Leibniz Institute for Baltic Sea Research Warnemünde

C r u i s e R e p o r t

r/v "Elisabeth Mann Borgese"

Cruise- No. EMB099

17 – 30 March, 2015

Western and central Baltic Sea

This report is based on preliminary data

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1. **Cruise No.:** EMB099

2. **Dates of the cruise:** from 17.03.2015 to 30.03.2015

3. **Particulars of the research vessel:**
   Name: FS Elisabeth Mann Borgese
   Nationality: Germany
   Operating Authority: Baltic Sea Research Institute (BSRI) Warnemünde

4. **Geographical area in which ship has operated:**
   Western and central Baltic Sea

5. **Dates and names of ports of call**
   None

6. **Purpose of the cruise**
   Monitoring cruise in the framework of HELCOM programme

7. **Crew:**
   Name of master: Uwe Scholz
   Number of crew: 10

8. **Research staff:**
   Chief scientist: Dr. V. Mohrholz
   Scientists: Dr. J. Kuss
   Engineers: R. Mars
   Technicians: S. Beier, F. Cordes, M. Pötzsch, J. Donath
   B. Sadkowiak, A. Emmerich, J. Wölk, S. Bücker

9. **Co-operating institutions:**

10. **Scientific equipment**
    CTD + Rosette water sampler, Phytoplankton net, Zooplankton net (WP2), VMADCP, Thermosalinograph, Mooring, PumpCTD, ScanFish

11. **General remarks and preliminary result** (ca. 2 pages)
    The second monitoring cruise of the Leibniz Institute for Baltic Sea Research Warnemünde in 2015 was carried out with FS "Elisabeth Mann Borgese" between 17th and 30th March 2015. The cruise is part of the German contribution to the HELCOM COMBINE program and contributes to IOW's long term data series in the central Baltic Sea.

    The area under investigation covered the Baltic Sea between Kiel Bight and the northern Gotland Sea. Marine meteorological, hydrographic, hydrochemical and hydrobiological investigations were performed according to the COMBINE program of HELCOM.

    For detailed information and preliminary results refer to the attached detailed cruise report.

Appendix: Detailed scientific cruise report and preliminary results

Cruise report – EMB099

Leibniz-Institute for Baltic Sea Research Warnemünde, Germany
On board, 30.03.2015

Content

1. Basic information

Ship: FS Elisabeth Mann Borgese
Cruise: EMB099
Date: 17.03. – 30.03. 2015
Chief scientist: Dr. Volker Mohrholz

Objectives

The cruise EMB099 was carried out as a joined cruise of the environmental monitoring program of the Federal Maritime and Hydrographic Agency (BSH) and the Baltic Sea long term observation program of the Leibniz-Institute for Baltic Sea Research Warnemünde (IOW). It was the second cruise in a series of five expeditions performed annually.

The data acquired are used for the regular national and international assessments of the state of the Baltic Sea, and provide the scientific basis for measures to be taken for the protection of the Baltic Sea ecosystem.
A special focus of the cruise was on the impact of the Christmas MBI 2014 on the environmental conditions in the central Baltic.
Additionally, a test program to study the distribution of organic mercury compounds was carried out in the Gotland Basin.

Staff

	Name	***On board***	***Institution***	***Responsibility***
1	Volker Mohrholz	17.03.-30.03.2015	IOW Warnemünde	VMADCP, chief scientist
2	Sebastian Beier	17.03.-30.03.2015	IOW Warnemünde	MSS, PumpCTD
3	Joachin Kuss	17.03.-30.03.2015	IOW Warnemünde	Hg chemistry
4	Florian Cordes	17.03.-30.03.2015	Uni Rostock	Hg chemistry
5	Robert Mars	17.03.-30.03.2015	IOW Warnemünde	CTD, ScanFish, PumpCTD
6	Michael Pötzsch	17.03.-30.03.2015	IOW Warnemünde	Plankton sampling
7	Jan Donath	17.03.-30.03.2015	IOW Warnemünde	CTD, ScanFish
8	Birgit Sadkowiak	17.03.-30.03.2015	IOW Warnemünde	Nutrients
9	Jana Wölk	17.03.-30.03.2015	IOW Warnemünde	Nutrients
10	Anna Emmerich	17.03.-30.03.2015	Uni Rostock	Nutrients
11	Steffan Bücker	17.03.-30.03.2015	IOW Warnemünde	Nutrients, Trace gas

Area of investigation

The cruise EMB099 was dedicated to the Baltic monitoring program (BMP). Data collection covered the western and central Baltic from the Kiel Bight to the northern Gotland Basin. The majority of stations is located along the talweg transect of the Baltic Sea. The possible western pathway of saline water from the Bornholm Basin to the western Gotland Basin was not sampled, since there were no indications of a spreading of saline waters through this trench.

Along the southern rim of the eastern Gotland Basin an east-west transect of 7 CTD stations was worked, in order to gather information about the spatial distribution of the inflowing saline waters from the December 2014 MBI. Additionally, a number of CTD casts were carried out at stations aside both transects. On the way back to Rostock a ScanFish was deployed to perform a high resolution transect along the talweg from the eastern Gotland Basin towards the Arkona Sea.

An overview to the location of CTD stations, the ScanFish transect and the cruise track is given in Figure 1 and Figure 2. A station list is given in Table 6.

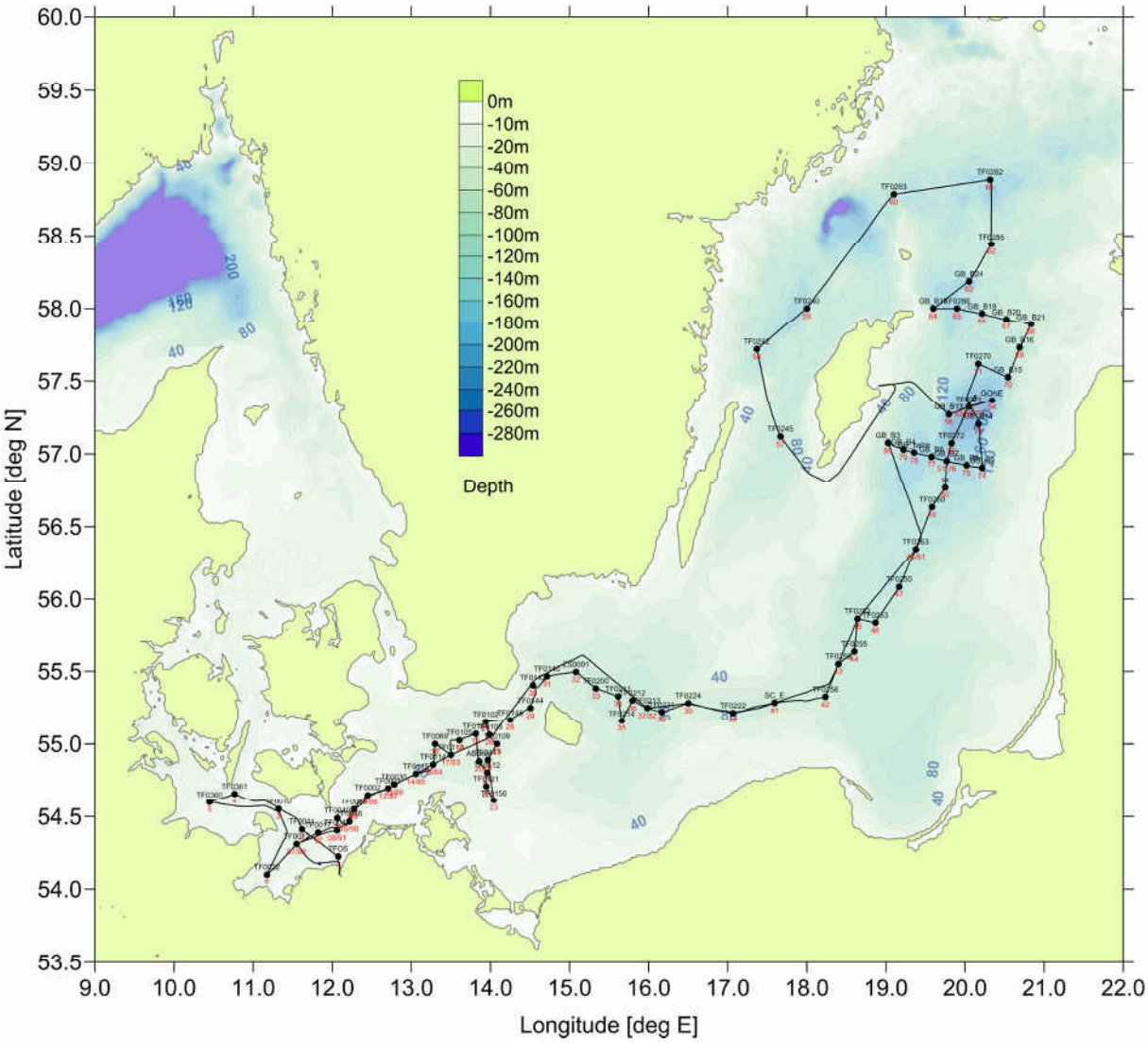

Figure 1: Map of stations and ship track of cruise EMB099 from 17. – 30. March 2015. Black dots and labels indicate the positions and names of CTD stations. The red labels depict the CTD station number.

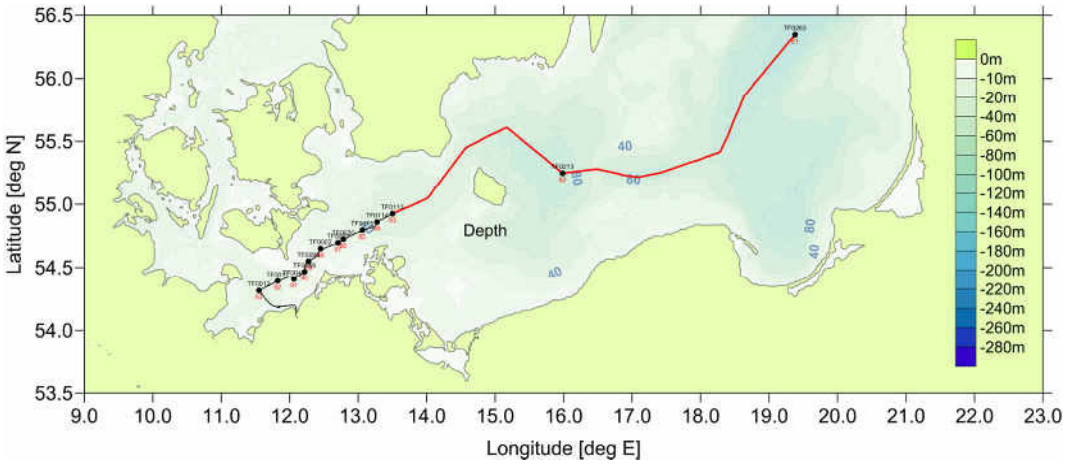

Figure 2: Map of ScanFish transect, CTD stations and ship track of cruise EMB099 at the high resolution transect in the southern and western Baltic (26. – 29. March 2015). Black dots and labels indicate CTD stations. The red line shows the position of the ScanFish transect.

Equipment

Data acquisition was carried out using the following devices and measuring platforms.

At stations and transects:

- CTD SBE 911+ with rosette water sampler
- PumpCTD with rosette water sampler
- Oceanographic mooring
- Towed CTD ScanFish (SF)
- Microstructure profiler
- Phytoplankton nets, Secci desk
- Zooplankton net (WP2)

Continuous measurements:

- Vessel mounted ADCP 150kHz OceanSurveyor
- Underway measurements of surface water properties
- Ship weather station
- Mercury compounds in surface water
- CO_2 and CH_4 concentration in surface water

Narrative of the cruise

Date	***Time***	***Task***
16.03.2015		loading of equipment, preparing devices for the cruise
17.03.2015	07:30	Embarking of scientific crew
	07:45	Safety instructions
	08:30	Departure from port Rostock-Marienehe
	10:00	Start of station work in the western Baltic
	18:00	Start of VMADCP current measurements, no tilt information is stored in the ADCP data, since the NMEA2 channel is occupied for heading data!
18.03.2015		Continuation of station work in the western Baltic, calm weather with optimal conditions for the field work.
19.03.2015		Continuation of station work in the western Baltic, calm weather with optimal conditions for the field work.

