

The Fifth Turkish Arctic Scientific Expedition (TASE-V)

Report 29.04.2025, 01.07.2025-07.08.2025, Jnr. 25/7700

Project Dates: 08.07.2025-31.07.2025

Purpose of Cruise: Investigation of the anthropogenic impacts in a global scale and the effects of global climate change.

Scientist in Charge: Prof. Dr. Burcu Özsoy

Introduction

Polar Research Institute (PRI) was established in 2019 within TÜBİTAK Marmara Research Center to ensure the coordination and logistics of the national polar expeditions. The Institute aims to provide support for R&D and scientific research studies to be conducted in polar regions, to operate Türkiye's polar research infrastructure, to plan and coordinate logistics, to facilitate communication among relevant organizations, to conduct bilateral international collaborations, to develop and implement the national polar strategy in cooperation with stakeholders, to raise awareness of polar regions at national scale. As the umbrella organization for polar research in Türkiye, PRI organizes scientific expeditions to Arctic and Antarctica to provide a better understanding of the past, present and the future of the Earth, and also to investigate the impacts of global climate change and human activities.

- The 1st Turkish Arctic Scientific Expedition (**TASE-I**) was conducted around Svalbard between 13-26 July 2019 onboard MY Anakena. RiS ID was 11301 and Cruise Information was specified as 190620 on Directorate of Fisheries.
- The 2nd Turkish Arctic Scientific Expedition (**TASE-II**) was conducted around Svalbard between 13-24 July 2022 onboard R/V PolarXplorer. Cruise information was specified with reference number 22/9853 by the Directorate of Fisheries.
- The 3rd Turkish Arctic Scientific Expedition (**TASE-III**) was carried out onboard R/V PolarXplorer between 04 July-02 Aug 2023 in Barents Sea.
- The 4th Turkish Arctic Scientific Expedition (**TASE-IV**) conducted R/V PolarXplorer from June 27 to July 25. In 2025.

The 5th Turkish Arctic Scientific Expedition (**TASE-V**) took place from 8-31 July 2025 on board Sola. In accordance with the permissions obtained under the "Regulations Relating to Foreign Marine Scientific Research in Norway's Internal Waters, Territorial Sea and Exclusive Economic Zone and on the Continental Shelf", the studies were conducted within

the Norwegian Territorial Waters, Norwegian Exclusive Economic Zone, the Fisheries Protection Zone around Svalbard, and Territorial Waters. The overall purpose of the scientific research was to investigate the presence and intensity of the anthropogenic impacts on a global scale, as well as to observe key parameters and effects of global climate change in the Arctic.

Conducted Projects

The following projects were carried out within The Fifth Turkish Arctic Scientific Expedition (TASE-V):

1. Investigation of Physical Oceanographic Processes in the Arctic Ocean Using CTD Profiles and Copernicus Arctic Ocean Model Reanalysis Data
2. What you see vs. what eDNA detects: Integrating eDNA and Visual Surveys to Monitor Cetacean Presence and Prey Availability in the Arctic Ocean
3. Microbial Diversity and Dispersal Potential of Floating Litter in the Arctic Ocean: A Latitudinal Study During the Turkish Arctic Expedition
4. Zooplankton, Ichthyoplankton, and Microplastic Distributions in the Arctic Ocean: Assessing Environmental Drivers and Pollution Impacts
5. Identification of Potentially Toxic Species and Their Produced Toxins Within the Arctic Phytoplankton Community
6. Determination of Pharmaceutical Active Ingredients Adsorbed onto Microplastics as a Passive Sampler Using Advanced Enrichment Methods with FT-IR and LC-MS
7. Occurrence and Environmental Risk Assessments of Antifouling Paint Booster Biocides in the Arctic Region
8. Towards Smart Biodiversity Monitoring in the Arctic: eDNA and Biogeochemical Sampling
9. Water Vapor Dynamics in the Arctic: GNSS Observations During Polar Expeditions (WVD-GNSS-ARCTIC)
10. Bio-Optical Remote Sensing for Arctic Waters (BIOS-ARCTIC)
11. The Use of Arctic Microorganisms in Biotechnology and Nanotechnology (NANOBIO-ARCTIC)
12. Collection of Marine Meteorological Data in the Arctic Region

The members of the expeditions and their institutions are given in Table 1.

Table 1. Expedition members, roles and institutions

No	Name	Role	Institution
1	Cpt. Doğaç Baybars İŞİLER	Expedition Leader	TÜBİTAK Marmara Research Center, Polar Research Institute
2	Assoc. Prof. Dr. Erhan ARSLAN	Expedition Co-Leader	TÜBİTAK Marmara Research Center, Polar Research Institute
3	Güldehan DERYAL ÇANLIOĞLU	Researcher	İstanbul University
4	Bilge DURGUT	Researcher	Middle East Technical University
5	Adil Enis ARSLAN	Researcher	Istanbul Technical University
6	Rafet Çağrı ÖZTÜRK	Researcher	Middle East Technical University
7	Aslıhan NASIF DONDURUR	Researcher	Dokuz Eylül University
8	Mustafa KANAT	Researcher	Turkish Naval Forces Department of Navigation Hydrography and Oceanography
9	Şebnem COŞKUN	Photo Journalist	Anadolu Ajansı (Turkish Official News Agency)
10	Lucas MARTÍNEZ	Researcher	Universidad Nacional de San Martín-Instituto Antártico Argentino
11	Svetoslav DIMOV	Researcher	Sofia University-National Center for Polar Studies
12	Sara CIFUENTES	Researcher	Universidad San Francisco de Quito

The titles and brief information of the conducted projects are given below.

