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"A Dynamic Arctic in Global Change"

BOOK OF ABSTRACTS

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EARTH SYSTEM IN CRISIS (OPENING LECTURE)

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Science begins to draw a consistent picture of the past co-evolution of (i) the planetary environment, and (ii) human civilization. Unfortunately, the latter has turned into a geological force now, as epitomized by the "Anthropocene" notion. As a consequence, modern research urgently needs to explore also (iii) Earth system change as driven by anthropogenic forces. These forces are transforming the Arctic before our very eyes.

In all the three contexts mentioned, nonlinearity and irreversibility play crucial roles. My lecture will highlight this finding from various perspectives. Remarkably, the cryosphere is a key to that analysis.

The first part of my talk will look back into the past, focusing on paleo-climate dynamics, on the one hand, and on the emergence of modern societies through fossil fuel use, on the other hand. The second part will address the so-called tipping elements in the planetary machinery, which may be modified / annihilated by anthropogenic global warming and other human perturbations. The last part will discuss the ambitious Paris Agreement on climate action and particularly explore how the associated targets might still be met.

I will conclude with a couple of quotes from Pope Francis, who has made sustainability a cornerstone of his spiritual mission.

PL 01 THE RAPIDLY CHANGING ARCTIC: WHAT WE KNOW, WHAT WE NEED TO KNOW AND HOW WE CAN IDENTIFY AND OVERCOME CHALLENGES IN ARCTIC SCIENCE

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We are entering a time of unprecedented climatic and environmental changes in the Arctic that are likely to have significant local and global societal consequences. However, there is great spatial variability in both climatic changes and impacts while long term trends can be moderated or even over-turned by unpredictable short-term events often represented by extremes and new records for the instrumental period. A general tendency for up-scaling and generalisation in science provides information for the global community on issues such as feedbacks to climate and sea level change. However, such Earth-system approaches fail to give local inhabitants the understanding and forecasting of change, and particularly extreme events, needed for adaptation. Although there are important research agendas that set out major, agreed priority research questions, there are persisting constraints on our attempts to understand changing Arctic environments and ecology despite many major technological and methodological advances. This simple paper focuses on personal experience from over half a century, and on experience working within the INTERACT Consortium of Arctic research stations on specific challenges to our understanding of change. The aims of the paper are not to review major science advances and challenges that are presented in several authoritative documents such as ACIA 2005, SWIPA 2011, and the three ICARP meetings of 1995, 2005 and 2015. Instead, we explore fundamental challenges presented by time scales, spatial scales, and approaches and we explore how networking can facilitate arriving at potential solutions.

PL 02 CYBERATLAS TECHNOLOGY IN THE NORTH: LINKING INDIGENOUS KNOWLEDGE, TECHNOLOGY, AND SCIENCE, FOR COMMUNITY RESEARCH AND ACTION

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Cyberatlas technology is increasingly finding application in rural and Indigenous communities around the world for a variety of uses - from mapping land and resource use, to documenting traditional knowledge, to asserting rights and sovereignty. The technology blends digital mapping capabilities with multimedia to create a highly visual, interactive tool that communities are using for research, education, sharing narratives, decision-making, and more.

Over the last year, the community of Clyde River, in Nunavut, Canada, has been developing a cyberatlas that focuses on the marine environment and brings together Inuit knowledge, science, technology, and visuals arts (photography, videography, and drone imaging) to assemble a rich resource of knowledge about the area. The project builds on an open source software platform that incorporates the experiences of other communities and projects while allowing for customization to meet specific needs. The atlas was initiated locally and is managed by young Inuit technicians, artists, and leaders from the community who train and exchange skills with visiting university-based researchers and other technicians.

The nature and rate of social and environmental change in the Arctic and globally is driving interest in how to best discover, make available, and link all kinds of knowledge and information. The Clyde River Knowledge Atlas is one example of how technology, science, and Indigenous knowledge can come together for the benefit of a diverse group of users, but especially a small northern community, putting knowledge into action and supporting Arctic residents in taking control of research and decision-making around their lands and waters in their own way.

PL 03 NATURAL VARIABILITY OR CLIMATE CHANGE IMPACTS ON ARCTIC PLANKTON COMMUNITIES?

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Arctic plankton communities show strong seasonal changes in abundance, community composition and timing of life cycle events. These changes are strongly driven by light, nutrients, prey-predator interactions, temperature and hydrography. West Spitsbergen fjords have recently experienced increased heat content from inflowing warm and saline Atlantic Water originating from the West Spitsbergen Current, due to more frequent and prolonged flooding events of the West Spitsbergen Shelf. To study the effects of hydrographical conditions as well as seasonal and interannual variability on Arctic plankton communities we established a high-Arctic time series station in Isfjorden, West Spitsbergen (the IsA time series station) which has been sampled regularly since 2011. The data obtained include vertical salinity, temperature, light and fluorescence profiles as well as depth-stratified water and plankton net samples for determination of different size groups of plankton as well as metagenetic and metatranscriptomic analyses. Our analyses of the first three years of data showed high interannual variability in hydrography and in the timing and magnitude of the spring bloom which again impacted the zooplankton community. Particularly meroplankton abundances were strongly correlated with the phytoplankton biomass. The community composition of the microbial eukaryotes also displayed strong seasonality with large shifts during spring and summer. In contrast, during the light-limited polar night period, highly similar communities were observed during the three sampled winters. In spite of large interannual differences in hydrography, timing of the bloom and plankton community composition throughout spring and summer, our analyses suggest the existence of a rather resilient system that re-sets every winter. The potential influence of southern immigrants into the West Spitsbergen fjords may thus be limited by the extreme winter light conditions. Long-term time-series are essential to disentangle the effects of natural variability from climate change impacts on these high-Arctic systems.

PL 04 INDIGENOUS KNOWLEDGE WILL LEAD YOU CLOSER TO UNDERSTANDING THE ARCTIC

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With the world's binoculars fixed on the Arctic, indigenous peoples experience an enormous interest in our homeland and the resources on which we depend. What was previously more or less ignored, as so-called cold and remote wilderness, is now experiencing a revival, and is hotter than ever. States and other parties from all over the globe race to join the Arctic Council, to participate in all the exciting opportunities that will appear with the loss of the old ice and cold weather.

One of the things happening is climate change. Changes in the climate affect indigenous peoples first, and the changes affect our way of living, our economy and our cultures. World leaders express worry about climate changes. However, in the next breath, these changes seem to represent certain opportunities. If the tundra melts, then access to minerals is easier. If the sea ice melts in the North-East Passage, and disappears, European cargo ships will get to Asia faster and cheaper.

Europe and the developing world need/demand minerals and energy. Recycling and renewable sources are not enough, and new extraction projects are needed. Yet, the inhabitants of the Arctic are rarely mentioned in such plans. If the tundra melts, indigenous peoples fear for the consequences, for their way of living and for their future.

Indigenous peoples´ traditional knowledge, or indigenous knowledge, is crucial to secure that responsible, well-informed and constructive decisions are made and solutions found. Reindeer herders spending every day, and sometimes nights, in the tundra or mountains, watching the herd, need a certain knowledge to do their job. Listen to them. Fishermen and hunters will be able to tell you something about variation of the species in the sea, in the river and in the mountains and woods. Listen to them.

The Ministers at the first White House Arctic Science Ministerial emphasized the importance of listening to holders of traditional and local knowledge in developing the Arctic and the communities in the Arctic. That is a step in the right direction.

How do we work together in this matter, balancing economic development as well as ensuring the way of life for indigenous peoples, and that the rights of indigenous peoples will not be violated in the name of climate change, economic growth and research? How do we work together for the benefit of the Earth, and all its inhabitants, to avoid the suffering that will increase all over the globe if we continue with "business as usual"? This is a task that needs to be solved together at multiple levels, as well as in science, how to avoid further colonization of indigenous peoples' traditional knowledge and to not continue reaffirming the old mistakes of the past.

I will put further light on this complicated issue and hopefully bring you some guidance.

PL 05 STILL MYSTERIOUS SVALBARD GLACIERS (THEIR EVOLUTION AND ENVIRONMENTAL IMPACT)

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Why Svalbard glaciers are so important? They cover only 12% (c. 34,000 sq. km) of the of the entire glaciers and ice caps area in the Arctic (excluding Greenland Ice Sheet) but are the best studied polar ice masses over the world. Variety of glacier types and sizes together with long series of observations and relatively easy access make Svalbard a key area for experimental research and monitoring of changes.

This presentation highlights crucial findings that are arising from the study of different responses of glaciers to climate warming across the Svalbard Archipelago with a focus on Southern Spitsbergen, where the Polish Polar Station is located. Special attention is paid to tidewater glaciers producing >10 Gt of icebergs yearly. Calving comprises more than 1/3 of the total ablation and is the major factor of front recession. Area of glaciers in the Hornsund Fjord basin decreases by more than 3 sq. km/yr during last years. Such recession will lead to opening of new marine strait between Hornsund and Barents Sea in next decades. More frequent surges of glaciers have been observed latterly. Examples of impact of rapid deglaciation and glacier surges on marine and terrestrial environment are given in the talk.

Progress in research provide more data on the surge phenomena and factors driving of iceberg calving. Higher level of knowledge pose new important questions. Selected fundamental ones on evolution of glaciers under climate warming are raised in this presentation. Svalbard ice masses are still mysterious and fascinating.

The archipelago is a sort of field laboratory for detailed studies of glacial processes in polar areas which provide results for further implementation to models of large ice sheets. Behavior of Svalbard glaciers is a regional issue but with a global reach providing clues to understand worldwide environmental changes.

PL 06 ARCTIC SOCIAL SCIENCES AND INTERDISCIPLINARITY: ANTHROPOLOGICAL PERSPECTIVES ON THE BUILT ENVIRONMENT

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Ever since the International Polar Year (IPY) 2007/2008, interdisciplinarity seems to have arrived in arctic science. In the decade since, however, “interdisciplinarity blues” has set in among natural and social scientists alike. The author considers this a healthy sign of awareness that “disciplinarity” is not obsolete but the foundation for interdisciplinarity. The meeting point for different disciplines in arctic research has typically been the so-called natural environment, which often has dominated the outside (and inside) view of the Arctic. At the same time, the increasing involvement of social scientists has not only reminded us that the Arctic is inhabited by people but also that people modify the environment in which they dwell and thereby build it.

The focus of this presentation is on the affordances of the built environment and infrastructure for interdisciplinary arctic research. As a first step, the current state of social science research on infrastructure and the built environment in the Arctic, which was often considered to be of limited relevance compared with the natural environment, will be presented. Examples will include both large infrastructure projects, as well as the few social science attempts to address them academically. Transportation infrastructure will play a prominent role in this overview, addressing the possibilities and limitations of the existing projects by the author and others. This will provide an opportunity to think about future opportunities for increased collaboration between the natural and social sciences, including the involvement of engineers in it. After all, we want to understand why, how and what people build, and how the built rebuilds the people.

PL 07 SVALBARD: A GATEWAY FOR POLLUTANTS INTO THE ARCTIC

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Svalbard is the mildest and wettest region in the Arctic. This is popularly attributed to influences from the tail end of the oceanic transport of Gulf Stream waters. Surface ocean currents are wind driven and the pathway of the waters towards the archipelago are forced by atmospheric flow and geographic circumstances. Both the atmosphere and the oceans are thus transporting mass and energy towards the Arctic across, over and around Svalbard. AMAP has estimated that 50% of atmospheric pollutant transport into the Arctic occurs near Svalbard. Oceanic pollutant transport around Svalbard into the Arctic is undoubtedly vastly influential for the state of the Arctic Ocean. Monitoring of pollutants and climate change in Svalbard is therefore of profound importance for assessing ongoing, and future change, in the whole Arctic. The transport pathways have seasonal variations, which influences the timing, quantities and types of pollutants that arrive in the Arctic. This talk will present examples showing both the development of our understanding and present limits of understanding for both chemically active and passive pollutants. Perspectives will be given for the influence of climate change in the region for the continued transport and transformation of pollutants. As climate change alters the atmospheric conditions and wind patterns, we can anticipate numerous changes in how the classic and emerging pollutants may behave in the Arctic. The need for continued monitoring and further development of observation systems in the Arctic and Svalbard in particular are more relevant than ever.

ORAL AND POSTER PRESENTATIONS

S01 THE STATE OF ARCTIC GLACIERS AND ICE CAPS

KL 01 MASS BALANCE OF THE AUSTFONNA ICE CAP, SVALBARD, 2004–2015

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The Austfonna ice cap (~8000 km^2) is the largest ice cap in Svalbard. Direct surface mass balance measurements were started in 2004 and have been run continuously since then. Specific net mass balances are measured at ~20 stakes across the ice cap, and winter balances are inferred from snow soundings, snow pits and GPR profiles of the snow distribution. The south-west facing drainage basin of Etonbreen covering ~640km^2 has the best continuous data indicating a slightly negative mean net surface mass balance of - 0.1 m ± 0.1 m w.eq./yr for 2004-2015. Extrapolated to the entire Austfonna, this corresponds to a total mass loss of - 0.8 ± 0.5 Gt/yr. Yearly variations are large, and mainly driven by the summer ablation. The years 2004 and 2013 were strongly negative while 2008 was strongly positive. The annual net balance is well correlated to that of Kongsvegen on North-West Spitsbergen (R^2 = 0,75) for the 12 years of joint measurements.

The geodetic mass balance of entire Austfonna based on ICESat data for the period 2003-2008 revealed a mean annual balance close to zero of +0.01 m ± 0.04 m w.eq./yr, in good agreement with the direct measurements during the same period.

Calving is important with 2.5 Gt/yr in the period 1990 to 2001 and stands for 30-40 % of the total mass loss. When this number is used the overall mass balance is negative, by ca. 3,3 Gt/yr or - 0.4 m w.eq./yr.

However, many outlets are of surge-type and a recent surge in Basin 3 resulted in a temporary tripling of the calving loss from the entire ice cap with 5,2 Gt/year calving loss during April 2012 to July 2016 and thus has a temporary large impact on the mass balance.

KL 05 SPATIAL AND TEMPORAL CHANGES OF THE SNOW COVER IN GREENLAND

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The Greenland ice sheet (GrIS) is known to have the potential to contribute to sea level rise in a warming climate. The snow cover on the ice sheet, which is the direct link between a potentially warmer atmosphere and the ice itself, is, however, poorly investigated and little is known about the microstructure and especially about the spatial and temporal variability of the snowcover, except from indirect evidence from remote sensing. This project is a pilot study to develop future projects. The dataset gathered during a first campaign in spring 2015 will be analyzed in detail. It represents the first detailed spatially distributed observation of the GrIS snowpack since the 1950ies. The current dataset consists of high-resolution snow profiles located at stations of the Greenland Climate Network. The project will in particular link snow physics with snow cover modeling through the evaluation of the snow cover models with high-resolution snow microstructure measurements. Further, the measured variables are essential for remote sensing applications (e.g. correlation length for microwave remote sensing, snow surface SSA) and therefore provide the unique opportunity to unambiguously investigate the microwave emission as well as the albedo of the snowpack on an ice sheet.

O 001 MASS BALANCE OF ICELANDIC GLACIERS OBSERVED WITH VARIOUS TECHNIQUES

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The total volume of Icelandic glaciers is about 1 cm sea level equivalent that would cover the island with a 35 m thick ice layer if evenly distributed. The water storage in the glaciers is about 20 times the annual precipitation, and the mass turnover is large due to the maritime nature of the climate. Various methods are applied to monitor the changes in Icelandic ice caps, the longest records were started in the thirties with volunteers of the Icelandic glaciological society measuring length changes at a number of location. Stake measurements are done on both Vatnajökull and Langjökull ice caps in spring and autumn to estimate the total mass balance. Mass balance measurements on Vatnajökull commenced in autumn 1991 and during the first three years the average net balance was positive but since then it has been negative, with the exeption of the year 2014-2015 that experienced positive mass balance due to a combination of high winter precipitation and little melt during that summer. Vatnajökull has since 1995 lost 122 km^3 of ice or about 4% of the total ice volume and about 16% of the volume since 1890 when it had its largest extent in recent times. Aerial photographs taken at different times during the 20th century have been used to create digital elevation models (DEM) that are used to assess long term volume changes. A number of long term records for the ice caps in Iceland have been created using this method and they are presented here.

O 032 GLACIERS ZONES FROM SAR AND GPR DATA. VESTFONNA (NORDAUSTLANDET), SVALBARD AS AN EXAMPLE

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Extent of glacier facies and their changes in time are one of the indicators of climate changes. Moreover, information about their spatial distribution is very important for mass balance calculations and assessment of glacier drainage system state. For monitoring of large and often inaccessible areas of Arctic glaciers satellite data are very valuable source of information. Radar satellite data (SAR) as one of remote sensing techniques provides us information not only about spatial location of an object but also about its surface characteristic. Moreover, independency of SAR sensors on daylight makes this technique exceptional for detection of glacier facies extent during the polar night. Another source of information for glacier facies detection are GPR data based on which it is possible to analyze subsurface characteristic of glaciers, useful for interpretation or validation SAR data.

This research presents results of a new approach for advanced glacier zones recognition, based on methods mentioned above. Area of interests of this project is western part of Vestfonna where in May 2009 GPR measurements were performed. From the same time ERS SAR and ALOS PALSAR satellite images were processed in order to extract information about backscattering coefficient (sigma0) along the GPR profile. Additionally, based on fully polarimetric ALOS PALSAR image, new approaches such us polarimetric decompositions and complex Wishart classification were performed and unsupervised classification of ERS SAR image was done. Moreover, GPR data were a subject of visual interpretation and Internal Reflection Energy (IRE) coefficient calculations. As both sigma0 and IRE values represent strength of reflectivity it was possible to compare possibility of detection glacier facies based on satellite and field sources. Finally, comparison of results of GPR visual interpretation, sigma0 and IRE classifications as well as polarimetric analysis for glacial facies detection are presented and discussed.

O 031 EVOLUTION OF THE SUPRAGLACIAL DRAINAGE SYSTEM, FROM REMOTE SENSING DATA AND ITS COMPARISON WITH MODELLED SUBGLACIAL DRAINAGE SYSTEM, SVALBARD GLACIERS

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In a context of climate change and rapid melt of glaciers around the world, it is important to characterize the evolution of the meltwater drainage system and its influences on glaciers behavior. Due to its direct impact on englacial and subglacial drainage system, supraglacial drainage system studies are the first crucial step. It allowed locate where the supraglacial system switches into an internal system via moulins, shear fractures or crevasses. Our study is focus on the land-terminating glacier Werenskioldbreen and the tidewater glacier Hansbreen both located in the southern part of the Svalbard archipelago. They are characterized by a polythermal regime with most surfaces composed by cold ice. That implies an impermeable layer which results to a well channelized dendritic supraglacial drainage system.

The supraglacial drainage system of both glaciers has been mapped thanks to high resolution satellite images from 2010 and 2015 and orthophotomaps based upon Norwegian Polar Institute aerial photos from 1990 and 2011 and field observations. This allowed us to compare it on a decadal and inter-annual timescale. The subglacial drainage system of 2015 has been modelled based on the hydraulic potential, the thickness of the ice, the topography of the bed and the surface of the glaciers.

Non-linear thinning (not equal in the same elevation zone) causes possible changes in hydraulic potential and in consequence temporal modification of subglacial and supraglacial drainage system. Considering the lack of study with direct measurement of the water behavior inside the glacier body, the actual subglacial drainage system modelled for both glaciers is based on huge assumptions which lead to some inaccurate predictions of the subglacial channels locations. Thanks to the location of discrete water recharge inside the glacier mapped for the year 2015, we criticized classical Shreve's hydraulic potential model and discussed about the importance of this new parameter.

O 062 SEISMOLOGICAL EVIDENCE FOR ICE SHEET PRESSURE MELTING IN GREENLAND

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Basal conditions of the Greenland Ice Sheet (GrIS) are a key research topic in climate change studies. The recent construction of a seismic network provides a new opportunity for direct, real-time, and continuous GrIS monitoring. Here we use 4.5-year ambient noise surface wave data from seismic stations all over Greenland to detect both seasonal and long-term changes in seismic velocity beneath the inter-station lines. We find a clear summer/long-term velocity decrease proportional to summer/long-term snow accumulation beneath a line in the north-central inland GrIS, which is considered the first direct evidence of increasing meltwater at the GrIS base due to ice sheet pressure melting. Further seismic monitoring will contribute to a more direct and quantitative estimation of water balance in the Arctic region.

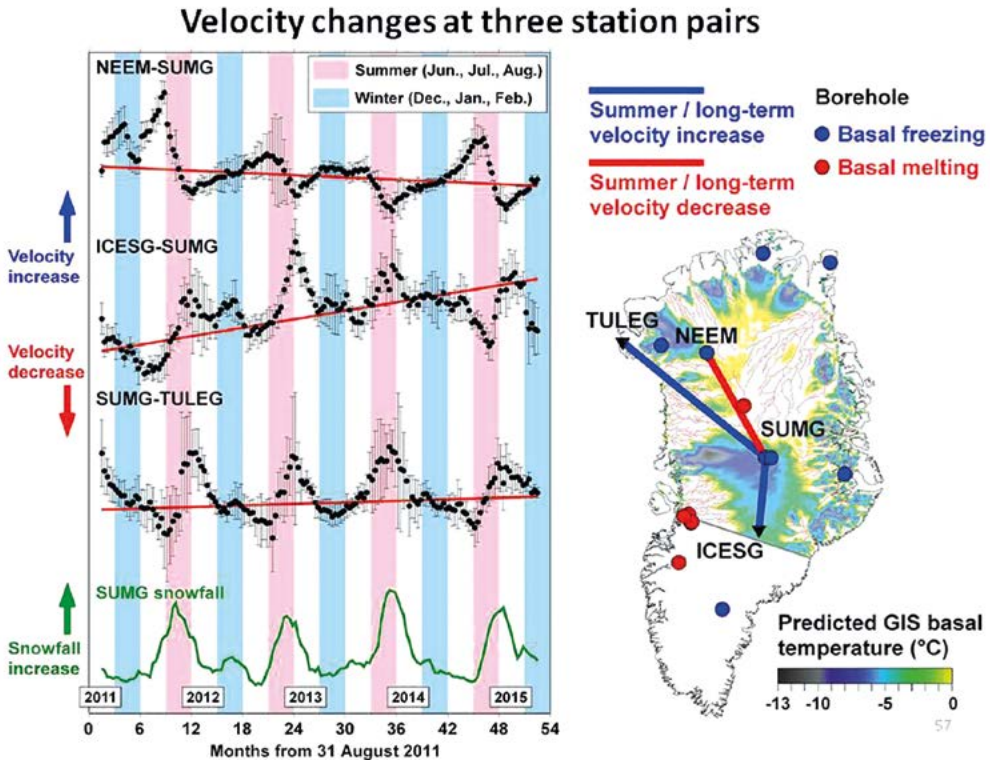

Figure. (left) Comparisons of 4.5-year relative seismic velocity with snowfall and surface snow height. (right) Comparisons with predicted GrIS basal temperatures below the pressure-melting point. The inter-station lines indicate summer/long-term velocity decreases (red) and increases (blue). Possible subglacial drainage routes (red lines) are also shown. Basal melting and freezing observed by deep boreholes are shown by red and blue circles, respectively.

Seismic velocity changes beneath north-central Greenland suggest increasing meltwater at ice base proportional to surface pressure increase. We find that seismic data from inland Greenland have high-sensitivity on the GrIS' dynamics. Continuous monitoring of seismic velocity might be used as a pressure gauge at the GrIS base, as well as for real-time estimation of the GrIS basal meltwater amount in both short and long terms. This may drastically increase the accuracy of water balance prediction in the Arctic region.

O 004 EFFECT OF VOLCANIC ASH LAYER ON THERMAL RESPONSE OF ARCTIC GLACIERS AND PERMAFROST

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Despite active volcanism, permafrost and glaciers in the Arctic and Sub-Arctic often exist on slopes of high-elevation or high-latitude volcanoes. Volcanic eruptions are one of the major causes of the burial of ice and snow. This has been demonstrated on volcanoes in Russia, USA, Iceland, New Zealand and Chile, where the combination of a permafrost-favorable climate and a thin layer of tephra with low thermal conductivity is sufficient to reduce the sub-tephra layer snow ablation substantially causing ground ice formation and permafrost. Even for the same region volcanic ash may have not only different ages, different chemical composition of the glass, but also different weathering stages, mineralogical composition, and water saturation, furthermore, these ashes may be permanently frozen or unfrozen. These differences might be the reason why the critical thickness of tephra, at which the effect on ice and snow is rather insulating than ablative, for the volcanic material from different volcanoes may vary so much. The determined values of critical thickness deviate from 24 mm reported by Driedger (1980) for the glaciers at Mt. St. Helens, USA, and by (Manville *et al.*, 2000) for tephra erupted in 1996 by Mt. Ruapehu, New Zealand, to <5.5 mm for tephra from the 1947 eruption of Hekla volcano and from Villarica volcano, Chile, reported by Kirkbride and Dugmore (2003) and by Brock *et al.* (2007). So far the reasons of disparity is not known. Ayris and Delmelle (2012) assumed that the particle size and porosity might be the reason. Taking into considerations that during ablation period tephra covering the glaciers is wet, thermal conductivity of this material should not be overlooked. This review summarizes existing data on the effects of climate change on permafrost and glaciers response, the properties of volcanic soils in cold regions, and the glaciers and permafrost's thermal behavior.

O 034 RESPONSE OF AUSTRE LOVÉNBREEN GLACIER IN SVALBARD TO CLIMATE CHANGE

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Glaciers in Svalbard region are sensitive to the North Atlantic warm and the corresponding climate change. In past ten years, the Austre Lovénbreen glacier was intensively studied, including meteorology, mass balance, bed topography, surface motion, as well as the profile/snout evolution, which satisfied the input requirement for applying sophisticated numerical models to study the response of the glacier to climate change. In this study, we utilize a High-order Ice Flow Model coupled with simple Energy Balance Model to investigate the fate of Austre Lovénbreen glacier in the end of this century. The twenty-first-century climate scenarios from an ensemble of global climate models were introduced into our simulations for climate forcing. The results indicate that by 2100, the volume of the glacier will shrink by 50~90% relative to 2010. Even with the future climate warming restrained in 1.5°C, only limit part of the glacier will survive in a diminished state. Additionally, the evolution behaviors of other glaciers in the region and the corresponding influences on regional hydrology and sea level rising are discussed.

O 063 ACCUMULATION OF AIRBORNE RADIONUCLIDES IN ARCTIC AND ANTARCTIC CRYOCONITES

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Cryoconites are aggregates of mineral and organic substances that can be found on glaciers surfaces. They accumulate large amounts of airborne pollutants by binding them to extracellular polymeric substances secreted by microorganisms. The cryoconites are common located in ablation zones of glaciers, particularly those located at high latitudes and high altitudes. They accumulate dust eluted from the atmosphere by dry or/and wet precipitation. The research was carried out in three areas of Spitsbergen (Kaffiøyra, Bellsund, Hornsund), on South West Greenland ice sheet and in the Antarctic. Measurements conducted in such a variety of localizations influenced by different environmental conditions provides an opportunity to study the impact of glaciological characteristics on contaminant accumulation in cryoconites. In this study contents of airborne radionuclides (^{137}Cs, Pu isotopes, ^{210}Pb) in cryoconites were determined. The cryoconites collected from the Waldemar Glacier in Kaffiøyra area reveal the highest activity concentrations of the anthropogenic (^{137}Cs and Pu isotopes) and natural (^{210}Pb) radionuclides. Activity concentrations of airborne radionuclides (^{137}Cs, Pu isotopes, ^{210}Pb) in cryoconite samples from Spitsbergen were higher than in the soils and lakes of Spitsbergen. The main source of anthropogenic radionuclides in the Arctic is global fallout from atmospheric nuclear weapon tests and local fallout from tests conducted at Novaya Zemlya. In the southern hemisphere, the intensity of global fallout was lower than that in the northern hemisphere, which is reflected by lower activities of $^{239+240}$Pu and higher activities of ^{238}Pu in the Antarctic cryoconites. The discrepancy was due to the relatively higher, but more localized input of ^{238}Pu from the accidental re-entry of the SNAP 9A satellite in 1964 over Madagascar. Those contaminants were accumulated for several dozen years in glaciers, and now, high contents of radionuclides during melting period may negatively influence downstream ecosystems e.g. food web.

O 035 ICE CAVE VIRTUAL TOURS FOR ARCTIC ECOLOGICAL TOURISM DEVELOPMENT AND MONITORING OF THE STATE OF GLACIERS

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Ice cave is a unique natural phenomena of cold regions. They form in glaciers and contain significant amount of frozen water, glittering and sparkling in the rays of spelunker light. Several ice caves on Svalbard are great tourist attractions and mirror of ice cover state in the Arctic.

During field work in April 2016, joint team of Czech Speleological Society and the University Centre in Svalbard investigated 3 ice caves (in Scott Turnerbreen, Tellbreen and Longyearbyen glaciers) near the northernmost settlement Longyearbyen (78°N) and made the high-resolution photography sessions with special optic and tripod (21 shots on each working stations). Further processing of images allowed to create high-performance spherical panoramas and interactive virtual tours in internet, where one can virtually walk in the cave from point to point, zoom to the small stain scale and turn around.

In the presentation we will show virtual tours and describe ice caves formation, features and dimensions.

The virtual tours as a unique opportunity to get acquainted with the ice caves can be used for promotion of ecological tourism in the Arctic and for monitoring of changes of the caves.

Figure. Screenshot of on-line virtual tour in Scott Turnerbren Glacier

http://vt.evzenjanousek.com/svalbard/

O 002 MODELLING HISTORICAL MASS BALANCE VARIATIONS OF THE CANADIAN ARCTIC ICEFIELDS

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Icefields of the Canadian high Arctic have experienced dramatic changes over the last two decades [Gardner et al., 2011], accounting for the largest glacial contribution to global sea level rise outside of the Greenland Ice Sheet. Icefield mass balance is monitored at several sites in the Canadian Arctic, and satellite altimetry provides a distributed spatial view of glacier change over the last ~15 years. However, several factors complicate efforts to monitor and model large-scale changes in glacier mass. This includes processes of englacial meltwater storage and firn densification, which complicate the altimetry signal. Measurements and models of glacier mass balance and the associated sea level change need to include a realistic representation of these processes. We introduce a distributed mass balance model of Canadian Arctic icefields and ice caps which uses a surface energy balance scheme to calculate snow and ice melt and includes a firn model to simulate the surface-layer temperature evolution, meltwater percolation, and refreezing processes. The model is driven by ERA-Interim reanalyses, with available mass balance observations used to help constrain and evaluate the mass balance model. Historical reconstructions are compared with those from a simpler positive-degree-day models, as well as available altimetry data, to assess the overall spatial pattern of glacier change that is modelled from the different approaches. Taking the glaciologically-modelled mass balance reconstructions as ‚accurate', one can isolate the firn densification signal from the altimetry records and evaluate the magnitude of this effect over the Canadian Arctic icefields. The mass balance reconstructions also provide an independent estimate of overall glacier mass change in the region, which helps to separate the GRACE gravitational signals from the Canadian Arctic and western Greenland.

Gardner, A.S. et al., 2011. Sharply increased mass loss from glaciers and ice caps in the Canadian Arctic Archipelago. *Nature*, 473, 357-360.

O 030 FACTORS CONTROLLING THE FRONT POSITION OF HANSBREEN, A TIDEWATER GLACIER IN SVALBARD

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Hansbreen is a tidewater glacier in southern Spitsbergen, Svalbard, for which there is available an ample set of field and remote sensing observations. This makes this glacier very suitable for evaluating mechanisms and controls on calving, some of which are considered in this contribution. We use a full-Stokes thermomechanical flow model (Elmer/Ice), paired with a crevasse-depth calving criterion, to estimate Hansbreen's front position at a weekly time resolution. The basal sliding coefficient is re-calibrated every four weeks by solving an inverse model. We investigate the possible role of backpressure at the front (a function of ice mélange concentration) and the depth of water filling crevasses by examining the model's ability to reproduce the observed seasonal cycles of terminus advance and retreat. Our results suggest that the ice-mélange pressure plays an important role in the seasonal advance and retreat of the ice front, and that the crevasse-depth calving criterion, when driven by modelled surface meltwater, closely replicates observed variations in terminus position. These results suggest that tidewater glacier behaviour is influenced by both oceanic and atmospheric processes, and that neither of them should be ignored.

O 060 MONITORING SUPRAGLACIAL LAKE DEPTH IN GREENLAND WITH LANDSAT 8

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Supraglacial lakes play a significant role in glacial hydrological systems - for example, transporting water to the glacier bed in Greenland or leading to ice shelf fracture and disintegration in Antarctica. To investigate these important processes, a physically-based method can be used to retrieve supraglacial lake depths from multispectral remote sensing imagery. Landsat 8 is the newest satellite in the Landsat series. With a unsurpassed image acquisition rates, higher dynamic range, and 12-bit radiometric resolution, the Operational Land Imager (OLI) aboard Landsat 8 is well-suited to supraglacial lake depth retrieval.

This study uses Landsat 8 imagery over western Greenland to study seasonal and interannual variability in lake extent and lake depth since Landsat 8's launch in 2013. In addition, this presentation will show preliminary results produced using Google's cloud-based parallel-processing platform and associated API - Google Earth Engine. With EarthEngine, large datasets can be queried and analyzed in a fraction of the time it would take to do so with traditional computational methods. Lake behavior will be compared with weather station data to attempt to understand variability in water storage.

O 033 RECENT GLACIER CHANGES ON VESTFONNA ICE CAP, NORDAUSTLANDET, SVALBARD, FROM REMOTE SENSING AND IN-SITU DATA

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Observed melting of glaciers and ice caps in the polar regions contribute to the ongoing global sea level rise (SLR). A rising sea level and its consequences are one of the major challenges for coastal societies in the next decades to centuries.

Gaining knowledge about the main drivers of SLR and bringing it together is one recent key-challenge for environmental science. The high arctic Svalbard archipelago faced an environmental and strong climate change in the last decades, associated with a change in the cryosphere.

Vestfonna, a major Arctic ice cap in the north east of Svalbard, harbour individual land and marine terminating glaciers, which expose a variability of behaviour. High resolution **remote sensing** data from space borne radar (TanDEM-X, TerraSAR-X, Sentinel-1a), acquired between 2009 and 2015, coupled with space borne laser altimetry (ICESat), glacier outline (GLIMS) and in situ data, enables us to delineate high accurate **glacier velocity and surface elevation changes** and to separate individual glacier basin changes for further mass balance and SLR contribution studies.

Results indicate a slight interior thickening contrasted with wide spread thinning in the ablation zone of the marine terminating outlets. While one glacier system draining to the north west shows re-advance and possibly surge evidence, the majority of the outlets draining south- and eastwards are in stable or retreating dynamic conditions. Only two southern outlet glaciers speeded up between 2009 and 2015. Despite some surge events, these findings follow up on a period of relative stable mass balance conditions.

O 061 GREENLAND VOLUME CHANGE TIME SERIES SINCE 1992 FROM SATELLITE ALTIMETRY

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In this paper, we choose to compute height time series for bins spaced at 5m resolution over Greenland ice sheet. A bin is a circular region with a given radius for the calculation points. Within a given bin, the raw height measurements from all cycles were least-squares fitted to a space and time function for reduction of heights. We used a robust least-squares estimator that is resilient against outliers to estimate the parameters. In order to obtain a valid estimate of the elevation change rate in a bin, the potential outlier points with residuals larger than 5 m were removed and the parameters for the fitting function were recomputed iteratively until all residuals were less than the threshold. With this procedure, high resolution height change time series over Greenland were derived from ERS-1, ERS-2, Envisat and Cryosat-2 data, respectively. They were spanning from June 1992 to June 1996, from May 1995 to June 2003, from July 2002 to June 2012, and from July 2010 to May 2016, respectively. It shows that extensive height increase in Greenland inland are observed from ERS-1 and ERS-2 results, and negative height change along the east and west coast. Moreover, there are no obvious height change in Greenland inland are observed from Envisat and Cryosat-2, while more increasing negative height change along the east and west coast. After removing the offset between different satellite altimetry, we derive the volume change time series between June 1992 and May 2016. It turns out that a slight volume increase over Greenland ice sheet were observed from 1992 to 2003, and becomes negative after 2003.

P 001 A TWO-STEP MASS-CONSERVATION APPROACH TO INFER ICE THICKNESS MAPS: PERFORMANCE FOR DIFFERENT GLACIER TYPES ON SVALBARD

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Satellite remote sensing based on optical or radar instruments has enable us to measure glacier-wide surface velocities as well as changes both in glacier extent and in surface elevation with good coverage worldwide. Yet, for the large majority of all glaciers and ice caps, there is in fact no information on how thick the ice cover is. Any attempt to predict glacier demise under climatic warming and to estimate the future contribution to sea-level rise is limited as long as the glacier thickness is not well constrained. Moreover, the poor knowledge of the bed topography inhibits the applicability of ice-flow models because the basal topography exerts major control on the dynamic response of grounded ice. As it is impractical to measure ice thicknesses on most glaciers, reconstruction approaches have been forwarded that can infer thickness fields from available geometric, climatic and ice-flow information. Here, we presented a two-step, mass-conserving reconstruction approach to infer 2D ice-thickness fields with prior knowledge on source and sink terms in the mass budget.

The first-step reconstruction is aimed at glaciers for which not much information is available. Input requirements for this first step are comparable to other reconstruction approaches that have successfully been applied to glaciers world-wide. In fast-flowing areas where surface velocity measurements are most reliable, these observations enter a second-step reconstruction providing an improved thickness estimate. In both steps, available thickness measurements are readily assimilated to constrain the reconstruction. The approach is tested on different glacier geometries on Svalbard were an abundant thickness record was available. On these test geometries, we show that the approach performs well for entire ice caps as well as for marine- and land-terminating glaciers. The reconstructed thickness field is provided together with an error-estimate map which stems from a formal propagation of input uncertainties through the underlying equations.

P 002 SELECTED REGRESSION METHODS IN PROGLACIAL DISCHARGE MODELLING – APPLICABILITY AND EFFICIENCY COMPARISON; A CASE STUDY OF WALDEMAR RIVER (SVALBARD)

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Main aim of the work was to perform the analysis of the suitability of artificial neural networks (MLP) and multivariate adaptive regression splines (MARS) techniques for modelling of the daily values of outflow from the Waldemar River catchment. It is located in the Kaffiøyra region, NW Spitsbergen (Svalbard) and constitutes the example of the small, partly glacierized river basin typical for that part of Arctic. As the comparative background of the MLP and MARS efficiency the classic multivariate linear regression (MVR) technique was used.

The study material was collected in the summer seasons of 2010, 2011 and 2012. It constitutes of daily values of the Waldemar River discharge and basic meteorological parameters: air temperature, precipitation, relative humidity, wind speed, atmospheric pressure and solar radiation. Several runoff models were constructed based on the combined data from summer seasons of 2010 and 2011. Due to specific character of the data and modelling goal, two groups of models were established: the first was based on meteorological inputs only, while the second included also the preceding day's mean discharge. MLP and MARS models were optimized in order to identify the optimal solutions for proglacial discharge modelling. Two-step evaluation has been used. It consisted of the internal evaluation (based on the calibration data from 2010 and 2011) and the external evaluation (based on the data from summer season of 2012, which has not been used in models construction and optimization).

The performed study showed that the nonlinear regressive modelling realized by the MLP gives the most accurate results in both groups of models. In relation to the simplicity of the MLP implementation (most calculations were made automatically by the software) and its satisfactory results, it was found that it is a valuable alternative to previously used MVR technique.

P 003 MELT PONDS AREA AND MARGINAL ICE ZONE DYNAMIC FROM PASSIVE MICROWAVE REMOTE SENSING DATA

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Studies of spatial and temporal properties of sea ice distribution in polar regions help to monitor global environmental changes and reveal their natural and anthropogenic factors, as well as make forecasts of weather, marine transportation and fishing conditions, assess perspectives of mineral mining on the continental shelf, etc. A new algorithm of sea ice concentration retrieval in polar regions from satellite microwave radiometry data is discussed. Beside estimating sea ice concentration, the algorithm makes it possible to indicate ice areas with melting snow and melt ponds. Melt ponds are an important element of the Arctic climate system. Covering up to 50% of the surface of drifting ice in summer, they are characterized by low albedo values and absorb several times more incident shortwave radiation than the rest of the snow and ice cover. The analysis of changes of the relative area of melt ponds on summer ice cover for the period 1992-2016 is performed. It was shown that changes in melt ponds area is an indicator of climate change. The marginal ice zone is defined as the area where open ocean processes, including specifically ocean waves, alter significantly the dynamical properties of the sea ice cover. Depending on factors like wind direction and ocean currents, it may consist of anything from isolated, small and large ice floes drifting over a large area to a compact edge of small ice floes pressed together in front of solid pack ice. The marginal ice zone is very dynamic due to the influence of the weather and rapid changes. Changes in its extent may take place over hours or days. The marginal ice zone location from differ algorithms in comparison with visual ship data is presented.

P 004 CHANGING THERMAL REGIME AND SPATIAL VARIABILITY OF ICE THICKNESS OF VESTRE BROGGERBREEN GLACIER, NY-ALESUND, SVALBARD, ARCTIC

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Vestre Broggerbreen glacier, Svalbard has been monitored since 2011 focusing annual mass balance, ice thickness, ice flux, surface ice movement and snout retreat. A two -week field survey of each year during 2011, 2015 and 2016 have carried out for the acquisition of a dense mesh of Ground-Penetrating Radar (GPR) data on the glacier surface. We have used a sledge -mounted 200MHz and MLF GPR to map the thickness of ice, sub glacier channel and distribution of warm and cold ice across the glacier tongue. The Vestre Broggerbreen has experienced an overall negative balance, a cumulative mass loss of -3.2 m we with an average of -0.62m we per annum during 2011 to 2016. We have mapped the thickness of the entire glacier including the thickness of warm and cold ice separately to understand the relation between glaciers shrink and thermal regime change. Change in thermal regime may indirectly control water movements by affecting the way in which water moves through sub- glacial channels. Observation revealed that Vestre Broggerbreen has experiencing warm ice (at 0^{o}C) in their interior where ice is thick and cold ice (below 0^{o}C) around their margins where ice is thin. We have also observed that parallel to snout retreated (3-5m/y), the boundary between the warm- and cold-based ice has also retreated by 5-20m/y during 2011-2016. Apart from above, reducing ice thickness and increasing Equilibrium Line Altitude(ELA) have also accelerate the rate of rereading the boundary between the warm- and cold-based ice in this glacier. An inverse -relation has been observed between ELA and annual mass balance for this glacier. The glacier has an average ice thickness of 64±10m with a maximum depth of 148±23m in accumulation that account a volume of 0.291 ± 0.045 km^{3}. Superimposed ice accounts for ~26% of the total net accumulation.

P 005 COMPARATIVE STUDY ON DARKENING AND MELTING OF GREENLAND ICE SHEET DERIVED FROM MODIS AND AMSR-2 SATELLITE IMAGES

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Expansion of dark ice area on the Greenland ice sheet is one of the factors to cause albedo reduction and mass loss of the ice sheet in recent years. Dark ice appears on ablation area in summer and accelerates melting of the ice sheet due to its intense light absorption. Dark ice is due to impurities in the surface ice such as mineral particles, glacial microbes, organic matter and their aggregate called cryoconite granules. Cryoconite granules are formed by microbial activities and are darker than abiotic mineral particles. Since the microbes can be active only on melting ice surface, duration of surface melting possibly affect the microbial activities and thus formation of cryoconite granules. Therefore, spatio-temporal variation in surface melting is important to understand the darkening process.

We report temporal variations in surface reflectance and brightness temperature derived from MODIS and AMSR-2 satellite images in order to understand relationship between darkening and melting processes of the ice surface from April to August in 2013 and 2016. Reflectance (660 nm) and brightness temperature (18 GHz Horizontal polarization) were investigated at the nearest-neighbor pixel of the Automatic Weather Station (67.07N, 48.83W). The brightness temperature showed the different timing of the onset of surface melting between 2013 and 2016. The surface reflectance also changed distinctively between the two years. It started to decrease in mid July down to around 0.4 at the end of July in 2013 (Fig. 1a). In contrast, it rapidly decreased in early June down to 0.3 in mid July in 2016 (Fig. 1b). These results suggest that earlier onset of the surface melting causes the earlier appearance of the dark ice surface and extends its duration.

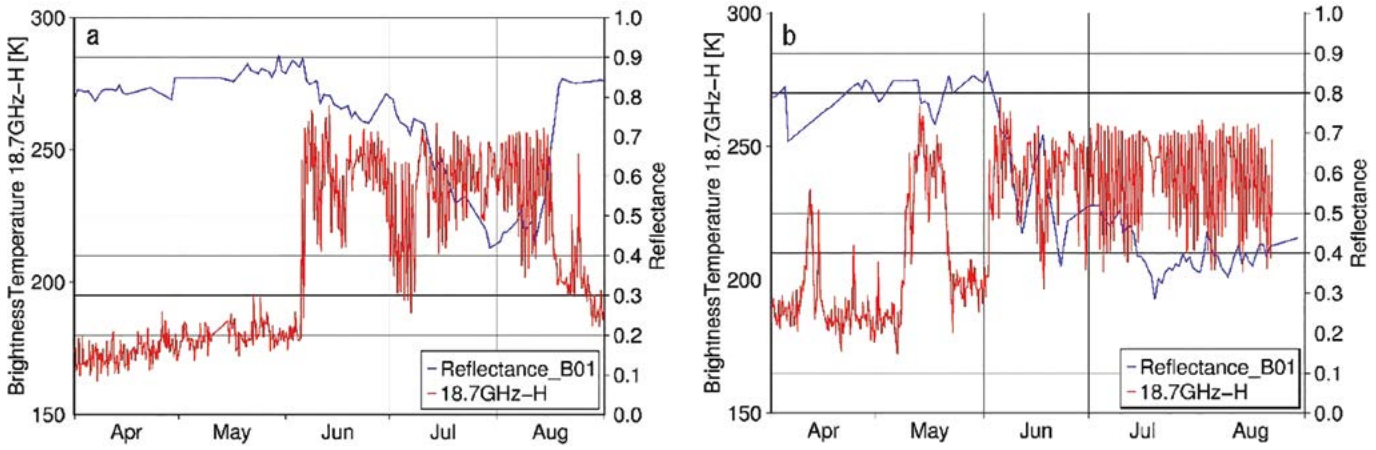

Fig. 1: Brightness temperature (18 GHz Horizontal polarization) and reflectance (660 nm) seasonal variations from April to August in 2013 (a) and 2016 (b).

P 006 DEVELOPMENT OF METHODS FOR AUTOMATIC IDENTIFICATION OF ARCTIC ICEBERGS (ICEBERGS DISTRIBUTION IN THE CONTEX OF GLOBAL WARMING)

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Paper focuses on new method for identification of arctic icebergs. This topic is actual and important for navigation and sea shelf operations. Icebergs can be detected by remote sensing, particularly on Optical images and Radar images (SAR). Optical images have a number of limitations such as inability to use in cloudy weather and at night. In this paper we use SAR images which is deprived of these limitations. We have developed an automated algorithm of iceberg detection for SAR images. Algorithm based on Computer Vision methods called 'Blob detection'. It is used to detect small drop-shaped objects in the image. In the original method implemented 3 approaches to the detection of blobs: Difference of Gaussian, Laplacian of Gaussian and Determinant of Hessian. The last one is recognized as the most effective. We adapted it for use with satellite images and iceberg detection. Algorithm may be configured with the 7 parameters. As a result of applying the algorithm returns an array containing the coordinates of the "blobs" characteristic dimensions of detected icebergs. Results obtained in the analysis of the distribution of icebergs sea Barents using this algorithm.

P 007 SELECTED PROBLEMS OF SNOW ACCUMULATION ON GLACIERS IN NORTH-WESTERN SPITSBERGEN, SVALBARD

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The primary objective of this work is to present the essential conditions and characteristics of changes in the dynamics of snow accumulation on glaciers of the Kaffiøyra region, an area of Svalbard, located in north-western Spitsbergen. Most of the research consisted in direct field measurements carried out in 1997-2014. The investigations of the glacier snow accumulation and its properties in the Kaffiøyra region are especially important, being some of only a few long term snow available regarding Svalbard.

The Kaffiøyra region comprises an area of about 310 km^2. It is coastal lowland situated on Forlandsundet. In the years 1997-2015 the average air temperature during the summer season in this region was 5.4 °C.

The mass balance of Kaffiøyra region glaciers is clearly negative. From the time of their maximum extent in the late 19th and early 20th centuries to 2015, the total area of this region's valley glaciers decreased by about 43.0% on average.

Field studies of snow depth of Kaffiøyra region glaciers at about 100 points in April or early May have been carried. Snow density, structure, grain type, and hardness were measured in pits and at representative points using standard methods.

Glaciers of the Kaffiøyra region glaciers had a large spatial diversity of their snow cover thickness, and its distinct changeability with the changing altitude. The spatial distribution of the winter snow accumulation on the glaciers of this region shows some rules observed every winter. Snow cover on the Kaffiøyra region glaciers shows some specific physico-chemical properties. Snow depth on the glaciers of the Kaffiøyra region has the high temporal and spatial variability, which is the result of local conditions, both orographic and topoclimatic.

P 010 THE SURGE OF AAVATSMARKBREEN AND ITS IMPACT ON LANDFORMS DEVELOPMENT (NW SPITSBERGEN, SVALBARD)

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Glacier surge is a phenomenon that significantly impacts the ice dynamics and ice-mass balance. From 2006 to 2013, the average recession of Aavatsmarkbreen was 363 m (52 m a^{-1}). A subsequent surge during 2013-2015 resulted in a substantial advance of a glacier front of over 1 km and an increase of its surface area by more than 2 km^2. Significant ice flow acceleration was noted whereby the highest surface velocity reached 4.9 m d^{-1}. In the case of Svalbard glaciers, surge propagation occurred as a result of enhanced basal sliding and deformation of a thin sediment layer beneath the glacier sole. During the surge, transverse basal crevasses and full-depth radial crevasses were formed. This surge-related crevasses system was responsible for the development of transverse and longitudinal crevasse-fill ridges, as well as frontal and oblique push moraines. Additionally, the ephemeral water-escape structures, flutings with initiating boulder and mini-flutings on the fine-grained till surface that formed during the surge

are indicative of high subglacial pore-water pressure and enhanced basal sliding. Moreover, two genetic types of clast pavements occurred in the marginal zone of Aavatsmarkbreen. These were formed as a result of surge-related glacier erosion and melting-out of subglacial and supraglacial clasts. The obtained results of glaciological and geomorphological studies on the dynamics of the Aavatsmarkbreen surge and its impact on landforms development in the Kaffiøyra region provide insight into the behaviour of fast-flowing glaciers and ice-streams.

P 011 THE PRIMARY ASSESSMENT OF PASSIVE MICROWAVE SATELLITE SEA ICE CONCENTRATION DATASETS IN ARCTIC NORTHEAST PASSAGE

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The accurate sea ice concentration (SIC) data is the very important basis for Arctic Passage shippings, but filed sea ice concentration data is hard to acquire. Passive microwave satellite (PM) become a effective tool to obtain large scale sea ice concentration. Unfortunely, no much available filed observation data could be used to evaluate SIC in Arctic. In this paper, seven passive microwave satellite sea ice concentration (PM-SIC) datasets including AMSR2/ASI, AMSR2/Bootstrap, SSMIS/ASI, SSMIS/Bootstrap, SSMIS/NASATEAM, MASAM, OSI-SAF was assessed, using the ship-based sea ice concentration observations (OBS-SIC) during the 5th CHINARE Northeast Passage cruise from July to September, 2012.

Totally 604 pairs OBS-SIC from around 20 days in-ice cruise are used for evaluation here. We picke up 604 pairs SIC from PM-SIC datasets according to the latitude and longitude of OBS-SIC. To avoid the bias from daily changes of sea ice and different spatial resolutions, a method to calculate daily mean of PM-SIC and OBS-SIC for comparison is used in this paper, refered to the similar work in Antarctica done by Beitsch et al., 2015.

Results show that, 4km resolution MASAM sucessfully detect the small ice floe area near Poluostrov Taymyr on July 25, 2012 and Ostrov Vrangelya on September 1, 2012, but others fails. Seven PM-SIC have high similar skills to detect whether the grid was totally water or sea ice involved, but differ largerly about how much percent of sea ice is in the sea ice grid. Quantitatively evoluation by comparing with OBS-SIC show that AMSR2/ASI, AMSR2/Bootstrap, SSMIS/ASI and SSMIS/Bootstrap perform well, but SSMIS/NT and MASAM perform badly. AMSR2/ASI have the smallest bias of 1% and RMSE of 11%, and SSMIS/NT underestimate the SIC largely with mean bias of -15% and RMSE of 21%. High resolution and timely updated make AMSR2/ASI best choice for real-time shipping-guide.

S02 THE ECOLOGY OF SEA ICE, PELAGIC AND BENTHIC BIOTA IN ARCTIC SEASONAL SEA ICE ZONES

O 107 THE ARCTIC OCEAN'S INVISIBLE FOREST IN TIMES OF RAPID CLIMATE CHANGE

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The icescape in the Arctic Ocean is rapidly transforming from multi-year ice into a seasonal first-year ice system. This transformation of the Arctic icescape will have consequences for the ice-associated ecosystem. Ice algae and phytoplankton form the invisible forest of the Arctic Ocean and are at the base of the ice-associated ecosystem. During the Norwegian young sea ice drift expedition (N-ICE2015), we had the unique opportunity to study the flourishing of this invisible forest under the new ice regime as the sun returned to the Arctic in spring and were able to get a "sneak preview" of what the future seasonal ice zone may look like.

We observed an early phytoplankton bloom below the snow-covered ice possibly resulting from the thinner and more dynamic sea ice that allowed more light transmission to the ocean, especially through leads. The under-ice bloom was dominated by the haptophyte algae *Phaeocystis pouchetii* in contrast to previous under-ice blooms that were dominated by diatoms. This shift in phytoplankton species dominance, associated with early under-ice phytoplankton blooms, could have important implications for the strength of the biological carbon pump and energy transfer in Arctic marine food webs.

Another striking observation during N-ICE2015 was the thick snow cover on the dominant first-year and second-year ice that limited ice algal growth under these ice types. However, the heavy snow load also resulted in widespread negative freeboard during the drift in early June. This led to infiltration of seawater through cracks in the ice and growth of phytoplankton at the snow-ice interface. These snow-infiltration communities are commonly observed in the seasonal ice regime of the Antarctic, but have been rarely reported from the Arctic and could be another harbinger of a new Arctic sea ice regime.

O 105 RETREATING SEA ICE IN COASTAL SYSTEMS – IMPLICATIONS FOR SEAWEED COMMUNITIES IN KONGSFJORDEN (SVALBARD) AND BEYOND

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Progressing atlantification of coastal ecosystems in the European Arctic is expected to induce significant changes in productivity, diversity and functionality of benthic communities. Such transitions in rocky shallow-water ecosystems, originally influenced by landfast sea ice, have already been noted in Kongsfjorden, Svalbard. Benthic community surveys conducted in 1996/98 and 2012/14 point to a considerable increase in seaweed species richness particularly in the eulittoral to infralittoral fringe zone, but also to a reduced vertical distribution of large brown seaweeds (kelps). Furthermore, a considerable biomass increase of kelps and concomitant functional change of the associated fauna became apparent in the shallow sublittoral. Both biomass and production of zoobenthos increased in this zone. Changes in zonation and biomass of kelp are probably a consequence of contrasting effects induced by Arctic warming: With the retreat or disappearance of seasonal landfast ice, radiation transfer into the water column has increased during spring, while mechanical stress by ice scouring has become reduced. In parallel, sediment discharge by enhanced terrestrial meltwater run-off likely has resulted in increased water turbidity during summer and autumn. Results from more than 20 years of seaweed research in Kongsfjorden point to the overall large acclimation potential of most seaweed species. However, response of kelps to climate-induced changes largely differs among the various life history stages, with the microscopic stages often responding more sensitively than their macroscopic counterparts, especially towards irradiance. Taking Kongsfjorden as potential model system for rocky-shore coastal ecosystems in the Arctic, large-scale changes in benthic community composition and ecosystem functioning, as observed in Kongsfjorden will likely also happen in other coastal areas of the Arctic. Thus, kelps are expected to obtain increased biomass at hard-bottom locations along Arctic coasts because of future warming. The major research priorities are discussed for future benthic ecosystem studies in Kongsfjorden and beyond.

O 138 DENSE AND PLENTIFUL: IS THE MESOPELAGIC LAYER OF ENERGY-RICH ORGANISMS AN IMPORTANT COMPONENT OF THE HIGH ARCTIC ECOSYSTEM?

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In January 2012, a large upwelling event was observed from Northern Svalbard to Franz Josef's land. This area has been ice covered from approx.1800 until 2000 and the ice retreat seen the last decades may turn the area along the shelf break into an Arctic high productive area. Using a multifrequency ship-based echosounder, we documented the possible effects of such upwellings on the distribution and abundance of pelagic organisms north of Svalbard. In Whalers Bay, a mesopelagic sound scattering layer (SSL) was consistently observed in the lower part of the Atlantic water mass (2-4°C; 400-600 m) during the midnight sun period. Net sampling confirmed that the SSL was mainly composed of large zooplankters (e.g. *Themisto* spp and krill) and juvenile pelagic fish (e.g. *Sebastes* spp., *Mallotus villosus* and *Boreogadus saida*). During the polar night, the SSL occupied a similar temperature range, but was detected shallower, between 0 and 400 m. We suggest that the depth of the SSL throughout the year was related to bottom-up processes. Temperature and the vertical distribution of prey were likely the main factors influencing the vertical distribution of the large zooplankter and pelagic fish, in particular in winter when upwelling events could have advected prey within the SSL. Fatty acid trophic

markers from key species in the SSL provided new insights in trophic transfers in this part of the Arctic Ocean, and we suggest that the prevalence of a high energy SSL might explain the large Dutch bowhead whaling that took place in Whalers Bay between 1670 to 1800, as well as the recent observations of whale aggregations. This study is a part of the RCN funded ArcticABC and Marine Night projects (http://www.mare-incognitum.no/) and Arctic Size University of Tromsø.

O 106 THE PARADOX OF POLAR OCEANIC NITROGEN FIXATION

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Measurements of biological nitrogen fixation are typically conducted in oligotrophic subtropical and tropical marine environments where concentrations of fixed inorganic nitrogen are low. To date, only a handful of studies have reported nitrogen fixation rates from high latitude marine environments. However, further investigation is needed to resolve the activity of marine diazotrophic assemblages and their potential to introduce new nitrogen into polar ecosystems. Nitrogen fixation rates were measured at 19 locations across the Atlantic sector of the Arctic Ocean in summers 2015 and 2016 using a modified gas dissolution 15N2-tracer addition method. While we measured sub-nanomolar to nanomolar rates only in distinct samples in the upper 100 m of the water column (in the presence of micromolar concentrations of dissolved inorganic nitrogen), the natural abundance delta ^{15}N values of particulate organic matter at these and other depths were very low. These results combined would indicate active nitrogen fixation that might be very variable in time and space, possibly due to the nutrient replete conditions. Together, these measurements aim to reconcile the paradox of polar marine nitrogen fixation and elucidate how nitrogen fixers could potentially impact current concepts in Arctic carbon and nutrient cycling.

O 143 IS WHEN THE TABLE IS SET MORE IMPORTANT THAN HOW MUCH IS ON IT? WARMING AND SOUTHEASTERN BERING SEA FISHERIES

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The amount of primary production ultimately sets the upper limit on the biomass of fish in a region, but the timing of that production may affect the disposition of primary production within the regional fish and shellfish communities. The extent and timing of sea-ice-retrea affects not only the availability of ice algae, but also the timing of the spring bloom. The timing of availability of algae and phytoplankton in spring over the middle shelf is critical in determining egg production and larval growth and survival of large, lipid-rich zooplankton. Consumption of these lipid-rich zooplankton by age-0 walleye pollock (*Gadus chalcogramma*) and Pacific cod (*G. macrocephalus*) is essential for the sequestration of lipids in age-0 walleye pollock and Pacific cod during summer and fall. Without these lipids, age-0 pollock, and possibly cod, survival to recruitment is low.

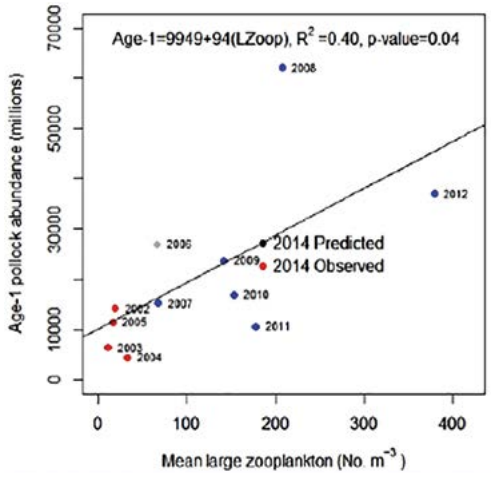

Figure 1: Linear relationships between mean large zooplankton abundance during the age-0 life stage of pollock and the estimated abundance of age-1 pollock abundance of the year class 2002-2012, from Ianelli et al. (2015). The 2014 points are the observed stock assessment estimates of age-1 pollock from Ianelli et al. (2015) and the predicted age-1 pollock estimates are from our regression model using large zooplankton From Eisner, L. and Yamiichi, E. 2016. NPFMC Ecosystem Considerations for 2016, p. 127.

Pacific cod year class strength correlates strongly with year class strength of pollock, and thus both species share periods of strong and weak year-classes. If the recruitment of these commercially important fish is ultimately dependent of the timing of the availability to zooplankton of algae in spring, then, as the timing of that early production changes, there may be a very severe impact on two of the eastern Bering Sea's most valuable groundfish fisheries.

O 140 THE INFLUENCE OF SEA ICE CONCENTRATION ON PHYTOPLANKTON COMMUNITY STRUCTURE IN THE CHUKCHI AND EAST SIBERIAN SEAS

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To understand the influence of sea ice retreat on the phytoplankton community distribution in the rapidly warming Arctic Ocean, the field surveys were conducted in August 2012 and 2015 in the Chukchi and East Siberian Seas. Pigment analysis and chemical taxonomy were used to enumerate major phytoplankton groups. The average sea ice concentration in August 2012 was lowest since the sea ice observations from 1979, with higher sea surface temperature. The deeper mixed layer depth (MLD) and higher surface nitrate concentrations were due to exposure of the sea surface to wind in August 2012. The euphotic depth and subsurface chlorophyll maximum layer were deeper in August 2015 than those in August 2012. Even though a little difference of the average of phytoplankton biomass between two periods, phytoplankton community structure dramatically

different during two study periods. Small phytoflagellate groups, prymnesiophytes, prasinophytes, dinoflagellates, cryptophytes, were dominated in phytoplankton biomass in August 2012, while the diatoms predominated in the study area in August 2015. Several environmental factors were found to affect the interannual variation of phytoplankton community structure in the surface layer of the Chukchi and East Siberian Seas, but they appeared to be controlled mainly by deeper MLD and seeding from sea ice caused by sea ice retreat and extend, respectively. Furthermore, underwater light conditions might be one of the influential factors for phytoplankton distribution in the subsurface layer of this area.

O 139 MONITORING OF ARCTIC MARINE MICROBES VIA AN OBSERVATION STRATEGY INTEGRATING AND STANDARDIZING STATE OF THE ART SAMPLING AND MOLECULAR TECHNOLOGIES

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Information on current diversity and biogeography of Arctic marine microbes (bacteria, archaea and single cell eukaryotes) with adequate temporal, spatial and taxonomic resolution is urgently needed to better understand natural dynamics of ecosystem states in space and time, and consequences of environmental change caused by anthropogenic factors. Here, we introduce a standardized molecular-based observation strategy for high resolution assessment of marine microbes in space and time, even in remote areas such as the Arctic Ocean. The observation strategy involves molecular analyses such as Next Generation Sequencing (NGS) and quantitative polymerase chain reaction (qPCR) of diverse environmental samples, collected from sea ice, water column and seafloor with a complementary set of automated and ship-based sampling approaches. This includes newly developed automated under-way sampling, moored sediment traps and year-round water samplers, as well as CTD-casts, multi-corers, bottom landers and in the future seafloor crawlers. An integrated standardized dataset including linked, searchable information on synchronous environmental variables provides comprehensive information on the diversity, abundance and biogeography of Arctic marine microbes, covering all three domains of life. The development of the observation strategy involves a set of coordinated pilot studies testing questions of temporal and spatial resolution, i.e. to assess the impact of sea-ice on Arctic marine single-cell eukaryote community composition, or of ocean warming in Eastern Fram Strait since the year 2000. In the future, the observation strategy for Arctic marine microbes will be implemented as a distributed Molecular Microbial Observatory in the framework of the Arctic observatory FRAM (Frontiers in Arctic Monitoring) and contributes to the ATLANTOS strategy for an integrated Atlantic observatory including genomic information.

O 141 ARCTIC BENTHIC COMMUNITIES STRUCTURE AND FUNCTIONING DURING SPRING SEA ICE CONDITIONS

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Diminishing sea ice cover may have consequences for functioning of Arctic marine ecosystems by leading to altered quantity and quality of primary production, and changes in organic matter export fluxes.

The aim of this study was to examine macrozoobenthos community structure and function in relation to sea ice cover, stage of spring bloom, and depth. Samples were collected during R/V Polarstern PS92 “TRANSSIZ” and R/V Helmer Hanssen “ARCEx” cruises in different environmental conditions, from shallow Svalbard fjords, continental shelf to the deep Sophia Basin and Yermak Plateau, and along a gradient in sea-ice cover. Organic Matter (OM) fluxes, the main food source for the benthic communities, were sampled from sediment traps, and from chlorophyll *a* maximum layer and above the bottom. In order to determine benthic community structure sediment samples were sieved on 0.5 mm. Additionally, samples for stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes analysis were collected to determine food sources and trophic position of animals. For each station, push-cores (10 cm Ø and 20 cm deep cores) were collected and used for bioturbation analyses.

The OM concentrations and export flux at all stations were depended on the sea ice cover, bloom state, and depth. OM origin differed depending on the location, and both terrestrial and fresh ice algal and phytoplankton production were observed. Presence of fresh OM on shallower stations was related to higher macrozoobenthos abundance and diversity, and intensity of bioturbation.

O 109 AN ATLANTIC DISTRIBUTED BIOLOGICAL OBSERVATORY (DBO) INITIATIVE

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The presentation informs and invites input to a new initiative on establishing an Atlantic Distributed Biological Observation (DBO) network. It is motivated by the challenge of observing the rapid changes in the Arctic marine physical environment and ecosystem responses. This is both due to the remote location restricting observations, cloudiness and sea ice limiting earth observations, shortcoming of biological sensors to be deployed on moorings, as well as the lack of surface water data from mooring observations due to sea ice constrains. The European Arctic, including the Atlantic inflow to the Arctic Basin, has turned out to be one of the regions showing larges anomalies compared to the 1980-2010 period with respect to sea ice extent, sea ice thickness, increased productivity due to longer open water periods, appearance of autumn phytoplankton blooms, new species establishing including northward expansion of fish species. There is therefor a need for innovative and collaborative strategies to increase our observations in the seasonal ice zone of this region.

Inspired by the successful Pacific Arctic marine DBO program where scientists have collaborated in Arctic marine data collection and compilation since 2010, an Atlantic DBO initiation workshop was organized in Tromsø, November 2016 (co-founded by IASC mwg and RCN). The aim was to establishing a complementary initiative on the Atlantic side of the Arctic Ocean. A board was established and the group came up with 5 suggested transects (Figure 1). These five transects (A_DBO 1-5) is selected partly based data from on existing time series and their guidance for good observational sites, and partly on the need to increase or coordinate observations in specific regions, motivated by planned research activities. Utilizing the framework and experience from the DBO on the Pacific side, this is an important step towards a Pan-Arctic observational system.

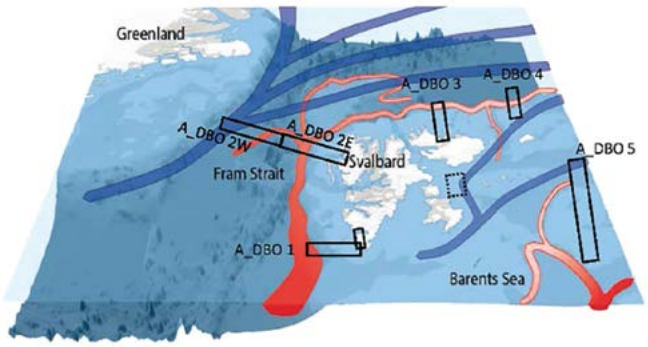

Figure 1. Altantic DBO transects.

O 142 CONCEPTS AND THEORIES FOR A UNIFYING PAN-ARCTIC PERSPECTIVE: CONCEPTUALIZING ARCTIC ECOSYSTEMS AND PROCESSES IN AN ERA OF CLIMATE CHANG

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Many nations, both Arctic and non-Arctic, are elaborating major research programs aimed at advancing our understanding of the Arctic Ocean system in a time of change as a pre-requisite to managing the imminent pressures derived from the forecasted increase in industry operations in the Arctic and as the cascade of effects of Arctic change affecting the rest of the world. However, these programs, involving great efforts and resources, are largely lacking a shared paradigm, or understanding to help identify the key processes and levers that such programs should aim to resolve. One reason for this shortcoming is that research in the Arctic Ocean has lagged behind efforts elsewhere in the work, largely through the geopolitical status quo emerging from WWII. The risk is that these research programs will suffer from a lack of focus and their outcomes, while possibly scientifically relevant and sound, may fall short of providing the high level understanding required, leaving us in only a marginally better position to manage the impacts economic growth and industry operations in the future Arctic. Applying a Pan-Arctic Perspective we present a set of conceptual models for time and geographic variation of the Arctic Ocean, manly from the seasonal ice zone. Based upon this exercise we generate a shared, high-level paradigm synthesizing our understanding of the key processes and elements governing the response of the Arctic ecosystem in relation to current pressures and changes. We aim at generating a new and parsimonious conceptual model of the functioning of the Arctic Ocean.

P 012 KONGSFJORDEN AS HARBINGER OF THE FUTURE ARCTIC? – RESEARCH PRIORITIES OF THE KONGSFJORD ECOSYSTEM FLAGSHIP PROGRAM

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Atlantification of the Arctic marine system causes polar species to be progressively replaced by boreal ones. Due to its location right at the interface of Arctic and Atlantic systems, Kongsfjorden and the Ny Ålesund area are crucial sites for the detection of environmental changes, and its ecosystems are considered early warning indicators of upcoming changes extrapolated to a pan-Arctic perspective. The marine Kongsfjord Flagship Program has identified “Adaptive responses of keystone components of Arctic marine ecosystems under global climate change” as a high-priority research topic.

Long-term research and monitoring activities, coupled with multidisciplinary knowledge on Kongsfjorden and adjacent systems, are great strengths that are currently lacking elsewhere in the Arctic. However, understanding the potential of acclimation and adaptation to mitigate changes and maintain critical ecosystem functions remains scattered. Under the umbrella of the Ny Ålesund Science Managers Committee (NySMAC), the Kongsfjord Flagship Program aims to integrate and coordinate research activities with respect to the structure, function and dynamics of the Kongsfjord ecosystem. Through long-term ecological studies, perturbation experiments and modelling, responses to environmental changes will be elucidated in order to predict the future conditions of Arctic fjords as well as oceanic areas that are directly linked to open fjords. Future research must be multidisciplinary, encompassing climate, physics, chemistry and responses of the biota. The approach must be integrative, including key polar and boreal species, populations, and communities in order to make predictions of ecosystem services.

Here we provide an overview on the research conducted in the frame of the Kongsfjord Flagship program and highlight identified gaps in knowledge, research priorities, but also constrains for ecosystem research on marine systems in the Arctic.

P 013 ARCTIC PRODUCTIVITY IN THE SEASONAL ICE ZONE -ARCTIC PRIZE

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Arctic PRIZE is a £2.5 million project funded through the UK Natural Environment Research Council. It is a project within the NERC Changing Arctic Ocean Program that aims to understand how change in the physical environment (ice and ocean) will affect the large-scale ecosystem structure and biogeochemical functioning of the Arctic Ocean. Arctic PRIZE will run from 2017 to 2021 and focus its field campaigns in the Barents Sea, particularly focussing on processes and conditions the evolve in the seasonal ice zone. We will investigate the seasonally and spatially varying relationship between sea ice, water column structure, light, nutrients and productivity and the roles they play in structuring energy transfer to pelagic zooplankton and benthic megafauna. Arctic PRIZE will utilise robotics technologies (specifically ocean gliders and autonomous underwater vehicles) to target the critically important but under-sampled seasonal transition from winter into the post-bloom summer period. The project will also develop the predictive

tools necessary to assess how the Arctic ecosystems will respond to a reducing sea ice cover. This will be achieved through a combined experimental/ modelling programme. The project is embedded within international Arctic networks based in Norway and Canada and coordinated with ongoing US projects in the Pacific Arctic. A key objective of Arctic PRIZE is the forging of lasting engagement with the international Arctic research community. In particular, Arctic PRIZE is committed to the development of the next generation of Arctic researchers.

P 014 CROSS-SHELF DISTRIBUTION AND STRUCTURE OF MESOZOOPLANKTON COMMUNITIES IN THE EAST-SIBERIAN SEA

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The East-Siberian Sea remains the most understudied of all Arctic shelf seas due to its remote location and difficult sampling conditions. It interacts both with the adjacent Atlantic-influenced Kara and Laptev Seas, and the Pacific-influenced Chukchi Sea and may play a significant role in local circulation and production through riverine input and by being an important source of sea ice and dense water formation. We examine recent (September 2012, 2015) as well as historical (August-September 1948, 1973) data to describe the distribution and community structure of mesozooplankton in the region. We found that the biomass and abundance are lower than in the adjacent Chukchi Sea, but higher than previously estimated, around 25-35 mg DW m^{-3}. Diversity was low and characteristic for other Arctic shelf seas, with increasing number of species towards the shelf break. Biomass was dominated by small copepods (*Pseudocalanus* spp., *Oithona similis*) and chaetognaths (*Parasagitta elegans*). Advected Pacific species (*Eucalanus bungii, Metridia pacifica*), as well as Atlantic species (*Calanus finmarchicus*) were found in off-shore waters, but not on the shallow shelf. Several major assemblages of zooplankton were identified using multivariate analysis and tied to the physical properties of the water masses present.

P 015 LIPID AND FATTY ACID TURNOVER OF ARCTIC ZOOPLANKTON ORGANISMS REVEALED BY STABLE ISOTOPE ANALYSES

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High latitude marine ecosystems are characterized by strong seasonality in incoming light and thus primary production and food availability. Polar zooplankton organisms have developed the ability of storing large amounts of lipid reserves to face this variable environment. Lipids are composed of fatty acids, which are transferred from unicellular algae via zooplankton to higher trophic levels. In our experiments, a ^{13}C labeled diatom-flagellate mix was fed to key zooplankton species (copepods and thecosome pteropods) over some days to a couple of weeks to follow the fatty acid carbon assimilation and possible *de novo* synthesis of fatty acids and alcohols. The ^{13}C incorporation was monitored using compound specific isotope ratio mass spectrometry.

Among the small sized copepods *Pseudocalanus minutus* and *Oithona similis*, maximum lipid turnover occurred in *P. minutus*, which exchanged 2.6% day^{-1} of total lipid, whereas 0.5% day^{-1} were exchanged in *O. similis*. In *P. minutus*, the diatom markers 16:1(n-7), 16:2(n-4), and 16:3(n-4) were almost completely renewed from the diet within 21 days, while 15% of the flagellate markers 18:2(n-6), 18:3(n-3) and 18:4 (n-3) were exchanged. In *O. similis*, 15% of both flagellate and diatom markers were renewed within 21 days. Thecosome pteropods, in contrast, are less lipid-rich and less studied, although they can contribute with more than 20% to the zooplankton biomass in Arctic waters. The daily turnover rate of lipid was between 0.15% day^{-1} in *L. helicina* and 1.3% day^{-1} in *L. retroversa*. High carbon assimilation was found in both diatom and flagellate markers in *L. helicina* accounting for 0.8% over 6 days. In *L. retroversa*, 0.8% of the diatom markers were exchanged after 6 days while 13.9% were renewed in flagellate markers. Our methods allow us to estimate carbon turnover rates of Arctic key organisms to better understand the energy flux through the high latitude marine ecosystems.

P 016 SEA ICE-FREE CONDITIONS IN INNER FJORD ON SPITSBERGEN (MIMERBUKTA, BILLEFJORDEN) IN EARLY HOLOCENE

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Mimerbukta is a small bay in the northern part of Billefjorden, Central Svalbard. Uplifted marine terraces formed by relics of Pleistocene to Holocene glacigenic, marine, deltaic and glaciofluvial sediments are located in Mimerdalen near Mimerbukta.

The MD1 section (28 m a.s.l.) is from the base to the top of the terrace formed by subglacial-supraglacial tills, marine pelagic deposits, coarse-grained delta bottomset and delta foreset-topset deposits. Marine pelagic and bottomset deposits contain some fossils preserved in living positions. Dating indicates the depositional age of 10.5 ± 0.1 cal. ka BP for the diamicton 3 and 9.7 ± 0.2 cal. ka BP for deltaic bottomset.

Age of section MD1 was determined by means of AMS 14C method (calibrated using 90% marine influence) based on shells of *Mya truncata* molluscs found in living position.

Composition of species in diamicton 3 (mainly *Mya truncata* 54%, *Macoma calcaera* 27%, *Hiatella arctica* 12%, *Mytilus edulis* 4%) and bottomset (*Mytilus edulis* 56%, *Macoma calcaera* 18%, *Mya truncata* 12%, *Littorina littorea* 4%) proves much richer biodiversity than in present time. Parts of ribs (picture 1) and one almost complete vertebra of *Balaenoptera*? whale were also found in the bottomset.

The presence of relatively thermophile species, which prefer warmer and/or tidal conditions (e.g., *Mytilus edulis, Littorina littorea and Arctica islandica*) also supports the absence of complete sea ice freezing during winters in the time of the MD1 formation. This conclusion also partly confirms the existence of whale bones in the bottomset. All these findings indicate considerably warmer shallow sea environment than in present time.

Picture 1: Parts of whale rib of *Balaenoptera*? genus in the bottomset of the MD1 section.

Acknowledgements

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P 017 SPATIO-TEMPORAL VARIATIONS IN BENTHIC FUNCTION IN A HIGH ARCTIC FJORD (KONGSFJORDEN, SVALBARD)

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Arctic marine ecosystems are characterized by strong seasonality in sea ice cover, light, and food availability. Climate change is enhanced in the Arctic and these changes are expected to have repercussions for ecosystems functioning. It is still unclear, however, how benthic organisms will respond to variations in food sources (quantity, quality) and environmental conditions. Kongsfjorden, an Arctic fjord on the west side of Svalbard, is influenced by warm Atlantic waters inflows, and its sea ice cover has disappeared over the last decade. The main aim of this study was to characterize spatial and seasonal variations of benthic activities in this changing fjord.

In spring, summer, fall and winter, organic matter (OM) fluxes from the water column to the seafloor were quantified and characterized (chlorophyll *a*, particulate organic carbon, phytoplankton, zooplankton fecal pellet carbon, lipids, proteins, and carbohydrates). The response of the benthos to these inputs was studied in terms of respiration (overall benthic community activity), bioturbation (intensity of macrofauna activities), and stable isotope signature of C and N (trophic relations among organisms).

While vertical fluxes of OM exhibited strong seasonal variation, OM quality and quantity in sediments showed stronger spatial variation than seasonal variation due to glacial inputs. Interestingly, benthic activities did not seem to respond to these variations as changes in respiration and bioturbation were low to null. This suggests that the benthos of Kongsfjorden does not rely on seasonal inputs of OM, such as in other ice-covered areas, and is more influenced by warm Atlantic water and glacier inputs.

P 018 VERTICAL PARTICLE FLUX MEASURED IN SEDIMENT TRAPS DEPLOYED IN THE CENTRAL ARCTIC OCEAN AND IN EASTERN FRAM STRAIT

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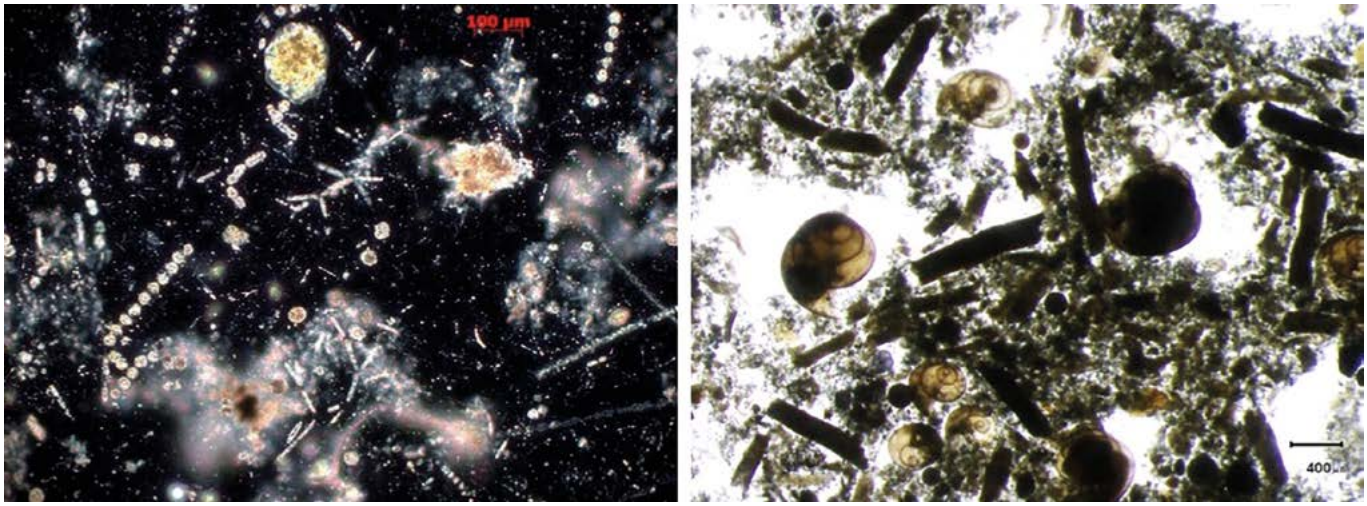
Moored sediment trap arrays were deployed from September 2011 to August 2012 on both sides of the Gakkel Ridge in the Nansen and Amundsen Basins to measure vertical particle flux at 200 m and 3800 m under near complete ice cover in the Central Arctic Ocean (CAO). Although the moorings where deployed relatively close to each other and vertical flux pattern of particulate organic matter (POC) was similar, particle flux patterns of total particulate matter (TPM), of particulate biogenic silica (PbSi), and of dominant diatom species were different. Whereas in the CAO ice related diatoms mainly dominated the recognizable flux fraction, faecal material usually prevailed in traps deployed at the LTER (Long-Term Ecological Research) observatory HAUSGARTEN in the periodically ice covered eastern Fram Strait between 2000 and 2012, pointing towards different systems of organic matter production and modification. Results of biomarker composition analyses of the sinking particles confirmed those differences related to ice cover. Molecular genetic approaches were introduced to further understand differences in protist sedimentation. Since 2014, investigations are continuing within the greater framework of the Arctic long-term observatory 'Frontiers of Arctic Marine Monitoring' (FRAM) that has been established to improve our knowledge of environmental and biological data in high temporal and spatial resolution in ice covered waters.



Pictures: Content of sediment trap samples. Left: Central Arctic Ocean at 200 m, nearly 100% ice covered, ice attached algae *Melosira arctica*, *Nitzschia frigida* and others. Right: Eastern Fram Strait at 280 m, almost no sea ice, zooplankton faeces, algal fluff & aggregates, swimmers and sinkers of zooplankton.

P 019 HIGH-END TECHNOLOGY MEETS A WELL-ESTABLISHED SAMPLING TECHNIQUE: ADVANCES OF COMBINING AN ACOUSTIC ZOOPLANKTON AND FISH PROFILER WITH SHORT-TERM SEDIMENT TRAPS

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Short-term sediment traps are a well-established sampling technique to investigate the vertical biomass flux in the upper water column within a short period (hours to few days). The sinking material is collected in the sediment trap cylinders and can, after trap array retrieval, be analyzed for various kinds of sinking material. If the sediment trap cylinder is modified with a gel jar, also the size composition of sinking material can be investigated. To interfere mechanisms *why* much or little biomass is sinking out at a certain sampling location, a set of hydrographical parameters (temperature, salinity, fluorescence) and suspended biomass data (chlorophyll a, particulate organic carbon, phytoplankton) is commonly determined in combination with the trap deployment. One of the most important factors modifying the sinking material is however zooplankton. Depending on its composition and abundance, these grazers may reduce the amount of sinking biomass substantially or modify its size composition by sloppy feeding (fragmentation) or production of fecal pellets. Sampling techniques used so far, such as zooplankton nets or optical instruments (e.g. vertical profiles with a laser optical plankton counter), resolve the horizontally and vertically highly patchy zooplankton distribution poorly over an extended time period and can thus only provide a snap shot picture about the zooplankton distribution in relation to the sinking material collected in the sediment traps. In our new approach, we used an acoustic zooplankton and fish profiler (AZFP) and short-term sediment traps on the same mooring and this allowed us resolving this challenge. The AZFP determined the abundance and vertical positioning of the zooplankton in the water column with a high temporal resolution throughout the period of the sediment trap deployment and we could thus assess the grazers' impact on sinking material in a comprehensive way.

S03 ARCTIC CLOUDS, AEROSOLS AND CLIMATE EFFECTS

O 113 INSIGHT ON THE CORRELATION AMONG PRIMARY PRODUCTION, SEA ICE MELTING, NORTH HEMISPHERE CIRCULATION MODE AND BIOGENIC AEROSOL IN THE ARCTIC

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Here we present the relationships linking methanesulfonic acid (MSA, arising from the atmospheric oxidation of the biogenic dimethylsulfide, DMS) in atmospheric aerosol, satellite-derived chlorophyll a (Chl-a), and oceanic primary production (PP), also as a function of sea ice melting (SIM) and extension of the ice free area in the marginal ice zone (IF-MIZ) in the Arctic. MSA was determined in PM10 samples collected over the period 2010-2015 at two Arctic sites, Ny Ålesund, Svalbard islands, and Thule, Greenland. PP is calculated by means of a bio-optical, physiologically based, semi-analytical model in the potential source areas located in the surrounding oceanic regions. Chl-a peaks in May in the Barents sea and in the Baffin Bay, and has maxima in June in the Greenland sea; PP follows the same seasonal pattern of Chl-a, although the differences in absolute values of PP in the three seas during the blooms are less marked than for Chl-a. The source intensity (PP) is able to explain more than 30% of the MSA variability at the two sites; the other factors explaining the MSA variability are taxonomic differences in the phytoplanktonic assemblages, and transport processes from the DMS source areas to the sampling sites. The sea ice dynamic plays a key role in determining MSA concentration in the Arctic, and a good correlation between MSA and SIM and between MSA and IF-MIZ is found for the cases attributable to blooming of diatoms in the MIZ. Such relationships are calculated by combining the data sets from the two sites and suggest that PP is related to sea ice melting and to the extension of marginal sea ice areas, and that these factors are the main drivers for MSA concentrations at the considered Arctic sites. Finally, the link between MSA and hemispherical circulation mode (NAO, AO) is investigated.

O 110 QUANTIFYING THE IMPACT OF ICELANDIC DUST STORMS ON HIGH-LATITUDE AEROSOL

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Using a combination of observations, meteorological climatologies and modelling we have developed an Icelandic dust storm emission inventory. Here we present results from a global modelling study quantifying the contribution of Icelandic dust to high-latitude: ice nucleating particles (INP), cloud condensation nuclei (CCN) and PM2.5. Our results suggest that Icelandic dust cannot explain the formation and persistence of summertime mixed-phase Arctic marine clouds, as summertime marine clouds are too warm for Icelandic dust to serve as INP. However, in colder regions (such as Greenland) Icelandic dust may sporadically contribute to INP. The contribution of Icelandic dust to high-latitude CCN was shown to be complex (Fig. 1). Indeed, our results indicate a decrease in high-latitude CCN in the aftermath of Icelandic dust storms (Table 1). This decrease is due to the short-term increase of the Arctic atmospheric condensation sink and the resulting suppression of nucleation processes (a significant source of Arctic summertime CCN). Finally, Icelandic dust storms are shown to significantly contribute to high-latitude summertime PM2.5 (and PM10) both during and in the aftermath of dust events (Fig. 1). Our results suggest that Icelandic dust storms (neglected in most global climate models) may in the short term increase aerosol optical depth (strongly correlated to PM2.5) at high latitudes. Additionally, Icelandic dust storms are likely to contribute to poor air quality as well as reduced visibility in the Arctic boundary layer. Thus, we argue for the adoption of high-latitude dust emissions in climate and NWP models.

	$\Delta PM_{2.5}$ (ugm^{-3})		$\Delta N50$ (cm^{-3})		$\Delta N100$ (cm^{-3})		$\Delta[INP]_{-10}$ (m^{-3})	
	min	max	min	max	min	max	min	max
June 6th 2001 (storm)	0	373	-30	683	-15	710	0	0.05
June 7th 2001	0	159	-75	285	-10	292	0	0.16
June 8th 2001	0	19	-119	30	-37	42	0	0.05
June 9th 2001	0	11	-193	22	-43	22	0	0.14

Table 1: Change (max-min) in modelled PM2.5, N50 (CCN >50nm), N100 (CCN >100nm) and INP during and in the aftermath of a simulated Icelandic dust storm.

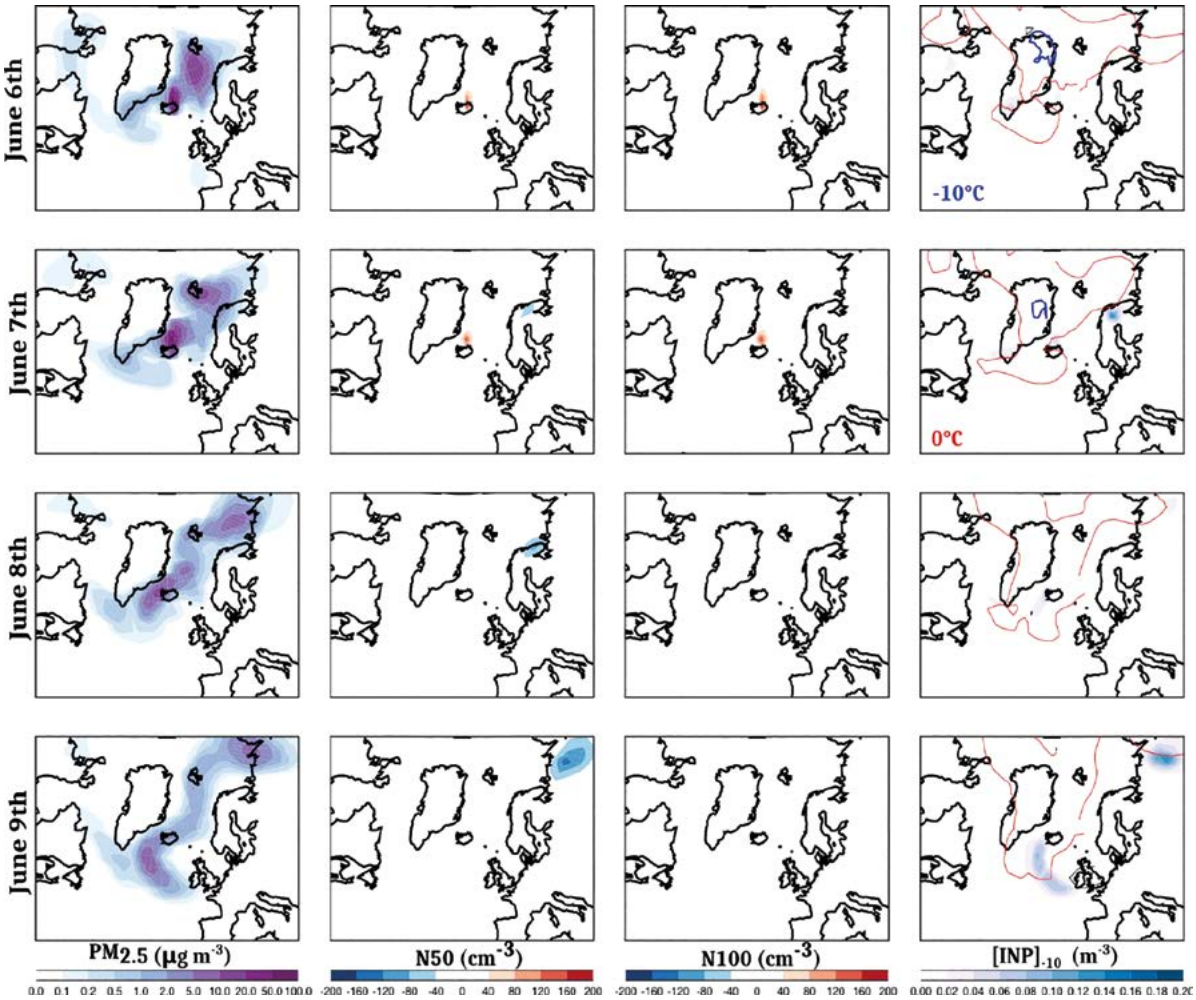

Figure 1: Icelandic contribution to PM2.5, N50, N100, and INP. Here we show the initial impact of a simulated storm on June 6th 2001 and the proceeding 3 days.

O 185 CLOUDINESS IN THE ATLANTIC ARCTIC: INTERANNUAL VARIABILITY FROM SURFACE OBSERVATIONS SINCE THE LATE 19TH CENTURY

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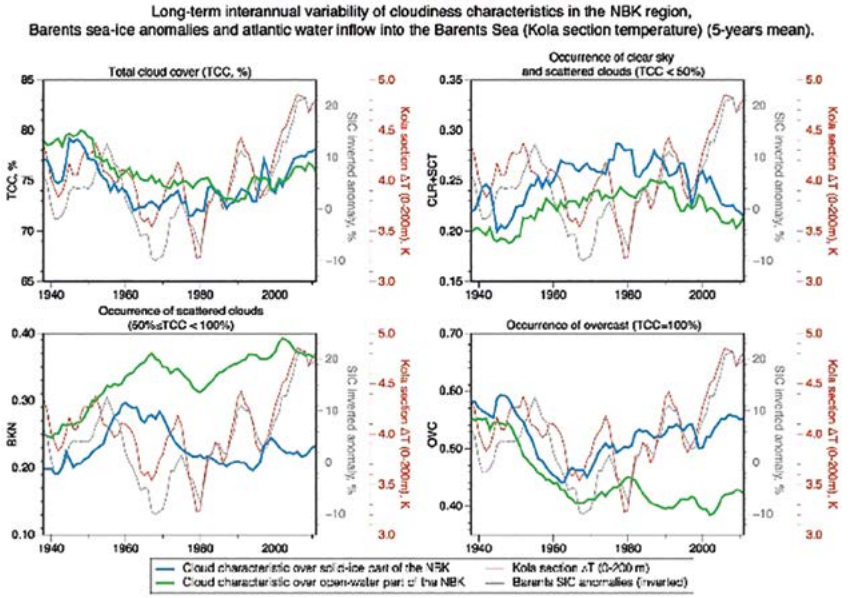
A long-term climatology of cloudiness over the Norwegian, Barents and Kara Seas (NBK) based on visual surface observations is presented. Annual mean total cloud cover (TCC) over the NBK is almost equal over solid-ice (SI) and open-water (OW) parts of NBK (73±3% and 76±2% respectively). In general, TCC has higher intra- and inter-annual variability over SI than over OW. A decrease of TCC in the middle of the 20th century and an increase in the last few decades was found at individual stations and for the NBK as a whole. In most cases these changes are statistically significant with magnitudes exceeding the data uncertainty that is associated with the surface observations. The most pronounced trends are observed in autumn when the largest changes to the sea-ice concentration (SIC) occur. TCC over SI correlates significantly with SIC in the Barents Sea, with a statistically significant correlation coefficient between annual TCC and SIC of -0.38 for the period 1936-2013. Cloudiness over OW shows non-significant correlation with SIC. An overall increase in the frequency of broken and scattered cloud conditions, and a decrease in the frequency of overcast and cloudless conditions were found over OW. These changes are statistically significant and likely to be connected with the long-term changes of morphological types (an increase of convective and a decrease of stratiform cloud amounts).



O 144 CHARACTERIZING ARCTIC AEROSOL PROPERTIES FOR EVALUATION OF AEROSOL-CLOUD INTERACTIONS ON THE NORTH SLOPE OF ALASKA

J. Creamean[1], M. Maahn[1], G. de Boer[1], A. McComiskey[2], A. Sedlacek[3]

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Aerosols that serve as cloud condensation nuclei (CCN) and ice nucleating particles (INPs) have the potential to modulate cloud microphysical properties. In regions such as the Arctic, aerosol-cloud interactions are severely understudied yet have significant implications for surface radiation. Further, uncertainties in model representations of heterogeneous nucleation are a significant hindrance to simulating Arctic mixed-phase cloud processes. Characterizing aerosol chemical, physical, and cloud nucleating properties is pertinent to evaluating of the role of aerosols in altering Arctic cloud microphysics, lifetime, and radiative forcing. We present an analysis of in situ observations of a wide range of aerosol properties on the North Slope of Alaska in combination with air mass trajectory and dispersion analyses. Airborne measurements from the U.S. Department of Energy's Atmospheric Radiation Measurement Airborne Carbon Measurements (ARM-ACME-V) campaign during the summer of 2015 provide valuable insight into the vertical and spatial heterogeneity of aerosols and their potential to influence cloud formation over the North Slope. Relatively high concentrations of small-sized aerosol were persistent, localized, and observed at low altitudes near the oil extraction and production of Prudhoe Bay. In these regions of high aerosol concentration, a decrease of cloud droplet size, potentially influencing cloud lifetime and albedo, has been found. The active Alaskan wildfire season also introduced relatively high concentrations of carbon monoxide and black carbon aerosols in layers elevated over the entire North Slope. Episodic influences from long-range transported aerosol also occurred at the highest altitudes flown. Ground-based observations are utilized to support ARM-ACME-V airborne measurements and to evaluate the sources of aerosol in the boundary layer as compared to the free troposphere. The goal is to improve process understanding of aerosol-cloud interactions in Arctic mixed-phase clouds and their subsequent impacts on the surface energy budget.

O 098 ICELANDIC DESERT AND VOLCANIC DUST EFFECTS ON THE ARCTIC ATMOSPHERE AND CRYOSPHERE

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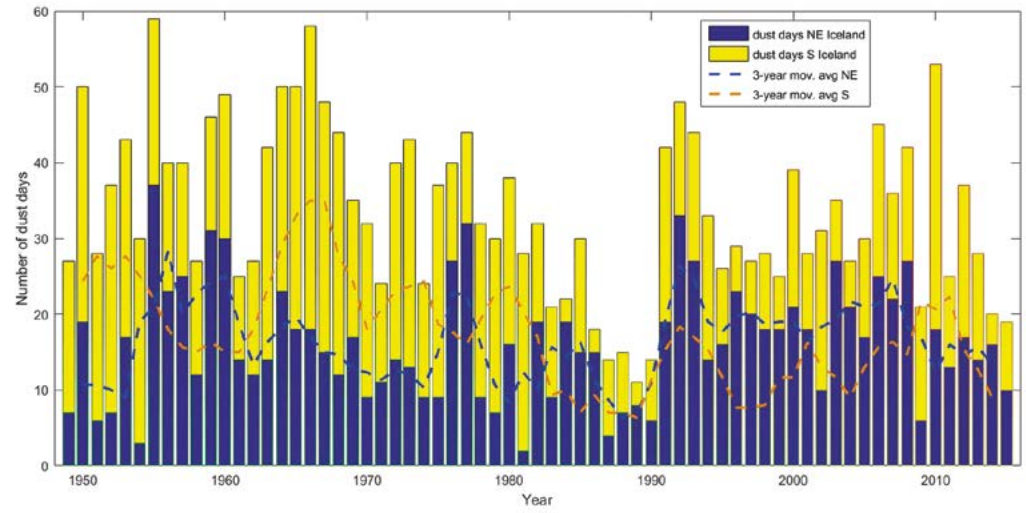
Arctic aerosol are often attributed to the ‚Arctic Haze and long-range transport tracers'. There is, however, an important dust source right in the Arctic/ Sub-arctic region which should receive more attention. The largest desert in the Arctic as well as in the Europe is Iceland with >40,000 km^2 of desert areas. The mean dust suspension frequency was 135 dust days annually in 1949-2011. The annual dust deposition was calculated as 31-40.1 million tons yr^{-1} affecting the area of >500,000 km^2. Satellite MODIS pictures have revealed dust plumes traveling >1000 km at times.

The physical properties of Icelandic dust showed differences in mineralogy, geochemical compositions, shapes, sizes, and colour, compared to the crustal mineral dust. Icelandic dust is of volcanic origin, dark in colour with sharp-tipped shards and large bubbles. About 80% of the particulate matter is volcanic glass rich in heavy metals, such as iron and titanium. Suspended dust measured at the glacial dust source consisted of such high number of close-to-ultrafine particles as concentrations during active eruptions. Generally, about 50% of the suspended PM10 are submicron particles in Iceland. Contrarily, suspended grains >2 mm were captured during severe dust storm after the 2010 Eyjafjallajokull eruption when the aeolian transport exceeded 11 t m^{-1} of materials and placed this storms among the most extreme wind erosion events recorded on Earth.

Our reflectance measurements showed that Icelandic dust deposited on snow lowers the snow albedo and reduces the snow density as much as Black Carbon. Icelandic volcanic dust tends to act as a positive climate forcing agent, both directly and indirectly, which is different than concluded for crustal dust in the 2013 IPCC report. The high frequency, severity and year-round activity of volcanic dust emissions suggest that Icelandic dust may contribute to Arctic warming.


dust days NE Iceland
dust days S Iceland
3-year mov. avg NE
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Number of dust days
Year
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10
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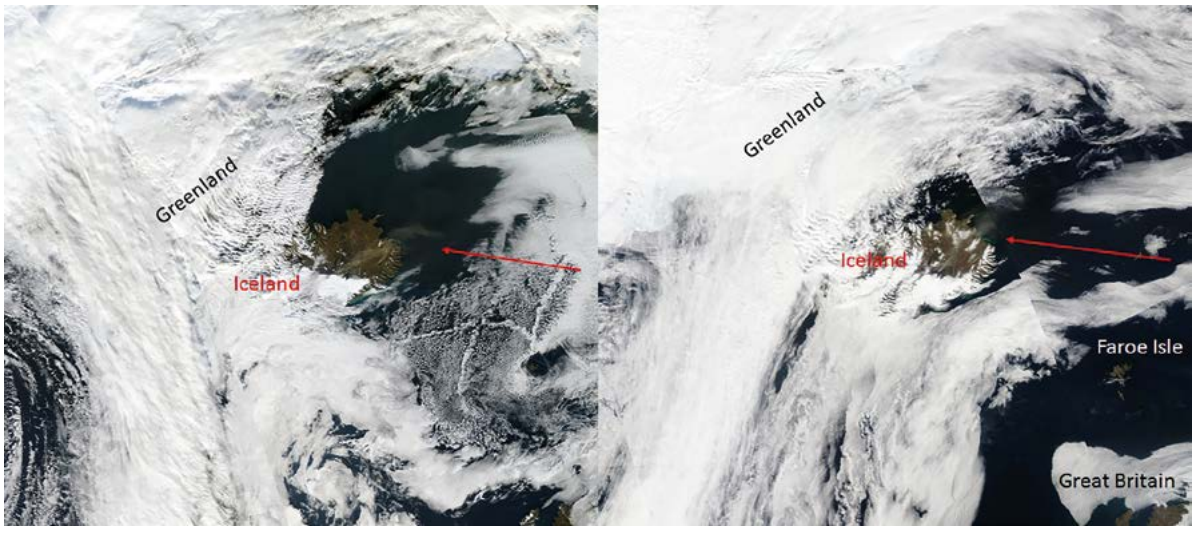
Greenland
Iceland
Greenland
Iceland
Faroe Isle
Great Britain

O 097 ARCTIC SEA ICE MELT LEADS TO ATMOSPHERIC NEW PARTICLE FORMATION

M. Dall'Osto[1], D. Beddows[2], P. Tunved[3], R. Krejci[3], J. Strom[3], H. Hansson[3], Y. Yoon[4], S. Becagli[5], R. Udisti[5], C. O'Dowd[6], R. Harrison[2], R. Simo[1]

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Atmospheric new particle formation and growth significantly influences climate by supplying new seeds for cloud condensation and brightness. Currently, there is a lack of understanding of whether and how marine biota emissions affect aerosol-cloud-climate interactions in the Arctic. Here, the aerosol population was categorised via cluster analysis of aerosol size distributions taken at Mt Zeppelin (Svalbard) during a 11 year record. The daily temporal occurrence of nucleation events in the polar marine boundary layer was quantified annually as 18%, with a peak of 51% during summer months. Air mass trajectory analysis and atmospheric nitrogen and sulphur tracers link these frequent nucleation events to biogenic precursors released by open water and melting sea ice regions. The occurrence of such events across a full decade was anti-correlated with sea ice extent. New particles originating from open water and open pack ice increased the cloud condensation nuclei concentration background by ca. 20%, supporting a hitherto not fully elucidated marine biosphere-climate link through sea ice melt and low altitude clouds that may have contributed to accelerate Arctic warming. Our results prompt a better representation of biogenic aerosol sources in Arctic climate models.

O 146 EFFORTS TO IMPROVE UNDERSTANDING OF AEROSOL-CLOUD INTERACTIONS IN ARCTIC CLOUDS

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Of the uncertainties surrounding our understanding of global climate, one of the largest involves the effects of aerosol particles on cloud radiative properties and precipitation intensity. The Arctic provides particular challenges when it comes to understanding these effects, in part resulting from an environment which includes mixed-phase clouds, a variety of stability regimes, a range of different aerosol properties, and other complexities. These challenges, in combination with those associated with observing the Arctic atmosphere in general, have left several key gaps in our understanding of aerosol influences on Arctic clouds, and the resulting modulation of the surface energy budget.

In this presentation, we present recent and ongoing efforts to better understand relationships between aerosol particles and Arctic clouds. This will include evaluation of aircraft in-situ and ground-based remote sensing datasets to evaluate a variety of relevant processes. To do so, we use measurements from the US Department of Energy facilities at Utqiagvik/Barrow and Oliktok Point as well as airborne measurements from the DOE Atmospheric Radiation Measurement (ARM) program Airborne Carbon Measurement Experiment (ACME-V), conducted during summer 2015 over Northern Alaska. Topics covered in these evaluations includes the vertical structure of the atmosphere and distribution of aerosol within the column, the observed response of cloud ice to aerosol perturbations, the observed influence of local anthropogenic and wildfire emissions on cloud properties in Northern Alaska, and evaluation of the influence of partitioning between cloud condensation nuclei and ice forming particles within the context of traditional aerosol indirect effects using large eddy simulations. Results on these topics will be put into the context of previous efforts to understand these processes, and next steps to unify these efforts will be discussed.

O 183 SIMULATION OF SPECTRA MEASUREMENTS OF THE POLARIZED RADIATION FOR INVESTIGATION OF THE ARCTIC CLOUDINESS

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The Arctic annual mean total cloud cover is about 0.7 [Chernokulsky A., Mokhov I., Adv Meteorol, 2012]. Since clouds play an important role modifying the distribution of radiative solar and thermal fluxes, monitoring their properties is the challenging objective in satellite remote sensing. Clouds and aerosols are the main polarizing factors in atmosphere, and thus the polarized radiation measurements can improve the quality of retrieval information.

To evaluate the benefits of such measurements we have carried out a set of numerical experiments with the 1-D forward Fast Line-by-Line Model (FLBLM), which rigorously treats particulate and molecular scattering alongside absorption by means of Line-by-Line and Monte Carlo methods. The model can calculate the spectra of full Stokes vector both for solar and thermal radiation with high spectral resolution and accuracy [Fomin B., Falaleeva V., Atmosphere, 2012], [Fomin B., Falaleeva V., IJRS , 2014], [Fomin B., Falaleeva V., JQSRT , 2016]. FLBLM has been carefully validated and tested for conditions of mid-latitude atmosphere.

Almost similar simulations have been conducted also by other authors [Cox et al., ESSD, 2016], but without considering polarization. We have performed calculations with FLBLM for the different cases of clouds (height, phase, optical depth, surface albedo) for conditions of the Arctic atmosphere and the clear-sky case. The results show that spectra of polarized radiation contain important information about clouds, which could be retrieved even when the clouds have low visible and temperature contrast with the cold surface, but the instruments should meet certain requirements. The polarization of thermal radiation becomes noticeable on the limb traces.

