Expedition Report

Atka Southeast Greenland 2024 Expedition

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Cover photo by Matthieu Klitting, design by Inês Jakobsson.

Introduction

Founded in 2020, Témoins Polaires is a non-profit endowment fund dedicated to raising public awareness of the beauty and vulnerability of the polar regions. The fund supports and promotes projects that emphasize the importance of these areas for the climate and advocate for their protection. In 2023, Témoins Polaires expanded their mission by co-developing a scientific polar expedition in partnership with national and international research laboratories. Two scientific projects were selected, led by scientists from Stockholm University and University of Basel. The expedition took place from August 9 to August 19. On board, the team consisted of two scientists, a videographer/photographer, and two sailors. The overall goal of the expedition was to better understand the key drivers and impacts (physical and biological) of climate change in the area of Southeast Greenland.

Synopsis of Operations

The field campaign for the ATKA24 expedition took place in August 2024 along the coast of SE Greenland. The ATKA arrived in Tasiilaq on August 9th after crossing the Denmark Strait from Reykjavik, Iceland. Both due to unusually intense ice conditions for the time of year and a major storm in the Danmark Strait, the expedition was delayed by nearly two weeks. Prior to departure from Tasiilaq, the expedition team evaluated ice conditions in the region of proposed scientific activities, including Køge Bugt and Ikertivaq regions, and determined based on recent satellite imagery that the heavy ice conditions impeded chances of successful expedition to the westernmost fjords. Therefore, two fjord areas were selected based on low ice cover and proximity to potential anchorage (Figure 1). Furthermore, based on the most recent wind conditions (onshore fetch), the options for traveling and/or sampling further offshore were eliminated due to heavy drift ice conditions along the coast.

The ATKA departed from Tasiilaq on the morning of August 10th and sailed to Sermilik fjord, the largest nearby fjord to the West. Field trials of scientific activities began during rainy weather in the morning and continued through the afternoon. Three successive profiler casts (here forward referred to as 'CTD' casts) were conducted to depths of 150, 200, and 400 m. During this time adjustments were made to the winch mechanism and Dyneema spool to reduce friction and risk of entanglement. Following CTD casts, successive water sampling operations were conducted to all depths (2, 5, 10, 15, 25, 50, 75, 100, 250, 500 etc). Field trial operations were concluded with a successful plankton net tow to 100 m at 20:22.

Favorable weather conditions in the following days allowed the team to travel along uncharted inner passages to Istertup Kangertiva fjord. Reaching the middle point of the fjord on the 12th, we conducted a single sampling station for CTD and plankton before a short overnight rest, drifting slowly into the fjord. Sampling resumed in the early morning at the furthest point in the fjord. Ice conditions at the head of the fjord were the most intense of the expedition, eventually impeding safe passage further toward the ice front. Sampling continued successfully down the fjord on the 13th and 14th. The speed and success of Isertup Kangertiva allowed us sufficient time to transit to the next major fjord system to the east, Nagtivit Kangertivat.

Nagtivit Kangertivat had a more complex fjord structure, with two marine termini of the Greenland ice sheet on west side and an outflow river from a lake-terminating glacier on the east. Two small lateral transect from the marine terminating glaciers were devised, and following successful activities there, we transited up the easternmost finger of the fjord to sample along the river outflow plume. Finally, with half a day to spare on our transit back to Tasiilaq, we devised a small transect (Stations 47–50) near the outside of Sermilik fjord and were able to profile down to 500 m.

Overall, data collection and sampling went exceptionally well. In two instances, the profiler made contact with the seafloor, with no impact on data collection. In both cases, the profiler returned to the surface with some clay/silt material and was rinsed clean with no apparent damage to instrumentation. The absence of local charts and relatively coarse resolution of multibeam data from prior expeditions made it difficult to profile as close to seafloor as we would have preferred.

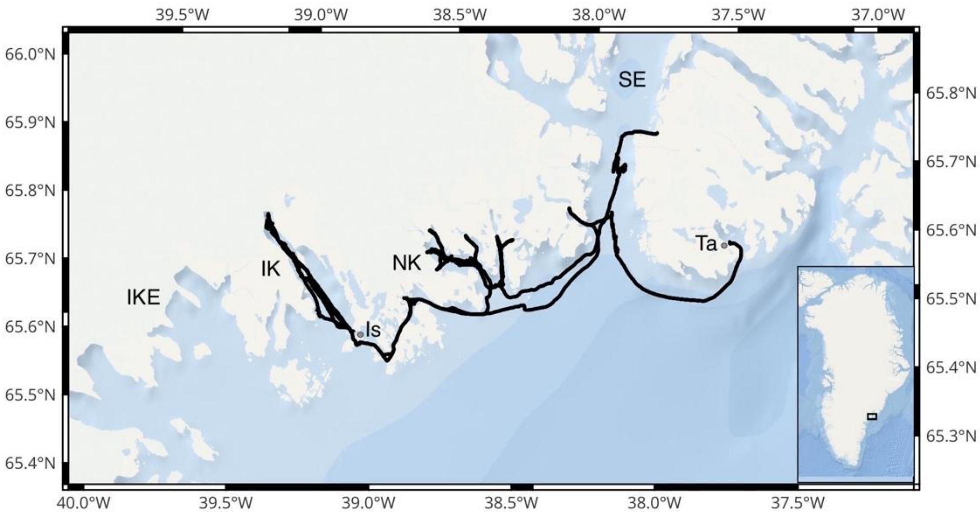

Figure 1. Map showing the sutdy area and expedition track between August 9th-19th in Southeast Greenland. Fjord systems are abbreviated as; NK = Nagtivit Kangertivat, IK=Isertup Kangertiva, IKE = Ikertivaq, SE = Sermilik. Towns and settlements are indicated as Ta = Tasiilaaq, Is = Isertoq.

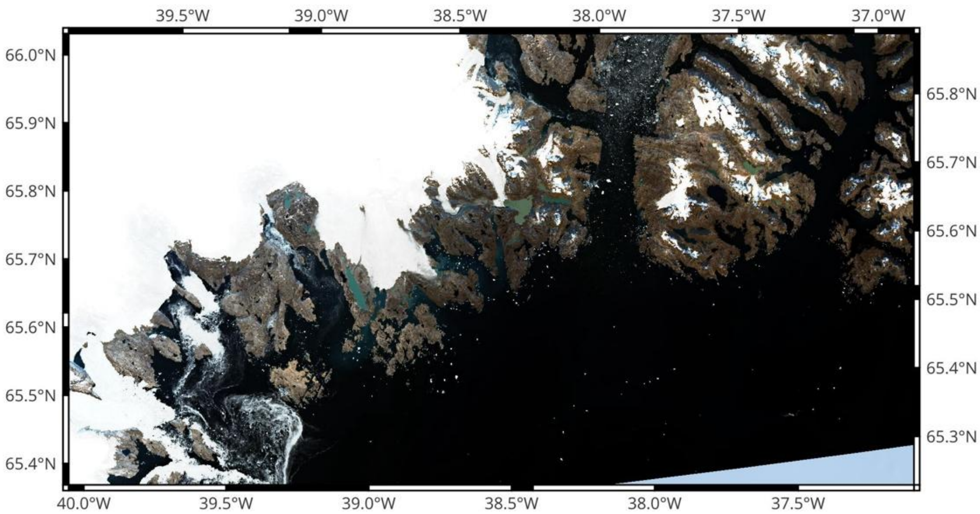

Figure 2. Satellite image (Sentinel 2-L2A, 19/9/2024) showing ice conditions in the study region. Isertup Kangertiva, Nagtivit Kangertivat, and Sermilik were relatively ice-free and were selected as the safest options for sampling. Images were captured using Sentinel-2 L2A and downloaded from the Sentinel Hub browser: https://apps.sentinel-hub.com/eo-browser