1. Investigation of Physical Oceanographic Processes in the Arctic Ocean Using CTD Profiles and Copernicus Arctic Ocean Model Reanalysis Data

5th National Arctic Scientific Research Expedition, organized within the framework of the TÜBİTAK-KARE program. During the expedition, oceanographic data concerning freshwater inputs resulting from glacial melt were collected at 69 stations, extending to a depth of approximately 190 meters, in both the open seas and fjords of the Svalbard Archipelago. Measurements were conducted using a Seaisun CTD device, with data transferred to a computer through the SST standard acquisition software. The raw data were recorded in *.srd format and subsequently converted into *.txt format for further processing. Data analyses were performed using MATLAB codes specifically developed for this purpose. These investigations focused on assessing the effects of freshwater inflows on the dynamics of the East and West Spitsbergen Currents and the North Atlantic Current, as well as their mutual interactions. The findings are

expected to contribute to scientific publications elucidating the impacts of glacial melt on large-scale ocean current systems.

In addition, a comparison of the datasets collected from identical locations in 2024 and 2025 revealed pronounced variations in salinity, particularly within fjord environments. Marked differences in conductivity values associated with these salinity changes were also detected. It is anticipated that if the project is systematically repeated during the same season each year, these variations can be monitored with greater precision and continuity.

2. What you see vs. what eDNA detects: Integrating eDNA and Visual Surveys to Monitor Cetacean Presence and Prey Availability in the Arctic Ocean

Whales and other marine mammals inhabit some of the planet's most remote and challenging regions, notably the ice-covered Arctic Ocean. Direct observation is often limited by sea ice, fog, and logistical constraints. This project will therefore combine traditional visual surveys with environmental DNA (eDNA) to monitor marine mammals in the Arctic. Immediately after each sighting of marine mammals from the research vessel, water samples were collected to be used as positive control in the analysis (As we visually saw the animal, it is likely to find their DNA in the surrounding). Additionally, samples were collected from 35 different stations around the Svalbard archipelago. Marine mammal specific primers will be used to track and identify marine mammal taxa to assess their presence.

Water samples were collected from surface and 30 m using a five-liter Niskin Bottle. Water samples (1 liter from each depth) were filtered through a 0.22 µm sized pores using a filtration system. No preservatives were used to fix the samples. Samples were stored at -20°C on board of the research vessel, transported to the Molecular Biology Lab in cold chain and further stored at -80°C for long term preservation. Downstream analysis (DNA extraction, PCR amplification and quantification, library preparation, sequencing) will be performed in the Molecular Biology laboratory of the Karadeniz Technical University.

3. Microbial Diversity and Dispersal Potential of Floating Litter in the Arctic Ocean: A Latitudinal Study During the Turkish Arctic Expedition

Microbial communities can colonize floating micro- and macro plastics on the sea surface. Depending on the type of the microplastic, surface size, and duration of floating on the sea, microorganisms can attach and float with the microplastics as they float on the surface which

may cause microorganisms to travel beyond their natural boundaries. This project use environmental DNA (eDNA) methods to assess the diversity and relative abundance of microbial taxa associated with these plastics. By using specific primers that targets microorganisms only, microbial community compositions and their abundance on plastic surfaces will be assessed. The study will identify which microbial taxa attach to and are transported by freely floating plastics at the sea surface, providing baseline knowledge for environmental monitoring and risk assessment. At least one article will be published on a high-impact journal to disseminate the findings.

Samples were collected using a plankton net with 200 μm mesh sized and 0.22 m^2 mouth area. Plankton nets were towed vertically from 50 m to surface, additionally towed horizontally for 10 minutes at 2 knots speed. Samples were collected from 32 different stations around the coastal waters of the Svalbard archipelago. Samples were placed in containers and fixed with ethanol (99%). Downstream analysis (DNA extraction, PCR, quantification of plastics, detection of polymer types, etc.) will be performed in Microplastic and Genetic laboratories of the Karadeniz Technical University.

4. Zooplankton, Ichthyoplankton, and Microplastic Distributions in the Arctic Ocean: Assessing Environmental Drivers and Pollution Impacts

Zooplankton and ichthyoplankton (fish larvae) are the base of Arctic marine food webs and are a primary food source for fish, seabirds, and marine mammals. Understanding their spatial distribution is essential for conserving the Arctic ecosystem, yet distributions vary widely with temperature, salinity, and proximity to land. This project aims to map the distribution of these planktonic groups across the Arctic region, comparing a northward transect with coastal areas (e.g., the Svalbard Archipelago) and offshore waters to assess how environmental conditions shape their patterns. The project will provide an updated baseline on the distribution of ichthyoplankton and microplastics in the Arctic.

Ichthyoplankton and zooplankton samples were collected using a 200 μm pore-sized ichthyoplankton net (0.25 m^2 mouth area). Net was equipped with flow meter to calculate the filtered volume of the water. Net was towed horizontally right below the water surface for 15 minutes at 2 knots. Samples were preserved in 500 ml plastic containers and fixed with formaldehyde (4%). Samples were kept at room temperature and transferred to ichthyology

laboratory of the Karadeniz Technical University. Samples were collected from 30 different locations around the Svalbard archipelago.

5. Identification of Potentially Toxic Species and Their Produced Toxins Within the Arctic Phytoplankton Community

Rising temperatures associated with global warming are accelerating permafrost thawing in the Arctic and intensifying glacier mass loss. These processes enhance the influx of inorganic and organic nutrients into coastal ecosystems, thereby altering light transmittance conditions within the water column. In phytoplankton communities, whose distribution and abundance are highly dependent on such parameters, these environmental changes have promoted the proliferation of potentially toxic species, leading to increased toxin production.

