

## **The Changing Arctic Ocean Seafloor (ChAOS) – How changing sea ice conditions impact biological communities, biogeochemical processes and ecosystems**

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The overarching aim of ChAOS is to understand the effects of changing sea ice cover on Arctic Ocean seafloor biodiversity and associated ecosystem functioning. Our main objectives are to:

- Quantify the total amount and macronutrient stoichiometry of organic matter delivered to the Arctic seafloor, its source, bioavailability, age, and its fate below the sediment-water interface
- Characterise the structure, activity and associated functioning of benthic infaunal assemblages under different ice cover scenarios
- Experimentally determine how the benthic community structure, biogeochemical processes, and other ecosystem functions might change in a future, more ice free and warmer Arctic shelf
- Analyse and monitor the amount and speciation of carbon and nutrient species recycled from the sediment into the water column under changing environmental conditions as induced by different sea ice scenarios
- Provide data for improved modelling parameterisation of benthic carbon and nutrient cycling to allow for more reliable predictive tools of changes to Arctic Ocean benthic biological and biogeochemical processes and functions under future climate scenarios

Specifically, the consortium will achieve this by determining the amount, source, and bioavailability of organic matter (OM) and associated nutrients exported to the Arctic seafloor; its consumption, transformation, and cycling through the benthic food chain; and its eventual burial or recycling back into the water column. Hence, we are studying these coupled biological and biogeochemical processes by combining (i) a detailed study of representative Arctic shelf sea habitats that intersect the ice edge, with (ii) broad-scale in situ validation studies and shipboard experiments, (iii) manipulative laboratory experiments that will identify causal relationships and mechanisms, (iv) analyses of highly spatially and temporally resolved data obtained by the Canadian, Norwegian and German Arctic programmes to establish generality, and (v) we will integrate new understanding of controls and effects on biodiversity, biogeochemical pathways and nutrient cycles into modelling approaches to explore how changes in Arctic sea ice alter ecosystems at regional scales.

Our region of focus is the central and northern Barents Sea, a part of the Arctic Ocean where drastic changes in sea ice cover and shifting boundaries between Atlantic and Arctic water masses are the main environmental controls. Our field campaigns in the summer months of 2017, 2018 and 2019 onboard the RRS James Clark Ross will form the core of our research activity. Specifically, we will conduct extensive and multi-disciplinary sediment investigations and sampling using a variety of instrumentation and sampling devices (e.g., trawls, boxcorer, megacorer) at five key benthic stations on a transect along 30° eastern latitude that are variably influenced by winter sea ice cover. We also intend to use additional cruises to locations that share similar sediment and water conditions in Norway and Canada. In support of our field campaign, and informed by the analysis of field samples and data obtained from our international partners (in Norway, Canada, USA, Italy, Poland and Germany), a range of well-constrained laboratory experiments will seek mechanistic understanding by exposing incubated natural sediment to environmental conditions that are most likely to vary in response to the changing sea ice cover.

The unique combination of expertise (micro-, meio- and microbiologists, organic and inorganic geochemists, ecologists, modellers) and facilities within our consortium will allow us to make new links between the quantity and quality of organic matter and the biological, ecological and functional response of Arctic shelf systems. To link the benthic sub-system to the Arctic Ocean as a whole, we have established close links with complementary projects studying biology and biogeochemistry in the water column. The combined data sets and new mechanistic understanding of key biological and biogeochemical processes are designed to assist in generating numerically efficient upscaling tools and develop predictive models to improve future visioning of the Arctic Ocean.