Table 1: Team members (on-board and onshore)

Name	**Role**	**Organisation**
Paul Marre	Captain	Témoins-Polaire
Matthieu Klitting	Executive Direction and Photo/Videographer	Témoins-Polaire
Maxime Dagorne	1st mate	Témoins-Polaire
Flor Vermassen	Principal Investigator, Project 1 (onshore)	Stockholm University
Julek Chawarski	On-board science leader, Project 1	Stockholm University/ASL Environmental Services
Christian Stranne	Collaborator, Project 1 (onshore)	Stockholm University
Helen Coxall	Collabrator, Project 1 (onshore)	Stockholm University
Julie Lattaud	Principal Investigator, Project 2 (onshore)	University of Basel/Stockholm University
Jakob Zopfi	On-board science leader, Project 2	University of Basel

Project 1. Atlantic Water inflow and planktonic communities

Motivation

The rate of ice loss from the Greenland Ice Sheet has risen considerably over the past two decades, with marine outlet glaciers contributing significantly due to increased melting and ice discharge. Periods of rapid retreat for these tidewater glaciers have been linked to the inflow of warm, Atlantic-sourced waters. However, the oceanographic characteristics of many fjords in Southeast Greenland remain poorly understood, with limited observational data constraining insights into the impact of these warm inflows on marine outlet glacier melting. Therefore, the first objective of the project was to measure the hydrographic properties of fjords with marine-terminating glaciers in the data-scarce region south of Tasiilaq/Angmagssalik Fjord. These measurements aim to improve our understanding of fjord circulation, variability in Atlantic Water inflow, and its interactions with marine outlet glaciers.

The second objective of the project is to investigate how planktonic communities respond to environmental changes in Southeast Greenland, particularly near marine outlet glaciers. This region is highly sensitive to climatic shifts, as it receives significant meltwater input from the Greenland Ice Sheet and is also influenced by warm ocean currents originating from the North Atlantic, some of which are diverted toward Greenland. These opposing influences introduce uncertainties regarding the long-term response of planktonic communities. Will increased meltwater runoff lead to greater productivity, or will the inflow of warmer currents drive a shift to warm-water species? Despite the importance of this region, it remains understudied due to its challenging accessibility. Consequently, the goal is to assess (zoo)plankton abundance and distribution in the water column to better understand the environmental factors that shape their presence.

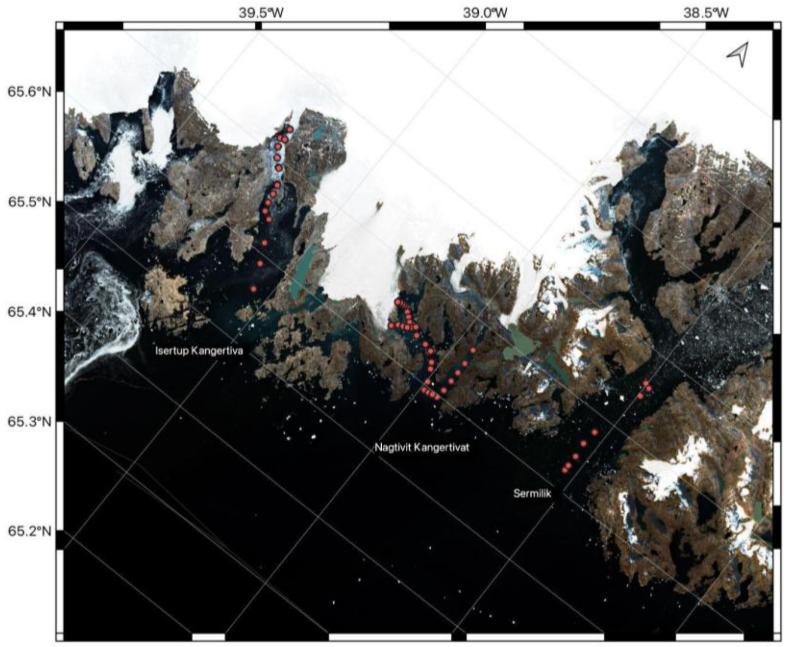

Figure 3. Overview of study area and sampling stations. Satellite image is from Sentinel L2a , 19-09-2024. Detailed maps of study areas and station numbers are provided in Fig. 4.