Within the scope of the project, vertical phytoplankton sampling was conducted from a depth of 30 m to the surface at 20 designated stations along the route of the Fifth National Arctic Scientific Research Expedition (TASE-V), using a 20- μ m-mesh plankton net. From each station, a 20-mL subsample was fixed with formaldehyde to enable qualitative analyses of phytoplankton communities in coastal regions affected by glacial melting and/or permafrost thawing, with a particular focus on potentially toxic species. The remaining samples (50 mL from each station) will be transported to the Phytoplankton Culture Laboratory of the Institute of Marine Sciences and Management, Istanbul University, for single-cell isolation and the establishment of monoalgal strains. These strains will subsequently be incorporated into the institute's Phytoplankton Culture Collection and used in controlled Eco physiological and toxicity experiments. The findings of this study are expected to contribute critical data for ecosystem models that predict the future impacts of global warming on the fragile and dynamic Arctic environment, particularly by identifying potential increases in harmful phytoplankton species and the environmental parameters driving their proliferation. A total of 40 samples were collected from 20 stations: 20 samples (20 mL each) were fixed with formaldehyde for qualitative phytoplankton analysis and 20 samples (50 mL each) were fixed for single cell isolation.

6. Determination of Pharmaceutical Active Ingredients Adsorbed onto Microplastics as a Passive Sampler Using Advanced Enrichment Methods with FT-IR and LC-MS

The scope of this study is to analyze pharmaceutical active ingredients adsorbed onto microplastics collected during the Arctic expedition using a plankton net. In recent years, the

widespread use of plastics and inadequacies in waste management practices have led to their emergence as a new class of pollutants across all marine environments. Owing to their long degradation periods, plastics gradually fragment and are now ubiquitously detected in aquatic systems as micro- and nano-plastics. Due to their physicochemical properties, microplastics can adsorb and retain organic pollutants from the surrounding environment. Through electrostatic and hydrophobic interactions, they may act not only as persistent pollutants themselves but also as vectors facilitating the transport of various organic contaminants. Within this framework, the present study also explores the feasibility of using microplastics as passive samplers in remote ecosystems, where regular and systematic monitoring remains logistically challenging. The target organic pollutants in this study were selected based on compounds previously detected at elevated concentrations in the region by the research group. These include estrogen hormones and their derivatives (estrone, 17- α -ethinylestradiol, 17- β -estradiol), analgesics (ibuprofen, diclofenac), and antidepressants (escitalopram, fluoxetine). Horizontal surface sampling was conducted while the vessel was underway, employing a 20- μ m plankton net for 5 minutes. The water collected in the net's cod end was first passed through a 200- μ m sieve, followed by filtration through a 50- μ m filter. In parallel, 17 L of surface water was collected from each sampling station and subsequently filtered through a 50- μ m filter.

All filters were transported to the IU DEBIEN Chemical Oceanography Laboratory, where microplastics will be characterized by polymer type using FT-IR spectroscopy. Following this, pharmaceutical residues adsorbed on the microplastics will be extracted by means of ultrasonic baths and solid-phase extraction, an advanced enrichment technique. In addition, 1-L water samples were collected from 18 stations as reference points for drug analyses. Chromatographic analyses of all samples will be conducted using LC-MS instrumentation.

Given the extreme environmental conditions of polar ecosystems—namely low temperatures and limited sunlight exposure—the degradation of pharmaceutical compounds is significantly delayed. Accordingly, concentrations above detection limits are anticipated. The results are expected to provide novel insights into the potential of microplastics as alternative sampling tools for monitoring organic pollutants in environments where conventional buoy-based or routine sampling is not feasible. To our knowledge, this will be the first study to directly investigate pharmaceutical active ingredients adsorbed onto microplastics sampled from the Arctic marine ecosystem. 1-liter samples (18 L total) were collected from 18 stations and filtered through 9 filters. 17-liter surface water samples were collected from 9 stations.

7. Occurrence and Environmental Risk Assessments of Antifouling Paint Booster Biocides in the Arctic Region

Within the scope of this project, antifouling paint–strengthening biocides were investigated. These compounds are widely used to prevent the accumulation of fungi, algae, and bacteria on the surfaces of marine vessels. Antifouling agents provide significant economic advantages by extending the effective lifetime of vessel coatings and maintaining vessel speed through the reduction of surface drag. However, their most controversial ecological feature is their dual impact: while they inhibit biofouling and consequently limit the transport of invasive species, their lack of selectivity leads to adverse effects on non-target marine organisms. Given the rapid increase in cruise tourism in the Arctic—a region characterized by its fragile and sensitive ecosystem—regular monitoring of antifouling biocides has become critical. For this reason, antifouling sampling was performed at the same stations studied during TASE-IV, as part of TASE-V. The presence, spatial distribution, and environmental impact values of selected antifouling paint biocides (chlorothalonil, Irgarol 1051, and dichlofluanid) will be assessed in water samples collected from 15 stations. Samples transported to the laboratory will be subjected to stir bar sorptive extraction, followed by gas chromatography–mass spectrometry (GC/MS) analysis. The results of this study will provide essential data to evaluate whether the Arctic marine environment—an area increasingly frequented by research and tourism vessels—has been contaminated with antifouling paint–derived biocides. Furthermore, the project will generate environmental impact assessments of these anthropogenic pollutants, with the aim of determining their potential ecological risks for aquatic organisms. 500 mL water samples were collected from 15 stations.

