

The critical role of a coordinated polar research vessel fleet in the Arctic Observing System

Authors: Verónica Willmott¹, Justiina Dahl², Mats Granskog³, Nicole Biebow¹ and the EU-project ARICE Consortium.

¹ International Cooperation Unit, Alfred Wegener Institute for Polar and Marine Research, Germany.

² Swedish Polar Research Secretariat, Sweden.

³ Norwegian Polar Institute, Fram Centre, Norway

Corresponding author: veronica.willmott@awi.de

Abstract

Polar research vessels (PRVs) are key infrastructures to address in situ multidisciplinary studies from the seafloor to the atmosphere in the Arctic Ocean. However, the lack of international coordination in the operation of these infrastructures often leads to a duplication of efforts, suboptimal use of total ship-time and thus cost-ineffective operations. A permanent mechanism and funding system should be implemented to support cross-border access to PRVs and the funding of research vessel charter for international collaborative research efforts.

1. Relevance and demand in support of an integrated and sustained pan-Arctic observation programme

1.1. Political relevance

Arctic research and sustainable development are high on the political agenda. With the “Communication on the European Green Deal” (COM/2019/640) from 11 December 2019, the EU committed to implement the Paris Agreement and the United Nations (UN) 2030 Agenda for Sustainable Development. EU activities taking place in, and relating to, the Arctic shall contribute to the success of these important protocols. This has been highlighted by aligning the new “EU Arctic Policy” (JOIN/2021/27) to the European Green Deal and to a sustainable blue economy (COM/2021/240).

1.2. Identification of knowledge gaps and barriers

Several recent European and international initiatives¹ have performed co-design and consultation processes that have identified research priorities, knowledge gaps and barriers that hamper knowledge progress in the Arctic Ocean.

¹ Among them - IASC¹ (IASC, 2016), the Arctic Science Ministerials (2016, 2018, 2020), the EU Project ERICON-AB¹ (ERICON, 2012), the EU-PolarNet project through the White Paper on European Polar infrastructure access and interoperability (Vieira et al, 2020) and more recently the European Polar Research Programme (EPRP) (EU-PolarNet,

All initiatives refer to the urgency in achieving an efficient international coordination, adequate funding, infrastructure and equipment availability, data management and political support for research in the Arctic. These priorities need to be addressed to achieve sustainable development goals and to provide policy makers and relevant stakeholders with improved strategic guidelines for future actions.

Polar research vessels (PRVs) including research icebreakers have been identified as key instruments to advance our knowledge of the Arctic Ocean (Vieira et al, 2020).

1.3. Data needs

Data from the Arctic Ocean is difficult to gather. The Arctic Ocean remains largely covered by ice in winter, and even in summer drifting ice places research (and non-research) vessels at risk. For this reason, available data from the Arctic Ocean has a marked seasonal bias, leaning heavily towards observations in the summer, when there is less sea ice (Zweng et al., 2017). Datasets from the Arctic Ocean are thus still scarce and scientifically very valuable, especially because it is a system in rapid change and these changes affect the whole planet.

The observation of in-situ ecological processes, including biodiversity and energy fluxes, interactions across trophic levels and diversity, especially in the polar night, are key in supporting improved understanding of ecosystem responses to ongoing changes. A coordinated effort in the Arctic Ocean data collection is urgently needed for a sustainable management of resources, worldwide climate change management and more accurate weather and sea ice predictions to reduce risks associated with operations in the Arctic Ocean.

PRVs including research icebreakers are thus indispensable to address multidisciplinary studies of extreme scientific value from the seafloor to the atmosphere in the Arctic Ocean.

2. Current situation

While many nations have strong polar research programmes, only few of them own and operate PRVs in the Arctic Ocean. At present, eleven PRVs between Polar Class Category² A and C are operated by countries from the European Economic Area in the Arctic. From them, only three are research icebreakers (PC1-PC3). These vessels are nationally owned, operated and funded, primarily serving national research interests and needs. Access to PRVs is regulated nationally, making admission for researchers belonging to a different country (trans-national or cross-border access) difficult (ARICE, 2019).

The lack of international coordination of the operation of PRVs leads to duplication of efforts, sub-optimal use of vessel capacity and reduced ship-time availability on board research icebreakers. Research icebreakers are not only used for research in the Arctic Ocean, but for operations elsewhere - including as supply vessels and for logistics and research the Southern Ocean around Antarctica. Together, these problems impede Europe's capacity to investigate the Arctic Ocean – especially areas only accessible with research icebreakers in the wintertime (ARICE, 2020; Lugdwigsen et al. 2018; Dañobeitia et al. 2014).

2020), as well as the United Nations Ocean Decade¹ - in particular the Regional Arctic Ocean Decade Action Plan¹ (2021).

² <https://www.imo.org/en/OurWork/Safety/Pages/polar-code.aspx>

Recent bottom-up, researcher driven initiatives, such as the Synoptic Arctic Survey³ (SAS) and the Multidisciplinary drifting Observatory for the Study of Arctic Climate⁴ (MOSAIc), have substantially improved data collection in the Arctic, by coordinating multinational efforts in a single (MOSAIc) or multiple (SAS) research expeditions. Also national bottom-up efforts, like the Norwegian Nansen Legacy program has intensified data collection in the European Arctic over the last years to an unprecedented level using new (national) research icebreaker capacity. However, these are for now single-off events and to date, there is no established mechanism allowing international cooperation to occur on a regular basis.

