The IRSES Activity IMCONet (Marie Curie Action no 318718, *Website*: www.imconet.eu) studies effects of rapid regional climate change in coastal systems at the West Antarctic Peninsula (WAP). Data from over 25 years of interdisciplinary ecosystem research in Antarctic coastal shallows of Potter Cove (PC), King George Island (KGI) were integrated into partial ecosystem models to relate changes in the abiotic environment to shifts in marine community composition and functioning. 70 scientists conducted long and shorter secondments between 16 European, South American, US and Canadian partner groups. While focussing on the climate change related processes in the showcase area Potter Cove, several WPs (Glaciology, Geology) were networking in a wider frame to compare the local (KGI) to the regional recent and late Holocene deglaciation patterns at the WAP (see Fig. 1) .

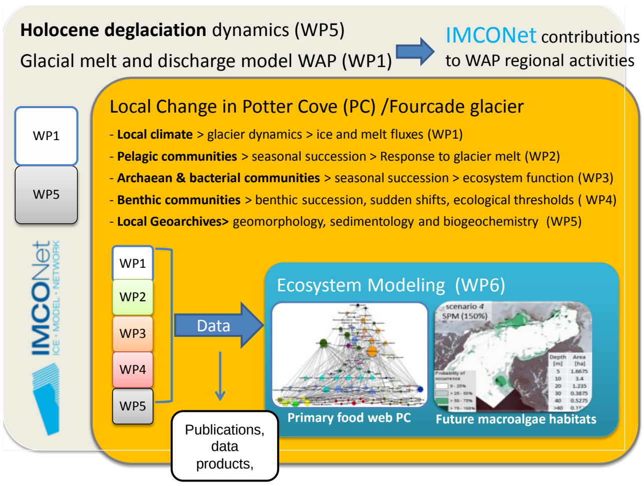


Fig. 1: IMCONet interdisciplinary approach, collaboration, and data flow.

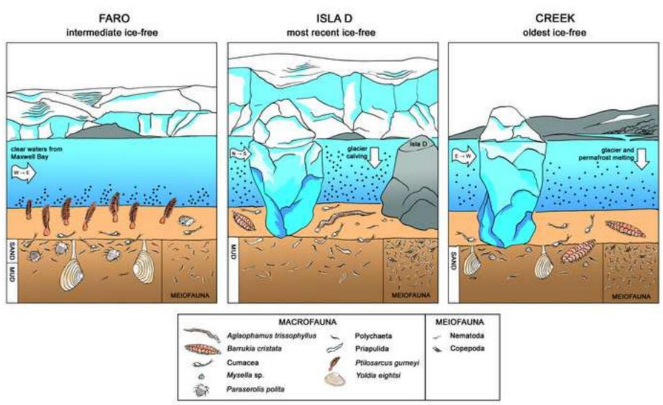
Several long-term ecological data series were analysed to track climate change across system compartments from glaciology to community composition**.** It is for the first time ever that the ecological impacts of the transgression from a tidewater to an exclusively land based glacier in an Antarctic cove is documented by a multi-disciplinary research team. Expansion of the research scope was possible through cross station networking with US and UK partner activities in different areas of the WAP.

A newly generated glacier inventory documents changes in glacier extent on the WAP. Intensive studies of ice dynamics in IMCONet revealed a strong dependence of glacier extension on overall geometry. Glaciers with a negative mass balance for 1992-1996 in the northern WAP region gained mass again between 2010 and 2014, in line with our climatological data showing colder temperatures and increased precipitation since 2001. Uncertainties of these estimates are still large. Models to estimate the amount of glacier melt water were run for Potter Cove to estimate the extent to which melting affects the coastal ecosystems. To further validate the models, IMCONet glaciologists integrated data sets from different in-situ observations, field activities, and from remote sensing.