8. Towards smart biodiversity monitoring in the Arctic: eDNA and Biogeochemical sampling

The aim of this project is to investigate the impacts of Atlantic water masses advancing into the Arctic, driven by climate change, and the spread of boreal species on biodiversity in the Barents Sea and Svalbard region. In this context, the environmental DNA (eDNA) metabarcoding method is integrated with oceanographic and biogeochemical measurements to analyze the diversity and distribution of prokaryotic and eukaryotic communities.

As a result of the project, scientific data reflecting biodiversity changes in Arctic ecosystems will be obtained, and a “biodiversity–biogeochemistry time series” will be established. A total

of 44 marine water eDNA filters, 44 frozen seawater samples (100 mL each), 28 sediment eDNA samples (approximately 0.2 g each), and 15 seawater samples (50 mL each, filtered through a 1 μ m filter) were brought to the laboratories for analysis.

9. Water Vapor Dynamics in the Arctic: GNSS Observations During Polar Expeditions (WVD-GNSS-ARCTIC)

24-hour measurement sessions were conducted at one-second intervals to determine the amount of evaporative water in the atmosphere using GNSS observations, which have widespread impact in the field of surveying. Location measurements were conducted to determine heat transfer parameters in the water-ocean interaction. These measurements were then analyzed in terms of raw data and signal behavior to develop a model that examines the atmosphere-ocean relationship. High-precision location data was collected at one-second intervals for 24 hours during the expedition.

10. Bio-Optical Remote Sensing for Arctic Waters (BIOS-ARCTIC)

Field sampling was conducted to determine parameters such as chlorophyll and light transmittance to analyze optical remote sensing data and to examine and increase the accuracy of marine observations using field samples. The samples were analyzed using a CDOM device, and based on the results obtained, a model was developed to verify and improve the accuracy of remote sensing data.

During the expedition, 500 ml of surface water samples were collected from station locations in airtight and light-tight bottles for analysis using the CDOM technique.

11. The Use of Arctic Microorganisms in Biotechnology and Nanotechnology (NANOBIO-ARCTIC)

This project aims to determine the feasibility of producing silver and copper nanoparticles by utilizing the ability of microorganisms living in Arctic waters to retain metals present in their natural habitats and introduced into the water from natural sources. The study was carried out using paired water samples collected from station points—one set stabilized and the other suitable for biomass formation. Analyses will investigate the potential for producing copper and silver nanoparticles from existing microorganisms.

During the expedition, paired samples were collected from the stations: 50 mL samples stabilized with formaldehyde and 200 mL samples suitable for biomass formation. In addition, sea ice samples were collected at appropriate locations.

12. Collection of Marine Meteorological Data in the Arctic Region

The aim of this study is to collect meteorological parameters throughout the expedition. An automatic meteorological observation station installed on the ship's deck recorded core meteorological variables such as temperature, pressure, wind direction and speed, and humidity, as well as solar radiation data. Location and time information were obtained from the GNSS station also installed on board. In addition, estimates were made to determine atmospheric dynamics (including water vapor and other gases in the atmospheric column). This entire dataset has provided an inventory to optimize future expeditions. Furthermore, long-term atmospheric observations will help explain the relationship between glacier melt and ocean-atmosphere interactions. Basic meteorological parameters were obtained at 10-minute intervals, providing information on weather changes during the expedition. The relationship between diurnal variations in solar radiation and temperature or other parameters will be explored using machine learning, enabling improved planning and execution of future expeditions. Continuous measurements of temperature, pressure, wind speed and direction, and humidity, along with solar radiation data, were collected at 10-minute intervals throughout the expedition.

The coordinates of the sampling points are given in Table 3. In addition, the sampling points are shown on a map in Figure 1.

Table 3. Coordinates of the sampling points and their corresponding dates

Sampling Points	Date	Latitude	Longitude
SP21HL	10.07.2025	78° 13.95 N	15° 38.72 E
SP21C.2	10.07.2025	78° 38.94 N	16° 01.97 E
SP21C	11.07.2025	78° 31.45 N	16° 53.63 E
SP21B	11.07.2025	78° 40.38 N	14° 23.36 E
SP21H	11.07.2025	78° 19.65 N	15° 09.96 E
SP19	12.07.2025	78° 33.30 N	09° 48.50 E
SP18	12.07.2025	79° 04.36 N	09° 31.94 E
SP18A	12.07.2025	79° 21.11 N	11° 43.24 E
SP18A.M	12.07.2025	79° 20.07 N	11° 44.87 E
SP18F	12.07.2025	79° 12.61 N	11° 49.38 E
SP18C	12.07.2025	79° 11.91 N	12° 12.09 E
SP18B.M	12.07.2025	79° 17.93 N	12° 06.98 E
SP18D	13.07.2025	79° 03.05 N	11° 22.89 E
SP16A	13.07.2025	79° 37.95 N	11° 26.60 E
SP16B	13.07.2025	79° 43.83 N	11° 01.15 E
SP14A.2	14.07.2025	80° 26.38 N	12° 20.03 E