Date	*Time*	*Task*
	16:00	Test of MSS power block winch and probe. The MSS power block winch did not work properly. The pressure sensors of MSS055 are biased for unknown reason. We will change both, and try it again tomorrow.
20.03.2015		Continuation of station work in the Slupsk furrow, calm weather with optimal conditions for the field work.
	10:30	Partial solar eclipse was not visible due to complete cloud coverage, however the reduced light intensity was observed.
	16:00	First PumpCTD / MSS deployment on station TF0253
21.03.2015	07:00	Continuation of station work in the eastern Gotland basin, wind speed has increased to 15ms^{-1} (7 Bft).
	12:00	Wind speed has increased to 20ms^{-1} (8 Bft) from northerly directions. The station work has been interrupted until the wind calm down.
	23:30	Continuation of station work at station TF0271
22.03.2015	08:00	Arrival at mooring position GONE
	08:30	Mooring GONE successful recovered, no missing devices
	12:00	Continuation of station work at station TF0271. PumpCTD failed after 30min of operation at TF0271, due to electrical problems of the CTD pump. The pump has been changed, but the station was not finished due to increasing wind.
	17:00	The station work has been interrupted due to havy winds
	21:00	Arrival at anchor position near the eastern coast of Gotland at Östergarn Bay
23.03.2015	08:00	Still at anchor position near the eastern coast of Gotland, havy winds prevent continuation of station work
	23:45	Leaving the anchor station east of Gotland and proceeding to the western Gotland Basin.
24.03.2015	08:20	Start of station work at station TF0245 in the western Gotland Basin
25.03.2015		Continuation of station work in the northern Gotland Basin
	03:00	PumpCTD cast was shifted from TF0282 to TF0285 due to bad wind conditions
26.03.2015		Continuation of station work in the eastern Gotland Basin. Wind strength increases from 5 to 6…7 Bft
	04:30	Start PCTD cast at station TF0271
	14:00	End PCTD cast at station TF0271, proceeding to the south Gotland CTD transect
	21:00	South Gotland CTD transect finished
27.03.2015	01:00	Start PCTD cast at station TF0263
	08:00	End of station work at TF0263
	08:30	Start of first ScanFish transect towards the Slupsk Furrow and the Bornholm Basin
28.03.2015		Proceeding with first ScanFish transect towards the Bornholm Basin
	09:00	End of first ScanFish transect at station TF0213
	09:30	Start of station work at station TF0213 in the Bornholm Basin
	11:00	Start of second ScanFish transect towards the Arkona Basin
29.03.2015	06:00	End of second ScanFish transect at station TF0113
	06:30	Begin station work in the western Baltic
	20:30	End of station work in the western Baltic
	21:00	End of scientific work, Transit to port Rostock-Marienehe
30.03.2015	07:30	Arrival at port Rostock-Marienehe
	09:00	Unloading of scientific equipment
	11:00	Disembarking of scientific crew, end of cruise EMB099

2. Data processing and quality assurance

Stations

A station name and a station number were assigned to all stations, where scientific equipment was used. The station name identifies a geographical position. The station number is an integer number that is incremented for each new station. The station number was applied according the station number rules of the ship. For the cruise EMB099 the first station number is 001.

CTD

The CTD-system "SBE 911plus", SN-09P43260-0853, (SEABIRD-ELECTRONICS, USA) was used to measure the variables:

- Pressure
- Temperature (2x SBE 3)
- Conductivity (2x SBE 4)
- Oxygen concentration (2x SBE 43)
- Chlorophyll-a fluorescence (683nm)
- Turbidity
- PAR
- SPAR

To minimize salinity spiking, temperature- (SBE 3), conductivity (SBE 4) and oxygen sensors (SBE 43) are arranged within a tube system, where seawater is pumped through with constant velocity. The CTD was equipped with a double sensor system for temperature, conductivity and oxygen. The temperature is given in ITS-90 temperature scale. Salinity is calculated from the Practical Salinity Scale (1978) equations. Fluorescence and turbidity are measured with a downward looking WET Labs fluorometer. Pressure is determined with a Paroscientific Digiquartz pressure sensor, maximum range 6800 dBar.

Data were monitored during the casts and stored on hard disk with Seasave Version 7. For each station a configuration file (stationname.con) was written which contains the complete parameter set, especially sensor coefficients used for the conversion of raw data (frequencies) to standard output format.

Additionally the CTD-probe was equipped with a Rosette water sampler with 13 Free Flow bottles of 5l volume each. This design allows for closing of bottles automatically at predefined depth during down-casts. Closing depth and sensor values are aligned by appropriate choice of parameters of the CTD software generating the “bottle files”.

Sampling

A CTD cast was started below the sea surface with the pressure sensor usually at about 5m depth to prevent a contamination of the CTD pumping system with air bubbles. Data were collected down to 3-5m above the bottom at all stations. An attached altimeter was used to determine the bottom distance. Sampling rate of the CTD probe was 24Hz. Data were displayed online to determine appropriate sampling depth and stored on a PC hard drive.
The probe sheds water in its wake over a long distance. Hence, only downcast registration was reliable. Upcast registration was used only for water sampling, if the closing depth was determined during the downcast. At downcast bottles were closed while fiering, for closing the bottles during upcast the probe was stopped and bottles were closed after a time span of about 30s. When the device was back on deck oxygen samples were taken first, followed by water samples for salinity, nutrients and water for several biological and geochemical techniques.

Sensor check
The CTD sensors were checked during the cruise by comparison measurements.

At stations with well mixed water layers temperature was measured with a high precision thermometer SBE RT35. Salinity samples were taken second day. The samples were stored in white glass bottles and will be analyzed after the cruise in by means of a salinometer AUTOSAL Model 8400B (accuracy of 0.001). Most samples were taken from near surface layers, only a few deep well mixed layers could be found.

Slope and offset of the oxygen sensors SBE 43 were determined by help of water samples. Oxygen content of the samples was determined with a titration set (Winkler method, accuracy of 0.02ml/l). Oxygen concentration is calculated using Seasoft, oxygen formula "1",

$$ox = Soc\,[V + V_{offset} + Tau] * oxsol(T,S) * F_t(T) * F_p(T,p)$$

The pressure sensor was checked by measuring depth on deck both before the cast.
Calibration measurements for the fluorometer data have not been done, since no quantitative phytoplankton analysis was performed during the cruise.

Table 1: Type and serial numbers of mounted CTD sensors

Sensor	*Type*	*SN*	*Last calibration*
Pressure	Digiquartz	100070	16.05.2006
Temperature 0	SBE 3	5491	31.01.2015
Temperature 1	SBE 3	5492	31.01.2015
Conductivity 0	SBE 4	4006	31.01.2015
Conductivity 1	SBE 4	4007	31.01.2015
Oxygen 0	SBE 43	1993	05.11.2014
Oxygen 1	SBE 43	523	05.11.2014
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	2484	11.01.2012
PAR sensor	Biospherical Licor Chelsea	70256	12.08.2009
SPAR		20364	12.08.2009

VMADCP 150kHz

A 150kHz Acoustic Doppler Current Profiler (VMADCP) Ocean Surveyor (frequency 150 kHz, beam angle 30deg), manufactured by RDInstruments, was mounted downward looking at the ship hull. The data output of the ADCP was merged online with the corresponding navigation data derived from DAVIS output, and stored on the hard disc using the program VMDAS. Additionally, heading information was provided by the gyro-compass. The VMADCP was operated continuously during the entire cruise. The following configuration was used for data acquisition.
Post-processing of the VMADCP data was carried out using the Matlab® ADCP toolbox of IOW. The final profiles are 120s and 300s averages of the single ping profiles.
At sections where bottom tracking was available the heading bias of the instrument was calculated. This value and the magnetic deviation of were applied during post processing.

Table 2: Configuration of 150kHz VMADCP

Command	*Parameter*	*Value*
WP001	Broad band pings	1 ping per ens
WN60	number of depth cells	60
WS0400	bin length	4m
WF0400	blank after transmit	4m
WV390	Ambigiuity velocity	3.9m/s
BP0001	bottom track	1 ping per ens
BX03000	max bottom distance	300m
WD111100000	data output	vel, corr, intensity, % good
TP000000	time between pings	As soon as possible
EZ1020001	sensor source	temperature
EX00000	co-ordinates	use beam co-ordinates

ED00050	transducer depth	5m
ES10	salinity	10
Data option dialog of VMDAS software	heading source	NMEA
	navigation source	NMEA
	time per ensemble	1s
	time between pings	1s
	heading alignment	45 deg
	heading bias	0 deg
	short term average	60s
	long term average	300s
	data screening	off

ScanFish towed CTD

The ScanFish towed CTD (SF) was used on several transects during the cruise. The platform consists of a Seabird 911+ CTD mounted on a wing shaped body undulating between sea surface and about 130m depth when towed behind the ship. Additionally to the usual CTD sensors, the probe is equipped with sensors for dissolved oxygen concentration. Hydrographic data are transmitted via a multi-conductor cable and stored in the lab on a computer disc. The instrument will be deployed over the stern of the ship. The cable is operated from a separate winch to be mounted at the aft deck. The cable is guided by a pulley block mounted below the A-crane. The A-crane will be used for deployment and recovery.
The device will be towed with 5-7 knots, the undulation depth is steered from the lab. Control commands are transmitted via the cable.

Sensor	***Type***	***SN***	***Last calibration***
Pressure	Digiquartz	76058	11.10.2006
Temperature	SBE 3	1700	19.02.2015
Conductivity	SBE 4	1390	19.02.2015
Oxygen	SBE 43	157	19.02.2015
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	3274	27.09.2013

During the cruise one ScanFish transects was performed along the talweg transect of the Baltic from the eastern Gotland Basin to the Arkona Sea. The transect was interrupted for additional CTD sampling at station TF0213 in the Bornholm Basin. The ScanFish worked without technical problems and delivered high resolution data about the inflow water distribution from the Christmas MBI 2014.

Pump CTD

At selected stations a PumpCTD system was used to sample larger amounts of water from different depth. The PumpCTD system was equipped with a high pressure pump and connected to a special pump. This system was developed with new technological features in close co-operation of the IO Warnemuende instrumentation department and the MPI Bremen nutrient group in 2001 according to the ideas of Gernot Friedrich et. al. from MBARI California during the end of the 1980s.
Water sampling is carried out with the 13 5 l FreeFlow bottles and a continuous water stream of approximately 2 litres per minute from the CTD through cable and winch into the analytics lab. The system consists of the submersible CTD-, Rosette-, pump probe unit, a special pump cable and a computer controlled winch. It allows the measurement of vertical profiles of the CTD parameters given above in combination with sophisticated online water sampling down to a depth of 400 m. For the high pressure pump unit, mounted to the CTD-rosette frame a PROCON Series 3 vane pump and a 0.5 kVA Franklin motor are used. The pump cable (FALMAT) consists of a nylon hose in the centre (inner/outer diameter: 6/8mm), 9 electrical wires for pump and other power supplies in the probe, 4 twisted pairs for data transmission, a strengthening Kevlar layer and an outer PUR mantle (over all diameter: 18mm, breaking strength: 3 t). The individual pump function was stable during the cruise and the flow rate is usually constant in the range of 2 l/min.
The slip ring fluid output of the winch is connected to the lab outlet via a deck nylon hose 6/8mm, 15 to 25 m long. Here the flow meter was installed to release the sample water at working places in the chemical lab.

Sensor	*Type*	*SN*	*Last calibration*
Pressure	Digiquartz	117524	10.12.2009
Temperature	SBE 3	5213	15.01.2015
Conductivity	SBE 4	3724	15.01.2015
Oxygen	SBE 43	1733	15.01.2015
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	1223	unknown

Mooring

GONE (Long Term Mooring **Go**tland **N**orth**e**ast)
Main purpose of the GONE mooring is obtaining hydrographic time series of temperature, salinity, oxygen and currents from the deep water range in the eastern Gotland Basin, the central basin of the Baltic Sea. The data are used for long term observation of environmental conditions in the deep water of the Baltic and for detecting the impact of saline inflow events. The mooring consists of a bottom mounted ADCP 300kHz, 1 SeaCat thermosalinometer SBE16, three RBR TR1060 temperature recorder, an RBR TRD2050 temperature pressure recorder and 3 PME oxygen optodes (Figure 3: Sketch of the GONE mooring deployment 28.).
On 22.03.2015 07:30 UTC the GONE mooring (NE28) successful recovered after six month of operation. All devices were saved. Two hours later the mooring (NE29) was redeployed after maintenance.

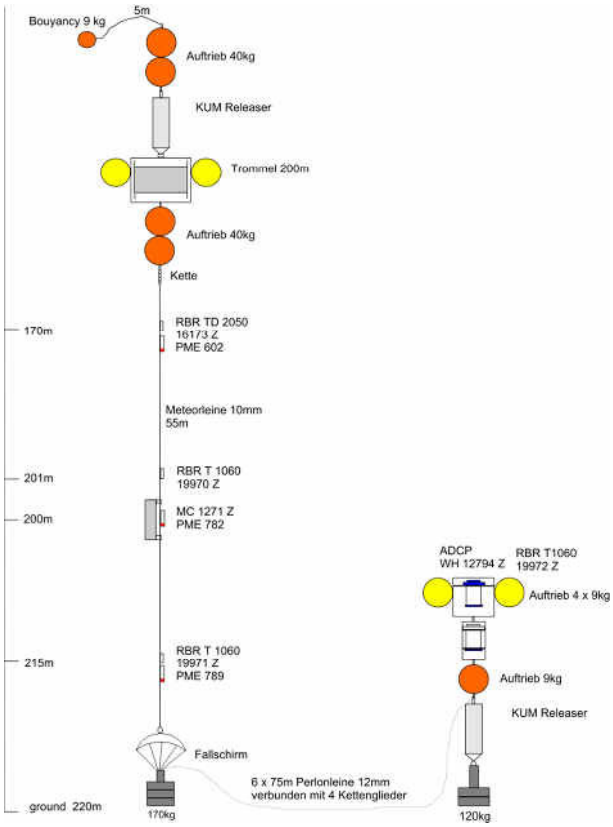

Figure 3: Sketch of the GONE mooring deployment 28.

Microstructure Profiler (MSS)

During the cruise 45 microstructure profiles were gathered with the microstructure-turbulence profiler MSS 90-S at selected stations. The MSS 90-S (Serial number 038) is an instrument for simultaneous microstructure and precision measurements of physical parameters in marine waters. The MSS profiler was equipped with 2 velocity microstructure shear sensors (for turbulence measurements), a microstructure temperature sensor,

standard CTD sensors for precision measurements, an oxygen sensor, a turbidity sensor, and a vibration control sensor.
All sensors are mounted at the measuring head of the profiler, the microstructure ones being placed about 150 mm in front of the CTD sensors. The sampling rate for all sensors was 1024 samples per second. At each station a set of 3 to 5 subsequent profiles was gathered. The profile to profile interval depends on water depth and ranges from 4min in 60m to 20min in 500m water depth respectively. The profiler was balanced with negative buoyancy, which gave it a sinking velocity of about 0.6 m/s. It was intended to deploy the MSS with a "Power Block Winch". However, due to technical problems this winch was not usable. Thus, a spare winch WM1000 was used instead. It was operated from the stern of FS Elisabeth Mann Borgese. Disturbing effects caused by cable tension (vibrations) and the ship's movement were excluded by a slack in the cable. After each deployment the sensors were flushed with pure water to prevent fouling.