High-resolution polarized sounding appears to be a useful tool in obtaining information on the types and vertical structures of the clouds. And the FLBLM model may be applied in planning satellite experiments and validation models.

This work is supported by RFBR, research project No. 16-35-00585.

O 094 MAIN DRIVERS OF ANNUAL CYCLE OF ACCUMULATION-MODE AEROSOLS IN THE ARCTIC

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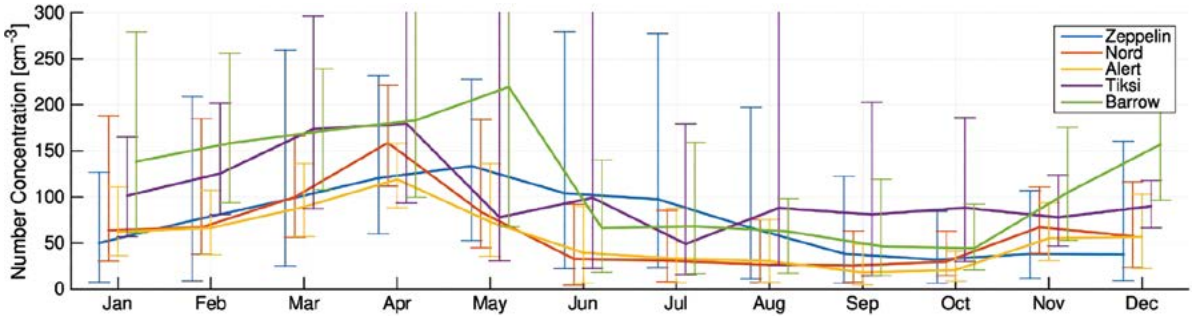
Accumulation-mode particles, with a size ranging between 100 to 500 nm, are climate active because of their relative abundance and interactions with radiation and clouds. The concentration of these particles (*Nacc*) in the Arctic varies throughout the year, but climate and chemical transport models still struggle to reliably characterize their properties. This adds more uncertainty to future projections.

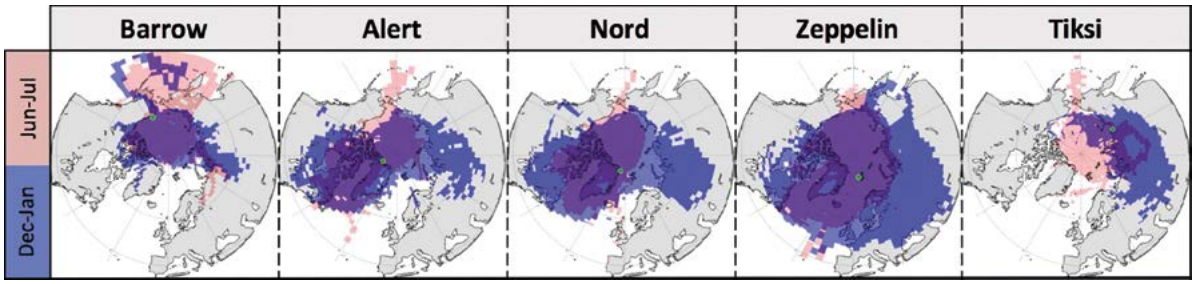
Different transport and meteorology-related factors that may serve as main drives for the annual cycle of *Nacc* were explored for five Arctic sites - based on three to five years of observations. Each observed hourly aerosol size distribution was associated with a 240-hr Hysplit-4 back-trajectory.

The results indicate that despite some common features, the differences in the annual cycle of *Nacc* between the sites are beyond the year-to-year variability. Part of it is related to the local weather and topography specific to each site.



The monthly median number concentration of accumulation-mode particles. The error bars represent the 10th to 90th percentile range.

Furthermore, it is shown that the transport of aerosols is the main factor in modulating the seasonal Arctic *Nacc* cycle, but removal by precipitation as well as cloud processing are sometimes important too. The longer lifetimes of the accumulation-mode particles in winter and spring, together with higher average wind speeds, enable the transport of pollution from remote sources to form the Arctic Haze.



The seasonal geographical coverage of the 240-hr back-trajectories. The shaded areas incorporate grid cells with trajectory-crossing probability greater than 0.5%.

There is no single site that can be considered as fully representative for the entire Arctic region - at least with respect to climate active aerosol concentrations. It is therefore important to understand what causes the differences between the sites and improve the aerosol parameterizations in climate models, so that they can capture these effects and better match the observations.

O 184 UNDERSTANDING RAPID CHANGES IN PHASE PARTITIONING BETWEEN CLOUD LIQUID AND ICE IN AN ARCTIC STRATIFORM MIXED-PHASE CLOUD

H. Kalesse[1], G. de Boer[2], A. Solomon[2], M. Oue[3], M. Ahlgrimm[4], D. Zhang[5], M. Shupe[2], E. Luke[6], A. Protat[7]

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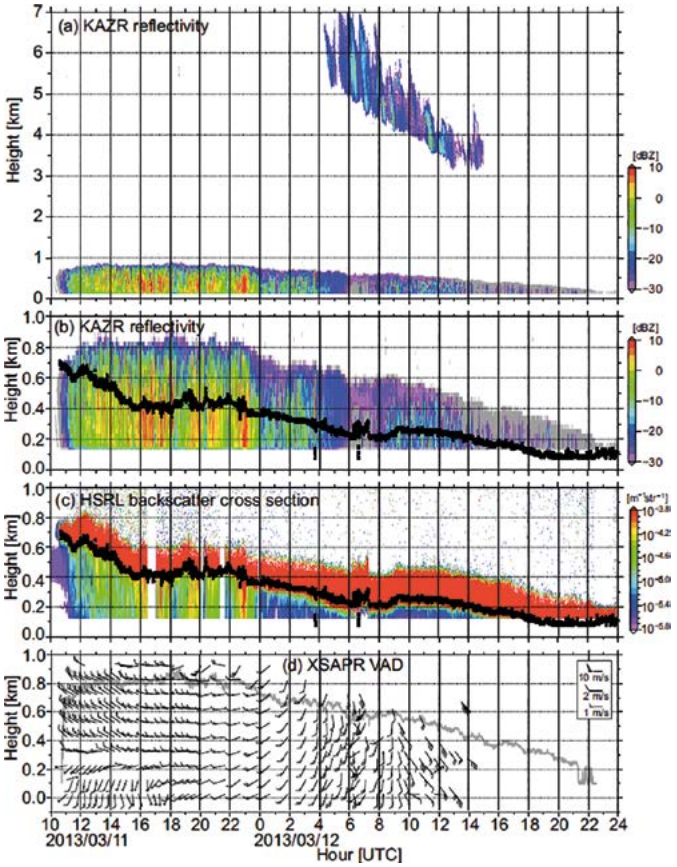
In the Arctic, a region particularly sensitive to climate change, mixed-phase clouds occur as persistent single or multiple stratiform layers. For many climate models, the correct partitioning of hydrometeor phase (liquid vs. ice) remains a challenge. However, this phase partitioning plays an important role for precipitation processes and the radiation budget. To better understand the partitioning of phase in Arctic clouds, observations using a combination of surface-based remote sensors are useful.

In this study, the focus is on a persistent low-level single-layer stratiform Arctic mixed-phase cloud observed during March 11-12, 2013 at the US Department of Energy's (DOE) Atmospheric Radiation Measurement (ARM) North Slope of Alaska (NSA) permanent site in Barrow, Alaska. This case is of particular interest due to two significant shifts in observed precipitation intensity over a 36 hour period. For the first 12 hours of this case, the observed liquid portion of the cloud cover featured a stable cloud top height with a gradually descending liquid cloud base and continuous ice precipitation. Then the ice precipitation intensity significantly decreased. A second decrease in ice precipitation intensity was observed a few hours later coinciding with the advection of a cirrus over the site.

Through analysis of the data collected by extensive ground-based remote-sensing and in-situ observing systems as well as Nested Weather Research and Forecasting (WRF) simulations and ECMWF radiation scheme simulations, we try to shed light on the processes responsible for these rapid changes in precipitation rates. A variety of parameters such as the evolution of the internal dynamics and microphysics of the low-level mixed-phase cloud, large-scale advection of different air masses, and the influence of the cirrus cloud are evaluated.



The cloud as seen by (a) - (b) Ka-band radar (KAZR) reflectivity, (c) high spectral resolution lidar particle backscatter cross-section, (d) horizontal winds estimated by X-SAPR.

O 145 DIRECT OBSERVATIONS OF CLOUD ACTIVATED AEROSOL PARTICLES AT ZEPPELIN STATION, NY ÅLESUND

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Low level clouds in the are one of the major players controlling radiative balance in the Arctic. Cloud residual particles are aerosol particles, which have been activated into cloud droplets and ice crystals. The individual cloud droplets started their lives as aerosol particles that acted as condensation nuclei. At the most fundamental level, understanding the processes that determine cloud properties from microscale to global scale requires an understanding which particle actually form cloud droplets under various different conditions. While dynamical processes and amount of water vapour determine where supersaturated environments can be created in the atmosphere, cloud properties are determined by aerosol/cloud interactions at the individual particle level. We will present, for the first time, cloud residual microphysical properties in the Arctic on a seasonal basis. From November 2015, a ground-based counterflow virtual impactor (CVI) inlet is operational at Zeppelin station in Ny-Ålesund, Svalbard. Using the CVI inlet, the cloud residual particles number density and size distribution was measured. In addition, the black carbon content and the water vapour mixing was determined as well. A cloud condensation nuclei counter (CCNC) measuring behind the CVI inlet allowed to determine the ambient supersaturation at which the aerosol particles where activated. Compared to ambient aerosol properties, size dependent fraction of aerosol particles activated into cloud droplets and ice crystals was derived.

O 148 SIMULATIONS OF DIRECT AEROSOL RADIATIVE FORCING IN THE EUROPEAN ARCTIC

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An aerosol optical properties and their impact on radiative budget in polar region is discussed. This study was made within the framework of the Impact of Absorbing aerosols on Radiating Forcing in the European Arctic (iAREA) project. Presented data were obtained from Navy Aerosol Analysis and Prediction System (NAAPS) and Fu-Liou radiative transfer model. NAAPS global model was used to simulate particle concentration and aerosol optical concentration at 1x1° spatial resolution. The NAAPS re-analysis includes 2D aerosol optical depth assimilation based on the MODIS observation. Aerosol direct radiative forcing (RF) simulations were done for clear sky and all-sky conditions defined based on NAAPS re-analysis and satellite observation of cloud and surface properties. RF is discussed at Earth's surface, and top of the atmosphere (TOA), and in the atmosphere for anthropogenic and biogenic particles, mineral dust, smoke and seas salt as well as for absorbing and non-absorbing particles.

The case study of biomass burning event in July 2015 is presented. Numerical simulations have been shown that smoke particles observed over Arctic must be considered extreme with a significant impact on energy budget. The mean surface, TOA, and atmosphere RF averaged for latitudes above 75.5°N were -13.1, 0.3, and 13.4 W/m^2 for clear-sky and -7.3, 5.0, and 12.3 W/m^2 for all sky respectively. Data averaged over Svalbard region (5-30°E, 74-83°N) shows stronger negative RF at the surface (-24.1 and -10.3 W/m^2 for clear and all-sky condition) and also negative value at TOA for clear-sky (-9.9 W/m^2) while positive (3.3 W/m^2) for real clouds. On another hand over the Central Alaska (source region of biomass burning) both surface and TOA clear and all-sky RF are strongly negative. Positive TOA RF in the Arctic is mostly related to bright surface albedo (for clear sky) aerosol high altitude (for all sky).

O 147 MACC MODEL BASED LONG-TERM COMPARISON OF ARCTIC AOD EVENTS AGAINST GENERAL CIRCULATION PATTERNS

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It has been recognized, that a considerable long-range transport of anthropogenic aerosols from various sources to the Arctic takes place in winter and spring. In the past decade the occurrence of the Arctic Haze became weaker, less frequent due to changes in meteorological patterns, but last year's observations of air pollution revealed a very strong biomass burning event that was found to be more important than typical early spring Haze events.

In this work we present the MACC model dataset based on aerosol optical properties calculated for two Spitsbergen stations, Ny-Ålesund and Hornsund, for a period between 2010 and 2015.

We focus on Arctic Aerosol Optical Depth, were we found a slightly decreasing trend in AOD over the study period, leading to the alteration of the state of polar atmosphere. Potential differences observed between stations are not statistically significant. We also do not observe significant differences in chemical composition. Our goal is to focus on variability of special events in the Arctic, and compare them with the annual cycle. Model is surprisingly good in reproducing AOD, what we can conclude from a very strong Biomass Burning event in Canada in 2015, which produced smoke plumes, with range reaching Spitsbergen. Other in-situ measurements show a multiple increase in mean values of Black Carbon fraction.

Moreover, our findings are compared and discussed with the results reported by Stock (et al. 2014) to understand derivations of aerosol load over both sites. We want to show the correlation between general circulation patterns based on increasing and changeable AOD behavior. This work includes the period 1995-2008 with clear atmospheric conditions, with only a few cases of known origin being omitted. These patterns will be used to correlate the events with the aerosols source, and thus explain some small differences between stations in Ny-Ålesund and Hornsund.

O 095 AEROSOL IN HIGH ALTITUDE RUSSIAN ARCTIC

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Aerosol serves as a tracer of arctic pollution and allows a link to climate response when its major characteristics relating to natural and anthropogeneous sources are defined. Long - time gap in consistent aerosol observations in the Russian Arctic strongly limited the assessment of air pollution and climate impacts. The International Hydrometeorological Observatory Tiksi was established on the coast of Laptev sea through an cooperation during the International Polar Year. Modern research station "Cape Baranova" was built on archipelago Severnaya Zemlia for the long-term atmospheric and ice observations. Aerosol stations were installed to carry out on-line monitoring, sampling, and analyses of atmospheric aerosols from 2014. Physico-chemical characterization combining aethalometry, analytical chemistry, and individual particle analyses is used in order to identify the seasonal variability of aerosols and link their composition to possible sources, as well as to characterize the differences in aerosol chemical composition between natural background conditions and BC-pollution episodes.

The present study reports the first results from the HMO Tiksi and station "Cape Baranova" on season-dependent and source-influenced characteristics of aerosol species supported by individual particle analysis. Aerosol is found to be originated from natural marine and biogenic as well as influenced by regional pollution from the continent. Characterization of aerosols during pollution episodes, combined with analysis of the wind direction, atmosphere stability, and air mass trajectories, allows for the identification of the sources which are responsible for the emission of hazardous compounds. It is occurred to catch the plumes transported from industrialized regions of Siberia thus proving that anthropogenic sources, probably gas flaring, pollute high altitude.

O 112 AN INTENSE BIOMASS BURNING EVENT IN THE ARCTIC: HYGROSCOPIC AND RADIATIVE PROPERTIES

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In July 2015 an intense event of biomass burning aerosol from North America appeared in the European Arctic. On 10 July several layers with very strong aerosol backscatter have been found, predominantly below 3.5km altitude. By comparing contemporary data from a "3+2" Raman-Lidar and a radiosonde in a layer in the free troposphere in which the relative humidity rose from about 50% to more than 90% the hygroscopicity of the aerosol could be estimated by calculation of the color ratio and lidar ratio from the lidar data. Only a clear hygroscopic growth above 80% relative humidity was found. This will be discussed, together with the meteorological situation in which the aerosol arrived above our station in Ny-Ålesund, Spitsbergen. Further, the radiative forcing of this aerosol event could be calculated by comparing the measured surface radiation on the site with the AOD of a sun-photometer for the event day and clear background conditions. Next to a strong decrease of direct radiation also an increase of diffuse radiation was found. This diffuse radiation must be considered when photometers with small field-of-view are compared to hemispheric radiation sensors. It was found that radiative forcing and the aerosol modification factor are smaller than expected from the Lambert's law and the photometer data. Only a combination of the Lambertian extinction with a contribution of multiple scattering explained the observed relation between forcing and the AOD.

O 111 SHIP-BASED OBSERVATIONS OF ATMOSPHERIC BLACK CARBON PARTICLES OVER THE ARCTIC OCEAN: COMPARISONS WITH REGIONAL CHEMICAL TRANSPORT MODEL SIMULATIONS

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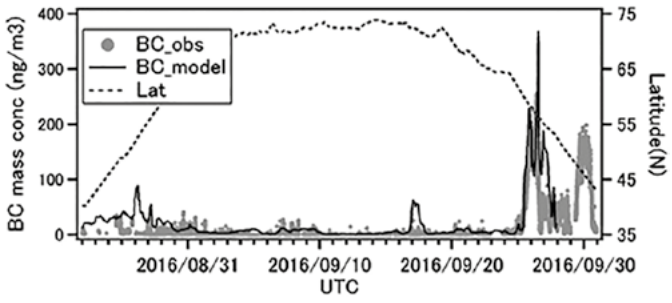
Black carbon (BC), formed through the incomplete combustion of fossil fuels, biofuels, and biomass, is a major component of light-absorbing particulate matter in the atmosphere, causing positive radiative forcing. Also, BC deposition on the surface reduces the Earth's albedo and accelerates snow/ice melting by absorbing the sunlight. Therefore, the impact of BC on the Arctic climate needs to be assessed; however, observational information has been still insufficient. Over the Arctic Ocean, we have been conducting ship-based BC observations using a single particle soot photometer (SP2) on *R/V* Mirai every year since 2014. To estimate the transport pathways of BC, we have also conducted model simulations during the period of cruise using a regional transport model (WRF-Chem 3.8.1). Initial and lateral boundary conditions for the meteorological field were taken from NCEP GFS analysis, and anthropogenic and biomass burning emissions were based on EDGAR 4.2 and the near-real-time version of FINN, respectively.

Figure 1 shows temporal variations in the BC mass concentrations along the ship track during the arctic cruise in 2016. The variations in the observed concentrations, after eliminating data influenced by ship exhaust, were qualitatively well reproduced by the regional chemical transport model. Quantitatively, however, the model tended to overestimate the BC levels, suggesting the possibilities that the emission rates were overestimated and/or the removal rates were underestimated. The observed average mass concentration during 2016 was 0.8 ng/m^3 in >70N°, similar to the levels (~1.0ng/m^3) recorded during our previous observations in the Arctic during 2014 and 2015. We will present further analysis on the size distribution, coating, and possible sources.

Fig 1:



O 187 WARM-AIR ADVECTION AND CLOUDS OVER MELTING ARCTIC SUMMER SEA ICE

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Over the last decade or more, the influence of anomalous advection of heat and moisture into the Arctic from the south has been discussed and argued; however, very few studies have been based on observations and the focus has mainly been on winter. In summer a very special situation is set up by the fact that the ice and snow on surface of the ice, is melting, constraining the surface temperature to near the melting point. When warm and moist air is advected in over the ice, this leads to the formation of very strong surface inversions; in these inversions the relatively high moisture often leads to formation of fog, while partial turbulent decoupling at the MIZ often leads to formation of low-level jets. This leads to a competition between several factors and the vertical structure of the PBL and hence the thermodynamic forcing of the fog and the inversion from turbulence and radiation is determined by the balance of these factors.

In this presentation we will present an analysis of these processes using observations from the Arctic Clouds in Summer Experiment (ACSE), conducted as a part of the SWERUS-C3 expedition on board the Swedish icebreaker Oden, in summer/autumn 2014 traversing across the Arctic from Tromsö, Norway, to Barrow, Alaska, in July and August, and back again in late August and September arriving back in Tromsö early October. The observations include a suite of remote sensing instruments (W-band cloud radar, 449 MHz wind profiler, scanning microwave radiometers as well as a 3D scanning lidar and several ceilometer lidars, etc.) as well as in-situ instruments (radiosoundings, weather station, IR surface temperature and broad-band incoming short- and longwave radiation, as well as eddy-covariance turbulent fluxes).

O 096 AEROSOL CHEMICAL COMPOSITION AT NY ALESUND (SVALBARD ISLANDS): A FOCUS ON ELEMENTAL AND ORGANIC CARBON

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During polar sunrise, the Arctic troposphere is a unique chemical reactor, being affected by emissions both from human activity in the mid/high latitude areas and from natural sources in the Arctic Ocean. Moreover, light-induced chemical reactions occurring in this season cause changes in atmospheric composition. The synergistic effect of meteorological patterns and extreme variations in solar irradiance starting in spring make difficult to disentangle the factors of the production and removal of many environmentally relevant chemical compounds.

At this purpose, daily PM10 and size-segregated (by 4-stage impactor) aerosol samples were continuously collected at Gruvebadet station (Ny Ålesund, Svalbard Islands, 78.9°N, 11.9°E) during the spring-summer period (March-September) along six consecutive years (2010-2015) and were analyzed for ion, metal and EC/OC (Elemental/Organic carbon) content.

Here we focus on the Elemental and Organic fraction of the aerosol and on selected organic anions (e.g. oxalate, formate, glycolate), because of their importance in the absorption of solar radiation (EC) and their sensitivity to oxidation processes and to the atmospheric production/consumption triggered and/or mediated by solar radiation (organic compounds). Organic anions usually show very low concentrations in all the years, with the exception of oxalate, which is always dominant among the organic anions.

The temporal trends of the measured compounds is studied in comparison both with the broad band UV solar irradiance data in order to evaluate the effect of the photochemistry on the studied compound, and with the size distribution data in the nm-range, in order to check a possible relationship between nucleation events and the concentration of species potentially contributing to new-particle formation such as nitric and organic acids.

Moreover, correlations among different chemical markers are studied, together with backtrajectory analysis, in order to spot the long-range transport events delivering these compounds together with pollutants from the anthropized areas of the Northern hemisphere.

O 114 VERTICAL PROFILES OF AEROSOL OPTICAL PROPERTIES IN THE ARCTIC

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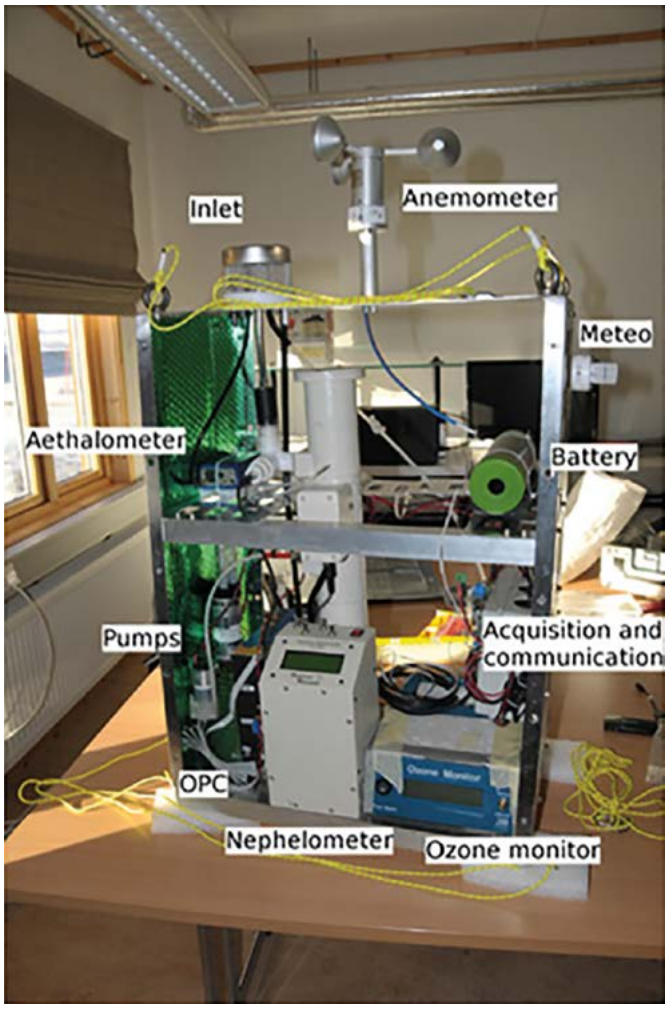
A novel airborne gondola has been developed to profile the Arctic boundary layer using a tethered balloon system. The instrumented gondola AGAP (Atmospheric Gondola for Aerosol Profiling) has been designed and realized in Italy during summer 2014. The aerosol instrumentation includes a Radiance Research nephelometer M903, an AethLabs AE51 micro-aethalometer, an OPC produced by FAI instruments and an ozone monitor 2B Technologies, besides meteorological sensors (Figure 1). Three measurements campaigns were performed with this setup: the first during fall (8-29 September 2014) while the other two during spring (7 April-8 May 2015 and 3-28 April 2016). As we write, a new campaign is planned for March 2017 with a longer rope (2 km). Thirty-five profiles were obtained during the first campaign, 43 during the second and 40 during the third one. Aerosol profile measurements were carried out from outside the Gruvebadet laboratory, where many in-situ aerosol sampling are continuously carried out, by means of a helium-filled tethered balloon (50 m3, Figure 2). An electric winch controls the balloon ascent/descent rate which is typically set at 30 m min-1. The temporal resolution of the measurements varies between 1 s for aerosol scattering coefficient and meteorological parameters, 6 s for the size distribution, 10 s for ozone concentration and 1 minute for BC . This determines the vertical resolution of the experiments which is 0.5 m for aerosol scattering coefficient and meteorological parameters, 3 m for the aerosol size distribution, 5 m for ozone concentration and 30 m for the BC concentration.

We demonstrates for the first time on a tethered balloon the capability of measuring at the same time aerosol light scattering and absorption coefficients and size distribution, which is very promising for deducing the aerosol (and potentially cloud) optical properties, as a function of height along the atmospheric column.



O 186 ARCTIC CLOUD STUDY AT NY-ÅLESUND, SVALBARD IN GRENE ARCTIC CLIMATE CHANGE RESEARCH PROJECT

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Cloud is one of the main processes in the climate system and especially a large feed back agent for Arctic warming amplification (Yoshimori et al., 2014). However, its behavior is still uncertain and especially the role of low level and mixed phased clouds are to be clarified. From this reason, observation of polar cloud has been emphasized and 95 GHz cloud profiling radar in high precision was established at Ny-Ålesund, Svalbard in 2013 as one of the basic infrastructure in the GRENE (Green Network of Excellence Program) Arctic Climate Change Research Project (2011-2016). The radar, "FALCON-A", is a FM-CW (frequency modulated continuous wave) Doppler radar, composed of smaller parabolic antennas separated 1.4 m from each other. Polarized Micro-Pulse Lidar (PMPL), which is capable to measure the backscatter and depolarization ratio, has also been deployed to Ny-Ålesund, and operated to perform collocated measurements with FALCON-A. Synergetic analyses of cloud macro- and micro-physics, such as cloud vertical profile, effective radius of particles and ice/liquid water contents are made with the algorithm based on Okamoto's originally developed for satellite cloud profiling radar and lidar (Okamoto et al., 2010). From the comparison with collocated satellite path, good agreements were shown with the radar reflectivity by CloudSAT CPR including some differences due to the different vertical resolution. Aquisition data are to be archived on "Arctic Data archive System (ADS)" and opened.

Analyses of cloud observations and radiation are to be made referenced to the climate condition at Ny-Ålesund, for two typical condition under warm maritime air and cold Arctic air. In winter, warming is pronounced in the recent, together with the increasing frequency of southerly winds (Maturilli & Kayser., 2016) which bring humid air form the Atlantic. We are also planning to establish Ny-Ålesund observatory as the validation site for EarthCARE (JAXA-ESA) mission.

P 021 ICP-MS DETERMINATION OF RARE EARTH ELEMENTS IN POLAR AEROSOL AS SPECIFIC GEOCHEMICAL MARKERS OF NATURAL AEROSOL SOURCE AREAS

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Metals and Rare Earth Elements (REEs) in the aerosol have conservative properties from the formation to the deposition and can be useful to identify and quantify their natural and anthropic sources and to study the atmospheric transport processes. In spite of their importance, relatively little is known about metals and especially REEs in the Artic atmosphere due to their low concentration in such environment. The present work reports the first attempt to quantify and interpret the behavior of REEs in polar aerosol at high temporal resolution. Daily PM_{10} samples of Arctic atmospheric particulate have been collected on Teflon filters, during six spring-summer campaigns, since 2010, in a ground-level laboratory in Ny Ålesund (78°56' N, 11°56' E, Svalbard Islands, Norway). A suitable method for the quantification of trace and ultra-trace metals in very low concentration in daily Arctic aerosol samples was developed using an Inductively Coupled Plasma Mass Spectrometer equipped with a desolvation nebulizer inlet system, allowing to reduce isobaric interferences. Rare Earth Elements (often in the ppt range) can be considered as soil's fingerprints of the particulate matter source areas and their determination, together with air-mass backtrajectory analysis, allows to link geochemical areas to specific REEs profile and ratios of the aerosol reaching the Arctic. The identification of mineral aerosol source areas is then useful in order to study the transport processes of anthropogenic particulate matter from industrialized areas of the Northern hemisphere. Moreover, the observed seasonal trends give detailed information about the different impact on the Arctic during the year of natural and anthropic emissions driven by phenomena such as the Arctic Haze and the melting of the snow.

P 020 BLACK CARBON IN SVALBARD SNOW AND ICE: WHAT DID WE LEARN AND WHAT ARE THE NEXT CHALLENGES?

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Black Carbon (BC) is originated from combustion of fossil fuel and biomass burning. In Svalbard, several groups have been focusing on the effect of BC on climate, but we still lack understanding of the role BC plays within climate processes. BC reduces the albedo of snow, but the link between snow physical properties and BC concentration is still poorly described. The origin of BC particles is a large uncertainty, particularly in Svalbard due to its different atmospheric sources. The type of BC that is emitted, whether from traffic, flaring, forest fires or industrial sources have different properties and therefore aging in the atmosphere. Sources will determine the ability of BC particles to be or not to be transported to the Arctic, and even less known, its scavenging properties and interaction with clouds. Considering the current Arctic warming with the potential increase of mixed phase clouds will certainly affect the scavenging properties of BC, and aerosols in general. Modeling BC concentration and deposition in snow has been complicated, probably due to the lack of dedicated project focusing on linking both BC modeling, sampling and variability in snow.

During the last decade, we have been monitoring the BC in snow surface at Ny-Ålesund and we also extracted two shallow ice cores from a nearby site (40 km). Unexpected BC trends have been measured and reasons are not yet fully determined. We will present our last results from this work combining snow and ice core BC content together with model outputs using different sources type of BC. We hope to open the discussion to a larger group in order to create a better communication and collaboration on the BC issues in the Arctic, a large climate forcer whose positive forcing is very uncertain and is still causing of a large scientific debate.

P 022 THE INFLUENCE OF SYNOPTIC CONDITIONS ON SELECTED METEOROLOGICAL VARIABLES IN A PETUNIABUKTA BAY (SVALBARD) IN 2016

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The aim of the project is to present the results of studies of the meteorological and bioclimatic conditions for the area of western part of the Petuniabukta bay (Svalbard) in July and August 2016. The report is based on observational data, which were carried out near the Adam Mickiewicz Polar Station in Petuniabukta bay (Svalbard). The data contain information about air temperature, relative humidity, atmospheric pressure, cloudiness and type of clouds. Measurements and observations were performed every 3 hours at 5 measuring points. They were located in horizontal profile from the west coast of the Petuniabukta Bay to the Pyramiden hill (height difference between successive measurement points is about 200 meters).

In the measurements, air temperature and relative humidity HOBO Prov2 recorders were used. Regarding the impact of synoptic conditions on the values of the individual meteorological elements, the classification of types of weather was based on the typology by Kozłowska-Szczęsna (1997). In terms of the meteorological parameters, the basic statistical measures were calculated. The project analyzes the average daily mileages according to the radiation types of weather, medium and classical nonradiation conditions (overcast and high wind speed).

P 023 IMPACT OF LARGE BIOMASS BURNING EVENT ON RADIATIVE FORCING IN HIGH LATITUDE REGION (NY-ALESUND, SPITSBERGEN)

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The aim of the research was to study the impact of layers containing absorbing aerosol on radiative transfer over Arctic region. Thus, the strong biomass burning event occurring on 10-14 July 2015 over Spitsbergen was chosen for the simulations due to its exceptional impact on the optical properties observed in Ny-Alesund, Spitsbergen. Aerosol optical depth, scattering and absorbing coefficients were measured on the level of 1.2, 145 Mm^{-1} and 10 Mm^{-1} respectively exceeding mean summer values with a factor of more than 10.

Aiming to study different aspects of the event we ran three models: Modtran (MODerate resolution atmospheric TRANsmission), 3D Monte Carlo and Fu-Liou taking into account the possibilities of the models and computing power. In particular, we focused on radiative transfer calculations with respect to the impact of the vertical structure of aerosol single-scattering properties, 3D effects as well as time and spatial distribution respectively. For the simulations of the first two models we implemented extinction profiles (532nm) from Koldeway Aerosol Raman Lidar (KARL), meteorological data profiles from radiosounding and single-scattering properties measured by in-situ instruments. Regarding Fu-Liou simulations, also satellite data (Terra & Aqua) combined with NAAPS results were implemented into model.

The mean value of short-wave instantaneous radiative forcing (RF) on 10-12 July 2015 over Ny-Alesund, Spitsbergen was estimated on the level of -83W/m^2 (Modtran) and -67W/m^2 (Fu-Liou) for clear sky simulations with respect to the RF measured by radiometers (-71W/m^2). Although the values were very high in Ny-Alesund, the main part of the biomass burning plume was located west from Spitsbergen, however, the existence of clouds weakened the RF effect. Finally, 3D Monte Carlo computations revealed some local effects due to topography and the albedo distribution within the vicinity of Ny-Alesund Valley.

P 024 IMPACT OF AEROSOLS ON CHEMISTRY OF SNOW COVER IN HORNSUND AND NY-ÅLESUND, AT CONDITIONS WITH HIGH ATMOSPHERIC POLLUTION

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European Arctic lies within the range of air pollution transported from industrial areas of Eurasia and North America. Due to poor network of monitoring stations, information available about the air quality and contaminants deposition in the Arctic environment is limited. For this reason, data on seasonal snow cover is an important source of information.

In early May 2006 a high pollution event was recorded in Hornsund and Ny-Ålesund (Svalbard). Anthropogenic haze was an effect of rapid transport of Biomass Burning aerosols (smoke) from agricultural fires in Eastern Europe. We want to present the results from chemical analysis of fresh snowfall, and how the atmospheric boundary layer impacts hydrochemical processes and the transformation of atmospheric precipitation and deposits.

The chemical properties of precipitation and snow cover have been monitored at the Hornsund Polish Polar Station, Spitsbergen. The chemistry of fresh snow and the properties of snow cover were monitored in the altitudinal profile of the Hansbreen Glacier. Meteorological data from the coastal stations (Hornsund and Ny-Ålesund) and from the glacier helped to examine, the impact of atmospheric processes on the snow cover contamination. An episode with extremely acidic precipitation was recognized in snow cover analyzed in spring 2006. A source area of pollution and type of synoptic situation which enhanced transfer of pollution to the European Arctic were identified. Conditions in atmosphere were also identified based on in-situ measurements by AERONET database and Karl lidar. Also MACC model reanalysis was used to compare how the constituents of aerosols spread over two locations: Ny-Ålesund and Hornsund with results of chemistry on the ground.

P 025 CROSS-POLAR TRANSPORT AND SCAVENGING OF SIBERIAN AEROSOLS CONTAINING BLACK CARBON DURING THE 2012 ACCESS SUMMER CAMPAIGN

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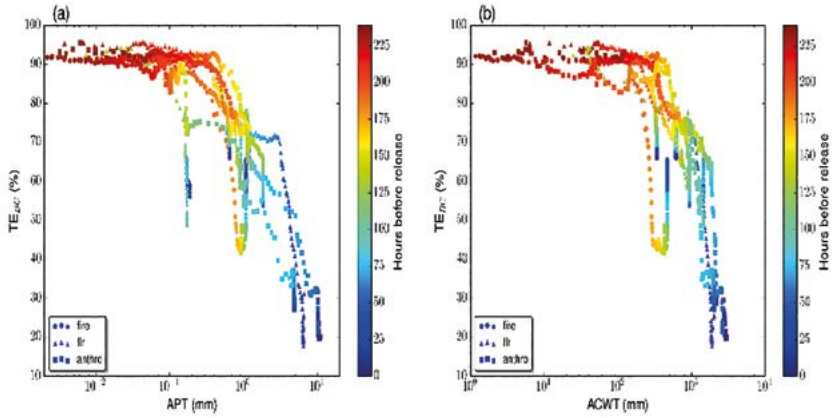
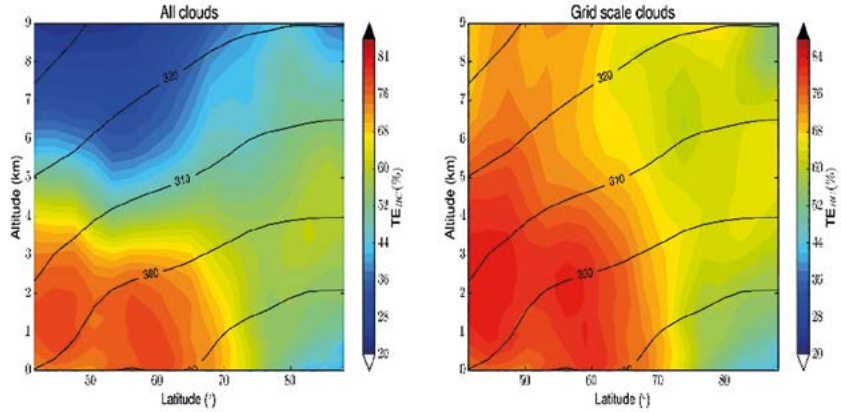
During the ACCESS airborne campaign in July 2012, extensive boreal forest fires resulted in significant aerosol transport to the Arctic. A 10 day episode combining intense biomass burning over Siberia and low-pressure systems over the Arctic Ocean resulted in efficient transport of plumes containing black carbon (BC) towards the Arctic, mostly in the upper troposphere. A combination of in situ airborne observations, satellite analysis and WRF-Chem simulations are used to understand the vertical and horizontal transport mechanisms of BC with a focus on the role of wet removal.

During transport to the Arctic region, a large fraction of BC particles are scavenged by two wet deposition processes, namely wet removal by large-scale precipitation and removal in wet convective updrafts, with both processes contributing almost equally to the total accumulated deposition of BC. Our results underline that applying a finer horizontal resolution (40 vs 100km) improves the model performance, as it significantly reduces the overestimation of BC levels observed at a coarser resolution in the mid-troposphere. According to the simulations at 40km, the transport efficiency of BC (TEBC) in biomass burning plumes is about 60%, which is impacted by small accumulated precipitation along trajectory (APT) (1mm). In contrast TEBC is very small (<30%) and APT is larger (5-10 mm) in plumes influenced by urban anthropogenic sources and flaring activities in Northern Russia, resulting in transport to lower altitudes.



TEBC due to grid scale precipitation is responsible for a sharp meridional gradient in the distribution of BC concentrations. Wet removal in subgrid parameterized clouds (cumuli) is the cause of modeled vertical gradient of TEBC , especially in the mid-latitudes, reflecting the distribution of convective precipitation, but is dominated in the Arctic region by the grid-scale wet removal associated with the formation of stratocumulus clouds in the PBL that produced frequent drizzle.



P 027 SULFATE SOURCE APPORTIONMENT IN THE ARCTIC AEROSOL

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PM10 aerosol samples were collected at daily resolution at the Gruvebadet observatory, Ny-Ålesund (Svalbard Islands), during the spring-summer Italian Arctic Campaigns from 2010 to 2015. Samples were analysed for ion (inorganic anions and cations, selected organic anions) composition aiming to evaluate the seasonal pattern of sulfate, as a key component of the Arctic haze. Ionic balances indicated a strong sulfate seasonality with mean spring concentration about 1.5 times higher than that measured in summer. The spring and summer aerosol was almost neutral, indicating that ammonia was the major neutralizing agent for atmospheric acidic species. The linear regression between sulfate from potential acidic sources (non-sea salt sulfate and non-crustal sulfate) and ammonium indicated that the mean sulfate/ammonium ratio was intermediate between semi (NH4HSO4) and complete ((NH4)2SO4) neutralization. Using sea-salt sodium as sea-spray marker, non-sea-salt calcium as crustal marker and methanesulfonic acid as biogenic marker, a detailed source apportionment for sulfate was carried out. The anthropogenic input (calculated as the differences between total sulfate and the sum of sea-salt, crustal and biogenic contributes) was found to be the most relevant contribution to the sulfate budget in the Ny-Ålesund aerosol in summer and, especially, in spring. In this last season, anthropogenic sources accounted for about 75 % of the total sulphate budget.

P 029 BACTERIAL COMMUNITIES IN MARINE AEROSOLS REVEALED BY 454 PYROSEQUENCING OF THE 16S RRNA GENE

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Although bacteria are an important biological component of aerosol particles, studies of bacterial communitiesin remote marine aerosol are largely lacking. In this study, aerosol samples were collected over thewestern Pacific Ocean, the northern Pacific Ocean, the Arctic Ocean, and the Norwegian Sea during the FifthChinese National Arctic Research Expedition (CHINARE 5). The diversity and structure of aerosol bacterialcommunities, based on 454 pyrosequencing, were explored in these samples. The bacterial community in theaerosols collected over the Pacific Ocean was more diverse

than over the Norwegian Sea. Both temporal andspatial variations in aerosol bacterial communities were observed based on phylogenetic analysis. Theseresults suggest that the source of air masses shape bacterial communities in aerosol particles over remotemarine regions. Aerosols are clearly important for long-range transport of bacteria. Since potential humanpathogens (e.g., Streptococcus sp.) were retrieved in this study, further investigation is needed to evaluate thepotential for their long-distance migration via aerosol.

P 030 DEPENDENCY OF ICE-CLOUD ON CLOUD BASE TEMPERATURE WITH THE POLARIZED MICRO-PULSE LIDAR OVER NY-ALESUND

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Cloud is one of the important factor to affect on the surface energy budget. Polarized micro-pulse lidar (PMPL) is useful instrument to retrieve information of cloud particle phase by receiving polarization. We started polarization measurements with PMPL (SigmaSpace MPL-4B-IDS-532) at NyAlesund (78°56'N, 11°52', 40m a.s.l.; Figure 1), Svalbard in 2013. In this study, we estimated the dependency of cloud base temperature (CBT) for ice cloud.

The data of PMPL is used from May, 2014 to December, 2015, which period is continuously observed except for the middle of September to the middle of December, 2015. The range resolutions are 30 m for the data from 5 December 2014 to 6 March 2015 and 15 m for other observation period. Data are acquired every 1 minute. In this study, vertical and time resolutions are smoothed for 90 m and 15 minutes, respectively. To retrieve CBT, vertical profiles of temperature observed by radiosonde are used. Radiosonde observation at Ny-Alesund is operated by the AWIPEV on-site staff at 11 UTC. To obtain CBT, temperature is interpolated by radiosonde data to adjust lidar temporal resolution. Cloud phase is classified by depolarization ratio (Δ).

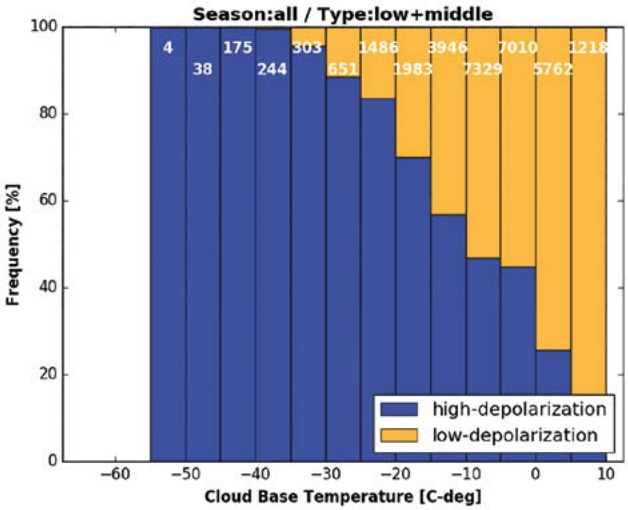
Figure 2 shows the frequencies depending on CBT for low and middle cloud (CBH <6km). For low and middle cloud, frequency of cloud appearance with bottom of ice (high Δ) increases with decreasing CBT. The ratio of water (low Δ) cloud is smaller than half (50 %) with CBT below -10°C and smaller than 5 % below -30°C. The dependency of ice cloud on temperature is similar to the result at Barrow, Alaska (Shupe, 2011).

Figure 1. Location.

Figure 2. Frequencies of CBT for low-middle over Ny-Alesund. Numbers at top are retrieval frequencies.

References

Shupe, M. D. (2011). Clouds at Arctic atmospheric observatories. Part II: Thermodynamic phase characteristics. Journal of Applied Meteorology and Climatology, 50(3), 645-661.



S04 HEMISPHERIC AND REGIONAL ATMOSPHERIC IMPACTS OF A RAPIDLY CHANGING ARCTIC CLIMATE

KL 03 AIR-SEA FLUX CHARACTERISTICS CLOSE TO THE SEA-ICE EDGE DURING COLD AIR OUTBREAKS

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Cold Air Outbreaks (CAOs) are associated with large heat fluxes from the ocean surface to the atmosphere close to the sea-ice edge. Due to the strong air-sea interaction and its implications for the coupled ocean - sea-ice - atmosphere system, the accurate and consistent simulation of CAOs is crucial for weather and climate prediction models.

In this study, we compare specific CAO events, defined by a CAO indicator for the winter season 2015/2016, in high-resolution forecasts with a range of coarser resolution global prediction systems, such as ECMWF's medium range integrated forecasting system, as well as ECMWF's ensemble prediction and reanalysis systems. The high-resolution data is based on hindcasts of a novel operational convective-scale (2.5 km resolution) atmospheric prediction system for the European Arctic (AROMEArctic). This system is in operation since November 2015, providing short-term atmospheric forecasts and assimilating various conventional and satellite observations every 3 hours.

The goal of this study is to give an overview of the consistency between the models in simulating air-sea flux characteristics, dependent on their respective spatial resolutions and coupling strategies. Specifically, we will show to which extend the models consistently represent integral fluxes over certain areas and will discuss the spectral characteristics of air-sea interactions.

KL 02 CHANGES IN ARCTIC SEA ICE DRIFT SPEED AND CIRCULATION WITH A FOCUS ON RECENT YEARS

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Air temperatures in the Arctic are increasing twice as fast as the global mean. As a consequence, the sea ice extent in the Arctic is declining (4%/decade). In summer the decline is strongest. In conjunction also ice thickness, volume, and age decrease while ice drift speed and melt season length increase.

Here we present an update on changes in sea ice drift speed and circulation from satellite remote sensing observations. Both buoy observations and satellite microwave radiometer based sea ice speed estimates show a strong increase in Arctic sea ice drift speed for the period 1979-2007 and 1992-2009, respectively. From the satellite data the strongest ice speed increase is observed after 2004. Changes in wind speed cannot explain the ice drift speed increase overall and thinning of the sea ice is identified as the main driver for these ice speed changes.

Analysis of sea ice speed data from satellites from September to May (winter) for the ten years 2007 to 2016 show that the ice speed stays on a high level for these years but only increases slightly for the complete Arctic Basin during this period. There is, however, strong spatial variability in the speed trend pattern (Figure 1). The winter ice speed and circulation in the Beaufort Gyre continues to increase, which hints to a further accumulation of freshwater. As well does the ice speed in the Laptev Sea and north of it increase, while the ice speed in the East Siberian Sea and north of Greenland decreased.

The changes will be discussed in context with changes of atmospheric forcing, i.e., wind speed and pressure.

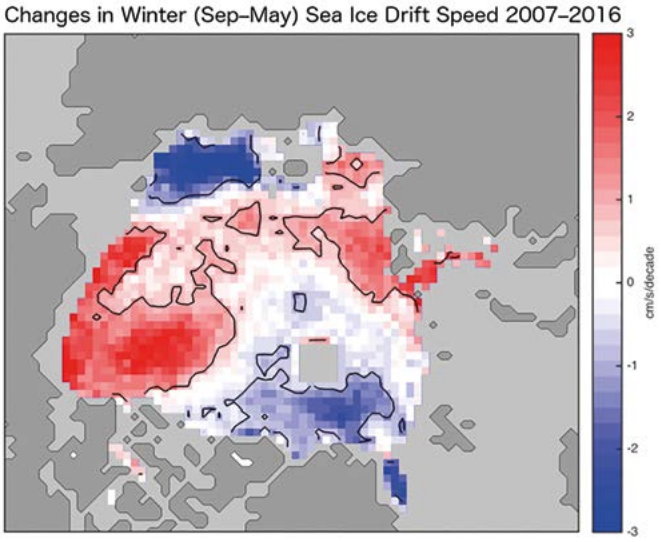

Figure 1: Sea ice drift speed trends (Sep-May) from satellite ice motion for 2007-2016. Statistically significant trends are inside the black contour ($p > 0.99$).

O 051 GASEOUS AND FREELY-DISSOLVED PAHS FROM THE NORTH PACIFIC TO THE ARCTIC BASED ON PASSIVE SAMPLING: SPATIAL TRENDS AND AIR-WATER EXCHANGE

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Polycyclic aromatic hydrocarbons (PAHs) have accumulated ubiquitously in the Arctic environments, but their fate under climate change is controversial. Polyethylene passive sampling was performed to quantify gaseous and freely dissolved PAHs in air and surface water from the North Pacific to the Arctic Ocean along the cruise track of the 6th Chinese National Arctic Research Expedition in summer 2014. Freely dissolved aqueous concentrations of PAHs were dominated by fluoranthene and phenanthrene. These were also the dominant PAHs in the gas phase. And both the concentrations of gaseous and dissolved PAHs showed a generally decreasing trend with increasing latitude. Air-water exchange flux indicated that PAHs are mostly undergoing net volatilization in Bering Sea and the Arctic Ocean, while an air-to-water PAHs flux calculated by level III fugacity model was shown in Bering Sea in the summer of 2010. The abnormally high pressure in the Bering Basin during May to July in 2014 made the basin area dominated by south wind, leading to the continuous warm Pacific Ocean current with higher PAHs flowing into the Bering Sea, which might account for the net volatilization of PAHs in the Arctic. Based on characteristic PAH ratios, gaseous and freely dissolved PAHs at most sites originated from the combustion of fossil or biomass fuels.

O 050 THE ATMOSPHERIC BOUNDARY LAYER RESPONSE TO THE DYNAMIC NEW ARCTIC OCEAN DURING FALL

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The increasing surface air temperatures and ice-free area in the Arctic Ocean has transformed its climate system to one with more dynamic boundary layer and clouds. During fall, the open ocean surface sensible heat flux (SSHF) may be crucial for the loss of excessive heat to the atmosphere. In fact, it has been speculated to play an important role in the recently observed cloud cover increase and boundary layer (BL) instability in the Beaufort and Chukchi seas. Based on multi-year Japanese cruise ship observations from the ice-strengthened R/V Mirai, we are able to characterize the late summer and early fall SSHF-BL interactions in this region. The BL over the ice-free ocean is found to be well-mixed more than 90% of the time, with increasing values of maximum depth observed in recent years. The SSHF, however, can explain only ~10% of the BL height variability, contributing more significantly to turbulent mixing during conditions of uplift (low-pressure) and strong surface wind speeds. Similar to past observations (SHEBA, ASCOS) over sea ice, it appears that BL mixing is more likely dominated by cloud-generated convective turbulence (resulting from moist adiabatic and radiative processes). The efficiency of sensible heat exchange is not particularly sensitive to the ocean-atmosphere temperature difference (ΔT). It is low during the cold stratocumulus cloud regime, despite observations of enhanced ΔT and deeper mixed layer heights. It is possible that stratocumulus clouds and the deep stratocumulus-topped boundary layer are caused by frontal dynamics (for example, cold air advection across the marginal sea ice zone). Our analysis suggests that the local boundary layer response to the loss of sea ice cover is not straightforward, but strongly influenced by variability in the large-scale circulation (winds, clouds, etc.).

O 048 ANALYSIS OF ARCTIC WIND EXTREMES USING HIGH-RESOLUTION REGIONAL CLIMATE SIMULATIONS

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Simulations using the regional climate model COSMO-CLM at a horizontal resolution of 15 km (C15) are analysed for the Arctic with respect to extreme values of the 10-m wind speed. Results are compared to ERA-Interim (ERA-I), the Arctic System Reanalysis (ASR) data set, the CCMP data set and measurement stations for the winter periods 2002/03-2011/12 (Nov.-Apr.). The results of applied extreme indices and return levels (RLs) estimated by the 'peaksover-threshold' (POT) method show that wind speed extremes increase with increasing horizontal resolution. The most extreme winds occur over the ocean off the south and southeastern coast of Greenland. In this area wind speeds of hurricane force occur on about 4 days a year and 40m/s is calculated as the 10-year return level. ERA-I is found to underestimate extreme winds considerably.

O 017 INFLUENCE OF WINTER WEATHER ON SUMMER SEA ICE COVER IN THE ARCTIC

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This study examines the relationship between the winter wind field and summer ice cover by using daily data of the ice concentration and ice motion derived from satellite microwave sensors AMSR-E and AMSR2. The summer Arctic ice cover has a large interannual variability. One possible cause of the interannual difference is the ice thickness difference in spring before the start of melting. Spring ice thickness is controlled by the winter ice movement and ice divergence/convergence. In the divergence area, formation of leads and polynyas promotes new ice production and results in higher fraction of thin ice. Conversely ice convergence promotes dynamic deformation and accompanied thickening of sea ice. For example of the Barents and Laptev Seas, offshore/inshore anomaly of the winter ice motion and wind field in each sea leads lower/higher summer ice concentration. Based on this relationship, we can predict the summer ice cover in spring by analyzing the winter ice motion or wind field. This forecast looking several months ahead is useful for human activity in the Arctic.

O 049 A MODEL-BASED CLIMATOLOGY OF WINTERTIME LOW-LEVEL JETS IN THE NARES STRAIT

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Analyses of the wintertime low level jets in the Nares Strait are presented based on 13yr of wintertime simulations (Nov-Apr, 2002/2003-2014/2015) from the atmospheric regional climate model COSMO-CLM. COSMO-CLM simulations have a high resolution of 15km, which is necessary to resolve the Nares Strait, a small channel, bounded by steep topography of Ellesmere Island and Greenland.

The topography of the Nares Strait provides a good environment for orographic channeling effects that are coupled with a strong pressure gradient from Lincoln Sea to Baffin Bay. The channeling causes the formation of low-level jets with high near-surface winds. 10m winds in winter are found to reach speeds with monthly means of up to 19 m/s. The maximum wind is located in the southern part of Smith Sound at the opening to Baffin Bay, influenced by the gap flow effect. In the same region the North Water Polynya forms regularly, suggesting that the intensified winds enhance the polynya formation. Wind events stronger than 20 m/s occur in average almost once a week during winter with high interannual variability from 11 to 44 events per winter. In comparison, the Arctic System Reanalysis data (2000-2012) show that 30km resolution does not capture the maximum locations and magnitudes.

O 080 TRENDS IN ENERGY FLOWS THROUGH THE ARCTIC CLIMATE SYSTEM 2000–2016

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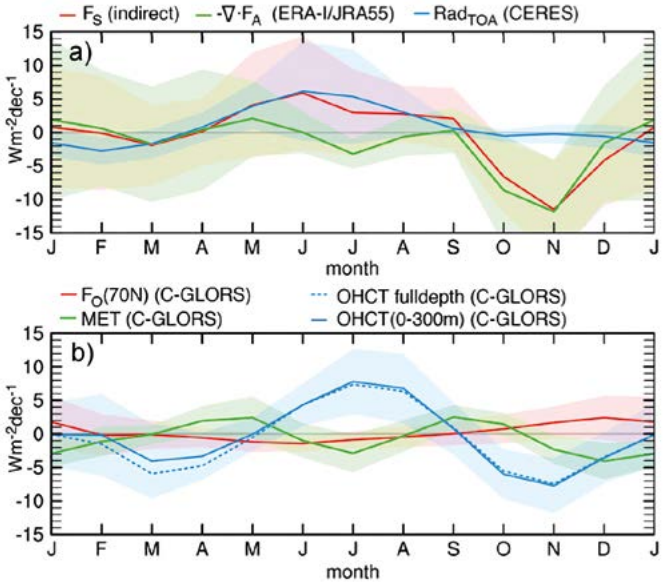
While Arctic climate change can be diagnosed in many parameters, a comprehensive assessment of long-term changes and low frequency variability in the coupled Arctic energy budget still remains challenging due to the complex physical processes involved and the lack of observations. Here we draw on strongly improved observational capabilities of the past 16 years and employ observed radiative fluxes from Clouds and Earth's Radiant Energy System (CERES) along with state-of-the-art atmospheric as well as coupled ocean-ice reanalyses to explore recent changes in energy flows through the Arctic climate system.

Various estimates of ice volume and ocean heat content trends imply that the energy imbalance of the Arctic climate system was similar to that of the global climate system (1 Wm^{-2}) during the 2000-2016 period, where most of the extra heat warmed the ocean (~0.85 Wm^{-2}) and a comparatively small fraction was used to melt sea ice (~0.15 Wm^{-2}). The Arctic energy imbalance was partly fed by enhanced oceanic heat transports into the Arctic, especially in the mid 2000s.

Seasonal trends of net radiation show a very clear signal of the ice-albedo feedback. Stronger radiative energy input during summer means increased seasonal oceanic heat uptake and accelerated sea ice melt. In return, lower minimum sea ice extent and higher sea-surface temperatures lead to enhanced heat release from the ocean during fall season. These results are consistent with modeling studies finding an enhancement of the annual cycle of surface energy exchanges in a warming Arctic. Moreover, stronger heat fluxes from the ocean to the atmosphere in fall tend to warm the Arctic boundary layer and reduce meridional temperature gradients, thereby reducing atmospheric energy transports into the polar cap.

Although the observed results are a robust finding, extended high-quality datasets are needed to reliably separate trends from low frequency variability.



a) Seasonal trends of Arctic average (70N-90N) net surface energy flux (F_S), lateral atmospheric energy convergence ($-\nabla \bullet F_A$), and net radiation at top-of-the atmosphere (Rad_{TOA}). b) Seasonal trends of ocean heat transport into the Arctic (F_O (70N)), Arctic average tendency of sea ice melt enthalpy (MET), and ocean heat content tendency (OHCT) over various depths. Units are W m^{-2} $decade^{-1}$.

O 078 NORTH AMERICAN ARCTIC/MID-LATITUDE WEATHER LINKAGES IN DECEMBER 2016: CAUSAL DRIVERS OF WINTER COLD EXTREMES

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Eastern North American mid-latitudes suffered episodic severe winter (DJF) extremes, for example during 2010, 2011, 2014 and 2015 and December 2016, which result in economic loss and personal disruptions. These cold spells are linked to a wavy meandering tropospheric jet stream and in some cases a tendency to a negative Arctic Oscillation index (AO). The multiple nature of the drivers behind these cold events remains controversial, as no long-term increase in winter climatologies of extremes has occurred. Here, far-field temperature and geopotential height fields associated with eastern North American winter extreme cold events are documented since 1950. From 33 monthly samples, three large-scale patterns emerge. In nearly all cases an Alaskan Ridge (AR) develops with higher 700 mb heights and positive temperature anomalies, the well know ridge/trough pattern over North America. Ten cases were labeled Greenland Blocking (GB) with positive temperature anomalies centered west of Greenland. A third type was a more Zonal (Z) pattern with positive temperature anomalies across northern North America. Early December 2016 had an extreme AR case. The ridge extended into the Arctic with a local maximum in the geopotential height field centered on the north coast of Alaska. Extreme warm surface temperatures (above freezing) and a connection to the lower atmospheric height field were verified by *in situ* observations and lack of November sea ice. The high amplitude North American ridge/trough developed bringing record low temperatures to the eastern US. While abnormally high northeast Pacific sea surface temperatures relate to many cases of the AR pattern, to our knowledge this may be the first clear case study of a downstream Arctic influence on eastern US cold events, although it has been proposed based on surface temperature trends.

O 018 ARCTIC AUTUMN AIR-ICE-OCEAN INTERACTIONS RESULTING FROM RECENT SEA-ICE DECLINE

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The recent decline in Arctic sea-ice extent has produced large areas of open water in September that were previously ice covered. Autumn air-ice-ocean interactions in these regions are now characterized by ice-edge or marginal ice zone (MIZ) processes rather than by primarily air-ice refreezing processes. This study will utilize field program measurements to illustrate this change in processes, provide examples of new processes, and to quantify changes in energy fluxes resulting from some of the key processes. Observations from SHEBA (1998) and near the North Pole during ASCOS (2008) are used to illustrate freeze-up over existing sea ice ("old Arctic" processes) while observations from ACSE (2014), Mirai (2014), and Sea State (2015), supplemented with mesoscale model output, are used to illustrate "new Arctic" processes. In the "old Arctic", energy budgets show that freeze-up over remaining end-of-season sea ice occurred in late August, primarily because of the high albedo of the ice enhanced by snowfall events. In the "new Arctic" with extensive open water, summertime upper-ocean heating, formation of atmospheric ice-edge fronts, atmospheric thermal circulations, formation of thin new ice, ocean waves, and upper-ocean mixing all play a role in the autumn freeze-up process. These new processes also significantly impact the temporal extent and magnitude of the ocean heat loss to the atmosphere during this critical season from September to November, and possibly beyond. The magnitude of this heat loss plays an important role in various hypotheses regarding the impact of Arctic sea-ice loss on mid-latitude atmospheric circulations. While these hypotheses will not be discussed, the observations directly provide estimates of heat loss magnitudes in the "old Arctic" and the "new Arctic", thereby quantifying changes in heat loss, which can then be used to assess the accuracy of the various models and reanalyses.

O 076 ON THE OBSERVED CONNECTION BETWEEN ARCTIC SEA ICE AND EURASIAN SNOW IN RELATION TO THE WINTER NORTH ATLANTIC OSCILLATION

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The Arctic climate system has demonstrated remarkable and rapid changes in the last decades (sometimes called, Arctic amplification characterized by the rate of the Arctic surface air temperature growth being twice as fast as the global average) and also, by rapidly declining sea ice extent and snow cover. These signals have profound implications for the weather and climate variability in mid-latitudes. Recent studies reveal that variability in sea ice concentration (SIC) over the eastern Arctic and snow cover extent (SCE) over central Eurasia in late autumn may stay as potential predictors for the winter Arctic Oscillation (AO) and its regional representation, the North Atlantic Oscillation (NAO). Here we focus on the NAO, the most prominent pattern of atmospheric circulation variability in the Euro-Atlantic sector, which has a strong influence on the regional surface climate in Europe. We applied maximum covariance analysis (MCA) to investigate the links between monthly Barents-Kara SIC anomalies and Eurasian SCE anomalies with winter sea level pressure (SLP) in the North-Atlantic-European region over 1979-2015. The most significant MCA mode for SIC appears in November, which is consistent with previous works. The MCA modes for SCE are not statistically significant, which contrasts with previous observational evidence; however, November shows some statistically significant SCE anomalies preceding the winter NAO index itself, but not October. Changes in regional temperature, specific humidity, SIC and SCE anomalies in November are likely modulated by an anomalous anticyclonic circulation over the Ural-Siberian region that acts as a precursor of the winter NAO, which appears not to be linked to the Siberian High but to the subpolar low-pressure belt.

O 079 CONTRIBUTION OF INTERNAL ATMOSPHERIC VARIABILITY AND EXTERNAL RADIATIVE FORCING TO THE RECENT TEMPERATURE TRENDS IN HIGH NORTHERN LATITUDES

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Relative contributions of internal atmospheric variability, lower boundary conditions and external radiative forcing to the recent warming trends in high northern latitudes are investigated based on large (30 members) ensemble of numerical simulations with an atmospheric general circulation model. The model is forced with the same historical boundary conditions (sea surface temperatures and sea ice concentrations) for 1979-2012 period and different initial conditions with and without time varying radiative forcing. It is found that simulated ensemble mean Arctic temperature changes considerably underestimate the observed temperature increase. The difference between model results and observations may not be explained by internal atmospheric variability that is well simulated by the model. Analytical model describing climate zonal trend uncertainty as a function of internal fluctuations of zonal temperature anomalies is suggested and found to successfully describe the model's results. Introducing direct radiative forcing considerably improves the model's results in simulating Arctic temperature trends. The strongest contribution of direct radiative forcing is found in the European part of Russia and in the Western Arctic. Comparison of the simulated trends with observations suggests possible problems with sea ice concentration data used to force atmospheric models.

O 077 IMPACTS OF TROPOPAUSE POLAR CYCLONES FROM DAYS TO SEASONS

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Tropopause polar vortices (TPVs) are coherent upper-level potential vorticity anomalies with typical radii of 100 to 1000 km and lifetimes of days to months. This study combines observations and numerical modelling to demonstrate that Arctic TPVs impact (1) synoptic weather, focusing on surface cyclones and Rossby wave breaking, (2) seasonal circulations through associated eddy forcing, and (3) summer sea ice loss through both storms and larger circulations.

To model associated coupled, multi-scale interactions and dynamics, experiments are designed using the non-hydrostatic dynamical core from the Model for Prediction Across Scales (MPAS) embedded within the Community Atmosphere Model (CAM) of the Community Earth System Model (CESM). Simulations leverage the flexibility of the fully-coupled (atmosphere, land, ocean, and sea ice) MPAS-CESM and the local refinement capability of the MPAS atmospheric component.

A set of extreme summer sea ice loss events are identified from the top percentile of spectrally filtered two-day changes in satellite-derived 1979-2014 sea ice extent. Event-relative composites demonstrate key roles of surface cyclones associated with TPVs in driving considerable sea ice loss. Idealized TPV modification experiments confirm the central role of TPVs in surface cyclone development and the corresponding sea ice response.

MPAS-CESM simulations focused over two summer seasons (2006 and 2007) characterized by strongly contrasting seasonal circulations, TPV trajectories, and sea ice extents highlight important interactions between TPVs and larger scales. In 2007, a large-scale anticyclone promotes anomalous thermodynamic sea ice loss and more equatorward trajectories of smaller-scale cyclonic TPVs. As sea ice recedes, TPVs act as an effective trigger for surface cyclogenesis near the baroclinic sea ice margins. In 2006, a single, long-lived central-Arctic TPV feeds a seasonal polar cyclone limiting ice loss. Idealized TPV modification experiments demonstrate both more intense surface cyclogenesis and more amplified lower-latitude wave breaking from strengthened TPVs.

O 047 EXTREME AIR TEMPERATURES OVER THE ARCTIC AND MID-LATITUDES

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Extreme winter and summer air temperatures in the Arctic and mid-latitudes are analysed for the period 2007-2016. Attention is paid to the role of the large-scale atmospheric circulation and local conditions, such as the surface energy balance and atmospheric boundary layer (ABL) structure. The large-scale atmospheric circulation is characterized by the Polar front jet stream, planetary waves, cyclone tracks, and circulation indices, such as AO, NAO, and PDO. Self-Organizing Maps are applied to cluster the data. Seasonal and spatial differences in the relationships are analyzed, with a particular focus on the occurrence and strength of extremes over the sea and land.

In winter, strong warm and cold anomalies are more common in the Arctic than at mid-latitudes. This is partly due to the shallower ABL with a smaller heat capacity in the Arctic and, in the case of warm anomalies, the occurrence of extreme cases of warm-air advection in the Arctic. Extreme winter temperatures often form a pattern of warm central Arctic surrounded by cold continents, which is associated with mid-tropospheric advection of warm, moist air-masses from the Pacific and Atlantic. Considering temperature anomalies, however, also an opposite pattern of cold central Arctic surrounded warm continents is common, and favoured by rather small shifts in the sectors of positive and negative meridional wind component. Strongest positive T2m anomalies over the Arctic Ocean are driven by influences from mid latitudes, which may dominate over local mechanisms favouring cold weather in the Arctic. For Siberia, the marine Arctic may serve as a source of warmer air in early winter. Strongest cold anomalies in Europe are often not directly affected by the central Arctic. In summer, the Arctic coastal zone experiences large variations in 2-m air temperature, but only in rare cases the anomalies extend far over the melting sea ice zone.

P 031 THE RELATIONSHIP BETWEEN SEA ICE AND VERTICAL TEMPERATURE VARIATION IN CENTRAL SPITSBERGEN, SVALBARD

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The atmosphere-sea ice interactions in the Arctic are of crucial importance to our comprehension of climate change and its consequences; however, our understanding of them is still limited (Vihma et al., 2014). The response of polar environment on enhanced temperature can be quite variable even on small spatial scale, especially in the ice-free areas with large topographical differences, such as Svalbard archipelago.

In this study, the relationship between sea ice and atmospheric boundary layer development is examined for September 2014 - June 2015 in two sites in Svalbard archipelago: Longyearbyen (central Spitsbergen) and Petuniabukta, which is located approx. 60 km to the northeast from Longyearbyen. The main objectives are evaluation of a) air temperature differences, b) air temperature vertical profile up to 500 m altitude with an emphasis on air temperature inversions, c) the relationship between sea ice conditions and the selected temperature characteristics.

The vertical temperature profile examination is based on near-surface lapse rates derived from hourly air temperature data measured by two pairs of automatic weather stations (Table 1), while the automatic weather station in Svalbard Lufthavn (Longyearbyen) belongs to Norwegian Meteorological Institute (Norwegian Meteorological Institute, 2016a). The sea ice conditions in the vicinity of the study areas were determined from sea ice charts (Norwegian Meteorological Institute, 2016b) on a weekly basis.

Table 1: Selected topographic characteristics of automatic weather stations (AWS) in Longyearbyen and Petuniabukta, central Spitsbergen.

station	locality	surroundings description and location	latitude (°N)	longitude (°E)	altitude (m a. s. l.)
AWS1	Longyearbyen	Svalbard Lufthavn	78.2453	15.5015	28
AWS2		regolith, Sverdruphamaren	78.2207	15.5700	428
AWS3	Petuniabukta	tundra, marine terrace	78.6989	16.4325	23
AWS4		regolith, spur of Mumien Peak	78.7008	16.3903	455

Norwegian Meteorological Institute. 2016a. Norwegian meteorological institute-eklima. http://www.eklima.no.

Norwegian Meteorological Institute. 2016b. Norwegian Ice Service - MET Norway. http://polarview.met.no.

Vihma, T. et al. 2014. Advances in understanding and parameterization of small-scale physical processes in the marine Arctic climate system: a review. - Atmospheric Chemistry and Physics 14, p. 9403-9450.

P 055 INFLUENCE OF SYNOPTIC CONDITIONS ON THE HEAT BALANCE OF THE ARCTIC OCEAN ACCORDING TO THE EXPERIMENTAL SHIP-BASED MEASUREMENTS

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In this study we discuss experimental measurements of sea surface heat balance components (radiation and turbulent fluxes), obtained during two research cruises, which were organized in 2013 and 2015 as part of international observational campaign NABOS (Nansen and Amundsen Basins Observational System). Both cruises took place in the same season (August - September) and had similar routes through Barents, Kara, Laptev and East-Siberian seas. State of the sea ice cover along their routes was also quite similar. However, experimental measurements of the sea surface heat balance and its components show significant differences between two cruises. The key distinction is related to the turbulent heat flux: in 2015 it was several times higher than in 2013, while values of radiation balance were similar (Fig 1). Accordingly, resulting values of the heat balance were mostly positive in 2013 and mostly negative in 2015. Such differences are in good agreement with measurements of the sea surface temperature, temperature profiles in the upper ocean layer, obtained by CTD sounding, and with synoptic conditions. Moreover, it was shown that specific patterns of synoptic conditions along the routes led to appearance of observed differences in heat balance. In 2015 prevailing wind direction was permanently changing during the cruise, and in 2013 consequence of synoptic conditions along the route provide prevailing of southern winds and permanent advection of warmer air from the continent or southern sea areas. As a consequence, advection of warm air led to decrease of temperature difference between sea surface and lower atmosphere and to less intensive turbulent exchange. This result has significant methodological value, because it shows the importance of detailed analysis of synoptic conditions and taking their into consideration during interpretation of observation data, obtained in such cruises.

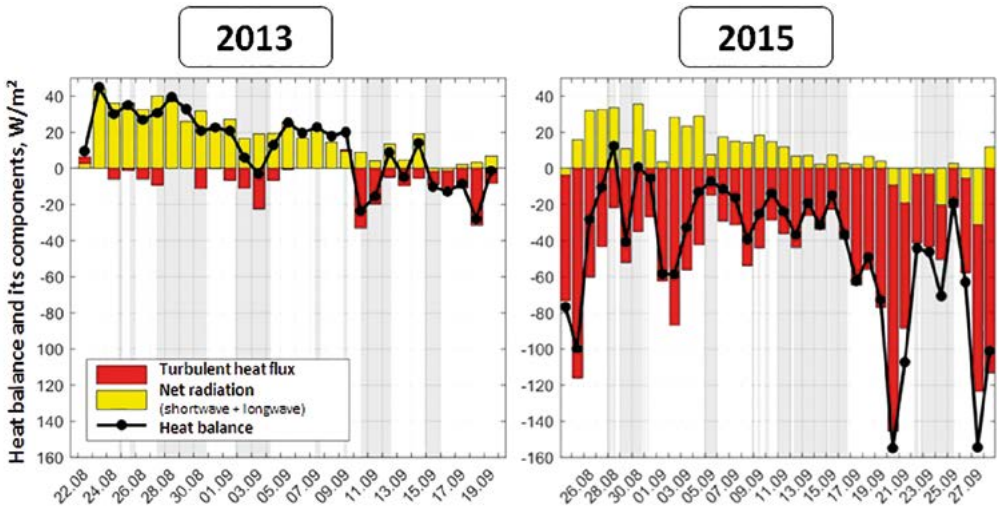

Fig 1: Daily mean values of heat balance and its components during two cruises.

P 041 SEA ICE EDGE POSITION IMPACT ON THE ATMOSPHERIC BOUNDARY LAYER TEMPERATURE STRUCTURE ACCORDING EXPERIMENTAL OBSERVATIONS AND NUMERICAL MODELLING

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Changes and processes taking place in global climate system could dramatically affect the Arctic. In 2000s the amount of sea-ice covered area in the Northern Polar region decreases. High amplitude of changes observed in the Arctic climate, enforce the development of more accurate numerical climate and weather forecasting models. It is necessary to know the physics of the interaction between atmosphere and underlying surface to improve the models and give more accurate forecasts.

Sea ice conditions significantly affect the atmospheric boundary layer. Ice cover influence the heat and momentum exchange between the surface and the atmosphere. At the ice edge areas intensive interaction takes place. Temperature structure and dynamics of boundary layer at the ice edge areas are not investigated enough according to the hard climate conditions. This study is based on the continuous high-resolution measurements, including atmospheric boundary layer temperature and state of sea ice cover data, collected in the Arctic ocean during two NABOS cruises (in 2013 and 2015) and remote sensing data about ice conditions (obtained by NASA TEAM2 and VASIA2 algorithms). Temperature profiles of the atmosphere were obtained by Meteorological Temperature Profiler (ATTEX, Russia). It is a passive radiometer, which provides continuous data on heights 0-1000 m. Observed data was compared with results of mesoscale hydrodynamical model COSMO-CLM numerical experiments, used for downscaling of ERA-Interim and NCEP reanalysis.

Findings: 1)The atmosphere boundary layer temperature structure changes rapidly in the ice edge areas; 2) The impact of the underlying surface on the atmosphere above it was observed on the heights 0-1000 meters; 3) The ice edge position data obtained from the satellite and the vessel varies greatly; 4) Modelled and observed atmospheric boundary layer temperature structures near ice edges show good agreement in case, in case of use sea ice data with adequate position of edge for modelling.

P 032 A SATELLITE BASED VIEW OF HALOGEN OXIDES IN THE ARCTIC TROPOSPHERE IN A CHANGING CLIMATE

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Halogens play an important role for atmospheric composition and radiation properties of the Arctic troposphere. They are photolyzed by sunlight to halogen radicals which deplete the major greenhouse gas ozone. Hence, changes in halogen abundance potentially impact on radiation properties, temperature and regional climate of the Arctic atmosphere. As ozone is a precursor of OH, they may also change the oxidising capacity of the troposphere. While iodine containing compounds are released into the atmosphere mainly from phytoplankton and dissolved organic matter in the ocean, bromine release is dominated by the so called bromine explosion. The latter is a complicated chemical chain reaction which takes place during polar spring and initially requires the release of bromine from young sea ice, snow or frost flowers into the atmosphere. In the past, it was widely believed that the bromine explosion requires low wind speed weather conditions. More recent studies have shown that it can also take place during high wind speeds (through production of e.g. blowing snow) as they occur at the location of storm fronts. It is also favored by low temperatures.

Over the last decades, climate change has led to larger temperature changes of the Arctic lower atmosphere than in other parts of the globe, a phenomenon known as Arctic Amplification. Within the framework of the German project (AC)^3, this study tries to assess changes in Arctic halogens by satellite remote sensing. Based on already existing retrievals of bromine and iodine monoxide over the past twenty years, a consistent long-term data set from different UV-vis satellite remote sensors will be compiled. This will build the basis to study changes in halogen concentrations, links to changes in halogen sources, favoring weather conditions and cyclone activity. Here, we will give a general overview of the research theme, including ongoing research efforts and initial results.

P 036 EFFECTS OF SURFACE TEMPERATURE ANOMALIES IN THE NORTHERN HEMISPHERE ON 2-M AIR TEMPERATURE IN EUROPE AND NORTHERN ASIA

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Inter-seasonal relationships between Northern Hemisphere (NH) surface temperature (T_s) anomalies and 2-m air temperature (T_{2m}) in different regions of Europe and Northern Asia is explored using the ERA-Interim reanalysis for the period 1979-2014. As a result, we have identified individual areas in NH, where spring T_s anomalies may remotely affect T_{2m} in the following summer in Europe or/and Northern Asia.

Many studies have focused on the linkages between the Arctic Amplification and mid-latitude weather patterns, in particular on the effects of changes in sea ice, terrestrial snow or open ocean SST on the air temperature in mid-latitudes. From the point of view of the atmosphere, however, it does not matter much whether the surface thermal forcing originates from sea ice melt, snow melt, or changes in SST. More important is to quantify how the atmosphere locally and regionally responds to surface temperature anomalies, and how the local/regional responses may affect weather patterns in remote areas.

Our methodology was as follows: we divided the Northern Hemisphere in grid cells with size 1.25° x 1.25° and calculated the correlation coefficient between T_s in all the grid cells and T_{2m} in 13 different study region in Europe and Northern Asia. The study regions were selected based on similar physiographic conditions. We analysed the temperature linkages with focus on seasonal, lagged inter-seasonal, and lagged inter-monthly relationships.

It was found that regional summer T_{2m} is usually poorly correlated with spring T_s of the same region. This suggests that the inter-seasonal effects are mostly teleconnections instead of processes related to the memory of the local surface heat capacity. There are more significant positive than negative correlations. In general, warm summers in Europe are often preceded by high springtime Ts in the central Arctic, Canadian Arctic archipelago, and the Labrador, Irminger and Iceland seas.

P 033 CHARACTERISTICS OF THE EARLY 20TH CENTURY WARMING IN THE ARCTIC INFERRED FROM OBSERVATIONAL DATA AND 20TH CENTURY REANALYSES

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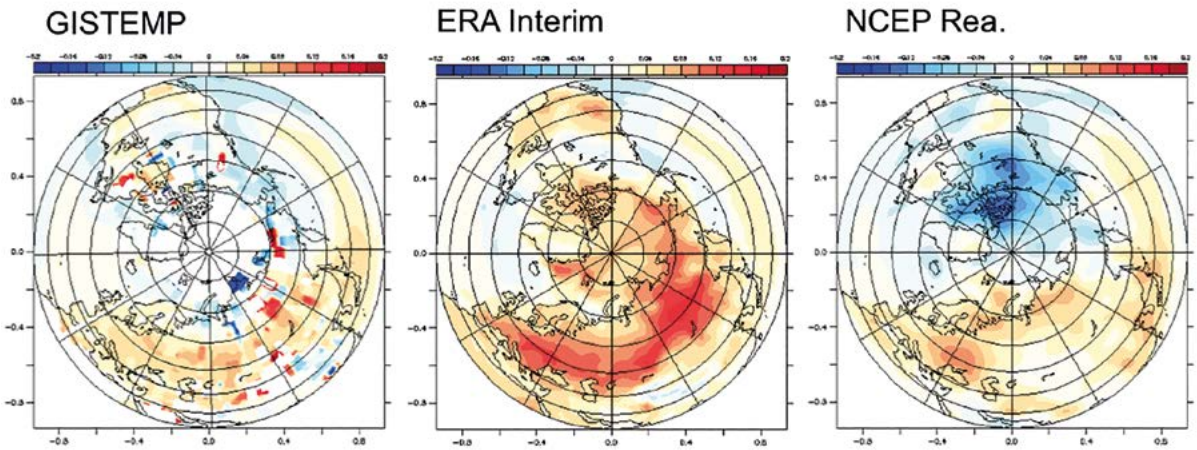
Recent warming in the Arctic has been continuing in the beginning of 21st century despite the global warming hiatus. Arctic climate changes in the recent decades represent probably the strongest manifestation of global climate change processes. The current Arctic temperature anomalies, however, hardly exceed those observed during the mid-20th century period, the peak of the so-called Early Twentieths century warming (ETCW) that started in the beginning of the 20th century in the period of relatively weak anthropogenic forcing. Considering global temperatures change comparable to recent period, ETCW is the key for understanding mechanisms of the recent warming and sea ice retreat, Arctic amplification, and building reliable scenarios of future climate change in the Arctic. Analysis of the ETCW phenomenon is hampered by a lack of reliable observational data in the first half of the 20thcentury. The recently developed 20th century reanalyses (NCEP/NCAR and ERA 20C) provide fully data coverage for the whole 20th century but derived reanalysis data including surface air temperature for the earlier period require validation. Here we consider surface temperature trends from the beginning of the 20th century with particular focus on the ETCW in the Arctic using different gridded temperature datasets (CRUTEMP and GISTEMP) and reanalysis data (NCEP/NCAR 20th Century and ERA 20th century reanalyses). Spatial and temporal characteristics of the ETCW are presented and problems with representation of this event in reanalyses data are highlighted (fig. 1). An overview of main hypotheses of the ETCW mechanisms is presented.

Fig 1. Difference between of surface air temperature trends °C during ETCW and the recent warming (1915/44-1975/2004).



P 034 PHOTOCHEMISTRY OF HYDROXY PAHS IN ICES AND IMPLICATIONS FOR THE POLAR AREAS

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Hydroxyl polycyclic aromatic hydrocarbons (OH-PAHs) are derived from hydroxylated PAHs. They are ubiquitous in the aqueous and atmospheric environments and may exist in the polar snow and ice, which urges new insights into their environmental transformation, especially in ice. In present study the simulated-solar (λ > 290 nm) photodegradation kinetics, influencing factors, pathways and photoinduced toxicity of four OH-PAHs [9-Hydroxyfluorene (9-OHFL), 2-Hydroxyfluorene (2-OHFL), 1-Hydroxypyrene (1-OHPyr) and 9-Hydroxyphenanthrene] in ice were investigated, and the corresponding implications for the polar areas were explored. It was found that the kinetics followed the pseudo-first-order kinetics with the photolysis quantum yields (Φ_s) ranging from 7.48×10^{-3} (1-OHPyr) to 4.16×10^{-2} (2-OHFL). The 9-OHFL , a representative OH-PAHs, photodegrades faster in freshwater ice and seawater ice than in pure water ice, which is attributed to the effects of main aqueous dissolved matter (e.g., Cl^-, NO_3^-, Fe(III) and humic acids) that accelerate the photodegradation. A toxicity test using *Vibrio fischeri* revealed the photomodified toxicity of 9-OHFL. These results are of importance toward the goal of assessing the persistence and risk of OH-PAHs in the arctic snow and ice. These 4 OH-PAHs were proposed to undergo photoinduced hydroxylation, resulting in multiple hydroxylated intermediates, particularly for 9-Hydroxyfluorene. Extrapolation of the lab data to the real environment is expected to provide a reasonable estimate of OH-PAH photolytic half-lives ($t_{1/2,E}$) in mid-summer of the polar areas. The estimated $t_{1/2,E}$ values ranged from 0.08 h for 1-OHPyr in the Arctic to 54.27 h for 9-OHFl in the Antarctic. In consideration of the lower temperature and less microorganisms in polar areas, the photodegradation can be a key factor in determining the fate of OH-PAHs in sunlit surface snow/ice. These results are of importance toward the goal of assessing the persistence and risk of OH-PAHs in the polar snow and ice.

P 035 ARCTIC SEA ICE DECLINE AND ITS INFLUENCE ON MOISTURE TRANSPORT FROM THE ARCTIC OCEAN: A LAGRANGIAN PERSPECTIVE

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In recent years Arctic sea ice has been suffering important reductions with downward trends in both, sea ice extent and concentration over the Arctic Ocean. This results in an ice-free situation over a greater area and for longer period of time with asymmetric situation for different parts of the Arctic having occurred the highest reductions over the Barents and Kara Seas. This changes toward a more ice-free Arctic produce an increase on the heat and moisture released into the atmosphere, affecting the hydrologic cycle. In the sense that moisture flux shows positive trends over most of the Arctic seas. In this study we use the lagrangian model FLEXPART to identify sinks areas for moisture departing every Sea into the Arctic and for the complete Ocean. In order to study the possible influence of sea ice retreat on moisture transport, variations on moisture contribution from the Arctic over the period 2003-2015 were analyzed, including an analysis of trends. Correlation between moisture flux over the ocean and its moisture

contribution were also realized. The complete Arctic Ocean and its Seas individually have, in general, a local influence. Moisture contribution is limited to the own Ocean itself, having only small contributions over continental areas in North America or Eurasia. Not a clear relation have been found between moisture flux and moisture supply, being significant positive correlations limited to small areas and showing some place negative ones. Significative trends on the moisture contribution from the Arctic have not be found in general for relevant areas

P 037 MODELING AND ANALYZING REMOTE CONNECTION BETWEEN ARCTIC ENVIRONMENTAL CHANGES AND EXTRA-ARCTIC CLIMATE: INITIAL RESULTS FROM ARCS PROJECT THEME 5

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We present initial results from the theme 5 of the project ArCS, which is a national flagship project for Arctic research in Japan. The goal of theme 5 is to evaluate the predictability of Arctic-related climate variations, wherein we aim to: (1) establish the scientific basis of climate predictability; and (2) develop a method for predicting/projecting medium- and long-term climate variations. Variability in the Arctic environment remotely influences middle and low latitudes. Since some of the processes specific to the Arctic environment function as a long memory of the state of the climate, understanding of the process of remote connections would lead to higher-precision and longer-term prediction of global climate variations. Conventional climate models have large uncertainty in the Arctic region. By making Arctic processes in climate models more sophisticated, we aim to clarify the role of multi-sphere interaction in the Arctic environment. In this regard, our newly developed high resolution ice-ocean model has revealed the relationship between the oceanic heat transport into the Arctic Ocean and the synoptic scale atmospheric variability. We also aim to reveal the mechanism of remote connections by conducting climate simulations and analyzing various types of climate datasets. Our atmospheric model experiments under possible future situations of Arctic sea ice cover indicate that reduction of sea ice qualitatively alters the basic mechanism of remote connection. Also, our analyses of climate data have identified the cause of recent more frequent heat waves at Eurasian mid-to-high latitudes and clarified the dynamical process which forms the West Pacific pattern, a dominant mode of the atmospheric anomalous circulation in the West Pacific region which also exhibits a significant signal in the Arctic stratosphere.

P 059 PAN-ARCTIC SEA-ICE LEAD FREQUENCY AND DISTRIBUTION FROM THERMAL INFRARED SATELLITE IMAGERY, 2003–2015

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Polynyas and leads are key elements of the wintertime Arctic sea-ice cover. They play a crucial role in surface heat loss, potential ice formation and consequently in the seasonal sea-ice budget. We apply and evaluate lead segmentation techniques based on sea-ice surface temperatures as measured by the Moderate Resolution Imaging Spectroradiometer (MODIS). A fuzzy cloud artifact filter is implemented to mitigate cloud artifacts and the associated potential misclassification of leads. We present quasi-daily pan-Arctic lead maps and monthly lead frequencies for the months of January to November from 2003 to 2015 at a spatial resolution of less than 2 km². An investigation of the inter-annual regional lead dynamics reveals pronounced patterns with significant variability mainly in the marginal ice zone and in the Beaufort Sea. The quasi-daily lead product can be used to deduct the occurrence, structure and dynamics of wintertime sea-ice leads and to assess seasonal divergence patterns of the Arctic Ocean.

P 039 EVALUATING PHYSICAL PROCESSES DURING THE FREEZE-UP SEASON USING A COUPLED SEA ICE-OCEAN-ATMOSPHERE FORECAST MODEL

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Improved sea ice forecasting must be based on improved model representation of coupled system processes that impact the sea ice thermodynamic and dynamic state. Pertinent coupled system processes remain uncertain and include surface energy fluxes, clouds, precipitation, boundary layer structure, momentum transfer and sea-ice dynamics, interactions between large-scale circulation and local processes, and others. In this presentation, we use a fully-coupled ocean-sea ice-atmosphere forecast system as a testbed for investigating biases in 0-10 day forecasts, with a focus on processes that determine fluxes at the ocean-ice-air interface.

Results and validation examples from this experimental, limited-area, fully-coupled atmosphere-ice-ocean model (named, RASM-ESRL) are presented from the 2015 and 2016 fall sea-ice freeze-up seasons. RASM-ESRL, developed from the larger-scale Regional Arctic System Model (RASM) architecture, includes the Weather Research and Forecasting (WRF) atmospheric model, Parallel Ocean Program (POP2) model, Community Ice Model (CICE5) and the NCAR Community Land Model. The domain is limited to the Arctic and all components are run with 10 km horizontal resolution. Components are coupled using a regionalized version of the CESM flux coupler (CPL7), which includes modifications important for resolving the sea ice pack's inertial response to transient (i.e. weather) events. The model is initialized with a GFS atmosphere, AMSR-2 sea ice concentration, and an ocean reanalysis product. Lateral boundaries are forced by 3-hourly GFS atmospheric forecasts and model-derived monthly means in the ocean.

Experimental forecasts were run daily from late-July through mid-November in 2015 and 2016. These daily forecasts have been compared with observations of surface fluxes and vertical atmospheric profiles at land sites, and with atmospheric and oceanic observations obtained within and near the sea ice from measurement campaigns in 2015 (ONR-supported SeaState cruise) and 2016 (NOAA-supported Arctic Heat experiment). Examples of how modeled coupled processes compare to this variety of observations will be presented.

P 040 TENDENCIES IN CURRENT CLIMATE CHANGES AND ATMOSPHERIC CIRCULATION VARIABILITY IN THE ARCTIC REGION OF WEST SIBERIA

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The main goal of this study is to carry out the investigation of changes in the climatic parameters over the Arctic region of West Siberia (60°-70°N, 60°-90°E). It is also revealed the influence of global and regional circulation processes on these tendencies.

The analysis of climatic characteristics, i.e. temperature and atmospheric pressure fields, soil temperature, cloudiness, amount of precipitation, snow depth and surface albedo over the territory of West Siberia was carried out using observational data at meteorological stations and reanalysis data (JRA-55, ERA Interim, MERRA). The period of under study is 1975-2015. It was established that in the beginning of XXI century, there is both air and soil temperatures decrease in winter and autumn and its statistically significant increase in spring and summer. There are also changes in the thermal state of cryolithic zone in West Siberia during last decades: the tendency to permafrost area destruction is observed for the Arctic region. Relationships between climatic characteristics and permafrost parameters are obtained over this territory. When investigating the regional climate system, it is also important to consider the influence the atmospheric circulation variability. Changes in circulation could be revealed through zonal and meridional wind speed components, meridional temperature gradient in the lower troposphere, global circulation indices and through eddy (cyclonic and anticyclonic) circulation. The influence of sea ice concentration in the Kara and Barents Seas are also taken into consideration.

Thus, in the framework of this study the climatic parameters variability over the Arctic region of West Siberia and the role of atmospheric circulation characteristics in their trends were revealed.

The work is supported by the grant of the RF President MK-2018.2017.5 and by RFBR, according to the research project No.16-35-60088 mol_a_dk.

P 042 OBSERVATIONAL EVIDENCE FOR PREDICTIVE SKILLS FROM ARCTIC SUMMER SEA ICE EXTENT

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The Arctic is warming twice as fast as the global average. This feature, known as the Arctic amplification, results in and is a result of the melting sea ice in the region. The latter connection is understood to have significant impact on large-scale atmospheric circulation at high- and midlatitudes.

Using National Snow and Ice Data Center sea ice data and ERA-Interim reanalysis data, we here show that summer sea ice extent (SIE) and temperature are the most important predictors of annual SIE minimum (maximum from July and June to September, respectively). Winter SIE and temperature also have significant prediction skill for spring SIE, while spring and autumn conversely show low memory into following season.

Based on the most important month for annual SIE minimum prediction (July), we then performed a lead/lag regression analysis of sea ice concentration, temperature and atmospheric circulation. We find that anomalous low July SIE is associated with significant warming (cooling) in the troposphere (stratosphere) within the Arctic Circle from May to September, along with weakened Westerlies. Before and after this period, summer sea ice anomalies have little impact.

Our results offer new understanding for seasonal sea ice prediction of the opening Arctic Ocean. This is of high interest to many actors, also beyond the scientific community. Moreover, we add to the ongoing heavily debated role Arctic amplification has for weather extremes in midlatitudes.

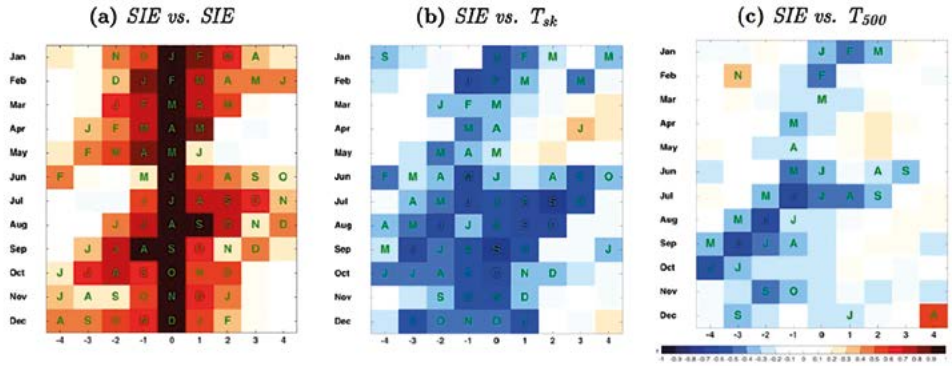

Figure 1: *Monthly lead/lag correlation coefficients between (a) Arctic sea ice extent (SIE) and SIE (autocorrelation), (b) SIE and skin temperature (T_{sk}) and SIE and 500 hPa temperature (T_{500}). For each SIE month along the y-axis, negative (positive) values along the x-axis represent correlation from a previous (the current) T_{sk}, SIE or T_{500} (SIE) month to the current (a coming) SIE (T_{sk}, SIE or T_{500}) month. Significant correlations on a 95 % confidence level ($\alpha = 0.05$) are indicated by the initial of the lead/lag month, where the threshold for significance is dependent on month and lead/lag value. The thresholds are assessed using the t statistic, where the effective sample size is estimated using the relationship outlined in Bretherton et al. (1999). All data are deseasonalized and detrended, and T_{sk} and T_{500} are spatially averaged over the Arctic (defined 66.5–90.0° N).*

P 043 SHORT-TERM TEMPORAL VARIABILITY OF SURFACE WIND SPEED OVER CENTRAL SPITSBERGEN, SVALBARD

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Atmospheric boundary-layer processes as well as the wind field on the Svalbard archipelago differ significantly due to the local forcing effects related to complex topography, land-surface characteristics or sea ice occurrence. In contrast to intense atmospheric research carried out in the vicinity of the largest settlements and research stations, information about the wind field structure from the other part of the Svalbard is still insufficient. Therefore, the aim of the study is to use yearlong measurement in central Spitsbergen to 1) analyse the temporal variation in the near-surface wind field and 2) evaluate the relationship between large-scale weather systems and the wind speed among different locations within the fjord.

We focused primarily on the analysis of the near-surface wind characteristics measured in Petuniabukta and Mimerbukta close to Russian settlement Pyramiden (Fig. 1) during 2013. Two automatic weather stations were located on the raised marine terrace at altitudes from 15 and 20 m a. s. l. Pattern of atmospheric circulation was identified using 850 hPa geopotential heights and geostrophic winds. Moreover, Weather Research and Forecasting (WRF) mesoscale model outputs (Skamarock et al. (2008) with the Quasi-Normal Scale Elimination parameterization scheme with 1-km horizontal resolution of the inner domain were used for identification of local circulation systems. We found that the large-scale flows were often modified by channelling and drainage effects accompanied by an increase on local wind speed in the coastal zone. Moreover, the occurrence of low level jets were identified and successfully simulated by the WRF model.

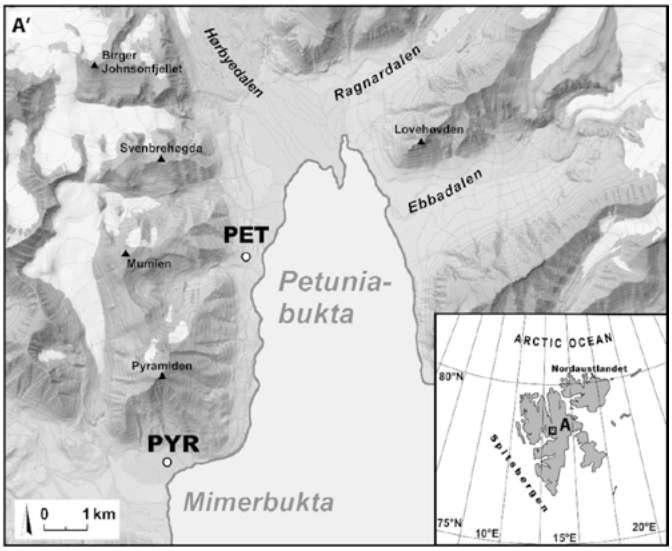

Fig. 1: The location of automatic weather stations (PET, PYR) in the northern part of Billefjorden, central Spitsbergen. The modified map is based on Svalbardkartet data, Norwegian Polar Institute.

Skamarock, W.C. et al. 2008. A Description of the Advanced Research WRF Version 3. Mesoscale and Microscale Meteorology Division, National Centre for Atmospheric Research, 125 pp.

P 044 DYNAMICS OF ATMOSPHERIC CONDITIONS FAVORABLE FOR THE POLAR LOWS CYCLO-GENESIS

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Recent rapid Arctic warming is causing changes of atmospheric conditions and therefore can also significantly affect intensity and frequency of mesoscale cyclones forming. In this study our attention is focused on caused by global climate change variations of atmospheric conditions favorable for the Polar Lows cyclo-genesis.

Data obtained by the global large-scale climate model of intermediate complexity “Planet Simulator” under RCP 8.5 climatic scenario conditions are used in this study. The first leading mode from the Empirical Orthogonal Function (EOF) analysis of monthly mean geopotential height anomalies at 1000 hPa and a convective available potential energy (CAPE) are considered. The first leading mode from the EOF analysis is used as the leading teleconnection pattern in the atmospheric circulation, and the CAPE is used as the measure of the atmospheric state that is favorable for the genesis of the mesoscale cyclones (Holton 2004; Rasmussen and Turner 2003). It is shown that changes of the spatial structure of leading EOF mode and the significant increase of the CAPE are caused by the climatic forcing. Spatial redistribution of the correlation between the two above mentioned characteristics and the absence of the significant changes in their values are also presented.

This work is supported by RFBR grant #16-05-00558.

Fraedrich K., Jansen H., Kirk E., Luksch U., and Lunkeit F., 2005: The Planet Simulator: Towards a user friendly model // Meteorol. Zeitschrift, 14, 299-304.

Holton J. R. Ed., 2004: An Introduction to Dynamic Meteorology. Academic Press, 535 pp.

Rasmussen E.A. and Turner J. Eds., 2003: Polar Lows. Cambridge University Press, 612 pp.

P 045 THE ROLE OF THE OCEAN ARCTIC AS MOISTURE SOURCE FOR PRECIPITATION IN THE EUROPEAN NORTH ATLANTIC COASTS

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In this study we analyze the role of the Arctic Ocean as a major moisture source for precipitation along the European north Atlantic coasts. To do this we use a Lagrangian approach based on the dispersion model FLEXPART widely used for global and regional studies of moisture sources and sinks. Sinks are estimated by tracking particles leaving the oceanic regions forward in time and then analyzing variations on relative humidity along the trajectories. In this work, the moisture oceanic sources taken are every Sea into the Arctic and for the complete Ocean. The use of the period 1980 to 2015 permits not only to calculate the climatological contribution of the Arctic sources for precipitation in the Atlantic coast but also to analyze possible trends and interannual variability. A correlation analysis with evaporation over the sources was also carried out to account for major drivers of trends.

P 046 OBSERVED PRECIPITATION SYSTEM AND MOISTURE TRANSPORT ASSOCIATED WITH ARCTIC CYCLONES DURING THE 2015 R/V MIRAI CRUISE

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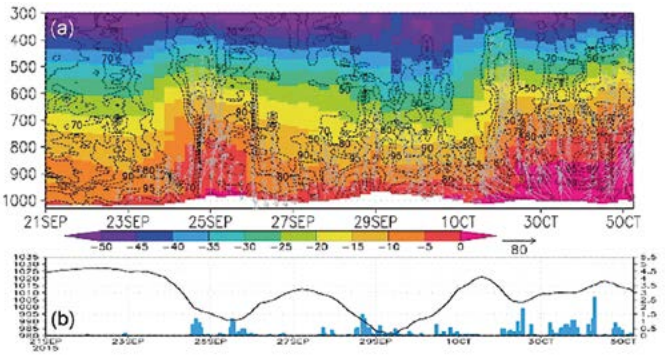
Accompanied with the recent sea ice reduction, changes in the lower clouds and cyclone activities over the Arctic have been investigated in previous studies. It is also expected that changes in the precipitation system and moisture transport in this region, but there are few studies particularly based on field observation. While the amount of water vapor over the Arctic was increasing during the past three decades due to the large Arctic warming, there is no long-term trend of the moisture transport from the surroundings into the Arctic. In addition, although cyclone activities contribute greatly to the moisture transport over the Arctic, there are few observation research and discussion of the precipitation and moisture transport associated with individual cyclone.

We performed 6 hourly radiosonde soundings, Doppler radar and surface meteorological observation over the Chukchi and Bering Seas from September to early October as R/V MIRAI Arctic cruise. In the early and middle periods of the cruise (9/6 - 9/23), strong wind at the edge of the Beaufort high and a quiet state in the high were observed off Barrow. In the late period (after 9/24), three cyclones passed near the R/V MIRAI. The cloud and precipitation systems accompanied with the fronts of the cyclones on September 24, 28 and October 2 were captured by the radiosonde and Doppler radar observations. In addition, the cyclone center was observed on September 29. While the moist and warm advections were observed in the entire level of the troposphere associated with the cyclones on 9/24 and 10/2, while the moist and warm advection associated with the cyclone on 9/27-28 was restricted in the lower level of the troposphere.



P 047 AN INFLUENCE OF DATA SMOOTHING ON THE CORRELATION BETWEEN CLIMATIC INDICES AND AIR TEMPERATURE AND PRECIPITATION IN SVALBARD ARCHIPELAGO

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The Arctic climate system is characterised by inter and intra-annual variability. In this region, changes in annual runs of air temperature and precipitation play crucial roles and have implications for the abiotic and biotic environment.

In this study we investigate correlations between daily air temperature and precipitation at six meteo stations in Svalbard, and climate indices, including NAO, Arctic Oscillation (AO), Scandinavian pattern (SCA), Polar/Eurasia pattern (POL), East-Atlantic pattern (EA), East Atlantic/West Russian pattern (EA/WR) and sea ice extent (SIE). Consistent direct observations in time series were obtained from six meteorological stations: Bjornoya, Hopen, the Polish Polar Station Hornsund, Barentsburg, Longyearbyen Airport, and Ny-Ålesund.

For that purpose, we used the novel methodology of Moving Average over Shifting Horizon (MASH) that allows for the signal separation into two bins, weather (with small-scale variability and influence of local factors) and climate (with large-scale variability and influence of regional and global factors). An analysis of correlation was carried out for the original and smoothed observations and climate indices. The outcomes show lower correlation values for original time series than for smoothed time series, indicating that there are additional factors that shape highly diverse and dynamic local climatic conditions. Higher values of the correlation coefficients for the smoothed time series indicate that applied smoothing procedure allows the filtering out of local physical relationships and additional sources of climatic conditions variability, such as wind and orography.

The study was supported by Polish National Science Centre through grant no. 2013/09/N/ST10/04105.

P 048 SURFACE ENERGY BUDGET AND TURBULENT FLUXES AT ARCTIC TERRESTRIAL SITES

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[2] *NOAA/ESRL/PSD, Boulder- CO, USA*
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[4] *University of Colorado/CIRES, CIRES/NOAA/ESRL/PSD, Boulder- CO, USA*
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[6] *A. M. Obukhov Institute of Atmospheric Physics, Moscow, Russian Federation*

Determination of the surface energy budget (SEB) at the air-surface interface and all SEB components are required for a wide variety of applications. Here, comparisons of net surface energy budgets (SEB) at two Arctic sites are made using long-term near-continuous measurements of hourly averaged surface fluxes (turbulent, radiation, and soil conduction). One site, Eureka (80.0° N; Nunavut, Canada), is located in complex topography near a fjord ~200 km from the Arctic Ocean. The other site, Tiksi (71.6° N; Russian East Siberia), is located on a relatively flat coastal plain <1 km from the shore of Tiksi Bay, a branch of the Arctic Ocean. We first analyze diurnal and annual cycles of basic meteorological parameters and key SEB components. Although located on different continents and at different latitudes, the annual course of the surface meteorology and SEB components

are qualitatively similar at the two sites. Our direct SEB measurements show that the sum of the turbulent sensible and latent heat fluxes and the ground (conductive) heat flux systematically underestimate the net radiation by about 25-30%. This lack of energy balance is a fundamental and pervasive problem in micrometeorology, and reasons for the lack of SEB closure at these sites are discussed. In particular, various storage terms are present (e.g., air column energy storage due to radiative and/or sensible heat flux divergence, ground heat storage above the soil flux plate, energy used in photosynthesis, canopy biomass heat storage). For example, our observations show that the photosynthesis storage term is relatively small. All turbulent fluxes are highly correlated with net radiation because this balance between solar and longwave radiation is the principal energy source for surface warming, evaporation, and photosynthesis. Furthermore, turbulent fluxes of carbon dioxide and sensible heat are closely linked and, on average, change sign synchronously during the diurnal cycle.

P 049 FEEDBACKS OF WINTER SEA-ICE RETREAT ON MID-LATITUDES ATMOSPHERIC CIRCULATION AND LONG-RANGE TRANSPORT OF BLACK CARBON IN THE ARCTIC

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The ongoing shrinkage of the Arctic sea ice cover is likely linked to the global temperature rise, the amplified warming in the Arctic, and possibly weather anomalies in the mid-latitudes. By applying a novel statistical method in climate science, the Independent Component Analysis (ICA), to global atmospheric energy anomalies in winters from 1980 to 2015, we show the link between the sea ice melting in the Arctic and the combination of only three atmospheric oscillation patterns approximating observed spatial variations of near-surface temperature trends in winter. Two of these large scale atmospheric circulation patterns connect by independent dynamical processes the sea ice melting and related atmospheric perturbations in the mid-latitudes. At the same time, we investigated the possible feedbacks of these independent dynamical processes on the long range transport of pollutants from the mid-latitudes to the Arctic. We focused in particular on the transport and deposition on Arctic sea-ice of black carbon (BC) aerosol particles, which may further impact the regional and global climate, through direct radiative forcing and by modifying the snow and sea-ice albedo. Winter anomalies of meteorological fields from the global reanalysis are processed together with BC surface concentrations and deposition simulated by a general circulation model coupled with atmospheric chemistry and physics (ECHAM5-HAMMOZ). The feedback of winter sea-ice retreat and surface temperature warming on the transport of BC to the Arctic was quantified with Maximum Likelihood Estimates of atmospheric concentrations and deposition of BC in the Arctic associated to the three independent atmospheric patterns. We found that negative anomalies of the NAO likely favor the transport of BC in the upper troposphere, with small deposition over the Arctic sea-ice. Stable high pressure systems (atmospheric blocking) near Scandinavia favor the near surface transport directly from Western Europe towards the Barents Sea, with increasing deposition over the sea-ice.

