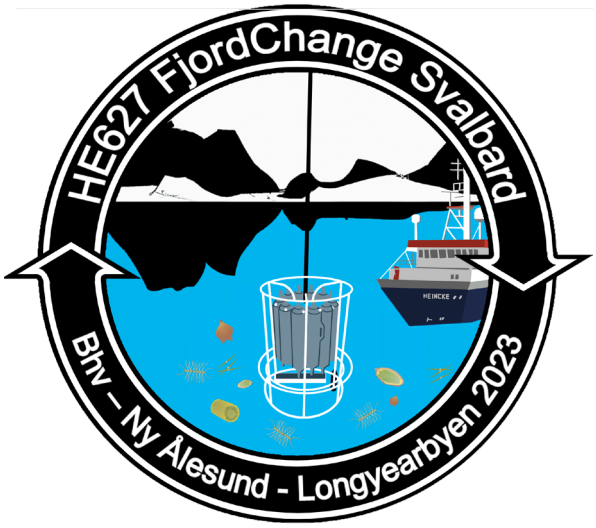
HEINCKE-Bericht

Impact of atlantification on ecosystem structure and function in Arctic fjords (Svalbard)

Cruise No. HE627

12.08 – 02.09.2023,
Bremerhaven (Germany) – Longyearbyen (Svalbard/Norway)
FjordChange 1a



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2023

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1 Cruise Summary

1.1 Summary in English

The FjordChange research cruise (HEINCKE HE627) was the first of three cruises within the FjordChange project to better understand the effects of Atlantification on communities and ecosystem processes. The sampling took place in Van Mijenfjorden, Kongsfjorden, Wijdefjorden and Rijpfjorden. Due to various circumstances, not all of the planned 11 scientists were able to participate, so we had to adapt the program to three stations per fjord. In order to understand the studies on the diversity and activity of the plankton community in relation to seasonal changes, moorings were installed at the mouth of the Van Mijenfjorden and in the Wijdefjorden. The aim is to document the currents and temperature throughout the year, as well as the succession of the plankton community using sediment traps. By taking sediment samples at the mouth and in the middle of fjords, we want to analyze the changes in the communities since industrialization for Svalbard. We also took samples of rivers and glacier water run-offs as well ice samples in each fjord, which should provide information about the influence of glacier melt. It was impressive to see how much the glaciers have retreated compared to voyage HE492 in 2017. The aim of the sampling was to record the oceanographic parameters, the chemical parameters of the water column (inorganic and organic compounds) and biological parameters and to document the distribution of the microeukaryotes and prokaryotes present.

1.2 Zusammenfassung

Die FjordChange-Forschungsfahrt (HEINCKE HE627) war die erste von drei Fahrten im Rahmen des FjordChange-Projekts zum besseren Verständnis der Auswirkungen der Atlantifizierung auf Lebensgemeinschaften und Ökosystemprozesse. Beprobt wurden der Van Mijenfjorden, Kongsfjorden, Wijdefjorden und Rjipfjorden. Aufgrund verschiedener Umstände konnten nicht alle der geplanten 11 Wissenschaftler teilnehmen, so dass wir das Programm auf drei Probennahmen pro Fjord anpassen mussten. Um die Untersuchungen zur Vielfalt und Aktivität der Planktongemeinschaft im Zusammenhang mit den jahreszeitlichen Veränderungen zu verstehen, wurden Verankerungen an der Mündung des Van Mijenfjordens und im Wijdefjorden ausgebracht. Es sollen so die Strömungen und die Temperatur über das ganze Jahr hinweg dokumentiert werden, sowie auch durch Sedimentfallen die Sukzession der Planktongemeinschaft. Durch die Entnahme von Sedimentproben an der Mündung und in den Fjorden wollen wir die Veränderungen in den Lebensgemeinschaften seit der Industrialisierung analysieren und für Svalbard aufzeigen. Außerdem haben wir in jedem Fjord Proben von Flüssen und Gletscherwasser und auch Eisproben genommen, die Aufschluss über den Einfluss der Gletscherschmelze geben sollen. Es war beeindruckend zu sehen, wie stark sich die Gletscher im Vergleich zur Reise HE492 im Jahr 2017 zurückgezogen haben. Ziel der Probenahme war die Erfassung der ozeanographischen Parameter, biologischen und chemischen Parameter der Wassersäule (anorganische und organische Verbindungen) und die Dokumentation der Verteilung der vorhandenen Mikroeukaryoten und Prokaryoten.

2 Participants

2.1 Principal Investigators

Name	Institution
John, Uwe, Dr.	AWI

2.2 Scientific Party

Name	Discipline	Institution
John, Uwe, Dr.	Marine Biology / Chief Scientist	AWI
Eikrem, Wenche, Prof.	Taxonomy / Scientist	NIVA / U Oslo
Giesler, Jakob	Marine Biology / Student	AWI / U Bremen
Pein, Carla	Marine Biology / Student	U Hamburg
Kühne, Nancy	Technician	AWI
Matz, Judith	Marine Biology / Student	U Oldenburg
Happe, Anika	Marine Biology / Student	ICBM / U Oldenburg
Albinus, Michelle	Bio-Optics / Student	ICBM / U Oldenburg

2.3 Participating Institutions

AWI	Alfred-Wegener-Institut Hemholtz Zentrum für Polar- und Meeresforschung
NIVA	Norsk institutt for vannforskning, Norwegian Insitute for Water Research
ICBM	Institut für Chemie und Biologie des Meeres

3 Research Program

3.1 Description of the Work Area

The working area is given in figure 4. The main areas and coordinates are: North and West Svalbard (Spitzbergen): Van Mijenfjorden, Wijdefjorden, Rijpfjorden, Kongsfjorden.
First station: Latitude: 77°35 ‘N; Longitude: 13°10 ‘E at Van Mijenfjorden
Last station: Latitude: 78°50 ‘N; Longitude: 7°50 ‘E at Kongsfjorden (Hausgarten)

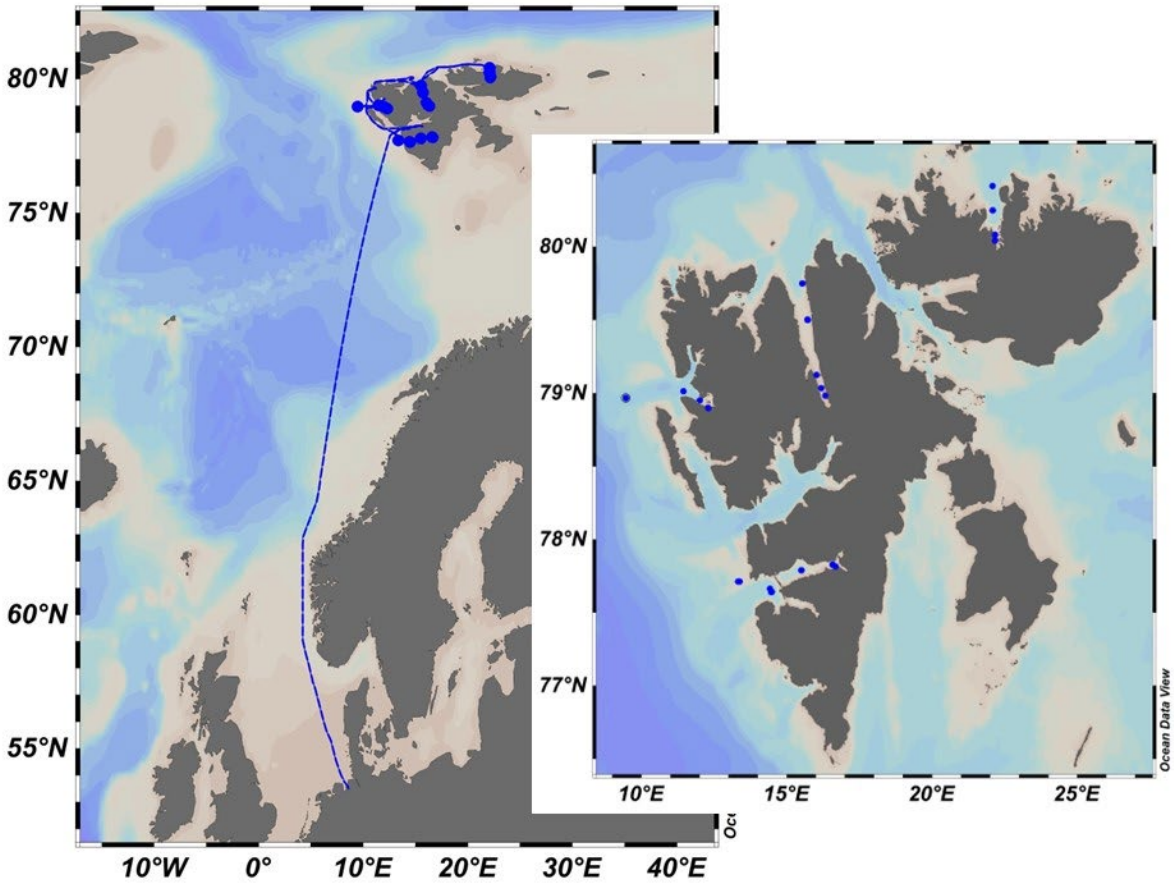

Fig. 3.1 Track chart of RV HEINCKE cruise HE627.

3.2 Aims of the Cruise

Global change is causing fundamental environmental changes in the Arctic. The fjords of Svalbard are exposed to the increasing influence of warm, salt-rich water masses from the North Atlantic (Atlantification). In addition, the increased melting of glaciers is leading to an increasing freshwater inflow within the fjords. The FjordChange project investigates changes in physical properties (stratification, circulation) as well as eukaryotic and prokaryotic plankton diversity and activities along a gradient of atlantification and their effects on primary production, biogeochemical fluxes.

