Science Session

Arctic Ocean observation activities and international collaboration

Michael Karcher (AWI)
based on input from many colleagues and the G7 FSOI Arctic documents for Germany

Ongoing and planned Arctic Ocean observing activities

Scheduled Expeditions

- Polarstern – Central Arctic Ocean- Arcwatch I - Summer 2023
  - sea-ocean-marine ecoystem coupling from the surface to the deep ocean
- Polarstern – Fram Strait – FRAM observatory - Summer 2023
  - longterm ocean-marine ecosystem monitoring
- Polarstern – Central Arctic Ocean - Arcwatch II - Summer 2024
  - large scale assessment of ocean-sea ice change
- Polarstern – Frams Strait – FRAM observatory - summer 2024
  - longterm ocean-marine ecosystem monitoring
- ICEBIRD aircraft campaigns (Sea ice, atmosphere) in Winter and summer 2024 and 2025: Surveys from Canada - Greenland - Svalbard

Proposed expeditions (decision pending) after 2024

- Polarstern - Central Arctic Ocean - ArcWatch III – early summer 2025
  - contrasting sea ice-ecosystem coupling in different sea ice types
- Polarstern- North Greenland shelf seas - EGC Sources – late summer 2025
  - unexplored circulation north of Greenland and implications for ocean driven glacier melt and carbon cycle

Observatories

- Frontiers in Arctic Marine Monitoring (FRAM) observatory in FRAM Strait – longterm physical-biogeochemical-biological monitoring based on mooring time series and annually repeated ship-based observations
- Multidisciplinary Ice-based distributed observatory (MIDO) observatory in Central Arctic Ocean – sustained sea ice-ocean monitoring based on ice buoys
- Observatory HAUSGARTEN- Long-Term Ecological Research in the deep Fram Strait region
- AWIPEV Station in Ny Alesund (Svalbard) – atmospheric and coastal marine biology monitoring

Research collaborations

International collaboration is essential to tackle the challenging research questions as well as the logistic challenges of Arctic Ocean research. This is a list with examples for existing collaborations as well as new initiatives:

- International expeditions with Polarstern (e.g. Arcwatch, Coordinated Drift Experiment MOSAiC and follow up analyses projects, Aircraft Campaigns such as ICEBIRD)
- Large EU Projects such as EU-PolarNet 2, Arctic PASSION, OCEAN:ICE, ARICE, EUROFLEETSplus and the new POLARIN (Polar Research Infrastructure Network)

- Bilateral research projects, e.g. with BAS and UCL (as part of the NERC CAO program), with NPI, UiT, JAMSTEC, UAF, and others
- Participation in the Joint Programme for Scientific Research and Monitoring (JPSRM) of the Central Arctic Ocean Fisheries Agreement (CAOFA) (a follow-up project to EFICA is in preparation)
- Networks and Observing Systems like SIOS, A-DBO, ARGO, Arctic Science Partnership (ASP) (https://asp-net.org/), International Arctic Buoy Programme (IABP), Fram Strait Arctic Outflow Observatory (NPI initiative)
- The 'Arctic GOOS Regional Alliance (GRA)' in formation', will have the potential to play a pivotal role for the marine observations, coordinating with more specified components of marine research and monitoring programmes/systems such as IABP, and the four DBOs (Pacific, Atlantic-Arctic, Siberian and Davis Strait/Baffin Bay). Funding will play a role for the effectiveness of the Arctic GRA.
- SAON could play an important overall role for sustaining observations, depending on structure and funding.

Knowledge gaps to address through international collaboration and the utilization of Japan's new research icebreaker as a global research platform.

- There is a need for coordinated multi-disciplinary research and monitoring of the Arctic Ocean as part of the larger coupled system. In this context an additional research platform like the new icebreaker of Japan could offer additional support for the newly developing set of Distributed Biological Observatories (DBOs), which in addition to the existing Pacific DBO will be covering areas in the Siberian central Arctic, The Atlantic Arctic and the Baffin Bay/Davis Strait region. There is a possibility to install an additional central Arctic DBO in future to which the new icebreaker could be a pivotal contributor.
- Furthermore, there is the opportunity for multi-ship experiments in the ice-covered part of the central Arctic, such as the Canadian Basin or the last ice area with the enhancement of the international icebreaking research vessel fleet. This also will have a strong positive impact on the SAS II and the IPY capabilities. The availability of the additional ice-breaking platform allows much enhanced options for documenting the development of the freshwater lens of the Beaufort Gyre and the Atlantic Water under the ice covered part of the Canadian Basin in international coordination.
- The monitoring of fisheries resources and ecosystem parameters in ice-covered waters is essential to provide management advice in the changing polar oceans. Japan's new icebreaker can make a significant contribution by enhancing international monitoring capabilities, for example in the context of the Central Arctic Ocean Fisheries Agreement (CAOFA), to which Japan is a signatory party. To achieve this, the ship would best be equipped to conduct fisheries surveys. Furthermore, a collaborative research program facilitating exchange of scientists between different research vessels could enhance highly needed international collaboration.
- Assessing the current and future trace element composition of the ocean is crucial for understanding oceanic transport, marine ecosystems and those depending on it. In this area, Japan has delivered an outstanding contribution to the international GEOTRACES programme, which requires special sampling capabilities and cross-calibration of analyses between groups and countries. We hope that this contribution can now be expanded further to the polar regions.

- The new Japanese icebreaker could allow more regular access including tools like ROVs and AUVs. It also offers the option for joint 2-ship expeditions in the central Arctic and the use of work-class ROVs (in-situ experiments), as well as mutual support to operate in difficult sea ice conditions.
- There is a desire for joint technical developments, such as the "pressure chain' to host deep sea organisms (ex-situ experiments), in which the new ship could play an important role as a platform.