3. The Arctic Research Icebreaker Consortium

Observations and research in the Arctic are beyond the capacity of single nations, and it has been proven that international cooperation and coordination is necessary to tackle the knowledge gaps in responding to common research priorities.

What is lacking are mechanisms or funding systems for cross-border access that could support the funding of research vessels' charter for truly international collaborative research efforts. One possible way of addressing this is to create an international consortium that jointly funds international expeditions in the Arctic Ocean, with contributions from international funding organisations and national polar programmes.

This would establish for the first time dedicated research platforms for the Arctic Ocean that support sustained observations or large-scale initiatives such as MOSAIc or SAS. To achieve that, today's heterogeneous national polar research strategies need to be aligned and science planning to be based on an open, transparent and international process that opens for shared access to research icebreakers.

Coordinated international planning, funding and implementation of research cruises, would substantially contribute to achieve a more efficient and cost-effective use of research infrastructures, facilitating the international leveraging of funds to operate them and opening the access to and contributions from researchers working in countries that do not own or operate such infrastructures.

Improved coordination will also enable better interaction with industry and the private sector, as well as their engagement, boosting research and society interactions.

References

ARICE, 2019. Deliverable 1.2. Guidelines on the conditions to access European PRVs. https://arice-h2020.eu/wp-content/uploads/2021/07/arice_d1_2_guidelines_on_the_conditions.pdf

ARICE, 2020. Deliverable 1.4. Identification report on contribution of a coordinated PRV fleet to fulfilling EU member states' research interests in the Arctic Ocean. https://arice-h2020.eu/wp-content/uploads/2021/07/arice_d1_4_identification_report_on_contribution.pdf

³ Synoptic Arctic Survey is a bottom-up, researcher driven, initiative aiming at collecting empirical data in the Arctic Ocean that cannot be done in any other way than through cruises. <https://synopticarcticsurvey.w.uib.no/>

⁴ MOSAIc was the first year-round expedition into the central Arctic exploring the Arctic climate system. <https://mosaic-expedition.org/>

COM/2019/640. Communication from the commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal. https://ec.europa.eu/info/publications/communication-european-green-deal_en

COM/2021/240. Communication from the Commission to the European Parliament, the Council, the European Economic and Social committee and the Committee of the Regions on a new approach for a sustainable blue economy in the EU. Transforming the EU's Blue Economy for a Sustainable Future. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2021:240:FIN>

Dañobeitia, JJ, Biebow, N., Willmott, V, Ojeda, MA, Thomsen, H., Tannerfeldt, M., 2014. Status and foreseeable evolution of the European and International Polar Research Fleets & Equipment. Available at: EUROFLEETS2-WP3-D3.1-210114-V0.7.doc. Last Visited July 22, 2021.

ERICON, 2012. Scientific Research in Polar Seas: ERICON Science Perspective 2015-2030. Publisher: European Science Foundation. Editor: Veronica Willmott. ISBN: 978-2-918428-82-4.

EU-PolarNet, 2020. Integrated European Polar Research Programme (Eds. Velázquez D, Houssais MN, Biebow N). 91 pp. Bremerhaven: Alfred Wegener Institute. <https://doi.org/10.5281/zenodo.4256024>

IASC, 2016. Integrating Arctic Research - a Roadmap for the Future 3rd International Conference on Arctic Research Planning ICARP III. Available at: https://icarp.iasc.info/images/articles/downloads/ICARPIII_Final_Report.pdf. Last visited December 13, 2021.

IPCC, 2019: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. 2019

IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

JOIN/2021/27. Joint communication to the European Parliament, the Council, the European Economic and Social committee and the Committee of the Regions. A stronger EU engagement for a peaceful, sustainable and prosperous Arctic. https://eeas.europa.eu/headquarters/headquarters-homepage/105481/joint-communication-stronger-eu-engagement-peaceful-sustainable-and-prosperous-arctic_en

Ludwigsen, C.A., Pirazzini,R., Sagen, H., Hamre, T., Sandven, S., Stette, M., Babiker, M., Schewe, I., Soltwedel, T., Behrendt, A., Andersen, O.B., Beszczynska-Möller, A., Walczowski, W., Ottersen, G., Renner, A., Morvik, A., Sejr, M.K., King, A., Gustavsson, D., Johannessen,T., Smedsrud,L.H., de Lange, T., Arduin, F., Heygster, G., Buch, E., Storvold, E., Falck, E., Houssais, M-N., Aarnes, Ø., 2018. Deliverable 2.1 Report on present observing capacities and gaps: ocean and sea ice observing system. Available at:

https://intaros.nersc.no/sites/intaros.nersc.no/files/D2.1%20final_31May2018_0.pdf. Last visited July 22, 2021.

Vieira, Gonçalo, Biebow, Nicole, & Velázquez, David. (2020). Vieira, Gonçalo, Biebow, Nicole, & Velázquez, David. (2020). White Paper on European Polar infrastructure access and interoperability, including an infrastructure implementation plan for the European Polar Research Programme. Zenodo. <https://doi.org/10.5281/zenodo.4253015>, including an infrastructure implementation plan for the European Polar Research Programme. Zenodo. <https://doi.org/10.5281/zenodo.4253015>

Zweng, M. M., Boyer, T. P., Baranova, O. K., Reagan, J. R., Seidov, D., and Smolyar, I. V., 2018. An inventory of Arctic Ocean data in the World Ocean Database, *Earth Syst. Sci. Data*, 10, 677–687, <https://doi.org/10.5194/essd-10-677-2018>.