The study area comprises 4 fjord systems that are affected to varying degrees by Atlantification: Van Mijenfjorden (south) and the now year-round ice-free Kongsfjorden (north-west) are severely affected. The Wijdefjorden in the north shows significantly less Atlantification and ice cover in winter, while the Rijpfjorden (north-east) is under the influence of polar water. The planned series

of investigations will enable us to analyze the variability of the fjord characteristics with the influence of Atlantic Water from the West Spitsbergen Current and the freshwater inflow. Paleometagenomic analyses of sedimentary ancient DNA (sedaDNA) from sediment cores will be used to trace shifts in biodiversity over the last 200 years. The analysis along the physio-chemical gradients from south to north will then make it possible to draw conclusions about the future development of the fjord systems, which should ultimately lead to an upscaling of model-based estimates of the effects of climate change on energy transfer in marine food webs and the performance of the biological carbon pump. Two objectives were addressed with the research cruise.

Objective 1
Understanding the impact of Atlantification on the physical and chemical oceanography in Arctic fjord ecosystems.

(Q1) What is the impact of Atlantic Water and glacial melt water on water mass distribution, stratification, light availability, nutrient concentrations, and input and distribution of dissolved organic matter in the four fjord systems?

(Q2) How is lateral nutrient transport from the fjords to the shelf systems affected by inflow and circulation of Atlantic Water within the fjord systems?

Objective 2
Investigating the impact of atlantification on ecosystem structure and function (including assessing the recent and past changes of the eukaryotic and prokaryotic plankton diversity)

(Q3) What is the impact of Atlantification on the pelagic community composition and function, from prokaryotes to microplankton?

(Q4) Has warming since the industrial changed the biodiversity an associated process?

3.3 Agenda of the Cruise

The journey began on 12 August 2023 at 08:00 from Bremerhaven. On 18 August 2023, we took the remaining scientists on board and began taking samples the next day. A mooring was deployed in the Van Mijenfjorden, sediment samples were taken twice with a MUC and the water column was sampled at three stations. River and glacier ice samples were taken at the head of the fjord. We then repeated this in the Wijdefjorden. No moorings were deployed in the Rijpfjorden and Kongsfjorden, as there are moorings in both fjords. Samples for sediment analysis were also only taken once in these fjords at the center station of MUC. The aim of the sampling was to record the oceanographic parameters, the chemical parameters of the water column (inorganic and organic compounds) and to document the distribution of the microeukaryotes and prokaryotes present. A detailed study of the temporal, spatial and functional relationships between the representatives of the plankton communities in the fjords was coordinated and compared with the prevailing oceanographic conditions defined by the temperature and salinity gradients and the profile of dissolved organic carbon (DOC), solid phase extracted organic matter (SPE-DOM), dissolved macronutrients and chlorophyll from different depths. Plankton samples were collected with net tows (40 m vertically integrated) and in Niskin bottles or with large-volume pumps from specific depths, subsequently size-fractionated and then analysed in the laboratory by metabarcoding of rRNA markers and by metatranscriptomics for their species composition and gene activities

associated cellular processes, respectively. Microscopic examination of the micro- and nanoplankton revealed a summer bloom or late summer bloom with moderate, but in some fjords also high chlorophyll concentrations, moderate plankton biomass and a relatively high abundance of copepods and micrograzers, mainly heterotrophic dinoflagellates, tintinnids and other ciliates. The proposed cruise will have negligible short-term and undetectable long-term environmental impact. Our research were largely restricted to the water column with only a few surface and cored sediments collected from approx 1 m^2 footprint. Our sampling of plankton, sediment and particulate organic matter in the surface waters and sediments had not cause any noticeable changes in the plankton and benthic ecosystems. We did not sampled any threatened features of the marine ecosystem. We have not applied acoustic methods and net hauls were restricted to phyto- and zooplankton collected from the upper water column (40 m). There were few hazardous chemicals required in small quantities on board and these were used exclusively in the laboratories. Leftovers and waste were disposed and collected according to the Best Practice for German research vessels. Disposable and leftover chemicals were send back to the home laboratory for final disposal.

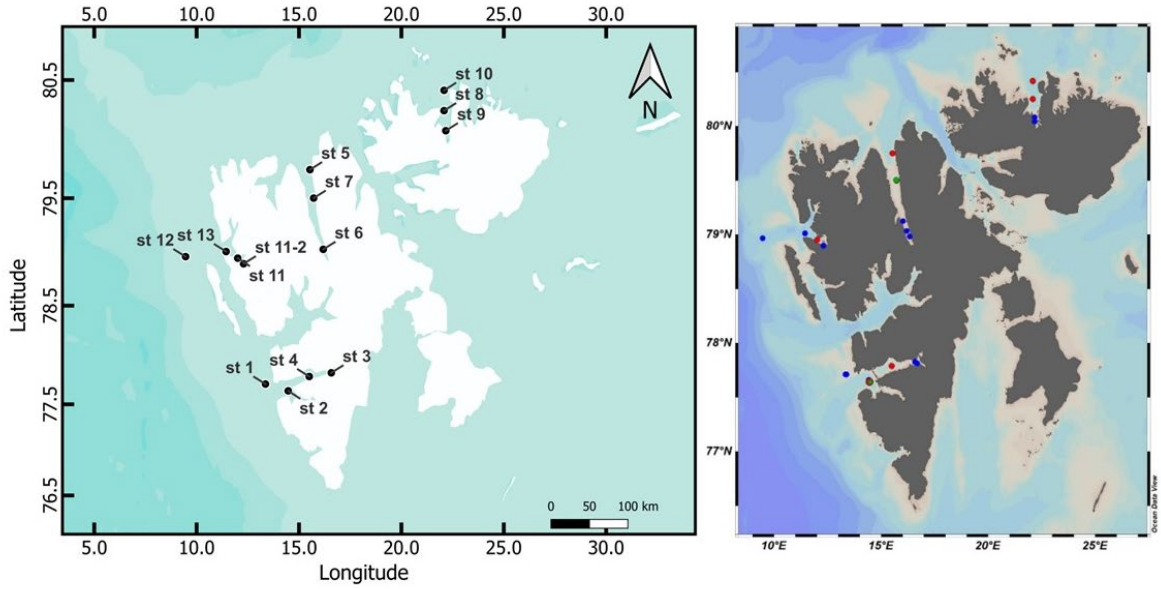

Fig. 3.2 Track chart of RV HEINCKE cruise HE627. Stations plan with numbers in van Mijenfjorden, Kongsfjorden Widjefjorden and Rijpefjorden. Blue general sample stations, red MUC station, green moorings.

4 Narrative of the Cruise

11.08.2023: RV HEINCKE arrived at 09:00h the AWI Handelshafen pier and we have started loading the mooring gear, followed by MUC and all other items. We used the time at the pier to set up most of the laboratories and stayed onboard overnight. We left Bremerhaven at 08:00h on the 12th of August. Got our safety introduction and continued the laboratory preparations. On the 13th and 14th of August we set up the mooring strategies and the samples plans as two additional persons could not join the cruise and we to adjust sampling and extractions plan from 11 down to 8 scientists onboard. So, we left with 6 scientists and will boarding the remaining two in

Longyearbyen. On the 15th around 09:00 we passed the Arctic Circle. The sea is a bit rougher, and we will most probably reach Longyearbyen not before the 18th. At the 18th at 6:45h the two more scientists (Prof Wenche Eikrem, and Anika Happe) arrived and have been boarded in Longyearbyen. We reached the test station at 14:00h and performed a limited sampling using all devises except MUC and BOP. We used the time for aligning the sampling and extraction protocols and fixing a few items.

Van Mijenfjorden (19-21.08.2023): Next day (19th 0f August 2023, sample station 2) at 08:00h first sampling station at 77° 38.5N; 14° 28,2E starting with plankton net, followed by CTD, pump and BOP. Net sample (20 µm mesh size) showed high diversity of dinoflagellates dominated by *Scrippsiella*-like cells, but also larger cells such as *Dinophysis norvegica, Tripos longipes* and *Balechina gracilis* were present. Both phototropic and heterotrophic dinoflagellates were abundant. The CTD profile showed that the water column was stratified in temperature with the first, warmer (~6.4 °C) layer until 40 m, a turbulent mixed layer from 60 to 130 m and a colder (~4 °C) layer between 130 m and the bottom (~155 m). Salinity continuously increases from 32.4 at the surface to 34.9 at the bottom forming layers from 2-15 m 15-40 m, 40-100 m, and bottom. The Chlorophyll maximum was in 6 m in depth, from there decreasing rapidly until at 20 m it was gone completely. Also, the beam transmission indicated the lowest temperature layer to be less turbid (approx. 20 m above ground). At 13:00h we applied the first MUC and recovered 5 cores of about 25 cm length but two third dense clay layers. At 14:30h we started to prepare the mooring and started to deploy at 16:17h (high tide predicted for 16:02h) finished at 17:27 at 77° 38.5 N; 14° 28,167 at 160 m. Rope length is 130m. After the deployment, we moved into the fjord to the 3rd station. 20th of August 08:00h 77° 49.7N; 16° 34.5E (sample station 3), we started with land sampling of river and melt water at two spots at the south coast of the fjord. Additionally, we did some glacier ice sampling, all water and ice samples will be used for later chemical analyses. Sea ice pieces (glacier) are only in close proximity to the glacier and not much sea ice was floating around the fjord. At 12:00 the station sampling started with the plankton net. The net sample was dominated by dinoflagellates with *Scrippsiella*-like cells being the most abundant. Species diversity is less than at Station 2. Heterotrophs such as *Protoperidinium pallidum* and *P. cerasus* present. CTD showed the surface layer remains at 6.5 °C compared to station 3 but with a much fresher (28) layer at the very first meter of data that decreases about 4.5 and 3 °C in the mixed layer until 15 m. Between 15 and 42 m we find a relatively stable layer (ΔT = 1.5 °C, ΔS = 2 salinity). At the bottom (~65 m) the water is coldest with 0.8 °C and the highest salinity of 34.1. Chlorophyll is present in the first 10 m with the maximum at 3 m. Later around 19-21:00h we were in a broad green yellowish patch of a Scrippsiella-like species blooming around 50-70 meters of the first two meters. 77° 47,4 °N, 15,30E sample station 4 started at 08:00h (21.08.2023). Net samples were dominated by dinoflagellates with Scrippsiella-like cells being the most abundant. Species diversity is less than at Station 2. Heterotrophs such as *Protoperidinium breve* and *Katodinium glaucum* were present. CTD showed that the surface temperature was the same as during the other stations but then decreased linearly to -0.2 °C. We again found the fresh layer as at station 3, however it is thicker (d = 5 m) and probably a mixture of the surface salinities of station 2 and 3 (~ 30 salinity). From there, salinity increases exponentially until it reaches 34.4 salinity at the bottom. Chlorophyll resembles the profile from station 3 and beam transmission the turbid layer as in station 2 (approx. 20 m above ground). With two MUC holes we gained 6 sediment cores of around 35 cm with a relatively large benthos contribution in the upper layer and

less clay. We finished the station at 15:00h and left the fjord towards Wijdefjorden. On the way out we observed a beluga school of about 4-6 animals on the north coast side of the fjord when leaving the fjord through the channel. The Van Mijenfjorden has nearly no water ending glacier left and non or very small and few sea ice floating around, mostly at the tip.