Sampling Points	Date	Latitude	Longitude
SP14A.3	14.07.2025	81° 21.44 N	14° 18.13 E
SP13.A	14.07.2025	81° 59.35 N	23° 04.81 E
SP12.A	15.07.2025	81° 05.47 N	28° 00.41 E
SP12	15.07.2025	80° 21.49 N	34° 32.35 E
SP40	16.07.2025	79° 35.31 N	25° 47.05 E
SP41	16.07.2025	79° 15.01 N	22° 58.56 E
SP42	17.07.2025	79° 44.69 N	21° 45.32 E
SP43	17.07.2025	79° 38.66 N	18° 42.83 E
SPCTD1	17.07.2025	79° 22.74 N	20° 22.37 E
SPCTD2	18.07.2025	78° 54.26 N	22° 43.46 E
SP51	18.07.2025	78° 13.47 N	21° 32.39 E
SP32	18.07.2025	78° 07.59 N	19° 33.37 E
SP33.M	18.07.2025	78° 10.37 N	18° 59.84 E
SP31.M	18.07.2025	77° 26.94 N	17° 58.28 E
SP31	18.07.2025	77° 13.30 N	17° 52.77 E
SP30	19.07.2025	76° 44.74 N	17° 48.04 E
SP50	19.07.2025	76° 38.05 N	22° 30.84 E
SPCTD3	19.07.2025	77° 11.45 N	25° 53.22 E
SPCTD4	19.07.2025	77° 14.06 N	30° 25.54 E
SPCTD5	20.07.2025	77° 14.49 N	34° 48.43 E
SP7	20.07.2025	77° 14.69 N	37° 33.93 E
SPCTD6	20.07.2025	76° 13.65 N	37° 20.16 E
SPCTD7	20.07.2025	75° 18.67 N	36° 47.15 E
SP6A	21.07.2025	74° 37.56 N	34° 59.89 E
SPCTD8	21.07.2025	73° 46.13 N	32° 58.04 E
SP52	21.07.2025	72° 53.63 N	30° 59.14 E
SPCTD9	22.07.2025	72° 48.37 N	27° 41.23 E
SPCTD10	22.07.2025	72° 43.76 N	24° 30.27 E
SPCTD11	22.07.2025	72° 37.89 N	21° 09.46 E
SP53	22.07.2025	72° 31.53 N	17° 50.75 E
SPCTD12	23.07.2025	73° 26.02 N	16° 18.15 E
SPCTD13	23.07.2025	74° 21.64 N	14° 38.12 E
SP54	23.07.2025	75° 15.03 N	12° 58.90 E
SP55	24.07.2025	77° 02.96 N	16° 42.25 E
SP24	24.07.2025	76° 13.23 N	16° 36.10 E
SP23B	25.07.2025	76° 55.29 N	14° 31.49 E
SP22	25.07.2025	77° 33.21 N	12° 52.31 E
SP22A	25.07.2025	77° 29.97 N	14° 43.62 E
SP21K	26.07.2025	77° 57.86 N	12° 28.01 E
SP21	26.07.2025	77° 59.39 N	12° 03.96 E
SP20	26.07.2025	78° 02.60 N	10° 57.36 E

Sampling Points	Date	Latitude	Longitude
SP20A	26.07.2025	78° 26.69 N	11° 54.62 E
SP20D	26.07.2025	78° 35.37 N	12° 23.60 E
SP20D.2	27.07.2025	78° 35.37 N	12° 23.59 E
SP20B	27.07.2025	78° 21.79 N	12° 47.39 E
SP20C	27.07.2025	78° 08.72 N	13° 13.36 E
SP21J	27.07.2025	78° 09.38 N	13° 52.62 E
SP21J.2	27.07.2025	78° 17.75 N	13° 56.70 E
SPCTD14	28.07.2025	78° 15.02 N	14° 36.89 E
SP21C.3	28.07.2025	78° 23.60 N	16° 12.49 E
SP21C.4	28.07.2025	78° 26.77 N	17° 22.05 E
SP21C2	28.07.2025	78° 38.94 N	16° 53.63 E
SPCTD15	29.07.2025	78° 24.83 N	15° 49.79 E
SP21.N	29.07.2025	78° 21.58 N	14° 11.42 E