P 050 LONG-TERM ANALYSIS OF CIRCUMPOLAR POLYNYA REGIONS AND ICE PRODUCTION IN THE ARCTIC

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Spatial and temporal characteristics of 17 prominent coastal polynya regions over the entire Arctic basin are presented. Thin-ice thickness distributions (≤ 20cm) are calculated from high-resolution MODIS ice-surface temperatures, combined with ECMWF ERA-Interim atmospheric reanalysis data in an energy balance model for 13 winter seasons (2002/2003 to 2014/2015; November to March). Daily thin-ice thickness composites are computed in order to derive quantities such as polynya area and total thermodynamic (i.e., potential) ice production. A gap-filling approach is applied to account for cloud and data gaps in the MODIS composites.

All polynya regions combined show an average total winter-accumulated ice production of about 1811±293 km³, whereby the Kara Sea region, the North Water polynya (both 15%), polynyas on the western side of Novaya Zemlya (20%), as well as scattered smaller polynyas in the Canadian Arctic Archipelago (all combined 12%) are the main contributors. Despite the short record of 13 winter seasons, positive trends in ice production are detected for several regions of the eastern Arctic (most significantly in the Laptev Sea region with an increase of 6.8 km³/yr) and the North Water polynya, while other polynyas in the western Arctic show a more pronounced variability with varying trends. We emphasize the role of the Laptev Sea polynyas as being a major influence on Transpolar Drift characteristics through a distinct relation between increasing ice production and ice area export.

We note distinct differences to earlier studies on pan-Arctic polynya characteristics. A new and for the first time direct comparison to a similar data set based on AMSR-E passive microwave data (Iwamoto et al., 2014) for the period 2002/2003 to 2010/2011 addresses this topic and yields insights into sensor-specific capabilities and error sources for large-scale polynya monitoring.

P 051 INTERCOMPARISON OF SURFACE HEAT TRANSFER IN THE ARCTIC FOR MULTIPLE REANALYSES, SATELLITE DATA AND FIELD OBSERVATIONS

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This study evaluated surface heat fluxes from reanalyses (ERAInterim, NCEP/NCAR, ASR) in the Arctic Ocean during summer and fall. Several types of surface conditions are compared: very new ice cover during a period of low temperature, ice-free conditions, ice with leads and melt ponds, pack ice and marginal ice zone. Meteorological and micrometeorological observations were used to validate the temperature profiles and surface heat fluxes in the major reanalyses. The NABOS field experiment was carried out in the central part of the Arctic and in the eastern Arctic seas during summer and fall period of 2004-2009, 2013, 2015. With the explicit treatment of the ice concentration, ERA-Interim generally reproduces the surface heat transfer, while NCEP/NCAR, based on a 55% concentration threshold, shows obvious disagreement with the observations in highly ice-covered and ice-free situations. The spatial and temporal patterns of the resulting flux fields are investigated and compared with those derived from satellite observations such as HOAPS, from blended data such as AOFLUX (in the open water cases). A computation of the sensible heat flux at the surface is formulated on the basis of spatial variations of the surface temperature estimated from satellite data. Based on the comparison of field experiments data, satellite derived data and reanalysis the causes of underestimation of the values of turbulent heat fluxes in the Arctic modern reanalysis are

investigated. Reanalyses data are sometimes used to calculate the surface heat budgets over polynyas to estimate ice production in polar/sub-polar oceans. In particular, the near surface air temperature and wind fields, which are difficult to observe using satellites or with in-situ measurements, are key parameters for estimating turbulent heat fluxes. If the sea-ice concentration and SST in reanalyses are not treated appropriately, careful attention is needed when using the resultant air temperature for such calculations.

P 052 IMPROVED FORECASTS OF WINTER WEATHER EXTREMES OVER MIDLATITUDES WITH EXTRA ARCTIC OBSERVATIONS

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Recent cold winter extremes over Eurasia and North America have been considered to be a consequence of a warming Arctic. More accurate weather forecasts are required to reduce human and socioeconomic damages associated with severe winters. Uncertainty in predicted atmospheric circulation at midlatitudes sometimes stems from large uncertainty in initial conditions over the Arctic region, partly because of a sparse observing network. Here we show that additional Arctic radiosonde observations from the Norwegian young sea ICE cruise project 2015 drifting ice camps and existing land stations during winter improved forecast skill and reduced uncertainties of weather extremes at midlatitudes of the Northern Hemisphere. For two winter storms over East Asia and North America in February 2015, ensemble forecast experiments were performed with initial conditions taken from an ensemble atmospheric reanalysis in which the observation data were assimilated. The observations reduced errors from uncertainty in initial conditions in the upper troposphere over the Arctic region, yielding more precise prediction of the locations and strengths of upper troughs and surface synoptic disturbances. Uncertainty of predicted upper troughs at midlatitudes would be brought with upper-level high potential vorticity (PV) intruding southward from the observed Arctic region. This is because the PV contained a “signal” of the additional Arctic observations as it moved along an isentropic surface. This suggests that a coordinated sustainable Arctic observing network would be effective not only for regional weather services but also for reducing weather risks in locations distant from the Arctic.

P 053 INFLUENCE OF OCEANIC HEAT ANOMALIES IN THE BARENTS SEA ON WINTERTIME CLIMATE VARIABILITY IN MIDDLE LATITUDES

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There is a growing evidence that wintertime extreme weather events and climate variability over Eurasia are related to anomalies of the sea ice cover in the Barents Sea. A signal in the wintertime sea ice cover to which the atmosphere could respond may come from oceanic forcing. Our earlier studies indicate that about 70% of the interannual variance of the total wintertime sea ice area in the Barents and Greenland Seas can be explained by Atlantic water temperature (AWT) anomalies at the entrance to the Barents Sea in the preceding summer. This presentation is mainly intended to summarize our recent findings, most of which have been already published in Climate Dynamics (2016), about remote atmospheric teleconnections to oceanic variability in the Barents Sea. We will show, using oceanic observations and atmospheric reanalysis data from the period 1982-2006, that summertime AWT anomalies in the Barents Sea are significant precursors of the large-scale atmospheric variability in winter. Positive AWT anomalies precede westerly wind anomalies in high latitudes and easterly wind anomalies in middle latitudes. Near-surface easterly wind anomalies over Eurasia are locally deflected southward, maintaining cold spots near mountain chains when a warm anomaly is forced over the Barents Sea. An Eulerian analysis of synoptic variability will be used to demonstrate that the AWT-related climate teleconnections involve reorganization of mid-latitude storm tracks. In particular, the AWT anomalies explain about 60% of the variance in the storm track activity at the tropopause level averaged over Eurasia and North Pacific from 35° to 55°N. The AWT-related wintertime atmospheric anomalies are uncorrelated with the concurrent anomalies related to the North Atlantic Oscillation, which increases the potential for seasonal prediction of wintertime climate variability in middle latitudes based on summer AWT anomalies. Finally, preliminary results on the persistence of these relationships after 2006 will be presented.

P 054 POSSIBLE ROLE OF ELECTRIC-FIELD GRADIENTS IN BROMINE ACTIVATION DURING POLAR BOUNDARY LAYER OZONE DEPLETION EVENTS

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Emission of bromine from sea-salt aerosols, frost flowers and snow results in nearly complete removal of surface ozone during springtime in the polar regions. Despite the wealth of information, bromine activation, namely the origin of the seed bromine that becomes amplified by HOBr-driven bromine explosion reactions is still not clear, as well as role of environmental conditions and substrates of ozone depletion events (ODE) initiation. The proposed hypothesis attempts to explain some experimental data that cannot be fully understood by taking into account the influence of electrical phenomena on the snow surface. Author suggests that ODEs may be initiated by the electric-field gradients created at the sharp tips of ice formations as a result of the combined effect of various environmental conditions. According to the author’s estimates, these electric-field gradients may be sufficient for the onset of point (corona) discharges followed by generation of high local concentrations of the reactive oxygen species and initiation of free-radical and redox reactions. This process may be responsible for the formation of seed bromine which then undergoes further amplification by HOBr-driven bromine explosion. The proposed hypothesis may explain a variety of environmental conditions and substrates as well as poor reproducibility of ODE initiation observed by researchers in the field.

According to the author’s estimates, high wind can generate sufficient conditions for overcoming the Rayleigh limit and thus can initiate “spraying” of charged aerosol nanoparticles. These charged aerosol nanoparticles can provoke formation of free radicals, turning the ODE on. One can also envision a possible emission of halogen ion as a result of the “electrospray” process analogous to that of electrospray ionization mass-spectrometry.

P 056 CHANGES IN ICE EDGE CONFIGURATION IN THE REGION NORTH OF SVALBARD IN PERIOD 1997–2016

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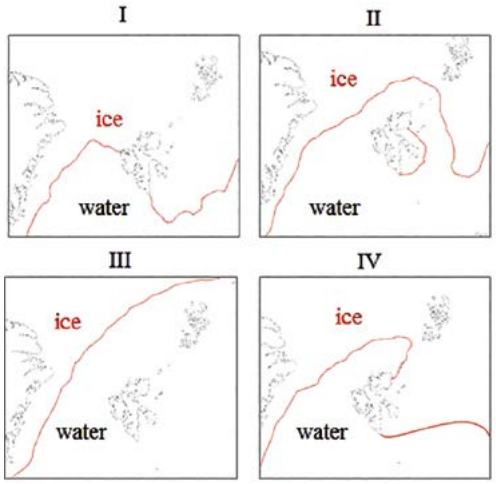
Svalbard's shelf is the principal region for the Atlantic water pass and it is very dynamic area which has been changing a lot in XX-XXI centuries. In this study, we focus on the region north of Svalbard, which is also known as Whaler's Bay polynya. Atlantic water (AW) inflow has great influence on ice conditions in this area. It provides heat to prevent winter ice freezing and helps melting ice during summer. However, not all changes in ice edge position and configuration can be explained by AW temperature. Using AARI ice charts archive ice conditions were divided into four main classes: 1 - closed ice around Svalbard; 2 - open water path to the Barents Sea around Svalbard; 3 - ice edge to the north of Svalbard and not connected to it; 4 - Whaler's Bay polynya exists, ice edge connected to Svalbard shore. All types schematically presented on picture 1.



Archive starts from 1997 and has one ice chart per week. Ice conditions in this region are characterized by high week-to-week and annual variability. In 1997 mostly presented types 1 and 4, polynya exists mainly in April - October, ice edge doesn't cross 82° north. In later years ice edge moves to the north and east, Whaler's Bay polynya reaches Franz Jozef Land. In most years polynya exists since December to February, closed ice - April-May, open water - August-October. Three years with lightest ice conditions were distinguished - 2006, 2012, 2016. Changes in ice conditions were analyzed in relation with AW temperature, air temperature, atmosphere circulation indexes and wind conditions. Study showed that wind conditions strongly affects changes in ice edge configuration inside a year.

P 058 SPRING SNOW ALBEDO FEEDBACK OVER RUSSIA: COMPARING IN-SITU MEASUREMENTS WITH REANALYSIS PRODUCTS

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Global warming is enhanced at high northern latitudes where the Arctic surface air temperature has risen at twice the rate of the global average in recent decades - a feature called Arctic amplification.

This recent Arctic warming signal likely results from several factors such as the albedo feedback due to a diminishing cryosphere, enhanced poleward atmospheric and oceanic heat transport, and changes in humidity. Looking at the Northern Hemisphere with its large landmasses, snow albedo feedback is especially strong since most of these landmasses experience snow cover during boreal wintertime.

Unfortunately, so far there remains a lack of reliable observational data over large parts of the cryosphere. Satellite products cover large parts of the NH, however lack high temporal resolution and have problems with large solar zenith angles as well as over complex terrain (eg. Wang et al. 2014). Fletcher et al. 2015 compared albedo feedback processes in CMIP5 model families and found while the models represent the feedback process accurately, there are still inherent biases and outdated parameterizations.

Our analysis focuses on the Russian territory where we utilize in-situ radiation and snow depth measurements. We found ca. 40 stations which measure both variables on a daily basis for the period 2000-2013. Since Hall (2004) found that 50% of the total NH snow albedo feedback caused by global warming occurs during NH spring, we focus on the transition period of March to June (MAMJ). We use the daily observations and state of the art reanalysis products to 1) evaluate reanalysis products in respect to radiation properties, 2) investigate the magnitude of snow albedo feedbacks during spring and 3) show the temporal and spatial evolution of snow albedo feedback for our domain.

S05 ARCTIC OCEAN DYNAMICS, TRANSFORMATIONS, AND ECOSYSTEM RESPONSE

KL 09 THE PACIFIC ARCTIC REGION: A WINDOW INTO SHIFTING BENTHIC POPULATIONS IN RESPONSE TO ECOSYSTEM CHANGE

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A key ecological organizing principle for the northern Bering Sea and the adjoining southern Chukchi Sea in the Pacific Arctic is that the shallow, seasonally productive waters lead to strong pelagic-benthic coupling to the sea floor, with deposition of fresh chlorophyll coinciding with the spring bloom as sea ice retreats. Both in situ production and advection of upstream phytodetritus to these regions support persistent biological hotspots that connect benthic prey to upper trophic benthivores. This northern marine ecosystem is dominated by marine macroinvertebrates (e.g. clams, polychaetes, and amphipods) that feed on the high production deposited rapidly to the seafloor, which in turn serve as food resources for diving mammals and seabirds, such as gray whales, walruses, and spectacled eiders. Between St. Lawrence Island and Bering Strait and northwards into the Chukchi Sea, the persistence of seasonal sea ice has significantly declined over the past two decades, and along with warming seawater temperatures, these changes have potential ramifications to ecosystem structure. Times-series data over the last 25 years indicate that these regions have experienced a northward shift in macrofaunal composition and a decline in core benthic biomass that matches patterns of reduced sea ice, warming seawater, and changing sediment grain size that relates to varying current patterns. This presentation will discuss these data in the context of both process studies from the region and results from the Distributed Biological Observatory (DBO), an international network of time series transects that is providing a framework to evaluate status and trends on a latitudinal bases in the Pacific Arctic region.

O 216 PATHWAYS OF THE ARCTIC NORTH ATLANTIC WATER IN EDDY-ADMITTING AND EDDY-PERMITTING GLOBAL OCEAN SIMULATIONS

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We present results from the model tracer release experiment in two high-resolution configurations of the global NEMO model at 1/4 and 1/12 degree resolution. (NEMO - stands for Nucleus for European Modelling of the Ocean.) The study examines North Atlantic water (NAW) inflow in the Arctic Ocean in the models with the “eddying” capability and investigate the role of the eddy dynamics on the NAW spread and trough the Barents Sea and Arctic Ocean interior. The NAW tracers have been released within the principal known pathways: across the Greenland-Scotland Ridge, in the eastern Fram Strait and in the western Barents Sea and tracked off-line for the period 2000-2015 using the 5-day averaged model velocity fields. The model results show that downstream from Fram Strait NAW is advected eastwards along the Siberian continental shelf slopes within the Arctic Circumpolar Boundary Current (ACBC) but also extends from the shelf slopes into the Nansen and Amundsen basins interior, with the eddy transport being a principal mechanism for the spread. We asses the eddy contribution to the heat loss from the ACBC on its way along the Siberian shelf slope. From comparing the eddying runs with the companion runs at a lower non-eddying resolution, we assert the differences in the NAW model dynamics at low and high resolutions and assert importance of eddy resolving model capabilities for the accurate representation of the NAW pathways.

O 194 RELATING SUMMER OCEAN TEMPERATURES AND WINTER FIRST-YEAR SEA ICE THICKNESS THROUGH LAGRANGIAN TRACKING OF FLOES

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In a first-year ice dominated environment, positive climate feedbacks in the Arctic persist from year to year when increased summertime melt results in decreased ice growth the following winter. This study evaluates the relative contributions of delayed freeze-up dates, increased oceanic heat flux, and changing atmospheric forcing on over-winter first year ice growth. To accomplish this, ice parcels defined around IceBridge sea ice thickness retrievals in areas of first-year sea ice are tracked backwards through time using the Pathfinder ice motion product to estimate a floe track. This track is then used to sample ice concentration data products, reanalysis atmospheric estimates, and prior-summer surface temperatures (as a proxy for trapped oceanic heat). In a multiple-regression analysis of these factors, delaying freeze-up by one week leads to about 5 cm thinner ice cover at the end of the winter season. Warming summer ocean temperatures contribute to delayed freeze-up, but even after controlling for changing freeze-up dates and atmospheric forcing, each degree (C) of warmer summertime temperatures results in 2 cm of thinner ice cover at the end of the winter season. This indicates that oceanic heat flux due to trapped seasonal heat compounds the loss of ice growth due to delayed freeze-up resulting in thinner first-year ice cover in the Arctic seasonal ice zones.

O 219 FORMATION AND TRANSPORT OF CORROSIVE WATER IN THE PACIFIC ARCTIC REGION

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Ocean acidification (OA), driven by rising anthropogenic carbon dioxide (CO2), is one element of rapid change presently occurring in the Pacific Arctic Region (PAR). It has been shown to compound natural variability in carbonate chemistry, producing conditions newly corrosive to biologically important carbonate minerals. Here, we synthesize data from across the PAR to investigate the formation of waters that are potentially corrosive to biogenic carbonate and their transport into the Arctic Ocean. The data show the seasonal accumulation of CO2 in colder, denser winter-modified Pacific waters from a variety of mechanisms over shallow shelves during summer and fall, which are subsequently transported off the shelf. In the

Chukchi Sea, most of the offshore flux occurs through Barrow Canyon. We estimate that this outflow delivers ~2.24 Tg C yr-1 of corrosive winter water to the Arctic Ocean. Downstream of Barrow Canyon, moored data records indicate that 0.5-1.7 Tg C yr-1 may be returned to the atmosphere via upwelling events along the Beaufort Sea shelf. This efflux is more than sufficient to eliminate corrosivity in the upwelled Pacific halocline waters. However, moored and discrete data records indicate that potentially corrosive Pacific waters are present in the Beaufort shelfbreak jet during 80% of the year, indicating that carbon accumulation far outweighs mitigation created by upwelling. Overall, we estimate that persistent corrosivity of the Pacific halocline is a recent phenomenon that appeared between 1975 and 1985. Over that short time, these potentially corrosive waters originating over the continental shelves have been observed as far as the entrances to Amundsen Gulf and M'Clure Strait in the Canadian Arctic Archipelago. The formation and transport of corrosive waters on the Pacific Arctic shelves may have widespread impact on the Arctic biogeochemical system reaching all the way to the North Atlantic.

O 237 CLIMATE CHANGE EFFECTS ON THE LOWER TROPHIC LEVELS IN THE ATLANTIC AND PACIFIC SECTORS OF THE ARCTIC

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In the marine Subarctic and Arctic, primary production depends mainly upon light and nutrient input. Under anthropogenic climate change, solar radiation to the water column will generally increase due to decreased ice coverage, causing higher annual primary production. Increases in light levels for the Barents and Bering seas by 2090 are projected to be 27% and 24%, respectively, with increased primary production of order 10%. A loss of large, and an increase in small, phytoplankton species will occur. Increased light levels, higher primary production and reduced phytoplankton size will affect fish spawning times and larval prey. As ice cover is reduced, ice algal communities will be lost and fewer algae will be transport to the Subarctic. Reduced sea-ice will tend to favour a pelagic-dominated ecosystem over a sea-ice algae-benthos ecosystem. In the Barents Sea, increasing temperature will likely increase the production of the dominant warm-water zooplankton species, *C. finmarchicus*, but decrease that of the cold-water species, *C. glacialis* while on the Arctic shelves, the abundance of *C. glacialis* is expected to increase. Many of the mechanisms controlling production, growth and individual size of the phytoplankton and zooplankton in the Atlantic and Pacific sectors of the Arctic are similar. A major difference is advection (e.g. fluxes mainly into the Pacific Arctic but 2-way in Atlantic Arctic sector being into and out of the Arctic). Also, the lower density Pacific waters are retained in the upper layers of the Arctic Ocean, but the denser Atlantic waters tend to sink into the subsurface layers. Finally, comparisons between the Barents and Bering seas must take into account differences in light (Barents is north of the Bering), temperature (Barents is warmer), and nutrients (Pacific source waters have higher nutrient concentrations than Atlantic waters).

O 195 SATELLITE OBSERVATION OF THE ARCTIC OCEAN SEA SURFACE SALINITY

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ESA Soil Moisture and Ocean Salinity (SMOS) mission, launched in 2009, has as main objectives to measure soil moisture over the continents and sea surface salinity (SSS) over the oceans. However, SMOS is also making inroads in Cryospheric science, as the measurements of thin ice thickness and sea ice concentration. SMOS carries an L-band (1.4 GHz, or 21-cm wavelength), passive interferometric radiometer (called MIRAS) that measures the electromagnetic radiation emitted by the Earth's surface, at about 50 km spatial resolution, full polarization, continuous multi-angle viewing, wide swath (1200-km), and with a 3-day revisit time at the equator, but more frequently at the poles.

Although the SMOS radiometer operating frequency offers almost the maximum sensitivity of the brightness temperature (TB) to sea surface salinity (SSS) variations, such sensitivity is rather low, even lower at cold waters: Over 90% of ocean, SSS values span a range of brightness temperatures of just 5K. This implies that the SMOS SSS retrieval requires a high performance of the MIRAS interferometric radiometer.

New algorithms, recently developed at the Barcelona Expert Center (BEC) to improve the quality of SMOS measurements , allow for the first time to derive cold-water SSS maps from SMOS data, and to observe the variability of the SSS in the higher north Atlantic and the Arctic Ocean.

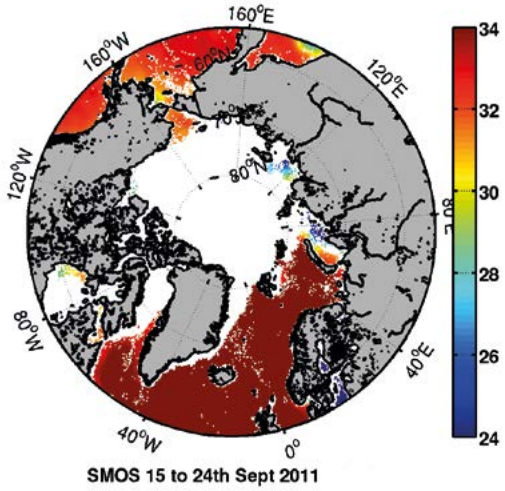

Figure 1: SSS observed by SMOS in September 2011.

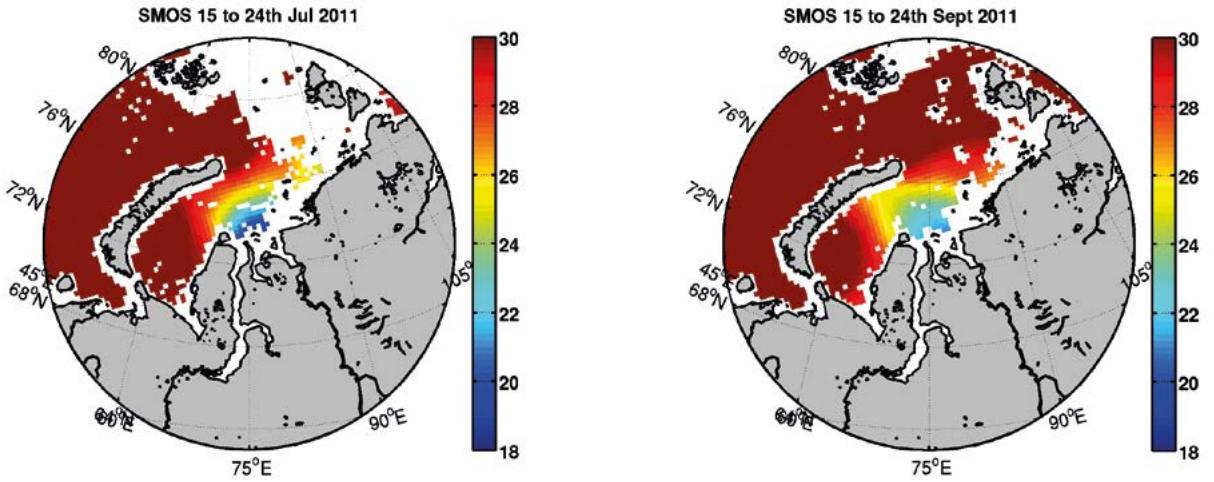

Figure 2: Ob river discharge in the Kara Sea in July and September 2011 observed by SMOS.

In this work, we will provide an assessment of the quality of these new SSS Arctic maps, and we will illustrate their potential to monitor the impact on ocean state of the discharges from the main rivers to the Arctic Ocean. Moreover, results show that assimilating SMOS Arctic SSS data could be beneficial for the TOPAZ Arctic Ocean Prediction system.

O 238 DECADAL VARIATIONS IN PHYSICAL PROPERTIES IN THE OCEAN AROUND ICELAND AND THEIR ROLE IN ECOSYSTEM PROCESSES

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Iceland lies close to the outflow of Polar water from the Arctic Ocean and sometimes the conditions over the shelf north and east of Iceland are heavily influenced by it, whereas at other times it is surrounded by warm Atlantic water. This and the fact that there has been over half a century of monitoring of various physical and biological parameters, make this area ideal for studying the effects of shifts in ocean and atmospheric forcing, that can serve as examples of how the ecosystems of the inflow areas in the Arctic Ocean may respond to such changes. After a long period with Atlantic water dominance there was a sudden cooling in the late sixties of the waters north of Iceland due to an increased flow of Polar water. After 1970 variable conditions were observed while during the mid-nineties there was a sudden shift with an increase in temperature and salinity of the Atlantic water flowing towards Iceland that is still ongoing. The changes discussed above had major impacts on the ecosystem around Iceland such as changes in phytoplankton productivity as well as changes in distribution of species and even introduction of new species and disappearance of others. The changes in the ecosystem will be described in relation to changes in the physical forcing. It will be demonstrated that local atmospheric conditions are important for timescales from days and at least to the seasonal timescale. On longer timescales, the large scale atmospheric circulation and large-scale dynamics of the sub-polar gyre and the Arctic Ocean play major roles.

O 240 MODELLING CIRCULATION PATHWAYS IN THE ARCTIC OCEAN: POTENTIAL IMPACT FOR OIL SPILLS

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Due to the retreat of sea-ice in the Arctic Ocean, shipping through the Northern Sea Route (NSR) is predicted to increase, and, consequently, an Arctic oil spill is becoming more likely. A short operational season limits the amount of time available for a potential spill to be dealt with. This raises the chances of a clean-up operation being partially or fully unsuccessful, in which case the long-term fate of the unrecovered oil must be considered.

Biodegradation is inhibited by freezing temperatures, so there are two main possibilities for what could happen to spilled oil: some of it would become entrained into the water column and follow ocean currents, and some of it would encapsulated into sea-ice. It is the former case that we address here. In order to understand what will happen to this fraction of the oil, it is necessary to investigate circulation pathways in the Arctic Ocean. A Lagrangian particle-tracking technique is employed to accomplish this.

We utilise 5-day averaged output from a 1/12° resolution simulation of the NEMO (Nucleus for European Modelling of the Ocean) ocean model, running under DRAKKAR DFS5 atmospheric forcing. Offline circulation output from this model is used in conjunction with particle-tracking software, Ariane, to simulate trajectories of point particles that represent spilled oil.

At 15 locations along the NSR, these particles are released into NEMO's flow field. 100 particles are seeded per release site, and releases take place every ten days throughout the navigable season (June-October). By analysing these particles' trajectories, we can predict where spilled oil is likely to go, how long it will take to get there, and what variability is associated with this. Potential risk factors, such as propensity to downwelling, are also investigated.

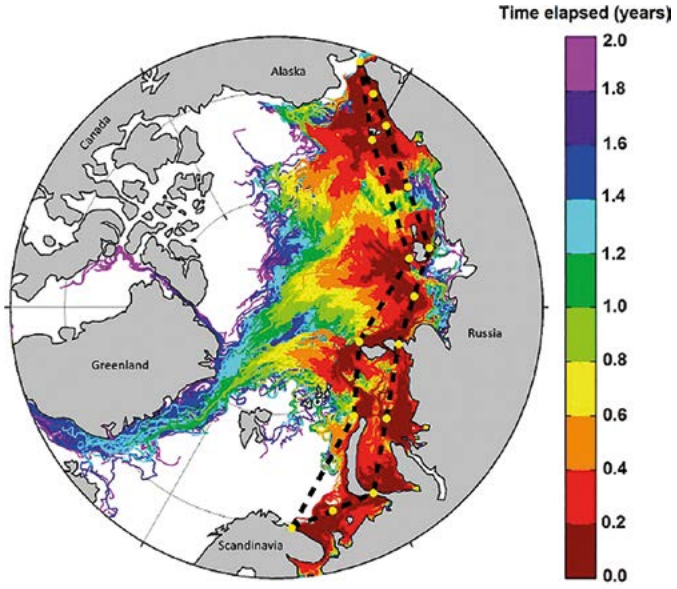

Figure 1: Overview of trajectories, coloured by age, seeded from release sites marked by yellow dots. Northern Sea Route denoted by dashed lines.

O 217 HYDROGRAPHIC RESPONSES TO REGIONAL COVARIATES ACROSS THE KARA SEA

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The Arctic Ocean warms, becomes less saline and stays in summer ice free for a longer period. The Arctic is entering a state not measured before. The hydrologic fluxes control surface temperature (SST) and salinity (SSS) and create seasonal and decadal variation of surface hydrography. We study the response of surface hydrography to hydrologic fluxes created by ice conditions, atmospheric forcing and river discharge. The effects operate in different spatial and temporal scales which complicates the study setting. Our study aims to reveal the complex nature of hydrographic variation in an Arctic shelf sea.

We use a hierarchical spatiotemporal Bayesian model to study surface hydrography in the Kara Sea with point observations from 1980 to 2000. The seasonal and inter-annual variation of hydrography is explained by ice concentration, Arctic oscillation and discharge of the river Yenisei. The lowest SSS is found in front of the river Yenisei estuary. SSS increases with distance to the river Yenisei as the impact of discharged water decreases. Moreover, SSS is affected by Arctic oscillation through water circulation and saline water inflow from the Barents Sea. SST decreases from south to north and is related to ice concentration and Arctic oscillation, which affects in addition to water circulation also sea ice formation and transport. We created hydrographic hindcast for the study period, which showed an increase of SST and a decrease of SSS.

This is the first study on hydrography in the Kara Sea with a spatiotemporally explicit model. We assess the expected mean value and uncertainty about it, which is an essential feature for the utilization of the model results in other applications. Since there is a need for more hydrographic information from the Arctic for marine area planning, climate change studies and biodiversity assessments, our methodology supports them with an efficient statistical tool.

O 218 NUTRIENT DYNAMICS AFFECTING PHYTOPLANKTON DISTRIBUTIONS IN THE PACIFIC ARCTIC REGION

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[3] *Hokkaido University, Faculty of Fisheries Sciences, Hakodate, Japan*
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The Chukchi Sea and Canada Basin are areas in the Pacific Arctic characterized by northward advection and spreading of Pacific-origin water that transports nutrients into the Arctic Ocean, and thus plays an important role in phytoplankton distributions. In this study, we examined ship-based and mooring data to understand nutrient dynamics and its influence on phytoplankton distributions. In the southern Chukchi Sea, our data suggest that, in contrast to spring blooms that are caused by a nutrient supply with the advection of Pacific-origin water, autumn blooms there are maintained by regenerated nutrients from the bottom of the shallow sea where particulate organic matters are largely accumulated in autumn (Fig. 1).

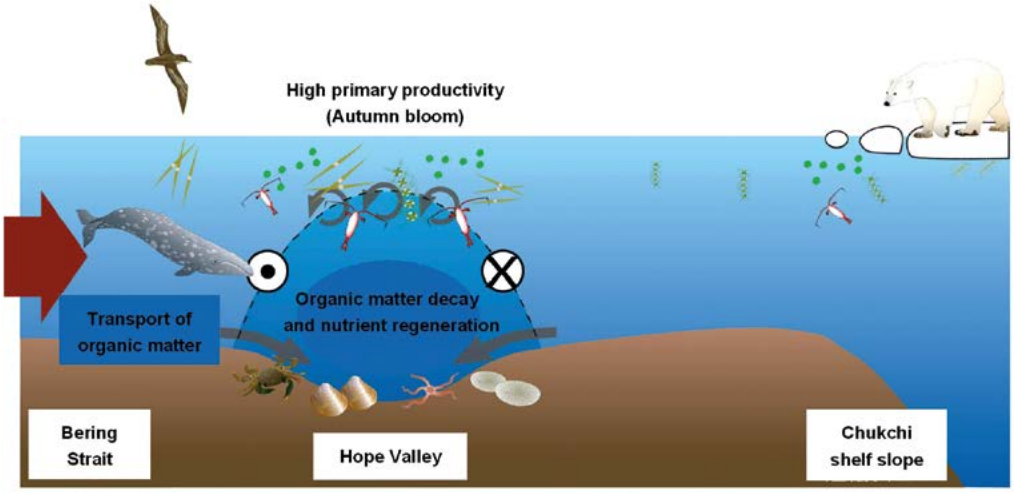

Fig. 1: Schematic of autumn bloom in the southern Chukchi Sea. Over the Hope Valley, there is a dome-like structure of the bottom water, suggesting ocean circulation in a counter-clockwise direction and converge of deep water there. The autumn blooms are, therefore, likely to be associated with particulate organic matters transported into the bottom of the valley, where nutrients such as ammonia are produced to increase phytoplankton with the organic matter decomposition.

On the other hand, large-scale ocean circulation controls nutrient distributions in the Canada Basin where sea ice reduction in recent years has changed the ocean circulation and thus impacts on the nutrient and phytoplankton dynamics (Fig. 2). We found that oceanographic and biological responses to the sea ice loss are quite different between the Alaskan and Siberian sides of the region. On the Alaskan side, eddies also play an important role in the nutrient and phytoplankton distributions. However, on the Siberian side, data are still lacking and various biogeochemical processes should be clarified in future studies.

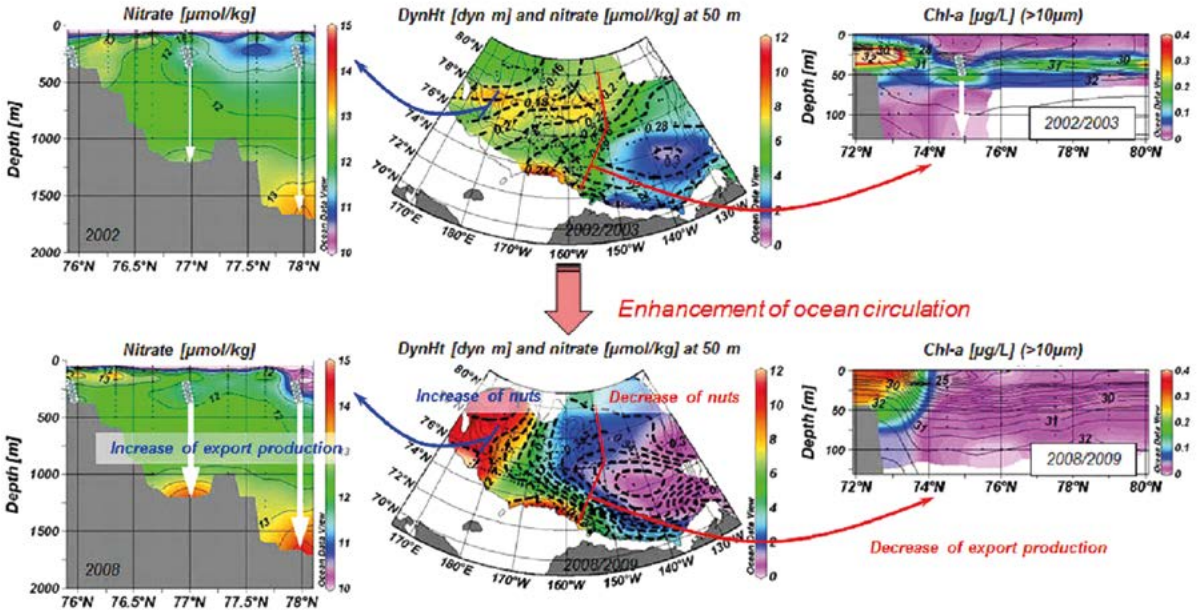

Fig. 2: Schematic of an enhancement of the Arctic Ocean circulation and changes in nutrient distributions and biological activities due to the recent loss of sea ice. (Middle panels): Distributions of dynamic height (dyn. m; dotted lines) at a depth of 50 m relative to 250 m and nitrate (μmol/kg; colors) at the 50 m depth in 2002/2003 (upper panel) and 2008/2009 (lower panel). (Right panels): Vertical sections of phytoplankton chlorophyll a (μg/L) in large-sized cells of >10 μm (colors) and salinity (contours) along red lines in 2002/2003 (upper panel) and 2008/2009 (lower panel). (Left panels): Vertical sections of nitrate (μmol/kg; colors) along blue lines in 2002 (upper panel) and 2008 (lower panel).

O 196 VALIDATING REANALYSIS-BASED VOLUME AND TEMPERATURE TRANSPORTS THROUGH ARCTIC GATEWAYS AGAINST MOORING-DERIVED ESTIMATES

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Recently, new estimates of volume-, temperature and freshwater transports into the Arctic Ocean through the four major gateways (Davis-, Fram-, and Bering Strait and the Barents Sea Opening) have become available through the ARCGATE project ("Maximizing the potential of the Arctic Ocean Gateway array"). The ARCGATE estimates are derived from mooring data in the four straits under the constraint of mass-, and salinity conservation. Currently, ARCGATE data are already available from September 2005 to August 2006.

We seize this novel opportunity to validate an ocean reanalysis - namely the Centro Euro-Mediterraneo sui Cambiamenti Climatici Global Ocean Reanalysis System "C-GLORS, Version 5" - against the largely independent (i.e. not assimilated in the reanalysis) observation-based data from ARCGATE in the straits.

First, we compare time series of total volume-, and temperature transports through each strait from ARCGATE and C-GLORS against each other. We find good agreement in Fram Strait volume-, and in Bering Strait temperature transports. The net export of volume out of the Arctic Ocean derived from C-GLORS is - 0.05 ± 0.22 Sv, about one third of the - 0.14 ± 0.06 Sv ARCGATE estimate. Considerable disagreement is found in Davis Strait and the Barents Sea Opening for both transport types.

We further investigate the source of discrepancy by preparing cross section plots of velocity, temperature and temperature transport. Generally, the patterns agree remarkably well, except for a few locations. For example, we attribute the discrepancy in Davis Strait transports to the West Greenland slope region, where upper-ocean currents are northward in ARCGATE and southward in C-GLORS (see Fig. 1 at 200 km distance). In the Barents Sea Opening, we find a similar disagreement in the Bear Island Channel. Velocity patterns in Fram Strait agree well, but weaker currents in the reanalysis lead to a discrepancy in the temperature transport.

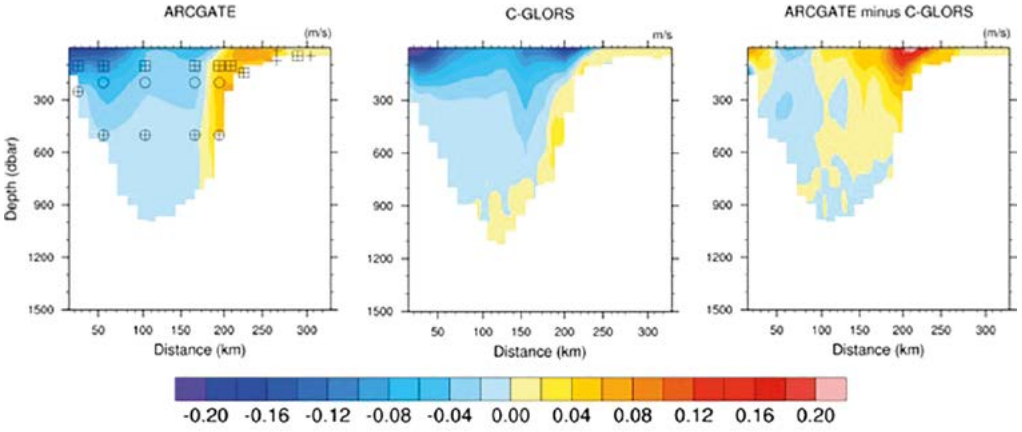

Figure 1: Velocity (m/s) cross sections for Davis Strait obtained from ARCGATE (observation-based), C-GLORS (reanalysis) and the difference between the two. Velocities are averaged over the one-year study period. Distance (x-axis) is the great circle distance to a point on the coast of Baffin Island (66.6° N and 61.3° W). Positive velocity transport signifies Arctic inflow and goes into the paper. The symbols in the ARCGATE cross section show the locations of moored instruments in the strait: Circle = RCM (different types of Aanderaa current meters measuring temperature and velocity, and in some locations also salinity), plus sign = SBE (SeaBird instruments measuring temperature and conductivity) and square = ADCP (Acoustic Doppler Current Profiler measuring velocity profiles). A combination of two symbols signifies locations of both instrument types (for example, a plus sign in a circle).

O 192 CAUSES AND CONSEQUENCES OF DECADAL SEA LEVEL CHANGES IN THE ARCTIC OCEAN IN 1954–2016

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Sea level (SL) time series from coastal stations in the Siberian Seas (Kara, Laptev, East Siberian and Chukchi) for the period of 1954-2016 are analyzed to investigate the major features of Arctic sea level variability at decadal time scales. The estimated rate of SL rise for these stations over the 1954-2016 is 2.52 ± 0.35 mm per year (after correction for glacial isostatic adjustment, GIA). Until the late 1990s, the SL time series correlate relatively well with the AO index and with the inverse of the sea level atmospheric pressure (SLP) at the North Pole, but then due to sea ice melt, warming of surface layers and persistent anticyclonic winds, the sea level regime changed. Consistent with these influences, sea level dropped significantly after 1990 and reached a minimum in 1996-1997 when the circulation regime changed from cyclonic to anticyclonic. In contrast, from 1997 to 2006 the mean SL has generally increased while the AO and SLP remained more or less stable. After 2008, sea level has had a decreasing tendency, showing no apparent correlation with the AO nor SLP at the North Pole. Since sea level change exhibits large interannual variability and is the net result of many individual effects of environmental forcing, it is difficult to evaluate the significance of the change in relative terms. Although not statistically robust, the changing tendency toward decreasing SL rise may be due to steric effects associated with some stabilization of surface ocean warming and its freshwater content.

O 193 IS THERE A SATURATION LEVEL FOR FRESH WATER ACCUMULATION IN THE BEAUFORT GYRE REGION?

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Hydrographic data in the Beaufort Gyre (BG) region of the Arctic Ocean between 2003-2016 document an increase of over 6500 thousand km^3 of liquid freshwater content (or 40%) relative to the climatological values of the 1970s. This fresh water accumulation was a result of persistent anticyclonic atmospheric regime forcing accompanied by sea ice melting. A slight decrease of freshwater content between 2010 and 2013 indicated a weak rebound which would be expected if the system was returning to a cyclonic circulation regime. This short and weak freshwater release was much less than would be expected based on climatological behavior with well pronounced decadal variability. In both 2015 and 2016, the magnitude of freshwater content in the BG region was greater than ever measured previously. It is speculated that this is a result of increased Ekman transport convergence due to extreme wind observed over the region in spring of 2016 and continuation of ice melt in the Arctic Ocean.

O 215 WIND DRIVEN MIXING AT INTERMEDIATE DEPTHS IN AN ICE-FREE ARCTIC OCEAN

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The Arctic Ocean is generally quiescent with the interior basins characterised by low levels of turbulent mixing at intermediate depths. There is evidence, however, of energetic internal waves under conditions of reduced sea ice cover that have been attributed to increased momentum transfer from the atmosphere to the ocean. Here we present new measurements including profiles of the rate of dissipation of turbulent kinetic energy made in the Canada Basin during the unusually ice-free and stormy summer of 2012. These show the previously-observed enhancement of internal wave energy associated in response to the ice-free conditions. However, the profiles of dissipation provide no evidence of enhanced mixing at intermediate depths away from significant topography. These new results imply that, contrary to expectations of increased wind-induced mixing under declining Arctic sea-ice cover, the stratification in the central Canada Basin continues to suppress turbulent mixing at intermediate depths to effectively isolate the large Atlantic water heat reservoir from the sea surface.

O 239 MODELING THE INFLUENCE OF ATLANTIC WATER INFLOW ON PRIMARY PRODUCTION AND PHYTOPLANKTON COMPOSITION IN THE FRAM STRAIT

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In the Fram Strait flow of Atlantic water on one side and Arctic water on the other side of the strait influences, temperature, salinity and nutrient availability. This in turn influences the primary production in the strait. In particular the ratio of nitrate to silicate differs across he strait and it is hypothesized that this difference causes in addition to the physical environment influences the relative abundance of diatoms and flagellates across the strait. A regional model for the Fram Strait with resolution 3.5 km has been set up as a coupled physical-biogeochemical model, HYCOM-NORWECOM, nested into a 15-km basin-scale model for the North Atlantic and Arctic. Both the basin scale and regional model has been compared to the same in-situ dataset covering mostly the eastern part of the Fram Strait. Using the model we investigate how the inflow of Atlantic water in the model affect the primary producers in the Fram Strait and which physical factors control the primary production and phytoplankton composition. On the west side of the strait the ratio of diatoms to non-diatoms increase with increasing inflow of Atlantic water as a result of an increased nitrate-to-silicate ratio. On the west side of the strait, no relationship wit transport was found, but there was a tight relationship between ice-cover and diatom biomass. A possible mechanism is that silicate-rich water exits the Arctic on the west side and a reduction in ice cover exposes this water to more light, increasing the diatom production.

O 220 EFFECTS OF TEMPERATURE, CO2 AND SALINITY ON THE GROWTH DYNAMICS OF ARCTIC PHYTOPLANKTON COMMUNITY

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The rapid climate changes in the Arctic Ocean is emerging such as warming, ocean acidification and sea ice reduction. Such environmental perturbations could alter the ecosystem structure but the information is very limited to evaluate those effects on the Arctic plankton communities. Here, we conducted a manipulation experiment using natural plankton community around the Barrow Canyon in the western Arctic region. Temperature (2.2 or 7.2°C), CO_2(300 or 600 µatm) and salinity (29.4 or 27.8) were manipulated using thermostat circulator, the addition of high CO_2 seawater, and Milli-Q water, respectively. Warming significantly increased in the net specific growth rate of phytoplankton at about 1.5 and 2 fold in the large (>10 µm) and small (0.7-10 µm) sized phytoplankton. Both of each high CO_2 and low salinity condition also enhanced the growth of small-sized phytoplankton. Synergistic effects of temperature, CO_2 and/or salinity were marginal and insignificant. Phytoplankton groups responsible for the increase in growth rate under the higher CO_2 levels were *Synechococcus* and nano-sized eukaryotic phytoplankton. Phytoplankton pigment and nutrient drawdown ratio imply the reduction of diatom biomass under the higher temperature conditions. These results suggest that each of temperature, CO_2 or salinity change in the Arctic Ocean enhance the dominance of small-sized phytoplankton groups. Although recent sea ice reduction can increase the area and duration of productive condition for marine phytoplankton, the efficiency of the biological pump and the production of higher trophic levels may not be strongly enhanced in the changing Arctic Ocean.

P 063 BEHAVIOR OF WATER MASSES AROUND THE CHUKCHI BORDERLAND, WESTERN ARCTIC OCEAN

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We investigated the behavior of water masses around the Chukchi Borderland (CB) in the western Arctic Ocean using historical hydrographic survey data and yearlong ocean mooring data. The water masses were mainly analyzed with salinity, temperature, and ocean current. Anomaly of sea ice extent (SIE) is negatively correlated with temperature anomaly of the Pacific summer water (PSW) whereas it is positively correlated with salinity anomaly of surface melt water (MW). It implies that oceanic heat content from the Pacific plays a significant role on melting sea ice and increasing freshwater content in the western Arctic Ocean. Yearlong temperature and water velocity data showed spatial and temporal variations of water masses over the Chukchi Plateau (CP). The westward current was dominant in the southern CP while the southward current was significant in the northern CP from summer 2014 to summer 2015. From autumn to mid-winter of 2014, PSW in the southern CP appears to be suppressed by a mixed layer beneath sea ice and sustained for nearly 4 months, indicating that substantial heat storage within the PSW layer is associated with wind pattern (northeasterly) and sea ice covering. In addition, we will discuss on the relationship between water mass and biochemical properties (e.g., dissolved oxygen, nutrients, and chlorophyll-a) to understand the ecosystem response to the variation of water masses.

P 060 THE SEASONAL SUSPENDED PARTICULATE MATTER VARIATIONS AT THE FRONT OF THE TIDEWATER GLACIER HANSBREEN, HORNSUND (SPITSBERGEN)

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The tidewater glaciers are the main source of the SPM to the fjords of Arctic. The main goal of this work is to document the seasonal variations of SPM, POM and PIM amounts in Hansbukta, a glacial bay in front of Hansbreen, from May 2015 to June 2016. The SPM concentration ranged from 2.3 to 82.8 mg/l during the year. During the summer, the higher SPM amounts were in the near-surface, lower salinity water layer, namely 0-10 m. During the rest of the year, the SPM concentrated in deeper water, below 20 m (Fig. 1). The POM and PIM amounts ranged from 1.4 to 19.9 mg/l and from 1.4 to 75.4 mg/l, respectively, and their distributions in the water column were similar to total SPM (Fig. 2). The highest POM was in spring, mainly due to the phytoplankton blooms. The POM decreased in summer and autumn, while PIM concentration increased. The seasonal SPM concentration variations do not result only from glacial meltwater input, but from a combination of meteorological, oceanographical, biological and glacial forcings. The remote sensing-based studies focused on SPM distribution may not reflect the real SPM amount and variations in the glacial bays, since major SPM amount is in subsurface water.

Fig. 1. Yearly meteorological, oceanographical and SPM changes in Hansbukta. The upper water stands for 0-10 m, deeper water is below 20 m.

Fig. 2. POM and PIM concentrations in various seasons.

Acknowledgement

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P 061 INTERANNUAL VARIABILITY OF BOTTOM OXYGEN CONCENTRATION AND PRIMARY PRODUCTION IN THE SOUTHERN CHUKCHI SEA BIOLOGICAL HOTSPOT

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Hope valley located in the southern Chukchi Sea is known as one of the biological hotspot (southern Chukchi Sea hotspot, SCH). Large benthic biomass in the SCH is supported by high primary productivity through the water column. The dissolved oxygen (DO) sharply decreases at the bottom of SCH from summer to fall as a result of the high sediment community oxygen consumption in the benthic fauna, while DO is saturated during winter and spring. We examined annual/inter-annual variability of bottom DO and its mechanisms by analyzing ship-board and mooring hydrographic data, satellite derived primary production, and 1-D ecosystem model.The bottom DO showed large interannual variability (104-300 μM) and it negatively and significantly correlated with cumulative primary production ($r = -0.66$, $p < 0.05$). Such negative correlation suggests organic carbon flux to the sea floor drives the activity of the benthic community. Environmental process of decreasing in DO was assessed using the 1-D ecosystem model optimized for the SCH bottom layer. The model also captured bottom DO is sensitive to the flux of primary production from the upper layer. Our results suggest inter-annual variability of primary production is a key factor determining the recent changes in biomass and distribution of the benthic organisms.

P 062 N-ICE2015: OBSERVATIONAL STUDY ON DRIFTING ARCTIC SEA ICE NORTH OF SVALBARD FROM WINTER TO SUMMER

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Between January and June 2015 the Norwegian Polar Institute‘s research vessel Lance served as a research station in the drifting sea ice in the Arctic Ocean north of Svalbard during the international Norwegian young sea ICE (N-ICE2015) expedition. The main objective of the project was to understand the effects of the shift to a younger and thinner sea ice regime in the Arctic on energy flux, ice dynamics and the ice-associated ecosystem, and local and global climate. To improve our capacity to model the future, more direct observations in the Arctic are needed to understand key processes in the thinner ice world. The expedition consisted of drifts with RV Lance moored to in total four ice floes. Here we report on the layout of the study, the main work conducted during the campaign and some initial results. Data show that the behavior of the thinner sea ice regime is quite different from what we have learned from earlier work conducted on thicker sea ice prior to N-ICE2015. The data and results are also used in other related projects and initiatives, such as the project ID Arctic for increasing collaboration between Norway and the USA and Canada, and the Centre for Integrated Remote Sensing and Forecasting for Arctic Operations in Tromsø, Norway.

P 064 CALCULATION AND ANALYSIS OF SEA ICE DRIFT IN ARCTIC REGION USING SATELLITE DATA

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The first systematic observation of the ice drift had been held more than a century ago. Initially it was the visual (or using optical instruments at polar stations), then using the Arctic drifting buoys.

Drift of buoys can provide information sea ice motion with high temporal resolution, but, however, they provide only data of single tracks. Therefore, it is necessary to find supplementary ways to study sea ice motion. Spatial ice drift vector fields can be retrieved from remote sensing data. The sea ice motion is estimated by comparing the points of sea ice patterns in two subsequent snapshots.

We propose a feature tracking algorithm for sea ice drift retrieval from sequential satellite synthetic aperture radar (SAR) images. The method is based on feature tracking comprising of feature detection, description and matching steps.

The approach exploits the benefits of nonlinear multi-scale image representations using keypoints, which is a method that detects and describes image features in an anisotropic scale space that preserves important object boundaries while adaptively removing noise and small image details. These techniques were implemented as a part of ice drift retrieval algorithm and tested on dual polarized Sentinel-1A C-SAR extra wide swath mode data over Arctic Seas. Method contain several processing steps: SAR data preprocessing, feature point detection using scale-space image representation, feature description - construction of so-called descriptor which describes the area around feature point in a format of 1- D vector, feature matching step that results in ice feature displacement through the images and filtering of erroneous vectors.

To evaluate the developed of sea ice drift retrieval algorithm we performed a series of experiments over the Arctic seas. Data collection and processing is done in real time. Validation of the results performed in parallel and includes comparisons with other statistical and manual methods.

P 065 INTERANNUAL VARIABILITY OF PACIFIC WATER INFLOW INTO THE ARCTIC BASIN VIA BARROW CANYON

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Over the past few decades, sea ice retreat during summer has been enhanced in the Pacific sector of the Arctic Basin, in part due to increasing summertime heat flux of Pacific-origin water from the Bering Strait. Barrow Canyon, in the northeast Chukchi Sea, is a major conduit through which the Pacific-origin water enters the Arctic Basin. Our study focuses on the quantitative estimate of volume, heat and freshwater fluxes through Barrow Canyon by mooring observations and its impact on Pacific water variability in the Canada Basin. We conducted year-round mooring observations from 2000 to 2016 in the mouth of Barrow Canyon. The annual mean poleward volume, heat and freshwater fluxes through Barrow Canyon were 0.43 Sv, 31 mSv and 2.12 TW. The annual averaged heat flux displayed substantial interannual variability, ranging from 0.93 TW to 3.34 TW. Comparing heat content in the Barrow Canyon and satellite derived sea surface temperature around Barrow Canyon, we derive and assess a proxy for estimating heat content in the canyon for the summer time period, which is when most of the heat passes northward towards the basin. The estimated heat content shows increasing trend from 1980 to 2015 and 1.5 times larger than the average value from 1980s to 2010s. Measurements from hydrographic surveys in the Canada Basin since 1990 reveals that warming of Pacific summer water layer in the Canada Basin tended to be enhanced around 2010s, probably due to higher heat transport via Barrow Canyon into the basin in 2007, 2010 and 2012.

P 066 CALCIUM CARBONATE SATURATION STATES IN THE CHUKCHI SEA DURING THE SUMMER 2016

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Aragonite saturation states were calculated from dissolved inorganic carbon (DIC) and total alkalinity data collected over the Chukchi Sea in the summer 2016. The surface waters (0-50 m) were supersaturated with respect to aragonite. In the Chukchi slope area, the aragonite undersaturation was observed at the water depths of 50-250 m. In the Chukchi basin area, aragonite undersaturation was found at a little deeper depth, 75-300 m. The deep waters (300-2000 m) were supersaturated with respect to aragonite. The aragonite undersaturation at the middle depths was probably associated with the acidic waters (high DIC and low pH) which were produced by the organic matter remineralization and transported from the Chikchi shelf area. Nutrient (N, P, Si) concentrations showed a maximum at the aragonite undersaturated depths, which supported the above explanation.

P 067 EFFECT OF SEA ICE MELTING PROCESSES ON PHYTOPLANKTON PHYSIOLOGY IN THE NORTHERN CHUKCHI SEA

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We investigated phytoplankton physiology in the northern Chukchi Sea in the late summer of 2015 and 2016 during cruises of icebreaker R/V Araon. We used a novel ultra-sensitive Fluorescence Induction & Relaxation system, called a mini-FIRe, to measure a set of parameters that characterize photosynthetic light-harvesting processes, photochemistry in Photosystem II (PSII), and the photosynthetic electron transport rate. The amount of sea ice was greater in the late summer of 2016 than in 2015. Due to difference in sea ice extent, the thickness of the surface low-salinity layer was larger in 2015 than in 2016. The influence of fresh water content enhanced the stratification in the upper ocean. The stratification index calculated by the density profile was larger in 2015 than in 2016. Previous studies reported that the thickness of freshwater layer may also affect the depth of nitracline, which was closely related to depth of subsurface chlorophyll maximum (SCM), because nitrate is usually the main limiting nutrients in the Arctic Ocean. As a result, depths of nitracline and SCM in 2015 were 39±10 m and 53±6 m, which were deeper than the depths of 30±11 m and 45±10 m in 2016. There was a statistically significant correlation between freshwater content and the depth of nitracline ($r=0.78$, $p<0.01$). In physiological parameters of phytoplankton, the quantum efficiency of photochemistry in PSII ($Fv/Fm = 0.43\pm0.09$) in MLD was about 20% lower than that (0.55 ± 0.03) in SCM, because of nitrate depletion in the surface layer. The functional absorption cross section of PSII () in SCM depth were higher than those in MLD indicating that the phytoplankton improved its light-harvesting capability of the photosynthetic pigments under low light condition in depth of SCM. We will discuss how the difference in thickness of fresh water from melting sea ice influences the physiological status of phytoplankton.

P 068 SYNERGISTIC USE OF SATELLITE OBSERVATIONS TO STUDY ARCTIC OCEAN FRESHWATER CHANGES

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Arctic Ocean freshwater content and distribution are changing due to the combined effects of river runoff, precipitation, sea-ice melt, and wind-driven ocean circulation. These changes can impact North Atlantic Ocean circulation and the related transports of heat, freshwater, carbon, and nutrients that have potential influence on climate and weather as well as water cycle and biogeochemistry. Satellite observations can alleviate the sparsity of in-situ salinity observations in the Arctic Ocean. This study explores the complementarity of satellite observations of sea surface height anomaly (SSHA), ocean bottom pressure (OBP), and sea surface salinity (SSS) to characterize Arctic Ocean freshwater content, distribution, and pathways and to decipher the freshwater sources. OBP measures changes in ocean mass due to freshwater inputs from runoff and precipitation. The difference between SSHA and OBP anomaly provides an estimate of steric change integrated over the water column, which is mostly due to salinity change in the upper Arctic Ocean. SSS is indicative of the effects of runoff, precipitation, and sea-ice melt as well as being affected by ocean dynamics. Moreover, SSS is expected to be coherent with the freshwater content in the halocline, thereby providing a potential proxy for freshwater content. Nevertheless, the current L-band radiometers used to measure SSS have relatively low sensitivity to salinity in cold waters. While technology advancement is being explored to improve the sensitivity, it is worthwhile to examine the capability of current satellite SSS in depicting the Arctic Ocean given the large magnitude of Arctic SSS signal that helps improve the signal-to-noise ratio. This presentation will highlight results of these investigations using satellite-derived SSHA, OBP, SSS, and a 4-dimensional variational ocean data assimilation product, as well as the implications for future satellite observing system needs.

P 069 DYNAMICS OF NONLINEAR INTERNAL WAVES ACROSS KARA STRAIT

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It has been revealed that the nonlinear internal waves are ubiquitous around the Kara sea, a marginal sea of the Arctic ocean. Three hotspot source, one of which is the Kara Strait, has been identified based on Envisat Asar. In this work, the generation and evolution of nonlinear internal wave by the interaction of tide and topography across the Kara Strait is studied based on an nonhydrostatic numerical model. The model captured most of the wave characteristics as from the satellite data. Typical wavelength in the Barents sea side is about 25km in the summer season with an phase velocity of about 0.6m/s, the northward background current could intensify the accumulation of energy during the generation process and has little influence on the other properties of the generated waves. One interesting phenomenon is the single solitary wave structure followed the main wave trains, with a following distance of about 5-8km. It is found from the numerical results that this wave is generated with the leading wave packets at the same tidal period. The difference is that this wave is generated by the impinging of an internal tide beam with the pynocline from the north side slope, while the leading wave evolved from the unsteady lee wave mechanism. In the winter, due to the growth of sea ice, stratification across the Kara strait is mainly determined by the salinity with an almost uniform temperature close to the freezing. The pynocline deepened close to the middle of the water and so the nonlinear internal wave process is not so significant compared with its counterpart in the summer.

P 070 REGIONAL CHARACTERISTICS OF SEA ICE THICKNESS IN CANADIAN SHELF AND ARCTIC ARCHIPELAGO MEASURED BY GROUND PENETRATING RADAR

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Ground Penetrating Radar (GPR) measurements of sea ice thickness including undeformed ice and ridged ice were carried out in the central north Canadian Archipelago in spring 2010. Results have shown a significant spatial heterogeneity of sea ice thickness across the shelf. The undeformed multi-year fast ice of (2.05±0.09)m thick was investigated southern inshore zone of Borden island located at middle of the observational section, which was the observed maximum thickness in the field work. The less thick sea ice was sampled across a flaw lead with the thicknesses of 1.05±0.11m for the pack ice and 1.24±0.13m for the fast ice. At the northernmost spot of the section, the undeformed multi-year pack ice was (1.54±0.22) m thick with a ridged ice of 2.5-3 m. At the southernmost station (SL), nevertheless, the undeformed sea ice thickness was around (1.67±0.16) m, which was significantly thinner than that of (3-5) m at the same area in 1970s (Melling, 2002).

P 073 FATE AND INVENTORIES OF PAHS IN THE ARCTIC DEEP SEA: IMPACT FROM ICE-MELTING AND WATER MASSES

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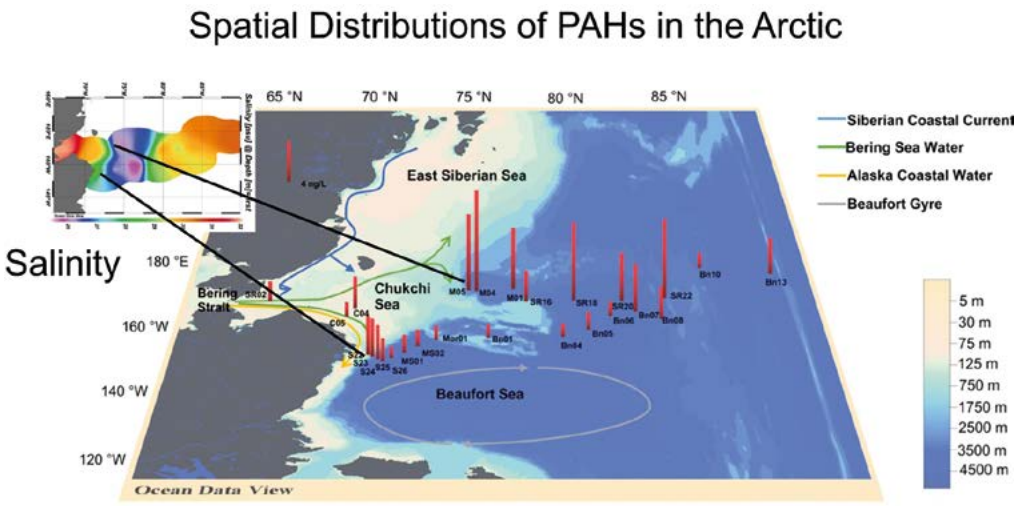
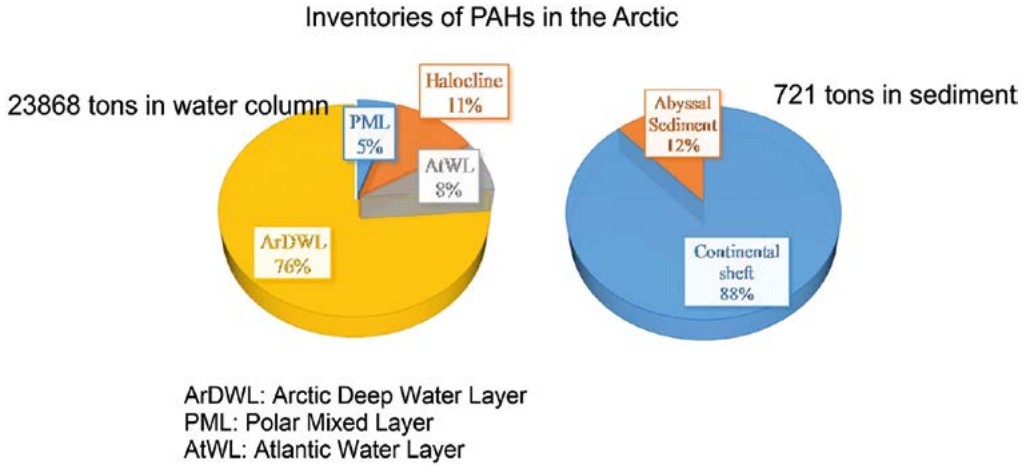
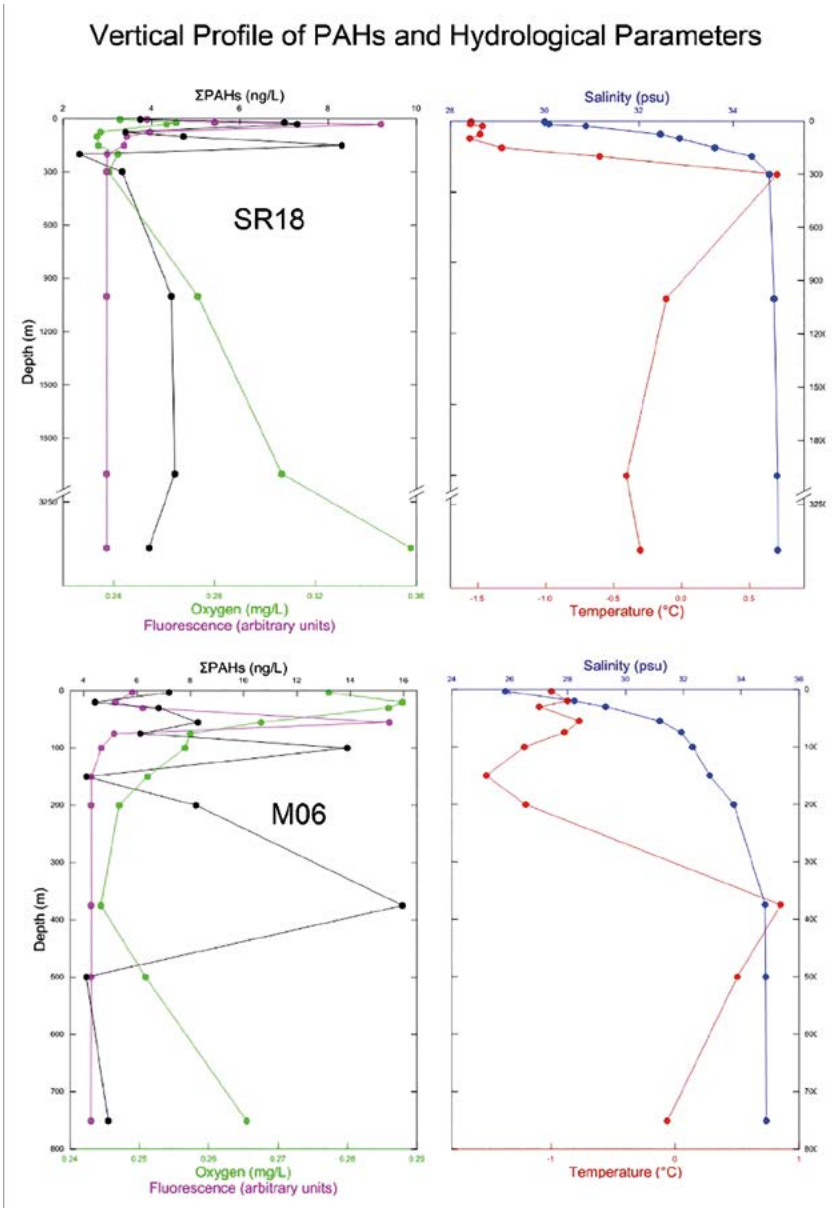




ArDWL: Arctic Deep Water Layer
PML: Polar Mixed Layer
AtWL: Atlantic Water Layer



Under the background of global warming, the fate of semi-vlatile persistent organic pollutants (POPs), such as polycyclic aromatic hydrocarbons (PAHs), will be susceptible to sea ice/snow melting and the changes of hydrologic condition in the Arctic. In this study, dissolved PAHs in the 26 surface waters and 6 vertical profiles, as well as PAHs in surface sediments from the Chukchi Sea to the central Arctic ocean (67.50°N-88.39°S) in 2010 were investigated. Firstly, detected $\sum_7$PAHs concentrations in surface seawater were in the range 1.11 to 10.02 ng L^{-1}, and generally showed a decreasing trends with altitude increasing. PAH concentrations near the Siberian (averaged 5.75 ng L^{-1}) were obviously higher than those near the Alaska side (averaged 2.18 ng L^{-1}), which may indicate the influence of surface ocean currents spatial disparity. Surprisingly, distinct higher PAHs levels were observed near the continental shelf break of Chukchi Sea, located in the marginal ice zone with a relatively low salinity (averaged 26.42 psu), implying the significant possibility of PAHs release from sea-ice melting and enhanced riverine input in summer. Depth profiles of dissolved PAHs in the Arctic generally showed a subsurface-maxima and depth-depletion distribution pattern, however, maximum values of PAHs has also been observed in intermediate and near-bottom depth. Inventory results of PAHs in water columns and sediments revealed that intermediate and deep seawater were main compartments for PAHs, and 88% of the PAHs in the Arctic sediment were reserved in the continental shelf area (645.97t), demonstrating the important role of the Arctic shelf in burying anthropogenic carbon. At present, we are also working on the detection of PAHs, together with its compound-specific carbon isotope, and basic parameters in a sediment core from the Chukchi sea, seeking to reconstruct the deposition and source history of PAHs in the Arctic.

P 074 PARTICULATE EXPORT AND BIOLOGICAL PUMP CONTROLS ON PAHS IN THE PACIFIC ARCTIC

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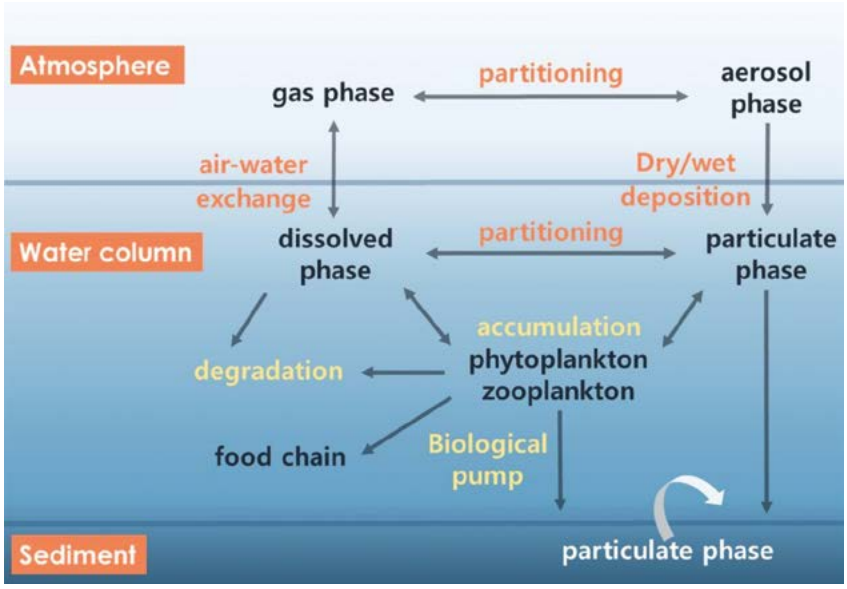

The Pacific Arctic is undergoing rapid changes in terms of climate and organic matter stocks, which have presumably posed an influence on the fate of persistent organic pollutants (POPs). The dissolved POPs are potential to be depleted by the key biogeochemical processes in the water column, such as accumulation in planktonic organisms and the subsequent settling, which consequently drive a diffusive adsorption flux from the atmosphere to the water. Here, polycyclic aromatic hydrocarbons (PAHs) were measured in samples of full-depth water columns from the Bering Sea and the Pacific Arctic during the summer of 2012. PAHs in the dissolved phase ranged from 0.7 to 12.0 ng L^{-1}. The partition coefficients of PAHs between particulate and dissolved phases, which ranged from 0.3 to 24, increased continuously with depth. Based on the disequilibria between $^{210}Po/^{210}Pb$ and their applications in estimating particulate organic carbon (POC), the vertical fluxes of particulate PAHs out of the surface seawater were 0.7, 11.2 and 1.3 ng m^{-2} d^{-1} in the Bering Sea respectively. Except the phytoplankton activities, the hydrological stratification was suggested to be responsible for the surface-enrichment depth-depletion distribution. The upper thermocline probably weakened the vertical diffusion and gave rise to a sub-maximum of PAHs at the depth of 200 m. Such export fluxes reflected the variability in contaminant concentrations and nutritional conditions. In conclusion, field evidence and quantification for the influence of the biological pump on POPs depletion in water columns were presented in this study, which also suggests that radioactive isotope disequilibria provided a powerful path for quantifying the ocean's biological pump control on the POPs.

P 075 THERMODYNAMIC TRANSFORMATIONS OF ICE RUBBLE IN COLD AND WARM WATERS

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Sea ice ridges are formed due to the compression of sea ice in places of floes contact. Ice rubble consists of a set of ice blocks submerged into the water or pushed out at the surface of surrounding level ice. From numerous field studies it is known that old ice ridges are fully consolidated, while in the first year ice ridges ice blocks occupy from 60% to 80% of total ridge volume, and voids between the ice blocks are filled with the water in submerged part of the rubble. Thermodynamic consolidation of ice rubble occurs due the water freezing between submerged ice blocks under the influence of the atmospheric cooling and due to the freezing of freshened water trapped inside the rubble. The water freshening is caused by ice rubble melting from below. In the present study we consider new model of thermodynamic consolidation of sea ice rubble taking into account both of above mentioned physical mechanisms of thermodynamic consolidation and analyze the process depending on the atmosphere and ocean heat fluxes. It shown that for the ocean heat flux less than 10 W/m2 representative time of full consolidation of ice rubble is about 500 days. The ocean heat flux to ice rubble can reach 100 W/m2 when the rubble drifts from cold water region to warm water region with water temperature around 0C - +1C. In this case thermodynamic consolidation due to the melting of the ice rubble from below occurs during few tens of days. The last effect can be important for characterizing ice conditions in the regions of offshore development in the Barents Sea. From large scale view point ice rubble consolidation is associated with formation of new ice and gives an input in fresh water balance in the Arctic.

P 076 INTERRANUAL VARIABILITY OF THE SEA ICE DRIFT AND ITS CONNECTION WITH SEA ICE AREA FLUCTUATION IN THE ARCTIC OCEAN (1979–2016)

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In the last decade the problem of global warming has attracted great interest largely due to the Arctic sea ice area decreasing and its dramatical minimums in the 2007 and 2012. Many scientists consider the thermal factor as the main cause of the ice reducing. But in the last 100 years the surface ocean temperature increased almost linearly, while the ice cover experienced significant fluctuations.

To explain these fluctuations was made a research of the dynamic factors, influense on the sea ice in the Arctic. The dynamic processes also are reflected in the ice cover structure: the ice movements change the distribution of the ice and its thickness.

On the base of the satellite data and the ice drift fields calculation (1979-2016) we made a research of the core large-scale structures of the Arctic sea ice drift: Transpolar drift and Beaufort gyre. These elements have time cycles with a predominance of different frequencies in the Eurasian and Amerasian parts of the Arctic basin. The intensity and the position of the Transpolar drift and the center of the Beaufort gyre is changing from year to year, creating the conditions for various ice distribution and ice removal.

Different types of surface water and ice circulation is formed under the influence of atmospheric pressure and wind fields over the Arctic ocean. The survey of predominant synoptic types in each year led us to allocation of the types, that can create the conditions for ice accumulation (at an agreeable temperature range), for ice removal and for the sea ice opposition formation.

The variability of the ice drift under the influence of the global atmospheric circulation plays an important role in the formation of the conditions, that defines the changing of sea ice area and the average thickness of the ice in the Arctic Ocean.

P 077 PREDICTABILITY OF THE ARCTIC SEA-ICE EXTENT BY CLIMATE MODEL MIROC

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To examine the predictability of Arctic sea-ice extent (SIE) on seasonal time scales, we carried out ensemble hindcasts initialized in January, April, July, and October for each year from 1980 to 2011, using the Model for Interdisciplinary Research on Climate, version 5. The predictive skills suggest that winter SIE can be predicted until 3-12 months ahead, especially 1 year for December. Lagged correlation and regression analyses show that December SIE is closely related to the sea-ice states over the Barents Sea in December and the ocean heat content originating in the North Atlantic in March-September, which suggests sources for the Arctic December SIE prediction. Conversely, only the hindcast started in July has significant skill for September SIE, possibly, due to the sea-ice states over the Beaufort, Chukchi, and East Siberian Seas.

P 078 CARBON TURNOVER IN A KELP BELT FOOD WEB IN KONGSFJORDEN (SPITSBERGEN)

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Quantitative descriptions of Arctic coastal ecosystems using ecosystem models are scarce, but particularly needed to understand and predict the impact of environmental changes at ecosystem level. For the first time the carbon flow through an Arctic kelp belt was studied by dividing the kelp belt in four subsystems at 2.5, 5, 10 and 15m along a depth gradient. For each of the subsystem a quantitative food web was constructed, consisting each of 18 living and 2 non-living compartments. Ecological network analysis methodologies were used to compute ecosystem level indices for each of the subsystems: total system throughput, average path length, developmental capacity, relative redundancy and Finn cycling index. The kelp dominated subsystem at 2.5, 5, 10 m sustained the highest heterotrophic biomass and production and kelp alone accounted for 24.3, 8.4 and 1.3 % of the subsystem total system throughput at 2.5, 5, 10 m, respectively. The total system throughput of the four subsystems decreased from 8525 mgC m^{-2} d^{-1} at 2.5m to 1943 mgC $m^{-2}d^{-1}$ at 15m. The average path length and relative redundancy increased with increasing depth, ranging from 23.5 (2.5 m) to 33.8 % (15m), indicating higher stability of the system at deeper depth. Detritivory exceeded herbivory in all subsystems, while the relative amount of detritivory increased along the depth gradient. The decreased relative redundancy and Finn cycling index at shallow depth (2.5 and 5 m) suggested a less matured system still undergoing successional development.

P 079 OBSERVED COVARIABILITY OF ARCTIC AND NORTH ATLANTIC FRESHWATER CONTENT

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Recently, freshwater changes have been observed both in the Arctic Ocean and the subpolar North Atlantic. Aiming on investigating possible links we compared the liquid freshwater content of the subarctic North Atlantic with the sum of liquid and solid freshwater content of the Arctic Ocean from observations. We find a significant multidecadal anti-correlation of the freshwater anomalies in these two regions. Furthermore these changes are correlated with the Arctic and North Atlantic Oscillation indices. We suggest Arctic freshwater accumulation and release as a response to multidecadal alternations of the dominant large-scale atmospheric variability. Moreover, we suggest changing freshwater export from the Arctic Ocean as a consequence to be responsible for the anti-correlation between the two regions. According to the present phase of this large-scale atmospheric variability, the freshwater accumulated during the previous decades in the Arctic Ocean might be released into the sub-Arctic Seas in the coming years. This has the potential to impact on the North Atlantic meridional overturning circulation. To further investigate the involved processes and proof our hypotheses we show results from a simulation using a global finite-element sea-ice-ocean model.

P 080 ANOMALOUSLY LOW CENTRAL ARCTIC SALINITY IN A YEAR OF CONVERGING ATMOSPHERIC CONDITIONS

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The Arctic Ocean has shown several years of very low sea-ice extent and redistribution of liquid freshwater within the region since the the 1990s. Yet, the mechanisms underlying this variability in the light of decadal trends and oscillations are not fully understood.

Using obervations, we show anomalously low salinity in the central Arctic during summer 2015. Values of practical salinity at the North Pole were around 28, whereas they were 30 or more in prior observations since 1992. The freshwater inventory from the surface to the 34 isohaline paints a similar picture with the anomaly continuing into 2016.

We find that the freshwater anomaly is likely driven by above average levels of sea-ice melt and Ekman transport from the direction of the Siberian shelves and of the Canada Basin. This is associated with strong freshening of Polar Surface Water and elevated levels of waters of Pacific origin throughout this layer. Our results are part of Arctic-wide changes in sea-ice cover and freshwater distribution on decadal timescales.

P 081 UNDER-ICE TURBULENT MICROSTRUCTURE AND UPPER OCEAN VERTICAL FLUXES IN THE MAKAROV AND EURASIAN BASINS, ARCTIC OCEAN, IN 2015

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The Arctic Ocean is generally assumed to be fairly quiescent when compared to many other oceans. The sea-ice cover, a strong halocline and a shallow, cold mixed-layer prevents much of the ocean to be affected by atmospheric conditions and properties of the ocean mixed-layer. In turn, the mixed-layer and the sea-ice is largely isolated from the warm layer of Atlantic origin below by the lower halocline. Yet, the content of heat, freshwater and biologically important nutrients differs strongly between these different layers. Hence, it is crucial to be able to estimate vertical fluxes of salt, heat and nutrients to understand variability in the upper Arctic Ocean and the sea-ice, including the ecosystem. Yet, it is difficult to obtain direct flux measurements, and estimates are sparse.

We present several sets of under-ice turbulent microstructure profiles in the Eurasian and Makarov Basin of the Arctic Ocean from two expeditions, in 2015. These cover melt during late spring north of Svalbard and freezeup during late summer / autumn across the Eurasian and Makarov basins. Our results are presented against a background of the anomalously warm atmospheric conditions during summer 2015 followed by unusually low temperatures in September.

4-24 h averages of the measurements generally show elevated dissipation rates at the base of the mixed-layer. We found highest dissipation levels near the Eurasian continental slope and smaller peaks in the Makarov Basin where Bering Sea Summer Water (sBSW) lead to additional stratification within the upper halocline. The elevated levels of dissipation around sBSW and the base of the mixed-layer were associated with relatively low levels of vertical eddy diffusivity.

We discuss these findings in the light of the anomalous conditions in the upper ocean, sea-ice and the atmosphere during 2015 and present estimates of vertical fluxes of heat, salt and other dissolved substances measured in water samples.

P 082 CLUSTER III (PUTATIVE ANAEROBIC BACTERIA) DOMINATE THE DIAZOTROPH COMMUNITY IN THE CHUKCHI SEA, PACIFIC SECTOR OF THE ARCTIC OCEAN

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Marine nitrogen fixation is recently considered to occur in colder regions including Arctic Ocean beyond tropics and subtropics. The overlooked nitrogen fixation could contribute to global nitrogen budget and local nitrogen cycling, but in the Arctic Ocean, we are only beginning to study the nitrogen fixation. The present study examined diazotroph community structure and activity in the Chukchi Sea, Pacific sector of Arctic Ocean. Simultaneously, nitrate assimilation rate was determined to evaluate importance of nitrogen fixation to the nitrogen cycling. The diazotroph community determined by Illumina amplicon sequencing of *nifH* gene, encoding the iron subunit of nitrogenase, was mainly composed of Cluster III phylotypes (putative anaerobes), which is clearly unique from other oceanic regions. The most highly recovered operational taxonomic unit was identical with sediment derived *nifH*. Interestingly, the *nifH* sequences except Cluster III are mostly affiliated with UCYN-A2, which is considered to thrive in subtropical and temperate regions. UCYN-A2 was minor constituent in the diazotroph community (max. 15% of total sequence), and the distribution pattern of UCYN-A2 abundance determined by qPCR analysis was different from that of nitrogen fixation, suggesting that most of UCYN-A2 were inactive. Nitrogen fixation vertically sporadically occurred at almost all stations, seemed to be not related with light environment, and was detected not only nitrate-depleted (< 0.1 μM) waters but nitrate-rich (> 1 μM) waters. Depth-integrated nitrogen fixation ranged from 2.00 to 37.5 μmol N m^{-2} d^{-1} (average 10.7±7.36 μmol N m^{-2} d^{-1}), and was negatively correlated with sea surface temperature. This relationship is inverse in the tropical and subtropical ocean. Nitrogen fixation sometimes exceeded nitrate assimilation in oligotrophic waters, and thus, it was significant new nitrogen source in a local scale.

P 083 RAPID GLACIER RECEDING AND FORAGING HABITATS OF MARINE BIRDS AND MAMMALS IN THE ARCTIC FJORD

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Climate-induced glacier retreat is considered in the context of its reducing the sea-ice contact zone used by marine birds and mammals as important foraging grounds and may cause declines in their numbers. To test this hypothesis, a survey was conducted in diversified habitats of a rapidly deglaciating Arctic fjord in Svalbard. Of the 15 seabird and four mammal species found, coastal surface-feeders prevailed over benthic-feeders and pelagic pursuit-divers. Deep tidewater glacier bays were used by the most numerous but least heterogeneous foraging community, in contrast to the shallow lagoons of coastline-terminating glaciers and deglaciated shorelines. After the 15 years of glaciers retreat documented in Hornsund, the sea-ice contact zone used by birds and mammals has not declined. On the contrary, the increasing freshwater supply from underwater glacial rivers raising zooplankton up to the surface, thus making it available to seabirds, enhances the attractiveness of tidewater glacier bays. Along with the

stage of retreat, the importance of glacier bays as feeding grounds changes. Foraging conditions deteriorate when the glacier terminus reaches the coastline and the glacier bay becomes shallower. However, glacier retreat enlarges the area of littoral habitats accessible to benthophages. Glacier-related habitats situated close to colony are used as alternative/emergency feeding grounds by seabirds that normally forage outside the fjord. This is especially important during the chick-rearing period and also during bad weather conditions in the open sea. Our study demonstrates that, so far, the abundance and species diversity of seabirds foraging in the rapidly deglaciating Hornsund are both high, suggesting that they benefit from the current intensive glacier melt. However, with further climate change an apparent biodiversity paradox may occur. Here, overall biodiversity will increase but local diversity of pagophilic species will decline. Such nonlinear responses complicate the prediction of future polar ecosystem dynamics.

P 084 FORMATION METHANE IN FREEZING SEDIMENTS IN TIDAL AREA OF THE KARA SEA

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A problem of impact of climatic changes on the state and properties of the permafrost region is widely discussed in the literature. Along with the permafrost degradation under continental conditions, the processes of permafrost aggradation have been observed in the modern deposits of the Arctic seas. Modern low accumulative surfaces (i.e. tidal flats) are relatively widespread along the Kara Sea coast. Modern marine accumulative landforms, accumulative alluvial-marine lowlands are also widespread at the river estuaries. The borehole (69°36`, N 66°49` E) was drilled from the surface of tidal flats near Marre-Sale weather station in the area of modern marine sedimentation; 2.5-m-deep borehole was equipped with metallic pipe 76 mm in diameter. The surface of tidal flats is covered with water during tides, surge waves, and storms. The boreholes were drilled and soil samples were collected to determine concentration and isotopic composition of methane using a “head space” method. Concentration of methane in soil samples was determined in the Institute of Physical, Chemical, and Biological Problems in Soil Science RAS using a gas chromatograph ХПМ 4 with flame ionization detector. Based on distribution of methane concentration with depth, we can conclude that the soil temperature of -3.5 to -4.0°C is a threshold for bacterial methane production in conditions of tidal flats of Western Yamal. Methane cannot be produced in frozen saline soils when the temperatures are below this threshold. Frozen soils contain only preserved methane which was produced before the freezing.

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P 085 PAN-ARCTIC OCEANIC VOLUME, TEMPERATURE & HEAT TRANSPORT VARIABILITIES DURING 2004–2010

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Entire Arctic boundary through Bering, Davis, Fram Straits and Barents Sea Opening (BSO) has been monitored since 2004. Gathering of all the data together allows for a comprehensive estimate of oceanic transports across the Arctic gateways: quasi-synoptic estimate in summer 2005 [Tsubouchi et al., 2012] and a full annual cycle in Sep. 2005 - Aug. 2006 [Tsubouchi et al., in review].

Followed by the previous studies, this study aims to reveal, for the first time, an inter-annual variability of horizontal oceanic heat transport through the Arctic gateways. We analyze around 1,000 moored instruments across the pan-Arctic boundary during October 2004 to May 2010, with supplement of 37 repeat CTD sections in BSO. Volume conserved velocity fields are obtained applying box inverse model for consecutive 68 months. The result shows that obtained volume transports are reasonable both in averaged value and it’s variability in each four Arctic gateway. We quantify amount of heat exchanged between Arctic Ocean and surrounding seas due to the ocean circulation is 154±50 TW (mean ± standard deviation) by summing up oceanic temperature transports in each gateway (figure 1). We find that the net oceanic heat transport has a clear seasonal cycle, with highest values of ~210 TW in October-December and lowest values of ~100 TW in April-June. We also find that magnitude of the seasonal cycle changes from year to year. We will investigate driving factors of the variability and it’s impact on the sea ice extent variability.

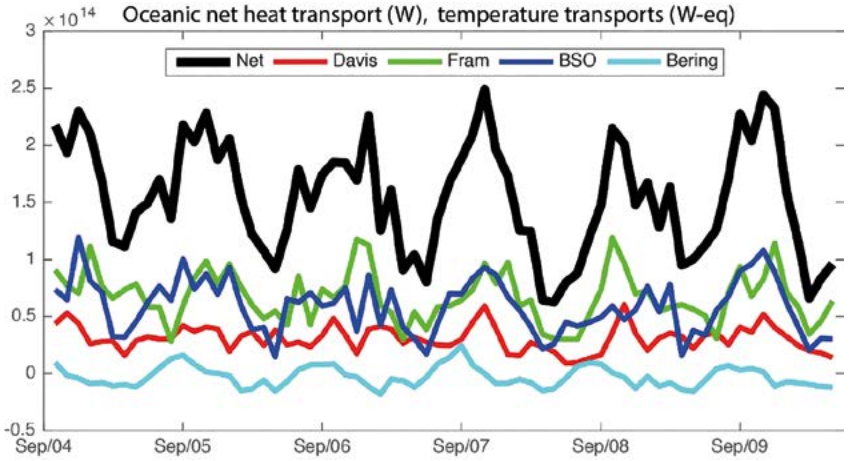

Figure 1: Net oceanic heat transport (W) in black, and its component of oceanic temperature transport in each gateway (W-eq) in colours.

P 086 DEGRADATION OF SUBMARINE PERMAFROST AND METHANE EMISSION: AN EXAMPLE OF KARA SEA

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Permafrost plays an important role in global climate change and affects biological, hydrological and human activities in the Arctic. According to the modern understanding, submarine permafrost (SMP) in the Kara Sea shelf can be encountered in the area from the coastline up to the water depth of 120 m, which corresponds to decrease in the sea level during the Last Glacial Maximum about 20,000 years ago. Potential depth of freezing and corresponding SMP thickness could reach 300 to 400 m.

A map of SMP distribution of Kara Sea was developed basing on the drilling data and high-resolution seismo-acoustic profiling for SMP identification. The SMP of Kara Sea has a discontinuous character.

Data of sea bottom temperature (SBT) from 1900 to 2000 was analyzed, and the rate of SBT increasing was estimated as 0,5 - 2,5 degrees/100 years for the different regions of Kara Sea.

2D computer model of SMP degradation was developed for the numerical calculations. The real rate of the Permafrost degradation under modern thermal conditions is about 2-4 cm. per year. Using the methane content data in the frozen Quaternary sediments it allows us to estimate an additional methane flow into sea water.

This study is supported by RSF, grant №16-17-102. Methane content in frozen Quaternary sediments is studied in framework of RFFI grant № 16-05-00612.

P 087 WINTER TRANSPORT OF SUBSURFACE WARM WATER TOWARD THE ARCTIC CHUKCHI BORDERLAND

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Winter transport of subsurface warm water toward the Arctic Chukchi Borderland was investigated by mooring measurements and modeling analyses. In mid-winter or spring of 2011-2014, subsurface warming signals under sea ice were detected by the multi-year bottom-tethered mooring data in the Chukchi Abyssal Plain (CAP) of the western Chukchi Borderland. Lateral advection of shelf-origin ocean heat is a key process for the subsurface warming. To address the detailed pathways and processes of subsurface warm water transport, an interannual experiment for 2001-2014 was performed using a pan-Arctic sea ice-ocean model configured in a high-resolution framework. The horizontal grid size was set to approximately 5 km so that narrow intense currents along complex sharp topography could be resolved. The model result captured the similar seasonality of subsurface temperature in the CAP region and produced interannual variability in the ocean heat content associated with the shelf-origin water distribution around the Chukchi Borderland. In addition to the Barrow Canyon throughflow, westward jet streams along the steep flank of the Chukchi shelf break constituted a primary pathway for the subsurface warm water transport toward the Chukchi Borderland. Since the shelf break jet was much faster than main streams of the Beaufort Gyre, its individual role as an efficient ocean heat conveyor should be considered separately. Whereas ocean heat in the Chukchi shelf break region was partly lost via wind-driven turbulent mixing into upper halocline depths, a substantial amount of the subsurface warm water remained even after mid-winter. The highly stratified condition due to anomalous sea ice meltwater was further preferable for the winter heat transport.

P 088 HETEROTROPHIC PROTISTS COMMUNITY AND GRAZING IMPACTS ON THE PICOPLANKTON IN THE CHUKCHI SEA AND EAST SIBERIAN SEA, ARCTIC OCEAN

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To examine the importance of heterotrophic protists in the plankton ecosystem of Arctic ocean, we investigated the heterotrophic protistan community and its grazing impact on picophytoplankton and bacterioplankton in the Chukchi borderland and Mendeleyev Ridge using the icebreaker R/V Araon as a part of the Korean Arctic Research Program. A variety of environmental conditions and trophic condition were encountered, from low chlorophyll-a in the Chukchi borderland to diatom bloom (maximum 17.1 ug L^{-1}) in the northern part of the East Siberian Sea which is characterized by high phytoplankton and bacterial biomass driven by the influx of more productive waters from the river. Picophytoplankton biomass accounted for 11 to 83% of total phytoplankton and for a greater percentage in the Chukchi borderland. Of the heterotrophic protists, naked ciliates dominated at low chlorophyll-a concentration area and small heterotrophic dinoflagellate dominated at high chlorophyll-a concentration area. Heterotrophic protists exerted higher grazing pressure on picophytoplankton compared to bacterioplankton. Picophytoplankton growth rate and mortality rate ranged from undetectable (i.e. not significant) to 2.0 d^{-1} and undetectable to 2.4 d^{-1}, respectively. Heterotrophic protists removed >100% daily picophytoplankton production, and their grazing rate was highest in the Chukchi borderland. Bacterioplankton growth rate and mortality rate ranged from undetectable (i.e. not significant) to 1.74 d^{-1} and undetectable to 1.07 d^{-1}, respectively. Heterotrophic protists often removed average 89% of daily bacterioplankton production. Therefore, heterotrophic protist were the major consumers of picoplankton production, and that their grazing is one of the most important loss process affecting the picophytoplankton and bacterioplankton biomass during summer in the Arctic Ocean. This study suggests the importance of microbial loop in the planktonic ecosystems of the Arctic Ocean.

S06 ARCTIC HYDROLOGY: BIOGEOCHEMICAL AND PHYSICAL FLUXES

O 134 SUSPENDED PARTICLES CHARACTERISTICS AND FLUXES IN AN ARCTIC FJORD (KINGSBAY, SVALBARDS)

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As a part of the ESCOFAR project, an experiment was carried out during the summer 2015 along the coastal waters of Kongsfjorden in Svalbards to quantify the inputs and behaviour of meltwaters and associated suspended particles. We used in-situ optical and acoustic measurements to assess the hydrological and hydrodynamic characteristics of coastal waters as well as suspended particles properties, mostly composed of sediments, in a source to sink approach. Results allowed us to identify the structure of turbid meltwater plumes that are exported toward the exit of the fjord. The transfer of suspended particles is made through a large surface plume as revealed by satellite image. This plume is fed by two sources: the most important one was an upwelling of fresh and turbid water coming from a tide-water glacier: the Kronebreen, and the secondary one from a continental glacier: the Kongsvegen. We estimated that these two sources discharged about 2.5 ± 0.36 × 106 t of suspended sediments during the two months of melting. The major part of these sediments is deposited within the first kilometre due gravitational forces for the coarser fraction and due to flocculation phenomenon for the finest fraction. In the absence of organic matter, flocculation is caused by the salinity gradient and high suspended particles concentrations, initiated below the surface turbid plume. Finally, our estimates of suspended particles fluxes by a typical arctic coastal glacier showed that it's important to consider sediment fluxes from arctic glaciers into the global sediment budget in the context of climate change. The increase of suspended particles fluxes into the coastal area may also cause severe damages to the ecosystem due to limitation of light availability and high bottom sedimentation rates.

O 135 ARCTIC CATCHMENT RELEASES MOSTLY YOUNG AQUATIC CARBON DESPITE COMPLETE THAWING OF OLD ORGANIC-RICH PERMAFROST SOILS DURING GROWING SEASON

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Radiocarbon (^{14}C) dating of dissolved organic carbon (DOC) in Arctic freshwaters has been used as a crucial tool for detecting old C mobilised from thawing permafrost, but DO^{14}C in major Arctic rivers is usually quite young. The mobilisation of old C sourced from deepening permafrost soil active-layers into Arctic freshwaters has the potential to form a significant positive climate feedback.

We compare ^{14}C in DOC and CO_2 at five time points over a single growing season from streams, ponds and lakes underlain by continuous permafrost in the western Canadian Arctic. Using age distribution analysis based on atmospheric $^{14}CO_2$ records, we estimated the age of aquatic C that would otherwise be labelled as "modern" due to the ^{14}C bomb peak. We then calculated the vertical and lateral C fluxes in the study systems, and estimated the proportion derived from old permafrost C. The upper organic-rich soils are the dominant hydrologic pathway, which were completely thawed by late season, and we hypothesised that mobilisation of older, deeper organic soil C would be visible in the aquatic ^{14}C by late in the season.

Early in the season, median aquatic DO^{14}C and CO_2 ages were 65-131 years old (all ^{14}C ages reported here are years before sampling date). By the end of the season, DO^{14}C was 156-271 years old, while CO_2 was 113-161 years old, demonstrating that aquatic C ages reflect the mobilisation of thawing older permafrost C. Only two CH_4 two dates were obtained: 202 and 1,970 years old.

Overall there was limited evidence of very old permafrost organic C, which comprised 010% of vertical and lateral aquatic fluxes. Our results demonstrate that permafrost thaw will result in the mobilisation of old C into the aquatic phase as DOC, CO_2 and CH_4, but also indicate potential resilience within these systems in response to climate change.

O 172 HYDROLOGICAL AND HYDROCHEMICAL INVESTIGATIONS IN THE LENA RIVER DELTA DURING THE WINTER PERIOD

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Results of the special hydrological and hydrochemical measurements carried out on channels and lakes of the Lena River delta during the winter period 2015-2016 are provided.

The water discharge measured in April, 2016 on the Main channel of the Lena River was 1384 m3/sec that there correspond to an average long-term runoff in April for the period 1951-2004 equal 1515 m3/sec. The suspended supply was 6,17 kg/sec in April, 2016 is approximately equal to mean annual value (7,76 kg/s). Water speed and runoff of the Olenekskaya channels in the day of measurements was absent. It corresponds to noted average long-term values of a discharge for April for the period 1977-2004 when runoff was noted only 6 times.

In April, 2016 conductivity of water in channels was quite high - 494-581 μS/см in comparison with summer values in 103-160 μS/cm. Content of the dissolved oxygen in lakes in the spring 2015 was 2,7-7,6 mg/l, conductivity - from 130 to 391 μS/см, pH - 6,6-7,5, aCDOM [440nm] equaled 1,14 - 4,40 m-1. In April, 2016 conductivity varied from 140 to 277 μS/cm, the content of the dissolved oxygen - from 6,34 mg/l (48% of saturation) to 12,26 mg/l (93%). DOC in lakes in April, 2015 valued from 10,8 to 18,6 mg/l. Isotopes $\delta^{18}O$ varied from -14,22 (water of the thermokarst lake) to 31,48 (snow on the Main channel).

The drilling of talik has given an additional hydrochemical parameters of talik water: the conductivity changed from 944 to 1688 μS/см (in April 2015) and 333-828 mg/l (in April 2016), aCDOM[440nm] values equaled 36,72 m-1, DOC was 21,9 - 32,3 mg/l equaled to the values for streams noted in the summer from the thawing ice complex.

Winter observations in the Lena River delta will be continued in April, 2017.

O 169 WATER TEMPERATURE DYNAMICS IN TWO HIGH ARCTIC STREAMS, SVALBARD

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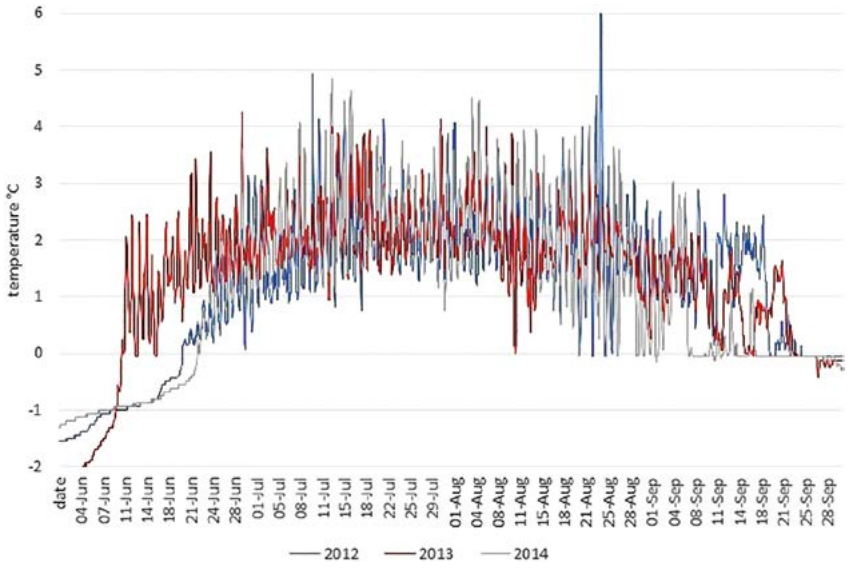
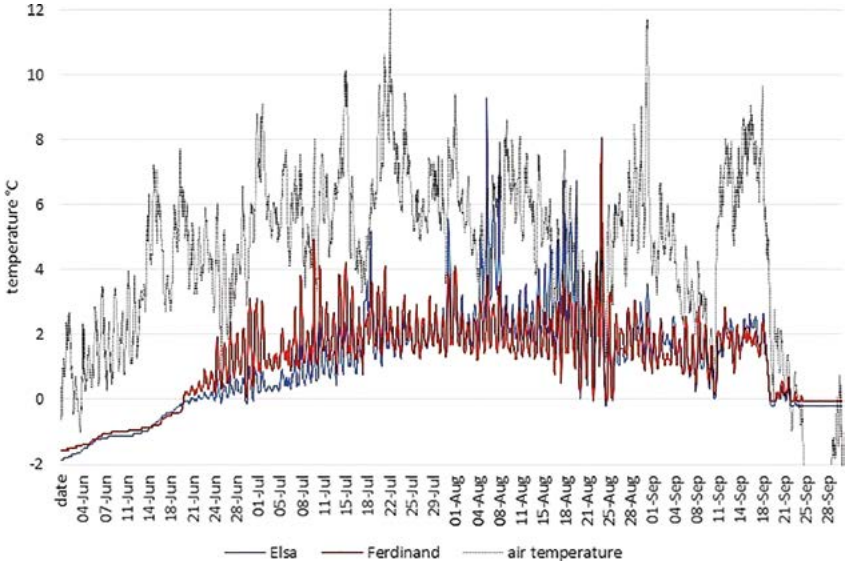
Two neighbouring high Arctic streams are examined for their water temperature dynamics during summer seasons 2012-2014. The study site is located in central Svalbard, Petuniabukta. Elsa glacier - fast retreating cirque glacier - 0,5km^2, Ferdinand glacier 1,17km^2 (Malecki, 2013). As a result Ferdinand catchment has higher level of glaciation (12% Elsa; 25% Ferdinand). Other environmental and physical characteristics are similar.

Mean summer water temperature is 2,19°C for Elsa Stream and 1,86°C for Ferdinand stream respectively, excluding below zero temperatures. Standard deviation of water temperature in Elsa Stream is 1,37°C whereas only 0,86°C in Ferdinand Stream. Rather large difference is observed also in duration of the summer season and onset of the recorded flow season - from June 6th in 2013 to June 20th in 2012 and 2014 in Elsa, from June 10th in 2013 to June 22nd in 2014 in Ferdinand. Length of the season varied from 80 days (2014) to 108 days (2013) on Elsa Stream and from 86 (2014) to 104 days (2013).



Water temperature dynamics is related to atmospheric parameters such as air temperature and global radiation. Both variables are found to be the driving forces influencing diurnal variation of water temperature in both streams as well as its seasonal variability. Elsa catchment, however, reacts more distinctly to changing atmospheric variables probably due to lower areal proportion of glacier cover making the catchment more sensitive to atmospheric forcings as described also for other Svalbard streams (e.g. Blaen et. al., 2012).



References:

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O 137 OVERVIEW OF 10 YEARS RADON MEASUREMENTS IN HIGH ARCTIC GLACIER WATERS

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We present a possibility to investigate the outflows of glacierized basins in introducing a radioactive isotope, in combination with more classical parameters like temperature and electrical conductivity. The noble gas radon, more precisely its isotope ^{222}Rn, with a half life of 3.8 days, constitutes a short time tracer and allows continuous measurements. Here we report on 10 years (2006-2015) repetitive investigations in meltwaters from high arctic glaciers. The target glaciers are situated in the Hornsund area, Southern Spitsbergen. Our investigations were mainly focused on the outflows of the land-based Werenskioldbreen, close to the Arctic Polish Polar Station. Here radon levels show surprisingly high values, up to 34 Bq/L, in the waters draining from this land-based glacier in the accumulation season. In the ablation period varying radon concentrations can be linked to mixing of meltwaters from different origins: supraglacial/englacial (no radon) and subglacial (varying radon).

Results from several years of radon measurements on Werenskiold glacier, in ablation and accumulation seasons, are presented and discussed. In the accumulation period, radon measurements proved that the subglacial distributed system was active. In the ablation period it was possible to assess mixing rations at the main outflow. The results of continuous measurements gave approximate information on flow paths and the character of the subglacial drainage system. Radon has a decisive advantage over ion species as it is not affected by solute rejection during refreezing. Furthermore, the time factor is included in the radon message.

O 167 INVESTIGATING RESIDUES OF ORGANOCHLORINE PESTICIDES IN SURFACE WATER SAMPLES FROM THE ARCTIC CATCHMENT OF REVELVA RIVER (HORNSUND, SVALBARD)

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The organochlorine pesticides (OCPs) have been used for decades, although the environmental consequences of their widespread application have only been discovered with the development of analytical techniques. Unfortunately, the effectiveness of OCPs in pest and disease control was outbalanced by environmental persistence (slow and difficult decomposition). Due to their lipophilicity and high volatility, the OCPs underwent biomagnification and long-range transport. The Arctic, due to location and climate, received the pesticides emitted further south, accumulating legacy OCPs, a viable threat to the Arctic environment, within permafrost, snow and ice.

The aim of this study was to apply the surface water samples concentrations (in lakes, watercourses and glacial outflows) in the examination of the pesticide transport pathways in the High Arctic Revelva catchment. The investigation encompassed 16 pesticides (α-HCH, β-HCH, γ-HCH, Hexachlorobenzene, Heptachlor, Aldrin, Heptachlor epoxide, 4,4'-DDE, Dieldrin, 2,4'-DDD, Endrin, 4,4'-DDD, 2,4'-DDT, 4,4'-DDT D8, 4,4'-DDT, Mirex) in N=16 water samples collected in the summer season of 2015. The determination of OCPs was conducted using the SPE preparation technique and GC-MS for the concentration measurement. Four compounds were determined in all samples: γ-HCH (3.478-7.175 ng/L); Hexachlorobenzene (0.027-0.705 ng/L); 4,4'-DDE (0.008-0.556 ng/L); 2,4'-DDD (0.256-0.703 ng/L). In a few samples, Heptachlor was detected. The obtained results enabled the observation of pollutant migration out of the melting snow and glaciers, and the investigation of this catchment adaptation potential, in respect to long-term accumulation of atmospheric pollutants. Despite the emission restrictions or bans on the most persistent pesticides, they still occur in the environment in levels responsible for adverse effects on the ecosystem functioning, wildlife and people of this remote region.