Wijdefjorden (23-25.08.2023): 08:00h 79°45'N; 15°31'E Station 5. A sunny morning with calm weather. The light microscopic observation of the plankton net sample showed a clear diatom (most likely atlantic species) dominated community and chain forming species also accumulate above 150µm. The water column at station 5 was structured into three salinity layers, one with 29.6 from the surface to 5 m, one with 33.3 at ~ 13 m and one with a salinity of 34.7 between 15 and 160 m of depth. Temperature resembled the first two layers, starting at ~6.5 °C in the first layer, followed by 5.5 °C in the second and decreased with a roughly linearly trend in the third to around 1 °C. Chlorophyll was highest at 18 m, forming a second maximum (1/3 of the main maximum) at 30 m and a third (1/10 of the first maximum) peak at 50 m. Net sample dominated by Dinobryon and diatoms such as *Chaetoceros, Skeletonema* and *Pseudo-nitzschia*. Dinoflagellates, ciliates and other flagellates are also present but scarce. CTD at the tip of Wijdefjord had a very weak chlorophyll signal at around 10 m. MUC gave six cores but finally only three remain perfect for the downstream analyses plus one that will be used partly for DNA sampling. At 14:00h we started the transect screening with a 150 kHz ADCP, but some small ice bergs will reduce steaming speed and the course of the transect. Transect matrass finished at 03:30h, we recorded with ACDP until 06:00h. On the 24.08.2023 at 08:00h with a calm sunny day land sampling was done, and we performed station 6 the plankton net, CTD, pump and BOP casts. Net samples with a lot of copepods, nauplii and arrow worms. Aggregates of copepod pellets/debris with ciliates and picoflagellates common. Phytoplankton is dominated by diatoms such as *Pseudo-nitzschia, Skeletonema* and *Chaetoceros* and the crysophyte *Dinobryon*. Dinoflagellates and ciliates also abundant. On the 25th of August 2023 station 7 was performed, with sunny but windy (18m/sec Bft 7-8) conditions. We could perform net sampling, CTDs casts and MUC, but do to the wind conditions we shifted the mooring deployment to a later date on our way back from Rijpfjorden. Species composition was as station 6. Chlorophyll occupied the first 30 m with a maximum at 10 m. From the very top layer (5.3 °C/32.5 PSU) a second layer was warmer (5.5 °C) but saltier (33 PSU). Salinity decreased from there to 34.5 PSU, prevailing between 40 and 120 m, whereas temperature decreased about 4 °C until 0.3 °C at the bottom.

Rijpfjorden (26^{th}-27^{th} of August 2023): Station 8 (innermost) 26.08.2024 (78°58'N ; 16°18'E) Land sampling for sediment and glacier and river run-off at 08:00 with Zodiak. At the tip of Rijpfjorden, chlorophyll is only weakly present in 15 m of depth coinciding with a warm intrusion (4.2 °C) into the linearly decreasing temperature (4- (-1) °C). Salinity increases simultaneously from around 31 to 34.5 in the bottom layer that is stable from 150 m. Net sample was dominated by jelly plankton, copepods and star fish and ascidian larvae. Very few phytoplankton were present, only a few nano-sized heterotrophic dinoflagellates and other nano and pico-sized flagellates were observed. Station 9 (middle) 27.08.2024 (Coordinates). In Rijpfjorden we find a fresh (~30 PSU) and 5 °C layer in the top 5 m of the water column that, after a 5 m thick mixed layer, transforms into a relatively stable, 20 m thick warmer (5.5 °C) and more saline (32.5) water body. Below the layer chlorophyll peaks at around 25 m and is gone after the halo- and thermocline at 30 m. Below that lies a dense (avg. 0 °C and 34 salinity) water mass. Net sample with copepods, nauplii and larvae of starfish and ascidian larvae. Very few microalgae, the diatom *Chaetoceros*,

chrysophyte *Dinobryon* and prasinophyte *Pterosperma* were present. Dinoflagellates such as *Protoperidinium* were found. Aggregates with some tintinnid ciliates and nano and pico sized flagellates occurred. A polar bear had visited the RV HEINCKE swimming and we had to wait approx. 120 minutes before we could finish sampling and steaming to the next station. At the outermost of Rjipfjorden (Station 10), chlorophyll was highest (4-5 times compared to the Station 8 and 9) in 22 m of depth in a 5 °C warm and average 33.4 PSU saline top layer reaching down to 40 m. After half a meter, temperature then drops to 0 °C becoming even colder (almost -1.9 °C) towards the bottom where salinity is also highest with 34.5. Microalgal community rich in species, but low in biomass. The crysophyte *Dinobryon* is common. Diatoms such as *Skeletonema, Chaetoceros* and *Pseudo-nitzschia* present. Both phototrophic dinoflagellates like *Tripos* and the heterotrophic *Protoperidinium, Pronoctiluca* and *Oblea* occurred. Ciliates were present with *Acanthostomella norvegica* as the most common. MUC sampling was successful.

After the station we were teaming from Rjipfjorden back to Widjefjorden for deploying the mooring at (79° 30'026N; 015° 42,911'E). This time the weather condition have been good and after around 2 hours the mooring was under the water 15 m depth with a rope of 110m. After that we have steamed towards Kongsfjorden.

At Kongsfjorden (29.08-01.09.2023) we started with a land station 08:00h (78° 59,2'N ; 12° 23,4'E) and we took sedimend, glacier Ice and river run-off water samples. After that, the first 5 m at station 11 (29.08.2023 (78° 57,1'N ; 12° 00,6'E)) had a 5 °C warm and 31 PSU top layer, followed by a warm (8 °C) water body down to 30 m of depth after a 10 m thick thermocline. Temperature then decreases until 4 °C towards the bottom. Salinity constantly increases about 3.5 PSU until 50 m, from there on it stays at 34.8 PSU until ground. The planktonnet sample dominated by tintinnid ciliates, copepods and nauplii. Low biomass of algae, very few diatoms but *Pseudo-nitzschia* and *Pleurosigma* occurred. Species of *Dinophysis* and *Tripos* including *T. arcticus* present together with heterotrophic dinoflagellates such as *Protoperidinium* and *Nematopsides*.

At the next day we sampled Station 12 (78° 58,1'N ; 009° 27,6'E, 30.08.2024 08:00h). After the 34.6 PSU and 8 °C warm top layer in the first 3 m we found an intrusion where salinity increased to 34.95 PSU. After a 15 m thick thermos- and halocline a relatively stable layer with 5 °C and 35 PSU from 45 to 170 m was present. In the last 50 m salinity decreased about 0.1 PSU and about 2 °C. Chlorophyll was highest at 15 m of depth. The planktonnet sample dominated by the diatom *Proboscia alata*. High diversity and abundance of diatoms and both heterotrophic and phototrophic dinoflagellates together with tintinnid ciliates. Common dinoflagellates were species of *Tripos, Dinophysis* and *Protoperidinium*. Station 13 (79° 00,9'N ; 11° 26,3'E, 12:00h) had the highest Chlorophyll in 8 m of depth coinciding with the warm (8 °C) and avg. 33 PSU layer from surface to approximately 40 m. Salinity increased continuously from the surface towards 60 m. From there it remains at stable 34.8 PSU, whereas temperature keeps decreasing until it reaches 1.5 °C at the bottom. The planktonnet sample with copepods, nauplii and tintinnid ciliates. Microplankton community dominated by photrophic and heterotrophic dinoflagellates such as *Tripos, Dinophysis* and *Protoperidinium* species. The chrysophyte *Dinobryon* and diatoms such as *Proboscia, Skeletonema* and *Rhizosolenia* were also present. MUC sampling was successful.

On 31.08.2023 we entered the port of NY-Alesund (31.08-01.09.2023). We packed the equipment and on 1 September 2023 we unloaded the scientific equipment and loaded it into the container for shipment to Bremerhaven. The freezer samples (-20°C) were brought to the corresponding AWIPEV container and we received the 04°C and -80°C samples from the AWIPEV station and

stowed them on the ship. At the end of 01.09.2023 we set off for Longyearbyen.On the 2nd of September the ship was refuelled and then moored at the pier in Longyearbyen. The ship was cleaned and the following scientists were received and the handover of the ship was discussed. Departure home on 03.09.2024 at 05:20h5

5 Preliminary Results

5.1 Physical Oceanography and bio-optics

(Michelle Albinus, Daniela Voss, Rohan Henkel)

The CTD casts were performed with a Seabird 'sbe911+' CTD probe with sampling rosette (onboard device, Fig 5.1, left) at each station, as an initial activity at the station to determine further key discrete sampling depths, e.g., to locate chlorophyll maxima. Live data acquisition was carried out via CTD-client onboard and data post-processing with Seasoft V2. Salinity and depth were calculated from pressure values, and temperature was corrected to ITS-90. The CTD was equipped with additional sensors for transmission, fluorescence, and oxygen. CTD data is available at Pangaea® (https://doi.org/10.1594/PANGAEA.964694).

