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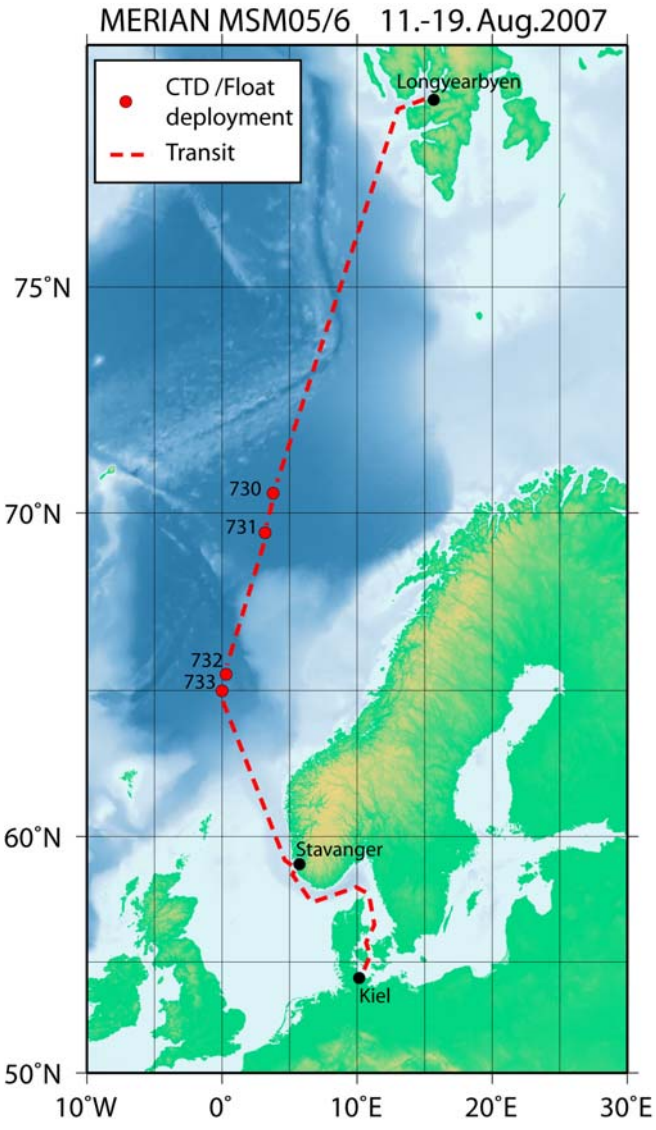
Cruise Report
RV MARIA S. MERIAN Cruise MSM05-6

Longyearbyen - Kiel
11. – 19. August 2007
Chief Scientist: Detlef Quadfasel
Captain: Klaus Bergmann

Technical Report 2-07

The scientific party of RV Maria S. Merian cruise MSM05-6a.



Ship track of RV Maria S. Merian Cruise MSM05-6 with locations of float deployments and CTD casts marked.

1. Preface

Cruise MSM05-6 was originally planned to cover two scientific projects:

- A study of the exchanges of water masses through Fram Strait using shipboard hydrographic observations and mooring data, and
- A study of the transformation of subtropical waters entering the Arctic Ocean west and north of Svalbard.

The first programme is part of a long term project run by the Alfred Wegener Institute for Polar Research Bremerhaven, the second is an experiment of the Institut für Meereskunde of the University of Hamburg within the Sonderforschungsbereich 512.

These two cruise programs did, however, not materialize. During the previous cruise MSM05-5 some problems with the two main propulsion systems developed which did not allow to run the engines on full power. Since the major part of the planned cruise programme of leg 6 was to be carried out in ice covered regions, requiring the full power to be available, it was decided to dock the vessel in a shipyard in Kiel, Germany, and have the propulsion system repaired.

Merian therefore sailed from Longyearbyen to Kiel, allowing only a small scientific programme to be carried out during transit.

2. Objectives

RV Maria S. Merian cruise MSM05-6 was carried out by the Institut für Meereskunde at the Centre for Marine and Atmospheric Sciences of the University of Hamburg. A scientist and a technician from the Helmholtz Zentrum Geesthacht also participated in the cruise.

The measurements contributed to two projects:

- the Marine Environment and Security for the European Area (MERSEA), funded by the European Union, and
- Sonderforschungsbereich 512, funded by Deutsche Forschungsgemeinschaft.

The revised objectives of the cruise were to deploy four autonomous profiling floats as part of the international ARGO project and to take underway air samples for the analysis of Perfluorinated Alkylated Substances.