New sediment core archives for Holocene (11,700 years to present) deglaciation events were analyzed during IMCONet. BAS, UOldenburg, and UGent partners studied deglaciation and relative sea level change, and compared the impact of volcanic activity and past changes in climate, sea-ice distribution and relative sea level on one of the largest gentoo penguin colonies in Antarctica using novel penguin guano and biomarker analyses of lake sediments from KGI and Ardley Island (Roberts et al. Nature Com. in press). A major focus was to explain and date submarine landforms (glacial moraines and basins) in PC also to understand how an ecosystem rebuilds during and after deglaciation. The “youngest” parts of the inner cove are delimited by the most prominent moraine which formed during the “Little Ice Age” cold climate phase. This inner part is most clearly under the impact of glacier melt and many susceptible species are literally excluded from this area (e.g., fish, amphipods, sensitive algae, gorgonians).

Meltwater production and shading of coastal biota by layers of sedimentary run-off alter the environmental regime for primary producers, pelagic and benthic algae, in the inner cove. Only few macroalgal species colonize newly ice free hard substrates in glacial vicinity. These species have to be low light adapted to manage with only a short growth phase in early spring and furthermore need to cope with iron levels higher than normal which enhances cellular stress symptoms. Spatial models combining multilayered environmental information with experimental work on macroalgal response to

change predict reduction of suitable macroalgal habitats in the cove under increased melting. Glacial erosion further shifted entire benthic assemblages in PC since the beginning of the studies in 1995. Sensitive filter feeder species were decimated while sediment tolerant flat form ascidians and pennatulides gained space and increased in density, leading to a reduction in biodiversity in the inner cove. These benthic shifts in PC were validated by dynamic community modeling (Sahade et al. 2015).
Twenty five years of field data and experimental results were combined into a first one-dimensional numerical model of water column productivity in PC, coupling physical processes to bloom dynamics under different melt scenarios, to explain recent observations of more frequent and strikingly high peaks of pelagic summer blooms since 2010. These blooms are atypical for the meltwater influenced Potter Cove. The models analyze the combination of bottom up (low temperatures and late onset of melt water discharge) and top down control caused by the absence of krill (since 2007, Fuentes et al. 2016) and by extremely low density of smaller zooplankton that would normally feed on the microalgae in some years. Thus secondary effects on grazers that do not cope well with the melt conditions can potentially explain these new bloom observations. The analysis is continued in cooperation with colleagues from Palmer Station where similar changes are observed. It is unclear to which extent such peaks in pelagic production affect the ecosystem. We were however startled to detect algae with a potential for toxin production: two classes of marine biotoxins were detected in Antarctic waters of PC: Yessotoxin was present during summer 2014 and Pectenotoxin-2 during the entire year. These results are first evidence for a potential risk of harmful algal proliferation in a warming Southern Ocean (AWI and CONICET partners).



New information on pelagic ecosystem seasonal biodiversity patterns were obtained for archaean and bacterial communities by IAA and RUG partners through genomic analysis. A dominant strain of previously undescribed ammonium oxidizing Thaumarchaeota was newly identified in Potter Cove (Hernandez et al. 2015). Pelagic bacterial community structure is strongly shaped by salinity which indicates that glacial melting is of major influence for the composition of the coastal microbiota.

Fig. 2: Sea floor communities in the sedimentary systems of Potter Cove differ strongly in response to their deglaciation history and the acute glacial influence (Pasotti et al. 2014).

Within IMCONet we have gained fundamental new understanding of how current climatic change affects Antarctic coastal ecosystems, using detailed observations from Potter Cove and combining with results from regional WAP investigations. The Antarctic islands with their smaller icecaps are highly sensitive to climate changes and their ecosystems are rapidly responding. Hence, they can be seen as early warning systems for regional change predictions. Although far away from Europe, rapid changes of Antarctic ice masses and shifts in marine biodiversity affect our own living conditions in more ways than only by raising sea level around Europe. We need to join efforts in networking projects to observe and protect these unique and extreme ecosystems. Observation, experiments and modeling have successfully been combined in IMCONet and can serve as a basis for the development of permanent coastal observatories in Antarctica.

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