Cruise report – EMB179

Leibniz-Institute for Baltic Sea Research Warnemünde, Germany
On board, 29.03.2018

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1. Basic information

Ship: FS Elisabeth Mann Borgese
Cruise: EMB179
Date: 19.03. – 28.03. 2017
Chief scientist: Dr. Volker Mohrholz

Objectives

The cruise EMB179 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 subsequent MBIs, observed between 2014 and 2017, on the environmental conditions in the central Baltic.

Staff

	Name	***On board***	***Institution***	***Responsibility***
1	Dr. Volker Mohrholz	19.03.-28.03.2018	IOW Warnemünde	VMADCP, MSS, chief scientist
2	Martin Kolbe	19.03.-28.03.2018	IOW Warnemünde	CTD, ScanFish, MSS
3	Jan Donath	19.03.-28.03.2018	IOW Warnemünde	CTD, ScanFish; MSS
4	Birgit Sadkowiak	19.03.-28.03.2018	IOW Warnemünde	Nutrients and chem. samples
5	Susanne Schöne	19.03.-28.03.2018	IOW Warnemünde	Nutrients and chem. samples
6	Stefan Otto	19.03.-28.03.2018	IOW Warnemünde	Nutrients and chem. samples
7	Greta Feddersen	19.03.-28.03.2018	IOW Warnemünde	Nutrients and chem. samples
8	Uwe Hehl	19.03.-28.03.2018	IOW Warnemünde	Moorings, Plankton sampling
9	Michael Pötzsch	19.03.-28.03.2018	IOW Warnemünde	Biol. and plankton sampling
10	Ireneusz Litwin	19.03.-28.03.2018	Slupsk	Polish observer

Area of investigation

The cruise EMB179 was dedicated to the Baltic monitoring program (BMP), and to the Baltic long term observation program of the (IOW). 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 CTD stations was worked, in order to gather information about the cross basin distribution of hydrographic parameters in the main basin of the Baltic proper. Additionally, a number of CTD casts were carried out at stations aside the main transects, especially in the western Gotland Basin. The use of ScanFish undulating CTD was planned on the way back to Rostock. Due to technical problems this transect could not be measured with the ScanFish system.

An overview of the location of CTD stations, mooring positions, and the cruise track is given in Figure 1. A station list is given in Table 8.

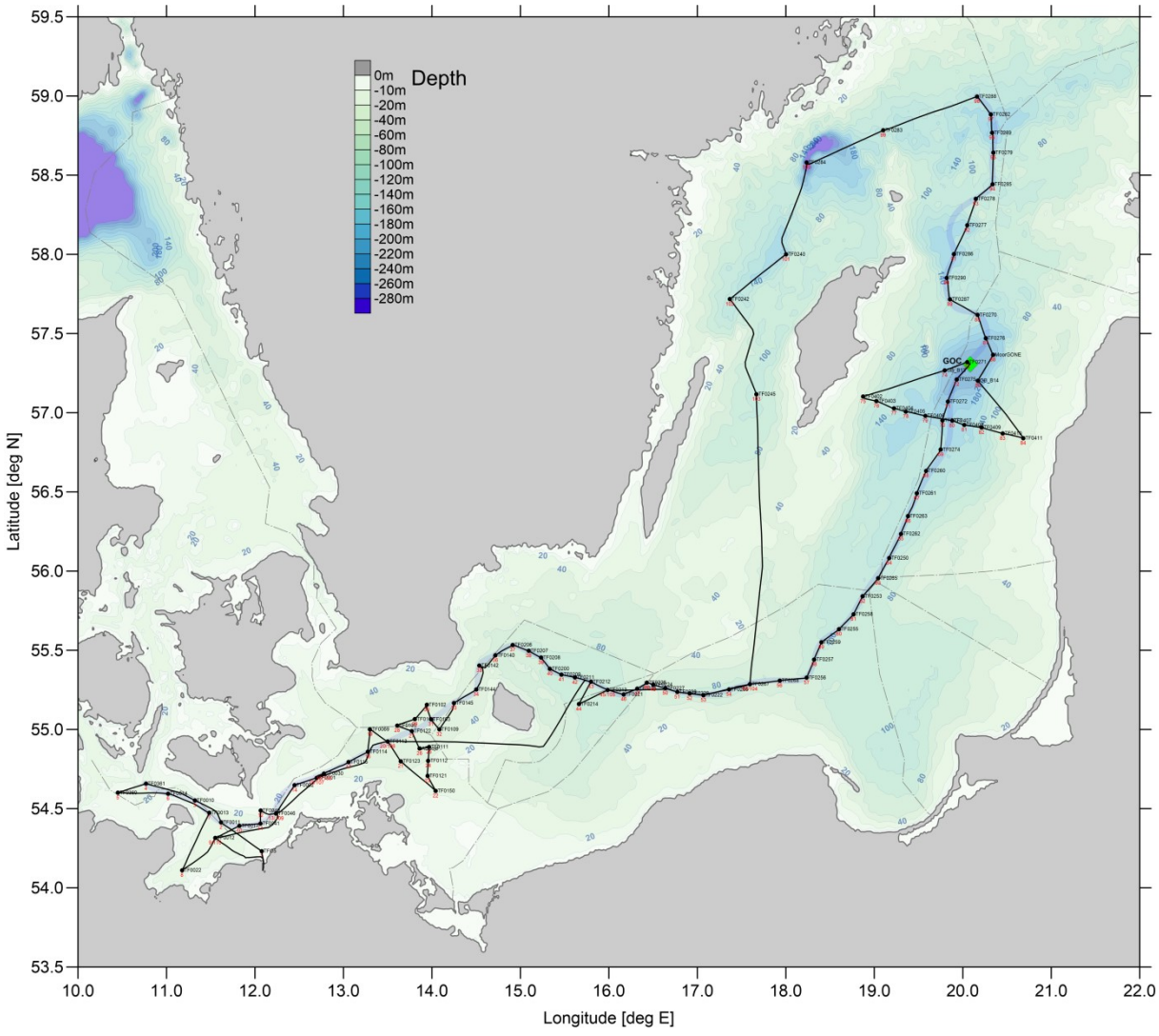

Figure 1: Map of stations and ship track of cruise EMB150 from 19. – 28. March 2018. Black dots and labels indicate the positions and names of CTD stations. The red labels depict the CTD station number. Green diamonds mark the location of mooring GOC in the eastern Gotland basin.

