2021-02-22

Upcoming Arctic marine expeditions with Icebreaker Oden 2023 & 2024

2023, April – June; The North-Atlantic sector of the ice-covered Arctic Ocean

Scientific theme: Atmospheric rivers and the onset of sea-ice melt (ARTofMELT)

Proposed content: The Arctic climate is ultimately determined by a balance between heat imported from the south, predominantly in the atmosphere, and energy lost to space by radiation at the top of the Arctic atmosphere. While the former is a large-scale process, depending on atmospheric dynamics over the extratropical norther hemisphere, the latter is dominated by local processes; melt of sea-ice and snow, clouds, aerosols and other albedo changes – all that alters the radiation to space. The link between the two is airmass transformation during intrusions into the Arctic of warm and moist air. The periods of change between winter and summer, so-called shoulder seasons, are central to the Arctic environment. The start and end of the sea ice melt, determines the length of the biologically active summer period and are also indicators of climate change. The spring melt onset is important for the predictability of summer sea ice, hence, understanding what triggers melt onset improves the ability to predict the evolution of sea ice the following summer. On shorter timescales, location and characteristics of sea ice are important for forecasting extreme weather. A central question is if the seasonal transitions are gradual, forced by the annual solar cycle as over continents, or abrupt.

Scientific goals of the expedition: understanding the interactions between midlatitude and the Arctic as well as what happens when the sea ice melt starts is at the heart of many Arctic scientific disciplines:

- ✓ Atmospheric sciences: meteorology, atmospheric chemistry, aerosols and aerosol/cloud inter-action and air pollution transport
- ✓ Physics and chemistry of snow, as melt starts
- ✓ Sea-ice physics; ice response to a changing surface energy budget
- ✓ Upper-ocean mixing and heat transfer, from the ice and downward
- ✓ Marine chemistry, biology and biogeochemistry
- ✓ Coupled vertical fluxes of energy, momentum, gases and matter between all of the above

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2023, July – September; Eurasian Arctic

Scientific Theme: the functioning and response of the Ocean and Cryosphere systems and their linkages to large-scale biogeochemical cycles under present and historical changes to the climate.

Proposed content: to target the dispersal and fate in both the freshwater plume and by deep convection of CH4 (CO2 and N2O), of ocean acidification, of permafrost-derived organic matter, of nutrients and of contaminants; on destabilization of slope methane hydrates; on the effects of increases in both Atlantification and riverine freshwater supply; and to study many of these processes in both the modern Arctic as well as in past periods of rapid climate warming.

Scientific goals of the expedition:

The Theme Eurasian-Arctic Shelf-Basin Interactions of Climate-Cryosphere-Carbon-Contaminants (EURASIAN-ARCTIC C4) will address internationally-prioritized research challenges on the functioning and response of ocean and cryosphere systems and their linkages to large-scale biogeochemical cycles, incl. greenhouse gases, under present and historical changes to the climate.

- ✓ Shelf-Basin dispersal and biogeochemical fate of CH4 and other GHG (CO2, N2O)
- ✓ Shelf-Basin dispersal and biogeochemical fate of organic matter released to the shelf system from thawing permafrost
- ✓ Shelf-Basin dispersal of severe shelf-observed Ocean Acidification
- ✓ Contaminant transport to and distribution in the Arctic Ocean
- ✓ Shelf-Slope-Basin cascading and dispersal of winter convection into deep basins
- ✓ Methane release from collapsing slope hydrates
- ✓ Massive C/N/GHG remobilization during earlier warming and sea-level rise
- ✓ Atlantification and effects on high-Arctic sea ice

2024, July – September; North of Greenland

Theme of the expedition:The North Greenland Marine Cryosphere in a Changing Climate

Proposed content: Assessment of the history, dynamics and future development of North Greenland's marine cryosphere in a changing climate and the responses of the marine and terrestrial ecosystems and the Northern Greenlandic Ice Sheet contribution to global sea-level rise.

Scientific goals of the expedition:

- ✓ Unravelling the Late Glacial to Holocene history and dynamics of the North Greenland Ice Sheet
- ✓ Providing new insight into the variability of the marine cryosphere of North Greenland and the adjacent Arctic Ocean.
- ✓ Investigating the interaction between ecosystem community composition, anthropogenic dynamics and climate fluctuations
- ✓ Quantifying ecosystem production and nutrient state in changing marine ecosystems north of Greenland: Thinning and retreat of Arctic sea ice has led to a doubling of the marine productivity in Arctic shelf ecosystems over the past two decades, fundamentally changing the carbon cycle.
- ✓ Mapping of the remote ocean frontiers: There has been growing recognition that our limited knowledge of the seafloor shape and depth (<20% of the seafloor in the Arctic Ocean has been directly mapped) has a severe impact on our ability to model ocean circulation and global heat transport, understand sediment dynamics and glacial history, assess sea-level rise, predict tsunamis and storm surge, and manage critical benthic habitats.
- ✓ Mapping the presence of gas hydrates in marine sediments and gas in water column and atmosphere: The dynamic interactions between the marine hydrate reservoir and the global ocean and climate system is a vital component for understanding the carbon cycle on geologic time scales, ocean acidification, and future climate change.
- ✓ Numerical modelling of the ice-ocean-atmosphere-geodynamic system: Estimates of the potential future contribution of global sea-level rise from the northern sector of the Greenland Ice Sheet under different climate scenarios, requires numerical modelling of interactions between the atmosphere, ocean, cryosphere, and the solid earth.