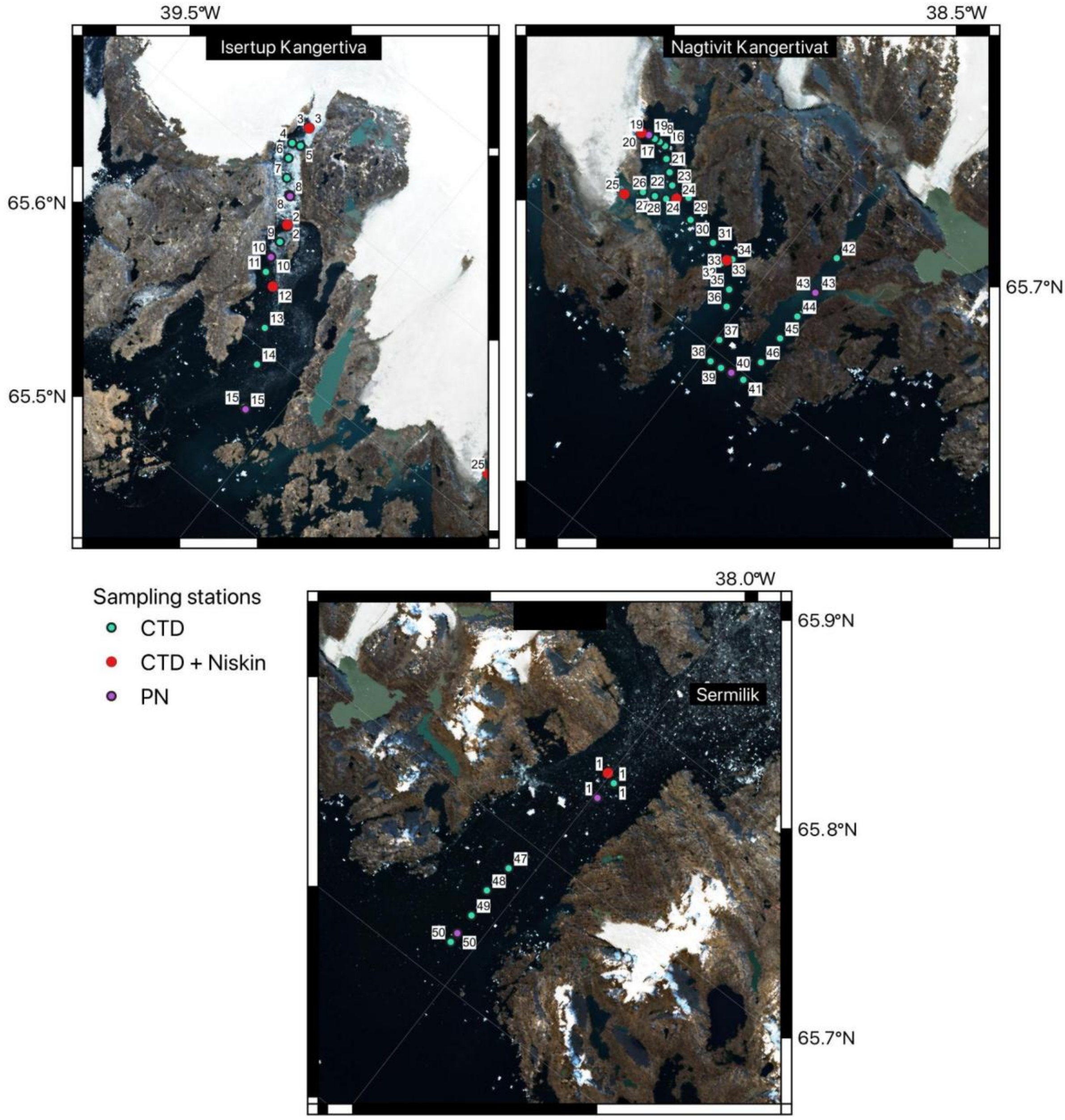

Figure 4. Detailed maps of sampling locations obtained in three different fjords; Isertup Kangertivat, Nagtivit Kangertivat, and Sermilik. CTD = Conductivity, Temperature, Depth; PN = Plankton Net.

Methods and data collection

1) Oceanographic sampling

Data were collected using a custom-built profiler (**Figure 5**) carrying conductivity, temperature, turbidity and depth sensors (RBR Concerto+ ©), a light sensor (TDR-mk9, Wildlife Computers ©), a turbidity and chlorophyll fluorescence sensor (ALC-CLW, JFE Advantech ©), a zooplankton and particle imaging camera (UVP6, Hydroptic ©), and a 200 kHz Acoustic Zooplankton Fish Profiler (AZFP-*nano*, ASL Environmental Sciences ©).

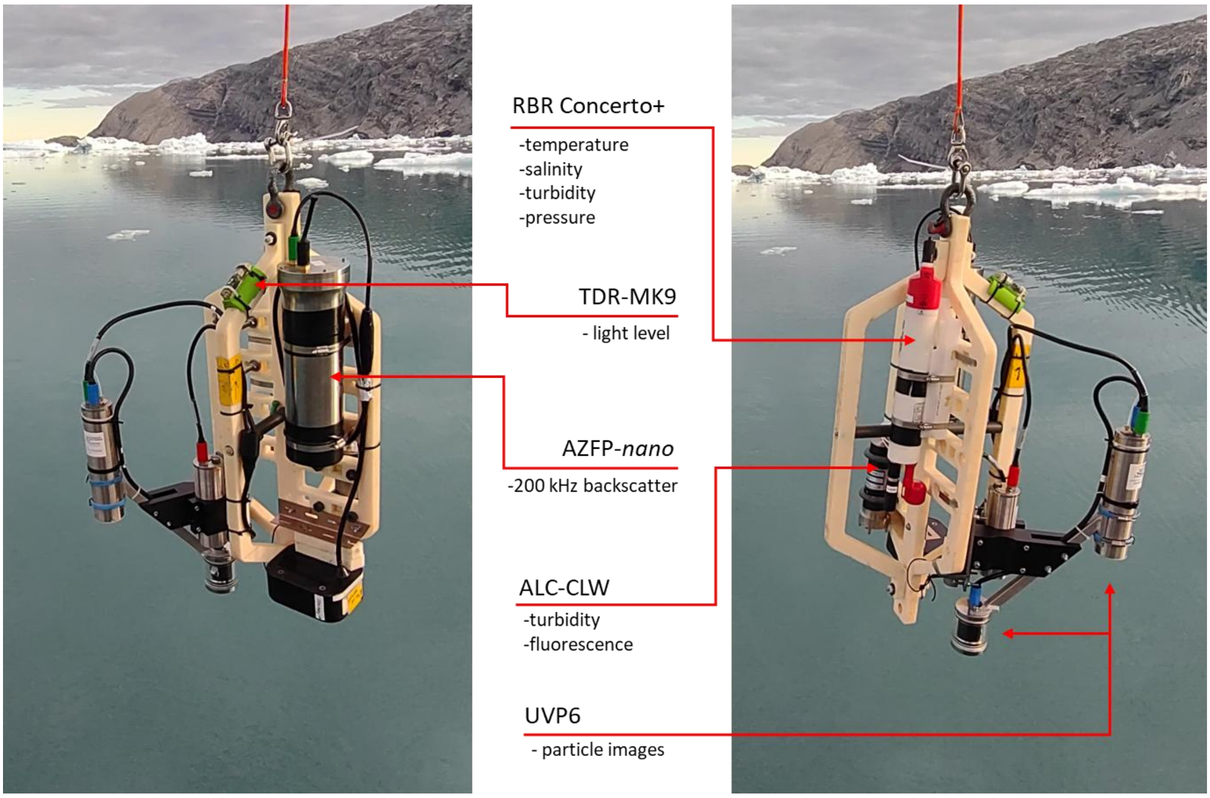

Figure 5. Custom-built profiler equipped for measuring, temperature, conductivity, turbidity, light, chlorophyll fluorescence, zooplankton/particle images, and acoustic backscatter. Profiler frame is composed of a collapsible plastic cage, ring clamps, and metal hardware. With sensors, the whole profiler weighed approximately 25 kg and was easily deployed from the stern winch.
Photo: Matthieu Klitting

Hydrography and Physical Parameters. Water column parameters measured included temperature, salinity, turbidity, chlorophyll fluorescence, and light. Prior to each deployment, each instrument was initiated before the profiler was lowered from the stern to the sea surface. Each profile required two personnel to operate, one to manage the winch, and the other to launch the profiler (**Figure 6**).

