude that top predators in aquatic ecosystems depend in part on detritus in sediment and that the strength of such trophic links can be revealed through the use of d34S.

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SILICON CYCLE IN THE MEDITERRANEAN SEA: OCCURRENCE OF DEEP BIOGENIC SILICA MAXIMA IN OLIGOTROPHIC REGIONS OF THE EASTERN BASIN (BIOSOPE & BOUM CRUISES).

Results from the BOUM cruise (June-July 2008) evidenced the presence of a deep biogenic silica (BSi) maximum in an ultra-oligotrophic anticyclonic gyre, where the nitracline was as deep as 100 m. This peak of BSi accumulation located at 100 m corresponded to a decrease in Si(OH)4 concentrations to values close to 0.4 µM, which is quite low for oligotrophic Eastern Mediterranean system. This biological drawdown signature was only observed at the center of the gyre, while the edges of the gyre revealed more classical homogeneous Si(OH)4 profiles from 0 to100 m before increasing below that depth. Particularities of particulate biogenic and lithogenic silica distributions as well as silicic acid availability along longitudinal gradients in both the Western and Eastern basins will be discussed and put in perspective with similar results obtained from a previous autumn cruise (PROSOPE-1999). These data will help improve our understanding of the silicon cycle in the Mediterranean Sea, which to this day remains poorly investigated.

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THE IMPORTANCE OF PREDATOR-PREY INTERACTIONS IN A MODERATE-COMPEXITY, MASS-CONSERVATIVE, KOLMOGOROV ECOSYSTEM MODEL

We decompose a moderate complexity marine plankton ecosystem model into its constituent predator-prey interactions and explore the factors controlling the dynamics of the simple and complex systems. When calibrated with parameter values demonstrated to be valid for simulating plankton dynamics in the Barents Sea the model has a complicated and highly robust limit cycle. The key features of the model are that it is a 'Kolmogorov system' and that it conserves mass, properties of many contemporary ecosystem models. We find that, in many cases, the properties of the simple predator-prey systems provide useful insights in to the properties and dynamics of the complex model. In particular, we find that the dynamics of the predator-prey systems define the dynamics on the boundaries of the complex model and that the unstable equilibrium points of the simple models provide "signposts" that largely determine the dynamics of the complex model. We also discuss the complex model's ability to produce both regular sequential "blooms", of species, and irregular "breathers", where a species emerges from an exponentially small state to briefly dominate the system.

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CIRCUMPOLAR SYNCHRONY IN BIG RIVER BACTERIOPLANKTON

The composition of bacterioplankton communities was investigated in the six largest rivers in the Pan-Arctic watershed (Ob', Yenisey, Lena, Kolyma, Yukon, Mackenzie) using DNA samples collected from 2003 to 2006, and analyzed with PCR-DGGE and clone library sequencing of 16S rRNA genes. Bacterioplankton community composition in the six rivers shifted synchronously with changes in the Arctic seasons, clustering into three groups: winter/spring, spring freshet, and summer/fall. Community shifts were linked to seasonal shifts in organic matter quantity and form (DOC, DO14C, a375, SUVA, LP), and physico-chemical factors (temperature, pH, alkalinity). These three seasonal communities re-assembled each year in all six rivers, and were remarkably similar among rivers, particularly during the spring freshet. Clone libraries prepared with DNA collected in spring, 2005, showed that these rivers share a common diversity, measured at the phylum/subphylum level and species level. In fact, nearly half of the species-level taxonomic groups (97% sequence similarity) identified in this study included sequences from two or more rivers. The phenomena of synchrony, seasonality, and annual re-assembly in bacterioplankton communities have only been identified in a handful of small regional studies. Our results demonstrate that these patterns also occur on global scales and that bacterioplankton communities shift predictably with circumpolar seasonal changes in environmental conditions.

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LINKS OF GROUNDWATER TO COASTAL NITROUS OXIDE FLUXES

Anthropogenic nutrients in groundwater may stimulate nitrification and denitrification which are major sources of the greenhouse gas nitrous oxide (N2O). N2O fluxes from coastal waters and intertidal zones were hypothesized to be enhanced by groundwater-derived nutrients delivered to a eutrophic embayment of West Falmouth Harbor, Massachusetts.

In 20 sites throughout the harbor during fall 2007, surface waters were 1.5 to 10 times supersaturated with nitrous oxide, corresponding to an average N2O flux of 16 micromol N2O m-2 d-1. N2O concentrations paralleled those of the groundwater tracer, 222-Rn, suggesting groundwater is a N2O source. N2O fluxes from sandy intertidal were also measured in transparent flux chambers during the summer and fall of 2008. Fluxes were 75 micromol N2O m-2 d-1 throughout the harbor and 565 micromol N2O m-2 d-1 along a 12 m transect in a shallow groundwater discharge zone. Intertidal fluxes exceeded previous reports, likely due to both nutrients and direct contributions of underlying groundwater which was 14-135 times supersaturated with N2O. This research highlights the role of groundwater as a significant source of nutrients and N2O to coastal ecosystems.

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PHOSPHATE UPTAKE BY A CORAL REEF FLAT : A MEASUREMENT OF THE STANTON NUMBER

The mass-transfer-limited equation for nutrient uptake is m = St×Ub×Cb, where St is the Stanton number, which is a physical descriptor of the bottom; Ub is water velocity, and Cb the bulk water nutrient concentration. We measured St in the field by using phosphate uptake across a 300m wide mixed coral-algal reef flat in Reunion Island. Phosphate concentrations and current velocities were measured at six stations evenly distributed along a cross-shore transect. We used peristaltic pumps to get integrated water samples for 4-6 hr over the rising tide, to smooth the variability created by complex current trajectories. The gradient (k) of the natural logarithm of phosphate concentration, versus distance along the transect, was $(43\pm6)\bullet10^{-4}$ m^{-1}. Water velocities were measured in the middle of the transect, using an acoustic Doppler current profiler. Depth-averaged cross-reef horizontal velocity (Ux) was 0.042±0.011 $m.s^{-1}$. To account for oscillatory flows, we measured Urms (0.102±0.030 $m.s^{-1}$), using dissolution of plaster forms at the six stations. k was multiplied by the mean water depth, and Ux/Urms, giving the reef flat Stanton number. St was $(19\pm4)\bullet10^{-4}$, which is consistent with published values for coral communities in flumes, given the low water velocities and high 3-dimensional relief of the reef. This corroborates the idea that phosphate uptake by reef flats operates very near a mass-transfer limit.

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GLOBAL PATTERNS IN MARINE MICROBIAL ECOLOGY: IS BACTERIAL GROWTH RESOURCE-LIMITED OR PREDATOR-LIMITED?

Because general trends in microbial ecology are difficult to test using experimental approaches, it is of great advantage to make use of meta-analysis and comparative analysis using empirical datasets available to produce synthesis and integrate studies. In this work we present a meta-analysis to test how and where bacterial growth is controlled by resources (inorganic nutrients and carbon) or predators. In order to reach this goal we have used databases and papers from 1980 until nowadays and briefly reviewed and compared how the slope (k) and the intercept (γ) of the relationship between bacterial biomass and productivity can change between contrasting ocean basins (e.g. Mediterranean Sea, South Pacific Ocean and others). We also explored a density-dependent logistic growth model to estimate the ecological state of bacteria in contrasting ecosystems. The implications of the changes in the parameters (k and γ), possible inferences from growth equations and the possibility of conforming different hypotheses across a gradient of productivity are also discussed in order to understand the role of bacterial growth and its implication in biogeochemical cycles at a global scale.

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INVASIVE QUAGGA MUSSEL BENTHIFICATION NOW DOMINATES AREAL CARBON, NITROGEN, AND PHOSPHORUS INVENTORY ON THE LAKE MICHIGAN MID-LAKE REEF COMPLEX (MLRC).

Formerly bare rock reefs in the MLRC (6% of lake bottom) of central Lake Michigan are now covered with up to 60,000 quagga mussels (*Dreissena bugensis*; QM) per square meter. Collapse of planktivorous fish populations (alewife, chub, whitefish) has been ascribed to QM clearing of seston by filter feeding and subsequent transfer of resources to the benthos. Two offshore reef stations and a depositional control were analyzed for dissolved, seston, zooplankton, and benthic carbon, nitrogen, and phosphorus. In $mmol/m^2$, organismal inventories ranged from 1000-10,000 C, 150-2000 N, and 5-50 P. QM accounted for 70-95% of inventory on the reefs, with areal totals 2-5 times greater than the deeper, depositional station. Seston C:N:P was 191:27:1, more P-rich than zooplankton (300:23:1) and less N-rich than mussels (194:38:1). All food web components were lean in P compared to the Redfield Ratio. Mussels therefore accumulate elements from water column seston beyond their immediate surroundings and enrich the benthos. Structural modification and organic matter deposition as (pseudo)feces have begun a major alteration in the biogeochemistry of formerly bare bottom habitats as well.

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EARLY SEASON OXYGEN DEPLETION IN THE CHESAPEAKE BAY, 2001 – 2008

Beginnings in the 1940's historical records reflect a trend of seasonal oxygen reduction in the deeper portions of the main-stem of the Chesapeake Bay. We measured oxygen, temperature, salinity and chlorophyll concentrations at 20 stations in the Bay each June from 2001 – 2008. We deployed a SeaBird CTD with SBE 43 oxygen probe in full water column casts during a 36-hour transit of the Bay each year. Despite some inter- annual variation in the extent and intensity of oxygen depletion in bottom waters along the main axis of the Bay, it appears that oxygen concentrations continue to decline. Although the Bay typically stratified for only 1 – 2 months prior to our early June sampling, we consistently documented extensive zones of oxygen concentrations < 2 mg/l. The slope and depth of the pycnocline along the Bay axis governed the location of oxygen-depleted bottom waters. We calculated the rates of marine-water subduction and the attendant reduction in oxygen concentration by plotting oxygen changes along isopycnals extending from the mouth of the Bay mouth to its upper reaches.

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BIOPHYSICAL MODEL OF MICROALGAL PRODUCTIVITY IN PONDS

To optimize the design and operation of mass cultures of algae for the Cellana Group and to facilitate comparisons among studies, we developed a quantum-based biophysical model that predicts net production of carbon in a vertically mixed pond over the course of a day as a function of solar irradiance, water depth, and the biomass and photophysiological characteristics of algae. Photosynthesis is a function of absorbed radiation, accounting for all visible wavelengths of sunlight with realistic descriptions of light absorption normalized to biomass for different types and acclimation states of algae. Photosynthetic quotients account for nutrient source and end products (e.g., lipid). The respiration function can come from the literature or relevant observations. The model predicts maximum productivity in ponds in any locale, given explicit assumptions that are easily assessed through sensitivity analysis. Several factors could reduce the yield including down-regulation of photosynthesis in bright light and reductions in the maximum quantum yield of photosynthesis as may occur during nutrient deprivation. All of these processes can be modeled and potentially assessed autonomously in large scale culture operations.

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THE INFLUENCE OF WAVE ENERGY ON PLANT COMMUNITIES AND SEDIMENTARY PROCESSES IN SALT MARSH AND SHALLOW SUBTIDAL ESTUARINE HABITATS

Wave energy is an important, although often unmeasured, parameter influencing the distribution, structure and function of soft-bottomed estuarine habitats. We developed a wave energy model utilizing bathymetry, fetch and wind data and used it to quantify wave energy regimes along estuarine shorelines in North Carolina. Salt marshes, tidal flats, seagrasses, and subtidal sediments are among the habitats that occur along these shorelines, and their distribution is generally limited by wave energy. We examined the relationship between wave energy, plant biomass and sediment accretion in salt marshes, and found that marshes in shoreline environments exhibit higher accretion rates in short Spartina found at higher elevations, in contrast to the higher accretion rates associated with tall Spartina found along lower energy tidal creeks. In shallow, subtidal sediments, we found that the depth distribution of benthic microalgal biomass varied with wave energy and particle-size. In environments where light limits benthic primary production, the contribution of wave energy to light attenuation via sediment resuspension, reflection and refraction is an additional example of the influence of wave energy on ecosystem structure and function.

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DIVERSITY AND COMMUNITY DYNAMICS OF SMALL EUKARYOTES IN THE SARGASSO SEA

Small photosynthetic eukaryotes are common primary producers, but their specific contributions to the carbon cycle are poorly understood. To establish the abundance, diversity and biomass of specific populations in the open-ocean, we explored phytoplankton dynamics at the Bermuda Atlantic Time-series Study (BATS) station where the thermocline was relatively shallow, and at a northern Sargasso Sea (NSS) station, with a deeper thermocline and presumably higher nutrient concentrations. Samples were analyzed using flow cytometry, 18S rDNA libraries, FISH and qPCR. In the NSS, carbon estimates indicated that picoeukaryotes (<2 micrometers) comprised up to 3.3 micrograms carbon/liter. Clone libraries differed at the two sites, but contained sequences from prymnesiophytes (uncultured), prasinophytes (*Micromonas* and *Ostreococcus*), and biliphytes, three groups with different evolutionary histories. Based on specific probes, prymnesiophytes appeared to be the dominant eukaryotes at BATS. *Micromonas* was more abundant in the NSS than at BATS, where it was rarely detected. Similar distribution patterns were observed for *Ostreococcus*. Preliminary results for growth and grazing mortality rates show that, at least for the NSS, picoeukaryotes contributed significantly to carbon production within the picoplankton size fraction.

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PART 1. SIBEO, FLUXES AND DYNAMIC.

The natural resources and environmental diversity of Mexico's coastal zone, have experienced changes and deteriorations of different magnitude in its circulation dynamics, geology, physic-chemistry, biology, as well as in the naturals resources, due to different human activities. In order to rehabilitate these environments, or to allow a sustainable use, it is necessary to apply technologies like the Wave Energy Pumping System (SIBEO, as Spanish acronym), that allows for exchange between coastal water bodies and the ocean without artificial opening of sandbars. In the present work the theoretical effect of the SIBEO is evaluated in the water circulation, hydrochemistry and metabolism of two coastal water bodies chosen by their environmental challenges and fisheries management (Ensenada Port, Baja California and Lagartero Lagoon, Oaxaca). Recommendations for the optimal management based on the SIBEO from hydrological parameters analysis for these ecosystems are provided.

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CHANGES IN THE PHYTOPLANKTON COMMUNITY AND HARMFUL ALGAL SPECIES OF A LOUISIANA (USA) ESTUARY INFLUENCED BY FRESH, NUTRIENT LOADED, MISSISSIPPI RIVER WATER

Water diversion projects, while important for delivering sediments to estuarine systems, also deliver nutrients that can cause eutrophication leading to harmful algal blooms. The presence of algal species, including many toxic cyanobacteria, are determined by changes in their physical and chemical environment over time. Since 1991, Breton Sound Estuary in southeast Louisiana (USA) has been directly influenced by Mississippi River water through the Caernarvon Freshwater Diversion Project. The resulting effects of the changes in salinity and nutrients on the phytoplankton community in the estuary, especially harmful algal species, have yet to be fully investigated. We determined the effects of nutrient loaded freshwater on the phytoplankton community composition on an annual timescale and under varying flow regimes within the estuary, specifically focusing on harmful algal species. By observing changes in harmful algal species' presence and abundance, we also determined when favorable conditions for bloom formation occur within the estuary. This information can aid management decisions regarding the manipulation of diversion projects, helping to prevent the formation of blooms and contamination of commercially important estuarine food webs by harmful algal species.

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A NEW FLUID DYNAMIC MODEL FOR ANALYSIS OF PLANKTONIC PREDATOR-PREY SYSTEMS AND SMALL-SCALE FLUID MOTIONS

We apply a new method of Lagrangian fluid dynamic analysis to a planktonic predator-prey system in which moon jellyfish Aurelia aurita uses its body motion to generate a flow that transports small plankton such as copepods to its vicinity for feeding. With the flow field generated by the jellyfish measured experimentally and the dynamics of plankton described by a modified Maxey-Riley equation, we use the particle Lagrangian coherent structure (pLCS) method to identify the capture region in which prey can be captured by the jellyfish. The properties of the pLCS and the capture region enable analysis of the effect of several physiological and mechanical parameters on the predator-prey interaction, such as prey size, escape force, predator perception, etc. The method can be readily extended to study the effects of physically or biologically-induced small-scale fluid motions on planktontic systems.

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EFFECTS OF THE PAH PYRENE ON SHALLOW WATER SEDIMENT COMMUNITIES DEPEND ON THE DEGREE OF EUTROPHICATION

The aim of this study was to investigate if benthic community response to PAH contamination differs with degree of eutrophication with respect to direct and indirect effects and resilience. Effects of a one-time exposure of pyrene to two sediment communities with different degree of eutrophication were studied in a flow-through mesocosm experiment during 58 days. Pyrene was added to give a concentration ~20μg/g DW (100 nmol/g DW), which is in the higher range for pyrene alone, but in the lower for total PAH in marine sediments. Effects were measured using both functional and structural variables. Functional variables included nutrient and oxygen fluxes, primary and bacterial production as well as potential denitrification, and the structural variables included, Chl a, and community composition of benthic microalgae (BMA), meio- and macrofauna. Pyrene had the largest effect on functional variables in the eutrophied system, whereas effects on structural variables, especially meiofauna, were more pronounced in the non-eutrophied system. Both direct effects and indirect food-web mediated effects were observed, but resilience could not be compared as the impact of pyrene lasted throughout the experimental period.

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PCO_2 DYNAMICS IN A COASTAL SYSTEM IN THE N SOUTH CHINA SEA UNDER THE INFLUENCE OF BOTH A RIVER PLUME AND UPWELLING

Coastal ocean is known to be an important component of the earth climate system, yet the carbon fluxes therein are to be better constrained. Among others, river plumes and coastal upwelling are two of the major meso-scale processes that may cause the variability in both time and space in the coastal ocean. We investigate the dynamics of the surface water pCO_2 and hence the air-sea CO_2 fluxes in a highly dynamic system under the influence of both a strong riverine plume and upwelling based on a cruise to the N South China Sea in July 2008. This plume is apparently associated with a historically strong flood upstream in the Pearl River and extended > 200 km on the shelf, which appears to be highly dynamics at a time scale of weeks. Within the plume, pCO_2 in the surface water was significantly drawdown (to as low as ~ 150 μatm) by intensive biological activities stimulated by the nutrient loads from the Pearl River. Within the near shore upwelling zones, pCO_2 is slightly supersaturated or in equilibrium with the atmosphere, suggesting that the upwelling zone is a weak net source to the atmospheric CO_2 despite of the strong biological consumption therein. The interplay between the riverine plume and nearshore upwelling clearly complicates the interpretation of the pCO_2 dynamics, this presentation will therefore attempt to elucidate the major controls of pCO_2 in such a complex coastal system.

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TOWARDS A GENERAL THEORY OF PHYTOPLANKTON PHOTOACCLIMATION

Phytoplankton cells adjust their intracellular chlorophyll-to-carbon ratio (Chl:C) in response to changes in light, nutrients, and temperature. Chl:C is therefore directly related to phytoplankton specific growth rate (μ). However, to be able to reliably derive μ from Chl:C, it is necessary to mechanistically link the two variables. Different mathematical models have been developed to accomplish this task, but often they are based on empirical expressions and their parameters show relatively large variations that appear to be species specific. Here, an attempt is presented to solve this limitation. A mechanistic model of photoacclimation, based on testable first principles, is presented. In this steady-state model, cellular resources invested in the light-harvesting apparatus are adjusted to the carbon-fixing capacity, which in turns is assumed to be dependent on nutrient availability. Model predictions will be compared to existing experimental data sets to evaluate the robustness of its parameters.

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EASTERN TROPICAL PACIFIC PROJECT: A CHANGING ENVIRONMENT

The goal of this project is to characterize the spatial and interannual variability of physical, chemical, and biological properties between low productivity and high productivity regions of the eastern tropical Pacific, particularly in relation to the oxygen minimum zone (OMZ). During October 2007, we sampled offshore of southern Mexico (Tehuantepec Bowl) and southward to the Costa Rica Dome upwelling region. Highest chlorophyll concentrations (1.79 μg chl l^{-1}) occurred offshore of the Gulf of Tehuantepec, likely driven by trans-isthmic wind jets. Nutrients were higher in surface waters of the Costa Rica Dome, although chlorophyll concentrations remained relatively low (max. 0.74 μg l^{-1}). Microzooplankton grazing exceeded phytoplankton growth at the Costa Rica Dome, but not at the northern site. Microzooplankton concentrations were highest in surface waters and decreased with depth at all sites. The upper depth of the OMZ was relatively shallow (40 m) compared to earlier studies. Fine scale vertical profiles using a laser line-scan imaging system (SIPPER) indicated that a dense *Rhizosolenia* bloom occurred at the Tehuantepec Bowl station. In general, mesozooplankton were most abundant above the OMZ.

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USING STABLE ISOTOPES TO ASSESS TROPHIC POSITION OF AURELIA SP.5 (CNIDARIA: SCYPHOMEDUSAE) IN MLJET LAKES (CROATIA)

Determining the trophic position and interactions of medusae with other members of the pelagic community is complicated by their sudden appearance and aggregated spatial dispersion during blooms. Moreover, their gelatinous composition makes it difficult to define their diet using gut content analysis or to detect their presence in their predators' guts. Stable isotope (SI) analysis is a powerful tool for such studies but has been rarely used to discern trophic position for these animals. The saltwater 'lakes' of Mljet Island (Croatia) contain a year-round resident population of Aurelia sp.5 (Cnidaria: Scyphomedusae) and afford a uniquely controlled environment to study the role of medusae in a marine food web. Gut content analysis from previous years has provided background data to inform stable isotopic assessments. We present results on the stable isotope ratios of seston, zooplankton, medusae, and larval and juvenile fish as a first step toward the evaluation of the trophic position and interactions between medusae and other members of this marine community.

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INVASIVE MACROPHYTES AND TROPHIC WEBS IN NATURAL REGIONAL PARK OF BRIERE (WESTERN FRANCE)

Biological invasions in preserved wetlands as the Regional Natural Park of Brière result in huge changes, particularly of aquatic vegetation. Thus macrophytic vegetation of Brière, which was very rich and diversified gradually rarefied because of the predation by Louisiana Crayfish (*Procambarus clarkii*). Thus the Water Primerose (*Ludwigia grandiflora* ssp. *hexapetala*), macrophyte classified among the 10 worst invasive species into the world, could colonize these empty aquatic areas. Then the crayfish from now on attacked Water Primerose which was almost eliminated from the ditches and ponds. An invasive rodent, the Coypu (*Myocastor coypus*) contributed to the dissemination of Water Primeroses towards the wet meadows where the crayfish feeds when they are flooded. Lastly, a predatory bird of crayfish, the African Sacred Ibis (*Threskiornis aethiopicus*) settled in the park. Radical changes occurred at the same time of the macrophytic vegetation, with the replacement of the indigenous species by introduced species, but also with the rise of new trophic webs with invasive taxa which modified the functioning of the whole ecosystem.

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CLOSING THE GAP BETWEEN PRIMARY AND FISH PRODUCTION: THE NEED FOR A PARADIGM SHIFT TOWARDS MORE DIVERSE AND INTRINCATE CARBON CYCLING WEBS IN THE HCS

Wind-driven coastal upwelling of nutrient rich waters in the Humboldt Current System (HCS) promote high levels of primary production that supports one of the most important fisheries of the global ocean. Coastal upwelling ecosystems have been assumed to be composed of short trophic pathways, to account for thermodynamically efficient energy transfer to fish. Here we show that bacterioplankton in the HCS may be respiring over 80% of the carbon fixed by primary producers in the photic zone in what appears to be a highly coupled primary and microbial secondary production ecosystem. This observation has profound implications for both fisheries and biogeochemical models raising the question of how it is that the HCS can support some of the world's largest fisheries if the trophic transfer of energy to fish appears to be seriously reduced by bacterial activity. We propose that any attempt to balance carbon budget through different trophic levels in upwelling systems should take in consideration new trophic routes from primary producers to fishes.

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ACCUMULATION OF PERIPHYTIC BIOMASS IS NOT DIRECTLY CORRELATED WITH NUTRIENT LEVELS IN IRISH STREAMS

Nutrient enrichment threatens freshwater ecosystems worldwide. Yet, there is still a remarkable lack of knowledge on the ecological consequences of nutrient enrichment in streams. Such knowledge is urgently required to establish nutrient criteria, particularly in those many regions of the world where pristine streams are under threat of human development. We have studied periphyton accumulation and macro-invertebrate communities in summer, autumn and spring in 32 streams (ranges of nutrients: 0-0.55mgP/L and 0-10mgN/L). There were no seasonal differences in stream nutrient status, *i.e.* a stream that had low nutrients at one season had also low nutrients at the other two seasons and *vice versa*. The relationships between nutrients and periphyton were best described by filled "humped"-shape curves. The decrease of Chl *a* at higher nutrients in summer was strongly correlated with increased biomass of specific grazers (*e.g. Baetidae*), suggesting top-down regulation of primary production. Thus, contrary to our expectation higher nutrient levels did not elicit higher algal biomass, but apparently higher grazing pressure. Our results question whether Chl *a* level is a suitable parameter to determine trophic status of streams.

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ECOSYSTEM THRESHOLDS WITH HYPOXIA

Hypoxia is one of the common effects of eutrophication in coastal marine ecosystems and is becoming an increasingly prevalent problem worldwide. The causes of hypoxia are associated with excess nutrient inputs, although the response is strongly modulated by physical processes. Changes in climate, particularly temperature, may also affect the susceptibility to hypoxia. Hypoxia is a particularly severe disturbance because it causes death and catastrophic changes in the ecosystem. Bottom water oxygen deficiency not only influences the habitat of living resources, but also the biogeochemical processes that control nutrient concentrations. Three large coastal marine ecosystems (Chesapeake Bay, Northern Gulf of Mexico, Danish Straits) all demonstrate thresholds whereby repeated hypoxic events lead to an increase in susceptibility of further hypoxia and accelerated eutrophication. Once hypoxia occurs, reoccurrence is likely and may be difficult to reverse. Therefore, elucidating ecosystem thresholds of hypoxia and linking them to nutrient inputs is necessary for the management of coastal marine ecosystems. Finally, projected increases in warming show an increase in the susceptibility of coastal marine ecosystems to hypoxia such that hypoxia will expand.

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BACTERIAL COMMUNITY PROFILING FOR CORAL RESTORATION

Coral aquaculture and transplantation are currently being employed to address worldwide decline of coral reefs and promote reef ecosystem recovery. Concerns with these restoration strategies include possible introduction of diseases onto natural reefs and the vulnerability of transplanted corals to bleaching and disease. Before microbial community composition can be incorporated into assessments of coral health, it is necessary to understand the spatial and temporal variability in coral-microbe associations. Molecular (ARISA) and culture-based and methods were employed to determine composition and variability in the microbial community associated with corals used for restoration. Spatial sampling on three coral species (Diploria clivosa, Montastraea annularis, Montastraea faveolata) revealed significant differences in microbial communities found in mucus collected from different locations within the surface of a single coral colony. A temporal sampling experiment revealed that corals (or their associated microbes) can adapt to reduce Vibrio numbers upon repeated sampling. The mechanism of this adaptation is currently unknown, but will be a focus of future studies. Understanding microbe-coral interactions is key for the future incorporation of microbial community profiling into coral health assessments, which has direct implications for coral restoration and conservation.

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THE FATE OF VIRAL PRODUCTION IN PELAGIC AND BENTHIC MARINE SYSTEMS

Marine viruses represent a significant source of mortality in a wide range of organisms, influencing ecological processes and biogeochemical cycles of the world's oceans. Since viral abundances can be relatively stable over seasonal timescales, it has been hypothesized that rates of viral production and loss should be equal. However, as viral production and viral decay are probably controlled by different factors, it has been also suggested an imbalance between viral production and decay rates budgets. In the present study we carried out independent measures of viral production and viral decay in surface seawaters, in shallow and in deep-sea sediments (at different sediment horizons), in order to quantify gross viral production, viral decay and the actual viral-induced prokaryotic mortality. The analysis of viral dynamics indicated an imbalance between that viral production and decay, in both seawater and sediments. The addition of a pool of enzymes (proteases, proteinases and DNases) did not determine a significant increase of viral decay in the sediment. These results provide new insights on the factors influencing viral-prokaryotic dynamics in marine ecosystems.

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FIDDLER CRAB BURROWS ARE "HOT SPOTS" FOR *VIBRIO PARAHAEMOLYTICUS*

Vibrio parahaemolyticus are common, naturally occurring bacteria in coastal environments. Introduction by tidal flooding and the physical advection of porewater into and out of sediments accounts for the transport of *V. parahaemolyticus* to and from the rhizosphere of salt marsh plants. Infaunal burrows also serve as conduits for increased transport of *V. parahaemolyticus* by providing open channels from the rhizosphere to tidal creeks. A seasonal study was conducted in Georgetown, SC to quantify *V. parahaemolyticus* in tidal water, infaunal burrow water and interstitial porewater. Fiddler crab burrows were significantly enriched relative to creek water and porewater. A seasonal trend of increased abundances during the warmer months was observed. Average CFU counts during the summer months were 256 CFU/ml for creek water, 4791 CFU/ml for burrow water and 106 CFU/ml for porewater. Rep-PCR and MLST analysis of isolates identified strain level genetic variation of *V. parahaemolyticus*. These results indicate that burrows are "hot spots" of bacterial numbers and strain diversity. Tidal transport of enriched burrow water has significant implications for *V. parahaemolyticus* ecology and public health management initiatives.

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NUTRIENT LIMITATION OF ALGAE AND BACTERIA IN LAKE KIVU (EAST AFRICA)

Nitrogen and phosphorus frequently limit phytoplankton growth in oligotrophic aquatic systems. Iron limitation is less susceptible to occur in lakes because of the proximity of terrestrial influences. We challenge this hypothesis in Lake Kivu (East African Rift Valley) during dry and wet seasons 2007 and 2008. The objective of this study was to examine the role of Fe in modifying the response to P and N supplementation of Lake Kivu phytoplankton, with a special attention to N-fixing cyanobacteria. Six nutrient enrichment experiments involving the addition of nutrient (nitrogen, phosphorus and iron) alone, as well as in combination, were conducted with epipelagic waters from two offshore stations of the lake. Phytoplankton biomass and composition were followed by HPLC measurements during 4-5 days, while bacteria were enumerated by flow cytometry. Algae co-limitations by Fe and N were frequently observed during dry seasons while Fe-limitations disappeared during wet seasons, with more frequent P-limitations. Results, including phytoplankton stoichiometry and competition with bacteria, will be discussed with the influence of hydrological and meteorological events.

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DISTRIBUTION OF BENTHIC AND HYPORHEIC INVERTEBRATES ALONG A FLOW PERMANENCE GRADIENT IN A NEW ZEALAND ALLUVIAL RIVER

Naturally intermittent rivers comprise a substantial proportion of the Earth's freshwater ecosystems, but the state of knowledge about these rivers is rudimentary. Tools for analyzing flow intermittence and quantitative intermittence-biodiversity relationships are lacking. The Selwyn River (South Island, New Zealand) is a natural laboratory for exploring intermittent flows and their ecological consequences. Along the mainstem of the river there is a 58 km-long flow-permanence gradient (7-100%), with losing and gaining segments and perennial, intermittent and ephemeral reaches. Cross-sections along the river were visited monthly from 2004 to 2006 to measure discharge and vertical hydraulic gradients and to collect benthic and hyporheic invertebrates. Discharge data were used to calibrate a hydrologic model that predicts long-term flow conditions at each site and computes intermittence statistics. Multivariate analyses indicated that differences in invertebrate communities along the river were best explained by long-term flow-permanence, drying frequency, and duration of flow prior to sampling. Across sites, invertebrate density and richness and assemblage stability were correlated with flow permanence. Invertebrates that were restricted to intermittent reaches were rare. Instead, invertebrate assemblages at intermittent sites were nested subsets of assemblages at perennial sites.

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LONG-TERM PATTERNS OF THE MACROBENTHOS OF CHESAPEAKE BAY, USA (1985-2007) – LESSONS AND LIMITS OF RESTORATION EFFORTS

An essential restoration goal for Chesapeake Bay is the amelioration of eutrophication effects as indicated by reductions in nutrient levels, chlorophyll levels and rates of primary productivity. We summarize restoration efforts and present results of long-term trend analyses that include (1) spatially widespread flow effects for total nitrogen and dissolved inorganic nitrogen but few flow effects for total phosphorus and dissolved inorganic phosphorus, (2) few significant improving trends in nutrients especially when autoregressive terms are included, (3) strong differences in chlorophyll versus primary productivity patterns with the latter including non-linear trends of concern. We present trends in the Benthic Index of Biotic Integrity (B-IBI) developed for the Bay with data from both fixed-point stations (1985-2007) and probability based stations allocated among ten strata (1996-2007). Using the probability based data, significant increases in the area of a stratum with degraded benthic community condition occurred for several of the strata. Despite substantial restoration efforts, significant changes in benthic condition that would indicate widespread improvements in abundance, diversity, or biomass of organisms, were not observed.

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IMPACT OF GLOBAL CHANGE ON FUNCTIONAL STRUTURE AND DIVERSITY OF STREAM FISH COMMUNITIES

It is now widely accepted that climate change affects ecosystems. Nonetheless, few studies have assessed the impacts of global warming on functional structure and diversity of communities. Yet, functional approaches are mechanisms oriented and could help defining general laws about the ecological impacts of global warming. In this study, we analysed temporal changes in functional structure and diversity of 7 stream fish communities submitted to significant warming (ca +2°C) during the last two to three decades. We used 22 traits that were divided into three main niche axes : habitat, diet and reproduction. We found that proportions of downstream species, herbivorous species and r-strategists increased during the study periods. The functional richness of all the three niche axes rose, indicating that new comers occupied new niches. However, the functional evenness decreased indicating that few niches were gradually more occupied compared to the others. The promotion of r-strategists and – at least transitionally – of the functional richness suggests that, besides the specific impacts of the warming, climate change also acts on ecosystem dynamics as other disturbances.

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DEVIATIONS FROM REDFIELD RATIO: WHY COMPETITION WITHIN THE PLANKTONIC COMMUNITY MATTERS

The Refield ratio is a cornerstone of our understanding of the ocean biogeochemistry. The long observed deviations from Redfield ratio have been subject to diverse mechanistic interpretations. In most of these interpretation, as well as in Redfield's original theory, coexistence between fixers and non-fixers is taken for granted. We argue that such a coexistence is not granted, and that more generally, competition within the plankton may play a major role in the stoichiometry of the water column. Building on the resource-ratio theory and its recent extensions to nutrient recycling, we present a biogeochemical model that accounts for the competitive interactions within the phytoplankton. From the model, it comes clear that competition mechanisms drive the overall stoichiometry of the community. As the outcomes of competition depend on the nitrogen to phosphorus ratios supplied to the water column, these ratios determine whether the seston's stoichiometry is homeostatic, or whether it is defined by bottom up mechanisms. We discuss these theoretical results in the light of recently published data on seston stoichiometry in fresh and marine waters.

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FACTORS AFFECTING PHOSPHATE CYCLING IN BERING SEA SEDIMENTS

Phosphate flux between marine sediments and bottom water is affected by rates of organic-matter oxidation, bioirrigation, and sorption processes. We assessed the relative importance of these processes in sediments of the Bering Sea, a region where nutrient exchange between the broad shallow shelf and overlying water may influence water column productivity and where climate change appears to be causing a shift in ecosystem dynamics. We directly measured phosphate flux using core incubations and we also measured rates of bioirrigation, sediment oxygen consumption, infaunal burrow densities, amorphous iron-hydroxide concentrations and phosphate sorption isotherms at each station. The results indicate that processes controlling phosphate cycling vary among different regions of the Bering shelf. On the middle shelf, phosphate flux positively co-varies with infaunal burrow densities whereas along the outer shelf it is dependent upon the rate of oxygen consumption and the concentration of amorphous iron hydroxides. This variation in control of phosphate cycling suggests that these regions of the Bering Sea shelf will show differential responses to climate-driven ecosystem change.

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HINDCASTING SEA NETTLE ABUNDANCE AND HISTORIC EFFECTS ON THE CHESAPEAKE FOOD WEB

The scyphomedusa, *C. quinquecirrha* (the sea nettle), is a dominant consumer in the Chesapeake Bay food web. Its abundance has varied dramatically over the past 50 years, most likely as a result of changes in the abundance of oysters, which provide substrate for the overwintering polyps, but may also be affected by climate variability. A long term program of visual counts in Solomons, Maryland, near the mouth of the Patuxent River, was begun in 1960 by David Cargo, and is continued at present by our laboratory. These data have contributed to understanding inter- and intra-annual variation in sea nettles, but do not provide quantitative information on absolute abundances needed to understand historic effects on the food web. During 2008 we conducted simultaneous sampling with visual counts, plankton nets, hand-towed nekton nets, and tucker trawls at a number of sites to predict historic densities from the earlier, more qualitative data. We present these hindcasted densities, and the effects that changes in sea nettles have potentially exerted on the Chesapeake Bay food web for a variety habitats, from 1960 through the present.

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COMPARING YEAR-TO-YEAR TO SEASONAL AND TIDAL VARIABILITIES FOR ZOOPLANKTON DENSITIES IN A TURBID ESTUARY USING A 26 YEARS SURVEY (GIRONDE ESTUARY, FRANCE)

In the high turbid Gironde estuary, zooplankton is localized at the basis of the pelagic trophic web linking the continental input to exploited macrofauna since primary production is light limited. Estuarine zooplankton community is dominated by copepods and mysids. Three kinds of temporal variability of zooplankton densities were investigated using a long-term survey in the oligomesohaline area of the Gironde estuary: (i) year-to-year: monthly survey from 1978 to 2003, (ii) seasonal: 9 months per year and (iii) tidal: 4 times per tidal cycles. The 3 kinds of variability were significant in explaining fluctuations of zooplankton densities (nested ANOVA design). The relative importance of year-to-year variability is low compared to seasonal variability which was the dominant source of variation for the copepod *Eurytemora affinis* and the mysids *Neomysis integer* and *Mesopodopsis slabberi* or to tidal variability, which is the dominant source for *Acartia bifilosa* and *A. tonsa*. Year-to-year variability is mainly due to 3 and 8-years cycles related to North Atlantic Oscillation. No significant long-term trend was highlighted except for *A. tonsa*, a species recently introduced into the upstream estuary.

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SIMULTANEOUS DERIVATION OF EQUILIBRIUM AND KINETIC INFORMATION FROM SITU DYNAMIC MEASUREMENTS OF METALS IN NATURAL WATERS

Fluxes measured using dynamic techniques, such as voltammetry and DGT (diffusive gradients in thin-films), can be affected by the distribution of species, their transport dynamics (diffusion) and the dissociation rates of the complexes, but. unravelling this information is challenging. Manipulation of the physical properties of DGT has enabled the simultaneous derivation of kinetic and speciation information for natural waters. Deployment of multiple DGT devices with a range of diffusion layer thicknesses can provide directly a visually informative kinetic signature for a range of metals, and with more sophisticated interpretation, information on the dissociation rates of complexes. Complementary information on the discrimination between species on the basis of molecular size, as related to their diffusion coefficients, can be obtained by co-deployment of devices with gels layers with different diffusion layer characteristics. With a single suite of measurements, an iterative procedure can be used to obtain both speciation and kinetic information. In situ measurements using this approach in a freshwater were consistent with other speciation techniques, while providing new information on the in situ rates of dissociation and diffusion coefficients of complexes.

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DISSOLVED ALUMINIUM IN THE ARCTIC AND ANTARCTIC OCEANS

Samples were collected for dissolved Aluminium (Al) with a new all-titanium ultraclean CTD system for trace metals (de Baar et al. 2008, MarChem, 111, 4-21) during the IPY-GEOTRACES program of the ARK XXII/2 and ANT XXIV/3 expeditions aboard R.V. Polarstern. These are the first ever comprehensive datasets of dissolved Al in the polar oceans. Surface concentrations of Al in the Arctic indicate that neither fluvial nor atmospheric inputs were significant. The deep Al concentrations provide evidence that water from the Barents Sea and Kara Sea strongly influence the deep waters of the Eurasian Basin by deep slope convection. Furthermore, Al showed a nutrient type profile and a strong correlation was found between Al and the nutrient Silicate. In the Southern Ocean and Weddell Sea Al concentrations were much lower and no correlation with Silicate was found. However, like in the Arctic, surface concentrations indicate atmospheric input was insignificant in the Southern Ocean. The deep Al concentrations show that deep water formation also increases the Al concentration in the deep Southern Ocean and Weddell Sea.

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CELL LYSIS DURING COCCOLITHOPHORID BLOOMS IN THE NORTHERN BAY OF BISCAY

Phytoplankton cell lysis occurs in natural populations and is often associated with viral activity and zooplankton grazing. Cell lysis rates are expected to increase towards the decaying phase of the bloom and may be associated with enhanced microbial activity and export of particulate matter to the seafloor. Their estimation was based on the measurement of esterase (a cytoplasmic enzyme) activity expected to appear in the water only after cell breakage. Field investigations, supported by remote sensing data, were conducted in recent years during late spring in the Northern Bay of Biscay, where frequent and recurrent coccolithophorid blooms are observed. Results on cell lysis rates determined in surface waters will be presented with relevant biogeochemical parameters (temperature, particulate organic and inorganic carbon, transparent exopolymer particles, nutrients, chlorophyll a) in order to investigate phytoplankton dynamics in relation to coccolithophorid development. The use of this parameter to characterize bloom termination, especially during coccolithophorid blooms will be discussed.

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AN ESTIMATION OF EXPERIMENTAL ARTIFACTS DURING ANAMMOX INCUBATIONS

Anaerobic ammonium oxidation (anammox) and denitrification are considered the main N_2 producing processes in anoxic waters. Although anammox has only recently been shown to occur in natural environments, it might be more important than denitrification under certain conditions. Anammox has been found to dominate N_2 production in oxygen minimum zones (OMZ) including that off the Chilean coast. To verify these results, we designed experiments to study the effect of experimental artifacts on the intensity of anammox and denitrification. We added different amounts of N_2O to the OMZ water to investigate if denitrification was slowed down when removing N_2O during degassing the OMZ water. We also added 7μM oxygen to the anoxic water to investigate the effect of accidental oxygen introduction during handling and sampling on denitrification and anammox rates. Both experiments showed that anammox remained the dominant process. A final experiment showed that denitrification dominated over anammox in electron donor incubated OMZ water. This suggests that the limited supply of electron donors in the OMZ limit denitrification to such extent that anammox becomes the dominant N_2 producing process.

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TIMING AND PLACING SAMPLINGS TO OPTIMALLY CALIBRATE A REACTIVE TRANSPORT MODEL: EXPLORING THE POTENTIAL FOR *ESCHERICHIA COLI* IN THE SCHELDT ESTUARY

For the calibration of any model, measurements are necessary. As measurements are expensive, it is of interest to determine beforehand which kind of samples will provide the maximum of information. Using a criterion related to the Fisher information matrix, it is possible to design a sampling scheme that will enable the most precise model parameter estimates. This approach was applied to a reactive transport model (based on SLIM) of *Escherichia coli* in the Scheldt Estuary. As this estuary is highly influenced by the tide, it is expected that careful timing of the samples with respect to the tidal cycle will have an effect on the quality of the data. The timing and also the positioning of samples were optimised according to the proposed criterion. In the investigated case studies the precision of the estimated parameters could be improved by up to a factor of ten, confirming the usefulness of this approach to maximize the amount of information that can be retrieved from a fixed number of samples.

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POTENTIAL NUTRIENT RETENTION IN RESTORED FLOODPLAINS AND STREAM BEDS

Floodplain restoration is often carried out for hydrological and /or nature development reasons. However, the nutrient retention capacity of restored floodplains and streambeds is rarely taken into account. In this study the potential of these restoration projects to retain nutrients is explored, based on analysis of field data and modeling the nutrient cycling. Predominant mechanism is the increase in time of travel or hydrological residence time. Also, the increase of sites that promote sedimentation and denitrification contribute to nutrient retention. Retention capacity from different lowland catchments is calculated from mass budgets and estimated process rates. In addition, a hydrodynamic model of a river and a lowland stream are constructed and run for different options. With this, the effect of re-meandering, floodplain reconnection, period and frequency of inundation are studied. Also seasonality is addressed. Field data analysis and modeling results are used to set up simple relationships for estimating retention rates based on major catchment and stream properties.

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PART 2. PREVIOUS HYDRO-CHEMICAL CONDITIONS, MONITORING METHODS AND SIBEO EFFECTS IN DILUTION AND LARVAE PUMP.

The natural resources and environmental diversity of Mexico's coastal zone, have experienced changes and deteriorations of different magnitude in its circulation dynamics, geology, physic-chemistry, biology, as well as in the naturals resources, due to different human activities. In order to rehabilitate these environments, or to allow a sustainable use, it is necessary to apply technologies like the Wave Energy Pumping System (SIBEO, as Spanish acronym), that allows for exchange between coastal water bodies and the ocean without artificial opening of sandbars. In the present work the theoretical effect of the SIBEO is evaluated in the water circulation, hydrochemistry and metabolism of two coastal water bodies chosen by their environmental challenges and fisheries management (Ensenada Port, Baja California and Lagartero Lagoon, Oaxaca). Recommendations for the optimal management based on the SIBEO from hydrological parameters analysis for these ecosystems are provided.

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PAST PERIODS OF VARIABLE ACIDITY IN THE EASTERN MEDITERRANEAN

Present assessments of ocean acidification usually refer to the Mediterranean as a carbonate oversaturared thus not so endangered ocean basin, whereas the short ventilation time of ~50 years suggests a rapid potential response to changing environmental conditions. However, when looking into past records, clearly rapid variations in Mediterranean acidification state have occurred. Considerable decreases in sedimentary carbonate are known to occur in organic-rich units (sapropels. Obviously, such events are not limited to these intervals but occur more regularly. Part of these observations may be related to changes in ecology but partly also to dissolution events. These variations must be related to the very subtle balance in the eastern Mediterranean where slight environmental/climatic disturbances have resulted in major and abrupt system perturbations with dramatic consequences. Not only such major changes on the ~ 20 kyr but also higher frequency, distinct but more delicate, variations appear to occur.

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EVOLUTION OF PLANKTON CELL SIZE IN TURBULENT WATERS

The balance between size-related matabolic activities and sinking is known to affect size composition of planktonic communities both on the ecological and the evolutionary timescale. It is believed that the major driver towards reducing plankton size is the fact that larger cells with negative buoyancy sink below the mixed mayer. In this work, we address the role of small-scale turbulence and of its temporal fluctuations in the adaptive evolution of cell size. We show that the outcome of the evolutionary dynamics, that is the prevalence of small or large-sized particles, depends both on the turbulent state of the mixed layer, affecting the dependence of the sinking rate on the cell size, and on the frequency of periodic changes in turbulence properties. In general, larger-size plankton is favoured for higher turbulence and for fast changes in the turbulent state. This opens a question on whether one can recognise regional-level processes whereby the properties of small-scale turbulence (modulated by wind, for instance) cause an inversion of the evolutionary trend towards small sizes, and on the time scale of evolutionarily relevant variations in turbolence.

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RNA INTERFERENCE IN THE MARINE DIATOM PHAEODACTYLUM TRICORNUTUM

Diatoms are a key phytoplankton group in the contemporary ocean. In the last years, different laboratories have put a lot of efforts to develop molecular-based techniques and to make diatoms accessible to genomics technologies. However, still a major limitation for the study of their biology is the lack of tools to generate targeted gene knock-out or knock-down mutants. We have recently demonstrated that it is possible to inhibit gene expression in Phaeodactylum tricornutum using RNA interference, a double-stranded RNA triggered post-transcriptional gene silencing process that efficiently works in many organisms. In particular, we have shown that it is possible to silence a GUS reporter gene, expressed in transgenic diatoms, by introducing into the cells a vector containing an antisense or inverted-repeat fragment of the GUS gene. Remarkably, RNAi seems to work also on endogenous target genes. The data open the way for functional genomics studies and represent a major advance for understanding diatom biology and ecology. In addition, the presence of poorly conserved silencing machinery in diatoms provides further information for the continued investigation of evolution and diversification of RNAi pathways in eukaryotes.

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DECOUPLING AND ADAPTATION OF TROPHIC INTERACTIONS IN AQUATIC FOOD WEBS UNDER CLIMATE CHANGE

Climate warming has been shown to advance the seasonal timing of life cycle events. Species-specific differences in these changes in phenology may result in a decoupling of trophic relationships in food webs and subsequent cascading effects on community structure. For the timing of life cycle events each species requires specific cues, used as proxies for the suitability of the environment for their reproduction and growth. Climate change may change the validity of the proxies different species use. The fundamental questions underlying our research are threefold: 1) What proxies do different members of the aquatic food web use to estimate the suitability of environmental conditions for successful reproduction and growth? 2) Could projected climate warming invalidate the use of these proxies and lead to a decoupling of trophic interactions? 3) Can adaptation to projected climate warming maintain or restore trophic interactions? We have tested hypotheses generated from these fundamental questions using an integrated approach of both experiments and models. Our observations indicate that the composition of the overwintering community and the trophic state of lakes impact the occurrence of cascading effects.

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THE ROLE OF BIOCONVERSION BY HARPACTICOIDS AT THE BASIS OF MARINE FOOD WEBS: COMBINING FATTY ACIDS AND STABLE ISOTOPE TRACERS

In both freshwater and marine environments polyunsaturated fatty acids (PUFAs) are essential compounds that can limit zooplankton productivity. Efficiency in energy transfer in food webs has been related to differences in food quality in terms of fatty acids (FA) at the plant-animal interface. Copepods play a crucial role at this interface acting as grazers on primary production and as food for higher trophic levels. In the laboratory, the harpacticoid copepod *Microarthridion littorale* grazed during 9 days on 13C labelled diatoms and bacteria. A screening for 13C enrichment and FA composition of both food sources and the grazer showed that this harpacticoid copepod was able to bioconvert short chain FA into long chain PUFAs. From an ecological point of view these data suggest that the ability of harpacticoids to elongate fatty acids enables them to live on poor quality food which may present an advantage in niche competition. In contrast to planktonic Cladocera and Calanoida that are very inefficient in bioconversion, it seems that benthic copepods developed this ability to strive on poor quality food.

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COMPARATIVE ANALYSIS OF GENOME FRAGMENTS OF ACTINOBACTERIA AND ALPHAPROTEOBACTERIA FROM A FRENCH MESOTROPHIC LAKE

Five environmental fosmid clones from a bacterial freshwater metagenomic library were sequenced. From the small-subunit rRNA genes, these clones were affiliated to clades acI-A acI-B and acIV of Actinobacteria and GOBB-C201 and LD12 of Alphaproteobacteria. Annotation analysis allowed the identification of 164 open reading frames (ORFs). The taxonomic affiliation of Actinobacteria ORFs showed that all genes of clade acI (A and B) belonged to this pylum whereas several genes from clade acIV resulted from likely horizontal transfert from various bacterial phyla (Cyanobacteria, Proteobacteria). Genes from clade LD12 were similar to those of marine bacteria Candidatus pelagibacter ubique. The functionnal annotation of all these genes evidenced that most of CDSs from Actinobacteria fosmid were related to amino acid and nucleic metabolisms and that these metabolic pathways were less represented in fosmids belonging to alphaproteobacteria. The CDSs of this latter subclass were related to xenobiotic degradation and stress regulation. From these results and previous metagenomic experiment (15000 fosmid-end sequences), we are able to propose some hypothesis about ecological role of these bacteria in lakes.

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CHANGES IN THE BIOMASS AND DISTRIBUTION OF BERING SEA JELLYFISH IN RELATION TO REGIME SHIFTS

A dramatic increase in jellyfish biomass over the eastern Bering Sea shelf was documented during the 1990s. Their biomass peaked in summer 2000 and then declined precipitously, stabilizing at a moderate level after 2001. The onsets of the biomass increase and decline coincided with transitions between climatic regimes. The relationships between jellyfish biomass and temperature, ice cover, atmospheric variables, current patterns, zooplankton biomass, and associated fish biomass in two regions were examined using Generalized Additive Models (GAM). Analyses indicate that jellyfish outbreaks were influenced regionally by interacting variables such as sea ice cover, sea surface temperature, currents, wind mixing and food availability. During the 27-year time series, the distribution of jellyfish spread northwestward from localized areas along the Alaska Peninsula to cover much of the eastern Bering Sea shelf. An ocean circulation model is being used to understand factors responsible for the observed changes in jellyfish spatial distributions. High latitude jellyfish may not thrive in warming seas, but populations may move northward with continued global warming.

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PRO_2FLUX : A SOFTWARE FOR PROFILE QUANTIFICATION AND DIFFUSIVE O_2 FLUX CALCULATIONS

We report a new software, PrO_2flux, to quantify the vertical distributions of O_2 concentration measured in aquatic sediments. The program proposes a friendly graphical user interface to visualize and quantify oxygen profiles semi-automatically. Once a data set selected and various parameters set in the program (e.g. solubility, diffusivity), user is invited to indicate the position of the sediment-water interface to convert the brut signal (e.g. in volts) in concentration units. Then, PrO_2flux enables making diffusive O_2 calculations among three of the most widely used models: (1) Fick's first law, (2) a quadratic curve-fitting approach and (3) the Berg's model (PROFILE program). In the last case, the software generates automatically the input data file for running afterward the PROFILE program. PrO_2flux has been developed with the intention of integrating microelectrode data obtained specifically with *Profix* and *SensorTrace Pro* from *Unisense®* (Denmark). However, the program can be modified to process any ASCII file containing similar data. The details of the software are presented throughout examples to document the various possibilities of this program.

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HYDROGEN PRODUCTION BY CHLAMYDOMONAS REINHARDTII

Green microalgae are able to produce molecular hydrogen. But rates of production remain actually too low for an industrial scale application. Important breakthroughs are requested in the optimisation of metabolic conversion, as well as in the development of adapted production processes (photobioreactors). Even for classical application (like biomass production), efficiency of such processes is highly dependent of the light supply and reactor geometry. In the particular application to H2 photobioproduction, complexity is increased, metabolic pathways being indeed not well identified, and a high coupling being observed between culture conditions and biological responses. The overall H2 release is thus a result of complex, interacting, and transient intracellular mechanisms, influenced by extracellular conditions making optimisation very difficult to achieve. An integrated approach is presented, combining bioprocess and physiological studies for a methodical optimization of H2 production using photosynthetic microorganisms. Indepth characterisation of the relation between biological kinetics and evolution of culture conditions under H2 producing conditions allow to set-up new culture protocols and control strategies, to adapt for example, environmental conditions in photobioreactors during H2 producing process by Chlamydomonas reinhardtii.

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LATE SUMMER MESOPELAGIC CARBON REMINERALISATION IN THE ATLANTIC SECTOR OF THE ANTARCTIC CIRCUMPOLAR CURRENT

We analysed mesopelagic biogenic barium (mesoBaxs) in suspended matter during the Bonus-Goodhope (BGH) IPY-GEOTRACES cruise. The sampling area covers a north – south transect from the Subtropical Zone (STZ) up to the northern Weddell Gyre (WG) along the Greenwich meridian. Baxs profiles exhibit a maximum as is usually observed in the upper mesopelagic zone (200-550m). Using the mesoBaxs depth weighted average as a proxy for carbon remineralisation, we found that mesopelagic remineralisation is maximal in the Polar Front Zone (PFZ). Compared to the PFZ, remineralisation is lower by 20% to 50% in the WG and the STZ area, respectively. A similar latitudinal trend was already observed during late spring for the Australian sector of the Southern Ocean, but the intensity of remineralisation seems to be systematically higher during BGH. These results confirm higher mesopelagic remineralisation in summer compared to spring and also more intense remineralisation in the PFZ. The data will be discussed along with other parameters such as phytoplankton community, nutrient utilization and carbon export.

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EMERGING DIVERSITY WITHIN WELL KNOWN HETEROTROPHIC FLAGELLATES GROUPS REVEALED BY ENVIRONMENTAL SURVEYS

During the last ten years, an overwhelming amount of data has been generated from culturing independent techniques to study the diversity of marine protists. These studies show a large diversity and the existence of new groups, such as MAST (Marine Stramenopiles) or MALV (Marine Alveolates). However, there are many other phylogenetic groups that appear with a low clonal contribution that have not been analyzed together, and potentially constitute an important source of information related to protists diversity and distribution. Using sequences from our studies, from GenBank, and from CAMERA, we have been able to define several novel clades in three important marine groups of heterotrophic flagellates, such as Choanoflagellates, Chrysophytes and Bicosecids. These novel clades correspond to uncultured organisms. Analyzing all sequences together permits to observe this diversity, which was already presented by generally ignored. Only an important data mining work developed using GenBank allows this novel diversity hidden inside well-known groups to emerge from the enormous sea of data generated.

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AQUATIC CO2 EMISSIONS AS A KEY EMERGING PROPERTY OF THE BOREAL BIOME

The boreal ecosystem is the largest biome on Earth, and plays a crucial role on the global C balance. Freshwater systems are a major component of the boreal landscape, yet their role in regional C budgets is still unclear. We estimated the magnitude and variability of total CO2 emissions from surface waters in a large block of boreal territory in Northern Québec, by combining GIS-based landscape analysis with ecosystem-specific models of CO2 for streams, rivers and lakes. The resulting C emissions are not only regionally significant relative to other better known aspects of the boreal C balance, but also remarkably constant: Aquatic CO2 flux per unit landscape varied less than two-fold across this boreal landscape, despite a 10-fold range in aquatic surface. Our results suggest a complex interplay between the biogeochemical processes that determine the intensity of C emissions in these different types of aquatic systems, and the geomorphologic and climatic features that determine the distribution of aquatic systems in the landscape. These total aquatic emissions, which we term Net Biome Aquatic C Evasion (NBACE), thus represent an emergent property of the boreal biome that can not be derived or predicted from any of its individual components.

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EBULLITION CAUSES EXTREME METHANE EMISSION FROM A SWISS HYDROPOWER RESERVOIR

Lake sediments are significant methane sources and bubble evasion is the most effective methane transport pathway from sediments to the atmosphere in shallow lakes and reservoirs. We have conducted a year-long study of methane evolution in Lake Wohlen (LW), a shallow hydropower reservoir in Switzerland. Dissolved methane concentrations increased by an order of magnitude along the 8 km long reservoir from the river input to the dam and net methane production positively correlated with water temperature. Ebullition surveys using inverted funnels indicated that on average ~1000 mg CH4 m-2 d-1 was emitted from the bottom. Similar estimates were derived by echo sounding. Using a bubble dissolution model we calculated that the average methane emission from LW to the atmosphere was an order of magnitude higher than that of typical temperate reservoirs, and is greatly dominated by ebullition, as opposed to diffusion. Thus, this small reservoir acts as an efficient transformer of terrestrial organic carbon into atmospheric methane.

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EVALUATION OF THE *RBCS* GENE AS A TARGET FOR REAL-TIME NASBA DETECTION OF *PSEUDO-NITZSCHIA*

The marine diatom genus *Pseudo-nitzschia* includes species that produce the neurotoxin domoic acid, which has been responsible for illness and death in humans and wildlife. Accurate detection methods that monitor environmental concentrations of *Pseudo-nitzschia* can enable early detection of blooms and predict the subsequent bioaccumulation of toxin. Sensitive molecular techniques, such as Nucleic Acid Sequence-Based Amplification (NASBA), provide a rapid way of distinguishing and enumerating species of *Pseudo-nitzschia*. The ribulose-1,5-biphosphate carboxylase-oxygenase small-subunit (*rbcS*) gene is being evaluated as a target gene for detection and quantification. Using the *rbcS* gene of *P. multiseries*, an assay was designed that demonstrates excellent linearity ($r^2 > 0.99$) over four orders of magnitude and sensitivity to one cell. The assay detected four strains of *P. multiseries*, as well as 6 out of 10 strains representing other species of *Pseudo-nitzschia*. To evaluate this gene's potential for species-specific detection, the *rbcS* was sequenced from all strains. Testing with non-target phytoplankton and environmental samples is also being conducted, and the assay will eventually be integrated into the Autonomous Microbial Genosensor (AMG) developed at USF.

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COMPARISON OF NUTRIENT TRANFORMATIONS IN STREAMS ACROSS A LAND-USE GRADIENT

Organic nitrogen comprises a substantial fraction of total N loads in streams and rivers and may represent an emerging pollutant that contributes to coastal water quality problems. This study relates land use change to transformations of organic N at the stream reach scale and investigates the role of benthic "hot spots" in influencing N transformations in stream channels. Mass balance estimates were used to quantify nutrient transport and transformations in streams across a land use gradient draining urban, suburban and forested watersheds. Laboratory incubation experiments were used to quantify organic N transformations in different benthic "hot spots" (debris dams, algae, fine sediment) and complement mass balance and benthic habitat mapping at the stream reach scale. Mass balance indicates there were large changes in transport/retention of carbon and nitrogen in the urban Gwynns Falls watershed, while there was net retention of nitrogen in Pond Branch, a small, forested watershed. Results indicate the ecological significance of dissolved organic matter and how it may be transformed in forest vs. urbanizing stream networks en route to N sensitive coastal waters.

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ELIOS (EASTERN LIGURIAN INTERDISCIPLINARY OBSERVING SYSTEM): A MODULE OF THE INTEGRATED SYSTEM OF MEDITERRANEAN OBSERVATORIES.

The Ligurian Sea is a Mediterranean key-site for dense water formation and high carbon export fluxes. It is also strongly influenced by river inputs. These factors are likely to be deeply affected by climate change. The warmer surface water temperatures of the last decades have favored the "intrusion" of alien and southern species, and the frequent occurrence of thermal anomalies has caused large-scale mortality events of marine benthic invertebrates. In light of the need to monitor these changes, predict future trends, and provide data for a sound science-based management of the coastal zone, ENEA and CNR in La Spezia have been monitoring, since the early 1990's, the following parameters in the Eastern Ligurian Sea: -fluxes and water mass characteristics at the Corsica Channel; -meteo-oceanographic/hydrological, water-quality parameters at a coastal station; -characteristics of the benthic communities (Coralligenous and Posidonia) and invasive/harmful species. The main results of these activities will be presented, along with ELIOS (Eastern Ligurian Interdisciplinary Observing System), an Italian initiative which, in synergy with the French program MOOSE, aims at the creation of a harmonized Mediterranean observatory.

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USE OF VOLTAMMETRIC SOLID-STATE MICROELECTRODE FOR STUDYING THE EFFECT OF TIDAL FORCING ON BIOGEOCHEMICAL PROCESSES IN MUDFLAT OF THE ARCACHON BAY (FRANCE)

Little is known about how the composition of sediment porewaters in intertidal sediments responds to the diurnal rise and fall of the tide. To examine the role of tidal forcing on early diagenetic processes, we used voltammetric microelectrodes to measure the concentration of several redox species (O_2, Mn(II), Fe(II), HS^-) at different locations and different times during the tidal cycle in the Arcachon Bay (France). The observations were supplemented with measurements of pH, nutrients, Corg, reactive manganese and iron, TCO_2, DOC, sulfate, porosity, salinity, and grain size. Our results indicate that biogeochemical processes at high tide display a classical diagenetic sequence with high concentrations of dissolved Fe(II) and the absence of dissolved sulfide in the sediment porewater. At low tide, depth-profiles measurements suggest that an upward advection of porewater may transport reduced chemical species, resulting in the appearance of high concentrations of sulfide at depth and a concomitant lower concentration of dissolved Fe(II). This shows clearly that tidal forcing influence the biogeochemistry of this intertidal mudflat. This work is supported by the ANR within the frame of the project "PROTIDAL".

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THE BIOGEOCHEMICAL MN-FE-P-SHUTTLE AT THE REDOXCLINE OF THE MODERN BLACK SEA AND ANOXIC DEEPS IN THE BALTIC SEA

Redoxclines of anoxic basins and deeps form the suboxic transition between oxygenated surface and anoxic or even sulfidic bottom waters. Intense element cycling, favoured by elevated microbial activity, causes steep gradients of nutrients and redox-sensitive trace metals. In this contribution we present a new conceptual model for authigenic particle formation at pelagic redoxclines, which is based on the tight coupling of Mn, Fe, and P cycles. Textural and geochemical analyses of particles from the redoxclines of the Black and Baltic Seas emphasise mixed particles containing Mn, Fe, and P as a new solid species. These mixed particles act as a Fe-P curtain influencing vertical phosphate signatures and probably also primary production. Additionally, this particulate Mn-Fe-P-shuttle must have played an important role for the cycling of P and certain trace metals in ancient ocean basins, e.g., during development of Black Shales and should be considered in future modelling approaches dealing with oxic/anoxic interfaces of aquatic ecosystems.

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COLWELLIA PSYCHRERYTHRAEA STRAIN 34H: A MODEL ORGANISM FOR STUDYING BACTERIAL HETEROTROPHY IN THE COLD

Despite global warming, most of Earth's biosphere remains cold, given the vast volume of the cold deep ocean and the surface area (10-20%) of the planet that is frozen (as glacial ice, sea ice, permafrost or snow), and inhabited predominantly by microbes. The environmental settings of planets and moons targeted in the search for microbial life elsewhere in the solar system are deeply frozen. Having a model microbe to study physiological, ecological and evolutionary aspects of bacterial heterotrophy in the cold (and dark) can advance understanding of the habitability of many extreme environments on Earth and elsewhere. *Colwellia psychrerythraea* strain 34H, a gamma-proteobacterium, presents an ideal candidate for study: it holds the low-temperature record for growth (with *Psychromonas ingrahamii*), as well as for motility and viral infection (all at minus 12 degrees C); it overproduces cold-active extracellular enzymes when subjected to subzero temperatures; and it overproduces exopolymers not only at subzero temperatures, but also under elevated hydrostatic pressures. The availability of its whole genome sequence and an infective virus is yielding numerous insights on the evolution of cold adaptation.

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PHYTOPLANKTON COMMUNITY TRANSITIONS ACROSS CONTRASTING NUTRIENT REGIMES

Photosynthetic eukaryotes contribute significantly to primary production, but taxon specific contributions are not well known. To better understand ecological factors that might drive differences in phytoplankton assemblages, we explored populations along a transect through different nutrient regimes. Stations included California coastal (with considerable anthropogenic inputs), natural upwelling and open-ocean waters. 0-5 meter chlorophyll concentrations along the gradient declined from 2.5 to 0.07 micrograms/L. As expected, primary production transitioned similarly. Low levels in open-ocean surface waters coincided with the scarcity of eukaryotic phytoplankton, detected by flow cytometry, and in 18S rDNA clone library sequences. This contrasted with the DCM at the same station, where eukaryotes composed only 6% of the phytoplankton in terms of abundance, they formed 44% of the biomass and numerous *Bathycoccus* sequences were retrieved. This contrasted with the coastal site where *Micromonas* and *Ostreococcus* were found. Since clone libraries do not necessarily reflect environmental abundance, specific qPCR probes are being employed for enumeration. Relationships between these organisms, as well as bacterial counterparts (e.g. cyanobacteria) are also being compared with those seen in an eddy during the same expedition.

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ENVIRONMENTAL REPORT CARDS: A TOOL FOR BETTER MANAGEMENT, MONITORING AND RESEARCH

Environmental report cards are an important tool for integrating metrics of ecosystem health and for communicating scientific understanding to decision makers and the general public. Report cards rely on a suite of environmental indicators (i.e., performance measures, vital signs, reference values) and thresholds (i.e., goals, criteria, standards). The process of combining indicators is an important aspect of ecosystem health assessments and can be accomplished by a variety of mechanisms which influence the results. The specificity of reporting regions influences the impact of the report cards and geographically-explicit report cards can be a powerful human motivator and create peer pressure (e.g., Kura River, Caspian Sea). Report cards can engender a healthy competition between communities and community leaders to achieve better environmental grades (e.g., Moreton Bay, Australia). The credibility of environmental report cards needs to be established by a transparent process in which the data, indices, maps and conceptual foundation are explicit (e.g., Chesapeake Bay, USA). Report cards can stimulate research (e.g., Chincoteague Bay, USA), and provide timely, synthesized monitoring information to a broad audience (e.g., Mesoamerican reef, Great Barrier Reef, Australia).

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CHARACTERISATION AND COMPARATIVE GENOMICS OF GREEN ALGAL VIRUSES

Ostreococcus tauri, the smallest known and ubiquitous marine photosynthetic eukaryote, whose genome is completely characterised, is a host for many large DNA viruses, and we have analysed the life-cycle of one of them. OtV5 is a lytic phycodnavirus with a 185,373 bp long linear genome. Surprisingly, the virus does not degrade its host chromosomes before the host cell bursts. Analysis of its complete genome sequence confirmed that it lacks expected site-specific endonucleases, and revealed the presence of 16 genes whose predicted functions are novel to this group of viruses. OtV5 carries at least one predicted gene whose protein closely resembles its host counterpart and several other host-derived DNA sequences, suggesting that horizontal gene transfers between host and viral genomes may occur frequently on an evolutionarily scale. 57.5% of the 268 predicted proteins present no similarities with any known protein in Genbank, underlining the wealth of undiscovered biological diversity present in oceanic viruses. Lytic viruses infecting other prasinophytes genera were isolated. Sequencing is underway and a preliminary comparison of these novel genomes will be presented.

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DEVELOPMENT OF NEW CONTINENTAL VEGETATION PROXIES IN LAKE SEDIMENTS : EXTRACTION AND SORTING OF POLLEN OFF SEDIMENT BY FLOW CYTOMETRY.

Analysis of lakes sediments allow reconstruction of the lacustrine ecosystems but also that of the surrounding continental vegetation. Pollen is one of the most important fossil plant remains and is used for paleovegetation reconstructions. Pollen contain sporopollenin, that conserves the morphological characteristics of the pollen grains, allowing systematic studies and plants types determination (C3,C4, PFT). These plant types may be characterize by δ13C values of pollen sporopollenin. But detection and isolation of fossil pollen in sedimentary matrixes is time consuming. We show in this work the first use of flow cytometry sorting to isolate specific pollen species of fossil sediments. This cytometry sorting method was applied on fossil pollen from four sediment samples from two crater lakes (Tanzania) according to pollen green fluorescence and light scatter. Sorting efficiency was 25% and the purity of the sorted fraction was good (74% of pollen). Flow cytometry associated with flow sorting appears to be a promising tool in palynology for pollen isolation from a mixed community.

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NITROGEN TRANSFORMATION PROCESSES IN THE ELBE RIVER: DISTINGUISHING BETWEEN ASSIMILATION AND DENITRIFICATION BY MEANS OF STABLE ISOTOPE RATIOS IN NITRATE

During a 9-day Lagrangian sampling campaign along the free-flowing section of the Elbe River in July 2005, water from the river as well as from major tributaries and sewage treatment plants was sampled to investigate major nitrogen transformation processes, focussing on denitrification and N-assimilation by phytoplankton. Samples were analysed for δ15N-NO3, δ18O-NO3, δ15N-NH4, nutrient concentrations, Chl. a, and particulate organic matter. A strong decrease in nitrate concentration accompanied by strong increases in Chl. a, particulate organic carbon (POC) and δ15N- and δ18O-NO3 values were measured along the river. The ratio of the increase in δ15N vs. δ18O of the river nitrate samples was 1.19:1, indicating a major role of nitrogen assimilation by phytoplankton. This finding is supported by budget calculations, while nitrate inputs from the sampled tributaries and from sewage treatment plants were of minor importance for the nitrogen budget of the Elbe River.

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COMPARISON OF EUTROPHICATION ASSESSMENTS IN EUROPEAN AND AMERICAN WATERS

The development of ecological classification systems is one of the most important and technically challenging parts of the implementation of nutrient management programs. In recent years, a number of ecological assessments have been used to assess the status of coastal and marine waters for both a priori and post priori management of eutrophication risk. These procedures are different in their scope, spatial extent, typology, and how they correspond to regulatory and policy outcomes, though they also have some similarities. Eutrophication assessment tools currently used in Europe include the Water Framework Directive, OSPAR and the TRIX ranking process. These approaches differ from the Assessment of Estuarine Eutrophication Status (ASSETS) used primarily by US National Oceanic and Oceanic Administration, and the US Environmental Protection Agency's National Coastal Assessment (NCA). These assessment procedures are based on common parameters to describe ecosystem state. The WFD, OSPAR, ASSETS, and NCA also use parameters to indicate ecosystem function and/or undesirable disturbance. The aim of this work was to compare these tools, to apply them to a selected area in UK waters, and to compare the outcomes from the different approaches.

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DENITRIFICATION AND ANAMMOX RATES MEASURED IN ^{15}-N LABELED INCUBATION EXPERIMENTS IN THE ARABIAN SEA OXYGEN DEFICIENT ZONE

Two day experiments were conducted with water from the oxygen deficient zone (ODZ) of the Arabian Sea in gas-tight bags with samples collected from 106m and 150m and were amended with either ^{15}-N labeled ammonium or nitrite either singly or in combination with amendments of POC, DOC, or O_2. Anammox rates calculated from ^{29}-N_2 formation were 0.08-0.13 μM/y. In contrast denitrification rates calculated from the rate of ^{30}-N_2 varied between 2.3-10 μM/y. For denitrification, higher rates came from 106m. Incubations were allowed to continue until a significant fraction of the nitrogen oxides were converted to N_2 and changes in nutrient concentration were followed. In all incubations there was very little change in nitrate, nitrite or ammonium initially (~2 days). Added POC prevented the accumulation of nitrite before the formation of significant production of N_2. In all other treatments there was a significant build up of nitrite. This suggested that POC promoted denitrification. Ammonium never accumulated in any treatment. In incubations with added ammonium there was only a slow removal of ammonium, which suggested a low and constant rate of anammox.

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VENUS: A FACILITY FOR INTERACTIVE LONG-TERM AQUATIC SCIENCE

The Victoria Experimental Network Under the Sea (VENUS) is a permanent coastal cabled observatory fully installed and operating in the coastal waters off the west coast of Canada. It is the world's most advanced cabled marine research laboratory. The facility includes shore stations providing kilowatt power and Ethernet communications to subsea research platforms. VENUS has two arrays: Saanich Inlet and the south-central Strait of Georgia. Instrumented platforms with a wide range of sensors record zooplankton distributions and diel migrations, current profiles, seawater temperature, salinity, and dissolved gas concentrations, and ocean turbulence. Specialized systems include broadband ambient sound hydrophones, scanning sonars, broadband echo-sounders, and various camera and imaging systems. A broad range of research is underway to study Fraser River slope stability, estuarine circulation, zooplankton bioturbulence, marine mammal vocalization, deep water renewal events, and benthic-pelagic ecosystem coupling. Plots and raw data are freely available for download via the project web page (www.venus.uvic.ca), and proposals have been submitted to expand the experimental sub-systems to include surface mapping, autonomous vehicles, and 3D imagery. A brief overview of the entire project will be presented.

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THE MANAGEMENT OF LAKE EUTROPHICATION USING STERILE TRIPLOID GRASS CARP AND HYPOLIMNETIC WITHDRAWAL IN A SUBURBAN TEMPERATE MESOTROPHIC LAKE

Eutrophication is a major issue in many lakes around the world. We monitored and managed a suburban temperate mesotrophic lake over the last eight years in response to the stocking sterile triploid grass carp (Ctenopharyngodon idella) as a means to manage aquatic vegetation. Although aquatic vegetation was successfully controlled over the first five years after the addition of carp, evidence of nutrient enrichment, substantiated by a shift in the phytoplankton community towards cyanobacteria blooms earlier in the year, as well as reduced water clarity, were noted. The combination of these factors and possibly others (higher intensity storm events, reduced efficacy of carp) resulted in a significant increase in aquatic vegetation, early dominance of cyanobacteria, and a general decline in water quality in the sixth year of the study. As a result, an application was made to stock additional carp. In addition, we performed a hypolimnetic withdrawal to lower the lake level. This served to reduce the aquatic nutrient pool and expose the sediment seed bank to freezing conditions. Water quality has since improved and will continue to be monitored.

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USING THE ZOOIMAGE AUTOMATED SYSTEM FOR THE ABUNDANCE AND BIOMASS ESTIMATION OF COPEPODS FROM THE SW ATLANTIC OCEAN.

Recent advances in automated counting and identifying zooplankton using image analysis systems provide opportunities to rapidly analyze samples for abundance and biomass estimations. Zooplankton samples were collected with a babybongo net in neritic waters off the Buenos Aires province, Argentina (34°-41°S). Images were obtained from 33 digitized samples and analyzed with ZooImage software in order to compare automatic and traditional (microscopic) estimations of copepod abundance and biomass. Subsamples were taken according to the density of organisms, and sieved into two fractions with a 500 μm mesh to maximize the number of individuals in the scanning cells without overlapping. A training set composed by all zooplankton categories was built. Copepods were discriminated according to size into big calanoids, small calanoids and cyclopoids using LDA recognition algorithm. Size/Biovolume equations of copepods from the study area were included in the software to estimate biomass. There were no significant differences for any of the copepod categories between manual and automatic counting. Present results emphasize the utilization of ZooImage method as a great potential tool in quantitative estimations of copepods.

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SPATIO-TEMPORAL HABITAT HETEROGENEITY ACROSS AN ALPINE STREAM SYSTEM

Alpine stream systems provide unique habitats for riverine biota as a result of their dynamic flow, water temperature and suspended sediment regimes. Understanding how these spatio-temporal physicochemical variations influence macroinvertebrate communities could provide insights into how alpine lotic ecosystems are likely to respond to climate change or other more direct human influences (abstraction/regulation). However, detailed year-round data sets are rare for alpine stream systems, yet such knowledge is clearly a prerequisite to obtaining a holistic understanding of how these ecosystems function. This paper reports findings from year-round data collection at the Odenwinkelkees Glacier braidplain, Austrian Alps. Repeat aerial photography showed that the extent of flowing channels varied both diurnally and seasonally primarily as a consequence of meltwater pulses. Analysis of physicochemical data revealed high heterogeneity of flow regimes, water temperature and turbidity both spatially (reach to basin-scale) and temporally. For example the average discharge and turbidity were lower for predominantly groundwater-fed sites compared with meltwater-fed channels but water temperature was higher. This heterogeneity appears to play a key 'filtering' role underpinning spatio-temporal patterns of benthic macroinvertebrates.

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SYNCHRONOUS REGIME SHIFTS ALONG ENVIRONMENTAL AND DIVERSITY GRADIENTS IN THE BALTIC SEA

The Baltic Sea is the largest brackish water body in the world and is characterised by strong environmental and biodiversity gradients. In recent years increasing temperatures, a reduction of inflow events, eutrophication and high fishing pressure had severe impacts on the entire Baltic. To assess these influences we performed integrated analyses of hydro-climatic, nutrient, phyto- and zooplankton as well as fisheries data covering a period from 1979-2006 of 7 Baltic sub-systems, each representing different environmental conditions and food web structures. In the late eighties quasi-simultaneous regime shifts were detected in all systems affecting multiple trophic levels. Common trends in ecosystem state indices were extracted and overall environmental drivers and corresponding threshold values of indicator variables identified. However, ecosystem responses following the synchronous shift were considerably different: While in the Central Baltic Sea an alternative stable state was reached characterised by a change from a cod- to a sprat dominated system, other sub-systems showed an increasing importance of top-predators and partly flipped back to their previous state. We thus suggest system-specific chains of mechanisms being important for stabilising or reversing ecosystem states.

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DIFFERENTIATING SOURCES OF BACKSCATTERING IN THE SOUTHERN OCEAN FOR OCEAN COLOR REMOTE SENSING: CALCITE, BUBBLES AND PHYTOPLANKTON

Remote sensing reflectance from the southern ocean is higher than most of the world's oceans. We propose to evaluate several primary hypotheses for the high reflectance: 1) Southern Ocean waters contain high levels of backscattering materials such as Particulate Inorganic Carbon (PIC); 2) High reflectance is primarily due to the excessive amounts of bubbles produced by consistently high winds in this region; or 3) Elevated reflectance is due to problems with atmospheric correction. Understanding the magnitude of the spectral reflectance from the Southern Ocean requires a detailed understanding of the backscattering properties of the water column in relationship to wind-driven processes. Here, we will present data collected in conjunction with the Southern Ocean GasEx experiment in the Atlantic Sector of the Southern Ocean from March 10 through April 4, 2007. We will evaluate wind-driven processes (e.g., bubbles and whitecaps) and water-column properties (e.g., calcite, coccolithophores and detached coccoliths, dissolved and particulate organic matter, etc.) in order to evaluate the contribution of each to measured inherent and apparent optical properties. High water-leaving radiance may have little impact on spectral ratios used in standard remote sensing algorithms, but significantly impacts the more advanced remote sensing algorithms that quantify backscattering and particulates from the magnitude of water-leaving radiance.

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SURFACE MIXED LAYER DEPTH AND LIGHT LIMITATION. CAN SVERDRUP HELP TO CONSTRAIN ECOSYSTEM MODELS?

It is commonly agreed that the open ocean's stratification will change in a warming world. This will have an effect on surface mixed layer depths. As (in combination with solar radiation entering the ocean and turbidity) the depth of the surface mixed layer determines the temporally averaged light experienced by phytoplankton cells dispersed in the surface mixed layer, this will impinge on growth rates of phytoplankton. In turn, a change of growth might well influence the biotic sequestration of carbon in the ocean. We show, by revisiting the "critical depth" concept of Sverdrup (1953), that state-of-the-art ecosystem models as implemented in circulation models show surprisingly diverse responses towards changes in surface mixed layer depths. We propose that the "critical depth" is a useful metric to evaluate ecosystem models. This is of some significance since on one hand parameters associated with ecosystem models are generally poorly constrained due to a lack of data while on the other hand "critical depths" can be derived from Argo floats equipped with fluorosence sensors.

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IMPACT OF TEMPERATURE, SALINITY AND [CO32-] ON THE MG/CA AND SR/CA IN BENTHIC FORAMINIFERA (AMMONIA TEPIDA): RESULTS FROM CULTURE EXPERIMENTS.

The trace element composition of calcitic foraminiferal tests has become an important tool by which paleoceanographers reconstruct past oceanic conditions. On timescales much shorter than their residence time, the elements strontium and magnesium occur in seawater with nearly constant ratios to calcium. Variation in Sr/Ca and Mg/Ca in benthic foraminiferal tests can then be explained as a function of environmental parameters that control their incorporation into the tests. For benthic foraminifera, temperature appears to be the dominant parameter, however, a better understanding of the possible impact of other parameters such as pH or [CO32-], and salinity is needed to increase the accuracy of element ratio proxies. Towards this goal the benthic foraminifer Ammonia tepida was cultured under three different salinities (20, 33 and 40) and two different pCO2 conditions (120 and 2000ppm), both sets of experiment were run at two different temperatures (10 and 15°C). Weights and elemental composition were determined. Results indicate that both Mg and Sr incorporation are enhanced with increasing temperatures and increasing salinity. Changes in [CO32-] or total dissolved inorganic carbon do not affect the Mg partitioning coefficient. On the contrary, Sr incorporation is enhanced under increasing [CO32-]. Shell weights decrease with decreasing [CO32-], and increase with decreasing temperature.

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NITROGEN CYCLING AND METABOLISM IN THE THALWEG OF A PRAIRIE RIVER

N cycling in rivers is poorly described. We measured ammonium uptake, metabolism, nitrification, and denitrification in the thalweg of the Kansas River (discharge = 14,360 L/s). We estimated gross and net uptake with a depleted ^{15}N-ammonium release, metabolism with diel O_2 measurements, and denitrification with dissolved N_2 measurements. Net ecosystem production was negative. Net ammonium uptake length was 2.1 km with elevated concentrations, and gross uptake length was 1.9 km at ambient concentrations. Gross uptake rate measurements were comparable to estimates from streams (systems with 1/10th or less the discharge). Calculated lengths were maximal because the isotope pulse was primarily confined to the thalweg, and not the shallow side channels or backwaters. Denitrification and nitrification rates were below detection by our methods. In the Kansas River, rates of N cycling are driven by heterotrophic processes, and considerable processing of N, particularly ammonium uptake, occurred over a few kilometers of river length. Relationships of nitrogen cycling rates as a function of concentrations derived from smaller streams can probably be used to model river network N dynamics and transport.

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DOES BIODIVERSITY ENHANCE FOOD-CHAIN LENGTH IN LAKES?

Food-chain length (FCL) in ecosystems has been studied extensively, and recently, many empirical studies supported the ecosystem size hypothesis predicting longer FCL in larger ecosystems. The mechanism behind the ecosystem size hypothesis comprises effects of increasing species diversity, habitat heterogeneity, or total productivity of the system. Cohen and Newman (1991) theoretically tested the relationships between FCL and ecosystem size and they concluded that ecosystem size increases species diversity and consequently enhance FCL. If so, FCL in ancient lakes with high biodiversity can be predicted to be much longer than in recent lakes with similar ecosystem size. By contrast, Post and Takimoto (2007) concluded that the species diversity could increase the degree of trophic omnivory and consequently not enhance FCL. We tested the above hypotheses using the FCLs in ancient and recent lakes from published papers. Our results showed hat FCLs in ancient lakes were not longer than in recent lakes with similar lake volume. Thus, species diversity in an ecosystem and also historical processes do not enhance FCL in lakes.

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PHOSPHORUS IN FRESH-WATER AND MARINE ECOSYSTEMS

Phosphorus is an essential nutrient) sustaining biological productivity which often limits the growth of microbial and algal communities in water environments. The review summarizes the present knowledge on species of phosphorus and their origin in water ecosystems both inland and marine. Understanding the transfer of phosphorus from terrestrial to aquatic ecosystems can improve the management of soil productivity and water quality. The dynamics of biological cycling, usage and fate of P-compounds are particularly outlined. Factors affecting transport, transformation, turnover and availability are discussed. Open water as well as sediment processes are considered at time scales from rapid short-term cycling processes to long-term responses of entire systems. Particular attention will be given to alterations of phosphorus supply and availability due to climate change, eutrophication, oligotrophication and anthropogenic interference.

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SIMILAR PATTERNS OF COMMUNITY ORGANIZATION CHARACTERIZE GROUPS OF DIFFERENT TROPHIC LEVELS IN THE PLANKTON OF THE NW MEDITERRANEAN SEA

We compared Ceratium of the phytoplankton, tintinnids of the microzooplankton, and large omnivorous and carnivorous copepods by sampling over a 4 week period. In all three groups, diversity as H' or species richness, was much less variable than concentrations. Species accumulation curves approached plateau values but only a small number of species were consistently present (core species) and these accounted for most individuals. For Ceratium, the core species numbered 10, for tintinnids 11 species, and for large copepods, 4 core species during the day and 16 at night. Ceratium, tintinnids and large copepods showed some similar patterns of community structure in terms of species abundance distributions. Ceratium species were distributed in a log-normal pattern. Tintinnid species showed a log-series distribution but core species alone were log-normal. Large copepod communities were highly dominated; night samples showed much higher abundances and greater species richness than day samples. However, species abundance distributions were similar between day and night and were mostly log-normal. A super-saturation of species characterized groups of distinct trophic levels. Financial support provided by the ANR Biodiversité/Pôle Mer PACA project AQUAPARADOX.

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EFFECTS OF N, P AND SI ENRICHMENT ON PHYTOPLANKTON COMPOSITION AND GROWTH IN THE GUADIANA ESTUARY (SW IBERIA)

A comprehensive understanding of how nutrients affect phytoplankton dynamics is necessary to properly assess the impact of nutrient enrichment and the efficiency of nutrient reduction strategies. In the Guadiana estuary, no experimental evidence exists showing which or even if nutrients are limiting to phytoplankton growth. Therefore, the main goal of this work was to determine the limiting nutrient for phytoplankton growth and its seasonal variation, and to understand the effects of anthropogenic nutrient enrichments on phytoplankton community structure in the Guadiana. Microcosm experiments were performed in different seasons, using water samples collected in the upper estuary. Nitrate, ammonium, phosphate and silicate were added, alone and in combinations. Phytoplankton response was determined through inverted and epifluorescence microscopy. Primary production was also evaluated using radiolabelled bicarbonate. Results showed that the phytoplankton community was probably light-limited during winter, since nutrient addition had no effect on phytoplankton growth. Then, during spring and summer, nitrogen became limiting. Diatoms seemed to be co-limited by both nitrogen and silicon. Additionally, nitrogen enrichment led to a huge growth of dinoflagellates, especially in the summer. Primary production was significantly higher in the Si addition experiment, attaining values over 12,500 mg C m-3 d-1 in the summer.

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EFFECTS OF NITROGEN (UREA, AMMONIUM, NITRATE) INPUT ON PHYTOPLANKTON ABUNDANCE, COMMUNITY COMPOSITION AND TOXICITY IN PRODUCTIVE LAKES: A MESOCOSM EXPERIMENT

Eutrophication of lakes is a widespread problem that reduces aquatic ecosystem integrity and degrades water quality for human use. The role of phosphorus in controlling phytoplankton growth is well known but there is uncertainty surrounding the importance of nitrogen inputs to phosphorus rich systems. To test the effects of nitrogen on phytoplankton abundance, community composition and toxicity, we conducted a replicated mesocosm experiment in a productive lake located in the Northern Great Plains. Treatments consisted of three, weekly additions of urea, nitrate, or ammonium. Relative to the control, all nitrogen treatments increased chlorophyll-a levels and the growth of toxic *Microcystis* spp. Comparison between treatments revealed that nitrate had the lowest chlorophyll-a levels but the highest relative abundance of *Microcystis* spp. Urea and ammonium had similar chlorophyll-a levels but urea favoured *Microcystis* spp. more than did ammonia. We conclude that nitrogen influx to phosphorus rich systems can further degrade water quality by stimulating toxic cyanobacteria. This is particularly important in agricultural regions where fertilizer application can saturate catchment soils with phosphorus, and where nitrogen use has increased 15-fold since 1970.

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CARBON ISOTOPIC METHODS TO EXAMINE SEDIMENT BIOGEOCHEMISTRY AND GROUNDWATER FLOW FROM AN UNCONFINED AQUIFER

Submarine groundwater discharge (SGD) is defined as discharge of fresh meteoric groundwater and recirculated seawater to the ocean. Radiotracers are effective in quantifying SGD, and in confined aquifers 14-DIC was shown to distinguish sources. Our focus was to use 14-DIC to trace SGD in an estuarine system with an unconfined aquifer where residence times and sources are subject to more forcing. Sediment carbon and porewater DIC samples (7-115 cmbsf) were collected from a nearshore site, where hydraulic head is greatest. Freshwater and marine endmember 14-DIC samples were also collected from a beach well and overlying IRL surface waters. SOC-14 decreased significantly with depth (0.90 – 0.29 fMC). Porewater 14-DIC was fairly uniform with depth (0.57-0.54 fMC) but depleted in 14C relative to both the beach well (0.89 fMC) and the overlying surface waters (0.91 fMC) indicating DIC input from SOC remineralization near the base of the sediment profile. The observed depletion of porewater 14-DIC relative to SGD endmember DIC source terms suggests coupled effects of sediment biogeochemistry and hydrological flow significantly alter SGD associated 14-DIC flux in unconfined aquifer estuarine systems.

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MICROSCALE PHYTOPLANKTON DISTRIBUTIONS: TAXA-SPEPCIFIC PATTERNS AND TURBULENCE

For phytoplankton, life defining processes such as mixing, competition, predation and infection take place over distances of micrometers to centimeters. Hence, the measurement of phytoplankton distributions approaching these scales is fundamental to expanding our ecological understanding of aquatic ecosystems. Recent results from microstructure profiles taken in the presence of strong turbulence have revealed increased levels of phytoplankton patchiness at the oceans microscale (<1m). These findings suggest the biological properties of phytoplankton such as size, buoyancy, abundance and stickiness may influence the extent and dynamics of microscale phytoplankton patchiness. Using the latest microstructure profiler (TurboMAP-L) and multi-excitation fluorometer we show taxa-specific patterns of fluorescence microstructure. Quantification of the differing patch distributions in relation to the local community structure and turbulence is supported by coinciding images of phytoplankton distributions taken using a novel mini-camera system mounted on TurboMAP-L. Our findings begin to reveal how the characteristic properties of different phytoplankton groups may influence their distribution at the scales most relevant to plankton ecology.

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MESOSCALE AND SUBMESOSCALE STRUCTURATION OF PHYTOPLANKTON COMMUNITIES FROM MULTISATELLITE DATA: THE ROLE OF LATERAL STIRRING

Here we look at the composition of a phytoplankton community through the PHYSAT algorithm, that labels L2 SeaWiFS pixels (2 km res.) with the dominant plankton group. Properties of lateral stirring, such as tracer filaments induced by mesoscale eddies and mixing, are obtained by re-analysing the altimetry data with a Lagrangian method (the Lyapunov exponent calculation). The identification of transport barriers provides a validation for the PHYSAT algorithm at the mesoscale. More generally, it allows to address the interaction between transport mechanism and ecological dynamics. The PHYSAT algorithm unveils some clear filaments and fronts at the interior of the chlorophyll bloom, where chlorophyll gradient are relatively homogeneous. In some cases, these spatial structures are in good agreement with the tracer filaments obtained from altimetry, suggesting that they originate from horizontal stirring. Looking at the evolution of the tracer filaments, we propose a three-step process in community structuration: (i) isolation: a patch is first isolated by a mesoscale structure (e.g., an eddy); (ii) structuration: the patch then intrudes the environment when filaments are formed; (iii) mixing: the patch becomes eventually mixed when the filament thins and is dispersed by small-scale turbulence. The filament dynamics occurs on the same timescale of a plankton bloom, indicating a strong coupling between mesoscale transport and ecological dynamics.

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UNPRECEDENTED HARMFUL JELLY BLOOM IN IRISH WATERS KILLS 250,000 FARMED SALMON

Pelagia noctiluca is best known for its major outbreaks in the Mediterranean where it impacts negatively on both fisheries and tourism. The impact of these blooms on fish and mollusc populations may be considerable as P. noctiluca is a top planktonic predator feeding on almost all zooplankton, including eggs and larvae of nekton. Considering this notoriety and its wide geographical distribution (subtropical and temperate waters of the Atlantic and Pacific oceans) there are comparatively few published records of P. noctiluca harmful jelly blooms outside the Mediterranean. Here we document the widespread occurrence of P. noctiluca in continental shelf and coastal waters off Ireland in October 2007, just prior to a major fish kill induced by the species, and discuss the historical occurrence, likely origin, causes and wider ecosystem impacts of this event. We also describe the fish kill event, the immediate factors that contributed to such a major fish kill, and the response of the Irish and UK governments to this harmful jelly bloom.

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BIOGEOGRAPHY OF FRESHWATER CYANOBACTERIA – IMPORTANCE OF HISTORICAL AND ENVIRONMENTAL FACTORS

Microbes – like all organisms – have biogeographies, i.e. ranges in their distribution of biodiversity over space and time Very little is known about factors that are of importance in shaping microbial communities. Microbial biogeography may differ from traditional biogeography of plants and animals as historical factors should be much less important for microbes than biological and physical factors. In this study, the community composition of bacteria and the subgroup Cyanobacteria was measured with the ARISA fingerprinting method in lakes and estuaries in Sweden. The relative influence of historical connectedness and age of lakes, geographic distance and habitat factors on microbial community composition will be presented.

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DELAYED HATCHING EGGS PRODUCTION IN THE CALANOID COPEPOD ACARTIA TONSA (DANA)

Two regional strains of Acartia tonsa from the Baltic Sea area were investigated to monitor their resting egg production under low and high food concentrations. While subitaneous eggs of Acartia tonsa hatch within 48 hours at 17°C, we found successful hatching of eggs over an extended period of one month. The slow hatching eggs were not categorized as diapauses eggs or quiescent eggs (sensu Grice and Marcus 1981) but merely as delayed hatching eggs (Chen and Marcus 1997). The fraction of delayed hatching eggs was highest under low food conditions. Preliminary measurements further suggest that delayed hatching eggs have a lower respiration rate and development rate (embryogenesis) than the subitaneous eggs. We suggest that the reproductive strategy is to produce eggs with a highly variable hatching time to ensure an extended recruitment period of nauplii to the water column. These observations are raising interesting questions about life traits of neritic calanoids involving egg sediment banks and emergence of copepods from the sediment.

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THRESHOLDS, SHIFTING BASELINES AND COASTAL ECOSYSTEM TRAJECTORIES

The expectations that ecosystems will respond to decreasing pressures by following trajectories of recovery reverse to those experienced under deterioration is a major tenet of scientific, legislative and managerial frameworks. However, there is increasing evidence that ecosystems often fail to revert to their original status once disturbed. In this tutorial I provide evidence, using coastal eutrophication as an example, that these expectations do not conform to observed patterns of ecosystems response following the release of environmental pressures. I then examine how shifting baselines and non-linear responses involving threshold effects affect the trajectories of marine ecosystems in response to environmental pressures and their subsequent release, and address the implications for our scientific understanding and restoration capacities.

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RECRUITMENT PATTERNS ANALYZED WITH 3D LASER SCAN

Recruitment structures were immersed at two depths (3 and 25 m) in Banyuls bay, in the Western Mediterranean Sea (42°23N, 03°08W). Structures corresponded to those used in the MARBEF Program (MarPace) to analyze recruitment patterns along the European shores. A 2-month survey of the recruitment patterns was realized, with a sample every week. Panels were collected every week by divers in containers, analyzed in the laboratory and replaced at sea. A program was written to collect: (1) surface data consisting mainly in high resolution pictures of the panel surface, (2) topographic data obtained from a laser telemetric scan (200 x 200 micron mesh, vertical resolution: 15 microns). Surface data were analyzed with a set of image treatment routines for extraction of interesting bi-dimensional features. 3D telemetric data were analyzed with three dimensional dynamic modules computing volume changes of the structures installed on the panel surface during the settlement processes. Settlement patterns of a Serpulid annelid (Pomatoceros triqueter) and colonies of the Hydroid Clythia are presented, with surface and volume changes during the early settlement processes.

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DIRECT AND INDIRECT IMMOBILISATION AND SPECIATION CHANGE OF SOLUBLE URANIUM BY ALGAE AND AQUATIC MACROPHYTES

The distribution of U species in surface water below mining sites was calculated with hydrochemical model PHREEQ. It illustrates the presence of U mostly in form of soluble carbonate complexes. We have proven the effect of photoautotrophs on the fate and speciation change of U. The dominant process is biosorption (surface complexation) on submerse and emerse macrophytes and associated periphyton. Depending on concentration of U and the biomass U was fixed up to the percentage level. As shown by means of sequential chemical extraction the desorption efficiency of citrate is high. About 90 percent of U were removed by EDTA. In the course of growth a relevant share of U was incorporated. We suggest from EDAX analysis of biominerals in *Lemna* cells complexation of U with Ca oxalate. DOC exsudation induced by P-limitation decreases U mobility and uptake due to U complexation in the milieu. Furthermore pH change and calcification due to CO_2 assimilation drives destruction of U carbonate complexes in the water and increases fixation of U near the surface of submerse vascular plant and algae.

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ADVANCES IN METHODOLOGY TO ASSESS LIPID DEGRADATION BY "LIPASE +" BACTERIA

In oceans, organic matter (OM) is made of diverse chemicals, and interactions between targeted chemicals and associated bacterial species are still poorly understood. Lipids are good tracers of the carbon cycle and represent 3 to 55% of OM in aquatic environments. Prior entering cells, lipids are hydrolyzed thanks to ectoenzymatic lipases produced by bacteria. However, not all bacteria are responsible for the total activity on the same degree. So, to better understand lipid-lipases interactions, we need to estimate the bacterial fraction of microbial community responsible for the measured hydrolysis rates. Classical methodology, based on hydrolysis of fluorogenic substrate (like MUF-palmitate) enables to measure lipids hydrolysis rates. However, it does not enable to identify "lipase +" bacteria. Tests were conducted *in vitro*, with the substrate "ELF-palmitate". Labelled cells (7%) were observed in pure cultures of "lipase +" bacteria (Duflos *et al.* 2008). Improvement in sensitivity of such methods (Nedoma *et al.* 2005, Van Wambeke *et al.* 2008) will allow to better assess the response of the bacterial community to variations of quantity and quality of OM.

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INDEPENDENCE AND INTERDEPENDENCIES BEHAVIORS OF POC CONTENT AND DOMINANT PHYTOPLANKTON GROUPS AT GLOBAL SCALE

Global maps of inherent optical properties have been generated with the Loisel and Stramski, 2000's method for the SeaWiFS archive (1998-2006). The near-surface concentration of the particulate organic carbon (POC) was estimated from the backscattering coefficient of particles with the method of Loisel et al, 2002. Recently, global annual and seasonal maps of the near-surface POC content have been generated for the SeaWiFS archive (Duforet-Gaurier et al, submitted). Similarities were observed between the distribution of the particulate organic carbon and dominant phytoplankton groups as identified by the PHYSAT method. Large POC concentrations are coincident with blooms of diatoms observed in the Southern Ocean during austral summer and in the Northern Atlantic Ocean during northern spring. These observations are coherent with previous results showing that diatoms accounts for 40% of total POC export (Jin et al, 2006). We proposed to study if there is effectively a correspondence between the distribution of POC and phytoplankton species. Among other things, the probabilities of co-occurence will be established to provide an illustration of the dependence and interdependence among POC content and dominant phytoplankton groups.

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IS TUNA DISTRIBUTION CLIMATE-DRIVEN? : A META-ANALYSIS

Over the last few decades, large-scale increases in the heat content of the world's ocean have been observed. Therefore, species are expected to move towards the poles in response to climate change. This study aims to find evidence of recent climate change forcing on the latitudinal distribution of tuna and "tuna-like" species. Catch per unit of effort data from the International Commission for the Conservation of Atlantic Tunas (ICCAT) have been used to conduct this study. The correlation between Atlantic temperature anomaly and catch latitude of nine species in both hemispheres have been calculated over the Atlantic. Then, a meta-analysis has been conducted to combine these correlation coefficients across all species and fleets of the Atlantic. It resulted in an overall non-significant relationship between temperature and Tuna spatial distribution.

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ANTHROPOGENIC AMMONIUM INPUTS HAVE CONTRIBUTED TO REDUCED PRIMARY PRODUCTION IN SAN FRANCISCO BAY

Estuaries and coastal regions have been subjected to increasing anthropogenic nitrogen as a result of increased manufacture and use of nitrogen fertilizer, compounded by the rapid growth in human populations in coastal regions. Most commonly the effects of cultural eutrophication include oxygen depletion and proliferation of harmful algal blooms. However, decreased primary production can occur in concert with increased nitrogen inputs as in Delaware Bay and San Francisco Bay (SFB) as a consequence of the chemical speciation of DIN. In SFB, 15N labeled nitrate and ammonium uptake revealed that in the presence of elevated ammonium concentrations advected downstream from up-river sewage treatment facilities, phytoplankton seldom utilized nitrate. A long term decline in primary productivity in northern SFB began in the early 1980's when treatment plants switched to secondary treatment and discharged nitrogen as ammonium. Spring blooms now occur there only rarely, when ammonium concentrations fall to low values, allowing access to the large pool of nitrate. Ammonium has impacts on lower trophic levels that will be manifested as chronic food limitation of estuarine ecosystems.

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TEMPERATURE ADAPTATION IN THE BIG SULFUR BACTERIUM BEGGIATOA SPP.

Temperature has great impact on the activity of all organisms. To overcome the limitations imposed by extreme temperatures organisms have developed various strategies of adaptation. Here we show that the motility of the colourless sulfur bacterium Beggiatoa spp. is adapted to their environment's temperature and that it is under physiological control. We found that below 6 °C arctic Beggiatoa spp. glide faster than temperate Beggiatoa spp. Their physiological temperature range is 15 °C below that of temperate Beggiatoa. Temperate Beggiatoa spp. are capable to extend their temperature range at the lower end when cold acclimatizised. Arctic Beggiatoa spp. even sustain motility after freezing and thawing. We measured oxygen and sulfide profiles on mats from an arctic and a temperate location. Similar gradients suggest that Beggiatoa spp. mats in cold environments are as metabolically active as in temperate environments.

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PHYLOGENETIC CHIMERAS OF METABOLIC PATHWAYS IN THE MARINE PHYTOPLANKTON

Phytoplankton genome sequencing projects have revealed several metabolic pathways that are phylogenetic chimeras where the attendant proteins were acquired from different sources, which might result in novel physiologies. For example, in the marine diatoms, the proteins comprising a complete urea cycle have evolutionary origins in the chloroplast symbiont, the host for the secondary endosymbiotic event, and potentially a marine Bacterium. Protein localization studies with transgenic diatoms show that many of the proteins of this cycle are targeted to the mitochondria, revealing a novel subcellular configuration. The reinvented pathway may recycle the products of photorespiration in the mitochondria and likely plays an important role in NO synthesis. In order to identify other metabolic pathways that are phylogenetic chimeras, the predicted proteins from 13 complete phytoplankton genomes were associated with KEGG metabolic pathways. Separately, phylogenies for each protein and non-redundant genomic orthologues were constructed, providing insight to the evolutionary origins for the proteins within each KEGG pathway. The results of these and several other protein annotations have been assembled into a public database named PHYTAX to facilitate further comparative genomics-based studies of marine phytoplankton by the general community.

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CAN COASTAL WATER DARKENING CAUSE PERSISTENT MASS OCCURRENCES OF THE JELLYFISH *PERIPHYLLA PERIPHYLLA*?

The deep-water scyphomedusae *Periphylla periphylla* is found worldwide but in relatively low abundances. These abundances have apparently increased dramatically in certain Norwegian fjords during the last decades. It has previously been hypothesised that these mass occurrences are regulated by the light regime and the topography of the fjords, and that the mass occurrences have been facilitated by a long term darkening of the coastal water. To test this hypothesis, we use 100 years long time-series of Secchi disk measurements (obtained from ICES) and coastal salinity observations together with an individual based model parameterized by observed swimming behaviour.

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IS CHLOROPHYLL RETRIEVED BY THE MODIS SATELLITE IN THE NEW CALEDONIA LAGOON : THE VALHYBIO PROJECT

Is chlorophyll correctly retrieved by MODIS in the large tropical lagoon of New Caledonia (NC)? Coral reef lagoons are areas of high biodiversity, sensitive to climate change. Satellite chlorophyll is a proxy for phytoplankton biomass and primary production, used for validating biogeochemical models and for monitoring the carbon

balance. The NC lagoon is semi-enclosed and connected to the Coral Sea through a barrier reef. In deeper waters, waters are oligo- to mesotrophic, with low turbidity. River inputs are low, except during the last La Nina event (Valhybio cruise, March-April 2008, PNTS). A new OC3-type polynom, relating satellite reflectance ratios and chlorophyll, has been determined from 3 MODIS images coincident with the Valhybio cruise. In the deeper part of the lagoon and for chlorophyll less than 1.5 mg.m-3, OC3 performs also with a reasonable accuracy. The examination of the relationships between optical properties (a, bb, c) and pigments during Valhybio and previous cruises (Bissecote, 2006 and Echolag, 2007) helps in determining the influence of non-chlorophyllous particles and CDOM in the retrieval of chlorophyll and primary production in this tropical lagoon.

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DEVELOPMENT OF METHODS AND DETERMINATION OF TOTAL AND INORGANIC ARSENIC IN IRISH MARINE BIOTA

Arsenic occurs naturally in both organic and inorganic forms in marine waters and sediments, and is taken up from them by a range of marine biota. As a result marine biota may contain concentrations of total arsenic up to one hundred times greater than regulatory limits applied to other foods under Irish legislation. The majority of marine species consumed by humans have complex uptake and metabolic systems which concentrate, but also detoxify, arsenic to the extent that the predominant form (arsenobetaine in fish) is considered to be virtually non-toxic. However, this natural safeguard is insufficient to protect public health as highly toxic inorganic forms persist alongside over thirty further metabolites. Full separation and quantification of arsenicals is necessary for risk evaluation, but routine monitoring requires higher sample turnover. With the correct sample pre-treatment, hydride generation and spectroscopic detection provide a number of solutions. Results for total arsenic are presented for various species in Irish waters, following the development of a method applicable to routine analysis. A novel method for the rapid detection of the inorganic fraction is also discussed.

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GYROTACTIC TRAPPING: THE FORMATION OF THIN LAYERS OF PHYTOPLANKTON

Thin layer aggregations of phytoplankton are frequently observed meters beneath the surface in coastal waters. Characterized by algal concentrations orders of magnitude larger than the surrounding waters, thin layers of phytoplankton stretch in the horizontal for many kilometers. These coherent structures significantly affect the marine ecosystem, influencing nutrient fluxes, zooplankton growth dynamics, and the survival rates of fish larvae. The mechanisms responsible for generating thin layers are the subject of intense debate. Here we propose a new mechanism, which we call 'gyrotactic trapping', based on the biophysical interplay between directed swimming (i.e. gyrotaxis) and variable ambient shear. Using a novel experimental setup, we demonstrate that vertical migrations of phytoplankton can be disrupted by gradients in shear. The resulting thin layer accumulation is shown to closely match results from an individual-based model designed to mimic the experiments. Furthermore, a continuum advection-diffusion model demonstrates that gyrotactic trapping is capable of generating thin layers in the ocean where spatial scales are on the order of meters and turbulence tends to smooth heterogeneity.

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MOLECULAR FEATURES OF ORGANIC CARBON (OC) THAT FOSTER OC BURIAL IN LAKES

In this study, lakes with different trophic states, oxygen exposure times, and OC sources were compared to decipher which organic components become selectively preserved. Oxygen exposure time and terrigenous OC were found to trigger burial. Indicators for the diagenetic aging of the bulk OC, the Chlorin and Dauwe indices, showed that reactive amino acids and chlorin are removed fast during initial phases of decomposition, whereas neutral and non-protein amino acids selectively accumulate. Likewise, with increasing degree of remineralization, bacterial-derived biomass accumulated, particularly in lakes with a high share of autochthonous OC. By using ultrahigh resolution mass spectrometry (FT ICR MS) and electrospray ionization it was also found that from autochthonous organic matter, unsaturated compounds undergo abiotic sulfurization and therefore accumulate along aging. Terrigenous organic matter did not form organic S-compound and stayed rather inert during early diagenesis. Results from this study show that OC burial in lakes is mostly driven by high share of terrigenous organic matter and its inertness to degradation, by selective accumulation of bacterial transformation products and bacterial biomass, and abiotic sulfurization.

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CONTRIBUTION OF DIFFERENT DIATOM GENERA TO TOTAL COMMUNITY SILICIFICATION IN A COASTAL TO OPEN OCEAN TRANSECT AND IN RESPONSE TO IRON FERTILIZATION

Diatom primary production is a major component of the global carbon and silicon cycles. Growth rate and silicification are processes linked by iron limitation, which has been found in both physiological and genetic studies. The changing nutrient environment of a coastal to open ocean transect in the subarctic Pacific was studied to understand the contribution of individual members of the diatom community to shifts in total silicification. We also conducted an on-board iron enrichment experiment to stimulate changes in production, community composition, and physiology. We measured biogenic silica and fluorescent properties of the total community and incubated samples with a fluorescent stain (PDMPO) that incorporates into newly deposited silica. The fluorescent intensities of these stained cells were quantified by flow cytometry and epifluorescent microscopy to determine the relative contribution of individual cells to new silicification. This study will help clarify which members of a diatom community are producing new silica and their influence on silicification in changing nutrient environments.

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PRESENTATION OF THE MARINE ECOSYSTEMS RESPONSE IN THE MEDITERRANEAN EXPERIMENT INITIATIVE (MERMEX) FOR THE MEDITERRANEAN SEA

The French community working in marine biogeochemistry is currently structured to initiate the MERMEX project (Marine Ecosystems Response in the Mediterranean Experiment). This project led by the 'Institut National des Sciences de l'Univers (INSU)' will be associated to other projects related to the study of the hydrological cycle and atmospheric chemistry in the Mediterranean basin. MERMEX aims to deepen the current understanding of the Mediterranean marine ecosystems to better anticipate their upcoming evolution. It will focus on the response of ecosystems to the variability of physical (hydrodynamics, temperature, light radiation, habitats), chemical (stoichiometric ratios, contaminants) and socio-economic (fishing, recreational activities) forcings.
We intend to set up an integrated experimental approach considering the continuum between the coastal zone and the open sea and its interfaces, including ocean-continent, ocean-atmosphere and water-sediment. This comprehensive experimental effort aims to precisely describe the current state of the main Mediterranean ecosystems, understand the interactions between forcing factors, and validate the tools used to forecast their changes. We present an overview of this initiative for a large biogeochemical program in the Mediterranean and call for international collaboration.

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MODELLING THE COUPLING OF OCEAN ECOLOGY AND BIOGEOCHEMISTRY

We examine the interplay between ecology and biogeochemical cycles in the context of a global three-dimensional ocean model where self-assembling phytoplankton communities emerge from a wide set of potentially viable initialized cell types. We consider the complex model solutions in the light of resource competition theory. The simulations have clear and plausible organization of the emergent community structure by the physical regime: Strongly seasonal, high nutrient regimes are dominated by fast-growing bloom specialists, while stable, low-seasonality regimes are dominated by organisms that can grow at low nutrient concentrations, and are suited to oligotrophic conditions. In these latter regions, resource competition theory is capable of predicting not only the competitive outcome amongst organisms, but also the ecosystems control on the ambient nutrients. Sensitivity experiments clearly indicate the strong coupling of ecology and biogeochemical cycles: Changes to the phytoplankton physiology had a predictable effect on nutrient concentrations. Resource competition theory is a powerful tool for interpreting complex models of marine ecosystems (and perhaps their real world counterparts) in physical regimes of appropriately low seasonality.

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EFFECTS OF CARBON DIOXIDE-INDUCED ACIDIFICATION ON ALGAL QUALITY FOR COPEPOD REPRODUCTION

Increasing dissolved CO_2 concentrations and the associated decrease in ocean pH affect the phytoplankton cell physiology, biochemical and elemental composition and community structure. Since the biochemical composition of phytoplankton can control zooplankton growth and reproduction, trophic transfer efficiency and secondary production might change in response to the alteration of pH. Experiments were conducted to test whether growth or reproductive success of copepods is related to the pH of the growth medium with *Thalassiosira weissflogii*, *Prorocentrum minimum* or *Phaeocystis globosa*. Algae were grown in turbidostats under either ambient air or enhanced CO_2 concentration of 500 or 1000 ppm. Feeding, egg production, hatching success and faeces production of the copepod *Temora longicornis* and *Acartia tonsa* were determined, accompanied by measurements of carbon, nitrogen and lipid contents of the food. No direct effect of the reduced pH on copepod feeding and reproduction was observed when food grown at ambient conditions was fed to the copepods under reduced pH. However, growth or reproduction of the copepods was lowered or enhanced when algae grown at increased CO_2, likely due to changes in algal biochemistry.

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LEARNING MARINE SCIENCE CONTENT IN A VIRTUAL WORLD

Virtual worlds, where individuals can interact with each other in a rich digital environment, are increasingly popular, and represent an important medium for free choice learning. Here we highlight our experiences in developing inquiry-based activities for free choice learning about marine science in the virtual world of Whyville (www.whyville.net) operated for 8-15 year olds by Numedeon Inc. Results from our activity on harmful algae suggest that a high percentage of participants understood one or more of our learning metrics, for example linkages between nutrient supply and algal growth. With several hundred thousand children participating in this free choice learning, we are able to reach many more children with science content then we would in a more formal educational context.

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EXPRESSION OF A NITRATE TRANSPORTER IN CULTURES AND FIELD POPULATIONS OF THE COCCOLITHOPHORE EMILIANIA HUXLEYI

It is well appreciated that phytoplankton nutrient scavenging systems are complex and that the abundance and activities of important groups, such as coccolithophores, can be driven by nutrient availability. In this study, we examined the expression of an E. huxleyi ntitrate transporter gene. The expression of this gene is up-regulated by nitrogen (N) depletion, but is not influenced by growth on different N substrates, or by phosphorus physiology. The relative expression of this nitrate transporter also tracks with C:N ratio in N-limited semi-continuous cultures. In short, it appears to be a good marker of N-limitation and could be used to specifically diagnose N physiology in E. huxleyi field populations. An initial screen of field samples from a transect in the western North Atlantic detected expression of the nitrate transporter, but it was not significantly up-regulated relative to controls. The application of such gene expression assays may help to identify nutrient controls on E. huxleyi dynamics in this and other systems.

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IMPACT OF CLIMATE CHANGE ON DYNAMICS AND PRODUCTIVITY IN THE PERU-CHILE UPWELLING SYSTEM USING A REGIONAL COUPLED DYNAMICAL-BIOGEOCHEMICAL MODEL

The Peru/Chile upwelling system, also known as the Humboldt Current System (HCS), is the most productive region of the world oceans in terms of fisheries. It produces 20% of the global fish catches (mainly small pelagic fish such as anchovy and sardines) although it represents less than 1% of the ocean surface. This resource is highly variable at various time scales, and the societal and major economical impacts of fish catches fluctuations can be expected in the context of regional climate change. This work is a first step towards understanding the impact of potential climate change due to anthropogenic greenhouse gases increase on the fish habitat in the HCS. A regional, eddy-resolving, coupled physical/biogeochemical model (ROMS/PISCES) is used to diagnose possible changes under idealized CO2 quadrupling climate scenario. The model is forced by dynamically (using the LMDz atmospheric model) and statistically downscaled atmospheric forcing, and by physical and biogeochemical initial and boundary conditions originating from the IPCC IPSL-CM4 global simulations. Regional changes are analyzed in terms of nearshore upwelling intensity, meso- and submesoscale dynamics, planktonic biomass content and oxygen concentration.

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CONTINUOUS MEASUREMENTS OF THE PARTIAL PRESSURE OF CARBON DIOXIDE IN THE WESTERN BLACK SEA

The partial pressure of carbon dioxide in the surface seawater (pCO2w) and the above marine atmosphere (pCO2a) was measured continuously in the Western Black Sea shelf during autumn 2007 on a SESAME project cruise. The underway sampling system employed a showerhead type equilibrator and a non-dispersive infrared analyzer as a detector for the determination of carbon dioxide mixing ratios. Results show that the surveyed area was undersaturated in CO2 with respect to the atmosphere at the time of the cruise, regarding both open and coastal waters. A uniform distribution of pCO2w levels was observed in the surface waters of the main western part of the basin with a mean value of 320 μatm. Waters along the Romanian coast and the Danube river estuary exhibited strong undersaturation conditions of highly variable pCO2w levels with values as low as 132 μatm. A negative correlation pattern was found between pCO2w and chlorophyll a during the cruise that appeared to be stronger on coastal waters, suggesting biological CO2 uptake and illustrating the influence of the Danube input on the surface water carbon regime.

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CORRELATING NIFH GENE EXPRESSION TO NITROGEN FIXATION RATES IN THE MARINE DIAZOTROPHIC CYANOBATERIA CROCOSPHAERA SPP. AND TRICHODESMIUM ERYTHRAEUM IMS101

In the open ocean, nitrogen is typically the limiting nutrient for phytoplankton growth. However, diazotrophic cyanobacteria are able to fix atmospheric N2 into a biologically available form, thereby contributing a limiting nutrient to surface waters. In the field, qPCR analysis of nifH expression is used to indicate the presence and activity of nitrogen-fixing microbes, whereas the rate of nitrogen fixation is determined by acetylene reduction assay or 15-N2 uptake. The objective of my research was to determine if nifH qPCR expression values correlate to nitrogen fixation rates, in order to develop a new method for estimating nitrogen fixation in situ. Trichodesmium erythraeum (IMS101) and Crocosphaera spp. (WH8501, WH0005, and WH0401) were grown in nitrogen free media on a 14:10 hour light:dark cycle. Nitrogen fixation rates were determined using the acetylene reduction assay and samples were frozen in liquid nitrogen for later qPCR nifH transcript quantification. Nitrogen fixation rates normalized per nifH transcript number and the potential field relevance of these data will be discussed.

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LAKE RESTORATION WITH ALUMINIUM, BENTONITE AND PHOSLOCK: THE EFFECT ON SEDIMENT STABILITY AND LIGHT ATTENUATION

Many shallow eutrophic lakes cannot meet the EU WFD-criteria in 2015 without restoration. The sediment P-pools must be reduced. Chemical treatment like aluminium-addition is an obvious technique in reaching the WFD-criteria. But there is no information available on the effect of chemical treatments on aluminium mobility, sediment stability or light climate. A laboratory flume experiment including three shallow Danish lakes was conducted. We measured the effects of aluminium, Phoslock (a commercial product), bentonite, and a combination of bentonite/aluminium. Each treatment caused a varying consolidation of the sediment. The largest consolidation occurred using Phoslock- and bentonite-addition followed by bentonite/aluminium-addition, whereas aluminium alone had no effect. Sediment stability thresholds were measured before and after addition. Especially Phoslock, but also bentonite and bentonite/aluminium increased sediment erosion threshold, with respectively 200%, 43% and 57%. Aluminium, bentonite/aluminium, and Phoslock improved the light conditions in the water phase, with respectively 60%, 57% and 50%, whereas bentonite created higher turbidity. Conclusively aluminium improved the light conditions but was very mobile and had no positive effect on sediment stability and compaction, whereas the combination bentonite/aluminium improved all parameters.

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OSMOTROPH RESPONDS TO ORGANIC-C ENRICHMENT IN AN ARCTIC PELAGIC ECOSYSTEM

In order to investigate how the carbon-flow through the microbial community is affected by mineral nutrient limitation, mesocosm experiments were carried out in Ny Ålesund, Svalbard (78° 55' N, 11° 56' E). Mesocosm were supplied with equal amounts of nitrogen and phosphorus, +/- silicate and glucose in a gradient in order to create an increasing limitation of mineral nutrients and labile DOC, respectively. Heterotrophic bacteria were successful to compete for mineral nutrients when labile DOC was available, and the growth were increasing with increasing glucose addition. The effect was opposite for the phytoplankton, and total biomass measured as Chl a decreased with increasing glucose addition. Not all groups of phytoplankton followed this general tend, as pico eukaryotes showed the same pattern versus glucose gradient as heterotophic bacteria. Community responds to glucose addition was strongly affected by the phytoplankton composition, e.g. diatom or flagellate dominance. The results from our arctic experiment were also quit different from similar designed experiment preformed at lower latitudes and in warmer water.

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SCLERACTINIAN CORALS PHOTOSYMBIONTS CONTAIN SCANT VARIABLE ANTENNA AND LOW PSI/PSII RATIO UNDER THE LOW LIGHT REGIMES IN THE DEEP TROPICAL REEF.

The deeper reef environment (50-150m) is characterized by seasonally varying low light intensity (0.5-30.0 micro mol photons m-2 s-1) and a narrowing of the light spectrum. Under such extremely low light conditions the corals still harbor photosynthetic dinoflagellate symbionts from the genus Symbiodinium (zooxanthellae). Here we present a depth dependent decrease in photosystem I (PSI) abundance and activity. In addition, the non-photochemical quenching activity of zooxanthellae obtained from 65 meter depth corals was 5 to 10-fold lower than that of shallow water corals collected from 3 meters. According to current dogma, low light acclimation in zooxanthellae may occur via two major pathways; an increase in antenna size per photosynthetic unit (PSU) in order to optimize light capture and utilize the maximal quantum efficiency possible at such low light environments, or an increase of the number of PSU per cell. A few of the studies have indicated that there is no significant change in the symbiont chlorophyll content at depths below 25m. Our findings suggest that deep reef zooxanthellae adapt rather then acclimate to low light. Deep reef zooxanthellae have scarce variable antenna and a low PSI/PSII ratio as compared with shallow species.

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USE OF AN INSTRUMENTED AUV AS AN ENVIRONMENTAL MAPPING WORKHORSE FOR ROUTINE MONITORING APPLICATIONS

A cost-effective autonomous underwater vehicle has been developed specifically for water quality monitoring and bottom mapping applications. The vehicle weighs 22 kg and can be deployed by one person. The vehicle contains a CTD, depth sounder, sidescan sonar and 5 additional sensor ports for field installation of a range of water quality sensors including algae pigments, turbidity, dissolved oxygen, tracer dyes, and pH. Intuitive mission planning and vehicle control software results in a short learning curve. The vehicle collects data at a rate of 1Hz, travels at speeds between 1-4 knots, and is capable of 8-10 hour missions. The result is extremely high spatial resolution sidescan and water quality data at a very small operational cost. Use of an undulation feature allows the vehicle to fly two defined altitudes providing vertical and horizontal data. Water quality and sidescan data will be presented from a lake and coastal mapping mission conducted during the summer of 2008 in the United States.

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CHARACTERIZATION OF THE HADAL MICROBIAL COMMUNITY IN THE PUERTO RICO TRENCH AND CULTIVATION OF A NOVEL OBLIGATE PSYCHROPIEZOPHILE

Deep ocean environments could harbor the greatest numbers and diversity of microorganisms on the planet. The Puerto Rico Trench, the deepest site in the Atlantic Ocean, offers reasonable accessibility compared to other deep ocean trenches and may yield insight into the diversity and evolution of prokaryotes from a hadal zone. Initial characterization of the microbial community present at 8,350 m depth indicated a high diversity of Bacteria within the α, β and γ Proteobacteria, as well as sequences known only from environmental surveys. Archaeal groups were dominated by group I marine Crenarchaea and group II Euryarchaea. Trench water was also employed for high-pressure cultivation experiments using dilution-to-extinction methods in a seawater-based medium at high hydrostatic pressure. This cultivation effort resulted in the first isolation of an obligately psychropiezophilic α-Proteobacterium, designated strain PRT1. This strain falls within the Roseobacter lineage and has a calculated doubling time of ~32 hrs. Diverse cultivation techniques at high hydrostatic pressure are underway in an effort to expand the diversity of piezophilic Bacteria and Archaea in culture.

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ROLE OF BIOGENIC MINERALS IN PARTICLE AGGREGATION PROCESSES AND POTENTIAL SENSITIVITIES TO OCEAN ACIDIFICATION

Recent studies have highlighted the role of biogenic minerals for the export of organic matter to the deep ocean. Aggregated with organic matter, mineral particles are expected to act as ballast, and to delay bacterial decomposition. Coccolithophores are one major marine phytoplankton group producing particulate minerals, but their ability to precipitate calcium carbonate is expected to decline with increasing seawater acidification. Therefore, the export of organic particle aggregates may change in the future. During several experiments, we examined the formation, decomposition and sinking of aggregates derived from the coccolithophore Emiliania huxleyi, including aggregates formed by calcareous cells, non-calcareous cells and by cells grown in acidified seawater. Our results emphasize the importance of biogenic calcium carbonate for the coagulation efficiency of cells, as well as for the size and sinking velocity of aggregates and the decomposition of organic matter. Based on our findings, potential effects of ocean acidification for particle export are discussed.

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PROKARYOTIC COMMUNITY PATTERNS IN THE ANOXIC FRAMVAREN FJORD AS REVEALED BY CARD-FISH

The super-sulfidic Framvaren Fjord is located in the south – west of Norway and shows a permanently anoxic waterbody. Previous surveys of other anoxic systems like the Black Sea or the Cariaco Basin (Venezuela) revealed significant differences in total prokaryotic abundance and community patterns along the O_2/H_2S - gradient. In this project we analyzed the diversity of bacteria and archaea in the redoxcline, immediately below the redoxcline and in deeper sulfidic waters of the Framvaren Fjord in two different seasons, in order to elucidate the microbial community structures in this relatively recent anoxic system. Total prokaryotic cell numbers were evaluated by the use of 4',6'-diamidino-2-phenylindole (DAPI). Specific prokaryotic groups were identified and enumerated by fluorescence *in situ* hybridization (FISH) with ribosomal RNA-targeted oligonucleotide probes, modified with horseradish peroxidase (catalyzed reporter deposition [CARD]). Depending on the depths, the universal eubacteria – (Eub338 I-III) accounts for 50% - 60% of the DAPI stainable cells, whereas the archaea (ARCH915) varied between 7% - 20%. Ongoing research will reveal more precise patterns by the use of group specific probes, as presented on our poster.

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EVIDENCE OF METHANE AS ENERGY SOURCE FOR THE FOOD CHAIN OF A TROPICAL FLOODPLAIN LAKE (PANTANAL, BRAZIL)

The aim of this study was to evaluate the relative importance of methane in the food chain of a floodplain lake located in the Pantanal, Brazil. Samples from primary producers and consumers were collected on November 2006 and their stable C and N isotopic ratios content determined with an IS/MS Delta Plus Finnigan. The carbon isotopic signature of chironomids, chaoborids, polychaetes and ephemeropterans (-35 to -40 ‰) and the most negative carbon signature found for zooplankton (-42 ‰) collectively suggested that methanotrophic bacteria might be an important food source for the benthic and pelagic compartments. The carbon isotopic composition of different species of fish varied from -27 to -37 ‰, indicating that the range of their diet vary from aquatic macrophytes to insects and zooplankton. These results suggest that the energy fixation by methane oxidation might support higher consumer levels in the food chain and that the importance of methanotrophy as energy source for food chains in aquatic systems may be more relevant than previously thought.

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SPATIAL AND TEMPORAL CHANGES IN PICOEUKARYOTE COMMUNITY STRUCTURE IN A SUBTROPICAL ESTUARINE SYSTEM, TEXAS, USA

The Mission-Aransas estuary is a shallow bay-estuarine system on the Gulf of Mexico. The salinity gradient in the system is determined primarily by riverine inflows, which are dominated by infrequent storm events. These events can lower salinities in the system for long periods. While these large events greatly affect physico-chemical conditions in the system, their effect on primary production is unknown. We characterized the phytoplankton communities along the estuarine gradient, to provide data for future studies of their functional role in this system. In summer 2007 and 2008, samples were collected from three sites of different salinities. DNA was extracted from the 0.45-5 micron size fraction, as this is often the dominant size class in terms of chlorophyll. Communities were compared by RFLP analysis and sequencing of a fragment of the small subunit ribosomal RNA gene. Our results show that the estuarine picoeukaryote communities are highly diverse, consistent with results from other aquatic environments. There is little overlap between the sequence types from the three sites, suggesting that particular types may be adapted to different estuarine zones.

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TEMPERATURE EFFECTS IN REPRODUCTION OF THE MEDITERRANEAN SPONGES

Potential effects of global change act from the physiological level to the community and can lead to diversity loss and affect ecosystem functioning. Baselines on reproduction cycles of marine invertebrates are needed to better assess the possible effect of the environmental changes at the population level. Sponges represent one of the most ubiquitous groups of metazoans within benthic communities. Consequently, these organisms have a special set of adaptations, including life and reproduction strategies. With the programme PHENOMED "Climate change, phenology and reproduction: Mediterranean sponges as models", we revisited the successive reproductive phases of four Mediterranean sponges with distinct reproductive strategies and sensitivity to environmental changes. Samples of each species were collected monthly over several years in a site of the NW Mediterranean equipped with a permanent temperature recorder. In spite of different reproductive cycles, all investigated species exhibited responses to change in seawater temperature. It is too early to predict potential effects of the global warming on Mediterranean populations, but these first findings fully justify the monitoring of life cycles and reproductive effort of benthic organisms.

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CO2 SEQUESTRATION BY OCEAN FERTILIZATION AND CACO3 DISSOLUTION: A CASE STUDY IN THE NORTHERN GULF OF AQABA (NGA, EILAT) AND ITS CORAL REEFS

Coupling of photosynthesis-respiration and $CaCO_3$ production-dissolution are major processes in the oceanic carbon cycle. Efficient $_2$ sequestration may be achieved by increasing the downward flux of organic carbon and dissolution of sedimentary $CaCO_3$ when this flux is oxidized. Observations in the NGA suggest that the sedimentary $CaCO_3$ reservoir is already responding to ocean acidification and to anthropogenic eutrophication. Perhaps the worlds largest "fertilization experiment" was induced in the NGA by fish farming which added ~ 250 ton N and 50 ton P per year for the last 10 years. This enrichment increased phytoplankton production by a factor of 2.5 relative to previously reported rates, while calcification of coastal coral communities decreased by more than 60%. The deep water nutrient reservoir nearly doubled with an equivalent decrease in the dissolved oxygen inventory. Oxidation of organic matter within the deep water sediments caused $CaCO_3$ dissolution resulting in a steady increase of alkalinity of ~3 microeq per Kg per year. Nutrient enrichment in such environments may be able to sequester atmospheric CO_2 at the expense of the flourishing and well being of coral reef communities.

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TRACING NITROGEN FLOW THROUGH CONSTRUCTED WETLANDS USING A WHOLE SYSTEM STABLE ISOTOPE ADDITION

Constructed wetlands are commonly used for the tertiary treatment of sewage effluent. They are diverse ecosystems with a range of processes that transform, assimilate and remove nutrients from the waste stream. The role constructed wetlands play in removing nitrogen has traditionally been accomplished through the use of mass balance modelling with less attention given to the individual internal nitrogen processes. This presentation will describe a whole system isotope labelling experiment where 15NH4+ was released and followed in a commercial scale constructed wetland. We will present results on the flux of 15N within the dominant wetland nutrient compartments over a 4 month period. We will also describe the modification of 15N, via process such as denitrification and anammox, as it traverses through the wetland.

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THE DECLINE AND RESTAURATION OF A COASTAL LAGOON (LAKE VEERE) IN THE DUTCH DELTA.

The Dutch Delta Plan, response to the disastrous 1953's flooding, resulted in the complete 'reconstruction' of the Rhine/Meuse/Scheldt delta (SW Netherlands) with a reduction of the coast line with no less than 700 km and reshaping former tidal marine and estuarine areas into semi and fully stagnant, partly with fresh water, basins. Among them the three systems Eastern Scheldt, Grevelingen lake and Veere Lake were turned respectively into a tidal marine bay, a stagnant marine lake and a brackish lake with intermittent communication with the sea. During the twenty to thirty years after the completion of the works, these three systems have shown a continuous degradation of their ecological value in terms of habitat, diversity and or biomass of macrofauna organisms. As a first measure of remediation, the exchanges between the tidal Oosterschelde and the Lake Veere were restored in 2004. This study gives an overview of the changes in the Lake Veere during both periods before and after the restoration measures. Hypotheses are made about the effect of water exchanges management on the ecosystem functioning of lagoons and the possible use of it in controlling the ecological status of these systems.

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SEDIMENT TRAP STUDY OF DINOFLAGELLATE CYST PRODUCTION IN THE CENTRAL STRAIT OF GEORGIA, CANADA.

To study the ecology of organic-walled dinoflagellate cysts we examined 3-year (1996-98) changes in species composition and seasonal variations of cyst flux in GSCM-3 sediment trap deployed in the central Strait of Georgia, BC, Canada. Samples were collected bi-weekly at 150m water depth. The initial results revealed a total of 36 cyst morphotypes, 21 of which were identified to species level. Throughout the study period, dinoflagellate cyst assemblages were dominated by cysts of heterotrophic Protoperidineaceae (Protoperidinium conicoides, P. avellanum, P. leonis, and P. americanum). Cysts produced by heterotrophic dinoflagellates peak in June-July, during or following the observed diatom blooms, whereas cysts of autotrophic species are most abundant during August-September. Production rate of dinoflagellate cysts varies from 5*102 to 1*105 cyst m-2 day-1. Cysts of opportunistic P. reticulatum and Pentapharsodinium dalei noticeably increased their abundance in 1997 El-Niño year. In general, dinoflagellate cyst flux and species composition reflect water quality conditions in the Strait of Georgia, in particular the sea-surface temperature and salinity.

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FROM THE OCEAN TO THE PHOTOBIOREACTORS: STUDY OF THE IMPACT ON PRODUCTIVITY OF PHYTOPLANKTON PHOTORESPONSES TO LIGHT VARIATION.

Photobioreactor for bioenergy production are aiming at optimizing the storage of light energy into biomass. The strong light gradient generated by the algal biomass induces a rapid alternation through dark and intensely illuminated zones leading thus successively to respiration and photoinhibition. Cells react to light variations by changing their pigment content, in order to either improve absorption or mitigate photodamage. Very few studies analyzed whether the interplay of these processes enhances biomass growth. We address the problem with a modeling approach, accounting for dynamic interaction between photoacclimation, photodamage and repair. Our model is able to reproduce hysteresis due to the asymmetry in photoresponses to opposite light shifts. We focus our attention on the impact of photoresponse interaction and hysteresis in scenarios ranging from larger time scale (oceanic situations) up to the rapid time scales in photobioreactors. We show that the overall impact is a frequency dependent depression of carbon assimilation in light fluctuating scenarios with respect to constant light. These results motivate the development of a unifying approach for photobioreactor modeling, integrating both small-scale turbulence and phytoplankton physiology.

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PHYTOPLANKTON DIVERSITY SPECTRA IN CONTRASTING SITUATIONS OF THE NW MEDITERRANEAN

Diversity is often defined as an estimation of the number of species in a particular habitat, generally weighted according to their abundance or some other relevant magnitude. However, the spatio-temporal structure of diversity may convey interesting information, which is lost in point to point estimates. R. Margalef proposed the use of

phytoplankton diversity spectra, in which a diversity index is calculated for proggressively larger sampling spaces, and suggested how the shape these spectra could be related to ecosystem characteristics. This communication presents a study of diversity spectra calculated for series of surface (0-35 m) and deep (36-70 m) phytoplankton samples taken during winter and summer along a transect in the NW Mediterranean. Comparison of these diversity spectra indicated a higher diversity in summer and in the deep layers than in winter and in the surface waters, indicating a more structured environment during the summer period and supporting the suggestion from Margalef that communities at the base of the photic zone could function as a repository of biodiversity.

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CONTRIBUTION OF CONTINUOUS MONITORING SURVEY FOR THE UNDERSTANDING OF PROCESSES AND LONG-TERM DISCRETE TIME RECORDS IN A MACROTIDAL ESTUARY

In order to understand main processes (hydrological and geochemical) taking place in an European macrotidal model estuary, a continuous monitoring survey has been set up in the Gironde Estuary (MAGEST NETWORK): during three years, temperature, salinity, suspended matter and oxygen contents were measured every ten minutes, at four stations covering the whole estuary. New insights in marine intrusion phenomena, migration of the high turbidity zone, settling-resuspension cycles of suspended matter and oxygen depletion of waters were obtained. Moreover, these data are and will be very useful to better understand long-term discrete records (more than thirty years) of these parameters inside the estuary.

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ANAEROBIC METHANE-OXIDIZING BACTERIA: SURPRISING PLAYERS IN THE METHANE AND NITROGEN CYCLE

Anaerobic methane oxidation coupled to sulfate reduction is a globally important methane sink. It is carried out by methanotrophic archaea, probably living in symbiosis with sulfate-reducing bacteria. We have enriched another anaerobic methane-oxidizing microbial community, which reduces nitrate and nitrite to dinitrogen gas (Raghoebarsing et al. 2006, *Nature*). By analyzing two independent enrichment cultures carrying out this process, we found that archaea are dispensable for the process, and that bacteria from the "NC10" phylum are dominant (~80 %). This phylum is so far only known from environmental sequences, present in many aquatic habitats worldwide. In order to understand the physiology and ecological niche of these anaerobic methane-oxidizing bacteria, we carried out genomic, proteomic and physiological studies on the enrichment cultures. From the metagenome, the genome of the dominant "NC10" bacterium could be largely assembled. Surprisingly, we found a combination of anaerobic and aerobic pathways, which were both found to be expressed (proteome analysis) and functional (enzyme assays, ^{15}N-labelling). Our findings have wide implications for the understanding of methane oxidation under anaerobic conditions and the interpretation of metagenomic libraries.

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CHARACTERISTICS OF PHYTOPLANKTON COMMUNITY STRUCTURE IN THE NORTHWEST SUBTROPICAL PACIFIC DURING EARLY SUMMER 2006

We investigated the characteristics of phytoplankton community composition in the NW subtropical Pacific during early summer of 2006. At oceanic stations, *Prochlorococcus* was most abundant among picophytoplankton. *Prochlorococcus* accounted for 31-53% of total Chl *a* levels at the oceanic stations and for 14-15% at coastal stations. PCR-DGGE revealed that low-light adapted eNATL2A and eMIT9313 *Prochlorococcus* ecotypes existed only at subsurface chlorophyll maximum (SCM) layers, but high-light adapted eMIT9312 ecotype occurred both at surface and SCM layers. *Synechococcus* was the secondary or tertiary constituents in the autotrophic picoplankton in surface waters, but their cell density declined rapidly with depth. The *Synechoccoccus* observed in this study was classified into clade II and clade VII. Picoeukaryotes were relatively dominant at SCM in the oceanic stations and at coastal waters. Among eukaryotic phytoplankton, prymnesiophytes and chrysophytes were predominant as estimated by pigment signatures. Our PCR-DGGE detected a few chrysophytes, but their genetic information has little been available from nucleotide sequence databases. Substantial development of the databases for eukaryotic phytoplankton must be required for better understanding of the biodiversity of phytoplankton in the study area.

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THE SIGNIFICANCE OF VIRUSES FOR SOUTHERN OCEAN MICROBIAL ECOSYSTEMS

Despite the importance of viruses in the ecology and biogeochemistry of marine environments little is known of their role in the microbial communities of the Southern Ocean. Due to this regions' particular vulnerability to global change it is imperative that baseline measurements are made to determine if and how it's microbes are being perturbed. We report on two cruises to the Southern Ocean conducted during the Austral Summers of 2007 and 2008, namely SAZ-SENSE and ANT/XXIV (Geotracers). During both studies the abundance and distribution of the microbial community (viruses, bacteria and pico and nanophytoplankton) was determined by flow cytometry and a variety of methods were employed to assess viral induced mortality and grazing of both the bacterial and pico/nanophytoplankton communities. Preliminary results indicate that virus infection is responsible for a significant fraction of picophytoplankton microbial-mortality in the Subantarctic Zone, whilst in latitudes above the Polarfrontal Zone, viral-induced mortality becomes insignificant and the pico and nanophytoplankton are primarily controlled by grazing. Whereas, for bacterial populations, viral lysis was a significant mortality source throughout the different water masses of the Southern Ocean.

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TRAIT BASED APPROACHES TO HARMFUL ALGAL BLOOMS

Since the introduction of filter feeding zebra mussels (ZM, *Dreissena polymorpha*) into Michigan (USA) lakes, there has been an increase in the occurrence of *Microcystis sp.* and other phytoplankton producing the toxin microcystin. This increase is most prominent in low nutrient lakes where toxin-producing species are typically rare. To test potential mechanisms of ZM effect, trait based modeling of phytoplankton competition was undertaken. *Microcystis* and other toxin producing phytoplankton are typically buoyant or buoyancy regulating, have high nutrient requirements, and may be resistant to filter feeding by ZMs. Modeling results show that the outcome of competition with non-buoyant species is highly dependent on the relative nutrient requirements (half saturation constant) of the species and secondarily on the relative mortality of the species (as would be caused by selective feeding by ZMs). Nutrient assays on local *Microcystis* strains show that the half saturation constant for growth on phosphorus is above the range where reasonable levels of selective feeding would change the competitive outcome. This indicates that the observed ZM effect on toxic blooms is probably not due to selective feeding.

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THE FATE OF CARBON AND NITROGEN FROM BENTHIC MICROALGAE IN TROPICAL, TEMPERATE AND ARCTIC INTER-TIDAL SEDIMENTS: 13C AND 15N PULSE-CHASE EXPERIMENTS

13C and 15N pulse-chase experiments were undertaken in tropical, temperate and arctic inter-tidal sediments to determine the fate of carbon and nitrogen from benthic microalgae in different climate zones. Benthic microalgae (BMA) were labeled by spraying the sediment surface with15NH4Cl with NaH13CO3. This label was followed through the lower food web and biogeochemical processes for 30 days. Pathways considered include uptake by bacteria (D-Alanine, PLFAs), meiofauna and macrofauna, loss via sediment-water fluxes of DO13C (proxy for EOC; inundated), DI13C (respiration; inundated), 13CO2 (respiration; exposed), 29N2 and 30N2 (denitrification/ anammox; inundated, exposed), DO15N, 15NH4, and 15NO3 (inundated) and storage in the bulk sediment at different depths. Preliminary results show that labeled BMA biomass was still being respired after 20 days and labeled BMA nitrogen was released via N2 effluxes for up to 10 days. Budgets of excess 13C and 15N label showing the fate of carbon and nitrogen from benthic microalgae in different climate zones will be presented.

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BOTTOM-UP EFFECTS OF DOC AND TOP-DOWN EFFECTS OF YOY PERCH ON A NATURAL PELAGIC COMMUNITY – A MESOCOSM EXPERIMENT IN AN UNPRODUCTIVE LAKE IN NORTHERN SWEDEN

The effects of terrestrial dissolved organic carbon (DOC) inflow to lakes have largely been studied from a 'bottom-up' perspective. We took this one step further, and examined the combined effects of DOC addition (bottom-up) and fish predation (top-down) on pelagic food web dynamics in a full-factorial mesocosm experiment. We hypothesised that DOC addition would release bacteria from dependence on phytoplankton carbon, thus increasing the importance of the heterotrophic energy pathway; and secondly, that selective grazing by young-of-the-year perch on copepods would decrease net bacterioplankton production, by releasing bacterioplankton grazers from copepod predation. However, in our experiment it appeared that the effects of DOC and perch addition did not overlap. DOC addition only increased bacterioplankton production and the effects of perch grazing were only evident down to flagellates. Nevertheless, food web configuration in mesocosms with both DOC and perch addition were more similar to control mesocosms than mesocosms with DOC or perch addition treatments alone. This suggests that the cascading effects of perch grazing may decrease the importance of the heterotrophic energy pathway, even when DOC concentrations are relatively high.

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ZOOPLANKTON 210-PO/210-PB DYNAMICS IN RELATION TO TROPHIC CONDITIONS IN MONACO BAY DURING A ONE YEAR CYCLE.

Monthly sampling in Monaco Bay showed that during May a marked zooplankton bloom was present, preceded by a prolonged increase in particulate matter in the water column which began at the end of March. Rainfall showed an inverse trend during this period with the lower amounts occurring when zooplankton biomass was higher. The natural radionuclide 210-Po in water and zooplankton showed an opposite trend during the sampling period. No correlation was found between zooplankton biomass and 210-Po in zooplankton, but the trend was negative. 210-Pb uptake was low in zooplankton while levels were comparatively higher in water during this period. In zooplankton, the lowest 210-Po concentrations were found in May-June during the peak of the zooplankton bloom when 210-Po concentration in water was at its peak. Rainfall is apparently working as a dilution factor in zooplankton 210-Po accumulation. 210-Po, 210-Pb and its parent 22-Rn atmospheric inputs are distributed among the different matrices of the "system", water, phytoplankton and zooplankton. Given the organic nature of zooplankton, it is absorbing more 210-Po but is also "diluted" when higher biomasses are present.

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DOC REMOVAL AND CO2 EMISSIONS IN HIGHLY HUMIC TROPICAL LAGOONS

The upsurge in the microbial loop paradigm and the studies on dissolved organic carbon (DOC) photo-degradation gave rise to the belief that microbial processing of humic substances (HS) should sustain aquatic food-webs in humic waters. However, our data do not support the microbial loop as an efficient energy transfer pathway in highly humic coastal lagoons. Highly humic tropical lagoons showed proportionally lower bacterial production rates and higher bacterial respiration rates than other lakes. In addition, we found that some tropical humic ecosystems presented the highest DOC photo-chemical mineralization rates reported in the literature, exceeding up to 3-fold the rates reported for temperate humic ecosystems. Furthermore, these humic lagoons are net heterotrophic and showed very high rates of CO2 emissions. We concluded that HS may be an important source of energy for aquatic bacteria in humic waters, but probably not as important as a substrate to bacterial growth, as HS consumption is mostly channelled through microbial respiration. In these humic lagoons, HS is mostly oxidized into CO2 and emitted to atmosphere.

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SUCCESSION AND NITROGEN UTILIZATION BY PHYTOPLANKTON IN THE DEVELOPMENT OF AN UPWELLING BLOOM

Diatoms often dominate in upwelling environments, and are responsible for up to 25% of marine primary production. We hypothesize that their success depends partly on their ability to exploit new nutrients rapidly. An upwelling event - and subsequent phytoplankton bloom - was simulated in a mesocosm experiment in Monterey Bay to investigate the differential growth of phytoplankton groups in the early stages of upwelling. N (NO_3^- and NH_4) and CO_2 uptake by three size fractions (0.7-5μm, 5-20μm, >20μm) was measured daily through stable isotope tracer incubations. The biomass was initially dominated by the <5μm size fraction, but the largest fraction experienced the greatest change in mass over the evolution of the bloom. NO_3^- assimilation was greatest by the >20μm size fraction, while the smallest fraction dominated NH_4 uptake. Photosynthetic pigment measurements (total and size-fractionated) corroborated the increasing dominance of diatoms in the community. Cell counts by light microscopy documented different patterns of abundance change within the diatom assemblage. Microscopy and clone libraries based on nitrate reductase and rubisco genes both detected high diversity of eukaryotic phytoplankton early in the bloom.

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SEDIMENT MICROBIAL DIVERSITY AND COMMUNITY CHANGES OF AN INTERMITTENT SOUTHERN ONTARIO STREAM

Microbial communities in aquatic ecosystems are ubiquitous and maintain ecological balance when interacting with dissolved organic carbon (DOC), metazoans and higher trophic levels. Here we present seasonal and temporal patterns in genetic diversity in the hyporheic zone of two streams in southern Ontario, Canada. The streams, one permanent and one intermittent, serve as a natural proxy for environmental change. We combined molecular fingerprinting tools that include terminal-restriction fragment length polymorphism (T-RFLP), denaturing gradient gel electrophoresis (DGGE) and nuclear magnetic resonance (NMR) spectroscopy in a field-based study. We show how biota found in the hyporheic zone varied spatially and temporally following consecutive flooding and rewetting events. Bacterial communities at the intermittent site increased in diversity immediately following a flooding event, then subsequently decreased. An overall loss of rare species was also observed. Eukaryotes were more influenced by seasonal watershed factors at the permanent site, and by local spatial factors at the intermittent site. We also show how these results may be related to molecular changes in DOC. Since our understanding of microbial food web responses to environmental stress is limited for these environments, we highlight the importance of linking small-scale hyporheic processes to large-scale riverine processes.

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MIXOTROPHY IN A DEEP ALPINE LAKE: THE EFFECT OF SOLAR RADIATION ON SPECIFIC PATTERNS OF PHAGOTROPHY

Vertical changes of mixotrophic activity have been studied in several chrysophyte species of a deep high mountain lake (Lake Redon, Pyrenees) and the effect of UV and PAR radiation was investigated by in situ experimentation. Species patterns of algal bacterivory were established using a catalyzed reported deposition – fluorescence in situ hybridization (CARD-FISH) protocol, particularly suited to asses the phagotrophy of mixotrophic algae on prokaryotes. The results showed that most species increased prey ingestion under UV and high PAR radiation, whereas ingestion was lower when cells were submitted to no UV and low PAR radiation, supporting that mixotrophy is an advantageous life strategy for algae inhabiting environments stressed by sunlight. The importance of sample origin in the species response was analyzed. The ecological implications of mixotrophic activity in microbial food webs of deep lakes will be discussed

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INTERACTIVE EFFECTS OF IRON, IRRADIANCE, AND CO_2 ON THE PHYTOPLANKTON COMMUNITY OF THE ROSS SEA, ANTARCTICA

The Southern Ocean plays a role in modulating global climate and will be one of the ocean regimes most influenced by anthropogenic global change. Among the many future changes that are likely to occur here are rising seawater pCO_2 and falling pH, changes in aeolian and upwelled supplies of the limiting nutrient iron, and mixed layer shoaling due to warming and ice melting. We conducted a factorial shipboard continuous culture incubation experiment to examine the interactive effects of changing iron, irradiance and CO_2 on the Ross Sea phytoplankton community. After eighteen days of steady-state incubation, iron enrichment increased phytoplankton biomass, nutrient drawdown, diatom and *Phaeocystis* abundance and some photosynthetic parameters, consistent with previous studies. Many of these iron effects were further magnified in the incubations carried out under elevated irradiance. CO_2 concentration mainly affected the composition of the diatom community (large centric versus small pennate abundance). These results suggest that shifts in light, iron and CO_2 and their mutual interactions will all play a role in controlling Ross Sea phytoplankton community structure and biogeochemistry in the future changing ocean.

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TRACE ELEMENTS IN THE VAR RIVER CATCHMENT (FRANCE): NATURAL AND ANTHROPOGENIC CONTRIBUTIONS

Waters of the Var catchment basin are feeding groundwater resources used by more than 600 000 inhabitants of the Nice region. Starting from 3000m altitude, waters are draining areas affected by increasing population density towards the mouth, without inducing yet a strong impact on the water quality. This typical Mediterranean hydrological system is affected by climate change, mainly characterized by longer dry seasons, and increasing anthropologic pressure, which will modify natural and anthropogenic chemical contributions. A detailed geochemical study is performed on trace elements in surface and ground waters and in rocks of the catchment, with the aim to better understand this system and establish a hydro-geochemical natural reference frame. First data show that (1) the geology is sufficiently contrasted to give specific natural geochemical signatures in waters from different zones of the catchment, (2) well defined natural geochemical domains appear and will be used to detect even low level anthropogenic contributions in the future, (3) a detailed comparison between waters and rocks compositions allow understanding the origin of trace elements in waters and distinguishing natural (As) and anthropogenic pollutions.

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CARBON CYCLE IN CONTINENTAL AQUATIC ECOSYSTEMS: ALGAE BIOMASS AND CARBONATE FLUX DYNAMICS IN ALPINE LAKES IN A GLOBAL CHANGE CONTEXT.

Carbon natural cycle is primarily controlled by biomass, weathering and deposition dynamics. Its balance relies on two main processes: biological activity through photosynthesis and respiration, and calcite precipitation/dissolution balance. Since they are the major place of continental carbonates deposition, lakes may play an important role in its regulation. Considering the Earth is currently experiencing a climate change caused by anthropogenic carbon emissions, understanding the carbon cycle is a relevant matter. Here we present methodological elements that will be used to monitor these processes at different time scales. Study will be based on 20 years CTD and O2 profiles collected bimonthly on two subalpine natural lakes (Lac du Bourget and Lac d'Aiguebelette, France). Combining these data to the real-time, high temporal resolution ones from ANR program Proliphyc enables determination of the lake carbon balance at time scales varying from hour to decade. This assessment will be established by using dioxygen as a biomass activity proxy and conductivity as a calcite dynamics proxy. Linking these parameters to the meteorological data may help to understand the impact of environmental factors on this balance.

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LATITUDINAL VARIABILITY IN PRIMARY PRODUCTION, N_2 FIXATION AND *TRICHODESMIUM* SPP. ABUNDANCE IN THE ATLANTIC OCEAN

Diazotrophy can represent an important source of nitrogen for new production in tropical and subtropical regions of the open ocean. However, coupled measurements of primary production and N_2 fixation are scarce. During the TRYNITROP (*Trichodesmium* and N_2 fixation in the Atlantic Ocean) cruises, we determined size-fractioned chlorophyll concentration and primary production, $^{15}N_2$ fixation and *Trichodesmium* spp. filaments abundance in the Atlantic Ocean. Measurements were conducted along 29°W between 29°N-33°S in November 2007 and April 2008. The highest rates measured on each cruise were 0.25 mmol N m^{-2} d^{-1} in November 2007 and 0.15 mmol N m^{-2} d^{-1} in April 2008. For the two cruises, higher rates of primary production (>10 mmol C m^{-2} d^{-1}) and N_2 fixation (>0.04 mmol N m^{-2} d^{-1}) occurred between 20°N and 10°S. Over this latitudinal range, the mean N_2 fixation rate (n=17) was 0.05 mmol N m^{-2} d^{-1}. Our results illustrate the biogeochemical significance of N_2 fixation over large expanses of the tropical Atlantic Ocean.

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NITROGEN FIXATION UNDER PERMANENT AND SEASONAL UPWELLING REGIMES IN THE EASTERN SOUTH PACIFIC REGION.

Nitrogen fixation was studied in 2007 (15N assimilation) in the permanent upwelling off Peru and northern Chile (12 - 20°S) and a seasonally active upwelling system at 36°S. Both sites are considered important nitrogen sinks (mainly through denitrification), driven by subsurface oxygen deficient conditions. Rates obtained off Peru reached maximum values of 2.24 nmoles L-1 d-1 in surface waters (average 0.52 ± 0.6 nmoles L-1 d-1) and remained high within the oxygen minimum zone (max. 2.96 nmoles L-1 d-1). Rates obtained in central Chile (36°S) during winter and spring reached 1.8 nmoles L-1 d-1 in surface waters and 3.54 nmoles L-1 d-1 at suboxic levels. These results show that diazotrophy occurs in oxic and suboxic waters of the eastern South Pacific and coincide with nitrogen losses through denitrification and anammox in both time and space. Furthermore, nitrogen fixation is active along a wide latitudinal gradient and at low sea-surface temperature. The finding of nitrogen fixation within oxygen minimum zones and associated surface waters suggest the ubiquity of this process and a strong overlap between marine sinks and sources of N.

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ESTHETES PORE DENSITY IN CHITONS (MOLLUSCA: POLYPLACOPHORA)

Chitons are marine mollusks covered dorsally with eight overlapping plates. Located, in the interior of the plates, are the esthetes, a sensorial organ system with a fork-type distribution that ends in surface pores. We characterized the esthetes pore density to determine if it responds to a designated genetic pattern. We studied pore density in two morphologically similar species of the genus Ischnochiton: I. striolatus and I. erythronotus. We compared them with Stenoplax purpurascens, of the same family. The mean density values were: S. purpurascens 2954 pores/mm² (ds=493, N=13), I. striolatus 5214 pores/mm² (ds=503, N=10), and I. erythronotus 4358 pores/mm² (ds=445, N=9). The mean pore density for S. purpurascens is significantly smaller than the I. striolatus (p<1.31x10-9, t-test) and I. erythronotus (p<1.44 x 10-6, t-test). The pore density is similar between the two species of the same genus. A significant correlation between pore density and chiton size was not found (S. purpurascens, r=0.408; I. striolatus, r=0.0604; I. erythronotus, r=0.0843).The size independent tendency establishes the potential of that criteria for the identification of immature specimens.

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EUTROPHICATION AND AQUACULTURE – LA VIE EN ROSE?

Farmed production of aquatic resources is increasingly seen as a mechanism for satisfying the growing demand for fisheries products, while accommodating the systematic decrease in capture fisheries. In China in particular, annual cultivated shellfish production now exceeds nine million tons. In parallel with the importance of shellfish production, as a source of food and employment, bivalve aquaculture provides important goods and services in mitigating potential effects of nutrient discharge, contributing to a reduction of chlorophyll and organic detritus, and maintaining acceptable concentrations of dissolved oxygen. The Farm Aquaculture Resource Management (FARM) model was applied to a farm in Sanggou Wan, a 140km2 bay in Northern China, with a bivalve production of over 150,000 t y-1. The model simulates production of oysters, both in monoculture and as Integrated Multi-Trophic Aquaculture (IMTA). IMTA increases shellfish production and return on investment, and oyster farming has a significant effect in the reduction of eutrophication symptoms, equivalent to the removal of 0.5 ton y-1 of nitrogen, or about 120 population equivalents. These results are scaled to the shellfish production in the bay, and illustrate the role that bivalve cultivation plays in limiting the expression of eutrophication symptoms. Some conclusions are drawn on the impact of shellfish culture in Chinese coastal systems, and lessons learnt about potential use in EU and US coastal management.

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THE FUTURE OF SCLERACTINIAN CORALS IN A WARMING MEDITERRANEAN SEA

The response to global warming of symbiotic scleractinian corals living in the NW Mediterranean Sea was investigated through field observations and laboratory experiments. Several mortality events, starting in summer 1997, have regularly been reported, and affected corals and other taxa, on a large geographical and depth range. A strong correlation between sustained elevated temperatures and mortality events was observed during the summers 1999, 2003, 2005 and 2007 suggesting that temperature is a real stress for corals. This correlation was then evidenced with laboratory experiments. The endemic species Cladocora caespitosa, presented tissue degradation and death after 5-7 weeks incubation at 24°C. The alien coral Oculina patagonica, seemed more resistant because of a through rapid physiological acclimation. However, all corals showed tissue degradation and death when elevated temperatures (>24°C) were sustained for more than 4-5 weeks. Our results lead to the conclusion that elevated and prolonged temperatures is the cause of the Mediterranean corals mortality events. Since global warming seems more rapid than a corals potential adaptation, these species might be threatened of disappearance.

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ECOSYSTEM RESPONSE TO CLIMATE CHANGES IN LAKE BAIKAL (SIBERIA) DURING LAST INTERGLACIAL AND HOLOCENE

Surface waters of the cold Siberian Lake Baikal are projected to warm considerably and these changes likely induce important ecosystem changes. Instrumental data allow to study the past century, while paleolimnology records document the long-term response of the lake's ecology to past temperature changes. The history of Lake Baikal's surface temperature is presented for the Holocene and Last Interglacial using the novel paleothermometer proxy TEX86, based on the distribution of membrane lipids of aquatic microbes (non-thermophilic Crenarchaeota). Air temperature changes and the relative fluvial input of terrestrial organic material were also estimated based on terrestrial archaeal lipids. The climatic changes are related to the lake autotrophic phytoplankton productivity and community composition based on fossil pigments and published fossil diatom records. Interactions with other environmental impacts are discussed.

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INTERACTIVE EFFECTS OF NUTRIENT SUPPLY, TEMPERATURE AND UV RADIATION ON PHOTOSYNTHESIS AND PIGMENTATION IN TWO CULTIVATED SEAWEEDS

Seaweeds, especially Ulva spp. and Gracilaria spp., are used as biofilters to remove nutrients from fishpond effluents, thus reducing the negative environmental impacts of aquaculture. Potential interactive effects of nutrient supply, temperature and UV radiation on photosynthesis and pigmentation in Ulva lactuca. (Chlorophyta) and Gracilaria conferta (Rhodophyta) grown in 600 l tanks supplied with high (HNS) and low nutrient (LNS) loadings were analyzed. After 2 and 5 days of culture, photosynthesis and pigmentation were determined before and after short-term exposure (1.5 h) to PAR, PAR+UVA and PAR+UVA+UVB radiation following by shade conditions (3.5 h). HNS increased both photosynthesis, as chlorophyll fluorescence (electron transport rate), and the concentration of Chla, Chlb and phycobiliproteins. However, biomass yield and the accumulation of other nitrogen compounds (mycosporine-like aminoacids) in G. conferta increased under LNS conditions. UV-B reversed the negative effect of UV-A radiation under additional stress (high temperature increase). The acclimation capacity of U. lactuca to the stress was higher and faster than that of G. conferta. Possible competition for nitrogen source among various physiological processes and interactive effect of light quality is discussed.

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THE USE OF FLOW CYTOMETRY FOR SPECIES IDENTIFICATION AND LIFE CYCLE STUDIES IN DINOFLAGELLATES

Dinoflagellate species of the genera Alexandrium and Karlodinium are well-known by their difficulty to be differentiated using morphological characters. For this reason, species of these genera were analyzed using flow cytometry to determine if the haploid DNA content of each species may be used as a valid criterion for species identification. Species often confused for each other since they overlap in size and often co-occur such us A. ostenfeldi and the complex catenella / tamarense, A. minutum and A. tamutum, and Karlodinium veneficum and Karlodinium armiger showed very different DNA content. The only cases of DNA overlapping were A. ostenfeldi and A. peruvianum, and A. catenella with A. tamarense, two groups not yet clearly established either morphologically or genetically. Intraspecies DNA content variability was only observed in the species Karlodinium veneficum. However, although we did not find significant differences between the two Alexandrium tamarense strains analyzed, the haploid DNA value obtained (63 pg.cell-1) was very different from the one reported before for this species (103.5 pg.cell-1), suggesting cryptic speciation within this group. Field samples were also analyzed using flow cytometry and Karlodinium veneficum was identified as the causative species of a bloom, which suggests that this method may be a useful tool for species identification in natural blooms.

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FISH DEEP IN DEBT: OPTIMAL BEHAVIOUR IN HYPOXIC GRADIENTS

Eutrophication is a main environmental problem in many lakes and coastal regions. To the fish inhabiting eutrophic, hypoxic and turbid water columns these factors harbour both challenges and opportunities, both of which involve active behaviours and strategies. We present a detailed model of fish physiology, involving explicit and coupled energy and oxygen budgets, with diel and spatial mechanistic representation of encounter processes for a planktivorous fish with both its piscivorous predators and zooplankton prey. We then use dynamic programming to find the optimal behaviour of the planktivore over a diel cycle depending on internal oxygen debt (lactate), stomach fullness and time of day. We analyse how particular environmental gradients, predator and prey abundances affect growth, survival and fitness. Throughout we compare clear and more turbid environments. The model demonstrates that, under given conditions, the hypoxic habitats may act as a refugium that benefits planktivorous fish. We also show how predator abundance, their search efficiency or the presence of refugium changes fish behaviour, predation risk and optimal growth rates.

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PALEOHISTORY OF PLANKTON COMMUNITY SIZE-STRUCTURE ECHOES CHANGES IN CLIMATE AND OCEAN STRATIFICATION.

Changes in the size and taxonomic structure of phytoplankton assemblages can strongly influence energy transfer through the food web and carbon cycling in the ocean. The fossil record of plankton provides a record to assess how climate change can alter the size and taxonomic structure of phytoplankton and the resulting consequences on marine food webs and carbon biogeochemistry. An analysis of the size structure of oceanic diatoms and dinoflagellates over the Cenozoic exhibit an extremely similar pattern in their median size over time even though species diversity of the two groups has opposing trends, indicating that the macroevolutionary size change in the plankton is an active response to selection pressure rather than a passive response to changes in diversity. The changes in phytoplankton median are highly correlated with both deep ocean temperatures and the thermal gradient between the surface and deep waters, indicating the magnitude and frequency of nutrient availability may have acted as a selective factor in the macroevolution of cell size in the plankton. Our results suggest that climate, because it affects stratification in the ocean, may act as a universal abiotic driver that has been responsible for macroevolutionary changes in the size structure of marine planktonic communities. This underscores the need for climate models to incorporate the size-structure of plankton to predict how anthropogenic climate change may alter patterns of primary & export production

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STREAMS ARE BRANCHING CONTINUA, AND SMALLEST BRANCHES (HEADWATERS) ARE VITAL TO BASIN-SCALE DIVERSITY.

Traditionally, longitudinal river continua are considered in a single (linear) dimension. Patterns of biodiversity observed in this context often reveal relatively depauperate headwaters with diversity gradually increasing towards some downstream maximum. Clearly, streams are not linear but are bifurcating networks. Analogous to a tree or a lung, for a given "mainstem," there is a multitude of contributing branch tips (headwaters). Each tip may have relatively low diversity, but there is growing evidence that the combination of network tips comprises substantial beta (among-site) diversity that accounts for a large proportion of overall network diversity. I will provide examples suggesting that this pattern is widespread among stream types and geographic regions, as well as when quantifying diversity at either genetic or species level. I conclude with a specific focus on genetic diversity patterns in a desert stream insect: 1) to demonstrate that isolated headwater populations may be variably sensitive to climate change and other disturbance; and 2) to quantify the expected decrease in system-wide diversity following local extinction of some particularly sensitive populations (i.e. following the breaking off of some network branches).

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SPECIES-SPECIFIC RESPONSES OF HAPLOID AND DIPLOID STAGES OF COCCOLITHOPHORES DUE TO PCO2 INCREASE IN THE SEAWATER

Coccolithophores are cosmopolitan, calcifying phytoplankton with complex, not completely known life-stage cycles. They alternate sexual and asexual reproduction and show diploid, non-motile cells bearing coccoliths and haploid, scale-bearing, flagellates and filamentous cells. The linear relationships of calcification rate with carbonate ion concentration and carbonate saturation state have been questioned and species-specific and intra-specific effects might play a role. If so, this should be taken into account when assessing whole ecosystem responses to changing carbonate chemistry. The present work investigates the effects of high pCO_2 on calcification, growth rate and other physiological parameters of two of the most productive coccolithophores species (Emiliania huxleyi and Calcidiscus leptoporus). We compared the responses to pCO_2 (380 ppm and 760 ppm) of calcifying and non-calcifying strains of each species. We observed a marked decrease of the growth rate for the N stage of Emiliania huxleyi at the highest pCO_2 level and enhanced calcification rates in both the haploid and the diploid stages at higher pCO_2. This suggests possible intra-specific variations in the calcification response linked to the different life-stages.

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DYNAMICS OF ALGAE AND NUTRIENTS ALONG A LOWLAND RIVER CONTINUUM: SIMULATING THE IMPACT OF GLOBAL CHANGE

The concentrations of nutrients and plankton along a river continuum show characteristic longitudinal and temporal patterns reflecting transport, transformation and retention. Here, we describe the processing of phosphorus, nitrogen and silica and the development of phytoplankton composition and biomass along a 586 km stretch of the River Elbe using data from four Lagrangian sampling campaigns and from monitoring stations. Strong phytoplankton growth augmented the particulate organic carbon load along the river continuum. Dissolved nutrient concentrations decreased significantly along the river during the growth period, caused by intense algal uptake. Phytoplankton growth was mostly light-limited, and population dynamics were temporarily strongly controlled by zooplankton grazing. Simulation runs with the water quality model QSim under various status quo and global change scenarios showed that ecosystem processes react differentially on climatic and socio-economic drivers along the river. Increasing temperature and decreasing discharge would lead to higher algal biomass and shift the maximum chlorophyll concentrations upstream along the continuum, even under a scenario of reduced nutrient concentrations. In downstream regions, the probability of nutrient limitation and control by zooplankton would increase.

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SULFUR CYCLING BY THE COLD SEEP SIBOGLINID TUBEWORM, LAMELLIBRACHIA LUYMESI

All known vestimentiferan tubeworms have similar anatomy and hemoglobins that bind both sulfide and oxygen which they must transport from the external environment to their internal chemoautotrophic symbionts. Hydrothermal vent vestimentiferans use their plume as the primary site of both sulfide and oxygen uptake. A cold seep species, Lamellibrachia luymesi, is very long-lived and sulfide is rarely detectable around the plumes of adults. Laboratory experiments demonstrate that L. luymesi can take up sufficient sulfide across its buried posterior portions ("roots") to fuel net DIC uptake and autotrophy. These "roots" can extend meters into sulfide rich sediments and create a rhizosphere strongly influenced by the tubeworms. Models based on empirical data indicate that seepage alone could not provide sufficient sulfide to support assemblages over their centuries-long lifespan. Recent additional experiments with live animals, enzyme assays, in situ measurements, and models indicate that these tubeworms release the waste products of sulfide oxidation (sulfate and hydrogen ions) across their roots and can live for centuries as a result of symbioses with both internal chemoautotrophic bacteria and external consortia of free-living microbes.

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MICROBIAL FOOD WEB STRUCTURE AFFECTS BOTTOM-UP EFFECTS AND ELEMENTAL STOICHIOMETRY IN PERIPHYTON ASSEMBLAGES

Periphyton is responsible for a major proportion of primary production in many shallow aquatic ecosystems. Nevertheless the role of the heterotrophic part for propagation of resource enrichment and top-down control has rarely been addressed systematically. We report results from 6 laboratory experiments differing in their trophic structure by including different functional groups (algae, bacteria, flagellates, ciliates, rotifers). We manipulated the supply of organic carbon, phosphate, light, and the presence of the respective top-consumer in full factorial designs. Increased resource supply increased total periphyton biomass in almost all experiments, but the relative effects on heterotrophic and autotrophic components of the periphyton assemblages strongly depended on trophic structure. For instance including more elements of the microbial food web decreased C:P ratios throughout, i.e., led to higher retention of P within the assemblage. Our experiments revealed a strong importance of the benthic microbial food web for both top-down and bottom-up propagating effects of consumers and resources, respectively.

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INTERACTIONS BETWEEN JELLYFISH AND FISH: PREDATION VERSUS COMMENSALISM

Fishes in the family Gadidae are commercially important fish species that are preyed upon by jellyfish as larvae and early juveniles. As larger juveniles Gadids can adopt a positive commensal association with jellyfish. Laboratory experiments attempting to mimic fish and jellyfish interactions included larval gadids in the presence of jellyfish, juvenile gadids in the presence of jellyfish and a predator, and a predator in both the presence and absence of jellyfish. Intense predation by jellyfish on larval Pacific cod suggested that increasing jellyfish biomass may have strong negative effects on the survival of 0 group fish. The absence and presence of jellyfish with a predator experiment illustrated the sensitivity of 2 year Pacific cod to jellyfish stings. After approximately eight stings, predators learned to avoid contact with jellies. Increased juvenile gadid survival from both predators may be due to ontogenetic adaptations. Although juvenile cod species were not seen associating with jellyfish in the laboratory, as has been observed in the field, increasing jellyfish biomass may be creating a larger habitat for juvenile 0 group fish seeking shelter from larger predatory fish.

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BACTERIAL ASSIMILATION OF RIVERINE ORGANIC NITROGEN

Europe accounts for 8 % of global dissolved organic nitrogen (DON) export from rivers to coastal waters annually. It is likely that this export contributes to observed detrimental impacts on fresh and coastal water quality. DON is a mixture of compounds of variable chemical structure, with bacteria primarily responsible for its biomodification. However, the fate of the DON and the bacteria responsible are largely unknown. The objective of this research is to examine the biomodification of selected (natural and anthropogenic) DON compounds by riverine bacteria. DON biomodification is being studied using laboratory incubations containing cleaned river water (low DOM and nitrate) containing indigenous bacterial inocula. The degradation patterns of DON substrates are examined by electrospray ionisation-tandem mass spectrometry (ESI-MSn). Quantification is possible through external calibration during the ESI-MS analysis. Initial results show that atrazine, a herbicide, is not modified over an 11 day period. Additional incubations, with other compounds, and over longer time scales, are in progress. Bacterial consortia responsible for DON degradation will, in the longer term, be identified using PCR amplification of their DNA with 16S rDNA primers.

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PHYTOPLANKTON COMPOSITION OF MUCILAGINOUS AGGREGATES IN THE NORTHERN ADRIATIC SEA

Our research revealed the composition of phytoplankton assemblages in different types of mucilaginous aggregates collected during the summers of 1997 and 2000 using pigment biomarkers (HPLC). Phytoplankton biomass in the mucilage samples was very high (from 7.9 µg/g to 390.8 µg/g of chlorophyll *a* per unit of dry mass of mucilage). The phytoplankton community in the early stage of mucilaginous aggregates was heterogeneous, as indicated by diversity of detected pigments. The number of phytoplankton groups decreased as the aggregates aged and diatoms increased in relative biomass (up to 92.7 %). Phytoplankton biomass in seawater was similar in years with and without mucilage; however, significantly higher contributions to the total biomass of 19'-hexanoyloxyfucoxanthin-containing phytoplankton (prymnesiophytes) were found in the upper 10 m preceding the mucilage phenomenon, followed by prevalence of diatoms in summer. The role of prymnesiophytes and other small flagellates is crucial for the initial phases of mucilage appearance. Aggregates represent a favourable environment for the secondary development of opportunistic diatoms that foster mucilage formation.

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THE REESTABLISHMENT OF ZOSTERA MARINA MAY PARTLY BE INHIBITED/ DELAYED BY A REDUCED ANCHORING CAPACITY OF THE COHESIVE SEDIMENTS IN ESTUARIES AND LAGOONS

In a large Danish eelgrass-project (REELGRASS) we study to what extent eutrophication has changed the physics, biogeochemistry and biology of estuarine sediments. Our hypothesis is that the organic content has increased and changed the sediment to a more muddy structure with a lower anchoring capacity for rooted plants. In a flume experiment, seedlings of eelgrass were transplanted in sediments with varying water and organic content. After the sediment had consolidated, the plants were exposed to a gradient of current velocity and shear stress defining the threshold for loss of anchoring. In sandy sediments eelgrass seedlings avoided erosion until current velocity exceed 60 cm s-1. In gradually more muddy sediments, eelgrass seedlings became eroded at current velocities of only 4 cm s-1. Even in non-tidal areas of the inner Danish waters this threshold is often surpassed. These results stress that the reestablishment of eelgrass may be physically restricted by the spread of organic and less consolidated sediments in shallow waters.

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SEARCHING FOR UNDESIRABLE DISTURBANCE. THE OSPAR EUTROPHICATION ASSESSMENT METHOD APPLIED TO MARINE WATERS OF ENGLAND AND WALES

The OSPAR Eutrophication Strategy (2003) set a new scientific challenge in requiring assessment to be based on the ecological consequences of nutrient enrichment and not just on nutrient enrichment alone. The challenge is in finding reliable evidence for accelerated growth of algae and higher forms of plant life producing an undesirable disturbance to the balance of organisms and deterioration in water quality. The coastal and offshore waters of England and Wales were assessed against OSPAR's harmonised criteria of nutrient concentration and ratios, chlorophyll concentrations, phytoplankton indicator species, macrophytes, dissolved oxygen levels, incidence of fish kills and changes in the zoobenthos, using region specific thresholds. None of the thirteen assessment areas, including six areas assessed as nutrient enriched, exhibited evidence for undesirable disturbance or deterioration in water quality. This paper details the challenge posed by some of the methods, and the overall outcome of the assessment. It presents evidence for light limitation preventing undesirable disturbance in certain areas. The results of an international peer-review were used to improve the robustness of the assessment.

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DERIVING ECOLOGICAL QUALITY STANDARDS FOR LAKES USING HYPOLIMNETIC OXYGEN DEPLETION

The ecological quality of lakes and other surface water bodies in the European Union is determined by the quality of the structure and functioning of the aquatic ecosystem. The depletion rate of oxygen in the hypolimnion is an important process in thermally stratified lakes and the distribution of consumption between water and sediment an important structural characteristic. It is shown that the variation of volumetric oxygen consumption rate with trophic state can be used to select lake water total phosphorus and chlorophyll concentrations that correspond to changes in the functioning of the lake. Lake morphometry has little effect on this aspect of lake function and the relative amount of oxygen consumption in the water and sediment changes only a little with trophic state, most of the consumption being in the water. Suggestions for the reference condition, good and moderate ecological quality are made using the changes in this aspect of lake function and they are presented as lake water total phosphorus and chlorophyll concentration.

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HYDRODYNAMIC WAKE STRUCTURE OF SEAGRASS PATCHES WITH HETEROGENEOUS DENSITY STRUCTURE

Whilst the interaction of hydrodynamics with homogeneous seagrass beds is becoming well understood, the hydrodynamic implications of the fragmented structures that seagrass meadows often exhibit is much less well understood. This fragmented structure is particularly a feature of stressed seagrass beds. Hence, understanding of the interactions of hydrodynamics with heterogeneous seagrass distributions, and the transport, deposition and re-suspension of matter that they control, can make a significant contribution to the management of these threatened environments. We report the results of laboratory flume experiments in which the structure of the downstream wakes of patches of artificial seagrass (whose geometric and mechanical properties were matched with those of real seagrass) were measured. Different patterns of high and low density elements of the patches were studied, and detailed measures of the flow structure within and downstream of the patches were recorded. Hydrodynamic modelling of the flow and turbulence profile structures was verified and calibrated by the experimental data, giving us a tool for up-scaling these patch-scale measurements to landscape scale, and thus directly informing understanding of natural seagrass environments.

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VIRUSES-PROKARYOTES-NANOPLANKTON INTERACTIONS IN BATHYPELAGIC WATERS OF THE MEDITERRANEAN SEA

Bathypelagic ecosystems strictly depend on the prokaryotic heterotrophic production, but little information is available on the fate of the prokaryotic heterotrophic production in the deep–water layers. To evaluate the prokaryotic mortality due to viral infections and nanoflagellate grazing we performed a series of experiments. Incubations were performed in the dark and at in situ temperature on samples collected at 1500 m depth at 10 sites from the Atlantic Ocean to the Eastern Mediterranean. Nanoflagellate grazing was determined by the dilution technique. Prokaryotic biomass varied from <0.5 to 2.4 μ gCl^{-1} increasing eastward as nanoflagellate ingestion rates (0.11 - 11.9 μ $gCl^{-1}d^{-1}$). The impact of nanoflagellate grazing on prokaryotic production was, however, modest, as in most cases prokaryotic growth rates were higher than grazing rates (estimated production up to 2.39 μ $gCl^{-1}d^{-1}$). Due to the very low abundance, the potential impact of microzooplankton on prokaryotes was likely negligible (1.5 - 78 ind.l^{-1}). Mortality rates due to nanoflagellate grazing were compared with viral induced prokaryotic mortality in order to evaluate the relative importance of biotic factors potentially controlling prokaryotic dynamics in bathypelagic waters.

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CONFIRMATION OF FACILITATIVE INTERACTIONS OF CALIFORNIA MUSSELS (*MYTILUS CALIFORNIANUS*) ON ROCKY SHORES IN BRITISH COLUMBIA

Increases in survival or recruitment that result from aggregated distributions constitute one type of facilitative interaction. Previous studies found that sea stars (*Pisaster ochraceous*) preferentially consume small rather than large mussels (*Mytilus californianus*). Small mussels (juveniles and small adults) nested in dense, protective aggregations of large mussels are more likely to survive browsing by sea stars than exposed small mussels. Surveys of mussel bed layering indicated that a veneer of large adults protects juveniles from browsing sea stars. The strength of this effect depends on the intensity of predation (e.g. shore level differences in sea star access). Experimental manipulation of sea star densities established high, low, and ambient levels of predation. We recovered marked juveniles less frequently from plots with the veneer removed than from plots with it intact. ANOVA confirmed that the protective effect of the veneer depends on the intensity of predator pressure. Our empirical evidence supports recent theory that facilitative interactions are among the mechanisms that propagate and maintain mussel beds, structural foundations which facilitate other intertidal species.

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ASSIMILATION OF SEAWIFS CHLOROPHYLL DATA INTO A 3D COUPLED PHYSICAL BIOGEOCHEMICAL MODEL APPLIED TO A FRESHWATER INFLUENCED COASTAL ZONE

We tested an assimilation scheme based on sequential data assimilation of SeaWiFS chlorophyll data into a coupled 3D physical-biogeochemical model. The modelled area is located in the Eastern part of Gulf of Lion, a continental shelf submitted to major Rhone River outflows. The 3D hydrodynamic model Symphonie was coupled to the biogeochemical modelling platform Eco3M simulating a one year period in 2001. SeaWiFS data reprocessed with the OC5 algorithm were sequentially assimilated using a Singular Evolutive Extended Kalman (SEEK) filter. An original method in constructing the Empirical Orthogonal Functions (EOF) was proposed in order to keep the method efficient over the whole simulation period. This method consisted in computing the EOF by retaining a full state vector every 12 h during 60 days preceding the image to assimilate. A total of 108 images from 2001 were visually retained to be assimilated due to their large coverage of the modelled zone. The assimilation process increased significantly the match between model outputs and remotely sensed data. Efficiency of the method is discussed considering the seasonal biogeochemical dynamics in the area.

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THE BEHEMOTH CRUISE : A MULTIDISCIPLINARY ECOLOGICAL INVESTIGATION OF LIVE FORAMINIFERAL COMMUNITIES IN THE GULF OF LIONS (NW MEDITERRANEAN)

The BEHEMOTH cruise (August-September 2006, N/O Tethys 2, CNRS-INSU) gave us the opportunity to realize an ecological investigation of live (Rose Bengal stained) foraminifera from shelf and slope environments in the Gulf of Lions (NW Mediterranean). The main objective of this cruise was to precise the changes of the foraminiferal density, diversity and microhabitat in response to the complex physico-chemical conditions prevailing at and below the sediment-water interface. 20 stations were sampled on the shelf off the Rhône River delta. Their depth ranges between ~20 and ~100 m. 6 stations were sampled on the open slope between the Grand Rhône Canyon and the Petit Rhône Canyon (eastern part of the Gulf of Lions), describing a bathymetric transect from ~350 to ~2000 m depth. Our investigation provided a large environmental data set (organic matter quality and quantity, sedimentation rate, granulometry, nutrients and oxygen concentration in the sediment, …). that allowed to enlighten us on the ecological behaviour of different foraminiferal communities.

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PHYTOPLANKTON SIZE STRUCTURE, DISTRIBUTION AND PRIMARY PRODUCTION AS THE BASIS FOR TROPHIC ANALYSIS OF CARIBBEAN ECOSYSTEMS

An oceanographic survey was conducted in Caribbean waters in April and May 2006 to assess the marine ecosystem. According to analyses of pigment and absorption data, phytoplankton community was determined to be dominated by pico- and nano-phytoplankton, particularly at the deep chlorophyll maximum. From cluster analysis on remotely-sensed data, three dynamic provinces were defined for the region. A five-year time-series of sea-surface temperature and chlorophyll concentration provided information on the annual cycle of the bio-physical processes and the phytoplankton response to ENSO events. To implement the computation of primary production on a synoptic scale, parameters characterising the biomass profiles and photosynthesis-irradiance relationships were assigned using four different protocols: two regional approaches, a regression with surface chlorophyll and the Nearest-Neighbour Method, the last of which has the advantage of assigning parameters on a pixel-by-pixel basis. Monthly images of primary production were computed over an annual cycle using MODIS chlorophyll-a concentration and the Nearest-Neighbour Method emerged as the method of choice for parameter assignment. Finally, carbon-to-chlorophyll ratios were assessed to compute the production-to-carbon ratio for phytoplankton, a key input to Ecopath models.

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MICROBIAL FOOD WEB RESPONSES TO INCREASED ALLOCHTHONOUS CARBON IN AN ARCTIC LAKE

Climate-induced changes in catchment areas will alter the carbon flux entering lakes. The effects of dissolved organic carbon (DOC) on bacteria, picoplankton, phytoplankton and nanoflagellates were studied in an arctic, clear water lake in northern Finland. Natural DOC from two different sources (arctic and boreal) was added to replicated 42 L mesocosms, where zooplankton were excluded, doubling the initial DOC concentration of lake water. The additions lead to an increase in bacterial abundance and productivity, and a decrease in primary productivity. The affect was most pronounced at the very beginning of the one-week experiment and was similar in both DOC alterations. The study showed that increased levels of DOC in oligotrophic arctic lakes shift the pelagic microbial food-web based on primary production to a food-web that is based on heterotrophic production. Large variations in the loading of allochthonous organic carbon (e.g. due to climatic variations) may have considerable effects on the biostructure and productivity of lakes.

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REMOTE SENSING AND THE ECOSYSTEM APPROACH: INTEGRATING PHYTOPLANKTON ECOLOGY, BENTHIC PROCESSES AND FOOD WEB MODELS

An aim of D.H. Cushing in writing his classic work in 1975 was to encourage communication between the marine disciplines. Remote sensing is an important tool in this context, delivering high-quality, synoptic information that is widely available, easily understood and useful to many different applications. Foundations for uptake of RS are access to digital images in GIS-ready format and confidence in the accuracy of products. Service providers of the GMES project are providing rapid access to archive and real-time images, and quality is ensured by end-user validation against in situ data from buoys and ships. This is particularly important in the Case-II waters around the UK, where generic algorithms may often fail. Recent integrated observations of phytoplankton from space and in situ from sites in the North Sea support Cushing's insights into bloom timing and magnitude. Comparisons of sediment chlorophyll with satellite-derived surface chlorophyll indicate close coupling between pelagic and benthic systems. In addition, dynamic models of higher trophic levels are increasingly using information on the size-spectrum of primary producers determined from space or from biogeochemical models.

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MARINE MICROBIAL COMMUNITY RESPONSE TO ORGANIC NUTRIENT AMENDMENT IN THE OLIGTOTROPHIC NORTH PACIFIC OCEAN

As part of the 2008 CMORE summer course, "Microbial Oceanography: Genomes to Biomes," we conducted a cruise into the oligotrophic waters of the North Pacific Subtropical Gyre (June 15 – 23). An objective was to evaluate microbial responses to alterations of nutrient concentrations and stoichiometry. As part of this, we assessed time-dependent changes in microbiological and biogeochemical properties during a mesocosm organic nutrient perturbation experiment by examining the seawater microbial community response to the addition of nutrients of differing elemental (N, P, S) compositions. Triplicate twenty-liter carboys were filled with near surface ocean seawater. Treatments were amended with equimolar carbon amounts of DNA, glycolate or methionine and compared to unamended controls. Samples were collected for determinations of microbial biomass, diversity, and metabolism, as well as associated changes in water column biogeochemistry. The treatment receiving DNA sustained the greatest rates of primary and bacterial production, with a possible drive towards nitrogen-limitation towards the end of the experiment. All treatments resulted in an apparent shift in the phototrophic community from one dominated by cyanobacteria (namely *Prochlorococcus*) to assemblages dominated by photosynthetic eukaryotes.

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METABOLIC INTERACTIONS IN NITROGEN-FIXING DIATOM-CYANOBACTERIA SYMBIOSES

Hemiaulus haukii and *Rhizosolenia clevei* are two oceanic planktonic diatoms that associate with the heterocystous cyanobiont, *Richelia intracellularis*. Abundances of these symbioses can be high, and their contribution to new and primary production is substantial. Yet, the benefit of these relationships is neither fully understood nor characterized. Using a high resolution nanometer-scale secondary ion mass spectrometry (nanSIMS) approach with $^{15}N_2$ incubations (24-76 hr) of field populations from the Gulf of California, we imaged and estimated the cellular distribution of N uptake by symbiont and in addition, within the host. Fixation and transfer occurred within 24 hrs, as enrichment in symbionts and in regions of the host structure ranged 7.4×10^3-1.3×10^4 per mil. There was no significant difference between the enrichment of the vegetative cells and heterocyst of the *Richelia* trichome and the host after 24 hr, suggesting that the fixation and transfer was rapid. After 76 hrs, the enrichment was 80% and 70% higher in symbiont and host, respectively. Our nanoSIMS imaging represents the first evidence for the fixation and transfer of N within these planktonic symbioses.

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REVISITED C-COUPLING BETWEEN BACTERIA AND PHYTOPLANKTON IN AQUATIC SYSTEMS

Positive relationships between bacteria and phytoplankton primary production (respectively BP and PP) have been reported for several areas, suggesting that material produced by phytoplankton was major substrate for bacterial growth. BP was thus considered as secondary production, averaging 20% of PP (Cole et al. 1988). Since then, thousands of simultaneous measurements of both PP and BP have been performed. A review of all these data shows the net BP may largely exceed the particulate PP in the lowest productive oceanic waters and freshwaters. In contrast, BP is a rather small component of total secondary production in high productive waters. In oceanic waters, BP seems not to be synchronised with PP which may not support the immediate bacterial C demand. In freshwaters, the strong co-variation observed between BP and PP seems mainly due to a common response to sudden nutrient loadings into enclosed systems, leading to similar range of growth rates and synchrony of the temporal variations of their production rates. Therefore, because direct dependency of bacteria on phytoplankton is questionable, others C sources might be more significant for bacterial growth.

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SCAVENGING AND RETENTION OF BISMUTH BY MARINE PLANKTON

Bismuth has both natural and anthropogenic atmospheric sources to the aquatic marine environment. The natural radiogenic isotope 210-Bi (half life = 5.0 days) in the 222-Rn daughter series can gauge atmospheric scavenging residence times, and similarly is suggested to trace short term surface ocean processes. Laboratory radiotracer experiments were initiated using 207-Bi to quantify the bioavailability, accumulation and cycling of Bi in marine plankton. Kinetics of Bi scavenging and release in detrital particles produced by plankton was also investigated. Accumulation of 207-Bi by phytoplankton was very rapid and equilibrated after only a day in both light and dark conditions. Volume concentration factors were five to six orders of magnitude after several days, and activity in cells was dialyzable against sea water, with a half-time release of approximately 11 days. Transfer of phytoplankton-associated radioactivity to copepods was about 4 percent, and unassimilated radioactivity was slowly released from voided feces. Scavenging of bismuth from water by copepod feces was rapid, comparable to particulates from sediment-traps. These results suggest bismuth is as biogeochemically reactive as other particle reactive U-Th series or transuranic elements.

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THE ROLE OF DIFFERENT LIFE CYCLE PHASES IN THE ECOLOGY OF EMILIANIA HUXLEYI

The coccolithophore *Emiliania huxleyi* is a major component of marine phytoplankton assemblages, contributing significantly to fluxes of carbon and sulphur between the oceans, atmosphere and litosphere. The quasi-totality of information concerning this species takes into account exclusively one phase of the haplo-diploid life cycle: the calcified diploid phase. Very little is known about the ecological role of the non-calcified motile haploid phase. Using a modified fluorescent in situ hybridization approach, we revealed the presence of the haploid phase in various marine environments as a background sub-population, following the same dynamics as the predominant diploid calcified population. This strategy may allow *E. huxleyi* to respond rapidly to environmental changes and probably contributes significantly to the ecological success of this marine microalga. This knowledge is also important to further understand the population dynamics, diversity and biogeochemical impact of this important phytoplankton as a whole, comprising both the calcified and the non-calcified phases.

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CONTROLS ON NITROUS OXIDE YIELD AND PRODUCTION MECHANISMS IN A MARINE AMMONIA-OXIDIZING BACTERIUM

Nitrous oxide (N2O) is a climatically important trace gas that is supersaturated throughout much of the ocean. It is important to understand the mechanisms of N2O production to predict how changes in ocean circulation and productivity could affect the production and release of N2O from the ocean. We investigated the impact of oxygen concentration, nitrite concentration, and cell density on the N2O yields and production pathways in batch cultures of Nitrosomonas marina c113-a. In contrast to previous work, we found that N2O yields were low and not significantly different between high oxygen (20%) and low oxygen (0.5%) conditions. The yield of N atoms that went into N2O ranged between 2/1,000 and 3/10,000. Exogenous nitrite had a larger impact on yield than oxygen concentration; 1 mM nitrite additions nearly doubled N2O yields. We also used the N2O nitrogen and oxygen isotopic signatures and N2O 15N site preference (SP) to estimate the contributions of different production pathways to the total N2O produced by c113-a. Both SP and d18O data indicated an increase in the nitrifier-denitrification pathway as O2 decreased.

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DIVERSITY, ABUNDANCE, AND BIOGEOCHEMICAL ACTIVITY OF AMMONIA-OXIDIZING COMMUNITIES IN COASTAL ESTUARINE SEDIMENTS: ELKHORN SLOUGH, CALIFORNIA

Ammonia oxidation—the microbial conversion of ammonia to nitrite—plays a critical role in nitrogen cycling and removal in coastal/estuarine systems. The overarching goal of this study was to examine rates of ammonia oxidation in conjunction with the diversity and abundance of ammonia-oxidizing archaea (AOA) and bacteria (AOB) at multiple sites in Elkhorn Slough, a small agriculturally-impacted coastal California estuary that opens into Monterey Bay. ^{15}N-based measurements of nitrification rates from 4 distinct locations revealed higher rates at the well-mixed/lower-nutrient sites, compared to the heavily-impacted/nutrient-rich sites. Although AOA *amoA* (encoding ammonia monooxygenase subunit A) richness was consistently higher than AOB *amoA* richness, qPCR analysis revealed that AOB outnumbered AOA by a factor of 2 to 236-fold across the 4 sites. Archaeal *amoA* sequences were phylogenetically diverse and grouped within previously described 'sediment' and 'soil/sediment' clusters. Sites with high nitrification rates primarily contained marine/estuarine *Nitrosospira*-like bacterial *amoA* sequences, while sites with low nitrification rates were predominated by estuarine *Nitrosomonas*-like sequences. Overall, this study yields valuable insight into how estuarine AOA and AOB communities and nitrification rates vary across physicochemical gradients.

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EFFECTS OF NUTRIENT INPUTS ON MICROALGAE COMMUNITY IN A MEDITERRANEAN STREAM

Nutrient input in streams can alter the density and species composition of attached algal communities in open systems. A nutrient enrichment experiment in a oligotrophic forested stream was performed to verify this hypothesis. Nutrients were artificially increased by adding nitrogen (as nitrate and ammonia) and phosphorus (as reactive phosphate). Moderate nutrient addition consisted of increasing basal phosphorus (P) concentration 3-fold and basal nitrogen (N) concentration 2-fold. Algal epilithic biofilm was sampled in both enriched and unenriched reaches. Non diatom algae and diatoms were identified by microscopy and chlorophyll a determination. Moderate nutrient enrichment caused significant variations in the chlorophyll a concentration, changes in the cell density and in the diversity of the algae community. Shannon diversity index increased in the enriched stream for diatoms community instead decreased for the non diatom community.

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LONG-TERM RESPONSE OF WATER QUALITY AND BIOLOGICAL COMMUNITIES TO SEWERAGE IMPLEMENTATION IN TRANSITIONAL WATERS: THE CASE OF THE NERVIÓN ESTUARY (N. SPAIN)

The Nervión estuary is a 22 km long system formed by the tidal part of the Nervión river (N. Spain). Because of the intense industrial development of the area since the mid-19th century and the increase in population, the estuary received wastes from many sources. This deteriorated drastically its environmental quality, leading to a great degradation of the biological communities. To reverse this situation, a sewerage scheme was approved in 1979 and started the implementation in 1982. The 'clean-up' of water began in 1991 (with only physico-chemical treatment for about 30% of total waste water flow) and the biological treatment came into operation in 2001. In order to survey the evolution of the estuarine quality, a monitoring programme (physico-chemistry, microbiology, contaminants and the main biological communities), began in 1989. The results from this programme show that water quality is clearly improving: concentrations of bacteria and nutrients are significantly decreasing and dissolved oxygen and transparency are significantly increasing. This means that the system has a greater ecological potential. In fact, biological communities are progressively colonizing the inner parts of the estuary. Conclusions on the response/recovery time of biological elements and physico-chemical variables in response to management actions will be emphasized, thus providing interesting information for modelling scenarios on ecological potential assessment and improvement.

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BACTERIAL AND MEIOBENTHIC RESPONSE TO PHYTODETRITUS SEDIMENTATION IN CONTRASTING SHALLOW SUBTIDAL SEDIMENTS.

We investigated the response of bacterial and meiobenthic communities to organic matter (OM) deposition in subtidal cohesive and permeable sediments. Biogeochemical patterns at the cohesive sediments were governed by diffusion, bioturbation and bio-irrigation while advective currents through the permeable sediments inhibited the establishment of well-defined vertical profiles. Bacterial communities at both stations were different. Seasonal differences were observed, but the signal was stronger at the cohesive sediments. Vertical differences within the sediment were observed at both stations as well. The contrasting biogeochemical patterns invoked different responses in the meiobenthos that were reflected in the benthic food web. In general, meiobenthic 13C signatures remained relatively constant over time and were not coupled with changes in water SPM and sediment POM. There was vertical variation in meiobenthic 13C signatures in fine sediments. Deeper dwelling nematode genera feed on more degraded OM, while other genera migrate upwards to feed on freshly deposited OM. In permeable sediments, such vertical differences were absent because of sediment biogeochemical properties. δ13C and δ15N values of copepods clearly indicated a chemoautotrophic food source within the fine-grained sediment.

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A COMPARISON OF OPC-DERIVED ZOOPLANKTON SIZE STRUCTURE IN DIFFERENT MARINE ECOSYSTEM:

Since 1999, a laboratory Optical Plankton Counter OPC (Herman, 1988) was used to count and size mesozooplankton (from 200 µm to 2 mm) from various types of pelagic ecosystem: oligotrophe (South pacific gyre, Gulf of Guinea , south western and eastern Mediterranean sea), mesotrophe (Kerguelen plateau, Gulf of Lion) and eutrophe (Bay of Biscaye), and for two annual time series in the Arcachon bay and Marseille Bay. One advantage of this new automatic system is that it quickly provides size spectra from which both, zooplankton abundance and biovolume can be estimated. From our various campaigns, we made comparisons of biomasses and abundances derived from the OPC with those obtained from direct measurements. The slopes of the zooplankton size spectra from these different areas are compared in connection to the environmental characteristics of production, as well as the linkages with the diversity index. The use of zooplankton size spectrum as descriptor of the structure and dynamics of zooplankton component in these ecosystems is discussed.

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TEMPORAL EVOLUTION OF PLANKTON SIZE SPECTRA AND ITS DETRITUS FOUND IN THE BLACK SEA WATER MASS ENTERING THE MEDITERRANEAN SEA

The temporal evolution of the size spectra of plankton and its detritus found in the Black Sea water mass entering the Mediterranean Sea was studied in spring 2008 using a langrangian approach with a free-drifting sediment trap placed at the bottom limit of this water mass (16m). Mesozooplankton fecal pellet production rate as well as the size-spectra, biomass, and species composition of phyto- and mesozooplankton were obtained in the water column above the trap. Size spectra were also determined for plankton detritus (phytoplankton cells, zooplankton carcasses and fecal pellets) collected by the trap and were analyzed for elemental and stable carbon (C) and nitrogen (N) isotopic composition. Carcasses size spectra were corrected for swimmer effect to obtain the flux due to the non-predational zooplankton mortality. The size spectra of plankton and its detritus revealed the contribution of phytoplankton, meso- and macrozooplankton detritus to the total C and N vertical flux. Important variations over small time scales (<day) were observed both at quantitative (vertical flux of C and N) and qualitative levels (change in the relative contribution of detritus).

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THE STRUCTURE AND STABILITY OF MARINE ECOSYSTEMS

Exploring the spatial and temporal patterns of productivity in our global oceans is vital to understanding the prospects for sustainable use of living resources. One of the challenges associated with this effort is the analysis and integration of multi-variate, empirical observations across levels in the food web, and the establishment of so-called "baselines" against which to assess change. Several of the most intensively monitored marine systems in the world are the mid-latitude, continental shelf ecosystems of the North Atlantic and Pacific. In these areas, large-scale changes have occurred over brief time periods, interpreted as resulting from the interplay of harvesting and/or climate change and underlying ecosystem processes, leading to alterations in ecosystem state. Recent insights regarding food web dynamics and the structural and functional reactions of these systems to such perturbations are manifold. Case studies will be reviewed from the perspective of developing the ability to define quantitatively, and ultimately predict, how contemporary marine ecosystems are modified by harvesting and, increasingly, by environmental change.

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LARGE PROPORTIONS OF DEAD CELLS HAVE LITTLE EFFECT ON VARIABLE CHLOROPHYLL FLUORESCENCE (FV:FM): IMPLICATIONS FOR FIELD SURVEYS

Variable fluorescence (FV:FM) is widely used in biological oceanography to assess the 'state of health' of phytoplankton, and to help estimate primary productivity. Variability in the absolute values of FV:FM depend to some extent on the measuring system, but overall, changes in FV:FM are interpreted in terms of cellular acclimation to changing irradiance (photoacclimation, photoinhibition) and nutrient availability (N, Fe). Recent measurements of phytoplankton assemblages reveals large proportions of dead cells in many regions; the effect of these dead cells on FV:FM is largely unknown. By mixing live and dead cells and measuring variable fluorescence, we show that photosynthetically non-functional (dead) cells have surprisingly little effect on FV:FM; in a number of species, mixtures containing 50 % dead cells had FV:FM of 0.5, a common value in nature. A simple model indicates that the non-linear nature of the ratio is responsible for this counterintuitive result. We conclude that 'high' values of FV:FM cannot be used as evidence for low mortality. Our findings highlight the need for more information on the physiological status of both eukaryotic and prokaryotic microalgae in nature.

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PREDATION WITHIN THE MICROZOOPLANKTON-EXPERIMENTAL EVIDENCE IN THE GULF OF NAPLES, ITALY

It is well established that microzooplankton are an important link between small primary producers and mesozooplankton. However, some microzooplankton consume other microzooplankton, clearly complicating the system. We have evaluated the impact of predation within the microzooplankton, specifically in an environment where mesozooplankton abundances are relatively low. By modifying the classical dilution method of Landry and Hassett (1982), we estimated protozoan growth rates and microzooplankton internal predation. Natural samples were diluted with screened ambient seawater (5 or 10 μm) to create the dilution series. In undiluted samples the apparent ciliate growth rate was between − 0.87 and 0.16 d− 1, while in the absence of internal predation, the predicted specific growth rate of microzooplankton was between 0.65 and 2.15 d− 1, indicating substantial predation within the microzooplankton. Changes in the abundance and biomass of dinoflagellates were similar, albeit generally less pronounced, to those observed for the ciliates. We discuss the trophodynamics of our system and the importance of carbon recycling by the microzooplankton.

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PATTERNS IN ACTIVE MICROBES UNDER DYNAMIC CONDITIONS

This study was undertaken to track how changes within the active and resident bacterial populations correlate to changes in environmental drivers. By narrowing the focus to two widely spaced locations, a New Zealand Fjord and a Caribbean river plume, this study hoped to find patterns in species-specific bacterial activity associated with a number of measured parameters. Both areas demonstrate an isolated surface layer with a sharp salinity gradient and represent highly dynamic conditions. This work utilized molecular techniques to track how changes within the active and resident bacterial populations correlate to changes in environmental drivers. For all samples, the 16S rRNA gene and rDNA were analyzed individually to separate the active microbial community from the resident population. It was found that a number of measured environmental parameters can be linked to individual phylotypes/species. In the Orinoco and Doubtful Sound, these correlations accounted for approximately 40% and 56% of the entire resident and 45% and 58% of the active population, respectively. This and the fact that the rRNA gene and rDNA investigations lead to different conclusions, support the concept that it is essential to try and isolate the behavior of individuals from the active community and the resident faction separately.

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IS INCREASED NUTRIENT DELIVERY COMPROMISING THE ECOLOGICAL INTEGRITY OF FLORIDA'S SPRING-FED COASTAL RIVERS?

Increased nutrient loads and altered flow regimes represent two likely drivers of changes in the abundance, distribution and species composition of submersed aquatic vegetation in Florida's spring-fed, coastal rivers. The broader ecological consequences of these changes in vegetation are becoming apparent. In the Chassahowitzka and Homosassa Rivers, two spring-fed systems along the Gulf coast of peninsular Florida, sampling initiated in 1998 has documented marked increases in nutrient loads and concomitant declines in submersed aquatic vegetation, with several rooted macrophytes and key native flora apparently extirpated from the Homosassa River. Recent sampling of fish assemblages indicates significant differences in the numbers, sizes and biomass of both small-bodied and large-bodied fishes in the two rivers. Activity patterns, home ranges, growth rates, and diets of an apex fish predator also differ significantly between systems, suggesting habitat-mediated changes in behavior and ecology across multiple trophic levels. These findings merit immediate attention from resource managers charged with preventing further degradation of water quality and ecological integrity in these spring-fed systems.

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IDENTIFICATION OF BACTERIOLOGICAL WATER QUALITY HAZARDS USING A BACTERIAL SOURCE TRACKING APPROACH IN A SUBTROPICAL URBAN ESTUARY

The Vernon River basin drains 6500 hectares of a densely populated urbanized area in the southeastern US including the cities of Savannah and Vernonburg, Georgia. Several small rivers within the basin have been identified as not meeting water quality standards because of fecal contamination, low oxygen, and fish contamination. However, because of the complexity of potential sources of contamination and the complexity of political and jurisdictional responsibility, it has not been possible to identify the sources of contamination or to develop an effective comprehensive mitigation plan. In this study, a Bacterial Source Tracking project was conducted to identify the source of fecal contamination and to develop a basin wide water quality management strategy. Based on Multiple Antibiotic Resistance profiling, a large proportion of contamination in five estuarine rivers within the basin was determined to originate from animal sources with birds and dogs the most likely sources. This information is being utilized to re-assess public health risks, develop new management plans, and will be used to guide long-term regional development plans that will include increased permeable buffer zones and wildlife corridors.

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IDENTIFICATION OF LACTATE-METABOLIZING IRON-REDUCING AND FERMENTING MICROORGANISMS IN RICE PADDY SOIL

The anaerobic turnover of organic matter in sediments and wetlands is driven by several guilds of microorganisms cooperating in the anaerobic microbial food chain, however, the specific identity of the microorganisms involved in situ is largely unknown. In this study, we identified 13C-lactate-metabolizing microorganisms that utilize iron(hydr)oxides as electron acceptor in rice paddy soil incubations by stable isotope probing (SIP) of rRNA. Slurries were incubated anaerobically in the presence of 13C-lactate, and the ironhydroxides ferrihydrite or lepidocrocite. Turnover of 13C-lactate started immediately as detected by the formation of 13C-carbondioxide and 13C-methane, albeit ferrihydite presence reduced methane emission up to 44%. After 24 h and 168 h of incubation, rRNA was extracted from samples and fractionated by density using isopycnic centrifugation. Specifically active populations were identified by analysis of clones in libraries of "heavy" rRNA fractions. In ferrihydrite containing slurries, Clostridia and Geobacter spp. were predominant, whereas in slurries with lepidocrocite clones from within the Firmicutes dominated. In conclusion, rice paddies inhabit a diverse and highly responsive lactate-metabolizing anaerobic microbiota that responds differently to the availability of ironhydroxides.

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CARBON TO NUTRIENT RATIOS IN MARINE SESTON: DEPATURES FROM REDFIELD.

The stoichiometry of the biological pump of the North Atlantic and Arctic Ocean exhibit both regional and seasonal variability, still most ecosystem models use a fixed "Redfield" relationship. As part of the project Marine Ecosystem Response to a changing CLImate (MERCLIM), a metadatabase was gathered with carbon and nitrogen observations from the Barents Sea, North Atlantic and Arctic Ocean, and a high-resolution 10-year dataseries off the Norwegian coast. It is used to evaluate the realistic variation in C:N and C:P ratios and the inherent patterns related to season, depth, latitude, salinity and temperature (watermass), light and chlorophyll. By use of C:chlorophyll ratios we will also assess the fraction of autotrophs in total seston mass. Ultimately these data will be used for improved parameterizations of a coupled ocean-ice-biochemical ecosystem model (SINMOD). The data demonstrate a tighter regulation of C:N relative to C:P which can be accredited a stronger coupling of photosynthesis and N-uptake relative to P-uptake. Seasonality, light conditions, salinity and fraction of autotrophs in the seston are discussed as major determinants of seston stoichiometry.

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SI-ISOTOPIC CONSTRAINTS ON THE SI-BIOGEOCHEMICAL CYCLE IN THE SOUTHERN OCEAN DURING THE KEOPS AND BONUS-GOODHOPE SURVEYS

The development of new oceanic proxy tools with different sensitivities to physical and biogeochemical forcing is evolving fast. One of these proxies is the natural Si-isotopic signature [δ^{30}Si (‰)]. This proxy allows to better constrain the Si-cycle since it integrates over long time scales (seasonal), contrasting with the very short time scales usually achieved during direct uptake measurements. Isotopic variation in the ocean apparently seems mainly controlled by diatoms, which incorporate Si under constant isotopic fractionation. δ^{30}Si was measured during two late summer Southern Ocean expeditions: (i) KEOPS (2005) in the Kerguelen Plateau PFZ area (10 profiles; particulate and dissolved Si), and (ii) BONUS-GOODHOPE (BGH) (2008) covering a section from the Cape Basin to the northern Weddell Gyre along the Greenwich Meridian (8 profiles of dissolved Si). Our BGH δ^{30}Si results are the first to document the whole water column along a full section through the ACC in summer. We also will present preliminary results of the reconstructed natural Si-biogeochemical cycle (production, dissolution, mixing) during KEOPS, as obtained using an inverse box model.

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MOLECULAR GUT CONTENT PROFILING IN GELATINOUS ZOOPLANKTON: WILL IT WORK AND WHAT WILL WE LEARN?

The ability to accurately investigate trophic interactions for zooplankton species is vital for understanding the processes that structure marine ecosystems. However, because of the difficulty of directly assessing gut content and the biases associated with classical incubation based approaches, relatively little is known about the in situ diets of most zooplankton species. This is particularly true for the gelatinous zooplankton. A promising new strategy is the use of molecular methods to detect prey-specific nucleic acid molecules as biomarkers of trophic interactions. Various different assays have been developed, but the general strategy of these methods is to purify DNA from stomach contents followed by detection using PCR -based methods targeting gene fragments specifically associated with prey organisms. We will present the state-of-the-art in this methodology, including qualitative and quantitative assays, comparing different zooplankton taxa. Preliminary results from studies with appendicularians and doliolids addressing the question of what controls gelatinous blooms will also be presented.

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MODELING THE IMPACTS OF CLIMATE CHANGE ON PHYTOPLANKTON BIOMASS IN LAKES

The impacts of the expected climate change on phytoplankton biomass in lakes can be assessed using modeling approach. Regional climatic scenarios are produced by means of general circulation models and regional climatic models. Data representing regional climatic models is used as input in the models calculating nutrient transport from drainage basins as well as in the lake models themselves. The case study lakes were Lake Roine in Finland, Loch Lomond in Scotland, Lake Võrtsjärv in Estonia and Lake Burtnieks in Latvia. As the drainage basin model, CATCHLOAD was applied. As lake models, a water quality model developed in Finland on the basis of the Swedish model PROBE, and a model based on the AQUASIM software were used. In the models, phytoplankton was simulated either as total biomass or as two groups. The results show in general enhanced eutrophication and altered timing of phytoplankton peaks, even though the results depend on the characteristics of the case study lakes and the climatic scenarios studied.

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PHYSICAL STUDY OF THE SEA SURFACE MICROLAYER FILMS

The sea surface microlayer (SSM) forms the interface between the atmosphere and oceans covering about 71% of the Earth's surface. Although the SSM is temporally and structurally unstable, it hosts the main exchange processes of organic matter, gases, heat and energy between those two compartments. The enrichment of the SSM in organic matter affects physical features of the air-sea interface thus influencing the air-sea fluxes. Hence, it is of considerable interest to get insight into morphology, structural changes and build-up mechanisms of the natural SSM. In this study the microlayers were investigated without any pre-treatment and as ex-situ reconstructed films after previous microlayer extraction by organic solvents of different polarity. Monolayer technique has been applied for investigations of elastic properties of different microlayers throughout determination of the surface compression modulus. Alongside, Brewster angle microscopy (BAM) was used for characterization and optical visualization of microlayers at the air-water interface without perturbing their structure and/or morphology. Fractal analysis of 2D BAM images enabled new assign into the morphology and structural changes of original microlayers and reconstructed films in static and dynamic condition.

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THE EFFECT OF THIN LAYERS ON THE BEHAVIOR OF COPEPODS AND HYDROMEDUSAE

An active area of research is focused on zooplankton behavior in response to microscale biological, chemical and/or physical discontinuities in the marine environment. It has been suggested that behavioral responses to light, salinity and prey availability, in conjunction with variations in the flow regime, constitute the primary reasons for the aggregation of gelatinous zooplankton and copepods. Furthermore, increasing observations of gelatinous zooplankton in the world's oceans gives rise to the concern over their predatory impact. In an attempt to provide some insight into the use of enhanced resources found within thin layers, laboratory experiments were conducted to test if and how vertical haloclines and thin layers of prey consisting of adult copepods, Acartia tonsa and green algae, Nannochloropsis sp., affected the distribution and swimming behavior of hydromedusae, Bougainvillia superciliaris. Results suggest that Bougainvillia superciliaris are ambush predators demonstrating a strong predatory impact on thin layers of Acartia tonsa. Gaining knowledge from medusae:copepods predator:prey interactions and behavioral responses to discontinuities will contribute to filling in the gaps in understanding the biology and ecology of these influential planktivorous predators.

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INTEGRATING ECOLOGICAL STOICHIOMETRY AND ECOTOXICOLOGY

The balance of elements available in the environment can strongly affect key physiological processes in producers and consumers. However, standard toxicological studies typically attempt to minimize variation in physiological processes and therefore can fail to capture ecologically meaningful variation. Here we test the hypothesis that elemental food quality affects the sensitivity of zooplankton to chemical exposure. We synthesized the results from a series of tests that exposed Daphnia grown on variable food quality to a range of concentrations of different chemicals. We found food quality could increase, not change, or reduce the chemical toxicity on different physiological end-points. For example, the toxicity of fluoxetine on Daphnia growth and survival was significantly reduced in P-limited animals whereas copper toxicity was largely not changed by food quality. The chemical-specificity in our results likely results from variable modes of action and interactions with the growth metabolism of the organism. Our results demonstrate the need to consider variable chemical toxicity resulting from differences in elemental food quality and its idiosyncrasies in future chemical risk assessments.

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INTERACTIVE INFLUENCES OF CHANGING PCO2 AND PHOSPHATE AVAILABILITY ON TOXIN PRODUCTION AND PHYSIOLOGY OF THE HARMFUL BLOOM DINOFLAGELLATE KARLODINIUM VENEFICUM

We used semi-continuous laboratory culture experiments with the toxic dinoflagellate Karlodinium veneficum to examine its acclimated response to a matrix of changing CO2 levels and phosphate availability. A Delaware Inland Bays isolate (CCMP 2936) was grown under six conditions: P-replete and either 190ppm, 380ppm or 750ppm CO2; and P-limited and either 190ppm, 380ppm or 750ppm CO2. Growth rates, karlotoxin production, maximum photosynthetic rates, primary production, elemental ratios and cellular carbon and phosphorus quotas were determined. Results showed that growth rates, toxin production and carbon fixation were sensitive to the availability of CO2 and phosphate both alone and in combination, consistent with what is known about its carbon acquisition and nutrient physiology. This unialgal culture experimental approach suggests that the growth rates and toxicity of the harmful bloom species K. veneficum could increase substantially in the future high CO2 ocean, and that simultaneous changes in pCO2 and nutrient availability can have significant interactive effects on dinoflagellate cell physiology and toxin production.

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COMBINING NITROGEN GEOCHEMISTRY WITH MICROBIAL FINGERPRINTING TO EXPLORE N_2 PRODUCTION PROCESSES IN THE BLACK SEA

Understanding the controls on N_2 production is necessary for predicting N cycling in the past and future. Profiles of in situ [N_2] and ^{15}N-N_2 in the suboxic zone of the Western Gyre of the Black Sea are temporally variable. Calculations using biologically produced (excess) N_2 and ^{15}N-N_2 suggest heterotrophic denitrification activity in 2000 and 2001, correlating with high organic N (TON). This denitrification signal was absent in 2003 and 2005. Correlations between satellite chlorophyll concentrations in the euphotic zone

(Nezlin, 2008) and TON in the suboxic zone infer a link, presumably by sinking organic matter. Terminal Fragment Length Polymorphism (TRFLP) peaks corresponding to DNA from the anammox bacteria *S.sorokinii* were present in all years, but were significantly higher and existed over a larger depth range in 2000, correlating with significantly higher excess [N_2] and [NO_2-]. This data gives us a first glimpse into microbial controls on N_2 production processes in the Black Sea. Stimulation of denitrification by abundant organic matter can explain temporal variability in ^{15}N-N_2 while high [N_2] can be explained by stimulation of anammox by high [NO_2-].

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A MULTI-PERSPECTIVE ANALYSIS OF JELLYFISH BLOOMS IN THE CATALAN COAST: ECOLOGICAL ASPECTS

Many areas world-wide have experienced jellyfish outbreaks during recent decades. In the Northwestern Mediterranean, where jellyfish populations have increased considerably this phenomenon has aroused much interest due to its severe impact on human activities. The records acquired by the project conducted by the local Administration of Catalunya (Agencia Catalana del Aigua) constitute the first data about jellyfish abundance in the Spanish coast. The presence of jellyfish have been observed constantly since 2000 but their abundance has been highly variable and without any clear trend. Years 2000, 2003, 2005, and 2006 were identified showing summers with a higher presence of jellyfish. Moreover, there seems to be an unequal apparition of jellyfish along the coast. In order to identify patterns in the occurrence of jellyfish and trying to relate it with some environmental variables, we conducted fuzzy data analysis. First results shown that the direction and intensity of winds are critical to the arrival of jellyfish to the coast. This first approach demonstrate that it is mandatory the existence of research programs that study the phenomenon not only onshore but also offshore.

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ASSOCIATION NETWORK ANALYSIS SHOWS POTENTIAL MARINE FOOD WEB INTERACTIONS

Through advances in molecular genetic characterization of microorganisms, we can determine which organisms are present in a particular sample. The next step of determining the interactions among those organisms, and with the physico-chemical environment, is much more difficult. We have approached this with a Systems Biology approach at the San Pedro Ocean Time Series. With monthly sampling (here reported for the chlorophyll maximum depth), we have characterized the community composition of bacteria, archaea, and protists by whole community fingerprinting (ARISA, TRFLP) and quantitative PCR. The composition data, along with data on temperature, chemistry (salinity, nutrients), and bulk biology (e.g. chlorophyll, microbial counts, thymidine incorporation), were all analyzed statistically to look for pairwise correlations, contemporaneous and with time lags, by local similarity analysis. These correlations were displayed to show which groups of organisms and parameters tend to co-occur or tend to exclude each other. Surprisingly few organisms, including protists, correlated strongly to nutrients or temperature, and the strongest interactions were among organisms. To us this suggests that the niches in this system are largely biologically defined.

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IDENTIFICATION OF FOOD SOURCES OF POND SNAIL, CIPANGOPALUDINA CHINENSIS MALLEATA, USING FATTY ACID ANALYSIS.

Pond snail, Cipangopaludina chinensis malleata, is one of the dominant freshwater snails in Japan. The ecological study of this species is very few and its food source remains unclear. This study aimed to elucidate its food source based on fatty acids (FA) profile of this snail and its potential food source, such as surface sediment, suspended matter and attached algae on pond snail shell. Each sample was collected at paddy fields on July and September 2008. As a result, FA profile of pond snail and all potential food sources varied in July and September. This temporal difference of pond snail would be corresponded to changes of assimilated food source. To evaluate a similarity of temporal variation of fatty acids profile between pond snail and all potential food sources, principal component analysis (PCA) was used. Surface sediment and attached algae on pond snail shell were found to be close to pond snail plot, but not for suspended matter. This suggested pond snail assimilated mainly surface sediment and attached algae on pond snail shell while suspended matter was not important food source.

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PHYSICAL FORCING OF ALTERNATE STABLE STATES ON CORAL REEFS

Coral reefs are dynamic systems capable of switching from coral-dominated communities to less desirable algal-dominated communities. Resilience to such 'phase shifts' may be eroded by the removal of key biological groups, where for example, the loss of herbivorous fish can lead to the sudden collapse of reef systems already under pressure from eutrophication and thermal stress. While conserving these key biological groups has now become a priority, the role of physical forcing in preventing or exacerbating coral reef phase shifts has remained largely unexplored. Given that abiotic factors often set overall limits to the distribution of species, physical forcing may limit the likelihood of an algal-dominated community arising in a given coral reef habitat or location. We examined the potential for wave energy to limit the distribution of macroalgae on coral reefs devoid of herbivores. Comparing measures of wave-induced force with the biomechanical attributes of tropical macroalgae, we found that wave energy can substantially limit where macroalgae occur on coral reefs. We discuss how such biophysical thresholds may be used to understand and predict future coral reef phase shifts.

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CLIMATE FORCING AND HUMAN INFLUENCE: WHAT CAN OUR KNOWLEDGE OF FUNDAMENTAL NUTRIENT CYCLING PROCESSES TELL US ABOUT THE FUTURE OF A NEW ENGLAND ESTUARY?

Like many coastal ecosystems Narragansett Bay (RI, USA) has undergone dramatic changes in recent decades. We have seen changes in fish and phytoplankton community composition, in the timing and magnitude of phytoplankton blooms, in the amount of benthic oxygen uptake and nutrient remineralization, and in the magnitude and direction of important N cycling processes. These important changes are believed to have resulted largely from long term warming. In the coming years Narragansett Bay will undergo another striking change – a major reduction in total nitrogen loading as local wastewater treatment plants transition from secondary to tertiary treatment. For a bay that has been intensively fertilized with nitrogen for over a century this will undoubtedly cause additional major ecosystem changes. How will this anthropogenic N reduction interact with the climate induced oligotrophication of the mid and lower bay? How do we balance goals of hypoxia reduction with desires to maintain high secondary productivity?

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VERTICAL FLUXES OF C, N AND P IN SHELF WATERS OF THE GREAT BARRIER REEF

The Great Barrier Reef (GBR) ecosystem is a large (322,000 km2) tropical shelf ecosystem with complex bathymetry. Reef and benthic habitats support a diverse community of microbial mineralizers, detritivores and filter feeders. GBR waters are characterized by enhanced concentrations of suspended particulate and organic matter derived from reefal and inter-reefal benthic communities, plankton, and resuspension of sediments and associated organic matter. Directly measured sedimentation fluxes using moored and drifting sediment traps indicate a dynamic carbon and nutrient sedimentation environment. Daily sedimentation fluxes of total suspended matter, C, N and P range from < 10 percent to > 100 percent of water column standing stocks. Sedimentation fluxes of carbon are only loosely correlated with local water column primary productivity. Wind-driven resuspension of detrital organic matter, regardless of shelf location, is the major source of trapped material. Regional-scale N and P budget calculations indicate that water column vertical fluxes (sedimentation and resuspension) and recycling processes (uptake and microbial mineralization) considerably exceed estimates of external nutrient source and sink terms for N and P.

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LONG-TERM CYCLIC PERSISTENCE AND PHASE SIGNATURE IN AN EXPERIMENTAL PREDATOR-PREY SYSTEM

Predator-prey cycles are predicted by the simplest ecological models and, theoretically, allow indefinite coexistence of predator and prey populations, despite the exploitative character of their interaction. Yet, it remains an open question for how long cyclic dynamics can be self-sustained in real communities. We performed chemostat experiments with a planktonic model system: an algal prey and its rotifer predator. We report a predator-prey time series of unprecedented length, with sustained oscillations for more than 50 cycles and about 300 predator generations. Multivariate wavelet analyses reveal continuous oscillations of population sizes and stages that persisted throughout the entire experiment. The system also displayed resilience, i.e., returned to well defined phase relationships after disturbance. The mutual phase differences between all measured time series can be compactly encoded in a single polar histogram, providing a characteristic phase signature for the temporal succession within the stage-structured predator-prey system. Our results establish the phase signature as a robust measure for identifying species interactions in dynamical systems and demonstrate the potential for infinite coexistence of predator and prey populations in a cyclic dynamic regime.

