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Short Cruise Report
Maria S. Merian MSM139

Reykjavik - Reykjavik

25.07.2025 – 27.08.2025

Chief Scientist: Dr. Uwe John

Captain: Björn Maaß

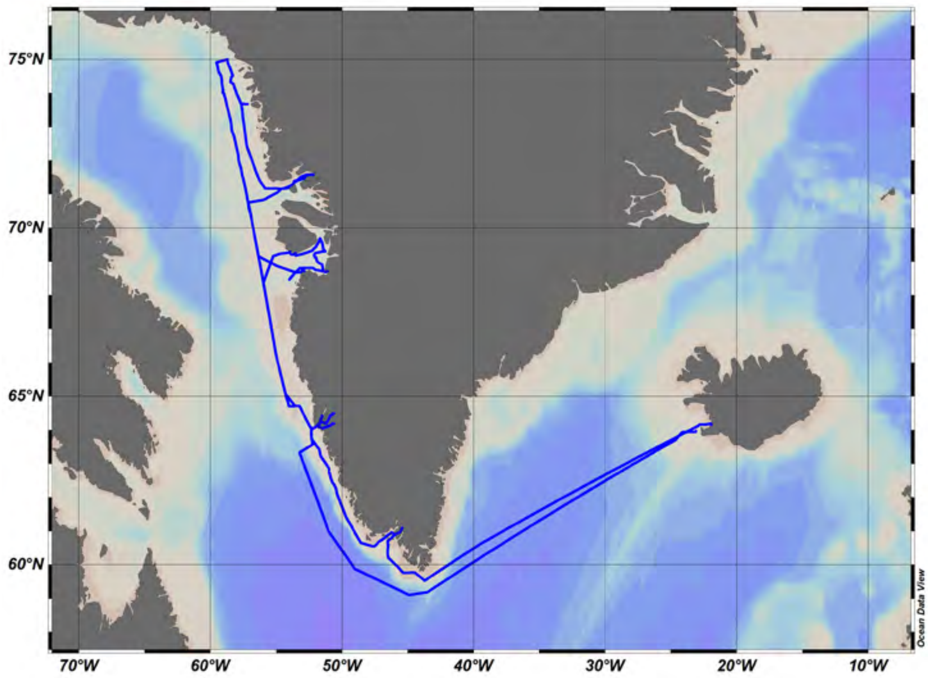

Fig. 1: Cruise ship track map.

