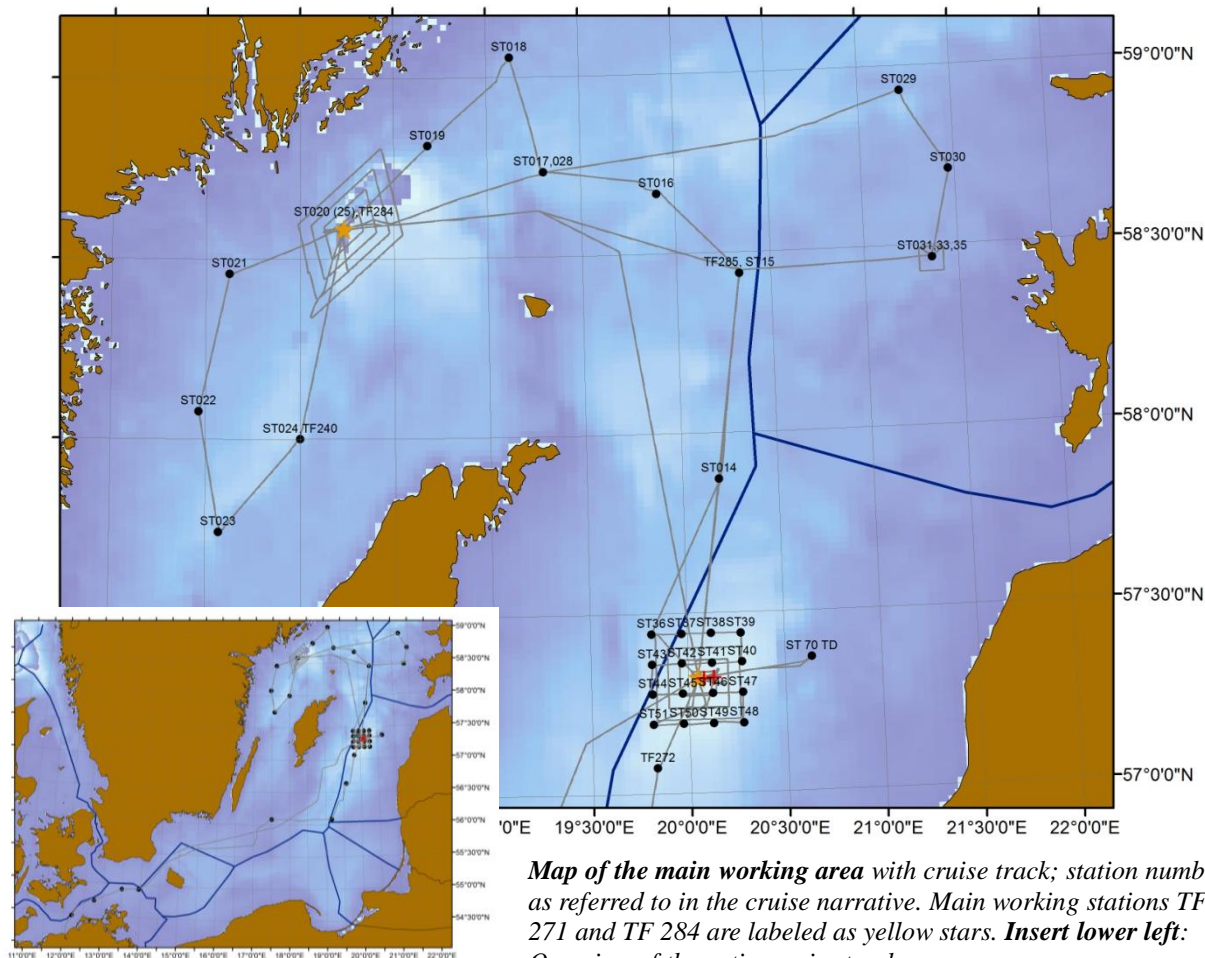


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Short Cruise Report R/V METEOR Cruise M87 Leg 4

Rostock - Rostock
27th June 2012 – 22nd July 2012



Chief Scientist: Prof. Dr. Gregor Rehder
Captain: Thomas Wunderlich

Objectives

The overarching goal of RV METEOR Cruise 87 Leg 4 was the synoptic acquisition of all relevant processes and variables in connection to formation and consequences of the summer cyanobacterial bloom in the Central Baltic Sea with high temporal and spatial resolution. Optical measurements were performed to allow a better parameterization of remote sensing techniques used to follow the summer bloom. The impact of potentially limiting factors such as the partial pressure of CO₂ (pCO₂) in combination with other key parameters, or the effect of upper water column turbulence on cyanobacterial development, were investigated using new methodological approaches. Potential mechanisms to understand the so far enigmatic availability of phosphate for the summer bloom were addressed. This includes spatially and temporally highly resolved investigation of turbulent mixing in the upper layer, the acquisition of data of all potentially relevant phosphate reservoirs (organic, inorganic, and cellular), fractionation of phosphate-containing compounds during remineralization, as well as changing P/N/C ratios of particulate material. To assess the influence of mesoscale hydrographic processes on nutrient availability, FS METEOR worked in a stationary mode for several days, while the hydrographical near-field was recorded by a coordinated expedition of IOWs research vessel ELISABETH MANN BORGESE. Incubation as well as open field experiments were designed to address specific questions with respect to function and controlling mechanisms during the cyanobacterial bloom. Additionally the effect of cyanobacterial abundance and light conditions on the production and consumption of environmentally relevant volatiles such as methane, halogenated hydrocarbons or mercury was scrutinized.