The dissipation rate of turbulent kinetic energy was calculated by fitting the shear spectrum to the theoretical Nasmyth spectrum in a variable wave number range from 2 to maximum 30 cycles per meter (cpm). The low wave number cut off at 2 cpm is to eliminate contributions from low frequent tumbling motions of the profiler.

The MSS data were calibrated by comparison with data from the SeaBird CTD 911+ (Table 3).

Table 3: Calibration of MSS raw data

Sensor	***Calibration***
Shear	The shear sensors 072 (she1) and 073 (she2) were used for the deployments. Both sensors were calibrated by the manufacturer.
Temperature	The temperature sensor depict only minor deviations (<0.01K) from the SBE CTD temperature readings. No correction was applied.
Fast temperature (NTC)	The fast temperature sensor (NTC) depicted significant slope and offset to the SBE CTD temperature readings. A slope and offset correction was applied: Temp = 0.9905 * NTC_Temp + 0.7773.
Conductivity	During the field work no significant differences between CTD and MSS conductivity sensor data were observed. No correction was applied.
Turbidity	According to the observed minimum values in deep water an offset of +0.05 NTU was applied to the turbidity raw data. Used range: 0-25 FTU
Oxygen	The MSS oxygen sensor revealed no usable data. The sensor data were rejected during the post processing.
Pressure	The pressure sensor was not corrected. The measured pressure at the sea surface was in range between 0.2 to 0.3dBar.

The probe file "MSS038_EMB099.PRB" was used for data acquisition and processing. The following batch jobs were used for post processing of the MSS raw data:

shear_c_71_72_emb099.msb	calculation of physical values and shear from raw data
dissipation_emb099_p001_ff.msb	calculation of derived parameters and vertical average to 0.5m bins
MeanProfile	calculation of a mean profile for each station

Underway measurements

The FS Elisabeth Mann Borgese is equipped with numerous sensors, which continuously provide many important environmental parameters. This consists of weather parameters, surface water properties, navigation information, rope length, winch speed and more. The data are collected by a data acquisition system DAVIS manufactured by WERUM. All data are stored in a data base and can be extracted by a web interface. A description of all collected parameters is given in the ship specific DAVIS manual. All data are snapshots taken and stored every second. After the cruise the full data set was extracted.

This data set consists of:

- time (UTC)
- latitude and longitude

- ships heading
- depth
- air pressure
- air temperature
- humidity
- global radiation
- infra red radiation
- Surface conductivity
- Surface salinity
- Surface water temperature
- Surface chlorophyll-a fluorescence
- Surface turbidity
- Wind direction
- Wind speed

Plankton sampling

Plankton sampling was performed by means of a rosette sampler (combined with CTD) as well as with a small phytoplankton net and a zooplankton net (WP2). Samples were taken from different depths in order to get representative data from the euphotic zone. Additionally, samples for micro biological analyses were taken at station TF0271 in the central Baltic.
The plankton sampling positions are indicated in the list of stations (Table 6)

Determination of mercury species

As a pilot study for a planned project to identify sources and transport processes of organic mercury compounds in the Baltic Sea, about 250 measurement of dimethylmercury (DMHg) were done and 65 samples were taken for total mercury (Hg^{tot}) and monomethylmercury (MMHg) determinations, respectively, in the IOW trace metal lab. Elemental mercury (Hg0) was measured in series with DMHg from continuously supplied water in a 5 min resolution. On board water was analyzed for DMHg by a membrane equilibrator and a bottle equilibrator, enrichment on Carbotrap/Tenax adsorbens tubes, desorption, gas chromatographic separation, pyrolysis, and cold vapour atomic fluorescence detection (Tekran 2700). Surface seawater was continuously pumped by R/V Elisabeth Mann Borgese´s clean seawater supply system and for greater depth down to the bottom by the new fast pump-CTD system (fP-CTD) with a larger tube size made of dedicated inert polvinyliden difluorid (PVDF). In accordance with the vertical distribution of organic mercury compounds transport processes were investigated by current and microstructure measurements, using MSS and VM-ADCP supported by CTD and undulating CTD measurements (scanfish). The mercury sampling positions are indicated in the list of stations (Table 6).

Long term investigations of CH_4, N_2O and CO_2 distribution

Sampling for simultaneous CH_4 and N_2O observation was carried out in frame of an extension to the long term data collection program. The sampled stations are indicated in Table 6 with the abbreviation “SG”.
At the stations in the Gotland basin additional samples were taken if water, originating from the saltwater inflow was present. At the core depth of inflow water 3 additional samples were taken, as well as 5 meters below and above. All samples were fixed with 500 µL saturated $HgCl_2$-solution to prevent microbiological activity and stored dark. (Responsible scientists: Jan Werner, Prof. Gregor Rehder)

One complete depth profile was sampled at station TF0271 for the long term data collection of CT, AT, and pH. Also these samples were fixed with 500 µL saturated HgCl2-solution to prevent microbiological activity and stored dark. (Responsible Scientist: Dr. B. Schneider)

3. Preliminary results

The results presented in the following section are preliminary and not comprehensive, since they are based in most cases on unvalidated data! The aim of this section is to give a first impression on the collected data set. An advanced data analysis will follow after all validated data sets are available.

Meteorological conditions

During the first three days of the cruise weak to moderate wind from southerly directions were observed. This allowed the fast sampling of stations in the western and southern Baltic. On 21st March, when the ship reached the eastern Gotland Basin, the wind changed to northeast and increased rapidly at the back side of an eastward traveling low pressure system. At noon the wind speed reached gale force with up to 20ms^{-1}.
The wind calm down on 22nd March for half a day. In the evening of the 22nd March the wind speed increased again to gale force due to a new low pressure system that passed the investigation area. The station work was interrupted for one day, and the ship went to a save position on the east coast of Gotland. The wind data gathered at this position on 23rd March do not reflect the real conditions at sea, since the wind was shadowed by the island.

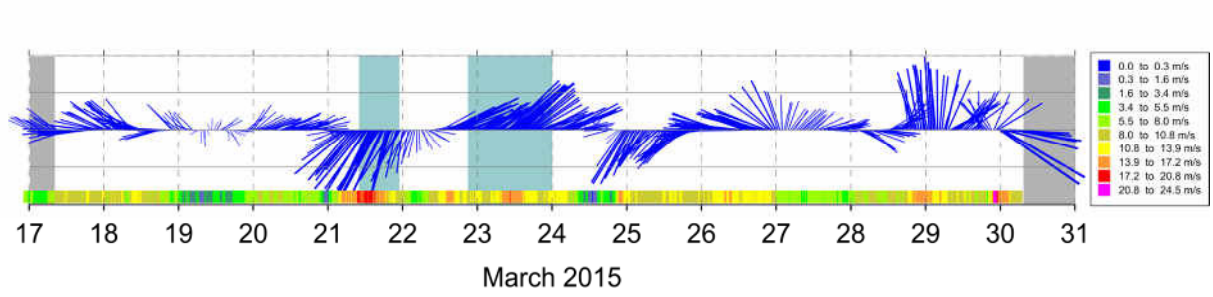

Figure 4: Stick plot of wind vector measured by the ship weather station of FS Elisabeth Mann Borgese. The grey shaded areas indicate periods when the ship was in port. Blue shaded ranges are times when the field work was interrupted due to high wind speeds.

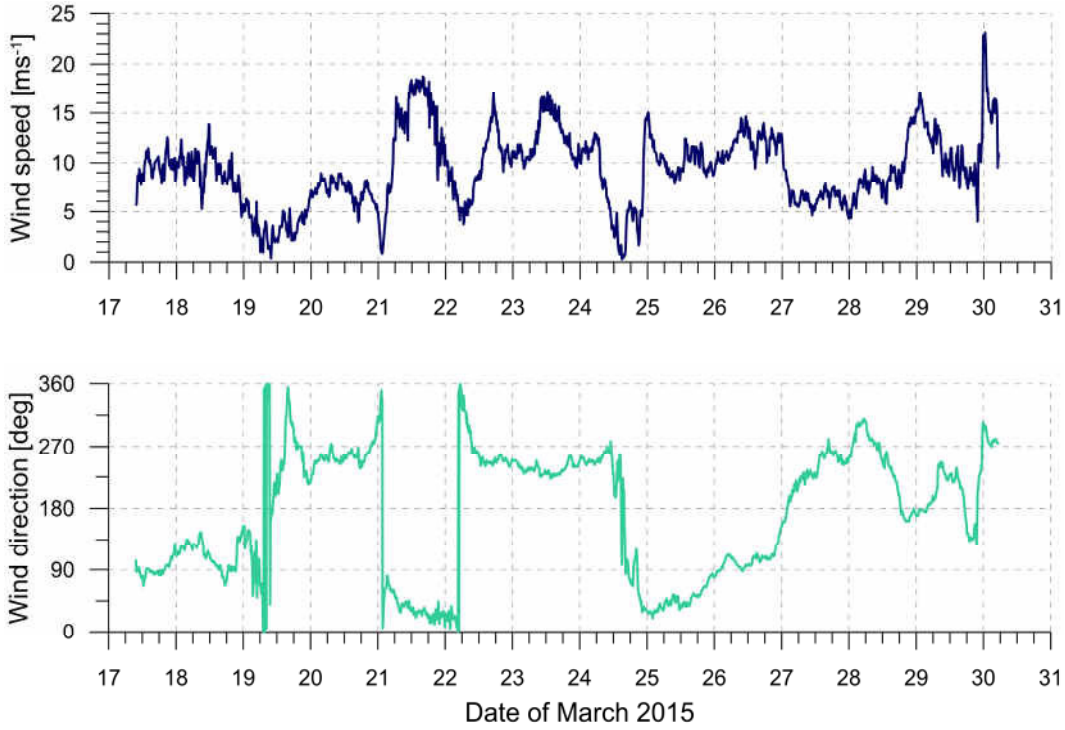

Figure 5: Wind speed and direction measured by the ship weather station of FS Elisabeth Mann Borgese.

The following three days until the 27th March were characterized by moderate to strong wind conditions, with changing wind directions. From 27th March to the end of the cruise on 30th March the wind decreased further to mean wind speed between 5 to 12ms^{-1}.

Figure 4, 5 and 6 show the temporal development of wind conditions that were dominated by the series of passing low pressure systems.

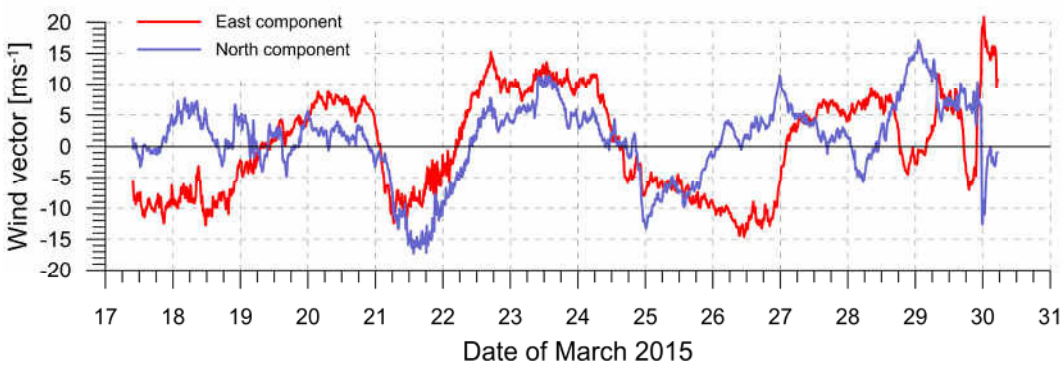

Figure 6: Wind vector east and north measured by the ship weather station of FS Elisabeth Mann Borgese.

Until the 20th March the air temperature was at about 6°C. Later on the air temperature decreased to 3 to 4°C, interrupted by two episodes of temperatures near the freezing point after the passage of low pressure systems. The air pressure variations show the typical time scale of passing low pressure systems of 2 to 3 days.

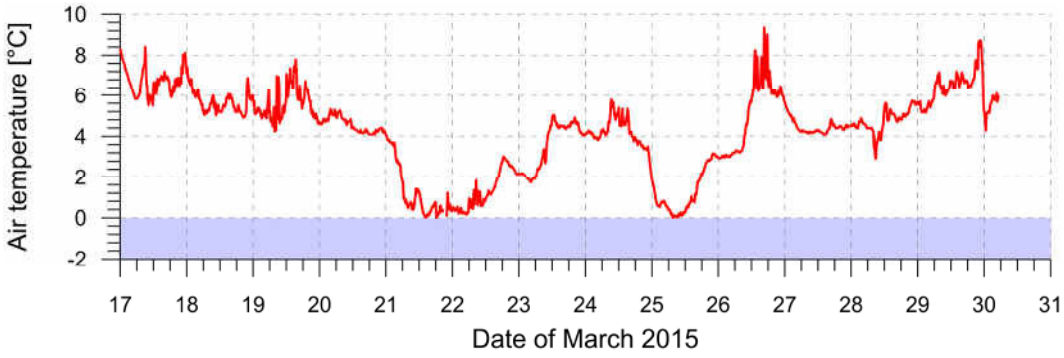

Figure 7: Air temperature measured by the ship weather station of FS Elisabeth Mann Borgese.