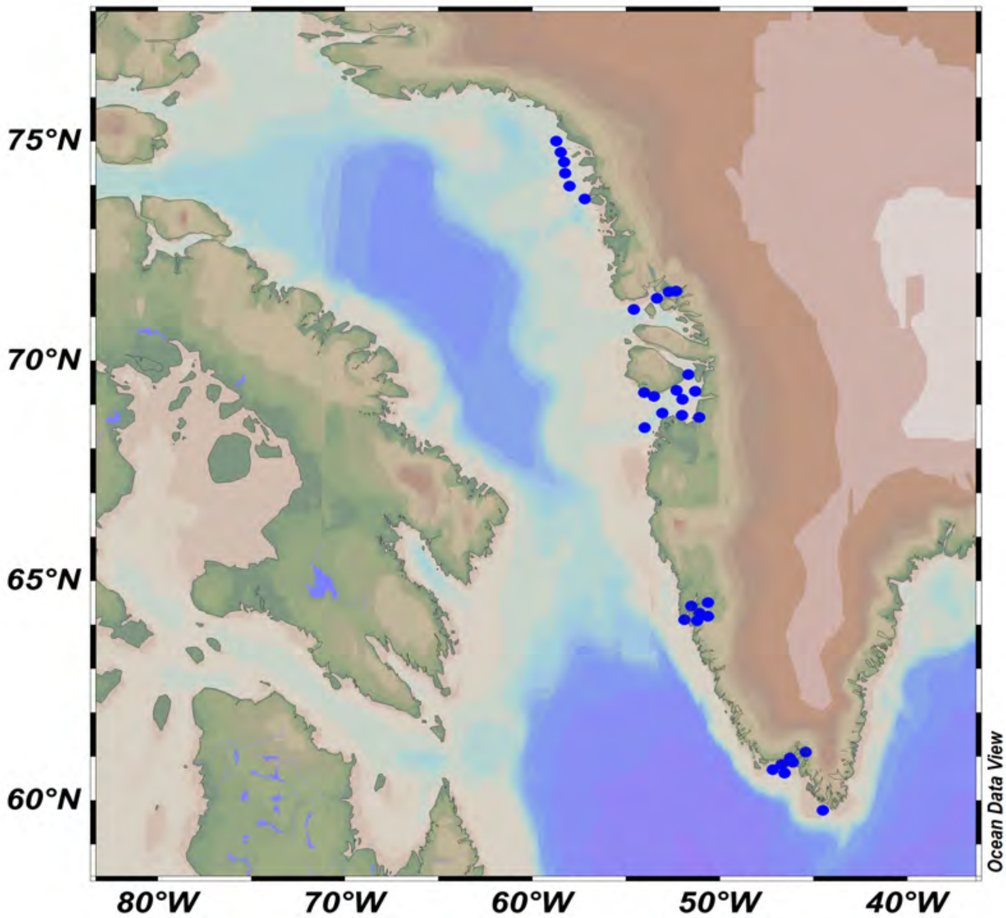

Fig. 2: Cruise map with research stations as blue dots.

Objectives

Harmful algal blooms (HABs, i.e., mass occurrences of microalgae species that produce toxins or cause other damage to marine ecosystems) which are primarily known from temperate and warm coastal regions, are now an increasing threat to Arctic ecosystems.

This expedition MSM139 (Fig. 1) through the “GreenHAB” project investigates the interactions between hydrography, bio-optics, planktonic composition and community connectivity (especially toxigenic algae and their toxins). This is in combination with environmental genomic approaches (metatranscriptomics, metabarcoding, population genomics, paleometagenomics) conducted in five research areas (Fig. 2) in West Greenland fjords and coastline which differ in their ice coverage, glacial melt water runoffs, and history. The survey results will be used to estimate quantifiable effects of HABs on the ecosystem, which are driven by an accelerated glacial melt water runoff. In addition, sediments will be examined for resting stages (cysts) and paleo-communities, focusing on toxigenic species.

The scientific work is divided into four working groups complementarily addressing past and present plankton communities and their adaptations.

<u>1) Oceanography, water chemistry, primary productivity, ammonium and nitrate uptake:</u> To investigate the abiotic conditions in the areas, a comprehensive oceanographic characterization of the sampling area, including high-resolution physico-chemical (CTD - conductivity, temperature and depth profiles) with dissolved nutrients (DOC, PON and POP samples) and optical measurements along several transects from the shelf to the inner fjord systems will be performed. Carbon, nitrate uptake rates and primary production of phytoplankton will be measured at three different temperatures with stable isotopes to determine the productivity to assess expected changes in productivity under temperature changes due to global warming.

<u>2) Experimentally investigate plankton community change under warming and presence of harmful algal species:</u> Changes in phytoplankton community composition, grazing, competition and productivity will be tested in microcosm experiments under three different temperatures to simulate changes under global warming using an invasion of HAB species into the existing plankton communities. An experimental setup using dilution experiments will be conducted to investigate the effects of feeding activity on the phytoplankton community in three temperature-controlled laboratory setups.

<u>3) Molecular ecology and plankton diversity:</u> Using microscopic and molecular community analysis, specifically environmental genomic approaches including amplicon sequencing and metatranscriptomics. Samples of microscopic plankton communities will be collected from Niskin bottles of the CTD rosette from four depths per station (surface (3m), 15m and 40 m, and chlorophyll maximum) and a phytoplankton net tow. Microscopic samples will be analysed onboard by microscopy, and individual cells sampled for culture cultivation and single cell analysis. Data analyses will involve transcript assembly and taxonomic and functional annotation, and transcript profiles will be related to environmental parameters, oceanography and water chemistry using multivariate statistical approaches.

<u>4) Past changes of plankton diversity and activities (paleometagenomics):</u> Sediment cores for cyst analyses and paleo-biological metabarcoding will be used to determine a) how long the potentially toxic species have been present; b) if cyst beds are already established; and c) for pre-industrial community dynamics assessment. Sediment cores targeting the last 150-200 yr. (~0.5m-in length) from the post-industrialization to contemporary era collected in the different locations selected based on the sediment geology. Plankton samples (both vegetative organisms and resting stages preserved in the sediments) and organic carbon samples are used to calibrate the genetic data.