The assistance of the Polish Polar Station crew with sampling is acknowledged here, as is the funding source of this study (National Science Centre grant number 2013/09/N/ST10/04191).

O 168 WATER BALANCE ANALYSIS IN SEVEN CATCHMENTS IN THE HORNSUND REGION, SOUTHERN SPITSBERGEN

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The aim of the study is to estimate water balance elements in five partly glaciated catchments (Ariedalen, Sofiedalen, Lorchbreen, Bautabreen, Gashamna) and two non-glaciated catchments (Fuglebekken, Lisbetdalen) located in the Hornsund region, Southern Spitsbergen. This is the first comprehensive investigation of hydrological processes and water balance in this region. Due to the harsh environment and logistical difficulties, complex meteo-hydrological investigations in the Arctic are sparse and major gaps remain in our understanding of freshwater balances. Hydro-meteorological observations referred to in the study were conducted at the Hornsund Polish Polar Station and in the surroundings of Hornsund fjord. They included discharge measurements, snow thickness and snow density, solid and liquid precipitation, and glacier mass balance measurements in the partly glaciated and non-glaciated catchments.

The results indicate that runoff is dominated by snowmelt and glacial melt in all glaciated catchments. The annual sum of runoff is higher than observed precipitation and varies between catchments. These differences result from catchment location, area and morphology. Annual sums of potential evaporation, calculated using Hamon method, are low and depend on catchment location. Estimated water balance and volume of fresh water outflow to the sea are the key components of understanding Arctic fjord ecosystem mechanisms.

The results of this investigation show how mechanisms and processes responsible for water balance respond to observed seasonal climatic variations in this area.

The study was carried out in the framework of "AWAKE2 - Arctic Climate System Study of Ocean, Sea Ice and Glaciers Interactions in Svalbard Area" project, that was funded by Norway Grants.

O 136 CLIMATE WARMING INDUCED CHANGES IN THE ARCTIC TERRESTRIAL ECOHYDROLOGICAL REGIMES

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The Arctic has experienced a set of various changes due to warming climate and increasing human activities. The significant changes include increased vegetation biomass, permafrost degradation, increased river discharge, and decreasing sea ice. The declining sea ice has associated with the deepening of snow cover on the terrestrial surface, sequentially affecting permafrost and ecohydrological cycle along the seasonal processes. A land surface model CHANGE applied to the terrestrial Arctic over the period 1979-2013 and examined the warming climate induced changes in the Arctic eco-hydrologic system. In addition to enhanced snow insulation, the Arctic warming triggered deeper active layer thickness, which positively correlated to evapotranspiration and net primary productivity. Changes in snow processes, for example deeper snow-cover and the early melt, resulted in earlier and larger discharge peak in spring. Temperature warming significantly affected river-ice phenology, resulting in later fall freezeup and earlier spring breakup. As a result, longer ice-free period contributed to warming river water, consequently increasing warmer freshwater to Arctic Ocean. These results increase our understanding on the warming climate derived changes in the Arctic ecohydrological system and on potential changes under the future climate.

O 170 TEMPORAL VARIABILITY OF THE THERMAL REGIME OF THE ARCTIC LAKES

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It is known that climatic changes take place in the environment and the Polar Regions are resistant least to these processes. Lakes in the Arctic cover large areas with a global importance. Thermic regime of lakes - one of the most capacious factors, by which change can be estimated climate. The study objects are lakes located in Yakutia, Russia (the central part - Syrdahk Lake and the Lena River delta Lakes). The evaluation of a temperature regime in the lake can be produced using FLake model (www.lakemodel.net) developed jointly by Russian and German scientists.

Using of the model Flake allowed to receive thermal regime parameters of lakes in two regions of Yakutia for two periods: the first period 1970s characterized by non strong climate warming in the Arctic, the second one is the first decade of recent century marked by difference meteoparameters. As for Lakes on the Lena River Delta measured data are available only for the period 2009-2012. Modeling allowed to perform a retrospective evaluation of the water thermal regime for the 1970-ies. As for lakes in Central Yakutia measured data are available for the 1970s. Current thermal regime parameters have been obtained based on the model Flake. Therefore, conduct comparative analysis has been done with following results.

A significant increase of water temperature in bottom and surface layers have been noticed for Lakes of the Lena River Delta as well as for Lake Syrdakh of the Central Yakutia. Moreover, there are contradictory processes in a thermic change: a surface temperature increase and reducing a bottom temperature simultaneously. At present, the temperature values are aligned, this is due to warming in the Arctic.

The study is realized under support the NCI 18.42.1414.2015 of St. Petersburg State University, the RFBR grant 14-05-00787 and from of Department for young staff training at Arctic and Antarctic Research Institute

O 171 CHEMICAL DENUDATION PROCESSES IN TWO BASINS AFFECTED BY DIFFERENT STAGES OF GLACIER RECESSION

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Climate warming is causing glacier recession and thinning in almost all glacierized regions worldwide. However, there is currently limited knowledge on the impact of glacier recession on chemical denudation processes in glacierized basins. Our study aims to determine the qualitative and quantitative variability of chemical denudation in two basins in the Arctic: Werenskioldbreen in SW Svalbard (60% glacierized) and Obruchev Glacier in Polar Urals (2% glacierized). To address this research aim, we have collected water chemistry data and discharge data over several years from both sites. The results show that sulfide oxidation is the dominant reaction operating in the intensively glacierized basin in Svalbard, whereas carbonation with atmospheric $CO_2$is dominant in the catchment with advanced glacier recession in the Polar Urals. The results also show that chemical denudation in subglacial channelized systems below glaciers is strongly affected by water originating from long water flow paths. The chemical denudation in proglacial areas is driven by carbonation of carbonates or geochemically reactive silicates coupled with atmospheric CO_2 drawdown. Furthermore, high loads of ions (primarily $Ca^{2+}$and HCO_3^-) delivered to the ocean may inhibit ocean acidification and thereby result in a slower dissolution of atmospheric CO_2 into seawater. The chemical denudation system (defined as the relationship between weathering and transport) differs between basins with intensive glacier-cover and basins with advanced glacier recession. In intensively glacierized basins, transport has a first-order control on chemical denudation followed by chemical weathering (a transport-weathering system), whereas in basins with advanced glacier recession, chemical denudation is almost entirely controlled by transport. We conclude that the chemical denudation system in glacierized basins changes as a consequence of glacier recession - from transport-weathering systems controlled by sulfide oxidation in intensively glacierized catchments to nearly entirely transport-controlled carbonation coupled to dissolution of silicates in basins with advanced glacier recession.

P 089 SEASONAL AND ANNUAL DYNAMICS OF DISSOLVED ORGANIC CARBON AND NUTRIENTS IN THERMOKARST LAKES IN THE LENA RIVER DELTA

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The Lena River delta, the largest delta of the Arctic Ocean, differs from other deltas because it consists mainly of organomineral sediments, commonly called peat, that contain a huge organic carbon reservoir (Bolshyanov, et al. 2015). Today the Lena River delta is part of the permafrost area of northern Siberia where permafrost thickness reaches 500-600m (Gavrilov et al. 1986). Lena River Delta is characterized by lots of lakes and most of them are thermokarst and polygonal lakes, mostly slight by area (less than 1 km^2).

Hydrological and hydrochemical studies of water objects year annually carry out in the framework of Russian-German expedition "Lena Delta" more than 10 year. The investigated thermokarst lakes are located on Samoilovsky Island and another nearest islands. Large amount of water samples we have collected during the winter and summer seasons for the analysis of dissolved nutrients and dissolved organic carbon.

The investigated lakes are in an area with moderate human impact. Except of the lake which is used for water consumption and household purposes. This fact allows us to study in-situ the processes, occurring in this lakes, for evaluation the external environmental influences.

A wide range of nutrients were observed during our investigations (C_v 0,7 -1,3). This is probably explained by the different sources of dissolved organic matter and by the fluctuations in moisture areas, as well as the influence of thermokarst processes. (Chetverova et al. 2013).The analysis results revealed a clearly marked dynamics of seasonal and annual variability of dissolved hydrochemical components (nutrients and DOC) in the permafrost zone and has allowed to calculate the budget and lakes ecosystems condition during climate change processes.

P 090 EVALUATING THE CLM4.5 LAND SURFACE MODEL WITH 30 YEARS OF OBSERVATIONS AND INVERSE MODELING OUTPUT

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The Arctic has undergone dramatic changes during the past 30 years and the current warming trend can have multiple impacts on different components of the climate system. To properly study such large-scale impacts and to predict future changes, contributions from global land surface models are needed. These large scale mechanistic models, in turn, need to be properly evaluated against state-of-the-art datasets, in order to reduce uncertainty in future predictions. We simulated the past 30 years of biogeochemical and biophysical fluxes with the Community Land Model (CLM4.5), and used a unique combination of multiple datasets to evaluate land surface fluxes. The datasets consist of surface and satellite observations as well as output from atmospheric inverse modeling. We present results from comparison of simulated and observed albedo, gross primary production (GPP), net ecosystem production (NEP), net ecosystem exchange (NEE), and leaf area index (LAI).

The goals of this study are to evaluate the CLM4.5 model with a focus on the ability of the land surface model to simulate the impacts of the recent warming trend on Arctic ecosystems. We also aim to quantify - within the framework of the ICE-ARC project - the expected future changes in ecosystem productivity and carbon budget in response to climate change. To achieve this goal, we will also perform future simulations, forced by different Representative Concentration Pathways (RCP) scenarios. This evaluation of CLM4.5 is therefore a necessary step towards a better understanding of potential biases and limitations of the model to be taken into account for future simulations.

P 101 MONITORING THE EXTENT OF WATER-ROCK INTERACTION IN PERMAFROST DOMINATED CATCHMENTS USING LI AND U ISOTOPES

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Permafrost in the Arctic is both decreasing in extent and the depth of the seasonally thawed layer, the active layer, is also increasing. Increased exposure to water is increasing fluxes of organic and inorganic solutes with potential impacts on the global carbon cycle and marine ecosystems. Understanding the relationship between solute release and active layer depth will be critical in order to model downstream impacts. In this study we focus on inorganic solutes released by the chemical weathering of rocks in two small catchments located in the High Arctic (Svalbard).

In order to measure instantaneous weathering fluxes, we collected stream water samples from two small catchments in Svalbard. Sampling was conducted early in the 2012 melt-season when there was still significant snow-cover and in mid-summer when most of the seasonal snow-pack had melted. Meteorological variables such as temperature and precipitation are very similar between both catchments but one catchment is glaciated.

The extent of lithium (Li) isotope fractionation provides information on the balance between the dissolution of primary phases and the formation of secondary phases such as clay minerals. The uranium activity ratio provides information on water-rock interaction times and the degree of physical erosion. In these catchments the highest U activity ratios and Li isotope values (those most distinct from bedrock) are observed in summer in the unglaciated catchment when the active layer depth is expected to be at its maximum extent, whereas the lowest values are observed in the glaciated catchment. We therefore conclude that the extent of chemical weathering is directly linked to the active layer depth (which is restricted in the glaciated catchment due to a layer of 'dead ice' underneath the sandur) and could therefore be a useful tool to assess changes in active layer depth at catchment scales.

P 091 FEATURES OF THE HYDROLOGICAL REGIME OF THE ARCTIC DELTAS AND DANGEROUS PHENOMENON IN THEM AT THE CHANGING CLIMATIC CHARACTERISTICS

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Recently, in connection with the trend of increase air temperature in Northern areas hydrological conditions in the Arctic riversheds and the coastal zone of the seas changes. The harsh climate, ice conditions and thermal abrasion processes limit the use of natural resources in these regions and require an assessment of the risks of dangerous hydrological situations in the event of changes of climatic characteristics and increasing anthropogenic load.

The first group of factors influencing to the regimes of river mouths includes mainly water flow and sediment yield of the river, physical and chemical properties of river water, ice and temperature regimes, the second group − the fluctuation of sea level, currents, tides, wind waves, physical and chemical properties of seawater, coastal drift of deposits. In addition, there are other important factors are geological (including the distribution of frozen grounds), physical geographical and anthropogenic.

The deltas of Lena (Russia) and Mackenzie Rivers (Canada) are the largest deltas on the Arctic coast and located in the zone of continuous distribution of frozen grounds. The hydrographic network of both deltas is very complex and includes several major branches, many smaller and ducts connecting them, and thousands of karst and thermokarst lakes.

The Arctic river deltas are characterized by a long ice season. The spring ice break is often accompanied by significant blockings of ice, causing an increase in water level of 5−10 m. Sometimes ice clogging with the high water runoffs or strong surges can lead to a significant increase of water level and flood at the delta, and can provoke channel deformations (Lena, Indigirka, Yana, Northern Dvina, Mackenzie mouths).

Further possible changes of climatic characteristics in the Arctic region will contribute to a relatively rapid change in hydrological conditions of the Northern rivers mouths, which will increase the probability of dangerous phenomena in mouths.

P 092 THE INFLUENCE OF CHEMICAL PARAMETERS AND METALS PRESENCE ON BACTERIAL ABUNDANCE IN THE REVELVA CATCHMENT (SOUTHWEST SPITSBERGEN, SVALBARD)

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The Arctic has undergone dramatic change during the past two decades. The phenomenon of Arctic pollution (besides small local sources) arises from a combination of long-range transport of pollutants and the Arctic haze phenomenon-locking contaminated air in the area for months. The freshwater samples were collected from the Revelva catchment located in the Wedel-Jarlsberg Land, in southwestern part of Spitsbergen in summer 2015. The main river (Revelva) is fed both directly by atmospheric precipitation, snow melt water streams and a river originating from the Arie glacier. The catchment is characterised by a dominance of left tributaries, of which the proglacial Ariebekken is the largest. The Revelva catchment has only one small glacierised part but past glacial activity has left traces in its upper part. The bottom part of the Revelva valley is an elevated marine terrace, with abrasion stacks. The diversity of the catchment landscape provides an ideal setting for a comprehensive study of processes of pollutants and metals deposition in different parts of the abiotic environment. The main purpose of conducted research was to determine selected metals and ions present in studied area. Additionally, the total number of bacteria, size and biomass were checked. Chemical and microbiological analysis have been conducted using selected techniques, for example: ion chromatography technique and inductively coupled plasma mass spectrometry for detection of ions and metals. Furthermore, parameters such as dissolved organic carbon, electrical conductivity and pH have been measured. Microbiological analysis have been conducted using epifluorescence microscope to estimate the impact of chemical compounds presence on the microbiological abundance.

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P 093 THE FLUXES OF PAHS IN A SMALL GLACIAL CATCHMENT IN THE HIGH ARCTIC

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Glacial catchments are potential repositories of persistent organic pollutants (POPs), hence it is important to monitor the mass fluxes of these compounds that enter and leave this environment. This work provides new data on the PAHs concentrations and fluxes of a small glacial catchment in the High Arctic (Foxfonna glacier, Nordenskiöld Land, Svalbard). The data were collected during the 2012 summer field campaign and encompassed the media of surface snow, supraglacial and proglacial rivers, and superimposed ice. The spatial distribution of PAHs in the surface snow followed a pattern related to their hydrophobicity, with the highest PAH concentrations found in the lower parts of the glacier, and especially so for the least hydrophobic naphthalene. An exception from this pattern was phenanthrene, which was most abundant in the upper and eastern part of Foxfonna.

The average ΣPAHs flux in the period of possible measurement in the supraglacial stream in 2012 was estimated for 11.36 μg s^{-1}, with the domination of naphthalene in the beginning of the melting season (snow melt), which was later, in the ice melt period, exceeded by phenanthrene flux. The comparison of two bulk flux estimations, the 0.341 kg ΣPAHs income in the pre-melt snow and the 18.33 ΣPAHs kg in the outflowing river waters, shows a strong overbalance of the PAHs release from the catchment. This flux was most likely generated from the englacial and subglacial environments, since the supraglacial ΣPAHs fluxes were small (0.023 kg in a supraglacial catchment occupying approximately 1/5 of the whole investigated catchment area). Therefore, we conclude that this small Arctic glacier has been a net source of PAHs in the study period.

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P 094 INFLUENCE OF HYDROMETEOROLOGICAL CONDITIONS ON TRANSPORT OF ORGANIC COMPOUNDS IN PROGLACIAL SCOTT RIVER (SPITSBERGEN, SVALBARD)

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Climate warming accelerates melting of cryosphere elements and thus favour releasing of contaminants stored even for years in Arctic ice. The rate of glacier melting is of particular importance for not only hydrology of glacial rivers but also for chemistry of their waters. We examined more than eighty surface water samples collected during period of 42 days from Scott River, of glacial-hydrological regime (NW Wedel-Jarlsberg Land), on the fluctuations of physicochemical parameters and presence of selected organic pollutants. Comparison of water chemistry in two transects of the river (gorge ad mouth) allow us to link differences in amounts of organic carbon in these two points with activity of herring gull (*Larus Argentatus*) colony located in the mouth of the river.

Studies of Scott River water discharge (Q) and weather conditions (temperature, precipitation) allowed for study response of Scott River water chemistry on changes in hydrometeorological conditions. Results of correlation matrix indicate on Scott River hydrochemical response on changing meteorological conditions, while PCA analysis allow for distinguish two principal components (hydrometeorolorogical and biogeochemical condition) responsible for 71.1% hydrochemical variation in total.

Presented studies not only confirm existence of a link between increased of glacial river discharge (Q) with the rise of mean air temperature (T) (r=0.67), in some cases accompanied by precipitation, but also incidents of release more concentrated pulse of chemical compounds from Scottbreen glacier in response to these events (moderate positive correlation).

Acknowledgments

The study was conducted in the scope of 24th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, supported by grants of the National Science Centre No. 2011/01/B/ST10/06996 and No. 2015/17/N/ST10/03177. Special thanks for the technical support and meteorological equipment provided by Prof. dr hab. Krzysztof Migała and MSc. Eng. Piotr Modzel and for the field and technical assistance of Dr. Grzegorz Gajek.

P 242 WHAT DO FLUVIAL SEDIMENTS IN ARCTIC REALLY SAY?

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Fine materials in glacier's catchment have different origin e.g. materials from mass movement processes on slopes and moraines, which are delivered mostly as a result of snowmelt or intensive precipitation. Following more, sediment materials come from the proglacial sandur with increasing active layer depth, which are given potentially more materials to elute. The one of the most important source for polythermal glacier which is Werenskioldbreen (Spitsbergen) is material from glacier-bed. In this context, the aim of this presentation is determine the role of the subglacial sediment sources in the glacier ending on land.

Estimation of the amount of material carried by the glacier (suspended sediment concentration - SSC, suspended sediment load - SSL) and analysis of the grain size composition using a laser diffractometer allowed to point out more intense moments of greater elution and connected them with rainfalls or with ablative peaks. Therefore, a second objective is examine how extreme events such as heavy precipitation (especially in the second part of the ablation season, in the fall) modify sediment transport in longer time series (6 seasons: 2007-2012).

The interpretation of records from Werenskioldbreen suggests that sediments can be used as an indicator of hydrological reactions of the glacier, also for neighboring tidewater glaciers (e.g. Hansbreen), where quantitative measurements are difficult.

P 095 NEAR-SURFACE GROUND ICE VARIABILITY IN ICE-WEDGE POLYGONS IN ADVENTDALEN, SVALBARD

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The oceans influence heat transfer to the Arctic, and permafrost can respond rapidly to changing climatic conditions. Rising air temperatures have caused increases in active-layer thickness, the thaw of near-surface ground ice, and enhanced microbial activity in permafrost environments. In the LowPerm EU research project, the universities of Sheffield (UK) and Aarhus (DK), the University Centre in Svalbard and the university college in Sogn og Fjordane (NO) aim to understand nutrient transport within lowland permafrost landscapes at field sites in western Svalbard, which may lead to changes in greenhouse gas production and fertilization of the Arctic Ocean. Part of the research focuses on better defining physical conditions and processes in lowland permafrost. Near-surface ground ice is a key physical property that impacts hydrological, geomorphological, and geochemical processes, and thus its distribution in the active layer and top permafrost is important to characterize and include in numerical modelling of biogeochemical fluxes at the landscape scale.

Here we present preliminary results from a coring campaign defining the distribution and variation in near-surface ground ice in ice-wedge polygons in the Adventdalen valley in Svalbard. The objectives are to: characterize ground ice content/type of polygons with different soil moisture conditions (i.e. wet, low-centred polygons vs. dryer polygons with subdued topography), (2) define within-polygon ground ice distribution on the polygon ridges, shoulders, and centres, and (3) determine the potential amount of groundwater release and ground subsidence upon thawing of parts of the upper permafrost. These findings contribute to quantifying potential hydrological and biogeochemical inputs to lowland permafrost environments from the thaw of ground ice, and to defining spatial variation in near-surface ground ice content in polygonal terrain, which has not been rigorously described in most environments.

P 096 SEASONAL AND INTERANNUAL VARIATIONS OF ATMOSPHERIC HYDROLOGICAL CYCLE IN THE ARCTIC AND ANTARCTIC REGIONS

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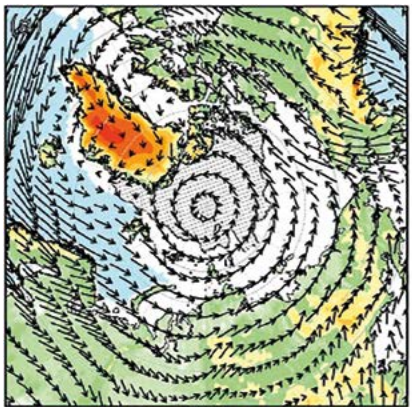
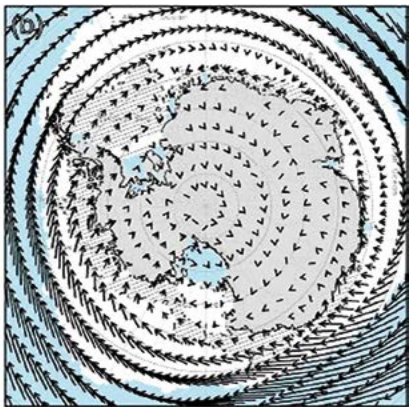
We have investigated seasonal and interannual variations of water cycles in the Arctic and Antarctic based on vertically integrated moisture flux and estimated net precipitation (precipitation minus evaporation). There were some similarities and dissimilarities in the water cycles. The Arctic and Antarctic are regions of moisture flux convergence through the year, where the precipitation exceeds the evaporation and the net precipitation is positive. Therefore, the atmospheric moisture transport is a primary input of water into the polar regions. The climatological seasonal cycle of net precipitation over these regions is dominated by transient moisture flux associated with cyclone activities. On the other hand, the interannual variations are governed by the stationary flux. The Arctic Oscillation and the Antarctic Oscillation as an atmospheric internal variability in the Northern and Southern Hemispheres change not only large-scale atmospheric circulation but also moisture transport over the Arctic and Antarctic. Consequently, the atmospheric internal variability is one of the key factors controlling the water cycles in the Arctic and Antarctic. In addition to these, recent climate changes must have influenced on the water cycles in polar regions. Time series of poleward moisture flux in the polar regions during 1979-2015 indicated that there were no significant trends of the poleward moisture flux both in the Arctic and Antarctic. On the other hand, the precipitable water (total water vapor amount in an atmosphere column) were gradually decreasing over the Antarctic, and clearly increasing over the Arctic during the same period. The reason for the increasing is mainly due to the large Arctic warming, while the decreasing in the Antarctic is unknown.





P 097 THE USE OF HBV MODEL FOR ARCTIC UNGLACIATED CATCHMENT

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In this study we focus on development of hydrological model describing the arctic catchment response to observed recent changes in weather and climate. The analysis was carried out for small unglaciated catchment Fuglebekken, located in the vicinity of the Polish Polar Station Hornsund on Spitsbergen. Within two hydrological years 2013-2014 and 2014-2015 a number of hydro-meteorological measurements were conducted, including snow cover depth, snow water equivalent, air temperature and precipitation. During the ablation season outflow was measured with 10 minutes interval by portable device Nivus PCM F with active Doppler sensor.

For hydrological modelling we used the conceptual catchment runoff model, namely HBV. The model was calibrated and validated for each year independently. Model calibration together with an estimation of parametric uncertainty was carried out using the SCEM-UA algorithm (Shuffled Complex Evolution Metropolis). In addition, an analysis of the influence of data time step on the obtained results of calibration and validation was performed. That effect was examined through a numerical experiment where the HBV was calibrated with data of different temporal resolution: 10, 20, 30, 40, 60, 90 minutes, 2, 3, 6, 12 and 24 hours. The influence of time step on the calibration and validation results as well as the relationships between model parameters and time step, were tested.

The outcomes of numerical calculations indicate that the results of calibration depend on the data time step and also data averaging. More than satisfactory results of calibration and validation were obtained, which can justify the application of the HBV model in other years and gives the opportunity to assess the actual state, as well as simulate future changes.

The study was supported by Polish National Science Centre through grant no. 2013/09/N/ST10/04105.

P 098 DECOUPLING OF THE SEASONAL EVOLUTION OF HYDROCHEMISTRY, GEOCHEMISTRY AND MICROBIAL ASSEMBLAGES IN A SOUTHERN GREENLAND GLACIER

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Polar ice sheet melt waters are important conduits of particulate and dissolved elements (e.g. silica and iron) to proglacial environments and oceans. Both biotic and abiotic process in the subglacial environment enrich glacial melt waters in solutes, where it has been inferred that subglacial hydrology and microbial communities are intimately linked in generating the geochemical signature of meltwaters. At the glacier terminus, ejected water is mixed from differing sources, such as the surface, meteoric, sub-glacier or englacier. Thus, water collected at the terminus for hydro-geochemistry or microbiology, while informative is not solely representative of subglacial biogeochemical weathering processes.

Here we utilize multiple lines of evidence to disentangle the potential sources of waters, microbiology and geochemical weathering products. We present a late melt season progression of glacial hydro-geochemistry, isotope geochemistry and microbial community diversity from Qoorqup Sermia, a land-terminating glacier in southern Greenland.

During the 2015 field season, despite stable water geochemistry, there were several large punctuated increases in the phylogenetic diversity of microbial communities. The lack of correlation between phylogenetic diversity and the geochemistry of the bulk subglacial outflow, suggests that changes in diversity may not be driven by a change in the subglacial system. Rather, microbial diversity changes at the terminus may be indicative of englacial processes driven by localized climatic events during the melt season. These results, although preliminary, may indicate a relationship between surface melting and meteoric water flux through a glacier, and suggest microbes carried along with these waters may be used as indicators of changing water source inputs.

P 099 COMPARISON OF ANNUAL CARBON BUDGET OF ALASKAN FOREST DERIVED BY THREE METHODS: FOREST INVENTORY SURVEY, FLUX MEASUREMENT, AND MODEL SIMULATIONS

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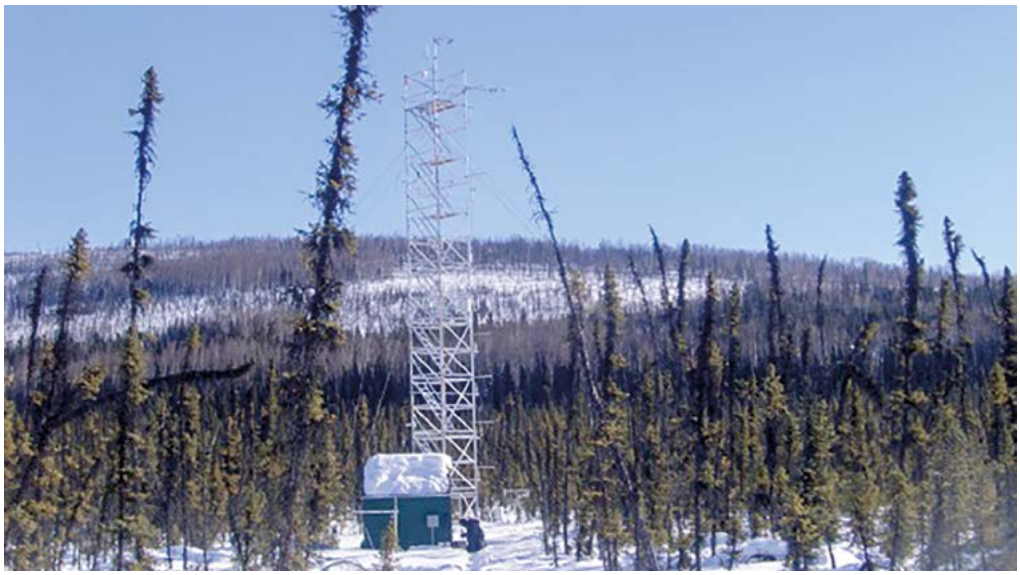
Arctic regions face drastically changing climate and environment, showing, for example, a conspicuous climatic warming trend. This would consequently modify the carbon cycle driven by the boreal ecosystem, which occupies about 60% of the total carbon stock in global ecosystems. However, the quantitative evaluation of the carbon budget remains uncertain. This study made an attempt to demonstrate the carbon budget (annual uptake) of a sparse black spruce forest (Fig. 1), most common forest in Alaska, at Poker Flat near Fairbanks, Alaska, by three methods.

[Forest inventory survey] We established a 30m x 30m quadrat at the black spruce forest in Poker Flat and carried out forest inventory survey to measure the above-ground biomass in 2010 and 2014, and calculated the growth rate between those two years. [Monitoring of the CO_2 flux by eddy covariance (EC) measurement] We constructed a 17m observation tower in the black spruce forest of Poker Flat (Fig. 1), and continuously monitored the CO_2 fluxes above the forest and near the forest floor by the eddy covariance method from 2010 to present. The annual CO_2 uptake was derived from the annual cumulative amount of the CO_2 budget. [Ecosystem models] We employed seven ecosystem models and simulated the annual cumulative carbon budget based on the common tower-observed meteorological values.

The annual carbon uptake derived by the forest inventory survey was 4 g C/m^2/yr (from 2010 to 2014), while those by the EC measurement and the model simulations were 56.6g C/m^2/yr (mean from 2011 to 2014) and 57.3g C/m^2/yr (mean from 2010 to 2013 averaged among 7 models), respectively. The forest inventory survey showed considerably smaller value than the other two methods and further discussion will be required, while these results suggest that the uptake of the black spruce forest is several g C/m^2/yr to several tens g C/m^2/yr.



P 100 THE FRESH WATER CHEMISTRY IN PERIGLACIAL ZONE OF THE BELLSUND FIORD (SPITSBERGEN) OBSERVED DURING THE TWO ARCTIC SUMMER SEASONS

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The region of South Bellsund where selected to performed research on fresh water chemistry in the area of periglacial environments. The changes taking place in glaciers and permafrost areas are frequently regarded as one of the key indicators of global climate change. The observed in last decades glaciers retreat and related to it dynamic environmental changes makes this region valuable area to study water chemistry as a direct response of landscape evolution. Moreover, despite global climatic conditions, there are many local factors influencing fresh water chemistry. Samples were taken from six tundra lakes located in the area between forehead of two glaciers Renardbreen and Scottbreen, and shore of the Bellsund Fiord. Water chemistry of studied lakes were compared to the result obtained from the Tyvjobekken Creek. Samples were collected during two summer camps (2013 and 2014). In the water samples, ions and trace elements were detected and quantified. Additionally, the parameters of pH, specific electrolytic conductivity (SEC_{25}) were determined. SEC_{25}, considered as a general parameter concerning ion content in lakes, was in range 184-321 [$\mu S \cdot cm^{-1}$]

and 7.3-236 [μS·cm^{-1}] for the samples taken in 2013 and 2014, respectively. In the Tyvjobekken Creek SEC_{25} were in range 270-287 [μS·cm^{-1}] and 189-350 [μS·cm^{-1}] in 2013 and 2014, respectively. Comparison of two data series allowed us to conclude that water samples from four lakes that periodically dry out have lower concentrations of chemical compounds in comparison to the lakes that are larger and more stable in the context of water storage. Seasonal drying out of ponds may influence water chemistry by deflation of evaporites from exposed lake beds and, at the same time, with lower concentration of chemical compounds in water.

Acknowledgements

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P 102 SIZE-DEPENDENT VALIDATION OF THE MODIS MCD64A1 BURNED AREA OVER SIX VEGETATION TYPES IN BOREAL EURASIA: LARGE UNDERESTIMATION IN CROPLANDS

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Pollutants emitted from wildfires in boreal Eurasia can be transported to the Arctic and their subsequent deposition could accelerate global warming. The MODIS MCD64A1 burned area product is used widely for global mapping of burned areas. However, uncertainties due to the “moderate resolution” (500 m) characteristic of the MODIS sensor could be introduced. This study compared MCD64A1 with higher resolution satellite products (Landsat 7 ETM+, WorldView-2, GeoEye-1, and RapidEye) to assess their agreements and errors in the 2012 burning season. Burned areas in 6 ecotypes over 12 regions of boreal Eurasia spanning western Russia/Kazakhstan to eastern Siberia were analyzed. It was found that 64-97% of burned areas in forests, grasslands, shrublands, and wetlands were >500 ha, of which spatially 30-86% were detected correctly by MCD64A1. However, MCD64A1 detected only 0.9% of the burned areas in croplands because 70% of them were <100 ha. The high commission and omission errors in estimations of cropland fires were attributed to their transient nature and to possible interference from the dark soil texture. High omission errors in deciduous needleleaf forests were due to the large number of fire areas <100 ha. After correction of commission errors to negate spatial displacement, MCD64A1 burned areas were 101%, 106%, 125%, and 70% of the estimates by higher resolution satellite products in grasslands, shrublands, mixed forests, and deciduous needleleaf forests, respectively. In comparison, MCD64A1 burned areas were 13% and 213% of those estimates by higher resolution satellite products in croplands and wetlands, respectively. Our results indicate that the actual burned area in boreal Eurasia could be ~16% higher than suggested by MCD64A1. We suggest applying correction factors of 0.5-8.2 when using emission rates based on MCD64A1 burned areas in chemistry and climate models of the studied regions.

P 103 CARBON DYNAMICS IN STREAMS ACROSS DIVERSE PERMAFROST LANDSCAPES, YUKON AND NORTHWEST TERRITORIES, CANADA

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Permafrost thaw is exposing sediment, solutes, and organic carbon previously sequestered in frozen soils to biochemical processing and fluvial transport. While mineralization of permafrost organic carbon contributes significantly to CO_2 in headwater streams, chemical weathering of previously frozen mineral soils may convert CO_2 to bicarbonate, rendering it much less susceptible to atmospheric exchange. However, there is limited understanding of the degree to which mineral weathering tempers the release of CO_2 generated during permafrost thaw, and how these dynamics vary across geologically and geomorphically diverse landscapes. Therefore, we investigated mineral weathering-CO_2 dynamics in 32 streams across four diverse permafrost landscapes: (1) previously unglaciated foothills extending from uplands underlain by carbonate and shale bedrock; and previously glaciated (2) fluvially incised hummocky moraine with retrogressive thaw slump activity unearthing highly weatherable till sediments; (3) organic-rich spruce/willow lowlands; and (4) spruce/alder plains with carbonate till. DIC was consistently higher in streams draining unglaciated terrain (29.2 mg L^{-1}) compared with other regions (2.7-7.7 mg L^{-1}), despite intense thaw slump activity in the ice-rich hummocky moraine. Overall, pCO_2 decreased from first to fourth order streams (2,735 to 861 μatm) and DIC shifted from biogenic towards geogenic sources (-16.6 to -7.2‰ $\delta^{13}C_{DIC}$), perhaps owing to CO_2 fixation by mineral weathering. Investigating carbon dynamics both within and across stream networks, especially in light of permafrost disturbance, will elucidate patterns in carbon cycling in rapidly changing permafrost regions.

S07 CARBON VULNERABILITY OF PERMAFROST SOILS

O 173 EVALUATING EFFECTS OF CLIMATE-DRIVEN TERRESTRIAL ECOSYSTEMS CHANGES ON SOIL CARBON BALANCE IN THE CIRCUMPOLAR ARCTIC

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In this study we use field observations, satellite data on NDVI, and modelling to access changes in the ecosystems' carbon uptake in the 21st century under the CMIP5 ensemble climatic projection. Firstly, we developed the statistical climate- and permafrost-driven model of the ecosystem zones that accounts for the key northern biomes, i.e. barrens, graminoids, prostrate-shrub, erect-shrub, pre-tundra, taiga, and alpine vegetation. The model was calibrated using contemporary data from the Russian vegetation map and circumpolar vegetation map, and then used to calculate zonal shifts under projected for the 21st century climatic and permafrost conditions.

Secondly, we developed statistical models linking NDVI-based estimates of productivity in each of the ecosystem zones with climatic predictive indexes characterizing summer warmth and moisture conditions derived from CRU TS 3.22 gridded temperature and precipitation data. The model indicated that summer warmth is the main factor governing the cumulative carbon uptake by permafrost ecosystems with the effect depending on the season. Throughout the entire circumpolar Arctic region we found strong positive correlation of biome productivity with June and August temperature sums, and mostly negative correlation with July temperature sums, which could be attributed to the suppression of photosynthesis in the driest and warmest month.

Predictive calculations under ensemble climatic projection are illustrated in Figure 1. They account for the effects of biome shifts and changes in the ecosystem's productivity within each biome. Results indicate that by mid-21st century ecosystem's carbon uptake in the circumpolar region may increase by 3.25 Pg/y, which is more than 3 times the projected increase of the carbon flux from permafrost soils. Differentiation between the carbon fluxes in the form of carbon dioxide and methane are needed for better understanding the effect on the global climate.

O 177 RESPONSE OF ARCTIC PERMAFROST SOIL MICROBIOMES TO ELEVATED TEMPERATURE

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Microorganisms are key players in the turnover of soil organic carbon (SOC) in the large carbon storages of the arctic permafrost soil region. While available data and modeling suggest a significant temperature-induced increase of greenhouse gas emissions from these soils by the end of this century, the responses of the underlying microbiomes are largely unknown. We have tackled this lack of knowledge in two globally important permafrost soil systems.

In a first study a temperature-gradient experiment with anoxic peat soil microcosms was conducted to identify microbiome-level changes in metabolic and trophic interactions of microorganisms during anaerobic SOC degradation to CH4 and CO2 along a temperature gradient. We used metatranscriptomic, metagenomic, and targeted metabolic profiling to assign specific microorganisms to their respective function in the metabolic network. The study revealed critical temperatures at which microbial adaptations cause changes in metabolic bottlenecks of anaerobic carbon degradation pathways. In particular, taxonomic shifts within functional guilds at different levels of the anaerobic C mineralisation cascade enable a fast adaptation of the microbial system resulting in high methane emissions at all temperatures.

A second study with mineral soils of Siberia investigated the effect of temperature and priming on soil microbiomes and C mineralisation rates. It revealed a soil horizon-dependent response of microbiomes, where C and N priming exhibited differential effects on SOC mineralisation in top soils and subsoils.

In conclusion, we begin to better understand the structure, function and interactions of arctic permafrost soil microbiomes and the factors controlling their response to temperature. However, there is a long road ahead to a comprehensive understanding.

O 176 SMALL-SCALE PLANT-SOIL INTERACTIONS IN NORTHERN SIBERIAN PERMAFROST: SPATIAL PATTERNS OF SOIL ORGANIC CARBON STOCKS AND MACRONUTRIENTS

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Thawing permafrost, driven by climate change, alters pedogenic processes and properties as well as plant community composition in high-latitude regions. Increased plant-available macronutrients, *i.e.* nitrogen (N) and phosphorus (P), may induce vegetation growth and further vegetation community shifts in cold regions, subsequently, leading to changes in the spatial structure of soil organic carbon (SOC), N and P stocks. However, the influence of permafrost thaw on the spatial distribution and variability of permafrost-affected soil properties remains unclear.

This research studied changes in spatial distribution and variability of SOC, N and P stocks due to permafrost thaw and further influences on vegetation communities within six studied grids (4m x 4m). These grids, characterized by various active layer thickness (ALT) and under different vegetation communities, were located within the forest-tundra ecotone underlain by warm and discontinuous permafrost at the Little Graviyka Creek catchment (67°28.933'N, 86°25.682'E). We collected 122 soil samples per grid from two depth increments, topsoil and subsoil, with a sample spacing of 0.2, 0.5 and 1.0 meters. Detailed plant species composition data were collected for each grid.

We found that permafrost thaw caused a decrease of SOC, N and P stocks and their spatial variability and released previously bounded plant-available P within the studied small-scale grids. Based on vegetation analyses, higher grid-specific vascular species abundance was observed for grids with a deeper ALT likely due to the increased availability of macronutrients, while species diversity was lower likely due to more homogeneous distribution of macronutrients. Concluding, the changes in vegetation communities in high-latitude regions could be an indicator of permafrost degradation linked to possible vegetation shifts and changing carbon sequestration potential in the Arctic regions. Combined research on vegetation structure and ecosystem carbon storage capacity can be seen as a key approach to estimating carbon and biodiversity losses due to permafrost degradation.

O 178 EVALUATING SPATIOTEMPORAL DIFFERENCES IN METHANE FLUXES ON THE NORTH SLOPE OF ALASKA VIA EDDY COVARIANCE FOOTPRINT MODELLING

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Arctic permafrost soils store 1300-1370 Pg of organic carbon, twice the current atmospheric stock. This region is warming at approximately 1°C per decade, and permafrost soils could lose 381-616 Pg C by 2300, with a large portion potentially being released as the potent greenhouse gas methane (CH_4). Despite intensive investigation, uncertainty estimates of CH_4 emissions have changed little since the first estimates in 1974. Two main difficulties in creating a baseline flux estimate is the region's remote nature and the high spatiotemporal variability in methane fluxes. This project examines fluxes from three eddy covariance sites in Barrow, Alaska by applying the Kormann and Meixner (2001) footprint model to investigate the spatio-temporal variability. A LiDAR digital elevation model collected by NGEE Artic at a very fine resolution (0.25m) and WorldView2 data have been used to give quantitative metrics for vegetation and microtopographic differences over these three sites. Preliminary results show significant differences (p-value < 0.05) in CH_4 emission patterns in the footprints that could bias flux estimates by 20%. Furthermore, the pattern of footprint variability shows divergent spatial patterns between summer and winter fluxes. The largest mean summer fluxes were observed in a low lying sedge-dominated drained lake basin (7.74 mg CH_4 m^{-2} day^{-1}) with the less degraded, more polygonal area having an average flux of (5.82 mg CH_4 m^{-2} day^{-1}). In the winter "zero curtain" period, the pattern reversed with higher fluxes coming from the polygonal area (3.58 mg CH_4 m^{-2} day^{-1}) and slightly lower fluxes (3.35 mg CH_4 m^{-2} day^{-1}) observed from the lake basin. This highlights that flux drivers differ by season and that these dynamics should be considered for estimating annual and regional fluxes.

O 174 CHEMISTRY AND SPECTROSCOPIC PROPERTIES OF SURFACE HORIZONS OF ARCTIC SOILS FROM UNDER DIFFERENT TYPES OF TUNDRA VEGETATION (SW SPITSBERGEN)

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Detailed studies of soil organic matter (SOM) are currently very important, especially in the permafrost-affected soils of the High Arctic, as many of these soils contain a large amount of SOM, which may be very susceptible to decomposition due to climate change. The main objective of this study was to determine the chemistry and spectroscopic properties of surface horizons of High Arctic soils from under different types of tundra vegetation in the Fuglebergsletta coastal plain (SW Spitsbergen) in the context of SOM susceptibility to decomposition. The obtained results indicate that SOM from the surface horizons of the soils covered with wet moss and ornithocoprophilous tundra vegetation shows high potential susceptibility to decomposition due to a high proportion of the non-humified fraction of organic matter and humic substances exhibiting a low degree of humification and aromatic condensation. Despite clear differences in the elemental composition of all the soil surface horizons (O, Ah, AC), the mean C/N ratio for the studied horizons is low and very similar. This indicates that C/N ratio is not a good indicator of degree of organic matter decomposition for the High Arctic soils in areas affected by seabirds. The FTIR spectroscopy data indicate a prevalence of aromatic rings over aliphatic chains in the surface horizons of Cryosols under polygonal and geophytic initial tundra vegetation and a prevalence of aliphatic chains over aromatic rings in the surface horizons of soils covered with wet moss and ornithocoprophilous tundra vegetation. This pattern indicates the highest degree of aromatic condensation of humic substances in the horizons of Cryosols under polygonal, geophytic initial tundra vegetation, intermediate degree in the horizons of Cryosols under lichen-heath tundra vegetation, and the lowest degree of aromaticity of humic substances in the surface horizons of soils covered with wet moss and ornithocoprophilous tundra vegetation.

O 175 THE CURRENT STATE OF LOCAL CO2 FLUX MEASUREMENTS IN THE TUNDRA: FROM REVIEW TO FUTURE PUBLICATIONS

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Tundra regions play an important role in the carbon cycle as they store approximately 50 % of global soil carbon reservoirs. However, these regions have a lot of local variation both in the carbon stocks and also in the CO_2 fluxes. This presentation summarizes the current knowledge of CO_2 fluxes based on local chamber measurements conducted during the growing season in the tundra environment. We performed a meta-analysis of recently (2000-2016) published tundra studies resulting in 60 publications. The aim was to describe how flux studies are geographically distributed and what kind of environmental drivers have been used to explain fluxes. According to the results, meadows and wet regions have been studied the most. Less attention has been given to High-Arctic regions, shrub tundra and dry environments. Additionally, soil and vegetation carbon stocks have been included in the flux studies rather insufficiently. Based on this review, two future articles are presented. The first article will focus on the relationship between soil organic carbon stocks and fluxes, namely gross primary production and ecosystem respiration. In the second article, large environmental gradients and vegetation communities will be investigated to understand the role of local environmental conditions in vegetation CO_2 fluxes. In the next step, we aim to model the spatial distribution of soil organic carbon stocks and CO_2 fluxes across tundra landscapes.

P 104 CARBON CONTENT AND HUMIC SUBSTANCES COMPOSITION IN SOILS OF VARIOUS TERRESTRIAL ENVIRONMENTS OF YAMAL REGION, NORTH-WEST SIBERIA, RUSSIA

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Soils of Yamal and Gydan peninsulas were investigated in terms of organic carbon (OC) and nitrogen contents and humic acids molecular composition and stability. Soils (n=120) of various terrestrial environments were examined on types of OC vertical distribution and turbic (cryogenic) redistribution. It was shown that the total OC stocks were about 15-32 kg/m2 of soil active layer with average C/N ratio about 10-16 units. Across the studied region soils contained an average 12 % OC. Among the surface layers the highest content of carbon fixed for Histic horizons (47 %),

while the lesser was typical for topsoils of the various Spodosols (1,5 %). Average topsoil OC content values were 12-15 %. About 55 % of soils investigated showed the profile redistribution of organic compounds which resulted from turbic (cryogenic) processes. The OC contents and stocks in buried or suprapermafrost horizons are comparable with those in upper part. Humic acids, isolated from soils, were assessed by solid state 13-NMR and electron spin resonance spectroscopy. The molecular composition of humic acids characterizes by a prevalence of aliphatic compounds (more than 60 %) on aromatic ones and their elemental and functional groups remains highly constant, both regional and in depth. At the same time, the concentration of free radicals, revealed by spectroscopy of electron spin resonance was essentially higher in northern mot soils that in soil of southern part of region. This indicates increasing of stabilization of humic acids in latitude gradient. Soils of Yamal region contain organic carbon which is stable at present climatic conditions. However, this stability is jeopardized due to low degree of molecular stabilization of humic substances molecules.

P 105 VULNERABILITY OF CRYOTURBATED CARBON IN SIBERIAN ARCTIC

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Arctic permafrost soils contain more than 1300 Pg of organic carbon (C) about half of the global soil C. They are, therefore, important components in the global C cycle, having acted as C sinks since the beginning of the Holocene. Substantial amount of this C is stored in buried pockets of organic matter (OM) by the process of cryoturbation. Cryoturbated soils contain more than one third of the arctic soil C. However, the information about their decomposability is scares.

We here present results from the project that aimed at identifying the role of microbial functioning and decomposition of OM in cryoturbated soils from Siberia and at accessing the potential vulnerability of this OM in future climate.

Our main findings were:

Temperature is not main control for decomposition of cryoturbated OM. Cryoturbated OM with comparable C content exhibited continuously lower respiration rates and methane production, demonstrating that factors other than temperature must control OM decomposition.

The microbial community is not able to decompose the organic matter in cryoturbated pockets. The microbial biomass of the buried material was very low and microbial community different from topsoil and more similar to subsoil microbial communities. It thus seems that there was a mismatch between microbial community and organic matter quality that added to the retarded decomposition of cryoturbated OM.

In cryoturbated OM nitrogen availability is reduced and N cycling decelerated. We demonstrated different nutrient limitations of the permafrost microbial communities. While no priming was observed in topsoil, in cryoturbated material the N-containing substrates led to a significant priming effect, indicating a strong N limitation of the microbial community in this soil.

We are able to demonstrate that, in addition to unfavorable environmental conditions, decomposition processes in cryoturbated arctic soils are retarded by a combination of changes in microbial community composition reduced nitrogen availability and decelerated nitrogen cycling.

P 106 FIELD-BASED INCUBATION EXPERIMENT WITH “BURIED” ORGANIC MATTER, LENA DELTA, SIBERIA

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Frozen organic material is a potential substrate for microbial decay and, as a consequence, carbon release into the atmosphere and hydrosphere.

To find out a microbial response and carbon release (in gaseous forms: CO_2, CH_4 and other forms) from organic matter that has been permanently frozen, we placed it *in situ* condition field-based incubation experiment on Samoylov island, Lena Delta, Russia (72°22’N, 126°28’E) in a rim of ice-wedge polygon. Frozen «buried› organic matter were taken from eroded Lena river bank of Samoylov Island and transferred to the soil surface (cryoturbation processes mimicking). The experiment has been installed in August, 2015. During July-August, 2016 soil respiration (CO_2 and CH_4 fluxes) were measured by the closed chamber technique. In field-based experiment mean season methane efflux from soil surface was 0.55±0.07 mg CH_4 m^{-2} h^{-1}; mean season methane efflux from plots without “buried” organic material (disturbance control) was 0.50±0.02 mg CH_4 m^{-2} h^{-1}. CO_2 emission measured by dark chambers did not differ in magnitude in all plots until beginning of August and then was approximately 1.5 times higher in plots containing organic material. Heterotrophic respiration rate from soil surface was mainly connected to soil temperature dynamic than with air temperature. The input of “buried” organic material in rim of ice-wedge polygon slightly increased methane emission during the whole vegetation period, and emission of CO_2 - at the second part of vegetation period. In this connection, we conclude that input of “buried” organic material immediately involves in methane-driving cycle, while heterotrophic part of microbial community needs some period for adaptation to chemical properties of introduced organic matter (approximately 3-4 weeks). This work was partly upported by the Russian Government Megagrant (Project № 14.B25.31.0031), and RFBR (grant № 16-04-01677).

P 107 CAN CHANGES OF SUBARCTIC SNOW COVER STRUCTURE INFLUENCE THE PENETRATION OF GAS FROM PERMAFROST INTO THE AIR?

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Snow cover in subarctic is characterised - due to longer periods of low air temperature - by frequent development of “suggar snow“, e.g. layers or full snow profile constituted by faseted or deep hoar crystals. In the framwork of comparative studies between the natural conditions of the Krkonoše Mts. (Central Europe) and Abisko area (Subarctic of Sweden) our interest concerned the description of snow profiles on subalpine heaths and mires including palsa mires. We have found repeatedly large system of vertical columns of height up to 20 cm and 20 cm apart within “suggar snow” cover in transect Riksgransen - Abisko - Tornetrask - Kiruna. Columns originated probably from chains of depth hoar crystals exposed to flux of vapour. Central parts of some of them were formed by ice column. Within the low snow cover on subalpine heaths exposed to wind, columns have formed from the snow base, or rather from the soil surface. Within deeper snow cover in palsa area Tornetrask and mires nearby Kiruna airport they form two layers separated by horizontal ice layer. Former, on May/June 2006, similar columns, though comprised of firn grains, have been commonly observed on the base of rest of snow patches, and they reflect the moving of thawing water.

Snow profiles in wetter and a little warmer climate conditions of the Krkonoše Mts. form mainly firn grains, low layers of depth hoar develop only exceptionaly. System of ice columns , similar to “suggar snow” in Abisko area, is not known.

On base of these observation, it should be supposed that certain changes of penetration of gases (methane, CO2) from subarctic soils and mires through snow cover with the connection to more frequent episodes of warmer and wetter weather, resp.with more frequent occurance of dense firn than “suggar snow”, will occur.

P 108 ACCUMULATIONS OF BIOGENIC METHANE IN PERMAFROST AND PERMAFROST-AFFECTED SOILS

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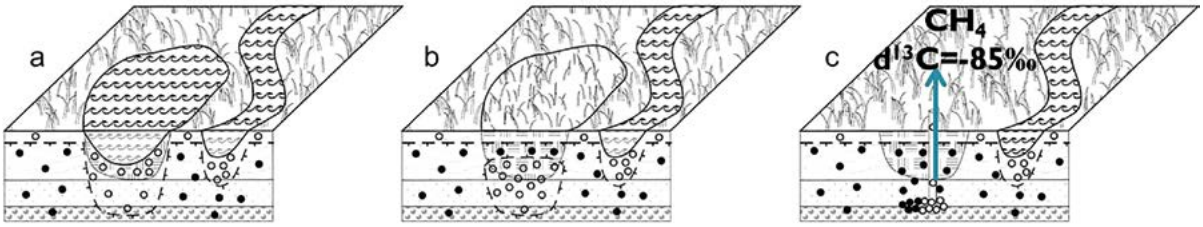
Biogenic greenhouse gases are the main products of degradation of permafrost carbon. Richness in decomposable organic matter of tundra soils, proximity of impermeable permafrost table, moist soils and humid climate all serve for conditions favorable for methanogenesis. The onset of freezing does not cease methanogenesis in thawed part of active layer as experimental studies suggest, because the keep activity even at below-zero temperatures. We measured profiles of methane in frozen taliks and frozen parts of active layer. We show evidences that freezing creates favorable conditions for methane conservation. It either creates dispersed profiles or concentrates trapped in lithological or permafrost pockets. The initial flux of methane from the one pocket disclosed by drilling was at a rate of more than 2.5 kg C(CH_4) m^{-2} h^{-1}, with stable isotopic composition showing clear biogenic origin of methane. This is shown on the Figure of the stages of methane redistribution in freezing talik, with frozen methane in permafrost represented with black circles, and in thawed sediments with open circles. Existence of such methane accumulations in permafrost and active layer could alter the dynamics of methane emissions during summer active layer melt, and could have effect on dynamics of permafrost degasation during degradation. Such methane accumulations could be responsible for hotspots of ebullition fluxes when permafrost thaws in subaqueous environments, and formation of the features like Yamal crater when blowout. On the other hand the process of concentration of methane in soil during freezing was tracked by several soil gas profiling experiments. The freezing controls on timing of methane release from permafrost-affected soils and permafrost are discussed.

This study was supported by the grant of the President of Russian Federation MK-9417.2016.5.



P 110 STOCKS OF ORGANIC CARBON IN TUNDRA ECOSYSTEMS OF NORTHERN FENNOSCANDIA

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Arctic and Subarctic ecosystems accumulate significant quantities of carbon. One of the most effective methods of studying the biochemical carbon cycle is mathematical modeling. However, the accuracy of predictions obtained on the basis of models is largely determined by the quality of initial input data, including the initial data on carbon stocks in soil and plants. For example, analysis of data on carbon stocks in the tundra soils provides rather various estimates, because authors often use approximation of the values of the density of the soil horizon or soil masses in it.

Our studies were carried out in 2011-2013 from July to August in the area of the Abisko research station (Northern Sweden). Eight tundra ecosystems which are located to the mountain and plain area were studied.

Despite the small thickness of tundra soils, they contain 60-97% ecosystem carbon stocks (mountain tundra: 1.60-5.85 kg C/m^2; plain tundra: 34.0-39.0 kg C/m^2; plain peat-bog: 45.7 kg C/m^2). The maximum carbon stocks were detected in plain tundra dwarf-shrub ecosystems and peat-bog due to the higher density of soil horizons and the absence of inclusions in the form of rock debris. This confirms the importance of consideration of the volume weight of soil in an individual soil sample in calculating element stocks.

Piant biomass is the second carbon pool in the tundra ecosystems. The maximum stocks of C in aboveground biomass are characteristic of dwarf-shrub ecosystems and wetland ecosystems, which is due to the largest stocks of biomass in these communities. It was established that most of the tundra ecosystems have carbon stocks largely in belowground biomass. On the whole, this distribution of carbon stocks reflects the correlation between the aboveground and belowground parts of plants.

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P 111 HOW STRONG IS THE EFFECT OF BEDROCK CHEMISTRY ON THE INITIAL SOIL DEVELOPMENT?

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Soil chronosequence is a common tool for the examination of soil development after glacier retreat. Although the soil succesion in the glacier forefields has been studied intensively, little is known about the microbial functioning which plays a significant role in the soil development, especially in the High Arctic where the rate of all proceses is influenced by harsh climate and strong nutrient limitations. We assume that bedrock chemistry is particularly important for initial microbial colonization and establishment in this this nutrient poor environment.

We sampled the initial soil from the Nordenskiöldbreen forefields, Svalbard (78.67°N, 16.78°E). The newly exposed ground in front of glacier has different geology on its southern and northern forefield. While the northern "silicate forefield" is mostly made of mica schists and orthogneiss, the southern "silicate + carbonate" forefield is build of magmatites, metamorphites and limestones and is a source of a significantly higher cationt exchange capacity. Collected soil from four zones of increasing age (I. 0-25, II. 26-44, III. 45-79 years) and tundra behind the front moraine (IV. > 107 years) was analyzed for microbial characterictics (microbial biomass, DNA, enzyme activity) which were supplemented by a set of physical (soil texture, WHC, bulk density) and chemical parametres (elemental soil analysis, pH, TOC, TN, $\delta^{13}C$ values, DOC, available nutrients).

We expected that observed differences in the physical and chemical soil parameters will be reflected in the microbial characteristics and overall soil development within chronosequences. However, the affection is apparently not uniform across the forefields and probably interconnected with other factors besides the bedrock. This pos sible effect of bedrock on microbial establishment and other entering variables will be discussed.

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P 112 CONTRIBUTION OF ROOT AND MICROBIAL COMPONENTS TO SOIL RESPIRATION IN ARCTIC SOILS

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Soil respiration is one of the main natural sources of carbon dioxide in the atmosphere. One of the primary factors affecting on the carbon dioxide emission is climate. Components of soil respiration (*root and microbial respirations*) respond to the climate change differently. Research of contribution of the individual soil respiration components is essential for prediction of global climate change, and also understanding and estimation the impact of environmental change on a carbon cycle.

Separation of root and soil microbial respiration in Arctic soils has some peculiarities, associated with influence of permafrost and severe climate. Respectively, methods of separate determination of root and microbial respiration must be selected in view of these peculiarities.

The research took place near the town Nadym, north of West Siberia (Russia) in august 2014, 2015 and 2016. The study area was located in the northern taiga with discontinuous permafrost.

Two methods were tested for the separation of microbial and root respiration. 1) "Shading" (shading of green aboveground parts of the plants); 2) a modified method of roots exclusion (It is to compare the emission of soils of "peat spots", without of vegetation and roots, and soils located in close proximity to the spots on which there is herbaceous vegetation and moss).

The experiments on method of "Shading" in the forest and on the frozen peatland were established 12 plots, 6 plots in the forest and at 6 plots on frozen peatland; 6 of them - control. Measurement of carbon dioxide emissions (chamber method) was carried at first day and after 72 hour of shading.

The experiments showed the following results: contribution of root respiration in peatlands was 10-50%, in forest - 7-50%. Both methods gave a positive result and can be used for permafrost-affected soils.

P 113 FIRST RESPONSE OF FROZEN PEATLAND SOILS TO FIELD AND LAB WARMING (NORTH-WESTERN SIBERIA, RUSSIA, NADYM SITE)

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Peatlands located in Russia contribute up to 35% of the global carbon stock in peatlands and it should be focused on due to predictable climate changes. Considering this fact we performed our study to comprehend the frozen peatland soils response to temperature increase.

In the field (aug 2016) the soil transplant experiment was performed in a frozen bog ecosystem in forest-tundra (65°18′55″N, 72°52′34″E). We established two experimental sites with contrasting soils daily average temperatures (0-5 cm): "cold site", 5.5 °C, and "warm site", 11.8 °C. Undisturbed soil samples in PVC tubes were cored from cold site: one part was transported to the warm site and the second part was placed back as a control. After one week of CO_2 efflux measurements we've found the transported soils CO_2 efflux rate to be 4 times higher comparatively to control (320 and 76 mg/m^2*per h. correspondingly).

In the laboratory (autumn 2016) Carbon (C) mineralization rate, basal and substrate-induced respiration (BR&SIR), labile soil organic carbon content ($labile_{SOC}$) were analyzed to estimate the soils first response to warming. We found almost positive soils feedback that was shown as 90% growth in C mineralization rate on the last 30th day of sequential temperature increase from 5 to 30 °C. BR&SIR rates were in line with C mineralization rate and at 25 °C after 5 days of equal-time incubation were 3-4 times higher as compared to incubation at 5 °C for upper soil layers. Instead of these results the $labile_{SOC}$ content at 25 °C was 2 times higher than at 5 °C for similar upper soil layers.

In summary our first results indicate a possible frozen peatland soils adaptation to substantial increase in temperature of their functioning and this item should be considered if discussing soils respiration contribution in various climate prediction models.

S08 MICROBIAL DIVERSITY IN THE WAKE OF WEAKENING BIOGEOGRAPHIC ZONES AROUND THE ARCTIC

O 221 WHETHER THE WARMING ARCTIC BECOMES MORE HOSPITABLE ENVIRONMENT FOR HEALTH SIGNIFICANT BACTERIA?

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As a part of our studies on culturable bacterial diversity in the Kongsfjorden in Norwegian arctic, we explored the possibility of spread of health significant bacteria into this pristine environment. We hypothesized that migratory birds, especially the Svalbard population of migratory bird Barnacle ghoose, (*Branta leucopis*) which does wintering in the Solway firth between England and Scotland as a possible vector which could bring in health significant bacteria to the arctic environment. *B. leucopis* breeds in Svalbard region during summer and forages in the tundra where it leaves considerable amount of droppings, which ultimately find their way into the Kongsfjorden along with snow melt water from the adjoining tundra. We could isolate several serotypes of *Escherichia coli* including pathogenic phylotypes from the droppings of *B. leucopis*. The antibiogram of the isolates revealed several multidrug resistant strains. We also encountered several strains of *Enterobacter ludwigii* and *Stenotrophomonas maltophilia* emerging pathogens causing nosocomial infections, from the water and sediment of Kongsfjorden. Antibiogram of the bacterial isolates from fjord water and sediment revealed that fjord sediments offer better selection pressure for the emergence of drug resistant mutants of bacteria. We assume that the mesophilic strains such as *Enterobacter ludwigii* and *Stenotrophomonas maltophilia* are finding their way into the Kongsfjorden with the warm Atlantic water from lower latitudes which extend its tongue into the fjord during summer. Our results also revealed predominance of psychrotrophic strains rather than true psychrophiles indicating the effect of warming trend in the arctic environment on the bacterial community.

O 222 WATERMASSES AND MICROBIAL SIGNATURES IN THE KONGSFJORDEN INDICATES INCREASING ATLANTIFICATION OF THE FJORD DURING ARCTIC SUMMER

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We have analyzed the hydrography, phytoplankton, chlorophyll and bacterial diversity of the Kongsfjorden on a regular basis since 2008. Sampling is done from select stations across the Kongsfjorden during the summer and early winter months and analysed for hydrography, bacterial diversity (both culture based and metagenome based) and chlorophyll pigments. Watermasses in the Kongsfjorden were identified based on temperature/ salinity (T/S) profiles. Our observations during 2011 -13 clearly revealed the warming trend of the Kongsfjorden water which prompted us to install a mooring for continuous observations, which is in place since 2014 summer. Since Atlantic water influx and melting of glaciers are linked to climate variability, we have followed these patterns closely. We could observe that gamma proteobacteria dominating the bacterial community in June and alpha proteobacteria in July and August. On the basis of culture based analysis we have encountered 13 non-polar species and 9 polar species of bacteria in the water samples from the Kongsfjorden. During mid-summer there was good diversity of non-polar strains in the outerfjord, which started appearing in the inner fjord towards the end of summer. October sampling yielded only *H. titanicae* as the only non-polar species in the fjord and polar species started dominating the system. Population of *H. titanicae*, the most abundant non-polar species increased 20-25% with the increased intrusion of Atlantic water during October. *L. aequorea* is the predominant polar species of bacteria encountered both in the out and inner fjord during October. Metagenome based analysis revealed presence of 12 operational taxonomic units dominated by Proteobacteria and Bacteroidetes. SAR 406 and TM7 were the true marine phyla seen in the outer fjord and Chloroflexi and Acidobaceria were the facultative, oligotrophic anoxygenic phyla seen only in the inner fjord. Both the water mass profiles and microbial signature indicate increasing Atlantification of the Kongsfjorden.

O 224 SIMILAR PATTERNS OF DIVERSITY IN MICROSCOPIC METAZOANS (ROTIFERA) IN ARCTIC AND ANTARCTIC

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The structure of diversity is a key characteristic of a biome that can be difficult to estimate for microscopic organisms, due to their high abundance in samples. Although rotifers (Rotifera) is one of the most common group of micrometazoa in the polar ecosystems, not much is known about their diversity in terrestrial polar habitats, in terms of qualitative (species composition) and quantitative parameters (diversity metrics). It is still not understood whether the patterns known for polar macroorganisms (in particular, higher endemicity of Antarctic fauna in comparison with Arctic) are the same in rotifers and other terrestrial microorganisms. In the present study, we compared diversity metrics of rotifer communities from Svalbard (the High Arctic) and Antarctica, and adjacent temperate regions of both hemispheres (Europe, Chile, New Zealand).

The material used for the analysis (over 500 samples of soil, algal mats, wetland and dryland moss and lichens) was stored frozen or dried before processing. Both morphology and DNA analysis were used for species identification.

Morphological analysis revealed certain similarity in species composition between Svalbard and Europe. No common morphospecies were found between Antarctica and other investigated regions of the Southern Hemisphere, although these were reported previously. However, species identified by DNA taxonomy have shown almost no similarity between Svalbard and Europe (more detailed investigation needed), likewise between Antarctica and elsewhere. Moreover, diversity metrics estimated for particular habitats (mineral soil, wet moss/algal mats, dry moss) in some cases revealed no significant difference both between Arctic and Antarctic rotifer faunas, and those from adjacent temperate regions. These results indicate that (1) higher than estimated before degrees of isolation and endemism may exist for microfauna in the High Arctic islands, similarly to Antarctica (2) there are similar rotifer diversity patterns in the same habitat types both between Arctic and Antarctic, and polar and moderate zones.

O 223 PHYLOGEOGRAPHY OF VANNELLID AMOEBAE: PRESENCE OF LINEAGES WITH BIPOLAR DISTRIBUTION

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Vannellids (Amoebozoa: Vannellidae) are flattened and fan-shaped eukaryotic microorganisms ranging in size from about five to tens of micrometres. They are widespread throughout the world and have an important role in communities of microorganisms preying on bacteria. They are relatively abundant in various freshwater/soil and marine habitats. Phylogenetically, they are divided into freshwater and marine clades. In comparison with other larger groups of Amoebozoa, vannellids only rarely form cysts.

We analysed our large, previously created vannellid dataset, completed with 13 novel strains of the Arctic (Svalbard) and the Antarctic (James Ross Island) origin. A fragment of cytochrome oxidase I gene was amplified using the Folmer primers and sequenced directly or following a molecular cloning. A translation to amino acids confirmed a RNA-editing in vannellids. In total, 240 sequences including those of molecular clones (representing 90 strains of vannellid amoebae) were analysed by Maximum likelihood. Interestingly, the phylogenetic analysis revealed two polar strain lineages consisting of strains from the both polar regions. Of these, one lineage unites strains of the freshwater/soil origin whereas the other one those of the marine origin. Both these lineages have an extreme disjunct, bipolar distribution.

Bipolar distribution is known in various organisms; however, vannellids deserve a special attention. They can be kept in culture quite easily; therefore they offer an excellent opportunity of studying factors which favour their polar distribution. Our preliminary results suggest that the growth of polar vannellids in the laboratory is not inhibited by a higher (20 °C) temperature.

Supported by LM2015078 CzechPolar2 - Česká polární výzkumná infrastruktura.

P 114 DIVERSITY AND DISTRIBUTION OF PHYTOPLANKTON COMMUNITIES IN NY-ALESUND OF ARCTIC REGION

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Phytoplankton is a taxonomically diverse group of photosynthetic aquatic microorganisms, mostly single-celled, that sometimes join into colonies, drifting with the currents. Phytoplankton plays a crucial role in the primary production, nutrient cycling, and food webs and makes up a significant proportion of the primary production in aquatic ecosystems. These are considered as one of the major biological elements used for the assessment of the ecological status of surface water bodies, and the variation in the biotic parameters is an excellent indication of energy turnover in aquatic environments, due to its sensitivity to any change in the environment. Even though the study of microalgae in the Arctic spans more than a decade, it has been concentrated more towards larger cells >20 µm, despite the fact that small phytoplankton dominates primary production. Keeping the previously mentioned points, we analyzed phytoplankton diversity during Indian Arctic summer IV expedition June 2011. The samples collected from Arctic marine, fresh waters and other moss habitats of Himadri region (India's Arctic Research Station). A total of 51 planktonic taxa were identified belonging to the class Bacillariophyceae Chlorophyceae, Chrysophyceae, Cyanophyceae and Dinophyceae (Plate - 1 & 2). The biodiversity calculations, relative abundance, Shannon's Weaver Index and Simpson index of diversity further supported the data for a better understanding of the phytoplankton diversity in the study area.

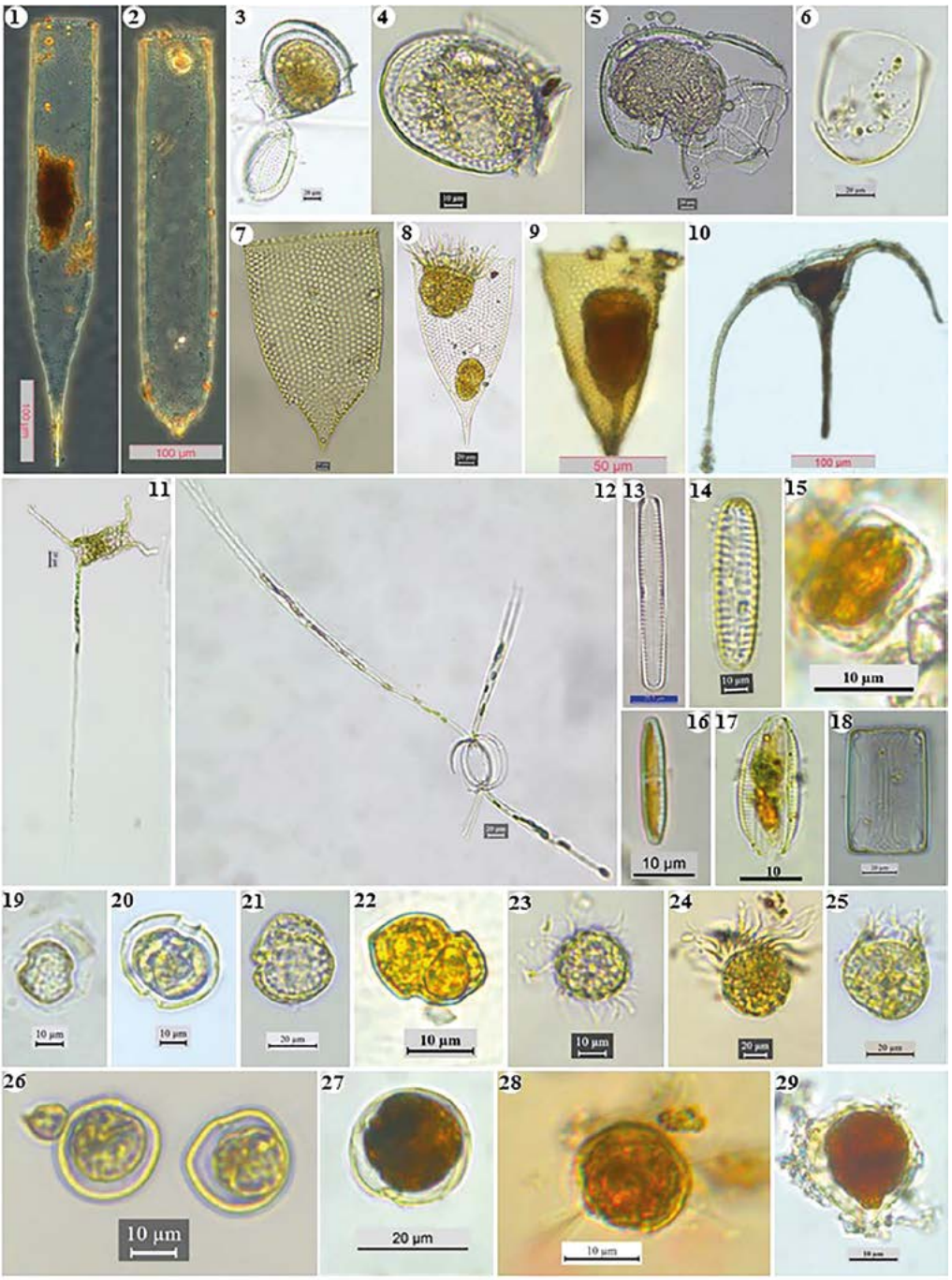

Plate-1 (Figs. 1- 29):

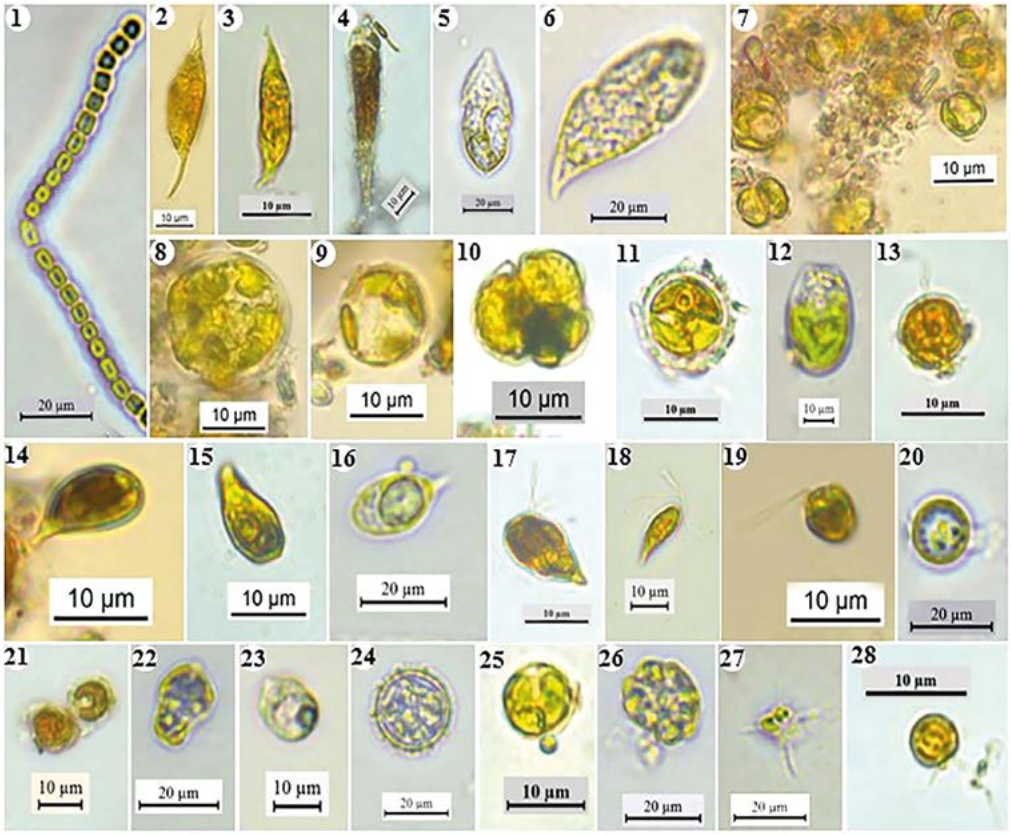

Plate-2 (Figs. 1- 28):

S. No	Phytoplanktons taxa	Plate/Fig. No.
1	*Helicostromella fusiformis*	Pl. 1; Fig.1
2	*Parafavella gigantean*	Pl. 1; Fig.2
3	*Dinophysis acuminata*	Pl. 1; Fig.3
4	*Dinophysis sp.*	Pl. 1; Fig. 4
5	*Helicostromella sp.*	Pl. 1; Fig. 5
6	*Acanthostomella norvegica*	Pl. 1; Fig. 6
7	*Parafavella sp.*	Pl. 1; Fig. 7
8	*Parafavella sp.*	Pl. 1; Fig. 8
9	*Parafavella denticula*	Pl. 1; Fig.9
10	*Ceratium lingipes*	Pl. 1; Fig.10
11	*Chaetoceros tenuissimus*	Pl. 1; Fig.11
12	*Chaetoceros sp.*	Pl. 1; Fig. 12
13	*Navicula sp.*	Pl. 1; Fig.13
14	*Pinnularia sp.*	Pl. 1; Fig. 14
15	*Diatoma mesodon*	Pl. 1; Fig.15
16	*Navicula sp.*	Pl. 1; Fig.16
17	*Amphora veneta*	Pl. 1; Fig.17
18	*Eunotia sp.*	Pl. 1; Fig. 18
19	*Alexandrium pseudogonyaulax*	Pl. 1; Fig.19
20	*Diplosalopsis bomba*	Pl. 1; Fig.20
21	*Gyrodinium undulans*	Pl. 1; Fig.21
22	*Achradina pulchra*	Pl. 1; Fig.22
23	*Stobilidium sp.*	Pl. 1; Fig. 23
24	*Strobilidium spiralis*	Pl. 1; Fig. 24
25	*Lohmanniellaoviformis*	Pl. 1; Fig.25
26	*Alexandrium sp.*	Pl. 1; Fig. 26
27	*Alexandrium tamarense*	Pl. 1; Fig.27
28	*Acanthoica quattrospina*	Pl. 1; Fig.28
29	*Kentrosphaeragrandis*	Pl. 1; Fig. 29
30	*Pseudanabaena sp.*	Pl. 2; Fig.1
31	*Pronoctilucapelagica*	Pl. 2; Fig.2,3
32	*Eutreptiellabraarudi*	Pl. 2; Fig.4
33	*Eutreptiellagymnastica*	Pl. 2; Fig.5&6
34	*Lobococcusirregularis*	Pl. 2; Fig.7&8
35	*Dictyococcusfusisporus*	Pl. 2; Fig.9
36	*Trochisciopsis tetraspora*	Pl. 2; Fig. 10 & 11
37	*Chloromonas sp.*	Pl. 2; Fig.12
38	*Chrysochromulina sp.*	Pl. 2; Fig.13
39	*Leucocryptis marina*	Pl. 2; Fig.14&15
40	*Plageoselmis prolonga*	Pl. 2; Fig.16&17
41	*Eutreptiellaeupharyngea*	Pl. 2; Fig. 18
42	*Metromonas simplex*	Pl. 2; Fig. 19
43	*Chlorella homosphaera*	Pl. 2; Fig. 20
44	*Kirchneriella sp.*	Pl. 2; Fig. 21
45	*Chrysochromulina birgeri*	Pl. 2; Fig.22
46	*Amphidinium carterae*	Pl. 2; Fig. 23
47	*Algirosphaerarobusta*	Pl. 2; Fig. 24
48	*Oophilaamblystomalis*	Pl. 2; Fig. 25
49	*Phaeocystispouchetii*	Pl. 2; Fig. 26
50	*Scenedesmusminutus*	Pl. 2; Fig. 27
51	*Chlamydomonas sp.*	Pl. 2; Fig. 28

P 115 MICROSCOPIC FUNGI COMPLEXES IN SOILS CONTAMINATED BY INDUSTRIAL PLANTS EMISSIONS OF THE KOLA ARCTIC

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The Murmansk region is a part of onshore Arctic area of the Russian Federation. The geographical region of research focus is characterized by a unique combination of natural and anthropogenic factors: severe climatic conditions and intensive industrial development (Kandalaksha aluminum smelter and the copper-nickel Severonikel and Pechenganikel plants).

The number of microscopic fungi is determined by the deep seeding method on a nutrient media, and the biomass is determined by the fluorescence microscopy method. The fungi identification has been carried out based on cultural-morphological features using standard determinants.

High sensitivity of soil fungi to the habitat pollution from aluminum smelter emissions and a relative sustainability towards the copper-nickel plants emissions as compared to the procaryotic community have been identified. However, the rate of decrease of the microfungal number and biomass relative to background has been found to be higher near the copper-nickel plants as compared to the area of impact of the aluminum smelter emissions.

A reduction of species diversity and structural changes of soil microscopic fungi complexes as a result of the influence of industrial plants emissions have been revealed. An increase of diversity of fungi genera *Aspergillus, Fusarium, Alternaria, Cladosporium* and a change of intrapartum structure of genus *Penicillium*: namely, an increased share of fungi sections Biverticillata and Asymmetrica, is observed in contaminated areas. The above genera and structure of genus *Penicillium* are typical for soils of more southern districts.

The fraction of potentially pathogenic fungi in the soils contaminated by aluminum and copper-nickel plants emissions as compared to the background soil has been found to increase by 15%. This first and foremost includes the agents of mycoses of the genus *Aspergillus (A.fumigatus). The Alternaria alternata, Aureobasidium pullulans, Mucor pusillus, Penicillium aurantiogriseum, P. glabrum, Trichoderma viride, T. koningii* also have pathogenic properties causing diseases of the respiratory and digestive systems.

P 116 BACTERIAL COMMUNITY IS ASSOCIATED WITH THE DEGREE OF SOIL ORGANIC MATTER DECOMPOSITION IN MOIST ACIDIC TUNDRA SOIL

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The increasing temperature in Arctic tundra deepens the active layer, which is the upper layer of permafrost soil that experiences repeated thawing and freezing. The increasing of soil temperature and the deepening of active layer seem to affect soil microbial communities. Therefore, information on soil microbial communities at various soil depths is essential to understand their potential responses to climate change in the active layer soil. We investigated the community structure of soil bacteria in the active layer from moist acidic tussock tundra in Council, Alaska. Council in Alaska is located in boundaries of Arctic and Subarctic regions. The relationship of bacterial community and some relevant soil physicochemical characteristics along soil depth with a fine scale (5 cm depth interval) was investigated. The bacterial community structure was found to change along soil depth. The relative abundances of *Acidobacteria, Gammaproteobacteria, Planctomycetes*, and candidate phylum WPS-2 rapidly decreased with soil depth, while those of *Bacteroidetes, Chloroflexi, Gemmatimonadetes*, and candidate AD3 rapidly increased. A structural shift was also found in the soil bacterial communities around 20 cm depth, where two organic (upper Oi and lower Oa) horizons are subdivided. The quality and the decomposition degree of organic matter might have influenced the bacterial community structure. Besides the organic matter quality, the vertical distribution of bacterial communities was also found to be related to soil pH and total phosphorous content. This study showed the vertical change of bacterial community in active layer with a fine scale resolution and the possible influence of the quality of soil organic matter on shaping bacterial community structure.

S09 TERRESTRIAL ALGAE – MOLECULAR DIVERSITY, GEOGRAPHICAL DISTRIBUTION, ECOLOGY AND PHYSIOLOGY

KL 07 DO WINTER CONDITIONS IN TERRESTRIAL POLAR ECOSYSTEM SELECT ENDEMIC AND INVASIVE PHOTOSYNTHETIC MICROBES?

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Cyanobacteria and eukaryotic microalgae are at the root of plant evolution and possess an enormous biodiversity. In some extreme habitats such as polar terrestrial environments, they are often the only biota that produce visible biomass as soil crusts or microbial mats. This, combined with the fact that the Arctic and Antarctica are geographically isolated and have a different climatic and tectonic history, but share similar environmental conditions, including harsh period during winter. Recent studies are starting to reveal that the incidence of endemism is quite high in some groups, which can in part be explained by long-term survival in glacial refugee and evolution continued in isolation habitats from the start of the Cenozoic glacial-interglacial cycles. However, in contrary, there are also evidences of unlimited dispersal capacities in microorganisms and that their transportation is aided by various factors such as atmospheric circulation, bird migrations and human activities. Consequently, knowledge of the rates of dispersal input, survival of the imposed stresses of the transfer process, and viability on arrival including winter survival, is essential for understanding ecosystem stability and resilience. The current debate also concerns to what extent polar microbiomes are genetically and physiologically different from the rest of the global microbial genepool. In presentation I will focus on role of winter conditions, including winter survival and environmental stresses which follows this period on selection of endemic versus invasive species.

O 201 SURPRISING DIVERSITY OF PRASIOLALES FROM THE ARCTIC AND THE FIRST INSIGHTS ON PRASIOLA CRISPA GENOMICS

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[7] *University of Warwick, School of Life Sciences, Coventry, United Kingdom*
[8] *Bezhin Rosko, Santec, France*
[9] *Università Politecnica delle Marche, Dipartimento di Scienze della Vita e dell'Ambiente, Ancona, Italy*
[10] *University of Hawai'i at Mānoa, Department of Botany, Honolulu, USA*
[11] *University of Western Ontario, Department of Biology, London, Canada*
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Members of the Prasiolales are among the most common green algae in the polar regions. The group displays an exceedingly wide range of ecological strategies, yet it is best known from nitrogen-rich terrestrial biotopes both in the Arctic and Antarctic. Our sampling around Petuniabukta in Spitsbergen, Svalbard, revealed unexpected cryptic diversity and led to description of two new genera and species, *Prasionema payeri* and *Prasionella wendyae*. Our findings suggest that the diversity of Prasiolales in the Arctic has been underestimated and requires further investigations.

We are also studying the genomics of the flag-ship species of Prasiolales, *Prasiola crispa*. We've completed the annotation of both organellar genomes, mitochondrial and chloroplast. To analyze the whole nuclear genome, we combined shorter Illumina reads with long reads from the advanced Oxford Nannopore MinION technology into a hybrid assembly that yields better completeness and contiguity.

O 199 SUCCESSIONAL DYNAMICS OF CYANOBACTERIAL COMMUNITIES FOLLOWING THE RETREAT OF TWO GLACIERS IN PETUNIA BAY (SVALBARD)

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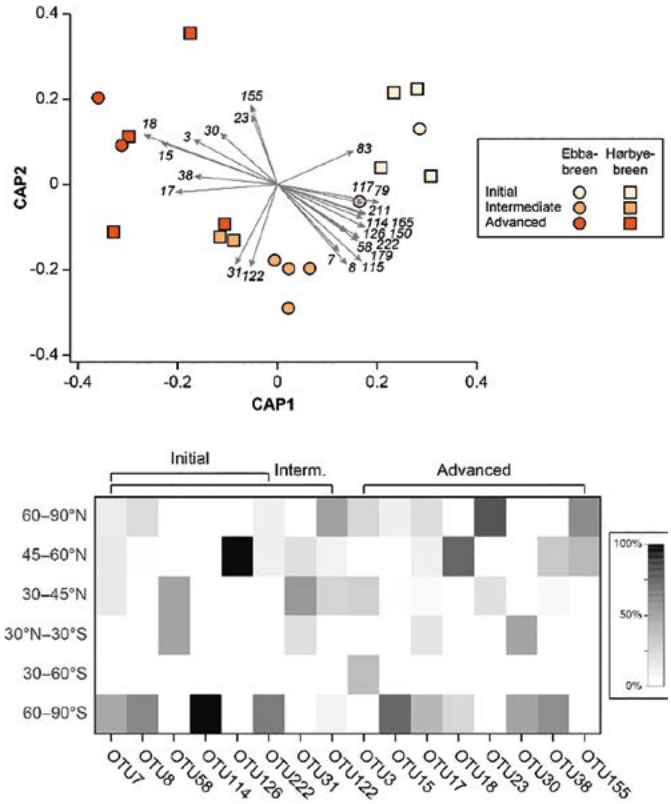
Most glaciers in Svalbard have been retreating and thinning since the end of the Little Ice Age in the late 19th century. As a glacier retreats, it exposes new terrestrial habitats for the colonization by pioneering (micro)organisms. Here we report on the successional trajectories of cyanobacterial communities along a 100-year deglaciation gradient in the Ebba- and Hørbyebreen glacier forefields (Petunia Bay, central Svalbard). Cyanobacterial biomass and community composition were evaluated by epifluorescence microscopy and pyrosequencing of partial 16S rRNA gene sequences. Pseudanabaenales was the most abundant order in both forefields, followed by Chroococcales, Oscillatoriales, Synechococcales, Nostocales and Gloeobacterales. Succession was characterized by a decrease in phylotype richness and a marked turnover in community structure, resulting in a separation between initial (10-20 years since deglaciation), intermediate (30-50 years), and advanced (80-100 years) communities (Figure 1). Community turnover was explained by a combination of temporal and environmental factors, which accounted together for 46.9% of the variation in community structure. Interestingly, phylotypes associated with initial communities were related to potentially novel taxa (i.e. <97.5% similar to sequences currently available on GenBank) and sequences predominantly restricted to polar biotopes (Figure 2), suggesting that the initial colonization is performed by cyanobacteria from glacial and periglacial habitats. Advanced communities, on the other hand, included genotypes with a wider geographic distribution, which are likely able to establish only after the microenvironment has been modified by pioneering taxa.



O 200 CYANOBACTERIAL COMMUNITY COMPOSITION AND ASSOCIATED ECOLOGICAL PROCESSES IN ARCTIC SOIL CRUSTS

E. Pushkareva[1], J. Kvíderová[1], M. Šimek[2], J. Elster[1]

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Soil crusts vary depending on the disturbance rate (water-wind erosion, soil cryo-disturbance, anthropogenic activities, animal grazing, etc.) from poorly-developed to well-developed stages. However, little is known about the factors driving small scale patterns of soil crust community structure and associated ecological processes. Here, we describe and compare these processes in biological soil crusts from Central Svalbard at different stages of development. Studied soil crusts presented gradient (from poorly-developed to well developed) based on chemical parameters and cyanobacterial community composition. Biovolume of microbial phototrophs, dominated by cyanobacteria, increased with soil crust development. However, lichen cover negatively influenced their growth which resulted in a decrease of microbial phototrophs abundance. Gradient from poorly-developed to well-developed soil crusts also reflected the changes in nitrogenase activity and photosynthesis to microclimatic parameters (temperature and photosynthetically active radiation, PAR). Nitrogenase activity decreased from poorly to more developed soil crusts. Moreover, nitrogenase activity was not recorded in well-developed soil crust, probably, due to dense lichen cover. Diurnal courses of photosynthetic activity differed among the soil crust types showing shifts in diel minima and maxima. Moreover, the poorly-developed soil crust reacted faster to changes in temperature and PAR than more developed soil crusts. In addition, higher temperatures led to inhibition of photosynthetic activity and increased energy dissipation, indicating acclimation/adaptation of the soil crust photosynthetic microorganisms to a cold environment.

O 198 CYANOBACTERIA FROM THE FOREST SOILS OF THE PASVIK RESERVE (MURMANSK REGION, RUSSIA)

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We investigated biodiversity of cyanobacteria in the Al-Fe-humus podzols soils from birch and pine forests in the Pasvik Reserve. Studied area is located in the north-west part of the Russia, and almost entirely belongs to the arctic region. The Pasvik State Nature Reserve is located in the north-west part of Kola peninsula, along the Pasvik River, on the border with Norway. Pine and birch forest are covering 44% of total area of Reserve. Acidic soils with the thin organic layer are very commonly distributed (Al-Fe-humus podzols) here.

Samples were collected from birch and pine forest soils in June 2013/2015. A total 42 soil samples were examined. Strains were isolated from environment samples using standard isolation techniques.

We have recorded 9 species of cyanobacteria, whose account for approximately 17% of the total number of algal species in the reserve. The lowest number of cyanobacteria was found in pine forest with low soil acidity (2 species); the maximum species richness was detected in the birch forests (9 species).

We found several common species for soils, such as *Microcoleus vaginatus*, *Phormidium* sp., *Nostoc* sp., *Aphanocapsa* sp., and *Leptolyngbya* sp. Also, extremely rare *Woronichinia* sp., *Johannesbaptistia* sp., *Myxacorys* sp. and *Stienomitos* sp., were detected. *Microcoleus vaginatus*, *Nostoc* sp., and *Myxacorys* sp. were further confirmed using molecular data (16S rDNA gene sequence), additionally, secondary structures of the 16S-23S intergenic spacer (ITS) region were taken into consideration.

In conclusion, species richness of the soil cyanobacteria from Pasvik Reserve is having small number,species composition was represented mostly by filamentous cyanobacteria. The future direction of our investigation is to taxonomically describe rare taxa using modern technics, as well as to continue sampling cyanobacteria from the podzol soils.

P 117 TOLERANCE OF PENNATE DIATOMS (BACILLARIOPHYCEAE) TO EXPERIMENTAL FREEZING: COMPARISON OF POLAR AND TEMPERATE STRAINS

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Environment in Polar Regions is characterized by many extremes. Low temperatures, lack of fluid water, irregular nutrient and light supply, fluctuations in daily and annual cycles could seem unfavourable for life. In spite of this, diatoms (Bacillariophyceae) are one of groups of microorganisms that apparently well adapted to such environment and dominate in a wide range of polar habitats. For many organisms, dormancy is a strategy to overcome unfriendly conditions, but morphologically distinct resting stages are observed rarely in diatoms. In this study, the tolerance of polar and temperate diatoms to freezing was experimentally tested and the difference in survivability of vegetative and resting cells was assessed. Diatom strains for the experiments were isolated in 2014 using natural samples from the Maritime Antarctica (James Ross Island, Vega Island) and the Arctic (Spitsbergen). Further strains were acquired from culture collections of microorganisms (CCCryo and BCCM). Resting cells were induced by incubation under nitrogen and light limitation in lower temperature. The vegetative and resting cells of 26 strains were exposed to six different freezing treatments (including those simulating natural conditions) to -4 °C, -20 °C, -40 °C and -180 °C (liquid nitrogen). Treatments differed also in the rate of freezing and thawing (continuous versus abrupt). The study concludes that diatoms are sensitive to freezing. Overall, the difference in survival between polar and temperate strains was not significant. However, obvious trends were found in the -20 °C treatments, where polar strains showed higher percentage of viable cells. The importance of resting cells for the freezing survival was not confirmed.

P 121 ALGAE AND CYANOBACTERIA IN SOILS OF RYBACHY PENINSULA, RUSSIA

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This research dealt with the biodiversity of algae and cyanobacteria in different soil types of Rybachy Peninsula. This area belongs to the subarctic tundra zone.

In total, 80 taxa belonging to the divisions Chlorophyta (31), Ochrophyta (25), Cryptophyta (1), Charophyta (5), Cyanobacteria (18) have been recorded. Soil series of ascending species diversity: cryogenic and primitive soil (6 species) - Al-Fe-humus podzols (13) - podburs (18) - soils dry-peaty (39) - peats low moor (53).

Most of the species in the Al-Fe-humus podzols and podburs belong to the following classes of the green algal Chlorophyceae and Trebouxiophyceae. *Borodinellopsis cf. oleifera* Schwarz, *Elliptochloris bilobata* Tschermak-Woess, *Leptosira* sp., *Parietochloris* sp., *Pseudococcomyxa simplex* (Mainx) Fott, *Stichococcus bacillaris* Nägeli have been found to be the most common species here.

We have found considerably larger variety of cyanobacteria in the soils dry-peaty (18% of the total species number), in compare with another types of soil. *Eunotia praerupta* Ehrenberg, *E. bilunaris* (Ehrenberg) Schaarschmid, *Pinnularia borealis* Ehrenberg, *P. subcapitata* W. Gregory, *P. viridis* (Nitzsch) Ehrenberg, and *P. lata* (Brébisson) W. Smith. were found here as well, and they account for 26% of the total species richness.

The highest abundance of species were found in the soils low moor peats. Members of the green algae, blue-green algae and diatoms contribute, approximately, equal number of the species to the overall species richness. *Cosmarium impressulum* Elfving, *C. quadratum* Ralfs ex Ralfs, and *Mougeotia* sp.(Conjugatophyceae) being typical taxa for wetland and aquatic habitats also found here. *Microcoleus vaginatus* Gomont ex Gomont, *Geitlerinema splendidum* (Greville ex Gomont) Anagnostidis, and *Pseudanabaena* sp. were found to be the most common species of cyanobacteria in low moorland peat soil. In addition, representatives of *Aphanocapsa*, *Aphanothece*, *Chroococcus*, *Nostoc*, and *Anabaena* were found here. Also, diatoms of the genera *Hantzschia, Pinnularia, Rhopalodia, Frustulia* were detected in this soil.

P 118 SPACE WEATHER AND ATMOSPHERIC ELECTRO/CHEMISTRY – DO THEY AFFECT POLAR TERRESTRIAL CRYPTOGAMS?

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The space weather influences significantly physical and chemical properties of the Earth atmosphere at daily, monthly, seasonal or climatological scales. Such changes may be demonstrated in polar terrestrial cryptogams, since the cosmic radiation penetrates to the lower atmosphere more than in lower latitudes.

This proposed project focuses thus on questions such as:

How do changes in atmospheric electro/chemistry affect polar cryptogams?

How serious are these effects in comparison with effects of other microclimatic parameters (temperature, irradiance, water availability)?

How is the actual physiological status of polar cryptogams correlated to space weather - atmospheric events, as revealed by complementary atmospheric and meteorological data (static electric field, UV radiation, ozone, NOx, standard meteorological data) and measured microclimatic parameters?

We are comparing parameters describing physiological status of studied cryptogams (based on variable chlorophyll fluorescence approach) with ground-based monitoring of cosmic rays, electric field intensity, atmosphetic chemistry, and basic micro/meteorological conditions. Ground-based data are complemented by space-borne observations of solar activity. Specific shielding and light-probe protocols shall provide deeper insight into the bio-sensing mechanism and help construct a causality model of possible space weather-atmosphere-biosphere interactions.

Since 2013, we are performing regular measurements of variable chlorophyll fluorescence (quantum yield) at Lomnicky štít 2634 m a.s. l. (High Tatra Mountains, Slovakia) in the community of mosses, lichens and cyanobacteria (aerophytic community *Phormidium* sp.). At this point, the solar physics measurements have been performed there since 1964, the cosmic rays since 1981.

This set of measurements is proposed for a methodology for long term observation of effect the space weather and atmospheric electro/chemistry on cryptogams physiology (photosynthesis) in Svalbard. In presentation, data from Lomnický štít will be introduced.

P 119 THE BIOGEOGRAPHY OF CYANOBACTERIAL COMMUNITIES IN THE SVALBARD ARCHIPELAGO

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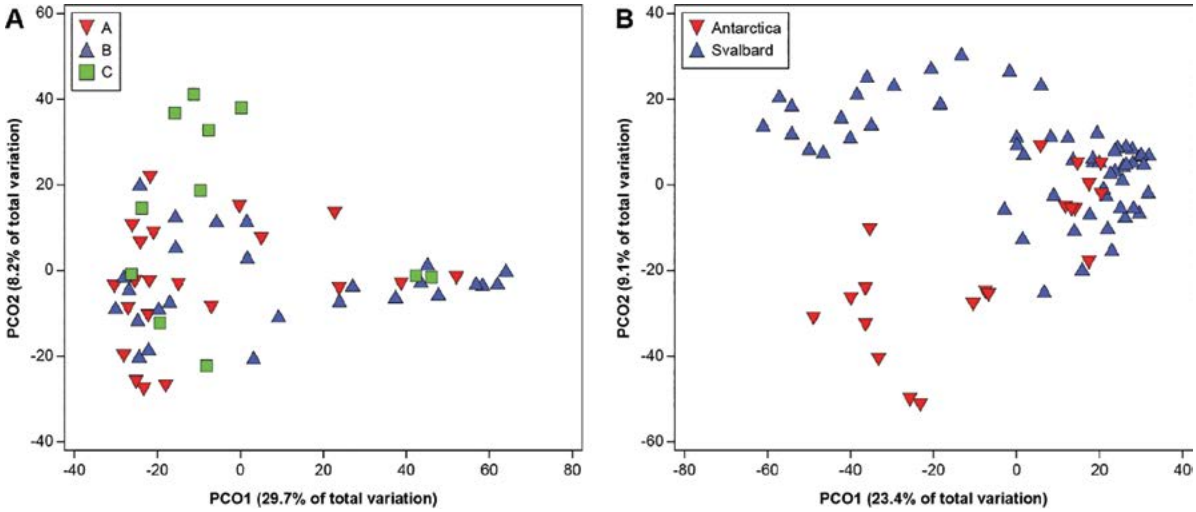
Cyanobacteria are key organisms in freshwater and terrestrial Arctic ecosystems, being ubiquitously found in coastal and inland lakes, meltwater streams, cryoconite holes and soils. In these small and simple ecosystems, they are the driver for numerous ecological functions, such as biomass accumulation and nitrogen and carbon fixation. To understand the impacts of global change on Arctic ecosystems, baseline knowledge on cyanobacterial diversity and distribution is crucial. Here we investigate the biogeographic patterns of cyanobacterial communities across the Svalbard archipelago. A total of 72 microbial mats and biocrusts samples were collected from eight different locations distributed among three distinct bioclimate subzones (A, “Arctic Polar Desert”; B, “Northern Arctic Tundra”; and C, Middle Arctic Tundra) and analysed by pyrosequencing of partial 16S rRNA gene sequences. Community structure was fairly homogeneous across all locations (Figure 1), with a predominance of phylotypes affiliated to filamentous, non-heterocystous Pseudanabaenales, although phylotype richness was significantly lower in the Arctic Polar Desert subzone. When compared to data obtained for similar Antarctic biotopes, a clear separation in community structure becomes apparent (Figure 1). Phylotype richness was significantly higher in the Arctic, and multivariate analyses clearly discriminated between the two Polar Regions. BLAST analyses revealed a predominance of potentially endemic and novel phylotypes in both poles (52-67%). These results suggest constant dispersal of cyanobacterial propagules across Svalbard, such that no clear biogeographic patterns are evident within the archipelago. On the other hand, a sharp barrier to dispersal seems to exist on a global scale, resulting in disparate cyanobacterial communities across the Polar Regions, despite the somewhat similar environmental constraints.



P 120 DISLODGING AND QUANTIFICATION OF CYANOBACTERIA FROM FEATHER MOSSES

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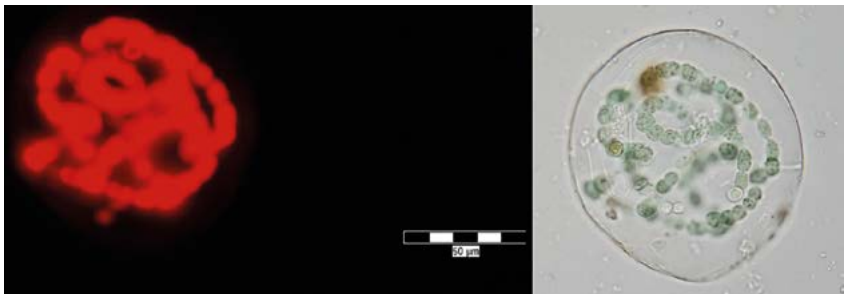
Nitrogen fixing cyanobacteria associated with bryophytes are an important component in input of nitrogen into the arctic wet meadow habitats. These habitats are characterised by one of the highest plant’s productivity and represent a crucial carbon sink. Little is still known about the response of cyanobacteria-mosses interaction to climate change and its consequences to the habitat’s conditions. In this work the methodology for dislodging of cyanobacteria associated with mosses and their further quantification and isolation was developed. The cyanobacteria quantification was done on the base of biovolume calculation which could be hypothetically correlated to measurements of nitrogenase activity, an often discussed value.

Because of the large surface of moss leaves it was impossible to examine the cyanobacteria-moss association under the microscope without any preceding changes. Air-dried moss samples were brought from Svalbard to Institute of Botany, AS CR, Třeboň and 2 methods have been tested. Samples have been first frozen in liquid nitrogen, melted to powder and diluted in water; and secondly they have been sonicated using UP50H ultrasonic processor. From both procedures biovolume under fluorescence microscope was calculated where cyanobacteria of the order Nostocales were always significantly predominant.



Picture 1: Nostoc under fluorescence microscope.

The freezing of samples with liquid nitrogen was revealed to be too destructive, individual cyanobacterial filaments have been teared off into pieces which made the identification difficult. The sonication was in this regard proved to be more suitable method even though the differentiation of cells remained difficult and the uncertainty whether all cyanobacteria have been successfully dislodged was present.

To obtain another assessment of cyanobacterial community and to test primers, Sanger pilote sequencing was applied. The 16S rRNA gene was amplified using specific cyanobacterial primers, which unfortunately amplified chloroplast DNA of the moss. The specificity was improved by sonication of the samples before the DNA isolation.

S10 ARCTIC ANIMALS AND THEIR PARASITES

O 123 INTESTINAL PARASITES OF MAMMALS INTRODUCED TO SVALBARD

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Non-indigenous animals, both intentionally and unintentionally introduced can bring their parasites to new areas. Since new parasites can endanger native animals and people, such introduced parasites should be well monitored. For example, introduction of sibling vole Microtus levis enabled completing of *Echinococcus multilocularis* life cycle, despite the fact, that the tapeworm was imported by polar foxes (Knapp et al. 2012).

Faeces of sibling voles (63), dogs (36) and horses (4) were examined for parasites. Voles were also dissected and examined for *Echinococcus* cysts. Samples were collected in central part of Svalbard and examined in Czech Republic by microscopic and molecular methods for detection of protists and helminths.

No vole harboured cysts of the *Echinococcus multilocularis*. In one sample from vole a new genotype of *Cryptosporidium* has been found. Almost 20 % of dog samples *Enterocytozoon bieneusi* genotype very similar to EntCanA genotype and PtEbIX (Mathis et al. 1999, Lobo et al. 2006) was recorded. One sample from dog was positive for *Cryptosporidium canis*. No intestinal parasites were found in horses.

These results show a very low number of intestinal parasites. In case of sibling voles, this phenomenon could be elucidated as bottle neck consequence. There aren't other rodent species in Svalbard and introduced sibling vole cannot be infected by other rodent host-specific parasites. Finding of *E. bieneusi* genotype is rather surprising. This EntCanA/PtEbIX genotype wasn't recorded in arctic regions yet.

Our hypothesis that non-indigenous mammals can be source of parasitic infections for free-living animals in Svalbard was endorsed.

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O 120 COOL VIRUSES FROM COLD CLIMATE AREAS – BIOLOGY OF VIRUSES IN ARCTIC

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Numerous viruses of animals are present in Arctic. They have a great impact on ecology of their hosts and some of them can potentially infect human. Study of these viruses was a neglected topic in medical biology for a long time and therefore we have only limited information regarding these viruses. Our research is focused mainly on arboviruses, avian influenza virus (AIV) and viruses of canids (wolves and foxes) from Svalbard, Jan Mayen, Iceland and Greenland.

Screening thousands of mosquitoes and hundreds of ticks, we were not able to detect any pathogens (viruses, bacteria or protozoa) transmitted by these vectors in studied areas. Nevertheless, growing numbers of vectors and climatic changes would allow introduction of these pathogens in future. Therefore we will continue in surveillance.

Screening of Black-legged kittiwake sera collected from birds nesting in the colony in Pyramiden (Svalbard) showed presence of anti-AIV antibodies in these birds. Frequency of seropositive birds varied from 14-30% between individual years. PCR screening showed presence of AIV RNA in several samples which demonstrates that AIV is endemic on Svalbard. Further typization of AIV from kittiwakes as well as screens for AIV in samples from waterfowls are currently being processed.

Samples of Carpathian wolves from central Europe and Arctic foxes from Iceland showed no presence of Canine parvovirus 2. Further screens for other viruses (picornaviruses, caliciviruses, rotaviruses, herpesviruses) are prepared. We are also looking for suitable samples for rabies virus and (canine or phocine) distemper virus screens.

Presence of important animal and potentially human pathogens was detected in Arctic. Further surveillance for these pathogens is needed to study their ecology, epidemiology and their role in biology of their hosts. This is a very demanding task which is almost impossible without extensive collaboration is sample collection and screening. Therefore we are looking for any collaboration in this mission.