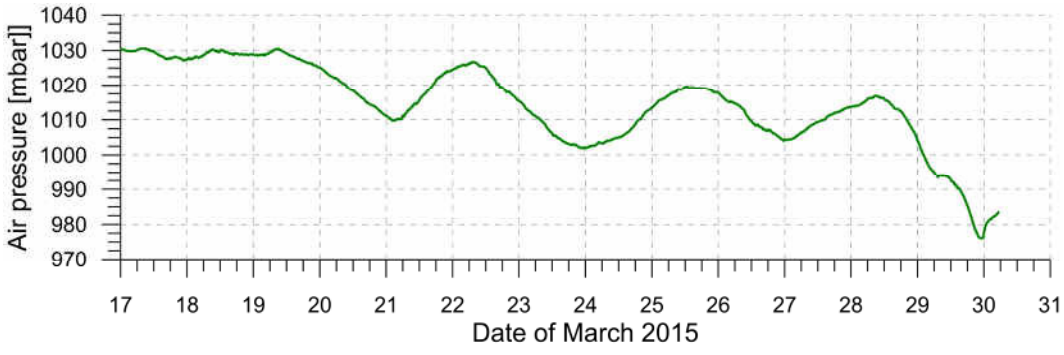

Figure 8: Air pressure measured by the ship weather station of FS Elisabeth Mann Borgese.

The humidity was relatively high, changing between 50 and nearly 100%. The global radiation was strongly related to the cloud coverage. Maximum values, at noon on sunny days, were about 600 Wm^{-2}. Remarkably, the partial eclipse on the 20th January is clearly seen as a strong drop in global radiation.

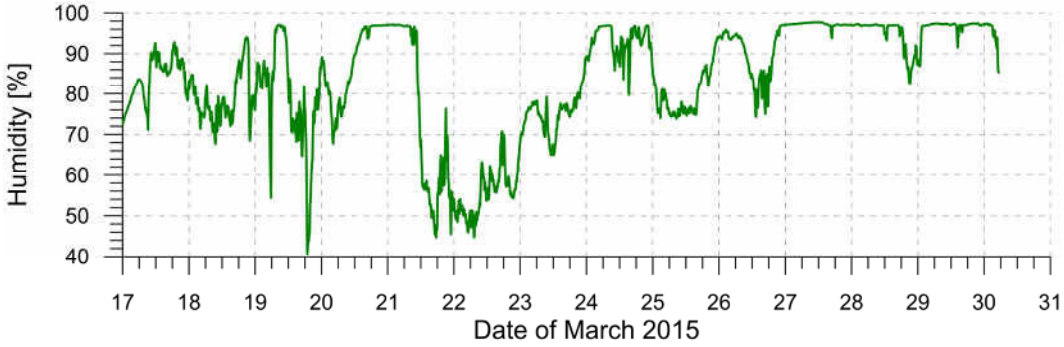

Figure 9: Air humidity measured by the ship weather station of FS Elisabeth Mann Borgese.

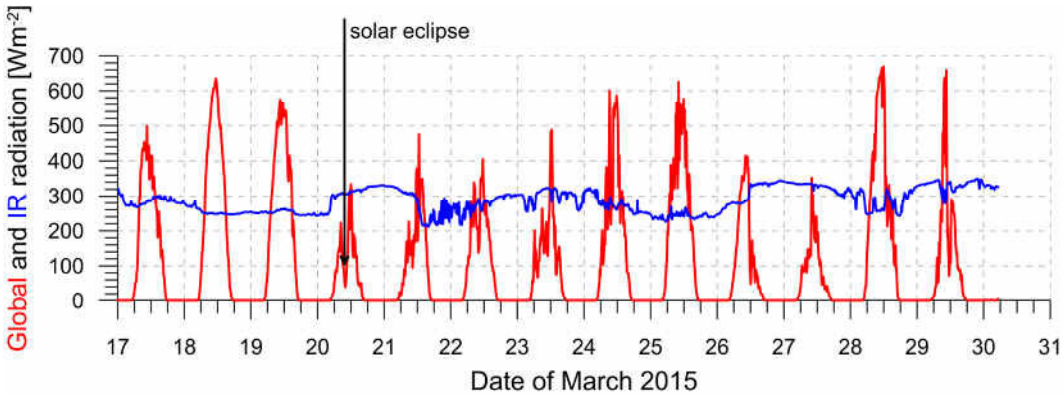

Figure 10: Global and infra red radiation measured by the ship weather station of FS Elisabeth Mann Borgese.

Sea surface temperature and salinity

Sea surface temperature and surface salinity distributions in the investigation area were compiled from data gathered with the ships thermosalinograph. The distributions shown in Figure 11 are based on unvalidated data.

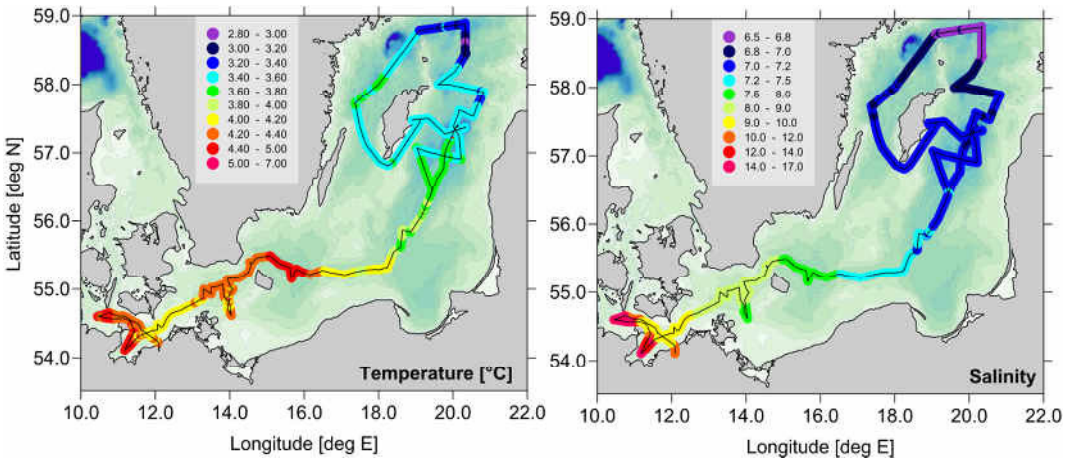

Figure 11: Surface temperature (left) and surface salinity distribution (right) along the cruise track of EMB099 in the western and central Baltic.

In the Kiel Bight and the Mecklenburg Bight the warm and saline surface waters indicate remaining waters from a recent inflow event. In the beginning of the cruise strong outflow conditions were observed in the western Baltic. Generally, the sea surface temperature (SST) and salinity (SSS) decreases from west to east. In the Arkona Basin SSTs were about 4.3°C and SSS about 8.5 compared to values of 3.0°C and 6.8, respectively in the northern Gotland Basin. Due to the extremely mild winter the surface temperatures were well above the long term average and also above the density maximum, which is important for the onset of stratification and spring bloom during the following weeks. Highest surface temperatures of about 4.7°C were observed in The Bornholm Basin. This was caused by a local heating of a thin surface layer during the calm and sunny conditions in the beginning of the cruise.

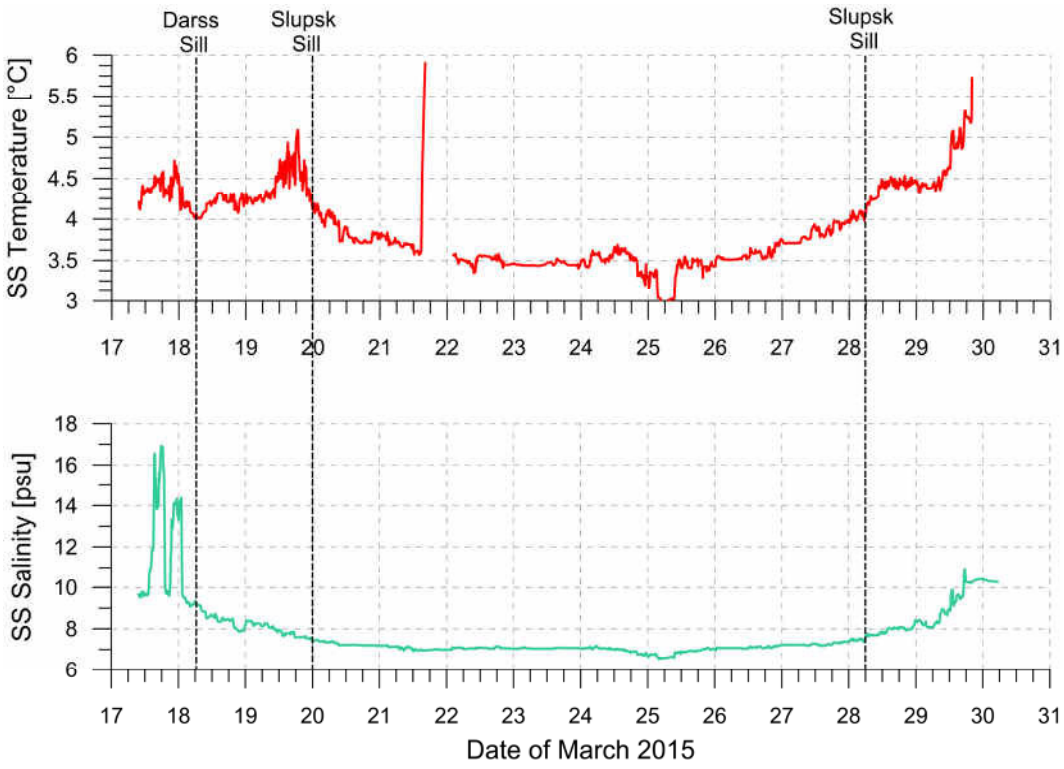

Figure 12: Surface salinity and temperature measured with the ship thermosalinograph of FS Elisabeth Mann Borgese.

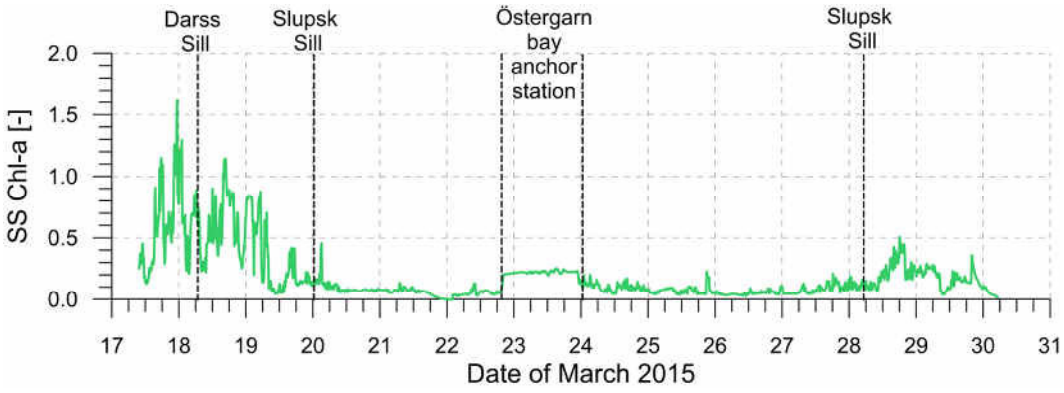

Figure 13: Surface chlorophyll-a fluorescence measured with the flow through fluorometer of FS Elisabeth Mann Borgese.

The surface distribution of Chlorophyll-a fluorescence supplied information about the beginning spring bloom. West of the Bornholm gat elevated Chlorophyll-a fluorescence values indicate that the spring bloom has already started in the Belt Sea and the Arkona Basin. Also in the Bornholm Basin slightly increased Chlorophyll-a fluorescence was observed. East of the Slupsk Sill the Chlorophyll-a fluorescence was weak.

Observations at main stations

The following tables list the surface and bottom values of the most important parameters measured at the main stations of the monitoring program. Since the Swedish authorities did not allow a sampling at the station TF0284 Landsort deep, no data were gathered there. The station is indicated as not sampled (*n.s.*) in Table 4 and 5.
For positions of the particular stations refer to Figure 1 and Table 6. Negative values in the oxygen column are hydrogen sulfide concentrations. The oxygen values in brackets depict the raw readings of the CTD oxygen sensor 0.

Table 4: Surface values of main hydrographic parameters at the main stations.

Area ***Date***	***St. name*** ***St. no.***	***Depth*** ***[m]***	***Temp*** ***[°C]***	***Sal***	***O_2*** ***[ml/l]***	***PO_4*** ***[µmol]***	***NO_3*** ***[µmol]***	***SiO_4*** ***[µmol]***
Kiel Bight 17.03.2015	TF0360 005	2	4.46	14.08	8.74 (8.82)	0.13	0.14	5.4
Meckl. Bight 18.03.2015	TF0012 007	2	4.12	14.45	8.46 (8.78)	0.13	0.04	6.6
Lübeck Bight 18.03.2015	TF0022 006	2	4.49	14.34	8.65 (8.89)	0.08	0.07	5.4
Darss Sill 18.03.2015	TF0030 013	2	4.09	8.96	9.10 (9.26)	0.24	0.16	5.7
Arkona Basin 18.03.2015	TF0113 017	2	4.29	8.48	9.02 (9.45)	0.10	0.01	3.1
Bornholm Deep 19.03.2015	TF0213 037	2	4.30	7.71	9.00 (9.10)	0.66	2.27	13.7
Slupsk Furrow 20.03.2015	TF0222 040	2	4.18	7.56	8.73 (9.08)	0.63	2.31	13.9
SE Gotland Basin 20.03.2014	TF0259 043	2	3.95	7.43	9.02 (9.00)	0.71	2.56	15.6
Gotland Deep 21.03.2015	TF0271 053	2	3.50	7.18	8.97 (8.92)	0.62	2.90	15.3
Farö Deep 25.03.2015	TF0286 065	2	3.40	7.03	8.96 (9.01)	0.60	3.09	14.7
Landsort Deep	*TF0284*	*2*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Karlsö Deep 24.03.2015	TF0245 057	2	3.48	7.17	8.88 (8.84)	0.92	3.21	19.3

Table 5: Bottom values of main hydrographic parameters at the main stations.