Narrative of the MSM139 GreenHAB Expedition – West Coast of Greenland, 2025

On 24 July 2025, we boarded the *RV Maria S. Merian*, settled into our cabins, and began unloading the containers and setting up the laboratories. After safety briefings and drills the following morning, we set sail from Reykjavik on 25 July, heading towards the first sampling stations off Greenland's west coast. The GreenHAB project, involving 18 scientists, investigates the impact of climate change on coastal marine ecosystems. Our focus lies on phytoplankton dynamics, biodiversity, and the potential spread of toxic algae in Greenlandic waters. To achieve this, we collected water column samples, analysed plankton communities, extracted sediment cores, and conducted experiments under varying temperature and nutrient scenarios to assess the resilience of these ecosystems.

We began sampling on 28 July at 59°46.566′N, 44°29.59′W under rough sea conditions but completed the programme efficiently. Entering the Skovfjord, early analyses revealed diatom dominance within the plankton community, alongside potentially toxic genera such as *Pseudo-nitzschia*, *Alexandrium*, and *Dinophysis*. Near Narsuarssuaq, we extracted sediment cores up to five metres long, providing records of ecosystem changes over the past 200–300 years. Concurrently, onboard experiments were launched to investigate how native plankton adapt to rising temperatures and nutrient shifts, comparing Greenlandic communities with temperate counterparts.

After leaving the first area, we navigated through ice-filled Bredefjord towards Nuuk. In the Godthåbsfjord system, we collected further sediment cores and plankton samples. Diatoms again dominated, but we confirmed the presence of potentially harmful dinoflagellates. Experiments here and in all other research areas focused on primary production, grazing, competition, potential invasion, and carbon and nitrogen cycling under warming scenarios.

By early August, we reached our northernmost station at 75°00.2′N, 58°43.7′W, and successfully extracting four-metre sediment cores to reconstruct past environmental conditions. Over several days, we sampled six additional stations, measuring phytoplankton growth rates, impact of grazing and nitrogen uptake dynamics under different temperature regimes. Comparing nitrate and ammonium assimilation providing insights into future shifts in productivity as climate change alters nutrient availability.

On 9 August, we entered the Uummannaq Fjord system, sampling near the glacier front under challenging ice conditions. We then proceeded to Disko Bay, where we conducted detailed investigations and involved local students from Aasiaat Gymnasium in our work, fostering discussions about marine research and climate change. In Disko Bay, we successfully extracted sediment cores at several stations, including near the Jakobshavn Isbræ glacier and Qeqertarsuaq, supporting pre-existing long-term monitoring efforts.

During the final phase, we returned south to Nuuk, where we met with 60 students from GUX Nuuk for our second student outreach session, before sampling the Ameralik Fjord, our last site. Two sediment cores were recovered here, and final onboard experiments examined the combined influence of nutrients, temperature, predation, and invasive species on plankton community resilience. After 33 stations and 4575 nautical miles, the expedition was a success. Across 39 CTD deployments, we sampled 28,900 metres of the water column, filtered approximately 17,000 litres of seawater, and collected over 550 plankton isolates, 67 MUC sediment cores, and 15 gravity cores. These extensive datasets and samples will underpin future analyses, helping us understand ecosystem responses to climate change and potential risks to the sensitive Greenlandic environment.

