Institute of Oceanology
Polish Academy of Sciences

Report
from the RV Oceania
research cruise

AREX 2025

Leg I (1.07-19.07.2025)

Cruise leader: Dr Agnieszka Beszczyńska-Möller

Leg II (19.07 - 30.07.2025)

Cruise leader: Dr Ilona Goszczko

Leg IIIa (30.07-12.08.2025)
Leg IIIb (12.08-22.08.2025)

Cruise leader: Dr Katarzyna Grzelak

Leg IV (22.08-27.08.2025)

Cruise leader: Prof. Jan Marcin Węsławski

Leg V (27.08-08.09.2025)

Cruise leader: Dr hab. Sławomir Woźniak, prof. IOPAN

AREX 2025 cruise PI/coordinator: Dr Agnieszka Beszczyńska-Möller

Content

1 Scientific background of the AREX 2025 cruise

1.1 Long-term large-scale Arctic monitoring program AREX

Oceanographic, physical, atmospheric, and biogeochemical measurements conducted since 1987 in the Nordic Seas and Fram Strait by the Institute of Oceanology of the Polish Academy of Sciences in Sopot aim to investigate and describe the processes shaping ocean climate and ecosystem of the subarctic and Arctic regions, with a particular focus on the European Arctic.

The annual summer measurement expeditions, known as AREX, involve multidisciplinary in situ measurements, including oceanographic, optical, acoustic, biogeochemical, biological, and atmospheric data collection in the Nordic Seas, Fram Strait, and the fjords of western Svalbard. In recent years, these studies have also extended to ice-free areas of the Arctic Ocean. The measurements are carried out annually at similar times of the year on a regular grid of over 300 research stations covering the Norwegian Sea, Greenland Sea, the entrance to the Barents Sea, Fram Strait, fjords of western Svalbard (Hornsund, Isfjord, Kongsfjord), and the southern part of the Nansen Basin.

The time series of key oceanic variables (EOVs, Essential Ocean Variables) collected over more than 31 years of AREX measurements allow for monitoring changes occurring on various temporal scales in the physical and biological Arctic environment. They also contribute to improving existing models of the ocean, sea ice, and climate in the Arctic region.

The AREX program also represents the contribution of the Institute of Oceanology of the Polish Academy of Sciences (IOPAN) to research conducted as part of international collaborations, including European projects such as VEINS (1997–2000), ASOF-N (2003–2005), DAMOCLES (2006–2009), INTAROS (2016-2021) as well as Polish-Norwegian research projects AWAKE (1 and 2), PAVE, POLNOR, CLISE, CDOM-HEAT, and DWARF (2013–2016). The collected data are also used in numerous projects funded by the National Science Centre (NCN) and the National Centre for Research and Development (NCBR), as well as in doctoral research.

The measurements planned during the AREX 2025 cruise also constitute IOPAN's contribution to the implementation of international projects, including EU HE HiAOOS (2023–2026), HE MARBEFES (2022–2026), HE Euro-Argo ONE (2025–2027), HE Sea-QUESTER, the infrastructure project ArgoPolska (Euro-Argo ERIC), as well as other projects carried out in national and international cooperation (SURETY, LAPSE, TWINS, DraginNEST, OpticalGreen, and others). The long-term measurements conducted on standard transects and stations form IOPAN contribution to the international observational program in the European Arctic, A-DBO (Atlantic Arctic Distributed Biological Observatory), as well as to long-term ocean observation series that are part of the ICES Report on Ocean Climate, published annually by the ICES Ocean Hydrography Working Group (OHWG).

1.2 International and national projects with fieldwork during AREX2025

1.2.1 HE MARBEFES

The **MARBEFES** project is based on the concept that biodiversity constitutes a continuous and interconnected system in space and time, transcending traditional boundaries such as "estuary," "coast," or "open waters." MARBEFES considers the gradient from river to ocean, utilizing 12 Broad Transect Belts across four major EU marine regions – the Arctic, Baltic, Atlantic, and Mediterranean. The primary goal of MARBEFES is to establish clear links between biodiversity, ecosystem functions, and the societal benefits they provide. This goal is achieved through an innovative set of ecological, economic, and socio-cultural tools, enabling a comprehensive valuation to support sustainable policy and management of marine ecosystems.

1.2.2 HE HiAOOS

The **HiAOOS - High Arctic Ocean Observing System** project aims to develop, implement, and validate new ocean observation technologies to improve the acquisition of measurement data from the ice-covered regions of the Arctic Ocean. A network of multifunctional, moored measurement arrays will be deployed for two years in the Nansen Basin, the Amundsen Basin, and north of Svalbard. To better utilize the capabilities of the new observation system, new methods and tools for data analysis and visualization will be developed, including the use of modern machine learning techniques. For training purposes and to enable the use of new data and methods by a wide range of stakeholders, the Blue Insight platform will be developed, serving as a digital analog of the studied Arctic Ocean regions.

1.2.3 HE SEA-Quester

The **Sea-Quester - Production, Export, and Sequestration of Blue Carbon in Emerging Polar Ecosystems** project studies the carbon cycle in new polar marine ecosystems that are forming as a result of climate change. Melting sea ice, shifting currents, and warming oceans are already influencing species distribution, behavior, and metabolism. However, little is known about how these changes will affect marine biodiversity and the functions and services of ecosystems, such as carbon sequestration, in polar seas. These changes could have significant implications for achieving biodiversity conservation goals and mitigating the effects of climate change.

1.2.4 HE Euro-Argo ONE

The **Euro-Argo ONE (EAONE)** project aims to develop mechanisms enabling the implementation of OneArgo by Euro-Argo ERIC. This requires adapting the OneArgo concept to the European context, improving the Argo data system, strengthening Euro-Argo ERIC's operational and technical capacities, and engaging a wide range of stakeholders, including scientific and operational users, national administrations, the education sector, and the general public interested in climate change and ocean health. The overarching goal of the project is to expand the activities of Euro-Argo ERIC partners to ensure Europe's effective contribution to the global OneArgo network. In particular, the project addresses challenges such as developing a comprehensive European OneArgo network structure, improving the delivery of OneArgo data and services, enhancing operational efficiency across diverse marine environments (including through collaboration with sensor manufacturers), increasing the uptake of OneArgo products in operational services and research, strengthening European and international cooperation, and promoting the societal value of OneArgo observations.

1.2.5 International observing network A-DBO

The **Atlantic-Arctic Distributed Biological Observatory (A-DBO)** is an international initiative focused on creating a comprehensive observational network for climate and environmental monitoring in the Atlantic sector of the Arctic Ocean—one of the key gateway regions to the Arctic, currently experiencing rapid environmental, climatic, and ecosystem changes. Together with the pioneering observatory in the Pacific sector of the Arctic Ocean (DBO), the DBO in the Davis Strait/Baffin Bay, and the Siberian DBO, the Atlantic DBO (A-DBO) aims to make a significant contribution to the pan-Arctic observational collaboration network. IOPAN is among the initiators of the A-DBO, with data from the long-term observational program AREX representing its contribution to the A-DBO observational network.

1.2.6 Argo Poland

The **Argo Poland** Infrastructure Project - Poland's participation in the European Research Infrastructure Consortium Euro-Argo ERIC has been ongoing since 2008, representing Poland's contribution to modern oceanographic research using Argo profiling floats. The Argo system is an organized network of 4,000 autonomous, drifting research devices that profile the water column of the world's oceans. Poland's involvement in the Argo network began with the deployment of Argo floats in the Arctic in 2008, and since 2016, the measurement system has been expanded to the Baltic Sea. From 2021 to 2026, new measurements and data analyses are planned, as well as an extension of research to include polar fjords. In addition to standard floats, advanced biogeochemical Argo floats (BGC-Argo) will be utilized. The project includes innovative development activities, such as continued work on a float recovery system and improvements in data processing and quality control for Argo float data.

1.2.7 NCN SURETY

The **SURETY** project aims to develop an optical method for determining surfactant activity, potentially eliminating the need for surface water sampling in the future. The project proposes the use of optical fluorescence measurements of surfactants and voltammetric measurements of surfactant activity (using the "mercury drop" method) to identify a new optical index of surfactant activity. This index, when incorporated into a mathematical formula alongside wind speed, is expected to provide better alignment with measured gas exchange velocity values than existing models that rely solely on wind speed.

1.2.8 NCN TWINS

The **TWINS - When 'Together' Means 'Apart': Niche Partitioning Between Twin Zooplankton Species in a Warming Arctic** project aims to compare habitat and dietary preferences between twin zooplankton species (small and large copepods, amphipods, krill, and chaetognaths) that have different distribution centers (Arctic or boreal).

1.2.9 NCN LAPSE

The **LAPSE - What Really Matters for a High-Arctic Zooplanktivorous Seabird Foraging in a Rapidly Changing Environment: Prey Size or Energy Content?** project focuses on studying the response of the population of a typical Arctic seabird, the zooplanktivorous little auk (*Alle alle*) from Svalbard, to variability in marine environmental conditions. The aim is to compare oceanographic conditions and the composition of zooplankton communities between the foraging areas of little auks nesting in five breeding colonies located in regions with diverse marine environmental conditions.

1.2.10 NCN DRAGONnest

The **DRAGONnest - Investigating Biodiversity Patterns of Sea Dragons in the Arctic** project aims to conduct taxonomic and molecular identification of selected species of Kinorhyncha, belonging to the genus *Echinoderes*, collected from various Arctic regions (Spitsbergen, Eastern and Western Greenland, Alaska). To date, the genetic structure of sea dragons inhabiting Arctic regions has not been studied. The application of molecular techniques, which have become a common tool for discovering species and identifying cryptic species, sheds new light on the biodiversity of Arctic Kinorhyncha and allows for the verification of previous assumptions about the wide distribution of certain species or their potential cryptic speciation.

1.2.11 NCN OptiCal-Green

The aim of the OptiCal-Green project is to understand how ongoing warming of the Arctic Ocean affects the ability of phytoplankton to utilize increased solar energy, produce organic matter, and sustain the functioning of the marine biological pump under changing environmental conditions. Organic carbon in the ocean is largely produced by phytoplankton, which, through photosynthesis, drives the biological pump and influences the optically and satellite-observable color of the water. In the Arctic Ocean, these processes are rapidly changing due to warming, sea ice retreat, and increased terrestrial inputs of dissolved organic matter. The project investigates how changing physical, chemical, and biological conditions influence phytoplankton light utilization and organic matter production. In situ measurements of optical properties, pigment concentrations, DOM fractions, and environmental parameters will allow these relationships to be quantified. The resulting data will support the development of light propagation models and algorithms for improved interpretation of satellite observations.

2 Research program of the AREX 2025 cruise

2.1 Research tasks during Leg I Tromsø – Longyearbyen (Barents and Greenland Seas, souuthern Fram Strait)

- Investigation of the structure and dynamics of the Norwegian Atlantic Current and the West Spitsbergen Current in the eastern Greenland Sea, in the Barents Sea Opening and in the southern Fram Strait (Task I.4).
- Investigation of the variability of temperature, salinity, and ocean currents on the shelf and continental slope the easterne Greenland Sea, in the Barents Sea Opening and in the southern Fram Strait (Task I.4).
- Studies of the volume and heat transport in the Norwegian Atlantic Current and the West Spitsbergen Current (Task I.4).
- Characterization of marine aerosol properties, including size distributions, concentration, optical properties, and the contribution of absorbing aerosol components to the marine aerosol composition (Task I.3).
- Assessment of the impact of aerosols on radiative fluxes at the sea surface (Task I.3).
- Meteorological conditions during the measurements (SURETY project, Task I.3).
- Determination of vertical CO_2 fluxes in the near-surface atmospheric layer (Task I.3).
- Determination of ship-motion corrections for wind speed and direction (SURETY project).
- Determination of CDOM properties and concentrations in the surface layer (sea surface microlayer and subsurface layer, 0–1 m) in order to identify relationships between CDOM enrichment in the sea surface microlayer and the gas exchange velocity between the ocean and the atmosphere (Task I.3, SURETY project).
- Determination of the spatial variability of pCO_2 and the structure of the carbonate system in surface waters (PROSPECTOR project, Task II.7).
- Characterization of the qualitative and quantitative composition and spatial distribution patterns of plankton communities (protozoan plankton and zooplankton) in the epi- and mesopelagic zones of the West Spitsbergen Current, in relation to environmental conditions (Task I.5).
- Assessment of the genetic diversity of zooplankton organisms in the Atlantic and Arctic waters of the Nordic Seas (Task I.5).
- Investigation of habitat and feeding preferences of twin zooplankton species characterized by different distribution (in the boreal or Arctic biogeographic domains) across three distinct zones of the Polar Front: the Atlantic zone, the Arctic zone, and the mixing zone (TWINS project).

2.2 Research tasks during Leg II Longyearbyen – Longyearbyen (nothern Fram Strait, north of Svalbard)

- Investigation of the water masses properties structure and dynamics of the West Spitsbergen Current in the northern Fram Strait and north of Svalbard (Task I.4).
- Studies of the volume and heat transport in the West Spitsbergen Current and Fram Strait Branch of Atlantic water inflow (Task I.4).
- Characterization of marine aerosol properties, including size distributions, concentration, optical properties, and their impact on radiative fluxes at the sea surface (Task I.3).
- Meteorological conditions during the measurements (Task I.3).
- Determination of vertical CO_2 fluxes in the near-surface atmospheric layer (Task I.3).
- Determination of ship-motion corrections for wind speed and direction (SURETY project).
- Determination of the variability of organic matter enrichment in the sea surface microlayer (Task I.3).
- Determination of sensible and latent heat fluxes between air and ocean (Task I.3).
- Characterization of the qualitative and quantitative composition and spatial distribution patterns of plankton communities (protozoan plankton and zooplankton) in the epi- and mesopelagic zones of the West Spitsbergen Current, in relation to environmental conditions (Task I.5).
- Assessment of the genetic diversity of zooplankton organisms in the Atlantic and Arctic waters of the Nordic Seas (Task I.5).
- Investigation of habitat and feeding preferences of twin zooplankton species characterized by different centers of distribution (in the boreal or Arctic biogeographic domains) across three distinct zones of the Polar Front: the Atlantic zone, the Arctic zone, and the mixing zone (TWINS project).

2.3 Research tasks during Leg IIIa Longyearbyen – Longyearbyen (Hornsund)

2.3.1 Marine Ecology Department - plankton (PEP)

- Study of the qualitative and quantitative composition and distribution patterns of plankton communities in the Hornsund and its forefield in relation to environmental conditions (Task I.5).
- Determination of zooplankton abundance in the feeding grounds of little auks in the forefield of the Hornsund fjord (Task I.5).

2.3.2 Marine Ecology Department - plankton (PFBP)

- Assessment of the foraging resource availability for the little auk breeding in Hornsund (HOR) using WP2 nets (180 µm) and optical methods (LOPC, UVP) (Task I.7, LAPSE and SEAPOP III projects, ZOOM).

- Investigation of carotenoid variability in key Arctic zooplankton species (Calanus copepods) and its impact on diet quality and the condition of their main predators, planktivorous (little auks), during the breeding season (Task I.7, ORANGE and ZOOM).
- Characterization of the spatial distribution and qualitative–quantitative composition of plankton communities in Hornsund (HOR) in relation to environmental factors, using both traditional methods (plankton nets, water samplers) and optical techniques (LOPC, UVP) (Task I.7, T-Trait and Bipolarity projects).

2.3.3 Marine Ecology Department - benthos

- Determination of the taxonomic composition, biomass, and abundance of macro- and meiobenthos, as well as benthic biodiversity assessed using both traditional and metagenomic methods at monitoring stations in the Hornsund fjord (Task III.1).
- Determination of the taxonomic composition, biomass, and abundance of macro- and meiobenthos, as well as local-scale distribution patterns within the Hornsund fjord at 32 stations located along 5 transects, and comparison of the current community structure with data from 20 years ago (Task III.1).
- Assessment of the diversity and distribution patterns of Kinorhyncha in the Hornsund fjord, with particular emphasis on widely distributed species, based on morphological and molecular analyses (Task III.1, DRAGONnest project).
- Determination of the taxonomic composition of megafauna and analysis of spatial distribution patterns, organism behavior, and the occurrence of traces of biological activity on the seafloor surface (Lebensspuren) in the Hornsund fjord using video methods (a downward-looking underwater camera) (Task III.1).
- Documentation of the presence of macroalgae in the Hornsund fjord in the context of their role in the organic carbon cycle (blue carbon) in fjord systems (Task III.1).

2.3.4 Marine Dynamics Department - physical oceanography

- Study of thermohaline and oxygen properties and the distribution of water masses in the Hornsund fjord and the western Spitsbergen shelf area (Task I.4).

2.3.5 Marine Physics Department - marine optics

- Determination of the optical properties of waters in Spitsbergen fjords in order to develop local satellite algorithms for estimating the concentrations of seawater constituents in the North Atlantic (Task II.5, SeaQuester project).
- Determination of the spectral characteristics of vertical profiles of solar irradiance attenuation in the water column and surface spectral reflectance distributions using the C-PrOPS (COPs) profiling radiometer (Biospherical) and Ramses radiometer systems (TRIOS) (Task II.5, SeaQuester and OptiCal-Green projects).

- Determination of vertical profiles (down to 200 m) of spectral absorption and beam attenuation coefficients, as well as chlorophyll-a concentration and suspended matter (acs) (Task II.5, SeaQuester and OptiCal-Green projects).
- Characterization of biogeochemical and physical properties of suspended particles and dissolved substances in fjord waters (Tasks I.2 and II.5, SeaQuester and OptiCal-Green).
- Quantitative and qualitative determination of the composition of suspended and dissolved organic and inorganic matter based on measurements of CDOM absorption and fluorescence, salinity, temperature, chlorophyll-a concentration, and other phytoplankton pigments (Tasks I.2 and II.5, SeaQuester and OptiCal-Green projects).
- Determination of primary production values in the water column using the ^{14}C method in the polar region (Tasks I.2 and II.5, SeaQuester and OptiCal-Green projects).
- Establishment of empirical relationships between inherent and apparent optical properties of seawater and the concentration of particulate organic carbon in the fjord waters of western Spitsbergen (OptiCal-Green project).

2.3.6 Marine Chemistry and Biochemistry Department

- Determination of contamination levels of bottom sediments, waters, and suspended matter by heavy metals, organic pollutants, and radioactive isotopes in the glacial bay of the Hornsund fjord (Task II.2).
- Determination of contamination levels of benthic organisms by heavy metals, organic pollutants, and radioactive isotopes in the glacial bay of the Hornsund fjord (Task II.2).

2.4 Research tasks during Leg IIIb Longyearbyen – Longyearbyen (Kongsfjorden, Isfjorden, Magdalenefjorden)

2.4.1 Marine Ecology Department - plankton (PEP)

- Characterization of the qualitative–quantitative composition and spatial distribution patterns of zooplankton communities in Kongsfjorden and its forefield in relation to environmental conditions (Task I.5).
- Investigation of habitat and feeding preferences of twin zooplankton species characterized by different centers of distribution (in the boreal or Arctic biogeographic domains) in fjord and shelf waters (TWINS project).

2.4.2 Marine Ecology Department - plankton (PFBP)

- Assessment of the foraging resource availability for the little auk breeding in Kongsfjorden (KGF) and Magdalenefjorden (MG) using a WP2 zooplankton net (180 µm) and optical methods (LOPC, UVP) (Task I.7, LAPSE and SEAPOP III projects).
- Investigation of carotenoid variability in key Arctic zooplankton species (Calanus copepods) and its impact on diet quality and the condition of their main predators—

planktivorous SBE9/11+s (little auks)—during the breeding season in KGF and MG (Task I.7, ORANGE and ZOOM projects).

- Characterization of the spatial distribution and qualitative–quantitative composition of plankton communities in Kongsfjorden (KGF) and Isfjorden (ISF) in relation to environmental factors using both traditional methods (plankton nets, water samplers) and optical techniques (LOPC, UVP) (Task I.7; T-Trait and Bipolarity projects).

2.4.3 Marine Ecology Department - benthos

- Determination of the taxonomic composition, biomass, and abundance of macro- and meiobenthos, as well as benthic biodiversity assessed using both traditional and metagenomic methods at monitoring stations in Kongsfjorden (Task III.1).
- Determination of the taxonomic composition, biomass, and abundance of macro- and meiobenthos, and local-scale distribution patterns within Kongsfjorden, and comparison of the current community structure with data from 20 years ago (Task III.1).
- Assessment of the diversity and distribution patterns of meiofauna, with particular emphasis on Kinorhyncha, in Isfjorden and its branches, based on morphological and molecular analyses (Task III.1, DRAGONnest project).
- Determination of the taxonomic composition of megafauna and analysis of spatial distribution patterns, organism behavior, and the occurrence of traces of biological activity on the seafloor surface (Lebensspuren) in Kongsfjorden, Isfjorden, Magdalenefjorden, and Smeerenburgfjorden using video methods (a downward-looking underwater camera) (Task III.1).
- Documentation of the presence of macroalgae in selected fjords in the context of their role in the organic carbon cycle (blue carbon) in fjord systems (Task III.1).

2.4.4 Marine Dynamics Department - physical oceanography

- Investigation of thermohaline and oxygen properties, and the distribution of water masses in Kongsfjorden and in the region of the western Spitsbergen shelf (Task I.4).

2.4.5 Marine Physics Department - marine optics

- Determination of the optical properties of waters in Spitsbergen fjords in order to develop local satellite algorithms for estimating the concentrations of seawater constituents in the North Atlantic (Task II.5, SeaQuester project).
- Determination of the spectral characteristics of vertical profiles of solar irradiance attenuation in the water column and surface spectral reflectance distributions using the C-PrOPS (COPs) profiling radiometer (Biospherical) and Ramses radiometer systems (TRIOS) (Task II.5, SeaQuester and OptiCal-Green projects).
- Determination of vertical profiles (down to 200 m) of spectral absorption and beam attenuation coefficients, as well as chlorophyll-a concentration and suspended matter (acs) (Task II.5, SeaQuester and OptiCal-Green projects).

- Characterization of the biogeochemical and physical properties of suspended particles and dissolved substances in fjord waters (Tasks I.2, II.5, SeaQuester and OptiCal-Green).
- Quantitative and qualitative determination of the composition of suspended and dissolved organic and inorganic matter based on measurements of CDOM absorption and fluorescence, salinity, temperature, chlorophyll-a concentration, and other phytoplankton pigments (Tasks I.2 and II.5, SeaQuester and OptiCal-Green projects).
- Determination of primary production values in the water column using the ^{14}C method in the polar region (Tasks I.2 and II.5, SeaQuester and OptiCal-Green projects).
- Establishment of empirical relationships between inherent and apparent optical properties of seawater and the concentration of particulate organic carbon in the fjord waters of western Spitsbergen (OptiCal-Green project).

2.4.6 Marine Chemistry and Biochemistry Department

- Assessment of contamination of bottom sediments, waters, and suspended matter by heavy metals, organic pollutants, and radioactive isotopes in the glacial bays of Isfjorden and Smeerenburgfjorden (Task II.2).

2.5 Research tasks during Leg IV Longyearbyen - Longyearbyen (Isfjorden)

2.5.1 Marine Ecology Department and Climate and Ocean Research and Education Laboratory - ecology

- Implementation of the project funded by Miljøvernfond, "Coastal points," involving the repetition of coastal surveys in Isfjorden at the same locations as in 2018.
- Continuation of cooperation with Academia Sinica (Taiwan) based on a signed agreement.
- Continuation of cooperation with PGS Sopot based on a signed agreement.

2.6 Research tasks during Leg V Longyearbyen - Gdańsk

2.6.1 Marine Physics Department - marine optics

- Conducting empirical measurements of the inherent optical properties of the surface layer of seawater, the basic biogeochemical properties of optically relevant water constituents in this layer, characteristics related to the trichromatic perception of water color, spectra of remote-sensing reflectance of the sea, and depth profiles of the spectral diffuse attenuation coefficient of downwelling irradiance in the water column, in selected regions of the Atlantic Ocean (open ocean and coastal zone) (Tasks I.1 and II.5).

2.6.2 Marine Physics Department - marine acoustics

- Determination of the scattering properties of biological objects and their aggregations occurring in the water column using a split-beam echosounder, and comparison of the obtained results with measurements of the physical parameters of seawater (Task II.6).

3 General schedule of the AREX 2025 cruise

Table 3.1. General schedule of the AREX 2025 cruise

Leg	Date	Region	Cruise leader	Comments
I	1.07 - 19.07.2025	LYR-LYR (Norwegian and Greenland seas, southern Fram Strait)	Agnieszka Beszczyńska-Möller	Departure LYR 16:00
	19.07.2025	stay in LYR (logistics) crew exchange		
II	19.07 - 30.07.2025	LYR-LYR (northern Fram Strait, north of Svalbard)	Ilona Goszczko	
	30.07.2025	stay in LYR (logistics) crew exchange		
IIIa	30.07 - 12.08.2025	LYR-LYR (Hornsund)	Katarzyna Grzelak	Departure LYR 1.08.25 18:00
IIIb	12.08 - 22.08.2025	LYR-LYR (Kongsfjorden, Isfjorden, Magdalenefjord)	Katarzyna Grzelak	Leg limited to Isfjorden due to technical problems
	22.08.2025	stay in LYR (logistics) crew exchange		
IV	22.08 - 27.08.2025	LYR-LYR (Isfjorden)	Jan Marcin Węsławski	
	27.08.2025	stay in LYR (logistics) crew exchange		
V	27.08 - 08.09.2025	LYR - Gdańsk	Sławomir Woźniak	

4 AREX 2025 cruise itinerary

Time given as Local Time (CEST)