Equipment

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

At stations and transects:

- CTD SBE 911+ with rosette water sampler
- Oceanographic moorings (GOC)
- Towed CTD ScanFish (SF)
- Phytoplankton nets
- Zooplankton net (WP2)
- Secci desk

Continuous measurements:

- Vessel mounted ADCP 150kHz Ocean Surveyor
- Vessel mounted ADCP 300kHz WH mounted in the moon pool
- Underway measurements of surface water properties
- Ship weather station

Narrative of the cruise

Date	***Time [UTC]***	***Task***
16.03.2018		loading of equipment, preparing devices for the cruise
19.03.2018	06:00	Embarking of scientific crew
	06:30	Safety instructions
	07:00	Departure from port Rostock-Marienehe, weather predictions for the next two days are good.
	08:10	Start of station work in the western Baltic, test station off Warnemünde. Begin of data acquisition with the VMADCP 300kHz.
	15:30	Station work at western most station TF0360
20.03.2018		Continuation of station work in the western Baltic. During the night the wind increased to 8Bft, slowly decreasing to 7Bft in the morning hours
	08:15	Work at MARNET station Darss Sill. The planned recovery of three OBS moorings has been cancelled due to heavy winds and high sea state.
	08:30	Begin of data acquisition with the VMADCP 150kHz at the Darss Sill. (cast 001)
	13:00	Wind is decreasing to 5Bft.
	21:40	Work at MARNET station Arkona
21.03.2018		Continuation of station work in the eastern Arkona basin.
	06:40	Passing the Bornholmgat, weather is good, sunshine and moderate winds
	19:00	Start station work on Bornholm Basin central station TF0213
22.03.2018		Continuation of station work in the eastern Bornholm basin.
	00:22	Passing the Slupsk Sill, continuation of station work in the Slupsk Furrow.
	06:00	Wind has increased during the night to 6Bft from westerly directions
	08:30	Passing the eastern rim of Slupsk Furrow
	10:09	VMADCP150 switched to narrow band mode with extended range (cast 002)
	22:00	Entering the eastern Gotland Basin, Wind is decreasing to 5Bft
23.03.2018	06:15	Arrival at mooring position Gotland Central GOC
	06:34	Mooring successful released
	07:09	Mooring successful and completely recovered
	07:22	Start station work on Gotland Basin central station TF0271
	10:07	Mooring successful deployed, with calm wind conditions
	10:30	Continuation of station work on Gotland Basin central station TF0271

Date	*Time [UTC]*	*Task*
	16:00	Start cross basin transect from Gotland towards the Latvian coast
24.03.2018		Continuation of cross basin transect towards the Latvian coast
	02:00	End of of cross basin transect
	08:00	Continuation of station work on thalweg transect to the northern Gotland Basin, Wind starts to increase (5Bft), a bit fog in the morning hours.
	12:00	Wind speed reached 6Bft, wave field also starts to increase. Sky is completely cloud covered by deep stratus clouds
	23:42	Northernmost station at the thalweg transect
25.03.2018		Proceeding to the western Gotland basin stations
	03:56	Start station work in the western Gotland Basin, wind speed is about 6Bft, rough sea conditions
		Switch time by one hour to middle European daylight saving time (MESZ)
	07:20	Start station work at Landsort deep. Wind is decreasing
	11:30	End station work at Landsort deep, Continuation of station work in the western Gotland Basin
	22.30	End of station work in the western Gotland Basin, heading southward to the Slupsk Furrow
26.03.2018	08:00	Arriving at station TF0267. Begin of first ScanFish Transect
	09:00	SF transect interrupted, due to technical problems with the pump of the ScanFish CTD. Trying to solve the problem, while the ship is moving on to the Bornholm Basin.
	10:00	Trying to repair the connection between CTD and pump inside the ScanFish
	13:30	The pump is running, starting the second trial with ScanFish
	14:10	Second trial with ScanFish interrupted, the technical problems with the pump were not solved,
	16:00	Continuation with the hydrographic program in the Bornholm basin at TF213
	17:36	Switch VMADCP150 back to high resolution mode (cast 003)
	18:00	During the second CTD cast a communication error occur between the deckbox and the CTD. The search for the male function revealed a too low isolation resistance in the winch cable. The CTD system itself works without problems. Since it was more or less impossible to fix the winch cable at sea, we decided to use the ScanFish winch for the remaining CTD operations. However this required fit the CTD cable to the ScanFish system. We decide to steam during the night to station TF113, while we work on fixing the cable connection.
	22:00	The CTD works on the ScanFish system, which works as a spare system for the CTD operations
27.03.2018	05:00	Arriving at position TF0113. The CTD was moved on back deck. It causes some difficulties to fit the CTD mechanically to the ScanFish cable.
	07:30	First successful CTD profile with the ScanFish system
	11:00	Approaching Marnet station Darss Sill. Recovery of OBS moorings
	11:20	First OBS released and recovered
	12:00	Second OBS released and recovered
	13:00	Third OBS released, but not recovered. It did not appear at the surface. Triangulation has revealed the original position. The recovery will require divers.
	13:30	Continuation of station work at station TF0030
	20:45	End of scientific work of cruise EMB179
		Heading towards Rostock port
28.03.2018	06:00	Arrival at port Rostock-Marienehe
	07:00	Unloading of scientific equipment
	11:00	Disembarking of scientific crew, end of cruise EMB150

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 EMB150 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 redundant sensor system 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 fluorimeter. Pressure is determined with a Paroscientific Digiquartz pressure sensor, maximum range 2058 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 depths during down-casts. Closing depth and sensor values are aligned by appropriate choice of parameters of the CTD software generating the “bottle files”. The CTD is attached to a heave-compensating winch, enabling the CTD during a cast to be nearly completely decoupled from the ships heave and roll movements.

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 1m above the bottom at all stations. An attached altimeter and a down-facing underwater camera including LED spotlights and laser were 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 in an auto-fire mode. For sampling during upcast, the CTD was stopped and bottles closed manually after a 30 second adjustment period. 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 35. Salinity samples were taken every day. The samples were stored in white glass bottles and will be analyzed

after the cruise by means of a salinometer AUTOSAL Model 8400B (accuracy of 0.002). 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",

$$ox = Soc * (V + V_{offset}) * (1 + A*T + B*T^2 + C*T^3) * OXSAT * \exp(E*P/k)$$

The pressure sensor was checked by measuring pressure on deck 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	17.01.2017
Temperature 1	SBE 3	5492	17.01.2017
Conductivity 0	SBE 4	4006	17.01.2017
Conductivity 1	SBE 4	4007	17.01.2017
Oxygen 0	SBE 43	1732	13.11.2017
Oxygen 1	SBE 43	1733	13.11.2017
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	2484	11.01.2012
PAR sensor	Biospherical Licor Chelsea	70256	08.12.2009
SPAR	SPAR/Surface Irradiance	20364	12.08.2009

On 26.03.2018 at station TF0213 a communication error occurs between the deckbox and the CTD. The search for the male function revealed a too low isolation resistance in the winch cable. The CTD system itself works without problems. Since it was impossible to fix the winch cable at sea, we decided to use the ScanFish winch for the remaining CTD operations. After finishing the required fit of the CTD cable to the ScanFish system the CTD was operated on the work deck.

