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Short Cruise Report

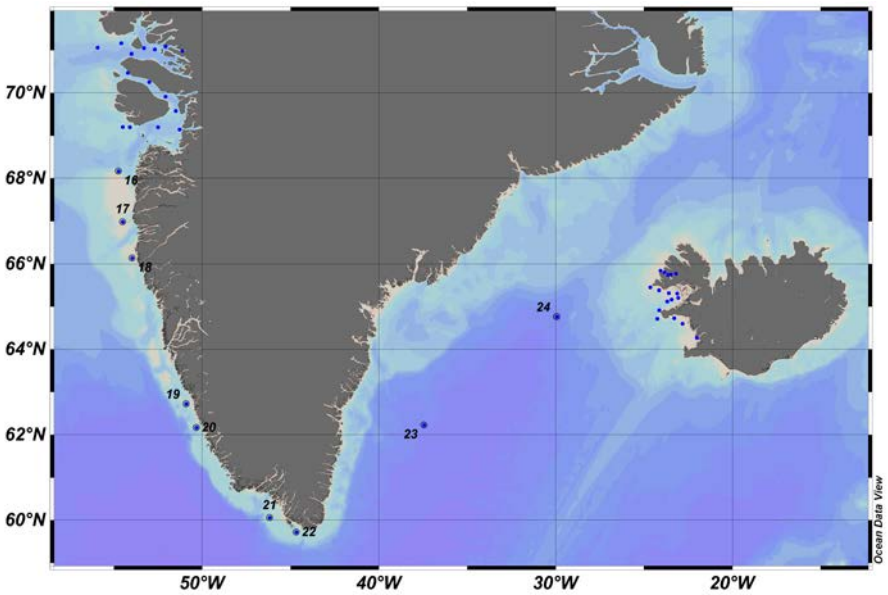
RV Maria S. Merian Cruise MSM 21/3

Nuuk, Greenland – Reykjavik, Iceland

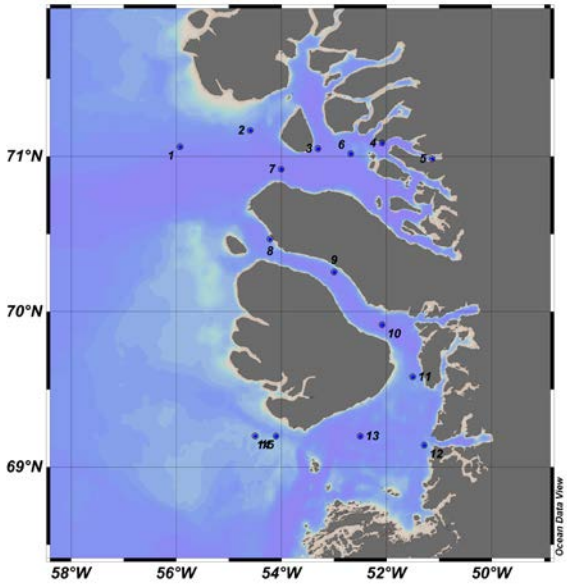
25 July – 10 August 2012

Chief scientist: Allan Cembella

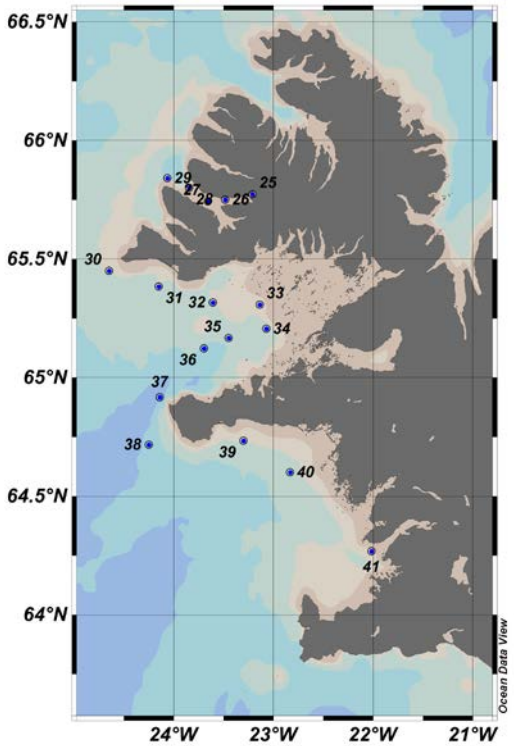
Captain: Klaus Bergmann



Map and cruise track of MSM21/3 expedition sampling stations from the west coast of Greenland across the Irminger Sea to the west coast of Iceland