Further standard physical oceanographic parameters (temperature, salinity, oxygen, chlorophyll fluorescence, CDOM fluorescence and turbidity) were recorded in one-minute interval by a Pocket FerryBox system. Temperature and salinity as well as fluorescence were also investigated by the ships' flow-through system (data not shown). Additionally, at stations, a bio-optical package (Fig. 5.1, right) was used to collect the inherent optical properties (IOPs) of the water column. Near Surface Remote Sensing Reflectance (Ocean Color) was assessed by radiometers. From the radiometer setup mounted on the ship's bow, continuous readings of remote sensing reflectance (R rs; relation of water leaving radiance to downwelling irradiance) will be calculated. Current velocity magnitude and direction were recorded on selected transects using a RDI Teledyne Surveyor 150 kHz ADCP mounted in the hull of RV HEINCKE. Bin size was set to 4 m resolving a maximum depth of approximately 225 m and pinging at 1.5 Hz. On bord, the in-situ data was used to monitor the current situation in Van Mijenfjorden and Wijdefjorden to successfully deploy the mooring (long-term current magnitude not exceeding 1 m/s). The underlying sea floor topography was obtained from the external depth sensor of *RV HEINCKE*. Occasionally occurring spikes in bathymetry are caused by wrong depth sensor readings and will be corrected in further data analysis.

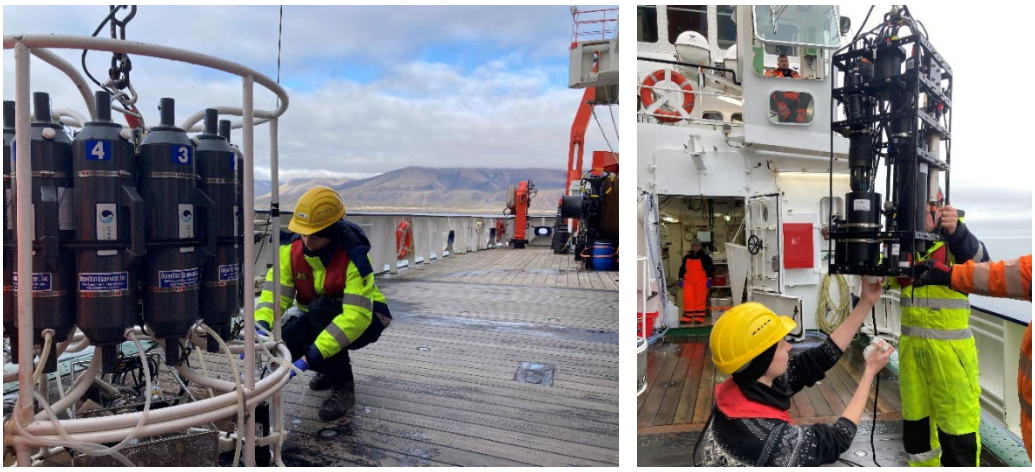

Fig. 5.1. Onboard CTD device of *RV HEINCKE* to investigate the physical properties of the water column (left), bio-optical package (BOP) to determine the inherent optical properties in profile mode through the water column.

Exemplarily, data of investigated fjordic areas are shown for the CTD in the following figures (Fig. 5.2, Fig. 5.3). Data analysis of station data and underway data is still in progress.

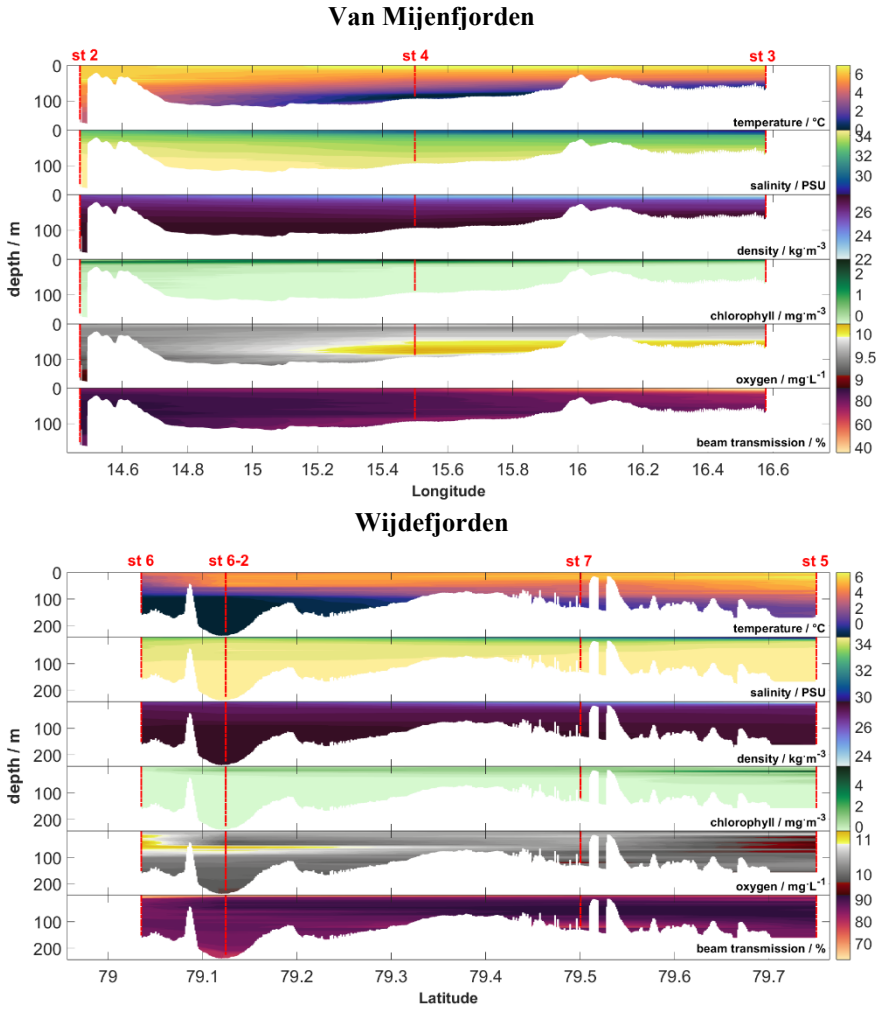

Fig. 5.2 Contour plots for in situ temperature, practical salinity, density, chlorophyll fluorescence, oxygen, and beam transmission within the Van Mijenfjorden (top panel) and Wijdefjorden (bottom panel). Stations are marked by number with a red line and corresponding label.

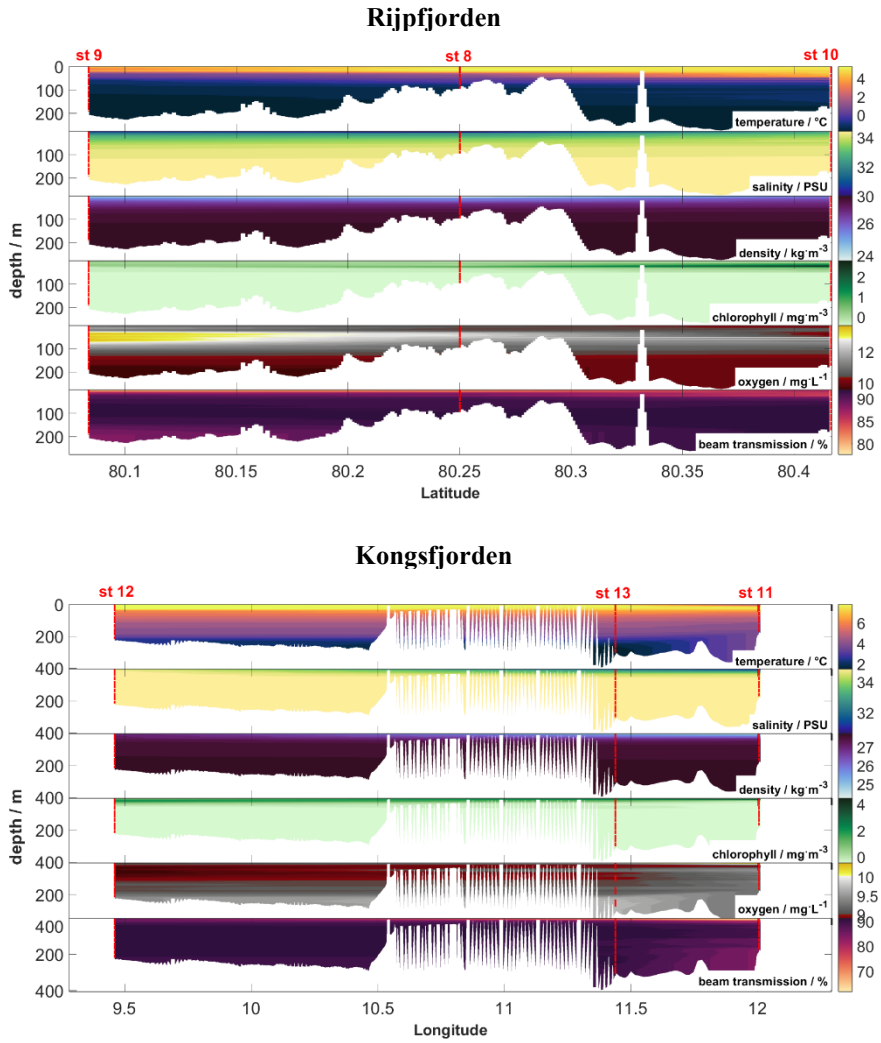

Fig. 5.3 Contour plots for in situ temperature, practical salinity, density, chlorophyll fluorescence, oxygen and beam transmission within the Rijpfjorden (top panel) and the Kongsfjorden (bottom panel). Stations are marked by number with a red line and corresponding label.

Water samples were collected at each station from defined depths to measure suspended particulate matter (SPM) and chlorophyll *a* (Chl *a*). Chl *a* was determined (up to 6 L volume) after sample filtration through Whatman GF/F filters, pre-washed and rinsed with 0.2 µm filtered seawater. Filters were stored onboard at -80°C and analyzed later in the laboratory after pigment extraction with acetone followed by fluorometric measurements and calculation of chlorophyll *a* concentration according to the instrument's manual and EPA method 445. All chlorophyll concentrations are uploaded to the Pangaea database with specific cruise identifier HE627 (in review). For SPM determination, water samples (up to 8 L volume) were filtered through pre-combusted and pre-weighed Whatman GF/F filters, pre-washed and rinsed with Milli-Q water. Filters were frozen immediately at -25 °C and reweighed in the laboratory after the cruise. The SPM concentrations were normalized to 1 L. Data are available on request.