O 122 FOXY PARASITES OF THE NORTH

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Parasites as a source of the infectious diseases are one of the threats to the wildlife conservation programmes worldwide. Even though they rarely cause rapid decline in the number or species extinction, the infection can make populations more susceptible to factors such as climate or environmental change. These changes are most noticeable at high latitudes. Arctic fox (*Vulpes lagopus*) as one of the major predator in the Arctic is a key element in the functioning of the local ecosystem. Therefore, study of their parasitofauna as a factor affecting health status of the populations is very important. Several potentially dangerous parasites both for foxes and human was found in Arctic foxes (e.g. roundworm *Trichuris vulpis* or *Eucoleus aerophilus*). However the list of parasite is incomplete. Non-invasive methods, such as those coprological are often the only option when studying wildlife parasitofauna. However, the detection and identification of parasites is enhanced in combination with molecular methods.

Acknowledgement

The research was supported by the project LM2015078 CzechPolar2 - Czech Polar Research Infrastructure, provided by Ministry of Education, Youth and Sports. The authors would also like to thank to the Czech Arctic Research Infrastructure "Josef Svoboda Station" (as a part of the Czech Polar Research Infrastructure, CzechPolar2) and its crew for their support.

P 122 CAN TERNS EFFECTIVELY ADAPT TO HUMAN PRESENCE? -NESTING BEHAVIOUR AND ANTIPREDATION STRATEGIES OF ARCTIC TERNS IN TWO COLONIES ON SVALBARD

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Arctic terns (*Sterna paradisaea*) are colonially nesting birds breeding in the High Arctic area. Given the extreme conditions of the environment, it is crucial for the birds to properly evaluate costs and benefits and correctly react to environmental and human-induced risks in order to successfully breed. It is well known that human impact can change animals´ behaviour. We examined impact of human presence on reaction and behaviour of nesting terns in two different colonies on Svalbard: one with permanent human presence (in Svalbard´s main settlement, Longyearbyen) and one without it (colony on glacier foreland in Adolfbukta).

Results from incubation behaviour study show significant effect of human presence on the behaviour of Arctic terns. Due to higher disturbances in the Longyearbyen incubating birds tended to spend more time out of the nest per day than in Adolfbukta (mean=2.20% respectively 3.03%; Linear model, $F_{1,27}$=4.36, p<0.05). Moreover, average off-bouts were significantly longer in Longyearbyen than in Adolfbukta (mean=38.15s respectively 36.85s; Generalized linear model, p<0.05).

Longyearbyen terns were also significantly more aggressive towards humans compared to terns from Adolfbukta, but returned to the nest quickly after the initial disturbance, while the Adolfbukta terns lingered out of the nest for a much longer period of time (Linear model, $F_{1,59}$=145.75, p<0.001). The return time of parents to the nests was shorter in Longyearbyen (mean=48s) than in Adolfbukta (mean=421s).

These findings indicate that reaction of terns is not optimal in either of the breeding colonies. In Longyearbyen, terns are more aggressive, spend less time incubating eggs due to frequent human-induced disturbances, but after disturbing they return to the nest quickly. Whereas terns breeding in Adolfbukta are not adapted to human presence and as consequence those sporadic disturbances can cause damages to the nest (e.g. chilling eggs, predation) due to prolonged absences of the parents from the nests.

P 124 BREEDING SURVEY AND UAV MONITORING ON BIRDS IN THE NORTHERN GREENLAND

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Monitoring breeding status is a fundamental step to study ecology of wild animals. Recently breeding populations in arctic birds have rapidly changed over past decades. From July to August in 2016, I surveyed a costal region (latitude 82°47.6´N and longitude 42°13.7´W) near the J. P. Koch Fjord in the north Greenland for checking the status of breeding birds and accessing an unmanned aerial vehicle, so-called 'drone' (Phantom 4 advanced, DJI co.), to monitor a large flock of birds. Here, we aim to measure the behavioral responses of wild animals when approached by a drone. In an Arctic region, I tested the possible impacts of drone on Pink-footed goose (*Anser brachyrhynchus*). During the survey period, I checked the breeding attempts of 8 long-tailed skua breeding pairs (*Stercorarius longicaudus*), 7 ruddy turnstones (*Arenaria interpres*), 8 sanderlings (*Calidris alba*) and 3 common-ringed plovers (*Charadrius hiaticula*) within approximately 10 km2 near the sea-shore. Also, I approached a quadricopter drone over pink-footed geese flocks (*Anser brachyrhynchus*) resting on the ground. The birds were vigilant to the approaching machine even 50 m away and more sensitive to the vertical movement.

P 123 HOW CLIMATE CHANGE CAN AFFECT THE MOST NUMEROUS ARCTIC SEABIRD

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Arctic seabirds, composing the pelagic food webs, are an essential element of the ecosystem. Little auk (*Alle alle*) is the most numerous Arctic seabird, feeding on zooplankton and transporting huge amounts of organic matter from sea to land, thus supporting functioning of the nutrient-deprived Arctic ecosystem. High energy demands force little auks to focus on energy-rich zooplankton species, associated with cold Arctic waters. Predicted changes in climate and oceanography in the Arctic, a stronger impact of Atlantic-origin waters, will affect the quality and availability of food for planktivorous seabirds. For all these reasons, the little auk constitutes a model species, which physiological and behavioural reactions will indicate changes in the Arctic ecosystem. The study assess the physiological, behavioural and ecological reactions of birds to the natural and artificially induced stressful conditions. First, we revealed that in the season of stronger impact of Atlantic waters, and consequently less favourable foraging conditions for planktivores, adult birds increased the overall duration of their foraging trips and decreased the frequency of chick feeding, what resulted in reduced chick survival. Second, in the artificially induced stressful conditions, we found that the provisioning rate in little auks can be regulated according to the chick's needs (expressed by the intensity of the begging display), however, it is primarily determined by the parents' body state. The results support the idea that little auks will decrease their parental effort and redirect the available energy towards self-maintenance, when the costs of foraging and parental care become too high. The obtained results suggest that, despite of a high range of the little auk's behavioural plasticity, the predicted changes in climate and oceanography in the Arctic may exceed its abilities to adapt and affect its breeding success, as well as, population number and/or distribution of little auks in the future.

P 241 DIFFERENTIATION OF ARCTIC PLANT COMMUNITIES BY PLANKTON- AND FISH-EATING COLONIAL SEABIRDS IN SPITSBERGEN

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The role of seabirds as sea-land biovectors of nutrients is well documented. However, no studies have examined whether and how colonial seabirds that differ in diet may influence terrestrial vegetation. Therefore, the purpose of the our study was to describe and compare plant communities located in the vicinity of the two most common types of seabird colonies in Arctic, occupied by plankton- (little auk, Alle alle) or fish-eating species (mixed colony of Brunnich's guillemot, Uria lomvia, and black-legged kittiwake, Rissa tridactyla). Within 46 plots in four transects in the vicinity of plankivorous and piscivorous colonies we measured the following: guano deposition, physical and chemical characteristics of soil, total nitrogen and its stable isotope signatures in soil and plants, ground vegetation cover of vascular plants and mosses, and the occurrence of lichens, algae and cyanobacteria. Based on LINKTREE analysis we distinguished five plant communities, which reflected declining influence along a birds fertilization gradient measured as guano deposition (Fig. 1). These communities differed significantly in species composition, with the differences related to total soil nitrogen content and $\delta^{15}N$, distinctive levels of phosphates, potassium and nitrates, and physical soil properties, i.e. pH, conductivity and moisture (Fig. 2). Our results shows that ornithogenic vegetation could be differentiated into subtypes based on the diet of the bird colonies. The immediate vicinity of the plankivorous colony was characterised by a Deschampsia alpina-Cerrastium arcticum community while under the piscivorous colony a Cochlearia groenlandica-Poa alpina community was present. Despite the similar size of the colonies and similar magnitude of guano input, differences between ornithogenic communities were connected mostly to phosphate content in the soil. Our results show that the guano input from seabirds which have different diets can affect High Arctic vegetation in specific and more complex ways than previously realized.

Fig. 1.

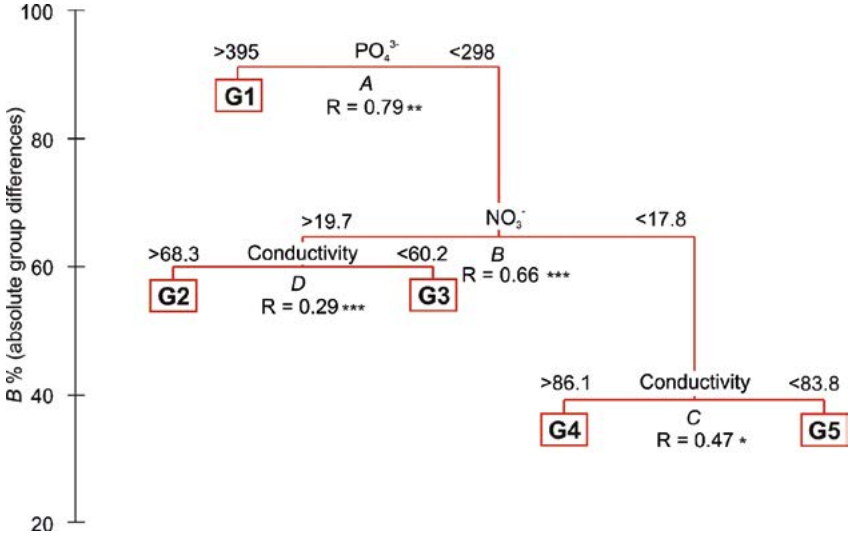
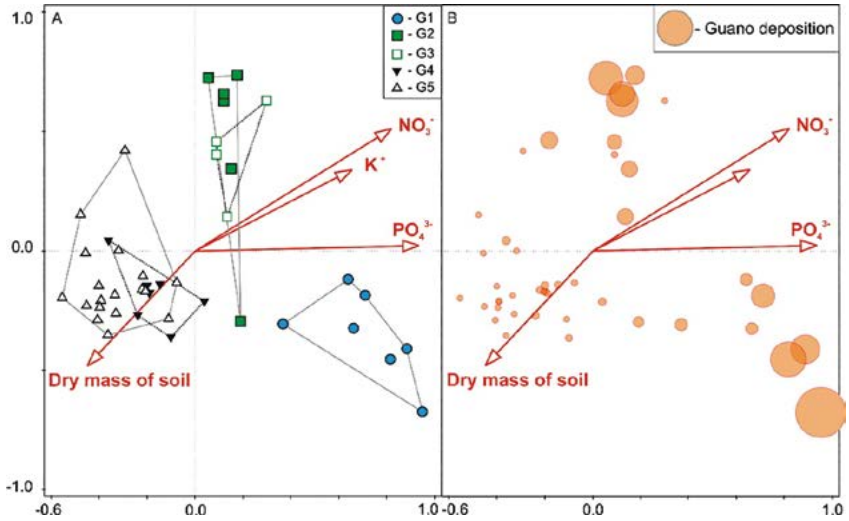


Fig. 2.



S11 CLIMATE WARMING EFFECTS ON ORGANISM SIZE AND GROWTH RATE IN THE ARCTIC SYSTEMS – FROM PAST RECORDS TO FUTURE CONSEQUENCES

KL 08 GENOME SIZE AND BODY SIZE IN ECTOTHERMS RELATED TO TEMPERATURE; ECOLOGICAL AND EVOLUTIONARY DRIVERS

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Several empirically based ecological 'rules', collectively known as the Bergmann rule or Bergmann clines, predicts larger body size in colder environments. The underlying mechanisms for this appear to be very different in endo- and ectotherms. In ectotherms, this prediction is based on studies demonstrating that a wide range of organisms obtains increased body size, cell size or genome size in low-temperature habitats. This may reflect evolutionary changes. However, phenotypic plasticity is also important, as individuals raised at low temperature generally become larger than siblings raised at higher temperature (the Temperature-Size Rule). Conversely, this also implies a potential for reduction in size with global warming, affecting all levels from genome size and cell volume to body size, community composition and food webs. Increased body size may be obtained either by increasing the cell size or the number of cells. Processes leading to changed cell size are of great interest from an ecological, physiological and evolutionary perspective. Cell size scales with fundamental properties such as genome size, growth rate, protein synthesis rates and metabolic activity, although the causal directions of these correlations are not clear. Changes in genome size will thus, in many cases, not only affect cell or body size, but also life-cycle strategies. Symmetrically, evolutionary drivers of life-history strategies may impact growth rate and thus cell size, genome size and metabolic rates. Although this goes to the core of many ecological processes, it is hard to move from correlations to causations. This presentation will first outline these general principles and drivers, and then substantiate this with examples from the two large arthropod groups insects and crustaceans that show some striking inter- and intra-class differences in genome size related to phylogeny, life history and other evolutionary drivers.

O 227 INSIGHTS ON RELATIONSHIP BETWEEN DISTRIBUTION OF DIFFERENT PLANKTON SIZE FRACTIONS ALONG VARIOUS ISFJORDEN (SPITSBERGEN) ENVIRONMENTAL GRADIENTS

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Observing global warming will most probably lead to negative changes in the size structure of plankton communities in the Arctic, which will be manifested in increased contribution of small sized taxa. In this study we assessed the entire plankton community of the largest Spitsbergen fjord - Isfjorden, which is also one of the least discovered areas of European Arctic in terms of pelagic communities. Our investigations were conducted by using the innovative and conventional methods in four consecutive summers (2013-2016) along 60 km transect crossing waters of strong environmental gradient. Starting from Billefjorden - the deepest, innermost part of Isfjorden, bounded with glacier branches, freshened by meltwaters highly loaded with suspended mineral particles, through central part up to Adventfjorden generally strongly influenced by Atlantic water inflow. The water samples for chlorophyll *a* concentrations, nano- and microplanktonic protists taxonomic composition and abundance were taken by Niskin bottles simultaneously with samples for mesozooplankton enumeration and taxonomy collected with plankton nets at few Isfjorden stations located along the transect of automatic optical measurements. During two last seasons full particle-size structure (between 1 µm to 10 mm) was measured for the first time in combination of Laser In-Situ Scattering, Transmissometry (LISST-100x) and Laser Optical Plankton Counter (LOPC). The obtained optical data classified into pico-, nano-, micro- and mesoplankton demonstrated noteworthy relationship between smaller and bigger plankton. The combined results of pigments concentration (chlorophyll a), taxonomy (microscopy), particle-size and biovolume distribution (LISST and LOPC) allowed us to discuss relative roles of various plankton size fractions in Isfjorden pelagial. Different environmental conditions faced during our survey, with rapid melting and increased Atlantic water inflow enable us to improve the overall knowledge on the possible effects of various hydrographical scenarios on relationship between small and large plankton in the warming Arctic.

O 246 BODY SIZE AND CONDITION AFFECT OXYGEN STORAGE CAPACITY IN BELUGA WHALES (DELPHINAPTERUS LEUCAS)

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Arctic marine ecosystems are currently undergoing rapid environmental change. Long- lived Arctic vertebrates with low reproductive rates are particularly vulnerable, having evolved specialized adaptations for extreme environmental conditions. Beluga whales (*Delphinapterus leucas*) are the most abundant Arctic odontocete and may be a potential indicator species for the ecological and physiological consequences of climate change. The eastern Beaufort Sea beluga whale population, one of Canada's largest, has experienced a twenty-year decline in individual growth rates, hypothesized to be the result of climate-induced prey shifts. We examined the relationships between body condition and physiological parameters pertaining to body oxygen storage capacity in Beaufort Sea belugas. We also used physiological parameters to estimate aerobic dive limits of beluga whales. Male beluga whales had significantly higher body oxygen stores than females due to larger body size and higher hemoglobin concentrations, consistent with deeper foraging dives recorded in males. Importantly, body condition indices strongly affected myoglobin and hemoglobin concentrations and % hematocrit. Considering the recent decline in individual growth rates within the population, this result implies that declines in prey quality that impact body condition may cause a decrease in dive duration and associated foraging efficiency. Belugas that are larger and in better physical condition may also perform better under stressful circumstances such as evading predators or ice entrapments. Understanding the physiological limits and constraints of beluga whales will be useful for future conservation efforts as well as identifying vulnerable individuals within the population.

O 259 SHRUB GROWTH RATE AND COORDINATED TRAIT RESPONSES TO SOIL WARMING AND NUTRIENT ADDITION IN A TUNDRA ECOSYSTEM

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Tundra shrubs are slow-growing species limited by low air temperature and scarce nutrient availability. Higher growth rates, denser canopies, and changes in shrub traits are expected with climate warming. These changes in shrub growth and traits may alter the interactions among vegetation, atmosphere and permafrost, which might feed back to regional climate. Despite the importance of tundra vegetation–climate feedbacks and research efforts done, uncertainties of shrub growth and trait sensitivity to climate remain. To explore the effects of climate warming on shrub growth and traits, we combined experimental manipulation of two suggested growth drivers (soil temperature and nutrient availability) with dendroecology in a Siberian tundra ecosystem. We measured plant traits related to growth, structure, and the leaf economics spectrum in four shrub species present in the experimental plots. Shrub growth was mainly limited by nutrient availability and not by soil temperature. Nutrient addition and to a lesser extent soil warming, caused shrubs to produce more biomass and shift from resource conservation to faster resource acquisition (thinner leaves with greater surface area, higher nutrient concentration, and lower dry mass content). We also found negative treatment interaction effects on bark thickness and negative correlation between bark investment and growth rate for some of the species. These findings suggest that shrubs will change their growth and nutrient acquisition towards more rapid ones with climate warming, which will result in taller shrubs and denser canopies, promoting in turn shrub expansion in the short term. However, the faster resource acquisition, thinner bark, and lower bark investment may enhance shrub vulnerability to herbivory, pests, and climate extremes, which are projected to become more frequent. Experimental dendroecological approaches simulating projected climate scenarios and an increasing number of study species and locations will reduce uncertainties related to shrub growth sensitivity to climate, providing insight into tundra shrub–climate feedbacks.

O 228 SIZE RESPONSE TO GLOBAL WARMING IN HIGH LATITUDE AND ARCTIC MARINE ZOOPLANKTON – DWARF-ING IS LIKELY

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Size is one of the main organismal features shaping key processes in ecosystems, first of all influencing the flow of energy and matter within the food webs. At the same time, temperature is one of the main environmental factors influencing life at different organization levels, including body size of species or size structure of communities. Declining species or community size have been found as one of the universal responses to global warming.

Motivated by the above notions, a study was undertaken, under the umbrella of research project “DWARF Declining size - a general response to climate warming in Arctic fauna?”, which aimed at verification of hypothesis assuming that marine zooplankton species and communities attain smaller size in environments of higher water temperature regimes.

The study was performed in six fjords, spanning from temperate Norway to Arctic Svalbard, offering study locations that spread along a natural temperature gradient. Zooplankton was collected with nets (MPS 180µm, WP2 60µm) and assessed *in situ* with a Laser Optical Plankton Counter (LOPC). Environmental variables (temperature, salinity, chlorophyll a) were measured alongside the zooplankton sampling. The study material provided data on body size of the main zooplankton species (e.g. *Calanus*) and zooplankton community composition, size spectra and other community properties (e.g. secondary production), which allowed for comparing the size related zooplankton properties between the fjords, as well as for assessing relations between the observed properties of zooplankton and the environmental variables.

Most of the results support the hypothesis predicting a decline in size of zooplankton species and community size structure with increasing water temperature, however some deviations from the general pattern were also observed, resulting, probably, from influence of other environmental factors such as food availability or elements of fjord’s oceanography.

O 261 GROWTH DYNAMICS OF ARCTIC SHRUBS – FROM UNDERSTANDING ECOLOGY TO ASSESSING FUTURE

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The Arctic is considered one of the most rapidly changing environments with respect to global warming. At the same time, increasing scientific, logistical, economical, or touristic interests in this region puts new pressures and demands onto this fragile environment. Moreover, the Arctic ecosystems can largely influence local climate and in the consequence also the socio-economic situation not limited to both sides of the North Atlantic. Unfortunately, Arctic region offers a scarcity of long direct instrumental observations which biases our understanding of environmental processes and climate development. To assess predicted climate/environmental change and its impacts, appropriate proxy archives are therefore needed to understand its past dynamics. Such archives represent ice cores, lake/marine sediments, and, for tundra ecosystems, also woody perennial shrubs.

Dendroecology investigates past ecological processes imprinted in wood which can help to analyse spatially extensive, abundant, and detailed environmental archives - Arctic shrubs. It provides (sub)annual resolution and in some species also longevity (several hundreds of years). Shrubs are directly and abruptly influenced by climate drivers, which put them into the spotlight to become important actors in paleo-environmental/climatic studies, and help both to complete and strengthen the knowledge obtained from other archives. Application of dendroecology to slow growing Arctic species was nevertheless restricted due to high time consumption until recently. Nevertheless, to be able to use this archive we first need to understand its ecology.

We present the study on primary growth speed of *Juniperus communis*. Ten individuals from SW Greenland were sampled along the stem from the root collar to the branches. The stem-discs were analysed following standard dendrological approach (Gärtner et Schweingruber 2013) and cross-dated to obtain the information on the primary growth dynamics. This is the first study of this sort on the species considered as the best climate archive among all Arctic tundra shrubs.

O 225 BODY SIZE VARIATIONS BETWEEN TEMPERATE AND ARCTIC POPULATIONS OF MARINE AND TERRESTRIAL ECTOTHERMS; CALANOID COPEPODS AND COLLEMBOLA AS MODEL ORGANISMS

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Marine and terrestrial ectotherms face highly different challenges when adapting to polar regions. Marine organisms will experience low temperatures but with fairly long growth season and prolonged life span. Typical responses are larger body size in cold waters; i.e. showing Bergmann clines, and often also increased genome size. The evolutionary basis of these responses is poorly understood, as a Bergmann cline also may reflect phenotypic plasticity, as low developmental temperatures generally leads to increased body size; the Temperature Size Rule (TSR). To address this question we have studied body and genome size in temperate and high arctic populations in four calanoid species. All high arctic populations had larger bodies and genomes than their temperate conspecifics, suggesting a parallel microevolution in response to temperature.

Terrestrial ectotherms in the Arctic will often not show similar clear Bergmann clines, in fact an opposite trend (converse Bergmann) is quite common. This likely reflects adaptation to a selection for fast growth to complete an annual life cycle in the short arctic summer, rather than an effect of low temperature per se. One question is whether such species react opposite on the developmental temperature, or if they also follow TSR, but that this effect is masked by adaptation to increased time limitation. These life-cycle versus temperature responses are addressed by comparing both field populations and common garden experiments of temperate and arctic populations of two Collembolan species. It is found that all populations followed TSR even though the arctic populations did not grow larger in the field.

O 243 WILL SIZE IN ARCTIC BENTHIC COMMUNITIES RESPOND TO CLIMATE WARMING? VARIABILITY IN BIOMASS SIZE SPECTRA ALONG LATITUDINAL GRADIENT (60–80˚N)

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Recent studies predict organisms' body-size declining as a consequence of global warming in both aquatic and terrestrial systems. Unfortunately, patterns of spatial variability and drivers of size structures at the community level are still rarely studied, particularly for marine benthic communities. Here we present the first study of benthic biomass size spectra along the latitudinal/thermal regimes gradient spanning the continental Norway and Arctic fjords. The "space for time analogue' approach was applied to determine possible future effects on Arctic benthic ecosystems' structure (size spectra) and functionality (secondary production) in response to global warming. The study was conducted in six fiords representing a wide geographical (60 to 80°N) and temperature regimes range (-1 to 8°C bottom water temperature). At each location we collected meiobenthic and macrobenthic samples, acquired hydrographic settings and collected sediments for geochemical analyses. Organisms were identified and measured using microscope-based Image Analyses System to asses biovolume and individual biomass needed to construct biomass size spectra. Secondary production was estimated with use of Artificial Neural Network modelling. The shape of size spectra was very conservative across all localities, despite prominent differences in total biomass and abundance among them. The locations of a pronounced gap between meiofauna and macrofauna as well as meiofaunal and macrofaunal peaks were stable across the studied fiords. An increment of the fauna in the highest size classes was observed in Arctic localities. Fresh organic matter availability (as indicated by chlorophyll *a* content in sediments) defined the levels of the total benthic biomass and secondary production, but had no impact on the partitioning of the standing stocks among direct size classes. We conclude that climate warming and related enhancement of primary production may alter the composition and functioning of benthic communities, but most probably will not alter their size structure.

O 258 DENDROCLIMATIC RESPONSE OF SALIX AND BETULA ALONG THE ARCTIC TRANSECT ABISKO/TROMSØ – BEAR ISLAND - SPITSBERGEN

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Climate of the Arctic and observed changes are determined by the complex system covering not only the atmosphere, but also the hydrosphere, cryosphere, soil and biosphere. The importance of the Atlantic sector of the Norwegian Arctic is crucial to recognize large scale atmospheric processes and mechanisms of climate, affecting the environment globally. Dendrochronological study in the meridional transect Abisko/Tromsø, Bjørnøya and Spitsbergen give an opportunity to identify dynamics and scale of the environmental changes taking place in the Atlantic part of the Arctic. Development of dendrochronological scales, including pre-instrumental period, allow to identify the most important climatic factor influencing growth-ring formations and their possible reconstruction. The following tree, shrub and dwarf shrub species were used in dendrochronological research: dwarf birch, downy birch, polar willow and net-leaved willow. 20 to 40 plant samples or cores were collected in each research site. Research results indicate positive growth-ring width correlation with precipitation (Bjørnøya and Spitsbergen) and with summer temperature (Abisko andTromsø). The samples with clear influences of non-climatic factors, like mass movements activity, nutrient supply in the vicinity of bird colonies, were excluded from dendroclimatological analysis. Standard dendrochronological procedures were used to develop chronologies of ring-width for Abisko (1820-2015 time span), Tromsø (1820-2013), Bjørnøya (1900-2012) and for southern Spitsbergen (1951- 2012). Common pointer years were found in the course of all chronologies which will allow the reconstruction of selected climate signals. In addition, record of Rain-On-Snow events in growth rings series was detected. After episodes of snow melt, a rapid temperature drop took place. Lack of a deep and stable snow cover which isolates and protects plants against frost damage resulted in a very narrow growth ring formation. The dendroclimatic analysis in the Arctic are reliable source of information about climatic variability in the past.

O 257 DOES THE SIZE REALLY MATTERS? THE EFFECTS OF CLIMATE VARIABILITY ON THE SIZE OF BENTHIC FORAMINIFERA

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The main aim of the presented study was to provide a basic understanding of the effects of the climate-driven environmental changes on the size of benthic foraminifera. It is well known that foraminiferal abundance and diversity in the Arctic varied since the last glacial times. This variability was connected mainly to the Atlantic and Arctic water mass balance in the postglacial and the Holocene. However, the response of foraminiferal test size to changing climate has not been explored.

The variability in foraminiferal test size was investigated in two ~ 14 000-years-old sediment cores located in Storfjordrenna and on south-west Spitsbergen shelf off Hornsund. All the chosen foraminifera species showed roughly similar trend in the changes of the test size - there was a tendency of foraminifera test size to increase with a temperature decrease. During the Younger Dryas interstadial (~12 800-11 500 cal yr BP) and in the mid- to late Holocene (~ 9 500-1000 cal yr BP) foraminifera test volume was noticeably higher, whereas the reduction of the test size was observed in the warm intervals, i.e. Bølling-Allerød (~ 14 700-12 700 cal yr BP) and the early Holocene (~ 11 500-9 500 cal yr BP). In both studied sites, cooling periods were characterized by less pronounced presence of Atlantic waters, extensive sea-ice cover and enhanced water stratification. Therefore, it is likely that the variation in foraminifera test size is linked to the combination of temperature-related environmental variables e.g., ice cover and productivity.

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O 241 IMPACTS OF CLIMATE CHANGE ON PRODUCTIVITY OF ARCTIC MARINE FOOD-CHAINS

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Arctic organisms possess unique adaptations to life at high latitudes, and one of the most dramatic examples of this is observed in Arctic copepods of the genus *Calanus*. High production of storage lipids promotes survivaland reproduction and makes *Calanus* a critical link in Arctic food-webs. The Arctic *Calanus* species are usually larger and, importantly, have been suggested to contain disproportionately larger lipid stores than their boreal congeners. A continued climate warming with subsequent changes in the primary production regimes is predicted to result in a shift from the larger lipid-rich Arctic species (*C. glacialis, C. hyperboreus*) to the smaller boreal *C. finmarchicus*. Here we show that size alone determines lipid content, and there is considerable overlap in size between *C. glacialis* and *C. finmarchicus*. Additionally, our life-history modeling predicts that copepod secondary production and energy available to predators will not decrease in a warmer ‚New Arctic' with longer periods of algal production. Instead, transmission of energy from primary producers to higher order predators may be more efficient in a future Arctic. These findings indicate that Arctic marine food-webs may be more resilient to climate-related shifts in the *Calanus* complex than previously assumed.

O 256 SPATIAL AND TEMPORAL TRENDS IN BRYOZOAN ZOOID SIZE AND SHAPE VARIABILITY ALONG LATITUDINAL GRADIENT IN THE NORTH ATLANTIC

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During last few decades rapid warming of climate has been observed. Although climate changes has cyclically appeared throughout the evolutionary history, rate of temperature increase were not as abrupt as now. Environmental changes has a great consequence for marine fauna. Understanding the organism's response to that changes is primary concern of contemporary biological science.

Declining body size is suggested as a one of the universal response to climate warming. In the current study we tested hypothesis, using sessile invertebrates Bryozoa as a model group, weather zooids (individuals within bryozoan colony) size respond to changing water temperature. During the present study bryozoan zooid size were measured in wide latitudinal gradient (60-79°N), which is associated with strong water temperature changes (averages for investigated regions range between ~1 and 9°C). All measurements were made both on recent collection as well as on historical material collected at the beginning of XX century. Overall results indicated that zooid size of Bryozoa from recent collection increase toward higher latitude/lower temperature. However species with smaller zooids collected from lower latitudes (60-63°N) were replaced in higher latitudes (69-79°N) by species, with bigger zooids. Within species, increasing pattern of zooid size were observed for five taxa, while four did not presented trends with latitude.

Comparison of zooid size between Bryozoa from recent collection and historical material indicated lack of significant differences.

O 245 ERYTHROCYTE SIZE AND GENOME SIZE IN ARCTIC CHARR (SALVELINUS ALPINUS). A LINKAGE TO TEMPERATURE AND BODY SIZE?

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Body size is an important life-history trait and its variation across environmental gradients has been formulated as Bergmann's rule, i.e. the tendency for organisms to be larger at higher latitudes or colder climate. If the rule applies, declining body size maybe a universal response to global warming. While Bergmann's rule originally dealt with endotherms, later studies have focused more on ectotherms. Since body growth may occur by increasing cell size and/or cell number, recent studies have also been focusing in more detail on potential corresponding relationship between temperature

and cell- or genome sizes. The Arctic charr (*Salvelinus alpinus*) population in Norway is an ideal ectothermic species to test this prediction as it is distributed across a large thermal gradient and is the only freshwater fish species in the High Arctic i.e. in Svalbard. We assessed the relationships between latitude, water temperature, body size, cell volume and genome size in Arctic charr populations distributed along a latitudinal gradient from 58 - 80ºN and showing strong intra- and inter-population variability in body size, primarily related to life history. Our data revealed variability in genome and cell size both between and within the studied populations. Genome size and cell size increased with decreasing water temperatures, and to some extent also with decreasing body size. This could either be a direct temperature response, or an indirect response related to oxygen solubility. No strong correlation was found between genome size and cell size. The results will be discussed in relation to Bergmann's rule and potential implications for Arctic charr under climate change.

O 242 TEMPERATURE CONTROLLED SIZE CHANGES IN MARINE CRUSTACEANS

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To test the size - temperature relation in marine poikilotherms, several species of higher crustaceans (Malacostraca) were examined along the temperature gradient from Mediterranean to the Arctic. In most cases the size increase with temperature drop was documented, what brings the question on the reverse process - i.e. shrinking polar species with the increasing temperature. As the populations living in high latutudes are strongly seasonally controlled (spring- summer only food availability) , the completition of life cycle in one year is unlikely - so there is a limit how small polar crustacean can be. From over 20 species examined we present the species that are likely prone to size changes.

O 226 CLIMATIC EFFECTS ON THE SIZE OF THE ARCTIC KEYSTONE COPEPOD CALANUS GLACIALIS: CLUES FROM THE MITOCHONDRIAL GENOME

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Most zooplankton biomass in the Arctic shelf seas is formed by *Calanus glacialis*, a lipid-rich calanoid grazer, which is a key link between low-energy microalgae and higher trophic levels, including fish and plankton-eating seabirds.

Our first goal was to test if genetic variation in this Arctic species has changed during the Quaternary, and to assess its spatio-temporal population structure. *C. glacialis* was sampled in the fjords of Spitsbergen (Hornsund and Kongsfjorden) between 2003 and 2012. The sequence of a mitochondrial marker, belonging to *nd5* gene, allowed the resolution of 3 main clades, although there was no visible trend in the distribution of haplotypes, either by geographic distance or by time. However, interestingly, hindcasting with a Bayesian Skyline Plot suggested that a 1000-fold increase in population size occurred approximately 10 kya before present, indicating a recent expansion after the Last Glacial Maximum.

Finally, using NGS platform, we sequenced the complete mitochondrial genome of *C. glacialis*. Despite a good coverage (approx. 100 fold), we were unable to retrieve the complete mitochondrial genome after assembly; instead, two contigs of 15kbp and 8kbp were assembled. The typical set of mitochondrial genes is present in this genome but the non-coding (NC) regions are unusually long and complex. This structure is somewhat similar to the closest mitochondrial genome available, belonging to the North Pacific *Calanus sinicus* and in contrast with the much more simple mt genome of the deep-water Arctic copepod *Calanus hyperboreus*. The structural similarities parallel the genetic distances in this case, reflecting the general evolutionary trend for expansion of NC regions within mitochondrial genomes of Arctic *Calanus* species. We speculate that this phenomenon is associated with the well-known general trend of body size change within this lineage.

O 244 FOOD AND DISTURBANCE EFFECTS ON ARCTIC BENTHIC BIOMASS AND PRODUCTION SIZE SPECTRA

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At the community level, changes in size distributions may influence energy transfer pathways in the benthic food webs and ecosystem carbon cycling; nevertheless they remain poorly explored in benthic systems, particularly in polar regions. The present study is the first comprehensive assessment of the patterns and environmental controls of benthic biomass size spectra (across both meio- and macrofauna) in Arctic fjord sediments.

The samples were collected in two Arctic fjords off West Spitsbergen (76 and 79ºN), at 6 stations which represent three regimes of varying food availability and glacial sedimentation disturbance intensity. The organisms were measured using image analysis to assess the biovolume, biomass and the annual production of each individual. The shape of benthic biomass size spectra at most stations was bimodal, with the location of a trough and peaks similar to those previously reported in lower latitudes. In undisturbed sediments macrofauna comprised 89% of the total benthic biomass and 56% of the total production. The lower availability of food resources seemed to suppress the biomass and secondary production across the whole size spectra, rather than to reshape the spectrum. At locations where poor nutritional conditions were coupled with disturbance the biomass was strongly reduced in selected macrofaunal size classes, while meiofaunal biomass and production were much higher. As a result, the partitioning of the benthic biomass and production shifted towards the meiofauna that took over the role of the benthic metazoan key-player in terms of processing the organic matter in sediments.

As both the food availability and the intensity of glacial disturbance are foreseen to change in the course of the climate warming, the results of this study can be used to predict the climate change effects on benthic communities structure and function in Arctic coastal waters.

P 125 THE ARCTIC TRAITS PROJECT

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Today Arctic ecosystems are facing rapid transitions in hydrography, seasonality, and productivity, additionally having to deal with stressors like northward migrating species and increased human activities. Although a huge amount of data on the structural properties of marine communities was gathered in the last decades, we are currently not able to estimate or predict how the ongoing (and prospective) environmental changes will affect ecosystem functioning. One major obstacle is that there is not a single index that can describe overall ecosystem functioning, but rather a multitude of

parameters that should be considered. Consequently, there is an obvious need for holistic approaches that encompass various measures of different biotic components and ecological processes. Here we show how one promising method - the biological trait approach (BTA) - can be applied on Arctic communities to indicate the ecosystem functioning. We constrain the approach to one compartment, the zoobenthos, which is involved in the regulation of fundamental ecosystem processes such as carbon and nutrient cycling, sediment oxygenation and decomposition of organic matter. We introduce the *"Arctic Trait Online Platform"* as a tool to access and share Arctic trait information within the scientific community and to foster and facilitate the application of trait-based approaches in future studies.

P 126 FORAMINIFERAL CARBON SHARE IN SEDIMENTARY CARBON POOL: SEASONAL STUDY IN ADVENTFJORDEN, SPITSBERGEN

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The main aim of the presented study was to determine the relationship between the foraminifera test size and the quantity of foraminiferal organic and inorganic carbon in Adventfjorden (Spitsbergen, Svalbard). The investigation was based on three dominant calcareous species: *Cassidulina reniforme, Elphidium clavatum*, and *Nonionellina labradorica*. The test size was approximated by the formulae based on 0.5 times the volume of a sphere ($4/3\pi r^3$), where r was the mean shortest and longest diameter and the foraminiferal carbon content was expressed

The results of the study revealed a significant share of inorganic foraminiferal carbon in total carbon pool in the sediments. In summer months, foraminiferal carbon made up to 38% of inorganic carbon pool of the sediment. In Spitsbergen fjords, where benthic fauna is dominated by non-calcifying organisms, foraminifera may be one of the major producers of calcium carbonate. At the same time, foraminiferal organic carbon made up to 0.4% of total organic carbon pool in the sediments. This implies that, in contrary to previous assumptions, foraminifera in fjords do not comprise an important source of biogenic matter.

The abundance and test size of investigated foraminiferal species showed clear seasonal dynamics. However, seasonal aspects of the organic and inorganic carbon contents varied between species and did not clearly follow the patterns of changes in abundance and test size. This discrepancy might be explained by the characteristics of the particular species, e.g., tolerance to the environmental stress, test thickness and the amount of protoplasm in the test.

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P 127 EFFECT OF SNOW COVER ON PHENOLOGY IN THE MOSS RACOMITRIUM LANUGINOSUM

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Bryophytes show a number of phenological patterns that reflect their adaptation to wide variety of environments. A regulating effect of environmental factors on bryophyte reproduction has been established for several species. The length of the growth period is thought to be one of the regulating factor controlled by some environments such as temperature and water availability. In this study, we focused on the effect of the length of the growth period controlled by snow cover.

We compared the seasonality of development of gametangia and sporophytes of *Racomitrium lanuginosum* in two distinct habitats, seasonally snow-covered site (*ca.* 2200 m alt. on Mt. Fuji) and snow free site (*ca.* 645 m alt. on Mt. Mihara). The number of inflorescences and the number, size and developmental stages of male and female gametangia and sporophytes were recorded throughout the year.

At both sites, antheridia took longer to mature than archegonia, and antheridia and sporophytes developed during winter. At Mt. Fuji, although the development of antheridia and sporophytes stopped under snow cover for 4.5 months, gametangia maturation and spore dispersal occurred in June, the usual season for fertilization and spore dispersal in bryophytes. It is assumed that snow cover is not a barrier to the reproduction of these species.

At Mt. Mihara, some notable phenological patterns were observed, such as the dispersal of sperm from antheridia before archegonia matuation, and the occurrence of spore dispersal during winter. These phenological patterns observed at Mt. Mihara indicated that this site was close to the limit of successful sexual reproduction, based on the discordance of phenological parameters between male and female shoots. Effect of climate change on the phenological parameters of this species observed in this study will be discussed.

P 128 A SEMI-AUTOMATED IMAGE ANALYSIS METHOD FOR BENTHIC NEMATODES SIZE ASSESSMENT

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Regardless its ecological importance, meiofaunal size and biomass is rarely assessed in marine studies due to either time consuming and costly indirect procedures or inaccurate direct methods. Here, we present a semi-automated image analysis method for obtaining widths and lengths of photographed nematodes (major meiofauna component) and then estimating their biovolume and biomass. We analyzed 10 meiofauna samples (Bengal rose stained) from two different localities: Arctic fjord muddy bottom and seagrass-vegetated sands. 100 randomly picked specimens from each replicate sample were photographed and measured manually (length and maximum width) by three independent analysts and semi-automatically (length and average width) by Leica LAS Image Analysis software, what allowed us to check for interpersonal differences and to compare both methods. The Automatic Image Analysis was used based on the detection of objects of selected color threshold with specified ranges of size and red color contribution. The analyses with use of semi-automated method were almost two times faster than those employing the manual method. The length measurements did not differ among the three analysts and computer, while maximum width measurements (only manual ones) were significantly different among analysts. Nematodes biomass assessed on basis of semi-automated measurements and formula using equation for a volume of cylinder was similar to the biomass obtained on basis of manual measurements and commonly used Andrassy (1956) formula. The automatic protocol seems to be not only more time and cost effective, but also less biased, when compared with standard (manual) method. We believe that utilization of this method will promote more frequent inclusion of meiofaunal biomass assessments in marine benthic surveys.

P 129 THE DIFFERENCES IN THE STRUCTURE OF SUB-ARCTIC AND ARCTIC ZOOPLANKTON SAMPLED WITH TWO DIFFERENT NETS (56 VS. 180 MM MESH)

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In sub-Arctic and Arctic regions the most studied zooplankton size fraction is mesozooplankton, organisms of sizes between 0.2 and 20 mm. The major reason of such state, is due to the fact it contains the main zooplankton biomass in the area. Some studies however, have revealed that smaller zooplankton may considerably exceed abundances of catches from mesozooplankton nets. The main goal of the present study was to describe the differences in the structure of sub-Arctic and Arctic marine zooplankton communities sampled with two plankton nets of different filtration efficiency. The first net was fitted with 180 µm mesh, commonly used in mesozooplankton sampling. The second net had 56 µm mesh, to collect smaller specimens, often omitted in researches. Only multicellular zooplankters were taken into account in this study. It was hypothesized that the losses of zooplankton sampled with 180 µm mesh net, would mainly apply to young developmental stages of copepods and other holoplanktonic taxa, as well as to small meroplanktonic larvae of benthic fauna. The zooplankton under study were collected in sub-Arctic and Arctic fjords, and additionally also in boreal fjord in order to distinguish the variation in the structure of the tiniest fraction of zooplanktonic metazoans in the wider range of temperature. It was motivated by the fact that boreal species are usually characterized by smaller sizes than their Arctic counterparts, hence, it is suggested that in the course of warming of high latitude regions, the role of smaller taxa in ecosystems functioning will increase. The results of the study will show how much of zooplankton abundance, and what particular taxa, are omitted in common mesozooplankton sampling in sub-Arctic and Arctic regions. Furthermore, it may give an insight into what could be the possible change in the structure of tiniest metazoans from Arctic ecosystems to temperature rise.

P 130 VARIATION IN SIZE AND SHAPE OF BRYOZOAN ZOOIDS ON CONTINENTAL SHELF AND SLOPE OF SOUTHERN ICELAND

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Body size is one of the most important biological characters as it defines many aspects of organism functioning at the individual (e.g. metabolic rates, energy assimilation) and community (e.g. trophic interactions) level. As the trait covers many ecological aspects of species, it is often used as indicator of ecosystem status. Spatial patterns of variability in body size are quite well known for terrestrial organism, but remain understudied in case of marine ecosystem. So far no consistent mechanism driving size shift is proposed. In this study we investigated bathymetric variability in zooid's size and shape in aquatic colonial animals Bryozoa. Although the response of bryozoan zooid size to temperature or food concentration was experimentally proved, the effects of natural environmental variability on marine bryozoan populations has been much less explored. Presented investigation aimed to assess the bathymetric patterns and environmental drivers of bryozoan zooid size on continental shelf and slope of southern Iceland (across the depth range 50-1000 m and the corresponding 5-6° C change in sea water temperature). 196 colonies of 11 species representing different colonial forms and taxonomic groups were selected for zooid dimensions measurements. A pattern of depth-related increase in zooid size was documented for *Bicellarina alderi*, *Chartella barleei and Sarsiflustra abyssicola*, no statistically significant effects were detected for the other eight species. Two species *Bicellarina alderi* and *Caberea ellisii* had significantly longer zooids in deeper water, shape of the remaining species did not change along the bathymetric gradient. Intercolonial coefficient of variation in zooid size did not change across the depth gradient. No consistent linear relationship between zooids' length, area or shape with depth is suggested to be result of species specific reaction to environmental conditions. Additionally for some species little temperature differences or food concentration along studied depth could be also responsible.

P 131 THE PATTERNS OF FORAMINIFERAL TEST SIZE CHANGE ALONG THERMAL GRADIENTS

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The aim of the study was to determine how the size structure of benthic foraminifera community responded to changing thermal regimes. The temperature change is one recognized driver for size changes, and declining body size is proposed as common response to global warming. The main hypothesis was that temperature variations induced foraminifera size changes i.e., elevated temperatures caused size reductions in a range of foraminifera species.

Samples were retrieved at sites located along the gradients of thermal regimes off Norwegian and Svalbard coasts (i.e., latitudinal gradient from 60°N to 80°N). Six species of calcareous foraminifera have been chosen for the study: *Cassidulina reniforme, Cibicides lobatulus, Elphidium clavatum, Islandiella norcrossi, Melonis barleeanum* and *Nonionellina labradorica*. Two dimensions: the longest and the shortest diameter were measured in 30 specimens of chosen species in each sample. The size of foraminifera was expressed as test volume approximated by formulae based on 0.5 times the volume of a sphere ($4/3\pi r^3$). To understand the linkage between the environmental gradients and size of the organisms, the data was supplemented with measurements of temperature, salinity, sediment grainsize and sedimentary carbon concentration.

Documentation of the patterns of spatial variability of biota size distribution and determination of the environmental drivers of this variability are especially important in the Arctic, where effects of the global changes are predicted to occur more intensively and earlier than at lower latitudes. The shift in size distributions in communities can have serious impact on ecosystem functioning as it will affect food web structure, productivity and biogeochemical cycling.

The project was funded from Norway Grants in the Polish-Norwegian Research Program operated by the National Centre for Research and Development; contract number Pol-Nor/201992/93/2014 and the funds of the Leading National Research Centre (KNOW) received by the Centre for Polar Studies for the period 2014-2018.

P 132 WHEN THE SIZE SPECTRUM REFLECTS ONLY A PART OF THE STORY- ZOOPLANKTON SIZE STRUCTURE ALONG NATURAL TEMPERATURE GRADIENT (60–80 °N)

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Body size is a fundamental biological characteristic that scales with ecological and metabolic processes. According to the temperature-size-rule, majority of species exhibit larger adult size in colder environments and, consequently, the reduced body size is an expected response to global warming in aquatic systems. Therefore our main goal was to examine the size response of zooplankton to temperature gradient in natural environments. Changes in size were analysed at individual, population and community levels in six fjords along Norwegian and Svalbard coasts.

While most of the studied taxa clearly followed the expected patterns, i.e. decreasing size with increasing temperature, the community size spectra did not reveal significant differences along the studied gradient. Because body size is one of the key determinants of community structure, and its relationship with abundance can describe how biomass is partitioned among the biota within an ecosystem, the observed unity in zooplankton size spectra was especially interesting. As the investigations of the size related zooplankton properties at the community level have been based on concurrent measurements with a Laser Optical Plankton Counter and zooplankton sampling with nets (MultiNet with 180 µm mesh, WP-2 with 60 µm mesh), it was possible to supplement the size spectrum analysis with the study on zooplankton taxonomic structure. This allowed us to perform the size portioning of different zooplankton components and functional groups (particular species, size fractions, meroplankton, copepods etc.) in various temperature regimes, and to analyse individually correlations between the size related properties and water temperature in the studied regimes.

Although temperature turned out to be an important determinant of the zooplankton body size, our investigation strengthen the importance of other, not studied aspects, such as ontogeny and food availability, for shaping zooplankton community size structure in different environmental regimes of the northern hemisphere.

P 133 INFLUENCE OF FOOD AVAILABILITY ON BENTHIC BIOMASS AND PRODUCTION SIZE SPECTRA IN DEEP ARCTIC OCEAN (FRAM STRAIT)

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Benthic Biomass Size Spectra (BBSS) is an important descriptor of functioning of the community in terms of productivity and energy flow. The quantification of the basic patterns as well as the recognition of the factors controlling distribution of BBSS and benthic production is crucial for understanding of the present day functioning and monitoring of Arctic benthic systems. The patterns of BBSS in marine systems remain poorly described, compared to the literature on this subject related to pelagial communities, what is usually explained by methodological constrains of benthic sample size spectra analysis. The relationship between the organism size and its productivity has provided the basis for estimation of secondary production in benthic systems.

The present study is the first comprehensive assessment of the patterns and environmental controls of BBSS (across both meio- and macrofauna) along the bathymetric gradient covering shelf, slope and deep-sea sediments in the Arctic. The location is a long-term monitoring site of AWI (Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany), with over 18 years record of temporal and spatial variability of environmental conditions (hydrodynamic conditions, physical, chemical and biological parameters of water form surface to bottom).

At all stations shape of BBSS was bimodal but with increasing water depth the size spectrum changed. At shallow stations (76-283m) a wide range of size classes (31 size classes, form $5 \cdot 10^{-10}$g DW to 1g DW) was observed, whereas at the deeper stations (below 1200m) elimination of the biggest macrofaunal size classes was documented (>0.03 g DW size class). With increasing water depth contribution of macrofauna in benthic biomass and secondary production dramatically decreased, most probably due to lower food quantity and quality at greater depths. The BBSS and productivity patterns are related to environmental factors, especially the indicators of organic matter supply.

P 134 MORPHOMETRIC SNAPSHOTS REVEAL NO EFFECT OF LATITUDE ON WATER BEARS (TARDIGRADA) BODY SIZE

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One of the predicted consequences of current climate changing is the decrease in the size of the animals. In fast changing polar ecosystems, such shifts in body size can be crucial for the whole system functioning, especially if the considered group of animals plays an important role as food or predators. One of such functionally important invertebrate groups are water bears (Tardigrada). The phylum, Tardigrada, presently consists of over 1200 species with size ranging from ca. 50 to 2200 µm. Water bears inhabit terrestrial and aquatic environments across the globe. They can reach high densities, up to hundreds per 1 gram of dry sample. However, there are few data on tardigrade morphometry and potential effect of latitude and increasing temperatures on their body size have never been studied. We tested hypothesis that tardigrades body length increase from warm temperature European to low temperature high Arctic localities. In analysis we used two Palearctic tardigrade species: *Testechiniscus spitsbergensis* and *Pilatobius recamieri*. We measured body length in five populations of *T. spitsbergensis* (Scotland, North of Norway, Svalbard: Bjørnøya, Spitsbergen (Hornsund), Nordaustlandet) and three population of *P. recamieri* (Svalbard: Spitsbergen (Hornsund), Fuglesongen and Phippsøya). According to the literature one of the factors which may influence tardigrade body size in Arctic regions is the presence of seabird guano which provides an additional source of organic enrichment in the terrestrial systems. Thus, for both species we used two-way univariate ANOVA (with two factors: latitude=sites and guano presence) to test differences in body length. In *T. spitsbergensis* statistically significant differences in body length were found only between North of Norway and two sites: Scotland ($p=0.004$) and Hornsund ($p=0.004$)). There were no significant differences related to the presence of birds guano. Relating to latitude or guano, no significant contrasts in body length of *P. recamieri* were found.

S12 CHANGES IN ARCTIC SPRING AS OBSERVED IN NY-ÅLESUND, SVALBARD

KL 04 THE OCEANOGRAPHIC SPRING DETERMINED BY A MARINE OBSERVATORY

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The Scottish Association for Marine Science and partner Norwegian Institutes (UNIS, UiT, NPI) have maintained a moored observatory in Kongsfjorden since 2002. Kongsfjorden is typically an Atlantic Water dominated system with minimal seasonal sea ice. However, since the inception of the observatory we note considerable interannual variation and phases of behaviour characterised by ‚Warm' and ‚Cold' years depending on the extent of Atlantic Water occupation. Here we will focus on the varying oceanographic characteristics encountered during spring and relate these to other measured physical and biological parameters. In particular we look at the time and extent of Atlantic Water occupation in the fjord. We contrast the spring conditions in Kongsfjorden with those measured by identical observatories placed in other fjordic locations in Svalbard.

KL 06 HOW BARNACLE GEESE ADAPT THEIR TIMING TO EARLIER SPRINGS

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In early spring, grasses have the highest protein content. Due to a relatively simple digestive tract, with almost no cellulose digestion, geese require spring grasses to acquire enough energy for reproduction. Arctic breeding geese have timed their migration to follow the green wave of nutritious grass to the breeding grounds. But global warming does advance spring, and these advancements increase with latitude. The Arctic is warming faster than the temperate wintering grounds. Can the geese adapt to these changes? A study on timing of migration and breeding phenology over a 25 year period has shown that only a long-term data set does show the process of adaptation. Periods without change, suggesting a trophic mismatch, are followed by a sudden advance in the timing of breeding, after which there is a new period of relative stability in timing. Overall the geese do follow the earlier snow melt, but it is a stepwise process. Young birds do adapt faster than the oldest birds. In this presentation, we will link snow melt, grass quality and individual variation in the timing of reproduction of this herbivore to ultimate breeding success. As geese are an important food source for predators, the effects of spring advancement will be discussed on three trophic levels in the Arctic food web.

O 055 VARIATIONS IN TEMPERATURE-RELATED EXTREME EVENTS (1975–2014) IN NY-ALESUND, SVALBARD

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Global warming-induced intensification of climate extremes is causing dangerous changes to society, the economy, ecosystems, and human health. High latitudes experience the largest warming in response to increased CO_2 due to polar amplification and can be taken as a precursor of extreme weather events in mid-latitudes. In the study, we present a comprehensive analysis of temperature extremes in Ny-Ålesund (78.9° N, 11.9° E), Arctic. Results show that climate change in Ny-Ålesund from 1975 to 2014 shows more than four times faster than global mean state. The continuous warming here since mid-1990s is different from the significant decrease or even hitaus in global warming trend. The changes in temperature extremes in Ny-Ålesund show the decreases in cold extremes and increases in warm extremes with larger magnitude than the global mean states. The diurnal temperature range (DTR) shows a decrease in boreal winter with minimum daily temperature increasing faster than maximum daily temperature. But a very different increasing trend for DTR exists in summer, consistent with the DTR behavior in Europe. In Ny-Ålesund, annual occurrence of warm days (cold nights) have increased (decreased) by 26 (49) days, frost days and ice days have decreased by approximately 12 days and 32 days, and growing season length has extended by 20 days since 1975. In addition, the decreases in extreme minimum temperatures are greater than the increases in extreme maximum temperatures. The temperature in coldest days and nights exhibit a significant trend with large positive change (2.5°C per decade). But the temperature of hottest days and nights of a year are less marked. Warm spells have significantly increased while cold spells significantly decreased greater in magnitude. This asymmetry in the changes in cold versus warm extremes would hints at potential changes in the shape and/or scale of the distribution of temperature observations in Ny-Ålesund.

O 052 CHANGES OF FAST ICE EXTENT AND THICKNESS OVER THE LAST TWO DECADES IN KONGSFJORDEN, SVALBARD

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Sea ice in the Arctic affects the energy exchange at the atmosphere-ocean interface, and it is crucial for the Arctic marine ecosystem. Beyond that, the existence and changes of Arctic sea ice have also direct implications for the society. Observations at coastal sites and fjords with relatively easy access give the possibility to study and monitor Arctic sea ice in more detail over months and years under conditions where thermodynamic ice growth dominates versus dynamic growth, than it is usually possible from shipbased expeditions. Inner Kongsfjorden is covered with seasonal landfast sea ice at times in winter and spring. Scientists from the Norwegian Polar Institute have observed fast ice in Kongsfjorden systematically since 2003. From some earlier years, sporadic information from process studies exists. Key elements of the monitoring at Kongsfjorden are sea ice extent observations, in-situ sea ice thickness, snow thickness and freeboard measurements. Occasionally, additional data are collected and samples are taken, often as a part of process studies. In recent years, the duration of time with sea ice in Kongsfjorden has been shorter, the extent less. Ice has been thinner than earlier, and there has been less snow covering the ice. However, interannual variability of fast ice scenarios in Kongsfjorden is high. Therefore sea ice trends in Kongsfjorden cannot be detected with observation only over a few years. The presentation will give an overview on the monitoring setup, and updated results of sea ice extend and thickness levels and trends will be presented. The results will be also set in context with observations at other Svalbard locations.

O 053 ATLANTIC ADVECTION DRIVEN CHANGES IN GLACIAL MELTWATER: EFFECTS ON PHYTOPLANKTON CHLOROPHYLL-A AND TAXONOMIC COMPOSITION IN KONGSFJORDEN, SPITSBERGEN

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Changes in Atlantic advection and increased heat content of this water have transformed the physical conditions that shape biological activity on the West coast of Spitsbergen. Atlantic advection decreases winter sea ice formation in fjords and enhances glacial melting of marine terminating glaciers, and can introduce different phytoplankton and zooplankton populations. We investigated the effect of Atlantic advection on Kongsfjorden (Spitsbergen, 79˚N, 11˚40'E) phytoplankton biomass and composition using year round weekly pigment samples collected from October 2013 to August 2016 at the Underwater Observatory. In addition, phytoplankton dynamics and physical and chemical characteristics of the 2014 spring bloom (April -June 2014) were assessed in two locations in Kongsfjorden. Chlorophyll a declines during the polar night to a minimum of 0.01 mg m^{-3}, followed by an up to 1000-fold increase, peaking at the end of May -early June. Early spring was characterized by spatial and temporal differences in abundances of flagellates (prasinophytes, haptophytes, chrysophytes, and cryptophytes) and diatoms. Increased abundance of flagellated phytoplankton was observed in the non-stratified central Kongsfjorden, whereas diatoms were more abundant in the stratified inner fjord in 2014. The distributions of flagellates and diatoms were indicative of the different aspects that were influenced by Atlantic advection. Contrasting conditions between locations were reduced when glacial melt water stratification expanded towards the mouth of the fjord, mediating a diatom dominated surface bloom at both locations. This suggested that the Atlantic advection driven release of glacial melt water governs spring bloom timing and composition. The absence of sea ice allows for earlier initiation of phytoplankton activity but it appears that this does not advance the timing of the Kongsfjorden spring bloom.

O 081 COUPLING PROCESSES AT THE INTERFACE OBSERVED AT THE CLIMATE CHANGE TOWER IN NY ALESUND(SVALBARD)

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The Climate change is affecting the Arctic faster than other region of the planet. The models still fail in forecasting the variability of the climate system. More attention has to be paid to study the processes to allow better parameterization into the models as well as more integrated data must be provided. The Amundsen-Nobile Climate Change Tower (CCT) is an important scientific platform implemented in Ny-Ålesund Svalbard by CNR with the aim to investigate coupling processes involving atmosphere, criosphere, biosphere at and near their interface (www.isac.cnr.it/~radiclim/CCTower).

Standard and fast response instruments located on the tower different levels allow to measure continuously wind, T and RH vertical gradients, as well as turbulence to study the ABL dynamics. Broadband radiometers located at 33 m of height collect information on downwelling and upwelling radiation fluxes and average surface albedo. Surface heat fluxes, depth, skin temperature and spectral reflectivity of snow layer, are also monitored. Sensors deployed on the CALM grid area and in a 50 m deep borehole allow to measure vegetation coverage and temperature profiles in the permafrost. The parameters, observed, describe the thermodynamic characteristic of the lower atmospheric layers and the variability of processes at the surface providing an overview of the phenomena occurring in the Kongsfjord area. Even if the time series lenght does not yet allow climatological studies, an attempt to answer to questions about the Convective Boundary Layer (CBL) and about the structure of the Stable Boundary Layer (SBL) conditions is given.

CCT dataset is stored in a digital infrastructure that allows users, to visualize, access and download the data. This policy contributes to strengthen the collaboration with the scientific community operating in Svalbard. Integration of such measurements with other ground based remote sensing to extend the vertical profiling at higher level and improve is also foreseeen.

O 054 DYNAMICS OF ORGANIC MATTER-DEGRADING BACTERIA AND THEIR RESPONSE TO ENVIRONMENTAL CHANGE IN KONGSFJORDEN, SVALBARD

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Bio-degradation of organic matters in marine environments is a very important biogeochemical process, which represents the initial and key steps of the oceanic carbon, nitrogen and other elements circling. Marine microorganisms play vital roles in organic matter degradation in marine environments, and yet community structures of organic matter-degrading microbes in polar seas and their degradation mechanisms are largely unknown. Kongsfjorden, deeply influenced by land, glacier, atmosphere as well as biological activity, constitutes an relatively fast-changing and fragile ecological environment and is an ideal region for long-term investigation on diversity of polar marine organic matter-degrading bacteria and the environmental effect on them. Although we have recently preliminarily characterized the community composition of cultivated alginate lyase-producing bacteria from Kongsfjorden (Marine Drugs 2012, 10, 2481-2491), organic matter-degrading bacteria in Kongsfjorden are scarcely studied. Using multi-disciplinary approaches including microbiological, genomic, biochemical and structural biology methods, we are now systematically studying the population structures, annual variation and degradation mechanisms of typical organic matter-degrading bacteria (like protease-producing or polysaccharide-degrading groups) in Kongsfjorden, results of which will be greatly helpful to clarify the particularity of the microbial degradation of organic matter and the roles of organic matter-degrading bacteria in elements cycling in Arctic seas and the effect of climate and environment change onto the Arctic microbial diversity.

O 083 LONG-TERM GLACIER MASS-BALANCE INVESTIGATIONS OF AUSTRE LOVÉNBREEN GLACIER IN SVALBARD

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Glacier mass balance in Svalbard region is sensitive to the North Atlantic warm and the corresponding climate change. It is one of the key regions of the glacier mass balance monitoring in the world. In this paper, mass balance variation of the Austre Lovénbreen glacier in Svalbard was analyzed, using the data measured by the Yellow River Station. Based on the stake and snow pit measurements of glacier surface, annual mass balance was calculated by contour maps of accumulation and ablation, and the influence of terrain elements was considered.

The following conclusions were obtained: (1) Annual mass balance contour pattern was basically same in the past 10 years, which indicated that the spatial heterogeneity of the mass balance on glacier surface was small. (2) Inter-annual fluctuation of mass balance was significant, the mass balance has been mainly negative from 2005 to 2016, and there was an obvious tendency for negative balance. The only positive mass balance was occurred in 2013/14 and the negative balance remained in the other years. (3) Average annual mass balance between 2005 and 2016 was -412 mm, and the equilibrium line altitude (ELA) oscillated between 212.10 and 570.87 m, with the mean value of 391.22 m. The ELA was negatively correlated with the mass balance. Analysis of daily mean temperature from May to September and daily precipitation form October to April shown that summer air temperature was the main controlling factor affecting the glacier mass balance.

P 135 SNOW DEPTH INVERSION IN NY-ÅLESUND, SVALBARD FROM GNSS REFLECTED SIGNALS

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Snow plays an important role in climate change and water circulation. However, the existing detection approaches have many limitations in snow depth detection. In recent years, GNSS-Reflectometry (GNSS-R) which utilizes GNSS reflected signals or multipath signals to retrieval surface information on land and ocean, has attracted widely attention. There are several significant advantages in snow depth inversion with GNSS reflected signals, such as all-time, all-weather, large amount of data and low cost. In our research, the GNSS-R inversion methods are summarized systemically firstly, and the improved method based on Signal to Noise Ratio (SNR) observation is proposed. Secondly, GNSS-R experiment is designed at Chinese Arctic Yellow River Station in Ny-Alesund, Svalbard, and SNR observations from GNSS reflected signals are collected. The effects on snow depth inversion, including satellite elevation angle, length of time series, number of satellites, azimuth, time scale, constellation structure, signal frequency and SNR intensity, are discussed comprehensively. Finally, the accuracy and practicability of the snow depth inversion with reflected signals can be obtained. This experimental results show that snow depth derived from GNSS-R is in good agreement with field measurements with a precision of several centimeters, which means GNSS-R technology can be used to obtain snow depth over the polar region.

P 136 GLACIAL MELT WATER STRATIFICATION PROMOTES NUTRIENT LIMITATION IN KONGSFJORDEN, SPITSBERGEN, THEREBY ALTERING PHYTOPLANKTON COMPOSITION BUT NOT PRODUCTIVITY

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Effects of nutrient limitation on post bloom phytoplankton composition and productivity were investigated along a 3 station transect in Kongsfjorden (Spitsbergen) in June 2015. Increasing glacial melt water input intensified stratification at all locations. Short term (60 h) nitrate addition experiments revealed increasing N-limitation of surface phytoplankton over time in the middle of the fjord. This coincided with a pronounced change in the flagellated phytoplankton community, replacing relatively large (10 µm) chrysophytes (85% of chl-a) with smaller haptophytes (60% of chl-a) and prasinophytes (20% of chl-a). Changes were less pronounced near the glacier, where average surface nutrient concentrations were higher. Surface chl-a concentrations (5 m), chl-a normalized maximum carbon fixation rates and water column productivity were variable and showed no clear trends over time. The initial rate of carbon fixation correlated inversely to irradiance and surface salinity, in addition to a positive correlation to chrysophyte chl-a. We conclude that N-limitation causes pronounced changes in Kongsfjorden phytoplankton composition and size structure, with minor effects on chlorophyll-a and water column productivity.

P 137 RAIN ON SNOW EVENTS IN NY-ÅLESUND: SNOW AS A CLIMATE DRIVER FOR ARCTIC TUNDRA ECOSYSTEMS

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Snow is the primary medium that connects all Arctic environments, and it is the dominant component in the Arctic terrestrial water cycle. It is therefore at the forefront of climate research both as an actor as well as an indicator of changes. In Svalbard, due to the strong oceanic influence, there is an increasing frequency of winter warming that significantly impact snow cover and snow-pack properties - the so-called “Rain-On-Snow” (ROS) events. ROS leads to formation of a denser snow-pack with ice lenses and in extreme cases, the formation of basal ground-ice. These lenses or ground-ice can have a strong impact on plant abundance and block access to forage for terrestrial animal populations. The timing of ROS is crucial for ecosystems, as earlier formation of basal ground-ice have a larger effects on plants and block the foraging for the herbivores for a longer time period.

During the last 15 years we have annually monitored the amount of snow and ground-ice around the Brøgger Peninsula, Ny-Ålesund, as well as the population size of the endemic Svalbard reindeer. Here we summarize current evidence on snow and ice as drivers of ecosystem dynamics, with special focus on the simple high-Arctic ecosystem in Svalbard. We emphasize the need for more high-quality data and particularly the need to study the effect of snow and ice on plant abundance and survival to complete our understanding of snow and ROS effects on the food web. We outline how an ecosystem-based monitoring of the physical (snow) and biological environment within a new initiative, Climate-ecological Observatory for Arctic Tundra solves the challenge. Such new interdisciplinary approaches will contribute to our understanding and ability to evaluate the vulnerability of an Arctic ecosystem to climate change.

P 138 OBSERVATIONS AND THE SOURCE INVESTIGATIONS OF BOUNDARY LAYER BRO ENHANCEMENT EVENT IN NY-ÅLESUND ARCTIC

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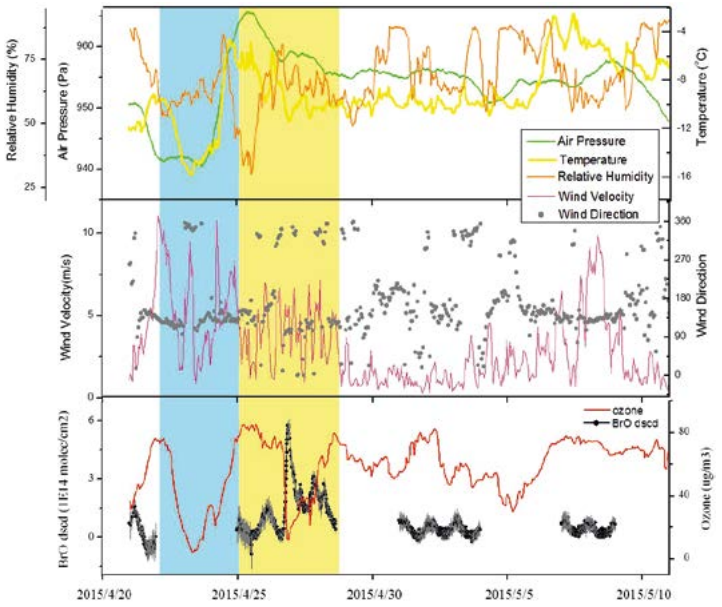
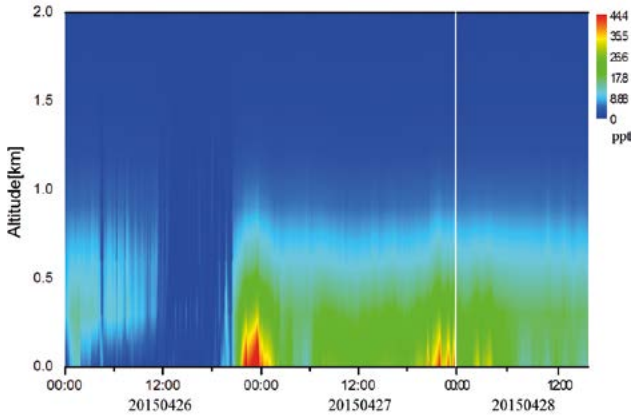
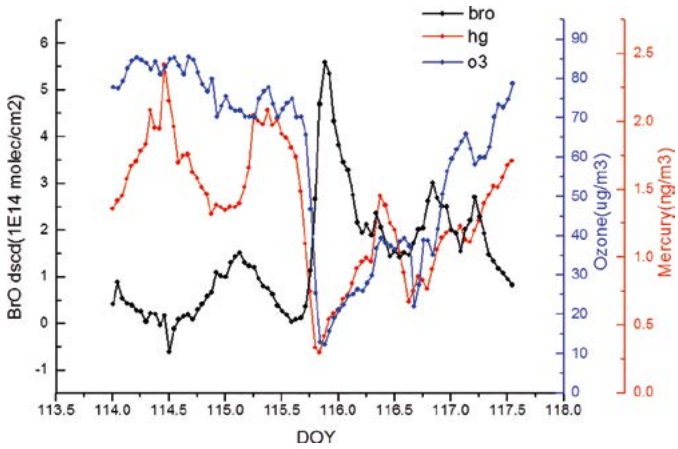
Bromine monoxide is a reactive halogen species which has profound impact on the chemistry of the tropospheric polar boundary layer. During spring, BrO enhancement can be detected by satellite based observations in large-scale coastal area of both northern and southern polar regions. However, for source investigation of polar boundary layer reactive bromine it is not enough. In this study, we found a typical process of enhanced bromine and depleted ozone in Ny-Ålesund boundary layer using ground based MAX-DOAS techniques from April 21th to May 11th, 2015 (fig.1). The vertical distribution showed nearly 50 ppt BrO was existed at boundary layer during the ODE period (fig.2), which is a very high level compared to other

time at this place. Considering meteorology, sea ice and HYSPLIT model calculations, air mass coming from High Arctic coastal area with high level BrO as well as the blowing sea ice in the Kings Bay area are possible sources of this bromine enhancement. During the BrO enhancement event, the boundary layer ozone and gaseous mercury has synchronously reduced by 85% and 90% separately (fig.3). The key role of bromine on the atmospheric oxidation and the ecosystem will be further discussed.







P 139 DISTRIBUTION CHARACTERISTICS AND TENDENCY OF PAHS IN MULTIMEDIA OF NY-ÅLESUND

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Concentrations of 16 polycyclic armomatic hydrocarbons (PAHs) in seawater, sea sediment, soil, moss and reindeer dung collected at Ny-Ålesund of the Arctic were measured to show the distribution characteristics , tendency and accumulation in the multimedia of the environment. Compared with the other regions, the proportions of 2+3 ring PAHs to the total PAHs were higher, whereas the proportions of 5+6 ring were lower in all the compartments at Ny-Ålesund. Significant log/log-linear relationship was observed between the sub-cooled liquid vapor pressure (p^*_L) and the soil/moss quotient(Q_{SM}). The relation was similar to the relationship between the gas/particle partition coefficient (K_p) and p^*_L of PAHs, implying Q_{SM} would be a "mirror image" of K_p. Excellent log/log-linear relationships were observed between Q_{SM} and K_{OA} as well as between the moss/dung quotient (Q_{MD}) and K_{OW}. The results presented here indicate the physicochemical properties are suitable for characterizing the distribution of PAHs in soil, moss and reindeer dung.

P 140 COUPLING GIS-BASED TOPOGRAPHY ANALYSIS AND SELECTED REGRESSION METHODS FOR LATE-SPRING SNOW THICKNESS MODELLING ON THE WALDEMAR GLACIER (SVALBARD)

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Presented work describes the approach of coupling GIS-based topography analysis and selected regression methods for late-spring snow thickness modelling on the small Arctic glacier, Waldemarbreen (NW Svalbard). Following regression techniques were used in the study: multilayer perceptron type of the artificial neural networks (MLP), multivariate adaptive regression splines (MARS) and linear multivariate regression (MVR).

Three types of data were used in modelling:

1. snow depth measurements performed in selected spring seasons of 2001-2009 period,
2. selected topography indexes extracted from DEM (e.g. slope, aspect, curvature, slope stability and wind exposition factors),
3. basic meteorological data for each season collected in Ny-Ålesund station.

The dataset was divided into a two subsets: internal dataset (IDS) and external dataset (EDS). IDS aggregates data for snow accumulation, corresponding GIS-based features and meteorological variables for spring seasons of 2001, 2005, 2007 and 2008. EDS consists of the same type of data for 2009 season. Snow thickness models were established and calibrated based on IDS, while the EDS was devoted for the independent evaluation of each algorithm efficiency. Several MLP and MARS models were constructed to determine their optimal architecture and to minimalize the risk of the over-fitting. Modelling results evaluation was made separately for IDS and EDS. It was based on the weighted coefficient of determination, Nash-Sutcliffe coefficient of efficiency and error analysis. In addition, for each model the sensitivity analysis was made in order to assess the contribution and importance of each input variable on the modelling results

Results showed that presented approach can be succesfully used in late-spring snow thickness modelling on the glacier. Non-parametric regression methods of MLP and MARS are more accurate than MVR technique.

S13.1 ARCTIC DATA AND INFORMATION SCIENCE MEETS SYSTEM SCIENCE

O 038 STATUS OF THE CIRCUMPOLAR ALASKA VEGETATION ARCHIVE AND THE REGIONAL ARCTIC ALASKA PROTOTYPE

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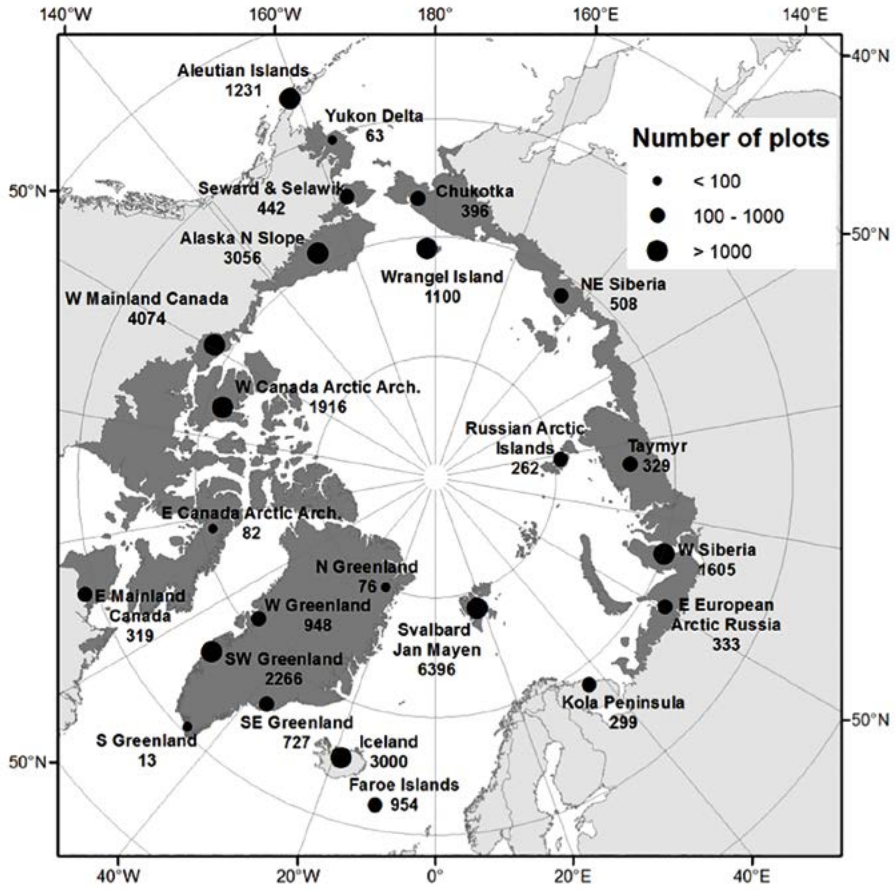
The Arctic Vegetation Archive (AVA) is a vegetation-plot database for the Arctic tundra biome. The geographic scope of the AVA spans seven countries across the circumpolar region and maritime boreal tundra areas, and is estimated to include approximately 30,000 plots (Fig. 1). A Pan-Arctic Species List provides a standard list of accepted vascular plant, bryophyte, and lichen species names. Work on the AVA is being accomplished within individual Arctic countries. Here we provide an overview of the AVA, and report on the status of the Alaska prototype of the AVA (AVA-AK).

The AVA-AK is freely accessible to scientists and the public via the Arctic Alaska Geoecological Atlas, an on-line resource being developed by the Alaska Geobotany Center and the Geographic Information Network of Alaska with funding from the National Aeronautics and Space Administration initiative called the Arctic-Boreal Vulnerability Experiment. The AVA-AK utilizes a Turboveg database program that makes it compatible to other similar databases throughout world. Species cover and ancillary data, including environmental, soils and spectral data, photos, maps, and publications, are linked to each plot's geographic location. These data are also archived in the ORNL-DAAC, NASA's Distributed Active Archive Center, and VegBank (the U. S. Vegetation Archive); and referenced through the Global Index of Vegetation Databases (GIVD). Approximately 3,000 plots from 24 separate studies have been imported thus far.

Most existing Arctic plant-community data have been collected using Braun-Blanquet approach, so an early goal for the AVA-AK is to develop a prodromus of Arctic syntaxa following the hierarchical floristic structure compatible with the European vegetation classification. Our classification is focusing first on a preliminary classification using the AVA-AK. We are using numerical clustering methods to examine the suite of available plot data to see if the existing high-level syntaxa recognized worldwide form a sufficient foundation for an AVA-AK classification.

Figure 1:



O 009 GET CREDIT AND VISIBILITY FOR YOUR DATA: DOIS AND THE POLAR DATA CATALOGUE

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A Digital Object Identifier (DOI) is a unique alphanumeric string assigned to particular content, providing a persistent link to its location on the Internet. DOIs have been assigned to published journal articles for decades, but did you know that DOIs can now be assigned to data sets? This means that data sets are citable and the authors of the cited data set receive credit for their contributions.

The Polar Data Catalogue (PDC, https://www.polardata.ca), Canada's primary publicly accessible repository for metadata and data from Arctic and Antarctic research in the natural, health, and social sciences, now has the ability to assign DOIs to data sets that are contributed to its archive. The PDC has recently assigned DOIs to more than 300 datasets comprising nearly 2.7 million individual data files.

The primary goal of the PDC is to facilitate access to polar data and information now and for years into the future to a range of stakeholders, including researchers and students, people living in Arctic communities, Canadian and international decision makers, and the interested public. We are working with Canadian and international polar data portals to build a global metadata sharing network and are increasingly linking with numerous online repositories to maximize awareness of and access to our respective collections. The ability to assign DOIs to datasets enhances these connections through the globally standardized DOI system, facilitating automatic interoperability of data management infrastructure around the world and complementing metadata harvesting protocols in place at the PDC and other data centres. Joining the DOI system improves the visibility of PDC data sets and simplifies their tracking as they are increasingly reused for new research, discovery, and knowledge of Arctic systems.

O 036 THE SIOS DATA MANAGEMENT SYSTEM – FROM INDIVIDUALS AND INSTITUTIONS TO NETWORKS AND PROGRAMMES

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Svalbard Integrated Earth Observing System (SIOS) aims to be a regional observational system for long term acquisition and proliferation of knowledge on environmental change.

Svalbard is located in a region alternately influenced by cold Arctic or mild marine climate conditions at time scales of weeks to years. It is also located in the region with the strongest inflow and outflow between the Arctic and lower-latitude oceans and has the needed facilities to study and quantify the extraterrestrial and especially solar influence on climate.

Several long-standing observational programmes exist in and around Svalbard. The SIOS challenge is to move these from a collection of efforts by individual scientists or institutions to a comprehensive and coordinated programme. To achieve this, SIOS require coordination and integration of existing efforts, taking into full account the technical, cultural and political implications of establishing a long-term programme in the Arctic.

A core effort in building SIOS is the integration of existing data centres into a unified system, the SIOS Data Management System (SDMS). Each data centre has its own procedures and technical solutions tailored to the needs of that data centre. SDMS will not change this, but tries to bridge, using internationally accepted interoperability standards and technologies. The most challenging task is brokering of semantic information and interoperability at the data level.

In order to fully understand and use the data made available by the SDMS, a thorough knowledge of the observation facilities and their procedures is required. SIOS is following the efforts of WMO Integrated Global Observing System (WIGOS) developing a metadata representation of observations and measurements for this purpose.

Implementation of SIOS depends on a coordinated effort among all SIOS partners within tight resource constraints. Thus, SIOS has outlined a long term vision with a prioritised order of functionality and a stepwise implementation plan.

O 037 THE PERMAFROST INFORMATION SYSTEM PERSYS-AN OPEN ACCESS GEOSPATIAL DATA DISSEMINATION AND VISUALIZATION PORTAL FOR PRODUCTS FROM ESA GLOBPERMAFROST

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The Permafrost Information System (PerSys) is conceptualized as an Open Access geospatial data dissemination and visualization portal for Earth Observation EO datasets produced within ESA DUE GlobPermafrost [2016-2019]. The first ESA DUE Permafrost project [2009-2012] developed EO services to support research communities and international organisations on better understanding permafrost. Now GlobPermafrost reflects on the capability of new EO sensors to fulfill the evolving user requirements and expands on this successful approach by including both polar hemispheres as well as mountain permafrost regions.

Currently, the GlobPermafrost team is creating prototype remote sensing derived datasets for defined product and user groups. The prototype and final remote sensing products and their metadata will be visualized in the PerSys WebGIS and described and searchable via the PerSys Data Catalogue. The WebGIS visualization is managed via the AWI WebGIS infrastructure maps@awi relying on OGC-standardized Web Mapping Service technologies. The PerSys WebGIS projects allow visualisation of raster and vector products such as land cover, trend datasets, lake and wetland extents, InSAR-based surface deformation maps, rock glacier velocity fields, spatially distributed permafrost model outputs, and land surface temperature datasets. Each of these WebGIS projects is adapted to the spatial scale of the specific products, ranging from local to hemispherical coverage. The PerSys Data Catalogue will provide the metadata and the access to all mature-state and final-state GlobPermafrost products.

PerSys is also a core component of the Arctic Permafrost Geospatial Centre (APGC), a geodata portal for permafrost launched within the framework of the ERC PETA-CARB project at AWI. APGC features permafrost-specific geospatial data projects, including PerSys. We will open the information systems for external data integration of permafrost-specific remote sensing derived raster and vector data.

The Open Access data library PANGAEA will serve as permanent archive for the GlobPermafrost final products, providing permanent Digital Object Identifiers (DOIs).

O 010 POLAR DATA INSIGHTS THROUGH SEARCH ANALYTICS, MACHINE LEARNING AND ADVANCED VISUALIZATION

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The accelerating rate at which data and information about the Arctic environment is being produced is challenging our ability to find and make sense of this information. We describe the goals and early results of the project “Polar Deep Insights”, which is developing polar-specific indexing and search paradigms for improved content discovery, information extraction, reasoning and natural language processing, while extending current search capabilities to the deep web and nontraditional (e.g. multimedia) content. These next-generation search technologies are making it possible to understand people, places, things and the connections between them through analysis of unstructured text as well as online images, videos, web pop-ups, online forms, web scripts and other ways information is presented on the web. The Polar Deep Insights project, funded by the National Science Foundation under the EarthCube program, incorporates a deep web crawler based on Apache Nutch, an extraction and content analysis system for heterogeneous content types based on Apache Tika, and an interactive visualization and analytics system that makes scientific data exploration easier for the user. We extract geographic locations automatically from both text and structured scientific data. We use Machine Learning-based clustering techniques to explore relationships between contract extracted from the crawled content. This can lead to generation of new insights such as relations of web pages to data and multimedia documents not previously linked; new aggregations of related documents; groups of similarly edited images and videos and other objects. Community input is guiding the development of reference text with keywords indicative of the Polar domain and gold standard web sites used to discriminate and prioritize relevant content. Future work will focus on adding a larger corpus of science-prioritized web sites and content; and will focus on adding semantic query capability and knowledge on top of our existing system.

O 039 SOLUTIONS FOR SYSTEM ANALYSIS AND INFORMATION SUPPORT OF THE VARIOUS ACTIVITIES IN THE ARCTIC

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The paper presents an overview of research and development of the Institute for Informatics and Mathematical Modelling of Technological Processes of the Kola Science Center RAS. The Institute focused on information and analytical support for various activities in the Arctic region. The range of supported activities is quite broad.

The tools for information support of interdisciplinary studies of the Arctic are the two types of systems that complement each other. The first is a “traditional” database. Its structure is based on the triad “object of research”-“researcher”-“result of research”. The database contains structured information about the objects of the Arctic region, researchers (research teams) who study these objects from various points of view, research projects and results of study. The second type is represented by a system of integrated space knowledge about the Arctic in the form of a formal ontology. The ontology is realized as a system of the Content Ontology Design Patterns (CODP). Each pattern is a small holistic fragment of the ontology which formalizes the generalized situation of the subject area. The technologies of ontological modeling allow also deduce new knowledge on the base of presented in ontology.

A number of methods and information technologies were proposed to solve specific problems at all levels of regional safety management.

Models and methods of computer simulation were developed to forecasting of rational training and the use of limited labour resources in the Arctic regions of Russia.

Great attention is devoted to the information technologies for improve the primary processing of mineral raw materials. Modeling tools were proposed for improving the efficiency of existing processes of ore concentration and for synthesis new, more effective schemes of ore-dressing and separation devices. Works in this area are carries out in close cooperation with the Mining Institute KSC RAS.

O 007 A MULTI-SCALE ARCTIC OBSERVING AND DATA DISSEMINATION SYSTEM

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The nature and rate of social and environmental change in the Arctic and globally is driving an urgent need to establish how to best discover, make available and link all kinds of knowledge and information in support of the decisions and actions needed for a sustainable future. The foundations of knowledge are observations and synthesis of these observations to form understanding. Thus, establishing a comprehensive, highly connected observing system coupled with an effective means for discovering and sharing the data generated from these observations is critically important for stimulating knowledge-based action.

In this presentation, we provide a review of current developments and future needs in the establishment of a multi-scale Arctic observing and data dissemination system that is part of a broader global network. The focus will be on the activities of Sustaining Arctic Observing Networks initiative (SAON) and its connection to other bodies such as the Arctic Council, International Arctic Science Committee, Global Earth Observing (GEO), Research Data Alliance as well as a sampling of regional, national, and local initiatives and infrastructures. This will include an overview of recent inventory and workshop results.

By providing Conference participants with an understanding of the current state and future requirements of the Arctic observing and data systems, we will contribute a foundational layer required for the dialogue, discussions and networking needed for enhanced knowledge-based action. Ultimately, the flow of observations, data and knowledge between and among researchers, residents, policy-makers and the public is critical to bringing knowledge to action.

O 008 UNDERSTANDING AND BUILDING THE ARCTIC DATA E-COSYSTEM

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The concept of an information or data ecosystem is being used in multiple contexts and applications, typically as a metaphor, however research is required to further develop the theory and practical application of this approach. We apply ecological principals and theory to a specific case study, the “Mapping the Arctic Data E-Cosystem” project, which is led by the international Pan-Arctic Options project as a contribution to several global initiatives. Preliminary results of the mapping and analytical process are reported.

Mapping activities include the identification and description of organizations, infrastructures, tools, data catalogues and registries, funding bodies and other entities. Mapping entails both concept mapping and establishing geographic locations where appropriate. Analysis of the network establishes the flows of information and the functions of various entities. Some act as keystone species that play central roles disproportionate to their frequency, others act as decomposers (transformers) that mediate information to support re-use and multiple applications. Flow of funds and resources clearly influence the morphology and topology of the network system.

We demonstrate how Semantic Web and other network modeling tools have been used to support analysis and visualization. Examples focused on specific disciplines and communities of practice are presented.

Early results indicate that the use of an ecosystem framework is highly effective in supporting analysis and understanding of the arctic data system. This approach can inform planning and support studies of global environmental change, and support innovative, evidence-based governance and policy options

O 005 BIODIVERSITY OF CANADIAN ARCTIC VASCULAR PLANTS: FIELD WORK AND FLORISTICS

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Exploration of the vascular plant flora of the Canadian Arctic has been ongoing for almost two hundred years, yet substantial gaps remain in our floristic understanding of this large, rapidly changing and difficult-to-access region. Detailed information on the diversity and distribution of Arctic plants is urgently needed to understand the potential impacts of climate change on the region’s flora. Since 2008 we have been conducting detailed floristic surveys in botanically-understudied regions of the Canadian Arctic. The comprehensive baseline data of our >8000 new collections, all housed permanently in the National Herbarium of Canada at the Canadian Museum of Nature, and other herbaria in Canada and internationally, adds important knowledge to our understanding of Arctic plant biodiversity, which may inform future terrestrial monitoring efforts by identifying areas that contain rare species or unique habitats, for example. Our collections include first records for specific areas (e.g., territories, national parks, territorial parks), major and minor range extensions, second or third collections of poorly-known species at the northern edges of their ranges, discoveries of rare species, and they fill in gaps in the known distributions of Arctic species. We are also working on a new Arctic Flora of Canada and Alaska, which aims to bring together all available information on the diversity and distribution of vascular plants in Arctic Canada and adjacent Alaska, including keys, descriptions, nomenclature, distribution maps, images and other information.

O 040 THERMAL STATE OF PERMAFROST AND ACTIVE LAYER THICKNESS OVER THE LAST DECADE: REPORT FROM GLOBAL TERRESTRIAL NETWORK FOR PERMAFROST (GTN-P)

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[5] *WSL Institute for Snow and Avalanche Research SLF, Davos Dorf, Switzerland*
[6] *Instituto de Geografia e Ordenamento do Território- Universidade de Lisboa, Lisboa, Portugal*
[7] *Institut de Géographie Alpine, Grenoble, France*
[8] *Arctic Portal, Akureyri, Iceland*

Global Terrestrial Network for Permafrost (GTN-P) provides systematic long-term measurements of permafrost temperature and active layer thickness (ALT), and is part of the Global Terrestrial Observing System of the Global Climate Observing System. Long-term monitoring of permafrost thermal state and active layer thickness generates essential baseline information for the assessment of climate change impacts in polar and high mountain regions. The GTN-P launched a sophisticated data management system (DMS, gtnpdatabase.org), which allows automatic data submission, standardization, quality control, processing, and data access. Presently 1350 TSP boreholes and 250 active layer sites are registered in the DMS. Using DMS capabilities we selected sites with data available around the last International Polar Year and in the last five years (2010-2015) and estimated changes in thermal state of permafrost and active layer thickness between the two reference periods. ALT exhibits large interannual variability, but has generally increased in the majority of regions, especially in European Arctic where several sites experienced permafrost degradation. Permafrost temperature has generally increased across the entire permafrost domain which is consistent with air temperature trends. The greatest increases in permafrost temperature are found in the High Arctic of Canada and western Siberia and are generally pronounced in regions with cold continuous

permafrost such as Russia and North America. In the Subarctic, where permafrost temperatures are relatively high and within 2°C of the freezing point, there has been little change and permafrost temperature is similar to that of the IPY snapshot. In Alpine permafrost areas most measurement sites also show significant warming since 2009. In Antarctica, permafrost temperature showed various trends, depending on regional changes in atmospheric temperature and snow accumulation. This work reveals further need for improved geographic coverage of the observational network in order to assess changes in permafrost system at global scales.

O 006 FACILITATING PAN-ARCTIC DATA SHARING AND VISUALIZATION: THE ARCTICCONNECT PROJECT

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Facilitating Pan-Arctic Data Sharing and Visualization: The ArcticConnect Project.

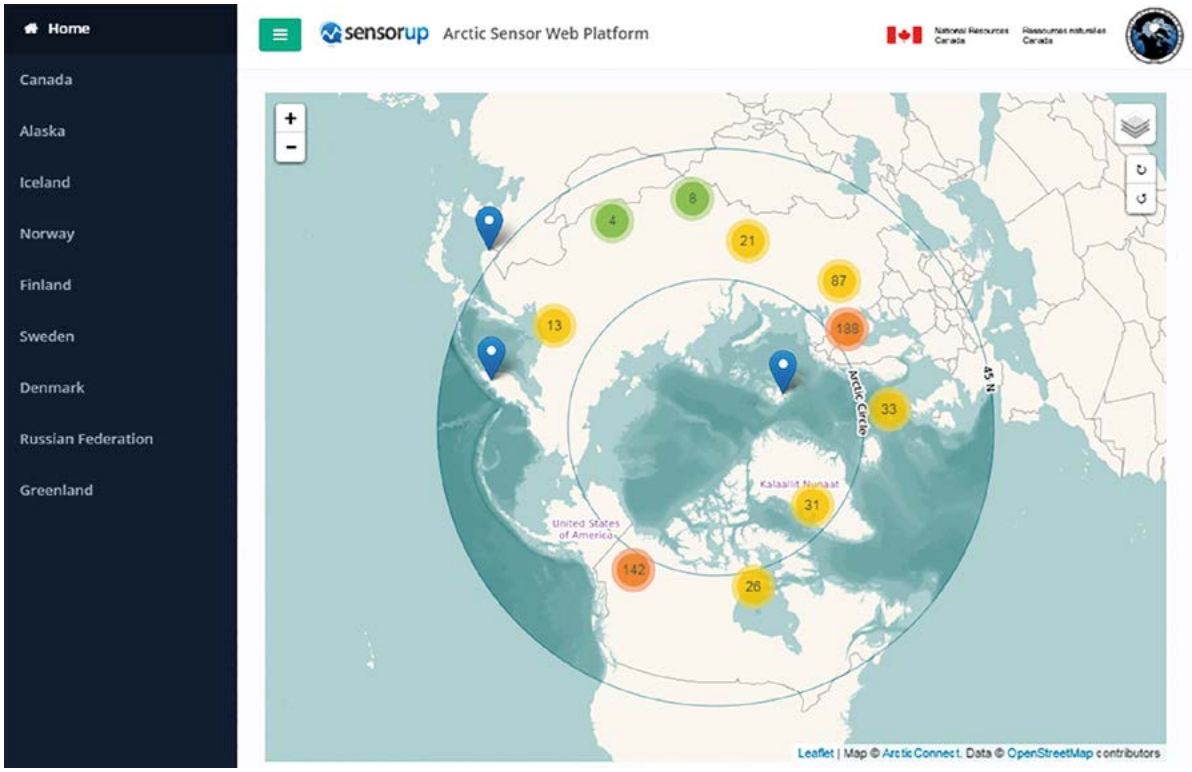
ArcticConnect is a network-enabled platform that hosts services for sharing and visualizing information about arctic systems. Launched in 2014, two of these services, Arctic Web Map and the Arctic Sensor Web, have proven to be particularly good resources for distributing, displaying, and accessing arctic data. Designed to facilitate international data sharing and collaboration, these open source and open access tools are now being used by researchers, organizations, educational institutions, and government who work in and around the circumpolar Arctic.

Funded by CANARIE, ArcticConnect is the result of a collaboration between the Arctic Institute of North America, University of Calgary's Department of Geomatics Engineering, and Cybera Inc.

Arctic Web Map

Arctic Web Map (AWM) is a web-based mapping tool based on accurate polar projections. This Arctic-specific web mapping tool provides researchers scientifically accurate map projections for visualization and analysis, a function that is critical for Arctic system research but missing in other existing web mapping platforms; it also provides a visually appealing tool for education and outreach to a wider audience. It is open source and can be used freely with other systems and is currently used by organizations and individual researchers internationally.

Arctic Sensor Web



Arctic Sensor Web (ASW) enables research stations around the pan-Arctic to connect their sensors, including those that provide near real-time data, to a cloud service for visualization, information sharing, and collaborative analysis. Updated with a new search interface in 2016, Arctic Sensor Web currently provides detailed sensor information for more than 550 research stations internationally.

P 142 RUSSIAN ARCTIC DATASETS OF RELEVES MEETING REQUIREMENTS FOR CLASSIFICATION OF VEGETATION USING BRAUN-BLANQUET APPROACH

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The vegetation diversity of the Russian Arctic is great due to the huge area (about 27,000,000 km^2) and large variety of landscapes (Matveyeva et al. 2013). According to the preliminary Prodromus (Telyatnikov, unpubl.) about 80 associations have been recorded within 35 alliances of 18 orders and 14 classes while about 40 new associations have not been placed into higher units.

The status of Russian Arctic vegetation datasets owned by several RAS institutes was reviewed as a part of the Arctic Vegetation Archive project (AVA) (table 1). All these datasets are of landscape level. In addition to relevés they may also include information on different ecotope parameters, productivity of communities and etc. The main pool of relevés is stored in Komarov Botanical Institute RAS (St. Petersburg, Russia).

At this stage dataset of K. Ermokhina (Earth Cryosphere Institute SB RAS) is imported in AVA, datasets of S. Kholod (Komarov Botanical Institute RAS) and M. Telyatnikov (Central Siberian Botanical Garden RAS) are at work. Datasets of N. Matveyeva, L. Zanokha, O. and I. Lavrinenko, N. Sinelnikova and N. Koroleva are next to go.

Table 1. Russian Arctic datasets of releves meeting requirements for classification of vegetation using Braun-Blanquet approach

region of Russia		author of dataset	number of plots
Kola peninsula		N. Koroleva	299
East European Arctic		E. Kulyugina	199
		O. Lavrinenko	58
		O. and I. Lavrinenko	348 (about 1200 at hand)
		N. Matveyeva	53 (about 250 at hand)
		N. Matveyeva and O. Lavrinenko	34
West Siberia		D. Walker	60
		K. Ermokhina	594
		O. Sumina	670
		M. Telyatnikov	468
Taymyr		L. Zanokha	150
		N. Matveyeva	179
NorthEast of Siberia		M. Telyatnikov	483
		M. Raynolds	25
Chukotka		V. Razzhivin	261
		O. Sumina	102
		N. Sinelnikova	33
Russian Arctic Islands	Spitsbergen	N. Koroleva	115
	F. Jozef Land	D. Walker	10
	Severnaya Zemlya	N. Matveyeva	252
	Wrangel Island	S. Kholod	1100

P 143 ARCTIC SEA ICE CONCENTRATION OBSERVED WITH SMOS DURING SUMMER

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The launch of the Soil Moisture and Ocean Salinity (SMOS) mission, in 2009, marked the dawn of a new type of space-based microwave observations. Although the mission was originally conceived for hydrological and oceanographic studies, SMOS is also making inroads in the cryospheric sciences by measuring the thin ice thickness. SMOS carries an L-band (1.4 GHz), passive interferometric radiometer (the so-called MIRAS) that measures the electromagnetic radiation emitted by the Earth's surface, at about 50 km spatial resolution, continuous multi-angle viewing, large wide swath (1200-km), and with a 3-day revisit time at the equator, but more frequently at the poles.

A novel radiometric method to determine sea ice concentration (SIC) from SMOS is presented. The method uses the Bayesian-based Maximum Likelihood Estimation (MLE) approach to retrieve SIC. The advantage of this approach with respect to the classical linear inversion is that the former takes into account the uncertainty of the tie-point measured data in addition to the mean value, while the latter only uses a mean value of the tie-point data. When thin ice is present, the SMOS algorithm underestimates the SIC due to the low opacity of the ice at this frequency. However, using a synergistic approach with data from other satellite sensors, it is possible to obtain accurate thin ice thickness estimations with the Bayesian-based method.

Despite its lower spatial resolution relative to SSMI or AMSR-E, SMOS-derived SIC products are little affected by the atmosphere and the snow (almost transparent at L-band). Moreover L-band measurements are more robust in front of the accelerated metamorphosis and melt processes during summer affecting the ice surface fraction measurements. Therefore, the SMOS SIC data set has great potential during summer periods in which higher frequency radiometers present high uncertainties determining the SIC.

P 144 THE RUSSIAN ARCTIC LOCAL FLORAS DATABASE ALLOWS ASSESSMENT OF BIODIVERSITY GRADIENTS AT THE LANDSCAPE LEVEL

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Local floras concept has been used by Russian botanists for more than 50 years (Khitun et al. 2016). More than 250 localities with the area of approximately 100 km^2 each were visited in the Russian Arctic and their total vascular plant diversity were assessed. A local floras database was started in the Integrated Botanical Information System (IBIS) created by Zverev (1998, 2007). It allows study spatial gradients of different floristic variables. Several taxonomical variables of local floras, such as number of species, genera and families; number of species in 5 and 10 richest families; ratios of Asteraceae to Poaceae, and Cyperaceae to Poaceae, were significantly different between the Yamal-Gydan, Taimyr and Chukotka sectors. Both taxonomic and typological variables can be compared with the help of IBIS. Zonal trends reflecting decreases in summer warmth are clearly exhibited in species richness of local floras and in proportions of the Arctic, Hypoarctic and Boreal phytogeographical groups. Well pronounced decrease of local floras richness is exhibited in Yamal -Gydan (185-215 species in subzone E vs 75-99 in subzone B) and in Taimyr (ca 200-300 in subzones F and E, 98-149 in subzone B and 46-62 in subzone A). There is also a longitudinal trend. The sharpest contrast is between West Siberian local floras (100-200 species) and Chukotka ones (250-450 species). The reasons are difference in relief (lowland vs mountainous) and the history of floras (flora of the territory which experienced glaciations and marine transgressions during Pleistocene vs more ancient, which developed continuously since Tertiary). Certain limits for variation can be shown within sectors. The database is used for study of geographical patterns of floristic variables and also has a direct implementation for conservation issues - indicating botanically valuable areas.

P 145 LARGE-SCALE GEOBOTANICAL MAPPING OF THE EAST EUROPEAN TUNDRA

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Since 1996 we are doing large-scale geobotanical mapping of the East European tundra, based on the ArcGIS, relevés (1500) and remote sensing. The following works were performed:

Vegetation maps projects (scale 25 000-100 000) for the 10 regional nature reserves and protected areas.

GIS Project "The Red Book of the Nenets Autonomous Okrug", which contains 1300 location 102 rare plant species and the layers with the key areas for the conservation of rare species.

132 geobotanical districts have been allocated to East European tundra territory. Distribution of the maximum NDVI correspond to this scheme geobotanical zoning. Maps of geobotanical districts conservation values are prepared on the basis of analysis of the diversity of rarespecies.

Maps of long-term dynamics of the vegetation for Vaigach and Kolguev Islands were prepared using remote sensing techniques and field relevés. The maximum NDVI values increased over the last 25 years to 30 and 15% respectively. A high correlation there was between growth of phytomass and an increase of the average summer temperatures, lengthening the growing season and the amount of accumulated heat over this period.

With use of satellite images were shows that between 1973 and 2010 area of marshes with vegetation in the Kolokolkovoy bay (Barents Sea coast) was not constant and varied from 357 to 636 ha and after a severe storm on 2010 was reduced to 43-50 ha. A comparative analysis of species composition in the relevés made in 2002 and again in 2011, allowed to evaluate syntaxa changes on the various levels of marches.

Draft of the typological scheme of vegetation territorial units (Braun-Blanquet classification) was prepared for Kolguev Island as model. 4 ranks of typological units were offered: department, class, type and subtype, which correspond to the basic levels of the hierarchical organization of vegetation. This typology is consistent with the EUNIS habitat classification.

P 146 VEGETATION OF THE EAST EUROPEAN TUNDRA: CLASSIFICATION AND DATABASE

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More than 40 sites on East European tundra plains were visited within 1996-2016 when 1500 relevés in the Braun-Blanquet school were made along the latitudinal gradient from typical tundra to forest-tundra. Prodromus contains 17 classes, 20 orders, 27 alliances and 53 associations (20 new ones). Vegetation of *Juncetea maritimi* marshes, *Oxycocco-Sphagnetea* and *Scheuchzerio-Caricetea nigrae* bogs and mires, *Carici rupestris-Kobresietea bellardii* on calcareous rocky grounds and *Thlaspietea rotundifolii* on unstable substrates fell-fields was studied rather well. The new *Rubo chamaemori-Dicranion elongati* alliance within *Oxycocco-Sphagnetea* is proposed for dwarf-shrub-cloudberry-moss (*Dicranum elongatum, Polytrichum strictum*)-lichen communities of oligotrophic palsa bogs and peatlands of the Subarctic, in contrast to boreal *Oxycocco-Empetrion hermaphroditi* with dwarf-shrub-*Sphagnum* communities of ridges and hummocks in ombrotrophic raised bogs. The necessity of new class for zonal tundra vegetation on placor (interfluve habitats with loamy soils), which unites the diverse sedge-dwarf-shrub-moss communities, is obvious. Their structure and composition are characterized by: continuous or discontinuous plant cover with regular frost boils with bare ground; high (more than 200) species richness; well-developed (up to 8 cm) moss layer dominated by common tundra bryophytes (*Aulacomnium turgidum, Hylocomium alaskanum, Ptilidium ciliare, Tomentypnum nitens*); dominance by *Carex arctisibirica* / *C. lugens* in grass layer; high dwarf-shrub willows (*Salix reticulata, S. polaris*) abundance; non constants presence of *Dryas octopetala* / *D. punctata* and shrub willows (*Salix glauca, S. lanata*). We reserve the name *Carici arctisibiricae-Hylocomietea alaskani* for coming new class. The practice to put zonal tundra communities into *Carici rupestris-Kobresietea bellardii*, *Loiseleurio-Vaccinietea* or *Juncetea trifidi* blurs their ecological affinity and brings disbalance in Arctic syntaxonomy. There are plans to continue classification with long-term perspectives to use results in making vegetation maps as well as in zonation with updating the between/inside boundaries and geobotanical subdivision schemes.

P 147 FACTORS OF SPATIAL VARIATION OF SOIL PROPERTIES IN DISCONTINUOUS PERMAFROST ZONE OF THE NORTH OF WESTERN SIBERIA

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Soil efflux of carbon dioxide - an important parameter that can indicate the functioning of terrestrial ecosystems. For correct estimation of the process and to identify the factors affecting it, the study of soil CO2 emissions should be made with taking into account its spatial and temporal variability.

Objective: Identification and quantification of the main factors of spatial heterogeneity of properties and parameters of functioning of soils, which are formed in different environmental conditions of discontinuous permafrost zone of Western Siberia. This area is characterized by severe climatic conditions: a long winter, the average annual air temperature of about -5°C, precipitation varies from 450 to 650 mm per year. Investigations were carried out on the frozen peatland with peat-mineral soils and in pine forest with podzols.

Two ten-meter transects were established with step of 1 meter in both ecosystems. At each point of transects once a day within a week were measured: carbon dioxide efflux (closed chamber method), volumetric moisture and temperature at 10 cm depth. In the laboratory the pH, the total, labile and microbial carbon were measured for each point.

Average CO2 efflux for all study period on peatland was 74± 30 mgCO2/(m2 hr), in the forest 559±115 mgCO2/(m2 hr). The average daily temperature of the upper 10 cm layer was significantly higher in the forest than in the peatland soil (8,0°C and 2,8°C). Volumetric moisture was 10,6% in the forest and 19,2% in the peatland soil.

Forest and peat soils were significantly different in temperature; value of CO2 efflux, labile carbon content. On the peatland, all parameters are characterized by a significantly higher variability. In peatland soil moisture is a leading factor in determining the temperature of the soil and the vegetation types. In forest, soil temperature and moisture, the vegetation types determine CO2 efflux.

P 148 A REVIEW OF SELECTED PHYSICAL PARAMETERIZATION SENSITIVITY SETTINGS WITHIN POLAR-WRF MODEL OVER SVALBARD AREA

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In this work we present the results of the sensitivity study using the mesoscale meteorological Polar Weather Research and Forecasting model (Polar-WRF) for high-resolution dynamical downscaling done over the Svalbard area. In total, 36 unique simulations were performed for January 2009 and June 2008. For each model run, we have used different configuration of physical parameters, including the tests of long and shortwave radiation schemes, planetary boundary layer, microphysics and cumulus parameterizations. Additionally, two model runs were tested using the same configuration for physical parameterizations, but with two different digital elevation models: the default one as provided in the WRF Preprocessing System, and a high-resolution layer available for the Svalbard area. The sensitivity of the model in terms of spatial resolution is also analyzed, as the Polar-WRF model was configured using three-way nested domains with 27km, 9km and 3km grid cell resolutions.