1 July	Arrival of the team in LYR at 10:00 LT. Embarkation, trip to the town. Drill alarm at 14:00. Organizational meeting at 18:30. Assignment of watch duties and discussion of the work plan. Due to an unfavorable forecast for the following day, the departure was postponed until 2 July.
2 July	Anchorage in LYR. The forecast for the Svalbard region was very unfavorable (sea state up to 8 B, waves over 3 m). A decision was made to remain at anchor until the end of the day, with a new forecast to be checked by the morning of 03 July. Two test casts were carried out in Adventfjorden. A problem occurred with the old (repaired) pylon—no communication with the CTD probe. The pylon was replaced with a new one. The deck unit was also replaced with a new one. After the replacement, the system was fully operational.
3 July	Weighed anchor at 08:00 LT. Transit to the beginning of section V2. Moderate weather conditions, 4–5 B, waves over 2 m, decreasing. Strong swell. Decision to reduce cruising speed to 5–6 knots due to strong ship rolling (at the same time, no conditions for operations if arriving earlier at the section).
4 July	Transit along section V2. Start of measurements at station V38 at 08:00 LT. Good weather, 3 B, waves 1–1.5 m, swell.
5 July	Completion of measurements on section V2 at 08:30 LT. Transit to section K. Start of measurements on section K from station K-3 at 18:20 LT. Continuation of measurements on section K. Good weather, 2–3 B, waves up to 1 m.
6 July	Continuation of measurements on section K. Stations K2 to K9. Good weather, 2–3 B, waves up to 1 m, moderate swell.
7 July	Continuation of measurements on section K. Stations K10 to K15. Deployment of the CoreArgo float after station K12 at 14:23 LT at position 75°02.776'N, 008°26.803'E. Good weather, sea state 2–3 B, waves up to 1 m, moderate swell.
8 July	Stop of measurements at station K18 due to high waves (up to 2 m) at around 12:00 LT. Storm avoidance at minimal speed in the vicinity of the station while waiting for an improvement in conditions. Decision to skip section O and proceed directly to the western end of section N.
9 July	Resumption of measurements at station K18 at 00:20 LT. Completion of measurements on section K at 03:40 LT. Transit to section N. Start of measurements at station N-15 at 14:10 LT. Good weather, 3 B, waves approx. 1 m. Continuation of measurements on section N. Stations N-15 to N-13.
10 July	Continuation of measurements on section N. Stations N-12 to N-6. Moderate weather, approx. 3–4 B, waves 1–1.5 m. Increasing wave height during the night.
11 July	Continuation of measurements on section N. Stations N-5 to N1. Good weather, approx. 2–3 B, waves 0.5–1 m.
12 July	Continuation of measurements on section N. Stations N1P to N3P. Deterioration of weather; around noon approx. 4 B, wind waves up to 1.5 m. After station N3P, measurements were interrupted due to high waves and a decision was made to enter Hornsund. Transit to Hornsund. Stop in drift at the entrance to Hansbukta beyond the sill. Transit to the anchorage in Gåshamna. Anchoring. Visit of the polar station team. Borrowing of tools for repairs on Oceania.
13 July	Weighed anchor at approx. 08:30 LT. Transit past the Polish Polar Station, return of the borrowed tools. Departure from Hornsund at approx. 10:00 LT. Transit to section N and resumption of measurements from station N5 at 10:45 LT. Completion of measurements on section N at station N4P at 13:40. Transit to section S. Good weather, 2–3 B, but with a high and increasing swell exceeding 2 m. Due to the swell, a decision was made to stay overnight in a sheltered bay at the entrance to Bellsund.
14 July	Departure to section S at approx. 09:00 LT and start of measurements at station S-2 at 10:00 LT. Strong swell, approx. 1–1.5 m, decreasing. Continuation of measurements on section S up to station S6. Good weather, 3–4 B, later approx. 3 B, moderate swell.
15 July	Continuation of measurements on section S. Stations S6 to S12. Very good weather, approx. 1–2 B, waves 0.5 m.
16 July	Continuation of measurements on section S from station S12 to S17. Good weather, approx. 3–4 B, waves 0.5–1 m. Completion of measurements on section S at ??. Transit to section Z. En route, avoidance of an ice field extending east of Z14.
17 July	Transit to section Z, avoidance of the ice field during the night. Start of measurements at station Z14 at 05:30. Continuation of measurements to station Z11. Upon reaching the position of station Z10,

	a decision was made to interrupt measurements due to high waves (over 2 m). Storm avoidance in the vicinity of Z10.
18 July	ue to persistent high waves of 2–2.5 m, at 01:30 LT a decision was made to proceed to the eastern stations of section Z. Storm avoidance was carried out until 09:00 LT in the vicinity of station Z4. Because of the continuing high waves (2–2.5 m) and a forecast indicating no possibility of resuming operations within the next 5–6 hours, a decision was made to terminate measurements on section Z and transit to LYR. Arrival in LYR at approximately 19:00 LT. Anchorage. Disembarkation of two crew members.
19 July	Anchorage in LYR. Exchange of the scientific team (departure of three persons, arrival of two persons). Arrival of two crew members. Cancellation of the flight of one scientific team member. Refueling from a bunker vessel. Berthing at the quay at 19:30 LT. Due to the postponement of the arrival of one person until 21 July, a decision was made to depart from LYR and complete section Z before returning to LYR. Very good weather, 1–2 B, sunny.
20 July	Departure from LYR at 00:00 LT. Transit to section Z and start of measurements at station Z1 at 07:00 LT. Continuation of measurements on section Z from station Z1 to Z10. Very good weather, 2–3 B, sunny, wave height <0.5 m.
21 July	Completion of measurements at station Z10 at 03:10 LT. Transit to LYR. Exchange of one scientific team member (delayed arrival). Battery replacement and LADCP calibration ashore. Departure from anchorage at 19:30 LT, with a planned arrival at section EB2 at 07:30 LT. At 20:00 LT, a meeting with the scientific team and selected ship crew (bridge and engine room) was held to present plans for the coming hours. Very good weather: 1 B, partly cloudy with light drizzle. Cruising speed 9.3 kn.
22 July	Start of measurements on section EB2 at 07:30 LT, from station EB2-1 to EB2-6. Very good weather, 1 B, wave height <0.5 m, slight to moderate swell, sunny. After stations EB2-1 and EB2-1p, a microplastic net tow was carried out (ship speed reduced to 2 kn); otherwise, transit speed was up to 6 kn due to short distances between stations. In the afternoon, the wind increased from the west to 4 kn, 2 B; overcast, with reduced ship motion.
23 July	Continuation of measurements on section EB2 from station EB2-6p to station EB2-10. Very good weather, approx. 2 B; wind W–NW, 5 kn; wave height <0.5 m; almost no ship motion; overcast. In the morning, calm conditions, 0 B, no ship motion. At 12:00 LT (at station EB2-9), the marginal ice zone became visible on the horizon. After completing station EB2-10 at 18:30 LT, a decision was made to terminate the section and move to the western part of section EX, along the ice edge. Foggy conditions. Cruising speed approx. 8 kn.
24 July	Start of measurements on section EX at 00:20 LT, from station EX8p. Good weather, 2–3 B; wave height approx. 0.5 m; no significant ship motion; overcast. To the west, the ice edge was located at a distance of 1–2 NM. At 09:00 LT, loose sea-ice floes prevented reaching the planned position of station EX6; after rerouting, the station was carried out 0.5 NM to the east, with the vessel oriented port side to the waves to allow drifting toward the SE. The next station was performed in a similar way, while subsequent stations were completed without obstacles. Wind and waves increased during the day, but conditions remained good: 3–4 B, partly cloudy, westerly wind 14 kn. Completion of measurements on section EX at 19:30 LT, followed by a plankton/microplastic net tow and the start of transit to section NB (approx. 12 h) via Smeerenburgfjorden.
25 July	Start of measurements on section NB at 08:00 LT, from station NB1. Good weather, 3–4 B; wind N–NW, 13 kn; wave height approx. 0.5 m; overcast with drizzle. Station NB6 was repeated due to missing LADCP data (CTD casts 143 and 144), with strong drift toward the S–SE. At 19:30 LT, measurements were terminated at station NB10 due to reaching an ice field drifted by NW winds. A plankton/microplastic net tow was carried out, followed by transit to section WB (approx. 40 NM).
26 July	Avoidance of the ice edge and individual ice floes; measurements began only at station WB4 (80°17.2'N) at 00:35 LT. After the station, a plankton/microplastic net tow was conducted. Good weather: 3–4 B; wave height <0.5 m; overcast; NW wind 11 kn. Completion of section WB at 06:30 LT. Transit through Smeerenburgfjorden (approx. 40 NM = 5–6 h, cruising speed 6 kn) to the beginning of section Y; start of measurements at 11:30 LT, stations Y1 to Y12.
27 July	Continuation of measurements on section Y. Completion of measurements at 01:35 LT at station Y13, just before the edge of the drifting ice field. Start of transit toward section EX, station EX9. Very good weather: 3 B; wave height <0.5 m; overcast. Straight-line distance 55 NM; with ice avoidance, estimated at up to 70 NM (approx. 10 h). Ice was drifting east of the planned station; at 11:30 LT, a decision was made to head south, bypassing the marginal ice zone, toward station EB2-11. Due to the eastward shift of the ice edge (station EB2-9p), the measurement plan was modified and a new section, EB3, was initiated, deviating toward the SW (heading 215°) from section EB2 (approximately parallel to the ice edge, at a safe maneuvering distance). Very good weather: 2 B; wind 4 kn; fog ranging from slight to dense near the ice edge; partly cloudy.

28 July	Continuation of measurements on section EB3, stations from EB3-4 to EB3-10. Good to very good weather: 4 B decreasing to 3 B; swell from 08:00 LT; overcast. At 12:00 LT, the distance to the ice edge (visible on the horizon) was approximately 1 NM. After the final CTD station, a plankton/microplastic net tow was conducted. Completion of measurements at 16:30 LT. Transit toward Isfjorden, with a planned surface plankton/microplastic net tow before entering the fjord (around 05:00 LT).
29 July	Transit to Isfjorden. At 05:00 LT, plankton/microplastic net tow. At 10:00 LT, anchoring in the vicinity of Bjørndalen. At 13:30 LT, relocation to an anchorage closer to Longyearbyen. From 14:15 LT, shore transport by dinghy was available, with return scheduled for 16:00 LT or after the planned refueling from the bunker vessel at 18:00 LT. Completion of refueling at 20:15 LT and return of the team on board (by dinghy). Very good weather, 2 B, wave height <0.5 m.
30 July	Anchorage. Disembarkation of five crew members, with the first transfer to the airport at 11:20 LT and the next at 14:30 LT. Arrival of nine persons and handover of duties to the leader of Leg III of the cruise. Berthing at the quay at 22:00 LT (until 06:15 LT on 31 July) to take on freshwater and load equipment. The chief engineer began the winch engine replacement, first removing the damaged unit and then installing the new one. Repair works continued until morning.
31 July	Winch engine repair works continued. At approximately 14:00 LT, it became clear that additional parts were required, as the engine failure had damaged the entire electrical circuit. Attempts were undertaken to obtain the necessary components from local shops in Longyearbyen. In the evening, the chief engineer suspended the work—the failure proved too complex to be resolved without the assistance of a qualified electrician. The bridge contacted the nearby vessel *Nordsel* to request assistance.
1 August	At 08:00 LT, the electrician was picked up from *Nordsel*. At approximately 12:00 LT, another visit to town was made to obtain additional electrical components. At around 16:00 LT, the repair was successfully completed: the starboard-side system was restored, and the port-side system—previously operational but also affected by the failure—was repaired. The electrician was returned, and at approximately 18:00 LT the vessel departed and transited toward Hornsund. During the transit, weather was moderately good, with strong winds of 4–5 B.
2 August	At 06:20 LT, CTD profiling began along section Rm1–Rm6. At each station, a full-depth CTD profile from the surface to the bottom was carried out. From 10:40 LT, plankton and optical studies were conducted at station H1/AUK1. During preparation, it was discovered that the LOPC was not functioning. Contact was made with Emilia Trudnowska, responsible for the LOPC, and a decision was taken to perform three (instead of one) up-and-down UVP camera profiles in the 0–50 m layer at stations originally planned for LOPC measurements. In addition, intermediate stations (hereafter designated with a "p") were added on transects where the LOPC had been planned for towing. After completing sampling and optical measurements, seabed imaging was conducted. Due to unfavorable weather forecasts and a short weather window in the Hornsund forefield, a decision was made to carry out work on only two (instead of four) key transects. Transit to station AUK13 followed, and at 17:30 LT plankton and optical studies began at the "little auk foraging ground." Zooplankton sampling continued at subsequent stations along the transect: AUK14, AUK15, and AUK16. Between these stations, additional intermediate stations (AUK13p, AUK14p, and AUK15p) were established, where CTD and UVP profiles were conducted. Completion of work at station AUK16 at 01:30 LT. Due to persistently unfavorable forecasts, a decision was made not to continue to the westernmost station of the transect, H7/AUK18. Wind 5 B, sea state 2–3.
3 August	At 03:15 LT, work began at station N4, designated as a potential future monitoring site within the ADBO network. CTD profiling, zooplankton net tows, and optical measurements were conducted. Equipment for primary production (PP) measurements was deployed. Completion of work at 10:30 LT, followed by transit to the next "little auk" transect. At 12:15 LT, work began at station AUK9, where plankton studies were carried out. Plankton sampling and optical measurements continued at stations AUK10 and AUK11/H6, where benthic samples were also collected. At the final station of the transect, AUK12, very strong winds and currents prevented UVP profiling. Water sampling with the rosette was also not completed, as the hydraulic hose of the starboard-side crane ruptured, causing hydraulic fluid leakage and contaminating the WP2 plankton net. Completion of work at the station at 02:30 LT. Strong winds and waves exceeding 1.5 m.
4 August	After 03:00 LT, the vessel entered Gåshamna and remained at anchor until 08:00 LT. Increasing wind gusts and wave conditions prevented the planned hydrological profiling along the fjord axis (R0–R13) scheduled for that day. Given the prevailing conditions (winds 6–8 B), a decision was made to proceed further into the fjord. At 10:30 LT, work began in Sammarinvågen at benthic stations along transect E, sequentially at stations E6, E5, E4, E1, and E2. Completion of work at 00:40 LT, followed by transit to Brepollen.

5 August	Ok 02:30 LT, start of CTD and UVP measurements on the hydrographic section from station R13 toward the fjord mouth. Weather conditions (wind up to 9 B) allowed work to continue only as far as station R4; at R4, UVP profiles were not carried out due to high waves and strong current. Completion of work at approximately 07:30 LT and return into Brepollen. At 11:00 LT, start of work at station HB1-opt (later designated HB0). Due to its proximity to the glacier, a full set of biological–optical–hydrographic investigations was conducted. Benthic samples were collected, a Nemisto core was taken, and zooplankton samples were collected. Optical measurements were then carried out at station R13. Plankton and benthos sampling and optical measurements continued at station H3. In the evening, benthic samples were collected at the monitoring station HB1. Completion of work at 23:40 LT. A decision was made to check weather conditions outside Brepollen.
6 August	Slight improvement in weather conditions allowed work to continue outside Brepollen. At 00:00 LT, optical measurements were carried out at station R9, followed by zooplankton sampling at the monitoring station H4. Due to persistent ship motion, UVP measurements were not conducted. From 03:00 to 05:30 LT, work was completed at the remaining stations of the hydrographic section (R3, R2, R1, and R0), CTD only (no UVP due to weather conditions). Transit into Burgerbukta to gain shelter from the wind. Four stations were planned at increasing distance from the glacier front (BR0 to BR3). At BR0 and BR1, CTD profiles were carried out and the camera was deployed; at BR2, no work could be completed due to increasing wind and inability to hold anchor. Station BR3 was ultimately cancelled. Transit back to Brepollen to shelter from the wind. At 14:40 LT, start of benthic sampling at stations along transect G, in the sequence G5, G4, G2, and G1. Completion of work at 22:10 LT and transit to Adriabukta for the night. Anchorage. Wind 6–7 B, gusting to 9 B.
7 August	In the morning, an attempt was made to conduct work at the monitoring station HB2. However, the rope anchor did not hold and, due to persistently unfavorable weather conditions, the vessel returned into Brepollen. Around noon, benthic sampling began at stations along transect F, sequentially at F4, F1, F2, and F3. Strong drift at the last station. Difficulties with reliable anchoring; in many cases, holding position at the station took more time than the work itself. Completion of work at 20:00 LT. Overnight anchorage in Adriabukta.
8 August	At 04:00 LT, start of work at station E3/R8. Optical measurements were carried out and benthic samples were collected. Further work continued at station D3 and at the monitoring benthic station HB2. At 11:30 LT, work began at stations in the glacial bay Körberbukta (HK1, HK2, HK3). Seabed imaging was conducted, macrofauna samples were collected, and sediment samples were taken for biogeochemical analyses. Due to the stony seabed, a Nemisto core was not collected (successful only at station HK2). Each station concluded with a dredge haul. Completion of work at 20:00 LT. Work continued. At 21:15 LT, zooplankton sampling and optical measurements began at the monitoring station H2, followed by an attempt to locate the mooring in Hansbukta. However, due to excessive wave conditions and inability to approach closer to the glacier, the attempt was unsuccessful. At 00:30 LT, work began at the monitoring benthic station HB3.
9 August	After 03:00 LT, the vessel entered Gåshamna and anchored in the vicinity of station C4. At 09:30 LT, work began at this station, but due to the stony seabed it was not possible to collect benthic samples. Transit to station C3; however, anchoring was again unsuccessful. Transit into Burgerbukta to shelter from the wind and completion of CTD profiles and seabed imaging at stations not completed previously, i.e., BR2 and BR3. From 15:20 LT, continuation of benthic work at station D1. Weather conditions still did not allow departure and operations in the central or outer fjord. Return to Burgerbukta once more, this time into the eastern branch. From 18:30 to 00:00 LT, CTD profiling and seabed imaging were carried out at stations BRE00, BRE0, BRE1, BRE2, and BRE3. Continuation of work on transects D and C.
10 August	From 01:00 LT, benthic work at station D4, and from 03:10 LT continuation at station C3. Unsuccessful attempts to collect three Van Veen grabs (two deployments were successful). At 05:10 LT, work at the combined optical–benthic station C2/R5, and from 08:00 LT benthic sampling at station C1. Transit to station B5; however, after nearly 1.5 hours of anchoring attempts, a decision was made to move to the next combined benthic–optical station, B3/R3. From 13:30 LT, benthic work at station B1. Due to the very stony seabed, box-core sampling was not possible. Station B1 is located near the Polish Polar Station and Hansbukta. At approximately 16:00 LT two members of the University of Gdańsk ornithological team were picked up from the Hornsund station and embarked. Return to station B5, deployment of the chain anchor, and benthic sampling. Due to unfavorable weather conditions—persistently strong winds (gusting to 8–9 B) and high waves—it was not possible to continue work at the remaining planned stations (transect A at the fjord entrance). A decision was made to terminate operations in Hornsund. At 19:00 LT, departure from Hornsund and course set for Longyearbyen.
11 August	At approximately 08:00 LT, arrival in Longyearbyen and anchorage. At approximately 12:00 LT, the ornithologists disembarked and were transferred to the airport. Minor repairs were carried out,

	including repairs to the davits on the starboard and port sides. Anchorage maintained until the next day.
12 August	From 12:00 to 18:00 LT, alongside at the quay. At 12:30 LT, disembarkation of one scientist, and at 15:00 LT embarkation of a new research team member. End of Leg IIIa. The planned departure from the quay at 18:00 LT was postponed to 19:30 LT.
13 August	At 11:00 LT, disembarkation of the cook and transfer ashore. At 11:30 LT, weighed anchor. Decision to remain in Isfjorden while awaiting a replacement cook. From 14:30 LT, work was carried out in the glacial bay Borebukta at stations IB1, IB2, and IB3. At each station, seabed imaging was conducted, macrofauna samples were collected, and sediment samples were taken for biogeochemical analyses. Completion of work at approximately 21:00 LT.
14 August	At 08:00 LT, work began at station ISA. Plankton samples were collected, water was taken for phytoplankton analyses, and a vertical UVP profile (0–50 m) was conducted. Station ISA is the starting point of the ISA–ISF3–BAB transect, where LOPC measurements are conducted annually. Due to the instrument failure, replacement measurements were continued using UVP (up-and-down profiles in the 0–50 m layer) at the main stations of the transect and at additional mid-point stations, i.e., ISA-p and ISF3_p. At station ISF3, in addition to plankton sampling, optical measurements were also conducted. At station BAB, seabed imaging was additionally performed and samples were collected within pilot studies for the TWINS BIS project. Completion of work at approximately 23:00 LT. Overnight anchorage in Adolfbukta.
15 August	From 06:00 LT, benthic sampling at stations IA1 and IA2 and at stations IP1 and IB1_S; at the latter, a Nemisto core was also collected. At approximately 15:00 LT, completion of work and course set for Longyearbyen. At approximately 18:00 LT, embarkation of the new cook. In the meantime, a temperature sensor of one of ship's generators was damaged. For safety reasons, continuation of the cruise was not possible until the sensor was repaired. As the failure occurred in the afternoon when all supply stores in Longyearbyen were already closed, any potential repair had to be postponed until Monday, 18 August.
16 August	From 08:30 LT, work at stations IY1, IY2, and IY3 in the glacial bay Ymerbukta. At 18:00 LT, start of optical measurements and zooplankton sampling at station ISK for the TWINS BIS project. From 22:00 to 23:00 LT, benthic work at station T4F for the DRAGONnest project.
17 August	Entry into Dicksonfjorden and, from 08:00 LT, benthic work at stations along the fjord axis: ID1, IDS, and ID6. From 16:00 LT, work in Ekmanfjorden at the station located at the fjord entrance (IE3) and at the mid-fjord station IE2. Work was interrupted at IE2 due to the presence of ice; therefore, the inner station IE1 was not completed. To maximize the available time, the scientific team decided to conduct optical measurements at additional stations: Moni6, Moni5, and Moni3. Work continued until 05:00 LT.
18 August	At approximately 07:00 LT, anchorage in Longyearbyen. Attempts to purchase parts to repair the damaged sensor in the generator not successful, the necessary parts had to be delivered from Poland. The broken generator prevented continuation of the cruise outside Isfjorden, meaning Leg IIIb could not be implemented. A meeting of the scientific team was held to discuss the plan for the remaining days and the possibility of carrying out additional studies of interest to most teams. A station with 24-hour monitoring of the water column was proposed, involving the optical and plankton teams. Due to very unfavorable weather forecasts for virtually the entire Isfjorden, a decision was made to seek shelter deeper in the fjord and carry out measurements at station BAB. This location was also optimal for the benthos team, for the planned project related to jellyfish and their role in carbon transfer to bottom sediments.
19 August	At 00:00 LT, water-column monitoring was initiated at station BAB (designated BABA for the purposes of this project). CTD and UVP profiles were carried out, optical measurements were conducted, seabed imaging was performed, and zooplankton samples were collected. CTD and UVP measurements were conducted hourly over the following 24 hours, while optical measurements and zooplankton sampling were carried out every 4 hours, i.e., at 04:00, 08:00, 12:00, 16:00, and 20:00 LT. Jellyfish collected from a dinghy in the vicinity of the vessel.
20 August	At 08:30 LT, dredging was conducted to supplement material for the jellyfish project. At 10:30 LT, benthic sampling began at station SBI1 and continued at stations SBI2 and SBI3. Completion of work at 20:00 LT. Overnight anchorage in Gipsvika.
21 August	At 08:00 LT, seabed imaging (camera only, without CTD) was conducted in the Gipsvika area. At 09:30 LT, work began at the final benthic station of this stage, SBI4. Due to weather conditions, the vessel proceeded into Skansbukta, where from 15:00 LT cleaning of the ship and securing of equipment began. At 17:30 LT, the vessel proceeded to the roadstead in the vicinity of Longyearbyen.

22 August	At 10:15 LT, berthing alongside the quay and disembarkation of the scientific team, marking the end of leg IIIb. At 16:00 LT, embarkation of the Leg IIIc scientific team on board. At 18:00 LT, departure toward Isfjord Radio.
23 August	Research activities at Isfjord Radio and Trygghamna, followed by transit to Ekmanfjorden and anchoring in Dicksonfjorden.
24 August	Research activities in Dicksonfjorden, followed by transit to Billefjorden and anchoring in Tempelfjorden.
25 August	Research activities in Tempelfjorden, followed by transit to Grumantbyen and Colesbukta.
26 August	At 06:00 LT, arrival in Longyearbyen. At 14:00 LT, disembarkation of the Leg IV scientific team.
27 August	Preparations for the start of Stage V of the AREX2025 cruise in the port of Longyearbyen; departure at 18:00 LT.
28 August	From 09:00 to 10:05 UTC, optical measurements and CTD profiling at station M4 followed by laboratory work and measurements in the shipboard laboratory.
29 August	From 09:00 to 09:55 UTC, optical measurements and CTD profiling at station V12. From 10:00 to 14:00 UTC, calibration of acoustic equipment at position V12, followed by laboratory work and measurements.
30 August	Due to strong winds and high sea state, measurements at the planned station were cancelled for that day; laboratory work continued in the wet lab (calibration of laboratory bottle volumes).
31 August	From 09:00 to 09:32 UTC, optical measurements and CTD profiling at station IO10bis. From 10:39 to 15:20 UTC, acoustic measurements and CTD profiling along the transect from position IO10bis to position IO10 followed by laboratory work.
1 September	From 09:00 to 09:38 UTC, optical measurements and CTD profiling at station IO09bis. From 09:40 to 14:37 UTC, acoustic measurements and CTD profiling along the transect from position IO09bis to position IO09, followed by laboratory work.
2 September	From 09:05 to 09:49 UTC, optical measurements and CTD profiling at station IO08bis. From 10:43 to 15:19 UTC, acoustic measurements along the transect from position IO08bis to position IO08, followed by laboratory work.
3 September	From 09:05 to 09:50 UTC, optical measurements and CTD profiling at station IO07bis. From 10:42 to 15:03 UTC, acoustic measurements along the transect from position IO07bis to position IO07, followed by laboratory work.
4 September	Due to very strong winds and high sea state, measurements at the previously planned station IO06 were cancelled for that day.
5 September	From 09:05 to 09:55 UTC, optical measurements and CTD profiling at station IO05bis. From 10:43 to 15:15 UTC, acoustic measurements along the transect from position IO05bis to position IO05, followed by laboratory work.
6 September	From 09:02 to 09:40 UTC, optical measurements and CTD profiling at station IO04. From 10:05 to 14:18 UTC, acoustic measurements along the transect from position IO04 to position IO04bis, followed by laboratory work. At 15:00 UTC, after completion of all measurements, the vessel set course for the return transit to the port of Gdańsk.
7 September	Transit toward the port of Gdańsk.
8 September	Transit toward the port of Gdańsk; at approximately 20:00 LT, the vessel berthed at the quay in the port of Gdańsk.

5 Mesurements and sampling program during AREX 2025 Leg I-II

5.1 General information about Leg I and II

Due to the planned (but ultimately unrealized) cruise of RV *Oceania* to the Azores, the oceanic Leg I of the AREX2025 cruise started exceptionally in Longyearbyen, Svalbard, instead of the standard departure from Tromsø along the section at the entrance to the Barents Sea (V1). For this reason, and because of the reduced working time allocated to the oceanic legs in 2025, section V1 was not carried out. Owing to unfavorable weather conditions, the departure of the vessel from LYR was also delayed by more than two days. During Leg I, measurements were conducted along the standard sections V2, K, N, and Z, while sections V1, H, and O were omitted due to insufficient available measurement time. The deterioration of weather conditions during work on section N additionally forced an interruption of measurements and sheltering in Hornsund, resulting in the loss of a further 1.5 days of measurement time.

During the oceanic Leg II, unfavorable ice conditions in the northern part of Fram Strait (eastward displacement of the ice edge, followed later in the cruise by a change in wind direction and a southward drift of the ice field) necessitated a significant shortening of the standard sections EB2, EX, Y, WB, and NB. The two northernmost sections north of Svalbard were limited to the shelf and upper continental slope zone (NB) or to the shelf only (WB). For this reason, an additional meridional section, EB3, was carried out on the return to LYR between sections EB2 and Z, following the ice edge. Weather conditions during Leg II were predominantly good to very good.

5.2 Detailed description of oceanographic measurements

Description of measured parameters and collected samples

The distribution of measurement stations during the oceanic leg of the AREX2025 cruise (Legs I and II) is shown in Fig. 5.1. During the oceanic legs of the AREX2025 cruise, hydrographic measurements—including pressure, temperature, salinity, dissolved oxygen concentration in seawater, and fluorescence (as a proxy for chlorophyll *a* concentration)—were carried out at 175 CTD stations along full-depth profiles, comprising 106 CTD stations during Leg I and 69 stations during Leg II. The list of stations together with a description of the measurements is presented in Table 5.2.

At 16 CTD stations, water samples for nutrient analysis were collected at standard depth levels of 2, 10, 25, 50, 75, 100, 150, 200, 400, 750, and 1000 m (depending on bottom depth). At six selected deep stations, water samples for salinity calibration were collected from two depth levels within the deep, homogeneous water layer.

Description of methods and measuring equipment

Hydrographic measurements were carried out using a Sea-Bird CTD 9/11+ measuring system. The primary instrument was the "new" Sea-Bird CTD 9/11+ probe, mounted on a Sea-Bird SBE32 rosette sampler equipped with 12 Niskin bottles of 12 L capacity each. The Sea-Bird CTD 9/11+ probe was fitted with a dual (new) set of temperature and conductivity sensors (first temperature sensor: SBE3 SN4670; first conductivity sensor: SBE4 SN3342; second temperature sensor: SBE3 SN3342; second conductivity sensor: SBE4 SN3322) and a Digiquartz 410K-105 pressure sensor (SN100967).

The most recent calibration of the temperature and conductivity sensors was carried out in November/December 2024, while the pressure sensor was calibrated in May 2024. In addition, the CTD probe was equipped with a dissolved oxygen sensor (standard Sea-Bird SBE43 SN1620, calibrated in January 2025). The CTD was also connected to a SeaPoint fluorometer (SN2935) and a new Benthos PSA-916 altimeter. A mechanical bottom contact sensor (a weight on an approximately 5 m line) was also used; however, its performance was not always reliable (e.g., during strong ship motion or intense vessel drift). The specifications of the oceanographic sensors of the SBE CTD 9/11+ system used throughout the AREX2025 cruise are provided in Table 5.1.

Table 5.1 Sensor specifications used in the CTD 9/11+ system during the AREX 2024 cruise.

CTD system SBE9/11+ (new body, new CT sensors)		
Sensor	**SN**	**Calibration date**
Pressure Digiquartz	100967	8-May-24
Condictivity SBE4	3342 3322	03-Dec-24 03-Dec-24
Temperature SBE3	4670 2937	26-Nov-24 26-Nov-24
Oxygen SBE43	1620	08-Jan-25
Fluorometer Seapoint	2935	-

Teledyne RDI WorkHorse 300 kHz LADCP (SN 21589) was installed in a downward-looking configuration (with the acoustic transducers facing downward) and was used at every CTD station. The collected hydrographic data were stored on the CTD acquisition computer, with a backup copy saved on the same machine. Preliminary data processing was carried out on an ongoing basis, whereas the final datasets will become available after salinity measurements of the collected water samples and post-cruise calibration.

LADCP data were recorded in individual files and retrieved directly from the instrument memory after each station. Throughout the entire cruise, measurements of ocean currents in the upper ~200 m layer were also conducted underway using a vessel-mounted Acoustic Doppler Current Profiler (VM-ADCP), a Teledyne RDI Ocean Surveyor (SN 1819) operating at 150 kHz. The VM-ADCP measurements were performed in BroadBand mode with vertical bin averaging over 8 m intervals.

The CTD, VM-ADCP, and LADCP data collected during the AREX2025 cruise were subjected to standard processing procedures in accordance with the “best practice” recommendations for the respective instruments. The processed datasets, converted to NetCDF format and containing a complete set of metadata for each measurement as well as a common DOI for the combined dataset from Legs I and II of the AREX2025 cruise, will be archived in the ODIS eCUDO data repository and made publicly available after the embargo period.

During Leg I, two ARGO profiling floats were also deployed along section K near 75°N. One Core Argo float (measuring pressure, temperature, salinity, and dissolved oxygen) was deployed within the core of Atlantic Water (at 15°26’E), while the second Core Argo float was deployed in the outer (western) branch of the Atlantic Water flow (at 8°30’E). Each float deployment was preceded by a CTD cast at the deployment site to provide reference data.

Table 5.2 List of measurement stations during Legs II and III of the AREX2024 cruise. The 'CTD-LADCP' or 'CTD' measurement indicates measurements using the SBE9/11+ 9/11+ probe (with or without the LADCP mounted on the rosette, respectively).