Water transparency measurements were performed with a 0.3 m diameter white-black Secchi disc. The Forel-Ule (FU) color scale is composed of 21 colors, from 'indigo blue' to 'cola brown' and represents the range of colors that can be found in the open sea, coastal, and continental waters. Based upon a historical background, this provides an estimation of the present water constituents influencing the water color. The color of the water is determined over the Secchi disc at half the

disc's depth (where the disc disappears). Secchi disc and Forel-Ule observations were only conducted during daytime and were strongly influenced by currents. Instrumentation (Fig 5.4) and data of observations are shown in Figure 5.5 (Secchi disc on the left, Forel-Ule scale index on the right).

Fig. 5.4 Secchi disc above and in water (left, middle) and Forel-Ule (FU) color comparator scale to determine the water color (right).

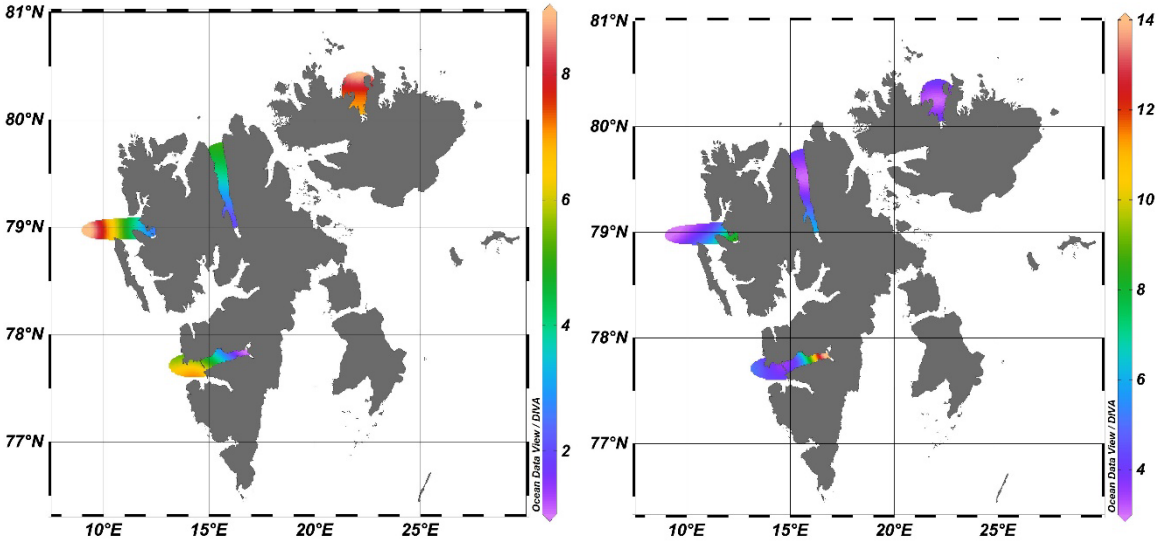

Fig. 5.5 Secchi disc depths (left) and FUI reading (right) for the investigated fjord systems of HE627. Deepest Secchi disk depth corresponds to lowest FUI numbers.

5.2 Nutrients and DOM

(Anika Happe, KUL. Boris Koch)

Nutrients: Subsamples of seawater were directly collected from the Niskin bottles of the CTD-rosette-system (from the depths of 40m, 15m, 3m and the chlorophyll-*a* maximum), filtered through a 0.2 µm syringe filter into a 30 ml plastic vial and stored at -20°C until further analysis in the laboratory. Nitrate, nitrite, ammonium, phosphate and silicate were measured with an autoanalyzer system (Evolution III, Alliance instruments) by standard seawater methods (Kattner and Becker 1991). All samples were analyzed in duplicate; the accuracy was set by running three standards at the beginning and two standards after each 8 samples. The analytical precision of replicates was approximately 0.05 µM for nitrate, silicate and ammonium and 0.01 µM for

phosphate and nitrite for the range of concentrations in this study. Results for nutrient distribution of nitrate and silicate are shown in Figure 10.

DOM: Subsamples of seawater were collected from the Niskin bottles of the CTD-rosette-system (from the depths of 40m, 15m, 3m and the chlorophyll-*a* maximum), filtered through a 0.2 µm syringe filter into a 2ml cryovial. The cryovials were stored at -20°C until further analysis in the laboratory. Analysis is still ongoing.

POC/PON sampling and extraction (Anika Happe Judith Matz): For the measurement of particulate organic carbon (POC) and particulate organic nitrogen (PON), two liters of sampled seawater (from the depths of 40m, 15m, 3m and the chlorophyll-*a* maximum) were glass fiber filtered (Whatman GF/F, pre-combusted at 450°C for 5 h). The filters were kept in cryovials and stored at -20°C until further extraction in the lab. The frozen filters were defrosted, dried at 60°C before and after acidification with 0.1% HCl, and packed into 5x12 tin capsules. The packed filters were measured in the AWI-owned CN analyser and the final contents of POC/PON in microgram per liter were calculated using the filtration volumes from the lab book. Two samples were lost during this process. First results can be seen in Figure 5.6.

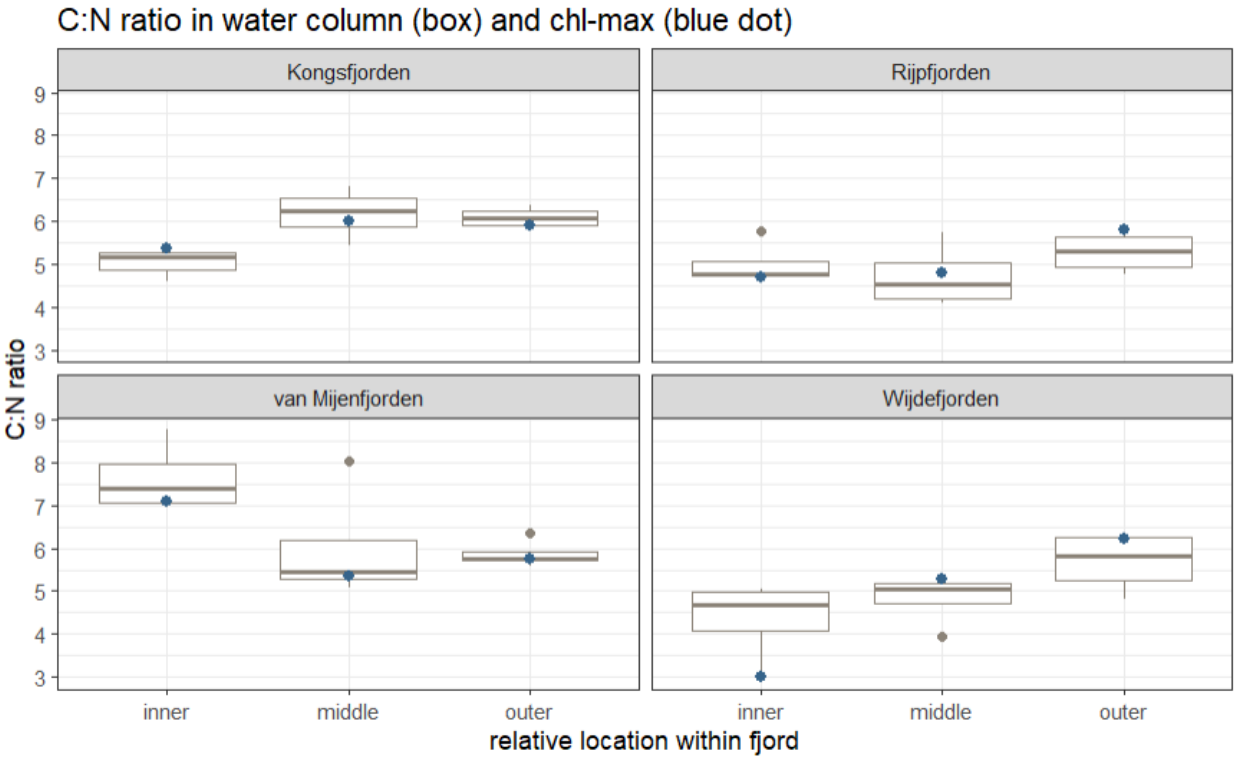

Fig. 5.6 C:N ratios in each fjord, separated into innermost, middle and outermost stations. The blue dot highlights the C:N ratio at the chlorophyll maximum.

5.3 Microplankton Species Diversity

(Wenche Eikrem)

At every station plankton was sampled by vertical net tows through the upper 30 m (few times 40 m) water column by a 20 µm-mesh size phytoplankton net (Hydrobios). Plankton communities were characterized by onboard microscopic examinations of live or freshly preserved subsamples of these net tows. At each station 90 mL of a diluted net tow subsample was transferred into a 200

mL brown medicine flask and added 5 mL formalin (1% final conc.) and 0.5 mL glutaraldehyde (0,1% final conc.) for light microscopy (to IOPAS, PL).

Microscopic observations of live material were conducted with an inverted microscope (Leitz Aristoplan), and a right microscope (Zeiss AxioStar), both with an attached camera for documentation. The main aim was to establish species identity and identify dominant taxa, and documentation by taking micrographs. Also the identification of interesting samples for cell isolation of target taxa for single cell genetic analyses and for culturing from the microplankton community was one goal.

When species of interest were detected in the net tow single cells were isolated by microcapillary pipette establishing monoalgal cultures. The cells were placed into single wells of 96-well plates. Plates were incubated on-board at 5°C and at 50 µmol photons m^{-2} s^{-1} photon flux density. The taxonomic groups in focus were dinoflagellates and diatoms, with additions of some silicoflagellates and haptophytes. After the cruise, plates were brought back to the laboratory and processed for clonal culture establishment at UiO, as part of the RCN project TaxMArc.

5.4 Molecular Biodiversity

(Nancy Kühne, U. John)

Assessing the eukaryotic and prokaryotic biodiversity and link their composition and activity to the chemical and physical environment was one of the prime targets of the research cruise.

