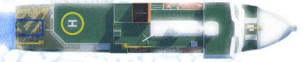




International Workshop on Arctic Ocean Observation:
Future Collaboration by Research Vessels and Icebreakers
November 17-18, 2023 @ IINO CONFERENCE CENTER, Tokyo, Japan.



Science Session

“Arctic Ocean Observation Capability”

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In my presentation, I will cover two topics. Firstly, I will give a brief overview of my thoughts and aspirations as a physical oceanographer. Additionally, I will report on the Arctic session of the G7 FSOI working group meeting held on November 14.

Regarding the hydrographic conditions of the Arctic Ocean, they form the foundation of Arctic Ocean changes and are crucial not only for a physical understanding but also for addressing various environmental issues. The water masses of the Arctic Ocean primarily originate from inflows from the Atlantic and Pacific Oceans.

Recently, significant progress in 'Atlantification' and 'Pacification' on both sides are progressing significantly closely related with on-going sea ice decrease in the Arctic Ocean ¹⁾. Consequently, the strengthening and weakening of Arctic Ocean stratification are underway and will likely continue in the future on the Pacific and Atlantic sides of the Arctic Ocean, respectively ²⁾. A detailed understanding is critical for predicting future changes in the Arctic Ocean environment. While some gateways and shelf slopes of the Arctic Ocean have been observed, and their changes in hydrographic conditions are relatively well-known, there remains a knowledge gap in the central Arctic Ocean due to limited observations. The Synoptic Arctic Survey (SAS) was conducted from 2020 to 2022 with the aim of collecting empirical data in the Arctic basin that cannot be obtained through any other means. Currently, the project is in its synthesis phase, during which the observed data becomes available, and scientific results are being published ⁴⁾. The SAS addresses research questions related to physical drivers, which are as follows;

- RQ1. How are Arctic Ocean water masses and circulation responding to changes in sea ice properties, and atmospheric, advective and freshwater forcing?
- RQ2. What are the states of, and changes in, heat and freshwater budgets in the Arctic region?
- RQ3. What are the changes in water mass sources, sinks and transformations?

These questions remain crucial, especially given the rapid changes in the Arctic Ocean. From a physical oceanographic perspective, a land-to-land full-depth hydrographic observation can unveil the water mass structure and ocean currents across a section using inverse methods. Such observation has never been conducted in the Arctic Ocean and will hopefully be able to accomplish when a new research icebreaker becomes available, and international research collaborations, such as SAS, continue. SAS members are currently discussing the next joint observation, hopefully in 2030. Additionally, the next International Polar Year is scheduled to be in 2032-2033. I believe that such international events enhance research collaboration, allowing observations not only on gateways and shelves but also in the central Arctic Ocean.

The G7 Science and Technology Ministers' Meeting was held from May 12-14 in Sendai, Japan, and the G7 Science and Technology Ministers' Communique was released. In the communique, the Arctic and Antarctic regions were recognized as regions significantly affected by climate change, and the need to support international cooperation was highlighted as a new emerging issue for the G7.



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“Observations can be strengthened by capitalizing on technological developments, sharing various data, and developing human resources and capacity through international observation platforms such as Arctic and Antarctic research vessels. Arctic research should be done in partnership and collaboration with Indigenous Peoples, with long term research relationships built on trust, respect, and mutual interest.”

(after “G7 Science and Technology Ministers’ Communique”)

“Furthermore, Arctic Ocean Observation Capability has been approved by the G7 FSOI Working Group as a new emerging issue to work on in 2023, aiming at enhancing in-situ observations and data sharing in the Arctic region.”

(after “Annex 3: G7 Future of the Seas and Oceans Initiative (FSOI) Working Group”)

Following the Sendai meeting, the G7 Future of the Seas and Oceans Initiative (FSOI) working group (WG) nominated Arctic experts from each country to identify priority issues and information needs related to Arctic Ocean observing activities, infrastructure, and international or regional partnerships. For this purpose, we developed a document submitted to the G7 FSOI, based on inputs from members and group discussions.

The expert members identified five items as “issues for G7 considerations,” as follows;”

- Enhanced coordination to monitor Marine Environmental Changes and Their Global Impact
- Pollution and Environmental Protection
- International research collaboration
- Indigenous and local involvement and engagement
- Data collection, documentation, sharing, and dissemination

In addition to the issues for G7 considerations, we composed the opening statement. The key sentences of the statement are as follows: 'Establishing a well-coordinated ocean observing system throughout the Arctic, such as through a Global Ocean Observing System (GOOS) Regional Alliance (GRA), is an achievable and much-needed step in the right direction. Fortifying such efforts would reaffirm a strong commitment from the G7 countries to the Arctic, translating our words into actions that underline the G7’s unwavering support for a more peaceful, sustainable, and resilient Arctic Ocean.”

The G7 FSOI WG meeting is held in Tokyo from November 14-16, and the topic of “Arctic Ocean Observation Capability” is selected as the first session of the meeting. We have presentations and discussions about the background document and input from each member, which provides priorities and opportunities for collaboration, including aligning activities and investments. In my presentation, I would report the session of “Arctic Ocean Observation Capability” and future perspective.

[References]

- 1) Polyakov, I.V. et al. (2020). Borealization of the Arctic Ocean in Response to Anomalous Advection From Sub-Arctic Seas. *Front. Mar. Sci.* 7:491., doi: 10.3389/fmars.2020.00491
- 2) Mulwijk, M. et al. (2023). Divergence in Climate Model Projections of Future Arctic Atlantification. *J. Climate*, 36, 1727-1748, doi: 10.1175/JCLI-D-22-0349.1
- 3) Bluhm, B.A. et al. (2020). The Pan-Arctic Continental Slope: Sharp Gradients of Physical Processes Affect Pelagic and Benthic Ecosystems. *Front. Mar. Sci.*, 7:544386, doi: 10.3389/fmars.2020.544386
- 4) Nishino, S. et al. (2023). Atlantic-origin water extension into the Pacific Arctic induced an anomalous biogeochemical event. *Nat. Comm.*, 14, 6235, doi: 10.1038/s41467-023-41960-w