3. Narrative

Saturday, 11. August 2007
Noon position: Longyearbyen

The scientific party, consisting of only three persons, embarked on Merian during the day and evening. All containers and equipment of the previous and the ongoing cruises were

loaded on board to be taken to Kiel and the vessel sailed at 10 p.m. from the port of Longyearbyen in Spitsbergen. Drizzling rain and low clouds reflected the mood of the crew, who had been looking forward to an exciting cruise in the Arctic ice. The air sampling equipment was installed and measurements began at midnight.

Sunday, 12. August 2007

Noon position: 76° 08.1' N, 009° 24.8' E
Air temperature: 4.5 °C, wind: WNW 3 Bft, air pressure: 1017.9 hPa

The four Argo floats to be deployed on passage were set up and tested and the CTD-Rosette system was rigged up. All instruments worked satisfactory. The evening saw a well attended birthday party for the captain of the vessel.

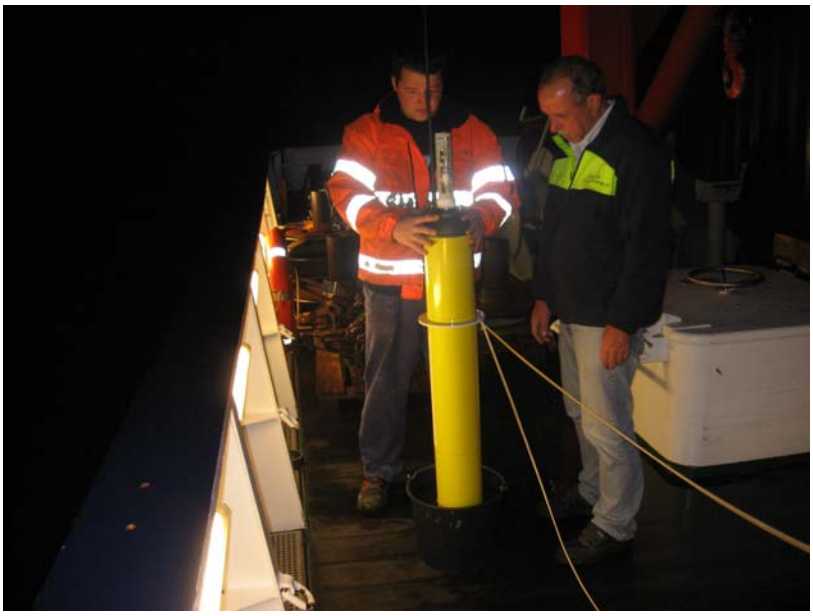
Monday, 13. August 2007

Noon position: 71° 31.7' N, 004° 51.2' E
Air temperature: 7.7 °C, wind: NNE 6 Bft, air pressure 1011.6 hPa

The wind had picked up during the night, but with tail winds and sea Merian made good speed. During the afternoon the first float was deployed and a calibration CTD cast taken at latitude 70° 30' N, the second float went out just before mid-night at 69° 30' N.

Tuesday, 14. August 2007
Noon position: 67° 40.3' N, 001° 49.3' E
Air temperature: 10.2 °C, wind: S 4 Bft, air pressure: 998.2 hPa

The day was spent with paperwork preparing lists and invoices for customs in Kiel. The third float was deployed at 65° 30' N late in the evening, again with a CTD cast alongside.



Preparation for deployment of an ARGO float. The floats drift at a depth of 1000 m for just over 9 days, sink to 2000 m and then ascend to the surface, taking CTD measurements underway. The data is then transmitted via satellite to a land station.

Wednesday, 15. August 2007

Noon position: 63° 59.7' N, 000° 58.9' E
Air temperature: 12.6 °C, wind: NE 6/7 Bft, air pressure: 987.3 hPa

The fourth and last float was deployed at 65° 00' N during the night. In addition to the standard sensors for pressure, temperature and salinity this float was equipped with a dissolved oxygen sensor and a fluorometer. The CTD cast showed strong stratification in the upper part of the water column indicating only shallow (200 m) convection depths during the previous winter season.

Thursday, 16. August 2007
Noon position: 60° 37.3' N, 004° 01.1' E
Air temperature: 12.4 °C, wind: S 7 Bft, air pressure: 988.3 hPa

Packing of containers. During the night Merian went into Stavanger anchorage to pick up a technician from ATLAS Hydrographic, who was going to work on the vessel's Parasound System.

Freitag, 17. August 2007
Noon position: 57° 50.4' N, 007° 33.1' E
Air temperature: 14.5 °C, wind: W 6/7 Bft, air pressure: 1005.8 hPa

Several profile test runs for the Parasound system were done in Skagerrak.