Onboard sampling: Sampling for molecular biodiversity (Metabarcoding), metatranscriptomics and single-cell gene-sequencing and transcriptomics was achieved by three approaches (Fig. 5.7) CTD/water-rosette; 2) plankton net (20µm); 3) membrane pumping at discrete depth around Chl*a*. Collected water samples were size fractionated into >200µm, 200-100µm, 100-20 µm with gravity power over filter towers and 20L combined from three Niskin bottles of the water-rosette samples of the CTD system were filtered over 20-3 µm and 15L 3-0.2 µm size fractions in a series of tripod filtration units using a peristaltic pump collecting the plankton on polycarbonate filters.

Fig. 5.7 Seawater sampling devices used for size fractionation during the cruise.

In brief, the samples from the vertical plankton net tows (20µm) were filtered via a 150µm mesh, filled up to 2L and equally divided for DNA and RNA extraction as well for phytotoxin and metabolomics analysis. Further, filters for DNA from the deepest point of each station were taken from the Niskin bottles of the CTD-rosette-system. Polycarbonate filters were cut in four equal pieces, which were dedicated for DNA, RNA, metabolomics and one backup sample. Filters for metabolomics were immediately extracted with methanol and stored at -20°C for analysis in the home laboratory.

Metabarcoding: For the micro- and nano-plankton fractions, as well as for the Picoplankton DNA was extracted as Genomic DNA, using the soil-kit to obtain DNA from eukaryotes and bacteria (Macherey-Nagel, 2011). PCR gene amplification of the V4 regions of the 18S rRNA and for the 3-0.2 µm size fraction also of 16S rRNA will be performed in the laboratory (AWI). In total 133 x 18S rRNA and 36 x 16S rRNA gene ligraries have been made. Generated libraries will be Illumina MiSeq sequenced and the obtained data analyzed with the established bioinformatics pipelines at the AWI. Short sequences (reads) combined with metadata have been published. Data will be analyzed with multifactorial statistics to elucidate the linkage of biodiversity and environmental parameters.

Metatranscriptomics: 1 mL TriReagent (SigmaAldrich) was added to each RNA samples in a 2 mL cryovial with three small spatula-tip aliquots of acid-washed glass beads and stored at -80°C until further analysis. In total 96 RNA samples have been extracted and after quality check 68 have been used for cDNA library generation and were sequenced.

5.5 Flow Cytometer

(Jakob Giesler, Antonia Ahme, Nancy Kühne)

To estimate abundance of nano-, pico-, and bacterioplankton, we used an Accuri C6 flow cytometer. The instrument measures the scattering and fluorescence of particles, that are excited

by a laser. Thus, for each single cell of a certain size, information about its autofluorescence, cell structure and for bacteria and archaea, SYBR green stained DNA content, becomes available. Cell counts are then gated and grouped into categories based on their structure and fluorescent signature. Picoplankton and nanoplankton cell counts were measured for four different depths: Surface, DCM, 40m and the pooled water samples used for molecular biodiversity.

5.6 Microcosmos Experiments

(Judith Matz)

24-hour incubations using the 13C/15N method and two treatments (ammonium/nitrate) were done using water samples from the chlorophyll maximum, which were passed through a 200 µm gauze to eliminate grazers before filling them into square bottles with total volume of 0.615 L. A t0 sample and triplicates were prepared for each treatment (nitrate/ammonium). The nitrate treatment was spiked with 0.118 µmol L-1 of ^{15}N-labelled sodium nitrate, while the ammonium treatment with an equal amount of ^{15}N-labelled ammonium chloride. A control for each treatment received an equivalent amount of unlabeled nitrate or ammonium. The t0 sample was filtered immediately on pre-combusted 2.5 cm Advantec filters, while the remaining samples were incubated at 4°C on a light plate at 100 mmol m-2 s-1. After 24 hours, 12 ml of the incubated and labelled samples were sterile filtered into an exetainer and stored at 4°C. For each replicate and the natural abundance control, 500 ml were filtered the same way as the t0 sample and the filters were frozen at -20°C. The POC/PON content was prepared as described above, but the ^{13}C/^{15}N was measured at the EA-IRMS in Gothenburg. The DIC content was determined using a cavity ring down spectrometer at the University of Groningen. Carbon and nitrogen uptake rates per volume per day were calculated for each station by dividing the t1-t0 delta or the measured POC/PON content by the atom% for the respective element, multiplying this with the total biomass and dividing it by the incubation time.

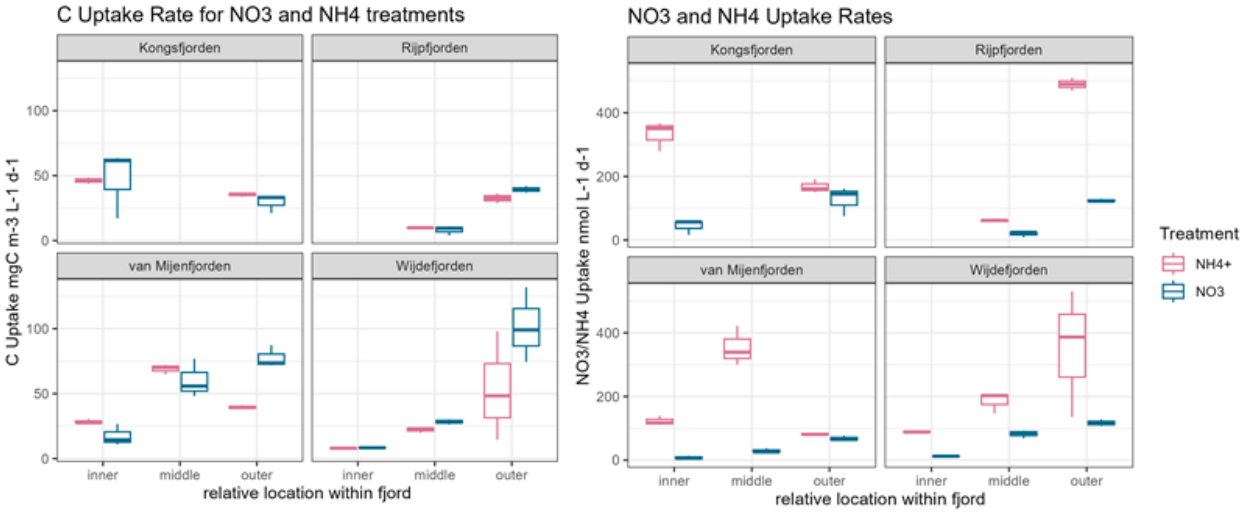

Fig. 5.8 Preliminary results: Carbon and nitrogen uptake rates per fjord and innermost, middle and outer station in the sampled fjords. The middle station in Kongsfjorden and the inner station in Rijpfjorden were not sampled.

5.7 Multi-Core Sediment Sampler (MUS Sampling)

(Jakob Giesler)

Multicore samples were taken at stations 2, 4, 5, 7, 8, 10, and 11. At each respective station, at least 4 intact core samples were retrieved, labeled and photographed (Fig.5.9, left). Three out of four cores were directly processed on board and used for pore water extraction, methane sampling, and sedimentary DNA. One additional core was immediately frozen for subsequent dating analysis in the AWI lab.

For porewater sampling, supernatant was removed until 1cm of water column was left for bottom water sampling. Afterwards, the remaining supernatant was discarded. Porewater sampling was conducted every cm for the upper 10 cm of sediment. Below 10 cm, 2cm sediment layers were pooled and the subsequent 1cm layer was discarded between sampling layers (Fig.5.9, right). To extract the porewater, sediment slices were transferred into falcon tubes with pre-drilled holes in the lid. Rhizones mounted on 20 ml syringes were used to extract as much porewater as possible from the sediment layers in the falcon tubes (Fig.5.10). After extraction, porewater samples were transferred into crimp vials. Samples were fixed with HgCl2 and gassed with Argon before sealing and storing at 6°C.

For methane analysis, the same depth layers were sampled. After the supernatant water was removed, 3 microcores of every layer were sampled using a shortened syringe and were immediately fixed in HCl and were gased with Argon. Methane samples were stored at 6°C. The remaining sediment of each respective layer was transferred to glas petri-disks and stored at -20°C.

For DNA sampling, cores were sampled for the upper 10 cm in 1 cm intervals. After the supernatant was removed, a subsample from each layer was extracted using a sterile spoon. Samples were immediately frozen at -20°C for later DNA extraction. In total, 28 intact cores could be retrieved from a total of 7 stations sampled across 4 fjords. Samples for porewater, methane, DNA and general dating of the cores are currently employed. Owed to the properties of the sediment in most fjords of the Svalbard Archipelago, the length of the cores mostly did not reach up to 40 cm.

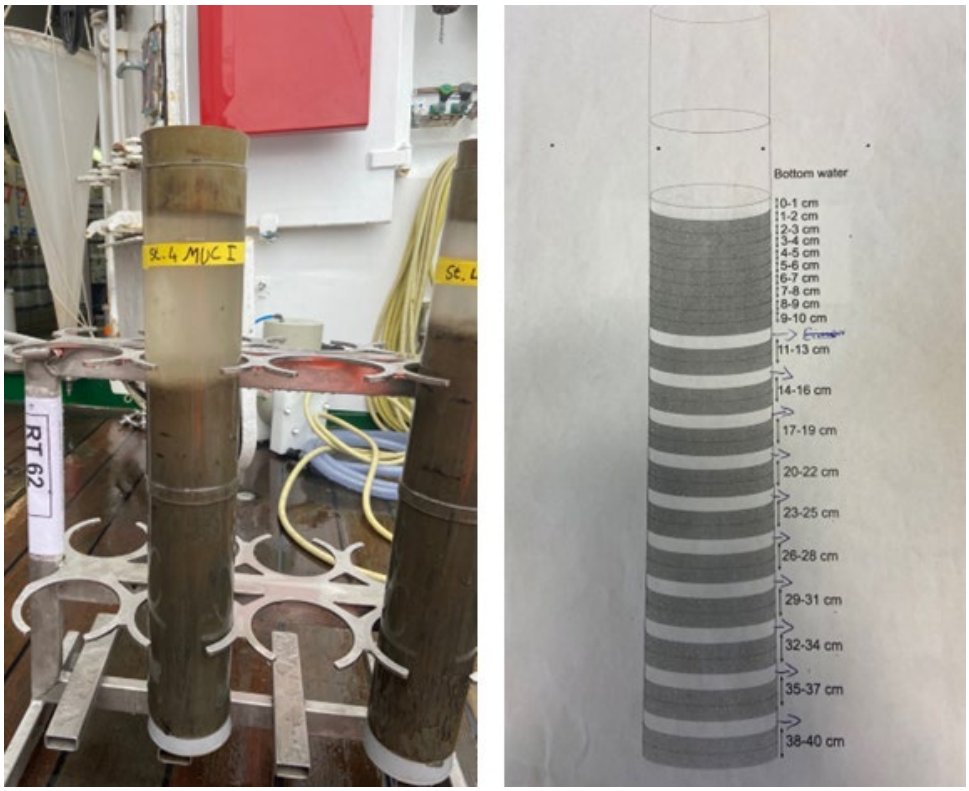

Fig. 5.9 Exemplary picture of a multicore sample after plumbing (left). Sampling layers for multicore samples determined for porewater extraction and methane sampling. For DNA sampling the sampling scheme applies for the upper 10 cm layers (right).