Prior to each profile, a 'rinsing' sequence was undertaken, whereby the profiler was lowered to 10 m before returning to the surface, a procedure that allows sensors to adjust to ambient conditions and allows sufficient time for the initiation of the UVP6 imaging pressure sequence. Sensors measuring turbidity, fluorescence, light, and acoustic backscatter were matched with pressure measurements from the CTD to create depth profiles (**Figure 7**).

Figure 6. Profiling operations. During a typical profiling activity, one crew was responsible for controlling the winch while another assisted the winch by lifting the profiler and stabilizing it with a gaff. The profiler was retrieved at a slightly faster rate (~0.8 m/s), during which crew members shared the responsibility of spooling back the Dyneema rope.
Photo: Matthieu Klitting

Optical Data. Particle images were collected using an Underwater Vision Profiler (UVP6, Hydroptic ©) mounted to the water column profiler. The UVP6 system detects and counts all marine particles in the 100–2000 μm range in 0.65 L volume illuminated with a digital camera (Picheral et al., 2021). The system automatically detects and stores vignettes of objects. The acquisition rate was set to 25 Hz. The rosette was lowered with an average descent speed of approximately 0.5 ms^{-1}; however, speeds may have varied by 0.1-0.2 ms^{-1}. Image vignettes and metadata were processed using the UVPApp2 V2.3 and the project was uploaded to the EcoTaxa database. The project title ATKA24 can be found here: https://ecotaxa.obs-vlfr.fr/prj/14590

Biophysical Profile Preliminary Results

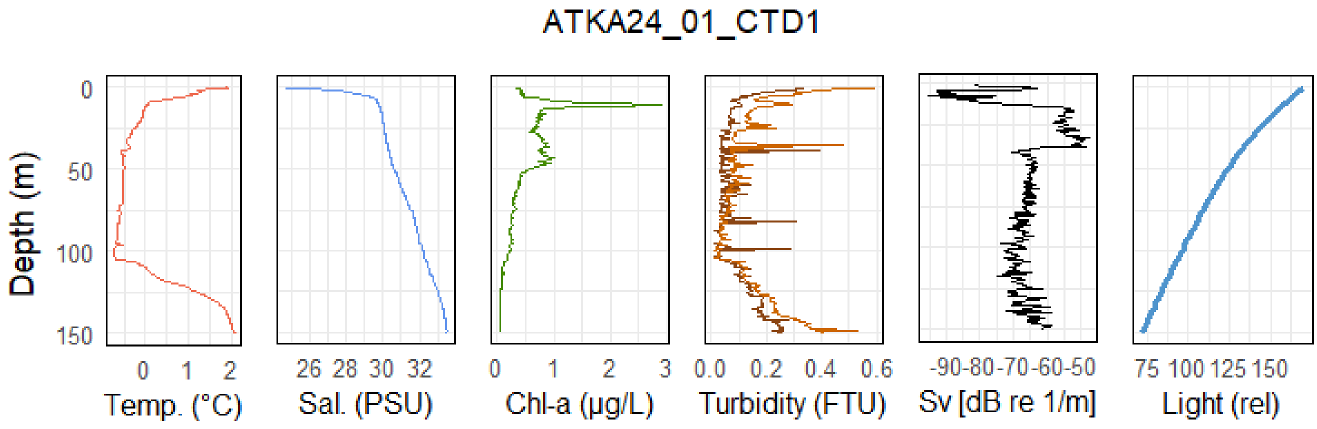

Figure 7. Example profile of all measured parameters on the lowered profiler (excluding UVP6) from station ATKA24_01_CTD1. Turbidity plot includes measurement from both the RBR CTD (light brown) and ALC-CLW (dark brown).

A total of 1,237,708 images were captured with the UVP6 during the downcast of profiles during the expedition. Automated processing of image vignettes results in summarized profiles of Large Particulate Matter (LPM) abundances (**Figure 8**). A small proportion (~5 %) of images were classified as living zooplankton (**Figure 9**). These images can be used to distinguish taxa within scattering layers measured with acoustics and the high quality of these images will facilitate size and morphology parameters in the estimation of plankton biomass. The remaining images are of biogenic particulates, commonly referred to as marine snow. Marine snow can often be composed of senescent or partially digested phytoplankton and phytodetritus, the bodies of dead zooplankton and fecal pellets, and in the coastal Arctic are often combined with glacial particles. The abundance and condition of marine snow can provide indicators for the functioning of the particle pump, impacting the amount of nutrients reaching the seafloor.

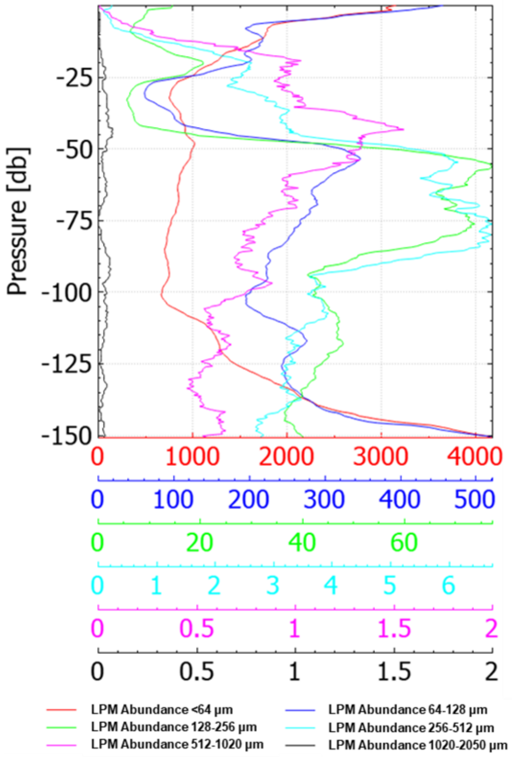

Figure 8. UVP6 Particle profiles of Large Particulate Matter (LPM) from ATKA24_01_CTD1. Particles sizes are automatically processed using UVPAppv2.0 software, precluding any further classification in EcoTaxa.