Saturday, 18. August 2007
Noon position: 57° 07.9' N, 011° 37.9' E
Air temperature: 15.0 °C, wind: WSW 7 Bft, air pressure: 1013.5 hPa

Steaming to Kiel.

Sonntag, 19. August 2007
Noon position: Kiel

Kiel pilot came on board at 8 a.m. and Merian went alongside in Kiel at Bollhörnkai at 9:30 a.m.

4. Cruise participants

Scientific party:

Quadfasel, Detlef	Chief Scientist	IfM-ZMAW
Bödewadt, Christian	Technician	GKSS
Dreyer, Annekatrin	Scientist	GKSS

IfM-ZMAW: Institut für Meereskunde
Centre for Marine and Atmospheric Sciences
University of Hamburg, Germany

GKSS: Helmholtz Zentrum Geesthacht
Germany

Ship crew:

BERGMANN, Klaus	Master
GUENTHER, Matthias	Chief Officer
SCHMIDT, Ralf	1st Officer
SOSSNA, Yves-Michael	2nd Officer
OGRODNIK, Thomas	Chief Engineer
ROGERS, Benjamin	2nd Engineer
DOHRN, Thomas	Motorman
NEITZEL, Gerd	Electrician
RIEDEL, Frank	Electronics
TOMIAK, Martin	SysOps
KREFT, Norbert	Bosun
NEVROTOV, Evgenij	Fitter
BADTKE, Rainer	A/B
SCHWIEGER, Hardy	A/B
SCHOENBECK, Thorsten	A/B
PRUCHNOW, Bernhard	A/B
BREITZKE, Ulrike	S/M
ECKARDT, Alexander	S/M
ARNDT, Waldemar	Cook
LUX, Karl-Heinz	2nd Cook
LIIDERS, Frank	Steward

Briese Schiffahrts GmbH & Co. KG
Abt. Forschungsschifffahrt
Hafenstrasse 12
D-26789 Leer

5. Technical information

CTD system

4 CTD casts were completed on this cruise using a 12 bottle stainless steel frame configured in the following way:

Seabird 9/11 plus CTD (IfM CTD No. 2)
Seabird 24 position carousel
12 x 5 L Ocean Test Equipment “niskin” bottles

The configuration of IfM CTD-2 was:
Seabird 9+ underwater unit
Seabird 3 P temperature sensor s/n 1526
Seabird 4 Conductivity sensor s/n 1222
Digiquartz temperature compensated pressure sensor s/n 53573
Seabird 5T submersible pump
Seabird altimeter s/n 1119
Seabird 12 position carousel
Seabird 11+ V2 deck unit

Casts were initiated and terminated on deck. Twelve water samples were taken per cast for calibration of the conductivity sensor.

ADCP

The Acoustic Doppler Current Profiler (ADCP) had been running almost constantly during the cruise without any problems. The instrument, which has been manufactured by RD Instruments (Poway, Ca., USA), has a working frequency of 75 kHz, ping rate of 0.7 Hz, and is specified for a maximal ship speed of 22 kn. Despite the fact that this instrument is specified for a maximal bottom track depth of 950 m, the operational maximal bottom search depth was set to 500 m. A constant salinity of 35 was utilized to calculate the velocities.

Thermosalinograph

The Thermosalinograph is permanently flushed by pure sea water. The manufacturers are Sea & Sun Technology GmbH (salinity sensor, type: CT 48) and Isotech (temperature sensor, type: PT100-1509). These sensors have a working range of 0-65 mS/cm and –3° C to 36° C.

Echosounding

During the cruise a multi-frequency ship mounted echo sounding system had been used, which does not interfere with the above described ADCP. The vertical mounted single beam echo sounding system EA600, manufactured by Kongsberg (Simrad) in Denmark, uses three different frequencies of 12 kHz, 38 kHz, and 200 kHz. With this setup the pulse duration (maximal transmitter power) is 16 ms (2000 W), 4 ms (2000 W), or 1 ms (1000 W), respectively. The maximal detection depth is 10000m, 3000 m, and 500 m, respectively. No problems occurred during the cruise with this instrument.

Meteorology

As part of the below described Data Logging facility, throughout the cruise the following data had been collected permanently: wind direction, wind speed, air temperature, air pressure, and humidity.

The wind direction and speed sensor, manufactured by Thies, are located at the top of the radar mast, where turbulences should be negligible. The accuracy of the direction is 2.5 degree.