Though a large number of stations have been sampled, two main stations were investigated several times and for several days in detail: Station TF 271 (57°19,2N; 20°03,0E) in Latvian waters and TF 284 (58°35,0N; 18°14,0E) in Swedish waters.

During our mission, TF 271 was characterized by a low initial abundance of cyanobacteria, obviously decaying in the consequence of several storm events untypical for the season, while TF 284 showed a more mature community of cyanobacteria, which also sustained during the mentioned episodes of strong winds. Except for the very last day, no surface accumulations of cyanobacteria were encountered. In the aftermath of the expedition, the results are expected to push forward our understanding of the interplay between cyanobacterial development and production, and the physical (meteorological and hydrographical) framework.

Narrative of the Cruise

Wednesday, June 27th to Friday, June 29th

After exchange of the scientific and most of the ship's crew, installation of scientific gear and first safety instructions, R/V METEOR left the port of Rostock on Wednesday, July 27th, at 18:00 local time. In transit to our main working area in the central Eastern Gotland Sea (near TF 271), some of the stations of the monitoring / long term observing program of IOW were visited and CTD/rosette casts were used to obtain basic biological and chemical parameters (ST001 - ST003), as well as to fine tune and practice some of the sampling routines. First nitrogen fixing cyanobacteria were already encountered in the central Arkona Basin (ST004). So two 1000 L large scale water samples were collected and a series of plankton net hauls was performed in order to sample an end member for an experiment to assess the performance of nitrogen fixers under different $p\text{CO}_2$ /salinity settings ($p\text{CO}_2 \sim 320 \mu\text{atm}$ at the sampling site). This experiment was aborted after some days because of large differences in the composition of the N-fixing cyanobacterial community in the water collected for the "low CO_2 endmember" later on (ST025). With continuous measurements of the partial pressures of methane, carbon dioxide and volatile mercury (Hg^0) and some additional hydrographic stations in the southern Gotland Sea (ST005 to 007, TF 250, 260, and 272), we arrived at our main working area in the Central Gotland Sea around Station TF271 ($57^\circ 19,2 \text{ N}$, $20^\circ 03,0\text{E}$) close to midnight.

Saturday, June 30th

The night was used to perform a surface survey of the hydrography and volatiles (ST008) in an area of approximately $12 \times 12 \text{ nm}$ around TF 271, which showed unexpectedly strong spatial patterns for all parameters. In the morning, a detailed sampling of the water column with high vertical resolution was performed, followed by a series of optical measurements to determine the wavelength-dependent penetration of light and a series of hauls of various plankton nets. Subsequently, the profiling mooring GODESS (Gotland Deep Environmental Sampling Station) was deployed about 2 nm to the east of our main station (ST10, $57^\circ 19,19\text{N}$, $20^\circ 7,99\text{E}$), which will record a vertical profile of a variety of hydrographic parameters approx. every 2.5 h and will be recovered at the end of the cruise. Immediately afterwards, a drifter equipped with a series of CTD and T-logging units and an upward looking ADCP was deployed (ST011), which will not only gain insight into the residual current situation of the upper water layer, but before all record continuous data of water temperature and salinity from various depth levels down to 40 m, as well as the current situation in the upper water column. At the end of the day, a 3 h deployment of the pump CTD was performed to check the possibility to link the device to our continuous operating system for the detection of CO_2 and CH_4 .

Due to the fact that the central eastern Gotland Sea was still without signs of the onset of a cyanobacterial bloom and the need for higher abundances and biomass for some of the planned biological experiments, we decided to head north and later northwest. Satellite imagery suggested the onset of a cyanobacterial bloom northwest of the northern tip of Gotland, a situation which has been often observed over the past years.

Sunday, July 1st to Monday, July 2nd

A total of 11 stations was sampled with CTD/Rosette casts for nutrient distribution, optical properties (during day time) and plankton composition in the surface layer around the Island of Gotland, with the western Gotland Basin sampled first closer to the Swedish coast and then more in the central part of the basin (ST014-025). The small yet measurable concentrations of inorganic phosphorus in the eastern Gotland Basin went below detection limit north and west of Gotland, and a cyanobacterial bloom dominated by *Aphanizomenon* was encountered west of Gotland in accordance to the satellite imagery, with highest abundances at ST020, i.e. TF 0284 (Landsort Deep). Sampling on the stations focused substantially on the upper water column, in particular on layers with different expressions of the specific chromophores phycocyanin and phycoerithrin, two chromophores believed to be specific for different kinds of N-fixing bacteria, which can be detected now by new sensors attached to the CTD. These sensor measurements guide sampling for optical parameters, “wet biogeochemistry“, chromophore analysis, and rate measurements.

Tuesday, July 3rd to Wednesday, July 4th

After return to TF 284 (58°35,0N; 18°14,0E), a daylong sampling program was executed at the station (ST025). After a CTD cast, a long pump-CTD deployment was used to gather vertical profiles of volatile mercury (Hg0, downcast), as well as of $p\text{CO}_2$ (upcast). To follow the daily cycle of some parameters, interim CTD casts were performed twice during the night, thus with the two instruments in the water simultaneously. Over the course of the day, several CTD casts were performed and sampled, and optical measurements to monitor the light availability were executed. Large amounts of water were sampled and prepared for controlled incubation experiments to test the dependence of the development of cyanobacteria and other bacterial key players on different levels of phosphate and $p\text{CO}_2$, as well as on surface turbidity. Samples were also collected using the AFIS-samplers for shore-based analysis of the gene expression. Various plankton net hauls served the collection of seed population for these experiments. During the night, a surface survey of the homogeneity of T, S, $p\text{CO}_2$ and Hg0 was performed (ST026), showing very strong small scale variations, a proof of concept for the need to interpret profiling measurements in the framework of the surrounding hydrographic pattern.