Area ***Date***	***St. name*** ***St. no.***	***Depth*** ***[m]***	***Temp*** ***[°C]***	***Sal***	***O_2*** ***[ml/l]***	***PO_4*** ***[µmol]***	***NO_3*** ***[µmol]***	***SiO_4*** ***[µmol]***
Kiel Bight 17.03.2015	TF0360 005	17	3.62	22.23	7.19 (7.26)	0.34	3.36	7.5
Meckl. Bight 18.03.2015	TF0012 007	23	4.34	21.78	5.53 (5.61)	0.79	10.77	20.4
Lübeck Bight 18.03.2015	TF0022 006	22	4.30	21.49	6.38 (5.47)	0.62	9.64	18.4
Darss Sill 18.03.2015	TF0030 013	22	3.88	9.28	8.79 (8.94)	0.40	1.24	8.6
Arkona Basin 18.03.2015	TF0113 017	45	4.81	15.75	4.76 (6.70)	0.69	5.88	13.9
Bornholm Deep 19.03.2015	TF0213 037	87	6.93	19.50	4.07 (4.44)	1.16	9.48	26.5
Slupsk Furrow 20.03.2015	TF0222 040	88	7.25	16.37	4.76 (4.77)	1.25	8.10	26.2

Area *Date*	*St. name* *St. no.*	*Depth* *[m]*	*Temp* *[°C]*	*Sal*	*O_2* *[ml/l]*	*PO_4* *[µmol]*	*NO_3* *[µmol]*	*SiO_4* *[µmol]*
SE Gotland Basin 20.03.2014	TF0259 043	87	6.51	13.25	3.39 (3.49)	1.70	7.13	35.0
Gotland Deep 21.03.2015	TF0271 053	232	7.11	13.40	0.89 (1.35)	2.26	8.98	51.6
Farö Deep 25.03.2015	TF0286 065	187	6.38	11.86	-1.14 (0.06)	3.42	0.00	62.4
Landsort Deep	*TF0284*	*431*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Karlsö Deep 24.03.2015	TF0245 057	105	5.02	9.57	-0.70 (0.08]	3.95	0.00	59.3

Baltic transect

The majority of the stations worked during the cruise EMB099 was arranged along the talweg transect from the Danish straits, through the western Baltic Sea, and further towards the northern Gotland basin. This transect supplies a good overview about the hydrographic and environmental state of the entire Baltic Sea. The transect was worked from 17th to 26th March and depict both, the typical patterns of late spring conditions and the signatures of the MBI events of December 2014 (Figure 14 and Figure 15).

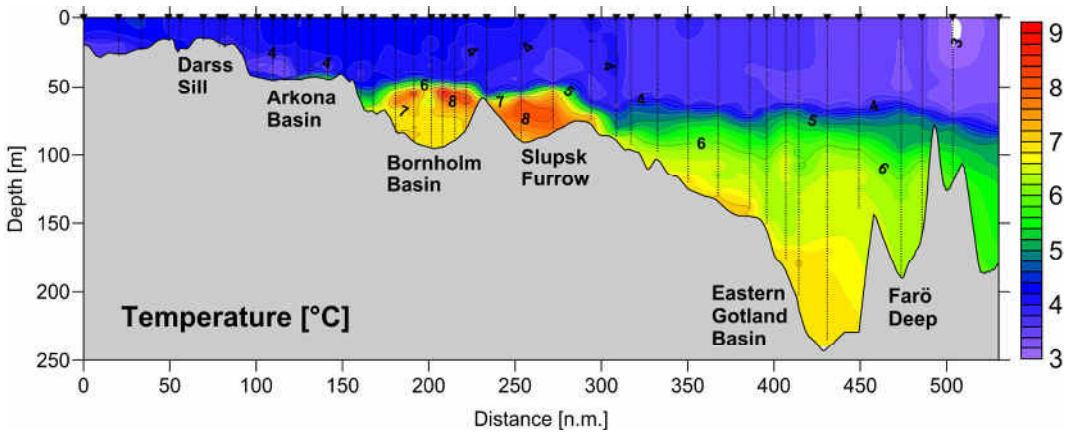

Figure 14: Distribution of temperature along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 17.03. - 26.03.2015.

The temperatures in the surface layer decreases from about 4°C in the west to 2.8°C in the northern Gotland basin. The thickness of the well mixed upper water layer increases eastward from 30 to 40 m in the Arkona Basin to nearly 70m in the central Baltic. Due to the mild winter season the temperatures were in the entire Baltic above the temperature of maximum density. In contrast to "normal" years the first heating of surface layer during spring will stabilize the surface water by the onset of thermal stratification, and the typical early spring convection will not happen this year

The outflow conditions before and during the first part of the cruise have flushed the Belt Sea with low saline surface water of the Baltic. Only the bottom layer of the Kiel Bight and the Kadet furrow were covered by high saline waters.
During the Christmas MBI 2014 large amounts (198km^3) of high saline water entered the Baltic. This water body determined to a large extent the conditions below the halocline of the central Baltic. The saline waters of the inflow have already passed the Arkona Basin. There only a thin saline bottom layer of 3 to 4m thickness was detected. The temperature of this water body was about 4.5°C. Thus, it must originate from a later small inflow in January/February 2015
The deep layers in the Bornholm Basin were completely filled up with the saline water from the MBI 2014. The salinity increases from the halocline at 55m depth from 15 to 19.3 near bottom. The temperature varies below the halocline between 9.0 and 6.8°C. The warm and less salty waters at the top of the halocline are a mixture of old Bornholm Basin bottom water and saline water from the MBI.

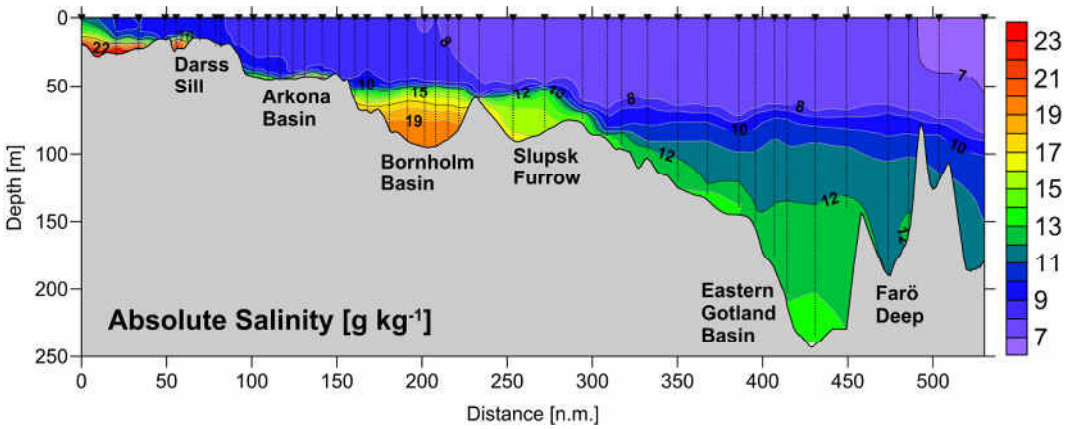

Figure 15: Distribution of Absolute salinity along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 17.03. - 26.03.2015.

This mixed water mass has also filled up the Slupsk Furrow and reached the deep layers of the Eastern Gotland basin. On its pathway the entrainment of less saline ambient water lowers the salinity and temperature of this water mass. The temperature and salinity at the bottom of the Gotland deep was 7.1°C and 13.4, respectively.

The oxygen distribution along the central transect is shown in Figure 16. Due to the 2014 MBI event the western Baltic and also the western part of the central Baltic are well ventilated. The oxygen concentration in the deep layers of the Bornholm Basin and the Slupsk Furrow was above 4ml l^{-1}. However, in the eastern Gotland basin the oxygen concentrations below the halocline were low. At intermediate depth between 120 and 170m hydrogen sulfide was present. This layer depicted a high dynamic, and small scale temperature and salinity fluctuations point to an ongoing mixing process with inflowing MBI water. At some positions oxygen and hydrogen sulfide were present concurrently. Below 170m the eastern Gotland Basin was ventilated by the saline MBI water. Here oxygen concentrations between 0.4 to 0.9 ml l^{-1} were observed. The surface layer of the Baltic is well ventilated mainly due to wind induced deep mixing during the winter season.

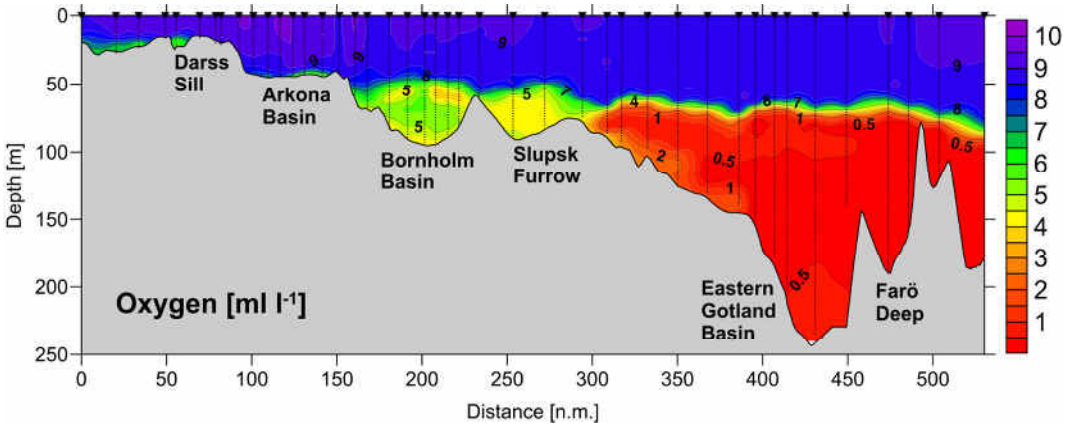

Figure 16: Distribution of oxygen concentration along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 17.03. - 26.03.2015.

The chlorophyll-a fluorescence data gathered along the transect indicate that the spring bloom has already started in the western Baltic (Figure 17). The entire surface layer of the Arkona Basin show high fluorescence values. Also in the western part of the Bornholm Basin the chlorophyll-a fluorescence is enhanced. In the southern and central Baltic the chlorophyll-a fluorescence values were still low.

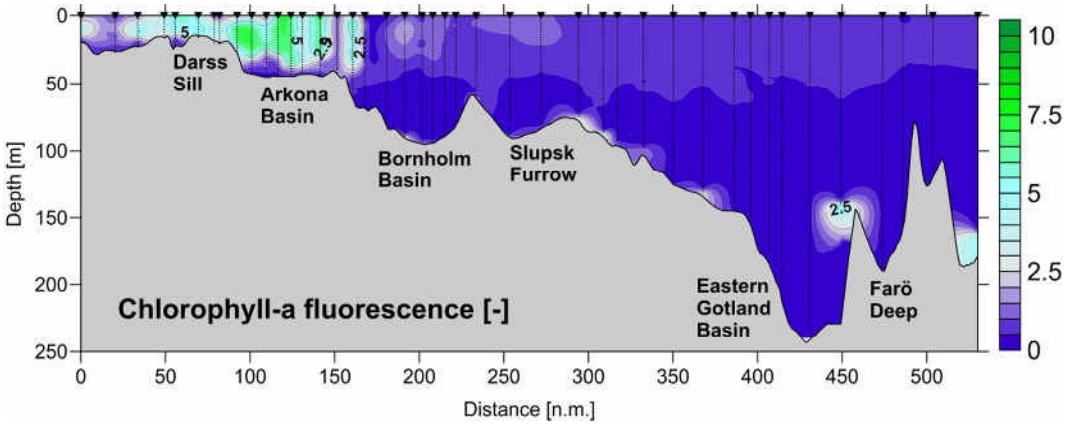

Figure 17: Distribution of Chlorophyll-a fluorescence along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 17.03. - 26.03.2015.

The turbidity in surface water is well correlated to the pattern of the Chlorophyll-a fluorescence. Below the thermocline the turbidity depicts enhanced values in anoxic waters. The highest peaks were found in the redoxclines at the top and the bottom of the anoxic layer (Figure 18).

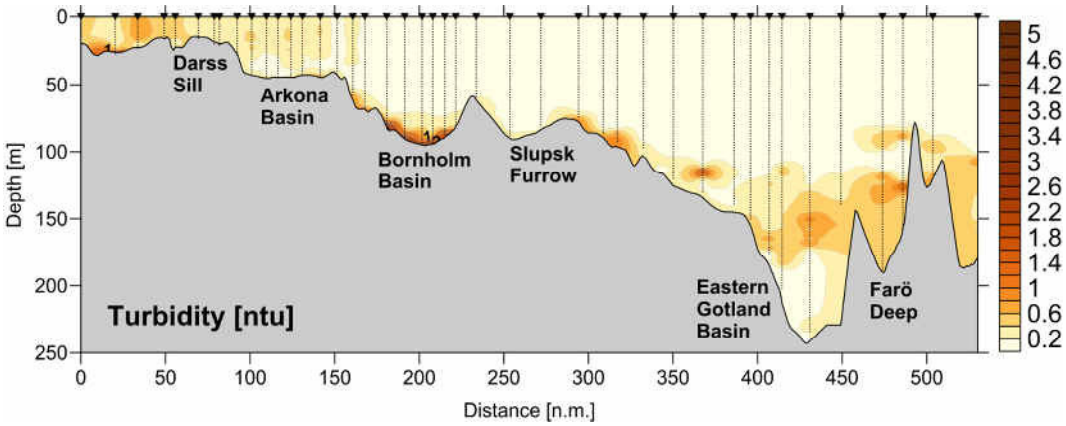

Figure 18: Distribution of turbidity along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 17.03. - 22.06.2015.