The air temperature are measured with a resistor PT-100, manufactured by Friedrichs, and has an accuracy according to 1/3 DIN B or EN60751, respectively. The humidity is measured by a sensor produced by Rotronic. These sensors are mounted in a Labyrinth case located on monkey island.

The air pressure sensor from AIR has an accuracy of 0.5 hPa and is determined by considering QFN (air temperature is considered for calculating the pressure).

No calibrations of the meteorological data had been performed during the cruise.

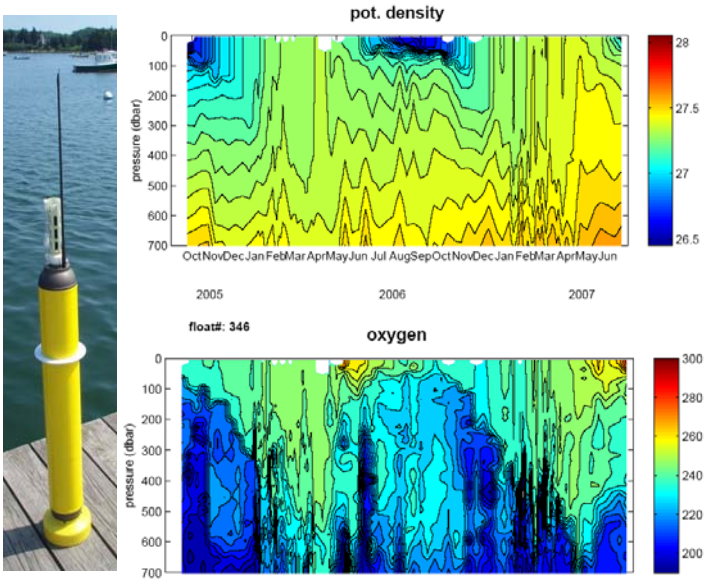
CTD observations

A CTD cast was run right after the deployment of each profiling float. The data serve as in-situ calibration for the float sensors.

Float deployments

As part of the international ARGO programme four freely drifting autonomous profiling APEX floats were deployed in the Lofoten and Norwegian basins. The floats drift at a depth 1000m for a period of little more than 9 days, they then descend to 2000 m depth and then ascend to the surface. While ascending, temperature and salinity measurements are taken at 72 depth levels. One of the floats was also equipped with sensors for dissolved oxygen content and Chlorophyll content. While at the surface, the data are transmitted to a shore station via satellite link. Worldwide about 3000 of these floats are in operation. The float's lifetime ranges between 3 and 5 years, during which up to 150 profiles are obtained.

The float programme in the Nordic Seas started in 2001 and is presently maintained by the Institute of Marine Research in Bergen (Norway) and the Institut für Meereskunde Hamburg. The Nordic seas float programme is aimed at the monitoring of water mass formation and transformation that is an important source for the dense outflows across the Greenland-Scotland Ridge, feeding the deep waters of the North Atlantic and in part driving the global overturning ('conveyor belt') circulation.



About 3000 profiling floats (left) are presently in operation world wide. The graphs on the right show the development of stratification and dissolved oxygen content over two seasonal cycles, measured from a float drifting in the North Atlantic. During winter the surface water cools and the water column mixes to several hundreds of metres. During summer the water stratifies again. Oxygen and other gases are injected into the water column during winter and used up by biological activity during the course the year.

Distribution and Transport of poly- and perfluorinated organic Compounds

For more than 50 years, perfluorinated organic tensides are industrially used to make surface water, oil, and dirt repellent. These compounds, so called perfluorinated alkylated substances (PFAS) or polyfluorinated organic compounds (PFC) were used in a variety of applications, such as impregnating agents, fire fighting foams, or food packaging. However, due to their thermal and chemical persistence that makes them favourable for industrial and consumer use, some PFAS accumulated in the biotic and abiotic environment. Perfluorinated octanoic acid (PFOA) and perfluorinated sulfonic acid (PFOS) are the most famous compounds and have been determined in arctic ice cores as well as in numerous vertebrates in remote regions, such as polar bears and seals of the Canadian and European Arctic. Their specific human toxicity is still field of ongoing research.

So far, the transport and global distribution of PFAS is not fully understood. Besides direct transport of the persistent perfluorinated acids with ocean currents, transport via the atmosphere appears to be a main distribution pathway. Emitted volatile and semi-volatile precursor compounds e.g. fluorotelomer alcohols and perfluorinated sulfonamides are degraded during or after the atmospheric transport to perfluorinated carboxylic and sulfonic acids. First studies about polyfluorinated (semi-)volatile substances in air samples confirm the importance of the atmospheric transport pathway.
In order to further characterize the transport pathways of PFAS, air samples were taken at the cruise MSM05/6. Air sampling for (semi-)volatile polyfluorinated compounds using high volume samplers was performed daily on the observation deck. Particle-bound PFAS were collected on a glass fibre filters, gaseous PFAS were concentrated on cartridges filled with polyurethane foam and the polymer resin XAD-2 as adsorbent. Filters and cartridges were extracted and will be measured at GKSS Research Centre. Information about the transport mode as well as characteristics of the atmospheric transport will be obtained.