In the early morning of the next day, a drifting mesocosm experiment was started (ST027) with the aim to study the formation and degradation of volatile halogenated hydrocarbons (VHOCs), as well as to identify the involved microbial key organisms. The execution of this experiment requires very smooth sea state, as sampling is performed with the ship's zodiac, and in particular the air sampling is very time consuming. Due to slightly increasing winds, the successful experiment was ended in the afternoon. While the ship was maneuvering to stay close to the mesocosm and zodiac, the time series at the station was continued and ended with another AFIS sampling in the late afternoon.

Satellite imagery still indicated very low abundance of cyanobacteria in the central Gotland Sea, but another bloom on the eastern side of the Baltic near the western coast of the Island of Saaremaa. Thus, we headed east to investigate this bloom, mainly interested in differences of the N-fixing community at this site compared to the western Gotland Basin.

Thursday, July 5th to Friday, July 6th

After some hydrographic stations to depict the optimal sampling site for the day program and to investigate the abundances of phytoplankton species (ST028-ST030), we spent the day monitoring the day cycle of hydrographical and optical parameters, but in particular for three CTD/AFIS casts in order to investigate the daily cycle of gene expression patterns (ST031-35). As at our key site in the North of Gotland (ST025,027), the cyanobacterial community, though diverse, was dominated by *Aphanizomenon sp.* After investigating this site, we headed south towards our dedicated main field site (TF0271) in order to assess the 3-dimensional distribution of chemical and some biological parameters in the upper water column around this site. A 15x15 nm grid with a spacing of 5 nm (i.e. 16 Stations, ST036-051) was sampled within a time frame of 24 h, a program only possible due to the dedication of the involved scientists and technicians.

Saturday, July 7th

After finishing the last stations of the 16-hydrocast grid, the drifter was successfully recovered at 57°14,0N, 20°01,0E (ST052), only about 5 nm from the location of its deployment one week before. We then headed to TF 0271, where a CTD cast to determine the distribution of methane in the water column with high resolution was taken, followed by microstructure measurements at the same site (ST053). After this, we started a survey of the surface water column (ST054), which was ended after 4 hours because R/V ELISABETH MANN BORGESE arrived in the area and we prepared for exchange of some scientific material as well as a final discussion for the joined field experiment aboard the IOW research vessel. After this, we headed to our central station at 57°19,2N; 20°03E (TF 271), where we executed a CTD cast to gather water needed for zooplankton grazing experiments, tested the performance of the WP2 plankton net, and started a program to allow for microstructure measurements every other hour whenever possible (ST056).

Sunday, July 8th

Starting today, the general plan is to keep R/V METEOR almost stationary at position, while R/V ELISABETH MANN BORGESE performs grids with towed instruments around us, all dedicated to resolve the current and turbulence field around our central station. Whenever possible, every other hour on board Meteor will be dedicated to microstructure measurements, while the deployment of other instruments will be scheduled in between. So the station plan mutated from a regular station plan to a 24 hour timetable, and only one new station No will be given each day (ST057 on July 8th) during this part of the cruise. In the morning, however, we were informed that the Scanfish deployed from R/V ELISABETH MANN BORGESE had entangled the mooring, which had been deployed 4 week before from R/V METEOR. Fortunately, the mooring did not take damage and was redeployed from R/V ELISABETH MANN BORGESE after we secured the samples already taken, brought them to the cold room of R/V METEOR, and transferred some material which was needed for the redeployment to the other vessel. After this, the drifter was set to water again about 0.5 nm from the central station at 8:00 h. The day program was composed of CTDs with the scope to collect enough water for a new batch experiment, for high resolution measurements of the development of the methane subsurface maximum, plankton hauls for incubation experiments and phyto- and zooplankton investigations, as well as optical and light penetration measurements. Without interruption, every 2nd (uneven) hour was dedicated to microstructure measurements.

Monday, July 9th

The day (ST058) was scheduled for high resolution profiles of organic and inorganic nutrients as well as some of the biological rate measurements. In combination with this work, a pump CTD cast was performed for 6 hours to gather profiles of $p\text{CO}_2$ and Hg_0 . Due to the dedication of the ship, we were able to have the pump CTD out in the water without interrupting our frequent microstructure (MSS) measurements, which was realized by running the two systems simultaneously. A hydrocast to investigate the development of the subsurface structure of dissolved methane and zooplankton hauls in the very early morning for grazing experiments were also part of the program. In total, a No of 27 different deployments was executed during that day.

Tuesday, July 10th

This day (ST059) was dedicated for a record of the diurnal variations of parameters important in connection to productivity in the surface layer. The backbone was a CTD cast every 4 hours from midnight to midnight (local time) sampled for (amongst others) organic and inorganic nutrients, biological assemblage, N-fixation and productivity rates, as well as chromophores. CTD/AFIS deployments were scheduled for 8, 12 and 20 h local time, though the last one was cancelled. Optical and light penetration measurements over the course of the day, as well as hauls to assess the zooplankton distribution, completed the program. Unfortunately, the day was characterized by high wind velocities and up to 2m-high waves, which lead to a deepening of the mixed layer obscuring the anticipated diurnal variation. Due to a strong time discipline, we only had to skip one “slot” for the microstructure measurements. At the end of the day, 33 different instrument deployments had been recorded in the station bookkeeping system of R/V METEOR.