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THE ECTOCARPUS GENOME PROJECT

Brown algae are predominant primary producers in temperate marine coastal ecosystems. A survey of several species led to *Ectocarpus siliculosus* being proposed as a genetic and genomic model for this group of organisms (Peters et al., J. Phycol. 2004). A genome sequencing project for this organism was initiated at Genoscope in 2004, involving the generation of about three and a half million sequencing reads from genomic libraries, plus an additional 91,000 cDNA reads. A draft assembly of the 200 Mbp genome was completed in the summer of 2007, making *Ectocarpus* the first-ever fully sequenced seaweed. Protein coding genes in the genome were predicted at the VIB in Ghent using the automatic annotation program Eugene. An international consortium of annotators led by the French Roscoff Marine Laboratory is currently annotating the genome manually. The presentation will describe some of the major steps of this project and some of the complementary projects that are being carried out. The focus will be on new insights into brown algal physiology and ecology.

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ENDOGENOUS ALTERNATION OF FUNCTIONAL TRAITS YIELDS HIGH BIOMASSES AND COMPENSATORY DYNAMICS IN A MULTI-SPECIES PREDATOR-PREY SYSTEM

Classical predator-prey models consistently predict pronounced predator-prey cycles or equilibria with either the predator or the prey dominating or suppressed. In contrast, we observed a remarkable coexistence of predator (algivorous ciliates) and prey (small phytoplankton), both at relatively high biomasses over 15-30 generations. The observed dynamics were captured by a multi-species predator-prey model when predator species differed in their food selectivity, and prey species in their edibility. Food-selectivity and edibility were related to the feeding and growth characteristics which represented ecological trade-offs. For example, the prey species with the highest edibility also had the highest maximum growth rate. Data and model revealed endogenously driven ongoing species alternations, which yielded a higher variability in species-specific biomasses than in total predator and prey biomass. This holds for a broad parameter space as long as the species differ functionally. A dynamic-trait model based on the same assumptions delivered comparable results. It enabled the simulation of a continuum of functionally different species and the adaptability of predator and prey communities to ambient conditions, while keeping the number of equations and free parameters rather low.

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TOXICITY EVALUATION OF THE EFFLUENT FROM AN INSTALLATION OF CLEANSING AND URANIUM RECOVERY USING A BATTERY OF BIOASSAYS

On July 7, 2008, a leak of effluent from an Installation of Cleansing and Uranium Recovery (Tricastin, France) led to the spillage of 74 kg of uranium in the environment and the contamination of a stream. Uranium contents were measured in different compartments of aquatic habitats (surface water and sediment), allowing the estimation of exposure concentrations in the stream. Moreover, the acute toxicity of the effluent was evaluated, and compared to the standard toxicity of uranium, in bioassays using different organisms: Chlamydomonas reinhardtii (algae), Daphnia magna (Crustacean), Chironomus riparius (Oligochete) and Danio rerio (fish). Results showed that effluent was toxic to algae and daphnia between 0.3 and 1 mg uranium.L-1, while standard toxicity of uranium occurred at higher concentrations. The LC50 96h of effluent to C. riparius was 22 mg U.L-1. The HT50 (hatching time 50%) of D. rerio embryos exposed to 30-300 µg U.L-1 was higher than controls, without any differences with the standard toxicity of uranium. The differences of sensitivity of these ecotoxicological models, and potential consequences of the uranium spillage of in the stream are discussed.

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TEMPORAL PERSISTENCE AND CROSS-SYSTEM PREVALENCE OF AN INVERSE RELATIONSHIP BETWEEN PHOSPHORUS AVAILABILITY AND MICROBIAL MAT PRODUCTION IN KARSTIC WETLANDS

Shallow coastal wetlands often support high biomass (200-500 g m^{-2}) of microbial mats that form a carpet on the limestone substrate and plant stems. These mats engineer the ecosystem by precipitating stromatolitic soils, regulating gas and nutrient concentrations and contributing to complex food webs. Carbonate adsorption limits phosphorus (P) bioavailability in these systems, so most are highly susceptible to small changes in P input. Ecological legacies of P-enrichment in developing watersheds are notable, and Everglades wetlands of South Florida present a case history. However, while P-stimulates plant productivity in the Everglades, a paradoxical inverse relationship exists between P availability and microbial mat production. Any persistent increase in P above ambient levels causes a decline and eventual disappearance of microbial mats. An investigation of similar karstic wetlands across the Caribbean shows that this negative relationship to P availability is pervasive. Chemostat experiments show that P stimulates bacterial production that consumes mat detritus and dissolves the calcium carbonate matrix. Consequences of P-stimulated mat dissolution to gas and nutrient flux and food web complexity are being examined experimentally and across karstic Caribbean wetlands.

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ARCHAEAL COMMUNITIES IN THE DEEP ARCTIC OCEAN UNVEILED BY MASSIVELY PARALLEL TAG SEQUENCING

The Arctic Ocean plays a critical role in controlling nutrient budgets between the Pacific and Atlantic Ocean. Nutrients flowing through the Arctic are cycled by microorganisms but very little is known about their distribution and identity. Archaea, as key players in the nitrogen cycle, are an important component of the marine ecosystem. Nevertheless, their community composition has not been studied in the deep water masses of the Arctic Ocean. Here we characterize archaeal communities from four different water masses of the Arctic Ocean using massively parallel tag sequencing of the V6 region of the 16S rRNA gene. Our results reveal an archaeal community dominated by Group III Euryarchaeota and demonstrate biogeographical traits for Arctic marine Archaea. We present the first description of archaeal communities by tag sequencing and show that it is possible to assign a taxonomical identity bellow phylum level to many of the archaeal V6 tags, making tag sequencing a powerful tool for resolving the diversity of specific microbes in the environment.

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SIGNALS OF CHANGE: THERMOPHILIC ALIEN SPECIES IN THE MEDITERRANEAN SEA

Over 600 alien marine metazoan species have been recorded in the Mediterranean Sea. The majority of aliens are thermophilic species originating from the Indo-Pacific or Indian Oceans, which have entered the Mediterranean through the Suez Canal. Data, gleaned from a recently assembled database tracing the spread of alien species in the Mediterranean, allow examination of the possible impacts of climate change. Thermophilic species have been introduced for much of the 20th century, yet few spread outside the Levantine Basin until the 1980s. Multiple anthropogenic stressors – pollution, eutrophication, destruction and fragmentation of habitats, fisheries overexploitation, climate change – are implicated in the decline in the richness and diversity of the native Mediterranean littoral ecosystem. Yet, it is proposed that the rising sea water surface temperature in the past two decades has favoured the thermophilic aliens reproduction, growth, and survival, and provided them with a distinct advantage over native temperate Mediterranean taxa. The influx of thermophilic aliens impacts tourism and the already teetering fisheries through proliferation of noxious and poisonous species, displacement of commercially-important native species, and the alteration of the food web.

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THE ROLE OF PLANKTON BEHAVIOR, BREAKING INTERNAL WAVES, AND MIXING IN THE FORMATION OF FINE-SCALE PLANKTON LAYERS

Mixing generated by breaking internal waves and plankton behavior was studied in the Gulf of Chiriqui, Panama, an area where fine-scale plankton layers form, using an optical imaging sensor (Video Plankton Recorder: VPR) coupled with a cabled oceanographic observatory (PLUTO (Panama LJL Underwater Tropical Observatory; http://4dgeo.whoi.edu/panama). At the observatory node, a variety of oceanographic sensors and a 1.2 mHz ADCP operate continuously generating a high resolution biophysical time-series. A VPR was used to observe and quantify plankton populations and swimming behavior. An influx of cold (14-16oC) water resulting from an internal tide lead to strong vertical oscillations of the thermocline (internal waves) with a 10 min period. During passage of internal waves, acoustic backscatter and vertical velocity increase while Richardson's Number decreases below 0.7 indicating strong vertical mixing. The energy dissipation rate, as measured from particle tracking from the VPR, is highest on both the leading and trailing edges of an internal wave. Plankton shift from a relatively non-motile community to one of densely packed, rapid swimmers on the leading edge of internal waves forming fine-scale plankton layers.

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ANALYSIS OF SAHARA DUST DEPOSITION EVENTS IN THE MEDITERRANEAN AND THEIR EFFECT ON OCEAN PRODUCTION

Dust from the Sahara desert is transported over long distances and may stimulate marine planktonic life when deposited over the ocean. We used satellite true color images (2000-

2007) to identify dust storms over the Mediterranean area, and then we picked several storms that had actually deposited material at sea. We used weekly-averaged satellite chlorophyll data to analyze the response of the marine system to the dust input with a resolution of 1 X 1 degrees. Significant increases in chlorophyll were observed between two to three weeks after the basin-scale dust deposition event, often accompanied with a previous decrease in chlorophyll just during and/or immediately following the event. This trend was observed at different times of the annual cycle of chlorophyll. In order to predict Mediterranean marine ecosystem dynamics it may be important to consider the many Sahara dust deposition events including the ones that are smaller in intensity and/or more localized. In addition, as Northern Africa erosion trends are increasing with global change, future production scenarios will also need to take into account these events.

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SPATIAL AND TEMPORAL VARIABILITY OF SILVER CONCENTRATIONS IN THE NORTH PACIFIC OCEAN

Dramatic increases in coal combustion in Asia over the last three decades have induced the transport of substantial atmospheric emissions over the North Pacific Ocean, where they can potentially alter trace element biogeochemical cycles in oceanic surface waters and North America. These perturbations have recently been evidenced by measurements of elevated silver, which is a geochemical marker of coal combustion, in surface waters of the North Pacific, where this metal now appears to be the most contaminated trace element, relative to its natural concentration. However measurements there have been few and far between since they were first made over two decades ago. We will partially fill this void by presenting vertical profiles of silver concentration (HR-ICPMS) measured in archived samples from the VERTEX IV-V (1983-84) and IOC-IV (2002) cruises in the North Pacific, as well as in new samples from the GoA (2007) cruise in the Gulf of Alaska. These data will allow us to assess major temporal changes in silver pollution and to trace lateral transport of this metal across the North Pacific.

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DIVERSITY OF TOXIC PHYTOPLANKTON MEASURED BY QPCR BASED ASSAY. DOES THE INNOVATIVE MOLECULAR TECHNOLOGIES CAN OVERCOME THIS TASK?

Coastal areas are more frequently affected by high biomass proliferation of autotrophic protists that can produce toxic compounds noxious for humans and economic activities related to the coastal zones, and impacted negatively on the marine ecosystem. These phenomena are in expansion also with occurrences of new microalgal species typical of the inter-tropical areas. Molecular technologies exploring marine protist diversity have contributed to attain knowledge on their ecological roles and functions in both neritic and pelagic zones worldwide. Ribosomal gene sequences resulted highly informative to infer phylogeny relationships at inter and intra taxa level and design species - specific molecular probes. Rapid and sensitive identification and enumeration methods of target harmful protists in aquatic environments are now required for both exploring their community dynamics and life cycle stages, and strategies in water-monitoring programmes. Based on our studies of the identification and quantification of different dinophyta and haptophyta species on cultured and field samples by quantitative PCR, we can take out some considerations on the achievement and limits of this molecular technique applications in marine based ecosystems.

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DUAL ISOTOPE ADDITION (^{15}N AND ^{13}C) REVEALS SPATIOTEMPORAL CHANGES IN A NEW ENGLAND SALTMARSH FOOD WEB

Numerous primary producers may contribute to the diet of saltmarsh consumers despite the historical assumption that *Spartina* spp. detritus is the basis of estuarine food webs. To address the relative dietary contribution of primary producers to saltmarsh food webs in the Plum Island Estuary, Massachusetts, we conducted studies using natural abundance stable isotopes and simultaneous enriched stable isotope additions (^{13}C and ^{15}N). An array of consumers over multiple trophic levels, with various feeding modes were analyzed over space and time including the deposit feeding annelids (i.e. *Streblospio benedicti*, *Manayunkia aestuarina* and *Paranais litoralis*), the amphipod *Orchestia grillus*, the killifish *Fundulus heteroclitus* and the grass shrimp *Palaemonetes pugio*. In general, we found benthic and pelagic algae to be the dominant contributors to diets of saltmarsh consumers regardless of feeding mode or habitat. However, dietary contributions from *Spartina* detritus increased for some consumers late in the growing season when sediment microalgal biomass decreased. Consequently, assimilation of *Spartina* spp. detritus seems limited and perhaps associated with the scarcity of algae. Addition of isotopes was simple and effective and increased confidence of feeding pathways.

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BIOLOGICAL RESPONSE TO A RIVER PLUME AND INTENSIFIED UPWELLING OVER A WIDENED SHELF IN THE NORTHEASTERN SOUTH CHINA SEA: MODELLING STUDY

A coupled physical and ecosystem model was utilized to study the ecosystem response to the wind-driven upwelling over a distinctly widened shelf in the northeastern South China Sea. Driven by a sustaining upwelling favorable wind, relatively high surface chlorophyll-a concentrations are formed over the widened shelf and near the coastal promontory. This high chlorophyll-a is stimulated by the nutrient input through the amplified shoreward cross-isobath transport of nutrient-rich deep waters near the head of the widened shelf, as a result of concomitant intensified upwelling over the widened shelf. The upslope transport of nutrients subsequently moves toward the inner shelf and upwells at the lee of coastal cape to form the near-shore high surface chl-a concentration. Co-existed with the high productivity upwelling waters inshore, nutrient input from the Pearl River also generates distinct high surface chlorophyll-a concentrations initially confined in a bulge-shaped zone at the mouth of the Pearl River Estuary and ensued with southeastward advection by the coastal jet. A strong subsurface chlorophyll maximum is formed by the maximum diurnal light penetration to the nutricline and diminished beneath the river plume by the attenuation of PAR. Abundant zooplankton is generally distributed farther offshore of the phytoplankton bloom as a result of surface Ekman drift and the time lag in biological response. The simulated results qualitatively resemble to the measurements.

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ABUNDANCE AND DIVERSITY OF *ARCHAEA* IN SWEDISH FRESHWATER LAKES

Archaea are known to be inhabitants of extreme environments and are seen taxonomically as one of the oldest inhabitants on earth. While *Archaea* are well studied in terrestrial and marine environments, less is known about their abundance and diversity in freshwater inland lake areas. In aspects of microbial biogeography the abundance of *Archaea* becomes important in understanding evolutionary processes involved in occupation of environmental niches and adaptation to environmental changes. Here, we study the abundance and diversity of Archaeal groups in 5 lakes from different regions in Sweden. We use 16S rRNA sequence information to compare results to Archaeal groups found in marine and terrestrial environments and local habitat characteristics. Besides the use of published primers we have designed and tested newly developed primer sets allowing a theoretical coverage of 95% of the known sequences of Archaeal groups.

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IN SITU VERSUS LABORATORY OBTAINED HIGH RESOLUTION METAL PROFILES USING DET AND DGT PROBES: POSSIBLE ARTIFACTS

DET/DGT probes, arranged back to back, were inserted in situ for 24 hours at 12°C. In the laboratory, DET/DGT probes, arranged back to back, were inserted into cores for 24 hours at 20°C. Running these deployments at a very short distance from each other creates a similarity of conditions that reduces experimental uncertainty. Although the pairing is not totally exact, any variation caused by this is reflected as a component of random measurement error. Total and labile metal (Fe, Mn, As, Co, Cu, Cd) concentrations were assessed with DET and DGT, respectively. Significance testing indicated that the in laboratory DET deployment results were on average higher than those obtained with in situ deployment, while the reverse is true for DGT. Labile and non-labile metal fractions dramatically changed between in situ and laboratory deployments (a factor 2 on average). Our data showed also that the sources of unpredictability (uncertainty + variability) were more pronounced during in laboratory deployment, especially for oxygen sensitive elements such as Mn, Fe, Co and As.

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A POTENTIAL RISK TO BLUE CRAB FISHERIES: EXPOSURE OF THE BLUE CRAB (*CALLINECTES SAPIDUS*) TO CYANOTOXINS PRESENT IN LAC DES ALLEMANDS, LOUISIANA, USA

Toxic and noxious phytoplankton blooms are of increasing concern due to eutrophication of aquatic environments worldwide. Cyanobacteria, common harmful algal species inhabiting fresh and brackish waters, are often capable of producing multiple toxins. The most common cyanotoxins are hepatotoxic microcystins produced by several genera including, *Microcystis* and *Anabaena*. Although drinking water supplies generally undergo sufficient treatment to prevent cyanotoxin poisonings, exposure through food sources may provide another route for intoxication in humans. Prey preference for filter-feeding organisms make the commercially important blue crab species, *Callinectes sapidus*, a strong candidate for cyanotoxin contamination. Enzyme-Linked Immunosorbent Assay was used to evaluate microcystin concentrations within crab tissues and surface water taken from Lac des Allemands, Louisiana, USA. Highest microcystin toxicity in crab tissue were found in hepatopancreas (82.0 μg kg^{-1}) followed by edible portions (10.5 μg kg^{-1}) and viscera (6.5 μg kg^{-1}). The highest microcystin concentration from surface water (1.42 μg L^{-1}) was above the WHO guideline limit of 1.0 μg L^{-1}. Evaluation for microcystin in blue crab demonstrates contamination in these higher-order benthic consumers, therefore illustrating potential for impact on human health.

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DNA DAMAGE RECOVERY AFTER CHRONIC UV EXPOSURE AVOIDS CELL DEATH IN THE UNICELLULAR CHLOROPHYTE DUNALIELLA TERTIOLECTA.

Dunaliella tertiolecta were grown at 100 µmol m-2 s-1 in continuous PAR until they reached mid log phase. At this point, they were transferred to different UV treatments (17 Wm-2 UVA and 1Wm-2 UVB, unweighted) during 7 days: PAR (P), PAR+UVA (PA), PAR+UVA+UVB (PAB) and UVA+UVB (AB). UV radiation has been reported to cause cell death in some phytoplanktonic species concurring with the activation of caspase-like activities. Caspase-like activities were detected and measured however, UV did not induce cell death in D. tertiolecta and cells reached a latent state during the incubation under UV. While cell numbers remained constant, thymine dimmers were formed, and the accumulation of proteins related with mechanisms of base excision repair (BER) and nucleotide excision repair (NER) in the DNA were detected. The expression of these proteins showed a very different pattern depending on the UV treatment. The photoreactivation mechanism was analysed and a photolyase activity was measured and cloned. Its activity suggests that this protein is very efficient, being in part responsible for avoiding UV-induced cell death, as well as for driving the cells to a "stand-by" state.

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COPEPOD SIZE SPECTRA ANALYSIS OF TWO MULTI-DECADAL TIME SERIES IN THE MEDITERRANEAN WESTERN BASIN

Size is considered in theoretical ecology as an intrinsic characteristic that links through metabolism an individual organism to population, community and ecosystem functionality by prey-predator interactions and trophic-web organisation. We have used community size structure as a synthetic index for detecting pelagic-ecosystems changes related to climate change. Data have been acquired with the ZOOSCAN imaging system which provided us with standardised measurements of size and abundance for two zooplankton time series in the Western Mediterranean Sea; Point B (Villefranche Bay) and st. MC (Gulf of Naples). Monthly copepod-size spectra have been analysed in both time series, from 1974 in the case of Point B and from 1984 for st. MC. Copepod size structure of both time series has shifted to a community characterised by higher proportion of large individuals. At Point B the shift has occurred around 1987 while for st. MC the size increase is detected after its mid-90s major sampling interruption. Local environmental changes and prey-predator interactions will be discussed as probable causes for this community shift. Also correlations with environmental conditions at basin scale will be presented.

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FREEZE LYSABLE INORGANIC NUTRIENTS IN AN INTERTIDAL MUDFLAT: DEPENDENCE WITH MICROPHYTOBENTHIC ABUNDANCE

Freezing is a common treatment for sediment samples preservation. However it has been suggested that freezing breaks cells releasing variable amounts of intracellular nutrients to the porewater, referred as freeze lysable inorganic nutrients (FLIN). To clarify the role of microalgae to the release of intracellular nutrients to the porewater after freezing, parallel extractions were carried out. Sediment cores (n = 48) were taken from the intertidal areas of Cadiz Bay and sliced in several layers: 0-1, 1-2, 2-3, 3-5 and 5-10 mm. Layers of the same depth were divided in two subsample sets: one were centrifuged to extract porewater and other were freeze at -80ºC, thawed and centrifuged. Nitrite, nitrate, ammonium and phosphate were measured in the extracted porewater. Chlorophyll a and c were measured in the same sediment samples. Freezing produced a significant increase in the porewater concentrations of all inorganic nutrients. FLIN contents were significantly correlated with chlorophyll a and c ($p < 0.01$), r2 ranged from 0.54 for nitrate to 0.94 for ammonium, indicating that most FLIN were associated with the release of intracellular compounds from microalgae.

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THE INFLUENCE OF SUBMARINE GROUNDWATER DISCHARGE ON DISSOLVED INORGANIC NUTRIENT AND PHYTOPLANKTON LOADS IN A KARSTIC COASTAL AREA, CASTELLO (SPAIN)

Submarine groundwater discharge (SGD) to coastal areas is a traditionally unexplored pathway for the transfer of dissolved inorganic nutrients and other chemical components from land to sea. It is now recognized that a considerable amount of seawater, in addition to terrestrial freshwater, is also recirculated through coastal aquifer systems. The significance of total SGD was examined in a karstic coastal area of 400 km^2 (Castelló, NW Mediterranean Sea), where brackish submarine springs are known to exist. In May 2008, short-lived radium isotopes (^{223}Ra and ^{224}Ra) and ^{222}Rn were used as tracers of SGD discharge, coupled with measurements of dissolved inorganic nutrients, chlorophyll-a and phytoplankton populations in seawater and groundwater samples. Ra isotopes and ^{222}Rn suggest that significant SGD is occurring, both from coastal springs and local submarine discharge, extending as far as 11.5 km offshore. High concentrations of DIN in groundwater (mainly as NO_3), further appears to have led to enhanced DIN concentrations in coastal seawaters, consistent with observed concentrations of chlorophyll-a (average of 1.5 μg·L^{-1}). Moreover, we found that dinoflagellates were the dominant group of the phytoplankton community.

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IMPORTANCE OF IN SITU CHROMOPHORIC DISSOLVED ORGANIC MATTER (CDOM) PRODUCTION IN THE CDOM BUDGET OF COASTAL WATERS: EVIDENCE FROM THE MISSISSIPPI RIVER

Rivers deliver substantial amounts of Chromophoric Dissolved Organic Matter (CDOM), derived from terrestrial and estuarine processes, to the coastal ocean. This may be the dominant source of CDOM in coastal surface water. However, biological processes, possibly enhanced by fluxes of nutrients and organic material from rivers and by stratification associated with river plumes, can generate significant additional CDOM. High resolution surveys of CDOM and other properties were conducted in the Mississippi River plume in August, 2007 using the UMassBoston EcoShuttle, a towed, undulating vehicle with a variety of in situ and in line sensors. Analysis of the resulting data shows regions of high CDOM concentration, relative to the linear mixing curve between

Mississippi and Gulf of Mexico end members, at the base and edge of the river plume. We will show that this *in situ* source represents a major fraction of the CDOM exported to the Gulf of Mexico.

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ADAPTATION TO CLIMATE CHANGE: ADDRESSING CHALLENGES IN THE U.S.-MEXICO BORDER REGION

Temperature increases and drought are projected to exacerbate pressures on vulnerable water supplies and riparian environments in the US-Mexico border region. At recent workshops, border water managers identified water supply, infrastructure integrity, and energy-water trade-offs as critical issues. Border ecosystem managers expressed concern with sustaining environmental flows for wildlife habitat. Water and resource managers at these workshops identified face-to-face decision support processes, flexible online tools for risk management "discussion support," and public education as integral to building the capacity to adapt. We report on efforts to build knowledge networks of border region scientists and decision-makers, in order to characterize urban and agricultural water users' vulnerabilities, identify policy opportunities, and improve US-Mexico climate science information flows. Initial investigations show: key rural vulnerabilities result from intensification of export agriculture, high energy use for groundwater pumping, overdraft of aquifers, and pressure from urban expansion. Urban vulnerabilities include exposure of water supplies to drought, high energy consumption for water conveyance and treatment, and inadequate infrastructure. Treated wastewater reuse and desalination are seen by regional water managers as key strategies for coping with climate changes.

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PHYTOPLANKTON SIZE STRUCTURE ALONG EUTROPHICATION GRADIENTS IN THE BASQUE COAST (NORTHERN SPAIN)

During 2008, surveys were conducted quarterly along 22 stations that involved estuaries, coastal waters and shelf waters in the Basque Country (North of Spain). These stations were selected in order to characterize gradients of nutrient enrichment in aquatic marine systems and to search for changes in the structure of the phytoplankton communities. Thus, the study was focused on the systems influenced by the rivers with the highest flows along the Basque coast, and also, on the systems influenced by inputs of nutrients from anthropogenic origin (submarine outfalls and estuaries receiving discharges of urban wastewater treatment plants). Physico-chemical conditions were described by measuring concentrations of dissolved inorganic nutrients (ammonia, nitrate, nitrite, phosphate and silicate), elemental composition in the water (C, N and P), salinity and oxygen saturation. Phytoplankton size structure was studied by measuring the concentration of chlorophyll-a in two size fractions (<10 um and > 10 um). The relative contribution (%) of the small phytoplankton component tended to decrease when the total phytoplankton biomass (chlorophyll-a concentration) increased. Relationships between nutrients (concentration and ratios) and chlorophyll size fractions were also explored.

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MEDCHANGE: AN INTERDISCIPLINARY PROJECT TO PROMOTE MEDITERRANEAN MARINE BIODIVERSITY CONSERVATION FACE TO GLOBAL CHANGE

Mediterranean rocky benthic communities dominated by long-lived species are presently under the combined pressure of human-induced impacts such as pollution, fishing, diving activities, invasive species and climate change. This scenario poses serious questions about the consequences for the conservation of these communities. To better understand and anticipate the impact of large scale disturbances interdisciplinary research efforts are required. In this framework the Medchange project focused on the effects of climate change allowing (1) to acquire high resolution temperature data to characterize temperature regimes of the study areas and temperature anomalies, (2) to set-up a new system to map at high-resolution the selected communities, (3) to study diversity dynamics on the selected communities by through long-term data analysis, diversity surveys and phylogeographic analyses, (4) to study resilience of gorgonian populations by demographic surveys, modeling population dynamics and analyzing the population genetic structure as well as their diversity, (5) to study the sensibility and the adaptation capacity of gorgonian populations using experimental approaches. Different markers potentially related to stress are being used to determine the resistance status of populations to increasing disturbances.

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TEMPORAL PATTERNS OF PLANKTON DYNAMICS IN AN EUTROPHIC COASTAL LAGOON

Patterns and mechanisms of phytoplankton and mesozooplankton seasonal succession in the eutrophic freshwater Curonian lagoon are well documented. However, there is no holistic view on the interactions within the plankton communities as a whole including the microbial food web components. Moreover, in the hypereutrophic Curonian lagoon top-down interactions are not so clearly pronounced and the microbial food web components expected to be of key importance. The aim of this study was reveal the mechanism of plankton seasonal dynamic including bacteria and ciliates in the Curonian lagoon. The plankton communities' seasonal dynamic studied in two sampling sites representing the northern estuarine and the central freshwater parts of the lagoon. Ciliate, phytoplankton, metazooplankton and bacteria were sampled weekly from the end of March 2007 till the end of February 2008. The physico-chemical parameters: Secchi depth, pH, temperature, salinity and dissolved oxygen were also measured. The relationship between different plankton assemblages and environmental factors was estimated by multivariate statistical methods to delineate the relationship between the different taxonomic and functional assemblages as well as environmental factors. Additionally the matter flows through the plankton communities were evaluated using the modeling approach to asses the fate of the primary plankton production in the lagoon.

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ACTIVITY OF DIFFERENT BACTERIAL GROUPS IN DIFFERENT SEAS. CAN WE GENERALIZE ABOUT THE ROLE OF DIFFERENT BACTERIAL GROUPS IN THE OCEANIC C CYCLE?

Linkages between microbial diversity and ecosystem functioning are rarely analyzed in oceanic waters. One of the possibilities is through the use of MARFISH (microautoradiography combined to fluorescence in situ hybridization). The methodology has been used with several low-molecular weight substrates, in different oceans, and with probes for different prokaryotic groups. We will compare the data obtained by us in the Mediterranean Sea, the North Atlantic and the Arctic Ocean, and with the work of other authors in other oceanographic settings. We will discuss what type of questions can be answered with this approach and will particularly focus on whether bacteria can be subdivided into ecologically meaningful boxes for the purpose of modelling the flow of carbon through different bacterial subgroups.

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OCEAN ACIDIFICATION PERTURBATION EXPERIMENTS: APPROACHES AND TOOLS

Although future changes in the carbonate chemistry are well constrained, their impact on marine organisms and ecosystems remains poorly known. The biological response to ocean acidification is a recent field of research as the first purposeful experiments have only been carried out in the late 1990s. The potentially dire consequences of ocean acidification attract a lot of scientists and student with a limited knowledge of the carbonate chemistry and its experimental manipulation, which could generate confusion. Perturbation experiments are one of the key approaches used to investigate the biological response to elevated pCO2. They are based on measurements of physiological or metabolic processes in organisms and communities exposed to seawater with normal or altered carbonate chemistry. Seawater chemistry can be manipulated using different ways depending on the facilities available and on the question being addressed. The goal of this presentation is (1) to examine the benefits and drawbacks of various manipulation techniques used to date and (2) to describe a new version of the R software package seacarb which includes new functions aimed at assisting the design of perturbation experiments.

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FAUNISTIC ASSEMBLAGES WITHIN COLONISATION EXPERIMENT ON A HYDROTHERMAL VENT: SPATIAL AND TEMPORAL SCALES VARIABILITIES

This study focus on the community structure that had established within Titanium Ring of Alvinella Colonization (TRAC) devices deployed and recovered during two successive oceanographic cruises (LADDER 1 & 2) on the East Pacific Rise (EPR) in 2006 on a hydrothermal vent chimney on both temporal (4, 15 and 30 days) and spatial scales (gradient from the diffuse flow). Analyses of metazoan have shown that number and density of species were the highest for the intermediate zone of the chimney and for the experiments that lasted for 15 days. Percentage of trophic guilds varied following time and space. In order to decipher the trophic relationship, we used stable isotopes analysis on 8 target vent species. Interestingly δ13C data have shown that there was competition for carbon source on the higher zone of the chimney compared to a wide range of carbon source on the intermediate zone. Using δ15N values of the epiobionts of Alvinella pompejana as a trophic baseline, we have established the trophic position (TP) of each organism that was used for this stable isotopic analysis within TRACs.

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INFLUENCE OF NUTRIENTS, TEMPERATURE, LIGHT AND SALINITY ON THE OCCURRENCE OF THE DIATOM *PARALIA SULCATA* AT HELGOLAND ROADS, NORTH SEA

Paralia sulcata is a tychopelagic diatom species common in the benthos and pelagial of the North Sea and is assumed to play an important role as food source for pelagic grazers. We investigated the ecological behaviour of *P. sulcata* on the basis of the Helgoland Roads long-term data set, where phytoplankton and physicochemical parameters have been sampled from 1962 onwards. Multivariate statistical analysis was applied to detect species-environment relationships. For niche analysis, yearly outlying mean indices were calculated for *P. sulcata* and 17 other algae which occurred at Helgoland Roads. The most important factors influencing the algal community were temperature, light and nutrients. *P. sulcata* is found in fall and winter at Helgoland Roads. But a long-term trend showed that this diatom occurred in the summer period since the last ten years. Niche position and niche breadth of *P. sulcata* varied over the sampling period. From 1979 to 1992 the niche breadth was small indicating a more specialized niche of *P. sulcata* whereas from 1998 onwards the niche position changed and the niche breadth was broader indicating a more generalized niche.

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THE BIOLOGICAL PUMP IN THE GREENHOUSE: A STATUS REPORT OF OUR CURRENT UNDERSTANDING.

The gravitational settling of POC out of the sunlit surface ocean to the sediment water interface removes C from exchange with the atmosphere and contributes to sustaining benthic life. The deeper the POC penetrates into the ocean interior, the longer the time scales on which C is removed from exchange with the atmosphere. In order to feedback to the present atmospheric CO2 increase, the strength of the biological pump has to be changed from its pre-industrial level. The past decade brought increasing evidence for a potential reorganization of marine ecosystems in response to e.g. ocean acidification or global warming. Changes in ecosystem structure driven by e.g. external nutrient input, carbonate chemistry, stratification, has the potential to drive the biological pump away from its pre-industrial baseline. Despite recent advances in our understanding of processes controlling the efficiency of the biological pump, as well as of likely future changes, the magnitude and sign of associated feedbacks are still under debate. We will present a synthesis of modeling and experimental studies across all relevant processes and domains with the objective to provide a first order estimate of feedbacks between the biological pump and atmospheric CO2. We will highlight knowledge gaps and outline future research strategies to tackle the problem.

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NOVEL, NON-INTRUSIVE MEASUREMENTS OF PHYTOPLANKTON GRAZING: ARE TRADITIONAL TECHNIQUES BIASED?

Traditional methods for estimating phytoplankton grazing in the open ocean are based on in vitro measurements. For example, in the dilution experiment- perhaps the most widely used technique- sea water is transferred to the laboratory, potentially disturbing both grazers and prey. Here we report on a new technique- the Averaging Lagrangian Pump Array (ALPA)- a direct, non-intrusive method for measuring phytoplankton grazing in situ. Changes in phytoplankton concentration are measured in water parcels tracked with drifter drogues using an array of small pumps, which trickle water into inflatable infusion bags for 20 min, thereby averaging out the effects of small-scale patchiness. Concurrent extensive measurements of turbulence, currents and temperature provide detailed information on lateral advection and vertical mixing. The rate of phytoplankton grazing measured with ALPA in the oligotrophic water column of the Red Sea was on average two times higher than the rate measured concurrently with the dilution technique. These findings indicate that a revision in our understanding of carbon transfer via phytoplankton grazing in oligotrophic waters may be warranted.

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CHEMICAL COMMUNICATION IN PLANKTON REVISITED: NEW HIGH THROUGHPUT ANALYTICAL METHODS REVEAL COMPLEX RELEASE PATTERNS OF METABOLITES FROM PHYTOPLANKTON

Chemical communication and allelopathy are recognized as important factors mediating the interaction of plankton species. However, our knowledge about the release of potential infochemicals by intact phytoplankton cells is very limited and only few approaches focus on the determination of specific metabolites in the water. Using high throughput metabolomic methods we are able to survey the water-borne metabolites released by cells in algal cultures, mesocosms and in the phytoplankton. A surprisingly complex pattern of specific metabolites was detected in all investigated cultures. Metabolite release is fluctuating over time and some metabolites show similar kinetics as quorum sensing mediators from bacteria. Release patterns and first experiments towards the function of the exo-metabolome are presented.

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LIPOXYGENASE ACTIVITY IN DIATOMS

The discrepancy between diatoms as a good food source for copepods on one hand, yet often detrimental to copepod reproduction on the other, has been a main point of discussion for the past 15 years. Secondary metabolites originating from oxidation of fatty acids, are viewed by many as the main mediators of the "toxic" effect of diatoms. Since lipoxygenase is one of the main enzymes involved in this process, lipoxygenase activity studies can be a useful tool for measuring "toxic potential" of diatoms, considering that analysis of oxylipins is laborious. One method for measuring lipoxygenase activity is based on the colorimetric detection of lipid hydroperoxides produced from fatty acids. The other registers the concomitant consumption of oxygen polarographically. Both methods, based on data obtained mainly in laboratory experiments with different diatom species are presented and their applications and limitations discussed. Both methods are also compared to the "traditional" method of determining "toxic potential", namely mass spectrometric analysis of oxylipins as metabolic end products. Furthermore the applicability of these faster and easier methods to field studies are highlighted.

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COMPARISONS BETWEEN IN SITU BACKSCATTERING MEASUREMENTS AND INVERSION PRODUCTS USING AN OPTICAL TIME SERIES

The particulate backscattering coefficient (bbp) is a key factor in estimating Particulate Organic Carbon (POC) and Particle Size Distribution (PSD) from ocean color satellite measurements. A time series of Inherent and Apparent Optical Properties (IOPs and AOPs) is collected at a deep ocean mooring (BOUSSOLE project) in the north western Mediterranean Sea (60 km offshore Nice, France). All data are simultaneously recorded every 15 minutes at 4 and 9 m depth. This data base allows comparison of bbp measurement with inversion product, either derived from concomitant underwater AOPs measurement or from remotely sensed satellite ocean color. The aims of this presentation are: (1) to describe the variability in bbp at time-scales of days and seasons; (2) to examine the uncertainties of the inversion products.

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SEDIMENT METABOLISM IN THE FLUCTUATING TERRESTRIAL- AQUATIC INTERFACE OF A SAND- BED STREAM

Climate change models for Central Europe predict increased frequency of hydrological extreme events. Seasonal or supra-seasonal droughts will shift upstream reaches of lowland streams from perennial to temporary and flush flows will disturb these by re-deposition of the sandy sediments. The streams of the newly created experimental watershed Chicken Creek, Brandenburg, East Germany, exhibit frequent cycles of expansion and contraction and sediment re-deposition, and can be model of future situation. We investigated the sediment metabolic activity and regulation factors in Chicken Creek along a gradient terrestrial, semi-aquatic and aquatic. Among the aquatic sites we distinguished sediments percolated by upwelling groundwater, perched flow and downwelling stream water. Results show that despite high frequency of sediment disturbances, water availability and quantity and quality of organic matter control carbon transformation rates. Wetted channels and especially groundwater upwelling zones are focal sites of biological activity. Carbon turnover rates are significantly higher at aquatic than at semi-aquatic or terrestrial sites. Hence increasing fluctuations of flow permanence can lead to carbon accumulation in temporary stream reaches with implications on the energy flow of whole stream ecosystems.

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EFFECTS OF DISSOLVED NUTRIENTS ON PLANT LITTER DECOMPOSITION: AN APPRAISAL OF NEW AND PUBLISHED DATA

Effects of dissolved nutrients on autotrophic processes have long been a cornerstone of aquatic ecosystems ecology and management. Heterotrophic processes have received much less attention, although processes such as litter decomposition may be even more important for overall system functioning than primary production particularly in many benthic aquatic systems. Nutrient enrichment experiments in a range of experimental settings have clearly demonstrated the sensitivity of litter decomposition to both N and P supply, mediated by microbial decomposers and/or litter-consuming detritivores. Threshold concentrations of dissolved nutrients beyond which no further stimulation of decomposition is detected are low (e.g. 200 µg N/l) compared to concentrations measured in most regions of the world where cultural eutrophication has occurred. This together with the multitude of other factors influencing decomposition rate explains why clear responses to dissolved nutrient supply are not always seen in broad-scale surveys. Experiments in streams suggest that dissolved nutrient concentrations may not only control decomposition rates per se but that they are also instrumental in shifting the relative importance of litter nutrient concentrations vs carbon quality in determining litter decomposability. Most effects on decomposition in nutrient enrichment experiments have been positive. However, there is evidence also for negative effects of nitrogen supply, similar to findings in terrestrial environments, and this inhibitory effect could be exacerbated under global warming. The underlying mechanisms are poorly understood, however. Unraveling the intricacies of dissolved nutrient effects, both positive and negative, at a mechanistic level remains a major challenge towards fully understanding controls of decomposition rates in ecosystems.

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ENVIRONMENTAL FACTORS EXPLAINING THE VERTICAL DISTRIBUTION (0-1000 M) OF MARINE BACTERIAL COMMUNITIES IN THE NW MEDITERRANEAN SEA

The explanatory power of multivariate statistical analysis of bacterial community structures coupled with fine measurements of numerous environmental parameters was used to analyze a complex dataset from a one month sampling period from the surface to 1000 m depth at the JGOFS-DYFAMED station (NW Mediterranean Sea). Direct multivariate analysis (canonical correspondence analysis - CCA) revealed that resources ("bottom-up" control) as well as other factors such as pressure, temperature, O2 and photosynthetically active radiation controlled simultaneously the vertical zonation of bacterial communities in the water column. In parallel, analysis of lipid biomarkers of the organic matter sources and fates suggested that bacterial community structure at the surface layers was in part explained by lipids from chloroplast origin. Further detailed analysis of pigment-based phytoplankton diversity gave evidence of a compartmentalized influence of several phytoplankton groups on bacterial community structure in the first 150 m depth. This study gives a rare example of analysis employing a complex environmental dataset in combination with microbial community profiles to unravel the mechanisms underneath bacterial assemblages in marine systems.

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FULL DEPTH PROFILE (2-4000M) OF MICROBIAL PARAMETERS IN THE E. MEDITERRANEAN: A POSSIBLE TOOL TO DETECT CHANGES IN A VULNERABLE ECOSYSTEM

Abundance and biomass of viruses, heterotrophic bacteria, cyanobacteria, auto- and heterotrophic flagellates and ciliates were measured throughout the water column (2-4000m) in the Eastern Mediterranean Sea (Ionian, Libyan, Aegean Seas), during March-April 2008, in the framework of the Integrated Project SESAME. In general, most of the stations showed impressively low abundance of all populations, this fact verifying the extreme oligotrophic character of the E. Mediterranean. However, at the stations placed close to the outflow of the Black Sea waters in the Northeast Aegean Sea, the surface layer of 20m displayed high abundance of all microbial parameters. All populations decreased by one to three orders of magnitude from surface to 4000m. Heterotrophic bacteria decreased less with depth, whereas ciliates the most. The increase in water temperature of the Mediterranean Sea, recorded during the last years, is expected to influence the microbial community. The study of the microbial food web throughout the water column is of crucial importance since the carbon storage in deeper layers via sinking particles ("biological C-pump") is related mainly to the microbial community.

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DOLIOLID BLOOMS: WHAT ARE THE DRIVING VARIABLES? INVESTIGATIONS OF TROPHIC INTERACTIONS

Despite current knowledge on the abundance and potential ecological significance of Doliolidae, actual ecological data is rather limited and fundamental ecological questions exist. What do doliolids eat in situ, and at what rate? Does the phytoplankton composition control the formation and demise of doliolid blooms? Based on their anatomy, distribution, and some detailed laboratory studies conducted to accurately replicate field conditions, we present the hypothesis that small doliolid zooids experience difficulties ingesting large diatoms typical of advanced intrusions of nutrient-rich upwellings. Also, their intake of small cells could be sharply reduced because the abundant large diatoms, touching the sensitive lobes surrounding doliolid mouths, cause feeding current reversals and therefore limit food intake. Therefore, is the change in particle composition/size distribution of food particles over time detrimental to the growth of very small doliolid zooids, and thus is affecting the persistence of their populations? We will present background information, and rationale to contribute to the understanding that new approaches for molecular gut content will be important for advancing our understanding of the ecology of gelatinous zooplankton.

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HYDROGRAPHIC CONTROL OF SAR11 AND RCA DYNAMICS IN THE COASTAL NORTH SEA

Bacteria of the SAR11 clade and the Roseobacter Clade Affiliated (RCA) cluster belong to the most prominent bacterioplankton components in temperate to polar seas. However, still little is known about the biological and environmental controls of both bacterial groups. Therefore, we assessed their abundance by quantitative PCR in the North Sea at various seasons (May, June, September) and related their occurrence to biological (chlorophyll, bacterial activities) and hydrographic properties. RCA constituted 2-22% and SAR11 2-60% of total bacteria, respectively, and SAR11 dominated in most cases over RCA. In September, RCA dynamics were positively correlated to chlorophyll, whereas SAR11 did not exhibit any correlation to biological parameters. In the German Bight, visited in June, we found that highest abundances of RCA occurred at low salinities and of SAR11 at stations with very stable salinities during the preceding 23 days. The stations' hydrographic (current field, temperature, salinity) history during this period was back-traced by a 3-D medium-resolution hydrographic model. These findings suggest that SAR11 bacteria, but not RCA, prosper in neritic seas predominantly at conditions of sustained low mixing and turbulence.

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REGULATION OF DMSP FLUX THROUGH THE DEMETHYLATION AND CLEAVAGE PATHWAYS IN *SILICIBACTER POMEROYI*

Bacteria degrade DMSP via two major pathways: a cleavage pathway that results in the sulfur moiety being released into the environment as DMS, and a demethylation pathway that results in the sulfur moiety being incorporated into biomass or oxidized for energy. Bacteria are thus the major determinants of whether the reduced sulfur in DMSP is vented into the atmosphere or retained in the ocean food web. At present, the environmental and physiological factors influencing which pathway is operating are unknown. Marine bacterium *Silicibacter pomeroyi* has both pathways and thus is an excellent model organism to examine how bacteria may control the fate of DMSP in the ocean. Here, a transcriptional analysis of *S. pomeroyi* based on a 12,000 element whole-genome microarray was used to show that the regulation is complex. While both pathways were found to be constitutively expressed, cells exposed to DMSP did not upregulate either pathway, while cells exposed to a degradation product of the cleavage pathway increased expression of genes in the demethylation pathway, with a concomitant decrease in the amount of DMS released from the cells.

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MULTI PROXY RECORDS OF TROPHIC STATE AND HYPOLIMNETIC ANOXIA IN A LARGE HARD-WATER LAKE (LAKE BOURGET, FRENCH ALPS)

Lithological, geochemical, grain-size and bio-markers analyses have been used to reconstruct the trophic level and hypolimnion oxygenation in Lake Bourget during last century. Radionuclide dating confirmed the annual rhythm of laminations in the sediments. Biochemical varves are generally composed of three layers: a spring diatom lamina, a spring/summer bio-precipitated calcite-rich lamina and a winter lamina rich in organic matter and detrital particles. The eutrophication and the first anoxic facies appeared simultaneously in AD 1943 +/- 1 year. This eutrophication is characterised by drastic increases in biogenic silica (mostly diatoms), lacustrine organic matter and larger calcite crystals (15-30µm). It is mostly caused by the inflow of untreated sewage effluents, and – to a lesser extent – by non-point phosphorous source coming from the lake catchment area. The oxygenation conditions of the hypolimnion are mainly controlled by the eutrophication, but also by oxygen supplies via underflows during Rhone floods and colder winter temperature. The sediments do not show a decreasing of the trophic level and anoxia since the diversion of waste waters directly to the Rhone in 1980.

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SEASONAL CHANGES OF MICROBIAL COMMUNITIES IN THE WESTERN ENGLISH CHANNEL USING 16S-TAG PYROSEQUENCING

Characterising the marine microbial communities, which are responsible for the majority of the worlds biogeochemical cycling, has been identified as a fundamentally important activity. The use of high-throughput sequencing techniques provides unparalleled access to the diversity of microbes in these environments. Through the International Census of Marine Microbes we have provided a detailed analysis of the microbial diversity at one coastal marine observatory in the Western English Channel. Using the 16S-tag sequence database produced from this study with tRFLP diversity assessments and associated environmental metadata we have shown that bacterial diversity in the Western English Channel is significantly compartmentalised by changing abiotic and biotic factors. The most important factors were identified as temperature, phosphate concentration and the availability of total organic carbon. This study represents the first use of this technology for a long term time series of a coastal marine ecosystem and importantly identifies the capability of this technique to link microbial diversity with ecosystem function through high resolution interrogation of taxonomic variability.

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A MULTI-PERSPECTIVE ANALYSIS OF JELLYFISH BLOOMS IN THE CATALAN COAST: SOCIETAL ASPECTS

It has been observed that populations of jellyfish have increased considerably in the Northwestern Mediterranean as in another areas world-wide. In Spain, despite the relevance of this phenomena, there is none study covering the whole Mediterranean Spanish coast. Although, biggest research efforts have been concentrated in the Catalan coast, where the local administration, Agencia Catalana del Aigua, had supported scientific research during the last years to evaluate the presence of jellyfish blooms in the coastal area. Main efforts were concentrate on the participation of local administration and organizations to achieve data about jellyfish presence. For this purpose, informative material as identification guides, posters and data sheets were elaborated. Also, were necessary formative briefings. Beside to data obtaining, this project concentrate on how to mitigate the impact of jellyfish proliferation on human activities, first with information and second with specific actions. Other aspects as: jellyfish cultures, establishment of monitoring sampling stations and fresh material collection, are also included. This pioneering experience in the Spanish coast has proven to be an effective tool to evaluate jellyfish blooms in coastal areas.

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EVALUATION OF PROCESSES AND FUNCTIONS IN MEDITERRANEAN COASTAL ECOSYSTEM AT DIFFERENT SPATIAL AND TEMPORAL SCALE WITH THE LOICZ BIOGEOCHEMICAL MODEL

The biogeochemical budget approach of LOICZ was applied to 22 different marine coastal systems of the Italian Network for Coastal lagoons (www.lagunet.it). Additional budgets were calculated in the frame of the DITTY project (www.dittyproject.org) and in a pilot project of the coastal module of the Global Terrestrial Observing System (www.fao.org/gtos). Approximately 100 budgets were calculated for very heterogeneous systems which differ for morphology, trophic state, management and exploitation. Budgets and associated indicators, e.g. the Net Ecosystem Metabolism (NEM), were analyzed at sub-national, national and regional scale and, in some systems, considering seasonal and multiannual evolutions. Budgets and NEM were then compared with Vollenweider's trophic status classification schemes and with the Transitional Water Quality Index (TWQI). Finally the budgeting approach was used as an assessment tool of nutrient delivery to oceans from watersheds throughout the adjacent coastal system.

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MICROBIAL COMMUNITY STRUCTURE IN THE OCEAN SURFACE LAYER

The resolution of marine microbial community dynamics is limited by the scope of data sets, which are seldom up to the task of illuminating the highly structured and rhythmic patterns of change that occur in the ocean surface layer. We studied spatial and temporal patterns in microbial community composition in a set of 413 samples collected on Bermuda Atlantic Time-series (BATS) study cruises between 1991 and 2004, using rRNA gene profiling by terminal restriction fragment length polymorphism (tRFLP) and metagenomics. Spring phytoplankton blooms followed by summer lows in productivity are reliable features at the BATS site, where cool and stormy winter conditions cause convective overturn, annually mixing the surface layer to 200– 300 m. These "natural fertilization experiments" triggered a succession of phytoplankton blooms that shifted with the progression of stratification. One third to one half of all bacterial markers were seasonal, and over 40% of tRFLP markers were stratified with depth, suggesting that highly specialized adaptations and interactions govern the success of microbial populations in the oligotrophic ocean.

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INTRODUCTION TO LOICZ SOCIAL-ECOLOGICAL SYSTEMS (SES) ANALYSIS

While SES case studies were very much the main focus earlier, synthesis and analysis will be emphasized. Different ways of linking natural and social science knowledge and data will be explored, such as innovative approaches to SES analysis, participatory modeling and the construction of scenarios. It will be argued that the development of interdisciplinary methods for coastal and marine research may become a main focus in the further development of approaches to SES analysis. While a large number of methods and tools from the social as well as the natural sciences can be used in interdisciplinary coastal and marine research, methods to integrate and synthesize knowledge from different disciplines and from sources "beyond the disciplines" are still in their infancy. SES analysis may have the future potential to upgrade ICM and to incorporate it into an interdisciplinary social-ecological research framework.

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CHEMOAUTOTROPHIC *PROTEOBACTERIA* FEED A MICROBIAL FOOD WEB IN A PELAGIC REDOXCLINE OF THE CENTRAL BALTIC SEA AS DETERMINED BY ^{13}C ANALYSES

In general, chemolithoautotrophic activity in marine pelagic redoxclines contributes significantly to the pelagic carbon cycle, but little is known about the identity of responsible organisms yet. To close the gap between the identity of organisms and the apparent CO_2 fixation rates we applied a biphasic approach based on the analysis of natural carbon isotope signatures in fatty acid methyl esters, as well as on CO_2 incorporation experiments pulsed with ^{13}C-bicarbonate. Our results demonstrated that fatty acids indicative for *Proteobacteria* were significantly enriched in ^{13}C slightly below the chemocline. RNA-SIP revealed that two different *Gammaproteobacteria* and three closely related *Epsilonproteobacteria* of the *Sulfurimonas* cluster were actively dark CO_2 fixing microorganisms, with a time-dependent community shift between these groups. A labelling of *Archaea* was not detectable, but after 72 h of incubation the ^{13}C -label had been transferred to a potentially bacterivorous ciliate related to *Euplotes* sp. Thus, RNA-SIP provided direct evidence for the contribution of chemolithoautotrophic production to the microbial food web in this marine pelagic redoxcline, emphasizing the importance of dark CO_2 fixing *Proteobacteria* within this habitat.

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AUTOMATED VOLTAMMETRIC PROFILING ACROSS THE SEDIMENT-WATER INTERFACE AT THE KILO NALU COASTAL OBSERVATORY, OAHU, HAWAII

Major advances in ocean research sciences are increasingly tied to technological capabilities, and development of ocean observing networks offers a great opportunity for testing and improving cutting edge methodology. Electrochemical methods have often been used to study environmental processes, and in recent years there have been significant advances allowing for real time geochemical measurements using these and other techniques. One particularly promising application is that of in situ voltammetry, and it is a natural step to further develop voltammetry for extended unattended observing applications. In voltammetric work, current is measured while scanning the entire voltage range of the solid-state electrode, which allows the simultaneous measurement of more than one chemical species at a given time in the same region of space. Because transport and transformations of redox-active chemical species in sandy sediments is not well characterized, and because Oahu's south shore offers access to a wide annual range of predictable physical forcing inputs, the Kilo Nalu Coastal Observatory provides an excellent opportunity for studying oxygen and sulfide dynamics in porous sediments, as well as extended time-series testing of voltammetric sensors.

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IMPACT OF MODEL RESOLUTION ON THE SIMULATED SOURCE WATERS OF THE COASTAL UPWELLING OFF MAURITANIA

Productive coastal upwelling areas and subsurface oxygen minimum zones (OMZs) are often in close proximity to each other. In order to understand possible feedbacks between oxygen-sensitive processes in the OMZs and biogeochemical reactions in the waters upwelled above, it is essential to understand how water is transported between the two regions. Modeling studies for the coastal upwelling off Mauritania using an ocean circulation model with 1/12° horizontal resolution show that on decadal timescales only about 1% of upwelling waters originate in the OMZ. Most of this transport occurs via small-scale diapycnal mixing and not in form of main advective currents. However, preliminary studies suggest that supply routes into the coastal upwelling strongly depend on the model resolution. Models with lower horizontal resolutions (0.25°, 0.5° and below) which are typically used for climate forecast seem to have a much stronger link between the OMZ and the coastal upwelling than higher resolution models (up to 10% of upwelling waters originate in the OMZ on decadal timescales in 0.5° models). The different intensity of the transport between OMZs and upwelling regions in models of different resolution has implications for the understanding and forecasting of biogeochemical feedbacks in the climate system.

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SETTLING VELOCITIES OF AUTHIGENIC MINERALS AT PELAGIC REDOXCLINES OF ANOXIC BASINS: AN EXPERIMENTAL APPROACH

After iron, manganese is the most abundant transition metal in the earth's crust and it plays an important role as both an electron donor and acceptor in stratified marine environments. Redox transformations between dissolved Mn(II) and insoluble oxides and oxyhydroxides of Mn(III, IV) in the chemocline control the biogeochemical cycling of manganese and drive the "manganese pump" as an important shuttle for other elements as well. The efficiency of this process is governed by the vertical flux of precipitated manganese-rich particles and a good estimate of the settling processes involved is indispensable for budget assessments. To date, almost all studies use settling velocities calculated after Stokes law or estimated from budget calculations. By using the method of high-resolution Particle Image Analysis (PIV) with backlit-imaging arrangement (shadowgraphy), proper calibration and measurement control mechanisms, we were able to determine sinking velocities of genuine manganese-rich particles from the Central Baltic anoxic Basin under ambient environmental conditions. Data determined this way were used for the first time in manganese flux calculations. This study demonstrates the need to utilize observational data in models and calculations.

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CARBON AND NITROGEN CYCLING IN SURFACE SEDIMENETS: RECENT ADVANCES AND FUTURE CHALLENGES

The processing of organic material within the sea floor plays an essential role for element cycling of carbon and nitrogen on local, regional and global scales. This degradation of organic matter proceeds through a complex web of biologically mediated pathways. Even though new pathways occasionally do appear, we currently have a reasonable understanding of the processes involved and their internal regulation. However, most of this insight has been gained from studies under idealized laboratory conditions. There is a growing awareness that in situ conditions could be far more dynamic and heterogeneous than what we can mimick on our lab benches. Therefore, multi-faceted and integrative in situ studies (employing a range of complementary techniques) are needed to validate our conceptual understanding of organic matter diagenesis under natural settings, and its spatial and temporal variability. This clearly poses challenges to the applied technology, experimental designs, data handling, interpretation and extrapolation. Based on a number of recent case studies, I discuss the current state, short-comings and advances of methods that target organic matter processing in surface sediments.

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LONG-TERM CHANGES IN FRENCH COASTAL ECOSYSTEMS: DISENTANGLING THE IMPACT OF HUMAN AND CLIMATIC FORCING.

Coastal ecosystems, located at the interface between the continent, the ocean and the atmosphere, are important areas of exchange of materials and energy and play a crucial role in many biogeochemical cycles. Theirs locations make them highly vulnerable to anthropogenic and hydro-climatic forcing. The objectives of this work are to characterize long-term changes in large-scale hydro-climatic forcing (e.g. sea level pressure, temperature, precipitation) and to quantify their consequences on French coastal ecosystems using data from the monitoring program SOMLIT. It is shown that climate exerts a pronounced influence on French coastal ecosystems. However, its influence is modulated by local characteristics of sampling sites such as hydrodynamics, distance to the coast and the proximity of rivers. Long-term changes in regional climate are linked to large-scale climatological indices such as the North Hemisphere Temperature (NHT) anomalies and the Atlantic Multidecadal Oscillation. These results suggest that coastal ecosystems are being impacted by global climate change.

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INVESTIGATING THE EFFECTS OF SAND TYPES AND SPATIAL DISTRIBUTION ON MICROBIAL COMMUNITY STRUCTURE IN COASTAL SEDIMENTS

Sand grains are covered by bacterial biofilms and their exposure to hydrodynamic forcing offers rapid changes in biogeochemical conditions. Still little is known about how bacterial diversity in sediments can be influenced by grain size, hydrodynamics and permeability. Here, we describe the microbial diversity in three compartments, i.e. sand grain-associated biofilms, sediment porewater and water column, using a fingerprinting technique (ARISA) and explaining the resulting diversity patterns using a large set of environmental and spatial parameters. Multivariate analyses such as NMDS and ANOSIM were applied on this dataset obtained from coastal North Sea sediments. Microbial community present in biofilms seemed to be clearly different from the community in the porewater as described by these analyses. Moreover, similarity comparison between samples showed that changes in microbial community structure followed a trend according to grain type. By using all available contextual parameters (e.g. depth, spatial coordinates, nutrients, enzymatic activities, chlorophyll a), variation partitioning and constrained ordination analyses enable a more specific assessment of the level of environmental control present in the sandy ecosystem.

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CHARACTERIZATION OF THE TOXICITY OF COCHLODINIUM POLYKRIKOIDES ISOLATES FROM NORTHEAST US ESTUARIES TO PLANKTIVOROUS FISH AND LARVAL BIVALVES

Harmful algal blooms caused by Cochlodinium polykrikoides are annual occurrences in coastal ecosystems around the world although the precise mechanism of bloom toxicity is unknown. We report on the toxicity of Cochlodinium polykrikoides strains recently isolated from US east coast estuaries to planktivorous fish and larval bivalves and on potential mechanisms of toxicity. Cochlodinium cultures caused complete fish mortality within ~1 h at densities as low as 300 cells/mL. The toxic activity per Cochlodinium cell was dependent on the growth stages of cultures with early exponential growth cultures being more potent than cultures in late-exponential or stationary phases. The ichthyotoxicity was also dependent on cell density and fish size. Simultaneous exposure of fish to Cochlodinium and a second algal species increased survival time of fish, suggesting additional cellular biomass mitigated ichthyotoxicity. Cell-free culture medium connected to a culture through a 5um nylon membrane caused mortality in fish, although fish death time was significantly increased relative to direct contact. The enzymes peroxidase and catalase significantly reduced toxicity of Cochlodinium, but hydrogen peroxide did not mimic the ichthyotoxicity of cultures.

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PHOSPHATE UPTAKE BY SYMBIOTIC ZOOXANTHELLAE IS DEPENDENT UPON HOST CONTROL AND INTERNAL PHOSPHORUS POOLS IN THE TROPICAL CORAL *STYLOPHORA PISTILLATA*.

Despite the importance of phosphate for cnidarian biology, studies on its uptake by corals and their zooxanthellae are lacking. Uptake rates of this nutrient were assessed under laboratory conditions for the tropical coral *Stylophora pistillata* and its symbiotic algae using depletion experiments of phosphate from enriched seawater. Results showed that this uptake involves an active carrier-mediated mechanism displaying a relatively high affinity ($K_m = 1.08 \pm 0.42$ µM), is driven by zooxanthellae *in hospite* and is positively affected by light. Phosphate uptake by freshly isolated zooxanthellae occurs twice as rapidly as for algae *in hospite* ($K_m = 0.57 \pm 0.18$ µM) under oligotrophic conditions. We report evidence showing that phosphate uptake by corals is controlled both by the host and by the repletion status of phosphorus stocks within the symbionts.

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RELATIONSHIPS OF MACROZOOBENTHIC COENOSIS ON NEAR-BOTTOM ENVIRONMENTAL PARAMETERS IN THE SOUTHWESTERN BALTIC SEA AND THEIR PREDICTIVE MODELING

Spatial distribution of benthic macrofaunal coenosis was related to patterns in near-bottom environmental parameters, analyzing the observed data for the limited area in western Baltic Sea by means of various statistical methods (e.g. rank correlation, PCA, MDS, BIO-ENV). The core of data represents 208 stations, sampled simultaneously for benthic macrofauna and associated sediment and near-bottom hydrographical characteristics, in depth range 7.5 - 30 m, within a stripe of one degree of longitude width. In the southwestern Baltic Sea salinity and oxygen concentrations are especially significant among major factors of macrozoobenthos communities composition. The area was chosen for its relatively small salinity gradients: the main idea was to lessen the dominance of those factors in the analysis to illuminate the impact of others. Distinct benthic assemblages were defined, discriminated by particular dominating species (*Hydrobia ulvae – Scoloplos armiger*, *Lagis koreni – Mysella bidentata*; *Capitella capitata – Halicryptus spinulosus*), each related to different spatial subarea and characterized by certain variability of environmental parameters. Several benthic species indicated the most well-defined responses to depth and sediment parameters as total organic content, median grain size and sorting.

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DECIMETRIC SCALE SPATIAL VARIABILITY OF LIVE (STAINED) BENTHIC FORAMINIFERA FROM THE RHONE PRODELTA (NORTHWESTERN MEDITERRANEAN)

Live (rose-Bengal stained) benthic foraminifera (>150 µm fraction) were investigated at two stations (A and N) from the prodelta off the Rhône River (Gulf of Lion, NW Mediterranean). Station A is located in front of the river mouth at 19 m depth, and station N at 68 m depth. Both stations were sampled with a multicorer in September 2007 (RIOTECH cruise, CHACCRA program). At each site, four replicate cores were studied until 2 cm depth. An important dataset of environmental parameters (temperature, salinity, pore water and sediment oxygenation, organic mater quantity and quality) was constituted. Replicates from station A present quite similar densities but dominant species are different between cores. At station N the dominant species are identical in the four replicates but foraminiferal densities show important spatial variability. At station A, foraminiferal assemblages diversity may be due to environmental stress and contrasted conditions prevailing at shallow depths under the influence of Rhône river discharge. In station N, spatial heterogeneity of organic mater distribution at the sediment-water interface may induce the decimetric scale spatial variability of foraminiferal density.

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RELEASE OF D-AMINO ACIDS BY MARINE BACTERIOPLANKTON DURING CELL GROWTH

Recent developments in chromatographic techniques have allowed to know that D-amino acid concentration in marine systems is significant, though its source is largely restricted to bacteria. In this study we measured dissolved total amino acids (DTAA) in two coastal stations of the Bay of Biscay by HPLC. D-amino acids accounted for up to 39% of the DTAA and D-Alanine (D-Ala) and D-Aspartic acid (D-Asp) were the most abundant. We analysed the evolution of the concentration and prokaryotic uptake of D- and L-Ala and D- and L-Asp in seawater microcosms. During the growth of the prokaryotic community D-amino acids were released and their D/L uptake ratio was favoured. Owing to the fact that the prokaryotic community did not consume all released D-amino acids, there was an accumulation of D-Ala and D-Asp in the seawater. Experiments with axenic cultures of *Vibrio furnissii* and *Vibrio alginolyticus* growing with glucose as the only source of carbon and energy also showed an accumulation. These results indicate that the growing prokaryotic community can be an important source of D-amino acids in marine systems.

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TROPHIC ARCHITECTURE OF THE *ASCOPHYLLUM NODOSUM* ZONE THROUGH REGIONAL AND SEASONAL VARIATIONS: A $D^{13}C$ AND $D^{15}N$ STUDY

The $\delta^{13}C$ and $\delta^{15}N$ of the major sources and the dominant consumers of the *Ascophyllum nodosum* zone were measured at three seasons and at two sites distant from several 100s kilometres. Filter-feeders relied mostly on suspended particulate organic matter together with macroalgal and microphytobenthic organic matter. Grazers were essentially generalists and predators included much omnivory in their diet. Although being the main primary producers, *A. nodosum*, *Fucus vesiculosus* and *F. serratus* were not at the base of this web but used in a mixed diet combining most of the available organic sources. The great variability in $\delta^{15}N$ prevented from establishing clear distinctive trophic levels and revealed the complex architecture of the *A. nodosum* zone. At both sites, the study evidenced the presence of similar major sources and dominant consumers. It also revealed the stability though time and space of the relative position of the most relevant consumers within each trophic group. This suggested a structural stability of the trophic web of the *Ascophyllum nodosum* zone at a regional scale.

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SEASONAL DYNAMICS OF HETEROTROPHIC BACTERIOPLANKTON IN A SEMI-ARID ESTUARY (GUADIANA ESTUARY, SW IBERIA)

Heterotrophic bacterioplankton play a significant role on the carbon and energy fluxes along the trophic web of estuarine environments. The aim of this work is therefore to understand which factors have a greater impact on the distribution, growth and production of heterotrophic bacterioplankton in the Guadiana estuary. This estuary has been affected by increasing anthropogenic perturbations and by climate change in the last decades. Samples were taken fortnightly from four stations locate along the upper, mid, and lower reaches of the Guadiana estuary from March to December 2007. Several physical and chemical parameters were determined, including teperature, suspended particulate matter, nutrient availability and chlorophyll a concentration. Heterotrophic bacterioplankton abundance and biomass were determined through epifluorescence microscopy after acridine orange staining, and bacterial production was analysed using 14C-leucine incorporation. Microcosm experiments were also udertaken to estimate the effect of nutrient enrichment (C, N, and P) and predator's removal on bacterial growth rate. Seasonal monitoring showed that bacterial abundance and biomass reached maximum values during early spring and summer. Microcosm experiments demonstrated that dissolved organic carbon was a major limiting factor to bacterioplankton growth.

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DISTRIBUTION PATTERNS OF FLAVOBACTERIA POPULATIONS IN THE NORTH ATLANTIC OCEAN (NAO)

Flavobacteria (phylum *Bacteroidetes*) are one of the main components of bacterioplankton in coastal areas and open ocean. They are highly diverse and abundant, however, little information is available about the distribution patterns of uncultured lineages or of isolated genera. Our objective was to study the distribution of Flavobacteria populations in contrasting water masses along a transect from the East Greenland Current to North Atlanctic Gyre. We hypothesized that there is a change in Flavobacteria diversity and abundance of populations along the transect, possibly reflecting different life strategies. 16S rRNA gene clone libraries from different stations showed little overlap in diversity among them. Furthermore, 16S rRNA oligonucleotide probes targeting defined Flavobacteria clades were designed and optimized. *Polaribacter* related microorganisms were detected as one of the major populations showing a "cosmopolitan" distribution. However, many of the identified populations were present in very low abundances. Using a newly developed fluorescence in situ hybridization approach we were able to reliably quantify those rare populations in the per mill range. Moreover, we investigated which environmental factors better explain the observed distribution pattern of Flavobacteria populations.

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SPECIALIST BACTERIA CONSUMING THE DIVERSE DISSOLVED ORGANIC CARBON (DOC) POOL

Bacteria are the main consumers of marine dissolved organic carbon. Specific labile DOC compounds are known to account for large portions of the bacterioplankton carbon demand (e.g. glucose, amino acids, DMSP, acetate and pyruvate). However, little is known about the specialization of different bacterial groups in consuming these defined carbon sources in the sea. To investigate the relevance of these compounds for the structuring of bacterioplankton community composition we did seawater culture experiments in different seas (Mediterranean, North Sea and Baltic), where we determined bacterial growth response and phylogenetic diversity. Enrichment with amino acids or glucose resulted in high bacterial growth rates compared to cultures supplemented with acetate or pyruvate. Notably, DGGE analysis and 16S rDNA sequencing showed that different carbon sources stimulated different members of the bacterioplankton community. For example, in the North Sea, two phylotypes (Vibrio and Flavobacteria) became dominant in the glucose treatment while glycolate selectively stimulated growth of a Roseobacter. Our findings suggest that changes in the marine DOC pool could be a major driver determining temporal and spatial dynamics in the bacterioplankton species composition.

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DEGRADATION OF ORGANIC MATTER BY A SUB-ARCTIC DEEP-SEA COMMUNITY: A PULSE-CHASE EXPERIMENT WITH 13C-LABELLED ALGAE

Deep-sea benthic communities are dependant upon organic matter produced in the overlying waters. In northern latitudes, the pulse of diatoms that reaches the deep sea following the collapse of the spring bloom may represent the majority of their annual food supply. The feeding activities of sediment-dwelling organisms in the deep sea are thought to play a major role in dictating the ultimate fate of organic carbon (C), although logistical constraints make this difficult to study. Here we present an investigation into the fate of a phytoplankton pulse in deep-sea, sub-arctic sediments from the Faroe-Shetland Channel (FSC), NE Atlantic. To our knowledge, this study is the first to investigate biologically-mediated C-cycling at a temperature of ~0 oC. We introduced 13C-labelled diatoms into replicate sediment cores retrieved from 1000 m and incubated them alongside control cores without the addition of diatoms at ambient temperature for 6 days. The response of the benthic community to the diatom addition was analysed in terms of respiration (accumulation of 13CO2 in the overlying water), uptake of the 13C-label into benthic fauna and incorporation of 13C into bacterial tissue.

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CARBON FLUX THROUGH CHEMORGANOTHROPHIC PROKARYOTES IN A OLIGOTROPHIC COASTAL SYSTEM

The bacterial growth efficiency (BGE) by which chemoheterotrophic bacteria use the DOC pool is a key factor in understanding bacterial influence in cycling organic carbon and regeneration of organic nutrients in aquatic ecosystems. BGE can be a sensitive index of the response of aquatic bacteria to their environment. Ideally, estimates of BGE should be obtained from direct measurements of net C production and consumption. However, the lack of simultaneous bacterial net production and respiration measurements are scarce holding back our knowledge of the functioning of planktonic metabolism. In addition, the release of dissolved photoassimilated carbon can be an important autochthonous organic carbon source for heterotrophic bacteria. The response of bacterial community to phytoplankton production is not always synchronised. In the present work we aimed to study the amount of phytoplankton DOC production that can support the bacterial carbon demand. We also estimate empirically BGE by different methods (bacterial production in filtered versus unfiltered assemblages, initial bacterial production versus throughout the incubation time) to boost our understanding of the carbon flux through heterotrophic bacterioplankton in two coastal oligotrophic ecosystems.

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EFFECT OF ORGANIC EXUDATES IN THE FE(II) OXIDATION RATE

The oxidation of Fe(II) in aerated conditions has been studied in the presence of organic exudates from phytoplankton cultures (*Phaeodactylum tricornutum* and *Dunaliella tertiolecta*). The results have been compared with Fe(II) oxidation experiments without organic material. The differences between both studies allow us to determine the effect of exudates in the oxidation kinetic of Fe(II) and in the speciation. The experiments were made at different stage of growth, concentration of Fe(II), temperature, pH and ionic strength. The second and fourth days of culture were used to study the effect of the parameters. The labile and total iron(III) in seawater were measured. This work helps us to have a greater understanding of biogeochemical cycles of iron in the marine environment.

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VARIABILITY IN THE STRUCTURE AND DYNAMICS OF THE MICROBIAL PLANKTON COMMUNITY IN A COASTAL UPWELLING SYSTEM

The dynamics of the microbial plankton community in the coastal upwelling system of the Ría de Vigo (NW Iberia) was studied during four periods of the seasonal cycle (winter, spring phytoplankton bloom, summer stratification and autumn upwelling) using a mesocosm approach. The data obtained were interpreted using a simple NPZD model, which was also utilized to characterize the functional aspects of the microbial community. Although modeling has traditionally been used for predictive purposes, it was here used to interpret the bulk dynamics of the community. When simulating the four experiments, the strategy was to keep without modification as many model parameters as possible. Seeing which parameters had to be varied to accurately simulate the data gave important clues on significant aspects of the community structure and processes which differed between seasons and influenced the plankton dynamics in the bags. With this procedure, differences between plankton community structure and dynamics could be explained by just varying a few parameters (as phytoplankton maximum growth rate, bacterial growth efficiency, and grazing or sedimentation rates) of the forty parameters used in the model.

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GENOME ANALYSIS OF THE PROTEORHODOPSIN-CONTAINING MARINE BACTERIUM POLARIBACTER SP. MED152 (FLAVOBACTERIA): A TALE OF TWO ENVIRONMENTS

The phylum Bacteroidetes makes up a significant fraction of marine bacterioplankton, typically 10-20% of the prokaryotic community. Despite their abundance, little is known about the life strategies of these organisms, their ecotype differentiation and metabolism. We annotated and analyzed the genome sequence of Polaribacter sp. strain MED152, a representative of the Bacteroidetes, isolated from the Blanes Bay Microbial Observatory. MED152 contains a substantial number of genes for attachment to surfaces or particles, gliding motility, and polymer degradation. This agrees with the currently assumed life strategy of marine Bacteroidetes. It also contains the proteorhodopsin gene, together with a remarkable suite of genes to sense and respond to light, which may provide a survival advantage in the nutrient-poor, sun-lit ocean surface when in search of fresh particles to colonize. Furthermore, a proteorhodopsin-mediated increase in CO2 fixation in the light suggests that the limited central metabolism is complemented by anaplerotic inorganic carbon fixation. The Polaribacter genome thus provides new insights into the physiological capabilities of marine bacterioplankton, in general, and proteorhodopsin-containing bacteria, in particular.

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PH, ALKALINITY AND INORGANIC CARBON DISTRIBUTION DURING THE BONUS GOOD-HOPE CRUISE, 2008

In the framework of the IPY and during the BONUS GOOD HOPE cruise three parameters, related with the carbon dioxide system, total alkalinity, total inorganic carbon and pH, were measured in the water column. The area studied along this cruise between 33.58°S 17.14°E and 57.33°S 00.02°W, presents important frontal zones, eddies and meanders which affect to the carbonate distribution correlated with the water mass properties, in particular with the salinity values. Results for pH in total scale at 25°C, total alkalinity and total inorganic carbon are presented. The stations have been selected just before and after frontal zone STF, SAF, PF, SACCF and SBdy. Changes in the vertical profiles are related to changes in seawater properties of the different water masses and frontal zones. The effect of an anticyclone in station 36 affects to the surface pH and total inorganic carbon distribution in the first 600 meters acting as important carbon pump.

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CLIMATE CHANGE IMPACT ON LIMNOLOGICAL CONDITIONS IN THE KINNERET ECOSYSTEM

Long-term (1970 – 2005) data set analysis (LOWESS 0.8; Stata 9.1) of climatological and limnological conditions in Lake Kinneret and its drainage basin indicated the following trends: Annual precipitations became smaller by 100 mm, River Jordan flows declined; Air and epilimnetic temperatures were lowered until 1985 and increased later (1.8 0C); Water level lowering (annual means from 209.70 to 212.3 mbsl); Mean depth of the thermocline became shallower (20.3 - 18.6 m); Concentrations of TN and Organic – N in Jordan waters decreased (0.9 and 0.6 ppm respectively) and SRP increased by 0.019 ppm; Epilimnetic concentration of TP increased (0.01 ppm) and TN declined (0.3ppm) whilst Chloride decreased until 1992 and increased later; Epilimnetic TN/TP mass ratio was lowered (from 70 to 25); Secchi depth became shallower (0.6m); Nitrogen deficiency resulted in decline of Peridinium spp biomass. Diatoms, chlorophytes and cyanophytes biomass increased, probably due to P sufficiency. PP and chlorophyll concentration were lowered; Aridity of the peat soils in Hula Valley probably enhanced P flux downstream. Epilimnetic N deficiency and P sufficiency enhanced blooms of N2 fixing cyanobacteria .

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MEDITERRANEAN – A TIME FOR CHANGE

The semi-enclosed nature of the Mediterranean and the Black Sea together with their smaller inertia compared to the open ocean and the increasing trend of human activities in their coastal regions make these basins very sensitive to climate variability and human influence. Understanding of ecosystem level requires an integrative effort of existing and new information from different fields in dynamics at both the quantitative (biogeochemical cycling) and qualitative (ecological structure) response to natural changes (e.g. climate variability) and anthropogenic forcing. The assessment of ecosystem changes requires the identification of the major changes or regime shifts and variability in ecosystems that occurred in the past. They affect significant goods and services – tourism, fisheries, ecosystem stability through conservation of biodiversity, and mitigation of climate change through carbon sequestration in deep waters and sediments - with potentially high societal importance. Several national or European projects were dedicated to the assessment of Climate change effects on the Mediterranean basin. Here we will synthesize the available information on pelagic and coastal ecosystem evolution in relation to the Mediterranean hydroclimate variability

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PARTICLE FLUX : CONTROL AND PROCESSES AFFECTING POM DEGRADATION

The efficiency of the biological pump is important in determining the supply of energy to subsurface and deep heterotrophic ecosystems. Results of sediment trap experiments provide empirical relationships for the description of POM fluxes as a function of the depth. However, a quantitative understanding of processes affecting POM degradation at depth is still lacking and represents an actual challenge for modelling carbon cycle in the ocean. With this aim, drifting traps set up at high frequency sampling were deployed at 200 meters depth, during periods of a few days to several weeks (1995 to 2004), and at different seasons at the time series DYFAMED station, NW Mediterranean. Using lipid class biomarkers, the qualitative and quantitative changes of particles exported from surface to the meso pelagic layers were studied and their degradation rates investigated through in vitro degradation experiments. Results highlight relationships between physical, biological and biogeochemical factors in controlling the depth of particle dissolution and thus carbon sequestration in the ocean. We will present and discuss feedbacks between biology and biogeochemistry, and the underlaying mechanisms such as ballast-carbon interactions and prokaryotic community structure. Acknowledgements to projects : PECHE (Production and Export of Carbon: Control by HEterotrophs) funded by JGOFS-France INSU-CNRS LEFE program, MEDFLUX NSF, EC CARBALIS and ANR POTES (Pressure effects On procaryoTES).

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CONSUMPTION OF DIFFERENT CHEMOLITHOAUTOTROPHIC BACTERIA BY CO-OCCURRING HYDROTHERMAL VENT GASTROPODS

The most abundant and diverse group of primary consumers at hydrothermal vents on the East Pacific Rise (EPR) belong to the Gastropoda, particularly the patellomorph limpets. Gastropod densities can be as high as 2000 individuals m^{-2}, and there can be as many as 13 species of gastropods in a single aggregation of the siboglinid tubeworm *Riftia pachyptila*. To determine the mechanisms of species coexistence among primary consumers and to track the flow of energy in hydrothermal vent communities, we employed molecular genetic techniques to identify the gut contents of four species of co-occurring gastropods, collected from a single diffuse-flow hydrothermal vent site on the EPR. Unique haplotypes of the 16S gene that fell among the epsilon-proteobacteria were found in the guts of every species, and two species had gut contents that were similar only to epsilon-proteobacteria. Two species had gut contents that also included haplotypes that clustered with delta-proteobacteria, and one species had gut contents that clustered with alpha-proteobacteria. Differences in the diets of these four hydrothermal vent gastropods may reflect microhabitat conditions where these species typically occur or where they were located at the time of the collection. Results from this work provide insights to the "bottom-up" regulation of primary consumers and tracking chemical fluxes through biological communities at hydrothermal vents.

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THE STABILITY OF FINE SEDIMENT DEPOSITS IN LOWLAND PERMEABLE (CHALK) STREAMS

Lowland streams in the UK are experiencing an increase in fine sediment deposition caused by changes in land use practices and reduced water flows. Fine sediment deposits are linked to aquatic habitat degradation, the obstruction of surface-groundwater flow, and the storage of contaminants, such as pesticides and heavy metals. Despite extensive research into sediment dynamics, little is known about the stability of fine sediment deposits in fluvial systems. I am investigating: 1) the spatial and temporal variability of sediment stability in chalk streams, and 2) the major physical, chemical and biological components of the sediment responsible for stability and cohesion. Field surveys are currently being conducted in the Frome-Piddle Catchment (Dorset, England) over a 2 year period, using paired sediment cores and in situ cohesive strength measurements in areas of fine sediment accumulation. The role of sediment characteristics, such as clay content, organic content and the abundance of extracellular polymeric substances (EPS), is being addressed through multivariate analysis of survey data, and further examined in laboratory flume experiments. Preliminary data from the field survey will be presented.

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INTEGRATING CONSUMER BIOMASS INTO STABLE ISOTOPE ANALYSIS OF FRESHWATER FOOD WEBS

Natural concentrations of stable isotopes are increasingly used to detect whether aquatic or terrestrial resources are the carbon source for freshwater benthic communities. In most studies, presence-absence abundance data of macroinvertebrate consumers is the basis for estimating the contribution of food resources to their diet. However, this qualitative approach assumes that consumers occur in the same density and biomass and have the same significance for the transfer of matter within benthic food webs. We compared this to a quantitative analysis using biomass and stable isotope data from consumers and food resources from two sites of a lowland river section. The comparison of the two approaches revealed that the quantitative approach resulted in a higher contribution of suspended organic matter and a lower contribution of periphyton, macrophytes and benthic organic matter. Hence, the contribution of organic carbon derived from aquatic sources increased substantially compared to the qualitative analysis. We conclude that the use of consumer biomass into stable isotope food webs may provide a more realistic picture of the transfer of matter through benthic food webs.

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QUANTIFICATION OF BACTERIA ATTACHED TO PHYTOPLANKTON IN MONTEREY BAY, CALIFORNIA USA

Direct interactions between phytoplankton and bacteria have been hypothesized to impact bloom dynamics, community succession, and primary productivity. Although such impacts are critically dependent upon bacteria attaching to phytoplankton, few studies have quantified this relationship in natural marine waters and even less is known regarding factors regulating attachment. We took advantage of a major study of thin layer dynamics in Monterey Bay, California to collect and analyze 18,000 phytoplankton cells for the presence or absence of attached bacteria. We focused our statistical analysis on abundant diatoms and dinoflagellates often associated with thin layers and surface slicks. The majority of phytoplankton cells did not harbor bacteria. A single attached bacterium was the most common occurrence when colonization had occurred. Visually healthy phytoplankton were rarely colonized, but those collected outside of dense thin layers and surface slicks had higher incidences of colonization and often harbored multiple bacteria. Longer diatom chains had a higher probability of colonization, and bacteria selectively attached to specific regions. These results strongly suggest that phytoplankton abundance, health, and morphology regulate colonization by bacteria in the natural marine environment.

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CONTRIBUTION OF JELLYFISH PREDATION TO ICHTHYOPLANKTON MORTALITY: IS THERE ENOUGH TO MATTER TO THE STOCK?

Jellyfish are often cited as voracious predators of fish eggs and larvae, yet there is limited understanding of what this ultimately means to fish stock recruitment. Many fisheries oceanographers would argue that there is strong compensatory fecundity, especially nearshore where jellyfish predation is likely greatest. In the coastal northern Gulf of Mexico, a number of commercially, recreationally or ecologically important fishes (e.g.., Lutjanidae, Carangidae and Sciaenidae) have seasonal spawns that overlap in time and space with jellyfish blooms during spring, summer or fall. We utilize a 2+ year data set of ichthyoplankton distribution and abundance in the northern Gulf of Mexico and apply historical information of jellyfish (medusae and ctenophores) distribution to derive potential ichthyoplankton mortality rates due to jellyfish predation. We then apply these mortality rates to a forward-projecting 'equivalent adult model' (EAM) to estimate the impact of jellyfish predation relative to estimated overall mortality used in stock assessment models. From these estimates, we hope the relative contribution of jellyfish predation to overall natural mortality can be incorporated by fisheries management as a useful metric in stock predictions.

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BASIN-SCALE VARIABIALITY OF VERTICAL FLUX OF NITRATE DERIVED FROM MEASUREMENTS OF TURBULENCE KINETIC ENERGY IN THE ATLANTIC OCEAN

The vertical flux of nitrate through eddy diffusion has generally been considered the main source of new nitrogen in open-ocean regions. Due to methodological limitations and theoretical assumptions, the rate of turbulent mixing has been extremely difficult to measure in the past. Only recently, it has been possible through direct measurements of turbulence kinetic energy and tracer release experiments. A recent compilation of direct observations and empirical estimates of vertical diffusion coefficients range between 10^{-4} and 10^{-4} m^{-2} s^{-1}. Doubts about the representativeness of these values, and of the underlying theoretical assumptions, prompted efforts to obtain more direct measurements of the mixing, specially along large spatial scales. Direct observations of eddy kinetic dissipation rates by using a microstructure turbulence profiler were carried from 28ºS to 29ºN in the Atlantic Ocean during the TRYNITROP2 cruise in spring 2008. Turbulence mixing data were combined with nitrate profiles in order to compute the supply of nutrients into the euphotic layer through vertical diffusion. These fluxes provide the context to evaluate the relevance of N_2 fixation processes also investigated during this cruise.

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HYDROPHYSICAL AND HYDROBIOLOGICAL CHANGES IN WATERS OF NORTH-WESTERN SHELF OF THE BLACK SEA

We have considered existential changes of hydrophysical and hydrobiological characteristics in the North-West Black Sea shelf using materials of research work over the last 50 years. We have estimated tendencies of average seasonal temperature and salinity course and variability of hydrophysical and hydrobiological characteristics for the last 20 years. The analysis of temperature and salinity changes has shown that the most significant tendencies usually took place during the winter periods. Substantial temperature growth has been noticed in surface level of 0-10 m. Presented data show

that average water temperature has raised during the winter period on 2˚C in surface level and more than on 3 ˚C in benthonic level. The comparative analysis of qualitative and quantitative structure of microalgae and zooplankton for two periods has been carried out: for the periods of 1993 – 1999 and 2003 – 2007. Specific variety of phytoplankton depend on seasonal and long-term changes. The long-term tendency expressed in increasing number of species which is based on increasing number of rare species, including fresh-water ones. Considerable reduction of zooplankton amount is noted.

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THE BROWNIFICATION OF LAKES – CAUSED BY CLIMATE CHANGE, DECREASED SULFUR DEPOSITION OR CHANGED LAND USE?

Stream and lake water often contain high concentrations of brown-coloring DOC. Most of this is allochthonous, originating in forest and wetland ecosystems. DOC concentrations in surface waters are not stable, but show pronounced fluctuations and trends on multiyear time scales. In several regions of N Europe DOC concentrations in lakes have increased appreciably during the last decades, causing a reduction in biodiversity and recreation value, and increased costs for production of drinking water. If brownification is a long-term trend, or decadal cyclical fluctuations, and what is the driving force, are controversial issues. There are three, not mutually exclusive, candidates: more precipitation (in combination with higher temperatures), lower sulfur deposition (reversed acidification) and changes in land use (less agriculture land and more coniferous forests). Monitoring data are partly consistent with the sulfur hypothesis, although year to year variations in precipitation also affect DOC. Paleolimnological reconstructions of DOC on the other hand indicate influence of drivers acting on longer time scales, possibly connected to changes in land-use or climate.

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NITRATE N AND O ISOTOPE DISTRIBUTIONS ON THE EASTERN BERING SEA SHELF DURING THE 2007 SPRING BLOOM

We present measurements of the stable N and O isotope ratios of nitrate in water samples collected aboard the USCG icebreaker Healy on the eastern continental shelf of the Bering Sea in spring 2007. This work is part of the BEST program (Bering Ecosystem STudy), which aims to characterize patterns in inter-annual spring production in light of climate-induced changes in mean sea ice cover. We describe the distribution of nitrate isotopes on the shelf, and estimate the contribution of wintertime nutrient replenishment under ice. The nitrate N and O isotopes define sources of nitrate to the shelf: the shoaling of nutrient-rich deep basin water, over-wintered regenerated nitrate, or coastal end-members. The explosive phytoplankton blooms that developed in marginal ice zones in late spring were characterized by distinctive N and O isotopic enrichments. Our measurements of ammonium and DON, and of the N-isotopic ratios of DON, suggest an efficient transfer of nitrate directly to particulate organic matter, as well as almost complete particle export out of the surface mixed layer to the shelf sediments. We also consider the impacts of receding ice on patterns in N distribution and consumption on the shelf.

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A ROLE FOR MEMORY IN CHEMICAL TRACKING IN TURBULENT FLOWS

Models of organisms tracking chemicals to their source in turbulent-flow environments often employ instantaneous-reactive (memory-less) steering strategies. We explored a new strategy for animals or robots operating in turbulent regimes between $1<Re<1000$. This strategy combines in a single adaptive mechanism the well-studied strategies of levy walks and correlated random walks with memories for chemical concentration and intermittency sensed during the tracking attempt. This strategy is guided by local, instantaneous chemical concentration and flow measurements. We developed a computer simulation environment in which we could "play-back" local concentration and flow measurements (2-dimensional LIF/PIV plume laboratory datasets) from real turbulent flows to a simulated agent implementing this strategy. We ran over seven thousand simulated plume-tracking attempts to search the parameter space of the strategy. This allowed us to identify the optimum form of the adaptive strategy in terms of accuracy, path directness and overall efficiency of chemical source localization. The results indicate that memory leads to improved performance in stochastic search under turbulent flow conditions. We speculate that optimum performance depends on the parameters of the turbulent regime.

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ARE JUVENILE FISH COMMUNITIES IN EUROPEAN SALT MARSHES STRUCTURED THROUGH HABITAT FRAGMENTATION AND CONNECTIVITY?

To what extent is the fish fauna of a European salt marsh dependant on the area and quality of the surrounding habitat? If habitat connectivity is important, then conservation of a single large may not be as effective as conserving smaller, interconnected salt marshes. To answer this question, samples of the creek fish fauna were taken from nine euhaline marshes along the Essex-Suffolk coastline, United Kingdom, each with differing bio-physical characteristics. Sampling was intensively performed over a short time period (April-May 2008) to reduce the impact of seasonality on the data. Thirty biological, physical and spatial parameters were derived or measured for each sample to compare inter-marsh community structure. Significant differences in fish community structure and biomass were observed between marshes, and spatial factors, particularly the length of the seaward edge of the marsh, the number of marshes and the area of intertidal mudflat 200m from the sampled marsh, were shown to strongly influence the fish community structure inhabiting the marshes. This study stresses the importance of integrating spatial factors when considering fish nursery sites and salt marsh conservation.

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SYNOPTIC DEPLOYMENTS OF THE SECOND-GENERATION ENVIRONMENTAL SAMPLE PROCESSOR (2G ESP) FOR REMOTE DETECTION OF HARMFUL ALGAE: 2007

Detection of harmful algal bloom (HAB) species and their toxins in near-real time has been identified as a critical need in the U.S. In response, several in situ technologies have emerged to provide public health alerts. The Environmental Sample Processor (ESP; http://www.mbari.org/ESP) is one example The ESP employs molecular probe techniques for detecting various plankton taxa, including HABs, and the phycotoxin domoic acid. As a first step towards integrating the ESP in larger scale observatory frameworks, we deployed 2 instruments at different locations in Monterey Bay CA, USA, during 2007. Concurrent autonomous underwater vehicle (AUV) surveys and satellite (MODIS) observations provided additional context. ESPs were deployed such that sampling inlets were near surface, sampled synoptically, and performed assays for various HABs. Water samples were collected manually from a small boat to ground truth ESP results. HABs were detected in situ at concentrations below those that would trigger public health warnings or concern for wildlife, indicating that the ESP shows promise as a tool for resource management. Challenges remain to better utilize the ESP in ocean observing networks.

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CORAL SKELETAL GROWTH ANOMALIES IN WAIʻŌPAE TIDE POOLS, HAWAIʻI ISLAND.

In Hawaiʻi, reports of coral diseases have increased over the recent years. The Waiʻōpae Marine Life Conservation District (MLCD) on Hawaiʻi Island is composed of tide pools with relatively high coral cover. These tidepools experience fluctuations in salinity and temperature, and are exposed to terrigenous runoff through the porous substrate. Our monitoring of corals 2006-2008 shows that susceptibility to unhealthy conditions is species dependant ($p<0.01$) with *Porites compressa* being the most (22.5±3.9% unhealthy) and *Pavona varians* the least (1.1±0.27% unhealthy) susceptible. The proportion of unhealthy corals was: higher inside the MLCD than outside for *Montipora* and *Pocillopora* ($p<0.01$); not different between two areas for *Porites*; and higher outside MLCD than inside for *Pavona* ($p>0.05$). Skeletal growth anomaly (SGA) was disproportionally observed ($p<0.05$) in *Montipora* spp., especially *M. capitata*, 13.6 (±0.37) % of which were afflicted by this condition. There is no clear correlation between the progression of SGA (change in size or frequency) and species, location, or season. Some coral colonies are showing a level of resilience against SGA while others have succumbed to it within the Waiʻōpae population.

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EXPERIMENTAL EVIDENCE FOR PULSED MINERALISATION IN THE WATER COLUMN

A new mechanism, "pulsed mineralization" (Denis et al., 2003), was proposed to account for secondary peaks of respiratory activity (Packard, 1971) in mesopelagic waters. During the Dynaproc 2 cruise in north western Mediterranean (Sept.-Oct. 2004) this hypothesis was tested by combining respiratory activity determinations and flow cytometry analyses on seawater samples collected every 3 h over periods of 36 h along the water column. Results confirmed the existence of pulsed mineralisation achieved by live bacteria. However, the lack of periodicity discard diel vertical migration as the main factor inducing this pulsed mineralisation. By analogy with the critic micellar concentration (CMC) of lipids in solution and consistently with literature, we suggest that transparent exopolymer particles (TEP) make sinking aggregates when their concentration goes over a given threshold and, by the way, draw down bacteria that colonise them. This mechanism would automatically flush down organic matter, preventing its accumulation in surface waters, transfer new organic matter along the water column, seed deeper waters with live bacteria from surface, and contribute to the CO2 sequestration in the deep ocean.

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A FRAMEWORK FOR WATERSHED-BASED CUMULATIVE EFFECTS ASSESSMENT

Many undesirable ecological conditions in aquatic ecosystems have their roots in human activities on watershed lands. When those activities are numerous, intense and diverse, cumulative effects on the aquatic ecosystems occur. Cumulative effects assessment, particularly as practised in the context of project-specific environmental assessments required by governments, has so far proved to be largely ineffective in identifying key impact pathways so that developments can be designed to reduce or eliminate undesirable cumulative effects. We argue for a regional watershed-based approach to cumulative effects assessment. Our framework outlines how regional scientific studies focussed on watershed sustainability provide the requisite basis for confident assessment of project-specific cumulative effects. We highlight appropriate roles for retrospective science, which seeks to illuminate basic cause-effect relationships between developments and watershed conditions, and prospective science, which focuses on predictive modelling of likely effects of specific proposed developments on future watershed conditions. With implementation of a targeted monitoring program, all the ingredients are in place for an adaptive-management system that should strengthen the pursuit of watershed sustainability. The framework is currently being tested in specific watersheds in Canada from coast to coast. (Submission as Tutorial)

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METHANE-SUBSIDISED SECONDARY PRODUCTION IN A FAST FLOWING LOWLAND RIVER

We measured the $\delta^{13}C$ values of dominant primary consumers and their potential food sources in a fast flowing lowland river. Whereas the $\delta^{13}C$ for consumers such as *Gammarus* and *Simulium* reflected that of the dominant forms of primary production, the cased larvae of three genera of caddisflies (*Agapetus, Silo, Drusus*) were isotopically light (min. $\delta^{13}C$ -44‰ vs. PDB) throughout the year. Interestingly, the river water was consistently supersaturated (~50 times atmospheric) with methane, reflecting both supersaturation in the groundwater and local production in fine sediments. Pore water in the fine gravels had consistently lower concentrations of methane than in the water column and we measured significant methane oxidation in the biofilms associated with these gravels, on the caddisfly cases themselves, and on the bottom of larger rocks. These caddisflies are thought to acquire most of their carbon from grazing of periphyton on the tops of such rocks. However, their light $\delta^{13}C$ values indicate that ~20% of their biomass may comprise methane-derived carbon and probably comes from the grazing of methane oxidising bacteria on their cases.

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THE LARGE SCALE SPATIAL DISTRIBUTION OF THE PLANKTON COMMUNITIES IN A TRANSITIONAL COASTAL LAGOON

Lagoons and estuaries are extremely dynamic environments, characterised by both highly variable physical processes and hydrochemical conditions. The interplay of strong gradients in river flow, mixing, nutrient inputs, salinity and temperature produces spatially and temporally heterogeneous conditions for plankton communities. The aim of this study was to describe the patterns of plankton spatial heterogeneity and evaluate impact of environmental factors on plankton communities spatial variability along river-lagoon gradient in the Curonian lagoon. The samples of plankton including ciliates, phytoplankton, metazooplankton and bacteria were collected at 19 stations during cruise on July 29-30, 2007. The physico-chemical parameters: Secchi depth, pH, temperature, salinity, current velocity and dissolved oxygen were also measured in each station. The dominance of small bacterivorous ciliate species: Strombidium sp., Srobilidium velox in Nemunas River mouth was shifted towards the large herbivorous tintinid species Codonella cratera, Tintinnidium pusillum and Tintinnopsis tubulosa in the lagoon. The metazooplankton community structure was quite uniform along the river-lagoon gradient, dominated by cyclopoid species, slightly lower densities of cladocerans was found in the river mouth than in lagoon stations. The multivariate redundancy analysis (RDA) was applied to evaluate the relationship between environmental factors and plankton communities' structure.

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OXYGEN AND CARBON DYNAMICS IN A CARBONATE SUBALPINE DEEP LAKE AT DIFFERENT TIME SCALES: FROM DAY TO YEAR.

Vertical profiles of CTD, O2, pH and chl-a were conducted at fortnight interval over a year and every 2 h during one day to study physical and biogeochemical processes in a large subalpine lake. Contrasted vertical distribution and dynamics were evidenced during the stratified period, showing conductivity depletion in the epilimnion, the development of a deep chlorophyll maximum at the bottom of the metalimnion and oxygen accumulation in the upper metalimnion. Authigenic calcite precipitation was quantified using the C25 method. It was likely triggered by epilimnetic spring bloom. Phytoplankton composition and biomass dynamics were quantified using multiwavelength fluoroprobe and showed an unprecedented cyanobacterial bloom during summer 2008. Comparison with oxygen profiles showed that the maximum were vertically shifted during spring and summer with oxygen accumulating beneath the epilimnion thermal cap. Diurnal cycle showed a rapid metric vertical translation in chlorophyll, conductivity and oxygen profiles, due to internal wave dynamics. Profiles deformation affects drastically the biomass integration, and the calcite flux calculations at this time scale.

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INTER- AND INTRAANNUAL VARIATION IN POLYPHENOLIC ALLELOCHEMICALS IN THE SUBMERGED MACROPHYTE *MYRIOPHYLLUM SPICATUM* L.

Chemically defended plants should allocate sufficient resources into the production of allelochemicals. In some plants, the same compounds may have different functions as allelochemicals against e.g., primary producers or herbivores. Additionally, resource availability may affect the production of especially high quantities of phenolic secondary metabolites. For our model system *Myriophyllum spicatum*, we have a long-term data set on plant phenolics and stoichiometry in plants collected at Lower Lake Constance. This prealpine lake has undergone strong re-oligotrophication during the past 20 years, and is also affected by climate-driven water level fluctuations. I will compare the field data on *M. spicatum* with laboratory experiments, where we tested the impact of defined environmental factors on the production of polyphenolic allelochemicals and plant stoichiometry. The major factors explaining the variability found *in situ* will be discussed.

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MICROBIAL COLONIZATION AND DEGRADATION OF ZOOPLANKTON CARCASSES

Within freshwater systems zooplankton play an essential role in the food web as consumers of primary production, a food source for planktivorous fish, and as a potential substrate for bacteria. It is therefore critical to quantify their carcasses within a system in order to assess the relative importance of copepods and cladocerans in each of these roles. On average 6% and 8% of the zooplankton were identified dead in Lake Stechlin and Lake Dagow, Germany. These carcasses represent concentrated reservoirs of organic substrates for water column bacteria. Fresh carcasses of Daphnia cucullata, Diaphanosoma brachyurum, and Eudiaptomus gracilis were rapidly colonized and decomposed by bacteria within 24 h. In all treatments, cell-specific protease activity, lipase activity and production rate of heterotrophic bacteria inside the carcasses were higher than for those in the ambient water. Daphnid carcasses were colonized by bacteria faster than copepod carcasses, suggesting that daphnid carcasses are more prone to exploitation by bacteria, yet copepod carcasses lost carbon at higher rates. Overall our results suggest that pelagic zooplankton production can be directly converted to water column bacterial production via carcass decomposition in lakes.

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EPSILONPROTEOBACTERIA REPRESENT THE MAJOR PORTION OF CHEMOAUTOTROPHIC BACTERIA IN SULFIDIC WATERS OF THE BALTIC SEA AND BLACK SEA PELAGIC REDOXCLINES

Marine pelagic redoxclines are usually characterized by high dark CO_2 fixation rates. Recent studies indicated that chemoautotrophic *Epsilonproteobacteria* might play an important role, especially as anaerobic or microaerophilic dark CO_2 fixing organisms. Knowledge on their distribution and abundance as actively CO_2 fixing microorganisms in redoxclines is still rare. We determined the contribution of *Epsilonproteobacteria* to dark CO_2 fixation in the sulfidic area of a Black Sea and a central Baltic Sea redoxcline by combining CARD-FISH with microautoradiography using [^{14}C]bicarbonate. 29% of the Baltic prokaryotic cells fixed $^{14}CO_2$ and 12% of the Black Sea prokaryotes, respectively. $^{14}CO_2$ incorporating cells exclusively belonged to the phylum *Bacteria*. Among these, approximately 70% in the central Baltic and up to 100% in the Black Sea were members of the *Epsilonproteobacteria*. For the Baltic Sea, the *Sulfurimonas* subgroup GD17, which has been previously hypothesized to be involved in autotrophic denitrification, was the most abundant group fixing CO_2. The genome analysis as well as autecological studies with an isolate of group GD17 should provide more information about its metabolic potential.

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ENHANCEMENT OF FATTY ACID PRODUCTIVITY IN MICROALGAE BY A SELECTION-MUTATION METHOD

Microalgae exhibit a high energetic lipid storage potential and high growth rates as well. Therefore they are considered to be good candidates for biofuel production. The selection of highl lipid-productive strains is a major bottle-neck for projects dedicated to biofuel production with microalgae. We developed a mutation-selection method in order to increase microalgae fatty acid productivity . A two step method based on UVc irradiation followed by a flow cytometry selection applied to a set of previously high lipid containing cells was used and lipid content was assessed by means of Nile-red fluorescence measurements. The method was first tested with *Isochrysis affinis galbana* (T-Iso). After one round of mutation-selection the total fatty acid content increased from about 150 mg.(g C)$^{-1}$ for the wild-type to about 280 mg.(g C)$^{-1}$ for the selected population. Cell size also rose but to a less extent, leading to a 25% increase of biovolume. On the other hand, growth rate remained unaffected by the process and resulted in a 97% increase of lipid productivity for the selected population.

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FEEDBACKS ASSOCIATED WITH WATER FLOW MODIFICATION BY SUBMERSED CANOPY-FORMING VASCULAR PLANTS

The architecture, size, and shape of beds of submersed aquatic vegetation affect water flow through and around the plant canopy. Wave height, current velocity, flow-deflection, and water residence time are regulated by plant bed structure, which varies in space and time. This flow modification results in "trapping" of suspended particles within the bed, which begets both positive and negative feedbacks on plant growth. Our study was conducted in a bed of *Stuckenia pectinata*, a dense canopy-forming species in the mesohaline region of Chesapeake Bay, USA. Wave and current attenuation were measured throughout and after the growing season. Particle trapping was estimated by continuous measurement of suspended solids and proxies at three stations (inside, outside, and edge of bed). Feedback effects associated with trapping were explored by measuring light availability, epiphyte accumulation, sediment grain size, and porewater ammonium and sulfide concentrations and by underway mapping of water quality from small boats moving across beds of varying size. These data elucidate the extent to which plant growth influences particle trapping and vice-versa, and implicate the bed's edge as a dynamic "buffer."

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EFFECTS OF LIGHT CLIMATE AND RIVERINE DOM ON MICROBIAL COMMUNITY DEVELOPMENT

Interactive effects of simulated riverine DOM (dissolved organic matter) and variable light climate on Baltic Sea microbial communities were studied in a 31-day-long mesocosm experiment (five meter high, 2.5 m3). The mesocosm tubes were filled with brackish water from the Gulf of Bothnia. By controlled heating / cooling of the tubes, a thermocline at variable depths (1.5 m and 3.5 m), and thereby light climate, was obtained. Twelve mesocosms were divided into four experimental groups, (I) High addition of simulated riverine DOM (humus and yeast extract) and thermocline at 1.5 m depth, (II) No addition of DOM and thermocline at 1.5 m depth, (III) High addition of DOM and thermocline at 3.5 m depth IV) No addition of DOM and thermocline at 3.5 m depth. Microbial community structure was assessed using microscopy, chlorophyll-a analyses and terminal-restriction fragment length polymorphism (T-RFLP) analysis of bacterial 16S rRNA genes. Our results showed that the simulated riverine DOM addition changed bacterial community composition. In contrast, the thermocline depth linked to the simulated light climate had minor effects on the bacterial community.

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SPECIES SPECIFIC GROWTH CONDITIONS IN THE HELGOLAND ROADS DATA: CLIMATE OR NUTRIENTS?

The Helgoland Roads Data is one of the most detailed plankton long term data series in the North Sea. The data are sampled work-daily from 1962 until today and comprise 370 species of phytoplankton including nutrients and physical parameters. We strive to classify the species specific optimal growth conditions determined by the abiotic factors with an analysis of the points of maximum growth. Correlations between the growth of 18 phytoplankton species and the abiotic factors are traced by diverse methods of multivariate statistics (PCA, cluster analysis, etc.). The changed environmental conditions (e.g. increased sea water temperature, decreased ammonium concentration) and known regime shifts in the German North Sea can be found in this time series. We focus on the consequences for these 18 phytoplankton species and discuss consistencies for higher trophic levels of the Helgoland food web. First results show temperature (and light conditions) as the driving forces of phytoplankton growth in this system. Nutrients do not show a strong influence on the phytoplankton growth by this method. So the impact of climate change has to be highlighted for this habitat.

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GENOTYPE BY ENVIRONMENT INTERACTIONS IN THE DIATOM *ASTERIONELLA FORMOSA*

An increasing number of studies suggest that genotype by environment (GxE) interactions in parasites represent powerful selective agents in host populations. So far, the main focus was directed to $G_{Parasite}$x E and $G_{Parasite}$x G_{Host} interactions regarding the fitness of the parasite. However, little is known about G_{Host}x E interactions and their potential influence on the maintenance of genetic diversity within phytoplankton host populations. Thus the real impact of parasitism on the genetic structure of natural host populations remains unresolved. In Lake Maarsseveen, blooms of the diatom *Asterionella formosa* are host to the obligatory killing chytrid *Zygorhizidium planktonicum*. The chytrid epidemics can reach infection prevalences larger than 95% and thus are predicted to act as a strong selective agent on the host. However, in the field, the selective effect of the parasite on host genotype frequencies may be confounded by concurrent changes of environmental factors such as seasonal temperature changes. We intend to disentangle temperature mediated and parasite mediated selection of diatom genotypes on basis of G_{Host}x$G_{Parasite}$xE interaction experiments in laboratory batch cultures. First results of these experiments will be presented.

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APPLICATION OF MEMBRANE INLET MASS SPECTROMETRY TO ASSESS DISSOLVED GASES TO INVESTIGATE DENITRIFICATION, PHOTOSYNTHESIS, AND RESPIRATION.

N_2, O_2 and Ar are the three most concentrated gases in aerobic waters affected by both biological and physical processes. Ar is affected strictly by physical processes. Deviation of these dissolved gases from equilibrium concentrations reflect biological and physical activates such as denitrification, photosynthesis, and bubble formation. Current methods for measuring denitrification in sediments are hampered by photosynthetic bubble formation. Because bubbles strip out more N_2 than Ar. The project investigates the influence of photosynthetic bubble formation on the remaining dissolved gases measured by membrane inlet mass spectrometry(MIMS). Sediment core samples with /Ulva lactuca/ were taken from the Choptank River in Cambridge MD, and were setup in a temperature-controlled cylindrical chamber with 170ml of headwater. Test tube samples were taken from the headwater and run by MIMS. Increasing levels of dissolved O_2 and insignificant fluctuation of dissolved N_2 were observed. This result supports the fact that denitrification does not take place during the day. The research project provides a method to measure and investigate an overall natural aquatic system metabolism using MIMS.

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RESPONSES OF COASTAL OSMOTROPHIC PLANKTONIC COMMUNITIES TO SIMULATED EVENTS OF TURBULENCE AND NUTRIENT LOAD THROUGHOUT A YEAR

The effects of turbulence on osmotrophic plankton strongly depend on the size of the organisms, on the specific composition of the community, and on the nutrient conditions. The impact of turbulence episodes is therefore likely to show a high variability throughout the year. Here we present the results of a one-year long series of monthly laboratory experiments, which we conducted in order to analyse the changes in the short time response of the osmotrophic planktonic community of Blanes Bay (NW Mediterranean) to simulated turbulence and nutrient input events. Both experimental factors triggered a relative increase of biomass in the enclosures, in terms of chlorophyll *a*, bacteria and particulate organic matter. Short-time responses to experimental forcings were found to be influenced by initial physico-chemical conditions, but not by community composition or size structure. The response to turbulence was maximum in spring. The response to nutrient enrichment was seasonal, and was correlated to initial nitrate and silicate concentrations and to Secchi depth, which are proxies of recent inputs of nutrients by episodes of resuspension and river discharge.

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HIGH CHLOROPHYLL NEAR BOTTOM LAYER IN BARCELONA COASTAL WATERS

High Chlorophyll Near Bottom Layers (HCNBLs) develop during spring and summer, mainly in south and centre of the Catalan coast. They are usually found between 20 and 50m depths with several meters thick and extend some kilometres along the coast. Their origin is probably diverse: downward displacement of the spring phytoplankton bloom, nutrient enrichment due to the breaking of internal waves or bottom currents enhancing nutrient diffusion from sediments, or due to direct nutrient supply from submarine sewage outfalls, among others. In these layers, the presence of classical or microbial trophic web and the balance between organic and inorganic nutrients will generate different horizontal and vertical gradients. These dynamics may play an important role in nutrients processing in coastal waters. We present the results of the first approach to the HCNBL in Barcelona coastal waters made in summer 2007. In that case the layer was originated by enhancing nutrient diffusion from sediment due to physical processes. This HCNBL showed structural complexity, characterized by gradients in the different parameters analyzed, and a rich horizontal and vertical spatial structuring of phytoplankton communities.

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ECOLOGICAL STOICHIOMETRY IN BENTHIC FOOD WEBS: EFFECTS OF LIGHT, NUTRIENTS AND FOOD WEB CONFIGURATION ON GRAZERS AND PERIPHYTON NUTRIENT RATIOS

Grazer-periphyton interaction is a valuable model to test predictions of the ecological stoichiometric theory. We conducted an enclosure experiment to evaluate individual and interactive effects of nutrients, light and food-web configuration (presence/absence of an omnivorous fish) on the nutrient ratios of grazers and periphyton in a humic tropical lagoon. Both nutrients and light strongly affected periphytic nutrient content. We observed higher C:N and C:P ratios in low light conditions, which may be attributed to lower grazing pressure and higher contribution of carbon-rich detritus to the whole periphytic community biomass. Nutrient content of grazers were also positively affected by nutrient addition and mirrored periphyton stoichiometry, highlighting grazer plasticity in body nutrient composition. Fish effect on periphyton stoichiometry was weak throughout the experiment and was not significant on grazer stoichiometry. Our data showed that nutrient and light interactively affected periphyton stoichiometry and suggest that, despite the general recognition of bottom-up and top-down effects on community biomass, only nutrient effects, but not predator, propagates along food-web.

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MINERALIZATION OF ORGANIC CARBON IN SEDIMENTS OF LAKES WITH DIFFERENT LOADING OF TERRESTRIAL DOC – DEPENDENCE ON TEMPERATURE

We present a seasonal cross-system survey of eight lakes in Central Sweden, with different trophic state and loading of terrestrial DOC. Sediment respiration was measured in situ, along a depth gradient within each lake, as dissolved inorganic carbon production. Sediment respiration was correlated with temperature (r2=0.61, p<0.0001, n=219). A PLS (partial least square) regression of sediment respiration against temperature and a number of parameters indicating the substrate quality in the sediments (C/N ratio, C, N, P concentration) and TP concentration in the water column, showed an overriding effect of temperature. The sensitivity of sediment respiration to temperature change was markedly higher at lower temperatures (below 5 oC). Accordingly, despite of large differences in water and sediment properties, temperature emerged as a major predictor of sediment respiration. Our data suggest that this is mostly due to direct temperature regulation of metabolism, rather than an indirect effect of cross correlations between temperature and other conditions of the ecosystem. The strong temperature effect has possible implications for the balance between mineralization and burial of carbon in a changing climate.

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COPEPOD SIBLINGS IN ARCTIC FJORDS: A NEW METHOD TO DISCRIMINATE PSEUDOCALANUS SPP.

In high-latitude marine environments, where pelagic species diversity is generally reduced, assessments of ecological and functional diversity are complicated due to the occurrence of morphologically very similar species. Examples are the copepod siblings *Pseudocalanus minutus* and *P. acuspes*, common in arctic coastal waters. To determine their potentially different distribution patterns around Svalbard, an archipelago northwest of the Barents Sea, a species-specific polymerase chain reaction (PCR) was developed using the mitochondrial gene cytochrome oxidase I (mtCOI). DNA sequence variation confirmed the presence of both species in Svalbard waters and species-specific primers were designed for a competitive duplex PCR of individual females. The statistical comparison of the morphological identification with the PCR results remained ambiguous, a Chi-square test yielding a significant difference, but with low power due to a low sample size. However, this indicates that microscopic species determination, when attempted, may often be wrong. Morphometrics revealed deviations from expected length ratios, while the PCR sometimes failed to produce results. This may point to the presence of a third species, potentially *P. major*, for which no molecular information is available at present.

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BACTERIAL GROWTH EFFICIENCY REGULATION AT A TROPICAL EUTROPHIC ESTUARY IN NORTHEASTERN BRAZIL

In spite of their importance in evaluating the magnitude of carbon flow through bacterioplankton, simultaneous measurements of bacterial production (BP) and respiration (BR) are still scarce in tropical estuarine systems. Here, bacterial growth efficiency (BGE) regulation was evaluated along a tropical eutrophic estuary (8º03'S; 34º53'W – Recife Estuary, NE Brazil). Surface samples were collected at three fixed stations during the ebb and flood tidal phases and during the dry and wet seasons. Salinity variation (28.2-36.2) indicates tidal oscillation and seasonality, while water temperatures remained steady (28.6-30.7ºC). BP (0.06-0.4 µmol L^{-1} h^{-1}), BR (1.0-5.7 µmol L^{-1} h^{-1}) and BGE (5-17%) were not influenced by temperature, DOC (49-79 µmol L^{-1}), distance from the ocean, tidal or pluviometric variation. However, BP and BR were directly correlated to chlorophyll-a contents (1.0-9.6 µg L^{-1}), mainly those of pico and nanoplankton fractions, suggesting a coupling between the phytoplankton and bacterioplankton compartments. The low BGE values indicate that the bacterioplankton act more as a sink of organic matter and source of inorganic carbon and nutrients than as a source of particulate organic matter for higher trophic levels.

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EVALUATION OF SUB-LETHAL TOXICITY OF NONYLPHENOL AND 17Β-ŒSTRADIOL ON MARINE MUSSELS (*MYTILUS GALLOPROVINCIALIS*)

The endocrine disruptors are present in seawater, mainly in ports, urban and industrial effluents. Nonylphenol (NP) and 17β-œstradiol (E2) are commonly found in surface waters nearby municipal wastewater treatment plants. In marine biomonitoring, biomarkers are used as tools to assess the aquatic environment health. The marine mussels, *Mytilus galloprovincialis*, are routinely chosen as "sentinel" organisms in Mediterranean coastal monitoring programs. The purpose of this study was to investigate the toxic effects of NP and E2, feminizing substances, on biomarker responses on male and female mussels. The organo-somatic index, gluthation-S-transferase, catalase, superoxide-dismutase and lipid peroxidation were measured after exposure to increasing concentrations of organic pollutants. NP concentrations used in the present study reflect the levels of this toxic compound found in the marine environment. Three organs were considered regarding to their physiological functions: gills (filtration), hepato-pancreas (digestion) and gonads (reproduction). Results, obtained with biomarkers of defence and damage, were discussed in function of the sex of animals.

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MEIOBENTHOS DYNAMICS IN THE BENTHIC BOUNDARY LAYER OF THE DEEP (2347 M) NW MEDITERRANEAN

A temporal survey of the benthic boundary layer using sediment traps set 4 m above the bottom at the DYFAMED-BENTHOS station (43° 24.61' N – 7° 51.67' E) was carried out between January 1996 and April 1998. The identification of "swimmers" picked from the 55 samples collected showed that 97% of the organisms were meiobenthic. Copepods (including nauplii) dominated and were on the average 87% of the organisms. Then came annelids (7.8%), nematodes and bivalves (1.8% each), ostracods, isopods, and amphipods (1.2% altogether). Of the 3930 copepods (excluding nauplii) examined, 4% were calanoids, 15% were harpacticoids, and 81% were cyclopoids. Temporal variability in swimmer fluxes was high (they varied between 26 and 361 individuals m-2 d-1), but not all groups/taxa were equally affected. Temporal variations, both seasonal and interannual were the result of the variability of both physical (bottom current flow) and trophic (particulate organic matter fluxes) local environmental factors.

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DUNE PROJECT (A DUST EXPERIMENT IN A LOW NUTRIENT LOW CHLOROPHYLL ECOSYSTEM): RESULTS FROM THE FIRST FIELD CAMPAIGN.

The Mediterranean Sea – etymologically, sea surrounded by land, is submitted to atmospheric inputs that are variable both in frequency and intensity. During the stratification period, only atmospheric deposition is prone to fertilize surface waters which had become very oligotrophic due to the nutrient depletion (after the spring bloom). The main goal of DUNE is to estimate the impact of atmospheric inputs on such oligotrophic ecosystem submitted to strong atmospheric inputs. From 1st June to 1st July 2008, the first DUNE experiment took place in Scandola (Corsica). Two groups of 3 large mesocosms (33 m3), only made with plastic material were installed (depth ~ 30 m): triplicates of 'control' and triplicates of 'dust addition'. Two fertilization experiments were performed, each lasting for 9 days. Daily sampling at different depth of the bags allowed to follow the evolution of the physico-chemical conditions, the response of the ecosystem (bacteria-phytoplankton-zooplankton) and the particulate material export. We will examine the main results acquired, in particular the impact on nutrient cycle, and show some very significant response at different trophic levels.

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NEARSHORE DYNAMICS OF NUTRIENTS AND CHLOROPHYLL DURING MEDITERRANEAN TYPE FLASH FLOODS EVENTS

A year-long study (October 2004 to October 2005) in the Bay of Banyuls-sur-Mer (France, NW Med) assessed the inputs from a local intermittent river and the stimulation of nearshore phytoplankton blooms. The offshore response to the single major flow event (October 2005) was monitored daily during two weeks at 350 m (8 m water depth) and 1.4 km from the river mouth (long-term monitoring station, 27 m water depth). The flash-flood signal was partly hidden at the shallowest site by swell resuspension of bottom sediments. At the deepest station, three phases were identified : (1) at the beginning of flow, river dissolved inputs dilute conservatively leading to increased dissolved inorganic nitrogen and silicate concentrations and decreased seawater salinity, (2) during the main turbid pulse, phosphate is released and (3) after the water column cleared, a 2 µ g L^{-1} peak of Chlorophyll $_A$ 0 was observed, which vanished three days later. This dynamics of nutrients and chlorophyll during a flash-flood event is consistent with long-term weekly monitoring data but question phosphate recycling during such events (on-going project CRUMED).

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EFFECTS OF AQUATIC PLANT SPECIES RICHNESS AND COMPOSITION ON ECOSYSTEM PROCESSES AND PLANT PERFORMANCE: A FIELD EXPERIMENT

The knowledge of how plant diversity affects ecosystem processes is still largely based on terrestrial and small-scale laboratory studies, while our understanding of these processes in the marine environment is still limited. To study the effects of angiosperm diversity on ecosystem processes, a 4 month field experiment was conducted in the Baltic Sea. Using a replacement design, 4 plant species (*Zostera marina* L., *Potamogeton filiformis* Pers., *Potamogeton perfoliatus* L. and *Zannichellia palustris* L.) were planted in all possible combinations with standardized planting density. The aim was to investigate how plant species richness and composition influence above- and belowground biomass and nutrient usage among plants e.g. nutrient uptake and sediment porewater nutrients. Species rich communities increased the total biomass production, while the sediment

porewater nutrient availability decreased with increasing species number. Some plant species performed better in mixtures than expected and according to additive partitioning, positive selection and complementarity effects strongly influenced primary production. These results are informative of mechanisms driving productivity and biomass allocation patterns in mixed plant assemblages, and implicate altered performance and functions of communities experiencing species loss.

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RESPONSE OF THE PLANKTON COMMUNITY OF A TROPICAL COASTAL LAGOON TO NUTRIENT ADDITIONS USING MESOCOSMS

In order to determine the response of the plankton community (phytoplankton size fractions, and bacterioplankton), we employed mesocosms amended with +N, +P y +Si, along seven days and measured the response in terms of biomass (Chlorophyll a, size fractions) and bacterioplankton abundance in the wet and dry seasons. Significant differences were detected between +N (14.98 y 9.06 mg Clor a m^{-3} dry and wet seasons) and the rest of the treatments confirming nitrogen limitation to the phytoplankton and bacterioplankton communities. Similarly to chlorophyll, picophytoplankton abundance measured by flow cytometry increased significantly during the wet season experiment from 7474 in day one to 39000 cel ml^{-1} on day seven. Bacterioplankton also responded positively to + N treatment with maximum abundances of 15.8 x 10^7 cel ml^{-1} and 12 x 10^6 cel ml^{-1} in the dry and wet season respectively. The relationship between bacterioplankton and phytoplankton was low (r^2 de 0.25 for dry y 0.24 and wet season respectively) but similar to studies of other estuarine systems confirming the low dependence of bacterioplankton for C supplied by phytoplankton.

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CARBON FLUX THROUGH MAJOR PHYTOPLANKTON GROUPS ACROSS CONTRASTING ENVIRONMENTAL CONDITIONS OF THE SUBTROPICAL NORTHEAST ATLANTIC OCEAN

We have adopted a pigment-based approach to characterize phytoplankton community structure, quantified growth and grazing rates for major groups and calculate the associated carbon fluxes, synthesis and destruction, in the Subtropical North East Atlantic. Phytoplankton in the upwelling was growing fast and free of nutrient limitation with all groups growing at similar rates. In oligotrophic waters, phytoplankton growth rate was lower suffering from weak but consistent nutrient limitation. Here, the mean growth rate value masks the higher rates of Diatoms and Synechococcus compared to those of Prochlorococcus and Prymnesiophyceae. Growth rate of photosynthetic prokaryotes was only slightly nutrient limited, while that of Diatoms and especially Prymnesiophyceae was severely limited. Microzooplankton grazing rates were higher in upwelling than oceanic conditions and mirrored the group-specific growth dynamics. Combination of Chla synthesis and destruction rates with C/Chla estimates yielded the carbon flux through major phytoplankton groups. The pattern of higher carbon flux in the upwelling and lower in oligotrophic waters was driven by phytoplankton biomass rather than rates.Diatoms channelled most of the primary production in the upwelling while Prochlorococcus and mainly Synechococcus, dominated this flux in the oceanic oligotrophic region.

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MOLECULAR AND CULTURAL APPROACHES OF THE SULFATE-REDUCING BACTERIA IN DIFFERENT SUB-OXIC ENVIRONEMENTS: IMPLICATIONS FOR MERCURY METHYLATION

Sulfate-reducers may have harmful impacts due to sulfide production, metal corrosion, or mercury methylation activities. They are widespread in anoxic environments but can be present and active in micro-oxic to oxic water bodies. Nevertheless only few studies exist on their presence and diversity in such environments. Their diversity can be assessed with genetic markers based on the 16SrRNA or the disulfite-reductase (dsrAB) genes. Nevertheless, when sulfate-reducers are not abundant these techniques failed due to few targets available for PCR amplification. In the context of mercury methylation studies, we developped new primers for the amplification of the dsrAB genes by nested PCR. We demonstrated the presence of sulfate-reducers in different natural environments such as Mediterranean water bodies, acid mine drainage waters, freshwater aquatic macrophyte roots. We also demonstrate their activity in an oxic lab-scale reactor by RT-PCR allowing the detection of the mRNA of the disulfite reductase. These overall results demonstrated the presence of sulfate-reducers in sub-oxic microniches and their potential role on mercury speciation in such environments .

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MODELING PRESENT-DAY SPATIAL AND SEASONAL VARIABILITY OF CARBON DIOXIDE IN SURFACE WATERS OF THE SOUTHERN BIGHT OF THE NORTH SEA

The 3D ecological MIRO&CO-CO2 model is used to describe the spatial and seasonal variations of air-sea CO2 exchanges in the English Channel and the Southern Bight of the North Sea receiving important nutrient and carbon river loads. Runs are performed for years 2003 and 2004 using actual sea water temperature, light, wind speed and river forcings. MIRO&CO-CO2 simulations show large spatial and seasonal variations of surface pCO2 (range 100 - 600 ppm). Significant under- (and over-) saturation are simulated in spring (and summer) due to the dominance of auto- (and heterotrophic) activities. The highest pCO2 values are simulated in the vicinity of river mouths. Similarly, the computed annual air-sea CO2 fluxes varies spatially, predicting sources of CO2 to the atmosphere near estuaries but moderate sinks (or neutral) in offshore waters. Sensitivity studies are further performed to estimate the contribution of organic and inorganic carbon and nutrient river loads on the air-sea CO2 flux simulated in the area.

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PORE WATER DYNAMICS OF IRON, MANGANESE AND PHOSPHATE AT THE SEDIMENT-WATERINTERFACE IN THE GULF OF FINLAND (BALTIC SEA) MEASURED USING DGT

The technique of diffusive gradients in thin-films (DGT) was implemented to study the dynamics of iron (Fe), manganese (Mn) and phosphate (PO42-) at the sediment-water interface in the Gulf of Finland (Baltic Sea). DGT was additionally used for the measurement of dissolved sulphide. DGT results are supported by pore water centrifugation and sediment solid phase digestion. Active remobilisation of Mn2+, PO42- and Fe2+ was found at the sediment-water interface. High Mn2+ and PO42- concentration was well but not completely buffered by the sediment solid phases. The results are characteristic for sulphidic organic-rich sediments, emphasising the contrasting behaviour of Fe and Mn in sulphidic sediments du to the different solubilities of Fe and Mn sulphides.

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INEFFICIENT CARBON MINERALIZATION IN THE ANOXIC PART OF THE MEROMICTIC LAKE CADAGNO, SWITZERLAND.

In the meromictic Lake Cadagno dense populations of purple and green sulfur bacteria are developed in the chemocline at about 11m. The anoxygenic phototrophs contribute 45-65% of the total carbon fixation in the lake. Furthermore, 44% of the carbon fixation takes place in the dark. Using fluorescent in situ hybridization (FISH) and microautoradiography (MAR) we found that purple sulfur bacteria are important for the dark fixation in the lake. The importance of anoxygenic phototrophs for the total carbon production in a meromictic lake is typically dependent on how much organic matter becomes available for the sulfate-reducing bacteria. In Lake Cadagno almost all organic matter produced in the oxic part of the water column is remineralized in the oxic epilimnion. In contrast, only 16 % of the organic matter produced in the anoxic part is remineralized there by sulfate reduction. The difference between aerobic and anaerobic mineralization efficiency may be related to the trophic structure of the two environments and has important consequences for the carbon cycle in the lake.

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A COMBINED GENOMIC APPROACH TO UNDERSTANDING HARMFUL ALGAL BLOOM DYNAMICS

Harmful algal blooms (HABs) pose a major threat to human health, ecosystem health, and fisheries resources throughout the world. Our model system is the toxic dinoflagellate Alexandrium tamarense, a unicellular alga that produces saxitoxins, the neurotoxins that cause paralytic shellfish poisoning, the most widespread of all HAB poisoning syndromes. With the recent development genomic resources for A. tamarense, it is now possible to conduct studies of environmental regulation of gene expression in this important species and to begin to unravel the mysteries of bloom dynamics and cellular metabolism at a level that has never before been possible. We are transcriptomics and gene expression profiling to identify regulated genes and pathways during the three general stages of a bloom: initiation, development, and termination.

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JELLY BLOOMS: HOW *DEEP* IS THE TROUBLE

According to the popular press, global jellyfish numbers are rising, with climate change and ocean acidification as underlying causes. The scientific evidence supporting these assertions, however, is spotty. First, it impossible to generalize about "jellyfish" since this category includes at least scyphomedusae, hydromedusae, siphonophores, and ctenophores, each with a different life history and a different set of optimal conditions for reproduction and survival. Second, even within these groups, except for cases of invasive species, there are few data sets that can be used to test for long-term environmental correlations. Here I examine some of the published evidence for historically recent increases in "jellyfish" populations and review the case for the existence of these purported trends. I also propose a mechanism for improving our understanding of long-term jelly bloom dynamics. Can we extrapolate from conspicuous coastal scyphomeduase to other planktonic cnidarians and ctenophores? Are there any indications of recent changes among deep-sea species? Better knowledge of jelly distributions and their correlations with climate variables are important for detecting environmental change and making effective management recommendations.

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ENUMERATION OF NOVEL MARINE CYANOBACTERIAL NITRATE REDUCTASE SEQUENCES SHOWS VERTICAL AND SPATIAL PATTERNING

Synechococcus spp. and *Prochlorococcus* spp. have genetic differences that determine the sources of dissolved inorganic nitrogen (DIN) they can incorporate into organic nitrogen. Genome sequencing indicates that *Synechococcus* spp. assimilate nitrate through the activity of assimilatory nitrate reductase (*narB*) while *Prochlorococcus* spp. lack the *narB* gene. We used PCR with degenerate *narB* primers to examine the diversity of cyanobacteria with potential to utilize nitrate in two low N environments: the equatorial subtropical N. Pacific and the Sargasso Sea. Phylogenetic analysis of the environmental *narB* sequences revealed three novel groups of sequences distantly related to other environmental sequences and those from cultivated cyanobacteria. We used quantitative PCR (qPCR) to compare their abundance in these environments. The distribution patterns of these groups indicate that they are distinct cyanobacterial groups, likely adapted to different niches. Multidimensional scaling analysis was used to define associations between these groups and the environmental conditions in which they occurred. We are targeting nitrate transporters (*nrtP*) in marine *Synechococcus* to further study how the genetic capability to utilize DIN relates to the ecological distribution of these unicellular cyanobacteria.

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MODELING INTRA-ANNUAL CHANGES IN BIOMASS AND PRODUCTIVITY OF PRIMARY PRODUCER GROUPS IN AN INTERMITTENTLY CLOSED / OPEN LAGOON (WILSON INLET, SW AUSTRALIA)

Wilson Inlet is an intermittently closed / open coastal lagoon in a Mediterranean-type climate zone where biomass and productivity of primary producer groups (phytoplankton, microbenthic algae, sea grass and macro algae) vary throughout the year in response to changing physical-chemical conditions. In order to reveal temporal regime shifts in primary producer groups and respective changes in biogeochemical cycles we developed a model coupling the hydrology and nitrogen dynamics at whole system scale. Field data are used to calibrate and validate the model. Concurrent with a high inflow of nutrients in the late winter / early spring a phytoplankton bloom occurs. In early summer, productivity of microbenthic algae rapidly increases as sufficient light becomes available at the sediment surface. As a consequence, benthic ammonia fluxes decrease terminating the preceding phytoplankton bloom. Whole system primary productivity rapidly declines in autumn. Primary productivity of sea grass and macro algae is far less variable throughout the year, yet, their respective biomasses are much higher. Significant amounts of bioavailable nitrogen are flushed out, because phytoplankton predominance occurs concurrently with the opening of the bar.

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ECOLOGICAL STOICHIOMETRY AS A NOVEL FRONT IN THE MICROBIAL REVOLUTION: LINKING COMMUNITY COMPOSITION TO ECOSYSTEM PROCESSES

While there is ample evidence that microbial biomass stoichiometry affects ecosystem processes, little is known about the intracommunity dynamics that govern community biomass stoichiometry. Recent technological advances have allowed for the application of stoichiometric theory to microbial ecology at an unprecedented level of resolution. In this talk we show how coupling fluorescent in situ hybridization (FISH) with Raman spectroscopy and elemental analysis allows the partitioning of community stoichiometric signals into their constituent population stoichiometries and each population further into its constituent macromolecules. Using these novel empirical approaches a rich body of conceptual ecological framework, ecological stoichiometry, can now be coupled with the molecular front of the microbial revolution to give increased insight into how microbial community composition affects large scale biogeochemical processes.

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VARIATION IN GROSS PRIMARY PRODUCTIVITY IN THE COLORADO RIVER BELOW A LARGE DAM

Dams alter carbon inputs to rivers by severing the connection between a river and its watershed. The Colorado River, USA, historically carried high sediment and organic loads, which likely led to light-limitation of primary production. Following closure of Glen Canyon Dam, sediment and organic loads were greatly reduced. Therefore, primary production may drive the food web in the 360-km reach below the dam, even though tributary-derived sediment causes high turbidity during certain times of the year and tributary-derived organic matter likely dominates inputs to this reach. To test this hypothesis we measured open-channel primary production at 5 sites below the dam tailwater in Grand Canyon seasonally for 3 years. Production ranged from <0.5 to 4.5 g $O_2 m^{-2} d^{-1}$ and was highest at upstream sites during clear water seasons. Production was nearly zero when sediment loads were elevated due to tributary inputs. Invertebrate diets tracked algae production, with more algae in guts in times and places of high production. Although allochthonous inputs are large, primary production rates can be high seasonally and constitute, in part, the base of the food web.

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QUANTIFICATION AND DISTRIBUTION OF *ENTEROCOCCUS SPP.* IN WET AND DRY BEACH SAND OVER SPACE AND TIME

Enterococcus, the fecal indicator bacteria that are the standard for measuring biological water quality at marine beaches, were detected in wet and dry beach sands at a beach whose waters frequently exceed bacterial standards (Avalon Bay, CA). To determine the amount of *Enterococcus* in beach sands, distribution over space and time, and corresponding presence of potential human pathogens, nucleic acids were extracted with a commercial kit. *Enterococcus spp.* were detected with qPCR using a standard-curve dilution series of purified *E. faecalis* genomic DNA. Extraction efficiency and inhibition, measured with an external DNA standard, were used to estimate cell number/gram. No significant difference in amounts of *Enterococcus* along the beach transect was observed. Both wet and dry sands exhibited similar temporal abundance patterns, but with relatively more *Enterococcus* present in midsummer wet sands, and more in dry sands in late summer. *Campylobacter* was detected, with a PCR assay, in wet sands on days that had both peak and relatively low amounts of *Enterococcus*. These data suggest *Enterococcus* is not a good indicator of pathogen presence or fecal contamination in beach environments.

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SIMULATING MARINE DMS PRODUCTION IN A COUPLED OCEAN-ATMOSPHERE MODEL

verage required to fully assess the role of DMS in mediating climate. It is therefore imperative that parametrisations are developed and tested, which allow the realistic incorporation of DMS production into Earth System models, enabling testing of these feedbacks under future climate scenarios. Both the Anderson et al. (2001), and Simo and Dachs (2002) DMS schemes correlate seawater [DMS] with basic biological and physical parameters, and therefore lend themselves ideally to incorporation into coupled physical-biogeochemical climate models. We have included these parametrisations into the Met Office Hadley Centre biogeochemical model Diat-HadOCC, and compared the results with data from the Kettle et al.(1999) database, focussing on global fluxes, seasonality and the spatial distribution of DMS production. Using the Simo and Dachs (2002) DMS scheme we accurately reproduce the seasonal cycle present in the Kettle et al. (1999) dataset, capturing the 'Summer Paradox', and closely matching the resulting radiative forcing.

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NITROGEN FIXATION IN SOUTH PACIFIC OLIGOTROPHIC GYRE

Nitrogen fixation is thought to be a significant input of new nitrogen in oligotrophic regions, although very little direct data on N fixation rates exist for the South Pacific, the Earth's largest (4.4 x 10^7 km^2) and most oligotrophic ocean region. In January 2007 we investigated the N-cycle of the upper 200 m of the water column at 11 stations throughout the subtropical gyre in the southern Pacific (Knox02RR Expedition). Nitrate and phosphate concentrations were near detection limit at all depths, and ammonium concentrations ranged between 0.03 to 0.05 µM. Chlorophyll exhibited deep maxima of 0.3 to 0.4 µM at water depths between 100 m and 200 m (at the center of the gyre). $^{15}N_2$ incubations (both light and dark) give N_2 fixation rates in the gyre between 0.002 nM h^{-1} and 0.2 nM h^{-1} with a median rate of ca. 0.05 nM h^{-1}. The highest rates of N_2 fixation tended to occur above rather than in the chlorophyll maximum. Presently, we are using gene expression of *nifH* to identify the organisms responsible for nitrogen fixation at these sites.

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THE NEW Z SCHEME OF PRIMARY PRODUCTION

Chl-specific net primary production (NPP) varies with light and temperature, but the effects of nutrient limitation are debated. The strong positive dependence of Chl:C on N-limited µ suggests that cells adjust Chl to growth conditions. Seven productivity indices were used to assess N-limited steady-state cultures of *Dunalliela tertiolecta* with a range of µ. NPP · Chl^{-1} is constant (128 ± 29 µmol C (mg Chl · hr)$^{-1}$) for all growth rates, as was observed 30 years ago by Laws and Wong (1978). Chl-specific gross (GPP) and net O_2 production were measured using ^{18}O:^{16}O and membrane inlet mass spectrometry. GPP was 4 times greater than NPP · Chl^{-1} and remained unchanged with µ. In contrast, both Chl-specific net O_2 production and ^{14}C fixation rates (20min and 24hr incubations) are growth dependent. Chl-specific GPP and NPP define constant production limits within which P^b_{max} varies; providing the link in a new and very different conceptual "Z scheme" of primary productivity. The variability of P^b_{max} with growth rate can be explained through changes in the fraction of photosynthate that is used for production of short-lived (<20 min) C products. Indeed, ^{14}C incorporation into carbohydrate was 5 times slower in cells growing at 0.12 d^{-1} compared to 1.2 d^{-1}.

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DYNAMICS OF POLYSACCHARIDES AND TRANSPARENT EXOPOLYMER PARTICLES DURING A COCCOLITHOPHORE BLOOM IN THE BAY OF BISCAY

Polysaccharides are an essential component of organic matter in the ocean. The production of carbohydrates in seawater is mainly linked to autotrophic processes. They serve as structural and storage compound or are released by exudation, cell lysis or leakage to the organic matter pool. Recently, it has been shown that polysaccharides, in particular acidic polysaccharides, are involved in aggregation processes, e.g. the formation of transparent exopolymer particles (TEP). Furthermore, it has been demonstrated that an increased production of TEP and therefore potentially enhanced particle aggregation is linked to ocean acidification. Here, we present results on the abundance and composition of neutral and acidic polysaccharides and of TEP. Data were obtained from field investigations and from CO2-controlled chemostat experiments conducted during a coccolithophore bloom in the Bay of Biscay 2006. Based on our findings we will discuss the temporal dynamics of carbohydrates and their partitioning into gel particles and the consequences for the organic matter export.

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LARGE ORGANIC FALL PROCESSING BY DEEP SEA COMMUNITIES AND THE GENERATION OF BIOGENIC REDUCING HABITATS – A MODELING EFFORT

Large organic falls (LOF) consist of massive packages of organic matter (e.g., whale and wood falls) that reach the seafloor and cannot be ingested whole by benthic infauna or epifauna. Our presentation describes the anatomy of a LOF-processing model by deep sea floor communities. The proposed model incorporates two of the three stages of processing: (a) the fragmentation, ingestion, and digestive processing of LOF organic matter by benthopelagic metazoa, and (b) the dispersal of fragmented material to the sea floor sedimentary microbial communities. Two specific falls from the California Borderland Basins region are used as case studies to develop the proposed modeling concept. The availability of field data from the case studies regarding the characteristics of the falls, processing rates, and impact of fall processing on monitored parameters permitted the assessment of the model output. We discuss how linking this model output to multi-component reaction transport models allows the study of the development of biogenic reducing habitats as a result of the third and final stage of LOF processing: (c) the sedimentary microbial processing of LOF-derived organic matter.

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SIZE AND AGE SPECTRA OF MESOZOOPLANKTON IN THE OPEN OCEAN: THE DOMINANCE OF SMALL, YOUNG COPEPODS

Mesozooplankton are a critical component of marine pelagic food webs and are often used as early indicators of climate-driven ecosystem change. To accurately assess temporal and spatial change in mesozooplankton communities these populations must be sampled appropriately. However traditional sampling methods, e.g. plankton tows using a 200-µm mesh net, can systematically under-sample small species and juveniles. Here we compare a 12-y record of zooplankton collected with 200-µm and 64-µm mesh plankton nets to determine the importance of small copepods in the subtropical North Pacific. We find significant differences in the size spectra of "traditional" (200-µm) vs. smaller mesh (64-µm) nets, with plankton < 500-µm in most cases under-sampled by the larger mesh size. This size constraint affects the species and ages observed, with higher numbers of appendicularians, harpacticoid copepods (e.g., *Microsetella* spp.) and young, small calanoid (*Calocalanus* and *Paracalanus* spp.) and cyclopoid copepods (*Oithona* and *Onacea* spp.) found in the 64-µm net collections. We explore the 12-y dataset to determine if the loss of size, age and species information constrains our understanding of the zooplankton response to phytoplankton blooms, seasonal cycles and major ecosystem shifts.

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DEEP OCEAN SINKS FOR DISSOLVED ORGANIC CARBON

The ocean pool of dissolved organic matter contains 662 Pg C. Net DOC production occurs in the surface ocean, with eventual export to depth at a rate of about 2 Pg C/yr or 20% of total export production. Until now, our knowledge of dissolved organic carbon biogeochemistry on the global scale had been limited to few high precision measurements scattered widely across ocean basins. Here we employ a new, vastly enlarged global ocean data set (>20,000 measurements) to produce unprecedented resolution and insights on the distribution and dynamics of dissolved organic carbon. Highly resolved DOC concentration gradients in the deep ocean trace the flow of the thermohaline circulation, allowing characterization of the deep water masses by their DOC signatures. DOC removal rates in the deep are very slow, as evidenced by removal in the Pacific at a few nmol/kg/yr. This very slow removal may have both biotic and abiotic components, both of which need to be investigated.

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LARVAL GROWTH OF THE DOMINANT POLYCHAET POLYDORA CILIATA (L.) IS INDEED FOOD LIMITED IN A EUTROPHIC DANISH ESTUARY

The total biomass of meroplankton were similar or exceeded that of the holoplankters during spring-autumn in a eutrophic, shallow water Danish estuary, Isefjord. Hence, indicating a trophic significance of meroplankton as grazers in the studied estuary. We performed larval growth incubation experiments with the temporary and numerically dominant polychaete larvae Polydora ciliata successively from May to November in natural seawater as well as in enriched seawater by adding cultured prey algae in excess. This to answer if meroplankters were functionally food limited. During the study period the prey field was quantified using a FlowCAM and it changed in its taxonomic composition, cell sizes, and quantity. Despite of very high algal biomass abundances during most of the study period, Polydora ciliata larvae exhibited increased growth in 7 out of 8 treatments with added prey algae suggesting inadequate nutrition of the natural phytoplankton assemblage. The growth experiments were compiled with laboratory studies of particle retention, grazing and growth kinetics. We conclude that the trophic significance of the meroplankton in general should be considered in future carbon flow budgets for eutrophic boreal estuaries.

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ECOSYSTEM MANAGEMENT UNDER REGIME SHIFTS: EXPECTED AND UNEXPECTED CHANGES IN A DANISH COASTAL LAGOON, RINGKØBING FJORD

Ringkøbing Fjord is a coastal lagoon that has experienced several ecosystem changes due to variation in salinity and nutrient loading. The most recent occurred after 1995 when changes in the hydraulic control of water exchanges with the North Sea increased the salinity in the lagoon allowing the suspension-feeding clam, Mya arenaria, to settle and exert grazing control on the phytoplankton. Chlorophyll levels plummeted by more than an order of magnitude and secchi depths more than doubled. The intensification of benthic grazing changed the phytoplankton community from dominance of colony-forming cyanobacteria to dominance of fast-growing small centric diatoms. Further, the sediment biogeochemistry was modulated through increased bio-irrigation and reduced sedimentation. However, despite improved light conditions the submerged aquatic vegetation first declined and has recovered only lately, more than 10 years after the salinity change. The unpredictability of the ecosystem responses caused intense political debate on appropriate management actions with claims to revert the lagoon back to the phytoplankton dominated system. This study shows that small changes in the physical setting can lead to large cascading ecosystem changes with complex interactions.

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EFFECTS OF TEMPERATURE AND FOOD ON THE PRODUCTION OF CALANUS FINMARCICUS AND C. GLACIALIS BEFORE, DURING AND AFTER THE SPRING BLOOM IN WEST GREENLAND

Competition between the co-existing, Arctic lipid rich, Calanus glacialis and the, Atlantic thinner, C. finmarchicus in relation to climate changes is of major importance to understand the structure of the Arctic food web in a possible warmer future. To investigate the importance of the timing of break-up of sea ice and spring bloom development 3 experiment was carried out; before, during and after the bloom. The experiment focused on grazing activity and egg production of the two species at different temperature ranging from 0oC to 10oC, combined with absence or saturated food conditions. During each two-week experiment egg and fecal pellet production was monitored. Prior to the bloom the production was highest for C. glacialis in all treatments with increasing production from 0oC to 7,5oC and decreasing at higher temperatures. The highest production of C. finmarchicus was observed during the bloom and increased over the entire temperature span. In a future warmer climate the biomass of C. finmarchicus potentially could increase on the expense of other Calanus spp. with huge consequences for the productivity of the area.

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WITHIN AND BETWEEN COLONY VARIABILITY OF THE COMMUNITY COMPOSITION OF BACTERIA ASSOCIATED TO THE COLD-WATER CORAL MADREPORA OCULATA

Deep water coral ecosystems are more wide-spread, diverse and productive than previously thought, however, only little is know about their interaction with microorganisms. In this study, the within and between colony variability of the community composition of bacteria associated with the mucus and tissue of cold-water coral Madrepora oculata was evaluated using a 16S rRNA gene PCR and denaturing gradient gel electrophoresis (DGGE) approach. Bacterial community composition (BCC) clearly differed between living coral and reference samples (dead coral and surrounding water; 80% dissimilarity). Sequencing of bands showed that most detected phylotypes belonged to a gammaproteobacterial group most closely related (95-97% similarity based on the partial 16S rRNA gene sequence) to a Spongiobacter-type phylotype, which occurred in several clusters. A large within (35-40% dissimilarity between polyps) and between colony variability (ca. 50% dissimilarity) of BCC was detected. The high intraspecific variability found has consequences for selecting sampling strategies when assessing bacterial diversity and refines the question of controlling mechanisms of bacterial diversity on corals.

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EUROPEAN PROJECT ON OCEAN ACIDIFICATION (EPOCA)

The European Project on OCean Acidification (EPOCA) was launched in May 2008 with the overall goal to advance our understanding of the biological, ecological, biogeochemical, and societal implications of ocean acidification. Its consortium includes 107 principal investigators from 27 institutes. The research efforts of this 4-year long project are divided into four themes. Theme 1 focuses on past and present spatiotemporal changes in ocean chemistry and biogeography of key marine organisms. Paleo-reconstruction methods are used on several archives to determine past variability in ocean chemistry and to tie these to present-day observations. Theme 2 studies the impacts of ocean acidification on marine organisms and ecosystems. Molecular, physiological and ecological approaches are used to study climate-relevant biogeochemical processes, including calcification, primary production and nitrogen fixation. Theme 3 will integrate results from themes 1 and 2 in biogeochemical, sediment, and coupled ocean-climate models to project future responses of the Earth system to ocean acidification. Finally, theme 4 will evaluate uncertainties, risks and thresholds ("tipping points") related to ocean acidification and assess the decrease in CO_2 emissions required to avoid such thresholds.

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MNEMIOPSIS LEIDYI: SIZE SPECIFIC CLEARANCE RATES AND PREDATORY IMPACT IN A SWEDISH FIORD

The ctenophore Mnemiopsis leidyi was first sighted in Northern Europe a few years ago. Since then there has been great concern how the advent of this voracious feeder may affect the existing plankton community. One approach to evaluate this is to calculate Mnemiopsis population clearance potential from data on predator concentration and individual clearance rates. We measured the size specific clearance rates of Mnemiopsis using different prey types. Repeated day-night sampling at different depths in the Gullmarsfjorden gave a picture of the Mnemiopsis-concentration in late August 2008. Total ctenophore concentrations were high but heavily dominated by the smallest size fractions. Still, the estimated population clearance of Mnemiopsis was high enough to alter the late summer plankton composition in the study area.

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THE ROLE OF HETEROTROPHIC PROTISTS AS AN INTERMEDIARY LINK BETWEEN PHYTOPLANKTON AND COPEPODS- A STOICHIOMETRIC STUDY

Primary producers show a large flexibility in their nutrient stoichiometry under different growing conditions. In contrast, most heterotrophic organisms are much more homeostatic, and have a much more constant stoichiometry of carbon, nitrogen and phosphorus. Consequently, many consumers face the problem of sub-optimal feeding conditions, especially late in a phytoplankton bloom, when the nutrient content of the algae decreases relative to the carbon content. These nutrient-limited (high C:nutrient ratio) algae can have significant negative effects on growth and reproduction of the consumers, as these have to rid themselves of the excess carbon. Heterotrophic protists are important grazers on autotrophic components of the plankton and simultaneously are consumed by a number of copepod species. Despite this importance, relatively little is known of their reactions to food of different quality, or their ability to maintain homeostasis. Hence, we studied the effect of differently cultured algae on Oxyrrhis marina, a phagotrophic protist, as well as the effect of these differently fed protists on the development of the copepod Acartia tonsa, and observed that homeostasis in O. marina is far from perfect.

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TRACKING CARBON AND NITROGEN FLOW THROUGH THE SEDIMENT MICROBIAL COMMUNITY OF A SHALLOW SUBTIDAL LAGOON

Sediments in shallow coastal bays are sites of intense biogeochemical cycling facilitated by a complex microbial consortium. Unlike deeper estuaries, much of the benthos is illuminated by sunlight in these bays. As a result, benthic autotrophs such as benthic microalgae (BMA) and macroalgae play an integral role in nutrient cycling. Investigating pathways of carbon (C) and nitrogen (N) flow through individual compartments within the sediment microbial community has previously proved challenging due to methodological difficulties. It is now possible using stable isotopes and microbial biomarkers such as fatty and amino acids to track C and N flow through individual microbial pools. We investigated the uptake and retention of C and N by bacteria and BMA in a shallow subtidal system. Using bulk and compound specific isotopic analysis, we traced the pathways of dissolved inorganic 13C and 15N under various treatments: 1) in ambient light or dark, 2) from porewater or water column sources, and 3) in the presence or absence of bloom forming nuisance macroalgae. Our results support a tight coupling between BMA and bacteria in shallow illuminated systems.

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SEASONAL AND INTERANNUAL VARIABILITY IN SIZE-SPECIFIC PRIMARY PRODUCTION OF EASTERN BOUNDARY UPWELLING ZONES DERIVED FROM SATELLITE OCEAN COLOUR

Availability of phytoplankton in suitable size ranges is an important factor for success of first-feeding larvae of small pelagic fish. Phytoplankton size classes (PSCs) and size-specific primary production (sPP) for the Canary, Benguela, California and Humboldt eastern boundary upwelling regions are estimated from remotely-sensed ocean colour without reference to chlorophyll-a as an input. The optical absorption coefficient of phytoplankton derived by ocean colour inversion was used to link PSCs to primary production. Satellite observation of PSCs and sPP showed a dominance of nano- and microplankton in the upwelling zones, and found that sPP per volume estimated from satellite is largest for microplankton whereas area-integrated sPP is largest for nanoplankton in these regions. A 10-year time series of PSCs and sPP derived from satellite ocean colour showed long-term trends in sPP over the last decade (1998-2007). Analysis of intra-annual variability showed the annual cycle of sPP by nano- and microplankton was approximately in phase for the Canary, California and Humboldt regions, with microplankton lagging nanoplankton by <6 weeks, whereas for the Benguela they were completely out of phase.

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TOWARDS A COMPREHENSIVE C-BUDGETING APPROACH OF A COCCOLITHOPHORID BLOOM IN THE NORTHERN BAY OF BISCAY (JUNE 2006)

A biogeochemical multidisciplinary survey was carried out in the northern Bay of Biscay, in early June 2006, during which ^{14}C-based primary production and calcification were determined as well as O_2-based community respiration. Contemporary remote sensing images showed several patches of high reflectance (HR) in the investigated area. Based on remote sensing and in situ measured biogeochemical parameters, the area exhibited varying coccolithophorid bloom stages from its early development to the post-bloom stages. The major HR patch, characterizing a post-stationary stage of the bloom, was located between 48°N and 49°N over the shelf along the continental margin. It was associated with moderate chlorophyll-a levels, never exceeding 1.0 µg L^{-1}, dissolved phosphorus and silica depletion, and undersaturation of CO_2 with respect to atmospheric equilibrium. Considered as the main drivers of the C cycle in this area, the CO_2 fluxes associated with primary production, calcification and respiration were integrated in order to provide a comprehensive C budget in the area.

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DEVELOPMENT OF A POLARIZATION-BASED ATMOSPHERIC CORRECTION ALGORITHM FOR OPEN OCEAN WATERS. APPLICATION TO PARASOL SATELLITE SENSOR

Recent studies showed that the polarized satellite radiance in the blue is nearly insensitive to phytoplankton concentration for open ocean waters. Thus, an original atmospheric correction algorithm is developed to improve the retrieval accuracy of oceanic parameters. The new atmospheric correction algorithm consists in two steps. The first step focuses on the retrieval of atmospheric parameters using the influence of directional properties of the aerosols (including the non spherical aerosols) on the polarized and unpolarized radiance. The second step of the algorithm deals with the retrieval of the marine reflectance using a coupled atmosphere-ocean radiative transfer model that includes the polarization state of light. The algorithm is applied to PARASOL satellite sensor (CNES). As a validation, comparisons of marine reflectances derived from PARASOL atmospherically corrected images with in situ measurements and other satellite data are performed. Note that the proposed atmospheric correction algorithm might be extended to any sensors capable of measuring the directionality and polarization from space such as the Aerosol Polarimetry Sensor which will be shortly launched on the Glory (NASA) satellite.

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CHARACTERIZING TEMPERATURE REGIMES OF NW MEDITERRANEAN COASTAL WATERS TO BETTER UNDERSTAND THE RESPONSES OF BENTHIC COMMUNITIES TO CLIMATE CHANGE

In order to better understand the potential responses of benthic communities to the current climate change in the NW Mediterranean coastal areas, temperature regimes of coastal waters (5-40 m depth) were characterized through the analysis of high resolution time series (hourly measurements). Since 1998, temperature recorders were progressively deployed at 8 sites encompassing different areas in the NW Mediterranean. Temperature regimes shared the seasonal dynamics associated to NW Mediterranean waters. However, the inter-annual study of temperature series allowed to detect specific patterns (mean and variability) for each site. These patterns show contrasted temperature conditions to which the populations could have been adapted to. Furthermore, the temperature series allowed to characterize the 1999, 2003 and 2006 positive anomalies which were related to the occurrence of large-scale mortality events of key structuring species. These events confirmed that populations may be submitted to their upper thermal thresholds and are very sensitive to extreme temperatures. Overall, the study of temperature regimes coupled to the response of populations to temperature warming are key to anticipate the future of coastal communities under the current climatic projections.

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MESOZOOPLANKTON GRAZING IMPACT ON PROTISTS AND GRAZER-MEDIATED CARBON FLUX DURING SPRING BLOOM IN TWO COASTAL ATLANTIC SEMI-ENCLOSED BAYS

Protists in aquatic environments play an essential role in the carbon flux from nutrients and microbial matter to higher trophic levels. To assess the importance of mesozooplankton – mediated carbon transfer of microbial matter during spring blooms, we compared the grazing impact through bottle experiments in Arcachon and Marennes-Oléron Bays (French Atlantic Coast), of different dynamic regimes. Predators were cirriped nauplii (both bays) and dominant copepods (*Parapontella brevicornis, Euterprina acutifrons* in Arcachon bay and *Centropages hamatus* plus a grazer mix in Marennes bay). In both bays, all grazers were omnivores, yet significantly preferring large ciliates. Loricate ciliates were rejected; other cells (diatoms, dinoflagellates, nanoflagellates) were grazed in proportion to their abundance. Grazing impact of cirriped nauplii was similar to or greater than that of copepods. Due to their great seasonal biomass, diatoms in both bays provided most of the daily carbon rations (65-84% d^{-1}), followed by ciliates (9-20%), and nanoflagellates (2-6%). Daily carbon flux due to mesozooplankton grazing was significantly greater in Arcachon than in Marennes, suggesting a potentially greater participation of detritus and microbial-based fluxes in Marennes during spring bloom.

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IS THE COMPETITION BETWEEN ROTIFERS INFLUENCED BY THE NUTRITION MODE OF THE OSMO-MIXOTROPHIC FLAGELLATE *CHLAMYDOMONAS ACIDOPHILA*?

Mixotrophy is the widespread ability of organisms to acquire carbon through both photosynthesis and via uptake of organic material. The nutrition mode (auto-, mixo-, heterotrophic) influences for instance the biochemical composition of flagellates. The potential impact of such biochemical changes in mixotrophic flagellates on the competitive behavior of their consumers (rotifers) was investigated. In laboratory experiments, the osmo-mixotrophic flagellate *Chlamydomonas acidophila* was fed two rotifer species (*Elosa worallii, Cephalodella* sp.). *C. acidophila* was cultivated auto- and mixotrophic at two light intensities as well as heterotrophic. In semi-continuous cultures, the growth rates of the rotifers both with and without competition were investigated. The competition between the species was influenced by the nutrition mode of *C. acidophila*: the larger the amount of heterotrophy in the nutrition of *C. acidophila* the lower the competitive strength of *E. worallii*. This behavior can lead to a vertical niche seperation of *Cephalodella* sp. and *E. worallii*, as observed in the field.

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DISTRIBUTION AND SWIMMING BEHAVIORS OF HETEROTROPHIC PROTIST PREDATORS IN RESPONSE TO THE TOXIC RAPHIDOPHYTE ALGA *HETEROSIGMA AKASHIWO*

We tested the hypothesis that avoidance of the prey alga *Heterosigma akashiwo* by potential protist predators reduces prey mortality and results in the accumulation of cells and formation of harmful algal blooms. In the laboratory, we exposed the marine ciliate *Favella ehrenbergii* and two heterotrophic dinoflagellate species (*Oxyrrhis marina*, *Gyrodinium dominans*) to discrete layers of *H.akashiwo* at concentrations known to kill fish. In a 30cm/1L tank, *H.akashiwo* aggregated at the halocline within 15min. Using video and image-analysis, the population distributions, 3D-movements, and dispersal rates of protist predators and *H.akashiwo* were quantified hourly throughout the tank. After 4h, the majority of predators aggregated to the halocline, regardless of the presence of *H.akashiwo*. Similarly, *H.akashiwo* distribution did not change in response to the presence of predators. These results suggest that neither dinoflagellate nor ciliate species avoided *H.akashiwo* layers and that the prey species showed no predator avoidance. Therefore, the potential for grazing interactions exist and other mechanisms, aside from avoidance behaviors (e.g. reduced feeding rate), must account for decreases in cell loss, leading to the formation of harmful algal blooms.

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FLUORESCENCE YIELD IN NATURAL DIATOM ASSEMBLAGES – A CONSTANT RATIO OF MULTIPLE VERSUS SINGLE TURNOVER

The fluorescence response of phytoplankton to single and multiple turnover flashes is still not fully understood. In the past, either one or the other method was applied depending on the instrument that was used. Only recently, instruments became available that allow direct comparisons of both approaches. Here, we investigate the variable over maximum fluorescence response (Fv/Fm) of natural phytoplankton assemblages on both. Consistent measurements were performed using a Xe-PAM (Walz, Germany) that was set up for single as well as for multiple turnover flash applications. A set of single turnover flashes was applied, immediately followed by a set of multiple turnover flashes on identical phytoplankton samples. Our study comprises phytoplankton samples from temperate and subtropical regions and of different physiological state. Samples were collected in the North Sea, the North Atlantic, and the Gulf of Aqaba. The phytoplankton community was in all cases dominated by diatoms. During the GAP 8 workshop in Eilat, Israel, nutrient enrichment bioassays were performed. Phytoplankton in the Gulf of Aqaba revealed a physiological response to nutrient additions by an increase in Fv/Fm. Despite all these differences, including natural phytoplankton samples with and without nutrient additions, we found a remarkably constant relationship in the Fv/Fm response between multiple and single turnover flashes for diatom dominated phytoplankton. Implications of these findings are discussed.

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UPWARD NUTRIENT TRANSPORT BY *DAPHNIA* VERTICAL MIGRATION

In pelagic systems a continuous downward nutrient flux is caused by sinking organisms due to gravity; nutrients thereby are concentrated in deeper water layers. During stagnation periods of the water column, physical upward transport processes are unlikely, which could result in a shortage of nutrients in the epilimnion. Excretions of zooplankton, performing diel vertical migration (DVM), could lead to an upward nutrient transport and a nutrient enrichment for phytoplankton in the epilimnion. We examined the upward transport of phosphorus by *Daphnia* DVM experimentally in large indoor mesocosms. For an exact quantification of the phosphorus transport, we used the radioactive tracer ^{33}P. The results show that *Daphnia* DVM could be a mechanism for an upward nutrient transport. During daytime where all daphnids remained in the hypolimnion, no phosphorus transport from the hypolimnion to the epilimnion took place. At the beginning of the nighttime and starting upward migration of the daphnids, a continuous increase of the phosphorus concentration in the epilimnion could be measured.

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PALEO-RECONSTRUCTION OF POST-SETTELMENT DEGRADATION OF WATER QAULITY UNDER INTENSIVE AGRICULTURE

Intensive agricultural practices have had dramatic effects on natural lakes by drastically increasing rates of nutrient and sediment loading. Concerns involving increasing rates of eutrophication as well as a lack of empirical evidence regarding historical water quality in these systems have generated interest in quantifying ecological changes since European settlement. Diatom and loss on ignition stratigraphy has been used in previous regional studies as paleo-indicators of changing trends in trophic status. Similar analyses were applied to three lakes in Northwest Iowa (the most intensively agricultural region in the world) using sediment cores taken from the deepest basin of each lake. In addition, sediment accumulation rates and sediment dating were calculated using the 210-Pb constant rate of supply model. Preliminary results suggest the arrival of Europeans to the region, and the effects of their subsequent land alteration, are reflected in the sediment record by tenfold increases in sedimentation rates, an increasing abundance of diatom species found within eutrophic ecosystems, and a sharp rise in percent inorganic matter.

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NITROGEN DYNAMICS IN A SPRING-FED FLORIDA RIVER

Mechanistic understanding of nitrogen (N) removal in large rivers lags behind that in small streams. Here we describe spatial and temporal dynamics of N removal in the spring-fed Ichetucknee River, Florida, USA, and evaluate factors that influence N removal. In addition, we use high-resolution *in situ* measurements of nitrate (NO_3) and dissolved oxygen (DO) to evaluate assimilation as a mechanism of N removal. Over a twenty-year period, NO_3-N removal averaged 116 kg N d^{-1} (0.75 g N m^{-2} d^{-1}) over the upper 4.5 km of the river. Relationships between discharge and N removal indicate floodplain N retention at high flows, while longitudinal patterns suggest that N removal is strongly influenced by channel morphology. N assimilation estimated from diel NO_3 variation and gross primary productivity (GPP) agreed closely but accounted for <10% of N removal, supporting denitrification as the primary mechanism of N loss. In comparison to rivers of similar hydraulic geometry, N removal efficiency is extremely high in the Ichetucknee. Hydrologic connectivity with hyporheic and floodplain sediments plays a larger role in spring-fed rivers of northern Florida than previously thought.

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THE ROLE OF THE MICROBIAL LOOP IN BLOOMS OF THE TOXIC DINOFLAGELLATE KARENIA BREVIS IN THE EASTERN GULF OF MEXICO

Annually recurring blooms of the toxic dinoflagellate *Karenia brevis* cause significant economic and ecological damage in the eastern Gulf of Mexico. We tested the hypothesis that nutrient recycling through the microbial loop is important in sustaining these long-lasting, high-biomass blooms by examining size fractionated bacterial and primary production and phosphorus regeneration within 4 *K. brevis* coastal blooms of varying size, maximum cell concentrations and severity. At bloom concentrations of up to 3 x 10^5 *K. brevis* cells L^{-1}, the contribution by the 0.7 – 3.0 um fraction of the plankton to primary productivity was positively correlated with increasing *K. brevis* concentration. At higher *K. brevis* concentrations, the contribution of the smaller fraction was relatively constant at approximately 60%. Phosphorus regeneration rates within blooms at the lower *K. brevis* concentrations were dominated by > 64 um zooplankton, shifting to the 0.7-3.0 um fraction at the higher bloom concentrations. These data suggest that the microbial loop contributes significantly to the maintenance of larger *K. brevis* blooms through changes in food webs and nutrient cycling that occur with increasing *K. brevis* concentrations.

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BIOGEOCHEMICAL FEEDBACKS IN OLIGOTROPHIC OCEAN WATER TO ATMOSPHERIC TRACE METAL INPUTS

Some trace metals (TMs) are essential for planktonic microorganisms and thus involved in organic matter synthesis and regeneration processes according to the Redfield model, while the biogeochemical cycling of other TMs is more governed by passive scavenging processes. We present here data of a recently finished 18 month survey (July 2007-December 2008) of TMs distributions (Ag, Cd, Co, Cu, Ni) of the upper 500m of a 2200m deep water column in the centre of the Ligurian gyre, Western Mediterranean. This LNLC region is characterised by a long stratification period during which surface waters are nutrient depleted. Cd (0.08-0.20 nM) and Ag (2.8 – 17 pM) depicted conservative profiles with seasonal variations, while Cu (0.9 - 2.7 nM) and Ni (3.4 - 5.5 nM) depicted typical nutrient like profiles. Despite its known bioactive character, Co depicted a scavenged-like profile (31-133 pM) which suggests high atmospheric inputs in comparison to the biological uptake. The mechanisms controlling biogeochemical cycling of TMs (atmospheric inputs, physical forcing and interactions with planktonic microorganisms) are discussed according to their physicochemical properties and their biological importance.

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NUTRIENT CYCLING IN COMPLEX RIVER FLOODPLAIN SYSTEMS: WATER AND SEDIMENT PROCESSES

Riparian zones and floodplains are key components within river ecosystems controlling nutrient cycling by promoting transformation processes and thus, act as biogeochemical hot spots. Especially these areas have been altered by river regulation and land use changes over the last 200 years leading to the deterioration of the functioning of these systems. These consequences have prompted rehabilitation and restoration measures of riparian zones and riverine wetlands which aim to increase the spatial heterogeneity, the complexity, of these ecosystems. Yet, a more integrated approach is needed considering the present status of nutrient dynamics and the effects of measures within large-scale rehabilitation and restoration projects. The presented paper analyses the effects of river side-arm restoration on ecosystem functions within the side-arm and highlights potential effects on the main channel in a large river, the Danube River. We demonstrate that principles of hydromorphological dynamics control nutrient cycling in the water column and sediment compartments. These findings confirm the environmental control on these processes and their potential use as proxies to assess the consequences of hydrological changes by restoration measures on river ecosystem functioning.

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THE EFFECT OF PH ON FRESHWATER ALPHAPROTEOBACTERIA AND FRESHWATER SAR-11

Recent studies suggest that Alphaproteobacteria are crucial components in freshwater microbial communities. Despite the frequent detection of the freshwater sister group of the ubiquitous marine SAR-11 group, no investigations have assessed the distribution and diversity of this group in different lakes or identified the environmental factors controlling its abundance. Effects of pH on abundance and community structure of Alphaproteobacteria were studied in a field study combined with a laboratory experiment. Eight Swedish lakes ranging in pH from 5 to 8 were analyzed for Alphaproteobacteria using 16S rRNA analysis and CARD-FISH. Alphaproteobacteria abundance increased with pH and sometimes approached 40% of eubacteria. Clone libraries and Alphaproteobacteria-specific T-RFLP suggested that freshwater SAR-11 were strongly positively correlated to pH and both methods indicated that Alphaproteobacteria prefer high pH environments.

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HOW OLD IS MARINE SEDIMENT AT THE BURIAL STAGE?

A method for predicting the ages of solid sediment compounds with respect to their ``deposition vintage year'' onto the sediment surface is presented within the framework of the global biogeochemical ocean general circulation model HAMOCC. The simulation of the time dependent age distribution in the sediment mixed layer and in the eventually accumulating sediment will enable the proper data assimilation of marine sediment core data into predictive climate models at a later stage. The age simulation is based on a passive tracer transport method taking into account varying vertical advection rates within the sediment top layers, chemical pore water reactions, as well as bioturbation. It turns out that different weight fractions of the modelled sediment have different ages in one horizontal geometric depth-in-core level depending on location, the particle rain onto the sediment, and the reactivity of the material within the sediment pore waters. The impact of varying reaction rates and bioturbation rates on the age structure of marine sediment is tested, opening the perspective to inversely estimated those parameters from real sediment cores.

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FINE SCALE COASTAL WIND PATTERNS AND THEIR EFFECT ON LARVAL DISTRIBUTIONS

Winds are often the most important forcing mechanism for currents in the pelagic ocean, and they affect the transport and spatial distribution of plankton including fish larvae and eggs. Spatial and temporal variations in winds force corresponding variations in currents. This is especially important in coastal regions where orography modifies winds and bathymetry modulates currents. For management applications like surveying the number of eggs in a bay, the spatial-temporal variability in egg concentration can be extremely important. Consequently, ocean models used to predict egg drift should be forced by realistic wind fields. We report here on the use of RADARSAT-1 SAR imagery to derive temporally varying fine scale spatial wind patterns in two Newfoundland bays. These patterns were used to drive an ocean model to simulate spatial distribution of eggs for a number of scenarios. The importance of using spatially and temporally variable winds is discussed as is the feasibility of this approach.

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IN VITRO-CELL-BASED ASSAYS FOR THE DETERMINATION OF TOXIC EFFECTS OF NORTHERN SCYPHOZOAN SPECIES CYANEA SPEC. AND AURELIA AURITA

Scyphozoa as a major component of gelatinous zooplankton communities express successful foraging behaviour and may impact fish larvae and small fish especially when they occur in masses. The predation impact and severe toxic effects on fish are still under investigation. The present investigation compares the toxic potential of two Cyanea species and the Moon Jelly Aurelia aurita, their different toxigenic organs and of various organism sizes on the basis of the cytotoxic activity. A rainbow trout gill cell line is utilized as an indicator for ichthyotoxic effects. Cultures of gill cells were exposed to whole fishing tentacle venom at different protein concentrations. Dose depended morphological changes in cell growth as well as viability responses of the affected cells are documented. Morphological changes can be observed within 1h after treatment above concentration of 0,05µg/mL. Detachment, clumping and lysis occur in a dose dependent manor. Further cell – based in vitro assays will be introduced as prolific methods to evaluate the toxic potential and variety of cytotoxic effects of Scyphozoa.

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DEVELOPMENT OF DNA MICROSATELLITE MARKERS FOR THE GENETIC ANALYSIS OF BYTHOTREPHES LONGIMANUS INVASIONS OF MINNESOTA (USA) LAKES

The spiny waterflea (*Bythotrephes longimanus*) is a zooplankter that invaded the Laurentian Great Lakes in the 1980s and has recently expanded its range into several inland lakes and rivers in northern Minnesota, USA. Genetic analyses of *Bythotrephes* populations using molecular markers may allow the pathway by which this species is spreading to be identified, and enable natural resource managers to focus their control efforts on water bodies that are the major sources (hubs) for new invasions. Five DNA microsatellite (simple sequence repeat – SSR) loci for *Bythotrephes* have been identified by a previous study, but additional SSR loci are needed to elucidate the genetic relationships among closely related populations. In preparation for a multi-population study of invaded water bodies inland of the Great Lakes, we are using the PIMA (PCR-based isolation of microsatellite arrays) method to develop additional SSR markers. Our presentation will report on progress in the development of new SSR markers and how the genetic composition of one inland lake population in Minnesota (Island Lake) compares to that of Great Lake populations of *Bythotrephes*.

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OBSERVATIONS OF TROPICAL SPONGE EXCURRENT JETS: SPATIAL STRUCTURE AND ENVIRONMENTAL FACTORS AFFECTING PUMPING RATES

On many tropical reefs, sponges play a significant role in benthic-pelagic coupling and modify a reef's bottom boundary layer. Water drawn into a sponge is taken from a relatively broad area, processed by the sponge, and expelled in strong excurrent jet(s). In 2006 and 2007 we made in situ measurements of flow structure and dissolved oxygen (O_2) over Xestospongia muta (Giant Barrel Sponge) individuals. ADVs and O_2 sensors were systematically moved in a grid pattern to construct velocity and O_2 plume fields. Each excurrent forms both a momentum jet (with velocities >10 cm/s) and a scalar plume, with physical and chemical properties distinct from ambient water; both interact with the ambient cross-flow. In a second set of measurements, the relationship between sponge pumping rates and ambient environmental conditions was investigated using multi-day time-series of temperature, salinity, O_2, PAR, and turbidity. Pumping rates were relatively insensitive to the measured environmental conditions. The records include periods of reduced pumping and decreased excurrent O_2 occurring synchronously between individuals, and a day-night cycle in excurrent O_2 likely associated with the sponges' autotrophic symbionts.

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MODELING CORAL BLEACHING USING MULTIPLE ENVIRONMENTAL PARAMETERS

NOAA's Integrated Coral Observing Network (ICON) Program obtains meteorological and in situ oceanographic data hourly in near real-time, and utilizes these data to produce ecological forecasts, such as for coral bleaching. A data-driven expert system shell called G2 (Gensym, Inc.) and custom programming have been utilized to integrate in situ, satellite and other data sources, including Pulse Amplitude Modulating (PAM) fluorometry, to model the relative influence of not only sea temperature, but light and wind on coral bleaching through a Stimulus/Response Index. Other influences such as onshore flux can also be included in these models. Forecasts are validated from collaborators and ICON in situ station maintainers in the field. Results obtained from three different in situ networks and from satellite data show the forecasts are usually successful. Results from PAM fluorometry trials in the Bahamas indicate the role of not only high sea temperature, but high doses of solar radiation (both visible and ultraviolet), though further study is indicated. Results from the PAM study also showed a detection of coral bleaching stress before traditional satellite predictions.

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DETERMINATION OF FATTY ACID CONCENTRATIONS IN FRESHWATER MUSSELS AND SEDIMENTS IN A MISSISSIPPI RIVER TRIBUTARY USING GAS CHROMATOGRAPHY-MASS SPECTROMETRY

The Tyronza River, located in Northeastern Arkansas is a reservoir for many pesticides and fertilizers used in the agricultural cultivation of cotton and soybeans. Here previous data shows that nutrient loading combined with agricultural run-off and sediment loading has significantly decreased water quality and in-stream habitat. Adaptation to these conditions by freshwater mussels suggests that they not only thrive in these conditions but, are functional components of the nutrient biogeochemical cycles mitigating some of the loading effects. Many aquatic organisms, as a response to increased contamination excrete fatty acids into the water systems. These fatty acids often accumulate in the sediments. Filter feeding organisms, such as mussels, accumulate these fatty acids and store them as nutrients in their tissues. Mussel and sediment samples were collected from a section of the Tyronza River. Fatty acids in the form of methyl esters were extracted from the sediments and mussel tissues. Using GC-MS, fatty acid concentrations was shown to increase from the upper to the lower portion of the river which is an indication of fatty acid concentration increasing with nutrient load.

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CONTRASTING HYDRODYNAMICS AND PARTICLE TRAPPING RATES IN SUBMERGED VEGETATION

Mediterranean seagrass meadows are experiencing widespread decline while both endemic and invading algal species like e.g. Caulerpa are expanding their ranges. This affects the hydrodynamic properties of the seafloor, since Caulerpa canopies differ in height, stiffness and density from seagrasses canopies. Here we evaluate the effects of various canopy structures on hydrodynamics and particle trapping capacities. Hydrodynamic properties and particle-trapping rates were measured under controlled circumstances on laboratory scales using a racetrack flume. Volumetric flow rates, Turbulent kinetic energy profiles and integrated total Reynolds stresses in the water column above the canopies were studied in relation with canopy structure. Particle retention was separated in background retention and effective retention for the canopy area. We modeled retention rates by canopies (kv) and found correlations with shear velocities above the meadows. Retention was corrected for m^2 leaf area, to evaluate capture efficiency of the macrophytes. We discuss possible implications of our laboratory results on coastal scales. Effectively, replacement of seagrasses by Caulerpa species should have a limited effect on particle retention properties of the ecosystem.

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ALTERNATIVE BLEACHING MECHANISMS DRIVE LONG TERM CHANGES IN CORAL COMMUNITY STRUCTURE

Bleaching is generally defined as a loss of colour, either through decreased *Symbiodinium* density or down-regulated chlorophyll *a*; as such, all corals can potentially bleach. Here, using data collected from the Seychelles, we provide evidence that reef community structure is dependent upon the predominant (inherent) bleaching mechanism. During long term heat stress experiments, two bleaching responses were observed (assessed using fluorometry, absorption and metabolism data): catastrophic and non-reversible sloughing of host tissue containing zooxanthellae off the skeleton (Type 1), or chronic gradual down-regulation of zooxanthellae photosynthesis within intact host tissue on the coral (Type 2). We interpret these bleaching responses within an ecological and evolutionary context: Type 1 corals grow rapidly, have low tolerance but high short term reproductive output. Type 2 corals grow slowly, have high tolerance and therefore high long term reproductive output. Having survived recent catastrophic environmental events, Type 2 corals consequently dominate large size fractions of coral size frequency distribution. Both bleaching responses are evolutionarily viable but understanding the mechanisms behind these responses is critical for future reef conservation.

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MODELLING FEEDBACK MECHANISMS IN CYANOBACTERIA-DRIVEN SYSTEMS

While we have some understanding about the influence of physical processes on biological variables, our knowledge about biological-physical feedback loops in marine ecosystems is scarce. In this model study the impact of cyanobacteria on their environment and life cycle stages is assessed by a coupled biological-physical model. Several positive and negative feedback loops are identified including a short temperature-cyanobacteria-temperature loop which is embedded into longer ones running on the seasonal time scale. The short positive feedback loop leads to an increase of cyanobacteria and a simultaneous decrease of eukaryotic phytoplankton biomass in summer. However, the induced changes in the nutrient and temperature field result in enhanced eukaryotic phytoplankton growth in autumn, which degrades winter light conditions for resting spores of cyanobacteria. Nevertheless, positive feedback prevails and overall, cyanobacteria gain from their own presence. This study emphasizes the importance of considering species and life cycle characteristics in studies dealing with feedback mechanisms.

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MOVEMENT AND SITE FIDELITY OF TWO SPARID FISHES (DENTEX DENTEX AND DIPLODUS SARGUS) IN A MEDITERRANEAN MPA. DOES SPILLOVER OCURR?

Marine reserves are being used as a resource management tool for the conservation of marine fish populations and potentially improve fisheries by spillover to adjacent areas. Many studies have used visual census techniques to determine if spillover has occurred in MPAs, but results have not been conclusive because visual surveys do not directly measure fish movements. Acoustic tracking technologies allow us to directly measure spillover by tracking individuals and indirectly estimate spillover by determining the home range of a group of individuals. Additionally, acoustic tracking technologies provide information about the life history of a species, such as diel movements or site fidelity. Using acoustic tagging techniques, we tagged and monitored 40 individuals of two species of sparid fishes with different live histories (Dentex dentex and Diplodus sargus) to determine their patterns of movement, site fidelity and their residence time inside the Medes Islands MPA (Catalonia, Spain). Results after one year of monitoring showed that both species exhibited relatively small movements and high site fidelity, showing a low flow of individuals between inside and outside the MPA.

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DISSOLVED INORGANIC CARBON FIXATION IN THE DEEP NORTH ATLANTIC: SIGNIFICANCE OF AUTOTROPHIC MICROBES IN THE OXYGENATED NORTH ATLANTIC DEEP WATERS.

Heterotrophic prokaryotic growth in the interior of the ocean is mainly supported by the organic matter exported from the euphotic zone with most of the exported particulate and dissolved organic matter remineralized in the mesopelagic water column. Recently, it has been shown that prokaryotic growth in the dark ocean of the North Atlantic might exceed particulate organic carbon supply. This suggests that carbon and energy sources other than organic matter might be utilized by prokaryotic plankton as well in the oxygenated water column of the meso- and bathypelagic ocean. Prokaryotic fixation of dissolved inorganic carbon (DIC) amounts to about 15 % of the organic matter reaching the dark North Atlantic. While Marine Crenarchaeota Group I are responsible for a substantial DIC fixation in the mesopelagic waters, DIC fixation in the bathypelagic waters was essentially limited to Bacteria as revealed by MICRO-CARD-FISH. This hitherto unrecognized sink for DIC represents a source of autochthonously produced 'primary production' for the ocean's interior and hence, might substantially contribute to the organic carbon cycled in the deep-water microbial food webs.

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RELATIONSHIP BETWEEN AARS ACTIVITY AND GROWTH RATE OF PARACARTIA GRANI NAUPLII AT DIFFERENT TEMPERATURES

The activity of the enzymes aminoacyl-tRNA synthetases (AARS) in naupliar stages of the planktonic marine copepod Paracartia grani was studied at different temperatures (12, 16, 20, 24, 26 and 28°C) in the laboratory. The aim of this work consisted on the validation of the AARS method (Yebra and Hernández-León, 2004) as an index of in situ growth for the early naupliar stages. This method is simple and inexpensive and does not need especial laboratory equipment, therefore, suitable for oceanographic studies. The nauplii were reared feeding on saturating concentrations (1000-3642 cells•ml-1) of the flagellate Oxyrrhis marina in a 12h light-dark cycle. Measurements of somatic growth rate and enzymatic activity were compared at the different temperatures. Specific AARS activity showed a highly significant correlation ($r2=0.96$, $p<0.05$) with the direct measurement of growth rates in the laboratory.

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PRODUCTION, OXIDATION, AND UTILIZATION OF METHANE-DERIVED CARBON IN ARCTIC LAKES

CH4 is produced in lake sediments and CH4-derived carbon is a potential carbon source for consumers, especially larval Chironomus. Although this result has been reported in several lakes in recent years, there has been little study OF variability in the importance of methane-derived carbon in Chironomus across oligotrophic lake ecosystems. In a survey of lakes in the Arctic Foothills region of Alaska in the vicinity of Toolik Lake, we found considerable variability in DOC concentration, del 13C DOC, and del 13C of larval Chironomus. In laboratory experiments using intact sediment cores, methane production and oxidation varied across lakes, and Chironomus del 13C was lower in lakes where there was more methane oxidation. Chironomus del 13C was negatively correlated with DOC concentration. These results suggest that variability in landscape loading of DOC determines variability in methanogenesis, which thereby affects utilization of methane-derived carbon in the foodweb.

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IMPACT OF DUST ON NITROGEN FIXATION RATES IN SURFACE SEAWATER OF THE SE MEDITERRANEAN

Studies have shown that, in the long-term, dry atmospheric deposition is an important net supplier of N, P, Fe and other trace metals to the Low Nutrient Low Chlorophyll Eastern Mediterranean Sea (EMS). Significant quantities of leachable nutrients from dry atmospheric inputs become potentially bioavailable. Recent nutrient budgets for the EMS suggest that a high percentage of these nutrients are exported by the anti-estuarine circulation through the Sicily straits while the rest are probably important drivers for the unusual high N:P ratios in the EMS deep water. Nitrogen fixation has been suggested as one of the potential processes generating the high N:P ratios. Such N fixation is generally triggered in areas of relatively high Fe and/or P supply. Because both nutrients are supplied to the EMS via atmospheric deposition, preliminary on-board microcosm experiments (autumn and winter) were conducted to follow the impact of dust addition on nitrogen fixation rates. Preliminary results show low nitrogen fixation rates in both treatments of dust and N+P additions, perhaps reflecting seasonally low requirements for N-fixation when nutrient availability is enhanced via mixing.

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STOICHIOMETRY IN THE CELL; GROWTH RATE, P-LIMITATION AND GENOME SIZE IN PLANKTON

One of the most prominent patterns across various taxonomic levels is the positive correlation between genome size and cell size. Another striking patterns is the negative correlation between genome size and growth rate, while a positive correlation between RNA and growth rate. These patterns suggest strong ties between growth rate, cell size and RNA:DNA-ratio. Based on empirical evidence that P (and RNA) rich cladocera commonly face P-limitation of their growth rate it is hypotesized that the miniaturized genomes in cladocera could be caused by an evolutionary reallocation of P from DNA to RNA. Compared with copepods, cladocera have small genomes, fast development, and present almost fifteen-fold higher RNA:DNA-ratios (24.8 in cladocerans vs. 1.6 in copepods). Hence, small genome size in cladocerans could reflect an evolutionary pressure towards "efficient" genomes to conserve a key element needed to maximize growth rate. This presentation will discuss how stoichiometry and P-allocation may shed light on the causal relationships between genome size and basic life cycle attributes.

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BIOGEOCHEMICAL INSIGHTS FROM METAGENOMIC ANALYSES OF SURFACE WATER MICROBIAL ASSEMBLAGES ACROSS THE CENTRAL PACIFIC EQUATORIAL UPWELLING REGIME

The equatorial Pacific Ocean experiences upwelling causing enhanced rates of particulate primary production and bacterial production in surface waters in the region from ~12oN to ~12oS compared to the surrounding oligotrophic tropical waters. The enhanced primary production has strong impacts upon bacterioplankton production, with higher rates than in surrounding waters. We conducted a metagenomic survey of surface water microbial assemblages at 7 locations between 16oS and 13.5oN, representing a gradient of productivity across the equatorial upwelling regime, and generating 1.31 million individual reads. Approximately 44.8 % of reads matched protein encoding genes in sequenced microorganisms. The majority of reads were bacterial and archaeal (87 %), with fewer eukaryotic (9 %) and viral (3 %) sequence reads. The phylogenetic affiliation of metagenomes was on average 86 % similar between stations, but metagenomes demonstrated variability in strain-level read recruitment corresponding to habitat. Gene fragments encoding for important biogeochemical processes, including nitrogenase, nitrate assimilation, phosphorus uptake and photosynthesis were observed in metagenomes. Moreover, these results provide an interesting comparison between the genomic potential for function and measured biogeochemical parameters.

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BACTERIAL DORMANCY: A DEFENSE MECHANISM AGAINST GRAZING?

Bacterioplankton grazing by protists is one of the major controls on microbial community abundance and is the main route of returning nutrients to higher trophic levels. In order for a dormant bacterioplankton community to be maintained in the presence of grazers, these cells must be either resistant to grazing or there must be a rapid transition of active to dormant cells to maintain the dormant pool that is being grazed. It is hypothesized that dormancy is a defense mechanism employed by bacterioplankton to reduce grazing pressure and that protists will preferentially consume metabolically active prey. To test this theory bacteria contained in the food vacuoles of bacterivorous protists were compared to the community composition of bacteria from active and inactive cell groups. A combination of high speed flow cytometric sorting, whole genome amplification, PCR and T-RFLP were used to compare the bacterial composition in different sorted cell groups from Boothbay Harbor, Maine. Samples taken at different seasons yielded variable degrees of grazing selectivity. In some cases grazers showed preference for more active bacteria, while in other samples there appeared to be little selection.

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VERTICAL GRADIENTS IN PHYTOPLANKTON COMMUNITY COMPOSITION: HOW IMPORTANT ARE PIGMENT AND LIGHT ABSORPTION CHARACTERISTICS?

We test the hypothesis that phytoplankton pigments and light absorption characteristics are important for driving phytoplankton distributions in the ocean. A trait based multi-species model developed at MIT, in which tens of phytoplankton 'ecotypes' are stochastically assigned physiological characteristics, was modified to incorporate pigment and light absorption characteristics for different phytoplankton types. A 1-D application of the model was tested for the South Atlantic Gyre and model outcomes were compared to observations. Resolution of the light spectrum provided additional niche space for competition and coexistence of the model phytoplankton ecotypes. Vertical separation of phycobillin-containing and carotenoid-containing ecotypes matched the distributions of *Synechococcus* and picoeukaryotes in the data. In contrast, photoinhibition was also necessary to reproduce vertical gradients in high-light and low-light *Prochlorococcus*-like ecotypes. Our analysis confirms that phytoplankton pigment compositions are important adaptations that contribute to phytoplankton distributions in the ocean. Further, the approach we adopt allows investigation of the relative importance of physiological traits in driving phytoplankton distributions, and how this may vary between phytoplankton type, location and over time.

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CONTRASTING EFFECTS OF ABOVE AND BELOWGROUND HERBIVORY ON AQUATIC MACROPHYTES

Avian herbivores can have drastic effects on macrophyte vegetation in shallow lakes. However, belowground herbivory on sago pondweed tubers (*Potamogeton pectinatus*) by Bewick's swans is fundamentally different from aboveground herbivory on pondweeds by ducks and coots in summer. In a four year exclosure study in the shallow lake Lauwersmeer we simultaneously investigated the effect of aboveground summer herbivory and belowground herbivory in autumn on macrophyte biomass and species composition. Herbivores in summer drastically reduced biomass of *P. pectinatus* negatively affecting tuber density in autumn. Swans in autumn heavily predated on sago pondweed tubers but the effect on biomass the year after was limited due to compensatory plant growth. The diversity of the community was positively affected by summer herbivores as the relative contribution of subordinate *Potamogeton pusillus* increased. Tuber predation promoted both the absolute and relative contribution of *Zannichellia palustris*. Hence, herbivores affect the biomass of macrophytes but the level of compensation depends on the timing of herbivory. Both herbivore assemblages have a positive effect on plant diversity with each favoring different subordinate plant species.

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MORPHOLOGICAL CHARACTERISTICS OF *DISTEPHANUS MEDIANOCTISOL* (SILICOFLAGELLATES) IN THE CENTRAL ARCTIC OCEAN, ACEX 2004 SUMMER

Biometric analysis of living marine phytoplankton *Distephanus medianoctisol* (Silicoflagellata with seven-sided basal ring) was performed on three different sample types from the central Arctic Ocean, taken in 2004 summer during the IODP Arctic Coring Expedition (ACEX) 302. They are: (1) seawater, (2) sea-ice; and (3) diatom mat samples, representing a total of 1226 specimens. The objectives of this study are to clarify morphological characteristics of D. medianoctisol with biometry per three respective environments. The classification employed is based on their skeletal forms, and the measurement proceeded follows the algorithm used by Tsutsui (2000). The differences in environmental characteristics reflect in the length of radial spines: seawater group has 1.16 times longer spines than those of diatom mat group. Sea-ice group has an intermediate spine length between diatom mat and seawater groups. In summary, the spine length of *D. medianoctisol* appeared significantly different depending on the surrounding environments. Sea-ice group has longer spines than those of diatom mat group reflecting the difference in ambient physical conditions. The spine length of *D. medianoctisol* is found to be a useful environmental index.

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INTERANNUAL AND SEASONAL CHANGES IN DISSOLVED ORGANIC CARBON (DOC) CONTENT AND COMPOSITION IN AN URBAN LAKE: EFFECTS OF WATER MANAGEMENT AND MONSOON STORMS

Tempe Town Lake is a man-made lake in downtown Tempe, AZ. It is an isolated segment of the dry Salt River channel enclosed by inflatable dams. The lake is highly productive, DOC concentrations average 400 ± 86 μM, and seasonally, there can be very high (1.5 mM) DOC inputs due to summer monsoon storms. Usually there is little or no water flow into or out of the system, but in 2005 and again in 2008 upstream dam releases prompted water managers to release water through the lake. In these years, the lake was essentially reset with fresh river water and subsequent biogeochemical processes proceeded from a known starting point. High-resolution time-series measurements of water chemistry, nutrients, DOC content and DOC composition from Jan. 2005 through the present reveal patterns at a range of temporal scales reflecting water management practices, interannual and seasonal effects due to local rainfall patterns, as well impacts from individual storm events. The composition and reactivity of the DOC to both microbial degradation and photooxidation varies seasonally, and likely depends upon source.

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THRESHOLDS-BASED REGULATION: CHALLENGES AND OPPORTUNITIES IN THE MANAGEMENT OF COASTAL AND MARINE WATERS

European environmental policies have set standards and introduced management measures such as specific programmes for protecting the environment. Our analysis of relevant documents and legal processes shows that although ecological thresholds have not been used as a legal concept, many existing standards and programmes are implicitly based on assumed but unknown thresholds. Depending on the chosen regulatory regime different issues arise in the use of thresholds. Most European legislation for coastal waters and marine areas is based on regulatory approaches that perceive ecological thresholds as rigidly definable reference points. We show that ecological thresholds are problematic in this respect due to the lack of detailed understanding of the mechanisms underlying thresholds, and the uncertainty with respect to when thresholds are approached. Uncertainty and risk will always be relevant in the context of ecological thresholds. This implies that regulation based on adaptive governance regimes are preferable over a rigid use of thresholds. Key characteristics of such governance is appropriate monitoring, ex post evaluation and, in particular, mechanisms for revision of goals and management criteria.

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MICROBIAL RESPONSE TO AEOLIAN NUTRIENT ENRICHMENT IN THE NORTH EASTERN SUBTROPICAL ATLANTIC

Atmospheric deposition of dust is considered an important source of limiting nutrients to the open ocean. The response of bacterioplankton to atmospheric dust and elevated nutrient additions was studied in the surface waters at eastern fringes of the North Atlantic subtropical gyre in January and February 2008. Freshly collected aerosol was added either directly to surface seawater samples or indirectly as a "leachate" after rapid dissolution of aerosol in deionised water. Bacterioplankton response to ambient dust inputs was also studied *in situ*. Uptake rates of radio-labelled amino acids (a proxy for production) were used to indicate microbial response to nutrient and dust additions. Responses of total bacterioplankton and flow cytometrically sorted dominant microbial populations were examined. Bacterioplankton production was stimulated by organic nutrient additions, but not inorganic nutrient or dust additions. Although the metabolic response of the whole microbial community was limited, certain dominant groups of flow cytometrically sorted bacterioplankton showed positive responses to dust deposition *in situ*, which were masked by the rest of the community. These results suggest differential responses of indigenous bacterioplankton populations to Aeolian nutrient enrichment.

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CAN SUBMERGED MACROPHYTES INFLUENCE TURBIDITY AND TROPHIC STATE IN DEEP LAKES?

A positive feedback between submerged macrophytes and transparency stabilizing the clear, macrophyte-dominated regime has been described so far for shallow lakes. We hypothesize that submerged macrophytes in deep lakes may also influence turbidity if morphometry allows sufficient coverage. We present evidence from narrow, dimictic Lake Scharmützelsee that lost its submerged vegetation and became turbid during eutrophication from the 1960s to 1990. Since 1990, external nutrient load was drastically reduced, but phytoplankton biomass in summer remained high and transparencies low. In 2003, a sudden increase in water transparency was followed by a rapid return of Characeae meadows and Ceratophyllum demersum stands. This re-colonization initially was a consequence of decreased turbidity, but the increase of submerged macrophyte coverage potentially contributed to the stabilization of clear conditions at the mesotrophic state during subsequent years. Phosphorus uptake by the rootless macrophytes, phosphorus immobilization in their marl crusts and other macrophyte-related mechanisms may result in a positive feedback between plant abundance and transparency.

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INVESTIGATING THE BLOOM BLACK BOX: A MOLECULAR PEEK BEHIND *EMILIANIA HUXLEYI'S* CLOSED DOORS

The prolific coccolithophorid *Emiliania huxleyi* is a single-celled calcifying phytoplankton with an important role in both the global carbon and sulphur cycles. One of the most striking aspects of *E. huxleyi* biology is its ability to form huge “blooms,” in which cells rapidly proliferate, covering kilometres of marine surface waters. Despite decades of study, titillating questions regarding *E. huxleyi's* reproductive strategy during bloom development remain. To date, *E. huxleyi* has only been observed to reproduce asexually, however two lines of evidence suggest that a sexual stage may occur in the life cycle: (1) nuclear labelling studies have established the existence of haploid cell types and (2) molecular studies using highly variable regions of DNA called microsatellites have shown a great deal of genetic variation at the species level. Here we present data analyzing microsatellite variation between single cell lines of *E. huxleyi* isolated during mesocosm experiments in Bergen (2008) and covering the pre-bloom, bloom peak, and post-bloom stages. We discuss the role of sexual reproduction in this globally significant bloom forming phytoplankton together with potential effects on calcification rates.

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CHARACTERIZATION OF EPIBIOTIC BACTERIAL COMMUNITY ASSOCIATED WITH WILD-TYPE AND LABORATORY CULTURED *TRICHODESMIUM*

Trichodesmium are globally important nitrogen fixing cyanobacteria that form intense blooms in oligotrophic environments. They possess numerous epibiotic bacteria whose function has remained enigmatic. We investigated the epibiont communities associated with *Trichodesmium* to understand if consistent phylotypes exist among various *Trichodesmium* samples, and if these epibionts are involved in quorum sensing (QS). *Trichodesmium* colonies were collected at the Bermuda Atlantic Time Series station and from the Woods Hole Oceanographic Institution culture collection. *Trichodesmium* epibionts were visualized by microscopy and characterized by culture dependent- and independent-methods. Bacterial isolates were screened for acylated homoserine lactone (AHL) mediated-QS activity using biosensor strains and high performance liquid chromatography coupled to electrospray ionization mass spectrometry. While genomic evidence suggests that *Trichodesmium* does not synthesize AHLs, it may be sensing signals produced by their epibionts that trigger important metabolic processes. Our results may help to explain the adaptation of *Trichodesmium* to harsh, oligotrophic environments and the notorious difficulty in obtaining these cyanobacteria in pure culture.

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IMPACT OF MICROPHYTOBENTHOS ON THE SEDIMENT BIOGEOCHEMICAL CYCLES: AN APPROACH BY FINE SCALE MODELING.

To investigate the impact of microphytobenthos (MPB) on early diagenesis, we built a fine scale dynamic model, based on OMEXDIA diagenetic model, and including the MPB compartment. Model outputs were compared with a dataset of sediment sampled in Florida Bay. The model showed that MPB activities induced a nycthemeral rhythm on concentration profiles, nutrient fluxes, and mineralization processes. When MPB was present at the sediment surface, organic matter mineralization was strongly enhanced thanks to the supply of labile organic compounds by phototrophs. In contrast, coupled nitrification-denitrification was inhibited by a factor 3.6 due to competition for nitrate and ammonium between MPB and bacteria. Nitrogen uptake of MPB represented 96% of the daily supply of dissolved inorganic nitrogen. This strong uptake was 53 times more important than N consumption by denitrifcation. Sediment nutrient supplies to water column were reduced by almost a factor of 100, indicating that sediment colonized by MPB represent a minor source of nutriments for pelagic primary production and bacterial production. Our results showed that benthic models should take into account MPB in the modeling of shallow ecosystems.

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FORAGING OPTIMIZATION IN PUMPKINSEED SUNFISH

Individual foraging specializations are an important source of intraspecific variability in feeding strategies. Both biotic and abiotic factors can impact foraging behavior. We evaluated stomach contents of individual pumpkinseed sunfish, *Lepomis gibbosus*, in a small unexploited lake in Michigan's Upper Peninsula, USA. We tested the hypothesis that diet specialization would increase with metabolism as water column temperature increased during the growing season. We obtained evidence that individual diets were more specialized in August than May. With a seasonal increase of 10C, mean individual diet diversity decreased (specialized) from 4 orders to 2.5, but pooled population diet diversity increased (generalized) from 6 orders to 12.6. Our analysis suggest that population foraging responses may represent the sum of unique individual foraging responses.

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WAVE-INDUCED RELEASE OF METHANE IN LAKE LITTORAL ZONES

In lakes, surface waves provide an important energy source and thus hydrodynamic disturbance in the littoral zone, where most of the wave energy is dissipated. Waves are associated with currents in the water column that interact with the sediment surface in terms of particle resuspension and pore water exchange. Simultaneous, high-resolution measurements of the surface wave field, wave-induced currents, the acoustic backscatter strength and the concentration of dissolved methane gave evidence that waves enhance the release of dissolved methane in the shallow littoral zone. Thereby the amount of released methane is highly related to the production in the anoxic zone of the littoral sediments, which depends on water temperature, and the course of the present surface wave field. Parallel to the near-shore investigations, we conducted measurements of the spatial and temporal distribution of dissolved methane in the littoral and the pelagic zone. The results suggest that the release of methane in lake littoral zones is the source of dissolved methane responsible for the unexpected high concentrations in the epilimnetic water of the pelagic zone.

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DISTRIBUTION AND OF AEROBIC ANOXYGENIC PHOTOTROPHS IN THE MEDITERRANEAN

Distribution of Aerobic Anoxygenic Phototrophs was investigated in the Mediterranean Sea using infra-red epifluorescence microscopy and the diversity of the phototrophic population was analyzed by fluorescence in situ hybridization technique.The phototropic bacteria were present within the euphotic layer at all sampled stations. The abundances ranged from 1.5 x 10^3 cells per mL in oligotrophic Eastern Mediterranean up to 60 x 10^3 cells per mL in a cyclonic eddy induced bloom. The AAPs formed on average 2-3% of total prokaryotes in the oligotrophic waters and up to 8% in the coastal environment. However, at one station located inside of the cyclonic eddy AAP cells represented up to 15% of total prokaryotes. Moreover, at this station, the AAPs population was dominated by filamentous cells up to 16 um long.

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SOURCES OF, AND PATHWAYS FOR, THE INCORPORATION OF LARVAL FISHES INTO A DEVELOPING WARM CORE EDDY OF THE LEEUWIN CURRENT, SW AUSTRALIA

Incorporation of planktonic biota into eddies is well documented although there remains a paucity of direct examination of the timing and mechanisms of this process. In situ measurement of meso-scale oceanography during formation of an anti-cyclonic (warm-core) eddy of the Leeuwin Current enabled elucidation of the sources and pathways for the incorporation of larval fishes into the eddy. Coupling of Lagrangian drifter and ADCP current velocity data with depth-integrated sampling of larval fishes provided a process-oriented examination of transport pathways. The Leeuwin Current was identified as the major pathway but it appears that incursions of the current onto the shelf north of the developing eddy induces mixing and modification of the T/S signature as well as entrainment of fish larvae of shelf-origin. The occurrence of larvae of oceanic species in the eddy is due to both Leeuwin Current transport and spawning within the eddy. The period of eight days taken for the drifter to travel around the eddy perimeter is well within the 3-4 week period of larval duration of neritic fishes and is an important consideration with respect to their ecology and fate.

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A COMMUNITY-BASED EXPOSURE ASSESSMENT AND RISK CHARACTERIZATION OF DIETARY MERCURY EXPOSURE

The integration of community-based participatory research (CBPR) techniques with conventional exposure assessment methods offers a refreshing approach to generating scientifically sound and socially relevant mercury exposure information. Ninety-five community-specific seafood consumption surveys were administered to women (ages 16-49) residing in the East End community of Newport News, Virginia. Approximately 65% of the women surveyed do not fish; however, 83% of the women surveyed had consumed seafood within the last seven days. Of the women surveyed, 94% stated that grocery/seafood markets were the main sources of the seafood items consumed. Mercury concentrations in these seafood items will be determined and the daily mercury intake rate probabilistically defined. The objectives are to determine if the: 1) average seafood consumption rate of women in the East End is greater than the average seafood consumption rate of U.S. women, 2) average daily mercury intake of women in the East End is greater than the average daily mercury intake of U.S. women, and 3) proportion of women in the East End exceeding EPA's oral RfD for mercury is greater than the exceedances of U.S. women.

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THE ROLE OF TRIBAL GOVERNMENTS IN WATER RESOURCE MANAGEMENT IN WASHINGTON STATE

The role of tribal governments and their level of participation in water resource management in Washington State has evolved over these past several decades. Their roles have changed from being a litigant, interested public, affected government, and more recently as co-manager of the water resources. Tribal involvement in water governance creates an opportunity to integrate state and national policies with local watershed management control.

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THE IMPORTANT ROLE OF SCYPHOPOLYPS FOR THE DEVELOPMENT OF JELLYFISH BLOOMS – REPRODUCTION OF THE LION'S MANE IN THE BRACKISH BALTIC SEA?

In metagenetic scyphozoans, the inconspicuous sessile polyp stage releases free swimming jellyfish often appearing in massive blooms. The settlement sites of scyphopolyps are mostly unexplored and knowledge of their ecology and distribution is poor. One example is the painfully stinging Lion's mane (*Cyanea capillata*, Scyphozoa) with annual mass occurrences in the Baltic Sea. Previous authors suggested that the occurrence of the Lion's mane medusae in the brackish Baltic Sea depends on the inflow of North Sea water masses of higher salinity since the polyps are not able to survive at salinities below 20 psu. However, present results show that the polyps are more adaptable to low salinity than expected. If polyps of the Lion's mane settle and reproduce in the western Baltic Sea, the occurrence of medusae would not solely depend on the inflow of North Sea water. This example shows that studies on the distribution and ecology of polyps are important to understand, predict and mitigate jellyfish blooms and the radiation of metagenetic scyphozoans.

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STOICHIOMETRY OF BACTERIA AND ALGAE IN LAKE KIVU

Bacteria stoichiometry is still largely unexplored while they may constitute a large part of producers in aquatic systems. Due to their small size, bacteria are efficient competitors for nutrients. We expect that bacteria stoichiometry should be in favour of lower C:N and C:P ratios than for algae. We challenge this hypothesis in the oligotrophic and meromictic Lake Kivu (East African Rift Valley). Sampling of bacteria and phytoplankton communities was carried out during rainy and dry seasons 2008. Our measurements showed that surface bacterial production (BP) was of the same order of magnitude than net primary production (PP), with mean values of 445 (BP) and 538 (PP) mg $C.m^{-2}.d^{-1}$. A peak of bacteria abundance and BP was noted during both seasons at the interface between oxic and deep anoxic layers. Single-cells bacteria stoichiometry was explored by TEM-Xray microanalysis. Our first results indicate, for surface waters, similar C:P in bacteria (mean C:N:P = 309:48:1) and algae (256:27:1), but lower C:N in bacteria than in algae. These results highlight the high potential of bacteria as a nutrient-rich prey for higher trophic levels.

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BALLAST-SUPPORTED AND RESIDUAL PARTICULATE ORGANIC CARBON FLUX IN THE WESTERN PACIFIC SUBARCTIC GYRE

The relationship between particulate organic carbon (POC) flux and mineral ballasts ($CaCO_3$, biogenic opal, lithogenic material) fluxes was investigated with time-series sediment trap dataset from the subsurface (~ 150 m) to the deep (~ 5000 m) of Western Pacific Subarctic Gyre (WSG). As a result of multiple linear regression analysis for individual sediment trap seasonal data, most of POC flux (~ 90%) in the deep was correlated well with mineral ballasts ($R^2 = 0.91$, n = 96) and about 70% of this "ballast-supported" POC flux was associated with biogenic opal flux. Thus biogenic opal plays an important role in POC vertical transport in the WSG while it has been reported that $CaCO_3$ is more important as ballast on the global scale. Proportion of the ballast-supported POC flux in total POC flux at subsurface was only about 60%, i.e. POC flux not supported by ballast (residual POC) was about 40%. Residual POC flux tended to increase with decreasing depth. Magnitude of vertical change in residual POC flux was much larger than that in ballast-supported POC flux as reported previously.

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PHOSPHORUS HOMEOSTASIS AND FITNESS IN VARIABLE ENVIRONMENTS

Zooplankton and other organisms experience heterogeneity in resource quality. For instance, seston phosphorus (P) stoichiometry, one determinant of resource quality, often varies with depth. Previous work has shown that *Daphnia magna* integrate over this heterogeneity and increase their growth rate by storing P found in high quality patches and using it later in low quality patches. It is also known that zooplankton differ in the degree of homeostatic regulation of P content. We therefore hypothesized that the ability to integrate over heterogeneity will vary negatively with the degree of P homeostasis. We measured both the P homeostasis of seven *Daphnia* sp. And their ability to integrate over heterogeneity. Three of the seven *Daphnia* species were not integrators; growth rates were a linear combination of diet-specific growth rates. In contrast, the four integrators achieved growth rates higher then expected based on linear combinations. Integrators tended to be less homeostatic than non-integrators. This study addresses the ecological and evolutionary significance of stoichiometric homeostasis. Homeostatic and non-homeostatic daphnids differ in their temporal response to heterogeneity and therefore have differing roles in consumer-resource dynamics.

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HETEROTROPHIC FEEDING DOES NOT COMPENSATE FOR REDUCED PHOTOSYNTHESIS IN THE MEDITERRANEAN CORAL CLADOCORA CAESPITOSA

For scleractinian corals, the contribution of photosynthesis compared with heterotrophic feeding to overall energy budgets has long been debated. For many corals, heterotrophic feeding primarily provides a source of nutrients. However, recent studies indicate that when photosynthesis is reduced (e.g. during bleaching), heterotrophic feeding is up-regulated to a level where it is sufficient to meet metabolic requirements. In this study we investigated the relationship between photosynthesis and heterotrophy by monitoring changes in these processes for colonies incubated under 3 light (0, 80 and 250 μmol photons m-2 s-1) and 2 feeding (fed and unfed) regimes during a 7-week period. Feeding

initially increased under all treatments, but reached a plateau after 2 weeks for dark-incubated corals. For corals grown under high light, feeding increased linearly over time, and increased more strongly for unfed corals. These results demonstrate that heterotrophy does not compensate for reduced photosynthesis in Cladocora caespitosa. Instead, this species is strongly reliant on photosynthetic energy acquisition : a fact that makes it vulnerable to future declining water quality and increasing water temperatures in the Mediterranean sea.

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DOES CHANNEL GEOMORPHOLOGY DETERMINE HOW TIGHTLY FOREST AND STREAM ECOSYSTEMS ARE LINKED?

The food webs of small streams and adjacent riparian forests are inextricably linked. Riparian forests can contribute substantial amounts of organic matter (OM) to small streams, dramatically increasing the productivity of stream food webs. We examined how stream channel geomorphology (sediment grain roughness) controls the strength of riparian-stream linkages by determining the retention and storage rates of terrestrially-derived OM particles (deciduous leaves, conifer needles, wood fragments, etc.). Experimental releases of deciduous (alder) leaves and conifer needles in 18 stream reaches (sediment grain sizes ranging from fine gravel to boulders) showed that while the retention of both OM types increased with bed roughness, conifer needles were generally retained more rapidly than deciduous leaves. Amounts of OM stored by streambed sediments were also positively related to bed roughness. However, relationships between OM storage and sediment roughness were unexpectedly non-linear, suggesting that particle size-related thresholds for retention may control detrital resource availability.

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HAS THE SUMMER ZOOPLANKTON COMMUNITY OF THE ARCTIC'S CHUKCHI SEA CHANGED OVER THE PAST 50 YEARS?

The Chukchi Sea represents one of the major gateways into the Arctic Ocean where large quantities of Pacific heat, nutrients, phytoplankton and zooplankton enter the region through the shallow Bering Strait in a complicated mixture of water masses each with distinct assemblages and quantities of Pacific-origin zooplankton. Zooplankton studies have been undertaken in this region for more than 50 years, suggesting that it should be possible to document any ecosystem responses to climate change over that period. Direct comparison between these studies is often hampered the lack of access to the original data, changes in taxonomy and/or differences in gear type. Datasets from the 1980's (e.g. ISHTAR) are however available, allowing us to compare patterns in these data with those from the 2000's. Overall, there appears to have been no striking change in the composition of the late summer zooplankton communities in the southern Chukcki Sea, and biomass also seems similar between these two periods (~ 2 g DW m-2). Nonetheless, this does not preclude that the duration and extend of penetration of this largely Pacific fauna has not been changing over time, and we discuss how to address this possibility.

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EFFECT OF CO2 ON PHOTOSYNTHESIS IN IRON LIMITED PHYTOPLANKTON

Rising atmospheric CO_2 levels are expected to have impacts on marine ecosystems and oceanic biogeochemistry in part due to effects on organismal physiology. Increases in phytoplankton productivity have been observed in experiments manipulating CO_2 levels though the mechanisms behind these increases are not well understood. We hypothesized that elevated CO2 levels could result in more efficient photosynthesis either through direct stimulation of RubisCO or by a reduced need to power a carbon concentrating mechanism (CCM). This increase in photosynthetic efficiency could stimulate the growth of iron limited phytoplankton as iron limitation is essentially a limitation on photosynthetic energy generation. We assessed molecular level responses of the primary components of algal photosynthesis (the energy generating photosynthetic apparatus, the CCM, and carbon fixation) to changes in iron and CO_2 availability in field assemblages from the iron-limited Gulf of Alaska and laboratory cultures of Thalassiosira weissflogii. We observed a down-regulation of the CCM and photosynthetic apparatus at elevated CO_2 potentially allowing more efficient photosynthesis at elevated CO_2.

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DIFFERENCES IN BACTERIAL ACTIVITY AND COMPOSITION OF SURFACE MICROLAYER AND UNDERLYING WATER IN MOUNTAIN LAKES

We assessed the differences in water physico-chemical characteristics, in bacterial community composition (BCC) and single-cell activity between the surface microlayer (SML) and the underlying water (ULW) of six mountain lakes located across an altitude gradient. SML-samples consisted on the first 900 µm of the lake surface, whereas the ULW was sampled at 0.2 m depth. Single-cell activity and BCC were determined by a combination of microautoradiography and catalyzed reporter deposition fluorescence *in situ* hybridisation (MAR- and CARD-FISH). Both, the SML and the ULW were dominated by *Betaproteobacteria* followed by *Actinobacteria* (except in one lake). The abundance of the latter group was found to be significantly higher in the underlying water of all lakes, whereas *Betaproteobacteria* had the highest single-cell activity in both layers. DOC concentrations were significantly higher in the SML of all lakes. Our results indicate that the air-water interface of mountain lakes represents a particularly active water layer mostly dominated by *Betaproteobacteria*.

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DAVID CUSHING – FISH RECRUITMENT AT THE HEART OF MARINE ECOLOGY

David Henry Cushing died in 2008 on his 88th birthday. He left a legacy of rich ideas and concepts of how life in the Seas works. Central to them all, was the desire to understand how the great fish stocks are regulated – the so-called "stock and recruitment" problem of fisheries. But to solve this problem needs the input of almost all branches of marine ecology and oceanography; and David Cushing embraced them all as a fisheries ecologist. Which is why David Cushing's work is so well known to so many. The motivation for his science was far from academic. David Cushing saw the failure of fisheries managers to be a failure of the science, and the study of recruitment not merely "desirable" but a necessity. This paper looks at the motivation for David Cushing's work and why the science of recruitment remains central to marine ecology and fisheries management. It is a tribute to his memory. (Dr Joe Horwood worked with David Cushing at Lowestoft for several years, particularly on the modelling of fish larval dynamics, eventually taking his job as Deputy Director of Fisheries Management Division at the "Fisheries Laboratory" (now Cefas))

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A PROBABILISTIC PROCESS MODEL FOR PELAGIC MARINE ECOSYSTEMS INFORMED BY BAYESIAN INVERSE ANALYSIS

Marine ecosystems are complex systems with multiple pathways that produce feedback cycles, which may lead to unanticipated effects. Models abstract this complexity and allow us to predict, understand, and hypothesize. In ecological models, however, the paucity of empirical data usually prohibits direct estimation of all parameters. Monte Carlo models typically specify unknown parameters a priori, but here we propose a new approach that uses inverse analysis to parameterize the predictive process model based on biogeochemical flux estimates derived from empirical data, expert opinion, and ecological theory. Previous inverse analyses that use an optimization protocol have not fully addressed the uncertainty in empirical data. Furthermore, an optimized inverse solution fails to adequately represent the uncertainty inherent to the system. Hence, we developed a Bayesian approach that explicitly addresses observation error. We use it to construct a probabilistic process model for a tropical coral atoll that was originally studied by other researchers using optimized inverse analysis. Our model shows that fluxes involving DOC affect the ecosystem's long-term response to anthropogenic or environmental inputs, whereas the microbial loop affects the short-term response.

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FREE-CHOICE LEARNING TUTORIAL

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FREE CHOICE LEARNING OPPORTUNITIES AT BEACON INSTITUTE

The Beacon Institute for Rivers and Estuaries is an environmental research organization focused on scientific and technological innovation that advances research, education and public policy regarding rivers and estuaries. Located in Beacon, New York at Denning's Point State Park, the Institute's Center for Environmental Innovation and Education serves as the park's Visitor Center and primary education and outreach facility. The facility houses a multi-purpose space for classroom, exhibit, public forum and social events. Programming ranges from seminars to formal and informal learning opportunities on topics from the Rivers and Estuaries Observing Network (REON) to the history of Denning's Point. Beacon Institute is also a member of the Centers for Ocean Science Education Excellence Networked Ocean Worlds (COSEE-NOW). COSEE-NOW facilitates meaningful and productive collaborations between scientists and educators and creates educational material that uses observing systems data in new media formats for formal and informal settings. This session will provide examples of the informal or free-choice learning experiences, both internet-based and placed-based, provided through the Institute's facilities.

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ARE CARBON AND OXYGEN CYCLES DIRECTLY LINKED? A COMPARISON OF DISSOLVED O_2 CYCLING WITH ^{13}C FIXATION RATES BY STREAM BIOFILMS.

When calculating the primary production and respiration rates of stream communities, many aquatic scientists assume that carbon and oxygen cycles are directly linked. This assumption may not be true if oxygen cycling increases without additional carbon fixation. We compared oxygen cycling and carbon fixation rates in stream biofilms enclosed in 4.2-L flow-through chambers. Primary production and respiration rates were calculated using paired dark and light chamber treatments and dissolved oxygen measurements in Ditch Creek (Wyoming, USA). We added a $\delta^{13}C$-$NaHCO_3$ tracer to light chambers to directly measure biofilm carbon fixation during photosynthesis (with a target enrichment of 700‰). Respiration rates from dissolved oxygen calculations averaged -50 mg O_2 m^{-2} hr^{-1}, while primary production averaged 130 mg O_2 m^{-2} hr^{-1} during short term (1-3 hour) incubations. We will compare biofilm $\delta^{13}C$ fixation rates with chamber primary production rates calculated using dissolved oxygen data.

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DEEP-OCEANIC GELATA PROVIDE A MOSAIC OF HABITATS FOR WIDE RANGING PREDATORS: INSIGHTS FROM DEEP-WATER NET TOWS AND ANIMAL-BORNE SENSORS

Within marine ecosystems, gelatinous zooplankton (or gelata) are often considered as mechanisms of top-down control, yet less frequently as prey items themselves. This gap in our knowledge has resulted from the difficulty of gathering empirical data on predator and prey in remote locations, with most studies limited to anecdotal observations in coastal seas. Here we present a new approach to studying gelata from the perspective of a wide-ranging obligate predator, the leatherback turtle Dermochelys coriacea. By combining more than 20 years of rectangular mid-water trawl data for gelata throughout the north Atlantic (N=587 trawls; max depth 4500m) with satellite derived movement and diving data for 11 leatherback turtles (>9 years data in total; 26,000+ dive profiles) it was evident that the community structure and vertical distribution of deep-water gelata varied greatly between different oceanic regions and on a latitudinal scale. These variances clearly manifested themselves within the leatherback dive data and could be linked to the infrequent, yet exceptionally deep-dives (down to 1250m) conducted by these animals and the ultimate reasons driving their seasonal migrations across the open ocean.

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HIGH-PRECISION U-SERIES AND ^{14}C DATING OF THE DEEP-SEA CORAL *ENALLOPSAMMIA ROSTRATA*

We are engaged in a systematic approach to utilize deep-sea corals to reconstruct past ocean conditions over centennial to millennial timescales. As part of this endeavor we present results on the deep-sea scleractinian species *Enallopsammia rostrata*. We show that *E. rostrata*, collected live from three locations in the Line Islands (≈ 160°W) in the Equatorial Pacific, has the potential to act as a recorder of changes in deep-sea environments over centennial time scales. To improve the utility of this scleractinian species as a monitor of interior ocean variability, we have applied a high-precision, low blank technique to measure ^{230}Th and ^{238}U-^{234}U in small amounts of modern and near modern calcareous skeletons using the Neptune MC-ICPMS. Colony life spans ranged from 108 ± 5 yrs to 607 ± 6 yrs. Paired U-series and ^{14}C dating measurements on the same sub-samples of colonies of *E. rostrata*, allow us to estimate ^{14}C-ventilation rates of the water masses that the corals experienced on centennial timescales. Our initial results document a centennial periodicity in the ^{14}C ventilation ages in this region of the North Pacific Basin.

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CAPACITY OF THE ELECTROCHEMICAL ADHESION SENSOR FOR SIMULTANEOUS DETECTION OF DISSOLVED MOLECULES AND ORGANIC PARTICLES IN SEAWATER

Molecules adsorb and soft particles adhere at the mercury electrode/seawater interface. Adhesion of soft particles which results in electrical signals well-defined by duration in milliseconds and amplitude in microamperes (0.1-10 μA) is affected by the presence of adsorbed organic molecules. This is the basic principle for simultaneous detection of dissolved and particulate organic matter in aquatic systems. Nonpolar and negatively charged dextrans were selected as models of dissolved polymers and marine nanoflagellate *Dunaliella tertiolecta* as model soft microparticle. The experiments were performed in 0.1 M NaCl and pH 8. The amplitude and frequency of adhesion signals decrease significantly both at positively and negatively charged electrode upon addition of nonpolar dextran to the cell suspension. In contrast, the presence of negatively charged dextran does not change the amplitude nor the frequency of adhesion signals at the negatively charged electrode. Results obtained from the experiments done on a model system show the capacity of the electrochemical adhesion sensor, here the static mercury drop electrode, for simultaneous detection and characterization of soft microparticles and polarity of dissolved molecules in seawater.

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LONG-TERM VARIATIONS OF PHYTOPLANKTON COMMUNITY IN RESPONSE TO EUTROPHICATION AND WARMING IN THE LAKE BIWA

We compiled and analyzed long-term time series data, including chemical, physical and phytoplankton community data, for the Lake Biwa ecosystem from 1962 to 2003. Analyses on environmental data indicate that Lake Biwa had experienced intensified eutrophication (according to total phosphorus concentration) in the late 1960s and recovered to a normal trophic status around 1985, and then exhibited rapid warming and thus increased water column stability since 1989. Total phytoplankton cell volume largely followed the trend of total phosphorus concentration, albeit short-term fluctuations existed. However, phytoplankton community shifted dramatically in response to those changes of the environmental states. Moreover, most phytoplankton species do not show a strong linear correlation with environmental variables, suggesting nonlinear transitions among different states. Phytoplankton species can be statistically classified into groups depending on whether their abundance variations showed a positive or negative response to those events. We discuss differential responses of phytoplankton in light of their known life history and ecological characteristics.

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CHANGES OF CDOM FROM LAND TO OCEAN - AFFECTED BY LAND-COVER TYPES

The largest source of coastal chromophoric dissolved organic matter (CDOM) is often freshwater CDOM, which is presumably washed out of terrestrial soils as rainwater runs off land into the river system, estuary, then to the coastal ocean. In attempt to better understand the transportation and transformation of CDOM from land to coastal ocean, the whole course was separated into three parts due to the different water dynamic conditions. 1. From land to river: Neponset watershed, a typical urban watershed, was selected to study changes of CDOM in freshwater affected by land-cover types in the watershed (Monthly sampling for two year at five major land-cover endmembers). 2. From river to estuary: Hudson estuary and three tributaries were selected to study the behavior of freshwater CDOM and the changes of estuarine CDOM due to land-cover types along the estuary (three cruises covered three seasons: June 2005, October 2006 and April 2007). 3. From estuary to coastal ocean: Hudson river plume was selected to study CDOM transportation from estuary to coastal ocean (three cruises: May2004, April2005 and May2006).