Research area overviews

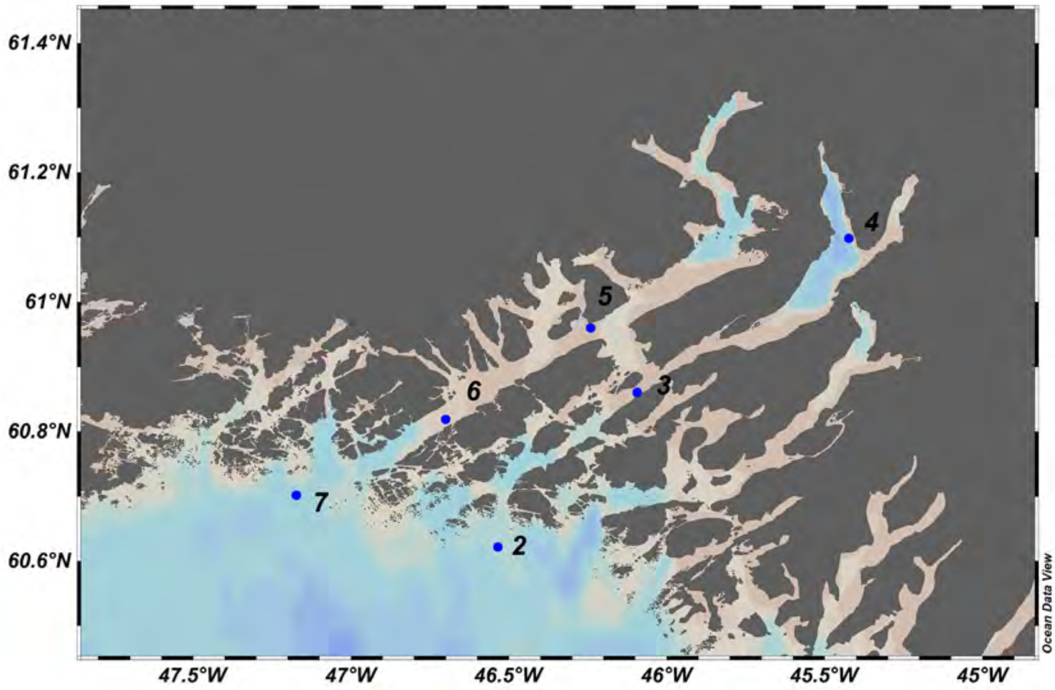

Fig. 3: Overview of research area A around Narssaq and Narsuarssuaq and the sample station marked as blue dots. Station 2-4 in Skovfjord Fjord and 5-7 in Bredefjord.

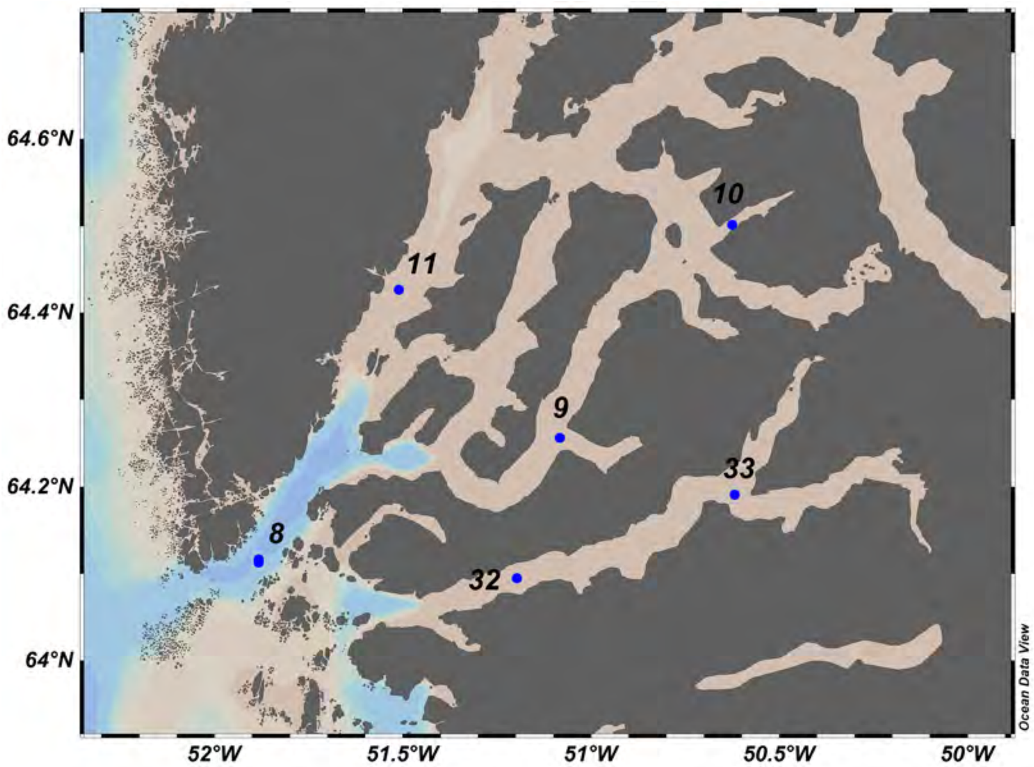

Fig 4: Overview of research area B around Nuuk near station 8 and 9-11 in the Godthabs Fjordsystem. All samples stations marked with blue dots. The station 32 and 33 are in the Ameralik Fjord.