Detailed Map of stations in West Greenland



Detailed map of stations on the west coast of Iceland

Objectives

The Ecosystem component of the MSM21 cruise **ARCHEMHAB** (Leg MSM21/3) addressed interactions and feedbacks among hydrographic regimes, biogeochemical and bio-optical signatures and phytoplankton species diversity, with a focus on potentially toxigenic species associated with Harmful Algal Blooms (HABs). In particular we focused on key questions regarding population genetics in relation to molecular ecological and chemically defined marine provinces and potential spreading of selected toxic species within the Arctic and adjacent waters. With respect to global change, the objective was to characterize the composition of coastal water for definable organic components and marine biooptical properties, with linkages to the effect of coastal proximity and glacial melt in the fjordal systems.

These objectives were addressed by the following specific elements: 1) establishing an inventory of the phytoplankton diversity with emphasis on HAB species and of phycotoxins in various planktonic fractions; 2) on board isolation and culturing of selected HAB taxa from plankton populations and cysts for further investigations on molecular genetics, life history strategies, mixotrophy, allelochemical capacity and production of bioactive natural products including toxins; 3) determining the composition of DOM in the water column by the measurement of bio-molecules (e.g. amino acids, sugars, lipids) and extraction of DOM for FT-ICR-MS measurements. By combining data from the oceanographic, biogeochemical and bio-optical components with conceptual modeling, we contributed to major advances in understanding Arctic coastal ecosystems with regards to the distribution and dynamics of key HAB species and to the influence of glacial melt-water discharge on water chemistry.

Narrative

The MERIAN departed Nuuk Harbor 14 h earlier than originally planned at 20:00 UTC on 25.07.12 under favourable weather and sea conditions. The ship proceeded directly to the first station (ST503 at 71°04’N 55°56’W), where several hours were required for trouble-shooting the operation and deployment of equipment. Subsequent sampling within Uummannaq Fjord included deployment of the CTD/Rosette device, with water samples partitioned along the water column for both chemical and biological analysis. Comparable water samples were obtained by

pumping from fixed depths and sieving to obtain various size-fractions for toxin analysis and species diversity characteristics by DNA sequencing. Complementary vertical tows of a phytoplankton net from 30 m yielded cell concentrates of plankton of >20 µm size-fraction. Two known genera of potentially toxic phytoplankton were detected by microscopic observation of the plankton samples. Water samples from the Rosette bottles were collected for chemical analysis, chlorophyll, and suspended particulate matter (SPM) from fixed water depths. Bio-optical properties of the fjordal water were determined by a radiometric profiler and measurements of inherent optical properties. Surface waters of Uummannaq Fjord were aquamarine blue with transparency reduced by suspended glacial silt. Benthic sediment samples obtained by grab samplers provided by WHOI yielded low concentrations of recent dinoflagellate cysts archived for critical identification and culturing. At the head of the Perlerfiup Fjord, meltwater and ice samples were collected directly in front of the glacier by deployment of the rubber rescue boat.

The Merian MSM21/3 cruise departed the Uummanaq fjord region and proceeded southwest along the transect through the Vaigat channel (approximately 70.5 – 69.5°N 54 – 52°W), essentially following the centre line of the channel with depth varying from 200 – 500m among the stations. The standard sampling regime included deployments in the following order: the CTD/Rosette device, phytoplankton net tow (usually repeated twice), pumped water from fixed depth intervals, sediment grab sampler, followed by repeated casts with the Secchi disk and Satlantic radiometric profiler. Radiometric and turbidity data indicated decreased water column transparency relative to the northern stations in Uummanaq and Perlerfiup fjords. Visual observations also confirmed the decreasing number of small icebergs within the Vaigat channel, generally in favour of larger blocks of highly degraded ice. Phytoplankton composition determined from the net tows and pump samples revealed a general shift from apparent late spring bloom dominance by diatoms to a nanoplankton community, with occasional low abundance of putatively toxic target genera of dinoflagellates. Benthic sediment sampling yielded soft silt-clay substrate with low numbers of cysts of *Alexandrium* isolated and archived for culture experiments.