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LONG-TERM ACOUSTIC MEASUREMENTS OF DIEL VERTICAL MIGRATION OF *DAPHNIA HYALINA* IN LAKE CONSTANCE (GERMANY)

The vertical distribution of zooplankton in Lake Constance is being measured since April 2006 using ADCP (Acoustic Doppler Current Profiler). Here we present an analysis of this long-term acoustic dataset in terms of the vertical distribution and diel vertical migration (DVM) of *Daphnia hyalina*. In this context our attention was drawn on the mechanisms, which are responsible for the course and particularly the timing of the start of DVM on seasonal as well as on diurnal time scales. Effects of physical and biological factors on this timing are discussed. Our analysis discriminates between active swimming of zooplankton (e.g., DVM) and vertical advection by water movements, mainly internal waves occurring during the stratified season on time scales between a few minutes and several days.

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A NEW CARBON ASSIMILATION CYCLE FROM THE HYPERTHERMOPHILIC ARCHAEUM *IGNICOCCUS HOSPITALIS*: THE DICARBOXYLATE/4-HYDROXYBUTYRATE PATHWAY

Ignicoccus hospitalis is an anaerobic, autotrophic, hyperthermophilic Archaeum that forms together with *Nanoarchaeum equitans* the first purely archaeal association of microorganisms. *I. hospitalis* uses a novel autotrophic CO_2 fixation pathway that starts from acetyl-coenzyme A (CoA), which is reductively carboxylated to pyruvate. Pyruvate is converted to phosphoenol-pyruvate (PEP), from which glucogenesis as well as oxaloacetate formation branch off. The primary CO_2 acceptor molecule acetyl-CoA is regenerated by reduction of oxaloacetate to succinyl-CoA by an incomplete reductive citric acid cycle lacking 2-oxoglutarate dehydrogenase or synthase. Succinyl-CoA is reduced to 4-hydroxybutyrate, which is then activated to the CoA thioester. 4-Hydroxybutyryl-CoA is dehydrated to crotonyl-CoA by the radical enzyme 4-hydroxybutyryl-CoA dehydratase. Finally, beta oxidation of crotonyl-CoA leads to two molecules of acetyl-CoA. Thus, the cyclic pathway forms an extra molecule of acetyl-CoA, with pyruvate synthase and PEP carboxylase as the carboxylating enzymes. The pathway was elucidated by in vitro transformation of 4-hydroxybutyrate, detection of all enzyme activities, and in vivo labeling experiments. It is termed dicarboxylate/4-hydroxybutyrate cycle.

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THERMOPHILIC SULFATE-REDUCING BACTERIA ARE ABUNDANT IN MARINE SEDIMENTS FROM PERMANENTLY COLD ARCTIC FJORDS

Sulfate reduction was measured experimentally after heating sediments from two arctic fjords (Svalbard) to much higher than in situ temperatures. Incubations over a temperature gradient from 0 to 96°C resulted in temperature optima for sulfate reduction at 22°C and 55°C. Following pre-pasteurization at 85°C, sulfate reduction was only detected in the thermophilic range, indicating activity of thermophilic gram positive Desulfotomaculum spp. that persist in cold sediments as endospores. This group was readily detected following PCR amplification of 16S rRNA genes in DNA extracted from sediment after incubation at 50°C. Time-course experiments at 50°C showed that after an initial lag period SRR increased to much higher than in situ (4°C) rates. These were complemented by greater changes in volatile fatty acid concentrations at 50°C compared to 4°C. Hydrolysis patterns for copmlex organic substrates indicated different enzyme sets were active at either temperature. The results suggest mineralization of the organic matter in these sediments is much greater at artificially high temperatures than in situ and is mediated by induction of a distinct thermophilic microbial community. Abundances of >104 Desulfotomaculum spores cm-3 in Smeerenburgfjorden sediment were estimated from exponential profiles of SRR down to 23 cm depth. The sedimentation rate calculated to be 0.2 cm y-1, indicating a stable flux of these spores into this sediment of >107 m-2 y-1 for over 125 years.

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ECOSYSTEM IMPACTS OF NUTRIENT-RICH TRIBUTARIES IN THE LOWER GREAT LAKES-ST. LAWRENCE RIVER SYSTEM

Proliferation of benthic chlorophytes, cyanobacteria and vascular macrophytes is an increasingly visible problem in littoral areas of the Lower Laurentian Great Lakes and St. Lawrence River (LGL-SLR). Biological response to nutrient-enrichment is difficult to assess due to small scale (< 1 km) and short-term (day-week) variability. A number of taxa have the potential to produce toxins, or organic volatile compounds (geosmin and MIB) inducing musty taste and odour in drinking water, thus at high biomass, they can exert negative socioeconomic and ecological impacts. We assessed the distribution and environmental characteristics of metaphytic algae and macrophytes in the LGL-SLR, to test the hypothesis that species composition reflects the combined effects of hydrology and water chemistry. For this, a 950-km survey of over 40 tributaries of lakes Erie, Ontario and of the St. Lawrence River (between Kingston and Trois-Rivières) was carried out in August-September 2008. Contrasting composition and biomass of benthic filamentous chlorophytes, cyanobacteria and vascular macrophytes upstream, within, and downstream of tributaries reflect water quality degradation and act as an early warning of incipient habitat degradation.

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AN EMPIRICAL MODEL FOR PLANKTONIC PHOSPHORUS REGENERATION IN MARINE ECOSYSTEMS

Planktonic nutrient regeneration is a fundamental process that maintains most of the primary productivity in marine and freshwater environments. Although a predictive model that describes the pattern and efficiency of phosphorus cycling has been recently published for lakes, a similar empirical model does not exist for P-limited marine systems. Planktonic regeneration rates were obtained from published studies that used a diversity of methods in different environments (e.g., Mediterranean Sea, North Atlantic Ocean, and South Pacific Ocean). The range in planktonic regeneration rates across these systems ranged from 1 to 25 pM P/min When regressed along a trophic gradient (measured as particulate P in each system), regeneration rates were well described by a linear model (log regeneration rate (pM P/min) = 0.868(log particulate P (pM)) – 3.28, n = 25, R2 = 0.77). The turnover rate of planktonic P had a range of 9 to 49% per day and these rates were invariant to the trophic status of each system. A comparison between marine and freshwater systems revealed differences and similarities in rates along the trophic gradients.

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EFFECTS OF PRE AND POST NATAL EXPOSURE TO ELEVATED TEMPERATURE ON THE SURVIVAL AND REPRODUCTION OF *DAPHNIA MAGNA*

We compared survival and reproduction of *Daphnia* exposed prenatally to different temperature regimes for variable periods of time. Parental generation (P) *Daphnia* were born to animals maintained for 0, 1, 3, 5, or 7 days at a constant temperature of 20C, 24C, 30C or 32C, or a diurnally variable temperature of 22C day and 29C night. P *Daphnia* and their offspring were followed to 12 days of age. Exposure to constant 30C had no effect on survival but reduced reproduction compared to 24C, while exposure to constant 32C resulted in 100% mortality. Diurnally variable temperatures had little effect on survival; reproduction was lower than at 24C but higher than at 30C. Constant exposure to 20C had no effect on survival but reduced reproduction compared 24C, 30C and variable temperature conditions. There was no effect of duration of prenatal exposure to 30C or variable temperature on survival or reproduction. Survival and reproduction of the offspring of these animals did not differ from their parents. However, reproduction of the offspring of 20C exposed animals was lower than reproduction of their parents.

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SIZE-SCALING OF PHYTOPLANKTON ABUNDANCE AND CELL-SPECIFIC PHOTOSYNTHESIS IN THE OLIGOTROPHIC ATLANTIC OCEAN

Classical allometric theory predicts that individual metabolic rates (R) scale with body size (M) following the ¾-power rule or Kleiber's law, whereby R is proportional to $M^{3/4}$. Meta-analysis studies covering around 20 orders of magnitude in body size support the universality of this allometric rule for photosynthetic organisms ranging from unicellular to terrestrial plants. However, recent experimental work questions its applicability for the metabolism of natural phytoplanktonic organisms. Using the photosynthetic rate as a proxy for phytoplankton metabolism we have determined the size scaling of the community during two cruises in the tropical and subtropical Atlantic ocean. Our results revealed that the power relationship between photosynthesis per cell and cell size has an exponent very close to 1 (isometric scaling) in surface waters and not statistically different from ¾ (allometric scaling) in the deep chlorophyll maximum. These differences could be explained by size-related differences in the package effect. Our measurements of the metabolism-size scaling relationship have implications to understand the trophic structure of the community and the energy flow through the ecosystem.

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SEASONAL AND SPATIAL VARIATIONS OF SILICON ISOTOPES IN LARGE TROPICAL RIVERS

Here we present the first large dataset of dissolved silicon isotopes signatures ($\delta^{30}Si$) in different tropical rivers, including the Amazon and the Congo, the two largest silicon suppliers to the ocean. A one-year-long monthly series is presented for the Congo River, upstream from the Kinshasa/Brazzaville urban zone. Spatial and temporal variations in the Amazon River and its main tributaries have been studied. Both Congo and Amazon convey similar mean $\delta^{30}Si$ signatures (close to +0.8‰) to the ocean, in the range of previously published values. The Congo River exhibits limited seasonal variations, with the exception of some large $\delta^{30}Si$ variations that seem related to the presence of high biogenic silicon content in the water column. This could be due to diatom activities at the level of the Pool Malebo, a lake-like widening in the lower reaches of the Congo River upstream of Brazzaville. In contrast, other rivers such as the Mekong (Vietnam) and the Tana (Kenya) can exhibit much higher $\delta^{30}Si$ values of up to +2‰. These differences may be linked to different parameters including higher weathering rate and human impact.

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UNEXPECTED DIVERSITY WITHIN THE RIMICARIS EXOCULATA EPIBIOTIC COMMUNITY - INSIGHTS INTO SULFUR AND CARBON METABOLISM

The shrimp *Rimicaris exoculata* harbors a specialized epibiotic community in its enlarged gill chamber. We analyzed specimen from the Snake-Pit hydrothermal vent field on the Mid-Atlantic-Ridge by complementing a 16S rDNA survey with the analysis of genes involved in carbon, sulfur and hydrogen metabolism. In addition to epsilonproteobacteria, the epibiotic community unexpectedly also harbors deltaproteobacteria of a single phylotype, closely related to the genus *Desulfocapsa*. These results are in congruence with functional gene analyses, which indicate the presence of autotrophic sulfur-oxidizing epsilonproteobacteria and sulfur-metabolizing deltaproteobacteria. In addition, hydrogen metabolism might play an important role as hydrogenases from both groups were identified. Our data further suggest that autotrophic carbon fixation is primarily carried out by epsilonproteobacteria using the reductive TCA cycle. Interestingly, the community composition of the gills seems to differ from that of the inner lining of the gill chamber. Overall, our results show that the epibiotic community is more diverse than previously assumed. The co-occurrence of sulfur-oxidizing and sulfur-reducing epibionts indicates that these are involved in the syntrophic exchange of sulfur, possibly increasing the overall efficiency of the symbiosis.

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NUMERICAL SIMULATION OF SEDIMENT-FLUID INTERACTION ALONG THE SEA-FLOOR

The mathematical description of interactions between flowing fluids and sediments is one of the fundamental problems of sediment transport. Numerous publications show that most approaches about sediment-transport initiation rest on empirical observations in flow channels. Major aim of our investigations is the simulation of fluid and grain interactions along the sea-floor on a micro scale level. We focus on grain behavior under different flow conditions and observe different types of sediment transport. A further attention lies on the development of boundary layers (Brinkman layer). Therefore two different numerical simulation techniques, the Discrete Element Method (DEM) and the Finite Difference Method (FDM), have been coupled. We developed a 3D box model which is filled at the base with sediment grains (DEM) overlain or/and perfused by a flowing fluid (FDM). At any time step, high resolving informations are available at each position of the model. That enables detailed observations of interactions between fluid and sediment. Additionally, it gives access to relevant data (e.g. force effects on the sediment grains) which allows a quantification of former empirical surveys.

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INTERANNUAL VARIABILITY IN PLANKTON SPECIES COMPOSITION EXPLAINED AS SEASONALLY ENTRAINED CHAOS

The species composition of plankton communities may vary markedly from year to year. Such interannual variability is often attributed to year-to-year variation in weather conditions. However, recent experiments have shown that multispecies interactions can generate chaos in plankton communities, even when cultured under constant laboratory conditions (Becks et al. Nature 2005; Beninca et al. Nature 2008). As a next step, we studied the effects of regular seasonal forcing on model communities consisting of multiple phytoplankton and zooplankton species. The population dynamics had a peculiar character. Seasonal variation in total community biomass was quite regular, with a clear temporal organization of community structure. Yet, the species composition varied from year to year in an irregular fashion. These simulated patterns closely resemble those observed in long-term time series of natural plankton. Our findings suggest that interannual variability in species composition, observed in many plankton communities, is not necessarily driven by the weather. Instead, interannual variability is an intrinsic property of multispecies communities embedded in seasonal environments.

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IMPACT OF SIZE-SELECTIVE PREDATION AND INDUCED LIFE HISTORY SHIFTS ON COMPETITION

We studied the effect of size-selective predation on the outcome of competition between two differently sized prey species in a homogenous environment. We used a physiologically structured population model parameterized according to the example of fish predation on two differently sized cladoceran species, *D. pulicaria* and *D. galeata*. While the larger *D. pulicaria* was principally the better competitor for food, competitive superiority shifted to *D. galeata* under certain predation scenarios, defined by varying predation intensity and the switchpoint of size-selectivity where negative selection of small prey size-classes turns into positive selection of larger prey. The lowest predation intensity needed to induce a shift from *D. pulicaria* to *D. galeata* was found when the switch in size-selection was in between the sizes at maturity of both species. A reduction of this trait in *D. galeata* as a phenotypic response to the presence of fish resulted not only in an increased capability to withstand predation, but also in competitive dominance shifts over *D. pulicaria* at lower predation intensities and a much wider range of size-selectivity as a trait-mediated indirect effect.

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THE EXPRESSION OF PHOSPHATE TRANSPORTER GENE (*PSTS*) IN PICOPLANKTON COMMUNITY: PRIMER DESIGN AND FIELD TESTS IN THE EAST CHINA SEA

The cell wall-associated phosphate-binding transporter gene (*pstS*) is potentially a diagnostic marker for phosphorus stress in photosynthetic picoplankton. In order to detect the *pstS* mRNA levels in the East China Sea by Q-RT-PCR (real-time quantitative reverse transcription polymerase chain reaction), suitable primer sets have to be designed according to the *pstS* gene diversity in the same region. For this purpose, 45 homologous *pstS* sequences were collected during two cruises conducted in Mar. 2006 and Apr. 2007. The phylogenetic analysis indicated that most sequences obtained from Mar. 2006 cruise belonged to *Prochlorococcus*. In contrast, sequences obtained from Apr. 2007 cruise were equally distributed in *Synechococcus* and *Prochlorococcus*. According to sequence alignments, two degenerated primer sets were designed for *Synechococcus* and *Prochlorococcus*, respectively. The specificity of primers was confirmed using DNA extracted from an oligotrophic, *Prochlorococcus* dominated station (K.14) and an eutrophic, *Synechococcus* dominated station (K.12) in southern East China Sea. During an Asia dust storm event in Mar. 2007, the *pstS* mRNA abundance detected by the *Synechococcus*-specific primer set correlated well with the changes of inorganic phosphate concentration and the mixing strength in the water column.

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CHEMOTAXIC MEDIATED DISPERSAL OF CARIBBEAN MANGROVE ASSOCIATED SPONGES

Sponges have short living, lecithotrophic larval stages and therefore hydrology and stochasticity are considered the principal components explaining spatial patterns in adult sponge distributions. However, a positive relation between sponge coverage and tannin concentrations of roots of the red mangrove Rhizophora mangle was recently observed. Whether sponge larvae are attracted to exudates of mangrove roots or increases in tannin concentration can be induced upon coverage by sponges remained illusive. Here we report chemotaxis and inherent chemoreception by larvae of the sponge Tedania ignis attracted to tannic acid, while increases in mangrove tannin concentrations could be induced by transplantation of adult T. ignis specimens to bare roots. Our results complement the postulated facultatitive mutualism between several sponge species and R. mangle, amplify the questionability of the role of tannins as anitiherbivory and antifouling substances in marine environments and even suggest that tannins can be positively involved in ecological interactions. Since chemotaxic mediated larval recruitment patterns in part resemble spatial patterns in adult sponge distributions in Caribbean mangrove ecosystems, incorporation of chemotaxis in future modeling of larval dispersal is warranted.

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CONTINUOUS MEASUREMENTS OF SURFACE WATER CO_2 CONCENTRATION IN A BOREAL HUMIC LAKE AND APPLICATIONS IN MODELING LAKE METABOLIC PROCESSES

We constructed a measuring system where surface water CO_2 concentration was continuously measured from equilibrated air stream with a rugged, affordable and commercially available CO_2 probes. We present the data of the continuous measurements in a boreal humic lake over two open water periods. The data revealed that in this steeply stratifying lake the stability of stratification and the depth of water column mixing strongly controlled the surface water CO_2 concentrations. We also demonstrate how primary production and community respiration can be modeled from the high frequency surface water CO_2 data using computational method commonly used in forest ecology. This method enabled determination of rates of primary production and community respiration with 10-min time resolution and thus resulted in substantial improvement when compared with traditional bottle incubation methods. Our free water approach resulted in productivity and mineralization rates that were clearly higher than obtained with the traditional bottle incubations.

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PHOSPHORUS FIXATION BY BENTHIC COLONIES OF APHANOTHECE IN THE LITTORAL OF A MEROMICTIC LAKE

The direct contribution of microorganisms as a regulator for benthic phosphorus (P) fluxes is often neglected in conceptual models of the internal P cycle. The outstanding importance of benthic cyanobacteria as a P pool in sediments was shown by a study of the small meromictic Lake Burgsee (Germany). In the littoral sediment high abundances of green gelatinous clumps of Aphanothece stagnina were observed down to a sediment depth of 20 cm. A screening including 44 sampling sites showed a patchy distribution of colonies which occur in shallow areas until a water depth of 4 m (=76 % of total lake area). The physiological and chemical status of colonies in different sediment depths were evaluated by PAM fluorometry, by oxygen microsensors and by elemental analysis. The specific P content of separated Aphanothece-colonies was higher (9.0 ± 2.8 mg P g-1 dw) than of sediment without colonies (1.95 ± 0.58 mg P g-1 dw). 31P NMR investigations of separated colonies revealed that poly-P is a main cellular P compound. Compared to approx. 60 kg P in the epi- and hypolimnion the calculated 100 kg P stored in the benthic biomass of Aphanothece-colonies could be a relevant P pool controlling the P availability in the water.

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INTRA-COHORT CANNIBALISM AND SIZE BIMODALITY: A BALANCE BETWEEN HATCHING SYNCHRONY AND RESOURCE FEEDBACKS

Cannibalism is a common interaction in animal populations and has major influences on the dynamics and structure of populations and communities. Size variation among individuals allowing for cannibalism to occur may not only result from variation between year-classes (cohorts) but is also observed among individuals within cohorts. In the latter case, the size variation may relate to extended hatching periods. Here we investigate the environmental conditions under which size bimodality in cohorts experiencing extended hatching periods can emerge as a result of cannibalism. We use a physiologically structured population model (PSPM), specifically suited to handle the dynamics of size-structured populations to study cannibalistic fish cohorts. In addition to long enough hatching periods, we show that the occurrence of size bimodality within cohorts is heavily dependent on consumer density and the feedback on consumer performance that occurs via the shared resource (zooplankton). Furthermore, we argue that the emergence of cannibalistic individuals which can gain energy from consumption of conspecifics and thereby accelerate in growth may be crucial to avoid stunted growth and subsequent recruitment failures resulting from starvation during winter.

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THE WHOLE IS GREATER (OR LESSER) THAN THE SUM OF THE PARTS: EXPERIMENTAL METHODS TO EXAMINE SYNERGISMS AND ANTAGONISMS BETWEEN MULTIPLE GLOBAL CHANGE VARIABLES

With the current urgent need to predict the biological effects of rising pCO2 and attendant ocean acidification, we sometimes neglect the obvious fact that anthropogenic global change influences on the ocean biota extend well beyond this single factor. Along with acidification, phytoplankton must deal with simultaneous changes in temperature, mixed layer depth and irradiance, major nutrient and iron supplies, and biological controls such as predation and competition. It is not an exaggeration to say that virtually every important limiting factor for phytoplankton growth is now in flux in the rapidly changing anthropocene ocean. The effects of some of these global change variables may tend to reinforce each other, while others may tend to cancel each other out. For instance, the light reactions of photosynthesis are affected by both iron and light availability, while the dark reactions are subject to changes in both temperature and pCO2. I will present examples from laboratory and field studies which illustrate the need for experimental approaches using a multi-variate approach, which I argue offers much greater predictive power than the results of single variable manipulations.

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CN COMPOSITION OF THE FOOD WEB IN LAKE MICHIGAN

Carbon and nitrogen ratio is used to measure the energetic changes of the aquatic food web. The study provides information about factors related to the invasion of mussels. It emphasizes in quantifying the C: N in seston, zooplankton and animals living in the benthos, on an m2 of the lake. Calculated concentrations of ammonium, nitrate, CO2 and chlorophyll were made in order to understand the flow of nutrients. Samples of North East Reef, Sheboygan Reef and Fox Point Station were used. The concentrations remain constant, with a significant increase in ammonium at North East Reef, and a lower production of chlorophyll compared with last year. This finding promoted another experiment; measuring the amount of ammonium that mussels excrete in 3 hours. Consequently 1 mussel can excrete 0.5 μm per day and 10 000 excrete 5mmol x m2, meaning that the concentration of ammonium is at the bottom of the lake, limiting the growth of producers. C: N concentrations were 1:10 for the organism tissue and water column; in Fox Point the concentration was higher due to the absence of mussels.

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A NEW OCEAN COLOR AND SST FRONT DETECTION ALGORITHM: APPLICATIONS FOR FISHERIES OCEANOGRAPHY IN THE NORTHEAST U.S. CONTINENTAL SHELF LARGE MARINE ECOSYSTEM

Enhanced primary and secondary productivity is often associated with oceanic fronts. While sea surface temperature (SST) fronts are well documented, the location, frequency and strength of chlorophyll fronts are virtually unknown. Using satellite data from several high-resolution ocean color and thermal sensors (SeaWiFS, MODIS-Aqua and MODIS-Terra) a climatology of chlorophyll and SST fronts in the Northeast U.S. Continental Shelf Large Marine Ecosystem was produced with a new front detection algorithm. The new algorithm is based on gradient approach and uses a contextual median filter to preserve important chlorophyll features. The chlorophyll and SST frontal climatologies document spatial, seasonal and interannual variability of a variety of fronts in this region. The

diverse fronts are associated with western boundary currents (Gulf Stream Front), water mass boundaries (Shelf-Slope Front), and tidal mixing including fronts around Georges Bank, Nantucket Shoals, and the Eastern Gulf of Maine. The chlorophyll and SST fronts provide an enhanced remotely-sensed product at synoptic, seasonal and annual scales that have the potential to describe oceanographic processes and environmental factors that are relevant to fisheries research and management.

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CHEMICAL ECOLOGY OF THE PLANKTON: PRESENT STATUS AND FUTURE CHALLENGES

Planktonic organisms produce a plethora of novel secondary metabolites that play fundamental roles as defences against competitors, predators and pathogens, and are therefore driving ecosystem functionality. For example, microalgae can produce allelopathic substances inducing either deleterious or advantageous effects that are crucial in the competition for available resources. They can also produce feeding deterrents to discourage consumption by predators, or teratogens promoting congenital malformations and fetal mortality in the offspring of animals feeding on them, with dramatic consequences on population recruitment rates. Some of these new products are part of a wider group of highly unstable physiological mediators called ROS (Reactive Oxygen Species), well known for their toxic and apoptotic activity in mammalian and plant cells. Studies on chemical interactions in the plankton are still in their infancy compared to benthic organisms, but there is great scope for research into the effects of toxins on population dynamics and ecosystem functioning. My presentation will highlight some of the most important findings regarding the role and possible function of these active metabolites and how their discovery has prompted a whole new area of research and interest on chemical ecology in the plankton and marine food web functioning.

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MACROPHYTE SPREADING AND ECOSYSTEM CHANGES IN THE LOWER EBRO RIVER AND ITS ESTUARY: A NOVEL ECOSYSTEM SHIFT ?

The lower Ebro river and its estuary have recently undergone changes in water quality, structure and composition of biological communities. This study aims to investigate causes and consequences of this ecosystem shift, characterized by a quick macrophyte spreading. Data on water quality, hydrology, composition and abundance of biological communities was obtained both from existing data and new surveys (14 sampling points) carried out seasonally from 2006 to 2008. Results indicate that in the last decade an oligotrophication process is taking place. Phosphorus decrease has triggered a phytoplankton decline, a huge proliferation of macrophytes, massive colonization of Simulidae, and changes in benthic invertebrates and fish assemblages. In the estuary, the phytoplankton decrease in the upper layer has allowed light to penetrate in the salt wedge leading to a decrease of organic matter inputs and the disappearance of anoxic conditions in summer. Although phosphorus decrease is likely the main cause of the shift, river flow and flood decrease, and the increasing number of some invasive species of fish and bivalves, can also play a role. Bottom-up versus top-down effects are discussed.

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DESCRIPTION OF NITRATE POREWATER PROFILES IN SANDY SEDIMENTS AFFECTED BY SGD USING AN ADR MODEL AS A PRELIMINARY TOOL TO STUDY NITRATE CYCLING PATHWAYS

A free-boundary solution of an Advection-Dispersion-Reaction model was used to describe porewater nitrate profiles collected during one year of sampling at a groundwater seepage site in the Ria Formosa, Portugal. Sequential reaction layers were included in the model based on the local distribution of the benthic C:N organic ratio and prior mass balance calculations. Excellent concurrence between modeled and measured profiles was obtained. Model-derived nitrate fluxes concurred with in-situ flux measurements. Sensitivity analysis confirmed that in similarly advective-dominated environments, benthic reactivity over small spatial scales may significantly impact resulting porewater gradients and sediment-water fluxes. Nitrate oxidation and reduction rates extracted from model fits of the data agreed with literature values (10^{-2}-100 mmol m^{-2} h^{-1}). Because dispersive effects are not included in direct mass balances based on the porewater concentrations, the model presented here increases the accuracy of reaction rate estimates and geochemical zonation at SGD sites. We suggest that tools such as the one described here might be used to advantage in preparing further experimental studies of local reaction kinetics affecting nitrate distribution in sediments affected by groundwater discharge.

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REFLECTING WITH HINDSIGHT ON COASTAL PROBLEMS RELATED TO BIOMASS EXTRACTION AND PRODUCTION

The main extraction of biomass for human consumption in the coastal zone , including fish and shellfish, have been obtained historically by fishing and harvesting. However, overexploitation has produced profound changes, whereby extraction has started to alter to production by aquaculture and ranching as the source of supply for this biomass. This change has had impacts on the environmental , ecological, economical and social fabric of the coastal zone. These impacts are examined within the framework of Driver, Pressure, State, Impact and Response using case studies for salmon, prawns, oysters and stalked barnacles.

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RESPONSES OF MARINE PHYTOPLANKTON POPULATIONS TO CHANGES IN OCEAN PH

From the mid-Mesozoic, coccolithophores, have been major calcium carbonate producers in the oceans. Recent debate on the fate of these organisms in future ocean conditions has raised questions of how natural populations adapt/acclimate to environmental selection pressure. In the lab, the use of different strains and protocols to manipulate the carbonate system, has prompted questions of whether intraspecific variability in the response of phytoplankton to changing seawater pH, and different responses to alternative methods to manipulate the carbonate chemistry are likely in natural populations. We present laboratory and field data addressing how populations are likely to adapt/acclimate to changing pH. Our findings are relevant to biogeochemical modeling and address the relationships between biological diversity and ecosystem functioning.

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FLOW CYTOMETRIC MEASURES OF OXIDATIVE STRESS IN FRESHLY ISOLATED ALGAL SYMBIONTS AS A FUNCTION OF TEMPERATURE AND IRON AVAILABILITY TO CORAL COLONIES.

The photophysiology of coral-algal symbioses is critical to the survival of coral reefs globally. We used flow cytometry and intracellular fluorescent probes to assess the photophysiology of freshly isolated zooxanthellae (FIZ) from the coral *Stylophora pistillata*. Intracellular reactive oxygen species (ROS) were measured using the fluorescent dyes dihydroethidium and CMH_2DCFDA, and cell membrane integrity was assessed using SYTOX, a cell-wall impermeable dye. We hypothesized that greater photophysiological stress would occur in FIZ from *S. pistillata* colonies kept at high temperature (31°C) relative to control colonies (27°C). Also, stress might be greater still at higher temperatures when iron availability was low, conditions created by adding the strong iron chelator desferrioxamine B to seawater bathing the colonies. Our findings that FIZ contained a significantly *lower* level of ROS (superoxide radical) and maintained a *higher* than predicted level of cell membrane integrity under low iron, high temperature conditions are suggestive of an induced photoprotective mechanism. These results are consistent with increases in photoprotective pigment in these FIZ, implying that diminished iron availability renders corals more prone to decreased photosynthetic efficiencies under bleaching conditions.

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SEXUAL REPRODUCTION IN THE GIANT JELLYFISH *NEMOPILEMA NOMURAI* (RHIZOSTOMEAE; SCYPHOZOA): A HISTO-ECOLOGICAL APPROACH

The giant jellyfish *Nemopilema nomurai* has bloomed annually since 2002 in the Yellow, East China, and Japan seas. Medusae appear in spring as ephyrae grow to >100 kg wet weight and become sexually mature in late fall. Because a mature female carries >100 million oocytes, sexual reproduction is important for its population explosion. To understand sexual reproduction in the giant jellyfish, we investigated gonadal maturation, spawning, and fertilization. The genital organs are like sacs protruding beneath the umbrella, with the ovary or testis at the bottom of each sac. Gonadal maturation of medusae is induced by physical damage and maturation is completed 4-5 days after the damage. Oocytes accumulate yolk substances via special cells (trophocytes) but no trophocytes occur in the testes, where sperm accumulate in the sperm follicles. Spawning of both sexes is induced by light exposure. Sperm release takes place about 1 h before egg spawning, which occurs 1.5 h after first light. Fertilization may occur in the female's gastrovascular cavity, where eggs released from the ovary meet sperm introduced from the ambient water.

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LATEGLACIAL ENVIRONMENTAL AND CLIMATIC CHANGES AT THE MALOJA PASS, CENTRAL SWISS ALPS, AS RECORDED BY CHIRONOMIDS AND POLLEN AT A PALAEO-LAKE

Chironomids and pollen were studied in a radiocarbon-dated sediment sequence obtained from a former lake near the Maloja Pass in the Central Swiss Alps (1865 m a.s.l.) to reconstruct Lateglacial environment. Pollen assemblages imply a vegetation development around the Maloja Pass from shrub tundra at the beginning of the Allerød to coniferous forest during the early Holocene with a lowering of the timberline during the Younger Dryas. Chironomid taxa able to survive hypoxia occurred in the second part of the Allerød and during the Preboreal, and but were absent during the Younger Dryas cold phase. This suggests summer thermal stratification and unfavourable hypolimnetic oxygen conditions in the palaeo-lake during the warmer periods. Mean July air temperatures were reconstructed using a chironomid-temperature transfer function from the Alpine region. The inferred temperatures during most of the Allerød were slightly lower than modern values. During the Younger Dryas temperatures were distinctly lower than modern values with the coolest temperatures inferred for the first part of this cold episode. During most of the Preboreal, the temperatures were higher than present-day values by ca 3°C.

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CHIRONOMIDS OF A HIGH ALPINE LAKE: NEO- AND PALAEOECOLOGICAL ASPECTS WITH SPECIAL REFERENCE TO HOLOCENE CLIMATIC RECONSTRUCTION

The main aim of this investigation is to reconstruct Holocene climatic changes in the Austrian Alps by means of chironomid analysis of a sediment sequence retrieved from Schwarzsee ob Sölden, a high alpine lake situated above the present tree line at 2796 m a.s.l. In order to assess the modern distribution of chironomids in respect to their habitat preferences, benthic samples were taken at 2.5–3 m intervals along a north-south transect across the deepest point in the lake (18 m). The obtained information about the modern distribution contributed to a better understanding of changes in fossil chironomid assemblages from a long sediment core covering the past 10,200 calibrated radiocarbon years. Based on the fossil chironomid record, past temperatures were reconstructed using a chironomid–July air temperature transfer function from the Alps. The climatic inferences from the chironomid data revealed millennial- to century-scale climate variability and climatic events during the Holocene, such as the rapid warming during the early Holocene, the "8.2k" cold event, the Hypsithermal/Neoglaciation transition, the Middle Bronze Age cooling, and recent climatic warming).

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ZOOPLANKTON CHANGE COLONY MORPHOLOGY OF *MICROCYSTIS*

Microcystis forms colonies of which sizes are relatively large within plankton communities, and this has been considered as resistance against grazing from zooplankton. We hypothesized that the colony morphology of *Microcystis* would be related to the presence of grazer. In the present study, we investigated the changes in colony morphology of *Microcystis* under grazing pressure. Two *Microcystis* species isolated from a pond were exposed to the grazer *Daphnia pulex*. After two weeks of the exposure, the size and shape of *Microcystis* colony were analyzed. We found the increase in colony size of *Microcystis* in the presence of *D. pulex*, though composition of colony shape was markedly not changed. We also performed the experiment where *Microcystis* was exposed to the chemical substances derived from the grazer, and again found the increase in colony size. In these experiments, we could not find differences in colony size and shape of two *Microcystis* species, thus the trend might be general to many *Microcystis* species.

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SUBSTRATUM TYPE AND THE ABUNDANCE AND PERSISTENCE OF THREE CAULERPA (CHLOROPHYTA) SPECIES

Two year monitoring of the invasive Caulerpa taxifolia and Caulerpa racemosa have shown the great influence that the substratum type (consolidated vs. non consolidated) has on the abundance of these species. Presence of C.taxifolia and C.racemosa on four substrata was measured in three shallow areas indicating that consolidated substrata (rock with photophilic algae and dead rhizome of Posidonia oceanica) were more favourable than non consolidated substrata (sand) for the development of these species. An experiment was designed to evaluate the growth and persistence of C.taxifolia, C.racemosa and Caulerpa prolifera on different types of substrata by fixing Caulerpa fragments to plots of dead rhizome and sand and monitoring their development over time. Mean wave conditions were propagated to the shore using a physical model and near-bottom orbital velocities calculated on the experimental sites. Caulerpa species showed a higher cover and persistence on dead rhizome than on sand. Results showed that cover area of C.taxifolia exposed to estimated near-bottom orbital velocities >25cms-1, temperatures <22oC and photoperiods <11h started to decline. Bottom velocity measurements with ADVs on dead rhizome were lower (1.5±0.2cms-1) than on sand (2.2±0.2cms-1). The friction coefficient of dead rhizome was higher (1.04E-01) than sand (2.33E-02). These results could contribute to understand the process of invasion by predicting which substrata would be more susceptible to be invaded.

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CELL WALL DEGRADATION PRODUCTS INDUCE ANTI-HERBIVORE RESISTANCE IN MARINE ALGAE

Herbivory often induces reduced palatability in plants. The cues that trigger such responses in seaweeds are largely unknown, although their identification is a necessary precondition for the understanding of the ecology of defenses and potential coevolutionary links between hosts and their enemies. We here demonstrate that defense can be induced in the rockweed *Fucus vesiculosus* in the absence of herbivory by application of oligoguluronate. This oligosaccharide is generated during the degradation of alginic acid, a main constituent of the algal cell wall, and is released from the faeces of grazers. Up to 3 d after application of the cue, there was a significant reduction in the consumption rate of the isopod *Idotea baltica*, a main feeding enemy of *F. vesiculosus*, suggesting an induction of anti-herbivory defence. This indicates that cell wall derived saccharides are used by rockweeds and kelps as signals to induce anti-herbivory and anti-pathogen defenses, respectively. Functionally homologous oligosaccharides are also used by red algae and vascular plants in the induction of defense against pathogens. This kind of enemy perception thus appears as a result of evolutionary convergence.

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FLOW FIELD MEASUREMENTS IN THE BENTHIC BOUNDARY LAYER USING AN ACOUSTIC DOPPLER VELOCIMETER

A new system for precise measurement of vertical profiles of mean and turbulent flow structure immediately above the sediment-water interface is introduced. This system has an acoustic Doppler velocimeter (ADV) attached to an elevation system to allow precise measurement of the vertical profiles of three-component velocities in the range of 0.1 to 20 cm above the sediment surface in the field. This system enables an onboard operator to accurately measure height and move the ADV vertically to any point. The system was applied to in situ measurements of velocity profiles immediately above the sediment. As results of the measurement, detailed vertical profiles of three-component velocities immediately above the sediment surface, which was considered to be quite important for understanding turbulent field in the benthic boundary layer, were obtained. Data analysis showed that shear velocity could be estimated even under non-steady condition using correlation with the turbulent velocity. From measurement results, it was suggested that turbulent dissipation rate could be calculated by the power-law scaling of the energy spectrum under Re* > 80 conditions.

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IMPACT OF SUBMESOSCALE DYNAMICS ON BIOGEOCHEMICAL BUDGETS IN AN IDEALIZED NORTH ATLANTIC OCEAN

Satellite images and oceanographic data have revealed the presence of energetic (sub) mesoscale that accommodate a diverse set of physical, biological interactions influencing marine biogeochemistry on wide range of space and time scales.Though how oceanic turbulence modulates biological budgets through short- and small-scale mechanisms is now well understood,its role in the long- and large-scale equilibrium of nutrient distribution and biological productivity is still an unresolved issue. For this purpose,we have set up an idealized doublegyre configuration simulating the circulation at different horizontal resolution (up to 2km).The ocean dynamics is coupled with an online biogeochemical model. The impact of small scales is assessed by comparing the mean state of the model calculations at different resolutions,and evaluating the transport trends at large scales for each experiment. In our study, the increase in resolution drastically altered the model's behavior.Major differences are an intense fine-scale activity,and consequently a large change in the basin-scale circulation with the emergence of strong zonal jets at middle latitudes that results in a large reduction of the poleward transports of mass, heat and nutrients.Enhanced turbulence and the ensuing modification of the subsurface nutrient reservoir play a relevant role in setting new production pattern and phytoplankton concentration,despite the importance of local response on short-time scale for those quantities.

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IMPACT OF THE INVASIVE SPECIES *ACARTIA TONSA* ON THE DISTRIBUTION OF AUTOCHTONOUS CONGENERIC SPECIES IN ESTUARIES OF THE BAY OF BISCAY

The abundance of *Acartia* copepods was monitored in the euhaline region of two contrasting estuaries, Bilbao (highly polluted) and Urdaibai (less polluted), located on the Basque coast, Bay of Biscay, from 1999 to 2005. Until the appearance of the non-indigenous species *Acartia tonsa* in 2002, *Acartia clausi* dominated the congeneric assemblage of *Acartia* species in Bilbao, whereas in Urdaibai *A. clausi* dominated the high salinity zone and the brackish *Acartia bifilosa* the low salinity zone. The establishment of *A. tonsa* caused the spatial niche of *A. clausi* to shrink in both estuaries, been practically driven out from the 30 salinity zone in the estuary of Bilbao. Low oxygen levels in this salinity zone of the estuary of Bilbao may have helped the establishment of *A. tonsa*, which is more tolerant to hypoxic conditions than *A. clausi*. In the estuary of Urdaibai there was large overlapping of the spatial and temporal niches of *A. tonsa* and *A. bifilosa*. The establishment of *A. tonsa* caused the displacement of the annual maximum of abundance of *A. bifilos* a from summer to spring in Urdaibai.

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ONTOGENETIC VERTICAL

Through its interaction with vertical current shears, the vertical migration of planktonic organisms influences the direction and speed at which they are transported. This interaction is thought to be critical because diel or tidal migration cycles are almost universal. For larvae however, the longer-term migration patterns, throughout ontogeny, are still poorly known. Similarly, those may be key to the balance between dispersal and retention. We studied ontogenetic vertical migration in the communities of coral-reef fish larvae around Barbados (West Indies) and Tetiaroa (French Polynesia) using vertically stratified net tows. Most taxa display downward ontogenetic migration patterns, which are surprisingly consistent at the community-level. The influence of those patterns on transport is estimated through numerical modeling. In stratified environments, ontogenetic vertical migration generates either very high or very low retention depending on the conditions before the onset of the migration. In weakly stratified currents, commonly observed around oceanic islands, vertical migration does not induce retention expect in rare cases. Given the very low recruitment rate of fish larvae, those few exceptions may well be crucial in supporting local replenishment.

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INVASION OF FRESHWATER ZOOPLANKTON ACROSS THE PACIFIC OCEAN

Biological invasion is notoriously known to be a great threat to biodiversity and ecosystem services. Lack of careful taxonomical investigation may hinder discrimination of invaded species from native species. Freshwater zooplanktons have been anthropogenically introduced and invaded between North America and Europe via ballast water of ships. For example, previous studies have shown that Daphnia ambigua in North America recently invaded Europe and now distributes throughout Europe. Although the occurrence of D. ambigua has been reported in Japan since 1980s, lack of genetic studies for the specimens hindered the discrimination of the invasion. To address Japanese D. ambigua, we analyzed mitochondrial DNA sequences (12S rRNA and CO1) of North American populations (N=28) and Japanese populations (N=14). Japanese populations had only three mitochondrial haplotypes: all were parts of North American clades; and two were identical to North American haplotypes. The severe genetic bottleneck found in Japanese populations indicates recent invasion from North America to Japan. The invasion may have incidentally occurred with the recent introduction of freshwater fishes (e.g. bluegill and rainbow trout) from North America.

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HORIZONTAL AND VERTICAL DISTRIBUTION OF JELLYFISH, AURELIA AURITA MEDUSAE, AND ITS FEEDING IMPACT ON ZOOPLANKTON COMMUNITY IN TOKYO BAY

Natural aggregations of Aurelia aurita medusae were observed by eye and by underwater video system in the innermost part of Tokyo Bay, Japan, in 2006. Observations were conducted throughout day and night. Most of aggregations were equally distributed in the water column between surface and bollom layer. Apparent diel vertical migrations were not observed in A. aurita medusae. Significant difference in the bell diameter of medusae among the depths was not observed. We calculated the density and the biomass of A. aurita medusae in the innermost part of Tokyo Bay. Moreover feeding impact of A. aurita medusae on the biomass and the production in the zooplankton community was also estimated.

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CHANGES IN BACTERIAL COMMUNITY STRUCTURE ACCOMPANYING OXYGEN DEPLETION OF THE DEEPWATER ZONE OF LAKE BIWA, JAPAN

Recently, it has been observed that eutrophication was causing oxygen depletion in the deep water zone of Lake Biwa, and global warming has exacerbated this. Sulfur oxidizing bacteria Thioploca sp. was newly identified in 1991 and followed by manganese oxide particles like Metallogenium in 2002, which signify the changing metabolisms of the bottom of the lake. The warm winter of 2006/2007 had air temperature in February that was the second highest recorded since 1894. This caused the vertical mixing period of Lake Biwa to be shorter than usual, which supposedly case of serious oxygen depletion the following year. For this reason, water temperature and oxygen concentration were monitored carefully from April 2007 to February 2008 at a depth of 90. Bacterial community in the sediment were analyzed with denaturing gradient gel electrophoresis (DGGE) of 16S rRNA gene fragments. In this study, bacterial community stricture was considered to be applicable as a biological indicator to particular attention to phosphate-accumulating organisms in the sediment.

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MORPHO-MOLECULAR TXONOMY OF RADIOLARIANS

Radiolarians are marine protists with a siliceous shell, they have a broad distribution and a significant ecological impact in open oceans. Their morphological taxonomy observed in fossil records is extensively used in paleo-oceanography. Currently, more than 800 radiolarian taxa can be distinguished and are classically distributed into three super groups (i.e. Spumellaria, Nassellaria, Collodaria). Nevertheless, their shell complexity prevents a fine understanding of their taxonomy and evolutionary relationship. Molecular phylogeny could help to address these issues. Here we present a procedure to simultaneously extract genetic material from a single cell while preserving its shell integrity. Our study of specific member of the Spongodiscidae family (Spumellaria) suggest the species *Spongodiscus osculosa* does not actually belong to the Spongodiscidae but rather evolved from the Pylonium group in late Pliocene. Our morpho-molecular analyses of the Spumellaria challenges the classical taxonomy and also permitted to infer evolutionary processes putatively induced by changes in oceanographic conditions such as consequences of the Isthmus of Panama closing.

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INTERACTION BETWEEN MNEMIOPSIS LEIDYI AND BEROE OVATA AND THEIR INFLUENCE ON THE ZOOPLANKTON OF IZMIT BAY (NORTHEASTERN MARMARA SEA)

The invasion of alien species has become a great problem for many seas of the world due to increasing international commerce combined with the use of ballast water on ship. In the early 1980s, the ctenophore, Mnemiopsis leidyi, first invaded the Black Sea and later it spread to the Marmara Sea and B. ovata, predator of M. leidyi, appeared in this sea in the late 1990s. We focused in this study on the summer dynamics of M. leidyi and on the mesozooplankton after the invasion of the Izmit Bay, Northeastern Marmara Sea, by the ctenophore B. ovata. In summer 2001, M. leidyi and B. ovata population was higher than in summer 2002. While maximum abundance of M. leidyi was found in western part of the Izmit Bay, B. ovata reached at maximum abundance in eastern part in September 2001.

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PARTICULATE ORGANIC MATTER EXPORT: DEGRADATION PROCESSES AND BALLASTING EFFECTS

We calculated vertical fluxes from in situ profiles of aggregate size-specific abundance measured during a ship cruise off Cape Blanc (Mauritania), using estimated sinking speeds and aggregate masses. Calculated fluxes agreed well with sediment trap data for the same area and period. We estimated carbon consumption from the fluxes and used consumption changes to identify degradation processes at different depths. Calculated copepod abundances needed to remove the majority of carbon in the upper 80 meters were consistent with previous observations. In deeper waters carbon consumption fitted measured bacterial degradation rates. Highest degradation rates were in the upper ~200 meters and limited by aggregate residence time (sinking speed), which we argue depends on ballast material. We observed high sinking speeds for the aggregates formed on material from Cape Blanc due to presence of liths from coccolithophorids and high input of dust. In laboratory experiments bacterial carbon specific degradation was independent of ballast material whereas sinking speed increased with denser aggregate constituents. Thus, aggregated carbon flux should be greater for aggregates containing ballast material than for pure diatom aggregates.

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EXPLORING MICROBIAL COMMUNITIES SIX BILLION BASES AT A TIME: COUPLED METAGENOMIC-PROTEOMIC ANALYSES PROVIDE NOVEL INSIGHTS INTO DIVERSITY

New DNA sequencing and protein identification technologies are enhancing the ability to explore community diversity at an unprecedented scale. We collected the <0.8 micron size fraction from surface seawater in Puget Sound, WA (USA) and used an Applied Biosystems SOLiD Analyzer and nanoLC/MS/MS Mass Spectrometer to sequence DNA and detect proteins, respectively. A single run of the SOLiD instrument produced six gigabases of 35bp DNA sequence fragments. Approximately 15% of the highest quality reads aligned to microbial genomes (NCBI RefSeq) or Global Ocean Survey (GOS) reference data, yielding high sequence coverage of hundreds of GOS coding sequences and surprisingly, several whole marine bacterial genomes, with partial coverage of dozens more. High quality reads were assembled to produce longer sequences, resulting in >10,000 novel contigs. Tandem mass spectra generated from the same cells will be interrogated using our assembled contigs, microbial genomes, and GOS coding sequence. Preliminary interrogations have already detected >3000 peptides and >600 proteins, including proteorhodopsin, archaeal ammonia monooxygenase, and many transport proteins. This combined approach provides novel insights into the diversity and function of a natural microbial community.

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ELECTROCHEMICAL ADHESION IMAGING OF MARINE PARTICLES

Electrochemical adhesion imaging presents an approach for in situ characterization of microparticles in aqueous environments. Confined organic microparticles, such as vesicles, droplets and cells with fluid membranes can be characterized through appearance of well-defined adhesion signals due to their fast attachment, deformation and spreading at a charged aqueous mercury interface. On the other hand, gel microparticles with flexible 3D network do not form permanent contact with the electrode. The adhesion signals at the mercury electrode immersed in seawater capture the primary structure of microparticles. Incidents and shape of adhesion signals reflect particle size, concentration, polydispersity and reactivity. Major distinction in adhesion behavior between various classes of marine particles (unicellular algae, liposomes, droplets and polymer gels) in seawater was identified through appearance of adhesion signals at characteristic potentials of mercury/seawater interface. Advantages of this approach, as revealed from monitoring and mesocosmos experiments in the Northern Adriatic are single particle analysis, in situ fast sample processing preventing loss in primary particle structure.

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BALANCING THE COSTS OF CARBON AND PHOSPHORUS: EFFECTS OF FOOD C:P RATIO ON THRESHOLD FOOD CONCENTRATION FOR GROWTH OF DAPHNIA SPECIES

TFC (Threshold Food Concentration) is one of the important factors determining a competitive outcome between consumers sharing the same food. However, it is not clear how elemental ratios of food (e.g., C:P ratio) affect on the TFC. Here, we performed experiments with seven Daphnia species to examine how TFC would change according to C:P ratio of algal food. The results showed that Daphnia significantly increased it's TFC when fed on P-poor algae compared to those fed on P-rich algae. The magnitude of the increase in TFC, however, differed highly among Daphnia species with different body sizes and relative body P contents. Within Daphnia species, the clearance rates were not affected by algal P:C ratio, suggesting that the increased TFCs are not attributable to increase in C costs by compensatory feeding for P-poor food. Rather, it is suggested that the increased TFC at P-poor food was due to P costs for maintenance that are proportional to the relative body P contents. Implications of species-specific difference in the relative body P contents will be discussed.

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DIVERSITY EFFECTS ON LITTER BREAKDOWN IN A MEDITERRANEAN STREAM

Here we evaluated the interactive effects of the diversity of leaf litter and decomposer organisms on stream litter breakdown. Breakdown rates of mixtures of up to 4 litter species with contrasting traits were compared after 6 weeks of exposition in a 3rd-order stream in southern France. Using litter bags with different mesh sizes (5, 1 and 0.25 mm) we manipulated access for different decomposer communities (large shredders and predators, small shredders, microorganisms). Large and small shredders contributed to increased leaf mass loss of 8.6 and 13.4 %, respectively, compared to microbial decomposition. Mass loss was more influenced by the identity than by the diversity of litter species. Fast-decomposing species, however, decomposed more rapidly in mixtures than expected from single species treatments in coarse ($P=0.008$) and medium mesh bags ($P<0.001$) only. This result was apparently related to a small but highly dominant litter feeding caddisfly (Micrasema, Brachycentridae). Overall, our results suggest that litter mixture effects on breakdown rates may be due to the activity of a key-stone shredder taxa.

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PARTICLE SIZE DISTRIBUTIONS AND THEIR IMPLICATIONS FOR ZOOPLANKTON FEEDING.

We have deployed the autonomous particle-sensing SOLOPC float on 5 cruises more than 8 times. We now have more than 300 profiles of particle size (100 um - 1 cm) and abundance between the ocean surface and 100 m. The profiles consistently had a subsurface maximum in particle volume. The median (by volume) equivalent spherical diameter for the particle distribution was 0.4-0.8 mm and increased with depth in a manner similar to that observed in coagulation simulations. There was a very sharp cutoff at the bottom of the high particle concentration region. We argue that this could be the result of enhanced zooplankton feeding at the particle base that could represent flux feeding. Such behavior could explain why zooplankton feeding is frequently observed at the particle maximum rather than the productivity maximum.

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TWILIGHT ZONE CARBON EXPORT AND REMINERALIZATION IN THE SOUTHERN OCEAN (SAZ AND PFZ AREAS SOUTH OF TASMANIA)

The biological pump efficiency is set by the different processes controlling formation and export of biogenic material from the surface layer and also the processes consuming organic C deeper in the mesopelagic. We applied different proxy-approaches to evaluate the potential for C export (new production), C export production from the surface

(234Th deficit) and remineralization of organic C at greater, mesopelagic depths (BaSO4 accumulation, bacterial activity) for different entities of the Southern Ocean. These include SAZ and PFZ systems differing in planktonic composition and functioning as well as shelf and margin systems naturally supplied with Fe, studied during S.O. expeditions including KEOPS/2005 and SAZ-SENSE/2007. Production, export and remineralization rates are compared between these different provinces to investigate spatial variability of C sequestration efficiency. Our findings about efficiency of C export and remineralization highlight the importance of: -type of phytoplankton dominance, with diatoms dominated systems leading to shallower remineralization; -phytoplankton biomass and grazing, with evidence for relatively less mesopelagic remineralization under conditions of high biomass and high grazing pressure; -the important control of prokaryotes on organic carbon remineralization length scales.

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MOLECULAR GENETIC ANALYSIS OF THE SPIROLIDE-PRODUCING DINOFLAGELLATE ALEXANDRIUM OSTENFELDII WITH FOCUS ON PKS GENES

The marine dinoflagellate A. ostenfeldii is the only known biosynthetic source of the polyether macrocyclic imine toxins known as spirolides. Dinoflagellate polyethers are often assumed to be derived via polyketide biosynthetic pathways and indeed this pathway was confirmed in A. ostenfeldii for one spirolide derivative. There is no proven allelochemical interaction of spirolides against other protists and the chemical ecological significance of these toxins remains unknown. We applied a variety of molecular genetic methods to elucidate the general gene content and genomic organization of A. ostenfeldii and to obtain polyketide synthase (PKS) gene sequences. Two cDNA libraries provided insights into the gene content of this dinoflagellate and several PKS domain sequences were annotated. These sequences provided the basis for primer design for RACE (rapid amplification of cDNA ends) to yield full length PKS transcripts and also for probe design to screen genomic libraries. This study is the basis for further research on the gene expression of polyether toxins as potential modulators of dinoflagellate blooms and programmed synthesis of novel compounds of pharmaceutical value.

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THE INFLUENCE OF WATER COLUMN DEPTH AND MIXING INTENSITY ON ALGAL COMMUNITY TRAITS

Water column depth and the intensity of vertical mixing may have complex effects on the availability of light and nutrients, algal production and sedimentation, and the vertical distribution of phytoplankton and nutrients. To explore their separate and combined effects we independently manipulated mixing intensity (strong artificial mixing vs. background turbulence) and water column depth (2, 4, 8, and 12 m) in a field enclosure experiment. To accentuate the vertical light gradient enclosures had black walls resulting in a euphotic depth of only 3.7 m. Mixed enclosures became gradually dominated by pennate diatoms. Low turbulence enclosures, however, showed pronounced vertical structure in water columns > 4 m. They were dominated by motile flagellates in the upper water column and by pennate diatoms in deeper strata, suggesting vertical niche partitioning along opposing light and nutrient gradients, which resulted in a higher diversity in the unmixed enclosures. This interpretation is supported by a primary production assay, where phytoplankton originating from different water depths in low turbulence treatments had the relatively highest primary productivity when incubated at their respective depths of origin.

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USING SCANNING FLOW CYTOMETRY TO CHARACTERIZE PROTISTEAN SUB-POPULATION DYNAMICS IN DILUTION EXPERIMENTS

The scanning flowcytometer allows identification of sub-populations of phototrophic protists along with individual cell fluorescence. By integrating chlorophyll fluorescence of each cell within specific groups , we were able to study the phytoplankton dynamics through a series of grazing dilution experiments in nutrient enriched mesocosmos experiments. While the overall growth and grazing of the phytoplankton community displayed typical values, individual groups behaved very differently. A clear example was *Skeletonema marinoi*, which was grazed on at different rates over time, suggesting an initial lag phase of saturated microzooplankton grazing, followed by a numerical response and increase in the grazing on the diatom population. Other phytoplankton species, such as cryptophytes, suggested more cryptic dynamics, likely influenced by trophic cascading effects during incubations and mixotrophy. Scanning flowcytometry is a promising and potential powerful tool that can replace traditional chlorophyll extraction, and has a significantly higher sample-processing rate compared to traditional light microscopy methods. Moreover, the separations of sub-populations of phytoplankters provide a window into the dynamics of individual species within dilution experiments also when using live samples

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PORE WATER FLOW IN RIPPLED BEDS – A COMBINED EXPERIMENTAL AND NUMERICAL APPROACH

Advective porewater flow strongly affects biogeochemistry and interfacial solute fluxes in sandy sediments. Measurements of porewater flow, however, are hard to obtain and most modeling attempts are based on a few, 20 year old pressure measurements on triangular dunes. Here, we report on porewater flow in a rippled sandy bed that was studied in a small flow channel by dye-plume tracking. Particle Image Velocimetry was used to characterize the open channel flow. 2D-modeling was done in a water and sediment domain that exactly matched the channel and bedform geometry. A turbulent flow model with k-omega closure scheme was used to model the open channel flow. The resulting pressure distribution was then imposed to the sediment domain to predict porewater flow based on Darcy's equations. Modeled porewater flow patterns closely agreed with measurements. Predicted porewater velocities were generally slower than measurements, but within a range that can be explained by uncertainties in sediment permeability. We conclude that the applied modeling approach is capable to predict porewater flow in rippled sandy beds based on field observations of bedform, currents, and sediment permeability

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ASSESSING THE CONTRIBUTION OF SMALL EUKARYOTIC PHYTOPLANKTON TO PRIMARY PRODUCTION IN THE SUBTROPICAL NORTH ATLANTIC OCEAN

The marine picoplankton community, comprising cells <3 μm, is a major contributor to global biomass and primary production. Within this community, phototrophic picoeukaryotes (PPEs) are widely distributed, and may be the major carbon fixers along with other small phototrophic nanoeukaryotes (SPNEs), cells <10 μm in size, which are often overlooked. In January 2008 we investigated the contribution of specific phytoplankton groups, and particularly PPEs and SPNEs, to C fixation in the subtropical North Atlantic Ocean, using a 14C-bicarbonate radiotracer in combination with flow cytometric cell sorting. Subsequently, fluorescent in situ hybridisation technology was used to identify the specific PPE and SPNE classes responsible for the high CO2 uptake rates. PPEs comprised an assemblage of mainly pelagophytes and chrysophytes while SPNEs were dominated by prymnesiophytes. Crucially, given the low numerical abundance of these organisms, these groups together contributed up to a half of the total primary production, and with on average the SPNE group responsible for 20% and the PPE group 10% of this total. Our data reinforces the idea that small eukaryotes are major players in marine C cycling.

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VARIATION IN SPINE MORPHOLOGY AMONG POPULATIONS OF THE SNAIL, MEXACANTHINA LUGUBRIS – A RESPONSE TO MORPHOLOGICAL PLASTICITY IN THE BARNACLE, CHTHAMALUS FISSUS

Chthamalus fissus, a barnacle found in the high intertidal of Southern California, develops narrow or bent defensive morphologies when exposed to the predatory snail, *Mexacanthina lugubris*. We compared the degree of operculum plasticity among populations of *C. fissus* that differ in their history of exposure to the predator, *M. lugubris* and we also compared feeding spine morphology of *M. lugubris* among these sites. Barnacles from the southern study site near Ensenada, Mexico, which falls within the historic northern limit of *M. lugubris*, develop significantly narrower operculum openings compared to barnacles from the two northern populations whose operculum widths do not differ. Southern snail populations typically had shorter, narrower spines compared with the northern snail populations. The observed variation in spine morphology may reflect local adaptation to the degree of operculum narrowing in the barnacle population.

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THE ROLE OF SEED VIABILITY IN THE RECOVERY OF CHESAPEAKE BAY ZOSTERA MARINA POPULATIONS FOLLOWING A LARGE SCALE DECLINE

In 2005 large declines in perennial eelgrass populations occurred in the Chesapeake Bay. Transects were established and monitored for changes in eelgrass abundance in two regions of the York River from 2004 to 2008. In 2007 additional monthly monitoring of shoot origin (seedling or vegetative) and seed bank abundance and viability was conducted to characterize bed re-development. During 2006 eelgrass beds at both sites recovered with seedlings providing 48 – 54 % of the total density. By 2007 vegetative shoots were dominate with seedlings comprising only 0 – 6 % of total density. During 2007 a second decline occurred in the upriver site. Recovery was minimal in 2008 with maximum density of 6 ± 6 shoots m^{-2}. The lack of seedlings in the downriver site in 2007 and the minimal recovery in the upriver site in 2008 may be attributed to the lack of long-term eelgrass seed reserve in the Chesapeake Bay. These findings highlight the importance of seed reserves and seed viability in eelgrass meadow recovery from episodic stresses and potential impact of recurring stresses on the persistence of perennial beds.

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COMPOSITION OF THE METAZOOPLANKTON COMMUNITY AND STRUCTURE ACROSS THE CONTINENTAL SHELF OFF TROPICAL NW AUSTRALIA

This talk focuses on the distribution pattern and grazing impact of different functional metazooplankton groups in a tropical marine ecosystem. We studied the metazooplankton distribution across the continental shelf from eutrophic mangrove areas to the oligotrophic deep blue ocean off NW Australia. Chlorophyll *a* concentrations were reduced by factor 10 along the transect including a shift towards small sized primary producers. The metazooplankton biomass followed the same pattern. Even though low in abundance, copepods were most frequent followed by larvaceans, doliolids, other thaliacea and chaetognaths. Small size classes < 200 μm dominated the zooplankton and e.g. 80 % of the larvacean community belonged to the micro-size fraction. We show that gelatinous zooplankton is of key importance for the carbon cycling in this tropical area. Larvaceans exceeded the copepod grazing impact on the primary producers especially in oligotrophic areas. The metazooplankton community structure and production reflect biotic and abiotic conditions of the system. We show that small size classes, especially larvaceans, have a higher contribution to secondary production and carbon cycling in tropical oligotrophic areas than previously thought.

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PHAGOTROPHY OF CYANOBACTERIA, AN ECOLOGICAL ADVANTAGE FOR THE DINOFLAGELLATE *ALEXANDRIUM CATENELLA* TO FORM BLOOMS IN THE THAU LAGOON (SOUTH OF FRANCE)

The phytoplankton species *Alexandrium catenella* is a toxic dinoflagellate able to supplement its photo-autotrophy by mixotrophy, feeding on the cyanobacterium *Synechococcus sp*. Both these genera appeared simultaneously in Thau lagoon waters (South of France) during an oligotrophication phase in the 90's, thus mixotrophic abilities of *A. catenella* may represent a potential advantage in species competitiveness. To study the importance of this organic nutrition in *A. catenella* population development, cultures experiments and *in situ* observations were realized. Cultures experiments consisted in mixing ^{15}N-labeled cells of *Synechococcus* with *A. catenella* cells under various nutrient concentrations of ammonium and N-urea. The phagocytosis process was analyzed measuring the variations of ^{15}N isotopic ratio and pigment signature of *A. catenella* cells. Analysis at the cellular scale using confocal microscopy allowed the visualization of *Synechococcus* trapping and digestive vacuoles, and revealed that phagotrophy seemed to be an additional nutrition process whatever the nutrient background. *In situ* observations during the *A. catenella* bloom in June 2008 confirmed the ecological importance of this organic nutrition with up to 38 % of *A. catenella* cells showing *Synechococcus* ingestion.

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INVESTIGATION OF BOTTOM SHEAR STRESS CONTROL DEVICES

The control of bottom shear stress plays a significant role in investigation of many scientific studies, such as benthic processes in marine biogeochemistry, performance of bioreactors in process engineering and biotechnology. In aquatic systems, benthic chambers are widely used to study the flux exchanges at the sediment-water interface under reduced shear stress conditions. So far only a few devices for generation of uniform bottom shear stress have been developed. By a detailed experimental as well as numerical simulation of the flow and pressure field in the present devices we demonstrate their limitations in generation of fully uniform bottom shear stress.

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BACTERIAL ANOXIC NITRIFICATION IN PRESENCE OF MANGANESE OXIDES IN ARCACHON BAY SEDIMENTS (FRANCE)

Recents studies highlight new biological pathways in nitrogen cycle such as heterothophic nitrification or anaerobic ammonium oxidation subject to environmental conditions. Presence of several chemical compounds in marine sediment, such as manganese oxides (MnO2, highly reactive chemical species), can interact with nitrogen cycle and modify balances or open new metabolic ways. Thermodynamically favorable anaerobic reactions implying mangenese oxide reduction coupled with ammonium oxidation to nitrate (anoxic nitrification) have been shown within sediments. However, the occurence of this putative bacterial mediated process is still subject of controversy. Direct evidence of this transitory nitrate production remains difficult due to anoxic conditions supporting high denitrification rate. 15N-Isotope pairing method gives indirect proof of this new metabolic way at a multi-scale level (from sediment to single strain level). Short and long duration isotope incubations made it possible to highlight the anoxic bacterial nitrification process within the sediments of Arcachon bay. From long term incubations, non-fermentative strains able to produce nitrate from ammonium in presence of manganese oxides have been isolated. These strains have a large spectrum of metabolism including coupling anaerobic nitrification/denitrification.

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ECOLOGICAL ASSESSMENT OF THE CTENOPHORE INVADER MNEMIOPSIS LEIDYI IN THE WESTERN BALTIC SEA

The recent invasion by the comb jelly Mnemiopsis leidyi became a topic of major concern after its appearance in the Baltic Sea. A permanent sampling in the Western Baltic Sea provided the basic knowledge on its seasonal dynamics and ability of being established. We showed the late summer outbreak in 2007-8 with a 10 fold increase in abundance that coincided with high reproduction activity. The drop of mesozooplankton prey was due to predatory control of fish larvae and no seasonal overlap between M. leidyi and fish eggs or larvae could be detected. We discussed the main environmental conditions which might trigger the outbreaks. The simulated drift pattern of M. leidyi during its first year of observation illustrated the possible advection route through the Baltic Sea. It is hardly possible that M. leidyi has penetrated from Kategat Skagerak as a single source of spread. Instead ballast water release and the subsequent spread away from recipient harbors might have led to the population's concentration in the deep basins. The predatory impacts of M. leidyi on mesozooplankton were discussed.

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RELATIVE ABUNDANCE OF NIRS-DENITRIFIER AND ANAMMOX GENES AT OXYGEN DEFICIENT ZONE DEPTHS WHERE ANAMMOX RATES ARE HIGH

Conventional denitrification was long assumed to be the major process responsible for fixed N loss in the water column of oxygen depleted zones (ODZ). Direct isotope measurements now show that anammox rates greatly exceed denitrification rates in the ODZ water column, where denitrification often cannot even be detected. In the ODZ region off the coast of Peru, we found that anammox was localized near the top of the ODZ; both rates were minimal in the center of the ODZ in the vicinity of the secondary nitrite maximum. Based on Q-PCR assays of nirS (denitrifiers) and anammox 16S rRNA gene abundance, we found that denitrifier abundance greatly exceeded that of anammox bacteria in the ODZs of both the Arabian Sea and the Peruvian upwelling region. Even at stations where we measured high anammox rates, anammox abundance was very low and ranged from 2 to 12 % of the total nirS abundance. Both genes represented a variable proportion of the total microbial community, and both were undetectable in surface waters. Denitrifier assemblages were diverse while anammox was represented by a single type.

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COMPARISON OF NUTRIENT ACQUISITION STRATEGIES ACROSS DIATOM SPECIES: INSIGHTS FROM PHYSIOLOGICAL AND GENE EXPRESSION STUDIES

Primary production by diatoms is fueled by the availability of nutrients in the environment. Scarcity of nutrients can limit diatom growth and production, and often multiple nutrients are co-limiting. Recent whole-genome sequencing projects of diatom species indicate their

genetic blueprint for nutrient acquisition and for responding to nutrient stressors. Studies assessing diatom gene expression under different nutrient regimes reveal the metabolic pathways that diatoms engage under optimal and nutrient-limiting growth conditions. Genes that are highly regulated under different nutrient levels can be useful indicators of whether wild populations are stressed for a specific nutrient or for multiple nutrients. Physiological and gene expression studies from a number of groups are illuminating our understanding of how diatoms acquire nutrients needed for growth.   In addition, new approaches are under development that compare nutrient limitation responses using proteomics and whole-transcriptome RNA sequencing. These approaches should provide us with a comprehensive view of how different pathways of diatom metabolism intersect and illuminate specific vs. global responses to limiting nutrients.

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THOMPSONIAN VS. DARWINIAN CONTROL OF DEFORMATION, ADHESION, RECOGNITION AND BIOGEOCHEMISTRY IN THE HYDROSPHERE

At lake and ocean surfaces, biologically-produced polymeric material (BPM) adds viscous and elastic forces to surface-tension forces when the surface is compressed or dilated and when it is sheared. BPM thus influences cross-surface gas exchange, aerosol production, and both wave and ripple damping. In the bulk phase, BPM adds to the Newtonian viscosity of pure water (and salt) both within and outside plankton colonies and organic aggregates. BPM modifies flocculation and aggregate strength, diffusion and biogeochemistry. It may modify turbulence and erosion of plankton-rich thin layers, and in algal blooms BPM can clog fish gills. Attraction, repulsion and adhesion vary between pairs of abiological surfaces, and this may give rise to diverse structures like those described by D'Arcy Thompson. When at least one surface is biological, such adhesion is biologically modified, and is then termed "recognition". Recognition is thus controlled genetically, so is subject to Darwinian evolution. Investigation of the relative importances of Thompsonian and Darwinian influences at explicitly stated scales might be a fun way to discover which aspects of the Hydrosphere are most vulnerable to biological change.

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PHOSPHORUS MOBILIZATION BY SULFIDE OXIDATION IN CARBONATE SEDIMENTS FROM SEAGRASS AND UNVEGETATED SITES IN THE US VIRGIN ISLANDS

Sulfide produced by sulfate reduction (SR) can be oxidized by seagrass root O2 flux in shallow carbonate sediments low in Fe. The sulfuric acid produced from sulfide oxidation, as well as metabolic acids from aerobic respiration, has the potential to mobilize solid phase phosphorus (P) pools in support of seagrass nutrition. Fresh sediments from four US Virgin Islands sites were modestly acidified to near-neutral pH in slurries. Following sulfuric acid amendments, the mobilized P pools in the slurry water and the sediment-adsorbed pools were quantified. P mobilization rates in the field were also calculated using field estimates of SR rates applying 35SO43-. Phosphorus release was significantly higher in seagrass than bare sediment, and at sites close to anthropogenic sources of nutrients compared to pristine sites. These results, along with those from our earlier studies in Florida Bay, a carbonate seagrass-dominated estuary, highlight the potential importance of P release from acid dissolution of carbonate-bound P pools.

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ANAEROBIC AMMONIUM OXIDATION IN THE ARABIAN SEA

Bacterial denitrification in the oxygen minimum zone (OMZ) of the Arabian Sea has long been recognized as an important sink for fixed nitrogen (N), estimated to ~20% of the pelagic denitrification in the world ocean. Recently, anaerobic ammonium oxidation with nitrite (anammox) has been found to be the main N-loss pathway in the OMZs of the Eastern Tropical South Pacific and the Benguela upwelling system. Here we explore the possibility that anammox is also a dominant process for fixed N removal in the world's largest oxygen-deficient water mass, the Arabian Sea OMZ. We performed incubation experiments with 15N-labeled nitrogen compounds to investigate the vertical distribution of denitrification and anammox through the OMZ from the Omani shelf offshore towards the Indian coast. Intriguingly, there was no evidence of either anammox or denitrification in the northeastern Arabian Sea, which is generally considered to be the main region of N-loss in the Arabian Sea. Instead, our results point to a substantial N-loss due to anammox from the Omani upwelling area. Both incubation experiments and functional gene expression analysis indicate that anammox is coupled to dissimilatory nitrite reduction to ammonium. These results provide the first direct evidence for active N-loss from the southwestern Arabian Sea.

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2D GEL PROBES FOR FE^{2+}, $\sum PO_4$ AND S(-II) DISTRIBUTION STUDIES IN AQUATIC SEDIMENTS

Thin-films techniques introduced by W. Davison *et al.* in early 1990's are well adapted to study distribution of dissolved compounds in sediment of aquatic systems. We present here a development for inorganic phosphate distribution ($\sum PO_4$) of a previously described probe, able to provide information on both iron and sulfide 2D distributions. Iron and $\sum PO_4$ distributions are semi-quantitatively obtained by an imaging method: after *in situ* equilibration of a sampling gel, a reactive gel containing a specific reagent (Ferrozine-ascorbate or molybdate-ascorbate respectively) is applied on the equilibrated gel. A specific color appears within minutes (magenta in rich Fe^{2+} zones, blue in $\sum PO_4$ ones). Sulfide distribution is obtained with a DGT-like device: a PVC reactive film develops a gray coloration in the H_2S rich zone. 2D probes were deployed in the Arcachon lagoon (France), in two contrasted stations (with or without *Zostera noltii*), in late September (2007) corresponding to the end of the eelgrass growth period. $\sum PO_4$ distribution is heterogeneous with some hot spots in *Z. noltii* meadow site, whereas it presents a larger distribution with higher concentrations in absence of grass.

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INFLUENCE OF ENVIRONMENTAL FORCING ON PLANKTON DYNAMICS IN THE GULF OF MAINE REGION

Climate change-induced variability of water properties and circulation patterns may have significant consequences on plankton dynamics and trophic interactions in coastal/shelf ecosystems. Observational data from the Gulf of Maine region suggest that changes in surface low-salinity Scotian Shelf Water inflow and deep slope water intrusion appear to be the main driver for the plankton phenological shift and productivity variation at higher trophic levels, possibly through a bottom-up process. However, the causal relationship is yet to be examined quantitatively. A 3-D coupled biological-physical model was used to examine the influence of environmental forcing on the timing and magnitude of phytoplankton blooms, net primary productivity, and copepod population dynamics in the Gulf of Maine. The model results indicate that 1) increased surface freshening can stimulate earlier phytoplankton blooms but may reduce overall winter-spring primary productivity by impeding vertical-mixing-induced nutrient supply; 2) phytoplankton biomass and productivity vary in response to the alternation in the intrusion of Warm vs Labrador Slope Waters that have different nutrient concentration; and 3) bottom-up process through phytoplankton-zooplankton interaction has limited contribution to the inter-annual variability of copepod populations, suggesting a possible predatory control in the system. The apparent mis-match between field data and model results may be due to temporal undersampling.

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HEAT EXPOSURE OF CORALS: INVESTIGATING THE "OTHER" DIFFUSIVE BOUNDARY LAYER

Radiant energy reaching shallow water corals can cause their temperature to increase above that of the surrounding water, an effect which is reduced as flow increases. In order to better understand the thermal exposure of corals under bleaching conditions, we used temperature microsensors to investigate the thermal boundary layer (TBL) of a branching and a hemispherical coral species (*Stylophora pistillata* and *Porites lobata*). The TBL thickness for both species was 2 mm at quasi stagnant flow (0.3 cm/s), and declined exponentially at increasing flow. Dimensionless analysis of heat transfer (Nusselt-Reynolds number plots) resulted in a heat exponent of approx. 0.5, indicative of a laminar boundary layer and consistent with predictions from engineering theory for simple geometrical objects. However, additional measurements of oxygen transfer across the diffusive boundary layer (DBL) and a dimensionless analysis (Sherwood-Reynolds number plots) resulted in a greater exponent for mass transfer (~0.7) thus suggesting that heat and mass transfer at the surface of corals should not be treated as analogous processes.

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DEVELOPMENT OF A RRNA–TARGETED OLIGONUCLEOTIDE PROBE FOR FISH QUANTIFICATION OF CHYTRIDS (FUNGI) IN AQUATIC ENVIRONMENTS

We have recently shown that fungi, primarily the typical pelagic Chytrids, are important members of the complex community of small heterotrophic eukaryotes in pelagic ecosystems. In these systems, Chytrids mainly occurred as phytoplankton parasites. The host-fixed living forms (i.e. sporangia) ultimately produce uniflagellated propagules (i.e. zoospores), a potentially important food source for consumers which, probably, have been wrongfully regarded as protistan bacterivores in previous studies. The present study was designed to test the suitability of *in situ* hybridization to detect and quantify a group of uncultured chytrids putatively identified as phytoplanktonic parasites. A 18S rRNA probe was designed from freshwater database and FISH optimizations were performed using Escherichia coli clones containing plasmids with target and non target 18S rDNA insert, i.e. clone−FISH. Tests with a pure culture of chytrid parasites of the diatom *Asterionella sp.* were positive and the application to environmental samples as well. This may lead to a better understanding of the ecological importance of chytrids, and their implication in carbon flows within aquatic microbial food webs.

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PHYTOPLANKTON SPRING BLOOM RESPONSE TO OLIGOTROPHICATION AND CLIMATE VARIABILITY

Phytoplankton dynamics are influenced by a multitude of biotic and abiotic factors including nutrient and light availability as well as herbivory. During the past three decades total phosphorus concentrations in deep warm-monomictic Lake Constance dropped 10–fold while spring water temperatures and water column stability increased – albeit with a high interannual variability. The response of phytoplankton biomass and community composition during the spring bloom to these two different stressors was analysed using a long-term data set with a biweekly temporal resolution. Oligotrophication affected mainly the maximum biomasses whereas climate variability was more influential in determining the timing, i.e., the start and end of the spring bloom. The reduction in phosphorus concentrations reduced maximum phytoplankton spring biovolume approximately by 60 per cent mostly due to a reduction of chlorophytes and diatoms. Earlier spring bloom development resulted in a higher biovolume of especially cryptophytes. Overall, oligotrophication and changing climate lead to modified seasonal patterns with shifts in community composition, lower spring maxima, a less pronounced clear water phase and a shift to biomass maxima during the summer months.

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DENITRIFICATION RATES IN SEDIMENTS OF THE GERMAN WADDEN SEA: N2:AR MEASUREMENTS IN SEDIMENT CORE EXPERIMENTS

Rates of denitrification in German Wadden Sea sediments have been measured to assess its impact on the total nitrogen budget of the German Bight. During a cruise in August 2008 intact sediment cores and bottom water were collected at seven sites including different sediment types along the gradient between the nutrient-rich outer Elbe Estuary and the nutrient limited coastal area of Sylt. Continuous-flow sediment core experiments have been used to measure inorganic nutrient and O2 fluxes and net denitrification rates. The relative fluxes of N2, O2 and Ar were measured by membrane inlet mass spectrometer (MIMS). The flow-through experiments showed an increase of the sedimentary oxygen demand from about 0.5 up to 3 mmol O2 m-2 h-1 while net denitrification rates increased from about 20 up to 500 µmol N m-2 h-1. These in situ fluxes show that German Wadden Sea sediments have a higher capacity to act as a sink for nitrate than previously being estimated.

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FUNCTIONAL GENOMIC APPROACHES TO STUDY SPECIES INTERACTION AND ECOPHYSIOLOGICAL PROCESSES IN THE TOXIGENIC HAPTOPHYTE PRYMNESIUM PARVUM

Prymnesium parvum is a toxic bloom-forming haptophyte causing mass fish mortalities in fresh, brackish and coastal marine waters. A functional genomic approach within the EU project ESTTAL (Expressed Sequence Tags of Toxic Algae) was adopted to investigate toxicity, growth regulation, with emphasis on the allelochemical potency of this species (Rhodomonas and erythrocyte lysis assays). An EST library comprising ~6230 unique sequences was analysed in silico as the basis for oligonucleotide design to produce a microarray for gene expression analysis. Microarrays were developed to elucidate the genetic regulation of toxicity and growth-related processes in Prymnesium cultures under environmentally relevant stress conditions: nutrient depletion (N and P-deficiency), salinity and temperature extremes as bottom up control, and species interactions, specifically competition against dinoflagellates and canobacteria and/or grazing of Oxyrrhis marina as a top down control mechanisms. Here we present results of this extensive gene expression project, which has contributed to further understanding processes of bloom formation affected by extrinsic (grazing, competition) and intrinsic (growth modulators, primary and secondary metabolism) regulatory mechanisms and gene expression.

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CLIMATE CHANGE IMPACTS ON LAKE STRATIFICATION – A LARGE SCALE SIMULATION APPROACH

Lake stratification is to a large extend determined by regional climatic conditions. Changes in climate patterns like increasing air temperature will lead to a shift in lake characteristics thus changing the physical basis for live in the aquatic system. Using numerical simulations with a k-epsilon turbulence model we simulate the seasonal hydrodynamics of lakes in Europe. To account for hydrodynamical differences due to lake morphometry and trophic state, we use several model lakes differing in depth and absorption coefficients, respectively. The model lakes are forced by meteorological data given as gridded fields over Europe for current climate condition as well as for future climate scenarios. This results in several tens of thousands simulations of lake temperatures and turbulent diffusivities, from which we extract cardinal events and values such as the onset of stratification, length of stratification period, thermocline depth or ice cover duration. Using the reference meteorological conditions our simulations provide predictions for differences in lake hydrodynamics and ecology across the latitudinal, longitudinal and altitudinal gradients.

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PHYSICAL DRIVERS OF ESTUARINE FOOD WEB STRUCTURE AND FUNCTION: COMPARISON ACROSS SYSTEMS

The structure and function of estuarine food webs change in response to both natural and anthropogenic stresses. The construction and network analysis of quantitative food webs is a popular means of characterizing such ecosystems. Previous studies have suggested network analysis indices, alone or in combination, which indicate system stress, stability, resilience, and maturity; however, our understanding of how these are related to the physical characteristics of the environment is limited. We first established the most robust network analysis indices to various methods of food web construction, and we then used multivariate statistical methods to examine the relationship between these indices and physical measures (e.g. residence time, tidal range, temperature range, sediment characteristics and salinity) across a geographical range of estuaries. We identified the physical factors that relate most strongly to ecosystem size, average path length, redundancy, Ascendency, and overall connectance, and we discuss the relationship between physical setting and ecosystem characteristics such as stability and resilience. These results enhance our understanding of estuaries and aid the defining of goal functions in ecosystem management.

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ISOLATION AND CHARACTERIZATION OF MARINE PHYTOPLANKTON AS A NEXT GENERATION BIOFUEL

Global energy demands continue to rise, but global fossil fuel production is struggling to keep up. Further, fossil fuels contribute to the increase in global atmospheric carbon dioxide and are a major driver of global climate change. To address these concerns, Cellana BV is pursuing the use of marine phytoplankton as a next generation, low carbon-profile biofuel. Marine phytoplankton have three major advantages over other biofuels including (1) they do not use freshwater (2) they do not require arable land and (3) phytoplankton can grow much faster than traditional plant-based biofuels. Working with Cellana, our group has isolated phytoplankton strains from diverse locations and some have significant lipid content. Using an efficient experimental strategy, we have analyzed promising candidates from this collection and discovered a wide range of growth rates and lipid compositions in conditions simulating environmental scenarios associated with commercial applications. Here we describe our screening process and show that some phytoplankton have characteristics that make them excellent candidates for commercial-scale production suggesting that marine phytoplankton are the leading contenders for large scale production of next generation biofuels.

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FROM METAGENOMES TO GENES TO ENZYMES - THE REMARKABLE DIVERSITY OF MICROBIAL DIMETHYL SULPHIDE PRODUCTION IN THE OCEANS

Many different bacteria catabolise the abundant anti-stress molecule dimethylsulphoniopropionate (DMSP), which occurs in many phytoplankton and some angiosperms. In many cases, this releases the climate-changing gas dimethyl sulphide. Using genetics, we identified four different ways whereby marine bacteria undertake this important biotransformation. These include DMSP lyase, which releases DMS plus acrylate, an acyl CoA transferase that modifies DMSP prior to DMS release and two other pathways, using enzymes in different enzyme families. Introducing the corresponding cloned “ddd” (DMSP-dependent DMS) genes to E. coli confers the ability make DMS from DMSP. These ddd genes are very likely subject to horizontal gene transfer among distantly related bacteria, including “terrestrial” species, and even between bacteria and eukaryotic fungi and phytoplankton. Some bacteria, (e.g. Roseovarius), catabolise DMSP via the important demethylase and also have multiple ways of making DMS from DMSP. Metagenomic data bases reveal the widespread distribution of different ddd genes in the oceans. The implications of these remarkable examples of genetic, genomic and metagenomic diversity will be discussed. References: Todd et al Science 315: 666 (2007), Curson et al Environmental Microbiology 10:757 (2008), Todd et al Environmental Microbiology In the press (2009)

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MOLECULAR ADAPTATION TO HIGH TEMPERATURES IN THE DEEP-SEA VENT POLYCHAETE ALVINELLA POMPEJANA: SEARCH FOR ADAPTIVE SIGNATURES FROM AN EST COLLECTION

Alvinella pompejana, the “Pompeii worm” is a tubicolous polychaete that lives on the walls of active chimneys at deep-sea hydrothermal vents on the East Pacific Rise, a patchy, harsh and unstable environment. It is among the first metazoans to colonise young hot chimneys and, as such is known to be one of the most thermophilic marine eukaryotes on Earth. To live in this harsh environment, the worm displays specific biochemical adaptations to relatively high temperatures. To study thermal adaptation, the whole transcriptome of *A. pompejana* was sequenced from full-length tissue-specific cDNA libraries and compared to an EST collection of a closely-related species living in a cooler habitat: *Paralvinella grasslei*. First, amino acid replacement and GC content were compared across annelids and molluscs to trace back putative molecular signatures of thermal adaptation and codon selection in this peculiar lineage using well-conserved genes encoding ribosomal proteins. Second, a set of hundreds orthologous proteins was analysed between the two alvinellid species to search for amino-acid/codon specificities. Both analyses indicate shifts towards positively charged amino-acids and a high hydrophocity index in the Pompeii worm.

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INFLUENCE OF HISTORICAL AND CONTEMPORARY PROCESSES ON THE GENETIC STRUCTURE AND CONNECTIVITY IN A METAPOPULATION OF THE POLYCHAETE TUBEWORM PECTINARIA KORENI

Understanding connectivity is fundamental for conserving and managing the diversity of biological systems. Among marine species exhibiting bentho-pelagic life cycles, larval dispersal is crucial in ensuring population connectivity over different spatial scales. The scale of effective dispersal, which is governed by hydrodynamics, specific life history traits and ecological interactions, affect local population dynamics, regional structures and the temporal stability of whole metapopulations. Molecular tools are now routinely used to quantify the extent of effective marine connectivity. However, hidden historical effects of recent colonization, large effective population sizes and remnant ancestral polymorphisms may blur patterns of presently restricted gene flow and lead to erroneous predictions about real spatial connections and the genetic structure of source populations. Particularly, the spatio-temporal dynamics of source populations and how they may influence larger scale processes needs to be assessed. To overcome this methodological challenge and identify contemporary connectivity patterns within the metapopulation of Pectinaria koreni in the English Channel, we combined hydrodynamic modelling and population genetics, and further assessed the spatio-temporal structure of an important source population in the Baie de Seine.

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USING D/H RATIOS OF BULK FRACTIONS TO CONSTRAIN THE BIOCHEMICAL SOURCES OF PARTICULATE ORGANIC MATTER

As marine particulate organic matter (POM) is transported to the deep ocean, it is chemically altered such that much of it becomes unidentifiable at the molecular level. Because it can compose the large majority of POM in deep waters, understanding the source of this molecularly unidentifiable material is important to building a detailed, mechanistic model of carbon export to sediments. A proxy for the unidentifiable organic matter is the fraction remaining after hydrolysis in 6 M HCl - the acid-insoluble (AI) fraction. Previous investigations into bulk properties of the AI fraction have resulted in conflicting hypotheses on the biochemical source(s) of this material: is it carbohydrate-like, lipid-like, or a transformed mixture of other compounds? Because D/H ratios vary between biochemical classes to a greater extent than other isotopic signatures, the determination of δD in the AI fraction could help constrain its source more precisely. Here we will present a new approach to measuring the D/H ratios of nonexchangeable hydrogen in bulk organic fractions, together with the first measured δD values for the AI fraction from POM.

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GIS ANALYSIS OF THE DISTRIBUTION OF REEF FISH AMONG HABITATS WITHIN LA PARGUERA, PUERTO RICO CORAL REEF ECOSYSTEM

In this study, the abundance and biomass of reef fish in fourteen habitats in the La Parguera region of Puerto Rico was characterized using spatial analysis software. The objectives were to 1) develop a GIS map of pre-sorted fishery habitats ; 2) use ArcInfo software to overlay spatial information on fish biomass and abundance from a 100 meters square transect within each habitat type; and 3) calculate the mean fish biomass. Particular emphasis was placed on the three most common species associated with each habitat identified. ArcInfo 9.1, ArcMap 9.2, and Microsoft software were used to analyze the raw data and to generate the GIS map. The data were accumulated, randomly selected, and arranged by habitat types using NOAA's previous benthic habitat maps. The species of fish were identified using visual census technique. Fish biomass and abundance data were overlaid and joined based on their latitude and longitude points. This information is useful in creating models to predict fishery productivity and valuable habitat areas.

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CAN WE USE NATURAL TAGS TO MEASURE CONNECTIVITY AND SURVIVAL OF FISH?

The past five years have seen burgeoning interest in the use of natural tags to measure connectivity and dispersal of fish, especially for larvae and juveniles. The predominant natural tag used now is otolith chemistry, although others such as parasites or meristics have been used historically. An investigation of the literature shows that otolith-chemistry tags can be very specific at surprisingly fine scale. They have been widely used to measure rates of dispersal between nursery areas for Marine Protected Areas. I will summarize and evaluate the value of natural tags on such spatial scales. Once such a natural tag is present, then the real challenges occur, as estimation of survival and movement can be very problematic because of their high potential for bias. I discuss the use of statistical techniques that provide valid estimates of survival, dispersion and connectivity. I show application of these methods in seagrass nurseries along the U.S. East Coast.

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DOC ISOTOPE TRACER REVEALS LAKE BACTERIAL “SWEET TOOTH”

To evaluate effects of increased DOC loading on pelagic food webs and lake metabolism, we are making monthly additions of cane sugar during 2008/9 to Alinen Mustajärvi, a small, oligotrophic, mesohumic lake in southern Finland. Cane sugar (C4 plant, different carbon stable isotope signature from local C3 DOC) also serves as an isotope tracer. In 2007 we made mesocosm trials with water from Alinen Mustajärvi and from a larger, mesotrophic lake, Pääjärvi. Sugar addition to Pääjärvi mesocosms produced the expected stimulation of bacterial metabolism, and the carbon isotope signature of cladoceran zooplankton increased by several per mil reflecting transfer and incorporation of sugar

carbon. Sugar additions to Alinen Mustajärvi mesocosms produced no stimulation of bacterial metabolism, probably because of nutrient limitation. However, zooplankton isotope signatures still increased, reflecting equivalent transfer and incorporation of sugar carbon. We attribute this to preferential utilization by bacteria of simple substrates even though total DOC utilization is constrained by nutrient stoichiometry.

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COUPLING BETWEEN COASTAL FLOW AND FISH LARVAE DISTRIBUTION AROUND CABRERA NATIONAL PARK (MEDITERRANEAN SEA)

Islands play an important role in maintaining marine populations because they modify the flow affecting planktonic organism accumulation, retention and dispersal. In Marine Protected Areas (MPAs), coastal flow can uphold biodiversity by favoring the replenishment of populations inside the MPA or in nearby areas. We analyze the circulation around Cabrera National Park and its influence in fish larvae transport and accumulation. This protected area comprises two small islands and several smaller islets situated south of Mallorca (Balearic Islands). We present results from temporal and spatial surveys carried out during 2007 in which hydrological and biological measurements were obtained. Numerical modeling is used to interpret observational data and to analyze flow scenarios. The dynamics of the island-scale flow at Cabrera is driven by density differences between water masses of different origins and by wind-induced currents interacting with the local topography. Results suggest that specific composition and abundance of fish larvae is influenced by the water masses present in the area. In addition, flow modification by local bathymetry favors fish larvae retention west of Cabrera, partially precluding dispersal towards the open sea.

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PRESENCE AND MINERALIZATION OF INOSITOL HEXAKISPHOSPATE IN LAKE SEDIMENTS

In most soils inositol hexakisphosphate (IP6) constitute the major part of the organic phosphorus (Turner et al. 2002) and may therefore make an important contribution to terrestrial input of organic phosphorus to aquatic environments. An understanding of the IP6 cycle in these environments may therefore be important for the management of lakes. In this study the amount of IP6 in the sediment from a Danish lake was determined by 31P NMR. In the mesotrophic Lake Vedsted 0.11 ± 0.03 mg P g-1 DW of IP6 was found in the top centimeters of the sediment. This was 27 % of the organic P. The mineralization of IP6 under oxic and anoxic conditions was followed in an experiment where IP6 was added to the sediment. After 44 days 81% and 67% of the added quantity was mineralized at oxic and anoxic conditions, respectively. Control groups showed no change in the amount of natural occurring IP6 which may indicate that natural occurring IP6 is refractory. To further investigate this discrepancy, mineralization experiments and profiling of IP6 in the sediment are in progress.

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QUANTIFYING RESPONSES OF SCOMBRIDS TO FISHING USING HIERARCHICAL MODELS

Since the 1950s Scombrids have been subject to large removals of biomass in their populations. The impacts of fisheries on tuna species have been a hot debate in the last few years giving rise to widely different views on the present status of large predatory tunas. This family is comprised of 48 species distributed throughout the world oceans which have developed diverse life history strategies and therefore can be expected to respond differently to fisheries exploitation. This study characterizes and quantifies the responses of Scombridae species to fishing exploitation on a global scale. We have attempted to compile all fisheries data sets worldwide, including catches, size composition and biomass estimates. Biomass trends and changes in size structure were estimated using both traditional and Bayesian hierarchical models. These methods combine different sources of information and consider the hierarchical nature of the data. The understanding of how "data rich" species respond to exploitation can help with a priory predictions of responses of related stocks with similar life history traits and lacking the proper data to be well managed.

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HISTORICAL RECORD OF PCB, PAH, PBDE AND METALLIC TRACE ELEMENTS DEPOSITION IN A FRENCH ALPINE LAKE

Eight short sediment cores from Lake Bourget were analysed for PAH, PCB, PBDE and trace elements (Cu, Cd, Pb, Zn). PAH and trace elements profiles reflect the industrial and urban development of the catchment area while PCB and PBDE profiles are more linked to their industrial history. PAH, Cu, Pb and Zn inputs start to increase in the 1900s with the development of industrial activities. PAH inputs to the lake are declining since 1935 probably due to the shift from coal and wood to electricity as energy source. For trace elements, it is the improvement of sewage management which resulted in their simultaneous decrease in the 1980s. PCB inputs were maximum in the late 1970s (γ7PCB fluxes: 0.172 $\mu g.cm^{-2}.year^{-1}$) and declined significantly in the 1980s. Despite the PCB ban on usage and production, concentrations in surface sediments are still high ([γ7PCB]: 63 $\mu g.kg^{-1}$ dw) due to volatilisation from contaminated soils. PBDE profiles are dominated by BDE209 and display a clear trend to increase over the last twenty years ($[BDE209]_{1997}$: 2,74 $\mu g.kg^{-1}$ et $[BDE209]_{2006}$: 24,66 $\mu g.kg^{-1}$).

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ACOUSTIC STUDIES REVEAL DIVERSE BEHAVIOR AMONG MESOPELAGIC JELLYFISH

An upward-looking, bottom mounted echosounder situated at 270 m depth was used to study the jellyfish *Periphylla periphylla* with a temporal resolution of 1 sec^{-1} through a 4 months registration period. The population of jellyfish appeared to be segregated into 4 modes with different behavior. The shallowest mode inhabited the upper 100 m, carried out diel vertical migrations with limited amplitude, and immediately reversed the evening ascent upon encountering an upper pycnocline. A mid-water group of jellyfish inhabited waters at about 200 m during the day, ascending at dusk and descending at dawn. Individuals of a third and deeper-living component of the population were continuously migrating up or down at vertical speeds of 1-2 cm s^{-1} regardless of time of day, yet the range of their asynchronous vertical migrations encompassed the entire water column at night. A last group of primarily large jellyfish remained motionless for prolonged periods, intermittently changing their vertical distribution slightly. This acoustic study has unveiled much more diverse behavior among the jellyfish than previously found using other methods.

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IMPACT OF LAKE LEVEL CHANGES ON DEEP WATER RENEWAL AND OXIC CONDITIONS IN A LARGE SALINE LAKE (LAKE VAN, TURKEY)

The level of closed basin Lake Van (salinity: 21 g/kg, pH = 9.7), Turkey, rose by about 2 m in the time period between 1988 and 1995. The lake level then decreased again until 2003 to 0.5 m above the level of 1988. Based on physical-limnological measurements (CTD, noble gases, transient tracers, thermistor data, dissolved oxygen) we demonstrate that deep-water exchange in Lake Van was significantly reduced after the beginning of the lake level rise and as a consequence a more than 100 m thick anoxic deep-water layer developed. The lake level rise resulted from increased fresh-water inputs which probably stabilized the water column and hence prevented convective mixing. Although the lake level decrease finished already in 2003, significant deep-water renewal and oxygenation of the deep water began earliest in winter 2005 / 2006. The data suggest that small short-term changes in the hydrological regime can lead to significant and long-lasting changes in mixing and oxygen conditions in deep saline lakes.

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INCREASED PHYTOPLANKTON BLOOMS DETECTED BY OCEAN COLOR

Global trends in the magnitude of phytoplankton blooms were evaluated using ocean color data during the last 11 years. Annual maxima in monthly mean chlorophyll-a concentration were assumed to be representative of the annual phytoplankton bloom magnitude. The analysis shows that the bloom magnitude has increased significantly in many areas of the world during the last 11 years. Increased phytoplankton blooms are most notable in eastern boundary upwelling systems and in a number of areas with known eutrophication. Increased blooms in eastern boundary currents may be caused by increased upwelling, but we are unaware of any direct evidence supporting that. The areas with increased blooms are likely to be environmentally stressed and undergoing undesirable environmental changes such as a higher frequency of harmful algal blooms and oxygen depletion in bottom layers of oceans, estuaries, and lakes.

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RESPONSE OF BACTERIA AND OSMOTROPHIC ALGAE TO CLIMATE CHANGE: EFFECTS OF TEMPERATURE AND ORGANIC CARBON

We investigate the consequences of increased temperature and enhanced input of dissolved organic carbon (DOC) into lakes for pelagic microorganisms. Particularly, we focus on bacteria as main DOC consumers and on mixotrophic algae which use DOC osmotrophically in addition to photosynthesis. We test the hypotheses that enhanced DOC input will promote bacteria and decrease the biomass of osmotrophic algae due to tightened competition for phosphorus. In growth experiments in batch cultures, bacteria and Chlorella protothecoides increased their growth rates at higher DOC concentration at 15°C whereas enhanced DOC concentration hardly stimulated their growth at 20°C. In competition experiments in chemostats, bacterial and Chorella biomass rose after increased carbon input at 15°C. In contrast, bacterial biomass increased only slightly and algal biomass decreased at 20°C. Thus, temperature determines the response of microorganisms to enhanced DOC concentration.

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EFFECT OF ALGAL EXUDATES ON CLOSELY RELATED STRAINS OF PLANKTONIC BETAPROTEOBACTERIA

We managed to isolate several members of a core group of Betaproteobacteria, the R-BT065 subcluster of the Rhodoferax sp. BAL47 cluster. They belong to the widely distributed, abundant and metabolically highly active members of freshwater bacterioplankton. Previous field studies indicated that the population dynamics of the R-BT065 bacteria is tightly affected by phytoplankton development. To confirm their ecological properties and substrate requirements, we investigated an effect of phytoplanktonic exudates. First, all isolated strains were found to grow solely on the exudates of axenic algal cultures. Then we tested the growth of four closely related isolated strains in semi-natural conditions in the "light" (active photosynthesis) and in the "dark" (no photosynthesis) treatments. All four tested strains significantly increased their biomass in the "light" (up to 150 % of the "dark" biomass). The largest strain II-D5 achieved its biomass maximum rapidly and depleted the system within 3 days. In contrast, the smallest and slower growing strain II-B4 kept growing until the end of experiment with consistently higher biomass in the "light" treatments. In addition, this strain II-B4 showed a larger biomass yield than the strain II-D5. Population dynamics of R-BT065 bacteria in both 0.8- and 200-μm filtrates in the "light" was similar and mimicked the pattern observed for the II-B4 strain. Possible ecological strategies of the closely related bacterial strains are discussed.

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TEMPORAL CHANGES IN COMMUNITY COMPOSITION OF HETEROTROPHIC BACTERIA DURING IN SITU IRON ENRICHMENT IN THE WESTERN SUBARCTIC PACIFIC (SEEDS-II)

Little is known about the effects of iron on heterotrophic eubacterial community composition (HBCC) in high-nutrient, low chlorophyll (HNLC) waters. Here we show HBCC in surface waters during an *in situ* iron enrichment experiment (SEEDS-II) in the western subarctic Pacific as determined with denaturing gradient gel electrophoresis (DGGE) of 16S rDNA fragments. DGGE fingerprints showed that HBCCs differed between inside and outside the iron-enriched patch. Sequencing analysis revealed that at least five phylotypes of *Alphaproteobacteria* including *Roseobacter*, *Cytophaga-Flavobacteria-Bacteroides* (CFB), *Gammaproteobacteria*, and *Actinobacteria* occurred inside the iron-enriched patch. Although autotrophic nanoflagellates bloomed during SEEDS-II, HBCC inside the iron-enriched patch was similar to those in the other *in situ* iron fertilization experiments where diatoms bloomed. Accumulation of dissolved organic carbon was not detected in surface waters during SEEDS-II, but growth of *Roseobacter* might be particularly stimulated after iron additions. Two identified phylotypes related to the algicidal genus *Saprospira* might degrade the phytoplankton assemblages increased by the iron enrichments. Our results suggest that responses of heterotrophic bacteria to the iron enrichments could be different among their phylotypes during SEEDS-II.

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MIXING EFFICIENCY OF SWIMMING ANIMALS IN STRATIFIED FLUIDS

The potential role of animal-fluid energy interactions in ocean mixing is a topic of increasing study that has been limited by the need for data at the scale of individual animals. Previous findings suggest that the energetic input by swimming animals to the ocean mixing energy budget may impact mixing at the same level as winds and tides, whose respective rates of kinetic energy dissipation are of the same order of magnitude. However, these results equate dissipation of mechanical energy with mixing; not all mechanical energy that is dissipated goes into mixing a fluid. The mixing efficiency should instead be an indicator of mixing. We present a method to determine the mixing efficiency of swimming animals that combines the techniques of DPIV, PLIF and dye visualizations. This methodology is then applied to multiple swimming cycles of *Mastigias* to answer whether mechanical energy at small animal scales can achieve any substantial mixing before it is dissipated as heat.

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MODELING AN END-TO-END FOOD WEB WITH PHYSICAL FORCING

Determining the effects of climate change on fish stocks and fisheries, and separating climate impacts from localized anthropogenic sources, is an important issue in current fisheries research. However, most fisheries models focus on the upper trophic levels and top-down control of ecosystems, with very limited resolution of fluctuations in primary production driven by changes in nutrients and light. We have modified a popular fisheries ecosystem model, Ecopath with Ecosim (EwE), to include light- and nutrient-dependent primary production. By imbedding this biological model in a one-dimensional water column model, we are able to investigate the effects of changing physical conditions on a full food web that includes phytoplankton, zooplankton, fish, and a few top predators. The model is tested here for a simple ecosystem in the Eastern Subarctic Gyre of the North Pacific.

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MODELLING THE EFFECTS OF TEMPERATURE CHANGE ON PRIMARY PRODUCTIVITY-IRRADIANCE CURVES FOR THE TOXIC CYANOBACTERIUM CYLINDROSPERMOPSIS RACIBORSKII

Cylindrospermopsis raciborskii is a toxic cyanobacterium found in an increasing number of freshwater systems world wide. While C.raciborskii has been the subject of many ecological studies, there is currently not enough information to model growth or primary productivity of this species as a function of light, temperature and nutrients. In this study, the effect of temperature on primary production was determined for samples from a reservoir dominated by C.raciborskii (Lake Borumba, Queensland, Australia). Primary production-irradiance (P-I) curves were determined for incubation temperatures ranging from 20 oC to 32 oC. Four models were fit to the data: a mechanistic and an empirical P-I model, and 2 machine function learners (Random Forest and Support Vector Machine). Incubation temperature had a similar effect on the P-I curve parameters of each model, but only the mechanistic model was able to explain the effect of temperature in terms of physiological parameters (electron turnover time and PSU damage rate). This study also demonstrates how uncertainty of the P-I parameters can be quantified through the application of multiple models to a single data set

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THE CENTER FOR MICROBIAL OCEANOGRAPHY RESEARCH AND EDUCATION: RESEARCH FROM GENOMES TO BIOMES (OR: WHAT WOULD YOU DO WITH $52,000,000?)

The Center for Microbial Oceanography: Research and Education (C-MORE), established in August 2006, is an NSF sponsored Science and Technology Center designed to facilitate a more comprehensive understanding of the diverse assemblages of marine microorganisms. Its scope includes asessment of the connections between different hierarchical levels of biological complexity (including gene and organism diversity, physiological function and regulation, and community structure and function), and biogeochemical and physical dynamics. C-MORE's primary mission and unifying vision is: Linking Genomes to Biomes. Its challenge is to determine which of a myriad of possible issues in microbial oceanography should receive attention. Presentation will review priorities developed and determined by a series of strategic planning workshops that consider the 10-year lifetime of the Center and the current state of readiness of sampling, analytical and modeling tools.

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COASTAL HYPOXIA RESPONSES TO REMEDIATION

Recent reviews have stressed both the worldwide growth in the occurrence and the time-space scales of anthropogenic coastal hypoxia and the apparent resistance to remediation for many eutrophic hypoxic systems. We provide a brief description of the diversity of observed linear and non-linear (e.g., thresholds, time-lags, hysteresis) temporal trajectories that hypoxia has been shown to follow in response to nutrient input reduction and other forms of remediation for many hypoxic coastal systems. We investigate relationships between response trajectories and the physical characteristics of these coastal systems and their catchments. We discuss the wide range of ecological and biogeochemical mechanisms that have been shown or hypothesized to control hypoxia responses to changes in nutrient loading. More detailed analysis of three case studies (Long Island Sound, Chesapeake Bay and Northern Gulf of Mexico) is provided to explore alternative explanations and to develop coherent conceptual models for threshold responses that appear related to large-scale ecological regime shifts. Results of this analysis are used to suggest novel approaches for remediation of hypoxia and restoration of different classes of eutrophic coastal systems.

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EXAMINING THE ROLE OF GRAZING BY DIFFERENT ZOOPLANKTERS ON SPRING PLANKTON SUCCESSION IN A LARGE LAKE

A depth resolved mechanistic model of phytoplankton growth and zooplankton grazing coupled with a one-dimensional hydrodynamic model was used to simulate the spring-summer plankton dynamics in deep monomictic Lake Constance. Utility of different functional forms for grazing and mortality terms are also assessed during the sensitivity analysis – calibration procedure. After being able to reasonably simulate the plankton succession, we conducted simulation experiments to highlight the most important mechanisms driving the plankton development. The main emphasis was on the role of ciliates in early bloom development where our findings support that ciliates play an important role in Lake Constance, as has been reported in the literature based on field observations. Also a statistical approach for calculation of ciliates is presented which would be computationally less costly compared to the mechanistical approach.

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HABITAT INFLUENCES *LITTORINA IRRORATA* GROWTH RATES, POPULATION SIZE, AND DISTRIBUTION

The salt marsh periwinkle, *Littorina irrorata*, grows significantly larger (shell length and body mass) when found in *Spartina alterniflora* marshes than in artificial rocky intertidal habitats . Reciprocal transfer experiments verified that habitat controlled growth rate. Snails which were transferred to the marsh grew more quickly in three out of four of the trials, averaging 0.115 grams and 1.023 millimeters increase in mass and shell length, respectively over six weeks. The snails moved from the marsh to the rocks grew less, gaining an average of 0.0955 grams of mass and 0.375 millimeters in shell length. Temperatures of the snails found in the sun and in the shade on the rocks exceeded those from the marsh by 2.32 °C and 1.83 °C , respectively. Population of the rocks was significantly more dense at 8.50 snails per m^2 than that in the marsh at 4.34 per m^2. I am currently testing the effects of temperature on growth in laboratory experiments.

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MASS MORTALITIES OF *CLADOCORA CAESPITOSA* IN RELATION TO WATER TEMPERATURE IN THE COLUMBRETES ISLANDS (NW MEDITERRANEAN)

The bay of L'Illa Grossa in Columbretes Islands (NW Mediterranean) harbours an important *Cladocora caespitosa* population in a depth range of 5 to 25 m. Mass mortalities affecting Cladocora colonies were recorded after the summers of 2003, 2004, 2005 and 2006, while no necrosis was detected after the summers of 2002 and 2007. After the mortality events, 80 % of the colonies suffered tissue necrosis at some extent and around 27 % totally died. Recurrent partial necrosis on the same colonies was recorded during these events. The mortality parameters studied (percentage of affected colonies, percentage of damaged area and percentage of totally affected colonies) correlate significantly with the SST anomalies. In detail, the best correlations found were between the percentage of totally affected colonies and the "intensity attribute" of the SST anomalies and between the percentage of damaged area and the "persistence attribute". These results provide, for the first time, correlative evidence of the positive relationship between the seawater temperature and the mortalities affecting *C. caespitosa* in the field, according to what has already been detected in aquarium thermotolerance experiments.

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CAN SATELLITE MEASUREMENTS OF SUNLIGHT BACK-SCATTERED FROM THE OCEAN HELP TO CONSTRAIN BIOGEOCHEMICAL MODELS OF THE OCEAN CARBON CYCLE?

Biogeochemical models of the ocean carbon cycle are frequently validated by, or tuned to, satellite chlorophyll data. However, for climate prediction, ocean carbon cycle models are required to accurately model the movement of carbon, not chlorophyll. Due to the high variability of the carbon to chlorophyll ratio in phytoplankton, chlorophyll is not a robust proxy for carbon. However, using IOP inversion algorithms it is now possible to also derive the backscattering coefficient (b_b). Using empirical relationships between particulate organic carbon (POC) and b_b, a 1-d biogeochemical model is used to simulate b_b at 490nm. The model can now be compared with either remotely-sensed chlorophyll or b_b data. Here I test (by model-tuning with a genetic algorithm) whether using b_b in conjunction with chlorophyll can help to constrain more model parameters than using chlorophyll alone. Since there are several IOP algorithms available for estimating b_b, the consequences of the uncertainty in b_b are also investigated.

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MODELING FLOW AND CONCENTRATION DISTRIBUTION IN AND OUTSIDE THE C. PLUMOSUS BURROWS

Bioirrigation caused by tube-dwelling macrozoobenthos species in sediment-water boundary layers is an important process for the exchange of dissolved substances between porewater and the overlying water body. Due to the difficulties associated with the optical access into the burrows, much of the hydraulic and hydrodynamic of bioirrigation activities of larvae have remained unknown. In this study, we modeled the flow and concentration distribution within and outside the burrows generated by the pumping activity of C. Plumosus larvae.

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GROWING SEASON VARIABILITY OF NITRATE ALONG A TROPHIC GRADIENT - CONTRASTING PATTERNS BETWEEN LAKES AND STREAMS

We studied the growing season (May to October) variability of NO3-N across Swedish lakes and streams. We found that NO3-N concentrations showed the highest growing season variability among all water chemical variables tested, both in lakes and in streams. However, the growing season variability of NO3-N increased with increasing trophic status in lakes while it decreased in streams. We attributed the contrasting pattern between lakes and streams to the relative importance of biological uptake and denitrification with increasing trophic status. Our results highlight the relation between growing season NO3-N variability and trophic status which is positive in lakes but negative in streams. The findings of this study have important ramifications for ecosystem studies as well as water management. We suggest that the assessment of growing season variation of NO3-N in aquatic systems can be improved by considering the effect of trophic status.

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BIOLOGICAL CONTROL OF AN INVASIVE SPECIES CAUSING IMMENSE ECOSYSTEM DAMAGE WITH BEROE OVATA IN THE CASPIAN SEA

The precious Caspian ecoystem is in a catastrophic condition due to an invasive jellyfish species (the ctenophore Mnemiopsis leidyi). This species, transported via ballast waters from the northeastern American coasts, first to the Black Sea and later to the Caspian, is outcompeting the native pelagic fish through voracious feeding on their food items (i.e. zooplankton). Some of the documented impacts from this event are decreased zooplankton (both in quantity and in biodiversity), increased phytoplankton and hence eutrophication, almost ceased pelagic fishery, mass mortalities of fish as well as of some top predators (e.g. Caspian seal) due to malnutrition, havoc for the fishing community and severe economic damage of riparian countries. The appearance of the predator (another ctenophore species, Beroe ovata) of M. leidyi helped significantly in the ecosystem recovery in the Black Sea. B. ovata presents a great opportunity for solving these environmental and social problems in the Caspian despite the fact that the biocontrol as a method has no successful application in a marine environment.

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NEW TWISTS IN THE MARINE DMS(O) CYCLE

The marine organosulfur cycle has historically been focused on dimethylsulfide (DMS) and dimethylsulfoniopropionate (DMSP), as they represent an important link between upper ocean biogeochemical dynamics and cloud formation and climate regulation. However, it has become evident that dimethylsulfoxide (DMSO) is also a pivotal sulfur species regulating DMS in the water column, and often times dissolved DMSO is the main organosulfur species in the water column. We have made several observations that further highlight the importance of DMSO. In particular, DMSO and DMS can be directly formed from the non-enzymatic oxidation of cellular DMSP, fundamentally changing our view of the cycling of these compounds in marine algae. Furthermore, DMSO is readily reduced to DMS in both DMSP-containing and non-DMSP containing marine algae. This process is ubiquitous and significant, as DMSO reduction can be the main source of DMS in many marine algae, especially those lacking DMSP or DMSP lyase. DMSO reduction also provides a plausible mechanism to recycle DMSO back to the putative antioxidant, DMS.

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PHOTOCHEMICAL PRODUCTION OF DISSOLVED ORGANIC AND INORGANIC NUTRIENTS FROM RESUSPENDED SEDIMENTS

A series of photolysis experiments were conducted in the presence and absence of tidal creek and continental shelf sediments to address the role of resuspension on nutrient fluxes in estuarine and coastal waters. There was a significant increase in TDN, phosphate and DOC when sediments were resuspended in overlying water and exposed to six hours of simulated sunlight. The majority of dissolved N was released as DON (87%) with relatively lesser amounts of ammonium (13%) with little or no nitrate. Results from autoclaved sediments suggest the mechanism of photolytic release was predominately abiotic. No significant changes were observed when filtered and unfiltered water were irradiated in the absence of resuspended sediments indicating that ambient particles and dissolved species were not photochemically active in these experiments. Results demonstrate that photoproduction from resuspended sediments is an episodically significant source of dissolved nutrients to coastal ecosystems receiving sediment plumes. The presentation also considers how fluxes of organics and nutrients from sediments respond during salinity alterations, such as periods of sea level rise, with possible implications on wetland loss and coastal storage of carbon.

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BIOLOGICAL DMS CONSUMPTION IN DIVERSE OCEAN WATERS

Biological Dimethylsulfide Consumption (BDMSC) affects surface water DMS concentrations and thereby sea-air exchange. We measured BDMSC rates with ^{35}S-DMS in the surface mixed layer of diverse oceanic environments. BDMSC rates ranged from 0.1 to 10 nM/d and some of the highest rates occurred in polar waters (Ross Sea) whereas some of the lowest occurred in a subtropical gyre (Sargasso Sea). Field data suggest that at the highest in situ DMS concentrations, BDMSC rates approach kinetic saturation. Laboratory experiments confirmed that BDMSC was saturated at relatively low concentrations (10-30 nM). BDMSC rates were positively correlated with Chl a concentrations and bacterial production rates. Rate constants for BDMSC ranged from 0.04 to 1.9 per day and were generally lower in the surface mixed layer than below it, possibly due to greater ultraviolet radiation exposure in the mixed layer. DMSO was a major end product of BDMSC when turnover rate constants were low, whereas sulfate was the major product when rate constants were high. BDMSC was a major loss process for DMS and a major source of DMSO in the surface mixed layer.

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TIDAL CURRENTS AND RECRUITMENT INTENSITY IN THE NORTH-WESTERN GULF OF AQABA (THE RED SEA): WHERE HAVE ALL THE FISH GONE?

We present a previously undocumented pattern of variation in the recruitment intensity of coral reef fishes. Namely, in two years of observation (2003 & 4), recruitment of several fish species to the northern-western Gulf of Aqaba was limited to periods in which the long-shore tidal current was of relatively low intensity. The result is surprising for two reasons. First, at least two of the species monitored reproduce continuously throughout the survey (June – November). Secondly, in at least one of these two years, variation in the intensity of the long-shore current was decoupled from the lunar cycle. The reason why larvae failed to recruit during the periods of relatively high-intensity currents remains a mystery; particularly since recruitment commenced almost immediately with the drop in current intensity, and continued until the current intensified again. Moreover, no other measured variable showed any association with tidal-current intensity (wind velocity, temperature, chlorophyll concentration). These results represent an invitation to use the Gulf's unique hydrological features to study how physical processes interact with larval biology/ecology to affect recruitment.

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USE OF STABLE ISOTOPE NICHES FOR ELUCIDATING TROPHIC RELATIONSHIPS IN NEOTROPICAL STREAMS BEFORE AND AFTER AMPHIBIAN EXTIRPATIONS.

In food web studies, stable isotope niches are used to represent the area occupied by individuals of a species in δ- space by plotting δ^{13}C versus δ^{15}N. We used this approach to examine the impacts of amphibian extirpations on trophic relationships among upland stream macroinvertebrate taxa in headwater streams in Panama before and after frog extirpation events. Clear separations of isotope niches among dominant insect species within functional feeding groups were observed, suggesting that food partitioning was occurring. After the extirpation event, changes in niche space were apparent for scraper taxa *Psephenus* and *Petrophila* that potentially competed with tadpoles, and in one predator, *Limnocoris*, which likely preyed on tadpoles. There were also changes in isotope niches of autotrophic components of the basal resources, presumably as a result of changes in nutrient cycling resulting from the loss of the tadpoles.

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DIEL VARIABILITY OF NITROGEN UPTAKE BY CULTURED STRAINS OF KARENIA BREVIS

Karenia brevis blooms have become an annual feature along the west Florida shelf. To quantify the ability of K. brevis strains to utilize a suite of nitrogen substrates in the light and dark, we performed nitrogen uptake experiments every 4 hr. over the course of a 24 hr. period. Short-term (0.5 hr) incubations were performed with labeled (N15) inorganic (ammonium and nitrate) and organic substrates (urea and amino acid mixture) added at both trace (0.1- 1.0 umol N/L) and saturating (10 umol N/L) levels. Uptake was examined in three strains of K. brevis; preliminary results indicate that the strains were able to take up all substrates offered with the highest uptake rates for ammonium and nitrate. In general, the first hours of the light period exhibited the highest rates of uptake while the first hours of the dark period had the lowest rates of uptake.

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IMPORTANCE OF MICROBIAL ROLES IN POLONIUM SCAVENGING IN THE OCEAN

The naturally occurring radionuclide Po-210 is typically deficient relative to its parent Pb-210 in the surface ocean due to preferential removal by biota, while in near equilibrium or excess below the surface due to their remineralization. However, we found a negligible deficit of Po-210 in continental shelf waters, in contrast to a large deficit in the oligotrophic ocean's interior. This argues against the generally-held concept that the removal of reactive elements depends on the population of settling particles. A Po-210 mass balance model suggests that polonium is taken up efficiently by bacteria and transferred to higher trophic levels in this environment, while it resides in the subsurface ocean for much longer periods as it is taken up by abundant non-sinking free-living bacteria in productive areas of the ocean. The measured colloidal Po data and scavenging modeling show more detailed scavenging processes of Po in the ocean. This study suggests that microbial roles are important for sulfur group scavenging in the ocean, and that it may be useful as a tracer of nitrogen fixation.

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UNUSUALLY HIGH ENRICHMENTS OF MREES (MIDDLE RARE EARTH ELEMENTS) IN THE SOUTHERN SEA OF KOREA

Concentrations of dissolved rare earth elements (REEs) were measured in natural waters including groundwater, seawater, and river waters along the southern coasts of Korea in 2007 and 2008. We found consistently higher MREEs in groundwater, coastal seawater, and river water when the REEs were normalized by the PAAS (Post-Archean average Australian Shale). The REE concentrations in salty groundwater and coastal shallow seawater were 1-3 orders of magnitude higher than those in fresh groundwater and open ocean seawater. The concentrations of ^{141}Pr, one of the light REEs (LREEs), ranged from 0.8 to 510 nmol kg^{-1} (average 4.8 nmol kg^{-1}, n=63) in groundwater and 0.020 to 1.4 nmol kg^{-1} (average 0.24 nmol kg^{-1}, n=119) in seawater. The elevated MREE pattern in coastal seawater seems to be associated with the discharge of brackish groundwater highly enriched in MREEs. Our results suggest that natural enrichments of MREEs desorbed or leached from local soils, rocks, and sediments can be the potential source of relatively high MREEs in the coastal water.

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EVALUATION OF REMOVAL RATES OF MICROCYSTIS AERUGINOSA THROUGH THE BIOMANIPULATION EXPERIMENT USING 13C, 15N TRACERS IN AGRICULTURE RESERVOIR

We examined the removal rates of Microcystis aeruginosa by aquatic organisms(plants:Iris pseudoacorus, bivalve:Cipangopaludina, shrimp:Caridina denticulate and fish:Pseudobagrus fulvidrao) in mesocosm experiments using stable isotope tracers(13C, 15N) for 9 times during 3 weeks(1, 2, 3, 4, 6, 8, 10, 14, 22 day) in October 2007. Chl. a concentrations in all mesocosms were reduced during the experiment periods. Iris pseudoacorus showed the maximum Chl. a decrease, and the second largest reduction of Chl. a concentration was occurred in the combination of Caridina denticulate and Pseudobagrus fulvidrao. Organic carbon and nitrogen contents in particle organic matter showed to similar trend of Chl. a concentrations. 13C atom(%) in Caridina denticulate which was added by Pseudobagrus fulvidrao exhibit the maximum value, indicating active assimilation of Microcystis aeruginosa. 15N atom(%) in Iris pseudoacorus showed the maximum value, it suggests that aquatic plants rapidly takes up the DIN, compared to Microcystis aeruginosa. Caridina denticulate and Pseudobagrus fulvidrao addition in mesocosm demonstrated better removal efficiency rather than only Caridina denticulate. The large size of Cipangopaludina(longer than 15cm) have assimilated effectively, without any apparent releasing in to the water

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DISTRIBUTIONS OF DISSOLVED ORGANIC CARBON (DOC) AND NUTRIENTS

The concentrations of dissolved oxygen (DO), nutrients, and DOC were measured in the East/Japan Sea from 2001 to 2007. The DO inventory was almost constant in the bottom water during 2001-2007 although it had decreased gradually from 1930 to 2001 due to a slowdown of thermohaline bottom-water formation. The concentrations of DOC were 66 – 81 μM and 50 – 66 μM in the surface layer (< 100 m) and deep layer (> 100 m), respectively. The concentrations of DOC in the deep ocean were higher than those in the Atlantic Ocean (ave. : 50 μM), which may be associated with the rapid ventilation of DOC from the surface layer. The vertical distribution patterns of nutrients were typical of nutrient profiles in the open ocean, with N:P ratios of about 13. These lower N:P ratios relative to the Redfield ratio appear to be due to rapid ventilation of surface waters (N:P ratio : ~11) into the deep ocean. Our study suggests that the budgets of carbons and nutrients are tightly linked to the water ventilation system in the East Sea.

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VIRAL-INDUCED PHOTO-PHYSIOLOGICAL STRESS AND UNCOUPLING OF PHOTOSYNTHESIS

Photosynthetic efficiency reflects the metabolic and physiological status of phytoplankton cells. Therefore, disruption of cellular processing or physiological state caused by stress factors such as nutrient limitation or viral infection should be measurable by observing changes in photosynthesis. This suppression or elevation of photosynthetic physiology may have an important influence on carbon and nutrient flux. However, although nutrient stress is often considered in biogeochemical models, the direct impact of viral stress has been relatively unexplored. Using both cultured viral: host systems and a semi-natural, mesocosm experiment in a Norwegian fjord, we measured the photo-physiological response of the coccolithophorid *Emiliania huxley* during both the initial early stages of EhV infection and subsequently throughout the succession of a nutrient-induced bloom. Here we discuss how viral infection and subsequent lysis may create photo-physiological stress within the phytoplankton hosts, interrupting electron transfer rate in Photosystem II (PSII), and ultimately leading to the uncoupling of photosynthesis. In the context of the mesocosm experiment the interactions between nutrient- (P- limitation) and viral-induced stress and consequent implications for *Emiliania huxleyi* bloom dynamics will be discussed.

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A COMPARISON OF THE MESOZOOPLANKTON RESPONSE TO HYPOXIA IN CHESAPEAKE BAY AND THE NORTHERN GULF OF MEXICO USING THE BIOMASS SIZE SPECTRUM

We compared the biological response of mesozooplankton to hypoxia in Chesapeake Bay and the northern Gulf of Mexico using an optical plankton counter (OPC) and pump collections. Our results showed that the mesozooplankton response may be dependent on the amount of the water column that is hypoxic. The Chesapeake Bay mesozooplankton biomass size spectrum was altered when > 45% of the OPC measurements were made in hypoxic water. There was no consistent shift in size distribution of northern Gulf of Mexico or Chesapeake Bay mesozooplankton biomass in hypoxic water when < 25% of OPC measurements were made in hypoxic water. Pump counts for both systems showed that smaller-sized mesozooplankton were more abundant in surface water. Bottom (hypoxic) pump counts also showed a prevalence of smaller-sized mesozooplankton, but had a secondary abundance peak at larger sized mesozooplankton. Vital staining found that < 40% of mesozooplankton collected from hypoxic water in the northern Gulf of Mexico were alive, compared to > 70% alive in surface water. This suggests that the OPC may be overestimating mesozooplankton biomass in hypoxic water.

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CULTURE AND FIELD-BASED EXPERIMENTAL APPROACHES TO ASSESS IMPACTS OF INCREASED CARBON DIOXIDE ON PHYTOPLANKTON TRACE METAL REQUIREMENTS

Future increases in the partial pressure of CO_2 (pCO_2) are likely to significantly change marine phytoplankton trace metal requirements. We examined algal trace metal quotas and cell physiology in both culture and field-based incubation experiments, using trace metal clean techniques and air:CO_2 mixtures including glacial (190 ppm), current (380 ppm), and year 2100 estimates (750 ppm). Diazotrophic cyanobacteria cultures grown at 750 ppm pCO_2 had increased cellular quotas of Fe and Mo relative to cells grown at 190 and 380 ppm, consistent with their higher N_2 and CO_2 fixation rates. In contrast, a natural Ross Sea assemblage dominated by the prymnesiophyte *Phaeocystis antarctica* had decreased cellular quotas of Fe, Zn, Mn, Cd, and Co at 750 ppm pCO_2. Other experiments examined diatom metal quota/pCO_2 interactions in both cultures and in field incubations in coastal and oceanic regimes. Laboratory and field approaches for global change experiments offer differing perspectives, but both predict that rising oceanic pCO_2 may lead to significant shifts in phytoplankton trace metal quotas, with associated impacts on the oceanic biogeochemistry of C and N.

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RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS AND CONCENTRATIONS OF FECAL INDICATOR BACTERIA AT CAMPBELL COVE BEACH

Campbell Cove beach is a small beach, located in Bodega Bay, CA and receives over 75,000 visitors annually. Water samples are collected and analyzed weekly for fecal indicator bacteria (FIB) due to the requirements of California Assembly Bill (AB 411). The state standards for a single sample are 10,000, 400, and 104 most probable number (MPN)/100mL for total coliform, fecal coliform, and enterococcus. FIB concentrations at Campbell Cove often exceed state standards. We analyzed historical data from 2001-2007 to determine if environmental factors such as tidal range, wind speed, and water temperature contributed to high concentrations of FIB. Annual increases and seasonal differences were also examined. We found no relationships between high concentrations and tidal range, water temperature or year. However, we found a seasonal difference and an association of fecal contamination with weak wind conditions. High concentrations of FIB occurred more often during the later sampling months (August-October) than earlier months (April- July). Further, high concentrations tended to occur when wind were less than 17 km/h, presumably due to weaker flushing and dilution of bacteria.

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HIGH SEDIMENT TOTAL PHOSPHORUS IN ORGANIC FLOCCULENT SEDIMENTS OF SHALLOW FRESHWATER ECOSYSTEMS IN SOUTHWEST MICHIGAN

Phosphorus (P) is often the limiting nutrient in aquatic ecosystems and is strongly controlled by sediment binding and release processes. To investigate sediment P-binding characteristics in shallow freshwater ecosystems, we obtained 32 sediment samples in southwest Michigan. Most samples had thick (~10cm) layers of loose, flocculent sediment. Cores were separated into consolidated and flocculent strata for percent organic matter (%OM), total phosphorus (TP), and HCl-extractable iron (HCl-Fe) analyses. Sediment TP ranged widely (0.13-2095 ugP/gdw), averaging 318 ugP/gdw. Average flocculent sediment TP was three times (644 ugP/gdw) that of consolidated strata (217 ugP/gdw). Flocculent sediment was also higher in %OM and HCl-Fe. Sediment TP was unrelated to HCl-Fe, but was positively related to %OM. Sequential P fractionation performed on a subset of samples suggests that most of P in these sediments is in organic fractions. Although many past studies have focused on the reactivity of inorganically-bound orthophosphate in sediments, our study suggests the potential importance of organic P fractions. Future studies should investigate the reactivity of this quantitatively dominant fraction, with particular focus on the unique processes of flocculent sediments.

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MARINE SNOW AGGREGATES, ATTACHED MICROBES, AND VERTICAL MATERIAL FLUXES: INTRODUCTION TO THE SESSION

Marine snow aggregates are important vehicles for vertical material transport in the ocean, but attached microbes remineralize aggregates, retarding vertical fluxes. While processes governing formation of aggregates are generally understood, we know little about the processes that determine their degradation rate. A number of features suggest that pelagic bacteria are adapted to a life on or near particles. The production of quorum sensing molecules, the elevated activity of attached vs suspended bacteria, the motile behaviour and chemosensory capability, as well as the production of warfare molecules in many pelagic bacteria are all features that can best be understood as adaptations to a life on or near particles. Suspended pelagic bacteria rapidly colonize sinking aggregates, consistent with this comprehension, and a model combining observed colonization rates with observed particle size spectra suggests that most pelagic bacteria should be particle bound. Yet, observations suggest that only a minor fraction of pelagic bacteria are attached. We speculate about possible reasons for this discrepancy and identify critical issues that need to be addressed if we are to understand the biological mechanisms governing sequestration fluxes.

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WHAT PLANKTERS DO, HOW THEY DO IT, AND WHY: EFFECTS OF SMALL-SCALE FLUID MOTION ON PLANKTONIC ORGANISMS

Fluid flow at the scale of an individual plankton organism may affect its fundamental activities: the flow may bring nutrients and prey, it may transport chemical signals, it may itself be a signal, and it may interfere with the motility of the plankter and modify the distribution its food. Understanding small-scale fluid-organism interactions is therefore essential to plankton ecology. I will illustrate the field with example of both some new and some established problems, including a discussion of (i) the significance of swimming and feeding currents in osmotrophic and interception feeding flagellates; (ii) how the efficiency of feeding current depend on the motility of the plankter; (iii) how a copepod attacks a prey without pushing it away, (iv) how swimming, jumping and feeding currents generate and spread signals; and (v) how turbulence may enhance nutrient acquisition due to effects on encounter rates and concentration gradients. Common to these problems is that while we may observe what plankters are doing, we need to use insights in small-scale fluid physics to understand how and why they do what they do.

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GLOBAL DISTRIBUTION PATTERNS OF PHOTOSYNTHETIC PICOEUKARYOTES IN OPEN OCEAN ENVIRONMENTS

Photosynthetic picoeukaryotes (PPEs) are important primary producers in marine food webs. This diverse grouping includes species from all known algal lineages, with several new classes discovered over the last few years. However, little is known of the composition of the PPE community, particularly at large spatial and temporal scales, or of the underlying biotic and abiotic factors that influence this structure. In order to address this we analysed PPE community structure along cruise transects in the Arctic, Atlantic, Pacific and Indian Oceans using dot-blot hybridisation technology and class-specific plastid-targeted 16S rRNA gene probes. Our data indicated a dominance of members of the Prymnesiophyceae and Chrysophyceae over large areas of the open ocean, classes where pico-sized marine members are poorly described or unknown. Interestingly, these classes often showed a strong complementarity in distribution pattern. Concurrent clone library construction allowed phylogenetic assessment of the classes found, revealing several novel lineages.

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THE MORE THINGS CHANGE, THE MORE THEY STAY THE SAME... OR DO THEY? N CYCLING IN THE BLACK SEA.

The availability of fixed nitrogen, controlled by the balance between N fixation and N removal by heterotrophic denitrification and anammox, is of prime interest in considering the development of the Earth's oceans and atmosphere over millennial time scales. The modern day Black Sea, with oxic, suboxic, and anoxic layers, provides an ideal location for studying both "ends" of this cycle. Using seasonal data from one location in the northeast Black Sea, we show that the microbial community is not static and that various components of the N cycle can not be easily constrained by a few representative rate measurements. As has been previously indicated by isotope and mass balances, the presence of N-fixing and other microbes determined by functional gene fingerprints (T-RFLP) exhibit substantial variation between seasons. Moreover, additional data suggests that N fixation and ammonia oxidation, at least, can be important in unexpected places. We are working to understand these variations and tease apart spatial and temporal differences in this model system.

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THE MARINE CARBON CYCLE IN IRISH WATERS: PLANS AND FIRST RESULTS

"Impact of increased atmospheric CO2 on ocean chemistry and ecosystems" is an Irish governmental funded project aimed at studying the inorganic carbon cycle and evaluating potential ecological impacts of future ocean acidification in Irish waters. One of the goals of this project is to establish the capabilities for measuring the inorganic carbon parameters (AT, CT, pH and pCO2) in Ireland and to carry out several sampling cruises covering the continental shelf west of Ireland and the Rockall Trough. The cruises will reveal the present situation and lay a foundation for long term monitoring of the Irish waters. This poster presents the project and the AT and CT from the first two cruises, one in May and one in September 2008, on the continental shelf west of Ireland.

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TRAIT-BASED COMMUNITY ECOLOGY: THEORETICAL APPROACHES

There has been much recent interest in trait-based ecology. Here we summarize, compare and contrast several related approaches to modeling the selection and dynamics of traits in communities. These include optimization, game theory, quantitative genetics, and complex adaptive systems. An important concept in all these approaches is growth rate when rare, which integrates physiological traits into a measure of ecological fitness. Complications arise when there is spatial or temporal heterogeneity or population structure, but all can be accommodated. We give examples of these techniques applied to N:P stoichiometry and cell size.

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INTERMITTENT RIVER SEDIMENT RESUSPENSION: CHANGES IN PHOSPHORUS TRANSFORMATIONS AND RESPONSE OF MICROBIAL COMMUNITY

Resuspension of suspended particulate matter (SPM) are driven by hydrodynamics controlling the particle exchange between sediment and water column. We have performed a laboratory resuspension experiment using a newly designed hydrodynamically calibrated device. The aim was to follow phosphorus (P) transformations and to test the effect of intermittent resuspension on temporal dynamics of bacterial abundance and diversity. P binding forms were determined by a step-wise filtration and chemical fractionation. Particle-associated (PA) and free-living (FL) bacteria were separated by sequential filtration (5.0 and 0.2 µm Nucleopore membranes). Resuspension lead to a temporary dominance of iron-bound P associated to larger particles and to an increase in dissolved P. Numbers of PA directly followed SPM dynamics. Numbers of FL also slightly decreased after resuspension but strongly increased 5-15 hrs after maximum SPM concentration. Simultaneously there was a shift in community of FL (DGGE analyses of 16S rRNA). In conclusion, resuspension events change availability of bacterial substrates, e.g. P, and favour growth of specific bacteria. In natural environments such as rivers resuspension, thus, has a highly variable impact on dynamics of heterotrophic bacterial communities.

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SHORT-TERM VARIABILITY IN PHYTOPLANKTON DYNAMICS & PRIMARY PRODUCTION. IMPACTS ON SEASONAL SUCCESSIONS IN TWO MACROTIDAL COASTAL ECOSYSTEMS OF ENGLISH CHANNEL

Seasonal successions studies have to lead to a better understanding of primary production dynamics and help to predict eventual harmful algae events. In this context time variability of phytoplankton dynamics has been considered. On a short scale, from a few hours to a few days, the physical and chemical structure of the water column is controlled by physical forcing, such as wind events and tidal forcing, and by biological activity. The short-term variability in physical forcing and in biological activity influences the dynamics of phytoplankton. From March-2006 to October-2008, we conducted a sampling program in two typical coastal ecosystems of Western Europe, i.e. a Bay protected from winds and with low gyre movements, and a site exposed to dominant winds and with high gyre movements. In the area protected from winds the phytoplankton dynamics was influenced by nutrient availability, whereas in the area exposed to the dominant winds this dynamics was mainly influenced by the physical forcing. These various forcing impacted differently the primary production (14C/PAM) , the species successions and the Pseudo-nitzschia spp harmful events.

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IPY-GEOTRACES: SOURCES AND DISTRIBUTION OF DISSOLVED IRON IN THE ARCTIC AND SOUTHERN OCEANS

Dissolved iron is of major importance for plankton biology in the world oceans. The low concentration makes it difficult to quantify Fe in seawater. Samples were taken with a new ultraclean CTD sampling system (de Baar et al., 2008), deployed during the IPY-GEOTRACES program on board R.V. Polarstern. The results are the first ever comprehensive overview of the distribution of dissolved Fe in the deep basins and surface waters of the Arctic Ocean. Shipboard analyses by flow injection were calibrated with excellent agreement versus certified standard (SAFe) seawater (Johnson et al., 2007). High iron values in the surface waters, indicate terrestrial or shelf influence. This is in line with salinity data. Elevated iron concentrations at ~2500 meter depth above the Gakkel Ridge, corresponding with manganese and transmission anomalies, suggest hydrothermal activity. For the Southern Ocean transects over the prime meridian, Weddell Sea and Drake passage are presented. Dissolved iron appears to follow aluminium in the surface waters and clearly decreases in regions with high biological activity. At the Southwest Indian Ridge, values at about 2000 meter depth indicate hydrothermal activity. Johnson et al. (2007), Eos 88, 131-132. De Baar, H.J.W., M. Klunder et al. (2008), Marine Chemistry, 111, 4-21.

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THE INFLUENCE OF ALLOCHTHONOUS DISSOLVED ORGANIC MATTER ON PHYTOPLANKTON GROWTH IN SEAWATER

The purpose of this study was to investigate the influence of allochthonous dissolved organic matter (DOM) on phytoplankton growth. The experiments were conducted as batch growth experiments with Rhodomonas salina (Cryptophyceae) at six different DOM concentrations ranging from 0-4800 μM DOC and two different initial concentrations of ammonium. Our hypothesis was that both positive and negative effects on phytoplankton growth could occur due to either adsorption of ammonium to DOM or remineralization of nitrogen from DOM. The results showed that chlorophyll a concentrations were constant or even slightly decreasing with increasing DOM concentrations at low DOM concentrations. On the contrary chlorophyll a concentrations at the highest DOM concentrations were higher than predicted by a linear relationship to DOM concentration. Adsorption of ammonium to dissolved organic matter is suggested to outweigh remineralization at low DOM concentrations and thus lower the total availability of inorganic nitrogen for phytoplankton growth. Different hypothesis for interactions between DOM, inorganic nitrogen and phytoplankton growth were tested with a dynamic modeling approach.

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CONTRIBUTION OF AEROBIC ANOXYGENIC PHOTOTROPHS TO THE ORGANIC CARBON CYCLING IN THE MEDITERRANEAN SEA

Activity of Aerobic Anoxygenic Phototrophs (AAP) was investigated in the Mediterranean Sea. The phototropic bacteria formed on average 2-3% of total prokaryotes in oligotrophic waters, with up to 15% of the community in the more productive regions. The phototrotrophic community in the Western Mediterranean grew at rates from 1.1 to 1.5 day^{-1}. To assess the cell pigment and carbon quotas, the AAP cultures were grown in chemostats. Using the laboratory data we estimate that the production of the AAP community in the open Mediterranean waters was between 0.4 – 1.1 μg carbon L^{-1} day^{-1}. Assuming carbon utilization efficiency 45% AAP community utilize in total 0.9 – 2.4 μg carbon L^{-1} day^{-1}.

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VITAMIN B12 AND IRON CO-LIMITATION OF PHYTOPLANKTON GROWTH IN THE NORTH PACIFIC OCEAN

More than half of phytoplankton species surveyed are vitamin B12 auxotrophs, requiring an exogenous source of this vitamin for growth. Multiple studies in HNLC regions of the Southern Ocean have shown that phytoplankton community growth rates can be limited or co-limited by the supply of vitamin B12. Here we present a study from coastal and HNLC regions of the North Pacific Ocean which examines uptake rates of vitamin B12, as well as incubation experiments examining vitamin B12 as limiting or co-limiting nutrient. Results show that the majority of vitamin B12 uptake in both coastal and HNLC regions was by picoplankton (0.2-2um) and that B12 uptake rates were significantly correlated with levels of nitrate and phosphate. Incubation experiments within HNLC regions demonstrated that enrichment of B12 and Fe yielded significantly higher phytoplankton growth rates than enrichment with Fe alone or control treatments. Enrichment with B12 and Fe yielded a drawdown in nitrate relative to control treatments and specifically elicited growth responses from diatoms and dinoflagellates, but not from cyanobacteria. Results from high Fe, low nitrate regions will also be presented.

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PHYTOPLANKTON DIVERSITY AND GEOLOGICALLY RELEVANT CARBON: USING METAGENOMICS TO DETERMINE PHYTOPLANKTON BIOMARKER PRODUCTION

Phytoplankton play an important role in the global carbon cycle over both short and long time scales. Organic carbon fixed by phytoplankton seasonally in the surface ocean can be preserved in sediments and sequestered in rocks on geologic time scales. Recalcitrant forms of biomass such as lipids, are important in this cycle. Preserved lipids with taxonomic specificity are used as fossil biomarkers to characterize the community of organisms that contributed to ancient carbon sinks. Currently, it is not well understood how the complex mixture of organic compounds preserved in the geological record represents the original community that produced those molecules or how the diversity of organisms in a community is reflected in the lipid biomarkers they collectively synthesize. We have begun to investigate these relationships by characterizing lipid biomarker production in modern phytoplankton communities with metagenomic data sets. We have identified genes involved in lipid biomarker biosynthesis found in a number of metagenomes and placed these genes in a phylogenetic context using a method designed to deal with short (100-400bp) metagenomic sequences. The degree of taxonomic diversity of biomarker production measured with gene sequences can be more specific than lipid analysis alone. Here we use sterol biosynthesis as a case study to evaluate the information provided by metogenomic analyses on community biomarker biosynthesis.

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NORTHERN PINK SHRIMP (PANDALUS BOREALIS) EGG HATCH AND SPRING PHYTOPLANKTON BLOOM TIMES MATCH THROUGHOUT THE NORTH ATLANTIC

We examined long term average egg hatching times, surface and bottom temperatures, and phytoplankton bloom characteristics in relation to recruitment success for 13 stock areas of the northern pink shrimp Pandalus borealis throughout its wide latitudinal (42°N-78°N) range in the North Atlantic. Egg hatching and phytoplankton bloom times are significantly correlated on a large geographic and long temporal scale among stock areas, but not within them in the short term, where bottom temperatures largely determine annual egg incubation and hatch times. We conclude that the reproductive cycle of P. borealis has adapted to local average bottom temperatures and phytoplankton bloom times to maximize the chances of a match between larval release and food availability, a strategy that could result in considerable population fluctuations in response to mid-to-long term changes in oceanographic conditions. This model has considerable power in explaining previous observations, including recent widespread increases in the abundance of the species, and its negative correlation with surface and bottom water temperatures. The implications of these results are discussed in relation to the match-mismatch theory, fisheries management, and climate change.

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CHANGES IN GENOME SIZE AS A MECHANISM OF POPULATION DIVERGENCE IN THE MARINE PLANKTONIC DIATOM DITYLUM BRIGHTWELLII

In many taxa, differences in genome size are correlated to differences in cell size and physiological rates. Changes in genome size can lead to immediate reproductive isolation among populations and eventually speciation. Relative genome sizes were, therefore, compared for recent isolates of D. brightwellii representing two metapopulations (A and B) found in Puget Sound, Washington, USA known to have cell size differences in the field. Cell size and acclimated growth rates were measured for each clonal culture. Isolates from metapopulation B had 1.5 times the amount of DNA, grew more slowly and were larger than clones from metapopulation A. In addition, clones from New Zealand were examined: their ITS1 sequences, cell and genome sizes placed them within metapopulation A, but their growth rates were within the range of the slower-growing metapopulation B isolates. Large-scale genomic changes appear to mediate ecological differentiation between metapopulations of D. brightwellii currently living in sympatry; however, physiological variability over greater geographic distance within a metapopulation is likely due to microevolutionary changes leading to local adaptation.

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ELEMENTAL COMPOSITION OF BLOOM FORMING SCYPHOMEDUSAE IN THE NORTHERN ADRIATIC

Five bloom forming scyphomedusea, *Aurelia aurita, Chrysaora hysoscella, Cotylorhiza tuberculata, Pelagia noctiluca* and *Rhizostoma pulmo*, were sampled seasonally in the Adriatic Sea from 2005 to 2007. Elemental analyses (C, H, N, S and P) were done directly after drying and repeated on dialyzed (MWCO 1,000) samples. Both whole specimens as well as isolated tissues were analysed. The mean carbon, nitrogen, hydrogen, sulphur and phosphorus contents of non-dialyzed samples were significantly lower than the contents of dialyzed samples. The highest mean values of the element content observed were those for *R. pulmo* and *C. tuberculata* while the lowest were those for *A. aurita*. The difference in elemental composition of *A. aurita* sampled at two locations (Mljet lakes and the Gulf of Trieste) was also observed. The C, H, N, S and P contents were lower in the case of the Mljet samples. Also two methods of drying (freeze-drying and oven-drying) were compared. In further studies we will relate this data to the corresponding values of net zooplankton to understand better the material transfer through trophic levels.

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FEEDBACK EFFECTS OF AQUATIC VEGETATION ON TURBIDITY IN A LOWLAND RIVER

Submersed macrophytes have been shown to improve their own light supply by increasing net sedimentation of turbid particles in shallow lakes. We studied the importance of this positive feedback in a lowland river. We compared concentrations of seston and phytoplankton at the beginning and the end of a 28 km river course, mapped the aquatic vegetation, measured light attenuation in the water column, light absorption by epiphyton, shading by bank vegetation and impounding effects of macrophytes. Seston net retention was negligible in the period of phytoplankton dominance (1988-92) and out of the vegetation period. In summer seasons with a mean dry weight of macrophytes above 100 g/m2, seston concentration declined by 50-76% and light attenuation by 30% along the river course. This positive feedback was partly compensated by a water level increase of 25%. In the critical initial phase of macrophyte development, turbidity was highest due to the spring peak of phytoplankton, high discharge and low particle retention. During summer, retention was high, but light supply of submersed macrophytes was controlled by bank vegetation and epiphyton.

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HALOTAXIS OF CYANOBACTERIA FROM AN INTERTIDAL HYPERSALINE MICROBIAL MAT

Hypersaline cyanobacterial mats from an intertidal flat rapidly changed color upon changes in salinity of the overlaying water. Above 150‰ the mats were bright red, at lower salinity dark green. We investigated the causes of this phenomenon using a polyphasic approach (DGGE, microscopy, pigment analyses, hyperspectral imaging, oxygen microsensors). *Microcoleus chthonoplastes* filaments were found to migrate up and down in response to these salinity changes, causing the greening of the mats' uppermost layer. Examination of the influence of several salinity-dependent factors, such as oxygen solubility and water activity, led to the conclusion that the observed migration was likely due to a direct response to ionic stress and not an indirect consequence of changes in these salinity-dependent physico-chemical parameters. We propose to call this behavior "Halotaxis", and suggest that it may play an important role for the survival of cyanobacteria in environments exposed to rapid salinity fluctuations (e.g. intertidal flats). The exact mechanism of halotaxis needs further investigation.

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CLIMATE MODULATED CHANGES IN A HIGH ALPINE LAKE OVER THE LAST 10000 YEARS – HAS IT EVER BEEN NICE WATER?

We present a Holocene lake sediment record of a high alpine lake that is covering the whole lake's history from its ontogeny to present. The multi proxy record includes stratigraphies of diatoms, chironomids, pollen, mineralogical, granulometric, ferromagnetic, and geological analyses. We show that species rapidly settled in the lake after retreat of the glaciers but with low abundance and low diversity. In contrast, the development of a more productive lake ecosystem with higher carbon and nitrogen content took much longer (ca. 2000 yrs) although the early Holocene was a very warm period. We discuss natural, climate driven changes in the lake ecosystem reflected in changes in species composition, productivity, redox conditions and stratification. We show that changes in solar modulation significantly influence the stratification. From this long term perspective, we address reference conditions for "nice high alpine waters" within a changing climate.

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INFLUENCE OF PHYSIOLOGY AND TROPHIC ECOLOGY ON HG BIOACCUMULATION IN TOP PREDATOR FISH FROM THE WESTERN INDIAN OCEAN

Large fish naturally bioaccumulate Hg, accumulated levels varying with factors such as species, size and feeding behavior. Thus, these factors should be considered before comparing Hg levels in fish from different geographic areas or assessing the potential health hazard linked to their consumption. We measured total Hg levels in the muscle of 183 fish of five commercially important species from the tropical Western Indian Ocean, taking into account their size and sex. Hg levels were comparable in the muscle of the same species from other areas. The highest Hg levels were noted in Swordfish from Reunion Island waters (3.97±2.67 µgg−1 dwt). Following the Swordfish, in decreasing order of Hg content, were the Yellowfin Tuna and the Skipjack, then the Common Dolphinfish and the Wahoo. In the North Mozambique Channel, Swordfish had higher Hg levels than Yellowfin Tunas, and Dolphinfish exhibited intermediate Hg levels. Size and species were determining factors of Hg burden. Differences in size–normalized Hg levels were observed between the two study zones for Swordfish and Common Dolphinfish. Nitrogen stable isotope analyses indicate that these differences might be due to the trophic levels at which these fish feed rather than linked to a difference in water Hg levels in both areas. The muscle Hg levels presented here suggest that consumers from the Western Indian Ocean should limit not exceed one Swordfish based meal/week, or one tuna or Common Dolphinfish based meal/day.

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TYPHOON EVENT EFFECTS ON WATER EXCHANGE IN TOKYO BAY

Heavy precipitation associated with typhoon events result in the input of a large amount of fresh water into Tokyo Bay. However, the effect of these episodic events on water circulation, mixing and flushing remains poorly understood. To investigate mixing and water exchange at the bay mouth we conducted extensive field measurements using a microstructure profiler (TurboMAP) and RD ADCP prior to and immediately following the direct hit of a typhoon. Our data shows an obvious change in the strong mixing layer due to increased fresh water outflow following the typhoon. By cross comparing our field data with a three dimensional hydrodynamic model (GETM) we accurately estimate the bay flushing time. In addition, as a Lagrangian approach, we used passive particles to investigate the rate and characteristic patterns of water exchange at the bay mouth. Finally, we discuss the consequences of the modified water circulation and exchange patterns observed during the typhoon event for the overall ecosystem health.

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MECHANISMS OF SUMMER BLOOMS IN THE NORTH PACIFIC SUBTROPICAL GYRE: OCEAN PERTURBATION EXPERIMENT (OPEREX) STUDY.

We will report preliminary results of the field experiment led by the Center for Microbial Oceanography: Research and Education (CMORE) aimed at understanding the dynamics of summer blooms in the North Pacific Subtropical Gyre (NPSG). Although the NPSG is characterized by vanishingly low nutrient concentration and low biomass standing stocks, photosynthetic properties of phytoplankton indicate high level of photosynthetic performance, poised to respond quickly to the episodic nutrients injections. In August 2008 the NPSG practically exploded with ephemeral blooms, producing a spectacular example of photosynthetic dynamics in this generally quiet portion of oligotrophic ocean.

The surveyed blooms were limited to the top 40 meters of the water columns, with little or no change in the depth, or the strength of deep chlorophyll maximum. Blooms were localized at the peripheries of local eddies and on the gradients of sea surface height, and were associated with high concentrations of Trichodesmium. These blooms appear to export carbon, as indicated by the sediment trap data. We will discuss whether, and to what extent these blooms are results of the local convergence zones, or the local vertical transport of nutrients/trace metals within the shear zones of interacting eddies. Ship-deck incubations using surface water enriched with 10% of deep (200-500 meters) water indicate that the latter mechanism is largely responsible for formation of the summer blooms in NPSG.

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RIPARIAN FOREST COMPOSITION DETERMINES STREAM ORGANIC MATTER PROCESSING DYNAMICS

Energy subsidies link headwater streams and riparian forests. Forest harvesting alters the composition of riparian tree species, which can affect the structure and function of stream ecosystems through changes in terrestrial resource subsidies. We examined how variation in the ratio of deciduous to coniferous forest composition may affect stream invertebrate and microbial consumers and subsequent leaf litter breakdown rates of red alder (deciduous tree) and western hemlock (conifer) in 10 headwater streams. Breakdown rates of alder litter were faster in streams containing a greater proportion of deciduous than coniferous canopy; whereas breakdown rates of hemlock litter were independent of canopy composition. When invertebrates were excluded using fine mesh to isolate microbe-specific processing dynamics, breakdown rates of both species were an order of magnitude less and did not vary with canopy composition. Benthic invertebrates, and not microbes, appear to explain variation in organic matter processing dynamics attributed to forest canopy composition. Additional research investigating the relationships between riparian forest canopy, and stream invertebrate and microbial community diversity may reveal multi-trophic consumer variation in responses of stream food webs to terrestrial subsidies.

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THE INFLUENCE OF LIGHT, IRON AND SILICIC ACID ON PHYTOPLANKTON COMMUNITY COMPOSITION ACROSS THE SCOTIA SEA.

Fe is a key factor limiting phytoplankton production in high nutrient, low chlorophyll waters of the Southern Ocean, thus playing a critical role in carbon cycling. Where blooms do occur in the Southern Ocean, for example downstream of oceanic islands, they are typically dominated by diatoms with high Fe requirements for growth. Other major controls on diatom blooms are silicic acid and light. The Scotia Sea, in the SW Atlantic, supports intense phytoplankton blooms. During the austral summer of 2007, a detailed survey of phytoplankton community composition was made in this region extending from the ice edge, up to the north Scotia Ridge. To the south, phytoplankton biomass was high near the South Orkney Islands and , to the north,a dense bloom formed near to the island of South Georgia (Chl a ~ 7 mg m-3). However, blooms to the south were not dominated by diatoms as expected; cryptophytes or dinoflagellates dominated the total cell count (~80%). Blooms close to South Georgia, in deep water, were dominated by diatoms (>66%) although this switched to a dominance of dinoflagellates over the island's shelf. This study will examine the influence of Fe, silicic acid and light availability in shaping the phytoplankton communities observed during our survey.

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INFLUENCE OF SALINITY VARIATIONS ON THE DESORPTION AND LABILITY OF SOIL ORGANIC CARBON ASSOCIATED WITH A TIDAL FRESHWATER WETLAND

Tidal freshwater wetlands (TFWs) are intermediary systems bridging the gap between terrestrial and aquatic ecosystems and are important in the sequestration of soil organic carbon. This multidisciplinary study assessed the amount, lability and optical characteristics of desorbed organic carbon in tidal freshwater wetland organic and mineral soils through the exposure to a range of salinities (0-35 practical salinity units). To quantify the desorbable organic carbon for each representative soil type, a leachate was performed and the parameters, bacterial production, dissolved organic carbon (DOC) and carbon lability, and excitation-emission fluorescence spectroscopy (EEM), were measured. Initial desorption shows an increase in the amount, rate and percentage of DOC in the organic soil in comparison to the mineral soil. These measurements also indicate as salinity increases, there is a positive correlation in respect to the amount, rate and percentage of DOC. EEM fluorescence spectra of the DOC was used to better elucidate the organic carbon autochthonous and allochthonous components. Understanding how salt water intrusion affects desorption and lability of soil organic carbon can demonstrate how climate change will play on global carbon cycle.

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BIOLOGICAL NEUTRALISATION OF ACIDIC PIT LAKES – POTENTIALS AND LIMITS

Acidic pit lakes are an increasing environmental problem worldwide. The stimulation of microbial sulfate reduction by addition of organic substrates has been considered a promising approach for the remediation of such lakes. We carried out a variety of experiments in an upscaling approach from laboratory columns to field mesocosms in Mining Lake 111, Germany, applying organic matter and lime to the sediment surface. While high sulfate reduction rates were obtained at the sediment water interface, the sustainable precipitation of iron sulfide turned out to be the limiting step of the neutralization reaction. We observed sulfate reduction in acidic sediment layers were iron sulfide could not precipitate but H_2S was re-oxidized. Furthermore most of the iron sulfide initially formed was re-oxidized by ferric iron which served as an electron shuttle between the oxic water column and the anoxic sediment. This was triggered by the annual overturn of the water column. As result of this counteractive effects low neutralization rates of 2.3 meq m^{-2} d^{-1} were obtained which is in the range of naturally occurring alkalinisation rates in lakes.

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SEDIMENT PROPERTIES AND PORE WATER GEOCHEMISTRY OF A SUBTERRANEAN ESTUARY (WADDEN SEA, NORTHERN GERMANY)

Two neighbouring but stratigraphically and lithologically distinct cores of about 20 m length have been drilled in the central backbarrier area of Spiekeroog Island. The main part of core A comprises 8.5 m thick mud-rich sediments of a channel filled during the Holocene transgression. Core B contains a sequence of permeable sandy sediments of the Saale and Weichsel glaciations. The Eemian interglacial is represented by a fen peat layer overlain by mud-rich marine sediments. The top of core B is formed by 4.5 m of Holocene mud-rich inter- to supratidal deposits. Pore water salinities decrease with depth from sea water concentrations to 10-15 ppt. In both cores the steepest gradients of pore water biogeochemistry occur in the upper parts of the low permeable mud-rich sediments. Maximum concentrations of DOC, methane, and ammonia and depletion in sulphate are found in the centre of the channel fill deposits of core A. The pore water profiles in both cores are controlled by lithology and indicate the existence of a subterranean estuary at about 3 km distance from the present day shore line.

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CHANGES IN ISOTOPIC AND FATTY ACID COMPOSITION OF SETTLING LEAPING GREY MULLET LIZA SALIENS JUVENILES IN A MEDITERRANEAN COASTAL LAGOON: IMPLICATIONS FOR DIET

Mugilidae is one of the most abundant families of commercial interest in the Mediterranean lagoons. Their larvae hatch in sea and their juveniles migrate towards lagoons where they grow until sexual maturity. Settlement is a crucial step for the recruitment of new individuals. In this study, stable isotope and fatty acid analyses were used to investigate the resource use and the dietary shifts during the settlement and the early post-settlement stages of *Liza saliens* (Pisces, Mugilidae) in a Mediterranean coastal lagoon (NE Greece). Food web components, settling and post-settlement "larger" early *Liza saliens* juveniles were collected during the recruitment season. During the study period, up to 4‰ and 5‰ increase of $\delta^{13}C$ and $\delta^{15}N$ respectively was observed between settling and post-settlement individuals. Moreover, the 16:1/16:0 and 22:6ω3/20:5ω3 ratios as well as the proportion of 22:6ω3, 20:4ω6, 18:3ω3, 18:1ω7 in the storage lipids underwent important modifications during settlement. More than a simple equilibration to the local food web, these results suggest important dietary shifts during settlement and slightly different feeding habits than those described in literature.

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ASSESSMENT OF A POSSIBLE RELATION BETWEEN THE VARIABILITY OF ENVIRONMENTAL PARAMETERS AND THE DISPERSION OF INVASIVE MOLLUSCS IN THE HELLENIC SEAS

The rate of dispersion of invasive mollusc species in the Hellenic Seas is exponentially increasing with time since more than half of these species have been recorded after 90's. The increased rate of invasion in these Seas could be the result of a synergy of different reasons, the most important of which could be the intensive research on the marine biota during the last two decades, which led to the discovery of many molluscs not reported previously, the increased anthropogenic activities over the last decade such as aquaculture and tourism (contributing factors to increase of maritime traffic) and finally the possibility of a gradual colonization of this region due to climatic changes. The comparative study of surface temperature variability in selected areas of the Eastern Mediterranean have revealed that current conditions in the S. Aegean are comparable to the mid-90's values recorded in the southeastern Levantine basin, thus creating conditions favorable to Lessepsian migrants. In this work we attempt an assessment of the relation of temperature increase to the rate of new alien species appearance in the Hellenic Seas.

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MERCURY INFLUENCE ON MICROBIAL COMMUNITIES IN RIVER IDRIJCA: *MER* A GENE QPCR AND DELAYED FLUORESCENCE

The effect of total mercury pollution on microbial communities in the river Idrijca (Slovenia) was investigated in 2006-2007. In this study we used quantitative polymerase chain reaction (qPCR) for determination of relative copy number (RCN) of Hg resistant genes downstream of the source of contamination. Such measurement based on the DNA level shows long-term effect of mercury pollution on the bacterial communities. merA RCN differed seasonally as well as along the river. In general, the lowest quantities were measured at the reference site close to the river spring, whereas the highest were near the abandoned cinnabar ore smelter downstream. Relatively high RCN were found also near towns. merA RCN was reduced only several kilometers downstream and was correlated to the total Hg concentration on the same locations. Photosynthetic periphyton biomass, measured with delayed fluorescence was also related to the environmental situation. Biomass was highest around the pollution sites, especially near the sewage plant. It was reduced downstream, where it was even lower as at the reference site. Additionally, algal taxa composition differed among the polluted and unpolluted sites.

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DYNAMICS OF REDOX-SENSITIVE TRACE METALS IN THE WATER COLUMN AND PORE WATERS OF A TEMPERATE TIDAL SYSTEM: RESPONSE TO BIOLOGICAL ACTIVITY

Seasonal and tidal dynamics of redox-sensitive trace metals and their response to biological activity were investigated in the open water column and shallow pore waters of the German Wadden Sea (Southern North Sea). The trace elements Mn and V showed strong tidal and seasonal variations with water column concentrations generally increasing towards low tide and summer. However, distinct fluctuations were observed for Mn during summer months caused by Mn pool sizes and microbial activity in the sediments. Mo and U mainly behaved conservative in the open water column with elevated values during high tide. Exceptions were observed for Mo which showed significant depletion after breakdown of summer algae blooms. Subsequently, distinct enrichments were found for Mn, Mo, Fe, U, and V in shallow pore waters. This behaviour can be explained by a tight coupling of geochemical, biological, and sedimentological processes. The release of organic matter during breakdown of algae blooms causes formation of trace metal-rich aggregates, which are incorporated into the sediment after deposition. Elevated microbial activity and a corresponding change in redox-conditions lead to interfacial transfers of trace metals.

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PARTICIPATORY DECISION SUPPORT FOR SUSTAINABLE COASTAL MANAGEMENT AND OCEAN GOVERNANCE

Formal and informal approaches to a wise decision-making for a future sustainable development of coastal zones and open marine regions increasingly ask for capable scientific methods. Concepts, tools, models and technologies are needed to generate information adjusted to the certain steps of decision-making processes and to make this information available. Integrated modelling (IM) amalgamates any kind of models, database-systems and valuation methods to integrate, to evaluate and to visualise complex socio-ecological issues. Especially in multifaceted systems like coastal zones, where data are comprehensive and models get complex, the valuation of the results is crucial. In order to meet the needs of non-specialists in participatory decision-making, information must be aggregated to coherent, compact knowledge. The paper introduces applications-oriented examples of our transparent decision-support-tools. We show how methods are coupled and how scientists, stakeholders and the broad public share their information. Lessons learnt from the participative development of IM tools as shaped, developed and applied jointly with stakeholders engaged in management schemes from a more local to the European level, highlight: IM counteracts fragmentation and offers transparency in communication.

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TURBULENCE IN A WIND- AND TIDAL-DRIVEN ESTUARINE FLOW

Small-scale turbulence has an important role in e.g. sediment resuspension and plankton aggregate formation in estuarine flows. For this application it is not feasible to simulate all the flow scales. One approach is to only resolve the largest eddies in the flow and model the small-scale dynamics of the flow and particles. Here, we present a large-eddy simulation of a (stratified) oscillating channel flow subjected to a wind stress as is typical for the tidal flow in estuaries. Turbulence is mainly produced in the bottom and free-surface layers, where a strong mean shear is present. In these regions elongated turbulent streaks are observed. The orientation of free-surface streaks and bottom-wall streaks might differ due to the direction of the wind stress. The isotropy of the turbulence in the interior is strongly affected by the turbulent structures in the boundary layers. Fully resolved simulations of turbulence with the same characteristics can be used to obtain small-scale models for plankton dispersion. In the end this would allow for studying plankton dispersion in geophysical applications.

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CO_2 AND LIGHT EFFECTS ON GROWTH, PHOTOSYNTHESIS, CARBON ACQUISITION AND NITROGEN FIXATION OF THE DIAZOTROPHIC CYANOBACTERIA *TRICHODESMIUM*

Recent studies on the diazotrophic cyanobacteria *Trichodesmium* showed a pronounced CO_2 dependency in N_2- and C-fixation. However, significant uncertainties remain as to the degree of sensitivity to CO_2, modification of these responses by other environmental factors, and the underlying processes. To this end, we investigated carbon acquisition and nitrogen fixation in *Trichodesmium* IMS101 under different CO_2 and light levels. In these acclimations, growth rates, cellular C and N content, and respective isotopic values were measured. *In vivo* activities of photosynthetic O_2 evolution, O_2 uptake, CO_2 and HCO_3^- fluxes were obtained using membrane inlet mass spectrometry methods (MIMS). Nitrogen fixation rates were determined using the acetylene reduction assay, and chlorophyll a fluorescence was measured via fluorescence induction and relaxation method (FIRe). Photosynthesis and N_2-fixation increased with CO_2 and this effect was even more pronounced under high light. Moreover, our data suggest a shift in the distribution of metabolic energy between photosynthesis, carbon acquisition and N_2-fixation in *Trichodesmium*. The observed stimulation in photosynthesis and N_2-fixation may enhance the productivity in N-limited oligotrophic regions.

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SINKING AND REMINERALISATION OF PARTICULATE ORGANIC MATTER IN LARGE-SCALE MODELS OF MARINE BIOGEOCHEMISTRY

Sinking and remineralisation of particulate organic matter (POM) in large-scale models of marine biogeochemistry is usually parameterised by a prescribed function of an idealised particle's settling velocity and decay rate. Here we investigate two common representations of sinking (remineralisation) with respect to their intrinsic assumptions and their effect on POM mass and sedimentation profiles. Using a model of an idealised water column, we additionally investigate the effect of an assumed surface particle size spectrum on deep sedimentation. Conversely, the effect of sinking on deep particle size spectra is examined. A constant, uniform sinking speed does not appear appropriate for long-term simulations. A size spectrum of particles causes the average sinking speed of POM to increase with depth, although the increase is not strictly linear. Its particular form depends on the size spectrum at the surface; thus, regional variations of the surface POM size spectrum might cause regional variations of remineralisation length scales. In the deep ocean, the combined effects of sinking and remineralisation can lead to unimodal particle size distributions.

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BENTHIC METABOLISM AND CARBON GAS (CO2 AND CH4) BALANCE IN TWO TANZANIAN MANGROVE FORESTS UNDER DIFFERENT ANTHROPOGENIC INFLUENCE

Sediment metabolism and carbon gas balance was measured in the anthropogenically impacted Mtoni and the pristine Ras Dege mangrove forest, Tanzania. In situ CO2 and CH4 emission from sediments and open creek water were determined at high and low tides. Sulfate reduction (SRR) and iron reduction (FeR) was quantified from sediment incubations. CO2 emission from sediments was lowest at the freshwater influenced inner part of Mtoni. Benthic metabolism was primarily driven by FeR (54-78%) and to lesser extent SRR (9-12%), except for organic-rich inner sites at Ras Dege (FeR: 38% and SRR: 46%). Other processes (aerobic respiration and methanogenesis) accounted for 10-15%, except for 37% the inner part of Mtoni. CH4 emission was 3 orders of magnitude lower than for CO2; highest at the inner part of Mtoni. Pneumatophores and crab burrows increased emissions considerably. Highest emissions from open creek waters occurred during low tide due to porewater seepage. Primary production estimates and measured emissions reveal that the densely vegetated Ras Dege is an efficient sink of greenhouse carbon gases, while clear-cutting has reduced the capacity considerably at Mtoni.

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POTENTIAL REESTABLISHMENT OF ZOSTERA MARINA IN A SHALLOW DANISH FJORD WAS EVALUATED BY FIELD, LABORATORY AND MODEL ACTIVITIES.

The sediment erosion thresholds were measured at 13 stations in Odense Fjord. Basic sediment parameters such as water content, organic matter, grain size distribution, total N and P were measured on these and 79 other stations. The basic sediment parameters and the erosion thresholds were correlated. The thresholds correlated linearly to the top layer sediment organic content ranging from 0 to 2% of the dry weight. Here the erosion thresholds declined from 0.40 to 0.25 ms-1. Organic matter content between 2 and 7% showed stable erosion thresholds of about 0.25 ms-1. Our hypothesis: that reestablishment of eelgrass only appears in areas with infrequently resuspension events were tested in a newly developed dynamic model. All site specific data including current and wave action was implemented in the dynamic mathematical model to describe the potential distribution of Zostera marina. In the model the reestablishment of eelgrass is described by growth that is dependent on light and nutrient availability, while biomass losses are described by erosion thresholds dynamics. A suite of simulations indicated that the reestablishment of eelgrass belongs to a distant future.

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CHANGES IN BACTERIAL CARBON METABOLISM IN RESPONSE TO INCREASING TEMPERATURE

Marine dissolved organic matter holds as much carbon as there is carbon dioxide in the atmosphere. This carbon pool is largely regulated by bacterioplankton that, to the extent that it is available, convert DOC into bacterial biomass or remineralize it into carbon dioxide. If bacterial processing of the DOC pool is limited by temperature, global warming can reduce the amount of carbon stored in DOM. Bacteria in permanently cold waters have been argued to be more sensitive to temperature, but this is not independent of substrate and nutrient availability. This study provides experimental data on the regulation of bacterial production, respiration and growth efficiency in the Fram Strait. We investigate how bacterial processes are regulated by temperature and nutrients within a temperature range that is likely to be realized before the turn of the century.

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WHY IS THE EASTERN MEDITERRANEAN SEA PHOSPHORUS LIMITED AND WHY DOES THE EXPLANATION MATTER TO IDEAS OF GLOBAL NUTRIENT CYCLING

Two very different explanations proposed to explain the observed high Nitrate: phosphate (28:1) ratios in the EMS. Bethoux and others suggested this high ratio is caused by regionally high rates of N2 fixation. At the time no measurements of N2 fixation had been made in the EMS. A limited number of isotopically light 15N-NO3 and PON measurements supported this explanation. However the EMS is a P starved ecosystem. If N2 fixation is causing the N:P ratio to stabilise at well above 16:1, then this explanation is incompatible with the generally accepted mechanism resulting in the Redfield ratio elsewhere in the global ocean. Recently we have suggested, based on a basin-wide nutrient budget, that all the nutrient inputs to the basin have an N:P ratio greater than 16:1 and that there is very little denitrification in the basin, due to its extreme ultra-oligotrophic nature, to reduce the N:P ratio towards 16:1. Here relevant new results are summarised. Several new measurements of N2 fixation have been made all of which show low values. The 15N results for atmospheric input (light), for PON (Light) and for DON (heavy) are interpreted as being the result of microbial cycling in a P limited system without requiring any significant N2 fixation. Existing reviews which conclude major N2 fixation is the EMS are shown to have misquoted previously published data. All of the new data supports or is compatible with there being low N2 fixation rates in the basin.

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CHANGES IN PHYTOPLANKTON BIOMASS IN THE WESTERN SCHELDT ESTUARY DURING THE PERIOD 1978-2006

Changes in annual mean chla concentrations were studied the eutrophic and turbid macrotidal Western Scheldt estuary. Three stations were investigated: WS1 (30 PSU at the mouth of the estuary, station WS6 (17 PSU) and station WS11 (10 PSU). No significant long term changes in yearly averaged chlorophyll a (chla) concentrations were observed in WS1 and WS6, but in WS11 a large decrease. Spectral analyses revealed a possible periodicity of 7 years in mean chla which we could not relate to abiotic factors. Strong phenological responses in the timing of the spring/summer bloom were observed: the center of gravity or the day at which 50% of the cumulative chla was reached during the year advanced with 1-2 days per year. All stations showed an earlier initiation of the bloom, whereas the day at which the phytoplankton bloom terminated also moved forward in time, WS11 excepted. As a result the bloom length decreased in station WS1, remained the same in station WS6 and increased in WS11. This complicated pattern in bloom phenology demonstrates the complex nature of ecosystem functioning in estuaries.

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MORPHOLOGICAL TRAITS AS DESCRIPTORS OF PHYTOPLANKTON FUNCTIONAL VARIETY

The most objective approach to construct functional groups of phytoplankton is to cluster species according to their functional traits. We use information on more than

700 phytoplankton freshwater species and more than 200 lakes, spanning the subpolar to the tropical regions. We construct a classification based on nine morphological individual traits easily determined with a light microscope and applicable to all phytoplankton species without reference to dubious taxonomy. We validate the predictive value of morphology by showing its correlation with functional properties such as growth rates and population abundances in the field. For each of the seven obtained morphology-based groups we formulate the potential ecological performances to the main constraining environmental processes. Finally, a model based on measurable lake variables is performed and predictability is analyzed.

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IMPACT OF SHRIMP POND EFFLUENTS ON SEAGRASS BEDS IN TROPICAL HAINAN, CHINA

Expanding aquaculture increasingly endangers ecosystem health in tropical coastal zones. In order to obtain information on the impact of effluents from shrimp ponds on seagrass beds, we investigated three sites at the east coast of Hainan, China. Density of aquaculture ponds in the hinterland and numbers of draining channels to the seagrass beds varied from site to site. Effluent discharges contained up to 673µM dissolved inorganic nitrogen and 20µM phosphate. Dissolved inorganic nutrients as well as total nitrogen and d15N of seagrass and epiphyte tissue were particularly high at nearshore seagrass beds in regions with intermediate and high pond densities and mostly decreased with distance to the shore. Chl a concentrations in the water column between 10 and 26 µgl-1 and seagrass leaf/epiphyte ratios of =1.7 indicate a significantly enhanced algal production in these nearshore areas. The seagrass displayed a patchy distribution with a reduced shoot abundance and biomass compared to the control site, which is less exposed to pond effluents. Our results suggest that eutrophication of nearshore waters by shrimp pond effluents impairs seagrass health through shading by elevated growth of epiphytic algae.

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LOW FAUNAL ABUNDANCE AND DIVERSITY IN MEDITERRANEAN SEAGRASS IS LINKED TO THE SEGREGATION OF SEAGRASS RESIDENT PREDATORS AND THEIR POTENTIAL PREY

Seagrasses are considered superior habitats for fish, especially juveniles, seeking refuge from predation provided by structural complexity, while leading to avoidance of less complex and riskier habitats. However, predation risk is mediated by predation mode and the numerical response of predators and prey. Censusing fauna in geo-/video-referenced scuba transects in a Mediterranean lagoon revealed that mosaic-like distributed habitats (rocky-algal, seagrass, bare sediments) had unique faunal assemblages, equally delineated by the kind of 3D structure and its presence/absence. Seagrass harbored lowest faunal abundance and diversity and was avoided by most taxa; the opposite was true for bare sediments. Two common ambushing/stalking predators strongly preferred seagrass, while bare sediments were highly preferred by small and juvenile fish. The segregation of predator and prey on a small scale (seagrass vs. neighboring habitats) was highly predictive of faunal abundances on larger scales. These results demonstrate how the relative importance of different predation modes can reduce or increase the value of alternative habitats and how seagrass resident predation can exclude potential prey (especially juvenile fish); thereby negatively affecting total faunal abundance and diversity in seagrass.

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QUANTIFICATION OF CRENARCHAEOTA AT MARINE METHANE SEEP SITES

Anaerobic methanotrophs (ANME-1, -2, -3) are controlling methane fluxes from the seabed. They are presumably a syntrophic consortium of uncultivated relatives of methanogenic archaea and sulfate-reducing bacteria. However, it has been proposed for habitats, e.g. deep biosphere sulfate-methane transition zones (SMTZ), that other types of methanotrophs are responsible for the anaerobic oxidation of methane since the known ANME groups have not been found. Crenarchaeota of the Miscellaneous Crenarchaeotal Group (MCG) and the Marine Benthic Group B (MBGB, Deep sea archaeal group) dominated 16S rRNA gene libraries from subsurface sediments but have never been seen. The function of these Crenarchaeota is still unknown and no quantitative data are available yet. In this study, we aimed to find hot spots of marine benthic Crenarchaeota. Ribosomal RNA slot-blot hybridization with specific probes was used to screen for MBGB and MCG in various sediment samples from different methane seep sites and subsurface SMTZ. Obtained quantitative data will be discussed with respect to AOM rates and other biogeochemical parameters.

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SHIFTING GENETIC STRUCTURE OF AN ALPINE CADDISFLY IN RESPONSE TO ENVIRONMENTAL CHANGE

Alpine waters are changing rapidly in response to climate change. Models predict not only a general warming in temperature, but also an increase in extreme weather events such as floods and droughts. Populations of alpine aquatic insects are often insular in nature and respond quickly to these extreme weather events. We examined changes in the population genetic structure (microsatellites and mitochondrial COI gene sequences) of an alpine caddisfly (*Allogamus uncatus*) following an extremely hot and dry summer that resulted in a population bottleneck. We collected larvae from permanent and temporary streams in each of four valleys, located within two regions in the Swiss Alps. Larvae were collected in 2003 before the bottleneck, then in 2004 or 2005, and again in 2008. We found that the population genetic structure shifted greatly as a result of the bottleneck, and that the shift in genetic structure resulting from the bottleneck differed between regions. Our results show that extreme weather events, such as droughts, can have a significant impact of the population genetic structure of alpine aquatic insects.

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TRACKING BENTHIC MEGAFAUNAL COMMUNITY SHIFTS FROM WITHIN MONTEREY BAY TO THE ABYSSAL NORTHEAST PACIFIC

Most deep-sea research focuses on examining variation over either time or space. Here we present video transect results from 2005-2008 surveys that included 24 benthic stations along a depth and food availability gradient of 3800 m from Monterey Bay to an abyssal station over 175 km to the south. Over the substantial depth and distance gradient we found decreased species richness of megafauna at deeper, more distant locations. Several clear abundance changes were noted including decreases in overall abundance and specifically with regard to fishes and molluscs, but increases in the proportional abundance of hexactinellid sponges and certain echinoderms. The dominant fauna at various abyssal stations ranged from echinoderms, to tube-dwelling amphipods, to hexactinellid sponges. The studied megafauna can integrate environmental and resource forcing over interannual scales, so longer timeseries will be needed to determine if the communities are fluctuating in synchrony in response to a common variable such as climate or food supply.

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CHANGES IN MICROBIAL DIVERSITY AND DOM COMPOSITION AFTER UNIFORMLY-13C-LABELED GLUCOSE ADDITION TO A COASTAL MICROBIAL CONSORTIUM

Numerous studies have described the metabolic pathways of simple substrates within single microorganisms. However, relatively few studies have elucidated the pathways of these same substrates within complex consortia. We have examined the metabolism of uniformly-labeled ^{13}C-glucose in a coastal microbial community. We collected seawater on an incoming tide and amended it with glucose and ammonium. At selected times, replicate bottles were sacrificed for microbial community and dissolved organic matter (DOM) analyses. Using ultrahigh resolution electrospray ionization mass spectrometry, we observed significant changes in DOM composition. At 24 hrs, low-molecular-weight material (≤ 500 Da) dominated the mass spectrum. At 48 hrs, the spectra were dominated by multiply-charged, high-molecular weight (≈ 6000-7000 Da) compounds, consistent with small peptides or peptidoglycans. At 9 days, DOM composition resembled the initial seawater. These data suggest that we have identified short-lived metabolites of DOM consumption produced by a complex microbial community. Using parallel assessments of metabolically-active microbes, we observed incorporation of ^{13}C into microbial biomass and shifts in community composition. Together these data allow us to elucidate the link between microbes and DOM in aquatic systems.

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IMPACT OF CLIMATE CHANGE ON THE LAKE BIWA ECOSYSTEM

Dissolved oxygen is becoming increasingly depleted in the benthic boundary layer of Lake Biwa, Japan. We developed a model to predict the annual minimum dissolved oxygen, and the model gave a good fit to field data from 1965 to 1987. The predictive ability of the model, however, broke down for data after 1988. The model residuals between the field data and the predicted values were correlated with lake phosphorus concentrations, with an outlier in 2000. We also found that the snow equivalent water around Lake Biwa was negatively correlated with phosphate residuals (p-value = 0.004, r = - 0.48). The results suggest that under a cooler climate, oxygen is supplied into the benthic boundary and reduces phosphate release from bottom sediment, while a warmer climate enhances thermal stratification and suppresses the oxygen supply to bottom waters. The resultant low dissolved oxygen concentrations likely caused the death of endemic fish (Isaza gobi) in December 2007, with implications for climate impacts and ongoing deterioration of the Lake Biwa ecosystem.

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CALIBRATING THE CURRENT METHODS FOR MEASURING STREAM NITROGEN FIXATION AND EXAMINING THE FATE OF NITROGEN FIXED IN STREAMS

Acetylene reduction is the most common method used for measuring nitrogen fixation in streams, and the nitrogen fixation rates in Wyoming, USA, streams can be very high (1-4.5 mg N m^{-2} h^{-1}) using this method. However the acetylene reduction method does not measure N_2 directly, so we measured N_2 fixation as $^{15}N_2$ uptake as well on three streams during summer 2007 in order to examine the theoretical assumed ratio of 3:1 moles ethylene produced to nitrogen fixed. Our empirically measured ratio of 7.8 ± 0.4 moles ethylene produced to ^{15}N fixed is more than two times greater than the theoretical ratio of 3:1. The acetylene reduction method directly measures nitrogenase activity while $^{15}N_2$ methods measure fixed nitrogen that is incorporated into biomass. Nitrogen fixation is more than two orders of magnitude greater than N accumulation in the biofilm in Ditch Creek, WY throughout the summer season showing that much of this fixed N must be lost as dissolved N or biofilm sloughing.

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IRON UPTAKE IN DIATOMS: EMERGING CONSENSUS AND LINGERING QUESTIONS

Among eukaryotic marine phytoplankton, diatoms have received the most attention towards understanding mechanisms of Fe acquisition. This, coupled with genome-enabled methods, has led to significant advances in our understanding, but important uncertainties still linger. For example, a consistent picture regarding the roles and regulatory mechanisms of Cu-containing ferroxidases – with respect to Fe nutrition – in model diatoms such as T. pseudonana has yet to emerge. Moreover, diatoms such as P. tricornutum lack any apparent Cu-containing ferroxidase gene altogether. This begs the questions of how Fe(II) – which can be formed from cell surface Fe reductases - is transported and whether some degree of niche differentiation exists, on either the basis of Cu availability or meaningful differences in Fe(II) transporters, among diatoms. With regard to cell surface reduction of Fe(III) in Fe-siderophore complexes (with standard redox potentials far below that of biological reductants), it would seem that tertiary complexes with cell surface ligands would be necessary to facilitate the reduction. The presence of cell surface Fe(II) stabilizing ligands are consistent with the Fe(II)s model (Shaked, Kustka and Morel 2005), but specific siderophore-destabilizing ligands have not yet been explored. Published data will be reviewed and new experimental findings that address some of these uncertainties will be presented.

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EFFECT OF THE HIGH TEMPERATURE AND CO2 ON GROWTH AND FATTY ACID OF PHYTOPLANKTON SPECIES

The pH of the present ocean is 8.2 which is lower than 0.12 compared to that before the Industrial Revolution. The pH of the world ocean is expected to decrease further down to 7.9 by 2100, while sea water temperature is reported to increase 0.04℃ every year. In this study, growth rate and pCO2 uptake of phytoplankton species were measured at different conditions of CO2 concentration. Two different CO2 concentrations were defined as normal condition(pCO2: 380ppm) and high condition(pCO2: 1000ppm). The growth rate and fatty acid of phytoplankton species were also measured at four different temperatures (15, 20, 25 and 30℃). Nitzschia sp. and Melosira nummuloides showed higher chlorophyll-a concentration and population under the high condition than under the normal condition. However, Prorocentrum minimum showed higher chlorophyll-a concentration under the normal condition than under the high condition. In addition, there was no a clear difference of growth rate between high and normal conditions in cases of Cylindrotheca closterium and Phaeodictylum triconutum. Prorocentrum micans showed the highest chlorophyll-a concentration at 25℃, following by 20℃ and 15℃. The lowest chlorophyll-a concentration of P. micans was found at 30℃. The highest chlorophyll-a concentration of Chattonella antiqua lasted 34 days at 25℃. However, after 36 days, the highest chlorophyll-a concentration of C. antiqua was found at 20℃.

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CHANGING PATTERNS OF MICROBIAL BIOGEOCHEMISTRY AS SIGNAL OF MEDITERRANEAN CLIMATE VULNERABILITY.

In the '90s a transitional climatic event (EMT, Eastern Mediterranean Transient) has changed not only the physical characteristics of the Mediterranean Sea but the microbiological, too. According with the coupling of physical forcing and biological processes, in the Levantine and Ionian Seas the deep remineralization has rose due to the intrusion of the outflowing Aegean waters that carried new organic matter and dissolved oxygen at depth. A reduction of remineralization has appeared in the Southern Adriatic Sea, as a compensation to the deep water renewal. Recent experimental observations have shown new scenarios since the respiratory rates monitored in the Mediterranean sea during 2004 (MedGoos 9), 2007 (Transmed) and 2008 (Sesame) have showed further changing trends. The occurrence of changing patterns in microbial biogeochemistry has emphasized the Mediterranean vulnerability to climate changes, confirming that the export of biogenic carbon is partially driven by the biological pump and enhanced by lateral advection as well as suggesting that climatic phases of cooling and heating could conversely stimulate microbial community to make the Mediterranean Sea a source or sink of CO2, respectively.

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POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATION IN POSIDONIA OCEANICA

Polycyclic Aromatic Hydrocarbons (PAHs) are listed as priority substances in annex X of the European Union Water Framework Directive (WFD), and 16 PAHs are listed as priority pollutant by the US Environmental Protection Agency (EPA). Terrestrial plants are used in standard process to evaluate environmental contamination. In the Mediterranean Sea, main organisms investigated for PAHs are some fish species and some bivalve molluscs. The present communication focused the PAH concentration in Posidonia oceanica (an endemic seagrass). This reveals a higher concentration in Posidonia oceanica from the impacted sites (Toulon-France) than in those from the pristine site (Calvi-France). More precisely, Toulon samples seem to present higher concentration in high molecular weight PAH than Calvi samples. This study underlines the potential use of this seagrass to give information in aquatic PAH contamination.

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IS THE CYCLING OF NITROGEN AND SULFUR IN MARINE PELAGIC REDOXCLINES RELATED TO ONLY A FEW ARCHAEAL AND BACTERIAL KEY SPECIES?

Marine pelagic redoxclines are areas of pronounced biogeochemical cycling and inhabited by distinct functional groups of prokaryotes. Interestingly, for Baltic Sea redoxclines it has been demonstrated that only one *Sulfurimonas*-related key species, representing up to 22 % of the total cell counts, could explain the occurring denitrification coupled to oxidation of reduced sulphur compounds. We were interested if an analogous phenomenon could be observed for the suboxic, aerobic ammonium oxidation zone, potentially based on crenarchaeal activity. Thus, we investigated the diversity, distribution and abundance of *Archaea* using 16S rRNA cloning, 16S rRNA fingerprinting and CARD-FISH. Based on fingerprints, 9 crenarchaeal and 2 euryarchaeal sequences were detected. However, clone libraries were dominated by only one distinct crenarchaeal group with 97 % sequence similarity to *Candidatus* Nitrosopumilus maritimus. Application of specific CARD-FISH probes revealed that this group dominated crenarchaeota by practically 100 % and reached up to 30% of total prokaryotic cell numbers slightly above the chemocline. This presents further evidence that the main biogeochemical transformations in marine pelagic redoxclines are driven by only a few key species.

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THE FUTURE COASTAL OCEAN: THE IMPACT OF OCEAN ACIDIFICATION AND WIND CHANGES ON COASTAL PRODUCTIVITY AND CARBON CYCLING

Eastern Boundary Upwelling Systems (EBUS) are major highly variable oceanographic ecosystems that are well known for their high productivity and for playing an important role in the marine carbon cycle. EBUS are particularly sensitive to changes in upwelling-favorable winds and ocean acidification induced by the anthropogenic greenhouse forcing perturbation. The potential biological responses to wind perturbations and to the chemical changes associated with ocean acidification vary substantially from one EBUS to another depending on the local environmental, physical and chemical conditions. Here, we investigate the vulnerability of EBUS to such changes by conducting eddy-resolving simulations with the Regional Oceanic Modeling System (ROMS) coupled to a state-of-the art ecosystem model for two of the four major EBUS, namely the California and the Canary Current Systems. We examine how potential changes in wind stress might affect the productivity in both upwelling systems and explore past, present and future changes in pH, CaCO3 saturation horizons, and other biogeochemical and ecological processes in response to elevated atmospheric CO2. A particular focus of our analyses is on the rate of change and on the timing when critical thresholds will be passed in the different EBUS.

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ENHANCING LIPID PRODUCTION BY PHYTOPLANKTON CELLS: NITRATE DEPLETION AND LIGHT/DARK CYCLE

In the context of global warming and exhaustion of fossil fuel stocks, the need for new sources of biofuel becomes crucial. To determine the growth conditions which favor lipid production by marine autotrophic microalgae under natural irradiance, we studied the high frequency response of lipid composition of Isochrysis galbana grown with different light regimes (light/dark cycle or constant light), and different rates of nitrogen limitation. We show that structural lipids (glycolipids and phospholipids) and triacylglycerols (TAG) display very different responses to growth conditions, in relation with their cellular function. At constant light, TAGs accumulate at a decreasing rate along nitrate depletion, and are re-consumed for metabolic needs after nitrate replenishment. Under light/dark regime, the diel variations of cell properties - chlorophyll, carbon, nitrogen, total sugar, lipids and protein, as well as nitrate uptake rate - which are observed under nitrate-replete conditions disappear as soon as the cultures are nitrate-limited. The effects of nitrate depletion on lipid production are very different according the imposed light regime. This study gives some new indications to improve biofuel production by microalgae.

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RELATIVE IMPACT OF NATURAL VARIABILITY AND ANTHROPOGENIC PRESSURE ON PRIMARY PRODUCTION IN THE SOUTHERN NORTH SEA. A MODELLING STUDY.

Primary production in the Southern North Sea (SNS) shows spatial heterogeneity due to the varying contribution of rivers (nutrient-enriched) and of Atlantic waters. The interannual variability of river loads is driven by anthropogenic pressure and meteorological conditions (precipitation). The influx of Atlantic waters is governed by climate variability which can be related to the North Atlantic Oscillation (NAO). In this study a 3D biogeochemical model is used to study the relative impact of natural (meteorological/climatic) variability and anthropogenic pressure on the primary production in the SNS. The MIRO&CO model has been implemented for the region between 48.5°N-4°W and 52.5°N-5°E by using actual river loads, SST and meteorological forcing (1993-2006). The sensitivity to natural variability is assessed considering different meteorological years but fixed river loads (for two situations, wet/dry). The sensitivity to anthropogenic pressure is estimated by constraining MIRO&CO with constant meteorological conditions (for two contrasted NAO) and 1993-2006 river inputs. Primary production results are analysed in terms of the respective contribution of diatoms and *Phaeocystis*, the latter being considered as undesirable for the area.

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BACTERIAL COMMUNITY STRUCTURE AND ACTIVITY OF KEY BACTERIAL GROUPS UNDER CONTRASTING ENVIRONMENTAL CONDITIONS IN THE NW MEDITERRANEAN SEA

With the aim to better understand the importance of different bacterial groups to the cycling of carbon we investigated the bacterial diversity, and the activity of key bacterial groups under contrasting, but representative environmental conditions at an offshore site in the northwestern Mediterranean Sea. Based on 16S rDNA clone libraries, the bacterial communities hosted by winter and spring phytoplankton blooms were distinctly different from those present in low salinity surface waters that recurrently occur due to freshwater input. Bacteroidetes were the dominant bacterial group (50% of the total number of clones) during the spring phytoplankton bloom (0.6 µg chlorophyll a l^{-1}) composed of *Synechococcus* sp. and picoeukaryotes each accounting for roughly 50% of total phytoplankton biomass. The bacterial community composition in low salinity waters was overall more diverse than during the phytoplankton bloom and revealed a dominance of the SAR11 cluster (32% number of clones). Applying MICRO-CARD-FISH, we determined the contribution of key bacterial groups to the incorporation of different organic substrates and thus their importance in the degradation of organic matter of probably different origin and composition.

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WATER RESOURCES VARIABILITY IN THE CONTEXT OF CLIMATIC FLUCTUATIONS : CASE STUDY ON EACH SIDE OF THE ATLANTIC OCEAN

The determination of the impact of climate change on hydrological systems and their water resource constitutes a major stake of the 21st century. It is necessary to understand how climate are expressed in the hydrosystems. Those studies of our team involve analyses of hydrological systems located: (1) in various climatic and geomorphological contexts (NW France, N Africa, USA), (2) at various spatial scales (small watersheds - large rivers). Long-term changes, oscillations and fluctuations of hydrologic variables (precipitation, discharge...) were investigated by using wavelet analysis. We note an intensification (from 1990 up to now) of the annual energy band which corresponds to the hydrological cycle. In the NW of France and North Africa, we observe 2-3 and 5-7-years modes which could be linearly related to fluctuations in the NAO. In the USA, we notice similar modes that could be related to the characteristic 2-4 and 4-8-years of SOI. In any case, two major temporal discontinuities were systematically recovered around the 1970's and the 1990's. These results would describe a global pattern in hydrological processes as a response to climate fluctuations.

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ACTIVE EXPRESSION OF NITROGEN CYCLING FUNCTIONAL GENES IN THE ARABIAN SEA OXYGEN MINIMUM ZONE

The Arabian Sea Oxygen Minimum Zone (OMZ) is considered to be one of the three major regions in the world´s ocean where altogether 20-40% of nitrogen loss occurs in the water column. However, the exact pathways and microbial players involved in the dinitrogen gas production, as well as the cycling of other inorganic nitrogen species, are not entirely clear. Using functional gene expression analyses, here we identified and quantified active nitrogen transformations that were co-occurring in the Arabian Sea OMZ. We detected much higher expression of the anammox-type nitrite reductase gene (*nirS*) than that of the denitrifier-type *nirS*, particularly along the Omani coast; whereas both were hardly expressed in the centre of the Arabian Sea OMZ. Nitrification occurred within the OMZ and contributed to nitrite production. Nitrification was predominantly mediated by *Crenarchaeota* over bacteria, as shown by the expression of their ammonia monooxygenase genes. Meanwhile, *narG* and *nrfA*, functional gene biomarkers for nitrate reduction and dissimilatory nitrate reduction to ammonium (DNRA), were also actively expressed. These functional gene expression results were consistent with parallel rate measurements via ^{15}N-incubation experiments.

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IMPACT OF LIGHT ON CELL GROWTH AND PROTEORHODOPSIN EXPRESSION IN SAR11 BACTERIA

Proteorhodopsin (PR)-containing bacteria are hypothesized to use both light and organic compounds as energy sources. Recent studies have examined their abundance in marine waters, but the impact of light on their growth and on the expression of PR genes remains unclear. We examined the effect of light on PR-containing SAR11 bacteria using 30 L microcosms of Delaware coastal water exposed to continuous light, continuous darkness, and 12h-12h dark-light cycles for a week. Diversity of PR-containing organisms was monitored by PCR amplification and sequencing of PR genes, and the abundance of PR genes and transcripts was assessed using QPCR. Our results reveal the growth of PR-containing SAR11 populations under light and dark-light cycles. Expression of PR was up-regulated by continuous light and down-regulated during dark-light cycles and continuous darkness. Collectively, these results suggest the importance of light for both the growth of PR-containing bacteria and expression of PR genes.

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DIRECT MEASUREMENT OF EPISODIC PARTICLE EXPORT DURING A SPRING PHYTOPLANKTON BLOOM IN THE NORTH ATLANTIC.

During the initial phase of a spring phytoplankton bloom in May 2008 in the North Atlantic downward particle flux was repeatedly measured between 150 m and 700 m using several neutrally buoyant sediment traps (PELAGRA). This provided material for a wide variety of chemical and biological measurements using amongst others, imaging-in-flow technology. A massive flux event occurred lasting only a few days with POC export of between 1 and 8% of the annual flux in any one day. This event was apparent from the time series of vertical profiles of fluorescence and backscatter and was dominated by sedimentation of resting diatom cysts of the genus Chaetoceros. Four days before and after the event, the cysts did not dominate the sediment trap material. Variable fluorescence measurements of the material were high before and after incubation at 4deg C indicating the presence of live and potentially active cells. To examine this further, material from several depths was incubated under in situ near surface conditions. Within 38hrs, excystment of the heavily silicified valves had occurred, followed by rapid cell division.

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DYNAMICS OF AEROBIC PHOTOTROPHS IN A MEDITERRANEAN LAGOON SYSTEM

The presence of aerobic anoxygenic phototrophs (AAPs) was recently reported from various marine and freshwater environments but no observation exists up to date for lagoon systems. The dynamics of AAPs in the lagoon La Palme, one of the oligotrophic Mediterranean lagoons preserved from large anthropic inputs, was investigated from November 2007 until October 2008. The abundance of AAPs, the fluorescence signal and the concentration of bacteriochlorophyll *a* (Bchl *a*) were determined on a monthly basis and related to bulk bacterial abundance and heterotrophic production. AAPs revealed a pronounced seasonal dynamics significantly correlated to the temperature evolution. Isolation of bacterial strains from the samples collected in March showed that 9 % of the total bacterial abundance were cultivable and that 24 % of the isolated strains revealed a positive BChl *a* fluorescence signal. Multiple regression analysis showed that the temperature and the concentration of phytoplankton-derived material (pheopigments) could explain a high proportion of the spatio-temporal variability in the BChl *a* fluorescence. This suggests that these parameters may be key factors in controlling AAPs distribution.

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ECOLOGICALLY-BASED INDICATORS FOR PHAEOCYSTIS DISTURBANCE IN EUTROPHIED BELGIAN COASTAL WATERS (NORTH SEA) BASED ON FIELD OBSERVATIONS AND ECOLOGICAL MODELING

Phaeocystis records and historical ecosystem model simulations are used to define and diagnose undesirable eutrophication in the Belgian coastal zone (BCZ). The methodology includes the definition of a reference *Phaeocystis* cells from which the disturbance could be scaled. This number is derived from the *Phaeocystis* attribute that creates ecosystem disturbance: the ability of forming colonies which can reach sizes unmanageable for copepods. The obtained threshold ($4x10^6$cells L^{-1}) corresponds to the maximum *Phaeocystis* cells contained in the grazable colonies (<400µm) recorded in the BCZ between 1988 and 2000. Interestingly this number is similar to the maximum *Phaeocystis* cells simulated for pristine time by the coupled RIVERSTRAHLER-MIRO (R-MIRO) model suggesting that natural *Phaeocystis* ecosystems are well balanced and efficiently transfer their production to higher trophic levels. However, both the field records and the 1950-2000 historical reconstruction of eutrophication in the BCZ simulated by R-MIRO are showing contemporary *Phaeocystis* maxima well above the threshold value. Considering that the return to pristine is not achievable, we discuss the use of ecological modeling as tool for exploring trophic status indicators and nutrient thresholds.

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LAGRANGIAN STUDIES OF PHYTOPLANKTON DYNAMICS IN THE CALIFORNIA CURRENT ECOSYSTEM

The experimental strategy of CCE-LTER Process studies in the California Current is to investigate the details of process interactions and community dynamics over the range of contemporaneous system spatial and seasonal variability to gain insight into mechanisms and potential trajectories of community response due to climate change. In Lagrangian-designed experiments, we follow the dynamics of phytoplankton communities in marked water parcels for 3-5 days while complementary in situ and shipboard experiments elucidate the contributions of growth, grazing and export processes to net observed rates of change. Independently measured growth and loss processes account for 86% of variability in net ambient community trajectories, providing an important point of validation for using these field-generated data to parameterize models. These results illustrate both bottom-up (growth regulating) and top-down (mortality regulating) mechanisms exert substantial impacts on the magnitudes and directions of net community rates of change and on the resulting taxon-specific composition of the phytoplankton assemblage.

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EXAMINING CELL-SPECIFIC GROWTH AND DIVISION IN PHYTOPLANKTON USING TIME-LAPSE PHOTOMICROGRAPHY

Microbial growth rates within a population are often assumed to be uniform or to exhibit simple Gaussian distributions. Many ecological models rely on such assumptions to predict changes in microbial populations or assemblages over time. Yet it is becoming increasingly apparent that cell-specific properties such as division period are neither uniform nor well represented by simple statistical distributions, even with clonal organisms cultured under tightly regulated conditions. Within-population variability may have important ramifications for modeling population growth in phytoplankton and may be fundamental to understanding the trajectories that natural assemblages take over time. We developed an automated photomicrography system that collects time-lapse imagery of individual phytoplankton cells as they grow and divide over several generation periods. Analysis of this imagery makes it possible to quantify differences among individual phytoplankton cells in terms of several fundamental properties of growth and division, to better quantify the distributions of these cell-specific properties within a given population. This approach can be used to monitor the evolution of such properties within and between lineages of cells, as well as over multigenerational time scales.

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BACTERIAL MODEL SYSTEMS AS TOOLS TO TEST RELATIONSHIPS BETWEEN BIODIVERSITY AND ECOSYSTEM SERVICES

Global decline in biodiversity triggered by environmental change has focused attention on the relationship between biodiversity and ecosystem functioning. Quantification of this relationship relies upon experimental manipulation of species richness, but logistical constraints limit investigations to only a small minority of possible species combinations. Here we present examples from a range of experiments where we used communities constructed from bacterial isolates. We constructed communities using six bacterial species and measured substrate utilisation over time in cultures that contained one, two or three substrates (glucose, xylose and galactose) in all possible combinations. In addition we used this dataset for model simulations that tested how sample size and sampling strategies influence the variability of the functional response. We also tested how temperature fluctuations influence the relationship between bacterial diversity and resource utilisation, and found that species richness effects on resource utilisation were strongest under highly fluctuating conditions. Moreover, resource utilisation was highest under highly fluctuating conditions, which was probably caused by dominance of one particularly resistant species.

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ORGANIC MATTER DEGRADATION IN CHILEAN SEDIMENTS – FOLLOWING NATURE'S OWN DEGRADATION EXPERIMENT

Degradation of sedimentary organic matter was studied at two stations from the shelf of the Chilean upwelling region. Sediment cores were taken at 1200 m and 800 m water depth and were 4.5 m and 7.5 m in length, respectively. The objective of this study was to assess the degradability of the organic matter from the sediment surface to the deep sediments. This was done by analysing amino acids (both L- and D-isomers) and amino sugars in the sediment cores, covering a timescale of 15.000 years. Diagenetic indicators (percentage of carbon and nitrogen present as amino acid carbon and nitrogen, the ratio between a protein precursor and its non-protein degradation product and the percentage of D-amino acids) revealed ongoing degradation in these sediments, indicating that microorganisms were still active in 15.000 year old sediments. Since the microbial activity in the deep sediments is very low, it is still not possible to measure it directly. Following nature's own experiment back in time will provide us with new insights about the microbial activity in the deeply buried sediments.

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RECOVERY OR DECLINE OF THE NORTHWESTERN BLACK SEA?

During recent decades anthropogenic activities have dramatically impacted the Black Sea ecosystem. High levels of riverine nutrient input during 1970-80s caused eutrophic conditions leading to collapse of benthic habitats on the northwestern shelf. Intense fishing pressure depleted stocks and the introduction of exotic species caused further ecosystem changes. Economic collapse of surrounding socialist republics in the 1990s resulted in decreased nutrient loading and ecosystem recovery has begun; but under rapidly changing economic and political conditions future recovery is uncertain. Here we use a multidisciplinary approach to integrate information from socioeconomic and ecological systems to identify the main threats to ecosystem integrity. The Driver-Pressure-State-Impact-Response framework was used to construct a conceptual model explicitly mapping ecosystem impacts of socio-economic drivers. Findings indicate that variations in policy have significant consequences for ecosystem health, and recovery is directly linked to socioeconomic choices through levels of natural resource exploitation. This work is discussed in the context of the European Commission's recently published Marine Strategy Directive with emphasis on the role of international cooperation and multilateral environmental agreements in achieving a sustainable future for the region.

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PHYTOPLANKTON PRODUCTION AND EXPORT IN A SUBARCTIC INLAND SEA, HUDSON BAY, CANADA.

Primary production and organic material sinking export were investigated in the Hudson Bay system during early fall. Primary production and biomass were measured at 7 euphotic depths and organic material sinking export and composition were assessed using free-drifting interceptor traps deployed at 50 m. Spatial patterns of production and export emerged. Hudson Strait and eastern Hudson Bay, where diatoms dominated the phytoplankton biomass, were more productive than western Hudson Bay, where ciliates and choanoflagellates dominated. In Hudson Strait, diatoms were exported as amorphous detritus and intact cells, whereas in eastern Hudson Bay, diatoms sank as part of herbivorous zooplankton fecal pellets. Contrary to expectations, both regions showed low export ratios (i.e., sinking export to primary production ratio). In western Hudson Bay, the sinking export was mainly in the form of amorphous detritus and bacterial carbon; export ratios were high in this region. This study highlights strong spatial variations in organic material production and export during early fall in the Hudson Bay system, a subarctic inland sea strongly affected by climate change.

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EFFECT OF TEMPERATURE AND SALINITY ON DMSP PRODUCTION IN *GEPHYROCAPSA OCEANICA*.

Laboratory studies of the effect of various environmental forcing factors on the production of DMSP have frequently been confined to the single species, *Emiliania huxleyi*. Whilst this is informative of the sign of a potential forcing on net DMSP production, the situation in the oceanic environment is more complex, where multiple species compete, and species succession occurs. Whilst *E. huxleyi* prefers sea temperatures of 18-20 C, under warmer (22-23C) conditions *Gephyrocapsa oceanica* may become numerically dominant. Warming of the oceans in this temperature range may therefore lead to an increase in the ratio of *G. oceanica* to *E. huxleyi*. A single clone of *G. oceanica* (CS-335) was cultured and found to grow over a wide range of temperatures (8-30C) and salinities (20-45 ppt) and the cellular DMSP content, growth rate and so net DMSP production over these temperature and salinity ranges will be reported.

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NITROGEN AND PHOSPHORUS RETENTION IN THE PROXIMAL COASTAL ZONE AND ITS IMPACT ON OCEANIC NUTRIENT CYCLING

Human activity is leading to major changes in terrestrial nutrient inputs to the ocean. Here, we present a model of the coupled nitrogen (N) and phosphorus (P) cycles for the proximal coastal zone at the global scale. The model consists of a succession of generic box models along the world coastline at a half degree resolution. Different parameterizations for the box models are established using a global coastal typology based on hydrological, lithological, morphological and biogeochemical criteria. Simulations are performed with spatially explicit inputs and forcings to quantify the role of coastal waters as a filter for terrestrial nutrient inputs. Model results indicate in which type of ecosystem (estuaries, fjords, lagoons, deltas) most of the nutrient retention occurs and provide insight in its spatial distribution. Using a global biogeochemical ocean general circulation model we then assess the effects of nearshore N and P retention on primary production and nutrient cycling in the coastal and open ocean.

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ISOTOPIC TRACING OF DISSOLVED AND PARTICULATE INPUTS IN A N.-W. MEDITERRANEAN BAY

Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) natural isotopic ratios were assessed in different biological compartments to trace effects of rivers run-offs and anthropogenic inputs (fish farm and urban sewage outfalls) in the NW Mediterranean bay of Golfe-Juan. Transplanted mussels and natural seagrass communities (*Posidonia oceanica* leaves and epiphytes) were sampled at different locations through the bay, both during the tourism

summer period and during a rainy event. For seagrass and epiphytes, a pronounced seasonality in C:N ratios was highlighted near the outflows, whereas this temporal variation was smoothed at control sites (i.e. open sea). The lowest $\delta^{15}N$ values were always found at the control site. In mussel tissues, $\delta^{13}C$ values exhibited also a strong seasonality between summer and autumn. For γ15N, a clear pattern could be evidenced only in autumn, with lower values at control sites. These results suggest temporary and localised influences of both natural and anthropogenic nutrients inputs in the bay. Natural isotopic ratios measured in marine organisms seem thus to be quite sensitive to short term hydrologic conditions, and vary according to rain regime or tourism pressure.

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NEUROTOXIC POLYPEPTIDES FROM THE NORTHERN SCYPHOZOA CYANEA CAPILLATA AFFECTING VOLTAGE-GATED SODIUM CHANNELS

Cnidaria exhibit a wide array of toxic polypeptides including neurotoxins that is able to paralyse prey immediately. In general, neurotoxins are fast-acting compounds which influence the neuromuscular transmission of the prey. At the pre-synaptic region they modify the frequency and duration of action potentials of voltage-gated ion channels and the secretion of neurotransmitters. A mouse neuroblastoma cell assay was established for the detection of sodium channel active neurotoxins. The suitability of the assay for the investigation of the fishing tentacle venom of Cyanea capillata is shown. A venom fraction with channel blocking activity was obtained by size exclusion chromatography and subsequently analysed by matrix-assisted laser desorption ionization time-of-flight mass spectrometry. As a preliminary result, the received mass spectra reveal a set of 16 principal components. These putative polypeptides show a molecular mass range from 2.2 to 5.7 kDa. The presented fractionation of the crude venom is part of a multidimensional assay-guided approach for the isolation and structural characterisation of neurotoxins.

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SUNKEN WOOD COLONIZATION IN THE MANGROVE SWAMP IN RELATION WITH CHEMICAL VARIATIONS OF THE MICROENVIRONMENT

Sulfide-oxidizing symbioses have been recently described from sunken woods of shallow and deep waters. Sulfide enrichment levels at the wood surface and its relationship with colonization processes are however poorly known. We realized experimental immersions of Rhizophora mangle and Cocos nucifera pieces in a mangrove swamp. Sulfide concentration and pH were monitored using in situ microsensors while regular sampling allowed studying the kinetics of wood colonization. Sulfide contents reached almost millimolar levels within 4 to 7 days. This sulfide enrichment is sustained over several weeks, with significant difference between the surface and inner part of the wood piece. First organisms associated with woods are observed after one week of immersion involving numerous protozoans and small invertebrates from meiofauna which reach their maximum abundance when sulfide contents are stabilized, and disappear when sulfide starts to decrease in concentration. The relationship between the presence of these organisms and the dynamics of sulfide production was thus better constrained. This relationship is further supported by the detection of bacterial ectosymbionts covering some of these organisms (hybridization experiments, microscopy observations).

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PHOTOPROTECTION CAPACITIES DIFFER AMONG DIATOMS: POSSIBLE CONSEQUENCE ON THEIR SPATIAL DISTRIBUTION RELATED TO FLUCTUATIONS IN THE UNDERWATER LIGHT CLIMATE.

In order to cope with fluctuating light intensities, diatoms have developed various mechanisms for the regulation of photosynthesis and for the photoprotection of their photosynthetic apparatus. Among these mechanisms, the dissipation of excess energy (or NPQ for 'non-photochemical chlorophyll fluorescence quenching') is considered as one of the most important mechanisms during fast fluctuations in irradiance. We recently showed (L&O 52:1188-1194) a fundamental difference between diatom species from different marine habitats in their ability to cope with changes in irradiance, including NPQ capacity. Estuarine species show a higher and more flexible capacity for photo-acclimation/-protection than oceanic and coastal species. This resulted in maintenance of growth in a fluctuating light regime, conferring the estuarine species an adaptive advantage. The ability of diatoms, and to a larger extent other phytoplankton (like prochlorophytes), to occupy a wide range of ecological niches depends critically on their capacity to exploit the differences in underwater light climate. These results may explain how diatoms adapt to the challenge of maintaining optimal photosynthetic production in turbulent waters where the rate of light changes is high.

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MARINE DEBRIS IN THE PACIFIC OCEAN: QUANTIFYING THE "EASTERN GARBAGE PATCH"

Marine debris, 60-80% of which is buoyant plastic, is increasingly abundant in the global ocean. Because of its long residence time, this debris accumulates in regions of oceanic convergence, such as subtropical gyres. We present a 7-year time series of plastic distribution in the eastern North and South Pacific (17°S–57.5°N, 85°W–177°W) collected in more than 1400 neuston net tows. The region of highest concentration is associated with the North Pacific subtropical gyre, commonly known as the "Eastern Garbage Patch". These large-scale surveys allow the first standardized quantification of the spatial and temporal distribution of plastic microdebris (mm's in size) in this region. In a June-July 2008 cruise from Honolulu to San Francisco, the distribution of marine debris was measured concurrently with seabird distributions to identify potential plastic concentrations in habitats where far-ranging surface-feeding seabirds (order Procellariiformes) forage. While the single transect did not detect small-scale (10's km) relationships between seabird and plastic concentrations, it revealed associations with water masses. Studying the biogeographic associations of seabirds and debris is key to interpreting plastic ingestion rates by these far-ranging predators.

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PHYSICAL – BIOLOGICAL INTERACTIONS IN THE MEDITERRANEAN SEA: AN ANALYSIS OF SEAWIFS SATELLITE DATA AND ARGO FLOATS PROFILES

The seasonal dynamic in the mixed layer depth (MLD) governs both nutrient flux in the upper layer as well as the exposition time of phytoplankton to solar radiation. A combined analysis of the dynamics in MLD and in phytoplankton biomass could give insights into the impact of the physical forcing on marine ecosystems. If surface phytoplankton biomass dynamic is well resolved from spacebased sensors (e.g. SeaWiFS), this is not the case for MLD which, until recently, remained largely undersampled in the Mediterranean Sea. Thanks to the MedArgo program, this limitation is now partly solved, with a network of profiling floats, which extensively measure physical parameters (T/S). A combined analysis of in situ MLD data derived from ARGO floats and simultaneous and co-located satellite chlorophyll-a concentration was thus undertaken in the Mediterranean Sea to explore physical/biological interactions. Our analysis shows that different types of coupling between physical forcing and phytoplankton response does exist in the Mediterranean and that diverse mechanisms are present in the basin. Furthermore, this work demonstrated the potential use of the Argo data to interpret satellite biological observations.

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MAGNETIC STUDY OF IRON BIOMINERALISATION IN MARINE PHYTOPLANKTON

The analytical technique of measuring the temperature dependence of the AC magnetic susceptibility of biological matter was successfully used to monitor iron (Fe) metabolism processes in mammals (Gutiérrez et al. 2006). In this preliminary study, we applied this technique to detect the presence of iron-containing minerals in eight species of marine phytoplankton. We first determined the elemental composition of the samples using ICP-MS, and established that Fe was the most abundant magnetogenic metal. We then measured the temperature dependence of the in-phase component of the susceptibility of the phytoplankton samples and detected an overall paramagnetic behaviour typical of iron-containing proteins without mineralisation in the form of iron (oxyhydro)oxides. However, in addition to this paramagnetic component, the temperature dependence of the magnetic susceptibility of *Heterosigma carterae* presents a reproducible maximum at about 40 K, and that of *Dunaliella tertiolecta* an anomaly at about 10 K. These anomalies cannot be explained by the presence of only isolated (paramagnetic) Fe atoms and suggest that some Fe mineralisation, as it occurs in mammalian ferritin, is taking place in these species.

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A MODEL-BASED CLIMATOLOGY OF THE BIOGEOCHEMISTRY OF THE MEDITERRANEAN SEA SUB-BASINS

A series of decadal simulations of the Mediterranean Sea ecosystem has carried out in order to assess and estimate the biogeochemical fluxes occurring in the Mediterranean Sea. The system used to perform the simulations is a three-dimensional coupled eco-hydrodynamical model (BFM and OPA-tracer model) for the whole Mediterranean Sea. The biogeochemical module is a multi-nutrient carbon-based biogeochemical flux model (BFM). Key aspects of the model are the potential for limitation by macronutrients (nitrogen, phosphate and silicate), adjustable (i.e. non-redfilian) C:N:P:Si ratio into zooplankton and phytoplankton compartments, chlorophyll to carbon variable dependency. The forcing fields for the tracer model consisting of temperature, salinity, zonal and meridional current, vertical eddy diffusivity are obtained sub sampling high resolution OGCM models. Simulations cover periods spanning from 1998 to 2004, and are validated against satellite chlorophyll datatsets. Estimates concerning the temporal course of the concentration of key variables, such as macronutrients, chlorophyll, phytoplankton biomass and productivity for different sub-basins and depths as well as fluxes of those variables among sub-basins, are provided by our results. These results constitute a model derived climatology for the Mediterranean basin.

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CASCADING TROPHIC INTERACTIONS IN MACROPHYTE BEDS: THE ROLE OF DIRECT AND TRAIT MEDIATED EFFECTS.

Although cascading trophic interactions are well-documented within pelagic or lotic food-webs, there is little evidence for their existence in the littoral of lakes. Macrophytes are thought to be not strongly influenced by herbivory which suggests that there is no trophic cascade controlling macrophyte growth within large macrophyte beds. Here we examine the potential for direct and trait mediated effects of a trophic cascade between macrophytes (Potamogeton perfoliatus), a generalist herbivorous moth (Acentria ephemerella) and fish (Gasterosteus aculeatus). We manipulated fish presence (with and without) in a mesocosm experiment and examined the direct effects on herbivore density and macrophyte biomass. We also investigated the effects of herbivore density on their growth response and physiological changes in plants. Fish strongly reduced Acentria abundances. Moreover, plant biomasses were significantly higher with fish than without fish. Moreover, our data suggest that predation and herbivory induced changes in life history of moth larvae and phenology of plants, respectively. Consequently, our results demonstrated strong direct and trait mediated interactions between fish, herbivores and macrophytes, contributing to cascading trophic interactions within littoral food webs.

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CHEMOSYNTHETIC COMMUNITIES AND BIOGEOCHEMICAL ENERGY PATHWAYS ALONG THE MAR: THE CASE OF BATHYMODIOLUS MUSSELS

Hydrothermal vents fields from the Mid-Atlantic Ridge (MAR) are hosted on diverse geological contexts. Resulting contrasted end-member chemistries are reflected by variable compositions of high temperature black smoker fluids. Despite this variability, two Bathymodiolus mussel species dominate the chemosynthetic fauna on almost all vent fields. Both species harbour similar sulfide- and methane-oxidizing endosymbionts in their gills, which are expected to allow them to adapt to the different environmental conditions encountered along the MAR. Distribution, abundances and nutritional role of the two symbiont types tend to be correlated with end-member fluid composition, but the mechanisms controlling this variability cannot be explained without considering local influences. Here, processes governing the environment of mussel aggregates in terms of electron donor availability, energy sources, and influence of biotic and abiotic processes will be discussed. Both subsurface transformations and the influence of mussels on their own environment significantly modify the availability of electron donors. Recent observations suggest that flexible response of symbiont populations may be a key adaptation allowing mussels to colonize the diversified MAR vent habitats.

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DIAZOTROPHIC UNICELLULAR CYANOBACTERIA IN THE NORTH WESTERN MEDITERRANEAN SEA: A SEASONNAL CYCLE

Although diazotrophy could significantly contribute to the Mediterranean biogeochemical cycles, very few study have yet concerned organisms which are responsible for this activity. Unicellular diazotrophic cyanobacteria ($UCYN_2$-Fix) were detected using whole cell hybridization of specific Nitro821 oligonucleotide probe, at the coastal and oligotrophic station off Marseilles (France). This station was sampled monthly, for a year and a half. Surprisingly, $UCYN_2$-Fix community was dominated at 99.9% by picoplankters (0.7-1.5 µm), which were either mainly free-living organisms or associated with inert particles or dinoflagellates. These cells were present all the year long with a mean density of 4.6 $cell.ml^{-1}$, except in summer 2006 where concentrations reached 5.3×10^3 $cell.ml^{-1}$, thus accounting for 10.7% of the picocyanobacterial community. Hardly any nanoplanktonic $UCYN_2$-Fix and *Trichodesmium* sp. were detected. We hypothesize that a combination of abiotic parameters, such as elevated temperature, absence of nitrate, presence of phosphate and exceptionally high urban pollution event, may explain the large bloom of potentially diazotrophic picocyanobacteria. Further studies are needed to confirm the identity of these small cells and their role in nitrogen cycle and marine productivity.

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THE NUTRIENTS AND CHLOROPHYLL STATUS OF THE SOUTHERN OCEAN IN THE ATLANTIC SECTOR DURING THE INTERNATIONAL POLAR YEAR

The multidisciplinary and international MD166 BONUS-GOODHOPE cruise was conducted during the austral summer (Feb.-March 2008) in the Southern Ocean and the south-eastern Atlantic aboard of the French R.V. MARION-DUFRESNE between 33.58°S 17.14 °E and 57.33°S 00.02°W. The spatial distribution of silicic acid, nitrate, phosphate, ammonia, phaeopigments and chlorophyll-a have been studied from analyses of 78 deep-casts. The preliminary results of nutrients and chlorophyll status will be presented. Meridian gradients of nutrients were recorded in the upper water column across the several oceanic provinces as well as vertical gradients, typical of the nutrient-like distribution. Chlorophyll-a, degradation products and ammonium indicated oligotrophic conditions in the subtropical region, a post-bloom within the Polar Frontal Zone and the Polar Front, and surprisingly a pre-bloom in the Weddell Gyre. The silicon signature (Si*; Sarmiento et al, 2003) was negative in the SubAntarctic Mode Waters and Antarctic Intermediate Waters. The results will be discussed in regards with dynamics and biogeochemistry issues of this cruise.

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SPECIES-SPECIFIC SILICIFICATION RATES IN A LONGITUDINAL NUTRITIONAL GRADIENT IN THE MEDITERRANEAN SEA DURING THE BOUM CRUISE.

During the BOUM cruise (June-July 2008), the Si cycle was fully characterized on a longitudinal gradient from coastal systems in the Western basin to ultra-oligotrophic gyres in the Eastern basin. Diatom contribution to primary production in this region is still very poorly quantified and new data will be presented here regarding their distribution and the recurrent occurrence of a deep diatom maximum in the Eastern basin. The recent development of new molecular markers (fluorescent hybridization methods) have made it possible to visualize important biogeochemical processes such as biogenic silica production down to the level of individual cells. The new PDMPO-marker methodology allows quantification of the relative contribution of each cell or diatom species against total Si production rates by using image analysis in epifluorescence microscopy. Results of this new fluorescent probe labelling will also be presented here and will give fresh insights into the actively silicifying diatom community of the Mediterranean Sea.

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MASS DEPOSITION EVENT OF *PYROSOMA ATLANTICUM* CARCASSES OFF IVORY COAST (WEST AFRICA)

The deposition of vast quantities of Thaliacean carcasses (*Pyrosoma atlanticum*) was observed between February and March 2006 at the seafloor off Ivory Coast (West Africa), between 20 and 1275 meters depth. ROV video transects were used to estimate the carcasses distribution at the seabed, and recording the local megafauna interactions with the gelatinous material. Large patches of decomposing pyrosomids were observed at the continental slope and canyons covering extensive areas, while minor aggregations were found in the shelf. Fresh samples were used to analyze the carbon content, enabling the extrapolation to the densities and sizes recorded in the video surveys. The standing stock of carbon associated with the carcasses was estimated over 22 g C m^{-2} in certain areas of the slope, with an average in the whole survey around 5 g C m^{-2} (higher than annual carbon fluxes derived from sediment traps in the area). Several megafaunal taxa were observed directly scavenging the decomposing carcasses. Gelatinous organism-level measurements, and the fate of their biomass, provide here new evidence of their significance in regional carbon biogeochemical processes and elemental cycling

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MODELLING THE ADAPTIVE RESPONSE OF PRIMARY PRODUCERS TO A WARMER CLIMATE

Evidence is accumulating for that climate variability is transforming aquatic food-webs in particular on the structural level. Our capability for generating reliable scenarios for how ecosystem structure, e.g. represented by functional community properties, will respond to changes in physical forcing is yet premature. We argue that a trait-based model will be best suited to address questions like how the ongoing temperature rise will affect average cell size in coastal plankton communities, in particular before and during the spring bloom. We applied a trait-based model integrating primary production, adaptation in cell size and zooplankton grazing to mesocosm experiments. In these experiments, a temperature increase modifies the phytoplankton community structure in terms of species relative abundance leading to the success of smaller phytoplankton under warmer conditions (Summer and Lengfellner, 2008). This response can be reproduced by a combination of top-down and bottom-up effects. Our model studies shows how also food availability (bloom timing, biomass) and food quality as relevant for the upper levels of marine food-web will be changed under different temperature or light regimes. TS52,TS82,GS07.