Wednesday, July 11th

On Wednesday, the wind calmed down substantially and the day’s work (ST060) was dedicated mostly to investigate the recovery of the upper water column after the disturbance of the mixed layer, and to continue our time series of all measured parameters in the surface layer, as well as for the development of the methane subsurface maximum.

Thursday, July 12th

With the forecast of calm weather before increasing wind speeds expected for the next day, we decided to perform another diurnal variation experiment (ST061) with sampling for inorganic and organic nutrients, N-fixation and various biological parameters, volatile concentration etc., though some of the measurements of the July 10th cycle could not be performed due to time conflict with the work on the incubation experiments. Also, the work was done with a 6h rather than a 4h time interval, and AFIS-sampling was not performed because the low residual biomass in the upper water column would not have been sufficient for the shore-based genomic investigations. During the afternoon, the pump-CTD was run simultaneously to other instruments, allowing the pumping of water for volatile mercury investigations from the depth horizon of the phycoerithrin layer (one of the chromophores under investigation).

Friday, July 13th

As if the date called for it, the day, dedicated for high resolution sampling of the biogeochemical parameters, started with some concerns about the drifter (deployed on Sunday, July 8th), which did

not report its position via Iridium telecommunication for almost four hours. So for the first time since Sunday, R/V METEOR left the circle of 1nm around its central position (TF 0271) and headed for the last reported position of the drifter. During transfer, however, the missing reports came in within irregular time intervals. We were relieved to easily find the drifter, and after the position reporting (every 15 minutes), which had obviously been interrupted due to a malfunction of the satellite communication rather than of our instrument, was back on schedule, we returned to our day program without further delay. Over the day (ST062), a series of CTD casts was performed, partly used for a high resolution sampling of organic and inorganic nutrients, as well as for CO₂-system parameters. The time series of optical measurements was continued. In the night, 2 hauls for zooplankton were performed at 22:30 and 2 a.m. on the next day (local time), guided by acoustic water column imaging data showing the arrival and disappearance of vertically migrating zooplankton. In total, 26 different deployments were recorded for this day.

Saturday, July 14th

Time series measurements continued (ST063), though the wind (~6Bft) had again blurred any substructure of the water above the summer permanent thermocline, leaving behind a mixed layer depth of almost 20 m. Microstructure measurements were continued every other hour just like during the rest of the week, as were the other measurements centered around the “central CTD cast” at 12 noon to keep the long-term data series. However, with another expected depression approaching with its peak foreseen in the night from July 15th to 16th, it was apparent that no rapid changes in the phytoplankton community were expected over the next 2-3 days. So, potentially inspired by the French history of July 14th, we took the liberty to leave TF 271 closely before midnight, after a last CTD station and zooplankton net haul dedicated to further evolve a potential link between zooplankton abundance and the development of the methane concentration pattern in the subsurface layer. R/V METEOR set sail to revisit Station TF 284 (58°35,0N, 18°14,0E). The intention of this move was to investigate a.) whether this week of alternating phases of high and low wind speeds had caused a decay of the well-established, *Aphanizomenon*-dominated cyanobacterial community at the site, and b.) to revisit a site allowing sampling for cyanobacteria for some of the groups relying on higher abundances/biomass. Our decision was facilitated by the knowledge that R/V ELISABETH MANN BORGESE would still record the hydrographic setting at least until the morning hours of July 16th, as would our permanent operating hydrographic gear, i.e. the drifter and the GODESS mooring.

Sunday, July 15th

We arrived at station TF284 (58°35N, 18°14E) at 1p.m. under relatively moderate winds (3-4 Bft). Already during the last part of our transit, we recognized that the water still hosted considerably more phytoplankton biomass. A first CTD cast supported this impression. Also, the high abundance of *Aphanizomenon sp.* was persistent. After a series of instrument deployments (ST064), including also an AFIS deployment, we set sail for a 19 h long surface survey of S, T, *p*CO₂ and Hg₀ (ST065). This decision was triggered by increasing wind speeds which would have made continuous station work difficult, and the interesting finding that the *p*CO₂ in the area had considerably increased since July 3rd despite the still existing high abundance of cyanobacteria. It should also be noted that the – at first glance very successful - incubation experiment series, investigating the development of the cyanobacterial seed population under varying phosphate availability and CO₂ partial pressures, was

terminated after 11 days as scheduled.

Monday, July 16th

Despite a rough night with wind peaks of up to 8Bft and some wet floors in the laboratories, we were able to finalize the surface water survey, which revealed large spatial variability at least in the T, S and $p\text{CO}_2$ fields. With winds calming down, the survey was ended after approximately 18 hours and we took position again at TF 284 and started with the main CTD-cast, this day with two hours delay at 2p.m. local time (ST066). The remainder of the day was used for a series of CTD casts, microstructure profiles and plankton net hauls, with two hauls dedicated to sample for vertically migrating zooplankton at the surface at the approximate time of arrival (around 22:30 h local time) and return to the deeper water layers (~02:00h), clearly derived from Multibeam WCI data obtained on R/V ELISABETH MANN BORGESE. An interesting finding was that the strong winds between July 15th and July 16th did only result in moderate deepening of the mixed layer, and did not suppress the abundance of primary producers significantly.

Tuesday, July 17th

Encouraged by calmer winds and the fact that the optical sensors showed the persistent abundance of higher biomass, another diurnal variation sampling day was scheduled for this day, with measurements of a high no of properties, including productivity and N-fixation, every 6h (ST067). Also, the CTD/AFIS system was used 3 times over the course of the day to allow for later investigations of stressors and limitations on the gene expression level. A total of 34 instrument deployments was recorded over the course of the day.