The results were compared against meteorological observations gathered at 9 weather stations. These preliminary results show high sensitivity of the obtained dynamical downscaling geophysical fields to the selected model configuration. For example, mean values of Pearson correlation coefficients for near-surface air temperature may vary from 0.3 up to 0.73 in June and from 0.79 up to 0.97 depending on analyzed locations. Significant differences of stations mean error (ME) distributions occur for longwave radiation schemes (particularly for CAM and New Goddard). This study is an attempt to address the most optimal model configuration for the area of Svalbard in order to downscale a future climate scenarios as accurate as possible.

P 149 CCADI: THE CANADIAN CONSORTIUM FOR ARCTIC DATA INTEROPERABILITY

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The Canadian Consortium for Arctic Data Interoperability (CCADI) is composed of a group of Canada's foremost Arctic scholars and Arctic data managers at: the University of Calgary (Arctic Institute of North America), the University of Waterloo (Canadian Cryospheric Information Network/ Polar Data Catalogue), Carleton University (Geomatics and Cartographic Research Centre), the University of Manitoba (Centre for Earth Observation Science), Université Laval (Centre d'études nordiques), University of Ottawa, Inuit Tapiriit Kanatami, Natural Resources Canada (NRCan), Polar Knowledge Canada, and private partners from SensorUp, and Cybera Inc.

CCADI members are also leading contributors to:

the Arctic Data Committee (ADC) of the International Arctic Science Committee and Sustaining Arctic Observing Network

the International Study of Arctic Change (ISAC)

the Canadian Network of Northern Research Operators (CNNRO)

ArcticNet

and the Polar Libraries Colloquy.

It is well-positioned to take leadership in advancing collaboration, nationally and internationally, through development of an integrated national data management system that facilitates information discovery, establishes metadata and data sharing standards, enables interoperability among existing data infrastructures, and is accessible to the broadest possible audience of users.

P 150 AN ARCTIC VEGETATION ARCHIVE FOR CIRCUMPOLAR ARCTIC VEGETATION CLASSIFICATION

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Vegetation classification of the circumpolar Arctic tundra biome is a priority project of the Conservation of Arctic Flora and Fauna (CAFF), the biodiversity working group of the Arctic Council. The project was delayed for many years since it was first proposed in 1992, due to difficulties in standardizing and archiving such a large amount of information. Recent rapid advances in international vegetation databases have helped to revitalize the idea and prompted the creation of the Arctic Vegetation Archive (AVA) initiative. Approximately 30,000 vegetation plots, are potentially useful for developing the classification. The data include plant-species-cover and environmental data. A prototype Alaska AVA (AVA-AK) is described in this poster. The AVA-AK data are part of a web-based publically accessible portal, the Alaska Arctic Geobotanical Atlas and (http://alaskaaga.gina.alaska.edu). A Catalog record for each dataset describes the associated research project, purpose and methods of data collection along with links to the Turboveg v2 database and related ancillary data. The Turboveg database includes the species data standardized according to panarctic taxonomic references and standardized environmental header data. Ancillary data in the Catalog record contain additional information about the dataset, including plot photographs, plot-location maps, the species, soil, and environmental data prior to standardization, as well as relevant publications, data reports, and metadata. The first Arctic Vegetation Classification (AVC) will focus on Alaska and use the Braun-Blanquet approach to define and name plant communities. The syntaxa are organized according to their typical occurrence in habitat types, similar to the approach used in the European Vegetation Classification. The next step will be to assemble similar archives for other regions of the Arctic. A longer-term goal is to use the same archive to develop a classification according to the EcoVeg approach of the U.S. National Vegetation Classification and develop a crosswalk between the two approaches.

S13.2 ARCTIC TRANSECTS

O 099 EXAMINING ARCTIC ENVIRONMENTAL GRADIENTS WITH REMOTELY SENSED DATA – THE ESA GLOBPERMAFROST PROJECT

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Permafrost cannot be directly detected from space, but many surface features of permafrost terrains and typical periglacial landforms are observable with a variety of EO sensors ranging from very high to medium resolution at various wavelengths. In addition, landscape dynamics associated with permafrost changes and geophysical variables relevant for characterizing the state of permafrost, such as land surface temperature or freeze-thaw state can be observed with space-based Earth Observation. Suitable regions to examine environmental gradients across the Arctic have been defined in a community white paper (Bartsch et al. 2014, https://doi.pangaea.de/10.1594/PANGAEA.847003). These transects have been updated within the ESA DUE GlobPermafrost project.

The ESA DUE GlobPermafrost project develops, validates and implements Earth Observation (EO) products to support research communities and international organisations in their work on better understanding permafrost characteristics and dynamics. Prototype product cases will cover different aspects of permafrost by integrating in situ measurements of subsurface properties and surface properties, Earth Observation, and modelling to provide a better understanding of permafrost today. The project will extend local process and permafrost monitoring to broader spatial domains, support permafrost distribution modelling, and help to implement permafrost landscape and feature mapping in a GIS framework. It will also complement active layer and thermal observing networks. Both lowland (latitudinal) and mountain (altitudinal) permafrost issues are addressed.

The selected transects and first results will be presented. This includes identified needs from the user requirements survey, a review of existing land surface products available for the Arctic as well as prototypes of GlobPermafrost datasets, and the permafrost information system through which they can be accessed.

O 101 STATUS-QUO OF PHYTOSOCIOLOGICAL VEGETATION CLASSIFICATION ALONG LATITUDINAL AND ALTITUDINAL GRADIENTS AS BASELINE FOR LONG-TERM SURVEILLANCE OF GLOBAL WARMING IN GREENLAND

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We present a short account on the plot-based vegetation studies in Greenland. The vegetation variation in Greenland will be mapped based on Arctic subzones A-F (CAVM-Team 2003) including altitudinal zonation.

Zonal vegetation is the dominant vegetation determined by the respective climate, of subzone A polar deserts (Drabo-Papaveretea dahliani), B dwarf-shrub graminoid tundra (Carici-Kobresietea bellardii), C-E acidophytic dwarf-shrub vegetation (Loiseleurio-Vaccinietea), and the boreal enclave birch-scrub (Vaccinio-Piceetea). Nemoral vegetation occurring in warm sites is extrazonal (6 classes) while intrazonal and azonal vegetation is determined by special edaphic or physico-chemical properties the former linked with one zone, the latter occurring across zones. Intrazonal Arctic vegetation is the Arctic-steppe (Saxifrago tricuspidatae-Calamagrostietea purpurascentis) and grassy tundra in disturbed and nutrient-enriched sites (Saxifrago cernuae-Cochlearietea groenlandicae). The azonal vegetation is diverse with the vegetation of beaches, rocks, screes, snow-beds and of moist-wet habitats (10 classes). The expected differences in response to climate-change will be discussed with respect to the subzones and altitudinal belts.

However most of the vegetation studies stem from the low-Arctic part of Greenland (subzones E-D) whereas only very few studies have been performed in high-Arctic Greenland (subzones C-A). This contrasts with the situation in Arctic Canada, Svalbard and Franz-Joseph-Land.

There is a strong need to set up such vegetation research in northernmost high-Arctic Greenland with the establishment of permanent research sites for long-term surveillance of the impacts of global warming. The vegetation types of these subzones likely are the most sensitive for direct and indirect impacts of global warming.

The monitoring-work in SW-Greenland in the framework of the altitudinal-zonation-project AZV (Sieg et al. 2006) needs continuation in near future.

CAVM-Team. 2003. Circumpolar Arctic Vegetation Map. CAFF-Map-No.1. U.S.-Fish-and-Wildlife-Service, Anchorage, Alaska.

Sieg, B., Drees, B. & Daniëls, F. J. A. 2006. Vegetation and Altitudinal Zonation in Continental West Greenland. Meddelelser om Grønland-Bioscience 57: 1-93.

O 102 PERMAFROST CONDITIONS ACROSS THE LARGEST CLIMATIC GRADIENT IN THE HIGH ARCTIC BETWEEN WARM SVALBARD AND COLD NORTHERN GREENLAND

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The largest climatic gradient in the Arctic exist across the Fram Strait between the relatively warm Svalbard and the relatively cold Greenland. This is due to the sea current distribution with the East Greenland Current transporting cold water from the Arctic Basin down south along the east coast of Greenland, while the North-West Atlantic Current brings warm water up along the west coast of Svalbard. The mean annual air temperature was in central Svalbard -0.1C in 2016 while at St. Nord in northernmost Greenland the mean annual air temperature is typically around -16°C. The distance between these two sites is only around 720 km.

In summer 2014 two 20 m permafrost boreholes equipped for thermal monitoring was established as part of the Villum Research Station at St. Nord at 81°N in northern Greenland. These represent some of the northernmost boreholes existing for permafrost monitoring in the Arctic. Earlier, in 2012, two 18 and 20 m deep boreholes were established also with permafrost thermal monitoring at the Zackenberg Research Station at 74°N in NE Greenland. In central Svalbard at 78°N permafrost thermal monitoring in similar landforms has since 2008 shown that the warmest permafrost in the high Arctic is located there. With the establishment of the new Villum Research Station, in otherwise rather inaccessible northern Greenland, for the first time it became possible to do an Arctic transect study across this largest Arctic climatic gradient to determine to which degree the permafrost thermal state is climatically controlled along this transect. The borehole locations allow studying also directly the influence of snow on the permafrost thermal state along the gradient. Results from the period 2014-2016 show large interannual but also intersite variation in the permafrost thermal state largely controlled by snow dynamics.

O 065 VEGETATION COMMUNITY AND ECOSYSTEM PROPERTIES ALONG THE EURASIAN ARCTIC TRANSECT (EAT)

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A common methodology for examining the effects of climate variables on ecosystem properties is to utilize a geographic transect that exhibits spatial variability in one specific climatic variable. We sampled locations along a latitudinal temperature gradient in northwestern Siberia, from the forest-tundra transition in Nadym, Russia, north through the Yamal Peninsula, to the Franz Josef Land Archipelago. At each of six locations, we constructed 50 x 50 m grids of homogeneous vegetation, with different grids representing spatial variability in soil texture related to landscape age. Within each 50 x 50 m grid, we systematically and uniformly sampled the Normalized Difference Vegetation Index (NDVI), the Leaf Area Index (LAI), and the active layer depth. Each of the grids also contained five 5 x 5 m subplots within which species composition, vegetation biomass, NDVI, LAI, and surface soil properties were all sampled. The summer warmth index (SWI - sum of mean monthly temperatures > 0°C) ranged from 1.9 at the Franz Josef Land location to 44.1 at Nadym. NDVI increased linearly, and LAI increased exponentially, along the SWI gradient, although the increase was greater on sites with finer textured soils. Total live biomass increased from <100 g m^{-2} to > 1000 g m^{-2} along the SWI gradient, and there were no significant differences between loamy and sandy textured soils. Plot-scale species richness was relatively constant along the SWI gradient, and richness was generally consistent between loamy and sandy soils. However, the landscape-scale beta diversity indicated a 47% increase in richness with sampling of sites with different soil textures. The regional-scale beta diversity was 2.89, indicating that sampling across the full latitudinal gradient essentially tripled species richness. The extensive sampling conducted along the EAT provides valuable information as to the effects of temperature on plant community and ecosystem properties in arctic tundra.

O 067 CLIMATE AND SOIL TEMPERATURE VARIATION IN THE FOREST-TUNDRA TRANSITION NEAR NADYM, WEST SIBERIA, RUSSIA

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The soil temperature regime is a significant integral indicator of the functioning as soils individual and the landscape as whole. In the changing climate is obvious necessity of detailed study of the soil and permafrost temperature, especially in the transitional areas, areas with unstable permafrost conditions.

Four-year monitoring of soil temperature regime in three typical landscapes of northern taiga of West Siberia, Russia, located in the discontinuous permafrost zone was carried out.

Based on average annual parameters, the soils function in different temperature regimes. For palsas soils (Histoturbels and Hemistels) annual temperature regime is Subgelic (the mean soil annual temperature above -4°C, permafrost). Temperature regime of forest soils (Haplocryods) is Cryic (the mean soil annual temperature is more than 0°C, but less than 8°C, no permafrost).

The soils of the study area are functioning in a narrow range of temperatures: at a depth of 20 cm for soil of all landscapes more than half of the soil temperatures are ranged from -2,5°C to 0°C, due to their high moisture, low thermal conductivity, snow cover regime and the cooling effect of near-lying permafrost. Annual soil temperature parameters correlate weakly with the average thermal air conditions. A direct correlation of the annual soils temperature regime with snow cover dynamics (average and maximum depth, melting date), with a winter N-factor (thermal index of the surface) and sum of positive temperatures has been identified. Because the insulating effect of vegetation is significantly lower than snow (Summer N-factors - 0.7-0.9; winter N-factors - 0.11-0.32), summer air temperatures interannual fluctuations will significantly affect the soil temperature regime and the whole permafrost conditions in region.

O 103 RESILIENCE OF ARCTIC ISLAND ECOSYSTEMS TO DIFFERENT DRIVERS OF CHANGE

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Ecosystem resilience to drivers of change may depend on several aspects, including species diversity. High species diversity reflects high functional and response diversity and is related to large local and regional species pools. For most organism groups, species diversity and species pools decline with latitude on a global scale. This latitudinal gradient is even apparent within the Arctic biome: Regional floras and faunas of the high Arctic are smaller than in the low Arctic. On a regional scale, other features may interfere with the global species diversity gradient, such as the distribution of land and oceans where isolated islands usually have smaller species pools than larger mainland. We would therefore expect ecosystem resilience to drop from the low to the high Arctic and from mainland to islands within a bioclimatic sub-zone of the Arctic. In this talk I will discuss resilience of Arctic island ecosystems to two drivers of change, climate warming and grazing pressure, based on experimental and observational studies of plant communities of two island systems, the high Arctic Svalbard and the low Arctic and sub-Arctic and Iceland with some comparisons to mainland Northern Norway (low Arctic).

O 104 KRKONOSE/GIANT MTS (CZECH REPUBLIC) – THE SOUTHERNMOST AZONAL SITE OF THE ARCTIC-ALPINE TUNDRA IN EUROPE

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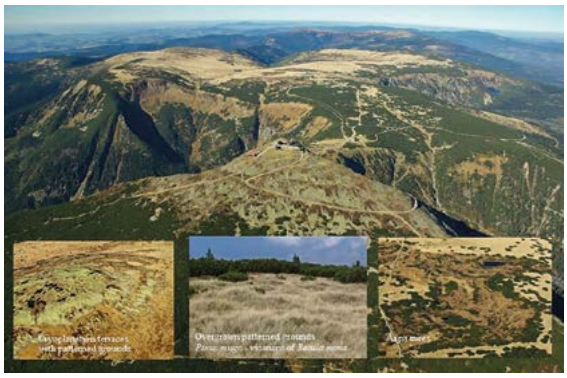
Geographical position of the Krkonose Mts in the narrow corridor between the Pleistocene glaciation of the Alps and the Scandinavian ice sheet (and in addition within its periglacial zone) strongly influenced their natural values. As an isolated mountain island rising 1000 m above German-Polish lowlands and the Czech Basin, the Krkonose Mts offered suitable conditions for the arctic-alpine tundra to survive on summit peaks, etchplains and glacial corries throughout the whole Holocene. Recently, several tens of plant and animal species from the CAFF list as well as many arctic-alpine, boreo-alpine, boreo-montane and endemic species are protected by the Czech and Polish NPs there. Arctic-alpine mires belong to wetlands of the Ramsar Convention. The area above the treeline, the highest part of the High Sudetes (50°44´N 15°42´E, 1250-1603 m asl, ca 1400 ha), thus represents a relic of the arctic-alpine tundra in Central Europe. Even though it is situated 2000 km south of the polar tree line and 1000 km from the nearest arctic-alpine tundra in S Norway or Scotland, complexity of subarctic climate (MAT 0.4-1.8°C, MAP 1300 mm, six months of snow cover), relics of Pleistocene/Holocene patterned grounds and unique flora and fauna enable to put it on the level of Arctic bioclimate subzones D/E-E. MJuT ranges from 8.0°C to 10.5°C, SWI from 33.7°C to 45.2°C; patterned grounds with low intensive frost activity are partly or fully overgrown by grasses or low shrubs. Permafrost melted ca 5000 BP but its function of an impermeable layer is replaced by a stony bedrock and ortstein horizon. Soil freezes up to the depth of tens cm seasonally. Recently, there are some indices of impacts of climate change on plant and animal communities of the arctic-alpine tundra (e.g. changes of plant composition in the GLORIA plots, declining populations of montane birds).



O 068 CRYOGENIC LANDSLIDE ACTIVITY IN EARLY 1970'S AND LATE 1980'S IN CENTRAL YAMAL, RUSSIA, OBSERVED FROM SATELLITE IMAGE TIME SERIES

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During years 1989-1990 several hundred landslides occurred in Central Yamal peninsula. Cryogenic landslides are commonly divided into two types: active-layer detachments (ALDs) and retrogressive thaw slumps (RTSs). Area is rich in permafrost. Increased precipitation and wetting of active layer triggered landslides on several slopes. Another large set of landslide occurred in the same area in the early 1970's. Database of satellite images was collected to follow landslide activity during years 1969-2014. Imagery used was CORONA (1969), Landsat MSS/TM/ETM+7 (1984, 1988, 1990, 2014), SPOT (1993, 1998), and Quickbird-2 (2004) and Worlview-2 2013. In data analysis ERDAS Imagine 2015 and ArcGIS 10.4 were used.

Change detection using NDVI identified clearly larger landslides, but was not generally reliable enough alone to estimate the occurrance and the size of the landslides. Totally in the study area there were about 3978 landslides in 1980s event and about 3700 in 1970's event. Most of the slides are spatially small scale with average size of 0,6 ha while the largest were as vast as 27 ha.

Analysing multispectral HR or VHR optical satellite imagery was found most useful as a method for mapping the landslides. HR Landsat TM and SPOT images were found useful for mapping extensive, < 20 years old ALDs, whereas VHR images from QuickBird-2 and WorldView-2 performed well in detection of little vegetated landslide surfaces even after 24 years since landslides occurred.

O 066 CHARACTERISTICS OF CRYOGENIC SOILS ALONG THE LATITUDINAL TRANSECT IN THE NORTHWESTERN SIBERIA, RUSSIA

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The Russian permafrost affected soils cover more than 65% of the total territory. Though the area of cryogenic soils is only about 16% of the total soil area, they store 50% of the soil organic carbon in the upper meter. At the same time their properties are very different in different landscape zones and in different parts of Siberia. So it is particularly important to study the cryogenic soils and the relationship it with temperature, active-layer thickness, vegetation, soil texture.

Here we present a synthesis of the soil information relevant to permafrost, plants and parent material along the Eurasia Arctic Transect (EAT). During the 4 years (usually in August) we have studied the soil cover of 4 landscape areas (forest-tundra, tundra, arctic desert) along the EAT. Soil pits were described and soil samples were collected from 6 locations at a distance of more than 1500km. All locations had representative key sites on zonal loamy or sandy parent material and soils investigations covered complete cycle of the surface cryogenic microrelief patterns. We also measured in the field the active-layer thickness, soil moisture and temperature and CO2 fluxes. In the lab we analyzed soil chemical and physical properties.

In general soils of EAT is similar and support moist acidic conditions. Most of soils characterized by well drained, weak texture and low organic matter content. Largely the soil properties determined by climate, the parent material and cryogenic processes. Most soils have strongly developed cryogenic features, including warped, broken and distorted soil horizons due the intense cryoturbation. They have a small thickness of the organic horizons (< 40 cm) and a low biological activity (CO_2 emission <150 mg / m^2 / h). The differences between soils are due to local conditions, cryogenic processes and the decrease the intensity of soil processes from south to north.

O 069 FACTORS OF SPATIAL DIFFERENTIATION OF CRYOGENIC GEOSYSTEMS OF THE BELY ISLAND ARCTIC TUNDRAS

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The study of cryogenic geosystems of the island started like a part of project of NASA Land-Cover and Land-Use Change (LCLUC) 2009 has led to the organization of the stationary complex on the Bely Island and expansion of the research program carried out on the island.

As a result of studies on the geological structure of the island we have studied the genesis of the deposits forming the island and clarified the age if composing strata with the help of methods of radiocarbon analysis. The results obtained have significantly changed the existing idea that the island was composed primarily of deposits I of marine terrace. The radiocarbon age of autochthonous organic matters near the subsurface sediments indicates Sartan, and in some cases Karghin period of deposit formation.

In the study of the morphological structure of cryogenic geosystems of the island on remote sensing data in the north-western and north-eastern parts of the island we have revealed a number of anomalies in the spatial distribution of the lakes, in the nature of combination of herbal complexes, as well as some differences in the nature of spread, forms of expression and intensity of cryogenic geological processes. In order to identify the causes of anomalies in the landscape structure of the island we have analyzed the deep seismic survey data, which revealed the deep positive structures in the main reflecting horizons to a depth of 5.5 km that cannot be reflected in the current relief of the island. A comparison of the established boundaries of deep structures and landscape structure anomalies revealed their almost complete coincidence. Thus, we have found that neotectonic activity in the Arctic tundras of the Bely Island is one of the leading azonic factors determining the spatial structure of the cryogenic geosystems.

O 100 MEASURED AND MODELED CHANGES IN PERMAFROST ALONG NORTH AMERICAN ARCTIC TRANSECT

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The impact of climate warming on permafrost and the potential of climate feedbacks resulting from permafrost thawing have recently received a great deal of attention. Ground temperatures are a primary indicator of permafrost stability. Most of the research sites in our permafrost network are located along a North American Arctic Permafrost-Ecological Transect. This transect spans all permafrost zones in Alaska from the southern limits of permafrost near Glennallen to the Arctic coast in the Prudhoe Bay region and further into the high Canadian Arctic. In this presentation, the results of more than 30 years of the permafrost and active layer temperature observations along this transect will be presented. Most of the sites in Alaska show substantial warming of permafrost since the 1980s. The magnitude of warming has varied with location, but was typically from 0.5 to 3°C. However, this warming was not linear in time and not spatially uniform. While permafrost warming was more or less continuous on the North Slope of Alaska with a rate between 0.2 to 0.5°C per decade, permafrost temperatures in the Alaskan Interior started to experience a slight cooling in the 2000s that has continued during the first half of the 2010s. There are some indications that the warming trend in the Alaskan Interior permafrost resumed during the last three years. The observed climate warming has triggered near-surface permafrost degradation. Several climate change scenarios were used to make projections of possible changes in permafrost during the 21st century. A high resolution (770x770 m) stand-alone permafrost dynamics model was used to illustrate how changes in climate together with industrial development of the North Slope will impact permafrost and ecosystems in this region. Results of these modeling will be presented and the possible consequences of the present and future permafrost degradation will be also discussed.

O 064 VEGETATION OF THE EUROPEAN ARCTIC TRANSECT (EAT), YAMAL PENINSULA AND FRANZ JOZEF LAND, RUSSIA

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The Eurasia Arctic Transect was established during the Greening of the Arctic (GOA) initiative of the International Polar Year (2008-2009). The primary goal was to determine how vegetation, permafrost, active-layers, species diversity, aboveground biomass, and the Normalized Difference Vegetation Index (NDVI) vary with climate and soil (loamy vs. sandy textures). We were also interested if we could detect the effects of ubiquitous heavy reindeer grazing along the Yamal Peninsula portion of the gradient. In each of the five Arctic bioclimate subzones plus the forest-tundra transition, we surveyed the vegetation and soils in five 5 x 5-m plots within large 50 x 50-m areas of homogeneous mesic vegetation. At all study locations we examined the vegetation on different aged marine/ alluvial terraces that corresponded to differences in soil texture (more loamy soils on the older surfaces). July mean temperature (˚C) increases approximately 3x from north to south along the Yamal Peninsula and about 16x along the full gradient. Biomass increases about 2.5x, and approximately ten-fold along the full gradient. Ordination of the plant-species-composition data using Detrended Correspondence Analysis revealed clear groupings of plots that reflect their position along the latitudinal/temperature (first axis) and soils texture (second axis) gradients. There is some correspondence to described vegetation types in the European Vegetation Classification, but there is a continuum of change that may be enhanced by the homogenizing effect of reindeer grazing. The subzone A group of plots (Franz Jozef Land) showed the highest degree of separation that reflected their geographic separation (about 800 km north of the Yamal Peninsula). We also contrast the vegetation of the EAT with that of a similar transect in America, which has a more continental climate and relatively low levels of herbivore impact.

P 151 CARBON EFFLUX AND SOIL CARBON STORAGE: TRANSECT FROM TAIGA TO TUNDRA OF WESTERN SIBERIA

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Understanding the heterogenity in carbon exchange in terrestrial ecosystems in different permafrost zones is a significant step towards understanding the global carbon cycle. The aim of our study was to assess variability in the soil organic carbon pool and CO_2 efflux from the peatlands and bog in taiga, forest-tundra and tundra of Western Siberia (Russia).

The taiga research site (Nadym) is located in discontinuous permafrost zone. The average active layer thickness was 163±8 (August 2015). The CO_2efflux from the peatlands was low (202 ± 37 mgCO_2/m^{2}hr). The upper horizons of the peatland soils statistically differed from those of the bog in the contents of the total (31.88 ± 3.02 and 37.96 ± 2.00% respectively), labile (1400 ±300 and 31100 ± 2200 mg C/kg soil) and microbial carbon (4260 ±330 and 240 ± 50 mg C/kg soil).

The forest-tundra research site (Urengoy Gas Field) is located in continuous permafrost zone. The average active layer thickness was 85±10 (August 2015). CO_2 efflux from peatland soil was low and characterized by high variability (202±25 mgCO_2/m^{2}hr). The average content of total organic carbon was high (29.58 ± 5.02%). The average content of labile organic carbon in the peatland soils was smaller than in the bog soils (1350±150 and 25 400 ± 4000 mg C/kg soil respectively).

The tundra research site (Urengoy) is located in continuous permafrost zone. Soils of this research site are characterized by low active layer thickness, CO_2 efflux and content of microbial carbon (August 2016).

Thus CO_2 efflux from permafrost-affected soils of frozen peatland and bog in taiga, forest-tundra and tundra don't differ significantly. But depth of permafrost table differed significantly. It explains the necessity of adequate assessment of the spatial variability on the active layer thickness as a significant factor influencing regional CO_2 emission.

P 153 DIVERSITY AND DENSITIES OF TARDIGRADA ALONG A TRANSECT ON THE LONGYEAR GLACIER, (ADVENTFJORDEN, SVALBARD)

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Tardigrada known also as water bears, are a phylum of microscopic ecdysozoans with a global distribution. On a glaciers tardigrades inhabit cryoconite holes, puddles and lakes. In this study, we tested the hypothesis that Tardigrada assemblages inhabiting cryoconites in the ablation zone change along the transverse transect, with the distance from glacier's edge to its main axis. In order to test our hypothesis one subtransect to the main axis of the glacier was established on Longyearbreen (Spitsbergen). In the transect seven samples from cryoconite holes and puddles were collected. Additionally, we checked if mosses may be the source of tardigrades on glaciers. Thus windblown mosses were collected from the glacier's surface. In the seven cryoconite samples three taxa of Tardigrada were found. The dominant species were - *Pilatobius recamieri* Richters, 1911 and *Hypsibius* sp. A. One specimen of *Isohypsibius* sp. A. was found. Tardigrade densities were not correlated with the distance from the glacier's edge to the main axis. Moreover, our study shows that the diversity of tardigrades on glaciers does not change along with an environmental gradient. Contrary to our expectations, we found the same species in mosses and in cryoconites. No other species were found (typical carnivorous tardigrades for tundra). Our results indicate that glaciers are unique habitats with tardigrade assemblages being different than those in tundra. What is more, we suspect that typical tundra tardigrades had been flushed from mosses which, in consequence, were re-inhabited by glacial Tardigrada assemblages - *Pilatobius recamieri*, *Hypsibius* sp. A. and *Isohypsibius* sp. A.

P 154 VEGETATION CHANGE (1986–2014) NEAR CAMBRIDGE BAY, VICTORIA ISLAND, CANADA

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A tundra vegetation complex including anthropogenous vegetation and discontinuous tundra vegetation with grass heath, dwarf shrub heath, shrub vegetation, mire, snowbeds, freshwater and salt meadow vegetation was studied according to the Braun-Blanquet method and the vegetation types (formations) were mapped on a surface of 1.62 km² in 1986. This test area is positioned about 10 km southwest of Cambridge Bay (Victoria Island, Canada). The study area was revisited and resampled in 1998 and 2014. Most of the vegetation seems still unchanged. However two changes could be observed, an increase in disturbance due to anthropogenic activities and an increase in snow-bed-like vegetation. The increasing influence of anthropogenic activities was clearly visible within 30 years. Natural vegetation was locally disturbed and destroyed and small huts have been built. Typical anthropogenic plant communities with *Puccinellia nuttalliana, P. vaginata, Descurainia sophioides*- and *Matricaria matricarioides*, lacking in 1986, are present now. Four to five percent of the surface area of the natural vegetation appeared changed, likely due to climatic changes. In this continental area, snowdrifts in the late winter have created sites with a shortened vegetation period characterized now by snow-bed-like plant communities with typical small-flowering plants such as the *Cerastio regelii-Poetum alpinae* and *Phippsia algida*-, *Cetrariella delisei*- and *Ranunculus pygmaeus*- communities.

P 155 ROTIFER COMMUNITIES ON WATER-TERRESTRIAL GRADIENT OF CENTRAL SVALBARD WETLANDS

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Hydrobiont communities, however mostly highly tolerant to extremes through the anhydrobiosis and parthenogenesis, need liquid water for their life. Rotifers live in both aquatic as well as terrestrial conditions but community composition is different. Changes in rotifer community in the ecotone between shallow lake and terrestrial arctic desert have been studied in Petuniabukta bay, Central Svalbard in the High Arctic in relation to chemical conditions in sites of different trophic state. Sampling was conducted during July 2014. A total of 60 samples from four transects were studied during the research. Each taxon was identified to the species level and was assessed in relation to particular environmental factors as well as moisture gradient. Field research showed the existence of 60 species of rotifers from Bdelloidea families Adinetidae, Habrotrochidae and Philodinidae, and from Monogononta families Colurellidae, Lecanidae and Dicranophoridae. Twenty-two of them were new for Svalbard. The results shows, that wetland - terrestrial transect explained important part of species variability and is only significant driving factor for the rotifer communities in contrast to other chemical conditions including nutrients. In spite of the assumptions we found a large amount of Bdelloidea and little Monogononta through the all transects. We did not find any significant effect of nutrients on the rotifer community, however effect of transect was significant. The highest rotifer abundance as well as diversity was in moist sites, decreasing along with moisture.

P 156 CLIMATE-ECOLOGICAL OBSERVATORY FOR ARCTIC TUNDRA (COAT)

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Arctic ecosystems are challenged by climate change more than most others on Earth. The rapid shifts to new climate regimes may give rise to ecosystems with unknown properties, making science unable to predict the consequences on biodiversity. The Climate-Ecological Observatory for Arctic Tundra (COAT) is an ecosystem-based observation system aiming at real time detection, documentation and understanding of climate impacts on biodiversity in the Norwegian sector of the terrestrial Arctic (www.coat.no). COAT uses the adaptive monitoring approach, having question and hypothesis-driven conceptual “climate impact path models” at the core of the program. COAT aims to establish causal relations between food web components that are important to ecosystem functioning and/or management (response targets) and climate and management drivers (predictor targets). The models encompass key species, functional groups and communities within the food webs and their mutual linkages. Management actions can enter this design in an experimental fashion and thus be tested and adapted to become rational and effective. The two focal regions -the Low Arctic Varanger Peninsula and the High Arctic Svalbard archipelago - provide pertinent contrasts in ecosystem complexity, climate, and management regimes. The overall approach, the expectations for climate-ecosystem interactions, as well as the monitoring state variables are described in detail in a peer-reviewed science plan. The study designs are common for a suite of state variables at spatio-temporal scales that allow discrimination of natural variation from climate impacts. COAT builds on and expands the ongoing research and long-term monitoring with methods ranging from field observations to remote sensing. Development of i) appropriate statistical modelling tools and ii) new technologies that generate high quality data with a minimal environmental footprint are important outcomes of COAT. The combination of state-of-the art study designs, monitoring and analysis methods enables COAT to answer both scientific and management questions.

P 159 RELATION BETWEEN MICRO ANIMALS (TARDIGRADA, ROTIFERA) AND ENVIRONMENTAL FACTORS ON THE MARGIN OF GREENLAND ICE SHEET

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Glaciers and ice sheets constitute an important element of biosphere in terms of freshwater, carbon cycle, and habitat for extremophiles. Despite extreme conditions like low temperatures, high melt rate of ice and high doses of irradiations supraglacial zone is environment for various organisms from primary producers to higher trophic consumers like micro animals. Animals (mainly tardigrades and rotifers) are constant element of cryoconite holes. They densities may rich up to several dozen per milliliter of cryoconite sediments. Despite those facts, ecological studies on the animals on polar glaciers are limited. The main aim of this study was determine links between micro animals with biotic (algae, cyanobacteria, bacterial abundances) and abiotic (water depth, physicochemistry, radionuclides, distance from the ice edge) factors in margin of Greenland ice sheet (GrIS). Moreover we tested what kind of cryoconite material micro animals preferred as a habitat (mud vs granules). Cryoconite samples were collected from the margin of GrIS towards ca. 1.5 km. inland. In total 33 cryoconite samples were collected. Only one species of Tardigrada were found - *Pilatobius recamieri* (Richters, 1911). Rotifers were not identified but both, bdelloids and monogonts were detected. We did not find relationships between density of animals and biotic and abiotic factors. Significant relation was found between animals and cryoconite granules. Additionally we found that density of Tardigrada were higher in samples collected from inland points (ca. 1 km). Lack of clear pattern between biotic and abiotic components of cryoconite reservoirs may be affected by fast melting of GrIS, thus rapid flushing from the margin which negatively influence biota communities. Strong relation of invertebrates and cryoconite granules which may form in more stable cryoconite reservoirs indicate that granules are stable feeder for micro animals.

S15 LONG-TERM PERSPECTIVES ON ARCTIC CHANGE: IMPLICATIONS FOR ARCHAEOLOGY, PALAEOENVIRONMENTS AND CULTURAL HERITAGE

O 075 GEOARCHEOLOGICAL AND PALEOECOLOGICAL RECORDS OF NUVUK ISLANDS (NUNAVIK, CANADA)

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A multidisciplinary study (paleogeography, paleoecology, micromorphology, archeology) was undertaken at KcFs-2 in the Nuvuk Islands archipelago (Nuvuup Qikirtangit) in Low-Arctic Quebec (Canada), in order to document the relationship between humans and their environment in the context of climate change. KcFs-2 is a mixed context site (Dorset, Thule and Inuit). Several marine terraces were 14C-dated with shells in order to reconstruct the area's uplift (glacioisostatic rebound) curve. Plant macrofossil and pollen analyses of peat extracted from several pond margins was conducted to reconstruct past vegetation and, indirectly, past climate. Archaeological surveys were undertaken in the region and semi-subterranean houses were excavated at the KcFs-2 Site.

The isostatic rebound rate for the Nuvuk Islands at approximately 0.8m/100 years between 5000 and 7000 BP. This differed from the rates to the south in eastern Hudson Bay, and also to the east in southern Hudson Strait. Paleoecological data indicate that during the period correlated with the Late Dorset presence, conditions were generally dry. Radiocarbon dates derived from plant remains placed this phase between 950-650 cal. yr. BP, which also includes the early Thule Inuit period reflected by the recovery of Thule Type III harpoon head. The next phase of occupation was to a more limited degree, around 300 cal. yr. BP (midpoint age), and this corresponded to the historic Inuit period. The site was interpreted to have been abandoned between these dates, based upon the disappearance of plant species associated with human activity (*Montia fontana*, or water blinks and *Cardamine pratensis*, or cuckoo flower). Analyses of thin sections (micromorphology) from a house floor and nearby midden revealed anthropogenic features indicating a discontinuous occupation, probably seasonal.

O 044 LETTING THE HERITAGE MELT AWAY?

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The Altai Republic (part of Russian Federation) is famous for its archaeological heritage, especially 2500 years old frozen tombs of so-called Pazyryk culture. Located in permafrost, these barrows preserved in unique condition the ancient organic materials including the oldest surviving carpet in the world or spectacularly tattooed human bodies. Since the late 1980s and early 1990s the archaeological research in general and of frozen tombs in particular has been contested and later practically halted by the grassroots initiatives of Altaians, indigenous Turkic-speaking inhabitants of the republic. Interestingly, the state authorities have met such mood with certain sympathies, leading to recent repatriation of the body of so-called Altaian princess from Novosibirsk to the republic's museum. G. Plets even argues that archaeology and heritage in this context became a statecraft mechanism. There is nevertheless one local demand that seems destined to ultimate failure, the demand of reburial of archaeological finds, especially well preserved human remains. Decay, which would ultimately and irreversibly follow the reburial, seems antithetical to the very concept of legitimate heritage care. Recently, however, some archaeologists and heritage scholars started rethinking decay (Pétursdóttir) while exploring the possible extension of ethics from humans to non-humans (Sørensen). In this paper, I shall address convergences and divergences of this theoretical framework and local Altaian attitudes towards "archaeological heritage". I will especially explore what the theoretical scrutiny of the concept of heritage could mean for the current debates in Siberian archaeology, where the danger of decay is often singled out as the main indisputable argument for the continuation of excavations of tombs allegedly melting due to the global climate change.

O 070 SETTLEMENT CHOICE UNDER CONDITIONS OF RAPID SHORELINE DISPLACEMENT IN WEMINDJI CREE TERRITORY

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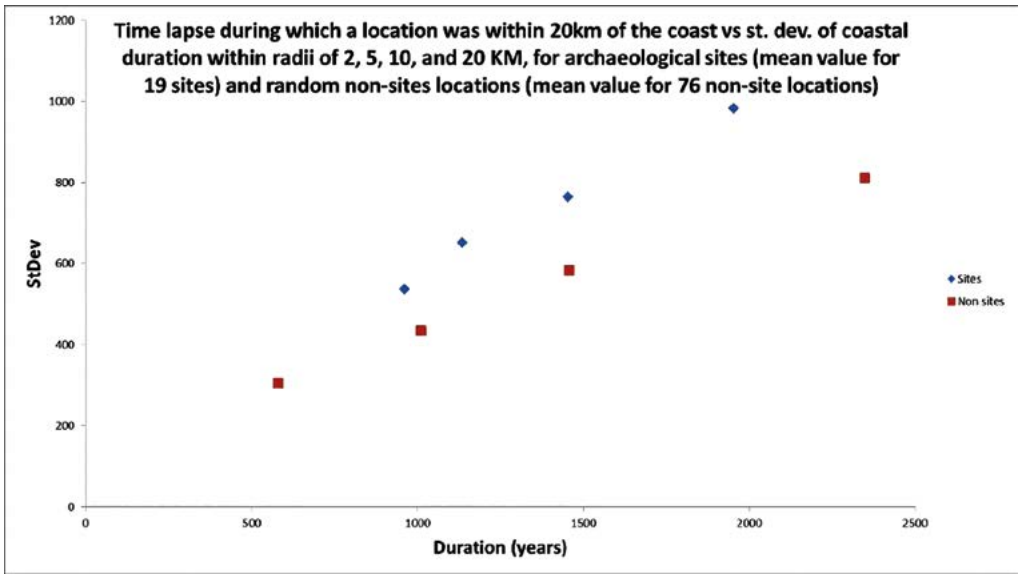
How do northern hunter-gatherers select settlement and other activity sites under conditions of rapid environmental change? We test the hypothesis that both duration of coastal proximity and diversity in rate of shoreline displacement in the surrounding area are major factors in site location in Wemindji Cree territory in Northern Quebec. Using GIS analysis, we find that known archaeological sites in the region are more likely to be in locations that were coastal for longer than a sample of random locations, and that they are more likely to be situated in areas that show a high diversity of shoreline displacement rates. As the coastal duration increases, we find that regional diversity in rate of shoreline displacement becomes more important in site selection. In other words, relative to a sample of random points, archaeological sites tend to be located in places that are stable but surrounded by instability. Above a certain threshold of local coastal stability, regional instability is favoured. We propose that this pattern shows that settlements tend to be selected for long duration but also for access to diverse resources over a long period of time.



O 016 THE EFFECTS OF THE LITTLE ICE AGE ON NEO-INUIT SUBSISTENCE PRACTICES, FOXE BASIN, NUNAVUT, ARCTIC CANADA

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Zooarchaeology can be an effective means of determining—quantitatively—the impacts of climate change on precontact subsistence. In this paper, I examine Neo-Inuit (ca. AD 1250 to present) responses to decreased temperatures and increased sea ice associated with the Little Ice Age (ca. AD 1300 to 1900) in the resource-rich Foxe Basin region of central Nunavut, Arctic Canada. Cooler temperatures should have rendered coastally-adapted Neo-Inuit increasingly dependent on landfast-ice-dwelling small seals (e.g., *Pusa hispida*) during winter months. However, an analysis of faunal remains from Foxe Basin's largest-known Neo-Inuit winter site, *Pingiqqalik* (NgHd-1), suggests a subsistence economy based largely on walruses (*Odobenus rosmarus rosmarus*), which prefer open water and moving ice; large (*Erignathus barbatus*) and small seals were also taken in smaller numbers. This pattern is relatively consistent from the thirteenth to sixteenth centuries. Two conclusions can be drawn from these results: 1) a system of recurring polynyas were insulating site residents from the worst effects of the LIA, and 2) residents were effectively weathering any changes through a unique sea-mammal caching regime, a form of which continues among area residents today. This work has the potential to inform on how anthropogenic climate change is affecting the sea-mammal hunting economy of contemporary Inuit in the Foxe Basin region.

O 045 HOW TO STUDY AN EXEMPLARY SOCIAL-ECOLOGICAL SYSTEM: PASTORALISM IN A PERMAFROST LANDSCAPE

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The *alas* landscape of Central Yakutia (Republic of Sakha) constitutes a unique Sub-Arctic social ecological system, which offers exemplary insights into permafrost-based landscape development and indigenous forms of land use. Environmental change during the holocene has led to patchy degradation of permafrost and provided the basis for cattle and horse pastoralism of the Yakuts (Sakha) whose ancestors migrated to this region 500 to 800 years ago. Using the grasslands of thermokarst basins in this otherwise forested region, local land users came to modify the landscape, e.g. through drainage. However, to assess the scope of these changes remains a scientific challenge. Hence the questions to be addressed in this paper: (1) To what extent have indigenous residents shaped this landscape, considering the rapid dynamics of environmental change under local permafrost conditions? (2) In this light, what is the record of material traces of human engagement with this landscape, and how will current policies of cultural heritage and indigenous land use affect the landscape in future years? (3) How can methods of geomorphology, hydrology, historical anthropology and archaeology be combined to obtain a more detailed understanding of landscape development and land use?

O 043 THE NUNALLEQ SITE (SW ALASKA): LATE PREHISTORIC HUMAN ADAPTATIONS TO A DYNAMIC CLIMATIC ENVIRONMENT (17TH C. A.D.)

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The scientific datasets generated from the Nunalleq site are providing unique insights into prehistoric adaptation to the Little Ice Age in Western Alaska, a period of climate instability and rapid change potentially impacting subsistence resources and requiring cultural resilience and flexibility. Focusing on the permafrost-preserved site of Nunalleq, researchers from Scotland, France and the United States, are working with the local Yup'ik community to (1) preserve the archaeology of the site; (2) investigate the local paleoclimate and human ecocultural world, and past adaptive strategies in the region; and (3) explore the use of archaeology in reinforcing indigenous cultural resilience. Community-embedded archaeological research in Quinhagak, including workshops integrating archaeological artefacts and 'ecofacts' with traditional craft activities and ecological knowledge, are creating positive

dialogues between researchers and stakeholders, enhancing both scientific investigation and community well-being. This presentation will focus on the ways in which archaeology in Quinhagak is positively changing the face of local heritage management practice and policy. We will also address the ways in which these datasets could be useful in informing policy on a broader level (e.g. archaeological resource management, subsistence hunting, local resettlement strategies, etc.).

O 071 ECODYNAMICS AND SOCIO-NATURAL SYSTEMS AT WALAKPA: RESCUING HERITAGE AND DATA FROM AN ARCTIC COASTAL SITE

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Walakpa is a coastal Arctic site with spectacular preservation, due to frozen conditions. Occupations reaching back at least 3000 years are documented. Although partially excavated in the 1960s, much of the site remains intact. Long considered stable, Walakpa began eroding rapidly in 2013, threatening the remaining data.

A large volunteer effort began in 2016, with support from the local and archaeological communities. Recovered data is already being used in studies of ring seals, polar bears, and walrus, attempts to refine the correction factors for calibration of marine C14 samples, studies of North Slope wood use, a pilot study of ceramic raw material, and attempts to refine the Walakpa site chronology and the Barrow area regional chronology, as well as various student training.

Walakpa is only one of many significant sites in the north, all under threat from climate change. We review what has been accomplished to date at Walakpa, as well as what we have learned that may be helpful to others dealing with similar situations.

O 014 THE PALEODEMOGRAPHIC AND ENVIRONMENTAL DYNAMICS OF PREHISTORIC ARCTIC NORWAY: A REVIEW OF HUMAN ECO-CLIMATIC COVARIATION

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This paper presents the first paleodemographic model of Northern Norway´s population history and the results of a newly assembled region-wide radiocarbon record, never before put to paleodemographic or -environmental use. The dataset contains a near exhaustive collection of BC dates in the area (n = 1200), covering the Arctic regions of Norway and spans the entire BC settlement history from 9500 to 0 cal BC. Utilizing local, high-resolution paleoclimate data, the paper tests the correlation between climate and demographic dynamics, looking for hunter-fisher-gatherer responses to climate variability. The paper compares both long term climate trends and short term disruptive climate events with the demographic development in the region. The results demonstrate dramatic demographic fluctuations throughout the period, characterized by a step-like accumulation punctuated by some major discontinuities (figure 1). Some highly correlated climate/demographic covariations are identified (figure 2). Still, as the eco-demographic covariation is rather ambiguous (table 1), the paper addresses some potential explanations for the lack of overall correspondence, pointing to the resilient adaptations of the population to the circumpolar environment. The paper ends by tracing the implications of the results for the prospect of combining paleodemographic and paleoenvironmental data in general. It highlights the importance of employing climate proxies of sufficiently high resolution, with relevance to local species-ecology and human subsistence adaptation to local niches.

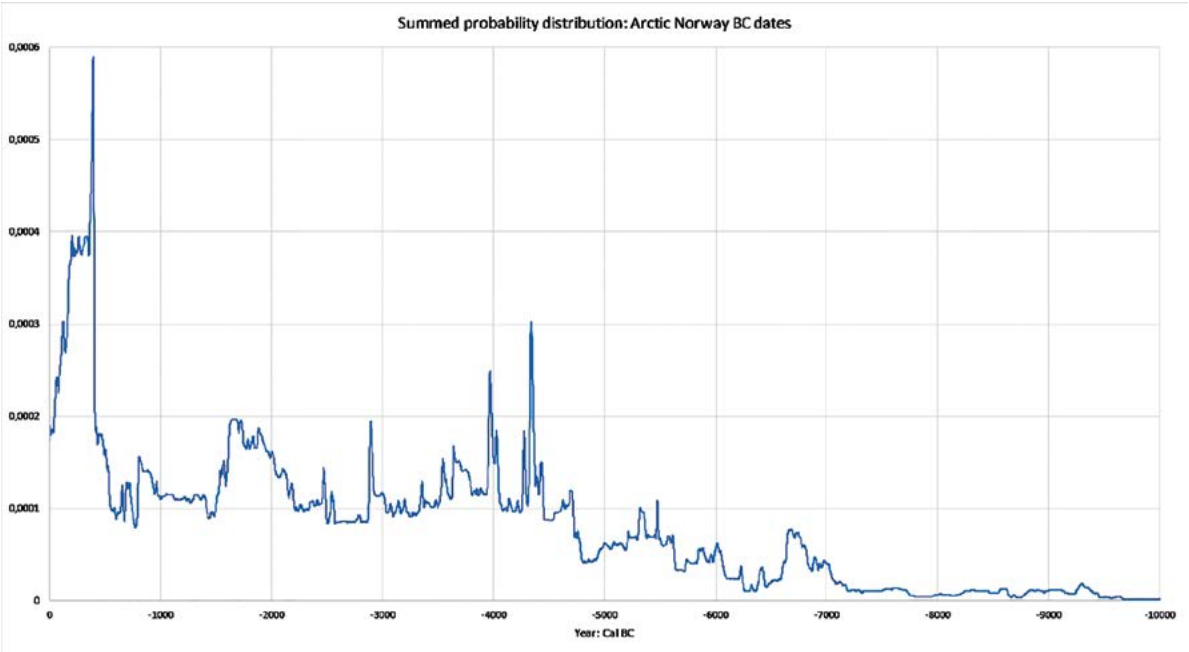

Figure 1.

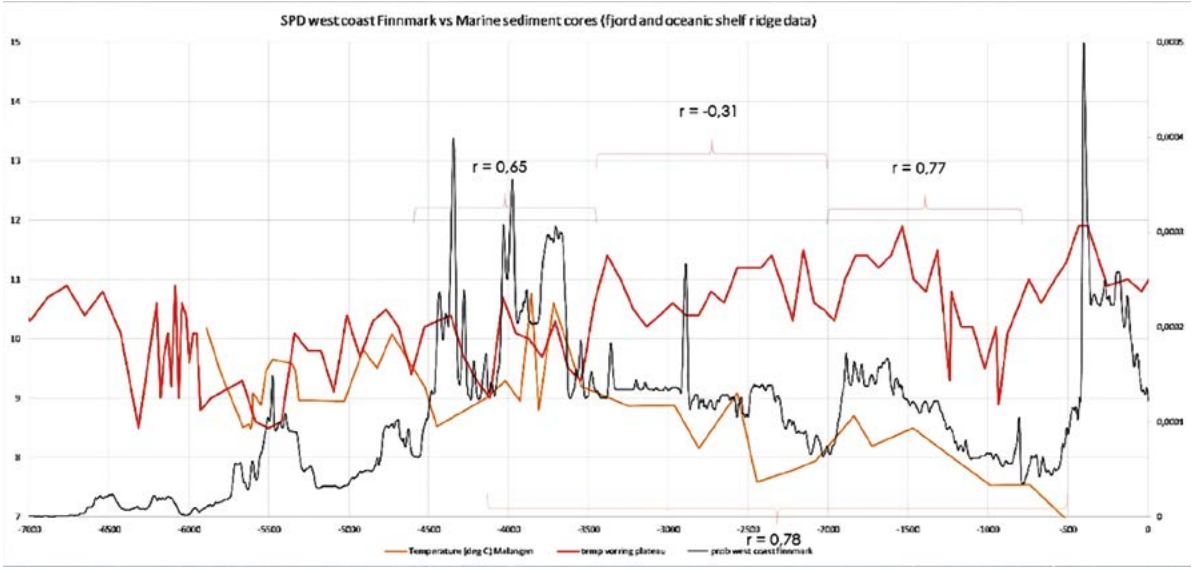

Figure 2.

Coastal proxy (Malangen) vs West Coast Finnmark SPD	r=	Marine proxy (Vorring) vs West Coast Finnmark SPD	r=
4137-507 BC	0,786885261	10434 BC - 473 AD (total series)	0,29588824
5891-507 BC (total series)	0,218524213	2024-800 BC	0,77733863
		4600-0 BC	0,056277
		2024-0 BC	0,54279382
		4604-3544 BC	0,65658217
		3500-2000 BC	-0,3163753

Table 1.

O 072 BUILDING WORLD'S ONLINE ARCTIC ETHNOLOGY MUSEUM: ONE HALL AT A TIME

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The transition of Museum records and collections to the 'digital era' in the last 10-15 years contributed to a revolutionary change in how people survey and assess museum heritage collections. With many collection catalogs and/or summaries of museum holdings now posted online and available for search, one may explore, for the first time, the entire 'collection heritage universe,' the overall world's richness of ethnographic objects in possession of many museums, large and small. Previously, it required expensive and time-consuming efforts to survey holdings of major museums in various countries one by one - via personal visits or correspondence. We do not have to do such surveys today by physical visits to individual museums, as long as their catalogs, often, with the images of objects are accessible online. This is critically important to residents in distant rural communities, students, Elders, and Indigenous cultural workers, who may have limited options to visit major museums in national and local urban hubs.

The paper focuses on indigenous heritage (ethnological) collections from the Arctic region held in many dozen national, regional, and local museums across the circumpolar zone. It introduces preliminary statistics for the Arctic ethnology collection 'universe' of at least 200,000 objects worldwide and discusses certain practical steps that may help open world's heritage collections from the Arctic to multiple users, first and foremost, to Northern indigenous 'online' visitors. One of the prime practical efforts is to create a printed and electronic 'guide' to Arctic heritage collections in different countries that would overview and organize them by nations/regions as well as by major Arctic indigenous groups.

O 012 RECONSTRUCTING LONG-TERM HUMAN-ENVIRONMENT RELATIONS IN THE RUSSIAN ARCTIC: A HOLOCENE OVERVIEW

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[3] *Institute of the History of Material Culture, Stone Age Department, St. Petersburg, Russian Federation*
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This paper examines patterns of human-environment interactions across Northern Eurasia during the Holocene. The goal is to summarize current knowledge but also identify key areas for future research. To achieve these goals authors integrate currently available chronological, cultural and palaeo-environmental datasets from the Russian Arctic for the last 10,000-12,000 years. Study regions include the Kola Peninsula, North European Russia, Northwest Siberia, the Taimyr Peninsula and Northeast Siberia. The paper identifies several broad-scale correlations between climatic fluctuations and cultural responses (e.g. shifts in prehistoric technology, subsistence strategies, settlement systems and occupation densities), but concludes that much more inter-disciplinary research will be needed to construct higher-resolution understandings of prehistoric cultural responses to past environmental changes in the Eurasian Arctic.

This study was supported by the Russian Science Foundation, grant RNF 16-18-10265.

O 046 QUARRIES, CARIBOU, AND SEASONAL INLAND TRAVELS: UNDERSTANDING PRE-DORSET AND DORSET CULTURE ADAPTATIONS ON SOUTHERN BAFFIN ISLAND, NUNAVUT

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The emergence of the Dorset culture in the archaeological record coincides with a dramatic cooling event at the end of the subboreal period (5,000-2,500 BP). In response to longer, harsher winters and an expanded sea ice environment, Dorset populations have been interpreted as adapting to these changes by developing a more sedentary, coastal-oriented way of life focused on the exploitation of sea mammal resources. Long-distance seasonal travels to neighbouring interior regions are presumed to have declined, along with the exploitation of caribou among other terrestrial resources. But in the deep interior of southern Baffin Island, large and exceptionally well-preserved Dorset site deposits contradict this pattern indicating, at least regionally, that these "ice-adapted" peoples continued a way of life seemingly unchanged from that of their Pre-Dorset predecessors. The localized availability of resident caribou herds in the island's interior would have been an important resource-base incentive drawing all human populations inland; however, our ongoing research on the availability of chert toolstone suggests this essential raw material was an equally significant attraction. In 2013, we identified a large chert quarry located in the intermediate zone separating southern Baffin Island's coast and interior regions. In 2015, we used a combination of remote sensing technologies to assess how intensively Pre-Dorset and Dorset populations may have used it. This paper presents the results of our 2015 investigations, and explains how this quarry articulates with two large inland habitation sites occupied by both the Pre-Dorset and Dorset. Our findings suggest that despite the dramatic shift in the Arctic climate at the end of the subboreal period, human populations in this region of the Arctic maintained continuity in seasonal land use and resource exploitation patterns given the geographically and geologically localized availability of caribou and chert toolstone, and the essential need for human populations to acquire them.

O 073 THREE SUMMERS OVER 73 YEARS: INVESTIGATING THE DORSET ARCHAEOLOGICAL RECORD IN THE NUVUK ISLANDS (NUNAVIK, CANADA)

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[2] *Laval University, Geography, Quebec- QC, Canada*

In 1936 one of the first generation of Canadian Arctic archaeologists, Douglas Leechman, visited KcFs-2 on the Nuvuk Islands, near Ivujivik in northwestern Quebec. There he excavated a 'double-igloo' from which he recovered exclusively Dorset material. During the 1930's, the Palaeo-Inuit Dorset culture had only recently been recognized by southern researchers. Knowledge of the Dorset material record was confined to artifact assemblages derived from mixed contexts; architecturally, it was still a mystery. Another investigation of the site took place in 1959, when William Taylor recovered a small collection of Dorset artifacts and found evidence for a rich midden. Fifty years later, in 2009, the site was the focus of a multidisciplinary study which sought a higher-resolution investigation of the relationship between humans and their environment. Palaeoecological, geoarchaeological, and archaeological data was collected and analysed towards this end. Radiocarbon dating of archaeological caribou bone and charcoal gave an occupation date range of 1290-800 cal. yr. BP, while the artifacts and architectural information showed the site was most intensively occupied during the Late Dorset period but also visited by Thule Inuit. Zooarchaeological analysis yielded a heavy emphasis upon small seal, with a substantial proportion of juvenile seal suggesting exploitation from late winter through summer. Murre also formed an important contribution to subsistence.

The position of this site within the history of arctic archaeological research in Canada provides a unique opportunity to compare site appearance over 73 years within the context of modern climate change. While erosion is a critical threat to the archaeological record as formerly perma-frozen ground is melting across the Arctic, another factor is expanded vegetation growth which has the effect of obscuring sites. With the ongoing shrubification of the Low Arctic, Nunavik's archaeological record is reducing in visibility.

O 013 IT'S IN THEIR BONES: A MULTI-DISCIPLINARY, LONG-TERM INVESTIGATION INTO THE SUSTAINABILITY OF AN IMPORTANT SUBSISTENCE SPECIES – THE PACIFIC WALRUS

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[3] *UIC Science, Barrow, USA*
[4] *University of Alaska Fairbanks, University of Alaska Museum, Fairbanks, USA*

One of the many species affected by climate change in the Arctic is the Pacific walrus (*Odobenus rosmarus divergens*). Walruses are of critical importance to subsistence consumers in Alaska and other Arctic regions both for practical, financial reasons, as well as cultural ones. It is difficult to implement proposed co-management and conservation plans based on data from the relatively short time span of modern ecological work; much less to project the impact of further changes to the Arctic ecosystem on both walruses and the humans subsisting on them. We present 2000 years of data, not yet published, including archaeology, traditional ecological knowledge, biology, and ecology. Utilizing proxy data, such as aDNA, stable isotopes, steroid hormones, and trace element analysis, we track long-term trends of walrus feeding ecology, foraging location, and stock genetics over the last 2000 years. Each set of proxy data acts as a building block to better understand walruses, and how they adapt to change in the Arctic ecosystem. Foe example, steroid hormone levels change during recent decades compared with prehistoric/historic levels and might be associated with walrus population size. Stable isotope analysis has revealed several shifts in feeding habits over the last 2000 years. The last 5 years are significantly different from historic and prehistoric time periods. Concentrations of some trace elements exhibit cyclical fluctuations, likely reflecting seasonal migrations. Analyses from annual growth layers in teeth indicate that walruses' diets change by location, each with distinct $\delta^{15}N$ and $\delta^{13}C$. $\delta^{15}N$ and $\delta^{13}C$ in teeth appear to fluctuate between reliance on higher and lower level trophic prey every 3-5 years, perhaps correlating with availability of preferred benthic prey such as clams. Utilizing archaeological materials to better understand long-term change of a single or multiple species is essential to gauge effects of future change in a rapidly warming Arctic.

O 041 HUNTER FISHERS AND FARMERS AT THE ARCTIC FRINGE – THE INSECT EVIDENCE

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Pioneer settlement patterns and their success or failure are a result of the interplay between cultural choice and the effects of environmental and climate change. Insect remains from sites related to human activity in northern Sweden and Norway during the Late Holocene, help to provide some understanding of these patterns. In northern Sweden, where inland sites are frequently concealed by forest, the story is complex, with occupation extending back into the mid- Holocene. Finding a signal for human activity based on insect remains from these areas can be a challenge, and only since farming activities were initiated on a significant scale in the post-medieval period is there a relevant palaeoecological signal for human activity outside of actual settlement sites. In coastal northern Norway the evidence includes early synanthropic assemblages linked with seasonal hunter gatherer settlement. During the medieval and post-medieval period, the accumulation of farm mounds appears intimately related to fisheries, a pattern also apparent in parts of Iceland, and samples provide interesting palaeoentomological data regarding the nature and activities of these coastal sites.

O 042 NE SIBERIAN ARCHAEOLOGICAL RECORD: ARCTIC ADAPTATIONS IN LATE PLEISTOCENE – EARLY HOLOCENE ENVIRONMENT

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From the very beginning, human habitation in Arctic Siberia was constantly driven by environmental changes whose effects on the human spatial distribution pattern, culture, and behavior are well-pronounced in the archaeological record. A few lines of evidence indicate human presence in the Arctic Siberia as early as 45,000 BP. They continued living in the region during the LGM as demonstrated by recent finds in Yana-Indighirka coastal plain. The evidence for these occupations is linked to mammoth procurement, but currently lacks conclusive cultural attribution.

Decline of the mammoth population within Western Beringia during and after the LGM probably led to important cultural changes that are visible archaeologically. Dispersion of the Beringian Microblade tradition follows the area populated by mammoth in a northerly direction when mammoth habitat shrinks. In mammoth-depopulated areas, humans completely switch to the procurement of herd species. Thus, mammoth extinction serves as a trigger for archaeologically visible technological changes. Notably, the oldest known microblades in Arctic Siberia date to ~12,500 years BP.

The youngest pre-Holocene archaeological material in Arctic Siberia in all cases relates to mass accumulations of mammoth remains. Culturally, these sites reveal a stable trans-Beringian analogy known as a Chindadn point.

The early Holocene human occupation record of the Western Beringia is represented by a limited number of sites known mostly in Chukotka. In the arctic Western Beringia it is characterized by two sites only, both found in the New Siberian Islands. Possibly the early Holocene climate change drove unusual subsistence startegies such as mass polar bear hunting in Zhokhov site. Lack of more known early Holocene sites can probably be explained by mass erosion and denudation development which degraded permafrost and thus created a taphonomic bias. Population decline is a possible alternative explanation. This study is supported by Russian Science Foundation project 16-18- 10265-RNF.

O 011 AIR TEMPERATURE IN NOVAYA ZEMLYA ARCHIPELAGO AND VAYGACH ISLAND FROM 1832 TO 1920 IN THE LIGHT OF EARLY INSTRUMENTAL DATA

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[1] *Nicolaus Copernicus University, Department of Meteorology and Climatology, Toruń, Poland*

In this paper, the results of an investigation into the air temperature conditions in Novaya Zemlya Archipelago and Vaygach Island (NZR) from 1832 to 1920, on the basis of all available early instrumental data gathered during exploratory and scientific expeditions, are presented. Traditional analysis based on mean monthly data was supplemented by an approach less popular in the scientific literature, i.e. the additional use of daily data. Moreover, the daily data used were not limited only to mean daily air temperature, but include also maximum daily temperature, minimum daily temperature, and diurnal temperature range. Such rich sets of data allowed for more comprehensive and precise recognition of air temperature conditions in the NZR. Based on these kinds of daily data it was also possible to calculate the number of so-called 'characteristic days' (i.e. the number of days with temperatures exceeding specified thresholds) and day-to-day temperature variability and, for the first time, to determine different characteristics of thermal seasons (duration, onset and end dates) according to Baranowski's (1968) proposition. The results were compared with contemporary temperature conditions (1981-2010) to estimate the range of their changes between historical and present times.

Analysis reveals that in 1832-1920, the NZR was markedly colder than today in all seasons. Coldest was autumn (on average by ca. 5°C), and least - summer (by 1.6°C). Mean annual air temperature was colder than today by about 3°C. The majority of mean monthly air temperatures in historical times lie within two standard deviations from the modern mean. This means that values of air temperature in historical times lie within the range of contemporary air temperature variability. Different air temperature characteristics calculated on the basis of daily data for the NZR for historical/ contemporary periods also confirm the occurrence of climate warming between the studied periods.

O 015 INVESTIGATING LONG-TERM HUMAN-ENVIRONMENT RELATIONSHIPS IN THE EUROPEAN ARCTIC

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Northern Fennoscandia boasts one of the few areas of the Arctic that has witnessed continuous occupation by hunter-gatherers practically through all of the Holocene, i.e. for more than 10.000 years. Material evidence of this long human occupation history remains well preserved and also highly visible in the modern coastal landscapes of Arctic Norway. Many locations, such as the Varanger Fjord, have been relatively well researched archaeologically, historically and environmentally, presenting uniquely detailed datasets for investigating long-term cultural and demographic transitions among prehistoric communities. In contrast, other areas, including Western Finnmark, still require additional fieldwork and analysis before fuller understandings of regional-scale diversity and change can be reconstructed. This paper presents an overview of a new research project *Stone Age*

Demographics which is undertaking a program of fieldwork in Sørøya Island and surround areas of Western Finnmark to investigate the dynamic interrelationship between socio-cultural processes, palaeodemographic patterns and past environments. Through on-going multi-scalar fieldwork and analyses it will provide higher-resolution insights into the range of factors that drove long-term transformations in prehistoric communities, including their cultural and demographic responses to past climatic and environmental changes.

O 074 LINKING INTERNATIONAL AND INTERDISCIPLINARY DATA TO ENABLE DATA-INTENSIVE RESEARCH ON LONG-TERM HUMAN ECODYNAMICS IN THE NORTH ATLANTIC: THE DATAARC PROJECT

C.A. Strawhacker[1], A. Brin[2], R. Opitz[3], E. Lethbridge[4], P. Buckland[5], T. Dawson[6], G. Palsson[5], P. Pulsifer[1], I. Mainland[7], J. Cothren[8], T. McGovern[9], T. Ryan[9]

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[4] *University of Iceland, Reykjavik, Iceland*
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[6] *St. Andrews University, School of History, Fife, United Kingdom*
[7] *University of the Highlands and Islands, Kirkwall, United Kingdom*
[8] *University of Arkansas, Center for Advanced Spatial Technologies, Fayetteville, USA*
[9] *City University of New York, Graduate Center, New York, USA*

Uniquely situated at the intersection of research, data, and information from the social sciences, natural sciences, humanities, and informatics, the DataARC project (cyberNABO.org) is ambitiously pursuing the creation of digital tools to link data from a variety of interdisciplinary sources to address grand challenge questions on the long-term human ecodynamics in the North Atlantic. These questions include, but are not limited to, how people in the past mediated vulnerabilities to climate change, how and why the fates among various villages and regions differed despite similar challenges, and how people in the past used local knowledge to carefully manage vulnerable resources. To enable and ease the ability for researchers to address these questions with a variety of data sources, the DataARC team will create digital tools that allow for non-specialist scientists to discover, access, download, and more easily understand data from a number of different sources, including archaeology, the Icelandic Sagas, paleoclimate proxies, and paleoenvironmental records to address broad scale, multidisciplinary questions. Additional outreach tools and stories will be created throughout the project to better engage the general public. The proposed presentation will provide an overview of DataARC objectives and progress, including the introduction of an initial prototype of an online tool for feedback from the wider international Arctic scientific community.

P 160 EVOLUTION OF ARCTIC TOWNS FROM THE PERSPECTIVE OF URBAN MORPHOLOGY

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Urban Morphology is a research discipline between geography, history, architecture and urban planning. It is defined as the study of the external construction (shape and physiognomy) and the internal construction (layout) of a town and the genesis (origin and evolution) of particular town parts. Time range of morphological studies is usually long because the study should reach to the very beginning of the town or even earlier if the town arose from a different type of settlement. Evolution of the urban space is reflected in morphological and functional changes. Morphological changes refer to the transformation of physical elements of the town (which are buildings and their related open spaces, plots or lots, and streets) and changes in its layout. In turn, functional changes are understood as succession of function or relocation of function. The main research method of Urban Morphology is the Town Plan Analysis which according to M.R.G. Conzen involves comparing chronologically set plans of a particular town.

The aim of the poster is to show the Conzenian Town Plan Analysis as a useful tool to the reconstruction of the history of human activity in Arctic region which is reflected (among others) in creating urban settlements. The issue is presented on the example of the evolution of the urban space of Rovaniemi.

P 161 POLLEN- AND NON-POLLEN PALYNOMORPHS – ANALYSES FROM SPITSBERGEN

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Since 1988 we have performed several short expedition to Spitsbergen. For palaecological research, we collected 60 cm deep profile from open pit (NW part of Spitsbergen, Bockfjord region, at the foot of the Sverrefjellet Volcano).

All 15 samples of this shallow profile consisted of mixture of mainly volcanic ash and fine detritus. There were no macroremains suitable for radiocarbon dating, the samples were analysed for pollen and non-pollen palynomorphs.

Frequency of pollen and non-pollen palynomorphs was quite low. Only the local taxa produced pollen in greater abundance (e.g. *Salix* and *Cyperaceae*). The pollen spectrum was considerably varied, even though most taxa were present in lower abundances. This was due to low pollen productivity of the arctic flora, which propagates mostly in vegetative way. In order to obtain as much information from the profile as possible, we analysed the non-pollen palynomorphs as well.

The results of the pollen analysis are presented in the pollen diagram and compose a picture of the arctic flora. Apart from the autochtonous shrubs (*Salix*), there were several cases of long-distance transport of some tree pollen. Pollen grains of *Centaurea cyanus*, *Cerealia - Triticum* t. and *Scleranthusannuus* were found at the base of the profile, presence of which provided the only (tentative) estimate of the age of the profile. We believe this pollen could have been brought in material transported by whalers and fishermen, sometime around the 16-th or 17-th century, such as crops, hay, or straw.

This analysis contributed to the more detailed knowledge on the occurrence and ecology of Tardigrada in the past. Tardigrada nowadays play an entirely accepted and useful part in the palaeoecological analyses as a non-pollen morph taxa.

P 162 PRELIMINARY REPORT OF THE PALAEONTOLOGY AND ECOLOGY OF LEMINGSDALE, PEARY LAND, NORTH GREENLAND

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Lemingsdale, Peary Land, north Greenland is famous for the celebrated Cambrian fossil locality, Sirius Passet (82° 47.603′ N, 42° 13.394′ W), which is a conservation Lagersttäte. Nevertheless, due to its extreme remoteness, the area including the fossil locality itself has remained understudied. Since the first discovery of Sirius Passet in 1984, there have been only six times of palaeontological expeditions to the area. In 2016 season, Korea Polar Research Institute carried out an expedition to Sirius Passet, and collected around 1,500 slabs containing about 3,000 fossil specimens from the outcrop and the scree of the Lower Cambrian Buen Formation. The specimens include various metazoans, such as sponges, arthropods, stem-group arthropods, primitive mollusks, annelids, cycloneuralians including priapulids and loriciferans, primitive deuterostomes, and a possible chordate, which would help reveal the aspect of the 'Cambrian explosion' of the animals. The ecology of the area, which also remains unstudied, has been briefly surveyed, as well. The preliminary survey reveals that, despite the high latitudinal geographic position of the area, the fauna and flora are quite flourished. Studies of the behavioral ecology on the mammals and the birds were undertaken, and some freshwater invertebrates, including tardigrades, were collected. Korea Polar Research Institute is planning to visit the area annually for the next three years, which would bring more information on the palaeontology and ecology of this remote area in the Arctic.

P 163 LATE PLEISTOCENE – HOLOCENE CLIMATE CHANGES AND HUMAN HABITATION IN ARCTIC WESTERN BERINGIA (BASED ON PALAEOBOTANICAL DATA)

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Paleoenvironmental and paleoclimatic changes at the transition from the Late Pleistocene to the Early Holocene in the western Yana-Indighirka lowlands were reconstructed based on ^{14}C dating, pollen analyses, and plant macrofossils analyses of Quaternary deposits from the Northern Point locale of the Yana Paleolithic site (Yana RHS).

Based on the proxy record from the the second terrace of the Yana river in the Yana RHS site vicinity we have reconstructed paleogeogrpaphic events that took place 37,000-10,000 ^{14}C years ago. For the first time, we obtained high-resolution records of climatic changes operating with narrow time slices of 500 and 1000-year length. For each of them, we reconstructed a sequence of changes in plant communities and main climatic indicators, such as the temperature of the warmest month, the average annual temperature and the average annual precipitation.

These analyses reveal the basic trend of paleoclimatic changes in the second half of Late Pleistocene, also revealing the succession of climate fluctuations within MIS3, MIS2, and the beginning of the Holocene (MIS1). They allow determining the timing and intensity of the maximum cooling during the LGM, clarifying the chronological transition to Holocene for the Yana-Indighirka coastal plain, and forming a quantitative paleoclimatic assessment of this transition.

Palynological data are the basis for a detailed description of landscape changes during the second half of Late Pleistocene - Early Holocene. Environmental conditions both during MIS 3 and MIS 2 influenced the fate of the inhabitants of these areas and were mild enough to allow people to spread into and live in the Siberian Arctic. The results of our investigations show that the question regarding the LGM depopulation of Siberia can be closed. Authors are grateful to Russian Science Foundation for support provided under project 16-18-10265-RNF.

P 164 AIR TEMPERATURE AND HUMIDITY CONDITIONS IN THE NORTHERN PART OF NORDAUSTLANDED (SVALBARD) AT THE END OF WORLD WAR II

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All Norwegian meteorological stations operating in Svalbard were destroyed during the World War II (WWII, 1941) by the German army and therefore there are considerable gaps in the data concerning that period. Later on, however, the German army decided to set up eight automatic and manned stations in Svalbard because weather information for this part of the Arctic was very important for military operations. All of them used to work about one year, and half of them operated in the final year of the war. Until now, however, no detailed statistics from those observations, except for monthly means calculated by the Norwegian Meteorological Institute for some stations, have been presented to the scientific community. The period of WWII was the warmest part of the Early Twenty Century Warming period (1921-1950), mostly manifested in the Arctic, and in Greenland and Svalbard areas in particular. For the aforementioned reasons, any new information about weather and climate is very valuable. In this paper, a detailed thermal-humidity characteristics of the northern part of Nordaustlandet (Wordiebukta located in the south-eastern part of Rijp fjord, φ = 80°4'N, λ = 22°24'E) is presented based on meteorological measurements made during the Haudegen expedition led by dr. Wilhelm Dege. Data were taken from 'Wissenschaftliche Beobachtungen auf dem Nordostland von Spitzbergen 1944-1945' published in Berichte des Deutschen Wetterdienstes, Nr.72. Besides the mean daily values, also extreme temperatures were used in analysis. The temperature and humidity conditions occurring during the study period were compared both with historical (end of the 19th century) and present (end of the 20th century) values of the analysed variables. The analysis shows that the historical period clearly was the coldest one, in particular in the cold half of the year. On the other hand, humidity did not show any significant changes.

P 166 THE INFLUENCE OF ATMOSPHERIC CIRCULATION ON THE SPATIAL DIVERSITY OF AIR TEMPERATURE IN THE AREA OF FORLANDSUNDET (SPITSBERGEN) IN 2010–2013

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The relationship between atmospheric circulation and climate in Svalbard has been described in dozens of studies. However, the data used for that purpose usually came from permanent stations on the coast. The influence of atmospheric circulation on topoclimatic diversity has not been explored so often and hardly at all for other periods than the arctic summer. In this article, the relationships between circulation and air temperature are described using daily data sourced from 6 sites located around Forlandsundet (NW Spitsbergen) in 2010-2013. The analysis was conducted independently for 3 seasons identified as: winter (November-March), spring-autumn (April-May and September-October) and summer (June-August) and also for three air temperature parameters: diurnal mean (Ti), maximum (Tmax) and minimum (Tmin) temperature. The atmospheric circulation in the studied area was described using Tadeusz Niedźwiedź's classification of diurnal circulation types for Svalbard. The influence of atmospheric circulation on the spatial pattern of air temperature is not uniform across different parts of the Forlandsundet region. Different temperature patterns to circulation types were noted for coastal and inland parts of the study area. Thus, generalisation of air temperature-atmospheric circulation relationships for the entire area of Spitsbergen based on data only from coastal stations is not appropriate. The influence of atmospheric circulation on the spatial pattern of air temperature in the Forlandsundet region also changes through the year. In the cold season (Sep-May) it differs significantly from that observed in summer (Jun-Aug), and this feature is also seen in analyses of the 10% highest (≥ 90th percentile) and lowest (≤ 10th percentile) thermal differences. In summer, the relation of atmospheric circulation to air temperature in the topoclimatic scale are definitely less stable than in the cold season. The reactions of the three analysed thermal parameters to atmospheric circulation also differ significantly.

S16 MARINE, COASTAL AND TERRESTRIAL ARCTIC PRODUCTIVITY IN HUMAN AND ECOSYSTEM CONTEXTS – A MULTI-DIMENSIONAL LOOK INTO HISTORY AND FUTURE OF THE PAN-ARCTIC SYSTEM

O 026 CHANGES IN THE DISTRIBUTION OF WATER AND SEDIMENT CHLOROPHYLL IN A HIGH-PRODUCTIVITY AREA OF THE DISTRIBUTED BIOLOGICAL OBSERVATORY, CHUKCHI SEA

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Chlorophyll has been measured in the water column and in surface sediments in the southern Chukchi Sea each July from 2000-2016. The southern Chukchi shelf has high biological productivity due to the transport of high-nutrient waters through the Bering Strait. Parallel measurements of the benthic biological community have shown changes in species and biomass, and an apparent northward movement of the maximum benthic biomass in this "hotspot". Water column measurements show consistently high chlorophyll biomass, but high variability in the annual maximum is observed (8-33 mg m^{-3}), and the location of the annual maximum varies by depth (surface to bottom water) and latitude (66.7 to 68.3 degrees N). Benthic biomass has also varied during 2000-2016 at the same locations, suggesting that short-term water column measurements are insufficient to resolve changes in the productivity of the ecosystem. However, measurements of chlorophyll deposited to surface sediments, which provide a longer-term indication of the deposition of organic matter to the benthos, match patterns observed in the benthic macrofauna. Sediment chlorophyll inventories have remained universally high (~30 mg m^{-2}) at the northern end of the study region, but similar inventories of sediment chlorophyll previously observed (2000-2006) at more southern stations are no longer present. The carbon isotope composition of the organic carbon fraction of surface sediments has also declined ~0.5 per mille, which is consistent with heavier isotopic ratios reported in sediments for the southern Chukchi Sea of ~1 per mille over several decades. These data suggest a recent change in the transport and deposition of organic materials to the southern Chukchi Sea that is consistent with higher quality organic carbon transport further north, but a decline in deposition to the south. This may be due to an increase in organic carbon transport through Bering Strait or to changes in local biological productivity.

O 025 FISHERIES, SEA ICE COVER AND THE BIOLOGICAL PRODUCTIVITY IN THE EUROPEAN ARCTIC SEAS

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Here we present data on the location of the minimum summer ice edge between Svalbard and Franz Josef Land (20-45ºE). By combining information from logbooks of early whalers and explorers with more recent aerial and satellite observation, we cover a period of nearly 450 years from 1580 to 2015. The record shows long periods with reduced ice cover from 1580 to 1620, 1680 to 1780 and 1970 to 2015 and periods with extended ice cover from 1620 to 1680 and 1790 to 1970. During the last period of extended ice cover, there was periods between 1840-1875 and 1920-1940 during which the ice edge retracted northwards.

In periods of reduced ice coverage there has been extensive resource exploitation in the region, Dutch bowhead whaling between 1680 and 1790, cod fisheries in the 1870ties and 1920/30 ties. We discuss how these high productive periods can be related to increased upwelling of nutrient-rich water of Atlantic origin along the shelf break, increased production of the high energy lipid rich *Calanus* populations and how this changes the shelf break area from an Arctic desert to a production hotspot. This study is a part of the RCN funded Arctic ABC and Marine Night projects (http://www.mare-incognitum.no/) and contribution to Arctic Size programme University of Tromsø.

O 027 DOES PLASTICS LITTER IMPACT ON THE PRODUCTIVITY OF ARCTIC MARINE FOOD WEBS?

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Plastic litter is ubiquitous in the world oceans and plastic particles of various sizes have been recorded in all marine habitat matrices in the Arctic: the water column, sediments and sea ice. Clearly, they pose a risk for arctic marine ecosystems and seafood safety. Here, we review observed chemical compositions of plastics from arctic beaches and sediments, as well as data on plastic ingestion of arctic zooplankton and seabirds as representatives of low and high trophic level consumers. Both groups ingest plastic particles of different size classes consistent with their prey fields and we hypothesize that their productivity can be reduced when they are feeding in plastic litter hot spots, such as oceanographic convergence zones, near effluent outlets or upon release from contaminated melting sea ice. Exposure to adsorbed contaminants via plastic ingestion appears to be less of an issue. Weathering, degradation and formation of biofilms alter the physical properties of plastic and can promote ingestion and thus bioaccumulation of plastic, but the impacts, both on individuals and at population level, are poorly understood, hampering estimations of productivity reduction and other impacts on ecosystem services of arctic marine ecosystems. We conclude that microplastics are a problem in arctic marine ecosystems that requires further research.

O 029 YESTERDAY IS HISTORY, TOMORROW IS A MYSTERY: POLAR BEAR USE OF TERRESTRIAL FOOD SOURCES REVEALED BY COMPOUND-SPECIFIC STABLE ISOTOPES

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Polar bears (*Ursus maritimus*) are the internationally recognized face of Arctic climate change. In Alaska, two polar bear stocks are recognized, the Southern Beaufort Sea (SBS) and the Chukchi Sea stock. The SBS stock is currently in decline, and poor body condition, reduced fecundity, and survival have been noted. We analyzed bone collagen of SBS bears obtained from subsistence harvests (2006-2016), University of Alaska Museum (1906-1971), and archeological digs (1850BP-1180BP) for bulk stable isotopes (SI) and compound specific SI (CSI) of 12 amino acids (AA). Bulk $\delta^{15}N$ did not differ among present-day, historic, and ancient bears, while ^{13}C was depleted in modern bears over other time periods (Suess corrected). This suggests increased carbon sourcing from open-water phytoplankton over ice-associated primary production or reliance on terrestrial prey. $\delta^{15}N$ of essential AA (e.g., phenylalanine that change minimally in trophic transfer) did not differ among bears indicating that baseline $\delta^{15}N$ values in the Arctic food web have remained unchanged. Threonine is a unique AA; its deamination involves an enzyme system, where catabolism leads to depletion rather than enrichment of ^{15}N. Interestingly, threonine was enriched in ^{15}N of modern bears. We propose three reasons: 1) modern bears are in better body condition than in the past; 2) the modern food web is shorter leading to less nitrogen reworking; 3) modern bears rely more on terrestrial food webs. $\delta^{13}C$ isotopic proxies, specifically differences between glycine and phenylalanine and valine and phenylalanine can discriminate marine and terrestrial foods. Modern bears were depleted in these isotopic proxies pointing to terrestrial diets. Moreover, SI of bone collagen represent a lifelong average of dietary protein indicating that bears are sourcing terrestrial prey their entire life. CSI of archived bone can answer important questions about polar bear land use, consequences of habitat loss, and resiliency moving to an uncertain future.

P 168 A BAYESIAN MIXING MODEL APPROACH TO UNDERSTANDING FOOD WEB LINKAGES OF A MARINE TOP PREDATOR IN THE BEAUFORT SEA ECOSYSTEM

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As a top predator with a circumpolar distribution, beluga whales (*Delphinapterus leucas*) may be a potential indicator species for the effects of climate change. The eastern Beaufort Sea beluga whale population, one of Canada's largest, has experienced a twenty-year decline in individual growth rates, hypothesized to be the result of climate-induced prey shifts. To understand food web dynamics and diet linkages, we used ecological tracers and Bayesian statistics to reconstruct the diet of beluga whales and identify food web linkages useful for evaluating this hypothesis. Ecological tracers such as fatty acid and carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios can provide valuable information on changes in productivity and food web dynamics. We used these tracers in Bayesian mixing models to reconstruct diets of beluga whales from 2011-2014. During a warm year anomaly (2012), beluga habitat-use groups demonstrated greater overlap in dietary tracers, whereas greater differences among size classes occurred in years with greater sea ice extent in the Mackenzie Shelf (2013 and 2014). Body condition indices were highest in belugas in 2011 and 2012 and lowest in 2014, possibly a reflection of annual variability in sea ice and prey fluctuations. Individual diet estimates using a Bayesian mixing model identified Arctic cod (*Boreogadus saida*) and capelin (*Mallotus villosus*) as the dominant prey, but beluga whales also consumed shrimp and octopus. Diet estimates varied annually, with belugas most opportunistic (consuming the greatest prey diversity) in 2014 and consuming a higher proportion of shrimp in 2012. As Arctic marine ecosystems are currently undergoing rapid change, understanding inter-annual variations in beluga diet in response to environmental conditions, and in particular, the long-term effects of beluga whales shifting from an Arctic cod to a capelin-dominated diet, should be a conservation priority for this population.

P 167 RECONSTRUCTION OF THE HISTORY OF THE THERMOKARST LAKE DURING THE MIDDLE HOLOCENE BASED ON THE ANALYSIS OF SUBFOSSIL CLADOCERA (SIBERIA)

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Cladocera (Crustacea, Branchiopoda) remains and their fossilized ephippia (cladoceran exuvia containing resting eggs) were studied to determine Holocene environmental and thermokarst lake history. Column of the bottom sediments of the lake KB7 (~4 m long) was selected from the small pingo in Central Yakutia (61°49'58,1" N, 130° 38'34,3" E) for multy-proxy investigations including micropalaeontological analysis. Organic material and bulk sediment for selected samples were dated with the AMS method to determine 14C ages for thermokarst deposits.

According to Cladocera analysis the formation of the lake coincided with the Holocene climatic optimum ~6600 cal. yrs BP. Cladoceran ephippia were found between 313 and 80 cm bs (below surface) covering the period between ~6600 and ~6000 cal yr BP. Our record indicates considerable change in the cladoceran assemblages at 234 cm bs (6503 cal yr BP). At this depth, the abundance of *Daphnia* resting eggs is increasing sharply. Four statistically significant ecological zones were identified using cluster analysis, which are based on changes in the composition of subfossil cladoceran communities. The period of optimum conditions for Cladocera (between ~6500 and 6350 cal yrs BP) is characterized by the presence of complex community structures and numerous cladoceran remains in sediments. During that time the thermokarst lake rapidly emerged, grew, and disappeared. Declining thermokarst processes were probably affected by local hydrological conditions after that.

Our analysis of the core KB7 shows that there is no clear evidence of long-lasting and stable lacustrine conditions, as would be expected according to the classic knowledge of thermokarst development.

Reconstruction of the Holocene optimum conditions using Cladocera as a bioindicator was performed within the framework of the grant of Russian Scientific Foundation (project 16-17-10118) and Arctic Ecological Network (Arc-EcoNet, BMBF 01DJ14003). Laboratory research was performed with financial support of Russian Foundation for Basic Research (project 15-05-04442).

P 169 PALEOENVIRONMENT RECONSTRUCTION ON THE BASE OF SUBFOSSIL CLADOCERA (BRANCHIOPODA, CRUSTACEA) FROM BOTTOM SEDIMENTS OF LAKE MEDVEDEVSKOE (KARELIAN ISTHMUS, RUSSIA)

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In spring of 2012 two sediment cores of 1 and 2.5 m correspondingly were selected from the ice surface of the Lake Medvedevskoye (60 ° 14‘ N, 29 ° 54‘ E, 102.2 m a.s.l., surface area is 0.44 km^2, 0.5 km width, 1.18 km length, maximum depth is about 4 m) which is located in the Central highlands of Karelian Isthmus and due to its’ high-altitude location has not been flooded by the waters of the large periglacial basins after the last deglaciation and is characterized by a high degree of the rate of sedimentation. The lake basin formed before 13000 cal.yr. BP, possibly due to melting of stagnant glacier ice.

The sediment subsamples from the core were collected for the radiocarbon dating by an accelerator mass spectrometry (^{14}C AMS-method), for loss on ignition (LOI %), lithostratigraphy, and micropaleontological analyses including Cladocera analysis.

According to results of Cladocera analysis the most abundant taxa were *Bosmina (Eubosmina) cf. longispina* (15,8 %), *Alonella nana* (15,5 %), *Acroperus harpae* (12,1 %), *Chydorus* cf. *sphaericus* (9,9 %). The qualitative and quantitative dominants are typical littoral taxa (51,5%). Taxonomic richness and organic content (LOI) was lower at the bottom of the core and increased towards the sediment surface. During the development of the lake the cold-water species are twice replaced by thermophilic taxa. The average value of the Shannon index is 3,05±0,08, index of ecological groups uniformity of Pielou - 0,73+0,01.

The study is supported by Russian Foundation for Basic Research (projects 13-05-41457, 15-05-04442).

P 170 CLIMATE-INDUCED CHANGES IN NORTHERN BERING AND CHUKCHI SEAS MACROFAUNA INDICATES THAT BENTHIC DIVERSITY INFLUENCES ECOSYSTEM PRODUCTIVITY AND FOOD WEBS

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Increasing water temperatures, major reductions in seasonal ice cover, and corresponding changes of carbon export fluxes to the sea floor may effect the high biomass, abundance and diversity of benthic organisms in the northern Bering and Chukchi Seas, one the most productive marine ecosystems in the world. This could have critical consequences for benthic food webs and ecosystem productivity. We describe multi-year changes of macrobenthic communities in the “hot spot” (defined as areas of high biodiversity, biomass and/or rates of change), of the northern Bering and Chukchi Seas with a goal of assessing biodiversity vulnerability to increasing temperature and sea ice decline, and its potential effect on the food webs and thus ecosystem productivity. Invertebrate samples were sampled in: southwest of St. Lawrence Island, the Chirikov Basin north of St. Lawrence Island, the southeastern Chukchi Sea, and Barrow Canyon, at the same stations in 2007 and 2008, as part of the International Polar Year Canada’s Three Oceans (C3O) project and subsequently in years: 2010, 2011, 2012, 2013 and 2014 as part of the international Distributed Biological Observatory (DBO) program in coordination with C3O. Additional samples for compound-specific stable isotope analysis of amino acids ($\delta^{13}C_{AA}$, $\delta^{15}N_{AA}$) were undertaken in each ‘hot spot’ in 2015. Benthic infaunal species diversity, abundance and biomass were determined in relationship with physical and chemical data from the water column and sediments. Changes observed include a decline of biomass and a switch in some dominant species, and an increase in species diversity in recent years. Food web analysis suggested that variation in carbon and nitrogen isotope values, which indicated differences in food source and trophic level shift respectively, was related to environmental factors. This study is a contribution to the international DBO effort (http://www.arctic.noaa.gov/dbo/index.html), and represents a continuation of benthic time series sampling program since the 1980s.

P 171 MANAGING NEW RESOURCES IN ARCTIC MARINE WATERS: THE INVASIVE SNOW CRAB CASE

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Along with the Arctic’s icy barriers melting which allows species to move northwards, new invasion corridors also arise with the opening of new shipping routes. The Snow Crab in the North West Atlantic is suspected to be a stowaway transferred via ballast water from the North Pacific. It was identified two decades ago in the southeastern Barents Sea and has been expanding its geographical range and abundance, thus allowing the opening of a new fishery in international waters. The high commercial value of the fishery has led to a proliferation of articles discussing the regulatory regime and management of the resource which poses challenges due its nature as a ‘sedentary species’ colonizing the Barents Sea continental shelf shared by Norway and Russia and approaching the fishery protection zone around Svalbard. Conversely, little research has looked into the implications of the invasion partly because the impacts are still beyond credible assessment due to biological uncertainties. For the purposes of articulating ecosystem management strategies we consider the value of the fishery and the potential impacts from the invasion in tandem. We look at the variation in participants in the Snow Crab fishery straddling Arctic waters which lends towards different productivity under different management and we delineate acceptable risk levels in order build up a bioeconomic framework that pinpoints the underlying trade-offs. We also address the difficulties of managing the resource under uncertainty and discuss how ecosystem dynamics alter with the introduction of a new resource. For that purpose we infer experiences from the Red King Crab, an invasive crustacean that has been wriggling its way into the Arctic, further south in the Barents Sea. Despite the differences in legal status and property rights, we use this experience to address overfishing issues, externalities upon neighboring jurisdictions and invasion frontiers control via commercial harvesting.

P 172 USING FAUNAL PROXIES AS AN INDICATOR OF CHANGING OCEAN TEMPERATURE AND PRODUCTIVITY: RESULTS FROM THE MINK ISLAND ARCHAEOLOGICAL SITE (XMK-030)

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The Mink Island archaeological site (XMK-030), located on the east coast of the Katmai National Park and Preserve along the Shelikof Strait, Alaska, features an occupation period spanning nearly 7000 years, from approximately 6500-270 years ago. The continued analysis of the archaeological assemblage, collected over several years of excavation, has revealed a shifting pattern in tool technology and subsistence practices. Given the known global changes in climate throughout this period these shifting patterns may relate to adaptive strategies as a response to changing environments at the end of the Hypsithermal and through the Neoglacial. An evaluation of the faunal record in particular has identified a number of proxy species useful for a discussion of changing environmental conditions in the region and the resultant impact to local populations. Specifically, changing abundances of certain fish species (e.g. salmon, cod, and herring) in correlation with marine mammal species (e.g. harbour seal, northern fur seal, sea otter, and steller sea lion) can indicate changes in sea temperature and ocean productivity. Similarly, relative abundances of certain bird species (e.g. northern fulmar, eider, murre, and gulls) were found to be associated with increases in atmospheric moisture, roughly correlating with the timing of the Medieval Warming Period. The results of the analysis indicate that large archaeological assemblages of faunal material can function as useful climate proxies for oceanic and atmospheric conditions.

P 173 ORGANIC MATTER IN THE EUROPEAN SECTOR OF THE ARCTIC OCEAN ACROSS DEPTH AND SEA ICE GRADIENTS

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Decreasing sea ice cover and thickness may result in modifying quantity and quality of primary production: sea ice algae production is predicted to be replaced by proportionally increasing phytoplankton production. Changes in organic matter *export fluxes will likely* have further consequences for the production and carbon cycling in Arctic marine ecosystems, especially in the *deep-sea*.

This study aimed to analyze organic matter concentration and distribution in the water column and sediments during spring bloom in sea ice covered areas. Twelve stations located along the sea ice gradient were sampled from sea ice free to first year sea ice covered stations, along the depth gradient - from shelf to deep basins during cruises of R/V Polarstern "TRANSSIZ", in May and June 2015, and R/V *Helmer Hanssen "ARCEx" to Svalbard fjords and Barents Sea, in May 2016*. Particulate organic matter (POM) samples were collected from sediment traps set from 20 to 200 m depth and additionally from chlorophyll *a* maximum and above the bottom layers. Organic Matter (OM) and stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes were determined. Furthermore for each station push-cores (10 cm Ø and 20 cm deep) were collected from a box corer and sediment OM profiles were analysed.

The OM concentrations in the water column decreased with depth, and increased with the bloom progress. The $\delta^{13}C$ signatures suggested different organic matter origin, from terrestrial to fresh ice algal production, depending on the location and sea ice cover characteristics. OM in the sediment profiles did not reflect the OM water concentrations.

P 174 USING PACIFIC WALRUS TEETH TO STUDY PATTERNS OF CHANGE IN ALASKA FOOD WEB DYNAMICS

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Like tree rings, Pacific walruses (*Odobenus rosmarus divergens*) lay down seasonal growth layers in their teeth. Seasonal data can provide insight into foraging plasticity throughout lifetimes of individual walruses. We obtained stable isotopes from these cementum layers as proxies to study spatiotemporal patterns in ecosystem production. Pacific walruses are iconic sentinels of Arctic climate change, threatened by loss of sea ice habitat, and an important subsistence species for many Native communities, but key ecological relationships (e.g., annual diet variability) are poorly understood. Creating historical dietary baselines over the lifetime of walruses by sex, age, and location expands existing knowledge of food web dynamics.

In partnership with museums and Alaska Native subsistence users, we selected teeth from female and male walruses collected between 1880-2016. This timeline encompasses impacts of the Industrial Revolution reaching the Alaskan Arctic and changes in seasonal sea ice extent. Using a MicroMill attached to a microscope, cementum layers were extracted from teeth pre-cut longitudinally down the centerline. Collagen was isolated from tooth powder through lipid extraction and demineralization. Stable carbon and nitrogen isotope ratios were obtained using a Elemental Analyzer Isotope Ratio Mass Spectrometer (EA-IRMS).

Using Pacific walrus teeth to study patterns of change in Alaska food web dynamics improves understanding of how past ecosystem production was impacted by environmental variability and ability to model future connectivity. We found that $\delta^{13}C$ and $\delta^{15}N$ fluctuated annually based on sex, age, and location; *Chart 1* and *2* display variability in these values for a sub-set of sampled teeth by year. There is also evidence to support distinct isotopic signals for different foraging locations while discrepancies may be correlated with changes in benthic prey assemblages. High variability in diet may indicate that walruses are more generalist predators than previously believed, suggesting these pinnipeds may have some resiliency to ecological changes.

Chart 1:

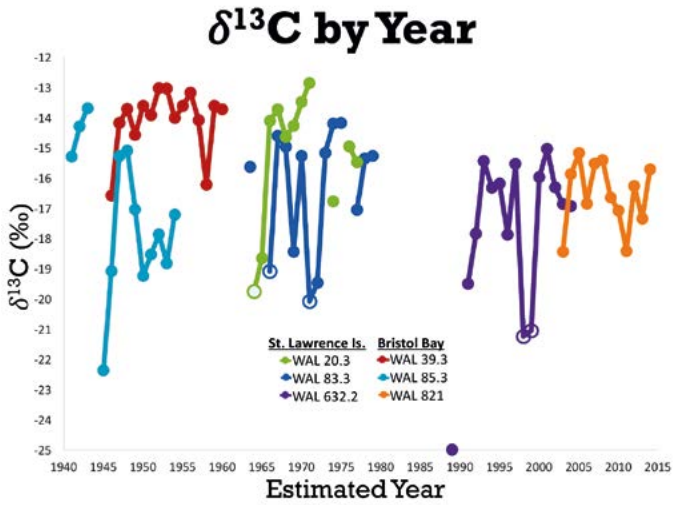
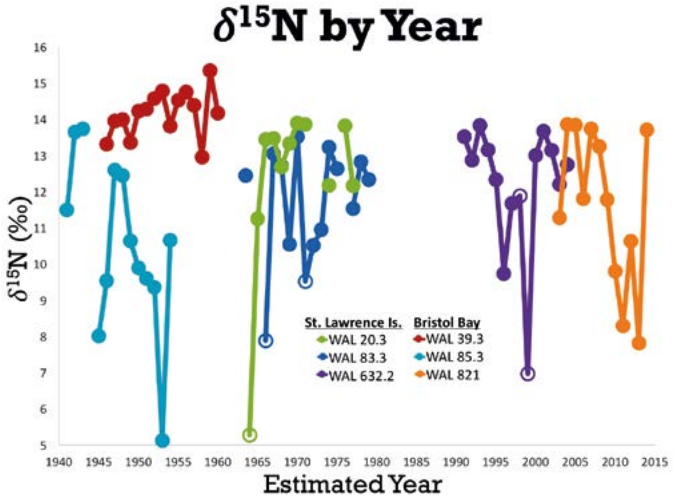


Chart 2:



S17.1 SUSTAINABILITY AND RESILIENCE MONITORING IN THE RAPIDLY CHANGING ARCTIC

O 019 NORTHERN COMMUNITY CLIMATE CHANGE ADAPTATION PLANNING: THE CASE OF HOMER, ALASKA

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Climate models forecast further increases in temperature, more extreme weather events and a rise in sea-level, which will result in greater risk to northern coastal communities. Planning for climate change adaptation is under represented in local government, particularly in the north, as is empirical (key informant) research that critically investigates the decision dynamics around why and how communities incorporate planning for climate adaptation into policy and practice.

The proposed presentation will highlight findings from research into the motivational factors (e.g. slow v. immediate threats), extent (e.g. embedded v. appendage actions) and nature (e.g. reactionary v. anticipatory) of adaptation planning in Homer, Alaska, a northern community that has demonstrated commitment to increasing their resilience to climate variability.

As the intent of the research was to be investigative and probing, it included semi-structured interviews with a range of key informants from the community: managers that could speak to governance around adaptation plan conception and development; planners that could address how implementation is incorporated into land use planning, transportation planning, infrastructure and utilities planning, as well as other key community officials (e.g. Mayor). Analysis of strategic planning documents (e.g. Official Community Plan, Adaptation Strategy) was included to triangulated findings, and to help guide the research protocol. Broadly speaking, this study provides insight into community preparedness for climate variability and contributes to the emerging literature on resilience theory. By exploring the decision dynamics around community adaptation plan/ policy conception and action implementation, this research sheds light on the role planners play, and the skills/ expertise planners harness in order to help their community become resilient to an increasingly variable climate.

O 021 DEMOGRAPHIC TRENDS AND SUSTAINABILITY IN ARCTIC ALASKA

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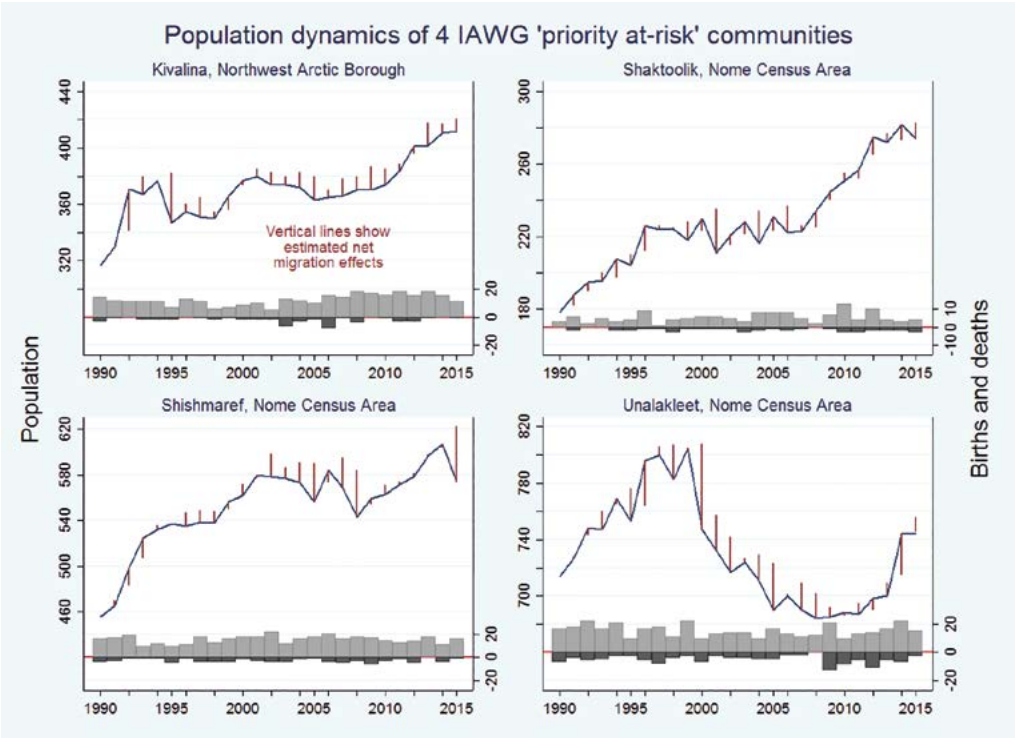
Recent analysis of Arctic Alaska communities finds that many of the places most threatened by climate-linked erosion (such as Kivalina, Shaktoolik and Shishmaref) also have growing populations, placing more people physically at risk from storm effects, or dependent on at-risk infrastructure, while raising potential costs of relocation. Although demographic trends have high relevance for sustainability issues, and particularly affect the challenges facing erosion-threatened communities, they have not been widely acknowledged in planning documents or public discussion. Addressing this gap, the Sustainable Futures North project continues development and analysis of an integrated database monitoring annual demographic change in 43 individual Arctic Alaska towns and villages. The data are currently up to date through 2016. The complete 43-community, 1990-2016 database, which also includes downscaled monthly climate indicators for each place, is publicly available for use by others, and has been documented in peer-reviewed papers. Work is currently underway aimed at constructing and analyzing a similar demographic database covering regions and communities Nunavut, Canada.



O 022 CLIMATE CHANGE AND ENVIRONMENTAL SAFETY OF MINING INDUSTRY IN THE ARCTIC

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[1] *Kola Science Center of the Russian Academy of Sciences, Institute of Industrial Ecology Problems in the North, Apatity, Russian Federation*

In Murmansk region annually stored more than 150 million tons waste, total volume has reached about 8 billion tons, including off-balance sheet and passing the ore stacked in piles - 2.4%, rock stripping - 72.4%, tailings - 24%, the balance being slag and ash.

Geochemical factors determining emissions of pollutants from mining:
- the mobility of pollutants from solid phases (soils, rocks) in liquid phase (waters);
- migration capacity - change the scale and intensity of the movement of chemical elements in natural ecosystems;
- transformation of the composition of tailings and, as consequence, change the structure of the scattering flow of pollutants in environment.

Development of local technogenesis and climate. Climate will affect:
- operation of industrial sites within the technogenic objects that have a mutual influence on each other (career depression crater – tailings storage - water sump), as well as on the natural drainage system and groundwater;
- the presence of a complex technical drainage system with intense water cycle large volume of water, the existence of “suspended” reservoirs with high salinity and significant volume of water mass - filtering through the bottom and walls of dam;
- generation of loosely coupled, disintegrated tailings not protected by natural soil and vegetation covers, which activates the processes of weathering;
- the accumulation of contaminants in technogenic objects and natural environment (soils, sludges, vegetation, animals, etc.).

Involvement in the processing of new raw materials will cause an increasing of pollutants numbers (new minerals, reagents). Complicate internal water circulation in mining. Need to develop new water purification systems. For example, we found that the intensive development of apatite-nepheline ore deposits of the Khibiny accompanied by intense hypergenic interaction of multiple occurrences of molybdenite, which leads to the appearance of molybdenum into natural waters in concentrations exceeding the limits in 20-30 times.

O 159 GLOBAL CHANGE, BIODIVERSITY, ECOSYSTEM FUNCTIONS, AND LIVELIHOODS IN NORTHERN YAKUTIA ACROSS SCALES AND DISCIPLINES

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In 2009, the University of Zurich has established a research focus on changing tundra ecosystems in Northern Yakutia, feedbacks with climate and permafrost, and socio-ecological impacts (http://www.gcb.uzh.ch). At the Kytalyk site (71°N, 146°E), the research goals are to:
- Assess and monitor biodiversity (Iturrate-Garcia, 2016). Future plans include lake biodiversity.
- Understand vegetation change. Results highlight the sensitivity of shrub growth to warming and nutrient addition (Myers-Smith, 2015; Iturrate-Garcia, subm.). Future plans include a drought experiment.
- Quantify the effect of vegetation and land surface changes on the energy budget (Juszak, 2016). Future emphasis will be on plant trait changes and related feedbacks (Iturrate-Garcia, in prep.).
- Assess the perception of local people on climate and biodiversity changes, their impact on livelihood, and the effect of political transformation on their resilience using interviews (Ksenofontov, in rev.).

The presentation summarizes methods, results and data to foster discussion on panarctic integration of this unique tundra site.

Iturrate-Garcia (2016), Interactive effects between plant functional types and soil properties determine tundra species diversity and community composition. Ecology and Evolution.
Iturrate-Garcia (in prep.), Changing strategy - tundra shrub trait development under future climatic conditions.
Iturrate-Garcia (subm.), Shrub growth rate and bark responses to soil warming and nutrient addition.
Juszak, I. (2014), Arctic shrub effects on NDVI, summer albedo and soil shading. RSE.
Juszak, I. (2016), Contrasting radiation and soil heat fluxes in Arctic shrub and wet sedge tundra. Biogeosciences.
Juszak, I. (in rev.), Drivers of shortwave radiation fluxes in Arctic tundra across scales. RSE.
Ksenovontov (in rev.), To fish or not to fish?: Fishing communities of Arctic Siberia in the face of environmental change and political transformations, Polar Record.
Myers-Smith (2015), Climate sensitivity of shrub growth across the tundra biome. NCC.

O 023 MONITORING OF SUSTAINABILITY AND RESILIENCE OF RUSSIAN ARCTIC ECOSYSTEMS

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Zones of “instability” and loss of resilience in Russian Arctic were revealed by means of remote sensing and field investigations. Space images (sensor *Modis* data) of the period from 2000 till 2014 with resolution 2x2 km were used. The images cover territories of Russian Arctic (Fig. 1). The spectral channels were selected especially for studies of the vegetation productivity, which was regarded as indicator of ecosystems sustainability. As a result two types of territories with various trends of vegetation development were distinguished: (1) highly-productive and (2) low-productive.