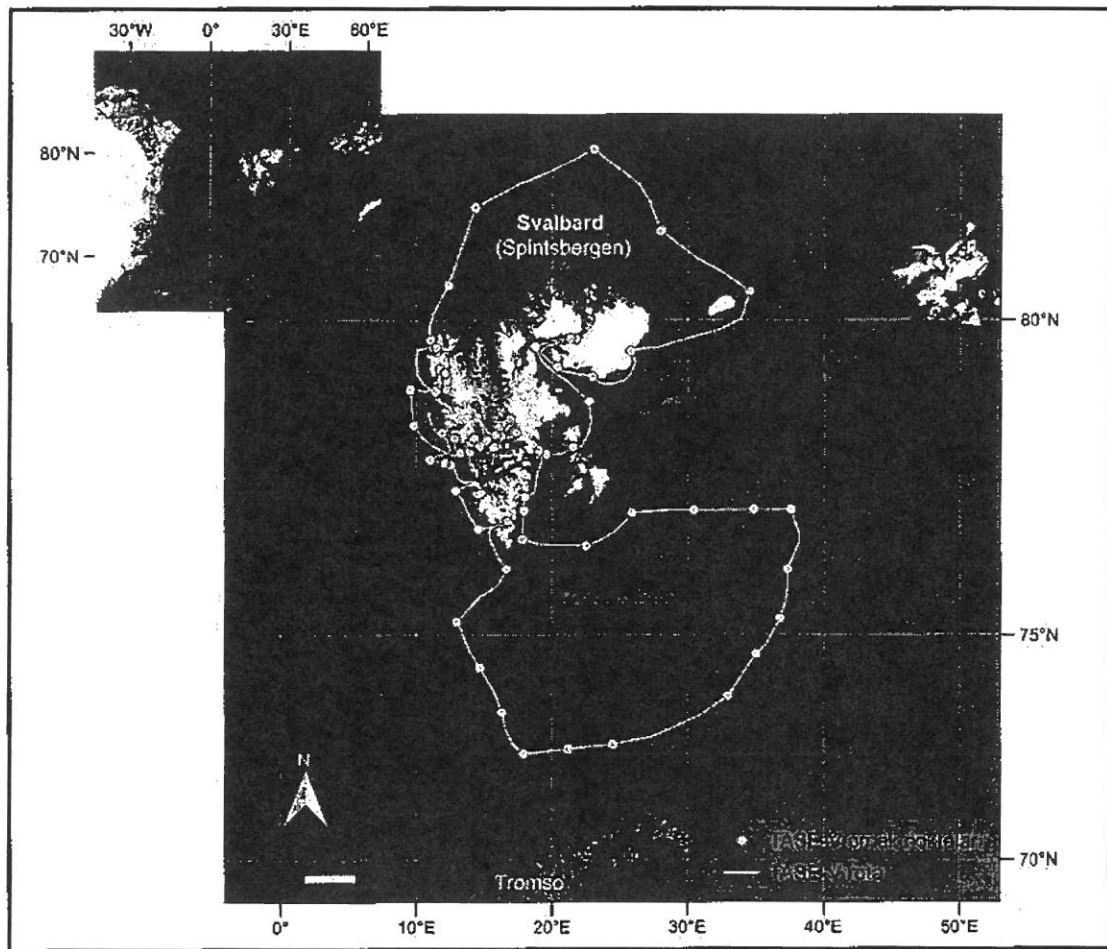


Figure 1. TASE-V route

Results

SVP (sound velocity profile) measurements were carried out in 69 sampling points during TASE-V. Station numbers, date, time, SVP depths, wind, and pressure data are presented in Table 4. Data gathered from SVP device are available on demand.

Table 4. SVP Measurement Parameters

Station Point	Date	Time (Local)	CTD Depth (m)	Water Column Depth (m)	Wind Direction (°)-Wind Speed (m/s)	Pressure
SP21HL	10.07.2025	14:26:00	55	57	240-9	1003
SP21C.2	10.07.2025	20:23:00	30.84	32	150-4.3	1004
SP21C	11.07.2025	09:43:00	45.86	50	202-4	1008
SP21B	11.07.2025	15:55:00	24.95	30	199-3.3	1006
SP21H	11.07.2025	19:45:00	190	273	180-3.6	1005
SP19	12.07.2025	05:00:00	120	120	202-4.7	1006
SP18	12.07.2025	09:02:00	60	60	182-11.9	1006
SP18A	12.07.2025	15:15:00	76	80	175-7.5	1007
SP18B.F	12.07.2025	17:41:00	115	308	351-3.6	1007
SP18C	12.07.2025	19:13:00	84	97	170-3.7	1007
SP18B	12.07.2025	21:10:00	52	46	181-8	1007
SP18D	13.07.2025	09:31:00	177	330	160-7.4	1006
SP16A	13.07.2025	14:20:00	110	112	160-4.9	1006
SP16B	13.07.2025	17:15:00	82	95	139-9.9	1006
SP14A.2	14.07.2025	00:21:00	182	389	170-5	1006
SP13.A	14.07.2025	22:50:00	164	1000	293-6.3	1005
SP14A.3	14.07.2025	10:00:00	157	801	125-9.3	1007
SP12.A	15.07.2025	08:30:00	61	60	217-6.33	1002
SP12	15.07.2025	16:15:00	122	270	215-14	1001
SP40	16.07.2025	07:26:00	77	77	190-11	1008
SP41	16.07.2025	14:30:00	53	51	264-3	1007
SP42	17.07.2025	00:55:00	32	45	211-1.9	1007
sp42a	17.07.2025	11:00:00	65	65	211-1.9	1007
SP43	17.07.2025	15:20:00	137	295	141-6.7	1008
SPCTD1	17.07.2025	20:00:00	110	120	115-15	1008
SPCTD2	18.07.2025	02:50:00	132	130	307-5.32	1008
SP51	18.07.2025	09:00:00	39	37	76-2.2	1009
SP32	18.07.2025	12:25:00	63	63	35-3.5	1010
SP33M	18.07.2025	14:00:00	25	25	73-3.3	1010
SP31M	18.07.2025	19:30:00	20	19	200-3.5	1011
SP31	18.07.2025	21:30:00	90	90	191-3	1010
SP30	19.07.2025	00:55:00	164	162	186-3.4	1010
SP50	19.07.2025	09:00:00	161	160	140-3.3	1009
SPCTD3	19.07.2025	15:30:00	85	87	138-3.5	1009
SPCTD4	19.07.2025	22:00:00	165	200	141-3.3	1009