The different water masses observed during the cruise can be clearly identified using its temperature, salinity and oxygen signature. Figure 19 gives an overview about the different water masses in a TS-O diagram. The following water bodies were identified and depicted in the figure:

A - Western Baltic surface water
B - Mecklenburg Bight bottom water
C - Central Baltic surface water
D - Bornholm Basin bottom water
E - Bornholm Basin halocline water + Slupsk Furow bottom water
F - Eastern Gotland Basin halocline water
G - Eastern Gotland Basin upward lifted old bottom water
H - Eastern Gotland Basin new bottom water

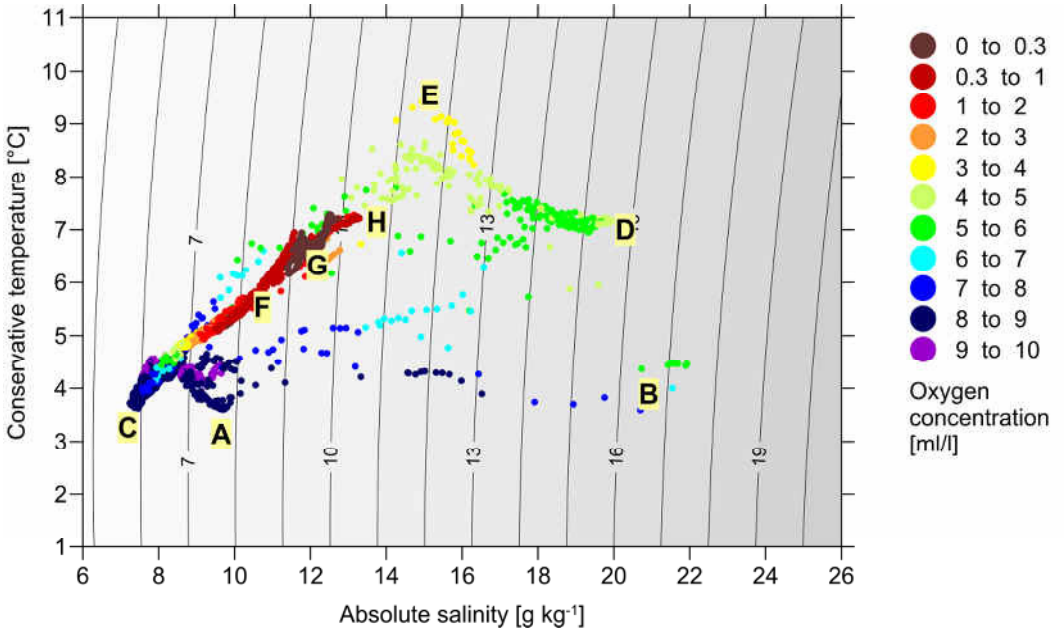

Figure 19: TS-diagram of the Baltic transect. The capital letters indicate the different water masses (see text).

The ongoing inflow process of dense saline water into the eastern Gotland Basin can be illustrated by two profiles subsequently taken at station TF0271 on 21st and on 26th March 2015 (Figure 20). In a 20m thick bottom layer the inflow cause a slightly increasing temperature, salinity and oxygen concentration (A). The vertical extend of the ventilated bottom water layer increases during the five days by about 10m from 60 to 70m (D). This process lifted up the anoxic intermediate layer (red color). However, it upper limit remained at 125m indicating an additional erosion of this layer from above. Both profiles show high small scale variability in all parameters below the halocline pointing to small scale intrusions and enhanced mixing. The halocline itself was eroded from the high wind forcing and changed the vertical position from 70m to 75m (B).

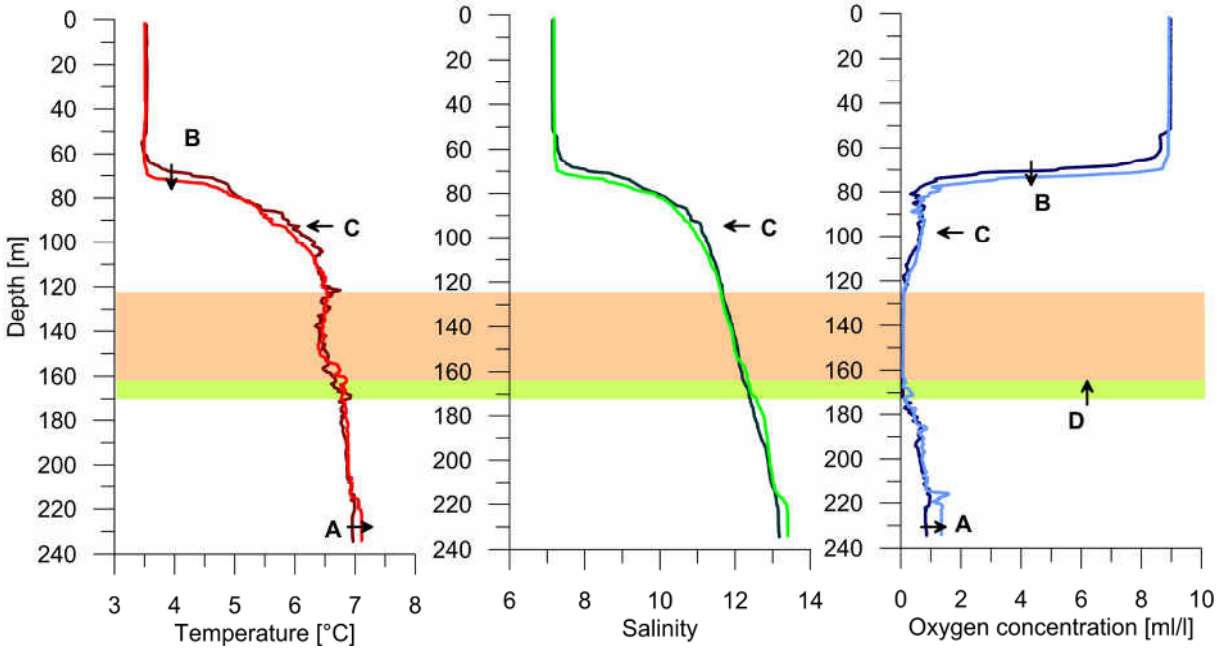

Figure 20: Vertical profiles of CTD data taken on station TF0271 on 21.03.2015 (dark color) and four days later on 26.03.2015 (bright color).

Southern Gotland Basin Transect

From 27th March a zonal transect at the southern rim of the Eastern Gotland Basin was performed (compare Figure 1). It shows the stratification at the entrance of the Eastern Gotland Basin. The inflowing saline water enters the Basin at the eastern slope, visible as a patch of higher temperature, salinity and oxygen concentration between 150m depth and the bottom. The turbidity is enhanced in the older anoxic bottom water.

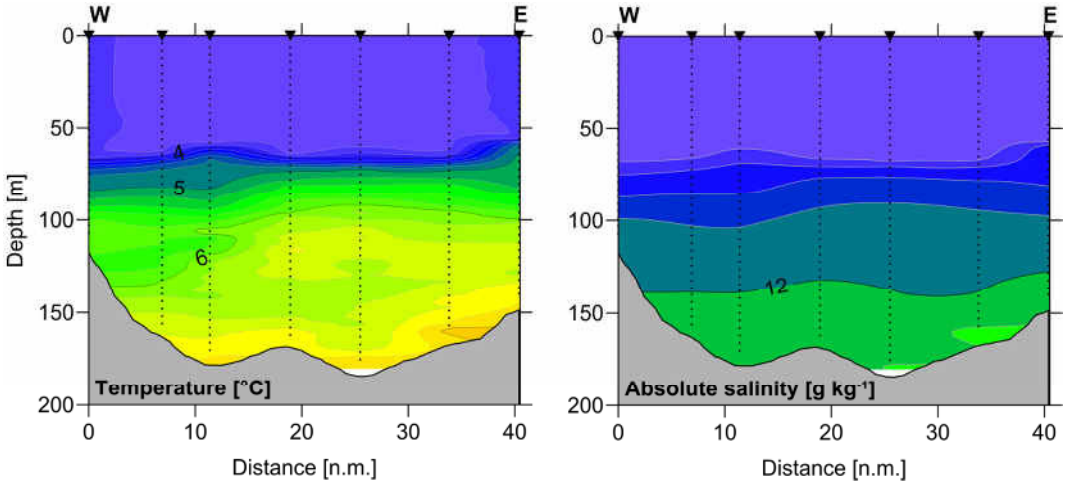

Figure 21: Temperature and salinity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 27.03.2015).

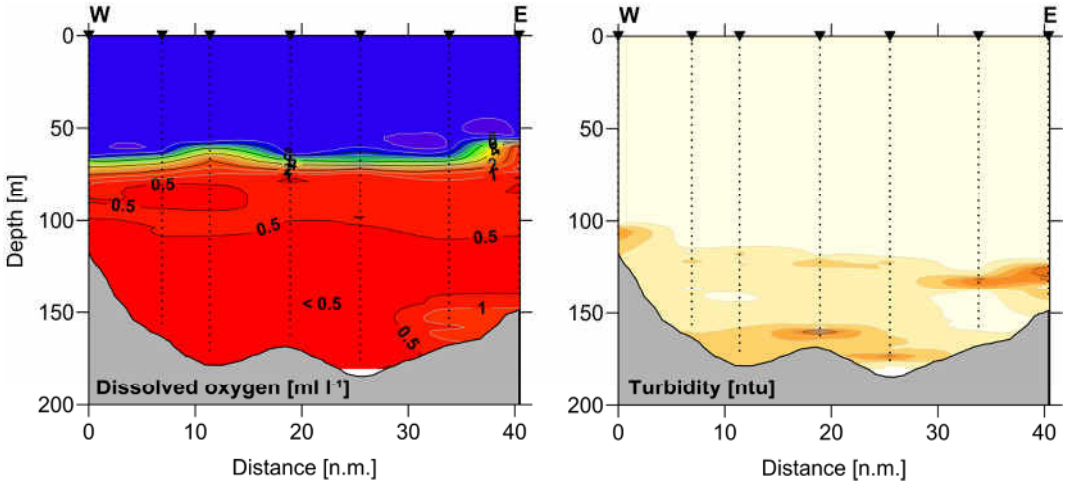

Figure 22: Dissolved oxygen and turbidity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 27.03.2015).

Arkona Basin to Slupsk Furrow ScanFish transect

In order to obtain high resolution data about the distribution of inflow water along its pathway from the Arkona Basin towards the Eastern Gotland Basin a ScanFish undulating CTD was deployed on the way back to Rostock. The transect could be successful completed. The gathered data depict the same pattern as observed with the vertical CTD but in a horizontal resolution of about 1km. The preliminary data of this transect are depicted in Figure 23 to 26.

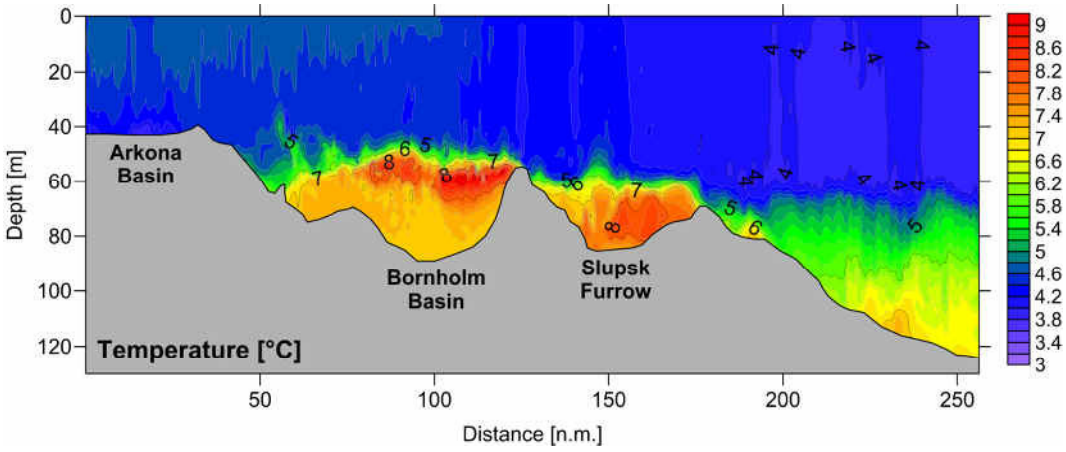

Figure 23: Temperature distribution along the ScanFish transect from the Arkona Basin to the southern rim of the Eastern Gotland Basin (data gathered from 27th to 29th March 2015).