CTD file	Station	Water depth (m)	Date	Time UTC	Lat (deg min N)	Lon (deg min E)	Measurement and sampling
AR25_001	**T1**	70	02.07.25	13:20	78 14.051	15 36.629	CTD-LADCP, CTD carousel (all bottles)
AR25_002	**T2**	70	02.07.25	14:05	78 14.059	15 36.683	CTD-LADCP, CTD carousel (all bottles)
AR24_003	**V38**	28	04.07.25	6:54	76 23.952	16 36.752	CTD-LADCP, CTD carousel nutrients (2,10,25)
AR24_004	**V37**	55	04.07.25	8:14	76 21.096	16 44.654	CTD-LADCP
AR24_005	**V36**	105	04.07.25	8:58	76 18.965	16 47.174	CTD-LADCP
AR24_006	**V35**	215	04.07.25	10:00	76 14.480	16 50.494	CTD-LADCP
AR24_007	**V34**	284	04.07.25	11:31	76 07.500	17 00.180	CTD-LADCP
AR24_008	**V33**	315	04.07.25	14:28	75 58.984	17 07.981	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,310)
AR24_009	**V32**	289	04.07.25	16:19	75 50.030	17 20.107	CTD-LADCP
AR24_010	**V31**	208	04.07.25	17:46	75 42.025	17 32.977	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200)
AR24_011	**V30**	131	04.07.25	20:41	75 31.854	17 43.320	CTD-LADCP
AR24_012	**V29**	102	04.07.25	22:12	75 23.036	17 55.177	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100)
AR24_013	**V28**	60	05.07.25	0:13	75 16.063	18 01.378	CTD-LADCP
AR24_014	**V27**	69	05.07.25	1:35	75 06.006	18 11.443	CTD-LADCP
AR24_015	**V26**	69	05.07.25	2:57	74 56.938	18 24.944	CTD-LADCP
AR24_016	**V25**	196	05.07.25	3:55	74 52.009	18 29.856	CTD-LADCP
AR24_017	**V24**	225	05.07.25	5:07	74 47.056	18 34.504	CTD-LADCP
AR24_018	**V23**	100	05.07.25	6:10	74 41.968	18 39.966	CTD-LADCP
AR24_019	**V22**	67	05.07.25	7:18	74 36.997	18 45.192	CTD-LADCP
AR24_020	**V21**	24	05.07.25	8:18	74 31.985	18 53.165	CTD-LADCP
AR24_021	**K-3**	151	05.07.25	16:25	75 00.023	17 59.899	CTD-LADCP
AR24_022	**K-2**	115	05.07.25	18:28	74 59.995	17 30.092	CTD-LADCP
AR24_023	**K-1**	127	05.07.25	19:50	75 00.084	17 00.143	CTD-LADCP
AR24_024	**K0**	224	05.07.25	21:17	74 59.976	16 30.233	CTD-LADCP
AR24_025	**K1**	216	05.07.25	23:23	75 00.006	16 05.048	CTD-LADCP
AR24_026	**K2**	336	06.07.25	0:28	75 00.036	15 46.950	CTD-LADCP
AR24_027	**K3**	808	06.07.25	1:45	74 59.987	15 25.565	CTD-LADCP
AR24_028	**K4**	1094	06.07.25	3:50	75 00.043	15 00.036	CTD-LADCP
AR24_029	**K5**	1510	06.07.25	9:57	75 00.000	14 22.093	CTD-LADCP

AR24_030	**K6**	1800	06.07.25	12:23	74 59.944	13 45.068	CTD-LADCP
AR24_031	**K7**	1975	06.07.25	14:59	74 59.970	13 11.054	CTD-LADCP
AR24_032	**K8**	2128	06.07.25	17:53	74 59.962	12 33.072	CTD-LADCP
AR24_033	**K9**	2345	06.07.25	21:48	75 00.029	11 38.011	CTD-LADCP
AR24_034	**K10**	2495	07.07.25	2:09	75 00.016	10. 25.070	CTD-LADCP
AR24_035	**K11**	2595	07.07.25	6:10	75 00.011	09 09.743	CTD-LADCP
AR24_036	**K12**	2688	07.07.25	9:47	75 00.119	08 29.818	CTD-LADCP
AR24_037	**K13**	2184	07.07.25	14:29	74 59.929	07 38.984	CTD-LADCP
AR24_038	**K14**	2015	07.07.25	17:16	74 59.978	06 49.782	CTD-LADCP
AR24_039	**K15**	2830	07.07.25	20:30	74 59.963	06 00.017	CTD-LADCP
AR24_040	**K16**	3032	08.07.25	0:40	74 59.941	04 59.785	CTD-LADCP
AR24_041	**K17**	3061	08.07.25	5:38	74 59.948	03 59.924	CTD-LADCP
AR24_042	**K18**	2476	08.07.25	22:28	75 00.036	02 59.491	CTD-LADCP
AR24_043	**N-15**	3146	09.07.25	12:05	76 29.930	00 00.103	CTD-LADCP
AR24_044	**N-14**	3185	09.07.25	16:15	76 29.964	00 59.952	CTD
AR24_045	**N-13**	3196	09.07.25	19:15	76 29.956	01 59.900	CTD-LADCP
AR24_046	**N-12**	2738	10.07.25	0:04	76 29.754	02 59.363	CTD-LADCP
AR24_047	**N-11**	2473	10.07.25	4:26	76 29.975	03 59.958	CTD-LADCP
AR24_048	**N-10**	2369	10.07.25	8:00	76 29.946	04 58.957	CTD-LADCP
AR24_049	**N-9**	2535	10.07.25	10:56	76 29.905	05 29.900	CTD-LADCP
AR24_050	**N-8**	2498	10.07.25	13:58	76 30.016	06 00.116	CTD-LADCP
AR24_051	**N-7**	2543	10.07.25	17:09	76 30.061	06 30.337	CTD-LADCP
AR24_052	**N-6**	2801	10.07.25	20:56	76 29.864	06 59.918	CTD-LADCP
AR24_053	**N-5**	2480	11.07.25	0:47	76 29.868	07 29.292	CTD-LADCP
AR24_054	**N-4**	2003	11.07.25	4:10	76 29.874	07 59.768	CTD-LADCP
AR24_055	**N-3**	2255	11.07.25	6:55	76 29.749	08 29.500	CTD-LADCP
AR24_056	**N-2**	2252	11.07.25	9:58	76 29.928	08 59.893	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,750, 1000,1000)
AR24_057	**N-1**	2207	11.07.25	13:40	76 29.942	10 00.511	CTD-LADCP
AR24_058	**N0**	2088	11.07.25	17:11	76 29.960	10 59.905	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,750, 1000)
AR24_059	**N0P**	2003	11.07.25	20:08	76 29.999	11 29.944	CTD-LADCP
AR24_060	**N1**	1886	11.07.25	22:53	76 30.044	12 00.080	CTD-LADCP
AR24_061	**N1P**	1731	12.07.25	1:20	76 30.014	12 29.099	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,750, 1000)
AR24_062	**N2**	1525	12.07.25	3:55	76 30.005	13 00.097	CTD-LADCP
AR24_063	**N2P**	1240	12.07.25	6:11	76 30.088	13 29.876	CTD-LADCP
AR24_064	**N3**	710	12.07.25	8:34	76 30.192	14 00.660	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,637)
AR24_065	**N3PP**	395	12.07.25	9:57	76 30.020	14 11.810	CTD-LADCP
AR24_066	**N3P**	223	12.07.25	11:07	76 29.920	14 29.609	CTD-LADCP
AR24_067	**N5**	55	13.07.25	12:45	76 29.944	15 59.708	CTD-LADCP
AR24_068	**N4P**	141	13.07.25	13:54	76 29.833	15 30.122	CTD-LADCP
AR24_069	**N4P**	158	13.07.25	15:13	76 29.999	15 00.011	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,155)
AR24_070	**S-2**	130	14.07.25	12:04	77 37.024	14 29.728	CTD-LADCP
AR24_071	**S-1**	137	14.07.25	13:17	77 35.993	14 00.011	CTD-LADCP
AR24_072	**S0**	140	14.07.25	14:31	77 35.009	13 30.103	CTD-LADCP
AR24_073	**S1**	131	14.07.25	16:05	77 33.965	13 00.102	CTD-LADCP
AR24_074	**S2**	94	14.07.25	17:29	77 32.989	12 30.134	CTD-LADCP
AR24_075	**S3**	173	14.07.25	18:41	77 32.107	11 59.612	CTD-LADCP
AR24_076	**S4**	278	14.07.25	20:24	77 31.111	11 30.104	CTD-LADCP
AR24_077	**S5**	686	14.07.25	21:37	77 30.066	10 59.808	CTD-LADCP
AR24_078	**S6**	1244	14.07.25	23:13	77 29.068	10 29.512	CTD-LADCP

AR24_079	**S7**	1576	15.07.25	1:20	77 27.871	10 00.110	CTD-LADCP
AR24_080	**S7P**	1897	15.07.25	3:47	77 27.027	09 29.833	CTD-LADCP
AR24_081	**S8**	2051	15.07.25	6:32	77 26.030	08 59.604	CTD-LADCP
AR24_082	**S8P**	1299	15.07.25	9:30	77 25.045	08 29.638	CTD-LADCP
AR24_083	**S9**	2306	15.07.25	11:27	77 23.982	08 00.055	CTD-LADCP
AR24_084	**S9P**	3600	15.07.25	14:07	77 22.955	07 29.860	CTD-LADCP, CTD carousel salinity (3200, 3400)
AR24_085	**S10**	2672	15.07.25	18:07	77 21.970	07 00.083	CTD-LADCP, CTD carousel salinity (2300, 2500)
AR24_086	**S11**	2111	15.07.25	21:08	77 21.032	06 30.270	CTD-LADCP - cast not recorded
AR24_087	**S12**	2563	15.07.25	23:44	77 20.111	05 59.846	CTD-LADCP
AR24_088	**S13**	2390	16.07.25	3:16	77 18.077	05 00.011	CTD-LADCP
AR24_089	**S14**	2398	16.07.25	6:15	77 17.057	04 30.095	CTD-LADCP
AR24_090	**S15**	2465	16.07.25	9:21	77 16.058	04 00.223	CTD-LADCP
AR24_091	**S16**	2881	16.07.25	13:43	77 13.901	02 57.617	CTD-LADCP
AR24_092	**S17**	3175	16.07.25	17:30	77 12.036	01 59.714	CTD-LADCP, CTD carousel salinity (2850, 3050)
AR24_093	**Z14**	3058	17.07.25	3:45	78 02.992	01 29.870	CTD-LADCP, CTD carousel salinity (2700, 2900)
AR24_094	**Z13**	2992	17.07.25	8:16	78 03.750	02 49.796	CTD-LADCP
AR24_095	**Z12**	2832	17.07.25	12:36	78 05.108	04 00.282	CTD-LADCP
AR24_096	**Z11**	2424	17.07.25	16:19	78 05.506	05 00.026	CTD-LADCP
AR24_097	**Z1**	257	20.07.25	5:08	78 10.505	10 59.990	CTD-LADCP
AR24_098	**Z2**		20.07.25	6:57	78 10.051	09 59.744	CTD-LADCP
AR24_099	**Z3**	262	20.07.25	8:37	78 09.850	09 29.951	CTD-LADCP
AR24_100	**Z4**	697	20.07.25	9:18	78 09.625	09 14.884	CTD-LADCP
AR24_101	**Z5**	1091	20.07.25	10:30	78 09.420	09 00.016	CTD-LADCP
AR24_102	**Z6**	1550	20.07.25	12:11	78 08.738	08 39.983	CTD-LADCP
AR24_103	**Z7**	2167	20.07.25	14:24	78 08.411	08 10.003	CTD-LADCP
AR24_104	**Z8**	3441	20.07.25	17:00	78 07.812	07 29.905	CTD-LADCP, CTD carousel salinity (3000, 3200 m)
AR24_105	**Z9**	2242	20.07.25	20:46	78 06.962	06 39.888	CTD-LADCP
AR24_106	**Z10**	2473	20.07.25	23:34	78 06.130	05 50.390	CTD-LADCP
AR24_107	**EB2-1**	203	22.07.25	5:52	78 49.912	9 15.826	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,199), WP net
AR24_108	**EB2-1P**	212	22.07.25	7:24	78 50.047	9 1.163	CTD-LADCP
AR24_109	**EB2-2**	221	22.07.25	8:18	78 50.054	8 46.127	CTD-LADCP
AR24_110	**EB2-2P**	377	22.07.25	9:13	78 50.063	8 36.142	CTD-LADCP
AR24_111	**EB2-3**	647	22.07.25	10:16	78 50.049	8 25.997	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400, 643), WP net
AR24_112	**EB2-3P**	813	22.07.25	12:11	78 49.924	8 16.522	CTD-LADCP
AR24_113	**EB2-4**	936	22.07.25	13:38	78 50.024	8 6.409	CTD-LADCP
AR24_114	**EB2-4P**	1045	22.07.25	15:20	78 49.932	7 51.488	CTD-LADCP
AR24_115	**EB2-5**	1090	22.07.25	16:48	78 49.953	7 36.482	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,750,1000), WP net
AR24_116	**EB2-5P**	1183	22.07.25	19:01	78 49.936	7 21.650	CTD-LADCP
AR24_117	**EB2-6**	1335	22.07.25	20:29	78 50.086	7 6.191	CTD-LADCP
AR24_118	**EB2-6p**	1537	22.07.25	22:12	78 50.083	6 52.331	CTD-LADCP
AR24_119	**EB2-7**	1726	23.07.25	0:06	78 50.051	6 40.165	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,750,1000)
AR24_120	**EB2-7P**	2019	23.07.25	2:10	78 50.048	6 24.898	CTD-LADCP
AR24_121	**EB2-8**	2294	23.07.25	4:23	78 50.033	6 10.076	CTD-LADCP
AR24_122	**EB2-8P**	2447	23.07.25	6:42	78 50.062	5 55.122	CTD-LADCP
AR24_123	**EB2-9**	2522	23.07.25	9:24	78 49.903	5 39.860	CTD-LADCP
AR24_124	**EB2-9P**	2564	23.07.25	11:55	78 49.988	5 24.784	CTD-LADCP
AR24_125	**EB2-10**	2583	23.07.25	14:26	78 49.980	5 10.013	CTD-LADCP, CTD carousel nutrients (2,10,25,50,75,100,150,200,400,750,1000), WP net
AR24_126	**EX8P**	2460	23.07.25	22:31	79 25.049	5 1.234	CTD-LADCP, CTD carousel salinity (2000, 2200 m)
AR24_127	**EX8**	2202	24.07.25	1:01	79 24.929	5 30.019	CTD-LADCP

AR24_128	**EX7P**	1763	24.07.25	3:28	79 24.935	6 0.046	CTD-LADCP
AR24_129	**EX7**	1428	24.07.25	5:37	79 24.998	6 30.451	CTD-LADCP, WP net
AR24_130	**EX6**	1164	24.07.25	7:52	79 24.886	7 2.839	CTD-LADCP
AR24_131	**EX5**	987	24.07.25	9:52	79 24.982	7 21.925	CTD-LADCP, WP net
AR24_132	**EX4P**	751	24.07.25	11:23	79 25.039	7 40.352	CTD-LADCP
AR24_133	**EX4**	474	24.07.25	12:36	79 25.036	7 55.322	CTD-LADCP
AR24_134	**EX3P**	273	24.07.25	13:38	79 24.967	8 10.516	CTD-LADCP
AR24_135	**EX3**	190	24.07.25	14:37	79 25.028	8 30.145	CTD-LADCP, WP net
AR24_136	**EX2**	131	24.07.25	16:10	79 24.920	8 59.952	CTD-LADCP
AR24_137	**EX1**	130	24.07.25	17:16	79 24.904	9 29.884	CTD-LADCP
AR24_138	**NB1**	53	25.07.25	6:36	80 33.223	16 32.159	CTD-LADCP
AR24_139	**NB2**	128	25.07.25	7:33	80 36.963	16 24.203	CTD-LADCP
AR24_140	**NB3**	162	25.07.25	8:12	80 38.800	16 19.682	CTD-LADCP, WP net
AR24_141	**NB4**	177	25.07.25	9:28	80 40.682	16 15.715	CTD-LADCP
AR24_142	**NB5**	193	25.07.25	10:06	80 41.665	16 13.606	CTD-LADCP
AR24_143	**NB6**	552	25.07.25	10:44	80 42.549	16 11.446	CTD, WP net
AR24_144	**NB6**	539	25.07.25	12:00	80 42.491	16 11.138	CTD-LADCP
AR24_145	**NB7**	637	25.07.25	12:54	80 43.441	16 9.512	CTD-LADCP
AR24_146	**NB8**	736	25.07.25	13:53	80 44.414	16 7.364	CTD-LADCP
AR24_147	**NB9**	965	25.07.25	15:09	80 45.372	16 5.138	CTD-LADCP
AR24_148	**NB10**	1141	25.07.25	16:38	80 46.441	16 2.873	CTD-LADCP
AR24_149	**WB4**	194	26.07.25	0:42	80 17.158	12 24.401	CTD-LADCP
AR24_150	**WB3**	199	26.07.25	1:51	80 13.264	12 28.852	CTD-LADCP, WP net
AR24_151	**WB2**	176	26.07.25	3:23	80 9.320	12 33.518	CTD-LADCP
AR24_152	**WB1**	188	26.07.25	4:13	80 5.398	12 38.133	CTD-LADCP
AR24_153	**Y1**	34	26.07.25	9:42	79 39.632	10 21.895	CTD-LADCP
AR24_154	**Y2**	86	26.07.25	10:22	79 41.025	10 13.909	CTD-LADCP
AR24_155	**Y3**	136	26.07.25	10:59	79 42.302	10 5.500	CTD-LADCP
AR24_156	**Y4**	306	26.07.25	11:40	79 43.819	9 58.325	CTD-LADCP
AR24_157	**Y5**	373	26.07.25	12:31	79 45.318	9 50.339	CTD-LADCP, WP net
AR24_158	**Y6**	426	26.07.25	13:54	79 47.696	9 36.460	CTD-LADCP
AR24_159	**Y7**	453	26.07.25	15:06	79 50.231	9 22.633	CTD-LADCP
AR24_160	**Y8**	455	26.07.25	16:02	79 53.866	9 2.774	CTD-LADCP
AR24_161	**Y9**	479	26.07.25	17:13	79 57.316	8 42.514	CTD-LADCP
AR24_162	**Y10**	496	26.07.25	18:57	80 0.912	8 22.490	CTD-LADCP, CTD carousel microplastic (497, 497 m)
AR24_163	**Y11**	508	26.07.25	20:18	80 4.384	8 2.057	CTD-LADCP
AR24_164	**Y12**	534	26.07.25	21:27	80 8.008	7 41.490	CTD-LADCP
AR24_165	**Y13**	556	26.07.25	23:10	80 11.034	7 23.590	CTD-LADCP
AR24_166	**EB3-1**	2560	27.07.25	13:26	78 49.900	5 26.734	CTD-LADCP, CTD carousel salinity (2400, 2200 m)
AR24_167	**EB3-2**	2417	27.07.25	16:24	78 45.821	5 11.937	CTD-LADCP
AR24_168	**EB3-3**	2322	27.07.25	19:05	78 41.748	4 57.088	CTD-LADCP
AR24_169	**EB3-4**	2342	27.07.25	21:07	78 37.709	4 42.556	CTD-LADCP
AR24_170	**EB3-5**	2342	27.07.25	23:18	78 33.613	4 28.472	CTD-LADCP
AR24_171	**EB3-6**	2335	28.07.25	1:35	78 29.525	4 13.984	CTD-LADCP
AR24_172	**EB3-7**	2291	28.07.25	4:16	78 25.445	4 0.185	CTD-LADCP
AR24_173	**EB3-8**	2322	28.07.25	6:36	78 21.313	3 45.681	CTD-LADCP
AR24_174	**EB3-9**	1911	28.07.25	9:21	78 17.218	3 31.598	CTD-LADCP
AR24_175	**EB3-10**	2765	28.07.25	11:39	78 13.151	3 17.515	CTD-LADCP, CTD carousel microplastic (2761, 2761 m)

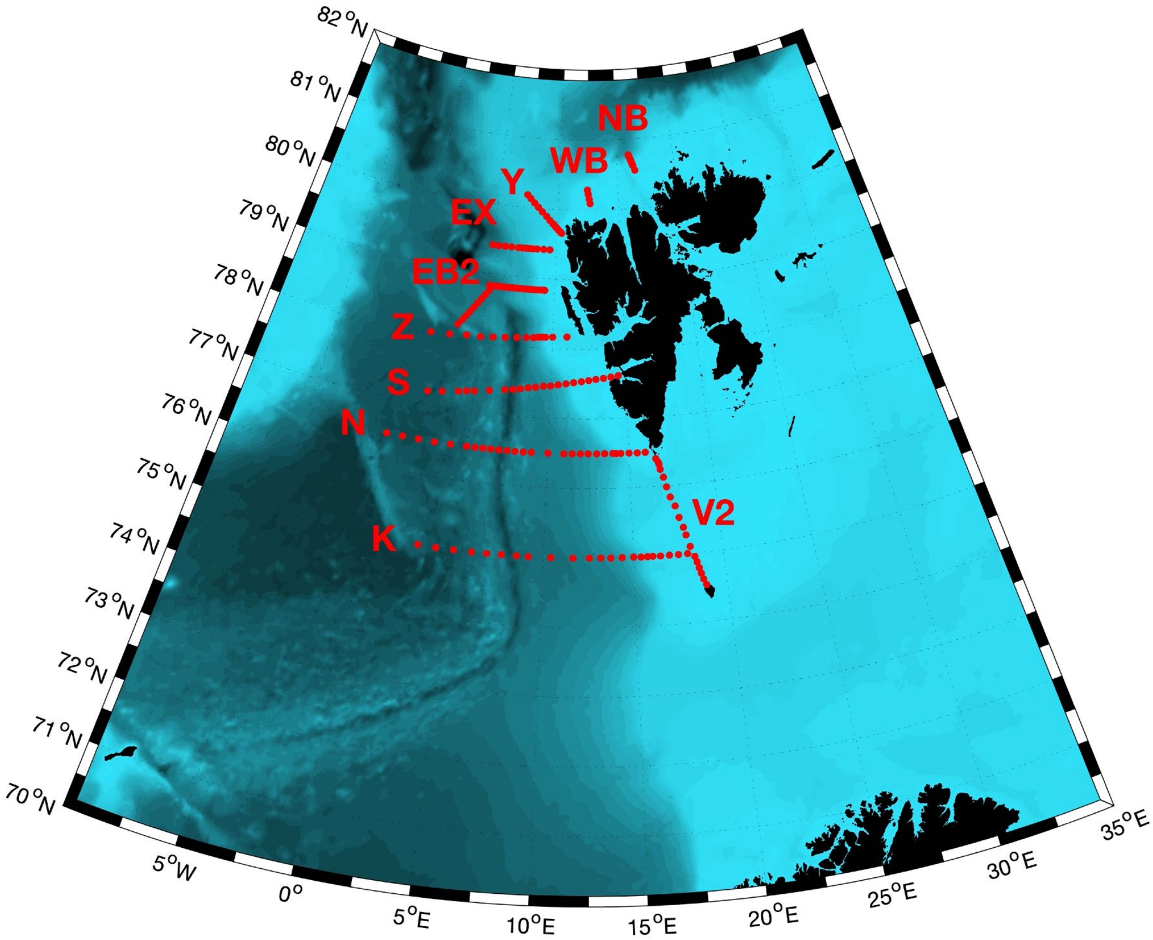


Fig. 5.1 Map of measurement stations and CTD sections during Leg I (sections V2, K, N, S, and Z) and Leg II (sections EB2, EX, Y, WB, NB, and EB3) of the AREX2025 cruise.

5.3 Detailed description of aerosol and meteorological measurements

Measurements were carried out using the following research equipment: an Optical Particle Counter (OPC-N3), two gas analyzers (LI-COR 7200 and LI-COR 7500), two acoustic anemometers (GILL), an automatic meteorological station (Vaisala WXT563), a Microtops II sun photometer, an autonomous ship motion and tilt detection system (Ellipse LPMS-1G1P-RS232), and a stationary aspirator (Dadolab Gemini).

The measured parameters included: aerosol particle size distribution in the near-surface atmospheric layer, concentration of marine aerosol, atmospheric CO_2 and H_2O concentrations and fluxes, wind speed and direction, air temperature and humidity, and ship motion using an inertial motion detection system. Measurements were conducted in continuous mode. Under favorable meteorological conditions (cloud-free sky), aerosol optical thickness measurements were also performed.

Meteorological conditions during Legs I and II of the AREX2025 cruise are shown on Figs 5.2 and 5.3.

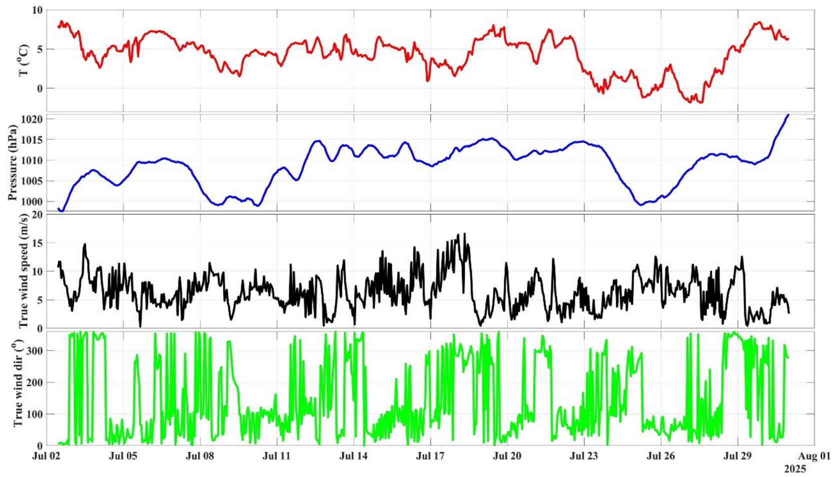
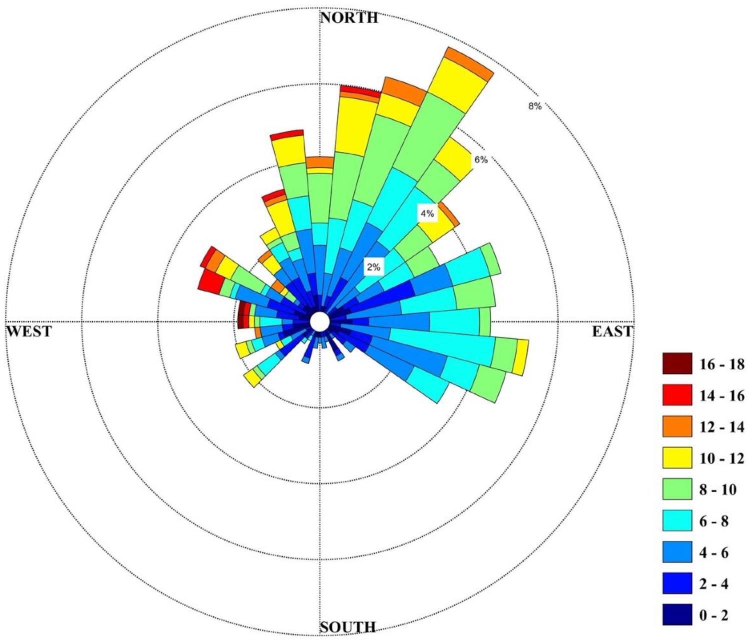


Fig. 5.2 Meteorological conditions during Legs I and II of the AREX2025 cruise



Rys. 5.3 Wind rose based on measurements collected during Legs I and II of the AREX2025 cruise.

Long-term atmospheric air sampling was conducted using the Dadolab Gemini aspirator. Samples were collected on filters, and two independent sets of samples were obtained.

The first set consisted of samples for inorganic ions (cations and anions). This series of filters will be used for the identification and quantification of the major water-soluble ionic species in marine aerosols (e.g., Na^+, K^+, Mg^{2+}, Ca^{2+}, NH_4^+, Cl^-, NO_3^-, SO_4^{2-}). These data will provide information on the chemical composition of airborne particles over the ocean, supporting studies of air–sea exchange, aerosol transport pathways, and the role of marine aerosols in atmospheric chemistry and climate-related processes.

A parallel series of filters was dedicated to the collection of airborne microplastic particles. These filters will subsequently be subjected to laboratory analyses, including advanced microscopic and spectroscopic techniques (FTIR, Raman spectroscopy), to determine polymer types, particle morphology, and size distributions. The resulting dataset will contribute to the development of this emerging field of research on marine microplastics, with particular emphasis on assessing atmospheric transport, deposition processes, and potential impacts on marine ecosystems.

The combined dataset from inorganic ion chemistry and microplastic identification will provide a unique and comprehensive characterization of marine aerosol composition. This methodology ensures comparability with international monitoring efforts and will support interdisciplinary research linking aerosol sources, transformation processes, and impacts on climate and the marine environment.

At selected stations, seawater samples were also collected to assess the concentration of suspended microplastics in the water column.

Table 5.3 List of seawater sampling stations for microplastic content analysis.