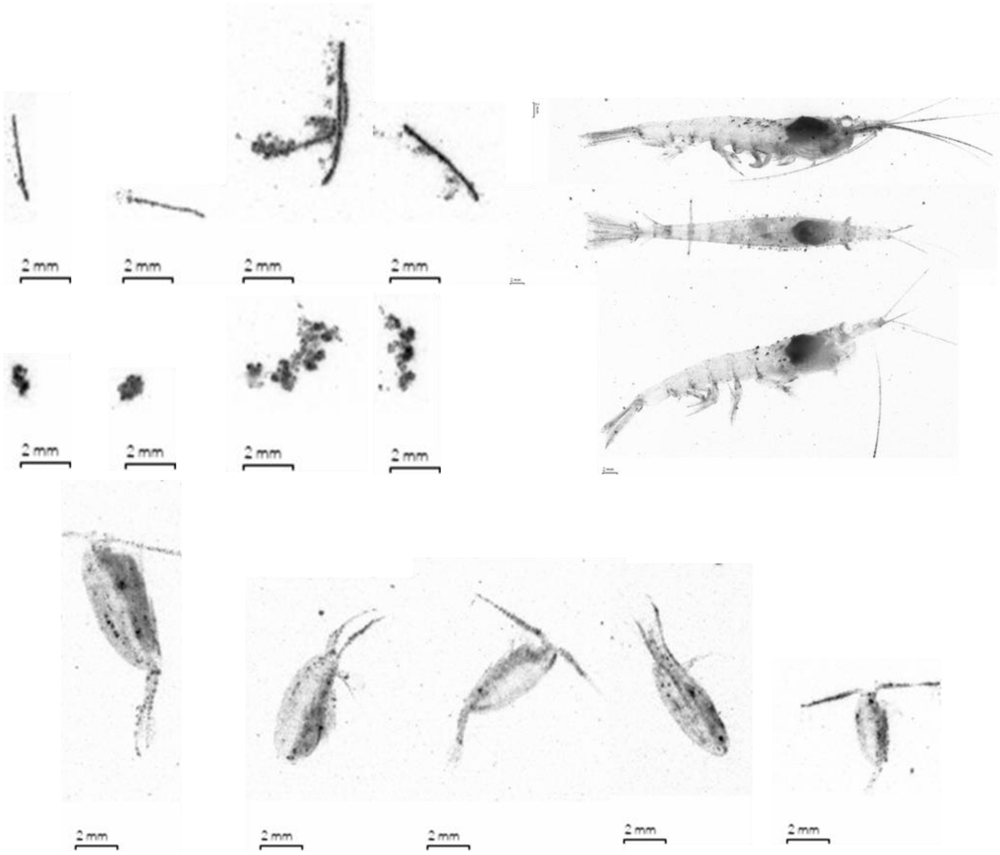

Figure 9. Exemplary images captured by the UVP6. Marine snow particles represent the largest proportion of images in the database accounting for approximately 85% of images (top left). Rare, high quality images of euphausiids accounted for <0.1 % of images (top

right). Copepods, and copepod-like images (bottom) accounted for approximately 5% of the database.

Acoustic Data. Acoustic data (volume backscattering strength S_v in dB re 1 m^{-1}) for the measurement of mesozooplankton distribution were collected using a profiler mounted Acoustic Zooplankton Fish Profiler (AZFP-*nano*, ASL Environmental Sciences ©), equipped with a downward facing 200 kHz transducer. Data were collected to 50 m range using a 1 s sampling interval and stored using a 64000 Hz digitization rate, defined as the frequency at which the analog-to-digital converter is sampling. Pulses were transmitted using 300 µs pulse length and data were collected using a nominal sound speed of 1450.5 m/s, an absorption coefficient of 0.0230 db/m, and a two-way beam angle of -19.7 dB.

As acoustic propagation is impacted by water mass properties, acoustic data must be corrected for sound speed, absorption, range, and two-way beam angle as the profiler moves through the water column. Following the cruise, these values were adjusted on a per-ping basis using sound speed and absorption values computed using coinciding temperature, salinity and pressure data averaged over a 50 m range from the transducer during a given ping (Francois & Garrison, 1982). Two-way beam angle and time-varied gain (TVG) range corrections were made using equations 1 and 2, where c is the sound speed (m s^{-1}), t is the pulse length (µs), and ψ is the two-way beam angle (dB re 1 steradian) (Demer et al., 2015). A calibration offset of 1.2 dB was applied to account for system bandwidth effects for volume backscatter.

$$〚Range〛\_corrected = 〚Range〛\_measured - c\tau/4 \qquad [R, meters] \qquad (eq. 1)$$

$$\psi\_adjusted = \psi\_manufacturer \ (c\_measured \ /c\_nomimal)\text{^}2 \qquad [\psi, dB\ re\ 1\ steradian] \qquad (eq. 2)$$

Data were averaged into 0.5 m depth and range bins to generate echograms and mean volume backscatter (MVBS) was calculated for each depth to generate a profile (**Figure 10**).

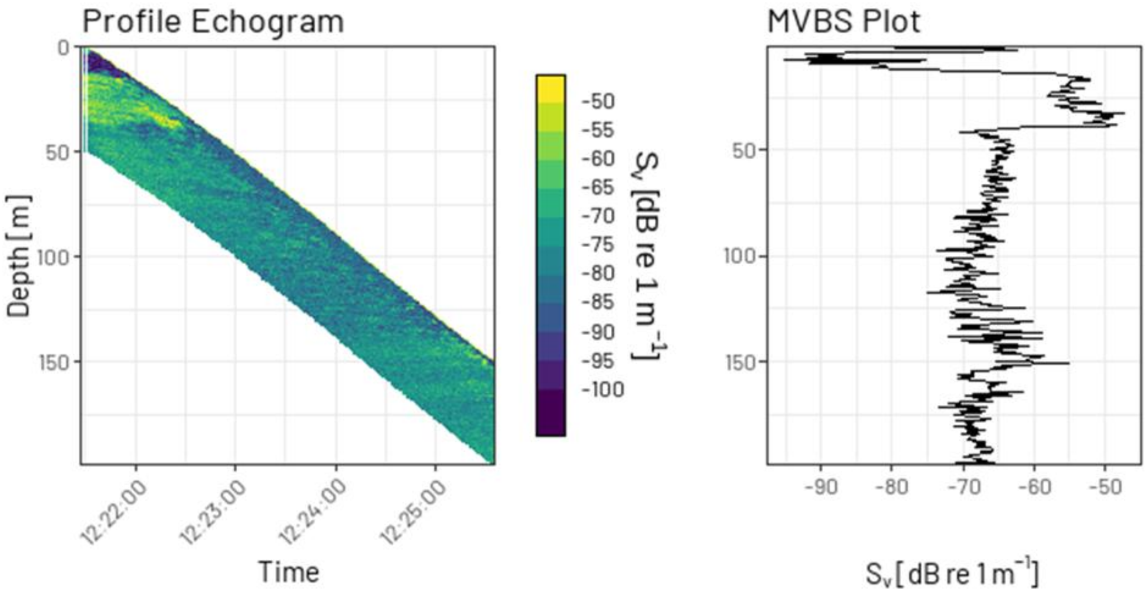

Figure 10. Examples of echogram (left) and MVBS profile (right) from the first station of the Atka 24 Expedition (ATKA24_01) taken in Sermilik fjord on 08-11-2024.

Transducer mounting. As the ATKA24 Expedition provided an opportunity for prototype testing of the AZFP-*nano*, we carefully considered the tradeoff of mounting the transducer in a horizontal vs vertical orientation. In previous expeditions, horizontal facing transducers were trialed with other instruments; however the beam pattern and physical artifacts near the surface (i.e. ice and ships keel) prevent reliable data collection in the upper 10–25 m of the surface. On the other hand, by placing the transducer at the bottom of the frame, we risked potential damage in case of profiler touching the seafloor. In the end, we were pleased with the result of the vertical transducer orientation as it facilitated high quality data collection near the surface and seafloor. Nonetheless, in some cases, vessel adjustments requiring engagement of the propellor induced up some undesired backscatter, masking data collection in the upper 5–10 m.