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ENVIRONMENTAL MONITORING OF THE DEEP-SEA FORAMINIFERAL DIVERSITY BY MASSIVE SEQUENCING TECHNOLOGY

It is only recently that benthic meiofauna has been considered as potential bio-indicators for monitoring marine environmental conditions. These extremely diverse and ubiquitous small-sized organisms represent excellent candidates for monitoring pollution and disturbance at the sea bottom. However, until now their use as bio-indicators was largely impeded by time-consuming and requiring a lot of expertise morphological species identification. Today, the development of massive sequencing technologies have opened new avenues for exploring the richness of marine biodiversity making many of us dreaming about using DNA for marine species inventory at global scale. In our study, we apply Solexa (Illumina) sequencing method to assess the diversity of benthic foraminifera, which are the major component of deep-sea meiofauna. We will show here that it is possible to identify most of the foraminiferal species present in a sediment sample by the sequencing of a very short fragment of the SSU rDNA. The preliminary results show that the new sequencing technologies offer an excellent tool for assessment of foraminiferal diversity and can be use in the future as a rapid and efficient method for environmental monitoring.

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A TRIP DOWN MUDDY CREEK WITH CDOM: THE SPATIAL SIGNIFICANCE OF MARSH DERIVED CDOM TO THE RHODE RIVER

Dissolved Organic Matter (DOM) derived from freshwater and brackish tidal marshes of the Chesapeake Bay has significantly different chemical and optical properties compared to DOM in the surrounding estuarine waters. DOM derived from the marsh is typically enriched in dissolved organic carbon (DOC) and is characterized by higher molecular weight. The marsh-derived colored fraction, CDOM, has relatively high absorption and fluorescence magnitude and lower absorption spectral slope and fluorescence-to-absorption ratio. Kirkpatrick is a brackish marsh in the Rhode River sub-estuary along the western shore of the Bay. Studies along transects from the Kirkpatrick towards the mouth of the Rhode River allowed measurement of gradients in water quality and CDOM characteristics. At low-tide during the summer season, when biomass in the marshes is peaking, DOC amounts, CDOM optical properties, dissolved inorganic carbon (DIC), and partial pressure CO_2 were measured. Results revealed that the Kirkpatrick marsh has significant influence on DOM properties several hundred meters out in the Rhode River, affecting optical and chemical properties of estuarine waters.

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ARE AGGREGATES OR FECAL PELLETS MORE IMPORTANT FOR POC FLUX?

Aggregates and fecal pellets have both been suggested as major sources of sinking particulate organic carbon in the ocean water column. Are these two processes important at the same times and depths? Using data from MedFlux experiments and sediment trap collections in the NW Mediterrranean, we will discuss how the relative contribution of aggregates and fecal pellets to POC flux appears to change with season and with depth. In spring when flux is highest, pigment, amino acid, and lipid data from sediment traps and decomposition experiments with aggregates and fecal pellets suggest that aggregates are only important to export POC from the euphotic zone, but that fecal pellets transport material deeper in the water column. In summer when flux is low, pigment data suggests that particulate flux is dominated by material produced by microzooplankton or heavily degraded by microbes. Both seasons are dominated by carbonate over opal minerals, so that increasing ocean acidification may disrupt these patterns.

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THE ECOLOGICAL CHARACTERISTICS OF *ZOSTERA MARINA* ON THE SOUTHERN COAST OF KOREA.

The phenology, morphology, production and reproductive efforts of *Zostera marina* were studied from September 2002 to September 2005 at intertidal Dongdae Bay (IDB), subtidal Dongdae Bay (SDB) and Aenggang Bay (AB), in the south coast of Korea. The biomass, shoot density, growth, production and reproductive efforts of the study sites were highest in summer and lowest in winter, and these values were positively correlated with water temperature. The biomass, shoot density, growth and production were highest at IDB due to the higher organic content and finer grain size at this station. Three populations of *Z. marina* exhibited a perennial habit, and sexual reproductive efforts and seed production were significantly greater at SDB than other sites ($p < 0.01$). Result of this study will be an important contribution for the study of *Z. marina* associated with shallow coastal ecosystem of Korean Peninsula, which can be a useful and effective species for future rehabilitation of currently degraded such ecosystems in the south coast of Korea.

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THE EFFECTS OF BIOMANIPULATION ON CARBON & NITROGEN CYCLES IN AGRICULTURAL RESERVOIR: A MESOCOSM STUDY

In this study, we investigated the effects of biomanipulation on carbon & nitrogen cycles during cyanobacterial blooms. A few aquatic organisms such as aquatic plant (*I.pseudoacorus*), bivalve (*U.douglasiae*), shrimp (*C.denticulate*) and shrimp & fish (*C.denticulate* & *P.fulvidraco*) were added into the each mesocosm to control blue-green algal blooms. Aquatic plant (*I.pseudoacorus*) was the most effective organism to reduce concentration of particulate organic matter (POM) and *U.douglasiae* was most ineffective in this study. At the latter period, *U.douglasiae* couldn't assimilate POM in their tissue and spitted OM from their stomach to water, so in this mesocosm, concentration of ^{13}C labeled POM was higher than control mesocosm's. In the mesocosm which was treated with *C.denticulate* & *P.fulvidraco* (shrimp & fish), ^{13}C labeled POM concentration was largely reduced and relative abundance of C20:5ω3 was higher than treated only with *C.denticulate*, it suggests that *P.fulvidraco* should affect the feeding rate of *C.denticulate* and particulate fatty acid composition during the experiment. After 22 days, ^{13}C labeled 20:5ω3 was increased at all mesocosms except control.

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A MULTIMARKER APPROACH (STABLE ISOTOPES AND FATTY ACIDS) TO DECIPHER TROPHIC INTERACTIONS OF CO-OCCURING SUSPENSION FEEDERS IN TWO INTERTIDAL ECOSYSTEMS

Intertidal ecosystems are characterized by the diversity of food sources and the complex trophic relationships between suspension feeders. In this study, both natural stable isotopes (C, N) and fatty acid biomarkers were used to evaluate the yearly dynamic of food source contributions to the diet of the oyster Crassostrea gigas and of its potential competitors (Mytilus edulis, Cerastoderma edule, Crepidula fornicata, Lanice conchilega and Sabellaria alveolata) in two contrasting intertidal ecosystems: an estuarine bay (EB) and a sand flat (SF). The isotopic approach showed that planktonic microalgae were the main food source for bivalves, particularly in SF due to the strong marine influence. However, microphytobenthos and detritus (continental and macroalgae) contributed to the diet of suspensivores during the summer and the autumn in EB. These results were confirmed by the seasonal monitoring of fatty acid biomarkers, which showed a high contribution of the diatoms and also a significant contribution of bacteria. The interspecific competition is not likely since the species have shown the capacity to shift from a food source to another depending on their availabilities along the year.

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A NEW TOOL TO ASSESS OXYGEN DYNAMICS IN THE OCEAN INTERIOR

Quantifying organic matter remineralisation along the whole water column is essential for assessing the role of the microorganisms in the global carbon cycle in relation to global change. Different approaches may be used to assess the remineralisation rate along the water column, i.e. in situ bulk measurements in relation to hydrological properties, enzymatic assays (ETS, hydrolytic activities), particles exportation rates. We have developed an in situ auto sampler to measure at high frequency the in situ oxygen concentration, temperature and the oxygen dynamics within a 5 litres incubation chamber. The $IODA_{6000}$ (In situ Oxygen Dynamic Auto-sampler), is an equipressure system which has been developed within the framework of the APO, ANR POTES and ANTARES projects. The $IODA_{6000}$ is programmable and can be deployed at any depth up to 6000 m. Using real-time data collected by the $IODA_{6000}$ at the ANTARES site (2000m), coupled with hydrological parameters (T, S, currents, O_2) we are installing a deep-sea observatory in the Mediterranean Sea (EuroSITES program). This strategy is coupled with the deployment of drifting and fixed instrumented mooring lines equipped with four $IODA_{6000}$.

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RELATIONSHIPS BETWEEN TROPHIC LEVEL AND BACTERIAL TAXA: ARE THERE REGULAR PATTERNS IN THE OCEAN?

Bacteria represent abundant and significant players in aquatic microbial food webs. Understanding their specific distribution is one of the primary goals in microbial ecology. Experiments relying on clones libraries and FISH analysis have shown that bacterial community structure (BCS) vary between ecosystems and seasons. However, factors controlling BCS are poorly described on a general basis. It has been postulated that different bacterial taxonomic groups can exhibit specific responses to trophic levels, describing linear, hump-shaped or U-shaped quadratic relationships. But, are the patterns similar when using a range of techniques for the estimation of BCS? Do the observed curvature depend on the phylogenetical level at which BCS is analyzed? We have used a combination of approaches, including the meta-analysis of published data and experimental determinations using Fluorescence in situ hybridization (FISH) with common probes, and Flow Cytometry to determine patterns of known microbial groups, in order to test and analyze the relationships between the microbial community structure and the trophic level of marine ecosystems and to establish whether regular patterns and general laws exist in the composition of aquatic microbial communities.

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PELAGIC FOOD WEBS: COMPETITIVE INTERACTIONS OF HETEROTROPHIC MICROBES WITH PHYTOPLANKTON AND METAZOANS

Prior to the 1980s, marine pelagic food webs were generally perceived as a linear sequence of steps through which organic matter (OM) was transferred from phytoplankton toward large animals (i.e. the herbivorous food web). At the end of the 1970s, the discovery of small autotrophic and heterotrophic plankton and their trophic roles led to the development of new models where the microbial food web was originally seen as another pathway that contributed to the channelling OM toward large animals. A more recent view is that recycling pathways within pelagic food webs are such that heterotophic microbes consume most OM derived from phytoplankon, even when the latter are mainly grazed by large zooplankton, hence, the quantity of OM that is transferred to metazoans is small. In this presentation, we explore, using a steady-state food-web model, the proposal that food-web metabolism is largely governed by competitive interactions of heterotrophic microbes (bacteria and microzooplankton) with phytoplankton and metazoans, e.g. bacteria compete with phytoplankton for dissolved inorganic nutrients and with mesozooplankton for organic particles, and microzooplankton compete with mesozooplankton for large phytoplankton.

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ALLELOPATHIC ACTIVITY IN THE DINOFLAGELLATE *ALEXANDRIUM*: EFFECT OF SALINITY, HIGH MOLECULAR WEIGHT CONCENTRATES OF SEAWATER AND TURBIDITY

Alexandrium minutum, *A. catenella* and *A. tamarense* produce bioactive substances, which can be fatal (PSP toxins) or detrimental to competitors (allelochemicals). These dinoflagellates bloom in coastal areas with changing salinity regimes and chemically complex combinations of dissolved organic matter and suspended particles. We tested the effect of these highly dynamic indicators on the allelopathic activity (AC) of *Alexandrium*. Algal strains were adapted to different salinity (28, 32, 38) for 2 weeks prior to measuring their AC using bioassays. HMW concentrates of seawater were isolated at four occasions in the shellfish estuary Charente (France) using tangential filtration. AC of all *Alexandrium* species was compared after 3 days exposure to HMW concentrates and changing turbidity. Over the salinity range, *Alexandrium* growth rates were constant but AC varied 20-50 %. *A. minutum* AC increased at low salinity while the opposite was found in *A. catenella*. Neap tides HMW affected positively AC of two *Alexandrium* species. Turbidity affected negatively AC in all species indicating surface adhesion of active metabolites. Our results indicate that AC is regulated as a physiological adaptation to *Alexandrium* chemical surroundings.

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FORMATION OF SMALL SCALE CHLOROPHYLL PATTERNS DURING THE NORTHEAST ATLANTIC SPRING BLOOM: A LAGRANGIAN ANALYSIS BASED ON MULTI-SATELLITE DATA

In the northeast Atlantic, the spring phytoplankton bloom and the subduction of subpolar mode waters occur during the same period. Spatial and temporal variations in phytoplankton abundance associated with the bloom drive changes in the biochemical properties of the surface waters before they are subducted into the ocean interior.
In this work we study the formation of small scale (mesoscale and sub-mesoscale) phytoplankton variability patterns by horizontal stirring. This is done by analyzing satellite derived surface chlorophyll, Sea Surface Hight (SSH) and Sea Surface Temperature (SST). The analysis is based on the derivation of Lagrangian diagnostics from the time-dependent geostrophic velocity field calculated from the altimetry data. We present a systematic analysis of the impact of horizontal stirring in modulating chlorophyll variability, covering the period of the spring bloom in six consecutive years (1998-2003). We identify two mechanisms by which the geostrophic velocity field acts on chlorophyll patterns: (i) a direct effect of the horizontal transport on already-formed chlorophyll; (ii) an indirect effect on in-situ chlorophyll production mediated by nutrient upwelling.

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PREDATOR ENERGY STORAGES IN PLANKTON – DO THEY MATTER?

In a Rosenzweig- MacArthur model of prey predation - parameterized for zooplankton – phytoplankton interaction - we included constructs for energy reserves and predator feeding strategies. We examined three predator strategies corresponding to cessation of feeding at three levels of prey density. During non-preying periods the predator used its nutrient storage for continued maintenance and growth. With increasing prey protection, the predator – prey system oscillated less, cycle lengths became shorter, lowest density of prey and predator became larger, as became average prey density, but predator density became lower. We found support for the results in experimental observations, but we found neither support, nor contradictory results from any in-situ observations. Thus, the question.

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SPECIES-SPECIFIC RESPONSES OF BALTIC SEA PHYTOPLANKTON TO 3 DIFFERENT GRAZERS

The species-specific responses of coastal summer phytoplankton community to 3 different grazers was examined during 44 h laboratory experiment. Selected grazers were copepod *Eurytemora affinis*, cladocer *Pleopsis polyphemoides* and naupliis of barnacle *Balanus improvisus*. Grazers and the nutrient-boosted natural phytoplankton community originated from the archipelago of Tvärminne, northern Baltic Sea. The aim of the study was to analyze which phytoplankton species suffer and which might even benefit from the presence of these three different grazers. All treatments were conducted as triplicates, and the study included microscopy of phyto- and zooplankton and analysis of chlorophyll a. The results were analyzed with multivariate community analyzing methods and anova, and will be presented in the ASLO Aquatic Sciences meeting 2009.

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AN OVERVIEW OF CLIMATE CHANGE IMPACT ON MEDITERRANEAN MARINE BIODIVERSITY

Climate change is undoubtedly already influencing the Mediterranean. Time-series records of physical parameters have demonstrated the occurrence of several large-scale events during the last decades. Major ecological events driven by climate change include the 1980s' positive NAO causing northward migrations and disequilibrium in planktonic communities or the 1990s' thermal anomalies involving mass mortalities and algal blooms. We have reported each of these events from the NW Mediterranean and we present an overview aiming at highlighting relationships between physical and biological events, interactions between ecological events at the whole basin scale. More specifically, we discuss possible consequences of such individual and combined events on biological systems, from individual adaptation to ecosystem functioning, and of the superimposition with other disturbances (e.g. invasive species). Development of predictive models of forthcoming physical and biological events is essential. However, the current lack of reference data in the southern and eastern parts of the Mediterranean makes any attempt to predicting changes incomplete to some extent. Developing research priorities in such directions thus appears an essential task for the scientific community.

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EFFECTS OF DIFFERENT ALLOCHTHONOUS CARBON SOURCES ON MARINE BACTERIOPLANKTON DIVERSITY AND FUNCTION

We analyzed the effect of different allochthonous C nutrient sources and on the diversity and function of marine bacterioplankton. In order to determine the way these variables change with the additions we performed several mesocosms experiments. Three different environments and situations were studied: Oil spill consequences were evaluated in the Galician coast (NW Spain), nutrients inputs from different origins (terrestrial and atmospheric) were investigated in Blanes Bay (NW Mediterranean) and the effect of the environmental conditions at different depths affecting bacterial communities were studied in the North Atlantic Ocean. We used the DGGE technique in all experiments to compare the amount of change in structure between different manipulations. We compare the responses and stablish the effects of the origin of the water, the type of manipulations, the effect of predators, and the addition of a nutrient that limits bacteria, algae, or both.

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THE BROWNING OF FRESHWATER ECOSYSTEMS: IMPLICATIONS FOR FOOD WEBS AND FUNCTION

Growing evidence suggests that terrestrial-derived dissolved organic carbon (DOC) export to aquatic ecosystems is on the rise. Increasing temperatures, land use change, altered hydrology, and atmospheric deposition have all been identified as potential factors responsible for this global-scale "browning" of freshwater ecosystems. In this talk, I review and synthesize existing knowledge about how changing DOC inputs affect freshwater ecosystems. In particular, I focus on the following topics: 1) Allochthony: the mechanisms and degree to which terrestrial organic matter supports production of aquatic food webs, 2) Stability: the importance of terrestrial DOC as a donor-controlled resource that determines how ecosystems respond to perturbations, and 3) Alternate carbon pathways: the direct and indirect mechanisms by which terrestrial DOC influences carbon flow, including microbially mediated CO2 recycling and methanotrophy. Importantly, this review will highlight a suite of techniques and approaches, including simulation modeling, experiments, and molecular tools that are being used to better understand how changes in the strength of land-water linkages will influence aquatic food webs and function under existing and future global change scenarios.

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BENTHIC PHOTOTROPHIC COMMUNITIES MEDIATE SEDIMENT P RELEASE

As a result of a 10-fold increase in phosphorus (P) loading between the early 1960's and the 80's, the sediments of the Wadden Sea represent a large reservoir of P sorbed to metal oxides and clay minerals. Through desorption, P can be released into the water column, thus increasing the available nutrient pool for primary producers. Sorption depends on equilibrium between the amount sorbed and the water P concentration, but is affected by environmental conditions such as pH. A lower pH can cause the dissolution of the metal oxides causing P release, while a higher pH (>7) may favor desorption itself, as a result of competition between P and the hydroxyl ion. In surficial sediments pH is mainly controlled by the balance between photosynthesis and respiration. The benthic phototrophic communities (BPC), through photosynthesis, can induce pH changes in the surficial sediments from 7 up to 10. The effect of pH on sorption and sediment water exchange of P was studied using sediment suspensions and whole-core incubations under different light intensities.

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FIELD MEASUREMENTS OF INORGANIC NITROGEN UPTAKE BY EPIFLORA COMPONENTS OF THE SEAGRASS *POSIDONIA OCEANICA*

Crustose corallines, crustose and erect brown algae and epifauna are major components of the epiphytic community of the seagrass *Posidonia oceanica*. Nitrogen uptake by *P. oceanica* and its epiflora was measured using the isotope ^{15}N at a 10 m depth (Corsica, Mediterranean Sea). The epiphytic brown algae appeared at the end of spring, later than the crustose corallines, and after the nitrate peak. Because of their later development in the season, epiphytic brown algae mostly rely on ammonium to ensure their N needs. We make the hypothesis that the succession of epiphytes plays a crucial role in the N dynamics of this community under natural conditions and is potentially disturbed under anthropogenic pressure. The corallines have a growth rate lower than that of brown algae, but, interestingly, a higher N uptake rates. This could reflect their greater N requirements (i.e. lower C/N ratios). Epiflora incorporated inorganic N more rapidly than their host. Nevertheless, *P. oceanica*, due to its biomass, was the most important contributor to N uptake by benthic primary producers.

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MORPHOLOGICAL FLEXIBILITY OF COCCONEIS SP. NANOSTRUCTURE ALONG A NATURAL SALINITY GRADIENT

Diatoms possess a silica frustule decorated with unique patterns of nano-size features. Here, we show for the first time from in situ samples, that the size of the nano-pores present at the surface of a diatom species varies with fluctuating salinity levels. The reduction of the nanopores size with decreasing salinity is in accordance with previous laboratory experiments. In particular, our results suggest that diatoms compensate the decrease in diffuse layer by modifying their pore size in order to maintain an equal diffusion capacity at any salinity. By doing such, diatoms guarantee that they will always be able to absorb the same amount of nutrients whatever the salinity. These results suggest that the overall ecological success of diatoms, and their ability to react to environmental changes, may be associated with their capacity to modify the morphological characteristics of their frustules.

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DMSP MICROBIAL DYNAMICS ALONG A NATURAL IRON GRADIENT IN THE NORTHEAST PACIFIC

The Alaskan Gyre is an HNLC region characterized by high concentrations of dimethylsulfide (DMS), a biogenic gas with a potential cooling effect on climate. In the North Pacific, both aeolian deposition and vertical mixing may contribute to the replenishment of iron in the surface mixed layer and the stimulation of algal growth. During the 2002 SERIES experiment at Ocean Station Papa (OSP), the artificial fertilization of a 10 x 10 km2 surface with iron resulted in an increase in dimethylsulfoniopropionate (DMSP), the precursor of DMS, but no change in DMS levels. The aim of the present study was to determine if iron delivered through vertical mixing would generate a similar response. To do so, we measured concentrations of DMS(P) and the microbial metabolism of DMSP along a natural iron gradient extending from the Canadian West coast to OSP in May 2007. Our results show that natural iron addition can stimulate both the growth of the DMSP producers and the microbial DMSP metabolism in these HNLC waters, as observed during SERIES.

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PAN-SVALBARD ASSESSMENT OF DECADAL-SCALE CLIMATE FORCING AND ECOSYSTEM VARIATION: EVIDENCE FROM BIVALVE GROWTH RATES

Understanding the consequences of climatic change in the Arctic necessitates linking ecosystem responses to climatic variations over a range of temporal and spatial scales. We examined growth rates of 178 specimens of the circumpolar Greenland Cockle (*Serripes groenlandicus*) collected from nine sites around the Svalbard archipelago, spanning a range of oceanographic and environmental gradients from strongly Atlantic-influenced on the west coast to high-Arctic in northeast Svalbard. Absolute growth was up to 3 times greater at Atlantic-influenced locations compared to the most Arctic-influenced areas. Standardized growth indices exhibited interannual patterns with some common features, including a marked shift from relatively greater to poorer growth in the mid-1990's. This was consistent with phase-shifts in large-scale climatic drivers. Growth rates were also related to local manifestations of the large-scale drivers including atmospheric pressure, precipitation, and sea ice. Some relationships were stronger when the environmental parameters were lagged with respect to growth. Site-to-site variability in the precise relationships between growth and environmental variability indicate that effects on growth are determined by the interaction between large-scale climate drivers and local environmental parameters, and through the regulation of production and food availability on a local scale.

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EVIDENCE THAT BACTERIA PLAY AN IMPORTANT ROLE IN THE UPPER OCEAN SULFUR CYCLE AT THE BERMUDA ATLANTIC TIME-SERIES STATION

Dimethylsulfide (DMS) is a climatically relevant trace gas produced and cycled by the surface ocean food web. Previous work suggests that phytoplankton taxonomy, productivity and physiological status play a dominant role in DMS production. A new 10-month time-series at the Bermuda Atlantic Time-Series Station suggests that bacterial processes dominate the upper ocean sulfur cycle in oligotrophic waters. Bacterial and phytoplankton potential enzyme activity, DMS and dimethylsulfoniopropionate (DMSP) concentrations and a suite of rate measurements were quantified during monthly cruises from February through November 2008. Potential enzyme assays quantify the abundance of active enzymes responsible for DMS and DMSP transformations. This study presents the first measurements of bacterial potential enzyme activity in oligotrophic waters and the first time-series of phytoplankton potential enzyme activity. Phytoplankton activity peaks in the late spring whereas bacterial activity is highest in the late summer concurrent with high DMS concentrations. Profiles of net bacterial activity (bacterial DMS production- bacterial DMS consumption) as measured using the potential enzyme assay are highly correlated with water column DMS suggesting that bacterial transformations are the primary determinants of DMS concentrations.

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MARINE PLANKTON COMMUNITY RESPONSE TO WINTER WARMING – THE KIEL MESOCOSM EXPERIMENT

Predicted increase of sea surface temperature in winter could considerably influence the spring phytoplankton community. However temperature is not the only factor responsible for these changes. Light seems to play an equally big role. In our study we examined temperature as well as light influences on the natural plankton community from Kiel Bight (Baltic Sea) by indoor mesocosm system under controlled temperature and light conditions. Two temperature regimes (0°C and 6°C elevation above present conditions) and three light scenarios (32%, 48% and 64% of sea surface irradiance) were combined in factorial design. The timing of the spring bloom showed advancement in response to warming. Biomass and composition of phytoplankton varied significantly between temperature treatments but light effect was less pronounced. Moreover we found a shift to smaller cell sizes in warmer treatments and a replacement of zooplankton species under warming conditions.

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BIOGEOCHEMICAL PROCESSES INVOLVED IN GROUNDWATER-SURFACE WATER EXCHANGE AT A LOWLAND RIVER

Transport processes and chemical transformations of nutrients along their pathways through the aquifer, the hyporheic zone and the water body are investigated at a study site at the lowland river Spree north-east of Berlin. To determine spatial heterogeneity and temporal variability of water composition on different scales from centimeters to several hundred meters different sampling techniques are used such as two transects of piezometers (meter to several hundred meters), two fields of multi-level-samplers (decimeters to meters) and two-dimensional dialysis samplers (centimeters to decimeters). As restoration measure an oxbow located on the study site was reopened. Impacts on hydrodynamic and biogeochemical processes are studied. Due to the availability of easily degradable organic matter in the upper soil layers and high groundwater levels nitrate is eliminated effectively soon after nitrate-rich groundwater enters the aquifer of the floodplain. In the aquifer of the floodplain and in the hyporheic zone, hot spots of intense phosphorus mobilization are identified. That phosphorus mobilization is partly coupled to the degradation of organic matter and partly coupled to the dissolution of iron compounds.

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INVESTIGATING THE LINK BETWEEN METHANE OXIDATION AND SULFATE REDUCTION IN DIFFERENT MICROHABITATS AT PACIFIC METHANE SEEPS

The current opinion is that anaerobic oxidation of methane (AOM) is carried out by a consortium of sulfate-reducers and methanotrophs, resulting in a consumption of methane and production of sulfide through sulfate reduction (SR) at a molar ratio of ~1:1. Pacific methane seep environments are characterized by different 'microhabitats' of chemosynthetic microbial mats and clam beds fueled by sulfide. Investigations in sediment cores taken from methane seep environments in the Eel River Basin (Northern California) and Hydrate Ridge (Oregon) during a cruise with R/V Atlantis in 2006, showed significant differences in geochemical gradients and microbial activity between microhabitats and demonstrated that AOM and SR are not always linked. In subsequent laboratory experiments using sediment slurries, we further investigated the coupling between these two processes. Incubation experiments, as well as inhibition and radiotracers studies showed clear differences in microbial activity between the microhabitats and in some cases a consumption of methane decoupled from sulfate reduction. Molecular analyses of the slurries are underway to elucidate the presence or absence as well as the abundance of microbial groups potentially involved in AOM.

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AIR-SEA CO2 FLUX ASSOCIATED WITH CYCLONIC EDDY IN SUMMER IN THE W SOUTH CHINA SEA

Recent observations have revealed that meso-scale processes may have introduced spatial heterogeneity and temporal variability of CO_2 fluxes which has not been well defined in marginal seas. Meso-scale eddies can profoundly alter the distributions and the dynamics of the chemical constituents, and eventually influence the CO_2 fluxes at the air-sea interface. This presentation attempts to quantify the influence of a meso-scale eddy system on the air-sea CO_2 fluxes based on the data collected in Aug-Sep., 2007 to the western South China Sea. The partial pressure of CO_2 (pCO_2) in surface seawater ranged from 380 to 440 μatm with the maximum at the eddy center and the minimum in the outside frontal zone. Biological uptake did not significantly influence the air-sea CO_2 fluxes. Overall, the surface pCO_2 was primarily controlled by thermodynamics. However, the effect of upwelled CO_2-enriched subsurface water appeared after removing the effect of temperature. A preliminary estimation shows that this cold-core cyclonic eddy enhanced the local CO_2 effluxes by >100%. We noticed that what was observed in our eddy system is considerably different from other eddy systems such as the Eddy Lee off the main Hawaiian Islands in the subtropical North Pacific Gyre, which showed a more prominent bloom and more straightforward correlation between temperature and pCO_2. We therefore contend that different meso-scale eddies may induce different effects on the CO_2 fluxes at the air-sea interface.

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A QUARTER CENTURY OF FLOW CYTOMETRY IN MICROBIAL OCEANOGRAPHY

In 1983, the technology of flow cytometry was introduced to limnology and oceanography by Yentsch and others as an electronic technique for the analysis and sorting of aquatic particles. In 2008, the evolutionary implications and new horizons of single cell analysis in plankton research were portrayed anew by Yentsch and Yentsch. Over this quarter century period, flow cytometry has made an indelible contribution to microbial oceanography. The challenges for oceanographic cytometrists in a changing world need to be addressed by connecting the local scales at which single cell analysis is made to regional and global scales at which biogeography and biogeochemistry emerge.

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DEPLOYMENT OF AN SELF-CONTAINED UNDERWATER PARTICLE IMAGE VELOCIMETRY (UWPIV) SYSTEM IN LAKES

A low-cost self-contained underwater Particle Image Velocimetry (UWPIV) system has been developed to measure small-scale turbulent flow structures in environmental fluids. The UWPIV employs a compact continuous-wave (CW) laser and an optical scanner to deliver a light sheet that illuminates small particles in natural waters. Particle images are taken by a CCD camera along with an ultra-compact PC. The non-tethered and compact design can be fit in two small underwater housings with all components powered by batteries: an ideal design for a variety of in situ deployments. The system has been field-tested in the coastal water of Lake Michigan. Turbulent flow structures of the wave-current bottom boundary layer are measured over the nearshore lakebed, which has been densely covered by quagga mussels (Dreissena bugensis). Measurement results, including the vertical profiles of mean velocity, Reynolds stresses, dissipation rate of the turbulent kinetic energy and turbulent viscosity, are presented and discussed. Moreover, we have demonstrated that the UWPIV system can be applied to measure concentration distribution of particles, and the turbulent flux of particles can be determined directly. With further calibrations on particle concentrations, the UWPIV system can be applied to measure the consumption rate of phytoplankton by mussels in situ.

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CHARACTERIZATION OF METACASPASES FROM THE COCCOLITHOPHORE, *EMILIANIA HUXLEYI*.

Metacaspases are considered to be ancestral cysteinyl aspartate specific proteases involved in the initiation and execution of programmed cell death (PCD). Their widespread presence among a variety of phytoplankton, suggests that their activation plays a fundamental role in cell turnover. We report induction of caspase-like activity and metacaspase protein expression from four diverse phytoplankton species, including a chlorophyte (*Dunaliella tertiolecta*), haptophyte (*Isochrysis galbana*), diatom (*Thalassiosira weissflogii*), and dinoflagellate (*Amphidinium carterae*). Recently metacaspases and caspase activity were shown to play a critical role in the successful viral infection of the coccolithophore, *Emiliania huxleyi*. An *E. huxleyi* 1516 and *EhV86* host-virus model system was used to link dramatic increases in caspase specific activity with metacaspase gene signatures. Caspase activation was measured through *in vitro* cleavage in cell extracts of fluorogenic peptide substrates (IETD-AFC and YVAD-AFC) with up to ~170 fold elevation during the progression of infection, consistent with metacaspase protein expression. A subset of proteins were partially purified from infected cell extracts that were both associated with enhanced caspase specific activity and displayed hybridization to *E. huxleyi* metacaspase antibodies.

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AN END-TO-END APPROACH FOR ANALYSING EFFECTS OF CLIMATIC AND FISHING CHANGES ON ECOSYSTEMS

Different natural and anthropogenic disturbances are affecting marine ecosystems simultaneously. Moreover, direct effects are affecting many biological and biogeochemical components through cascading effects and indirect interactions. In order to evaluate the possible effects of disturbances in a truly ecosystem perspective it is necessary to link biogeochemical processes and species dynamics, accounting also for the wide biological diversity in the ecosystem. In the present work the biogeochemical processes are integrated into a widely used food web model, Ecosim, in an End-to-End approach. Biogeochemical processes are integrated by accounting of results of complex hydrodinamic-biogeochemical models that are forced with Regional Climate Model outputs, whereas fishing exploitations are included in the food web description. The methodological integration is discussed and the conceived End-to-End tool is here used for analysing scenarios of simultaneous climatic and exploitation changes over time. Ecosystem structural and functional changes are analysed also through ecological properties and indices such as trophic level and cycling index. A scenario analysis is also carried out for understanding the role of biological resolution in shaping the observed ecosystem changes.

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USING CPR TO MONITOR THE BIODIVERSITY OF GELATINOUS PLANKTON OUTBREAKS

Gelatinous zooplankton includes species of different groups which are characterized by a regular seasonal cycle, but are also able to quickly achieve extremely high abundance when environmental conditions are favourable. During such events, called 'outbreaks' or 'blooms', hundreds-thousands of individuals can occur per cubic meter, usually over vast spatial scales, and often representing a disturbance to the marine environment. In recent years an increasing frequency of gelatinous zooplankton outbreaks have been recorded worldwide. Although a relationship between such events and hydroclimatic changes has been hypothesized, a basic gap in our information still exists with regard to their population dynamics, community composition and spatial distribution. Molecular genetic analysis has been successfully used for the taxonomic identification of gelatinous zooplankton collected from the Continuous Plankton Recorder (CPR). Considering that the CPR performs the most spatially extensive plankton monitoring in the world, such a combined approach may provide a useful tool to investigate the biodiversity of gelatinous plankton outbreaks at appropriate spatial scales to help understand the ecological causes and consequences of these outbreaks.

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TEMPORAL AND SPATIAL VARIABILITY IN *PSEUDO-NITZSCHIA SPP.* IN ALABAMA COASTAL WATERS: A "HOT SPOT" LINKED TO SUBMARINE GROUNDWATER DISCHARGE?

The potentially-toxic diatom Pseudo-nitzschia is common in the northern Gulf of Mexico. Seven sites in Alabama have been monitored since 2003 and Pseudo-nitzschia spp. was detected in 489 of 829 samples (59%). Analysis of relative frequency distributions showed that Little Lagoon Pass had a higher frequency of bloom densities and a lower frequency of absences than other sites. Salinities in the pass were higher and less variable than at other sites. Freshwater transport in most of the study area has been shown to be primarily through submarine groundwater discharge (SGD) into the Gulf of Mexico. Groundwater has high nitrate concentrations and discharge is most likely to occur adjacent to Little Lagoon. Blooms of Pseudo-nitzschia spp. at Little Lagoon Pass in spring were highly correlated with discharge from the Styx River, a proxy for SGD. Little Lagoon Pass may be a hot-spot for blooms of Pseudo-nitzschia spp, because local maxima in SGD supply nutrients without significant reductions in salinity. In anticipation of a bloom at Little Lagoon following an increase in groundwater level, Pseudo-nitzschia spp were monitored in the lagoon in spring 2008. Spectral light attenuation, salinity, temperature and nitrate concentrations were monitored hourly for 3 weeks. Pseudo-nitzschia spp. density, domoic acid concentrations, and particulate and dissolved nutrients were monitored daily. This mooring coincided with a sustained bloom, as predicted from groundwater levels.

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USING TIDAL FLAT MICROCOSM TO ASSESS FATES AND IMPACTS OF OCEAN DISPOSAL WASTES IN MACROINFAUNAL COMMUNITIES

A microcosm experiment was conducted to test the short-term effects of ocean disposal wastes (sewages from domestic and industrial waste treatment plants) on macrobenthic infauna over a period of 9 weeks. The experiment consisted of four types of sewage sludges and four treatments using dried natural sediment with addition of 0%, 25%, 50% and 75% of sewage sludge. Forty eight benthic microcosms (plastic basket with 30*20*10cm) were embedded on the macro-tidal flat in the West Sea of Korea. One microcosm at each treatment was retrieved for the identification of macrofaunal changes every three weeks of exposure. Macrofaunal community structures were identified using multivariate analysis and also compared to the chemical properties of sediment in microcosm such as the ignition loss and grain size compositions. The present findings demonstrated the dose–response relationship of benthic species changes under controlled addition of sewage sludge. This sediment microcosm will be a good alternative for the estimation of ocean waste disposal impact to the benthic community.

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THE ROLE OF METACOMMUNITY DYNAMICS IN STRUCTURING EPIBENTHIC PROTOZOAN DIVERSITY

Dispersal among local communities is an important factor in structuring local and regional diversity. Local diversity is expected to show a unimodal relationship with dispersal rate, whereas regional diversity should be negatively affected by dispersal due to homogenization of local communities. In a first microcosm experiment, we tested the influence of different dispersal rates on the diversity of benthic protozoan communities. A metacommunity consisted of six local communities and contained five ciliate species with the possibility to migrate actively among the local communities. Four levels of connectivity were compared, with treatments differing in number and length of dispersal paths. For eleven weeks, abundances of ciliates were surveyed to compare diversity among the four treatments. At the end of the experiment, both local and regional diversity were enhanced by dispersal when compared to the undivided control treatment. The highest and the lowest connectivity levels resulted in the highest diversity values, whereas intermediate connectivity yielded the lowest diversity among the three dispersal treatments.

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WHO IS DOING WHAT: IN SITU SPECIES DIVERSITY AND GENE EXPRESSION PROFILE ENABLED BY DINOFLAGELLATE-SPECIFIC MOLECULAR ANALYSES

One of the most important oceanographic questions is to know who is doing what. For phytoplankton, it is very difficult to obtain this information without bottle incubation which often blends in artifacts. In the genomic era, it has become feasible to look at species composition without culturing by using taxon specific molecular markers. For dinoflagellates, it also has become possible to determine what functional genes are being expressed in situ. Based on the spliced leader sequence unique for dinoflagellate nuclear-encoded mRNAs, we have developed a protocol to specifically synthesize cDNA of dinoflagellate mRNAs from field-collected plankton samples to yield snapshots of gene expression profiles at time of sample collection. Using both dinoflagellate-specific 18S rDNA primers and the spliced leader, we have analyzed both dinoflagellate species diversity and transcriptomes in Long Island Sound and Mirror Lake. We unveiled high species diversity and active expression of an unsuspected set of genes in these natural environments.

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ASSESSING OXYGEN FLUX AND PHYSICAL CHARACTERISTICS OF PERMEABLE SEDIMENTS FROM THE OREGON SHELF

In order to investigate oxygen consumption by permeable sediments from the Oregon shelf, SCUBA divers collected cores from a water depth of ~15 m at 44°51.6N; 124°03.4W during July/August 2008. Oxygen microelectrodes were used to obtain high spatial resolution profiles of oxygen consumption rates in five of these cores via a flow through method. Aerated water was pumped through each sediment core in a

laboratory at 10°C, and the linear decrease in oxygen concentration during short flow-off periods was measured at different depths. Additionally, permeability and porosity were measured. Oxygen fluxes calculated by integrating the volumetric oxygen consumption rates to a presumed oxygen penetration depth of 4 cm ranged from 42 to 140 mmol m^{-2} d^{-1}. Permeability and porosity averaged 23×10^{-12} m^2 and 43.5%, respectively; consistent with other permeable coastal sediments. Estimates of local oxygen drawdown driven by sediment respiration, according to these oxygen flux values and accounting for water depth (15 m), suggest rates between 2.8 and 9.3 mmol m^{-3} d^{-1}; extrapolating to over the entire Oregon shelf (100 m mean depth), these values are 0.4 to 1.4 mmol m^{-3} d^{-1}. In comparison to earlier estimates which placed sediment consumption at 0.1 ± 0.1 mmol m^{-3} d^{-1}, the benthic contribution to shelf hypoxia events may be much more significant than previously estimated.

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MASS MORTALITY EVENTS IN NW MEDITERRANEAN GORGONIAN POPULATIONS: UNDERSTANDING THE IMPACT AND POTENTIAL RECOVERY THROUGH A DEMOGRAPHIC APPROACH

During the last decade, large scale mortality events linked to climatic change have strongly affected high-diverse Mediterranean marine benthic communities dominated by long-lived gorgonian species (Paramuricea clavata, Eunicella singularis and Corallium rubrum). Because of their extremely long life spans, the acquisition of baseline long-term data (1999-present) on population structure and dynamics of these species has allowed a reliable assessment of the impacts and the potential recovery of affected populations. These demographic data, obtained through in situ measurements and photogrammetric methods, have used to develop population viability analysis (PVA) models to investigate the long-term consequences of mass mortality events. Furthermore, the evaluation of the impacts at a large spatial scale (from the Spanish to the French littoral including Balearic and Corsica Islands) provided useful descriptors and protocols to gradually expand the assessment of climate change impacts towards a Mediterranean-wide scale. Our results may offer some guidelines to contribute to the conservation of benthic communities dominated by long-lived gorgonian species.

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MUSSEL FARMING FOR COMBATING COASTAL EUTROPHICATION – EXPERIENCES FROM SWEDEN

Phytoplankton is the main feed for mussels and therefore mussel farming and harvest has since the 1980's by Swedish authorities been recognized as a possible measure to combat eutrophication in order to improve coastal water quality. The cultivation of blue mussels using the long-line farming method is a cost-efficient and environment-friendly way of taking care of nutrient discharges. When harvesting the mussels, a known amount of the nutrients are recycled from sea to land as sea food or as raw material for feed-stuff, fertilizer or other products. Mussel farming and harvest can recycle up to 3 ton N and 210 kg P per hectar of sea area and year at a good site. Concepts and management strategies on how to increase mussel farming for environmental purposes have been suggested where the main principle is nutrient trading. This imposes demands on those who emit the nutrients through emission quotas which are traded and bought by the emitter. The seller is a nutrient harvesting enterprise, e.g. a mussel farmer. A full scale nutrient trading operation is ongoing in Lysekil, Sweden.

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CAN MULTIPLE MECHANISMS SHAPE MICROBIAL COMMUNITY STRUCTURES IN LAKES?

It is presently being debated whether the contemporary local environment or regional dispersal processes are more important in shaping local microbial community structure, i.e. whether species sorting, mass effect or neutral processes are of greater importance. In this study, bacterioplankton and phytoplankton communities were analysed in lakes and streams and related to local environmental variables as well as dispersal predictors. Analyses were conducted by means of canonical variance partitioning. The aim is to analyse under which circumstances species sorting and mass effect as well as neutral processes could be of greatest relative importance. It can be hypothesised that different processes should be of importance depending on organism group due to differences in functional plasticity, growth rate, abundance and ability to be dispersed alive. Further, the character of the habitats studied could also play a role, depending on hydrological connectivity, for instance.Phytoplankton communities were analysed by microscopy and bacterioplankton communities by tRFLP of the 16S rRNA gene.

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ORGANICALLY BOUND IRON ACQUISION AND THE REDUCTIVE PATHWAY – A FIELD STUDY IN THE GULF OF AQABA

Organically complexed iron is the dominant Fe species in a variety of marine environments. An inducible reductive pathway for iron acquisition has been described for iron stressed diatom cultures and natural populations in HNLC regions. How then do phytoplankton in high-iron coastal waters acquire organically bound iron? Here we report a mechanistic study of iron acquisition in the Gulf of Aqaba by an iron replete phytoplankton population dominated by *Synechococcus sp.* To this end, the siderophore Desferrioxamine B (DFB) served the dual purpose of a model organic Fe ligand as well as an iron-stress inducer with which to probe the iron nutrition of natural phytoplankton residing in the Gulf of Aqaba. Both incubation and short term iron uptake experiments showed the FeDFB complex to be bioavailable to phytoplankton, but less so than the naturally occurring iron in the Gulf. The addition of excess DFB inhibited growth and uptake significantly – suggesting a reductive iron uptake pathway as discussed in the model presented by Shaked et al. (2005). Field observations were supported by similar experiments with cultures of *Synechococcus* (WH8102). Shaked, Y., Kustka, A. B., and Morel, F. M. M. 2005. A general kinetic model for iron acquisition by eukaryotic phytoplankton. Limnol. Oceanogr. 50: 872–882

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AIR-SEA TRANSFERS AND THEIR ROLES IN ATMOSPHERE AND OCEAN

Air-sea transfer of volatile forms of various elements is important for the (bio)geochemical cycling of the elements, as well as for atmospheric chemistry and climate. Calculation of gas fluxes across the ocean-atmosphere interface requires knowledge of the kinetics of the exchange process, as quantified by a transfer velocity, and the thermodynamic concentration difference that drives the fluxes across the surface. Our knowledge of the factors that influence the transfer velocity has improved recently through direct measurements using micrometeorological techniques, such as eddy correlation and eddy accumulation, at sea. It now seems that even at intermediate wind speeds bubbles play important roles as gas exchangers, leading to solubility dependent differences in the transfer velocity between different gases. In general, the concentration difference term has to be obtained by direct measurement for each gas of interest. For some gases, such as carbon dioxide and dimethyl sulphide (DMS), there is a large and growing database of concentration measurements. For most other gases the number of available data is small, with poor spatial and temporal coverage. This makes global or even regional extrapolation of fluxes difficult and subject to large uncertainty. In addition to DMS, the presentation will cover some of the following trace volatiles: organo-halogens, ammonia, Hg, Se, as well as factors such as Fe and pH which may change their air-sea fluxes.

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TRAIT-BASED COMMUNITY ECOLOGY OF PHYTOPLANKTON

Trait-based approaches are being increasingly used to explain the organization of ecological communities. We propose using traits that define fitness to explain and predict major patterns of phytoplankton community structure and dynamics. We discuss how the distributions of major functional groups of phytoplankton along environmental gradients can be explained based on their resource utilization traits. We show that many trait correlations and trade-offs, including allometric relationships, can be predicted based on first principles such as surface to volume ratios and enzyme kinetics. Combining information on functional traits and phylogenetic structure can provide new insights into drivers of the ecological and evolutionary organization of phytoplankton communities.

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MODELING OF DENITRIFICATION IN MARINE SEDIMENTS

Denitrification is the main contribution to N-loss in permeable marine sediments. We developed a denitrification model based on Lattice-Boltzmann-Method (LBM) to demonstrate how different rates of reduction and general inhibition of denitrification account for the observed patterns of nitrite, nitric oxide, and nitrous oxide accumulation. The simulation shows that the high permeability and strong pore water advection in the sediments contribute to the high rates of N-loss, and quantititively agrees with the recent observations. It further shows that oscillatory flows over the rippled seabeds may be the key factor for this kind of pore water advection. The effect of water height, wave number, Peclet and Reynolds number on the N-loss rate is discussed in detail.

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A NEWFOUND ANCIENT DIVERSITY OF PROTISTS DOMINATES PHOTOSYNTHESIS IN OPEN OCEANS

Over the last twenty years a dogma has become established that cyanobacteria, which evolved oxygenic photosynthesis more than three billion years ago, are still the major light harvesters driving primary productivity in open oceans. Here we show that tiny (<3μm) unicellular eukaryotes belonging to the haptophyte lineage are dramatically diverse in the planktonic photic realm, where they appear to dominate photoreception. The use of Haptophyta-specific primers and PCR conditions adapted for GC-rich genomes circumvented biases inherent in classical genetic approaches to exploring environmental eukaryotic biodiversity, and led to the discovery of hundreds of novel haptophyte taxa in five clone libraries from polar and tropical oceanic waters. Phylogenetic analyses suggest that this diversity emerged in Paleozoic oceans, thrived and diversified in the Mesozoic Panthalassa, and currently comprises thousands of ribotypic species. This high biodiversity correlates to the pervasive presence in the ocean of 19'-hexanoyloxyfucoxanthin (Hex), a photosynthetic pigment found exclusively in plastids of haptophyte origin. Our estimates of depth-integrated relative abundance of Hex suggest that haptophytes actually dominate the photo-reception standing stock in modern oceans. Their ecological success, arguably based on mixotrophy, may have significantly impacted the biological pump.

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PLANKTONIC MICROBIAL FOOD WEB DYNAMICS IN HONG KONG COASTAL WATERS

We have conducted monthly surveys and process studies to study microbial food web structure and trophic dynamics in Hong Kong coastal waters at two contrasting sites, one that is strongly influenced by the Pearl River discharge on the west side and the other in the mesotrophic eastern waters. Food web components, from virus to mesozooplankton were quantified. Phytoplankton at both sites was mainly composed of microphytoplankton, especially diatoms, though picophytoplankton contributed more to total phytoplankton biomass in the mesotrophic eastern waters. PE-rich Synechococcus, the dominant type of marine picocyanobacteria, could rarely be observed at the estuarine site, but was abundant at the eastern site during summer. PC-containing Synechococcus, common in freshwater and brackish water, were detected in the estuarine water, especially during wet season. Microzooplankton consumed a great proportion (~60%) of phytoplankton production, whereas mesozooplankton consumption averaged only a few percent. Taxon-specific growth and mortality rates were investigated using HPLC-pigment analysis and molecular approaches. Trophic cascades induced by mesozooplankton grazing on microzooplankton, the main consumer of pico- and nano-plankton, was clearly exist. Seasonal variation in the composition and dynamics of the planktonic food web can be related to the nutrient-rich freshwater discharge from the Pearl River and the intrusion of various water masses modulated by monsoonal winds.

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MICROPLANKTON PHOSPHORUS-DEFICIENCY INFLUENCED BY THE MIXING BETWEEN KUROSHIO AND A SHELF MARGIN UPWELLING IN THE EAST CHINA SEA

The intensity of phosphorus deficiency experienced by microplankton and its relationship to upwelling strength were investigated in the shelf break region northeast to Taiwan. Three cruises were conducted in June, August, and September, 2007, respectively, and the sampling stations were arranged alone a cross-shelf line from mid-shelf to Kuroshio. In June and August, the values of alkaline phosphatase activity (APA) ranged from 1.4 to 9.5 pmole PO_4^{3-} (μg Chl. *a*)$^{-1}$ min^{-1} in surface water. In September, a strong upwelling appeared at stations on the shelf side, but did not mix extensively with Kuroshio. The low APA between 1.0 and 6.2 pmole PO_4^{3-} (μg Chl. *a*)$^{-1}$ min^{-1} were observed in the upwelling region, and high values between 25.8 and 53.3 pmole PO_4^{3-} (μg Chl. *a*)$^{-1}$ min^{-1} were observed in the Kuroshio. There was a significant linear relationship between the logarithms of APA and ambient phosphate concentration. These results suggested that phosphorous-deficiency of microplankton is correlated to the extend of mixing between Kuroshio and upwelling waters.

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EFFECT OF CHANGES IN PCO2 CONCENTRATIONS AND TEMPERATURE ON PROKARYOTIC GROWTH IN MESOPELAGIC WATERS

The anthropogenically elevated atmospheric pCO2 results not only in global warming but also in ocean acidification. Prokaryotes are the main mediators of the carbon and nutrient cycles in the dark ocean, however, our understanding on how they would respond to the elevated pCO2 and temperature remain very limited. We investigated the abundance, respiration, production and growth efficiency of mesopelagic prokaryotes off the Bay of Villefranche (water depth ~ 300 m), France. In addition, perturbation experiments were carried out at two temperatures (13 and 16°C) and six pCO2 gradients: lower (~280 ppm), ambient (400 ppm) and elevated pCO2 (550 ppm – 1500 ppm). Our preliminary experiments showed that the production rate of mesopelagic prokaryotes decreased linearly with the increase in pCO2 concentrations. For example, the production rate was >3-fold higher at reduced than at the highest pCO2. The percentage of high fluorescence prokaryotic flow cytometer groups, an indicator of bacterial activity, also decreased with increases in pCO2. Highest respiration rates and growth efficiencies were found highest at reduced pCO2. Thus, our results suggest a negative effect of elevated pCO2 on prokaryotic growth.

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DIMETHYLSULFONIOPROPIONATE (DMSP) ACCUMULATION IN DINOFLAGELLATES UNDER TURBULENT CONDITIONS

Dimethylsulphoniopropionate (DMSP) is the biological precursor of dimethyl sulfide (DMS), which constitutes the major pool of organic sulfur in the pelagic. DMSP is produced in relatively large quantities by some marine dinoflagellates. However, its ecophysiological role (osmoprotection, defense from predation or protection against oxidative stress) and the environmental factors that can affect its intracellular dynamics are poorly understood. In the field, dinoflagellate proliferations appear to be favoured by calm weather and water column stability. Further, small-scale turbulence affects different ecophysiological processes in this phytoplankton group. Since it has been observed that mechanical stress stimulates DMSP lyase activity (i.e., DMSP destruction) in some dinoflagellates, we aimed to explore the effect of small-scale turbulence on the DMSP intracellular concentration in the HAB producer Alexandrium minutum. The shaken cultures exhibited a transitory arrest of their cell cycle in G2/M phase, had lower growth rates and cell numbers, and increased their DMSP content per unit cell volume compared to the still ones. The results suggest a possible link between DMSP and the mechanorreception mechanisms and/or the cell division processes in A. minutum.

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STRATIFICATION AND MIXING IN DYNAMICS IN A MEDITERRANEAN ESTUARINE BAY

The hydrodynamics of Alfacs Bay, a Mediterranean estuarine bay in Northeast Spain, is examined through scaling arguments and simulations conducted with a three-dimensional model, using data collected in the field in previous years. Alfacs Bay is subject to weak tidal forcing and receives freshwater from the Ebro River through several irrigation channels, which are closed during winter time. Transport and mixing processes in the bay are strongly determined by wind forcing, in interaction with stratification, Coriolis forces, low through-flow and water surface oscillations of around 10 cm amplitude. In summer time, the water column stratifies as a result of moderate freshwater inflows, weak tidal mixing, and insolation. Strong mixing and large horizontal density gradients develop episodically during this time in response to wind events with speeds larger than 5 m s^{-1}. Our simulations suggest that additional sources of freshwater (probably from underground water seepage) must exist in order to explain the stratification observed during winter, when the freshwater channels are closed. This knowledge will be applied to the study of harmful algal bloom development in the bay.

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SPATIO-TEMPORAL SHIFT IN THE PLANKTON TROPHIC INTERACTIONS IN THE NORTH SEA OVER THE LAST 50 YEARS

Traditionally, marine ecosystem structure was thought to be bottom-up controlled, although there were also few examples of top-down regulation. Evidence is accumulating that the type of trophic forcing varies temporally and spatially and an integrated view is emerging. Correlations between multidecadal time series of the abundances of adjacent trophic levels are conventionally used to assess the type of control: bottom-up if the correlation is positive or top-down if this is negative. However, this approach implies assuming that there is no temporal change in the type of trophic regulation over time and therefore can hide part of this temporal variability. Using spatially-referenced phyto- and zooplankton biomass extracted from the Continuous Plankton Recorder, this study addresses the potential dynamic character of trophic structure at the planktonic level in the North Sea, usually considered to be bottom-up. By using a novel spatio-temporal statistical approach, which allows for non additive dynamics, we show that the type of relationship between phytoplankton and zooplankton might have shifted from a positive relationship to a negative one. Moreover, the new regime would be characterized by a spatial component

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COMPARING VIRAL INFECTION AND PREDATION AS CONTROLS OF HARMFUL ALGAL BLOOMS

There is growing experimental evidence that viruses are involved in the termination of phytoplankton blooms. An alternative thought is that grazing by predators is the leading loss factor of phytoplankton. A set of coupled ordinary differential equations for the mean concentration of phytoplankton (P), viruses (V) and zooplankton (Z) are considered analytically and numerically. Parameter values, found experimentally, for *Heterosigma akashiwo*, its virus HaV and predator *Oxyrrhis marina* are incorporated into the model and numerical simulations are compared with observed populations of these species. For realistic parameter values, the dynamics of the P-V and P-Z systems display damped oscillations towards a stable equilibrium. By the competitive exclusion principle, the P-V-Z system tends to either the P-V or P-Z system depending on the parameters. The simple model for P-V interactions is extended to investigate how the following alter the bloom dynamics: (1) the effect of turbulent flow and motility on the contact rate; (2) the time lag between P being infected and lysing, modelled using delay differential equations.

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HERITABILITY OF MORPHOLOGICAL AND LIFE HISTORY TRAITS IN A PELAGIC TUNICATE

Populations may adapt in response to selection pressures imposed by global environmental change. Yet the potential for evolution among marine planktonic organisms remains an understudied topic, and measurements of heritability are still rare. Here we demonstrate the feasibility of conducting assortative mating experiments with the dioecious appendicularian Oikopleura dioica to explore the narrow-sense heritability and genetic correlation among morphological and life-history traits. At our standard laboratory conditions, mature females were larger (1.214 ± 0.19 mm, mean±SD) and lived longer (8.508 ± 2.18 d) than males (1.115 ± 0.15 mm, 7.645 ± 2.07 d). The heritability (±SE) of morphological characters was low (body size, 0.03 ± 0.16) or moderate (gonad, 0.31 ± 0.28; house, 0.38 ± 0.26; tail size, 0.48 ± 0.29). In contrast, life-history traits showed moderate (clutch size, 0.32 ± 0.30) and high heritabilities (lifespan, 1.03 ± 0.47) and may therefore respond rapidly to selection pressure. Significant genetic correlations found indicate that animals evolving shorter lifespans in response to increasing temperatures would have smaller houses and tails, but gonads relatively bigger, resulting in an enhanced rate of natural increase.

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COMPETITION VS. PREDATION: IS THE SMALL DINOFLAGELLATE *GYRODINIUM* SP. A COMPETITOR FOR FOOD OR A PREY FOR THE BIG TINTINNID *FAVELLA* SP. ?

We investigated the grazing impact and competition patterns of two different groups of microzooplankters, dinoflagellates and ciliates, preying upon the flagellate *Scrippsiella* sp.. Two model predators isolated from Helgoland Roads (North Sea) were chosen for the experiments, the big tintinnid *Favella* sp. and the small dinoflagellate *Gyrodinium* sp.. The grazing impact of both species as single predators and both predators in combination on the prey *Scrippsiella* sp. was investigated. Since *Gyrodinium* sp. ranges in the same size as the prey organism *Scrippsiella* sp., its role as a potential prey item for the ciliate *Favella* sp. was additionally investigated. The aim of the present study was to elucidate potential competition patterns between both predators and, furthermore, to answer the question if the big tintinnid can be considered as a consumer of predominantly autotrophic or heterotrophic prey items. Our data indicate that *Favella* sp. prefers autotrophic prey, but the results of the present feeding experiments will be discussed in the light of food quality aspects, too.

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COMPARISON OF TOTAL VERSUS ACTIVE BACTERIOPLANKTON COMMUNITY FRACTIONS IN RELATION TO LOCAL AND REGIONAL FACTORS

The study aimed at observing the seasonal dynamics of bacterioplankton communities across eight predominantly mesotrophic lakes and their respective inlets in relation to the lakes' theoretical hydrological retention time (THRT) as well as a set of environmental parameters. Moreover, the dynamics of the total as well as active fraction within these bacterioplankton communities were compared with each other. We hypothesised that (1) inlet bacterioplankton exert a greater influence on the community structure in lakes with a short THRT compared to lakes with a long THRT. Secondly, we believe that (2) this relationship differs with the season and the therewith interrelated differences in hydrological regime as well as temperature. Lastly, we are of the opinion that (3) this relationship depends on whether the total or active fraction within the community is on focus. First results show that similarity in community structure as determined by t-RFLP is not a simple function of THRT and season. Further statistical analyses will be conducted to reveal the underlying mechanisms at work.

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BIOAVAILABILITY OF DISSOLVED NUTRIENTS FROM THE REMINERALIZATION OF DISSOLVED ORGANIC MATTER IN THE CALOOSAHATCHEE RIVER ESTUARY, FLORIDA, USA.

About 20% of the nitrogen load entering the head of the estuary is inorganic and immediately available for uptake by algae, bacteria and other plants while the remainder of the nitrogen load is organic. However, it is unknown how much of this dissolved organic nitrogen can become available to support phytoplankton production. Dark bottle experiments were conducted every three months for two years along the estuarine gradient of the Caloosahatchee River. Surface water was pre-filtered through 0.7µm filters and incubated at ambient temperature for 2 months. Concentrations of dissolved organic carbon, dissolved inorganic nitrogen and phosphorus were measured. Results indicate that a portion of the dissolved organic matter is remineralized in 14-28 days, after which the inorganic nutrients produced are utilized by the bacteria to produce organic matter, indicating a recycling of inorganic nutrients within the estuary in matter of about 2 months. Results also indicate organic matter is turned over on a shorter time scale in upstream sites compared with the downstream sites, suggesting that bacterial productivity may be higher in upstream sites compared with downstream sites.

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THE EFFECTS OF INCREASED CO2 AND LIGHT ON FE SPECIATION IN THE ROSS SEA

There is increasing concern over the impacts of CO2-driven acidification and stratification on marine ecosystems. The physicochemical speciation of dissolved iron, hence its biological availability, are expected to vary as a function of seawater pH and irradiance. Thus there is a need to develop a mechanistic understanding of the effects of decreased pH and increased irradiance on the bioavailability of Fe, and associated impacts on the phytoplankton community. A shipboard incubation experiment was carried out in summer 2005 in the Ross Sea to study the effects of increased Fe (1nM) CO2 (750ppm) and irradiance (33% I0) on phytoplankton and iron speciation in these low-iron (<0.2 nM) Antarctic waters. Iron addition increased the growth of both diatoms and Phaeocystis, regardless of irradiance and CO2 concentration. However, increased CO2 and light had a major effect on iron speciation, by mediating a decrease in the concentration of iron-binding ligands and an order of magnitude increase in free inorganic iron(III). These results have significant implications for the biogeochemical cycling of iron in the Southern Ocean under future greenhouse conditions.

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A MULTI-YEAR INCREASE IN SHALLOW POC EXPORT IS COUNTERED BY ENHANCED MESOPELAGIC POC ATTENUATION IN THE SARGASSO SEA

Regional variability in the attenuation of particulate organic carbon (POC) flux with depth and the mechanisms controlling POC transfer efficiency have received renewed attention. We present data from the Bermuda Atlantic Time-series Study indicating a coordinated increase in the magnitude of the biological carbon pump during the winter/spring period. Integrated epipelagic chlorophyll a (Chl a), primary production, suspended POC, and 150m POC flux all increased by 30-86% from 1997 to 2007. These changes in the shallow biological carbon pump are associated with significant decreases in relative abundance of diatoms and haptophytes and increases in *Synechococcus*. Over the same period, remineralization of POC flux between 150-300 m doubled such that the increase in the shallow biological pump did not increase the carbon flux to the mesopelagic. The increase in remineralization may be related to changes in the importance of zooplankton carbon demand. These findings document a disconnect between the shallow biological carbon pump and mesopelagic carbon sequestration in the oligotrophic oceans mediated by changes in plankton community structure.

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APPENDICULARIANS ECOPHYSIOLOGY, SEASONAL SUCCESSIONS, BIOGEOGRAPHY AND EFFECT IN WATER COLUMN: A MULTISPECIFIC MODELLING APPROACH

An ecophysiologic model representing food consumption, growth and production of particulate organic matter during the life cycle of an appendicularian was calibrated for the four most common appendicularian species. Using this model, we calculated the growth rates of the four species, and predicted the potentially dominant species according to the environmental conditions. This approach was validated by reproducing the seasonal distributions of the four species in the Bay of Villefranche-sur-Mer. Using satellite SST and chl a data we determined the potential physical and feeding conditions in the Atlantic, Pacific and Indian oceans. These conditions were used to estimate the potentially dominant species in a given basin during different seasons. Our predictions matched 63% of the 513 field observations described in the literature. We will discuss here the impact of appendicularians on the carbon cycling and compare the outputs of the model to in situ data.

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HOW MUCH SUBMERGED VEGETATION IS NEEDED FOR A STABLE CLEAR-WATER STATE? — PHYTOPLANKTON BIOMASS AND COMPOSITION IN INTERMEDIATELY VEGETATED SHALLOW LAKES

Unlike those in stable-state lakes, macrophyte-phytoplankton interactions at intermediate, nonequilibrium conditions in nutrient-rich, shallow lakes remain poorly known. Phytoplankton patterns in Norwegian shallow lakes dominated by *Ceratophyllum demersum* (CER lakes) or *Elodea canadensis* (ELO lakes), with vegetation cover (%cov) in the 20-80% range, were compared to those in unvegetated, reference lakes (REF lakes; %cov <10%). Macrophyte influence on total phytoplankton biomass was minimal. Lake morphometry and/or nutrient (TP) concentration influenced some taxa in REF lakes, but not as much in vegetated lakes. *Scenedesmus* was less abundant and *Microcystis* was virtually absent in vegetated lakes. CER lakes exhibited the lowest *Ceratium* density. Extent and longevity of diatom blooms were highest in ELO lakes. %Cov was a cofactor in shaping phytoplankton patterns in spring (May-Jun), while TP concentration was the main factor regulating midsummer (Jul-Aug) phytoplankton. Cyanobacteria biovolume was correlated with total phytoplankton biomass regardless of lake type. Macrophyte cover was not sufficiently high to establish a stable clear-water state in our study lakes. However, our results suggest that macrophyte influence on phytoplankton may start at %cov as low as 20-30%.

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BACTERIAL CELL WALL PRESERVATION DURING ORGANIC MATTER DIAGENESIS IN SEDIMENTS OFF PERU

The spatial distribution of total hydrolysable amino acids, total hydrolysable amino sugars and amino acid enantiomers (D- and L-forms) were investigated in surface sediments at 20 stations in the Peru margin: 9°45 S - 13°32 S. The objective of this study was to assess the preservation of bacterial cell walls during diagenesis of organic matter. Bacterial cell walls were traced by analysis of biomarkers uniquely produced by bacteria (D-amino acids and muramic acid). The diagenetic status of the sediments was evaluated from the percentage of carbon and nitrogen present as amino acid carbon and nitrogen, the ratio between protein precursors and their non-protein degradation products, compositional changes in the amino acid spectra and the percentage of carbon and nitrogen present as amino sugar carbon and nitrogen. The study clearly demonstrated a strong bacterial imprint in organic matter during early diagenesis. Hence, the key players in organic matter mineralization became an increasingly import component of refractory organic matter with ongoing degradation.

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BIOAVAILABILITY AND BACTERIAL DEGRADATION RATES OF DISSOLVED ORGANIC MATTER IN A TEMPERATE COASTAL AREA DURING AN ANNUAL CYCLE

The bioavailability and bacterial degradation rates of dissolved organic matter (DOM) were determined over a seasonal cycle in Loch Creran (Scotland) by measuring the decrease in dissolved organic carbon (DOC), nitrogen (DON) and phosphorous (DOP) concentrations during long–term laboratory incubations. The experiments showed that bioavailable DOC (BDOC) accounted for 29 ± 11 % of DOC (average ± SD), bioavailable DON (BDON) for 52 ± 11% of DON and bioavailable DOP (BDOP) for 88 ± 8 % of DOP. The seasonal variations in DOM concentrations were mainly due to the bioavailable fraction. BDOP was degraded at a rate of 12 ± 4 % d –1 (average ± SD) and the degradation rates of BDON and BDOC were 78 ± 18 % and 58 ± 17 % slower than for BDOP, indicating a preferential mineralization of DOP relative to BDON and of DON relative to DOC. Positive correlations between concentrations and degradations rates of DOM suggested that with higher concentration the faster DOM would be degraded. On average, 77 ± 9 % of BDOP, 62 ± 14 % of BDON and 49 ± 19 % of BDOC were mineralized during the residence time of water in Loch Creran, showing that this coastal area exported C–rich DOM to the adjacent Firth of Lorne.

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AN URBAN LAKE: A SINK OR SOURCE OF ATMOSPHERIC CARBON GASES?

Carbon gas fluxes from the urban Lake Vesijärvi in Southern Finland were investigated during the open-water period 2005. This clear-water lake has been a centre of studies on anthropogenic eutrophication since 1960s. Despite the diverted sewage loading, the lake still shows signs of eutrophication and for instance suffers from cyanobacterial blooms. This study is based on the fact that there is still little information on lake –atmosphere interactions from eutrophicated water bodies in urban settings. We measured CO_2 and CH_4 concentrations through water column and determined carbon gas fluxes from surface water concentrations. Our results showed that gas concentrations were higher in the anoxic hypolimnion than in the oxygenated epilimnion. CO_2 concentrations were 10 orders of magnitude higher than CH_4. Besides, hypolimnetic CH_4 concentrations were 160 times higher than epilimnetic ones. Total $CO_2$and CH_4 flux over the measuring period was 2.9 mol m^{-2} and 52.4 mmol m^{-2}, respectively. As a whole $CH_4$was of great importance and contributed 60% of GWP. Thus, this urban lake is an important contributor to carbon gas emissions.

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INORGANIC CARBON DYNAMICS IN A MEDITERRANEAN EUTROPHIC RESERVOIR.

In recent years, the carbon cycle has been widely studied in oligotrophic, non-calcareous lakes. However, studies on eutrophic, calcareous man-made reservoirs are much scarcer. In such ecosystems, the interaction between hypolimnetic water and the atmosphere is not just driven through epilimnetic processes. Additionally, carbon cycle may be determined not only by the net ecosystem production but also by the chemical equilibrium between calcite and species of dissolved inorganic carbon. In this context,

we used a mass-balance approach to study the inorganic carbon cycle in Sau Reservoir, an eutrophic calcareous system in Northern Spain. Monthly data from December 1999 to November 2004 were considered. During dry years, atmospheric carbon balance was positive (emission to the atmosphere) during the mixing period (November-March), and negative during stratification, emission being always higher than capture. During wet years, carbon dioxide capture was restricted to summer months (July-September). River flux was characterized by net CO_{2aq} export throughout the studied period. Even during periods with a net input of dissolved inorganic carbon, the reservoir exported CO_{2aq}, emphasizing its role as processor of inorganic carbon.

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PREDICTING CHANGES IN BACTERIAL COMMUNITY COMPOSITION AND COLONIZATION SUCCESS OF AIRBORNE BACTERIA IN ALPINE WATERS UNDER DIFFERENT SAHARAN DUST EVENTS

Dust exports to the atmosphere are increasing both in frequency and intensity mostly as a consequence of African droughts. These dust events mobilize particles, inorganic and organic nutrients, and microorganisms potentially viable. Previous studies have revealed a quick response of indigenous bacteria and a high viability of airborne bacteria, but their colonizing success of pristine waters is almost unexplored. We performed a factorial experiment simulating changes in the frequency (pulses) and intensity (quantity) of dust loadings to determine the changes in bacterial community composition (BCC) and the success of airborne bacteria to outcompete indigenous bacteria. Dust fertilization induced an increase of total bacterial abundance (BA) and production (BP), in particular of α- and β- proteobacteria, whereas the relative abundance of Cytophaga and Actinobacteria decreased. In presence of airborne bacteria, pulsed additions of dust reduced BP and BA and the success of β- proteobacteria, but not the relative abundance of α- proteobacteria. Consequently, the increase of Saharan dust inputs into alpine waters could lead to changes in indigenous bacterial community composition and the success of airborne bacteria.

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AGENTS OF CHANGE IN BENTHIC MARINE ASSEMBLAGES: THE EFFECT OF THE INVASIVE SEAWEED *CAULERPA RACEMOSA* VAR. CYLINDRACEA ON SOFT-BOTTOM MACROFAUNA

Invasive members of the macroalgal genus *Caulerpa* have the potential to add complexity and to change the attributes of the biotopes to which they are introduced. In the Gulf of Salerno (Central Tyrrhenian Sea), *Caulerpa racemosa* var. *cylindracea* has expanded over the last decade into areas formerly characterized by bare soft bottoms and by sparse seagrass meadows. In the frame of the Italian research project VECTOR, macrofaunal assemblages inside and outside of *C. racemosa* patches were analyzed for composition and structure during the season of maximal algal biomass (October) at two sites characterized by different sediment texture and exposure to land inputs. While differences in vegetated vs. unvegetated patches were obscure at the site dominated by muddy sediments, a detectable effect of the presence of *C. racemosa* on the overall community structure was found at the sandy site. Some taxocoenes (in particular, amphipods) appeared to respond more strongly to habitat differences. As has been observed for other invasive species, site-specific characteristics may have a major role in determining the extent of community modification induced by *Caulerpa racemosa* var. *cylindracea*.

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PHYTOPLANKTON PHENOLOGY AND SURVIVAL OF PACIFIC COD LARVAE IN THE GULF OF ALASKA AND BERING SEA

Recent warming trends have generated increased interest on the phenology of marine primary productivity. Warming may anticipate the timing of the phytoplankton bloom and therefore cause a mismatch with the peak of fish larval production. Consumption rates of endogenous reserves in fish larvae are greatly affected by water temperature, and in colder (warmer) water the negative outcome of a mismatch may be less (more) severe. In this study we use a spatially- and temporally-explicit modeling framework to assess the effect of water temperature and timing and location of the spring phytoplankton bloom on the survival of Pacific cod larvae in the southeast Bering Sea and Gulf of Alaska. In our analysis, we combine experimentally-derived rates of larval survival in relation to water temperature with satellite remote-sensing estimates of net primary productivity and sea surface temperature to predict survival success of cod larvae up to the time of encounter with their food resources. Simulations are made from 1998 to 2006, a span that covers a period of extreme warming, particularly for the Bering Sea. Our results will be discussed in the light of recent theories about year class strength of gadids in the North Pacific.

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PHYSIOLOGY AND ECOLOGY OF THE SYMBIOSIS BETWEEN MULTIPLE CO-OCCURING BACTERIA AND A GUTLESS MARINE WORM (OLIGOCHAETA)

The gutless marine worm *Olavius algarvensis* inhabits shallow permeable sands in the Mediterranean and harbors a consortium of 4 co-occurring sulfur-oxidizing and sulfate-reducing bacteria. Our autecological analyses showed populations of up to 25.000 individuals m^{-2}, with the highest abundances found at about 15 cm sediment depth. Porewater and *in situ* microsensor analyses showed that most of the population occurred in anoxic sediments. In laboratory experiments, the worms tolerated anoxic conditions for extended time periods of up to several weeks. They could not, however, tolerate anoxia indefinitely, indicating that they must periodically migrate to the oxygenated upper sediment layers for access to oxygen. For the sulfur-oxidizing symbionts, nitrate could serve as an alternative electron acceptor, particularly after storms, which led to considerable increases in porewater nitrate concentrations in the worm's environment. Although sulfate reduction rates were high at about 10 nmol cm^{-3} d^{-1}, sulfide concentrations were extremely low (below 1 µM). Experiments with a newly developed micro-respiration chamber for single worms showed that the symbiotic sulfur-oxidizing bacteria respired oxygen at 6 times higher rates than the worms themselves.

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ARE THERE LINKS BETWEEN ARCHAEA, PROTISTS AND THE REST?

Microbes in the ocean include phytoplankton, bacteria, diverse bacterial grazers and archaea. Using molecular biology techniques we are now able to identify species and ecotypes of not only phytoplankton but the entire community and it is becoming practical to match community composition with biomass, oceanic processes and biogeochemical and ecological pathways. Recent evidence indicates that Archaea may be key components in the nitrogen cycle, thus controlling the dominant form of nitrogen over large regions of the ocean. Many empirical studies report that communities where the primary N source is nitrate are made up of characteristic phytoplankton and zooplankton clades or taxa that differ from communities where ammonia is the primary N source. This leads to the conjecture that archaeal activity and distribution may be an indication of higher food web structure.

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A GAS-CONTROLLED AQUARIUM SYSTEM FOR HIGH-CO_2 OCEAN STUDIES

Altered upper ocean chemistry linked to rising levels of anthropogenic carbon dioxide portends adverse and uncertain consequences for marine life. Evaluating biological responses (acid-base regulation, respiration, growth) these chemical changes confer as they penetrate deeper (decreased pH) or shoal (aragonite, calcite saturation) in the world's oceans is critical to understanding their ecological impact. We've developed a gas-control system (GCA) to regulate pH, CO_2 and dissolved oxygen (DO) in aquaria for studying ocean acidification (hypercapnic, and, or hypoxic) effects on marine animals. GCA autonomously governs DO and pH or pCO_2 in four temperature-controlled water tanks, allowing multiple treatment exposures. The design employs mass flow controllers (MFC) to meter source gases (CO_2, O_2, N_2) to aquarium water via diffusive membrane contactors. Tank pH and O_2-optode sensor data, received through Ethernet-connected industrial controllers by a LabVIEW application, stimulates MFC-command signals to regulate water chemistry.

In daylong experiments using GCA, blood buffering in shallow-living crabs (*Cancer magister*) was nearly complete while deep-living crabs (*Chionoecetes tanneri*) displayed no compensation. Weeks-long work underway in the GCA with brachiopods (*Laqueus californianus*) suggests hypercapnia initially elevates respiratory rates.

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ECOLOGICAL AND EVOLUTIONARY RESPONSE OF PHYTOPLANKTON TO RISING CO2

Global atmospheric CO2 concentration has increased steadily over the past fifty years, with levels expected to climb from 380 ppm at present to near 1000 ppm during the next century. This increase has potentially dramatic direct impacts on the biosphere, beyond its indirect effects through climate change. Notably, phytoplankton, responsible for nearly half of the earth's biological carbon uptake, respond directly to increases in CO2. However, little is known about the effect of CO2 on phytoplankton communities. In laboratory experiments, we studied the effect of high (1000 ppm) vs. ambient CO2 on six species of freshwater phytoplankton representing three functional groups (cyanobacteria, chlorophytes and diatoms). We focused on the competitive interactions between these species in pair-wise and community (all six species) competition assays. We found that growth response to high CO2 varied among functional groups, which translated into changes in the competitive dynamics in assays under high CO2. We also tested for evolutionary adaptation to rising CO2 by investigating the response of the six phytoplankton species to a gradual rise in CO2 over a period of over 100 generations.

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HIGH THROUGHPUT SEQUENCING REVEALS NOVEL FEATURES IN THE TRANSCRIPTOME OF THE HETEROTROPHIC FLAGELLATE OXYRRHIS MARINA

Next generation sequencing technologies hold huge promise for the de novo characterisation of genomes, transcriptomes, and gene expression patterns from non-model organisms. Using 454 sequencing we have partially characterised the trascriptome of the flagellate Oxyrrhis marina and identified differences in gene expression patterns in response to salinity. Oxyrrhis marina is widely distributed marine flagellate common in coastal and intertidal environments. Previous study suggests that differential responses to environmental salinity may represent specific adaptiations to different coastal habitats. To identify potential mechanisms associated with slainity reponses, and as a step toward understanding the adaptive significance of salinity tolerance in O. marina, gene expression profiles were assessed under differing salinity treatments. A single strain of O. marina was grown a 10 and 45 psu in the laboratory under axenic conditions; subsequent cDNA fragment libraries were sequenced using the 454 GS F:X platform and following assembly sequencing depth used to identify transcripts differentially expressed between treatments. In this presentation we describe novel features of the O. marina transcriptome and highlight a strategy for the identification of candidate genes associated with physiological responses.

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USING PROTEOMICS METHODS FOR THE CHARACTERIZATION OF DISSOLVED PROTEIN IN SEAWATER

Tracing the sources, transformations, and fates of components of the dissolved organic matter (DOM) pool in seawater is an extraordinarily complex problem. Dissolved proteins comprise an important portion of the DOM pool that can be characterized at the molecular level and these structures are anticipated to reveal clues into the mechanisms of DOM cycling. Recent advances in mass spectrometry, separations, and proteomics methodology make characterization of dissolved protein in seawater more feasible than ever. Initially, ultrafiltration, and methanol/cholorform/water (M/C/W) precipitation were used for the extraction of dissolved proteins. Currently, a solid phase extraction method is being developed to replace the M/C/W precipitation. Through database searching, numerous peptide tags have been detected that reveal a trend of conserved sequences for membrane-associated proteins and enzymes. Both surface and deep water samples will be compared from the BATS and HOTS sites.

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DOES BENTHIC WEATHER AFFECT FISH SOUND PRODUCTION?

Sounds are produced in coastal waters by fishes for mating purposes. We used an instrumented tripod with a passive acoustic recorder to study linkages between measures of "benthic weather" (temperature, salinity, dissolved oxygen, waves, turbidity) and biological sound production. Nocturnal sound production by fishes began in spring and continued through autumn in frequency range 100-5000 Hz. Variations in the pulse rate and spectral quality of the sounds were associated with known species of fishes (silver perch, weakfish, spotted sea trout, red drum, Atlantic croaker (Family Sciaenidae), the striped cusk eel (Ophidiidae) and oyster toadfish (Batrachoididae). As a cold front passed the NC coast in April-May 2006, temperature of the Pamlico Sound declined and sound production by fishes was minimal, later increasing as water warmed. Sound levels remained high through the summer, declining as water temperature declined in the autumn. Tropical storm Ernesto passed directly over the study site in Sep 2006, and did not cause decline in fish sound production. We conclude that passive acoustic methods provide a cost-effective approach to document the spanwing of sound-producing fishes on ocean observatories.

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RIVER INPUTS TO SOUTHERN EUROPEAN SEAS: MAJOR DRIVERS FOR ECOSYSTEM CHANGES DURING THE PAST AND FUTURE DECADES?

We present a reconstruction of the spatial and temporal variability of river fluxes to the Mediterranean and Black Sea since the early 1960s. Our data indicate that Mediterranean rivers suffer from a reduction in freshwater discharge by at least 20%, contrary to rivers of the Black Sea, which do not depict clear trends. A decrease can also be expected for the fluxes of dissolved silica, mainly controlled by water discharge and potentially reduced by river damming. This contrasts with the fluxes of nitrogen and phosphorus, which were strongly increased by anthropogenic inputs. While N still remained at elevated levels in 2000, P only increased up to the 1980 – 1990s, and then rapidly dropped down to about the initial values. Thus, not only the quantitative, but also the qualitative nutrient supply was highly variable. Reported ecosystem changes both in the Adriatic Sea and the Black Sea are concomitant with major changes in the reconstructed river inputs and further work should be dedicated to quantify the role of rivers in the productivity of the coastal ecosystems in the Mediterranean and Black Sea.

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EFFECTS OF ORGANIC MATTER ON METHYLMERCURY ACCUMULATION BY PHYTOPLANKTON

The mechanism by which phytoplankton accumulate methylmercury (MeHg) from surrounding waters is not understood, and there are conflicting reports about whether dissolved organic matter (DOM) enhances or reduces MeHg bioavailability. We cultured phytoplankton in solutions with radiolabeded MeHg and varying concentrations of organic matter extracts from different sources within the San Francisco Bay Delta. The degree of MeHg enrichment in phytoplankton cells relative to ambient water (volume concentration factor; VCF) without added organic mater was as high as 3×10^5. For low organic matter concentrations (150-250 uM DOC), VCFs were $3\text{-}9 \times 10^4$. With high organic matter concentrations (500-850 uM DOC), VCFs were generally $< 2 \times 10^4$. These results indicated that DOM complexed MeHg and limited its bioavailability to phytoplankton. The geographic origin of the organic matter had no effect on MeHg VCFs. However, phytoplankton cultures containing hydrophobic organic matter had significantly lower VCFs than those exposed to the transphilic (a less hydrophobic) fraction. Living cells accumulated 2-4 times more MeHg than heat-killed cells, indicating that MeHg accumulation was partially an active biological process.

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TOWARDS A BETTER UNDERSTANDING OF A PERTINENT BIOMARKER OF CONTAMINANT EFFECT ON *CRASSOSTREA GIGAS*: THE PROPHENOLOXIDASE SYSTEM

Laccase and tyrosinase are two groups of phenoloxidase (PO) that catalyze the oxidation of a large number of diphenolic aromatic compounds. Unlike tyrosinases, laccases are unable to oxidize monophenolic compounds (Durán *et al.*, 2002). Therefore, assays of these two enzymes may differ, *i.e.* by using monophenolic (*e.g.* L-tyrosine) or diphenolic substrates (*e.g.* L-dopa). The pro-phenoloxidase (proPO) system is known to be implicated in immune mechanisms in several invertebrates (Cerenius *et al.*, 2008) and PO activity has been studied in the hemolymph of *Crassostrea gigas (C.gigas)*, an economical important organism in France (Thomas-Guyon *et al.*, submitted, Hellio *et al.*, 2007). Moreover, *in vivo* effects of several metallic and organic pollutants were investigated on

this hemolymphatic parameter (Bado-Nilles *et al.*, submitted, Bouilly *et al.*, 2006, Gagnaire *et al.*, 2004). The aim of this study was to determine whether laccases or tyrosinases are implicated on these mechanisms in order to contribute to a better understanding of the proPO system in *C.gigas* and to a more specific monitoring of phenoloxidase activity, considered as a pertinent biomarker of contaminant effect in oyster.

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BEATING THE BLUES: A WHOLE-LAKE "FLOCK & LOCK" EXPERIMENT SUPPRESSING CYANOBACTERIAL BLOOMS

In the Netherlands, despite numerous mitigating measures taken in the past, many freshwater systems are still suffering from intense cyanobacterial blooms. As climate-change is predicted to aggravate these harmful cyanobacterial blooms, additional measures are needed to restore our eutrophied water bodies. After intense laboratory and enclosure trials, in 2008 a whole-lake experiment was performed using a novel "Flock & Lock" technique. The combination of a polyaluminium-based flocculant and Phosphorus fixation by Lanthanum-modified claycan be considered an in situ dephosphatation measure, which is all year round applicable. The experimental lake, Lake Rauwbraken, has suffered heavily from cyanobacterial blooms prior to the treatment, leading to a 4 month swimming ban in 2007. The "Flock & Lock" application in April 2008, eradicated the bloom and surface scum already present and resetted the system to oligotrophic conditions. The entire bathing season the water was extremely clear and Secchi-depths reached 8 m. Our results show that "Flock & Lock" might be a fast, cost-effective and very promising measure preventing cyanobacterial nuisance and a way of meeting Water Framework Directive and Bathing Water Directive goals.

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TRACE ELEMENT SPECIATION AT OMZ INTERFACES AND EMANANTING FROM HYDROTHERMAL VENTS

Reactions at oxic-suboxic and suboxic- anoxic interfaces as well as at hydrothermal vents can lead to the formation of several meta-stable chemical species. Included in these are soluble metal-sulfide clusters and nanoparticles as well as Mn(III) compounds. These soluble species allow for the transport of metals that have traditionally been thought to precipitate. The lifetime of metal sulfide nanoparticles is significant and as soluble entities can be transported long distances within sediments as well as the ocean water column. Here we describe the formation, stability and reactivity of soluble Mn(III) compounds and metal sulfide nanoparticles. Field data will also be presented from the Black Sea, Chesapeake Bay and vent systems.

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BIOGEOCHEMICAL CONTROLS ON THE EXPORT OF DISSOLVED ORGANIC NITROGEN FROM FORESTED WATERSHEDS

Dissolved organic nitrogen (DON) typically dominates total dissolved nitrogen (TDN) export from unpolluted forested ecosystems while nitrate dominates TDN losses from ecosystems receiving high anthropogenic N loading. As inorganic N availability increases, we anticipate concomitant changes in both the concentration and bioavailability of DON. To examine this we compared patterns of streamwater DON, DOC and nitrate concentrations across 25 streams in the Great Smoky Mountains National Park (USA) spanning a gradient of N deposition (5-31 kg/ha/yr). Streams were sampled multiple times during early and late growing season to compare periods of low and high streamwater DOC. We found that: 1) DON was more highly correlated with nitrate than with DOC in both seasons; 2) that DOC and DON concentrations were much higher during the late growing season; and that 3) stream DON switches from being predominantly a C source in the early growing season to an important N source in the late growing season. These results indicate that anthropogenic N loading may result in seasonally important increases in DON loss from forested ecosystems.

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EFFECTS OF BIODIVERSITY ON PHYTODETRITUS PROCESSING BY DEPOSIT-FEEDING MACROFAUNA: TWO EXPERIMENTS WITH ISOTOPE TRACERS

The link between benthic biodiversity and ecosystem functioning is poorly understood even though benthic organisms are crucial in global cycling of organic matter. Direct observations of specific resource use by each species in single- and multi-species communities, as quantified by stable isotopes, allows mechanistic understanding of the effects observed from species loss. We tested the effects of altered biodiversity of deposit-feeding macrofauna on incorporation and burial of phytodetritus by four species, in combinations representing natural communities found in the sediments of the species-poor Baltic Sea. The four species, two amphipods, a bivalve and a non-indigenous polychaete, had different rates of incorporation and burial of carbon (C) and nitrogen (N) depending on type of phytodetritus (diatoms or cyanobacteria) and species composition in the benthic community. Communities of several species incorporated more C and N than predicted from the respective single-species treatments, due to higher incorporation by surface-feeders in multi-species treatments. In conclusion, more diverse sediment communities were more efficient in utilization of phytodetritus.

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LOCAL EFFECTS OF BLUE MUSSELS AROUND TURBINE FOUNDATIONS IN AN ECOSYSTEM MODEL OF NYSTED OFF-SHORE WIND FARM, DENMARK

The development of off-shore wind farms along the coastline of north-west Europe is rapidly increasing it is therefore important to study how this will affect the marine environment. The present study modelled the growth and feed-backs of blue mussels in natural beds and on turbine foundations in an off-shore wind farm (OWF) located in a shallow coastal ecosystem by coupling a dynamic energy budget (DEB) model to a small-scale 3D hydrodynamic-biogeochemical model. The model results showed that blue mussels located higher up in the water column on turbine pillars achieved a 7-18 times higher biomass than those located on the scour protection because the former experience an enhanced advective food supply. Secondly, the high biomasses of blue mussels on foundations created local 'hot spots' of biological activity and changed ecosystem dynamics due to their feed-back processes. Our study emphasised that OWF's seem to be particularly favourable for blue mussels in the western Baltic Sea and that the functioning of the OWF's as artificial reef ecosystems depends upon how the blue mussels interact with their local pelagic and benthic environment.

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ECHOES IN THE ECOSYSTEM: MULTIPLE STRESSORS AND REGIME SHIFTS IN A LAKE

Lakes are subjected to numerous environmental stresses that operate at different scales, can act sequentially or in parallel and can affect 'bottom-up' or 'top-down' processes. This study analysed long-term records, of over 50 years, from Windermere, UK. Historically, the main external stressors on Windermere have mainly been bottom-up processes that affect nutrient availability and lake productivity via local nutrient enrichment from within the catchment. This led to attendant knock-on effects of eutrophication such as high summer pH and oxygen depletion at depth. Recently, a combination of climate change and invasion of a non-native fish, probably linked to climate change, has altered the response of the lakes to nutrient load. This appears to have taken place via a top-down trophic cascade caused by a greater grazing pressure by fish, reduced summer zooplankton and increased summer phytoplankton despite phosphate removal from inflowing sewage works. The study should serve as a warning to lake regulators. Clear deteriorations in water quality can occur even when loads of limiting nutrients are reduced because of interactions within a lake, in this case driven by climate change.

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TARGETED METAGENOMICS: MAXIMIZING RECOVERY OF PHYLOGENETICALLY IDENTIFIABLE FRAGMENTS

We are interested in focusing metagenomic sequencing on particular phylogenetic and/or functional groups, using *Beggiatoa* mats as a test system. For phylogenetic targeting, we take advantage of homing endonuclease I-*Ceu*I, which cuts within large-subunit (23S) prokaryotic ribosomal RNA (rRNA) genes. I-*Ceu*I fragments should have partial 23S genes on one end, and partial 23S plus (in most cases) intact small-subunit (16S) genes on the other. Fragments suitable for fosmid cloning (ca. 40 kb) can be cloned directly, and end-sequenced for phylogenetic identification. Longer fragments must be further digested, followed by selection for those bearing rRNA genes; for this we are testing poly(T) tailing of I-*Ceu*I ends, followed by restriction enzyme digestion and poly(A) capture. To sample sequences more distant from I-*Ceu*I sites, we are developing a fragment circularization method, using biotin-labeled or triplex-DNA-binding linkers. Circularized fragments will be further digested, and labeled subfragments captured for cloning. To target functional groups, we envision using engineered nucleases (e.g. zinc finger nucleases) to cut within conserved functional-gene sequences in I-*Ceu*I fragments. Circularization would bring rRNA and functional genes together, connecting phylogeny and potential function.

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ABUNDANCE AND STRUCTURE OF DENITRIFIER COMMUNITIES AND ITS RELATIONSHIP WITH DENITRIFICATION AND NITROUS OXIDE PRODUCTION IN SALTMARSHES IN TEMPERATE ESTUARIES

In this study, the denitrifier communities abundance, structure and activity were studied in two temperate salt marshes: Cávado estuary (41°N), and Sado estuary (38°W). Denitrification potential presented a strong temporal variation, with higher rates during the summer and fall. Rates of N_2O productions were found to be higher in sediments colonized with plants than in un-colonized sediments. These differences could be partially explained by the microbial community structure studied by DGGE. While in Cávado estuary seasonal differences in denitrifying community structure reflected seasonality, in Sado estuary differences in denitrifiers community surpassed the differences between colonized and un-colonized sediments, in Sado estuary an opposite trend was found. Our results also suggest that denitrifier communities are adapted to distinct environmental pressures and that community structure alone cannot explain all the differences in denitrification rates. Moreover, denitrifier communities in rhizosediment can have an important contribution to the greenhouse effect through N_2O emissions. Since salt-marshes colonize large areas in temperate estuaries, the dynamic of the denitrification pathway should not be disregarded. This work was partially funded by FCT, Portugal, project POCTI/CTA/48386/2002.

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THE EFFECT OF NITROGEN STARVATION AND RESUPPLY ON PHOTOSYNTHESIS AND GROWTH IN THE TOXIC RAPHIDOPHYTE *HETEROSIGMA AKASHIWO*.

Microalgal blooms terminate if nutrients become unavailable. The ability to resume growth on nutrient re-supply depends on maintaining functional pathways for carbon acquisition. The toxic bloom-forming raphidophyte Heterosigma akashiwo was subjected to simultaneous nutrient- and light stress by stopping nitrate supply to continuous cultures that were acclimated to growth-saturating irradiance. Cell division ceased on exhaustion of nitrate. There was a 2.5x increase in C quota over 3 days, primarily due to carbohydrate accumulation, but no significant change in N or Chla quotas. Both the light-limited and light-saturated photosynthetic rates declined during N-starvation. The reduction in Pm was greater than in γ(60% vs 30%). This seemed inconsistent with preferential loss of the PSII RC protein D1 relative to the carboxylating enzyme Rubisco. Loss of photosynthetic performance was correlated with a loss in ATPase relative to D1 or Rubisco, consistent with regulation through loss of coupling between 'light' and 'dark' reactions. This was supported by changes in the xanthophyll de-epoxidation state. Cell division resumed rapidly when nitrate was re-supplied and returned to the acclimated, nutrient-replete state within 36 hours. This clone of H. akashiwo had a remarkable resistance to and very rapid recovery from light stress during nutrient starvation, which may play a role in its ability to bloom in surface waters with intermittent nutrient supply.

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SPATIAL HETEROGENEITY IN PHOSPHORUS AND CHLOROPHYLL DISTRIBUTION IN SHALLOW WATER HABITATS OF A SMALL PRODUCTIVE LAKE

The attainment of good ecological status in lakes under the provisions of the EU Water Framework Directive requires an improved understanding of the sources of limiting nutrients such as phosphorus. Whilst developments at the catchment level have allowed the allocation and assignment of source areas and sinks; at the lake scale, assumptions of spatial homogeneity in both supply of phosphorus and algal productivity often do not reflect the complex interactions taking place. Identification and quantification of lateral, vertical and inflow contributions of phosphorus have been made in a small temperate lake in the English Lake District. The use of horizontal transects and vertical profiles of phosphorus, combined with continuous automatic measurements using thermistor chains and meteorological variables have allowed the quantification and comparison of these fluxes over the period of stratification. Whilst in terms of absolute load, the inflow is likely to dominate; the spatial extent of its influence is significantly less than that of the smaller lateral and vertical fluxes. Implications for lake-scale ecosystem function are discussed.

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AN ASSESSMENT OF POTENTIAL IMPLICATIONS OF CLIMATE CHANGE ON THE MOBILIZATION OF DIFFUSE POLLUTANTS

Changes in the climate of temperate regions are likely to lead to increased losses of diffuse substances transferred from agricultural land to surface and ground waters e.g. sediment, carbon, nitrogen and phosphorus. As part of a UK based science-policy initiative Integrating Water and Agricultural Management (IWAM) we have developed a framework for assessing climate change impacts on the mobilization of diffuse pollutants from UK agricultural land. We have chosen three model farm systems (MFSs; arable, lowland dairy and upland sheep). In our assessment we have found that lowland dairy is potentially the most sensitive to the predicted climate changes (2020). The projected increase in winter precipitation and all year round rainfall intensity are likely to be the largest climatic drivers for significant increases in detachment and solubilisation. An important part of our assessment was to identify the scientific gaps and uncertainties around climate change and diffuse pollutant mobilization and to facilitate improved recommendations for policies related to sustainable land and water management. The findings of our assessment will be incorporated with two additional IWAM themes to support evidence based policies.

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A MODELING STUDY OF ALTERNATE STABLE STATES IN THE FLORIDA BAY ECOSYSTEM: A SYNTHESIS OF MODELS TO SIMULATE BENTHIC-PELAGIC COUPLING

The increasingly oscillatory behavior of oligotrophic Florida Bay, FL may poise the estuary between alternate stable states of benthic and planktonic dominance. The shallow subtropical bay was historically a seagrass system low in phytoplankton abundance; recent and expanding algal blooms may indicate an ongoing regime shift. In recent decades, the estuary has been altered by reduced freshwater inflow, diminished circulation, seagrass die-off and declining water clarity. A numerical model (SEACOM) of benthic-pelagic coupling provides a landscape-based tool for testing hypotheses about ecosystem processes, predicting potential ecosystem trajectories and cascading reactions. The model simulates biomass, production and community structure for three dominant seagrass species, Thalassia testudinum, Halodule wrightii, and Ruppia maritima, three phytoplankton functional groups and biogeochemical processes in the sediments and water column. Non-linear nutrient, light and salinity responses of autotrophic components related to the magnitude and seasonality of freshwater inflows predict shifts in species dominance. Sensitivity analysis of basin flushing rates, nutrient loads and internal nutrient cycling efficiency assess potentials for threshold responses contributing to a benthic-pelagic shift and reveals tipping points for state changes of the system.

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STUDYING THE IMPACT OF BACTERIA ON SUSPENDED PARTICULATE MATTER TRANSPORT PROPERTIES UNDER DIFFERENT HYDRODYNAMICAL CONDITIONS

Properties of suspended particulate matter (SPM) like size, fractal dimension, density and composition determine the transport and fate of sediment and particulate organic matter. It is still unclear, to what extent microorganisms have an impact on those properties. Therefore, an experimental study with natural SPM in the presence and absence of bacteria under four different hydrodynamical conditions was carried out in rolling chambers. Additionally, a size class-based model has been developed to mimic the aggregate dynamics in these chambers. It includes the processes of advection, centrifugal fluxes, diffusion, settling, aggregation and fragmentation of fractal aggregates. Experimental results indicate that the presence of microbes alter particle properties on a short timescale dependending on the hydrodynamical conditions - the higher the shear rate the less is the impact of bacteria on the aggregate dynamics. First model simulations point to an influence of bacteria on the aggregate strength and the collision efficiency. These results indicate a need for further studies on the interplay between bacteria and hydrodynamics as it could have several implications for the fate of sediment and organic matter in aquatic environments.

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VIRAL PRODUCTION AND PROKARYOTIC COMMUNITY STRUCTURE IN MUD VOLCANOES ECOSYSTEMS

Mud volcanoes are formed as the result of the emission of argillaceous material on the sea floor. In these environments, the combined effects of the deposition of allochthonous sediments, the presence of gas hydrates, and the emission of gases could lead to the formation of hot-spots of biodiversity and oases of microbial life. The emission of methane and other hydrocarbons, the presence of gas hydrates, and the release of high concentrations of iron and zinc sulphides could sustain diverse metabolic pathways and high microbial metabolic rates. However, mud volcanoes ecosystems are still poorly known, especially for what the microbial community structure and the role of viral infection on prokaryotic abundance is concerned. Here, we report the first data of abundance, heterotrophic production and diversity of benthic prokaryotic assemblages in sediments surrounding five mud-volcanoes located in the Eastern Mediterranean. We also investigated the abundance, production and the role on prokaryotic mortality of viruses in sediments with and without emission of gases. Our results give new insights on the understanding of microbial loop in these extreme environments.

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DMSP AND METHIONINE DEGRADATION EXACERBATES N2O PRODUCTION: FROM BACTERIAL CULTURES TO ESTUARINE SEDIMENTS

In this study we evaluated the effects of organic sulfur compounds dimethylsulfoniopropionate (DMSP) and methionine and some of its degradation products on the last step of denitrification in a pure culture of *Silibacter pomeroyi* and in different sediments from Douro and Ave estuaries (Portugal). Results showed that DMSP and methionine additions to sediments and to cell suspension *S.pomeroyi* caused a progressive accumulation of N_2O. Experiments with degradation products of DMSP and methionine suggested that methanothiol (MT) was a major inhibitor of the last step of denitrification. The accumulation of N_2O was linearly related to MT concentrations (either MT resulting from direct additions or produced from methionine) in both coastal sediments (R_2 =0.7 to 0.9, p<0.05) and in *S. pomeroyi* cell suspensions (R_2 =0.9, p<0.01). In some sediments, no inhibition of nitrous oxide reductase activity was observed after methionine additions, and this was related to the lack of MT accumulation in those sediments. Finally, our results represent a valuable contribution to the understanding of a completely new aspect of the complex interactions between marine nitrogen and sulfur cycles.

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RETHINKING WATER GOVERNANCE: COMPARATIVE PERSPECTIVES ON THE IMPACT OF REGIONAL INTEGRATION.

Most studies on comparative regional integration view these processes as positive advances toward economic cooperation, and negative environmental consequences are often perceived as collateral damage. Scholars rarely link studies of the economic impact of regional governance with analyses of environmental management, particularly in the field of water politics. This paper examines the economic and environmental impact of regional integration (or lack thereof) in border communities in Europe (France-Belgium), North America (Mexico-US) and South America (Colombia-Venezuela). It specifically analyzes the impact of local political decision-making processes on urban expansion and access to water distribution in comparative border contexts. It links these two fields through an ethnographic study of power and decision-makers in governmental institutions. The paper argues that the internationalization of urban planning and water management through regional integration schemes weakens public participation due to limited public knowledge of regional governance, exacerbating a democratic deficit in these fields.

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DECADAL CHANGES IN ABUNDANCE OF INTERNAL BIOERODERS IN CORAL REEFS OF THE SOUTHERN SINAI PENINSULA

Internal bioeroders play a crucial role in coral reef decline as they actively erode the carbonate substrate. Their role might even become more important when the reef framework will additionally be weakened by other stressors like ocean acidification. Fast assessment methods to quantify internal bioerosion are therefore needed to establish a "baseline". Abundance of internal bioeroders in the northern Red Sea were monitored in 1996 and again in 2007/2008 at 3 sites which are distinct with respect to stressors such as diving pressure and sedimentation. Line transects and small transects were used to assess substrate type and internal bioeroders. This was supplemented by photographing to evaluate the possibility of a more rapid assessment of internal bioerosion. The site with least diving pressure was least affected by internal bioeroders. However, the second site without diving pressure, but high sedimentation rates was flooded resulting in fresh water and sedimentation impact. This resulted in much smaller live colonies and a reduced infestation by bioeroders in both live colonies and dead calcareous substrates with decadal changes more being prominent at this site.

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EUTROPHICATION AND AMMONIA INHIBITION IN THE TAW ESTUARY, SW ENGLAND

The Taw Estuary is a small, well flushed system which repeatedly experiences severe algal blooms (chlorophyll 100 µg L^{-1}). It is an OSPAR Problem Area and designated under the EU Nitrates and Urban Wastewater Treatment Directives. Blooms usually occur during dry, warm weather, when freshwater input from the catchment is low. Phytoplankton biomass is highest in the central part of the estuary, adjacent to the outflow of a sewage treatment plant. Interrogation of a long term monitoring dataset showed that ammonia concentrations at this site were usually 3 – 10 µM whereas nitrate was 50 – 250 µM. The data, when related to chlorophyll concentrations, suggested that ammonia played an inhibitory role, preventing the phytoplankton from reaching their maximum theoretical biomass under *in situ* nitrate concentrations. This presentation discusses the nutrient regime in the Taw Estuary, with an emphasis on the impact of water residence times and different forms of nitrogen on algal growth and phytoplankton community successions during an intensively monitored bloom in Summer 2008. The findings are of high relevance to eutrophication management of similar systems under current EU legislation.

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INDIRECT EFFECTS OF NON-LETHAL PREDATION ON SEDIMENT BIOTURBATION

Deposit-feeding bivalves stimulate the mineralization of recently settled organic matter and affect nutrient cycling, by aerating the sediment, feeding and redistributing particles. Feeding above the sediment-water interface, however, makes them especially vulnerable to sublethal predation. Here, we investigated the effects of predation avoidance on the feeding activity and bioturbation of the bivalve Macoma balthica. Feeding activity at the sediment-water interface and bioturbation intensity were monitored using image analysis techniques. Detection of the predatory shrimp, Crangon crangon resulted in a reduction in feeding activity for an extended period of time. M. balthica also buried deeper into the sediment. This predator avoidance behaviour indirectly affected sediment bioturbation, increasing the thickness of the bioturbated sediment layer as well as the non-local transport of sediment particles at depth. Conversely, feeding activity and bioturbation remained unaffected when C. crangon was isolated from the sediment, suggesting that predator perception in M. balthica is tactile rather than being chemosensory. Collectively, these results demonstrate that trophic interactions, through predatory avoidance behaviours, can significantly impact sediment bioturbation and thus the incorporation of organic matter into the benthic food web.

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ACHIEVING A ROBUST EUTROPHICATION STATUS ASSESSMENT OF THE WATERS OF THE NORTH EAST ATLANTIC. APPLYING THE OSPAR COMPREHENSIVE PROCEDURE

The OSPAR Commission published a new assessment of the eutrophication status of the estuarine, coastal and marine waters of the north east Atlantic in 2008. The results will be illustrated with case studies. This paper will describe the development of the Comprehensive Procedure, taking account of lessons learned from the 2003 assessment and advances in applying relevant science. The way challenges, such as the setting of reference conditions and assessment levels for the various criteria, have been resolved will be discussed showing progress towards regional harmonization. The impact of data availability on the confidence that can be assigned to the assessment will be described together with a view on how novel data sources, including remote sensing, and improved data presentation tools could be used to enhance confidence. We will demonstrate that the assessment is a robust basis for the management of the consequences of nutrient enrichment and can be used in support of European legislation as well as being clearly based on sound ecological understanding.

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TIDE INDUCED EXPULSION OF DINOFLAGELLATES PYRODINIUM BAHAMENSE AND CERATIUM FURCA FROM LAGUNA GRANDE TO LAS CROABAS, PUERTO RICO

Pyrodinium bahamense var. bahamense and Ceratium furca are the most common dinoflagellate species in Puerto Rican coastal lagoons. Most of the bioluminescence observed in these habitats is caused by P. bahamense. This study describes how the inflow and outflow of the tide affects the entrance and exit density levels of these two species in Laguna Grande. Seven stations were established in the study area. At each station samples were taken to determine the concentration of nitrates, phosphates, fluorescence, salinity and temperature, and to determine the density of P. bahamense and C. furca. The average population density of P. bahamense y C. furca was higher in the lagoon and in the channel during the lowering tide. During the rising tide the average density of both species was lower in Las Croabas and in the entrance channel. These findings suggest a net expulsion of both species, from Laguna Grande to Las Croabas, caused by the rising and lowering of the tides. A similar pattern was observed in the In-Vivo fluorescence levels, also suggesting a net expulsion of phytoplankton.

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THE COPPER REQUIREMENTS AND ACQUISITION MECHANISMS OF MARINE PHYTOPLANKTON

Recent studies have demonstrated an interaction between Fe and Cu nutrition in marine diatoms. To further investigate this interaction, short-lived Cu radioisotopes were used to determine the Cu requirements and uptake kinetics of multiple phytoplankton taxa grown under various Fe and Cu conditions. The centric diatoms, *Thalassiosira oceanica* and *T. pseudonana*, exhibit distinct biphasic Cu transport rates as a function of Cu concentrations, suggesting the presence of a high- and a low-affinity Cu transport system. The two Cu transport systems followed Michaelis-Menten saturation kinetics, but were controlled differently by Fe and/or Cu limitation. The acquisition of Cu from strong synthetic and natural organic complexes was also investigated in laboratory cultures and in natural plankton assemblages in the NE Pacific. The results suggest that Cu(I) is preferentially taken up, and that the rates of Cu uptake are controlled by the relative concentrations of the metal and the ligand, rather than by inorganic Cu concentrations. We are currently using LC-MS/MS to investigate the differential expression of proteins in *T. oceanica*, grown under various Fe and Cu treatments.

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DECADAL OSCILLATIONS OF SCYPHOZOAN JELLYFISH AND MESOZOOPLANKTON IN THE GULF OF TRIESTE

Two periods of high scyphozoan jellyfish abundance were recorded during a monitored period (1974 – 2007) in the Gulf of Trieste (northern Adriatic Sea): from 1980 to 1986 and from 2003 on. The first period was characterised by mass occurrences of holoplanktonic *Pelagia noctiluca*, while from 2003 on very high densities of *Aurelia aurita* and *Rhizostoma pulmo* were recorded. Two other species (*Chrysaora hysoscella* and *Cotylorhiza tuberculata*) were also observed occasionally but never reached very high densities. In addition to jellyfish we examined oscillations in mesozooplankton biomass and selected environmental parameters (T, S, pH, Chl a). Mesozooplankton and chlorophyll biomass were higher during years with low jellyfish abundance. "Pelagia years" were characterised by colder than long term average temperatures in summer, warmer temperatures in autumn and salinities above average, all indicative of a stronger ingression of south Adriatic waters. After maintaining itself at rather high densities for several consecutive years, the *Pelagia* population of the northern Adriatic collapsed rather abruptly and for no obvious reason. It reappeared in low numbers during 2003-2007, again associated with higher salinities. During the same period blooms of *Aurelia* and *Rhizostoma* occurred.

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CELL SURFACE ARCHITECTURE OF PELAGIC MARINE BACTERIA IS SIGNIFICANT IN BACTERIA-ORGANIC-MATTER INTERACTIONS: AN ATOMIC FORCE MICROSCOPY STUDY

Bacteria and archaea mediate over one-half of the global ocean carbon cycling. They interact with marine productivity in the upper ocean to influence the biogeochemical fate of organic matter, system respiration and export flux --with implications for ecosystems and climate. Bacteria organic matter coupling has been studied using EFM, tracer and enzymatic approaches. Given the complexity of organic matter pool with which bacteria interact atomic force microscopy imaging could provide novel insights. We used AFM to image pelagic microbes and organic matter. Majority of microbes (>80%) had surface architectures of mucilage and pili. They interact with gels and fibrils in the organic matter pool. We suggested that cell surface architecture is an adaptive strategy to interact with continuum of organic matter. Characterizing surface architecture with hydrolytic enzymes and lectins- Q-dots conjugates showed architecture is chemically complex, including proteins and polysaccharides. We conclude that surface architecture influences carbon fluxes into the microbial loop and export flux. AFM offers a powerful tool to explore microbial interactions in the pelagic ocean.

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PHAGE PRODUCTION IN NATURAL IRON-FERTILIZED BLOOM EVENTS ABOVE THE KERGUELEN PLATEAU COMPARED TO HNLC ENVIRONMENTS

Above the Kerguelen Plateau in the Southern Ocean, a large phytoplankton bloom, which is sustained by vertical mixing of deep iron-rich waters, occurs during austral summer. Within the KEOPS project, we sampled a mature phytoplankton bloom along with the surrounding HNLC waters to study the role of viruses within the microbial food web affected by natural iron fertilization. Viral and prokaryotic abundance were both on average about twice as high within the bloom than in HNLC waters. Viral production was 7 times higher in the bloom than in the HNLC environments, while the frequency of infected cells (FIC) showed no significant differences between environments. The present study suggests that viruses are more important for bacterial mortality within the bloom, where bacterial mortality cannot be explained by protozoan grazing. Thus, the carbon is not transferred to higher trophic levels but becomes again part of the DOM pool through viral lysis. This may explain why in situ mesoscale iron enrichment experiments so far performed did not result in massive carbon export fluxes to the depths necessary for long-term sequestration.

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DIFFERENTIAL EFFECTS OF NUTRIENT-LIMITED PRIMARY PRODUCTION ON LARVAL FISH AND HYDROMEDUSAE CONDITION

To trace the cascading of algal mineral limitations through food webs, laboratory experiments were carried out using three- and four-trophic food chains, under the hypothesis that, as a result of the relative homeostasis of zooplankters for minerals, these limitations should not be transferred to the highest trophic levels. The algae Rhodomonas salina was cultured under nutrient-sufficient as well as N- and P-limited conditions. In three-trophic experiments, the copepod Acartia tonsa was reared on one of these algal diets and the manipulated copepodites were then fed to one of the two top predators, larval herring or hydromedusae. The heterotrophic flagellate Oxhyrris marina was added as primary consumer to the four-trophic experiment, serving as prey for A. tonsa. Fatty acids and stoichiometry of the two lower trophic levels showed significant differences between treatments. Additionally, copepod developmental rates were significantly reduced when they were primary consumers compared to copepods as secondary consumer. When herring was the top predator, significant lower nutritional conditions could be observed under p-limitation, while no effects were visible when the jellyfish was the top predator.

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DYNAMICS OF OSTREOPSIS CF. OVATA IN THE MEDITERRANEAN SEA, RELATIONS WITH ENVIRONMENTAL FACTORS AND CONSEQUENCES ON SHALLOW ROCKY ECOSYSTEMS

Blooms of benthic harmful microalgae represent a new phenomenon for temperate areas, presumably enhanced by climate change effects. A striking case is represented by Ostreopsis cf. ovata in the Mediterranean Sea, that, in few years, became a new widespread reality with great environmental, public health and economic concern. The dynamics of such blooms, the factors promoting them and the consequences on coastal ecosystems are studied in the Ligurian Sea since 2006. The paramount role of sea-water temperature and calm water conditions has been highlighted, but we cannot yet quantitatively foresee temporal dynamics and explain spatial variability of such blooms. Mass-mortalities of invertebrates (and in particular grazers) were recorded mainly in 2006, highlighting how these blooms can strongly affect the functioning of shallow rocky ecosystems. Such environments, interface between continent and ocean, are subject to several human disturbances (e.g. eutrophication, pollution, fishing and invasions): the eventual role of human disturbances on benthic harmful microalgae blooms and their synergistic/antagonistic effects on shallow rocky ecosystems are scarcely known and should represent a priority for future marine ecology research in the climate change perspective.

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IMPACT OF ANTHROPOGENIC INPUTS ON THE NITROGEN CYCLE OF A PERI-URBAN MANGROVE SYSTEM (DAR ES SALAAM, TANZANIA)

As the main intertidal ecosystems lining tropical coastlines, mangroves are increasingly affected by anthropogenic inputs. Being inherently oligotrophic, they are usually considered as nutrient sinks and may then help in mitigating coastal pollution. However, their filtering capacity and the mechanisms involved have rarely been assessed in natural systems. We investigated the nitrogen cycling in an estuarine mangrove system submitted to anthropogenic nutrient inputs (Dar es Salaam, Tanzania). The rates of the main N-transformation processes both in the sediment and the water column were assessed via ^{15}N-tracer experiments. Results indicate high inputs of nitrates with the freshwater end-member whereas ammonium and dissolved organic nitrogen appear enriched toward the marine end-member. Nitrates are efficiently removed along the mangrove creeks partly as a result of denitrification in the sediment which was observed to be high compared to pristine mangrove systems. Measurements of benthic diatoms production indicated that diatoms are more efficient at taking up ammonium than nitrifying bacteria. Nitrification rates were thus relatively low and limited the overall nitrogen removal potential of the system. This study was supported by EC-funded project PUMPSEA (INCO-CT2004-510863).

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A NEW INSIGHT INTO THE LACUSTRINE MICROBIAL FOOD WEB: STRUCTURE AND DYNAMICS OF SMALL EUKARYOTES (<5µM) TARGETED BY NEW OLIGONUCLEOTIDE PROBES

The seasonal dynamics of the planktonic small eukaryotes (<5µm) was investigated in a mesotrophic lake by targeting seven different phylogenetic groups: Chlorophycea, Chrysophyceae, Cryptophycea, Cercozoa, LKM11, Perkinsozoa (two clades) and Fungi. We reached in situ specific abundances of previously unquantified eukaryotic taxa within the small planktonic fraction performing TSA-FISH with newly designed probes. We could observe seasonal variations both in the global abundance and in the structure of the small eukaryotes assemblage. The dominant groups were the Chrysophyceae and the Chlorophyceae. The results confirmed the quantitative importance of putative parasites, Fungi and Perkinsozoa. We could link the dynamics of Perkinsozoa and Fungi to various phytoplanktonic species. Our results also revealed the recurrent presence of cells belonging to Cercozoa and LKM11. These quantitative results confirm that the classical functional groups which has been primarily defined within microbial trophic food webs are not sufficient to describe all the interactions existing. The quantitative approach based on the design of new probes (for FISH or qPCR) offers a promising way to deeply investigate the microbial food webs in lakes.

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DEVELOPMENT AND ANALYSIS OF SATELLITE CARBON DATA PRODUCTS FOR THE COASTAL OCEAN

In the coastal ocean, distributions of colored dissolved organic matter (CDOM), dissolved (DOC) and particulate organic carbon (POC) vary seasonally and inter-annually due to multiple source inputs and removal processes. Algorithms developed to retrieve CDOM, DOC, and POC from NASA's MODIS-Aqua and SeaWiFS satellite sensors are applied to study the processes that produce and remove organic matter in the coastal ocean. The CDOM absorption coefficient was correlated with in situ radiometry (reflectance band ratios) followed by correlation of DOC to reflectance ratios through the CDOM to DOC relationships. Our analyses have shown that DOC and CDOM can be retrieved from MODIS or SeaWiFS observations to within 15% and 25%, respectively, and POC to within 25%. However, the relationships between DOC and CDOM vary seasonally and between regions requiring variable coefficients for each region (southern Middle Atlantic Bight, Hudson River plume and Gulf of Maine, USA). Our results show that CDOM is a major contributor to the bio-optical properties of the northeastern U.S. coast, accounting for 35-70% of total light absorption at 443nm, as compared to 30-45% for phytoplankton and 0-30% for non-pigmented particles. In addition, SeaWiFS and MODIS data are applied to quantify winter inventories of POC, DOC and aCDOM which can used to ascertain impacts of natural meteorological events and climate change on coastal marine ecosystems.

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SPATIAL ANALYSIS OF THE EFFECT OF POLLUTION ON MACROALGAL COMMUNITIES OF THE LITTORAL AND UPPER SUB-LITTORAL ZONE IN THE NORTHWESTERN MEDITERRANEAN SEA

As a result of the European Water Framework Directive, we surveyed the entire French Mediterranean continental coast in 2007 and 2008 using CARLIT methodology. The result of this survey is a high resolution map showing dominant communities of the littoral and upper-sublittoral zone along the whole rocky coastline. We calculated the Ecological Status (ES) of the 28 water masses surveyed. The results range from 12 "very good" , 10 "good", 5 "moderate" and 1 "poor". Aside from providing these results, this complete geographic dataset shows the precise location and cover of macroalgal climax communities (*Lithophyllum bissoides* "trottoirs", *Cystoseira amentacea* var. *stricta* and *Cystoseira mediterranea* belts) as well as communities showing effects of disturbances. Using GIS analysis, we present a spatial relationship between ecological data, habitat loss and adjacent sources of pollution: urban runoff/proximity , boating/shipping activities, wastewater outfalls and fish and mussel farming. Sensitivity levels of communities are taken into account to calculate the spatial extent and intensity of the impact of these types of pollution on the littoral and upper-sublittoral communities.

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ASSESSMENT OF ECOLOGICAL QUALITY OF MEDITERRANEAN LOWLAND RIVER USING AQUATIC MACROPHYTES- IMPLEMENTATION OF WFD IN GREECE

Macrophytes are regarded by the Water Framework Directive as one of the key groups of biota suitable for ecological classification purposes. This study attempts to develop and discuss the applicability of macrophyte based methods for the assessment of the ecological quality of Louros River W. Greece. The ecological evaluation concerns: (a) the state of the natural environment (b) the land uses and the degree of the human influence. A survey of 17 sites was seasonally conducted during the period 2004-2007 covering the entire basin. The sites were surveyed using standard macrophyte techniques (Mean Trophic Rank, MTR). Additionally, 26 environmental and physicochemical variables were taken under consideration for each site in order to develop a river typology. Only sites which showed very minor human impacts considered as "reference sites". The ecological status classification is based on the calculation of the MTR score supplemented by additional criteria in order to produce an objective classification. The potential of forming a national macrophyte based method as a tool of assessing the ecological quality of running waters in Greece is further discussed.

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TEMPERATURE EFFECTS ON HERRING CARRYING CAPACITY: A N. ATLANTIC META-ANALYSIS

The major objective of our study is to identify the effect of temperature on herring (Clupea harengus) stock-recruit dynamics by meta-analyzing data across the species North Atlantic distribution. We use an extensive dataset of spawner biomass (S), recruitment (R) and spawning season temperature (T) time-series for 16 eastern and western herring stocks. The stock-specific observations are combined in a hierarchical, multi-level meta-analysis employing the Ricker SR model. In order to investigate the patterns and the intensity of environmental effects, the model is extended to integrate the influence of T on the Ricker alpha parameter, representing maximum reproductive rate and depending on pre-recruit survival. Bringing together observations across the herring distributional range, we can make inference both on the species and population levels, and identify T effects obscured by the low stock-specific sample size. Our results show that alpha is affected by T and the dependence is non-linear. Thus, the impacts vary geographically, with stocks located in colder (warmer) waters, experiencing temperatures up (above) to around 9oC during spawning and larval stage, being positively (negatively) affected by increasing temperature.

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ON THE IMPORTANCE OF ATMOSPHERIC NITRATE DEPOSITION IN THE N-CYCLE IN THE E. MEDITERRANEAN INFERRED FROM ISOTOPIC MEASUREMENTS OF NITRATE IN DEPOSITION

To quantify the role of atmospheric NO3- deposition in the E. Mediterranean Sea (EMS), we analysed NO3- and its 15N/14N ratio in samples of dry and wet deposition from April 2006 to September 2007 on the island of Crete. Both dry and wet deposition samples have consistently negative δ15N ratios, implying a strongly depleted atmospheric source calculated to be a weighted annual estimate of -3.1‰. The δ15N of wet deposition is in agreement with data from other environments, but the consistently 15N depleted signature of dry deposition is unusual and supports the view of an origin from association of atmospheric NO3- mainly with dust and sea-salt. We calculate that the unusually light δ15N of -2‰ of algae in surface waters of the EMS can be explained by 80% of the N supply being atmospheric and 20% from deep water nitrate without any N2-fixation. Thus the presence of isotopically light PON and NO3- in the intermediate and deep waters of the EMS cannot alone be used to prove the importance of N2-fixed nitrogen to the unusual N:P ratio in the basin.

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NITROUS OXIDE CONCENTRATIONS IN THE AMUNDSEN GULF OF THE ARCTIC OCEAN

Nitrous oxide (N_2O), a byproduct of both nitrification and denitrification, is a potent greenhouse gas with a global warming potential 311 times greater than CO_2. Surpringly few published measurements exist of N_2O concentrations in the ocean and none from the Arctic. We measured N_2O in the Amundsen Gulf in the high Canadian Arctic from December 2007 until July 2008 in surface waters and under the ice at several depths in the water column. We observed an 50-60% increase in N_2O concentrations at all depths from December until the beginning April, coinciding with an increase in the concentration of nitrate. Concentrations of N_2O remained high throughout April and decreased during May. In a spatially explicit survey of the Gulf during June and July, surface waters were always slightly supersaturated (110%) but varied little among sites. Given the observed increase in N_2O with the production of nitrate over winter and in the deeper waters during the summer, nitrification is the most plausible metabolic mechanism responsible for its production. Indeed nitrification may be an important source of oragnic carbon for the Arctic foodweb.

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EFFECTS OF EXPERIMENTAL DUST ADDITION ON THE BIOMASS AND METABOLISM OF MICROBIAL PLANKTON IN THE OLIGOTROPHIC ATLANTIC OCEAN

Dust deposition has the potential to affect biogeochemical fluxes in the upper ocean, through the input of materials that may be used by marine biota. During the TRYNITROP (Trichodesmium and N_2 fixation in the Atlantic Ocean) cruises, we have conducted 8 in vitro, dust addition experiments in widely contrasting regions of the Atlantic Ocean between 30N-33S along 29W in December 2007 and April 2008. Our data suggest that heterotrophic processes are more responsive to dust inputs than photoautotrophic ones. In most cases, changes in phytoplankton biomass and primary production were small or absent, whereas increases in bacterial production and/or community respiration were more frequently observed. The photoautotrophs only seemed responsive, mainly through increases in production rather than biomass, in less oligotrophic settings: in these cases, bacterial production decreased in response to dust inputs. Our results suggest that the degree of oligotrophy may affect the type and extent of microbial plankton response to dust inputs, with ultraoligotrophic regions showing mostly an increase in heterotrophic processes whereas enhanced photoautotrophic metabolism only takes place, if at all, in less oligotrophic regions.

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MEDITERRANEAN WARMING ACCELERATES SEAGRASS (POSIDONIA OCEANICA) LOSS

Anthropogenic global warming has been increasing ocean temperature for the last decades. Warming affects a range of biological processes, which at population level include reproduction and survival, having more severe impact on sessile than mobile populations, as they may not migrate into colder or warmer waters as rapidly as mobile ones do. Posidonia oceanica meadows, the dominant coastal ecosystem in the Mediterranean, play major roles in the functioning of coastal areas as well as that of the entire basin. P. oceanica meadows rank amongst the most threatened ecosystems on earth, mainly as a consequence of coastal deterioration. Yet, the recent observation of increased seagrass mortality and sexual reproduction after heat waves points out sea warming might contribute to seagrass loss. Here, we examine the trajectories of P. oceanica annual demographic parameters and temperature time-series available for the last decade along the Balearic Islands (Spain, Western Mediterranean), to (1) define empirical relationships between Mediterranean warming and P. oceanica demography, and (2) identify warming thresholds compromising P. oceanica meadow stability.

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THE EXTENT OF ANOXIA IN RESERVOIRS AND ITS CONNECTIONS WITH GLOBAL CLIMATE: THE ROLE OF EL NIÑO SOUTHERN OSCILLATION AND DECREASING STREAMFLOW TRENDS

Recently, a close coupling between streamflow entering reservoirs and its hypolimnetic oxygen content has been empirically established for a wide range of systems. In brief, high streamflow maintains anoxia at comparatively low levels. Here we analyzed a 44 years database on a monthly basis from Sau Reservoir in Spain to detect possible effects of climate variability on the anoxia extent, using the Nürnberg's Anoxic Factor as an appropriate surrogate. The rationale of the study relies on the fact that both global climate patterns like ENSO and climate change could affect streamflow and, consequently, the anoxia extent in the reservoir. Wavelet cross-spectrum analysis showed a strong and significant relationship between ENSO, streamflow, and the Anoxic Factor measured in the reservoir. These time series oscillated in a common frequency (between 0.014 and 0.03 cycles month^{-1}) during the whole period. In addition, we show that a decreasing streamflow trend related to climate change increased the anoxic factor in the reservoir during the last decade. These results represent one of the few records of tested effects of climate change on reservoirs using instrumental data.

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FLORENCITE: A SIGNIFICANT CARRIER OF THORIUM-230 IN MARINE PARTICLES

Particle-reactive and in situ produced Thorium-230 is widely used to evaluate marine particle fluxes but its host phases are controversial. We determined the abundance of Th-rich phases in Saharan aerosols, filtered marine particles and sediments from the western Mediterranean Sea. Florencite is a micron-size REE-Al phosphate containing 0.3% of Thorium-232. The florencite to rutile (an insoluble lithogenic mineral) ratio increases through the water column, indicating florencite production in the marine environment. Mineral separations performed on 2 sediment samples produced florencite-enriched fractions with a Thorium-230/Thorium-232 molar ratio (12-30×10^-6) intermediate between the lithogenic material ratio (4-5×10^-6) and the Mediterranean Deep Water ratio (20-40×10^-6). It implies that a significant fraction of the Thorium-230 in the concentrate is derived from seawater. A Th-REE budget indicates that florencite is the most likely carrier for the Thorium-230 in the concentrates and suggests that florencite carries a significant (>10%) of the Thorium-230 in the marine particles. Therefore, Thorium-230 may not be directly associated to the marine particle major components so that Thorium-230-based trapping efficiency and focussing/winnowing factor should be applied with cautions to these components.

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FERRITIN IS USED FOR IRON STORAGE IN BLOOM-FORMING PENNATE DIATOMS – CRYSTAL STRUCTURE AND ECOLOGICAL SIGNIFICANCE IN OCEANIC STRAINS

Previously we presented results on the identification of a ferritin gene (*FTN*) in several pennate diatoms and showed that *Pseudo-nitzschia multiseries FTN* transcript abundance is regulated by iron nutritional status. We now have determined the crystal structure of recombinant ferritin derived from *P. multiseries* and find that it displays characteristics of a maxi-ferritin that contains ferroxidase centers and binds iron. We recently isolated an oceanic strain of *Pseudo-nitzschia granii* from iron-limited waters in the NE Pacific. Over an identical range of iron concentrations, *P. granii* displayed a 20-fold range in *FTN* transcript abundance whereas the coastal *P. multiseries* displayed a 2-fold range. Using a continuous culture approach, enhanced iron storage by ferritin allowed initially iron-replete *P. granii* to undergo four extra cell divisions in the absence of iron than the comparably sized, putative non-ferritin containing, oceanic centric diatom *Thalassiosira oceanica* before growth rates declined below the dilution rate. Our results suggest that ferritin provides oceanic pennate diatoms with a competitive advantage when growing in iron-limited regions with intermittent iron inputs and helps explain their dominance in recent iron addition experiments.

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FROM THE TROPHIC ELEVATOR TO THE TROPHIC JAM

Transparent exopolymeric particles (TEP) mediated aggregation is a key mechanism for particle dynamics, including picoplankton-size particles. During a study conducted within the framework of the European project BIOHAB, Fereidoun and I investigated the role of TEP-mediated aggregation of picoplankton-size particles for the microbial trophic web functioning. We showed that depending on their concentration, TEP could control the microbial food web structure and functioning two ways. First, TEP production and the subsequent formation of mixed aggregates could act as “trophic elevator” by providing a direct lift for picoplankton-size particles and dissolved organic carbon to higher trophic levels, via the redistribution of small particles to larger size classes. Second, due to high sticking properties, the TEP mediated aggregation of active components of the microbial food web (i.e., bacteria, heterotrophic nanoflagelattes, ciliates) could cause a “trophic jam” activating the trophic elevator by forcing a detour to higher trophic levels, thus inhibiting the microbial food web and altering its structure. Both mechanisms would minimize the significance of the microbial trophic web for the transfer of energy from the dissolved phase back to higher trophic levels.

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OPTIMAL BEHAVIOUR AND DYNAMICAL IMPACT IN A PLANKTON PREDATOR-PREY SYSTEM

Ingestion rates and mortality rates of zooplankton are dynamic parameters reflecting a behavioural trade-off between encounters with food and predators. An evolutionarily consistent behaviour is that which optimizes this trade-off in terms of the fitness conferred to an individual. We argue that interaction rates used in models, rather than being prescribed, should be dynamic emerging properties that reflect this optimization. A simple example illustrates how predator and prey abundance and prey community structure can instigate prey switching with cascading trophic effects. Dynamical outcome of prey switching are also investigated in an idealized predator-prey system in which a single consumer optimally feeds on two prey items: motile, and not motile. The consumer acts as an ambusher or cruiser on the two prey items, with feeding interactions being prescribed using mechanistic arguments. The system is analyzed in terms of stability and persistence under different environmental conditions (light and turbulence).

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NUTRIENT THRESHOLDS IN MARINE SEDIMENTS

Papers referring to the nutrient load concentrations in marine sediments were reviewed and geochemical and biological data were collected. The objective was to investigate possible nutrient thresholds in marine sediments, and based on the present state of nutrient concentrations and fluxes in sediments and water column, to propose ways to achieve threshold levels. Nutrients are present in the sediments as organic and inorganic species, and in dissolved and particulate forms. Sediments often serve as a reservoir of nutrients that regularly recharge overlying waters and thus trigger increased productivity (e.g. algal blooms). The ability of marine sediments to assimilate nutrient loads is variable; therefore, threshold values cannot be absolute. Factors including physico-chemical characteristic of water and sediment, aquatic biota, etc., can all affect the ability of an aquatic system to assimilate nutrient and sediment loads. This makes all different parts of the world's oceans unique concerning nutrient load thresholds. An experimental study of thresholds in sediments with varying contents of iron to buffer sulfides and presence/absence of infauna will be used as an example.

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BIOAVAILABILITY OF DON IN THE BALTIC SEA

The Baltic Sea suffers from numerous environmental problems related to eutrophication; such as bottom water anoxia, decreasing fish stocks and nuisance algal blooms. In many areas it has been shown that nitrogen is the key nutrient limiting algae growth. The Baltic Sea has high concentrations of dissolved organic matter and the nitrogen containing part (DON) represents the largest pool of nitrogen in the water. Key questions are; how dynamic is the DON pool and to what extent is it bioavailable? Results from a project assessing DONs role in the Baltic Sea will be presented. A total of 31 biodegradation experiments where conducted at four locations over a year. The results show that DON constituted from 56 to 99% of TN with an average value of 81%. The bioavailable part of the DON pool varied from 2 to 60% with an average value of 21%. The bioavailable fraction was highest during winter. On average, the concentrations of DIN and bioavailable DON were about equal. Results suggest that the labile DON pool needs to be included in future nutrient budgets for the region.

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EXPERIMENTAL EVIDENCE OF SYNERGISM BETWEEN TOP-DOWN AND BOTTOM-UP CONTROLS ON CARBON DIOXIDE OUTGASSING FROM A TROPICAL HUMIC LAKE

We assessed the strength of bottom-up control by eutrophication and top-down control by omnivorous fishes on the air-water CO2 fluxes, using experimental mesocosms in a 2 X 2 factorial design with fish addition and nutrient enrichment as treatment factors in a tropical humic lake (Cabiúnas Lagoon, Rio de Janeiro, Brazil). The persistence of CO2 emissions to the atmosphere observed in all treatments and replicates confirmed that humic conditions might be coupled to CO2 supersaturation in lake waters. At ambient nutrient conditions, omnivorous fishes that eat both autotrophs and heterotrophs did not significantly changed CO2 fluxes compared with the control. In contrast, eutrophication increased CO2 evasion, but only after a lag phase and without fish introduction. A higher algae growth and a lower CO2 evasion were observed with the combination of omnivorous fish and eutrophic conditions. In conclusion, eutrophication might favour the net CO2 emission in humic tropical lakes, but depending on the characteristics of the trophic net. Our results suggested a synergism between bottom up and top down forces that might be crucial on CO2 air-water fluxes in tropical lakes.

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INFLUENCE OF MAN-MADE MEGA-STRUCTURES ON THE PLANKTON COMMUNITY ALONG THE DUBAI COASTLINE (UNITED ARAB EMIRATES)

The development of artificial islands on a scale similar to that within Dubai is unprecedented and little is known of how this development will affect the local marine ecosystem. In this work we examined whether the impact of a major coastal megaproject (Palm Jumeirah) on the plankton food web was local or had an affect at locations further from the artificial development. In April-May 2008, abundance and diversity of microphytoplankton and micro-mesozooplankton as well as local currents and nutrient concentrations were examined along five 2km transects out from the development. The results show that distance out from Palm Jumeirah was not the main parameter structuring plankton distribution. Plankton abundance and diversity varied on a much larger spatial scale, with significant differences in plankton communities only apparent between the west and east side of Palm Jumeirah. Since the highest abundance and diversity were found on the most protected side of Palm Jumeirah, we argue that Dubai's man-made islands may have an indirect role in structuring plankton along the Dubai coastline, through substantial changes in the water dynamics throughout the coastline.

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PHYTOPLANKTON RESPIRATION: SOME NEW MEASUREMENTS BASED ON C-14

We report on experiments using seawater from the Gulf of Aqaba in spring (the GAP2008 Workshop) and from the northwest Atlantic Ocean in summer (ONDEQUE 2008 program). Carbon assimilation over 12 and 24 h was measured on whole seawater, and samples that were diluted with filtered seawater to various levels. For the Gulf of Aqaba, carbon assimilation was a little higher in the diluted samples (~10%), but not significantly so, suggesting that carbon assimilation in undiluted seawater samples may be slightly affected by grazing at time scales of a day or less. For the Northwest Atlantic, carbon assimilation was unaffected by dilution across a range of oceanic and coastal stations. Data from both programs support the idea that phytoplankton respiration can be estimated from the overnight loss of carbon in incubations with C-14. Phytoplankton respiration is, accordingly, estimated to be 30-40% of gross primary production.

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CARBON-TO-NUTRIENT COUPLING: WHAT WE CAN LEARN FROM SEASONAL DYNAMICS IN A COASTAL SITE

The coupling between carbon and nutrient utilization in marine systems depends on a large number of biotic and abiotic variables. The interactions and feed-backs between all the biological players and the influence of physical forcing on biotic processes makes it difficult to track and to predict carbon and nutrient pathways. There are numerous examples of such complexity. A recent experimental study in the Arctic produced a counterintuitive conclusion: "more organic carbon gives less organic carbon", meaning that a higher proportion of dissolved organic carbon available for bacterial growth results in less total organic matter. This contribution explores the broadness of this finding using time series data from the Blanes Bay Microbial Observatory (Northwestern Mediterranean coastal site). The relevance of these studies lies in understanding how the ecosystem operates and in helping predict possible future scenarios marked by expected changes in C to nutrient ratio loadings.

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RESILIENCE OF MARINE BENTHIC AND PELAGIC COMMUNITIES THREATENED BY EUTROPHICATION AND CLIMATE CHANGE

Ecosystem resilience emphasizes two different aspects of stability i.e. the capacity of an ecosystem to tolerate disturbances (sensitivity) and rebuild itself when necessary (recovery). This paper examines the separate and combined contribution of eutrophication and climate variables on the resilience of submerged aquatic vegetation, benthic invertebrate and zooplankton communities in the Gulf of Riga, NE Baltic Sea, during the time period of 1972–2008. Our study showed that large-scale pressures such as eutrophication and climate change interactively defined local patterns of distribution; however, within these patterns small-scale abiotic factors modified the response of communities to these large scale pressures. To conclude, the relative contribution of climate variables on communities was strongest in shallow areas and the effect of eutrophication was strongest in sea areas with low level of water exchange. The study suggested that within observed amplitude, biological communities of the Gulf of Riga are not very sensitive to shifts in eutrophication level and climatic conditions and have a high recovery potential.

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EFFECTS OF OCEAN ACIDIFICATION AND GLOBAL WARMING ON MEDITERRANEAN CORALLINE ALGAE

Coralline algae are a major calcifying component of most Mediterranean benthic coastal ecosystems. They are of significant ecological importance and play a major role in the carbon and carbonate cycles. However, they are among the calcifying organisms that appear to be the most sensitive to ocean acidification. We investigated the effects of ocean acidification on coralline algae both through in situ observations in a volcanic CO_2 vent area and through a long-term and multifactor experimental approach combining the effects of elevated pCO_2 (lowered pH) and elevated temperature. We observed that coralline algae were absent at pH 7.7 in naturally acidified seawater where other calcifiers were living. We showed a strong combined effect of elevated pCO_2 and temperature on coralline algae in experimental conditions with a decrease in calcification in summer and an increase in mortality and tissue damage at pH 7.9 and temperature elevated by 3°C. Our findings suggest that the degree of ocean acidification and global warming expected over the next 100 years may have major consequences for the biodiversity and biogeochemistry of coastal ecosystems dominated by coralline algae.

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DOES VIRAL INFECTION OF PHYTOPLANKTON AFFECT GRAZING?

Grazing, sinking and viral infection are the main phytoplankton cell loss factors. Viral lysis converts particulate to dissolved organic matter thus reducing the transfer of biomass to higher trophic levels and accumulating nutrients, carbon and other elements in the surface water. Here we present a study looking whether zooplankton show selective grazing when feeding on viral infected and noninfected phytoplankton. If selective grazing is a widespread phenomenon, it would have significant implications for the marine ecology and biogeochemistry. The grazers we used were the microzooplankter *Oxyrrhis marina* and a heterotrophic nanoflagellate. The ecologically relevant picophytoplankter *Micromonas pusilla* and the nanophytoplankter *Emiliania huxleyi* were used as prey. The use of fluorescent viability probes allowed differentiating infected from healthy cells. The probes did not affect the grazing rates. Therefore, we were able to compare the numbers of infected and healthy phytoplankton cells ingested. Variables such as time post infection, prey and predator concentration were taken into account. Our first results indicate that there is no preferential grazing on both phytoplankton species by either of the grazers. Follow up experiments will be presented, discussed and compared to the literature.

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DECADAL CHANGES IN THE CHLOROPHYLL SEASONAL CYCLES. REGIONAL COVARIABILITY WITH SEA SURFACE TEMPERATURE AND MIXED LAYER DEPTH

A reprocessing of the CZCS and SeaWiFS data sets was previously performed (Antoine et al., 2005) to investigate the decadal changes in the global ocean chlorophyll (Chl). This global reanalysis showed an average increase of Chl by ~20%. Then, the spatial and temporal covariability between Chl and Sea Surface Temperature (SST) was investigated although limited to the Non Seasonal signal to better highlight the long-term variability (Martinez et al., in prep). A Chl-SST inverse relationship was frequently observed, and decadal changes essentially result from basin-scale low-frequency natural oscillations. Because Chl decadal changes were not fully explained by the Non Seasonal signal, the objective is now to investigate the seasonal cycle. The time downscaling of this work requires a sufficient temporal coverage of the considered parameters. Regional studies are necessary and performed where data are the most available, i.e. in the northern hemisphere. SST and Chl satellite data are completed with in situ temperature and derived mixed layer depth by de Boyer Montégut et al. (2004) to explicitly investigate the role of the oceanic stratification in the observed Chl changes.

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SHIFTS IN MICROBIAL AUTOTROPHIC/HETEROTROPHIC PROCESSES RATIOS AS A RESPONSE TO INORGANIC AND ORGANIC INPUTS ALONG A LATITUDINAL TRANSECT IN THE ATLANTIC OCEAN

Atmospheric nutrient deposition into the open ocean has increased as a result of human activity. The impact of nutrient loading likely depends on the type of input, the composition of the initial microbial community, and the interactions between microbial components.To test this hypothesis, we studied the effects of inorganic (nitrate, phosphate, silica) and organic (glucose, aminoacids) inputs, added separately as well as jointly, on microplankton community structure and metabolism in five microcosm experiments along a latitudinal transect in the Atlantic Ocean (from 26°N to 29°S). Measured responses were highly variable: Primary production rates increased from 1.1 to 1.7-fold, microbial community respiration rose by a factor of 1.3 to 12.5 and bacterial production increased from 1.4 to 58-fold. The largest increases occurred after mixed additions. Changes in microplankton biomass and community structure were fairly small as compared with those in metabolic rates. Our results suggest that subtle differences in either the initial environmental conditions or community composition, as well as variations in the quality of matter inputs, are likely to result in substantial changes in microbial autotrophic/heterotrophic processes ratios.

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INCREASING PHYTOPLANKTON PRODUCTIVITY AS A RESPONSE TO INCREASING FREQUENCY OF INTENSE WINTER MIXING EVENTS IN THE LIGURIAN SEA IN RECENT YEARS (DYFAMED T-S)

Hydrological and biogeochemical (pigments, nutrients) data were measured monthly at the DYFAMED time-series station (N.W. Mediterranean Sea) since 1991. During months of winter convergences (February/March) the measured phytoplankton biomass was unusually high in specific years. Chlorophyll a integrated biomass reached 230 mg m-2 in 1999, 180 mg m-2 in 2003, and 200 mg m-2 in 2006. In April 2006 we measured the maximal concentration of chlorophyll a of the 15 years monthly observations: 4.3 µg l-1 at 5 m depth. These high levels of biomass were related to the high increases in nutrients content in surface layers following the particularly intense water column mixing events and the subsequent development of an opportunistic diatom bloom (as seen by fucoxanthin content). Since the frequency of extreme events (high mixing, high nutrients, and high biomass) was increasing in recent years, our results suggest that the NW Mediterranean Sea could not be deriving towards a decreasing productivity as predicted by models.

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BACTERIAL COMMUNITIES AND MICROBIAL ACTIVITY IN MEDITERRANEAN AND CENTRAL EUROPEAN STREAMBED SEDIMENTS RECOVERING FROM DESICCATION

A pilot study was performed on the suitability of a sediment core perfusion technique for investigating the recovery of microbial communities and their metabolism during rewetting desiccated sediments from Mediterranean and Central European running waters. We determined bacterial abundance via fluorescence microscopy, bacterial community composition by TGGE, bacterial production by uptake of radiolabeled leucine, and extracellular enzyme activity by fluorogenic model substrates. The bacterial community composition changed only little in the sediments from the Central European stream Breitenbach during rewetting, whereas in the sediments of the Mediterranean Mulargia River (Sardinia) distinct changes were observed, especially within the first day. The noticeably high activity levels especially of enzymes involved in polymer degradation at the beginning of rewetting indicate persistence of extracellular enzymes during drought. The more pronounced and faster increase in the Central European stream can be attributed to its less complete desiccation, which resulted in the survival of a microbial community closer to the indigenous stream community than in the Mediterranean stream. However, after 2–4 days nearly all microbial activities investigated were re-established in both streams.

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FISH ASSEMBLAGE AND TROPHIC ECOLOGY OF AN INTERMITTENT TRIBUTARY AND NEIGHBORING PERMANENT REACHES

Mediterranean streams are affected by seasonal droughts, the frequency and intensity of which varies spatially and is expected to increase with climate change. We studied the effects of drought on the fish assemblage and its trophic ecology in a Mediterranean stream by comparing an intermittent tributary and two neighboring more permanent reaches. Although the three sites were dominated in abundance by the same two fish species, Mediterranean barbel (*Barbus meridionalis*) and chub (*Squalius laietanus*), the intermittent tributary had less fish density and abundance of eel (*Anguilla anguilla*). Fish from the intermittent tributary significantly displayed lower condition and gonadal weight (adjusted for length). Diet of barbel and chub consisted mainly of benthic insect larvae and fish from the intermittent tributary significantly had less food biomass in the gut, suggesting that effects of drought through reduced resource availability are, at least in part, responsible for the lower fish condition in the intermittent stream. Fish from the intermittent stream also showed narrower diet breadth and lower electivity indices, indicating avoidance of many small preys present in that stream.

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LOW OXYGEN SUPPLY REDUCES *ZOSTERA MARINA* SURVIVAL IN EXPERIMENTALLY ORGANIC ENRICHED SEDIMENTS

During the night, seagrasses depend on oxygen diffusing from the water column through the leaves to maintain oxic conditions in the rhizosphere. Oxygen released through rhizomes and roots oxidize toxic compounds such as sulfide, hereby avoiding their potential toxicity. However, if oxygen demand of the sediment is in excess of oxygen supplied through the roots, e.g. during the night in organically enriched sediments, sulfide can invade into seagrass tissues severely affecting photosynthesis, growth and survival. Here we evaluate the importance of oxygen concentration in the water column for *Zostera marina* performance in sediment mesocosms with different sulfide levels. Seagrass performance over a 4 week period was evaluated through measures of growth rate, survival, total sulfur content and stable isotopes in a two factorial design (high or low oxygen combined with high or low sulfide). The combined effect of low oxygen supply and high sulfide levels promoted a decrease in shoot survival of 60%, growth was reduced by 91% and lower concentration of sulfide oxidation products, confirming that water column oxygen concentration impair the defense of *Zostera marina* against sulfide intrusion.

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COMBINED EFFECTS OF FOOD QUALITY AND TEMPERATURE ON SOMATIC GROWTH AND REPRODUCTION OF TWO FRESHWATER CLADOCERANS

As a consequence of global warming, a shift in natural phytoplankton community structure could be observed, leading to a shift in food quantity and/or quality available for zooplankton. Although the trade-off between food quantity and temperature for maximizing fitness of zooplankters has been well studied, the interaction between food quality and temperature is still poorly understood. In this study, we investigated the effect of food quality, as determined by fatty acids, on somatic growth and reproduction of zooplankton at different temperatures (12°C, 15°C, 20°C and 25°C). Standardized growth experiments of two freshwater cladocerans, *Daphnia magna* and *Simocephalus vetulus*, were performed on a) high quality food (*Cryptomona sp.*), b) low quality food (*Scenedesmus obliquus*), and c) intermediate quality food (*Cryptomonas:Scenedesmus* mixture). Our results highlight an interaction between temperature and food quality effects on the somatic growth and reproduction of zooplankton. Food quality constraints on growth and reproduction of the two cladocerans decrease with increasing temperature. Thus, dietary constraints exerted by food quality for zooplanktonic development vary as a function of different temperature conditions.

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DISTRIBUTION OF AEROBIC ANOXYGENIC BACTERIA IN FRESH WATER LAKES OF MIDDLE AND NORTHERN EUROPE

The presence of aerobic anoxygenic phototrophs (AAPs) was first reported from marine environments, and over the following two decades, they were considered as marginal organisms. In 2000, Kolber and colleagues (Kolber et al., 2000) discovered bacterial photosynthesis in the upper layers of ocean. Subsequently, the presence of AAPs has been confirmed in a number of marine environments, however, up until now information regarding their distribution in fresh water is rather scarce. We surveyed over 50 fresh water lakes in the Czech Republic, Poland, Deutschland and Finland during summer season 2008. We used the following techniques; infra-red fluorometry, infra-red epifluorescence microscopy, fluorescence emission spectroscopy and pigment analyses. The results of our survey revealed that AAPs are regular constituent of the bacterioplankton community in oligotrophic and mesotrophic freshwater lakes. They often represent a surprisingly important part of the microbial community. We found that AAPs usually form 4 – 10% of the bacteriplankton but in several oligotrophic and mesotrophic lakes they formed 60 – 80% of bacterial biomass. AAPs shoved strong seasonal dynamics of both abundance and species composition with the maximum biomass in summer and the minimum in winter.

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HOW DOES FLOW AUGMENT PHOTOSYNTHESIS IN CORALS, ALGAE AND SEA-GRASSES?

Exposure to strong flow dramatically augments primary production in many benthic autotrophs. Traditional explanations relate this augmentation to enhanced in-flux of dissolved elements, such as DIC and nutrients. However, these explanations are incompatible with observations on the dynamics of the photosynthesis response and the high DIC concentration in many autotrophs. Our hypothesis was that photosynthesis is enhanced due to flow-dependent removal of oxygen from the organism to the ambient waters. Internal over-saturation of oxygen, expected to develop under weak flow conditions, can inhibit the CO2 binding capability of RubisCO and enhance photorespiration. Using a microelectrode, PAM, a real-time mass spectrometer and PIV we measured photosynthesis, photorespiration and flow in corals, sea-grasses and algae. In still waters, oxygen concentration within the organisms reached 3-5 times the ambient, dramatically enhancing photorespiration. Under 7-8 cm/s flow, the internal oxygen concentration was maintained at levels slightly above ambient, in spite of a dramatic increase in photosynthesis. Experimental addition of CO2 and nutrients had no effect on photosynthesis. Our study revealed the biophysical mechanism through which flow affects photosynthesis in marine organisms.

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DISREGARDED DIVERSITY AMONG MARINE PROTISTS

Despite the importance of marine protists that are at the base of all marine food webs, very little has been known for many years about their phylogenetic diversity, specially within the smallest cells that are hardly distinguishable by morphological features. Recent advances obtained through the application of molecular techniques to protist ecology have revealed that a) marine protist assemblages are widely diverse and this diversity occurs at all possible phylogenetic scales, including representatives of almost all supergroups, many classes, genera and species and probably ecotypic microdiversity analogous to bacteria, b) many of the observed taxa are new to science and have been disregarded and unnoticed until just very recently and c) the ecological and functional implications of this huge and novel diversity is becoming a promising and fruitful field for marine research. The results gathered after these molecular surveys have clear phylogenetic, evolutionary and ecological implications.

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LONG-TERM HYDROLOGICAL CHANGES OF THE SEINE RIVER DISCHARGE, FRANCE

The study focuses on the determination of the dominant modes which control the variability of discharge and precipitations in the Seine river watershed and of their possible link with the North Atlantic Oscillation over the 1946-2006 period.
The Seine river discharge is affected by a significant increasing trend across the period. Wavelet analysis of precipitations and discharge revealed similar spectral patterns, defining three time periods: before 1970, between 1970 and 1990, and after 1990. According to their wavelet spectra, hydrometeorological data and NAO did not seem to oscillate over the same modes of variability, although similar temporal discontinuities were revealed. However, the calculation of the NAO/Seine discharge wavelet coherence emphasized a strong degree of linear correlation between the two signals at annual time scales starting from the late 1980's. This result rises up the question of an intensification of the hydrologic cycle in the Seine river watershed in relation with the strongly positive phases of NAO from the very end of the last century up to now.

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SPECIATION OF TRACE ELEMENTS (CD, CU) IN THE SURFACE FRESHWATER REACHES OF THE GIRONDE ESTUARY (FRANCE)

Speciation and reactivity of Cd and Cu in the surface freshwater reaches of the Gironde Estuary were studied by high frequency sampling (every 30 min) during two consecutive tides (25 h) in July 2008. Cadmium and Cu concentrations were measured in different fractions obtained by filtration (>0.45µm, <0.2 µm and <0.02 µm), solid/liquid chromatography (Digisep®, SCP-Science) and in situ voltammetry (free and dynamic fractions). Environmental parameters (temperature, conductivity, dissolved oxygen, pH, SPM concentration, current velocity, water depth) were measured continuously and organic matter was characterized by several techniques.
Cadmium and Cu concentrations of all measured fractions were compared to environmental parameters and organic matter characteristics. The main parameters controlling the metal species concentrations were identified and the influence of physical (water body mixing), chemical and/or biological processes on Cd and Cu speciation and reactivity was studied. Moreover, experimental metal speciation data were compared with theoretical values computed using an equilibrium-based model. Based on the results, the role of the studied environmental parameters on Cd and Cu behavior and their availability to aquatic organisms in estuarine freshwater systems is discussed.

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D1 INDUCED-REPAIR AND ACCUMULATION OF PHOTOSYNTHETIC PIGMENTS UNDER UV RADIATION: CONSEQUENCES ON THE PHOTOSYNTHETIC CAPABILITY IN DUNALIELLA TERTIOLECTA.

The effect of different UV treatments on D1 protein, accumulation of photosynthetic pigments and the photosynthetic activity estimated as changes in the optimal quantum yield of fluorescence were evaluated at initial, 0.5, 1, 4, 8, 24, 48, 72 and 144 hours under UV. Cells at mid log phase were transferred to UV transparent cylinders under four different light treatments: PAR (P), PAR+UVA (PA), PAR+UVA+UVB (PAB) and UVA+UVB (AB), where P =100 µmol photons•m-2•s-1, UVA= 17 Wm-2 and UVB= 1Wm-2.A decrease in the optimal quantum yield was observed under UVR. However, under AB condition small recovery was observed at 24 hours, similar results as electron transport rates. The expression pattern of D1 protein showed a reduction in the active form. Nevertheless, under PAB a recovery to initial values at 72 hours was observed. This suggests a possible effect of D1 induced-repair by UVB combined with PAR. The content of chlorophyll a, b and neoxanthin only increased under AB, and lutein was constant in all treatments. The possible effect of the UV radiation on the xanthophyll cycle was also evaluated.

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MOLECULAR TOOLS TO ELUCIDATE THE BIOLOGY OF DIATOMS

Diatoms belong to the most abundant eukaryotic phytoplanktonic organisms in the oceans and are of great ecological relevance. *Phaeodactylum tricornutum* is a convenient model organism for studying marine diatoms. To study cellular processes like photosynthesis as well as the carbohydrate metabolism in more detail, the development of molecular tools for diatoms is an important prerequisite. Some methods like nuclear transformation and an annotated nuclear genome are already available for *P. tricornutum*. Here we present two molecular approaches for this alga that have been developed recently: (i) the introduction of a targeted mutation in plastid encoded genes and (ii) a first successful attempt to silence a gene in a diatom. By the mutagenesis approach we were successful in introducing mutations into the plastidic psbA gene which is encoding the D1 protein. For the gene silencing approach we chose the diadinoxanthin de-epoxidase (dde) as target gene. Since the dde mediates conversion of diadinoxanthin (DD) to diatoxanthin (DT) under excess light conditions, silencing this gene was expected to induce a clearly identifiable phenotype. RNA interference was either induced by transformation of the cells with plasmids containing antisense fragments the expression of a self-complementary hairpin like construct with a 5'-sense-overhang. The silencing approaches generated transformants with a phenotype clearly distinguishable from wild type cells.

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REMOTELY SENSED RESPIRATION VS. PRIMARY PRODUCTION IN A COASTAL OCEAN ECOSYSTEM

We consider here the balance between primary production and respiration of fixed organic matter in the coastal ocean. We have re-evaluated published empirical relationships between bacterial abundance, respiration and production as well as with temperature, chlorophyll and primary production with a significantly enhanced compilation of field data, with the goal of remotely estimating ocean respiration. We have tested such algorithms in the coastal waters of the Gulf of Maine, using the remotely sensed parameters of temperature, chlorophyll, ocean color, and primary production. We have measured system productivity and respiration in the vicinity of the Kennebec River plume in the Gulf of Maine, a coastal shelf sea, over two seasonal cycles to establish the variability and magnitude of the organic matter metabolism of this system. We discuss the usefulness of this approach over larger temporal and spatial scales than is possible from field studies.

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STABLE C AND N ISOTOPE CHEMISTRY OF CORALS TRANSPLANTED WITHIN AN ESTUARINE COMMERCIAL HARBOR, APRA, GUAM, USA.

A transplantation feasibility study was conducted in Apra Harbor, Guam using the dominant Porites spp. (mostly P. rus) that thrives in a muddy, turbid, estuarine (~ 31 ‰) harbor channel (~13 m deep). About 50 large (2-3 kg) colonies of coral were pulled quarterly for 1.5 years from the carbonate muds and transplanted ~ 3 km seaward (>33‰) away from the navigation channel onto an existing coral mound. Although vandalism by octopi and other large animals depleted the sample suite by ~25%, the transplanted corals were largely undisturbed and overgrew attached plastic cable ties at rates up to 1 cm/month. The C/N ratio increased slightly at both sites (6.8 to 7.1), but the transplanted corals lost a significant amount of "terrestrial" C (i.e., a one year increase in the δ13C from ~ -18‰ to -15‰ or 0.25‰/month) after transplantation to the higher salinity regime. Stable N isotope ratios did not change as the oceanic and terrestrial δ15N ratios of nitrate and organic N are not locally different. The transplantation of large coral colonies was successful and is recommended as one way to repopulate damaged and/or depauperate substrata.

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AN INTERACTIVE OCEAN EXPLORATION AND TECHNOLOGY EXHIBIT

In 2007, the Monterey Bay Aquarium Research Institute (MBARI) and the Monterey Bay Aquarium (MBA) partnered in this collaborative effort to generate an interactive exhibit that portrays excitement of deep-sea exploration and technology. This exhibit takes the visitor on an amazing adventure combining high-definition video of incredible deep-sea animals with the hands-on experience of using underwater robots and other high-tech tools to explore the ocean's depths. The exhibit provides the public to participate in three different missions: photographing deep sea animals, mapping underwater mountains and monitoring the surprisingly rich and varied sea life around a sunken whale carcass. During the time spent at this exhibit, the visitor learns about the cutting-edge research conducted each day at the Monterey Bay Aquarium Research Institute. This presentation will provide an overview of the process involved in this collaboration as well as a glimpse of the exhibit itself.

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DOMINANCE SHIFT DOES NOT COUNTERACT IMPACT OF OCEAN ACIDIFICATION ON TOTAL BIOMASS IN AN EXPERIMENTAL COCCOLITHOPHORE COMMUNITY

We experimentally tested whether species interactions in a coccolithophore community alter effects of ocean acidification on total community biomass compared to what would be expected from experiments on single species. We manipulated three levels of CO2-induced seawater acidification in semicontinuous monocultures of Emiliania huxleyi, Gephyrocapsa oceanica and Coccolithus brarudii and in mixcultures containing all three species. Both factors (pCO2 and culture identity) significantly influenced biomass production. At the end of the experiment total biomass in all three monocultures as well as in the mixcultures significantly decreased with pCO2. However, individual species in the mixcultures showed unanticipated effects from what could be expected from the monocultures. Whereas G. oceanica significantly decreased, C. brarudii was not affected and E. huxleyi significantly increased with rising pCO2 and became dominant at high pCO2. This dominance shift, however, was not sufficient to maintain total community biomass with rising pCO2. Our results show that community interactions, i.e. reduced competition by one species facilitating another species, can alter predicted effects of ocean acidification on single species but not on overall community functioning.

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BIODIVERSITY AND FUNCTION ACROSS TROPHIC LEVELS IN SHALLOW LAND-UPLIFT LAGOONS IN THE NORTHERN BALTIC SEA - DOES THE BEF HYPOTHESIS APPLY?

Shallow coastal land-uplift lagoons host diverse assemblages of vegetation, zooplankton and fish. These areas are highly productive and important as fish recruitment areas. The specific settings of a lagoon, i.e. habitat isolation (lagoon's water exchange with sea), archipelago position (inner-outer) and trophic status, generate diverse plant communities, but how this translates to biodiversity and function across trophic levels is not clear. Our results show that on a regional scale, habitat isolation interacts with the archipelago position in defining habitat types with characteristic zooplankton and fish assemblages. Further, the results give the first indications on that plant species composition and interactions influence largely zooplankton and fish diversity, and habitat quality on a lagoon scale. Despite diverse plant communities e.g. the fish diversity is highest in monocultures consisting of tall plant species (decoupling of diversity and function). We conclude that plant species identity is more important than richness per se and that plant interaction can have a large impact on the quality of habitat structure, possibly by affecting key factors such as food availability, refuge quality and maneuverability of zooplankton and fish.

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BIOFILM BATTLEGROUNDS: CHEMICAL COOPERATION AND DEFENSE IN MICROBIAL FOOD WEBS

In contrast to increasing interest in the chemical defenses of phytoplankton, the defensive function of bacterial metabolites and their impact on bacterivores in aquatic food webs have barely been explored. An emerging hypothesis is that sessile bacterial communities organized as biofilms serve as bacterial refuge from predation. By testing growth and survival of bacterivorous protists, we find evidence that chemically mediated resistance against predators is common among biofilm populations in a diverse set of marine bacteria. Using bioassay-guided chemical and genetic analysis, we identified one of the most effective antiprotozoal compounds as violacein, an alkaloid that we demonstrate is produced predominately within biofilm cells. Localized high cell densities in biofilms allow for higher violacein production through the induction of bacterial quorum sensing systems. Nanomolar concentrations of violacein inhibit protozoan feeding by inducing a conserved eukaryotic cell death program. Assuming that effective chemical defenses are a widespread phenomenon in bacterial communities, bacterial antipredator compounds and their molecular regulation could significantly affect the stability of communities, the functioning of microbial food webs and the coupling and direction of energy and nutrient fluxes.

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IMPACT ASSESSMENT OF COMBINED SEWER OVERFLOWS ON THE RIVER SPREE IN BERLIN, GERMANY

The combined sewer system in the historic centre of Berlin, Germany, drains an area of 168 km^2 with 1.6 million inhabitants. Combined sewer overflows (CSO) can have severe effects on the ecosystem of the receiving River Spree, reaching a high CSO to river mixing ratio above 1:1 during 2 to 3 rain events per year. A particular concern is the CSO input of organic matter leading to a decrease in dissolved oxygen (DO) in the River Spree. Of more than 150 CSO events recorded from 2003 to 2007, 46 led to DO<2 mg/L – the tolerance level of the most vulnerable local fish species (Aspius aspius) – lasting from 15 minutes to 3 days. Finally, major fish kills were recorded during two events. Apart from organic matter, stormwater-based contaminants and possibly sewage-based heavy metals and trace organics with retention >50% in sewage treatment plants, can reach maximum concentrations in the receiving river during CSO. Our ongoing activities aim at assessing management options to prevent situations most adverse to the River Spree ecosystem, based on extended monitoring, data analysis and integrated modelling.

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COUPLING, UNCOUPLING OF CARBON AND NUTRIENTS CYCLES IN THE UPPER MEDITTERANEAN SEA : PRELIMINARY RESULTS OF THE BOUM CRUISE.

The uncoupling of carbon and nutrients cycles is the upper ocean is assumed to be a key factor controlling anthropogenic carbon sequestration by biological processes. This uncoupling may lead to particular features such as differences in the depths of the nitracline and the phosphacline in a low P low chlorophyll oligotrophic area (Mediterranean Sea). The difference in nutriclines depths remains essentially unexplained. Several processes such as, stronger constrains on the C/N ratio compare to the C/P ratio in living organisms and nitrogen fixation, may play a role. In order to assess the relative importance of these processes in the observed depth differences of the nutriclines, we implemented a theoretical 1DV biogeochemical model based on preliminary BOUM cruise results.

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LINK BETWEEN SPECIFIC BACTERIAL PHYLOGENETIC GROUPS AND THE LYSOGENIC VIRAL CYCLE

Temperate phages have the potential to shape the bacterial diversity within an ecosystem. However, the role of bacterial traits involved remains unknown. For example, little information is available whether certain bacterial groups comprise more lysogenic cells than others. Therefore, we investigated the links between the frequency of lysogenic cells and the bacterial phylogenetic, physiologic and metabolic diversity. Bacterial communities from 20 different aquatic ecosystems were incubated with and without the inducing agent mitomycin C, and structural changes in bacterial phylogenetic groups were determined by CARD-FISH. Group specific activities (MAR-FISH) and single-cell characteristics (flow cytometry) of the in-situ bacterial community were also measured to determine if the establishment of lysogeny was solely due to the bacterial phylogenetic affiliation. The first results indicate that incubations with mitomycin C affect the bacterial community structure, but these structural shifts bear no resemblance to those obtained in control samples, indicating that the level of lysogeny is related to phylogeny. These results will be discussed with regard to the high variability of bacterial metabolic state at the single-cell and community levels.

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TEMPORAL DYNAMICS OF MARINE MICROBIAL POPULATIONS DETECTED BY MULTIPLEX RDNA BEAD ARRAY TECHNOLOGY

Heterotrophic bacteria and phytoplankton dominate the biomass and play major roles in the biogeochemical cycles of the surface ocean. We have designed and tested a fast, high-throughput, and multiplexed hybridization-based assay to detect populations of marine heterotrophic bacteria and phytoplankton based on their small subunit ribosomal RNA signatures. The assay is based on established liquid bead array technology, where labeled PCR products are hybridized to taxon-specific oligonucleotide probes attached to fluorescently coded beads. Detection of the beads and their associated signal is achieved by flow cytometry. Using this method, we have examined the population dynamics of 24 common bacterial and 11 eukaryotic taxa at Scripps pier in Southern California from daily samples collected for 35 consecutive days. In addition, various parameters such as salinity, temperature, and chlorophyll are collected at this site, providing information on the physical environment in which these communities are found. We uncovered both positive and negative correlations among taxa and will also discuss the timescales of population changes and the physical factors that play a role in community dynamics.

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SMALL- AND LARGE-AMPLITUDE CYCLES IN DAPHNIA-ALGAL SYSTEMS: IMPLICATIONS FOR ECOLOGICAL INTERACTIONS.

Structured models parameterized for Daphnia-algal systems reveal different types of predator-prey cycles. We show experimentally that these small- and large-amplitude cycles coexist in the same environment, and that small-amplitude cycles are more prevalent than large-amplitude cycles at a given level of enrichment. By following the performance of individuals in these populations we test the underlying mechanism giving rise to alternative cycles. We investigate the implications of these small-amplitude cycles on the dynamics of phytoplankton communities and nutrient cycles. Through a combination of modeling and experimental manipulations of Daphnia dynamics using mesocosm experiments, we show that diamond-shaped food webs tend to collapse to more linear food chains during small amplitude cycles under moderate levels of enrichment, and that the microbial loop appears to play an important role in the influence of stoichiometric constraints on Daphnia-algal dynamics.

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OXYGEN IN THE SOUTHERN CALIFORNIA BIGHT: MULTIDECADAL TRENDS, IMPACT OF EL NINO, AND IMPLICATIONS FOR DEMERSAL FISHERIES

We revealed the effect of strong El Nino events on hypoxia in important fisheries areas in the Southern California Bight (SCB), and documented the secular trend in hypoxia over the last 57 years. We used water mass properties to illustrate advection at mid-depths, showing that summer hypoxia at 200 – 300 m is caused by northward intrusion of warm, saline, low oxygen sub-tropical water associated with the summer strengthening of the California Undercurrent. A 50 – 60 m shoaling of the oxygen minimum zone (OMZ) occurred in the summer of strong El Nino years (1958 and 1997) in areas of significance to fisheries. We predict that demersal fish on the banks and submerged islands in the SCB at 180 – 240 m depths will experience hypoxia during strong El Ninos. 37% of the Cowcod Conservation Area (CCA) rockfish habitat at 240 – 350 m depths suffers hypoxia in the summer of normal years. In strong El Nino years, the area experiencing hypoxia increases by 18% (to 55% of the total habitat). There is a refuge from oxygen stress in the 100 – 180 m depth range. The secular trend in hypoxia over the last 57 years was not monotonic, but rather showed a trend reversal in the mid-1980s. Recent declines in oxygen on the order of 20% over the last two decades are the largest and longest sustained negative trend in the time series, and have brought oxygen concentrations back to levels measured in the late 1950s to early 1960s.

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CAUGHT IN THE ACT--GENE TRANSFER BY GENE TRANSFER AGENTS OF ALPHA-PROTEOBACTERIA IN THE MARINE ENVIRONMENT

Microbial gene transfer (eg. "prokaryotic sex") has traditionally been regarded to occur by the processes of conjugation, transformation, and transduction. One additional method, currently termed "constitutive transduction" and known to occur in alpha-proteobacteria is mediated by gene transfer agents (GTAs). GTAs are believed to be defective prophages that randomly package host chromosomal DNA into GTA-encoded viral capsids. A survey of marine alpha-proteobacteria indicated that several sequenced isolates contain GTA's similar to the original element described in *Rhodobacter capsulatus*. The GTA-containing strain *Roseovarius nubinhibens* ISM produced 10^8 GTA-like particles ml^{-1} in stationary phase. Utilizing this isolate we have generated chromosomal mutant strains resistant to Nalidixic acid and a strain containing a Tn5/Kan^R cassette. Both antibiotic resistant strains produce GTA's similarly to the parental wild-type. When GTA preparations from antibiotic-resistant hosts were overlaid onto the wild-type host a statistically significant increase in the occurrence of antibiotic resistance was observed, indicative of gene transfer. Transfer of Tn5 was also verified by PCR. Purified GTA preparations from Tn5-containing hosts elicited a similar increase in antibiotic-resistance amongst natural populations of marine bacteria from Tampa Bay.

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EFFECTS OF ELEVATED PHOSPHORUS FROM FOREST FERTILISATION AND INCREASING WATER COLOUR ON THE ISOETID FLORA OF UPLAND LAKES IN NORTHERN IRELAND

Upland lakes in Northern Ireland provide a refuge for an uncommon macrophyte flora of Isoetid species but many moorland catchments of these soft-water lakes were ploughed, fertilised and planted with conifers from 1960 to 1980 increasing lake phosphorus (P).

Further lake perturbations continue associated with clearfelling and replanting. The persistence of the Isoetid flora in forest impacted lakes in the southwest of Northern Ireland was determined by comparing the macrophyte community of 12 lakes surveyed in 2007 with a 1989 survey. Lake P (24 – 95 µg P L-1) continued to be high, with highest concentrations associated with clearfelling; pH remained similar, with a range of 6.17 - 8.18. Isoetid distribution remained unchanged but showed a significant decline in abundance since 1989. Water colour had increased and conductivity decreased. These changes occurred irrespective of forest management history, but coincided with increased pH in precipitation and potentially elevated exports of dissolved organic carbon to water. Forest management has had less impact on the Isoetid flora than expected from the elevated lake P concentrations perhaps indicating phytoplankton co-limitation by nitrogen and P.

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BENTHIC ANALYSIS OF BUCK ISLAND REEF NATIONAL MONUMENT (ST. CROIX, U.S. VIRGIN ISLANDS): CORALS VS. ALGAE

There has been a lot of debate over what exactly is causing a rapid decline of U.S. coral reefs. In recent decades, the ecological structure and function of coral reef ecosystems have deteriorated dramatically due to a combination of stressor including fishing, anchor drops, excessive nutrient inputs, Diadema die-off, mass coral bleaching related to irregular sea water temperatures, the emergence of widespread coral disease and extensive hurricane damage. All of these stressors have led to the die-off of corals and the increase of algae in and around the benthos of Buck Island Reef National Monument (St. Croix US Virgin Islands). Animals that feed on the algae, such as Diadema and Parrotfish, are disappearing because they need the coral reefs to survive, thus creating an increase in algae. The Center for Costal Monitoring and Assessment / Biogeography Branch designed this research project to investigate the decline of coral reef ecosystems in Buck Island Reef National Monument (BIRNM). BIRNM is located on the northeastern shelf of St. Croix USVI (approximately 712,000 m^2).The BIRNM study area is a Natural Reserve managed by the National Park Service.

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RESPONSE OF SALTMARSH SEDIMENT MICROBIAL COMMUNITIES TO DESICCATION AND SUBSEQUENT TIDAL REFLOODING.

Saltmarsh microbial communities are frequently subjected to desiccation and large salinity fluctuations. To study the effects on such communities from Colne Point saltmarsh (Essex UK), sediment desiccation was experimentally simulated over 23 days, where water activity and water content decreased from 0.98 to 0.84 and 71% to 28% respectively, and pore water salinity increased from 35 to 230. This caused a significant decrease in surface microphytobentos presumably due to downward migration to avoid desiccation, although total Chlorophyll a increased, suggesting increased production due to reduced light below the surface.16S rRNA RT-PCR DGGE, 454 pyrosequencing and Q-PCR revealed bacterial community structure remained similar up to day 14 (salinity 150; Aw 0.91), but changed significantly after extreme desiccation, coupled with a two order of magnitude decrease in both Bacterial and Archaeal numbers. Extracellular enzyme activity also decreased, although, following tidal reflooding, enzyme activities, Bacterial, Archaeal and surface microphytobenthic biomass, were all stimulated and returned to levels similar to or higher than before desiccation, highlighting the ability of microbial communities to adapt to, tolerate and recover from such environmental stresses.

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AN EVALUATION OF THE CUMULATIVE EFFECTS OF BIVALVE AQUACULTURE WITH AN EMPHASIS ON BENTHIC COMMUNITY INTERACTIONS

Interactions between bivalve aquaculture and the environment occur at multiple spatial and temporal scales and include both "negative" and "positive" impacts. Although relatively benign in the environment at low densities, great concentrations of bivalves, such as may be found in bivalve aquaculture, may have great cumulative effects on the ecosystem. Until recently, most research effort on bivalve aquaculture-environment interactions has concentrated on a select few interactions. This has led to a truncated view of the influence this activity. A more holistic view of the cumulative effects of bivalve aquaculture in the environment is needed. Results from recent studies on the influence of suspended mussel culture on benthic communities are presented. Mussel aquaculture is shown to influence benthic communities in a number of ways. These are discussed in the context of evaluating cumulative effects of bivalve aquaculture in the environment.

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METABOLIC BALANCE IN TROPICAL MANGROVE ESTUARIES WITH NATURALLY HIGH ORGANIC LOADS

Mixing by large tides and litter-fall from extensive mangrove forests results in the classification pristine mangrove estuaries in tropical Australia as hypertrophic in terms of carbon loading (*sensu* Nixon 1995). Oxygen flux measurements indicate that only the surface waters are in positive metabolic balance (with net O_2 production of up to 50 mmol O_3 m^{-2} d^{-1}), since high turbidity results in light limitation of phytoplankton production. Though water column respiration rates are high (10.6 ± 3.0 mmol O_2 m^{-3} d^{-1}), areal integration of oxygen fluxes demonstrates that these systems are predominately net autotrophic (Gross Production: Respiration ratios of 1.1 to 1.7). However, during the wet season, they become heterotrophic during low spring tides (GP:R < 1), and dissolved oxygen concentrations can fall below 2 mg l^{-1}. We adopted a multidisciplinary approach to determine the fate of waste nutrients from aquaculture in mangrove estuaries, combining hydrodynamic studies with measurements of major ecosystem processes. Tidal exchange is the most important mechanism by which waste nutrients are removed and oxygen is replenished. Oxygen-based models have proven useful in forecasting environmental assimilative capacity.

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DESCRIPTION OF A NEARSHORE CHEMOSYNTHETIC ECOSYSTEM BASED UPON INPUTS OF NATIVE FOREST DETRITUS

Since the first discovery of a hydrothermal vent community in 1979, a range of settings have been documented where chemosynthetically-fixed carbon supports secondary production. We present an example of a nearshore food web in Fiordland, New Zealand that is subsidized by chemosynthesis based upon decomposition of terrestrially-derived organic matter. Extensive intact native rainforest and steep topography produce large inputs of terrestrial organic matter into the fjord marine environment, resulting in highly organic sediments. Subsequent fermentation provides suitable conditions for chemoautotrophic bacteria. The objective of the current study was to determine the nutritional importance of chemosynthetically-fixed carbon to the benthos. Analyses of macroinfaunal composition tagged to species-specific values of $\gamma^{15}N$ and $\gamma^{13}C$ determined that chemoautotrophic-bivalve symbioses comprised up to 64% of macroinfaunal community biomass, although the abundance of symbioses was patchy. Fatty acid biomarkers, and $\gamma^{13}C$ of bacterial biomarkers indicated spatial variability in the basal source of carbon fuelling chemosynthesis. The importance of terrestrial production to specific marine communities in Fiordland suggests that marine ecosystem function in coastal areas can be influenced by the condition of associated catchments.

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HOW WELL DO ECOSYSTEM INDICATORS COMMUNICATE THE EFFECTS OF ANTHROPOGENIC EUTROPHICATION?

Anthropogenic eutrophication affects Europe's seas to various extents. Responses to nutrient loading and methods of monitoring relevant indicators vary regionally, hindering interpretation of ecosystem state changes and preventing a straightforward pan-European assessment of eutrophication symptoms. Here we compare pelagic responses to nutrient enrichment in the Black and the North Seas, comparing existing time-series of selected pelagic (phytoplankton biomass and community composition, turbidity, N:P ratio) indicators based on their effectiveness in assessing eutrophication effects. Our results suggest that the Black Sea appears to be recovering from eutrophication due to economic reorganization in its catchment. Eutrophication in the North Sea is primarily a coastal problem, but may be exacerbated by climatic changes. Indicator interpretation is strongly dependent on sea-specific knowledge of ecosystem characteristics, and no single indicator can be employed to adequately compare eutrophication state between European seas. Communicating eutrophication-related information to policy-makers could be facilitated through the use of consistent indicator selection and monitoring methodologies across European seas. This work is discussed in the context of the European Commission's recently-published Marine Strategy Directive.

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CONNECTING DOM CHEMICAL COMPOSITION AND BIOGEOCHEMICAL VARIABILITY IN THE MEDITERRANEAN SEA

Novel ultrafiltration technologies were employed to isolate DOM during a seasonal study at the DYFAMED site in the W. Mediterranean, and from several water masses and depths in the E. Mediterranean (5- 4500m). This strategy was successful in isolating (AVG ± SD) 49 ± 15% of total DOC before diafiltration. Bulk chemical characterization provided C:N:P ratios, stable C and N isotopes, ^{1}H-NMR spectra, and monomeric distributions of the protein and carbohydrate components of DOM. These analyses are complemented by collaborative investigations of suspended and sinking particles, inorganic nutrients, and estimates of autotrophic and heterotrophic production and community composition. Spatial and temporal variability observed for this comprehensive data set defines oceanic biogeochemical cycling, and this collective approach seeks to identify relationships between DOM chemical composition and the diverse and locally unique production and degradation regimes that are specific to basins in both the E. and W. Mediterranean. This link is critical for examining the turnover of DOM components that fuel the microbial loop and identifying the impact of DOM reactivity on global carbon and nutrient budgets.

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TRENDS IN BACTERIAL GROWTH LIMITATION IN MEDITERRANEAN SHALLOW LAKES

The ability of aquatic ecosystems to sequester carbon (C) from the atmosphere is influenced by the resource (energy or mineral nutrients) that limits bacterial growth. The light-to-nutrient hypothesis (LNH) predicts that bacterial growth is limited by phosphorus (P) in ecosystems with high light:nutrient ratio, but by carbon in ecosystems with low light:nutrient ratio. Few studies have tested LNH, and findings on microbial predictions are inconsistent. We test LNH predictions on bacterial growth limitation through an interlake observational approach, as in the original LNH study, for a set of 30 small shallow Mediterranean lakes spanning a wide range of light:total phosphorus ratios (Im:TP, 0.01-7.7). A threshold of Im:TP to differentiate between ecosystems with high or low light:nutrient ratio is established. Comparative analysis between both lake groups revealed an opposed pattern to LNH predictions, as bacterial growth was C-limited in lakes with high light:nutrient but mainly P-limited in lakes with low light:nutrient. Deviation may be due to differential ecosystem-specific characteristics linked to a regional-scale geographical pattern. Their potential role as carbon sequestering ecosystems is discussed.

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DISTRIBUTION OF PHOTOTROPHIC MICROORGANISMS IN THE LAKE BAIKAL REGION

We studied distribution of phototrophic microorganisms in the Lake Baikal and several saline (salinity from 0 to 204 g/L) and soda lakes (the concentration of CO_3^{2-} up to 2.5 g/L) in the Republic of Buryatia, Russia. The phototrophic community compositions have been analyzed by pigment chromatography. In the Lake Baikal, the phytoplankton population is composed of diatoms, green algae (major groups), cyanobacteria and dinoflagellates (minor groups). The main phytoplankton groups found in Doroninskoe were green algae, in Zun-Torey lake together with cyanobacteria whereas Hilganta lake contained green algae, diatoms and dinoflagelllates. The bacteriochlorophyll depth profiles and daily dynamics were measured by infra-red kinetic fluorometry. The highest amounts of bacteriochlorophyll were typically observed early morning (13.1 ng/L in Lake Baikal, 23.3 ng/L in Doroninskoe, 431.8 ng/L in Hilganta, 85 ng/L in Zun-Torey). The maximum of bacteriochlorophyll was measured at 15 m in the Lake Baikal, 4 m in Doroninskoe, and 1 m in Zun-Torey.

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MODELLING COUPLED SOCIAL AND ECOLOGICAL SYSTEMS IN EUROPE'S SEAS: STARK CHOICES FOR DECISION MAKERS

During the past four years, we developed conceptual and Bayesian Belief Network (BBN) models for Europe's seas as part of the 14-country EU Project "European Lifestyles and Marine Ecosystems". These models helped us to probe relationships between social and economic drivers, the pressures they produce on the marine environment and consequences to marine ecosystems. We applied them to studies of alternative future scenarios for economic development in Europe. These demonstrated the difficult choices that will be tackled by new European policies for the marine and terrestrial environment. They also allowed us to highlight areas where causal relationships are very uncertain, often because of the inadequate systematic gathering of appropriate data. We are now extending this approach to investigate social and economic impacts of ecosystem changes and the potential effectiveness of alternative approaches to governance. We illustrate our work with systems models from the Baltic, and Black Seas where future achievement of "Good Environmental Status" by 2020 (a legally binding requirement of the EU Marine Strategy Directive) will require a massive cooperative effort involving important lifestyle choices by EU Member States.

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POPULATION GENETICS STRUCTURE OF THE ELKORN CORAL IN PUERTO RICO

Over the last 30 years, a combination of stressing events and disease outbreaks has led to important losses in the Caribbean elkhorn coral Acropora palmata, today listed on the US Endangered Species Act. Using microsatellite markers, it was shown previously that its distribution range was cleaved by the Mona channel into a western and an eastern population. In spite of recent studies showing the existence of smaller, local genetic structure in corals, none was documented for A. palmata, a possibility that could promote local reef protection. In this study, we aimed to assess the local genetic structure of the species in Puerto Rico. Using 6 highly polymorphic microsatellite markers, we screened 71 samples from 9 reefs. Analysis through STRUCTURE did not favor the decomposition of the samples into well differentiated sub-populations. Nonetheless, significant pair-wise Fst between reefs was found in 2 occasions, hinting at an existing east-west differentiation between reefs. Future work will focus on increasing both the number of sampled reefs and samples per reef, as well as adding genetic markers (microsatellite and mtDNA) to the analysis.

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INCORPORATING THE SIZE-STRUCTURE OF PHYTOPLANKTON COMMUNITIES IN A 3-D OCEAN MODEL

Oceanic phytoplankton span a great range of sizes, ranging from prokaryotic and eukaryotic picoplankton of ca. 1 μm^3 volume to large diatoms and dinoflagellates of that can have volumes in excess of 10^7 μm^3. Shifts in the size structure of phytoplankton communities can affect the oceanic carbon cycle and food web dynamics. We constructed a size-structured multiple phytoplankton-nutrient-detritus model coupled with an Ocean General Circulation Model (OGCM). Nutrient uptake, photosynthesis, and growth rates of phytoplankton are parameterized based on our best current knowledge of empirical relationship between cell size, nutrient and light acquisition, and growth rates. The sensitivity of the size-structure of phytoplankton communities to model assumptions and parameters are investigated. We present the simulated size-structure of phytoplankton in different regional environments, showing how resource availability and model assumptions translate into regional and global changes in phytoplankton community size-structure.

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RESOURCE LIMITATION RESULTS IN ANOMALOUS GROWTH ALLOMETRY

It has been hypothesized that the frequently strong correlation between phytoplankton size structure and certain oceanic regimes is due to physiological differences in nutrient and light requirements and acquisition efficiencies. Using a suite of physiological models we assess how light and nutrient availability can alter the relative growth rates of phytoplankton species of different cell sizes (size scaling of growth rate). Our models predict a shift in the size-scaling of growth rate depending on the severity of growth rate limitation by light and nutrient availability. For all the models considered, under conditions of growth-saturated resource supply, phytoplankton growth rate (time-1) scales with cell volume with size-scaling exponent -1/4; light-limitation reduces the size-scaling exponent to -1/3, and nutrient limitation decreases the exponent to -2/3 as a consequence of the size-scaling of resource acquisition. The sensitivity of the size-scaling exponent of phytoplankton growth to model parameters and assumptions are described. More field and lab data, especially the size-dependence of maximum photosynthetic rate and elemental stoichiometry, are needed to resolve uncertainty in key model parameters and advance the modeling of size-dependent phytoplankton growth and size-structure in marine pelagic ecosystems.

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RESTORING ECOSYSTEM FUNCTIONS IN A HEAVILY DISTURBED ESTUARY

When considering estuarine restoration, managed realignment is not always an option, due to site characteristics or safety considerations. We present a restoration technique that combines safety with ecology on a site with an elevation far below mean high water. Lippenbroek is a flood control area with a controlled reduced tide (CRT). A well designed sluice system allows semi-diurnal water exchange between this study area and the estuary. This setup offers opportunities to restore estuarine functioning in embanked areas. Although the tidal amplitude was strongly reduced, the newly created marsh faces inundation characteristics similar to macrotidal estuaries, with a wide range of indundation frequencies. The system shows however a prolonged hydroperiod with stagnant phase. Nevertheless, we observed relationships similar to natural marshes between indundation frequency and sedimentation rate, vegetation or benthos. Sedimentation (and ecological development) on the long term is hard to predict because tidal volume entering the CRT is independent of site elevation. Mass balance studies illustrate the potential functions of a CRT within the estuarine nutrient cycling. When implemented on a larger scale it will improve overall estuarine functioning.

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OCEANOGRAPHIC FACTORS, SPATIAL CONTEXT AND THE PREDICTIVE MODELLING OF SPECIES RICHNESS OF CORAL REEF FISHES

We examined the extent to which geographic location and oceanography predicted spatial patterns in species richness of coral reef fishes using an extensive oceanographic dataset from a 0.01° geographical grid over the Torres Strait (Australia), combined with data of fish distributions from more than 220 reefs within this region. Generalized linear mixed-effects models (GLMMs) were used to gauge the relative importance of oceanographic and geographic predictors, and random effects were included in models to account for spatial autocorrelation. We found that (1) geographical coordinates alone predicted up to 74.4 % of the deviance in richness, (2) the top-ranked models including oceanographic predictors explained 76.7 % of the deviance, and (3) 87.6 % of the deviance was explained when all predictors were included. Sea surface temperature, salinity, nitrate and phosphate concentrations all contributed marginally to explaining variation in richness. Irrespective of the model considered, prediction error was spatially invariant and the same spatial gradient appeared in predictive maps of richness generated by the models. This suggests that broad-scale spatial gradients in oceanographic conditions partially determine richness patterns of coral reef fishes. More investigation of the interactions between oceanography and population connectivity, and their temporal variability, are required for reliable prediction of biodiversity patterns within the context of future global change.

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WATERMASS CHARACTERISTICS OF THE SUBPOLAR MODE WATERS IN THE NE ATLANTIC : IMPACT OF THE ONSET OF THE BLOOM AND OF THE SMALL AND MEDIUM SCALES

During the year 2001, the POMME programme was dedicated to the study of the subduction of Subpolar Mode Waters in the NE Atlantic (38-45°N, 18°W), and of the mechanisms driving their biogeochemical characteristics, with a specific emphasis on mesoscale processes. Numerical simulations at high resolution (5 km) using a thoroughly validated coupled dynamical – biogeochemical model are used to undertake a synthesis of this programme. The main results of this work will be presented : the subpolar Mode Waters have winter biogeochemical characteristics, as, at these latitudes, the bloom occurs after subduction ; the small and medium scales increase the rate of subduction, the range of density of the subducted waters and modify the flux of tracers trapped in the main thermocline. This part of the NE Atlantic Ocean is, in agreement with observations, a carbon sink for the atmosphere.

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PHYTOPLANKTON ASSEMBLAGE DURING A COCCOLITOPHORID BLOOM IN THE PATAGONIAN SHELF

An oceanographic cruise was conducted in the Patagonia shelf in January 2008, during a coccolithophorid bloom. The cruise was conducted as part of the Brazilian Antarctic Program activities for the International Polar Year. This region has an important influence of sub-antarctic waters from both the shelf and the Malvinas Current. This work presents the phytoplankton composition obtained by HPLC (photosynthetic pigments), microscopic observations and flow cytometry. The pigment data, analyzed with the Chemtax software, showed dominance of two Haptophyte types, which, from microscopic analyses, could be identified as Emiliania huxleyi and Phaeocystis cf. antarctica. Dinoflagellates were the third important group contributing to total chlorophyll-a. Diatoms were almost absent, except on one station dominated by Cylindrotheca cf. closterium, associated with the highest chlorophyll levels. The presence of small phytoflagellates belonging to Prasinophytes and Cryptophytes, as well as cyanobacteria (also detected by flow cytometry) were identified by HPLC. Although ocean color images of the study region showed a high reflectance patch typical of coccolithophorids, contributions by large dinoflagellates and Phaeocystis were also important to total phytoplankton biomass in the study region.

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USE OF COUPLED BIOGEOCHEMICAL-3D HYDRODYNAMICAL MODELLING OF THE PHYTOPLANKTONIC AND ULVA EUTROPHICATION TO ASSESS THE RESPECTIVE ROLES OF MERGING RIVER PLUMES

Nitrate loads to coastal waters off Brittany (France) have increased ten times during the four last decades. Eutrophication of this coastal area is now a recurrent problem, with ``green tides'', i.e. stranding of green Ulva macro-algae in nitrogen-enriched areas, and phytoplanktonic blooms, making colored waters more offshore. Toxic species can be present (e.g. Pseudo-Nitzschia), and induce banning of shellfish consumption. A coupled three dimensional physical-biogeochemical model has been built, to be used as a scenario simulator for regional authorities, once calibrated and validated. The biogeochemical model reproduces the nitrogen, phosphorus and silicon cycles, and includes loads of inorganic and organic nutrients from the 39 main rivers of Brittany. In a first step, the hydrodynamical model has been used alone with a specific conservative tracer per river to get, on the 2001-2003 period, the empirical density function of each tracer in every mesh of the domain. The corresponding 90 percentiles have been used to map the marine receiving area in front of every terrestrial catchment area. The model allows the simulation of what should be considered as the "pristine" situation, and reveals that in some embayments, the small local tributaries are responsible for Ulva proliferations on beaches, whereas dinoflagellate blooms are mainly triggered by nitrogen coming from distant rivers through the sea boundary.

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A NEW MULTIMETRIC INDEX TO ASSESS THE ECOLOGICAL QUALITY OF PONDS BASED ON MACROINVERTEBRATES.

Since ponds are limnologically different from lakes, we develop a proper biological method to assess their ecological quality. Recent multimetric approaches offer new monitoring prospects and allow comparisons between reference and degraded sites. Therefore, 134 ponds were sampled in Switzerland and a subset of 36 lowland sites were classified along a gradient from reference to degraded sites. The degradation was described through 7 parameters based on plant communities, land use, and the trophic state. A total of 55 candidate biological metrics based on macroinvertebrates were tested for their relationship with the site degradation. The three most relevant metrics to be integrated in the final index CMEPT were selected following a stepwise procedure. There were: the genera richness of Coleoptera (C), combined with the macroinvertebrate family richness (M), and the Ephemeroptera, Plecoptera and Trichoptera (EPT) family richness. Indeed, the CMEPT discriminate well between reference and degraded sites, responded significantly to the gradient of the site degradation. Moreover, this index has been successfully tested on an external dataset in France to illustrate its potential suitability also out of Switzerland. This index is particularly attractive for managers, especially for its replicated sampling design, its facility of use in routine biomonitoring, and the reduced cost of field and laboratory analyses.

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MODELING THE TIME SERIES OF PLANKTON SIZE SPECTRA IN THE BAY OF MARSEILLE

Advanced acoustic and optic sensors have provided us high-resolution spatial and temporal heterogeneous distributions of plankton biomass and their size distributions. To utilize these high resolution size based data, we have made significant efforts to address plankton population and trophic dynamics by developing size spectrum models. Though several partial differential equations and numerical models have been developed to simulate size spectra of plankton, the questions have been raised on how these models realistically represent 1) growth and mortality of populations, 2) prey and predation relationship and 3) carbon fluxes between trophic levels and burial. Our studies show that the parameters deduced from a size spectrum can be used to interpret the community structure and carbon fluxes. A numerical model based the partial differential equation describing carbon flow in a community is developed for simulating seasonal size spectra observed in the Bay of Marseille.

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AN ADAPTIVE-BASED APPROACH FOR MODELLING CHANGES IN A COASTAL PLANKTON COMMUNITY STRUCTURE

Being characterised by fixed parameters, current ecosystem models can be regarded in a sense as "static representations of reality". That is, the actual processes governing the interactions within plankton communities and between a community and the environment are based on fixed traits (i.e. fixed algal food value, fixed algal competitive ability, etc.). Excluding the possibility for communities to adapt and to change their properties in order to better fit the prevailing forcing at a certain time can result in serious mispredictions. In order to account for adaptive processes, we will describe here a method based on succession-driven evolution of community-aggregated properties. Drawing from the Adaptive Dynamics approach we will show that models of aggregate group behaviour can have great advantages in terms of downscaling the complexity of multi-species models and are able to capture the macroscopic characteristics of the entire community such as total aggregate biomass, average trait distribution and trait variance. This approach leads to an appropriate description of combined top-down and bottom-up controls in the plankton community structure of a coastal ecosystem and captures the observed changes in seasonal succession.

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INSIGHT ON LYSOGENIC INDUCTION AND VIRAL CONTROL OF MICROCYSTIS SPP. ECOLOGY

Abiotic parameters regulating Microcystis spp. dynamics have been extensively studied. However, there is a tremendous lack of information on the ecological control of Microcystis spp. exerted via lysogenic and lytic viral infection. Water samples collected in Portugal and United States were processed for isolation and characterization of Microcystis spp. and ultraconcentration and challenge experiments permitted isolation of a range of new virus-host systems. Five isolated host strains were challenged with potential prophage induction agents. Results showed significant reduction of host cell numbers 48-72 h post-mitomycin C addition and 96 h after exposure to UV light, with concomitant increases in viral abundance as compared to controls. Characterization of released and purified viruses is underway via transmission electron microscopy and sequence analysis. A range of infectivity assays have yielded new high titer viral lysates including two viral isolates from Lake Erie that revealed extensive geographic host range. Information pertaining to methods for isolation, induction experiments, and host range/specificity experiments using viral isolates infecting Microcystis spp. will spur discussion and provide insight to the potential ecological control of this important genera of Cyanobacteria.

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BENTHIC GEOCHEMISTRY AND FORAMINIFERAL ECOLOGY ALONG A TRANSECT ON THE NAMIBIAN SHORE

Modern sediments were sampled using a multicorer during the RETRO cruise in May 2008 towards the Namibian shore. The occurrence of upwelling along the southwestern African coast creates nutrient-rich waters in surface resulting in high productivity. Six stations were studied from 600m to 3000m water depth in order to investigate the decreasing influence of the upwelling on the diagenetic processes and the ecology of benthic foraminifera. Such transversal approach is scarce and can help paleoclimatologists to better constrain climate reconstruction based on the distribution of foraminiferal shells. Geochemical parameters (pH, O2, nutrients, Mn, Fe) were analysed in the sediment porewater within the first 10 cm of the cores. We have also investigated the live benthic foraminifera dwelling in the first cm of the sediment. We focused on the changes of density and diversity in response to the redox conditions. Primary results show that these organic-rich sediments contained high density of living foraminifera. We also observed variations of oxygen penetration according to the bathymetric transect and a response of faunas to redox conditions.

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TAXONOMIC AND BIOMASS VARIATION OF EPILITHIC ALGAE IN A CENTRAL EUROPEAN KARST STREAM UNDER DIFFERENT RUNOFF REGIMES

To answer the question of how varying flow patters (permanent vs. intermittent runoff vs. complete drought) affect the benthic Aufwuchs community in a Central European (Paderborn Plateau, Germany) karst stream, the temporal and structural dynamics of epilithic algae were investigated. Repeated sampling campaigns within a permanent-temporary transition zone took place between February and May 2007, covering the highest flow changes. Biomass of benthic algae was determined through *in situ* measurements using a novel fluorescence probe method and by conventional photometry. Taxonomic composition and AFDM of algae samples were determined consequently. The results showed that at the temporary site, drought could be considered as disturbance. Algae biomass and biodiversity was significantly lower compared to the permanent site and even dropped more over time. With greater flow intermittency the taxonomic structure of the algal community was increasingly altered and biomass further reduced, whereat lowest diversity was found in stream pools. However, restored water levels lead to a different and more complex characteristics as a result of abrasion and self-shading of the Aufwuchs community.

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WHEN AND WHY IS PARTICLE MIXING IN THE OCEAN FLOOR A DIFFUSIVE PROCESS?

Particle mixing in aquatic sediments results from a variety physical (e.g. erosion/ resupension) and biological (e.g. feeding, relocation, burrowing of macrofauna) processes , which induce particle displacement over different length and time scales. Despite this inherent complexity, tracer studies show that mixing is often well described by a simple diffusive model. To resolve this apparent contradiction between process complexity and model simplicity, we present an investigation into the "diffusive nature" of biological mixing (bioturbation). We propose a generalized stochastic description of bioturbation, where particle movement results from a sequence of random bioturbation events. The resulting model is a continuous-time random walk, and we examine the conditions under which these random walks generate "diffusive" behavior. This shows that there is a only single central criterion for diffusive mixing: the number of mixing events should be sufficiently large within the time frame of observation. This criterion has important consequences for the experimental tracer methods that are currently in use (radionuclides, luminophores).

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SEAGRASS BELOWGROUND DETRITUS IN A GLOBAL WARMING SCENARIO: FROM SINK TO CARBON SOURCE

Belowground detritus of the Mediterranean endemic seagrass Posidonia oceanica can accumulate in reef like structures, matte, with a thickness of up to 6 m and remain as macro-detritus for millennia. This accumulation, due to slow decay rates, act as an important carbon sink at Mediterranean scale. The central hypothesis of this project presumes that decay rates increase with temperature and transforms the matte into a carbon source playing a role in global warming. A secondary hypothesis states that the decay rates are age dependent and therefore change with matte thickness. Samples from 5 depths of a matte are incubated under anoxic conditions at 5 different temperatures for 6 months with monthly sampling in order to follow the decay of the matte. End metabolic products, such as CO2 and H2S, are measured to describe and quantitatively asses the response of matte decay to temperature change. Preliminary results indicate that global warming will lead to a higher decay rate within the matte and that the decay rate decreases with age suggesting less microbial activity in the old parts of the matte.

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USE OF C & N STABLE ISOTOPES TO EVALUATE INTERSPECIFIC TROPHIC DIVERSITY AMONG AMPHIPODS FROM *POSIDONIA OCEANICA* MEADOWS.

Amphipods are one of the most diverse and abundant taxa of vagile invertebrates associated to Mediterranean *Posidonia oceanica* meadows. Therefore, they likely play an essential part in those ecosystems' functioning, notably in organic matter transfers from producers to higher level consumers. Nevertheless, their trophic ecology remains poorly known, and they are generally regarded as epiflora grazers or generalist detritivores. Here, we focused on interspecific trophic diversity, and on the importance of other food sources (epifauna, *Posidonia* leaves & litter, suspended organic matter, …) in those amphipod's diet. To achieve these goals, we used C and N stable isotopes ratios as trophic tracers. We noticed considerable trophic diversity among amphipods from different species, with $d^{13}C$ values ranging from -16 to -26 ‰. Moreover, while some species (such as *Apherusa chiereghinii* and *Aora spinicornis*) seem to feed mainly on epiphytes, others, like *Dexamine spiniventris*, exploit other food sources. This study enhances the comprehension of the feeding ecology of these amphipods, and therefore of the way they interact with the *Posidonia* meadow ecosystem.

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CYANOBACTERIA IN ANTARCTICA: A MULTIDISCIPLINARY STUDY

Antarctic cyanobacteria biodiversity was investigated at various levels including the morphological, genetic and physiological aspects. Cyanobacteria were collected in Antarctica during the Austral Summer Cruise 2004; the strains were isolated from South polar lakes sediments, soil and liken associations and subsequently they were grown in laboratory conditions before to be analysed. The strains belong to the genera of Nostocales and Oscillatoriales were morphologically identified by microscopy. The fatty acid composition varied among the strains with a relatively high quantity of polyunsaturated fatty acid production. A first genetic investigation by RAPD markers was performed. Cyanobacteria strains were also identified by ITS and TrnL sequencing. Antarctic cyanobacteria diversity and their geographical distribution revealed their particular tolerance range to harsh environmental conditions. We confirm that the successful classification of cyanobacteria species requires the application of multiple taxonomic criteria. Research financed by the Programma Nazionale di Ricerche in Antartide (PNRA). Project LUP-PUS (1.4/ 2003-04).

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ACTIVITIES AND STRUCTURE OF BACTERIAL COMMUNITIES OF NITROGEN CYCLE IN INTERTIDAL ZONE

The main processes associated with the nitrogen cycle were studied in marine sediment of the interdital zone in March 2005 and June 2006 in Arcachon lagoon (Western France). Denitrification, nitrogen fixation, nitrification and Anammox rates were measured using inhibitor and/or 15N- isotope approaches. Here we describe the presence of microbial communities with the potential to carry out these processes in a natural marine intertidal sediment system. Natural microbial communities of denitrifiers, di-azotrophic and betaproteobacteria-ammonia-oxidizing bacteria and anammoxifiers were characterized in term of density and biodiversity by targeting the corresponding functional genes (nosZ, amoA and nifH, respectively) or fragment of 16SrDNA for anammoxifiers. Depending of the targeted genes, bacterial numerations were carried out by competitive PCR or Real Time PCR methods. For biodiversity studies, amplification products were analyzed by sequencing of clones and by denaturant gradient gel electrophoresis (DGGE). Sequence analysis of planctomycete clone libraries and sequences demonstrated a diverse microbial community and suggested the presence of new subdivisions, but no sequence related to organisms recognized as Anammoxifier was detected whereas the presence of ladderane, specific maker of anammoxifer was clearly showed.

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DISSOLVED MANGANESE IN THE ARCTIC AND ANTARCTIC OCEANS

Samples were collected for dissolved Manganese (Mn) with an ultraclean all-titanium CTD system (de Baar et al. 2008, MarChem, 111, 4-21) during the IPY-GEOTRACES program of the ARK XXII/2 and ANT XXIV/3 expeditions aboard RV Polarstern. This is the first ever comprehensive dataset of dissolved Mn in the polar oceans. Concentrations of Mn were elevated in the surface waters of the Arctic Ocean, especially in areas with apparent fluvial and/or shelf influence. Deep waters are extremely depleted in Mn, except for a distinct signal of hydrothermal input which was also visible in the dissolved Iron (Fe) concentrations, temperature and light transmission. Latter hydrothermal Mn input could be traced across a specific depth horizon in the entire Eurasian Basin. In the Southern Ocean also a site of suspected hydrothermal input with elevated Mn and Fe concentrations was observed. Surface concentrations of Mn in the Southern Ocean were extremely low and correlate well with low 234Th, nitrate and phosphate in the surface layer. Around 55° S the Mn surface concentrations were elevated and this corresponded with less biological activity.

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VIRUSES IN MARINE SEDIMENTS: BENTHIC PROCESSES ON A MICROSCALE

Marine sediments constitute one of largest biospheres on the planet and accounts for a substantial fraction of the global carbon turnover. One cm^3 of surface sediment typically contains 10^8-10^{10} bacteria and viruses; a 10-1000 fold higher concentration than is found in the upper lying water column. Surprisingly, the role of viruses in sediments has until recently remained largely unexplored, however, benthic viral ecology is a rapidly expanding research area, and recent studies have demonstrated that benthic viral communities are highly diverse, dynamic and important players in benthic ecosystems. With estimated turnover rates of 0.5-5 days, viruses may therefore constitute a significant loss factor for benthic bacteria (up to 100% of bacterial production), with potentially significant implications for bacterial dynamics and benthic nutrient cycling. Despite these progresses, we still lack even basic information of the distribution and dynamics of viruses on different spatial and temporal scales as well as an understanding of how virus-host interactions are regulated in the complex physical and chemical microenvironment of sediments. The presentation provides an overview of the current knowledge in the field.

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A 13C AND 15N TRACER STUDY OF PLANKTON DYNAMICS IN AN ESTUARINE PLUME

When nutrient-rich, light-limited, estuarine waters mix with low-nutrient marine waters, light conditions improve and plankton blooms develop. We simulated such as a bloom by enclosing estuarine waters to which 13C (in the form of bicarbonate or glucose) and 15N (as nitrate or ammonium) were added as tracers. Decoupling of nutrients was observed during and after a diatom bloom and P turned out to be the limiting nutrient. Following the bloom, a heterotrophic phase was marked by nutrient regeneration, and followed by a Phaeocystis bloom. While addition of 13C-bicarbonate showed a strong coupling between algal primary production and bacterial secondary production, addition of 13C-glucose provided ambiguous results for carbon cycling in the microbial loop. We could trace the 13C into mesozooplankton, concluding selective grazing on algae during a phytoplankton bloom and more opportunistic feeding strategies after the bloom. 15N tracer data confirmed these conclusions and provided additional information on nitrification and ammonium regeneration.

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THE ROLE OF TRANSPARENT EXOPOLYMERIC PARTICLES IN TRACE METAL CYCLING: A CASE STUDY (LAGOON OF NOUMÉA, NEW CALEDONIA)

Seawater samples were collected in the lagoon of Nouméa (southwest New Caledonia) along two transects from anthropogenically-impacted coastal bays to the oligotrophic barrier reef. Dissolved (<0.2 µm) and sub-micrometric (0.2-0.8 µm) concentrations of chromium, nickel and zinc were measured. Sub-micrometric concentrations were correlated with transparent exopolymeric particle (TEP) turnover rates, suggesting that this size fraction is representative of the TEP-metal association, and that a TEP pool rapidly cycling in the system is more reactive toward metals. TEP reactivity in the dissolved to particulate transfer efficiency of metals was estimated through variations of the metal partitioning coefficient (K) between sub-micrometer TEP and solution, as a function of the residence time of the water mass. Log [K] ranged between 5.2 and 7.5, and increased from high to low residence times of the water mass, thus suggesting that TEP reactivity toward metals increases when the water mass renews rapidly. This study shows that local hydrodynamics may control the dissolved to particulate transfer efficiency of metals via regulation of TEP reactivity toward metals. Complexation and adsorption are successively involved in the metal-TEP association.

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POTENTIAL ROLES OF WATER MIXING IN THE SPATIO-TEMPORAL DYNAMICS OF PROKARYOTIC COMMUNITY AND THE FUNCTIONING OF THE BIOLOGICAL PUMP

Despite recent advances in molecular and metagenomic approaches, it is still unclear how spatio-temporal variations in microbial communities influence the functioning of the biological pump, exporting organic carbon from the surface to the deep oceans. We address this important problem by constructing a simple metacommunity model of heterotrophic prokaryotes, consisting of two generalist ecotypes with asymmetric preference for two types of resources. The first ecotype has a higher preference for particulate organic carbon (POC), while the second one has a higher preference for dissolved organic carbon (DOC). The interaction between ecological processes, such as resource competition, and the physical process of POC sinking would lead to a higher abundance of the first ecotype in the deep layer compared to the surface layer, but vertical mixing in turn generates a net upward flux of this ecotype from the deep to the surface layer. This upward movement accelerates the shifts in the community composition during phytoplankton bloom, contributing to a higher efficiency in remineralization of POC at the surface layer and a lower export of organic carbon to the deep layer.

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DISTRIBUTION PATTERNS OF TWO LABRID SPECIES IN THE WESTERN MEDITERRANEAN: IS WATER WARMING AFFECTING THEIR ECOLOGICAL INTERACTIONS?

Climate warming should favor 'warm water' species over 'cold water' species at the same site. Regional warming in the Western Mediterranean has allowed the documented northward expansion of southern marine species. Conversely, very little is known on the response of cold loving species to temperature variations. We propose to work with two common coastal fishes: the rainbow wrasse *Coris julis* and the ornate wrasse *Thalassoma pavo*, with the general objective to exploring patterns of distribution and their potential to interact under warming conditions. Large scale quantitative observations revealed: (1) opposing trends in abundance along latitudinal (35° – 45°N) and depth gradients (0-36m), with *T. pavo* densities significantly higher in southern and shallow waters than those of *C. julis*; (2) differential distributions across shallow habitats, with *C. julis* occupying seagrass beds when the density of *T. pavo* was high; and (3) a marked depth segregation of the species only on steep coasts. These patterns are discussed with regard to the role of water warming. Significant ecological changes might occur in locations where the density of *T. pavo* is recently increasing.

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EXAMINING THE RELATIONSHIP BETWEEN *IN SITU* SURFACE DMS CONCENTRATIONS AND SOLAR RADIATION DOSE (SRD)

A global correlation between solar radiation dose (SRD) and dimethylsulphide concentration [DMS] was recently identified by Vallina & Simo (2007). Using data collected during the Atlantic Meridional Transect (AMT) programme, we examined this relationship from an f*in situ*, measurement-based perspective. We found a significant correlation (ρ=0.54; p < 0.01; n = 64) between SRD and [DMS], although the slope of the relationship was approximately half that identified by Vallina & Simo (2007). We then replaced *in situ* mixed layer depth (MLD) and surface insolation values with appropriate climatological values. Furthermore, we also replaced the light extinction coefficient (k) with a fixed value (following the methodology of Vallina & Simo (2007)). All of these procedures substantially improved the correlations with [DMS], and the best produced a correlation (ρ=0.76; p < 0.01; n = 64), which is comparable in strength to a simpler relationship (for the same dataset) between [DMS] and MLD alone (Bell et al., 2006). The details of this work will be discussed as well as work on the role of ultra-violet radiation (UVR) within the solar radiation dose.

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CAN SEA-ICE RAFTED DETRITUS BE DISTINGUISHED FROM THAT OF ICEBERGS?

Sediment transport in the Arctic occurs mainly by ice drift. Fe oxide grain mineralogy and geochemistry establish entrainment and deposition sites. Sediment core grain analysis can determine changes in entrainment areas and net ice drift patterns. Useful procedures for differentiating between grains transported by icebergs or sea ice remain unavailable. Fe grain and IRD texture is useful in delimiting an iceberg or sea ice transport agent because icebergs usually transport coarser material. Size may also be a discriminate factor since sea ice is selective of relatively finer material. Through electron microprobe analyses, source shelves have been identified. Grains traced to areas without record of glaciation are presumed sea ice material. Known glacial sources are those associated with the collapse of ice sheets during OIS 2. Source information combined with size analysis and roundness observations will be used in an attempt to establish a basis for distinguishing between transport mechanisms. Data will be discussed using samples from modern sea ice and Pleistocene moraines as end-member sources of IRD and sediment cores collected from the Fram Strait that cover the last 30k yr.

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IMPACTS OF NATURAL ORGANIC MATTER UPON THE OXIDATION OF FERROUS IRON BY HYDROGEN PEROXIDE

Iron is an important micronutrient in many aquatic systems with reduction of the highly insoluble Fe(III) to the much more soluble Fe(II) now recognised to be critical to iron bioavailability. While kinetics of reduction of Fe(III) by photochemical and biotic processes is important, so too is the rate of back oxidation of Fe(II) species by O_2 and, in many instances, H_2O_2, with this later peroxidation process potentially producing highly oxidizing hydroxyl radicals. While the peroxidation kinetics of inorganic Fe(II) are well understood, much less is known about the effect of natural organic matter (NOM) on the rate of this H_2O_2-mediated process. At pH 8.4, the well-characterised NOM Suwannee River fulvic acid has two major impacts upon Fe(II) oxidation: (i) retardation of the initial oxidation rate of Fe(II) by H_2O_2, and (ii) gradual formation of a species that is even more slowly oxidized by both O_2 and H_2O_2. These results imply that fulvic acids may significantly stabilize Fe(II) even under highly oxidizing conditions and suggest that the hydroxyl radical generation may only be significant in systems containing low concentrations of NOM.

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REDUCTION OF SPATIAL COMPETITION BETWEEN BENTHIC FOULING COMMUNITIES AND JELLYFISH POLYPS DUE TO SEASONAL HYPOXIA

Jellyfish blooms in the northern Gulf of Mexico broadly overlap with areas of low oxygen concentrations such as the seasonally hypoxic area of the Louisiana-Texas shelf. While it is suggested that eutrophication and hypoxia influence outbreaks of jellyfish, proximate mechanisms remain dubious. We hypothesize that low DO facilitates clearing of space in this highly space-limiting environment. To this end, we investigated the effect of low dissolved oxygen (DO) concentration on settlement, survival and growth of polyps of *Aurelia* sp. and on the space-competing sessile community through a series of laboratory and field experiments. Greatest planulae settlement rates occurred under lowest DO concentrations (1.3 mg-l), indicating that reduced DO promotes settlement, perhaps as signal of physiological stress on planula swimming. Survival of polyps under prolonged (56 days) hypoxic conditions decreased marginally; however, the rate of asexual budding was significantly reduced under these conditions. Fouling community coverage wad reduced by hypoxia, thus releasing open space for potential settlement and survival of polyps.

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TRAINING THE SEAUV/SEAUVC MODEL FOR IMPROVED INSHORE ESTIMATES OF UV OPTICS AND PHOTOCHEMICAL AND PHOTOBIOLOGICAL RATE CALCULATIONS

The SeaUV/SeaUVc model (Fichot et al., RSE, 2008) represents a useful set of algorithms for estimation of spectral attenuation and CDOM absorbance in the ultraviolet from remotely sensed ocean color in the visible, producing well-constrained estimates for surface ocean Kd(320) and ag(320) for use in photochemical and photobiological models requiring UV radiation fields. Developed and tested in coastal and blue waters, its performance in darker, inshore, high CDOM waters requires further evaluation. SeaUV/SeaUVc is based on principal component analysis and data from new optical environments not in the original training set can improve its universal performance. This study presents new optical data from dark waters around Sapelo Island, GA, and other coastal waters gathered to train SeaUV/SeaUVc for improved inshore performance. Retraining with additional dark water samples results in significant improvement of Kd(320) and ag(320) estimates. A presentation of model results after retraining with selected optical subsets (i.e. dark only, blue only) will examine accuracy over the full model with regard to optics and sensitivity testing for photochemical and photobiological calculations using different model training scenarios.

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CHIRONOMID-BASED RECONSTRUCTION OF THE TROPHIC HISTORY DURING THE LAST CENTURY OF TWO FRENCH LARGE LAKES: LAKE BOURGET AND LAKE PALADRU.

Instrumental data about lake functioning before anthropogenic disturbances of the last century are scarce and often discontinuous. To understand the recent history of two large French lakes (Lake Bourget and Lake Paladru), we developed paleolimnological studies of chironomid remains combined to organic matter, diatom and sedimentological analyses along sediment cores taken in the deepest part of both lakes and dated using radionuclides. In these records, changes in hypolimnetic oxygen, the main controlling factor of chironomid communities, were reconstructed from chironomid succession. In Lake Bourget, chironomids indicated the onset of a decrease in oxygen availability around AD 1943 and persistent hypolimnetic anoxia since AD 1960. This oxygen trend seems to be linked with the increase in autochthonous organic material in the sediment (indicated by Rock-Eval pyrolysis) and the increase in planktonic production (indicated by diatom assemblages). At Lake Paladru, our first results (Chironomids and LOI) suggested a similar pattern of the lake history. These trophic changes were mainly triggered by local factors (e.g. nutrient inputs) possibly modulated by global changes (warming).

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CAN JELLYFISH BLOOMS ALTER MESOZOOPLANKTON COMMUNITY STRUCTURE?

Gelatinous zooplankton, including medusae and ctenophores, are conspicuous members of coastal marine communities capable of forming large seasonal blooms. Despite the range and magnitude of these blooms, there remain gaps in our understanding of the ecological impact these animals have within planktonic communities. Numerous controlled studies suggest selective feeding by jellyfish, but does this translate into zooplankton assemblage shifts in nature? We present here a temporal and spatial analysis of marine zooplankton communities across the northern Gulf of Mexico (summer 2007 and 2008) and at one intensively sampled location offshore of Dauphin Island, Alabama (monthly; 2004-2006). Using multivariate analyses we have identified specific seasonality of communities associated with several major gelatinous bloom periods. Spatial analysis was performed to reveal assemblage differences that may be associated with the presence of jellyfish blooms.

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MOLECULAR GEOMICROBIOLOGICAL CHARACTERIZATION OF ANOXIC BASIN SEDIMENT MICROBIAL POPULATIONS WITHIN PALMYRA ATOLL LAGOON SYSTEM

This study describes microbial community structure and function within anoxic basin sediments of Palmyra Atoll. Hydrodynamic flow through Palmyra Atoll was greatly modified in the 1940s when the U.S. military constructed several causeways, and enlarged and joined islets. An ongoing, natural recovery of the atoll post WWII has increased flow patterns within the lagoons; however, multiple anoxic, sulfidic basins remain. A multi-disciplinary, international team is currently monitoring the slow recovery of the Atoll. Geomicrobiological efforts have focused on microbial population shifts and variances in metabolic activity to determine the role microbes are playing in the formation or maintenance of the anoxia. Therefore, high-throughput state of the art pyrosequencing of RNA derived SSU rRNA amplicons was used to determine the structure of the metabolically active fraction of the microbial community in six anoxic basins (>45 m water depth) and three oxic basins (two approximately 12 m and one >45 m water depth). Quantification of functional genes for nitrate (nosZ) and sulfate (dsrA) reduction identified the importance of these processes within the anoxic basins.

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HIGH RESOLUTION DATA FOR SELECTED TRACE ELEMENTS FROM THE PACIFIC OCEAN CLIVAR-CO2 REPEAT HYDROGRAPHY P16S AND P16N TRANSECTS

The Climate Variability and Predictability (CLIVAR)-CO2 Repeat Hydrography program is engaged in studying the world's oceans in order to describe and understand the physical processes responsible for climate variability. An integral part of this program is the investigation of biochemically-required trace elements and their distributions in the upper water column (1000m) where the majority of trace metal uptake and recycling occurs. Sampling during two CLIVAR cruises (P16 north and south transects) has produced high-resolution data for a suite of trace elements in the upper 1000m of the Pacific Ocean between 55.8N and 71.0S from Kodiak, Alaska to Antarctica along 150W. Total dissolved Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb were extracted from stored (acidified) samples (after UV oxidation) using Nitrilo-triacetic Acid (NTA) chelating resin and determined using isotope dilution ICP-MS (Mn and Co were calibrated by the method of standard additions). Observed trends will be compared to hydrographic, nutrient, and transient tracer data in order to interpret and understand elemental distributions, sources, trace metal-nutrient relationships, biogeochemical cycling rates, and transport in the water column.

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HYDROECOLOGICAL RESPONSE OF ALPINE RIVER SYSTEMS TO SHRINKING GLACIERS

In the current phase of global climate warming, many alpine glaciers are shrinking. Glacier shrinkage and associated changes in runoff amount and timing, water source contributions and physicochemical habitat will be a major driver of the future biodiversity of stream communities in alpine environments. Loss of snow and ice-masses will alter spatial and temporal dynamics in basin runoff changing the relative contributions of snowmelt, glacier melt and groundwater to stream flow. As a result changes to fluvial solute, sediment and thermal regimes and, thus, channel stability and habitat will occurr. The projected reduction in sediment load, warmer water temperature and increased channel stability will drive significant shifts in the floral and faunal composition of glacier-fed rivers. Increases in the richness and production of microorganisms, algae, macroinvertebrates and fish are predicted as glacier hydrological influence shrinks under a warmer climate. With reduced glacial influence, macroinvertebrate species trait diversity will increase with more organisms possessing larger body size, less specialized body shape and lower adult mobility. However, some species such as cold stenothermic taxa (including some endemic macroinvertebrates) may be vulnerable to extinction and therefore gamma (regional) diversity will be reduced. These sensitive macroinvertebrate taxa may be important biological indicators of environmental change in glacierized river basins.

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THE ROLE OF TIDAL CURRENTS IN THE TRANSPORT OF BIVALVE LARVAE THROUGH AN ESTUARINE INLET

Understanding larval transport mechanisms is fundamental to predict dispersal or retention of commercially important bivalves. The complex features of estuarine flows can become magnified at inlets where strong tidal currents meet a salinity barrier often causing asymmetric flow. Flows through estuarine channels are important in regulating flux of weak swimming bivalve larvae with the coastal ocean. By using an automated, multi-valve pump system, we sampled larvae continuously over each flood and ebb tide for a full lunar tidal cycle (29 days) in an estuary on Cape Cod, MA. Point samples across the channel (horizontal) and with depth (vertical) were taken to determine uniformity of larval concentrations within a horizontal cross-section. Three current meters were deployed throughout the channel during this time period to characterize the across-channel flow. Total flux of larvae was calculated from the change in channel area multiplied by the larval concentration over each sample interval. We found that the strength of flood tide currents varied across the channel and affected the total flux of larvae entering the estuary. We conclude that horizontal concentrations of larvae across a channel will have a greater influence on larval transport than their vertical positions in areas of strong flow.

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DIET OF *MYTILUS GALLOPROVINCIALIS* (LAMARK, 1819). FIRST RESULTS OF A FIELD STUDY IN THE GULF OF TRIESTE, ITALY

Mussels are important components of near-shore communities and significantly impact pelagic and benthic processes. Moreover, they play an important role in aquaculture and are widely farmed. In order to evaluate the diet composition and the prey selectivity of *Mytilus galloprovincialis*, gut contents of mussels farmed in the Gulf of Trieste (North Adriatic Sea, Italy) were compared to the plankton community in the same site. The organisms observed in the different samples were divided into: 1) organisms found only in the gut; 2) organisms found in the gut and plankton community; 3) organisms found only in the plankton community. Diatoms and dinoflagellates were the main taxa observed in the gut contents accounting for the 96.7% of the total abundance, followed by tintinnids, larval forms of micrometazoans, foraminifers and silicoflagellates. Our preliminary results indicate a prey selection inducing modification on plankton community. Ongoing research based on field and lab experiments will provide basis for increasing robustness of these conclusions and for extending them to not observable species in the gut contents.

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HOW IMPORTANT IS OLD CARB0N IN LAKE SUPERIOR?

Lake Superior acts as both a regional carbon source to the atmosphere (through net respiration and subsequent release of carbon dioxide) and as a sequesterer of organic carbon through burial in lake sediments. The known inputs of carbon to the lake (through photosynthesis, riverine inputs, and atmospheric exchange and deposition) are considerably lower than the known outputs of carbon, indicating that there must be either a spatial or temporal subsidy to the lake carbon cycle. Particulate OC (POC), dissolved OC and dissolved inorganic carbon from the stratified Lake Superior water-column was collected in August 2007. Radiocarbon ages show that, during the stratified period, surface open-lake POC had a greater bomb carbon component, and appeared more similar to DIC radiocarbon levels, than both deeper-water open-lake POC and nearshore surface POC. Based on a two end-member mixing, the potential subsidy of pre-aged POC increased from ~17% in the surface waters to 40% and 48% in nearshore and deep waters, respectively. Radiocarbon ages of bacterial respiratory CO2 and the relative contribution of pre-aged OC to microbial metabolism will be presented.