Number	Date	Time	Station
1	22.07.2025	06:50	EB2-1
2	22.07.2025	08:42	EB2-8P
3	23.07.2025	16:00	EB2-10
4	23.07.2025	17:00	BLANK
5	24.07.2025	17:45	EX1
6	24.07.2025	17:30	EX1
7	23.07.2025	18:20	BLANK
8	25.07.2025	18:01	NB10
9	26.07.2025	01:07	WB4
10	26.07.2025	04:30	WB1
11	26.07.2025	19:28	Y10
12	26.07.2025	19:15	Y10
13	28.07.2025	14:07	EB3-10
14	28.07.2025	14:00	EB3-10
15	28.07.2025	14:30	BLANK

All collected data will be deposited on the network drive at the Institute of Oceanology, Polish Academy of Sciences (IOPAN). The filter samples and seawater samples will be subjected to laboratory analyses, and the resulting data will also be deposited on the network drive.

5.4 Detailed description of sea surface microlayer (SML) measurements

Description of methods and measuring equipment

Sampling was conducted at 22 stations (Fig. 5.4) between 1 and 19 July 2025. The exact locations of the stations are provided in the corresponding table. Subsurface samples were collected from a depth of 0–1 m using a 10 L bucket, while samples of the surface microlayer (SML) were collected using a stainless-steel Garrett screen (WP net) with dimensions of 45 × 45 cm and a mesh size of 18 (wire thickness 0.36 mm and mesh opening 1 mm), yielding an approximate sampled SML thickness of 500 µm.

Part of the collected samples was used for the determination of pH, salinity, and temperature (WTW multimeter), which were measured onboard immediately after sampling. Samples intended for absorbance, fluorescence, and SAS analyses were placed unfiltered into containers and stored at −20 °C until analysis. During sampling, sea surface salinity and temperature at a depth of 0.6–0.9 m were measured using a CTD probe (Sea-Bird SBE 9/11+). Meteorological observations (wind speed and direction) were carried out throughout the cruise. Sampling was performed only under sea state conditions of 0–4 B (wind speed below 9 m s^{-1}) and in the absence of visible oil slicks.

Description of measured parameters and collected samples

Absorption measurements

Absorbance measurements were performed using a Perkin Elmer Lambda 650 spectrophotometer (Perkin Elmer, Waltham, Massachusetts, USA) with a 10 cm optical path length. Spectra were recorded over the wavelength range 240–700 nm, using Milli-Q water as a reference.

Based on the measured absorption spectra, several absorption-related parameters were calculated:

a) Ratios of CDOM absorption coefficients at wavelengths 250 and 365 nm, a_CDOM(250)/a_CDOM(365) (E2:E3), and at 450 and 650 nm, a_CDOM(450)/a_CDOM(650) (E4:E5). These ratios are used to track changes in the relative molecular size and aromaticity of CDOM molecules (as molecular size and aromaticity increase, E2:E3 and E4:E5 values decrease).
b) The spectral slope coefficient S, calculated over different spectral ranges, serving as a proxy for CDOM composition, including the relative contribution of fulvic versus humic acids and molecular weight.
c) The ratio of two spectral slopes, S275–295 and S350–400, known as the slope ratio (SR), which is correlated with the molecular weight (MW) of DOM and photochemically induced changes in the molecular weight of organic matter.

Fluorescence measurements

Fluorescence excitation–emission matrix (EEM) spectra were obtained using a scanning spectrofluorometer SFS-Go (Laser Diagnostics SA, Tallinn, Estonia) with a 1 cm optical path length. A series of emission scans (240–570 nm, 5 nm resolution) was measured over an excitation wavelength range of 225–350 nm at 5 nm intervals.

Analysis of EEM fluorescence spectra of seawater is based on the interpretation of emission bands used to derive several fluorescence parameters:

a) Fluorescence intensities of the main FDOM components A, C, M, and T (in R.U.), serving as indicators of FDOM concentration.
b) Relative contributions of the main FDOM fluorophores, reflecting changes in fluorophore composition.

c) The humification index (HIX), defined as the ratio of fluorescence intensity in the blue region of the spectrum (435–480 nm) to that in the UV-A region (330–346 nm) at an excitation wavelength of 255 nm. HIX reflects structural changes associated with humification, leading to increased aromaticity (C:H ratio) and molecular weight.

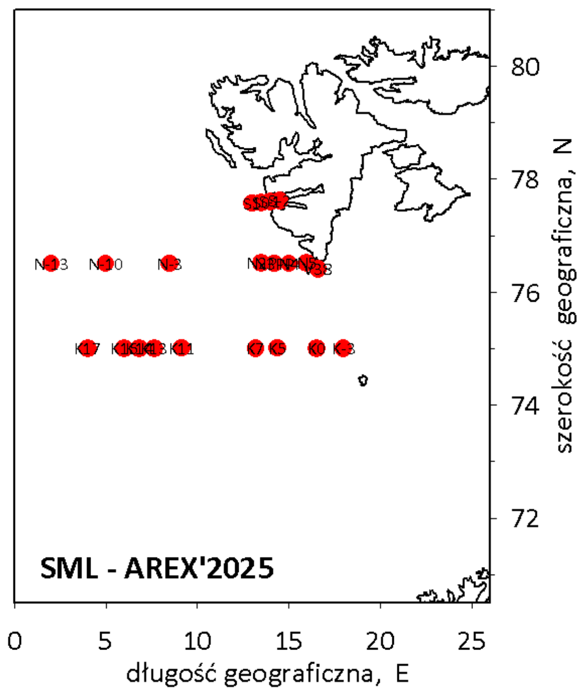
The calculated spectral indices (both absorption- and fluorescence-based) allow for the assessment of structural changes and compositional variability of FDOM, as well as for the quantification of allochthonous and autochthonous FDOM fractions along the investigated transect.

SAS (surface-active substances) measurements

Surface-active substances were determined electrochemically using the hanging mercury drop electrode method by means of alternating current (AC) voltammetry, employing a portable potentiostat (PalmSens, Houten, the Netherlands).

Table 5.4 List of sampling stations used for the analysis of surface microlayer enrichment.

Number	Date	Time	Station	Latitude	Longitude
1	7-4-2025	06:56:00	V38	76.4021	16.6007
2	7-4-2025	16:25:00	K-3	75	17.9988
3	7-5-2025	19:00:00	K0	75.0001	16.5164
4	7-6-2025	11:50:00	K5	75.0048	14.3782
5	7-6-2025	15:02:00	K7	74.9998	13.1825
6	7-7-2025	08:10:00	K11	75.0049	9.155
7	7-7-2025	14:12:00	K13	74.999	7.6496
8	7-7-2025	17:16:00	K14	74.9961	6.8301
9	7-7-2025	20:30:00	K15	74.9997	6.0013
10	7-8-2025	06:13:00	K17	75.0036	4.008
11	7-9-2025	19:10:00	N-13	76.4998	1.998
12	7-10-2025	08:00:00	N-10	76.499	4.9823
13	7-11-2025	07:00:00	N-3	76.4989	8.4924
14	7-12-2025	06:15:00	N2P	76.5065	13.4988
15	7-12-2025	10:00:00	N3PP	76.5008	14.2023
16	7-13-2025	12:35:00	N5	76.5117	15.9866
17	7-13-2025	15:10:00	N4	76.5013	15.0111
18	7-14-2025	12:00:00	S-2	77.6165	14.5046
19	7-14-2025	13:00:00	S-1	77.6	14.0007
21	7-14-2025	14:30:00	S0	77.5834	13.501
22	7-14-2025	16:00:00	S1	77.5679	13.0023



Rys. 5.4 Map of the sampling stations for the analysis of enrichment of the sea surface microlayer with organic matter during the AREX2025 Leg I .

Further processing of data and collected samples

The samples are currently stored in freezers at the laboratories of the Institute of Oceanology, Polish Academy of Sciences (IOPAN). Laboratory analyses will be carried out in January 2026. The results will be used to derive relationships between the enrichment of the sea surface microlayer (SML) with organic matter and the rate of gas exchange across the air–sea interface. These relationships are required for the implementation of the statutory research program as well as for the SURETY project.

5.5 Detailed description of biological measurements

Description of methods and measuring equipment

Zooplankton investigations during the oceanic legs of the AREX cruise were conducted following methods recommended for marine zooplankton ecological studies, with procedures and tools adapted to the specific objectives of the research. Sampling was carried out at fixed research stations selected from the network of hydrographic stations of the main cruise program. A total of 40 primary and 20 supplementary zooplankton stations were designated, distributed along 6 (V, K, O, S, EB) and 3 (Z, EX, Y) measurement sections, respectively.

At each station, zooplankton samples were collected while the vessel was drifting (and only rarely while at anchor). Sampling was performed using vertical hauls from the upper 200 m of the water column (the epipelagic layer), following a stratified approach, with hauls taken from depth layers defined in relation to the local thermohaline structure of the water column.

Based on previous hydrographic studies, three characteristic layers are typically distinguished in the thermohaline structure of the study region, and zooplankton samples were collected accordingly from: (i) the surface layer, characterized by nearly uniform temperature and salinity; (ii) the layer of sharp gradients in temperature and salinity (the thermo- and halocline); and (iii) the layer extending below these gradients down to the lower boundary of the epipelagic zone, characterized by gradual and uniform changes in temperature and salinity with depth. The vertical extent of these layers was determined individually at each station based on real-time temperature and salinity profiles provided by the physical oceanography team.

The primary sampling gear used in the study was a WP-2 zooplankton net equipped with a filtering mesh of 0.180 mm. The net was fitted with a mechanical closing system, which sealed the net by tightening a rope loop in the upper, non-filtering part of the net. This system consisted of a closing line attached to the net, a release mechanism, a Nansen-type mechanical closing device mounted on the main wire to which the net was attached, and a messenger weight that activated the closing mechanism.

For supplementary tasks, as well as as backup equipment in the event of damage to the primary net, a WP-3 plankton net with a 1.0 mm mesh and a Juday-type plankton net with a 0.064 mm mesh could also be used.

Description of measured parameters and collected samples

The primary samples collected to obtain research material for the main scientific objective - namely, to characterize the qualitative and quantitative composition and spatial distribution patterns of zooplankton in the epipelagic layer of the West Spitsbergen Current - were zooplankton samples collected using stratified vertical hauls with a WP-2 net equipped with a 0.180 mm mesh, at a predefined network of research stations. After collection, the zooplankton samples were transferred from the net cod end to sample containers (HDPE screw-cap bottles) and immediately preserved with a 4% formaldehyde solution in seawater, buffered with borax.

The sample containers were labeled using waterproof markers, with labels written both on the outer wall of the bottle and on the cap. Each label included a unique identification number and a set of basic metadata (station name, name and vertical extent of the sampled water layer, sampling date, and net type). In addition, each container included an internal label (a rectangular piece of technical tracing paper approximately 3 × 5 cm in size written in pencil and containing the essential metadata). Bottles with preserved and labeled samples were placed in dedicated transport boxes designed for this purpose.

In total, 115 zooplankton faunal samples were collected during the cruise to address the primary research objective, from 39 research stations. Of these, 107 samples were collected in a stratified manner, and 8 samples were collected from the entire water column. The latter were collected out of necessity due to malfunction of the net closing mechanism under difficult weather conditions and high sea state, which caused strong vessel motion.

Zooplankton samples intended for the establishment of a genetic reference database of planktonic organisms were collected using a WP-2 net (180 µm mesh) in vertical hauls from the 50–0 m water layer at selected plankton stations. Whenever possible, two zooplankton samples were collected at each station: one for genetic analyses and one for faunistic studies. The collected zooplankton was placed in individually labeled containers (bottles) and preserved either in 96% ethanol (for genetic analyses) or in a 4% formaldehyde solution in seawater buffered with borax (for faunistic analyses). In total, 8 samples were collected at 4 stations for the purpose of genetic diversity analyses.

Table 5.5. List of sampling stations. "TWC" – Total Water Column, a sample unintentionally collected from the entire water column. Abandoned – a station at which no samples were collected due to unfavorable working conditions (strong winds, high sea state). Code /A – faunistic sample. Code /G – genetic sample.

No.	Station	Date	Time	Deg	Min	Deg	Min	Bottom	Secchi	Sample	Code	Depth	Depth	Comment
		UTC	UTC	Lat	Lat	Lon	Lon	[m]	disc	nr		from [m]	to [m]	
1	V34	04.07.2025	11:51	76	7,563	17	0,603	284	7	25001	/A	200	0	TWC
2	V34	04.07.2025	11:51	76	7,563	17	0,603	284	7	25002	/A	40	18	
3	V34	04.07.2025	11:51	76	7,563	17	0,603	284	7	25003	/A	18	0	
4	V31	04.07.2025	18:10	75	42,223	17	32,861	208	12	25004	/A	200	0	TWC
5	V31	04.07.2025	18:10	75	42,223	17	32,861	208	12	25005	/A	50	10	
6	V31	04.07.2025	18:10	75	42,223	17	32,861	208	12	25006	/A	10	0	
7	V29	04.07.2025	22:29	75	23,137	17	56,564	102	11	25007	/A	195	80	
8	V29	04.07.2025	22:29	75	23,137	17	56,564	102	11	25008	/A	80	25	
9	V29	04.07.2025	22:29	75	23,137	17	56,564	102	11	25009	/A	25	0	
10	K-3	05.07.2025	16:41	75	0,18	17	59,604	151	14	25010	/A	145	35	
11	K-3	05.07.2025	16:41	75	0,18	17	59,604	151	14	25011	/A	35	10	
12	K-3	05.07.2025	16:41	75	0,18	17	59,604	151	14	25012	/A	10	0	
13	KO	05.07.2025	21:31	75	0,001	16	30,832	224	7	25013	/A	200	0	TWC
14	KO	05.07.2025	21:31	75	0,001	16	30,832	224	7	25014	/A	55	15	
15	KO	05.07.2025	21:31	75	0,001	16	30,832	224	7	25015	/A	15	0	
16	K4	06.07.2025	04:10	75	0,353	15	0,092	1094	5,5	25016	/A	200	45	
17	K4	06.07.2025	04:10	75	0,353	15	0,092	1094	5,5	25017	/A	45	15	
18	K4	06.07.2025	04:10	75	0,353	15	0,092	1094	5,5	25018	/A	15	0	
19	K4	06.07.2025	04:10	75	0,353	15	0,092	1094	5,5	25001	/G	200	0	
20	K4	06.07.2025	04:10	75	0,353	15	0,092	1094	5,5	25002	/G	200	0	
21	K7	06.07.2025	15:11	75	0,02	13	11,175	1975	12	25019	/A	200	50	
22	K7	06.07.2025	15:11	75	0,02	13	11,175	1975	12	25020	/A	50	15	
23	K7	06.07.2025	15:11	75	0,02	13	11,175	1975	12	25021	/A	15	0	
24	K10	07.07.2025	02:21	75	0,092	10	25,181	2495	4,5	25022	/A	200	0	TWC
25	K10	07.07.2025	02:21	75	0,092	10	25,181	2495	4,5	25023	/A	50	20	
26	K10	07.07.2025	02:21	75	0,092	10	25,181	2495	4,5	25024	/A	20	0	
27	K16	08.07.2025	00:54	75	0,105	5	0,302	3032	5	25025	/A	200	60	
28	K16	08.07.2025	00:54	75	0,105	5	0,302	3032	5	25026	/A	60	20	
29	K16	08.07.2025	00:54	75	0,105	5	0,302	3032	5	25027	/A	20	0	
30	K16	08.07.2025	00:54	75	0,105	5	0,302	3032	5	25003	/G	200	0	

31	K16	08.07.2025	00:54	75	0,105	5	0,302	3032	5	25004	/G	200	0	
32	N-11	10.07.2025	04:35	76	30,039	3	59,941	2473	16	25028	/A	200	37	
33	N-11	10.07.2025	04:35	76	30,039	3	59,941	2473	16	25029	/A	37	15	
34	N-11	10.07.2025	04:35	76	30,039	3	59,941	2473	16	25030	/A	15	0	
35	N-2	11.07.2025	10:18	76	30,051	8	59,794	2252	9	25031	/A	200	40	
36	N-2	11.07.2025	10:18	76	30,051	8	59,794	2252	9	25032	/A	40	20	
37	N-2	11.07.2025	10:18	76	30,051	8	59,794	2252	9	25033	/A	20	0	
38	NO	11.07.2025	17:36	76	29,658	10	59,154	2088	6	25034	/A	200	20	
39	NO	11.07.2025	17:36	76	29,658	10	59,154	2088	6	25035	/A	20	0	
40	N2	12.07.2025	04:04	76	29,987	13	0,171	1525	7	25036	/A	200	0	TWC
41	N2	12.07.2025	04:04	76	29,987	13	0,171	1525	7	25037	/A	20	10	
42	N2	12.07.2025	04:04	76	29,987	13	0,171	1525	7	25038	/A	10	0	
43	N3	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
44	N4	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
45	S3	14.07.2025	18:57	77	32,181	11	59,635	173	9	25039	/A	165	0	TWC
46	S3	14.07.2025	18:57	77	32,181	11	59,635	173	9	25040	/A	18	0	
47	S6	14.07.2025	23:22	77	29,263	10	29,41	1244	6	25041	/A	200	0	TWC
48	S6	14.07.2025	23:22	77	29,263	10	29,41	1244	6	25042	/A	28	0	
49	S8	15.07.2025	06:50	77	26,092	9	0,386	2051	7	25043	/A	200	45	
50	S8	15.07.2025	06:50	77	26,092	9	0,386	2051	7	25044	/A	45	20	
51	S8	15.07.2025	06:50	77	26,092	9	0,386	2051	7	25045	/A	20	0	
52	S10	15.07.2025	18:16	77	21,859	7	0,491	2672	12	25046	/A	200	40	
53	S10	15.07.2025	18:16	77	21,859	7	0,491	2672	12	25047	/A	40	15	
54	S10	15.07.2025	18:16	77	21,859	7	0,491	2672	12	25048	/A	15	0	
55	S16	16.07.2025	13:58	77	13,894	2	58,106	2881	14	25049	/A	200	0	TWC
56	S16	16.07.2025	13:58	77	13,894	2	58,106	2881	14	25050	/A	40	20	
57	S16	16.07.2025	13:58	77	13,894	2	58,106	2881	14	25051	/A	20	0	
58	Z13	17.07.2025	08:23	78	3,634	2	49,517	2992	15	25052	/A	200	35	
59	Z13	17.07.2025	08:23	78	3,634	2	49,517	2992	15	25053	/A	35	10	
60	Z13	17.07.2025	08:23	78	3,634	2	49,517	2992	15	25054	/A	10	0	
61	Z2	20.07.2025	07:11	78	10,097	9	59,573	-	9	25055	/A	200	45	
62	Z2	20.07.2025	07:11	78	10,097	9	59,573	-	9	25056	/A	45	10	
63	Z2	20.07.2025	07:11	78	10,097	9	59,573	-	9	25057	/A	10	0	
64	Z4	20.07.2025	09:28	78	9,711	9	14,581	697	5	25058	/A	200	40	
65	Z4	20.07.2025	09:28	78	9,711	9	14,581	697	5	25059	/A	40	10	
66	Z4	20.07.2025	09:28	78	9,711	9	14,581	697	5	25060	/A	10	0	
67	Z7	20.07.2025	14:38	78	8,451	8	10,031	2167	14	25061	/A	200	25	
68	Z7	20.07.2025	14:38	78	8,451	8	10,031	2167	14	25062	/A	25	10	
69	Z7	20.07.2025	14:38	78	8,451	8	10,031	2167	14	25063	/A	10	0	
70	Z10	20.07.2025	23:46	78	6,036	5	50,357	2473	11	25064	/A	200	20	
71	Z10	20.07.2025	23:46	78	6,036	5	50,357	2473	11	25065	/A	20	10	
72	Z10	20.07.2025	23:46	78	6,036	5	50,357	2473	11	25066	/A	10	0	
73	EB2-1	22.07.2025	06:02	78	49,872	9	15,763	199	7	25067	/A	200	40	
74	EB2-1	22.07.2025	06:02	78	49,872	9	15,763	199	7	25068	/A	40	10	
75	EB2-1	22.07.2025	06:02	78	49,872	9	15,763	199	7	25069	/A	10	0	
76	EB2-3	22.07.2025	10:55	78	50,339	8	27,266	647	6	25070	/A	200	60	

77	EB2-3	22.07.2025	10:55	78	50,339	8	27,266	647	6	25071	/A	60	25	
78	EB2-3	22.07.2025	10:55	78	50,339	8	27,266	647	6	25072	/A	25	0	
79	EB2-5	22.07.2025	16:59	78	49,859	7	37,471	1092	7	25005	/G	200	0	
80	EB2-5	22.07.2025	16:59	78	49,859	7	37,471	1092	7	25006	/G	200	0	
81	EB2-5	22.07.2025	16:59	78	49,859	7	37,471	1092	7	25073	/A	200	45	
82	EB2-5	22.07.2025	16:59	78	49,859	7	37,471	1092	7	25074	/A	45	10	
83	EB2-5	22.07.2025	16:59	78	49,859	7	37,471	1092	7	25075	/A	10	0	
84	EB2-7	23.07.2025	00:20	78	50,169	6	40,864	1725	7	25076	/A	200	50	
85	EB2-7	23.07.2025	00:20	78	50,169	6	40,864	1725	7	25077	/A	50	10	
86	EB2-7	23.07.2025	00:20	78	50,169	6	40,864	1725	7	25078	/A	10	0	
87	EB2-10	23.07.2025	14:40	78	49,923	5	9,094	2583	10	25007	/G	200	0	
88	EB2-10	23.07.2025	14:40	78	49,923	5	9,094	2583	10	25008	/G	200	0	
89	EB2-10	23.07.2025	14:40	78	49,923	5	9,094	2583	10	25079	/A	200	25	
90	EB2-10	23.07.2025	14:40	78	49,923	5	9,094	2583	10	25080	/A	25	10	
91	EB2-10	23.07.2025	14:40	78	49,923	5	9,094	2583	10	25081	/A	10	0	
92	EB2-14	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
93	EX9	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
94	EX8P	23.07.2025	22:49	79	25,137	5	1,471	2455	13	25082	/A	200	30	
95	EX8P	23.07.2025	22:49	79	25,137	5	1,471	2455	13	25083	/A	30	10	
96	EX8P	23.07.2025	22:49	79	25,137	5	1,471	2455	13	25084	/A	10	0	
97	EX7	24.07.2025	05:50	79	24,816	6	31,156	1428	15	25085	/A	200	55	
98	EX7	24.07.2025	05:50	79	24,816	6	31,156	1428	15	25086	/A	55	20	
99	EX7	24.07.2025	05:50	79	24,816	6	31,156	1428	15	25087	/A	20	10	
100	EX7	24.07.2025	05:50	79	24,816	6	31,156	1428	15	25088	/A	10	0	
101	EX5	24.07.2025	10:10	79	24,981	7	22,624	987	14	25089	/A	200	35	
102	EX5	24.07.2025	10:10	79	24,981	7	22,624	987	14	25090	/A	35	15	
103	EX5	24.07.2025	10:10	79	24,981	7	22,624	987	14	25091	/A	15	0	
104	EX3	24.07.2025	14:47	79	25,025	8	30,509	187	6	25092	/A	190	50	
105	EX3	24.07.2025	14:47	79	25,025	8	30,509	187	6	25093	/A	50	20	
106	EX3	24.07.2025	14:47	79	25,025	8	30,509	187	6	25094	/A	20	0	
107	NB3	25.07.2025	08:21	80	38,771	16	19,81	157	11	25095	/A	155	40	
108	NB3	25.07.2025	08:21	80	38,771	16	19,81	157	11	25096	/A	40	20	
109	NB3	25.07.2025	08:21	80	38,771	16	19,81	157	11	25097	/A	20	0	
110	NB6	25.07.2025	11:06	80	42,213	16	12,135	1552	11	25098	/A	200	40	
111	NB6	25.07.2025	11:06	80	42,213	16	12,135	1552	11	25099	/A	40	20	
112	NB6	25.07.2025	11:06	80	42,213	16	12,135	1552	11	25100	/A	20	0	
113	NB10	25.07.2025	17:11	80	46,457	16	3,928	1141	7	25101	/A	200	40	
114	NB10	25.07.2025	17:11	80	46,457	16	3,928	1141	7	25102	/A	40	20	
115	NB10	25.07.2025	17:11	80	46,457	16	3,928	1141	7	25103	/A	20	0	
116	NB11	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
117	NB13	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
118	WB12	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
119	WB9	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
120	WB6	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned
121	WB3	26.07.2025	02:04	80	13,249	12	29,046	198	6	25104	/A	195	45	
122	WB3	26.07.2025	02:04	80	13,249	12	29,046	198	6	25105	/A	45	25	

123	WB3	26.07.2025	02:04	80	13,249	12	29,046	198	6	25106	/A	25	0	
124	Y5	26.07.2025	12:47	79	45,283	9	50,916	371	6	25107	/A	200	50	
125	Y5	26.07.2025	12:47	79	45,283	9	50,916	371	6	25108	/A	50	10	
126	Y5	26.07.2025	12:47	79	45,283	9	50,916	371	6	25109	/A	10	0	
127	Y9	26.07.2025	17:35	79	57,363	8	42,997	481	7	25110	/A	200	60	
128	Y9	26.07.2025	17:35	79	57,363	8	42,997	481	7	25111	/A	60	25	
129	Y9	26.07.2025	17:35	79	57,363	8	42,997	481	7	25112	/A	25	0	
130	Y12	26.07.2025	21:49	80	7,981	7	41,581	533	10	25113	/A	200	60	
131	Y12	26.07.2025	21:49	80	7,981	7	41,581	533	10	25114	/A	60	20	
132	Y12	26.07.2025	21:49	80	7,981	7	41,581	533	10	25115	/A	20	0	
133	Y15	-	-	-	-	-	-	-	-	-	-	-	-	Abandoned

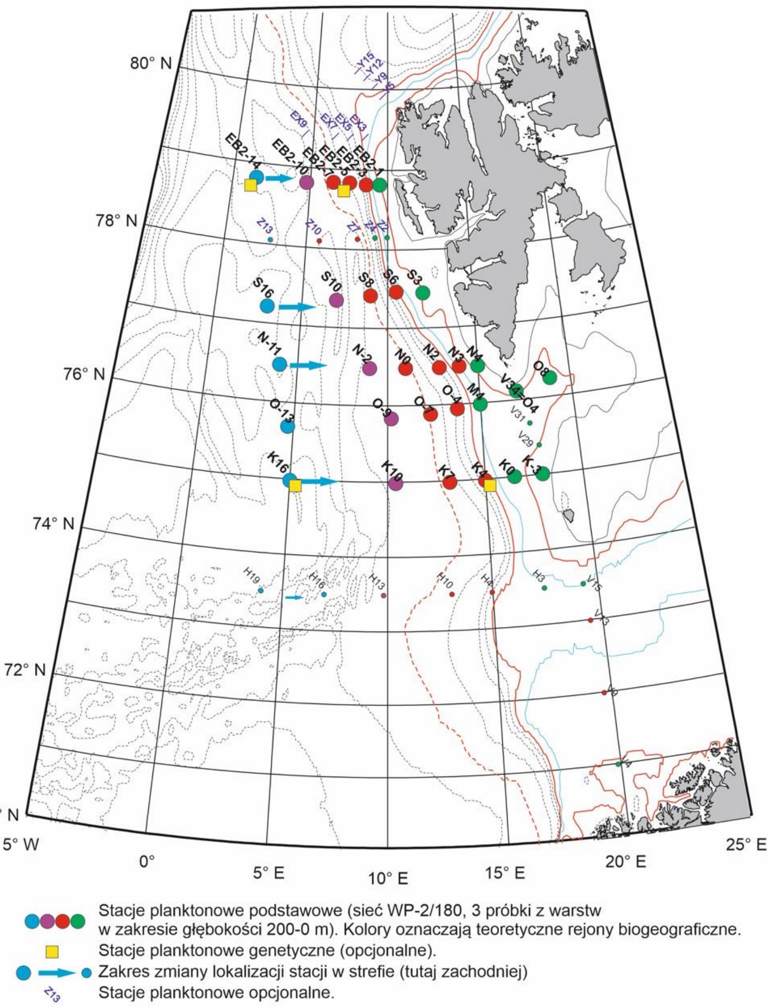


Fig. 5.5 Mapa stacji zbioru próbek zooplanktonu w czasie badań AREX 2025, część oceaniczna.

Further processing of data and collected samples

No analytical or research work was carried out on the collected samples during the cruise. All analytical work, including the qualitative and quantitative analysis of zooplankton composition, is conducted after the cruise in the laboratory using stereoscopic and compound optical microscopes, following established and adapted procedures for laboratory analysis of zooplankton.

6 Mesurements and sampling program during AREX 2025 Leg IIIa

6.1 General information about Leg IIIa

Leg IVa comprised research activities in the southern Svalbard region, including Hornsund fjord and shelf area in the forefield of Hornsund, the so-called *Alczykowisko* (little auk foraging area). The leg both started and ended in Longyearbyen, and was accompanied by a partial exchange of the scientific crew between Legs IIIa and IIIb. Embarkation of the scientific team for Leg IIIa took place in the afternoon of 30 July. Due to repairs of the starboard engine, departure from port was delayed by two days and was only possible on 1 August at 18:00 LT.