At ST 512 (69°55’N 52°05’W) the rubber rescue boat with three scientific crew members was sent to approach shallow waters in the vicinity of abundant freshwater inflow for sampling of dissolved organic matter (DOM) contributed to the Vaigat. The

transect continued with entry into Disko Bay and with a near approach to the Jakobshavns Isfjord for collection of water samples under influence from glacial meltwater. This was followed by a transect across Disko Bay to the outer station on Disko Banke. Bottom sediment samples yielded increasingly rich deposits of dinoflagellate cysts in the surface layer within Disco Bay. CTD profiles along the Vaigat-Disko Bay transect confirmed a persistent thermocline, and a relatively cold surface layer adjacent to the glacier, with unusually warmer water towards the outer coast.

Pump sampling was discontinued at the outer stations along the coastal transect to Cape Farvel, and the station plan was modified to include two stations per day at fixed times (10:00 and 14:00). After crossing the Irminger Sea, with only two stations sampled by CTD/rosette for deep water (2150 -2450 m) for chemical analysis and biooptical signatures from the upper water column, the Merian entered Armarfjördur, a major fjordal system on the Icelandic northwest coast. Sampling in Iceland was initiated on 05.08.12 at the head of the northern arm of the fjord at St 527 (65° 46.41’ N 23° 12.64' W) in shallow water (46 m), including the standard sampling protocols, beginning with CTD/rosette, plankton net, pumping at fixed depths, benthic grab sampler, Satlantic radiometric profiler and Secchi disk. The rescue boat was deployed to directly on the coast to sample run-off water and to collect a small benthic grab sample. Phytoplankton composition was dominated by centric diatoms with only a few target dinoflagellates observed by microscopic examination of the net tow samples from 30 – 0 m depth. Dinoflagellate cysts were abundant in the sediments, including some of putatively toxic *Alexandrium* species. Four stations were sampled within this fjord along the main axis, after which Merian headed southwest to Breidafjördur.

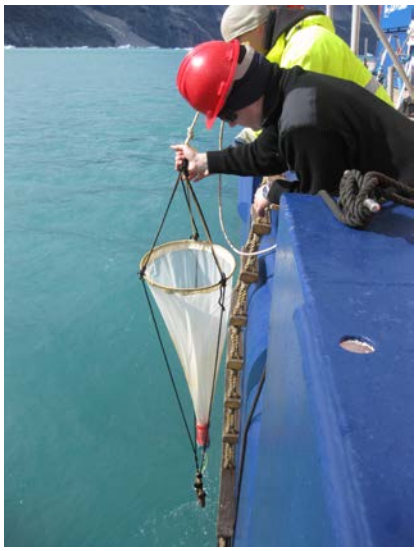
Merian entered Breidafjördur at St 532 (65° 27.0’ N 24° 39.0’ W) on 06.08.12, after which stations were sampled within the fjord parallel to the coast in shallow water (38 – 63 m depth) but only during daylight hours. The ship continued to cruise slowly at night within the fjord for operation of the continuous-flow Ferry-Box system for acquisition of biooptical data from the water column at 5 m. An additional four transect stations were sampled on 07.08.12 following the south coast of the fjord, mostly in shallow water (<200 m depth). The bottom topography of the head of the fjord was extremely uneven with frequent seamounts and abrupt changes of water depth. Sediment sampling was often unsuccessful in this area perhaps because of

the rocky substrate. In a few benthic grab samples, marine invertebrates were recovered, including the clam *Arctica islandica* and the Iceland scallop *Chlamys islandica* – these will be submitted to toxin analysis.