2) Biological Sampling – Plankton net

Plankton samples were collected with a ring net (60 cm diameter net opening, 83 µm mesh; **Figure 11**) hauled vertically from 100 m while on station. The ring net was retrieved at ~ 0.5 m/s using the stern winch. The plankton net was rinsed with seawater (from the outside). Plankton slurry was poured into sample bottles and preserved with an equal volume of 95% ethanol. Plankton will be sorted and identified at Stockholm University. Sampling sites are listed in Table 2.

Figure 11: Plankton net collection. Photo: Matthieu Klitting

Table 2. CTD and Plankton net operations

ID	Station	Operation	Cast	Target depth (m)	Date	Start time (Local)	IBCAO Depth (m)
ATKA24_01_CTD1	1	CTD1	1	150	2024-08-11	11:15:00	-888.3021851
ATKA24_01_CTD2	1	CTD2	2	200	2024-08-11	11:56:00	-890.1829834
ATKA24_01_CTD3	1	CTD3	3	400	2024-08-11	12:33:00	-890.1829834
ATKA24_02_CTD	2	CTD	1	400	2024-08-12	19:23:00	-440.4334412
ATKA24_03_CTD	3	CTD	1	225	2024-08-13	08:08:46	-322.0385132
ATKA24_04_CTD	4	CTD	1	200	2024-08-13	10:25:00	-345.306427
ATKA24_05_CTD	5	CTD	1	300	2024-08-13	14:51:50	-350.7937927
ATKA24_06_CTD	6	CTD	1	350	2024-08-13	15:39:55	-394.5568848
ATKA24_07_CTD	7	CTD	1	400	2024-08-13	16:33:25	-426.4339294
ATKA24_08_CTD	8	CTD	1	400	2024-08-13	17:32:00	-437.2147217
ATKA24_09_CTD	9	CTD	1	400	2024-08-14	07:18:00	-276.0068054

ATKA24_10_CTD	10	CTD	1	200	2024-08-14	08:27:00	-374.4107361
ATKA24_12_CTD	12	CTD	1	250	2024-08-14	10:19:00	-257.1404114
ATKA24_13_CTD	13	CTD	1	200	2024-08-14	15:58:00	-258.2843933
ATKA24_14_CTD	14	CTD	1	150	2024-08-14	16:43:00	-165.7362518
ATKA24_15_CTD	15	CTD	1	250	2024-08-14	17:28:00	-363.7462769
ATKA24_16_CTD	16	CTD	1	250	2024-08-15	11:39:00	-364.7157593
ATKA24_17_CTD	17	CTD	1	200	2024-08-15	12:13:00	-361.3806763
ATKA24_18_CTD	18	CTD	1	200	2024-08-15	12:42:05	-249.6171112
ATKA24_19_CTD	19	CTD	1	170	2024-08-15	13:20:00	-187.4335785
ATKA24_20_CTD	20	CTD	1	55	2024-08-15	15:37:00	N/A
ATKA24_21_CTD	21	CTD	1	300	2024-08-15	16:09:00	-362.9512634
ATKA24_22_CTD	22	CTD	1	300	2024-08-15	16:58:00	-343.6776733
ATKA24_23_CTD	23	CTD	1	300	2024-08-15	17:46:00	-322.4650879
ATKA24_24_CTD	24	CTD	1	300	2024-08-15	18:24:30	-320.23526
ATKA24_25_CTD	25	CTD	1	35	2024-08-16	11:07:00	N/A
ATKA24_26_CTD	26	CTD	1	45	2024-08-16	11:28:00	N/A
ATKA24_27_CTD	27	CTD	1	110	2024-08-16	11:42:00	N/A
ATKA24_28_CTD	28	CTD	1	200	2024-08-16	12:01:00	-292.294342
ATKA24_29_CTD	29	CTD	1	200	2024-08-16	12:33:00	N/A
ATKA24_30_CTD	30	CTD	1	300	2024-08-16	17:12:00	-376.3109436
ATKA24_31_CTD	31	CTD	1	350	2024-08-16	17:53:00	-421.7415466
ATKA24_32_CTD	32	CTD	1	350	2024-08-16	18:34:00	-423.3121338
ATKA24_33_CTD	33	CTD	1	400	2024-08-16	19:14:00	-423.680542
ATKA24_34_CTD	34	CTD	1	350	2024-08-16	19:54:00	-331.1323853
ATKA24_35_CTD	35	CTD	1	300	2024-08-16	20:56:00	-362.9125061
ATKA24_36_CTD	36	CTD	1	200	2024-08-17	14:07:00	-274.5913391
ATKA24_37_CTD	37	CTD	1	200	2024-08-17	14:43:00	-218.5544281
ATKA24_38_CTD	38	CTD	1	200	2024-08-17	15:27:00	-265.206604

ATKA24_39_CTD	39	CTD	1	200	2024-08-17	15:59:00	-241.8417358
ATKA24_40_CTD	40	CTD	1	175	2024-08-17	16:40:00	N/A
ATKA24_41_CTD	41	CTD	1	150	2024-08-17	17:14:00	N/A
ATKA24_42_CTD	42	CTD	1	105	2024-08-17	19:49:00	N/A
ATKA24_43_CTD	43	CTD	1	200	2024-08-17	20:20:00	N/A
ATKA24_44_CTD	44	CTD	1	200	2024-08-17	20:52:00	N/A
ATKA24_45_CTD	45	CTD	1	175	2024-08-18	07:08:00	N/A
ATKA24_46_CTD	46	CTD	1	200	2024-08-18	07:39:00	N/A
ATKA24_47_CTD	47	CTD	1	500	2024-08-18	11:55:00	-898.3849487
ATKA24_48_CTD	48	CTD	1	500	2024-08-18	13:01:00	-901.0025635
ATKA24_49_CTD	49	CTD	1	500	2024-08-18	14:18:00	-898.6563721
ATKA24_50_CTD	50	CTD	1	500	2024-08-18	15:26:00	-897.8807983
ATKA25_11_CTD	11	CTD	1	250	2024-08-14	09:30:00	-329.3679199
ATKA24_01_PN	1	Plankton net	4	100	2024-08-11	20:22:00	-892.3740845
ATKA24_02_PN	2	Plankton net	2	100	2024-08-12	20:21:10	-440.4528503
ATKA24_03_PN	3	Plankton net	2	100	2024-08-13	08:33:10	-321.7282715
ATKA24_08_PN	8	Plankton net	2	100	2024-08-13	18:15:35	-437.1177673
ATKA24_10_PN	10	Plankton net	2	100	2024-08-14	08:55:00	-374.4107361
ATKA24_15_PN	15	Plankton net	2	100	2024-08-14	18:01:00	-257.9547729
ATKA24_19_PN	19	Plankton net	2	100	2024-08-15	13:38:00	-196.8764801
ATKA24_24_PN	24	Plankton net	2	100	2024-08-15	18:54:20	-316.492981
ATKA24_33_PN	33	Plankton net	2	100	2024-08-17	13:00:00	-423.680542
ATKA24_40_PN	40	Plankton net	2	100	2024-08-18	08:10:00	N/A
ATKA24_43_PN	43	Plankton net	2	100	2024-08-17	21:27:00	N/A
ATKA24_50_PN	50	Plankton net	2	100	2024-08-18	16:22:00	-898.6176147