In Russian Arctic the area of highly-productive ecosystems increased during the period 2000-2014 and now is equal 307 432,8 km^2. This process could be called “greening” of tundra. Whereas landscapes’ degradation - replacement of zonal and intrazonal highly-productive plant communities by low-productive ones - takes place on the area of 314 068,7 km^2. So the processes of arctic ecosystems “greening” and the processes of their degradation compensate each other in absolute sizes of area, but significant differentiation is observed (Fig. 1). These processes are occupying about 10 % of the Russian Arctic territory.

The revealed effect of increasing of the highly-productive ecosystems’ area in Russian Arctic correlates with the evaluation of the NDVI data for all Arctic (Walker et al., 2012) and relates with synergism of climatic changes (especially warming) and economic development intensification (anthropogenic transformation of vegetation, soils and permafrost).

"Greening" of tundra means increasing of cover of more productive trees, bushes and grasses instead of decreasing of mosses' and lichens' cover. Field investigations in various regions of Russian Arctic proved mentioned above trends and determined new biogeographical phenomena: increasing of quantity and changes of arctic birds' migrations' routes, lemmings' quantity dynamics' cycles "flattening", wild reindeers' area fragmentation, boreal mammals' expansion to the North, etc.

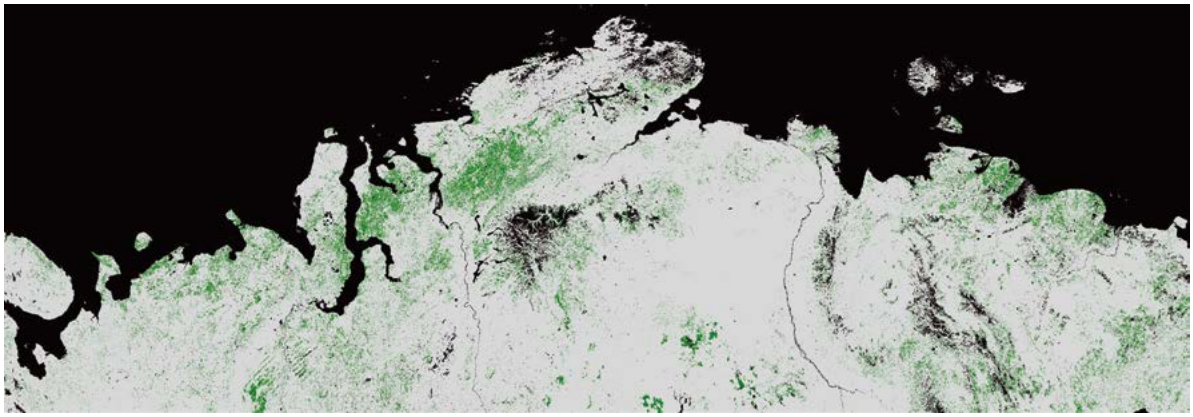

Fig. 1. "Greening" areas of Russian Arctic (fragment).

O 020 MONITORING LOCAL AND INDIGENOUS PEOPLES' CONTROL OVER SOCIO-ECOLOGICAL SYSTEMS SUSTAINABILITY: THE CASE FROM THE TAIGA ZONE OF SIBERIA

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[2] *Association ARUN indigenous peoples of the Evenkia, Vice-president, Baykit- Evenkiyskiy region- Krasnoyarskiy Kray, Russian Federation*
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Effective participation of local and indigenous people in decision-making process and governance institutions is viewed as one of the main pillars of the Arctic socio-ecological systems sustainability. As it was demonstrated by the Arctic Council Arctic Social Indicators report, the performance of such local people participation and governance at local or regional scales could be measured by fate control index, that incorporates four measures: a measure of political control (percentage of local people in the governing body of the jurisdiction), a measure of economic control (% of public expenses from locally generated funds), cultural control (% of people speaking their "mother tongue"), and control over land. The level and the character of fate control index is a key measure of the sustainability of the entire Arctic socio-ecological system, as it impacts and regulates from the bottom (local or regional scale) other important domains such as the state of the environment , material well-being equality, level of education and traditional knowledge, cultural values performance, access to food, energy and medical services, traditional land and natural resources. Being observed at local or regional scales it has important implications at the upper scales - national, zonal, pan-arctic and global. The identification of challenges and best experiences in fate control in local/regional case study of indigenous taiga communities of the Evenkia and Tarukhansk regions of the Krasnoyarsk Kray make it possible to identify key indicators for continuous sustainability monitoring in these regions experiencing high impacts from commercial forestry as well as poaching along with climate change disturbances influencing traditional subsistence activities of local people.

P 175 MONITORING OF PARAMETERS OF COASTAL ARCTIC ECOSYSTEMS FOR SUSTAINABILITY CONTROL BY REMOTE SENSING IN THE SHORT-WAVE RANGE OF RADIO WAVES

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Monitoring of the earth's surface by remote sensing in the short-wave band can provide quick identification of some characteristics of coastal Arctic ecosystems. This band range allows one to diagnose subsurface aspects of the earth, as the scattering parameter is affected by irregularities in the dielectric permittivity of subsurface structures. This method based on the organization of the monitoring probe may detect changes in these environments, for example, to assess hazardous natural phenomena, assessing sustainability, as well as some man-made hazards and etc. The problem of measuring and accounting for the scattering power of the earth's surface in the short-range of radio waves is important for a number of purposes, such as diagnosing properties of the medium, which is of interest for geological, environmental studies. In this paper, we propose a new method for estimating the parameters of incoherent signal/noise ratio. The paper presents the results of comparison of the measurement method from the point of view of their admissible relative analytical errors. The new method is suggested. Interpretation of the data is based on a statistical multiplicative model of the signal. Testing the method of obtaining a signal/noise ratio in this model was produced by the example of a double reflection of the probe signal from the SW ionosphere in a vertical sounding (remember that when using a satellite, the signal passes twice through the atmosphere and ionosphere). The work addressed issues of sensitivity of the model parameters that were studied. To obtain the necessary experimental data using the pulse method of coherent reception. Analysis of analytical error of estimation of this parameter allowed to recommend new method instead of standard method. A comparative analysis and shows that the analytical (relative) accuracy of the determination of this parameter new method on the order exceeds the widely-used standard method.

P 176 HEALTHCARE ISSUES IN RURAL AND REMOTE DISTRICTS OF THE RUSSIAN FAR NORTH

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Recent years, the Arctic region has been drawing attention of the world community due to its geopolitical position in the world, harsh climate, vast natural resources and economic potential. The great fundamental importance is given to education and health care in remote communities of the Far North in order to save indigenous environment, culture and traditional way of life.

We conducted sociological survey among people living in remote and sparsely populated areas of the Far North aiming to study the level of health care access to indigenous inhabitants. 30 inhabitants of Olyokminsky district from Byas-Kyuyol village took part in this survey. The hospital of medical district delivers medical care to 208 people. The distance to the central district hospital is around 180 km.

The proportion of respondents aged 41 to 60 years was 80%. According to the survey 26.6% of respondents consider themselves healthy. In 53.4% cases out of 73.4% of respondents, admitting functional disturbance, cardiovascular and respiratory system diseases were detected.

The survey outcomes represented that only 26.6% out of 30 respondents seeks medical advice in the event of illness, and 43.3% applies to the hospital on the occasion. Only 36.6% of respondents confirmed the possibility to get necessary medical assistance in the nearest hospital. Most of the respondents (84.2%) apply to the hospital for diagnosis and solution to a question on further modality, which includes a set of specialized clinical and diagnostic procedures like laboratory, ultrasound, functional diagnostics and consultation specialists. Rest of the respondents (15.8%) usually needs medical treatment only after previously performed treatment.

Main reasons that limit the availability of qualified medical care according to the survey outcomes are significant territorial remoteness of specialized medical health facilities from the place of living, the inability to travel to the health care institution due to limited transportation, and low income.

P 177 LONG AND SHORT-TERM CHANGES OF WERENSKIODBREEN'S FRONTAL MORAINE MORPHOLOGY

T. Glowacki[1], K.K. Grudzinska[1], P.P. Zagozdzon[1], L. Downar-Zapolska[1], D. Kasza[1], W. Ciezkowski[1]

[1] *Wroclaw University of Science and Technology, Geoengineering- Mining and Geology, Wroclaw, Poland*

Climatic changes, especially global warming is the main reason for glacier melting. The environment in vicinity of glaciers also changes (ice cores of moraines liquefy glacier riverbeds also switch places). In this paper, authors present the process of change of frontal moraine morphology of Werenskiold Glacier (SW Spitsbergen). Data spanning 80 years (1936-2015) was analyzed. Long term variations were calculated based on digital terrain model (DTM) processing taken from aerial photogrammetry of the 1936, 1960, 1990 and 2011, as well as from GPS measurements performed in 2015. The comparison of DTMs allowed to evaluate magnitude of changes of moraine in four time spans. The magnitude of changes varies over the moraine area. The biggest ones, were detected at northern part with 33 m subsidence. The total change of moraine volume was calculated by DTMs comparison and reached $15x10^6m^3$. Short term surface variations of moraine were determined by radar (InSAR) images processing. In this processing data from three summer periods were taken. Analysis of interferograms allowed to determine areas with greatest vertical changes. The biggest ones can be observed in northern and southern parts of moraine, which is consistent to geometric analysis based on DTMs and GPS results. Short term changes of moraine surface are result of covering material down flow and favorable conditions of ground. It is best seen in northern part where steepness of slopes accelerates loose material down flow. Moraine morphology changes are also result of melting ice that resides inside of the structure, so called moraine the ice core. This process can be observed by increase in watercourse quantity. Infrared measurements (with thermo-vision method) allowed to detect locations where this process appears to be the most intensive. Correlation of thermal and geodetic measurements allowed for more precise tracking of changes in this type of glacier's structures.

P 178 HIGH RESOLUTION MULTISPECTRAL SATELLITE IMAGERIES FOR MAPPING GLACIER SURFACES IN NY-ÅLESUND AND ENVIRON, SVALBARD

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The deteriorating state of glaciers, polar ice caps, snowfall, oceans, and lakes in the Arctic, Antarctic, and mountainous regions of our planet are at the very core of many environmental conditions being monitored. Snow, glacier and ice remote sensing utilizing satellite sensors and field data acquisition allow for process modeling by researchers for observing and trending changes in the Earth's Cryosphere. The present study explores the usage of high-resolution multispectral satellite imageries captured by WorldView-2 and Landsat series of satellites for mapping glacier surfaces in Ny-Ålesund and environ. The broad objective of this study is to understand the usage of multispectral satellite image classifications for characterization of the glacier surfaces to infer and quantify climate change in Arctic regions. Multispectral images (in particular Landsat data) have been extensively used to classify and study cryospheric surfaces. This study uses full-spectrum *in-situ* surface reflectance data from Ny-Ålesund region coupled with WorldView-2 and Landsat ETM+ imagery to explore glacier surface classification. Such simulation of satellite data would lead to new semiautomatic and rapid method for sustained and multi-temporal Arctic observations, and comparisons can be drawn with existing techniques. Our research also focuses on spatiotemporal cryospheric surface change detection studies in Arctic.

P 179 VERIFICATION OF ARCTIC SEA ICE FORECAST IN NMEFC

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[1] *National Marine Environmental Forecasting Center, Polar Environmental Research and Forecasting Division, Beijing, China*

The Arctic sea ice concentration forecast with the spatial resolution of 18 km has been done using MITgcm model in National Marine Envrionmental Forecasting Center, China. AMSR2 sea ice concentration data from University of Bremen was nudged as the daily initial condition. The forecast products were issued and sent to the Chinese icebreaker named Xuelong during its cruising in polar regions. The 24h, 72h and 120h forecast products during the seventh Chinese National Arctic Research Expedition (CHINARE 7) were evaluated. And four zones including Arctic Northeast Passage, Arctic Northwest Passage, Arctic Pacific Sector and Arctic Atlantic sector were divided and evaluated respectively.

P 181 THE INFLUENCE OF SNOW COVER ON SOIL TEMPERATURE IN WESTERN SIBERIA

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Snow cover is an important environmental factor having a significant influence on the soil temperature. Temperature regime affects many soil properties and processes. Thickness of the snow cover affects the depth and speed of freezing and thawing processes, the dynamics of permafrost.

The aim of the study is to assess the impact of snow cover depth and duration on soil temperature in the northern boundary of the taiga zone.

The study area is located in the North of Western Siberia, Russiain discontinuous permafrost zone.

Measurements of snow cover and soil temperature was carried out with temperature loggers Thermochron iButtons. They were laid on four key sites: the pine forest, on top of old frozen peatland, the young frozen peatland (micro elevations and micro depressions). At each site, the loggers were laid on the soil surface and in soil at depths of 20cm and 40 cm, above the soil with an interval of 20 cm to 1 meter. The measurements were carried out four times per day all year.

The study revealed a significant redistribution of snow between landscapes and due to the relief. It results in different snow cover depth and duration. Snow depth on old frozen peatland ranged from 20 to 40 cm, in the forest and in the young frozen peatland ranged from 80 to 100 cm, on micro elevation of young frozen peatland from 60 to 80 cm. Various snow depth have had a significant impact on annual soil temperature. Mean annual soil temperature at 20 cm ranged from 2.2°C in forest to -0.2°C on old frozen peatland.Therefore, we have identified a significant redistribution of snow in the studied region, which significantly affects the soil temperature regime and, as a consequence, the activity of microbiota and the speed of organic matter transformation.

P 182 LANDFORM TRANSFORMATION IN THE SOUTHEASTERN SPITSBERGEN COAST, 2005–2016

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Current climate warming is the main factor of landform trasformation in the southeastern coast in 2005-2016. Ridges of lateral, frontal and stadial ice-cored moraines were quickly lowered and flattened due to melting of ice which had consisted a majority (or almost the totality) of their volume. In valley bottoms (released from glaciers after 1900): kames and eskers underwent progressive degradation, sandurs became more extensive, and river beds were eroded in bedrock. The high (up to 30-50 m) lateral ice-cored moraines of the Hambergbreen glacier, preserved on the Hambergbukta fjord (on its northern coast and southeastern outlet) after 1900, were eroded and lowered due to cutting by storm waves. Uppermost parts of these moraines, situated at the foot of steep slopes, were covering up gravitationally with slope material. Coastal landforms underwent also significant changes: (1) new rocky cliffs appeared in the fjord head due to recession of tidewater glaciers, (2) the open-sea coastline generally retreated and beaches at foot of steep slopes were narrowed or completely declined, (3) lagoon lakes decreased due to filling them by alluvial fans, removing their bars to the foot of slopes, and burying them by slope material (the last two processes wasted two lakes which had been the remains of Davislaguna in 2005). Slope landforms were changed - due to intensification of mass movements, connected first of all with deepening the active layer (thawing in summer) on permafrost, and also with longer summer season, quicker melting of snow patches, etc. The Daudbjørnpynten headland underwent subsidence of the deepened active layer. (This document was produced with the financial assistance of the Prince Albert II of Monaco Foundation. The contents of this document are the sole responsibility of Jagiellonian University in Krakow and can under no circumstances be regarded as reflecting the position of the aforementioned Foundation).

S17.2 "ARCTIC IN RAPID TRANSITION" IN TIMES OF GLOBAL CHANGE - GLOBAL IMPACTS ON THE ARCTIC MARINE ENVIRONMENT AND COASTAL COMMUNITIES

O 190 SEA ICE, RAIN-ON-SNOW AND TUNDRA REINDEER NOMADISM IN ARCTIC RUSSIA

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Sea ice loss is accelerating in the Barents and Kara (BK) Seas in the northwest region of Arctic Russia. Assessing potential drivers and linkages between sea ice retreat/thinning and maintenance of the region's ancient and unique social-ecological systems is a pressing task. Tundra nomadism remains a vitally important livelihood for indigenous Nenets and their large reindeer herds. Warming summer air temperatures in recent decades have been linked to more frequent and sustained summer high-pressure systems over West Siberia, but not to sea ice retreat. At the same time, autumn/winter rain-on-snow events across the region have become more frequent and intense. Here we review evidence for autumn atmospheric warming and precipitation increases over Arctic coastal lands in proximity to BK sea ice loss. Two major rain-on-snow events during November 2006 and 2013 led to massive winter reindeer mortality episodes on Yamal Peninsula. Fieldwork with migratory Nenets herders has revealed that the ecological and socio-economic impacts from the catastrophic 2013 event will unfold for years to come. The suggested link between sea ice loss, more frequent and intense rain-on-snow events and high reindeer mortality has serious implications for the future of tundra Nenets nomadism. Nenets oral histories documented that smaller, more nimble privately owned herds fared better than larger collective herds. This strategy has worked well for dealing with encroaching infrastructure. If BK sea ice decline continues, better forecasts of autumn ice retreat coupled with additional mobile slaughterhouses could help to buffer against reindeer starvation following future rain-on-snow events. Even a few days of early warning could make a critical difference. Realizing mutual coexistence of tundra nomadism within the Arctic's largest natural gas complex under a warming climate will require meaningful consultation, as well as ready access to - and careful interpretation of - real-time meteorological and sea ice data and modelling.

O 188 PUBLIC VIEWS OF THE ARCTIC: RESULTS FROM RECENT US SURVEYS

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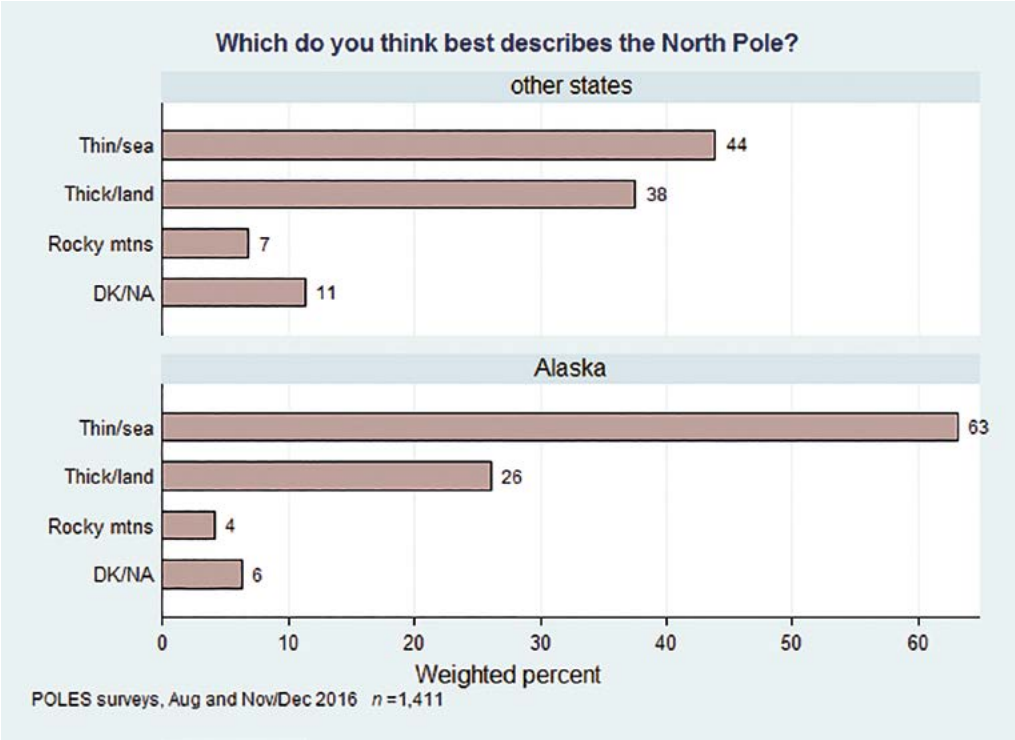
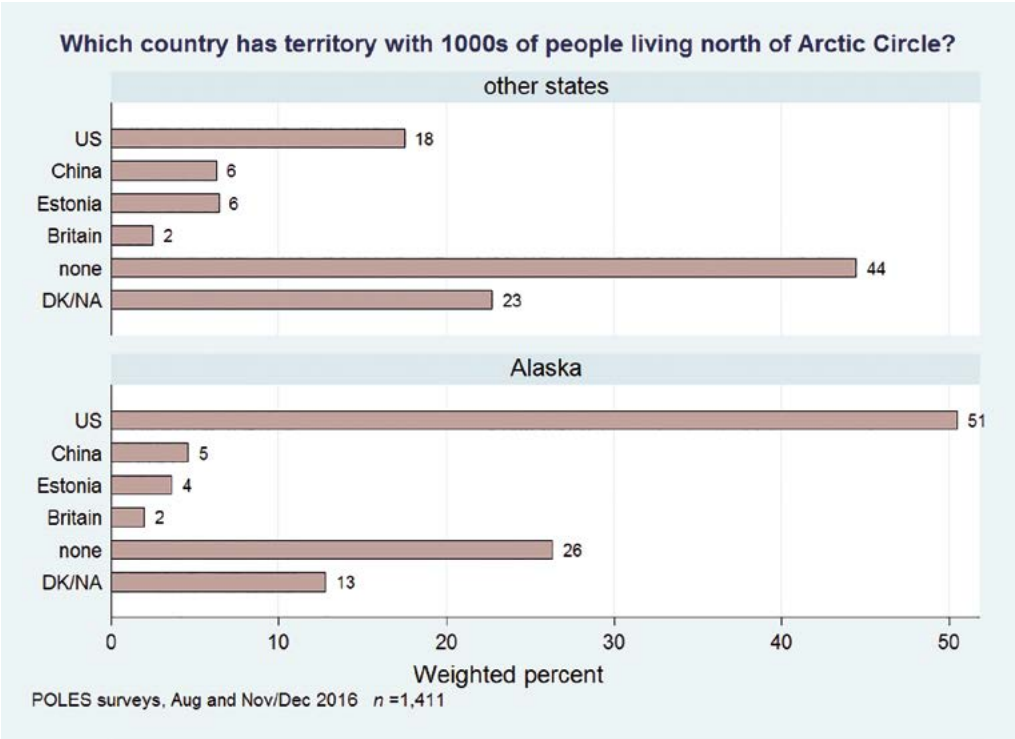
Many drivers of Arctic change originate in mid-latitude industrial societies, so public perceptions there matter to the future of Arctic residents and ecosystems. US general-public perceptions about the Arctic were previously studied by nationwide surveys in 2006, 2010 and 2011, which found broad concerns but limited knowledge. Two more recently surveys took place in August and November/December 2016, before and immediately after national elections. These 2016 surveys included, for the first time, interviews with representative samples of Alaska and rural Alaska residents - so their perceptions and knowledge could be compared with those of Americans living elsewhere. Here we present results and analysis from these 2016 Polar Environment and Science (POLES) surveys. Overall, Americans' knowledge about the Arctic is not high. For example, only 44% understand that the North Pole is on sea ice, and just 18% know that the US has territory and people living in the Arctic. Arctic awareness is better among Alaska residents, but still not very high. Sixty-three percent of Alaskans understand that the North Pole is on sea ice, and 51% of Alaskans know the US has territory and people in the Arctic - although these are in their own state. One fact that is recognized by both Alaskan and other US respondents is the declining area of Arctic sea ice. Apart from state of residence, Arctic knowledge and perceptions correlate with respondent demographic characteristics and political orientation.





O 191 THE ERODING COASTLINE OF SOUTHWESTERN BANKS ISLAND

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Arctic communities are increasingly vulnerable to the near-term effects of climate change. Increased storm intensity over the past decade in the Arctic coupled with increased warming and decreased sea-ice extent, all act as catalysts to shoreline movement.

This investigation quantified rates of shoreline change along a 44 km segment of Southwestern Banks Island, Northwest Territories, Canada. Thirty years of shoreline position data (from 1982-2015) were obtained from Landsat multi-spectral satellite imagery. An updated modelling methodology (Analyzing Moving Boundaries Using R (AMBUR)) technique was used to quantify rates of change over varying time-periods.

Results reveal that the 44 km stretch of Arctic coastline along Southwestern Banks Island retreated at an average rate of -0.98 meters per year over the duration of the study period. Further, the analysis revealed a dominant erosional signal across a significant portion of the study-area with approximately 71% of the shoreline retreating landward. A localized segment of shoreline in close vicinity to the main population centre of Sachs harbor was also analyzed over the more recent period of increased storminess (1998-2015). Data shows acceleration of erosion in this area over the short-term, with average retreat rates of 1.15 meters/year. Erosional hotspots (zones) exist to the west of Martha Point Spit and immediately east of the populated zone. Shoreline retreat along these areas, and by extension the coastline along Southwestern Banks Island, appear to be directly related to decreases in sea-ice extent that facilitate elevated wave amplitudes with storm passage.

O 189 ARCTIC IN RAPID TRANSITION: THE CASE OF PEVEK AND CHAUN-CHUKOTKA

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Chaunsky Distict or Chaun-Chukotka is one of the municipal divisions of Chukotka Autonomous Okrug, which is located on the northern shore of Chukotka around Chaun Bay (the East Siberian Sea). Its administrative center is the city of Pevek, an Arctic port city and the northernmost city of Russia. The port of Pevek is one of the most important ports of the Eastern part of the Northern Sea Route. Similar to many other Arctic places, Chaun Chukotka has been facing dramatic changes over recent decades as a result of interplay of several local, national and global factors including socio-economic processes and climate change. This presentation discusses the main drivers of ongoing and possible changes in Chaun-Chukotka, their consequences and how they are perceived by locals including the indigenous population.

P 183 ARCTIC IN RAPID TRANSITION (ART): A PAN-ARCTIC NETWORK

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The Arctic is transforming at an unprecedented pace, with the diminishing Arctic sea-ice cover being the most alarming factor. Sea ice plays a central role in the Arctic system, its decline and thinning has a multitude of implications ranging from physics and biology to geopolitics and economics. Timely planning and mitigation activities in the Arctic are challenging, though, given the mismatch between observed and predicted patterns of change. To enable robust projections of future conditions throughout the Arctic region, a holistic pan-Arctic approach spanning across disciplines is required. Arctic in Rapid Transition (ART; http://iasc.info/networks/arctic-in-rapid-transition) is an international and interdisciplinary pan-Arctic scientific network, developed and steered by early-career scientists that aims at such an approach. The main goals of ART are bridging time-scales by incorporating paleo-studies with modern observations and modelling, and applying various science disciplines to better understand the past and present response of the Arctic marine ecosystems to sea-ice transitions and climate change, thus improving our capability of predicting future scenarios. Initiated as a continuation of the International Conference on Arctic Research Planning II (ICARP II) Marine Roundtable in 2008, ART became an official International Arctic Science Committee (IASC) network in 2013. Past ART activities included the co-organization of two science workshops (in Poland, 2012, and France, 2014). The first workshop has resulted in a special issue in Polar Research, while the second one resulted in priority fact sheets for future Arctic research stated from an early career scientists' perspective, which contributed to the ICARP III process. Currently, ART focuses on active data collection. One example thereof is the TRANSSIZ (Transitions in the Arctic Seasonal Sea Ice Zone) expedition with the German research icebreaker RV "Polarstern", conducted in 2015.

P 184 THE MODEL OF PSYCHOLOGICAL SAFETY OF OIL AND GAS SHIFT WORKERS IN THE ARCTIC

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The study was sponsored by the Russian President's grant for state support of young Russian scientists - PhD (MK-7500.2016.6). The research is devoted to the justification of a model of psychological safety of oil and gas workers at shift work in the Arctic. The safety in industrial activity in the first place depends on the employee, at the same time not only by his relation to the observance of occupational safety and health, but also on the characteristics of the individual specialist, his subjective experience and the effectiveness of his psychological self-regulation. The study was conducted on the oil and gas industry with a shift labour organization in the Nenets Autonomous Okrug of Russia (shift duration is 30 days). The study involved 70 people between the ages of 24 to 60 years (mean age 38,7 ± 1,3). Methods are: the study of documentation, monitoring the work process, questionnaires, psycho-physiological and psychological testing, statistical methods of data analysis. The study clarified the concept of psychological safety as a mental state accountability subject complex internal and external factors ergatic system ensures updating of internal resources of the individual to the effectiveness of professional activities on the psycho-physiological and psychological level. Introduced and empirically grounded model of psychological security, which is represented by the following components: psycho-physiological level of functional status (reduced / optimal); psychological level of functional state (avralny / economical); the image of the object of labor (low hazard assessment undifferentiated / high differentiated risk assessment); the image of the subject (undifferentiated high / moderately differentiated high self-assessment); the image of the subject-object and subject-subject relations (neutral / negative / positive). Empirically studied and characterized components of psychological safety of oil and gas shift workers of different professional groups in the Arctic, taking into account seniority.

P 185 THE ART NETWORK'S "TRANSITIONS IN THE ARCTIC SEASONAL SEA ICE ZONE – TRANSSIZ": A CRUISE TO THE EUROPEAN ARCTIC MARGIN

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[10] *Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Geosciences, Bremerhaven, Germany*
[11] *Fisheries and Oceans Canada Freshwater Institute FWI, Manitoba, Canada*
[12] *Akvaplan-niva AS- Fram Centre/ Laboratoire des Sciences de l'Environnement Marin LEMAR, Brest, France*
[13] *AquaBiota Water Research, Stockholm, Sweden*
[14] *Stockholm University Department of Geological Sciences, Stockholm, Sweden*
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[16] *Various affiliations, Bremerhaven, United Kingdom*

The TRANSSIZ ('Transitions in the Arctic Seasonal Sea Ice Zone') cruise PS92 on the German research icebreaker R/V Polarstern in May/June 2015 was initiated by the "Arctic in Rapid Transition" (ART) International Arctic Science Committee (IASC) network. The overall cruise goal was to use a multidisciplinary approach to identify the potential characteristics in carbon production as well as to investigate similarities and differences in ecosystem functioning related to gradients in topography, sea ice and water masses, and to link past and present sea-ice transitions in the Arctic Ocean. During the transit to the investigation area changes of dissolved trace gases, nutrients and phytoplankton composition were studied from 57°N to 80°N. In order to achieve the overall goals of the cruise, ecological and biogeochemical early spring process studies were conducted from the shelf to the basins of the European Arctic margin and on the Yermak Plateau. At eight sea-ice stations R/V Polarstern was anchored for 36 hours to an ice floe in order to carry out process studies on productivity, ecosystem interactions, and carbon and nitrogen cycling.

Sea-ice station work involved sampling for biological, physical and chemical variables, trace gases and geological proxy validation. Special emphasis during this expedition was given to the quantification of the environmental preconditions for biological productivity (e.g. nutrients, stratification) under sea ice and in open waters. These studies will allow improving predictions of the potential annual primary production in a potentially ice-free Arctic Ocean in the future. Investigations during TRANSSIZ also enable reconstructions of productivity, food web carbon flux, and sea ice and ocean circulation across the few last glacial cycles. The cruise will further improve the understanding of ecosystem functioning and biogeochemical cycles in the transition from spring to summer in the European Arctic margin. (cruise-report at (http://epic.awi.de/39592/).

P 186 SPHEROIDAL CARBONACEOUS PARTICLES (SCPS) IN MARINE SEDIMENT FROM ARCTIC FJORD

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The present study explores the presence of Polycyclic aromatic compounds (PACs) and Spheroidal Carbonaceous Particles (SCPs) recovered from the sediments of Kongsfjorden, Ny-Ålesund, Arctic. As the increasing anthropogenic impact in the form of Polycyclic aromatic compounds (PACs), Polychlorinated biphenyls (PCBs) etc related to human activities and increased use of fossil fuels has been observed at many places along the Arctic regions. After releasing from their source these pollutants adsorb or attach to the Spheroidal carbonaceous particles and reach the Arctic travelling through air currents. SCPs porous structure also provides shield to the pollutants (PACs, PCBs etc) from the sunlight and stops the photolytic reaction.

S17.3 RAPID ARCTIC TRANSITIONS DUE TO INFRASTRUCTURE AND CLIMATE (RATIC)

O 118 CONTRASTING PUBLIC PERCEPTION OF CLIMATE AND ENVIRONMENTAL CHANGES IN THE ARCTIC AGAINST OBSERVATIONAL DATA

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Climate could be viewed as an inexhaustible public resource that creates opportunities for sustainable development in the Northern Lands. Long-term trends show that climate as a resource is becoming more readily available in the Arctic, notwithstanding the general perception that globally climate change is one of the challenges of the 21st century. Adaptation strategies are required for sustainable development of the Arctic under changing climate. Meanwhile, even the best designed policies would fail, if they are not supported by the public.

This study compares the observational data on climate and environmental changes with the results of the public survey conducted in Yakutia in the period 2012-2016 (Figs. 1 and 2). The survey involved more than 1600 respondents in 3 cities (Yakutsk, Aldan, Nerungri) and 2 villages (Ust-Maja, Saskhulakh) representing different economical, sociological, permafrost, vegetation, and climatic conditions.

Data in Table 1 show the percent of the population that noticed the selected climate change indicators. It follows that public perception of the climatic and environmental changes is not univocal, and is not always in accord with the observed long-term climate trends. Low probability extreme events, such as unusual weather patterns or abrupt landscape changes may have greater effect than the long-term climate trends. Currently less than half of the population in Yakutia consider climate change as an established fact, and are ready to take actions in this regard. Meanwhile, Yakutia is a region where observational records demonstrate the most pronounced changes in climatic regime compared to other parts of the Arctic. The contrast between the actual changes and public perception of such changes has important implication for developing adaptation strategies in the Arctic. To be effective, such strategies should combine knowledge coming from instrumental- and model-based analysis of environmental changes with the public perception of such changes.

O 116 DRIVERS OF LANDCOVER CHANGES IN TUNDRA REINDEER PASTURES OF YAMAL, WEST SIBERIA

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[4]researcher, Department of Geographical and Historical Studies, Joensuu, Finland

[5]professor, Arctic Centre- University of Lapland-, Rovaniemi, Finland

In central Yamal peninsula in West Siberia both natural and anthropogenic changes have occurred during the past 40 years. Mega size Bovanenkovo gas field (BGF) was discovered in 1972. In 2006 Gazprom launched a new plan for production and in October 2012 gas production began. Since then at least two new fields Novyi Port and Tambey fields have began to operate. We have studied gas field development and natural changes like increases in shrub growth, cryogenic landslides, thawing lakes in the region.

The traditional landuse in the Yamal is reindeer herding practiced by nomadic Nenets herders. The hydrocarbon industry is presently the source of most ecological changes in the Yamal peninsula and socio-economic impacts experienced by migratory Nenets herders who move annually between winter pastures at treeline and the coastal summer pastures by the Kara Sea

Employing a variety of high- to very high-resolution satellite-based sensors (Corona, KH-9, Landsat, SPOT, ASTER Terra VNIR, Quickbird-2, Worldview-2/3), we have followed the establishment and spread of Bovanenkovo. Extensive onsite field observations and measurements of land use and land cover changes since 1985 have been combined with intensive participant observation in all seasons among indigenous Nenets reindeer herders and long-term gas field workers.

Nenets managing collective and privately owned herds of reindeer have proven adapt in responding to a broad range of intensifying industrial impacts at the same time as they have been dealing with symptoms of a warming climate. Recent years reindeer herding has experienced two serious drawbacks, first Rain On Snow phenomenon in November 2013 iced large part of the southern Yamal peninsula pastures and led to death of about 65 000 reindeer. Secondly in summer 2016 anthrax outbreak in southern Yamal peninsula caused about 2000 reindeer deaths. Here we discuss the drivers of landcover changes in the reindeer pastures of Yamal peninsula.

O 152 EFFECT OF CLIMATE CHANGE AND RESOURCE SCARCITY ON ROAD AND RAILWAYS INFRASTRUCTURE: NORWEGIAN CASE STUDY

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The scenarios for future climate in Norway all predict milder winters and one could expect that frost related problems will be less severe or perhaps disappear altogether. However, it is also believed that the variations both in a single winter and from year to year will increase. This means that even if the average winter is milder the design winter could be colder and that we should prepare for even more frost related problems in the future. Thus, in most of Scandinavia, roads in regions that previously enjoyed stable winter conditions are now subject to several freeze-thaw cycles each winter. This will accelerate road deterioration and consequently increase maintenance costs. In general, cold climate countries have to cope with pavement deterioration effects, which in countries such as Norway represent ~30% of the maintenance budget. Damages due to frost heave are particularly difficult to repair since frost protective layers have to be placed deep in the road structure. For railways insulation of existing structures is costly, but possible without replacing the structure.

According the Norway's Arctic Policy published by the Norwegian Ministry of Foreign Affairs, more reliable infrastructure is one of the Government priorities. As it is written in the Norwegian National Transport Plan 2014-2023 (NTP), one of the objectives is "a well-maintained transport infrastructure built to withstand climate changes and other challenges to reduce the costs for infrastructure owners, traveler's/road users and operators. The significance and the consequences of climate change are increasing. It is necessary to consider climate change forecasts during the planning, development, operation and maintenance of infrastructure. New infrastructure must be designed to resist increasingly severe climate impacts".

In the presentation we are going to present the Norwegian case study that examine road and railway infrastructure changes due to changing climate and increased resource scarcity.

O 117 THE RUSSIAN ARCTIC OFFSHORE GAS PROJECTS: FACTS, SCALE, PROSPECTS AND CLIMATE CONCERNS AND LIMITATIONS

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The Russian Arctic gas reserves are so huge that they could meet current European gas demand for about one hundred years. The Yamalo-Nenets region provides about 80% of Russian gas, however, the offshore reserves are still unatapped. It is very important to understand this sector and what are its future development prospects. This would help to improve and adapt Arctic economic sustainable planning, environmental policy and the scientific efforts in this field of study.

Novatek is building a new sea terminal in Sabetta and has ordered a fleet of 16 Arc7 ice resistant LNG carriers for Yamal LNG. Offshore the industry has opted for the liquefaction technology due to economical and environmental reasons and transport flexibility. Currently, only Yamal LNG is in the final development phase with Arctic 2 LNG possibly operational until 2025.

A series of factors would determine the future of Russian Arctic LNG projects: world gas demand, commodity prices, climate budget concerns, renewable energy growth and technology change, competitive supply and political relations. In the short term the lower price of natural gas worldwide could have a significant impact on recent Arctic investment decisions. In the medium term, however, the carbon budget and the booming renewable sector will lower future demand for natural gas. The world LNG market is currently oversupplied and there is presumably still a ten to twenty years window opportunity for new Arctic LNG projects to materialize.

LNG terminals are megaprojects with a huge environmental footprint and sociological impact. Their development is strongly dependent on factors outside the Arctic decision domain. LNG projects and related infrastructure development would not be probably a radical driver of change for the Russian Arctic also because they might be very limited in number.

O 149 NORTHERN INFRASTRUCTURE STANDARDIZATION

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The paper describes the permafrost conditions of northern Canada, and the challenges of constructing and maintaining building and transportation infrastructure in Arctic communities in the presence of climate warming. It then describes the standardization initiatives that are under way in Canada, initiatives that began with an extensive consultation process. It describes four new standards that the Standards Council of Canada has prepared under the Northern Infrastructure Standardization Initiative, plus a fifth standard that is expected to be published in February 2017. These standards are being promoted through on-line and in-person training sessions to a wide variety of private and public sector audiences in Canada, including training in small Arctic communities. The standards have potential application throughout the circumpolar world as building and transportation infrastructure is adapted to climate warming. Standardization for sustainable infrastructure development is of great importance in the circumpolar world.

O 150 ACTIVE SNOW MANAGEMENT AS MITIGATION TO LIMIT PERMAFROST DEGRADATION AT INFRASTRUCTURE

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Permafrost degradation caused by climate warming is already affecting northern infrastructure construction and maintenance. These problems may be exacerbated because infrastructure embankments commonly trap snow, limiting ground heat loss in winter. Several adaptation and mitigation methods have been found to reduce ground temperatures and limit permafrost thaw. These include insulated embankments, high-albedo surfacing, air convection embankments, thermosyphons, heat drains, and open air ducts. Unlike these passive techniques, active snow management that decreases snow depth and/or increases snow density may be preferable as it requires no construction of stationary infrastructure, and thus may be targeted at sections of embankment in areas where the ground is ice rich and sensitive to degradation.

The objectives of this presentation are to describe: (1) measured and modelled ground temperatures at the toe of the Dempster Highway road embankment in western Arctic, Canada, (2) results from simulations that mimic active snow management as a potential maintenance activity to reduce ground temperatures, and (3) the operational feasibility of such snow management.

Permafrost is presently degrading at the Dempster Highway embankment toe at four of five instrumented sites, where deep snow accumulates. Numerical simulations of active snow management suggest that limiting snow depth and increasing the snow density in these settings serve to rapidly freeze back taliks (zones perennially frozen ground) and cool permafrost over several years. Effective snow management could be achieved by using, for example, a snowcat with blower attachment to reduce the snow depth, and plate compactor to increase the density of remaining snow. The feasibility of this method should be tested in the field to determine the efficacy and economy of operation.

O 119 PHYSICAL, CULTURAL AND ECONOMIC IMPACTS OF PERMAFROST THAW ON COMMUNITIES AND INFRASTRUCTURE IN YUKON AND THE NORTHWEST TERRITORIES, CANADA

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Arctic communities undergoing rapid environmental change can benefit from the collaboration between multiple disciplines and integration of local and traditional knowledge. Permafrost can be the nexus that brings together disciplines that are often struggle to work together, including physical and social sciences, humanities and indigenous knowledge. Permafrost underpins Arctic communities and landscapes; it is literally the foundation for the lives of northerners, including homes, roads, and hunting grounds. Using applied research, we are integrating physical, cultural, and socio-economic factors in assessments of permafrost vulnerability to thaw. We are innovating in applying art as a communication tool to provide tangible, useable results to communities that reflect their priorities and support decision making.

We have explored diverse contexts and issues as we mapped permafrost vulnerability in northern communities, in traditional territories, and along northern infrastructure. Permafrost thaw in communities affects buildings and homes, intensifying the housing crisis in northern Canada. Highways built on permafrost cost upwards of ten times in maintenance when compared to southern roads. Permafrost thaw is transforming natural habitat, potentially threatening important caribou habitat and exacerbating food insecurity.

Building on our permafrost vulnerability assessments, we are integrating economic principles and traditional land-use elements. We work with geo-technical engineers to identify adaptation options (e.g., improved building techniques, permafrost thaw mitigation approaches) and conduct an economic analysis of associated costs. We have integrated traditional land-use activities in assessments of permafrost thaw risk by layering hunting and gathering areas onto permafrost vulnerability maps. It became apparent that key habitat areas within the First Nation's traditional territory are situated on highly thaw-sensitive permafrost, and therefore at risk to be impacted by change. Using art as a unifying communication tool, we are sharing the implications of permafrost degradation on infrastructure, food security and land-use activities to inform adaptation planning and help communities identify future priorities.

O 151 IMPACTS OF TRANSPORTATION INFRASTRUCTURE: SOCIAL DYNAMICS AND SUSTAINABILITY ALONG THE BAM

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Baikal-Amur Mainline (BAM) is the main northern transportation route that connects Eastern Siberia and the Russian Far East. Conceptualized for geopolitical reasons (relations with China), the railroad has had unprecedented social and economic impacts. The BAM, similar to other large-scale infrastructure projects labeled "projects of the century", was an embodiment of Soviet nation-building policies and of communist ideology. In the 1970s and 1980s, the railroad construction process attracted a culturally diverse population from all across the Soviet Union to the region. As a result, not only the railroad was built, but also new communities, identities and a novel social environment were forged.

The economic crisis of the 1990s lead to a massive population outflow, public criticism of the BAM, as well as degradation of the railroad and its social infrastructure. While some objects (e.g., tunnels) were completed as late as 2003, others (such as factories, apartment houses, or side-tracks) were left unfinished due to a lack of investments.

Today, typical BAM communities include medium-scale cities and towns, that had been founded as train stations or temporary settlements, and a few indigenous and mixed villages in relative proximity to the railroad. Despite the fact that many BAM builders (*bamovtsy*) left the North, they still constitute the majority population along the railroad. New migrants have come to the region as a result of the reactivation of resource extraction and the launch of railroad modernization (to increase cargo and resource transportation capacities). Yet, these promises of infrastructure modernization are challenged by the growing competition for resources and the dependence of BAM communities on extractive industries and the railroad.

This paper uses the concepts of resource curse and sustainable development to analyze far-reaching social and economic impacts of industrial and transportation infrastructures on local communities.

O 153 MEASURING THE NORDICITY OF THE ARCTIC TODAY WHAT IMPACT OF GLOBAL WARMING AND ECONOMIC INTEGRATION?

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Coldness contributes significantly to the representation and definition of the Arctic. Thus, in a context of global warming, does the Arctic not reduce mechanically? Similarly, its common social representation associates it with a low-density settlement and traditional economies. Does accelerating integration of the boreal regions not affect their degree of nordicity?

The index of nordicity of Louis-Edmond Hamelin dates back to the 1960s and the author has already pointed out effects of retreat and extension (Hamelin, 1968). This composite index still holds a special place (Petrov, 1977). It combines 10 criteria: one is latitude, six concern physical environment and, four concern human environment. For each of them, a place takes points according to its degree of nordicity. Finally, the sum of all its points forms its polar value. L.-E. Hamelin thus defined ‚isonorths', lines of equal degree of nordicity, the one of '200' laying the southern limit of the Arctic.

We attempt to update this index using as much as possible global and free databases. Its calculation in 1960 and 2010 allows to conduct spatio-temporal analyze. This presentation focuses on the first part of this work, which concerns the physical environment, ie 6 out of 10 criteria. A raster with a spatial resolution of 25 km x 25 km is developed for each criterion. Then, a data conversion into points of nordicity is carried out according to a matrix adapted from L.E. Hamelin. Finally, the new raster is added to the stack to make the final sum.

The results show a retreat towards the north of the isonorths. Regional disparities appear and are discussed. The case study of Western Siberia for which all the criteria have been calculated show a retreat of the Arctic boundary also as a result of the urbanization and human infrastructure development over the 1960-1990.

O 115 RAPID TRANSITIONS CAUSED BY INFRASTRUCTURE AND CLIMATE, PRUDHOE BAY OILFIELD, ALASKA, USA

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The Prudhoe Bay Oilfield, Alaska is the largest Arctic oilfield in North America with a 65-year history of high-resolution aerial-photos that lends itself to time series analysis of changes due to infrastructure and climate. In a previous publication we reported the recent widespread expansion of thermokarst, starting in about 1989. Here we examine the annual air-photo record in the vicinity of two areas of intensive field studies to better pinpoint the years of major change. We also conducted detailed field studies of roadside changes using topographic surveys and soil, vegetation and ice-wedge coring studies. Both sites exhibit extensive ice-wedge degradation caused by a combination of a long-term warming trend a series of exceptionally warm summers, and infrastructure-related factors that melted the tops of ice wedges. Near-road thermokarst is enhanced by warmer soils associated with road dust, flooding, altered snow regimes, off-road vehicles, pipelines, communication cables, etc. These strongly affect roadside ecosystems and the infrastructure itself. Changes to ecosystems include altered hydrology, drying of polygon centers, formation of well-developed high-centered polygons and extensive thermokarst ponds. An unexpected result of flooding is the stabilization of ice-wedge degradation in some areas because the increased productivity of sedges in the flooded areas is producing large amounts of organic material that protects the tops of ice wedges from further degradation. The large increases in productivity in roadside areas also attract large flocks of waterfowl. Changes to the soils with the addition of thick layers of dust cause decreases in the plant diversity. There are also broad social and economic implications. For example, a flood along the Dalton Highway in 2015 caused extensive degradation of ice wedges, major damage to the Dalton Highway and affected transportation to and from the oilfield for several weeks in Spring 2015.

P 187 C BUDGET IN NORTHERN CITIES AND VILLAGES (THE CASE OF SAKHA (YAKUTIA))

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The creation of carbon-free zone in Eastern Siberia as the way of implementation in Russia the Kyoto (December 1997) and Paris (December 2015) protocols is actual. The data on C emissions in Russians regions or cities are not available due to lack of information. Analysis data of C emission obtained by project COPERA team for various settlements of Yakutia shows that it varies depending on the population density and the technology of generation of electricity and heating energy.

Fuel and energy complex of Yakutia is a huge open system because of the vast territory and different sources used for electricity and heating generation. About 40% of the territory of Yakutia, where about 85% of the population, are covered by centralized power supply in the Western (hydro generation), the Central (natural gas, coal) and South Yakut energy districts. Most of the territory of the Republic (60%) with a population of about 150 thousand people apply to the North energy district - the zone of decentralized power supply with energy sources of low power, mostly diesel power plants. Renewable energy sources (solar panels, wind power generation) are tested here also.

Factor analysis of Fuel and Energy Balance data shows that Yakutia receives the effect from modernization of the fuel and energy complex. To 2008 C emissions from anthropogenic factors have been reduced because of implementation of state programs of energy saving and gasification of settlements.

Estimates of C budgets of cities and villages of Yakutia lead to the conclusion that rapid urbanization in the northern regions can be one of the risk factors for the environment and the local climate. Integration of climate and social (spatial) model is perspective scientific task.

P 188 SOCIAL ARRANGEMENT OF FARM MANAGEMENT IN THE REPUBLIC OF SAKHA (YAKUTIA)

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The cause of the recent thermokarst depression over the Siberian permafrost is not only climate change, but also social change. Land degradation is highly conspicuous on the abandoned grasslands that were created by deforestation in Soviet times. The soil condition has been affected by the intensive large-scale stock farming, together with global warming. Therefore, it is crucial in any environmental investigation to track transformation of the social system at the same time. This presentation illustrates the current social setups working around the livestock farming economy in the Republic of Sakha (Yakutia).

A few years after the fall of the Soviet Union, the former *Sovkhoz* state-operated farms were dissolved in Sakha. Farm management was transformed from the state to individuals. At present, there are two types of farm management. One is the farmers' management, the operators of which must register with the government, can obtain privileges such as subsidies and grants-in-aid, and who are subject to certain obligations such as audit and payment of taxes. The other type of farm management is the individual household management. The operators of this type are not bound by such obligations, but they have to manage without any governmental support. The selection of the type of farm management to employ is left to the discretion of each person.

Meanwhile, there are some in-between organizations such as consumers' cooperative societies and farmers' associations. Each individual farmer has some links with these in-between organizations. Thus, even after the agents of farm management were transferred from the state to individuals, each state and individual, organization and market continues to be intricately entangled with one another. The transition of the social arrangement should be monitored carefully together with the method of land use.

P 189 URBAN CLIMATE RESEARCH IN ARCTIC: METHODOLOGY OF MEASURING URBAN HEAT ISLAND INTENSITY AND COMPLEX ANALYSIS OF PHENOMENON

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Since 2010, more than one half of Earth population lives in urbanizes areas. So, the problem of land-use and microclimate changes in city area becomes more important in the context of inhabitants' long-term quality of life.

The heat island for cities in tropical and temperate latitudes by now has been studied quite well. (Oke, 1987). According to (Oke, 1987; Ryu, Baik, 2012), one of the major reasons for its occurrence is considered to be more effective absorption and accumulation of solar heat in the town.

However, the formation of heat islands in the polar cities is scarcely explored: such work was carried out only in towns in Alaska (Magee et.al., 1999). In Eurasian big cities principal possibility of formation of heat islands in the polar night isn't still described well.

That's why in this report, we plan to discuss developed methodology of the UHI experimental research in big Russian Cities located to the north from the Arctic Circle and first results.

During our field trips in 2014-2016 we used a different measurements techniques:

1. Installation of two automatic weather stations (AWS) in rural zone and city center.
2. Installation of small temperature sensors (iButton) network in the city and suburbs.
3. Regular car-based temperature sounding of the city with AWS (on photo).
4. Using MTP-5 microwave temperature profiler.

Analysis of the collected data showed the existence of significant UHI with the difference between city center and surrounding landscape up to 5-8ºC

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P 195 URBAN HEAT ISLAND IN HETEROGENEOUS TERRAIN DURING UNDER CONDITIONS OF THE ARCTIC WINTER: ANTHROPOGENIC EFFECT OR INFLUENCE OF THE RELIEF?

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Experimental measurements in Apatity town in Kola peninsula in Russia (which is 5th biggest town, located to the north from the Arctic circle, with population about 56000) during winter seasons in 2014-2015 years has shown existence of the strong temperature anomaly around the town: temperature difference between town and weather station, located in few kilometers from it, reached values up to 10°C (Konstantinov et al., 2015) with mean value about 2 °C. However, understanding the nature of such anomaly is quite complicated. On the one hand, it could be caused by urban heat island effect, which is well-studied for the cities in moderate and tropical climate zones, but poorly investigated for high latitudes. On the other hand, possible contribution of the topography should also be taken into consideration, because town is located at the top of the hill, and weather station - at lower point near basement of this hill, where cold air could accumulated under conditions of the stable stratification. In our study contribution of these two factors was analyzed with application of newest experimental measurements, remote sensing data and numerical experiments with regional climate model COSMO-CLM, extended by specific urban parametrization. Finally, three independent approaches show approximately equal contribution of relief and anthropogenic effect to the genesis of observed anomaly. Accordingly, mean intensity of urban heat island effect, created by the town itself during the winter season, could be roughly estimated as 1°C , and its maximum values - as 5-6 °C, which is also significant in terms of house heating and meteorological comfort.

Reference: Konstantinov P.I. et al. Mapping urban heat islands of Arctic cities using combined data on field measurements and satellite images based on the example of the city of Apatity (Murmansk oblast)//Izvestiya - Atmospheric and Oceanic Physics. 2015. Vol. 51, N. 9. P. 992-998.

P 191 THE BIOLOGICAL ACTIVITY OF WEST SIBERIA SOIL IN RESPONSE TO LONG-TERM PERMAFROST DEGRADATION

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Permafrost ecosystems are sensitive indicators of environmental change. Anthropogenic impact disturbs the balance of natural ecosystems functioning, first of all soil and vegetation significant changes undergoes.

The aim is to estimate the response of soil and northern West Siberia permafrost ecosystems on permafrost thawing as a result of forty years exploitations of the pipeline. Ten transects, from the pipeline to a natural ecosystem area, of 50 meters in length with sampling points every 5 meters in different natural zones were investigated. The active layer of soil, the power of organic horizons, hydrothermal regime of soils were measured, also greenhouse gas emissions was studied. In the laboratory we studied the content of labile carbon and microbial biomass carbon (C mic), pH, basal (BR) and substrate-induced respiration were measured.

As a result of gas pipelines construction the permafrost thawing take place, ecosystem functioning, the temperature increases, moisture slightly decreases. The largest changes are seen for the vegetation: the part of vascular plants grows (from 20 to 70 %). For CO_2 fluxes nonsignificant increase is inherent, but in the case of flooding a significant increase in CH_4 emissions is noted.

Major changes are set for soil properties: there are increasing of soil temperature (from 4,5 to 13,5 ° C) and pH (from 3,5 to 5,3). The total and labile carbon (from 1,4 to 0.6 (mg C / g soil)) decreases. Microbiological activity is also decreases: BR (from 3 to 1 ($C\text{-}CO_2$ g / g of soil • h)), C mic (from 2,3 to 0,3 (mg C / g soil)).

As a result of permafrost degradation after 40 years of thawing we observe the significant changes of ecosystem: of the species vegetation composition, its biomass increasing and soil biological activity reducing.

P 194 SUSTAINABILITY OF THE ECONOMIC DEVELOPMENT OF THE ARCTIC REGIONS OF RUSSIA

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The aim of this paper is to examine the sustainability of the development of the Russian Arctic regions based on oil and gas production and to analyze the contribution of these regions to the development of the Russian economy as a whole. I analyze seven Arctic regions of Russia (Murmansk Oblast, Arkhangelsk Krai, Nenets AO, Yamalo-Nenets AO, Krasnoyarsk Krai Sakha Republic and Chukotka AO), according to the official definition of Russia, excluding Komi Republic.

Since the Russian Arctic areas are vast and significantly different from each other, I have distinguished three types of regions. The first is the regions where oil and gas production is a driving force of their socio-economic development. This type includes Yamalo-Nenets and Nenets Autonomous Okrugs. The second type is the regions where mineral resources other than oil and gas are their driving force, including such regions as the Sakha Republic and Krasnoyarsk Krai. The third type is other regions that are not so rich in mineral resources and that are trying to take advantage of their external relations with neighboring countries. This type includes Arkhangelsk and Murmansk Oblasts.

I analyze the contribution of these regions to the development of the Russian economy, in terms of GDP, regional budget, and oil and gas production. Although my tentative conclusion is that the economic development of the Arctic will bring considerable benefits to the development of Russia's economy as a whole, I point out and analyze risks and challenges to the Russia's Arctic development, including the drop in oil prices and the economic sanctions adopted in relation to the Ukrainian conflict.

S18 ARCTIC-FROST: ARCTIC SUSTAINABILITY IN THE GLOBAL CONTEXT

O 092 THE STEADY VILLAGE: HISTORY, POLICY AND ALASKA VILLAGE POPULATION

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Remote Rural Alaska contains most of the state's resource wealth but a small share of its population. Northern and western Alaska include many small communities scattered over a vast road less area. Communities range in size from less than 100 people to over 6,000 with most of the population outside of the larger regional centers. The villages are majority Alaska Native places. Their small size and sparse distribution support traditional harvesting that continue to provide significant real income.

As in other parts of the circumpolar north, rural Alaska has recently been a sending region losing population through out-migration. Unlike other parts of the north, village populations have remained relatively steady for most of the period since Alaska became a state, although some communities have recently experienced population decline. Within this history there has been a variety of experiences in particular villages with growth and decline reflecting history, size, location, and policy.

This paper describes long run population change in these communities. The variety of population change is examined across size and location of communities and for different time periods. The paper also examines the historic differences in contact, resources, and economic advantages across the communities.

The role of government policy in creating the steady village is also examined. Policies have been introduced to improve local economic advantage or the quality of life. Programs were also introduced to directly increase the incomes of residents of villages. The paper explains the impact on village population of coverage, and timing of policies.

The maintenance of Alaska's villages is a historic objective of public policy in Alaska. Budget issues at both the state and federal levels make this look at the factors influencing population change relevant. Lessons about the role of public policies in Alaska are extended to broader lessons for the circumpolar world.

O 088 SUSTAINABLE ENERGY DEVELOPMENT IN THE CANADIAN ARCTIC: HOW CLEAN ENERGY IS IMPACTING HUMAN DEVELOPMENT, RESILIENCE AND WELL-BEING IN CANADA'S NORTH

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The remote and far-flung communities of the Canadian North face many challenges, among them diminished resilience and lack of self-sufficiency due to high reliance on imported fossil fuels for their energy needs. Against a backdrop of oil dependence, climate change concerns, high fuel prices, local pollution and seeing their energy dollars flow south, Canadian Arctic communities are embracing a shift towards greater autonomy in their energy decisions, and beginning to develop clean, local, sustainable energy as a means of reclaiming this autonomy.

In doing so, many northern Indigenous communities are seeing clean energy not only as an economic and environmental imperative, but as a form of enhancing community resilience that has been compromised from past relocation and changing social realities. Clean energy is further seen as a means to align energy needs with traditional values, such as environmental protection and sustainable use of local resources. By diversifying the energy mix and relying less on imported fuel, energy dollars remain local, resilience and adaptive capacity are increased in Arctic communities, while employment, training, and local economic benefits are realized by northerners embracing a more long-term vision of their energy future.

This discussion will focus on key sustainability factors behind clean energy development in the Canadian Arctic, aligning energy with community and human development, local jobs, capacity enhancement and traditional values. It will highlight three case studies supported by Polar Knowledge Canada, which exemplify a strong desire for greater autonomy, sustainability and community resilience, and have resulted in successful transitions to a cleaner and more culturally-embraced local energy economy.

O 089 EFFECT OF GLOBAL SUSTAINABLE DEVELOPMENT INITIATIVES ON THE LOCAL LEVEL

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Intensive mineral extraction has been taking place in the Arctic zone of the Russian Federation since soviet times. The Murmansk region is a typical area where economic development centers on the activities of mining companies. In many towns of the region the mining companies are chief employers and the backbone for welfare of the local communities. Being the most developed economic agents the mining companies influence the development of the territories. A dilemma arises here concerning the balance between the business objectives and expectations of the local communities. Concept of sustainable development is most suitable as a base for common (mining companies and local communities) development strategy.

Russian legislation gives no clear answer how to provide sustainable development. However mining companies as an example of global business have adopted main global rules, such as global reporting initiative, stakeholder engagement practices, development and implementation of corporate sustainable development strategies, advanced approach to corporate social responsibility.

The presentation presents results of case-study in two mining towns (Apatity, Kirovsk, Murmansk region). The objects of this study are to find elements of global sustainable development initiatives adopted by mining companies which operate in these towns (JSC "Apatit" and JSC "SZFK") and estimate their effect on the local communities.

The findings suggest that the local community is a weak spot in the system ‚mining company - regional government - local society' when we tell about sustainable development. The local societies are not ready to face challenges of transition and act. The mining companies and regional government lead this process. Both local authorities and inhabitants don't understand what mean local interests in perspective of sustainable development and they have no vision of sustainable future. Who must bring knowledge about sustainable development to local societies and organize identification of local way to sustainable development?

O 087 ARCTIC-FROST: ARCTIC SUSTAINABILITY IN THE GLOBAL CONTEXT: LINKAGES AND CHALLENGES

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This presentation will summarize results of the Arctic-FROST research coordination network activities under the theme "Arctic-Sustainability in the Global Context." We identify major developments and knowledge gaps and reflect on the relevance of Arctic sustainability research in the global context and the interactions between Arctic-based and non-Arctic-based research. Presented results will stem from the third Arctic-FROST workshop that focused on Arctic-Global connections.

O 091 ARCTIC CITIES AS NEW MIGRANT MAGNETS: MIGRATION PROCESSES AND DIVERSITY POLICIES (RUSSIA CASE)

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The paper presents a new phenomenon of large-scale international migration against the full spectrum of demographic, economic and socio-cultural challenges in Russia's Arctic.

Nowadays Arctic regions, cities particularly, are magnets for migration flows - both for traditional domestic inter-regional labor migration (predominantly work under a rotation system) and new international labor migration with a steady trend towards immigration. The specific features of these international migration flows, including the following:

- over 85 percent of labor migrants come from CIS countries (countries of Central Asia are the major migrant donors)
- the vast majority of labor migrants practice Islam or originate from Muslim countries
- about 70 percent of labor migrants come from smaller cities and rural ethnically homogeneous areas
- migrants have limited Russian language proficiency

present many opportunities, as well as multifaceted challenges for the Arctic receiving societies. At the social level new migration processes contribute to the rapidly increasing complexity of the ethnic, cultural, and religious composition of the population, as well as evoke the higher levels of xenophobia/migrant-phobia and multidimensional conflicts.

The increase of complexity and diversity of urbanizing areas is going along with indigenous communities gradual transition from traditional to modern/configurative (M. Mead) culture. This transition is accompanied by both collective and individual identity crisis and aggravated by ongoing exploration and 'internationalization' of the Arctic, as well as a necessity to adapt to diverse urban communities.

Current situation requires a reassessment and revision of basic principles and approaches in migration management, as well as new forms of state regulation of increasing diversity, comprehensive support for indigenous peoples, and collaboration with new social groups/actors. Authors argue that the new forming concept of Good Governance can be an adequate response to the complexity of the changing social reality of the Russia's Arctic and contribution into sustainable development of this region.

O 093 HOW CAN EXTRACTIVE RESOURCE DEVELOPMENT HELP MAKE ARCTIC COMMUNITIES SUSTAINABLE?

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Until recently, most research considering the impacts of extractive resource development on the sustainability of Arctic communities noted the negative aspects. Over the past 20 years, representative organizations from certain regions of the Arctic have started to discuss extractive resource development as being crucial for the long-term economic survival of Arctic communities. In Alaska, Greenland, and Arctic Canada, local and regional political actors have started to actively promote extractive resource development. This paper examines the evolution of this discourse and summarizes the emerging discourse on how extractive resource development can help make Arctic communities sustainable?

O 090 INTERDISCIPLINARY ASSESSMENT OF ARCTIC URBAN DEVELOPMENT

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The majority of the Arctic population is residing in urban locations. Rapidly changing climatic, socio-economic and political conditions have had significant impacts on the landscapes that support the cities, affected housing, labor and ecological conditions. There is a critical need not only to address these challenges, but to provide an efficient and comprehensive methodology capable of measuring the state of Arctic urban centers, their promotion of sustainability, and the efficacy of such projects. Arctic PIRE is engaging an international network of scientists focusing on Arctic Urban Sustainability to address a complex set of inter-related systems, including thawing permafrost, boom-bust economic cycles, and the influx of migrant workers and other social-tensions among others. It will inform policy-makers on best sustainable practices and promote Arctic knowledge among the public through various media platforms, educational resources and outreach projects.

P 197 AN ARCTIC TOWN IN A GLOBALIZING WORLD – IS IT SO DIFFERENT FROM OTHER TOWNS?

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Globalisation as the process of international integration arising from the interchange of world views, products, ideas, culture, etc. has a huge influence on many aspects of human existence. It affects especially townspeople and their urban lifestyle, but in a consequence also the way of urban development of towns - beginning from activities of town dwellers, through town functions towards its urban morphology and architecture. As an effect there are many similar urban settlements located in different parts of the world with similar buildings, similar shopping centres, similar inhabitants etc. etc. The Arctic region due to its specific location on the outskirts of the "civilized world" and in extreme climatic conditions should be able to resist the global trend. In practice, however, there is no denying that even here at least some larger towns are being influenced by globalisation.

The aim of the poster is to raise the issue of contemporary changes appearing in urban space of arctic towns. Are they developing in the same direction? Are there visible effects of following global trends? What causes these changes? Is it the same in all parts of Arctic region? How progressive will this process be in the future? The problem is questioned from the point of view of urban morphology and urban geography. The research was conducted using the method of town plan analysis and GIS tools.

P 196 THE GEOTECHNICAL AND ECOLOGICAL PROBLEMS OF CONSTRUCTION'S STABILITY IN CONDITIONS OF GLOBAL WARMING IN ARCTIC

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Large industrial centers on permafrost are characterized by a set of geocryological conditions different from natural environment. Thermal state of foundations on permafrost in areas of economic development depends on climate trends and upon technogenic impacts, such as type of impact, area of facility, permafrost temperature and duration of the technogenic pressure.

This situation is exacerbated by climate warming in such cities as Vorkuta, Chita, Nerungry, Salekhard and others, where temperature rises at a rate of 0.4-1.2°C / decade over last 40 years. Warmer climate of 1990-2010, in comparison with the 1960-1990 climatic norm, led to a decrease in the bearing capacity of the foundations of buildings and structures by 17% in the region on average and in some areas by up to 45%. To evaluate impact of climate change and technogenic factors on permafrost temperature regime and foundation bearing capacity we compared several objects in Norilsk, the largest city on permafrost. We found a leading role of technogenic factors relative to climatic ones in dynamics of thermal state of permafrost in urban environment. Climate warming in Norilsk (0.15 °C/decade) was a small contributor, but gave an additional input to deterioration of geotechnical environment on permafrost. Field surveys carried out in northern Siberia during the last 30-40 years showed that the efficiency of steam liquid thermosyphon (seasonal cooling systems - SCS) functioning mostly depends on natural permafrost conditions, landscape conditions, climate change and technogenic objects. For example, steamliquid SCS proved to be highly efficient on hydroengineering objects in the Norilsk region, where after application of the method temperature of frozen impervious screen on dams decreased to 4-6°C.

Despite deterioration of permafrost conditions in the most Arctic regions due to technogenic pressure and climate warming, implementation of adequate engineering solutions allows stabilization of permafrost thermal regime.

S19 THE RESILIENCE OF THE ARCTIC'S WILDLIFE AND INDIGENOUS FOOD SECURITY IN THE CONTEXT OF GLOBAL DEVELOPMENT AND POLITICAL PROCESSES

O 179 LONG-TERM TRENDS AND ROLE OF CLIMATE IN THE POPULATION DYNAMICS OF EURASIAN REINDEER

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The resilience of indigenous peoples' livelihood in the Arctic is strongly dependent on the availability of natural food resources. Those resources are generally susceptible to changes in the environment, which can be for example related to climate or human disturbances. Reindeer (*Rangifer tarandus*) are one of the main food sources for many Arctic and sub-Arctic indigenous peoples. Many reindeer populations are already suffering due to global changes, but are all populations affected to the same degree? Our study aimed to assess the role of climate on the dynamics of fourteen Eurasian reindeer populations. We investigated if reindeer populations have been synchronously affected by climate and if climate has caused large-scale reindeer declines as previously suggested. We found that trends in reindeer numbers were remarkably heterogeneous. Population growth rates and synchrony in population dynamics were only partially explained by climate. For both wild and semi-domesticated reindeer populations, local weather, biotic interactions, habitat loss and human activities may have been more impacting than climate. In semi-domesticated populations, management strategies may have masked the effects of climate. Conservation efforts should aim to mitigate human disturbances, which could exacerbate the potentially negative effects of climate change on reindeer populations in the future. Special protection and support should be granted to those semi-domesticated populations that suffered the most because of the collapse of the Soviet Union, in order to protect the livelihood of indigenous peoples that depend on the species, and the multi-faceted role that reindeer exert in Arctic ecosystems.

O 181 THE ASSESSMENT OF THE SOCIO-ECONOMIC DAMAGE OF THE INDIGENOUS PEOPLES DUE TO INDUSTRIAL DEVELOPMENT OF RUSSIAN ARCTIC

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Nowadays some countries including Russia prepare and realize investment projects in Arctic. There are projects of exploration and production of hydrocarbons on the continental shelf, extraction of minerals, rare earth metals, diamonds, building infrastructure (pipelines, roads etc.). Their realization influences in one way or another on the indigenous peoples' living area. In the world practice the ecological expertise, the environmental impact assessment, public hearings or environmental damage assessment are used for these kinds of projects' justification and social and environmental factors accounting. In the Russian regions including Republic of Sakha (Yakutia) the acts on indigenous peoples' opinion and interests account are adopted (e.g. during investment project justification for the industrial developing of the Evenk traditional land of use). For the interests' coordination of the target groups (public authorities, investors, local residents), the environmental sustainable development providing and "green" economics principals realization it could be offered to complete the nature management methods by the ethnological expertise which is considered as a scientific research on changes' effects on the indigenous peoples' native environment especially on social and cultural development of the ethnos. The central place of the ethnological expertise belongs to cost assessment caused by land use within traditional habitat on the basis of annual gross revenue losses evaluation. This index is calculated according four types of the traditional activity: reindeer herding, hunting, fishing, gathering wild plants. In Russia the economic mechanisms for the effective target groups' collaboration including compensatory payments, social-economic development of the territory etc. must be developed to avoid the conflicts in Arctic.

O 182 HEALTH, INDIGENOUS FOOD SECURITY AND SOCIAL POLITICS IN THE ARCTIC REGION (WITH THE SPECIAL FOCUS ON MURMANSK OBLAST)

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Social policy is directly concerned with food security issues, which in the context of Arctic globalization are becoming essential to improve nutrition and health. It is obvious that Arctic social policies in term of food safety should be distinguished from the "non-Arctic" one, and be focused on identifying, assessing, monitoring and easing, if not completely eliminating the harmful impact of the risks involved.

However, most studies on the subject, focused mainly on the problem of small indigenous minorities, meanwhile the food security issues of newcomers and, later, rooted population studied not so detailed. Therefore, in this work the term "indigenous food security" refers to rooted North population - local communities, both aboriginal and, more generally, rooted population, which are residing in the Arctic territories longer then in a single generation. Geographically, we focus on the territory of the Murmansk region, as the region fully integrated into the Russian Arctic Zone.

Our study was designed to identify the various risks and threats to the health of the population of the Murmansk region. The various factors that are directly related to the manner, style and quality of nutrition, as well as the "weight" of these factors in human life quality in the North have been identified. It is evident the food security is necessary is important factor tightly connected with the human life quality in the Arctic.

O 180 ECOLOGICAL CHANGES OF WILD REINDEER MIGRATION AND SUSTAINABILITY OF NORTHERN SMALL-NUMBERED PEOPLES IN SAKHA REPUBLIC

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Since the 1960s, monitoring researches of tundra populations of wild reindeer (*Rangifer tarandus*) have been conducted in the republic of Sakha (Yakutia). These monitoring data shows the rapid increasing of domestic reindeer population and degradation of tundra vegetation including 'reindeer lichen' in the 80s. In the 90s, there were drastic declines in both of domestic and wild reindeer populations on all over the sub-arctic Yakutia. In the first decade of this century, population of wild reindeer has been further decreasing and some sub-populations have changed their distribution ranges. Therefore we conducted the satellite tracking monitoring of wild reindeer in Lena-Olenek (Anabar) district from 2010. We also conducted the traditional ground and aircraft monitoring (direct observations). In these studies, we clarified that the timing and route of their migration and the wintering grounds have significantly changed in relations to global climate change and some anthropogenic factors. In addition, northward expansions in distribution ranges of large carnivorous species (wolf, black bear, brown bear) have been observed. These ecological changes of wildlife caused new conflicts among wildlife (tundra reindeer, forest reindeer *R. t. ssp.*, musk-ox, etc.), domestic animals (domestic reindeer and horses) and the northern small-numbered peoples in the arctic and sub-arctic Siberia. These conflicts make both wildlife and local people hard to maintain sustainable lives and they need new policy and tactics in their conservation and resource use. So we are trying to set and manage a new type of adaptive wildlife management area for wildlife (especially for wild tundra reindeer) and local people in the republic of Sakha.

P 198 AVIAN BIOMONITORING IN THE SHADOW OF CLIMATE CHANGES

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Contaminants introduction into sensitive polar ecosystem may in longer perspective disrupt natural homeostatic mechanisms and lead to the collapse of ecological balance. Unique polar fauna and flora is highly vulnerable to raising pollutants level and contamination may has a significant impact on the quality of the environment.

The main purpose of our study was to determine levels of chosen persistent organic polutants and heavy metals in samples derived from chosen arctic birds. Heavy metal effect on biota is currently intensively investigated especially in sensitive environments, as well as POPs like DDT and they metabolites. Worldwide biota is under bigger anthropopressure, than even a decade ago. In samples taken from arctic birds (*Alle alle)* several persistent organic pollutants and heavy metals were detected in trace amounts. Special attention was addressed to mercury, cadmium and lead determination, as those metals are highly toxic and their adverse health effects is currently well known for many species. Birds are perceived as good biomonitoring tools as they are ubiquitous, migrate long-distances, have long life-span and are usually high in the trophic network. Interdisciplinary work is highly recommended to fully understand changes occurring currently in Arctic. Ecosystem of Spitzbergen archipelago is a subject to continuous changes, therefore it is highly important to conserve its unique nature.

S20 GOVERNANCE, LAW AND NON-STATE ACTORS IN THE CHANGING ARCTIC

O 254 THE INTERMESTIC ARCTIC: WHERE DOES DOMESTIC POLICY END AND FOREIGN POLICY BEGIN IN THE ARCTIC?

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Arctic governance straddles the local, the global, and everything in between. The Arctic policy statements developed by all eight Arctic states and the EU in the past eight years make neither apologies nor distinctions in their wide range of issue areas, from very local policy issues, such as education, infrastructure and health ("sustainable development"); to clearly international concerns such as traditional security, international law (e.g. UNCLOS), and global environmental issues like climate change.

What are the costs or consequences of lumping policy issues together under an "Arctic" umbrella without distinction or clarity on the levels or actors most responsible for its stewardship? Which issues are inherently intermestic? Which ones would benefit from a clearer association with an either domestic or foreign policy approach?

This paper will propose a framework by which to evaluate and position various Arctic-specific policy areas at the most appropriate level of governance. It will further identify the most constructive applications of Arctic foreign policy strategies, with a goal of informing the next round of Arctic international policy statements.

O 255 RESEARCH PERMITTING IN THE YUKON: PERSPECTIVES FROM RESEARCHERS, TERRITORIAL REGULATORS, AND FIRST NATION GOVERNMENT REVIEWERS

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The Yukon Scientists and Explorers Act is the legislation by which researchers from outside the Yukon Territory, Canada, must apply for permits in order to do scientific research in the territory. These permits are administered by the Yukon Territorial Government, and sent to any affected territorial government departments or First Nation governments for comment. Recently, there are additional permitting processes administered or being independently developed by several Yukon First Nations. Research permits can be, depending on the type of project, the sole mandatory step for a researcher before entering the Yukon. As such, the process could be the sole source of documentation regarding which research has taken place in the Territory. This exploratory project asked the following questions: 1) How was the permitting process developed in the Yukon? 2) How do researchers and communities interact through the permitting process? and 3) How could the permitting process be enhanced to further facilitate relationships? Using a mixed method approach, I interviewed 20 stakeholders involved in, or having a high familiarity with, the permitting process, including regulators, communities, and researchers. In addition, I reviewed the literature including historical documents, academic publications, newspapers, online articles, press releases and government reports. Insights regarding the permit process will also be collected via extensive participant observations. Results of this study will be delivered in the form of recommendations to Yukon Territorial Government on ranked policy options for the permitting process. This exploratory work exemplifies the influence of non-state actors in the northern context, particularly self-governing Indigenous groups. These results will be compiled by March 2017. This work was completed as an independent research project for the Jane Glassco Northern Fellowship (supported by the Walter and Duncan Gordon Foundation), a program which supports young northerners in policy and leadership training.

O 253 THE CONFERENCE OF PARLIAMENTARIANS OF THE ARCTIC REGION AND ITS ROLE IN THE CHANGING ARCTIC

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The Conference of Parliamentarians of the Arctic Region (CPAR) is a inter-parliamentary body operating as a biennial conference for parliamentarians representing the eight Arctic states and the European Parliament. The conferences also includes Permanent Participants representing the Arctic Indigenous peoples, as well as various observers interested in the Arctic cooperation. The first Parliamentary Conference concerning Arctic took place in Reykjavik in 1993. The Standing Committee of Parliamentarians of the Arctic Region (SCAPR), which is responsible for the work of the Arctic Parliamentarians between conferences, started its activities in 1994. The CAPR meets a few times per year in the different Arctic countries "to discuss current Arctic issues and the follow-up of the Conference Statement from the latest conference". One of the main first priorities of the SCAPR was to promote the establishment of the Arctic Council (AC). In 1998 the SCAPR officially became the observer of the AC and since that time it has been representing the CPAR which is the only inter-parliamentary organization present in the AC.

What does and what can the CAPR actually offer to the changing Arctic and how the SCAPR contribute to the work and evolution of the Arctic Council remains unclear since these institutions have not been scrutinized yet.

Based on the studies of inter-parliamentary cooperation and institutions functioning in the other parts of the world we will examine what roles are played by the Arctic Parliamentarians - through the CAPR and the SCAPR - in the Arctic governance landscape. Findings offered by this research will in turn contribute to a better understanding how can non-state actors support adaptive capacity of Arctic governance.

O 252 THE EU, THE ARCTIC AND SLCP GOVERNANCE

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The presentation prefaces questions about EU's potential role in relation to the governance of the so called *short-lived climate pollutants* (SLCP's) in the Arctic. SLCP's are powerful climate forcers that have a significant impact on near-term climate change compared to, e.g., CO^2. SLCP's are also dangerous air pollutants. However, the international efforts to mitigate climate change have been mostly focused on CO^2, and SLCP's have played a lesser role in international climate cooperation. Whereas the fundamental decarbonisation agenda attached to CO^2 is both difficult and time-consuming, reductions of SLCP's would already be possible through available technologies. Thus, there is a growing need towards the enhanced governance of the SLCP's, especially in the Arctic context. However, the *status quo* of international SLCP governance represents a range of largely

uncoordinated regulatory approaches through formal legal regimes, institutions and informal multi-stakeholder initiatives. *The EU has* been striving to find suitable pathways for intensifying its Arctic policy since 2008. Through its primary law, the EU has established a clear internal mandate towards dynamic external action - particularly in relation to "combating climate change" as in Art 191 of the TFEU. The EU is already reducing SLCP emissions via existing internal legislation, and more specific legislative measures are on their way that aim to target SLCP's especially. It has been suggested, by other scholars, that even within the fragmented governance landscape, the EU could positively contribute to integration and enhancement within some sectors of Arctic governance through influencing the relevant international frameworks, and by clearly focusing on its priorities in the Arctic context. Combining these viewpoints, the presentation discusses how the EU regulatory input to the SLCP's governance could potentially offer a viable platform for the EU to actually enhance its Arctic reach, and to contribute positively to Arctic climate governance more generally.

P 199 SCIENCE DIPLOMACY: HOW ARCTIC SCIENCE IMPACTS GLOBAL INTERNATIONAL RELATIONS

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Since the acceptance of non-Arctic state observers to the Arctic Council in 2013, scholars have been asking questions about their role in Arctic affairs. As climate change rapidly influences the world, non-Arctic states are increasingly interested in the decision making processes of the north, and how these choices will impact the global system. As a result, many non-Arctic states, including China, Japan, and Korea are heightening involvement in scientific research. This presentation will focus on the relationships created and maintained via scientific research and international partnerships, known as science diplomacy. Science diplomacy can have many forms such as advising policy actions, facilitating international cooperation, and improving international relations. This presentation will touch on all aspects of science diplomacy in the north, however it will have an emphasis on international relations between arctic and non-arctic states. Case studies will be presented that demonstrate the successes of increased globalization in the North and what impacts this will have on increased scientific research in the future. The chosen cases will highlight relationships cultivated between arctic and non-arctic states, including indigenous groups, known in the Arctic Council as Permanent Participants.

P 200 DYNAMIC INTERPLAY: A MODEL FOR INSTITUTIONAL INTERACTION IN COMPLEX ADAPTIVE SYSTEMS

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The US institutional governance structure applied to the Alaska Arctic is not well equipped to meet the demands for integrative responses that are dynamic and adaptive. The fragmented nature of US environmental resource institutions represents a historically derived structure designed to solve single-issue environmental problems. Such a structure is no longer adequate in the complex systems of the emerging Arctic. In addition, the model of institutional interaction currently in play i.e. uni-directional, authority driven, and hierarchical, is also not adequate. The current institutional structure and function is a poor fit to meet the needs generated by rapid environmental change and the relative rapid pace of knowledge accumulation (scientific and indigenous). This work presents a novel theoretical model and empirical analysis of institutional interaction (dynamic interplay) in a complex adaptive system of the Alaska Arctic. The model demonstrates how institutions retain their structural integrity and functional responsibilities for sectoral mandates while integrating across sectors to solve common problems. This is achieved through distinct operational states of divergence and convergence across time. The theoretical model is illustrated in a long case study of two resource sectors in Alaska. This work adds a new dimension to the literature on "interplay" (Young 1999, 2002, among others) and provides a practical roadmap for integrating data and knowledge systems towards solutions. The value of this analysis is in demonstrating a governance model that recognizes the integrity of existing institutional structure and function but is capable of dynamic and adaptive responses to underlying biogeophysical and socio-cultural change.

P 201 THE ARCTIC OF TRANSNATIONALS

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Economic activities in the Arctic play an increasingly important role in the globalizing world economy, given that this economy is largely based on natural resources (oil, gas, and minerals). The Arctic appears to be one of the last opportunities for global resources exploitation, an exploitation which, ironically, is made possible by the negative effects this very resources exploitation in the form of global warming and subsequent receding ice coverage of the circumpolar North. In other words, the Arctic will become a "geo-economic space". However, in this paper we will neither discuss whether this evolution is plausible nor whether it is desirable. Rather, we assume that, given the so far unaltered dynamics of industrial development, this evolution is going to take place. Instead, our paper will focus on the actors of Arctic resources development, namely on Transnational Corporations (TNCs). Yet, many of these TNCs are actually government-backed or even government-owned. Not astonishingly then, the biggest oil and gas firms active in the Arctic are currently State-Owned Enterprises (SOEs). In our paper, we want to better understand - by way of qualitative cases studies - whether these SOEs do have a competitive advantage (over non-State-owned TNCs) in developing Arctic resources. If so, why and how exactly do they make their privileged relationship with the State work to their advantage. In this paper will focus on the cases of Russia and Norway, but will later expand to include also Canada, the United States and others more. As such, this paper will therefore be a contribution to better understanding (and ultimately better forecasting) the role of some of the key actors when it comes to developing Arctic resources.

P 243 THE URBAN FUTURE OF INDIGENOUS SÁMI CHILDREN

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This paper evaluates the human right situation of Sámi children in the Nordic context. It is often stated that the indigenous children are among the most vulnerable and marginalized groups in the world and that global action is urgently needed to protect their survival. However, the Nordic welfare states provide equal social, health and educational starting points for all of their citizens. What is then the situation of Sámi children today and what kind of problems they are still facing? In Finland, already more than 70 % of the indigenous Sámi children are born outside their traditional territories, in urban cities like Helsinki, Oulu and Rovaniemi. This is a global demographic phenomenon of urbanization and it deeply affects indigenous peoples' lives. The questions reflect the current discussion on Sámi identity and merely the survival of the whole culture, where most of the Sámi population is living far away from their traditional lands and without no connection to land and waters which, however are considered to be the element distinguishing indigenous peoples from other minorities.

The paper also examines the political rhetorics used by the Sámi leadership in Finland to legitimize the collective claims for lands and waters that forms the basis of their culture. A more complex understanding of cultural rights is needed in order to evaluate the dual approach, that is, also a significant contemporary social challenge. The paper is part of a joint research project (NUORGÁV) funded by the Norwegian research Council.

P 203 ISSUES OF CIVIC ENGAGEMENT DEVELOPMENT ON TAIMYR PENINSULA

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The issue of growth of human environmental self-consciousness in the Arctic is the main issue of building civil society and active participation in decision-making by local population.

The sulphur dioxide emissions on Taimyr peninsula is the major environmental problem of MMC “Norilsk Nickel” by its Norilsk Division. Such an environmental situation, definitely, excited the public, not only locally, but also globally. However, local people are not interested in enviromental health of their local area. The activity of the Association of Indigenous Peoples of the North, the Government of the Russian Federation, and the world›s environmental organizations has an impact on the company›s activities. In my paper I consider the ways of impact and the its results.

We can claim that the impact of NGOs has a positive influence on environmental policy of «Norilsk Nickel», according to the fact of decreasing the number of air pollution that was achieved by Russian Non-Government Ecological Organizations and mediately by Russian government. Russian public environmental organizations are more interested in a just settlement of the company›s activities. They act as intermediaries and initiators in the dialogue between the Russian government and the company. Therefore, it can be concluded that an open dialogue on environmental damage is effective for the benefit of maintaining a healthy environment.

Unfortunately, inhabitants of Taimyr peninsula are not interested in dialouge with «Norilsk Nickel» to solve environmental problems. One of the reasons for this is a low level of civic engagement in Russia, especially on Taimyr Peninsula area (it caused by low levels of literacy of local indegenous peoples).

P 204 LAW OF EXPLORATION AND EXPLOITATION OF THE MINERAL RESOURCES IN THE POLAR REGIONS

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One of the important future question of the Arctic and Antarctic Polar Regions is the creation of appropriate legal system of exploration and exploitation of the mineral resources in the Polar Regions based on interests of the state and non-states actors balancing between conservation and exploitation polar ecosystem. Historically and currently, The Arctic and Antarctic Polar Regions are wholly different from the legal view, although there are some similarities of the polar south and north ecosystem. Antarctica represents one comprehensive legal system under The Antarctic Treaty and The Arctic governance is governed by general International Law, e.g. The United Nations Convention on the Law of the Sea (UNCLOS) or international environmental agreements.

Long-term development of the different legal system both regions was based on on different political, economic and military approach of state actors, especially during The Cold War. Changes of the international environment after the end of The Cold War have demonstrated necessity of rethinking of legal governance in the Polar Regions, mainly the Arctic. Law of the exploration and exploitation of the mineral resources in the Polar Regions fully reflects political and economic interests of the state and non-state actors in Antarctica and the Arctic. The Antarctic Treaty System still brings Antarctica some assurance of protection of mineral resources. The same legal method of protection of mineral resources in the Arctic is not possible. Also existing rules of the continental shelf under the UNCLOS shows in the case of the Arctic as an inadequate.

Law of exploration and exploitation of the mineral resources in the light of Arctic governance shall represent a complex mechanism of the hard and soft law instruments reflecting political, economic, social and environmental approaches of the state and non-state actors interested in the Arctic.

P 205 COMPARISON OF MINE RECLAMATION PROCESSES: SASKATCHEWAN AND NORWAY

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As the Arctic and sub-Arctic regions attract huge mining investments, Northern communities are demanding an approach to mining that promotes sustainable resource development. Mine closure is the last stage in the mining lifecycle. This includes the cessation of extraction activities and the reclamation of disturbed areas. The objective of paper is to study the impacts of mine closure regimes on indigenous people, through a comparative study of Northern Norway and Northern Saskatchewan. To date, there is no comparative study of mine closure regimes in Canada and Norway. Literature review, and a review of various types of documents, form the methodological foundation of this study. Research results reveal that differences in mine closure regimes in the two cases studied can be partly accounted for by cross country differences in macro political structures. This study could broaden my understanding of the role of contextual factors in influencing mine closure regulations.

P 206 SUBNATIONAL TIER OF ARCTIC GOVERNANCE

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This paper aims to examine the role of subnational actors, such as regions, members of federation, autonomies, administrative units, cities and municipalities in the Arctic policy-making and governance system. The subnational actors have been gradually transformed from passive policy-takers to policy-shapers. They have become active players not only in their traditional realms but also on all levels of Arctic governance. The substate units do not hesitate to use paradiplomacy to protect their interests and establish horizontal, network-type links with foreign partners. Various forms and methods of paradiplomacy as well as its implications for national sovereignty and regional governance are examined. Particularly, the role of the substate players in the desovereignization and deborderization dynamics in the High North is analyzed. The process of institutionalization of subnational actors' international activities is studied. The author arrives at the conclusion that paradiplomacy has become a part and parcel of glocalization process in the Arctic while the subnational level turned to be an important and integral part of the regional governance system.

P 207 LAW FOR RECONCILIATION OF CONFLICTS BETWEEN ARCTIC MINING AND TOURISM

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Two growing economic sectors in the Arctic are mining and tourism, which both significantly affect transformation of economic structures and natural environment. While mining industry is dominated by large international companies, the size on tourism companies vary from family size to large - although typically domestic - companies.

The relationship between these two sectors vary from case to case; it can be complementary, neutral and counter-productive. The relation is asymmetrically counter-productive, when another industry benefit and other suffer from each other. This is the case, when existing tourism activities are suffering from environmental impacts caused by new mines. In the Arctic, typical type of tourism is nature-based tourism, which is particularly sensitive to adverse environmental consequences.

Both tourism and mining industries as well as surrounding communities expect that public policies are predictable and create stable conditions for businesses and living. In concrete terms expectations may, however, differ. Tourism industry expects that landscape and other environmental resources crucial for their business would remain untouched, whereas mining industry expect quick and predictable decision-making processes to get access to mineral deposit. The surrounding communities and local non-governmental organisations expect that they can influence decision-making and economic structures of the region. The reconciliation of conflicts related to these two industries heavily depend on whether and how law-based policy instruments are able to satisfy contradicting expectations of different non-state actors.

In this presentation, we will explore the capacity of law-based policy instruments to resolve conflicts related to new mines and existing economic activities. We will use an ongoing mining project located close to a tourism resort in Kolari (Finland) as a case throughout the presentation. We aim to conclude with proposals how to improve law and policy to promote sustainable Arctic economy.

P 208 ARCTIC FIVE ACCORDING TO THE CONCEPT OF CLUB MODEL GOVERNANCE

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The emergence of the Arctic Five in 2008 brought a new constellation of the governance in the changing circumpolar Arctic. However, international relations in the region have many forms of cooperation and its quantifiable dimension has relatively eased in recent years, mostly due to political reasons. The Arctic Five appears as the intergovernmental institution, a unique constellation of different countries which share a group of common interests. Due to its closed membership, it is an exclusive club. This concept is studied on the ground of the international relations theory.

In this presentation, the author conceptualizes the Arctic Five defined in terms of the club model. This theoretical framework is based on a common work of Robert O. Keohane and Joseph S. Nye Jr. and within the liberal tradition is placed in the neo-institutional thought. To describe the unit of analysis, the author uses the institutional analysis as a methodological approach. The role of the Arctic Five in the Arctic governance is examined in accordance with its accountability - on the input side, and effectiveness - on the output side, which are essential categories in the operationalization of adopted methods for the purpose of this presentation.

The author discusses features of the unit of analysis such as a level of transparency, formalization, and barriers to participation therein. He also describes a struggling of the club model in cooperation with others from the governance triangle and non-Arctic actors in times of the diffusion of power. It implies certain problems for the Arctic Five to govern the issue-areas within the regional regime. Indeed, the old liberal example of cake-cutting in the international relations is still alive. This case study analysis is an exploratory one with the potential of defining more questions and hypothesis for further research of the concept of club model governance.

P 209 APECS AS AN ARCTIC STAKEHOLDER: TRAINING FUTURE LEADERSHIP OF THE POLAR RESEARCH COMMUNITY

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The Association of Polar Early Career Scientists (APECS) is an international, interdisciplinary NGO for undergraduate and graduate students, postdoctoral researchers, early career professionals, educators, and others interested in polar regions and the wider cryosphere. The existence of APECS as a stakeholder is fundamental towards developing diverse future leadership in the Arctic community. Celebrating its 10th anniversary in 2017, APECS has grown from a small group established during the 2007/08 International Polar Year (IPY) to a global community of more than 2,300 actively-engaged early career researchers (ECRs) and professionals (ECPs) interested in the polar regions, from over 60 countries; within the last decade, more than 7,500 individuals joined our network during the early stages of their careers.

APECS creates opportunities for innovative collaborations and information exchange amongst ECRs and established professionals, thereby helping to recruit, retain, increase cooperation amongst, and promote future polar experts. APECS works with polar organizations to enable skilled early career representatives to contribute to their goals and projects, including the International Arctic Science Committee (IASC) and the Arctic Council Working Groups 'Arctic Monitoring and Assessment Programme' (AMAP) and 'Conservation of Arctic Flora and Fauna' (CAFF). In these capacities, APECS members contribute to the scientific activities of the working groups, synthesizing research to identify and address areas of concern to Arctic ecosystems, communities, and Arctic residents.

This presentation discusses how APECS contributes to training future leadership in the Arctic community and how members influence polar science and policy. We highlight how APECS updates activities to reflect scientific, policy, and environmental challenges in order to provide the most relevant resources to our members. Early engagement of ECRs and ECPs develops a workforce more adept to bridging the divide between scientific research and sustainable development in the Arctic and, therefore, is an investment in the future of the Arctic.

S21 SECURITY AND GOVERNANCE IN A GLOBAL ARCTIC I

O 163 THE CENTRAL ARCTIC OCEAN: AN OPENING FRONTIER FOR INTERNATIONAL SCIENCE COOPERATION

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In recent decades, there have been dramatic reductions in the proportions of multi-year sea ice relative to first year ice, significant seasonal declines in sea ice extent, and warming water column temperatures. For the Central Arctic Ocean (CAO), these changes have regional to global implications with respect to climate change, light penetration and availability, productivity, northward migration of biological organisms and biodiversity, as well as future development of commercial fisheries. The five Arctic countries with economic zones extending into the Arctic Ocean (Canada, Greenland/ Denmark, Norway, Russia, and the United States) have acted upon these changes to limit the development of future fisheries expansion in waters under their control. Other international partners, including China, Iceland, Japan, Korea, and the European Union are also working with the five Arctic nations towards an international agreement to monitor and regulate potential fisheries that could develop in the CAO beyond national boundaries. Physical and biological oceanography, fish surveys, and marine mammal and seabird observations are all key elements that should be part of a CAO science effort to enhance our understanding of the ecosystem before any decision for expanding commercial fisheries and other human use occurs. There has been limited, coordinated international scientific sampling in the CAO. However, developing programs, such as the international Synoptic Arctic Survey (SAS), a coordinated simultaneous survey of Arctic Ocean conditions, and the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) could provide leveraged opportunities for high Arctic ecosystem studies as these programs are now in the planning stage. For this effort to succeed and serve the needs of evaluating the impacts of fisheries expansion, the international science community must prioritize and coordinate key scientific objectives for future research. This presentation will discuss key science components needed to better understand the CAO prior to decisions on human use.

O 127 'ENVIRONMENTIZED' SECURITY NEXUS OF THE 'GLOBAL' ARCTIC – OPPORTUNITIES FOR DISARMAMENT AND PARADIGM SHIFT?

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In security studies, there are discourses, premises and paradigms of security, and arms control and disarmament, as well as discussion who are the subjects of security. When it comes to the Arctic region, there are also different stages and special features of security, and changes in security premises due to grand environmental challenges (e.g. nuclear weapon systems deployed, as well as nuclear safety as a consequent). Although, there is neither military tension nor a real (nuclear) disarmament (except Svalbard as demilitarized zone), but more high geopolitical stability in the region. Furthermore, the security nexus of the globalized Arctic on the 2010s has been 'environmentalized' by growing concern on a state of the environment due to long-range pollution and climate change. These two wicked problems have acted as triggers to cause a change in security premises from military-security to environmental / human security.

This paper first, analyses the recent changes in Arctic security discourses and premises, as well as a lack of disarmament. Second, it also shows that due to the dualism of globalization - its impacts in the Arctic and implications of the globalized Arctic worldwide -, the grand environmental challenges, which the region is facing, are more complicated and demanded than the current military conflicts. Final, due to the new security nexus there are new subjects of security - Indigenous peoples, (I)NGOs, Scientific community - who require further and deeper changes in problem definition of security premises, as well as those in security paradigm. This paves a way to argue that there are both a need and possibility for a paradigm shift in Arctic security, and following from this, there is also a need for disarmament and demilitarization in the Arctic region.

O 126 THE ARCTIC SECURITY DILEMMA

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The "security dilemma" concept has long been influential in understanding the processes and implications of measures taken by states to enhance their security. The traditional security dilemma framework, which focuses on the buildup of arms for defence purposes, either intentionally or not actually can create insecurity between states with negative spillover effects. Though the Arctic has played a role in security thinking and analysis for decades, it is presently in a unique position with regards to the environment. The region is now embroiled in an "Arctic security dilemma". Many of the Arctic states are heavily dependent upon the extraction of fossil fuels as a significant part of their national incomes, which, contributes to their economic security. Additionally, many states maintain that this extraction also leads to their own energy security both on the national level or the energy security of consumers, domestic and international. This is the case for Norway, Canada, Alaska (USA), Greenland (Denmark), Russia, Iceland (exploring). Insofar as there is a "race for the Arctic", it is not an arms race but one for resources, where the role of fossil fuels continue to dominate, despite current price downturns and constant market volatility. Like the classic security dilemma, the measures employed towards ensuring local, regional and national economic security simultaneously create extensive insecurity. The negative spillover effect and insecurity is created in the burning of these same fuels, contributing to increasing CO2 emissions and rapid climate change, that has impacts both in the Arctic and globally. This presentation will examine the ways in which the Arctic security dilemma is the result of a tension between needs for economic and energy security and environmental security, where resulting increased CO2 emissions by burning these fuels threatens various societies and states in diverse and unpredictable ways.

O 161 A NEW APPROACH TO ARCTIC GOVERNANCE: TOWARDS AN INTERNATIONAL FISHERIES AGREEMENT FOR THE CENTRAL ARCTIC OCEAN

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On July 15, 2015 the five Arctic Ocean coastal states (Canada, United States, Russia, Norway, and Denmark/Greenland) signed the "*Oslo Declaration*" in which they agreed that their domestic commercial fishing fleets would not fish in the Central Arctic Ocean (CAO) until such time as there is a sufficient scientific base for sound decision-making and an appropriate management regime is in place. Since then, these five states have been negotiating with the European Union, China, Iceland, Japan, and Korea to develop a similar international agreement that would include all ten jurisdictions, which together cover all or nearly all of the world's distant-water fishing capacity as well as its icebreaker-based Arctic research capability. The configuration of the five Arctic coastal states plus the five additional states or jurisdictions is a novel approach to Arctic governance, reflecting geography, fishing capacity, and demonstrated commitment to Arctic oceanographic research. A collaborative, precautionary, science-based approach to high-seas fisheries management in the region would be a notable further contribution to effective governance and collective security in the Arctic. This presentation will outline the issues involved, the progress to date, and the prospects for eventual success.

O 166 THE ARCTIC IN A GLOBAL ENERGY PICTURE: INTERNATIONAL DETERMINANTS OF ARCTIC OIL AND GAS DEVELOPMENT

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The ongoing transformations occurring in the Arctic region are deeply intertwined with regional and global processes, both in the sense of the Arctic affecting and being affected by these processes that reach beyond the Arctic's southern borders. Natural sciences generally and climatology specifically have produced a significant amount of literature as to the ongoing and likely feedback loops between the climatic, environmental and atmospheric systems of the Arctic and the rest of the globe. Interdependencies between more social science aspects - such as (geo)political and economic developments, legal frameworks and patterns of livelihoods and generally organization of societies - influencing and being influenced by the ongoing changes in the Arctic region have so far received less attention.

To illustrate the governance actors, institutions and processes that operate at the interface of regional-global interdependencies, this paper analyses thus far neglected international determinants of Arctic oil and gas development. Such determining factors include international market developments, geopolitical tensions from outside the Arctic, competition with conventional and unconventional resources elsewhere, and thus far neglected forms of governance including the role and bargaining power of international energy companies. With this analysis, this paper shows the bigger picture of the Arctic's (actual and potential) significance in global energy supply and security, and the role of global political and economic trends for Arctic energy development. Finally, this paper provides a concrete example of the relevance of imaginaries for a concrete Arctic governance object, and how we need to be aware of and problematize the dominance of certain imaginaries.

O 165 LOSS AND DAMAGE FROM CLIMATE CHANGE IN THE RAPIDLY CHANGING ARCTIC

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Liability and compensation are addressed in international climate policy discussions, i.e. the loss and damage debate. Financing mechanisms to support adaptation actions can be provided from local, national, regional and international sources, but there is a need to define responsible parties and potential beneficiaries of climate change. Losses and damages cannot always be compensated by technical or financial support, if they include, for example, loss of culture and tradition. In the international climate policy arena, little attention and support has been given to Arctic vulnerable communities so far. Arctic climate change is happening about two times faster compared to the global average and Arctic communities, especially indigenous peoples have to find ways to deal with rapidly changing environmental conditions that are leading to social impacts such as outmigration, and other consequences that are often similar to global South. We conducted a systematic literature review to examine what kinds of impacts of climate change are already visible in the Arctic and to what extent Arctic studies have addressed climate change related loss and damage. We then discuss what implications these issues could have for the international debate on loss and damage. The results indicate the need for new governance mechanisms and institutional frameworks to tackle the risks and impacts of the Arctic and more international policy attention to address vulnerability of Arctic communities.

O 129 (UN)SECURITY IN THE ARCTIC - MASS-MEDIA AND THEIR IMPACT ON OFFICIAL POLICIES IN NON-ARCTIC STATES: THE POLISH CASE

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While the engagement of non-Arctic actors in the Arctic region is usually explained by their political and economic interests, the security aspects - paradoxically - are not so often highlighted in this framework. This position seems to be unjustified in the context of the public discourse developed in some of the non-Arctic states, especially narratives present in the public and private mass-media, which usually are very eager to focus on military threats stemming from the transformation happening in the Arctic

The presentation aims to analyse the content of materials presented in the chosen Polish media (primarily newspapers, magazines, internet portals and TV programs) in regard to the level of international (in) security in the Arctic in the recent years. The findings of such analysis will be confronted then with the official statements and scientific discussions in Poland to evaluate to what degree the media coverage influence the official approach of the Polish government towards the Arctic.

O 164 ENHANCE FRAMEWORKS FOR ENVIRONMENTAL INTELLIGENCE GATHERING FOR ARCTIC DECISION SUPPORT

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To adequately support decision-making in the face of unprecedented change in the Arctic, the United States and its international partners need improved scientific data collection and stewardship, understanding, and environmental predictions. This challenge requires frameworks for generating Environmental Intelligence: integrated environmental knowledge that is timely, reliable and suitable for the decisions at hand. Developing suitable Environmental Intelligence frameworks requires the integration of two distinct aspects of research. The first concerns the end-to-end integration of research across the linked and iterative steps of problem identification, environmental observing, understanding, prediction, and decision support. For example, safe marine transit through Arctic waters requires engagement with operators to understand the details of their information needs, such as high-resolution sea ice forecasts. To produce these forecasts, sparse yet detailed observations of sea ice from drifting ice buoys, community-based observers, and other in situ observations must be synthesized with broad, low-resolution satellite observations. Synthesized observations must then be assimilated into forecast models, which subsequently must be tested and validated through efforts like observational process studies—feeding back into an iterative cycle of improved observing and modeling capabilities. The second aspect of Environmental Intelligence requires integration of research across the components of the Arctic System, as most decision-making contexts require a holistic view. Building on the previous example, research is needed to inform how gridded estimates of sea ice thickness are interdependent with weather systems and ocean currents. Improvements within and across each of these areas will improve the ability to understand, communicate about, and support decisions in response to the impacts of Arctic change. With its emphasis on understanding the interconnected nature of the Arctic, Environmental Intelligence presents a model for Arctic System integration.

O 128 SECURITIZATION OF THE ARCTIC: THE US SECURITIZING ACTORS AND THEIR STRATEGIES

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The securitization theory provides an interesting lens through which the emergence of security issues can be analyzed. Securitization theory aims to reveal thresholds beyond which the securitization process begins. In the securitization process specific issues are framed as security threat, but in reality do not have to be necessarily a real-existential threat, but it is framed and presented to the audience in that way. Although, different societies may respond to the same security circumstances in different ways, the distinction between an articulated threat and a real security threat is fundamental for the society. Limited understanding of the mechanisms behind the securitization process makes the society/audience unable to evaluate whether the measures proposed by the political leaders are fully justified.

Due to the ongoing securitization of Arctic-related issues (related to e.g. global warming, indigenous peoples, mining), there is a growing risk of increasing tensions, which potentially can create conflicts. Conflicts can occur on many different levels and can be interconnected across sectors. By uncovering dynamics of securitization across sectors and actors on national level, the research gives a better understanding of the complexity of risks and threats related to securitization in the Arctic.

Securitization on the national level, could influence the decision-making process on a regional and/or global level. Security threats on national level and regional/global level are often interconnected. In order to understand securitization processes on the regional and global level it is vital to start from the lowest - national level (the United States).

The aim of the presentation is to discuss the securitization phenomenon in the Arctic with focus on the United States and to explain the mechanisms behind the securitization process and reveals the strategies of the US securitizing actors, which enables audience/society to evaluate the measures proposed by the political leaders.

O 130 IS THE UN STILL A SECURITY PROVIDER FOR THE ARCTIC REGION?

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In contrast with some theories on the UN diminishing role both in global and regional affairs in the post-Cold War era and the rise of regional institutions, *ad hoc* coalitions and bilateral arrangements in security politics, this study argues that the UN is still a cornerstone of the Arctic security architecture. Through its role of an international legal norms' producer and specialized bodies, such as the Commission on the Limits of the Continental Shelf, UN Environment Program, International Maritime Organization, UNESCO, Commission on Human Rights, Working Group on Indigenous Populations of the UN Economic and Social Council, etc., the UN plays an important role in shaping of the regional soft security regime. The UN is indispensable in resolving Arctic maritime border and shelf-related disputes, promoting maritime transportation safety, mitigating climate change implications, building sustainable development strategy, protecting marine environment and indigenous peoples' rights and unique way of life, etc. It should be noted that, in reality, the UN and its specialized bodies compliment various regional, subregionaland bilateral institutions and arrangements in the High North rather than contradict them. It is safe to assume that the UN will continue to play a crucial role of a soft security provider in the region in the foreseeable future.

O 162 SCIENTIFIC OPPORTUNITIES IN THE CENTRAL ARCTIC OCEAN AND GOVERNANCE CONNECTIONS

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With the diminishing of sea ice cover, the Central Arctic Ocean (CAO) is becoming more exposed and accessible to a range of activities. As a region beyond national territorial waters, cooperation between Arctic and non-Arctic actors has become vital to address the challenges that have risen for the CAO, especially in areas of marine environmental conservation and resource management. An example of such cooperation can be a potential fisheries agreement to prevent unregulated fishing in CAO's international waters currently being discussed between Arctic and non-Arctic states. Scientific

research in the CAO, however, remains too scarce to inform and support policy decisions and facilitate the establishment of proper governance in the region. Indeed, records of research vessel traffic and survey intensity show that CAO remains largely a region of sparse scientific data. If the above mentioned agreement is signed, it would set a novel precedent for governance of international waters in the Arctic, which would involve both Arctic and non-Arctic states and create a special case for collaborative scientific research.

Insufficient science often results in the opting of highly precautionary and conservative policy decisions in non-territorial regions - such as, the high seas - especially when economic forces are relatively weak to affect such decisions. Examples from the Southern Ocean and other regions will be discussed. Whether such will be the case for CAO, a region surrounded by a number of national waters, remains yet to be seen. What is certain, however, is that timely and adequate science will help ground the development of a management scheme in solid, quantitative rationale and minimize reliance on interim measures or decision-making based on assumed values. A dedicated scientific leadership in the form of an organized body will allow for the generation of opportunities in useful science, as well as good governance.