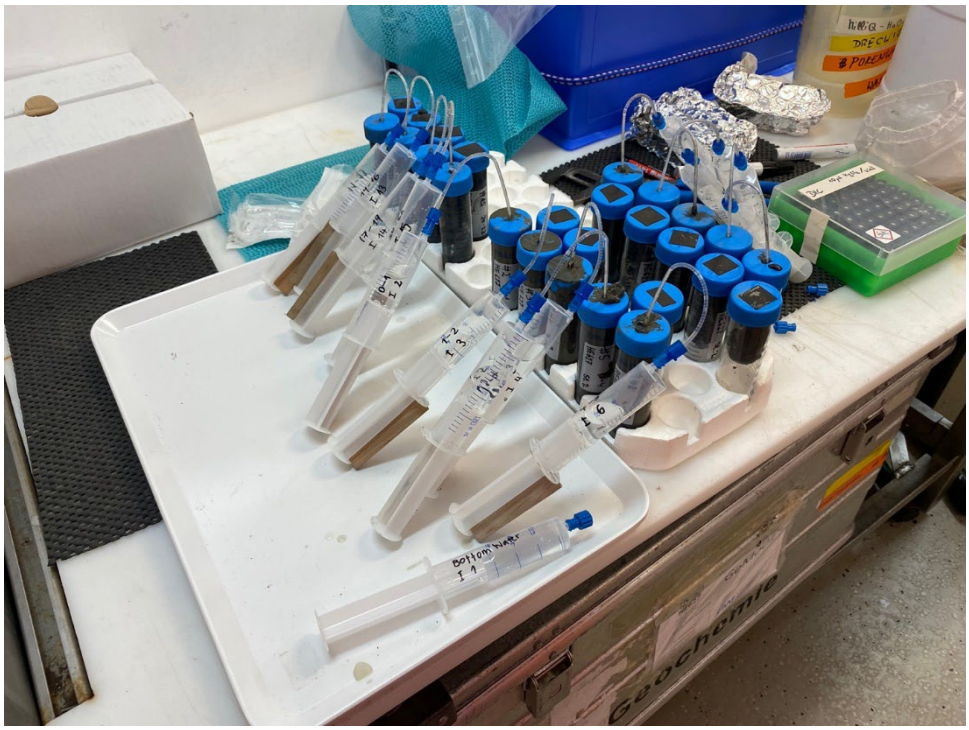

Fig. 5.10 Procedure of bottom water extraction using rhizone mounted on syringes.

5.8 Mooring Deployment

(Uwe John, Michelle Albinus, Matthias Monsees)

Two moorings were deployed, one at the outer van Mijenfjorden (77° 38.5'N; 014° 29.1'E) and the other at the outer Wijdefjorden (79° 30,3'N; 015° 42.7'E). The aim in both cases is to observe continuously for the duration of two years tidal, intra-seasonal (event-like) and seasonal evolutions of the hydrographic properties, fjord-shelf exchange flows, and export fluxes. The moorings were deployed at water depths of 159 m (van Mijenfjorden) and 126 m (Wijdefjorden). The moorings exhibit a quite similar setup. Both are equipped with three temperature-salinity recorders (Seabird SBE37), one near the sea floor, one at mid-depth, and one at the upper end of the mooring. Co-located with the bottom and top devices are Anderaa RCM11 acoustic point current meters. In addition, 4 temperature loggers (Seabird SBE56) were evenly placed along the mooring line. Finally, a sediment trap was installed near the sea floor. The sampling rates for the SBE 37, RCM11, and SBE56 are 60 minutes, 120 minutes and 1 minute, respectively.

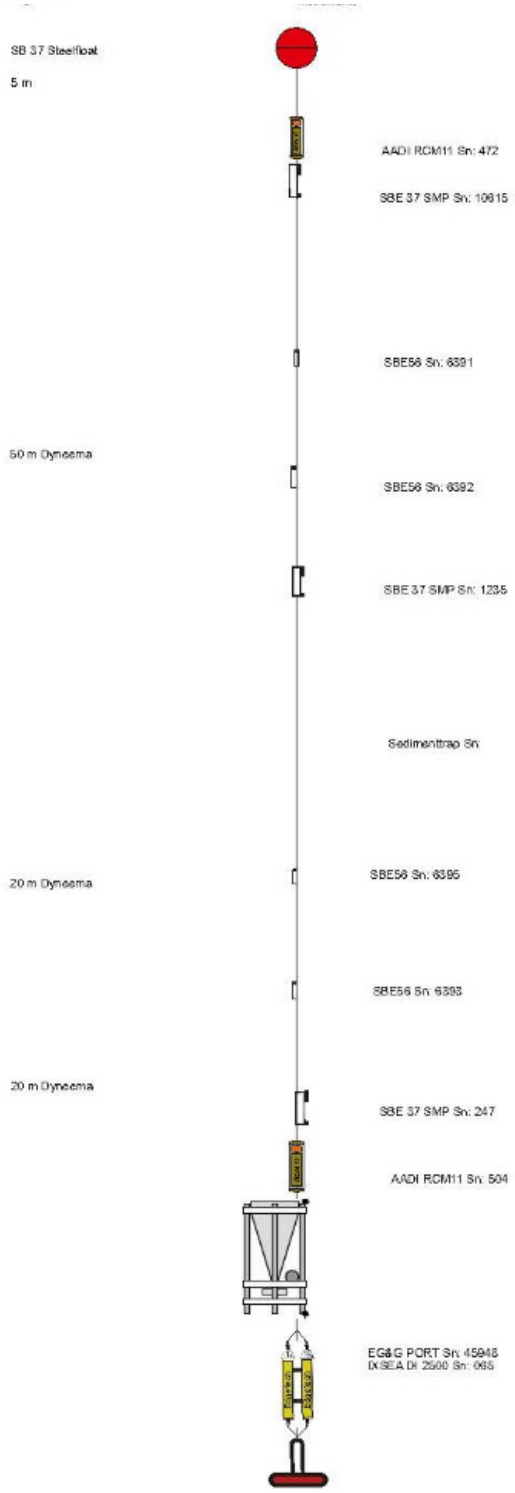

Fig. 5.11 Schematic of the mooring deployed during HE627.

6 Station List

6.1 Overall Station List

Station No.	Date	Gear	Time	Latitude	Longitude	Water Depth
HEINCKE	2023		[UTC]	[°N]	[°E]	[m]
HE627_1-1	18/08/	PLA	11:05	77° 42,765	013° 22,502	46
HE627_1-2	18/08/	Secdisk	11:06	77° 42,764	013° 22,483	45
HE627_1-3	18/08/	CTD	11:23	77° 42,707	013° 21,789	45
HE627_1-4	18/08/	ISP	11:45	77° 42,709	013° 21,024	47
HE627_1-5	18/08/	CTD	12:24	77° 42,714	013° 20,069	48
HE627_1-6	18/08/	BOP	12:40	77° 42,732	013° 19,565	49
HE627_2-1	18/08/	ADCP	21:30	77° 39,779	014° 24,893	139
HE627_2-2	19/08/	PLA	06:03	77° 38,455	014° 28,345	156
HE627_2-3	19/08/	Secdisk	06:07	77° 38,453	014° 28,336	157
HE627_2-4	19/08/	CTD	06:32	77° 38,477	014° 28,188	156
HE627_2-5	19/08/	ISP	07:47	77° 38,530	014° 28,303	155
HE627_2-6	19/08/	BOP	08:13	77° 38,486	014° 28,306	156
HE627_2-7	19/08/	CTD	09:27	77° 38,451	014° 28,007	156
HE627_2-8	19/08/	MUC	11:06	77° 38,503	014° 28,191	157
HE627_2-9	19/08/	MOOR	14:16	77° 38,502	014° 29,123	159
HE627_3-1	20/08/	BOAT	05:01	77° 48,906	016° 40,506	62
HE627_3-2	20/08/	PLA	10:01	77° 49,689	016° 34,633	65
HE627_3-3	20/08/	Secdisk	10:03	77° 49,687	016° 34,649	65
HE627_3-4	20/08/	CTD	10:31	77° 49,669	016° 34,701	65
HE627_3-5	20/08/	CTD	11:09	77° 49,716	016° 34,508	65
HE627_3-6	20/08/	CTD	11:45	77° 49,711	016° 34,533	64
HE627_3-7	20/08/	ISP	11:55	77° 49,704	016° 34,531	64
HE627_3-8	20/08/	BOP	12:21	77° 49,701	016° 34,544	65
HE627_4-1	21/08/	PLA	05:59	77° 47,367	015° 29,841	91
HE627_4-2	21/08/	Secdisk	06:04	77° 47,388	015° 29,918	90
HE627_4-3	21/08/	PLA	06:14	77° 47,399	015° 29,969	91
HE627_4-4	21/08/	PLA	06:24	77° 47,389	015° 30,022	90
HE627_4-5	21/08/	CTD	06:36	77° 47,389	015° 29,999	90
HE627_4-6	21/08/	CTD	07:24	77° 47,391	015° 29,946	90
HE627_4-7	21/08/	CTD	07:58	77° 47,384	015° 30,041	90
HE627_4-8	21/08/	ISP	08:09	77° 47,394	015° 30,024	90
HE627_4-9	21/08/	BOP	08:38	77° 47,391	015° 30,009	90
HE627_4-10	21/08/	MUC	10:56	77° 47,403	015° 30,030	90
HE627_4-11	21/08/	MUC	11:26	77° 47,406	015° 29,986	90
HE627_5-1	23/08/	PLA	05:53	79° 45,026	015° 31,963	164
HE627_5-2	23/08/	Secdisk	05:56	79° 45,025	015° 31,964	164
HE627_5-3	23/08/	PLA	06:03	79° 45,025	015° 31,970	164
HE627_5-4	23/08/	PLA	06:13	79° 45,024	015° 31,991	164
HE627_5-5	23/08/	CTD	06:25	79° 45,028	015° 31,993	164
HE627_5-6	23/08/	CTD	07:15	79° 45,007	015° 31,992	163
HE627_5-7	23/08/	CTD	07:50	79° 45,001	015° 32,033	162
HE627_5-8	23/08/	ISP	07:58	79° 45,001	015° 32,062	162