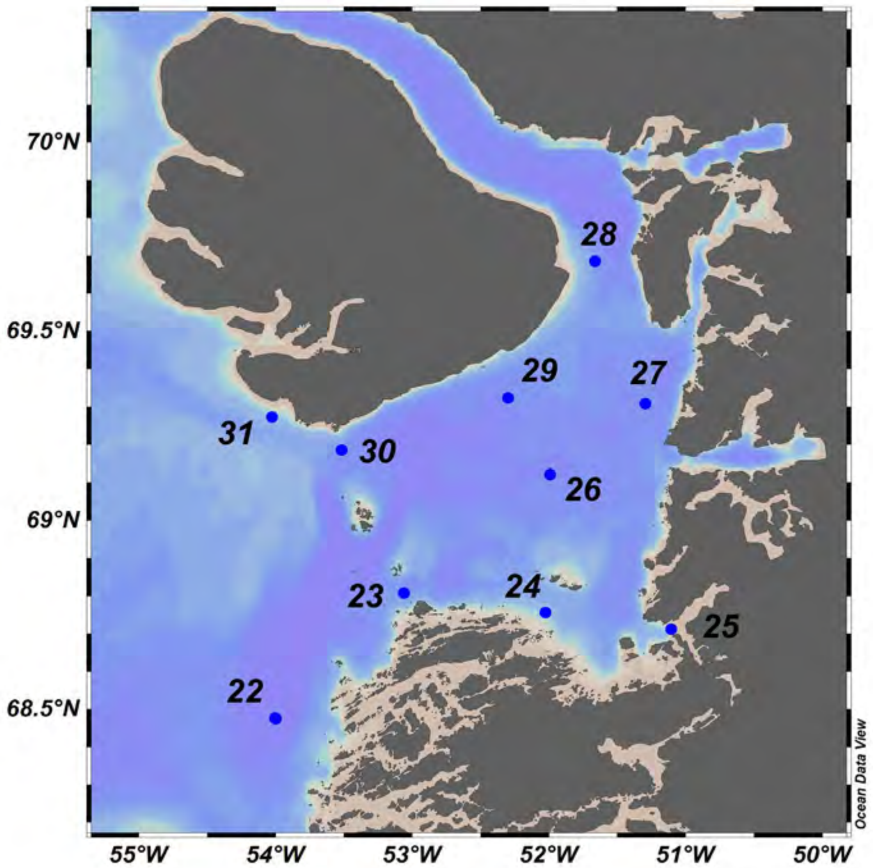

Fig 5: Overview of research area C Disko Bight and samples stations marked with blue dots. Aasiaat is close to station 23 and 27 to Ilulissiat. Qeqertarsuaq at station 30 on Disko Island.