Wednesday, July 18th

After the final station of the July 17th day cycle experiment and a final plankton haul, the ship transferred to our main working station at TF 271 (57°19,2N, 20°03,0E) some 120 nm miles in SSE direction, where we arrived exactly on schedule to allow for our main CTD at noon, kept for the long term data series. A second CTD cast was dedicated to get water for a last zooplankton incubation experiment to determine the potential role of zooplankton for methane production (ST069). Afterwards, the drifter was recollected some 20 nm east-southeast away from its release position 10 days ago (ST070). The device had kept us quite alerted for a while. After staying close to its release position for almost a week, which was the rationale to keep it in the water, it had picked up considerable velocity towards the east from the very moment we had left for the western Gotland Basin. However, we recovered the instrument in due time before getting too close to the shallow waters of the Latvian coast, and were delighted to see that all instruments had recorded well. The remaining program was filled with an additional CTD cast for trace gas studies, and the continuation of the MSS program at TF 0271 (ST071).

Thursday, July 19th

The last “full” day of station work had a rather sporty itinerary. After a series of microstructure measurements and an early CTD cast at 6a.m., the pump-CTD was deployed to test its combination with a newly developed auto-sampler for inorganic nutrient samples (ST072). The device worked flawlessly, and allowed the sampling of the upper 40 m of the water column with a 1m resolution within less than 15 minutes. This kind of profiles, which could not be gained from standard

CTD/rosette sampling, will be a substantial support for the calculation of turbulence-induced exchange of phosphate between the surface layer and the phosphate-containing winter water. After the instrument series at noon to keep the long-term series, the afternoon was dedicated for the recovery of the GODESS profiling mooring deployed during the first days of this cruise and the sediment trap mooring which had been deployed during Leg 3a of this METEOR cruise 87, and re-launched after the unintended recovery by R/V ELISABETH MANN BORGESE. Unfortunately, though the releaser of the GODESS mooring responded properly, the mooring did not come up (ST073). After several attempts, we decided to postpone and recover the sediment trap mooring first, which was performed successfully within less than 2 hours (ST074). After an additional unsuccessful attempt to release the GODESS mooring, it was decided to postpone the attempt to dredge for the bottom line of the mooring in the morning of July 20th, as the deck's crew and scientists had been up for too long already. So we returned to our central station and performed a CTD cast dedicated for some quality insurance purposes in connection to trace gas analytics followed by a series of plankton net hauls to sample and document the vertical zonation of zooplankton (ST 075). After this, we redid the surface survey for T, S and $p\text{CO}_2$ over night (ST076), and got prepared to dredge the GODESS mooring "last minute", on the last day available for station work.

Friday, July 20th

We started to dredge the GODESS mooring by letting out the spine-covered metal body ("hedgehog") along a transect crossing the line between the GODESS anchor position and the end of the bottom rope line at 6 a.m. After some modifications, we were able to pick up the bottom rope on the 3rd attempt, and at about 10:40 h local time, to our great relief, the instrument was safely on board (ST077). After a first inspection, it was clear that the winch had been entangled, not allowing for the ascent of the mooring, while the releaser indeed had functioned flawlessly. Our relief was even larger when it became clear that the system had recorded data over the entire programmed time range of data acquisition. We returned in time for a final 12 o'clock cast at our central working station (TF 271), and after the routine of CTD cast, optical measurements and plankton net hauls had been executed for a last time during this cruise, a final CTD cast was performed for the calibration of the storage-CTD unit just recovered from the GODESS station by lowering it with our main CTD/rosette system equipped with double sensor packages (ST078). At 14:30 h local time, this cast ended the station work program of R/V METEOR expedition 87. In a rather cynical move of nature, we started for our return from our central station back to the Port of Rostock with the first small accumulations of cyanobacteria dwelling at the surface on this 3rd calm day in the research area.

Saturday, July 21st to Sunday, July 22nd

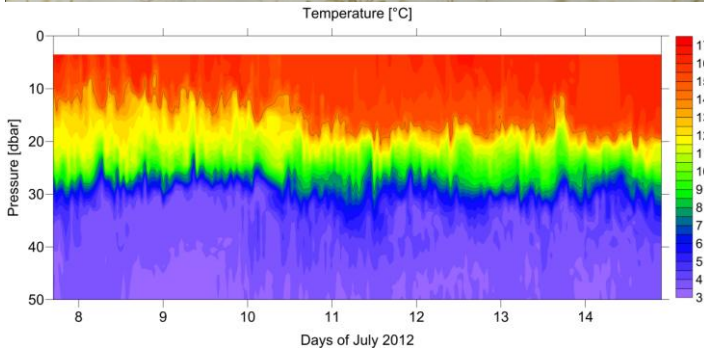
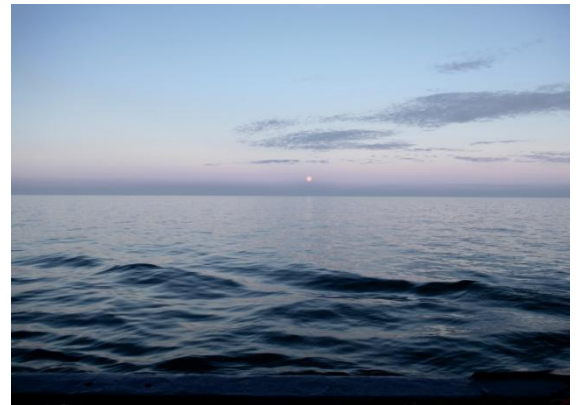
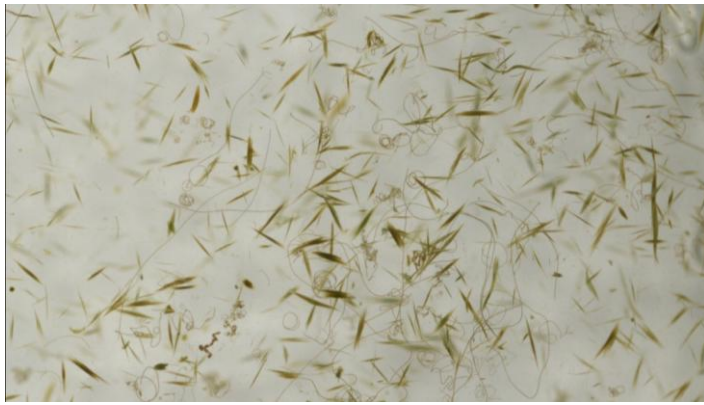
After we officially ended our scientific data recording when leaving the notified research area at 02:30 (local time) on July 21st at position 56°03,5N; 17°54,1E, we headed toward the port of Rostock, the time filled with packing and loading of the 2 containers aboard. With moderate seas, we reached the pilot at 06:00 am in the morning of Sunday, July 22nd as scheduled, and safe moorage in the port of Rostock was finalized one hour later. With this, R/V Meteor cruise 87 Leg IV ended after an partly unexpected, but surely successful scientific program of 3.5 weeks.