HE627_5-9	23/08/	BOP	08:29	79° 44,999	015° 32,051	162
HE627_5-10	23/08/	MUC	11:01	79° 44,999	015° 32,019	162
HE627_5-11	23/08/	ADCP	11:47	79° 45,020	015° 31,859	163
HE627_6-1	24/08/	BOAT	06:02	78° 59,082	016° 19,655	108
HE627_6-2	24/08/	PLA	10:59	79° 02,108	016° 11,020	156
HE627_6-3	24/08/	Secdisk	11:06	79° 02,104	016° 11,027	156
HE627_6-4	24/08/	PLA	11:05	79° 02,106	016° 11,038	156
HE627_6-5	24/08/	PLA	11:11	79° 02,115	016° 10,912	156
HE627_6-6	24/08/	PLA	11:18	79° 02,110	016° 10,979	156
HE627_6-7	24/08/	CTD	11:27	79° 02,107	016° 11,125	157
HE627_6-8	24/08/	CTD	12:14	79° 02,105	016° 11,110	157
HE627_6-9	24/08/	CTD	12:48	79° 02,103	016° 11,047	158
HE627_6-10	24/08/	ISP	12:59	79° 02,104	016° 11,117	157
HE627_6-11	24/08/	BOP	13:29	79° 02,101	016° 11,099	157
HE627_6-12	24/08/	CTD	14:59	79° 07,483	016° 01,018	233
HE627_7-1	25/08/	PLA	05:55	79° 30,042	015° 42,867	126
HE627_7-2	25/08/	Secdisk	06:01	79° 30,034	015° 42,895	126
HE627_7-3	25/08/	PLA	06:05	79° 30,035	015° 42,885	126
HE627_7-4	25/08/	PLA	06:11	79° 30,036	015° 42,900	126
HE627_7-5	25/08/	CTD	06:18	79° 30,031	015° 42,921	126
HE627_7-6	25/08/	CTD	07:02	79° 30,018	015° 42,916	126
HE627_7-7	25/08/	CTD	07:37	79° 30,014	015° 43,001	126
HE627_7-8	25/08/	ISP	07:45	79° 30,026	015° 42,934	126
HE627_7-9	25/08/	BOP	08:22	79° 30,046	015° 42,934	126
HE627_7-10	25/08/	MUC	10:56	79° 30,024	015° 42,934	125
HE627_7-11	28/08/	MOOR	05:25	79° 30,296	015° 42,716	126
HE627_8-1	26/08/	BOAT	05:02	80° 02,660	022° 09,728	68
HE627_8-2	26/08/	PLA	10:52	80° 15,010	022° 04,994	98
HE627_8-3	26/08/	Secdisk	10:52	80° 15,011	022° 04,994	98
HE627_8-4	26/08/	PLA	10:58	80° 15,023	022° 04,988	99
HE627_8-5	26/08/	PLA	11:04	80° 15,023	022° 05,107	104
HE627_8-6	26/08/	PLA	11:11	80° 15,017	022° 05,163	109
HE627_8-7	26/08/	CTD	11:19	80° 15,014	022° 05,112	103
HE627_8-8	26/08/	CTD	11:59	80° 15,020	022° 04,999	99
HE627_8-9	26/08/	CTD	12:34	80° 15,004	022° 04,953	95
HE627_8-10	26/08/	ISP	12:44	80° 15,016	022° 05,027	98
HE627_8-11	26/08/	BOP	13:15	80° 15,020	022° 05,024	98
HE627_8-12	26/08/	MUC	14:14	80° 15,006	022° 05,013	98
HE627_9-1	27/08/	PLA	05:48	80° 04,979	022° 10,152	201
HE627_9-2	27/08/	Secdisk	05:54	80° 04,994	022° 10,138	204
HE627_9-3	27/08/	PLA	06:01	80° 05,006	022° 10,112	203
HE627_9-4	27/08/	PLA	06:13	80° 05,014	022° 10,084	204
HE627_9-5	27/08/	PLA	06:21	80° 05,021	022° 10,027	203
HE627_9-6	27/08/	CTD	06:33	80° 05,018	022° 09,920	201
HE627_9-7	27/08/	BOP	07:23	80° 04,999	022° 10,036	202
HE627_10-1	27/08/	PLA	10:55	80° 25,028	022° 04,839	184
HE627_10-2	27/08/	Secdisk	11:00	80° 25,027	022° 04,931	178
HE627_10-3	27/08/	PLA	11:09	80° 25,014	022° 05,065	175

HE627_10-4	27/08/	PLA	11:18	80° 25,005	022° 05,074	175
HE627_10-5	27/08/	PLA	11:28	80° 25,004	022° 04,995	175
HE627_10-6	27/08/	CTD	11:40	80° 24,997	022° 05,047	175
HE627_10-7	27/08/	CTD	12:25	80° 25,005	022° 05,049	175
HE627_10-8	27/08/	CTD	13:03	80° 25,006	022° 05,035	175
HE627_10-9	27/08/	ISP	13:12	80° 25,002	022° 05,019	175
HE627_10-10	27/08/	BOP	13:54	80° 25,000	022° 04,975	175
HE627_10-11	27/08/	MUC	15:28	80° 25,007	022° 04,950	176
HE627_11-1	29/08/	BOAT	05:01	78° 53,925	012° 18,083	32
HE627_11-2	29/08/	CTD	06:05	78° 54,036	012° 17,600	41
HE627_11-3	29/08/	PLA	10:00	78° 57,159	012° 00,448	172
HE627_11-4	29/08/	Secdisk	10:03	78° 57,169	012° 00,425	174
HE627_11-5	29/08/	PLA	10:10	78° 57,173	012° 00,434	174
HE627_11-6	29/08/	PLA	10:17	78° 57,166	012° 00,438	173
HE627_11-7	29/08/	PLA	10:24	78° 57,158	012° 00,424	173
HE627_11-8	29/08/	CTD	10:34	78° 57,147	012° 00,359	175
HE627_11-9	29/08/	CTD	11:18	78° 57,057	012° 00,657	176
HE627_11-10	29/08/	CTD	11:52	78° 57,067	012° 00,657	175
HE627_11-11	29/08/	ISP	12:00	78° 57,064	012° 00,638	176
HE627_11-12	29/08/	BOP	12:33	78° 57,063	012° 00,693	175
HE627_11-13	29/08/	MUC	13:52	78° 57,067	012° 00,617	175
HE627_12-1	30/08/	PLA	05:55	78° 58,014	009° 27,711	224
HE627_12-2	30/08/	Secdisk	05:59	78° 58,023	009° 27,652	223
HE627_12-3	30/08/	PLA	06:03	78° 58,033	009° 27,612	222
HE627_12-4	30/08/	PLA	06:10	78° 58,037	009° 27,636	223
HE627_12-5	30/08/	CTD	06:20	78° 58,055	009° 27,624	223
HE627_12-6	30/08/	CTD	07:02	78° 58,115	009° 27,598	221
HE627_12-7	30/08/	CTD	07:34	78° 58,066	009° 27,499	223
HE627_12-8	30/08/	ISP	07:42	78° 58,057	009° 27,562	223
HE627_12-9	30/08/	BOP	08:16	78° 58,074	009° 27,643	224
HE627_13-1	30/08/	PLA	11:50	79° 00,795	011° 26,360	323
HE627_13-2	30/08/	Secdisk	11:56	79° 00,883	011° 26,256	314
HE627_13-3	30/08/	PLA	12:04	79° 00,890	011° 26,226	313
HE627_13-4	30/08/	PLA	12:13	79° 00,885	011° 26,292	312
HE627_13-5	30/08/	PLA	12:24	79° 00,865	011° 26,344	313
HE627_13-6	30/08/	CTD	12:36	79° 00,861	011° 26,320	319
HE627_13-7	30/08/	CTD	13:23	79° 00,851	011° 26,348	313
HE627_13-8	30/08/	CTD	13:58	79° 00,847	011° 26,357	313
HE627_13-9	30/08/	ISP	14:10	79° 00,859	011° 26,393	312
HE627_13-10	30/08/	BOP	14:41	79° 00,862	011° 26,332	313

7 Data and Sample Storage and Availability

All data are deposited either in Pangaea, at GFBIO or accessible upon request if no public depository exist (frozen DNA samples, DOM, toxin samples).

Table 7.1 Overview of data availability

Type	Database	Available	Free Access	Contact
CTD data	PANGAEA	2023	2023	daniela.voss@uol.de uwe.john@awi.de
Thermosalinograph	PANGAEA	2023	2023	rohan.henkel@uol.de uwe.john@awi.de
Underwater light field data	PANGAEA	2023	2023	daniela.voss@uol.de
Chlorophyll,	PANGAEA	2023	2023	daniela.voss@uol.de
SPM	ICBM	2023	on request	daniela.voss@uol.de
Radiometric data	ICBM	2023	on request	daniela.voss@uol.de
FU index, Secchi disc depth	PANGAEA	2023	2023	daniela.voss@uol.de
Metabarcoding	AWI	2024	on request	uwe.john@awi.de
DOC, DOM, Nutrients	AWI	2024	on request	uwe.john@awi.de
Metatranscriptomics	AWI	2024	on request	uwe.john@awi.de

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