Station Point	Date	Time (Local)	CTD Depth (m)	Water Column Depth (m)	Wind Direction (°)-Wind Speed (m/s)	Pressure
SPCTD5	20.07.2025	04:15:00	135	136	181-3.42	1015
SP7	20.07.2025	08:30:00	173	180	176-3.5	1010
SPCTD6	20.07.2025	15:30:00	185	280	143-3.6	1010
SPCTD7	20.07.2025	22:10:00	160	160	143-6.7	1010
SP6A	21.07.2025	04:15:00	170	260	157-3.6	1008
SPCTD8	21.07.2025	12:30:00	185	299	196-3.5	1010
SP52	21.07.2025	19:10:00	170	269	234-3.4	1009
SPCTD9	22.07.2025	01:47:00	185	250	249-7.32	1011
SPCTD10	22.07.2025	08:00:00	187	362	152-1.7	1009
SPCTD11	22.07.2025	14:00:00	187	396	224-7.8	1009
SP53	22.07.2025	20:40:00	169	360	161-8	1011
SPCTD12	23.07.2025	03:50:00	170	452	183-7.7	1015
SPCTD13	23.07.2025	10:30:00	186	230	119-2.5	1016
SP54	23.07.2025	16:50:00	156	258	171-10.9	1008
SP24	24.07.2025	01:25:00	185	260	190-5.6	1008
SP55	24.07.2025	12:00:00	48	48	178-5.08	1002
SP23b	25.07.2025	12:05:00	111	113	239-3.3	0999
SP22	25.07.2025	17:05:00	134	136	149-3.6	0999
SP22A	25.07.2025	20:45:00	42	38	204-2.0	0999
SP21	26.07.2025	13:30:00	187	228	265-2.1	1001
SP20	26.07.2025	16:00:00	176	219	159-5.2	1002
SP20A	26.07.2025	19:30:00	156	126	222-7.7	1003
SP20D	26.07.2025	23:00:00	51	50	269-1.77	1004
SP20D	27.07.2025	09:00:00	51	50	N/A	N/A
SP20B	27.07.2025	12:20:00	13	13	152-4.2	1007
SP20C	27.07.2025	14:25:00	184	256	34-1.6	1008
SP21J	27.07.2025	16:00:00	165	406	124-3.9	1008
SP21J2	27.07.2025	16:40:00	48	46	230-0.2	1008
SPCTD14	28.07.2025	11:30:00	187	200	330-0.2	1011
SP21C3	28.07.2025	13:30:00	114	115	284-1.2	1011
SP21C4	28.07.2025	15:40:00	24	22	129-4	1011
SP21C5 (covered station with 21C)	28.07.2025	22:30:00	44	44	N/A	N/A
SPCTD15	29.07.2025	12:00:00	167	191	124-0.8	1008
SPCTD21N	29.07.2025	16:00:00	25	23	217-0.9	1008

Meteorological data measured at each sampling points are given in Table 5.

Table 5. Meteorological data at each sampling points

Sampling Point	Date	Time (Local)	Depth (m)	Wind Direction (°)	Wind Speed (m/s)	Air Pressure (hPa)
SP21HL	10.07.2025	14:26:00	55	240	9	1003
SP21C.2	10.07.2025	20:23:00	32	150	4.3	1004
SP21C	11.07.2025	09:43:00	50	202	4.0	1007
SP21B	11.07.2025	15:55:00	30	199	3.3	1006
SP21H	11.07.2025	19:45:00	273	180	3.6	1005
SP19	12.07.2025	05:00:00	120	202	4.7	1005
SP18	12.07.2025	09:02:00	60	182	11.9	1000
SP18A	12.07.2025	15:15:00	80	175	7.5	1007
SP18A.M	12.07.2025	17:41:00	308	351	3.6	1007
SP18F	12.07.2025	19:13:00	97	170	3.7	1007
SP18C	12.07.2025	21:10:00	46	181	8.0	1007
SP18B.M	12.07.2025	09:31:00	330	160	7.4	1006
SP18D	13.07.2025	14:20:00	112	160	4.9	1005
SP16A	13.07.2025	17:15:00	95	139	9.9	1005
SP16B	13.07.2025	00:21:00	389	170	5.0	1006
SP14A.2	14.07.2025	22:50:00	> 1000	293	6.3	1005
SP14A.3	14.07.2025	10:00:00	801	125	9.3	1007
SP13.A	14.07.2025	08:30:00	60	217	6.3	1002
SP12.A	15.07.2025	16:15:00	270	215	14	1001
SP12	15.07.2025	07:26:00	77	190	11.0	1008
SP40	16.07.2025	14:30:00	51	264	3.0	1007
SP41	16.07.2025	00:55:00	45	211	1.9	1007
SP42	17.07.2025	11:00:00	65	211	1.9	1007
SP43	17.07.2025	15:20:00	295	141	6.7	1008
SPCTD1	17.07.2025	20:00:00	120	115	15	1008
SPCTD2	18.07.2025	02:50:00	130	307	5.3	1008
SP51	18.07.2025	09:00:00	37	76	2.2	1009
SP32	18.07.2025	12:25:00	63	35	3.5	1010
SP33.M	18.07.2025	14:00:00	25	73	3.3	1010
SP31.M	18.07.2025	19:30:00	19	200	3.5	1011
SP31	18.07.2025	21:30:00	90	191	3.0	1010
SP30	19.07.2025	00:55:00	162	186	3.4	1010
SP50	19.07.2025	09:00:00	160	140	3.3	1009
SPCTD3	19.07.2025	15:30:00	87	138	3.5	1009
SPCTD4	19.07.2025	22:00:00	200	141	3.3	1009
SPCTD5	20.07.2025	04:15:00	136	181	3.4	1015
SP7	20.07.2025	08:30:00	180	176	3.5	1010
SPCTD6	20.07.2025	15:30:00	280	143	3.6	1010
SPCTD7	20.07.2025	22:10:00	160	143	6.7	1010
SP6A	21.07.2025	04:15:00	260	157	3.6	1008
SPCTD8	21.07.2025	12:30:00	299	196	3.5	1010
SP52	21.07.2025	19:10:00	269	234	3.4	1009
SPCTD9	22.07.2025	01:47:00	250	249	7.3	1011