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ENVIRONMENTAL CONTROLS ON THE DISTRIBUTION OF HARMFUL ALGAE AND THEIR TOXINS IN SAN FRANCISCO BAY, CALIFORNIA

Harmful algae (HA) are some of the less studied Bay and Delta species and their distribution, abundance as well as the conditions promoting their proliferation are not well characterized. Accurate monitoring of HA and associated toxins is needed to establish a baseline for future comparison and to predict changes associated with climate change and anthropogenic impacts. Such information is crucial for mitigating future impacts of HA blooms (HAB) on water quality, considering predicted future environmental changes in temperature, stratification, nutrients and trace metals loading that can potentially alter the HA abundance and toxin production. To successfully allow early HAB detection and to design best management and preservation plans, we have adopted an adaptative monitoring strategy. Monitored variables include distribution of HA (cyanobacteria, diatoms, dinoflagellates) and their toxins (microcystins, domoic acid and saxitoxin) in the San Francisco Estuary as well as suspected environmental stressors. Preliminary results from monthly monitoring throughout the Bay and the Delta including spatial and temporal distribution of algae and toxins (domoic acid, saxitoxins, microcystins) in relation to a suite of important environmental variables will be presented.

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PROCESSES ENHANCING CARBON EXPORT IN THE MEDITERRANEAN: RESULTS FROM A MULTI-YEAR STUDY

Sinking particle fluxes have been studied at the DYFAMED site (Northwestern Mediterranean Sea) since 1986, constituting today the longest sediment trap time-series in the Mediterranean. Organic carbon flux measured at 200 and 1000 m depth were highly variable over time, ranging from 0.3 to 59.9 mg C/m2/d at 200 m, and from 0.2 to 17.1 mg C/m2/d at 1000 m. Highest carbon fluxes were usually measured in spring-summer while total mass fluxes were highest in winter. Mean annual POC flux did not change significantly over the studied period but, from 1999 onwards, the system has apparently shifted towards an increasing occurrence of pulsed extreme fluxes, in comparison to a steadier and more seasonal pattern in previous years. These high sinking carbon flux events appear to be associated to several processes including enhanced winter physical mixing of the water column, changes in the phytoplankton community structure and biomass, pulses of atmospheric dust deposition and increased settling of mucilaginous aggregates. A review of these processes and their impact on POC downward flux will be addressed.

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DENSITY-DEPENDENT GROWTH OF RED DRUM *(SCIAENOPS OCELLATUS)* IN SUBTROPICAL TEXAS ESTUARIES

Varieties of environmental and biological processes influence fish populations. The availability of high quality habitat is often limiting, thus animals may compete for resources in a density-dependent manner. Conspecific densities of juvenile fishes may negatively affect growth and abundance, with slowed growth at high densities. In a natural experiment, we tested the hypothesis that growth rates of juvenile red drum *(Sciaenops ocellatus)* does not vary at different densities. We collected red drum over four weeks (October – November 2007) from three bays with varying densities: Aransas Bay (high density), Corpus Christi Bay (intermediate density), and the upper Laguna Madre (low density). We also collected 180 red drum (60 from each bay) approximately 25 mm SL for otolith growth analysis. We measured the increment width of the last 10 d of otolith growth as a proxy for length to determine growth rates. Results show that there is no difference in growth rates among the bays with varying densities of red drum. This suggests that increased density alone may not influence growth of juvenile red drum.

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SUPRAMOLECULAR ORGANIZATION AND PROCESS OF MARINE GEL NETWORK FORMATION VISUALIZED BY ATOMIC FORCE MICROSCOPY

The macroscopic gel phase appears episodically in the northern Adriatic Sea. The phenomenon manifests itself in rapid production of enormous amounts of gelatinous matter - marine gel. Organic fraction of marine gel is mainly composed of polysaccharides, while proteins and lipids are present in small amounts. Although chemical composition of marine gel has been largely studied, determination of the structural parameters remains much more difficult, mainly due to the complexity and heterogeneity. Atomic force microscopy (AFM) has become an important technique for studying biopolymers since it offers high spatial resolution in three dimensions, down to subnanometer level with minimally perturbing sample preparation. We used AFM to study supramolecular organization of marine gel and its polysaccharide fraction at the molecular scale to reveal molecular mechanism of gel formation. Thermal denaturation of marine gel network to single short polymer fibrils upon heating and renaturation of the network after cooling was directly visualized by AFM. These results directly demonstrate the capacity of marine polysaccharides to selfassamble into complex gel network, but also reveal the molecular mechanism of gel formation in the ocean.

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STABLE ISOTOPE PROBING METHOD COMBINED WITH MAGNETIC BEAD CAPTURE HYBRIDIZATION, A NEW TOOL OF LINKING MICROBIAL COMMUNITY FUNCTION TO PHYLOGENY

We developed a stable isotope probing method combined with magnetic bead capture hybridization of 16S-rRNA (Mag-SIP) and micro elemental analyzer (μEA) coupled with an isotope ratio mass spectrometry (IRMS). We applied a nested set of biotin-labeled oligonucleotide probes which narrows targets stepwise from Bacteria to Deltaproteobacteria and further to *Desulfobacteraceae*. Stable isotope-labeled substrates were fed into a marine sediment, and total community RNA was extracted. 16S rRNA from particular phylogenetic groups was captured with probes, using streptavidin-coated paramagnetic beads. The $^{13}C/^{12}C$ ratio of the captured 16S rRNA was subsequently determined by μEA-IRMS. The protocol was modified to lower the detection limit of isotope ratio measurement. $^{13}C/^{12}C$ ratios in rRNA from glucose labeled sediments decreased with increasing probe specificity whereas the opposite was found with propionate labeling. This suggested that the *Desulfobacteraceae* incorporated more propionate than other groups in this community but less glucose. We demonstrated the first time application of this method for linking microbial community function to phylogeny at the family level. The main advantage over other stable isotope probing methods is that much less rRNA is needed for isotope ratio measurement.

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THE EVOLUTION OF LOW N:P RATIO OF THE MINIMUM CELL QUOTA OF PHYTOPLANKTON BY ZOOLPANKTON PREDATION

No study has tried to examine as to what N:P ratio of the minimum cell quota of phytoplankton has evolved under what environments. We examined the effects of zooplankton predation on the evolution of N:P ratio of the minimum cell quota of phytoplankton using computer simulation models. In the models, N:P ratio of the minimum cell quota for phytoplankton evolves to change depending on the internal cell allocation. The models assumed that high-growth rates of phytoplankton require larger amount of ribosomes so that phytoplankton with higher growth rates shows lower N:P ratio of the minimum cell quota. Then, the evolved N:P ratios under environments with zooplankton were compared with those under environments without zooplankton. The results showed that under environments with zooplankton, phytoplankton evolved to have decreasing N:P ratio of the minimum cell quota and increasing growth rates. In the present models, phytoplankton with P-rich and high growth rates could be favored owing to high zooplankton grazing pressure.

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GLOBAL SCALE FLUORESCENCE CHARACTERIZATION OF DISSOLVED ORGANIC MATTER IN ALPINE AND REMOTE LAKES

Due to their position in the landscape, alpine and remote lakes provide essential "end member" biogeochemical information without the confounding effects of diverse terrestrial inputs and local anthropogenic pollution. Here we take advantage of a global network of remote lakes (ECOSENSOR) to examine dissolved organic matter (DOM) in lakes of the Atlas Mountains (Morocco), the Sierra Nevada and Pyrenees (Spain), the Alps (Austria), the Patagonian Andes (Argentina), and the Canadian Arctic. Using PARAFAC modeling of fluorescence spectra, we found that the most remote alpine lakes exhibited high protein-like fluorescence, lack of a distinct humic peak (excitation/emission 350/420-480nm), and low fluorescence at high excitation wavelengths. We further evaluated the influence of Saharan dust deposition on lake DOM and found that, across a gradient of low to high deposition (Austria-Morocco), there was an increase in DOC, absorption coefficients, and fluorescence intensity. In light of rising desertification linked to global change, these results suggest that atmospheric dust deposition may be an important, yet thus far unrecognized control on lake DOM dynamics and that remote lakes provide a unique opportunity to monitor this influence.

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NETWORK ANALYSIS APPLIED TO DEEP-SEA HYDROTHERMAL VENTS WORLD-WIDE BIOGEOGRAPHY

Hydrothermal vents, discovered 30 years ago, were the first complex ecosystems based on microbial chemoautotrophic production. Despite recent advances, their origin, history, colonization pathways and the pattern of dispersal mostly remains to be elucidated. Here, we used an approach based on network theory to map the relationships between hydrothermal vents world-wide, in order to test the hypothesis presented so far about the identity, pattern, connectivity and history of biogeographic provinces. The networks were built based on the distribution of 592 species and 332 genus distributed in 63 hydrothermal fields across the world oceans, obtained by compiling information from several databases. Five instead of six distinct biogeographic provinces were highlighted by the network topology: the Mid-Atlantic Ridge, the Indian Ocean, the Western-Pacific, the Northeast-Pacific and the East-Pacific Rise. Also, network characteristics lead to challenge the hypothesis of the East-Pacific Rise province being a center of dispersion. Moreover, network analysis highlighted links between hydrothermal vent biogeography, the tectonic history of sea plates and the spreading ridge system, and appear as a powerful tool to unravel large scale factors driving biogeographic patterns.

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THE DIATOM FRAGILARIOPSIS CYLINDRUS: A MODEL FOR ALGAL ADAPTATION TO POLAR MARINE CONDITIONS

The marine diatom Fragilariopsis cylindrus is an indicator species for polar phytoplankton because it is an obligate psychrophile and significantly contributes to phytoplankton blooms in sea water and particularly sea ice of the Arctic and Southern Ocean. Diverse physiological and biochemical studies have been conducted to unravel its physiological adaptation. Furthermore, different EST libraries and gene-expression studies enabled first insights into its genetic adaptation to polar conditions. The genome sequence of F. cylindrus will become available soon, which will provide the first whole-genome sequence from any polar eukaryotic species. This contribution will summarize major insights into the biology of F. cylindrus and explains why this species is a potential model for algal adaptation to polar marine conditions.

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EFFECT OF CELL CYCLE ON NITRATE UPTAKE OF THE MARINE DIATOM THALASSIOSIRA WEISSFLOGII GROWN IN A CYCLOSTAT. IMPLICATIONS FOR MODELING GLOBAL FLUXES.

Lagrangian phytoplankton nitrogen assimilation in the water column is strongly nonlinear due to the coupling of physiological processes interacting at different time scales: absorption (second to minute), metabolic acclimation (minute to hour), and cell cycle (hour to day). Using high frequency-sampled, nitrate-limited or not limited continuous cultures of the marine diatom Thalassiosira weissflogii grown with L:D cycles, we show that control exerted by NO3 concentration and light intensity on uptake and assimilation of nitrate depends on the cell cycle stage. For example,nitrate uptake is inhibited when cells enter their mitotic stage. We also show that the synchronization level of cell population on the photoperiod is related to their nitrogen status. Carbon assimilation being not submitted to the same internal control and being restricted to the light phase, it follows that the C/N ratio and other internal quotas (chlorophyll, proteins, sugars) vary greatly at hourly scale. These experimental observations raise two questions: do individual properties triggered by the growth factor variability modulate significantly the global C fluxes, and, if yes, how to consider their effects in models?

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INTERACTION EFFECTS OF RADIATION AND NUTRIENT LIMITATION, IN PRESENCE AND ABSENCE OF APHANIZOMENON SP. ON PRODUCTION AND RELEASE OF NODULARIN

Summer blooms in the Baltic Sea, are dominated by the diazotrophic cyanobacteria *Nodularia spumigena* and *Aphanizomenon* sp. *N. spumigena* produce nodularin, a hepatotoxin and it has been suggested that the accumulation of nodularin within the cell and the release from the cell are affected by different environmental factors. In one laboratory experiment and two outdoor experiments we investigated the interaction of two radiation treatments, photosynthetic active radiation (PAR) and PAR +UV-A + UV-B (PAB); three nutrient treatments, nutrient replete (NP), nitrogen limited (−N),and phosphorus limited (−P) and the presence and absence of *Aphanizomenon* sp. on intracellular and extracellular nodularin concentration in *N. spumigena*. The allelopathic effect of *N. spumigena* on the specific growth rate (microns per day) of the co-existing *Aphanizomenon* sp. was investigated. Significant interaction effects were found between the factors investigated. The presence of *N. spumigena* had no significant effect on the specific growth rate of *Aphanizomenon* sp. under different radiation and nutrient treatments.

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CONSERVATION GENETICS OF THE RED GORGONIAN PARAMURICEA CLAVATA IN A CONTEXT OF CLIMATE CHANGE: ESTIMATION OF DISPERSAL ABILITIES AND GENETIC DIVERSITY

During the last years, two mass mortality events (1999 and 2003) of benthic invertebrate species were recorded in the north-western Mediterranean Sea. These events occured concurrently with abnormally elevated and constant seawater temperatures. The red gorgonian Paramuricea clavata was among the most affected species. This gorgonian is a sessile and long-lived species which plays an important role in the maintenance of the structural complexity of the associated communities. Taking into consideration the expected global warming, it is important to assess the population dynamics and the evolutionary potential of this species in this context of environmental modifications. The climate change effects on Paramuricea clavata will depend, among other parameters, on the connectivity levels among populations and on in-situ adaptation abilities. Genetic analyses are then necessary to address these questions. We used microsatellite loci to examine the genetic structuring at different spatial scales and so to evalute the species dispersal ability. These results can help to predict the population potential of recovery/extinction and the evolutionary trajectories of the associated communities.

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POTENTIAL FOOD WEB IMPACTS FROM CHANGING POLAR HYDROGRAPHY

In addition to widespread warming and declines in sea ice in the Arctic, there has been a marked change in the hydrography. One example of this change has been the northern expansion of North Atlantic water, also known as the West Spitzbergen current along the west coast of Spitzbergen, characterized by higher temperatures and the dominance of the copepod Calanus finmarchicus. This species replaces Calanus glacialis, dominant in the colder Sorkapp current originating on the east side of Spitzbergen. This is important as C. finmarchicus contains an order of magnitude less lipids and would require increased foraging time by predators to fulfill energy requirements. In a study conducted as part of an IPY project, concurrent measures of the physical environment, phytoplankton, and zooplankton, captured by nets and mapped acoustically using an autonomous underwater vehicle, were made to assess the food availability to the little auk (Alle alle). As this species has a limited foraging range and depends on copepods for breeding success, these food web model may serve as one of the better indicators of climate change in this region.

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ASSESSING CLIMATE FORCING ON PELAGIC ECOSYSTEMS ACROSS EUROPEAN SHELF SEAS: A SYNTHESIS THROUGH META-ANALYSIS

We have investigated large scale climate forcing on semi-enclosed European shelf seas and scaled the variations of the linkages between climate and pelagic ecosystems. The comparative approach used, based on synoptic climatology and meta-analysis techniques of time series data, allowed identifying significant variations in the atmospheric forcing during the years 1950-2000. By examining the variability of atmospheric, hydrological and ecological time series throughout European shelf seas, as well as their linkages with large scale climate patterns, we show that regional atmospheric variability cannot be explained by a single large-scale atmospheric pattern, and that climate forcing on European shelf seas has its roots in different sectors of the Atlantic Ocean and the Eurasian sector. In addition, the relationship between climate and plankton reveals periods of coherent changes in which the two signals vary in synchrony and other periods in which their linkage is uncoupled emphasizing the non-stationary behavior of the link between climate and plankton. We quantified such evolving relationship and showed that the linkage is modulated over several time scales.

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CALIFORNIA MODEL FOR MANAGEMENT OF COASTAL OCEAN RESOURCES

The State of California has developed a very progressive and effective science-based model for the management of coastal ocean resources. Commencing in 1998 with the passage of the Marine Life Management Act and the Marine Life Protection Act, California embarked on an ambitious plan to protect and enhance its marine resources. A key aspect of these two laws is the recognition of managing marine resources with an ecosystem approach. This set in motion a new ecosystem based management approach to fisheries and led to a process to establish a network of marine protected areas in California state waters. In response to two national ocean commission reports, California recognized the need for a more coordinated and comprehensive approach to managing its ocean and coastal resources. This new approach relies on support from the highest levels of government, the science community, and the general public. Governor Schwarzenegger released his Ocean Action Plan in 2004 followed by signing the California Ocean Protection Act into law. This law established the California Ocean Protection Council and led to the development of many new innovative approaches to ocean and coastal management.

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STOCHASTIC DYNAMICAL MODELS FOR ECOLOGICAL REGIME SHIFTS

Ecosystems are influenced by a variety of known and unknown drivers. Unknown drivers should be modeled as noise and it is therefore important to analyze how noise influences the deterministic skeleton of system equations. The deterministic skeleton of stochastic dynamical models contains the physical and biological knowledge of the system, and nonlinearities introduced here can generate regime shifts or enhance the probability of regime shifts in the case of stochastic models, typically characterized by a threshold value for the known driver. A simple model for light competition between phytoplankton and benthic vegetation with feedback mechanisms is formulated, and it is demonstrated that bistability can occur for specific parameter settings. When stochastic input and stochastic propagation of the states are applied on the system regime shifts occur more frequently, and the threshold definition and stability of regimes become less subtle. Ecological regime shifts and their modeling must be viewed in a probabilistic manner, particularly if such model results are to be used in ecosystem management.

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POPULATION DYNAMICS AND PREDATION IMPACT OF THE INTRODUCED CTENOPHORE MNEMIOPSIS LEIDYI IN THE GULLMARS FJORD, WEST COAST OF SWEDEN

Northern European waters, including Swedish waters, now faces a new problem with the invasion of the ctenophore Mnemiopsis leidyi. Given the rapid growth and high reproductive output of the species, severe effects on its prey populations may be expected. However since the effects on the ecosystem depend on complex interactions in the pelagic community, it is impossible to predict the outcome of the introduction into Swedish waters based on observations from other areas. It is therefore necessary to investigate the development and impact of M. leidyi locally. In the current project we study the development of the M. leidyi population in the well documented Gullmars fjord on the west coast of Sweden by weekly sampling of Mnemiopsis and zooplankton during the period August 2007 to November 2008. The potential predation impact of M. leidyi has been estimated by multiplying abundances with specific clearance rates measurements. The clearance rates have been obtained from both controlled laboratory experiments with different prey species and from gut content analysis of individuals from the fjord.

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HYDRODYNAMIC PROCESSES AND REEF-OCEAN COUPLING: A REVIEW

In this talk I will review the set of known mechanisms by which reefs physically communicate with the adjacent ocean. As revealed by field and numerical studies of reef hydrodynamics carried out over the past 50 years, ocean-reef exchanges can be supported by shoaling and possibly breaking internal waves and internal tides, eddies in energetic longshore currents, buoyancy driven flows associated with topographically created temperature differences, tidal and wave-driven jet/sink flows, and mixing produced by stratified flow past rough reefs. Examples of these for reefs in Florida, the Red Sea, Hawaii, French Polynesia, and the Great Barrier reef will be presented.

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EVALUATION OF THE PERSISTENCE OF MEHG AND TBT IN AQUATIC ECOSYSTEMS COMBINING EXPERIMENTAL INCUBATIONS SET UP WITH MULTIPLE ISOTOPICALLY LABELLED TRACERS

Tin and mercury organometallic species have been recently included in the list of priority toxic pollutants by the European Union. Depending on the chemical form, their toxicity, metabolism and bioavailability can be drastically altered. Therefore, the studies of the reactivity of these compounds (such as alkylation and/or de-alkylation processes) are of primary importance to investigate their toxicological impact in the aquatic environment. Thanks to the high sensitivity of mass spectrometric detection, it is possible to use enriched stable isotope tracers at sub-natural levels to record the reactivity of the different species. However performing successful isotope experiments and generating relevant data requires careful development of experimental procedures to insure that the investigated processes are accurately followed by the tracers. In this work, the development of mathematical isotope pattern deconvolution approaches has allowed the simultaneous determination of the different transformation factors affecting mercury and butyltin species. Different incubation conditions and seasonal variation have been investigated to clearly understand the transformation potentials in both water column and sediment of coastal ecosystems and to assess the relative contribution of chemical versus biological pathways involved.

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GLOBAL WARMING INDUCED, SHORT-TERM TEMPERATURE CHANGES MAY IMPACT FRESHWATER CARBON FLUX: A MICROBIAL PERSPECTIVE

Globally, freshwaters are abundant and important, and protozoa help structure their planktonic food webs. We hypothesized that short-term (episodic) shifts of 2–10 C, which will increase with global warming, significantly alter carbon flux associated with protozoan predator–prey dynamics within these food webs. We examined a common ciliate fed a common autotrophic flagellate in laboratory experiments, at relevant temperature and prey levels. Multiple regressions were obtained for: (1) flagellate growth rate and volume changes vs. temperature; (2) ciliate growth rates, grazing, and cell volume changes vs. temperature and prey concentration. The impact of temperature changes on carbon flux was examined using a ciliate–flagellate model, with and without the top grazer, Daphnia (parameterised using literature data). Predator–prey pulses occurred over 20 days, with the ciliate controlling the prey population. For ciliates and prey, carbon production peaked at 20 C and rapidly decreased, fourfold, above and below this. Including Daphnia failed to alter prediction that the ciliate controlled short-term flagellate pulses. We conclude that these temperature shifts influence the system in a non-nutritive fashion.

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SEASONAL, DAILY AND HOURLY DYNAMICS OF VIRUSES AND BACTERIAL DIVERSITY IN THE SEDIMENT OF A TIDAL MUDFLAT.

A seasonal survey was performed along a 2 Km transect across the intertidal mudflat of Marennes-Oléron Bay (French Atlantic coast). Sediment cores (z= 1 cm) were collected and virus analyzed at three stations in March, June, September 2003 and February 2004 at low tide. At all stations, virus peaked in September with a predominance of 65-105nm particles as compared to the classical <65 nm size class. Furthermore, in February 2008, sediment and microphytobentos biofilm were sampled hourly during the 4-hour diurnal emersion period over 3 consecutive days. Bacteria and viruses were enumerated and bacterial diversity was assessed (sequencing of the cultivable fraction and fingerprinting (TTGE)). During emersion, viral abundance apparently did not change and was not significantly different between sediment and biofilm ($p > 0.05$). However, virus abundance was spatially heterogeneous ($p= 0.03$) and changed over the three -day period. Similarly, spatial heterogeneity of bacterial abundance during emersion was greater than temporal variation and likewise varied over the three -day period. Among cultivable bacteria, opportunistic gamma Proteobacteria dominated.

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BIO-OPTICAL DAILY CHANGES DURING A MINI-DIATOM BLOOM IN THE GULF OF AQABA (EILAT).

Daily variability in spectral light absorption and phytoplankton composition was studied using several methods during the GAP-2008 workshop. From 01-06 April, surface (0-10m) and deep (25-65m) predawn samples from an open sea station (off Eilat), with deep mixing and a deep euphotic zone, are analyzed along with spectral irradiance. *In vivo* particulate absorption and coloured dissolved organic -matter were measured spectrophotometrically and using a point-source integrating-cavity absorption meter (PSICAM). Additional data include non-fractionated and <20 μ chlorophyll-a (Chl-a), silica uptake in diatoms and pico and microphytoplankton composition (microscopy), delayed fluorescence (DF) spectroscopy, and flow cytometry. The *In vivo* absorption spectra showed the greatest difference at 435 and 470 nm, varying as a function of phytoplankton abundances and composition confirmed by the DF results, cell size determinations, and flow cytometer data. Diatom growth rate (*Chaetoceros* sp.) and Si deposition increased up to April 03. *Chaetoceros* sp. represented 18E of the micro-phytoplankton total carbon biomass on April 03, while mean TChl-a (Chl-a + phaeopigments) was 0.5 ± 0.01 mg m^3. The numerous complementary results reinforce the need for taxonomic and physiological considerations in field research.

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DIVERSITY OF DIAZOTROPHS AND THEIR HABITAT IN A GLOBAL OCEAN MODEL

We explore the diversity of marine nitrogen fixers, or diazotrophs, as well as the factors that control their habitat in a global ocean model. We represent an ecosystem in which many tens of potentially viable phytoplankton types are generated stochastically from ranges of physiological characteristics guided by laboratory and field observations. When placed in the model environment, the ecosystem self-assembles and the fittest physiologies come to the fore. Here we focus on the emergent diazotroph analogs because of their central importance to global biogeochemical cycles. Analogs of *Trichodesmium*, unicellular cyanobacteria and diatom-diazotroph associations are successful in the model. They occupy habitats consistent with those observed in the ocean, confined to tropical and subtropical waters. We use resource competition theory to identify the trade-offs which control their habitat. Iron plays an important regulating role due to the high iron requirement of diazotrophs to create the enzyme nitrogenase. In the model's South Pacific, diazotroph abundance is extremely sensitive to the delivery of iron and parameterization of its biogeochemical cycle.

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LINKING SPECIES- AND ECOSYSTEM-LEVEL IMPACTS OF CLIMATE CHANGE IN LAKES WITH A COMPLEX AND A MINIMAL MODEL

To study the interaction between species- and ecosystem-level impacts of climate change, we focus on how climate-induced shifts in key species affect the positive feedback loops that lock shallow lakes in a transparent, macrophyte-dominated state or, alternatively, in a turbid, phytoplankton-dominated state. We hypothesize that climate warming will weaken the resilience of the macrophyte-dominated clear state. For the turbid state, we hypothesize that climate warming and climate change induced eutrophication will increase the dominance of cyanobacteria. Climate change will also affect shallow lakes through a changing hydrology. We study these phenomena using two models, a minimal dynamic model and a full ecosystem model. Qualitatively, there is a striking resemblance between the patterns shown by both models. We conclude that changes in nutrient loading, hydraulic loading and climate warming can all lead to shifts in ecosystem state. The simple model helps in interpreting the non-linear behaviour of the complex model. Analysis with the complex model allows for an interpretation of the results in terms of the seasonal dynamics and shifts in phenology of the dominant groups of phyto- and zooplankton.

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INTERANNUAL SEASONAL VARIABILITY OF PROTISTAN DIVERSITY AND COMMUNITY STRUCTURE IN THE SAN PEDRO CHANNEL, WESTERN NORTH PACIFIC

Cloning and sequencing of ribosmal RNA genes (rDNA) is now commonly used as a method to identify microbial taxa and to assess their diversity and community structure in environmental samples. This method is particularly useful for providing taxonomic information for species that have few distinctive morphological features. In the present study, protistan diversity and community structure were characterized in the deep chlorophyll maximum at a Microbial Observatory time series station in the Western North Pacific on a seasonal basis from January 2001 through October 2003 by analysing 18S rDNA clone libraries. A total of 1368 partial-length protistan sequences were analysed, revealing 256 distinct operational taxonomic units (OTUs), which were determined based on 95% sequence similarity by an automated OTU-calling program. Approximately 70% of the OTUs were comprised of only one or two sequences indicating a large pool of rare protistan taxa. Seasonal changes and interannual variability of protistan community structure regarding major taxonomic groups as well as particluar key species/genera will be discussed.

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NEXT GENERATION SOLID SEQUENCING METHODS: AN OVERVIEW

The SOLiD (Sequencing by Oligonucleotide Ligation and Detection) system is a next generation analysis platform that provides high accuracy as well as high throughput. We

used the SOLiD to generate a microbial metagenome from the <0.8 micron fraction of a surface sample collected in Puget Sound near Seattle, Washington, USA. A single sequencing run produced six gigabases of data, with aligned reads providing 5-30X mean coverage of *Pelagibacter ubique* (HTCC1062), *Rhodobacterales* (HTCC2255), and *Methylophilales* (HTCC2181), and partial coverage of many others. Such high throughput and accuracy is accomplished by the attachment of individual small DNA fragments (25-35bp) to beads, parallel PCR amplification, sequencing by ligation, and double interrogation of bases by specific fluorescent probes. All sequences are defined in a differentially coded "color space," and intensive data analysis by powerful computers is required to process the reads, align to large sequence databases, and store and manage large volumes of data. This poster will give an overview of the sequencing methods of the SOLiD system, including the preparation of DNA libraries, ePCR, and an explanation of the unique 4-color ligation process.

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ATMOSPHERIC CONTRIBUTION TO FERTILIZATION OF AQUATIC ECOSYSTEMS IN THE MEDITERRANEAN REGION

Atmospheric deposition of aerosols is a significant source not only of elements with gaseous phases but also of rock-derived ones. Lately we have been quantifying the atmospheric flux of elements into aquatic ecosystems of the South Iberian Peninsula, an area highly influenced by Saharan dust deposition. Analyses of back-trajectories of air masses and simultaneous weekly measurements of atmospheric deposition in three localities distant up to 40 km, showed the influence of Saharan dust at a regional scale. Previous results indicate that atmospheric contribution of P and Ca is essential to explain the functioning of oligotrophic high mountain lakes, and that atmospheric input of organic matter partially supports the pelagic food web of these ecosystems. Beyond these pristine systems, new results indicate than P-atmospheric deposition to the catchment area of a meso-eutrophic reservoir is of the same order of magnitude than the river loads. Therefore, P-atmospheric deposition should to be considered to P-budget in aquatic ecosystems of areas subject to Saharan dust influence, mostly taking in account the increase of dust deposition associated to Global Change.

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CHALLENGES OF GENE FISH – A NEW SINGLE CELL TECHNIQUE FOR IN SITU DETECTION OF FUNCTIONAL GENES IN ENVIRONMENTAL MICROORGANISMS

Techniques like Fluorescence in Situ Hybridization (FISH) targeting rRNA molecules are allowing us to determine the identity and abundance of microorganisms in environmental samples. A step further would be the use of FISH to detect functional genes in the same time with the identity of the microorganisms. This would provide a direct link between the taxonomic affiliation of a microorganism and its metabolic capabilities. We report here on the development of a new technique for single gene detection in microorganisms – gene FISH, which is based on catalyzed reporter deposition. First, we developed gene FISH on pure cultures. In the second phase of the study we are aiming to apply this method on environmental samples, more specifically for the detection of crenarchaeal ammonia monooxygenase subunit A (amoA) gene in South Atlantic water samples. Due to the high diversity of amoA gene, we have prepared clone libraries of crenarchaeal amoA for each sample and used the resulting sequences to design polynucleotide probes. This talk will focus on the challenges meet when applying this type of probes to complex natural environments.

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MICROBIAL FOOD WEB FUNCTIONING IN THE WESTERN ANTARCTIC PENINSULA UNDER GLOBAL CHANGE: A REVIEW AND AN EXAMPLE FROM A VERY LOW OZONE AND ICE COVER YEAR (2006)

Intense regional warming was observed in the Western Antarctic Peninsula (WAP) over the last 50 years. In addition, this region is seasonally exposed to ultraviolet B radiation (UVBR, 280-320 nm) due to stratospheric ozone layer thinning, which can significantly affect processes from the molecular to the ecosystem level. Both these factors (temperature increase and UVBR) could synergistically affect marine plankton communities, thereby modifying ocean carbon dynamics. Within this global change context, a review of the microbial food web structure and functioning in the WAP will be presented and illustrated with a case study. The study was based on a series of measurements performed at a fixed station within the Melchior Archipelago (Antarctica) from March to November 2006. A low biomass, microbial food web-like community, dominated the water column during early spring 2006. We hypothesize that both the high temperatures measured, which favoured sea-ice melting and a strong stratification of the water column, as well as the presence of enhanced UVBR acted concurrently to prevent the typical high productive diatom spring bloom in the WAP.

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BASIN-SCALE DISTRIBUTION OF CERTAIN BACTERIVOROUS AND SAPROTROPHIC EUKARYOTIC MICROBES IN THE DEEP TROPICAL ATLANTIC

The deep sea is largely unexplored in terms of the diversity and function of eukaryotic microbes. In this study, we use catalyzed reporter deposition fluorescence in situ hybridization (CARD-FISH) to enumerate and separate members of ubiquitous bacterivorous eukaryotic taxa from those which predominantly act as decomposers of organic matter. We hypothesize that the latter organisms may play an important role in the deep sea due to their ability to utilize refractory particulate organic matter which is unavailable to other organisms. Samples were collected in a deep-sea transect across the Atlantic Ocean from Brazil to western Africa, including the deep trench of the Romanche Fracture Zone. We followed several distinct water masses with a focus on the complex North Atlantic Deep Water, South Atlantic Central Water, Antarctic Intermediate and Bottom Waters, as well as oxygen minimum zones.

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SI-OC INTERACTIONS DURING DEGRADATION OF THE DIATOM SKELETONEMA MARINOI

To elucidate which mechanism is behind the relationship between ballast and carbon during particles sedimentation, we tested the hypothesis that one of the most common mineral ballasts, biogenic silica (bSiO2), protects associated organic matter from degradation (Hedges et al., 2001). We follow the degradation of the diatom Skeletonema marinoi in laboratory and a set of models were applied to our results to help elucidate mechanisms driving bSiO2 dissolution and organic compounds degradation. Results suggest that the diatom frustule is made up of two bSiO2 phases. A first phase mainly associated with membrane lipids and the amino acids glutamic acid, tyrosine, and leucine, was more soluble and made up one third of the total bSiO2. A second phase was more refractory and contained more neutral lipid alcohols and glycine. Enclosed between these phases, a pool of amino acids probably originating from the silicification processes was trapped. The first bSiO2 phase protected the second bSiO2 phase and much of the organic matter from degradation: POC, PON and the total pool of amino acids. In contrast, most lipids were associated to, rather than protected by, silica.

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PERIPHYTIC DIATOMS ALONG AN AGRICULTURAL POLLUTION GRADIENT AND RESILIENCE POTENTIAL OF THE COMMUNITIES

Diatoms were sampled from artificial substrates immersed at three sites in the Morcille river (Beaujolais vineyard area, SE France) during the pesticide spreading period (April-May 2008). From up- to downstream, we observed a gradient of trophic (mainly orthophosphate) and diuron pollution. Biofilm communities were allowed to settle on glass slides for 4 or 8 weeks at each site. After a 4-week colonisation some samples from the two contaminated downstream sites were transferred upstream to evaluate their restoration trajectories. Periphytic communities were characterised through biomass accrual and qualitative taxonomic identifications: brown algae always dominated. From up- to downstream, periphytic biomass and species richness decreased; the samples transferred upstream recovered quite well, most descriptors reaching a level comparable to that of the communities grown for 8 weeks at the pristine site. The taxonomic composition of the samples varied between dates and

along the gradient. The communities transferred upstream did not recover a pristine structure but the increase in diversity, associated with the settlement of sensitive species, suggested elevated resilience potential.

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A POLYCHAETE METACOMMUNITY IN A MEDITERRANEAN ECOSYSTEM: WHICH THEORY CAN EXPLAIN THE OBSERVED PATTERNS IN THE GULF OF LIONS?

Community assemblages of polychaetes were determined after sampling of 92 sites along the Gulf of Lions in September-October 1998 at different depths and on different substrates (mud, sand and mud mix, sand). These data allowed us to investigate marine metacommunity patterns in a Mediterranean environment characterized by low densities associated to a high biodiversity. Polychaete densities were used to test two theoretical distribution models: the neutral vs the species sorting models. Neutrality assumes that species have identical properties and community structure only emerges from dispersal processes. Species sorting is based on niche differences as a condition for the coexistence between species; hence local abiotic and biotic conditions determine the community composition. It results in differences in the distribution of species abundances within the metacommunity. We modeled the niche aspects using a structured population model that we developped for marine metacommunities, based on differential growth among species and competitive interactions. We assessed if this model may yield the observed species abundance distributions, and if this match is better than the one obtained using the neutral metacommunity model.

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THE MICROBIAL MEMBRANE META-PROTEOME REVEALS DIVERSE PATTERNS OF PROTEIN EXPRESSION IN THE SOUTH ATLANTIC OCEAN

Although marine community and isolate DNA sequencing studies have rapidly expanded the known world of sequence diversity, very little is known about the expression of corresponding gene products in nature. Here we identified strong patterns of protein expression along vertical and horizontal gradients in the South Atlantic Ocean. Membrane proteins were extracted from the <0.8 μm fraction of eighteen South Atlantic gyre and coastal seawater samples, then proteolyzed and analyzed by LC-MS/MS on a linear ion trap-Orbitrap mass spectrometer. Resulting tandem mass spectra were interrogated against Global Ocean Survey (GOS) and microbial protein databases available through the CAMERA web site. Our data verified the ubiquitous expression of bacteriorhodopsin in surface waters (n = 10), archaeal ammonia monooxygenase expression in coastal surface and 150m gyre samples, and the expression of putative iron, nitrogen, and phosphate transport proteins. Community structural analysis of protein variability in the South Atlantic membrane meta-proteome supports known patterns in community structure. We are currently constructing 16S rDNA clone libraries to explore links between spatial variability in protein expression and community composition.

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SUBMERSIBLE HYDRO-OPTICAL APPLICATIONS FOR LIGHT - LIMITED OCEANOGRAPHY (SHALLO)

Better atmospheric correction of ocean color data requires a combination of oceanographic and atmospheric research approaches. To meet the needs of researchers interested in coastal AOP measurements and to obtain relevant atmospheric data, Biospherical Instruments has produced a new series of radiometers specifically designed to deploy in shallow waters. Developed with funding from NASA SBIR, microradiometer-based SHALLO systems combine features necessary to obtain AOP vertical profiles in just a few meters of depth (rapid sampling, slow free-fall descent), with sensors for global surface irradiance with shadow-band capability and GPS, all in one integrated system. In situ optical measurements are collected using C-OPS, (Compact Optical Profiling System). Only 7 cm in diameter, C-OPS measures 19-wavebands of downward irradiance and either upwelling radiance or irradiance. The radiometrically matching surface reference sensor provides simultaneous measurements of incident irradiance. The shadow-band accessory provides atmospheric measurements of direct/global and direct-normal irradiance and aerosol loading (Langley technique). Profiles were collected from San Diego Bay (3 m) using freefall profiling techniques with speeds less than 10 cm/s and vertical resolutions of less than 1 cm.

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PHOSPHORUS UPTAKE BY FILAMENTOUS FRESHWATER ALGAE

Oligotrophic lakes that become more nutrient rich often experience enhanced growth of filamentous algae which may threaten the inherent isoetid vegetation. In this study we developed an assay for studying the uptake of $H_3{}^{33}PO_4{}^{3-}$ by filamentous green algae. The results could be fitted to the Michaelis-Menten enzyme kinetic model. The studied algae from oligotrophic lakes were *Oedogonium* sp. and *Spirogyra* spp. which showed V_{max} values of ~440 and 710 μg P gDW^{-1} h^{-1} and K_m values of 100 and 50 μg P l^{-1}, respectively. Preincubations of *Oedogonium* for 14 days at only 5 μg P l^{-1} decreased the K_m value to ~70 μg P l^{-1}, whereas V_{max} was unchanged. A comparison with *Cladophora* sp. from a eutrophic lake showed both lower V_{max} and K_m values of 5.4 μg P gDW^{-1} h^{-1} and 41 μg P l^{-1}. On basis of algal P concentrations it seems that Cladophora was nitrogen limited while *Oedogonium* and *Spirogyra* were phosphorus limited. These findings imply that if the phosphate concentration in oligo- to mesotrophic lakes can be lowered, growth of filamentous algae may be reduced accordingly.

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THE INFLUENCE OF LIGHT INTENSITY ON THE TRANSLOCATION OF FATTY ACIDS IN A ZOOXANTHELLAE / JELLYFISH SYMBIOSIS

The influence of light intensity on the translocation of fatty acids between zooxanthellae and tissues of the scyphozoan jellyfish *Cassiopea sp* was investigated by exposing jellyfish to 3 different light intensities (5%, 23% and 100% Photosynthetic Active Radiation: PAR) for 69 days. The jellyfish photo-adapted to the different light intensities (concentrations of zooxanthellae increased in the 100% PAR treatment, remained constant in the 23% PAR treatment and decreased in the 5% PAR treatments). Multivariate analyses indicated that the composition of fatty acids in the host tissues remained similar in the 100% and 23% PAR treatments but differed in the 5% treatment. The composition of fatty acids in the zooxanthellae remained similar only in the 100% treatment. Differences in the fatty acid compositions were largely driven by changes in the dinoflagellate markers 18:2ω6 and 18:4ω3. During the experiment, concentrations of both these fatty acids in the zooxanthellae decreased and concentrations in the host tissues increased in the 5% PAR treatment. These results indicate that light intensity and photosynthetic rates can influence the translocation of fatty acids between zooxanthellae and their hosts.

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CIESM TROPICALIZATION PROGRAM – TRACKING CHANGES IN MEDITERRANEAN MARINE BIODIVERSITY

In the Mediterranean Sea, which hosts some of the highest species endemism in the world, biodiversity changes are occurring at unprecedented rates. Investigating such changes is thus a matter of urgency. The expansion of exotic and native termophilic species, to the detriment of those of boreal affinity, is currently observed along with warming of Mediterranean waters. This process of Mediterranean "tropicalization" remains poorly understood, based on occasional, usually local observations. The new CIESM Tropicalization Program aims at using key biological macrodescriptors of change to map and quantify the effects of tropicalization across the Mediterranean Sea. Leading experts in marine taxonomy, biogeography and climate change from 16 riparian countries are examining historic and current information on Mediterranean marine fauna and flora to identify species that have undergone significant changes in their geographic range of distribution and abundance. The project will develop a basin-scale, long-term monitoring network to detect the expansion/ retreat of these species in response to climate. An overview of biogeographic changes already detected in the Basin is presented, and implications for conservation of Mediterranean marine biodiversity discussed.

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DISSOLVED AND PARTICULATE ALGAL AND NON-ALGAL MATTER DISTRIBUTION RELATED TO HYDROGRAPHY IN SANTOS BAY (BRAZIL)

Recent reports have shown an increase in abundance of potentially toxic dinoflagellates in Santos Bay (Southeastern Brazilian Coast) that composes an estuarine complex influenced by domestic and industrial sewage. During 2006 and 2007, 8 surveys were conducted during spring and neap tides to establish relationships between phytoplankton composition, termohaline structure and surface particulate and colored dissolved matter (CDOM). Results show shifts in phytoplankton community structure associated with both vertical stability and importance of CDOM absorption. In 2006, expected trends were observed, with higher vertical stability, phytoplankton biomass and dominance of diatoms occurring during neap tides. In 2007, a larger input of continental outflows preceding the surveys drastically enhanced vertical stratification but in this case, the contribution of dinoflagellates, *Prorocentrum minimum* and *Dinophysis* spp, and flagellates increased. CDOM contribution accompanied the input of low salinity water, suggesting some ability of these groups to utilize organic sources of nutrients. Future studies must focus on availability and incorporation of organic nutrients in this region by phytoplankton forming HABs, enhancing our knowledge concerning their dynamics in eutrophic tropical bays.

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RECENT CHANGES TO LAKES IN THE UINTA MOUNTAINS, UTAH (USA): NOT SO NICE!

Limnological research shows that Uinta Mountain lake systems are being significantly altered by human activities, but that lakes from different elevations have different responses to various anthropogenic forcings. A limnological survey of 65 lakes indicates that mid-elevation sites are most sensitive to metal pollution, whereas high elevation sites are most responsive to nitrate deposition. These differences are due to geographical differences, such as vegetation type and cover and snow cover and depth. Paleolimnological studies of two mid-elevation lakes show that metal deposition increased, most likely due to upwind mining activity, beginning in the late 19th century. Diatom community composition changes track changes in metal deposition, but only in the lake most proximal to mining, suggesting a biological response to metal pollution at a critical threshold. Water sampling of six high elevation lakes indicates that these sites presently have relatively low amounts of nitrates. However, sediment changes in the percentage of organics, chla and diatom fossil assemblages indicate marked changes beginning *circa* 1945 AD that we believe are linked to increasing nitrate deposition due to increasing agriculture and fossil fuel burning upwind of the sites.

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FLAGELLATES AT EXTREMELY LOW PH – SPECIALIST VS. GENERALIST LIFE STRATEGIES

Acid mining lakes (AML) are extreme aquatic habitats with strongly reduced biodiversity. They may harbor primarily specialists adapted to the harsh conditions or acidotolerant generalists that benefit from competitive release under acidic stress. To test for these alternative life strategies, we isolated two dominant flagellate species, *Chlamydomonas acidophila* and *Ochromonas sp.*, from each of two similar AML (pH ~2.6) located in Lusatia, Germany, and Langau, Austria. The strain *Ochromonas sp.* DS originating from Lake Constance served as reference for a closely related neutrophil species. To account for a potential synergistic stress effect of low pH and high temperature, we measured flagellate growth rates in the laboratory over a combination of 4 pH (2.5, 3.5, 5.0, 7.0) und 3 temperatures (10, 17.5 and 25 °C). Our experimental results demonstrate that *Chlamydomonas acidophila* is specifically adapated to the harsh environmental conditions, while growth rates of *Ochromonas sp.* were positively correlated with increasing pH. In addition to the opposing life strategies, we recorded significant intraspecific differences within the closely related strains from the two AML.

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EFFECT OF TOP PREDATORS ON FUNCTIONAL PLANKTON GROUPS AND CONSEQUENCES ON MICROBIAL FOOD WEB

The effect of top predators on the response of Functional Plankton Groups (FPG) using their allometric scaling was investigated in a 10 days mesocosm experiment realized at MEDIMEER. Six mesocosms were filled with natural waters and each pair of mesocosms was submitted to 3 treatments: addition of 10 oysters, addition of 30 juveniles fish, and without any addition. 31 allometric scaling of organisms were determined every day in all mesocosms. Under oyster filtration, 2 FPG were distinguished: lowest allometric scaling (viruses, bacteria, cyanobacteria and a size class of picophytoplankton) escaping from filtration and also benefiting from oyster excretions, and a second FPG regrouping all the other larger organisms filtered by the oysters. In contrast, fishes predated on FPG of zooplankton community and consequently all other FPG benefited from their absence except 2 size classes of bacteria, 1 class of heterotrophic flagellates and 1 class of ciliates. This underlines that allometric scaling of organisms can be used to distinguish the FPG. The consequences of top predator effect on FPG and food web dynamics will be discussed.

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EDDY-DRIVEN PULSES OF RESPIRATION IN THE SARGASSO SEA

Respiration is assumed to be much less variable than photosynthesis in aquatic ecosystems. The analysis of nine years of data from the NW subtropical Atlantic reveals that variability in heterotrophic processes associated with (sub)mesoscale features has a major impact on the balance between photosynthesis and respiration. Higher indirect estimates of net community production (NCPe) are associated with the center of Mode Water Eddies (MWE) and frontal regions of interaction between cyclonic and anticyclonic eddies (CA). The increase in NCPe rates observed at the center of MWE is mainly driven by an increase in autotrophic production, whereas in CA enhanced NCPe rates are the result of an important reduction in bacterial respiration. Plankton community composition in CA and MWE is branded by the reduction in bacterial biomass and the dominance of Prochlorococcus and Synechococcus (CA), and diatoms and dinoflagellates (MWE). Contrary to the common assumption, these results show for the first time that in highly dynamic ecosystems influenced by (sub)mesoscale dynamics respiration can be as variable as photosynthesis.

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EXPLORING SYMBIOTIC INTERACTIONS IN THE CNIDARIAN SEA ANEMONE-*SYMBIODINIUM* SP. MODEL BY LARGE-SCALE EST ANALYSIS

Most cnidarians have developed an endosymbiotic relationship with photosynthetic dinoflagellates, *Symbiodinium* sp. This symbiotic relationship, which is a key component in the preservation and the development of coral reefs, involves mutual molecular adaptations between the partners that are poorly known. A large ESTs collection (39,939 ESTs assembled into 14,314 unigenes) was generated from symbiotic, aposymbiotic (bleached) and stressed (temperature) sea anemones *Anemonia viridis* to characterize 1) the genes involved in the symbiotic association, and 2) the molecular response of this symbiosis to changing environmental conditions. Our *A. viridis* dataset, also including *Symbiodinium* sp. and prokaryotic sequences, was analysed against UniprotKB and annotated. A subset of 2,000 genes potentially involved in symbiosis (heterotrophic metabolism, transporter, cell cycle control…) was selected to design an oligonucleotides dedicated microchip. Comparative gene expression through microarray analysis between symbiotic, aposymbiotic and stressed specimens allowed identification of symbiosis specific genes. Compared to related corals, the giant size of *A. viridis* also permit tissue dissection into the ectoderm and endoderm layers, and symbiotic dinoflagellate, which enable assess compartments specificity of our identified genes of interest.

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APPLICATION OF REMOTE SENSING AND GIS TO DETECT PREDATOR-PREY INTERACTIONS BETWEEN SKIPJACK TUNA, PACIFIC SAURY AND SQUID IN THE NORTHWEST PACIFIC.

Remote sensing and GIS have facilitated marine ecosystem studies to spatial and temporal scales previously unattainable by ships. To investigate areas of possible predator-prey interactions in the Northwest Pacific (NP), we studied migration of skipjack tuna (SJT) from daily fishing data and compared it with fishing locations for Pacific saury (PS) and squid detected from remotely sensed DMSP/OLS night light. We also compared the locations of the three species to remotely sensed sea surface temperature (SST) from August to October, 2004. SST is a vital cue for SJT northern and southern migration in the NP. Results show that the temperature range of SJT expands from 19-22 oC to 17-22 oC from third to fourth week of September. This shows that SJT habitat expands to cooler waters. The maximum temperature of PS habitat is 18 oC. The 17-18 oC temperature is the range of optimum predator-prey interaction. The distance between SJT and PS's habitats also declines from 3rd to 4th weeks of September and a cold streamer, southern migration route of PS, develops in the third and fourth weeks of October.

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RESPONSES OF FATTY ACIDS IN MEGANYCTIPHANES NORVEGICA FROM DIFFERENT CLIMATE REGIONS TO VARYING TEMPERATURES

Acclimation of organisms to different temperatures is important for the ability to inhabit regions of different climate. Central in this process is the adjustment of the membrane fluidity to sustain membrane function, which is connected to its' fatty acid composition. Experiments with Meganyctiphanes norvegica were performed during 3 cruises, going to the Mediterranean, the Scottish Sea and the Kattegat. In on-board incubations the animals of each climate region were exposed to a range of different temperatures. After the experiment, animals were removed and analyzed for fatty acids. It was investigated whether the populations from the different climate zones exhibited differences in their fatty acid profiles in response to the experimental temperatures.

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TIDE LEVEL CHANGES IN BARNACLE RECRUITMENT TO CRACKS

Surface topography can influence settlement patterns of invertebrate larvae. Many studies have examined rugophilic behaviour of settling barnacles and most show preference for pits and cracks. Settling barnacles can respond rapidly to settlement cues and alter rugophilicity regionally (10's kms). Here, we examined recruitment of barnacles over 4 years at 5 plots in Hokkaido, Japan settlement rugophilicity among tide levels. Our results showed barnacles have differences in rugophilic behaviour over small spatial scales (50 cm) with barnacles in upper intertidal associating more with cracks ($p<0.0001$). This may be related to barnacles settling in cracks for desiccation protection or differential growth or survival in cracks in the upper shore. Barnacles from the upper shore within cracks, showed a size increase over those from outside cracks ($p<0.001$) greater than the increase expected from simulations of randomly located barnacles and cracks. Thus, barnacles recruiting to upper shore may settle selectively within cracks to exploit this size advantage. This change in barnacle recruitment pattern over a small spatial scale shows plasticity in surface topography settlement patterns that warrants consideration in future rugophilic behaviour study.

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TESTING A NOVEL FUNCTIONAL GROUP APPROACH FOR CARIBBEAN HARD CORALS BY COMPARING THEIR RANK ABUNDANCES ACROSS THE FLORIDA REEF TRACT

A functional group approach (FGA) categorizes organisms by traits instead of phylogeny. A FGA for corals predicts assemblage structure from fundamental habitat characteristics. Accordingly, dominance of coral species and functional groups is predictable, and depends upon rates of resource input and disturbance. Examination of patterns of rank abundance across 20 sites across a gradient of disturbance in the Florida Keys determined that eleven species out of 36 were significantly more abundant than the rest. These 11 species belonged to three different functional groups, and, for these species, the species members of each functional group were statistically more similar in rank and site affinity than were species belonging to other functional groups. The rarer species, alternately, showed rank-abundances across transects that were without pattern. The functional-group differences in rank-abundance were also highly non-random. The dominance patterns of each functional group relative to the level of disturbance measured fit the predictions of a functional group approach. Specific traits predicted the functional responses of coral species; all coral species are not equivalent in their functional responses.

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ACQUISITION OF ANTIOXIDANT ACTIVITY ENHANCED CELL DEATH IN TWO DISTINCT PHYTOPLANKTON SPECIES

Acclimation to an environmental stressor is thought to facilitate the cells' survival when exposed to this stress. However, studies on two different phytoplankton species, the dinoflagellate *Peridinium gatunense* and the green algae *Chlamydomonas reinhardtii*, indicated that this may not be the case. Oxidative stress induced cell death in cultures which possess high antioxidant activity but not in those without. Application of dehydroascorbate, a metabolite in the ascorbate/glutathione cycle involved in detoxification of reactive oxygen species (ROS), enhanced cell death in cultures which possess low antioxidant activity. This implicated ascorbate peroxidase activity, strongly enhanced by a preceding oxidative stress, in the induction of cell death. The response of *C. reinhardtii* to oxidative stress included carbonylation of various proteins and induction of transcription of MEK1, a MAPKK. An elevated caspase-3-like activity and higher abundance of a putative metacaspase transcript were also observed, consistent with a programmed cell death (PCD)-like process. Elimination of cells that were already damaged by oxidative stress may be the driving force for the evolution of this phenomenon in phytoplankton.

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LINKAGE BETWEEN PRODUCTION AND RESPIRATION ON THE LOUISIANA CONTINENTAL SHELF

We examined water column metabolic characteristics in the northern Gulf of Mexico on the Louisiana continental shelf, a region characterized by widespread summer hypoxia. The prevailing paradigm holds that historical increases in anthropogenic nutrient pollution has shifted net metabolism towards heterotrophy, thereby increasing shelfwide hypoxia. However, few studies have directly examined metabolism across the shelf. On each of five cruises, we occupied 3 sites distributed along the continental shelf (depth range ~ 7-20 m). The sites were sampled for standard CTD variables (temperature salinity, dissolved oxygen), chlorophyll-a, bacterioplankton abundance, bacterioplankton production, and community respiration. The sites varied markedly, but coherently, in freshwater content, phytoplankton biomass, bacterioplankton biomass, bacterioplankton production and community respiration. As expected, the site nearest the Mississippi River had the highest autotrophic and heterotrophic biomass and metabolic activity. A surprising result was that bottom waters underneath highly productive surface waters exhibited no evidence of enhanced metabolic activity. This spatial decoupling between surface layer production and bottom water respiration indicates that physical processes are more important than metabolic processes in predicting the location and extent of hypoxia

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A SINGLE CELL VIEW ON THE ECOPHYSIOLOGY OF ANAEROBIC PHOTOTROPHIC BACTERIA

Quantitative information on the ecophysiology of individual microorganisms is generally limited because it is difficult to assign specific metabolic activities to identified single cells. We developed and applied a novel method, Halogen In Situ Hybridization-Secondary Ion Mass Spectroscopy (HISH-SIMS), and show that it allows simultaneous phylogenetic identification and quantitation of metabolic activities of single microbial cells in the environment. Using HISH-SIMS, individual cells of anaerobic, phototropic bacteria inhabiting an oligotrophic lake were analyzed with respect to $H^{13}CO_3^-$ and $^{15}NH_4^+$ assimilation. Metabolic rates were found to vary greatly between individual cells of the same species, showing that microbial populations are comprised of physiologically distinct individuals. Furthermore, the least abundant species had the highest contribution to the total uptake of ammonium and carbon, thereby emphasizing that numerically inconspicuous microbes can play a significant role in nutrient cycles in the environment.

Our study opens new possibilities of research in environmental microbiology, by increasing the ability to examine the ecophysiological roles of individual cells, and by the capacity to track not only nitrogen and carbon but also other biological element flows within microbial communities.

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A COMPUTATIONAL MODEL OF NUTRIENT TRANSPORT AND ACQUISITION BY DIATOM CHAINS IN A MOVING FLUID

Numerical modeling plays and important role in study of effects of small-scale fluid motion on diffusive and advective mass transfer, and nutrient acquisition by diatoms. In this talk we present a mathematical model based on the immersed boundary method, that couples the interaction of non-motile, flexible diatom chains with the surrounding fluid and nutrient. We apply our model to investigate the impact of flexibility and length of diatom chains on nutrient fluxes in various flow regimes. Our numerical results obtained thus far confirm intuitive predictions, and open the door to possible experimental work.

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ASSESSING COASTAL AND TRANSITIONAL WATER QUALITY FROM MEDIUM-TERM (1995-2007) DATA SERIES: RESPONSE OF BIOLOGICAL ELEMENTS TO CHANGES IN ANTHROPOGENIC PRESSURE

Different biological elements (phytoplankton, benthos, macroalgae), together with physico-chemical variables from water and sediments, have been monitored between 1995 and 2007 in Pasaia coastal water body and Oiartzun transitional water body, within the Basque Country (northern Spain). The dataset obtained was used to analyze the response of those ecosystems to the sewerage plan that is being undertaken in the area since 1996. This sewerage plan includes: the elimination of the wastewater discharges to the estuary and to the coastline, their deviation to a submarine outfall, and a water treatment. The methodologies developed for the implementation of the Water Framework Directive (2000/60/EC) have been used here to study in an integrative way the response of the biological elements to anthropogenic pressures (wastewater discharges) and to the actions taken to remove such pressures (construction of a submarine outfall and water clean-up).

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USING SEAWEEDS FOR CARBON SEQUESTRATION

Numerous solutions to the problem of anthropogenic CO2 emissions have been proposed. The project 'Algae and Global Warming (AGW): Greenhouse Gas (GHG) Emissions Reduction Using Seaweeds,' started in June 2006. The purpose of AGW is to utilize seaweeds as GHG emissions reduction instrument and to develop practical mitigation and adaptation options. In south-eastern coast of Korea, high net primary productivity (2.9 ~ 7.5 gC m-2 d-1) of seaweed beds were obtained with increasing biomass (270 ~ 1001 gC m-2) in cold season. In addition, recent development of a red algal pulp / biofuel could provide an alternative to the use of trees / fossil fuels and will thereby reduce further CO2. As such seaweeds have been recognized for their utility as CO2 sinks and other adaptation and mitigation options, sustainable seaweed aquaculture production has become recognized as an important prerequisite. Future developments of AGW will need to take into account a range of environmental, social and economic parameters and to create an international consensus that seaweeds should be recognized as a significant GHG sink.

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INFLUENCE OF THE ORGANIC MATTER DERIVED FROM ZOSTERA JAPONICA ON BENTHIC FOOD WEBS IN TIDAL FLAT.

We studied organic matter origin compositions in particulate organic matter (POM) and sediment organic matter (SOM) to clarify the contribution of seagrass (Zostera japonica) for the POM and SOM in seagrass beds and nearby un-vegetation area. The influence of the seagrass organic matter to the benthic ecosystem through food web was investigated using the carbon and nitrogen stable isotopes (γ13C, γ15N) and the fatty acid biomarkers. From the results, the SOM composition was significantly different in seagrass beds and un-vegetation area, though there was no difference in the amount of the SOM. In seagrass beds, the SOM are mainly composed of the seagrass organic matters, while diatoms and some seagrass organic matters are present in un-vegetation area. No difference of POM composition was found in seagrass beds and un-vegetation area. This suggested that the decayed seagrass as SOM in seagrass beds was re-suspended as POM. Finally, decayed seagrass was transported to un-vegetation area due to sedimentation of POM. In addition, the bivalve in seagrass beds consumed mainly phytoplankton and hardly seagrass organic matter in POM.

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FIELD OBSERVATIONS OF MICROSTRUCTURES AND PHYSICAL-BIOLOGICAL SUBMESOSCALE STRUCTURES AT THE KUROSHIO FRONT

Submesoscale dynamics near ocean fronts have recently been found to play crucial roles in vertical exchange of heat and nutrients between sunlit surface and sunless lower layers. Results from high resolution CTD tow-yo surveys and two and three-dimensional numerical simulations in the frontogenetic conditions indicate that the frontal regions are characterized by the submesoscale downwelling of well-mixed water and chlorophyll pigments on the cold side and the phytoplankton blooms on the warm side of the front. In this study, we conducted two transect observations across the Kuroshio front in the Kuroshio-Oyashio confluence in August 2007 and 2008, using Moving Vessel Profiler (MVP), XBT, Microstructure profiler (TurboMAP), and RD ADCP. We observed a number of submesoscale tongues of high fluorescence and low salinity water elongated from the surface along isopycnals using MVP in the 2007 cruise. Maximum fluorescence is found near the surface on the warm side of the Kuroshio front, where a strong frontal jet exists. Results from nutrients water samplings and the microstructure observations from transect surveys in 2008 using TurboMAP and XBT will be discussed with Semi-Geostrophic diagnostics including vertical mixing.

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LARGE-SCALE VARIATIONS IN FULL DEPTH DISTRIBUTION OF PROKARYOTIC PRODUCTION IN THE CENTRAL PACIFIC (FROM 67.5° S TO 53° N)

Oceanic biogeochemical models rely on equations that describe the magnitude and the length scale of the remineralization of organic matter (OM) in the ocean's interior, but these models have yet to fully embed variations in fitting parameters such as the exponent of the Martin equation. Because prokaryotes are the major consumers of OM in aphotic layers, measurement of prokaryote production (PP) is useful to examine the extent and spatial patterns of OM remineralization. Here we report our data on PP collected during two meridional transect cruises conducted in the central Pacific. In the mesopelagic layer, there was a remarkable consistency between PP and the sinking flux of POC at a depth of 100 m (F100). In contrast, PP in the bathypelagic layer was only weakly correlated with F100 and was high in subtropical regions. Our data support the hypothesis that PP largely reflects sinking fluxes of POM, but they also suggest that a significant fraction of variation in OM mineralization in bathypelatic waters is accounted for by either lateral transport of OM, the flux of OM from sediments, or both.

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PHYSIOLOGICAL RESPONSES OF PROCHLOROCOCCUS MED4 TO SHORT-TERM PHOSPHORUS STARVATION AND LONG-TERM PHOSPHORUS LIMITATION

The marine picocyanobacterium Prochlorococcus is the dominant phototroph in mid-latitude oligotrophic oceans. The presence of phosphorus (P) acquisition genes among and within Prochlorococcus ecotypes is widely variable, as is the ability to utilize organic P. We utilized batch and continuous cultures to examine the response of high-light adapted Prochlorococcus MED4 to short-term P starvation and long-term P limitation. We determined expression of 10 genes associated with P sensing, transport and regulation using q-PCR and measured uptake kinetics of radiolabeled PO4 and ATP. The high-affinity PO4 binding protein, pstS, was upregulated under P-replete conditions and increased 10 fold during P starvation. In contrast, expression of phoA (alkaline phosphatase) and phoE (outer membrane porin) was downregulated under P-replete conditions, and increased 100 fold upon P starvation. Furthermore, the Km of PO4 uptake was lower in P-starved than P-replete cells, suggesting that Prochlorococcus MED4 may harbor both a low-affinity and high-affinity outer membrane P transport system. Expression of pstS, phoA and phoE under long-term limitation was comparable to short-term starvation, indicating the P acquisition response does not distinguish between limitation and starvation.

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IMPACT OF UV RADIATION ON TROPHIC TRANSFERS: EFFECTS OF NUTRITIONAL VALUE ON THE DEVELOPMENT OF *EUPOLYMNIA NEBULOSA* (POLYCHAET ANNELID)

The thinning of the stratospheric ozone layer has led to the increase of UV radiation (UVR) reaching Earth' surface. The negative effects of UV have been mainly documented on pelagic ecosystems. Among the effects, it has been suggested that the nutritional quality of phytoplankton may be significantly impaired, which would affect the higher trophic levels, notably the invertebrates living on the sea bottom. The aims of this study were to quantify the impact of UV radiation on the nutritional value of the pelagic diatom *Skeletonema costatum* and to investigate the biological consequences of these changes on the development of *Eupolymnia nebulosa* juveniles. An overall lower amino acid availability was observed in the irradiated culture and the long chain unsaturated fatty acids were depleted. The juveniles fed with impoverish algae exhibited an abnormal and lower growth rate. This may be related to the reduction of compounds essential for development and especially the deficiencies in both eicosapentaenoic acid and the potential precursors for docosahexaenoic acid. The present results confirm that UVR may affect indirectly the first trophic level of the benthic foodweb by the alteration of nutritional quality of primary producers.

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ALLELIC DIVERSITY AND POPULATION STRUCTURE IN DEEP-SEA VENT EPSILON-PROTEOBACTERIA AS DETERMINED FROM SEQUENCE ANALYSIS OF HOUSEKEEPING GENES.

There has been increasing interest in deep-sea vent epsilon-Proteobacteria because of their remarkably widespread distribution and significant impact on the ecology and geochemistry in deep-sea hydrothermal vent environments. They often account for over 90% of total rRNA in various habitats as both symbionts and free-living organisms associated with actively venting sulfide deposits and in areas where vent fluids and seawater mix. Deep-sea vent epsilon-Proteobacteria are mesophilic to thermophilic chemolithoautotrophs capable of oxidation of hydrogen and sulfur compounds coupled with the reduction of oxygen, nitrate, and sulfur compounds. In a recent breakthrough, genome sequences of deep-sea vent epsilon-proteobacterial strains provided insights not only into the mechanistic reasons for their prevalence in deep-sea vents, but also into the origins of virulence in their pathogenic relatives, Helicobacter and Campylobacter species. As an effort to trace the movement of deep-sea vent epsilon-Proteobacteria globally and to associate these microbes with geographic regions and habitat features, we developed a multilocus sequence typing (MLST) scheme as a genotyping tool. Closely related strains (at least 99.9% identical in rRNA gene) isolated from ten different geographically separated deep-sea vents were characterized. The MLST data revealed considerable diversity and also suggested that populations of deep-sea vent epsilon-Proteobacteria were isolated geographically.

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CARBON CYCLE ON CORAL REEF ECOSYSTEM ON FRINGING REEF FLAT AND OUTER REEF SLOPE BASED ON ESTIMATION OF PHOTOSYNTHESIS AND CALCIFICATION RATES

Net photosynthesis and calcification rates were measured by *in situ* incubations at ten sites that included six of the defined communities, which occupied most of the area on the reef flat and slope at the Shiraho fringing reef, Ishigaki Island, Japan. Net photosynthesis on the reef flat was positive overall, but the reef flat acts as a source for atmospheric CO_2 because the measured calcification/photosynthesis ratio of 2.5 is greater than the critical ratio of 1.67. Net photosynthesis on the reef slope community was negative. Almost all excess organic production from the reef flat is expected to be effused to the outer reef and consumed by the reef slope community. Therefore the total net organic production of the whole reef system is probably almost zero and the whole reef system also acts as a source for atmospheric CO_2. On the reef slope area, the difference between the organic carbon consumed and the carbon used for calcification is discharged to seawater, and some of this discharged inorganic carbon flows into the reef system again by currents and reenters the carbon cycle.

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SEASONAL AND INTERANNUAL TRENDS OF ELEMENTAL AND ISOTOPIC COMPOSITION OF MACROALGAE IN A SHALLOW-WATER COASTAL LAGOON

In shallow-water environments benthic primary producers can exert a strong influence on the dynamics and cycling of nutrients. This is especially true for water bodies subject to high nitrogen and phosphorus loads, because here nutrient-demanding macroalgae often dominate the producer community. In these systems the analysis of elemental and isotopic composition of macroalgae has proven to be a useful tool for understanding both nutrient origin and fate. We present a fifteen-year series of data on nutrient (carbon, nitrogen, phosphorus) and isotopic ($\delta^{15}N$, $\delta^{13}C$) content of macroalgae in a coastal lagoon. When data are grouped in classes of N or P limitation, according to threshold values of the C:N, N:P and C:P ratios, a clear pattern of increasing $\delta^{15}N$ with increasing total N content emerges, with the highest values (14.3 ± 0.7‰) always associated with high winter TN content (3.9 ± 0.7% dw) and high nitrate loads. Long term trends are less clear, however in the most recent years, increasing values of late-spring algal N:P ratios have been observed, which are inversely correlated with TP river load in the preceding month

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TRACING CARBON FIXATION PATHWAY WITHIN RIVERINE FOOD WEBS ELUCIDATED BY NATURAL ^{14}C ABUNDANCE

In this presentation, we introduce the ^{14}C methodology to evaluate riverine carbon fixation pathway. There are two major carbon sources in riverine ecosystems. One is the autochthonous production mainly by algae attached on a stone surface, which fix dissolved inorganic carbon (DIC). Another is the allochthonous production mainly by the terrestrial leaf litter from riverside vegetations, which has fixed atmospheric CO_2. Although their relative importance to the food webs has been discussed in many studies, the destination of each carbon fixation pathway has not been elucidated yet. As ^{14}C can evaluate carbon age and origin, we measured $\Delta^{14}C$ values of the two carbon sources (attached algae and leaf litter) and organisms. Algal $\Delta^{14}C$ values showed low, reflecting the old carbon from underground, while $\Delta^{14}C$ values of the litter showed high, reflecting the new carbon from atmosphere. We show the change of $\Delta^{14}C$ values from upstream to downstream in order to trace the destination of each carbon fixation pathway within riverine food webs.

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POTENTIAL IMPACT OF SMALL COPEPODS ON A CHANGING PELAGIC ECOSYSTEM: THE CASE STUDY OF *OITHONA SIMILIS* IN THE ARCTIC

The underestimated small copepods are key components of marine pelagic ecosystems, linking the 'classical' and microbial food webs. Despite a relatively low biomass contribution in the Arctic, *Oithona similis* (Cyclopoida) is highly and increasingly abundant. Moreover its population remains active year-round, unlike typical polar copepods. Using both optical and biochemical approaches, lipid energetic reserves of *O. similis* were investigated from early spring to late summer in 2006 and 2007 in Kongsfjorden (Svalbard, Norway). Seasonal changes of lipid stores coupled with informative individual variability reflected an adaptation to short term food availability rather than a seasonal pattern. Besides, trophic interactions were investigated at different seasons to assess the connections of *O. similis* with lower trophic levels. Whereas planktonic ecosystems in the Arctic are subjected to a strong seasonality, *O. similis* seemed to display a flexible and opportunistic life strategy which could act as stabilization factor of this ecosystem in the context of Arctic warming.

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ON BENTHIC ECOSYSTEM FUNCTIONING AND THE IMPORTANCE OF MEIOFAUNA

Nutrient cycling and degradation of contaminants are critical ecosystem functions performed by benthic communities, with prokaryotes as major contributors. Most studies indicate that the direct contribution of benthic meiofauna (size 40-1000 μm) to organic matter mineralization and contaminant degradation is small. Still, microbial activity and diversity can potentially be directly and indirectly controlled by the abundance and diversity of the meiofauna. Even though it is the most abundant and diverse size group of metazoa in aquatic sediments, the role of meiofauna in benthic ecosystem processes is still poorly known. We followed the benthic mineralization of a settled spring phytoplankton bloom as well as the degradation of the polycyclic aromatic hydrocarbon naphthalene in Baltic Sea sediment in the presence and absence of meiofauna. The rate of mineralization of organic matter, a function mediated mainly by many generalist bacteria, increased, while the rate of naphthalene degradation, carried out mainly by specialized bacteria, was reduced. This suggests that specialized ecosystem functions may be more vulnerable to disturbance, and that it is important to study several functions to generalize on the diversity-function relationship.

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ORGANIC MATTER RELEASE BY HERMATYPIC CORALS - A SYNOPSIS

Organic matter continuously released by hermatypic corals can dominate the suspended matter of reef waters and functions as energy and nutrient carrier. Thus, quantification of its release represents a fundamental basis for understanding coral reef element cycles. However, little information is available on species-specific release rates and influencing environmental key factors. This study presents first comprehensive data on organic matter release by all dominant hermatypic corals of a typical Red Sea fringing reef in high temporal and spatial resolution. Particulate organic carbon (POC) and particulate nitrogen (PN) release were highly variable and genus-specific, with corals of the genus *Stylophora* demonstrating maximum release (7.8 mg C and 0.5 mg N m^{-2} coral surface area h^{-1}) during all seasons. Dissolved organic carbon (DOC) release was detectable for *Acropora*, *Fungia*, *Goniastrea* and *Millepora*, revealing maximum values for *Acropora* (105 mg C m^{-2} coral surface area h^{-1}), whilst predominant DOC uptake was observed for *Pocillopora* and *Stylophora*. Unlike POC, genera-wide average DOC release displayed significant seasonal differences. All data are discussed in the context of environmental factors such as temperature and depth-mediated light availability.

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A STUDY OF THE FORMATION AND EVOLUTION OF SUBTROPICAL MODE WATER

Mode waters, thick layers of nearly isotropic homogeneous water, have been identified in every ocean basin and are significant in understanding the ocean's long-term climate system. This research project focuses on Eighteen Degree Water (EDW), the subtropical mode water of the North Atlantic. EDW is associated with the largest annual mean heat loss to the atmosphere of any other ocean and thus impacts the mid-latitude climate. The goal of this project is to better understand the annual renewal rate and the physical mechanisms responsible for Eighteen Degree Water. To do this, we use profiling float data, which provide a continuous time series of temperature, salinity and oxygen, from the Gulf Stream region. We will document changes in mode waters and the associated mixed layer through several winters. More specifically, we will investigate the evolution of oxygen, which provides a measure of ventilation age. Results show that EDW layers were found thickest during and just after late-winter outcropping and oxygen saturation decreased in the EDW by about 10% from late winter to late summer, indicating annual aging of the water mass.

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THE INTERACTIONS BETWEEN FAUNA AND SEDIMENT CHARACTERISTICS CONTROL ORGANIC MATTER BREAKDOWN IN RIVER SEDIMENTS

Particulate organic matter (POM) can be buried into river sediments. Leaf litter breakdown is well documented in surface waters with shredders playing a key role in this process, but remains poorly studied in subsurface environments. We expected the influence of shredders on POM breakdown in sediments to depend on the physical structure of the interstitial habitat. To test this hypothesis, the influence of gammarids on degradation of buried POM was measured in experimental systems (columns). We placed POM at 8 cm depth in three conditions of interstitial pore volume. For each pore volume treatment, we used 3 columns with and 3 columns without gammarids. After 4 weeks, POM mass loss and microbial variables (fungal biomass, bacterial abundance and enzymatic activities) were measured. The results showed that POM breakdown rates in sediment with pore volumes of 35% and 28% allowing access to gammarids were twice as high as in the lower pore volume condition (20%). Microbial analyses showed that gammarids had low effect on microbial communities developed on leaves, suggesting a direct implication of gammarids on breakdown through feeding on leaves.

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RESULTS FROM A EUR-OCEAN MESOCOSM RESEARCH INTEGRATION PROJECT AND FUTURE OPTIONS FOR INTERNATIONAL COOPERATION.

As a step towards research integration between European scientists and facilities, we explored possibilities to combine new molecular and chemical methods to investigate complex trophic interactions and chemical signalling in pelagic marine food webs, using the Espegrend mesocosm facility, University of Bergen, (http://www.bio.uib.no/pages/mbs.php). We addressed the fundamental question of how to design a large-scale mesocosm experiment to generate a controlled mono-specific diatom bloom in a natural plankton community and how to quantify its effects on a defined pelagic ecosystem. We also tested to what extent chemical signalling, i.e. release of potential infochemicals, in natural plankton may be analysed by novel analytic approaches, and whether feeding on specific prey by zooplankton can be quantified in natural plankton by applying novel technical approaches such as scanning flow cytometry and quantitative PCR. This poster gives an overview of the main results, while selected parts is presented in detail in a talk by Pohnert and posters by Jakobsen et al, Simonelli et al and Spielmeyer. In addition, upcoming possibilities for joint international (European and non-European) use of leading European mesocosm facilities will be presented.

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STAGE-STRUCTURED PREDATOR-PREY DYNAMICS: THE INFLUENCE OF NUTRIENT LIMITATION

Predator-prey systems in nature often experience limited abiotic resources, which can have a strong influence on population dynamics. In the Daphnia-algal predator-prey system, low phosphorus levels in the environment can produce alternative states with different ratios of carbon:phosphorus in the prey and pronounced shifts in both predator and prey density. Here I show experimentally that these alternative states can be generated by manipulating initial conditions, as suggested by theory. Such an experimental setup allows the study of competition among predator genotypes under alternative states while maintaining a common light and nutrient environment. Based on experiments with individuals, the influence of nutrient limitation differs between juvenile and adult stages. Here I expand a stage-structured predator-prey model to incorporate the influence of nutrient limitation on structured predator life-history. The model is used to study how nutrient limitation governs rates of selection among competing predators under different initial conditions, and how this is influenced by the different levels of phosphorus found in nature.

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BENTHIC DEGRADATION RATES IN SHALLOW SUBTIDAL CARBONATE AND SILICATE SANDS

Degradation and mineralization of organic matter (OM) in marine sediments largely depends on the physical properties of the sediment. The hypothesis was tested, whether carbonate and silicate sands with equal environmental settings, median grain size and permeability differ concerning their rates of OM degradation and mineralization. We used in situ chamber incubations to determine sedimentary total oxygen utilisation and nutrient release, and ex situ whole core flow through methods for sulfate reduction and potential oxygen consumption measurements. Although the total organic carbon content of the carbonate sand exceeded that of the silicate sand by a factor of 4-5, the sedimentary total oxygen utilisation rates were only 1.3 times higher. Higher C:N ratios in the carbonate sand (10 ± 7) compared to the silicate sand (3 ± 2) indicate a larger fraction of refractory compounds. We suggest that the porous structure of the carbonate sediment grains leads to higher OM content but limits its bioavailability, whereas the smooth surface of the silicate grains prevents accumulation of OM and promotes rapid cycling. Hence, the sediment type largely determines degradation and mineralization potential.

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LONG-TERM ECOLOGICAL RESPONSE OF SUBTIDAL MACROBENTHIC COMMUNITIES TO HUMAN PRESSURES AND EXTREME CLIMATIC EVENTS IN A TEMPERATE NE ATLANTIC ESTUARY

The analysis of a long term data set on the sub-tidal macrobenthic communities from the Mondego estuary (Portugal) illustrated the combined effects of anthropogenic pressures and natural events (e.g. floods and droughts) over the period 1990 to 2007. The spatial dynamics of physicochemical factors and communities' structure in different parts of the system was characterised and tracked. Moreover, changes in ecological conditions in a eutrophic area of the system were followed, based on data from a selected group of sampling stations, using the Portuguese Benthic Assessment Tool (P-BAT). Results showed that human pressures have been gradually driving long term system deterioration, while extreme climatic events may have dramatic overlapping short term impacts. As a consequence, in a global climate change scenario, this may represent an important difficulty in developing and implementing water policies. In fact, monitoring, management, and recovery programs aiming at dealing with disturbances caused by human activities and their consequent pressures, cannot disregard extreme climatic events due to the great impact they have on the communities living in these areas, and the subsequent effects on ecological conditions assessment.

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THE OCEANIC PROTIST COMMUNITY AND ITS CONTRIBUTION TO PARTICLE FLUX

In the warmer, more stratified oceans of the future, the phytoplankton community will likely shift from larger to smaller cells, presumably with negative implications for the efficiency of downward carbon flux. Using molecular methods, we assessed the importance of key taxonomic groups of eukaryotic phytoplankton as contributors to the biological carbon pump at a subtropical ocean site. We found significant compositional differences between the phytoplankton assemblages in the photic zone and those retrieved from shallow sinking-particle traps immediately below it. Diatom sequences made up at least a third of all sequences in each of the clone libraries from the euphotic zone but only a small proportion of the libraries of the trap samples. But in contrast, small taxa without mineral tests, such as prasinophytes and prymnesiophytes seemed to form a significant fraction of the sedimenting material. These findings challenge the notion that diatoms, when abundant in the water column, dominate carbon flux. They also indicate that the predicted shift to smaller taxa might not negatively affect the efficiency of the biological carbon pump.

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PLUMBING THE DEPTHS OF THE RARE BIOSPHERE WITH ULTRA-DEEP RIBOSOMAL SEQUENCE TAG PROFILES

The taxonomic composition of the 'rare biosphere' has received renewed attention through a parallel increase in the coverage of 16S rRNA gene sequence libraries. Serial analysis of ribosomal sequence tags (SARST; Neufeld et al. 2004. Environ. Microbiol. 6:131-144) was the first method developed for augmenting the throughput of phylotype profiling above traditional sequencing with Sanger technology. More recently, pyrosequencing has further increased the rate with which ribosomal sequence tags (RSTs) are retrieved from environmental samples. Despite these advances, few nucleic acid extracts from soil or aquatic environments have been sampled sufficiently for confident assessments of total prokaryotic diversity; rank abundance curves contain insufficient data for modeling the underlying distribution of microbial communities. The advent of next-generation sequencing technologies has radically increased the number of sequences collected above previous methodologies. This talk will highlight the milestones of high-throughput sequencing method development, present a proof-of-principle five-million sequence dataset generated by coupling RST profiling with the Illumina sequencing platform, and demonstrate how information from multimillion-sequence community profiles enables access to additional taxonomic and genomic content of uncultured organisms from the rare biosphere.

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SOUTHERN OCEAN PRIMARY PRODUCTIVITY IN A HIGH-CO_2 WORLD

Since the beginning of the Anthropocene, atmospheric CO_2 levels have risen to the highest concentration experienced on Earth in at least 400,000 years and a further increase is inevitable. As a consequence more CO_2 invades into the world oceans, particularly in polar areas. The resulting surface ocean pH and CO_2 changes in turn might have a large impact on the major bloom forming taxonomic classes: diatoms, nanoflagellates, and haptophytes (mainly *Phaeocystis antarctica*) of the Southern Ocean. During the ANT XXIV/3 cruise with the German R.V. POLARSTERN the effects of different CO_2 concentrations (190 ppm (Last Glacial Maximum), 380 ppm (Present) and 750 ppm (Future 2050 A.D.)) on the in-situ algal community were studied. Six CO_2 manipulation experiments under ambient temperature and light conditions were conducted in continuously aerated 10 L Polycarbonate carboys. Growth, vitality and carbon metabolism were monitored for 10 d to describe phytoplankton community changes as well as the underlying physiological mechanisms. Shifts in carbon acquisition mechanisms will be discussed in terms of physiological acclimation of the in-situ algal community and taxonomic adaptation.

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FRACTAL COASTAL FUTURES: EMERGING GLOBAL TRENDS: HOW CAN WE BETTER FORECAST COASTAL FUTURES IN THE FACE OF GLOBAL CHANGE?

The coastal zone is especially vulnerable to global change. Natural disasters and man-made disasters batter the coasts of the world. What can we learn from examining past crises in the coastal zone? Sometimes we see situations that, from the benefit of hindsight, we feel could have been predicted. The crystal ball of smug futurology has somehow rolled off the table and smashed on the floor before our very eyes! Surely, we should have seen the crisis coming? Why do we fail to forsee these hugely important non-linear changes? Sometimes they simply cannot be predicted because of divergent alternative pathways of equal probability, but this may not always be the case. What can we predict and how? What do we do when we cannot possibly predict the future (what happened to the Precautionary Approach?)?

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FEEDING MECHANISMS AND PREY SELECTION BY THE CTENOPHORE MNEMIOPSIS LEIDYI

The ctenophore Mnemiopsis leidyi is an important planktonic predator in both its endemic and invasive ranges. Although well documented as a copepod predator, M. leidyi also consumes a variety of other prey. Weekly samples of M. leidyi gut contents over a two year period indicate that, when differential digestion rates are considered, M. leidyi showed a significant preference for copepod nauplii and mollusc larvae and selected against adult copepods. Copepod nauplii and mollusc larvae are typically captured via entrainment in M. leidyi's ciliary feeding currents. These results indicate the importance of M. leidyi's feeding currents for understanding broader predatory impacts of this ctenophore.

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EATING YOUR COMPETITOR: ON THE FUNCIONAL TRIANGLE BETWEEN TURBULENCE, COPEPOD ESCAPE BEHAVIOR AND PREDATION FROM MUSSELS

The implications of mussel populations (Mytilus edulis) on the pelagic food web were investigated through i) a comparative study of the vertical distribution of plankton above a mussel bed and a bare sandy bottom and ii) experimental setups in the laboratory. In the field, vertical distributions of phytoplankton, bacteria, protozoa, meroplankton and copepods were significantly different above the mussel bed compared to the sand bed. In addition, turbulence enhanced the grazing impact considerably on all plankton groups. In the laboratory, clearance on different stages of the copepod Acartia tonsa by M. edulis was measured at different turbulence intensities. These results showed that the escape success of different stages of A. tonsa was interfered by turbulence although with significant ontogenetic differences and that the consumption by the benthic suspension feeder M. edulis increased with increasing turbulence supporting our field observations. In general, adult copepods escaped a filtering mussel better than nauplii and copepodites. This study demonstrates the interaction between turbulence, mussel predation and copepods, and illustrates the potential of benthic suspension feeders in shaping the pelagic food web.

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PHYSICAL AND BIOLOGICAL MESOSCALE ACTIVITY IN TWO COASTAL UPWELLING REGIONS AS CHARACTERIZED BY FRONTAL AND EDDIES DETECTION FROM REMOTE SENSING

The relationships between physical and biological processes are generally more obvious at the mesoscale level where oceanic structures such as upwelling fronts, filaments, or eddies occur. Their high level of energy increase the biological activity and the trophic energy in the system (Bakun, 2006). In eastern boundaries upwelling systems, as in the Humboldt and the Canary Current Systems, mesoscale structures are a recurrent pattern and induce a high spatio-temporal variability. Several works have shown that these physical structures have a dominant role on the control of marine populations. We proposed indices based on remote sensing data to characterize the mesoscale variability in the ocean and to study his effects on the chlorophyll distribution in Upwelling Systems. We apply advanced imaging technologies for the detection of oceanic mesoscale structures to characterize them in an automatic way. In order to synthesize and transfer the spatial results into a quantified information, we propose two gridded indices of mesoscale activity associated to fronts and eddies at weekly and monthly scales, and we present some of their biological implications.

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ENERGY TRANSFER FROM THE UP-SIDE DOWN JELLYFISH CASSIOPEIA TO PLANKTONIC MICROBES AND THE MYSID IDIOMYSIS TSURNAMALI IN A NORTHERN RED SEA CORAL REEF

Mucoid exudates released by hard corals are known to function as energy carrier from the animal to a range of benthic and planktonic consumers in coral reefs. Additionally, other symbiont-bearing representatives within the phylum Cnidaria continuously release such organic exudates as well, e.g. soft corals and gorgonians (class Anthozoa), milleporian fire corals (class Hydrozoa) and the upside-down jellyfish Cassiopeia spec. (class Scyphozoa). The latter animal commonly appears in corals reefs and often exhibits swarms of the mysid Idiomysis tsurnamali hovering above it. However, trophic interaction between both groups of animals is unknown. This study presents first data on abundance, benthic coverage and habitat specificity of Cassiopeia in a typical Red Sea fringing reef. It also comprises quantification and stable isotope labelling of dissolved and particulate organic matter released by the jellyfish. Furthermore, the uptake and subsequent degradation of this material by planktonic microbes and mysids was investigated. Our results reveal a new trophic interaction in coral reefs: the transfer of energy assimilated by the zooxanthellae in the jellyfish tissue to microbes and zooplankton via organic matter release by the jellyfish.

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THE PAST AND THE PRESENT STATE OF ZOOPLANKTON COMMUNITY IN THE COASTAL ZONE OF THE NE BLACK SEA

The Black Sea pelagic system has changed dramatically for the last twenty years. The appearance of ctenophore *Mnemiopsis leidyi* in the middle of eighties led to the decrease of zooplankton biomass and changed the species composition of zooplankton. Populations of Appendicularia and Cladocera have shrunk significantly, Chaethognatha have virtually vanished from zooplankton. The incursion of ctenophore *Beroe ovata* consuming *Mnemiopsis* in nineties led to the enhancement of zooplankton community. We performed a comparison of the past and present states of zooplankton community in the coastal area of the NE Black Sea. It was based on the monthly studying of zooplankton in 2005-2008 and compared with data obtained in 1978 and the early 1990s. The influence of predation and feeding conditions on zooplankton structure and abundance was studied. During the last decade, zooplankton structure and biomass was recovered. The possible effect of climate change and top-predators on seasonal shift in zooplankton dynamics is discussed.

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HARVEST INDUCED COMPENSATION IN FECUNDITY AND STAGE-SPECIFIC BIOMASS IN A DAPHNIA-ALGAE SYSTEM

I present an experimental study with Daphnia feeding on algae, where non size-selective harvesting on the Daphnia populations resulted in compensation in both juvenile biomass and total population fecundity. I present individual-level mechanisms as well as population-level responses that explain the compensation. Recently developed theory postulates that differences in the capacity of individuals to exploit a common resource determine whether maturation (when juveniles are inferior competitors) or fecundity (when adults are inferior competitors) is the regulating processes in the population. Depending on which process is more regulating, biomass compensation takes place in either the juvenile or the adult stage. With the help of a stage-structured model I also address the question; which stage is the more competitive one in a Daphnia population? In addition I argue that this kind of compensation, based on individual level differences, can have important community level consequences.

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LONG TERM VARIABILITY IN PHYOPLANKTON COMMUNITY COMPOSITION IN THE ADRIATI SEA

The evaluation of the time-series data set of primary production, chlorophyll a, phytoplankton community composition revealed the importance of considering climatic and environmental forces among the factors that may be responsible for the observed fluctuations. Diatom/Dinoflagelate ratio shows negative correlation with North Atlantic Oscillation (NAO) index demonstrating higher diatom abundance during NAO negative phase, while dinoflagellate grew better in years with positive NAO index. Seasonal respond of PP on changing NAO index is result of phytoplankton community structure. We can conclude that NAO index affect intensity of diatom winter/spring bloom through availability of nutrients. Intensity of toxic Dinophysis spp. bloom has been related to the NAO. Higher abundances of Dinophysis species and more frequent toxicity events occur in years wit negative NAO index. These changes are attributed to higher precipitation, which is important factor in controlling in situ blooms of toxic Dinophysis spp. and consequently, toxicity implications for shellfish.

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NUTRIENT LIMITATION OF PHYTOPLANKTON IN ANTICYCLONIC EDDIES OF THE NORTHERN SOUTH CHINA SEA

Baroclinic instability modulated by topography leads to the formation of two mesoscale anticyclonic eddies in the northern South China Sea: the Hong Kong Southeast Anticyclonic Eddy (HKSEACE) and the Hainan Island East Anticyclonic Eddy (HIEACE). In these eddies, downwelling caused by a depressed pycnocline leads to high temperature, low salinity, impoverished nutrients, reduced Chl a concentrations, and picoplankton dominance of phytoplankton assemblages in the euphotic zone. We tested the hypothesis that experimental nutrient enrichment would relieve biomass limitation of phytoplankton by opportunistic response of taxa with low nutrient affinity. Our results confirm that phytoplankton samples incubated in vitro under nutrient enriched conditions attained higher biomass, change in taxonomic dominance from dinoflagellates to diatoms, and shift in size class dominance from picoplankton to nanoplankton and netplankton. These responses were evident only when limitation to more than one nutrient was relieved. Phytoplankton in HKSEACE appeared to be co-limited by nitrogen and phosphorus, whereas at HIEACE it was co-limited by nitrogen, phosphorus and also silicon.

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POTENTIAL ROLE OF FUNGI IN THE PLANKTON FOOD-WEB FUNCTIONING: A SIMULATION ANALYSIS BASED ON LAKE BIWA INVERSE MODEL

Recent investigations on the molecular diversity of the plankton of lakes and coastal lagoons have shown an unexpected diversity of fungi and particularly chytrids. Microscope observations have provided evidence for the presence of two main forms. The sporangia are implied in algal parasitism. The propagules, i.e. uniflagellated zoospores, have been mis-identified as protistan bacterivorous nanoflagellates in previous studies, and might constitute an alternative resource for consumers. These results implicated modification in our vision of the plankton-food web, with less numerous bacterivorous cells than assumed before and with an algal parasitic activity that may strongly limit the primary production available for consumers or loss through sedimentation. According to these potential modifications, we revisit the model of carbon flows in the photic zone of the North basin of Lake Biwa, in summer, established using the inverse analysis method for estimating missing flow values. In the absence of quantification of flows induced by fungal activity, simulations of their potential roles in the plankton food web are proposed, based on assumptions from preliminary data.

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STOCHASTIC DYNAMIC ENERGY BUDGET MODELS FOR ZOOPLANKTON

We recently developed deterministic theory on population stability and the maintenance of diversity in zooplankton populations and communities. Resource-dependent vital rates, together with a dynamic developmental delay in consumers, produce a new type of small-amplitude population cycle that coexists with long-recognized, large-amplitude, consumer-resource cycles. Competing species or clones in an environment with small-amplitude resource cycles, experience lower rates of competitive exclusion than the large-amplitude cycles. These theoretical predictions were supported by laboratory studies of Daphnia. Here, we present a simple stochastic simulation model incorporating the same biological processes as the previous deterministic model. The state of an individual consumer (Daphnia) is characterized by a development index, related to size. The stochastic model has new parameters characterizing variability in consumer performance; these are estimated for Daphnia using previous lab studies. With careful attention to energy or carbon balance, we derive deterministic equations for the consumer population's size distribution. We use the model to investigate the robustness of our previous findings on both population stability and competitive exclusion rates. We also investigate "transitions" between the two types of cycle.

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THE IMPORTANCE OF SEA-ICE FORMATION IN THE SEA OF OKHOTSK FOR SUPPLYING IRON TO THE WESTERN SUBARCTIC PACIFIC

Atmospheric dust has been thought to be the most important source of iron supporting annual biological production in the Western Subarctic Pacific (WSP). Our study clearly indicates that there is another important source of iron for WSP. We conducted observations in the Sea of Okhotsk and found that iron was re-suspend from the sediments of the north-western continental shelf area. This source of iron is transported by ventilation processes, which are driven by sea-ice formation in the Sea of Okhotsk, and which distributes the iron to wide area of the intermediate layer in the WSP. Furthermore, we observed a clear seasonality in dissolved iron concentrations in the surface waters of the Oyashio region. The surface waters are significantly influenced by high iron concentrations in the intermediate waters through diffusion and winter mixing. Therefore, in addition to the traditional view of dust input, iron transported into the mesopelagic zone by ventilation of intermediate waters should be considered as an important source of iron for phytoplankton blooms in the Oyashio region. Additionally, resent studies have reported that the ventilation of the intermediate waters has been reduced through a reduction of sea-ice formation, probably due to global warming. Therefore, our findings contribute to a better understanding and prediction of the influence of environmental change on biogeochemical cycles and ecosystem in the WSP.

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A MOLECULAR, ISOTOPIC, AND ORGANIC GEOCHEMICAL ANALYSIS OF FRESHWATER MICROBIALITES FROM CUATRO CIÉNEGAS, MEXICO

The stable isotopic and molecular organic chemical signatures preserved in ancient microbialites contain information about past environmental conditions. However, interpretation of these preserved signatures requires an understanding of the microbial activities that lead to calcium carbonate accretion in modern microbialite systems. We have employed stable isotope, organic geochemistry, petrography, and molecular biology techniques to better understand community structure, nutrient cycling, and the preservation of isotopic and organic geochemical signatures in living freshwater microbialites from Cuatro Ciénegas, Mexico. Metagenomic and 16S rDNA PCR data depict a microbial community dominated by cyanobacteria and proteobacteria, whose coordinated activities create microenvironments suitable for carbonate precipitation. These results are further supported by organic carbon isotope distributions within the microbialite. Observed d13C values in the surface layers are reflective of a photosynthetic biomass and more depleted values at the interior indicate the heterotrophic incorporation of this photoautotrophic carbon. While photosynthesis is the dominant process at the microbialite surface, metagenomic, 16S PCR, stable isotopic, and electron microscopy (EDAX) analyses suggest the prevalence of sulfate reduction in deeper layers of the microbialite.

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VERTICAL MIGRATION STRATEGIES OF SOME ZOOPLANCTON SPECIES IN LIGURIAN SEA NW MEDITERRANEAN AND CONSEQUENCES.

Diel vertical migration is assumed to be one of the strategies zooplancton is using to increase food income and minimize mortality. It is considered in some ecosystem models as important to the dynamics of surface layer of the sea. However, not all species migrate and early life stages of a migrating species are usually weak migrators. During the DYNAPROC 2 cruise in Ligurian sea, frequent sampling with a Bioness net produced several profils of zooplankton larger than 500 µm, from 1000m to surface, with different vertical resolutions. Five different strategies are identified from non migrating species to strong migrators, reveiling that migration cannot be considered as a simple mechanism but as a species specific one. Moreover, vertical migration through hydrodynamic and food gradients should be an important component in the population dynamics of a planktonic species, especially when the whole life history is considered. A simple individual based model of vertical migration for one species is presented.

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IMPACTS OF PHYTOPLANKTON DIVERSITY ON RESOURCE USE AND LIGHT USE EFFICIENCY ACROSS A TROPHIC GRADIENT

Diversity has stabilizing effects on ecosystem functioning and enhances productivity. This was recently shown for phytoplankton communities from freshwaters and brackish habitats in the temperate region basing on analysis of large case observational data. We analysed long term data sets of phytoplankton dynamics in lakes of different trophy and morphometry in the temperate region to find out relationships between productivity expressed as resource use efficiency (RUE, phytoplankton biomass per unit total phosphorous) and light use efficiency (LUE, produced biomass per unit light supply) and diversity at different levels (species richness, functional diversity and biomass related Shannon Wiener Index). We hypothesize that the phytoplankton productivity is not generally linked with diversity, but depends on the ability of phytoplankton using either light or nutrient resources efficiently. Our results point towards high resource use efficiency and low diversity in highly eutrophic lakes and high light use efficiency and high diversity in mesotrophic systems. Consequences of trophic induced decoupling of productivity and diversity in lakes are discussed concerning steady state conditions of phytoplankton assemblages for instance under persisting dominance of Oscillatoriales.

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BENTHIC METABOLISM AND DENITRIFICATION RATES IN FRESHWATER LITTORAL SEDIMENTS WITH BENTHIC MACROPHYTES (*POTAMOGETON PECTINATUS*) AND MICROPHYTOBENTHOS

Interactions beteween benthic primary production and bacterial processes contribute dissipative (i.e denitrification to N_2) or conservative (i.e. assimilation and retention) nitrogen transformations, with different pathways in macrophyte or microphytobenthic and oligotrophic or eutrophic systems. In this work benthic metabolism, denitrification and N assimilation rates were measured seasonally in littoral sediments of a sand-pit lake with rooted macrophytes (*Potamogeton pectinatus*) and benthic microalgae and with water column nitrate concentration from 150 to 180 μM. Benthic metabolism was net autotrophic and the sediment was a net sink of dissolved inorganic nitrogen (2-2.5 mol m^{-2} y^{-1}). Overall, denitrification (1.2-1.5 mol m^{-2} y^{-1}) and assimilation rates (0.9 -1.8 mol m^{-2} y^{-1}) were comparable and higher in macrophyte than in microphytobenthic sediments. Differently from what was generally observed in coastal marine sediments, where at low nitrogen concentrations primary production kept low microbial denitrification, under the very high nitrate concentrations of this study, high denitrification rates were stimulated by *Potamogeton*. Overall, submerged macrophytes controlled the diffuse nitrogen load from the watershed (0.03-0.5 mol m^{-2} y^{-1}) acting as a potential nitrogen sink.

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BIOTUBATION BY INTERSTITIAL FAUNA IN A RIVERBED COVERED WITH FINE SEDIMENTS: INFLUENCE ON HYDRAULIC CONDUCTIVITY

Anthropogenic activities such as agriculture and urbanization increase the volume of fine sediments that accumulate at the water-sediment interface of streams. Fine sediment depositions typically reduce hydrologic exchanges between surface water and groundwater (i.e., the hyporheic zone). However, zones of fine sediment deposition are often colonized by active bioturbators like tubicid worms and chironomid larvae. The objective of the present study is to determine how bioturbation influences hydrologic function of experimental filtration systems clogged by the deposition of three fine-grained sediments (with different organic matter and pollutant contents). The effects of bioturbation by tubificids and chironomids were measured on sediment reworking and changes in hydraulic conductivity. Invertebrate influence on clogging process depended on their mode of bioturbation (construction of biogenic structures, burrowing and feeding activities) but also on the interaction between bioturbation activities and the characteristics of the clogged sediment layer. Reduction of clogging by animals was evident in OM-rich sediments. This result may be due to a stabilization of biogenic structures produced by animals in the system, these structures acting as water pathways through the clogged layer of sediments.

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DIVERSITY OF *SYNECHOCOCCUS* STRAIN ISOLATED FROM THE EAST SEA AND THE EAST CHINA SEA

In order to investigate diversity of marine *Synechococcus* strains isolated from seawater within euphotic depth of the East China Sea and the East Sea, phylogenetic analyses based on sequences of 16S rRNA gene and 16S-23S rRNA internal transcribed spacer region (ITS) and the ratio of PUB:PEB (phycourobilin; phycoerythrobilin) were investigated for 33 culture isolates. The phylogeny of 16S rRNA gene showed that the isolates were clustered into 10 clades including 2 novel and 8 previously described clades. Congruent result was obtained from a phylogenetic analysis of ITS sequences. The isolated strains could be categorized into 4 types by pigment compositions - clade VIII without PUB & PEB, clade V with only PEB, clades II, VI, IX, X & XVIII with low PUB:PEB ratio, and clades III & XVII with high PUB:PEB ratio. Interestingly, the pigment compositions of isolates belonging to clades V and VI differed from those reported for other oceanic regions. The presence of novel lineages and the different pigment patterns in the ECS and ES suggest the possibility that some *Synechococcus* lineages are distributed only in geographically restricted areas and have evolved to fit in these regions.

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KARST SINKHOLES IN LAKE HURON ARE BIOLOGICALLY DIVERSE CARBON SINKS FOR PELAGIC PRODUCTION

Karst sinkhole ecosystems in Lake Huron (North America) form unique microbial habitats where hypoxic, sulfate-rich groundwater floods the lake floor. Here, extensive cyanobacterial mats cover organic-rich sediments. To study sinkhole microbial diversity, we created SSU rRNA clone libraries using primers specific to *Bacteria*, *Archaea*, and *Eukarya*. Sequence analysis yielded cyanobacteria nearly identical to clones retrieved from permanently ice-covered Antarctic lakes, *Archaea* similar to known methanogens, and highly diverse eukaryotes. To discover the source and fate of carbon deposited in the sinkhole ecosystem, we measured the $\delta^{13}C$ in organic carbon pools. Sediment carbon ($\delta^{13}C$=-23.1‰) more closely resembled planktonic carbon captured in sediment traps ($\delta^{13}C$=-22.8‰) than the carbon fixed by the cyanobacterial mats ($\delta^{13}C$=-30.2‰). These data suggest that organic carbon in sinkhole sediments is derived from pelagic phytoplankton rather than benthic cyanobacteria. The fate of cyanobacterial production is unknown. Combined, molecular ecology and stable isotope studies highlight the uniqueness of the microorganisms in these habitats and place the activity of sinkhole microbes into the context of the larger lake ecosystem.

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RECOVERY AFTER HYPOXIC EVENTS: TESTING THE LINK BETWEEN DIVERSITY AND RESILIENCE OF MACROBENTHIC COMMUNITIES

Ecological resilience reflects the ability of ecological systems to absorb perturbations without being pushed into an alternative stable state. While an appealing concept, it is difficult to measure. Recent modelling studies suggest that recovery rate after perturbations may be a good indicator of resilience. We adopted this approach to empirically test the hypothesis that species diversity and resilience of ecological communities are positively related. We used monitoring data collected annually from the open Baltic Sea over the past 40 yrs. The diversity of benthic communities in the Baltic are strongly constrained by gradients in salinity, but biodiversity in the entire Baltic Proper is threatened by an increased prevalence of hypoxia. We focused our study on three regions within the Baltic that encompass broad-scale variation in salinity and species richness, and which all experience periodic disturbance and recovery from hypoxia. Our results demonstrate a positive relationship between diversity and resilience. The disturbance-recovery scenarios developed within a resilience framework should increase our capacity to predict how the Baltic Sea ecosystem will respond to remediation efforts or potential additional stressors.

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SPECIES ASSOCIATIONS AND EXCLUSIONS IN PLANKTON LAYERS IN COASTAL WATERS.

An important question regarding depth distributions of zooplankton is whether other species influence layering and patch formation, which is primarily imposed by physical processes. Optimal distribution is a balance between food availability and predation risk, and species that are especially vulnerable to predation may seek refuge outside their preferred habitat. In this study we examine depth distributions and the degree of aggregation of copepods in relation to gelatinous invertebrate predators and potential competitors in coastal waters, using data obtained with a digital Autonomous Video Plankton Recorder.

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NEW INSIGHTS INTO MARINE PROTISTS DIVERSITY

Implementation of 18S rRNA gene clone libraries is currently the gold standard approach to study microbial eukaryotes' diversity in the environment. However, it is largely admitted that PCR based techniques targeting the 18S rRNA gene provide a biased view of the in situ diversity and alternative approaches are required. Here we analyzed the metagenomic dataset from the Global Ocean Survey Expedition seeking eukaryotic 18S rDNA signatures. We also compared the protists diversity assessed by both rDNA and rRNA clone libraries on the same sample from the Mediterranean Sea. The metagenomic studies did not display a dramatically distinct diversity compared to PCR based clone libraries, but size fractionation suggested some groups, such as radiolarians and marine alveolates, may actually come from larger cells or DNA aggregates. Diversity assessed by 18S rDNA/rRNA libraries led to a drastically different view of the community. Taxa such as pelagophytes or picobiliphyte were only detected in this rRNA based survey, whereas MAST (Marine Stramenopiles) groups -3, -7 and -4 appeared as prominent grazers and Alveolates exhibited particularly low contributions. The three approaches provide complementary views of in situ diversity and suggest a taxonomic decoupling between biomass and production within eukaryotic microbes' communities.

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PLATFORM AND PROTOCOL IMPLEMENTATION FOR ESTIMATING CHLOROPHYLL-A WITH HR4000CG SPECTROMETER

The new European Water Framework Directive recommends the use of chlorophyll-a concentration estimates for the assessment of water quality in coastal areas. Ocean colour imagery is increasingly being used as a tool to determine this parameter in surface waters. However, algorithms designed for use at global scales are less accurate due to the variability of optically active in-water constituents near the coast; hence, regionally parameterized empirical algorithms are necessary. This contribution presents the implementation of an adapted measurement protocol and two custom-built platforms for the HR4000CG spectrometer: A stainless steel flotation device to mount the sensor on and measure the upwelling radiance (L_u) and a platform to measure downwelling radiance on a diffuse lambertian target (L_d). The protocol was established in the laboratory, and then tested in the field during a 20-day survey in May 2008 along the Bay of Biscay, where 68 spectral signatures and biogeochemical measurements were acquired. Results show a robust relationship between chlorophyll-a and remote sensing reflectances at the 510/560 nm ratio (r^2=0.78), which could be used in the future to develop a regional empirically-derived algorithm.

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ABUNDANCE AND TOXICITY OF A *KARLODINIUM VENEFICUM* BLOOM IN THE WEEKS BAY NATIONAL ESTUARINE RESEARCH RESERVE, ALABAMA

Weeks Bay NERR experienced multiple dinoflagellate blooms in 2007. The phytoplankton community was dominated by a bloom of *Prorocentrum minimum* in February followed by *Kryptoperidinium foliaceum* and *Karlodinium veneficum* in July - October. Night time anoxia was recorded in February and in August. Five fish kills occurred within Weeks Bay and its tributaries during the summer. Analyses of the water and the dead fish indicated that karlotoxin contributed to these. We mapped phytoplankton community structure, toxin levels and a range of environmental and optical variables repeatedly during the *Karlodinium* bloom. *Karlodinium* formed spatially localized peaks of cell density and cell toxicity. The highest abundance was 120 million cells/liter (466 µg/l Chla) in the upper reach of the estuary. High cell densities reflected elevated nutrient loading. Toxicity reached 1 ng/cell in the bloom. 67% of the variability in the environmental data (T, S, DIN, DIP and kd) was explained by the first 2 PCs in a principle components analysis. Per-cell toxin concentration was highly correlated with PC2, which was correlated ($p<0.05$) with DIP (R = 0.91) and kd (R = 0.81): toxicity was highest at low DIP/high water clarity.

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STOICHIOMETRY AND LIMITATION OF BACTERIA AND PHYTOPLANKTON ACROSS A PRODUCTIVITY GRADIENT

It is hypothesized that the importance of bacteria in pelagic systems should decline with trophic state primarily because algal productivity in oligotrophic systems is constrained by competition with bacteria for nutrients. There have been few studies that have simultaneously examined particulate nutrients, production, and limiting nutrients of bacteria and algae across a range of trophic state. We examined these variables in 17 US reservoirs. Bacteria were more P-rich than phytoplankton, as indicated by lower C:P (117:1 versus 187:1)and N:P (15:1 versus 24:1). Bacteria were consistently P-deficient across all systems, whereas algae exhibited N- and P-deficiency. Bacterial production (BPr) was always <30% that of algal production (PPr), but BPr:PPr declined with trophic state. Using production estimates and C:P, we estimated P demand for both bacteria and algae, and while bacterial production was always less than algal production, bacterial P demand was almost equal to algal demand in more oligotrophic systems due to higher P content of bacteria. Our results suggest that the intensity of competition for P between algae and bacteria is higher in more oligotrophic systems.

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IMPACT OF ENVIRONMENTAL CHANGES ON LIPID COMPOSITION OF THE PELAGIC AMPHIPOD *THEMISTO LIBELLULA* IN THE WARMING ARCTIC

Lipid-based energy fluxes are key determinant for the biodiversity and productivity of Arctic pelagic ecosystems. Understanding mechanisms of the different food-web pathways represents one of the main points of interest in Arctic research. As a key link between mesozooplankton and higher trophic levels, the amphipod *Themisto libellula* was studied in term of lipid classes and fatty acid composition in two fjords in Svalbard (79°-80°North, Norway). Lipid amount in organisms caught during summer 2006 in Kongsfjorden was high and dominated by accumulation of lipid reserves to sustain energetic needs for overwintering and reproduction, whereas smaller lipid storage was found in summer 2007. These changes should be considered in relation with the raising sea-water temperature recorded in the fjord during summer 2007, which corresponded to an increase of Atlantic inflow. We showed here how changes in environmental conditions related to global warming may have a negative influence on the quantity and quality of lipid accumulated by *T.libellula*, and thus may disturb higher food web levels as fish, birds and seals.

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ROLE OF UPPER TROPHIC LEVELS ON N:P BIOGEOCHEMICAL CYCLES: A BOX-MODEL APPROACH

There has been a long debate going on the factors driving the ocean's N:P stoichiometry, especially on the deep ocean N:P ratio. Recent findings prove that deep ocean N:P ratio is altered by a systematic change in phytoplakton C:N:P (Lenton and Klausmeier, 2007; Klausmeier et al., 2008). However, to date, the potential influence of upper trophic levels (herbivores and carnivores) on primary production, export production and deep ocean N:P ratio has been seldom considered. Here we examine these questions using a simple box-model approach. The biological model is derived from Tyrell's model (1999), and then modified to integrate the upper trophic levels. Furthermore, our model considers variable assimilation and accumulation efficiency for nitrogen and phosphorus for heterotrophs. The sensitivity of our model results to the parameterization of biological processes is then investigated; especially with regards to how the upper trophic levels impact on deep nutrient ratios, primary production and export.

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AMMONIUM FLUXES FROM CHANNEL DEPOSITS IN THE NEUSE RIVER ESTUARY, NORTH CAROLINA, USA: IMPLICATIONS FOR AMMONIUM INCREASE IN ESTUARINE WATERS

Ammonium and ^{222}Rn were surveyed seasonally in interstitial water of the Neuse River Estuary (NRE), North Carolina, USA to determine the amount of submarine groundwater discharge (SGD) and ammonium flux from sediments to the overlying water. Ammonium concentrations in sandy environments of the NRE are 10-fold higher than concentrations in the overlying water column and are temporally variable. SGD was also measured directly using seepage meters. Significant seasonal groundwater input to porewaters was detected, with ^{222}Rn concentrations in the range of 400 – 3,500 dpm×L^{-1}. Maximum SGD occurred during winter at a rate of 0.8 m^3 m^{-2} d^{-1}. The data indicate that high concentrations and production of ammonium in sandy nearshore environments are contributing to the overlying water column ammonium levels via groundwater discharge, an advective process. Seasonal trends in diffusional flux, groundwater seepage rates and ammonium concentration suggest that groundwater discharge is an important mechanism transporting nutrients from porewaters to the overlying water column. The findings from this study advance understanding concerning the role of ammonium in the chronic eutrophication of estuarine ecosystems.

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METHANE AT LAKE SURFACES – SHORTCUTS FROM THE BOTTOM?

Lakes constitute a globally significant source of methane the second most important greenhouse gas in the atmosphere. Most of the methane produced in anoxic lake sediments is oxidized before reaching the atmosphere. During summer stratification, the minimum methane concentration is in the depth layer where methanotrophic bacteria encounter both methane and oxygen. In our study lake Alinen Mustajärvi, a small, oligotrophic, mesohumic lake in southern Finland, this layer is around 3 m depth. However, above this dissolved methane concentration increases and is often higher at the very surface than in the layers below, even though no ebullition is detected. This anomaly is also seen in other lakes. Various explanations for the source of this methane are discussed. As diffusive methane release from lake to atmosphere is calculated from the methane concentration gradient between air and water and from wind speed, using methane concentrations from below the surface for such flux calculations can lead to underestimation of release.

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UNRAVELLING PATHWAYS OF CARBON AND NITROGEN CYCLING IN SHALLOW SUBTIDAL SEDIMENTS: A ^{13}C AND ^{15}N ISOTOPE TRACER EXPERIMENT

A ^{13}C and ^{15}N pulse-chase experiment was used to trace transfers of carbon and nitrogen through the lower food web and biogeochemical processes in shallow subtidal sediments of a subtropical estuary. Benthic microalgae (BMA) were labelled in situ with $NaH^{13}CO_3$ and $K^{15}NO_3$. Over 30 days, fluxes of $DO^{13}C$, $DI^{13}C$, $^{15}NH_4$, $^{15}NO_3$, $^{29}N_2$, $^{30}N_2$ and $DO^{15}N$, and uptake of ^{13}C and ^{15}N into BMA, bacteria, fauna and sediment were monitored. BMA rapidly incorporated ^{13}C and ^{15}N and remained enriched throughout the study. A gradual decline in excess ^{15}N within surface sediments was partly due to loss via $^{15}NH_4$ and $^{15}NO_3$. This was dominated by fluxes during the dark when there was limited assimilation by autotrophs. NO_3 uptakes suggest ^{15}N was also lost via denitrification, but effluxes of $^{29}N_2$ and $^{30}N_2$ could not be detected. Excess ^{13}C in sediments declined sharply over the first day, probably reflecting dilution with unlabelled material or loss of labelled BMA via grazing, resuspension or respiration. Excess ^{13}C and ^{15}N budgets will show the fate of carbon and nitrogen from BMA in subtidal subtropical sediments.

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COMPETITION AND ALLELOPATHY AMONG POTENTIALLY TOXIC CYANOBACTERIA AND A EUKARYOTIC COMPETITOR (PLANKTOTHRIX RUBESCENS, P. AGARDHII, AND MOUGEOTIA GRACILLIMA)

This study considers the potential for allelopathic interactions among three strains of *Planktothrix rubescens* (TCC 29-1, TCC 69-6, and TCC 69-7), three strains of *P. agardhii*, (TCC 83-2, PMC 75.02, and PMC 87.02), and a filamentous conjugate, *Mougeotia gracillima* (TCC 50-2), all isolated from freshwater ecosystems in France. Results indicate significant inhibition of the growth of *P. agardhii* TCC 83-2 in the presence of filtrate from *P. rubescens* TCC 29-1, a strain producing microcystins, as well as in that from *P. agardhii* PMC 87.02, which does not produce microcystins. Filtrate from *P. rubescens* TCC 29-1 also had an inhibitory effect on the growth of *M. gracillima* TCC 50-2, a local competitor appearing to occupy the same niche as *P. rubescens* in Lake Bourget. Inhibition potential of *P. rubescens* was observed to vary among strains and also appeared to be related to physiological state. This data will be confronted with results from a direct competition study on two of the strains concerned, in order to illustrate a hypothesis on the relative importance of allelopathy and abiotic conditions in cyanobacteria competition dynamics.

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C:N RATIO AND BIODEGRADABILITY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS ALONG LONGITUDINAL SECTIONS ACROSS THE NORTH PACIFIC OCEAN

As one of the fates of biological products provided within euphotic layers, dissolved organic matter (DOM) was accumulated in surface waters. We investigated the surface longitudinal distributions of DOM along the two meridian lines of 165E between 48N and 28N in the western North Pacific and 160W between 53N and 10S in the central North Pacific. The concentrations of dissolved organic carbon (DOC) and nitrogen (DON) were determined by high temperature combustion methods, and subsequently the C:N ratio of DOM were calculated. The clear trend of C:N ratios along the longitudinal sections, which were higher in the stratified subtropical area (ca.18-19) than the upwelling, i.e. high-latitude and equatorial, areas (ca.14-16) were found. Moreover, in order to investigate the potential biodegradability of DOM, these samples have been incubated in sealed glass ampoules under dark at room temperature. The change in C:N ratio of DOM during biodegradation in 1 weeks to a few years will be presented to discuss the regional variation in the microbial availability of surface accumulated DOM.

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MULTI-DECADAL VARIABILITY IN ZOOPLANKTON STABLE NITROGEN ISOTOPES IN TWO SECTORS OF THE CALIFORNIA CURRENT SYSTEM

We utilized naturally occurring variations in $^{15}N/^{14}N$ in four species of holozooplankton as a measure of climate influences on pelagic food web structure in a major eastern boundary current ecosystem. Our analyses focus on two species of particle-grazing copepods and two species of carnivorous chaetognaths, in both the southern and central sectors of the CCS. We address climate influences over a 54-year interval, on different time scales: interannual (dominated by ENSO), decadal, and multi-decadal, utilizing the extraordinary CalCOFI zooplankton time series. We detected a significant difference between regions in average stable N isotope content of the two species of copepods close to the base of the food web, but no regional difference in the chaetognaths. Three of four species showed evidence of an ENSO-related isotopic shift. Long-term variability of $^{15}N/^{14}N$ in *Calanus pacificus* covaried with measured plus hindcast NO_3, which suggests altered nitrated utilization as a primary explanatory mechanism. Over the 5-1/2 decades treated here, only *Eucalanus californicus* in the southern sector showed a significant secular trend, coincident with a long-term increase in water column stratification.

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SPRING TIME SI:N RATIOS IN NORTH-ATLANTIC MARGINAL ZONES

Large interannual hydrographic variations are observed north of Iceland. This arises mainly from the different proportions of Atlantic Water and Polar or Arctic Water in the area, these water massed differ in temperature and salinity and surface layer stability. Pre-bloom nutrient concentrations differ also between these water masses. We examine evidence for the hypothesis that physical and chemical interactions lead to variability (interannual and regional) in biogeochemical conditions for PTFs. Large interannual differences in Si:N ratio in surface wters are observed. Anomalously low silicate utilization has been related to *Phaeocystis pouchetii*, a non-siliceous algae, beeing a predominant component of the phytoplankton spring bloom and this occurs primarily when Polar influence is high. Here we present Si:N ratios observed in spring 2005 and 2006. In 2005 anomalously low Si:N ratio was observed in the surface layer (0 – 100 m) where silicate was only utilized to a limited extent. In 2006 the Si:N ratio was considerably higher. The N:P ratio not exhibit a significant difference between 2005 and 2006.

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CULTIVATION OF DIFFERENT JELLYFISH SPECIES: SOME PRELIMINARY RESULTS

During the last years culture of jellyfish in public aquarium and at research Institutes has became very significant. In spite of that, the available knowledge about essential parameters and specific aquaria required for each jellyfish species is very poor. During last summer, in the frame of a jellyfish research project in Barcelona (Spain), our laboratory is trying to growth the most abundant Scyphomedusae species in the NW Mediterranean Sea was established. After 3 months of work the first results has been achieve and the first cultures are established. Also, we are able to keep successfully adults, polyps and efirae of Rhizostoma pulmo, Cotylorhiza tuberculata and Aurelia aurita, while we are trying at the moment new tanks to rear Pelagia notiluca. We will describe the main observations and results to contribute with the knowledge about cultivation techniques for these marine invertebrates.

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AQUATIC ECOSYSTEM PRESSURES AND RESPONSES:

Recently the scientific standing of palaeolimnology has been enhanced through its contribution to understanding causes and consequences of climate change and aquatic pollution. It has been boosted as a means of achieving key objectives of the Water Framework Directive (WFD), notably reconstructing baseline conditions in lakes, and determining levels of anthropogenic impact where long-term monitoring data are lacking. An often expressed concern is the accuracy of sediment-based reconstructions, especially when environmental conditions fluctuate rapidly and several forcing factors interact. Lough Leane (southwest Ireland) experienced deterioration in water quality since the 1980s when important changes in agriculture and population density occurred in the catchment. The lake is currently eutrophic, and has been classified as 'probably at risk' (1a) of not meeting environmental quality standards for the WFD by 2015. Lough Leane monitoring commenced in 1972 and high quality meteorological and land-use data exist for the catchment. Recent palaeolimnological research has generated high resolution, multi-proxy sediment records that extend beyond commencement of monitoring. This paper compares instrumental and sediment-based data for the Lough Leane catchment using multivariate statistics, providing insight into the potential of palaeolimnology in water management and implementing the WFD where long-term monitoring records are unavailable.

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DEPTH RELATED CHANGES IN THE REPRODUCTIVE CAPACITY OF THE SEAGRASS ZOSTERA MARINA

Biomass allocation and demographic characteristics of a Danish Z. marina population was determined along a light gradient to evaluate the reproductive potential for meadow maintenance and recovery. Biomass, shoot growth and reproductive allocation was measured monthly from May to September at three depths (1.8, 4 and 6 m). Shoot density and biomass showed pronounced differences among depths with up to 12-fold lower shoot density and 6-fold lower biomass at deep compared to shallow sites. Comparatively little variation in leaf formation rates and rhizome elongation rates was found along the depth gradient. New shoots formed through vegetative reproduction, constituted a significantly smaller fraction of total shoot density at the two deepest sites (0.9-11.9 %) compared to the shallow site (16.6-25.6 %) during the sampling period. Biomass allocation to sexual reproduction was highest at intermediate and deep sites. The slow vegetative shoot recruitment rate suggests that deep-water populations may rely on sexual recruitment for meadow maintenance, whereas vegetative recruitment is the primary mechanism in shallow populations.

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SEDIMENT CHARACTERISTICS INFLUENCE THE RESPONSE OF *CYMODOCEA NODOSA* TO EUTROPHICATION: AN EXPERIMENTAL EVIDENCE.

Seagrass-sediment interactions are pivotal matters in management and functioning of seagrass ecosystems. We hypothesize that sediment characteristics exert a relevant influence on plant response to euthrophication. Specifically, carbonated sediments may adsorb phosphates, buffering part of their harmfulness. However, they have a very low iron-pool and thus a reduced ability to remove sulphides, which implies a limited capacity to alleviate sulphide toxicity to the plants. To assess our hypotheses, a laboratory experiment was conducted using three types of sediment: highly-carbonated, terrigenous and intermediate. Six microcosms per sediment type were planted with twenty *C. nodosa* ramets and half of them submitted to high organic-nutrient enrichment, remaining the rest as controls. The effects on seagrass performances were evaluated after two weeks. Photosynthetic yield decreased significantly in treated units, but the decrease was clearly higher in terrigenous than in carbonated sediments. Treatment also caused heavy epiphyte loading; however, and in contrast with photosynthetic yield, this response was higher in carbonate sediments. This suggests that the photosynthetic-yield reduction was probably related to sediment processes, more than to epiphytes shading.

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EFFECT OF LITTORELLA UNIFLORA ON NUTRIENTS IN A GROUNDWATER FED LAKE.

Lake Hampen is a Lobelia lake situated high up in the Jutland ridge and which lies close to the groundwater boundary. This means that the groundwater flow between the aquifer and the lake is not constant. Lake Hampen has a large discharge zone where the groundwater flows from the aquifer into the lake; and a smaller recharge zone where water from the lake flows back into the aquifer. This variable groundwater pattern combined with only minor surface inlets and outlets provides good conditions for studying the interactions between groundwater and Littorella uniflora. Preliminary results from ongoing field studies indicate that Littorella uniflora clearly stimulate nitrification within the rhizosphere. Internal nitrate peaks formed within the sediments, in both the discharge and recharge zones of the lake. These peaks ranged from 0,009 to 0,47mg NO3-N L-1 in the discharge zone; and from 0,49 to 0,88mg NO3-N L-1 in the recharge zone. There are also indications that the plants have the capability to effectively reduce high nitrate concentrations within the rhizosphere (reduction of 30 to 0,1mg NO3-N L-1 was observed).

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FLOW VELOCITY INFLUENCES RIVER METABOLISM IN THE REGULATED, ENERGY-LIMITED, LOWLAND RIVER MURRAY.

Due to discharge regulation the River Murray is isolated from its floodplain and the energy supporting river metabolism comes largely from channel productivity. River regulation also alters channel flow velocities and this can alter longitudinal distributions of metabolism. In this study we investigated the influence of flow velocity on rates of community photosynthesis and respiration, and their distribution between planktonic and benthic compartments. Flow velocity had a strong effect on river metabolism showing a bipartite distribution. Rates of community photosynthesis and respiration increased slowly as flow velocities decreased towards 0.2 m s-1. Below this velocity, metabolic rates were frequently large but fluctuated widely and were not influenced by water velocity; the benthic contribution to community metabolism increased; and the supply of allochthonous organic carbon increased. Consequently slow flowing reaches were more productive. However, for most of the river length these slow flowing reaches are a minor component formed by weir pools. Models comparing current and natural flows demonstrated significant alterations in longitudinal channel productivity due to velocity changes with implications for delivering irrigation and environmental water allocations.

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BALTIC SEA PHYTOPLANKTON COMMUNITY IN TEMPORAL SHIFT

During the last four decades the Baltic Sea phytoplankton has gone through a substantial shift in community structure. We have analysed the community composition of several thousand quantitative phytoplankton monitoring samples with a temporal range from 1966 to present, and the spatial range covering the whole Baltic Sea including Kattegat. By using community gradient analysis methods (DCA, MDS) we found a strong correspondence between sample ordination scores and sampling year. The association was stronger when the samples were geographically more confined and the temporal range sufficiently large. Only in the southern Baltic Sea and the Kattegat has the salinity gradient comparably strong associations with the phytoplankton community strucutre compared to the time shift over four decades. Eutrophication related parameters (total and mineral nutrients) revealed low association with the phytoplankton community structure in all sub-basins. The temporal shift was evident in the phytplankton summer community as well as in the spring bloom composition. In the northern Baltic Sea the latter revealed a shift from diatom dominance (70's) to predominantly dinflagellate spring blooms (90's).

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VARIABLE FORMATION OF VOLATILE METHYL SPECIES OF S, SE, TE AND PO BY MARINE MICROBES

Methyl species of Group Vib elements (S, Se Te and Po) are important volatile metabolites in marine waters controlling their biogeochemical fluxes across the air-sea interface. Aerobic, tellurite resistant microbes isolated from salt marsh sediments were examined for their capacity to methylate Group Vib elements in pure culture. Speciation and quantification of the volatile species was executed using highly sensitive GC-ICPMS analysis of headspace samples. All strains volatilized S, Se, Te and Po, with Se methylated at 10- to 1000-fold greater levels than Te. Consistent with this Se preference, co-amendment with selenite inhibited the production of volatile Te and Po species. The spectrum of volatile compounds was dependent upon the organism used. Yeast strains (*Rhodotorula* spp.) produced the greatest amounts and variety of volatile compounds (DMTe, DMDTe, DMSe, DMDSe and DMPo), while Gram+ bacterial isolates (*Bacillus* spp. and *Virgibacillus* spp.) predominantly generated S conjugates (DMTeS, DMSeS, DMS, DMDS and DMTS). These results indicate that marine yeasts and aerobic Gram+ bacteria play under-appreciated roles in the production and cycling of volatile S, Se, Te and Po species in coastal waters.

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A SYNTHESIS OF ARCTIC OCEAN MARINE PRIMARY PRODUCTION

Summer sea ice cover in the Arctic Ocean has been declining rapidly in recent years, This is expected to have significant impact on marine primary production (PP) through changes in irradiance and stratification. Primary production was estimated using 3 approaches: (1) historical field data; (2) using a vertically integrated model based on SeaWiFs retrieved chlorophyll a and euphotic depth; and (3) nutrient-based net community production for the current satellite data record (1997-2007). The Arctic Ocean was divided into functional regions classified by the dominant physical – biological forcing: (a) inflow shelves, (b) interior shelves, (c) outflow shelves and (d) deep central basin. Patterns and trends in PP within each of these regions will be discussed in tandem with ice concentration data from passive microwave sensors (SSM/I). An increasing trend in total annual PP has been observed in the last five years (2003-07), with a corresponding decrease in areal specific PP. Regional responses to the reduction in summer sea ice have differed and will be described.

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THALASSIOSIRA PSEUDONANA PROTEOME, RESPONSE TO DIFFERENT NITROGEN SOURCES

Marine diatoms are central to the biogeochemical cycling of important nutrients such as carbon, nitrogen and silicon. To understand the biology of nitrogen requirements by a centric diatom and explore how different nutrient conditions affect the proteome of T. pseudonana, we grew cultures of this organism under various nitrogen sources (NO_3, replete/starved, NH_4, and urea), and conducted whole-cell qualitative and quantitative shotgun proteomic analysis (ICAT, isotope-coded affinity tag). MS/MS data were searched using the Trans-Proteomic Pipeline and channeled into Gaggle and Pipe, bioinformatics platforms that allow visualization and analysis of proteomic data in context of metabolic pathways, and genome annotations. At least 25 percent of proteins identified were differentially expressed under the different conditions and included proteins involved in nitrogen and carbon cycling, photosynthesis, lipid metabolism, intracellular trafficking, secretion and cellular transport. Interestingly nitrogen starvation, leads to expression of specific proteins involved in cell death.

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DIFFERENT SCALES OF PHYTOPLANKTON VARIABILITY IN A MULTI-STRESSOR SUPPORTING ESTUARY

Predicting the response of estuarine phytoplankton to global warming is a difficult task given the between estuaries variability in driving forces and stressors. It is well documented that the existence of multiple stressors modulates to a great extent the response of estuarine phytoplankton to climatic-dependent factors such as river discharge, temperature and light. Morphological and hydrological changes in addition to nutrient enrichment cause that phytoplankton experience a higher spatial and temporal variability in estuaries than in coastal and open waters where the effect of climatic change on the physical structure of the water and hence in the structure of phytoplankton should be more predictable. We use data from 9 years of phytoplankton monitoring to address the main scales of variability of phytoplankton biomass and species composition in the Nervion River estuary, a temperate estuary that supports strong human influence. To gain insight into the potential effect of global warming, we present a conceptual framework of the relative incidence on phytoplankton structure of the top-down and bottom-up processes which alternate in the different estuarine environments.

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PHYTOPLANKTON DIVERSITY IN RELATION TO PHYSICAL DRIVERS IN A SUB-ARCTIC FJORD

Breidafjordur is a large fjord at the West coast of Iceland, with high biomass and diversity. Information on planktonic communities in the area is sparse and knowledge about phytoplankton and zooplankton interaction, and energy transfer through the food web is lacking. The objective of this research is to monitor the physical- and chemical environment in consortia with phytoplankton biomass and community composition. Samples are collected at 5 locations along two transects across the fjord. The preliminary results, of this ongoing study, indicate spatial- and temporal variability in the physical properties of the fjord, which are reflected in the chemical and biological characteristics. The water column in the outer part of the fjord gets stratified during summer, whereas the shallower part of the fjord remains well mixed throughout the year. Furthermore, the phytoplankton biomass shows a north-south density gradient, with seasonal alterations of location of the maxima. The project is considered the initiation of a time series study of phytoplankton dynamics and linkage of primary production to energy transfer through the food web of Breidafjordur.

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IMPACT OF UVB RADIATION ON TRANSPARENT EXOPOLYMER PARTICLES

Transparent exopolymer particles (TEP) are the most ubiquitous gel particles in the ocean, and play an essential role for aggregation and thus carbon flux, for air-sea gas exchange, and in food webs. The impact of ultraviolet-B radiation (UVB) on TEP concentrations is, however, not known, which is particularly disturbing in view of increasing UVB as a consequence of ozone depletion. We performed experiments to determine the net effects of visible and UVB radiation on TEP photogeneration and photolysis. Abiotic TEP photogeneration from dissolved precursor material was not observed in any treatment, but solar radiation, and especially UVB, completely photodispersed TEP in less than three days in the absence of organisms. UVB radiation enhanced TEP generation by microorganisms, which could compensate for direct abiotic TEP losses by photolysis. These results are particularly important in view of recent findings that TEP accumulate in the surface micro layer.

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OPTICAL PROPERTIES OF COLORED DISSOLVED ORGANIC MATTER (CDOM) AT JOBANERR, PUERTO RICO

We report characterization of CDOM at Jobos Bay National Estuarine Research Reserve, a mangrove lined embayment, using absorption spectroscopy, excitation-emission matrix fluorescence spectroscopy and dissolved organic carbon (DOC) analysis. Five fluorophores were identified. Components A: 350 nm Ex/(442-446)Em and E: (265-275) Ex/(304-455)Em suggest the presence of terrigenous humic material. Component B: (320-325)Ex/(436-439)Em and component C: 315Ex/(395-437)Em may be associated with anthropogenic humic matter but the latter appears only in enclosed mangrove areas. Component D: (290-305)Ex/(399-446)Em with high fluorescence intensity in enclosed mangrove areas may be a product of microbial decomposition. Fluorescence intensity of components A, B and E decreases towards offshore waters. Absorption slope values vary between 0.019 to 0.102 nm^{-1} offshore and 0.014 to 0.08 nm^{-1} in mangrove area. Absorption412 nm increases toward the mangrove area with a wide range from 0.088 to 11.48 m^{-1}. Absorption at the center of the bay and offshore ranges 0.019 to 0.75 m^{-1}. DOC values vary from 74 to 466 μM and present positive correlation to absorption (r^2=0.604, n=25, p=<0.0001) upon exclusion of samples from shallow seagrass environments.

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FACTORS INFLUENCING SPATIAL AND TEMPORAL DYNAMICS OF MICROPHYTOBENTHOS BIOMASS AND PRODUCTION IN AN ESTUARINE AND INTERTIDAL BAY (BAIE DES VEYS, NORMANDY)

Microphytobenthos (MPB) is a significant component of trophic web in estuaries and intertidal ecosystems, environments in which, MPB biomass and production highly vary both on spatial and temporal scales. The aim of this study was to decipher the factors that control these dynamics. Spatial heterogeneity was undertaken at the whole bay scale or at meso- (m) and micro-scale (mm). Temporal variability was measured on short term at two spring neap tide cycles (summer/winter) and on long term with a two-year sampling period. Measured variables were chla biomass (also depth microprofile), sediment features, EPS, and photosynthetic activity (PAM). Main results showed that MPB biomass was dependent on the percentage of mud in the sediment whatever spatially and temporally. In transitory phase, wind, spring and neap tide cycles, and bathymetry are factors controlling resuspension, advection and redeposition of mud and subsequently associated MPB biomass. In stabilized stages of higher mud percentage, primary production (which was mainly temperature and light dependent) and grazing are the factors controlling the biomass. The role of EPS in stabilizing or de-stabilizing the sediment will be further discussed.

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VIRAL LYSIS AND BACTERIVORY: SEASONAL PLANKTONIC FOOD WEB DYNAMICS IN TWO SEMI-ENCLOSED BAYS OF THE FRENCH ATLANTIC COAST

Spatial heterogeneity, seasonal and trophic dynamics of the microbial communities were compared between two semi-closed temperate bays (Arcachon and Marennes-Oléron) during 2005 and 2006, respectively. Parameters were regularly assessed (high tide) at several stations. In parallel, 48h batch incubations were conducted in April with natural assemblages to study microbial loop and viral shunt dynamics (differential filtration and viral enrichment). Contrary to Arcachon, Marennes Bay was nearly always spatially homogenous (physical, chemical, biological parameters and correlations between them (ANOVA, γ=0.05)). The two bays showed different trophic dynamics but exhibited a succession of typical coastal temperate patterns: Classical trophic pathways (herbivorous and microbial) appeared episodically while transition models (multivorous webs) dominated. Virus, rather than flagellates, influenced bacterial dynamics in both bays: Viral lysis dominated over flagellate grazing effects (simple and multiple regressions, p<0.05) and virus only stimulated bacterial growth (through in vitro virus enrichment). Nevertheless, flagellates significantly affected picoeukaryotes in Arcachon. Moreover, they influenced viral production, positively in Marennes and negatively in Arcachon. During bottle inclubations, bacterial diversity decreased (FISH) and dominance of Gammaproteobacter increased. * Collaboration : EPOC, Université Bordeaux, France

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CARBON SEQUESTRATION BY ARTIFICIAL UPWELLING - COULD WE EVER DEMONSTRATE SUCCESS?

With its huge capacity to store carbon and the large reservoir of unprocessed preformed nutrients, the oceans may provide attractive sequestration options. The recently proposed idea of artificial upwelling by ocean pipes is one way to tap into the biotically unprocessed nutrient pool to sequester carbon in the oceans. Using a coupled biogeochemical ocean-climate model, we find that ocean pipes may have the potential to reduce atmospheric CO2 by almost 100GtC by the end of this century. However, about 80% of this simulated carbon sequestration happens on land, where lower air temperatures, brought about by piping up cold waters in the ocean, are predicted to lead to slower carbon respiration in soils. Because of the dominant role of remote and spatially distributed processes, success or failure of CO2 sequestration by ocean pipes would be extremely difficult to demonstrate in practice.

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REGIME SHIFTS AND JUNK FOOD IN MARINE FOOD WEBS

Regime shifts has been observed in marine food webs and typically involve large changes in species abundance or distribution. Some of these shifts involve hysteresis mechanisms, i.e. negative feedback loops that hamper recovery of previously dominant species. Several identified regime shifts has been correlated to changes in climate, although a number of cases have identified unsustainable extraction of fish resources as important drivers of change. In e.g. the Baltic Sea, there are clear indications that overfishing of cod reduced the resilience of the ecosystem to climate variation, contributing to the change from a cod to a sprat-dominated system. Observations of top predators indicate that regime shifts may be closely associated with changes in food quality. In the Pacific Ocean, the North and Baltic Seas, seabirds have been influenced by a decrease in energy content of their preferred prey, or by changes from high- to low energy prey species. These changes appear connected to regime shifts and indicate that food quality may be an important feed back mechanism, which stabilize new regimes by influencing condition and recruitment of food web components.

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VARIATIONS IN THE REPRODUCTIVE CYCLE OF NORTHERN SHRIMP (PANDALUS BOREALIS) IN THE GULF OF ST. LAWRENCE: THE IMPACT OF MATCH/MISMATCH ON RECRUITMENT SUCCESS

Cushing's match/mismatch theory of recruitment variability is based on the idea that species' life histories should be adapted to synchronize egg/larvae production with the main production event (e.g., spring bloom). Shrimp population characteristics in the Gulf of St. Lawrence (GSL) and at one site on the Newfoundland shelf were examined to determine whether variations in the timing and duration of different stages of the reproductive cycle control the timing of larval emergence. The reproductive cycle starts and ends earlier in the eastern areas and egg incubation lasts longer where bottom temperatures are colder. The consequence is a longitudinal gradient in the time of larval emergence, with earlier hatching in the eastern sectors that is correlated with the initiation and maximum of the spring blooms. In one area, the northwest GSL, year-by-year comparisons of the timing of the spring bloom and larval emerge show the impact of a match/mismatch on larval survival. Sea-surface chlorophyll a maxima (mg m-3) were also positively correlated with the survival index. Remotely sensed ocean colour data combined with fisheries monitoring data could be useful in forecasting shrimp recruitment variability.

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IMPACT OF FOREST HARVESTING ON RESERVOIRS AND LAKES: ASSESSING THE CARBON BUDGET OF AQUATIC ECOSYSTEMS

Differences in dissolved CO_2 concentrations between man-made reservoirs and natural lakes suggest higher CO_2 fluxes to the atmosphere from reservoirs than from lakes; human-induced perturbations such as deforestation also force changes to the carbon cycle in aquatic systems. Water column integrated dissolved and particulate organic matter (DOM and POM, respectively), as well as above and below thermocline dissolved inorganic carbon (DIC) and POM samples were collected from natural and deforested lakes and reservoirs. FTIR, atomic C/N ratios, $d^{13}C_{org}$, $d^{13}C_{inorg}$ and $d^{15}N_{tot}$ analyses were carried out on all fractions, as well as on the sediment and flocculate material. Seasonal and between-scenario differences in concentrations, atomic C/N ratios, $d^{13}C_{org}$ and $d^{15}N_{tot}$ reflect the impact of deforestation on the quality and quantity of OM found in lakes and reservoirs. Water-column profiles of d^{13}C-DIC and d^{13}C-POM show large variability in all water bodies but help understanding the biogeochemical processes controlling carbon cycling in the different scenarios. These results suggest contrasting DOM/POM sources and degradation pathways in lakes and reservoirs, as well as a significant impact of deforestation on the carbon cycle in aquatic systems.

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SEASONAL VARIATION OF METABOLISM IN A *ZOSTERA NOLTII* COMMUNITY

This study intends to evaluate the metabolism of *Zostera noltii* at the community scale. Gross primary production and respiration of benthic community were estimated each month from in situ CO_2 flux measurements during emersion period. Three benthic chambers were used in the same time to integrate the spatial variability. The biomass of *Zostera noltii* leaves and epiphytic algae contained inside the benthic closed chambers were monitored. The Chlorophyll *a* content of the sediment was also measured in order to estimate the biomass of microphytobenthos. Gross primary production did not vary over the year, ranging from 80.7 (±3.2) $mgC.m^{-2}.h^{-1}$ in February to 120.4 (±8.8) $mgC.m^{-2}.h^{-1}$ in September. In contrast, respiration rates were significantly higher in summer (44.6 (±3.7) $mgC.m^{-2}.h^{-1}$) than in winter (13.1 (±3.8) $mgC.m^{-2}.h^{-1}$). The biomass of epiphytic algae varied inversely with the biomass of *Zostera noltii.* A seasonal variation of the main primary producer in the *Zostera noltii* community may explain the relative stability of gross primary production.

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RE-EVALUATING THE ^{238}U-SALINITY RELATIONSHIP IN SEAWATER

Knowledge of the concentration of ^{238}U in seawater is an important parameter required in application of U decay-series radionuclides to understanding particle cycling and flux in marine environments. Due to the intensive preparation and analysis required to determine ^{238}U concentrations in seawater, a conservative relationship observed between salinity and ^{238}U is often used to determine ^{238}U concentrations in these studies (Chen et al., 1986). Particularly in studies of particle flux obtained from ^{234}Th:^{238}U , the uncertainty of the ^{238}U concentration becomes important when the deviation from equilibrium is small. We have re-evaluated this relationship using inductively-coupled mass spectrometry techniques including a well-characterized ^{233}U spike and corrections of mass fractionation with the aim of obtaining more accurate and precise measurements than previous studies. Using these methods, high depth resolution samples from the Bermuda Atlantic Time-Series were analyzed and compared to other samples from the tropical North Atlantic Ocean and the Northwest Pacific Ocean. Of particular interest is the behavior of U at high salinity values (>37) and in local oxygen minima where changes in the redox chemistry of U may occur.

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METATRANSCRITOMIC SURVEY OF THE BACTERIAL COMMUNITIES IN THE NORTH SEA

Bacterial communities play an important role in ecology but our knowledge of the diversity of microbial life is still incomplete in terms of microbial physiology and genetics. The fraction of organisms that can be cultivated today is estimated to be 1-10%, leaving us little room to understand the diversity, function and interactions of microorganisms via culture-dependent methods alone. The introduction of metagenomics has opened the possibility to explore the genetic repertoire of microbial communities independent of culturing. Nevertheless, to get insights into their life-style, access to the expressed genes is necessary. In this study, we conduct a metatranscriptomic analysis on surface waters of the Long Term Ecological Research site "Helgoland Roads" to assess the gene expression profiles of the bacterial community. eEST (environmental Expressed Sequence Tags) libraries are generated by pyrosequencing of total bacterial mRNA. Expression levels of the discovered transcripts will be examined together with contextual habitat parameters as well as metagenomic and metaproteomic data. The study is expected to provide insights into the functions of the bacterial community and how it reacts to environmental changes.

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DETECTION OF DECHLORINATING *CHLOROFLEXI* IN MARINE ENVIRONMENTS

Toxic chlorinated compounds are common environmental pollutants. *Dehalococcoides* spp. are unique bacteria isolated from groundwater that require halogenated organics as respiratory electron acceptors and catalyze reductive dehalogenation reactions. Only six *Dehalococcoides* isolates are available, which, together with numerous environmental clone sequences, form a cluster deeply routed in the *Chloroflexi*. Recent efforts identified two separate clusters related to the *Dehalococcoides* group implicated in reductive dechlorination. Since a large variety of halogenated organics are produced in the ocean, we used 16S rRNA gene-targeted tools to detect *Dehalococcoides*-like bacteria in a variety of marine environments, including tidal flats, deep marine sediments, as well as coral and sponge tissue. Clone libraries generated form these environmental samples showed the presence of *Dehalococcoides*-like 16S rRNA gene sequences in a variety of samples. In addition, we are using degenerate primers and quantitative real-time PCR to explore reductive dehalogenases (RDase) gene sequences from marine sources. These sequences will add to the known RDase gene pool and provide clues about the origin and evolution of reductive dechlorination.

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CYANOBACTERIAL BLOOMS: THRESHOLD RESPONSES TO EUTROPHICATION AND CLIMATE CHANGE IN AQUATIC ECOSYSTEMS

Cyanobacteria form spectacular and, from water quality and human health perspectives, problematic blooms; manifesting themselves as toxic, food web altering and hypoxia-generating surface scums in freshwater and marine environments. Cyanoblooms are generally considered a response to nutrient over-enrichment, but they are also modulated by changes in physical parameters; i.e. altered irradiance, temperature, vertical mixing/stratification, and advective and flushing regimes. Cyanoblooms exhibit strong threshold responses to environmental changes, but ironically they are also promoted by highly stable physical-chemical conditions. This seemingly contradictory response to environmental cues can be reconciled by recognizing various strategies that allow specific cyanobacterial taxa to take advantage of and overcome environmental thresholds, including nutrient supply ratios, irradiance gradients, water column stability and residence times. Adaptive capabilities, such a buoyancy regulation, effective nutrient (N and P) acquisition, cellular nutrient storage, photo- and osmo-protective mechanisms in response to extreme but stable conditions are a key to cyanobacterial threshold behavior and dominance in human and climatically-altered aquatic ecosystems. These adaptations are likely to promote cyanobacterial dominance and proliferation in response to global warming, changes in precipitation patterns, and increasing eutrophication.

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MODELLING THE ROLE OF DOC IN THE GLOBAL CARBON CYCLE

The high age of the bulk of marine dissolved organic carbon (DOC) suggests that this carbon pool responds slowly. The long expected response time coupled to a very sparse observational coverage of DOC concentrations in the world ocean make direct assessments of the role of marine DOC in the global carbon cycle a near impossibility. Modelling studies also have had difficulties dealing with the very different time scales associated with production and relatively fast turnover of fresh DOC in the surface ocean on the one hand, and the extremely slow turnover of the rather refractory bulk of oceanic DOC on the other. We have coupled an adaptive plankton and DOM model tuned in a previous study for the North Atlantic to the UVic_ESCM global 3D ocean circulation model. The model is validated using available surface- and deep-ocean DOC measurements. The model is able to generate essential features of the marine DOC distribution, such as vertical and large-scale deep-ocean gradients, and is suggested to provide a useful tool for analysing the response of this large carbon pool on time scales of decades to centuries. We will discuss results of running the model with an IPCC-type global warming scenario for the next century.

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MANGANESE AND PHOSPHORUS SPECIES AT THE REDOX INTERFACE: COMPARATIVE STUDY IN THE BLACK SEA, THE BALTIC SEA AND THE OSLO FJORD

The joint analysis of the data of phosphorus and manganese species distributions (phosphate, polyphosphate, dissolved Mn, particulate Mn, and bounded Mn) obtained in the Black Sea, the Baltic Sea and the Oslo Fjord allowed to reveal the common features, that testify the similarity of the mechanism of the pelagic redox layer formation. Our investigations demonstrated that Mn bounded in stable complexes with hypothetically organic matter or pyrophosphate is observed in the redox zones in significant concentrations (up to 5 uM), and is likely presented by Mn(III), an intermediate product of Mn(II) oxidation. This bounded Mn(III) can explain phosphate distribution in redox interfaces – formation of so-called "phosphate dipole" with a minimum above the sulfidic boundary, a maximum just below, and with a steep increase of the concentrations between these two. This dipole structure serves as a geochemical barrier that decreases the upward flux of phosphate from the anoxic layer. Modeling results shown that exactly manganese cycle (formation of sinking down Mn(IV) and presence of dissolved Mn(III)) is the main reason of oxygen and hydrogen sulfide direct contact absence

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THE MARINE PHOSPHORUS CYCLE IN A BIOGEOCHEMICAL OCEAN MODEL: RESPONSE TO CHANGES IN SEDIMENT REDOX CONDITIONS

Phosphorus (P) is a key nutrient in marine biogeochemistry. In this study, we use a global biogeochemical ocean general circulation model (HAMOCC) that includes the oceanic carbon, silica and oxygen cycles, and expand it with a module for the sedimentary P cycle. Besides release of dissolved P through oxic and anoxic degradation of organic matter and reduction of Fe-oxides, we include P removal through formation of Fe-bound P and authigenic Ca-P. The global distribution of sediment P concentrations and burial rates predicted by the model are compared to observations from the literature for the deep ocean and near coastal areas. In a sensitivity analysis, we asses the potential long term effects of changes in (1) weathering inputs of P from rivers and (2) redox-dependent P burial on marine P cycling, primary productivity and organic carbon burial in the oceans.

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MICROBIAL COMMUNITY STRUCTURE AND FUNCTION RELATED TO GEOCHEMISTRY IN MERCURY CONTAMINATED STREAM SEDIMENTS

Streambed microbial communities were examined in Oak Ridge, TN across a mercury gradient using a functional gene array (FGA) and by phylogenetic characterization. The contaminated sites (e.g., mercury at 33.3 μg/g) exhibited elevated gene frequencies in general categories (sulfate reduction, denitrification, carbon utilization, and rubisco) and genes that could be associated with a response to contaminants (e.g., metal resistance and contaminant degradation) over the control site (e.g., mercury at 0.065 μg/g). The 16s clone libraries from the most highly contaminated had a higher proportion of cyanobacteria and lower diversity than the control. A synoptic snapshot of 6 sites (mercury range 0.071 μg/g to 39.1 μg/g) shows a poor correlation between mercury in stream sediments and in the water ($r = 0.71$). This observation is consistent with the complex relationship between stream sediment and stream water concentration that is likely influenced by geochemical factors and mercury speciation. The relationships among community structure, methyl mercury, total mercury, and other geochemical factors will be examined though further analysis (applying non-linear techniques such as artificial neural networks) of the data taken over a full year.

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HIGH RESOLUTION STABLE ISOTOPE DISTRIBUTION OF DISSOLVED AND SUSPENDED ORGANIC AND INORGANIC CARBON IN THE CONSERVATIVE ST LAWRENCE ESTUARY

The concentration and isotopic composition of dissolved inorganic, dissolved organic and particulate organic carbon (DIC, DOC, POC, respectively) were determined at high spatial resolution (19 stations, varying depths) along the St. Lawrence Estuary, Canada. In addition, lignin phenols, a terrestrial biomarker, and bulk stable carbon isotopes were measured in ultrafiltered dissolved organic matter and compared to bulk DOC stable carbon isotopes. Mass and isotope balance in the maximum turbidity zone suggests that

physical processes control carbon dynamics in the upper estuary with little evidence of exchange between the DOC and DIC pools until they reach the lower (marine) estuary. Efficient transfer of terrestrial carbon to the hypoxic zone of the lower estuary and subsequent partial degradation is revealed by changes in the stable isotope composition of the POC and DIC. The high spatial resolution sampling of DOC stable carbon isotopes reveals subtle differences in carbon dynamics within different zones of this apparently conservative system that would not have been evident by the use of conventional DOC sampling/analysis strategies, such as quantitation alone or ultrafiltration of a limited set of samples.

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QUANTIFYING THE INTERACTION BETWEEN MICROEVOLUTION AND METACOMMUNITIES

Species traits and local environmental conditions often correspond strongly. This correspondence may arise due to ecological species sorting, where dispersal and competitive species replacement determine composition. The correspondence may also arise due to local adaptation of resident species, where natural selection acts on existing genetic variation to determine genetic composition. As a result of the traditional separation of ecological and evolutionary timescales, methods that incorporate community composition, spatial descriptors, environmental gradients, as well as population genetic differentiation are lacking. We expanded on existing variation partitioning methods to explore the relationship between spatial isolation, community composition, and local adaptation. We then applied these methods to a survey of zooplankton communities and Daphnia pulex population genetics in southwest Michigan ponds. We found a strong association between D. pulex growth rate and local community composition. We believe our method appropriately substitutes for existing analysis of a subset of factors critical to explaining community composition and genetic differentiation, and that taking multiple factors (community composition, spatial descriptors, environmental gradients, and population genetic differentiation) into account is particularly insightful.

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SPATIAL DISTRIBUTION OF NITRATE (NARG AND NAPA) AND NITRITE REDUCTASE GENES (NIRS AND NRFA) AND POTENTIAL NITRATE REDUCTION RATES IN ESTUARINE SEDIMENTS

The spatial distribution of genes coding for key functional enzymes in the benthic nitrate reducing community along a macrotidal hypernutrified estuary (Colne estuary, UK), where strong gradients of nitrate and ammonium are found, was studied and related to process rates. Nitrogen removal capacity of the sediments and potential denitrification rates decreased from the head towards the mouth of the estuary, as well as with increasing depth in the sediment, whereas the opposite was observed for dissimilatory nitrate reduction to ammonium. The greater proportion of nitrate reduction seemed to be driven by the *nap* enzyme, with *nar* predominating only in surface sediments at the head of the estuary. The vertical profiles of gene copy numbers corroborated the results of process rates, as gene copy numbers were generally one to two orders of magnitude higher at the estuary head compared to the estuary mouth, being most abundant near the sediment surface. However, some less abundant phylotypes showed distinct patterns raising interesting questions as to whether there is an alternative role for these nitrate reducing enzymes.

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SEASONNAL VARIABILITY OF UV-PAR IRRADIANCE/RADIANCE IN RELATION WITH CHROMOPHORIC DISSOLVED ORGANIC MATTER OPTICAL PROPERTIES IN NW COASTAL MEDITERRANEAN SEA

We present here seasonal variability of UVB-R (305 nm), UVA-R (325 and 340 nm) and PAR (400-700 nm) penetration depth in relation with CDOM optical properties in marine coastal waters (Bay of Marseilles City; Longitude = 05° 17' 30 E, Latitude = 43° 14' 30 N) from November 2007 to 2008. In situ radiometric measurements were conducted monthly by using a free fall profiler, whereas absorbance and fluorescence measurements of CDOM were performed on discrete sea water samples. Our results show that the 10% irradiance depth [$Z_{10\%}(\lambda)$] of UVB-R (305nm), UVA-R (325 and 340nm) and PAR (400-700 nm) averaged on an annual basis was 6.1 ± 1.3 m, 7.9 ± 1.3 m, 10.1 ± 1.6 m and 24.8 ± 3.8 m, respectively. For 305 nm, maximum and minimum $Z_{10\%}(\lambda)$ were observed in December 2007 (8.1 ± 0.7 m) and May 2008 (4.7 ± 0.2 m), respectively. We evaluated the relationship between $Z_{10\%}(\lambda)$ and absorption coefficient of CDOM [$a_{CDOM}(\lambda)$]. Interestingly the best correlation was obtained at wavelength 325 nm (r^2= 0.67, p<0.01, RMSE = 4.01 %, n=10).

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ISOTOPIC EVALUATION OF THE RELATIVE IMPORTANCE OF PLANKTONIC VS PERIPHYTIC PRODUCTION IN LARGE RIVERS' SLACKWATER FOR PRIMARY CONSUMERS

Stable carbon isotopes ($\delta^{13}C$) constitute a natural tracer which is increasingly used to estimate the relative contribution of periphyton vs phytoplankton to river secondary production (invertebrates, fish). This approach, which has been essentially developed through studies of deep stratified lakes, remains to be evaluated in the context of large river's slackwater habitats, where there is a small resilient time, a high turbidity, and complex patterns of mixing due to their important macrophytes beds and the inputs of tributaries. We used grazers and filterers as integrators of periphyton and phytoplankton isotopic signals, respectively, at 12 stations in Lake Saint-Pierre, the last fluvial lake of Saint-Lawrence River, Canada. We found strong differences in $\delta^{13}C$ between grazers and filterers ranging from 1 to 7‰. When this benthic-pelagic isotopic differentiation was not detected, phytoplankton (chlorophyll a) dominated and deposited planktonic algae were consumed by benthic grazers. Our isotopic data suggest that large river's slackwater are constituted by a mosaic of areas characterized by alternate states ranging from complete domination by phytoplankton to strong reliance on benthic production.

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A MODELING SYSTEM TO MEASURE DISPERSAL CHARACTERISTICS AND MARINE POPULATION CONNECTIVITY

While metapopulation research with hypothetical dispersal matrices has shown how the scales of larval dispersal, transport processes, local recruitment, and temporal and spatial variability in dispersal influence population persistence, the pattern of demographic connectivity is still a key uncertainty. To address this problem, an open-source BiOphysical Larval Tracking System (BOLTS) has been developed that quantifies the degree of individual migration between populations. This spatially explicit model produces dispersal kernels and matrices for a range of scales over which dispersal is practically unquantifiable by current empirical methods. BOLTS's framework couples an individual-based Lagrangian scheme to larval traits, seascape modules, and 3-dimensional fields of ocean models of various resolutions through nesting. Two novel features of this modeling system, that greatly simplify practical problems associated with the data management and CPU intensive computations in such models, are on-the-fly data access from circulation models and parallel implementation of the code. We demonstrate the capabilities of the system in evaluating the natural variability and response to disturbance of population connectivity networks through scenarios operating at different scales and corroborated by empirical measurements.

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IDENTIFICATION AND BIODIVERSITY OF THE CRITICAL HABITATS IN THE MACRO-TIDAL COASTAL WATERS IN KOREA

Intertidal and subtidal areas of the Korean west coast, including major islands, tidal flats, estuaries and bays were classified into 10 Ramsar habitat categories by province. Physical conditions, geographical scales, human activities, pollution sources, species diversity and management plans were described for each habitat. For each Ramsar habitat type a single representative habitat was selected with the newly developed selection criteria; physical conditions, species diversity, geographical scales, conservation status, pollution status, ecological functions, possibility of future conservation, management plans, economical importance, and existing studies etc. Of those 10 representative habitats three critical habitats were selected in terms of the total scores using the selection criteria above. These were bay, estuary and mud tidal flat in order of importance for biodiversity in the macrotidal coastal waters. Snapshot biodiversity studies in the three areas were made in terms of the habitat type and important communities for each of the critical habitats. This study will be a good example for the rapid identification of biodiversity in large areas with diverse habitat types. Supported by GEF/UNDP Yellow Sea project.

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THE RELATIVE IMPORTANCE OF EXTERNAL ORGANIC CARBON AND *IN SITU* PRIMARY PRODUCTION FOR THE FOODWEB OF THE SAN FRANCISCO ESTUARY

The San Francisco Estuary (SFE) is characterized by low autotrophic biomass and relatively high external dissolved organic carbon (DOC) supply via seasonal freshwater input. Previous work in the estuary has indicated that *in situ* primary production is largely responsible for fueling the food web despite the potential DOC subsidy. A recent decline in higher trophic levels in the SFE and evidence of food limitation has focused attention on the need to constrain organic matter flow in lower trophic levels. One hypothesis is that low estuarine primary production has led to a reorganization of the foodweb to a system dependent on exogenous organic matter via the microbial loop. To test this idea, phytoplankton and bacterial activity as well as DOC were measured over two years in the northern SFE. Results suggest that net bacterial production may at times be roughly equivalent to *in situ* primary production and because of low bacterial growth efficiency, total bacterial carbon demand is generally several-fold higher than primary production. This implies a significant, although inefficient, subsidy of external DOC for the foodweb of the SFE.

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BIOTIC CHANGE AFTER EIGHTEEN YEARS IN A MEDITERRANEAN SUBMARINE CAVE: A RESPONSE TO CLIMATE WARMING?

Ligurian Sea ecosystems have recently experienced dramatic changes induced by climatic forcing, the last decade having been significantly warmer than the previous one. Marine caves are elusive and fragile ecosystems where climate change may cause great impact, but little evidence has been provided to date. A re-assessment of cave assemblages at Bergeggi (Ligurian Sea, NW Mediterranean) was undertaken eighteen years after the first quantitative survey (still frame photography) in 1986. The cover of sessile epibiota was classified into 12 growth forms and 8 trophic guilds, and compared through multivariate analyses. Analysis of growth forms showed that multivariate dispersion in 2004 was significantly lower than in 1986, with a generalized increase of indeterminate sheets. Considering trophic guilds, active filter-feeding were distinctive in both 1986 and 2004, especially with pumping (sponges) and ciliary (either serpulids or bryozoans) strategies; however, the trophic strategies within sites resulted substantially modified in the two periods. Increased structural homogenization and functional readjustment of the cave communities are both suggestive of an ecosystem phase shift in response to a parallel shift in thermal regime.

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FLUXES OF ESSENTIAL FATTY ACIDS, STEROLS AND ALKANOLS TO THE BENTHOS IN A COLD OCEAN COASTAL FOOD WEB DURING THE SPRING DIATOM BLOOM

Lipids were measured in plankton and settling particulate matter during the spring bloom in Conception Bay, Newfoundland to determine the source and quality of material settling from the upper mixed layer. Lipids were also measured in six suprabenthic and benthic invertebrates species from four phyla to determine nutritional content and trophic relationships in response to the sinking bloom. Maximal fluxes occurred at the bloom maximum, and a highly variable 13-73% of individual essential fatty acids survived transit through the water column. Total sterols and alkanols were transferred more efficiently (75-84%). Zooplankton sterols accounted for 40-43% of sterols in plankton and settling matter, while sterols from algae were 50-53%, of which macroalgal sterols accounted for 9-12%. In the benthos, the asteroid, *Ctenodiscus crispatus* had the highest concentrations of essential fatty acids as well as an unusual series of lipids identified by mass spectrometry as saturated diol ethers with carbon numbers ranging from C_{16}-C_{26}. Higher plant sterols were significant contributors to sea cucumber sterols while macroalgae sterols contributed significantly to the sterols of the mysid *Pseudomma truncatum*.

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SIZE STRUCTURED PLANKTON MODELS IN A BAYESIAN HIERARCHICAL FRAMEWORK

The need for improved techniques for model-data comparison and error analysis in marine biogeochemical models is widely accepted. Bayesian hierarchical modelling allows an integrated probabilistic treatment of observation error, process error and prior uncertainty. A key source of approximation and process error in biogeochemical models is the representation of diverse plankton communities by a small number of functional groups. In this paper, we explore the use of plankton size-structure to understand and model the process errors involved in these approximations. Literature meta-analyses combine data from many laboratory experiments to derive allometric relationships between eco-physiological parameters and individual size, but also provide information about inter-species variability. Field observations of biomass size spectra provide information about the structure of plankton communities. We draw on these data sets and previous models of plankton size spectra to formulate simple size-based stochastic models of plankton functional groups, and establish prior distributions for model parameters. Some important information gaps are identified. In particular, species diversity emerges as a key property linking inter-species variability to variance at the level of functional groups.

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EVIDENCE FROM SEDIMENT CORES OF AN ABRUPT CHANGE IN NUTRIENT CYCLING OF LAKE KIVU

Lake Kivu, one of the East African rift lakes, contains enormous amounts of dissolved carbon dioxide and methane. These gases are a tremendous hazard for this densely populated region since their sudden potential release could have catastrophic consequences. The dissolved methane is also a valuable renewable energy source. A recent study indicated that CH4 production has significantly increased in the past three decades. Our sediment core analyses show that a sudden change occurred in the lake's nutrient cycle around 1960. Sedimentation rate and the export fluxes of phosphorus and minerals increased by a factor three, while nitrogen and organic carbon fluxes rose between 10 and 60%. The most striking change is the apparition of calcite, which did not precipitate before 1960. These changes in the nutrient cycling could be due to the fast-growing population in its catchment basin and/or to the introduction of Limnothrissa miodon, the first pelagic and planktivore fish in Lake Kivu. In conclusion, changes in nutrient cycles 40 years ago are probably linked with the observed increase of methane concentration.

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THE EFFECT OF MACROPHYTES ON THE DRIFT PARADOX PROBLEM

Many small aquatic and marine organisms manage to persist in their native environment in spite of constant advection (`drift paradox'). Studies examining how zooplankton behavior can mitigate the effects of primarily unidirectional water flow have usually assumed flow unimpeded by vegetation; however, macrophytes inhabit many freshwater embayments for at least part of the year and can greatly influence water flow. Creating flows in an idealized channel using a three-dimensional hydrodynamic model, and modeling zooplankton behavior with an individual-based model, we explore the extent to which biological processes can counteract physical drivers. In particular, we examine how different zooplankton migration behaviors affect biological retention time under different flow regimes, and whether a combination of physical/biological regimes exists that allows the zooplankton to persist in the study system indefinitely. The hydrodynamic flows involve various configurations of macrophyte patches and exchange of water between embayment and lake caused by temperature differences. Zooplankton behavior includes normal migratory behavior modified by the presence of macrophytes.

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MULTI-PROXY STUDY OF PARTICULATE FLUXES EMBRACING THE 2006 DENSE SHELF WATER CASCADING EVENT IN THE GULF OF LION

As a part of the EC-funded SESAME (Southern European Seas: Assessing and Modelling Ecosystem changes) and HERMES (Hotspot Ecosystem Research on the Margins of European Seas) projects we provide a better understanding of the physical and biogeochemical processes that control canyon and slope ecosystems in the Mediterranean. Eight mooring arrays with sediment traps and current meters were deployed along three transects in the Lacaze-Duthiers (LD) and Cap de Creus (CC) canyons and on the adjacent southern open slope from October 2005 to October 2006. The settling material has been analyzed to obtain total mass, organic carbon, opal, calcium carbonate and siliciclastic fluxes, as well as organic tracers (chloropigments and amino acids) and grain size. Dense Shelf Water Cascading occurred from January to April 2006 as recognized by strong negative near-bottom temperature anomalies and increased current speeds, and resulted in two intense pulses of mass fluxes (up to 90 g m-2d-1) in January and March 2006. This event constitutes the major physical forcing of settling particles at almost all stations, and causes both high intra-annual temporal variability in mass fluxes and important qualitative changes in settling material. Major constituents and organic compound composition of settling particles during and after the occurrence of such event will be discussed to provide a unique picture of the processes controlling the origin and transfer of particulate matter in the study area.

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CONSEQUENCES OF A RECENT FLOOD EVENT ON THE BIOGEOCHEMISTRY OF THE RHÔNE DELTA

Deltas, as part of coastal areas, are usually sensitive areas where the biogeochemistry of sediments is greatly influenced by terrestrial inputs and especially material from rivers. This is particularly true in the sediments of River-dominated Ocean Margins (RiOMar systems). An example is given in the Rhône delta (Mediterranean Sea) where a major flood event has occurred in May-June 2008 affecting the major part of the delta and prodelta sediments. Detailed geochemical analyses of sediments (e.g. reactive Mn and Fe) and porewaters (Mn2+, Fe2+, NO3-, NH4+, ∑PO4, ∑CO2, DOC, SO42-) are reported for sampling stations along a depth gradient in the mouth and the plume of the Rhône River. These parameters were supplemented with microelectrode measurements of O2 and pH as well as benthic fluxes obtained from cores incubations processed under in-situ conditions. A numerical model of early diagenetic processes (OMEXDIA) was used to determine relative contribution of different organic carbon mineralization pathways as well as the oxygen consumption and sediment/water fluxes. This work is supported by the ANR through the project VMC CHACCRA.

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EXPERIMENTAL AND MODELING INVESTIGATIONS OF TH AND PO BINDING TO NATURAL SEDIMENTS UNDER MARINE CONDITIONS

Thorium and polonium are highly particle reactive and often used as particle flux proxies. However, relatively little is known about the processes by which they bind to particles. Natural particles are complex mixtures; therefore, artificial substrates are often used in binding process studies, each mimicking the individual components responsible for binding, e.g. iron oxides, organic matter. We conducted experiments on natural sediments with binding phases selectively removed to evaluate their various roles, then compared these results to predictions made using a surface complexation model (SCAMP). The experimental data produced equilibrium constants (Kd) in the range observed in the marine environment, with some differences as a function of particle concentration, equilibration time and the phases present in the particles. The model under-predicted binding to clay minerals, silica and carbonate in comparison to the experimental results. These inorganic phases play a greater role in scavenging processes than is frequently recognized and SCAMP, in particular, is under-parameterised in this respect. The role of inorganic phases needs to be recognized in coastal studies, where lithogenic material forms a greater proportion of the particle flux.

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TRACE METAL AND NUTRIENT SOLUBILITY IN DUST COLLECTED AT THE CAPE VERDE ATMOSPHERIC OBSERVATORY

Dust deposition to the oceans and the subsequent release of macro and micro-nutrients may exert a major influence on marine biogeochemical cycles. Major challenges associated with assessing this influence include capturing the sporadic nature of dust inputs, and understanding factors which control the solubility of trace metals and nutrients within the dust. To address this, an aerosol collection system has been installed at the Cape Verde Atmospheric Observatory since July 2007. The system draws air simultaneously through four replicate 47 mm filters, which are changed every 48 – 72 hours to create a continuous dataset of dust samples. Total acid digestion and a simple ultra-purified water leaching procedure have been used to investigate the total concentration of metals and nutrients in the dust and their readily soluble fractions, respectively. Results show relatively high atmospheric concentrations of non-sea-salt sulphate and nitrate (20 – 50 nmol m^{-3}), which correlate with mineral dust loading, indicating that Saharan dust sources are mixing with more polluted, possibly European, air masses.

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A MULTI-YEAR COMPARISON OF ECOLOGICAL INDICATORS OF BENTHIC MACROFAUNAL COMMUNITY CONDITION AT A REFERENCE AND EUTROPHIC SITE IN AN ESTUARINE SYSTEM

A set of ecological indicators were compared with regard to how each index captured changes in the state of two intertidal sites in the Mondego estuary over a period of seventeen years (1985-2002). The system conditions experienced a clear deterioration (1990s to 1997), followed by a partial ecological recovery after the application of experimental mitigation measures. A database on intertidal benthic communities was analysed, and macrofauna data were examined via an nMDS ordination. Two questions were addressed: a) Are the selected ecological indicators able to track the changes observed, which took place over the temporal and spatial scales? and b) Are the results obtained comparable? Indices' results were compared with the behavior of other biological descriptors (macroalgae, macrophytes). The Margalef index and the Total Taxonomic Distinctness were well succeed in detecting spatial and temporal differences regarding the two areas, but none of them alone had sufficient discriminating power to allow an accurate system EQS, compliant with the WFD requisites. In terms of management this consideration is crucial and raises a number of challenges.

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VIRUSES IN CORAL REEF SYSTEMS: IMPLICATIONS FOR NUTRIENT CYCLING PROCESSES

Viruses are abundant and ubiquitous across aquatic ecosystems. However, one ecosystem where information regarding viral ecology is limited is in coral reefs. Virus-like particle (VLP) and bacterial abundances were quantified in different coral reef water types, sediments and in micro-habitats within the reef framework, using flow cytometry. Large variations in VLP and bacterial abundances occurred between the different coral reef environments. One apparently important micro-habitat was the coral surface mucus layer (CSM), where elevated VLP abundances co-occurred with elevated bacterial abundances and viral production rates; suggesting a strong viral pressure on coral-associated bacterial communities. The reoccurring theme from this research is that viruses represent abundant members of the coral reef planktonic and benthic microbial community, and that interactions occurring between viruses and corals and/or their associated microbiota, appear to be a consistent feature of coral reef systems. The implications of viral infections in coral reef ecosystems are that viral lysis may alleviate nutrient limitation and contribute to the known high productivity rates that occur in these systems.

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NICE MARINE VIRUSES DON'T LYSE THEIR HOSTS—A TUTORIAL ON LYSOGENY IN THE OCEANS

Silent viral infections are common in nature. In bacteria such infections are termed lysogenic, and are caused by temperate phages. Amongst bacterial isolates, the frequency of occurrence of lysogeny has been reported at between 40 and 60%, with many strains containing multiple prophages (polylysogenic). The occurrence of lysogeny in the oceans is variable, being related to the trophic status and favorability of conditions toward microbial growth. Marine bacterial genomic sequencing has revealed a diversity of prophage genotypes, with some being highly organized while others are cryptic. Certain marine prophage genomes are remarkably similar to known coliphages (P2, lambda, N15, N4, Mu) and bacillus phages (PBSX), showing evolutionary constraint of prophage genomic architecture, even though the hosts are unrelated. When compared to lytic phages, marine temperate phages are characterized by their high abundance of repressors and transcriptional regulators, and absence of nucleotide salvage genes like ribonucleotide reductases, which is commensurate with their symbiotic lifestyle.

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MICROBIAL COMMUNITY STUDIES: BULK ELEMENTAL COMPOSITION MEASURED BY WAVELENGTH DISPERSIVE X-RAY FLUORESCENCE (WDXRF) SPECTROMETRY.

A method based on X-ray fluorescence spectrometry has been developed for measurements of key elements in marine microorganisms. We use a Bruker AXE S4 Pioneer instrument. Our use is outside the general use of XRF instruments and standard samples in not available. We use of GF/F filters, cut off at 0.7 micro m, for light elements (C, N) and e.g. P, S, and Fe. These filters are of matrix types which cause some absorption problems. Using Anodisc filters (Al filters, 0.2 micro m pore size), have a high level of phosphorus but they are relatively good for other biological macro elements. Elemental composition of size fractions are obtained by fractionated filtrations on Polycarbonate filters in series of 10, 5, 1 and 0.2 micro m pore sizes. We use 47 mm filter size and depending on the biomass we harvest particles from 50 ml - 1000 ml. The major challenge with this method is the calibration and the detection level for N due to absorption corrections needed.

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LYSOGENIC VERSUS LYTIC VIRUS LIFE STRATEGIES ARE STRONGLY RELATED TO SEASONAL AND SPATIAL DIFFERENCES IN PRODUCTIVITY IN ARCTIC OCEAN COASTAL WATERS

Despite the importance of viruses in aquatic ecosystems, the controls on lysogenic versus lytic strategies of viral infection are not well characterized. Potentially, the trophic level of the system affects the relative proportion of lysogenic cells. Here we show results from experiments conducted over several months at several locations in coastal Arctic shelf waters that ranged widely in productivity. Highest lytic viral production rates (ranging from 0.4×10^8 to 77×10^8 viruses L^{-1} d^{-1}) occurred in productive stratified waters, where viruses were estimated to lyse up to 26% of the bacterial standing stock per day. In contrast, the highest proportion of lysogens prevailed in well-mixed cold oligotrophic waters, and ranged from 3 to 34% of the bacterial cells. Additionally, lysogeny and viral lytic infection were inversely related. Overall, these results suggest that the relative importance of lysogenic versus lytic viral life strategies vary seasonally and are strongly influenced by the productivity of the system.

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COLONIZATION, LINEAGE SORTING AND PRIORITY EFFECTS IN BACTERIAL COMMUNITIES – AN OUTDOOR MICROCOSM EXPERIMENT

We use experimental microcosms to study the spontaneous colonization and priority-effects of the bacterial community in the aquatic ecosystem. In a first outdoor experiment, three-liter glass bottles were filled with sterilized pond water. Two different starter communities were used to look at the impact of a different inoculum on the development and structure of bacterial communities. We also monitored community assembly in microcosms that were not inoculated so as to monitor the rate of successful colonization. In addition to bacterioplankton we also study the taxon composition of microbial community in biofilms, using PVC slides as a substrate. Taxon diversity and composition in the bacterial communities were analyzed using denaturing gradient gel electrophoresis. Our observations will be presented in a context of metacommunity biology, focusing on patterns of lineage sorting, priority effects and dispersal limitation.

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MOVING IN TURBULENT WATER: AN ANALYTICAL MODEL AND A NUMERICAL TEST

In aquatic environments the encounter rates between small predators and their prey are increased by turbulence. We derive an expression for the flux of prey into the detective sphere of a small self-propelled predator. The model is then tested by a direct comparison of theoretical encounter rates and predictions from a numerical experiment where the Navier-Stokes equation is solved explicitly for a low Reynolds number turbulent flow. This allows us to estimate encounter rates under realistic small-scale flow environments, and to explore the accuracy of a simple theoretical formulation of this process. We find that the analytical model yield surprisingly accurate predictions independently of the assumptions made about the shape of the predator's reactive sphere and turbulence conditions. Two different motion strategies are considered, one with cruising and one with spiralling motions.

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SPATIAL AND SEASONAL VARIATION IN MICROBIAL DIVERSITY IN MARINE SUBTIDAL SEDIMENTS IN RELATION TO SEDIMENT GEOCHEMISTRY AND HEAVY METAL POLLUTION

Very little information is available on the diversity and structure of microbial communities in marine subtidal sediments, especially for micro-eukaryotes. In the framework of the Belgian MICROMET project, we investigated spatial and seasonal (February vs July) variation patterns in the molecular diversity of archaeal, bacterial and eukaryotic communities in 9 subtidal stations in the Belgian Continental Plate (BCP) in relation to sediment granulometry, geochemistry and metal contamination. Microbial diversity was determined using DGGE and clone libraries based on the SSU rDNA gene; metals were determined using DET/DGT. Sediments ranged from sandy and well oxygenated to muddy, anoxic and heavily metal contaminated. Eukaryotic diversity was surprisingly high (20-50 phylotypes per station) and was dominated by Stramenopila (mainly diatoms), Metazoa and Fungi, and to a lesser degree by Protozoa (Alveolata, Cercozoa, Foraminifera). While no clear trends in eukaryotic diversity between stations or seasons were found, community composition showed pronounced differences between sandy and muddy stations; seasonal differences were less marked. Archaeal diversity was very low to non-detectable in all stations. Bacterial diversity was dominated by γ- and γ-Proteobacteria and CFB bacteria; eubacterial diversity was significantly reduced in the muddy sediments.

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THE INTEGRATION AND APPLICATION OF A LOPC ON AN AUTONOMOUS UNDERWATER VEHICLE - A CASE STUDY FROM THE BARENTS SEA.

This presentation reports on a pilot study combining an advanced, autonomous instrument platform (AUV) with a laser based instrument (LOPC) able of making automated sampling of zooplankton size spectra, abundance and hydrographic variables. A test survey was undertaken on the Norwegian shelf-break targeting the diapausing population of meso-zooplankton in the North-Norwegian Sea, and in particular the subsurface 'hot-spots' previously detected in this region. Different sampling strategies were tested, and the performance of the integrated platform was analyzed. The long-term objective of this project is to develop a marine platform, which can be instrumental in ecosystem based management on the lower trophic levels, and be applied on a routinely basis.

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- PLANKTON - A SOURCE OF CARBON MONOXIDE IN THE OCEAN

Carbon monoxide (CO) is produced from the ocean surface and this source, which can have impact on the remote atmospheric chemistry, needs to be better characterized. In the framework of the European project OOMPH, we found in laboratory studies CO production from cultured algae following a daily light-cycle. During a ship campaign on-board the FS Meteor in 2006 (Mauritanian upwelling region) CO was again produced by active growing phytoplankton in decks incubations. The magnitude of this CO production however seemed to be governed by two processes, the incoming light and the species distribution in the water. A group dependant CO production was also found during a campaign on-board the R/V Marion Dufresne in 2007 (Cape Town-Punta Arenas), where during the passage over a phytoplankton bloom (along Argentinean coast) in situ CO levels reached up to 20 nmol L^{-1}, thus 20 times higher than background values and co-varied with the occurrence of pelagophytes. In conclusion beside the previous known light dependant photochemical production of CO a new biological based production of CO needs to be considered in modelling studies.

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ENVIRONMENTAL CHANGES AS A STUMBLING STONE FOR GONYOSTOMUM SEMEN (RAPHIDOPHYCEAE)

The raphidophyte Gonyostomum semen (Ehr.) is a well known bloom forming alga in acid brown water lakes in Northern hemisphere. Due to the water color, these strongly stratified lakes have poor light penetration restricting photosynthesis. Hypolimnetic anoxia through decomposition of organic matter is also common. In the absence of oxygen phosphorus bound in sediments is released to dissolved form and thus, strong nutrient

gradients are frequently found. G. semen seems to be well adapted to these peculiar conditions since it has two flagella enabling active movements, i.e. vertical migrations from the illuminated surface layers to the nutrient rich hypolimnion. The climate change may, however, alter the environmental conditions of brown water lakes. Here we studied the changes in G. semen population in a small humic brown water lake in Finland over a 15 year period. During this period the summertime rainfall as well as the lake DOC concentration increased, the spring meromixis became more frequent and the cell numbers of G. semen decreased. Simultaneously the non-flagellated algal species became more abundant and started to form blooms in the lake.

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DECLINE OF *DREISSENA POLYMORPHA* IN THE DUTCH LAKE MARKERMEER IN RELATION TO FOOD QUALITY AND FLUFFY LAYER DEVELOPMENT

Since 1992 the zebra mussel *Dreissena polymorpha* is strongly declining in lake Markermeer (Netherlands). The current poor condition of the mussels may be attributed to high amounts of inorganic suspended particles and the development of a fluffy layer of sediment on the bottom of the lake due to decreasing salinity. Clearance rates (CR) were determined for adult and juvenile mussels on a green alga with increasing concentrations of inorganic suspended particles. Results show an increase in CR for adult mussels on the alga up to 0.75 g inorganic sediment L^{-1} after which a collapse in CR is seen. For the juvenile mussels, a collapse is observed after 0.5 g inorganic sediment L^{-1}. These results show that zebra mussels can tolerate high levels of inorganic suspended matter and only lower feeding at very high values. Although these concentrations appear extreme, analyses of the vertical profile of suspended matter concentrations show that they frequently occur near the lake bed and may therefore be partly responsible for the decline of the mussel population in Lake Markermeer.

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ASSIMILATION, PROCESSING AND FUSION OF NEARSHORE OPTICAL DATA COLLECTED DURING A NATO CRUISE (LIGURIAN SEA CAL/VAL CRUISE 08- LSCV08)

Rapid environmental assessment in coastal regions requires integration of remotely sensed observations and in situ measurements from a variety of sensors and instruments at varying spatial and temporal scales. Our approach involves glider, satellite and airplane platforms to map out the distribution of bio-optical and physical properties. The analysis is focused on coastal regions that are highly dynamic and complex, because of in-homogeneities, bottom reflectance contamination, and increased atmospheric variability. By combining these measurements one can determine the uncertainties in radiometric data from remote sensed sensors and how this variability affects the retrieval of geophysical products, model results and decision aid reliability. The LSCV-08 cruise will provided a first attempt at determining in situ measurement uncertainties by comparing instrument specific calibrations and measurement protocols in an operational environment. During this sea trial, several ocean color sensors (MODIS, MERIS and CHRIS) will be validated by combining their observations with those measurements retrieved by gliders and in situ instruments (such as HyperPRO-II). An analysis of sensor specifications, radiometric calibrations, algorithms development and measurement uncertainty budgets will be presented and discussed.

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CONTRASTING ABILITY TO TAKE UP LEUCINE AND THYMIDINE AMONG FRESHWATER BACTERIAL GROUPS: IMPLICATIONS FOR BACTERIAL PRODUCTION MEASUREMENTS

We examined the ability of different freshwater bacterial groups to take up leucine and thymidine in two different lakes. Utilization of both substrates by freshwater bacteria was examined at the community level by looking at bulk incorporation rates and at the single-cell level by combining fluorescent in situ hybridization and signal amplification by catalyzed reporter deposition with microautoradiography. Our results showed that leucine was taken up by 70-80% of Bacteria positive cells, whereas only 15-23% of Bacteria positive cells were able to take up thymidine. Between 80-90% of Betaproteobacteria and 67-79% of Actinobacteria were positive for leucine uptake, whereas thymidine was incorporated by <10 % of Betaproteobacteria and by < 1% of the R-BT cells that dominated the Betaproteobacteria. Bacterial abundance was a good predictor of the relative contribution of bacterial groups to leucine incorporation, whereas when thymidine was used Actinobacteria represented the large majority (> 80%) of the cells taking up this substrate. Our results suggest that the use of thymidine to estimate bacterial production in freshwaters might underestimate the cell production of some abundant bacterial phylotypes.

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WHEN CLASSICAL PALEO-PROXIES FAIL IN DOCUMENTING PAST CHANGES IN LAKE TROPHIC STATUS.

Lake Annecy, a large, pre-alpine French lake, has undergone changes in its trophic status for the last century that have been well documented by historical data. The lake, that was originally ultra-oligotrophic, switched to oligo-mesotrophic between the early 1940's and the late 1960's. Restoration measures were taken in 1967 and the lake is now back to its original ultra-oligotrophic status. As a part of a broader paleo-ecological study, we investigated how well classical paleo-proxies for lake trophic status (P concentrations, organic carbon content, abundance of cladocerans remains, $\delta^{13}C$ and $\delta^{15}N$ of the sediment organic matter, photosynthetic pigment concentrations) reflect the eutrophication and re-oligotrophication of Lake Annecy during the last century. The eutrophication phase of Lake Annecy could relatively well be reconstructed by these proxy data. However, surprisingly, most proxies failed in documenting the re-oligotrophication process. Additional data showed that the increasing trophic status caused enhanced anoxic conditions in the sediment from the mid-60's, that could consequently reduce the degradation rate within the sediment. Such processes could hence compromise the reliability of some of the paleo-proxies we employed herein.

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INFLUENCE OF HYDROPHILIC ORGANIC MATTER ON COPPER AND MERCURY SPECIATION AND BIOAVAILABILITY IN URBANIZED RIVER

In aquatic systems, dissolved organic matter (DOM) plays a major role on the biogeochemical cycle of metals. Most studies focus on the interaction between humic substances (the most hydrophobic DOM fraction) and metals. However, because of the difficult isolation of the Hydrophilic DOM (HDOM), very little information is available regarding its composition and influence on metallic speciation, bioavailability and toxicity, particularly in urbanized rivers. In this work, the DOM isolated from upstream and downstream of Paris, as well as the effluents of the Parisian biggest Waste Water Treatment Plant (WWTP), was fractionated according to polarity criteria. Due to WWTP discharges, a strong enrichment in the HDOM fraction was observed downstream of Paris. This hydrophilic fraction presented stronger binding capacities for copper and mercury than (i) hydrophobic fraction from less urbanized site (upstream from Paris) and (ii) Suwannee river fulvic acid from IHSS. This feature was strongly correlated to the higher contents of organic N and S groups. Although, biotests highlighted a significant copper bioavailability decrease in presence of HDOM, the free ion activity model.hardly explained this bioavailability.

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DETECTION OF NODULARIN IN EUROPEAN FLOUNDER (*PLATICHTHYS FLESUS*) IN THE WEST COAST OF SWEDEN; EVIDENCE OF NODULARIN MEDIATED OXIDATIVE STRESS

Drifting algal mats, deep-water hypoxia, turbidity and cyanobacterial blooms are typical symptoms of eutrophication in the Baltic Sea. In coastal areas, algal blooms can cause excessive daily fluctuations in pH, dissolved oxygen and toxin release, which can stress or directly eliminate sensitive species, such as benthic fauna. Shallow water marine habitats are productive areas which act as nurseries for many coastal fish species. The brackish, bloom-forming cyanobacterium *Nodularia spumigena* produces a peptide called nodularin, which may induce liver damage in fish. In the summer of 2007, nodularin was detected in liver tissue of European flounder caught in Swedish waters of Öresund. Results suggested that nodularin accumulated in flounder livers during the summer of 2006, when vast *N. spumigena* blooms were observed in Öresund, and persisted over several months. In an intraperitoneal injection experiment, nodularin was shown to induce reversible oxidative stress in flounder liver in terms of decreased glutathione-S-transferase (GST) catalase (CAT) activity. Alteration of the enzymatic defense system may increase energetic costs, thus reducing fish growth and survival in shallow areas and potentially influencing the recruitment of coastal fish.

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FISH FARM IMPACTS ON *POSIDONIA OCEANICA* MEADOWS: INTEREST OF THE MICROBENTHIC LOOP

Posidonia oceanica, the seagrass endemic to the Mediterranean Sea, is a valuable tool to assess the environmental quality in coastal zones. However, only few studies have attempted to use characteristics of its sediment compartment as an indicator of environmental perturbations. In this study, the impact of a fish farm on the microbenthic loop (organic matter, bacteria, microphytobenthos and meiofauna) of *P. oceanica* meadows will be described. Samples were taken under an aquaculture situated in Calvi Bay (Corsica, France) at a depth of 22 m, in March and June 2008. The control site was the meadow situated in front of the research station STARESO (Calvi Bay, Corsica, France), sampled at the same periods and depth. Results concerning bacteria, microphytobenthos and organic matter will be presented here. For both seasons, differences between sites exist. For example, biomasses of organic matter, microphytobenthos and bacteria are higher in the fish farm than in the control site, indicating that the microbenthic loop has potential to be a good early indicator of pollution in this sea.

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ESSENTIAL ELEMENTS IN RIVER RESTORATION PROJECTS - LESSONS LEARNED FROM THE TRANSDISCIPLINARY "RHONE-THUR" PROJECT IN SWITZERLAND

From 2002-2007 we carried out a comprehensive river restoration project. The transdisciplinary project "Rhone-Thur" aimed at intensifying the cooperation between science and practice in river restoration projects. In Switzerland there is a big need for river restoration actions and considerable amount of money will be invested in future for the restoration of aquatic systems. In order to carry out successful projects the following 10 elements have to be considered: - inclusion of a reference system /guiding image - carrying out of a baseline monitoring - using synergies with flood protection - definition of clear project objectives - considering the project scale and priorities at a catchment perspective - specifying the ecological improvements - evaluating the planned restoration measures including alternatives - decision making and involving of interest groups (socio-economic approach)
- predicting the outcome of restoration - evaluation of the success and the outcome, communication Although all mentioned elements are important, the involvement of stakeholders and the success evaluation need special attention and will be a main focus in the presentation of case studies.

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MICROBIAL DIVERSITY AND ECOSYSTEM FUNCTIONING – IDIOSYNCRATIC RESPONSES IN AQUATIC BACTERIA

We examined functional redundancy in bacteria by investigating how function was lost or retained along with the loss of species richness caused by dilution-to-extinction of natural bacterioplankton inoculated into sterilized lake water. Serial dilution resulted in inoculum sizes ranging from 10E+5 to 0.1 cells. The cultures were allowed to grow until stationary phase and abundance, biomass, chitin-, and cellulose degradation activity were measured. This approach resulted in a gradient of bacterial diversity, as shown by T-RFLP of the 16S rRNA gene. We found a significant positive correlation between inoculum size and biomass as well as steady-state abundance, whereas growth rate, chitinase and cellulase activity were not related to inoculum size. Our findings contradict the idea that redundancy is high for general functions (growth) but low for specific functions (specific enzyme activities). In contrast, in particular regarding specific functions, we found support for the idiosyncratic response hypothesis, which states that the magnitude and direction of change is unpredictable, as each species contributes to an unknown extent to the overall ecosystem function.

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MECHANICAL ENERGY AND NUTRIENT LOAD AS DRIVERS OF COASTAL ECOSYSTEM PRODUCTION

Nutrient load and mechanical energy are main driving forces determining the structure and function of coastal ecosystems. In general, turbulent mixing introduces nutrients into the system and enhances primary production. There are numerous empirical studies and field surveys that support existing conceptual models of plankton dynamics as a function of nutrient load and mechanical energy. However, the spatio-temporal variability of the forcing drivers and the non-linear interactions both with each other and with the history of system state, make actual predictions difficult. In addition, nutrient load in coastal areas may be uncoupled from mechanical energy, usually producing system disfunctions that have to be taken into account, especially in highly humanized environments. We will show examples of coastal ecosystem dynamics as driven by the forcing variables and discuss pathways to increase our prediction power of system functioning and production.

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PLANKTON DYNAMICS IN AND AROUND A MUSSEL CULTURE UNIT

Plankton composition was studied in and around a long-line culture unit of blue mussels in Ría de Vigo, NW Spain. Hydrodynamic were assessed using a current meter, ADV probes and through a 3D numerical model of flow. Phytoplankton was measured as fluorescence profiles and size fractionated chlorophyll a on different scales from centimetres from the mussels to tens of metres from the culture unit. Zooplankton was collected in and around the unit. Flow speeds were reduced across the raft, but significant flow velocities could still be observed inside the raft. The hydrodynamic modelling showed flow separation around and below the culture unit. Increased turbulence at the corners facing the flow was both observed and evident from the modelling and could also be seen from the fluorescence measurements and chlorophyll near mussel profiles. We observed significant reduction in plankton concentrations through the culture unit, but the level of reduction was dependent on plankton size, behaviour and current velocity. Mussel retention spectre, presence of epibenthic passive suspension-feeders and zooplankton escape behaviour can explain the observed patterns.

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REGIONAL EXTINCTION OF THE CLADOCERAN *DAPHNIA LACUSTRIS* REVEALED BY PALEOGENETIC ANALYSIS OF THE RESTING EGG BANK

Zooplankton composition in European mountain lakes has often been substantially altered by anthropogenic acidification, eutrophication or introduction of previously absent fish species. This may have resulted in extinction of genetically unique locally adapted populations of various taxa. The water flea *Daphnia lacustris* Sars is a boreal faunistic element, presently known outside Fennoscandia from two Central European lakes only. Based on the historical literature, we tested the hypothesis that this species had been present 100 years ago in a glacial lake in the Bohemian Forest (Czech Republic), over 400 km from its nearest known locality. Paleogenetic analysis of subfossil resting eggs from the lake sediment allowed us to reconstruct the taxonomic composition of local *Daphnia* before the major environmental change in the 20th century; we indeed proved the coexistence of *D. lacustris* with another species of the genus. Analysis of zooplankton composition in other suitable localities in the same mountain range showed, however, that this taxon has become since then regionally extinct. This study accentuates the importance of mountain lakes as refuges of rare species with substantial conservation value.

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TROPHIC INTERACTIONS AND ENERGY FLOW WITHIN THE PELAGIC ECOSYSTEM IN THE ICELAND SEA

A trophic study was performed in August 2007 on the pelagic ecosystem in the sub-arctic Iceland Sea, north of Iceland, using carbon and nitrogen stable isotopes and fatty acid biomarkers. Stable isotope values and fatty acid profiles reflect dietary assimilation over longer time periods than the traditional stomach content analyses which can be biased as soft prey or prey with easily digested hard parts can be underestimated. The aim was to study trophic linkages and positions of the most important pelagic species in this ecosystem with special emphasis on the trophic ecology of capelin. Particulate organic matter was collected to be used as a sample of trophic level one. In addition, four species of copepods were sampled, three species of euphausiids, three species of amphipods, one of chaetognaths as well as several fish species. Multivariate statistical methods were performed on fatty acid compositional data making it possible to detect relationships and patterns in the data. This study is a part of an extensive ongoing ecological study in the Iceland Sea, lasting from 2006-2010.

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VERTICAL PATTERNS IN THE MICROBIAL COMMUNITIES OF BOREAL HUMIC LAKES

Strong vertical environmental gradients of light, temperature, oxygen and nutrients are characteristic of stratified water columns, and especially of steeply stratified humic lakes in the boreal region. Corresponding variations in their microbial communities might be expected. However, studies of aquatic microbial communities have traditionally been made from composite samples from throughout the water column and attention has mainly been paid to the upper layers. As part of a project to study the impacts of increased DOC loading on plankton communities and lake metabolism, we sampled two humic lakes in southern Finland in August 2008. Samples were taken every 0.5 m for analysis with molecular biology methods (LH-PCR, qPCR and sequencing) to evaluate the vertical variation and distribution of the microbial communities. Since we are particularly interested in those species participating in methane cycling, samples for analysis of methane concentration and methane carbon stable isotope values were also collected. Our aim is to link the species and their depth distributions to the different processes of methane production and consumption.

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ROLE OF VERTICALLY MIGRATING MYSIS RELICTA IN UPTAKE OF CONTAMINANTS FROM SEDIMENTS AND PREY IN LAKE MJØSA (NORWAY)

In Lake Mjøsa numerous environmental contaminants have been detected in relatively high concentrations, many of which can pose a serious threat to human health. Particularly mercury and persistent organic pollutants such as brominated flame retardants are contaminants of major concern, as they were found in alarming concentrations in lake sediments and sport fish caught in the lake. Mysis relicta is an omnivorous crustacean, and a key component of Lake Mjøsa food web, linking benthic and pelagic food webs by vertical migration. In this study two stations on Lake Mjøsa were compared, one in a shallow part of the lake and one in a deep part. Concentrations of several contaminants were higher in Mysis from the shallow station and, ratios between contaminants concentrations in Mysis and zooplankton were in the shallow station higher than at the deep one. Therefore, it is obvious that Mysis must have had at the shallow station additional food source besides zooplankton (sediments or benthos). Echosounding showed that Mysis migrate down to sediments in the shallow station, whereas in the deep station Mysis stay in the pelagial.

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PERMANENT OBSERVATORIES: OBSERVING FROM SMALL-SCALE TURBULENCE TO LARGE-SCALE PATTERNS

Hydrodynamics plays a primary role in aquatic ecosystems, affecting processes across a wide range of temporal and spatial scales. The understanding of any biological-physical interaction requires the characterization of the environmental changes derived from the transport mechanisms and the response of organisms to these changes. New ocean technologies are being effectively used to improve ocean sampling deficiencies using inter- disciplinary, multiplatform sampling strategies. In the last years, several initiatives around the world, such as NEPTUNE in Canada and USA or ESONET in Europe, has promoted the installation of large scale underwater networks to increase the variety and numbers of sampled variables and thus to fill in the gaps of the time-space continuum of interdisciplinary ocean observations . The present contribution, which is directed toward both modelers and observationalists, reviews emerging interdisciplinary observational capabilities and their optimal utilization, and particularly address the benefits of permanent observatories to multiescale characterization of the different processes that are taking place in the ocean.

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THERMAL STRESS ON TWO MEDITERRANEAN GORGONIANS: *EUNICELLA SINGULARI* AND *EUNICELLA CAVOLINII*. CONSEQUENCES OF THE SYMBIOSIS ON HEAT STRESS RESISTANCE.

Global climate change has deep impacts on many tempered marine invertebrates. Both 1999 and 2003 summers coincided with massive death of Mediterranean gorgonians, such as the symbiotic *Eunicella singulari*, and the nonsymbiotic *Eunicella cavolinii*. This work aimed to study the effects of strong and short hyperthermia on these two *Eunicella* species. Several biological and oxidative stress markers were analyzed to compare their respective responses and to test whether zooxanthellae endosymbiosis offers higher resistance or sensitivity to thermal stress. Increasing seawater temperature from 18°C (control) to 29°C (intense short-term hyperthermia) provoked fast tissue necrosis in both species, but with a 2-day delay for the symbiotic one, which did not presented any bleaching induction. This work, which first validates the use of several stress biomarkers on these temperate gorgonians, also pointed out high inter-individual variabilities. Although *E.cavolinii* had high antioxidative basal defense level, heat stress induced significant protein ubiquitination. On the other hand, *E. singularis* had reduced anti-oxidative basal defense level, albeit showed more plastic response, which can partly explain their better tolerance to hyperthermia.

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FORAY FORAGING BEHAVIOR OF COPEPODS: AN EMPIRICAL AND NUMERICAL STUDY

Observations of nighttime copepod vertical distribution has shown maximum abundance can occur below the depth of the chlorophyll maximum, yet copepods found in the deep water have guts filled with food items common in the shallower chlorophyll maximum layer. We hypothesized that copepods make repeated forays of less than ten meters between the food-rich surface layers and the deeper layer throughout the night. To test this, we developed "traps" to capture zooplankton as they migrated across a given horizon, and compared field data collected with these traps to numerical simulations of zooplankton migrations using hypothesized behaviors. Our results indicate that foray foraging behavior occurs in at least two species of copepods, *Calanus pacificus* and *Metridia pacifica*, but the patterns differ between species and with environmental conditions, with more distinct forays occurring when food stocks are lower. Model simulations show that foray behavior incurs both a survival advantage to those copepods that use it, and may increase active nutrient flux between surface and deep waters by copepods respiring and metabolizing in deeper water.

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GENOMIC INSIGHTS INTO THE LIFECYCLE AND BIOLOGY OF PICOPLANKTONIC EUKARYOTES : THE OSTREOCOCCUS TAURI (PRASINOPHYCEAE, CHLOROPHYTA) POINT OF VIEW.

Most planktonic eucaryotes are difficult to cultivate so that sequence data may provide the only means for studying their biology in the broad sense : i.e. reproduction, physiology and ecology. O. tauri belongs to the few picoplanktonic species that are easily cultured, and thus provides a good model for testing in silico predictions. The genome sequence of 3 strains of Ostreococcus spp. isolated from different ecological niches (coastal, oceanic and deepwater) has been completed and offers insights into the genomic basis of their niche specialisations. We made full use of the evolutionary genomics sequence analysis toolkit to screen both the proteome[1] and the intergenic sequences[2, 3] of these genomes. Genomic analyses revealed that fast evolving membrane proteins are important in the evolution of these species, whereas phylogenetic footprinting of the intergenic regions reveals the cis-regulatory element structure of these organisms. The output of these screens was further used to design neutral markers as tools for unravelling the genetic diversity of these organisms and the frequency of sexual reproduction of O. tauri in the Gulf of Lion[4]. [1.] Jancek,S., et al. Mol Biol Evol in press (2008). [2.]Piganeau,G. & Moreau,H. Gene 406, 184-190 (2007). [3.]Piganeau,G., et al. Unravelling cis-regulatory element structure in Ostreococcus. submitted. [4.]Grimsley,N., et al. Cryptic sex in the smallest photosynthetic eukaryote. submitted.

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PHYLOGENY AND PHYLOGEOGRAPHY OF INVASIVE ASIATIC CLAMS (*CORBICULA* SPP.) IN THE MEUSE

Asiatic clams (*Corbicula* spp.) are famous aquatic invaders in American and European rivers. The aim of our study is to identify the species of Corbicula present in the Meuse River on basis of existing molecular data from other rivers and to understand the genetic structure of populations. The first step was a sampling campaign in the whole Meuse River and a study of the mitochondrial COI gene sequences. Two morphotypes were found and associated to two main COI lineages. As some of those clams reproduce through androgenesis (asexual male reproduction) we also study nuclear genetic markers. Hypervariable markers such as microsatellites are used to study genetic diversity within populations. A (GA)n and (GT)n microsatellite-enriched library was constructed. This will allow applying our research to more rivers across Europe in order to understand colonization roads.

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EUTROPHICATION INDUCED SHIFTS IN COASTAL HABITATS AND RELATED CHANGES IN FAUNA STRUCTURE AND FUNCTION

Increased levels of nutrient discharges may favor the development of fast growing filamentous green algal mats in the shallow coastal zone. Algal mats can cover barren sediments or perennial vegetation as seagrass, and alter the habitat structure in these systems. This presentation review effects of such changes of coastal habitats on the structure and function of associated fauna (infauna, epibenthic fauna and fish) in a coastal region of the Skagerrak in Sweden. Coastal surveys and field experiments were carried out over several years covering different geographic scales. The results showed an immediate faunal response to the altered habitats manifested as shifts in functional groups (infauna) or species dominance (epibenthic fauna; fish), and consequently a shift towards an alternative functioning of the systems. As an example of such functional shift of the coastal habitats, a considerable reduction in the recruitment of two commercial important fish species was observed, and models predicted significant economic losses for the fishery.

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WHAT BACTERIA LEAVE BEHIND: BACTERIAL ORGANIC MATTER QUALITY AND BIOMARKER SIGNALS

Knowledge of the cellular content of bacterial biomarkers (D-amino acids and muramic acid) provides us with a powerful tool to trace production and fate of bacterially derived organic matter. The biochemical composition of prokaryotic cells was studied by re-growing a mixed community of native sediment bacteria in anoxic sediment pore water. Cellular concentrations of L- and D-amino acids and amino sugars were determined by high performance liquid chromatography (HPLC). The proportion of *Archaea*, Gram positive and Gram negative *Bacteria* in the prokaryotic community were determined using catalyzed reporter deposition fluorescent in situ hybridization (CARD-FISH). The results showed that the L-amino acid composition of native sediment prokaryotes was similar to that of other organic matter sources. It is generally assumed that benthic prokaryotic communities are dominated by Gram negatives, although there is a lack of data supporting this assumption. This study provides insight into the biogeochemical makeup of mixed communities of sediment prokaryotes and evaluates the significance of Gram positives, Gram negatives and *Archaea*, in relation to prokaryotic contribution to sediment organic matter pools.

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THE ROLE OF WIND IN THE GENERATION OF MULTISCALE PATTERNS OF PLANKTON HETEROGENEITY: IMPLICATIONS FOR ECOSYSTEM FUNCTION

Wind-induced circulation governs water temperature and stability and the formation of water masses in freshwater systems. Environmental heterogeneity due to vertical and horizontal structuring of lakes and rivers is reflected in the distribution of plankton food web components (bacteria, phytoplankton, and zooplankton). Wind physical forcing constitutes the first step of a hierarchy of abiotic (temperature gradient, nutrient fluxes) and biotic (microbial biological coupling) processes which are the proximal forces driving plankton patchiness. However, the relative importance of physical and biological processes for driving plankton food web distribution varies with scale. We present a review on the relative role of wind in structuring plankton patchiness with a multiscale perspective. The focus will on timescales over which physical drivers like wind contribute to the onset and the persistence of patches both vertically and horizontally. The importance of the application of new and advanced technology to assess physical forcing of plankton patchiness at the same time and space scales is also discussed.

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SPACIAL VARIATION IN DOC CONCENTRATIONS PROVIDING WIDE RANGE IN TROPICAL LAKES

Dissolved organic carbon (DOC) is a key property of aquatic ecosystems affecting the functioning of lake ecosystems, although most of the research derives from boreal or north-temperate lakes. Here, we present a survey of dissolved organic carbon (DOC) concentrations in lakes broadly distributed at low latitudes (between 0 and 30°) from different Brazilian Biomes, including Amazon, Pantanal and Atlantic System (Tropical and Subtropical Coast and Atlantic Forest). The data set was derived from literature compilation (N=24) and our own field surveys (N=112). A large variation in DOC concentrations was observed among tropical Biomes. Amazonian (N=17) and Atlantic Forest (N=19) lakes showed a median of DOC around 4,0 mg L^{-1}, five times lower than Pantanal (N=32) or Tropical Coastal Lakes (N=38). Subtropical Coastal Lakes showed intermediate values of 5,4 mg L^{-1} (N=29). The range of DOC concentrations for Brazilian lakes was higher than observed in previous global data sets, revealing a huge variability and data gap in the current literature for tropical lakes.

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THE SIGNIFICANCE OF BACTERIAL POLYSACCHARIDE DEGRADATION FOR CARBON EXPORT, TODAY AND IN THE FUTURE OCEAN

Bacterial degradation activity strongly controls the export flux of organic matter in the ocean. Bioreactive compounds like polysaccharides are preferentially consumed by marine bacteria, since they provide an excellent yield of carbon and energy for heterotrophic metabolism. Included in sinking particles, polysaccharides contribute substantially to the export of organic carbon, and impact sinking processes through the enhancement of marine snow formation. However, there are still few studies describing the fluxes of polysaccharide-derived carbon to marine heterotrophic bacterioplankton. Here, we stepwise pursue the pathway of bacterial polysaccharide degradation, presenting data on extracellular glucosidase activity, glucose uptake rates, and bacterial biomass production, as well as related impacts on polysaccharide concentration and composition from field and laboratory experiments. Since ocean acidification is currently shown to be a profound perturbation of marine systems, affecting processes in biogeochemical cycles, experimental simulations were an integral aspect of our studies. Results are included to discuss the importance of bacterial polysaccharide degradation for the efficiency of carbon export, the diagenetic alteration of sinking particles, and the properties of extracellular polymeric substances today and in the future ocean.

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INFLUENCE OF MACROFAUNAL BIOTURBATION ON THE BENTHIC MICROBIAL COMMUNITY STRUCTURE

A macrofaunal structure exhibits unique biogeochemical properties. Compared with microbes which are present at the sediment surface or in the sub-oxic/anoxic surrounding sediment, microbes within the burrow wall are subjected to very different and variable environmental conditions. For instance, they have to accommodate with (1) redox oscillations induced by the structure ventilation, (2) the presence of a mucus layer which represents labile organic matter, and/or (3) grazing activity of the burrow inhabitant or the associated meiofauna. It is now well established that bioturbation influences composition, biomass, productivity and activity of microbial communities within the sediments. On the other hand, relatively few reports deal with the effect bioturbation on the structure of bacterial communities. Based on *in situ* sampling of burrow, surface and ambient sediments (n = 15 for each), this preliminary work used the RISA fingerprinting approach, combined with a phylogenetic approach (cloning and sequencing of 200 clones per sediment group) to characterize the structure of bacterial communities of coastal sediments (Gulf of Fos, Mediterranean sea) bioturbated by the polychaete *Nereis diversicolor*.

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PLANKTONIC CILIATES: DISTRIBUTION, DIVERSITY AND FUNCTIONAL ROLE IN THE MEDITERRANEAN ECOSYSTEM

Planktonic ciliates are unicellular organisms (protozoa), capable of a quick response in case of excess food supply because they may double their populations within hours. In oligotrophic environments such as the Mediterranean Sea, phytoplankton is dominated by the pico- and nano- fractions and ciliates are the main grazers since copepods are unable to crop these size classes efficiently. Since it is known that ciliates are the link between the microbial and the classical food web, it is reasonable to expect that they play a key role in transferring nutrients up the food web when nutrients are discharged in oligotrophic environments. In the present study we have reviewed more than 150 scientific papers from the Mediterranean dealing with different aspects of ecology, distribution and ecological response of planktonic ciliates to different types of physical and anthropogenic forcing aiming at providing a synthesis of available information and elucidating their role in the world's most oligotrophic large marine water body.

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DIVERSITY AND SEASONAL POPULATION DYNAMICS OF HETEROTROPHIC FLAGELLATES FROM THE GULF OF GDANSK AND DURING SPRING AND SUMMER 2007

Bacterivorous nanoflagellates are an important link between the microbial loop and the herbivorous food chain. They are typically treated as a single functional unit in ecological studies because most species lack morphological features that allow for reliable microscopic discrimination. In order to investigate the diversity of bacterivorous flagellates in the Gulf of Gdańsk (Baltic Sea), we analyzed 18S rRNA gene sequences in clone libraries of environmental DNA collected in spring and summer 2007. In spring most sequences belonged to uncultured alveolates and stramenopiles, while in summer to uncultured cercozoans and haptophytes. Based on these results, we designed DNA-probes to investigate temporal changes of 5 flagellate populations by fluorescence in situ hybridization in samples collected weekly from 04.04. to 03.10. 2007. Alveolates and stramanopiles were most numerous in spring, and in most cases were absent in summer. In contrast, cercozoans were more abundant in summer than in spring. Investigated populations formed short-live blooms and were much more dynamic compared to total nanoflagellates.

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GLOBAL FORCING IS THE MAIN DRIVER OF PHYTOPLANKTON TEMPORAL VARIABILITY IN REMOTE LAKES

There is increasing evidence of on-going changes in phytoplankton communities in Northern Hemisphere lakes without local antropic influence. Here, we show that global forcing is the main latent factor driving recent phytoplankton variability in two remote lakes with contrasting lake and catchment features, and situated in two distinct climate regimes. Up to 85% of the phytoplankton variability assessed by principal component analysis of chrysophyte cyst records is explained by fluctuations in global forcing. Other climatic indicators with higher regional character, such as North Atlantic Oscillation indexes, only account for a maximum of 36%. Locally, these climatic latent factors show up as distinct combinations of climatic variables and differ between sites. However, variables indicating global forcing have more explicative power than any local climate variable by it-self. Our results indicate that lake phytoplankton response to global change in remote sites may be synchronized globally and that, although the specific features may locally vary, global forcing is the main driver of phytoplankton interannual variability in areas without local human disturbances.

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234TH AND POC FLUXES ALONG A TRANSECT FROM CAPE BASIN TO THE NORTHERN WEDDELL GYRE (BONUS-GOODHOPE)

We assessed POC export along a transect from the subtropical domain (40°S) till the eastern extension of the Weddell Gyre (58°S), crossing the Subtropical Front, the Subantarctic Front, the Polar Front, the Southern ACC Front and the Southern ACC Boundary. Total 234Th was recovered from 4L 230Th-spiked seawater and its activity measured on board, together with the activity of size-fractionated suspended matter (1< <51µm; >51 µm). 234Th fluxes are transformed into POC fluxes using suspended matter 234Th/POC ratios. The 1< <51µm fraction had 10x higher activity than the >51µm fraction, with activities of both strongly decreasing with depth. Strongest 234Th-deficits occur in Cape Basin subsurface waters (80 to 100m) north of the Subtropical Front. Between the SAF and the Southern Boundary also significant 234Th-depletions appear, confined to the upper mixed layer. The density gradient marking the bottom of the mixed layer marks the transition to less 234Th-depleted waters. Sites with enhanced surface waters fluorescence (PFZ; Weddell Gyre) were slightly less depleted suggesting local phytoplankton blooms keep the 234Th activity within the surface. POC fluxes will be compared with mesopelagic remineralisation.

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MERIDIONAL VARIATION IN THE PHENOLOGY OF MARINE PHYTOPLANKTON BLOOMS

In one of his textbooks, David Cushing wrote on meridional variation in the seasonal cycles of phytoplankton, and sketched their stereotypic characteristics, notably a change from one major bloom per year at high latitudes to two major blooms per year in mid-latitudes. We have explored simple models that account for such changes, and we have evaluated the results in the context of time series for chlorophyll concentration constructed from remotely-sensed data on ocean colour. The analysis has revealed unexpected properties of phytoplankton seasonality.

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COPPER COMPLEXING CAPACITY IN KRKA RIVER ESTUARY, EASTERN ADRIATIC, CROATIA

The copper complexing capacities (CuCC), were measured in the Krka river estuary. Krka river estuary is a carstic, salt wedge estuary situated on the Eastern coast of middle Adriatic area. The measurements have been done on the sampling stations along the estuary on different depths, i.e. in salt and fresh water layer.The measurements were done with electrochemical method of differential pulse anodic stripping voltammetry (DPASV). It has been found that the copper complexing capacity of the fresh water layer is several times higher (from 100 up to 270 nM) than of the saline layer beneath it (from 10 up to 130 nM). The average result for CuCC measured in 2008, of 103 nM is not different from the average value measured by the same technique 25 years ago (the average value of all measurements in 80-ties is 105 nM). The speciation modelling have shown that more than 99% of copper is present as organic complexes while free (hydrated) copper ion concentration is below the toxicity threshold of 10 -11 M, although in some situations total free (hydrated) + inorganically complexed copper could be above this threshold level.

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BALLAST MINERALS, SINKING VELOCITY, AND APPARENT DIFFUSIVITY IN ORGANIC AGGREGATES: IMPLICATIONS FOR HYDROLYSIS AND RESPIRATION BY ATTACHED BACTERIA

Empirical measurements of apparent diffusivity, oxygen uptake, and sinking velocities of different sources of marine macroscopic organic aggregates are presented. Apparent diffusivity and oxygen uptake were measured directly within aggregates using microsensor techniques. Averaged values of apparent diffusivity of gases within marine snow were 0.95 times that of the free diffusion coefficient in sea water. Porosities were > 0. 96. Carbon-specific respiration rates were relatively similar within organic aggregates (0.08 to 0.21 d-1) irrespective of biogenic ballast material content. This observation may largely be explained by high hydrolysis rates combined with high apparent diffusivities of solutes and oxygen supply for respiration, which support an efficient turnover of labile carbon across different particle sources and sizes in the ocean. Ballast minerals increases sinking velocity and, thus, also potential O2-fluxes to sedimenting aggregates. Hence, ballast minerals limit the residence time of aggregates in the water column by increasing sinking velocity, but apparent diffusivity and potential oxygen supply within aggregates are high whereby a large fraction of labile organic carbon can be respired during sedimentation.

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3D MODELING OF INFLUENCE OF OXYGENATED INFLOWS ON BIOGEOCHEMICAL STRUCTURE OF MEROMICTIC FJORDS

Certain fjord systems are characterized with meromictic structure when a sill restricts renewal of deep water. This leads to formation of anoxic conditions in bottom layer. Renewal of bottom waters occurs during winter time when density of inflowing water exceeds the one of basin water. Water renewal, partial or complete, can take place every year (Bunnefjord), once per several years (Drammensfjord) or once per several decades (Framvaren). Inflow events change biogeochemical structure either in appearance of oxic conditions for a long period, or in small scale violations leading to oxidation of metal sulfides and formation of metal oxides. To study these events we used a coupled hydrophysical-biogeochemical model. Biogeochemical processes were described with O-N-S-P-Mn-Fe ROLM model (Yakushev et al, 2007), designed to study processes of organic matter (OM) formation and decay, reduction and oxidation of species of nitrogen, sulphur, manganese and iron, transformation of phosphorus species. Phytoplankton, zooplankton and bacteria were also parameterized and divided into four groups according to their relation to particular energy source and to OM transformation. Hydrophysical processes where described with 3D General Estuarine Transport Model (Burchard et al, 2004).

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THRESHOLD VALUES IN THE ECOLOGICAL ASSESSMENT OF SURFACE WATERS UNDER EU WATER FRAMEWORK DIRECTIVE

A novel approach how ecological thresholds were used in development and harmonisation of the ecological classification systems required by the European Commission Water Framework Directive (EC 2000) is presented. Methodology for establishing of reference conditions and ecological target values was developed based on ecosystem approach and threshold concept (EC 2003). Dose - response relationships were developed between gradient of impact (e.g., eutrophication and acidification) and biological communities (e.g., taxonomic composition of phytoplankton and macrophytes, colonization depth and abundance of macrophytes, benthic fauna multimetric indices), using large-scale pan-European datasets. In several cases non-linear responses were observed, exhibiting clear discontinuities caused by ecological regime shifts. The threshold values were used for setting ecological status class boundaries. For instance, the threshold of phytoplankton biomass increase was found in shallow calcareous lakes where abundance of macrophytes decreases sharply, indicating shift from macrophyte-dominated to phytoplankton-dominated state – the chlorophyll-a value at this threshold indicates good-moderate class boundary. Ecological classification boundaries were included in the EU legislation, marking the first attempt in international water policy to move from physico-chemical quality standards to ecological quality targets.

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EXPLORING BENTHO-PELAGIC COUPLING ALONG THE CONTINENTAL SHELF OF THE WESTERN ANTARCTIC PENINSULA USING THE RADIOGENIC TRACER, ^{234}TH: INITIAL RESULTS

As part of the ongoing FOODBANCS2 (FOOD for Benthos on the ANtarctic Continental Shelf) project, we present initial results from two recent field cruises (February and July, 2008) during which the seasonal and interannual variability in bentho-pelagic coupling along the continental shelf of the Western Antarctic Peninsula was examined. Surface sediment (0-7 cm) inventories of the particle reactive radiogenic tracer, ^{234}Th were calculated at 5 stations along a NE-SW transect from 63 ° S to 68 ° S. Initial water column ^{234}Th fluxes were calculated at two endmember stations along the aforementioned transect. Bioturbation intensities (D_b) were estimated using ^{234}Th distributions in the sediment column during the austral summer and winter cruises. In addition, gut sediments of selected benthic detritivores were analyzed for ^{234}Th to explore seasonal feeding strategies. These data will be contrasted with similar data collected during the first FOODBANCS project (5 cruises between December 1999 - March 2001). Our previous results, along with data collected during the third FOODBANCS2 cruise (February 2009), will be examined to provide insight into the effects of changes in climate and ice coverage on high-latitude benthic ecosystems.

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A SYNERGISTIC APPROACH TO STUDY ENVIRONMENTAL CONTROL OF N_2O EMISSION FROM AQUATIC INVERTEBRATES

Filter- and deposit-feeding aquatic invertebrates have recently been found to emit the greenhouse gas N_2O, which is formed in their anoxic gut by ingested bacteria carrying out incomplete denitrification. Due to their high natural abundances, these animals have the potential to significantly enhance N_2O emission from aquatic ecosystems. It is, however, unclear as to what extent do environmental factors control the N_2O emission rate. We combined in situ experiments and numerical simulations to elucidate the effects of temperature and nitrate availability on the N_2O release by *Chironomus plumosus*, a widely distributed, sediment-dwelling freshwater midge. Imaging of oxygen by planar optodes and of a dispersed fluorescent dye was applied to characterize the burrow ventilation dynamics (pumping and resting intervals, water flow inside the burrow). Microsensors were used to quantify the sedimentary oxygen and nitrate consumption rates. Availability of oxygen and nitrate inside the burrow, which are the key factors affecting the ventilation behavior of and the N_2O release by the larvae, respectively, were then derived by numerical simulations employing a coupled reaction-transport model and the experimentally determined parameters.

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PLANCTOMYCETE DIVERSITY IN TWO SUB-ALPINE LAKES OF DIFFERENT TROPHIC STATUS

The Planctomycetes (i.e. members of the order Planctomycetales) form a distinctive division of the domain Bacteria. Thanks to recent advances in molecular techniques our knowledge of the diversity of Planctomycetes has considerably increased during the last decade, and members of this bacterial group are now recognized as being ubiquitous in the environment. However, most of this knowledge is from soils, sediments, bioreactors, wastewater treatment systems and marine ecosystems. Little is know about the diversity of these bacteria and the factors that control their dynamics in lakes. In this study, we examined the diversity of Planctomycetes in the different strata of the water column in two lakes with different environmental characteristics, one oligotrophic and the other mesotrophic. The mesotrophic lake is also characterized by summer developments of Planktothrix rubescens (cyanobacteria) blooms. The results showed important differences in the composition of Planctomycetes in the two lakes. The data are discussed in relation to environmental variables.

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INTERACTIVE EFFECT OF SMALL AND LARGE SCALE NUTRIENT LOADING AND CLIMATE CHANGE ON BENTHIC AND PELAGIC COMMUNITIES OF THE NORTHERN BALTIC SEA

Eutrophication and climate change are ranked among the most serious threats to the stability of marine ecosystems worldwide. The effects of eutrophication and climate change vary in direction, magnitude and spatial extent. To date the factors that are behind the scale-specific spatial and temporal variability are poorly known. In this study we assessed how variability in nutrient loads and climate variables at local, gulf and regional scales explained the spatial patterns and temporal trends of zooplankton and benthic invertebrates in the northern Baltic Sea. In general the effect of both local and regional scale environmental variability was important on benthic invertebrate communities and the variability was mainly due to local nutrient loading and regional climate patterns. Zooplankton species were equally affected by environmental variability at all spatial scales and all eutrophication and climate variables contributed to the models.

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BIOGEOCHEMICAL FLUXES IN THE MANAGEMENT OF THE COASTAL ECOSYSTEM OF TORRE GUACETO

A mass balance model has been set up to describe the four compartments of Torre Guaceto coastal ecosystem, constituted by a drainage basin, the marshes, the groundwater and the marine bay. A dual box one layer model has been defined trough mass-balance equations, in particular those used by Gordon *et al.* (1996), describing flow of water, salt and nutrients. In accordance with LOICZ guidelines it has been assumed that the differences in nutrient fluxes are due to biological process. Data has been collected during seasonal surveys from August 2001 and to January 2004, regarding ammonia, nitrite, nitrate, ortophosphate, salinity and bay and saltmarsh bathimetry. Air temperature, precipitations and land use data have been taken from literature and used to estimate evapotranspiration and surface flows of nutrients from the drainage basin. Using mass balance equation, groundwater input and salinity have been determined on the basis of the difference between atmospheric fluxes and marsh volume variation. Model results have been validated by literature data. The model results show that: the marsh system acts as a sink for both nutrients, while the marine bay is a source; the marsh is autotrophic while the bay is eterothrophic; nitrogen fixation processes prevail in both systems. The strong hydrodynamics of the bay probably lower the risk of developing eutrophication phenomena, even if the Canale Reale river is transporting high loads of nutrients to the marine area.