VMADCP 150kHz

A 150kHz Acoustic Doppler Current Profiler (VMADCP) Ocean Surveyor (frequency 150 kHz, beam angle 30deg), manufactured by RD-Instruments, was mounted downward looking at the ship hull. The data output of the ADCP was merged online with the corresponding navigation data and stored on the hard disc using the program VMDAS. Pitch, roll and heading data are converted from TCPTIP to UDP protocol with an own program, running on the VMADCP control PC. Current data are collected in beam coordinates to apply all corrections during post processing. The VMADCP was operated continuously during the entire cruise. The following configuration was used for data acquisition.

Table 2: Configuration of 150kHz VMADCP

Command	*Parameter*	*Value*
WP	Broad band pings	1 ping/ens
WN	number of depth cells	40
WS	bin length	8m
WF	blank after transmit	4m
WV	Ambigiuity velocity	6.5m/s
BP	bottom track	1 ping/ens
BX	max bottom distance	300m
WD	data output	u, corr, amp, PG
TP	time between pings	0
EZ	sensor source	temp
EX	co-ordinates (ENX)	beam
ED	transducer depth	4m

ES	salinity	10
Data option dialog of VMDAS software	heading source	Ext. Gyro
	pitch / roll source	Ext. Phins
	navigation source	Ext. GPS
	time per ensemble	1s
	time between pings	1s
	heading alignment	133 deg
	heading bias	0 deg
	short term average	20s
	long term average	300s
	data screening	off

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 were applied during post processing.

VMADCP 300kHz

A 300kHz Acoustic Doppler Current Profiler (VMADCP) Workhorse (frequency 300 kHz, beam angle 20deg), manufactured by RD-Instruments, was mounted downward looking at the ships moon pool. The system was used to increase the accuracy and resolution of current measurements in the upper 100m of the water column. The data output of the ADCP was merged online with the corresponding navigation data and stored on the hard disc using the program VMDAS. Pitch, roll and heading data are converted from TCPTIP to UDP protocol with an own program, running on the VMADCP control PC. Current data are collected in beam coordinates to apply all corrections during post processing. The VMADCP was operated continuously during the entire cruise. The following configuration was used for data acquisition.

Table 3: Configuration of 300kHz VMADCP

Command	***Value***	***Value***
WP	1 ping/ens	1 ping/ens
WN	50	50
WS	1m	1m
WF	1m	1m
WV	3.3m/s	3.3m/s
BP	1 ping/ens	1 ping/ens
BX	100m	100m
WD	u, corr, amp, PG	u, corr, amp, PG
TP	0.5	0.5
EZ	temp	temp
EX	beam	beam
ED	0m	0m
ES	10	10
Data option dialog of VMDAS software	Ext. Gyro	Ext. Gyro
	Ext. Phins	Ext. Phins
	Ext. GPS	Ext. GPS
	1s	1s
	1s	1s
	0 deg	0 deg
	0 deg	0 deg
	30s	30s
	300s	300s
	off	off

Post-processing of the VMADCP data was carried out using the Matlab® ADCP toolbox of IOW. The final profiles are 30s 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 were applied during post processing.

ScanFish towed CTD

It was planned to gather a high resolution hydrographic transect with the ScanFish towed CTD (SF) along the southern part of Baltic talweg transect. 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 is towed with 5-7 knots, the undulation depth is steered from the lab. Control commands are transmitted via the cable.
The ScanFish was deployed on 26.03.2018 08:00UTC in the Slupsk Furrow. Due to failure of the CTD pump inside the ScanFish, the deployment was aborted. After fixing the pump connection problem a second trial was performed. Short after the Beginning of this trial the malfunction appears again. The problem could not be fixed, thus the ScanFish was not deployed again during the cruise.

Moorings

GOC (Long Term Mooring **Go**tland **C**entral**)**
The mooring GOC obtains hydrographic and biological data in the center of the western Gotland Basin near the central station TF0271. The mooring consists of a sediment trap and combined MicroCat thermosalinometer SBE37 / PME oxygen optode sensor packages at five depth levels. A sketch of the mooring is shown in Figure 2. On 23.03.2018 07:09 UTC the GOC mooring was successful recovered. There was no damage on the mooring. The mooring was redeployed after maintenance just before noon of 23.03.2018 (for positions refer to Table 9).

OBS moorings at Marnet station Darss Sill
On 27.03.2018 on the Way back to Rostock three additional moorings should be recovered at the Darss Sill Marnet station. Only two of them could be successfully released and recovered. The third mooring did response to the acoustic release signal, but did not show up at the surface. After several trials it was decided to postpone the recovery to the next cruise when divers are on board. To fix the last position of the mooring an acoustic triangulation of the mooring was performed. The results are given in Table 4.

Table 4: Results of triangulation of the OBS mooring 2 which was not recovered

	Latitude	***Longitude***	***Distance***
1	54°42.066'N	12°41.617'E	120m
2	54°42.011'N	12°41.666'E	50m
3	54°41.986'N	12°41.674'E	82m
4	54°41.918'N	12°41.685'E	212m
5	54°41.975'N	12°41.404'E	290m

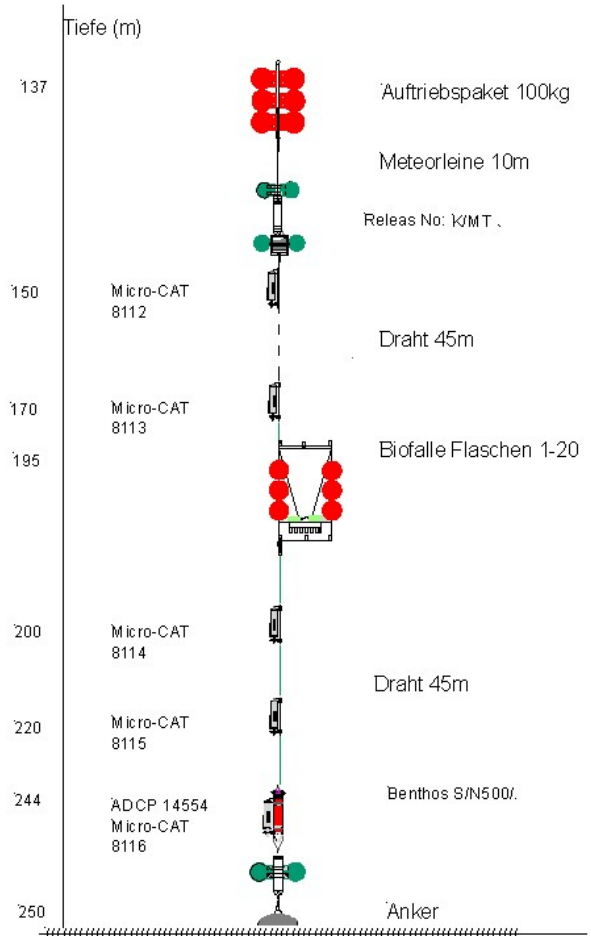

Figure 2: Sketch of the GOC mooring deployment 2018-3.