Participants

No	Name	Discipline	Institution
1.	Gregor Rehder	<i>Chief Scientist</i>	IOW
2.	Volker Mohrholz	Co-PI Hydrography	IOW
3.	Weinreben, Stefan	CTD/pump-CTD	IOW
4.	Siegfried Krüger	CTD/pump CTD	IOW
5.	Ralf Prien	CTD, GODESS mooring/ mixing	IOW
6.	Günther Nausch	Inorg. Nutrients, P-Cycle	IOW
7.	Jenny Jeschek	Inorg. Nutrients	IOW
8.	Lars Kreuzer	Inorg. Nutrients	IOW
9.	Jana Balke	P-uptake /P-cycle	IOW
10.	Pia Steinrücken	P-uptake /P-cycle	IOW
11.	Maren Voss	N ₂ -fixation	IOW
12.	Nicola Wannicke	N ₂ -fixation	IOW
13.	Norbert Wasmund	Primary production	IOW
14.	Anja Hansen	Phytoplankton composition	IOW
15.	Frindte, Katharina	Respiration, Gene expression	IGB
16.	Ballent, Anika	Phytoplankton growth, mercury	Jakobs Univ.
17.	Paul Dlugosch	Phycoerythrin, Phycocyanin	URostock
18.	Fred Möke	Limitations / stressors of cyanobacteria	URostock
19.	Herbert Siegel	Remote sensing, Optics	IOW
20.	Monika Gerth	Remote sensing, Optics	IOW
21.	Joachim Kuss	Volatile mercury	IOW
22.	Christian Stolle	bacterial turnover	IOW
23.	Anna Orlikowska	halogenated hydrocarbons	IOW
24.	Oliver Schmale	Methane production	IOW
25.	Michael Glockzin	<i>p</i> CO ₂ / <i>p</i> CH ₄	IOW
26.	Caroline Hammer	inorganic carbon	IOW
27.	Jenny Fabian	Cyanobacterial adaptation	IOW
28.	Natalie Loick-Wilde	Zooplankton, N-demand	GATECH
29.	Bernd Frey	Meteorology	DWD
30.	Holger von Neuhoff	Observer	IMMH

Institutions

IOW	Leibniz-Institute for Baltic Sea Research Warnemünde
URostock	University of Rostock
JakobsUniv.	Jakobs University Bremen
GATECH	Georgia Institute of Technology
IGB	Leibniz-Institut für Gewässerkunde und Binnenfischerei
DWD	Deutscher Wetterdienst, Geschäftsfeld Seeschifffahrt
IMMH	International Maritime Museum Hamburg



Some impressions from R/V METEOR Cruise 87 Leg IV: UL- *Aphanizomenon sp.* – dominated Cyanobacteria at 58°35N, 18°14E; ML- Upper water column temperature structure over a week recorded at 57°19,2N, 20°03E; LL- Two ship experiment with R/V ELISABETH MANN BORGESE in front and R/V METEOR in the background; UR&MR: Changing wave patterns, documenting the quick variability in “physical forcing” during this cruise; LR: Night work with the video-guided pump –CTD in the water.