Project 2. Effect of glacial meltwater on the biogeochemistry of the fjords

Motivation

Methane is an important greenhouse gas, and its concentration increase in the atmosphere over the last decade is responsible for 30% of the current warming (IPCC report 2021). Glaciers in the high Arctic form an impermeable cap that traps large reservoirs of subsurface methane (both biogenic and thermogenic). Greenland has been at the forefront of glacial retreat in the recent decades, at thus far unseen rates. The amount of methane that is liberated in association with glacier retreat is essentially unknown. East Greenland (EG) glaciers are, in particular, understudied in this regard due to limited accessibility of this remote region, but recent work in EG fjords highlighted methane hotspots in the water column, close to ocean-terminating glaciers. This expedition aimed at measuring methane release in three EG fjords that host large ocean-terminating glaciers that undergo significant melting at the moment. In addition, increased glacier meltwater will have an impact on the net biological nitrous oxide production, another potent greenhouse gas. Systematic methane and nitrous oxide concentration and isotopic measurements in the water column of the fjords will allow us to assess the impact of glacier-retreat associated greenhouse gas production in these understudied fjords.

Methods and data collection

Eight stations were sampled for:

1) Dissolved methane concentration

Sea water is collected directly from the Niskin bottle into 60 mL serum bottles, crimp capped and 2 mL of NaOH (10 M) is added to stop biological activity and force the dissolved methane (**Figure 12**). A 1 mL headspace is created to prevent the glass sample bottles from breaking due to liquid expansion caused by temperature variation during storage and transport. For the same reason bottles are kept a dark and persistently cool place. Some preliminary data can be seen in **Figure 13**.

2) Nitrous oxide concentration and isotopologue

As for methane, sea water is collected directly from the Niskin bottle onto 120 mL serum bottles, crimp capped and 3 mL of NaOH (10 M) is added. A 1 mL headspace is created and the bottles are kept in the dark and cool.

3) Water isotopes

Sea water is collected directly from the Niskin bottle into 1.5 mL glass vials without headspace, kept in the dark and cool. Preliminary results are provided in **Figure 13 and 14.**

4) Dissolved inorganic carbon isotopes

Sea water is collected directly from the Niskin bottle onto a 12 mL pre-poisoned (4 µL mercury chloride) exetainer without headspace, kept in the dark in the fridge. Radiocarbon isotopes will be measured at ETHZ with Negar Haghipour. For the next expedition, and to limit the use of mercury chloride, exetainers will be acidified with phosphoric acid 100% and pre-purged before collection.

Figure 12: (a) Adjunct of NaOH for the preservation of dissolved methane and nitrous oxide and (b) Filtration for particulate organic carbon. Photo: Matthieu Klitting

5) Particulate organic carbon (POC) concentration and isotopes

Only surface and bottom waters are collected for POC due to the time constraint. Store leftover water from the Niskin bottle (at least 4L) into a cubitainer. Filter the 4L onto a 47mm diameter GF/F filter (pre-combusted, pre-weighted) using a glass filtration unit (Millipore, Fig. 7b). The filters were briefly rinsed with MilliQ water to get rid of salt deposit. The filter was then stored in a sterile petri dish and air dried. Radiocarbon isotopes will be measured at ETHZ with Negar Haghipour.

6) Dissolved organic carbon concentration (DOC)

POC filtrate was collected into 40 mL amber glass bottles and acidified to pH 2 (with HCl 37%). DOC concentration will be measured at AWI Potsdam with Bennet Juhls.

7) Nutrient concentration and nitrate isotopes (d15N, d18O)

Sea water is collected directly from the Niskin bottle into a 50mL syringe and filtered onto a sterivex syringe-filter (0.2um pore-size), fill 2 x 15mL into separate falcon tubes (one for nutrients, one for N isotopes), store refrigerated, freezed upon arrival in lab. Nutrients will be measured at ISMER-UQAR with Andre Pellerin.

8) Microbial diversity

Sea water was filtered directly from the Niskin using the Vampire peristaltic pump. The samples were fixed with 2.5 mL RNAlater reagent in falcon tubes and kept cool until extraction of DNA in the home laboratory (Univ. Basel). Extracts of DNA have been sent for 16S rRNA gene amplicon sequencing at the Genomics Facility Basel. Data are expected for April 2025, and will provide crucial information regarding the microbial community structures in the different water masses, and e.g. their relation to greenhouse gas formation/consumption.

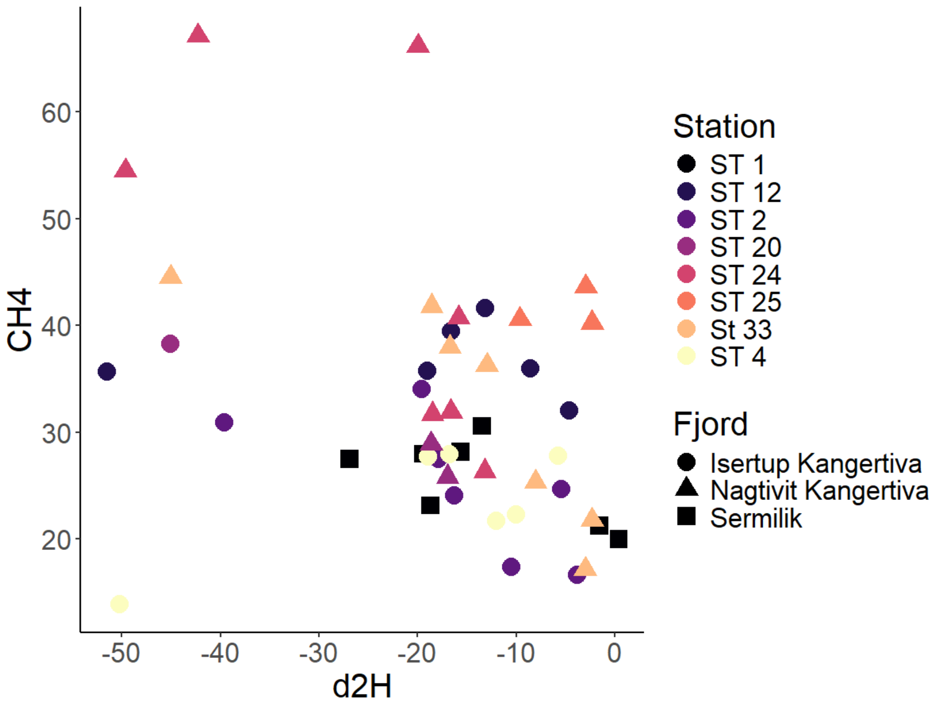

Figure 13. Water isotopes (d^2H in ‰ vs VSMOW) and dissolved methane concentrations in the different Fjord systems.