Underway measurements

The FS Elisabeth Mann Borgese is equipped with numerous sensors, which continuously provide important environmental and navigation parameters. The available data set 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. During the cruise a subset of the parameters was processed.

This data set consists of one minute averages of:

- time (UTC)
- latitude and longitude
- ships heading
- depth
- air pressure
- air temperature
- humidity
- global radiation
- infrared 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 some stations in the central Baltic.
The plankton sampling positions are indicated in the list of stations (Table 8) with the abbreviations “Phy” and “Zoo”.

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 8 with the abbreviation “TG”. One complete depth profile was sampled at station TF0271 for the long term data collection of CT, AT, and pH.
These samples were fixed with 500 µL saturated HgCl2-solution to prevent microbiological activity and stored dark.

Long term observations of salinity anomaly

In the Baltic Sea the salinity anomaly is mainly influenced by the input of calcium-carbonate by the drainage of rivers. This is in contrast to the oceans where salinity anomaly is caused by the spatial variability of silicate distribution. In the last decade measurements of the salinity-anomaly were performed systematically. In 2009 R. Feistel and colleagues have found significant deviations to earlier measurements by Millero and Kremling. The reason of these deviations is still unknown. To investigate the spatial distribution of the salinity anomaly, and their evolution in time, a long term sampling program at main stations of the Baltic basins was initiated.

During the cruise 11 samples have been taken for the analysis of salinity anomaly (Table 5). For its determination the practical salinity and the density have to be measured by means of a salinometer an u-tube densitometer, respectively. From both results the absolute salinity can be calculated. The salinity-anomaly is the difference between absolute salinity and the reference salinity according TEOS-10. The measurements will be carried out in the calibration laboratory of the IOW immediately after the cruise.

Table 5: List of samples for salinity anomaly measurements

Station	*Stat.No*	*Area*	*Surface*	*Bottle No*	*Depth*	*Bottle No*
TF0361	4	Kiel Bight	2m	-	22m	1
TF0113	20	Arkona Basin	2m	3	40m	4
TF0213		Bornholm Basin	2m	5	70m	6
TF0256		East of Slupsk Furrow	2m	7	70m	8
TF0271		Gotland Deep	2m	10	70m	9
TF0284		Landsort Deep	2m	11	40m	12

3. Preliminary results

The results presented in the following section are preliminary and not comprehensive, since they are based in most cases on unevaluated raw 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

The general meteorological conditions during the cruise were characterized by a continuous chain of low pressure systems, rapidly moving eastward over the Baltic. This caused fast changes in wind and cloud coverage. The cruise started with cloud free sky and moderate wind conditions. During the night from 19th to 20th March a passing front caused a rapid increase in wind speed from 8 to 18ms^{-1}. The wind slowly decreased during the following day. After a short period of moderate winds on 21st March the wind increased again. During the following period of weak winds on 23rd the mooring maintenance was performed with appropriate wind and sea state conditions. The following two days were again characterized by strong winds (Figure 3, Figure 5 and Figure 4). After the 26th March the wind was decreasing to moderate strength till the end of the cruise.

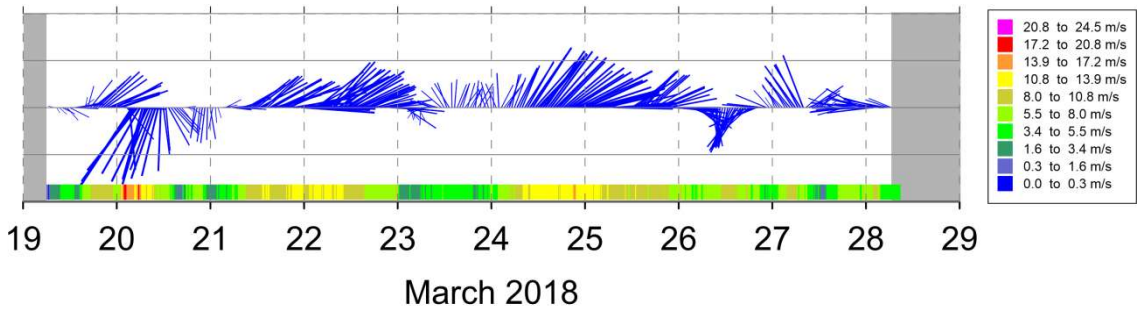

Figure 3: Stick plot of wind vector measured by the ship weather station of FS Elisabeth Mann Borgese. The grey shaded areas indicate periods when the ship was in port.

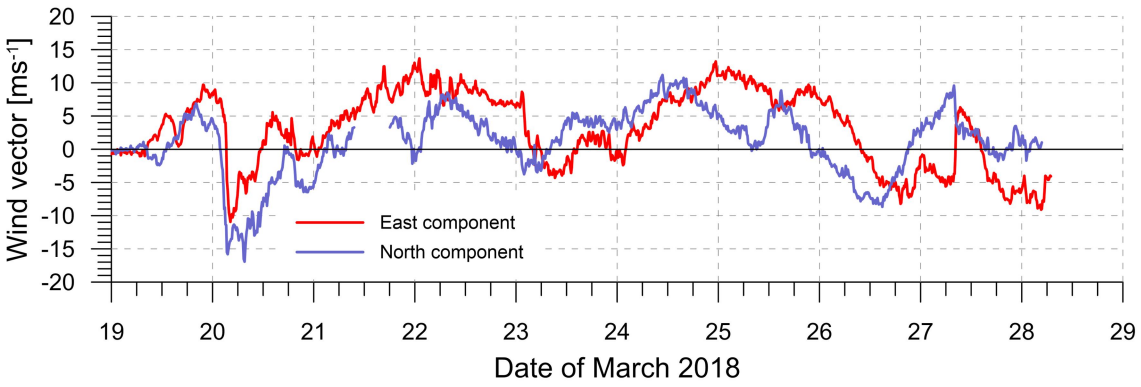

Figure 4: Wind vector east and north measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