Acknowledgements

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Saturday, 14.07.2012										
	03	1346	PLA	00:03	57	19:20	20	3:00	258	00:15
	04	1347	MSS	01:00	57	19:17	20	2:98	255	01:48
	05	1348	MSS	03:05	57	19:20	20	3:00	258	03:53
	06	1349	CTD	04:08	57	19:20	20	3:00	258	4:17 04:23
	07	1350	MSS	04:44	57	19:20	20	3:04	258	05:30
	08	1351	MSS	07:00	57	19:20	20	3:04	258	07:46
	09	1352	CTD	08:04	57	19:20	20	3:04	258	8:19 08:26
	10	1353	SD	08:17	57	19:20	20	3:04	258	08:18
	11	1354	TRIOS	08:32	57	19:20	20	3:04	258	08:42
	12	1355	SLS	08:52	57	19:20	20	3:04	258	09:00
	13	1356	MSS	09:00	57	19:22	20	3:08	258	09:50
	14	1357	CTD	10:10	57	19:22	20	2:98	258	10:20 10:30
	15	1358	TRIOS	10:32	57	19:22	20	2:98	258	10:46
	16	1359	SLS	10:48	57	19:22	20	2:98	258	10:57
	17	1360	MSS	11:08	57	19:22	20	2:98	258	11:46
	18	1361	PLA	12:03	57	19:20	20	3:00	258	12:57
	19	1362	MSS	13:03	57	19:20	20	3:00	258	13:51
	20	1363	SD	14:02	57	18:86	20	3:44	258	14:03
	21	1364	TRIOS	14:03	57	18:86	20	3:44	258	14:14 14:16
	22	1365	SLS	14:20	57	18:86	20	3:44	258	14:30
	23	1366	MSS	14:55	57	19:20	20	3:00	258	15:44
	24	1367	GWS	16:04	57	19:20	20	3:00	258	16:18
	25	1368	MSS	17:00	57	19:20	20	3:00	258	17:49
	26	1369	CTD	18:09	57	19:20	20	3:00	258	18:29 18:43
	27	1370	MSS	19:00	57	19:20	20	3:04	258	19:48
	28	1371	CTD	21:02	57	19:20	20	3:00	258	21:13 21:19
	29	1372	PLA	21:24	57	19:20	20	3:00	258	21:36
Sunday, 15.07.2012										
064	01	1373	CTD	10:53	58	35:00	18	14:00	459	11:22 11:46
	02	1374	SD	11:23	58	35:00	18	14:00	459	11:24
	03	1375	HN	11:25	58	35:00	18	14:00	459	11:28
	04	1376	TRIOS	11:53	58	35:00	18	14:00	459	12:08
	05	1377	SLS	12:10	58	35:00	18	14:00	459	12:19
	06	1378	MSS	12:25	58	34:97	18	14:09	453	13:34
	07	1379	PLA	13:56	58	35:03	18	14:10	453	14:04
	08	1380	PLA	14:05	58	35:03	18	14:10	453	14:07
	09	1381	CTD/AFIS	14:34	58	35:00	18	14:00	459	14:43 14:59
	10	1382	MSS	15:03	58	35:00	18	14:00	459	15:51
	11	1383	CTD	16:05	58	35:00	18	14:00	459	16:16 16:26
065	01	1384	Equi	16:34	58	35:06	18	14:12	459	10:26
Monday, 16.07.2012										
066	01	1385	CTD	11:59	58	35:03	18	14:02	459	12:22 12:49
	02	1386	SD	12:32	58	35:03	18	14:02	459	12:34
	03	1387	HN	12:45	58	35:00	18	14:00	459	12:50
	04	1388	TRIOS	12:52	58	35:00	18	14:00	459	13:06
	05	1389	SLS	13:08	58	34:98	18	14:09	459	13:17
	06	1390	MSS	13:23	58	34:94	18	14:20	453	14:25
	07	1391	PLA	14:41	58	35:00	18	14:00	459	14:45
	08	1392	PLA	14:45	58	35:00	18	14:00	459	14:49
	09	1393	MSS	15:07	58	35:03	18	14:00	459	16:11
	10	1394	SLS	16:14	58	34:57	18	13:19	270	16:25
	11	1395	CTD	16:40	58	35:00	18	14:00	459	16:58
	12	1396	MSS	17:11	58	35:00	18	14:00	459	17:58
	13	1397	CTD	18:17	58	35:02	18	14:02	459	18:39 18:52
	14	1398	MSS	19:03	58	35:00	18	14:00	459	19:57
	15	1399	PLA	20:30	58	35:00	18	14:00	459	20:47
	16	1400	MSS	20:57	58	35:00	18	13:98	459	21:53
067	01	1401	CTD	22:19	58	35:00	18	13:98	459	22:42
	02	1402	MSS	23:02	58	35:00	18	13:91	440	00:02
Tuesday, 17.07.2012										
	03	1403	PLA	00:21	58	35:00	18	14:07	459	00:35
	04	1404	MSS	01:00	58	35:00	18	13:89	459	01:56
	05	1405	MSS	03:00	58	35:00	18	14:00	459	03:57
	06	1406	CTD	04:12	58	35:00	18	14:00	459	4:20 04:32
	07	1407	CTD/AFIS	04:46	58	35:00	18	14:00	459	4:55 05:10
	08	1408	HN	05:18	58	35:00	18	14:00	459	05:20
	09	1409	MSS	05:50	58	35:00	18	14:00	459	06:43
	10	1410	MSS	07:02	58	35:00	18	13:97	459	07:53
	11	1411	CTD	08:15	58	35:00	18	14:00	459	8:35 08:54
	12	1412	SD	08:32	58	35:00	18	14:00	459	08:33
	13	1413	SLS	08:59	58	35:00	18	14:00	459	09:09
	14	1414	TRIOS	09:16	58	35:00	18	14:00	459	09:25
	15	1415	MSS	09:30	58	35:00	18	14:16	457	10:28
	16	1416	CTD	10:46	58	35:04	18	14:05	459	10:56 11:04
	17	1417	HN	11:06	58	35:00	18	14:00	459	11:11
	18	1418	SLS	11:11	58	35:00	18	14:00	459	11:20
	19	1419	TRIOS	11:25	58	34:96	18	14:24	444	11:33
	20	1420	CTD/AFIS	11:45	58	34:95	18	14:34	430	12:08
	21	1421	PLA	12:23	58	35:00	18	14:00	459	12:56
	22	1422	MSS	13:00	58	35:00	18	14:00	459	14:04
	23	1423	TRIOS	14:25	58	35:00	18	14:00	459	14:32 14:36
	24	1424	SLS	14:39	58	34:92	18	14:03	459	14:49
	25	1425	MSS	14:55	58	34:92	18	14:22	446	15:58
	26	1426	CTD	16:20	58	35:00	18	14:00	459	16:30 16:40
	27	1427	SD	16:36	58	35:00	18	14:00	459	16:37
	28	1428	HN	16:39	58	35:00	18	14:00	459	16:44
	29	1429	TRIOS	16:44	58	35:00	18	14:00	459	17:06
	30	1430	SLS	16:58	58	34:97	18	14:04	459	17:06
	31	1431	CTD/AFIS	17:21	58	35:00	18	14:00	459	17:28 17:51
	32	1432	MSS	17:58	58	35:00	18	14:00	459	18:44
	33	1433	CTD	19:00	58	35:00	18	14:00	459	19:09 19:15
	34	1434	MSS	19:26	58	34:98	18	13:95	459	20:17
	01	1435	MSS	21:01	58	35:00	18	13:96	459	21:50
068	01	1436	CTD	22:05	58	35:00	18	14:02	459	22:17 22:24
	02	1437	PLA	22:30	58	35:00	18	14:02	459	22:57
Wednesday, 18.07.2012										
069	01	1438	CTD	10:07	57	19:20	20	3:02	258	10:28 10:44
	02	1439	SD	10:33	57	19:20	20	3:02	258	10:36
	03	1440	HN	10:48	57	19:20	20	3:02	258	10:52
	04	1441	SLS	10:53	57	19:18	20	3:07	258	11:02
	05	1442	TRIOS	11:07	57	19:18	20	3:17	258	11:17
	06	1443	CTD	11:20	57	19:18	20	3:17	258	11:31
	07	1444	MSS	11:41	57	19:17	20	3:15	258	12:32
	08	1445	PLA	12:49	57	19:23	20	2:99	258	13:32
070	01	1446	TD	15:36	57	21:41	20	38:40	54	15:44
071	01	1447	CTD	18:00	57	19:21	20	3:01	258	18:16 18:22
	02	1448	MSS	19:00	57	19:20	20	2:98	258	
	03	1449	MSS	21:00	57	19:20	20	2:98	259	21:47
072	01	1450	CTD	22:11	57	19:20	20	3:02	259	22:29 22:40
	02	1451	MSS	22:58	57	19:20	20	2:92	258	23:50
Thursday, 19.07.2012										
	03	1452	MSS	00:58	57	19:20	20	2:92	258	01:56
	04	1453	MSS	03:01	57	19:20	20	3:02	258	03:53
	05	1454	CTD	04:06	57	19:20	20	3:02	258	4:27 04:39
	06	1455	MSS	04:59	57	19:20	20	3:00	258	05:44
	07	1456	bCTD	06:37	57	19:20	20	3:00	258	08:03
	08	1457	SLS	08:07	57	19:20	20	3:00	258	08:15
	09	1458	bCTD	08:19	57	19:19	20	3:26	258	10:57
	10	1459	MSS	08:30	57	19:16	20	3:24	258	09:19
	11	1460	CTD	11:15	57	19:20	20	3:04	258	11:34
	12	1461	SLS	11:37	57	19:22	20	3:03	258	11:48
	13	1462	HN	11:41	57	19:22	20	3:03	258	11:45
	14	1463	SD	11:47	57	19:19	20	3:06	258	11:50
073	01	1464	MOR	12:20	57	19:38	20	8:12	258	13:00 No
074	01	1465	MOR	13:51	57	19:17	20	4:85	260	14:52 Yes
073	02	1466	MOR	15:13	57	19:31	20	7:86	260	15:53 No
075	01	1467	CTD	16:15	57	19:20	20	2:99	258	16:38
	02	1468	PLA	17:09	57	19:20	20	2:99	258	17:16