The research program began with a transverse hydrographic section and plankton station H1 at the entrance to the fjord. Subsequently, owing to unfavorable forecasts and a very short weather window, the vessel proceeded to the forefield of Hornsund and began implementation of the research program in the Alczykowisko (little auk foraging area). During the night of 3 August, a decision was made to terminate offshore operations and head deeper into Hornsund Fjord. Strong winds and high waves began to significantly affect logistics and station selection. On 4 and 5 August, plans were repeatedly modified in response to changing weather conditions, and work was mainly conducted in more sheltered bays, such as Samarinvågen and Brepollen. In the following days, a series of plankton, benthos, optical, and oceanographic measurements was continued, although their scope and sequence had to be adjusted. Weather conditions, with winds reaching 7–9B and considerable wave heights, frequently forced the cancellation of UVP measurements and, in some cases, other planned activities. The final days of the leg, 9–10 August, were also marked by strengthening winds, which limited operations in the central and outer parts of the fjord. Despite these difficulties, a large portion of the research program was successfully completed: numerous CTD profiles were carried out; benthic and zooplankton samples were collected at monitoring stations and along transverse sections; seabed imaging was performed; optical measurements were conducted; and measurements were carried out in several glacier-influenced bays (including Burgerbukta and Körberbukta). After completion of the scientific work, the ornithologists from the Polish Polar Station in Hornsund were taken on board, and on the morning of 11 August the vessel entered Longyearbyen, thereby concluding Leg IIIa.

In addition, hydrographic and optical measurements were conducted, and biological samples (from both the water column and bottom sediments) as well as sediment samples were collected at a station located close to the glacier front in Brepollen (station HB0), in order to complement the assessment of environmental conditions along the fjord axis and the influence of meltwater on ecosystem components (as a supplement to the monitoring station profile HB1–HB3).

A complete list of all research stations and the measurements performed is provided in Table 6.1.

From the very beginning of the leg, the measurement equipment of the Pelagic Biocenosis Functioning Laboratory, the so-called LOPC, was not operational. Despite multiple attempts, it could not be repaired.

Table 6.1 List of research stations of Leg IIIa with a detailed overview of the measurements.

No	Station	Depth (m)	Date	Latitude (deg min N)	Lon gitude (deg min E)	Measurements and sampling
1	Rm1	65	02.08.25	76 59.689	15 14.348	CTD SBE9/11+, UVP
2	Rm2	121	02.08.25	76 58.602	15 16.372	CTD SBE9/11+, UVP
3	Rm3	133	02.08.25	76 57.778	15 18.379	CTD SBE9/11+, UVP
4	Rm4	166	02.08.25	76 56.999	15 20.194	CTD SBE9/11+, UVP
5	Rm5	145	02.08.25	76 55.175	15 23.749	CTD SBE9/11+, UVP
6	Rm6	81	02.08.25	76 54.631	15 25.313	CTD SBE9/11+, UVP
7	H1/R0	167	02.08.25	76 56.224	15 22.051	CTD SBE9/11+, UVP, WP2/180, MPS/180, WP2/500, C-OPS, TRIOS, bbe Fluoroprobe, camera, bathometer
8	AUK13	40	02.08.25	76 35.556	15 46.896	CTD SBE9/11+, WP2/180, WP2/500, UVP, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
9	AUK13P	57	02.08.25	76 34.216	15 36.696	CTD SBE9/11+, UVP
10	AUK14	95	02.08.25	76 33.020	15 27.456	CTD SBE9/11+, WP2/180, WP2/500, UVP
11	AUK14P	160	02.08.25	76 30.660	15 15.632	CTD SBE9/11+, UVP
12	AUK15	179	02.08.25	76 28.314	15 3.946	CTD SBE9/11+, WP2/180, WP2/500, UVP
13	AUK15P	225	02.08.25	76 26.429	14 52.106	CTD SBE9/11+, UVP
14	AUK16	591	02.08.25	76 24.588	14 39.953	CTD SBE9/11+, WP2/180, WP2/500, UVP
15	N4	147	03.08.25	76 29.894	15 1.877	CTD SBE9/11+, WP2/180, C-OPS, TRIOS, bbe Fluoroprobe, bathometer, ekspozycja produkcji pierwotnej, bathometer, camera
16	N4_2	148	03.08.25	76 29.869	15 1.828	CTD SBE9/11+
17	N4_3	147	03.08.25	76 29.847	15 1.609	CTD SBE9/11+
18	AUK9	199	03.08.25	76 34.885	14 6.421	CTD SBE9/11+, WP2/180, WP2/500, UVP
19	AUK9P	200	03.08.25	76 36.776	14 19.219	CTD SBE9/11+, UVP
20	AUK10	201	03.08.25	76 38.308	14 28.648	CTD SBE9/11+, WP2/180, WP2/500, UVP, C-OPS, TRIOS, bathometer
21	AUK10P	214	03.08.25	76 39.715	14 38.355	CTD SBE9/11+, UVP
22	H6/AUK11	213	03.08.25	76 41.256	14 48.185	CTD SBE9/11+, UVP, WP2/180, MPS/180, WP2/500, C-OPS, TRIOS, bbe Fluoroprobe, Van Veen, bathometer
23	AUK11P	202	03.08.25	76 43.126	15 3.081	CTD SBE9/11+, UVP
24	AUK12	55	03.08.25	76 45.075	15 18.293	CTD SBE9/11+, WP2/500
25	E6	110	04.08.25	76 55.976	16 16.267	CTD SBE9/11+, Van Veen, box core, camera
26	E5	111	04.08.25	76 56.887	16 14.873	CTD SBE9/11+, Van Veen, box core, camera
27	E4	110	04.08.25	76 58.043	16 13.099	CTD SBE9/11+, Van Veen, box core, camera
28	E1	89	04.08.25	77 0.877	16 7.615	CTD SBE9/11+, Van Veen, box core, camera
29	E2	52	04.08.25	76 59.998	16 9.490	CTD SBE9/11+, Van Veen, box core, camera
30	R13	70	05.08.25	77 2.026	16 33.115	CTD SBE9/11+, UVP
31	R12	119	05.08.25	77 0.491	16 30.029	CTD SBE9/11+, UVP
32	R11	125	05.08.25	76 59.870	16 25.376	CTD SBE9/11+, UVP
33	R10	118	05.08.25	76 59.338	16 20.888	CTD SBE9/11+, UVP
34	R9	105	05.08.25	76 58.795	16 13.945	CTD SBE9/11+, UVP
35	R8	46	05.08.25	76 59.238	16 8.118	CTD SBE9/11+, UVP
36	R7	78	05.08.25	76 59.605	16 4.325	CTD SBE9/11+, UVP

37	R6	109	05.08.25	77 0.005	15 59.912	CTD SBE9/11+, UVP
38	R5	174	05.08.25	76 59.538	15 53.156	CTD SBE9/11+, UVP
39	R4/H2	228	05.08.25	76 58.921	15 45.659	CTD SBE9/11+
40	HB1_opt	63	05.08.25	77 3.161	16 33.964	CTD SBE9/11+, UVP, WP2/180, Van Veen, Box Core, Nemisto, bathometer
41	R13	75	05.08.25	77 1.976	16 32.787	CTD SBE9/11+, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
42	H3/G3	134	05.08.25	77 0.511	16 29.678	CTD SBE9/11+, UVP, WP2/180, MPS/180, C-OPS, TRIOS, bbe Fluoroprobe Van Veen, Box Core, camera, bathometer
43	HB1	125	05.08.25	77 0.145	16 27.788	CTD SBE9/11+, Van Veen, Box Core, camera
44	R9_opt	106	05.08.25	76 58.804	16 13.224	CTD SBE9/11+, C-OPS, TRIOS, bathometer
45	H4	106	05.08.25	77 0.600	16 0.625	CTD SBE9/11+, MPS/180, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
46	R3	106	06.08.25	76 58.313	15 39.347	CTD SBE9/11+
47	R2	154	06.08.25	76 57.708	15 33.377	CTD SBE9/11+
48	R1	130	06.08.25	76 56.987	15 26.547	CTD SBE9/11+
49	R0	163	06.08.25	76 56.196	15 21.883	CTD SBE9/11+
50	BR1	168	06.08.25	77 3.392	15 51.290	CTD SBE9/11+, camera
51	BR0	126	06.08.25	77 4.643	15 49.584	CTD SBE9/11+, camera
52	G5	62	06.08.25	76 58.939	16 31.954	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
53	G4	74	06.08.25	76 59.765	16 31.007	CTD SBE9/11+, UVP, Van Veen, Box Core
54	G2	107	06.08.25	77 1.282	16 27.281	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
55	G1	62	06.08.25	77 1.978	16 25.677	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
56	F4	83	07.08.25	76 58.927	16 22.768	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
57	F1	81	07.08.25	77 0.340	16 17.677	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
58	F2	108	07.08.25	76 59.897	16 18.696	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
59	F3	117	07.08.25	76 59.404	16 20.263	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
60	E3/R8	82	08.08.25	76 59.004	16 10.681	CTD SBE9/11+, UVP, Van Veen, Box Core, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
61	D3	108	08.08.25	76 59.971	16 0.055	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
62	HB2	79	08.08.25	77 0.073	16 5.359	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
63	HK1	51	08.08.25	76 58.606	16 0.878	CTD SBE9/11+, UVP, Van Veen, camera, dredge, bathometer
64	HK2	13	08.08.25	76 58.594	16 2.387	CTD SBE9/11+, UVP, Van Veen, camera, Nemisto, dredge, bathometer
65	HK3	53	08.08.25	76 58.675	16 3.873	CTD SBE9/11+, UVP, Van Veen, dredge, bathometer
66	H2	221	08.08.25	76 59.117	15 45.670	CTD SBE9/11+, UVP, MPS/180, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
67	HB3	225	08.08.25	76 58.067	15 45.077	CTD SBE9/11+, Van Veen, Box Core
68	C4	26	09.08.25	76 57.186	15 51.641	CTD SBE9/11+
69	BR2	96	09.08.25	77 2.467	15 54.433	CTD SBE9/11+, camera
70	BR3	82	09.08.25	77 1.550	15 58.099	CTD SBE9/11+, camera
71	D1	111	09.08.25	77 1.585	16 0.662	CTD SBE9/11+, UVP, Van Veen, Box Core, camera
72	BRE00	81	09.08.25	77 5.478	15 57.289	CTD SBE9/11+, camera
73	BRE0	103	09.08.25	77 4.951	15 58.168	CTD SBE9/11+, camera
74	BRE1	83	09.08.25	77 4.048	15 58.568	CTD SBE9/11+, camera
75	BRE2	36	09.08.25	77 3.188	15 59.231	CTD SBE9/11+, camera
76	BRE3	57	09.08.25	77 2.397	15 59.811	CTD SBE9/11+, camera
77	D4	109	09.08.25	76 58.999	16 1.721	CTD SBE9/11+, Van Veen, Box Core
78	C3	209	10.08.25	76 57.953	15 51.710	CTD SBE9/11+, Van Veen, Box Core
79	C2/R5	181	10.08.25	76 59.621	15 51.760	CTD SBE9/11+, Van Veen, Box Core, C-OPS, TRIOS, bbe Fluoroprobe, bathometer

80	C1	167	10.08.25	77 0.033	15 52.073	CTD SBE9/11+, Van Veen, Box Core
81	B3/R3	118	10.08.25	76 57.959	15 40.807	CTD SBE9/11+, Van Veen, Box Core, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
82	B1	49	10.08.25	76 59.534	15 39.631	CTD SBE9/11+, Van Veen
83	B5	90	10.08.25	76 56.394	15 42.422	CTD SBE9/11+, Van Veen, Box Core

6.2 Detailed description of biological measurements – plankton (PEP)

Description of methods and tools

Studies on the qualitative and quantitative composition and spatial distribution of zooplankton in Hornsund Fjord and in the little auk foraging area in the forefield of Hornsund were conducted using standard ecological methods. Samples were collected at fixed monitoring stations using vertical hauls from the seabed to the surface, stratified according to the thermohaline structure of the water column.

The primary sampling tool was a MultiNet system equipped with 180 µm mesh nets, allowing precise sampling from selected depth layers through remote-controlled opening and closing. The vertical extent of individual layers was determined based on temperature and salinity profiles. Alternatively, at stations located within the little auk foraging area, a WP-2 net with a 500 µm mesh size was used. The aim of these investigations was to assess zooplankton abundance and its relationships with environmental conditions.

Description of measured parameters and collected samples

Studies on the qualitative and quantitative composition and spatial distribution patterns of plankton communities in Hornsund Fjord and its forefield were conducted in order to understand their relationships with environmental conditions. Zooplankton samples were collected using a MultiNet (MPS) plankton net system in vertical hauls covering the entire water column at five long-term zooplankton monitoring stations (Table 6.2).

To assess zooplankton abundance in the little auk foraging area in the forefield of Hornsund Fjord, zooplankton samples were collected at eight research stations using a WP-2 net with a 500 µm mesh from the upper layer of the water column (0–50 m). In addition, the same sampling procedure was applied at station N4, which was selected for pilot studies in preparation for future monitoring campaigns within the ADBO framework (Fig. 6.1).

All samples were preserved immediately after collection with a 4% formaldehyde solution in seawater, buffered with borax, and were carefully labeled.

In addition, hydrographic measurements were carried out at all plankton stations using an SBE 911plus CTD system. At stations located in the forefield of Hornsund (the little auk foraging area), water transparency was also measured using a Secchi disk.

Table 6.2 List of plankton stations of the Plankton Ecology Laboratory (PEP) during Leg IIIa.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
H1/R0- monitoring	fjord mouth	167	76 56.224	15 22.051	MPS
AUK13	Alczykowisko	40	76 35.556	15 46.896	WP2/500
AUK14	Alczykowisko	95	76 33.020	15 27.456	WP2/500
AUK15	Alczykowisko	179	76 28.314	15 3.946	WP2/500
AUK16	Alczykowisko	591	76 24.588	14 39.953	WP2/500
N4	Alczykowisko	147	76 29.894	15 1.877	WP2/500
AUK9	Alczykowisko	199	76 34.885	14 6.421	WP2/500
AUK10	Alczykowisko	201	76 38.308	14 28.648	WP2/500
H6/AUK11- monitoring	Alczykowisko	213	76 41.256	14 48.185	MPS
AUK12	Alczykowisko	55	76 45.075	15 18.293	WP2/500
H3- monitoring	Breepolen	134	77 0.511	16 29.678	MPS
H4- monitoring	inner basin	106	77 0.600	16 0.625	MPS
H2- monitoring	central basin	221	76 59.117	15 45.670	MPS

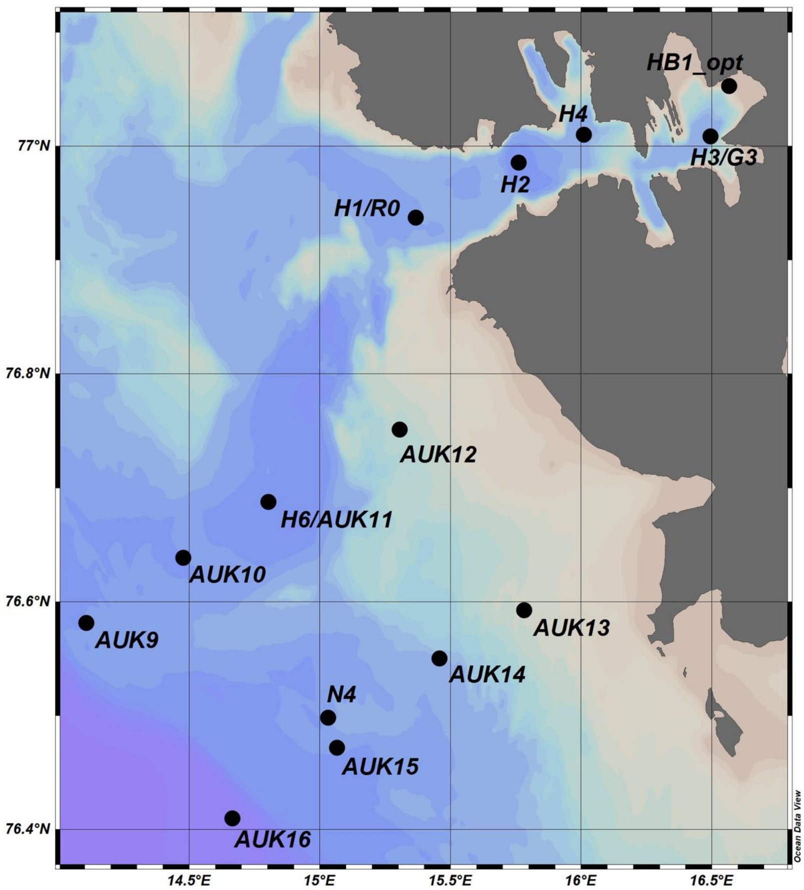


Fig. 6.1 Map of PEP plankton sampling stations in Hornsund during the AREX2025 Leg IIIa.

Further processing of data and collected samples

Analytical work on the zooplankton samples collected for faunistic studies, i.e., the qualitative and quantitative analysis of zooplankton composition, will be carried out after the cruise in the laboratory using optical microscopes and relevant scientific literature. The results of the microscopic laboratory analyses, providing information on the taxonomic composition and abundance of zooplankton organisms in the samples, will form the basis for estimating the composition and abundance of zooplankton communities occurring in the Hornsund region.

The collected data will also be analyzed with respect to the influence of environmental conditions (e.g., temperature, salinity, and nutrient concentrations) on the structure of plankton communities.

6.3 Detailed description of biological measurements – plankton (PFBP)

Description of methods and tools

Zooplankton composition and spatial distribution are analyzed using both traditional methods, such as plankton nets, and advanced optical techniques. The latter include a Laser Optical Plankton Counter (LOPC) and an Underwater Vision Profiler (UVP), which enable non-invasive measurements with high spatial resolution. During the studies conducted in the Hornsund region by the Pelagic Biocenosis Functioning Laboratory, only the UVP system was used due to a malfunction of the LOPC.

Consequently, measurements were limited to vertical profiles at selected stations, carried out in the upper layer of the water column (0–50 m). Whenever possible, three up-and-down profiles were performed; however, due to time constraints and weather conditions, this was not always feasible, and in such cases, measurements were restricted to a single profile.

In addition, the traditional method of zooplankton sampling using a WP-2 plankton net with a mesh size of 180 µm was employed.

Description of measured parameters and collected samples

Research conducted within the LAPSE/SEAPOP projects and as part of the long-term monitoring program in Hornsund Fjord and its forefield focused on assessing plankton abundance and its role in ecosystem functioning, in particular for little auks, which are key planktivorous seabirds breeding in the region (Figs. 6.2, 6.3). To this end, zooplankton samples were collected using a WP2/180 plankton net and by applying optical methods, namely the Underwater Vision Profiler (UVP). These investigations were carried out in the upper layer of the water column (0–50 m). After collection, zooplankton samples were frozen (one haul per station) and preserved in ethyl alcohol and formalin (the second haul divided into two subsamples).

To investigate the variability of carotenoids in key Arctic zooplankton species (Calanus copepods) and their influence on the diet quality and condition of planktivorous little auks, zooplankton samples for genetic and taxonomic analyses, as well as water samples for phytoplankton, carotenoid, and mercury analyses, were collected at selected stations in the forefield of Hornsund within the framework of the ORANGE project (stations H6 and N4; Table 6.3). At each station, two vertical hauls were performed with a WP2/180 plankton net from the surface layer of the water column (0–50 m). The collected material was frozen (one haul) for genetic analyses of zooplankton and preserved in ethyl alcohol (the second haul) for taxonomic analyses. Water samples from depths of 5, 15, 25, 35, and 50 m intended for carotenoid and mercury analyses were filtered through Whatman GF/F filters (0.7 µm pore size) and frozen, whereas integrated water samples intended for phytoplankton analyses were preserved with Lugol's solution.

Vertical UVP profiles were also conducted at additional stations located in different parts of the fjord, in order to partly compensate for the inability to use the LOPC system. In addition, hydrographic measurements were carried out at all plankton stations using an SBE 911plus CTD system.

Table 6.3 List of plankton stations of the Pelagic Biocenosis Functioning Laboratory (PFBP).

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
H1/R0	fjord mouth	167	76 56.224	15 22.051	WP2/180, UVP
AUK13	Alczykowisko	40	76 35.556	15 46.896	WP2/180, UVP
AUK13P	Alczykowisko	57	76 34.216	15 36.696	UVP
AUK14	Alczykowisko	95	76 33.020	15 27.456	WP2/180, UVP
AUK14P	Alczykowisko	160	76 30.660	15 15.632	UVP
AUK15	Alczykowisko	179	76 28.314	15 3.946	WP2/180, UVP
AUK15P	Alczykowisko	225	76 26.429	14 52.106	UVP
AUK16	Alczykowisko	591	76 24.588	14 39.953	WP2/180, UVP
N4 - ORANGE	Alczykowisko	147	76 29.894	15 1.877	WP2/180, UVP, bathometer
AUK9	Alczykowisko	199	76 34.885	14 6.421	WP2/180, UVP
AUK9P	Alczykowisko	200	76 36.776	14 19.219	UVP
AUK10	Alczykowisko	201	76 38.308	14 28.648	WP2/180, UVP
AUK10P	Alczykowisko	214	76 39.715	14 38.355	UVP
H6/AUK11-ORANGE	Alczykowisko	213	76 41.256	14 48.185	WP2/180, UVP, bathometer
AUK11P	Alczykowisko	202	76 43.126	15 3.081	UVP
R13	Breepolen	70	77 2.026	16 33.115	UVP
R12	Breepolen	119	77 0.491	16 30.029	UVP
R11	Breepolen	125	76 59.870	16 25.376	UVP
R10	Breepolen	118	76 59.338	16 20.888	UVP
R9	inner basin	105	76 58.795	16 13.945	UVP
R8	inner basin	46	76 59.238	16 8.118	UVP
R7	inner basin	78	76 59.605	16 4.325	UVP
R6	central basin	109	77 0.005	15 59.912	UVP
R5	central basin	174	76 59.538	15 53.156	UVP
HB1_opt	Breepolen	63	77 3.161	16 33.964	WP2/180, UVP
H3/G3	Breepolen	134	77 0.511	16 29.678	WP2/180, UVP
G5	Breepolen	62	76 58.939	16 31.954	UVP
G4	Breepolen	74	76 59.765	16 31.007	UVP
G2	Breepolen	107	77 1.282	16 27.281	UVP
G1	Breepolen	62	77 1.978	16 25.677	UVP
F4	Breepolen	83	76 58.927	16 22.768	UVP
F1	Breepolen	81	77 0.340	16 17.677	UVP
F2	Breepolen	108	76 59.897	16 18.696	UVP
F3	Breepolen	117	76 59.404	16 20.263	UVP
E3/R8	inner basin	82	76 59.004	16 10.681	UVP

D3	central basin	108	76 59.971	16 0.055	UVP
HB2	inner basin	79	77 0.073	16 5.359	UVP
HK1	Körberbukta	51	76 58.606	16 0.878	UVP
HK2	Körberbukta	13	76 58.594	16 2.387	UVP
H2	central basin	221	76 59.117	15 45.670	WP2/180, UVP
D1	Burgerbukta	111	77 1.585	16 0.662	UVP

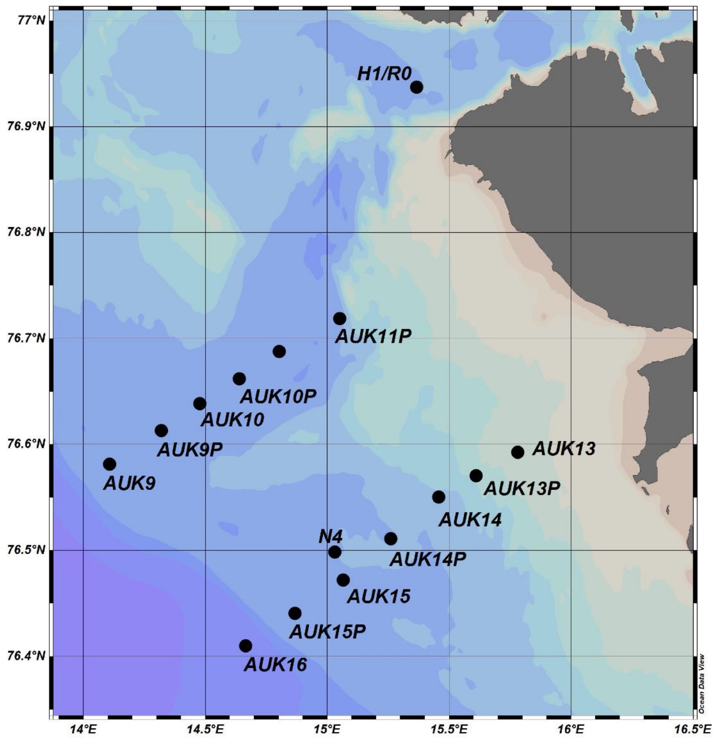


Fig. 6.2 Map of BFBP measurement stations in the forefield of Hornsund during the AREX2025 Leg IIIa.

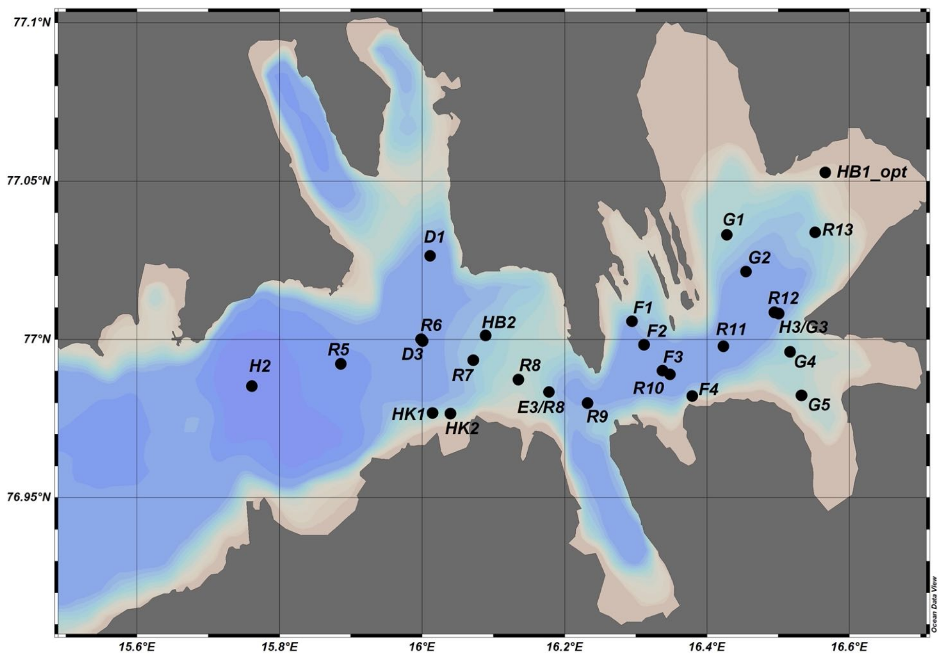


Fig. 6.3 Map of BFBP measurement stations in Hornsund during the AREX2025 Leg IIIa.

Further processing of data and collected samples

The samples will be subjected to qualitative and quantitative analyses at the Institute of Oceanology, Polish Academy of Sciences (IOPAN). The UVP measurements were saved on an external hard drive. Further analysis of these data will be carried out at IOPAN.

6.4 Detailed description of biological measurements – benthos

Description of methods and tools

Studies on the qualitative and quantitative composition and spatial distribution of benthic organisms in Hornsund Fjord were conducted using standard ecological methods. Sediment samples were collected using a Van Veen grab and a box corer.

Samples intended for macrofauna analyses, collected with the Van Veen grab, were sieved onboard through a 500 µm mesh and subsequently preserved in formalin. Sediments for meiofauna analyses were collected using a box corer, from which cores 5 cm in length were taken using a Plexiglas tube with a diameter of 3.6 cm and preserved in formalin. In addition, sediment samples for the analysis of environmental parameters, including chlorophyll *a* content in sediments, carbon and nitrogen content, and granulometric composition, were collected using the same method and frozen at −80°C and −20°C, respectively.

Furthermore, benthic biodiversity will be analyzed using modern metagenomic methods, allowing for more precise species-level identification and the detection of taxa that are difficult to identify using traditional approaches. For this purpose, the surface sediment layer was collected from the box corer using a sterile spatula and frozen.

Sediments for the analysis of Kinorhyncha were collected using a Van Veen grab and were then subjected onboard to the “bubble and blot” method, which enables their extraction from the sediment. The extracted individuals were preserved in 99% ethyl alcohol and frozen. Additionally, the surface sediment layer from one Van Veen grab sample was collected, transferred to a sterile bag, and frozen.

The distribution of megafauna organisms was analyzed using an underwater camera deployed to the seafloor. The duration of a single video recording was approximately 20–30 minutes.

Description of measured parameters and collected samples

The studies conducted in Hornsund Fjord aimed at a detailed analysis of benthic biodiversity and selected organism groups in the context of their spatial distribution and community structure. Samples were collected at long-term monitoring stations located in different parts of the fjord (Fig. 6.4), characterized by varying distances from the glacier front and, consequently, by contrasting environmental conditions. At each monitoring station (HB1, HB2, HB3), three Van Veen grab samples and three box corer samples were collected.