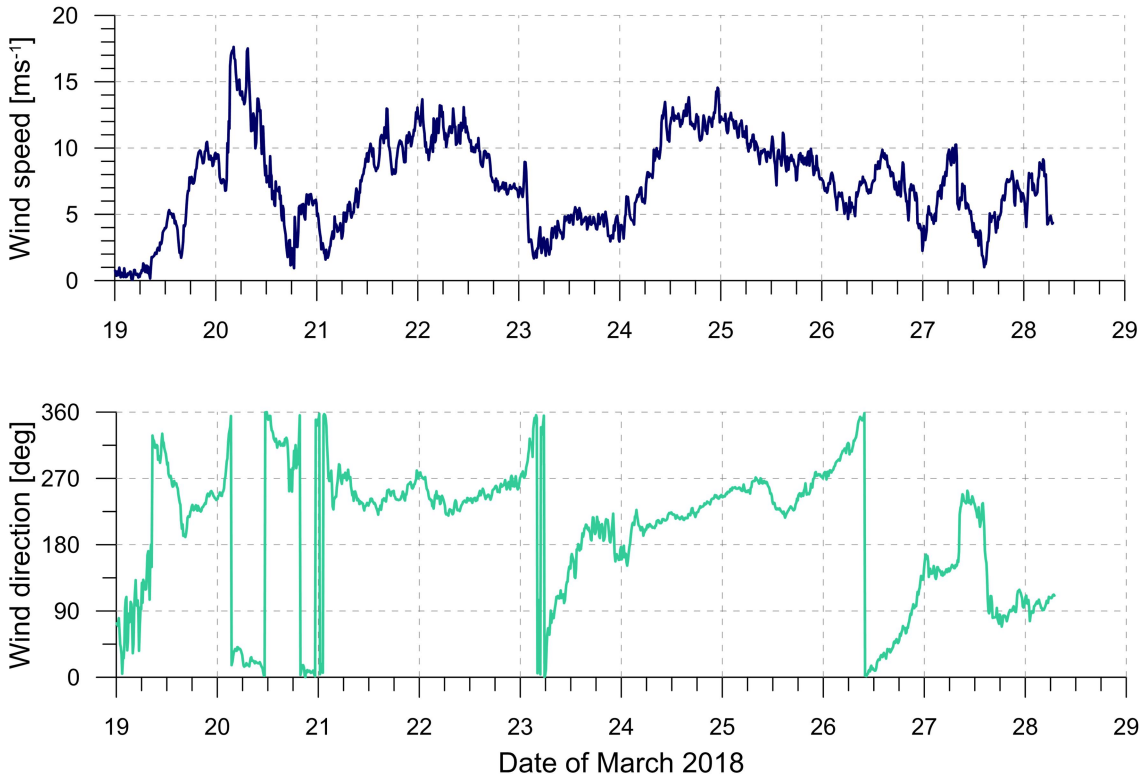

Figure 5: Wind speed and direction measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

The air temperature was cooler than average for the early spring season. From 19th to 23rd March, when the ship was traveling northward, the air temperature increased from about -2°C to 2°C in the central Baltic. For the rest of the cruise the air temperature remained at the low level around 2 to 3°C.

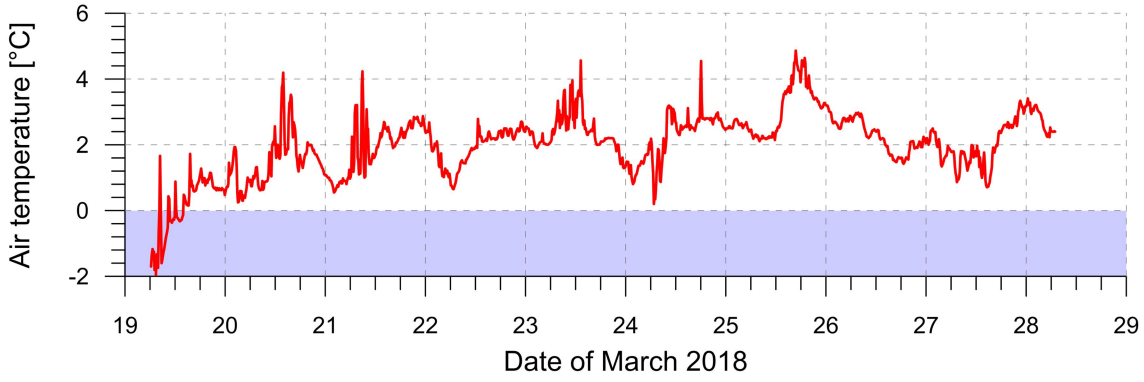

Figure 6: Air temperature measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

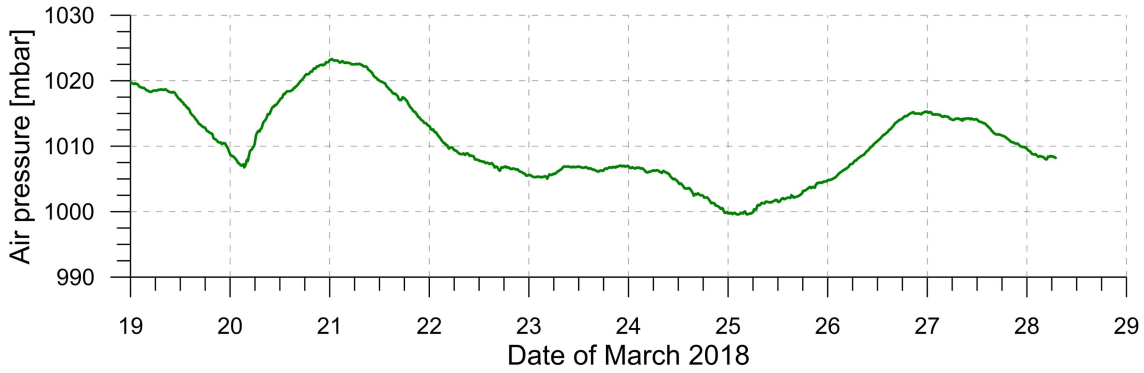

Figure 7: Air pressure measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

The air pressure variations during the cruise show the typical time scale of passing low and high pressure systems of up to 3 days duration. An overall decreasing trend was observed till the 25th March. Afterwards a small high pressure system over the central Baltic caused an increase of air pressure from 1000 to 1015mbar. The air pressure remained at about 1010mbar till the end of cruise.

The humidity was relatively high, but typical for the spring season varying between 70 and nearly 100%. On 27th March calm winds and cooling by the cold surface water caused the formation of sea fog during the time when the OBS moorings were recovered. The global radiation was strongly related to the cloud coverage. Maximum values, at noon on sunny days, were about 600 Wm^{-2} at the beginning of the cruise. On 22nd and 27th March the dense cloud coverage caused very low values of global radiation which were even at noon below the long wave radiation.