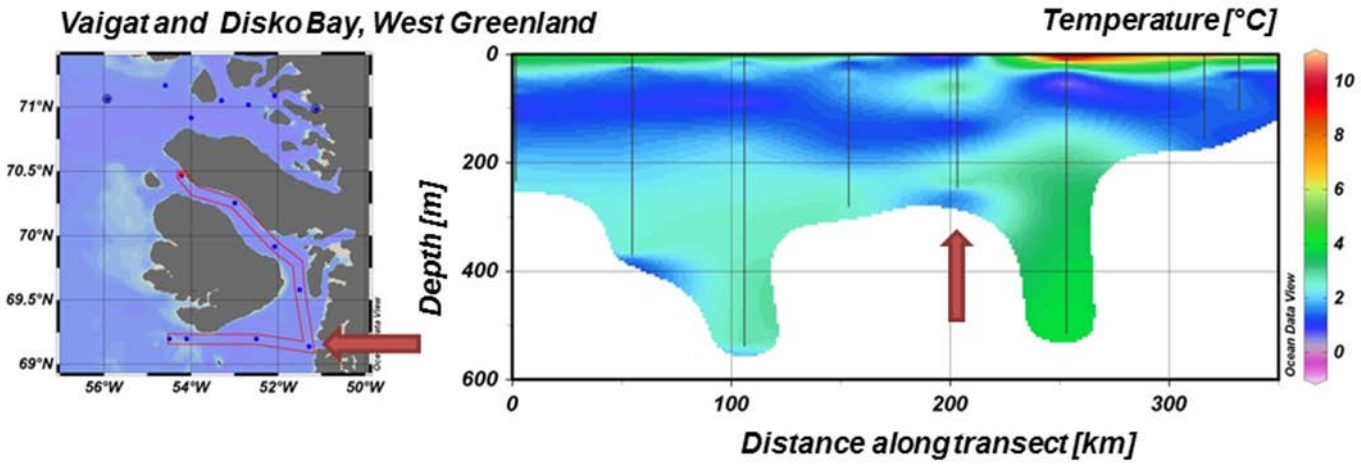
Upon exiting the fjord, at St 539 (64° 55.0' N 24° 08.50') a relatively deep position (330 m depth) was located for sampling of the bottom water by CTD/rosette. The following stations (St 540 – 543) were sampled along a transect parallel to the open coast towards Reykyavik in shallow water (26 – 93 m depth). The full sampling programme was carried out until the final station but collection of coastal water samples for chemical analysis of DOM was discontinued for the last few stations. All sampling activities for the MSM 21/3 cruise were concluded by 19:00 UTC on 08.08.12.

In summary, the persistent favourable weather and calm seas throughout the MSM21/3 cruise resulted in no time lost or equipment failure. The scientists accomplished the scientific objectives and gained important comparative insights into fjordal systems in Greenland and Iceland.

Plankton sampling in the Perlerfiup Fjord on the west coast of Greenland (Photo: Boris Koch, AWI)



Glacial melt-water sampling at the foot of the Perlerfiup-Semia glacier, West Greenland (Photo: Daniela Voss, ICBM, University Oldenburg)



Deployment of the Satlantic radiometric profiler within Vaigat on the west coast of Greenland (Photo: Oliver Zielinski, ICBM, University Oldenburg)

Deployment of the sediment grab sampler in an Icelandic fjord. Discovery of the clam Arctica islandica in a soft bottom sample .

Acknowledgements

The scientific team is very grateful to Captain Klaus Bergman and crew of the MERIAN for cooperative and efficient assistance with operation and deployment of scientific equipment, and for the friendly and positive working and social atmosphere on board. The HAB research was conducted as a core activity in the IOC/SCOR

programme on Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) within the Core Research Project on HABs in Fjords and Coastal Embayments. The ship time of RV Merian was provided by the Deutsche Forschungsgemeinschaft within the core program METEOR/MERIAN. ***ARCHEMHAB*** research activities were funded via budgets administered by the host institutions of the on board participants, namely WHOI (CINAR), ICBM and AWI. The AWI contribution was provided by the HGF Programme Earth and Environment under PACES Theme 2 (Coast) Workpackage 2: Integrating Evolutionary Ecology into Coastal and Shelf Processes.

Participants List and Affiliations

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1	Cembella, Allan, Prof. Dr.	Chief scientist	AWI
2	Krock, Bernd, Dr.	Scientist, toxin analyses	AWI
3	Tillmann, Urban, Dr.	Scientist , plankton ecology	AWI
4	John, Uwe, Dr.	Scientist, molecular ecology, 454/qPCR	AWI
5	Wohlrab, Sylke	PhD student, molecular ecology	AWI
6	Kühne, Nancy	Technician, molecular ecology	AWI
7	Weber, Anne	PhD student, toxins/molecular ecology	AWI
8	Koch, Boris, Prof. Dr.	Scientist, DOM	AWI
9	Graeve, Martin, Dr.	Scientist, plankton biochemistry, lipids	AWI
10	Burau, Claudia	Technician, marine chemistry	AWI
11	Baßler, Stephanie	Auszubildende/trainee, DOM	AWI
12	Zielinski, Oliver, Prof. Dr.	Scientist, bio-optics	ICBM
13	Henkel, Rohan	CTD / bio-optics engineer	ICBM
14	Voss, Daniela	CTD / bio-optics engineer	ICBM
15	Meier, Daniela	CTD / bio-optics engineer	ICBM
16	Holinde, Lars	PhD student, underwater light field	ICBM
17	Anderson, Donald, Dr.	Scientist, sediment/cysts, molec. ecology	WHOI
18	Richlen, Mindy, Dr.	Scientist, sediment/cysts, molec. ecology	WHOI