In addition, to determine the taxonomic composition, biomass, and abundance of macro- and meiobenthos, as well as their local-scale distribution patterns within Hornsund Fjord and to compare the current community structure with data collected 20 years ago, one Van Veen grab sample (for macrofauna analyses) and three box corer samples (for meiofauna analyses) were collected at stations located along transects B–G (Fig. 6.4).

At selected stations (Fig. 6.5), seafloor video surveys were also conducted to assess the distribution and biodiversity of megafauna. In addition to the stations where macro- and meiofauna were sampled, video surveys were performed in both branches of Burgerbukta, in the glacier-proximal bay of Körberbukta, at station H1 at the entrance to the fjord, and at station N4 on the fjord forefield.

Studies of the diversity and spatial distribution of organisms from the phylum Kinorhyncha will include both morphological and molecular analyses, enabling detailed species identification as well as the assessment of their spatial patterns within the fjord environment. For this purpose, within the framework of the DRAGONnest project, three Van Veen grab samples were collected at the long-term benthic monitoring stations and at two additional stations (C2 and B3). From one of these samples, Kinorhyncha specimens were extracted using the "bubble and blot" method, while the remaining samples were frozen for subsequent metagenetic analyses.

At each station, a set of sediment samples was also collected for the analysis of physicochemical parameters (three replicates each) from the surface sediment layer: chlorophyll *a* from the 0–2 cm layer, grain-size distribution and carbon and nitrogen content from the 0–5 cm layer, as well as three replicate samples for metagenetic analyses.

Seafloor video surveys were carried out whenever time and logistical conditions allowed (weather and sea state), at a total of 30 research stations. For the first time, seafloor imagery was obtained for both parts of Burgerbukta.

In addition, hydrological measurements were conducted at all benthic stations using the SBE911plus CTD system.

Table 6.4 List of benthic stations of the Benthic Ecology Laboratory and the Meiofauna Laboratory.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
H6/AUK11	forefield	213	76 41.256	14 48.185	Van Veen, Box core
N4	forefield	147	76 29.894	15 1.877	camera
H1/R0	fjord mouth	167	76 56.224	15 22.051	camera
E6	central basin	110	76 55.976	16 16.267	Van Veen, Box core, camera
E5	central basin	111	76 56.887	16 14.873	Van Veen, Box core, camera
E4	central basin	110	76 58.043	16 13.099	Van Veen, Box core, camera
E1	central basin	89	77 0.877	16 7.615	Van Veen, Box core, camera
E2	central basin	52	76 59.998	16 9.490	Van Veen, Box core, camera
HB1_opt	Breepolen	63	77 3.161	16 33.964	Van Veen, Box core
G3	Breepolen	134	77 0.511	16 29.678	Van Veen, Box core, camera
HB1	inner basin	125	77 0.145	16 27.788	Van Veen, Box core, camera
G5	Breepolen	62	76 58.939	16 31.954	Van Veen, Box core, camera
G4	Breepolen	74	76 59.765	16 31.007	Van Veen, Box core

G2	Breepolen	107	77 1.282	16 27.281	Van Veen, Box core, camera
G1	Breepolen	62	77 1.978	16 25.677	Van Veen, Box core, camera
F4	inner basin	83	76 58.927	16 22.768	Van Veen, Box core, camera
F1	inner basin	81	77 0.340	16 17.677	Van Veen, Box core, camera
F2	inner basin	108	76 59.897	16 18.696	Van Veen, Box core, camera
F3	inner basin	117	76 59.404	16 20.263	Van Veen, Box core, camera
E3	central basin	82	76 59.004	16 10.681	Van Veen, Box core
D3	central basin	108	76 59.971	16 0.055	Van Veen, Box core, camera
HB2	central basin	79	77 0.073	16 5.359	Van Veen, Box core, camera
HB3	inner basin	225	76 58.067	15 45.077	Van Veen, Box core
D1	central basin	111	77 1.585	16 0.662	Van Veen, Box core, camera
D4	central basin	109	76 58.999	16 1.721	Van Veen, Box core
C3	central basin	209	76 57.953	15 51.710	Van Veen, Box core
C2	central basin	181	76 59.621	15 51.760	Van Veen, Box core
C1	central basin	167	77 0.033	15 52.073	Van Veen, Box core
B3	outer basin	118	76 57.959	15 40.807	Van Veen, Box core
B1	outer basin	49	76 59.534	15 39.631	Van Veen, Box core
B5	outer basin	90	76 56.394	15 42.422	Van Veen, Box core
BR1	western Burgerbukta	168	77 3.392	15 51.290	camera
BR0	western Burgerbukta	126	77 4.643	15 49.584	camera
HK1	Körberbukta	51	76 58.606	16 0.878	camera
HK2	Körberbukta	13	76 58.594	16 2.387	camera
BR2	western Burgerbukta	96	77 2.467	15 54.433	camera
BR3	western Burgerbukta	82	77 1.550	15 58.099	camera
BRE00	eastern Burgerbukta	81	77 5.478	15 57.289	camera
BRE0	eastern Burgerbukta	103	77 4.951	15 58.168	camera
BRE1	eastern Burgerbukta	83	77 4.048	15 58.568	camera
BRE2	eastern Burgerbukta	36	77 3.188	15 59.231	camera
BRE3	eastern Burgerbukta	57	77 2.397	15 59.811	camera

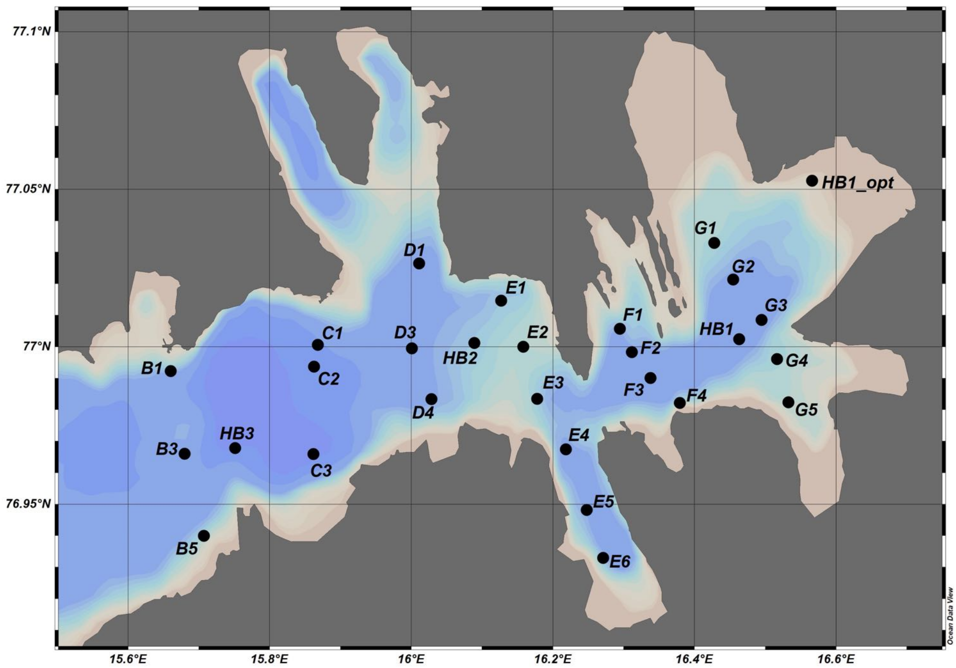
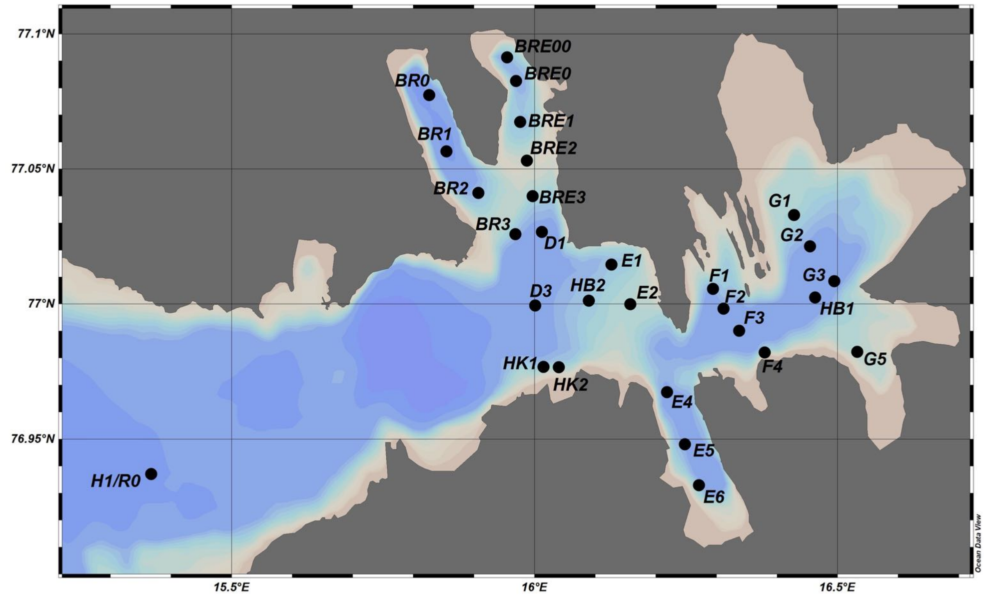


Fig. 6.4 Map of benthic stations in Hornsund (macrofauna and meiofauna) during the AREX2025 Leg IIIa.



Figs. 6.5 Map of benthic stations (megafauna) in Hornsund Fjord and its forefield, where seabed video surveys were conducted during the AREX2025 leg IIIa.

Further processing of data and collected samples

Preserved macrofauna and meiofauna samples will be subjected to qualitative and quantitative analyses in the laboratories of the Department of Ecology at IOPAN. Physicochemical analyses of sediments will be carried out partly at IOPAN and partly outsourced to external institutions. Samples intended for (meta)genetic analyses will be prepared in IOPAN laboratories and subsequently sent for sequencing to external service providers. Processing of images and video material obtained with the underwater camera will be conducted at the Department of Ecology, IOPAN. The analysis of the resulting data will provide valuable information on benthic biodiversity in Hornsund Fjord and will contribute to expanding knowledge on the ecology and evolution of poorly known organism groups, such as Kinorhyncha.

6.5 Detailed description of marine optical measurements

Description of methods and tools

Studies conducted by the Marine Remote Sensing Laboratory and the Marine Biophysics Laboratory aimed to characterize the optical properties of fjord waters of Spitsbergen in order to develop local satellite algorithms for determining concentrations of seawater constituents in the North Atlantic.

Measurements of the spectral characteristics of vertical profiles of solar irradiance attenuation in the water column and of surface spectral reflectance distributions were carried out using a profiling radiometer C-PrOPS (COPs; Biospherical) and RAMSES radiometer systems (TRIOS). These measurements were used to assess light transmission efficiency in different water layers, identify zones of varying biological productivity, and improve the interpretation of satellite data.

For this purpose, during the fjord leg of the cruise the following instrumentation and methods were used:

a) Optical profiling system – COPs: The COPs (Compact Optical Profiling System, Biospherical Instruments Inc.) was operated in free-fall mode. The instrument was deployed from the ship's side in a way that minimized the influence of the ship's shadow. Measurements were carried out down to the lower boundary of the euphotic zone, to the seabed in shallower locations, or to shallower depths under adverse weather conditions.
b) Deck-mounted pyranometers: These instruments measured the above-water downwelling irradiance Es(λ). The obtained data were used to calculate vertical PAR (Photosynthetically Active Radiation) profiles and to derive water color (ocean color) characteristics.
c) RAMSES radiometer (TRIOS): The RAMSES radiometer system (TRIOS) was mounted on a specially designed frame that enabled measurements of upwelling radiance just below the water surface, independently of weather conditions. As with the COPs system, underwater measurements were complemented by simultaneous above-water irradiance measurements using a sensor mounted on the vessel.
d) FluoroProbe fluorometer (bbe Moldaenke): This instrument measured the fluorescence of individual taxonomic groups throughout the entire water column, allowing for the determination of the vertical distribution of phytoplankton functional groups.

To characterize biogeochemical properties, discrete water samples were collected from the surface and from selected depths, identified based on the vertical distribution of fluorescence, temperature, and salinity. The samples were prepared for the determination of phytoplankton pigment concentrations, dissolved substances, total suspended matter (with separation into organic and inorganic fractions), and light absorption coefficients of particles and dissolved substances. Additional samples were used to assess DOM (dissolved organic matter) properties based on its absorption and fluorescence.

Primary production was quantified using the classical ^{14}C radioisotope method. Water was collected from depths of 0, 1, 2, 3, 5, 7, 10, 15, 20, and 30 m and incubated for 4 hours under natural light conditions. After incubation, the samples were filtered to determine chlorophyll and carotenoid concentrations by HPLC, chlorophyll a, and absorption coefficients of suspended particles (a_p), phytoplankton (a_ph), and detritus (a_d).

During each incubation experiment, temperature and salinity profiles were simultaneously recorded using the SBE911plus CTD system, and a series of optical measurements (C-PrOPS and RAMSES radiometers) was performed at the beginning, middle, and end of each incubation. This approach enabled a comprehensive assessment of changes in light conditions and environmental parameters during primary production measurements.

Description of measured parameters and collected samples

In addition to the instruments listed above that were used for in situ measurements of the optical properties of seawater, discrete seawater samples were also collected using a bathometer from three layers: 0–5 m (surface waters), from the layer of maximum chlorophyll concentration determined on the basis of temperature, salinity, and chlorophyll a (Chl a) profiles acquired immediately prior to sampling, and from the underlying layer characterized by distinctly different salinity conditions.

The collected water was filtered through filters of different porosities in order to obtain the following parameters during subsequent laboratory analyses at the Institute:

a) Chl a – chlorophyll a concentration determined spectrophotometrically,
b) HPLC – concentrations of chlorophyll and accessory carotenoids determined by chromatographic methods,
c) a_pl – light absorption coefficients of suspended particles in water, phytoplankton, and detritus, determined using the Tassan–Ferrari method.

In addition, water samples were preserved in borosilicate glass bottles to determine FDOM (excitation–emission fluorescence matrices of dissolved organic matter DOM) and DOC (dissolved organic carbon concentration).

Samples intended for the analysis of particle size distribution in water using the conductometric method were preserved with Lugol's solution and stored in plastic bottles at a temperature of 8 °C.

Table 6.5 Map of optical measurement stations at the Horsund forefield and in Hornsund measured during the AREX2025 Leg IIIa.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
H1/R0	fjord mouth	167	76 56.224	15 22.051	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
AUK13	Alczykowisko	40	76 35.556	15 46.896	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
N4	Alczykowisko	147	76 29.894	15 1.877	C-OPS, TRIOS, bbe Fluoroprobe, bathometer, ekspozycja produkcji pierwotnej
AUK10	Alczykowisko	201	76 38.308	14 28.648	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
H6/AUK11	Alczykowisko	213	76 41.256	14 48.185	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
					C-OPS, TRIOS, bbe Fluoroprobe, bathometer
HB1_opt	Breepolen	63	77 3.161	16 33.964	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
R13	Breepolen	75	77 1.976	16 32.787	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
H3/G3	Breepolen	134	77 0.511	16 29.678	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
R9_opt	inner basin	106	76 58.804	16 13.224	C-OPS, TRIOS, bbe Fluoroprobe, bathometer

H4	inner basin	106	77 0.600	16 0.625	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
R8	inner basin	82	76 59.004	16 10.681	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
H2	central basin	221	76 59.117	15 45.670	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
R5	central basin	181	76 59.621	15 51.760	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
R3	central basin	118	76 57.959	15 40.807	C-OPS, TRIOS, bbe Fluoroprobe, bathometer

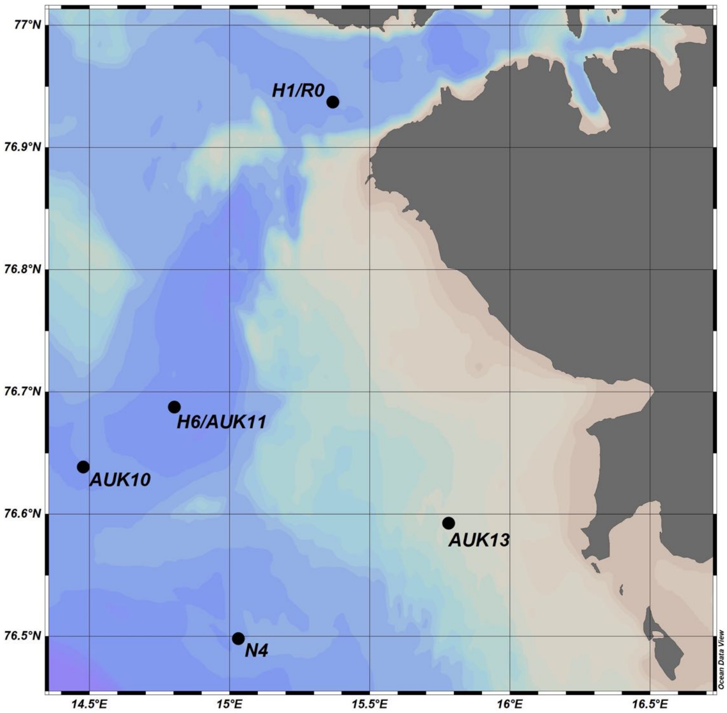
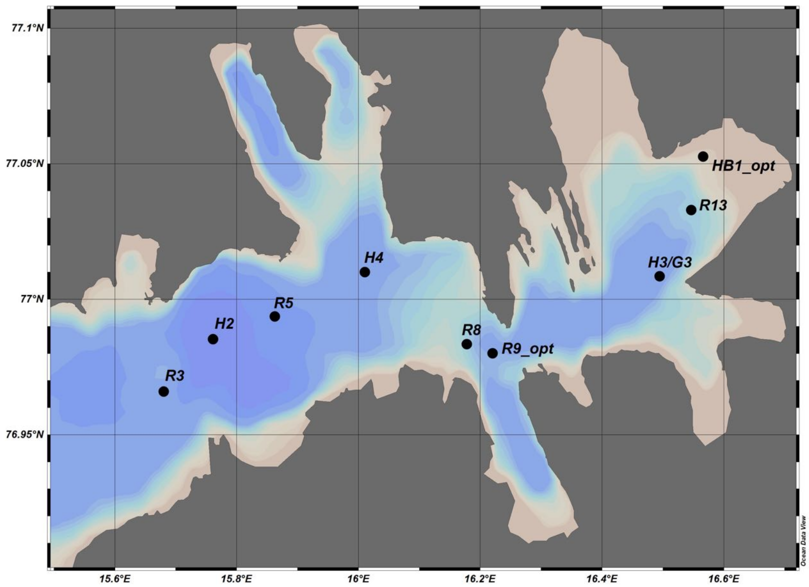


Fig. 6.6 Map of optical measurement stations at the Hornsund forefield during the AREX2025 Leg IIIa.



Rys. 6.7 Map of optical measurement stations in Hornsund during the AREX2025 Leg IIIa.

Further processing of data and collected samples

The samples collected on filters and the water samples intended for FDOM and DOC analyses were properly preserved and stored under appropriate conditions until further laboratory analyses at IOPAN.

6.6 Detailed description of marine chemistry measurements

Description of methods and tools

Studies aimed at determining the contamination of bottom sediments, waters, and suspended matter by heavy metals, organic pollutants, and radioactive isotopes, as well as the degree of contamination of benthic organisms by these compounds in glacier-influenced bays, were conducted using comprehensive ecological methods. Basic physical parameters of the water column were measured with a CTD probe. Water samples were collected from three depths: the surface (0 m), an intermediate layer (20 m), and the near-bottom zone. The samples were filtered, and both filters and water samples were preserved by freezing or by adding appropriate reagents, thereby preparing the material for analyses of heavy metals, organic pollutants, and radioactive isotopes in onshore laboratories.

Bottom sediments were collected using a Nemisto-type corer, which allows for the retrieval of undisturbed sediment cores. Each core was sectioned into 1-cm layers, enabling a detailed reconstruction of the vertical distribution of contaminant concentrations. Sediment samples intended for chemical analyses were immediately frozen to preserve their structure and chemical composition. Samples for microbiological analyses were taken from the surface layer of the Van Veen grab using a sterile spatula and then frozen.

Benthic organisms were collected using a bottom dredge, which allowed sampling from the sediment surface in the glacier-influenced bay area. The collected material was initially sorted and subjected to preliminary taxonomic identification. The organisms were then preserved by freezing, allowing their subsequent use in chemical analyses to determine concentrations of heavy metals, persistent organic pollutants, and radioactive isotopes.

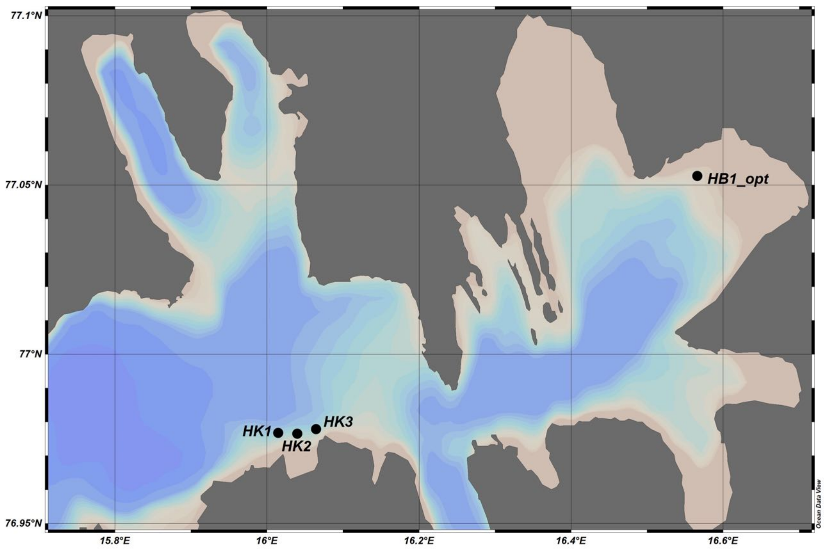
Description of measured parameters and collected samples

Studies conducted in Hornsund Fjord aimed to provide a detailed analysis of contamination levels in individual environmental components, i.e., the water column, sediments, and benthic organisms. Samples were collected in the glacier-influenced bay Körberbukta (Table 6.6; Fig. 6.8). At each station, bottom dredging was performed to obtain a quantitatively sufficient and taxonomically diverse sample of benthic organisms. Sediment samples for microbiological analyses were also collected using a Van Veen grab. At station HK2, a 30 cm-long sediment core was retrieved.

In addition, at station HB1_opt, located in the inner part of Breepolen, a 42 cm-long sediment core was collected. Investigations at this station will serve as an environmental background for monitoring the glacier-influenced bay area that has been exposed by the retreating glacier.

Table 6.6 List of sampling stations of the Polar Regions Contamination Laboratory.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
HB1_opt	Breepolen	63	77 03.161	16 33.964	Nemisto
HK1	Körberbukta	51	76 58.606	16 00.878	Dredge, Van Veen, bathometer
HK2	Körberbukta	43	76 58.594	16 02.387	Nemisto, dredge, Van Veen, bathometer
HK3	Körberbukta	53	76 58.675	16 30.873	Dredge, Van Veen, bathometer



Rys. 6.8 Map of marine chemistry stations during the AREX2025 Leg IIIa.

Further processing of data and collected samples

Laboratory analyses of the collected samples of suspended matter, bottom sediments, and benthic organisms will include the determination of concentrations of selected contaminants: heavy metals (using AAS and ICP-MS) and ^137Cs (using a gamma analyzer). In addition, sediment accumulation rates (using the ^210Pb method) and organic carbon content (CHN analysis) will be determined. These analyses will be carried out at the Polar Regions Contamination Laboratory. Analyses of organic pollutant concentrations will be performed subsequently at the Geotoxicology Laboratory. Depending on available funding, microbiological analyses will then be conducted in cooperation with the Marine Genetics Laboratory.

6.7 Detailed description of oceanographic measurements

Description of methods and tools

To investigate the thermohaline and oxygen properties as well as the distribution of water masses in Hornsund Fjord and its forefield, hydrographic measurements were carried out using the SBE 9/11+ CTD system. A detailed description of the SBE 9/11+ measurement system is provided in Chapter 5.

Description of measured parameters and collected samples

In the forefield of Hornsund, CTD measurements were performed only down to ~200 m in order to save time and because the focus was on processes occurring in the surface layer. In the fjord, full-depth profiles were carried out down to the bottom. Within the fjord, transects (spatially dense vertical profiles) were conducted both along and across the main axis of the fjord (at the fjord mouth) (Fig. 6.9) in order to investigate water dynamics, exchange with the shelf, and interannual variability relative to previous years. In total, 29 vertical CTD casts were performed. Additional vertical CTD profiles were also collected in Burgerbukta, in both its western and eastern branches (Fig. 6.9).

Furthermore, CTD measurements were conducted at every station where optical measurements were performed or where zooplankton or benthic samples were collected. Altogether (including the Rm and R transects), 83 vertical CTD casts were completed using the SBE 911plus system. Water samples for plankton, benthos, and optical studies were collected using a bathometer available on board the vessel. Throughout the entire leg, current mesurements werw also collected using VM-ADCP.

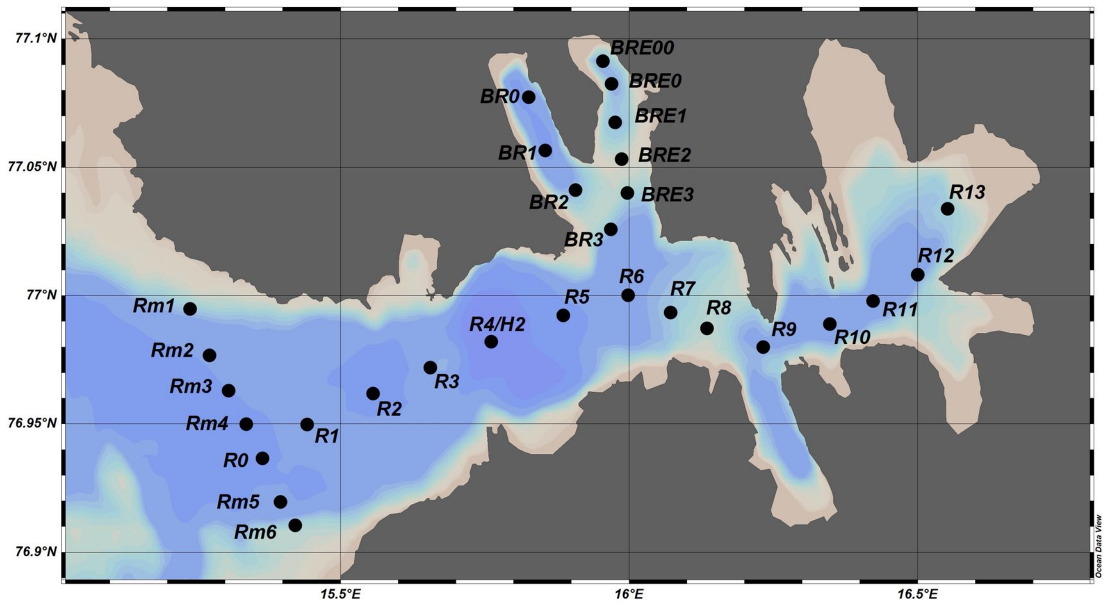


Fig. 6.9 Map of CTD stations measured in Hornsund during the AREX2025 leg IIIa.

Further processing of data and collected samples

The collected data were recorded and will be further processed and analyzed at IOPAN.

7 Mesurements and sampling program during AREX 2025 Leg IIIb

7.1 General information about Leg IVb

Leg IIIb began on 12 August with a berth stay in Longyearbyen, during which part of the crew was exchanged, freshwater was bunkered, and the previous leg of the cruise was formally closed. The planned departure was delayed due to the emergency disembarking of the crew member (cook) who was transported ashore. After weighing anchor, a decision was made to remain in Isfjorden while awaiting information on the arrival of a cook replacement.

Research activities commenced in the glacial bay Borebukta, where, at three stations, seabed video surveys were conducted, macrofauna samples were collected, sediments for biogeochemical analyses were taken, Nemisto cores were retrieved, and dredging was carried out. On the following day, work began on the profile comprising stations ISA, ISF3, and BAB. Due to the failure of the LOPC instrument since the beginning of Leg IIIa, replacement measurements using the UVP system were also carried out during Leg IIIb, both at the main stations and at intermediate points. Plankton samples and water for phytoplankton analyses were collected, optical measurements were performed, and in the BAB area additional seabed video surveys and sampling were conducted as part of the pilot studies for the TWINS BIS project. The night was spent at anchor in Adolfbukta.

Subsequently, a series of benthic surveys was conducted at stations in the central part of the fjord. After completing the scientific work, the vessel set course for Longyearbyen, where a new cook was embarked. However, at that time a failure of the ship's generator temperature sensor occurred, making further navigation outside Isfjorden impossible. As immediate repair was not feasible, the vessel remained in the Longyearbyen area. Attempts to obtain spare parts locally were unsuccessful, and their delivery from Poland required several days, which prevented the implementation of the main plan for Leg IIIb. As a result, the original objectives of Leg IIIb could not be achieved, and the planned research in Kongsfjorden and Magdalenefjorden could not be carried out.