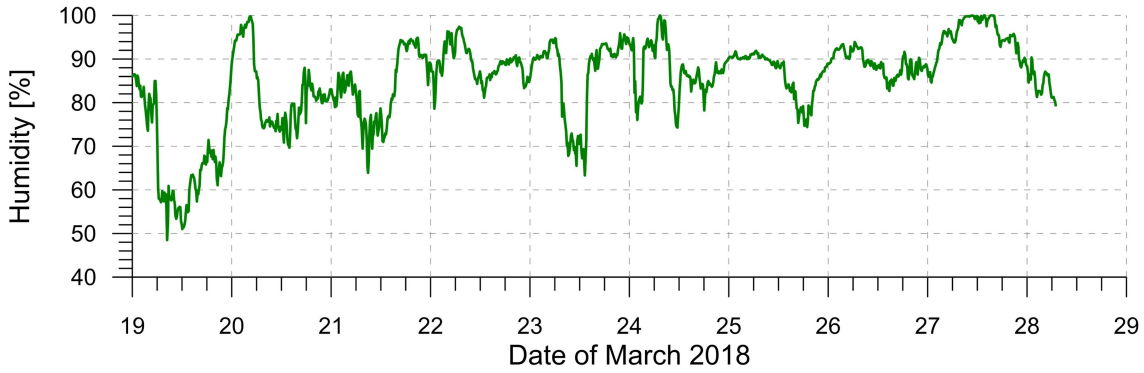

Figure 8: Air humidity measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

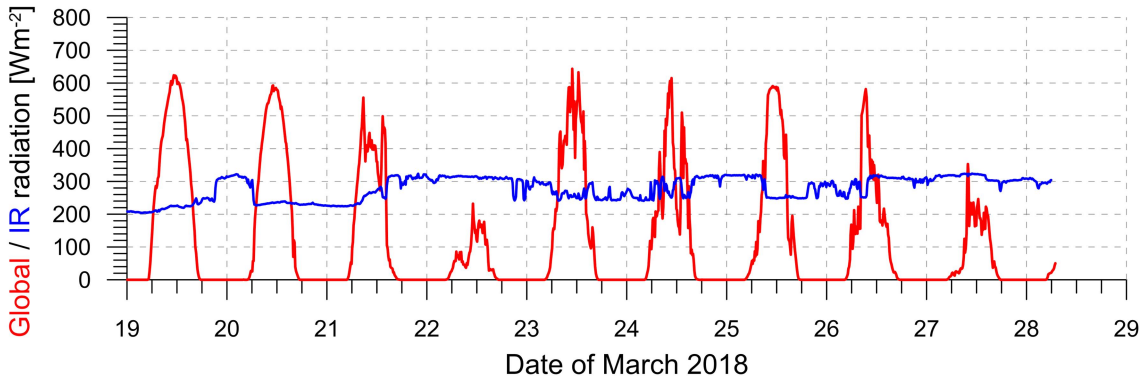

Figure 9: Global and infrared radiation measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

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 10 are based on unvalidated data.

In the Kiel Bight and the Mecklenburg Bight the saline surface waters indicate the transition zone between Baltic and North Sea. Generally, the salinity (SSS) decreases from west to east, whereas the minimum of SST was observed in the western Baltic. In the Arkona Basin SSTs were about 2.0°C and SSS about 8.0 in the beginning of the cruise on 20th March. Here the SST increased to about 2.5°C on 27th March due to seasonal warming. Low SST and SSS were also observed in the western Gotland Basin with 1.1°C and 6.3, respectively. Due to the extremely cold period before the cruise the surface temperatures were well below the long term average. The SST was partly below the density maximum, which is important for the onset of stratification and spring bloom during the following weeks. Highest surface temperatures of about 2.8°C were observed on 23rd March in the southeastern Gotland Basin.

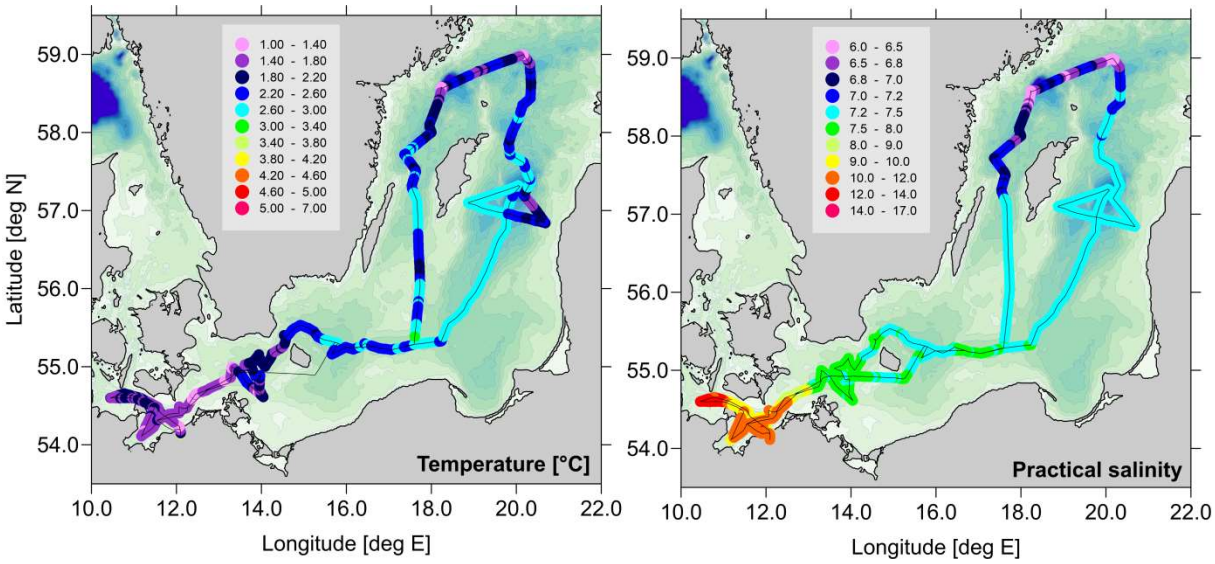

Figure 10: Surface temperature (left) and surface salinity distribution (right) along the cruise track of EMB179 in the western and central Baltic (10 min averaged values).