O 131 PARTICIPATING IN INTERNATIONAL NEGOTIATIONS AS AN INTERNAL CONSTITUENT: THE DEBATE REGARDING GREENLAND'S ROLE IN THE US MISSILE DEFENSE

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Greenland has had to deal with various issues in relation to the Thule base. In the second half of the 1980s, various problems from the Cold War era came to light. It became clear that the Thule had not only functioned as a major communication and reconnaissance outpost for defending the American homeland but also possessed the capability of carrying out a nuclear attack on the Eastern bloc. This prompted Greenland to consider policies that could put an end to its position of a ruled entity.

What is interesting is that Greenland was made keenly aware of its position as a ruled entity in its asymmetrical power relations with the US and not in relation to Denmark. Instead of simply agreeing or disagreeing with Copenhagen's decisions as a constituent of Denmark, what Greenland did was to request the powers to directly conduct negotiations with the US so as to be able to fulfil its responsibilities and duties as a an agent constituting Denmark. In other words, rather than questioning the level at which it can accept the agreements reached in international talks, Greenland, *from the standpoint of an internal constituent*, sought to get actively involved in the talks with the US as *one of the negotiators*. In 2004 Greenland actually participated in the negotiations regarding the modernization of the systems in the Thule as part of the US missile defense plan. That year a multilateral agreement called the Igaliku Agreement, involving Denmark, the US and Greenland, was signed. Here, after presenting an outline of the transformations of the Thule, I will look back on the negotiation process in 2004 and attempt to shed light on the policy intentions of Greenland, which has been trying to play the role of an international negotiator while keeping the status of an internal constituent.

S22 BUILDING PARTNERSHIPS AMONG MULTIPLE KNOWLEDGE SYSTEMS TO ENHANCE UNDERSTANDING OF A DYNAMIC ARCTIC

O 204 ARCTIC FUTURES MAKERS: TAPPING THE UNTAPPED RESOURCE MOST IMPORTANT TO ARCTIC FUTURES

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The promise of Arctic youth to actively shape the future remains an untapped resource in the pursuit of community resilience. Lebel and others (2010) have outlined six ways that social learning processes, like scenarios development, are potentially important for building adaptive capacity. My research is based on the concept that engaging and empowering young people through rigorous involvement in thinking, deliberating, and planning for futures develops a foundation for effective community resilience throughout their adult years. This paper reports on an exploratory project engaging Arctic youth in futures thinking - Arctic Future Makers (AFM). Through a two-day scenarios development workshop, high school students from every village in the Northwest Arctic Borough participated in thinking about futures to promote "backwards design," the ability for youth to plot out their paths towards a significant goal. The results indicate the students share similar ideas in terms of the key drivers of future resilience, when compared to adults who participated in separate scenarios workshops. However, AFM also revealed limitations of exploring deep uncertainty with high school students, especially in the U.S. where standards-based testing has downplayed innovative thinking in public school curricula.

O 203 KNOWLEDGE CO-PRODUCTION AND MOBILIZATION FOR SUSTAINABLE ARCTIC COASTAL COMMUNITIES

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Throughout the Arctic, communities are confronted with rapid and complex environmental, social, economic, and technological changes that require the capacity to adapt, reduce risk, and (in the long term) a high degree of resilience. With an unprecedented rate of change that exceeds previous experience and tests the limits of traditional ways of knowing and seeing, mobilizing different types of knowledge, values, and perspectives from multiple sources is essential. Acquisition and application of relevant knowledge for effective decision-making calls for a new approach to research and awareness, one rooted in the specific knowledge needs and values of individuals, households, communities, and government institutions in order to support an agenda for responsible and sustainable development. Arctic indigenous communities appreciate various ways of knowing and recognize the importance of research collaboration for knowledge co-production. The Circum-Arctic Coastal Communities KnOwledge Network (CACCON), forming part of the Arctic Regional Engagement Network of Future Earth Coasts, is committed to facilitating new partnerships and effective engagement for knowledge co-creation, bringing together and mobilizing the information and understanding required to build more sustainable communities, and promoting knowledge sharing and dissemination capacity for the benefit of other communities facing similar challenges. We share some of our experiences in relation to community knowledge needs, research awareness and readiness, and some of the enablers and barriers to knowledge co-production, sharing and mobilization, as well as other important aspects of stakeholder interaction and engagement for sustainable development. Where the research agenda is co-designed, co-produced, and tuned to the creation of knowledge for effective decision-making and positive action, it can be a powerful tool for developing sustainable and thriving communities, helping to identify pathways for transition to more sustainable futures.

O 202 THE USE OF TRADITIONAL/INDIGENOUS KNOWLEDGE (TK/IK) WITH SCIENCE TO SUPPORT RESOURCE MANAGEMENT DECISIONS

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Discussions pertaining to the collection and the use of Traditional/Indigenous Knowledge (TK/IK) with science to support resource management decisions can often be preoccupied with how to integrate data and/or information into the process. Sometimes these endeavors are successful; other times, due to vastly different formats and approaches, it is not feasible resulting in subsequent decisions not fully benefitting from all of the available information. We present a series of succinct examples of TK/IK and scientific research being successfully used to inform the decision-making process but, depending on the nature of the format, applied at different stages. These examples include: 1) using TK/IK in the design, planning, and conduct of research (science); 2) fully integrating the data from both knowledge systems at the earliest possible stage; 3) treating each as a separate, but comparable, knowledge system at a later analysis stage; 4) supporting decisions in-line with pertinent laws and regulations; and, 5) implementing directly at the programmatic decision-making stage. Clearly articulating, early in the process, how best to use these two different, but equal, knowledge systems allows for a better use of available information. The outcomes may provide the additional benefits of: a) facilitating openness by better documenting the decision-making process; b) the co-production of new knowledge which may also result in improved information; c) garnering understanding and acceptance among a wider group of stakeholders and partners; and, d) an enhanced understanding of indigenous perspectives by resource managers when making decisions.

O 205 SIBERIAN REINDEER HERDERS FACING CLIMATE AND ENVIRONMENTAL CHANGES: OBSERVATIONS AND ADAPTATIONS

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The paper explains how Siberian reindeer herding and hunting indigenous communities (the Evenk) observe climate and environmental changes - traditionally and together with scientists, as well as their adaptive strategies over the last 10 years. The Evenk have been noticing climate and environmental changes for decades, such as a rise in winter and summer temperatures, high weather variability and unexpected temperature jumps, as well as increases in summer precipitation, but these changes have been increasing more rapidly over the last 5/10 years.

We present results from the Evenk reindeer herders' transdisciplinary observatory of climate change (and global changes) in Siberia which is a part of the projects BRISK- BRidging Indigenous and Scientific Knowledge about global change in the Arctic (ANR) (UNESCO-MNHN-LMD-CEARC) and BRISK' OBS (IPEV). The Evenk observatory is managed by several Evenk reindeer herders. It links indigenous and scientific observation using methodologies designed collectively by the herders, anthropologists and climatologists. It was established in winter 2013 by S. Gabyshev, L. Egorova (Evenks) and A. Lavrillier. Since then, it provides daily observations according to criteria taking into account both Indigenous and Scientific knowledge (from social and environmental sciences). In addition, Gabyshev and Lavrillier (with other herders) developed co-production products of knowledge concerning Indigenous Environmental Knowledge, environmental changes, land use mapping, adaptive practices and socio-economical impacts of climate and global changes.

The results concern climate and environmental changes and events as perceived and faced by the Evenk reindeer herders from 2005 to 2016. Finally, with Kathy Law, we will present the evolution of this observatory as part of the PARCS (Pollution in the Arctic System) project (funded by Chantier Arctique Français). Here, we are interested in understanding further the perceptions of environmental changes, including pollution, and to explore possibilities to develop specific indicators or new observing methodologies to monitor such changes.

O 207 BODY MAPPING AS A YOUTH SEXUAL HEALTH INTERVENTION AND DATA COLLECTION TOOL AMONG YOUNG WOMEN IN NORTHERN CANADA

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This presentation describes and evaluates body mapping as 1) an arts-based activity within Fostering Open eXpression among Youth (FOXY), an educational intervention targeting female youth in the Northwest Territories (NWT), and 2) a research data collection tool. A developmental evaluation methodology and social ecological theory guided semi-structured interviews with 41 youth (aged 13-17) in six communities, descriptive and reflective field notes, and written reflections by seven FOXY facilitators collected from 2013 to 2016. A thematic analysis using immersion and crystallization techniques identified body mapping as a highly effective intervention tool for self-reflection, introspection, personal connectedness, and processing difficult emotions. Body mapping was also a data collection catalyst that enabled trust and youth voice in research, reduced verbal communication barriers, and facilitated the collection of rich data regarding personal experiences. This study highlights the importance of using methods that meet the unique needs of youth and can inform other interventions and research involving Northern youth populations.

O 206 INFORMATION SOVEREIGNTY AND INDIGENOUS KNOWLEDGE: LESSONS FROM DIGITAL TOOLS FROM THE EXCHANGE FOR LOCATION OBSERVATIONS AND KNOWLEDGE OF THE ARCTIC

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The Exchange for Local Observations and Knowledge of the Arctic (ELOKA, eloka-arctic.org) facilitates the collection, preservation, exchange, and use of local observations and knowledge of the Arctic. ELOKA provides data management and user support, and fosters collaboration between resident Arctic experts and visiting researchers. Recently completing its third phase, ELOKA has created numerous digital products largely guided by Indigenous partners, ranging from atlases preserving and visualizing Indigenous Knowledge and information, to online databases allowing for Arctic residents to upload local observations to share among other individuals, villages, and organizations. Now entering its fourth phase with funding from the National Science Foundation, ELOKA looks to continue and expand this mission while also creating a variety of outreach and training materials for different audiences. This paper will overview the progress on products and infrastructure made during ELOKA III, while introducing plans for the next, fourth phase of ELOKA. Ideas and prototypes for various outreach products will be demoed (e.g., Story Maps, video training sessions, etc.) and feedback will be requested from the audience on what teaching and outreach materials would be ideal and most useful for a variety of different audiences, including Indigenous community members, students, policymakers, and scientists.

P 210 OBSERVING COASTAL SEA-ICE STABILITY IN ARCTIC ALASKA: A FRAMEWORK FOR COLLABORATION, COMMUNICATION, AND PREDICTION

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The Arctic sea-ice environment is changing in rapid and profound ways, most of which have important implications for how Arctic coastal communities understand, observe, and use sea ice. As the integrity, reliability, and duration of sea ice as a platform for travel and traditional activities is reduced, there is opportunity to explore collaborative and applied frameworks for observing and predicting ice properties and dynamics relevant to ice users. The use of coastal shorefast ice in springtime by Alaska's Iñupiat whaling communities offers a relatively well-observed, yet highly sophisticated, instance for attempting to bridge and apply multiple knowledge systems. Shorefast sea ice provides hunters annually reoccurring access to marine mammals, yet, due to its ephemeral nature, presents a risk to human life and equipment. Through careful repeat observations, hunters track how different ice types and features evolve throughout seasons, continuously assessing both ice stability and trafficability. Here, the empirical and time-tested knowledge of Indigenous experts from Barrow, Alaska is summarized according to key processes and considerations for assessing safety. Using fault tree analysis (FTA), which relies on deductive logic to map causal relationships, this presentation outlines a conceptual

framework for monitoring shorefast ice stability that incorporates both Indigenous and science-based observations. Case studies of notable shorefast ice failure events from 2007 and 2014 are used to conceptually model the interaction of ice features, atmospheric and oceanic forces, and local to regional processes, while interfacing different knowledge systems. The FTA framework both necessitates and fosters improved communication between Indigenous communities and researchers. It allows for probabilistic assessments of risks that draw on Indigenous knowledge and sustained observations. By doing so, it may serve as a platform for joint evaluation of hazards, instruction, and knowledge co-production, potentially broadening collaboration to other stakeholders, including industry and other operational users of sea ice.

P 211 BRUNO LATOUR AND ELINOR OSTROM FOR THE ARCTIC: REINFORCING NATURE'S AGENCY IN THE ARCTIC DISCOURSE

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There is a peculiar discrepancy in terms 'colonisation of land' and 'colonisation of peoples'. If the latter is interpreted negatively and counteracted with ever growing indigenous presence in global and local Arctic fora, the former still retains a positive connotation as evidence of human survivorship. In the Arctic context, the issue of representativeness and agency is ever more apparent and pressing. The Arctic environment, once viewed as unproductive and empty, now appears as a complex interstice of natural and societal forces of change. Representations of the Arctic environment diverged in the past two decades, first, as a function of climate change paradigm and, second, as that of the region's projected economic potential. While climate change reinvoked nature's agency, a notion of the Arctic as a productive asset reinforced its passive definition. So how do we factor in the nature's agency, especially in areas with no indigenous or other human representation, and translate it to the political and economic discourses in order to minimise the risks of promethean expansionism in the northern frontiers?

The study interpreted the agency of the Arctic as ability of the environment to influence human-non-human interactions therein; agency is inseparable from such interactions as it materialises through them. The study evaluated the socioecological system approach (Ostrom) combined with Latour's Actor-Network Theory, which allowed for unbiased inclusion of all parties to such interaction into the analysis, as tools for inclusive representation of human and non-human inputs into the biophysical exchange regardless of the ontological (social/physical) viewpoint. It found that such interaction-based approach not only allows to account for multiple actors, points of intersection, and flows, but by lifting the agency of the environment it can also overcome social-natural dichotomy of traditional subject-based (society/nature) epistemologies.

P 212 DO'S AND DON'TS IN ARCTIC RESEARCH? AN INTERACTIVE WORKSHOP ON COMMUNITY-BASED RESEARCH WITH EARLY CAREER SCIENTISTS

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Research in Arctic and Sub-Arctic environments presents unique challenges and obstacles, in particular, establishing a necessary baseline understanding of environmental systems in the face of ongoing climate change. Pairing scientific and traditional knowledge approaches can help to close this gap, however creating a bridge between non-local, non-indigenous research scientists and traditional knowledge holders in northern communities can be challenging. For example, most researchers are likely less familiar with local norms, customs, as well as with social systems and protocols, leading to inevitable challenges for the scientists and communities.

In a cross-cutting initiative for the International Arctic Science Committee (IASC), Fellows of different the Terrestrial, Cryosphere and Marine Working Groups organized a workshop session on "Community-based Research: Do`s and Don`ts of Arctic Research" during the Young Researchers Workshop at the 11th International Conference on Permafrost in Potsdam, Germany, June 2016. This workshop brought together Early Career Scientists (ECS, including engineers) with resident Arctic representatives and experts to discuss best practices in the exchange of traditional and modern knowledge when conducting research in northern communities.

After a short presentation by the panelists, ECSs with invited experts split into small groups with an IASC Fellow as moderator. The break-out groups discussed their experiences and raised questions for the invited experts. These discussions generated a list of "do's and don'ts" from each group, which were presented and discussed with the larger audiences.

The format and organization of the workshop allowed an interactive and fruitful discussion, generating a diverse list of Arctic Research considerations and best practices. Key ideas from the workshop discussions are visualized in the word cloud figure. Recommendations from this workshop included enhancing future support opportunities, like the IASC cross-cutting initiative, to facilitate continued discussions between scientists and northern representatives to maximize the benefits of pairing traditional and modern knowledge to face future challenges.

P 213 "HACKING" TRADITIONAL KNOWLEDGE BASED SOLUTIONS TO CLIMATE CHANGE. THE NASA "SEA-ICE" APP CHALLENGE

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As the Arctic is facing unprecedented environmental and social challenges, novel and unanticipated ways to address northern sustainability are urgently needed. Outcome-driven open innovation competitions, at the interface of traditional knowledge and scientific research, could play a major role in developing innovative technologies and capacities that could increase communities' resilience to climate change in northern communities whilst also advancing knowledge of the Arctic as a system. This presentation will highlight lessons learned from the "Sea-Ice" app, a challenge of the NASA's Space App Hackathon, in which participants were given 48 hours to develop innovative traditional knowledge based ICT solutions, that support local/traditional activities, increase elder-youth interaction, as well as facilitate intercultural exchanges between scientists and Arctic community members of Barrow, Alaska. The results of this experiment could provide useful guidance for future solutions-orientated research with northern communities.

P 214 THE IMPORTANT ROLE OF NATURAL HISTORY COLLECTIONS IN DOCUMENTING ARCTIC BIOLOGICAL DIVERSITY AND GENERATING NEW ARCTIC KNOWLEDGE

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Core components of Arctic research infrastructure and the polar information spectrum are the millions of biological and geological specimens in natural history collections. Baseline biodiversity data from the past and present can provide critical points of reference for measuring changes in the diversity, distribution and ecology of species in the Arctic that is predicted or already occurring in response to climate change. Natural history specimens document the distribution of species in time and space; they serve as vouchers for datasets, allowing future workers to go back to original material to confirm or revise identifications; and they are sources of new data (morphology, anatomy, toxicology, genetic information, and more). A challenge many natural history museums are facing is the massive task of databasing and imaging their collections so they may be mobilized, discovered, shared and used. I will provide examples of ongoing collections-based Arctic research at the Canadian Museum of Nature, which houses the largest collection of natural history specimens from the Canadian Arctic, and other “Arctic Eight” museums - an alliance of Arctic natural history museums. I will also review the state of Arctic collecting in Canada and globally, and summarize the status of digitization of Arctic collections in Canada. Natural history museums should be more involved in Arctic science discussions to raise awareness and increase usage of their rich collections-based resources, and should actively engage with researchers who require a permanent repository for their Arctic field collections. Together we must ramp-up collections-based documentation of Arctic biodiversity.

P 215 EXAMPLES OF CO-DEVELOPED SYSTEM-LEVEL APPROACHES TO DECISION-MAKING

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Globally, there is rising demand from local leaders and sectors for approaches to decision-making that are based on transparent, best available information - including traditional knowledge, current field observations, and models - to help build socio-ecological resilience. Done right, social and ecological assessments provide insights into how factors such as climate change and proposed development impact ecological functions and people‘s well-being, on land and in the sea. In this talk we discuss our previous successes embedding social and ecological assessments into planning processes, co-developed by local people, First Nations and other governments, investors, and sectors who define objectives, and decide on shared visions for the future. Drawing on examples from the West Coast of Canada, we show how traditional knowledge, applied research, and predictive models have together helped illuminate synergies and trade-offs in ecological, social, and cultural values under multiple future options. Such an approach is the basis of the good governance and systems-thinking needed for resilience.

S23 COMMUNICATING ARCTIC CHANGE – SUCCESSES AND CHALLENGES OF EFFECTIVE SCIENCE COMMUNICATION FROM MULTIPLE PERSPECTIVES

O 251 FROM COMMUNITIES TO THE BOARDROOM. DISSEMINATING SCIENTIFIC ARCTIC KNOWLEDGE

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Over the coming years the landscape of the Arctic will change substantially- environmentally, politically, and economically. Furthermore Arctic change has the potential to significantly impact Arctic and non-Arctic countries alike. As a result our science is in-demand by local communities, politicians, industry leaders and the public. These stakeholder groups may not be the first port of call for us when we are disseminating our scientific results. However robust scientific knowledge is exactly what is needed for the development of better decision-making tools to support sustainable development, provide the information necessary for improved management of assets and operations in the Arctic region, for the benefit of Arctic societies, and for countries that will be significantly affected by climate change. Within this session we present some of the outreach work we have performed within the EU programme ICE-ARC, from community meetings in NW Greenland through to sessions at the United Nations Framework Convention on Climate Change COP Conferences, industry round tables, and an Arctic side event at the World Economic Forum in Davos.

O 250 TOWARDS A SUSTAINED KNOWLEDGE EXCHANGE: COLLABORATIVELY ADVANCING AWARENESS AND UNDERSTANDING OF THE IMPACTS OF ARCTIC ENVIRONMENTAL CHANGE

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As the Arctic faces unprecedented change and far-reaching impacts from sea-ice loss, there is increasing need to collaboratively communicate both the societal implications of change and actionable science. Yet, the usability of scientific information most often requires an established foundation for sophisticated and two-way dialogue regarding community and stakeholder needs, the state of the science, and pathways for potential application. Recognizing this need and the associated obstacles, the Study of Environmental Arctic Change (SEARCH) Program is developing an approach for creating *knowledge pyramids* to make scientific information broadly accessible to policymakers, educators, students, journalists, and scientists across diverse fields. Knowledge pyramids provide answers to specific societally relevant questions about Arctic environmental change, while organizing supporting information into underlying tiers of increasing detail. The apex of a pyramid provides an expert-written synopsis on a particular issue in the form of a concise, peer-reviewed, and jargon-free science brief. The tiers below the brief assemble more detailed summaries, synthesis literature, and technical building block material, which collectively may include graphics, scientific articles, guest perspectives from stakeholders, and technical reports. The resulting web-based platform for hosting the knowledge pyramids is intended to provide efficient access to timely and authoritative information, organized across a series of high-level topics, such as the links between Arctic sea ice loss and marine ecosystems, coastal communities, lower latitude weather, marine access, and geopolitics. Knowledge pyramids require an iterative approach for synthesizing, organizing, and communicating science so that increasingly sophisticated dialogue is possible regarding how to best tackle climate change challenges in the Arctic. Furthermore, the collaborative curation and writing process for such products also enhances communication as a growing network of researchers, students, and information users develop a shared understanding and define an arena for usable science.

O 247 FROM POLE TO PARIS: COMMUNICATING CLIMATE CHANGE THROUGH ACCESSIBLE TERMS

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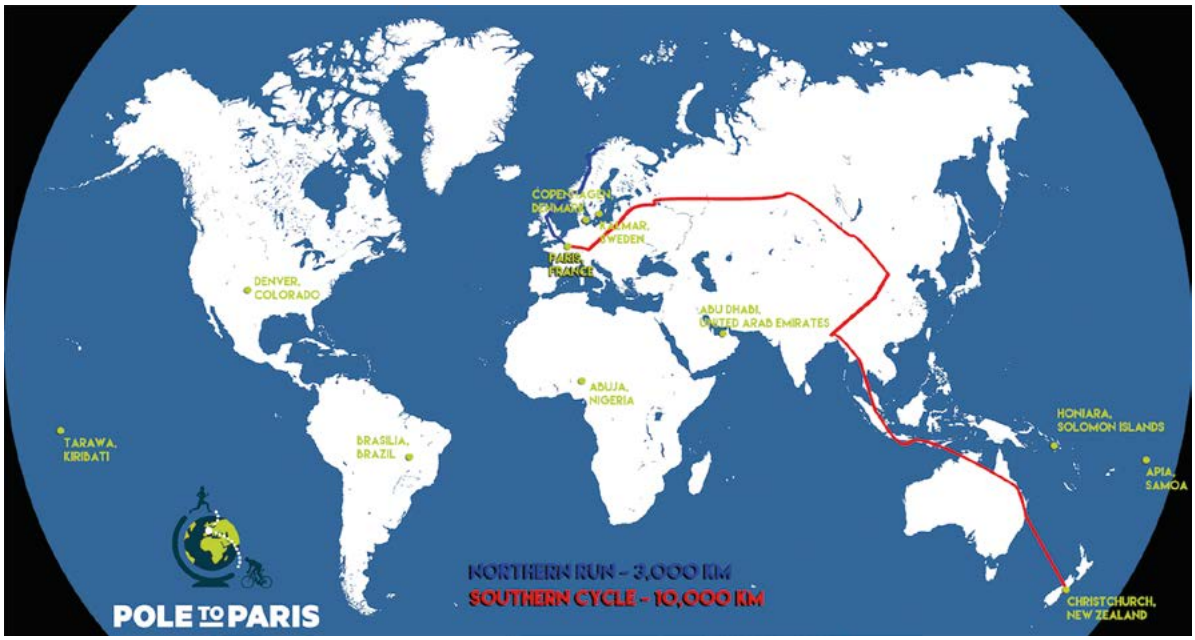
Two young climate researchers decided to leave their offices to cycle and run 13,000 km across half the globe from April to December 2015. Their goal? To raise awareness of climate changes in general and the importance of the climate summit in Paris (COP21) in particular.

Along the way from the two Polar Regions, Dr. Daniel Price and Dr. Erlend Moster Knudsen gave talks in schools and universities, organized open climate events together with scientific partners, engaged in dialogues with cycling, running and online followers, and tailored climate science for communication through traditional and social media. The main focus of the initiative Pole to Paris was a two-way interaction, also interviewing locals who already experience impact of climate changes in their daily life. Along with flags from the Arctic and Antarctic, their voices were carried along and retold on the way to and at COP21, emphasizing the impact the fastest changing regions of the planet have on the rest.

Supported by a young team and numerous volunteers, Pole to Paris was able to reach millions on six continents by offering a new narrative to the climate change story. Personal stories, easy language, common formats and accessible forums were key elements to these journeys.

In this talk, we will hear about the motivation for and experiences with the extraordinary outreach initiative Pole to Paris. It serves as an example of how science communication can be made more efficient, making use of both personal interaction and web-based technologies. However, it is also a story showcasing challenges with regards to coordination across time zones and personal backgrounds, as well as balancing academic careers and low funding resources.

The presenter, Dr. Knudsen, was recently nominated as a future Arctic leader by News Deeply. He will share his vision for a thriving Arctic.



O 249 POLAR VOICES: RELAYING THE SCIENCE & STORY OF POLAR CLIMATE CHANGE THROUGH PODCAST

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The resurgence of audio programming with the advent of podcasting in the early 2000's spawned a new medium for communicating advances in science, research, and technology. To capitalize on this informal educational outlet the Arctic Institute of North America (AINA) partnered with the International Arctic Research Center, the University of Alaska Fairbanks, and the UA Museum of the North to develop a podcast series called PoLAR Voices for the Polar Learning and Responding (PoLAR) Climate Change Education Partnership. Now entering its third season of production, PoLAR Voices has facilitated the communication of scientific knowledge regarding the impact of climate change on the Arctic and Antarctic, from the perspectives of both scientific researchers and Arctic indigenous peoples. An evaluation of the program has been conducted by the Goodman Research Group to assess the effectiveness of the program for communicating knowledge to the public. The results of the survey indicated two extremely productive aspects of the program: 1) The podcasts prompted listeners to engage more actively with climate change discussions and seek other venues to educate themselves on the subject, and 2) listeners connected with the humanism of the stories told by locals and gained a more profound appreciation for the impact climate change is having on Arctic communities. The results of this assessment will be used to further develop the program to effectively reach larger and more diverse audiences. The series is currently available on thepolarhub.org and iTunes and we are exploring opportunities to air the program on radio to reach as many people as possible.

O 248 RUSSIAN ARCTIC: SCIENCE IN FOCUS

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Education and outreach projects are an important component of the polar science promotion. Russian Arctic, one of the largest areas in the region, has received significant interest from research. However, the gap in formal knowledge about scientific outcomes still exists in the region. The dissemination of this kind of information is among the most important means of achieving the fundamental collective goals of the international scientific community and local people, including the development, economic growth, health, conservation, etc. A variety of free interactive webinar sessions aims to share knowledge about research in the Arctic region of Russia. In this project we have focused on the following goals: 1. Drawing the attention of various communities (international scientists, residents, visitors, etc.) to research in the region; 2. Understanding the environmental, social, political and economic impacts of regional studies on local and global level; 3. Creating a meaningful overall picture of investigations in the Russian Arctic; 4. Creating an effective dissemination strategy of polar science promotion for a wider audience. In this regard, the advantages and disadvantages of managing the project are discussed.

P 216 INTERACCESS – A SIMPLE TOOL TO MANAGE TRANS-NATIONAL ACCESS

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INTERACCESS is a new web tool developed for H2020 Research Infrastructure project INTERACT in order to manage calls for physical and remote Trans-national Access, applications submission, evaluation and recommendation, including an online repository and project reporting system.

The applicants prepare and submit their applications and related documents via the tool for sharing all applications with TA coordinator, the TA evaluation board members and the station managers of the stations where access is applied for. Evaluations and eventual recommendations are also given in the system.

Infrastructure's managers can login into the INTERACCESS for accessing the recommended projects and mark their final acceptance.

INTERACCESS is also used for collecting information related to reporting by both infrastructure's managers and accepted user groups who can also give feedback about their visit, and lists of publications (both scientific and public).

P 217 CREATING EFFECTIVE STEM EDUCATIONAL PATHWAYS FOR NORTHERN YOUTH: THE CASE OF NURSING

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Increasingly, well-paying and desirable jobs are coming from the "knowledge economy": one that is dependent on intellectual rather than material capital. Much of this related growth is arising from the Science, Technology, Engineering, and Math, or STEM, sector, and it seems likely this trend will continue in the medium and long term.

However the gap continues to grow between STEM achievement in rural northern, communities and urban, southern ones, and has huge impacts on northern economic development and self-determination. Science and math-intensive professional programs, including nursing, medicine, engineering, natural sciences, IT, accounting, agriculture & bioresources, face very significant challenges in the recruitment and retention of northern Aboriginal students. How can we become more effective in addressing this issue?

This paper will examine these issues using the challenges and needs of northern nursing programs across the Arctic region as examples. In particular, the experiences, challenges, and progress of the University of Saskatchewan nursing program in northern Saskatchewan will be discussed.

P 218 @OCEANSEAICENPI: POSITIVE PRACTICE OF ARCTIC SCIENCE OUTREACH VIA SOCIAL MEDIA

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As researchers, we are keen to share our passion for science with the general public. We are encouraged to do so by colleagues, journalists, policy-makers and funding agencies. How can we best achieve this in a small research group without having specific resources and skills such as funding, dedicated staff, and training? How do we sustain communication on a regular basis as opposed to the limited lifetime of a specific project?

The emerging platforms of social media have become powerful and inexpensive tools to communicate science for various audiences. Many research institutions and individual researchers are already advanced users of social media, but small research groups and labs remain underrepresented.

A small group of oceanographers, sea ice, and atmospheric scientists at the Norwegian Polar Institute have been running their social media science outreach for two years @OceanSeaIceNPI. Here we share our successful experience of developing and maintaining a researcher-driven outreach through Instagram, Twitter and Facebook. We present our framework for sharing responsibilities within the group to maximize effectiveness. Each media channel has a target audience for which the posts are tailored. Collaboration with other online organizations and institutes is key for the growth of the channels. The @OceanSeaIceNPI posts reach more than 6000 followers on a weekly basis.

If you have questions about our @OceanSeaIceNPI initiative, you can tweet them with a #ask_oceanseaicenpi hashtag anytime.

P 219 INTERACT GOES VIRAL: AN ADVANCED COMMUNITY STEPS INTO A GLOBAL ROLE

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INTERACT is a circumarctic network of 80 terrestrial field bases in all arctic countries and adjacent high alpine and forested areas. INTERACT is building capacity for identifying, understanding, predicting and responding to diverse environmental changes throughout the wide environmental and land-use envelopes of the Arctic.

During the first phase of the EU FP7 programme INTERACT, more than 500 scientists were granted access to the field through the Transnational Access programme. Their science was presented in a book and mass outreach course. The project also developed best practices in station management, a standardised presentation of the stations and an overview of monitoring/research projects from 2000 until present through its Station Managers Forum. This information has been published in several books available on INTERACT's web site (www.eu-interact.org). Three joint research activities developed standardised monitoring system for surface energy balance, technology for monitoring of phenology and an integrated database system for research stations - the INTERACT GIS.

INTERACT is now an advanced community grant in EU Horizon2020 programme. Now we will further develop the Transnational Access programme with access to twice as many stations. Also, physical access has been complemented with virtual (free access to metadata and data collected by the research stations) and remote (observations carried out by station staff) access. New Station Managers' Forum activities include safety at research stations, reducing emissions from research stations and improving access to data from the research station (taking INTERACT GIS to the next level). In addition, joint research activities will develop standardized monitoring schemes for biodiversity, drone technology in the field, local adaptation schemes and procedures for action when a hazard occur. We will also develop guidelines for storing real data through our Data Forum.

P 221 20 YEARS OF NORWEGIAN-RUSSIAN COLLABORATION IN HIGHT EDUCATION AND SCIENCE AT THE UNVERSITY CENTRE IN SVALBARD AND ITS FUTURE DEVELOPMENT

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The University Centre in Svalbard (UNIS) is the northernmost (78º N) high education institution, providing research-field-based education of next generation of Arctic experts. International collaboration is very important issue for sustainable Arctic development and essential part of strategy of UNIS, where students from all over the world (50% of total amount) come to get real Arctic experience and knowledge.

Arctic Technology (AT) department of UNIS increases understanding of engineering problems in harsh environmental condition, knowledge in the field Ice Mechanics, Applied Oceanography and Marine Technology and gives students unique experience of full-scale tests with sea ice and operation with cutting-edge equipment.

During 20 years AT department implements the international collaboration projects, involving students and professors from Norway and Russia in joint investigations for sustainable industrial development. Students participate in UNIS bachelor and master courses, fulfill Master project and getting degree in the home universities continue in the leading companies, institutions.

Since September 1996, when the first student from Saint Petersburg polytechnic University came to UNIS, more than 100 students participated in the program, several new universities have been involved. Beside UNIS and Norwegian University of Science and Technology (NTNU), there are Moscow Institute of Physics and Technology (MIPT), Moscow State University (MSU), State Marine Technical University of St. Petersburg (SMTU) in the team.

The new project SITRA (Safety of Industrial Development and Transportation Routes in the Arctic, 2015-2016), sponsored by Norwegian Centre for International cooperation in Education as a part of a High North Program, expand collaboration overseas. SITRA project units two Norwegian (NTNU, UNIS), a Canadian (Memorial University of Newfoundland), two US (Dartmouth College and University of Alaska Fairbanks), three Russian universities (MIPT, MSU, SMTU) and the whole scientific society.

The experience of collaboration, organizing of a multi-international educational and research network, corresponding challenges and perspective will be discussed in the presentation.

P 222 APECS' ONLINE CONFERENCE, VIRTUAL POSTERS, & WEBINARS TO THE WORLD

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The Association of Polar Early Career Scientists (APECS) is a multidisciplinary, international organization dedicated to maintaining a network of early career researchers (ECRs) and professionals (ECPs) to share ideas, develop collaborative research directions, provide opportunities for career development, and promote education and outreach as an integral component of Polar research. Science outreach is one of APECS' key objectives and we have found that online media is a powerful tool for STEAM (Science, Technology, Engineering, Art, and Mathematics) knowledge transfer. We introduce the use of online presentations as a platform for communication, education, and networking. APECS' Online Conference, virtual posters, and webinar series provide case studies to examine how online technology bridges geographic and disciplinary boundaries.

APECS' Online Conference allows ECRs and ECPs to present their research to an interactive, online room of viewers. The third iteration of this annual event (March 2017) appealed to science communicators with the theme: "Outside the Box: encouraging alternative solutions for undertaking and communicating polar research". Virtual poster sessions have allowed members to share work on an array of topics, from whaling and tourism to showcasing studies affiliated with specific national research programs. Webinars have covered a variety of skills-based and scientific topics, with invited speakers addressing everything from writing grant proposals to eco-cultural communication. Each presentation is recorded and saved on APECS' website as a free resource.

ECRs, ECPs, and APECS mentors from around the world attend our events, promoting diversity in networking and helping steer the Arctic community in positive directions. We will provide examples of connections fostered by and benefits of online events, including easier dissemination of ideas across geographically distant regions and minimal cost. While this presentation focuses on APECS' experiences, we will highlight how innovative communication promotes international cooperation and offer suggestions on how to incorporate similar elements into other outreach programs.

P 223 REVISITING THE ARCTIC STUDIES OF AC SEWARD: THE "FOSSILIZED" WORK OF A PALEO-BOTANIST ON GREENLAND FINDS NEW RELEVANCE

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About 100 years ago, Cambridge University Professor AC Seward achieved considerable renown as a botanist, particularly for studies of fossilized plants around the world. Amongst these studies were his examinations of material gathered in the Arctic. Seward also travelled to Greenland for a summer in order to elaborate his research, and he wrote a book about this time there, aptly called "A Summer in Greenland" (1923). This short and rather pleasant book records not only a clear portrait of Seward's joy during these months, but also documents the state of things in Greenland at that time through the auspicious eye of a leading scientist (even if he was on holiday). The lack of study on this book is itself a curious topic - it prompted me to examine why this work has been overlooked, especially as Seward was himself so committed to sharing knowledge with both scientists and not that he went ‚above and beyond' by writing works for both audiences. Nevertheless, his work has been buried in the annuls. My paper examines "A Summer in Greenland" formally and with historical context, as well as the reasons why this work is pragmatic to scholars today. I also open a discussion about the "hidden treasures" by other great scholars of the Arctic, and how such excellent knowledge can be so easily buried for decades or more.

P 224 THE CANADA GOOSE ARCTIC GALLERY AT THE CANADIAN MUSEUM OF NATURE: COMMUNICATING ARCTIC SCIENCE AT A NATIONAL NATURAL HISTORY MUSEUM

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Part of the core mandate of many museums is to generate new knowledge through research and communicate knowledge to the general public. A new permanent gallery focused on the Arctic will open at the Canadian Museum of Nature, in June 2017, in celebration of Canada's 150th birthday. Visitors will be immersed in the Arctic and explore its natural and human landscapes. The Arctic Gallery will build on the museum's strong history of scientific exploration, public engagement and partnerships in the North. A challenge in its development, however, is choosing which Arctic stories visitors need to know to engage with this increasingly changing and important part of Canada and the planet, even if they will never visit the Arctic themselves. The 8,000 square-foot bilingual (English and French) exhibition will use current approaches to nature inspiration, showcase the CMN's contributions to the body of knowledge about the North, and gather broad perspectives from scientists, artists, thought-leaders and northerners. It will offer tangible, participatory experiences of the Arctic through specimens (preserved and living) and touchables, first-person stories, multimedia experiences, immersive environments and a space for public programs or school workshops. A unique feature of the exhibition is the Northern Voices Gallery - a temporary exhibit curated by Indigenous or northern-based organizations. The Arctic Gallery features four themed sections: geography, climate, sustainability and ecosystems. These provide a platform for visitors to understand the contemporary Arctic by tracing each theme's evolution. The Canada Goose Arctic Gallery is produced in collaboration with many partners representing governments, industry, northerners and NGOs. Content is developed in close consultation with an advisory committee comprised of key external stakeholders, thus ensuring the gallery and associated educational resources are culturally appropriate, accurate and relevant.

P 225 SEEING EDUCATION WITH NORTHERN EYES

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Taking into consideration the diverse populations, cultures and socio-economical conditions of the Arctic region, social justice as a principled approach seems viable in responding to the needs of diverse student populations. This includes educational policies and practices that enable equity and equality; for example, ensuring that fair educational opportunities are available even in more remote areas. Socially sustainable development necessitates a contextual understanding on the part of future and current teachers and teacher educators. The important questions are for example: What is the social, economic, cultural, political and geographical context where teaching and learning takes place? and, How nationally developed curricula can be translated into the context of the region?

We, as teacher educators involved in the work of the UArctic Thematic Network on Teacher Education for Social Justice and Equality in Education, maintain that teachers living and working in the 'North' need a deeper understanding of their communities and cultures; seeing education with Northern eyes.

The poster presents our plan for a comparative study on teachers in small, northern communities, and how they understand their role in promoting social sustainability and responding to diversity. We want to stimulate discussion among the participants in the Arctic Science Summit Week 2017 about the need to focus on teacher education, teachers' identity, and their role in the community in and for the North.

S24 MEANINGFUL MULTI-DISCIPLINARITY AND THE GOVERNANCE OF EVOLVING GLOBAL DYNAMICS IN THE ARCTIC

O 210 INTERACTIVE MAP OF THE 'OLD VILLAGE' IN MAYO, YUKON TERRITORY: CAN THIS COLLABORATIVE, MULTI-STAKEHOLDER ENDEAVOR BE SEEN AS BOUNDARY OBJECT

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During the course of my fieldwork in Mayo, Yukon Territory, in summer 2016, I was collaborating with the First Nation of Na-Cho Nyäk Dun's (FN NND) heritage department on various heritage-related subjects. One on-going heritage project was the development of a heritage site called Old Village. Together with various stakeholders we created an inventory as well as an interactive 'map' of the former dwelling place of the FN NND. This experience was not only a cross-stakeholder experience involving administrative staff, a researcher, members of community, Youth and Elders but a multi-disciplinary one at the same time, being located at the intersection of geography, map-making, anthropology and heritage. During my first visit I given a tour by restoration/clean-up project members explaining the specifics of the site. An Elder told me stories related to the dwelling history of the place and provided general information in regards to the current use. Later on I revisited the site to take an inventory with a young local woman taking pictures, and administrative heritage staff as well as myself taking notes. Back in the office of the self-governing First Nation it turned out we had to figure out which cabin on site had belonged to whom, leading to the idea of creating a new map. Eventually a visualization of the Na-Cho Nyäk Dun Old Village was created with the help of a geographical map (MAPS), an Elders mental map and a historic schematic drawing by the Mayo Historical Society, as well as our drawings from the site and the visual data provided by the FN NND Youth operating the camera. In light of this experience I would like to discuss the concept of 'boundary objects' and if it applies to (the creation of) this particular artifact?

O 211 DEVELOPING AN ARCTIC INTER- AND TRANSDISCIPLINARY RESEARCH PROJECT INVOLVING THE CONCEPT OF BOUNDARY OBJECT

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This talk will give a brief outline of the attempt to draft a strong inter- and transdisciplinary project, including expertise from within and across natural and social sciences as well as engagement of stakeholders throughout the research process. The idea behind such a project is that we aim to strengthen the outcomes of science-policy interactions by involving Arctic stake- and rights-holders throughout the research process and by making research results accessible and useful for them. This builds on and augments, but does not replace, traditional basic scientific research and outreach approaches. Further, the project aims to use the concept of boundary object in the form of a set of scenarios for future Arctic development outlining possible developments over different time scales and the possible consequences of potential decisions that could be taken in regard to the Arctic environment and Arctic communities. While the project is still in the planning phase, some advantages and difficulties of such an approach can already be shared.

O 212 INTERDISCIPLINARY COOPERATION BETWEEN RUSSIAN AND CHINESE UNIVERSITIES ON ARCTIC GOVERNANCE

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In 2012 the Department of World Politics Study of Saint-Petersburg State University started a new private cooperation with the Institute of Law and Policy of China Ocean University (Qingdao). The collaboration bases on the Department of World Politics Study's research on new methods for cooperation between the natural and social sciences in the development of Arctic governance.

In the first leg of the research on how to increase multi-disciplinary collaboration in the development of Arctic governance that has been ongoing at the Saint-Petersburg State University since 1997, we studied the role and place of: a) international organizations, b) federal and local structures on the shaping of arctic policy and participating in arctic affairs in Russia.

In second leg, which began in 2010, we first contacted different private and public institutions in East-Asia to see if there were similar interests in the development of Arctic governance and business structures than we had discovered on the Russian side. An important tool in building this leg of collaboration in multi-disciplinary arctic research between Chinese and Russian institutions was a Singapore seminar and conference on Arctic issues organized between 2010 and 2012. Next to building this collaboration we researched the role of states in the shaping of strategical arctic researching planning and in arctic affairs.

The third leg of research has included an ongoing cooperation between Dr. Nadezhda Kharlampieva (Department of World Politics Study, Saint-Petersburg State University) and Professor Peiqing Go from Institute of Law and Policy of China Ocean University (Qingdao) on: a) Cycle of inter-disciplinary researching "The Arctic Policy in XXI century" (since 2009), and b) Annual Russian-China Science-Practical Interdisciplinary Workshop (since 2011). The research and practice of multi-disciplinary collaboration between Chinese and Russian institutions on Arctic issues has illustrated innovative possibilities for research that focuses on: 1) economic and ecological international interactions in and of the Arctic 2) transformation of decision making processes on local, regional and global levels, and 3) facilitation of the creation of interdisciplinary dialogs between the natural and social sciences in the governance of evolving Arctic issues.

O 208 A MAP'S LINES OF CONNECTION: REPRESENTATION BEYOND AND ACROSS REPRESENTED BOUNDARIES

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The Arctic region's territorial indeterminacy - melting, thawing, shifting, and moving 'homelands' - is prompting seemingly contradictory processes of re-asserted state sovereignty and re-imagined post-sovereign space. As such, the Arctic challenges traditional practices of politics, and in so doing, is inviting new modes of relating both socially and politically. This presentation focuses on one specific object - something as mundane as a map - and how this came to stand in for these shifting geographical imaginaries: representational lines, fixed on paper, which most of all bore testimony to their own inadequacy. Tracing the map through a series of connected events, I argue that it took on both shared and contrasting meanings for those who engaged with it; and, indeed, through their encounters therewith new meaning and understanding were generated. The first encounter was an interview, where latitudes traced by a finger came to signify shared identities across vast oceans, generations, and professions as interviewer and interviewee. Second, the story of the map and the encounter within which it came to intervene provided a point of departure for subsequent inter-disciplinary discussion; here, once more, the depiction of the same map engendered new stories and new relational meanings. Finally, the map was written into a research project, fixed on paper, symbolising something wholly new: an educational journey. In the end, my argument is less about what the map is intended to represent in and of itself - space, borders, territory - and more about the meanings with which any object with seemingly known attributes can become imbued when it enters a field of social interaction. With multiple but not exclusive meanings, such a familiar object thereby allows us to explore co-extant understandings of the Arctic and beyond, traversing disciplinary and professional (not to mention, geographical and generational) boundaries.

O 209 THE US INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE (IARPC) COLLABORATIONS – COLLABORATIVE INFRASTRUCTURE AS AN ENGINEERED BOUNDARY OBJECT

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The US Interagency Arctic Research Policy Committee (IARPC) was created by Congress in 1984 (Arctic Research and Policy Act as amended 1990, ARPA) with a joint mandate to create greater coherence across 14 government agencies engaged in Arctic research and to develop collaborations with outside partners. The law directed IARPC to create a plan every five years to guide agencies; the current plan is Arctic Research Plan FY2017-2021. In 2014, to most effectively fulfil its mandate towards working with outside partners, IARPC created IARPC Collaborations - a completely open collaboration infrastructure that consists of open teams, regular virtual meetings and a user content-driven web platform (iarpccollaborations.org). IARPC Collaborations was created from the recognition that Arctic research is diverse and requires cooperation between multiple types of participants. It could be viewed as an "engineered boundary object" (Bowker and Star, 1999) that was designed to bridge the gap between Federal funders, members of the research community, and other stakeholders.

IAPRC's collaborative infrastructure supports low friction engagement and seeks to democratize the process of advancing Arctic research. In the two years since the website launched, more than 1000 member have joined and contributed more than 2600 pieces of content (documents, updates or events), generating more than 350 comments. It has been observed that engineered boundary objects can fail to engage and bridge diverse groups if they lack plasticity or "ambiguity" (Stoytcheva, 2013). IARPC Collaborations (virtual meetings and website) bears many similarities to learning networks; it also supports self-organized sub-networks. In these aspects it supports plasticity and evolves organically. Yet a comprehensive assessment of its value to diverse stakeholders has not been undertaken. While IARPC Collaborations is still a young and evolving infrastructure, viewing it as an engineered boundary object presents a valuable framework to evaluate its effectiveness at bridging diverse communities moving forward.

O 213 FULBRIGHT ARCTIC INITIATIVE: INTERDISCIPLINARY COOPERATION FOR A SUSTAINABLE ARCTIC REGION

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This abstract draws on the group work of Fulbright Arctic initiative (FAI) alumni from the 2015-16 cohort http://www.cies.org/fulbright-arctic-initiative/scholars. The Fulbright Arctic Initiative, an innovative model for policy relevant research and public outreach, is a new multidisciplinary, multinational team research program designed around specific applied research challenges in the areas of water, energy, health and infrastructure. The Initiative is designed to have an immediate impact on our understanding of these Arctic issues within the timeframe of the U.S. Chairmanship of the Arctic Council (2015-2017).

The FAI brought together leading scholars, policy makers, government officials, indigenous peoples and other stakeholders to identify critical Arctic issues, conduct policy-relevant research, and widely share findings and policy recommendations. Research activities involved disciplines of environmental sciences, political sciences, anthropology, law, public health, biology, engineering and urban planning. This interdisciplinary collaborative work created an opportunity to learn from different disciplines and explore shared challenges relating to sustainable energy sources, community wellness, climate change and water. Three working groups were established; Enery, Water and Health&Infrastructure. As the Health & Infrastructure (H&I) working group, we worked with the goal of exploring how multidisciplinary approaches could enhance the understanding of community wellness and quality of life in the Arctic. Our research indicated that community wellness in the Arctic is a concept that is strived for and discussed by many who live and work in the Arctic regions. While holistic and multi-sectoral approaches are seen to be beneficial to community wellness, there is lack of interdisciplinary models for research collaboration across sectors and an interdisciplinary research platform for policy formulation. The H&I group has been working to develop such a holistic model for wellbeing in the Arctic that is more inclusive and responsive to the challenges and opportunities that characterize northern regions.

S25 PROJECT MANAGEMENT IN THE ARCTIC SCIENCE – THE UNKNOWN DRIVER OF CHANGES

O 057 ADDED VALUE THROUGH COOPERATION - AN EXAMPLE OF FUNDING AGENCY DRIVEN PROJECT MANAGEMENT

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The Svalbard Science Forum (SSF) is an international Forum consisting of the main scientific stakeholders in Svalbard (http://www.forskningsradet.no/prognett-ssf/Mandate/1253977852338). The forum shall serve as a coordinating and advisory body for research activities in Svalbard and is chaired by the Research Council of Norway (RCN), the main Norwegian funding agency for research. The SSF has developed the Research in Svalbard (RiS) database, which contains more than 3000 research projects and is a key tool for coordinating and managing scientific activity in Svalbard.

The objective of the forum is to increase scientific quality and achieve better coordination of research activities in Svalbard by providing integrated and easily accessible information about research currently ongoing in Svalbard. To expand and strengthen collaboration between individual researchers and research institutions - both Norwegian and foreign - that are involved in research activities in Svalbard. Thereby making it easier for Norwegian and foreign researchers and research institutions to obtain the support and guidance they need concerning the infrastructure, framework and services available to researchers in Svalbard.

The RCN is in the process of, by [KB1] order of the Norwegian government, preparing two scientific strategies. One for Svalbard as a whole and one for the research base of Ny-Ålesund. As the host for the international scientific community in Svalbard Norway aims to ensure that all research in Svalbard is of excellent quality and follows best practices for research such as open access, data sharing and has a high degree of international and interdisciplinary cooperation. To make sure that the new strategies will lead to better management and scientific development in Svalbard and be beneficial to all it is very important that the international scientific community is closely involved in the process. In this talk we aim to give an example of and insight into a funding-agency driven project management approach.

O 056 A SUCCESSFUL RTD PROJECT MANAGEMENT

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The success of a RTD project depends on careful planning, allocation and good stewardship of the resources, assessment of the risks and anticipation of the difficulties that may arise, the constant monitoring of progress and respect of deadlines, quality control, reporting, and communication.

Develop the best procedures to manage a big group of researchers and administrative people, coming from different academic institutions, with different level of experience could represent one of the most difficult tasks of the project, but even one of the keys of its success.

The FP7 infrastructure project INTERACT (2010-2015) is now entering in a new phase, funded by H2020 program, to coordinate a growing network of 77 research stations, managing a 4 years-project with 47 partners from 18 arctic countries.

Thanks to a decadal experience, supporting the coordination of other 22 RTD projects involving more than 2.000 scientists coming from 554 institutes in 56 nations, we contributed to identify a successful way of managing research projects, getting a high level of efficiency even within very big consortium.

To mention some of the coordinating topics that helped INTERACT being successful and still improving:

- harmonizing project schedule with scientific needs
- use specific tools developed to support communication among a large project team, permit a timely exchange of information, avoiding misunderstandings, duplicate messaging and unnecessary correspondence
- keep an accurate and updated overview of the progress, even working on a large number of tasks and deliverables
- planning and monitoring of resources, according to the activities performed
- deep knowledge of funding procedures
- being rigorous…but flexible.

O 086 ORGANIZING FOR RESEARCH: THE U.S. INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE'S 5-YEAR PLANNING AND IMPLEMENTATION PROCESS

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The United States Interagency Arctic Research Policy Committee (IARPC) is required to develop and implement a five-year research plan in consultation with the U.S. Arctic Research Commission, the Governor of the State of Alaska, residents of the Arctic, the private sector, and public interest groups[1]. Over the past four years, IARPC has been implementing the Arctic Research Plan 2013-2017. It utilized several innovative management tools to do so. One such tool is the IARPC collaborations website (www.iarpscollaborations.org), which brings together Federal program managers and the research community - both domestic and international - and embraces dialogue between stakeholders at the Federal, state, local and tribal level. The website has more than 1,000 users who support, implement, and use Arctic research, and it serves as a management tool for tracking progress on implementation.

In December 2016, IARPC released the second comprehensive Arctic Research Plan covering the years 2017-2021. This policy-driven plan identifies critical areas where research supports U.S. policy from community to global scales. The wheel diagram (figure 1) represents the Plan's four policy drivers, shown as arrows, and their intersection with nine research goals: broad topics where an interagency approach can accelerate progress. The eight goals are shown as wedges, and environmental intelligence, with its emphasis on system integration and tools for decision support, ties all wedges together at the center. The goals will be met by implementing research objectives and accompanying performance elements contained within the Plan.

The presenters will explain how a policy-driven plan can be implemented and managed with support from the research community at all levels (including internationally) and at the same time support decision-making at all scales.

Figure 1: Arctic Research Plan: Policy Drivers and Research Goals.

[1] *Arctic Research and Policy Act of 1984* (ARPA), Public Law 98-373, July 31, 1984, as amended by Public Law 101-609, November 16, 1990

O 059 STANDARDISED PROJECT MANAGEMENT FOR ARCTIC CLIMATE RESEARCH

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The Arctic region is undergoing the effects of climate change increasing the need for detailed climate and weather predictions in the region and beyond. The APPLICATE project, an Horizon2020-funded international research collaboration, aims to address the challenge of Arctic climate change prediction, developing a comprehensive framework for assessing and observationally constrain climate and weather models. The framework will be used to improve the current modelling capability and enhancing the predictive capacity of environmental conditions by contributing to the design of the future regional observational network.

With 16 partners drawn from academia, research institutions and operational prediction centres across Europe and a budget of 8M Euros over four years, the project is expected to deliver high-impact results and has strong links with policy makers and civil society. The timely delivery of results as well as their effective dissemination and exploitation call for a rigorous project management throughout all the phases of the project, including execution, monitoring and controlling.

In this presentation we will show how we manage the APPLICATE project through the integration of a globally recognised standard for professional project management, such as the PMP® by the Project Management Institute. The standard, traditionally implemented in various business sectors, can be transferred to the management of scientific research projects in a structured way thus enhancing efficiency and increasing impact.

O 084 BALANCING THE DEMANDS OF KNOWLEDGE CO-PRODUCTION AND BASIC RESEARCH FOR LARGE PROJECTS IN THE NORTH AMERICAN ARCTIC

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In the North American Arctic, increasing temperatures have been accompanied by a host of impacts for ecosystems, communities, and infrastructure. In turn, natural resource managers and decision makers have called for an improved capacity to project these impacts over coming decades. However, by 2009 commonly used modeling tools still lacked the ability to link climate, permafrost change, and ecosystem dynamics in ways that realistically portrayed the interactions and feedbacks among these processes. As a result, numerous federal and state/provincial agencies embarked on a multi-year, multi-million dollar effort to develop the Integrated Ecosystem Model for Alaska and Northwest Canada (IEM). The IEM combines three modules representing high-latitude landscapes in an approach that has been co-developed (i.e., through researchers and end-users working in partnership) for applications across the region.

Given the complexity and level of stakeholder engagement involved in developing and implementing the IEM, this project offers a number of "lessons learned" with regards to project management. Among the most daunting challenges was the development of a workflow strategy and infrastructure to capitalize on available high-speed computing resources. Likewise, with dozens of researchers, programmers, and technicians required to develop the model, personnel management and communication within the team was critical. While we took full advantage of social media and virtual interactions, we also found that regular face-to-face meetings involving everyone from senior scientists and funding agencies to graduate students and budget specialists were required. These at-least-monthly discussions included key stakeholders representing both eventual end users and outside researchers hoping to use IEM output. Perhaps most critical to the success of the effort was the embedding of communications and outreach staff within the IEM team. Key challenges moving forward include the need to develop custom products for users with limited technical capability, and the need to educate potential users regarding uncertainty.

O 085 MODEL PROJECT MANAGEMENT FOR ARCTIC RESEARCH AND DECISIONMAKING: CRITICAL INSIGHTS FROM THE ARCTIC RESEARCH CONSORTIUM OF THE UNITED STATES

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The Arctic Research Consortium of the United States (ARCUS) supports the strategic planning of large interdisciplinary Arctic research programs, convening and facilitating planning discussions, overseeing funds development and management, tracking program objectives and deliverables, and maintaining key communication platforms. ARCUS also fosters wider collaborations among the Arctic research community by hosting workshops and providing logistical support to large open meetings and conference events such as the Arctic Observing Open Science Meeting of November 2015. Serving as a key Arctic research project management hub within and across diverse academic, agency, and stakeholder communities, ARCUS project managers also foster the necessary community networking, synthesis, and interactions necessary to advance emerging Arctic research programs and broader initiatives.

Drawing on the knowledge, experience, and expertise of ARCUS's specialized project management staff, this presentation will highlight a model of project management that we believe works best to catalyze the interdisciplinary thinking, acting, and education that leads to the development of highly collaborative partnerships and which promotes the discovery and understanding necessary to inform sound Arctic decision-making.

O 058 POLAR PREDICTION PROJECT MANAGEMENT – FROM RESEARCH TO IMPROVED ENVIRONMENTAL SAFETY

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The Year of Polar Prediction (YOPP) scheduled from mid-2017 to mid-2019 is a major international activity to significantly advance our environmental prediction capabilities for the polar regions and beyond, on a wide range of time scales from hours to seasons, supporting improved weather and climate services. YOPP has been established by World Meteorological Organization's World Weather Research Programme resulting from the currently changing polar regions and raising opportunities such as increasing economic, touristic, transportation, and scientific activities. YOPP is a key component of the ten-year Polar Prediction Project (PPP) and will entail intensive observing, modelling, prediction, verification, user-engagement and education activities. Project management of YOPP as an international coordination project involves various stakeholders such as the scientific community, the operational centres, and providers and users of polar forecasting products. It has been planned in three stages - a preparation phase from 2013 to mid-2017, a core phase from mid-2017 to mid-2019, and a consolidation phase from mid-2019 to 2022. The PPP Steering Group representing both the observational and the research communities oversees and implements the goals in PPP, and in particular YOPP priorities. Hosted by the Alfred Wegener Institute in Bremerhaven, Germany, the International Coordination Office (ICO) for Polar Prediction was established in order to support the Steering Group, to manage everyday activities, and to coordinate, plan and prepare details of the various work packages within PPP. In particular, the ICO fosters communication to and between various internal and external stakeholders. Task Teams led by members of the Steering Group and partners have been established in order to further enhance specific activities during the Year of Polar Prediction. With various activities and involvement of a wide range of stakeholder groups, YOPP will contribute to the knowledge base needed to managing the opportunities and risks that come with Arctic climate change.

P 226 EU-POLARNET – PROJECT MANAGEMENT CHALLENGES IN CO-DESIGNING RESEARCH STRATEGIES

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EU-PolarNet aims to develop an integrated EU polar research programme by identifying short and long-term scientific needs and optimising the use of co-ordinated polar infrastructure whilst fostering trans-disciplinary collaboration in polar research.

In a first step, the project consortium has compiled a set of European research priorities for the Polar Regions, which shall serve as a basis for the upcoming research planning process in EU-PolarNet.

In a second step, EU-PolarNet will carry out a workshop, which shall result in a series of white papers. These white papers are intended to provide a state of the art for key issues, to identify the challenges in addressing the issue, and to outline possible approaches that could be addressed through a European Polar Research Programme. The innovative aspect of this task will be for researchers of multiple disciplines and stakeholders to actively cooperate in co-designing the white papers and to engage in cross-disciplinary discussions around the identified topics. This requires project management measures, which enable an efficient working process, while remaining inclusive and transparent at all stages.

P 227 ARCTIC PROJECT MANAGEMENT AS SEEN FROM DIFFERENT ANGLES AND EXPERIENCED BY DIFFERENT STAKEHOLDERS: TRICK OR TREAT?

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Successful project management is the key factor of any outstanding project. The topic of the project may vary from the purely scientific background and purpose to education and outreach activities, mapping, publishing etc. No matter what, the main idea of any project is to produce the product which will in the future serve the audience, the stakeholders of the Arctic; which will at certain level help to understand the region's changes. This is to say that project management plays a significant role in helping observe, understand, research and study, monitor the Arctic region. This also includes the different stakeholders from bigger institutions to every single individual (scientist, observer, Arctic resident etc.) involved in the project. When it comes from the project management point of view, the roles of these project participants are very well described and mostly well-known. But when it comes from the stakeholder's point of view, the perception of projects, their management and ways of implementation may greatly vary: from the "bunch of money" as seen by some research departments to the "part of my own life" when it comes to the indigenous groups or separate scientists, for example. How to balance this? How to try to understand and hear each other? How to better work together for successful project implementation? With this presentation I aim to give a few case studies from different projects and will try to find out the consensus.

S26 PROGRESS ON THE DEVELOPMENT OF A PAN-ARCTIC OBSERVING SYSTEM

O 234 MONITORING ARCTIC OCEAN CLIMATE USING SATELLITE ALTIMETRY

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The Arctic is a region of rapid climate change, evidenced by the dramatic loss of sea ice cover and the amplification of surface warming relative to the rest of the Earth. The Arctic Ocean plays an important role in the global ocean system, as freshwater export from the Arctic Ocean has the potential to modulate convective overturning in the northern North Atlantic. However, observing the Arctic Ocean heat and freshwater budgets and exchanges with adjacent seas - important quantities for Arctic Ocean climate monitoring - is made difficult by seasonal and perennial sea ice cover and the harsh climate. We demonstrate the potential for satellite altimetry to provide routine monitoring of important aspects of Arctic Ocean climate. Satellite altimetry allows us to estimate seasonal exchanges, changing distribution and accumulation of freshwater in the Arctic Ocean, provides a continuous record of Arctic Ocean sea level and reveals seasonal to decadal variability in sea ice volume and ocean circulation. The pan-Arctic observations provided by satellites offer the opportunity to extend conventional hydrographic measurements over hard-to-observe areas such as the shallow Siberian Shelf Seas. Satellite altimetry provides highly complementary measurements to conventional pan-Arctic Ocean observation systems, such as moored arrays across the boundaries and measurements of the vertical ocean structure in the interior from profilers.

O 232 STAKEHOLDER ENGAGEMENT IN SUSTAINED ARCTIC OBSERVATIONS: COMMUNITY-BASED OBSERVATIONS, SATELLITE REMOTE SENSING AND PARTICIPATORY SCENARIOS FOCUSING ON COASTAL SEA ICE

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The Arctic Observing Summit (AOS) 2016 Conference Statement identified the creation of opportunities for stakeholder engagement as a critical component of an effective pan-Arctic observing system that creates avenues for research collaboration, helps build capacity and involves local and Indigenous knowledge holders. We present first findings from work in northern Alaska that addresses these issues in the context of changes in the seasonal cycle of sea ice. Specifically, we examine changes in the timing of spring break-up and fall freeze-up, focusing on coastal communities in Arctic Alaska. Break-up and freeze-up constrain a range of human activities, including ice use by Indigenous hunters or coastal shipping. Observations of ice conditions by Indigenous sea-ice experts since 2006 indicate significant interannual variability in both the character and timing of freeze-up and break-up in coastal Alaska. From these observations, we developed an algorithm to extract the timing of these events from passive microwave satellite data. Data from 1979 to 2013 show break-up start arriving earlier by 5-9 days per decade and freeze-up start arriving later by 7-14 days per decade in the Chukchi and Beaufort Seas. To evaluate the implications of observed and projected changes for coming decades, we draw on participatory scenarios focusing on sustainable healthy communities, with a broad range of experts and citizens from northern Alaska contributing to a series of three workshops. Participants identified climate and sea-ice change as one of the key drivers of community health and sustainability. We see the combination of scenario development, extraction of key indicator variables and the implementation of an observing program that combines community-based observations and remote sensing as one of the most effective ways to engage stakeholders and build an observing system that addresses a range of pressing information needs.

O 231 A PAN-ARCTIC OBSERVATIONS VALUE TREE FRAMEWORK

S. Lev[1], J. Gallo[1], E. Klein[1], R. Miller[1], I. Ashik[2], C. Behe[3], N. Biebow[4], M. David[5], H. Eicken[6], L. Hinzman[7], M. Jefferies[8], E. Kruemmel[9], J.R. Larsen[10], J. Mathis[11], R. Nitu[12], T. Ohata[13], C.D. Olseng[14], A. Pope[15], P. Pulsifer[16], L.O. Reiersen[17], D. Scott[5], J. Staffansson[18], M. Strahlendorff[19], S. Starkweather[20]

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[13] *National Institute of Polar Research, Tachikawa-shi- Tokyo, Japan*
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The international Arctic scientific community has identified the need for a sustained and integrated portfolio of pan-Arctic Earth-observing systems, yet a consensus framework for addressing this need has not yet been identified. To identify the international community's current uses of Earth observations for Arctic activities, an international effort was undertaken to develop the first ever Value Tree framework for identifying common research and operational objectives that rely on Earth observation data derived from Earth-observing systems, sensors, surveys, networks, models, and databases to deliver societal benefits in the Arctic. A Value Tree Analysis is a common tool used to support decision making processes and is useful for defining concepts, identifying objectives, and creating a hierarchical framework of objectives. A multi-level societal benefit area value tree establishes the connection from societal benefits to the set of observation inputs that contribute to delivering those benefits. A Value Tree that relies on expert domain knowledge from Arctic and non-Arctic nations, international researchers, Indigenous knowledge holders, and other experts to develop a framework to serve as a logical and interdependent decision support tool will be presented. This framework can serve as a foundation for future national or international efforts to assess the contribution of Earth observations in the Arctic to achieving societal benefits. Such efforts would identify the specific observing products and areas of needed investment to contribute to the development of a sustained portfolio of Arctic observing systems.

O 236 OUTCOMES FROM THE 2016 ARCTIC OBSERVING SUMMIT AND PROGRESS TOWARDS 2018

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Arctic observing is an increasingly complex and comprehensive set of activities informed by diverse needs and expertise. Observational data is needed by northern peoples, for basic and applied scientific research, and by operational, government and private sector organizations. Observing programs range from large scale remote sensing initiatives to downscale local studies and collect data on different components and aspects of the Arctic system. Observing initiatives engage a broad spectrum of the biological, health, physical, and social sciences, and Indigenous knowledge experts.The biennial Arctic Observing Summit (AOS) serves as an opportunity for the broad community of Arctic stakeholders[1] to identify needs, opportunities, and challenges in observing, and to review and make progress on the development of a comprehensive, internationally supported, multi-purpose Arctic Observing System of Systems. Here we report on outcomes from the AOS 2016, including major recommendations and needed actions for building out the observing system, and we present plans for the AOS 2018.

[1] identified to include Arctic Indigenous Peoples and other residents, Arctic scientists, local, regional, and national governments with Arctic responsibilities or interests, private sector entities with Arctic interests, operational agencies with Arctic responsibilities, and inter-governmental and non-governmental organizations with Arctic-relevant mandates. The term science/scientist are used in the broadest sense to include the natural, social, engineering and health sciences.

O 233 SYNOPTIC ARCTIC SURVEY – A PAN-ARCTIC OCEAN RESEARCH PROGRAM

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The ongoing environmental changes that are now transforming the Arctic Ocean warrant new, coordinated, observations. Interrelated secular trends or shifts in water properties and circulation patterns, biogeochemical cycles, and ecosystems are emerging against a backdrop of diverse spatial and temporal variations. As climate changes progresses, they may intensify with significant local and global impacts and there are urgent needs for improved understanding of how the Arctic Ocean works and how it will evolve. We suggest a Synoptic Arctic Survey within *one* season of *one* year ocean to address this critical challenge; calling for the science community to act collectively in an unprecedented effort to produce new and reliable observations to better understand and quantify Arctic Ocean processes.

With the notable exception of the International Polar Year, collection of empirical data from the Arctic Ocean has been constrained by many factors, including national infrastructure capability and availability, accessibility to key areas, and few joint pan-Arctic efforts. Consequently, systematic coverage in space and time of the Arctic Ocean is essentially non-existent and many existing data sets are poorly inter-calibrated, making them largely inadequate for the integrated, large-scale assessments required to understand and predict system-scale changes.

The international Synoptic Arctic Survey (SAS) is designed to overcome these issues, and reverse the present situation where climate change outpaces scientific knowledge. The SAS program will engage the international fleet of ice-capable research ships and resources in an unprecedented pan-Arctic, near-synoptic survey of hydrography, biogeochemistry, and lower trophic level ecosystems, over the full water column depth. This will produce a broad set of data free from interannual variations, promote international Arctic Ocean research collaboration, and provide a firm fundament for future monitoring. This presentation provides a brief overview of the development of the SAS, an up-to-date synopsis of its Science Plan, and future plans.

O 235 COLLABORATIVE DEVELOPMENT OF GLOBALLY CONNECTED DATA AND INFORMATION SYSTEMS FOR ARCTIC OBSERVING: RESULTS OF THE POLAR CONNECTIONS INTEROPERABILITY WORKSHOP

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The 2016 Arctic Observing Summit Conference Statement (www.arcticobservingsummit.org) confirms the need for continued development of a globally connected data and information system of systems. Following on developments during the IPY and further evolved over a series of workshops and publications, the polar data community has been working together towards practical, useful, stable, and interoperable infrastructures to support Arctic research and communities.

The Arctic community identified interoperability as a foundational goal and theme. Interoperability can be defined as properties of data and information systems that allow them to connect to, and share with, other information products or systems in the present or future without unintended restrictions. However, interoperability is far more than an exercise in engineering. A truly interoperable, globally connected polar data system is a socio-technical system that crosses many scales and knowledge domains. Although developing an interoperable system is complex and challenging, significant progress is being made.

In November of 2016, 60 representatives from 17 countries and more than 15 polar data organizations and initiatives participated in the Polar Connections Interoperability Workshop. Based on a pre-workshop analysis and survey, several themes were used to organize the meeting activities:

Data discovery and services.
Representing Indigenous Knowledge, Community Based Monitoring, and the social sciences.
Virtual Research Environments and Cloud computing.
Governance and sustainability.
Capacity building (cross-cutting).
During the workshop, participants.
Recognized that many remaining challenges are social rather than technical, such as supporting human networks, promoting standards, and aligning policy with implementation;
Confirmed the need for interoperable, federated data discovery and identified existing systems to address this need;
Identified key data services and models in support of priority goals;
Enhanced models for engaging Indigenous people(s);
Initiated connections to global data and information communities for broader interoperability and engagement, including RDA, ESA, and others.
We conclude by summarizing outcomes to date, benefits to researchers and communities and proposing next steps.

O 229 THE US ARCTIC OBSERVING NETWORK - STRATEGICALLY INTEGRATING US EFFORTS

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Observations of the Arctic system (physical, biological and social) underpin our current understanding of its state and function. From human observed indicators through broad satellite retrievals, observations across scale and scope serve a range of needs from discovery research to decision support. Observations enable the development of complex forecasting and earth system models through providing insight into processes, providing the basis for initial or boundary conditions, and establishing the validity of model outputs. Direct analyses of observed long-term trends, like sea ice extent, are powerful narrative tools for illustrating states and change; they inform decision makers and the public alike.

Yet developing systematic approaches to observing the Arctic and translating those observations into broad uses has been a strategic challenge within and across disciplines, as well as within and across nations. Frequent critiques are made of the inadequate, *ad hoc* or underutilized state of Arctic observing, against the backdrop of common apologies: prohibitive expenses, harsh conditions and inadequate means for establishing priorities or integrating results. In response to these critiques, US agencies have launched a new interagency effort - US Arctic Observing Network (US AON) - to strategically advance the effectiveness of US observing efforts. Establishing national organizing bodies is responsive to a top recommendation of the recently concluded external review of the international Sustain Arctic Observing Network (SAON) process. US AON proposes to draw agencies together towards more focused actions, establish science teams to derive greater value out of existing systems and serve as coordination hub for international activities like SAON.

O 230 MONITORING ARCTIC SUSTAINABILITY: TRANSDISCIPLINARY APPROACHES AND METHODS

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The task to develop approaches for creating Arctic sustainability monitoring network for continuous observations of Arctic socio-ecological systems sustainability in changing natural and social conditions is undertaken within the ASUS project under the Belmonte forum programme. The aim of this presentation is to assess what has been already done in monitoring Arctic sustainability by different branches of science at different scales, what approaches and methods were implemented to delineate sustainability indicators and monitor trends, both positive and negative on the way towards sustainability in the Arctic. Special attention is put to the existing and developing interdisciplinary scientific approaches emerged within natural science and social science projects, sustainable development and resilience concepts putting principle attention to approaches and methods to delineate sustainability indicators to monitor trends for building sustainable Arctic socio-ecological systems. It is argued that the Arctic sustainability science is a valuable component of the whole and broader system of the Arctic sustainability knowledge co-produced with the help of transdisciplinary activities integrating science, local/traditional knowledge, entrepreneurship, education, decision-making. The sustainability monitoring activity is designed to be one of such transdisciplinary activities based on interactive continuous participatory process empowering deliberate choices of people that can shape the changes and enable transformation towards sustainability. Special attention is put to the necessity of the transdisciplinary knowledge co-production based upon “problem-solutions” and “human and social capacities focused” approaches for sustainability monitoring. Such sustainability monitoring activity is creating a tansdisciplinary space which is viewed as one of sources of learning and transformations towards sustainability making possible to shape rapid changes happening in the Arctic based on sustainability knowledge co-production. The construction of continuous ASUS monitoring network in key monitoring sites enables to define adaptation and transformation pathways in the Arctic - the most rapidly changing region of our planet.

P 229 FIVE YEARS OF CONTINUOUS, REAL-TIME COASTAL OCEAN OBSERVATION AND COMMUNITY ENGAGEMENT IN THE CANADIAN HIGH ARCTIC

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In August 2012, Ocean Networks Canada installed an experimental cabled ocean observatory at sub-tidal depths in the Canadian high Arctic near Cambridge Bay, Nunavut. The ‘Cambridge Bay Observatory’ consists of a multi-sensor underwater instrument and camera platform with a power and data link to shore, and a shore-based meteorological observatory, coastal camera and Automatic Identification System (AIS) receiver. Data from all cameras and sensors are relayed via satellite to the Ocean Networks Canada database at the University of Victoria, where there are freely available

online. The observatory has been a tremendous technical and scientific success, operating continuously since the original installation, with annual platform upgrades and a tripling of the instrumentation to meet the demands of a growing, multidisciplinary user group. Current underwater instrumentation includes a pan/tilt high definition video camera with LED lights, a CTD/fluorometer/turbidity package, pCO2 and pH sensors, a hydrophone, an acoustic fish tag receiver, and an acoustic, shallow-water ice profiler. During 2016 the observatory supported research into the thermodynamics of sea ice growth, under-ice plankton blooms, benthic community dynamics, and performance of pCO_2 and pH sensors, all critical areas of research in a warming Arctic. Preliminary results from these studies will be presented. We will also provide an overview and examples of Ocean Networks Canada's community engagement program in Cambridge Bay, that connects local schools and the entire village to the ocean observatory, through the development of curriculum materials, community activities and real-time public displays of observatory data. We will review plans for developing a long-term monitoring site at this location, for studying acidification of coastal Arctic waters and microbiological response to salinity and pH changes, and for refining thermo-dynamic models of ice growth and breakup by combining instrument data with local, direct measurement of ice and snow properties.

P 230 INTEGRATED ARCTIC OBSERVATION SYSTEM DEVELOPMENT UNDER HORIZON 2020 (INTAROS)

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INTAROS is a research and innovation action under the H2020-BG-09 call in 2016 and will run from 2016 to 2021. INTAROS will develop an integrated Arctic Observation System (iAOS) by extending, improving and unifying existing systems in the different regions of the Arctic. INTAROS will have a strong multidisciplinary focus, with tools for integration of data from atmosphere, ocean, cryosphere and terrestrial sciences, provided by institutions in Europe, North America and Asia. Satellite earth observation (EO) data plays an increasingly important role in such observing systems, because the amount of EO data for observing the global climate and environment grows year by year. EO data will therefore be integrated into iAOS based on existing products and databases. In situ observing systems are much more limited due to logistical constraints and cost limitations. The sparseness of in situ data is therefore the largest gap in the overall observing system. INTAROS will assess strengths and weaknesses of existing observing systems and contribute with innovative solutions to fill some of the critical gaps in the in situ observing network. INTAROS will develop a platform, iAOS, to search for and access data from distributed databases. The evolution into a sustainable Arctic observing system requires coordination, mobilization and cooperation between the existing European and international infrastructures (in-situ and remote including space-based), the modeling communities and relevant stakeholder groups. INTAROS will include development of community-based observing systems, where local knowledge is merged with scientific data. An integrated Arctic Observation System will enable better-informed decisions and better-documented processes within key sectors (e.g. local communities, shipping, tourism, fishing), in order to strengthen the societal and economic role of the Arctic region and support the EU strategy for the Arctic and related maritime and environmental policies.

P 231 THE CIRCUMPOLAR ACTIVE LAYER MONITORING NETWORK (CALM): LONG-TERM OBSERVATIONS ON THE CLIMATE-ACTIVE LAYER-PERMAFROST SYSTEM

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The uppermost layer of seasonal thawing above permafrost (the *active layer*) is an important regulator of energy and mass fluxes between the surface and the atmosphere in the polar regions. Active layer monitoring is an important component of efforts to assess the effects of global change in permafrost environments. The Circumpolar Active Layer Monitoring (CALM) program, established in the early 1990s, is designed to observe temporal and spatial variability of the active layer and its response to changes and variations in climatic conditions. CALM network is an integral part of the Global Terrestrial Network for Permafrost (GTN-P) operating under auspices of the Global Terrestrial Observing System (GTOS) /Global Climate Observing System (GCOS). Standardized thaw depth observations in the Northern Hemisphere are available for more than 200 GTN-P/CALM sites in the Northern Hemisphere. At each of the sites spatially-distributed ALT measurements have been conducted annually by mechanical probing. The locations of sites represent generalized surface and subsurface conditions characteristic of broader regions. The data is assimilated and distributed though CALM (www.gwu.edu/~calm) and GTN-P (gtnpdatabase.org) online databases. In this presentation we use data from approximately 20 years of continuous observations to examine temporal trends in active-layer thickness for several representative Arctic regions. Results indicate substantial interannual fluctuations in the active-layer thickness, primarily in response to variations in air temperature. Decadal trends in ALT vary by region. A progressive increase in ALT has been observed in the Nordic countries, the Russian European North, West Siberia, East Siberia, the Russian Far East, and the Interior of Alaska.

S27 CENTRAL EUROPEAN POLAR RESEARCH INITIATIVE

O 160 CZECH ARCTIC "JOSEF SVOBODA STATION" IN SVALBARD

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The Centre for Polar ecology aims to promote and facilitate research and education in polar ecological sciences at the Faculty of Science, University of South Bohemia in České Budějovice (USB). CPE operates the Josef Svoboda research infrastructure in Svalbard and represents the scientific community of the Czech Republic in International Arctic Science Committee. Czech Arctic Research Infrastructure "Josef Svoboda Station" was established on base of previous experiences and research results which were performed in different parts of the Arctic and Antarctic in second half of 20th and beginning of 21th centuries. In 2012 the USB opened a new department Centre for Polar Ecology and, in 2013 this department moved into newly reconstructed and equipped building. In 2013, the Czech research station Julius Payer House has been opened in Longyearbyen, Svalbard. In 2015, field camp Nostoc in Petunia Bay has been opened and research boat (Motor Sailor) Clione has been prepared for regular operation in Svalbard vicinity. In 2015 the project of research infrastructure construction was successfully finished and the Czech Arctic Research Infrastructure "Josef Svoboda Station" was opened for operation. The Infrastructure was named after Czech-Canadian Arctic plant-ecologist, Josef Svoboda, professor emeritus of University of Toronto. Infrastructure is equipped for interdisciplinary research and university education in main polar science research topics and covers in biological science; microbiology - phycology, botany and plant physiology, zoology and parasitology, and in geographical science; climatology - glaciology, geology - geomorphology and hydrology - limnology. These research topics are performed in study area since 2007 or 2010, respectively. The Czech Arctic Research Infrastructure "Josef Svoboda Station" in all its parts offers research collaboration for international arctic research in all branches of polar sciences which were mentioned before. Conditions under which the infrastructure can be used is introduced in technical description of infrastructure (http://polar.prf.jcu.cz/data/uploads/arctic-research-infrastructure.pdf, http://polar.prf.jcu.cz/data/uploads/operating-expenses-of-arctic-research-infrastruxcture.pdf).

O 158 PIGMENTS IN SEDIMENTS- A USEFUL TOOL FOR STUDYING ENVIRONMENTAL CONDITIONS IN ARCTIC REGIONS

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Pigments are a group of natural compounds widespread in aquatic environment. They are present in phytoplankton, macroalgae and bacteria but also, together with their derivatives, in detritus sinking through the water column and settling on the seabed. Pigments are used as markers of primary production, phytoplankton taxonomy and environmental conditions in different aquatic sediments from: lakes, open sea and shelf areas or estuaries. Only few people studied this topic in Arctic regions and the research concerned some pigments in water or in lake sediments. This is a first study of pigments in sediments as markers of environmental conditions in Hornsund fjord (western Spitsbergen).

Sediment samples were collected during cruise of r.v. 'Oceania' in July 2015, at three stations in Hornsund fjord and two in the intertidal zone. Pigments were analysed using HPLC-DAD/FL. Sediment samples contained parent carotenoids and their derivatives e.g.: 19'-hexanoyloxyfucoxanthin, 19'-hexanoyloxy-4-ketofucoxanthin, which are markers of haptophytes. The most abundant chloropigment derivatives among chloropigments-a were pheophorbides- markers of zooplankton and zoobenthos grazing.

Hornsund is an interesting area for studying pigments due to distinct climate changes observed there. The taxonomic composition of phytoplankton depend on: inflow of seawater (from open ocean) and of freshwater from glacier melting. Pigment records in sediments are good indicators of that what has happened over a period of time in a basin. The advantage of studying pigments in sediments is that samples can be collected once a year, not like in the case of water, wherein pigment concentrations change in time and space and samples are collected only in summer. The analysis of pigments in different seasons will help to understand the processes taking place in this environment and influence of climate changes on these phenomena. Pigments can be a valuable tool for study environmental conditions based on their record in Arctic sediments.

O 154 THE CZECH REPUBLIC AND POLAND IN THE CHANGING ARCTIC: SCIENTIFIC ACTIVITIES AND POLITICAL CONTEXTS

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The questions about the presence of the non-Arctic states in the Arctic region and their influence on different dimensions of the regional cooperation have been one of the most interesting issues in the analysis of the current situation of the region from the perspective of the international relations studies. However, most of the research is focused on the 'big players" (like Germany) or the 'new-comers' (like China or Japan). Questions related to the activities of less 'popular' or less influential actors still remain unexplored and this proposal has an ambition to offer a completely new insight just into this topic.

The Czech Republic and Poland share scientific interests in the changing Arctic and both are members of the international organizations which pay their attention towards the region. Although the traditions of research conducted by the states in the Svalbard Archipelago and their status in the regional forums of cooperation are not alike, they both have been faced with the same new developments in the geopolitical dimension of the transformation occurring in the Arctic for a few years. To what extent their responses to these Arctic challenges are still alike is to be examined.

The aim of this presentation is to compare the political contexts of the Czech and Polish scientific presence in the Arctic. Furthermore, to discuss the evolution of their approaches towards the region and to consider the possibility of their cooperation in the framework of organizations operating within and beyond the region.

O 157 A YEAR AT THE POLISH POLAR STATION: WHAT MENTAL HEALTH AND COGNITION CAN TELL US ABOUT CREW PREPARATION AND SELECTION

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Antarctic crew's psychological coping and cognitive learning behaviours have been described frequently in the literature (Palinkas & Suedfeld, 2008). The rationale behind these studies is to improve crew selection and support. This is thought to contribute to crew functioning and productivity.

We tested 10 out of the 11 crew members at the Polish Polar Station, Hornsund for mood, mental health and cognitive functioning. We described our study's preliminary findings at the First CEPM, Vienna, in November 2015. However, these included only two measurements of mood and mental health (July 2015, September 2015) and the personality questionnaire NEO-Five Factor Inventory (NEO-FFI).

We now have additional data from January 2016, April 2016 and June 2016. These provide a comprehensive insight into psychological functioning at the Polish Polar Station. We also have data for visual memory, visual and auditory attention and logical reasoning from September 2015, January and June 2016. Our results so far indicate that learning changes during polar missions. They also show that people's emotions affect their reaction speed, and that their personality affects their emotions. We interviewed our participants to allow them to reflect on their personal experiences and put their questionnaire and cognitive test results into perspective. We appreciate that the positivity of polar experiences generally falls short within the scientific literature.

Our approach to data analysis is unique in polar psychology because we will present to you frequentist statistics such as analyses of variance (ANOVA) but also include Bayesian statistics. The frequentist approach allows us to reject the null hypotheses of no effect of polar missions on mental health and cognition, but the Bayesian approach allows us to quantify which effects there are during polar missions for example mission time or weather. This facilitates conclusions about how to prepare and select personnel better, or how to help them cope psychologically.

O 156 THE LONG-TERM MONITORING PROGRAM AREX IN THE NORDIC SEAS AND FRAM STRAIT

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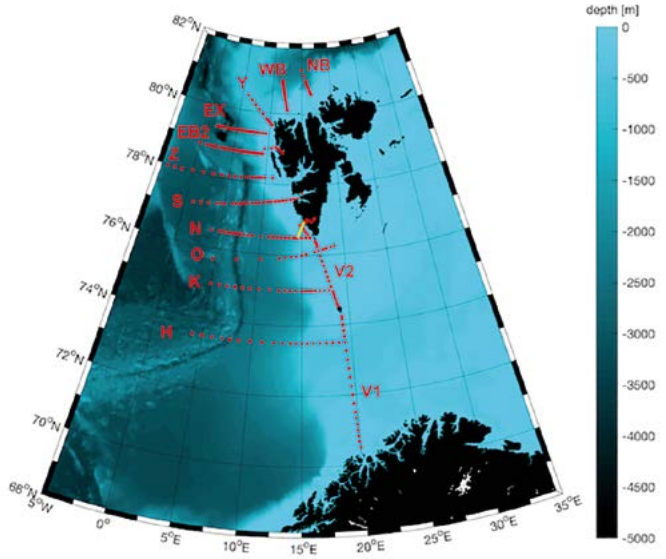
Understanding of Arctic climate processes is the main aim of the current oceanographic and atmospheric studies carried on in the polar region. The Institute of Oceanology Polish Academy of Sciences (IOPAN) contributes to this challenge with the strategic research initiative addressing the role of the ocean in changing climate and its effects on the European Seas. Its core activity, the long-term monitoring program AREX, is focused on multidisciplinary observations in areas such as physical oceanography, air-ocean interactions, ocean biogeochemistry and ecology to study the long-term changes of abiotic and biotic Arctic environment. Every summer since 1987 the large-scale field measurements have been carried out in the Nordic Seas and European Arctic from board of the IOPAN research vessel *Oceania*.

The main aim of the long-term AREX program and annual cruises, carried by RV *Oceania* for the last 30 years in the Nordic Seas and Fram Strait, is to recognize and describe processes responsible for changing ocean climate and marine ecosystem in the sub-Arctic and Arctic region with a special focus on the European Arctic. To achieve this goal a large-scale study area, covering the poleward flow of Atlantic water in the eastern Nordic Seas and Fram Strait, has been selected for annually repeated ship-borne measurements on a regular grid (Fig. 1).

The zonal sections following the Atlantic water inflow from the Norwegian Sea to the northern Fram Strait allow to assess transformation of water masses originating from the North Atlantic and advected northward. Two meridional sections cover the eastward flow of Atlantic water to the Barents Sea. Data collected every year in the same way, provide time series of key ocean variables which allow monitoring changes of the Arctic marine environment and improving numerical simulations of ocean, sea ice and climate in the Arctic region.



O 155 LANDSCAPE AND BIODIVERSITY TRANSFORMATION UNDER CLIMATE WARMING IN THE SOUTHEASTERN SPITSBERGEN COAST, 1900–2016

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Intensive landscape transformation occurred due to global and local climate warming since 1900. Dramatic transformations of all the landscape components led to significant changes in functioning of the environment. The snow line (together with the glaciers' firn and equilibrium lines) was uplifted due to temperature increase (the same refers to the upper limit of vegetation). Hence, accumulative zones and extents of glaciers became much smaller. Parts of glaciers located below their new equilibrium lines (after their uplift) underwent declining. The southeastern coast became significantly less glaciated: the net glaciation (extensive glacial covers with nunataks) was transformed into the mountain glaciation (with valley and cirque glaciers). Numerous valley glaciers were changed into cirque or slope (hanging) glaciers. New deposits, landforms and water bodies appeared in areas abandoned by glaciers if their bedrock was situated above sea level (uncovered bedrock below this level was flooded by sea). The new unglaciated landscapes underwent pioneer animal colonization, plant succession and soil formation (the same refers to the older unglaciated areas devoid of plants due to severe climatic conditions before). The aforementioned processes accelerated since the 1980s. After 2005, the active layer, thawing on permafrost in summer, became much deeper, and thus long sequences of this mountainous coast was lowered, rugged or eroded. Many more plants and birds (and their species) were observed in 2016 than in 2005. All these changes will lead to development of continuous tundra vegetation on the southeastern coast and transformation of the southern Spitsbergen peninsula into a new island (if climate cooling will not appear).
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P 233 DO PLANT TRAITS DIFFER ALONG A SUCCESSIONAL GRADIENT IN THE HIGH ARCTIC?

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Plant communities are clearly structured along a deglaciation gradient in Svalbard, which represent a successional gradient from almost bare or sparsely vegetated glacier forelands to well-developed tundra vegetation at long-time deglaciated marine terraces. Yet, there is rather little information about the structure of functional plant traits along this gradient. In this study we gathered information about functional traits of plant species sampled from different plant communities at central Svalbard. We investigated how these functional traits, namely specific leaf area (SLA), leaf nutrient (nitrogen and phosphorus) contents, and life strategy plant traits (e.g., clonal traits) change among plant communities forming this successional gradient.

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P 234 FIRST POLISH GREENLAND EXPEDITION 1937

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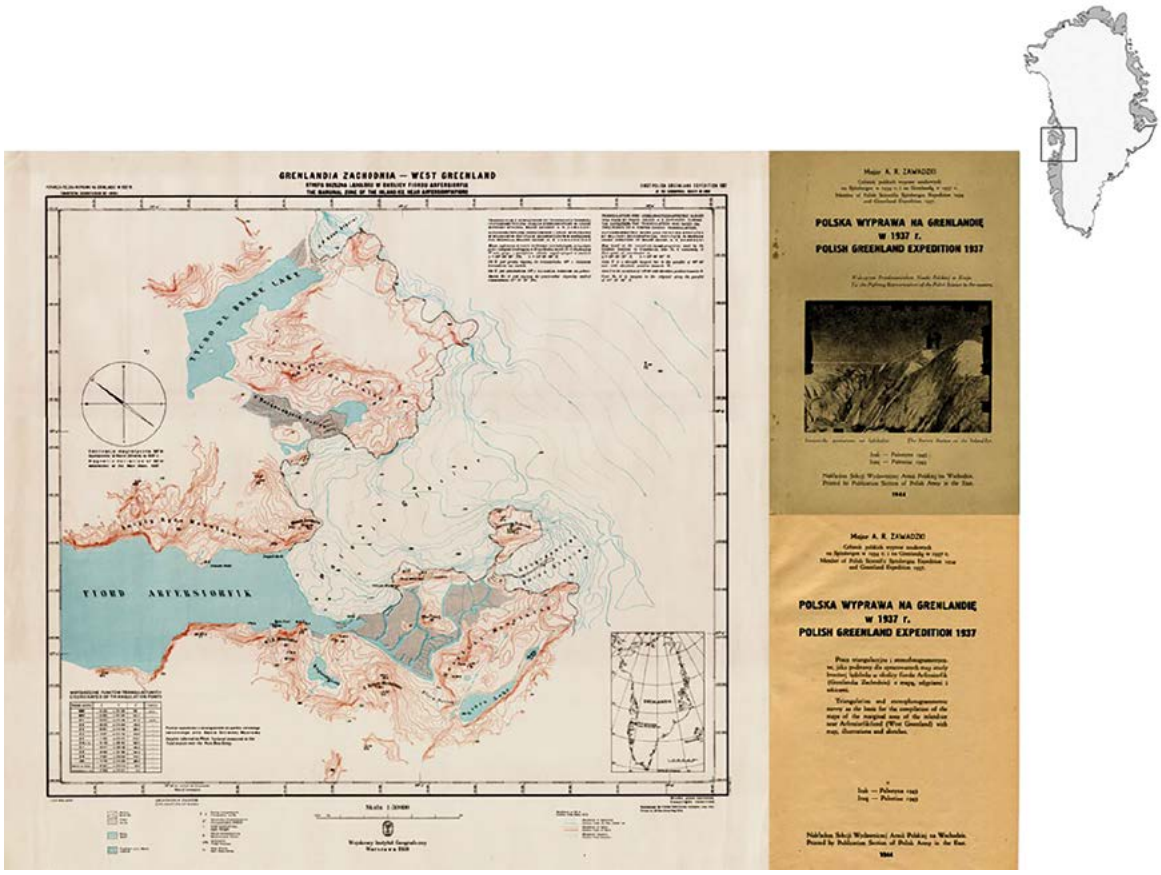
The presentation describe the first Polish expedition to Greenland in 1937. The field works were carried out in western Greenland at the eastern edge of Arfersiorfik Fjord at an area located between Disko Bay in the north and Nordre Strömfjord in the south. The main goal was to undertake a comprehensive study of a fragment of the Greenland ice sheet edge and its foreland focusing on a cartographic survey. The first ever map of this region entitled the Polish expedition to give new names. In the post-war history, expedition members exerted great influence on the development of Polish polar research.



Topographic map of the marginal zone of ice sheet in the Arfersiorfik Fiord area (left) and front cover of the methodological comment (copies from the original works, archive of A. Kosiba, Institute of Geography and Regional Development, University of Wrocław).

P 236 SHORT-TERM CHANGES IN THICKNESS OF ACTIVE LAYER IN KAFFIØYRA REGION, NW SPITSBERGEN, SVALBARD

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Kaffiøyra is coastal lowland situated on Forlandsundet, Svalbard. Since 1975 the thickness of active layer has been monitored in a few fixed measurement points on the Kaffiøyra Plain around of the Nicolaus Copernicus University (NCU) Polar Station. In recent years, thawing of the active layer in the Kaffiøyra region has been considerably varied in individual summer seasons. Measurements were carried over 100x100 m test fields, realizing requirements of CALM program, one of which is located on the sandy beach, about 2 m a.s.l. (*dry site)*, and another on the tundra plain, about 3 m a.s.l. (*wet site*). One of its aims was to determine seasonal and sub-seasonal changeability of the structure, dynamics and the temperature distribution of permafrost active layer and its substratum. On the basis of short-term measurements in summer 2015, a differentiation in the thermals and dynamics of the active layer in selected points in diverse conditions were found. While in dry ground conditions the thaw dynamics seems to be constant, in the water-soaked, low-lying, coastal-close terrain, presumably influenced by infiltrating brackish ground water, permafrost table development is unpredictable, partly with elevated ice lenses formation and partly with unfrozen water above. A considerable sloping of the land, combined with increased surface runoff and infiltration at the time of precipitation, makes the water penetrating into the active layer increase its temperature. This demonstrates that the local land forms (tidal channels and terminal moraines) have a substantial influence on the extent and rate of changes which occur in the active layer. The orthophotomap of the research area was also made.

P 232 SEDIMENT TRAPS ZOOPLANKTON VARIABILITY IN RIJPFJORDEN – A HIGH ARTIC FJORD

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Sediment traps may provide a useful tool to study Arctic zooplankton during the whole year, irrespective of environmental conditions or sea ice. We studied seasonal species composition, from the sediment trap deployed on a mooring at 60 m depth in Rijpfjorden (Nordaustlanded, Svalbard) between October 2014 and August 2015. We have found 56 taxa, of which the most abundant was *Oithona similis* with the maximum peak in October. Other Copepods were also numerous, especially *Calanus* spp.: *C. finmarchicus*, *C. glacialis* and *C. hyperboreus*, with consecutive development stages depending on the season. Based on zooplankton community composition, the samples could be divided into two main groups: spring - summer and autumn - winter ones. High abundance of larval stages of Echinoderms, Copepods and Harpacticoids were characteristic for the warmer months,

while older development stages of Copepods, Pteropods and Amphipods were more numerous in autumn and winter. Among other taxa, it is worth to mention Pteropods (especially juvenile stages of *Limacina helicina* and *L. retroversa*) smaller copepods (*Microcalanus* spp.) and Bivalvia veligers, which were present during entire year. The next step of our research will be multivariate analysis between biological and environmental data in order to find out how environmental processes impact zooplankton community structure in Rijpfjorden.

P 237 HOW MANY BEARS CAN SIT ON A LICHEN? LICHENS AS MICROHABITAT FOR WATER BEARS (TARDIGRADES) IN THE ARCTIC

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Terricolous lichens are one of the main features of the Arctic tundra. In addition to serving as reindeer forage, an important role performed by lichens is to provide a microhabitat for various invertebrates, including water bears (tardigrades). Until now, tardigrades in lichens have been poorly studied and only a few published papers have focused on their ecology and diversity.

In the present research, we provide new information on lichens as a habitat for Arctic water bears while paying attention to tardigrade abundance, species diversity, and distribution. Moreover, we present new records of lichens and tardigrades in the Svalbard archipelago. In the summer seasons of 2011 and 2013, 45 lichen samples were collected from various parts of the Svalbard archipelago: Danskøya, Fuglesongen, Nordaustlandet, Parrøya, Phipsøya, Prins Karl Forland, and Spitsbergen. Lichens were identified using traditional taxonomic methods and standard microscopy. During taxonomic identification of water bears, 321 specimens were prepared and analysed. The number of individual tardigrades found in each sample was extrapolated for 10 g of dry mass and this provided the basis for calculating the total density.

In total, 20 lichen species and 23 species of water bear were identified. The most frequent water bear species inhibiting lichen thalli were *Hypsibius pallidus*, *Diphascon pingue pingue*, and *Adropion prorsirostre*. The average number of tardigrades calculated per 10 g of dry material was 66. Lichens with the highest water bear density have a characteristic cottony-tomentose thallus surface composed of loose hyphae, and thus do not have a typical thick cortical layer, e. g. *Cladonia arbuscula*, *Cladonia mitis*, *Cladonia rangiferina*, and *Stereocaulon alpinum*. These lichens potentially provide the tardigrades with easier access to the photobiont layer containing algal cells. Usually, the most numerous tardigrades within samples are herbivores. Therefore, the availability of algal cells could influence tardigrade abundance in lichens.

S28 NATIONAL ARCTIC INITIATIVE

P 238 AN EXPERIMENTAL LABORATORY IN THE HEART OF THE ARCTIC – KINGS BAY MARINE LABORATORY, NY-ÅLESUND, SVALBARD

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The Kings Bay Marine Laboratory, located in Ny-Ålesund, Svalbard, is the world's northernmost experimental laboratory. It was designed by scientists to perform experiments in marine ecology, physiology, biochemistry, oceanography, marine geology and ice physics. The laboratory is the first common research infrastructure open to all researchers on the same premises.

The sea water from Kongsfjorden is pumped into the laboratory water tanks for either short- or long-term experiments. All tanks can be moved and various system configurations can be build according to different needs of the users. Several rooms are equipped with automated system-control of experimental variables (e.g. water and air temperature). Two large connected laboratory rooms in the basement make perfect working space for larger groups and for assembling bulkier equipment.

A large platform and a balcony outside provide space to work under ambient atmospheric conditions.Location right on the beach by the fjord, and an access to modern laboratory instruments and essential equipment allow processing the samples only minutes after their collection. The laboratory has a low-radioactive level laboratory room, and provides facilities for scuba diving with the only decompression chamber on Svalbard.

The marine laboratory includes a seminar room with a capacity for app. 30 persons, with presentation equipment.

The work boat "MS Teisten" is equipped with CTD, water- and sediment sampling equipment. Both the Marine Laboratory and MS Teisten are owned and managed by Kings Bay AS. Workspace and boat use are sublet on a commercial basis. All information is available on the Kings Bay AS website: www.kingsbay.no.

P 239 RUSSIAN SCIENTIFIC CENTER ON SPITSBERGEN – RESOURCES AND PERSPECTIVES

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For decades Russian scientists from eleven institutes have been working on Svalbard. However, due to the complicated logistics and limited funds the need for united infrastructure, closer cooperation, and coordination emerged few years ago. The Concept of the RSCS establishing in Barentsburg was approved by the Government of RF in 2014 to provide and develop the base for research groups on archipelago.

The center is managed by Arctic and Antarctic Research Institute and consists of few blocks - logistics, transport and equipment, up-to-date analytical lab, satellite receiving station and meteorological observatory; at least six- seven scientists are staying there the whole year. This structure gives an opportunity for long-term climate and environmental observations in Isfjorden and western Spitsbergen as well as developing interdisciplinary projects, in-depth experimental setups, sample preparation and immediate chemical analysis.

Since 2015 the center has been fully functioning and in summer season 2016 hosted more than 40 scientists as well as organized summer school for master students specialized in applied polar and marine sciences. The applications for supporting research activity around Barentsburg and Pyramiden are reviewed yearly by the scientific board on the competitive basis and integrated in one research program. Currently the projects on climate change, water mass transformation and its effect on marine organisms in the fjords, mass balance of the glaciers, permafrost and soil studies, meteorology and microcirculation, paleogeography, river runoff dynamics and pollution monitoring are logistically and instrumentally supported by the center. A long-term records of meteo-climatic and hydrographic characteristics and recently established according to CALM standards permafrost site align Barentsburg station with observatories at Cape Baranov and in Tixi (Russia) and allow looking over the gradual effects of climate change on the way of Atlantic water into the Arctic Ocean.

P 240 THE "ARCTIC EIGHT": AN ALLIANCE OF ARCTIC NATURAL HISTORY MUSEUMS DEDICATED TO ADVANCING AND SHARING ARCTIC SCIENCE

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Natural history museums hold the record of nature over time, including millions of specimens from the Arctic, yet museums have been largely on the periphery of Arctic science and Arctic polar data discussions. The "Arctic Eight" is a new alliance of eight national Natural History Museums in the eight Arctic Council countries: Canadian Museum of Nature; Finnish Museum of Natural History; Icelandic Institute of Natural History; National Museum of Natural History, Smithsonian Institution; Natural History Museum of Denmark; Natural History Museum, University of Oslo; Swedish Museum of Natural History; and Zoological Institute of the Russian Academy of Sciences. The Arctic Eight aspire to play a vital role in saving the world with evidence, knowledge and inspiration. Each of these institutions holds substantive collections of Arctic flora and fauna, as well as cultural artefacts and genetic and cryogenic resources, which provide a foundation for creating knowledge that is essential to a better, more sustainable natural future. The Arctic Eight are engaged in Arctic exploration and discovery, and have research expertise in diverse Arctic disciplines, such as taxonomy and systematics of Arctic fishes, marine invertebrates, lichens and plants, Arctic ecology, environmental monitoring, climate change monitoring, DNA barcoding and Arctic culture, human history and exploration. The Arctic Eight are engaged in finding ways to better work with each other and the broader scientific community to advance Arctic research and collections, and engage, inspire and educate citizens in a 21st century global context.

SCOTTISH ARTIST AND PAINTING LECTURER GEORGIA ROSE MURRAY

Georgia Rose Murray uses the language of painting to explore the mystical reality of Northern landscapes. Due to a specific interest in light and darkness, her investigations in recent years have led her to Iceland during a period of Polar Night and to Svalbard, specifically to witness the Midnight Sun.

For Murray painting is essential in helping decipher energies and in facilitating heightened states of awareness: symbiotically her conscious and subconscious selves gauge the magnitude of human existence within the universe. This forms the autobiographical baseline for her holistically realised work.

Significant interactions with remote natural landscapes create the baseline for innovative experimentations with paint. The paintings reflect a transcendental existence, initiated by sublime experiences, which are recorded in the moment with coloured pens or water-based paint in sketchbooks, and then further developed with a combination of oil paint, gloss paint and vivid powdered pigments on wooden boards in her studio.

During the summer of 2016, Murray was invited to spend the month of August as a guest of The Czech Center of Polar Ecology, Svalbard. Working alongside Scientists provided the opportunity to exchange knowledge and perspectives, empathising with the Arctic landscape on multiple levels. The experience of creating painting research in such an incredible environment, amid 24 hours of daylight was ultimately inspiring, liberating and humbling.

Murray's newest paintings capture the reality of the Arctic on many layers; brushmarks and colour expressively describe how it feels to be surrounded by such a powerful environment, where the elements and nature preside over humans. The works depict the intense beauty, alluring mysticism and sacred space that is the reality of the Polar landscape.

Ivory Gull Death Fly Live.

Longyear Breen.

AUTHOR'S INDEX

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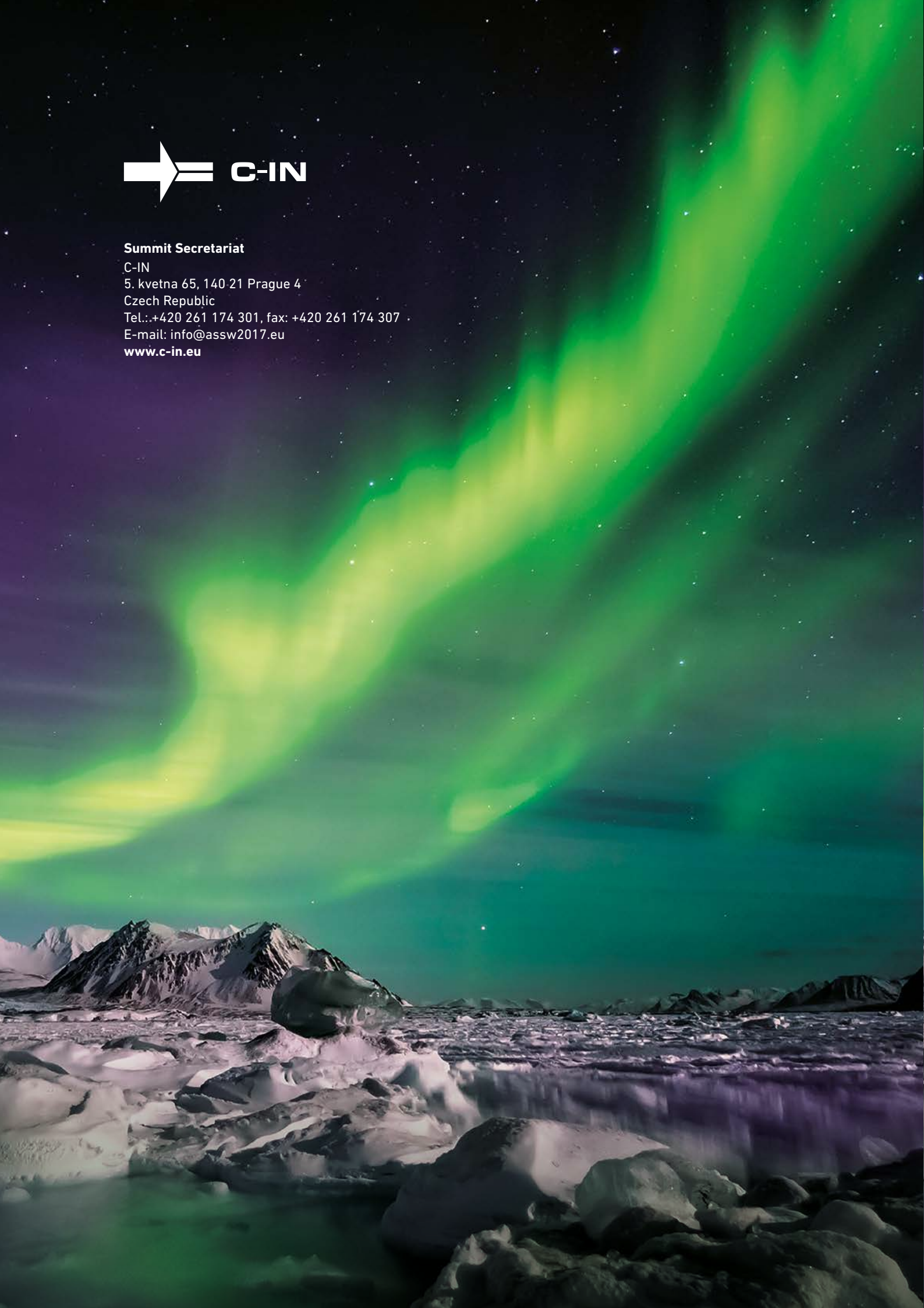

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