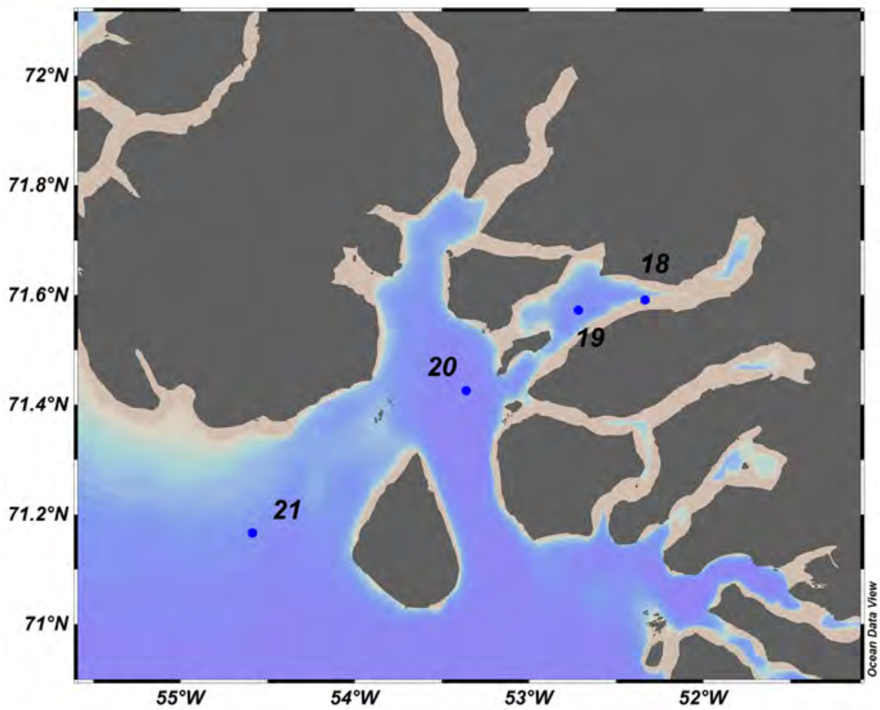

Fig 6: Overview of research area D in the Uummannaq Fjord system and samples stations marked with blue dots.

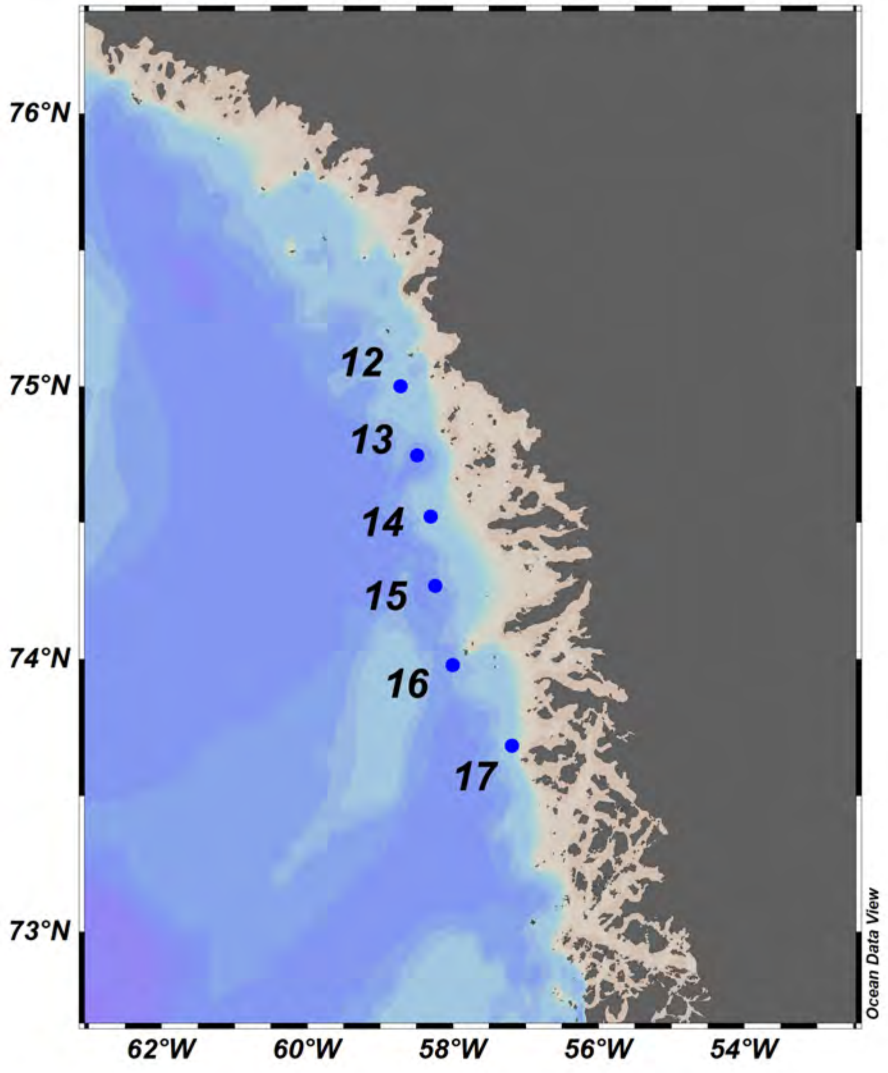

Fig 7: Overview of most northern research area E at the border to the Melville bight and samples stations marked with blue dots