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Station List and Geographical Positions

ID	Station [No]	Date	Time [UTC]	Lat	Lon
1	MSM21/503	27.07.2012	10:57	71° 03,65' N	55° 55,54' W
2	MSM21/504	27.07.2012	18:31	71° 10,01' N	54° 35,43' W
3	MSM21/505	28.07.2012	01:14	71° 02,99' N	53° 18,10' W
4	MSM21/506	28.07.2012	08:16	71° 05,20' N	52° 05,00' W
5	MSM21/507	28.07.2012	13:27	70° 58,99' N	51° 08,02' W
6	MSM21/508	28.07.2012	21:39	71° 01,00' N	52° 41,02' W
7	MSM21/509	29.07.2012	01:55	70° 54,98' N	54° 00,07' W
8	MSM21/510	29.07.2012	09:16	70° 28,06' N	54° 12,87' W
9	MSM21/511	29.07.2012	14:37	70° 15,27' N	52° 59,82' W
10	MSM21/512	29.07.2012	20:14	69° 54,95' N	52° 05,05' W
11	MSM21/513	30.07.2012	00:41	69° 34,84' N	51° 30,11' W
12	MSM21/514	30.07.2012	07:49	69° 08,43' N	51° 17,12' W
13	MSM21/515	30.07.2012	12:50	69° 11,93' N	52° 30,06' W
14	MSM21/516	30.07.2012	18:25	69° 11,95' N	54° 06,21' W
15	MSM21/517	30.07.2012	21:28	69° 12,00' N	54° 30,00' W
16	MSM21/518	31.07.2012	04:31	68° 10,02' N	54° 44,97' W
17	MSM21/519	31.07.2012	11:05	66° 59,02' N	54° 30,04' W
18	MSM21/520	31.07.2012	16:04	66° 08,17' N	53° 58,40' W
19	MSM21/521	01.08.2012	11:12	62° 43,35' N	50° 54,67' W
20	MSM21/522	01.08.2012	16:09	62° 10,09' N	50° 20,08' W
21	MSM21/523	02.08.2012	11:02	60° 03,51' N	46° 10,74' W

22	MSM21/524	02.08.2012	16:03	59° 43,38' N	44° 41,27' W
23	MSM21/525	03.08.2012	15:05	62° 13,95' N	37° 27,31' W
24	MSM21/526	04.08.2012	14:00	64° 45,71' N	29° 56,74' W
25	MSM21/527	05.08.2012	08:04	65° 46,41' N	23° 12,64' W
26	MSM21/528	05.08.2012	11:06	65° 45,02' N	23° 29,06' W
27	MSM21/529	05.08.2012	14:02	65° 44,60' N	23° 39,44' W
28	MSM21/530	05.08.2012	16:58	65° 47,97' N	23° 50,83' W
29	MSM21/531	05.08.2012	19:21	65° 50,44' N	24° 03,79' W
30	MSM21/532	06.08.2012	06:14	65° 27,00' N	24° 39,00' W
31	MSM21/533	06.08.2012	09:31	65° 23,01' N	24° 8,98' W
32	MSM21/534	06.08.2012	13:30	65° 19,00' N	23° 36,50' W
33	MSM21/535	06.08.2012	17:06	65° 18,44' N	23° 08,19' W
34	MSM21/536	07.08.2012	06:05	65° 12,33' N	23° 04,28' W
35	MSM21/537	07.08.2012	10:02	65° 10,00' N	23° 26,97' W
36	MSM21/538	07.08.2012	13:32	65° 07,37' N	23° 41,75' W
37	MSM21/539	07.08.2012	16:56	64° 54,97' N	24° 08,44' W
38	MSM21/540	08.08.2012	05:58	64° 43,00 N	24° 01, 50 W
39	MSM21/541	08.08.2012	10:02	64° 43,99' N	23° 17,99' W
40	MSM21/542	08.08.2012	13:32	64° 36,02' N	22° 49,99' W
41	MSM21/543	08.08.2012	17:45	64° 16,03' N	22° 00,98' W