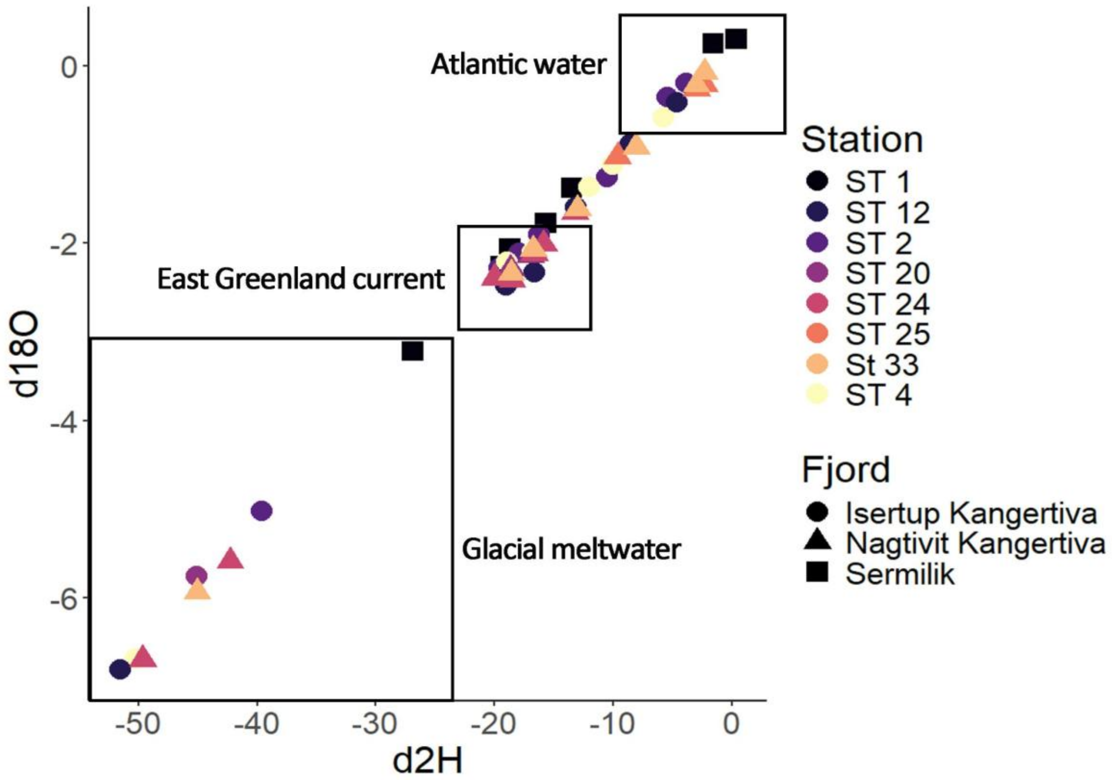

Figure 14. Water isotopes ($d^{18}O$ and d^2H in ‰ vs VSMOW) measured at the University of Basel by Daniel Nelson. The water masses are based on Azetsu-Scott and Tan (1997).

Table 3: Sampling stations for Project 2

ID	Station	Operation	Latitude (°N)	Longitude (°W)	Date (DD/MM/YY)	Bottom depth (m)
ATKA24_01_N1	1	Niskin	65°44.880	37°59.435	11/08/24	890
ATKA24_02_N1	2	Niskin	65°40.528	39°11.228	12/08/24	400
ATKA24_03_N1	3	Niskin	65°43.012	39°15.833	13/8/24	225
ATKA24_12_N1	12	Niskin	65°38.221	39°08.324	14/8/24	250
ATKA24_20_N1	20	Niskin	65°39.382	38°42.296	15/8/24	55
ATKA24_24_N1	24	Niskin	65°38.572	38°37.739	16/08/24	300
ATKA24_25_N1	25	Niskin	65°37.766	38°40.604	16/08/24	35
ATKA24_33_N1	33	Niskin	65°38.119	38°32.643	17/8/24	400

Table 4: Depth and parameters sampled for Project 2

ID	Station	Depth (m)	Nitrous Oxide	Methane	Water isotopes	DIC	POC (L filtered)	DOC	DNA (L filtered)	Nutrients / Nitrate isotopes
ATKA24_01_N1	1	2		x	x	x	4.125	x		x
		25		x	x	x				x
		50		x	x	x			2	x
		75		x	x	x			3	x
		100		x	x	x			3	x
		250		x	x	x			3	
		500		x	x	x	2.686	x	0.5	x
ATKA24_02_N1	2	2		x	x	x	2.925	x	3	x
		25		x	x	x			3.3	x
		50		x	x	x			3.35	x
		75		x	x	x			3.5	x
		100		x	x	x			4	x
		200		x	x	x			4	x
		400		x	x	x	4.65	x	4	x
ATKA24_03_N1	3	2		x	x	x	4.55	x	1.6	x
		25		x	x	x			3	x
		50		x	x	x			3	x
		75		x	x	x			2.6	x
		100		x	x	x			2.9	x
		200		x	x	x	2.525	x	4.2	x
	12	2		x	x	x	3	x	1.7	x

ATKA24_12_N1		25		x	x	x			3.1	x
		50		x	x	x			2.15	x
		75		x	x	x			2	x
		100		x	x	x			2	x
		250		x	x	x			2	x
ATKA24_12_N2	12	250					3.375	x	2	x
ATKA24_20_N1	20	2	x	x	x	x	3.55	x	0.9	x
		20	x	x	x	x			2	x
		40	x	x	x	x	4.426	x	2.9	x
ATKA24_24_N1	24	2	x	x	x	x	5	x		x
		25	x	x	x	x			2.2	x
		50	x	x	x	x				x
		75	x	x	x	x			2.4	x
		100	x	x	x	x			3.3	x
		200	x	x	x	x			2	x
		300	x	x	x	x	2.4	x	3	x
ATKA24_25_N1	25	2	x	x	x	x	1.1	x	0.9	x
		20	x	x	x	x			2	x
		40	x	x	x	x			2.9	x
ATKA24_33_N1	33	2	x	x	x	x	4.05	x	1.8	x
		25	x	x	x	x			3.2	x
		50	x	x	x	x			2.6	x
		75	x	x	x	x			3	x

		100	x	x	x	x			2	x
		200	x	x	x	x			3.6	x
		400	x	x	x	x	4.575	x	3.7	x

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