	03	1469	PLA	17:23	57	19:20	20	2.99	258		17:26	
	04	1470	PLA	17:35	57	19:20	20	2.99	258		17:41	
	05	1471	PLA	17:42	57	19:20	20	2.99	258		17:58	
	076	01	1472	Equi	18:00						03:40	
Friday, 18.07.2012												
	077	01	1473	MOR	03:55	57	19:19	20	7.99	257	08:40	Yes
	078	01	1474	CTD	10:04	57	19:20	20	2.99	257	10:32	10:38
	02	1475	SD	10:39	57	19:20	20	2.99	257		10:41	
	03	1476	HN	10:46	57	19:20	20	2.99	257		10:47	
	04	1477	TRIOS	10:46	57	19:20	20	2.99	257		11:02	
	05	1478	SLS	11:04	57	19:20	20	2.99	257		11:14	
	06	1479	PLA	11:24	57	19:20	20	2.99	257		11:35	
	07	1480	CTD									
Saturday, 21.07.2012												
			END OF DATA AOUISITION	00:30	56	3.50	17	54.10				

Device List M87/4

CTD	CTD/Rosette
CTD/AFIS	CTD with AFIS sampler
pCTD	pumped CTD
MOR	Mooring work
TD	Drifter
H	Handnet
PLA	Plankton net
HN	Hand Net
SD	Secci disk
TRIOS	TRIOS light sensor package
SLS	Satlantic light sensor package
GODESS	GODESS profiling mooring
MSS	Microstructure measurement
MESK	floating mesocosm
Equi	pCO ₂ and CH ₄ surface water equilibration