The vessel remained in Isfjorden, where, in accordance with existing permits and within the available logistical constraints, an alternative research programme was organized. Benthic, optical, and plankton studies were conducted, among others, in Dicksonfjorden, Ekmanfjorden, and at station BAB. The research teams also developed an alternative plan involving an intensive 24-hour monitoring of the water column at station BABA (located close to station BAB). Within this programme, CTD and UVP measurements were performed hourly, while optical measurements and zooplankton sampling were carried out every four hours. In parallel, the benthic and marine chemistry team conducted work related to a planned project on the role of jellyfish in carbon transfer to bottom sediments. Additional activities included seabed video surveys, sediment coring, dredging, and sampling within the TWINS BIS and DRAGONnest projects.

Despite the inability to leave Isfjorden, Leg IIIb was used to the fullest extent possible under the prevailing conditions, and the scientific team carried out a range of valuable substitute studies. The leg concluded with the return to Longyearbyen and the disembarkation of the research team on 22 August.

Table 7.1. List of research stations of Leg IIIb with a detailed overview of the measurements.

No	Station	Depth (m)	Date	Latitude (deg min N)	Lon gitude (deg min E)	Measurements and sampling
1	IB1	37	13.08.25	78 20.965	14 27.235	CTD SBE9/11+, UVP, Van Veen, camera, Nemisto, dredge, bathometer
2	IB2	39	13.08.25	78 20.621	14 25.512	CTD SBE9/11+, UVP, Van Veen, camera, Nemisto, dredge, bathometer
3	IB3	57	13.08.25	78 20.239	14 23.699	CTD SBE9/11+, UVP, Van Veen, camera, Nemisto, dredge, bathometer
4	ISA	165	14.08.25	78 14.578	15 16.392	CTD SBE9/11+, UVP, WP2/100, bathometer
5	ISA_P	152	14.08.25	78 20.644	15 40.201	CTD SBE9/11+, UVP
6	ISF3	90	14.08.25	78 26.807	16 04.699	CTD SBE9/11+, UVP, WP2/100, camera, C-OPS, TRIOS, bbe Fluoroprobe, bathometer
7	ISF3_P	114	14.08.25	78 33.354	16 24.744	CTD SBE9/11+, UVP, camera
8	BAB	183	14.08.25	78 39.684	16 44.316	CTD SBE9/11+, UVP, WP2/60, WP2/100, WP2/180, WP3/1000, camera, bathometer
9	IA1	87	15.08.25	78 39.221	16 49.628	CTD SBE9/11+, Van Veen, Box Core
10	IA2	173	15.08.25	78 39.869	16 47.105	CTD SBE9/11+, Van Veen, Box Core, camera
11	IP1	31	15.08.25	78 40.422	16 31.121	CTD SBE9/11+, Van Veen, Box Core, camera
12	IB1_S	66	15.08.25	78 38.052	16 27.124	CTD SBE9/11+, Van Veen, Box Core, camera, Nemisto
13	IY1	47	16.08.25	78 16.120	13 58.021	CTD SBE9/11+, Van Veen, camera, Nemisto, dredge, bathometer
14	IY2	46	16.08.25	78 16.116	13 59.273	CTD SBE9/11+, Van Veen, Nemisto, dredge, bathometer
15	IY3	37	16.08.25	78 16.132	14 00.764	CTD SBE9/11+, Van Veen, camera, dredge, bathometer
16	ISK	269	16.08.25	78 19.460	15 19.460	CTD SBE9/11+, UVP, WP2/60, WP2/180, WP3/1000, C-OPS, TRIOS,bbe Fluoroprobe, bathometer
17	T4F	228	16.08.25	78 17.346	14 57.857	CTD SBE9/11+, Van Veen
18	ID1	41	17.08.25	78 47.653	15 17.480	CTD SBE9/11+, Van Veen, Box Core, camera
19	IDS	69	17.08.25	78 42.064	15 19.654	CTD SBE9/11+, Van Veen, Box Core, camera
20	ID6	35	17.08.25	78 36.571	15 08.666	CTD SBE9/11+, Van Veen
21	IE3	92	17.08.25	78 34.285	14 44.183	CTD SBE9/11+, Van Veen, Box Core, camera
22	IE2	42	17.08.25	78 37.554	14 42.352	CTD SBE9/11+, Van Veen, Box Core, camera
23	MONI6	143	17.08.25	78 31.110	14 56.502	CTD SBE9/11+, C-OPS, TRIOS, bathometer
24	MONI5	227	17.08.25	78 23.192	15 11.674	CTD SBE9/11+, C-OPS, TRIOS, bathometer

25	MONI3	284	18.08.25	78 09.266	14 00.691	CTD SBE9/11+, C-OPS, TRIOS, bathometer
26	BABA	127	18.08.25	78 39.383	16 45.815	CTD SBE9/11+, UVP, C-OPS, TRIOS, bbe Fluoroprobe, WP2/180, bathometer, camera
27	BABA1	127	18.08.25	78 39.359	16 45.655	CTD SBE9/11+, UVP
28	BABA2	127	19.08.25	78 39.335	16 45.865	CTD SBE9/11+, UVP
29	BABA3	123	19.08.25	78 39.336	16 45.976	CTD SBE9/11+, UVP
30	BABA4	126	19.08.25	78 39.364	16 45.881	CTD SBE9/11+, UVP, C-OPS, TRIOS, bbe Fluoroprobe WP2/60, bathometer
31	BABA5	124	19.08.25	78 39.346	16 45.890	CTD SBE9/11+, UVP
32	BABA6	131	19.08.25	78 39.365	16 45.773	CTD SBE9/11+, UVP
33	BABA7	131	19.08.25	78 39.403	16 45.798	CTD SBE9/11+, UVP
34	BABA8	127	19.08.25	78 39.362	16 45.850	CTD SBE9/11+, UVP, C-OPS, TRIOS, bbe Fluoroprobe, WP2/60, bathometer
35	BABA9	139	19.08.25	78 39.442	16 45.823	CTD SBE9/11+, UVP
36	BABA10	124	19.08.25	78 39.337	16 45.955	CTD SBE9/11+, UVP
37	BABA11	123	19.08.25	78 39.356	16 45.785	CTD SBE9/11+, UVP
38	BABA12	124	19.08.25	78 39.336	16 45.818	CTD SBE9/11+, UVP, C-OPS, TRIOS, WP2/60, bathometer
39	BABA13	130	19.08.25	78 39.399	16 45.811	CTD SBE9/11+, UVP
40	BABA14	125	19.08.25	78 39.320	16 46.006	CTD SBE9/11+, UVP
41	BABA15	140	19.08.25	78 39.412	16 45.647	CTD SBE9/11+, UVP
42	BABA16	142	19.08.25	78 39.430	16 45.766	CTD SBE9/11+, UVP, C-OPS, TRIOS, bbe Fluoroprobe, WP2/60, bathometer
43	BABA17	126	19.08.25	78 39.367	16 45.996	CTD SBE9/11+, UVP
44	BABA18	122	19.08.25	78 39.329	16 46.244	CTD SBE9/11+, UVP
45	BABA19	107	19.08.25	78 39.222	16 46.295	CTD SBE9/11+, UVP
46	BABA20	115	19.08.25	78 39.250	16 46.254	CTD SBE9/11+, UVP, C-OPS, TRIOS, WP2/60, bathometer
47	BABA21	111	19.08.25	78 39.250	16 46.154	CTD SBE9/11+, UVP
48	BABA22	115	19.08.25	78 39.264	16 45.995	CTD SBE9/11+, UVP
49	BABA23	121	19.08.25	78 39.284	16 46.051	CTD SBE9/11+, UVP
50	BABA24	123	19.08.25	78 39.293	16 46.219	CTD SBE9/11+, UVP
51	SBI1	138	20.08.25	78 38.447	16 34.368	CTD SBE9/11+, Van Veen, Box Core, camera
52	SBI2	136	20.08.25	78 35.388	16 27.503	CTD SBE9/11+, Van Veen, Box Core, camera
53	SBI3	53	20.08.25	78 30.679	16 16.387	CTD SBE9/11+, Van Veen, Box Core, camera
54	SBI4	72	21.08.25	78 28.206	16 04.330	CTD SBE9/11+, Van Veen, Box Core, camera

7.2 Detailed description of biological measurements – plankton (PEP)

Description of methods and tools

Studies on habitat and feeding preferences of sibling zooplankton species, characterized by different centers of distribution, were conducted using vertically stratified net tows from the bottom to the surface. Sampling was performed with WP-2 nets with a mesh size of 60 µm and WP-3 nets with a mesh size of 1000 µm. The WP-2 (60 µm) net was also used to collect material at the 24-hour water-column monitoring station.

Description of measured parameters and collected samples

For the purposes of the TWINS BIS project, which investigates habitat and feeding preferences of sibling zooplankton species, the sampling set included zooplankton samples intended for genetic analyses and stable isotope analyses in planktonic organisms, as well as seawater samples for the determination of chlorophyll concentration, stable carbon and nitrogen isotopes, and the qualitative and quantitative composition of planktonic protozoans. The study was conducted at two stations located in Isfjorden: ISK and BAB (Table 7.2, Fig. 7.1).

Samples were collected using a WP2 net with a mesh size of 1000 µm from the 0–100 m layer. After collection, zooplankton samples were divided into two parts using a splitter and preserved accordingly. One half, intended for taxonomic analyses, was preserved in 4% formalin, while the other half was split again and frozen. These frozen subsamples were designated for stable isotope analyses in planktonic organisms and for genetic analyses (metabarcoding).

Additional samples were collected using a WP2-60 net from three depth layers: 0–25 m, 25–50 m, and 50–100 m. These samples were preserved in the same way as those from the previous WP net, i.e., in formalin for taxonomic analyses or frozen for subsequent genetic or isotopic analyses.

At each station, in addition to zooplankton samples, seawater samples were collected from four depths for the analysis of chlorophyll concentration, stable carbon and nitrogen isotopes, and the qualitative and quantitative composition of planktonic protozoans. Water samples for chemical analyses were filtered onto Whatman GF/F filters (25 mm and 50 mm), which were subsequently frozen, while samples intended for protozoan analyses were preserved with Lugol's solution.

For the purposes of the studies conducted at station BABA, i.e., the 24-hour water column monitoring, three net tows were performed from the following depth layers: 125–50 m, 50–25 m, and 25–0 m using a WP2-60 µm zooplankton net. Samples were collected every 4 hours.

Table 7.2 List of plankton stations of the Plankton Ecology Laboratory (PEP) during Leg IIIb.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
ISK	Isfjorden central basin	269	78 19.460	15 19.460	WP3-1000, WP2-60, bathometer
BAB	Isfjorden/Billefjorden-inner basin	183	78 39.684	16 44.316	WP3-1000, WP2-60, bathometer
BABA	Isfjorden/Billefjorden-inner basin	127	78 39.383	16 45.815	WP2-60

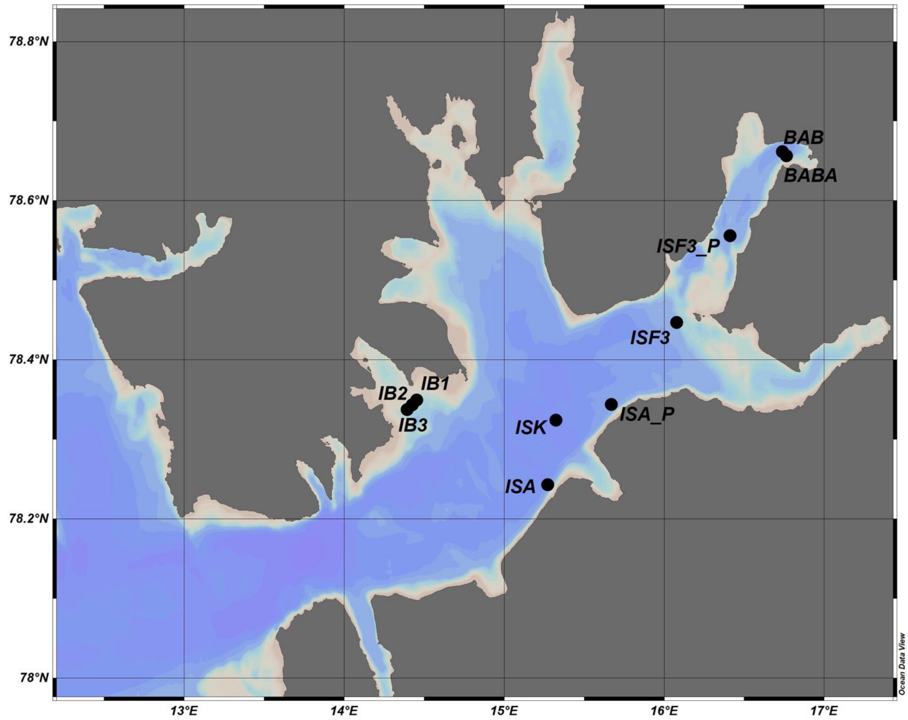


Fig. 7.1 Map of sampling stations of the Laboratory of Plankton Ecology (PEP) and the Laboratory of Pelagic Biocenosis Functioning (PFBP) in Isfjorden during the AREX2025 Leg IVb.

Further processing of data and collected samples

Stable isotope analyses and genetic analyses of selected zooplankton individuals will be carried out in specialized laboratories.

7.3 Detailed description of biological measurements – plankton (PFBP)

Description of methods and tools

The research methods and measuring equipment used by the Laboratory of Pelagic Biocenosis Functioning during Leg IIIb did not differ from those applied during Leg IIIa, with the exception of the plankton net: in the studies conducted in Isfjorden, the WP2-180 net was replaced by the WP2-100 net. A detailed description of the remaining methods is provided in Section 6.3.

Description of measured parameters and collected samples

In Isfjorden, the studies carried out by the Laboratory of Pelagic Biocenosis Functioning focused on measurements of zooplankton abundance, distribution, and taxonomic composition, as well as marine aggregates, using the UVP along a transect following the fjord axis, from station BAB through ISF3 to station ISA (Fig. 7.1). At these stations—unlike at all previous ones—zooplankton samples were collected using a WP2 net with a mesh size of 100 µm. Additional UVP measurements were performed at the intermediate stations along this transect, i.e., ISF3_P and ISA_P.

The PFBP team also participated in the 24-hour water-column monitoring conducted at station BABA. During this period, a vertical UVP profile from the surface to the bottom was carried out every hour. Data were also collected at stations IB1, IB2, IB3, and ISK.

All collected samples were properly preserved in accordance with the procedures described in Section 6.3 and stored until further analyses.

In addition, hydrographic measurements using the SBE911plus CTD system were conducted at all plankton stations.

Table 7.3 List of plankton stations of the Pelagic Biocenosis Functioning Laboratory (PFBP) during the AREX2025 Leg IIIb.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
IB1	Borebukta	37	78 20.965	14 27.235	UVP
IB2	Borebukta	39	78 20.621	14 25.512	UVP
IB3	Borebukta	57	78 20.239	14 23.699	UVP
ISA	Isfjorden/Adventfjorden	165	78 14.578	15 16.392	UVP, WP2/100
ISA_P	Isfjorden	152	78 20.644	15 40.201	UVP
ISF3	Isfjorden - Billefjorden mouth	90	78 26.807	16 04.699	UVP, WP2/100
ISF3_P	Isfjorden/Billefjorden	114	78 33.354	16 24.744	UVP
BAB	Isfjorden/Billefjorden inner basin	183	78 39.684	16 44.316	UVP, WP2/100
ISK	Isfjorden - central basin	269	78 19.460	15 19.460	UVP
BABA	Isfjorden/Billefjorden inner basin	127	78 39.383	16 45.815	UVP

Further processing of data and collected samples

The samples will be subjected to qualitative and quantitative analyses at the Institute of Oceanology, Polish Academy of Sciences (IO PAN). The UVP measurements have been saved on an external drive. Further data processing and analysis will be carried out at IOPAN after the cruise.

7.4 Detailed description of biological measurements – benthos

Description of methods and tools

The research methods and measurement equipment used by the Laboratory of Benthic Ecology and Meiofauna during Leg IIIb did not differ from those applied during Leg IIIa. A detailed description is provided in Section 6.4.

Description of measured parameters and collected samples

As in the case of Leg IIIa, the research conducted during Leg IIIb aimed at a detailed analysis of benthic biodiversity and selected groups of organisms in the context of their spatial distribution and community structure. Seafloor video surveys were carried out, and sediment samples were collected at stations located in different parts of Isfjorden (Table 7.4; Fig. 7.3).

Within the framework of the DRAGONnest project and the activities of the Meiofauna Laboratory, three Van Veen grab samples were collected at most stations, of which two were used for the extraction of Kinorhyncha individuals and one for metagenetic analyses. Extraction was performed using the “bubble and blot” method, and sediments intended for genetic analyses were frozen in sterile bags immediately after collection.

At each station, three replicate samples for qualitative and quantitative analyses of meiofaunal assemblages were also collected using a Box Corer. In addition, a set of samples for the analysis of the physicochemical properties of surface sediments was taken from the Box Corer: samples for chlorophyll *a* analysis from the 0–2 cm layer, and samples for granulometric analysis as well as carbon and nitrogen content from the 0–5 cm layer. At most stations, the collection of bottom sediments for taxonomic and environmental analyses was accompanied by seafloor video surveys documenting the occurrence of megafaunal organisms. In the vicinity of station BABA, not only seafloor video recordings were performed, but gelatinous plankton (jellyfish) was also collected in order to assess their carbon content and to estimate the magnitude of carbon transfer from the water column to the seabed mediated by these organisms (the “Medusa” project initiated by PEB and PZRP).

In addition, hydrograhic measurements using the SBE911plus CTD system were carried out at all benthic stations.

Table 7.4 List of benthic stations of the Benthic Ecology Laboratory and the Meiofauna Laboratory

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
IA1	Adolfbukta	87	78 39.221	16 49.628	Van Veen, Box core
IA2	Adolfbukta	173	78 39.869	16 47.105	Van Veen, Box core, camera
IP1	Petuniabukta	31	78 40.422	16 31.121	Van Veen, Box core, camera
IB1_S	Billefjorden	66	78 38.052	16 27.124	Van Veen, Box core, camera
IY1	Ymerbukta	47	78 16.120	13 58.021	Van Veen, camera
IY2	Ymerbukta	46	78 16.116	13 59.273	Van Veen, camera
IY3	Ymerbukta	37	78 16.132	14 00.764	Van Veen, camera
T4F	Isfjorden-central basin	228	78 17.346	14 57.857	Van Veen
ID1	Dicksonfjorden	41	78 47.653	15 17.480	Van Veen, Box core, camera
IDS	Dicksonfjorden	69	78 42.064	15 19.654	Van Veen, Box core, camera
ID6	Dicksonfjorden	15	78 36.637	15 06.808	Van Veen
IE3	Ekmanfjorden	92	78 34.285	14 44.183	Van Veen, Box core, camera
IE2	Ekmanfjorden	42	78 37.554	14 42.352	Van Veen, Box core, camera
SBI1	Billefjorden	138	78 38.447	16 34.368	Van Veen, Box core, camera
SBI2	Billefjorden	136	78 35.388	16 27.503	Van Veen, Box core, camera
SBI3	Billefjorden	53	78 30.679	16 16.387	Van Veen, Box core, camera
SBI4	Billefjorden	72	78 28.206	16 04.330	Van Veen, Box core, camera
IB1	Borebukta	37	78 20.965	14 27.235	camera
IB2	Borebukta	39	78 20.621	14 25.512	camera
IB3	Borebukta	57	78 20.239	14 23.699	camera

ISF3	Isfjorden-Billefjorden mouth	90	78 26.807	16 04.699	camera
ISF3_P	Isfjorden	114	78 33.354	16 24.744	camera
BAB	Isfjorden/Billefjorden - inner basin	183	78 39.684	16 44.316	camera
BABA	Isfjorden/Billefjorden - inner basin	127	78 39.383	16 45.815	camera

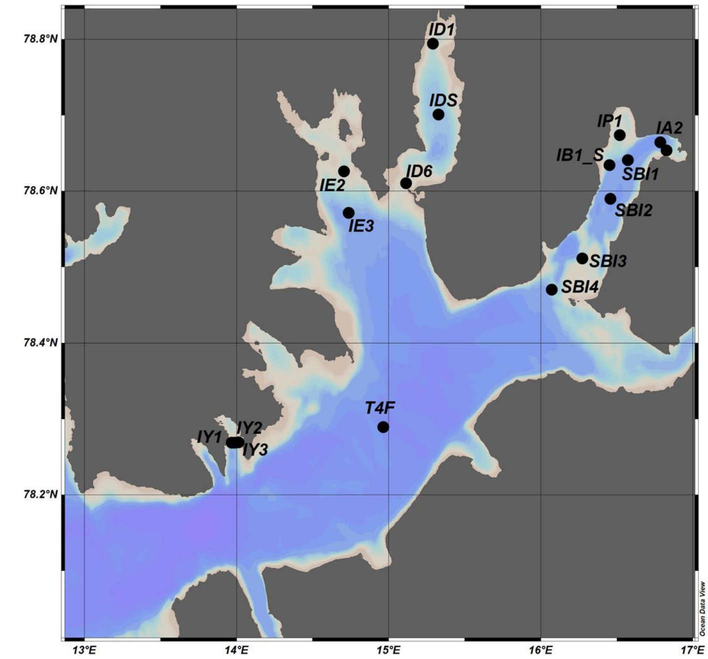


Fig. 7.2 Map of benthic stations in Isfjorden (meiofauna).

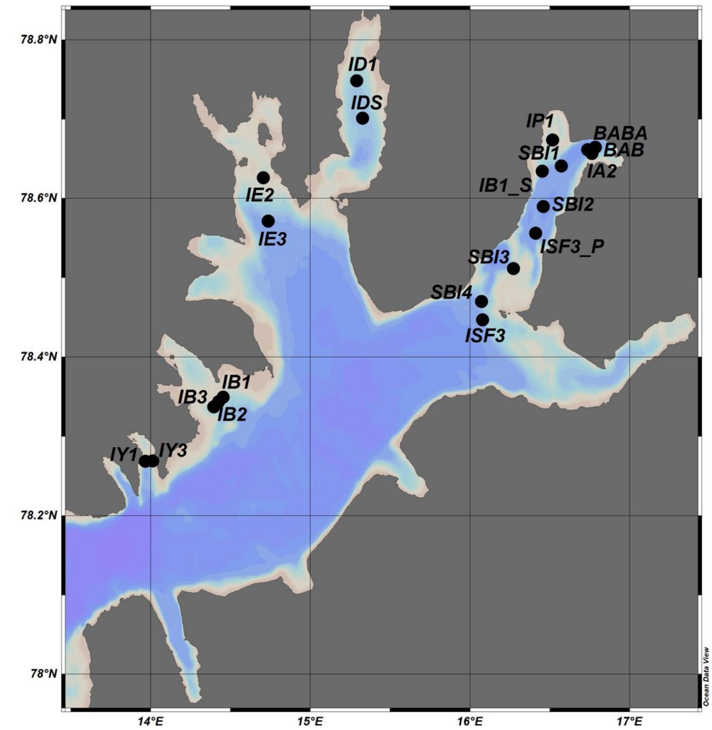


Fig. 7.3 Map of benthic stations (megafauna) in Isfjorden where seabed video surveys were conducted during the AREX2025 Leg IIIb.

Further processing of data and collected samples

Preserved meiofauna samples will be subjected to qualitative and quantitative analyses in the laboratories of the Ecology Department at IOPAN. Physicochemical analyses of sediments will be carried out partly at IOPAN and partly outsourced to external institutions. Samples for (meta)genetic analyses will be prepared in IOPAN laboratories and subsequently sent for sequencing to external companies. The analysis of the obtained results will provide important information on the benthic biodiversity of Isfjorden and will contribute to improving our understanding of the ecology and evolution of poorly known groups of organisms, such as Kinorhyncha.

7.5 Detailed description of optical measurements

Description of methods and tools

The measurement equipment used by the Marine Remote Sensing Laboratory and the Marine Biophysics Laboratory during Leg IIIb did not differ from that used during Leg IIIa. A detailed description is provided in Section 6.5.

Description of measured parameters and collected samples

In addition to the in situ measurements performed using the C-OPS and TRIOS instruments, seawater samples were also collected with a bathometer from two layers: 0–5 m (surface waters) and from the depth of maximum chlorophyll concentration, as determined from temperature, salinity, and chlorophyll *a* (Chl *a*) profiles acquired immediately prior to sampling. Furthermore, the water was preserved in borosilicate glass bottles and stored for subsequent laboratory analyses. A description of the analyzed seawater parameters is provided in Section 6.5. The list of optical sampling stations for Leg IIIb is given in Table 7.5 and shown in Figure 7.4.

Although the optical team had not originally planned to conduct measurements in Isfjorden, changes to the cruise schedule resulted in optical observations being carried out at five stations located in different parts of Isfjorden. In addition, the team participated in the 24-hour water column monitoring conducted at station BABA. During this period, optical measurements were performed and water samples were collected every four hours for further analyses.

Table 7.5 List of marine optics stations in Isfjorden during the AREX2025 Leg IIIb.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
ISF3	Isfjorden-Billefjorden mouth	90	78 26.807	16 04.699	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
ISK	Isfjorden inner basin	269	78 19.460	15 19.460	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
MONI6	Nordfjorden	143	78 31.110	14 56.502	C-OPS, TRIOS, bbe Fluoroprobe, bathometer

MONI5	Isfjorden central basin	227	78 23.192	15 11.674	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
MONI3	Isfjorden outer basin	284	78 09.266	14 00.691	C-OPS, TRIOS, bbe Fluoroprobe, bathometer
BABA	Isfjorden/Billefjorden-inner basin	127	78 39.383	16 45.815	C-OPS, TRIOS, bbe Fluoroprobe, bathometer

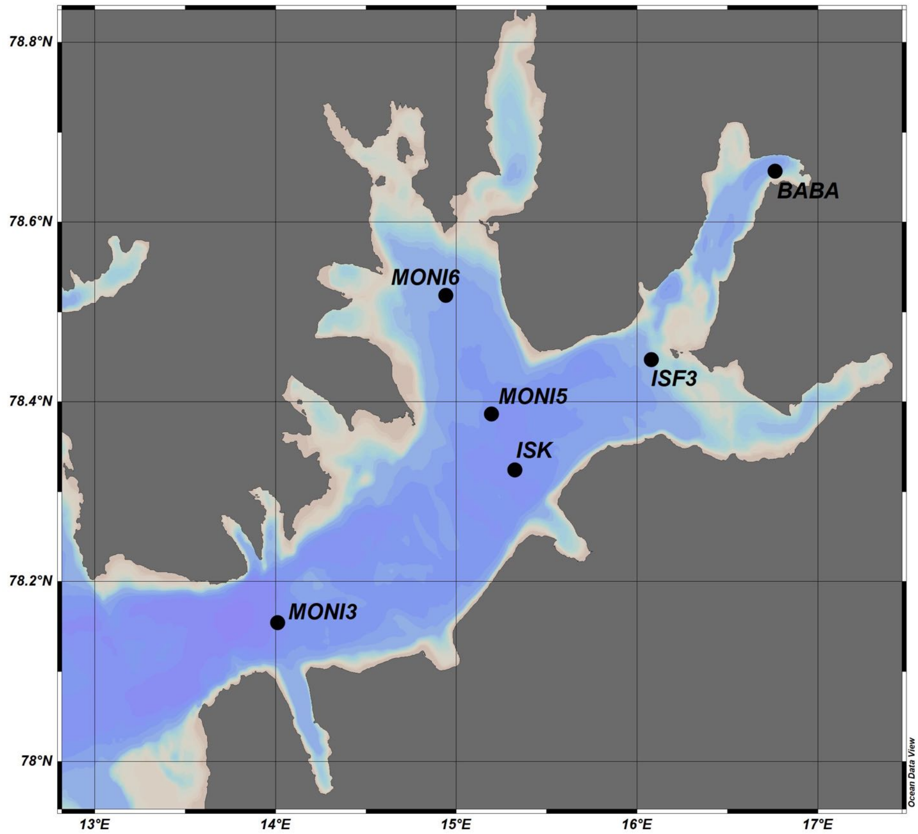


Fig. 7.4 List of marine optics stations in Isfjorden during the AREX2025 Leg IIIb.

Further processing of data and collected samples

Samples collected on filters and water samples intended for FDOM and DOC analyses were appropriately preserved and stored under suitable conditions until their subsequent laboratory analyses at IOPAN.

7.6 Detailed description of marine chemistry measurements

Description of methods and tools

The research methods and measurement equipment used by the Polar Regions Pollution Laboratory during Leg IIIb did not differ from those applied during Leg IIIa. A detailed description is provided in Section 6.6.

Description of measured parameters and collected samples

Similarly to the studies conducted in Hornsund, investigations in Isfjorden also focused on contamination of bottom sediments, waters, and suspended matter by heavy metals, organic pollutants, and radioactive isotopes, as well as on the degree of contamination of benthic organisms by these compounds in glacier-proximal bays. Samples were collected in the glacier bays Borebukta and Ymerbukta (Table 7.6; Fig. 7.5). In addition, bottom trawling was performed twice at station BABA in order to collect macro- and megafauna organisms for the newly initiated “Meduza” project, which investigates carbon transfer by gelatinous plankton to bottom sediments. To determine sediment accumulation rates in areas affected by enhanced meltwater discharge, a Nemisto sediment core was collected at station IB1_S in the vicinity of Pyramiden.