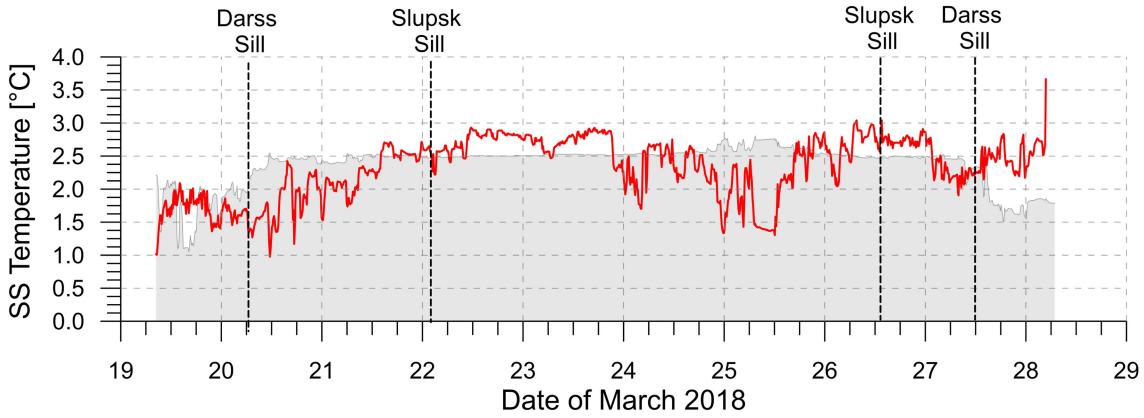

Figure 11: Surface temperature measured with the ship thermosalinograph of FS Elisabeth Mann Borgese. The gray shaded area indicates the range below the density maximum at the sea surface.

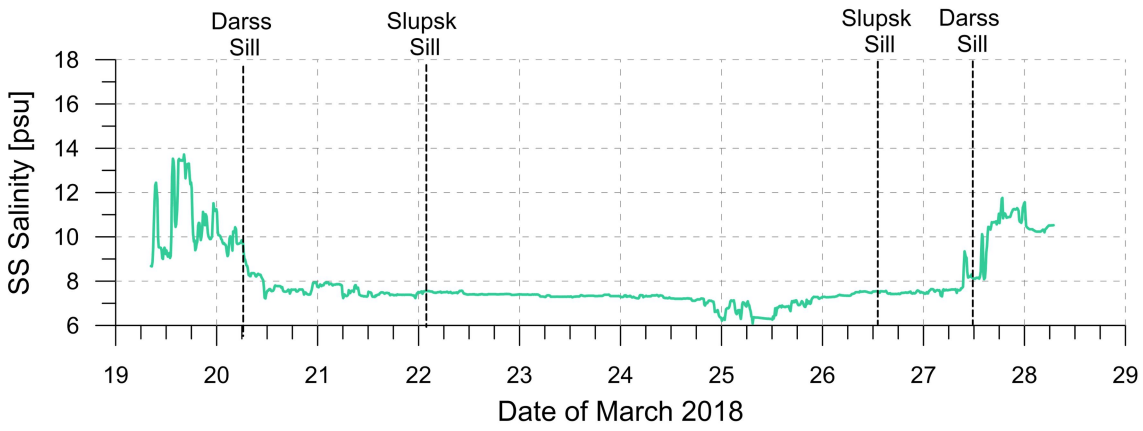

Figure 12: Surface salinity measured with the ship thermosalinograph of FS Elisabeth Mann Borgese.

The surface distribution of Chlorophyll-a fluorescence supplied information about the beginning spring bloom. In the first days of the cruise the Chlorophyll-a fluorescence was elevated west of the Darss Sill and in the Arkona Basin, indicating that the spring bloom has already started here. East of the Bornholmgat towards the eastern Gotland Basin the Chlorophyll-a fluorescence was very low. In contrast, higher Chlorophyll-a fluorescence was observed in the eastern Gotland Basin towards the Latvian coast. Here the start of the spring bloom was triggered by the onset of stable shallow surface stratification.

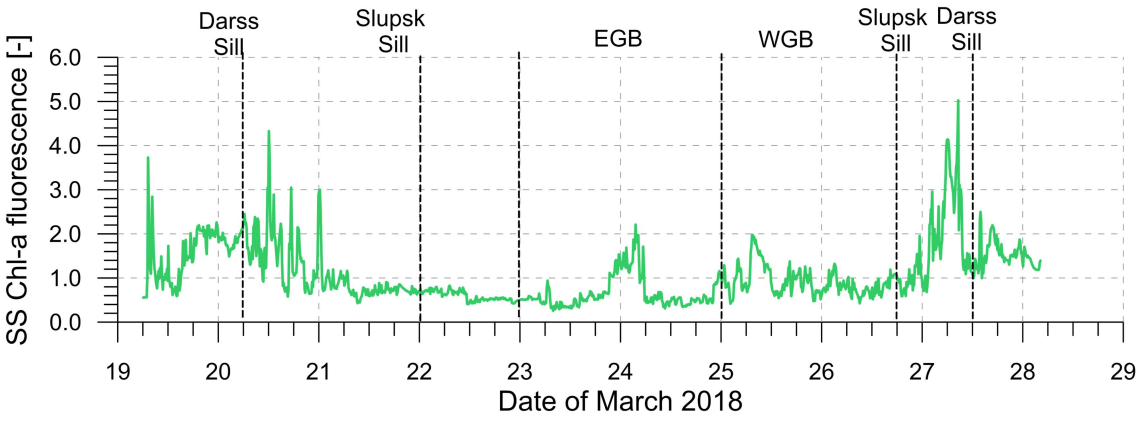

Figure 13: Surface chlorophyll-a fluorescence measured with the flow through fluorometer of FS Elisabeth Mann Borgese.