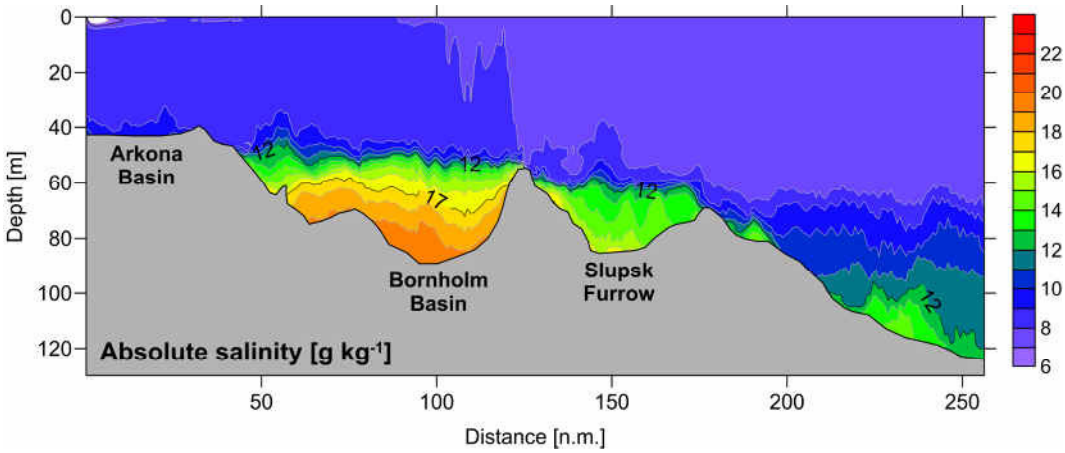

Figure 24: Salinity distribution along the ScanFish transect from the Arkona Basin to the southern rim of the Eastern Gotland Basin (data gathered from 27th to 29th March 2015).

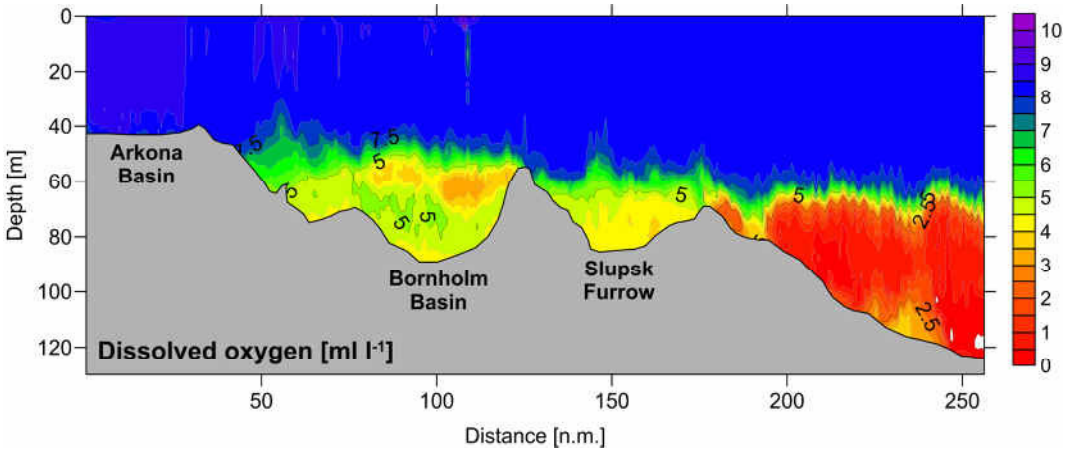

Figure 25: Distribution of dissolved oxygen along the ScanFish transect from the Arkona Basin to the southern rim of the Eastern Gotland Basin (data gathered from 27th to 29th March 2015).

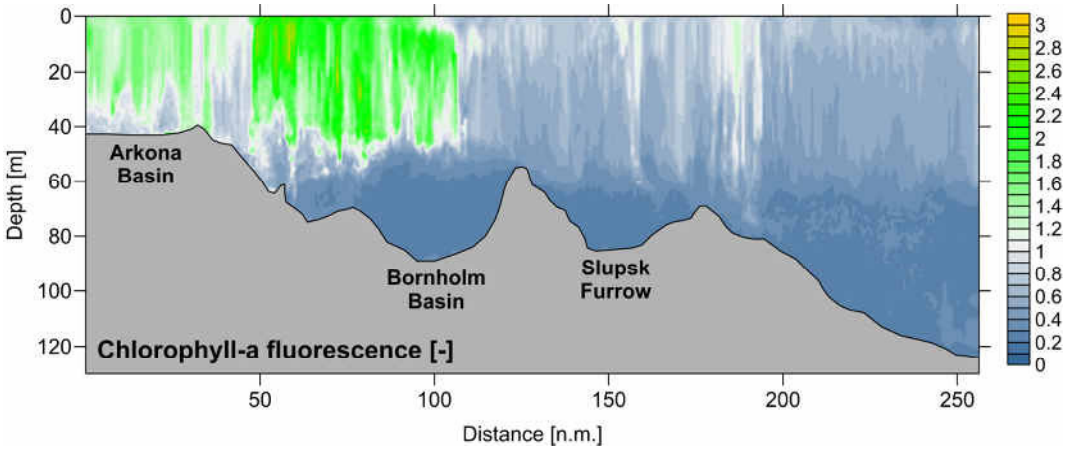

Figure 26: Clorophyll-a fluorescence distribution along the ScanFish transect from the Arkona Basin to the southern rim of the Eastern Gotland Basin (data gathered from 27th to 29th March 2015).

Organic mercury compounds subjected to transport processes

DMHg was determined at low concentrations of a few picograms per liter in bottom waters. Analysis of intermediate waters and surface waters rarely revealed values above the detection limit. The low concentrations in deep waters might be caused by the major inflow event of December 2014/January 2015 that re-oxygenated deep waters in large areas of the Bornholm Sea and the southern eastern Gotland Sea. Sulfate and iron reducing bacteria and methanogene archea produce organic mercury compounds in low oxygen and anoxic waters during particle remineralisation. Thus production of DMHg in Baltic Sea deep waters was hampered and additionally, remaining DMHg was potentially degraded. Moreover, longer and more intense sunshine in spring may have led to a declined concentration of DMHg in surface waters. MMHg and Hg_{tot} samples that will be analyzed in the next months will show the potential impact of the inflow event by comparison to measurements done in March 2014.

4. Stations and deployments

Table 6 and 7 list all stations and deployments carried out during the cruise EMB099. Standard sampling was CTD cast with nutrient samples at fixed standard depth. At some stations a number of additional samplings was performed. These tasks are indicated in the last column of table 6.

Additional sampling program on selected stations:

Bio - Biological sampling for BSH monitoring and IOW long term data program
SG - Trace gas sampling (CH_4 and N_2O)
Dens - Water samples for density measurements (IOW long term data program)
Hg - Water samples for mercury analysis
Zoo - Zooplankton sampling
MSS - Microstructure pofiler for tubulence and mixing study
PCTD - PumpCTD for mercury analysis
MolBio - Molecular biology

Table 6: List of stations, CTD casts, net samplings and additional samplings

Stat No.	Stat.Name (Depth)		Date	Time [UTC]	Latitude	Longitude	CTD cast(s)	Nets & samples
1	TFO5 (13.3m)	Begin	17.03.2015	08:48	54°13.7950N	12°04.4219E	V0001F01	
		End	17.03.2015	09:05	54°13.8730N	12°04.4553E		
2	TF0011 (25.6m)	Begin	17.03.2015	11:01	54°24.8425N	11°36.9509E	V0002F01	
		End	17.03.2015	11:10	54°24.8401N	11°36.9475E		
3	TF0010 (28.5m)	Begin	17.03.2015	12:39	54°33.1681N	11°19.1468E	V0003F01	
		End	17.03.2015	12:45	54°33.1557N	11°19.1592E		
4	TF0361 (23.3m)	Begin	17.03.2015	14:34	54°39.5754N	10°45.8808E	V0004F01	
		End	17.03.2015	15:02	54°39.5087N	10°46.0341E	V0004F02	
5	TF0360 (18.5m)	Begin	17.03.2015	16:13	54°35.9716N	10°26.8601E	V0005F01	Bio
		End	17.03.2015	16:41	54°35.9808N	10°26.9611E	V0005F02	
6	TF0022 (23.2m)	Begin	17.03.2015	22:42	54°06.5977N	11°10.4373E	V0006F01	
		End	17.03.2015	22:56	54°06.7535N	11°10.7343E		
7	TF0012 (24.5m)	Begin	18.03.2015	00:36	54°18.9293N	11°32.9824E	V0007F01	Bio
		End	18.03.2015	00:48	54°18.9262N	11°33.0044E		
8	TF0041 (20.0m)	Begin	18.03.2015	02:54	54°24.4049N	12°03.6629E	V0008F01	
		End	18.03.2015	03:02	54°24.4008N	12°03.6787E		
9	TF0040 (12.6m)	Begin	18.03.2015	03:41	54°29.2886N	12°03.8643E	V0009F01	
		End	18.03.2015	03:44	54°29.2937N	12°03.8757E		
10	TF0046 (26.0m)	Begin	18.03.2015	04:37	54°28.0218N	12°13.0053E	V0010F01	Bio, Hg
		End	18.03.2015	04:54	54°27.9303N	12°13.0277E		
11	TF0002 (18.1m)	Begin	18.03.2015	06:40	54°39.0030N	12°26.8491E	V0011F01	
		End	18.03.2015	07:25	54°38.9793N	12°27.0083E	V0011K02	
12	TF0001 (21.3m)	Begin	18.03.2015	08:25	54°41.7535N	12°42.0790E	V0012F01	
		End	18.03.2015	08:41	54°41.7731N	12°42.4235E		
13	TF0030 (22.5m)	Begin	18.03.2015	09:15	54°43.3937N	12°46.9458E	V0013F01	Bio
		End	18.03.2015	09:39	54°43.4971N	12°47.2944E		
14	TF0115 (30.1m)	Begin	18.03.2015	10:50	54°47.7194N	13°03.4216E	V0014F01	
		End	18.03.2015	10:56	54°47.7170N	13°03.4463E		
15	TF0114 (44.5m)	Begin	18.03.2015	11:56	54°51.5999N	13°16.5861E	V0015F01	
		End	18.03.2015	12:08	54°51.6126N	13°16.5524E		
16	TF0069 (46.5m)	Begin	18.03.2015	13:04	55°00.0141N	13°17.9842E	V0016F01	
		End	18.03.2015	13:16	55°00.0090N	13°18.0169E		
17	TF0113 (47.0m)	Begin	18.03.2015	14:09	54°55.5038N	13°29.9080E	V0017F01	Bio, Hg, Dens, SG
		End	18.03.2015	15:09	54°55.4976N	13°29.9778E	V0017F02	
18	TF0105 (46.5m)	Begin	18.03.2015	16:28	55°01.5020N	13°36.3466E	V0018F01	
		End	18.03.2015	16:37	55°01.4979N	13°36.3672E		
19	TF0104 (46.4m)	Begin	18.03.2015	17:27	55°04.0868N	13°48.7448E	V0019F01	
		End	18.03.2015	17:57	55°04.1157N	13°48.8988E		
20	ABBoje (45.7m)	Begin	18.03.2015	19:12	54°52.8072N	13°51.3661E	V0020F01	
		End	18.03.2015	19:24	54°52.7987N	13°51.4369E		
21	TF0112 (40.6m)	Begin	18.03.2015	20:08	54°48.1904N	13°57.4513E	V0021F01	
		End	18.03.2015	20:20	54°48.2065N	13°57.5039E		
22	TF0121 (30.5m)	Begin	18.03.2015	20:59	54°42.6246N	13°56.7572E	V0022F01	
		End	18.03.2015	21:12	54°42.6061N	13°56.8397E		
23	TF0150 (22.1m)	Begin	18.03.2015	22:03	54°36.7306N	14°02.5580E	V0023F01	
		End	18.03.2015	22:15	54°36.7041N	14°02.5945E		
24	TF0111 (44.7m)	Begin	18.03.2015	23:57	54°53.3961N	13°58.1368E	V0024F01	
		End	19.03.2015	00:03	54°53.3868N	13°58.1309E		
25	TF0109 (47.7m)	Begin	19.03.2015	00:58	55°00.0214N	14°04.9971E	V0025F01	Bio
		End	19.03.2015	01:33	55°00.0141N	14°05.0683E	V0025F02	
26	TF0103 (47.0m)	Begin	19.03.2015	02:28	55°03.7774N	13°59.3142E	V0026F01	
		End	19.03.2015	02:35	55°03.7726N	13°59.3578E		