Table 7.6 List of marine chemistry stations in Isfjorden during Leg IIIb.

Station	Location	Depth(m)	Latitude (deg min N)	Longitude (deg min E)	Sampling gear
IB1_S	Billefjorden	66	78 38.052	16 27.124	Nemisto
IY1	Ymerbukta	47	78 16.120	13 58.021	Nemisto, Van Veen, dredge, bathometer
IY2	Ymerbukta	46	78 16.116	13 59.273	Nemisto, dredge, Van Veen, bathometer
IY3	Ymerbukta	37	78 16.132	14 00.764	Van Veen, dredge, bathometer
IB1	Borebukta	37	78 20.965	14 27.235	Nemisto, Van Veen, dredge, bathometer
IB2	Borebukta	39	78 20.621	14 25.512	Nemisto, Van Veen, dredge, bathometer
IB3	Borebukta	57	78 20.239	14 23.699	Nemisto, Van Veen, dredge, bathometer
BABA	Isfjorden/Billefjorden - inner basin	127	78 39.383	16 45.815	dredge

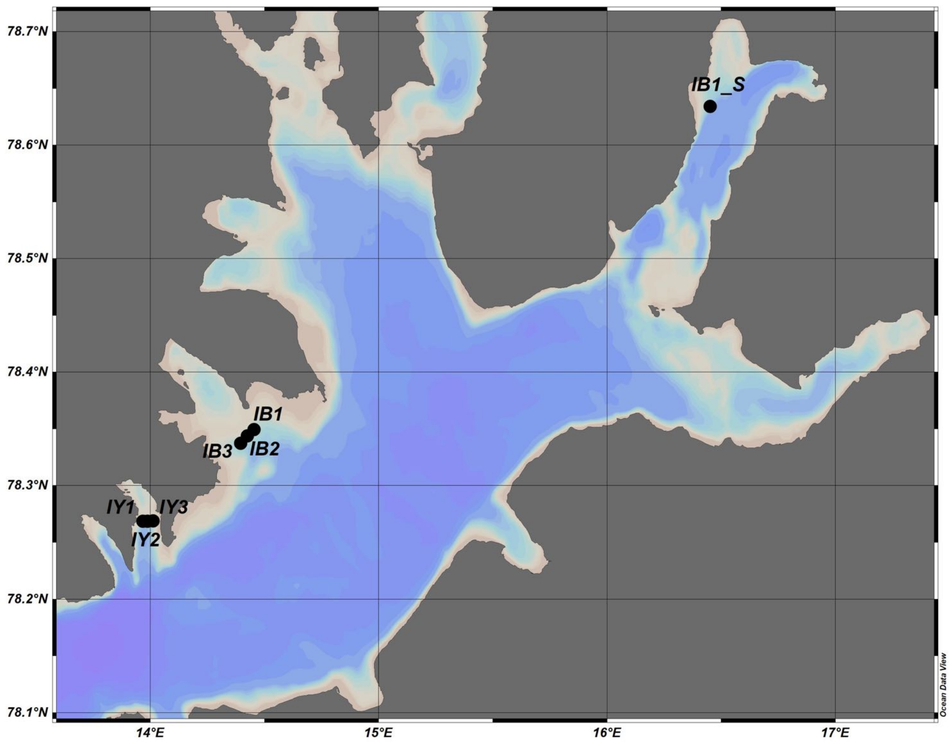


Fig. 7.5 Map of marine chemistry stations during the AREX2025 Leg IIIb.

Further processing of data and collected samples

Similarly to the samples collected in Hornsund, laboratory analyses of the suspended matter, bottom sediments, and benthic organisms collected in Isfjorden will include the determination of selected contaminants: heavy metals (AAS and ICP-MS) and ^{137}Cs (gamma analyzer). In addition, sediment accumulation rates (using the ^{210}Pb method) and organic carbon content (CHN) will be determined. These analyses will be carried out at the Polar Regions Pollution Laboratory. Analyses of organic contaminant concentrations will be conducted subsequently at the Geotoxicology Laboratory. Depending on available funding, microbiological analyses will then be performed in collaboration with the Marine Genetics Department.

7.7 Detailed description of oceanographic measurements

Description of methods and tools

The measurement equipment used by Observational Oceanography Lab during Leg IIIb did not differ from that applied during Leg IIIa. A detailed description is provided in Section 6.7.

Description of measured parameters and collected samples

Due to a change in the cruise plan and the necessity to remain in Isfjorden, the original research program of the Observational Oceanography Lab could not be implemented. Instead, it was replaced by a comprehensive water-column study in the Billefjorden area. It was decided to carry out a 24-hour monitoring of the physicochemical parameters of seawater at station BABA. For this purpose, CTD measurements were conducted hourly from the surface to the bottom. In parallel, measurements using the UVP camera were performed. In addition, every 4 hours, optical measurements were carried out, water samples were collected for FDOM and DOC analyses, and zooplankton samples were taken.

Hydrographic measurements using the SBE9/11+ CTD system (detailed description in Chapter 5) also accompanied the studies conducted by the other teams and were performed at all research stations during this leg. The list of stations at which hydrographic measurements were carried out is provided in Table 7.1. The location of station BABA is shown, among others, in Fig. 7.1.

Further processing of data and collected samples

The collected data were recorded and will be further processed and analyzed at IOPAN.

8 Mesurements and sampling program during AREX 2025 Leg IV

8.1 Detailed description of coastal measurements in Isfjorden

The intertidal zone inventory included photographic documentation of shoreline type and algal cover, counting of macroplastic items, and photographic surveys along 100-m transects, as well as the collection of intertidal invertebrate samples and the recording of benthic organisms using a drop-down camera. All data are presented on the project website.

Table 8.1. Measurement stations of Leg IV in Isfjorden during the AREX2025 cruise.

Nr	Place name/ GPS nr	Latitude	Longitude	Date time	Coast type	Plastic count area	Mytilus - living	Fucus	Littorina	Gamm. oceanicus	Gamm. setosus	Remarks
1	Isfjord Radio 47	78°03.831'	13°36.640'	25.08.22 22.00	gravel beach, rock	1 x 200m	yes	yes	yes	41	0	
2	Trygghamna 2 48	78°15.0807’	13°42.4732’	25.08.23 10.00	stones on the mud, skjerra	2000m	yes	yes	yes	20	6	minky whale next to the ship, 5 harbor seals on the shore
3	Trygghamna 3 49	78°15.5720’	13°42.8885’	25.08.23		2000m				25	5	
4	Ekmanfjorden 50	78°38.6666’	14°45.4068’	25.08.23 19.00	stony and gravel beach	2 x 100m	no	yes	yes	0	46	
5	Dicksonfjorden - Kapp Smith 51	78°39.6754’	15°13.7440’	25.08.24 10.00	stony and gravel beach	4 x 100m	yes	yes	yes	0	47	
6	Billefjorden - Adolfbukta 52	78°40.2715’	16°51.9805’	25.08.24 22.00	stony beach	4 x 100m	no	yes	no	4	52	single white whale
7	Tempelfjorden 53	78°23.9594’	17°09.6716’	25.08.25 10.00	stony and gravel beach	4 x 100m	no	yes	no	16	39	
8	Grumant 55	78°10.6667’	15°07.0514’	25.08.25 23.00	stony and gravel beach	200m	no	yes	yes	3	62	

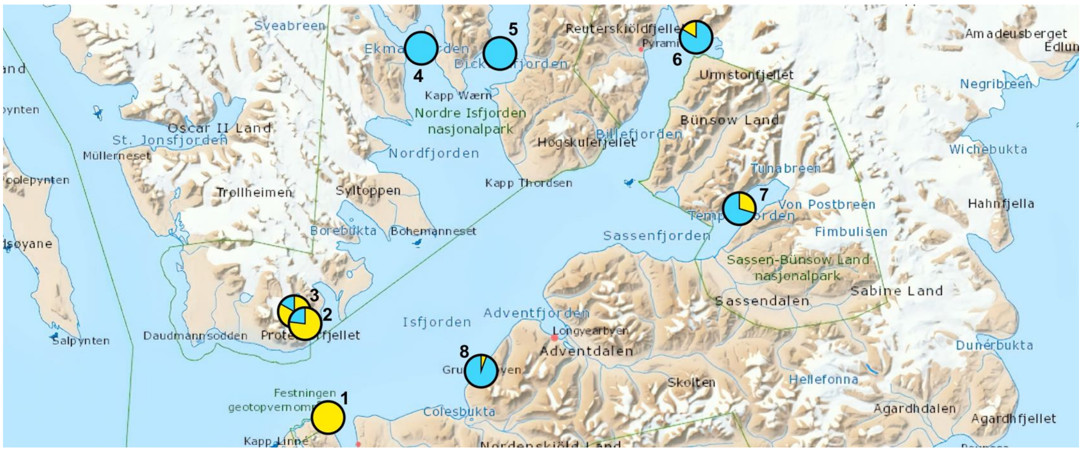


Fig. 8.1 Map of stations with results of the analysis of the occurrence of boreal and Arctic amphipods (Gammarus) during Leg IV of the AREX2025 cruise.

Further processing of data and collected samples

Data are presented on the project website, currently being prepared for publication: https://old.iopan.pl/projects/key_coastal_points/reports.html

9 Mesurements and sampling program during AREX 2025 Leg V

9.1 General information about Leg V

Between 28 August and 6 September, i.e., during the 10-day period allocated for measurement activities in Leg V, the weather conditions along the ship's route allowed empirical measurements and sample collection to be carried out on 8 days at 8 locations (measurement stations) (see Table 9.1). These included, among others, two ad hoc stations selected along the ship's route from the coast of the Svalbard archipelago to the northern coast of Norway (stations that in the current or previous years were designated as "M4" and "V12"). In addition, measurements were conducted at 6 stations out of the 7 originally declared and planned in the AREX 2025 cruise programme (stations IO10 to IO04, located along the Norwegian coast). Due to adverse weather conditions, measurements at one of the planned stations (IO06) had to be abandoned.

Furthermore, in order to save time and reduce transit distance, optical and biogeochemical measurements near the planned stations IO10, IO09, IO08, IO07, and IO05 were initiated at locations that had originally been intended as the end points of acoustic transects. Therefore, an additional designation "bis" was introduced in the station codes to distinguish these locations from the stations sampled in the previous year during the AREX2024 expedition.

Table 9.1. List of stations occupied during the AREX2025 Leg V.

Station number/day	Station/ section start	Date	Start latitude	Start longitude
1	M4	2025-08-28	76° 00.037' N	014°59.891' E
2	V12	2025-08-29	72° 45.409' N	019°31.673' E
3	IO10bis	2025-08-31	67° 45.251' N	010° 54.292' E
4	IO09bis	2025-09-01	66° 13.457' N	010° 03.950' E
5	IO08bis	2025-09-02	64° 19.462' N	008° 29.889' E
6	IO07bis	2025-09-03	63° 11.921' N	006° 10.092' E
7	IO05bis	2025-09-05	59° 13.949' N	004° 27.249' E
8	IO04	2025-09-06	57° 37.390' N	007° 31.363' E

9.2 Detailed description of marine optics measurements

Optical measurements, together with accompanying measurements of the basic hydrological characteristics of seawater and the main biogeochemical properties of optically relevant constituents, were carried out for the purposes of the Laboratory of Marine and Atmospheric Optics and the Laboratory of Marine Remote Sensing at IOPAN. Measurements and sampling at the stations were conducted during daytime, close to local solar noon. In situ measurements at the stations and sample collection included the following activities:

a) measurements of salinity, temperature, and density of seawater at the surface and in vertical profiles down to approximately 80 m using a CTD probe (SBE9/11+);

b) visual determination by an observer of the Secchi disk visibility range (zSD) and taking digital photographs with an "RGB" camera floating on the sea surface, documenting the colour of the disk submerged to a depth of ½ zSD and the colour of the surrounding water;
c) in situ measurements of the spectral values of the volume scattering coefficient (bb(λ)) using a HydroScat-4 instrument (Hobi Labs), carried out just below the surface and in vertical profiles down to approximately 80 m;
d) radiometric measurements at the sea surface (spectra of downwelling irradiance Ed(0) and upwelling radiance Lu(0)) required to determine the spectral remote-sensing reflectance of the sea (Rrs(λ)), using radiometers installed on the ship's deck and floating on the water surface (TriOS radiometer set);
e) collection of surface seawater samples (approximately 20–40 L) for analyses conducted in the shipboard laboratory and later in the onshore laboratories of IOPAN.

The following activities were then carried out directly in the shipboard laboratory on the collected water samples:

a) preparation of seawater samples and measurements of the spectral light attenuation coefficient due to the sum of suspended and dissolved substances in seawater (cn(λ)), the light absorption coefficient of dissolved substances (aCDOM(λ)), and calculations of the spectral light attenuation coefficient of particles (cp(λ)), using a Viper photometer (TriOS);
b) preparation of suspended matter samples retained on filters for storage, in order to later determine (in the onshore IOPAN laboratories) the mass concentration of total suspended matter (SPM), the concentrations of organic and inorganic fractions (POM and PIM), chlorophyll a concentration (Chla), concentrations of other phytoplankton pigments, as well as to measure the spectral absorption coefficients of all suspended particles (ap(λ)) and, separately, of phytoplankton and non-algal particles (aph(λ) and ad(λ));
c) preparation of preserved water samples for later analyses (in the onshore IOPAN laboratories) of particle size distributions (PSD);
d) preparation of water samples for later reference measurements (in the onshore IOPAN laboratories) of the spectral light absorption coefficient of dissolved substances (aCDOM(λ)).

The optical measurements and the accompanying measurements listed above were conducted at all 8 measurement stations previously listed in Table 9.1.

Further processing of data and collected samples

In the case of the collected data on the optical and biogeochemical properties of seawater, the results of the direct measurements have already been preliminarily archived, and the prepared samples of suspended matter and water have been and/or are being stored under appropriate conditions (frozen or refrigerated) until further analyses in the onshore laboratories of IOPAN. The collected data on selected inherent optical properties will enable the calculation of additional optical quantities, including the spectral particle scattering and backscattering coefficients (bp(λ) and bbp(λ)). The recorded RGB images of the submerged

Secchi disk and the surrounding water body will allow the derivation of a quantitative descriptor of water colour based on the trichromatic colour perception mechanism, i.e. the hue angle (α), as well as the assignment of the investigated waters to the traditional Forel–Ule colour scale classes (FU index). The radiometric measurements will enable the calculation of the spectra of remote-sensing reflectance of the sea (Rrs(λ)).

9.3 Detailed description of marine acoustic measurements

Measurements were carried out in the Norwegian Sea and the North Sea. Data were collected along six hydroacoustic transects. In addition, in situ measurements of the physical parameters of seawater were performed at the beginning, middle, and end of each transect. Furthermore, prior to the start of the hydroacoustic surveys, a calibration of the 70 kHz transducer of the SIMRAD EK-60 echosounder was performed, and an attempt was made to calibrate the 120 kHz transducer of the same echosounder. For technical reasons, the calibration of the 120 kHz transducer could not be completed. Due to adverse hydrometeorological conditions on 04 June 2025, it was decided not to carry out measurements along transect 6 and instead to perform measurements along an additional transect designated as transect 4. All surveys were conducted in the period from 29 August 2025 to 06 September 2025. The length of individual transects was approximately 12 nautical miles. The locations of the transects and the stations for measurements of the physical parameters of seawater are shown in Fig. 9.1, while details of the CTD measurements are presented in Table 9.2.

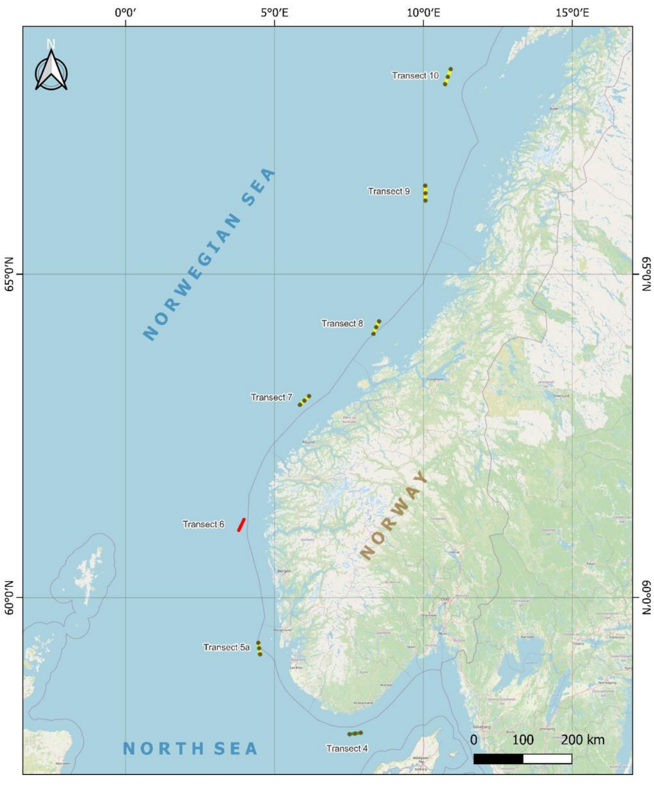


Fig. 9.1 Map of stations and sections with marine optical and acoustic measurements occupied during the AREX2025 leg V. The red line indicate cancelled section/station.

Table 9.2. Location of sections with acoustic measurements during the ARXE2025 leg V.

Section number	Start		Stop		Length (Nm)	Date and time (UTC)	Remarks
	Longitude (DM)	Latitude (DM)	Longitude (DM)	Latitude (DM)			
10	67°45.025'N	10°54.543'E	67°33.746'E	10°43.928'E	11,97	31.08.2025 11:38 – 15:06	Done
9	66°13.386'N	10°04.150'E	66°01.431'E	10°04.342'E	11,97	01.09.2022 10:06 – 14:23	Done
8	64°19.397'N	08°30.261'E	64°08.397'E	08°19.525'E	11,98	02.09.2025 11:16 – 14:56	Done
7	63°12.710'N	06°09.946'E	63°04.774'N	05°51.316'E	11,60	03.09.2025 11:06 – 14:51	Done
6	61°17.150'N	03°58.760'E	61°06.350'N	03°47.970'E	Cancelled due to bad weather conditions		
5a	59°13.814'N	04°27.305'E	59°02.010'N	04°30.873'E	11,92	05.09.2025 11:21 – 15:00	Done
4	57°37.407'N	07°31.327'E	57°38.807'N	07°53.538'E	11,98	06.09.2025 10:39 – 14:05	Additional

Table 9.3. Lista of CTD stations during the AREX2025 leg V.

Station	Longitude (DM)	Latitude (DM)	Date and time (UTC)	Max. depth [m]
IO_10_start	67°45.296'N	10°54.986'E	31.08.2025 10:39	105
IO_10_polowa	67°39.398'N	10°49.307'E	31.08.2025 13:14	104
IO_10_koniec	67°33.751'N	10°43.758'E	31.08.2025 15:20	173
IO_9_start	66°13.514'N	10°03.715'E	01.09.2025 09:40	244
IO_9_polowa	66°07.369'N	10°04.253'E	01.09.2025 12:21	280
IO_9_koniec	66°01.405'N	10°04.325'E	01.09.2025 14:37	271
IO_8_start	64°19.272'N	08°30.816'E	02.09.2025 10:43	294
IO_8_polowa	64°14.123'N	08°24.938'E	02.09.2025 12:52	296
IO_8_koniec	64°08.311'N	08°19.534'E	02.09.2025 15:19	295
IO_7_start	63°12.699'N	06°09.724'E	02.09.2025 10:42	107
IO_7_polowa	63°08.592'N	06°00.268'E	03.09.2025 12:56	144
IO_7_koniec	63°04.774'N	05°51.312'E	03.09.2025 15:03	195
IO_5a_start	59°13.741'N	04°27.426'E	05.09.2025 10:43	255
IO_5a_polowa	59°08.167'N	04°29.065'E	05.09.2025 13:04	252
IO_5a_koniec	59°01.950'N	04°31.018'E	05.09.2025 15:15	256
IO_4_start	57°37.435'N	07°31.216'E	06.09.2025 10:05	288
IO_4_polowa	57°38.098'N	07°42.538'E	06.09.2025 12:15	291
IO_4_koniec	57°38.892'N	07°53.894'E	06.09.2025 14:18	288

Description of methods and tools

The acquisition of hydroacoustic data along the research transects was carried out using a specialized scientific split-beam echosounder manufactured by Kongsberg SIMRAD (model EK-60). The 70 kHz and 120 kHz hydroacoustic transducers were mounted in a specially designed fairing attached to the side of RV *Oceania* using an aluminum pole.

For both transducers, calibration attempts were made and the obtained calibration values were intended to be implemented in the system software. In the case of the 120 kHz transducer, this procedure could not be completed due to technical problems; therefore, archival calibration data were used to update the settings of this transducer.

Data were recorded along six transects while maintaining the vessel's speed at approximately 3.5–4 knots. Data acquisition lasted for about 3 hours and was conducted during the morning–afternoon hours in order to obtain comparable records. Due to adverse hydrometeorological conditions on 04 September 2025, data acquisition along transect 6 was not carried out. Instead, supplementary measurements were performed on 06 September 2025 along an additional transect designated as transect 4.

Hydroacoustic data acquisition was carried out using dedicated software provided by Kongsberg SIMRAD. Positioning of the research vessel during data recording was based on readings from a differential GPS receiver (Trimble MPS 865). In addition, the QINSy software (version 8.17.1) was used to correct the offsets of the installation locations of key components of the measurement system, such as the pole with the fairing and echosounder transducers, the GPS antenna, and the ship's gyrocompass. This approach minimized the positioning error of the Kongsberg SIMRAD echosounder transducers to approximately ±0.5 m in the horizontal plane. After completion of the measurement campaign, the recorded data were copied to independent hard drives and securely archived.

To acquire data on the variability of the physical parameters of seawater, a CTD probe manufactured by Sea-Bird Electronics (SBE), model SBE 19plus, was used. Prior to the start of the measurement campaign, the probe was calibrated by the manufacturer. At each of the measurement stations listed in Table 9.2, the probe was lowered from the sea surface to the seabed at a speed of approximately 1 m s^{-1}.

Further processing of data and collected samples

he data obtained during the 2025 measurement campaign have been thoroughly analysed, and a final report summarizing the results of the conducted studies has been prepared. These results will be compared with data collected during the AREX 2024 cruise, as well as with results obtained by the team from the University of Gdańsk, which carried out similar measurements from the r/v *Oceanograf* in close proximity to the Norwegian coast in 2024. Based on the combined dataset, a joint scientific publication will be prepared, focusing on the scattering properties of aggregated and individual biological objects occurring in the North Sea and the Norwegian Sea, in the context of changes in the physical parameters of seawater associated with the inflow of Baltic Sea water masses into these regions.

9.4 Detailed description of aerosol and meteorological measurements

Due to changes and limitations in the composition of the scientific team during Leg V, aerosol and meteorological measurements requiring the presence of a dedicated operator were not conducted during the Leg V.

10 Summary of the AREX 2025 research cruise

The AREX 2025 research cruise took place from 1 July to 8 September 2025 and consisted of five legs, during which measurements were carried out in the eastern Norwegian and Greenland Seas, in Fram Strait and the southern Nansen Basin north of Svalbard, in the fjords of western Spitsbergen, and along the Norwegian coast during the return transit. The multidisciplinary research programme included oceanographic, meteorological and aerosol, optical, biogeochemical, as well as biological and ecological measurements. Due to a previously planned cruise to the Azores, the oceanic part of the AREX 2025 cruise was shortened and started in Longyearbyen, Svalbard.

The oceanic part of the AREX 2025 cruise was conventionally divided into Leg I, covering measurements between Bear Island and the southern Fram Strait, and Leg II, covering sections in the northern Fram Strait and north of Svalbard. Due to the shortening of this part of the cruise and the start of Leg I in Longyearbyen, the long-term sections V1 in the Barents Sea Opening and sections H and O in the Greenland Sea were not carried out. During Leg I, measurements were conducted along the standard sections V2, N, S, and Z, whereas during Leg II measurements were performed along the long-term sections EB2, EX, Y, WB, NB, and the additional section EB3 along the ice edge in Fram Strait. During Leg I, measurements had to be interrupted for more than two days because of adverse weather conditions, and the vessel sought shelter in Hornsund. Ice conditions during Leg II considerably limited the spatial extent of measurements along the northern sections.

In total, during the open ocean part of the cruise, CTD measurements covering the full water column were carried out at 175 stations, including 106 stations during Leg I and 69 stations during Leg II. At 174 stations, ocean currents were measured using LADCP, while currents in the upper layer (approximately 200 m) were continuously recorded using a VM-ADCP. At 16 CTD stations, water samples were collected for nutrient analyses, and at 6 selected deep stations, water samples were collected for salinity calibration. Continuous measurements of marine aerosols as well as atmospheric CO_2 and H_2O concentrations were conducted, together with standard meteorological observations. For studies of the sea surface microlayer, samples were collected and surface-layer temperature and salinity measurements were carried out at 22 stations during Leg I. As part of the biological programme of the open ocean part of the cruise, 115 zooplankton faunal samples were collected at 39 research stations, including 107 stratified samples and 8 samples collected from the entire water column. During Leg II, two Core Argo floats were also deployed along section K, in the core and in the outer branch of Atlantic Water in the Greenland Sea.

The fjord part of the AREX cruise was divided into three legs (IIIa, IIIb, and IV), covering measurements in Hornsund and Isfjorden. Due to a serious technical failure of the vessel's winches, Leg IIIa started with a two-day delay, which significantly reduced the available measurement time. During Leg IIIa, measurements were carried out in Hornsund (68 stations) and in the Hornsund forefield (“Alczykowisko”, 15 stations), including oceanographic, biogeochemical, and biological observations and sampling at a total of 83 stations. For the purposes of long-term monitoring, samples were collected at 5 stations within Hornsund and at 9 stations in the forefield of the fjord. At all stations in Hornsund and its forefield, full-depth CTD profiles were conducted. For analyses of plankton abundance and its importance for little auks, samples were collected at 14 stations in the forefield and 27 stations inside the fjord. Due to an instrument failure, vertical UVP profiles were carried out instead of LOPC transects. For analyses of benthic biodiversity and specific taxonomic groups, benthic and surface sediment samples were collected at 29 stations, and seabed video recordings were carried out at 29 stations. At 14 stations in Hornsund, measurements and sampling were conducted for studies of the optical properties of seawater, including analyses of light absorption and scattering by dissolved and suspended constituents, spectral characteristics of vertical light attenuation profiles, and surface spectral reflectance. Seawater samples were also collected for analyses of chlorophyll concentration, pigments, light absorption, DOM, and DOC. At station N4 (the A-DBO key station), additional primary production measurements were carried out. For studies of chemical contamination of bottom sediments, water, and suspended matter, samples of water and surface sediments were collected at 4 stations in Hornsund.

Due to a failure of the ship's generator, prolonged repair works, and crew-related problems, the available measurement time during Leg IIIb of the AREX 2025 cruise was significantly shortened. As a result, the planned measurement and sampling programs in Kongsfjorden and Magdalenefjorden were not carried out. The vessel remained in Isfjorden, where the measurement programme was expanded within the limits of existing permits. During Leg IIIb, oceanographic, biogeochemical, and biological measurements and sampling were conducted at a total of 30 stations, including a series of 24-hour observations at station BABA. For studies of habitat and feeding preferences of sibling zooplankton species, samples were collected at 3 stations in Isfjorden. Measurements of abundance, distribution, and composition of zooplankton and marine aggregates using UVP were conducted at 9 stations and at the 24-hour BABA station. For analyses of benthic biodiversity and specific organism groups, water and surface sediment samples were collected at 16 stations in Isfjorden, and seabed video recordings were carried out at 21 stations. At 6 stations, measurements and sampling were conducted to study the optical properties of seawater, following the same protocol as in Hornsund. Similarly to Hornsund, studies of contamination of bottom sediments, water, and suspended matter were carried out at 8 stations in Isfjorden. At all stations in Isfjorden, full-depth CTD profiles were conducted, including the 24-hour series at station BABA.

During Leg IV of the AREX 2025 cruise, an inventory of the intertidal zone in Isfjorden was carried out, including photographic documentation of shoreline types and algal cover, macroplastic counts, photographic surveys along 100-m transects, sampling of intertidal invertebrates, and documentation of benthic organisms using a drop-down camera. This documentation was performed at 8 stations in different parts of Isfjorden.

During Leg V, covering the return transit, optical and acoustic measurements were conducted along the Norwegian coast. Optical measurements and sampling were carried out at 8 stations during the 8-day return route. In addition, acoustic measurements were conducted along 7 transects, each 12 nautical miles long, while the vessel was steaming at a speed of approximately 4 knots. At 6 transects, CTD measurements were carried out at the beginning, middle, and end of each transect. Leg V of the AREX 2025 cruise ended with the vessel's arrival in Gdańsk on 8 September 2025.