7. Acknowledgements

We like to thank captain Klaus Bergmann, his officers and crew of RV Maria S. Merian for their support of our measurement programme and for creating a very friendly atmosphere on board.

The ship time of Merian was provided by the Deutsche Forschungsgemeinschaft within the core program METEOR/MERIAN. Financial support for the different projects carried out during the cruise was provided though Deutsche Forschungsgemeinschaft within Sonderforschungsbereich 512. We also benefited from financial contributions by GKSS. We gratefully acknowledge this support.

Float deployments:

Station No. 730

APEX Float No. 3376	Start time:	13. August 2007	14:30 UTC
Sensors:	Pressure, temperature, salinity		
Deployed	latitude:	70° 30.09’ N	
	Longitude:	003° 59.70’ E	
	Date:	13. August 2007	
	Time:	15:32 UTC	
	Depth:	3161 m (uncorrected)	
	Wind:	NNE 13 m/s	

Station No. 731

APEX Float No. 3377	Start time:	13. August 2007	21:00 UTC
Sensors:	Pressure, temperature, salinity		
Deployed	latitude:	69° 29.87’ N	
	Longitude:	003° 11.22’ E	
	Date:	13. August 2007	
	Time:	22:50 UTC	
	Depth:	3189 m (uncorrected)	
	Wind:	NNE 12 m/s	

Station No. 732

APEX Float No. 3378	Start time:	14. August 2007	21:00 UTC
Sensors:	Pressure, temperature, salinity		
Deployed	latitude:	65° 29.89’ N	
	Longitude:	000° 19.22’ E	
	Date:	14. August 2007	
	Time:	21:52 UTC	
	Depth:	2868 m (uncorrected)	
	Wind:	W 2 m/s	

Station No. 733

APEX Float No. 2308	Start time:	15. August 2007	02:00 UTC
Sensors:	Pressure, temperature, salinity, diss. oxygen, fluorescence		
Deployed	latitude:	64° 59.72’ N	
	Longitude:	000° 00.08’ W	
	Date:	15. August 2007	
	Time:	02:34 UTC	
	Depth:	2739 m (uncorrected)	
	Wind:	ESE 7 m/s	

List of Stations

EXPO-CODE	Stat. No.	Cast No.	Type	Date dd.mm.yyyy	Time UTC	Code	Position Latitude	Position Longitude	Bottom depth	Max Press.	Bottom Dist.	Comments
06MSM05/6	730	1	CTD/RO	13.08.2007	15:51	BE	70° 30.06' N	03° 59.83' E	3158			
06MSM05/6	730	1	CTD/RO	13.08.2007	16:35	BO	70° 30.06' N	03° 59.85' E	3155	2132	1000	
06MSM05/6	730	1	CTD/RO	13.08.2007	17:14	EN	70° 30.05' N	03° 59.84' E	3160			
06MSM05/6	731	1	CTD/RO	13.08.2007	23:04	BE	69° 30.11' N	03° 11.62' E	3189			
06MSM05/6	731	1	CTD/RO	13.08.2007	23:44	BO	69° 29.92' N	03° 10.72' E	3187	2121	1087	
06MSM05/6	731	1	CTD/RO	14.08.2007	00:31	EN	69° 29.49' N	03° 09.54' E	3186			
06MSM05/6	732	1	CTD/RO	14.08.2007	22:04	BE	65° 29.54' N	00° 18.84' E	2861			
06MSM05/6	732	1	CTD/RO	14.08.2007	22:52	BO	65° 29.54' N	00° 18.84' E	2862	2129	762	
06MSM05/6	732	1	CTD/RO	14.08.2007	00:31	EN	65° 29.54' N	00° 18.84' E	2861			
06MSM05/6	733	1	CTD/RO	15.08.2007	02:34	BE	64° 59.59' N	00° 00.26' W	2741			
06MSM05/6	733	1	CTD/RO	15.08.2007	03:25	BO	64° 59.59' N	00° 00.26' W	2742	2130	642	
06MSM05/6	733	1	CTD/RO	15.08.2007	04:17	EN	64° 59.59' N	00° 00.26' W	2743			