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PHYLOGENETIC CONSERVATISM OF GEOGRAPHIC RANGE SIZES: WHAT CAN WE LEARN FROM MICROBES?

As information becomes available for many groups of organisms a general pattern of phylogenetic conservatism in ecological characters or morphological traits is now widely recognized among macro-organisms. Conversely, conservatism of geographic range size throughout a lineage is still a contentious theme in general ecology with some studies claiming to find such phylogenetic conservatism while others failing to do so. However the studies exploring this topic have regrettably ignored microorganisms, which occupy most environments on Earth. Associating geographic data to the marine subset of the bacterial tree of life, the conservatism of geographic range was assessed using an asymmetry coefficient between the numbers of occurrences in pairs of sister OTUs and using the coefficient of correlation between the numbers of occurrences in pairs of OTUs. This approach brings a microbial example in the general debate of phylogenetic conservatism of geographic repartition and illustrates a collaborative approach between general ecologists and microbiologists.

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IN SITU BIOGEOCHEMISTRY OF METHANE, SULPHUR AND OXYGEN IN DIFFERENT CHEMOSYNTHETIC HABITATS AT THE GIGANTIC POCKMARK - REGAB

Cold seeps are unique ecosystems often related to high gas emissions mainly of the greenhouse gas methane. The 3000m deep "Regab" pockmark in the SE Atlantic harbours high benthic biomasses and diverse benthic communities associated with methane-laden sediments. The chemosynthetic communities are dominated by mytilid and vesicomyid bivalves or siboglinid polychaetes, but thiotrophic bacterial mats are rare. *Ex-situ* techniques (radiotracer incubations) and ROV-operated *in-situ* payloads (Microprofiler and Benthic Chamber) were used to investigate the microheterogeneity of the chemosynthetic habitats and the underlying biogeochemical processes. Here we present first data on the *in-situ* characterization, turnover rates and fluxes at the different habitats. High sulphide fluxes produced by AOM coupled to SR fuel different types of chemosynthetic communities. Microsensor measurements show variable oxygen penetration depths ranging from 1mm at the *Beggiatoa* mat to 5cm at the *Vesicomyidae* site. Total oxygen consumption rates vary greatly between the chemosynthetic communities but are generally ten-fold higher than the surrounding pelagic sediments. This study indicates that the establishment of different chemosynthetic communities is associated to variations in fluid flows and biogeochemical processes, and consequently methane emissions.

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FUNCTIONALLY AND TAXONOMICALLY DEFINED PLANKTONIC SOURCES OF INTACT POLAR LIPIDS IN THE SEA

Microbial activity in the surface ocean plays a significant role in global biogeochemical cycles. Therefore, expanding our knowledge of molecular markers for microbes will be of great importance in refining our understanding of the rates and influences of microbial processes in the ocean. To this end, our work has focused on identifying intact polar membrane lipids as proxies for processes important to carbon cycling in the upper ocean. The specificity of lipids and depth of information available through current liquid chromatography and mass spectrometry analysis makes lipids particularly attractive molecular proxies. We used two methods to identify groups of microbes for intact polar membrane lipid analysis: functionally defined groups, by using stable isotope tracers (^{13}C-labeled glucose and bicarbonate); and taxonomically defined groups, by using cell sorting flow cytometry. Through our analysis of samples from the North Atlantic we have identified a particular intact polar membrane lipid, phosphatidylethanolamine, which uniquely represents heterotrophic bacteria. Application of this molecular marker will aid our study of heterotrophic bacterial processes in the surface ocean.

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IMPACT OF OCEAN STRATIFICATION AND ITS POTENTIAL CHANGES ON THE PRIMARY PRODUCTION AND ECOSYSTEM DYNAMICS

Using a global ecosystem model driven by monthly, weekly, daily and 6h external forcing we analyse the resulting change in the stratification and its impact on ecosystem dynamics. We identify the features of upper mixed layer (UML) variability which have the greatest influence on ecosystem dynamics: i) The maximum penetration of winter mixing (determining nutrient supply); ii) Frequency and depth of storm-induced summer deepening of the UML (enhances nutrient supply and primary production if it is nutrient-limited as opposed to light-limited); iii) Average winter UML (influences the extent to which zooplankton can survive and exert grazing pressure); iv) Frequency and duration of short-term restratification during late winter due to calm weather (reduce light limitation and increase the coupling between phytoplankton and their grazers); v) Average summer UML (determines light limitation). Most global climate models predict a stronger stratification in future which may suggest reduction of the global primary production as a result of reduced nutrient supply. Our results show that impact of the stratification is not so straightforward and the biological response will be substantially different in different biogeochemical provinces.

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FACTORS AFFECTING PHOTODEGRADATION OF DISSOLVED ORGANIC MATTER IN AQUATIC ECOSYSTEMS

Photochemical degradation of dissolved organic matter (DOM) plays an important role in the carbon cycle. Irradiation experiments were conducted to evaluate the influence of chemical factors, specifically those expected to be altered in natural waters by climate change, on photodegradation of DOM. These included pH, nitrate and calcium. The experiments were carried out using stream and lake water samples with a wide range of dissolved organic carbon (DOC) concentration. Decreasing DOC concentration along with decreasing absorbance, fluorescence, and mean molecular weight were observed during three-week exposure to natural solar radiation as well as during laboratory experiments with artificial solar radiation. The pH of the samples significantly affected degradation rates of DOM, while no influence of nitrate or calcium concentration was observed. Lower pH favoured increased photodegradation rates. The results showed, in respect to future climate change scenarios that photodegradation rates of DOM will decrease during the recovery from acidification, while increasing or decreasing nitrate concentrations will have no effect on photodegradation rates.

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HYDROCHEMICAL STUDY OF GROUNDWATER IN LOWER VAR RIVER VALLEY, FRANCE

The alluvial aquifer of the Var River represents the main water resource. The anthropogenic pressure increases and makes this resource vulnerable. More contrasted seasons have been also recently observed with longer dry periods, which could modify the relative contributions of different water sources. The alluvial aquifer is supplied by infiltration of the Var River but also by lateral or deep groundwater flows from pudding rock or karstified limestone(1). This study aims to a better understanding of the mechanisms of this aquifer system. Whereas the most usual tracers in hydrogeology are major elements and stable isotopes, our approach is focusing on the trace elements concentrations in surface and ground waters. Most of trace elements exhibit low but homogeneous concentrations along the lower part of the studied area and over the year. Some of them reveal however significant variations which allows localizing groundwater supplies. When the aquifer system is better constrained, a powerful tool will be available to manage and protect the water resource. (1) Guglielmi Y. (1993) Hydrologie des aquifères plio-quaternaires de la basse vallée du Var. Thèse Université d'Avignon.

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A NEW METHOD TO DETECT AND IDENTIFY CYANOBACTERIA USING A CONTINUOUS IMAGING PARTICLE ANALYZER (FLOWCAM®)

Monitoring water systems for potentially toxic cyanobacteria is an important yet daunting task for research scientists. Cyanobacteria cells contain the pigment phycocyanin, and when 'excited' by certain wavelengths of light, emit a very distinct fluorescence signal. The imaging particle analyzer - FlowCAM® - has been used to study plankton in both marine and freshwater systems. The instrument utilizes a combination of light sources and filters (532 nm laser, Flash LED, and two emission filter sets) to detect and image microscopic organisms and particles in a mixed fluid assemblage. With an understanding of the natural optical properties of cyanobacteria, the FlowCAM® can be equipped with a new filter assembly that allows the instrument to detect the presence of both chlorophyll a (680-720 nm emission) and phycocyanin (645-665 nm emission) in algal cells. Once detected, organisms possessing these unique characteristics are imaged, and the unique optical parameters are measured and saved to help identify these organisms. An overview of this technology will be provided as well as enumeration studies of cyanbacteria from lakes and reservoirs where these organisms are typically present.

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ATMOSPHERIC INPUTS OF IRON AND OTHER NUTRIENTS TO THE TROPICAL NORTH ATLANTIC

The atmospheric deposition of Saharan dust is an important input of iron to the tropical North Atlantic. But iron is not the only nutrient supplied: Saharan dust also contains phosphate and other nutrients and in addition fixed nitrogen aerosol is often transported with it. Thus any attempt to quantify the effect of atmospheric deposition on the ecology of the tropical North Atlantic must also consider the flux of nutrients supplied relative to each other. We present here a synthesis of several aerosol data sets gathered on at least 20 cruises in the Eastern Tropical North Atlantic over the last 10 years. We examine the changing ratios of iron to other nutrients in the aerosol and discuss these not only as a tracer for source region but also in terms of nutrients supplied relative to the ecological requirements for the area.

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PHYSICAL AND BIOLOGICAL DYNAMICS OF CRYPTIC LAYERS

Recently, it has become apparent that thin layers of intense fluorescence are common in coastal waters. We used a Free-fall Imaging Device for Observing Phytoplankton (FIDO-Φ) to acquire vertical profiles of two-dimensional images of the distributions of fluorescent particles 20 um and larger. These data allow us to characterize individual particles as well as the bulk fluorescence. Analysis of the images revealed that there were often extreme variations in phytoplankton concentrations with no obvious variations in the fluorescence signature. We have called these "cryptic layers." Cryptic layers most often coincided with local maxima in the Richardson number, indicating possible formation by shear. Although it is often assumed that profiles of fluorescence provide a good indication of the patterns of phytoplankton concentration, these data demonstrate that the phytoplankton community structure can vary substantially independent of the biomass. These small-scale variations in community structure may strongly influence zooplankton foraging and carbon cycling in planktonic ecosystems.

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ABUNDANCE, DIVERSITY AND PHOTOPHYSIOLOGY OF PHOTOSYNTHETIC MICROORGANISMS IN SALT PONDS

The cascade of shallow, wind-mixed solar evaporation ponds north of Eilat, Israel form unique environments with gradients of salinity, oxygen content and variations in nutrient availability. In the studied ponds, salinity changes from that of seawater up to the hypersaturated brine. We have studied the composition and diversity of photosynthetic microorganisms in plankton and benthos along this gradient using a combination of classical morphological methods and low temperature emission spectroscopy. Salinity, nitrate and phosphorus determined the structure of the planktonic communities in each pond. The low temperature emission spectroscopy allowed us to distinguish the oxygen evolving photosynthetic organisms (algae and cyanobacteria) from the bacteriochlorophyll containing photosynthetic bacteria and the rhodopsin containig archea and to determine their excitation spectra and pigment composition. In the plankton, the relative abundance of bchl containing photosynthetic bacteria over oxygen phytoplankton increased several folds (from 1 % to >50%) with the increasing salt concentrations. In the benthic mats we characterised individual layers and their composition. Beside cyanobacteria and benthic diatoms, we observed spectra that indicate presence of various purple and green sulphur bacteria.

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TOWARDS OLIGOTROPHICATION OF THE NORTHERN ADRIATIC: A REALITY?

Long data series (1972-2007) of oceanographic parameters collected on a monthly basis on the Po River delta-Rovinj transect (northern Adriatic) were analyzed. In the last 5 years a clear signal indicating a reduction of the available orthophosphate in the ecosystem was identified. In the same period a general tendency towards a reduction of chlorophyll a concentration was also noted. Coupled with greater orthophosphate limitation an evident accumulation of total inorganic nitrogen (especially nitrate) was observed. The major cause is supposed to be an extreme change in the Po River freshwater inflow resulting in a decrease of nutrients load to the northern Adriatic ecosystem. A reduction of freshwater input on an annual scale of 48% was observed in the last three years.

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ENERGY SOURCES OF BENTHIC FAUNA IN LAKES ALONG A GRADIENT OF DISSOLVED ORGANIC CARBON

Stable isotope analysis was applied to assess the origin of organic carbon (OC) supporting the benthic communities in eight Swedish lakes with different concentrations of dissolved organic carbon (DOC). In humic lakes, benthic animals depended to a higher extent on allochtonous OC than in clear water lakes. The variability in OC source across depth gradients was higher in clearwater than in humic lakes. Profundal benthos was depleted in delta 13C compared to the littoral fauna. The delta 13C of zoobenthos in the littoral suggest reliance on benthic algae whereas depleted delta 13C of the profundal could be explained by dependence of allochtonous OC and in deeper lakes by a diet that included carbon derived from methane via methanotrophic bacteria. Moreover, we suggest that increasing DOC concentrations due to a warmer and wetter climate may enhance the role of the allochthonous organic carbon as a base in the food web both in the pelagic and in the sediments.

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OBSERVATION OF UNSTABLE HIGH-FREQUENCY INTERNAL WAVES IN THE NEAR-SHORE ZONE OF A LARGE LAKE.

Internal waves are a common phenomenon in lakes just as in the ocean. To explore their changing properties in the near-shore zone, the temperature and current velocity as well as the acoustic backscatter intensity in the littoral zone of Lake Constance were measured for several weeks with high resolution methods. These experiments yield information on internal waves and zooplankton distribution acting on a vertical spatial scale of one to fifty metres and temporal scales of seconds and minutes to days. The data frequently show unstable small-scale density inversion in the water column of the otherwise strongly stratified lake. The poster sums up results concerning the following two questions: To what extent does the density inversion depend on internal wave properties? How is the meso-scale plankton distribution affected by the small-scale water movement?

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HEAVY METAL SOURCE-TRACING IN URBANISED WATERSHED: THE SEINE RIVER STUDY CASE

The understanding of metal cycle in the environment is a crucial aspect in urbanised water basin management. This study aims to combine physical and chemical techniques, targeted for the Seine watershed in order to characterize different contribution of natural and anthropogenic metal sources and possible mechanism of metal release from the particles to the dissolved phase. Direct observation and analysis through scanning electron microscopy (SEM-EDS) and X-ray diffraction (XRD) was used to study chemical and physical associations of metal-bearing particles in bed sediment and suspended particulate matter. These analyses were completed with chemical analysis including total digestion and sequential and selective extraction. The efficiency of two pre-concentrating methods in obtaining observable and representative particles (magnetic and heavy liquid extraction) was also tested. Through SEM-EDS observations, Pb and Ni were found to be bound with pyrite. A runoff indication was marked by association between V and Ca, and also Zn and barite. Along with chemical digestion, microscopic particle analysis shows to be a powerful tool in the characterization of their different sources and their eventual mobility in the environment.

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COMPETITOR UNDERMINES ALLEOPATHY OF A RED TIDE DINOFLAGELLATE

The red tide dinoflagellate, Karenia brevis, forms nearly monospecific blooms, perhaps partly because K. brevis exudes compounds which inhibit the growth of competing phytoplankton. We investigated interactions between K. brevis and a model competitor Skeletonema costatum, finding that while blooms of K. brevis exuded compounds which inhibited the growth of S. costatum, bloom allelopathy varied considerably among collections and years. However, allelopathic potency of bloom samples did not correlate with K. brevis density or with concentration of known toxins. We found that when blooms samples were exposed to S. costatum before extraction, the growth-inhibiting effects of K. brevis blooms decreased significantly, suggesting that S. costatum may possess a mechanism for undermining K. brevis allelopathy. To determine whether this ability is unique to S. costatum we conducted similar experiments using laboratory K. brevis cultures and found that two of ten phytoplankton species were able to decrease K. brevis allelopathic potency. The results of this study indicate that competing phytoplankton may counteract allelopathy of K. brevis blooms, potentially changing bloom dynamics and shaping community structure.

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RESPIRATION IN THE LIGHT AND FUNCTIONING OF THE MICROBIAL LOOP IN A COASTAL ENVIRONMENT

It has long been postulated that there is some degree of linkage both on short and long timescales between heterotrophic and autotrophic processes in the oceans. However, even though it is generally accepted that autotrophic and heterotrophic compartments are coupled, traditional methods, using light and dark bottles to measure Gross Primary Production (GPP) and Respiration (R) ignore this paradigm. We show that R in the light (R_{light}) is higher than R_{dark}, resulting in an underestimation of GPP when estimated with light and dark bottles and that R_{light} was positively correlated to GPP. The relative contribution of bacterial respiration (BR) to community R_{light} represented up to 79 % at low Chl*a* (1 µg L^{-1}) and was negatively correlated with Ch*a* concentration. Although, bacterial production (BP) and BR were both enhanced in the light, BR was more stimulated than BP, resulting in a decrease in bacterial growth efficiency during light exposure. These results show that the impact of light on the functioning of the microbial loop needs to be taken into account for a better understanding of the oceanic carbon cycle.

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COPING WITH IRON-LIMITATION: A COMPARISON OF STRATEGIES IN TWO DIATOMS

It's well known that diatoms require iron for photosynthesis and other metabolic processes; however, the mechanisms different diatoms use to acquire and subsist with limiting levels of iron are poorly understood. For example, culture experiments show *Pseudo-nitzschia* spp., diatoms that bloom following iron enrichment experiments, acclimate to iron-limitation via a copper-dependent manner. In contrast, *T. pseudonana* can be readily starved for iron in the laboratory. We are interested in characterizing the variations of iron-stress responses utilized by diatoms. Our investigation focuses on the response of two diatoms, *T. pseudonana* and *T. weissflogii*, when grown under replete and iron-limiting conditions. We have targeted genes associated with two iron-limitation coping strategies: a protein replacement strategy (ferredoxin and flavodoxin) and a putative copper-dependent, high affinity iron uptake system as described in yeast and fresh water algae. Quantitative PCR analysis suggests these diatoms respond differently to iron-limitation as seen in the expression patterns of the target genes. Elucidating the molecular underpinnings of these variations could help explain disparate physiological responses to iron stress and may explain why certain species persist in different marine environments.

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GENETIC STRUCTURE IN THE MEDITERRANEAN SEAGRASS POSIDONIA OCEANICA. DISENTANGLING PAST VICARIANCE EVENTS FROM CONTEMPORARY PATTERNS OF GENE FLOW

Populations of the Mediterranean endemic seagrass Posidonia oceanica reveal a major division between the Western and the Eastern basins. Transition zone is situated in the Sicilian-Tunisian Channel and the Strait of Messina. Past vicariance is thought to have played a major role in shaping this cleavage, that seems maintained by contemporary low dispersal, demonstrated on this species at both local and regional scales. The strong East-West differentiation may be enhanced by specific physical drivers or barriers to gene flow such as currents in the contact zone, but may also result from a degree of reproductive incompatibility initiated during past vicariance events. To address these hypotheses, we used 13 microsatellite markers on 27 selected meadows and estimated patterns and directionality of gene flow. We also simulated displacements of P. oceanica floating fruits using 28-days long numerical Lagrangian trajectories. Results show that Sicily Channel populations have a higher affinity with the western basin, with the transition zone around Malta. Current dispersal limitations seem to be the key factor maintaining separation between the two main population groups.

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GRAZING BY RECENTLY ISOLATED AND NATURAL POPULATIONS OF KARENIA BREVIS FROM THE GULF OF MEXICO ON SYNECHOCOCCUS

In this study we have tested and quantified the amount nitrogen (N) that *Karenia brevis* obtains by ingesting *Synechococcus*, in culture and *in situ*. In the laboratory, we examined grazing by two recently isolated strains of *K. brevis* on coastal *Synechococcus* isolates. *Karenia brevis* isolated from Sarasota Bay and Jacksonville were able to remove ~50% and ~10-30% of the *Synechococcus* population within 24 hours of incubation, respectively. Laboratory ingestion rates ranged from 1.66 - 4.85 *Synechococcus K. brevis*$^{-1}$ d^{-1}. In the field, during a *K. brevis* bloom in October 2007 on the western Florida shelf ingestion rates were relatively high, ~10 *Synechococcus K. brevis*$^{-1}$ d^{-1}. LysoTracker Green®, a food vacuole stain that makes locating and enumerating prey inclusions much easier than using autofluorescence alone, is now being employed to determine predation by *K. brevis* on a variety of other picoplankton (i.e. heterotrophic bacteria, *Prochlorococcus*, single celled N_2 fixers, etc.). Additional culture studies are being conducted to determine the mechanism that *K. brevis* uses to ingest prey cells.

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BENTHIC NUTRIENT FLUXES IN THE TROPICAL BRANTAS RIVER ESTUARY AND MADURA STRAIT COASTAL WATERS, JAVA, INDONESIA

Tropical estuaries and coastal sediments are strongly influenced by high loads of organic and inorganic material exported by rivers. Due to the close benthopelagic coupling benthic recycling can make an important contribution to the nutrient inventory of shallow coastal waters. However, knowledge about benthic exchange rates from tropical regions is scarce. During four expeditions in the rainy and dry seasons in 2007 and 2008 sediment cores were sampled from Brantas River estuary and Madura Strait coastal waters. Pore water was collected and core incubation experiments were carried out to quantify benthic fluxes at sites with different influences of river run-off. Here we present first results of nutrient concentration profiles showing diverse pattern. Consistently low nitrate and nitrite values displayed no trend with depth, whereas phosphate, silicate and ammonium generally increased down core and revealed a large variability between sites. Diffusive flux rates based on pore water profiles are discussed in combination with total flux data. It is conceivable that benthic fluxes contribute significantly to the nutrient pool, particularly during dry season when river discharge is low.

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FINDING THE OPTIMAL STRATEGY: ZOOPLANKTON FEEDING STRATEGIES AS TRAITS IN A PLANKTON MODEL

Zooplankton grazing formulations govern the dynamics of marine ecosystem models, yet mechanistic descriptions of the various feeding strategies within this highly diverse group are rarely applied. Within a modelling framework, we interpret feeding mechanisms as traits which involve different energy costs and gains, depending on factors like prey density, motility or the predator-to-prey size ratio. Via the evaluation of the energy budget, trade-offs between different zooplankton sizes and feeding strategies can be implemented in the model. According to this approach, characteristics and densities of predators and prey determine the optimal feeding strategy which in turn shapes the structure of the plankton community. Looking at different marine ecosystems, we aim to investigate the effects of predator-prey interaction on size structure, trophic relationships and biodiversity.

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ALPINE AQUATIC ECOSYSTEMS: ARE THEY STILL NICE WATERS?

According to textbook knowledge, ~4 million lakes, i.e. 74% of all lakes are of glacial origin (Kalff 2002). This means that within the last 10,000 years a large number of lakes has undergone a characteristic shift from turbid glacial origins to clearwaters of high transparency – which has then been reduced with the encroachment of vegetation. The formation of new lakes, the early "life stage" and the first transition (turbid – clearwater) can now be observed in all regions where glaciers are retreating. Alpine lakes, however, are not only models for the early development of water bodies, but also sentinels of global anthropogenic and natural changes, from acid rain to alkaline dust, from heavy metals to PCBs, from UV radiation to global warming, from the invasion of aliens to conservation of endangered species. Since the alpine zone extends from 60° south to 70° north, alpine lakes are ideal objects for global comparisons of ecosystems, impacts and processes. Beside being excellent indicators of current changes, sediments of alpine lakes are providing detailed information about the Holocene climate and past environmental conditions.

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REGIONAL CONTROL OF PHYTOPLANKTON DIVERSITY AND RESOURCE USE

There is accumulating evidence that dispersal affects diversity of unicellular organisms. However, if dispersal affects microbial diversity – may microbial communities be under-saturated? Does microbial diversity affect ecosystem functions in similar ways as it is known from higher organisms? Using a large datasets from lakes across Fennoscandia, we show that phytoplankton diversity, measured as morphospecies richness, varies considerably in space. Diversity shows a considerable longitudinal gradient, with lowest diversity in western Norway, and highest found in Finland. While phytoplankton diversity is only poorly linked to local environmental factors, spatial analysis reveals strong spatial autocorrelation. Moreover, regional attributes explain >60 % of the variability seen in phytoplankton diversity. Thus, the data strongly indicate the existence of metacommunities, which promote similar species richness among communities of proximate habitats, irrespective of differences among local environmental factors. Phytoplankton biomass per limiting resource (total phosphorus) gives a measure of resource use efficiency (RUE). Using data from both freshwater and coastal sites, we show that RUE increases consistently with diversity. On the contrary, variability in resource use and community composition both are negatively correlated with diversity.

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THE ROLE OF HYDRODYNAMIC AND BIOMECHANICAL PERFORMANCE IN SURVIVING FLOW DISTURBANCE BY FRESHWATER MACROPHYTES

In flood-disturbed ecosystems, submerged aquatic vegetation is periodically exposed to high flow velocity (max. approx. 5 ms-1), which may induce plant uprooting or breakage. The aim of this study is to identify strategies combining both hydrodynamic performances and biomechanical traits that enable aquatic plant species to cope with high flow conditions. Hence, we measured hydrodynamic (drag, drag corrected for plant size) and biomechanical (breaking force and breaking strength of stems and leaves) parameters for a broad range of aquatic species colonizing fluvial ecosystems. We identified significant interspecific differences of breaking risk (breaking force/drag ratio). Species having low breaking risk at high velocity are characterized either by a low drag compensating a low breaking force, or by a low drag and a high breaking force. On the contrary, species having high breaking risk at high velocity are characterized by a high drag and a low to average breaking force. These contrasting responses will be used to understand species ability to cope with to hydrodynamic disturbances and hence to predict species spatial distribution in aquatic ecosystems.

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NEW INSIGHTS ON THE SIGNIFICANCE OF ATMOSPHERIC INPUT IN P-STARVED SURFACE WATERS OF THE MEDITERRANEAN SEA

In much of the world's surface oceans, phosphate concentrations are below the detection limit of conventional techniques. This is the case of the surface Mediterranean Sea which, during the stratification period, becomes a severely P-starved system. Atmospheric inputs have been generally recognized as a source of P to the surface Mediterranean Sea during the stratification season. However, the lack of phosphate data at nanomolar levels has so far precluded a quantitative evaluation of the P cycle at the atmosphere-ocean interface. In this study, we have applied for the first time the long path liquid waveguide capillary cell spectrophotometry technique (LWCC) to obtain a one-year time-series of nanomolar concentration of phosphate in the surface waters of the NW Mediterranean Sea. Simultaneous measurements of atmospheric fluxes allowed us to quantify their fertilizing potential during the stratification period. The LWCC technique was also used during artificial Saharan dust fertilization recently performed in the Mediterranean Sea (DUNE experiment) allowing the detection of a significant increase in surface phosphate concentration right after the seeding.

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THE EFFECT OF NUTRIENT ADDITION ON *DAPHNIA* PARASITES IN A LAKE

Natural populations of *Daphnia* water fleas are commonly infested with several species of different parasites. Changes in food nutrient stoichiometry may affect how much *Daphnia* are exposed to parasites and how well parasites are able to infect, grow and transmit to next host. The optimal food for *Daphnia* has a high P:C-ratio. Changes in diet (algal vs bacterial food) could affect *Daphnia* nutrition and thus their interaction with parasites. We added nutrients (N, P) into enclosures (diameter 2 m, depth 4 m) in a humic lake once a week during six weeks in July-August 2008. Our aim was to increase the availability of algal food to *Daphnia longispina* which relies heavily on bacterial food. We present results from the occurrence of three microparasites in *Daphnia*, the density of *Daphnia* populations, chlorophyll a and nutrient contents from seston and lake water from three experimental enclosures as compared to three control enclosures with no nutrient addition during a six week experiment.

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INTERANNUAL VARIATION OF STROBILATION BY MOON JELLYFISH IN RELATION TO POLYP DENSITY, TEMPERATURE, SALINITY, AND LIGHT CONDITIONS IN SITU

Jellyfish populations are renowned for large outbreaks that may be related to polyp density and environmental factors. Here, 14-15 sites underneath marina floats were monitored in 3 years; monthly photographs quantified strobilation (asexual production of jellyfish) of *Aurelia labiata* in relation to temperature, salinity, and light in situ. Strobilation occurred when those factors were increasing after annual minima. Polyps densities averaged 9.3 cm^{-2}, with little variation among years, and were not correlated with the amounts or beginning of strobilation. By contrast, the amounts and beginning of strobilation and physical factors differed significantly among years. Strobilation was greater (1.4- and 2.4-times) and earlier (1 month) in Yr2, when pre-strobilation temperature and light were higher and precipitation lower than in the other years. The differences in strobilation were greater than predicted from laboratory experiments, suggesting additive effects of environmental factors. Warming temperatures, nutrient delivery, and increasing sunlight enhance plankton production, providing food for the polyps and new jellyfish. Those environmental cues synchronize jellyfish and plankton production. With predicted climate changes, blooms of this and other temperate species may become larger and earlier.

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THE EFFECT OF ELEVATED TEMPERATURE ON AUTUMN PHYTOPLANKTON AND BACTERIOPLANKTON FROM THE GULF OF RIGA

As a result of anthropogenic action the climate of the Baltic Sea region is changing since last 100 years. The elevated temperature, enlarged precipitation, elevated nutrient supply and salinity decrease at the brackish ecosystems, promotes heterotrophic activity of microorganisms, changes phytoplankton taxonomical structure, diminishes species diversity etc. The development of arctic phytoplankton species (diatoms) can be prevented and warm water species can be promoted (cyanobacteria). The effect of elevated temperature was tested on bacterioplankton and phytoplankton communities from the Gulf of Riga in autumn season. The tested temperature ranged from +9 °C to +15°C. The elevated temperature generated rapid turnover of nutrients, raised an increase of bacterioplankton biomass and phytoplankton in vivo fluorescence. Our results show that elevation of temperature on several degrees in autumn season will suppress the development of *Diatomophyceae*, and favor the growth of *Chlorophyceae*, *Nostocophyceae* in the Gulf of Riga.

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MARINE MUCILAGE: A SPREADING OCEANS' INFLUENZA?

Marine snow is present in worldwide Oceans. Surface water warming and the consequent increase of the water column stability can favour the coalescence of marine snow into marine mucilage, composed by large massive aggregates. Marine mucilage is an ephemeral habitat that characterises aquatic systems with altered environmental conditions, such as the Mediterranean Sea. We investigated viruses and prokaryotes within mucilage and surrounding seawater in the Adriatic Sea, to examine mucilage potential to host new microbial diversity or spread marine diseases. Mucilage contained a large and unexpectedly exclusive microbial biodiversity, and hosted pathogenic species that were absent in surrounding seawater. We also analysed the location and frequency of mucilage appearance in coastal oceans worldwide in the last 60 years and found that the number of areas affected by mucilage, their spatial extension and temporal duration increased exponentially in the last decades, concurrently with an increase of the temperature anomalies. We conclude that mucilage is a potentially expanding carrier of diversity and diseases, and that the spreading of this sort of "marine influenza" can be triggered by Oceans' surface warming.

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ASSESSING THE ECOLOGICAL STATE OF LAKES BASED ON BENTHIC INVERTEBRATES

As lakes have traditionally been mostly seen as autotrophic systems, their ecological state is commonly assessed based on phytoplankton. However, besides eutrophication lakes are increasingly subjected to hydro-morphological alterations, as changes in water levels, use for inland navigation or recreation, and for urban development of the shores. The ecological effects produced by such impacts mainly affect the littoral zone. We suggest to use littoral invertebrate assemblages to indicate ecological effects of several modes of hydro-morphological alterations. As with other biological elements, indication results may be improved if sources for natural variation are known and considered. Natural variation between individual invertebrate samples may be produced by small-scale substrate heterogeneity. At larger scales, natural variation may be produced by differing wind exposure or connectivity of the lake to other water bodies. Currently an assessment tool is developed that is based on substrate-specific invertebrate samples that are compared to type-specific references, so that potential sources of error are minimized.

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THE NATURE AND LOCATION OF DEEP BIOGENIC SILICA MAXIMA (DSM) IN THE OCEANS

On several occasions, occurrence of a deep chlorophyll maximum associated to a deep biogenic silcia has been reported in different oceanic ecosystems. Her we examine the recurrence of such biogeochemical structures and their taxonomic composition. Possible mechanisms are proposed by taking into account the counterbalance between physiological adaptation to light and nutrient stresses (in the framework of co-limitation processes) as well as possible physical structure evolution at the base of the mixed layer. Finally the ecological significance of such structures is also discussed in terms of survival strategy for oceanic diatoms.

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INVADING *SPARTINA ALTERNIFLORA* IN SALT MARSHES OF THE BAY OF BREST AND IMPACTS ON THE SILICON CYCLE AT THE LAND-OCEAN INTERFACE.

The silicon cycle plays an important role in coastal waters where it may control phytoplankton dynamics. Eutrophication and dam building have altered the silicon cycle and it has been suggested recently (Ragueneau et al., 2005) that bioinvasions, through enhanced biodeposition, may also lead to important reductions of Si inputs from land to ocean. Here, we investigate in salt marshes of the Bay of Brest, the impact of an invasive plant (*Spartina alterniflora*) on the silicon cycle. Variations are observed in the accumulation of biogenic silica in plants and sediments, as a function of abiotic factors like salinity, flooding and site hydrology, which influence the growth and the primary production of *Spartina alterniflora*. Silicon as a possible indicator of stressful condition is compared with measurement of different metabolites. It is also found that there is an enhanced accumulation of biogenic silica in the sediment of an invaded salt marsh compared to bare mudflats, confirming the increasing retention on long time scales.

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MARITIME ANTARCTIC LAKE DYNAMICS IN THREE YEARS UNDER DIFFERENT CLIMATIC CONDITIONS

In this work we report the findings about the Lake Limnopolar in Byers Peninsula (Livingston Island, South Shetland Islands) during three consecutive summer seasons (2001-02, 2002-03 and 2003-04) characterized by extremely different meteorological conditions. Lake Limnopolar is a typical lake for maritime Antarctica region: kettle shape, relatively shallow (maximum depth 5m), small (surface over 22000 m2), oligotrophic, and with a moss carpet covering most part of the lake bottom. In this integrative, multidisciplinary study we relate watershed hydrology and limnological characteristics of this lake under different environmental conditions. During the three considered summer seasons, the meteorological characteristics dominated the dynamics of this lake producing important changes in the ice-free period duration, that triggered physical and chemical shifts that were followed by variations in the biological features of the lake. We also report the formation of an ice-dam that increased the lake volume dramatically during the summer thaw and the sudden break-up of the ice-dam that produced catastrophic washouts of the planktonic organisms inhabiting this lake. Finally, we will relate our findings with a scenario of global change.

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COMPARATIVE STUDY OF SOME METHODOLOGICAL APPROACHES TO ESTIMATE THE TURBULENT KINETIC ENERGY DISSIPATION RATE IN ALFACS BAY

The spatio-temporal variation of turbulence intensity and length scale has relevant implications on phytoplankton dynamics. Thus, it is important to estimate relevant parameters that characterize turbulence, such as its kinetic energy dissipation rates (epsilon). A main challenge constitutes the characterization of the physical dynamics at scales relevant to the microorganisms biology, i.e. over a few centimetres and hours. Here we compare different approaches to estimate epsilon in Alfacs Bay (Ebre Delta), an aquacultural site where recurrent harmful algal bloom events occur. This is a shallow basin (6 m maximum depth) where wind regimes and freshwater inputs control the mixing dynamics. First, we applied the solid boundary layer theory wind velocities obtained by a nearby meteorological station. Secondly, the temperature microstructure method, based on the Batchelor spectrum adjustment, was applied on temperature data obtained by a SCAMP. Finally, the velocity fields measured by a deployed high resolution 2 MHz acoustic Doppler current profiler where processed through the Reynolds decomposition considering isotropic turbulent and through the inertial dissipation method based on fitting measured fluctuation spectra to their respective theoretical and universal forms.

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THE USE OF SIZE DIVERSITY IN THE ANALYSIS OF SIZE DISTRIBUTIONS

The use of the size diversity to describe the shape of a size distribution is discussed. A size diversity measure gives a unique value per size distribution and has the advantage of a more intuitive interpretation of its ecological meaning, since the concept of diversity is well established. Differences found in size diversity and species diversity patterns in several aquatic communities are also investigated. We analyzed the most suitable method for the estimation of the size diversity. Size diversity is computed on the basis of the Shannon diversity expression adapted for continuous variables, such as size. It takes the form of an integral involving the probability density function (pdf) of the size of the individuals. Different approaches for the estimation of pdf, and the resulting size diversity, are compared. The kernel estimation of size diversity, after data standardization by division of sample geometric mean, arises as the most reliable and generalizable method of size diversity evaluation.

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RIVER CARBON AND NUTRIENTS AND THEIR FATE IN THE COASTAL MEDITERRANEAN SEA: A MULTI-COMPARTMENT APPROACH APPLIED TO THE RHONE RIVER

The Rhone River exerts a major influence on the Gulf of Lions which is the largest river-dominated ocean margin of the Western Mediterranean Sea. The biogeochemical fate of the Rhone River inputs (dissolved nutrients, particulate organic matter and detrital particles) to the continental shelf is largely influenced by the circulation in the Gulf of Lions and by deposition and transformation in the sediments. We have designed a multi-compartment study (CHACCRA) by coupling simultaneous measurements on the river inputs, the river plume processes and the benthic deposition to elucidate the transport and transformation of Rhone River material in the Gulf of Lions. A coupled physical-biogeochemical model is used to link the inputs and their fate in the Gulf of Lions. First results show that the river input of organic material is highly variable showing intra and inter-annual variability. The benthic deposition and transformation of this material shows a spatial pattern with a focus of organic deposition and intense recycling of organic particles at the river mouth. A disconnection with river plume production occurring further on the shelf is apparent.

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PHOTOSYNTHESIS VERSUS NITROGEN FIXATION IN THE DIAZOTROPHIC CYANOBACTERIUM CYANOTHECE SP EXPOSED TO DIFFERENT LIGHT/DARK REGIMES

Unicellular nitrogen-fixing cyanobacteria face a problem; they cannot photosynthesize and fix nitrogen at the same time because the nitrogenase enzyme is inhibited by oxygen. We investigated continuous cultures of the unicellular cyanobacterium Cyanothece sp. BG 43511 under conditions of obligate nitrogen fixation, when exposed to different light:dark regimes. Photosystem II dynamics and nitrogen fixation were both recorded online, at 30 and 10 mn intervals, respectively. Cyanothece mostly restrained its periods of nitrogenase activity to the dark period. All cultures showed identical potential (= maximum rate) capacity for nitrogen fixation; yet, the actual daily amounts of nitrogen fixed proved different. In all cultures, irrespective of the light:dark regime, fluorescence records in the dark period revealed a clear pattern in the quantum yield of PSII electron transport that closely matched that of nitrogenase activity. Results point at high flexibility of nitrogen fixation activities in unicellular cyanobacteria, at least with respect to the day-night cycle, which in potential would enable their growth at a wide range of different day-night regimes.

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DETECTION OF DECADAL CHANGES IN CARBON EXPORT FROM PHYTOPLANKTON BLOOM DURATION

The oceans absorb one quarter of the carbon dioxide (CO_2) emitted into the atmosphere by human activities every year. One biological pathway that controls the drawdown of CO_2 is the sinking of organic material following phytoplankton blooms. The current assumption is that phytoplankton blooms will continue into the future with the same activity as today. We estimate the contribution of phytoplankton blooms to the biological export production (EP) using satellite chlorophyll data from CZCS and SeaWiFS sensors and carbon export fluxes from sediment-trap data and an inverse model of nutrient observations. We identify the roles played by different phytoplankton functional groups using the PHYSAT algorithm. Phytoplankton blooms are characterized by their amplitude and duration. Long blooms of 10-15 weeks occur in the subtropics and are associated with low amplitudes and low EP. Short blooms of less than seven weeks occur in the subpolar regions and are associated with high amplitudes and high EP. The relation between bloom duration and EP is characterised by a linear function. We estimate a global decrease in carbon export of 5% over the last 20 years.

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NUTRIENT RECYCLING BY ZOOPLANKTON IN LAKE KINNERET - ISRAEL

Nutrient recycling by zooplankton influences the macro- and micro- nutrient budgets in aquatic ecosystems. The main goal of this study was to determine the contribution of the natural zooplankton community in Lake Kinneret (Israel) to macro-nutrient budgets of N and P in the Lake by examining the excretion rates of two major zooplankton groups: Copepoda, and Cladocera. To follow the seasonal pattern in excretion rates, monthly zooplankton samples were collected from the lake, and population excretion rates were determined after 3 hof dark. Analyses included nutrient and elemental composition as well as taxa identification and enumeration. Excretion rates were approximately 60% and 20% higher during summer-fall than during winter-spring for PO_4 and ammonia excretions respectively, while only minor changes were observed in the zooplankton assemblages from these experiments. These results provide initial support for our hypotheses that when external nutrient inputs are low (stratified months) high excretion rates occur supporting high production rates . Thus, zooplankton excretion rates provide a vital nutrient source for Lake Kinneret summer phytoplankton and bacterial populations.

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PARTICLES SIZE CHARACTERISTICS OF THE RHONE RIVER AND PLUME SUSPENDED MATTER

In the interdisciplinary network CHACCRA project (Climate and Human-induced Alterations in Carbon Cycling at the River-seA connection) specific attempts are made to determine the impact of anthropogenic and climate alterations on the carbon mass balance and ecosystem functioning at the river-sea interface (Rhone-Gulf of Lions, northwestern Mediterranean Sea). Characterization of the Rhone river particles and their behavior on the adjacent shelf were investigated using a multi-tools approach including a particles counter (Met-one; Hach), a laser size analyser (Malvern mastersizer S) and an in situ laser diffraction particles sizer (LISST-100 type B). Particles size distributions and concentrations were confronted in order to determine the fate of fine grain-sized fluvial particles transferred seaward at short time-scales during flood events. These results are also compared with d13C, d15N, POC and PON data. Our findings about particles characteristics highlight the importance of high discharge periods on the variability of particles size distribution, mainly for the 0.2-0.6 and 2-50 µm size classes. Surprisingly, particles larger than 150 µm did not increase during these events.

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DISSOLVED IRON ISOTOPIC COMPOSITION IN THE WORLD OCEAN

The iron oceanic cycle is involved in the global carbon cycle, notably through primary production limitation in HNLC areas. As for other elements, the study of iron isotopes will help better understanding its oceanic cycle, including tracing its sources to the ocean and studying its speciation (redox, organic and physical). Although several studies reported isotopic data in the marine environment (plankton tows, pore waters, aerosols, seafloor or marginal seas; i.e. Bergquist and Boyle, 2006; Severmann et al., 2006; de Jong et al., 2007), no dissolved iron isotopic data in seawater in the open ocean has been published so far because of the analytical challenge of this measurement due to the very low iron content of seawater combined to a concentrated salt matrix. This work will present the first dissolved iron isotopic composition data from the Southern Ocean (Kerguelen area and Atlantic sector) and from the Equatorial Pacific Ocean. Preliminary data, from a deep profile (30 to 4000 m depth) in the Atlantic Sector of the Southern Ocean, display small but significant variations around the crustal value (delta57Fe = -0.15 to +0.32 permil relative to IRMM-14). Complementary phases, such as suspended particles, phytoplankton, sediments, pore waters and aerosols will also be presented. These data will be discussed in terms of iron sources to the ocean and/or transfers between different iron reservoirs. Potential applications of this new tracer will be discussed.

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ADAPTATION OF THE PSII REPAIR CYCLE OF SYMBIODINIUM GENOTYPES WITH DIFFERENT SUSCEPTIBILITIES TO BLEACHING

Corals bleach as a result of the susceptibility of their symbiotic algae (Symbiodinium) to stress, primarily to high temperature and/or light. These factors appear to target processes associated with light harvesting and the build-up of excitation pressure within photosystem II (PSII). 'Tolerant' Symbiodinium types can have two strategies: either reducing this excitation pressure or investing energy into a high rate of PSII recovery. Here, we examined the response of the PSII repair of a thermally tolerant (A1) and a sensitive (A1.1) strain to light stress using bio-optical and bio-physical techniques. Gross photoinhibition (assessed in the presence of a D1 synthesis inhibitor) was similar in the two strains; however A1.1 displayed higher repair rate resulting in a lower net photoinhibition rate. Further experiments demonstrated that photoacclimation plays a major role in modulating the extent of repair by tuning photoprotection mechanisms (e.g. light dissipation through the xanthophyll cycle), which alter the excitation pressure and hence the need for repair. Thus, the combination of photoprotection and repair are key mechanisms that minimise photoinhibition and so convey 'tolerance' to specific genotypes of Symbiodinium and ultimately to their host corals.

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TOWARDS A NEW APPROACH OF THE BIOLOGICAL PUMP

There is no consensus on the mechanisms controlling the spatial and temporal variations in the efficiency of the biological pump. Complex biogeochemical and biological processes take place in surface waters and in the mesopelagic, which are not fully

understood and can not be represented adequately in ocean models. Hence, despite tremendous progress in their approach of reconstructing carbon fluxes as measured by sediment traps, models still fail at representing fluxes correctly. Looking at the functioning of the siliceous component of the biological pump, we have recently demonstrated that complex biogeochemical take place inside sinking particles, which link the fate of carbon to that of silica so that both components can not be modelled separately as presently done. Similarly, the Si:C ratio is evolving with depth in a way that can only be explained by a strong involvement of mesopelagic organisms, which behaviour is very difficult to introduce in simple models. We review these mechanisms and propose a new approach that accounts for this complexity by focusing on individual sinking particles and individual organisms which modify the quality and quantity of these particles.

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PHYTOPLANKTON DYNAMICS IN THE OLIGOTROPHIC WATERS OFF THE MEDITERRANEAN COAST OF ISRAEL

The spatial and temporal distributions of phytoplankton were studied for 2 years (2006-2008) off the Mediterranean coast of Israel at coastal and pelagic stations. These stations were characterized by extremely low chlorophyll a concentrations (0 - 0.5 µg L^{-1}) and a permanent deep chlorophyll maximum (DCM) between 90 - 120 m, dominated by pico-phytoplankton (e.g. *Synechococcus* and *Prochlorococcus*). The microphytoplankton were comprised mostly of diatoms (81%- 350 cell L^{-1}), followed by dinoflagellates (19% - 80 cell L^{-1}) which peaked after winter mixing (April-May). The diatoms were dominated by *Rhizosolenia* and *Chaetoceros* spp. that were broadly distributed throughout the water column, while dinoflagellates were generally located at the upper layer (0-50 m) and were dominated by the genus *Ceratium*. Both diatoms and dinoflagellates were found in small numbers (65 cell L^{-1} and 40 cell L^{-1} respectively) during summer stratification (June – October) when upper-water concentrations of N and P were extremely low (nitrate <10 nM and phosphate <2-5 nM). Higher alkaline phosphatase activity measured in the water column during this season further indicated the limited availability of P for primary production in these ultra oligotrophic waters.

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NOT WITHOUT COST: ECOLOGICAL SUBSIDY AND THE LATERAL EXTENT OF POLYCHLORINATED BIPHENYL (PCB) EXPORT FROM AQUATIC TO RIPARIAN FOOD WEBS

Although food webs can benefit from material transfer between ecosystems, there's a catch. Along with the transfer of nutrients and energy, resulting in subsidy, pollutants can be transferred, resulting in contamination. The transfer of pollutants from one ecosystem to another through biological processes, while less well studied than ecological subsidy, is receiving increasing attention. Here we examine the extent to which PCBs penetrate the riparian zone through the process of emergent insect consumption at the Sangamo-Weston-12 Mile Creek-Lake Hartwell, SC, USA, Superfund site. Spiders collected by hand and insects collected with canopy traps were examined for PCBs and stable isotopes. Patterns of isotopic ratios revealed the spatial extent to which predatory terrestrial spiders consumed aquatic insects. Levels of PCB contamination tracked aquatic insect isotope signals. Both aquatic insect consumption and elevated PCB contamination in spiders were restricted to within 5m of the shoreline. Predatory terrestrial insects also displayed elevated PCB levels. These results illustrate that food webs can mediate contaminant transfer across ecosystem boundaries, and that this is an important vector of contaminant exposure. Although this work was reviewed and approved by US EPA it may not necessarily reflect official agency policy.

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SILICIC ACID BENTHIC FLUXES IN ESTUARINE ZONES: IMPORTANCE OF SMALL TEMPORAL AND SPATIAL SCALES

The availability of Si relative to N and P plays a fundamental role in coastal phytoplankton dynamics. Nutrient ratios can be strongly modified during estuarine transit, which is not enough accounted for in studies linking coastal zones and watersheds. In this study, we focus on benthic processes and more specifically, silicic acid fluxes measured along two estuaries of the Bay of Brest (NW France), at various spatial and temporal scales. Spatial variability of fluxes is highlighted through i) an enhancement of fluxes with increasing salinity (estuarine scale), ii) small differences between the two estuaries (bay scale), iii) but comparatively larger differences over a cross-section of the river. Temporal variations take place over the year (seasonal scale), with fluxes typically increasing during the productive season. At higher temporal resolution, fluxes are strongly impacted by tides, which underlines the necessity of a robust methodology to study spatio-temporal variability of benthic fluxes in estuaries. The role of diffusion, bioturbation, bio-irrigation and microphytobenthos activity in controlling these variations in silicic acid benthic fluxes at these various scales will be discussed.

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ASSESSING THE SPATIOTEMPORAL DISTRIBUTION OF CHLOROPHYLL-A IN RELATION TO ENVIRONMENTAL PARAMETERS: APPLICATION ON THE NORTHERN AEGEAN SEA

The Aegean, although a relatively small sea, acts as a complex system in terms of the surface phytoplankton biomass distribution. We explore and assess the major influential variables of the surface phytoplankton biomass. Several different physical/chemical/environmental parameters were used (such as light intensity, sea surface temperature, wind, mixed layer depth, salinity, nutrients etc.) to identify which variables control or significantly affect the surface Chl-a of the Northern Aegean Sea (Eastern Mediterranean). The variables were acquired from a hydrodynamic and a coupled hydrodynamic-biogeochemical model. The remotely sensed surface Chl-a data were derived from the SeaWiFS sensor, for the period of 2002-2006. GAMs analysis showed that the combined effects of the variables used, explained >80% of the surface Chlorophyll variation. As a general rule, higher Chl-a values were associated with decreasing (colder) temperatures/salinity, increasing phosphate and declining nitrate trends. The negative correlation with nitrate indicates that generally the study area is phosphate limited one. Finally, the influence of cold, nutrient rich, and less saline waters of the Black Sea and/or riverine origin, is evident almost in every subarea.

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IMPACTS OF PEATLAND MANAGEMENT ON STREAM ECOSYSTEMS

Scientists have long recognised that human-induced landscape modifications have altered stream systems by changing the hydrology, geomorphology, water quality and biota. UK blanket peats represent 10-15% of those found worldwide, yet many are intensively managed through artificial drainage, rotational heather burning and remedial drain-blocking. This presentation discusses the impacts of these management types on stream benthic macroinvertebrates across northern England compared with intact peatland systems. At the community level there were no significant differences in total abundance or species richness between management types. However, results for individual species suggest some compensatory effects. For example, drainage and burning had a deleterious effect on *Ecdyonurus dispar*, *Isoperla grammatica* and *Perlodes microcephala*. Conversely, Simuliidae abundance was higher in these catchments, perhaps due to higher concentrations of suspended particulate organic matter serving as a food source. Species abundance and richness in drain-blocked catchments were typically similar to levels in intact systems. This catchment-scale rehabilitation method appears to be a useful method for aiding the rehabilitation of stream ecosystems in UK moorlands.

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EVIDENCE OF HISTORICAL LEGACIES IN THE SHAPING OF MICROBIAL COMMUNITIES SUBJECTED TO STRONG ENVIRONMENTAL GRADIENTS

Although spatial and temporal patterns are known to exist in microbial communities, yet the relative importance of historical (i.e. spatial distance) vs. contemporary (i.e. environmental heterogeneity) effects on the shaping of microbial diversity are not well understood. Here, we investigated changes in microbial community structure in a cold seep ecosystem in which sulfide fluxes deriving from anaerobic oxidation of methane create well-structured microbial and macrofaunal habitats. Our hypothesis was that under strong environmental gradients, spatial distance between microbial communities (either depth or geographic positioning) does not play a significant role in shaping microbial diversity. Community fingerprinting data and numerous contextual parameters were conjointly analyzed by using multivariate analyses (e.g. ordination, cluster analysis, direct gradient analysis, variation partitioning). Interestingly, variation in microbial beta diversity over 10 cm sediment depth was found to be as important as that between cores separated by hundreds of meters, despite the presence of strong local environmental gradients. This suggests that historical legacies (e.g. depositional history) may still be identified in the structure of microbial communities present in marine sediments.

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GENETIC DIFFERENTIATION IN RHIZOSTOMA PULMO (SCYPHOZOA)

Rhizostoma pulmo is a coastal species belonging to the class Scyphozoa with a life cycle including polyp and medusa phases and is widely distributed in the Mediterranean Sea and the adjacent Black Sea. Their life cycle enables them to rapidly shift between resting and more mobile phases. Even more, both phases efficiently contribute to an increase in numbers which result in occasional massive swarms. The ability to tolerate salinities and water temperatures over a great range as well as versatility in their food regime gives them the possibility to survive in many different environments. Putting together physiological characteristics and geological events over the distribution range of *R. pulmo*, a core issue arose concerning the phylogeographic structure of this coastal species and a question: does it reveal a pattern congruent with other marine species in Mediterranean Sea? All analyses were based on 650 bp alignment of COI sequences which contained 128 variable sites out of which 124 were parsimony informative. Phylogeographic analysis revealed a separation of haplotypes into groups consistent with examined geographical regions. Moreover, members of groups were genetically uniform without revealing nucleotide diversity, except in the northern Adriatic (π=0.0092±0.0063). The biggest genetic distance was observed between samples from the northern Adriatic and the Black Sea (0.357).

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DRIVERS OF BACTERIOPLANKTON COMPOSITION IN THE NORTH PACIFIC SUBTROPICAL GYRE

Although planktonic microorganisms dominate biomass and the transformation of inorganic nutrients, organic matter, and energy in the oligotrophic open-ocean, long-term studies of community structure and population dynamics are relatively scarce. As part of the multidisciplinary Hawaii Ocean Time-series program, we assessed the spatiotemporal dynamics of the bacterioplankton community at Station ALOHA, a site representative of the oligotrophic North Pacific Subtropical Gyre. Terminal restriction fragment length polymorphism and quantitative PCR analyses of 16S ribosomal RNA genes amplified from bacterioplankton collected over a four-year period (2004-2008) revealed clear spatial patterning with depth. The deep chlorophyll maximum appears to form a boundary dividing the epipelagic layer (0-200 m) into two distinct microbial communities, whose compositions were strongly influenced by phytoplankton dynamics. Temporal variability was generally weak, with only moderate seasonal dynamics detected in the upper mixed-layer. Spatial and temporal dynamics in bacterial taxa were examined using null model analyses, which revealed that, in addition to environmental filtering, interspecific bacterial interactions may play an important role in assembling bacterial communities in the oligotrophic ocean.

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DIAGNOSING, IDENTIFYNG AND COUNTING PHYTOPLANKTONIC FUNGAL PARASITES

We proposed a routine protocol based on size-fractionation of pelagic samples and the use of the fluorochrome calcofluor white for diagnosing, identifying and counting chitinaceous fungal parasites of phytoplankton. The protocol was applied to freshwater samples collected during different seasons in two lakes whose trophic status varied. Preliminary results from the proposed protocol indicated an increased in the diversity of infected host and parasite communities, compared to previous studies. Chytrid epidemics were omnipresent, infecting diverse phytoplankton host communities, primarily diatoms, chlorophytes and colonial and filamentous cyanobacteria. The diversity and the numerical abundances of sporanges and of hosts, and the prevalence of infection (range <1 to 24% of total host cells) as well, increased from the oligotrophic Lake Pavin to the eutrophic Lake Aydat, while the seasonal changes in parasites were apparently more influenced by the host community composition. The differences in the community composition of parasites were higher between seasons than between lakes. We conclude that the proposed protocol offers a valid method for the quantitative ecology of chytrid epidemics in aquatic ecosystems and food web dynamics.

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TERRESTRIAL INFLUENCES ON AQUATIC MICROBIAL COMMUNITIES AND THE SHREDDER *GAMMARUS ROESELII* DURING LEAF DECOMPOSITION IN LAKE CONSTANCE

Extreme changes in environmental conditions occur when leaves fall into lakes. We compared microbial shifts from terrestrial to aquatic habitats on unautoclaved leaves submerged in Lake Constance in winter (alder, beech) and summer (alder) to unautoclaved leaf discs (alder) in microcosms to determine environmental influences on community structure. Size-specific filtered lake-water was used to cultivate locally natural bacterial, fungal, or mixed (bacterial/fungal) communities. Molecular analysis was performed on leaves incubated for 0, 4, 8, or 22 days complimented by chemical analyses of leaves and determination of microbial biomass. DGGE profile cluster analysis revealed that bacterial communities were influenced by environmental factors, whereas aquatic fungal communities were often predetermined by terrestrial influences of tree specific fungal infections on leaves. Fungi were dominated by *Ascomycetes* and *Basidiomycetes*, and showed no succession. *Alpha* and *Beta-Proteobacteria* dominated bacteria, which exhibited succession. Microbial communities differed between leaf types. Additionally, microbial conditioned leaf discs were fed to the local invertebrate *Gammarus roeselii* to elicit if microbial community composition influences *Gammarus'* feeding habits. *Gammarus roeselii* favored fungal and lake conditioned leaves over other treatments.

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ZOOPLANKTON SIZE SPECTRA: PART 2, MODEL DEVELOPMENT

A time-dependent continuous model of copepods biomass size spectra is developed to explain zooplankton size spectra data. Time series of copepods, particles and Chlorophyll a from a station in the NW Mediter¬ranean Sea are used to estimate models parameters. In this model, predation by copepods on phytoplank¬ton and detritus and on itself and loss by predation from larger organisms (fish) are the main process governing the energy flow. The ratio of predator to prey is assumed to be distributed: predators may feed on a range of prey sizes with an optimum. Under these assumptions, it is shown that linear size spectra are stationary solutions of the model. Simulations are performed with observed forcing for phytoplankton and detritus in order to assess if the model reproduces the observed scales in copepods temporal variability

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STORAGE OF DMS AND DMSP IN SECRETORY VESICLES OF *PHAEOCYSTIS ANTARCTICA*

Mucopolysacharide secretory vesicles were isolated from a *Phaeocystis antarctica* culture. Dimethyl sulfide (DMS) and dimethylsulfoniopropionate (DMSP) were quantified in whole cells and secretory vesicles, after acidification and/or basification, with and without vesicular network dispersion by chelation of Ca^{+2} ionic bonds with EDTA. Acidification caused the vesicle to undergo volume phase transition with subsequent condensation, as expected. Vesicular DMSP represented ≥ 50% of total DMSP (DMSPt) measured in *Phaeocystis* cells. Interestingly, low pH conditions, which result in vesicle condensation, are used, independently, for stable storage of DMSP samples (while releasing DMS); however, acidification released 25-50% of DMSP present in the vesicles, with 15-25% of the loss accounted for by DMS. Acidification resulted only in 2-15% DMSPt loss in intact cells. In cells and granules, EDTA Ca chelation of the vesicle network approx. doubled DMSPt concentration, probably by making it accessible to measurement. On the other hand, DMS concentration in granules was equally high in all treatments, and comparable to DMSP concentrations.

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INTERACTIONS BETWEEN ZOOPLANKTON AND THEIR FOOD SHOW LARGE SEASONAL CHANGES IN AN ARCTIC LAKE, AS INDICATED BY STABLE ISOTOPE AND FATTY ACID ANALYSES

We addressed the question of how autotrophic and heterotrophic food sources contribute to the existence, high standing stocks and reproduction of several large-bodied zooplankton in oligotrophic arctic lakes. We quantified the pelagic food sources (bacteria, phytoplankton and nanoflagellates), measured bacterial and primary productivity, and sampled organic matter and zooplankton for stable isotopes and fatty acids between November 2007 and October 2008 in a high-latitude lake in Finnish Lapland. Results show that primary productivity that is restricted to four months from July to November allows zooplankton to build a lipid storage that accounts for 40-70 % of the body mass. This energy reserve allows copepod and cladoceran reproduction under the ice in March-April, after months of starvation and no access to algal food. Heterotrophic food sources available in small quantities in winter explained only a small portion of the zooplankton winter reproduction.

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EXPLOITATION OF METHANE-DERIVED CARBON BY FISH IN A TEMPERATE LAKE ECOSYSTEM

Recent research in lake ecosystems has clearly identified the contribution of methane-derived carbon to consumers at lower trophic levels, like some profundal chrinomid larvae. However, there is little more than circumstantial evidence to suggest that organisms from higher trophic levels, such as fish, might be supported by this alternative carbon source. Here we present data from a study specifically aimed to follow this isotopically distinct methane-carbon further up the food chain in a northern temperate lake Jyväsjärvi, in central Finland. We collected chironomid and ruffe (*Gymnocephalus cernuus*) samples for stable isotope ($\delta^{13}C$ and $\delta^{15}N$) analyses from different depths and oxygen concentrations during summer 2008. Both carbon and nitrogen stable isotope values of chiromids and ruffe were highly dependent on sampling depth and were considerably depleted at greater depths, $\delta^{13}C$ values of ruffe reaching -44‰ at depths over 10 meters and low oxygen concentrations. These $\delta^{13}C$ values are 10-20‰ more depleted than other potential prey (zooplankton and littoral macroinvertebrates) for ruffe. Up to 39% of the carbon in ruffe from greater depths was estimated to originate from biogenic methane.

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A MODEL OF THE PELAGIC ECOSYSTEM TO INTERPRET SHORT-TIME SCALE SAMPLING IN THE OFFSHORE WATERS OF THE LIGURIAN SEA

The multidisciplinary cruise DYNAPROC 2 (DYNAmic of rapid PROCesses in the water column) took place in the Ligurian Sea (NW Mediterranean Sea) in September and October 2004. The aim of the cruise was to study the short-time scale processes that occur when the ecosystem switches from summer oligotrophy to autumnal mesotrophy. To understand the physical and biological processes taking place, we used a one-dimensional, physical-biological coupled model, forced by meteorological data. The biological part includes ten state variables which account for three nutrients, three classes of phytoplankton, two zooplankton and two types of detritus. A new data assimilation approach was developed to reproduce isopycnal layers dynamics induced by horizontal advection events. This method is called IDA (Isopycnal Depth Adjustment) and consists in assimilating the measured variations of isopycnal depths in the model. The performance of this new approach is evaluated using a Taylor diagram. This model provides a better estimation of the relative contribution of physical and biological processes in the production layer in offshore waters of the Ligurian Sea.

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NITROGEN BALANCE IN THE SHALLOW EUTROPHIC CURONIAN LAGOON OF THE BALTIC SEA

Curonian lagoon is highly eutrophic estuarine lagoon receiving nutrient inputs from the drainage basin of 100000 km², including 45000 tons of nitrogen per year. From previous studies it is known, that phosphorus is the primary limiting nutrient during spring, while during summer – inorganic nitrogen is normally very low. However, it appeared that other sources like nitrogen fixation by cyanobacteria also play an important role in the nitrogen balance. The nitrogen fixing cyanobacteria, which, depending on a year, could have high abundances from late June up to October in the lagoon. The updated estimate of the balance includes river discharges, precipitation, nitrogen fixation and consumption by the reed belts abundant in the shallow parts of the lagoon. High interannual variation in riverine N discharges as well as atmospheric N fixation is also typical for the lagoon, so the climatic forcing on the N balance is discussed in the view of the regional climate scenarios.

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MODELING PHOTOCHEMICAL PRODUCTION OF CARBON DIOXIDE AND BIOLOGICALLY LABILE CARBON USING REMOTELY SENSED OCEAN COLOUR

Most photochemistry in the ocean is driven by coloured dissolved organic matter (CDOM). When considering carbon cycles, the two most important photochemical reactions involving CDOM are CO_2 production and alterations in biologically labile carbon (BLC). The large-scale photoproduction of both of these products can be modeled by combining remotely sensed ocean colour with spectral photochemical reaction efficiencies (i.e. apparent quantum yields: AQY) appropriate for each product and oceanic setting. To assign suitable AQY spectra for a subtropical coastal environment, water samples were taken in the vicinity of Sapelo Island, GA, USA, filtered, and irradiated for AQY determinations. CO_2 production in sealed quartz cells was measured as TIC with a Shimadzu TOC-V CPN analyzer. Photoconversion of refractory organic carbon to BLC was determined using O_2 consumption in postirradiation dark incubations by a cultured marine bacterium, *Silicibacter pomeroyi*. AQY spectra were input into the SeaUV/SeaUVc algorithms (Fichot et al., 2008) with remote sensing scenes to create coastal production maps of these products in the South Atlantic Bight. Results have significance for both the carbon cycle and microbial ecology in coastal marine systems.

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BIOGEOGRAPHIC DISTRIBUTION OF DAVIDSON SEAMOUNT MEGAFAUNA

Seamounts are topographic features that extend upwards a thousand meters or more from the ocean floor, but peak below the water's surface. Initial studies of seamount biota proposed a high level of endemicity on seamounts. However, further work has called this assumption into question. For the first time, global biogeographic ranges have been gathered for a marine assemblage, namely that of the Davidson Seamount (~35.7° N, 122.7° W). Only five percent of Davidson fauna are localized to this seamount, with the majority observed over a continuum of geographic ranges. As further evidence against the endemicity hypothesis, eighty percent of the megafauna have been found over a thousand kilometers away from Davidson Seamount. Moreover, taxonomic and sampling improvements have the potential to increase this figure, which suggests that most deep-sea assemblages are composed of widely distributed species.

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PHASE TRANSITION AND SELF-ASSEMBLY OF DISSOLVED ORGANIC MATTER: CONSEQUENCES FOR LAKE COLOR AND FOOD WEBS

Dissolved organic matter (DOM) can behave as a polymer gel that undergoes phase transitions (hydrated vs. condensed) and spontaneous assembly promoting, in both cases, its transformation into particulate organic matter (POM). These two processes appear to be mostly controlled by pH, ionic composition, and dielectric properties of the solvent. Lake waters cover a wide range of DOM properties and chemical environments, which make them ideal objects to study the dynamics of self-assembly and phase transitions of DOM, their ultimate mechanisms and potential consequences for water color and food webs. We performed extensive lake samplings in North temperate and Mediterranean inland waters with contrasting dissolved organic carbon (42- 3750 µM) and chemical environments (conductivity 9.6-61,500 µ S) to determine polymer size and the fraction of total organic carbon assembled using homodyne dynamic laser scattering and a fluorescence quenching assay. In addition, we experimentally confirmed the role of calcium and iron as promoters of DOM self-assembly and the changes of DOM optical properties during phase transitions.

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BENTHIC BIOGEOCHEMISTRY OF MICROBIAL IRON AND SULFATE REDUCTION IN THE GULF OF MEXICO HYPOXIC ZONE

The bottom waters of the northern Gulf of Mexico along the Louisiana shelf experience the increasing problem of hypoxic conditions during late spring and summer where the rate of oxygen consumption exceeds the rate of input from physical transport plus photosynthetic generation. Although previous studies suggest that during hypoxia anaerobic processes are favored in the sediment causing an increase in the concentrations of reduced components (i.e. ferrous iron and total sulfide), no studies to date have examined the microbial community structure in these sediments. Temporal and spatial variations of anaerobic respiration were investigated in the upper 20 cm of the sediment column using geochemical data. Pyrosequencing of reverse transcribed SSU rRNA was used to determine population distribution. Relative population density of anaerobic iron-reducing bacteria (FeRB) and sulfate-reducing bacteria (SRB) was determined by quantitative PCR amplification of group specific molecular gene targets (gltA and dsrA, respectively). The activity levels, supported by the total sulfide and ferrous iron concentrations, were lowest in the spring prior to hypoxia and highest during the summer hypoxia.

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COMPENSATION IRRADIANCE FOR PELAGIC COMMUNITY METABOLISM

The light compensation irradiance (Ec), the irradiance at which gross primary production equals community respiration, is an important property of planktonic metabolism as it helps determine the depth below which planktonic metabolism becomes heterotrophic as well as the impact of changes in light penetration on the planktonic metabolic balance. A meta-analysis was done to determine the Ec, collecting data from available literature or databases (e.g. JGOFS data), and experimental assessments. We will show that the pelagic planktonic communities are less tolerant to a decline in water transparency than benthic microalgae or microphytobentos are, possibly because the vertically-mixed pelagic planktonic community of the water column precludes efficient photoacclimation. We found that pelagic planktonic communities become heterotrophic at irradiance below 6.7 % of the surface irradiance, hence the use of the conventional compensation depth of 1 % of incident light to estimate community production may overestimates.

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ASSOCIATION BETWEEN PHYTOPLANKTON AND VIBRIO SPP ALONG THE SOUTH WEST COAST OF INDIA – A MESOCOSM EXPERIMENT

The genus Vibrio are natural autocthonous bacteria in aquatic environments and play important roles in nutrient cycling. Here we report the results from a mesocosm study of the inter-relationship between microalgae and Vibrio performed in Mangalore, India. Mesocosms were inoculated with plankton, plankton and sediment, or only sediment, and the development of a diatom bloom and an increase in Vibrio spp and V. parahaemolyticus abundance was followed among other parameters.. The highest diatom abundances were followed by an increase in Vibrio in all mesocosm, irrespectivelly of inocula, as well as in the field, clearly showing that the diatom bloom could support Vibrio growth. V. parahaemolyticus was however initially favoured by sediment. The results indicate that phytoplankton blooms, recorded as high levels of Chl a, should be used by precausion as predictions for future Vibrio epidemics, since the origin of the Chl a probably has significant impact on Vibrio abundance

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SEASONAL VARIATION AND SCALE DEPENDENT CHANGES IN DOM BIOAVAILABILITY ACROSS A STREAM NETWORK

The distribution of organic carbon compounds varies spatially in stream networks and temporally at individual sites. To understand the fate of carbon within watersheds, and its delivery to coastal systems we must understand the controls on its transport and transformation. I examined temporal and spatial variation of DOM in the South Fork Eel River, a pristine forested watershed in northern California. I measured DOM bioavailability in six streams at seven locations in the watershed using long-term incubations with common microbial communities. Stream DOM concentrations, and DOM biological availability, measured by degradation during incubation, increased with stream size. Seasonal increases in DOM, observed at all sites, were larger in downstream, open canopied sites compared to small headwater streams. Absolute degradation of DOM by bacterial communities increased in proportion to DOM increases at open canopied sites, but not at shaded sites. These results suggest that terrestrial and algal DOM vary greatly in their bioavailability. Rates of nitrogen and phosphorus cycling observed during incubations suggests that nutrient availability plays an important role in mediating DOM transformations in rivers.

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THE EFFECT OF STREAMBED TOPOGRAPHY ON MIXING AND MASS FLUX AT THE SEDIMENT-WATER INTERFACE

The exchange of nutrients and gases between the water column and the surface layer of streambed sediments plays a key role in biogeochemical processes occurring at the benthos. How nutrients and gases are exchanged depends upon turbulent transport through the water column and diffusive transport across the sediment-water interface. Fine-scale measurements of boundary layer flow and scalar transport were conducted within a 25 m by 0.6 m laboratory flume. Three flow rates were studied over three different bed topographies, composed of sand, gravel, or gravel with large cobbles. Fluorescein dye, containing dissolved nitrate, was injected along the bed surface. Scalar concentration and velocity was simultaneously measured 1m downstream from the source using a combined planar laser induced fluorescence (PLIF) and particle image velocimetry (PIV) technique. PLIF/PIV images were obtained at 50 Hz, enabling flux to be quantified throughout the water column using an eddy-correlation technique. Pore-water concentrations were measured using a flow-through fluorometer. Results indicate increased bed-roughness enhances mixing and scalar flux to the sediment-water interface. However, depending upon the size of roughness elements, exchange became spatially more heterogeneous.

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EVALUATION OF SEAGRASS HABITATS: USING STABLE ISOTOPES TO EXAMINE JUVENILE FISH GROWTH

Seagrass beds are commonly deemed nursery habitats for juvenile fish, but their value to fisheries has not been directly quantified. Defining the link between fitness and quality of habitat is an integral step in quantifying the value of seagrass-nursery environments. To examine this relationship, we are investigating the influence of carbon (C) and nitrogen (N) sources on juvenile fish growth over three years (2006-2008). The tightly coupled system of juvenile spotted seatrout (*Cynoscion nebulosus*) in Chesapeake Bay seagrass beds is our model system. We analyze signatures in the water and prey items to evaluate C and N sources, while analyzing C and N in fish muscle tissue as indicators of trophic structure. Calculating growth rates allows us to subsequently investigate the effects of the C and N sources on growth. Our preliminary results show significant differences in stable isotope signatures of spotted seatrout among our sampling zones. With further evidence we hope to demonstrate the value of seagrass nurseries and provide a method for quantifying which areas provide the most productive conditions for fish growth and subsequent survival.

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PHOSPHOROUS SPECIATION AND ORGANIC C:P RATIOS IN HYPERSALINE SEDIMENTS FROM GUERRERO NEGRO, BAJA CALIFORNIA SUR (MEXICO)

Phosphorous (P) sequential extraction was performed on eight cores taken from the increasingly saline waters of the evaporation ponds in the salt production site at Guerrero Negro, Mexico. Salinity ranges from 47 to 125‰, all water is oxic, and all sediments below approximately 0.5cm are anoxic. Previous studies have focused on microbial mats growing in one of the biogeochemically distinct ponds; however, the geochemistry of the sediments, up until now, has been ignored. Down core P concentrations were determined in centimeter increments for the four phases of P: absorbed+oxide, authigenic, detrital and organic, as well as organic carbon (C), and phosphate concentrations in the water. Data is presented on C:P of anoxic sediments, and the immobilization of sedimentary P from an environment free from outside influences or significant freshwater input. Average molar C:P (25,512±23015 to 1,095,095±2,260,078) show preferential regeneration of P compared to C, with the highest values measured where the most extensive microbial mats grow. Low concentration of dissolved phosphate (0.02 to 1.15 μM) with high authigenic (average 46%) and detrital P (average 40%) indicate immobilization of sedimentary P.

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THE DYNAMICS OF OXYGEN WITHIN A RIPPLED SAND BED STUDIED IN A LARGE WAVE FLUME

Experiments in a large wave flume (104-m long, 3.7-m wide) using random waves with a peak period of 4 s and wave heights ranging from 0.1 – 1.2 m were run to examine ripple formation and effects on surficial pore water circulation and oxygen penetration into a sandy seabed (average permeability = 4×10^{-11} m^2, C_{org} = 0.02 ± 0.01 wt%). Prescribed wave conditions were generated for 0.3 – 2 hours, and oxygen profiles were measured with microelectrodes both during and between wave runs in water depths of 2 - 3 m. Generally, bedforms stabilized rapidly as three-dimensional anorbital ripples with length scales of ~15 cm and heights of 1 - 4 cm. Oxygen penetration tended to scale with ripple height during waves, but reset to diffusion/consumption-governed profiles with penetration depths of 0.2-0.4 cm within hours of the cessation of waves. Implications of these findings to conditions on a dynamic shelf like the Oregon margin will be discussed in the context of Froude number scaling and wave climatology.

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MIXING OF WATER MASSES CREATES ECOTONES OF ENHANCED MICROBIAL ACTIVITY IN THE DARK OCEAN

Frontal systems in the euphotic layer are well-known for their elevated biological activity. However, boundary systems are also present in the deeper layers of the ocean when two distinct water masses mix. These deep-water ecotones might be particularly important in areas where different water masses are funneled through narrow passages. We conducted lab experiments, mixing aged surface- and deep-water, and monitored bacterial abundance, leucine uptake and the community composition using ARISA. Similar experiments were run on a cruise in the North Atlantic where water from adjacent water masses was used. Nutrients and dissolved organic carbon did not change measurably. However, cell-specific leucine uptake was generally enhanced in the mixed water mass as compared to the parent water masses. The bacterial community composition in the mixed water was similar to the parent water masses without major shifts over the course of the experiments. This suggests that dark ocean mixing events might allow for the utilization of substrate generally not available to the prokaryotic community in the parent water masses and hence, might stimulate overall deep water microbial activity.

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IN SITU STUDIES OF MIDWATER MACROZOOPLANKTON RESPIRATION RATES IN MONTEREY BAY, CALIFORNIA

Oxygen consumption measurements are integral to determining the metabolic rates and energy requirements of midwater macrozooplankton and micronecton. Nearly all of the respiration rates reported in the literature for these animals were based on laboratory measurements conducted at one atmosphere. The physiological stresses of capture and decompression undoubtedly affect such measurements. For gelatinous animals in particular, collection at depth and transfer to laboratory respirometry vessels seems likely to bias the rate of oxygen consumption. In addition, the activity levels of many midwater organisms has been observed to be lower at the surface than those observed at depth. To address these issues, MBARI developed an ROV deployed in situ midwater respirometry system (MRS) in late 2006. The MRS has been deployed in Monterey Bay, California at depths between 300 and 1300m over the last two years, collecting respiration rates from a variety of fish, squid and gelatinous mesopelagic species. We will present the results from our MRS deployments to date and compare them with laboratory derived results from our lab, as well as, from the historical literature.

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IDENTIFICATION OF NON-REACTIVE PHOSPHORUS IN LAKE WATERS BY 31P NMR SPECTROSCOPY

Until now it has only been possible to identify non-reactive phosphorus (nrP) by 31P NMR spectroscopy in sediment extracts, due to requirement of high P concentrations (>50 mg/l) in the samples. Here we present a novel and simple method for identification of nrP in lake water samples. This method allows for a detection limit of 10 µg nrP/L, which can be concentrated up to 5000 times. Twenty liter of filtered lake water is precipitated with aluminum. The precipitate is collected and redissolved in 20 ml of NaOH resulting in a 1000-fold concentration of P. The sample is further concentrated by rotary evaporation, centrifuged after which EDTA is added, to reduce line broadening. This allows for a good NMR spectrum and a high recovery (85-100%) of the nrP in the final NMR extract. Results from 3 lakes showed that orthophosphate-monoesters, orthophosphate-diesters, pyrophosphate, and an unknown P compound located at -9 ppm were all a part of the non-reactive phosphorus pool in lake waters. Further details of the method will be addressed in the presentation.

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BENTHIC COMMUNITY DISTRIBUTION ACROSS HABITATS IN COASTAL BRACKISH WATER LAGOONS

Benthic communities were studied across different habitats -macroalgae, angiosperms, unvegetated bottoms- in four coastal lagoons in Greece. Lagoons Logarou, Tsoukalio-Rodia and Tsopeli are located in Amvrakikos Gulf on the western part of Greece while Agiasma, in Nestos Delta, on the northern part. Macrobenthos was studied in autumn. Brackish water species formed the bulk of the communities₩ most of them showed a wide spatial distribution and often they were not characteristic of a single habitat. Higher densities of benthic organisms were found in the vegetated areas, as expected. The vegetated areas also supported a higher number of species with maxima in the angiosperm communities. Diversity varied independently of the habitats and was mainly related to the degree of marine influence. In the unvegetated areas, the diversity showed negative correlation with the percentage of fine particles in the sediment. Variation in diversity was mainly caused by fluctuations in the numerical abundance of a few dominant species, such as Abra segmentum, Cerastoderma glaucum, Nephtys hombergii, Microdeutopus gryllotalpa and oligochaetes.

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EFFECTIVE PROTECTION OF A CHANGING CORAL REEF ENVIRONMENT

Increasing threats to coral reefs, particularly those associated with global climate change and overfishing, have led to an increased need for marine protection policy with the specific goal of coral reef conservation. However, in order for large-scale implementation of marine protected areas (MPAs) to take place, their effectiveness in mitigating adverse effects on reefs and coral communities needs to be evaluated and a cost-benefit analysis should be completed based on geographic location. The island of Bonaire offers a unique opportunity for an evaluation because of its long-established no-take area (NTA) and previous reef mapping completed there. Change in coral reef cover and species composition over the time period 1985-2008 was analyzed and compared to the Caribbean-wide average as documented by the Atlantic and Gulf Rapid Reef Assessment (AGRRA). Bonaire was found to have significantly greater coral cover than the Caribbean-wide average, as well as greater species diversity. However, a decline in cover was also found over time on the island, following trends seen throughout the Caribbean, but this decline was less dramatic than declines on other reefs in the region.

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ACCUMULATION, AND ELIMINATION OF AN ANIONIC SURFACTANT THE LINEAR ALKLBENZENE SULFONATE (LAS) BY COASTAL MARINE ORGANISMS

The synthetic surfactants LAS, widespread used in detergency applications and produced annualy at more than one million tons, have been disposed of in wastewater and discharged into the aquatic environment with urban effluent for over 40 years. The fate of LAS in the marine environment is not well understood and the risk for organisms is thought to be negligible. This study is focused on characterising LAS bioaccumulation and elimination kinetics under controlled laboratory conditions. Five species of microalgae, an invertebrate bivalve and a pelagic fish were used as representative organisms from the North-Western Mediterranean coast. Results show LAS accumulation in all organisms exposed to environmentally realistic concentrations (≤10 µg/L). Accumulation varied with many parameters: tissue mass, physiological state of organisms, temperature or exposure concentration. LAS were accumulated heterogeneously in organs, mainly in the visceral mass or gall bladder. Regardless of the contamination pathway, LAS elimination from the body was rapid when animals were placed in non-contaminated seawater. This laboratory work confirms the need for monitoring LAS in coastal areas and for developing a tool to assess LAS contamination in organisms.

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DETECTING IMPACTS OF CLIMATE WARMING ON ARCTIC MARINE AND FRESHWATER ECOSYSTEMS

Climate warming, particularly in the Arctic, fundamentally alters the physical drivers of component ecosystems. Higher air and water temperatures, reduced ice cover, and the potential for increased storm frequency will impact biotic systems via both bottom-up and top-down mechanisms. Changes in organic matter production and transport will have consequences for remobilization and cycling of contaminants. Physical processes in the coastal zone will likely influence primary production over large areas of the Arctic continental shelf. Changes in productivity regime impact food supply for pelagic and benthic organisms. Range expansion of southern taxa may result in competitive displacement of Arctic species, or changes in the structure of prey communities. These are only several examples of how ecosystems change as climate warms. Recognizing these impacts and predicting consequences require multiple methodological strategies. Experimental studies and long-term data series can be used to detect thresholds for system resilience and identify potential ecosystem tipping points. Coupled physical-biological ecosystem models forced by projected climate drivers can provide an early view of the ecosystems of a warmer Arctic. The impacts of climate warming on Arctic marine and freshwater ecosystems will certainly have consequences for global biogeochemical processes, but their understanding will also be critical to managing the new social, economic, and political landscape of the Arctic.

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SEASONAL VARIATIONS OF $^{234}Th_{XS}$ IN THE SEDIMENTS OF A COASTAL LAGOON (JAMAICA BAY, NEW YORK, USA)

^{234}Th (half-life = 24 d) is a naturally occurring, particle reactive radionuclide produced in seawater through the decay of its parent isotope ^{238}U, which is generally conservative with salinity. The inventory of $^{234}Th_{XS}$ was measured in the surficial bottom sediments in Jamaica Bay, NY during four cruises. Although the $^{234}Th_{XS}$ inventories in the sediments varied spatially throughout the bay the mean inventory ranged from 3.35 to 4.88 dpm cm^{-2}. $^{234}Th_{XS}$ inventories in the upper 5 cm of the sediments were 2-3 times in surplus to the ^{234}Th production in the water column as estimated from salinity, suggesting an import of ^{234}Th from the ocean either dissolved or associated particles. Specific activity of ^{234}Th

on particles in the water column ranged from 2.2 to 14.8 dpm g^{-1} with the highest specific activities found at the inlet and just within the bay. High specific activity on particles at the inlet suggests that the surplus of ^{234}Th measured within the sediments is supported by an import of ^{234}Th associated with particles from the ocean.

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GENETIC DIVERGENCE AND LOCAL ADAPTATION IN POPULATIONS OF DINOFLAGELLATES IN RECENTLY FORMED SALINE ANTARCTIC LAKES

A fundamental question in ecology is whether microorganisms exhibit biogeographic patterns. Here, we approached this question by investigating possible genetic divergence due to local adaptation and geographic isolation, mechanisms which may lead to speciation. As a model system, we used dinoflagellates in recently formed Antarctic saline lakes. Clonal strains of two species were isolated from lakes of different salinities. To study local adaptation, we investigated salinity tolerance in marine and limnic strains. The genetic difference among the strains was determined using the DNA fingerprinting technique, AFLP. Our two species were the bipolar marine Polarella glacialis and a species closely related to the brackish Scrippsiella hangoei. The AFLP analyses indicated that the lake P. glacialis strains were more closely related to each other than to the marine strains. The salinity tolerance experiments showed that the limnic strains had a wider salinity tolerance than the marine strains, and that the limnic strains were adapted to the salinity ranges of their lake of origin. We tentatively suggest that the limnic populations have undergone local adaptation and are genetically isolated from the marine populations.

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IMPACT OF SMALL-SCALE DYNAMICS ON BIOGEOCHEMISTRY IN THE OMAN UPWELLING ZONE

The western boundary upwelling system of Oman associated with semi-annual Indian monsoon wind reversal is the main physical forcing of biogeochemistry in the Arabian Sea. Wiggert et al. (2004) highlighted that the challenge in modelling Arabian Sea biogeochemistry involves reproducing the observed levels of physical variability like the upwelling system and associated small-scale structures. The misrepresentation of small-scale horizontal advection in models is indeed invoked as the main limitation to understand biogeochemical variability in the Oman upwelling zone. We performed two interannual simulations of increasing horizontal resolution (eddy permitting: 25 km and eddy resolving: 9 km) that cover the Arabian Sea and particularly the Oman upwelling system. This allows to investigate and quantify the contribution of mesoscale dynamics to the biogeochemical budget in the upwelling system.

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EUTROPHICATION ASSESSMENT IN THE BASQUE ESTUARIES (NORTHERN SPAIN): PHYTOPLANKTON ECOLOGICAL STATUS ACCORDING TO THE EUROPEAN WATER FRAMEWORK DIRECTIVE

Methodologies for the assessment of the phytoplankton element within the context of the European Water Framework Directive in the transitional waters of the Basque Country (North of Spain) are presented. The indicators of ecological status based on phytoplankton employ data on chlorophyll-a and cell counts. Two estuaries are presented as study-cases. The Nervion estuary is a suitable system to observe temporal trends in water quality. A historical anthropogenic pressure on this estuary implied high nutrient loads, which were reduced 70% since the implementation of the wastewater biological treatment in 2001. The recovery process observed in the physico-chemical parameters is accompanied with changes in the indicators of phytoplankton status. In turn, the Oka estuary presents a distinct gradient of eutrophication from its head, where wastewater is discharged, to its mouth, which is highly influenced by tidal exchange with the adjacent low nutrient coastal waters. The indicators of phytoplankton status reflect this spatial gradient of eutrophication. We conclude that, although the indicators of ecological status based on phytoplankton present difficulties when applied to estuaries, they can discriminate different levels of eutrophication pressure.

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PATCHINESS AND DIEL VARIABILITY OF PHYTOPLANKTON COMMUNITIES IN THE NE SUBARCTIC PACIFIC OCEAN REVEALED BY CONTINUOUS-MONITORING FLOW CYTOMETRY

Some of the most enduring questions about the functioning of the biological pump and its impact on global biogeochemical cycles concerns the factors that regulate the dynamics of phytoplankton communities. Our understanding of these processes is limited by the difficulties in monitoring the distribution of phytoplankton at fine spatial and temporal scales. We developed a new generation of automated flow cytometers that enables continuous observations of natural assemblages of phytoplankton in the pico- to microphytoplankton size range. Here we report results from a 1475 km transect along line P from coastal to open-ocean iron limited waters in the NE subarctic Pacific Ocean and an iron-enrichment microcosm study (5 days) at station P in June 2008. Sampling of surface water along the transect revealed variability and patchiness in cell concentrations. Time series of the microcosm showed diel variability in cell concentrations, light scatter and pigment fluorescence of five iron-stimulated phytoplankton populations. The detailed analysis of each population will allow to better understand the factors influencing their growth rate and should help interpret patterns observed in bulk measurements such as those recorded by satellites.

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FOREST HARVESTING CHANGES COMMUNITY STRUCTURE IN STREAMS, EVEN WITH LARGE RIPARIAN RESERVES

Land use adjacent to water can impose large changes to aquatic communities and riparian reserves have been instituted to mitigate those impacts. However, there have been relatively few tests of whether riparian reserves are effective to reduce the rates of change from forest harvesting and on what time scales. We used a BACI design with 15 small streams in the Pacific coastal ecoregion of Canada, and each of the 4 treatments plus controls was replicated 3 times. We studied many response variables, including stream invertebrates and emergence of adult aquatic insects. We found large shifts in composition of benthos and emergence, even with 30 m reserves, and these changes have persisted for ten years. Densities more than doubled following harvesting, and most of those increases were amongst smaller-bodied species, such as Chironomidae. These changes include increases in a number species feeding on particulate organic matter, but surprisingly small changes in algal feeders. Shrub and herbaceous layer vegetation, and biofilms maintained the productivity of the food webs, but shifts in algal composition may account for lack of increase in herbivores.

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EFFECT OF OCEAN ACIDIFICATION ON EMILIANIA HUXLEYI CALCIFICATION: A MOLECULAR APPROACH

The cosmopolitan coccolithophore Emiliania huxleyi is intensively studied in eclectic domains such as global carbon cycling, biochemistry and biomineralization processes. This taxon, forming gigantic blooms in temperate to subpolar waters, is capable of carbon uptake by photosynthesis and intracellular calcification for respectively organic matter and calcite coccolith production. Consequently, the regulation of photosynthesis and calcification by coccolithophores is a key factor in the global carbon budget and constitutes one of the main targets of high-CO2 condition in the near future. Here we present the first attempt to monitor photosynthesis and calcification using quantitative RT-PCR in both the haploid and diploid phases of the life cycle of E. huxleyi strain RCC1217/16. Expression of genes, potentially involved in calcification, such as gpa, carbonic anhydrase (CA), calmodulin (CaM), starmaker (STM), Ca2+-channel (CaC) have been monitored in calcifying cells maintained in a continuous culture under high pCO2. Photosynthesis was followed through RubisCO gene (rbcL) expression. Variation in transcript abundance in between control condition (360 ppm) and high pCO2 (780 ppm) will be discussed and impact of lower pH on coccolithophore calcification suggested.

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RECENT THREATS ON COASTAL ECOSYSTEMS BY NEW POLLUTANTS: A MULTIPLE TRACE ELEMENTS STUDY

The Mediterranean Sea is an enclosed basin, highly submitted to anthropogenic pressures. Chemical pollution from coastal urban centres and industries, or carried by air and rivers, primarily affects its coastal ecosystems. Pollution by trace elements is rapidly evolving further to the recent modifications of their production and industrial uses by men. As a result, certain trace elements can now be considered as new environmental pollutants. Appropriate bioindicators are useful tools for the early warning of marine pollution. We presently investigate the use of the purple sea urchin *Paracentrotus lividus* and the marine phanerogam *Posidonia oceanica* as bioindicators to monitor the Mediterranean

coastal pollution by new trace pollutants (Be, V, Mo Mn, PGEs, Ag, Al, As, Se, Sb and Bi). Classic trace metals (Cd, Cr, Cu, Zn, Ni, Sn, Pb and Fe) are also studied. Organisms were seasonally collected in 2008 in a reference site and a polluted one, respectively Calvi bay (Corsica) and Marseille (France). Their tissular trace element concentrations were determined by ICP-MS. All the investigated trace elements were chosen for their potential toxic effects.

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TROPHIC ECOLOGY OF GREY-HEADED ALBATROSSES FROM MARION ISLAND, SOUTHERN OCEAN: INSIGHTS FROM STOMACH CONTENTS AND TROPHIC TRACERS

Albatrosses can alternate between long and short foraging trips to feed their young, potentially leading to marked differences in diet composition between adults and chicks. The trophic ecology of the grey-headed albatross *Thalassarche chrysostoma* was investigated during the chick-rearing period in April 2006 using a combination approach. Differences in diet between adults and chicks were assessed using stable isotope ratios and fatty acid (FA) profiles of blood and/or stomach oils, in addition to stomach contents analysis. FA profiles showed clear separation of blood from stomach oil, but less clear separation of adults from chicks. Stomach oils contained significantly greater levels of monounsaturates (16:1ω7, 18:1ω9 and 18:1ω7), whereas blood contained significantly greater proportions of essential FA (20:4ω6). Stable carbon isotope ratios were similar in adults and chicks, whereas stable nitrogen isotope ratios showed significant enrichment by >1‰ in chicks relative to adults. Combined FA, stable isotopes and stomach contents suggest there are differences in diet quality between adults and chicks. Comparisons of tracer data are made with literature values of potential prey species, in addition to recognizable stomach contents, to make conclusions regarding the diet of the albatross.

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COMPETITION AND COEXISTENCE OF SUBMERGED MACROPHYTES

The change of the water quality of Lake Constance is reflected by its variation of the submerged vegetation. A lot of aquatic macrophytes that declined due to the eutrophication in the 1960/70s in Lake Constance are recovering most probably due to the re-oligotrophication since the late 1980s. The community composition is still changing, and we notice particularly an increase in *Chara* spp. and a decline of *Myriophyllum spicatum* during the last 10 years. Our hypothesis is that either competition or allelopathy is responsible for this observed pattern. Firstly, *Chara* might be better adapted to the oligotrophic condition and therefore outcompete Eurasian Watermilfoil. Secondly, allelochemicals, which are produced by both macrophytes, might influence the interaction of both species. We therefore established laboratory and mesocosm experiments to investigate the role of limiting resources (especially light, phosphorus, nitrogen and carbon availability) in mono- and mixed cultures. Bioassays will be developed to test for allelopathic interference. We expect that the results will indicate whether exploitative or interference competition is determining the present macrophyte community composition.

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CELL WALL DEGRADATION PRODUCTS REGULATE THE DEFENSE OF A KELP AGAINST HERBIVORES

Kelps have been shown in the past to perceive the cell wall degrading activity of microorganisms and pathogens. Here we confirm that *Saccharina latissima* from the Baltic Sea responds with an oxidative burst and subsequently inhibited photosynthesis when it is challenged with homooligomeric guluronic acid originating from its alginic acid cell wall matrix. The analogy with other kelps is clearly reflected in the kinetics of the reactions. However, different from investigations conducted with other kelps bacteria associated with *S. latissima* were largely unaffected by the oxidative burst response. Instead, the elicitation with oligoguluronic acid resulted in a reduction of palatability for and in more frequent escapes of herbivores during the following days. A change in tissue composition apparently takes place after the recognition, probably due to upregulation of defense-related metabolic pathways. However, the measured phlorotannin values exhibit no correlation with palatability, suggesting that other metabolites must be responsible for the effect. Microorganisms that are capable of alginate degradation are always associated with kelps and our observations therefore lead to the question whether they can affect algal defense against herbivores.

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RISING TEMPERATURE CHANGES CARBON FLOW DURING A PHYTOPLANKTON SPRING BLOOM IN A MESOCOSM EXPERIMENT

The sensitivity of biological processes to temperature can differ greatly between individual components of an ecosystem. Most notably, the activities of heterotrophic organisms generally display a stronger temperature-sensitivity than those of autotrophs, which depend more strongly on incident light intensity and nutrient availability. Ocean warming therefore is expected to shift the balance between autotrophic production and heterotrophic consumption towards enhanced recycling and respiration of organic matter. To test this hypothesis, we conducted a series of in-door mesocosm experiments with natural plankton communities exposed to four different temperatures (in situ, +2, +4 and +6°C) and three light levels. Rising temperature accelerated respiratory consumption of organic carbon relative to autotrophic production, resulting in reduced inorganic carbon drawdown in the surface layer. Warming also shifted the partitioning of organic carbon between the particulate and dissolved phase towards an enhanced accumulation of dissolved compounds. Light intensity had a comparatively minor effect on the temperature-induced changes. The observed modulations of the carbon flow have the potential to weaken the ocean's biological carbon pump, thereby providing a positive feedback to rising atmospheric CO2.

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CARBON MINERALIZATION IN ANOXIC COASTAL SEDIMENTS: THE IMPORTANCE OF ADVECTIVE FLOW

We calculated the tidally driven circulation and discharge of pore waters within a shallow coastal aquifer. We used a numerical hydrogeological model, which is forced by high-resolution sea level and temperature data. Model calibration was done by comparison of simulated and measured pore water temperature and pressure data. The results show deep advective flow (up to 5 m) of pore waters towards the tidal flat margin, initiated when the sea level falls below the sand flat surface. This flow supplies the deeper sediments with fresh seawater. Pore water concentrations of sulphate decrease along the flow path as a result of microbially-mediated oxidation of organic carbon. Carbon mineralization rates by sulphate reduction are estimated to be on average 160 mmol*d^{-1}*m^{-2} of advectively affected sediment. The relatively young pore waters are highly enriched in degradation products and dissolved inorganic carbon when they discharge at a rate of approx. 0.25 to 0.36 m^3 per meter of shoreline and tide into the coastal ocean. The tidally forced flow is therefore responsible for an intensive carbon cycling in intertidal settings.

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CORAL POPULATION RESPONSE TO ACCELERATED BLEACHING AND MASS MORTALITY IN A CHANGING CLIMATE

A model of coral community response to bleaching and mass mortality of increased frequency with climate change suggests increased rarity of Acropora and increased dominance of robust faviids and Porites. Three species groups in two life-stages with competing juveniles but adults in a size-refuge were modelled. Aggressive Acropora dominate at equilibrium, which is unattainable due to mass mortality events that primarily disadvantage this group by >90% versus 25% in faviids and Porites about every 15 years. Unaltered community structure can persist despite repeated 90% mortality, given sufficiently high fecundity or import from connected populations. Frequency of disturbance determines the dominant group – in low frequency Acropora, in high frequency Porites. Isolated populations were more sensitive to parameter changes than connected populations, with highest sensitivity to mortality and recruitment rates. Community composition was sensitive to spacing of disturbances and catastrophic mortality. Unless a longer (>10 years) disturbance-free interval can be maintained, a permanent shift away from Acropora-dominance will be observed. A mortality rate of 99% in Acropora , as observed in nature in some populations in 1996 and 1998, is not sustainable if repetitive.

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A 40 YEARS RECORD OF SURFACE SEDIMENT CONTAMINATION IN THE BERRE LAGOON: INFLUENCES OF INDUSTRIAL REGULATIONS AND ANTHROPOGENIC SILT INPUTS

The ecosystem of the Berre lagoon (South-East France) was deeply impacted these last decades by strong inputs of contaminants associated to industrial and urban development in its watershed since the 1930's, as well as by huge freshwater and silts inputs from an hydro-electrical power plant set-up in 1966. Surveys of contamination of the surface sediment were carried occasionally since 1964 for management or research purposes. They were performed by various laboratories and concerned different chemicals, sampling areas and analysis protocols. Therefore, available data are discontinued in time and space and disparate in term of quality. Using simple statistical approaches, this work presents a method to build a coherent and interpretable long-term time series of contaminants in sediment from such kind of database. Reconstructed temporal trends 1) allow to quantify the effects of industrial releases regulations taken during the last decades on the sediment contamination, which is a very important question in terms of management, and 2) demonstrate the influence that could have an hydroelectric power plant and its associated particulate matter inputs on sediment contaminants contents in coastal area.

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LAKE-WIDE DISTRIBUTIONS OF TEMPERATURE, PHYTOPLANKTON, ZOOPLANKTON AND FISH IN THE PELAGIC ZONE OF A LARGE LAKE

We studied three-dimensional distribution patterns of temperature, phyto- and zooplankton and fish in the large, prealpine Lake Constance during spring 2007. A strong westerly wind induced an intense eastward displacement of epilimnetic water and complete upwelling in the western part of the lake. This led to the formation of an internal front separating cold, hypolimnetic water depleted of chlorophyll in the western part from epilimnetic, warm water with high chlorophyll concentrations in the eastern part of the lake. Hydroacoustic detection of zooplankton (by ADCP) and juvenile fish (by echosounding) revealed both to be passively transported by the wind. When wind velocities were lower, temperature was more evenly distributed whereas phytoplankton distribution was still heterogeneous with high chlorophyll concentrations at locations with increased resource supply. Our results show that spatial distributions of temperature and organisms are strongly controlled by wind forcing when wind velocities are sufficiently high whereas internal factors are responsible for heterogeneous distribution of organisms when wind is less strong. Simulation outputs from a coupled hydrodynamic- ecological 3D lake model (DYRESM-CAEDYM) complied with the observed patterns.

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MICROARRAY-BASED DETECTION OF SULFUR CYCLE-RELEVANT GENE EXPRESSION IN ENVIRONMENTAL POPULATIONS OF ROSEOBACTERS

Bacteria in the marine Roseobacter clade are known to have a central role in environmental sulfur cycles. We designed an oligonucleotide microarray for studying the expression of genes central to the metabolism of DMSP and other related sulfur compounds in natural communities of Roseobacters. The genes of interest for this array were selected based on previous laboratory studies with cultured members of this taxon. The oligonucleotide probes for the micorarray targeted 450 selected genes in *Silicibacter pomeroyi* and the corresponding orthologs in 12 other Roseobacter genomes. The 35-mer probes were generated using a hierarchical design resulting in probes which would detect mRNA transcripts from just one to up to all thirteen of the model genomes. After initial specificity testing in the laboratory, this newly designed microarray was used to follow Roseobacter gene expression during the development of a phytoplankton bloom in nutrient-enriched seawater microcosms. Our results indicate that 38 genes were upregulated and 48 genes were downregulated within the Roseobacter community transcript pool at the peak of the bloom in nutrient enriched microcosms compared controls.

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SPRINGS IN THE NORTHERN CHIHUAHUAN DESERT: NUTRIENTS AND WATER QUALITY MONITORING

A priority of Mexican Authorities (CONABIO) is to develop conservation programs for sustainable biodiversity management in the Northern region of the Chihuahuan Desert, particularly for water resources since drought periods increase groundwater overexploitation and potential loss of natural water systems. However basic limnology information is lacking. We sampled the Ojos Altos springs (3) monthly for one year to characterize physicochemical parameters and nutrients as well as the presence of microinvertebrates. Preliminary data analysis indicates that pH levels (6.08-8.12) were in the range for continental waters; fluctuations in pH (1.78-0.73 units) were observed in the springs through the year. Dissolved oxygen concentration was below the EPA fresh chronic criteria in two of the three springs. Sulfate (552-3496 mg/L) and Ca (468-775.2 mg/L) ions predominated in the springs while chloride (20.8-39.14mg/L) and Na (64.3-183.8mg/L) were found at low concentrations. Trace concentrations of Fe (<8.7mg/L), Cu and Mn (>0.2 and >0.3 mg/L, respectively) were detected. Microinvertebrates consisted of primarily rotifers and copepods. The present study provides basic information to help decision makers in the protection and sustainable management of aquatic systems.

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IDENTIFICATION OF PLFA BIOMARKERS FOR TWO ENDOSYMBIOTIC BACTERIA FROM A MID-ATLANTIC RIDGE DEEP-SEA HYDROTHERMAL VENT MUSSEL USING STABLE ISOTOPE TRACERS

The mytilid *Bathymodiolus azoricus* hosts a dual symbiosis with type I or X methane- and sulphide-oxidising bacteria located in gill epithelial cells. The symbionts are thought to support most of the mussel's nutrition, and their relative abundance appears to be related to CH_4 and HS^- availability at vent fields. To evaluate the relative abundance of both symbionts in mussel gills and to trace the transfer of carbon assimilated by gill-associated bacteria into other mussel tissues, phospholipid fatty acid (PLFA) biomarkers of the symbionts were investigated. We performed *in vitro* ^{13}C-tracer experiments, supplying *B. azoricus* from the Menez Gwen hydrothermal vent field (840 m deep) with ^{13}C-enriched substrates for the bacteria ($^{13}CH_4$ or $H^{13}CO_3^-$ in the presence of sulphide). ^{13}C incorporation in PLFA was monitored by gas chromatography - isotope ratio mass spectrometry. Newly characterized biomarkers should further be tracked in aquarium specimens kept with either methane or sulphide for 3 months and in wild mussels collected at differents periods of the year to observe symbiont responses to geochemical and seasonal events.

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INCORPORATING MORPHOMETRY INTO LAKE WATER QUALITY MODELS

It is shown that a consequence of expressing the nutrient loading to a lake in areal units is that morphometry is not included in the two most widely used steady-state lake water quality models, based on retention coefficient or sedimentation coefficient. Lake depth is known to correlate with important lake characteristics, such lake water nutrient and chlorophyll concentration, primary production, benthic biomass and fish yield, but it is suggested that lake morphometry should be more formally included in steady-state models. It is shown that lake maximum depth, rather than mean depth, is the morphometric property that is best at integrating the recycling of nutrients in relatively shallow lakes (maximum depth<30 m). A model for lake water total phosphorus and chlorophyll concentration is proposed, based on multiple regression with nutrient concentration in the inflow, hydraulic residence time and lake maximum depth as the predictor variables. It includes interaction terms to allow for the relationship between lake water concentration and inflow concentration to vary with (be moderated by) hydraulic residence time and maximum depth.

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BEHAVIOURAL AND TRAIT ADAPTATIONS IN GAMMARIDS AND CHIRONOMIDS TO DROUGHT IN CENTRAL EUROPEAN KARST STREAMS

Karst streams show extreme runoff patterns and can entail even drying of the stream bed within a short period. In Central Europe this pronounced pattern may occur after snow melting in early spring. We investigated two faunal groups in karst streams of the Paderborn Plateau, Germany. Gammarids and chironomids differ in aquatic life span and autecology. They thus were hypothesized to show unequal adaptations to the given conditions. In gammarids, two native species occur in the studied streams, where an ongoing invasion and displacement by the neozoan *Echinogammarus berilloni* can be observed. A comparative experimental study on autecology and biological life traits revealed the advantageous properties of the invador: greater resistance and fecundity during decreasing flow. In chironomids most of the 53 species found were euryoecious and thus suffered local and tempoaral extinction after drought. However, three preadaptations to outlast extreme conditions were observed: short life cycle in a small number of species, flexible behavioural adaptation in the larval stage of *Orthocladius thienemanni*, and a dormancy phase in *Synorthocladius semivirens*.

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COMPARATIVE EFFECTS OF TRIBUTYLTIN (TBT) AND TESTOSTERONE ON MALE AND FEMALE MUSSELS, *MYTILUS GALLOPROVINCIALIS*

Tributyltin (TBT) is an effective biocide that enters the aquatic environment mainly from its employment in antifouling paints on vessels, but also via discharge of wastewaters and dumping sewage sludge. Despite the fact that molluscs are known to be very sensitive to low concentrations of TBT, limited information concerning the mechanism of action of organotin compounds is available. The aim of the present work was to determine the impact of TBT, (at environmentally relevant concentrations) and Testosterone on biomarker responses on marine mussels (*Mytilus galloprovincialis*). The organo-somatic index, the lipid peroxidation level, the gluthation-S-transferase, catalase and superoxide-dismutase activities were assessed after 7 days exposure to increasing concentrations of the masculinizing substances. Results taken together will be discussed taking into account both the organs (gills, digestive gland and gonads) and sex of the bivalve molluscs. They will provide further information concerning the putative toxic effects of TBT.

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CHANGE IN RIVERBED INVERTEBRATE COMMUNITIES FOLLOWING A CATCHMENT-WIDE FLOOD EVENT IN SOUTH YORKSHIRE, ENGLAND

Results from previous research studies on hyporheic community responses to flood events are inconsistent and have rarely covered large areas. The summer floods of 2007 in South Yorkshire, England provided an opportunity to study how the hyporheic communities in multiple rivers respond to a single event. Not only was this a very high magnitude flood event, but it also occurred at a time of year when flooding is uncommon, potentially exacerbating its effects on the stream communities. Pre- and post-flood sampling of both hyporheic and benthic communities enabled us to observe the effects of the flood across multiple stream-types and anthropogenic influences throughout the Don river catchment. While benthic invertebrates were reduced to around 10% of their pre-flood levels for nearly all sites and taxa, hyporheic communities varied in their responses among individual taxa as well as between sites. These results suggest that local habitat complexity and life history characteristics are both important in determining the influence of flood events on hyporheic communities at a catchment scale.

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ENVIRONMENT AND DIATOM DISTRIBUTION IN HIGH MOUNTAIN LAKES: BEYOND WATER PH INFLUENCE

Diatom distribution in oligotrophic lakes are highly related to pH or alkalinity values, and this property have been successfully applied for reconstructing pH changes in the past using sediment records. However, there is still a lot of non explained variability in diatom assemblages when the effects of pH are taken into account. Here we explore what other factors are statistically significant and how they can be used to reconstruct from sediment records other features beyond water chemistry. The study is based on a survey of 72 high mountain lakes in the Pyrenees. The environmental gradients surveyed included the main bedrock types, altitudinal range and lake morphologies. A broad range of variables including proximal to landscape environments were measured at each site. Multivariate analyses were applied to examine species-environment relationships and determine which variables were suitable for reconstruction. Transfer-functions for selected variables were developed and their potential for environmental reconstruction is discussed.

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SELECTIVE GRAZING BY MICROZOOPLANKTON: EFFECTS ON BIOGEOCHEMICAL FLUXES IN THE UPPER OCEAN

Ecosystem processes, which both control biogeochemical cycles and are influenced by climate forcings, are generally regulated by the structure and composition of the planktonic community (i.e. plankton functional types; PTF). The "standing stock" of any PFT (or food web component) is the difference between its rates of growth and loss (i.e. mortality, sinking,, advection). Most (> 75%) of the primary production and carbon and nutrient remineralization in the World Ocean is mediated by autotrophic and heterotrophic picoplankton, and their microzooplankton grazers. Although the rates of growth of some of the PFTs have been measured in the laboratory and estimated during field studies, we know very little about their rates of mortality. In this talk, we combine a meta-analysis of published information and field studies carried out in the North Pacific and the North and South Atlantic Oceans to examine the potential effects of selective grazing by microzooplankton on several key classes of PFTs and the related upper-ocean biogeochemical cycles. Our results show that taxon-specific loss processes are major unconstrained parameters in ecosystem models.

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TEMPERATURE SENSITIVITY OF EXTRACELLULAR ENZYMATIC HYDROLYSIS IN ARCTIC AND TEMPERATE MARINE SEDIMENTS

The hydrolysis of high-molecular weight organic matter by microbial extracellular enzymes is the initial step in sedimentary organic carbon degradation and often seen as rate-limiting factor. Temperature effects on bacteria may therefore exert an indirect control on carbon mineralization. We explored the sensitivity of enzymatic hydrolysis in long-term temperature incubation experiments with North Sea and Arctic sediment under anaerobic conditions over 24 months using long-term incubation temperatures of 0, 10 and 20°C. Temperature gradient block experiments with chondroitin-sulfate suggested that the in-situ bacterial community catalyzing hydrolysis in arctic and temperate sediments appear to be more broadly adapted to temperature shifts than the terminally carbon-oxidizing sulfate-reducing bacteria. In all experiments, concentrations of short-chain fatty acids were low and indicated a tight coupling between the production and consumption of low-molecular weight carbon substrate. Still, higher incubation temperatures led to higher concentration of porewater carbohydrates. This observation corresponded to a decrease in potential hydrolysis rates of both chondroitin-sulfate and sulfate reduction rates and suggests the production of poorly hydrolyzable carbohydrates with increasing temperature. These results suggest that temperature changes in marine sediments significantly affect the downstream carbon mineralization and lead to the formation of apparently more refractory DOC

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EFFECTS OF GRAZING ON BENTHIC ALGAE FOLLOWING NUTRIENT ENRICHMENT IN A FRESHWATER BOREAL MARSH, ALASKA

In this study, we assessed the effects of grazing by the snail *Lymnaea* on benthic algal biomass and abundance following nutrient enrichment. We enriched enclosures *in situ* with a combination of nitrogen, phosphorous, and silica. Inside each enclosure, we deployed caged and un-caged substrates for algal colonization. We used a separate set of enclosures with nutrient enrichment, but without grazers as a true grazer exclusion control to investigate nutrient effects without grazers. Nutrient enrichment increased algal biomass and abundance compared to controls with and without grazers ($p < 0.05$). When grazers were present inside enclosures but excluded from substrates using a cage, algal biomass and abundance were greater compared to un-caged substrates. However, there was no difference between algal biomass or abundance inside grazer excluded enclosures and un-caged substrates ($p > 0.05$). These findings show that grazing directly reduces algal biomass through consumption. Furthermore, they suggest indirect effects of grazing, possibly through changes in nutrient supply. Given our understanding of consumer driven nutrient recycling in other systems, our results may be explained by snail nutrient recycling in the water column.

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ANTARES: A DEEP-SEA MEDITERRANEAN OBSERVATORY IN THE EUROSITES NETWORK

Long-term time-series data can offer some of the most important insights into the ways our oceans are changing. In the framework of EuroSITES (FP7), our objectives are focused on quantifying the in situ remineralisation rates coupled with hydrological parameters of the deep-sea waters at the ANTARES site. ANTARES site is located in the NW Mediterranean Sea and collect real time-data via an electro-optical cable. Principally devoted to neutrino astronomy, the ANTARES consortium has installed a pluridisciplinary instrumented line (IL07) providing high frequency information on key parameters (T, S, currents). These hydrological information, completed with the O2 concentration, will provide insight on the ventilation of the deep ocean as well as integrated long time scale remineralisation rates (Apparent Oxygen Utilisation). A dynamic approach for monitoring oxygen concentration has been developed within the framework of the ANR POTES project. A new tool, the In situ Oxygen Dynamic Auto-sampler (IODA6000) is moored since June 2008 at the top of the ANTARES line L12. This dual approach will provide insight at different time scale on in situ real-time remineralisation rates.

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SCAVENGING OF DISSOLVED ORGANIC CARBON BY BALLAST MINERALS

The reasons for the constant ratio between particulate organic carbon and dry weight (POC: DW ~5%) observed globally in sinking matter below 1000 m are unclear. Possibly, this 5% represents organic carbon coating inorganic particles. We investigated the formation of POC from dissolved compounds in the presence of minerals during 24-hours aggregation experiments. Exudates of diatom cultures were incubated with smectite (clay) or CaCO3 dust at concentrations between 0 and 50 mg L-1. Transparent exopolymer particles, TEP; which form abiotically from dissolved precursors; POC and DW were measured. After 24 h, microscopic aggregates formed and TEP concentrations increased with mineral concentrations. The POC: DW ratios decreased exponentially with increasing mineral concentrations, reaching minimum values of 1.1% and 0.9% for smectite and CaCO3, respectively. Our results indicate that minerals scavenge DOC, generating aggregates of minerals and POC. The carrying capacity of minerals for organic matter was dependent on types of minerals and exudates. The organic coating of minerals of ~1% is too small to explain the ~5% POC: DW ratio found in deep traps.

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MARSH AND COASTAL OCEAN INFLUENCES ON THE RELATIVE CONTRIBUTION OF BACTERIA AND PHYTOPLANKTON TO ECOSYSTEM RESPIRATION IN TERREBONNE BAY, LOUISIANA

Located between the Atchafalaya and Mississippi River deltas, Terrebonne Bay receives water inputs from both water draining the extensive marsh in the watershed and off-shore waters that move into the bay via tides, wind events and other processes. Local marshes flood about 75% of the days each year and sampling during flood-relaxation cycles suggests the marsh is a DOC source for channel waters. This large organic matter source fuels consistently net heterotrophic conditions at the marsh edge with the majority of respiration being done by bacteria. DOC decreases with distance from the marsh edge. When river flow was low in summer, water at a bay station 20 km away varied between net heterotrophy (lower salinity) and net autotrophy (higher salinity) suggesting that greater exchange of marsh-influenced freshwater increases the net heterotrophy of the bay. During spring, when river flow was high, net autotrophy corresponded with low salinity suggesting river-borne nutrient may have fueled net autotrophy. Bacteria generally account for lower percentage of ecosystem R with increasing distance from the marsh edge but the pattern differs with season and environmental conditions.

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CHEMICAL ATTRACTION: HOW PLANKTONIC PROTISTS RECOGNISE THEIR PREY

Planktonic protists are the major consumers of phytoplankton and bacterioplankton in aquatic environments, playing a pivotal role in carbon cycling and nutrient regeneration. Many phagocytic protists, particularly direct intercept feeders, exhibit selective feeding and this selectivity strongly influences the composition of their prey communities. There is a wealth of research that implicates the importance of chemical involvement in predator-prey interactions. Chemical-based selection can either be driven by the prey, through chemical defence, or by the predator, through prey recognition. The latter involves a response to dissolved chemical cues as well as cell surface recognition of prey. Although many studies indicate that chemical interactions play an essential role in prey acquisition and selection, still very little is known about the potential mechanisms involved. In addition to giving a brief overview of chemical interactions between protist predators and their prey, we will present our latest findings relating to proteins involved in cell surface recognition of prey by planktonic protists.

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BIOAVAILABILITY OF EFFLUENT ORANIC NITROGEN IN CHESAPEAKE BAY

Nitrogen from point sources, including wastewater treatment plants, contributes to the eutrophication of Chesapeake Bay. Discharge limits are enforced at these facilities, which attempt to reduce their impact on the environment while keeping technological processing costs to a minimum. A factor that may affect the future of these goals is the potential bioavailability of effluent organic nitrogen (EON). It has been suggested that EON is refractory and should therefore be excluded from discharge limits. Since there is currently no quantitative data to support this theory, we have been conducting bioassay experiments to determine the fraction of bioavailable EON. Effluents from the King William Wastewater Treatment Plant (VA) and the Truckee Meadows Water Reclamation Facility (NV) were added to four salinities (0, 10, 22, and 30 ppt.) collected along a transect in the James River in August 2008. Nutrient concentrations and biomass parameters were measured periodically over 48 hours. Preliminary results indicate that EON bioavailability varied between effluents and salinities.

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THE HYPORHEIC ASSEMBLAGE OF A RECENTLY FORMED STREAM FOLLOWING DEGLACIATION IN GLACIER BAY, ALASKA

Studies on the hyporheic assemblages of glacially influenced streams are scarce and none exist on the hyporheos of new watersheds that have evolved over the last several decades. We focus on the recently formed Stonefly Creek in Glacier Bay, Alaska. This complex system is buffered by 2 lakes and contains two distinctive sections, the upper is fed by surface run-off whereas the lower section is additionally fed by remnant ice. The upper section also contains a barrier to salmon migration. We hypothesized that hyporheic assemblages would differ between stream sites that had differing physical and biological characteristics, in particular suspended solids, temperature and presence of migrating salmon. Eight replicate wells were installed at each of 4 sites and sampled weekly during summer 2001. There were 21 taxa in the hyporheos of this new stream forming a subset of the epibenthic assemblage; obligate groundwater taxa were absent. The hyporheic assemblage differed significantly between sites but not between dates and assemblages were most abundant and diverse where temperature was higher, glacial flour was low and there were no salmon.

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DEVELOPMENT OF AN OSMOTIC SAMPLER FOR TIME-RESOLVED SAMPLING OF MARINE MICROBES IN SITU: CORRELATING COMMUNITY DYNAMICS WITH CHANGES IN HYDROTHERMAL CHEMISTRY

Osmosamplers use osmotic pressure to continuously sample seawater and can be deployed on the order of weeks to years. We have adapted these chemical osmosamplers for microbial sampling by the addition of various reagents in order to collect and preserve proteins, nucleic acids, and cellular structure. A 3-week pilot experiment consisting of independent samplers for ionic and volatile chemistry as well as protein and nucleic acid preservation was deployed at a diffuse flow vent site at the juan de fuca ridge. A significant change in mean temperature was recorded which correlated with a change in chemistry and in the microbial community. Closest relatives of communities sampled were dominated by gamma proteobacteria and were psychrophilic, endolithic and hydrothermal at all time points. The ridgeia piscesae symbiont comprised 21% of one library, and the presence of known sulfide oxidizers correlated with an increase in hydrothermal fluid. This proof-of-concept experiment allowed us to correlate changes in microbial population structure with changes in the physicochemical environment at a discrete location in the diffuse flow hydrothermal environment.

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THE IMPACT OF COASTAL UPWELLING ON AIR-SEA EXCHANGE OF CLIMATICALLY IMPORTANT GASES (ICON)

Coastal upwelling regions significantly influence oceanic biogeochemistry and atmospheric chemistry. They are areas of high nitrous oxide and methane emissions, and upwelled nutrient-rich water causes elevated primary production and a shift in plankton community structure which enhances dimethylsulphide production. Photodegradation of dissolved organic matter influences bacterial activity and the production of climate relevant gases. Upwelled filaments represent an important mechanism for carbon export to the open ocean still absent in global biogeochemical models. It is therefore essential that the biogeochemical characteristics of coastal upwellings are established, however their study is hindered by their complex variability. A UK SOLAS cruise will be the first to use sulphur hexafluoride labelling of an upwelled filament to study the dynamics of the NW African coastal upwelling. The specific objectives are to determine how air-sea exchange of climate relevant gases are influenced by 1) the physical supply of deep supersaturated water to the surface, 2) photochemical and microbiological degradation of upwelled and recently produced dissolved organic matter, and 3) the variability in plankton community structure and activity caused by supply of nutrient-enriched water.

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SHORT AND LONG-TERM CONTINUA IN FLOOD RESPONSE PATTERNS BY MACROINVERTEBRATES AND SESTON IN REGULATED RIVERS

Ecological responses of macroinvertebrates to floods occur at short and long time scales. Short-scale dynamics occur during a flood and include measures of organism drift and organic matter and sediment transport. Long-term response occurs over multiple years and include changes in response patterns as river systems shift to alternate ecosystem states. Spatial continua exist as flood waters are propagated downstream, but also at finer scales within river reaches. Results show that invertebrates and organic matter display different response patterns during floods and that these patterns are translated downstream. Both demonstrate hystersis, although drifting organisms show one peak while organic matter transport show two peaks. Long term dynamics show that response patterns to floods of similar magnitude change over time as rivers shift into alternate states.

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LONG-TERM VARIABILITY IN POPULATIONS OF THE SCYPHOMEDUSAE AURELIA SP. AND CHRYSAORA QUINQUECIRRHA IN THE NORTHERN GULF OF MEXICO WITH LINKS TO CLIMATE CHANGE

Jellyfish, when abundant, are a major pathway for carbon and nutrients in coastal ecosystems and may exert considerable pressure on fisheries through predation and competition. Potential drivers of jellyfish populations include climate forces at varying scales and the effects of anthropogenic activities. To determine if fluctuations in jellyfish populations were related these parameters and to update a previous assessment of long-term variations in two in the northern Gulf of Mexico scyphomedusae species, the abundance and distribution of *Aurelia* sp. and *Chrysaora quinquecirrha* were quantified. Fisheries resource trawl survey data from the National Marine Fisheries Service over a 20-22 year period were grouped into 6 statistical regions extending from Mobile Bay (AL) to the Louisiana-Texas border and seaward to the shelf break. *C. quinquecirrha* have increased significantly in abundance over time and have expanded their distribution offshore south of Louisiana. Increased catch frequency over time overlapped with regions impacted by freshwater discharge from the Mississippi-Atchafalya river system. While climate seemed to be the primary driver of variations in jellyfish populations, the effects of anthropogenic activities are likely compounding.

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IN SITU STUDIES OF THE DARK OCEAN: DEEP PELAGIC BIOLOGY AND ECOLOGY

Deep pelagic research is being transformed by new technologies and new methods that employ direct access to the habitat. MBARI's ROV-based midwater ecology program encompasses a broad spectrum of effort, from time-series surveys and behavioral studies, to in situ measurements of carbon flux and physiology. Results from quantitative video transects have disclosed seasonal cycles, episodic events and steady-state patterns, as well as invasive species and their ecological impact. Observations of behavior include mimicry, ink utilization, the function of tubular eyes, chemosensory activity, and the use of bioluminescence. In situ assessments show that very large, rapidly-sinking aggregates contribute at least a third of the vertical transport of organic carbon to the deep seafloor off Monterey Bay. Oxygen consumption measurements, made at depth and without decompression, provide an improved proxy for metabolic rates. These studies, coupled with continuing exploration, reveal a deep pelagic habitat that is radically different from the dark, empty volume depicted by traditional sampling.

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BOUNDARIES OF A FOUNDATION SPECIES IN A ROCKY SHORE COMMUNITY MAINTAINED BY COMPLEX SPATIALLY STRUCTURED EQUILIBRIA.

On rocky shores of British Columbia, large-scale experiments manipulated the densities of predatory sea stars (*Pisaster ochraceus*) causing vertical shifts in the lower boundaries of their prey, sea mussels (*Mytilus californianus*). While control mussel beds remained unchanged, reductions of sea star densities caused the downward extension of the boundary, and experimental increases in sea star densities caused the upward recession of the lower boundary well into a zone presumed to be a spatial refuge from predation. As small prey were depleted progressively from removal, to control, to addition sites, correspondingly larger mussels were attacked, including large individuals comprising the lower boundary of addition sites. Plots cleared within the initial boundaries were re-colonized to varying degrees, depending on predator densities. After thirty months, plots on sea star removal sites showed high densities of adult mussels, control plots showed intermediate densities, and addition plots showed only a sparse cover of alternative prey species. The findings contradict established theory of zonation based on prey refuges and support alternative theory in which boundaries are maintained by complex, spatially structured equilibria.

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BETWEEN RIVER AND REEF: MODELLING THE IMPACT OF ESTUARINE PROCESSES ON SEDIMENT AND NUTRIENT EXPORTS TO THE GREAT BARRIER REEF LAGOON

The Fitzroy Estuary in Queensland, Australia, receives highly episodic flows and is the largest estuary feeding into the Great Barrier Reef Lagoon. To understand the impact of changes in land use on coastal systems, we need to know not only how much sediment and nutrient material is generated within the catchment, but also how this material is affected by physical and biochemical processes in the river and estuary before it reaches the sea. A coupled, 3D hydrodynamic, sediment dynamic and biogeochemical model, supported by process studies and satellite-derived estimates of total suspended solids and chlorophyll a, has been used to quantify this impact for the Fitzroy Estuary. The results suggest that (a) the estuary and immediate coastal zone tend to accumulate material during flood events but export more than is delivered from the catchment in non-flood conditions; (b) the estuary tends to dampen the immediate impact of changes in land use, but this may not be so in the longer term; (c) the bioavailability of particulate nitrogen has a substantial impact on nitrogen export from the estuary.

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TEMPO AND MODE OF GENOME EVOLUTION IN MARINE CYANOBACTERIAL ECOTYPES

Marine microbes harbor a vast reservoir of functional gene diversity, but how this diversity is partitioned and the rates of gene exchange within populations are largely unexplored. We examined the patterns and rates of gene movement within a single functional guild: 23 marine unicellular cyanobacteria representing 17 ecotypes of *Prochlorococcus* and *Synechococcus*. We combined a genome-based organismal phylogeny with fossil and paleogeochemical evidence to estimate the origin and radiation of picocyanobacterial ecotypes during the last 600 million years, concurrent with major shifts in ocean chemistry and expansion of modern Eukaryotic phytoplankton. Our approach for detecting regions of both gene gain (genomic islands) and regions susceptible to deletion ('genomic lagoons') identified several instances of parallel losses of operons involved in N utilization and transformation. We calculate a lower-bound estimate of gene flux at 14 gains or losses per My per cell, translating to $> 10^{16}$ gene changes each day globally. Over geologic time scales the diverse flexible gene pool and paraphyletic gain and erosion of gene content enables disparate lineages to arrive at common adaptive solutions to life in the oceans.

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PROPAGATION OF VARIABILITY PATTERNS FROM INDIVIDUAL POPULATIONS TO FUNCTIONAL GROUPS AND COMMUNITIES: SPECTRAL ANALYSIS OF PLANKTON LONG-TERM TIME SERIES

Variability patterns of natural populations and communities are of focal interest e.g. within the ongoing biodiversity-stability debate. We study variability patterns at different temporal and hierarchical scales, based on long-term taxonomically resolved, high frequency measurements of plankton abundance in a large, deep lake (Lake Constance). We first examined the spline fits to the time series of individual phytoplankton, crustacean, rotifer and ciliate populations in order to identify the most prominent yearly patterns. We then carried out spectral analysis of the long-term time series, which reveals all periodic components present in the data and allows the characterisation of temporal variability of the different groups as well as their comparison. We also explored the variability patterns of functional groups, entire communities, and primary production, which allows a mechanistic understanding by indicating the turn-over rates within the system. We related the variability patterns found to ecological characteristics of the species and trophic interactions within the food web, and how they propagate to the level of functional groups, communities and the entire food web.

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A PALAEO-ECOLOGICAL RECORD OF NEAR SHORE REEF DEVELOPMENT UNDER CONDITIONS OF HIGH TURBIDITY AND TERRIGENOUS SEDIMENT INFLUENCE.

Recent published data from the central Great Barrier Reef lagoon suggests that sediment loading has increased five to ten fold, total nitrogen discharge has increased by a factor of four, and nitrate and total phosphorus by a factor of ten since the period of European settlement and subsequent land clearance (since circa 1850 AD) [1]. Whilst such inputs have intuitively been regarded as exerting a negative affect on nearshore coral communities, recent studies have shown high live coral cover on many of these reefs and stratigraphic data suggests that these reefs have grown through discrete periods of the mid to late Holocene. In addition, some recent studies have shown relatively stable community structures. This raises interesting questions about how nearshore coral communities may have changed over time in response. This study presents paleo-ecological records from reef cores obtained from King Reef, in the central section of the GBR, and compares these records to modern day coral communities on nearshore reef sites. These cores penetrate through the Holocene reef growth period, and radiocarbon dating shows that maximum reef accretion at this site took place between 6000 to 4000 years BP. 1) McCulloch M., Fallon S., Wyndham T., Hendy E., Lough J. & Barnes D. (2003) Coral record of increased sediment flux to the inner Great Barrier Reef since European settlement. Nature 421, 727-730.

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SUPPLY AND DEMAND: PHYTOPLANKTON AND BACTERIAL PRODUCTION AND DOC IN TROPICAL COASTAL SYSTEMS

Tropical coastal ecosystems are often ignored even though it is now recognised that these ecosystems can be important in terms of coastal carbon cycling. Recent work from New Caledonia and from the Bach Dang estuary, Vietnam, examined carbon cycling in these tropical coastal ecosystems. In the SW lagoon of New Caledonia, bacterial carbon demand was higher than the supply of dissolved primary production, implying a weaker linkage between bacteria and phytoplankton than previously observed in other oligotrophic sites. We also show that Zn additions at concentrations lower than the limits set by environmental protection agencies for tropical waters can result in considerable changes in microbial carbon cycling in both the structure and function of the auto- and heterotrophic compartments. Moreover, Zn contamination resulted in a 2-fold increase in the amount of total primary production incorporated into bacterial biomass. In contrast, in the Bach Dang Estuary, high ratios of BP to DOC point towards a higher lability of organic matter in this system as compared to temperate estuaries. These results further highlight the importance of studying these often neglected tropical systems.

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NATURALLY-OCCURRING ISOTOPES IN GROUNDWATER FROM A KARSTIC MEDITERRANEAN MARSH

The Spanish Levantine coast has numerous marshlands confined by sandy barriers and covered by organic vegetation in decomposition mixed with *terra rossa* (a paleosoil generated by carbonate dissolution consisting on insoluble red clays). This is the case of the Peníscola wetland, nourished by groundwater from a karstic aquifer that was channeled to the sea for agricultural and urban purposes. High concentrations of radium isotopes and radon (e.g. up to 3 kBq•m^{-3} for ^{226}Ra and 600 kBq•m^{-3} for ^{222}Rn) have been measured in marsh waters. The aim of this work was to elucidate the origin of the elevated concentrations of these radionuclides in marsh waters. The relationship between salinity and Ra activities in groundwater suggests that the radium enrichment is related to ionic exchanges between groundwater and clays regulated by the dynamics of marine intrusion and enhanced by the antrophic alteration of the water table. As a consequence, high ^{222}Rn concentrations in air were also measured in some places, such as the water treatment plant that mixes rain, marsh and waste waters.

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RESPONSE OF THE MEDITERRANEAN CORAL CLADOCORA CAESPITOSA TO MID- AND LONG-TERM EXPOSURE TO ELEVATED PCO2 AND TEMPERATURE

It is generally accepted that increase in atmospheric CO2 and seawater temperature will drastically affect tropical corals by the end of the present century. However, nothing is known for temperate corals. The Mediterranean coral Cladocora caespitosa were maintained under normal and elevated temperature (+3°C) and pCO2 (400 and 700 ppm), alone or in combination. Temperature (13-22°C) and light (20-60 µmol m-2 s-1) varied seasonally while pCO2 was kept constant. Photosynthesis and calcification as well as symbiont parameters were measured after one month and during a one-year study. While temperature was the predominant factor controlling the physiology of the coral, pCO2, alone or in combination with elevated temperature, did not affect photosynthesis and calcification. In contrast, tropical corals exhibit lower rates of calcification at elevated pCO2. The lack of sensitivity of C. caespitosa to high-pCO2 levels might be due to its slow growth rate, which seems to be more dependent on temperature than on the saturation state of calcium carbonate in the range predicted for 2100. These results suggest that the conventional belief that acidification could reduce calcification rates may not be widespread in temperate corals.

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FIRST BASELINE LEVELS OF PO-210 IN MUSSELS FROM THE ADRIATIC SEA: EARLY RESULTS FROM THE CIESM MEDITERRANEAN MUSSEL WATCH PHASE II

Polonium-210 (Po-210) naturally occurs in the marine environment at low concentrations, but may become a health hazard because of its high degree of bioaccumulation and

occurrence as by-product of fertilizers and phosphoric acid industries. The evaluation of changes in Po-210 levels cannot prescind from the knowledge of a zero reference. Baseline data on Po-210 concentrations in Mediterranean coastal areas are, however, sparse. This is why the newly launched Phase II of the CIESM Mediterranean Mussel Watch Programme includes this radionuclide among the key contaminants to be surveyed in the region. In this framework, CIESM joined forces with the IAEA. Following a joint international workshop (La Spezia, ENEA MERC, Autumn 2008), a common harmonised analytical approach for Po-210 measurements was selected and applied to the analysis of samples collected from some 15 Adriatic stations within the MYTIAD project (Summer 2008). Scientists from six Mediterranean countries are involved in this initiative which will result in the very first distribution map, to be presented in this meeting, of Po-210 levels in mussels at the scale of the Adriatic sub-region.

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CULTURE STUDIES OF IRON ACQUISITION BY *TRICHODESMIUM*: EVIDENCE FOR FACILE BIOLOGICAL REDUCTION OF IRON IN PHOTOREACTIVE SIDEROPHORE COMPLEXES

The iron acquisition strategies of the ecologically significant marine cyanobacterium *Trichodesmium* were investigated using laboratory cultures of *Trichodesmium* IMS101 and a radioactive isotope of iron. Radiolabeled ferric siderophore complexes and inorganic Fe(III) were used in conjunction with Fe(II) trapping/binding ligands to probe the iron acquisition capabilities of *Trichodesmium*. Results indicate that while strong ferric siderophores such as desferrioxamine B are unavailable to *Trichodesmium*, iron from the photoreactive marine siderophore aerobactin can be accessed to a similar extent as inorganic Fe(III), even in dark conditions. Preliminary data with Fe(II) binding ligands suggests that the majority of *Trichodesmium* iron uptake from Fe(III)-aerobactin is accomplished through biological reduction at the cell surface. These findings suggest that biological reduction of iron from photoreactive siderophores with the alpha hydroxy carboxylic acid binding group may be more significant to *Trichodesmium* iron acquisition than the release of iron via photochemical reduction.

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FUNCTIONAL ROLES OF ARCHAEA AND BACTERIA IN A SUBTERRANEAN ESTUARY AS SUGGESTED BY CHEMICAL AND MOLECULAR MARKERS

Human activity as increased the nitrogen load in coastal waters. A portion of this nitrogen travels through subterranean estuaries (STE), resulting in a different biogeochemical history than over-land runoff. Therefore, it is important to understand the biological processes that are active along this pathway. We present molecular, chemical, and isotopic evidence from porewater and a 3m sediment core taken through the saltwater and freshwater interface of an STE. Results suggest a nitrogen cycling community, segregated with depth, in the sediment column. Archaea dominate the ammonia-oxidizing population throughout the depth interval. Archaeal ammonia-monogenase (amoA) genes are present at all depths with peaks in abundance at the top and bottom of the 150-350uM subsurface nitrate plume. Bacterial amoA follows a similar pattern though in lower abundance. The ratios of the archaeal amoA to total amoA, and archaeal 16S to total 16S approach unity between the bottom of the nitrate plume and intruding salt wedge. Quantification of nitrate reductase genes (nirS and nirK) also reveal an increased presence of nirS between the nitrate plume and the intruding salt wedge.

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A COMBINED APPROACH TO ASSESS THE PHYSIOLOGY AND GENE REGULATION IN HAPLOID AND DIPLOID LIFE-CYCLE STAGES OF *EMILIANIA HUXLEYI*

Emiliania huxleyi with its global distribution, numerical abundance and the ability to form large blooms plays an important role in global carbon cycling. *E. huxleyi* exhibits a haploid-diploid life cycle. Recent work indicates important differences in physiological and ecological properties between both life stages. To explore possible differences in physiology, haploid and diploid stages of E. huxleyi were grown in semi-continuous cultures at low and high photon flux densities (PFD). Photosynthetic oxygen evolution as a function of DIC and PFD as well as external carbonic anhydrase activities were assessed using membrane-inlet mass spectrometry (MIMS). Short-term ^{14}C disequilibrium incubations were used to determine the carbon source(s) taken up for photosynthesis. Gene expression analysis was performed using microarray and quantitative PCR approaches. Our study allowed detailed assessment of physiological properties in combination with gene expression analysis. We present new insights on the light-dependent regulation of photosynthesis and calcification in the different life-cycle stages.

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DROUGHT AND REWETTING: DRIVERS OF RIVER ECOSYSTEM MATTER CYCLING

Abrupt hydrological fluctuations in river ecosystems are responsible for changing connections between benthic, hiporheic and flowing water compartments. Organic matter use and transport might be especially affected during transition from wet to dry and dry to wet conditions. Previous studies in temporary streams showed drastic changes in dissolved organic carbon content and compositions during drought and rewetting. The goal of this study was to further characterize the changes in benthic organic matter quantity and quality linked to changes in the flowing water. Organic matter was analyzed at the different stream compartments: the benthic accumulated material (on the biofilm grown on rocks and cobbles, in leaves and plant material, and in sand), the flowing water (dissolved and particulate fractions), and the groundwater. During wet to dry conditions, the benthic biomass was increased. During dry to wet conditions the available biodegradable organic compounds in the flowing water were efficiently retained. The obtained results suggest two linked effects due to abrupt hydrologic fluctuations: 1- Changes in the microbial use of available organic matter, and 2- changes in downstream organic matter loss dynamics.

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NEW ANTIPROLIFERATIVE COMPOUNDS IN A NON-NEUROTOXIC STRAIN OF THE DINOFLAGELLATE ALEXANDRIUM TAMARENSE

Recently we reported that an unialgal diet of the dinoflagellate Alexandrium tamarense, in both exponential and stationary phase, strongly reduced egg production and hatching success in the copepod Temora stylifera. Grazing rates were relatively constant over time, nevertheless egg viability dropped to 0% after 24 h of feeding. HPLC analyses revealed that the A. tamarense clone was non-neurotoxic and 1H-NMR analyses also revealed the absence of diatom-derived aldehydes. The dinoflagellate extract did not show anti-mitotic activity on sea urchin eggs, however it did block fertilization when eggs were first incubated for 30 min in extracts and then fertilized. We report the isolation of new antiproliferative compounds produced by the dinoflagellate A. tamarense and their identification by LC-MS/MS, GC-MS and NMR. Since low amounts of these products had been recovered from natural sources, a chemical synthesis of their analogues was carried out to perform toxicity tests. The synthetic molecules were tested on sea urchin embryos in comparison with structurally related compounds. These molecules were also tested for their impact on egg viability in copepods.

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A 30-YEAR STUDY (1975-2004) ON WARMING TRENDS ON COASTAL-WATER TEMPERATURES IN THE NW MEDITERRANEAN

We analyzed three 30-year temperature series (1975-2004) recorded at three coastal sites in the NW Mediterranean: Estartit (EST; surface to 80m; Catalan Coast), Villefranche-sur-Mer (VIL; surface to 75m) and Levant (LEV; surface only). Temperature series were based on daily to biweekly records with a fair continuity along the analyzed period allowing a consistent examination of their common/divergent evolution. The three series showed a significant warming trend over the 30-year period: +1°C EST, +0.8°C VIL and LEV. It is noteworthy that EST displayed the lower temperatures compared to the other two sites but showed the highest warming rates. This regional warming trend was based on the increase of the number of warm anomalies for the three surface records and at all depths at EST and VIL. In general, warm anomalies were detected at the three study sites evidencing that the detected warming was driven by regional phenomena over the local conditions. This study will help studies aiming to anticipate the potential consequences of climate change on NW Mediterranean coastal marine habitats.

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ENVIRONMENTAL CONTROLS ON LARGE-SCALE VARIATION IN COPEPOD DIVERSITY

The latitudinal gradient in species richness is a well known ecogeographical pattern showing an increase in species diversity from the poles to the equator. In the light of climate change, an identification of the environmental factors that control and maintain species gradients on the global scale is crucial. Studies on the distribution of copepod diversity, a key taxonomic group in transferring matter and energy from primary producers to higher trophic levels, have been undertaken from a regional to a basin-scale level. We provide, for the first time, a global picture of copepod diversity and examine its relationship with contemporary environmental parameters at an extensive latitudinal extent. We have quantified the influence of sea surface temperature, chemical and physical properties of the water column, primary productivity and seasonality on the geographical variation in copepod richness. Understanding the causes of variation in zooplankton diversity can allow the development of a model to forecast copepod diversity in function of its most important environmental descriptors and anticipate responses in ecosystem structure to environmental changes.

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PRODUCTION OF CHROMOPHORIC DISSOLVED ORGANIC MATTER BY MARINE PHYTOPLANKTON

Chromophoric Dissolved Organic Matter (CDOM) absorbs light at both ultraviolet and visible wavelengths. Due to its optical properties CDOM controls the quantity and quality of available light to phytoplankton in surface ocean waters. A fraction of CDOM emits the absorbed light as fluorescent radiation (FDOM). In marine systems, FDOM is a useful water mass tracer and an indicator of microbial and photochemical processes. FDOM in the oceans is imported from rivers and, mainly, produced *in situ*. While there are clear evidences that bacteria can produce FDOM, the role played by phytoplankton is still controversial. To add new information about the origin of marine FDOM, we performed incubation experiments with axenic cultures of four phytoplankton species of the genus *Chaetoceros*, *Skeletonema*, *Prorocentrum* and *Micromonas*. Our results showed that the four species produce fluorescent humic–like materials. The amount of produced FDOM varied depending on the species. The relevance of these findings for the utilization of FDOM as a tracer for biogeochemical processes in the oceans will be discussed.

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PHYTOPLANKTON STIMULATION DYNAMICS THROUGH A NW MEDITERRANEAN DUST STORM EVENT: AN EXPERIMENTAL SIMULATION

An experiment was conducted to assess the biological response of NW Mediterranean surface waters to Saharan dust additions of different concentrations, simulating aeolian deposition events of various intensities. On the assumption that planktonic growth was limited by phosphorus, dust effects were compared to those induced by equivalent enrichments of inorganic phosphate. Briefly, the maximum addition of dust (0.5 g dust per liter) set off an increase in bacterial abundance followed by a peak in heterotrophic flagellates. After 48h bacterial numbers decayed and an increase in autotrophic organisms –mainly nanoflagellates, but also diatoms- was observed. On the contrary, low inputs of dust (0.05 g dust per liter) and phosphate enrichments (0.5 micromol phosphate per liter) only produced increases in phototrophic nanoflagellates. Shifts within the planktonic community seemed to be dust dose-dependent and strongly related to the release of silicate, phosphate and labile carbon. These shifts are of major interest, because they might affect energy and carbon transfer to upper levels of the marine food web.

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HIGH-SPEED VIDEO REVEALS CAPTURE OF PARTICLES BY DIRECT INTERCEPTION BY CILIA DURING FEEDING OF THE GASTROPOD VELIGER LACUNA VINCTA

Ciliary feeding varies in arrangement of ciliary bands and mechanisms of capture of food. Some larvae use opposed parallel bands of preoral (prototroch) and postoral (metatroch) cilia. Hypotheses for the mechanism of particle capture include filtration by adhesion to a cilium that overtakes a particle (direct interception), but unequivocal evidence for this mechanism has been lacking. High-speed video recordings of *Lacuna vincta* veliger larvae indicated direct interception by prototrochal cilia. Adhesion between cilium and particle was seen when a prototrochal cilium tugged a diatom chain into the food groove. In several recorded events, a prototochal cilium overtook a particle during its effective stroke; then moved the particle inward with its recovery stroke and the particle subsequently moved to the food groove. In other cases, the particle was intercepted multiple times in one capture event or several cilia passed a particle without interception. Particles occasionally remained in the area of recovery strokes, indicating retention without continuing adhesion to a cilium. In three events, a particle lost from prototrochal cilia was intercepted and moved into the food groove by metatrochal cilia.

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DYNAMICS OF SUPEROXIDE PRODUCTION AND DECAY IN THE GREAT BARRIER REEF LAGOON

Redox conditions in the surface oceans are determined primarily by the chemistry of oxygen, with pseudo-equilibrium controlled by its dominant oxidation states, dioxygen and water. Perturbations to this pseudo-equilibrium, including formation of the reactive oxygen intermediates superoxide and hydrogen peroxide, are of paramount importance since exploitation of the energy contained in non-equilibrium chemical systems is required for life. On a cruise in the Great Barrier Reef lagoon, we measured superoxide steady-state concentrations, decay rates and formation rates, as well as steady-state concentrations of hydrogen peroxide at several locations. Microorganisms were found to be a major source of superoxide, and superoxide decay was observed to be slow at measured picomolar steady-state concentrations. Additionally, superoxide decay did not necessarily result in hydrogen peroxide formation. These findings suggest that organisms are able to use superoxide to create an environment that will facilitate the reduction of critical trace metals including iron and copper. At the low superoxide concentrations measured this process would be expected to require minimal energy expenditure, and would not create conditions conducive to production of harmful intermediates such as hydroxyl radicals.

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A MULTIPLE TROPHIC LEVEL LABORATORY STUDY OF INCREASED CO2 AND TEMPERATURE INTERACTIVE EFFECTS ON SOUTHERN OCEAN PLANKTON

Laboratory culture studies of potential climate change impacts have largely focused on single factor effects on phytoplankton. This approach may miss interactive effects on phytoplankton growth and physiology, and does not consider potential effects on trophic dynamics. Our experimental design incorporated individual and combined effects of increased temperature (+5oC) and pCO2 (+370 ppm) on a diatom (Chaetoceros) and a haptophyte (Phaeocystis) isolated from the Ross Sea, Antarctica. After characterizing temperature and pCO2 effects on photosynthetic parameters, nutrient ratios and intracellular quotas of these acclimated cultures, the phytoplankton were fed to a Ross Sea ciliate isolate (Euplotes) grown under the same conditions. This experimental design enabled examination of direct and indirect effects of the physiochemical factors and changes in prey quality on the protistan grazer. Differences in interactive temperature and pCO2 responses were observed between the two phytoplankton cultures, but increasing temperature had a consistently greater effect on all three cultures than did increasing pCO2. Our experiments demonstrate that a laboratory culture approach can be effectively used to investigate complex interactive variable impacts within a simple model marine food web.

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NUTRIENT DYNAMICS, TROPHIC STATE AND WATER QUALITY IN TWO MEDITERRANEAN COASTAL LAGOONS.

The Water Framework Directive (WFD) establishes a framework for the protection of all waters (including inland surface waters, transitional waters and groundwater) in order to achieve "good ecological status" by the year 2015. The Directive requires definition of ecosystem "typology" and "ecological status". Nevertheless, transitional water ecosystems are characterised by intense and sometimes unpredictable spatial and temporal variability in physical-chemical and biological conditions. This contribution aims to investigate the physical, biogeochemical and biological processes and their interactions, that determine

the trophic status of the two coastal lagoons of Lesina and Varano, on the southern Adriatic Sea coast (Italy). They are geographically adjacent therefore are influenced by the same meteorological forcing and tidal range; otherwise, the two lagoons are different in geomorphological features, salinity range, water residence time, nutrient loads and are influenced by different human activities in watershed. Physical-chemical parameters, nutrients and chlorophyll a concentrations, total and organic particulate matter were measured. Several indexes have been applied to classify the trophic state and water quality of these lagoons.

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IMPACTS OF MACROZOOBENTHOS ON HYDRODYNAMIC PROCESSES AT SEDIMENT-WATER INTERFACES

Tube-dwelling macrozoobenthos, e.g. *Arenicola marina*, *Urechis caupo*, *Nereis diversicolo* and *Chironomus plumosus*, builds U- or Y-shaped burrows inside the sediment and pumps water through the burrows for oxygen and food supply. Bioirrigation induces an advective transport of dissolved particles inside and outside the sediment. To evaluate impacts of macrozoobenthos the flow velocities in the burrows, the alternation of pumping and resting and transport processes in the sediment surrounding the burrows were analysed. Flow velocities in the burrows were measured with colour tracers and particle image velocity (PIV) on the example of *C. plumosus* larvae. This macrozoobenthos species irrigates muddy sediments and occurs in high abundances in limnic environments. The medical nuclear imaging technique positron-emission-tomography (PET) was applied to identify advective and diffusive transport caused by the organism in the sediment in the vicinity of the burrows. Our results show that flow velocities produced by *C. plumosus* larvae were underestimated up to now and bioirrigating macrozoobenthos highly affects the hydrodynamics in the sediment surrounding the burrows. Furthermore, a small-scale transport model was developed based on the results of the measurements.

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THE EFFECTS OF CORAL MORPHOLOGY ON SMALL-SCALE LOCAL FLOW PATTERNS

Small-scale flow patterns around individual coral colonies affect nutrient uptake and particle capture by the corals themselves and determine the flow environment experienced by corallivores. These small-scale flow patterns also determine the net drag exerted on the flow by individual coral heads and characteristics of the turbulence injected into the bottom boundary layer. Therefore, small-scale flow patterns around individual coral heads also have important implications for modeling larger scale flows over reefs. Morphological characteristics such as polyp size, branch thickness and spacing, and branching frequency vary widely between coral individuals. The irregular solid geometry and small-scale spatial variations pose significant challenges for measuring flow details in and around corals. In this study we obtained coral geometry from a CT scan of a Stylophora pistillata skeleton. A high-resolution three-dimensional computational grid was constructed from these data and the flow through and around an individual coral colony was simulated using the fluid mechanics solver FLUENT. Coral branch diameter was systematically varied by thinning and expanding branches to look at the effects on drag forces, turbulent fluxes and within-colony residence times.

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FRESHWATER BIODIVERSITY UNDER CLIMATE PRESSURE: THE WINNERS AND THE LOSERS IN ALPINE PONDS

Climate change is expected to have significant impacts on freshwater biodiversity. Ponds are abundant and widespread, and because of their small size they shelter simple communities, particularly in altitude. Therefore, alpine ponds should play an important role as sentinel and early warning systems in the assessment of the future changes in local biodiversity. Using predictive models, we forecast the potential response to climate warming of macroinvertebrates, Odonata, amphibians and vegetation for alpine ponds of Switzerland. The upper ranges of pond species richness were predicted for 2100. Predictions evidence potential strong species enrichment. This will result of a positive balance between numerous colonization events by lowland species (the "winners") and sparse extinction events of cold stenothermal species (the "losers"). Taking the Odonata as example, only 12% of the Swiss species pool is composed of cold stenothermal species, at risk of extinction. The other 88%, currently living in lowland, are potential colonisers of high altitude ponds. Furthermore, four Mediterranean species of Odonata have already colonized Switzerland these last 20 years.The same trends are also underlined for the other taxa.

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EFFECTS OF AGE AND MANAGEMENT PRACTICES ON BENTHIC INVERTEBRATE COMMUNITIES IN THREE SAND-PIT LAKES OF NORTHERN ITALY

In the last decades an increasing number of artificial lakes have been formed in northern Italy as a consequence of quarrying, especially in river floodplains. In the framework of a wider limnological research focused on the hydrochemical and biological characteristics of three sand-pit lakes of the Po river plain, the composition and depth preferences of their macroinvertebrate communities were investigated. One lake was still under dredging during the study period, whilst in the other two sand quarrying finished in the mid-1960s and 2004, respectively. In all the lakes, the most rich and diversified benthic assemblages were found in the littoral area; the deepest part was inhabited by few species adapted to hypoxic conditions (Chironomini and Tubificidae). The oldest lake, stocked and managed for sport fishing, showed the poorest community, with only small-sized organisms (such as Hydracarina, *Dugesia* sp., *Micronecta* sp.). In the others two lakes, currently under reclamation, Ephemeroptera Baetidae and Ephemeridae, Coleoptera Dytiscidae and Hydrophilidae, and Odonata Aeschnidae were found. Our results indicate that pit lakes, if correctly managed, may represent important hotspots of freshwater biodiversity in anthropized areas.

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MODELLING APPROACH TO CLIMATE AND ANTHROPOGENIC CHANGES ON WATER AND SEDIMENT FLUXES. CASE STUDY OF THE MISSISSIPPI RIVER.

Great rivers like the Mississippi River integrate the hydrologic response to climate at near-continental scale. By using wavelets analysis, we identified the principal modes of variability in hydrologic time-series data (streamflow, suspended-sediment) for 1950-1975 and compared them to climate fluctuations and anthropogenic changes in the watershed. Results showed common spectral structures dominated by intra-annual and annual fluctuations, however, significant inter-annual and multi-year fluctuations also were detected. These results indicate strong climatic influences that could be related to well-known patterns, for example ENSO. The analysis also indicates a loss of energy in the suspended-sediment load signal which can be attributed to anthropogenic changes, principally the construction of large reservoirs on the Missouri River in the 1950s. By parameterizing a sinusoidal model based on the observed spectral composition, we were able to remove the effect of this energy loss and estimate what suspended-sediment loads would be without the anthropogenic changes. From 1950 to 1975 the estimated decrease at the mouth of the Mississippi at the Gulf of Mexico was $2.25x10^8$ $t.y^{-1}$.

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RED CORAL (CORALLIUM RUBRUM) ACTIVITY: ENDOGENOUS RHYTHMS VERSUS EXTERNAL SIGNALS

Activity in passive suspension feeders has been related with factors such as hydrodynamism, water temperature or food concentration. To better elucidate the driving forces controlling activity rhythms in passive suspension feeders, the Mediterranean octocoral Corallium rubrum was investigated following three different approaches: 1) Seasonal in-situ monthly observations at 20m depth, 2) High frequency (one week) in-situ observations at the same depth, and 3) Laboratory video-recording flume controlled experiments. No clear seasonal trend was found in red coral activity. In the field, C. rubrum activity tightly correlated with tidal oscillation (open colonies at high tide). Laboratory experiments showed clear endogenous rhythms when no current, no chemical cue and no food were tested in filtered sea water. Increasing current speed significantly increased red coral activity, but the addition of chemical cue and food concentration had a higher effect on polyp expansion. It is concluded that several components (both endogenous and external) structure the complex behaviour of C.rubrum activity rhythms.

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MICROBIAL CARBON FLOW AND DIET SHIFT IN MACROFAUNA CONSUMERS DURING COMMUNITY REASSEMBLY IN INTERTIDAL SEDIMENTS

After disturbance, carbon flow in food webs may develop according to the diversity and identity of reassembling consumer communities. Consumers may also express plastic feeding behavior with consequences on ecosystem functions. Using ^{13}C as a tracer, we studied the relation between macrofauna communities and microbial carbon flow during recovery after severe hypoxia. We then asked whether the consumers contributing to carbon flow changed diet and functional role during community reassembly. Microbial carbon flow recovered faster than macrofauna community. More than 90% of microbial carbon flow to macrofauna was due to two consumers that recolonised within two months (*Macoma balthica* and *Hediste diversicolor*). *M. balthica* based its diet on benthic microalgae at an early stage of community development and utilized microalgal carbon more efficiently when early recolonisation took place during its reproductive period. During community reassembly, the simultaneous increase in biomass and decrease in microalgal diet maintained the accumulation of carbon by *M. balthica* constant. The dynamic relationship between population dynamics and feeding behavior deserves attention if we are to understand how biodiversity affect ecosystem functioning.

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APPLICATION OF SOUND WAVES TO CONTROL OF MNEMIOPSIS LEIDYI DENSITY IN LABORATORY CONDITION

Mnemiopsis leidyi (ML) which is originally native of the western Atlantic has been introduced in Caspian Sea in 1999. It has resulted in significant reduction in catches of kilka since 2001. Furthermore, it strongly reduced food resources for some large predators such as the beluga (Huso huso) and the Caspian seal (Phoca caspica).
The application of sound method developed by Idegostar-e- Sabz Research Group (ISRG), is aimed to reduce the density of ML. A total of 5 separated aquariums, which were the same in size, were filled by 25 Liter of filtrated sea water. Three aquariums were undertaken with sound wave as experiment and two others without any sound interference as control group. A total of 26 ML (13 mature and 13 immature), were released in each aquarium. The effects of under water sound (with the specific frequency) on ML were examined in a period of 8 days. Chemical and physical factors of sea water in each aquarium were monitored during the test period to check if the conditions are the same or not. The results already showed a promising reduction of ML in 3 experimental aquariums. It seems that this new method can be applied for controlling the density of ML and other gelatinous zooplankton.

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INTERCALLIBRATION OF REFERENCE CONDITIONS OF ENVIRONMENTAL INDICATORS BY ASSESSING FUNCTIONAL RELATIONSHIPS IN COASTAL ECOSYSTEM IN NE BALTIC SEA.

Assessment schemes for water quality of coastal waters under EU Water Framework Directive require establishment of reference conditions for used indicators to represent the state of the environment in case of minor human influence. Establishment of reference conditions has been made using variety of different methods and concepts including ecological modeling, paleoecological studies, using reference sites with low human impact and utilizing simple expert judgment. In our study we collected reference conditions of different biological and physical-chemical variables published in recent scientific literature as well as used by different water quality assessment schemes in northern Baltic Sea area. Functional relationships between different environmental and biological variables were established using monitoring data available through national and international (HELCOM, ICES) databases. Available reference conditions for pelagic variables as nutrient and chlorophyll a concentrations as well as different indicators of submerged aquatic vegetation were intercallibrated using established functional relationships.

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AIRBORNE ACIDIFICATION OF HEADWATERS: CAN IT BE DIFFERENTIATED FROM NATURAL CONDITIONS USING BIOTA?

Although anthropogenic acidification of lakes in the central and Southern Alps is well known, the effects of airborne pollutants on springs and headwater streams have hardly been documented. We studied water chemistry, benthic algae (focus on diatoms) and chironomids in headwaters of the UNESCO-Biosphere-reserve "Gurgler Kamm" with very-low-conductivity springs and outflows of an airborne acidified lake. We want to test the similarity/difference between various hydrochemical settings, and to test if acidified sites can be distinguished from natural low conductivity / pH environments by means of the biota. For this purpose the knowledge on habitat templets of chironomids and diatom species (mostly belonging to the genera Achnanthes sensu lato and Eunotia) from extensive earlier studies in high mountain springs and streams will be used. These should be a useful reference to classify the biota in question concerning potential acidification effects and their causes.

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PRODUCTION AND TRANSPORT OF PARTICULATE MATTER IN A REGIONAL CURRENT SYSTEM ADJACENT TO A FRINGING CORAL REEF

Recent studies have suggested that reefs may rely on importation of particulate matter from the adjacent ocean to sustain their high productivity. Here we examine cross-shelf gradients and transport of particulate organic matter and primary production in the Leeuwin Current system adjacent to Ningaloo Reef, Western Australia. Primary productivity, particulate matter, nutrient uptake rates and phytoplankton abundance and diversity (based on HPLC) were sampled in May 2008 along an 18km-transect running from the reef slope to the 500 m isobath, demonstrating marked variation over a short temporal scale (one week). On the first day of sampling, horizontal onshore-offshore gradients in salinity were observed and the phytoplankton community was dominated by diatoms with 10X greater concentration offshore (0.182 µg fucoxanthin/l) than close to the reef (0.02 µg fucoxanthin/l). During the following 48 h the physical and biological parameters along this transect became more uniformly distributed. Particle transport mechanisms are illustrated using modelling of particle trajectories, providing an explanation for the rapid temporal change observed in cross-shelf gradients, which has implications for the potential supply of oceanic particulate matter to the coral reef community.

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EVIDENCE FOR CONTROL OF FE(II) OXIDATION RATES BY STRONG FE(III) COMPLEXING ORGANIC LIGANDS IN EASTERN SUBARCTIC PACIFIC SURFACE WATERS

The redox cycling of Fe in seawater likely influences iron availability to phytoplankton, particularly in iron-stressed regions. We measured vertical profiles of Fe(II) oxidation rates (Fe(II)0=100 pM) in the eastern subarctic Pacific (OS PAPA 50° N 145°W) and adjacent continental shelf waters. Fe(II) oxidation rates were markedly faster in freshly collected surface seawater than measured after UV oxidation (UVO), which matched model predictions. Even so, oxidation rates in surface waters converged with UVO rates with progressive, stepwise Fe(II) additions. Conversely, Fe(II) oxidation rates measured in untreated and UVO waters from beneath the mixed layer were in close agreement, and these rates were not affected by Fe(II) titration. We hypothesize that Fe(II) oxidation in surface waters is accelerated by excess concentrations of strong Fe(III)-complexing organic ligands known to occur in seawater, and that this effect diminishes as excess (free) ligands are titrated with iron or destroyed by UVO. Given that Fe(II) oxidation rates were enhanced only in the surface mixed layer, our findings suggest that the nature and perhaps origin of organic Fe(III)-complexing ligands may differ between surface and deep waters.

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MODELLING THE EFFECT OF BOUNDARY SCAVENGING ON THORIUM-230 PROFILES IN THE OCEAN

The "boundary scavenging" box model is a cornerstone of our understanding of the particle-reactive radionuclide fluxes between the open ocean and the ocean margins. However, this box model does not describe the radionuclide profiles in the water column. As a consequence, particle settling speed a currently estimated with the 1D scavenging model. Here, I present the transport-reaction equations for radionuclides transported vertically by reversible scavenging on settling particles and laterally by horizontal currents between the margin and the open ocean. Analytical solutions are compared with existing data. In the Pacific Ocean, the model produces "almost" linear Thorium-230 profiles (as observed in the data) despite lateral transport. However, omitting lateral transport biased the Thorium-230 based particle flux estimates by as much as 50%. In the Arctic Ocean, the model reproduces non-linear Thorium-230 measured profiles that the 1D scavenging model or the scavenging-ventilation model failed to explain. Moreover, if lateral transport is ignored, the Thorium-230 based particle settling speed may by underestimated by a factor 4 at the Arctic Ocean margin.

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ROLE OF ALONGSHORE EKMAN TRANSPORT AND EKMAN PUMPING DUE WIND-CURL ON A MID-YEAR SECONDARY UPWELLING IN THE SOUTHERN CARIBBEAN SEA

We describe the contribution of alongshore Ekman transport and Ekman pumping to coastal upwelling in the Southeastern Caribbean (62°;W-64.75°;W). Alongshore wind-driven upwelling during December-April is known in the southeastern Caribbean, but a pulse around June-July, when coastal-wind is weaker, has not been explained. Satellite-derived offshore-wind from QuikSCAT was used to calculate Ekman transport (~ 37km from coast) and Ekman pumping due wind-curl (integrated until 100km offshore). Coastal-winds from local meteorological stations peak around March-April, while QuikSCAT offshore-winds showed an extended seasonal maximum (November-June). Calculated Ekman transport showed similar pattern as offshore-winds, while Ekman pumping presented small peaks in January, April and July. Overall, Ekman transport was the major contributor to upwelling in the Southeastern Caribbean (~ 85%). Due the extended maxima of offshore-winds, Ekman transport is the main cause of the secondary upwelling, although the contribution by Ekman pumping increased to > 20%. However, there are no QuikSCAT data closer to the coast, where winds tend to be weaker, which could result in overestimations of Ekman transport and sub-estimations of Ekman pumping.

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DOES IT IS POSSIBLE TO EVALUATE THE EFFECTS OF CREATION OF ESTUARINE INTERTIDAL MUDFLAT THROUGH THE MACROBENTHOS? CASE OF THE SEINE ESTUARY

Last infrastructure developments along Seine estuary (Normandy Bridge and Port 2000) have generated creation of mudflat to balance long term decrease of intertidal zone. North mudflat plays important role as nursery for several fishes, and is essential for shorebirds and waterfowl. Macrobenthic data (1987 to 2006) show very strong intra and inter annual variability's. Nevertheless, trends show a decrease for N. diversicolor suggesting a relationship between its occurrence and the sedimentology with two successive periods (1987-1997 and 2000-2006) correlated within the annual river flow. Similar trends were identified for C. volutator and M. balthica which are sensitive to mudflat surface changes and to meteorological variables: freshwater input, sediment change from mud to sandy mud due to decrease of freshwater flow. No relationship was observed for S. plana. This study illustrates the difficulty to identify relevant indicators to determine the effects of restoring estuarine functions and systems in the presence of both anthropogenic stress and natural and climate variability (sedimentology, river flow, salinity, temperature…), and the need to adapt sampling to estimate compensation actions of restored mudflat surfaces after infrastructure developments.

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SCIENCE OBJECTIVES AND DESIGN OF THE EUROPEAN SEAS OBSERVATORY NETWORK (ESONET)

The European Community is developing a European Seas Observatory NETwork (ESONET) to address a growing set of Earth science questions that require a broad and integrated network of ocean and seafloor observations. There is now wide recognition that research addressing science questions of international priority, such as understanding the potential impacts of climate change or geohazards like earthquakes and tsunamis should be conducted in a framework that can address questions across adequate temporal and spatial scales. We will outline several international science priorities in the four interconnected fields of geoscience, physical oceanography, biogeochemistry, and marine ecology, as well as the practical ways in which these questions can be addressed using ESONET. The development of ESONET provides a substantial opportunity for ocean science to evolve in Europe. Furthermore, ESONET and several other developing ocean observatory programs are integrating into larger science frameworks including the Global Earth Observation System of Systems (GEOSS) and the Global Monitoring for Environment and Security (GMES) program.

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DENITRIFICATION IN THE ARABIAN SEA: A 3D ECOSYSTEM MODELLING STUDY

A three-dimensional hydrodynamic-ecosystem model was used to examine the factors determining the spatio-temporal distribution of denitrification in the Arabian Sea. The ecosystem model includes carbon and nitrogen as currencies, cycling of organic matter via detritus and dissolved organic matter (DOM), and both remineralization and denitrification as sinks for material exported below the euphotic zone. Model results captured the marked seasonality in plankton dynamics of the region. Predicted denitrification was 26.2 Tg N yr -1, the greatest seasonal contribution being during the northeast monsoon when primary production is co-located with the zone of anoxia. Detritus was the primary organic substrate consumed in denitrification (97%), with a small (3%) contribution by DOM. Denitrification in the oxygen minimum zone was predicted to be fuelled almost entirely by organic matter supplied by particles sinking from the euphotic zone above rather than from lateral transport of organic matter from elsewhere in the Arabian Sea. Analysis of the carbon budget in the zone of denitrification indicates that the modelled vertical export flux of detritus is sufficient to account for measured bacterial production below the euphotic zone.

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IMPACT OF EPILIMNETIC PHOSPHORUS SUPPLY AND FOOD WEB STRUCTURE ON PHOSPHORUS SEDIMENTATION IN A THERMALLY STRATIFIED LAKE. RESULTS FROM ENCLOSURE EXPERIMENTS.

The downward phosphorus transport in lakes occurs due to chemical and biological processes influenced by trophic status and food web structure. *Daphnia* increase P sedimentation from epilimnion by additional transport of their exuviae and death individuals as well by high specific P content in their bodies. On the way into sediment, settling particles are transformed by microbial and chemical processes, which intensity depends on particles residence time in water column and availability of P binding forms. Consequently, P retention in sediments is indirectly affected by food web. In enclosures, we examined the impact of epilimnetic P supply (P_{epi}) and *Daphnia* biomass on P sedimentation and P content in settling matter. Moreover, P fractions at sediment surface at the end of stratification were characterised. Our experiments showed that mean specific P content in settling particles was significantly affected by P_{epi}, but not by food web structure. Total P content in sediments was significantly influenced by P_{epi} and correlated positively with Fe-bound P. Organic P fraction in sediment was not affected by P_{epi} and was higher when *Daphnia* dominated.

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COMBINING TH-234, BE-7 AND PB-210 TO INVESTIGATE PARTICLE DYNAMICS IN ESTUARIES: EXAMPLE OF THE GIRONDE ESTUARINE SYSTEM (S.-W. FRANCE)

There is a growing interest in understanding the mechanisms controlling the fate of particles and of associated contaminants at the land – ocean interface. Many chemically reactive contaminants are associated with particles, as are the naturally-occurring radioisotopes: Th-234 (half-life = 24.1 days), Be-7 (half-life = 53.3 days) and Pb-210 (half-life=22.3 years). The combination of these radioisotopes of different half-lives and origins is therefore an attractive approach to investigate particle dynamics in systems as complex as estuaries. Here we report a first attempt to apply these tracers in the Gironde Estuary, a macrotidal estuary in the S-W France. Suspended particulate matter (SPM) was collected monthly in 2006 and 2007 at repeated stations. Particulate activities of the considered radionuclides show large spatial and temporal variations, and these are more pronounced in the downstream estuary where the change of salinity due to mixing of ocean and fluvial waters is the largest. These changes could be ascribed to differences of particle residence times in the estuary. Aging of SPM, calculated from radionuclides, ranges from few weeks to several months depending on flow discharge and season.

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HYDROLOGIC DISCONTINUITY IN RIVER SYSTEMS: IMPLICATIONS FOR ORGANIC MATTER, BIODIVERSITY AND METABOLISM

Temporary streams and rivers are a common phenomenon in arid and semiarid areas, and they are expected to expand in space and time due to increasing water stress. As a consequence, hydrologic discontinuities will cause major shifts in ecosystem processes and biodiversity, both during the aquatic and terrestrial phases. Water flow interruption, at the surface and in the hyporheic zone, determines the quantity and quality of organic materials transported, including its biodegradability, and therefore their potential use by microorganisms. Autotrophic production may be a source of available organic matter, especially during low flow episodes. These interruptions in connectivity may have implications on the biodiversity and the metabolism of entire river networks, which may again will lead to major changes in the ecosystem services they provide.

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MOLECULAR COMPOSTION AND CELLULAR TEMPLATING OF THE GELATINOUS FILTER-FEEDING LARVACEAN HOUSE

Urochordate Appendicularians rely on a complex extracellular house, repetitively secreted from a monolayer epithelium, to filter food particles from seawater. To understand house structure and evolution, we used protein microsequencing and cDNA RDA to isolate a panel of genes (oikosins) expressed from epithelial sub-regions. Antibodies to some oikosin proteins have been generated to analyze specific structural roles in the house. We also identified a cellulose microfibril architecture underlying house construction. Urochordates are the only animals known to synthesize cellulose. Analysis of Oikopleura dioica cellulose synthase genes was consistent with a single prokaryotic gene transfer event at the root of the urochordate lineage. Through targeted disruption of cytoskeletal elements, secretory pathways, and plasma membrane organization, we find a cortical F-actin array templating microfibril orientation and glycosylphosphatidylinositol-anchored proteins in lipid rafts that may act as scaffolding proteins in microfibril elongation. Microtubules are involved in delivery and maintenance of cellulose synthase complexes to specific cell membrane sites. We elaborate a model for templating extracellular cellulose microfibrils in animal cells that shows convergence but also significant differences with phylogenetically distant plant models.

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ARE PELAGIC CILIATES AND HETEROTROPHIC DINOFLAGELLATES DIFFERENT ENOUGH TO BE SEPARATED IN ECOSYSTEM MODELS?

In pelagic ecosystem models, microprotozooplankton is often represented as one group feeding mainly on bacteria, nano- and picoplankton. This representation does not take into account differences between the organisms composing this group. Microprotozooplankton consists of two predominant groups of organisms: ciliates and heterotrophic dinoflagellates. They show different feeding modes and prey preferences. Ciliates are filter feeders, feeding on prey that is one tenth of their size. Heterotrophic dinoflagellates are raptorial feeders. They digest their prey externally, and are thus able to feed on prey up to ten times bigger than themselves. We compiled and analyzed data on grazing and growth of microprotozooplankton in order to derive parameterizations of grazing and growth rates for ciliates and heterotrophic dinoflagellates. We found lower grazing and growth rates for the dinoflagellates in comparison to the ciliates. Feeding preferences were also derived from the response of the maximal grazing and growth rates, half-saturation and threshold concentrations to the species of the offered prey. These parameterizations have been implemented in a global marine biogeochemical general circulation model (PlankTOM5). Splitting the microzooplankton into ciliates and heterotrophic dinoflagellates results in different grazing impacts, modifying the partitioning of the phytoplankton types they are preying on and thus also the primary production.

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SEASONAL EFFECTS OF VIRUSES AND PROTISTS ON BACTERIAL ACTIVITY

The effects on the bacterioplankton of their main consumers: viruses and heterotrophic nanoflagellates were followed in experiments using natural populations of coastal marine plankton. Four experiments were run, one in each season. Microcosms were filled with water filtered through 0.8 um or 5 um (containing only bacteria or both: flagellates + bacteria). Active viral concentrate was added in a half of the treatments, and inactivated virus concentrate in the other half. Microcosms were incubated for two days at in situ temperature and light conditions. We determined the activities of several ectoenzymes (alkaline phosphatase, aminopeptidase, beta-glucosidase) and we also analyzed functional diversity by determining the carbon sources potentially used by the bacterial community in Biolog plates. Addition of predators, viruses or flagellates, resulted in a decrease of specific ectoenzymatic activities. However, the highest decrease was observed for aminopeptidase (proteolytic) activity in the treatments enriched with viruses. Our results suggest that viral lysis of bacteria can be a source of amino acids and nitrogen containing carbon sources.

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UNDERSTANDING SURFACE DISSOLVED INORGANIC CARBON (DIC) DYNAMICS IN DIVERSE OCEAN ENVIRONMENTS, USING IN-SITU OPTICAL AND REMOTELY- SENSED DATA.

A major goal of our research is to develop methodologies that will enable remotely sensed retrievals of surface DIC status and its rate of change. We report on progress in three research efforts. The first describes relationships between in-water partial pressure of carbon dioxide (pCO2) and optical data in the complex coastal waters of the Gulf of Maine. The second reports on a methodology for understanding the spatiotemporal behavior of surface DIC dynamics through an analysis of satellite-derived particulate organic carbon stocks within a Lagrangian space-time frame. Finally we show preliminary results from a new project whose goal is to develop algorithms aimed at retrieving basin-scale pCO2 using MODIS ocean color satellite data. Satellite retrievals of DIC behavior are challenging because of the varying length & time scales of processes modulating DIC, as well as time lags between productivity and air-sea gas exchange. We submit that retrieval methods capable of tracking satellite data in time and space, and/or algorithms based within well-defined hydrographic or optical provinces will show the most promise.

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SOME OBSERVATIONS ON SPATIAL AND VERTICAL DISTRIBUTION OF GORGONIAN ASSEMBLAGES IN THE N. AEGEAN SEA

Knowledge on distribution, abundance and diversity of coralligenous communities with gorgonian facies is still rather poor in the Eastern Mediterranean Sea. This is mainly due to their considerably deeper distribution than their Western Mediterranean counterparts. In the framework of Nautilos 2008 Research Project a combined Submersible and ROV survey was conducted in a first attempt to assess the spatial and vertical distribution of such populations in the Aegean Sea. In 15, out of a total of 18 study sites, various gorgonian assemblages were recorded within a depth range of 36-117m. In general, Eunicella cavolinii and Paramuricea clavata were found to be the dominant species, while E. singularis and Corallium rubrum where only ccasional findings. Considering the susceptibility of these habitats to various anthropogenic impacts, this is an important first attempt to map their spatial distribution and give a general description of their composition and present ecological state.

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INCREASED USE OF NUTRIENTS OF ANOXIC HYPOLIMNION BY MOTILE PHYTOPLANKTON INDUCED BY EPILIMNETIC NUTRIENT DEPLETION

Lake phytoplankton is generally assumed to utilize epilimnetic nutrients. However, there is growing evidence from ponds to oceans that deep water nutrients are also available through various behavioural strategies. Particularly when hypolimnion is anoxic, high nutrient concentrations may be available relatively near to epilimnion. We applied a whole pond experiment to study how phytoplankton responds to nutrient limitation emerging after rapid reduction of zooplankton by introduced whitefish. The relief of grazing by fish resulted in fourfold increase in phytoplankton biomass. It was followed by epilimnetic nutrient depletion, which induced some motile algae to extend their diel vertical migration deep into the anoxic hypolimnion. At the same time high hypolimnetic phosphomonoesterase and leucine aminopeptidase activities resulted in decrease in total phosphorus and nitrogen proportional to the observed increase in phytoplankton biomass. Thus under epilimnetic nutrient depletion phytoplankton utilized not only inorganic but also organic nutrients of the hypolimnion. The results suggest that shift to the utilization of deep water nutrients by behavioural and physiological adaptations can rapidly compensate for epilimnetic nutrient depletion and may dampen the changes in phytoplankton species composition.

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EVIDENCE FOR THE USE OF THE NITRATE REDUCTASE PATHWAY AS A SOURCE FOR THE DISSAPATION OF EXCESS EXCITATION ENERGY IN *HETEROSIGMA AKASHIWO*

Several harmful raphidophyte species have become dominant members of the phytoplankton community in the Delaware Inland Bays. It has been shown that the differential utilization of various forms of nitrogen can play a significant role in competitive outcomes among phytoplankton. In addition, some algal types (e.g. diatoms) have been shown to utilize the nitrate reductase pathway as a possible sink for excess electrons during periods of high excitation pressure. Here we investigate the possible use of this pathway in the raphidophyte *Heterosigma akashiwo* isolated from Delaware, U.S.A. Electron transport rate through photosystem II (PSII) was monitored in unialgal

semi-continuous cultures grown on nitrate or ammonium. Initial comparisons of carbon assimilation and PSII electron transport in cells held under these two conditions is suggestive of substantial electron flow to nitrate reduction. Further results will be presented to address possible advantages this pathway holds when cells are subjected to greater photostress due to shifts in light and temperature, and the possible advantage such a pathway holds in the context of competitive exclusion when this alga is exposed to different forms of nitrogen.

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SEA SURFACE TEMPERATURE RISE IN THE MEDITERRANEAN SEA WITH A FOCUS IN THE LEVANTINE BASIN DURING THE PAST TWO DECADES

Increases in sea surface temperatures (SSTs) have been reported to occur globally over the past two decades. Here we analyze SST records from satellite data for the period 1985-2007 for the entire Mediterranean Sea and the Levantine Basin. We show that the entire Mediterranean has undergone an increase in SSTs with a leveling-off observed in the second half of the record. This warming is almost double that of the global oceans. The variability is characterized by a broad, basin-wide decadal warming and a weaker dipole pattern that fluctuates at interannual time scales, as depicted by empirical orthogonal function analysis. At a basin level, SSTs in the Levantine have also increased at interannual and seasonal scales. The driving mechanisms of these changes need to be investigated, as they may be driven by changes in annual latent heat losses and by the variability in regional wind speeds. It will be valuable to investigate future trends in SSTs to determine whether the observed patterns represent a continued pattern of persistent warming or a new direction for the Mediterranean Sea and the Levantine Basin.

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DO VIRAL GENES INCREASE HOST FITNESS? PHOSPHATE STARVATION GENES IN THE ENVIRONAMENTAL VIRAL POOL.

Host genes retained in phages could reflect key forces that have a selective effect on the host population. Indeed, phosphate-sensing and acquisition genes have been found in phages that infect organisms in low-phosphate environments. One of these genes, phosphate starvation-inducible protein (PhoH) has been detected in 5 cultured viruses and here we present evidence for a wide geographic distribution of this gene in the marine virus pool. This protein has been related to phosphate starvation in bacteria and is widely distributed both in Bacteria and Archaea. Phylogenetic analysis of these environmental viral sequences shows that the viral PhoH genes forms a distinct cluster different from the host PhoH genes but similar to the PhoH genes from the 5 marine viruses in culture. The wide distribution of the PhoH gene indicates that the gene must have an ecological role and it might be speculated that the gene influences phosphate uptake thereby increasing the host fitness in P-limited environments. In addition, the study provides evidence for a globally interconnected viral gene pool, as similar PhoH genes were detected at different geographical locations.

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WHICH FORMS OF NITROGEN FUEL *KARENIA BREVIS* BLOOMS IN THE GULF OF MEXICO?

The toxic dinoflagellate, *Karenia brevis*, is responsible for widespread persistent blooms in the eastern Gulf of Mexico. The nutrient sources that support these large accumulations of biomass are largely unknown. *Karenia brevis* blooms are believed to initiate offshore in relatively oligotrophic waters and then can be maintained closer to shore for months. We believe multiple nutrient sources and forms support *K. brevis* blooms, with the relative contribution of each source depending upon bloom physiological state, bloom environment and location along a latitudinal gradient. We measured inorganic and organic nitrogen uptake rates and photochemical production rates of nitrogen at six stations, including one with a *K. brevis* bloom, along the coast of southwest Florida during October 2007. Preliminary results suggest that ammonium was the most important nitrogen source at non-*Karenia* stations, while organic nitrogen forms were most important at *Karenia* stations. There was measurable photoproduction at most stations with ammonium being the most important nitrogen photoproduct.

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CARBON DIOXIDE OUT GASSING AND CARBON BUDGETS IN LOWLAND STREAMS AND LAKES

Carbon dynamics was measured in two streams in fertile, calcareous Danish lowlands. Streams were supersaturated with carbon dioxide to median levels 13 times air saturation. Evasion rates of carbon dioxide are the product of piston velocity and the water-air gradient and both determinants varied 50-fold with time and space, while evasion rates varied 200-fold. Annual evasion rates were highest in upper stream reaches (4500 g C per square meter of stream) where supersaturated soil water entered fast stream flow, while rates were 10-fold lower in slow-flowing lower reaches. Out gassing was approximately equal to inflow of free carbon dioxide and carbon dioxide released from labile organic matter. Carbon dioxide lost to the atmosphere was 15-17% of total carbon export in the streams, while organic carbon was 22-28% and soil carbon dioxide sequestered to bicarbonate alkalinity was 55-63%. Streams are the most important window to out gassing of carbon dioxide among Danish freshwater ecosystems, and stream transport of carbon from land to lakes influences their atmospheric exchange such that it does not represent the production-respiration balance.

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DIURNAL AND SEASONAL VARIABILITY IN THE PHYSIOLOGICAL CHARACTERISTICS AND PRODUCTIVITY OF MARINE PHYTOPLANKTON IN SAGAMI BAY, JAPAN

Biological processes of phytoplankton in the ocean are subjected to environmental stress such as rapid fluctuating irradiance. Under such conditions, photosynthetic strategy is most likely to occur to maintain productivity. The present study examined the diel and seasonal changes in physiological characteristics and productivity of phytoplankton using a fast repetition rate fluorometer in Sagami Bay, Japan. The photochemical quantum efficiency (Fv/Fm) and productivity displayed a die1 periodicity with a minimum and maximum, respectively, during the light period for all seasons. Low Fv/Fm observed at the surface and in fall indicated low proportion of functional reaction centers. Therefore, cells during spring-summer could be in a better physiological state than in fall. Diurnal cycles in the fraction of functional photo-system II reaction centers (Fv/F0) (PSII-RC) were observed during all seasons with a low under high irradiance due to photo-inhibition. Lower fraction of functional PSII-RC found in fall compared to those in spring and summer indicated a difference in physiological state. In short, cells under high irradiance exhibited photo-acclimation which serves to dissipate excessive energy and to minimize damage to the photosynthetic apparatus.

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ON THE INTERPLAY OF MESOSCALE HYDRODYNAMIC STRUCTURES AND PLANKTON GROWTH IN THE WAKE OF AN ISLAND

Plankton patterns as observed in satellite images of the ocean are a result of the interaction of population dynamics with physical transport processes. We study the planktonic biological activity in the wake of an island which is close to an upwelling region providing nutrients for the growth of the plankton. Our results are based on the numerical analysis of a simple kinematic flow mimicking the hydrodynamics in the wake coupled to a three component plankton model. We show that the mesoscale hydrodynamic structures can under certain conditions either act as a barrier blocking the transport of nutrients or facilitating transport of nutrients leading to an enhanced primary production. In particular we show that in a special case mesoscale vortices act as incubators for plankton growth leading to localized plankton blooms within vortices in the wake of an island. The mechanism of the emergence of these localized plankton blooms relies on the intricate interplay of hydrodynamic and biological time scales.

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MEASUREMENT UNCERTAINTIES ON INHERENT OPTICAL PROPERTIES AND THEIR IMPACT ON DERIVED OPTICAL PARAMETERS AND BIO-OPTICAL MODELS

Inherent optical properties (IOPs) are the initialization variables in optical modeling to calculate the underwater light field. Uncertainties in IOP are significant and have already been reported in optical closure exercises (Chang et al., 2003). Recent studies have also proposed coupled optical-ecosystem models (Fuji et al.,2007) in which any added uncertainty from the optical model could have a major impact on the ecosystem model. This work aims to estimate uncertainties of IOPs and specific IOPs retrieved in

a traditional manner and used in bio-optical modeling. We also present an alternative SIOP calculation method that reduces added uncertainty. Impact of SIOP uncertainties calculated with traditional approaches and this new calculation method are compared when used in bio-optical modeling to obtain derived optical parameters. This method can be applied to any constituent SIOP. Here we present a complete analysis for achl and achl*

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SEASONAL VARIABILITY OF CARBON DIOXIDE IN THE BENGUELA UPWELLING REGION

In the Benguela upwelling region a complex pattern of $f CO_2$ distribution appears from July 2005 to June 2008, with areas of super-saturation and low CO_2 concentrations relating to the temperature variability and the ocean circulation. The highest variability is related to the position of the most significant upwelling cells. Climatological seasonal cycles of SST and $f CO_2$ for the Southern Benguela region presented increased monthly anomalies and a bi-modal seasonal SST cycle related to the proximity to coastal waters, and the seasonal upwelled water between September and March, reducing the maximum Summer temperature. From 2005 to 2008 the $f CO_2$ in seawater has decreased from 2.5 µatm yr^{-1} in the Northern Namibia cell, to 0.4 µatm yr^{-1} in the Southern Benguela area. In the coastal area of South Africa, the continuous biologically mediated CO_2 drawdown, reduces the $f CO_2$ drastically in the area, and maintains the CO_2 partial pressure below the levels to be found in the atmosphere all year round.

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IN WHICH WAY ANOMALOUS MORTALITY EVENTS COULD AFFECT POPULATION TRENDS OF LONG-LIVED OCTOCORALS ?

The long-lived, slow-growing gorgonians Paramuricea clavata and Corallium rubrum (the overexploited, precious Mediterranean red coral), suffered in 1999 and 2003 anomalous mortality events in the North-Western Mediterranean, associated with a sharp temperature increase linked to GCC. As a consequence of these mortality events the P. clavata population living in the Gulf of La Spezia (Ligurian Sea, Italy), reduced by 75% and the dominant size class in the population shifted towards smaller-younger colonies. In recent years, after the detachment of older colonies, recruitment rate sharply increased. Simultaneously, shallow red coral population, in Italy and France, were affected by anomalous mortality events. In order to simulate the effects of such mortalities on population structure and dynamics, we developed demographic models in which population structure, survival and reproductive output are included. Such models allow us to project the population trends overtime. The results obtained suggest that, also if both gorgonians show a good resilience due, presumably, to the reproductive output of the smaller-younger colonies, more resistant to mass mortality, an increased frequency of such events could lead local populations to extinction.

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THE EXISTENCE OF *SYNECHOCOCCUS* IN DEEP WATER OF ADRIATIC SEA

The picoplanktonic cyanobacteria *Synechococcus* represent an important part of the total photosynthetic biomass in the oceans. This obligate autotroph often dominates under oligotrophic conditions in warm water systems and in environments non-limited by light. *Synechococcus* abundance usually fluctuates from 10^{-2} to 10^{-5} cell ml^{-1} through eutrophic zone both of coastal and open ocean waters. All the studies on *Synechococcus* were restricted to the upper ocean to the depths less than 200 m. Our study discovers the presence of these cyanobacteria in deep Adriatic layers down to 1000 m. Their maximum abundance was found at 800 m and the large values were found throughout the whole water column. After two months the concentrations decreased to near-zero levels due to hostile environmental conditions (lack of light). The deep abundance maximum has been associated to the fast ventilation and renewal of deep Adriatic waters with the surface waters. This also introduces a new role of *Synechococcus* as a tracer for dense water dynamics.

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THE ROLE OF DISSOLVED ORGANIC CARBON IN MEDITERRANEAN CARBON CYCLE

Dissolved organic carbon (DOC) and dissolved oxygen (DO) data collected since 1999 during several cruises in different regions of the Mediterranean Sea (from the Ionian to the Balearic Sea), will be presented and discussed. DOC and DO distributions were analyzed as tracers of water mass characteristics and circulation. Following the core of the Levantine Intermediate Water (LIW), a gradual DOC and DO decrease going away from its source was observed. In the deep layer of some Mediterranean areas, mainly close to deep water formation sites, DOC exhibited high concentration (>60 µM); whereas in other Mediterranean regions, both at mid-depth and bottom waters, DOC showed low values (30-45 µM), similar to those reported for the Oceanic deep waters (34-48 µM). This finding opens intriguing questions on the role of DOC in carbon export to depth, during deep waters formation and on the DOC utilization processes in different layers of Mediterranean waters.

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ACTIVITY AND ABUNDANCE OF ARCHAEAL AND BACTERIAL NITRIFIERS ACROSS A COASTAL TRANSITION ZONE IN THE EASTERN NORTH PACIFIC

Nitrification is a key process in the marine nitrogen cycle, but rates and the organisms active in this process are poorly constrained. We used a combination of isotopic and molecular biological approaches to determine the activity and abundance of nitrifying organisms at two stations, one on either side of the California Current, along CALCOFI line 67. Using $^{15}NH_3$ incubations, ammonia oxidation was detectable within the euphotic zone, although maximal rates were observed near the base of the euphotic zone. We also quantified crenarchaeal and beta-proteobacterial ammonia-monooxygenase genes (*amoA*) and 16S rRNA genes of a putative nitrite oxidizer, *Nitrospina*, using qPCR. Crenarchaeal *amoA* was detectable at all stations and depths, from the surface to 1000 m. Archaeal abundance was well correlated with *Nitrospina* abundance at all stations, and archaeal *amoA* transcripts were correlated with NH_3 oxidation rates within the upper 500 m. Despite low gene copy abundance in surface waters, beta proteobacterial *amoA* transcripts were detected at depths down to 100 m.

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EFFECTS OF ULTRAVIOLET RADIATION ON THE ACTIVITY, STRUCTURE AND DIVERSITY OF ESTUARINE BACTERIONEUSTON

The impact of prolonged exposure to environmental levels of ultraviolet-B radiation on the activity, community structure and relative abundance of specific bacterial groups of estuarine bacterioneuston from Ria de Aveiro (Portugal) was assessed by means of microcosm experiments. Culturable isolates resistant to UV radiation were also identified by 16S rRNA gene sequencing. Bacterial secondary productivity determined by leucine incorporation was stimulated in irradiated bacterioneuston. Results from 16S rRNA gene based analysis of the isolates and FISH (fluorescence in situ hybridization) indicated that members of the *Betaproteobacteria*, *Gammaproteobacteria* and *Actinobacteria* groups were more resistant to UV-B radiation, while *Alphaproteobacteria* and *Cytophaga*-like bacteria showed higher sensitivity to radiation. Denaturing gradient gel electrophoresis (DGGE) of 16S rDNA revealed significant compositional changes of bacterioneuston communities upon irradiation. These data suggest that increased UV-B radiation as a result of ozone depletion may result in UV-mediated shifts in bacterioneuston activities and communities with potential consequences to aquatic trophic nets.

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THE EFFECT OF FAUNA ON BENTHIC FLUXES IN MARINE AQUACULTURE IMPACTED SEDIMENTS UNDER GLOBAL CLIMATE CHANGE SCENARIOS

The increase in water temperature due to climate change may have profound consequences for sediment-water fluxes in organically enriched sediments such as those impacted by aquaculture. Benthic mineralization increase rapidly in response to increased temperature, whereas benthic oxygen supply is limited by physical factors, and increased temperature may therefore accelerate negative effects of organic enrichment. Through a mesocosm approach using non-enriched or fish feed enriched sediment with *Nereis diversicolor* at increasing temperatures (16 to 26ºC), we measured sediment-water fluxes of TCO_2 and O_2 . Vertical changes in sediment biogeochemistry were estimated by initial and final core sectionings. Preliminary results showed that organic enrichment and temperature dramatically increased mineralization rates, and TCO_2-release was generally much higher or equal to O_2-uptake. Observations of fauna indicate that bioirrigation was not affected by temperature and fauna reduced the importance of anoxic metabolism in organic enriched sediments.

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SEX RATIO AS A FUNCTION OF SIZE IN *CRASSOSTREA VIRGINICA* OF DELAWARE BAY

The eastern oyster, *Crassostrea virginica*, is protandric; individuals are initially male, and as they mature, they often function as females. Protantrism has implications for the male:female ratio and reproductive ability in *C. virginica* populations. This study focused on determining the relationship between sex ratio and size (age) in the *C. virginica* population within the New Jersey portion of Delaware Bay. In June 2008, a time corresponding to maximum gamete maturation, nearly 7,000 oysters were sampled from 20 oyster beds. The oysters were measured and binned into 10-mm size classes. Sex was determined for a subset of 1733 *C. virginica* from 7 contiguous oyster beds. The majority, 867 (50.03%), were male; 764 (44.08%) were female; 62 (3.58%) were hermaphrodites; 40(2.31%) were undetermined. Analysis of these data showed that the proportion of male *C. virginica* individuals was inversely related to oyster size in this population. The size differential between male and female oysters in this region has implications for harvesting, which tends to select larger individuals. This selectivity, coupled with other factors, such as disease, may contribute to declining oyster broodstock.

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REVISITING THE PHYTOPLANKTON-HETEROTROPHIC BACTERIA LINKAGES THROUGH CARBON EXCRETION: USE OF RADIOLABELED ALGAL EXUDATES IN THE MAR-FISH TECHNIQUE

Microautoradiography combined with fluorescent in situ hybridization (MAR-FISH) is a single cell technique used in marine microbial ecology that allows the description of the physiological state (activity/inactivity) of specific bacterial groups. Typically, microbial assemblages are incubated with an "artificial" radiolabeled substrate (leucine, thymidine, ATP, Amino acids, acetate, glucose, etc.). However, these substrates might not be representative of the natural pool of labile dissolved organic carbon available in the ocean (that would be largely composed of dissolved organic matter derived from phytoplankton). In order to improve our knowledge on how phytoplankton and bacterial communities interact in natural systems we developed the use "natural" substrates by growing axenic algal cultures with inorganic radiolabeled carbon and preparing the radiolabeled algal exudates for MAR-FISH. The incubations of sea water with radiolabeled exudates from different algal species revealed major differences in the percentage of cells of each bacterial type taking up the products, even when the algal strains were closely related. Our preliminary results indicate that there are specific relationships between bacterial phylogenetic groups and phytoplankton species, opening new perspectives into the study of the carbon links between phytoplankton and bacterioplankton.

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RESPONSE OF ALPINE VERSUS SUBALPINE LAKES TO NITROGEN DEPOSITION: SIMILAR BUT ASYNCHRONOUS COMMUNITY AND ECOSYSTEM-LEVEL CHANGES

Using paleolimnological and comparative lake sampling approaches, we compared community and ecosystem-level metrics of the response of phytoplankton to nitrogen deposition in alpine versus subalpine lakes. Three lakes of each type were selected in the central Rocky Mountains of the U.S., an area with low (<1.5 kg ha-1 yr-1) but increasing nitrogen deposition. Water columns of the six lakes were sampled annually in early July from 2003 to 2007. Diatom profiles from dated sediment cores collected from all six lakes in 2001, and surface sediments re-collected in 2007, reveal community shifts as the result of nitrogen enrichment. While the effects of N enrichment declined between 2001 and 2007 in the subalpine lakes, these effects continued or increased in the alpine lakes. N:P stoichiometric ratios from seston reveal that, since 2003, a transition from nitrogen to phosphorus limitation has occurred in both lake types, occurring earlier in subalpine systems. Chlorophyll concentrations have increased in alpine but remained stable in subalpine lakes during this period. The implications for plankton dynamics in these two types of lakes will be discussed.

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THE CO-IMPACT OF IRON AND COPPER ON PHYTOPLANKTON GROWTH IN THE SOUTH ATLANTIC AND THE SOUTHERN OCEAN

The limiting role of Fe in controlling phytoplankton growth is now largely admitted, particularly in the Southern Ocean (SO). Besides, other trace metals may act as co-limiting factors. In particular, Cu may be an important micronutrient in low-Fe regions of the sea because of its role in Fe acquisition. The co-impact of Fe and Cu was investigated in the sub-tropical South Atlantic and the SO (36°S-51°S) during the BONUS-GOODHOPE cruise. Deck-board incubations were performed at four stations. At all stations, after addition of major nutrients when needed, Fe addition enhanced chlorophyll-a (Chla) levels. Cu addition had contrasting effects. North of the Sub-Tropical Front, Cu addition enhanced Chla similarly to Fe addition. In the Sub-Tropical Front, Cu addition stimulated more the phytoplankton growth than Fe addition. Between the Sub-Antarctic Front and the Polar Front, Cu addition completely inhibited phytoplankton growth, and, in the North of the Weddell Gyre, Cu addition had no effect on phytoplankton growth. These very interesting contrasting effects show the complexity of the co-impact of Cu and Fe on natural phytoplankton community in this region.

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REMOTE SENSING OF PARTICULATE ORGANIC CARBON CONCENTRATION AND PHYTOPLANKTON GROWTH

Data on particulate organic carbon (POC) from various locations in the sea, and from cultures, are analysed as a function of chlorophyll concentration. Regression equations are established for estimating POC from chlorophyll concentration, a property that can be quantified by remote sensing. The analysis allows us to infer bounds on phytoplankton carbon-to-chlorophyll ratio. The same approach is extended to samples dominated by various phytoplankton types. We show further that the method can be developed to permit computation of carbon-based growth rates for phytoplankton by remote sensing. Our results facilitate the use of satellite data in fisheries-related models such as Ecopath and Ecosim.

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DISTRIBUTION AND ABUNDANCE OF AEROBIC ANOXYGENIC PHOTOTROPHIC BACTERIA IN TEMPERATE NERITIC WATER OF THE OTSUCHI BAY, NORTHEAST JAPAN

Early works in 1990's using culture-dependent techniques on aerobic anoxygenic phototrophic (AAP) bacteria showed large fluctuation of their distribution and abundance in temperate neritic water of the Otsuchi Bay, northeast Japan. However, what controls their dynamics is a still open question. In order to answer the question, we investigated the distribution and temporal change in abundance of these bacteria in the bay, from May 2007 to August 2008. We isolated the bacteriochlorophyll a-containing strains closely related to Roseobacter litoralis and Jannaschia sp. based on 16SrRNA gene sequences. Abundance of AAP bacteria counted using IR-fluorescence microscopy varied from 5.0×102 to 4.1×103 cells mL-1 and percentage in the total DAPI counted cells varied from 0.023% to 0.30%. In the spring, the peak of AAP bacteria abundance corresponded to a subsurface chlorophyll a maximum. We found that depth integrated abundance of AAP bacteria was significantly correlated to integrated chlorophyll a concentration during a period of spring phytoplankton bloom, suggesting heterotrophy of AAP bacteria in spite of their ability of phototrophic energy acquisition may determine their abundance in the bay.

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LONG-TERM VARIABILITY OF PARTICULATE ORGANIC MATTER CHARACTERISTICS IN THE GIRONDE ESTUARY

Coastal systems such as estuaries are located at the land-ocean interface and accommodate one third of world's population. In addition to global change, local and regional human activities tend to modify their functioning over time. Among these systems, estuaries are highly sensitive because they are hot-spots of anthropogenic inputs and pressures and subject to high hydrological fluctuations. The Gironde estuary is the largest estuary of Western Europe and has been studied for over 30-years. These studies revealed indications for significant warming and salinization of this estuary: + 2°C and + 3 salinity units between years 1978 and 2003. Moreover, there was also an upstream shift of the turbidity maximum inducing changes in zooplankton dynamics. In this context, we have investigated the long-term variability of particulate organic matter origin and composition using biomass ratios (particulate organic carbon to particulate organic nitrogen and to chlorophyll a ratios) and C and N stables isotopes. This study is based on the results of sampling and analysis carried out in the late seventies/early eighties, in the mid-nineties and in 2007.

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IMPACT OF DAM OPERATIONS ON HYPORHEIC EXCHANGE IN THE RIPARIAN ZONE OF A REGULATED RIVER

Dam operations on the Colorado River near Austin, TX alter the hydrologic connectivity of the river and riparian zone downstream by driving daily reversals in groundwater flow within the riparian aquifer. We monitored water table elevation, temperature, and specific conductivity in the riparian zone along a transect perpendicular to the river, where stage fluctuates daily by a meter. We estimate that one cubic meter of water enters and exits the riparian aquifer daily per linear meter of bank. Water table fluctuations extend over thirty meters into the riparian aquifer. In the absence of dam operations, groundwater would discharge steadily to the river because regional groundwater flow paths are towards the river. Under these natural conditions, an analog for the riparian zone would be gills on a fish: water would flow through the riparian aquifer in one steady direction, undergoing geochemical transformations along its path to the river. However due to dam operations, the riparian zone instead functions as a lung: oscillations in groundwater flow directions pump water into and out of the riparian aquifer, which induces transient thermal and biogeochemical conditions within meters of the river. We argue the need for more research to evaluate the biogeochemical and ecological implications of this fundamental shift, from gills to lungs, in riparian zone hydrodynamics downstream of dams.

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DIVERSITY OF ASSIMILATORY NITRATE REDUCTASE IN CANADA'S THREE OCEANS

Marine diatoms are estimated to be responsible for nearly half of global primary production and are thought to ordinarily use nitrate as their primary nitrogen source. Assimilatory nitrate reductase (NR), the enzyme responsible for the reduction of nitrate to nitrite, is essential for the incorporation of nitrate by diatoms and other phytoplankton. However, little is known of the distribution and diversity of NR in the polar and open oceans. As part of the International Polar Year project Canada's Three Oceans (C3O) we collected microbial DNA and RNA from the North Pacific, North Atlantic and Arctic Oceans. Our results from 14 clone libraries uncovered approximately 25 unique NR gene sequences, with most of them novel. Among these sequences, very few were recovered from more than one study site and only one sequence was recovered from all sites. We also found that different versions of NR were expressed in the three oceans, with implications for primary production patterns under changing oceanic circulation due to global climate change.

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FOOD WEB IN A NORTHERN BRITTANY KELP (*LAMINARIA DIGITATA* LAMOUR.) FOREST AS INVESTIGATED THROUGH A COMBINED STABLE ISOTOPE AND BIOCHEMICAL ANALYSIS

Kelp forests are among the more productive ecosystems on Earth. In spite of their ecological importance, food webs in these environments remain to date relatively poorly studied. This study aimed thus at studying the food web in a French *Laminaria digitata* (Lamouroux) forest, through a combined use of stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) and biochemical assays. The results pointed out that this food web was based on a wide diversity of basal food sources. Particularily, a clear opposition was found between (1) brown algae (comprising *Laminaria digitata*) that were not directly consumed by the different coexisting consumers (except *Helcion pellucidum*), and (2) red algae, epilithic and epiphytic biofilms that were consumed by several consumers. In addition, the results strongly suggest that the macroalgae enter the associated food web through the detrital pathway. The nutritive characterization pointed out that food sources consumed in this habitat were characterized by high protein content and a low C/N ratio, while non-consumed brown algae displayed high lipid contents. These results suggest that the nutritive value of basal food sources and particularily nitrogen-related factors (i.e. C/N ratio, protein content) are likely to be a major factor affecting the structuration of kelp forests communities.

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SPATIAL AND TEMPORAL PATTERNS OF WATER QUALITY IN THE INSHORE GREAT BARRIER REEF LAGOON- SYMPTOMS OF EUTROPHICATON IN AN OLIGOTROPHIC SYSTEM?

Coastal areas of the Great Barrier Reef receive substantial amounts of material from adjacent developed catchments, which can affect the ecological integrity of coral reefs. Large-scale data sets show elevated values of most water quality variables near the coast. A water quality time-series (since 1989) from 11 coastal stations in the northern GBR showed significant long-term changes of all variables except chlorophyll a, with values generally decreasing since the early 2000s, related to flow patterns of the closest river. Since 2005 data are collected under a Reef-wide Marine Monitoring Program to track trends in ecosystem status and water quality. Elevated chlorophyll a and phosphorus concentrations and high turbidity levels are the main water quality issues in the coastal GBR, based on observed exceedances of recently developed water quality guideline values. Other water quality variables exceeded guideline values during flood events. High-frequency instrumental monitoring of chlorophyll and turbidity is being undertaken at coastal reefs to resolve short-term variability in water quality and provide a better understanding of conditions faced by coral reefs and whether any locations or regions require management intervention.

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IMPORTANCE OF REGIONAL PROCESSES AND DISTURBANCE SEVERITY FOR MACROBENTHIC COMMUNITY RECOVERY, LOWER CHESAPEAKE BAY, VIRGINIA, USA

Dredging and the disposal of dredged material in open water are significant anthropogenic disturbances influencing coastal aquatic systems worldwide. Dredged sediments are also being used with increasing frequency to create habitat or to cap contaminated sediments as part of coastal and estuarine restoration projects. I examined community level responses of subtidal soft sediment macrobenthos to two relatively large-scale sediment disposal events in lower Chesapeake Bay during a multi-year study. The severity of physical disturbance and timing of disposal events relative to the dynamics of the natural community influenced recolonization and recovery. Sediment disturbance had significant effects on density, biomass, species richness and assemblage composition relative to the surrounding community, but only when the initial sediment overburdens were 15 cm or more in thickness; otherwise the assemblages were resistant to disturbance. Temporal patterns in the assemblages studied were largely synchronous over 10s of kilometers and among stations with differing histories of disposal. These results provide evidence that regional scale controls on benthic processes have important implications for habitat restoration projects.

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BENTHIC COMMUNITY RESPONSES TO MULTIPLE STRESSORS IN SHALLOW WATER HABITATS OF CHESAPEAKE BAY: THE IMPORTANCE OF BENTHIC-PELAGIC COUPLING

Shallow water benthic habitats are a key feature of estuaries. High light availability, coupled with nutrients, make these areas ideal for a variety of primary producers, which in turn support benthic and nektonic consumers. We examined shallow water benthic community integrity and benthic process rates along gradients of salinity and human activity, characterized by water and sediment quality impairments, at paired sandy and muddy sites in the Chesapeake Bay ecosystem. Within major salinity regimes, the Benthic Index of Biotic Integrity (B-IBI) for Chesapeake Bay was negatively correlated with regional water column DIN, and sediment organic matter concentrations were positively correlated with DIN, at muddy, but not sandy sites. Mirroring these trends, macrobenthic production and food web efficiency were positively correlated with benthic integrity at the muddy sites. Our sandy sites had high benthic integrity and bivalve biomass/production despite regionally high nutrient loading and apparent eutrophication impacts at nearby muddy sites. Overall, results suggest that regional water column nutrient enrichment does not necessarily translate to negative eutrophication impacts in the benthos locally and that the mechanisms of benthic-pelagic coupling matter.

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MODELLING NATURAL *DAPHNIA* POPULATIONS WITH A PHYSIOLOGICALLY STRUCTURED MODEL – ACHIEVEMENTS, PROBLEMS AND POSSIBLE SOLUTIONS

Forcing a physiologically size-structured *Daphnia* population model with a constant temperature reproduces regular predator-prey cycles of a *Daphnia*-algae system in accordance to laboratory studies. In a numerical experiment we externally forced the model by seasonal temperature and food variations for studying the impact of different environmental factors on spring dynamics of *Daphnia*. This study revealed temperature to be the most important environmental factor for the timing of *Daphnia* population development. In a second study we compared the model outcomes with field data of *Daphnia* populations regarding abundance and size structure from large Lake Constance and from a mesocosm experiment. While the phase of exponential growth of *Daphnia* was again well described by the model, even under very different spring temperature developments, problems appeared after the peak of *Daphnia* abundance. Under conditions of severe food limitation we found differences between model output and field data regarding the size structure of the *Daphnia* population. Therefore and for a better understanding of the underlying processes, we studied different strategies of energy allocation under varying physical and biological conditions.

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INVERTEBRATE SHREDDERS ENFORCE HEAVY METAL ENRICHMENT IN PARTICULATE ORGANIC MATTER.

Soluted heavy metals adsorb on leaf litter in contaminated ecosystems. During decomposition for example the uranium concentration increased significantly. However, the influence of functional groups like shredder on uranium fixation is unclear. In view of this, we investigated the influence of a shredder (*Gammarus pulex* L.) on uranium fixation during the decomposition of leaf litter. *Alnus glutinosa* Gaertn. leaf litter with a uranium content of 1152 mg kg^{-1} in dry biomass (DM) was used in a 14-day experiment. The developed particulate organic matter (POM) had a uranium load of 1427 mg kg^{-1} in DM at the end of experiment. The residues of the leaves showed a uranium concentration of 644 mg kg^{-1} in DM after the 14-days of experiment. The uranium concentration in the water was 34.3 µg L^{-1} at the end of experiment, while the DOC level increased up to 11.4 mg L^{-1} at the same time. The consequence of our studies is the significant influence of functional groups to uranium concentration in organic sediments.

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A DATA-BASED ESTIMATION METHOD FOR DERIVING PLANKTON SIZE-DENSITY DISTRIBUTION FUNCTIONS

The density distribution of plankton size is an elementary indicator of plankton community structure. But, efforts to determine abundance together with size of plankton are extensive, in particular if variations in size within individual plankton groups are resolved. Size spectra are precious for modelers, as they complement bulk data (e.g. chlorophyll concentration) such that simulations can be better constrained with respect to ecosystem functioning. Mathematical formulations of size distributions of different plankton groups are desired, for example, for devising models of trophic interaction. We will present a statistical approach to derive such density distributions from uneven distributed size measurements. Our exemplification is based on data from the IronEx II experiment. The method of kernel density estimation will be explained and the difficulty of choosing appropriate bandwidths. We will depict an analysis procedure that includes a Monte-Carlo method for adaptive bandwidth selection and bootstrapping. Different sources of uncertainty are regarded for bootstrapping: a) The uncertainty when counting small numbers, and b) the uncertainty in equivalent spherical diameter that derives from morphological presumptions and resolution errors when measuring cell lengths and widths.

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ANALYSIS OF THE ACTIVITY OF BACTERIA IN BIOFILMS – FIRST RESULTS

It is well known that biofilms consist of a variety of different organisms, embedded in exopolymer matrix. Obviously, the physiological condition of these organisms also differs. Moreover, studies revealed, that death of biofilm bacteria plays a certain role in biofilm development clearly influencing biofilm's structure and composition (e.g. Webb et al., 2003). On the poster, results will be presented of different assays to assess how active bacteria might be in the biofilm environment and to which degree this may be affected by grazing of protozoan predators. We present results from experiments run in a laboratory system under controlled conditions, this is to say, with a known composition of bacteria (and predators). We analysed the portion of viable and non-viable bacteria as well as their physiological status with different methods (e.g. Live-/Dead-staining, FISH etc.). Especially methods dealing with fluorescent dyes in combination with Laser-Scanning-Microscopy were chosen to be able to analyse the biofilm bacteria in their original, three-dimensional environment in biofilms. The results allowed a first insight in possible changes of the physiological conditions of bacteria under grazing pressure in biofilms.

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N-ISOTOPE RATIOS OF NITRATE, DISSOLVED ORGANIC NITROGEN AND PARTICULATE NITROGEN TRACE FUNDAMENTAL BIOGEOCHEMICAL PROCESSES IN THE E. MEDITERRANEAN SEA

We determined delta^{15}N-DON, delta^{15}N-PN, delta^{15}N-nitrate and delta^{18}O-nitrate for 17 stations across the E. Mediterranean Sea (EMed; Jan/Feb 2007). Delta^{15}N-nitrate and delta^{18}O-nitrate indicate an enriched nitrate residual in the photic zone (delta^{15}N-nitrate = +3.8‰ +/- 2.4‰; maximum up to +10‰; delta^{18}O-nitrate= +5.1‰ +/-2.4 ‰; maximum up to 11.5+‰) after a P-limited winter bloom that produced ^{15}N- depleted PN (delta^{15}N-PN = +2.0‰ +/- 2.0‰) and DON (delta^{15}N-DON= +1.1‰ +/- 2.1‰). Below 200 m, the patterns reverse (delta^{15}N-nitrate =+2.1‰+/-0.4‰; delta^{18}O-nitrate =+1.6‰ +/- 1.2‰; delta^{15}N-DON =5.2‰ +/-3.9‰; delta^{15}N-PN =+6.9‰+/- 1.6‰), consistent with mineralisation of particulate N feeding the deep nitrate pool via microbial N-oxidation pathways. The residual nitrate in the surface layer is more ^{15}N than ^{18}O-depleted, and ^{15}N is more depleted than expected from Rayleigh-fractionation of sub-thermocline nitrate alone. Both observations point to a significant external source of ^{15}N- depleted and ^{18}O-enriched nitrate to the EMed.

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A USER'S GUIDE TO FUNCTIONAL INDICES: ARE FUNCTIONAL DIVERSITY INDICES CONSISTENT AND COMPLEMENTARY?

Functional diversity represents the diversity of species traits in communities, e.g. through morphological traits reflecting their trophic niche. A variety of indices, broadly categorized as functional richness, evenness and divergence indices, have been proposed to characterize trait-based functional diversity. Although most of these indices have been individually described, their overall consistency has not been studied so far, so that the user of these indices may wonder whether some indices may be preferred. We tested the behaviour of several functional diversity indices, using virtual data sets, to assess whether: (i) indices respond to community changes as would be intuitively expected from their category; (ii) indices from the same category describe exactly the same piece of information about the studied communities; (iii) indices from different categories are independent. Our results suggest that evenness and divergence indices accurately qualify their respective properties while most richness indices perform poorly. Moreover, evenness and divergence indices display a high consistency within their category whereas richness indices measure very different properties of the community. Finally, some functional richness indices are not independent from functional divergence measures.

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IMPACT OF INTRODUCED FISH SPECIES ON THE FUNCTIONAL DIVERSITY OF EUROPEAN FISH COMMUNITIES

Worldwide the number of non-native species is steadily increasing. Their impacts on native communities, however, are still difficult to determine. In this large-scale study we used a functional approach to assess potential biological consequences of introduced species for the fish communities in 151 European drainage basins. Based on 14 morphological traits, which describe the niche space filled by each species, we calculated for each basin the functional diversity with and without introduced species. The specific differences in functional diversity provide information on the redundancy of the non-native species compared to the native ones, and are therefore an indicator of changes in competition. The direct comparison between the morphological traits of native and non-native species enables additionally to discover consistent morphological differences between them and thus to draw more detailed conclusions on differences in resource use. Regarding European fish fauna, this approach revealed that introduced species increased competition in most drainage basins despite some morphological differences compared to native species. Exceptions were found for some probably unsaturated drainage basins or for basins for which the observed patterns might only be transitional.

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DROUGHT SCENARIO OF CLIMATE CHANGE: EFFECTS ON LEAVE PROCESSING, MACROINVERTEBRATES, AND BENTHIC ORGANIC MATTER DYNAMICS AND QUALITY IN LOWLAND STREAMS

Climate change models for Central Europe predict summer drought and shift of low order streams from perennial to intermittent. We investigated leave input and leave processing during a supra-seasonal drought in a stream fragmented into a series of pools. Post-drought effects were assessed in this stream and two reference streams that differed in flow permanence during the drought. In the fragmented stream litter decay was slow and predominantly microbial mediated. Press disturbance, such as low oxygen and/or predation caused low diversities and low abundances of macroinvertebrates and leaf decaying fungi (hyphomycetes). In the post-drought year the fragmented stream had higher stocks of coarse and fine benthic organic matter (BOM) indicating that the litter input of the preceding drought year was not fully degraded with the beginning of the following leaf fall period. We conclude that, depending on degree of flow permanence, drought events can desynchronize litter input and decay processes and may have long-term repercussions for the macroinvertebrates and BOM quality and budget in lowland streams.

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MANAGING VIDEO FROM OCEAN OBSERVATORIES

In 2009 the Monterey Bay Aquarium Research Institute (MBARI) will deploy a novel low-light camera system called the Eye-In-The-Sea (EITS) on the Monterey Accelerated Research System (MARS), a deep-sea cabled observatory in the Monterey Canyon off the coast of California, USA. The MARS cabled-to-shore observatory provides continuous power and 100 Mbit Ethernet communications to the EITS instrument, enabling a continuous video stream 24 hours a day to be recorded on shore. To manage the large volumes of video, MBARI has assembled a system for detecting, tracking, cataloguing and visualizing events. The video management system has two main components, the Automated Visual Event Detection (AVED) system and the Video Annotation and Reference System (VARS). As cabled observatories are deployed the use of long-term video cameras will increase significantly. An overview of the system will be presented as an example of how other researchers might manage video data from deployed ocean video systems.

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DETECTION OF THE TOXIC CYANOBACTERIUM *NODULARIA SPUMIGENA* BY MEANS OF GLYCOSIDIC CAROTENOIDS

The cyanobacterium *Nodularia spumigena* forms recurrent blooms in the Baltic Sea and poses a health risk by being toxic. In this study the pigment and toxin content of 20 strains of Nodularia from different global locations was investigated. The molecular structure of the 4-keto-myxoxanthophyll-like pigment, which is a diagnostic pigment for *N. spumigena*, was determined by 2D NMR to be a 4-ketomyxol-2′-fucoside. In most of the strains an additional carotenoid was found, identified as the novel 1′-*O*-methyl-4-ketomyxol-2′-fucoside, which was found to be more important as diagnostic pigment than 4-ketomyxol-2′-fucoside for *N. spumigena* in the Baltic Sea. 15 of the strains produced the hepatotoxin nodularin. The content of carotenoids and nodularin was found to increase relative to chlorophyll *a* at increasing light intensity and at stationary growth, and nodularin was significantly correlated to both 4-ketomyxol-2′-fucoside and 1′-*O*-methyl-4-ketomyxol-2′-fucoside, and particular to the sum of these two pigments. Pigment analysis by HPLC and subsequent analysis by CHEMTAX can be used as a rapid and sensitive method for early warning of toxic blooms of cyanobacteria in the Baltic Sea.

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EFFECT OF CLIMATE CHANGE ON LAKE SURFACE HEAT FLUXES AND EQUILIBRIUM TEMPERATURES: GLOBAL PERSPECTIVE AND IMPACT ON A SENSITIVE LAKE.

Global lake surface equilibrium temperatures calculated from the climate in 2070-2099 predicted by a global atmospheric circulation model in the IPCC A1B SRES scenario are compared to those calculated for 1961-1990. The analysis shows that the expected changes in wind speed have a similarly strong impact on the thermal regime of lakes as the changes in air temperatures. Lakes in arctic and boreal zones react much more directly to increased air temperature than tropical lakes, which are more sensitive to alterations in wind speed and humidity. The effects of the changed heat fluxes on mixing in stratified lakes are exemplified using the case of Pfäffikersee, a typical temperate lake in Switzerland. At the present climate, this lake undergoes complete convective mixing about every second year. Simulations with a turbulence model show that the probability and duration of mixing is strongly sensitive to the climatic boundary conditions, which makes it a perfect object to compare the importance of the forcing parameters air temperature, wind, humidity and solar radiation.

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PICOPHYTOPLANKTON DISTRIBUTION IN THE ATLANTIC – GROUND-TRUTH FOR GLOBAL OBSERVATION OF PHYTOPLANKTON FUNCTIONAL GROUPS

Marine picophytoplankton, in particular cyanobacteria and prochlorophytes are ubiquitously distributed in the world's oceans and are often – especially in the more oligotrophic regions –among the most important primary producers. The present work shows the results of in-situ measurements taken on meridional transects across the Atlantic Ocean. Data for phytoplankton pigment composition and particulate absorption give information about the functional groups found in the study area. Flow cytometry and an analysis of phycobilins were employed to encompass genera of prochlorophytes and cyanobacteria. These in situ measurements are used as ground-truth for the validation of hyper-spectral remote sensing data. High spectrally resolved satellite data from SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric Chartography) on ENVISAT and GOME-2 (Global Ozone Measurement Experiment 2) on Meteosat are analysed with Differential Optical Absorption Spectroscopy (DOAS) and combined with the in situ data to improve determinations of phytoplankton functional groups distribution.

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TEMPORAL PATTERNS AND TROPHIC LINKS IN PLANKTONIC COMMUNITIES DURING A LATE WINTER BLOOM IN THE CANARY ISLANDS WATERS

Planktonic and microbial biomass were measured in the Canary Islands waters in order to study the characteristic late winter bloom of subtropical waters. Weakly sampling was performed between January and August 2005 in 6 stations around Gran Canaria Island. Different peaks in the different planktonic community biomass were observed from March to May. Picoplankton abundance showed a clear seasonal variation. Synechococcus and picoeucaryote populations were present from January to May while Prochlorococcus were present during summer. Mesozooplankton, picoplankton and bacteria showed similar trends during the late winter bloom, whereas microzooplankton and nanoplankton showed an inverse pattern. The predation of mesozooplankton on micro and nano-plankton fractions releases the picoplanktonic and bacterial biomass. Our results suggest the existence of a top-down control in the different plankton categories from mesozooplankton to bacteria. The overall late winter bloom of small plankton categories (0.2 to 75 µm) was observed for the first time in Canary Islands waters. The trophic interactions in subtropical waters seem rather complex and the effect of diel vertical migrants on epipelagic mesozooplankton suggests cascade effects of unknown consequences for the ocean biogeochemistry.

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DEPTH MATTERS: MICROBIAL EUKARYOTE DIVERSITY AND COMMUNITY STRUCTURE IN THE WESTERN NORTH PACIFIC AS INDICATED BY ENVIRONMENTAL GENE LIBRARIES

Acquiring information on protistan community structure and diversity has been impeded by the fact that protists' features are highly diverse making it difficult to collect and

characterize all members within a community. Culture-independent studies improve our ability to document species composition and spatial and temporal patterns within protistan communities. Protistan species composition and diversity along a depth gradient (1.5, 20, 42, 150, 500 and 880 m) in Southern California coastal waters was examined using 18S ribosomal gene sequence information. We inferred 259 Operational Taxonomic Units (OTUs) or 'species' for the entire dataset of 856 protistan sequences using an automated program and ≥95% sequence similarity cut-off for species-level distinction. BLAST matches to known protists within the NCBI database revealed the majority (~75%) of OTUs belonged to the Chromalveolates (alveolate and stramenopile clades). Species richness (Chao I estimate) and diversity (Shannon index) were greatest in the 150 m sample and lowest for protistan assemblages from within the oxygen minimum zone (500 and 880 m). Cluster analyses (Bray-Curtis coefficient) indicated that assemblages from all 6 depths were 10-35% similar in their community composition.

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THE DIFFERENCES IN SILICON, LIGNINE AND CELLULOSE CONTENT OF VARIOUS MACROPHYTE GROWTH STRATEGIES.

Although silica is not an essential element for plant growth, much evidence points towards its functionality for a better plant resistance against (a)biotic stress. Moreover, recently it was shown that terrestrial and marsh vegetation have a considerable impact on the silica biogeochemistry. Macrophytes have access to sufficient DSi and endure high hydrodynamic forces in rivers. It is, therefore, clear that they may also benefit from Si incorporation. However, detailed information was not available. We investigated the BSi content of 17 macrophyte/helophyte species for a 2 year sampling period in the Biebrza river (Poland). Grouping the species into macrophytes and helophytes showed a significant difference in BSi: 12.7±0.8 (n=135) and 8.4±0.9 (n=79) mg.g^{-1} dry mass respectively (p<0.001). Even some macrophytes had a higher BSi content than Phragmites australis, a helophyte which is assumed to have a big influence on the silica cycling. Comparing these data with the lignine and cellulose contents of the species showed no correlation although macrophytes had significantly more lignine (p<0.05) but less cellulose (p<0.01) than helophytes. Apparently, energetically low cost Si incorporation is not a good substitute for real structural molecules.

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STOICHIOMETRIC EFFECTS OF NUTRIENT LIMITATIONS IN PRIMARY PRODUCERS ON HIGHER TROPHIC LEVELS

Although it is known that varying nutrient levels in primary producers cause varying food quality at the bottom of the food web, it has only recently been shown that limitations can be traced to higher trophic levels. The propagation and effects of varying degrees of mineral limitation from primary producer to secondary consumer were tested with an experimental tri-trophic food chain consisting of the cryptophyte Rhodomonas salina, the calanoid copepod Acartia tonsa and larvae of the European lobster Hommarus gammarus in different stages of development. By growing the algae under nutrient-limited conditions and manipulating their nutrient content to create a limitation-gradient, the effect of different quality food on primary and secondary consumers was investigated. Feeding copepods reared on different nutrient limited diets to lobster larvae in various stages of development allowed to test for ontogenetic shifts in response to food of different quality. The different algal nutrient limitations caused stoichiometric and biochemical changes in the primary consumers, as well as the secondary consumers, whose dry weight and development were negatively affected by the limitations in the primary producers.