Sampling Point	Date	Time (Local)	Depth (m)	Wind Direction (°)	Wind Speed (m/s)	Air Pressure (hPa)
SPCTD10	22.07.2025	08:00:00	362	152	1.7	1009
SPCTD11	22.07.2025	14:00:00	396	224	7.8	1009
SP53	22.07.2025	20:40:00	360	161	8.0	1011
SPCTD12	23.07.2025	03:50:00	452	183	7.7	1015
SPCTD13	23.07.2025	10:30:00	230	119	2.5	1016
SP54	23.07.2025	16:50:00	258	171	10.9	1008
SP55	24.07.2025	01:25:00	260	190	5.6	1008
SP24	24.07.2025	12:00:00	48	178	5.08	1005
SP23B	25.07.2025	12:05:00	113	239	3.3	1002
SP22	25.07.2025	17:05:00	136	149	3.6	1002
SP22A	25.07.2025	20:45:00	38	204	2.0	1002
SP21K	26.07.2025	12:45:00	157	345	2.5	1001
SP21	26.07.2025	13:30:00	228	265	2.1	1001
SP20	26.07.2025	16:00:00	219	159	5.2	1002
SP20A	26.07.2025	19:30:00	126	222	7.7	1003
SP20D	26.07.2025	23:00:00	50	269	1.77	1004
SP20D.2	27.07.2025	09:00:00	50	N/A		N/A
SP20B	27.07.2025	12:20:00	13	152	4.2	1007
SP20C	27.07.2025	14:25:00	256	34	1.6	1008
SP21J	27.07.2025	16:00:00	406	124	3.9	1008
SP21J.2	27.07.2025	16:40:00	46	230	0.2	1008
SPCTD14	28.07.2025	11:30:00	200	330	0.2	1011
SP21C.3	28.07.2025	13:30:00	115	284	1.2	1011
SP21C.4	28.07.2025	15:40:00	22	129	4.0	1011
SP21C2	28.07.2025	22:30:00	44	N/A		N/A
SPCTD15	29.07.2025	12:00:00	191	124	0.8	1008
SP21.N	29.07.2025	16:00:00	23	217	0.9	1008

Table 6 shows the daily average values of meteorological data measured during the TASE-V expedition, based on data obtained from the automatic weather observation station. Accordingly, the lowest and highest air temperatures during the expedition ranged from 3.7 °C to 11.7 °C on the 14th and 11th days of the month. On the 14th and 23rd days of the month, the dew point temperature was measured at 1.8 °C and 10.2 °C, respectively. Humidity values were also observed to vary between 68% and 99%. Solar radiation was measured to fluctuate between 67 and 203 W/m². In the polar regions, high pressure was observed, consistent with this time of year, with partly cloudy, occasionally very cloudy weather prevailing.

Table 6. Mean meteorological data collected during the expedition

Date	Temperature (°C)	Humidity (%RH)	Pressure (hPa)	Dew Point (°C)	Solar Radiation (W/m ²)
11.07.2025	11.7	76	1007	7.4	141
12.07.2025	8.6	83	1007	5.8	203
13.07.2025	9.2	78	1006	5.4	119
14.07.2025	3.7	88	1006	1.8	73
15.07.2025	3.8	91	1003	2.4	118
16.07.2025	6.5	75	1006	2.4	67
17.07.2025	6.9	78	1008	3.1	68
18.07.2025	5.5	86	1012	3.2	114
19.07.2025	8.5	77	1015	4.4	134
20.07.2025	5.6	90	1013	3.9	94
21.07.2025	8.0	99	1013	7.8	66
22.07.2025	10.3	99	1013	10.2	157
23.07.2025	8.4	87	1013	6.3	133
24.07.2025	9.8	70	1000	4.2	99
25.07.2025	6.8	83	998	4.1	84
26.07.2025	6.8	83	1001	4.0	76
27.07.2025	7.2	75	1007	3.0	68
28.07.2025	10.8	68	1010	4.9	80
29.07.2025	9.2	71	1008	7.2	186
30.07.2025	8.7	75	1008	6.9	156

Conclusion

In order to identify the causes of global warming and climate change in the Arctic region, to understand their impacts on the ecosystem, and to develop scientific projections for the future, a total of 16 projects encompassing various disciplines—such as atmospheric sciences, GNSS measurements, oceanography, and microbiology—were implemented. These multidisciplinary scientific initiatives aim to elucidate the ecological changes triggered by sea ice melt and to gain a clearer understanding of the underlying drivers of warming in the region. Throughout the research activities, comprehensive datasets covering the physical, chemical, and biological characteristics of both the water column and the atmosphere were collected.

Within the field of marine sciences, the projects adopt an integrated, multidisciplinary approach to investigate the physical-oceanographic structure of the Arctic. Key research areas include the presence of microplastics and their interactions with pharmaceutical active compounds and other organic pollutants; the distribution and environmental risks of antifouling biocides used in ship paints; the identification of toxic phytoplankton species; the monitoring of marine

mammals through environmental DNA (eDNA) analysis; and the assessment of microbial diversity on zooplankton, ichthyoplankton, and floating marine debris. Furthermore, the effects of glacier melt on biodiversity have been investigated in detail through resistome analysis and metagenomic techniques. In the domain of physical oceanography, CTD measurements have been used to monitor temperature, salinity, and density profiles within the water column; GNSS-based measurements have been applied to determine water vapor dynamics in the atmospheric column; and meteorological stations have recorded temperature, pressure, wind, humidity, and solar radiation data at regular intervals.

These studies provide a comprehensive overview of the current state of the Arctic ecosystem, offering valuable scientific insights for predicting the potential impacts of climate change and identifying sources of pollution. The findings hold strategic value not only for fundamental science but also for environmental management, sustainability policies, and international cooperation. As international publications, conference papers, and other scientific outputs are produced from these projects, they will be shared with the relevant Norwegian authorities, thereby contributing to the global scientific community.

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