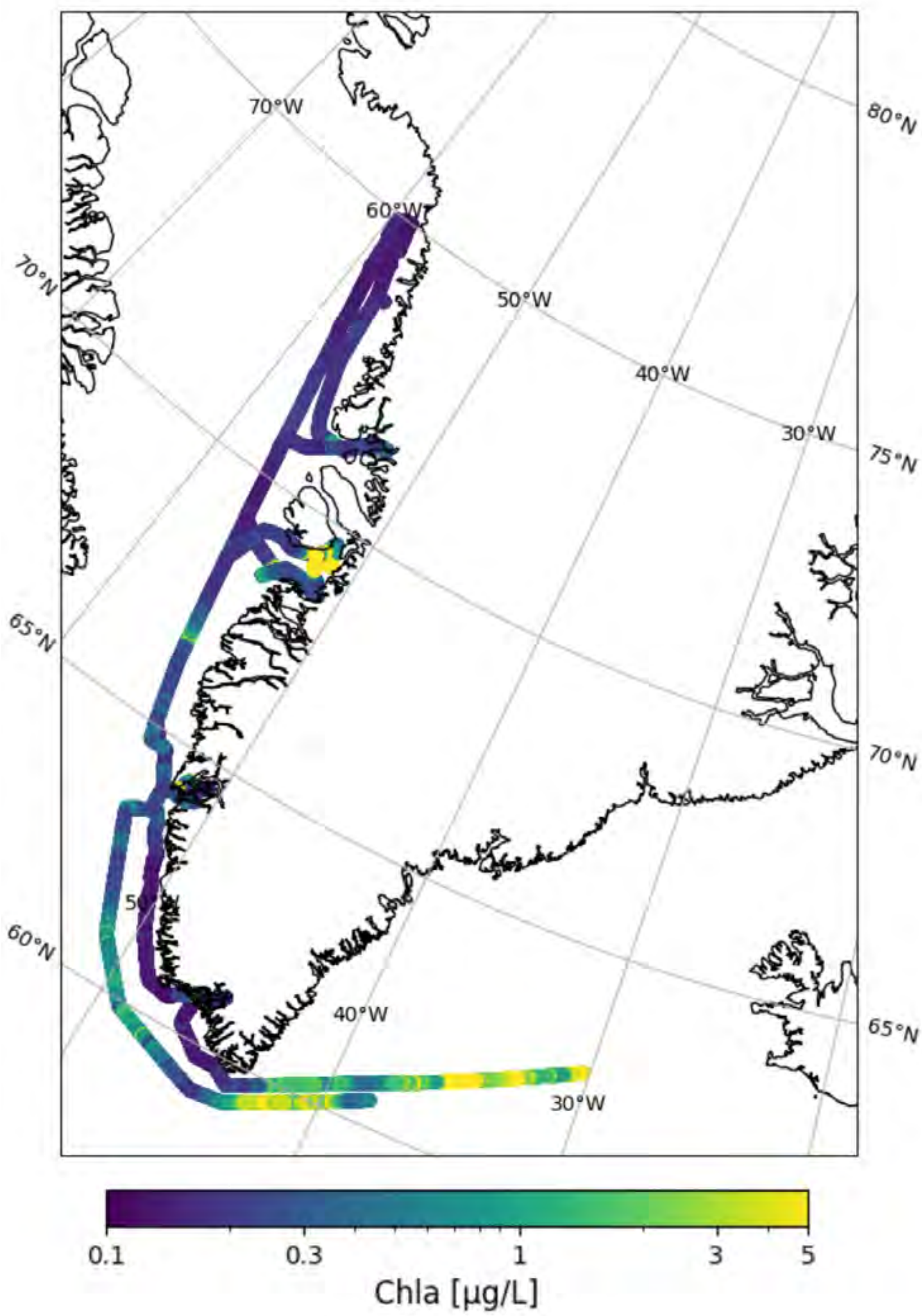

Fig. 8: Overview of the chlorophyll a data from the onboard measuring system (RSWS), also giving an overview of the overall track of the ship.