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HABITAT AND PREY SELECTION OF THE CORALLIVOROUS GASTROPOD *DRUPELLA CORNUS* IN THE NORTHERN RED SEA

Distribution patterns, abundance and habitat and prey selection of juveniles and adults of the corallivorous snail *Drupella cornus* were studied in the northern Red Sea. *Drupella cornus* was most abundant in shallowest reef parts (1m depth) and mainly associated with live corals, among which the genus *Acropora* was most frequently used. In contrast, *Montipor*a, *Pocillopora* and *Stylophora* were used less frequently than expected from their availability. *Seriatopora* and *Galaxea* remained unused. *Acropora acuminata* was preferred by juveniles, *A. selago* by adults. Adult and juvenile snails showed significant differences in habitat and prey selection: adults were associated with many substrates and coral growth forms, whereas juveniles were highly cryptic and restricted to live branching corals suggesting that juveniles have more specific habitat requirements. The observed mean density of 2.9 individuals m^{-2} is much higher than abundances recorded in previous studies from the northern Red Sea, suggesting that *D. cornus* populations have gradually increased in this region. Habitat degradation by *D. cornus* particularly affects *Acropora* corals, which may have severe consequences for associated organisms such as coral-dwelling fishes and invertebrates.

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HABITAT STRUCTURE AND PREDATION MODE PREDICT COMMUNITY ASSEMBLAGES IN THE SHALLOW BENTHOS OF AN ADRIATIC LAGOON

Top-down theories of community organization predict that mobile demersal macrofauna reach maximum abundance and diversity in structurally complex habitat, such as seagrass, which obstructs the vision and movement of predators. This prediction, however, oversimplifies by assuming a fixed predation mode and stable densities of predators and prey. If predators are mobile and can exploit structured habitat as ambush cover, then they can exclude most other macrofauna from structured patches. We assayed predator behavior and predation efficiency in fish communities in seagrass and neighboring bare sediment patches in experimental tanks and in nature in the Novigrad Sea, Croatia. We found (1) large ambush predators predominated in seagrass, and smaller chase-attack predators on bare sediment; (2) overall fish abundance was fourfold higher on bare sediment than in seagrass; (3) rates of biting, ingestion, and attacking were greatest in seagrass; and (4) ambush predators were more successful and aggressive than chase-attack predators. Our results are consistent with the conclusion that seagrass has a higher predation risk due to large, aggressive ambush predators, which have forced most small/juvenile fish out of seagrass and onto neighboring bare sediments.

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FLUXES OF DISSOLVED ORGANIC MATTER AND ITS STABLE CARBON ISOTOPES (DO13C) IN A SUGAR-CANE IMPACTED LAGOON SYSTEM OF NORTHEAST BRAZIL

The Manguaba lagoon in NE-Brazil was chosen for a study of the impacts of sugar-cane monoculture (rapidly expanding in tropical countries) on coastal waters. It receives its fresh waters from a sugar-cane monoculture dominated catchment area. Residence times in the lagoon are relatively long (weeks) whereby large amounts of dissolved organic matter (DOM) from lateral inputs are transformed along biotic and abiotic pathways. We traced the sugar-cane derived component of DOM along a full salinity gradient from the river endmember through the lagoon to the estuary by means of carbon isotope analyses on dissolved and colloidal organic matter. Unfractionated DOM mixed non-conservatively within the lagoon and conservatively through the estuary. This indicates efficient recycling of labile organic matter within the lagoon. Interestingly, less than 10% of the DOM is colloidal indicating a highly degraded dissolved OM fraction.

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CYANOBACTERIAL INHIBITORS LEAD TO REGULATION OF GUT PROTEASES IN DAPHNIA MAGNA: QUANTIFICATION BY REAL TIME PCR

Daphnia are the most important grazers of phytoplankton in limnic systems. Thus they are target organisms to different cyanobacterial defences against herbivores, e.g. protease inhibitors. These inhibitors, which are widespread in cyanobacteria, attack numerous proteases in the gut of Daphnia. However, some Daphnia magna clones counteract to those inhibitors by regulating their proteases when exposed to Microcystis aeruginosa. This could be shown by SDS-PAGEs of soluble proteins of Daphnia raised on different food treatments. The genetic level for this phenotypic plasticity could be demonstrated by quantifying the expression of digestive proteases of D. magna by Real Time PCR. 20% of M. aeruginosa in the food led to a considerable upregulation of proteases of D. magna. This regulation of proteases in Daphnia on the gentic level constitutes a feedback to cyanobacterial inhibitors. The ability of some D. magna clones to react to inhibitors may result in a shift in clone composition in lakes and thus to microevolution.

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PARAMURICEA CLAVATA (CNIDARIA, OCTOCORALLIA) AS FOUNDATION SPECIES. WHICH ROLE?

Foundation species, i.e. seagrasses, kelps, corals or mussels, are organisms able to modify their own habitat. For example they may reduce the flow velocity, as demonstrated for seagrass meadows, and decrease the resuspension processes, enriching the substrate by fine sediments. As a consequence, several other organisms can here find suitable habitat, characterized by specific physico-chemical conditions. The effect of foundation species on the ecosystem is difficult to define because of scattered experimental works on positive species interactions. Here we compare the time-averaged velocity of the water turbulence inside and outside a Paramuricea clavata population by using the plaster-balls method. Besides, the effects of the gorgonian forest presence on local community have been analyzed by photo analysis and panels. During calm sea conditions, inside the gorgonian forest, the water movement decreased of about 6% and the fine sediment fraction increased. Moreover coralline algae and Bryozoans are more abundant and diverse inside P. clavata forest highlighting the importance of this species as ecosystem modifier, allowing hypothesising the consequence of continuous threats of global warming and anthropogenic activities on coralligenous assemblages.

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PHOSPHATASES AS MOLECULAR MARKERS TO ASSESS HETEROGENEITY IN THE PHOSPHORUS STRESS RESPONSE IN MARINE BACTERIAL ASSEMBLAGES

Phosphorus (P) is a vital nutrient for all living organisms and often controls microbial growth in the ocean. In this study we investigated the molecular basis of bacterial phosphatases with the aim of providing a molecular marker for assessing the P-status of different groups in the marine environment. We found that homologs to *Escherichia coli* alkaline phosphatase (PhoA) were present in only a few marine isolates in the bacteriodetes and gamma-proteobacteria lineages. In contrast, PhoX, a recently described phosphatase, was widely distributed among diverse bacterial taxa and frequently found in the marine metagenomic GOS database. We next showed that PhoX was induced upon P-starvation and accounted for approximately 90% of the phosphatase activity in the model marine bacteria *Silicibacter pomeroyi*. Analysis of the available transcriptomic datasets and their corresponding metagenomes further indicated that PhoX is more abundant in oligotrophic environments, but unveiled that PhoA may play an important role in eutrophic waters. We observed heterogeneity in the P-stress of different bacterial groups under the same environmental conditions, which emphasized the need of molecular markers to address this issue.

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BETWEEN STARVING AND BEING EATEN: COPEPOD RESPONSES TO VARIABILITY IN ALGAL BLOOM AND PREDATOR PHENOLOGY

In deep lakes, the spring bloom provides a short period of high food quantity and quality for herbivorous zooplankton. The onset of the spring bloom is however highly variable due to meteorological forcing and thus affected by climate warming. This variability imposes a major challenge to species aiming at matching offspring occurrence and sufficient food supply in spring. We are analyzing a long-term data set to study how a copepod, Cyclops vicinus, is dealing with this high variability of spring bloom phenology and the consequences for reproductive success. The copepod performed a two-phase diapause, i.e. the actual diapause during summer/autumn followed by a retardation of maturation until the start of phytoplankton growth. This complex strategy ensures a high temporal match of offspring occurrence and spring bloom. Nevertheless, offspring abundances are higher in years with an early start of algal growth. We suggest that offspring might benefit from a warm spring due to a lengthened predator-free period or reduced time stress imposed by photoperiodically controlled induction of the summer diapause.

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THE LAKE SUPERIOR DEEP CHLOROPHYLL MAXIMUM RELATED TO ZOOPLANKTON GRAZING

Lake Superior's Deep Chlorophyll Maximum, located typically at 25-35m, is a persistent lake feature throughout the summer stratified period. The factors causing this DCM are not well understood. Often, in oligotrophic systems a DCM is associated with a nutrient or density gradient. However, previous studies from Lake Superior have not seen measurable nutrient gradients and Lake Superior's DCM is normally located below the density gradient. Another possible contributor is grazing pressure. Intense grazing pressure by the zooplankton community could keep phytoplankton populations low in the relatively warm surface layer. There is an increased abundance of zooplankton above the DCM. In this study, a series of dilution grazing experiments were conducted during six cruises over two years to determine grazing rates above, within and below the DCM. Grazing rates were often highest in the surface layer above the DCM, lowest near the DCM depth and sometimes high again well below the DCM depth. These results are consistent with the hypothesis that this major feature of Lake Superior's ecosystem is caused in part by top-down grazing pressure as a function of depth.

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DIFFERENT WAYS TO DIE: CELL DEATH MODES OF THE UNICELLULAR CHLOROPHYTE DUNALIELLA VIRIDIS UNDER DIFFERENT ENVIRONMENTAL STRESSES

Exposure of the unicellular microalga Dunaliella viridis to several environmental stresses such as osmotic shock, UV radiation, heat shock, nitrogen starvation and senescence, induced different cell death morphotypes, depending on the stimuli received. Senescent cells demonstrated unambiguous apoptotic-like characteristics. Acute heat shock caused general swelling and altered plasma membrane, but chromatin clusters and DNA strand breaks suggested a necrotic-like event. UV irradiated cells presented changes typical for necrosis and apoptotis, resembling an intermediate cell-death phenotype termed aponecrosis-like. Cells subjected to hyperosmotic shock revealed chromatin spotting without DNA fragmentation, and extensive cytoplasmic swelling and vacuolization, comparable to a paraptotic-like cell death phenotype. Nitrogen starved cells showed major cytoplasmic consumption, indicating a similarity to autophagic/vacuolar-like cell death.All environmental stresses tested produced a substantial increase in caspase-like activity.Cell death in D. viridis does not conform to a single pattern and how it dies depends on the injury received.These data support the theory that alternative, non-apoptotic programmed cell death, exist either in parallel or in an independent manner with apoptosis and were already present in single-celled organisms that evolved some 1.2-1.6 billion years ago.

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PHYSICAL AND CHEMICAL FACTORS IMPACTING UPON THE DISSOLUTION OF AEROSOL IRON IN SEAWATER

The bioavailability of iron controls primary production over large oceanic regions. The major external source of iron to the remote ocean is from atmospheric deposition of aerosol iron. However, due to the approaches used for iron dissolution, uncertainties remain in the estimate of available iron released from aerosols. We report a new approach to investigate the dissolution of aerosol iron in seawater using an incubator coupled with an automated sampler. Dissolved Fe in equilibrated samples was analysed using flow injection with chemiluminescence detection. The system provided high temporal resolution data over short (2 h) and medium (up to 3 days) timescales. This study highlights key factors impacting upon the dissolution process including aerosol solid phase association (Saharan vs. urban dust), dust concentration effect (high vs. low concentration), dissolution medium (natural seawater, UV-irradiated seawater, microwaved seawater), irradiation (light vs. dark) and iron binding model ligands (addition vs. absence of). Furthermore, the incubator system was used to evaluate the Fe seawater solubility in mixed high volume aerosol samples collected simultaneously over the Eastern Mediterranean Sea.

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THE JUMBO SQUID, DOSIDICUS GIGAS, SUPPRESSES METABOLISM DURING DIEL FORAYS INTO THE OXYGEN MINIMUM LAYER

The Jumbo squid, Dosidicus gigas, is a top predator in the Eastern Tropical Pacific that undergoes diel vertical migrations into a pronounced oxygen minimum layer. We investigated the physiological mechanisms that enable this active squid to tolerate extreme hypoxia despite high oxygen demand. Routine metabolic rates increased substantially between 20-25°C suggesting stress beyond this temperature range. Exposure to hypoxic conditions (1% O_2 at 10°C) caused a decrease in oxygen consumption by ~80% and a modest accumulation of anaerobic metabolites that partially offset the deficit in aerobic energy production. This metabolic suppression extends survival time at depth by conserving finite substrate stores and minimizing the accumulation of the deleterious anaerobic end products. A strong pH and temperature dependence of blood-oxygen binding by D. gigas supports oxygen extraction from hypoxic deep water while maximizing the release of oxygen to the tissues in warmer surface water. However, these adaptations may be maladaptive during future climate change and ocean acidification. Furthermore, metabolic suppression by migrant biota has important implications for the quantification of respiratory carbon flux in regions with a pronounced oxygen minimum.

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EVIDENCE FOR COUPLING BETWEEN SEA ICE COVER AND ANNUAL PRODUCTION IN ARCTIC SHALLOW WATER BENTHOS

The aim of this study was to test if sea ice cover through bottom-up processes affects the annual production of shallow water marine benthos. To test this, we used annual growth increments to 1) compare population growth rates of the bivalve *Clinocardium ciliatum* and the sea urchin *Strongylocentrotus droebachiensis* situated along an existing gradient of annual sea ice cover and 2) produce time series of inter-annual variation in growth in 5 populations of *C. ciliatum*. Annual growth was correlated to site-specific sea ice indices obtained from satellites between 1979 and 2003. Significant difference in annual growth rate was found between populations of both species and was related to annual ice cover. In two populations subjected to heavy ice cover about 25% of the inter-annual variation in growth could be correlated to changes in ice cover. Our data suggest that zoobenthic production is linked to sea ice dynamics through bottom-up regulation and that projected changes in sea ice cover could result in increased secondary production in the Arctic.

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GRAZER INDUCED TOXIN PRODUCTION IN ALEXANDRIUM –MECHANISMS AND CONSEQUENCES

Induced responses are abundant in phytoplankton but the mechanistic understanding and ecological consequences has received less attention. Both Alexandrium minutum and A. tamarense respond to trace amounts of waterborne cues from copepod grazers. The response is highly grazer specific. Some copepod species provoke an up to 28 fold increase in paralytic shellfish toxin content in A. minutum whereas other species has an intermediate or not detectable effect on cell toxicity. The copepod derived signal was isolated and partly characterized as an intermediately hydrophobic, compound, probably containing a peptide or protein. Grazer induced toxin formation was subsequently used to manipulate toxicity in Alexandrium cultures to investigate the effect of toxicity in feeding preference experiments. Copepods generally fed less on more toxic Alexandrium cells compared to non toxic or less toxic alternatives. Grazer induced resistance may therefore contribute to the formation of algal blooms by allocating grazing pressure away from more defended cells. Microarray analysis of grazer induced and non induced cells of the same strain of A. minutum was performed to reveal transcriptional changes behind grazer induced toxin formation.

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TEMPORAL AND SPATIAL DISTRIBUTION OF SUBMERGED VEGETATION AND DIASPORE BANK OF BRACKISH COASTAL LAGOON ON THE SOUTHERN BALTIC SEA

Interannual and spatial distribution of submerged aquatic vegetation were investigated along a salinity and eutrophication gradient along the German Baltic Coast (southern Baltic Sea). Submerged vegetations of inner coastal waters of the German Baltic Sea was analysed from 1999 to 2007. 108 transects in 23 waters were investigate in research projects and a first proof of the monitoring strategies for coastal waters. 28 species, included seven charophytes, were documented. The depth limit of submerged vege¬tations varied between 0.5 m and 5.3 m in the coastal waters. In addition to the vegetation diaspore bank in the surface sediment (upper 10 cm) was analysed. The depth distribution, density and coverage of vegetation and diaspores were analysed along the vegetations transects. The results show the geographical distribution and depth limit of vegetation in the inner coastal waters. The salinity is the key factor of geographical distribution. The recent distribution is lower than the ecophysiological potential of species and historical description. The eutrophication of coastal waters affects a lower depth limit of submerged vegetation and a loss of species in the coastal waters.

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FACTORS AFFECTING PARTICLE CAPTURE OF MARINE BACTERIA

In the sea, the number of submicron-sized particles such as viruses and colloids exceed that of bacterioplankton by one or two orders of magnitudes. We proposed that the initial step of bacterial utilization of those particles as nutrient source should be an association with them. We called it particle capture. Previously it has been suggested particle capture bacterial communities in marine environments. However, the mechanism of particle capture is still unknown. We hypothesized that filamentous structures on the cells, flagella, might play a key role to capture small organic particulates. In order to verify these hypotheses, we estimated particle capture ability inferred from enumeration of magnetically separated cells using model particles. Model organisms were Vibrio parahaemolyticus and Vibrio alginolyticus, both of which possess numerous lateral flagella and a single polar flagellum. The results using mutants indicated that possession of lateral flagella stimulate the capturing. On the other hand, the addition of chelating agents reduced the capturing ability, suggesting that electrostatic induction would play a role in the process.

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PHYCOCYANIN FLUORESCENCE OF FILAMENTOUS CYANOBACTERIA IN THE BALTIC SEA

Phycobiliproteins are the major light harvesting pigments in cyanobacteria and consequently their *in vivo* fluorescence can be used to detect cyanobacterial blooms. The type and amount of phycobiliproteins in cyanobacterial cells vary between species and the fluorescence wavelengths monitored must be selected accordingly. To critically assess the specificity of various commercial fluoroprobes for phycocyanin detection, their optical windows were compared with the excitation-emission fluorescence matrix measured for various phytoplankton groups with diverse pigmentation. Since 2005, phycocyanin fluorescence has been recorded operationally on a ferryboat commuting across the Baltic Sea. On a seasonal scale, phycocyanin fluorescence shows a linear relationship to the biomass of bloom-forming filamentous cyanobacteria, allowing the detection of spatio-temporal distribution of blooms. However, conversion from the fluorescence signal to the biomass is complicated as the phycobiliprotein content of cyanobacterial cells varies a lot. Dynamics of phycobiliproteins, in response to light and inorganic nitrogen conditions, are shown for two important bloom-forming cyanobacterial species in the Baltic Sea, *Aphanizomenon flos-aquae* and *Nodularia spumigena*.

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EFFECTS OF ULTRAVIOLET RADIATION ON PLANKTONIC PHOSPHORUS KINETICS

We examined the effects of ultraviolet radiation on the phosphorus kinetics in 15 North temperate lakes located in Ontario, and Saskatchewan, Canada. Lakes were thermally stratified or polymictic and were selected to encompass gradients in total phosphorus and dissolved organic carbon. The turnover time of the dissolved phosphate pool increased in ambient UVR exposed samples in 10 of 15 lakes. An effect of photosynthetically active radiation (PAR) on the turnover time was not observed. Planktonic regeneration rates of dissolved phosphorus were significantly reduced under UVR exposure in only one lake. Similarly, planktonic turnover rates (particulate phosphorus divided by regeneration rate) were only significantly reduced under UVR exposure in one lake. Changes in kinetic parameters were not significantly correlated with total UVB, total UVA, total UVR, nor total solar radiation exposure (sum of UVR and PAR). Although other kinetic parameters appear unaffected, our study demonstrates that the uptake of phosphate by plankton is a process that is affected by UVR exposure. This outcome suggests that the biogeochemical cycling of phosphorus in the surface waters of aquatic ecosystems may be altered by UV radiation.

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RECONSTRUCTION OF THE NITROGEN CYCLE IN THE GERMAN BIGHT/SE NORTH SEA BY MEANS OF STABLE NITROGEN ISOTOPES OBSERVATIONS IN SUSPENDED MATTER AND SEDIMENTS

Due to the amplified concentration of nutrients in estuaries and coastal waters of the German Bight/SE North Sea registered during the past decades, EU members bordering the North Sea agreed to reduce the inputs of reactive nitrogen into coastal waters to natural levels. To reconstruct the nitrogen cycle of the German Bight in pristine situations, we completed elemental analysis and stable nitrogen isotopes ($\delta^{15}N$) measurements in surface sediments, suspended matter and dated cores. The state of degradation of organic matter was also analysed to elucidate possible diagenetic effects related to $\delta^{15}N$ values. Upward increasing $\delta^{15}N$ values in sediment cores reflect changes in the N-isotope signature caused by natural processes and/or anthropogenic activities. Analogous, modern surface sediments showed $\delta^{15}N$ -enriched signals, which outline the anthropogenic nitrogen sources on land and revealed significant influences of discharged riverine material. $\delta^{15}N$ observations in modern surface sediments are used to validate the results simulated by the numerical 3D-ecosystem model ECOHAM, including a N-module and coincide in a similar spatial pattern, ultimately aiding to identify undisturbed river inputs of reactive nitrogen not measured in the past.

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ANTIBIOTIC RESISTANT ESCHERICHIA COLI IN WATERS OF THE SEINE RIVER BASSIN (FRANCE)

Faecal bacteria released in aquatic systems can contribute to the dissemination of antibiotic resistance. The first objective of this study was to evaluate the presence of AR faecal bacteria (E. coli) in rivers of the Seine watershed (France). The second one was to investigate the sources of AR E. coli. The following sources were analysed: (i) domestic and hospital wastewaters; (ii) surface runoff waters of pastured areas); (iii) surface runoff waters of forested areas. A total of 912 E. coli isolates were collected on plate counts (10 isolates per sample) and tested for their resistance to 12 antibiotics with the disc diffusion method. Among the 214 E. coli isolates from river samples, 42 % were resistant to one antibiotic or more. The resistance was highly variable from one antibiotic to another (maximum resistance observed for amoxicillin). Concerning the sources of AR E. coli, the higher percentages were found in hospital effluents followed by domestic wastewaters

and agricultural runoff waters. A very low number of AR bacteria was found in runoff waters from forested areas.

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HETEROTROPHIC BACTERIA IN SEDIMENTS OF ADRIATIC SEA (KAŠTELA BAY)

The quantity but more important the quality of the sedimented organic material are known to be key factors in controlling the distribution of bacteria in marine sediments. To asses the significance of organic matter for bacteria in shallow coastal sediments of the eastern Adriatic Sea, we investigated their relationship on a temporal scale as well as between different sediment layers. We used the concentrations of organic matter (OM), chloroplastic pigment equivalents (CPE), chlorophyll a (chl a) and phaeopigments (PHAEO) as indicators of substrate concentrations in sediments. Bacterial abundance, biomass and volume were strongly related to the indicators of substrate concentrations on both scales. The accumulation of labile OM in deeper layers also had a profound effect on the size and structure of bacteria. High amounts of OM and the low proportion of labile organic fraction (CPE; chl a and PHAEO) indicate that this environment acts as a sink for accumulation of detrital material.

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BIOPHYSICAL COUPLINGS, PATCHINESS AND INTERMITTENCY IN THE OCEAN: A MULTISCALE APPROACH

Since the recognition of the multiscale nature of turbulent structures and fluctuations, much has been written on biophysical couplins in the ocean. In this contxte, this contribution will review traditional approaches of the multiscale nature of biophysical fluctuations and couplings in the ocean and discuss their seldom considered, though ubiquitous, intermittent properties. Specifically, the impact of intermittency (i.e. sharp, local fluctuations over a range of low density values) on standard techniques traditionally used to describe plankton patchiness (e.g. spectral analysis) will be discussed. It will subsequently be shown that a -5/3 behavior in Fourier space can erroneously be considered as a passive scalar signature. This ubiquity of intermittency will be illustrated using a variety of datasets, including (i) turbulent velocity, temperature and salinity fluctuations, (ii) distribution of both predators and preys, (iii) motion behavior, and discussed in an evolutionary context. Finally, the relevance of intermittency on biogeochemical fluxes will be theoreticcaly investigated and discussed.

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COMPARATIVE STUDY ON BENTHIC PRIMARY PRODUCTION IN COARSE, SUBTIDAL SILICATE AND CARBONATE SANDS

Microphytobenthos is one of the most important primary producers in shallow marine areas like permeable sands, which cover 70% of the world's coastal shelf regions. Silicate and carbonate sands have different physicochemical properties. We investigated whether coarse silicate and carbonate sands with equal environmental settings, grain size and porosity differ in microphytobenthos abundance and primary production. We used microsensors to measure photosynthetic rates, direct counts and liquid chromatography to quantify microphytobenthos abundance and pigment content. At equal light intensities net photosynthesis (NPS) was 2.1 times higher in the silicate sand. In contrast, abundance and pigment concentrations were 1.7 and 1.4, TOC, total oxygen uptake and C:N ratio (measured in a parallel study) were 4-5, 1.3 and 2-3 times higher in the carbonate sand. Considering all data, the higher NPS rates yield for higher photosynthesis activity per photosynthetically active unit in the silicate sand. We suggest that the porous structure of the carbonate sand grains leads to accumulations and incorporations of organic matter, making it refractory, therefore decreasing organic matter bioavailability and photosynthetic activity, hence may act as a carbon sink.

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RESPONSE OF SEA NETTLE *CHRYSAORA QUINQUECIRRHA* TO LOW TEMPERATURE

A time series of visual surface counts and vertical net hauls in the Choptank River, a tributary of Chesapeake Bay, has shown that as temperatures approach 15°C *Chrysaora quinquecirrha* disappears from the surface, but persist in net hauls until temperatures reach 10°C. This observation suggests that low temperatures cause nettles to sink before cooling to the limit of their physiological tolerance and may have implications for the deposition of organic matter associated with the seasonal disappearance of sea nettles from Chesapeake Bay. To test our hypothesis, we exposed sea nettles to low temperatures in large static tanks and measured their depth and pulsation rates twice daily for at least six days. This procedure was repeated three times through the 2008 sea nettle season. On average, individuals exposed to temperatures below 15°C were found deeper and pulsed slower than those in the warmer control tank. These results support our hypothesis that nettles sink to the bottom as water temperature decreases; thus understanding the fate of sea nettle biomass in Chesapeake Bay will need to include it's interaction with the benthos.

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THE BERRE LAGOON ECOSYSTEM FUNCTIONING BY A CONCEPTUAL DPSIR APPROACH AND A 3D WATER QUALITY COUPLED MODELLING

The Berre lagoon (Southern France, Mediterranean Sea) is among the biggest brackish lagoons in Europe. The lagoon is connected to the sea by the Caronte canal, which allows tidal-driven water exchange. An average depth of 6 m makes the lagoon sensitive to wind stress as well. Anthropogenic activities (i.e. industrial and urban boom since the 1930s) seriously affected this coastal ecosystem which is presently considered as eutrophied. Since 2005, the lagoon has been the object of intensive monitoring surveys. The availability of water quality data, together with the multitude of natural and anthropogenic driving factors of environmental change, make the Berre lagoon an interesting case study for ecosystem modelling. First a conceptual model using the DPSIR approach was applied to point out possible drivers/pressures responsible of eutrophication. Then the TELEMAC 3D finite element model was used to simulate hydrodynamics, salinity and temperature. TELEMAC 3D was then coupled to the water quality model DELWAQ from Delft Hydraulics in order to simulate ecosystem functioning. The modelling strategy is described and model results for 2005 are presented and discussed with respect to measurements.

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BACTERIAL COMMUNITY RESPONSE TO A WHOLE-LAKE MIXING MANIPULATION

Global change may alter the frequency and seasonality of temperate lake mixing, with unknown ecosystem consequences. Mixing perturbs aquatic bacterial communities by disrupting vertical dissolved oxygen (DO) and temperature gradients that influence bacterial dynamics. We conducted a whole lake mixing manipulation to observe bacterial community response to episodic mixing. We mixed a dimictic bog during summer stratification. We deployed an instrumented buoy that measured high-resolution thermal profiles, surface DO, carbon dioxide, and weather, and autoprofiled vertical DO, turbidity, redox, temperature, chlorophyll, and conductivity. We collected bacterial community and water chemistry samples from the integrated epilimnion and hypolimnion, and from discrete depths. We mixed the lake by mechanically oscillating large volumes of water at the deep hole. Mixis was achieved after eight days, and followed bacterial community dynamics until fall overturn. Prior to treatment, the hypolimnion was anoxic and near five degrees. The hypolimnion eroded into the epilimnion until mixis at nineteen degrees. Though the lake slowly re-stratified, hypolimnion temperature remained high through summer. Oppositely, DO depleted in the hypolimnion within four days following mixis, and remained low until fall turnover.

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LINKING THE PHOTOCHEMICAL CYCLES OF HYDROGEN PEROXIDE AND IRON IN THE GULF OF AQABA

The redox transformations of H_2O_2 and Fe(II) were studied throughout the year in the Gulf of Aqaba. The Gulf's strongly illuminated oligotrophic (low phytoplankton abundance) waters and the absence of rain and runoff provide a unique opportunity for photochemical research. By combining recurrent high resolution sampling with *in situ* photochemical experiments, we were able to mechanistically link the redox cycles of these reactive species. A clear diurnal cycle in the surface concentrations of both species was observed, with Fe(II) closely following solar radiation intensity while H_2O_2 lagged behind by 2-4 hours. H_2O_2 concentrations varied seasonally in accordance to water column stability and CDOM concentrations, while Fe(II) showed no seasonal pattern. Both species showed photochemical-type vertical distribution. The slow decaying H_2O_2 (13-16 hours half life) extended down to the thermocline at 100 meter depth, while the fast decaying Fe(II) (0.5-3 minutes half life) was undetectable at 10 meter depth. Elevated Fe(II) oxidation rates were recorded in the Gulf when H_2O_2 concentrations exceeded 50nM. Iron reduction in turn was shown to slow down H_2O_2 formation by scavenging the superoxide radical.

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PHOTOSYNTHETIC RESPONSES OF THE TROPICAL SEAGRASS HALOPHILA STIPULACEA TO LIGHT ALONG A DEPTH GRADIENT. II: PLASTIC ACCLIMATIONS FOLLOWING TRANSPLANTATIONS

Halophila stipulacea is the dominant seagrass in the Gulf of Aqaba, where it grows from the intertidal to depths >70 m. The successful growth under such a broad irradiance gradient demonstrates either a high plasticity or longer-term adaptations, possibly resulting in the formation of ecotypes. To evaluate its acclimation potential, we transplanted Halophila shoots between 8 and 33mand compared photosynthetic pigments and parameters derived from PAM fluorometry generated light response curves (RLC) RLCs from the shallow (400 μmol photons m-2 s-1) and deep sites (35 μmol photons m-2 s-1 at midday) were characteristic for high- and low-light growing plants, respectively. Acclimation was observed after 6 days, when the RLCs of transplanted plants resembled those of the original plants growing at the specific depths. Both chlorophylls a and b decreased or increased after 14 days when the plants were transferred to high- vs. low-light environments, respectively. Yet chlorophyll a/b ratios remained constant. These rapid changes in photosynthetic responses and light absorption characteristics to varying light environments point to Halophila as being a highly plastic seagrass enabling dominance at a wide range of irradiances.

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ANOMALOUS ESTUARINE MICROBIAL C-BUDGETS IN HIGH NITROGEN WATERS

Microbial biogeochemical research has been carried out in the Delaware Estuary and subtributary Murderkill River, coastal plain estuaries in the mid-Atlantic region of the US. Both have very high ammonium and nitrate concentrations, largely from anthropogenic inputs. In measuring primary production and in estimating community microbial carbon budgets, we have found two interesting anomalies. The first is that at elevated ambient ammonium concentrations, primary production is markedly lower than at lower ammonium concentrations. The second anomaly is of high rates of dark dissolved inorganic carbon (DIC) uptake instead of net respiratory carbon production in the dark. We analyze here the apparent ammonium suppression anomaly using 25 years of field measurements of primary production. We also present analysis of the dark DIC uptake with the suggestion that it is due to the often overlooked chemoautotrophic process of nitrification.

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TURBULENCE, PHYTOPLANKTON, AND FISH AT A CONTINENTAL MARGIN

Phytoplankton cell size is an important factor controlling the fate of carbon in ecosystems. Large cells channel carbon to higher trophic levels, and also are a major component in the flux of particulate organic carbon to deep water and the sediments. Small cells tend to fuel the recycling microbial food web. The availability of nutrients affects cell size, with nutrient deplete systems favouring small phytoplankton. At the edge of the continental shelf of NW Europe localised vertical mixing of nutrients is driven by the break-up of an internal tide, with substantial vertical fluxes of nutrients to surface waters occurring at spring tides. These cause a marked shift in the phytoplankton community to one dominated by large eukaryotes, compared to communities dominated by cyanobacteria in the thermoclines of the adjacent shelf sea and open NE Atlantic Ocean. This shelf edge band of large-celled phytoplankton has major implications for the densities of fish (and fishing vessels), and for the export of particulate organic carbon at the shelf edge. More generally, horizontal gradients in vertical turbulent mixing are key to understanding ecosystem patchiness.

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INVESTIGATING THE BIOTIC FORMATION OF METHOXYLATED POLYBROMINATED DIPHENYL ETHERS (MEO-PBDES) IN MARINE ECOSYSTEMS

Many halogenated organic compounds were considered to be of anthropogenic origin, but there is now evidence for their production in nature. For example, MeO-PBDEs have been shown to accumulate in whale tissues, and radiocarbon evidence indicates a natural, ubiquitous, marine origin. We are interested in what these ubiquitous biotic marine source(s) may be. In order to identify potential pelagic biotic sources we have searched the Genbank environmental databases (GOS, ALOHA) for biosynthetic clusters similar to conserved halogenase genes that have been identified to participate in the biosynthesis of compounds with chemical structures similar to MeO-PBDEs. Based on sequence alignment studies with these sequences and those from well-characterized genomes containing the conserved gene sequence, a set of degenerate oligonucleotide primers will be used to screen for these halogenase genes in both pure cultures of marine bacterial isolates and marine environmental samples. The ultimate goal of this study is to demonstrate the microbial production of these compounds in the natural environment. This work has important implications regarding the fate of industrial analogs, as well as our understanding of contaminant biogeochemistry and remediation.

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INSTRUMENTING THE DEEP OCEAN FOR LONG-TERM MONITORING OF BENTHIC COMMUNITY PROCESSES

Continuous monitoring of deep ocean processes has long been a challenge. The development of cabled observatories, with continuous power and real-time communications, will enable more sustained monitoring of the deep sea. We are adapting several instruments, currently deployed at a 4000 m depth in the NE Pacific, for use with a cabled observatory system. The current instrumentation, which is autonomous, allows us to study benthic community structure via several methodologies: a digital time-lapse camera system that captures high-resolution images on an hourly basis over six months, and a bottom-transiting vehicle capable of measuring sediment community oxygen consumption at multiple sites and conducting photographic transects. In addition, we are developing an instrument that combines a traditional sediment trap with a digital imaging system and fluorometer. Our ultimate goal is to incorporate the time-lapse cameras, bottom-transecting, vehicle and sedimentation sensors into a cabled observatory system for deployment to abyssal depths.

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EEFECT OF OCEAN ACIDIFICATION ON IRON UPTAKE AND REQUIREMENTS IN MARINE PHYTOPLANKTON

Iron availability limits primary production in large areas of the oceans. The acidification caused by dissolution of anthropogenic CO_2 changes the chemistry and, hence, the bioavailability of iron (Fe) in seawater. We show that acidification of media containing various Fe-ligand complexes decreases the Fe uptake rate of model phytoplankton to an extent predicted by the changes in Fe chemistry. A slower Fe uptake with decreasing pH is also seen in incubations of natural assemblages from both HNLC and coastal regions in the North Pacific ocean. The Fe requirements of model species remain unchanged when the CO_2 concentration is increased above ambient. The net effect of the ongoing acidification of seawater is likely to be an increase in the Fe-stress of the phytoplankton in Fe-limited regions of the oceans.

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IRON LIMITATION REDUCES PHOTOSYNTHETIC EFFICIENCY IN *STYLOPHORA PISTILLATA* COLONIES AT HIGH TEMPERATURE

Coral bleaching involves chronic photoinhibition in zooxanthellae, associated with reactive oxygen species (ROS) generated under high light and temperature. ROS normally are scavenged by metal-dependent antioxidants, including superoxide dismutases (Cu-Zn; Mn; Fe), ascorbate peroxidase (Fe), and catalase (Fe). We postulated that trace metal availability might be suppressed sufficiently by thermal stratification of surface waters to compromise coral metalloenzymic defenses at times of bleaching stress. We varied iron availability using the siderophore desferrioximine B (DFB) to assess its effect on coral photosynthetic efficiency, f_v/f_m, a harbinger of bleaching, at low and high temperature. Two sequential experiments showed that dark-adapted f_v/f_m remained unchanged over >11 days in colonies maintained at 27°C irrespective of DFB treatment. However, temporal trends in colony f_v/f_m decreased significantly in normal seawater at 30–31°C and declined further with DFB added. These effects were pronounced on upper, directly illuminated surfaces of coral branches. Our preliminary findings indicate that low iron availability in seawater can compromise photosynthetic efficiency of zooxanthellae *in hospite*, suggesting that iron limitation may facilitate chronic photoinhibition at elevated temperatures, albeit apparently without involvement of enhanced ROS.

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EFFECT OF REGIME AND CLIMATE SHIFTS ON THE ABUNDANCE OF NATIVE AND NON-NATIVE GELATINOUS PLANKTON IN THE BLACK SEA

During the last decades, native and invasive gelatinous species have become the main drivers of the Black Sea ecosystem functioning subjected to their disturbance. With respect to their origin, all the Black Sea species may be subdivided into cold water, warm-water, eurythermal. Native gelatinous species belong to moderately cold-water species: the ctenophore Pleurobrachia pileus, two scyphomedusas Aurelia aurita and Rhizostoma pulmo, and the pyrophyte alga Noctiluca scintillans. The warm-water invader ctenophore Mnemiopsis leidyi arrived and established in the upper layer of the Black Sea, where there were no other predators or gelatinous competitors and where it could reach high abundance under optimal upper layer temperatures and high prey concentrations. Ten years later, its predator—the warm water ctenophore Beroe ovata arrived and established in the same upper layer. We analyzed the variability of the native and non-native gelatinous species population size, the level of their competition in the Black Sea as a response to the regime and climate shifts. Their different origins determine their different phenology, population growth and size, distribution, predation rates and competition for zooplankton.

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INTERPRETATION OF THE CARBON ISOTOPIC SIGNAL VARIATIONS OF SETTLING PARTICLES IN THE WESTERN SUBARCTIC PACIFIC USING A ONE-DIMENSIONAL ECOSYSTEM MODEL

$\delta^{13}C$ of settling particulate organic matter ($\delta^{13}C_{POM}$) collected by sediment trap moored at station KNOT (44°N 155°E, water depth 770m) from October 25 1999 to May 11 2006 varied significantly on seasonal timescales. Generally, minima occur in spring, maxima occur in fall, and gradual decreases from fall to spring occur with maxima in winter. The range of the values was from about -27.0 to -23.0 ‰. To interpret the processes controlling such variations quantitatively, we developed a one-dimensional ecosystem model including carbon isotopes. In our model, we considered the isotope effects by photosynthesis, precipitation of calcite and gas exchange. This model successfully reproduced the seasonal variations in dissolved inorganic carbon (DIC) concentration and $\delta^{13}C$ of DIC in the surface water, but did not reproduce those in $\delta^{13}C_{POM}$, especially the amplitude of about 4 ‰ seen in observed seasonal variations. This is mainly due to the fixed isotope effect for photosynthesis, and then we parameterized the isotope effect using both aqueous CO_2 concentration and growth rates of phytoplankton. We are analyzing the influence of isotope effect of each process on $\delta^{13}C_{POM}$.

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MICROBIAL DEGRADATION CHARACTERISTICS OF FATTY ACIDS OF MACROALGAE, MICROALGAE AND MARSH VEGETATION

Estuarine tidal flats are the transition zone from land to ocean system and receive materials such as organic matters and nutrients transported from rivers or oceans. Especially, macroalgae (Ulva sp.), microalgae (Cylindrotheca closterium) and marsh vegetation (Phragmites australis) are potential sources of organic matter and nutrients to surface sediment in the tidal flat. Recently, fatty acid has been used as biomarkers to trace the origin and flow of organic matter in marine food web. However, very few information has been reported on the use of FAs to investigate the microbial transformation of organic matter in tidal flat. The objective of this study was to examine changes in FA composition in 3 different organic matters during microbial decomposition. If the decomposition process of FAs is predictable, the composition changes in FAs through time could be used to determine the degradation state or age of sediment organic matters.

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DETERMINING SPECIES-SPECIFIC ICHTHYOPLANKTON PREDATION BY JELLYFISH USING DNA PROBES

Jellyfish are widely reported to be important predators of fish eggs and larvae, however details on species-specific predation rates are rare due to the difficulty associated with ichthyoplankton identification. A recently developed genetic technique for ichthyoplankton identification was applied to eggs recovered from the guts of the two jellyfish, *Aurelia* sp. and *Chrysaora* sp. in the northern Gulf of Mexico. This Taqman© real-time polymerase chain reaction (PCR) assay uses species-specific DNA probes targeting three commercially and recreationally important fish species: red snapper (*Lutjanus campechanus*), vermilion snapper (*Rhomboplites aurorubens*) and red drum (*Sciaenops ocellatus*). We present data on species-specific egg predation rates from gut contents of jellyfish collected during the summer and fall of 2007 and 2008, 45% of which contained fish eggs in their guts.

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EFFECTS OF BIOIRRIGATION ON METHYMERCURY FORMATION AND EFFLUX FROM MARINE SEDIMENTS

Mercury methylation within marine sediments and its subsequent mobilization to the water column is thought to be the primary source of methyl mercury to most coastal marine systems and may be an important source for open-ocean biota as well. We examined rates of mercury methylation, demethylation and transport in sediments from several locations in Boston Harbor, Massachusetts (USA). Our results indicate that the geometry and ventilation of burrows by benthic infauna influences both the formation of methyl mercury and its flux to overlying water. We developed a mathematical model of methyl mercury formation and transport in sediments to address questions regarding the nature of bioavailable methyl mercury and the role of sediment sorption, bioturbation, and bioirrigation in determining its fate in the marine environment. Our results indicate that bioirrigation by benthic macrofauna plays an important role in controlling the concentration, distribution, and fate of this important contaminant.

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DISTRIBUTION AND DIVERSITY OF OMEGA-3 POLYUNSATURATED FATTY ACID BIOSYNTHETIC GENES IN THE MARINE ENVIRONMENT

Bacterial production of long-chain omega-3 polyunsaturated fatty acids (PUFAs), such as EPA (20:5) and DHA (22:6), is constrained to a narrow subset of marine γ-proteobacteria. A preponderance of PUFA producing microbial strains have been isolated from deep-sea and polar environments however the physiological function of PUFA production remains unclear. The genes responsible for PUFA synthesis, designated pfaEABCD, encode large, multi-domain proteins akin to Type I iterative polyketide synthases. Both the gene order and domain structure of pfa gene clusters is well conserved amongst strains producing varied PUFA end-products. The present study interrogates a variety of marine habitats ranging from coastal and open ocean surface waters to the deep sea for the presence of genetic signatures implicating PUFA production. The environmental sequence data together with pfa gene sequence information from complete genome sequences and ocean metagenomic datasets reveals that pfa genes exist not only in the cold, deep sea but also in coastal temperate waters. Phylogenetic inferences based on all available sequence data aid in elucidating the form, function, and evolutionary history of microbial polyunsaturated fatty acid synthesis.

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COUPLING MICROALGAE PRODUCTION TO ANAEROBIC DIGESTION FOR ENERGY PRODUCTION AND CO2 MITIGATION

The potential of microalgae as a source of biofuels and as a technological solution for CO2 mitigation is subject to intense academic and industrial research. In the perspective of setting up massive cultures, the management of large quantities of residual biomass must be considered. The anaerobic digestion is a key process that can solve both this waste issue and the economical and energetical balance of such a promising technology. Indeed, the conversion of algal biomass after lipid extraction into methane is a process that can recover more energy than the energy from the cell lipid. Three main bottlenecks are identified to digest microalgae. First, the biodegradability of microalgae can be lows depending on both the biochemical composition and the nature of the cell wall. Then, the high cellular protein content results in a release of ammonia which can lead to potential toxicity. By rebuilding an ecosystem made of these two compartments and coupling them, it is also possible to purify both biogas in order to concentrate methane and even mitigate industrial gas.

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UNDERSTANDING THE SPATIO-TEMPORAL VARIABILITY OF PRIMARY PRODUCTION OVER AN ARCTIC/SUB-ARCTIC MARINE SYSTEM (THE HUDSON BAY) VIA COUPLED BIO-PHYSICAL MODELS

The temperature increase over the Arctic Ocean and its adjacent seas, as predicted by General Circulation Models, implies multiple environmental changes such as: intensification of the hydrological cycle, changes in stratification and water mass circulation and most importantly, large decrease in sea ice thickness and duration. The associated marine biogeochemical responses (marine production and associated fluxes) to such changes are still largely unknown. The focus is the Hudson Bay system (Hudson Bay, Foxe Basin and Hudson Strait), the largest inland sea in Canada with typical Arctic characteristics including cold, fresh waters and a complete seasonal sea-ice cover. This project attempts to better understand the Hudson Bay marine ecosystem in response to climate and ocean variability using coupled biological/physical models. Two biological models are developed for the understanding of sea-ice and pelagic biota, respectively, both driven by the sea ice-ocean model of Saucier et al. (2004) with realistic tidal, atmospheric and hydrologic forcing. We present here results concerning the simulated spatial and temporal variability for ice-algae and phytoplankton primary production and implications for the coupling of both ecosystem models.

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PHYSIOLOGICAL STATE OF MICROBES IN THE NATURAL ENVIRONMENT: DETERMINING ACTIVITY AND IDENTITY ONE CELL AT A TIME

Microbes in the environment appear to exist in states very different from those commonly observed in pure culture. Our concepts derived from decades of culture work, while useful in some ways, prevent us from a full understanding of the functioning of natural microbial communities. This presentation will review the state-of-the-art in single cell activity methods for marine bacteria, and attempt to provide some framework for considering these results in the context of emerging information about the diversity and evolution of marine prokaryotes. With the lack of physical, geographical barriers; the rapid generation rates of microbes ("everything is everywhere"); and the huge observed diversity in marine microbes, the question "what is a population?" becomes important to consider. What forces and maintains the high diversity? Single cell activity methods combined with single cell molecular tools, may have the potential to help us answer these questions and lead to better understanding of the function and mechanisms of natural microbial communities.

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DIVERSITY OF HETEROTROPHIC MARINE PROTISTS USING SINGLE CELL SEQUENCING AND CLONE LIBRARIES

As with marine bacteria, recent observations indicate that the dominant heterotrophic protists in marine waters are not represented by the most commonly or easily cultured taxa. We have developed a novel approach that combines high-speed cell sorting with whole genome amplification to obtain amplified genomes of single protistan cells. As part of an ongoing study of protistan grazing on bacteria we have obtained single amplified genomes of several heterotrophic protists from Boothbay Harbor, Maine, USA waters. We sort live cells directly from a natural sample after a short incubation with the fluorescent probe Lysotracker™ (Invitrogen), which preferentially tags eukaryotes with lysosomes, and has been shown to quantitatively label heterotophic protists from natural waters. Comparison of single cell sequencing with PCR clone library approaches yields different dominant taxa of protists. Single cell sequencing resulted in an abundance of cercozoa and taxa considered phototrophic. This approach avoids PCR biases, and provides information complementary to metagenomics data. With new high-throughput facilities these new tools will become practical for answering fundamental questions about the biology of marine protists.

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AN INTEGRATED APPROACH TO STUDY CHEMOLITHOAUTOTROPHIC PROCESSES AT DEEP-SEA HYDROTHERMAL VENTS AT 9°N, EAST PACIFIC RISE

At deep-sea hydrothermal vents, chemolithoautotrophic microorganisms mediate the transfer of energy from the geothermal source to the higher trophic levels. These organisms acquire energy from the oxidation of reduced inorganic compounds that are plentiful at deep-sea vents and are able to fix inorganic carbon, providing a continuous supply of organic carbon for heterotrophs and higher trophic levels. However, presently our knowledge on the identity and activity of chemolithoautotrophic microorganisms at vents is inadequate. To address the question of how much carbon is produced in diffuse flow areas and to determine which organisms are responsible for it, an integrated approach was taken by combining analytical chemistry, isotopic analysis, microbiological methods, and genomic approaches. Incubations utilizing labeled bicarbonate under varying conditions were performed to determine the identity of autotrophic microbes and their rates of carbon fixation. Further, metagenomic analyses provide an unprecedented and potentially unbiased view into the diversity, and, more importantly, the functional gene representation of the microbial communities. In conjunction with measurements of physicochemical parameters, this study contributes to a more comprehensive understanding of autotrophic processes at deep-sea hydrothermal vents.

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DO NATURAL AND ANTHROPOGENIC PRESSURES AFFECT SUBTIDAL AND INTERTIDAL BENTHIC COMMUNITIES IN A SIMILAR WAY?

Responses of benthic invertebrate communities to natural and anthropogenic stress might be very similar, confounding their use as indicators of human pressure. A medium-term data series of nearby intertidal and subtidal benthic communities of the Tagus estuary (Portugal), in a degraded area where mitigation measures were implemented, was used to understand how natural variation might confound the interpretation of recovery trends. A dataset consisting of 38 seasonal samples (1996-2007) revealed a clear separation between intertidal and subtidal assemblages, although having 50% of common taxa, including the most abundant. Density, taxa richness and diversity were consistently higher in subtidal when compared to intertidal communities and sediment composition and rainfall were the main environmental factors separating both areas. Although showing similar trends along the studied period, patterns of change in intertidal communities seem to be sharper, due to a higher exposition to rapid changes in environmental conditions (e.g. heavy rainfall, hydrodynamics, and temperature fluctuations). These results support the selection of subtidal communities for benthic quality assessment, since they seem to be less influenced by natural variations than intertidal communities.

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DOMOIC ACID TOXINS IN THE OCEANIC PACIFIC: NATURAL COMPONENTS AND ENHANCED PRESENCE IN IRON FERTILIZED COMMUNITIES

This is a companion presentation to that of Bargu et al. Here we document the presence of neurotoxin domoic acid (DA) in *Pseudo-nitzschia* diatoms in several oceanic environments of the Pacific and their descent into underlying mesopelagic waters. Additionally we report DA's presence in archived samples from mesoscale iron fertilization experiments (SOFEX and IronEX). We discuss possible ecosystem consequences of these findings, including food web alterations resulting from blooms of the toxic algae promoted by the trace metal addition . A major concern is that the increased abundance of cells during iron fertilization, even with their low particulate DA quotas, (<1 pg/cell), has unpredictable and potentially worrisome consequences for this proposed geoengineering strategy to reduce atmospheric CO2. Such conditions, however, may have a natural precedent, as glacial epochs also experienced naturally enhanced levels of iron in oceanic surface waters and likely led to increased populations of the DA-producing diatoms.

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THE POTENTIAL EFFECTS OF OCEAN ACIDIFICATION AND WARMING ON CORAL REEFS BASED ON NATURAL COMMUNITY SCALE OBSERVATIONS

We investigated the relations between calcification of an entire coral reef in the Northern Gulf of Aqaba, Red Sea and naturally occurring annual variations in aragonite saturation levels. Calcification rates correlated remarkably well with aragonite saturation showing

an exponential dependence between the two. These rates correlate remarkably well with reported experimental inorganic precipitation rates as a function of aragonite saturation and temperature. Other community scale calcification studies in the Indo-Pacific when subjected to this analysis show similar relations. Finally, some of the nighttime measurements showed net aragonite dissolution, despite super-saturation of the overlying water. The rates of dissolution reduced the gross calcification rate by roughly 20%. Considering future scenarios of aragonite saturation and sea surface temperatures, we estimated the decrease in calcification combined with aragonite dissolution for different future levels of CO_2 in over 9000 reef locations. These estimates suggest that most of the world reefs will be undergoing net dissolution by the time that atmospheric CO_2 reaches 750 ppm. If thermal bleaching of corals is also considered, most reefs will start dissolving at CO_2 level of 560 ppm.

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BENTHIC COMMUNITIES RECOVERY PATTERNS IN A MEDITERRANEAN AREA (N. EVVOIKOS GULF, GREECE) SUBJECT TO METALLIFEROUS WASTE DISCHARGE OVER 14 YEARS OF MONITORING.

The by products of the smelting procedure of a local ferro-nickel plant in the form of slag are discharged in a legally defined coastal area (N. Evvoikos gulf, Aegean Sea). This practice adopted over the last fourty years has led to the formation of a thick underwater deposit of slag. This work presents the long-term effects of this practice onto the benthic communities of the area over a 14 year monitoring period (1993-2006). The biotic index BENTIX efficiently reflected the communities' ecological status alternation between decline and recovery. Communities' recovery depends on the extent and rate of the discharge activity which varies spatially and over time as evidenced by bottom mappings of the deposit. Recovery can be described as a succession course of primary and secondary opportunists corresponding to the "sustainable ecological succession" of Ellis (2003). Recovery of the benthic communities subject to metalliferous waste disposal is a slow process and the communities' resilience to recovery increases as the discharge effects are accumulating. Complete restoration of the ecosystem after the implementation of a land disposal management plan, cannot be predicted.

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NEW APPROACHES TO ANALYSIS OF ENERGETICS IN PLANKTON POPULATIONS

Small heterotrophic eukaryotes, often known as heterotrophic flagellates (HF), currently include keystone microorganisms which play significant roles in the transfer of both prokaryotic and eukaryotic carbon to higher trophic levels in aquatic ecosystems. Recent investigations providing extensive data on sequences of DNA from ribosomal genes have resulted in major changes to the classification of these microorganisms and greatly increased our knowledge of their taxonomic and functional diversity. However, we are not much farther ahead today than we were two decades ago in our overall understanding of the ecological functions and physiological characteristics of these microorganisms. In reality, HF is a heterogeneous polyphyletic grouping of microorganisms, including a large number of genetically unrelated organisms from many different phyla, with many different ecological functions, and with phagotrophic, mixotrophic, and both saprophytic and parasitic modes of nutrition. A new understanding of the diverse functions of HF in aquatic ecosystems is necessary and of paramount importance in order to transcend the concept of 'the microbial loop' in aquatic microbial ecology.

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HYDROGEOMORPHIC AND ECOLOGICAL PERFORMANCE OF THREE RESTORING TIDAL MARSHES, SALMON RIVER ESTUARY, OREGON USA: TRAJECTORIES TOWARD RECOVERING RESILIENCE?

Over 1977-2004, we collectively investigated the recovery trajectories of three restoring emergent marshes in the Salmon River estuary, coastal Oregon, USA. After conversion of 250 ha (~65%) of the historic tidal marsh ecosystem in the estuary were converted to pasture land in the middle of the last century, three marshes (145 ha total) were successively restored to tidal inundation by dike removal in 1978, 1987, and 1996. Studies of vegetation change since 1977; intensive studies of marsh insects, benthic invertebrates and fish from 1997 to 2004; and, periodic and aerial image reconstructions of geomorphology have provided rates and patterns of recovery and the interactions among the geomorphic and ecological responses to tidal inundation. Comparisons to an adjacent reference marsh of the restoring marshes' vegetative, insect, and benthic invertebrate structure, and juvenile Chinook salmon *Oncorhynchus tshawytscha* habitat utilization and performance, indicate varying but progressive convergence and increasing complexity of ecological responses that support ecosystem resilience. Variation in the response variables may be explained not only by time since dike removal but also landscape organization and geomorphic changes during the diked period.

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MOLECULAR GUT CONTENT ANALYSIS TO DETERMINE PREY-SPECIFIC FEEDING BY COPEPODS IN NATURAL PLANKTON.

The study of copepod feeding ecology is critical for understanding the processes that structure marine ecosystems. Although methods have been developed to quantify copepod feeding in the field, to our knowledge none allow direct determination of in situ feeding on specific prey species. However, the recent use of molecular approaches including quantitative PCR (qPCR) have the promise to be able to quantify feeding on a variety of prey in situ, including non-pigmented prey (e.g. Nejstgaard et al. 2008 Mar Biol 153:565-577). Here we present the results of qPCR gut content assessment of the copepod *Calanus finmarchicus* consuming the diatom *Skeletonema marinoi* in natural plankton. The studies were conducted in April 2008 at the University of Bergen during a EUR-OCEAN pilot mesocosm experiment designed to investigate the initiation of diatom blooms. The feeding rates were decoupled from the biomass development of the diatom, but increased towards the breakdown of the bloom indicating a shift in specific feeding on *S.marinoi* cells. These data show that this approach can be used to quantify feeding on specific prey in undisturbed natural plankton.

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MEASURING VARIABILITY AND MODELLING ECOLOGICAL CHANGE IN SEDIMENT CORE RECORDS

Sediment core records from lakes provide a means to investigate how variable freshwater ecosystems are in the absence of anthropogenic pressures and to assess what the relative effects of various forcing factors are. Here we describe new statistical techniques that quantify natural variability in biological communities and which allow us to model changes in these communities through time as a function of independently-derived proxies representing forcing factors, such as climate change or atmospheric deposition. These methods allow changes in ecosystem variability before, during and after disturbance to be quantified, and the timing and extent of change attributable to different forcing factors to be identified and separated. We illustrate these techniques with two examples: i) a study of the effect of natural climatic variability on the diatom community of Kassjön, northern Sweden, which demonstrates that only at cold temperatures did climate appear to have an effect on species composition, and ii) a comparison of the dual roles of atmospheric deposition and recent climate warming in driving recent ecological change in Loch Coire Fionnaraich, north west Scotland.

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INFLUENCE OF FLUID SHEAR IN THE BENTHIC BOUNDARY LAYER ON THE NITROGEN UPTAKE AND ASSIMILATION OF KARENIA BREVIS

In situ observations of Karenia brevis near the sediment-water interface and video of cells interacting with the sediment suggest that cells access sediment-nutrients in oligotrophic water columns. Persistence of these near-bottom populations may depend on how cells interact with periods of elevated shear that occur within the benthic boundary layer. A high resolution current profiler characterized the water velocities and potential shear rates in the benthic boundary layer for two months. The effects of the observed shear rates on the uptake and assimilation of ammonium, nitrate and, urea were then determined using Couette flow chambers. The experiments simulated, 1) cells residing above the sediment-water interface and utilizing nutrients during exposure to shear or, 2) cells accessing the sediment porewaters and utilizing nutrients after exposure to shear. Shear rates in the benthic boundary layer varied from 0.02 s^{-1} to 3 s^{-1}. The uptake and assimilation rates of both ammonium and nitrate were higher in cells after exposure to shear than the corresponding uptake and assimilation rates during exposure to shear implying that cells exhibited morphological or physiological recovery during these experiments.

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IMPACT OF SEDIMENT BACTERIA ON NUTRIENT CYCLING AND VICE VERSA IN BALTIC SEA HYPOXIC BOTTOMS

External nutrient loading has increased hypoxia in the Baltic Sea bottoms accelerating phosphorus flux from the sediment. Despite the reduction in external loading, internal loading retards the recovery process of the Baltic Sea. Bacteria play a significant role in nutrient cycling. However, the impact of bacteria on nutrient fluxes and vice versa has not been widely studied in the Baltic Sea. We studied the bacterial communities in the sediment samples using 16S rRNA gene terminal restriction fragment length polymorphism and cloning. Sediment phosphorus and other sediment properties were also determined. We explored the relationships between community composition and chemical parameters on horizontal and vertical spatial scales using multivariate statistics. Bacterial community composition changed along the agricultural phosphorus gradient of the Archipelago Sea. In the Gulf of Finland organic indicators, such as carbon, had a substantial effect on the bacterial communities. Our results suggest that agricultural loading and organic matter affect the sediment bacteria. Sulphate-reducing bacteria, presumed to participate in the phosphorus cycling, were common in hypoxic sediments suggesting that these bacteria affect the phosphorus flux.

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DISSOLVED ORGANIC MATTER AND BACTERIAL COMMUNITY COMPOSITION: SEASONAL DYNAMICS IN THE COASTAL NORTH SEA

Dissolved organic matter (DOM) dynamics in the coastal North Sea were monitored over an annual cycle, in relation to the main producers (phytoplankton) and consumers (heterotrophic bacteria) of DOM. The DOM dynamics were related to the variations in the heterotrophic bacterial community. DOM accumulated from winter until the end of the spring bloom, associated with a high photosynthetic extracellular release of phytoplankton and an accumulation of semi-labile components. Thereafter, the DOM concentration decreased probably due to utilization by the prokaryotic communities and/or export. The bacterial community varied during the annual cycle, with decreasing numbers of OTUs (determined by T-RFLP fingerprinting) over the bloom period. A major seasonal succession of the bacterial community was determined (ANOSIM, r=0.56, p=0.1), and even month to month variations were considerably (ANOSIM, r=0.45, p=0.1). Bacteroidetes (as characterized by CARD-FISH) increased in abundance and percentage of active cells (micro-CARD-FISH) during the decline of the spring phytoplankton bloom, while Roseobacter and SAR86 increased in summer. Based on the data, we conclude that the pelagic heterotrophic bacterial community is essentially bottom-up controlled over most of the annual cycle.

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THE EFFECTS OF BREVETOXIN ON BACTERIAL ABUNDANCE AND COMMUNITY COMPOSITION

Brevetoxin is a potent neurotoxin produced by red tide Karenia brevis. Brevetoxin has been linked to fish kills, marine mammal kills, sea bird deaths, adverse human health affects and more recently has been shown to have allelopathic affects on several phytoplankton species. In this study we investigate the effects of brevetoxin on the abundance and community composition of natural microbial communities. Synthesized brevetoxin was added to bacterial communities from three different bay locations along the east coast and Florida, each representing a system with varying historical brevetoxin exposure. Brevetoxin additions elicited distinct responses in the microbial populations including significant changes in the total bacterial cell number and the proportion living versus dead bacteria after 24 and 48 hour incubations. Terminal restriction fragment length polymorphism (T-RFLP) analyses revealed significant changes in bacterial community composition. These results suggest that microbial populations previously exposed to brevetoxin may be less susceptible to its effects than populations that have limited or no exposure and that specific bacterial species may be more or less susceptible to the effects of brevetoxin than others.

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WEEKLY SATELLITE SEA SURFACE TEMPERATURE AROUND CORSICA, A DINEOF ANALYSIS OF AVHRR DATA (1998) FORESEEING COMPARISON WITH INTERPOLATED AND MODELLED FIELDS.

Providing wide coverage and high spatio-temporal resolution, SST satellite archives are valuable sources of information for sound understanding of the ocean dynamics, including validation of hydrodynamical modelling studies. Yet original SST fields have also many gaps (clouds, retrieval problems), but they are known to exhibit strong spatial and temporal correlations for regions of similar dynamics. This is exploited by the parameter free statistical technique DINEOF (Data Interpolation with Empirical Orthogonal Functions) [Alvera-Azcárate et al. (2005) Ocean Modell.; Beckers et al. (2006) Ocean Sciences] to produce full weekly analysis of the variability of the sea surface temperature (SST) around Corsica and in the Ligurian Sea at weekly temporal resolution during the year 1998. A detection of outliers implemented in DINEOF analysis is tested for pointing out unusual or invalid SST data. This study is realised foreseeing a comparison of DINEOF weekly averaged reconstructed fields with those obtained by interpolating methods on the same dataset (Data Interpolating Variationnal Analysis and Optimal Interpolation schemes), and with outputs of an implementation of the GHER 3D model in this area.

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IMPACT OF CLIMATE CHANGE ON THE BIGGEST NATURAL RIVER-FLOODPLAIN SYSTEM IN LATVIA

Climate change may have a considerable impact on watercourses and their functioning in Latvia due to the increase in annual precipitation and river discharge. Such changes will influence all elements of the drainage network; however, there are fewer consensuses about the related processes and their influence. In order to have a deeper insight into these issues in Latvia, studies of the environmental impact of climate change on the Upper and Middle Daugava floodplain system are currently carried out in terms of eventual disturbance of the natural river continuity. Preliminary results show that the consequences are likely to be an increasing flood risk and higher rates of nutrient and suspended sediments delivery resulting from intensification of water erosion in catchments. Both these tendencies will have negative effects on the Daugava fluvial ecosystems and river continuity through excessive siltation, increased turbidity and eutrophication of receiving watercourse. Simultaneously it could cause flooding of the territories downstream from Daugavpils City more often because the river bed will be getting shallower and the water storage capacity of the river channel will decrease.

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VARIATIONS IN MARINE PHOSPHORUS CYCLING IN EARTH'S PAST: REASSESSING THE NUTRIENT-CLIMATE CONNECTION

More than two decades ago, it was first proposed that variations in marine phosphorus (P) cycling could modulate the global carbon and oxygen cycles and thus earth's climate. With the advent of new techniques to determine reactive P in the geological record and new models for biogeochemical cycling in sediments and in the ocean, the role of this proposed "nutrient-climate" connection is being re-evaluated for various periods in Earth's past. Here, a summary of some recent findings on marine P cycling and organic carbon burial in the greenhouse world of the mid-Cretaceous is presented. We will specifically focus on the factors leading to episodes of oceanic anoxia and wide-spread deposition and preservation of organic matter ("black shales"). Our model results show that oceanic anoxic events (OAEs) can be triggered by enhanced P supply from land. Enhanced recycling of P under anoxia and reduced ocean circulation are necessary additional criteria. The model findings are corroborated by carbon and P burial data from the geological record. Potential future changes in marine P cycling due to human activities are also discussed.

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SEASONAL AVAILABILITY OF FOOD FOR PRIMARY PRODUCTION AND MUSSEL GROWTH AT KILLARY HARBOUR, IRELAND

Killary is a fiord-like estuary on the West coast of Ireland, economically important for farming of long line blue mussels (Mytilus edulis). Local growers report a decrease in annual tonnage and stock size in recent years. The UISCE project studied three shellfish aquaculture sites around Ireland, including Killary, in order to gain a better understanding of the processes influencing shellfish growth. Water quality sampling was carried out at 12 locations in Killary, monthly in winter and bi-weekly in spring/summer, from June 2007 to May 2008. Samples taken at all 12 locations were analysed for particulate matter, organic carbon/nitrogen, chlorophyll-A, phytoplankton and macro-nutrients. Hydrodynamic data were acquired to complement the water quality data set. Seasonal variations in food availability for mussel growth and primary productivity are reported here. It was found that food availability at Killary is primarily influenced by wind and tidal movement. Sites located toward the middle of the estuary where lower growth has been reported were found to be nutrient limited. A range of husbandry practice changes may increase production at these slow growing sites in the Estuary.

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FRESHWATER JELLYFISH C. SOWERBII DENSITY EFFECTS ON ZOOPLANKTON COMMUNITY ABUNDANCE

The freshwater cnidarian, Craspedacusta sowerbii, occurs throughout North America in lakes, reservoirs, quarries, and slow-moving inlets and tributaries of large rivers. C. sowerbii was observed and collected from Stone Pond in Danville, Kentucky, in the fall of 2008. C. sowerbii's effect on zooplankton abundance has been debated in the literature but recent research points to a significant negative impact on community abundance of common zooplankton species. In this study, a natural complement of zooplankton including rotifers, cladocerans, and copepods was used in a series of small mesocosm experiments. Varying densities of C. sowerbii medusa were used to test the effects of reported densities from the literature. Data was also collected on average size and chemical composition of the medusa. While C. sowerbii medusa blooms are sporadic, they may have significant effects on zooplankton communities with increasing effects when dense or prolonged blooms occur.

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EFFECTS OF ACIDIFICATION ON PRESERVATION OF DMSP IN SEAWATER AND PHYTOPLANKTON CULTURES: EVIDENCE OF RAPID DMSP CLEAVAGE IN SAMPLES CONTAINING PHAEOCYSTIS SPP.

Acidification of seawater samples to pH <2 has been used to preserve DMSP samples based on confirmed stability of DMSP in acid solution. We, however, observed substantial DMSP losses in acidified samples from a *Phaeocystis*-dominated bloom in the Ross Sea, Antarctica. Tests with cultures of colonial *P. Antarctica* and *P. globosa* showed that up to 70% of culture DMSP was lost during the first minutes after acidification with the highest losses at the lowest acid concentrations. DMS was produced after acidification indicating lyase involvement in DMSP loss. The effects of acid were unique to *Phaeocystis* spp. as no significant DMSP losses occurred with other phytoplankton genera. Tests with ^{35}S-DMSP showed that cellular rather than dissolved DMSP was cleaved during the time between acid addition and lyase inactivation. Experiments with the differentially permeable DMSP lyase inhibitors, p-CMB and p-CMBS, showed that only the membrane permeable, p-CMB, stopped DMSP loss under acidified conditions, confirming that DMSP cleavage occurred intracellularly. These results highlight the remarkable activity of DMSP lyase in *Phaeocystis* spp. and suggest that acidification is inappropriate for samples containing *Phaeocystis* spp.

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MOLECULAR AND BIOGEOCHEMICAL CHARACTERIZATION OF N LOSS PATHWAYS IN THE EASTERN TROPICAL NORTH PACIFIC OXYGEN MINIMUM ZONE

Loss of fixed nitrogen (N) in the ocean is mediated by two major microbial metabolisms; in its classical form, the anammox reaction utilizes ammonium and nitrite to form dinitrogen gas, while respiratory denitrification uses oxidized N species and organic carbon. To date, all studies examining these two processes in the ocean indicate anammox to be the dominant pathway responsible for N loss in suboxic waters. The greatest percentages of these losses occur in small, highly productive areas of the ocean, such as the eastern tropical Pacific and the Arabian sea. The eastern tropical North Pacific oxygen minimum zone constitutes one of the largest sinks for fixed N in the ocean, yet little has been done to assess the relative contribution of anammox and denitrification to N loss. In this study, isotope-pairing was employed to determine the contribution of anammox and denitrification to N loss in suboxic (<10 μM) waters, and molecular biological approaches used to assess the diversity and relative quantities of genetic markers for both processes at multiple depths in the OMZ.

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OPTIMAL UPTAKE KINETICS: PHYSIOLOGICAL ACCLIMATION EXPLAINS THE PATTERN OF NITRATE UPTAKE BY PHYTOPLANKTON IN THE OCEAN

Phytoplankton supply the base of the marine food web and drive the biogeochemical cycles of carbon and nutrients. Over much of the ocean their growth is limited by their uptake of nitrogen (as nitrate), which has most commonly been described by the hyperbolic Michaelis-Menten (MM) equation, but lack of a theory to explain variations in MM constants has hindered our ability to predict the response of marine ecosystems to changes in environmental conditions. The MM equation fits data from short-term experiments well, but does not agree with steady-state experiments over wide ranges of nutrient concentrations. The recently developed Optimal Uptake kinetics does agree with the latter and can also describe the observed pattern of MM half-saturation constants from field experiments. We present a simple explanation for the observed pattern of nitrate uptake in terms of Optimal Uptake kinetics, which provides a basis for predicting effects of climate change on marine ecosystems and biogeochemical cycles.

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ALLELOPATHY AFFECTING CYANOBACTERIAL SUCCESSION IN A TROPICAL RESERVOIR

Dominance of cyanobacteria has been related to diverse factors such as high temperatures, affinity for nutrients, nitrogen fixation and buoyancy control. Moreover, release of allelopathic compounds has been pointed as an important competition advantage in aquatic systems, favouring cyanobacterial blooms. In Funil Reservoir (Brasil), *Microcystis aeruginosa* (Kützing) Kützing blooms in summer months, outcompeting *Cylindrospermopsis raciborskii* (Woloszyńska) Seenayya et Subba Raju, which is the main species along the year. While investigating main factors related to the cyanobacterial succession, experiments were run to test allelopathic activity between the two species isolated from the reservoir. A strong inhibition on photosynthetic activity and growth of *C. raciborskii* was observed when exposed to *M. aeruginosa* exudates. However, *M. aeruginosa* was not affected in the presence of *C. raciborskii* exudates. Experiments indicated that *M. aeruginosa* produces allelopathic compounds only in the presence of *C. raciborskii*. Our results suggest that allelopathy might have played a role in the successional pattern of cyanobacterial dominance in Funil Reservoir.

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STRONG CARBON SINK AND CARBON SOURCE ACTION OF A SWISS HYDROELECTRIC RESERVOIR

We studied organic carbon (OC) burial and greenhouse gas emission in Lake Wohlen, a shallow hydroelectric reservoir in Switzerland. OC burial rates recorded along a transect from the inflow to the dam were high (mean 1000 g C m-2 yr-1) compared to other reservoirs. OC burial efficiencies were also high, averaging 84%. At the same time, the reservoir emitted large amounts of methane to the atmosphere (mean 200 g C m-2 yr-1), mainly by bubble evasion. Due to high sedimentation rates, oxygen exposure times (OET) of surface sediment in Lake Wohlen were extremely short (mean 18 d), triggering high OC burial efficiency. Further, the very short OET may explain the occurrence of bioavailable OC in deep, anoxic sediment layers, thus causing intense methanogenesis. Hence, this reservoir sequesters significant amounts of carbon, but simultaneously emits methane to the atmosphere at an extreme rate. Due to the high radiative forcing of CH4, the net effect of the simultaneous carbon sink and source action on climate change is positive.

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UVR EFFECTS ON PHYTOPLANKTON PHOTOSYNTHESIS IN A CLIMATE CHANGE CONTEXT

Ultraviolet radiation (UVR) exposure decreases primary productivity and biomass in many regions of the oceans, lakes and estuaries. However, incident UVR and other factors influenced by climate change interact in affecting phytoplankton metabolism, producing different responses than those expected from the addition of the individual effects. Nevertheless, most of the experiments to study effects on phytoplankton physiology and primary productivity under solar exposures still use UVR-opaque incubations. For cultures of T. pseudonana preacclimated to 20C, the extent of UVR photoinhibition increased with decreasing temperature, from 63% inhibition of PAR-only photosynthesis at 25C to 71% at 20C and to 85% at 15C. Cultures of the same species, natural lake and estuarine samples demonstrated that elevated CO2 concentrations (1000 ppmv) can increase sensitivity to UVR up to 38% compared to samples under atmospheric concentrations (380 ppmv). These results show that the effects of CO2 concentration and temperature in surface waters may act in opposing ways relative to future trends. They demonstrate the importance of including UVR when predicting the effects of climate change on the open ocean.

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SI-C INTERACTIONS IN THE DIATOM FRUSTULE: CONSEQUENCES ON PRESERVATION

Interactions between carbon and silica in the diatom frustule play an important role in the degradation of the diatom carbon (Moriceau et al., 2008). In order to understand better this process and to develop a mechanistic model describing the relative fate of Si and organic matter during degradation, we first have to understand the origin of these interactions and better characterize them. We undertook laboratory experiments with an ubiquitous diatom, *Skeletonema marinoi*, grown under nutrient limitations that alter the relative composition of the different carbon pools as well as the composition of the frustule itself. By coupling biochemical and structural analyses, we investigated the Si-C interactions in diatom frustules to understand how both components interact reciprocally on diatom degradation. A protocol using Fourier Transformed InfraRed (FTIR) spectroscopy was developed to qualify the Si-C interactions and the changes in macromolecular composition in diatom cell and particularly in the frustule. To quantify these interactions, carbon and nitrogen fluxes were followed by using isotopic tracers for different fractions (lipids, proteins, and carbohydrates) obtained from the protoplast and from the frustule by biochemical extractions. Moriceau, B., M. Goutx, et al. (2008). "Si-C interactions during degradation of the diatom *Skeletonema marinoi*." Deep Sea Research Part A. Oceanographic Research Papers accepted.

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IMPACT OF CHANGES IN PRECIPITATION PATTERN ON FISHING AND REARING ACTIVITIES OF BIVALVES IN A COASTAL LAGOON

A downscaling experiment linked a Regional Climate Model for Europe to a 3D biogeochemical model for the Venice Lagoon, and to three different type of models (a food web model for evaluation of cascading effects on ecosystem structure, a clam habitat suitability model, and a population dynamic bioenergetic filter feeders bivalve model) for evaluation of effects on fishing and aquaculture activities of Tapes philippinarum under present (1970-2000) conditions and future (2070-2100) IPCC scenarios. Results of multidecadal simulations suggest that, locally, summer and spring will be drier and winter and autumn more rainy. This will potentially increase winter nutrient concentrations but decrease primary and secondary productions, with an export of nutrient surplus to the Adriatic Sea. Food web model projection indicates that the suitability for higher trophic level organisms, including clams, will decrease. A more specific analysis on clams fishing and aquaculture indicates that these activities will suffer the decrease of primary productivity, and point to the need of implementation of proper management policies, to be defined basing on future conditions (adaptive management).

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DOES NITROGEN ATMOSPHERIC POLLUTION AFFECT THE SYNTHESIS AND ACCUMULATION OF MAAS IN PLANKTONIC ORGANISMS?

The synthesis and accumulation of photoprotective compounds such as mycosporine-like amino acids (MAAs) and carotenoids is one important strategy to minimize UV damage by planktonic organisms. Previous studies have shown that MAAs concentration in zooplankton from mountain lakes in the Alps is directly related to the depth refuge from UV radiation, however, this relationship is not evident in other geographical areas, suggesting that other factors are involved in their regulation. MAAs are N-reach compounds and there is evidence that N-limitation affects their synthesis rate. Here, I show that MAAs concentration in zooplankton and phytoplankton from remote lakes located in different geographical areas is positively related to the average atmospheric N-deposition rate, with the maximum found in the Alps. Further, results from nutrient enrichment (N, P, N+P) experiments with phytoplankton from a high-mountain lake located in the Alps suggest that the synthesis rate of MAAs was at its physiological maximum. These results imply that though N atmospheric pollution has a pervasive effect in alpine lakes, it increases the potential for an efficient UV photoprotection by MAAs in planktonic organisms.

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THE TOXIC DINOFLAGELLATE *ALEXANDRIUM OSTENFELDII* PROMOTES INCAPACITATION OF THE CALANOID COPEPODS *EURYTEMORA AFFINIS* AND *ACARTIA BIFILOSA*

Interactions between the toxic dinoflagellate *Alexandrium ostenfeldii* and calanoid copepods were experimentally studied with two Baltic, neurotoxin producing (STX, GTX2, GTX3) strains of the dinoflagellate. The copepods *Eurytemora affinis* and *Acartia bifilosa* were incubated for 24h with different concentrations of *A. ostenfeldii*, and grazing parameters and viability of the copepods were followed. Viability was also studied with separate experiments where copepods were exposed to different *A. ostenfeldii* cell concentrations and cell-free filtrates. The level of activity was estimated visually and copepods were classified according to this. Grazing studies revealed that neither of the copepod species were feeding actively on *Alexandrium*. Nevertheless, copepods that were exposed to the algae, or cell-free filtrates experienced inactivation of different level. *E. affinis* was more sensitive to *Alexandrium* compared to *A. bifilosa*: After 24 h, 80 % of *E. affinis* had lost their motility but 60 % of *A. bifilosa* were swimming normally. These results indicate that responses to *Alexandrium*-derived harmful substances are species-specific. The inactivation of copepods during heavy *Alexandrium* bloom may accelerate the bloom formation if water exchange in the area is depressed.

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IMPORTANCE OF SEA ICE ALGAE FOR ARCTIC ZOOPLANKTON

The Norwegian IPY-project CLEOPATRA conducted in 2007 an extensive seasonal study in Rijpfjorden, Svalbard. The aim was to investigate the role of light for timing, quantity and quality of primary and secondary production in a seasonally ice-covered ecosystem. Due to the predicted loss of sea ice we were particularly interested in the importance of ice algae for reproduction and growth of the herbivorous copepod Calanus glacialis. Rijpfjorden was ice-covered from early February until mid-July. Ice algae were present from March to June, with a peak bloom in April, two months prior to the phytoplankton bloom. Egg production, fatty acid analyses and experimental studies confirmed that ice algae were crucial for early reproduction, and early reproduction ensured that the offspring could fully utilize the phytoplankton bloom. Most of the population had descended to overwintering depths in October. The majority had reached copepodite stage V, suggesting a predominately 1yr life cycle. By utilizing both ice algae and phytoplankton C. glacialis extend its growth season substantially. Future scenarios with no sea ice may have negative impacts on the population growth of C. glacialis.

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PHOTOCHEMICAL ALTERATION OF RAINWATER DISSOLVED ORGANIC MATTER: IMPLICATIONS FOR BIOAVAILABILITY OF NUTRIENTS AND ORGANIC MATTER

Wet deposition of dissolved organic matter (DOM) to open ocean regions is comparable in magnitude to riverine inputs, likely fueling secondary productivity in organic poor, oligotrophic environments. Furthermore, exposure to sunlight in these optically clear waters could alter the chemical composition of rainwater DOM, increasing concentrations of bioavailable nutrients and organic matter. Irradiation of rainwater from Wilmington, North Carolina, USA, resulted in significant changes in its optical properties and production of small organic compounds such as C1-C3 aldehydes. The DOC and DON concentrations in irradiated and non-irradiated rain were statistically equivalent, suggesting that the DOM was not completely remineralized upon photolysis, but rather that larger molecular weight DOC was transformed into lower molecular weight, more bioavailable organic material. Changes in environmental conditions associated with anthropogenic effects (e.g., changes in rainwater DOM composition or UV radiation) could alter the rates of these processes, as well as solar radiative transfer and light attenuation, thus affecting marine primary productivity and hence the removal of carbon dioxide from the atmosphere.

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TRENDS OF NUTRIENTS AND NUTRIENT RATIOS IN THE DEEP WATER OF EASTERN MEDITERRANEAN SEA FROM 1986 – 2006

The nutrient regime of the Eastern Mediterranean Sea (EMS) is unusual in that it has very low nutrient content (nitrate ~6 μM, phosphate ~0.25 μM and Silicate ~10-12 μM) compared to deep oceanic waters elsewhere. It has also been subject to significant anthropogenic changes including major changes in nutrient fluxes such as increases in atmospheric nutrient supply, changes in riverine fluxes and in local point source and diffuse discharges. In this study we have examined temporal and spatial trends in nutrient concentrations in data collected in the Ionian, Aegean and Levantine Seas from 1986 to 2005. Basic AQC has been carried out to determine the quality of the data. Preliminary results have suggested that while changes have been observed in nutrient distribution as a result of the deep water transient, no significant changes have been observed in deep water values at the GEOSECS site in the central Aegean. An explanation for these and other observation will be presented.

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GREEN BEATS BLUEGREEN: ALLELOPATHY BETWEEN *MONORAPHIDIUM MINUTUM* AND *PLANKTOTHRIX AGARDHII*

Insight in mechanisms that change species composition in plankton communities can be of vital importance in water management. Competition between harmful cyanobacteria (blue-green algae) and green algae is of particular relevance, because harmful cyanobacteria can be a major threat to water quality. While investigating competition between filamentous cyanobacteria and green algae, the allelopathic activity between *Planktothrix agardhii* (M. Gomont) K. Anagnostidis & J. Komárek, a causative agent of harmful algal blooms, and *Monoraphidium minutum* (Nägeli) Komárková-Legnerová, a small chlorophyte, was examined. Unexpectedly, two different types of bio-assays (agar diffusion and liquid culture) confirmed that *Monoraphidium* can suppress the vitality of both a toxic and a non-toxic strain of *Planktothrix* , mainly by influencing its photosynthesis, through the release of a chemical substance. Conversely, *Planktothrix* did not hamper *Monoraphidium* in any of our experiments. Further experiments indicated that *Monoraphidium* produced allelochemicals only when brought in contact with *Planktothrix* . Thus, it seems that the allelochemical produced by *Monoraphidium* was inducible. The results obtained in this research might lead to interesting future applications in the control of harmful algal blooms (HAB).

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THE EFFECT OF ANTHROPOGENIC CHANGE ON HYBRIDIZING *DAPHNIA*: EVIDENCE FROM RESTING EGG BANKS

The eutrophication of aquatic ecosystems with nutrients leading to algal blooms and anoxic conditions has been a persistent and widespread environmental problem. Although there are many studies on the ecological impact of elevated Phosphorus levels (e.g. decrease in biodiversity and water quality), little is known about the evolutionary consequences for animal species. We reconstructed the genetic architecture of a *Daphnia* species complex in five European lakes using diapausing eggs which were isolated from sediment layers covering the past 100 years. Changes in total phosphorus were clearly associated with a shift in species composition and the population structure of evolutionary lineages; lakes with native *D. hyalina* were colonized by *D. galeata*. Although environmental conditions were largely re-established after peak eutrophication during the 1970s/80s, original species composition and the genetic architecture of species were not restored but evolved along new evolutionary trajectories. Our data demonstrate that anthropogenically induced temporal alterations of habitats are associated with long-lasting changes in communities and species via interspecific hybridization and introgression.

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OCEAN DYNAMICS AND AIR-SEA INTERACTIONS DURING THE IPY BONUS-GODHOPE TRANSECT

Prior to 1990, Southern Ocean (SO) observations were very few and sparse. Since then, an intense monitoring effort has been undertaken in two of the three SO chokepoints. The one south of Africa, which is the largest, has been undersampled despite its suspected importance in the Meridional Overturning Circulation (MOC). There, the SO plays a unique role in providing the export channel for North Atlantic Deep Water to the global ocean and by importing heat and salt from the Indian and Pacific oceans. This region is influenced by the largest turbulence ever observed. These local small-scale processes and the derived meridional fluxes constitute the major link between SO and MOC. To assess the role of SO in climate, all these phenomena need to be fully understood and to be integrated together with biological and biogeochemical estimates. Conceived in this framework the multidisciplinary IPY BONUS-GoodHope cruise was realized in early 2008. Building on the preliminary results of this unique experimental effort and ongoing studies, we will address the state of the art on the regional ocean dynamics and air-sea exchanges

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LINKING LAKE LITTORAL AND PELAGIC ZONES: RELATIONSHIPS BETWEEN MACROPHYTE COVER AND PELAGIC ZOOPLANKTON COMMUNITIES

Previous research has suggested a negative relationship between macrophyte cover and zooplankton communities, mainly based on the idea that large pelagic zooplankton use macrophytes as a refuge from predation. However, these studies have mainly been conducted in single, small, shallow lakes. Therefore, we examined the ability of lake macrophyte cover metrics to predict pelagic zooplankton communities in 60 north temperate lakes that vary in morphometry and trophic state. For each lake, we quantified five macrophyte metrics, pelagic Cladocera density, biomass, and average length, and performed univariate regressions to quantify patterns between macrophytes and zooplankton. The lakes ranged from 2-9 m in mean depth, 21-197 ha in area, and 4-66 ug/L total phosphorus. Macrophyte and Cladocera metrics also varied among the lakes (e.g., lake macrophyte cover ranged from 5% to 95%). Significant relationships between macrophyte cover metrics and pelagic cladocerans include a strong negative relationship between % macrophyte cover and cladoceran mean length ($r2 = 0.82$, $p = 0.01$). These results support the idea that lakes have strong littoral-pelagic linkages and that it is important to consider macrophytes when studying pelagic foodwebs.

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TEMPERATURE DEPENDENT INFLUENCE OF DIETARY LIPID CONTENT ON GROWTH, REPRODUCTION, AND LIPID CONTENT OF *DAPHNIA MAGNA*

Aquatic organisms experience strong short-term or seasonal variations in temperature during their life cycle. Varying temperature has profound physiological impacts, especially on the physical characteristics of cellular membranes because their structure and function has to be maintained, for instance by altering the fatty acid composition of phospholipids or changes in the membrane's sterol : phospholipid ratio. Since aquatic crustaceans are incapable of de-novo syntheses of membrane components such as sterols and polyunsaturated fatty acids (PUFAs) dietary deficiencies in these compounds can constrain growth and development. To examine the influence of temperature on the limitation of the keystone species *Daphnia* by dietary lipids we performed laboratory experiments with *Daphnia magna* at different temperatures. Growth rates, clutch size and lipid content of animals grown on a sterol and PUFA free cyanobacterium supplemented with increasing amounts of dietary lipids were determined. Both the temperature and the dietary lipid content significantly influenced the growth and lipid content of *D. magna*. The data suggest that the temperature dependent incorporation of lipids cause different growth limitations of *D. magna*.

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DIRECT QUANTIFICATION OF DIMETHYLSULFONIOPROPIONATE (DMSP) IN PHYTOPLANKTON AND SEAWATER USING UPLC/MS

Dimethylsulfoniopropionate (DMSP) is produced by many marine micro- and macroalgae as an antioxidant, osmolyte and/or cryoprotectant. Its cleavage product, dimetyhylsulfide (DMS), defends algae against grazers and serves as an infochemical. DMSP is cleaved to DMS and acrylic acid by the enzyme DMSP-lyase or by treatment with concentrated bases. Base mediated DMS release is generally used for the indirect quantification of DMSP by determination of the DMS content via gas chromatography. However, because other potential precursors of DMS have been reported in algae, these methods might lead to an overestimation of the DMSP-content. Here, we show that DMSP can be directly quantified from phytoplankton and seawater samples after derivatization. This quantification method has been applied to bacillariophyceae, prymnesiophyceae, cyanobacteria and chlorophyceae cultures and samples from a mesocosm experiment.

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PRODUCTION OF DMS AND DMSO FROM THE OXIDATION OF DMSP BY HYDROXYL RADICAL

Dimethylsulfide (DMS), a climatically active trace gas produced by a number of marine algal classes, has been thought to be produced primarily by enzymatic cleavage of dimethylsulfoniopropionate (DMSP) via DMSP lyase. However, the occurrence of DMSP lyase activity in marine algal cells is not universal nor is it limited to species known to produce DMS *in vivo*. We present evidence for the formation of DMS as a result of the OH radical oxidation of DMSP. This ultimately allows algal species that do not have detectable DMSP lyase activity to produce DMS. Furthermore, the related compound dimethylsulfoxide (DMSO) has also been shown to be produced directly from DMSP oxidation. An analysis of other reaction products offers insight into the mechanism of this oxidation, and the production of DMS allows for the first measurement of steady-state OH concentrations *in vivo* in marine algae.

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STABLE NITROGEN AND CARBON ISOTOPE COMPOSITION OF SUSPENDED MATTER AND SEDIMENTS IN A COASTAL LAGOON AFFECTED BY SUGAR CANE MONOCULTURE IN NE BRAZIL

The Mundaú-Manguaba-Lagoon complex in NE Brazil is affected by agriculture effluents from sugar cane monoculture in its hinterland. Total suspended matter (TSM) and short sediment cores were collected in March and October 2007 and February 2008. Samples were analysed for organic carbon (Corg), total nitrogen (TN) and the stable isotope composition (d15N,d13 Corg) in order to obtain information on the organic matter (OM) sources. Maximum Corg (21.2%) and TN (3.1%) contents of TSM coincided with a phytoplankton bloom in the Manguaba Lagoon in February 2008. d15N of TSM ranging between 7.7‰–9.6‰ during that time indicates little fractionation during N uptake, hence efficient nutrient utilisation. d15N of sediments ranged between 4.3 ‰ and 6.2 ‰ at the surface and increased with depth suggesting OM decomposition. d13Corg varied between -18.3 ‰ and -26.5 ‰ pointing to mixed terrestrial and marine sources of the deposited OM. It is conceivable that the contribution of land-derived C and N varies with the seasonal variation of precipitation and agricultural activities.

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COMPLEXITY, FOOD WEB THEORY AND MARINE ECOSYSTEM MODELS: UNDERSTANDING AND EMBRACING COMPLEXITY

Marine ecosystems are typified by a myriad of interactions between species and individuals as constrained by the abiotic environment. These complex non equilibrium systems are in a constant state of change with the overall system dynamics determined by the interaction of individuals with their abiotic and biotic environment. As such marine ecosystems are a classic example of complex adaptive systems (CAS) in which the aggregate of parts exhibit properties, which wouldn't be expected from the parts alone. As a result, a reductionist approach to their study will not lead to the prediction of their emergent properties e.g. biodiversity, sequestration of green house gas materials and exploited resources. However, the integration of quantitative and qualitative process knowledge will allow us to better understand the lever points - points at which a small perturbation can produce a directed effect of which a regime shifts are a classic example. Recognising the constraints imposed on prediction of CAS dynamics, a pragmatic approach to the development of a predictive understanding of the emergent properties of marine ecosystems is presented.

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A NEW SENSOR FOR SIMULTANEOUS IMAGING OF 2-D OXYGEN AND TRACE METAL DYNAMICS IN IRRIGATED SEDIMENTS

Sediment-dwelling organisms, that pump oxygenated water through their burrows, can affect appreciably the mobility and distribution of trace metals (e.g. Aller 2001). A new "sandwich sensor", consisting of a planar optode (Glud et al 1996) overlain by a 50 micrometer thin, semi-transparent DGT-gel (Davison & Zhang, 1994), was developed. The gel layer is sufficiently thin to allow visual observations and rapid diffusion of oxygen. DGT (diffusive gradients in thin-films) measures directly the locally induced flux, which can be interpreted as a concentration (Harper et al, 1998). The sandwich sensor is used for simultaneous measurements of 2-dimensional high resolution (<1 mm) distributions of oxygen and trace metal fluxes around an irrigated burrow system. The artificial "burrow" consisted of permeable dialysis tubing flushed with oxygenated seawater using a peristaltic pump. This set-up mimicked natural irrigation patterns and ventilation rates and demonstrated highly localized re-mobilization of Ni, Cu and Pb in the vicinity of the "burrow". The new sandwich sensor has great potential for resolving oxygen and metal dynamics in various complex benthic systems such as: rhizospheres, permeable sands and bioirrigated sediments.

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THE ROLE OF TEMPERATURE IN THE DISTRIBUTION OF NITROGEN-FIXING CYANOBACTERIA IN THE OCEANS

Virtually all nitrogen fixation in the ocean occurs in the tropics and subtropics where the surface water temperature is >25oC. It is attributed almost exclusively to cyanobacteria. This is strange firstly because diazotrophic cyanobacteria are found in other environments irrespective of temperature and secondly because primary production in temperate and cold oceans is generally limited by nitrogen. Cyanobacteria are oxygenic phototrophic organisms that evolved a variety of strategies protecting nitrogenase from oxygen inactivation. Free-living diazotrophic cyanobacteria in the ocean are of the non-heterocystous type, namely the filamentous Trichodesmium and the unicellular groups A-C. The high temperature is a prerequisite for diazotrophic growth because of the low oxygen solubility and high rates of respiration allowing the organism to maintain anoxic conditions in the diazotrophic cell. Heterocystous cyanobacteria are abundant in freshwater and brackish environments in all climatic zones but not in the ocean or seas. The heterocyst cell envelope is a tunable gas diffusion barrier that optimizes the influx of both oxygen and nitrogen, while maintaining anoxic conditions inside the cell.

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DIEL OBSERVATION ON THE WATER COLUMN MIXING AND BIOMASS DURING BLOOM IN THE GULF OF EILAT (AQABA), WINTER 2008.

Spring in the Gulf of Eilat (Aqaba) subjects the microbial community to an important transition in terms of resources available for growth. Therefore, diel variations of temperature, salinity, underwater light field, picophytoplankton diversity and biomass, chlorophyll a concentration and photosynthesis were examined during during spring (April) 2008 at station A1 as part of GAP 8. The mean euphotic depth was relatively shallow (58 ± 4 m) for oceanic waters most likely as a result of an algae bloom. The vertical attenuation coefficient, Kd (PAR), was 0.079 ± 0.006 m^{-1}, as might be expected from the relatively high chlorophyll a concentrations for this region (< 1.2 µg l^{-1}). Maximum chlorophyll concentrations were observed between the surface and 40m. Flow cytometry measurements of phytoplankton populations were typical of oligotrophic oceans, maximum of ~1.6×10^7 cells l^{-1}, eukaryotic algae, cyanobacteria (*Synechococcus*) up to ~2.7×10^7 cells $^{-1}$, and *Prochlorococcus* up to ~5.6×10^7 cells l^{-1}. The eukaryotic algae constituted up to 86% of the total biomass. During this study variation in the water column stratification had little effect on the phytoplankton community; in contrast the greatest variability of photosynthesis was observed with depth.

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TEMPORAL AND SPATIAL PATTERNS OF PHARMACEUTICALS IN SURFACE WATERS

In recent years, human and veterinary pharmaceuticals have received much attention as pollutants of water bodies or drinking water resources due to possible negative effects on humans or the ecosystem even at low concentrations. This presentation gives an overview about the main sources and pathways for human and veterinary pharmaceuticals entering surface waters. It discusses the main factors and processes like sorption and degradation controlling the environmental fate of these compounds in urban and agricultural systems. The emerging temporal pattern of pharmaceutical occurrence reveals fluctuations at different temporal and spatial scales that are illustrated with several examples. Certain compounds like veterinary antibiotics enter streams mainly during single discharge events causing strong changes in concentrations within hours. Seasonal patterns are related to the timing of manure application in agriculture but also to dissipation processes occurring within streams. Such effects may cause substantially higher concentration in winter compared to summer periods. On the time-scale of years, concentrations may change substantially due to changes in medication patterns. Spatial concentration patterns are closely related to the distribution of sources, which may differ between compounds.

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PARTICULATE IRON IN THE UPPER OCEAN AROUND THE CROZET ISLANDS, SOUTHERN OCEAN: FLUXES, CYCLING AND BIOLOGICAL AVAILABILITY

Iron and particulate organic carbon (POC) analyses were performed on particulate samples collected from the base of the mixed layer around the Crozet Islands on the edge of the Southern Ocean. Combining this data with POC export data (using the ^{234}Th method), export estimates for iron (Fe) have been obtained. The acid leachable Fe fraction has been separated from the refractory Fe phases and fluxes for each fraction ranged between 5 and 336 nmol $m^{-2} d^{-1}$ and 6 to 165 µmol $m^{-2} d^{-1}$ respectively. A comparison of labile Fe:C with in situ phytoplankton Fe:C ratios in the literature suggest preferential recycling of Fe relative to C in the upper water column. The Fe in the particulate phase is dominated by the refractory fraction (ca 100 times greater than leachable) and the question is raised to what extent this refractory Fe can be made available to micro-organisms.

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TIDAL FORCING OF NUTRIENTS AND PHYTOPLANKTON DYNAMICS IN A SMALL SOUTHERN CALIFORNIA HARBOR

A 15-day field study was undertaken during Aug-Sept 2008 to investigate the relationship between tidal cycle, nutrient concentrations, and phytoplankton community in King Harbor, a small Southern California harbor that has experienced red tides in recent years. A suite of sensors was deployed to collect hourly vertical profiles of environmental parameters, and additional water samples were taken at noon each day to describe changes in the nutrient composition and phytoplankton assemblage. Sampling was also performed during two 24-h diel cycles to provide a highly-resolved timeseries. Our data support an apparent relationship between tide and inorganic nutrient availability; for example, NH_4^+ concentrations varied from 1.4-5.5 µM following a tidal trend, with highest concentrations occurring at spring tide. The tidal cycle was positively correlated with the depth of maximum chlorophyll (ranged from 1.75-4 m), and with chlorophyll concentrations at this depth (but not at surface or near-bottom depths). These data will be presented in combination with photosynthetic efficiency and observed patterns in phytoplankton community composition, and implications for bloom dynamics in coastal ecosystems will be discussed.

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MARINE BENTHIC COMMUNITIES: THRESHOLDS IN THE NON-LINEAR RESPONSE TO HYPOXIA AND ANOXIA

Hypoxia and anoxia are key threats to shallow coastal ecosystems worldwide. Benthic community degradation during low dissolved oxygen (DO) events is not gradual but occurs in a series of sudden steps. Using a new underwater device, equipped with time-lapse camera and sensor equipment, we artificially induce anoxia in a sublittoral macrobenthic community in the Northern Adriatic. The deployment described here shows that atypical behavior and mortality occur at specific oxygen levels. The thresholds 2, 1, 0.5 ml O_2 l^{-1} and anoxia were associated with escape patterns in the epifauna, emerging infauna, initial mortalities and widespread community collapse, respectively. Whereas some behaviors are reversible, mortalities lead to long-term ecosystem shifts. The results increase our ability to predict thresholds and tipping points. This is a step forward in compiling a generally valid catalogue of behaviors, a list of sensitive and tolerant species, and a range of community compositions to determine in situ ecosystem status and stability. This provides crucial input for coastal management, which is called upon to reduce additional anthropogenic pressures (e.g. benthic trawling) during critical phases.

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CHARACTERISING WATER MASS MIXING IN THE ARCTIC OCEAN USING DISSOLVED ORGANIC MATTER FLUORESCENCE

The Arctic Ocean is currently experiencing considerable changes in temperatures and freshwater discharge due to climate warming. These changes can influence water mass mixing with subsequent effects on sea ice extent in the Arctic, and on the physical properties of the water exported to the North Atlantic. Traditionally the different water masses present, and their mixing, were examined using temperature, salinity, nutrient ratios and isotopes. Here we present the results of a new proxy, dissolved organic matter (DOM) fluorescence. The Arctic Ocean receives considerable amounts of dissolved organic matter (DOM) from rivers and this is reflected in its relatively high DOM concentrations in comparison to other oceans. DOM is a complex mixture of compounds with a range of lability. A sub-fraction is relatively refractory and fluoresces, and can be used to characterise water mass mixing. This new proxy offers insight into the characteristics and structure of the halocline layer in the Eurasian and Canada basins. This layer isolates the surface waters from the warm water from the Atlantic Ocean below. Without this layer Arctic sea ice would not form.

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MICROBIAL TURNOVER OF HIGH MOLECULAR WEIGHT DISSOLVED ORGANIC MATTER: WHERE ARE THE ROADBLOCKS?

Extracellular enzymatic hydrolysis is often assumed to limit microbial degradation of high molecular weight dissolved organic matter (HMW-DOM). Accordingly, 'fresh' biochemically-characterizable HMW-DOM is usually considered to be labile and thus rapidly degraded by pelagic microbial communities. Measurements of hydrolysis rates of specific polysaccharides in seawater shows that neither of these assumptions is always justified: some communities can hydrolyze specific polysaccharides faster than they can assimilate the hydrolysis products, and conversely certain 'chemically labile' polysaccharides are unavailable to other microbial communities on timescales of weeks. To investigate the relationship between hydrolysis of HMW-DOM and uptake of monosaccharides, enzymatic hydrolysis rates of six polysaccharides were compared with glucose assimilation and uptake at three sites and 12 depths in the Gulf of Mexico. A ribosomal DNA-based community fingerprinting technique (ARISA) was also used to assess the importance of microbial community structure in determining its biogeochemical function. Surprisingly, extracellular enzyme activity was high in deep-water communities in which bacterial production was low.

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DYNAMICS OF DMS, DMSP AND DMSO IN ANTARCTIC SEA ICE

Sea ice is an extreme habitat. Notwithstanding the very low temperatures, high salinities and low light conditions, high algal biomasses are found between snow and ice, in confined layers within the ice and at the bottom. These distinct habitats comprise different communities. It is hypothesised that DMS, DMSP and DMSO are major compounds to survive the harsh environment in sea ice. We will present data from two cruises into Weddell Sea sea ice with RV Polarstern (ANTXXII-2 and ANTXXIII-7). Physicochemical parameters, algal marker pigments and S-compounds were analysed in high-resolution sea-ice profiles. The dynamics within the sea-ice sulphur pool during melting experiments was followed through the addition of stable isotopes of DMS and DMSP. Various uptake and conversion pathways could be detected, indicating a dynamic system. In wintertime, the sulphur pool in sea ice exceeds the total water column burden many times. During ice melt, the release of S-compounds to the water can largely explain the built-up of concentrations in the water column, indicating the importance of sea ice as source for DMS(O/P) in the marginal ice zone.

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SEASONAL EFFECTS ON MICROBIAL BIOMASS AND COMMUNITY STRUCTURE IN LAKE SEDIMENTS

Phospholipid fatty acid (PLFA) analysis was applied to determine microbial biomass and community structure in sediments of eight lakes with different concentrations of dissolved organic carbon (DOC) and nutrient status during the course of a year. The total concentration of PLFA, an estimate of the microbial biomass, varied a lot during the seasons, with peak measurements in summer and lowest concentrations in winter. The highest PLFA concentrations were estimated in the sediment of the lake with the highest total phosphorus (TP) concentrations and intermediate DOC content (18.5 ppm). Biomass profiles depended more on the availability of nutrients than on DOC concentrations. In general, lakes with a larger depth gradient yielded clear differences in microbial biomass, whereas shallow lakes resulted in relatively similar PLFA patterns along profiles from the littoral to the profundal zone. The compositions of PLFAs indicate more variation between the lakes than across seasons and depths within the 8 lakes. The results imply that sediments strongly impacted by allochthonous organic carbon do not support high microbial biomass.

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TRITROPHIC INTERACTIONS ARE MEDIATED BY DIMETHYL SULPHIDE (DMS) RELEASE FROM MICROZOOPLANKTON

Copepods use mechanical and chemical sensory information when searching for mates or prey. For example, females release pheromones that can be tracked by male copepods and facilitate successful mating. Although chemical information is crucial for finding and identifying prey in many copepods, little is known about the infochemicals and mechanisms involved. We used several approaches to investigate the role of the biogenic trace gas dimethylsulphide (DMS) in the feeding ecology of *Temora longicornis*, Acartia tonsa and *Centropages hamatus*. During the first 10 seconds after microinjections of 1 to 1000 nM DMS the time spent swimming increased by 86 to 160 % in comparison to control injections in tethered *A. tonsa*. In tritrophic experiments using high DMS-producing nanophytoplankton, microzooplankton herbivores and tethered copepods DMS-production increased the time spent swimming from 31 to 52 % in *C. hamatus* and 3 to 32 % in *A. tonsa*. These findings are consistent with the hypothesis that DMS stimulates copepod feeding and facilitates predation on DMS-producing microzooplankton. Our results provide first evidence for the role of infochemicals in tritrophic interactions in pelagic ecosystems.

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PRACTICAL TOOLS FOR MARINE SPATIAL PLANNING TO ASSESS THE RISK OF CUMULATIVE EFFECTS OF HUMAN PRESSURES ON THE MARINE ENVIRONMENT

Assessment of the cumulative effects of human activities on the marine environment is a crucial part of the development of marine spatial plans. For UK waters practical and scientifically sound tools, methods and approaches are now required for the core part of planning. This study shows the first steps in the development of spatially explicit tools for cumulative impact assessment for UK waters. The tools allow the mapping of valuable and sensitive marine areas, and the assessment of overlapping human activities and associated pressures on those areas. This in turn allows for the categorisation of risk of cumulative impacts. Here we evaluate those tools and highlight their current limitations. Ultimately, this marine spatial planning tool box will support the implementation of an ecosystem approach to marine management, which enables the integration of the management of different sectors including fisheries, marine aggregates, cables, renewable energy and oil and gas.

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ARE GELATINOUS PREDATOR CONCENTRATIONS STILL INCREASING IN THE NORTH WEST MEDITERRANEAN SEA ?

A recent analysis of the multi-decadal changes (1966-1993) in the zooplankton community of the Bay of Villefranche sur Mer (Northwestern Mediterranean sea) suggested a regime change in the late 80's with an increase in jellyfish abundances and the reduction in copepods and chaetognaths concentrations. We have extended the analysis of the same zooplankton time series to assess if the long term changes that were reported continued to year 2003. Plankton collection was performed by means of vertical hauls of a zooplankton net from bottom to surface. Copepods were automatically recognised and objects longer than approx. 1 mm were visually identified on the images. We have analysed copepods, chaetognaths, jellyfish and siphonophores total counts and one hydromedusa species Aglaura hemistoma. The pattern of changes from 1974 to 1993 was consistent to the previous observations; decline of chaetognaths and copepods while increase of jellyfishes. Our results show a recovery trend from 1999 in copepods and chaetognaths while jellyfish remains abundant. Possible hydro-climatic causes for the pelagic-ecosystem changes will be discussed.

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PHYTOPLANKTON PRODUCTION IN LAKE TANGANYIKA: EVIDENCE OF A DECLINE IN PRIMARY PRODUCTIVITY IN RECENT DECADES

In this study, which covers the period 2002-2005, we provide new estimates of daily and annual primary production of phytoplankton in Lake Tanganyika, and we compare them with values published in former studies. Chlorophyll a (chla) in the mixed layer ranged from 5 to 120 mg chla m-2 and varied significantly between rainy and dry seasons. Seston C: P ratios also varied according to season, and phosphorus limitation seemed to occur more frequently than nitrogen limitation, especially during the rainy season. Measured particulate daily primary production ranged from 110 to1410 mg C m-2 day-1. In addition, measurement of surface chla and of the light attenuation coefficient by remote sensing, combined with determination of the photosynthetic parameters from in situ measurements, provided whole-lake estimates of primary production. Both approaches yielded estimates of annual primary production lower than those reported in previous studies: this adds to the evidence of a recent decline in primary primary productivity in Lake Tanganyika.

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DEFICIT OF POLONIUM-210 PREDICTS PARTICULATE ORGANIC CARBON FLUX FROM WINTER THROUGH SPRING AT THE BERMUDA ATLANTIC TIME SERIES (BATS) SITE

In a recent paper, the effectiveness of Th-234 as a POC export tracer was significantly higher during periods of enhanced primary production and carbon export than during more oligotrophic conditions in the Sargasso Sea. It has been proposed that Po-210 can also be a reliable proxy for organic carbon export, but the conditions under which to apply these two unique natural radionuclide proxies has not been well established. In this study we demonstrate that the polonium-lead disequilibrium system may perform better as a tracer of organic carbon export under non-bloom conditions in an oligotrophic setting such as BATS. This confirms earlier results that Po-210 can more effectively distinguish between bulk export (surface area) and organic carbon export than Th-234 under oligotrophic and lithogenic-driven flux regimes.

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EXPRESSION OF NITRATE REDUCTASE AND RUBISCO IN RESPONSE TO NITROGEN SOURCE, TEMPERATURE AND CARBON DIOXIDE CONCENTRATION IN *HETEROSIGMA AKASHIWO*

Future climate conditions predicted by global climate change models could lead to enhanced growth of several harmful algal bloom (HAB) species at the expense of co-existing harmless species. This study aims to provide a detailed analysis of the physiological and molecular level responses of several HAB species found in the Delaware Inland Bays to changes in nitrogen source, temperature and CO_2 concentration. Results obtained from initial experiments with unialgal cultures will be informative for predicting possible shifts in phytoplankton community composition that could lead to an increase in HAB events during the next century. Presently, semi-continuous cultures of *Heterosigma akashiwo* were used to examine the effects of nitrogen source, temperature and CO_2 concentration on the expression of key enzymes in the nitrogen and carbon assimilation pathways. Data describing changes in nitrate reductase activity and transcript abundance as well as rubisco transcript abundance will be presented and discussed.

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THE COUPLING OF BIODIVERSITY AND PRODUCTIVITY IN PHYTOPLANKTON COMMUNITIES: CONSEQUENCES FOR BIOMASS STOICHIOMETRY

There is widespread concern that loss of biodiversity can influence important ecosystem services. A positive relationship between diversity and productivity has been observed in investigations of terrestrial and aquatic plant communities. However, an increase in primary production (carbon assimilation) does not necessarily result in higher nutrient uptake by primary producers. There is a loose coupling between carbon assimilation and nutrient uptake in autotrophs, and their biomass carbon-to-nutrient ratios (stoichiometry) are flexible. We performed controlled laboratory experiments to investigate the effect of phytoplankton biodiversity on phytoplankton stoichiometry. Our results indicate that biodiversity influences carbon assimilation and nutrient uptake of phytoplankton communities in different ways, resulting in variations of biomass stoichiometry. Data from 46 lake communities also support this link. Shifts in the biomass stoichiometry of phytoplankton communities are generally attributed to environmental fluctuations in resources. However, our results show that biodiversity is also important in determining stoichiometric dynamics of phytoplankton communities.

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PROTISTAN DIVERSITY IN ANCIENT PERMANENTLY AND RECENT TEMPORARY ANOXIC BASINS

In anoxic and suboxic environments protists occupy the highest trophic level and influence biogeochemical processes due to their grazing impact on prokaryotic communities. Phylogenetic analysis of small subunit ribosomal RNA genes amplified from environmental samples revealed a tremendous diversity of protists in oxygen-depleted waters. Most of these surveys focused on permanently anoxic habitats like the Cariaco Basin (Venezuela). We examined protistan distribution and diversity in the water column of a temporary anoxic habitat, the Gotland Deep (Baltic Sea), which by sampling time recovered from an oxygenation event. The reported protistan diversity is distinctively different from the one in ancient, permanently anoxic habitats such as the Cariaco Basin in terms of phylotype richness and community composition. Presumably environmental systems like the Gotland Deep, which are subjected to dynamic oxygen regimes, favour organisms capable to survive inappropriate conditions or with high potential to react to changing oxygen conditions. In contrast, old permanently anoxic habitats seem to support the evolution of (endemic) strictly anaerobe lineages. Further efforts are necessary to understand the implications of different protistan communities for biogeochemical processes in these environments.

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OPTIMIZING LIPID PRODUCTION BY PLANKTONIC ALGAE

At present, the interest in renewable fuels is rising. Reasons for this are the global need to reduce emission of greenhouse gases, the increasing prices for fossil energy sources and the associated doubts of an assured supply of fossil energy in the future. Hitherto biofuel is being produced using terrestrial plants. However, rising biofuel production could have strong consequences for global food supply. While agricultural cycles are measured in months, algae can double their biomass several times a day and their cultivation does not necessarily compete with food production. Additionally, the lipid content of planktonic algae is considerably higher than of terrestrial plants. We isolated several algae, which showed both, high growth rates and potential high lipid contents. Population parameters, such as algal growth dynamics under different nutrient supply, the biomass yield per unit of limiting nutrients and lipid contents of biomass were estimated. We compared different cultivation systems (batch, chemostat) and growth conditions to optimize simultaneously growth and biomass lipid content of the different algal species.

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EFFECTS OF SMALL-SCALE FLUID MOTION ON BACTERIAL FORAGING :

Foraging of motile marine bacteria on dissolved organic matter can be affected by small-scale fluid motion in two manners: shear hinders motility and flow deforms nutrient patches. Both processes interfere with chemotaxis, altering nutrient uptake. We present a combination of microfluidic experiments and numerical modeling to study and quantify these effects.

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MICROBIAL EUKARYOTE DIVERSITY IN DEEP HYPERSALINE ANOXIC BASINS OF THE EASTERN MEDITERRANEAN SEA

The world's deepest (c. 3500 m) and most hypersaline anoxic basins (DHABs) occur on the seafloor of the eastern Mediterranean Sea. With a salinity exceeding > 10 times the one of seawater, DHABs represent one of the most extreme habitats on our planet. Yet, recent studies revealed an astonishing diversity of prokaryotic life in these DHABs. While it becomes more and more obvious that bacteria and archaea conquered even the most inhabitable places on Earth, comparable research on microbial eukaryotes is still in its infancies. We undertook to explore the diversity of protists in the DHABs L'Atalante, Discovery and Bannock. Using statistical and phylogenetic analyses of eukaryote small subunit ribosomal RNA (SSU rRNA) genes we address the following questions: (i) Are there signs of microeukaryotic life in the super-extreme environments of the DHABs? (ii) If so, is this life represented by a few potentially highly specialized (endemic) taxa or is it as diverse and abundant as in other, non-hypersaline, marine environments? And (iii), do the distinct biogeochemical characteristics of the basins under study select for different protistan communities?

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LIFE AT THE INTERFACE: BACTERIAL COMMUNITY COMPOSITION AND ACTIVITY WITHIN THE SEA-SURFACE MICROLAYER OF THE BALTIC SEA

The sea-surface microlayer (SML) is defined as the uppermost part of the ocean and is thought to be an extreme environment due to opponent factors (UV-radiation, pollutants, nutrients, etc.). However, it is still uncertain whether the bacterioneuston, i.e. bacteria inhabiting the SML, resembles a specialized community in the way it reacts to the habitats' conditions. In an interdisciplinary project we investigated SML samples of the Baltic Sea. In our study we found a highly similar community composition in samples from the SML and the underlying water as revealed by 16S rDNA fingerprints. However, 16S rRNA fingerprints demonstrated a change in active members within the neuston community. These changes were accompanied by observations showing a significant reduction of bacterioneuston productivity. Yet, similar abundances of total bacterial cells and highly-active (CTC-positive) cells in the SML and the underlying water were found. Although it remains unclear which factors dominantly influenced bacterioneuston activity, our results imply that bacterial communities in the SML of the Baltic Sea are not strikingly different from those of the underlying water and are mainly distinguished by their activity profiles.

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ARE THERE ANY NUTRIENT THRESHOLDS FOR HARMFUL EFFECTS CAUSED BY ALGAL BLOOMS?

The number of toxic and other harmful algal events have increased over the last decennia, especially in coastal waters close to densely populated areas. It has been hypothesised that the occurrence of harmful algal blooms causing such events is related to antropogenic loads of inorganic or organic nitrogen and phosphorus, or a changing ratio between these nutrients. Likewise, the increase of non-diatoms has been contributed to increased NP to Si ratios. Not only the abundance of HAB species, but also the magnitude of their harmful effect may relate to nutrient concentrations or ratios. For example, toxicity for some HAB species have shown to change with shifting N/P availability ratio. Moreover, such relationships may not be linear, but rather non-linear and there may be thresholds in nutrient concentration or ratios above which the probability of such harmful events will increase rapidly. An integrated signal for the combined effect of variation in HAB occurrence and toxicity is displayed in for example shellfish toxicity and fish kill frequency. In this study, it is hypothesized that the occurrence of such events is related to nutrient concentrations or ratios in coastal waters. Significant correlations and thresholds with respect to nutrient concentrations were found in some coastal regions with good data availability. However, in many areas where harmful algal events occur the data availability is unsufficient in order to draw general conclusions

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THE TIME SCALE OF PHENOTYPIC PLASTICITY, AND ITS IMPACT ON COMPETITION IN FLUCTUATING ENVIRONMENTS

Although phenotypic plasticity can be advantageous in fluctuating environments, it may come too late if the environment changes fast. Complementary chromatic adaptation is a colorful form of phenotypic plasticity, where cyanobacteria tune their pigment composition to the prevailing light spectrum. Here we investigate the time scale of phenotypic plasticity. We develop a competition model, in which green and red Synechococcus species compete against a third cyanobacterium that can adapt its color to the prevailing light conditions. We call the latter species the flexible phenotype. Model predictions are tested in a series of competition experiments in which the prevailing light color fluctuated at different frequencies. They show that the flexible phenotype was much more successful when it had sufficient time to fully adjust its pigmentation. The flexible phenotype benefits from its phenotypic plasticity only when fluctuations in light color were relatively slow, corresponding to slow mixing processes or infrequent storms in their natural habitat. Our findings demonstrate that the time scale of phenotypic plasticity plays a key role in competitive interactions, and affects the biodiversity of plankton communities in fluctuating environments.

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DETERMINATION OF YOUNG EPHYRAE OF 18 SPECIES OF THE CLASS SCYPHOZOA AND YOUNG MEDUSAE OF 4 SPECIES OF THE CLASS CUBOZOA (CNIDARIA) BY MORPHOLOGICAL CHARACTERS

Blooms of jellyfish of many species are common throughout the world. These blooms harm parts of the economy of many countries like tourism (e.g. box jellyfish blooms in Queensland during October to May; blooms of cyaneids in the Northern or Baltic sea during June to September) or fishery (e.g. 'jellyfish attack' of *Pelagia nocticula* on Irish salmon farm in November 2007). An early warning system for species harmful for men or fish farms that will bloom in the seasons to come could be useful and be established by watching the numbers of ephyrae or young medusae in plankton samples. Very similar characters of the ephyrae in some species like *Aurelia aurita*, *Rhizostoma octopus* and *Chrysaora hysoscella*, for the cold water species or like *Cephea cephea*, *Netrostoma setouchina* and *Mastigias papua* for the tropic species can cause confusion in the determination of these species. Therefore, an itemized list of morphological characters for the determination of young ephyrae of 18 species of the Scyphozoa and 4 species of the Cubozoa as the beginning of a determination catalogue is presented.

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CLIMATIC AND HYDRODYNAMICAL CONSTRAINTS ON SPRING BLOOM DYNAMICS IN EUROPEAN LAKES - A PAN EUROPEAN SIMULATION APPROACH

Spring bloom dynamics in lakes are strongly influenced by climatic forcing. Climate controls to a large extent the phenology of the bloom by setting the timing of the start and - at least in Daphnia dominated lakes via temperature controlled growth rates - the timing of the end of the bloom. During the spring bloom climate may additionally be influential via determining mixing depths and water temperatures. Hence, hydrodynamical models can provide the boundaries of spring bloom development and comparative analyses of plankton succession. Using a k-epsilon turbulence model we simulate the seasonal hydrodynamics of 16 model lakes differing in depths and turbidity all across Europe. The model lakes are forced by meteorological data given as gridded fields (2124 locations) over Europe. From these simulations (16 x 2124) we extract key events and characteristics relevant for biological processes such as the onset of stratification, duration of the spring bloom and timing of the clear –water phase. These characteristics provide predictions for a pan-European comparative ecology of plankton succession.

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DEVELOPMENT OF AN EXPRESSION VECTOR CONSTRUCT FOR THE MARINE MICROALGA *EMILIANIA HUXLEYI*

The gene transfer technology is a common tool for studying gene functions in eukaryotic cells. Genetic transformation methods have been described for some microalgae and provide powerful tools for functional genomics. The aim of this work was to establish a transformation system for the cosmopolitan coccolithophorid *Emiliania huxleyi*. Cell growth on solid medium and effectiveness of a variety of antibiotics for potential use as selective agents were tested. A putative promoter of a gene encoding for a fucoxanthin chlorophyll binding protein could be amplified from genomic DNA and fused in the diatom vector pPha-T1. It was used for preliminary transformation experiments with a PDS1000/He microparticle bombardment system. Prerequisites for the construction of a transformation system could be established. The results revealed that *E. huxleyi* cells can grow on solid medium and are sensitive to cycloheximide, puromycin, chloramphenicol and G418. Selection of transformants with zeocin was not possible, as the selection marker of the vector was not appropriate for *E. huxleyi*. The findings of this work provide a good basis for the development of an *E. huxleyi* specific expression vector.

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GEOGRAPHIC, SEASONAL, AND PHYLOGENETIC VARIATION IN BACTERIAL BIOVOLUMES BASED ON A NEW PROTEIN STAIN

Biovolume is an important cell characteristic that shapes the contribution of microbes to biomass and biogeochemical cycling. Most studies of bacterial cell volumes use 4'-6-diamidino-2-phenylindole (DAPI), which stains nucleic acids and therefore only a portion of the cell. We used SYPRO Ruby protein stain combined with fluorescence in situ hybridization to examine biovolumes of bacteria. Protein-based volumes were consistently larger than DNA-based volumes by 3.3-fold on average. Bacterial cells were about 30% larger in the Arctic Ocean and Antarctic coastal waters than in temperate regimes. We hypothesized that geographic differences in the abundance of specific bacterial groups drove the observed biovolume patterns. In support of this hypothesis, we found that Gammaproteobacteria and members of the *Cytophaga-Flavobacteria* group were larger in higher latitude waters and that the mean volumes of both groups were larger than the mean bacterial volume in all environments tested. Members of the SAR11 clade were larger than total bacteria on average, though this varied. Protein staining increases the accuracy of biovolume measurements and gives insights into how biovolume of marine microbial communities varies over time and space.

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CARBON SEQUESTRATION AND STOICHIOMETRY FOR MOBILE AND NON-MOBILE GREEN ALGAE

Growth of phytoplankton mainly depends on the availability of light and nutrients, which usually exhibit vertically opposing gradients in pelagic ecosystems. Mobile phytoplankton species are, to a certain degree, able to optimize the availability of light and nutrients by actively choosing their vertical position in the water column. However, mobility involves costs in terms of energy and nutrient expenditures. In contrast, non-mobile species have to cope with temporally variable ratios of light and nutrients because their position in the water column is left to chance. These different strategies may result in differences in carbon dynamics and biomass composition (stoichiometry). We conducted experiments with green algae species (four mobile and five non-mobile) over a gradient of light availability and quantified primary production, biomass accrual and algal biomass stoichiometry. Phytoplankton primary production and biomass stoichiometry differed between mobile and non-mobile species. Metabolic costs were higher and biomass carbon-to-phosphorus ratios were lower in mobile species. We conclude that higher energy demands and the necessity to maintain high biomass phosphorus content limit the advantages of mobility to specific environmental conditions.

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EFFECTS OF PERMAFROST THAW AND GLACIAL MELTWATER ON CARBON YIELDS FROM THE YUKON RIVER BASIN

Climate warming, permafrost thaw, and glacial meltwater are having measurable effects on inorganic and organic carbon yields from river basins in northern high latitudes. We discuss the source, seasonality, chemistry, and age of carbon exported from watersheds draining mostly continuous permafrost, discontinuous permafrost undergoing thaw, and glacial headwaters in the Yukon River basin of Alaska and northwest Canada. We also project changes in C yields by the Yukon River to the Bering Sea based on comparison of historical and current flux measurements. Inorganic C export is dominated by carbonate sediments in glacial meltwater, weathering of carbonates, and groundwater inputs. About half of annual dissolved organic material export occurs during spring runoff. This DOM is young and has a large terrestrial vascular plant contribution from boreal forest and lowlands. Older, less aromatic, DOM originates from glacial headwaters and from groundwater discharge and is more evident during base flow. Long-term projections indicate increased DIC yield and decreased DOM yield relative to water yield due to increased weathering and OM mineralization throughout the basin.

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COASTAL NUTRIENT BUDGET OF THE MEDITERRANEAN SEA

Due its practically enclosed character, the Mediterranean Sea is often used to assess the global change of the environment. Its northern shores are part of the EU and therefore its waters are of particular interest in the assessment of the environmental impact of the implementation of the EU Water Framework Directive and related legislation. Within this framework, nutrient loads from the adjacent land surfaces need to be assessed. In order to accomplish this, a GIS-interfaced hydrologic/water quality model, called AVGWLF (ArcView Generalized Watershed Loading Function Model), was used to simulate the applied to all coastal watersheds draining into the Mediterranean Sea. Simulation results show that the modelled average streamflow and nutrient loads fall within the literature-reported ranges and therefore, making the successful application of this model feasible. However, for improved representation of the actual Mediterranean Sea streamflow and nutrient status, better input data are required, particularly for the Asian and North African Mediterranean areas.

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SLOPES FROM SPACE - GENERAL PATTERNS IN COMMUNITY SIZE DISTRIBUTIONS AND ITS IMPLICATIONS

The community structure of the pelagic community ranging from bacteria to meso-zooplankton is examined on a global scale. This is accomplished by combining ecological theory on size distributions and satellite derived products in a model. The slope of the size distribution is the rate of change in biomass with size and hence indicative of the transfer efficiency of energy from lower to higher trophic levels. The size distributions of the pelagic communities are generally more or less of a log-linear nature (i.e. much more biomass,"y", in the smallest size class, "x", compared to the larger). The slope is more steep in regions with high chlorophyll (suggesting a rapid transfer of energy from lower to higher trophic levels), while regions with low chlorophyll has a less steep slope. The results are consistent with literature and opens up the possibility of an model of pelagic communities on a global scale. Furthermore, information on size distributed biomass can be used in combination with metabolic scaling theory to estimate the respiration (oxygen consumption), in the mixed layer, of the global ocean.

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NITROGEN AND CARBON ISOTOPE RATIOS IN SUSPENDED MATTER AND DISSOLVED INORGANIC CARBON IN A MEROMICTIC LAKE OF THE NORTHERN ALPS (BAVARIA, GERMANY)

The meromictic lake Alat is located near Füssen in the northern parts of the Alps. Starting in May 2005 to November 2005, we analyzed vertical profiles of nitrogen and carbon isotopes in suspended matter (SPM) and dissolved inorganic carbon (DIC), as well as environmental parameters such as the concentrations of dissolved O2, SO4, NH4, NO3, and PO4. The upper water column is well saturated in oxygen, and displays ion contents and nutrient profiles quite common for high mountain lakes. The lake has a pronounced vertical density stratification at about 17m water depth, separating a lower anoxic water body with high loads of SO4. Purple sulphur bacteria are concentrated on top of the lower water body in high quantities during all sampling intervals. Constantly low δ15N-values (-5‰) in the samples with abundant purple bacteria presumably originate from a strong N-isotope fractionation of unlimited NH4 at the bottom water column. Increased density of the surface water body may advect parts of the purple bacteria layer, as depicted from low δ15N (-3‰) in surface water SPM in November 2005 (winter mixing). The flux of organic matter from the purple bacteria contributes significantly to the sediment as seen in low δ15N of up to -3‰ in a sediment core from the lake. Our results offer an additional source for exceptionally low δ15N values in euxinic sediments, such as Mediterranean sapropels, or Devonian black shales, which can't be resolved by nitrogen fixation alone.

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FATE OF AUTOCHTHONOUS AND ALLOCHTHONOUS DISSOLVED ORGANIC CARBON IN A TEMPERATE COASTAL PLAIN RIVER

Littoral and coastal zones receive and process organic carbon (OC) from a broad spectrum of allochthonous (e.g., leaf litter, soil-derived) and autochthonous (e.g., algal, submerged aquatic vegetation (SAV)) sources. Of these sources, the fate of SAV-derived OC has been understudied. This research investigates the various autochthonous and allochthonous carbon sources and their fate in the Chickahominy River through chemical (natural abundance stable isotopes, optical) and biological (bioassays) techniques. Microbial bioassays of leachates from potential autochthonous and allochthonous OC sources resulted in a greater percentage of labile autochthonous OC and a lesser portion of allochthonous OC metabolized. Preliminary data confirm SAV leachate to be isotopically distinct from other potential OC sources. A two end-member mass balance equation, coupled with bioassays of each potential source leachate was used to constrain their metabolic fate. Further isotopic studies with the Respiratory Carbon Recovery System coupled with nutrient addition assays will help to further elucidate partitioning of specific OC sources to anabolic versus catabolic pathways.

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HYPORHEIC AND BENTHIC INVERTEBRATE COMMUNITY RESPONSES DURING A PERIOD OF VARIABLE FLOW

The river flow regime is a major determinant of the physical characteristics of surface habitats in lotic ecosystems, and hydrological variability is therefore a recognised influence on benthic invertebrate community composition. In contrast, the effects of hydrological variability on the hyporheos are poorly understood, research efforts being hampered by logistic difficulties in characterising hyporheic flow. Fluctuations in river stage are accompanied by changes in other physical and chemical parameters which may affect both surface and hyporheic habitats. Declining flow, for example, may deposit fine sediments that clog hyporheic interstices, whilst spate flows can mobilise surface sediments. In contrast to benthic fauna, hyporheic invertebrates may be afforded protection from some environmental fluctuations, however, competition for resources may increase if benthic invertebrates migrate into the hyporheic zone to escape unfavourable conditions in the surface channel. We present data collected during a period of spatial and temporal fluctuations in surface flow in the River Lathkill (Derbyshire, UK), comprising a period of flow recession and a subsequent spate. This data is used to investigate the drivers influencing benthic and hyporheic invertebrate community composition.

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EFFECTS OF SEASONAL HYPOXIA ON BENTHIC SECONDARY PRODUCTION AND COMMUNITY FUNCTION IN THE RAPPAHANNOCK RIVER, VA, USA.

Development has eroded Chesapeake Bay's health, resulting in an increase in the extent and severity of hypoxia (≤2 ml O_2 l^{-1}), adversely affecting community structure and secondary production of macrobenthos in the Bay and its tributaries. Changes in benthic secondary production were assessed in the lower Rappahannock River, a sub-estuary of Chesapeake Bay and an area known to experience seasonal hypoxia. Ten samples were collected during spring, summer, and fall of 2007 and secondary production estimated using Edgar's allometric equation. From early spring to late fall, dissolved oxygen concentrations were measured continuously at 2 of the 10 sites and the benthic community assessed through bi-weekly grab samples. Hypoxic sites had approximately a 60%-90% reduction in benthic secondary production, compared to normoxic sites, and secondary production was composed primarily of smaller, disturbance-related annelids. The functional role of the benthic community shifted from spring to summer, as larger infaunal organisms were replaced by smaller hypoxia-resistant spionids. We can only surmise the impacts a shift in benthic community function might have on higher trophic levels and acknowledge the need for further investigation.

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NUTRIENT CONTROL OF OCEANIC MICROBIAL COMMUNITIES DURING SPRING IN THE GULF OF AQABA

Bioassay experiments were performed as part of GAP 8 (Eilat, Israel) to examine how different components (autotrophs, aerobic anoxygenic phototrophic (AAP) and heterotrophic bacteria) of the microbial community respond to nutrient limitation during spring in the Gulf of Aqaba. *Synechococcus* sp. exhibited a positive biomass response (and pikoeukaryotes a negative response) to dual addition of nitrogen (N) and phosphate (P), and to a lesser extent of N alone, within 48h. This positive biomass response was preceded (24h) by an increase in PSII photochemical efficiency and a decrease in both PSII effective absorption and turnover time of electrons. CO_2 uptake rates did not increase with any treatment. AAP biomass also increased (and electron turnover time decreased) in response to N additions and was not co-limited by N and P. In contrast, heterotrophic bacteria biomass and production showed a positive response to 'deep' water nutrient additions but not the standard N or N and P treatments. We discuss these alternative responses in terms of implications for the flow of electrons (absorbed light) to carbon fixation (productivity) and ultimately the net ecosystem metabolism.

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EFFECTS OF RISING CO2 ON THE GROWTH AND DOMOIC ACID PRODUCTION OF THE TOXIC MARINE DIATOM PSEUDO-NITZSCHIA

The toxic diatom *Pseudo-nitzschia multiseries* was cultured using semi-continuous methods under a matrix of three pCO_2 conditions (190, 380 and 760 ppm), and two phosphate concentrations (20 μM, replete; and 0.5 μM, limited), yielding a total of six experimental treatments. Growth rates, primary productivity, maximum photosynthetic rates (PBmax), and the slope of the light limited part of the PE curve (alpha) were all significantly enhanced with increased pCO_2 during both P-replete and P-limited growth. Cell-normalized biogenic silica, phosphorus, and nitrogen quotas were all decreased by increasing pCO_2. The most interesting result was that the cell- or carbon-normalized production of the toxin domoic acid (DA) increased dramatically and incrementally with rising pCO_2. Our results indicate that increasing pCO_2 may have a significant effect on the production of this algal toxin, suggesting a potentially escalating negative impact of this harmful algal bloom species on the future marine environment.

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HIGHLY UNEVEN DISTRIBUTION OF VIRAL RICHNESS IN THE SEA

We used high throughput 454 pyrosequencing to examine the genetic richness of specific groups of viruses in natural samples collected in the coastal waters of British Columbia, Canada. A series of independent PCR reactions using degenerate PCR primers that amplify DNA sequences from myoviruses, algal viruses and podoviruses were used to interrogate three seawater samples and a sediment sample. Following amplification, PCR products for different groups of viruses from the same location were combined in a single 454 sequencing reaction, and subsequently binned into groups based on their primer sequences. Following processing to remove poor-quality reads and chimeras, sequences that were <98% similar were scored as different taxonomic units. The distribution of sequences for each of the viral groups was highly uneven. Most of the sequences were singletons, while the most abundant sequences occurred >150 times more frequently. Rarefaction curves did not approach saturation, even after >4000 sequences were included from the most frequently occurring viruses (myoviruses). The analysis indicates extremely high genetic richness for individual groups of viruses in the sea, even for one gene that is diagnostic of a subset of viruses.

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TYPHOON-INDUCED CHANGES IN ABUNADNCE AND COMMUNITY STRUCTURE OF PHYTOPLANKTON IN THE NW PACIFIC OCEAN

Although there is little evidence of any trend in frequency of tropical cyclones including typhoon, tropical cyclone intensity may have increased (IPCC, 2007). Here we assess the impacts of typhoon on the abundance and community structure of phytoplankton in the NW Pacific using satellite remote sensing and on-deck bottle incubation technique. During 1997-2006, total number of typhoons was 150, and 63% of them induced substantial increases in chlorophyll *a* level in tropical surface waters. As a typical example, surface chlorophyll *a* concentration in tropical open waters increased from 0.05 to 3.5 mg m^{-3} due to the Typhoon 17th, 2003. Our on-deck incubation experiments revealed that large-sized diatoms such as *Pseudo-nitzchia seriata* complex and chain-forming *Chaetoceros* spp. could bloom in the tropical open ocean after mixing the surface and subsurface waters. Then abundance of diazotrophs in terms of *nifH* gene copies was little affected by nutrient availability. Our results suggest that the enhancement of typhoon intensity may increase number of the blooms mainly consisted of diatoms, which are considered to be key players in marine ecosystems and biogeochemical cycles.

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PRODUCTION OF CALANUS FINMARCHICUS, C. GLACIALIS AND C. HYPERBOREUS DURING THE SPRING IN DISKO BAY, WESTERN GREENLAND, WITH EMPHASIS ON LIPID COMPOSITION

In Disko Bay in Western Greenland the mesozooplankton biomass is dominated by Calanus spp. In this area the Atlantic Calanus finmarchicus, and the Arctic lipid rich C. glacialis and C. hyperboreus co-exist. During spring 2008 the grazing activity, reproduction, condition and distribution of the three Calanus species was investigated. C. finmarchicus commenced feeding as soon as phytoplankton was available, and approximately 2 weeks before initiated egg production. C. glacialis commenced feeding at the same time but initiated egg production almost immediately. The egg production per female and number of spawning females was higher for C. glacialis than C. finmarchicus over the course of the spring bloom. This could indicate that C. glacialis is more adapted to unpredictable bloom conditions compared to C. finmarchicus who needs food to initiate spawning. Contradictory to earlier believes, C. finmarchicus and C. glacialis filled their lipid stores while spawning during the bloom. These results stress the importance of timing of their vertical migration in relation to the spring bloom initiation. A possible mismatch would likely affect the spawning rate and lipid accumulation for subsequent diapause.

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A POSITION SENSITIVE DETECTOR FOR SHEATHLESS FLOW CYTOMETRY

Flow cytometry has become powerful tool for high speed single cell and particle analysis in oceanography. In a traditional flow cytometer, particles are injected into the flow of clean sheath fluid in order to guide the particles along an optimal trajectory to the focal region of an optical system. However the need for a constant supply of clean sheath fluid limits the volume that can be analyzed. We designed a compact sheathless flow cytometer that uses a combination of three photo detectors to sense the position of single particles within a stream of raw sea water and thereby exclude unfocused particles from the measurement. This instrument performs continuous sampling of sea water at high flow rate and provides detection from pico to micro particles. Light scattering, pigment fluorescence of cells and particle concentrations can therefore be measured at very fine spatial and temporal scales. This instrument will provide new insight into the diel variability and patchiness of phytoplankton communities in the ocean.

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NUTRIENT ACCOUNTING IN COASTAL WATERS AND WATERSHEDS: LINKAGES AND APPLICATIONS

The Land Ocean Interactions in the Coastal Zone (LOICZ) program first attempted to outline a methodology to assess biogeochemical budgets of coastal water bodies and their implications for coastal ecosystem metabolism in the early 1990s. An original goal of LOICZ was to evaluate its global significance and regional variation, especially along the coastlines of developing countries (Gordon et al., 1996). Beginning around the same time, and working independently, research in the SCOPE Nitrogen project began to construct simple accounting approaches for relating nutrient inputs to coastal watersheds to nutrient export to the coast (Howarth et al., 1996). A primary aim was to demonstrate the relative importance of anthropogenic nutrient inputs to watersheds on the load to coastal waters. While the aims and development of the approaches were different, they exhibit some basic similarities. Here, we discuss some of the methodological similarities of the approaches, and examine the utility of combining them, with the aim of providing a simple framework for assessing the linkages between human activities in coastal watersheds and the effects of nutrient loads on coastal ecosystems.

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C AND N ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC MATERIAL BY SIZE FRACTION IN THE SOUTHERN OCEAN

The low values (down to -35‰) and great variability (>8 ‰) of the C isotopic composition of particulate organic carbon ($\delta^{13}C_{org}$) in the Southern Ocean have long been a puzzle and an impediment to using $\delta^{13}C_{org}$ as a paleoceanographic proxy. Variations in $\delta^{13}C_{org}$ should be controlled predominantly by photosynthesis, with phytoplankton growth rate and carbon concentrating mechanisms (CCMs) all contributing to variations in C isotopic fractionation. To ascertain the exact cause(s) of the anomalously low and variable Southern Ocean $\delta^{13}C_{org}$, we have analyzed a suite of 105 POC samples collected from the chlorophyll maximum during transects of the Antarctic sector of the Southern Ocean during GEOTRACES cruise "Zero and Drake" (ANTXXIV/3). These samples were split into 5 size fractions between 0.2 and 100 μm to determine which size fraction(s) were responsible for the low values and/or variability in $\delta^{13}C_{org}$. Results suggest that strongly depleted $\delta^{13}C_{org}$ values are a general feature of Antarctic phytoplankton, but that variability in $\delta^{13}C_{org}$ may be largely driven by the abundance of the diatom, *F. kerguelensis*, which tends to have relatively less depleted $\delta^{13}C_{org}$ values.

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BACTERIOPLANKTON-PROTIST INTERACTIONS: RESULTS OF A 13C-LABELING STUDY

Although grazing of bacteria by protists in aquatic systems has been extensively studied, uncertainties remain about this trophic relationship. Recent experimental evidence indicates that protists selectively consume active bacteria. This is not taken into account in current microbial food web models. For this to be done, a better understanding of this relationship is needed. Here we report results of a 16-day experiment with natural communities, where bacteria carbon was tagged using 13C-glucose, and traced through bacteria-specific phospholipids-derived fatty acids (PLFAs). PLFAs are used to identify active members of a community. The Δδ13C of bacterial PLFAs increased one day after the 13C-glucose injection, peaked at values > 25000 ‰ on day 4, and decreased to ~ 4900 ‰ at day 16. Among the non-bacterial PLFAs found throughout the experiments, a PLFA belonging to flagellates had the highest concentration. For that PLFA, the Δδ13C increased with 1 day delay (compared to bacterial PLFA), peaked at 15967 ‰ on day 4 and decreased at day 16 to 4134 ‰, a value higher than that of Δδ13C of dissolved inorganic carbon (< 700 ‰) and glucose. This indicates prey-predator relationship and allowed estimations carbon transfer between the two microbial compartments.

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SATELLITE-DRIVEN MODELING OF THE UPPER OCEAN MIXED LAYER AND AIR-SEA CO2 FLUX IN THE MEDITERRANEAN SEA

The air-sea CO2 flux, the carbon export to the deep layers, and more generally the carbon budgets are presently poorly characterized in the Mediterranean Sea. A first basin-scale estimation was proposed by D'Ortenzio et al. (2008), using an approach based on an array of unconnected 1D physical-biological-chemical coupled models, massively assimilating satellite information (in particular SeaWiFS ocean color observations). The method was applied to simulate the upper ocean physical and biogeochemical dynamics of the entire Mediterranean Sea over the years 1998 to 2004. In this work, the D'Ortenzio et al. (2008) approach was used to evaluate basin-scale Mediterranean CO2 fluxes for the two periods 1979-1984 and 1998-2004. The rationale here was to feed the 1D model with the CZCS-SeaWiFS coherent data base of ocean color observations presented by Antoine et al. (2005). Comparisons between the two periods on the influence of the physical and biological processes in shaping the pCO2 seasonal evolution will be presented.

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THE INFLUENCE OF BACTERIAL AND PHYTOPLANKTON FATTY ACIDS ON THE SOMATIC GROWTH OF *DAPHNIA*

It has been shown that food quality and fatty acid composition of diet has a big influence to the somatic growth of zooplankton. Recent studies have shown polyunsaturated fatty acids (PUFA) are essential fatty acids to *Daphnia* somatic growth, and eicosapentaenoic fatty acid (EPA, 20:5w3) might be the most important essential fatty acids to determining somatic growth of *Daphnia*. Polyunsaturated fatty acids are rare in bacteria, and thus bacteria should be poor food quality for *Daphnia*. Our preliminary results indicate that *Daphnia* can grow and even reproduce eggs when feeding on methane oxidizing bacteria. Additionally, the highest somatic growth was observed for mixed bacteria and phytoplankton diets. We also used a fatty acid biomarker approach to quantify lipid incorporation into *Daphnia* tissues.

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INVESTIGATION OF CHLAMYDOMONAS REINHARDTII GROWTH IN PHOTOBIOREACTORS: THE IMPORTANT PARAMETERS GOVERNING PRODUCTIVITIES

Industrial applications of photosynthetic microorganisms like microalgae involve specific processes for biomass production, namely photobioreactors (PBRs). In opposite to classical bioprocesses like fermentors, those systems request a light supply which modifies deeply the process engineering and running. PBRs are thus found of various geometries: cylindrical, tubular, flat panel. This work is devoted to the investigation of the main parameters governing PBRs productivities in light-limited conditions for which best productivities are achieved. The microalga Chlamydomonas reinhardtti has been cultivated in two photobioreactors with different geometries (torus and cylindrical). It has been demonstrated that, despite their difference in geometry, biomass productivities are fully related to three parameters: the photon flux density (PFD), the light fraction γ(ratio of the illuminated zone to the photobioreactor depth) and the specific illuminated surface (ratio between the illuminated PBR surface to culture volume). A deeper analysis has also shown the variation in biomass composition, especially pigment content, with illuminated conditions. This emphasizes the interest of developing kinetics and radiative transfer models to predict PBRs productivities and to scale-up those processes. Keywords: photobioreactor, biomass productivity, photon flux density, light fraction, radiative transfer.

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CYCLONIC EDDY DOWNSTREAM OF TSUSHIMA ISLANDS IN NOVEMBER 2007

The Tsushima Warm Current flows northeastward through Tsushima Straits, and cyclonic (or counterclockwise) eddy downstream of Tsushima Islands was found in the eastern channel of Tsushima Straits in November 2007 using CTD and ADCP data. The horizontal scale of the eddy is about 30 km, and the baroclinic current accompanied with the counterclockwise eddy was over 15 cm s^{-1} at the edge of the eddy (Rossby number: Ro=U/fL=0.06). The chlorophyll *a* and nutrients concentrations in the center of the eddy with upwelling flow of 0.03 cm s^{-1} were relatively high, suggesting high biological productivity. The island-induced cyclonic eddy moved east-northeastward with about 10 cm s^{-1} along the Tsushima Warm Current (background flow), transferring from the mean kinetic energy to eddy kinetic energy in the vicinity of Tsushima Islands.

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OCEAN ACIDIFICATION CAUSES SIGNIFICANT DECLINES IN THE SURVIVAL OF LARVAL SHELLFISH

The combustion of fossil fuels during the past century has enriched levels of atmospheric CO2. In the world's oceans, increasing levels of CO2 have decreased ocean pH and CO32- levels. The continuation of these changes this century will alter the growth, survival, and diversity of marine organisms which synthesize CaCO3 shells such as corals, coccolithophorids, and foraminifera. Here we present experiments which examined the development and survivorship of larvae from three species of commercially and ecologically valuable shellfish (Mercenaria mercenaria, Argopecten irradians, and Crassostrea virginica) at the levels of CO2 projected to occur in the 21st century and beyond. Under CO2 concentrations estimated to occur later this century (~650 ppm), Mercenaria mercenaria and Argopecten irradians larvae exhibited dramatic declines (>50%) in survivorship and development. In contrast, Crassostrea virginica larvae were unaffected at these levels of CO2 but displayed diminished survival at CO2 levels expected next century (~1,500 ppm). These results suggest recent, current, and future ocean acidification may deplete and/or alter the composition of shellfish populations in coastal ecosystems.

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PRESSURE EFFECTS: TO BE OR NOT TO BE? WHY WE MUST CONSIDERER IT?

The effects of elevated hydrostatic pressure concern all organisms living in the world's largest (by volume) habitat: the deep sea. The field of deep-sea microbiology was born 125 years ago and pressure-adapted microbes have been obtained readily from many different deep-sea regions by researchers around the world. From these piezophile strains, several adaptations have been pointed out. Microbial communities in the deep ocean may contain both autochthonous microbes adapted to in situ temperature and pressure and allochthonous microbes transported from the ocean surface layer. Activities of the latter decrease with depth, limiting their capacity to degrade organic matter sinking through the water column while deep-sea microbial activities are higher under in situ than at atmospheric pressure conditions. Only with microbial rates measured under in situ conditions (pressure, temperature, ambient food availability) do realistic calculations of the flow of matter and energy as mediated by microbes become possible for the deep sea, and thus throughout the water column. New model substrates must be investigated to be as close as possible to the quality of organic matter available in the dark ocean.

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PHYSIOLOGICAL RESPONSE OF THE SYMBIOTIC GORGONIAN EUNICELLA SINGULARIS TO A LONG-TERM TEMPERATURE INCREASE

Increase in seawater temperature is one of the major effects of global climate change that affects marine organisms including Cnidaria. Among them, NW Mediterranean gorgonians have suffered spectacular and extensive damage and one of the most affected species was Eunicella singularis. We have investigated in the laboratory the response of E. singularis to a long-term increase in temperature and we took a special interest in its photosynthetic and calcification responses to the stress. We have studied two populations, one collected at 15 m depth and the other at 35 m depth, in order to determine if there was a difference in sensitivity to thermal stress. Our results show that the population of E. singularis from shallow waters is less tolerant to thermal stress than E. singularis from deep waters. Since E. singularis is a symbiotic species, we also discuss the potential roles of symbiosis in the thermotolerance response.

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MESOPELAGIC MICROBIAL LOOP: ITS STRUCTURE AND FUNCTION

Much less is known about distribution and activity of microbial heterotrophs in the aphotic layer compared to the euphotic layer. Based on a series of study done with Fereidoun, I will review our results of the mesopelagic microbial loop in the northwestern Mediterranean: (1) Bacteria, heterotrophic nanoflagellates (HNF), and ciliates were always detected down to 2000 m, with one, two, and three orders of magnitude of depth-dependent decrease, respectively. This suggests that the balance between growth and loss processes is less variable for bacteria than for protozoa over the depth and that the density-dependent predator-prey relationship becomes less coupled between the three groups with increase of depth. (2) In the mesopelagic layer, bacterial abundance was controlled by both bottom-up (substrate) and top-down (predation) controls. (3) A simple food chain model analysis for the mesoepelagic layer suggested that bacterial mortality is similarly caused by viruses and HNF, and that HNF are potentially important remineralizers of the mesopelagic bacterial production. Future challenges will also be discussed to better understand the role of the microbial loop in ocean biogeochemistry.

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BACTERIAL DEGRADABILITY OF DISSOLVED ORGANIC MATTER RELEASED FROM SCLERACTINIAN CORALS

Coral mucus is well known to be incorporated by bacteria and stimulate the bacterial growth. However, the degradability of the organic matter has not been investigated quantitatively, and therefore it is still not understood what % of the released organic matter is actually mineralized into CO_2 by bacteria and what % is not. To investigate the degradability, three reef-building corals of *Acropora pulchra*, *Porites cylindrica*, and *Porites lutea* were first incubated in a submerged condition, and consequently, released organic matter to the ambient seawater. After taking out of the corals, the incubated seawater was filtered with Whatman GF/F filters and the filtrate containing dissolved organic matter (DOM) was put under dark to observe bacterial decomposition of DOM. The results showed that the coral-derived DOM had three different fractions in bacterial degradability: the first fraction was rapidly degraded within 1 week and accounted for 41% of the initial DOM on average. This labile DOM could be easily mineralized within or around the reef ecosystem. The second fraction was slowly mineralized within 3 months and accounted for 22%. The third fraction was very recalcitrant to the bacterial degradation and was not mineralized over 1 year. This refractory organic matter, which accounted for 37% of the initial DOM, might mean long-term CO_2 fixation by the coral colonies.

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CAPTURING QUANTITATIVE ZOOPLANKTON INFORMATION IN THE SEA: PERFORMANCE TEST OF LOPC AND VPR.

This study reports results from a cruise in two North Norwegian fjords in June 2008. Here LOPC and VPR were mounted together on a platform so that they should sample the same body of water. The two combined systems were operated by vertical profiling from surface to 100 m of depth in locations of the fjord representing different blooming conditions and zooplankton community structures. Data from the two instruments, as well as from CTDF, were logged concurrently and retrieved on deck after about 30 depth profiles. Primary data were analyzed according to standard routines and averaged for every five m depth bins. Size ranges from LOPC were selected based on species dominance, and similar groups were identified from the VPR data. Statistical tests (goodness of fit) comparing abundance estimates (numbers per m3) in the depth ranges between the two instruments are being tested for > 120 depth profiles. The analysis is supported by net samples.

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MUDDY WATERS: NATURAL ESTUARINE PARTICLES AND THEIR UPTAKE OF NITROGEN IN ESTUARIES

Organic nitrogen (ON) constitutes a major fraction of the riverine N flux to estuaries (> 50 %). While ON is partitioned between the dissolved and particulate phases, its speciation and reactivity are poorly quantified leading to major uncertainties concerning the factors controlling estuarine export of N to coastal waters. In this study, we measured dissolved ON (DON) uptake onto estuarine SPM using 14C-labelled amino acids (AA) as ON proxies. The SPM and AA concentrations used for the incubation experiments were similar to those measured in the estuary. The AA uptake onto the SPM under biotic and abiotic conditions was markedly different. Under abiotic conditions there was little uptake reagardless of the AA used. Under biotic conditions, uptake was rapid (80-90% in 24h), indicating that it was bacterially-controlled; some of the particulate AA was subsequently respired (30-50%). Thus, bacterial uptake of AAs onto SPM was much more rapid and quantitatively important than any other type of physico-chemical binding. However, sorptive preservation may become more significant after particle uptake so that a fraction of the labile N becomes occluded over longer timescales.

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UNVEILING THE GENETIC DIVERSITY OF PICOEUKARYOTES IN A TROPICAL GREAT LAKE

Heterotrophic flagellates, through the grazing of picoplankton, are known as a key link in the carbon transfer to higher trophic levels in aquatic environments (e.g. Massana *et al.*, 2002). This is especially true in Lake Tanganyika, one of the African Great Lakes, where picocyanobacteria represent up to 99% and 80% of total phytoplankton biomass and primary production, respectively (Descy *et al.*, 2005; Stenuite *et al.*, submitted; Stenuite *et al.*, 2007). However, compared to oceans, biodiversity of these eukaryotic microorganisms remains poorly investigated so far in freshwater ecosystems. Here we propose a first study of diversity of picoeukaryotes (0.2 to 5 μm) in a large tropical lake, using DGGE and gene clone libraries on 18S rDNA. As in other freshwater lakes, the microbial food web of Lake Tanganyika might be more complex than expected, considering the diversity of heterotrophic protists and their preys (Lefèvre *et al.*, 2008; Lepère *et al.*, 2008). Eventually, our objective is to contribute to an improved understanding of the food web of a large tropical lake, by addressing the functional diversity of picoeukaryotes, with specific attention to microzooplankton.

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THE DYNAMIC INFLUENCE OF PHYSICAL AND BIOLOGICAL FORCES ON KRILL-SWARM CHARACTERS

Antarctic krill is key to ecosystem function in the Southern Ocean. It is a major prey item of numerous higher predators and a significant component of the carbon cycle. Swarming is a fundamental trait of krill that can contribute to turbulent mixing. Swarm characters such as size, shape and packing concentrations vary enormously. We examined swarms across a large area of the Scotia Sea using a combination of echosounders, Doppler current profilers and net samples to determine the degree to which swarm characteristics were predictable. We found that a significant degree of variability in swarm size could be explained by the physiological state of krill, with the largest swarms being formed by juvenile krill in good body-condition. Local current velocities had a major influence swarm shape, with the swarm-length increasing relative to swarm-thickness in regions where velocities were high. The spacing between individuals within swarms was also greater in high velocity regions. The results reveal that swarm characters are a product of opposing physical and biological forces operating at a number of scales.

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ALPINE LAKES: MOLECULAR STRESS RESPONSE OF ZOOPLANKTON TO SOLAR UV RADIATION

Planktonic organisms living in UV-transparent alpine lakes are exposed to high solar radiation intensities. However, zooplankton have adapted to these harsh environments through strategies that reduce the risk of UV-induced damage. Here, we present results of in situ UV experiments conducted with the copepod Cyclops abyssorum tatricus to assess its molecular stress response. Animals were collected from Gossenköllesee (2417 m a.s.l., Tyrolean Alps, Austria), and exposed to full solar radiation, UV-A and PAR, PAR only, or kept in the dark for 1 to 4 h. UV radiation, PAR, and water temperature were simultaneously monitored. Western immunoblotting was used to quantify the level of constitutive and inducible isoforms of the Hsp70 family of stress proteins. High UV doses increased the Hsp70 levels in adult copepods, but not in nauplii and copepodid life stages. Thus, adult copepods seem to be relatively more UV-sensitive than young life stages, which are well-protected against solar UV radiation by the accumulation of high levels of photoprotective compounds, such as mycosporine-like amino acids and carotenoids.

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ESTIMATION OF OXYGEN CONSUMPTION IN LAKE BIWA, THE LARGEST LAKE IN JAPAN, USING OXYGEN ISOTOPE RATIO OF DISSOLVED OXYGEN

Lake Biwa, the largest lake in Japan, is a warm monomictic lake, where the development of anoxia is a matter of concern recently. In order to study oxygen dynamics in the lake, we have investigated vertical and seasonal variation of the oxygen concentration and its isotope ratio ($\delta^{18}O$) for three years. $\delta^{18}O$ value of dissolved oxygen (DO) is determined by the balance between air-water gas exchange, photosynthesis and respiration. We have measured fractionation factor of respiration (α_R) in water column using bottle incubation technique. Apparent fractionation factor (α) in hypolimnion during stratification period was calculated using the relationship between oxygen concentrations and $\delta^{18}O$ values. Using the α_R and the apparent fractionation factor α, it was suggested that about half of the oxygen consumption in hypolimnion was explained by sediment respiration in Lake Biwa.

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QUEST FOR THE CHEMOAUTOTROPHS DOMINATING THE CARIACO REDOXCLINE: A MULTI-FACETED CAMPAIGN

Chemoautotrophic production (dark 14-CO2 assimilation) across the redoxcline is a significant portion of water column productivity in the permanently anoxic Cariaco Basin. We have assessed the inorganic chemical species supporting this production by examining temporal variations in potential substrate and oxidant throughout the water column and by experimentally altering their concentrations in 14-CO2 incubations. Thiosulfate, elemental sulfur and ammonium all stimulated chemoautotrophy to varying degrees. FISH and T-RFLP surveys characterized diversity and community structure of stimulated and unstimulated assemblages. Epsilon and beta-proteobacteria and Archaea are consistently stimulated by sulfur compounds. Parallel stable isotopic probing (SIP) experiments were employed to identify stimulated ribotypes and diagnostic lipid biomarkers. Most probable number assays with several selective inorganic media were conducted repeatedly across the redoxcline to estimate abundances of the most common ecophysiotypes. Selective enrichment and isolation by dilution to extinction approaches have co-cultivated chemoautotrophs and heterotrophs. Molecular techniques were applied to most promising isolations to identify common ribotypes. Dominant ribotypes in isolation and SIP studies will be used for probe and primer design to assess in situ abundances by FISH and Q-PCR.

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CARBOHYDRATE CYCLING IN SEDIMENT MICROBIAL COMMUNITIES; SEASONAL DYNAMICS IN A TEMPERATE UK ESTUARY.

Little is known about how microbes influence the production and consumption of carbohydrates in estuarine sediments. The aim of this study was to characterise seasonal changes in carbohydrates, microbial composition and extracellular enzyme activity in salt-marsh and mudflat habitats. Samples were taken from the Colne estuary, UK throughout 2007. From the top 2 mm of sediment we measured a variety of biochemical parameters and identified differences in microbial community composition using denaturing gradient gel electrophoresis and pyrosequencing of 16S rRNA genes. There was greater seasonal and spatial variability in the salt marsh compared to the mudflat for all parameters. The salt marsh had much higher biomass than the mudflat and consequently higher levels of carbohydrates, reaching a peak during the summer months. There were distinct microbial communities in each salt-marsh creek and overall salt marsh habitats had greater microbial diversity. Carbohydrates represented around 25 to 40% of the water soluble organic carbon in mudflats and 30-68% in the salt marsh. Carbohydrate concentrations, especially the more complex fractions were positively correlated β-glucosidase activity suggesting that polysaccharides stimulate microbial activity.

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INTACT BACTERIAL HOPANOIDS AS TRACERS OF MICROBIAL CARBON IN POLAR OCEANS

Intact bacteriohopanepolyols (BHPs) are pentacyclic triterpenoids with polyfunctionalized side chains that appear as cell membrane lipids among a variety of prokaryotes, including cyanobacteria, methanotrophs, proteobacteria, and acetic acid bacteria. Resistant to degradation, remnants of these diverse structures can be preserved over geological time scales and have the potential to be ideal tracers of microbial derived organic carbon in aquatic systems. Due to differences in taxonomic expression by the bacteria which synthesize them, intact BHPs are also potential biomarkers of particular bacterial groups and processes. Recent developments in atmospheric pressure chemical ionization liquid chromatography/multi-stage ion trap mass spectrometry (APCI-LC/MSn) now allow the examination of these compounds in far greater detail. In surface sediments and POM collected from the Bering Sea and Western Arctic, we determined the diversity and abundance of intact BHPs and their likely bacterial sources. Potential signatures of cyanobacterial populations, "BHT-pentose" along with its C-2 methylated and unsaturated homologues, were found in Bering Sea samples; whereas the Western Arctic revealed various adenosylhopanes that are likely tracers of bacteria residing in terrestrial organic matter transported to marine sediments.

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UTILIZATION OF AN IN SITU UV FLUOROMETER FOR MONITORING TERRIGENOUS AND ANTHROPOGENIC INPUTS IN THE MEDITERRANEAN COAST

The coastal Mediterranean Sea is subjected to a strong anthropogenic pressure through the discharge of terrigenous materials and pollutants. Discrete measurements are useful but remain insufficient to describe the synoptic extension and the impact of these inputs. Our objective was to test the performances of an in situ UV fluorometer (Ex/Em: 254±25/360±50 nm) for tracking and quantifying the anthropogenic coastal inputs. Our strategy was to performed laboratory calibrations and deployments of the probe in the Bay of Marseille at different contrasted sites (clear stations, harbours, discharge point of waste waters). A significant temporal and spatial variability of the dissolved organic matter fluorescence signal was observed in the Bay of Marseille. We also found that the probe signal, due to its relative large bandwidths, covered the fluorescence signature of several groups of aromatic compounds: polycyclic aromatic hydrocarbons (PAHs), tryptophan-like material and humic substances, but was much more efficient in the quantification of PAHs at the μg level. This study is a part of the Sea Explorer project that aims at developping observation tools for operational oceanography and urban marine zone management.

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DIFFERENTIAL RESPONSE OF BACTERIOPLANKTON POPULATIONS TO INORGANIC AND ORGANIC NUTRIENT INPUTS ALONG A LATITUDINAL TRANSECT IN THE ATLANTIC OCEAN

Bacterioplankton are responsible for a large fraction of the respiration and DOM remineralization in the ocean; therefore, potential changes in their taxonomic composition due to changes in nutrient inputs may have important biogeochemical implications. We studied the effects of inorganic (nitrate, phosphate, silica) and organic (glucose, aminoacids) inputs, added separately as well as jointly, on bacterioplankton community composition in five microcosm experiments along a latitudinal transect in the Atlantic Ocean (26ºN-29ºS). The abundance of important bacterial phylogenetic (Roseobacter, SAR11, Gammaproteobacteria, Bacteroidetes), and cytometric (low, high and very high nucleic acid content) groups was followed using CARD-FISH and flow cytometry. Bacterial response varied depending on the initial microbial community composition. Inorganic additions caused only minor changes in bacterial composition. By contrast, SAR11 and Bacteroidetes responded negatively to organic and mixed additions, whilst Roseobacter and Gammaproteobacteria responded positively. Very high nucleic acid content bacteria were undetectable in the control and the inorganic treatment; however they reached high abundance in the organic and mixed treatments. Our results further suggest that changes in bacterioplankton community structure are related to changes in bacterial carbon use.

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PATTERNS OF ANAEROBIC AMMONIUM OXIDATION ACTIVITY IN TEMPERATE ESTUARINE SEDIMENTS

Anaerobic ammonium oxidation (anammox) and denitrification were measured in intertidal estuarine sediments. A seasonal survey was conducted along three Portuguese estuaries subject to different anthropogenic pressures. Production of $^{29}N_2$ and $^{30}N_2$ was measured in

anaerobic sediment slurries using a combination of ^{15}N-labelled and unlabeled NO_3^-, NO_2^- and NH_4^+ amendments. The different N masses ($^{28}N_2$, $^{29}N_2$ and $^{30}N_2$) were quantified using a membrane inlet mass spectrometer. The production of $^{29}N_2$ in the incubation with $^{15}NH_4^+$ confirmed the presence of anaerobic ammonium oxidation. Anammox activity was widely present and in some sites accounted for more than half of total N_2 production. Higher denitrification rates (up to 30 nmol N g^{-1} h^{-1}) were measured in locations with higher carbon and nitrogen loads. The production of N_2 did not account for all the nitrate consumption suggesting that other pathways, such as dissimilatory nitrate reduction to ammonia, might also serve as an important sink for nitrate in these sediments.

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SEMI-AUTOMATIC PATCH OUTLINES AND COVER CLASSIFICATION FROM MARINE BENTHIC COMMUNITIES

Knowledge on the abundance, spatial distribution, and diversity of species within a community is fundamental to understand ecosystems. The use of modern imaging techniques provides a view of non-destroyed benthic community structure over large spatial and temporal scales. However, there still is a paucity of analytical methods to obtain ecologically relevant data from images. The aim of this research is twofold: first, we introduce a software program to get semi-automatically segmented images (patch outlines) from underwater photographs of rocky benthic communities, where each individual patch is routinely associated to its cover and perimeter; second, we provide a semi-automatically classification of species or cover categories. The process starts with a hierarchical segmentation, using a colour space, texture parameters, and shape criteria adapted to the problem of segmenting complex benthic images (e.g. characterized by high coverage of sponges, cnidarians, bryozoans, and ascidians). As an end product, we obtain an image segmented into classified homogenous regions, which present measures for each part of the segmentation. The development of this semi-automatically outline tool and classification constitute an important step forward in the analysis of the sea-bottom images and represent a powerful technological platform to analyze underwater images (e.g. Mediterranean benthic communities, coral reefs, and Antarctic habitats) at any scale.

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BENTHIC OXYGEN DYNAMICS: COMPARING NEW IN-SITU TECHNOLOGY AND METHODS WITH CLASSICAL MEASUREMENTS

Oxygen is of primary importance to the marine environment. Recent publications indicate that, in terms of oxygen, the marine environment is much more dynamic than previously thought. Continuous in-situ measurements are needed and so are new methods to estimate oxygen consumption/production at the sediment water interface. During recent field work in the Baltic Sea we utilized a new type of fast responding long-term stable optical oxygen sensors (optodes) and advanced current meters to compare recent (eddy correlation) and new (gradient measurements) methods to estimate benthic oxygen consumption with more classical measurements including chamber lander incubations and oxygen consumption calculated from planar optode images. Advantages and inconveniences of the different methods will be discussed as well as the potential of the different methods to carry out long term (years) monitoring of oxygen consumption/production at interfaces.

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IMPACT OF ATMOSPHERIC INPUTS ON THE COMPOSITION AND FLUXES OF SETTLING PARTICULATE MATTER IN THE NORTH-WESTERN MEDITERRANEAN SEA

Atmospheric inputs impact the distribution of the major and trace elements in the water column and the sea surface biological activity, and thus the composition of the particulate matter that settles down. In order to study the role of the atmospheric inputs on particles flux and composition in the column water, two series of samples were used: (1) sediment traps samples of the French S.O. DYFAMED mooring in the NW Mediterranean Sea (42°44'N, 8°31'E, 200 m and 1000 m depth from March 2003 to March 2007) and (2) atmospheric samples collected during the same period at two coastal sites in Corsica and the French Riviera. As expected for a zone continuously submitted to anthropogenic atmospheric inputs and to strong Saharan pulses, the lithogenic fraction was on average the most important component of the sinking material. Extreme dust events come-along with high iron and phosphorus fluxes. Particular attention will be given to events that occurred during the stratified water column period, and their impact on the nutrient-depleted surface layer and on its biological activity reflected by the traps content.

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NUTRIENT INPUT MANAGEMENT, BENTHIC PHOTOSYNTHESIS, AND RESTORATION OF SHALLOW EUTROPHIC COASTAL ECOSYSTEMS

Restoration of many eutrophic coastal ecosystems has been stymied by a widespread tendency for water quality conditions to be relatively non-responsive to watershed nutrient management. The Corsica River estuary is a small, shallow, eutrophic tributary of Chesapeake Bay targeted for focused restoration and "adaptive management." Toward establishing management strategies to reduce nutrient loading and improve water quality and ecosystem processes, we developed an integrated analysis of nutrient fluxes and cycles, physical transport, water quality (nutrients, chlorophyll, turbidity), and ecosystem metabolism. A variety of modeling approaches were used to create a nutrient mass balance, which revealed that nearly half of the nutrient loading was associated with storm runoff which could be mitigated without the time-lags characterizing groundwater fluxes. Quantitative statistical relationships were established between nutrient loading and plankton chlorophyll, and between chlorophyll and both hypoxia intensity and water clarity. Key relationships showed threshold characteristics apparently associated with nutrient and suspended sediment trapping and retention associated with feedback effects from benthic algae and seagrasses. This rapid expansion of benthic plants with relatively small changes in water clarity suggests novel approaches for water quality management.

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PATTERNS IN PHYTOPLANKTON LIFE-FORM SPACE: RING DOUGHNUTS?

Margalef's mandala was a ring drawn on a energy-resource surface showing a sequence from diatoms to red tide dinoflagellates. It inspired the idea of plotting phytoplankton data into a space where the co-ordinate axes are the abundances of lifeforms such as 'pelagic diatoms' and 'medium-sized autotrophic dinoflagellates'. A phytoplankton community index (PCI) was proposed (Tett et al., 2009, ICES J.Mar.Res, 66) as a measure of deviations from a reference envelope drawn around a cloud of points so plotted. Should we expect such clouds to have empty centres - i.e., is there a hole in the phytoplankton doughnut? The paper will use empirical, and mechanistic physical-biological, models of phytoplankton seasonal cycles to argue for the existence of a hole in theory while showing how we might fail to detect one in practice.

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MINUTE-TO-MINUTE RESPONSE BY MICROALGAE TO MULTI-PULSE SEQUENCES OF PHOSPHORUS

Recent understanding of microbial nutrient-biota interaction is mainly due to three over-emphases: (I) describing distinct response patterns to environmental stimuli accomplished by organisms in stationary states of acclimation; (II) implying that environmental stimuli result in changes of species composition/biomass and are hence necessarily linked to cell division/growth, and (III) assuming that environmental resources fluctuating around conventional detection levels and lasting for minutes-hours are of minor impact on ecological processes. Following the conceptual framework that ecological processes are driven by the response of organisms to an actual environment, multi-pulse phosphorus uptake experiments are understood as information processing where information is encoded by phosphorus pulse-sequence pattern and interpretation of information mirrored by kinetic response curves. Results of our experiments with P-deficient cultures (*Emiliania huxleyi*) and bioassays (GAP, Red Sea) describe the transient-adaptive, short-term response to nano-molar pulsing filling the three gaps mentioned before. The dynamic of minute-to-minute and pulse-to-pulse responses is evaluated by conceptually different models: flow-force-relationship by Falkner, empirical first-order kinetics, and modified Michaelis-Menten. Culture experiments are supplemented by nutrient induced fluorescence transient effects (NIFTs) related to time-depended 32P-uptake.

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THE EFFECTS OF CHANGING CLIMATE AND NUTRIENT STATUS ON LAKE COMMUNITY PHENOLOGY

Freshwater lakes are sensitive indicators of climate change, where direct effects of climate on physical processes can affect the seasonal timing of planktonic communities. A number of studies have shown that spring biological events have advanced in recent decades, and concluded that these changes in phenology are driven by climatic change. However, studies of lake communities rarely address the possibility of non-climate drivers of changing phenology. This presentation will explore this under-studied aspect of plankton seasonal timing in lakes. By analysing extensive long-term data on Windermere (UK) and presenting the results of process-based modelling work, we show that the processes behind changing plankton phenology cannot always be attributed solely to long-term climate variation.

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PARASITIC INFECTIONS OF DINOFLAGELLATES IN ARCTIC MARINE WATERS.

Dinoflagellates contribute an important fraction of eukaryote biomass across the Canadian Arctic, and have diverse ecological roles in carbon cycling, cloud formation, trophic linkages to higher food webs and toxic algal bloom formation. Details of species dynamics among dinoflagellates in nature are therefore essential for understanding of basic marine processes. Dinoflagellates are often reported to be infected by parasites, but the extent and consequences of such infections are little studied. *Amoebophrya* , a Group II Marine Alveolate, is one of the major dinoflagellate parasites. We have recovered sequences closely related to *Amoebophrya* from Arctic marine 18S rRNA gene surveys. Microscopic examination of the samples revealed that dinoflagellates with *Amoebophrya* -type infections were also common in some Arctic samples. Initial results showed a vertical segregation of healthy dinoflagellates and infected dinoflagellates in the strongly stratified waters of the Canadian Arctic, with implications for the epidemiology of infection.

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PROBING THE MOLECULAR MECHANISM OF PROGRAMMED CELL DEATH IN THE DIATOM, *THALASSIOSIRA PSEUDONANA* USING WHOLE-GENOME MICROARRAY ANALYSIS

Programmed cell death (PCD) is a genetically controlled form of cell suicide initiated by a wide variety of environmental stimuli. As shown recently, the diatom *Thalassiosira pseudonana*, exhibits the morphological, biochemical, and molecular hallmarks of PCD in response to iron starvation. Six metacaspases, putative executioners of PCD, were identified, with expression of some coordinate with physiological stress and caspase activity. To identify additional genes involved in the execution and regulation of PCD, healthy and stressed cultures of *T. pseudonana* were subjected to whole-genome microarray analysis. A total of 632 genes were up-regulated at least 2 fold in Fe-starved cultures compared to replete, concurrent with the highest level of caspase activity. Although many were Fe-stress response genes, a few notable genes potentially involved in PCD were identified. Genes up-regulated include metacaspase 6 (2.4 fold), two death-specific proteins (DSP1 and DSP2; 2.8 and 8.7 fold, respectively), and the autocatalytic enzyme LrgB (3.2 fold). A putative inhibitor of PCD was down-regulated 12 fold. These data will hopefully provide a framework for understanding the molecular mechanism of PCD in unicellular organisms.

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WHO DOES WHAT – AND WHY SO – IN OXYGEN-DEFICIENT WATER COLUMNS?

Oxygen-deficient water columns and their interfaces with oxygenated waters are important components of several aquatic ecosystems, ideal environments for studying microbially-dominated communities, and – with their associated biogeochemistry – models of ancient oceans, which were dominated by anoxia through most of Earth's history. This presentation provides an overview of important advances and open questions in our understanding of community structure and biogeochemical cycles in pelagic redoxclines. One example is the discovery that two different microbial processes contribute to the conversion of fixed nitrogen to nitrogen gas: denitrification and anammox. Incubation-based studies of oxygen minimum zones and anoxic basins and fjords show a complementary distribution of the two processes with denitrification dominating at sulfidic interfaces while anammox prevails under oxygen-depleted, sulfide-free conditions (i.e. "anoxic" and "suboxic" conditions, respectively). In these studies, denitrification is primarily coupled to sulfide oxidation while sulfide may inhibit anammox. The suboxic dominance of anammox is more enigmatic, and potential explanations include differential oxygen sensitivity, spatio-temporal heterogeneity, tight coupling of microbial metabolisms, and unrecognized organotrophic pathways. These issues all have general relevance for understanding the geomicrobiology of oxygen-deficient waters.

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STRUCTURE OF THE PELAGIC ECOSYSTEM IN THE UPPER LAYER OF THE ARCTIC OCEAN DURING THE DRIFT OF THE TARA 2007-2008

Since the mid 90's, the pelagic ecosystem of the Arctic Ocean, although being still considered as oligotrophic, shows stocks and production of several trophic levels higher than previously observed. Yet, numbers of data collected in this particularly hard to study environment but nevertheless very important system, remain low. During the 4th Polar Year, in addition to the DAMOCLES program, a study of the pelagic ecosystem of the Arctic Ocean was undertaken during the drift of the Schooner Tara from spring 2007 to late winter 2008. In order to understand vertical and horizontal distributions of nutrients (nitrate, nitrite, phosphate and silicate), phytoplankton, microzooplankton and mesozooplankton, weekly samples were collected in the upper layer (bottle collections at 3, 10, 30, 60, 100, and 300m, 60-0m phytoplankton net tow and 200-0m zooplankton net tow). This expedition gathered new information on the functioning and the biodiversity of this system in spring and summer but also in winter when data are even scarcer. This allows us to present new insights into the possible future of this polar region

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REGRESSION OF THE CYSTOSEIRA POPULATIONS IN THE MEDITERRANEAN SEA – THE CASE OF THE FRENCH COAST

In the Mediterranean Sea, species from the genus Cystoseira (Fucales, Sargassaceae) are structuring the rocky habitats in three dimensions, hosting under their canopies a high biodiversity. The genus is much diversified in the Mediterranean Sea, with 28 species (20 are endemic) and 40 infraspecific taxa, present from the sea level to 60 m depth. Many authors are reporting a decline of these species in many parts of the Mediterranean Sea. We analysed the cause of this regression in all the Mediterranean and we focused on the continental French coast where populations have been monitored in 2007-2008. We focused on rock pools and eulittoral populations. Results have been analysed by comparing the actual situation to historical data. The diversity of Cystoseira species remains high with 15 taxa recorded. It appears that habitat destruction and overgrazing by herbivores are the main cause of massive regression for shallow waters species and that rock pools acts as a refuge for 10 stenoecious species. Mussel farming is reponsible for the decline of C. amentacea var. stricta and C. mediterranea.

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ACCUMULATION OF METALS IN THE AQUATIC MACROPHYTES ELODEA CANADENSIS AND ELODEA NUTTALLII. IMPLICATION ON PLANT-MACROINVERTEBRATES INTERACTIONS

Laboratoire des Interactions Ecotoxicologie, Biodiversite Ecosystemes, Universite Paul Verlaine - Metz, CNRS UMR 7146, Avenue General Delestraint, F-57070 METZ France. * Corresponding author. Tel.: +33 3 87 37 84 24; fax: +33 3 87 37 84 23. E-mail address: <mailto:thiebaut@univ-metz.fr>thiebaut@univ-metz.fr. Elodea nuttallii and Elodea canadensis colonized numerous water bodies in the North-East of France. Our goals were 1) firstly to analyze the metal content in plants, sediment and water of four polluted sites, and 2) to analyse the impact on metal bioaccumulation on plant-macroinvertebrates interactions. Concentrations of Cd, Cr, Cu, Mn, Ni, Pb, Zn and Fe and S were measured in water, river bottom sediments and into the two species in spring, summer and autumn 2006. The first results showed that metal accumulation varied according to site, species, metal and season. The studied species were highly efficient in the metal uptake. The performance of E. canadensis was higher. No significant season effect was established for plants and sediments. Significant correlations between concentrations of Mn, Fe and Cu in river bottom sediments and plants prove the ability of Elodea species to accumulate metals. Our results suggest that high metal accumulation ability of Elodea species could have an impact on their palatability in polluted sites.

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THE MEDITERRANEAN AS A LABORATORY FOR THE STUDY OF MICROBIAL P-CYCLING.

The Mediterranean is not only a region with a west-to-east eutrophy-oligotrophy gradient, but also a system where N:P-ratio in deep waters as well as physiological indicators in the upper layer strongly suggest P-deficiency. Although the mechanisms forcing this system away from Redfield stoichiometry is still under debate, the result is a natural laboratory allowing for exploration of the biological and ecological consequences of oligotrophy and P-deficiency. Investigations and ideas on properties of the microbial food web in this ecosystem, most of them developed in cooperation with Prof. Rassoulzadegan, are reviewed.

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COUNTERINTUITIVE CARBON-TO-NUTRIENT COUPLING IN AN ARCTIC PELAGIC ECOSYSTEM

Predicting the ocean's role in the global carbon cycle requires an understanding of the stoichiometric coupling between carbon and growth-limiting elements in biogeochemical processes. A recent addition to such knowledge is that the carbon/nitrogen ratio of inorganic consumption and release of dissolved organic matter may increase in a high-

CO2 world. This will, however, yield a negative feedback on atmospheric CO2 only if the extra organic material escapes mineralization within the photic zone. Here we show, in the context of an Arctic pelagic ecosystem, how the fate and effects of added degradable organic carbon depend critically on the state of the microbial food web. When bacterial growth rate was limited by mineral nutrients, extra organic carbon accumulated in the system. When bacteria were limited by organic carbon, however, addition of labile dissolved organic carbon reduced phytoplankton biomass and activity and also the rate at which total organic carbon accumulated, explained as the result of stimulated bacterial competition for mineral nutrients. This counterintuitive 'more organic carbon gives less organic carbon' effect was particularly pronounced in diatom-dominated systems where the carbon/mineral nutrient ratio in phytoplankton production was high.

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TEMPORAL AND SPATIAL FLUCTUATIONS IN ENVIRONMENTAL PARAMETERS DRIVE NUTRIENT UPTAKE ACROSS SCALES OF ORGANIZATION

Temporal fluctuations in nutrient concentration and hydrodynamic conditions create a complex response space driving community properties such as chemical exchange. We have used natural seagrass aggregations in situ to explore the interaction of turbulence and nutrient uptake for spatial scales ranging from individuals to systems. We have learned that uptake of ammonium by the whole community is a function of the time average mean of flow speed in the water column above the canopy while uptake rates of individual components of the community are best described by measures of turbulence within the canopy averaged over the height of the individual. Taking this information along with that for temporal fluctuations in nutrient concentration and hydrodynamic conditions (bulk flow speed, spatially averaged turbulence) across a seagrass ecosystem, we predict how ammonium uptake rates within a seagrass bed change over time and space. Results indicate that uptake of nutrients by seagrass communities are impacted by both fluctuations in current and nutrient concentration and that the distribution of uptake among members of these complex communities fluctuates on scales of seconds to hours.

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QUANTIFYING NITROGEN CYCLING AND FOODWEB STRUCTURE IN A TROPICAL STREAM

Few studies have used 15N tracer approaches to quantify N cycling in tropical streams. We are currently conducting isotope tracer studies (15N) to evaluate the ecosystem effects of light alteration, species addition (guppies), and the rapid evolution of life history traits. Here we report results from our pre-manipulation experiments in 2 adjacent streams. Spatially explicit sampling and modeling were used to quantify ammonium uptake kinetics, and N flux into algal and microbial assemblages. Uptake length (18m and 23m), uptake velocity and gross areal uptake rate were similar between streams. Longitudinal patterns in 15N nitrate were modeled to estimate nitrification rate and nitrate uptake kinetics. The isotope label was detected in all primary uptake compartments, several invertebrate taxa and Rivulus. We are currently using a donor-controlled modeling approach to estimate N flux between food resources, invertebrate consumers and Rivulus hartii. Results from the first year of this project indicate that our experimental streams operate much like their temperate counterparts with respect to N cycling rates and fate within the stream food web.

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IMPACT OF SALINITY CHANGES IN COPEPODS

During future climate changes the short time scale variability of salinity is likely to increase in coastal and esturaine waters due to increased terrestrial run-off. This may entail severe implications to al species in these environments and may ultimately inflict changes in habitat and geografical distribution of species. We assessed the potential salinity acclimatisation and resilience towards abrupt shifts in salinity in two closely related copepod species, Acartia tonsa and A. clausi. For A. tonsa, the energy partitioning between ingestion, production and respiration was relatively constant when acclimated to a wide range of salinities. Contrary, A. clausi exhibited significantly reduced ingestion and growth and highly elevated metabolic costs of growth at salinities = 20. Moreover, A. tonsa showed much higher resilience towards abrupt salinity changes than A. clausi. Mortalities was significantly lower in A. tonsa than in A. clausi when shifted between high and low salinities. Moreover, clearance rates declined only by 5% in A. tonsa subjected to a decrease from 32 to 4 PSU but decreased by 20% in A. clausi subjected to a decrease from 32 to 14 PSU. These results contribute to the prediction of future distribution patterns of both species along salinity gradients. Observed responses would allow the dominance by A. tonsa at low salinities, although higher energetic requirement and feeding activity may subject it to stronger predation pressure than competing A. clausi.

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CHEMOTAXIS IN STEEP CHEMICAL GRADIENTS

Classical results state that when organisms perform chemotaxis, their concentration can be approximated with an advection-diffusion equation. These results assume that the chemical gradients are weak, so that the advective flux is proportional to the chemical gradient. However, many ecologically important interactions are characterized by steep gradients which are localized in time and space. In particular, this study was motivated by an application to bacteria attracted to marine snow where gradients are so steep that the linear approximation becomes useless. Using the theory of stochastic processes rather than that of partial differential equations, we derived a new advection-diffusion equation which is valid for steep gradients. Here, the advective flux is a nonlinear saturating function of the chemical gradient and the dispersal is anisotropic. We investigate the robustness of the approximation and, using Monte Carlo simulation as well as time-scale comparisons, we discuss the validity of the diffusion approximation. Finally we discuss the applicability of the result in greater generality.

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EXPLAINING THE INTRIGUING CORRELATION BETWEEN CARBON AND NITROGEN STABLE ISOTOPE VALUES IN LAKE CHIRONOMID LARVAE

Biogenic methane has a low carbon stable isotope value, serving as a natural tracer for methane-based food chains. Highly variable $\delta^{13}C$ values (between -35‰ and -65‰) and strongly correlated $\delta^{13}C$ and $\delta^{15}N$ values are commonly reported, but hitherto unexplained characteristics of lake profundal chironomid larvae. To explore possible reasons for these intriguing reports, 16S rRNA genes and fatty acids were profiled from the guts of chironomid larvae with high and low $\delta^{13}C$ values. The stable isotope values of possible carbon and nitrogen sources for bacteria were also analyzed and stable isotope fractionation by methane-oxidizing organisms was measured. The results showed that, although the gut microbiota mostly consisted of anaerobic Gram-positive bacteria, the particularly low carbon and nitrogen stable isotope values were assigned to the biomarkers of two *Methylobacter*-related gammaproteobacterial methanotrophs. Their specialization on nitrate as their major nitrogen source could explain the correlated nitrogen and carbon δ values, since use of ammonium as a nitrogen source should lead to 15-20‰ higher $\delta^{15}N$ values than use of nitrate.

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INTERACTIONS BETWEEN JELLYFISH AND FISH LARVAE IN NW MEDITERRANEAN SEA: A BIOMARKERS STUDY

In the Mediterranean Sea Pelagia noctiluca, Rhizostoma pulmo, Cotylorhiza tuberculata, Chrysaora hysoscella and Aurelia aurita are some of the most abundant Scyphomedusae species. They are known to be both predator and prey of fish larvae and adult fish respectively. Besides, abundance of these jellyfish species has increased in the NW Mediterranean Sea last decades and its impacts on marine ecosystem may be very strong. This work tries to elucidate the interaction between these jellyfish species and fish larvae analyzing different biomarkers. The fatty acids composition and stable isotopes (carbon and nitrogen) signatures had shown to be a very good tool for the study of marine trophic webs. Moreover, the combination of both kinds of biomarkers makes the energy flow measure among trophic steps even more precise. During the summer 2008 samples of different Shyphomedusae species and fish larvae were collected along the Catalan coast and biomarkers measurements were done. The preliminary results show that different jellyfish species may have a different impact on fish larvae populations.

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RELATIVE IMPORTANCE OF NUTRIENT INPUTS FROM STREAMS AND THE SEA ENTRANCE FOR PHYTOPLANKTON DYNAMICS IN A SHALLOW ESTUARY –INSIGHTS FROM 3D MODEL SIMULATIONS

Danish estuaries are highly eutrophic due to high N and P inputs from local streams and a general increase in nutrient concentrations in the Baltic Sea region. Recovery plans have been implemented to reduce local loadings. A key issue for these plans is the relative importance of local sources of nutrients versus influx over the sea entrance. In order to resolve the question we have developed a coupled 3D hydrodynamic-ecological model for Horsens fjord which is a typical shallow and well ventilated Danish estuary. A numerical nutrient tracking technique was applied which allowed us to calculate the relative contribution to phytoplankton growth from nutrients originating from local sources and from the Baltic Sea outflow, respectively, which constituted the open boundary. Nutrient reduction scenarios were performed to asses the potential effects of reducing nutrient loadings from different sources (streams and open sea inputs) on phytoplankton growth and biomass. Model simulations revealed that local streams accounted for about 40% of the phytoplankton nitrogen content and that changes in local discharges and open sea nutrient concentrations almost had similar impact on phytoplankton biomass.

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ORGANIC CARBON TRANSFER RATES AND VARIABILITY AT DIFFERENT TIME-SCALES IN THE GULLMARSFJORD PLANKTONIC SYSTEM, SWEDEN

We compared selected transfer rates within the plankton of a temperate fjord estuary at seasonal, diel and spring bloom scales of variability by combined field observations and laboratory experiments. Field observations included chlorophyll levels, plankton abundance and downward fluxes from sediment traps. Biological rates included microzooplankton grazing, copepod gut fluorescence, pellet production and egg production rates. Strong seasonality induced ample variability in abundance of components and their biological rates; e.g. maximum copepod feeding (up to 1.2 ng pigment µg body C-1 and 84 pellets ind-1 d-1) and production (up to 148 eggs ind-1 d-1) occurred in late spring and autumn. Maximum sedimentation rates (ca. 500 mg C m-2 d-1) occurred in early summer coincident with highest chlorophyll levels in the water column. Interestingly, diverse biological responses showed important and usually synchronized variability also at shorter time-scales, suggesting that moderate changes in resource availability or quality may play a significant role in modulating organic carbon transfers.

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SMELLY JELLIES: AVOIDANCE RESPONSE OF THE CTENOPHORE MNEMIOPSIS TO CHEMICAL CUES FROM A PREDATORY CTENOPHORE

Ctenophores are common prey to other jellies, including other ctenophores, but the sensory and behavioral interactions involved in predator-prey contacts are not well elucidated. We examined the behavioral response of Mnemiopsis leidyi to chemical cues from the predatory ctenophore Beroe ovata in an experimental setup where Mnemiopsis were freely swimming around in an aquarium with a trapped Beroe. Preliminary results indicate that Mnemiopsis responded to the predator info chemicals by altering their motility and by descending in the aquaria, presumably to limit predator encounter. Such escape behavior may contribute to explaining published records of diel vertical migration, and stratified and near bottom distributions of Mnemiopsis in the field.

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QUANTITATIVE RELATIONSHIPS BETWEEN BACTERIA AND ALGAE WITH DIFFERENT PHOSPHORUS REQUIREMENTS AND ORGANIC CARBON EXUDATION: CHEMOSTAT EXPERIMENTS AND MODELING

Algae lose photosynthetically produced organic carbon by exudation. The exudates stimulate bacteria biomass production and phosphorus incorporation, leading to a negative feedback on algal growth. In chemostat experiments, heterotrophic bacteria were supplied with glucose and grown together either with an obligate phototrophic alga (PA) or with an osmo-mixotrophic alga, capable of assimilating external glucose (OA). We modified the availability of phosphorus or the light supply. While bacteria biomass responded positively if PA increased, bacteria remained low if OA increased. Model simulations and additional experiments revealed that the different numerical response of bacteria was based on lower exudation rates of OA compared to PA, but not on osmotrophic activity. Osmotrophy of OA may be considered as a mechanism to recycle organic exudates from near the cell-surface, limiting exudation losses. Although PA supported higher bacteria biomass, the biomass of PA was not reduced due to six times lower phosphorus cell concentrations of PA compared to OA. The results also indicate that bacteria sequestered less phosphorus per unit carbon when cultured together with PA and thereby received a positive feedback by enhanced exudation.

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THE LAKES NYOS AND MONOUN DEGASSING PROJECT: "THE PRESENT SITUATION IS TOTALLY SAFE" – A TWENTY YEARS ENDEAVOUR FOR CONTROLLED DEGASSING ON THE "KILLER LAKES"

For more than twenty years, a French dedicated team of scientists has carried out the many-sided project to enhance the safety in the surroundings of two gas-laden crater lakes in Cameroon. The project which is made up of humanitarian, scientific and technical components, is on the verge of reaching its final stage: the controlled withdrawal of carbon dioxide from both lakes, thus eradicating the risk of another gas burst from these lakes. At Monoun, 3 degassing columns were implemented (one in 2003, two in 2006). Practically all the dissolved gas amount has been removed and the system is now in a steady state equilibrium between the recharge and the degassed rate. At Nyos, the column installed in 2001 is still in function and resulted in a significant decrease of the remaining gas (the fountain which was 50 m high decrease now to 30 m). Two additionnal columns will be implemented next year, with a removal gas capacity being increased by a factor 8. This paper describes scientific and technical issues of the overall project and presents the first data bearing to the response of some limnological key parameters to the ongoing degassing process.

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ECOSYSTEM PROCESS HETEROGENEITY ACROSS AQUATIC-TERRESTRIAL GRADIENTS

Temporary rivers are dynamically linked aquatic-terrestrial ecosystems. There, ecosystem processes are supposed to strongly depend on resource availability, in particular on water, organic matter, and nutrients. Based on recent research across a Tagliamento river-floodplain complex in NE Italy, we compared various ecosystem processes, namely production, respiration, and decomposition of organic matter as well as leaching of nutrients, across wet-dry gradients. For example, soil respiration exhibited a high spatiotemporal heterogeneity mainly as a consequence of the patchy distribution of organic matter and temperature. However, decomposition rates were controlled by the inundation regime. Factors reducing the duration of inundation may decelerate breakdown rates, whereas a decrease in flow variation may even breakdown heterogeneity. While vegetated islands are highly productive landscape elements, aquatic habitats exhibit a much higher decomposition capacity for coarse particulate organic matter than adjacent terrestrial habitats. Therefore, linking habitats that differ in their capacity to produce, store, and transform organic matter and nutrients may increase the overall functional performance of the entire ecosystem. Finally, the relative extent and the spatiotemporal dynamics of dry and wet areas within a catchment may control greatly the capacity of the river network to efficiently retain nutrients and organic matter.

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THE EFFECTS OF NUTRIENT AND GRAZING CONDITIONS ON THE TRANSFER OF CARBON FROM PHYTOPLANKTON TO BACTERIA: A ^{13}C-LIPID BIOMARKER STUDY.

A ^{13}C tracer experimental field study was carried out in the Mediterranean coastal lagoon of Thau (South of France) to trace the transfer of carbon from phytoplankton to bacteria in low nutrient surface waters of Thau lagoon (LAG). The natural communities were also confined in two mesocosms. One mesocosm was initially enriched with nitrate and phosphate (NP treatment) and a second mesocosm was subjected to the same enrichments together with a 10-fold seawater dilution reducing grazing pressure (NPdil treatment). The incorporation of ^{13}C in phytoplankton and bacterial biomarkers was monitored over a 2-day period by carbon isotope analysis on lipid biomarkers on one occasion in LAG and 6 days after the beginning of the mesocosm experiment (NP & NPdil Treatments). The reduction of grazing pressure under enriched nutrient conditions led to a very intense primary productivity and strongly affected the relative species composition of the phytoplankton community with a rapid ^{13}C transfer from algae to bacteria. The degree of C-coupling estimated through the use of ^{13}C-lipids will be discussed together with the diversity and biomass of bacteria and phytoplankton community.

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CARNIVOROUS ZOOPLANKTON – THEIR ROLE IN PELAGIC FOOD WEBS

The relative importance of different components of the zooplankton community as agents of predation is not well investigated. Carnivorous zooplankton may have a substantial impact on prey communities and selective predation by zooplankton may influence the trophic structure of pelagic food webs. Therefore, this presentation will focus on how carnivorous zooplankton function in the pelagic food web and their role in structuring the pelagic community. I will talk about chaetognaths and predatory copepods, which co-occur in several systems and feed on similar prey, and present results from several different studies in temperate and arctic systems. In all studies, the feeding by *Pareuchaeta norvegica* was assessed by measuring egestion of faecal pellets and the chaetognaths were analysed for gut contents. Simultaneously, prey composition, prey production and vertical distribution were determined. Numbers of prey per chaetognath for the chaetognaths were among the highest values reported and they showed selectivity in their feeding behaviour. Predation impacts from the two groups were high, over 100% of the prey production. In the past, this impact has been underestimated in planktonic energy budgets.

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SULFUR CYCLING IN THE SARGASSO SEA – A TIME-SERIES REVISITED

To understand what drives seasonal variability in marine dimethylsulfide (DMS) and dimethylsulfoniopropionate (DMSP) at the Bermuda Atlantic Time-Series Study site we conducted once monthly vertical profiles of DMS and particulate and dissolved DMSP concentrations, as well as biotic and abiotic turnover rates, commencing in September 2005. The inclusion of rate measurements has allowed for a much deeper understanding of the forcing mechanisms and suggests that some of our currently held views may need to be altered. In particular, DMSPp peaks concurrently to the DMS summertime maxima suggesting a clear source. Additionally, all concentrations are poorly correlated to available biomass indicators, including HPLC pigment biomass, suggesting that phytoplankton succession does not play a dominant role. There are clear seasonal cycles in DMS consumption processes while measured microbial DMS production processes vary within a narrow range but display no seasonality. Modeled net DMS production rates are extremely large and peak in the summer confirming that they are also affected by the physical dynamics of the surface mixed layer and by meteorological forcing such as total solar radiation, UV radiation, and wind speed.

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NUTRIENT AND CARBON COMPETITION BETWEEN BACTERIA AND PHYTOPLANKTON IN THE ARCTIC SEA

The bacterial diversity in the Arctic Sea was determined by denaturing gradient gel elechtrophoresis (DGGE) in a mesocosm experiment in Ny Ålesund / Svalbard (79° N). The objective of the mesocosm experiment was to investigate the bacteria's ability to compete with the phytoplankton community for available mineral nutrients and organic carbon. A series of mesocosms with arctic sea water was manipulated with nutrients (phosphorus, nitrogen, silicate and carbon) to produce different competition situations between bacteria and phytoplankton. Changes in the bacterial community were followed by DGGE and sequencing of the 16S rDNA. By adding only mineral nutrients (N and P) a flagellate bloom was triggered whereas the silicate promoted a diatom bloom. The heterotrophic bacteria were stimulated by the addition of the glucose as well as by the organic matter released by the phytoplankton. Our results show that the phytoplankton community dominated by diatoms and flagellates respectively, affect the bacterial community differently. Independent from supplemental glucose, much higher bacteria numbers could be detected in diatom dominated treatments compared to treatments dominated by flagellates.

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LOST IN MIGRATION: LACK OF CORRELATION BETWEEN GEOMAGNETIC ANOMALIES AND CETACEAN STRANDINGS IN THE CARIBBEAN

Whether cetacean strandings can be attributed, at least in part, to coastal geomagnetic anomalies has been a source of controversy for many years. Differences in geologies of the studied areas have been accounted for the ambiguous results. To test this hypothesis we analyzed all available cetacean stranding data for the Caribbean (n = 286). We tested this hypothesis using two approaches: (1) matching locations of strandings events versus the presence or absence of geomagnetic anomalies and (2) matching areas of geomagnetic anomalies versus the occurrence or not of cetacean strandings for those localities. In neither case we found any correlation between anomalies and stranding events. However, the availability of stranding data is highly dependant on geography given that certain areas have been more studied than others. We suggest that the development of local scientific research is a major factor for these kinds of meta-analyses. We propose the creation of area-based databases for regions like these so data is easily available and encourages further research.

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DINAMYC OF SULFATE REDUCING BACTERIA AND METHANOGENIC ARCHAEA IN TWO TROPICAL COASTAL LAGOONS IN MEXICO

The goal of this work was to evaluate the temporal dynamics of sulfate reducing bacteria (SRB) and methanogenic archaea (MA) in the sediments of two coastal lagoons located in the Mexican Pacific (Chiapas State). Sediment samples were collected in the dry (June 2003, February, and May 2004) and wet (October, and November 2003, July 2004) seasons. The MPN method was used for selective enumeration of SRB, and MA with different substrates. Acetate competition was evaluated, with and without sulfates in the medium. To determine the differences in composition of the two microbial groups PCR-RFLP analyses were utilized. The SRB were the dominant group in dry season (10^8-10^{10} cells/g sediment). MA density was higher in months associated to the rainy season (10^7-10^8 cells/g sediment). The distinct seasonal shift in SRB and MA abundance was correlated with modifications in salinity, sulfate, and organic carbon concentrations. The specific activity with acetate was higher with sulfates in the medium, therefore the sulfate reduction was the most important process. PCR-RFLP analyses revealed temporal changes in the composition of both microbial communities.

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PLANKTON FOOD WEB OF ARCACHON BAY (FRANCE): A COMPLEX SYSTEM, RESISTANT BUT POORLY RESILIENT

The structure and functioning of the plankton food web of Arcachon Bay, a coastal lagoon whose study was motivated by its strong ecological (largest Zostera noltii seagrass bed of Europe) and economical (oyster culture) value, was described by a daily static carbon flux model during spring 2005, using Inverse Analysis. Some flows were measured in situ: (i) the net primary production rates of micro, nano and picophytoplankton, (ii) import and export of DOC, (iii) grazing rates of heterotrophic nanoflagellate and ciliate by micro and mesozooplankton. The main characteristic of this ecosystem is the dominance of autochtonous phytoplankton (dominated by microphytoplankton) as a carbon source compared to detritic allochtonous river inputs. The energy transfer by the microbial loop to the top consumers is low. Network analysis indices were calculated on the estimated fluxes and compared to several ecosystems from literature. The low recycling index and relative redundancy and the high internal relative ascendency describe a complex system, which can be considered as resistant, but poorly resilient to stress conditions.

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CONCENTRATIONS OF ANTHROPOGENIC CO2 AND LEVELS OF ACIDIFICATION IN THE WESTERN MEDITERRANEAN SEA.

The Mediterranean Sea ecosystems suffer from a very intense anthropogenic pressure that strongly affects most biogeochemical cycles. During the last century, the impact on the carbon cycle and especially on the carbonate system has been poorly understood given the scarce data available for total alkalinity (AT), total dissolved inorganic (CT), and/or pH. Since almost a decade however, several national and international programs were designed to increase the amount of high quality data in the region. Using profiles of measurements acquired during a SESAME 2009 cruise in the western basin of the Mediterranean Sea, we first describe the distributions for CT and AT. Using the recent TrOCA approach, we estimate the concentration of anthropogenic CO2 (Cant) accumulated since the pre-industrial era, from which the level of acidification can be also quantified. One of the main conclusions is that all waters (even the deepest ones) are contaminated by Cant. All water masses characterized on the sections are acidified but at different levels depending on their origin and history.

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NATURAL HABITAT OF POLYPS OF AURELIA SP. IN MIKAWA BAY, JAPAN

We surveyed Mikawa Bay, the most eutrophicated bay in Japan to find natural habitats of Aurelia sp. polyps. First, we searched for ephyra larvae by plankton-net around the bay. We found that ephyrae was most abundant on the coast of the two small islands located near the mouth of the bay. Next, we searched under floating piers of one of the island and found dense colony of Aurelian polyps under nearly all the floating piers of the island.

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DISSOLVED ORGANIC CARBON (DOC) ACCUMULATION IN NORTH-WESTERN MEDITERRANEAN SEA: BACTERIAL ROLE

In order to understand the process involved in DOC accumulation in Villefranche Bay occurring during summer stratification period, we examined during 16 months study (April 2005-July 2006) the seasonal DOC concentration changes in relation to microbial abundance and bacterial activity. Our results showed significant correlation between DOC concentrations and bacterial abundance that were controlled by the effect of predation (ciliates) and the viral lyses. In our study and during the dominance period of the predation pressure and the viral abundance, we found direct linkage to the low carbon assimilation and the low bacterial production and growth efficiency. The experimental approach investigating the phosphorus additions on bacterial responses in different seasonal experiment showed that this addition occurring during summer stratification period, enhanced, up to 10 fold the DOC consumption rates and the bacterial production in comparison to the control. This last finding, in addition to the predation effect on bacterial production and growth, were enough evidence to confirm the hypothesis of the 'microbial loop malfunctioning'. This hypothesis was suggested to explain the DOC accumulation observed during the summer stratification period that was a direct consequence of the phosphorus limitation and the predation effect on bacteria.

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DEGRADATION OF DOC IN LAKES AT DIFFERENT TIME SCALES – BRIDGING FROM SHORT-TERM EXPERIMENTS TO THE ECOSYSTEM SCALE

Dissolved and colloidal organic carbon (DOC) smaller than bacteria is generally the largest pool of reduced organic carbon in water, typically constituting roughly tenfold more organic carbon than all organisms and other larger particles together. Numerous experimental studies have been performed focusing on the degradation of DOC at relatively short time scales (days to weeks). In parallel there is a growing interest in the longer-term fate of DOC, considering its significant role in the carbon cycle even at the global scale, but a lack of studies bridging experimental insights into DOC dynamics with field observations and large scale cycling. We present an experiment on the degradation of DOC from different lakes in confined batches at an annual scale. We found a positive correlation between the concentration of terrestrial DOC in lakes and the rate of degradation. The stimulating effect of inorganic nutrients on degradation of DOC was higher in lakes with high concentrations of DOC. Priming of degradation of recalcitrant DOC by labile organic substrates was at most weak.

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WHAT HAVE WE LEARNED FROM TEN YEARS OF NUTRIENT INVESTIGATIONS IN THE WESTERN ARCTIC?

Primary producers at the base of the food web rely on two resources that are highly seasonal in the upper Arctic Ocean: nutrients and light. Their relative importance in controlling short-term and annual rates of primary production in seasonally ice-free regions is not well understood and needs to be addressed in the present context of rapid climate change. Here we discuss how nutrient loading can be affected by changes in (1) the freshwater balance (2) horizontal circulation and (3) the "rules of engagement" between the atmosphere and the water column. Examples are drawn from the large nutrient database obtained during the International North Water Polynya Program, two overwintering expeditions in the Southeast Beaufort Sea (Canadian Arctic Shelf Exchange Study and the IPY/Circumpolar Flaw Lead System Study) and annual ArcticNet surveys. Data gathered during summer and autumn are compared with winter baselines to assess the relative importance of initial conditions at the onset of the growth season, subsequent nutrient renewal and a protracted ice-free season on cumulative new production. This analysis highlights the relatively unproductive character of the Beaufort Sea under "average" conditions, but shows how local forcing events and the passage of remotely-generated oceanic singularities during autumn or winter set the stage for productive episodes.

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BACTERIAL COMMUNITY ASSOCIATED WITH TISSUE AND SKELETON OF THREE SCLERACTINIAN CORAL SPECIES: GALAXEA FASCICULARIS, PAVONA CACTUS AND TURBINARIA RENIFORMIS

Corals have been involved in a close relationship with bacterial communities. However, the variation of the bacterial composition among coral species is misunderstood. In this study, corals were incubated together in the same environment and bacterial diversity was compared among tissue and skeleton of three scleractinian coral species *Galaxea fascicularis*, *Pavona cactus* and *Turbinaria reniformis* using denaturing gradient gel electrophoresis on nested PCR amplified fragments of the 16S rRNA gene. The main question was to assess if the bacterial community composition in corals was species-specific and if the amount and composition of coral mucus could explain this diversity. Cluster analyses showed that the bacterial community in the coral tissues was species-specific, conversely to the community associated to the skeleton. Mucus excretion rate was significantly different for the three species, with the highest rate for *G. fascicularis*. The mucus of *G. fascicularis* and *P. cactus* mainly contained galactose and glucose compared to the mucus of *T. reniformis*, that contained glucose and xylose. The highest bacterial richness was found in the tissue of *G. fascicularis*, which also presented the highest rate of mucus excretion, leading to the hypothesis that the difference in the amount and composition of mucus can partly explain the differences observed in bacterial composition within the coral tissue.

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IRON AND TEMPERATURE EFFECTS ON PHOTOSYNTHETIC AND PHOTOPROTECTIVE PIGMENTS IN *STYLOPHORA PISTILLATA* ZOOXANTHELLAE

The mass bleaching of reef-building corals under elevated sea surface temperatures and intense sunlight initiate as sharp decreases in photosynthetic efficiency of the symbiotic zooxanthellae. Decreased photosynthetic efficiencies in pelagic phytoplankton can be related to iron limitation, but this effect has not been tested in corals. We show that reducing iron availability to *Stylophora pistillata* colonies at 27°C by addition of the siderophore desferrioximine B yields decreased cellular concentrations of photosynthetic pigments (chlorophyll a, c2, peridinin, protein complexes) in their freshly isolated zooxanthellae (FIZ). Colonies maintained under moderate heat stress (31°C) yield similar pigment concentrations with or without iron limitation. Decreased iron availability also affected diatoxanthin (DT)–diadinoxanthin (DD) balance, a photo-protective mechanism that limits over-reduction of PSII by increasing non-photochemical quenching. Under higher temperature and reduced iron availability, the DT/(DD + DT) ratio in FIZ increased 3-fold relative to lower temperature conditions, regardless of the level of available iron, corresponding to decreased Fv/Fm *in hospite*. Our findings suggest that decreases in iron availability in seawater could exacerbate the declining photosynthetic efficiencies in natural *Stylophora* colonies under elevated temperatures.

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WHOLE-SYSTEM EXPERIMENTAL STUDIES ON RESTORATION POTENTIAL OF BIOMANIPULATION FOR HYPEREUTROPHIC PONDS: ROLE OF SUBMERGED MACROPHYTES AND ZOOPLANKTON SIZE

Ten hypereutrophic phytoplankton dominated ponds (Brussels, Belgium) were biomanipulated (emptied with fish removal) for restoring ecological quality and reduce cyanobacterial bloom risks. Data on nutrients, phytoplankton, macrophytes and zooplankton were obtained before and after biomanipulation. Fish removal resulted in a drastic reduction of phytoplankton biomass and a shift to clear-water state in nine ponds. Lower phytoplankton biomass was associated with macrophyte recovery and/or marked increase in density and size of large cladocerans. Ponds with extensive submerged vegetation maintained a clear-water state even in presence of fish. Ponds with sparse submerged vegetation, increased in phytoplankton biomass after fish recolonization. In absence of macrophytes and fish, large cladocerans controlled phytoplankton. Overall in clear-water ponds, different macrophyte communities did not harbour substantially different zooplankton communities. High fish abundance was associated with low diversity and coverage of submerged macrophytes but without relationship to floating-leaved dominated ponds. This whole-system experiment confirmed the importance of revegetation and of grazing through large zooplankton for the maintenance of a clear-water state and restoration success in hypereutrophic urban ponds. The role of macrophytes is revised in this context.

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EFFECTS OF CO_2 ON GROWTH, PHOTOSYNTHESIS AND CARBON ACQUISITION OF KEY DIATOM SPECIES ON THE SOUTHERN OCEAN

The ecology and biogeochemistry of the Southern Ocean is strongly dominated by key diatom species. The impact of increasing pCO_2 on this ecological important group and its effect on the marine carbon cycle are still not understood. To gain a better understanding the effects of CO_2 on growth, photosynthesis and carbon acquisition were studied in natural phytoplankton assemblages and in laboratory experiments with key diatom species. Using a ^{14}C assay, inorganic carbon (C_i) kinetics were assessed in natural phytoplankton. Extracellular carbonic anhydrase activities, photosynthetic O_2 evolution as well as C_i fluxes as a function of light and C_i availability were determined by membrane inlet mass spectrometry. Differences in growth and the modes of carbon uptake were found in the investigated diatom species. Our results suggest that Southern Ocean diatoms are sensitive to changes in CO_2 and that key diatom species will respond differently to the predicted environmental changes. This might lead to changes in the community structure as well as in the photosynthetic productivity of this region, which can have a strong impact on the biogeochemical cycles in the future.

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ANAMMOX AND DENITRIFICATION: FLEXIBLE FRIENDS IN MARINE AND ESTUARINE SEDIMENTS.

The discovery of anammox has altered our fundamental understanding of the N cycle in the marine environment and beyond. In addition, anammox presents a new challenge to quantifying the loss of N from aquatic sediments. Previously we have shown that the distribution of 15N in the N2 pool, relative to that in the N2O pool, can be used to quantify anammox and denitrification separately in intact sediment. Using this technique we can now show that anammox dominates (65-70%) the production of N2 in deep water (2000 m) sediments but is of lesser significance (33%) in shallower coastal sediments (50 m). Interestingly, anammox is often very well correlated with denitrification which suggests some coupling, perhaps via NO2- as an intermediate of denitrification. Despite these advances, however, there are potential problems with this assay. For example, nitrate can be reduced to ammonium (DNRA), which, through the formation of 15NH4+ and in combination with 15NO3-, could produce spurious 30N2 and undermine the central assumptions of the 15N techniques. The theory and challenges to this new technique and results to date will be discussed.

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MOLECULAR GUT CONTENT ANALYSIS IN GELATINOUS ZOOPLANKTON: A QUANTITATIVE ASSAY.

A promising new strategy to quantify zooplankton feeding in situ is the use of molecular methods to detect prey-specific nucleic acid molecules as biomarkers of trophic interactions. However, due to rapid breakdown of prey genomic DNA in predator guts, quantitative estimates remain difficult to obtain. Molecular-based estimates of feeding rates in the gelatinous zooplankton Oikopleura dioica are in the range obtained using independent methodologies, but rates in copepods are significantly underestimated. Here, we compare the use of 14C-labeled algal prey with quantitative PCR and a recently developed differential length qPCR assay in several zooplankton taxa. The results provide a quantitative means to correct for DNA digestion such that absolute feeding rates based on prey DNA concentration can be obtained. Reduced rates of DNA digestion in O. dioica suggest that molecular gut content analysis may be particularly useful for the study of in situ trophic interactions in gelatinous zooplankton. This should lead to new insights in understanding the success of gelatinous filter-feeders in many ecosystems.

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THE USE OF SPECIFIC ANTIBIOTICS FOR ESTIMATING BACTERIA AND PHYTOPLANKTON NITROGEN UPTAKE RATES IN MARINE COASTAL WATERS

Competition for nitrate and ammonium between phytoplankton and heterotrophic bacteria is suggested for explaining the decline of phytoplankton bloom and low phytoplankton growth rates observed in oligotrophic waters. But the quantification of such competition is always difficult because phytoplankton and heterotrophic bacteria have an overlapping size range in natural samples. The combination of 15N-tracers addition and the use specific inhibitors was tested and applied for coastal microbial communities. At first, the concentrations of different inhibitors and incubation time have been investigated in Thau Lagoon to achieve the specific required effect of inhibitors on micro-organisms.Penicillin or streptomycin clearly inhibited the growth of bacteria sampled at different locations. Additional studies showed no direct effect of both antibiotics on the growth of different phytoplankton species in culture. Furthermore, the use of cycloheximine (specific eukaryote inhibitor) totally inhibited the growth of the cultivated phytoplankton. The addition of these inhibitors, combined with enrichments of stable isotopes (15N, 13C), was performed during a weekly sampling in Thau lagoon. This study will investigate the competition for inorganic nitrogen between bacteria and phytoplankton during the summer-autumn transition period.

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REMOTE SENSING AS AN AID TO STOCK-RECRUITMENT RELATIONSHIPS.

Most stock assessment models rely on estimates of recruitment to describe population dynamics. Myers et al. (1995) demonstrated that recruitment can be related to spawning biomass. However, recruitment can also be related to environmental conditions, such as the sea surface temperature and the North Atlantic Oscillation (Brander and Mohn 2004). Also, Platt et al. (2003) have demonstrated that recruitment in a dermesal fish species depends on the phase of the seasonal cycle of phytoplankton. These results are appealing because they invoke another mechanism, that recruitment is related to food availability at some critical (larval) stage. We present results extending the work of Platt et al. by directly incorporating remote sensing color data into the stock-recruitment relationships of cod and haddock on the Scotia Shelf of Canada. These results are assessed for their contribution to understanding groundfish population dynamics. The value of incorporating color data into routine stock assessment is discussed.

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ATMOSPHERIC CYCLING AND AIR-SEA EXCHANGE OF MERCURY IN THE SOUTH CHINA SEA

The distribution of gaseous elemental mercury (GEM) and dissolved (DEM) were determined in the surface airs and waters of the northern South China Sea (SCS) during 11 cruises of the SEATS (SouthEast Asian Time-series Study) between May 2003 and January 2007. Distinct seasonal patterns were observed for the GEM, which concentrations were higher in winter (4.8±2.1 ng/m3, n=4) and lower in summer (3.4±1.3, n=4) and for DEM were contrary to the GEM trend. Seasonal GEM variations were evident in relation to the East Asian monsoon cycles. Air masses in autumn, winter, and spring were observed from Eurasia continents, including Mongolia, China, Japan, and Korea, which exported the terrestrial and industrially anthropogenic materials to the SCS. On the other hand, air masses in summer were always from the Indochina Peninsula and Indian Ocean, which brought with the clean marine materials. For DEM investigations, most samples were oversaturated relative to the atmosphere, excepted for those in winter. Estimated Hg evasion fluxes took place during warm periods with a maximum in summer and early fall (mean : 430±210 pmol m-2 d-1) and invasion during cold periods in winter (mean: -140±110 pmol m-2 d-1). Overall, net sea-to-air Hg fluxes averaged about 200 pmol m-2 d-1 with a total of ~40 ton y-1 for the whole SCS area. Anyway, processes controlling the distribution and production of Hg0 in the SCS need to be further scrutinized.

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PHYTOPLANKTON DYNAMICS IN LAKE BIWA DURING THE 20TH CENTURY: COMPLEX RESPONSES TO CHANGES IN NUTRIENT STATUS AND CLIMATE VARIATION

We examined algal remains and fossil pigments in lake sediments dated using ^{210}Pb to elucidate historical changes in the phytoplankton community of Lake Biwa for the past 100 years and to identify environmental factors causing those changes. Fluxes of most fossil pigments and algal remains were few before the 1960s, but increased through the 1960s to the 1970s. However, after 1980 fluxes of all fossil pigments and algal remains decreased or stabilized. Multivariate analyses suggested that the decreased fluxes of most algal taxa that occurred in the 1980s resulted from changes in meteorological variables such as wind velocity rather than from changes in the lake's trophic condition. Additionally, sedimentary records revealed that *Aulacoseira nipponica* decreased dramatically after 1980, while *Fragilaria crotonensis* appeared abundantly. This replacement of dominant diatoms species is unexplainable merely by changes in the lake trophic condition. Rather, it is related with a recent increase in the winter water temperature. These results suggest that the phytoplankton community in this lake has continually changed since the 1960s due to eutrophication and successive changes in meteorological conditions including warming.

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MARKOV CHAIN ANALYSIS OF COMPLEX INTERACTION WEB IN ROCKY INTERTIDAL SESSILE ASSEMBLAGES AT THE PACIFIC COAST OF JAPAN

To examine the interaction web structure, a Markov chain model was applied in rocky intertidal communities based on a long-term (2002-2008) field study of sessile assemblages at the Pacific coast of Japan. Markov chains are one of the most effective tools to elucidate community dynamics, especially for sessile assemblages. In these models, an element of the transition matrix is the probability of transition from one species to another in one time interval, thus is likely to reflect intensity of species interaction. Utilizing this property, our model successfully projected interaction web within community quantitatively. Some important network properties were derived from interaction webs and their relationship with successional dynamics were investigated. For example, the degree of symmetry of interactions closely related to damping ratio, the rate of convergence to the stable species abundance distribution. Self replacement (persistent) rates related to successional entropy, the amount of variation in community change over a short time period. Understanding the relationships between interaction web structure and environmental factors or community structure will provide insight about origin and maintenance mechanisms of ecological community.

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ULTRAVIOLET RADIATION CONTROLS FISH INVASION IN LAKES

Many fish must spawn in shallow littoral waters because of adult requirements for warmer spawning temperatures. In transparent lakes this potentially exposes eggs and larvae to high levels of ultraviolet radiation (UVR). We used in situ larval incubation experiments to assess whether UVR conditions can control the suitability of nearshore habitats for an invasive warmwater fish species (Lepomis macrochirus) and for a native minnow species (Richardsonius egregius) in Lake Tahoe, USA. Our data show that the native minnow species is significantly more UVR tolerant than the invasive bluegill. We used our experimental data to model a UVR transparency threshold that could prevent the establishment and spread of this warmwater invasive fish. This threshold was applied to nearshore sites around Lake Tahoe and to smaller lakes in the Sierra Nevada range to assess invasion potential as a function of UVR transparency. Our model results suggest that current UVR conditions limit invasion in many of these lakes. Declining water transparency in lakes may facilitate the spread of bluegill and other UVR sensitive species by relaxing this important abiotic constraint on reproductive success.

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USING DNA-BASED STOCK IDENTIFICATION TO ELUCIDATE COASTAL MIGRATION OF JUVENILE SOCKEYE SALMON (ONCORHYNCHUS NERKA)

The ocean feeding grounds of juvenile salmon range over several thousand kilometres of highly variable physical ocean conditions, prey quality and abundance, and predator assemblages. Therefore, the fate of individual stocks may depend on where they migrate and how much time they spend in different regions. Using DNA stock identification techniques, we reconstructed migration patterns for juvenile sockeye salmon (n=4062) along the entire Pacific coast of North America. In spring and summer, the majority of fish were caught in close proximity to their respective rivers of origin. By fall, sockeye salmon were caught as far north and west as the Alaska Peninsula, with the majority of fish caught from Central British Columbia and SE Alaska. Juvenile sockeye salmon generally disappeared from the coast by winter, suggesting dispersion into the Gulf of Alaska. However, we also demonstrated stock-specific differences in migration patterns. For each stock identified, body size and energy density were higher at northern latitudes suggesting an environmental or food web influence on juvenile sockeye salmon growth or alternatively, that faster growing fish initiated their northward migration earlier.

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ADULT FREE CHOICE LEARNING ABOUT OCEAN SCIENCES IN ONLINE LEARNING COMMUNITIES AT THE COLLEGE OF EXPLORATION

Over the past ten years the College of Exploration has hosted over 8500 educators and scientists in online workshops and courses. These free-choice learning, highly interactive experiences enable scientists, educators and other interested adults and students to come together and share their knowledge, love and passion for ocean science. Every event is evaluated and the evaluation of the long term impact and application in various settings is being accumulated. Over time a core goup of participants have formed a virtual community and return over and over again to new programs to learn and to share. Examples from NOAA's Office of Ocean Exploration, NSF's Centers for Ocean Science Education Excellence and the College of Exploration seminars will be described and demonstrated. Opportunities for wider participation and issues of scale will be discussed.

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STABLE ISOTOPE PROBING OF SULFUR-OXIDIZING CHEMOAUTOTROPHIC BACTERIA IN THE CARIACO BASIN

Chemoautotrophic bacteria are important in biogeochemical cycles in aquatic environments. Chemoautotrophy is high within the chemocline of the Cariaco Basin, yet oxic respiration, nitrate reduction, and Mn, Fe and sulfate reduction do not entirely explain observed chemoautotrophic production. Experiments with 13C-bicarbonate establish the importance of intermediate oxidation states of sulfur - thiosulfate, sulfite and elemental S - as alternate electron donors for chemoautotrophy. Addition of thiosulfate to water from the chemocline stimulated biosynthesis of 13C-labeled bacterial fatty acids by 10-fold over amendments with sulfite, elemental S, or unamended controls. Fatty acid compositions and the degree of isotope labeling in individual fatty acids varied significantly between treatments. With thiosulfate, up to 80% of several fatty acids (14:0, 16:1w5, 16:1w7, and cyclopropyl-19:0) contained the C-13 label. Enumeration of bacterial community structure shows beta-, gamma- and epsilon-Proteobacteria are abundant within the chemocline; beta- and epsilon-Proteobacteria were stimulated by thiosulfate. Both subdivisions of Proteobacteria include sulfur-oxidizers that biosynthesize fatty acids that are highly C13-labeled and are likely important chemoautotrophs in the Cariaco Basin.

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DEGRADATION OF DEAD JELLYFISH *AURELIA* SP. BY NATIVE BACTERIAL ASSEMBLAGE

The microbial degradation rate of *Aurelia* sp. was studied in the laboratory and *in situ* experiments in the Gulf of Trieste and in the salt lake Mljet (Adriatic Sea). The whole tissue of the jellyfish was sonicated and the organic mixture was used as substrate, diluted in 8 litres of pre-filtered sea water (pore size 0.6 μm) containing only the natural bacterial community. After 24 hours of incubation, the protein concentration was reduced from 2.1 to 1.0 mg/l in a bottle with the jelly-mixture. An extensive growth of bacteria was recorded with a bacterial biomass increase from 8 to 79 μg C/l. Particulate organic phosphorous concentrations also increased from 2.3 to 8.9 μmol P/l. At the same time, dissolved organic phosphorous and orthophosphate decreased with concomitant NH_3 accumulation from to 6.3 to 83.3 μmol N/l. No changes were recorded in the control bottles without jelly-mixture substrate. Our preliminary results showed a rapid turnover of dead jellyfish by microbes which may be quantitatively important for recycling nutrients and energy to the food web during the collapse of a jellyfish bloom.

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ECOGEOMORPHOLOGY OF THE MISSISSIPPI RIVER DELTAIC PLAIN: IMPLICATIONS TO RESTORATION AND PROTECTION OF COASTAL LANDSCAPES

Restoring the Mississippi River deltaic plain requires a systems ecology approach to calibrating ecogeomorphic response to river engineering designs such as diversions. We have developed simulation models used to link geophysical processes, geomorphic features, and ecological succession in selected regions of Louisiana Coastal Area (LCA). The pattern reflects complex patterns of sediment distribution between both river flood and hurricane events that have been incorrectly described in recent publications on ecogeormorhic development of deltaic coasts. These recent conceptual models will be challenged with simulations of Wax Lake Delta and long term observations of sediment and plant ecology response. There is a predictable decrease in species that have strong flood tolerance, but poor competitive ability at higher elevations — these species may be considered delta 'ecosystem engineers' during the early phases of perennial marsh development as they are likely important in rapid sedimentation. Following the rapid expansion of the 'clonal giants', a perennial marsh develops in the wake, where lower stature grasses and sedges become the dominants. These species exhibit a more balanced allocation pattern to above- and belowground production, leading to organic soil formation. These patterns of plant development along with dynamics of delta building processes are simulated to describe self-maintaining deltaic coasts.