Stat No.	*Stat.Name (Depth)*		*Date*	*Time [UTC]*	*Latitude*	*Longitude*	*CTD cast(s)*	*Nets & samples*
27	TF0102 (44.8m)	Begin	19.03.2015	03:24	55°09.2658N	13°56.5317E	V0027F01	Hg
		End	19.03.2015	03:31	55°09.2651N	13°56.5248E		
28	TF0145 (46.5m)	Begin	19.03.2015	04:42	55°10.0317N	14°14.9803E	V0028F01	
		End	19.03.2015	04:49	55°10.0637N	14°14.9522E		
29	TF0144 (45.0m)	Begin	19.03.2015	05:53	55°15.1718N	14°29.8355E	V0029F01	
		End	19.03.2015	06:05	55°15.1622N	14°29.8974E		
30	TF0142 (60.0m)	Begin	19.03.2015	07:13	55°24.2822N	14°32.2224E	V0030F01	
		End	19.03.2015	07:26	55°24.3101N	14°32.2519E		
31	TF0140 (69.1m)	Begin	19.03.2015	08:26	55°27.9915N	14°42.9743E	V0031F01	Hg
		End	19.03.2015	09:22	55°27.9878N	14°42.9976E	V0031K02	
32	ZS0001 (84.7m)	Begin	19.03.2015	10:35	55°29.7537N	15°04.9858E	V0032F01	
		End	19.03.2015	10:53	55°29.7417N	15°05.5967E		
33	TF0200 (91.0m)	Begin	19.03.2015	12:00	55°23.0075N	15°19.9280E	V0033F01	SG
		End	19.03.2015	12:16	55°22.9968N	15°20.0400E		
34	TF0211 (95.3m)	Begin	19.03.2015	13:17	55°19.8097N	15°36.8812E	V0034F01	
		End	19.03.2015	13:35	55°19.8193N	15°36.9163E		
35	TF0214 (93.7m)	Begin	19.03.2015	14:42	55°09.5577N	15°39.6146E	V0035F01	MSS test
		End	19.03.2015	15:03	55°09.5673N	15°39.7101E		
36	TF0212 (95.1m)	Begin	19.03.2015	16:45	55°18.1132N	15°47.7823E	V0036F01	SG
		End	19.03.2015	17:02	55°18.1036N	15°47.8803E		
37	TF0213 (90.0m)	Begin	19.03.2015	17:51	55°15.0013N	15°58.9234E	V0037F01	Bio, SG, Dens, Hg, Zoo
		End	19.03.2015	20:49	55°14.9453N	15°58.8244E	V0037F02 V0037F03	
38	TF0221 (82.6m)	Begin	19.03.2015	21:52	55°13.3089N	16°09.9400E	V0038F01	
		End	19.03.2015	22:07	55°13.2931N	16°10.0514E		
39	TF0224 (62.1m)	Begin	19.03.2015	23:19	55°16.9925N	16°29.9600E	V0039F01	
		End	19.03.2015	23:34	55°17.0107N	16°30.1481E		
40	TF0222 (90.3m)	Begin	20.03.2015	01:31	55°12.9710N	17°04.0645E	V0040F01	Hg
		End	20.03.2015	01:44	55°12.9466N	17°04.2275E		
41	SC_E (83.6m)	Begin	20.03.2015	03:37	55°17.2025N	17°35.5956E	V0041F01	
		End	20.03.2015	03:47	55°17.1458N	17°35.4959E		
42	TF0256 (78.3m)	Begin	20.03.2015	06:09	55°19.6316N	18°14.1626E	V0042F01	
		End	20.03.2015	06:23	55°19.6038N	18°14.0196E		
43	TF0259 (89.5m)	Begin	20.03.2015	07:50	55°32.9735N	18°24.0454E	V0043F01	Bio, SG,
		End	20.03.2015	08:46	55°32.9632N	18°23.8388E	V0043F02	
44	TF0255 (94.8m)	Begin	20.03.2015	09:44	55°37.9954N	18°36.0425E	V0044F01	
		End	20.03.2015	10:04	55°38.0717N	18°35.9641E		
45	TF0252 (113.0m)	Begin	20.03.2015	11:27	55°51.9898N	18°38.4558E	V0045F01	
		End	20.03.2015	12:00	55°51.9815N	18°38.4565E		
46	TF0253 (100.6m)	Begin	20.03.2015	12:56	55°50.4503N	18°51.9967E	V0046F01	SG, MSS, PCTD, Hg
		End	20.03.2015	20:18	55°50.2382N	18°51.2452E	V0046F02 V0046K03 V0046K04 V0046F14	
47	TF0250 (123.0m)	Begin	20.03.2015	22:45	56°04.9814N	19°10.0611E	V0047F01	
		End	20.03.2015	23:08	56°05.0164N	19°09.9926E		
48	TF0263 (132.7m)	Begin	21.03.2015	00:46	56°20.8105N	19°22.6975E	V0048F01	SG, MSS, PCTD, Hg
		End	21.03.2015	01:55	56°20.8194N	19°22.7054E	V0048F02	
49	TF0260 (142.5m)	Begin	21.03.2015	03:44	56°37.9858N	19°34.9318E	V0049F01	
		End	21.03.2015	04:46	56°38.0315N	19°35.0332E	V0049K02	
50	34 (152.3m)	Begin	21.03.2015	05:49	56°45.9737N	19°44.8490E	V0050F01	
		End	21.03.2015	06:09	56°46.0133N	19°45.0504E		
51	GB_B7 (181.0m)	Begin	21.03.2015	07:40	56°57.0529N	19°46.1430E	V0051F01	
		End	21.03.2015	08:09	56°57.1932N	19°46.1952E		

Stat No.	*Stat.Name (Depth)*		*Date*	*Time [UTC]*	*Latitude*	*Longitude*	*CTD cast(s)*	*Nets & samples*
52	TF0272 (206.0m)	Begin	21.03.2015	09:41	57°04.2261N	19°49.7505E	V0052F01 V0052F02	
		End	21.03.2015	10:52	57°05.0182N	19°50.2524E		
53	TF0271 (237.5m)	Begin	21.03.2015	22:39	57°19.1734N	20°02.9171E	V0053F01 V0053F02 V0053F03 V0053F04 V0053F05 V0053F06	Hg, MolBio SG, CO_2
		End	22.03.2015	02:56	57°19.1803N	20°03.0068E		
54	GONE (215.5m)	Begin	22.03.2015	04:37	57°21.8618N	20°20.4905E	V0054F01	Mooring
		End	22.03.2015	10:18	57°21.7311N	20°19.0738E		
55	TF0271 (237.5m)	Begin	22.03.2015	11:19	57°19.2559N	20°02.9639E	V0055F01	Bio, Redox, MSS,
		End	22.03.2015	15:27	57°18.8881N	20°01.9339E		
56	GB_B13 (204.0m)	Begin	22.03.2015	16:29	57°16.0025N	19°47.8271E	V0056F01	
		End	22.03.2015	16:49	57°15.9591N	19°47.6748E		
57	TF0245 (109.2m)	Begin	24.03.2015	07:20	57°06.9976N	17°40.0763E	V0057F01 V0057F02	
		End	24.03.2015	08:15	57°06.9877N	17°39.9543E		
58	TF0242 (139.8m)	Begin	24.03.2015	11:45	57°42.9833N	17°21.9367E	V0058F01	
		End	24.03.2015	12:04	57°43.0280N	17°22.0649E		
59	TF0240 (164.1m)	Begin	24.03.2015	14:30	57°59.9967N	17°59.8145E	V0059F01	
		End	24.03.2015	14:52	58°00.0104N	18°00.0403E		
60	TF0283 (115.0m)	Begin	24.03.2015	20:14	58°46.9907N	19°05.9244E	V0060F01 V0060F02 V0060K03	
		End		21:08	58°47.0285N	19°06.0719E		
61	TF0282 (163.0m)	Begin	25.03.2015	00:50	58°52.9105N	20°18.8682E	V0061F01	MSS, Hg
		End	25.03.2015	02:08	58°53.5843N	20°19.6039E		
62	TF0285 (121.0m)	Begin	25.03.2015	04:46	58°26.3986N	20°19.7982E	V0062F01	MSS, SG, PCTD, Hg
		End	25.03.2015	09:24	58°24.6075N	20°17.9669E		
63	GB_B24 (160.7m)	Begin	25.03.2015	10:54	58°10.9356N	20°03.0972E	V0063F01	
		End	25.03.2015	11:15	58°11.0043N	20°03.0821E		
64	GB_B18 (121.5m)	Begin	25.03.2015	13:06	57°59.9795N	19°35.9848E	V0064F01	
		End	25.03.2015	13:15	57°59.9932N	19°36.0009E		
65	TF0286 (191.5m)	Begin	25.03.2015	14:21	57°59.9692N	19°53.9576E	V0065F01 V0065F02	SG, Hg
		End	25.03.2015	15:34	58°00.0482N	19°54.2914E		
66	GB_B19 (124.0m)	Begin	25.03.2015	16:43	57°57.7896N	20°12.8563E	V0066F01	
		End	25.03.2015	16:55	57°57.7828N	20°12.9519E		
67	GB_B20 (98.8m)	Begin	25.03.2015	18:05	57°55.3317N	20°31.2156E	V0067F01 V0067K02	
		End	25.03.2015	18:45	57°55.4004N	20°31.4253E		
68	GB_B21 (89.5m)	Begin	25.03.2015	19:52	57°53.2724N	20°49.8420E	V0068F01	
		End	25.03.2015	20:09	57°53.3309N	20°50.0555E		
69	GB_B16 (134.7m)	Begin	25.03.2015	21:19	57°43.6089N	20°41.4456E	V0069F01	
		End	25.03.2015	21:39	57°43.6674N	20°41.4353E		
70	GB_B15 (156.5m)	Begin	25.03.2015	23:02	57°31.4599N	20°32.5192E	V0070F01	
		End	25.03.2015	23:28	57°31.4771N	20°32.6247E		
71	TF0270 (142.5m)	Begin	26.03.2015	00:46	57°36.8744N	20°10.0955E	V0071F01	SG
		End	26.03.2015	01:07	57°36.9982N	20°09.9958E		
72	TF0271 (238.0m)	Begin	26.03.2015	03:02	57°19.1700N	20°02.8717E	V0072F01	MSS, PCTD, Hg
		End	26.03.2015	09:14	57°18.8365N	20°04.5418E		
73	GB_B14 (231.9m)	Begin	26.03.2015	10:12	57°12.1226N	20°10.1484E	V0073F01	
		End	26.03.2015	10:43	57°12.1553N	20°10.2278E		
74	GB_B9 (144.5m)	Begin	26.03.2015	12:31	56°54.3044N	20°12.8432E	V0074F01	
		End	26.03.2015	12:51	56°54.3278N	20°12.9780E		
75	GB_B8 (164.1m)	Begin	26.03.2015	13:37	56°55.4073N	20°01.0982E	V0075F01	
		End	26.03.2015	13:54	56°55.4018N	20°01.0954E		

Stat No.	Stat.Name (Depth)		Date	Time [UTC]	Latitude	Longitude	CTD cast(s)	Nets & samples
76	GB_B7 (182.3m)	Begin	26.03.2015	14:49	56°57.1169N	19°46.1447E	V0076F01	
		End	26.03.2015	15:11	56°57.0907N	19°46.2609E		
77	GB_B6 (165.8m)	Begin	26.03.2015	16:00	56°58.7924N	19°34.5392E	V0077F01	
		End	26.03.2015	16:15	56°58.8206N	19°34.6918E		
78	GB_batre (174.1m)	Begin	26.03.2015	17:08	57°00.5546N	19°21.0433E	V0078F01	
		End	26.03.2015	17:28	57°00.5268N	19°21.3063E		
79	GB_B4 (160.4m)	Begin	26.03.2015	18:04	57°01.7310N	19°13.0763E	V0079F01	
		End	26.03.2015	18:22	57°01.7674N	19°13.3317E		
80	GB_B3 (114.0m)	Begin	26.03.2015	19:12	57°04.3853N	19°01.4368E	V0080F01	
		End	26.03.2015	19:28	57°04.3977N	19°01.5509E		
81	TF0263 (131.8m)	Begin	27.03.2015	00:27	56°20.8208N	19°22.7285E	V0081F01	MSS, PCTD, Hg
		End	27.03.2015	08:18	56°16.7446N	19°16.4315E		
82	TF0213 (89.8m)	Begin	28.03.2015	08:31	55°14.9903N	15°59.1128E	V0082F01	Bio, Hg
		End	28.03.2015	09:53	55°14.6184N	15°58.5545E	V0082F02	
83	TF0113 (47.5m)	Begin	29.03.2015	04:36	54°55.5488N	13°30.0115E	V0083F01	Bio, Hg
		End	29.03.2015	05:39	54°55.5097N	13°30.0686E	V0083F02	
84	TF0114 (44.7m)	Begin	29.03.2015	07:01	54°51.6467N	13°16.6157E	V0084F01	
		End	29.03.2015	07:11	54°51.6192N	13°16.6432E		
85	TF0115 (29.5m)	Begin	29.03.2015	08:22	54°47.7173N	13°03.5649E	V0085F01	
		End	29.03.2015	08:31	54°47.6984N	13°03.5147E		
86	TF0030 (22.7m)	Begin	29.03.2015	09:44	54°43.4184N	12°47.0445E	V0086F01	Bio
		End	29.03.2015	10:09	54°43.3228N	12°46.8290E		
87	TF0001 (21.1m)	Begin	29.03.2015	10:35	54°41.7793N	12°42.3131E	V0087F01	
		End	29.03.2015	10:44	54°41.7470N	12°42.2805E		
88	TF0002 (17.6m)	Begin	29.03.2015	11:54	54°38.9841N	12°27.0090E	V0088F01	
		End	29.03.2015	11:57	54°39.0050N	12°26.9828E		
89	TF0083 (25.3m)	Begin	29.03.2015	13:04	54°32.9769N	12°16.5720E	V0089F01	
		End	29.03.2015	13:07	54°32.9690N	12°16.5593E		
90	TF0046 (25.4m)	Begin	29.03.2015	13:47	54°28.0362N	12°13.0974E	V0090F01	Bio
		End	29.03.2015	13:58	54°27.9262N	12°12.9678E		
91	TF0041 (18.8m)	Begin	29.03.2015	15:09	54°24.4891N	12°03.7911E	V0091F01	
		End	29.03.2015	15:15	54°24.4520N	12°03.6969E		
92	TF0017 (21.3m)	Begin	29.03.2015	16:35	54°23.5747N	11°49.5372E	V0092F01	
		End	29.03.2015	16:44	54°23.5104N	11°49.3749E		
93	TF0012 (24.3m)	Begin	29.03.2015	17:58	54°18.8265N	11°32.9937E	V0093F01	Bio
		End	29.03.2015	18:33	54°18.9434N	11°32.9274E		

Table 7: Mooring positions in the eastern Gotland Basin

Name	Depth	Latitude	Longitude	deployed	recovered	Comment
GONE (NE28)	220	57°21.951'N	20°20.772'E	*28.10.2014*	22.03.2015 08:00	Main station
	220	57°21.956'N	20°20.483'E			ADCP, end of ground rope
GONE (NE29)	224	57°22.000'N	20°20.000'E	22.03.2015 10:00	*Nov 2015*	Main station
	220	57°21.904'N	20°19.955'E			ADCP, end of ground rope