Acknowledgements

We would like to express our sincere thanks to Captain Björn Maaß and his team, who guided us perfectly through the waters with ice and missing bathymetric data and positioned us perfectly at the sample stations during this successful trip. We would also like to thank boatswain Enno Vredenborg and his entire team for their great support on deck and during sampling, and of course the team of Matthias Brem for the great catering and daily surprise. We would also like to thank Cora Hörstmann for all her great assistance from land/AWI. Thanks also to the AWI port warehouse and logistics team for all their help. Thank you all.

Cruise participant list

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4.	ANNELIESE LEITHOFF	CHRISTENSEN	Microalgae/Sediment Coring	KU
5.	ANDREA MONTSERRAT	BURFEID CASTELLANOS	Molecular ecology	UDE
6.	DAVID	CLARKE	Molecular ecology	MI
7.	WENCHE	EIKREM	Taxonomy/Microalgae	UiO
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Stations list

Station	Fjord	DateTime	Lat	Long	Depth (m)
MSM139_01	Area A	2025-07-28T08:18:36	59,776207	-44,493075	242
MSM139_02	Area A	2025-07-29T08:08:11	60,622185	-46,535452	89
MSM139_03	Area A	2025-07-29T14:44:58	60,860567	-46,094296	305
MSM139_04	Area A	2025-07-30T06:10:30	61,098562	-45,423287	126
MSM139-_05	Area A	2025-07-30T16:37:10	60,96028	-46,242084	353
MSM139_06	Area A	2025-07-31T08:16:40	60,819058	-46,701061	657
MSM139_07	Area A	2025-07-31T13:41:36	60,701603	-47,173538	131
MSM139_08	Area B	2025-08-02T09:20:48	64,116597	-51,882373	363
MSM139_09	Area B	2025-08-02T17:15:42	64,256966	-51,083721	360
MSM139_10	Area B	2025-08-03T09:13:20	64,501759	-50,626053	168
MSM139_11	Area B	2025-08-03T19:23:32	64,426704	-51,510986	617
MSM139_12	Area E	2025-08-07T09:15:09	75,00108	-58,721032	447
MSM139_13	Area E	2025-08-07T17:14:05	74,747655	-58,497579	1074
MSM139_14	Area E	2025-08-07T21:08:14	74,523448	-58,309764	471
MSM139_15	Area E	2025-08-08T07:27:24	74,270951	-58,246044	889
MSM139_16	Area E	2025-08-08T12:08:03	73,979689	-58,003823	400
MSM139_17	Area E	2025-08-08T18:27:39	73,68411	-57,193356	663
MSM139_18	Area D	2025-08-10T11:18:55	71,59115	-52,334283	897
MSM139_19	Area D	2025-08-10T21:10:36	71,572682	-51,715868	811
MSM139_20	Area D	2025-08-11T09:21:09	71,425838	-53,361274	620
MSM139_21	Area D	2025-08-11T15:14:57	71,1669	-54,588583	345
MSM139_22	Area C	2025-08-14T09:14:59	68,474914	-53,999995	513
MSM139_23	Area C	*2025-08-14T18:43:17*	68,80864	-53,063447	725
MSM139_24	Area C	*2025-08-15T09:08:51*	68,756796	-52,026263	123
MSM139_25	Area C	*2025-08-15T13:13:45*	68,712286	-51,108842	356
MSM139_26	Area C	*2025-08-15T19:29:59*	69,122388	-51,993951	510
MSM139_27	Area C	*2025-08-16T09:13:19*	69,308258	-51,295897	378
MSM139_28	Area C	*2025-08-16T15:11:11*	69,685971	-51,665631	247
MSM139_29	Area C	*2025-08-16T20:14:33*	69,323711	-52,299468	365
MSM139_30	Area C	*2025-08-17T09:09:03*	69,185114	-53,518609	337
MSM139_31	Area C	*2025-08-17T17:42:57*	69,273239	-54,026616	73,1
MSM139_32	Area B II	2025-08-21T13:27:00	64,191493	-50,619339	394
MSM139_33	Area B II	2025-08-21T17:10:00	64,095307	-51,19758	718