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DYNAMICS AND PROPERTIES OF COLORED DISSOLVED ORGANIC MATTER (CDOM) IN WETLAND ECOSYSTEMS AND COASTAL WATERS OF THE EASTERN MEDITERRANEAN

Dissolved organic matter, DOM, plays a key role in a broad range of processes and climate-related biogeochemical cycles in aquatic ecosystems. Yet, published studies on the optical quality, composition, photoreactivity and degradability of the coloured fraction of DOM in coastal waters and wetland ecosystems of the Eastern Mediterranean are extremely scarce, or even non-existent. As a result, we know little about the biogeochemical processing and fate of DOM in these waters and its effects on estuarine photochemistry, carbon cycling, water quality, and microbial activity. Here we present new data on the composition and optical properties of CDOM in various rivers, deltas and coastal wetlands along the SE European coastline, that vary widely in environmental characteristics and carbon sources. Measurements include hydrologic and water quality parameters, dissolved organic carbon concentrations, CDOM absorption and fluorescence properties, and DOM molecular weight distribution. Results provide critical information for characterizing landscape-scale variation in the quantity and quality of the dissolved organic compounds exported from different Mediterranean wetlands, and understanding implications of such variation for estuarine and coastal biogeochemistry, ecosystem productivity, and water optics.

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ECOPHENOTYPIC DIFFERENCES WITHIN PLANKTONIC FORAMINIFERA GENETIC CRYPTIC SPECIES: GLOBOROTALIA TRUNCATULINOIDES (TYPE 2)

Planktonic foraminifera, uniceller protists forming trochospirally or streptospirally coiled calcareous shells, play key roles in the oceanic environmental changes. The coiling direction of *Globorotalia truncatulinoides* is shifted according to the paleotemperature change. However, this morphospecies is comprised the four genetic types with specific biogeographic distribution. This study documents the "in situ" biogeography of *G. truncatulinoides* in the Sargasso Sea. All examined specimens having both coiling forms belong to genetic Type 2. The left-coiling specimens (Type 2-L) are dominant in the central water mass whereas the right-coilings (Type 2-R) are abundant in the subtropical gyre. At the boundary between these two water masses, both forms show the different depth occurrence corresponding to the water column structure. At a global scale, Type 2-L is found only in the North Atlantic. We suggest that Type 2-L is specifically adapted to hydrographic condition of the central water mass in the North Atlantic. The ecological preference of Types 2-R and 2-L indicates the ecophenotypic variation, which is potentially good paleoceanographic indicator reflecting the migration of water masses in the subtropical gyre.

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SPATIO-TEMPORAL VARIABILITY IN CAROTENOID AND CHLOROPHYLL PIGMENTS OF SEA ICE MICROALGAE IN SOUTHWEST GREENLAND

A survey of the algal pigment biomass and composition of fjord sea ice in SW Greenland was conducted during 2007. Cores of sea ice were collected from three fjords within a 10 km radius of Nuuk, which were characterised by marked differences in brine salinity and nutrient content. Both carotenoid and chlorophyll content of ice cores was greatest in the most saline location. By April, only two ice covered locations remained; a brackish one which had grown from ca. 40 to ca. 65 cm and a fully saline one reduced from ca. 40 to 30 cm. The most saline location continued to show greater carotenoid and chlorophyll content, which also correlated inversely with silicate content. Both locations showed a general increase in the relative proportion of carotenoid to chorophyll pigments between February and April sampling times as well as a within core increase in the lowest section of ice cores. The work shows that sympagic algal communities are heterogeneously distributed at local and mesoscales and temporally dynamic with regard to their pigment composition.

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HUMAN ACTIVITIES AFFECTING COMPOSITION AND FLUXES OF NUTRIENTS AND ORGANIC MATTER IN TWO TROPICAL RIVER-ESTUARINE SYSTEMS IN HAINAN, CHINA

Two river-estuarine systems (Wanquan and Wenjiao/Wenchang) in monsoon-tropical Hainan, China, were sampled for water and total suspended matter (TSM) during dry and wet seasons. The region experiences mixed agriculture and shrimp aquaculture, of which the latter covers large areas along the Wenjiao/Wenchang. The TSM concentration was fairly low and was influenced by in situ production and resuspension. TSM increased in the aftermath of typhoon-related heavy precipitation events. Elevated concentrations of ammonium and autochthonous organic matter (OM) were observed in the aquaculture-dominated Wenjiao/Wenchang estuary. Unlike for $\delta^{15}N$, $\delta^{13}C_{org}$ of TSM increased with salinity indicating a typical transition in the OM source from terrestrial/freshwater to marine. $\delta^{15}N$ of TSM varied between -2 to 10 ‰. Lowest $\delta^{15}N$ values occured in areas with high ammonium concentrations indicating that aquaculture effluents are a significant nitrogen source. A distinct anthropogenic impact on water quality and biogeochemistry was less evident in the Wanquan.

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SESTON SIZE SELECTION IN FIRST FEEDING OF *MYTILUS EDULIS* AND *CRASSOSTREA GIGAS* LARVAE

Planktonic stage of estuarine bivalve larvae experience high mortality. This critical stage may be governed by various biotic and abiotic factors. In this study, we hypothesize that bivalve larvae exhibit food particle size selection. First feeding selectivity of newly hatched mussel *(Mytilus edulis)* and oyster *(Crassostrea gigas)* larvae on natural seston were investigated. ^{13}C-enriched seston (<50 μm) was fractioned into 3 different size classes, 20-50, 5-20, and < 5 μm. All three fractions were recombined, with one size-fraction labeled in every treatment and given to mussel and oyster larvae to determine short-period feeding for 24 hours. First results of isotopic analysis of oyster larval samples showed feeding preference of the larvae for the small (< 5um) particle size class. Results for mussel larvae are forthcoming. Small-sized algae may play a crucial role in feeding of early life stage bivalve larvae. Mismatched or inadequate small-size food particles will lead to poor growth and metamorphosis, high mortality, and subsequently weak recruitment of population.

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MITIGATION OF STOICHIOMETRICALLY ADVERSE EFFECTS OF RISING CO_2 ON *DAPHNIA* BY ALGAL DIVERSITY

We performed CO_2 manipulation experiments under a phosphorus limited condition with a planktonic herbivore, *Daphnia*, and three algal species, *Scenedesmus obliquus* (green algae), *Cyclotella* sp. (diatoms) and *Synechococcus* sp. (cyanobacteria). Semi-batch cultures with single algal species (monocultures) and multiple algal species (mixed cultures) were grown at ambient (360 ppm) and high CO_2 levels (2000 ppm) that were within the natural range in lakes. Both in the mono- and mixed cultures, algal steady state abundance increased but algal P:C ratio decreased when they were grown at high CO_2. As expected, *Daphnia* fed mono-specific algae cultured at high CO_2 had decreased growth rates despite increased algal abundance due to P deficiency. However, when fed mixed algae cultured at high CO_2, especially consisting of diatoms and cyanobacteria or the three algal species, *Daphnia* maintained high growth rates despite lowered P content relative to C in the algal diets. These results suggest that higher algal diversities have higher probabilities to mitigate the stoichiometrically adverse effects of elevated CO_2 on herbivore performance.

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NORTHERNMOST RECORD OF THE TERMOPHILIC CARANGID FISH CARANX RHONCHUS IN THE MEDITERRANEAN

On August 2008 a specimen of Caranx rhonchus (Carangidae) was caught by trammel net in the Ligurian Sea (Arenzano). This fish (false scad) is one of the most termophilic carangid species but, until now, it was confined to southern areas, in Mediterranean. Thus, the record increases the amount of signals of the present northward extension of termophilic fish species in Mediterranean, due to the present climatic change.

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BIOLOGICAL AND PHOTOCHEMICAL DECOMPOSITION OF DISSOLVED ORGANIC MATTER AND ITS AUTOCHTHONOUS PRODUCTION IN LAKE PÄÄJÄRVI (FINLAND) – A 5-MONTH MESOCOSM STUDY

We addressed the dynamics of DOM in a mesocosm study with plankton communities at three light treatments. Black mesocosms assessed heterotrophic biological decomposition of DOM. Yellow mesocoms allowed the photosynthesis of phytoplankton but excluded the abiotic photodecomposition of DOC, since the photolytic blue and UV-radiation were filtered out. Open mesocosms allowed also the photodecomposition of DOM. During a-five-month summer, the heterotrophic plankton of black mesocosms decreased the initial concentration of chromophoric DOM (CDOM at 300 nm; 52 /m), dissolved organic carbon (DOC; 11.5 mg C/L) and phosphorus (DOP; 4.5 μg P/L) by 18%, 14% and 33%, respectively. In the end of summer, the concentration of CDOM and DOC were 3 /m and 1 mg C/L higher, respectively, in the yellow than in the black mesocosms indicating autochthonous production of DOM. The concentration of CDOM was smallest in the open mesocosms indicating that abiotic photochemistry dominated the decomposition of CDOM. In the whole lake, the allochthonous input of DOC exceeds the primary production and the biological decomposition of DOC in a major pathway in the organic carbon budget.

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LONG-TERM TRENDS OF THE WATER QUALITY IN GUANABARA BAY (BRAZIL), FROM 1997–2008.

Guanabara Bay is an estuarine ecosystem submitted to strong anthropic influences due to an unplanned occupation of its surroundings. The aim of this work was to quantify and describe the long-term trends of water quality. Water samples were collected between 1997-2008, from two sites that present different environmental characteristics. Oxygen, nutrients, chlorophyll and bacterioplankton analyses were performed. The trends were estimated by the regression equation. Although the water quality of Urca Inlet is better than Ramos Beach, the results indicate a decrease in the environmental quality condition for both regions in the last ten years. Even in the beginning of the study period, the values were already higher than shown in previous reports. This was attributed to the restriction of the water circulation in the bay, and the consequent reduction of water renewal and dilution of effluents. In the last years, it has been observed an increase in sewage discharges in Guanabara Bay. Based on this scenario and the data presented here, it could be predicted a continuous decreasing trend in water quality for the next years.

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MNEMIOPSIS LEIDYI BLOOM

In

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DORMANCY BREAK IN ZOOPLANKTON: TEMPORAL VARIATION AND ENVIRONMENTAL TRIGGERS

Hatching phenomena of zooplankton community was analysed in Río Seco Lake, a high mountain lake located in Sierra Nevada Mountains (SE Spain), during 2007 and 2008. The lake is ice-covered during 7-8 months per year. Pelagic samples show that the development of the zooplankton community starts inmediatly after thaw time, and summer populations originate mainly from the resting eggs buried in the sediments. We studied the hatching process by using hatching traps located in the lake bottom and by performing laboratory experiments. Hatching traps results show a different emerging timing for each zooplankton species. The species with longer life cycles (Cladocera and Copepoda) hatch earlier than the species whose life cycles are shorter (Rotifera). D. pulicaria and the copepod Mixodiaptomus laciniatus emerge during and inmediatly after thaw time, but the length of the hatching period is one month for D. pulicaria while it is two months for M. laciniatus. The results of the hatching laboratory experiments using resting eggs of D. pulicaria suggest that photoperiod and, in a secondary role, temperature affect the hatching timing.

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SALINITY TOLERANCE OF PYRODINIUM BAHAMENSE VAR. BAHAMENSE

Most of the bioluminescence observed in Caribbean bays and lagoons is produced by the dinoflagellate Pyrodinium bahamense var. bahamense. Salinity tolerance experiments can estimate the fate of P. bahamense populations if geo-physical events, such as excessive accumulation of sediments in the entrance channels of lagoons, facilitate an increase in the salinity of these habitats. Cultures were grown at different salinities (34, 36, and 38 p.p.t.) in order to find out the maximum salinity tolerance of this species. The highest survival rates were observed at 34 p.p.t.; however, all P. bahamense died at 38 p.p.t. Therefore, under culture conditions, the maximum salinity tolerance is between 36 p.p.t. and 38 p.p.t. These results suggest that P. bahamense, is very sensitive to small increases in salinity. They also suggest that the bioluminesce observed in some Caribbean lagoons could easily vanish with an increase in salinity.

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A MARINE MECHANISTIC MODEL OF MODULAR COMPLEXITY (M4C): LYAPUNOV STABILITY AT STEADY-STATES.

Here we describe a marine ecosystem model (m4c) whose level of complexity is modular, so it can be chosen a-priory. The aim is to provide a common ecosystem model frame for the study of the relationships between ecosystems' complexity and dynamical stability in the marine environment. The degrees of m4c's complexity vary along three axes: n-complexity (5 levels of recycling of nutrients); p-complexity (3 levels of phytoplankton diversity); z-complexity (4 levels of zooplankton diversity); and the different combinations between them gives a total of 60 model configurations. Predator-prey interactions are characterized by Holling Type III functional responses for multiple preys. The ecosystem is model is nitrogen-based and it is mass conservative. All 60 model configurations reach an stable-node steady state. Preliminary results from numerical analyses show that increasing the model's complexity decrease its Lyapunov stability, which is defined as the dominant eigenvalue of the Jacobian matrix at steady-state. However the observed decrease in stability is not symmetric along all three axis: the highest decrease in stability is caused by increasing the number of predators (ie. zooplankton) species in the model.

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DIURNAL FLUCTUATIONS IN ANTIOXIDANT PARAMETERS IN MASS CULTURES OF NANNOCHLOROPSIS SP.: COMPARISONS BETWEEN A FLAT PLATE PHOTOBIOREACTOR AND A RACEWAY POND

Outdoor mass cultures of *Nannochloropsis* sp. (Eustigmatophyceae) were compared in two different cultivation systems: a high rate algal pond (HRAP) (30 cm) and a vertical flat plate photobioreactor (FPP) (5 cm). Diurnal changes in physico-chemical and biological parameters as well as in photosynthetic activity were assessed in both systems during 2.5 days of experiment. Incident solar irradiance reached up to 2000 µmole photons m^{-2} s^{-1} at the study site during the experiment. Cultures in the FPP were exposed to more extreme conditions of temperature and pH than the cultures in the HRAP. The differences in physico-chemical parameters resulted in differences in pigment content of the microalgae and differences in photosynthetic parameters. Differences in the antioxidant system of the microalgae are also expected. Cells activate their antioxidant system to eliminate an excess active oxygen species, which are produced as a result of electron transport reactions. We will present data of total antioxidant activity in aqueous and methanolic extracts of *Nannochloropsis* sp. and of ascorbate and glutathion content, as well as of malondialdehyde, which is used as a biomarker of oxidative damage.

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RESTORATION OF ESTUARINE TIDAL MUDFLAT SEDIMENTS AFTER HYPOXIA

Ecosystem function recovery and benthic community recovery was investigated after experimentally induced depleted oxygen bottom water concentrations in a tidal mudflat (Paulinapolder, Westerschelde estuary). Macrofauna recovery developed through different succession stages and was structured by facilitative and inhibitive interactions: early colonizers had a positive effect on subsequent colonizers, while later succession species negatively affected the stable conditions created by the early colonizing tube-builders. Transitions between different stages were related to changes in environmental characteristics and biotic-environmental interactions (e.g. exploitation competition for food). Nematode community -and biogeochemical recovery were related to macrobenthic succession. Dense polychaete tube aggregations and the development of a fresh diatom bloom, as a result of the low grazing pressure by surface deposit feeding macrofauna during the first stage, stabilized the sediment and thereby enhanced macrobenthic and nematode recruitment success. Bioturbation impact of later succession species increased oxygen input in the sediment, resulting in an enhanced nitrification, denitrification and energy use.

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THE EFFECT OF LAND USE CHANGES ON SILICA TRANSPORT THROUGH RIVER BASINS

The role of dissolved silica in the eutrophication problem is well recognised. Nevertheless, so far, almost all studies of eutrophication and nutrient fluxes towards the coastal zone have considered silica mobilisation as independent of land use. In the LUSi-project (Land use and silica fluxes through the Scheldt river basin), we investigate the effect of land use on terrestrial silica mobilisation on a regional scale as well as on habitat scale and by local experiments, taking into account surface run off, subsurface drainage and storage and cycling through vegetation. Our results show that land use, and especially the conversion from forested and urban land cover towards agricultural cropland, has a significant impact on silica concentrations in adjacent rivers. With increased agriculture, more silica is mobilised, both in dissolved (DSi) and particulate amorphous (ASi) form. The use of different tillage techniques had an effect on silica mobilisation, e.g. conventional ploughing resulting in higher DSi mobilisation than direct sowing. These new insights are important for the eutrophication debate: the reference nutrient status on which estuarine and coastal eutrophication has been quantified in the past may have to be fundamentally reconsidered.

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RISING CO2 LEVELS AND THE IMPACT OF C:N STOICHIOMETRY ON TOXIN PRODUCTION BY HARMFUL CYANOBACTERIA

It is commonly argued that global warming is likely to promote harmful cyanobacterial blooms in eutrophic lakes. Microcystis is a common bloom-forming cyanobacterium which can produce a family of hepatotoxins known as microcystins. The microcystin variants are composed of different amino acids, and thereby differ in their carbon:nitrogen (C:N) ratio. We studied how the availability of dissolved inorganic carbon (DIC) and dissolved inorganic nitrogen (DIN) affects the microcystin production of Microcystis in chemostat experiments and in lake samples. Chemostat experiments showed that rising CO2 levels cause a shift to high cellular C:N ratios under nitrogen-limiting conditions, but a shift to low cellular C:N ratios under nitrogen-rich conditions. Interestingly, the nitrogen-richest microcystin variant, microcystin-RR, showed a strong negative correlation with the cellular C:N ratio in both the chemostat experiments and the lake samples. In total, our results indicate that rising CO2 levels can strongly affect cyanobacterial C:N stoichiometry and can lead to shifts in the cellular toxin composition of cyanobacteria.

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HUMIC SUBSTANCES AS LIGANDS FOR IRON AND OTHER METALS IN SEAWATER

Preliminary measurements showed that iron is complexed with humic substances (HS) in waters from coastal and oceanic origin. The limited data set for iron-HS species in ocean waters is here expanded using samples from the Southern Ocean. Reference material fulvic and humic acids were used for calibration of the HS concentrations which were linked to Fe-HS binding capacities by titrations with iron. Comparative measurements using complexing capacity titrations with detection by cathodic stripping voltammetry showed that the Fe-HS species account for a major proportion of the iron binding ligands in the marine system. Experiments investigating the dissociation of labile Fe-HS in the presence of EDTA showed that ligand competition for iron reaches equilibrium in a time span of hours. These kinetics are faster than expected for these highly stable complexes. The reaction kinetics to exchange iron for copper and zinc are also very rapid, reaching equilibrium within seconds. Using the competition between these metals and iron it was possible to determine the complex stability of humic acid and fulvic acid with copper and zinc in seawater.

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A NOVEL METHOD IN DIETARY STUDIES USING ECOTOXICOLOGICAL DATA

Aquatic top predators such as common terns and harbour seals acquire organic contaminants directly from water or indirectly via food. To assess bioaccumulation of contaminants in an estuarine environment, a pilot survey was conducted in the contaminated Westerschelde (south-west Netherlands) in 2005. In 2007 and 2008 more detailed surveys were conducted. A variety of samples were taken ranging from sediment and suspended matter to different types of biota, such as shrimps, worms, shellfish, comb jellies, several species of fish, common terns and harbour seals. Isotope signatures (delta13C/delta15N) were measured in all samples. Trophic levels were calculated using the cockle (Cerastoderma edule) as baseline measurement. The chemical results show that contaminants such as PCBs, PBDEs, HBCD and PFOS are easily transferred and biomagnify in most prey species. By combining trophic levels and contaminant concentrations a further insight can be gained into trophic relations in estuarine environments.

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DERIVATION OF THE MAXIMUM ALLOWABLE TEMPERATURE AS A STANDARD FOR THE GOOD ECOLOGICAL STATUS OF DUTCH LARGE RIVERS

Non-optimal temperature conditions may negatively affect diversity of ecosystems. The European Water Framework Directive (WFD) requires a Good Ecological Status (GES) for surface waters in terms of plant and animal species composition and abundance. To support this GES, standards for physico-chemical parameters that ensure a GES must be derived, including temperature. RIVM recommends the maximum temperature standard for the GES of Dutch large rivers to be set at 25°C based on literature and measurement data for benthic invertebrate fauna and fish. For springtime a lower maximum temperature of 20°C is recommended to ensure reproduction and growth of organisms. The standard recommended here, applies to the GES for natural waters and is lower than the current standard of 28°C, which does not take into account the demands of the WFD. A standard for non-natural waters (such as the Dutch large rivers) will be derived by the water managers, using the recommendation for GES as a starting point. The ecological standards are presently composed of plant and animal species composition and abundance. Possibilities of adding also some functional parameters are discussed.

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CAN *OCHROMONAS SP.* , A MIXOTROPHIC CHRYSOPHYTE, CONTROL TOXIC AND COLONY-FORMING CYANOBACTERIA

Grazing experiments with *Ochromonas*, a mixotrophic chrysophyte, were performed in the laboratory to test whether this flagellate can control cyanobacteria. We investigated three *Microcystis aeruginosa* strains that varied in toxicity and morphology and also one filamentous cyanobacterium, *Pseudoanabaena*. Furthermore, we analyzed the co-occurrence of *Ochromonas*, and *Microcystis* in natural systems. *Ochromonas* was able to feed on all four cyanobacteria tested, and showed high growth rates on all of them by reducing the net growth rates of the cyanobacteria significantly. Further, we observed that after four days of incubation with *Ochromonas* the total microcystin content in the *Microcystis* strains was reduced by more than 90% compared with the controls. Analysis of the field data from 460 Norwegian lakes showed that *Ochromonas* occurred in almost all lakes, while the distribution of *Microcystis* was linked to higher TN, TP, temperature and pH. *Ochromonas* occurred in 99% of the lake samples, while *Microcystis* was found in only 7%. *Ochromonas* co-occurred in 94% of the samples in which *Microcystis* was present and the interaction of both species might therefore be important in natural systems

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P.I.V. PATCH WORK – ANALYSIS OF SURFACE FLOW AROUND PATCHES OF SALTMARSH VEGETATION

In the past decade the effects of saltmarsh vegetation on currents and waves have been studied in flume tanks. In flumes, water is forced through the vegetation. In the field water may either flow through or around a patch. We tested the effect of patches of vegetation on hydrodynamics in a large-scale engineering facility. Due to the large spatial heterogeneity, measurements with current meters give limited information about the shape and size of wakes. We used large-scale Particle Image Velocimetry (PIV) to analyse the surface flow. In very shallow water, the wake behind a patch of *Spartina anglica* is surprisingly long. The limited water depth restricts the formation of Kelvin-Helmholz instabilities that would break up the sharp velocity gradients in deeper water. The PIV technique was valuable in highlighting the complex flow structures around emergent vegetation. Particularly with submerged vegetation, large differences exist between the surface flow and near-bed flow. Surface flow PIV is a valuable addition to analyse spatial flow patterns, but is not a substitute for conventional flow measurements.

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ZOOPLANKTON GRAZING MEDIATES INTRASPECIFIC INTERACTIONS IN MICROCYSTIS POPULATIONS

We conducted two laboratory experiments to investigate intraspecific interactions within Microcystis populations and the impact of zooplankton grazing on these interactions. In a first experiment, we investigated defences induced by infochemicals of Daphnia magna in Microcystis strains that differed in important ecologically relevant traits. In a second experiment, we studied interactions between Microcystis strains in mixed populations in presence and absence of Daphnia magna. The relative abundances of the strains were followed through time using Denaturing Gradient Gel Electrophoresis, and the growth rate of each strain in the populations was compared to its monoculture growth rate to determine the sign and magnitude of the interactions. Our data suggest that zooplankton has a relatively weak and strain-specific influence on the growth rate, microcystin production and colony formation of Microcystis strains compared to inter-strain differences in these traits. Grazing also impacted the interactions between strains in important ways. The presence of Daphnia resulted in weaker competitive interactions between strains and in strain-specific cases of facilitation. We interpret these results in the light of the maintenance of genetic diversity in cyanobacterial populations.

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LINKING PHYSICAL PROCESSES TO HIGHER TROPHIC LEVELS: RESULTS FROM COUPLING HYDROLOGICAL, BIOGEOCHEMICAL AND SIZE-BASED FOOD WEB MODELS

To predict changes and improve understanding of North Sea ecosystem structure and function, the General Estuarine Transport Model (GETM, see www.getm.eu) has previously been coupled to the Biogeochemical Flux Model (BFM, the successor to ERSEM, see www.bfm.cmcc.it). The BFM model incorporates the cycles of C,N,P,Si and has a functional group approach. The highest trophic level included in the BFM model is zooplankton (5 functional groups), while phytoplankton (4 groups) and benthos (5 groups) are also represented. Application of the coupled model provides 3D spatial and temporal fields of biomass per functional group in the North Sea. Depth-integrated biomass fields from a 10 year run with the GETM-BFM model are now being used to force a dynamic size-based food web model. This model focuses on body size rather than species identity to describe the role of individuals in the food web, and incorporates both fish and detritivore size classes in order to investigate the dynamic interactions between benthic and pelagic energy pathways. Forcing the size-based model with results from the GETM-BFM model is a first step towards linking hydrodynamics, biogeochemistry and food web processes at higher trophic levels. Preliminary outputs describe spatial variations in size-based food web structure and the dominance of benthic and pelagic pathways as a response to spatial and temporal changes in the environment during the modelled period.

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PHYTOPLANKTON IN THE OLIGOTROPHIC OCEAN SUBSTITUTE PHOSPHOLIPIDS IN RESPONSE TO PHOSPHORUS LIMITATION ON A GLOBAL SCALE.

Eukaryotic phytoplankton and cyanobacteria have the ability to decrease their cellular phosphorus content when phosphorus in their environment is scarce. Yet the biochemical mechanisms behind this response are largely unknown. We found that both eukaryotic phytoplankton and cyanobacteria reduce their cellular phosphorus requirements by substituting non-phosphorus membrane lipids for phospholipids. In the Sargasso Sea, where phosphate concentrations were < 10 nM, we found that only 1% of phosphate uptake was used for phospholipid synthesis; in contrast, in the South Pacific subtropical gyre, where phosphate was > 100 nM, plankton used 17%. Examination of planktonic membrane lipids at these two locations showed that classes of sulfur- and nitrogen-containing membrane lipids, which are devoid of phosphorus, were more abundant in the Sargasso Sea than in the South Pacific. Our results suggest that phospholipid substitutions are fundamental biochemical mechanisms that allow phytoplankton to maintain growth in the face of phosphorus limitation.

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HOW DO BACTERIA INFLUENCE THE EXTRACELLULAR CARBOHYDRATE POOL IN EXPERIMENTAL *EMILIANIA HUXLEYI* BLOOMS?

Bacteria are key players in the non-sinking biological carbon pump. But how do they affect freshly produced sugar compounds? We investigated the interactions between the extracellular carbohydrate pool of the coccolithophore *E. huxleyi* and associated bacterial communities, and how these affect the sugar dynamics and carbon partitioning in the microbial loop. By comparing the sugar concentration and (isotopic) composition, by means of HPLC-IRMS, and TEP formation between *E. huxleyi* cultures with and without bacteria, we determined the influence of bacterial activity on this major extracellular carbon pool. Furthermore, we studied the evolution of both the active particle-associated and free-living bacterial communities by means of DGGE fingerprinting of 16S rRNA. This approach allows the identification of the dominant active bacterial taxa which may be involved in the cycling of carbohydrates and TEP. Future stable carbon isotope pulse-chase experiments using compound-specific isotope analysis will focus on the carbon flows between the sugars in extracellular carbohydrates and bacterial communities in experimental *E. huxleyi* blooms.

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FLOW INTERACTION WITH PATCHY VEGETATION: A LARGE-SCALE FLUME STUDY

We studied the interactions between patchy emergent vegetation and spatial flow patterns in a large-scale flume facility (16x26m). Two patches of tidal marsh vegetation (*Spartina anglica*) with varying size and interdistance were used. Our results demonstrate a flow velocity decrease within the patches and downstream of the patches, but also an increase of flow velocity next to and in between the patches. The relative velocity increase and decrease depends on patch size and distance. Growth simulations with increasing patch size and decreasing patch distance show a clear concentration of flow in between and next to the patches. Remarkable, simulations with constant patch size but changing patch interdistance show no difference in the velocity increase between the patches and next to the patches. We demonstrate that these flow interactions with patchy vegetation determine the evolution of a tidal marsh landscape. Flow enhancement next to and in between patches will initiate channel erosion and limit plant growth, while flow decrease behind patches will promote sediment deposition, seedling establishment and plant growth.

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COMPARISON OF THE EFFECTS OF SUBMERGED MACROPHYTES AND DAPHNIA IN THE CONTROL OF PHYTOPLANKTON BIOMASS: A MESOCOSM STUDY

A bifactorial cattle tank mesocosm experiment was carried out to study the independent and interacting effects of submerged macrophytes (Elodea nutalli) and Daphnia on phytoplankton biomass. In the abbsence of fish in the mesocosms, there was no indication for a strong interaction between macrophytes and zooplankton in the control of phytoplankton biomass but macrophytes and zooplankton separately had a comparable negative impact on phytoplankton biomass. Grazing experiments carried out in each mesocosm indicated that low biomass in the presence of Daphnia was due to grazing. Macrophytes reduced top-down control by Daphnia so that low phytoplankton biomass in the combined presence of Elodea and Daphnia was mainly due to direct macrophyte effects. Macrophytes strongly reduced dissolved P concentrations but had a minor effect on N concentraties. Nevertheless, nutrient additions did not stimulate phytoplankton growth in the macrophyte treatments. When phytoplankton communities were exposed to Elodea in dialysis bags under saturating nutrient conditions, photosystem II activity and growth rates were reduced, suggesting allelopathic control of phytoplankton by Elodea.

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ZOOPLANKTON SIZE SPECTRA. PART I : FROM DATA TO MODELS

Plankton and particles size-spectra are synthetic measurements of marine ecosystems complexity. They are well documented in many areas using optical and imaging systems that provide size measurements. Recently several plankton size-based models have been proposed to simulate their dynamics, specially mesozooplankton (mainly composed of copepods). Because the nature of the objects detected by these systems is diverse, from non living detritus to plankton organisms, there is a need for the careful analyzes of the size spectra before interpreting their dynamics and incorporate them in models. We propose a general framework to analyze and validate size spectra before their use in a size based model of plankton dynamics. To do so, we analyze several concomitant times series of particles detected using a coulter counter and plankton collected by different nets and analyzed by an imaging system, the ZooScan. The time series of copepod size spectra provides useful information for modelers to help them defining conditions at limits as well as temporal scales of variation. Model hypothesis, structure and simulation of copepod dynamics is presented in the companion presentation.

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IDENTIFICATION OF A MUTATOR GENE IN BACTERIOVORAX MARINUS SJ

The halophilic Bacteriovorax marinus SJ are obligate predatory bacteria of other Gram-negative bacteria. They invade the prey cells by entering their periplasm and feeding on host macromolecules. The Nudix hydrolases are a superfamily of phosphoanhydrases that catalyze the hydrolytic breakdown of nucleotides, sugar nucleotides and coenzymes.

One of the phenotypes associated with the Nudix hydrolases is the prevention of mutations by removing damaged nucleotides from the nucleotide pool (mutT gene). We investigated the role of one of the Nudix hydrolases present in the SJ genome, BM3, as a putative mutator. To evaluate BM3 as a functional homolog of E. coli MutT, a complementation assay was performed. The BM3 gene was cloned in the pTRC99a plasmid. The clones were transformed into E. coli SB3 mutT- and plated in media supplemented with Streptomycin and Nalidixic acid to assess mutation frequencies. Results showed that BM3 complements the mutT phenotype of E. coli SB3 mutT-. We conclude that BM3 prevents spontaneous mutations by hydrolysis of oxidized nucleotides in E. coli, therefore it is likely that will have the same function in Bacteriovorax marinus SJ.

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ANY WAY THE WIND BLOWS - THE IMPORTANCE OF PASSIVE AERIAL DISPERSAL IN FRESHWATER INVERTEBRATES

The passive overland dispersal of freshwater invertebrates has fascinated scientists for more than a century. Yet the importance of wind as a dispersal vector is still subject of considerable debate. Few researchers have tried to quantify aerial dispersal in a direct way, usually with limited success. We quantified wind dispersal of freshwater invertebrates in a rock pool metacommunity using a combination of wind socks and glue traps. We measured relatively high wind dispersal rates in a diverse group of invertebrate taxa, which presumably fuel strong species sorting processes observed in active communities. Exposure of the dormant propagule bank and dominant wind direction were shown to be key factors affecting the yields. Not only single propagules but also propagule bank fragments containing multiple propagules contribute to local dispersal dynamics. Freshwater invertebrates clearly differed in their ability to disperse via wind; with smaller propagules, in general, being more dispersible than larger ones. We therefore argue that one should be careful in generalising presumed high dispersal capacity in zooplankton. Our results indicate that wind dispersal may be more important than previously thought.

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CHANGES IN THE ARTIC RESPIRATION RATES DUE TO TEMPERATURE INCREASES

The Arctic Ocean is the region of the Earth supporting the steepest warming rate and it is also particularly vulnerable to warming due to the vanishing ice cover. Intense warming in the Arctic has strong implications for biological activity and the functioning of an Arctic Ocean deprived of ice cover in summer. We evaluated the impact of temperature increase on respiration rates of surface marine planktonic communities, a property constraining the future role of the Arctic Ocean in the CO2 balance of the atmosphere. We performed experiments under four different temperature elevation regimes (in situ, +2, +4 and +6°C above the temperature of the sampled water) in cruises conducted in the Fram Strait region during winter, spring and summer. During winter no response to warming was observed whereas respiration rates increased in response to warming in spring and summer, although with variable strength.

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VIRALLY-INDUCED SPHINGOLIPIDS REGULATE HOST CELL FATE IN THE MARINE COCCOLITHOPHORE, EMILIANIA HUXLEYI

Emiliania huxleyi is a cosmopolitan coccolithophore forming massive blooms, routinely infected and terminated by lytic viruses. Coccolithoviruses were recently shown to induce and regulate host programmed cell death (PCD) as part of their lytic pathway. The genome sequence of E. huxleyi virus 86 contains a cluster of biosynthetic genes for sphingolipids. These genes have never been described before in any known viral genome and play a pivotal role in animals and plants regulation of cell fate. We characterized the 'lipidome' of various sensitive and resistant E. huxleyi strains in response to viral infection. We detected certain cerebroside-like glycosphingolipids in the sensitive E. huxleyi strains during the lytic phase, using high performance liquid chromatography/mass spectrometry. These particular glycosphingolipids were not detected in resistant strains. Addition of purified cerebrosides from infected cells induced PCD in E. huxleyi in a dose dependent manner, mimicking viral infection. We also analyzed natural coccolithophores for these unique lipid signatures as a novel biomarker of viral infection in the marine environment. This is the first characterization of sphingolipids as infochemicals that mediate virus-host interactions in marine phytoplankton.

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SEASONAL PLANKTON-FISH INTERACTIONS: LIGHT, PREY PHENOLOGY AND HERRING ENERGY STORAGE

When prey and predator are seasonal migrants, interaction strength depends on migration phenologies and environmental constraints on foraging. We have studied a predator-prey interaction with large biomasses involved: the Norwegian spring-spawning herring feeding on the copepod Calanus finmarchicus. Herring foraging is highly seasonal with body condition increasing considerably during a few weeks in early summer. We explore three hypotheses for this rapid seasonal fattening using data on prey abundance and a mechanistic model of ingestion rate. The herring feeding migration could have evolved to match the peak abundance of either the overwintering or the late stages of the following Calanus generation. The overwintering generation was too early and the offspring generation too late to explain the body condition increase in herring. Instead, the model suggests that longer days and increased irradiance are important to herring foraging – a feature that may make visually searching aquatic predators at high latitudes resilient to fluctuations in prey phenology. Light related constraints on foraging must be considered when evaluating the potential for trophic cascades and the robustness of aquatic ecosystems to environmental changes.

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SCALES OF SPATIAL VARIABILITY IN SEAGRASS SYSTEMS: AN EXAMPLE WITH BORER POLYCHAETES

The scale of spatial variability in seagrass meadow features, and in their associated benthic communities, has been poorly evaluated, especially in the *Posidonia oceanica* meadows of the Mediterranean Sea. Here we investigated the spatial variability in two *P. oceanica* beds (Ischia Island, Gulf of Naples, Italy), submitted to a different degree of human impact, following a nested, hierarchical spatial design: three sites (~180 m apart) per meadow, two stations (~25 m apart) per site, 3 randomly selected 1 x 1 m plots (~3 m apart) per station, and two replicates (40 x 40 cm) per plot. Here we report the distribution of borer polychaetes, sampled in summer 2007, which occurred with three species of Eunicidae. The borer frequency varied both between and within the studied meadows. Within each bed, significant differences were observed mainly at site level (~180 m apart), while a certain degree of variability was observed also at station level (~25 m apart). These variations can be related to local environmental differences between beds, as well as to life history traits and metapopulation features of the borer polychaetes.

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DIVERSITY OF SMALL PHOTOSYNTHETIC EUKARYOTES IN MARINE WATERS: COUPLING FLOW CYTOMETRY SORTING WITH PHYLOGENETIC ANALYSES.

Small photosynthetic eukaryotes play a key role in the production of marine waters. However molecular approaches have failed to fully explore their diversity because 18S rRNA gene clone libraries constructed from natural samples are often dominated by heterotrophic groups. To circumvent this, we developed an approach consisting in physically sorting by flow cytometry photosynthetic cell populations based on their size and pigment fluorescence. Genes from the sorted cells are then amplified and cloned. We have applied this approach to coastal waters from the English Channel and to open ocean oligotrophic waters from the South East Pacific. Nuclear 18S rRNA gene clone libraries constructed from such sorted populations exhibit very little contamination from sequences of heterotrophic organisms. Analyses have revealed the importance of novel groups such as Prasinophyceae clade IX or marine Chrysophyceae. By coupling this approach with whole genome amplification, the number of cells that need to be sorted can be lowered considerably (down to 10), resulting in samples where a single genotype dominates for which it should be possible to perform metagenomics analyses targeting uncultured eukaryotic groups.

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CHANGES ON DISSOLVED ORGANIC MATTER PROPERTIES ALONG A FLUVIAL NETWORK IN AN INTERMITTENT MEDITERRANEAN STREAM.

This study aims to asses changes in the quality of dissolved organic carbon (DOC) in a fragmented fluvial network. From a hydrological perspective, drying is a temporal-spatial gradual process during which the continuum fluvial network is converted into a fragmented landscape of isolated water pools. Hence, its dimension, persistence and age depend on site geomorphological and hydrological conditions (Lake 2003). The combination of these factors causes a remarkable shift in biogeochemical and redox properties among isolated water pools, with an increase of DOC and ammonium, and a decrease in dissolved oxygen, sulphate and nitrate. The expected DOC accumulation is coupled to an increase in the relative biodegradable DOC content (BDOC). Fluorescence

index shows that DOC in water pools is microbially derived. The SUVA index shows lower values in older water pools. The analysis of excitation-emission matrices shows two clear fluorophores (A and C). Fluorescence intensity is higher in fluorophore A (C/A ratio between 0.5-1).

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EVALUATION OF MHC DIVERSITY AS A MEANS TO STUDY MATE CHOICE IN QUILLBACK ROCKFISH (*SEBASTES MALIGER*)

The use of odor cues has been proposed as one method by which rockfish of the genus *Sebastes* recognize conspecifics and select mates. The major histocompatibility complex (MHC) is known to have primary function in the immune system in vertebrates but is also proposed to play a role in mate recognition within species. The goal of this project is to evaluate the MHC genetic diversity within a single species of rockfish. The MHC class 2 beta gene family was studied in 19 quillback rockfish (*Sebastes maliger*). We used degenerate primers and standard PCR protocols to amplify MHC sequences. Six to eight clones were selected from each individual for sequencing. In 227 sequences obtained, there were 97 distinct exon 2 sequences (79 coding sequences and 18 pseudogenes). In phylogenetic analyses, clusters of monophyletic *Sebastes maliger* sequences were found among other clades that were blended with rockfish MHC sequences from previously published research. As the project continues, we plan to study MHC in other species of rockfish and to examine captive-bred rockfish larvae for evidence of non-random mating based on MHC.

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CHANGES IN THE SPRING BLOOM COMPOSITION AND ITS CONSEQUENCES ON THE REPRODUCTION OF CALANOID COPEPODS

The diatom and dinoflagellate dominated Baltic Sea spring-bloom constitutes an important food source for zooplankton grazers. Recently, dinoflagellates have increased in relation to diatoms. This has been explained by lack of convective mixing after mild winters. As some diatom species are observed to cause impaired reproduction of copepods, it is possible that copepod reproduction success will improve while winters are getting warmer. We used cultured common spring-bloom species, the dinoflagellate (Scrippsiella hangoei) and the diatom (Skeletonema costatum), as food for the in situ caught calanoid copepod Acartia bifilosa, and followed up the egg production for four days in a temperature controlled room. Egg production was lower on the diatom mono-diet, than on the dinoflagellate mono-diet, or on the mixed diet of diatoms and dinoflagellates. The production decreased during the experiment when carried out after the spring bloom, but increased in a pilot experiment at the time of a really dense spring-bloom. Our results suggest that the changing spring bloom composition can have positive effects on zooplankton grazers, at least if their populations can develop fast enough to gain the advantage of the bloom.

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SEASONAL DYNAMIC OF DIFFERENT ANTARCTIC WATER BODIES

Our aim was to study the seasonal variation of a number of non-marine aquatic ecosystems at Byers Peninsula (South Shetland Islands, Antarctica) during the austral summer of 2006/07 from different points of view. Physical, chemical and biological data were collected from a lake, a pond and a river. We hypothesize that lakes from polar regions show less environmental variations than ponds and temporary rivers, thus biological variability (diversity, succession, etc) in lakes should be lower than that in more unstable ecosystems. Automatic instruments collected environmental data year-around and biological data were obtained at high frequency during the polar summer. We found that environmental variables changed at different time scales, from hours to weeks, while the biological variation took place at much longer scale. Adaptation to environmental changes and thresholds for ecological succession were evidenced in our results.

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PARTICLE CYCLING AND SCAVENGING OF 231PA AND TH ISOTOPES BASED ON DISSOLVED AND SIZE-FRACTIONATED PARTICULATE DISTRIBUTIONS (ANTXXIV-3, SOUTHERN OCEAN)

During the expedition ANTXXIV-3 (Feb-April 2008, GEOTRACES/IPY), Pa and Th isotopes (230Th, 232Th and 234Th) were determined in seawater and size-fractionated particles along 3 transects: Zero-Meridian, Weddell Sea and Drake Passage. These radionuclides, sampled in different environments (shelf, open-ocean, ice formation areas…), and for the first time in 3 different sizes of particles, give more insights into the particle dynamics in the water column. Pa and Th distributions are controlled by particle flux and boundary scavenging. Therefore, based on reversible scavenging models and distributions of these radionuclides, particle settling velocities, adsorption/desorption rates and aggregation/disaggregation rates were further investigated. At open ocean stations, most of the excess 230Th distributions display a linear increase with increasing depth down to 1000 m. These distributions are sometimes modified from the linear trend, in surface or deeper water masses, reflecting ice melting, downwelling of surface waters and ventilation of bottom waters. Terrigenous inputs are observed near the shelf. Our results will be compared with the distributions of other trace elements, analysed in the same samples (Nd, 227Ac) or in parallel sampling (CFC).

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INTRACELLULAR PH OF CNIDARIAN CELLS: FUNDAMENTAL PHYSIOLOGY IN AN ERA OF CLIMATE CHANGE

Intracellular pH (pHi) affects virtually all physiological mechanisms. In reef building corals these include the key processes of calcification and photosynthesis that underpin coral reef ecosystems. Despite the importance of pH to coral physiology, intracellular pH and how it is regulated in corals remains unknown. The threat of CO2-induced ocean acidification has led to growing interest into how corals control pH within their cells and at the interface between the tissue and skeleton. Using the reef building coral *Stylophora pistillata* and the symbiotic anemone *Anemonia viridis* as models, we have developed an confocal microscopy approach that allows the first-ever estimates of intracellular pH in symbiotic cnidarian cells. Our findings reveal spatial heterogeneity in pHi linked to the presence of algal symbionts and overall cell architecture. Our cellular imaging approach provides the basis to ongoing studies on how cnidarian cells regulate pH under changing environmental conditions.

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PEDUNCULATE BARNACLE POPULATIONS ON TWO BUOYS IN THE EASTERN TROPICAL PACIFIC: CORRELATION WITH ENVIRONMENTAL CONDITIONS

Pedunculate barnacles collected in May 1999 from the surface buoys of each of two TAO array moorings at 5N, 95W and 5S, 95W consisted of four species: *Lepas anatifera* (N=705 and 965, respectively), *L. hillii* (N=62 and 37, respectively), *Conchoderma virgatum* (N=29 and 48, respectively) and *C. auritum* (N=5 and 2, respectively). Both buoys were in place for about a year, and barnacle populations on both buoys were dominated by *L. anatifera* (88% for 5N and 58% for 5S). Species were sorted into small (<20mm), medium (20-40 mm) and large (>40 mm) size classes. At 5N, 83% of the *L. anatifera* were large, whereas the *L. anatifera* on the buoy at 5S were mostly small (42%) and medium (31%). *L. hillii* from 5S were exclusively small (70%) and medium (30%). The continuous record of SST and wind velocities from each mooring allowed us to correlate population differences with environmental conditions.

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EFFECTS OF MACROPHYTES ON DENITRIFICATION RATES IN SHALLOW FRESHWATER SYSTEMS: A 15N ENRICHMENT MICROCOSM STUDY

Different functional groups of macrophytes create different conditions in water and sediment, which may affect microbiological processes like denitrification. We tested the effect of floating and submerged vegetation on denitrification rates using the isotope pairing technique. Three vegetation treatments were applied to 18 microcosms: either a layer of duckweed (*Lemna sp.*), waterweed (*Elodea nuttallii*) or no vegetation (control).

Three replicates of each were measured under light conditions and 3 were measured under dark conditions. After 5 weeks of incubation we added ^{15}N enriched nitrate, closed the systems airtight, and took water samples every hour for 3 hours. Denitrification rates were then calculated from ratio's of 29/28 and 30/28 N_2. Additionally, $\delta^{15}N$ of sediment, water and macrophytes was measured to quantify macrophyte uptake and create a nitrogen mass-balance. Duckweed dominated microcosms showed significantly higher denitrification rates than waterweed dominated microcosms during the day, most likely due to the oxygen reducing effect of the closed floating layer. In line with this, waterweed dominated microcosms showed low denitrification during the day but increased 4-fold during the night.

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CLIMATE CHANGE AND THE POLAR ICHTHYOFAUNA: MOLECULAR EVOLUTION OF HEMOGLOBIN

Polar fish acquired sophisticated molecular mechanisms of physiological/ biochemical adaptations in response to variations in water conditions, e.g. oxygen level, temperature, salinity. Dramatic changes are occurring in the seas of both polar regions, calling for monitoring adaptation responses of fishes. Hemoglobin (Hb) is an interesting system for studying the relationships between environmental conditions and molecular adaptations. In the framework of a comparative study on structure/function of polar fish Hbs, the first molecular characterisations of the oxygen-transport system of Arctic species, namely one zoarcoid and three Gadidae (1, 2) were reported. In contrast to notothenioids, and similar to other acanthomorph teleosts, the blood of these Arctic fish displays high Hb multiplicity. Arctic and Antarctic globins have different phylogenies. The selective pressure of environment stability allows the phylogenetic signal to be maintained in the Antarctic sequences, whereas environmental variability tends to disrupt this signal in the Gadidae sequences (3, 4). 1. Verde et al (2002) J Biol Chem 277:36312-36320, 2. Verde et al (2006) J Biol Chem 281:22073-22084, 3. Dettaï et al (2008) Meth in Enzymol 436:535-566, 4. Verde et al (2008) Current Protein and Peptide Science, in press

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EXAMINING THE INFLUENCE OF MESOSCALE EDDIES AND ATMOSPHERIC DEPOSITION ON PARTICLE EXPORT FLUXES USING ^{234}TH AND ^{210}PO

Particulate organic carbon (POC) fluxes were measured in the Canary Current, a region strongly influenced by both mesoscale features and episodic inputs of Saharan dust, using the short-lived, particle reactive isotopes, ^{234}Th ($T_{1/2}$ = 24.1 days) and ^{210}Po ($T_{1/2}$ = 138.4 days). Samples were collected at targeted stations within both cyclonic and anticyclonic eddies, and at sites well-removed from the eddy flow-field. ^{234}Th derived POC export fluxes within the eddy features were similar, ranging from 3.5 ± 1.3 to 11.9 ± 2.7 mmol C m^{-2} d^{-1} (cyclonic) and from 4.0 ± 0.8 to 10.2 ± 2.3 mmol C m^{-2} d^{-1}, (anticyclonic). Outside the eddies, POC export fluxes were slightly lower, averaging 2.5 ± 0.6 mmol C m^{-2} d^{-1}. ^{210}Po derived POC fluxes, in contrast, were significantly higher and more varied, with 2-3 times higher export within anticyclones, as much as 10-fold higher export within cyclones, and up to 20 times higher export at the control, or non eddy impacted sites. These mismatches in flux estimates are likely due to a combination of tracer timescale, spatial differences in episodic Saharan dust events, and biological community structure.

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SEAGRASS REHABILITATION IN WESTERN AUSTRALIA; RETURN TO FUNCTIONAL MEADOWS

Large-scale manual transplantation is proceeding in Cockburn Sound, Western Australia to replace equivalent areas of seagrass lost to industrial development. Plagiotropic Posidonia australis Hook. f. sprigs were collected from meadows in Cockburn Sound and transplanted into a bare sandy area in Southern Flats, Cockburn Sound, Western Australia. Approximately three hectares have been planted, with survival at around 60 %. However, surviving plants also rapidly spread such that a sprig initially possessing three shoots developed over 20 shoots after 18 months. Posidonia sp. seedlings have also been attracted to the restoration area and are well established. Studies to monitor the success of broad acre restoration (~ three hectares) are currently taking place in the same area. Observed rhizome extensions of between 4 and 5 cm noted over a six-month period could effectively produce a continuous meadow in just over six years, based on 1 m distance between sprigs. The 0.5 m spacing presently used in the transplanting season therefore reduces the time it would take to form a continuous meadow within the transplanted area to an estimated three to four years.

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EFFECTS OF WILDFIRE ON STREAM MACROINVERTEBRATE ASSEMBLAGES IN THREE BIOMES: DO CLIMATE AND HYDROLOGY MEDIATE RESPONSES?

Macroinvertebrate assemblages often respond rapidly within the first year following a wildfire, though composition frequently becomes more dominated by disturbance-adapted taxa. Global variation in climate and hydrology could mediate such responses. In each of three biomes, we compared macroinvertebrates in three unburned watersheds vs. three that experienced wildfire 8-10 months prior to sampling. Study streams in Victoria, Australia experienced a drought of >10yr and low flows that encompassed the time of our study. Streams in Idaho, USA experienced high peak runoff the spring after wildfire. Those in Catalonia, Spain experienced strong floods immediately after fire. Significant negative effects of wildfire on macroinvertebrate diversity were observed only in Australia, and may have been mediated by drought. Across all biomes, invertebrate assemblages of burned streams had greater dominance of r-strategist insects (e.g., Chironomidae, Simulidae, Baetidae) than in unburned streams. In Catalonia and Idaho, the combined effect of wildfire and floods also appeared to increase these taxa, but was also apparently affected by flood timing. These comparisons suggest that the occurrence and timing of flood and drought may mediate fire effects on macroinvertebrates.

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EVIDENCE FOR WASTEWATER INFLUENCE IN A LOW IMPACTED AREA THROUGHOUT STABLE ISOTOPES ANALYSES OF THE LIMPET *PATELLA CAERULEA* AND EPILITHIC BIOFILMS

Eutrophication is considered to be one of the main threats to marine environments leading to changes in trophic status of ecosystems and alteration of biological diversity. Carbon and Nitrogen stable isotopes analyses were performed on the limpet *Patella caerulea* and one of its food sources (epilithic biofilms) to assess their potential as early indicators of eutrophication. Samples were seasonally collected in 2005-2006 on five locations gradually exposed to urban sewage in the Calvi Bay and in the Marseilles harbour. Stable isotopes signatures of *Patella caerulea* muscles exhibited steady site-specific values over seasons. In contrast to this time-integrated signal, wide variations in biofilm values show that either composition or isotopic ratios of food sources may vary greatly in time and space. Elevated $\delta^{15}N$ values of limpets and biofilms, typical of wastewater influence but unrelated to nitrogen loads, indicate the biological availability of derived-sewage nitrogen in the Calvi Bay and the Marseilles harbour. A reference level of $\delta^{15}N$ values is rapidly reached with increasing depth that indicates the limited vertical extent of pollution in the Calvi Bay.

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COMBINED EFFECT OF LIGHT AND METAL ON PHOTOSYNTHESIS OF ALGAE AND CYANOBACTERIA

Primary production of planktonic algae and cyanobacteria largely depends on the efficiency of light reactions of photosynthesis. Metals, including zinc, cadmium, and copper, belong to the group of environmental pollutants that are most harmful for phytoplankton. Light also may have an important impact on photosynthetic organisms. However, little is known about the interaction between these two factors. In this study, by using Pulse-Amplitude-Modulated fluorometry and rapid rise fluorescence kinetic, we have evaluated how a diatom, (*Navicula pelliculosa*), a green alga (*Chlamydomonas reinhardti*) and a cyanobacteria (*Microcystis aeruginosa*) have developed strategies to cope with combined effect of metal and light intensity. Phytoplankton previously grown under different light intensities (25, 75 and 500 µE m-2 s-1) and then exposed for 72 H to various metal concentrations demonstrated a strong decrease in photochemical activity (Phi'm) and a strong increase in non-photochemical quenching (NPQ) compared to control algae. The effect of metal was different among the studied species and growth light intensities. The effect of high light stress (500 µE m-2 s-1 for 1 H) on low light grown algae was also studied after different metal treatments (72 H). We will discuss the implication of our results for phytoplankton community change in polluted aquatic environment.

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HOW WILL INCREASED PCO_2 INFLUENCE PHYTOPLANKTON GROWTH AND COMPETITION?

Atmospheric CO_2 levels (pCO_2) are increasing at unprecedented rates. When CO_2 dissolves in water, it reacts to form bicarbonate and carbonate. The relative availability of each carbon species depends on pH. Increasing pCO_2 will decrease pH, increase the availability of dissolved CO_2 but will decrease the (relative) availability of bicarbonate. Most phytoplankton species can take up both CO_2 and bicarbonate but differ in their affinity for both nutrients. Changes in carbon availability will change phytoplankton carbon:nutrient ratio and may also change the competitive balance between phytoplankton species. Here, we present a chemical-biological model that couples aquatic carbon chemistry to phytoplankton carbon:nutrient stoichiometry and growth. Model predictions are validated against experimental data. We will use the model to explore changes in dominant physiological traits and phytoplankton dynamics along a range of carbon:nutrient concentrations.

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THE IMPORTANCE OF BACTERIA AS A SOURCE OF C, N, AMINO ACIDS AND FATTY ACIDS FOR BENTHIC FAUNA INVESTIGATED BY STABLE ISOTOPE LABELING

In order to clarify the importance of bacteria as a source of carbon, nitrogen, amino acids and fatty acids for the benthic fauna in intertidal mud flat sediment, we performed a dual stable isotope labeling experiment. 13C-glucose and 15N-ammonium were injected into the upper 10 cm of intertidal mud flat sediment. 13C and 15N were subsequently traced into bacterial biomass (represented by hydrolysable amino acids (HAAs) and phospholipid-derived fatty acids (PLFAs)) and benthic meio- and macro fauna (hand-picked). For three macrofaunal taxa (Nereis diversicolor, Heteromastus filiformis and Oligochaeta), 13C and 15N were specifically traced into their HAAs and fatty acids. Results reveal a strong preferential incorporation of bacterial nitrogen over carbon by most meio- and macro faunal taxa and indicate that bacteria can be an important source of nitrogen in the faunal diet. The compound-specific results provide detailed information about the pathways for uptake and synthesis of individual amino acids and fatty acids by the two polychaetes and oligochaetes.

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METABOLISM AND NUTRIENT CYCLING IN TWO CANALS OF THE URBAN CENTRE OF VENICE (ITALY)

Coastal ecosystems receive an increasing delivery of raw sewages with detrimental effects on water quality. An example is given by the canal network of the urban area of Venice. Here we studied two canals, aiming at assessing biogeochemical processes and water quality. Dissolved inorganic and organic nutrient concentrations in the water column were determined over four day-night cycles, under different tidal conditions in summer and winter. Organic carbon mineralization, denitrification (Dt), nitrate ammonification (DNRA) and sulphate reduction (SRR) rates and inorganic nutrients fluxes were measured both in the water column and at the water-sediment interface. The sedimentary organic matter bulk fuelled high bacterial mineralization rates, mainly through anaerobic metabolism. SRR accounted for up the 95% of total mineralisation rates, whilst Dt and DNRA represented only a small fraction of organic carbon respiration. Overall sediment metabolism accounted for about 60% of organic matter mineralization of the whole system (sediment and water column) but had a low capacity to dissipate the nutrient load which was mainly recycled to the water column as ammonium and reactive phosphates.

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OXYGEN DISTRIBUTION AND RESPIRATION RATES IN NW MEDITERRANEAN DEEP WATERS.

The rate of oxygen consumption by remineralisation processes is a crucial term for the quantification of the carbon exported to the deep ocean. Furthermore, recent evidence has raised the possibility of respiration rates in the dark ocean higher than previously believed. This could be particularly true for NW Mediterranean, due to its comparatively high temperature and dissolved organic matter supplies. Here we use hydrographical (temperature, salinity, density) and oxygen data obtained in NW Mediterranean, across the North Balearic Front, during the EFLUBIO-2 cruise (between March 25 and April 5 2005). We found minimum oxygen layers associated to the presence of Levantine Intermediate Water (LIW). The oxygen distribution was dominated by the pattern of deep water formation and the spreading and mixing of water masses in the region. Salinity and oxygen in the layers between the LIW and the Western Mediterranean Deep Water (WMDW) were fitted to a diffusion-advection mixing model. Discrepancy between the conservative tracer and oxygen allow an estimate of the rate of respiration in those waters.

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POTENTIAL IMPLICATION OF HOST/SYMBIONT RECOGNITION MECHANISMS DURING CORAL BLEACHING

If the stress triggering coral bleaching and the symptoms of bleaching are to date relatively well characterized, the molecular mechanisms underlying the symbiosis breakdown remain poorly understood. In the present study, we develop a novel global transcriptomic approach using a Suppression Subtractive Hybridization (SSH) technique and focus on genes early regulated under a thermal stress leading to bleaching. The associated result of Q-RT-PCR identified two promising gene candidates that showed an important decrease in their transcription rates following thermal stress and prior to zooxanthellae loss. After complete open reading frame characterization by RACE-PCR, the similarities and protein domain analyses showed that one of the genes contains a DC-SIGN domain characteristic for C-type lectin and the other a cystein array shared by snake toxins and some proteins involved in cell adhesion. We called these genes Pd-CLectin and Pdcyst-rich. The implication of these molecular actors suggests a possible role of recognition mechanisms between the host and its symbiont in the breakdown of the symbiosis during the bleaching phenomenon. Immunohistochemistry is currently underway to confirm our hypotheses.

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A GROWTH PHASE SPECIFIC RELEASE OF POLYUNSATURATED ALDEHYDES BY THE DIATOM *SKELETONEMA MARINOI*.

Polyunsaturated aldehydes (PUA) have been identified as potential signals triggering programmed cell death in diatoms. However the presence of PUA in the medium surrounding diatoms was only hypothesised. By analysing the medium of a *Skeletonema marinoi* culture, we discovered a synchronised release of PUA. The release occurs transiently before the culture changes to the decline phase, providing a time limited potential signal. When cultures are exposed during different stages of growth to PUA in concentrations found in the medium no general responses were found. However, an effect on cell concentration can be observed under specific conditions when cultures in the late stationary phase are challenged with PUA.

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FISH FARMING IMPACT ON FORAMINIFERAL COMMUNITY: PRELIMINARY RESULTS FROM FISH FARM AT DRVENIK ISLAND, ADRIATIC SEA, CROATIA

Foraminifera are unicellular marine organisms increasingly used as bioindicators. The fish farming impact on sediment and foraminifera has been studied at fish farm near Drvenik Island. Samples were taken under the cage (DT1, 44.9 m), near the cage margin (DT2, 52.3 m) and on reference station (DTR, 55.7 m). The association at the station DT1 is characterized by Epistominella exigua, Globocassidulina subglobosa, Haynesina germanica. The abundances of listed species are decreasing toward DTR station. Representatives of genera Elphidium, Bulimina and Brizalina have same trend in abundances. Contrary, species Asterigerinata mamilla, Neoconorbina terquemi and genus Cibicides are dominant at DTR and almost absent from DT1 and DT2 samples. Total phosphorus (TP) and total nitrogen (TN) concentrations in the sediments are enhanced at station DT1 and are decreasing gradually from the cage. The abundances of E. exigua,

G. subglobosa, H. germanica and genera Elphidium, Bulimina and Brizalina are correlated with TP and TN, indicating their dependence on nutrient input. The absence of A. mamilla, N. terquemi and genus Cibicides at DT1 and DT2 is consequence of degraded community of marine plant Posidonia.

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SEASONAL VARIABILITY OF DOC, MONO- POLYSACCHARIDES AND CHROMOPHORIC DISSOLVED ORGANIC MATTER IN MEDITERRANEAN COASTAL WATERS

The build-up of dissolved organic carbon (DOC) in upper ocean waters is an important process in carbon fluxes. Nevertheless, knowledge on the amplitude and the factors involved in this seasonal signal is far from complete, due to the limited availability of data with sufficient resolution an the poorly DOC characterization. Here we report on DOC, mono- polysaccharide concentrations (MCHO, PCHO) and chromophoric and fluorescent "marine humic-like" dissolved organic matter (aCDOM and MH) from filtered water samples. Surface samples were collected monthly at a fixed station during two years in Blanes Bay, in the NW Mediterranean Sea. DOC concentrations ranged from 68 in winter to 91 μM C at the summer maximum. PCHO ranged from 3 to 46 μM C and contributed to 40% of the summer DOC, while MCHO showed small seasonality with average concentrations of 10±0,7 μM C. aCDOM (355) and MH ranged from 0.09 to 0,32 m-1 and 1 to 10 μM C, respectively, with a maximum of MH in autumn. Data are discussed in relation to autotrophic and heterotrophic processes and the nutrient regime of the Bay.

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TRANSCRIPTOMIC ANALYSIS OF A SARGASSO SEA BACTERIOPLANKTON COMMUNITY ENRICHED WITH DIMETHYLSULFONIOPROPIONATE (DMSP)

We analyzed gene expression profiles of a prokaryotic community from surface waters of the western North Atlantic Ocean (BATS station). Samples were enriched with the organic sulfur compound DMSP (25 nM, final concentration) and compared with a no-addition control. An average of 270,675 unique reads were obtained per treatment after using 454 pyrosequencing technology to sequence the extracted and amplified messenger RNA (mRNA). Approximately 41% of the reads were assigned a protein function based on BLAST analysis against the NCBI RefSeq database. Transcripts in the DMSP treatment had more frequent hits to Gammaproteobacteria, suggesting that this group might be the first to react when DMSP becomes available. DMSP enrichment resulted in relatively higher expression of genes required for growth and energy generation. Separate specific enrichments with various products of DMSP degradation were also performed along with biogeochemical rate measurements (DMSP uptake, consumption and assimilation). Using bioinformatic tools to identify transcripts from known DMSP-related genes, we generated ecosystem-specific primers for several DMSP degradation steps. Rate measurements were less sensitive in tracking subtle changes in sulfur cycling than direct tracking of gene expression.

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TESTING THE POTENTIAL OF ^{90}Y /^{90} SR DISEQUILIBRIA IN ESTIMATING OCEANIC POC EXPORT OVER DAILY TIMESCALES

Short-lived radioisotopes have been used in marine systems as tracers of particle export over timescales of weeks (^{234}Th, $T_{1/2}$ = 24.1 days) to months (^{210}Po, $T_{1/2}$= 138.4 days). Here, we present some of the first seawater measurements of ^{90}Y/^{90}Sr disequilibria in order to investigate particle export on *daily* timescales, following the recent development of this novel proxy in a freshwater lake. In aquatic systems, ^{90}Sr ($T_{1/2}$= 29,1 years) originates predominantly from atmospheric fallout produced by nuclear weapons testing. Its radioactive daughter, ^{90}Y, is a beta emitter characterised by both a short half-life (64 hours) and high particle reactivity, similar to ^{234}Th and ^{210}Po. Several methods were tested and optimised for the quantitative and rapid extraction of ^{90}Y and ^{90}Sr at sea involving scavenging onto manganese fibers, co-precipitation with iron-oxide, and purification via ion-exchange chromotography. Methods were tested on seawater samples collected from Mediterranean Sea surface waters and in a depth profile from the Gulf of California. Our results suggest that ^{90}Y/^{90}Sr disequilibria is a potentially valuable tool for examining short-lived episodic particle export events in marine systems.

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ASSIMILATION OF CARBON BY CRUSTACEAN ZOOPLANKTON: EFFECTS OF NUTRIENTS AND UV RADIATION

We used in situ feeding experiments to study the carbon assimilation efficiency (CAE) in zooplankton in a set of 23 mountain lakes. CAE strongly varied among different zooplankton taxa (5-100%). In order to understand the potential mechanism behind CAE variability in nature, we performed field factorial experiments to examine the effects that manipulation of light (absence versus presence of UV radiation) and nutrient (addition of P) regimes exerted on primary production, seston and zooplankton C:P ratios and subsequently on the CAE in zooplankton. Adding P in the presence of UV radiation resulted in enhanced primary production, unaltered seston C:P ratio, decreased zooplankton C:P ratio (loss of C) and high CAE. In contrast, UV radiation did not significantly alter primary production, reduced seston C:P ratio, enhanced zooplankton C:P ratio (loss of P) and significantly declined CAE. These findings suggest that UV radiation has a strong role controlling the efficiency on which energy is channelled up the food web. The potential mechanisms responsible for the low CAE due to UV radiation will be discussed.

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INTEGRATION OF REAL-TIME DATA IN FORECASTING PHYTOPLANKTON DYNAMICS IN LAKES - APPLICATION TO METALIMNETIC CYANOBACTERIA

As the quality of freshwater bodies is a major concern of the European Water Framework Directive, a strong demand in autonomous monitoring and forecasting systems is rising. A main threat for lake water quality originates from phytoplankton blooms. Cyanobacteria are specifically targeted because many species, potentially toxic, can threaten public health and impair the water uses. The design of the developed system consists of a freshwater-adapted measurement buoy, the remote data transmission (Temperature, Chlorophyll, Oxygen,..), the definition of data-based phytoplankton indicators and the automated data integration into predictive modelling of phytoplankton dynamics. A first prototype has been launched in Lake Bourget, a deep, subalpine lake where a metalimnetic cyanobacterium frequently proliferates. Since July 2007, the system has been continuously measuring at a single depth (15m) in the metalimnion. In this communication, the medium-term predictive modelling framework and the first modelling results are presented. Previously, a method was developed in order to infer the vertical representativeness of the data time series. Particularly, the method takes into account the influence of the internal waves on data measured in the metalimnion. The results are used for defining phytoplankton growth indicators.

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DOES ALUMINUM RESTORATION OF LAKES AFFECT MACROPHYTE GROWTH? GROWTH OF *LITTORELLA UNIFLORA* AND *POTAMOGETON CRISPUS* UNDER ALUMINUM EXPOSURE.

Addition of aluminum (Al) to lakes has become an acknowledged method for inactivation of phosphorus. Effects of Al treatment have been studied for sediment parameters, benthic fauna and to some extent phytoplankton. To our knowledge no studies have yet focused on submerged macrophytes. Aluminum can inhibit growth of roots and impair uptake of phosphorus, but this has mainly been studied in plants in acidic lakes or soils. In a Danish soft water lake, which is going to be restored by aluminum treatment, we tested the effects of Al treated sediments on the growth of the macrophytes *Littorella uniflora* and *Potamogeton crispus*. While the growth of *L. uniflora* was 40 % lower when exposed to Al compared to the control group, no effects of Al were seen on the growth of *P. crispus*. However, the survival rates of *P. crispus* where 20 % higher in the control plants. No differences could be traced in phosphorus content in porewater or plants. The results suggest extra care should be taken during Al treatment of lakes with populations of *L. uniflora*.

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BIOGEOCHEMICAL TRANSFER OF TRACE NUTRIENT ACROSS THE OXIC/ANOXIC INTERFACE OF A CRATER LAKE: NEW CONSTRAINTS FROM MOLYDENUM STABLE ISOTOPES

Lake Pavin, a meromictic crater lake located in the French Massif Central, has a permanent oxic/anoxic interface that generates large vertical chemical gradients. For instance, the mesolimnion is enriched with iron sulfide colloids that play a role in the continuous removal of dissolved molybdenum. Above the mesolimnion, adsorption onto iron and manganese oxides, as well as assimilation by Diatoms, are transient removal pathways that also regulate molybdenum distribution. Dissolved molybdenum isotopic compositions were determined for 5 samples in order to characterize sources (river, mineral spring) and compartments (mixolimnion, mesolimnion, monimolimnion). Results exhibit a range of delta 98Mo from 0.2 to 1.4 per mil relative to JM-ICP standard (Siebert et al., 2001). Such large differences are only explained by fractionation within the lake. 1D reactive transport modeling was used to quantify the relative importance of biogeochemical processes in the water column that satisfies these isotopic constraints. The quantitative interpretation of this unique dataset provides a better understanding of how molybdenum isotopic signature is acquired in freshwater systems.

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PREFERENTIAL CONCENTRATION OF PLANKTON BY TURBULENCE: A CRITICAL EXAMINATION OF MECHANISMS.

The preferential concentration of plankton by turbulence is a potentially important effect, influencing the coagulation of detrital material and the contact rate of planktonic predators and their prey. Here, I critically examine the underlying physics, specifically processes that lead to differences between the trajectories of fluid elements and rigid, finite sized inertial particles. Two distinct mechanisms are identified. The first relates to the density contrast between planktonic particles and the fluid within which they are imbedded. This magnitude of effect is proportional to $(1 - c)$ St where c is a parameter expressing the density contrast and St is the Stokes' number. For neutrally buoyant particles $c = 1$, and this effect disappears. The other potential mechanism relates to spatial structures in the flow field. The case for this mechanism is much less secure as it only comes into effect for $St > 1$, a condition that in this context violates the legitimacy of underlying dynamic analysis.

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TEMPERATURE SENSITIVITY OF ISOLATED ZOOXANTHELLAE AND HOLOBIONTS OF THE CORALS MADRACIS SENARIA AND AGARICIA SPP.

The coral genera Madracis and Agaricia are abundant on Caribbean reefs and harbour clade B and C, respectively. Madracis corals hardly bleach, while Agaricia corals bleach frequently. We hypothesize that zooxanthellae from the corals Agaricia lamarcki and A. agaricites (both harbouring C types) have a higher temperature sensitivity than the zoox from M.senaria (type B7) due to a higher ratio of unsaturated and saturated fatty acids. We took samples of the zooxanthellae isolated from these coral genera for analysis of the lipid composition (currently being analysed). We performed experiments with zooxanthellae and with coral fragments at different temperatures. All freshly isolated zooxanthellae cultures showed a decline in the quantum yield during the first hours of incubation at 33 and 35oC compared to the control temperature (28oC). Zooxanthellae of A. lamarcki showed the lowest decrease in quantum yield compared to A. agaricites and M. senaria. Surprisingly, the quantum yield of zooxanthellae showed hardly a reduction when coral fragments were incubated at these temperatures. Apparently, the holobiont is less sensitive to temperature changes than isolated zooxanthellae.

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THE FATE OF TERRESTRIAL AND RIVERINE MATERIALS IN A MEDITERRANEAN EXPLOITATION SEAGRASS BED

Coastal marine ecosystems receive large amounts of organic matter from a variety of sources, both autochthonous, such as phytoplankton, microphytobenthos, macroalgae, and vascular plants, and allochthonous, such as riverine terrestrial materials. These sources of organic matter are unequally exploited by consumers as a function of their abundance, digestibility, nitrogen content and environmental constraints (e.g. hydrodynamism). In this study we analysed potential sources and the most abundant invertebrate consumers for carbon and nitrogen stable isotope ratios along a transect river-estuary-sea in southern Sicily (Italy) to explore the fate of terrestrial and riverine materials in the coastal marine ecosystem. We found very high variability in the isotopic composition of organisms. More depleted carbon isotopic signatures were exhibited in species collected in the river and estuary stations and a gradual enrichment was observed in the marine stations moving toward the open sea. The opposite trend was found for nitrogen stable isotope ratios. These results suggest there is exploitation of terrestrial riverine organic matter in the marine ecosystem, implying a direct link between the terrestrial and marine food webs.

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BIOAVAILABILITY OF METALS RELEASED FROM LYSED AND UNLYSED MARINE BACTERIAL CELLS

The release of four metals (Fe, Zn, Cd, and Am) from lysed and unlysed *Vibrio natriegens* cells was measured using radioisotopes, and the bioavailability of the released metals was assessed using the bacterium *Pseudoalteromonas atlantica* and the diatom *Thalassiosira pseudonana*. Viral lysis of radiolabeled *V. natriegens* cells released significantly more Cd into the dissolved phase (78%) than did unlysed cells (50%), but the other metals showed no such difference. Subsequent metal accumulation by diatoms was not significantly different whether the metals were released from lysed or unlysed bacteria. However, *P. atlantica* concentrated 11 times more Fe and 3 times more Am when the metals were released from unlysed bacteria compared to the lysed cells. The data indicate that viral lysis can enhance the release of at least some metals from bacterial cells to ambient seawater, but no consistent influence of viral lysis is observed on the relative bioavailability of released metals to bacterioplankton or phytoplankton. Data on the uptake of different metals by diverse marine bacterial strains will also be presented.

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MODELLING THE MARINE DMS CYCLE IN A GLOBAL PHYTOPLANKTON FUNCTIONAL TYPE MODEL: INFLUENCES OF ECOSYSTEM COMPOSITION AND ENVIRONMENTAL CONDITIONS

We study the seasonal dynamics of dimethylsulphide (DMS) and dimethylsulphoniopropionate (DMSP) using the global biogeochemistry model PlankTOM5, which includes 3 phytoplankton and 2 zooplankton functional types. A fully prognostic DMS module describes intracellular particulate DMSP production, concentrations of dissolved DMSP and the production and consumption of DMS. The model produces annual mean DMS fields that compare well with observations, and predicts emissions of 23 Tg S yr^{-1} for the present period. The modelled ecosystem composition and chlorophyll influenced zonal average DMS concentrations, but did not control the seasonal cycle in the low latitudes. The introduction of a direct, insolation-dependent DMS production term (exudation) improved the match between modelled and observed seasonalities and led to a decoupling of DMS and chlorophyll in the low latitudes (Summer Paradox). The agreement between model and data for DMS, DMSPp and DMSPd at the Bermuda Atlantic Time Series station is good, showing that these local DMS patterns can successfully be simulated in a global DMS model constructed to represent global DMS seasonality.

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USING FUNCTIONAL TRAITS TO INVESTIGATE THE DETERMINANTS OF ZOOPLANKTON COMMUNITY STRUCTURE

Recent approaches to defining determinants of community structure have used phylogenetic dispersion patterns to infer the relative importance of competition versus habitat filtering. Central to the approach has been the assumption that closely related species should be more functionally similar. We explored this assumption by directly using a matrix of functional traits to investigate dispersion patterns in zooplankton communities. Our analysis included the following traits: mean body length, feeding and predator evasion strategies, feeding selectivity, trophic group, and habitat preferences. For a dataset comprising 41 species of crustacean zooplankton across 53 lakes in South-Eastern Canada and spanning a wide range of physico-chemical characteristics, we found a strong signal for positive and negative species co-occurrences, suggesting that species distribution patterns were non-random. When exploring the influence of functional traits aggregated at the genus level, we found strong signals for over-dispersion in some lakes, but under-dispersion in others. These results suggest that habitat filtering might be the important structuring factor in some zooplankton communities, while competition might be more influential in determining the structure of others.

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IMPACT OF FRESHWATER INPUT AND SALINITY ON SHELLFISH RESPONSES IN THE CALOOSAHATCHEE ESTUARY, SW FLORIDA.

Alterations in freshwater inflow, resulting from watershed development and water management practices, have impacted salinity and water quality within southwest Florida estuaries thereby affecting responses of valued ecosystem components such as oysters. This study investigated the effects of seasonal changes, watershed management, freshwater inflows and salinities on oyster responses in the Caloosahatchee River, Florida. Significant relationship exists between freshwater inflows and salinities in the estuary (R2 69 - 84%). Prevalence and intensity of *Perkinsus marinus* infection varied over the sampling period and decreased with increase in freshwater inflows and lower salinities. While oyster spat were flushed downstream during high flow seasons, recruitment and juvenile oyster survival was low due to predation during drought years. Inflows between 500 and 3500 cubic feet per second would result in optimal salinities that would support and enhance oyster reefs in the Caloosahatchee estuary. Reduced freshwater inflows into the estuaries during the spawning months (May – October) will facilitate the spat recruitment onto oyster reefs.

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UNVEILING THE HIDDEN LIFE OF A VERY VISIBLE PHYTOPLANKTON: DEEP TRANSCRIPTOMIC COMPARISON OF 1N AND 2N LIFE PHASES OF *EMILIANIA HUXLEYI*.

Emiliania huxleyi is a cosmopolitan coccolithophore regularly forming massive blooms. The life cycle involves 2N calcified, non-motile cella and 1N non-calcified, motile cells. Little is yet known about 1N cells, but they might represent a survival strategy as 1N cells are resistant to viruses terminating 2N cell blooms. We conducted deep transcriptomic comparisons of 1N and 2N cells originating from the same parental strain, RCC1216, using high-throughput Sanger sequencing of normalized cDNA libraries and 454 pyrosequencing of non-normalized libraries. Large transcriptomic differences were seen both between 1N and 2N libraries and with the public EST databases from *E. huxleyi* CCMP 1516. Transcript reads related to signaling, motility, and cytoskeleton were represented more in 1N compared to 2N libraries. Flagella-related transcripts were 1N-specific. Transcript reads related to inorganic ion transport, carbohydrate metabolism, and energy production/conversion were represented more in 2N than 1N libraries. 2N-specific transcripts included homologs of calcium and carbonate exchangers. Core cell processes utilized separate but homologous genes in 1N vs 2N cells. This work documents the system-wide differentiation over the life cycle of *E. huxleyi*.

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EFFECT OF CYANOBACTERIAL PROTEASE INHIBITORS ON HERBIVORES: INTRASPECIFIC DIFFERENCES IN DAPHNIA MAGNA

It is becoming increasingly clear, that protease inhibitors are widespread in cyanobacteria. This strongly suggests that these inhibitors serve as a defence against herbivores. Here we ask how these inhibitors affect the major predator, the herbivore Daphnia, and how they interact with the digestive proteases of Daphnia. In growth experiments three clones of Daphnia magna proved to differ in sensitivity to the cyanobacterium Microcystis aeruginosa that produces protease inhibitors. However, the sensitivity of the digestive proteases of these three Daphnia clones did not differ. Gelelectrophoresis revealed that several digestive proteases are present in D. magna. In the presence of dietary protease inhibitors other digestive proteases are detected in the herbivores. The three clones of D. magna differed in their plasticity of digestive proteases, and the most resistant clone switched to less sensitive proteases when dietary protease inhibitors occured. These findings suggest that cyanobacterial protease inhibitors act as an anti-herbivore defence and may affect the clonal composition of Daphnia populations. The plasticity of Daphnia in the pattern of digestive proteases may constitute a feed-back to defensive protease inhibitors in cyanobacteria.

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NITROGEN CYCLING IN A MEDITERRANEAN STREAM: A 15N TRACER STUDY USING LABELLED NITRATE AND AMMONIUM

We conducted short-term (12 h) additions of 15N labeled nitrate (NO3) and ammonium (NH4) to investigate nitrogen (N) cycling at the whole-reach scale in a Mediterranean stream located in Catalonia (NE Spain). The 15N signature of different forms of N was analyzed in samples of stream water and primary uptake compartments collected before, during and after the additions. We also measured stream hydro-morphological and metabolism parameters, as well as the standing stocks of the primary uptake compartments. The use of the isotopic tracers allowed us to simultaneously quantify N removal (i.e. denitrification), retention (i.e. assimilatory uptake by the different primary uptake compartments), transformation (i.e. nitrification, DNRA) and export pathways. Results showed that the study stream had a strong ability to take up dissolved N, although NH4 was preferentially taken up over NO3. Nitrification and DNRA were relevant processes, whereas denitrification was undetectable. Export of the retained N was fast due to rapid regeneration. Overall, our results evidence fast N cycling in the study stream due to a strong coupling among retention, regeneration and transformation pathways.

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FLOCCULATION OF ALLOCHTHONOUS ORGANIC CARBON – A REGULATOR OF ORGANIC CARBON BURIAL IN BOREAL LAKES?

Precipitation and runoff are predicted to change in many areas due to climate change. Higher runoff leads to shorter residence times and higher concentrations of dissolved organic carbon (DOC) in boreal lakes. Higher DOC concentrations may result in enhanced flocculation of DOC relocating organic carbon from the water column to the sediments, and enhancing the role of sediments for the carbon dynamics. Along a gradient of boreal lakes with different DOC concentrations, we found that higher lake water DOC was related higher rates of sedimentation of flocculated DOC, and lower sediment respiration rates. This suggests that increased allochthonous DOC input to lakes results in increasing carbon sequestration in the sediments. We extrapolated the data from a representative set of lakes to a regional scale to assess the importance of sedimentation processes and benthic mineralization, and to predict how altered DOC concentrations would affect the carbon balance in a changing climate.

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C:N:P STOICHIOMETRY OF PERCH – EFFECTS OF ALLOMETRY, HABITAT AND DIET

Eurasian perch is a common and widespread fish species that show ontogenetic diet shifts, polymorphism, and resource use specialization. This makes it an interesting species for studies of C:N:P stoichiometry and its allometric and ecological correlates. We sampled 144 individuals in littoral and pelagic habitats in mesotrophic temperate Lake Erken. Length, dry mass, diet and morphology as well as C, N and P content were analysed. The mean elemental composition was 44.2%C, 11.93%N, and 3.16%P (molar C:N:P stoichiometry 37:9:1). C increased with size. P changed unimodally with size with a negative quadratic relationship. P and N contents were higher in littoral perch whereas C content, C:N, C:P, and N:P were higher in pelagic perch. A morphological index, correlated with habitat, explained 3-18% of the variation elemental content. Diet had a weak influence on stoichiometry. The limited variability in C:N:P suggest that these elements are homeostatically regulated. Stoichiometric models of growth and nutrient cycling should therefore be applicable. The high P content relative to that of the food indicate that non-piscivorous perch feed on resources that have a suboptimal P content.

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GLOBAL SPECIES STRUCTURE AND BIOGEOGRAPHY OF THE MARINE DIATOM PSEUDO-NITZSCHIA PUNGENS

We studied global and regional variation in molecular markers, sexual compatibility and morphological characteristics in populations of the marine pennate diatom Pseudo-nitzschia pungens. Sequence variation of rDNA internal transcribed spacers (ITS) and rbcL revealed three distinct genetic clades, corresponding to the morphological entities var. pungens, var. cingulata and var. aveirensis. The capacity for inter-clade hybridization was shown in laboratory experiments and in the field for the first two clades. A population genetic survey using 6 microsatellite markers of the most widespread clade pungens demonstrated significant geographical differentiation between the populations at a global scale with geographical isolation being significantly correlated with population genetic differentiation, while at a regional scale significant gene flow appears to occur resulting in single unstructured populations. We compare these results with other recent studies on marine and freshwater diatoms to discuss the roles of species sorting mechanisms, migration and speciation rates as determinants of diatom geographies.

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IRON CYCLING DURING THE DUNE EXPERIMENT

Understanding the fate of atmospheric dust particles in the surface ocean is crucial to estimate their contribution to ocean iron stock and biogeochemical cycling. The goal of the DUNE project is to investigate the impact of dust deposition on the functioning of oligotrophic ecosystems. In the frame of this project, dust additions into large "trace metal clean" mesocoms were performed in triplicate in the Mediterranean Sea. This experimental design represented a unique opportunity to investigate the fate of atmospheric dust particles and the release of iron in the surface ocean. During the experiment, dissolved and particulate iron were daily followed allowing a better comprehension of the relative importance of dissolution and adsorption processes in the release of iron to the surface ocean. In vitro dust dissolution experiments were performed simultaneously to the mesoscom experiments. Results indicate a significant increase of the dust iron dissolution capacity of seawater after a dust deposition episode. These results will allow producing parameterization schemes for modeling the impact of dust deposition on the oceanic iron cycle.

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COPEPOD GRAZING BEHAVIOR IN RESPONSE TO DIFFERENTIAL TOXIN LEVELS IN CLONES OF THE RED TIDE DINOFLAGELLATE, *KARENIA BREVIS*

The red tide-producing dinoflagellate *Karenia brevis* has been associated with lethal and sublethal effects on zooplankton. Reductions in copepod grazing on *K. brevis* have been attributed to acute physiological incapacitation and nutritional inadequacy of the dinoflagellate. We designed food-removal experiments using the copepod *Acartia tonsa* and *K. brevis* clones CCMP 2228, Wilson and SP-1 (S. Pargee, UTMSI) to evaluate the potential toxicity or nutritional inadequacy of *K. brevis*. These clones were characterized using LC-MS as having high, low and no toxin levels, respectively. Two sets of experiments were run exposing *A. tonsa* to monoalgal and mixed algal diets of either CCMP 2228 and Wilson, or CCMP 2228 and SP-1 clones. Variable grazing rates were found in experiments involving highly toxic CCMP 2228 and weakly toxic Wilson clones with no significant differences. However, in experiments with CCMP 2228 and SP-1 clones, *A. tonsa* grazed non-toxic SP-1 at significantly higher rates than the toxic CCMP 2228. Behavioral experiments, currently underway, are indicative of sublethal effects on swimming and feeding of *A. tonsa* exposed to toxic clones CCMP 2228 and Wilson.

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STABILITY OF COMMUNITIES IN A CHANGING WORLD: FUNCTIONAL DIVERSITY MATTERS MORE THAN SPECIES NUMBER

Theory predicts that more species-rich communities are more stable when faced with environmental stressors such as bioinvasions and climate change. Experimental evidence supporting the richness – stability theory, however, is scarce and often ambiguous. In an effort to seek a robust and general pattern we ran identical mixed observational/manipulative experiments investigating the structural response of marine benthic communities to an imposed environmental change in 16 shallow marine sites in 8 countries on 4 continents. Slow restructuring was considered a surrogate of community stability. Meta-analysis of the responses of several hundred investigated communities showed that resource availability and species dominance were destabilizing factors, while functional richness and species richness acted as stabilizing factors. However, the most commonly used metric of biodiversity, species richness, had the weakest relationship to stability and was significantly less important than functional diversity.

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CORAL REEFS CATALYZE PLANKTONIC NITROGEN AND CARBON TRANSFORMATIONS AT NINGALOO, WESTERN AUSTRALIA

At Ningaloo Reef, Western Australia, we documented rapid transformations in planktonic community structure over a hard coral dominated benthos. The benthic community was barely net autotrophic in late spring (P/R ~ 1.3); rapid increases in pelagic oxygen concentrations as oceanic water flowed over the reef showed the critical importance of benthic biogeochemistry for planktonic communities. Planktonic changes occurred over the relatively short (~8 h) residence time in the lagoon, and included changes in zooplankton size structure, a reduction in concentration of small (< 5 micron) phytoplankton and an increase in large phytoplankton concentrations. Zooplankton communities became more copepod-dominated and less diverse. Peaks in nitrate across the reef flat suggest it is a potentially major source of this important nutrient for large phytoplankton, the surf zone being a likely site for rapid biogeochemical transformations of carbon, and nitrogen (N). The oceanography suggests N limitation of coral reef benthic production, but even at moderate benthic production levels, we calculate that dissolved inorganic N would not be sufficient to support reef growth. Both zooplankton and phytoplankton N are likely to be important for the reef, but we speculate that dissolved organic N sources are also likely to be important. Clearly, coral reefs are dependent on planktonic nutrients to fuel benthic production while they strongly impact planktonic ecology and biogeochemistry.

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TRACE METAL DISTRIBUTIONS IN THE SOUTHERN OCEAN AND SOUTH-EASTERN ATLANTIC OCEAN

The meridional and vertical distribution of dissolved concentrations of trace metals (Fe, Zn, Cu, Cd, Ni, Mn, Al, Pb) was measured in samples collected during the BONUS-GOODHOPE cruise Feb-Mar 2008. Analysis was by isotope dilution-inductively coupled plasma-mass spectrometry (ID-ICP-MS). The samples span the temperate waters of the Southeast Atlantic – the waters off South Africa (34.5S 14.5E); across three frontal zones (Subtropical; Subantarctic; and Polar Front); into the polar waters of the Antarctic Zone and the Weddell Gyre, south of the Antarctic Circumpolar Current (57.5S 2W). The information on the trace metal concentrations will be analysed with regard to hydrological parameters (nutrients, temperature, salinity, dissolved oxygen); phytoplankton taxonomy and abundance; and compared to trace metal data measured using different methods by fellow cruise participants. The information obtained will provide insights into the link between phytoplankton species distributions and these trace metals as well as increase the small database of the dissolved trace metal concentrations in the world's oceans, particularly the Southern Ocean.

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POST-SETTLEMENT MOVEMENT IN A CORAL-DEPENDENT FISH AND POTENTIAL SIGNIFICANCE IN A CHANGING ENVIRONMENT

Habitat loss and degradation especially affects habitat-specialized reef fish that heavily depend on live corals. Flexibility in habitat choice, however, is important to compensate for a potential habitat alteration or loss, but detailed information about post-settlement movement of such coral-associated fishes is lacking. Moreover, susceptibility increases when fishes exhibit behavioral traits such as homing, partner and home-coral fidelity. Post-settlement movement, homing and the dependency on both home-coral and partner was surveyed in *Gobiodon histrio*, a coral-associated gobiid fish. Our study shows that movement frequency of *G. histrio* depends on social status, with single adults being very mobile and breeding pairs moving infrequently. Aquarium experiments revealed high habitat fidelity and considerable partner recognition. In general, habitat quality strongly affects fitness, and selection pressure thus generates strategies for optimal breeding habitat choice. The high proportion of single adults and their high movement rate indicates limitation of high quality habitats for breeding. Hence, inflexibility in breeding habitat preferences combined with high habitat fidelity increase vulnerability to habitat degradation, especially when individuals breed.

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MICROSCALE SPATIO-TEMPORAL PATTERNS OF OXYGEN DYNAMICS IN INTERTIDAL SEDIMENTS (SKALLINGEN, DENMARK)

Small scale heterogeneity of oxygen dynamics in an intertidal sand flat was monitored in situ over tidal cycles (24 hrs) by using a transecting microprofiler and in situ benthic chambers. Hydrodynamics and sediment transport were assessed by simultaneous measurements of currents, waves and turbidity. Data revealed an extensive temporal and spatial variation in microphytic photosynthesis and microbial respiration. In the submerged state hydrodynamic forcing and bed level change (erosion/deposition) proved to exert a prime control on the benthic exchange and activity. As the tidal flat emerged, changes in light conditions and (micro-) topography became dominant factors. The system rarely reached quasi steady state and the extreme dynamics in such environments compromise traditional approaches for quantifying estimates on the autotrophic and heterotrophic activity. Integrative in situ studies covering a range of spatial and temporal timescales are required to fully quantify the importance of such intertidal environments for regional element cycling. On the basis of an extensive data set the impact of short- and medium-term dynamics on production, mineralization and preservation of carbon is evaluated.

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ECOLOGICAL GENOMICS OF A MARINE OXYGEN MINIMUM ZONE

Oceanographic and climate models predict, and observational studies corroborate the expansion of marine oxygen minimum zones (OMZs) throughout the global ocean. This expansion is having a direct effect on coastal benthic ecosystems and the productivity of marine fisheries due to habitat loss and changes in microbial mediated nutrient cycling. In order to understand, respond to, or mitigate these transitions it is imperative that studies to monitor and model microbial dynamics in relation to physical and chemical oceanographic parameters be put into place. Despite recent progress, descriptions of the phylogenetic composition and metabolic potential of microbial communities within OMZ systems remain deficient. In this study, we generated time-resolved metagenomic profiles spanning the oxycline of Saanich Inlet, a seasonally anoxic fjord on the coast of British Columbia. Comparative metagenome analysis using phylogenetic and statistical ecology-based approaches identified taxa, genes, and metabolic pathways that characterized microbial consortia within hypoxic compartments of the water column. The findings are applicable to our general understanding of microbial diversity and energy metabolism within hypoxic marine ecosystems worldwide.

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BIODIVERSITY AND DISTRIBUTIONAL PATTERNS OF THE ROTIFERS IN CHIHUAHUAN DESERT WATERS (US AND MEXICO)

We surveyed 128 aquatic sites in the Chihuahuan Desert and identified 237 rotifer species, representing 11.7, 50.5 and 76.7% of species, genera, and families, respectively. Of these, 69% are Cosmopolitan; 14.8% are Nearctic, 1.5% are Neotropical. We used 4 indices of community similarity (Taxonomic Distinctness, STI, IFO, Analysis of Similarity) to compare species composition among sites. Sites in Big Bend National Park (TX) and Bottomless Lakes State Park (NM) demonstrate above average taxonomic distinctness. STI and IFO values for sites within BBNP and Mexico sites were quite high. Species composition was significantly related to geographic region (Global R = 0.125, significance level 0=0.2%). Nestedness Analyses showed that these sites are significantly nested (four null models, p<0.001); 10 species possessed unusual dispersions (idiosyncratic T > 2SD of mean matrix T). RDA indicates habitat types are significant variables that determine species composition and they differ in predictability, habitat permanence, and complexity. Thus Chihuahuan Desert rotifers are not randomly distributed, but occur as spatially ordered subsets of unique assemblages. Our findings will help inform conservation and management prioritization of these highly imperiled habitats.

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WAVE-DRIVEN SEABED RESUSPENSION: A KEY PROCESS MODULATING SEDIMENT AND SOLUTE DISPERSAL IN THE ALBEMARLE-PAMLICO ESTUARINE SYSTEM, NC , USA

Human activities have significantly altered sediment and solute fluxes to the coastal ocean, influencing the health of our estuaries. It is critical to examine individual systems so their land-ocean interaction is understood, and they can be appropriately managed. The Albemarle-Pamlico Estuarine System (APES) is a large, shallow microtidal coastal system in North Carolina, USA. Four rivers, draining approximately 64,000 km^2, discharge about 700 m^3/s and 9×10^5 tonnes/y of water and sediment, respectively, into the APES. In situ measurements of water and sediment transport and changes in down-core radionuclide profiles were used to evaluate fluvial deposition and the frequency and magnitude of seabed resuspension. Data indicate wave-driven seabed resuspension occurs over 50 times per year at a monitored site. Although the majority of resuspension events have shallow erosion depths, they still reflect regular and voluminous remobilization of fluvial sediments. Profiles of ^{137}Cs document ~5 cm of erosion associated with the passage of Hurricane Ophelia in 2005, far greater than the amount typically deposited annually (<1 cm/y). Seabed resuspension should be considered in any models of land-ocean exchange and ecosystem management.

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DISAPPEARING PERMAFROST AND THE RESPONSE OF ARCTIC LAKES

Roughly half of the world's lakes are located in the Arctic. In some permafrost regions lakes cover 20-40% of the land surface. Climate warming is causing widespread warming and thaw of permafrost, a process that commonly leads to the formation of thermokarst (thaw) lakes. Once initiated, thermokarst lakes can expand and deepen through thermal and mechanical erosion along lake margins. We show that degradation of permafrost associated with lake expansion in Alaska and Siberia releases large amounts of previously immobilized carbon, nitrogen and phosphorus, stimulating biogeochemical cycles in the lakes. A key response to thermokarst within lakes is the microbial production of methane, a potent greenhouse gas whose warming potential is 25 times stronger than CO2. Methane is produced by anaerobic decay of organic matter in lake sediments, and escapes predominately via bubbling hotspots. A first order estimate based on measurements of 50 lakes in Siberia and Alaska suggests that northern lakes are responsible for up to 6% of global atmospheric methane sources. Projected warming and thaw of permafrost could increase emissions from thermokarst lakes at least 10-fold.

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FACTORS INFLUENCING THE RELEASE OF FIXED N_2 AND C AS DISSOLVED COMPOUNDS BY *TRICHODESMIUM ERYTHREUM* AND *NODULARIA SPUMIGENA*

Diazotrophic marine cyanobacteria contribute to a large fraction of new nitrogen and carbon by releasing fixed N and C. Little is known about the factors supporting this

exudation processes. We compared in this study *Trichodesmium erythreum* and *Nodularia spumigena* N_2 and C fixation rates and release of dissolved compounds firstly under unbiased optimal growth conditions. There was a strong periodicity in fixation and subsequent release of N and C visible. On average 71 % (*T. erythreum*) and 89 % (*N. spumigena*) of fixed N_2 was released. Exudation of DOC accounted for 50 % (*T. erythreum*) and 53 % (*N. spumigena*) of fixed C. Moreover, factors supporting the release of TDN and DOC were tested. There was evidence that high light intensity and resulting electron over consumption, leads to a pronounced exudation of TDN and DOC. The observed amount of TDN released in short-term observation (< 30 min) consumed up to 52 % of the electrons harvested. Overall, exudation of TDN and DOC seemed to be influenced internally trough fixation activity and externally by changing light supply.

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A STUDY OF PARTICLE DYNAMICS IN SHALLOW WATER USING DUAL TRACERS: Y-90/SR-90 & TH-234/U-238

While measurements of Th-234 disequilibria have proven very useful in understanding particle dynamics in the open ocean, the interpretation of Th-234 data in shallow and nearshore systems becomes especially difficult due to sediment resuspension. Here we present new data collected during 5 cruises over a two-week period (October 2007) in a shallow (20 m) nearshore setting in Lake Michigan. Disequilibria exhibited by two independent radioisotope pairs – fallout derived Y-90/Sr-90 (Y-90 half-life: 64 hours) and naturally occurring Th-234/U-238 (Th-234 half-life: 24.1 days) – were measured at three depths on each cruise. Attendant data include daily mass and Th-234 flux measurements collected with a sequencing sediment trap and 3D water current profiles. Preliminary analysis suggests that the trap derived fluxes of mass and Th-234 overestimated and underestimated fluxes derived from Th/U disequilibria measured in the water column when TSM concentrations were high or low, respectively. Mass fluxes derived from Y/Sr disequilibria, meanwhile, always exceeded both trap and Th/U derived fluxes by at least an order of magnitude. An interpretation of these data in relation to particle dynamics in shallow water is in progress.

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THE IMPACT OF THERMAL ANOMALIES TO REEF COMMUNITIES DOMINATED BY THE CORAL POCILLOPORA IN THE EASTERN PACIFIC.

It is unknown how or if particular coral species and their microalgal symbionts of the genus Symbiodinium are capable of acclimatizing to future thermal anomalies that are a primary causative agent of coral bleaching. Some consider that changes in symbiont distributions could push certain coral communities toward survival or extinction. To this end, the symbiont distributions of the dominant coral Pocillopora sp. were assessed in several regions of western Mexico that have been differentially impacted by coral bleaching. The result of short-term thermal stress experiments on coral photobiology, as well as long-term analysis of recovery from natural bleaching, coral growth, and fitness in Pocillopora harboring dominant populations of either C or D-type Symbiodinium was investigated. Results suggest that while both algal symbioses are stable, corals harboring the C-symbiont are more susceptible to photoinactivation by light, heat and cold stress. Further, previous thermal anomalies in the eastern pacific have led to significant changes in symbiont distributions primarily by differential mortality of the coral host. The long-term implications for recovery from future bleaching events in the eastern Pacific will be addressed.

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SGD DYNAMICS IN A SHALLOW, SEMI-ENCLOSED, MESO-TIDAL BAY MEASURED BY RA AND RN TRACERS

The shallow, semi-enclosed Hampyeong Bay in the southwest of South Korea is characterized by semidiurnal tides with water levels ranging from 3-4 m and extended mud-dominated tidal flats bordered by sandy beaches. Intertidal groundwater seepage is common along the sandy coastline, and may be an important contributor to biogeochemical fluxes from land to the sea. In May (neap tide), July (spring tide and rain season), and September (spring tide) 2008, we sampled pore water and bay seawater samples for the analyses of 223Ra, 224Ra, 226Ra and 222Rn, nutrients, benthic and pelagic microalgal pigment composition, and γ15N signatures for intertidal sediments, water samples, and algae. SGD fluxes were calculated using the short-lived radionuclide 222Rn and the long-lived radionuclide 226Ra and comprised about 2 % of the total bay water volume. SGD inputs increased from May to July and September. The seasonal fluctuations of SGD, as well as biogeochemical implications for nutrient fluxes and primary productivity in this bay, are discussed in the presentation.

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THE IMPORTANCE OF OYSTER REEF COMMUNITY IN THE DIET OF PREDATORY FISH

Oyster reefs (*Crassostrea virginia*) are valued ecosystem components providing food, shelter and habitat for numerous species in estuaries on the East and Gulf Coasts of the United States including SW Florida. While oyster reefs provide habitat for over 300 species, trophic transfer from oyster reefs to predatory fish populations that are recreationally important are not well understood. Gut contents of 318 individuals of 12 different species of predatory fish captured during wet and dry seasons in Estero Bay, Florida, were analyzed for relative importance index of prey species. While the species of fish varied with season, the diet of fish caught during the wet and dry seasons did not differ significantly. Prey species belonging to the decapods crustaceans (*Eurypanopeus depressus, Panopeus* sp., and Xanthidae sp.) that are almost exclusive to oyster reefs occurred in the majority of stomachs and contributed to 43% of the relative importance index. Results demonstrate the ecological importance of oyster reefs in trophic transfer.

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HIGH LATITUDE WATER COLORS: OPTICAL DIVERSITY OF PERMAFROST THAW LAKES IN THE FOREST-TUNDRA

Thaw lakes and ponds ("thermokarst" systems) result from the irregular melting and erosion of permafrost soils, and occur abundantly throughout the circumpolar North. This major class of high latitude aquatic ecosystems is attracting increasing scientific attention related to climate change. Northern soils store globally significant amounts of organic carbon, and these waterbodies may act as bioreactors, releasing soil-derived carbon into the atmosphere as greenhouse gases. In the forest-tundra region of Nunavik (Québec, Canada), thaw lakes show large differences in color even among nearby lakes. The colors range from green to, brown or black. To quantify this optical variation and to determine its underlying controlling mechanisms, we studied the apparent (AOPs) and inherent (IOPs) optical properties of the lakes, and their empirical relationship to the concentrations of optically active substances in the water column. We found that the pronounced variations in spectral light absorption by colored dissolved organic carbon (CDOM) and suspended solids determined the optical diversity. The results are applicable to remote sensing surveys of the vast sub-arctic region, and to scale up greenhouse gas production estimates from local measurements.

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IMPACT OF SALINITY ON INVERTEBRATE COMMUNITY PATTERNS IN MEDITERRENEAN TEMPORARY WETLANDS: FIELDSURVEY VERSUS FIELD EXPERIMENT

In a former fieldsurvey in the Camargue (Tour du Valat, France), salinity was a key factor shaping invertebrate community structure in temporary coastal wetlands. Secondary salinisation due to climate change and intensive agriculture has become an important threat to many freshwater systems. In several Mediterranean regions this could lead to the extinction of specialized, often endangered species. Especially permanent inhabitants would be affected because they can not actively escape. A mesocosm experiment was designed to study the impact of expected changes in wetland salinity on communities of such permanent inhabitants by exposing a pooled resting egg bank to a range of salinity regimes. Salinity was found to significantly influence abundance, diversity, reproduction and succession in the hatching crustacean communities. Observed salinity responses of the microzooplankton (cladocerans, copepods and ostracods) were somewhat atypical, probably due to indirect effects through biotic interactions with macrozooplankton (large branchiopods). Our study contributes to a better knowledge of temporary Mediterranean wetland communities and to the conservation of these unique habitats.

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HIGH LEVELS OF PHYLOGENETIC DIVERSITY OCCUR WITHIN THE HETEROTROPHIC FLAGELLATE OXYRRHIS MARINA

Oxyrrhis marina is a widely distributed marine heterotrophic flagellate used extensively as a model in physiological and ecological studies. Further, O. marina occupies an important phylogenetic position as a sister taxa to the dinoflagellates. Despite its significance in ecological modelling and phylogenetic contexts, basic assessements of intraspecific diversity within O. marina are rate. Recent studies based on a small number of O. marina isolates suggest that the current species is genetically and ecophysiologically highly diverse, consisting of 2 divergent lineages. Here we assessed phylogenetic divesity of >60 globally distributed O. marina isolates using nuclear (5.8s ITS rDNA) and mitochondrial (cytochrome oxidase I) DNA fragments. The patterns of phylogenetic relatedness between O. marina isolates based on rDNA and mitochondrial sequences were concordant. Both phylogenies indicated the occurrence of three distinct clades. Sequence similarity between the most divergent clades was low (~38% and ~90% for 5.8s ITS rDNA and cytochrome oxidase fragments respectively), supporting the occurrence of at least 2 divergent lineages within the current O. marina designation. In a geographic context, the major clades represented broadly discrete areas.

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A CASCADE OF MICROBIAL PROCESSES KILLS SEDIMENT-COVERED CORALS

The mechanisms responsible for physiological stress and subsequent death in sediment-exposed corals are not well understood. We found that the lethality of sediments is positively related to their nutrient content. We exposed corals to artificially nutrient-enriched sediments, to test the hypothesis that damage of corals is microbially mediated by generating sulfide through sulfate reduction. Microsensor profiles showed a decrease in pH and oxygen, and an increase in sulfide concentration in the organic-rich sediment, but not in the organic poor sediments. In a series of incubations, corals were exposed to anoxia, decreased pH and/or increased sulfide concentrations. After 24 h the corals were dead through anoxia at low pH. Additional sulfide concentrations affected the corals synergistically. We conclude that sediments can kill corals within <24h through an autocatalytic process, triggered by high hydrolytic/fermentive microbial activity and enhancing lethality by increasing H2S.

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THE INFLUENCE OF LANDSCAPE SETTING AND FISH STATUS ON THE BODY SIZE OF CLADOCERANS IN MAINE (USA) LAKES

Size-selective predation by fish is considered a strong influence on cladoceran community structure. Fishless lakes in Maine are found in two landscape settings (acidic seepage lakes at low elevations and headwater lakes with steep outlet gradients at high elevation) and contain a greater density of large invertebrate predators than lakes with fish. We compared mean cladoceran body size (CBS) in 14 seepage (7 fishless) and 33 headwater lakes (17 fishless). CBS did not differ between fish-containing and fishless seepage lakes. In headwater lakes, CBS was smaller in fishless lakes compared to those with fish. When fish-containing lakes were categorized into those stocked with brook trout and those with both brook trout and forage fish, the largest CBC was measured in lakes containing only brook trout; CBC was smaller in fishless lakes as well as lakes with a mixed community of brook trout and forage fish. Overall, our results suggest a more complex model incorporating factors such as pH, stocking history, and invertebrate predation, is required to understand structural features of pelagic cladoceran communities at the landscape scale.

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TRANSCRIPTIONAL PROFILING OF THE MODEL PLANCTOMYCETE RHODOPIRELLULA BALTICA COPING WITH FREQUENT CHANGING ENVIRONMENTAL CONDITIONS DURING ITS LIFE STYLE

Rhodopirellula baltica SH[1]T is a marine representative of the globally distributed and environmentally important bacterial phylum *Planctomycetales*. It is a model organism with many interesting features like a specialization for aerobic carbohydrate degradation and a complex life cycle The complete genome sequence of *R. baltica* has been determined and functional annotation was performed (Glöckner et al. 2003). From the genome features it is possible to propose a certain life style for *R. baltica*. *R. baltica* cells are supposed to pass through the water column where they are exposed to rapidly changing environmental conditions e.g. ultraviolet radiation, high salinity, temperature changes and lack of oxygen. In order to study the stress response of all 7325 predicted genes of *R. baltica* to environmental factors, a whole genome DNA microarray was established The time series experiments showed that *R. baltica* is highly responsive to its environment and the data provide insights into the general and specific responses of the organism on the gene expression level. The experiments also propose new regulatory functions for several hypothetical genes in the genome. Glöckner et al. (2003) Complete genome sequence of the marine planctomycetes Pirellula sp. Strain 1. PNAS 100: 8298-8303

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SMALL-SCALE DIATOM-SEDIMENTATION FEEDBACKS CAUSE THE FORMATION OF REGULAR SPATIAL PATTERNS ON DIATOM COVERED MUDFLATS

During spring intertidal flats can exhibit a strikingly regular spatial pattern of diatom covered hummocks alternating with almost bare hollows. We hypothese that this landscape develops due to a strong interaction between benthic diatoms and sedimentation-erosion dynamics of fine-grained particles. This interaction can induce a spatially self-organized landscape. We present a combined empirical and mathematical study to test this hypothesis. We applied autocorrelation analysis to establish regularity and directionality of patterns that we observed on aerial photographs. We then determined how the sediment erosion threshold varied with diatom cover and elevation. Our results were incorporated into a mathematical model, showing the interaction between sedimentation, diatom growth and water redistribution could explain regular patterning, following Alan Turing's activator-inhibitor principle. By using this combined empirical-theoretical approach we were able to explain the underlying mechanisms of landscape formation on intertidal flats and its effects on ecosystem functioning.

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SEASONALITY AND SMALL SCALE DISTRIBUTION OF MEROPLANKTON IN THE CANTABRIAN SEA

We conducted a 1 year sampling program to determine the patterns of nearshore distribution of meroplankton. Samples were retrieved monthly at 11 stations distributed along a small-scale, 4 Km transect off the northern Spanish coast. Meroplankton was more abundant during the stratification phase, with dominance of barnacle nauplii from late winter to mid spring and of bivalve veligers from late spring to autumn. Three types of distribution patterns were observed. One was of decreasing abundance with distance from the coast, typical of early nauplii of the barnacle Verruca stroemia and consistent with a passive or random diffusion process. The opposite trend was observed for Verruca stroemia late nauplii, whose abundance increased with distance from the coast, which is suggestive of an offshore larval pool. Last, veliger larvae of the bivalve Hiatella sp. accumulated at internal tidal bores. These are the slowest swimmers, thus accumulation could be related to low swimming competence. These patterns are discussed in terms of potential recruitment, dispersal range and feeding performance.

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INTERACTIONS OF VIRUSES AND PROKARYOTES WITH ORGANIC AND INORGANIC SURFACES IN MARINE WATERS

Many cruises have been performed in aquatic viral ecology. However, while the water column and increasingly the sediments are well studied, we do not know much on virus-host interactions on surfaces and how surfaces influence these interactions. Here we investigated how transparent exopolymeric particles, black carbon, Sahara dust and coral mucus influence virus-prokaryote interactions. We found several mechanisms such as: 1) Surfaces can release viruses and prokaryotes into the environment, 2) they can release nutrients and organic matter and thus, stimulate production of prokaryotes and viruses, and 3) they can adsorb viruses thus, reducing viral infection and increasing prokaryotic production. Some of these processes change the relative proportion of viral flow cytometer groups and thus, likely viral community composition. Not surprisingly, the type of surface had an influence on virus-host interactions. Overall, organic and inorganic surfaces can have a significant but insufficiently considered effect on the ecology of viruses in marine systems.

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MICROBIAL FOOD WEB INTERACTIONS IN PRESENCE OF THE ALLELOPATHIC DINOFLAGELLATE *ALEXANDRIUM TAMARENSE*

Combined effects of competition, flagellate predation and algal allelochemicals on a natural bacterial community from an upwelling environment were investigated. Filtrates of a lytic and a non lytic *A. tamarense* strain were incubated with unfiltered or filtered (< 1 μm) seawater, partly enriched with peptone. Changes in bacterial and nanoflagellate production were followed over 96 h. Growth rate of bacteria was lower in the treatments containing *A. tamarense* filtrate during the first 48 h compared to controls. However, bacterial production in the first 24 h was inhibited by the presence of both allelopathic and non allelopathic *A. tamarense* filtrates. Further, bacterial yield was higher in presence of allelochemicals compared to other treatments indicating a reduced predation pressure. Allelochemicals interfered with the growth and size distribution of heterotrophic flagellates. Our results indicate that *A. tamarense* produces other bioactive substances than lytic allelochemicals, which can temporary inhibit production and growth of bacteria. Allelochemicals positively affect bacteria, rather by decreasing predation pressure than by providing DOM for bacterial growth.

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HABITAT EFFECTS ON PROTISTS ADAPTED TO EXTREMELY LOW PH

Acid mining lakes (AML) are extreme aquatic habitats with strongly reduced biodiversity. We performed laboratory experiments to test if the key organisms isolated from three geographically distant but similar (pH ~2.6) AML are adapted to a particular habitat type, irrespective of the history of their respective habitat. If historic aspects matter, we expect that microevolution affects the genetic composition in each environment and that the ecophysiological performance shows some site-specific peculiarities. We measured population growth rates of the dominant flagellates (*Chlamydomonas acidophila*, *Ochromonas* sp.) and ciliates (*Oxytricha* spp.) as a proxy of their fitness in a crossfactorial design under standardized laboratory conditions. Each isolate was exposed to the original water from its home habitat and from the two other AML with standard food organisms. All strains grew well under the experimental conditions. Both for flagellate and ciliate isolates, highest growth rates were obtained with water other than from their habitat of origin. We conclude that habitat effects are significant, but we found no evidence that site-specific local adaptation may prevent invaders from successfully colonizing similar habitats.

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DIFFERENTIAL EFFECTS OF SUMMER VERSUS WINTER WARMING ON THE INVASIVE CLAM CORBICULA FLUMINEA

The clam Corbicula fluminea has successfully invaded different freshwater habitats in the northern hemisphere. Environmental changes are believed to favour the invasion success of this species. We tested the effects of moderate warming on different fitness parameter of the clam in river bypass systems. The results showed that warming during winter results in positive effects on the growth rate of the clam. Furthermore, the reproduction rate in spring was strongly enhanced by winter warming. In contrast to these fitness gains due to winter warming, warming in summer resulted in negative effects on growth and survival. These negative effects could partly be compensated by food supplement suggesting that indirect (increasing food demand with warming at limited food levels) rather than direct temperature effects could explain this phenomenon. Overall, the results show that temperature changes will alter the fitness of the clam. However, the contrasting results between summer and winter warming also favour a differential view on warming effects with respect to the annual cycle.

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ADAPTATION AND HABITAT SELECTION OF ROTIFERS IN VERY ACIDIC WATER BODIES

Rotifers are often the only planktonic metazoa in very acidic habitats of pH< 3. Very acidic water bodies are either of natural origin e.g. they originate from volcanic activities or they are man-made due to mining activities. Consequently, they are spread out over all continents but are normally not directly connected with each other. Thus, they are islands of very specific habitat characteristics within the sea of land. In the present study, we investigated different rotifer strains from two genera that were isolated from three sites. Two sites were situated closely together, a third one several hundred km apart. In an experimental, cross-factorial design, we determined the ability of each strain to establish a population in each habitat. Additionally, we investigated the pH response of the strains. All strains were able to colonize all habitats, however strain- and habitat-specific differences were found. The study on the pH-response reveals that at least some strains are acidophilic with a pH-optimum at around pH 4. These strains may benefit from their pH-tolerance of very low pH and from competitive release.

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IRON ENRICHMENT STIMULATES TOXIC DIATOM PRODUCTION IN THE HIGH NITRATE LOW CHLOROPHYLL EASTERN SUBARCTIC PACIFIC

Oceanic High-Nitrate, Low Chlorophyll (HNLC) environments have been targeted commercially for large-scale iron fertilizations to help mitigate global climate change. Adding iron to HNLC waters in bottle and mesoscale experiments consistently stimulates rapid growth of pennate diatoms of the genus *Pseudo-nitzschia*. While coastal *Pseudo-nitzschia* species often produce the neurotoxin domoic acid (DA), sometimes causing major ecosystem impacts, oceanic *Pseudo-nitzschia* species are believed to be non-toxic. We show that the post spring bloom diatom community at Ocean Station PAPA (50°N 145°W) produced up to 48 pg DA L^{-1} during multi-day sampling of the photic zone. Fresh isolates of *P. cf. turgidula* produced DA in deck-board incubations, and cell numbers and toxicity increased with nanomolar iron amendments; a finding supported by parallel deck-board continuous cultures experiments. Moreover, cell toxicity was increased further by co-additions of trace copper, indicating that low purity of iron substrates used in commercial fertilizations may generate unwanted ecosystem responses. Given the potential negative effects of DA in coastal food webs, these findings raise serious concern about the success and sustainability of large-scale iron fertilizations and their ecological consequences.

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NUTRIENT TRANSFORMATIONS WITHIN TWO FLOODPLAINS OF THE DANUBE RIVER: EFFECTS OF RESTORATION

In Austria the Danube River is a ninth order river with a drainage basin of 104 000 km2. It is characterized by an alpine flow regime with highly variable and stochastic patterns. Particularly, there is a significant decrease of hydrologic exchange of surface waters due to channelization and human impacts. The secondary channels and various water bodies within the floodplain are disconnected from the main river flow for long periods. In order to counteract these negative impacts on the floodplains, large-scale restoration projects are focusing on the need to increase hydrologic exchange in slack water areas. During the growing season of 2006 and the end of the growing season 2007, a large-scale field survey was completed for two floodplains along the Danube River one of which has recently undergone restoration via reconnection to the Danube. The sampling compared the sediment nutrient concentrations and potential denitrification and respiration rates. With changing surface water connection to the Danube River, the water bodies in the two compared floodplains experienced different patterns of microbial processing rates, particularly potential denitrification.

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THIOTROPHIC BACTERIAL MATS AND THEIR ASSOCIATION WITH METHANE SEEPS - IS ENERGY AND FLUID FLOW REGULATING MAT DEVELOPMENT?

Mats of thiotrophic bacteria develop at cold seep sites where sulfide is migrating to the sediment surface. Subsurface degradation of methane or other hydrocarbons is the cause of high sulfide fluxes that lead to strongly increased oxygen consumption. Prominent representatives of the thiotrophic mat-forming bacteria are Beggiatoa, Thioploca, Thiomargarita and Arcobacter. However, little is known about the combination of environmental conditions selecting for the different thiotrophs. Here we provide a comparison of various bacterial mat habitats in terms of sulfide production and consumption by thiotrophic bacteria on a regional as well as global scale. In situ high-resolution oxygen, sulfide microprofiles and microbial turnover rates in densely colonized areas are compared to adjacent sediments were no bacterial coverage occurs. The composition of thiotrophic mats was found to differ considerably, and differences were related to sulfide and oxygen fluxes as well as sedimentological characteristics: I) Arcobacter is associated with high sulfide fluxes and fluidic sediments, II) Beggiatoa mats are found at medium to high sulfide fluxes and III) Thiomargarita are associated with low fluxes and an overlap between sulfide and oxygen.

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CONTRASTING INFLUENCES OF ZOOXANTHELLATE AND NON-ZOOXANTHELLATE JELLYFISH ON PELAGIC PRIMARY PRODUCTION AND PLANKTONIC ASSEMBLAGES

Excretion of dissolved inorganic nutrients (DIN) by non-zooxanthellate jellyfish is likely to stimulate pelagic primary production. Zooxanthellate medusae, however, excrete no net DIN since excretia are sequested by the zooxanthellae. We tested the effects of zooxanthellate (Phyllorhiza punctata) and non-zooxanthellate (Catostylus mosaicus) jellyfish on primary production and plankton in a 6-day experiment using mesocosms in eastern Australia. The experiment consisted of 5 treatments: Catostylus mosaicus (2 jellyfish per mesocosm), P. punctata (2 jellyfish per mesocosm), combined species (1 of each species per mesocosm), mesocosm control (no jellyfish) and lake control (sampling outside mesocosms). Chlorophyll a was >300% greater in the C. mosaicus treatment but the P. punctata and the combined species treatments had no influence on chlorophyll a. Mesozooplankton was depleted in all mesocosms containing jellyfish and both species of jellyfish caused changes to microzooplankton assemblages indicating that they can influence multiple trophic levels. Thus, while both species exerted top-down influence, only C. mosaicus exerted a bottom-up influence. This is the first empirical evidence that blooms of zooxanthellate and non-zooxanthellate jellyfish will have contrasting influences on pelagic primary production.

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IMPACT OF PHYTOPLANKTON ON BACTERIAL DIVERSITY ALONG A TRANSECT IN THE SOUTH PACIFIC OCEAN

The South Pacific Gyre is one of the most oligotrophic and undersampled regions of the world's oceans. The Biosope campaign in 2004 collected samples along a transect from the Marquesas islands (MAR) across the South Pacific Gyre (GYR) to the Chilean upwelling (UPX,UPW). Changes in bacterial diversity were studied along the transect in relation to the phytoplankton diversity at the surface and in the deep chlorophyll maximum using Single Strand Conformation Polymorphism (SSCP) and by 16S rRNA clone libraries. Dendrogram and MDS plots of bacterial SSCP profile similarity revealed that the coastal and offshore upwelling communities, dominated by picoeukaryotes and diatoms respectively, were distinctly different from the samples taken from the rest of the transect and were also very different from each other. Sequence analysis revealed that SAR11 dominated all libraries and was particularly abundant at the hyper-oligotrophic GYR station. *Actinobacteria* were abundant at the mesotrophic station MAR and at the eutrophic upwelling UPW whereas *Prochlorococcus* were found at stations MAR, and GYR but not at UPW. *Roseobacter* and Bacteroidetes were dominant members in the phytoplankton-rich upwelling waters

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LINKING BIO-OPTICS AND BIOGEOCHEMISTRY USING SATELLITE AND IN SITU OBSERVATIONS OF THE NORTH ATLANTIC SPRING BLOOM

The evolution of the North Atlantic Spring Bloom was observed using continuous, underway measurements of particle absorption and scattering in a ~10000 km2 area centered on 61N, 26W. Spectral particulate beam attenuation (cp), absorption (ap), and backscattering (bbp) were measured simultaneously using a novel flow-through system and these quantities and relationships amongst them are compared with satellite-derived inversion products and existing biooptical relationships. Despite a wide range in observed taxonomic variability (as revealed by flow cytometry, microscopy, and HPLC pigment analysis), consistent relationships between cp and bbp were observed. Further, the slope of this relationship is similar to that obtained in different oceanic environments (from oligotrophic to mesotrophic). This covariability of the two scattering indices suggests that they are, in large part, sensitive to the same pool of particles or that the particle size distribution is relatively conserved across large gradients in bulk chlorophyll. Empirical relationships between cp, ap, and bbp and coincident biogeochemical measurements such as chlorophyll, particulate organic carbon, and biovolume-estimated phytoplankton specific carbon will be discussed and their applicability to satellite ocean color data will be evaluated.

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LAKE ECOSYSTEMS BECOME INCREASINGLY DISSIMILAR IN A WARMER CLIMATE

Understanding variability patterns of biogeochemical conditions in waters is a key issue for water management strategies. Here a unique homogeneous data set of 1,041 Swedish boreal lakes, sampled during three lake inventories along an eight degree latitudinal temperature gradient, revealed a systematic increase in the variability of the water chemical composition between lakes with increasing temperatures. The variability pattern was consistent on a spatial and temporal scale and became especially apparent for water chemical variables showing a pronounced seasonality, such as nitrogen, silica and organic carbon. The degree of dissimilarity in the chemical composition between lakes was well related to the duration of the main growing and runoff season (DT>0), both on a spatial ($R2 = 0.57-0.79$, $P < 0.05$) and a temporal scale ($R2 = 0.99$, $P < 0.05$). It is suggested that DT>0 is a very suitable proxy to explain biogeochemical variability patterns between lakes. According to this study, a further temperature increase will result in an increased biogeochemical dissimilarity between lakes.

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DEVELOPING AND EVALUATING ONLINE REMOTE SENSING LEARNING ACTIVITIES FOR EARTH SCIENCE EDUCATION WITH REUSABLE CONTENT OBJECTS.

The Satellite Observations in Science Education (SOSE) project provides an Internet-based education environment with interactive learning experiences in remote-sensing principles and exploratory data analysis. The Web site seeks to improve the teaching and learning of the Earth system through quality educational resources that make use of satellite observations. A major feature of this project is the library of Reusable Content Objects (RCOs)—a toolkit adaptable to a wide variety of applications that allows educators to quickly assemble highly interactive web-based activities. The RCOs have recently been enhanced through the addition of Reusable Evaluation Objects (REOs). These are pre- and post-tests that can be made available for learning object evaluations. The REOs are customizable for each new application of an RCO. The activity designer can program how often users are given the choice of taking the pre- and post-tests. The results are aggregated on the server side for statistical analysis. Learning modules focused on coastal upwelling, icebergs, and Great Lakes water quality will be presented.

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CILIATE DIVERSITY AND COMMUNITY STRUCTURE IN A LOW-PRODUCTIVITY MARINE SYSTEM

Low productivity systems are usually expected to have low biodiversity. However, despite the oligotrophic status of the Gulf of Aqaba, ciliate species richness was high, with up to 55 morphotypes found in a single sample. This was despite very limited diversity

in the autotroph prey. Evenness was also high, with the most abundant ciliate species usually making up no more than 10% - 20% of total abundance. Up to 98% of the ciliates were from closely related taxonomic groups of the same size range, thus having similar food niches. Ciliate species richness and abundance were positively related to chlorophyll concentrations, though much more in spring and summer than in winter. Species abundance distributions in summer were most often consistent with Hubbell's neutral model, but during mixing and shortly after the onset of stratification, distributions consistent with niche partitioning theories gave a better fit to the data. High diversity evidently allows considerable overyielding, with much higher than expected ciliate biomass given the chlorophyll concentrations.

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MICROBIAL INTERACTIONS IN BIOFILM-FORMATION DUE TO PLANTS SECONDARY METABOLITES

As microorganism gain more recognition in the field of aquatic science, biofilms will play an especially important role as drivers for understanding trophic interactions.
We investigate the molecular interactions between submerged macrophytes and heterotrophic bacterial biofilms. We focus especially on *Myriophyllum spicatum*, which produces and releases large quantities of hydrolysable polyphenols. These secondary metabolites are important allelochemicals affecting competing primary producers and herbivorous aquatic insects. Culture-independent analyses of the biofilm on the surface of *M. spicatum* revealed a unique bacterial community. Several strains isolated from this environment were capable of surviving solely with hydrolysable polyphenols as carbon source. We developed a microcosm using axenic *M. spicatum* where various bacterial isolates in mono- and mixed culture could colonize the leaf surfaces. To investigate the influence of the carbon source on bacterial interactions during biofilm-formation, we observed the colonization using defined substrates in micro-flow-chambers. First results indicate specific adaptations and interactions of bacterial strains more or less adapted to the metabolization of hydrolysable polyphenols and strong cross-links between trophic levels mediated through allelochemicals.

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A NEW METHOD FOR THE SEPARATION OF DIFFERENT TYPES OF NEMATOCYSTS FROM SCYPHOZOA AND INVESTIGATION OF PROTEINACEOUS TOXINS

Jellyfish have an increasing impact on marine ecology. Cnidocysts bearing stinging cells afford, amongst others, prey capture and defence. Several different types of stinging capsules are found in one species and they are supposed to have specific functions, e.g. paralysing prey or adhering it. Due to these assumed different roles of the capsules it is suggested that toxins which are contained in the capsules differ in composition. Analysis of distinct types of nematocysts requires an appropriate method for the separation of the different types. Mixtures of types of nematocysts were obtained of two species of jellyfish, Aurelia aurita and Cyanea lamarckii, by maceration of the tissue. These mixtures were treated with a method called laser microdissection and pressure catapulting (LMPC). Optimized maceration methods, which were firstly introduced as a method for this purpose, in conjunction with optimized LMPC parameters lead to sufficient amounts of separated capsules of individual types for subsequent mass spectrometric analyses. In case of A. aurita, the resulting mass spectra had some constituents in common whereas the overall pattern the two distinct nematocyst types differed.

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MODELLING POPULATION DYNAMICS OF NOSTOCALES (CYANOBACTERIA) FOR DIFFERENT CLIMATE SCENARIOS

Nostocales benefit from climate change due to a shift in their phenology: earlier germination results in enhanced population size. As basis for the prediction of their future development under varying environmental conditions we develop a mathematical model that considers their complete life cycle. *Cylindrospermopsis raciborskii*, a tropical species, which spread to the northern temperate zone during the last decades, was chosen as model organism. The model was calibrated and validated with a 13-year data set of the species population dynamics in a shallow lake in northern Germany. A sensitivity study was used to rank the impact of model parameters on life cycle dynamics. Seasonal dynamics are mainly influenced by the temperature optimum of growth of the vegetative cells. The course of the pelagic population size and the resting stages (akinetes) in the sediment are highly dependent on lake temperature and underwater light intensity, and thus, on climatic conditions. A future increase in water temperature will therefore lead to an increase in population size of *C. raciborskii* and Nostocales in general.

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SAME SPECIES, DIFFERENT LAKES, DIFFERENT EGGS: MORE QUESTIONS THAN ANSWERS

We have been investigating variation among females and among populations in the quantity and composition of nutrient reserves incorporated into the eggs of a piscivorous teleost fish, the walleye (*Sander vitreus*). Egg size generally increases with female size in walleye but the strength of this relationship varies considerably among populations. Older, larger walleye produce eggs with more desirable fatty acid profiles than do younger, smaller walleye in some populations (Lakes Ontario and Nipissing) but not in others (Lake Winnipeg). We found little maternal influence on egg concentrations of metabolically important metals but there was substantial inter-population variation in egg metal concentrations. Thiamine concentrations were much lower in Great Lakes walleye eggs than in those from Lake Winnipeg. Causes and consequences of variability in egg composition are incompletely understood. Within-population variability in egg fatty acid composition is consistent with a life history strategy where older females devote more essential nutrient reserves to egg production than younger females. What remains to be determined is the influence of differences in the populations' abiotic environments on their strategies of nutrient provision to eggs.

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DISTRIBUTION AND COMPOSITION OF EXOPOLYMERS IN HYPERSALINE CYANOBACTERIAL MATS

Exopolymers (EPS) play a crucial role for the formation of cyanobacterial mats and can even be found in Precambrian stromatolites. To understand their formation, ecological function and preservation, we performed a detailed analysis of the EPS content, distribution and composition in hypersaline cyanobacterial mats. The EPS concentration was highest in the surface layer and decreased to lower concentrations in deeper layers. Carbohydrates as EPS constituents consisted mainly of glucose and rhamnose. Neutral and acidic amino acids dominated the protein fraction of the EPS and glucosamine represented the prevalent amino sugar. Different fluorescently labelled lectins used in combination with Laser Scanning Microscopy (LSM) indicated a stratification of the EPS in discrete layers and an involvement of different organisms in EPS production. The detection of EPS sheaths in deeper layers together with low but stable bulk EPS concentrations highlights their resistance to microbial degradation and their preservation potential within mats. This combination of compositional analysis of extracted EPS with LSM detection of EPS glycoconjugates and different microorganisms in integral mats reveals new aspects of fine-scale EPS distribution and dynamics in microbial ecosystems.

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USE OF A NEWLY DEVELOPED REMOTE SENSING PRODUCTION ALGORITHM TO ASSESS THE INDIAN OCEAN DIPOLE'S IMPACT ON REGIONAL TO BASIN SCALE BIOGEOCHEMICAL FLUXES

Characterizing the basinwide dynamical impact of the Indian Ocean Dipole (IOD) has been vigorously pursued over the past decade. A coincident biological impact is apparent in ocean color data, in eastern tropical waters, the southeastern Bay of Bengal and the Arabian Sea. Moreover, in situ measurements obtained during the 2006/2007 IOD reveal subsurface anomalies in the southwestern Indian Ocean. Despite the IOD's clear influence on biological variability, quantification of the accompanying biogeochemical impact has yet to be obtained. With the advent of algorithms to estimate net primary production (NPP) from ocean color, it is now possible to assess IOD impact on biogeochemical variability and fluxes at regional to basin scale. Here, the dynamical signatures apparent in remote sensing fields for the two SeaWiFS-era IODs are used to illuminate how these events are similar or distinct. A similar comparison of IOD-engendered surface chlorophyll anomalies is performed, with the dynamical fields providing the framework for interpreting the underlying mechanisms. NPP estimates are then used to provide the first characterization of how biogeochemical fluxes throughout the Indian Ocean are altered by IOD occurrence.

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TEMPORAL AND SPATIAL DISTRIBUTION OF SEDIMENTARY OXYGEN UPTAKE AND PELAGIC-BENTHIC COUPLING WITHIN A RED SEA FRINGING CORAL REEF

Calcareous sands are major places for the recycling of organic matter in coral reef ecosystems. Sedimentary oxygen uptake and pelagic-benthic coupling were studied in temporal and spatial resolution (water depths: 2.5 to 16.5 m) during 5 seasonal expeditions between May 2004 and May 2008 in a typical fringing coral reef bordering the Jordanian Red Sea coast. For this purpose, 12 independent in-situ experiments with stirred benthic chambers were conducted on highly permeable calcareous reef sands covering the reef seafloor of the investigated reef either in patches between coral colonies or as broad sand flats. Resulting sedimentary oxygen uptake ranged between 20 and 39 mmol m^{-2} d^{-1} and was strongly positively correlated with water depth. Oxygen uptake in small sand patches between corals was significantly lower than those rates measured for broad sand flat areas. Comparison of sedimentary oxygen uptake rates at the same location revealed little temporal and seasonal variation. All oxygen uptake rates are presented in the context of parallel quantification of particulate organic C and N sedimentation rates as derived from 48 independent sediment trap deployments.

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EFFECTS OF DRAWDOWN-INDUCED SEDIMENT RESUSPENSION ON PHOSPHORUS AVAILABILITY IN LAKE POWELL, USA

Climate change predicts decreased runoff in the Colorado River Basin, Southwestern USA, where the river provides water to >25 million people and >6000 km^2 of farmland. To maintain downstream supply, reservoir releases have compensated for lower river flows this decade. As demands increase in the basin, water managers must understand water quality implications of drastically varying reservoir levels. Since 1999, Lake Powell, the uppermost large Colorado River reservoir, has been drawn down as much as 44 m. This may have induced observed increases in primary productivity, which subsequently led to hypoxia in the water column and dam tailwater. Our research seeks to explain the connection between reservoir drawdown, a likely climate change scenario, and water quality. We hypothesized that phosphorus, the limiting nutrient here, is released during delta sediment resuspension in a low lake. Laboratory measurements with Lake Powell sediment show phosphorus association with calcite and a relationship between sediment particle size, mineralogy, and phosphorus sorption. Thus, different sediment delta regions, differentiated by particle size, release phosphorus differently upon resuspension, an important consideration for reservoir management during decreased inflows.

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ECOLOGICAL SIGNIFICANCE OF MICROBIAL ENDOKARST COMMUNITIES IN GROUNDWATER FROM ALPINE KARST AQUIFERS

Although groundwater from karst aquifers is an important water resource, information on microbial life in such systems is sparse. First evidence for the occurrence of spring-specific autochthonous microbial endokarst communities (AMEC) could be provided. During two annual cycles in situ heterotrophic prokaryotic production (HP)and its controlling factors were studied in two alpine karst springs of contrasting hydrogeology but of nearby catchments. HP, as determined by 3H-leucine incorporation, was low indicating a high biostability. Microautoradiography combined with catalyzed reporter deposition - fluorescence in situ hybridization (MAR-CARD-FISH) revealed that only about 7 % of the planktonic community took up 3H-leucine. Principal component analysis, including hydrological, chemical and biological parameters, indicated different controlling mechanisms on HP in both spring types, depending on the hydrological regime. Biofilms grown in situ showed noteworthy microbial activity, confirmed by HP measurements in aquifer sediments that revealed at least 106 fold higher HP-rates than in the planktonic fraction. The results suggest that surface associated AMEC could be relevant for biogeochemistry (e.g. karstification), self-purification processes within the groundwater reservoir and the resulting spring water quality by degradation of DOC.

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AROUND THE WORLD IN EIGHTY STATIONS – A GLOBAL PERSPECTIVE OF AQUATIC VIRUSES

Viruses are the smallest and most numerous of all biotic agents and represent perhaps the greatest pool of genetic diversity in the aquatic systems. In their day-to-day activities viruses are also important regulators of biological processes and perhaps amongst the greatest drivers of biological nutrient cycling. New methods and applications of novel genomic approaches, in tandem with improved access to a wide array of aquatic environments have contributed to enormous recent advances in the field of aquatic viral ecology. The results clearly indicate that viruses are emerging as important players in biogeochemistry global-scales. As part tutorial, this presentation will highlight the advances researchers have made in understanding how viruses influence aquatic systems and the global implications of these processes. Illustrations and comparisons will be drawn from recent large scale transoceanic examinations of virus activity to illustrate some of the remaining short comings in our knowledge concerning viruses in aquatic environments.

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DO MICROCYSTINS ACT AS AN INDUCIBLE DEFENSE AGAINST FLAGELLATE GRAZING IN *MICROCYSTIS AERUGINOSA*?

Toxic microcystins are produced by several cyanobacteria including *Microcystis aeruginosa* and have, amongst other functions, been considered as an inducible defense against grazers. We investigated the effect of grazing by the mixotrophic flagellate *Ochromonas* sp. on the microcystin content of *Microcystis aeruginosa*, using flow cytometer sorting followed by an enzyme-linked immunosorbent assay to distinguish between the toxins contained within *Microcystis* and taken up by *Ochromonas*. Furthermore, the growth and grazing rates of *Ochromonas* preying upon the toxic *Microcystis aeruginosa* strain PCC 7806 and its microcystin-deficient mutant have been compared. While microcystin concentrations within *Microcystis* remained constant throughout the experiment, they increased inside *Ochromonas* after grazing and reached concentrations comparable to those in *Microcystis* itself. Despite increasing *Microcystis* cell densities grazing rates of *Ochromonas* decreased after only two days. While the ingestion rates on the microcystin-containing wildtype were initially higher, they decreased rapidly below the rates on the mutant. Our results suggest that microcystin production offers some, although incomplete, protection against flagellate grazers, but does not seem to be inducible by grazing.

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COSEE COASTAL TRENDS: INCORPORATING SEAGRASS RESEARCH INTO AN EDUCATIONAL MODULE

Communicating ocean science to the general public is often difficult for scientists. At the same time, many secondary educators do not have a strong background in scientific research making it difficult to effectively communicate the subject. COSEE Coastal Trends is a program designed to bridge the gap between scientists, educators, and the general public and bring cutting edge research data concerning trends in ocean science into the public school classrooms. To accomplish this two Science-Educator teams were established; Team Seagrass and Team Hypoxia. Each team consisted of a scientist, a science teacher, a graduate student and an undergraduate student. Together they conducted research on their given topics and created educational modules for use by teachers and the general public. These modules consist of four sections: 1) learn about the subject; 2) explore the trend; 3) investigate current research; and 4) engage your classroom. This presentation will focus on Team Seagrass and will describe the step by step process of how the team incorporated their research into the educational module.

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POTENTIAL IMPACTS OF ESTUARINE AMMONIUM ON COASTAL PHYTOPLANKTON PRODUCTIVITY AND COMMUNITY STRUCTURE IN THE GULF OF THE FARALLONES, CA.

The productivity "hot spot" of the Gulf of the Farallones (GOF) located adjacent to San Francisco CA has two major nutrient sources feeding the lower trophic levels. Water from the San Francisco Estuary, rich in ammonium is supplied to the GOF through the Golden Gate while wind driven coastal upwelling along the northern California coast supplies high nitrate and silicate concentrations. A predictable productivity sequence has been described for this upwelling system where periodic relaxation of the upwelling favorable winds results in rapid uptake of nutrients by a diatom dominated community. However, this sequence may be disrupted by ammonium from the San Francisco Estuary outflow. High anthropogenic ammonium would be expected to inhibit nitrate uptake by diatoms and favor dinoflagellates, which have been observed nearshore. We have been studying seasonal and spatial patterns in the GOF of nutrients, phytoplankton community structure and nutrient use, along with experimental enclosures to investigate estuarine ammonium versus upwelled nitrate interactions on shaping phytoplankton community and productivity.

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THE INFLUENCE OF ZOSTERA SPP. ON SEDIMENT HABITAT IN THE TAY ESTUARY, SCOTLAND.

The Tay estuary, on the east coast of Scotland, contains a number of important biological features including mixed beds of the intertidal seagrasses Zostera marina var. angustifolia and Z. noltii, a priority habitat. The three species of Zostera, or eelgrass, occurring in the UK are considered to be scarce, and there has been an ongoing general decline of eelgrass populations since the 1960s. Scottish populations may be threatened by a number of factors including eutrophication and coastal development. In June 2008 a survey of eelgrass distribution was carried out in the intertidal zones of the outer Tay estuary, followed by detailed mapping of the location and density of eelgrass beds. In August 2008 sampling took place in and around six eelgrass beds to compare the biological, physical and chemical characteristics of sediment where eelgrass grows and bare sediment. This study provides an insight into the ecology of eelgrass in the Tay estuary and its role as an ecosystem manager. It may offer valuable data for its conservation, for example, contributing towards future monitoring, and to transplantation trials.

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RAINWATER: A DYNAMIC EPISODIC SOURCE OF DISSOLVED FE(II) TO SURFACE SEAWATER

Dissolved iron occurs in rainwater in approximately equal concentrations of Fe(II) and Fe(III) even in the presence of relatively high concentrations of hydrogen peroxide. Fe(II)(aq) has been protected against oxidation by organic complexation with a very strong ligand or ligand group in rainwater collected over the last ten years, however this has changed recently. Previous stability experiments showed that Fe(II) concentrations in rainwater remained unchanged for at least 24 hours of dark storage. Experiments conducted during the summer of 2008 indicate rapid oxidation of Fe(II) over time periods of hours. The oxidant remains as hydrogen peroxide, as in the past, however oxidation rate constants are much higher than previously observed in rain. This diminished stability probably contributes to the lower concentrations of Fe(II) observed in rainwater during 2008, and possibly earlier as well. This change in stability could not be explained by changes in rainwater pH or changes in the concentrations of hydrogen peroxide, total iron, dissolved organic carbon, or chromophoric dissolved organic matter. Rainwater is an important source of soluble iron to surface seawater. A decrease in this supply could diminish primary productivity in surface seawater, an undesirable change with respect to the rate of climate warming.

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THE EFFECT OF ENVIRONMENTAL FACTORS ON THE COMMUNITY STRUCTURE OF THE PREDATORY BACTERIUM, BACTERIOVORAX, IN CHESAPEAKE BAY SYSTEM

Bacteriovorax is a predatory, *Bdellovibrio*-like bacterium, that plays a role in bacteria mortality and is in salt waters. Until recently there were no defining properties of the organisms that could be practically used to differentiate operational taxonomic units. Ribotyping is now used and approximately 20 ribotypes of *Bx* have been reported. In this study, the analysis of ribotypes has been used to study the community structure of these predatory bacteria in Chesapeake Bay and sub estuaries. Samples of water, sediment and biofilm at sites representing low to high salinity areas were cultured to recover *Bx* using *V. parahaemolyticus* as prey. Up to four *Bx* plaque-forming units were randomly selected from culture plates, the 16S rRNA genes amplified and sequenced. The results revealed distinct and common ribotypes at each site and confirmed by UniFrac analyses. The community structure of the predators at the various sites was unique. Since the same prey was used to recover the predators, variation in environment factors, particularly salinity, may determine the community structure of the predatory bacteria.

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ASSESSING THE IMPACT OF HUMANS ON THE TYRONZA RIVER: AN AGRICULTURALLY DOMINATED WATERSHED

The study takes place along the Tyronza River located in northeastern Arkansas. The objective was to asses the river continuum of the Tyronza River, and to distinguish how it corresponds with the River Continuum Concept. The physical, chemical, and biological parameters of the upper, middle, and lower reaches of the Tyronza River were assessed by a cohort group. Data was obtained for each parameter from samples collected in triplicate at the upper, middle, and lower reaches of the Tyronza River. The data was then analyzed statistically using ANOVA to determine if a significant change had occurred from the upper reach to the lower reach. The physical parameters imply that there is a significant difference between the reaches; while the chemical parameters, although at higher concentrations than expected, were not significantly different between reaches. Analyses of the biological parameters were not significantly different between reaches; nevertheless the three parameters suggest that the Tyronza River has a reverse River Continuum and that the agricultural land use of the Tyronza River watershed significantly impacts the river continuum.

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LONG-TERM TRENDS OF ENVIRONMENTAL HEALTH-RELATED INDICES OF CHESAPEAKE BAY (1985-2007)

Water quality and biological measures were combined to formulate a Bay Health Index (BHI) that was used to detect regional patterns of improving and declining health in Chesapeake Bay. Dissolved oxygen, chlorophyll-a, and Secchi depth were averaged for the Water Quality Index (WQI), and the phytoplankton and benthic indices of biotic integrity (P-IBI and B-IBI, respectively) and the area of submersed aquatic vegetation (SAV) were averaged for the Biotic Index (BI). Despite restoration efforts that have decreased nutrient and sediment loading to the Bay in some areas, water quality and biotic metrics have generally shown little improvement since 1985. For instance, there has been an inexplicable bay-wide reduction in water clarity and few increasing regional trends for either P-IBI or B-IBI. One exception was SAV area which increased in some regions related to decreases in nutrient inputs from wastewater treatment facilities; significant statistical relationships sometimes revealed strong water quality or climatic regulations on abundance. The increasing frequency of multiple stressors, including bay-wide warming and sea-level rise associated with global change may have serious consequences for restoration efforts in Chesapeake Bay.

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GREAT OCEANOGRAPHIC MYTHS NO 1 – THE BOTTLE EFFECT

The so called "bottle effect" is one of the richest, if not the richest, lode of half-baked ideas in marine science. They span from suggestions from microbial concussion to very dodgy ideas surrounding the physical chemistry of adsorption. As for its existence, the evidence for flying saucers is much the same. I will take a journey through its questionable origins, the supposed evidence, the Fort Knox fallacy and proposed mechanisms, in an attempt to determine what may be there and what has been fantasised.

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ALGAL BIODIESEL AND BIOMASS PRODUCTION

The concept: algal growth rates are high; crop yields could reach 200 t dry weight/ha a, 10-times that of higher plants. *The opportunities*: long established use for pharmaceuticals, potential for biodiesel, animal feeds and possibly hydrogen. *The process*: systems may take the form of "high" technology/cost bioreactors or low technology/cost raceways or combined systems. *The positives*: i) marine algae and therefore seawater may be used for the growth medium, ii) soil fertility immaterial, desert or waste land may be used, thus no competition with food crops, iii) crop failures result in minimum down time, iv) can be made energy self-sufficient, has a good ecological footprint. *The downsides*: i) economics tight, ii) economic production of low cost products (biodiesel, animal feed) probably restricted to 30S to 30N, iii) in the case of biodiesel, although profit may be made from by-products (protein) their market might limit the scale of operation, iv) require considerable area of land adjacent to the oceans, v)carbon footprint doens not appear to be good.

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VERTICAL DISTRIBUTION OF ZOOPLANKTON IN SUBALPINE AND ALPINE LAKES: ULTRAVIOLET RADIATION, FISH PREDATION, AND THE TRANSPARENCY-GRADIENT HYPOTHESIS

The transparency-gradient hypothesis argues that UV radiation is a primary determinant of the vertical distribution of zooplankton in transparent lakes with fewer fish while fish predation is the primary driver in less transparent lakes where fish are more abundant. We measured vertical profiles of UV, visible light (as a proxy for fish predation), temperature, conductivity, Chl *a*, and zooplankton in seven subalpine and alpine lakes and examined the distribution of the major zooplankton groups relative to environmental variables using a canonical correspondence analysis (CCA) and multiple regression. The CCA revealed that conductivity, PAR, and UV were most related to zooplankton distribution and abundance. *Daphnia* was associated with high visible light while cyclopoids and nauplii were associated with low visible light. In contrast, the vertical distribution of calanoids was positively related to UV while *Holopedium* was negatively associated with UV. The regressions revealed that UV consistently explained more of the variance in zooplankton vertical distribution than did either visible light or Chl *a*, thus supporting the transparency-gradient hypothesis.

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AUTOTROPHIC PICO- AND NANOPLANKTON IN ZOOPLANKTON GUTS: EVIDENCE OF AGGREGATE FEEDING IN THE MESOPELAGIC ZONE AND EXPORT OF SMALL PHYTOPLANKTON

Zooplankton play a key role in affecting the efficiency of organic matter export. Mesozooplankton consumption of detrital aggregates has been hypothesized as a mechanism to enhance export of picoplankton from surface layers. We analyzed the guts of mesopelagic zooplankton using light and epifluorescence microscopy to determine if cyanobacteria and eukaryotic phytoplankton too small to be ingested individually were present. Hind-guts were dissected from multiple zooplankton species collected in discrete depth intervals between 0 to 1000 m during day and night at contrasting sites in the subarctic and subtropical Pacific Ocean. Autofluorescing cyanobacteria and small (2-20 μm) eukaryotic phytoplankton were found in the guts of nearly all species sampled and from the surface to 1000 m, indicating consumption of aggregates. At both sites most species' guts contained higher concentrations of cyanobacteria and other small phytoplankton at night than during the day. Guts of diel vertical migrators at their daytime residence depths still contained pico- and nanoplankton, indicating active export of these cells. Our results show mesozooplankton grazing on aggregates is a pathway by which flux of small phytoplankton can be enhanced.

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EFFECTS OF LOW PH ON ASEXUAL REPRODUCTION AND STATOLITH FORMATION OF THE SCYPHOZOAN *AURELIA LABIATA*

Although many anthropogenic influences such as global warming, overfishing, and eutrophication may contribute to jellyfish blooms, little is known about the potential effects of ocean acidification on jellyfish. Although jellyfish are "gelatinous", most form statoliths of calcium sulfate hemihydrate that are components of the balance organs (statocysts). This study was designed to test the effects of decreased pH on moon jellyfish, *Aurelia labiata*, asexual reproduction and statolith formation. Polyps were raised in three pH levels, 8.1 (within average current range), 7.7, and 7.3 at 15°C. Ephyrae (juvenile medusae) produced were counted over 122 days and preserved in EtOH. Ephyra statoliths were counted and measured using image analysis . Neither the numbers of ephyrae produced per polyp or the numbers of statoliths per statocyst differed significantly among pH treatments; however, statolith size decreased significantly in low-pH treatments. Our results indicate that *A. labiata* ephyra production is little affected by low pH, but their statoliths are significantly smaller. Future research on the behavior of ephyrae with small statoliths would further our understanding of the possible impacts on jellyfish survival in the wild.

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LARGE SCALE PATTERNS OF PROKARYOTES AND VIRUSES IN THE ATLANTIC AND ARCTIC OCEAN

During a cruise from Halifax to Kugluktuk we collected data on prokaryotic and viral abundance, the relative abundance of *Bacteria* by CARD-FISH, bacterial and archaeal community composition by T-RFLP, and viral community composition using RAPD-PCR. Prokaryotic and viral abundance varied between 1.0-26.7×10^5 ml^{-1} and 1.1-12.3×10^6 ml^{-1}, respectively. The relative abundance of *Bacteria* varied between 17-84 % of DAPI-stained cells. Bacterial richness varied between 17-51 peaks and archaeal richness ranged from 1-67 peaks. The number of viral bands detected by RAPD-PCR varied between 3-17 bands. In the southern Canadian shelf area bacterial community composition was strongly linked to viral abundance. In the Labrador Sea bacterial and archaeal community composition were linked to viral abundance. We found a strong relationship between bacterial and viral communities in the Labrador Sea and the adjacent Canadian shelf area. Changes in archaeal and viral community composition appeared to be linked in the Labrador Sea. However, prokaryotic and viral communities were decoupled in waters of the Baffin Bay and the Arctic.

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SCALING-UP MECHANISTIC TRADE-OFFS IN TROPHIC INTERACTIONS AND CELLULAR STOICHIOMETRY: FROM CHEMOSTATS TO SHELF ECOSYSTEMS

Trait-based models and related experiments have recently advanced the understanding of the intricate consumer-resource dynamics at a population level. This progress, however, is so far only based on heuristically formulated approaches and quantitative tests of trait-based models or applications to real ecosystems are rare. We use here knowledge on algal uptake and physiology to devise a size-based model. Starting from Holling's concept of a finite handling time, we show that ingestion rates depend on prey volume. By combining this function with size dependencies of algal metabolism and elemental stoichiometry we derive a mechanistic trade-off function. Its parameters can be entirely constrained by standard growth experiments as demonstrated by referring to the Chlorella-Brachionus chemostat studies of Fussmann et al. 2000 and Yoshida et al. 2003. The size-based model can quantitatively reproduce damped predator-prey cycles, revealing a critical dependence of the dynamics on the variance in prey diameter. A generalized version of this model applied on a well-monitored site in the North Sea displays cascading effects of carnivore grazing on the mean phytoplankton cell size.

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ZOOPLANKTON DISTRIBUTIONS IN THE EASTERN TROPICAL PACIFIC OXYGEN MINIMUM ZONE: RECENT CRUISE HIGHLIGHTS

Zooplankton distributions and trophic webs through the Oxygen Minimum Zone (OMZ) are being studied in the Eastern Tropical Pacific Project. During cruises in October 2007 and December 2008 (scheduled), vertically-stratifed day and night MOCNESS tows sampled zooplankton and micronekton (0–1200m). Fine-scale targeted sampling focused on the OMZ and its upper and lower oxyclines. Divers provided additional data for larger near-surface organisms. Zooplankton biomass was higher at the Costa Rica Dome compared to further north. Maximum abundances usually occurred in the surface mixed layer above the OMZ, but a substantial portion of the larger zooplankton migrated daily. Diel vertical migration into the OMZ extended to different depths and oxygen levels for different species and size fractions. While the low oxygen OMZ Core had the smallest zooplankton concentrations, the Lower Oxycline (~650m) showed a subsurface zooplankton peak associated with a particle layer. Zooplankton stable isotopes and potential food resources (particles, microbes) varied with depth and the environmental regime, and suggest interesting trophic interactions.

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INFLUENCE OF AGRICULTURAL PESTICIDE AND URBAN BIOCIDE USE ON LOAD DYNAMICS IN SURFACE WATERS

This study aims at identifying sources of biocidal pollution in surface waters which may originate from urban or agricultural areas. It focuses on a selection of important biocides and pesticides and their rain-induced losses. In a field study in 2007 we investigated a small catchment with mixed land use in the Swiss plateau. The results, based on more than 500 analyzed water samples revealed that both, urban and agricultural sources contribute to the overall pollution of surface waters with biocidal products. The pattern of pollution depends on land use and seasonal application periods. Some urban biocides with constant sources (material protection, household application) are mostly found in the outlet of the waste water treatment plant throughout the year. For substances with mixed use, several temporal patterns may overlap. Diazinon for example was always in the range of 20 to 50ng/ in the waste water outlet, it was elevated in the urban dominated catchment (50 to 100 ng/l) in May and June, and it reached up to 1000ng/l in the agricultural catchment in March an in the beginning of May.

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GENE EXPRESSION PATTERNS REVEAL THE ABILITY OF THE MARINE DINOFLAGELLATE ALEXANDRIUM TAMARENSE TO DETECT COPEPODS THROUGH WATERBORNE CUES AND INDUCED DEFENCE

Alexandrium tamarense forms harmful algae blooms associated with a phenomenon called Paralytic Shellfish Poisioning in costal, temperate waters („Red Tides"). Reducing mortality due to grazing to a minimum through active deterrence/defence the predator increases the possibility of achiving positive growth rates for bloom development. Copepods are one of the major grazers in costal systems and Alexandrium cells showed a significant higher PSP-toxin content when exposed to different copepods, or their waterborne cues. The effect from grazers and/or their cues on Alexandrium cells using a microarray platform designed from several Alexandrium species EST databanks was further analyzed on a transcriptomic level. On this basis it was possible to identify a common set of genes showing regulation even in cases where no higher PSP-toxin content was measureable. These results indicate that a perception of waterborne cues from different copepods exists, and that it is measureable through global gene expression patterns. Given these facts, a subtracted cDNA-library from diverse induction experiments with different species interacting with Alexandrium was constructed. This is a promising approach to further analyse the genomic cascade beyond induced defence and species interaction through waterborne cues in phytoplanton.

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TRAIT-BASED APPROACHES TO UNDERSTANDING THE OPTICAL BIOGEOGRAPHY OF MARINE PICOPHYTOPLANKTON

In a study of the optics and distribution of picoplankton in diverse water masses around the world, we find close complementarity between the bulk community-level spectral signature (e.g. the spectrum of photysynthetically active wavelengths stimulating chlorophyll or phycoerythrin fluorescence) and ocean color, as determined by remote sensing reflectance. This relationship particularly explains the evolution of a spectrally diverse suite of phycoerythrin pigments in marine *Synechococcus* and it persists even when analysis of phycoerythrin-containing strains isolated from a single water mass reveal the presence of some individual genotypes with very poor complementarity to the local condition. While these strains would seem to be at a selective disadvantage in an equilibrium setting, their presence provides the basis for a rapid microevolutionary or successional response to changes in the quality of the prevailing light field. We use these observations to explain the maintenance of the putatively weakly adaptive low-phycourobilin form of phycoerythrin in the open ocean.

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COMMUNITY COMPOSITION OF HYDROMEDUSAE IN KACHEMAK BAY, ALASKA

In order to decipher climate induced changes in gelatinous zooplankton "baseline" surveys need to be conducted to characterize the current community. This study was undertaken to assess hydromedusae abundance and diversity over three summers (2006-2008) in Kachemak Bay, Alaska, a productive and intensively used estuarine reserve. A previous study of Kachemak Bay found 27 species of cnidarians and ctenophores. After three summers, 11 cnidarian and 3 ctenophore species were added to this total. Community composition of hydromedusae shifted throughout each summer and varied among the three summers sampled. In all years, Catablema nodulosa was primarily found in early summer whereas Polyorchis penicillatus did not appear until July/August. Obelia spp. and Rathkea octopunctata were not observed in 2006, which was warmer than the proceeding summers, but were common in 2007 and 2008. Clytia spp and Eperetmus typus were dominant in 2006 and but were less abundant in other years. The interannual and seasonal variability of hydromedusae in Kachemak Bay points to the difficulty of establishing baseline data as well as the importance of linking environmental conditions to hydromedusae blooms.

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IS THE HYPORHEIC ZONE A REFUGIUM FOR MACROINVERTEBRATES DURING SEVERE LOW FLOW CONDITIONS?

The potential use of the hyporheic zone as a refugium by aquatic invertebrates during hydrological perturbations was initially proposed more than three decades ago. However, evidence of the use of this habitat as a refugium during low flows and drought remains divided. Some studies have reported that the hyporheic zone is a refuge for lotic organisms during low flows and river bed drying, although others have found little or no evidence of its use by lotic fauna. This paper examines benthic and hyporheic community changes within a groundwater dominated river during severe low flow conditions associated with a high magnitude supra-seasonal drought event. Evidence of the use of the hyporheic zone as a refugium by a limited number of benthic taxa is presented. The potential factors leading to changes recorded in the benthic and hyporheic assemblages are considered in relation to previous international research.

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INTERSPECIFIC COMPETITION BETWEEN EPIPHANES CHIHUAHUAENSIS & CEPHALODELLA STEREA FROM THE CHIHUAHUAN DESERT: EFFECTS OF POPULATION DENSITY & FOOD CONCENTRATION

Interspecific competition is a widespread phenomenon. We conducted four laboratory experiments to investigate interspecific competition in two rotifers that occur in Chihuahuan desert rock pools. Under low food concentrations (25,000 Chlamydomonas cells/mL), Epiphanes and Cephalodella could not coexist. Epiphanes caused Cephalodella to become extinct or significantly reduced their population size after 8 days (ANOVA, $p<0.0001$). If Cephalodella were allowed to establish a population size of ~2500 inds/L before Epiphanes were introduced, the Cephalodella population reached a peak on day 4 after introduction and then declined to 2133 +/- 2133 inds/L (mean +/- se). In the next two experiments Epiphanes were reduced to a population size of 75 inds/L daily. In the competition treatment under low food concentrations, Epiphanes reduced the Cephalodella population to 1685 +/- 948 inds/L compared to 42,665 +/- 2220 inds/L in the control. In 2 of 7 replicates Cephalodella was driven to extinction by day 6. When food concentration was increased four-fold, C. sterea populations reached 12,718 +/- 5130 inds/L and persisted in all replicates. These results indicate that food concentration may mediate coexistence of these species.

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ELEVATED PHOSPHATE CONCENTRATIONS IN THE SOUTH ATLANTIC GYRE AND IMPLICATIONS FOR NUTRIENT LIMITATION.

The northern and southern gyres of the Atlantic Ocean are normally accepted as being areas of oligotrophic, nutrient deplete waters. During the series of Atlantic Meridional Transect cruises (AMT) the nutrient concentrations were determined by nanomolar analytical techniques. These are presented for the cruise track traversing through the centres of both Atlantic Gyres. The presumed view that the Atlantic Gyres are oligotrophic is confirmed when observing the nitrate concentrations, which are generally below 5 nanomoles throughout the mixed layer. In the northern gyre the phosphate concentrations are invariably less than 10 nanomoles, and the potential phosphate limitation in the north western Atlantic has previously been described. However, data from the southern gyre show increased phosphate concentrations to over 200 nanomoles, while the nitrate is still below 5 nanomoles. This has implications when comparing and contrasting the N/P ratios of the Gyres. In the north the nitrogen species dominate, implying phosphate limitation, but in the southern gyre with the high phosphate then the N/P ratio becomes very low and implies a potential nitrogen limited system.

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A STICKY SITUATION: METHODOLOGICAL APPROACHES FOR STUDYING PREY RECOGNITION BY PLANKTONIC PROTISTS

Through selective feeding, protists play a fundamental role in structuring bacterial and phytoplankton communities within the marine environment. Although recent evidence indicates that protists can select food based on cell surface properties of their prey, the underlying mechanisms are poorly understood. We will present a number of experimental approaches useful in identifying and characterising the role of protist receptors in prey recognition. Purification of targeted receptors generally involves affinity chromatography with various different matrices, and bioassays to detect the receptor during different stages of the purification process. Alternatively, a proteomic approach can be utilised to reveal a suite of potential prey-binding proteins. Specialized kits allow the cell-surface membrane proteome to be targeted, thus aiding the specificity of this technique. Subsequent functional studies, such as feeding inhibition experiments, are extremely valuable in further characterizing the role of identified proteins in feeding.

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FROM THE TROPICS TO POLES: ECOLOGICAL AND GENOMIC VARIATION OF THE WIDESPREAD PRASINOPHYTE *MICROMONAS*

Modern oceans contain a polyphyletic diversity of algae, some with plastids of common ancestry with land plants (green algae) and others derived from red algae through secondary or tertiary endosymbioses (i.e., 'chromalveolates'). Several episodic bloomers among the latter have large genomes, whereas other phytoplankton have reduced genomes, like *Micromonas* (22 Mb), a green alga. Genomes of two strains within the purported species *"Micromonas pusilla"* were analyzed and much greater divergence was found than anticipated based on their 18S rDNA identity. Although *Micromonas* thrives from tropical to polar ecosystems, and coastal to open-ocean conditions, the genomes show the consequences of genome reduction ostensibly brought about by intense resource competition under ocean 'desert-like' conditions. The forces leading to reduced genome- and cell-size in picoeukaryotes, while presumably similar to those acting on open-ocean bacteria, came about via independent evolutionary paths for each *Micromonas* strain and *Ostreococcus*. Details of our analyses and those made in collaboration with a diverse group of scientists (i.e., the *Micromonas* genome consortium) will be presented in an ecological context.

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UNDERSTANDING IN SITU DEGRADATION OF THE CYANOBACTERIAL TOXINS MICROCYSTIN AND CYLINDROSPERMOPSIN

Diverse cyanobacterial species share the capacity of producing toxic secondary metabolites. These natural toxins pose a menace due to possible presence in drinking water, but also may threaten human health and ecosystem quality due to direct exposure in affected waterbodies. Therefore, efficient degradation in the field will play a mayor role in an adequate evaluation of the risk associated. In our work we focused on both microcystins, the most common cyanotoxins, and cylindrospermopsin, considered typical for tropical regions but lately being found in more template systems. Photodegradation and biodegradation dynamics of these toxins were evaluated and incorporated into basic modelling, thus allowing an approach to the understanding of the fate of these toxins once liberated from the producing cells. Important differences between the two toxins were observed. Microcystins are readily degradaded, biodegradation being the main agent responsible in most cases and situations. Photodegradation contributed mainly during possible lag phases and was clearly attenuated along the water column. Degradation of cylindrospermopsin seems to be more limited and thus explains accumulation of the toxin in the extracellular phase.

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UPTAKE AND BIOCHEMICAL ALTERATION OF ORGANIC MATTER BY INTERTIDAL POLYCHAETES

A description of biochemical changes occurring during macrofaunal digestion is key to understanding the early stages of organic matter (OM) decay and diagenesis. Microcosm experiments were performed to study such alteration during digestion by the species Arenicola marina and Hediste diversicolor. Individuals were fed with isotopically labelled algae for 8 days, and sampled after 8 and 20 days. After 20 days animals were transferred to fresh, un-labelled sediment, and kept for a further 20 days. Tissue, sediment and faecal pellet samples have been analysed for their bulk label contents, and also for their labelled amino acid and aldose suites. Results show strong uptake and retention of labelled OM by the polychaetes. The suites of labelled amino acids and aldoses in faunal tissues were different from both those in the source algae, and the sediments, suggesting that selective assimilation occurs. Further, it may be possible to link this selectivity to decay patterns observed in sediments. In addition, labelled amino acid and aldose suites were varied between species, implying that feeding behaviour and gut morphology can impact the fate of sedimentary OM.

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VERTICAL DISTRIBUTION OF IRON-BINDING DISSOLVED ORGANIC LIGANDS IN THE NORTH ATLANTIC NEAR BERMUDA

The concentration and conditional stability constants of iron (Fe)-binding natural dissolved organic ligands in seawater samples collected in the North Atlantic near Bermuda were determined with cathodic stripping voltammetry. Two groups of Fe-binding organic ligands L1 and L2 were observed throughout the water column. The stronger Fe-binding ligand L1 has concentrations higher than the total dissolved Fe concentrations, log conditional stability constants in the range of 21.3-21.8, and a concentration profile resembling the distribution of total dissolved Fe. In contrast, the weaker Fe-binding ligand has a log conditional stability constant of 20.7-21.2, a subsurface concentration maxima at the depth of chlorophyll maxima and decreasing concentrations with increasing depth. Our results suggest that Fe-binding natural dissolved organic ligands may be produced by biological activities and removed via microbial degradation. While the complexation of Fe by stronger Fe-binding organic ligand may stabilize both Fe and the stronger Fe-binding organic ligands against removal from the water column, the presence of weaker Fe-binding organic ligand does not appear to play an important role in oceanic Fe geochemical cycling.

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HIGH-RESOLUTION DEPTH PROFILE OF PROKARYOTIC ABUNDANCE, ACTIVITY, AND COMMUNITY COMPOSITION ACROSS THE OXYGEN MINIMUM ZONE IN THE EASTERN TROPICAL PACIFIC

The Eastern Tropical Pacific (ETP) is characterized by an extensive oxygen minimum zone (OMZ), which is a site of intense nitrogen cycling of global significance. To investigate the potential role of archaea and other microbes in the carbon and nitrogen cycling, we determined the diversity, abundance, and activity of prokaryotes in the upper 1000 m using fingerprinting (DGGE), functional gene analyses, CARD-FISH, and microautoradiography. The water column was highly stratified, which was reflected in shifts of the microbial community as revealed by DGGE for both 16S rRNA and archaeal *amoA*. Crenarchaeota comprised up to 20% of the total active cell fraction above the OMZ, and increased to 47% in the OMZ at 300 m, suggesting that crenarchaeota might be contributing to nitrification in these zones. This is further supported by the finding of sequences closely related to *Nitrosopumilus maritimus* and elevated copy numbers of archaeal *amoA* throughout the OMZ. Analyses combining CARD-FISH with microautoradiography using ^{14}C bicarbonate, as well as functional gene analyses are ongoing to further reveal the contribution of archaea to dark CO_2 fixation and nitrogen cycling.

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WILL BALTIC CYANOBACTERIA BENEFIT FROM INCREASED CO2 LEVELS?

The aim was to assess if Baltic bloom-forming cyanobacteria will benefit from increased concentrations of CO2. A decrease in the pH of the Baltic Sea has already been observed. The extensive cyanobacterial blooms in the Baltic Sea are dominated by the toxic Nodularia spumigena and by Aphanizomenon sp. It has been hypothesized that a doubling of the present CO2 concentration will lead to 10% increase in the rate of photosynthesis in many phytoplankton species. Unicellular marine cyanobacteria (e.g. Synechococcus) have shown taxon-specific responses to increasing pCO2. During August 2008 we performed 4 experiments where we studied the effect of increased CO2 (970 ppm) on a natural community dominated by the cyanobacteria Aphanizomenon sp. and on artificial communities of Nodularia spumigena. To our surprise, both species seemed to be negatively affected by additional CO2 but the effects were found to be related to phosphorus limitation as well as being density-dependent. For high densities of N. spumigena, extra CO2 had a positive effect on the photosynthetic capacity (Fv/Fm). Under phosphorus limitation, however, extra CO2 did not seem to have any effect.

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NUTRIENT-REGULATED TRANSCRIPTOME PROFILING IN THE BROWN-TIDE FORMING ALGA *AUREOCOCCUS ANOPHAGEFFERENS*

Harmful algal blooms are a global problem with widespread effects on public health, the coastal environment, and the economy. Brown-tides, caused by the alga, *Aureococcus anophagefferens* , occur regularly along the mid-Atlantic U.S. causing both eelgrass and shellfish mortality. Although the exact causes of brown tide blooms are unknown, reduced nitrogen (N) compounds are thought to be important while the role of phosphorus (P) remains unclear. In this study, we used Long-SAGE (Serial Analysis of Gene Expression) to profile the *A. anophagefferens* transcriptome under N and P deficient, and replete conditions, by sequencing over 112,000 gene tags (21 bp). Analysis of these gene tags identified a suite of genes responsive to N and P deficiency, some of which have known roles in nutrient metabolism, such as putative ammonia and urea transporters and a putative peptidase. This supports the hypothesized importance of reduced nitrogen compounds to *A. anophageferrens* growth. There are also a broad suite of P-regulated genes, including a putative 5'nucleotidase. These N and P regulated genes may be important targets for exploring nutrient controls on bloom formation in field populations.

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NUTRIENT LIMITATION OF PHYTOPLANKTON BY N AND P: EROSION OF THE PHOSPHORUS PARADIGM

Control of phytoplankton biomass by phosphorus is one oldest paradigms in modern limnology despite evidence from bioassays showing that N is as likely as P to limit phytoplankton growth. The phosphorus paradigm has emerged because of insufficient skepticism in the interpretation of: 1) the phosphorus:chlorophyll correlation in lakes (a tautology), 2) the results of whole-lake fertilization experiments, and 3) stoichiometric arguments based on total N:total P ratios of for inland waters. Despite arguments to the contrary, whole-lake experiments in the ELA region of Canada demonstrated that nitrogen stimulated phytoplankton growth more than did phosphorus. Stoichometric arguments for P limitation are weakened when the variable availability of dissolved organic nitrogen (DON) is taken into account. Analysis of world-wide bioassay data show that nitrogen limitation is markedly more common in regions where atmospheric N deposition is less than 4 kg N $ha^{-1}y^{-1}$. Long-term N-pollution from the atmosphere and agricultural may have driven natural systems to P limitation. A new paradigm based on parity between N and P control of phytoplankton in lakes seems more viable than the P paradigm.

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PROCESSES LINKING A FRINGING CORAL REEF WITH THE OPEN OCEAN AT REGIONAL TO ORGANISMAL SCALES: IMPLICATIONS FOR REEF FUNCTION AND RESILIENCE

While recycling of nutrients plays a key role in coral reef food webs, it is increasingly apparent that reefs may be highly dependent on the production, supply and incorporation of particulate nutrients from the ocean (plankton), which is controlled by processes over a variety of spatial scales. At the regional scale, plankton production available to reef consumers may be controlled by oceanographic processes. For instance, seasonal upwelling at Ningaloo Reef, Western Australia leads to 10-fold increases in nitrate concentrations and over doubling of primary production in adjacent waters. We explore the implications of upwelling for temporal and spatial patterns in reef benthos using synoptic stable isotope data. Scaling phytoplankton uptake we show that Ningaloo may be linked to an area of ocean on the order of 1000 – 10,000 km^2 during upwelling and non-upwelling periods, respectively. At the reef scale, wave-pumping over the reef flat drives plankton supply, with our data suggesting that uptake of phytoplankton alone represents a nitrogen flux to the reef up to an order of magnitude higher than typically reported for dissolved nitrogen. At the organism scale, there is increasing interested in the role that plankton feeding plays in energy budgets, calcification and resilience to stressors. Stable isotope and fatty acid biomarkers are used to examine species-level plankton uptake, which we suggest may have implications for maintenance of reef biodiversity.

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NUTRIENT-LIMITATION STATUS OF BENTHIC ALGAE IN A BOREAL WETLAND, ALASKA

We conducted two, 24-day mesocosm experiments to determine the individual and combined effects of nitrogen (N), phosphorus (P), and silica (Si) enrichment on the community of benthic algae in a freshwater marsh, Alaska. In the first study, we tested the effects of N, P, Si, and N+P+Si additions on algal chemistry (N:P ratio), accrual (chlorophyll *a*, ash-free dry mass, productivity, and abundance), and community composition. In the second study, we tested the effects of N+P, N+Si, P+Si and N+P+Si additions on the same parameters. Algal N:P ratios were higher in the N and lower in the P treatments compared to controls, and were near the Redfield ratio (16:1) in the N+P and N+P+Si treatments. N+P, N+Si, and N+P+Si treatments increased algal accrual compared to controls ($p<0.05$). In the control treatment, the community of benthic algae was comprised primarily of euglenoids, whereas colonial and coccoid greens and blue-greens were dominate in the N+P treatments. These data suggest complex co-limitation on algal communities, and show that nutrient enrichment can change algal dynamics in a northern boreal wetland.

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THE ROLE OF LAND USE IN MEDIATING DENITRIFICATION AND OTHER STREAM ECOSYSTEM PROCESSES

Agriculture land use can alter nutrient regimes and the supply of terrestrially-derived dissolved organic matter (DOM) to rivers. We sampled streams in southern Ontario, Canada that have catchments ranging in agricultural land use from 0 to >90% to assess whether alterations of the landscape change the loadings of nutrients and DOM and subsequently alter ecosystem function. At each site, we quantified benthic denitrification rates, microbial activity, fungal biomass, leaf-litter and wood decomposition, community respiration, nutrients and DOM. In accordance with ecosystem variability, bacterial production ranged from 0.8 to 429.2 µg C L-1 d-1 between sites. Denitrification rates ranged from 0 (pristine sites) to >25 mg N L-1 h-1 (high agriculture sites) and were correlated with nitrate concentration (r2 = 0.47). Several processes including denitrification flux and microbial activity especially bacterial production (r2 = 0.57) and alkaline phosphatase activity (r2 = 0.68) were positively related to the proportion of monoculture in the riparian zone. It appears that the delivery of nutrients and DOM from land can have a major effect on ecosystem function.

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CHROMOPHORIC DISSOLVED ORGANIC MATTER (CDOM) AND CARBON MONOXIDE (CO) IN ARCTIC FIRST-YEAR SEA ICE

Temporal distributions were followed of chromophoric dissolved organic matter (CDOM) and carbon monoxide (CO) in first-year sea ice in the southeastern Beaufort Sea in spring 2004 and spring-summer 2008. CDOM and CO in the bottom ice were found to co-vary with the evolution of ice microalgae and were highly enriched relative to overlying ice and underlying seawater, suggestive of direct or indirect microalgal sources of CDOM and CO. In many cases, the vertical distribution of CO in the ice column can be interpreted as a combination of the distributions of CDOM and solar radiation within the ice. This points to CDOM photooxidation as an important CO production mechanism in sea ice, as verified by laboratory irradiation experiments. The accumulation of CDOM and CO within sea ice in spring may serve as significant sources of these two constituents to seawater, and, in case of CO, to the atmosphere as well, when ice melts in summer.

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VERTICALLY BALANCED WATER COLUMN REDOX-INTERFACE BIOGEOCHEMICAL STRUCTURE: MODEL ANALYSIS OF THE RELATIVE SIGNIFICANCE OF THE AFFECTING PROCESSES

In this study we used a coupled hydrophysical-biogeochemical 1D O-N-S-P-Mn-Fe-model based on ROLM (Yakushev et al., 2007) and GOTM (Burchard et al., 2006). Processes of organic matter (OM) formation and decay, the reduction and oxidation of species of nitrogen, sulphur, manganese, iron, as well as transformation of phosphorus species are parameterized. The model parameters included phytoplankton, zooplankton and bacteria, that were divided into four groups according to their relation to a particular energy source and to OM transformation. It was demonstrates that the Mn species play the dominant role in the oxidation-reduction reactions at the pelagic redox interfaces. Numerical experiments demonstrate that the intrusions disturbed a balanced biogeochemical structure and promoted biogeochemical processes that were "launched" by additional amounts of electron-donors and electron-acceptors. The system returned to the balanced condition through several stages that are characterized by the successive occurrence of processes not typical for the balanced conditions. The frequency of alternation between balanced conditions and intrusions can explain the temporal sustainment of the transient redox structure that is often observed during the field studies.

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REPLACEMENT OF LARGE DIATOMS BY SMALL ONES WITH PROGRESSION OF EUTROPHICATION IN OSAKA BAY, JAPAN: EVIDENCE FROM SEDIMENT CORE RECORDS

Osaka Bay is an ecosystem where riverine inputs of nutrients have drastically changed in the past a hundred years due to human activities. We investigated size compositions of discoid diatom communities among six layers of a dated sediment core that was taken from this embayment. The genus *Coscinodiscus*, *Cyclotella*, *Paralia* and *Thalassiosira* comprised a significant portion of the communities during the last century. The diatoms larger than 100 μm in diameter were frequently observed before 1961 when eutrophication was less prominent. In contrast, such individuals were markedly decreased after this age. As a consequence, the median cell diameters of the communities were significantly changed before (42.7-58.7 μm) and after 1961 (26.4-28.4 μm). The replacement of the large diatoms by small ones passing with the time might be caused with the changes in nutrients concentration and balance in ambient seawater. Moreover, by considering the vertical distribution of biogenic silica in the sediment core, this replacement was likely to result in a decrease of biogenic silica flux from the water column to the sediment.

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EFFECT OF GLOBAL WARMING ON THE SPREAD OF INVASIVE BIVALVES IN JAPAN

Limnoperna fortunei (golden mussel) is an epifaunal mytilid, native to Chinese and south-eastern Asia. It causes economic damage to water intakes and cooling systems of facilities. In Japan, it was first found at Lake Biwa in 1992. Route for its arrival in Japan is believed to be alongside edible freshwater clams imported from China. In the 2000s, the spatial distribution of this mussel had expanded to eastern Japan. Although many freshwater bivalves are common between continent Asia and Japan, epifaunal mytilid has not been distributed in Japan before. The reason why *L. fortunei* can now succeed in inhabiting Japanese freshwater area may be partly due to anthropogenic alteration. *Musculista senhousia* (Asian mussel) is a native epifaunal marine mytilid, which can invade estuarine environment where commercial brackish Asiatic clam, *Corbicula japonica*, inhabits. Its byssal mat destroys clam fisheries and thus it is regarded as biofouling species. *M. senhousia* have been introduced to Australia, the Mediterranean, and the Pacific coast of the USA presumably through shellfish farming and trading. Global warming may accelerate the expansion of its distribution both directly and indirectly.

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PHYTOPLANKTON PATCHINESS: FROM METER TO CM & FROM CM TO MM

Phytoplankton patchiness and its ecological significance have been increasingly recognized over a few decades. Patchiness ranging from tens of kilometers to a few meter scales are regarded as ubiquitous features of marine systems. In recent years, several field programs have found phytoplankton thin layers using fluorescence probe. The scale of patchiness is as thin as one meter or less. What is the minimum scale of phytoplankton patchiness? Making use of our new microstructure profiler (TurboMAP-L) data, we demonstrate phytoplankton can be patchy at cm scale based on a LED fluorescence probe, first; then we show the patchiness at mm scale based on a newly developed laser fluorescence probe. A mini-camera system mounted on TurboMAP-L reveals micro-scale phytoplankton patchiness in still images and the features are consistent with the mm scale patchiness. We discuss how the micro-scale patchiness relates to turbulent flow field. We present the observed facts from coastal water, open sea and lake systems.

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UNDERSTANDING THE IMPACTS OF INCREASED SEAWATER PCO2 AND TEMPERATURE ON MICROBIAL COMMUNITY USING MESOCOSM EXPERIMENTS

To understand the impacts of the climatic change (rising seawater pCO_2 and temperature) on microbial community, we conducted a mesocosm experiment for 12 days with three different pCO_2 conditions representing ambient (298 ppm pCO_2 and 15.6 degree), high pCO_2 (946 ppm pCO_2 and 15.6 degree), and global warming scenarios (988 ppm pCO_2 and 18.9 degree). Growth rate of phytoplankton was relatively high in the ambient treatments. Free living bacterial biomass was not changed under all experiment conditions. However, each groups of heterotrophic protists showed noticeable responses to pCO_2 concentration and temperature changes. The abundance of heterotrophic flagellates and heterotrophic dinoflagellates subsequently increased in all treatments. However, their growth rates were lower under the global warming treatments than those under the other two treatments. In particular, the growth rate of heterotrophic dinoflagellates was the highest under the high pCO_2 condition. Abundance of ciliates increased until 4 days later and growth rate of ciliates was relatively low under the ambient treatment. This result suggests that each group of microbial community may respond uniquely with increasing seawater pCO_2 and temperature.

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FE SPECIATION AT THE TROPICAL EASTERN NORTH ATLANTIC TIME-SERIES OBSERVATORY SITE (TENATSO)

Fe speciation plays a key role in understanding the impact of changing dust deposition on marine ecosystems. A one-dimensional model of Fe speciation is coupled with GOTM (General Ocean Turbulence Model) and a NPZD-type ecosystem model and applied for the TENATSO site. We show: The amplitude of the daily photoredox cycling of iron at TENATSO depends on concentration and speciation of copper. With the assumption of 1 nM total copper concentration, the modelled concentration of hydrogen peroxide is close to the observations near TENATSO site. The strong and episodic deposition of Saharan dust plays a double role at TENATSO: it brings dissolved iron into surface waters, but also scavenges Fe(III). The fate of organic ligands affects Fe speciation. Our hypotheses of mechanisms controlling the cycle of organic ligands are: ligands are produced by phytoplankton and detritus remineralization; decay of ligands occurs via photochemical reduction and remineralization; organically complexed Fe is taken up by phytoplankton. We carry out sensitivity studies to these processes and compare the modelled profiles of free organic ligands and organically complexed Fe with observations.

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PHYSICAL PROCESSES AND MODELLING OF LAKE WINNIPEG

Lake Winnipeg is the tenth largest lake in the world. The lake is shallow (mean depth~12 m) and has two distinct basins. Significant changes in water transparency, biological species composition, algal productivity, and sedimentary chemistry indicate that the lake is on a trajectory of progressive eutrophication and approaching a state of deterioration that may affect ecosystem sustainability. Because of these reasons new research projects were initiated to study the relative roles of physical, chemical, and biological factors on the ecology of Lake Winnipeg at various space and time scales. Currents, water temperature, winds, solar radiation, waves and some water quality parameters were recorded at several fixed moorings in Lake Winnipeg during 2007. Circulation within and between the basins are dominated by surface winds and seiches in the basins. The thermal structure and exchange processes during summer stratification in the lake have also been examined using a time series data of horizontal velocity profiles from broadband ADCPs and temperature profiles at the moorings. A three dimensional model (ELCOM) has been used to model the water circulation and temperature in the lake. By using spatial and riverine stable isotope data we are able to validate the model and demonstrate the impact of river plumes in the coastal zones of Lake Winnipeg.

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INFLUENCE OF THE RECENT *LIRIOPE TETRAPHYLLA* (TRACHYMEDUSAE) INVASION ON ZOOPLANKTON COMMUNITY STRUCTURE OF THE HIGHLY STRATIFIED MARMARA SEA

Liriope tetraphylla is among the most common hydrozoans in the Mediterranean, while was not encountered in the Sea of Marmara before September 2005. The abundance of species displayed a tremendous increase in two years and occupied 40% of net zooplankton in 2006, reaching an abundance of 2978 ind. m-3. Mediterranean time series data from 1966 to 1995 revealed a maximum abundance of 9 ind.m-3, thus reflecting the magnitude of invasion. Consequently the very high abundance of *L. tetraphylla* in the upper layer of the highly thermohaline stratified basin caused remarkable shifts in zooplankton community structure. Principal component scores showed that L. tetraphylla is the most important factor along the non-temperature dependent second principal component. Moreover, as a unique cladocera dominated system, contribution of Cladocera reduced and abundance of *Noctiluca scintillans* declined 10-fold. In a severe mucilage event in the autumn of 2007, *L. tetraphylla* was the most abundant zooplankton species and crustacean zooplankton almost vanished. After the devastating *Minemiopsis leidyi* invasion in 1980's, *Liriope tetraphylla* intrusion is the most important modification in the Marmara ecosystem and the species' importance would increase in the following years, affecting trophic pathways.

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ORGANIC MATTER AVAILABILITY DURING PRE AND POST-DROUGHT PERIODS IN A MEDITERRANEAN STREAM

There is typically a summer drought period in Mediterranean intermittent streams, when hydrologic connectivity between surface and groundwater is interrupted and changes in organic matter use might occur. There was a significant decrease of the benthic leu-aminopeptidase enzyme activity and the number of living bacteria during the wet-drought process. The first rains after drought caused a recovery of living bacteria and an increase of B-glucosidase activity. Lipid and amino acid content in the benthic substrata were more abundant in the pre-drought period than in the post-drought period. Polysaccharides peaked in the river water immediately after the first rains in the post-drought period. The fast recovery of the heterotrophic metabolism might be due to the major availability of organic matter, mainly polysaccharides, accumulated during drought. Nevertheless, benthic enzymatic activities reach basal values after about three weeks of rewetting.

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PROKARYOTIC ABUNDANCE, ACTIVITY AND COMMUNITY COMPOSITION IN THE EASTERN MEDITERRANEAN SEA

A field study was conducted to assess the distribution pattern of prokaryotic abundance and activity, and bacterial community composition among the different water masses of the Eastern Mediterranean Sea. Bacterial community composition was assessed by both automated rRNA intergenic spacer analysis (ARISA) and terminal-restriction fragment length polymorphism (T-RFLP). The patterns of prokaryotic abundance below 100 m were a function of depth at all the stations, while the patterns of prokaryotic production showed a depth-related pattern only in two out of the five stations. Variations in prokaryotic production were explained by temperature. Although bacterial community composition was related to depth and hence stratified, the number of OTUs were not explained by any environmental variable and not related to prokaryotic abundance and production. Thus, despite orders of magnitude lower prokaryotic activity in the bathypelagic as compared to surface waters, prokaryotic richness is maintained on a similar level as in surface waters.

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CHARACTERISTICS OF MICROPHYTOBENTHOS BIOMASS AND PRODUCTION IN THE GANGHWA TIDAL FLAT, KOREA

Microphytobenthic biomass and primary production were investigated at two sampling sites (Donggeom and Yeocha) in the Ganghwa tidal flat from August 2006 to July 2008. Chlorophyll *a* content ranged between 5.5 and 187.5 mgm^{-2}, being higher at Donggeom than Yeoch by 2.8-fold. Both sampling sites showed large variation in chlorophyll *a* concentration during the study period, influenced by sediment type, water content, organic matter, patchy distribution and other environmental factors. No clear seasonal trend was observed in both sites. Primary production was between 1.0 and 783.0 $mgm^{-2}d^{-1}$, while photosynthetic activity (P^b_m) was between 0.2 and 11.2 $\times 10^{-3}$ $mgCmgChl\ a^{-1}h^{-1}$. Primary production and P^b_m increased during spring, which might have been caused by increasing temperature, irradiance and day length. However, microphytobenthos production and P^b_m decreased during summer and winter. The temperature of surface sediments rose to more than 30 degrees celsius during summer, and dropped to less than 10 degrees celsius during winter. In conclusion, microphytobenthos biomass and production in Ganghwa tidal flat were correated with environmental factors, such as sediment type, irradiance, temperature, water content.

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IMAPCTS OF THE INVASIVE TUNICATE *DIDEMNUM VEXILLUM* ON DIVERSITY AND SPECIES RICHNESS ALONG THE U.S. NORTHEAST CONTINENTAL SHELF

The invasive tunicate *Didemnum vexillum* has spread down the U.S. Atlantic Coast since its appearance in Maine during the 1980s. Using the towed, optical imaging system HabCam (Habitat Mapping Camera System), over a three-year period, we have chronicled *D.vexillum* abundance, distribution, and impacts on biodiversity and species richness in several areas on Georges Bank, an area important to commercial fisheries. *D.vexillum* mats were found to overgrow benthic organisms in addition to gravel, cobble, boulder, and shell substrate. Increasing density of *D.vexillum* was correlated with a decrease in density of sea scallops (*Placopecten magellanicus*) and 12 other benthic organisms. Percent cover of *D.vexillum* over the sea floor was higher in Closed Area II, an area closed to scallop and ground fishing, than the heavily disturbed regions outside of the closed area. Repeat surveys indicate a correlation between low temperatures and winter die-back of *D.vexillum* populations. However, continued year-round sampling of population densities, temperature, benthic shear stress, food availability, and other habitat requirements are needed to characterize the long-term impacts of *D.vexillum* on benthic community structure.

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INTERANNUAL CHANGES IN TEMPERATURE AND OXYGEN PROFILES DURING WINTER IN LAKE BIWA - IMPLICATIONS FOR THE ASSESSMENT OF ECOSYSTEM RESPONSES TO GLOBAL WARMING

Warming may impact on lake ecosystems in a complex fashion but one of the most serious issues for warm, monomictic large lakes such as Lake Biwa is the reduction of the extent of vertical mixing in winter, which may lower the annual minimum oxygen concentration in the deep layer. Here we present our data on changes over the past 6 years of the profiles of temperature and dissolved oxygen in winter in Lake Biwa (area 670 km^2, max depth 104 m). The data indicate that convection due to surface cooling primarily drives circulation, although intrusion of river water may also contribute to the transport of oxygen to the bottom layer. Our data also demonstrate that the circulation was incomplete during the warm winter (February) of 2007, which was followed by low oxygen levels in the deep layer at the end of the subsequent period of stratification. These data support the hypothesis that the ecosystem of Lake Biwa is highly sensitive to small changes in air temperature in winter.

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PHYTOPLANKTON COMPETITION FOR NUTRIENTS AND LIGHT IN A STRATIFIED WATER COLUMN

We analyzed a model of competition between two phytoplankton species in a stratified water column. We assume the surface layer is uniformly mixed and the deep layer is poorly mixed, as is commonly observed in lakes and the ocean. Two analytical techniques (Huisman & Weissing 1995; Klausmeier & Litchman 2001) are employed to analyze the competition outcome. At equilibrium, each species is either absent or resides in the benthic layer, in the deep layer, or in the surface layer. With a trade-off between nutrient and light competitive abilities, we obtained five spatial configurations of coexistence and the corresponding parameter regions. Good light competitors show two distinct ecological niches: in mesotrophic conditions, they live as understory species below a layer of good nutrient competitors; in eutrophic conditions, they live as competitive dominants in the surface layer. Multiple regions of alternative stable states are possible in parameter space. This work synthesizes the competition theory of phytoplankton in a well-mixed water column (Huisman & Weissing 1995) and the game theoretical approach in a poorly-mixed water column (Klausmeier & Litchman 2001).

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THE EFFECTS OF TURBULENCE AND TURBIDITY ON THE SURVIVAL AND REPRODUCTION OF *DAPHNIA MAGNA*

Increases in turbulence and turbidity, resulting from human activity and the effects of climate change on precipitation patterns, may significantly alter aquatic life. *Daphnia* are not naturally abundant in turbulent or turbid water thus if turbulence and turbidity increase, survival and reproduction of *Daphnia* may be affected. Eight, one-day old *Daphnia magna* were incubated in 200 ml Erlenmyer flasks containing 175 ml of water

and survival and reproduction were monitored daily for 12 days. Three conditions of turbulence (none, low and high) were combined with three levels of turbidity (none, low and high) to give 7 experimental groups. Three trials were conducted with each trial consisting of 10 flasks of each experimental group. The results indicate that: a) low turbulence alone did not decrease survival whereas high turbulence alone did; b) survival decreased more in response to high turbidity than to low turbidity; c) the combined effects of turbulence and turbidity were more detrimental to survival and reproduction than turbulence alone; d) turbulence alone and in combination with turbidity significantly decreased reproduction.

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ALTERATION OF ALKENONE UNSATURATION RATIO WITH DEPTH IN THE NORTHWESTERN MEDITERRANEAN SEA: POTENTIEL ROLES OF AUTOXIDATION AND STEREOMUTATION

To evaluate the relative importance of biotic and abiotic degradation processes on alkenones, suspended particle samples collected in the Northwestern Mediterranean Sea within the framework of the MEDFLUX program were investigated. The diverse functional groups that may be attached to the stable tetracyclic carbon skeleton of sterols appeared to be very useful for estimating the relative effects of biotic and abiotic degradation in the sample investigated. The strong predominance of abiotic degradation products over products of biotic degradation observed, showed that abiotic degradation strongly predominates in suspended particles in the NW Mediterranean. The alkenone insaturation index increased significantly (from 0.43 to 0.55) with increasing water depth. A good correlation obtained between variations of this index and concentrations of specific sterol autoxidation products supported the involvement of selective autoxidation of alkenones in suspended particles. Stereomutated alkenones were detected in the surface sediment. It could be estimated that stereomutation in this sediment resulted in a +0.05 increase in alkenone unsaturation index. Therefore, abiotic degradation may have adverse effects on alkenone-derived paleothermometry.

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MICROBIAL COMMUNITY STRUCTURE IN A SEASONALLY ANOXIC FJORD: SAANICH INLET

Marine oxygen minimum zones (OMZs) are widespread and expanding regions of low dissolved oxygen tension (hypoxia) that play a major role in the biogeochemical cycling of nitrogen and climatologically relevant trace gases, including methane, carbon dioxide and nitrous oxide, within the global ocean. To better understand microbial community structure and population dynamics across a range of hypoxic water column conditions we conducted cultivation independent molecular surveys targeting bacterial and archaeal small subunit ribosomal RNA genes traversing the depth continuum of Saanich Inlet, a seasonally anoxic fjord on the coast of British Columbia. Our surveys resolve temporal patterns of niche partitioning along defined geochemical gradients (oxygen, nitrate, methane, carbon dioxide and nitrous oxide) during stratification and renewal events. Several common indicator groups were found to dominate the hypoxic water column including free-living relatives of thiotrophic symbionts (gamma proteobacteria), Nitrospina and SAR324 (delta proteobacteria), marine group A (SAR406), and members of the marine Group I crenarachaea providing robust taxonomic markers for long-term monitoring studies of both coastal and open ocean OMZ systems.

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SIMULATION OF SEA COLOR FROM A 3D HIGH RESOLUTION PHYSICAL/BIOLOGICAL MODEL OF THE GULF OF ST. LAWRENCE : ASSESSING THE OPTICAL IMPACT OF CDOM FROM FRESHWATER

We recently demonstrated our capability to simulate the short (tidal and synoptic) to seasonal and inter-annual 3D coupled physical/planktonic variability in the Gulf of St. Lawrence (GSL). Comparisons of the model results with in situ monitoring data and satellite derived sea color (SeaWIFS) and surface temperature (AVHRR) data confirmed the ability of the model to produce realistic bio-geochemical (Chla and nutrients) fields. It also revealed the difficulty to assimilate ocean colour data due to the complex optical properties of the GSL waters which are a mix of Case I and Case II type waters. We present the first results from a spectral bio-optical model applied to existing solutions of the physical/biological coupled model for the main bio-optical active components, i.e. POC, chromophoric dissolved organic matter (CDOM) and phytoplankton. The spectral bio-optical model simulates both underwater and water leaving irradiance in the PAR domain (400-700 nm - 5 nm resolution). The results are used to assess the potential contribution of CDOM from the St. Lawrence freshwater to remotely sensed ocean colour in the GSL.

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VARIABILITY OF PRIMARY PRODUCTION OBTAINED BY SATELLITE AND SHIP DATA IN THE SEA OF JAPAN

Spatial and temporal variability of primary production (PP) in the Sea of Japan was studied to understand potential responses to environmental change. PP estimates derived from MODIS satellite data were compared with in situ measurements. Satellite estimates were reasonably well correlated with in situ measurements. The largest differences were observed in coastal areas and are believed to be caused by errors in satellite estimates of chlorophyll-a and variability in the assimilation number. Four regions were studied in detail: Peter-the-Great Bay, the central Japan Basin, the northern area and the southern area. Estimated PP was highest in the southern area (284 g C m-2 year-1) and lowest in the middle part of the Japan Basin (176 g C m-2year-1). In the southern area, peaks of primary production appeared in spring and fall; in the northern area, a single peak occurred in spring. The spring bloom contributed about 31% to annual primary production for the entire Sea of Japan. Different satellite models for PP were evaluated; we will present results of a tuned model for the region.

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CHANGES IN TROPHIC NICHES OF TWO SPECIES OF NEOTROPICAL STREAM FISH USING STABLE ISOTOPES, GUT ANALYSIS, AND BEHAVIORAL OBSERVATIONS

A species' isotopic niche represents the area occupied by individuals in the δ-space – obtained by plotting $\delta^{15}N$ against $\delta^{13}C$. As part of a broader NSF-FIBR Project, we assessed the isotopic niche of two fish species, *Rivulus hartii* (Hart's killifish) and *Poecilia reticulata* (guppy), from nine Trinidadian streams characterized by different predation and competition regimes. We also performed gut analyses and conducted behavioural observations on the two species. In each stream, fishes were sampled and observed from three different communities: *Rivulus+Poecilia*+other fish predators, *Rivulus+Poecilia*, and *Rivulus* only. We hypothesize that the niche breadth of the two fish species is directly affected by different predation and competition regimes. Preliminary results suggest that *Rivulus* and *Poecilia* show a larger niche overlap when they co-occur with predators. When only the two species are present, their niche overlap is smaller, due to a greater resource partitioning. We found no evidence of ontogenetic niche shift in *Poecilia*. *Rivulus* showed ontogenetic niche shift when released from predation pressure and competition. Our findings confirm the utility of multiple approaches to understand community food web dynamics in tropical streams.

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HABITAT FRAGMENTATION AND THE DISTRIBUTION OF THE SEA URCHIN *LYTECHINUS VARIEGATUS*

The sea urchin *Lytechinus variegatus* , Lamarck, is a common inhabitant of the seagrass meadows. Seagrass beds can be extensive and continuous or fragmented due to natural factors or anthropogenic activities. Landscape ecology techniques are being used to determine patterns that influence natural processes in marine ecosystems such as seagrass beds. We will study habitat fragmentation in two coral reefs in La Parguera, Puerto Rico using field and IKONOS satellite remote sensing data. The principal macro habitats in these areas are mangroves, sandy areas, coral reefs, and seagrass beds. The fragmentation analysis will use Fragstats software in combination with field assessments of sea urchin distribution. These data can be used to assess the condition of seagrass beds for change detection.

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IDENTIFYING AND CHARACTERIZING NITROGEN-FIXING MICROBIAL COMMUNITIES

Nitrogen fixation is a major source of N that controls the global ocean availability of nitrogen, and is believed to be largely due to cyanobacteria. The diversity of nitrogen-fixing cyanobacteria is greater than previously believed and includes several unicellular groups, one of which has yet to be cultivated. We found that there are spatial trends in distribution of nitrogen-fixing cyanobacteria in both the North Atlantic and South Pacific Oceans. The uncultivated Group A unicellular cyanobacteria dominated diazotrophic communities in the eastern equatorial Atlantic and in the southernmost extent of our transect in the South Pacific. These communities exhibited high nitrogen fixation rates. We characterized the Group A unicellular cyanobacteria using flow cytometry, quantitative PCR and 454 genomic sequencing (Titanium). We found that this cyanobacterium lacks genes for photosystem II and Rubisco, demonstrating that it is a photoheterotrophic cyanobacterium. The high rates of nitrogen fixation catalyzed by this unusual cyanobacterium are thus coupled with carbon recycling rather than carbon fixation, which has implications for carbon export from the surface ocean.

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BENTHIC BIODIVERSITY IN DEEP-SEA MUD VOLCANOES OF THE CENTRAL MEDITERRANEAN SEA

Mud volcanoes are areas of active fluid seepage and are considered potential 'hotspots' of deep-sea benthic biodiversity. The transport of organic-rich fluids from the geosphere into the biosphere can have a profound impact both on benthic ecosystems functioning and influence the feeding and ecology of specialized deep-sea organisms. Flux rates within passive margin fluid flow systems vary by several orders of magnitude from small, episodically active cold seeps to continuously active mud volcanoes. Here we investigated meiofaunal community structure and biodiversity in relation with the quantity and quality of the potential food sources of three mud volcanoes located at 150 m depth in Sicily Channel (Central Mediterranean Sea), characterized by variations in dimensions, morphology and composition of erupted material and fluids. Results will be discussed in order to assess the influence of direct (abiotic) and indirect (bacterial resource specificity) of sediment geochemistry on meiobenthic communities of the various sub-habitats in deep-sea cold-seep areas.

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COMMUNITY STRUCTURE, PRODUCTION AND GRAZING OF COPEPODS IN THE BOSPORUS AND DARDANELLES STRAITS AND ADJACENT SEAS (NE AEGEAN SEA, MARMARA SEA)

The Straits System controls the exchange of matter between the Black and the Mediterranean Seas. The main objectives of the present study, conducted during April 2008 within the SESAME project are: (a) to examine the composition and the spatial distribution of the mesozooplankton community in the Bosporus and Dardanelles Straits and the adjacent Marmara and NE Aegean Seas, (b) to compare the production and the grazing of copepods on phytoplankton and ciliates in the above areas and (c) to understand the transfer of phytoplankton production up the food chain. The mesozooplankton community was differentiated among the stations and copepod production was higher in the Bosporus Straits than the other stations. Copepod grazing on phytoplankton (cells > 2.0μm) was higher in both the Bosporus Straits and the Marmara Sea, whereas predation on ciliates was more important in the NE Aegean Sea. Finally, for the first time carbon flux budgets were established for the studied areas and the food web dynamics of those systems is discussed.

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EFFECTS OF TEMPORAL VARIATION IN PERMEABILITY ON THE METABOLISM OF SANDY ESTUARINE SEDIMENTS

Permeability is a key factor that determines the role of advective transport processes in the cycling of organic and inorganic material in sandy sediments. Spatial and temporal variation of the biological and physical sediment characteristics may result in significant changes in permeability and consequently sediment metabolism. Values in excess of 1×10^{-12} were measured in intertidal sandy sediments from the Ythan estuary (NE Scotland) and enabled advective pore water exchange at all times. More importantly, temporal changes in the sediment's permeability were observed over a 1-yr period. *Ex situ* stirred benthic chamber incubations also revealed a seasonal effect on sediment metabolism at this site. Higher respiration rates were observed in summer corresponding to lower sediment permeabilities and elevated macrofaunal abundance. The presence of microphytobenthos or the enhanced deposition of phytodetritus might explain the decrease in permeability during the summer season. Acknowledging that sediment permeability is prone to this seasonal variation indicates that future possible anthropogenic impacts such as increased land run-off will consequently also influence the ecosystem functioning of permeable sands.

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EXTREMOPHILE PROTISTS IN THE TINTO RIVER: DO THEY PREFER PARTICULAR GEOCHEMICAL "ISLANDS"?

The upper region of the Rio Tinto, Spain is fed by numerous springs and small streams flowing through diverse metal sulfide minerals of the Iberian Pyritic belt. On the microbial level, this part of the river is a patchwork of "islands" with distinct geochemical environments. We used ribosomal RNA clone library surveys combined with environmental data from TXRF, data loggers, and microsensors to show that distributions of protists are closely related to the pH (below 2.3) and concentrations of metals (up to 8,000 mg/L) at particular sites. While many organisms occur at multiple stations, others are strongly associated with individual sites. Fine temporal and spatial scale measurements describe some aspects of environments the microbial communities are exposed to, while experiments with cultured isolates from the river show how the organisms respond to varying environmental conditions. It should be noted that as powerful as the methods of molecular biology are, some organisms we have seen at the river using a field microscope have still not been detected in the extracted DNA, so a balanced approach using multiple methods is still needed.

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LOSS RATES FOR PHYTOPLANKTON IN THE NORTHWEST ATLANTIC OCEAN

The total daily phytoplankton loss in the mixed layer is estimated by combining remotely-sensed data on ocean colour with an analytical model for daily mixed-layer primary production. A Monte Carlo procedure is used to recover the total loss rates for ten geographic locations on the Northwest Atlantic continental shelf. The total loss is compared with the sum of individual contributions from algal respiration, excretion, grazing by micro- and macro-zooplankton, sedimentation and deepening of mixed layer. The closure of the system is examined, and the lower bounds of new production and f-ratio are calculated on an annual basis.

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METAL SPECIATION IN UPLAND STREAMS USING DYNAMIC MEASUREMENTS AND MODELLING

DGT (diffusive gradients in thin-films) is an situ technique that can provide information about the speciation and dynamics of metals in natural waters. In situ DGT measurements made in 34 upland streams were compared to total inorganic metal derived from total dissolved metals and DOC using the speciation model WHAM. Agreement was generally good for Zn and Cd, where there was little complexation by natural organic matter, but not for Cu where complexation by humic substances is generally dominant. In this case, for most waters, the DGT measurement was consistent with the maximum dynamic metal, which is calculated taking into account diffusion coefficients of complexes assuming complete lability. However, for some waters the measurement of Cu complexes by DGT was kinetically limited. Complexation by natural organic matter is not very important for Ni, but there appeared to be a significant colloidal fraction in most waters. For both Al and Pb it was more difficult to obtain definitive speciation information because complexation by humic substances is important and commonly there also appears to be a substantial colloidal fraction.

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MESO-SCALE COLD-CORE CYCLONIC EDDIES ALTER THE RELATION IN ABUNDANCE AND ACTIVITY BETWEEN ARCHAEA AND BACTERIA IN THE SOUTH CHINA SEA

We investigated the role of cold-core cyclonic eddies on the prokaryotic community metabolism in the South China Sea (SCS). The distribution and D- versus L-amino acid uptake of the bulk prokaryotic community and the major prokaryotic groups (Bacteria, marine Crenarchaeota Group I and marine Euryarchaeota Group II) were determined using microautoradiography combined with catalyzed reported deposition fluorescence in situ hybridization (MICRO-CARD-FISH). Significant differences in the distribution and activity of prokaryotic communities were observed between in- and outside the cyclonic eddy. Higher bulk D-Asp : L-Asp uptake ratios and greater crenarchaeotal contribution were found in than outside the cold-core eddy. We conclude, based on MICRO-CARD-FISH data and the distribution of chromophoric dissolved organic matter, that the higher contribution of refractory DOM in the cyclonic eddy was responsible for its overall lower prokaryotic activity as compared to outside the eddy. Furthermore, Crenarchaeota appear to be relatively more important for the carbon and nitrogen cycling in- than outside cyclonic eddy systems.

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EFFECT OF TURBULENCE ON PHOSPHORUS RELEASE FROM ESTUARINE SEDIMENT

Phosphorus (P) is an essential element for phytoplankton growth in aquatic ecosystems and is frequently the limiting nutrient in freshwaters and some marine systems. This study uses a mini-annular flume and water and SPM (suspended particulate matter) collected in the Tamar estuary, SW England to simulate the physicochemical conditions in a macrotidal estuary. The release of inorganic phosphorus (IP) and organic phosphorus (OP) during resuspension events was determined at different shear forces. Increasing the shear force (to 0.9 N m-2), and hence the SPM loading in the water column, caused negligible increase of dissolved IP and OP in the river end-member but significant and rapid increase in the marine end-member (24 µg L-1 IP and 35 µg L-1 OP). When the shear force was stopped there was limited re-adsorption of phosphorus species to the SPM over 18 hours. The additional IP released into the water column could therefore contribute to eutrophication in P limited systems and some of the released OP may also be bio-available.

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INVESTIGATIONS OF VIRUS AND BACTERIA ABUNDANCES IN DEEP-SEA SEDIMENTS IN LOW OXYGEN ENVIRONMENTS

Although marine viruses have been recognized as active components of aquatic ecosystems playing an important role in the carbon cycle, we still know little about the concentration of viruses in sediments, as well as about the factors influencing their distributions. We investigated the viral and bacterial abundances in sediments from two areas of low oxygen concentrations, the Santa Barbara Channel and the Gulf of California during two cruises in 2005. The abundances of viruses and bacteria were determined in the pore water of collected sediment cores down to a depth of 20 cm. This was accompanied by microsensor measurements (oxygen, sulfide), pore-water nutrient analyses and sediment geochemical analyses in the exact same cores. The environmental conditions varied at the different sites, which was also reflected in the depth distribution and abundance of bacteria and viruses. In general, the depth distribution of viruses closely followed the bacteria with a typical ratio of 20:1, except for stations where nutrient concentrations were very high, the ratios increased to 100:1. Our findings indicate how environmental conditions affect the distribution of viruses in marine sediments.

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RESOLVING THE DYNAMICS OF PHYTOPLANKTON BLOOM PHENOLOGY AND TROPHIC TRANSFER IN ECOSYSTEM MODELS

Understanding and simulating the effects of climate change on the phenology of events such as the spring bloom and the transfer of autotrophic biomass to higher trophic levels are key issues facing ecosystem modelers. We developed a five-phytoplankton group model (based on diatoms, dinoflagellates, coccolithophores, pico-phytoplankton, and cyanobacteria) to better simulate temporal bloom dynamics and the influence of different functional groups on trophic transfer efficiency. To introduce the consequences of changes in biochemical quality of phytoplankton to higher trophic levels, we employ a variable stoichiometry that also provides an improved representation of phytoplankton nutrient uptake and growth rates. The model includes four potentially limiting nutrients, temperature- and light-dependent growth rates as well as light-dependent Chl a to carbon ratios. In this presentation we identify the group-specific parameterizations and present a comparison with data from a 25-d mesocosm experiment. The approach allows aspects of food quality and concomitant changes in transfer efficiency to be represented within ecosystem and is a first step towards a more adequate representation of phenological changes and the flow of biomass and carbon in marine systems.

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DEVELOPMENT OF A SYBR GREEN RT-QPCR ASSAY FOR *DSRB* GENE TRANSCRIPTS TO ASSESS THE RELATIVE ACTIVITY OF SULFATE REDUCING BACTERIA IN MARINE SEDIMENTS.

Sulfate-reducing bacteria (SRB) contribute considerably to biocorrosion in oil and gas fields through sulfide production. Because sulfate reduction is putatively responsible for most of the corrosion in productive oil wells, and for more than half of the failures of buried pipelines and cables, a quick and easy method determining SRB relative activity in sediment is needed. Here we describe a SYBR Green RT-qPCR assay developed using the *dsrB* (dissimilatory sulfite reductase β-subunit) gene to detect general transcript abundance. To develop methods, the RT-qPCR assay was examined using *Desulfovibrio africanus* genomic DNA, in vitro generated dsrB transcript, and RNA from environmental sediment samples from St. Petersburg, FL. *DsrB* transcript copy number can be determined from sediment samples as small as 0.25cc, with a detection limit of around 10^5 copies per reaction. In environmental samples, adding tRNA before cell lysis increased transcript recovery three-fold. The ease of sampling, ability to archive samples for long periods, and the broad specificity of the *dsrB* primers with SYBR Green RT-qPCR render these methods useful for measuring relative transcriptional activity of SRB in marine sediments.

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BIO-OPTICAL SURVEY OF HARMFUL ALGAE BLOOMS IN THE NORTH SEA

The formation of Harmful Algal Blooms (HABs) as a natural hazard is perceived to be an increasing phenomenon in aquatic environments. The accumulation of algal cells and their toxins results in adverse effects on human- and ecosystem health as well as on economic sectors. Especially coastal zones are in focus, as they provide a wide range of services to human beings. Efforts to monitor and predict algal tides comprise techniques such as remote sensing, in situ measurements as well as fine scaled laboratory analysis - each methodology comprising advantages as well as limits within its range of implementation. In the context of HAB dynamics, real time results in a high resolution -in spatial, as well as temporal dimension- are demanded. Bio-optical methods provide a promising option to tackle these requirements. Results from recent joint bio-optical and chemical ecology transects along the Scottish, Norwegian, German and Danish North Sea coast will be presented, underlining the importance of bio-optical observations in search for HABs in coastal waters.

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ENHANCED ENZYMATIC DEGRADATION OF SPECIFIC POLYSACCHARIDES IN COASTAL WATER AGGREGATES

Coastal water aggregates play a key role in organic matter dynamics, since the potential of aggregate formation in coastal (turbid) waters is usually high. Aggregates represent microbial 'hotspots', where enzymatic activities are generally enhanced. The extent to which enzyme structural specificities may differ between aggregates and aggregate-free seawater, as well as the extent to which aggregate formation itself may affect enzyme activity, is unclear. Six different polysaccharide substrates were used to investigate enzyme activities of aggregates (formed using a roller table) from surface water from the northeastern Gulf of Mexico in three consecutive years. All six were hydrolyzed in surface waters, but a comparison of hydrolysis rates in 'whole water' (surface water not placed on the roller table) to hydrolysis rates in aggregates demonstrated that aggregate formation notably enhanced the activities of several of the enzymes. These results suggest that aggregate formation may enhance select enzyme activities (perhaps by processes such as quorum sensing), thereby increasing microbial degradation of specific high molecular weight components of aggregates.

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DMS AND DMSP IN THE UPWELLING AREA OFF MAURITANIA (NW AFRICA) IN FEBRUARY 2008

DMS and DMSP were measured in the surface layer (0-10m) along the Mauritanian coast during the peak of the coastal upwelling season in February 2008. The measurements were perfomed during the German SOPRAN cruise ATA-03 onboard R/V Atalante. Significantly increased DMS and DMSP concentrations were associated with the upwelled water masses. The average DMS concentration was 2.8 nM, with a maximum DMS concentration of up to 10 nM in the upwelling. This is in line with the view that coastal upwelling regions represent areas with enhanced DMS emissions to the atmosphere. Obviously the nutrient-rich upwelled water masses triggered a phytoplankton bloom which in turn resulted in a patchy distribution of DMSP producing algae of the taxa haptophytes and dinoflagellates. This distribution was roughly consistent with the patchy distribution of enhanced DMSP concentrations whereas enhanced DMS values seemed to be correlated to grazing, indicated by a high correlation with chlorophyll degradation products. Thus a high grazing pressure on phytoplankton could have led to an elevated release of DMSP to the seawater which, in turn, was probably affected by both bacterial consumption and conversion to DMS.

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COASTAL PHYTOPLANKTON DO NOT REST IN WINTER

Despite the widespread idea that winter is a season of slow phytoplankton growth and sluggish biological activity, frequent biomass highs and marked variability characterized the winter phytoplankton populations in the Gulf of Naples, Mediterranean Sea, over the years 1985-2006. Those highs resulted from different patterns in the physical forcing, produced different vertical distributions and were characterized by different species compositions. The largest blooms were mostly associated to a salinity-driven stratification and were often caused by colonial diatoms such as Chaetoceros spp., Thalassiosira spp. and Leptocylindrus danicus while higher mixing rates produced blooms with a dominance of flagellates, dinoflagellates and coccolithophores. In addition, trends in species composition and dynamics were detectable along the series. We will discuss on what distinguishes such blooms from the better studied early spring bloom and on the possible mechanisms coupling different species to different physical processes.

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HETEROTROPHIC BACTERIA PROMOTE THE GROWTH AND SURVIVAL OF THE CYANOBACTERIUM, PROCHLOROCOCCUS

The cyanobacterium Prochlorococcus is highly abundant in the oligotrophic ocean and contributes significantly to the global carbon cycle. Since its first isolation twenty years ago, efforts to understand the physiological and genetic basis for its ecological success have been hampered by difficulties in establishing and maintaining axenic (pure) cultures, and in isolating clones as colonies on agar media. We have discovered that by co-culturing Prochlorococcus with marine heterotrophic bacteria, robust colony formation can occur, which can be followed up by steps to eliminate the heterotrophic bacteria, rendering the Prochlorococcus culture axenic. We have learned that Prochlorococcus cells are especially sensitive to reactive oxygen species, and that the ability of their heterotrophic neighbors to eliminate these from the media is a key component of the "helping" phenomenon. We will present laboratory evidence further characterizing this phenomenon, and field data suggesting that heterotrophs help Prochlorococcus in natural as well as laboratory systems.

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FLUORESCENCE LIFETIME IMAGING OF CALCIUM-BINDING STRUCTURES WITHIN EXTRACELLULAR POLYMERIC SUBSTANCES OF TUFA-FORMING BIOFILMS

In studies of biological induced mineralisation processes one hypothesis highlights that binding of calcium ions to functional, negatively charged groups of extracellular polymeric substances (EPS) produced by cyanobacteria prevents calcium carbonate precipitation in stromatolites. For this purpose calcium-binding structures within tufa-forming biofilms of German hardwater creeks were investigated by fluorescence lifetime imaging (FLIM). In FLIM-based Ca-imaging studies inside living cells lifetime analysis of fluorescent calcium-sensitive dyes allows the quantification of Ca-free and Ca-bound dye fractions due to substantial changes of fluorescence properties. The application of different calcium-sensitive dyes to tufa-forming biofilms revealed that a lot of clear signals were detectable near the cell surface or as part of the closely bound EPS fraction around filamentous cyanobacteria. But unusual short lifetimes in combination with high intensities were detected in the envelope of filamentous cyanobacteria living within the tufa-forming biofilms. This was probably caused by aggregation and binding of the dye to proteins. This unexpected circumstance would have interesting implications for the detection of specific ion-binding proteins within the EPS matrix of calcifying biofilms in various habitats.

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VIRIOPLANKTON DISTRIBUTION PATTERNS IN THE MAURITANIAN UPWELLING AREA – INTERRELATIONS WITH BIOTIC AND ABIOTIC VARIABLES

The Mauritanian upwelling area in the Eastern Subtropical Atlantic is a hydrographically highly dynamic and biologically productive region influenced by both oligotrophic and nutrient-rich water masses. During a cruise with RV Meteor in this area, we investigated the distribution of viruses at different spatiotemporal scales within the euphotic zone using high-definition analytical flow cytometry (AFC). Covering diurnal fluctuations, transects along environmental gradients, water layers (e.g. the chlorophyll maximum) and larger subregions, we will relate viral abundances to various parameters characterising the communities of prokaryotes and phytoplankton, to the virus-to-bacteria ratio (VBR) as well as to a number of environmental variables (nutrients, POC, PON, temperature, salinity, oxygen). At selected stations during the cruise, in-situ analyses were supplemented with on-board incubation experiments to investigate viral and bacterial responses to changes in biotic and abiotic conditions. While the trophic state control of virus concentrations was clearly scale-dependent, correlative patterns proved viruses to be a dynamic microbial food web component. Distinct differences in linkages and interactions among functional groups were found both between water layers as well as between stations of contrasting trophy.

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ECOLOGICAL RESPONSES TO DECLINING WATER LEVELS IN LAKE KINNERET, ISRAEL

Experience gained from decades of multi-annual water level drawdown followed by rapid re-filling of Lake Kinneret, Israel's major source of drinking water, sheds light on ecological impacts of such management practices. Declining water levels are associated with reduced inflows and nutrient loadings, stimulating oligotrophication and improved water quality. However, this trend is counter-balanced by processes acting to increase internal nutrient recycling. As Kinneret water level declined, the metalimnion migrated deeper, most of the reduction in lake volume occurred by shrinking of the hypolimnion, which became more concentrated in products of anaerobic decomposition. Methane ebullition from the sediments increased substantially. The sediment belt impacted by internal waves migrated with the metalimnion, increasing nutrient recycling and focusing of organic matter from the lake boundaries to its center. The dominant fish, a zooplanktivore, exhibited exceptional recruitment success on the two occasions of lake fast re-fill. Within a year the above-natural large fish populations suffered from food shortage, the fishery collapsed, the entire food web was impacted. Overall, the management of Lake Kinneret maximized the amount of available potable water - at the expense of water quality and ecosystem stability.

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FOCUSED ION BEAM / SCANNING ELECTRON MICROSCOPY OF DIATOM FRUSTULES

In recent years, combination of focused ion beam system and scanning electron microscopy (FIB/SEM) began to be used in life sciences offering a possibility to manipulate biological samples under SEM. Cutting, milling and drilling of samples in different directions and at different magnifications was enabled on a nanometer scale. The samples can be handled in a highly controlled way and exposed subsurface structures viewed with a micrometer resolution. The aim of our work was to test the performance of FIB/SEM in structural research on a well known sample – diatom frustules. Frustule morphology plays an important role in taxonomy and therefore a lot of data already exist on morphological characteristics of different species. However, descriptions of morphological characteristics are usually limited to surface ornamentation and structures of valves. Subsurface structures are usually observed only on a randomly fractured frustule. With FIB/SEM cutting and drilling into the valves and exposing subsurface structures layer by layer was enabled and girdle band junctions or consecutive cuts into fultoportulae were imaged. Subsurface structures were exposed by precise cutting of structures of interest.

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NUTRIENT AND CARBON CYCLING IN THE DAM-IMPACTED KAFUE RIVER (ZAMBIA)

The lower Kafue River (Zambia; Qavg ~ 300 m3/s) is impacted by two dams that regulate flow and flooding, and in so doing have substantially degraded valuable habitats, including subsistence fisheries resources and richly diverse floodplain ecosystems. This presentation will explore N, C, and P cycling in the Kafue River and Itezhi-Tezhi Reservoir system. Low inorganic nitrogen levels (below 1uM nitrate and ammonium) were found along the entire river, despite its close coupling to a productive floodplain. The relatively high total nitrogen levels (>40 uM) suggest a riverine N budget dominated by organic N. Phosphate concentrations increased by a factor of 4 along the river (0.2 uM to 0.8 uM), and transitioned from representing only a small fraction of total P upstream to accounting for nearly 100% of total P downstream. A sharp decline in dissolved oxygen levels (from 5 mg/l to 1 mg/l) occurred a along a short (30 km) pristine river stretch, and low dissolved oxygen persisted for another 150 km downstream. The upstream reservoir's influence on downstream hydrology and chemistry will also be discussed.

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FORMATION AND FUNCTION OF THE GIANT GEL NETWORK IN A MARINE ECOSYSTEM

The enigmatic gel phase (mucilage) appears episodically in the northern Adriatic Sea. The phenomenon manifests itself in rapid production of enormous amounts of gelatinous matter in the water column and on the sea surface. Current views leave no doubt on phytoplankton as a proximal source of polymers constituting the gel network, but the mechanism leading to its rapid formation remains unknown. Using atomic force microscopy we address the extracellular polymer production of a marine diatom analyzed at the single cell level and supramolecular organization of native gel network as a link to the large scale phenomenon of gel formation in the Northern Adriatic. Our results support the hypothesis that extracellular polysaccharides produced by marine diatoms self-assemble to form a giant gel network, this process being independent on bacterial processing. Thereafter the giant gels function as efficient bioreactors to eliminate excess of photosynthesized material from the basin.

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DIFFERENTIAL GRAZING BY TWO HETEROTROPHIC NANOFLAGELLATES ON MARINE SYNECHOCOCCUS STRAINS

Grazing of heterotrophic nanoflagellates on marine picophytoplankton represents a major mortality factor for this important group of primary producers. However, little is known of the selectivity of the grazing process, which is often merely thought of as a general feature of cell size and motility. In this study, we tested the grazing of two heterotrophic nanoflagellates, Paraphysomonas imperforata and Pteridomonas danica, on 37 strains of marine Synechococcus spp. Both nanoflagellates proved to be highly selective in their grazing. Additionally, a number of strains were shown to be ingested, but not digested (and thus did not support growth of the the grazer). Both the range of prey strains that supported growth as well as those that were ingested, but not digested, was very similar for the two grazers, suggesting a common property of these prey strains that made them susceptible to grazing. In subsequent experiments with Synechococcus wildtype strain WH7803 and a spontaneous phage-resistant mutant, WH7803PHR, we found a pronounced difference in grazing susceptibility, supporting the idea that cell surface properties of the prey cells influence grazing vulnerability.

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