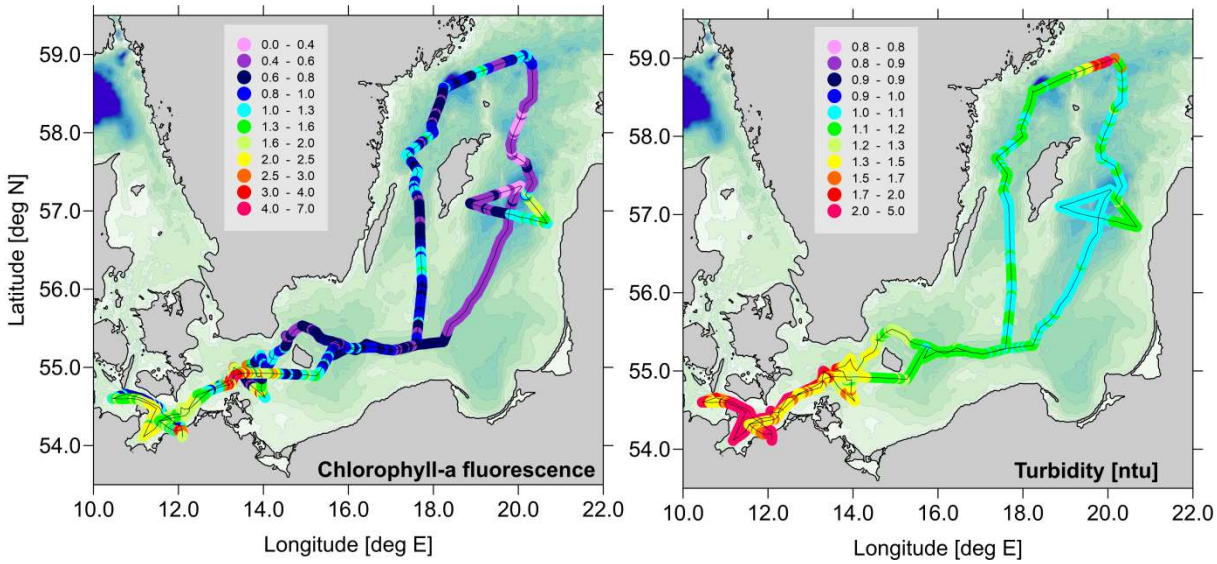

Figure 14: Surface chlorophyll-a fluorescence (left) and surface turbidity distribution (right) along the cruise track of EMB179 in the western and central Baltic (10 min averaged values).

The surface distribution of turbidity correlates well with the chlorophyll-a fluorescence. Higher turbidity was observed in regions where the spring bloom has started.

Observations at main stations

The following tables list the surface (Table 6) and bottom values (Table 7) of the most important hydrographic and chemical parameters measured at the main stations of the monitoring program. For positions of the particular stations refer to Figure 1 and Table 8. In the depth-column the italic number in brackets shows the BottleID of the corresponding sample. Blue colored values in the oxygen column are hydrogen sulfide concentrations. The italic oxygen values in brackets depict the raw readings of the CTD oxygen sensor 0.

Conversion factors: µmol l^{-1} H_2S * -0.0448 = negative oxygen equivalent ml l^{-1} O_2
µmol l^{-1} O_2 * 0.0224 = ml l^{-1} O_2

Table 6: Surface values of main hydrographic parameters at the main stations.

Area *Date*	*St. name* *St. no.*	*Depth* *[m]*	*Temp* *[°C]*	*Sal* *[psu]*	*O_2 / H_2S* *[µmol l^{-1}]*	*PO_4* *[µmol l^{-1}]*	*NO_3* *[µmol l^{-1}]*	*SiO_4* *[µmol l^{-1}]*
Kiel Bight 19.03.2018	TF0360 005	1 *(102)*	1.48	13.54	418 *(410)*	0.25	0.19	10.1
Meckl. Bight 20.03.2018	TF0012 009	2 *(202)*	1.50	10.29	419 *(410)*	0.36	1.0	12.7
Lübeck Bight 19.03.2018	TF0022 008	*1* *(177)*	1.21	9.97	429 *(420)*	0.09	0	6.9
Darss Sill 20.03.2018	TF0030 016	2 *(452)*	1.31	8.40	426 *(420)*	0.45	2.60	16.0
Arkona Basin 20.03.2018	TF0113 020	2 *(552)*	1.76	7.84	428 *(420)*	0.45	3.15	16.9
Bornholm Deep 21.03.2018	TF0213 045	2 *(1288)*	2.31	7.44	413 *(404)*	0.63	2.41	20.1
Slupsk Furrow 22.03.2018	TF0222 053	2 *(1552)*	2.32	7.55	406 *(398)*	0.62	2.29	20.0
SE Gotland Basin 22.03.2018	TF0259 059	3 *(1702)*	2.63	7.45	395 *(391)*	0.67	3.57	18.5
Gotland Deep 23.03.2018	TF0271 073	1 *(2202)*	2.45	7.35	402 *(396)*	0.65	4.24	16.8
Farö Deep 25.03.2018	TF0286 091	2 *(2777)*	1.93	7.24	408 *(403)*	0.61	5.38	19.1
Landsort Deep 26.03.2018	TF0284 100	2 *(3052)*	1.14	6.35	434 *(427)*	0.46	2.48	19.9
Karlsö Deep 26.03.2018	TF0245 103	*2* *(3252)*	2.53	7.30	398 *(390)*	0.72	3.46	19.2

Table 7: Bottom values of main hydrographic parameters at the main stations.

Area *Date*	*St. name* *St. no.*	*Depth* *[m]*	*Temp* *[°C]*	*Sal* *[psu]*	*O_2 / H_2S* *[µmol l^{-1}]*	*PO_4* *[µmol l^{-1}]*	*NO_3* *[µmol l^{-1}]*	*SiO_4* *[µmol l^{-1}]*
Kiel Bight 19.03.2018	TF0360 005	17 *(105)*	0.98	13.88	402 *(376)*	0.24	0.86	7.7
Meckl. Bight 20.03.2018	TF0012 009	23 *(205)*	1.60	13.80	394 *(380)*	0.46	3.56	15.5
Lübeck Bight 19.03.2018	TF0022 008	22 *(180)*	1.16	12.78	 *(394)*	0.32	4.44	12.6
Darss Sill 20.03.2018	TF0030 016	22 *(455)*	1.31	8.40	 *(420)*	0.45	2.73	16.4

Area *Date*	*St. name* *St. no.*	*Depth* *[m]*	*Temp* *[°C]*	*Sal* *[psu]*	*O_2 / H_2S* *[µmol l^{-1}]*	*PO_4* *[µmol l^{-1}]*	*NO_3* *[µmol l^{-1}]*	*SiO_4* *[µmol l^{-1}]*
Arkona Basin 20.03.2018	TF0113 020	46 *(558)*	2.27	12.91	414 *(376)*	0.62	2.33	19.0
Bornholm Deep 21.03.2018	TF0213 045	88 *(1286)*	6.89	17.02	0 / **2.23** *(1)*	6.17	0.00	69.5
Slupsk Furrow 22.03.2018	TF0222 053	89 *(1557)*	8.36	13.27	 *(97)*	1.59	7.76	39.6
SE Gotland Basin 22.03.2018	TF0259 059	87 *(1708)*	6.37	11.31	 *(115)*	1.80	6.27	39.5
Gotland Deep 23.03.2018	TF0271 073	234 *(2162)*	6.91	13.29	0 / **45.8** *(0)*	4.57	0.00	62.3
Farö Deep 25.03.2018	TF0286 091	190 *(2763)*	6.78	12.74	0 / **31.9** *(0)*	3.93	0.00	56.8
Landsort Deep 26.03.2018	TF0284 100	435 *(3013)*	6.21	11.37	0 / **29.9** *(0)*	3.23	0.00	55.8
Karlsö Deep 26.03.2018	TF0245 103	107 *(3259)*	5.54	10.12	*0 / **5.4*** *(2)*	3.65	0.00	56.9

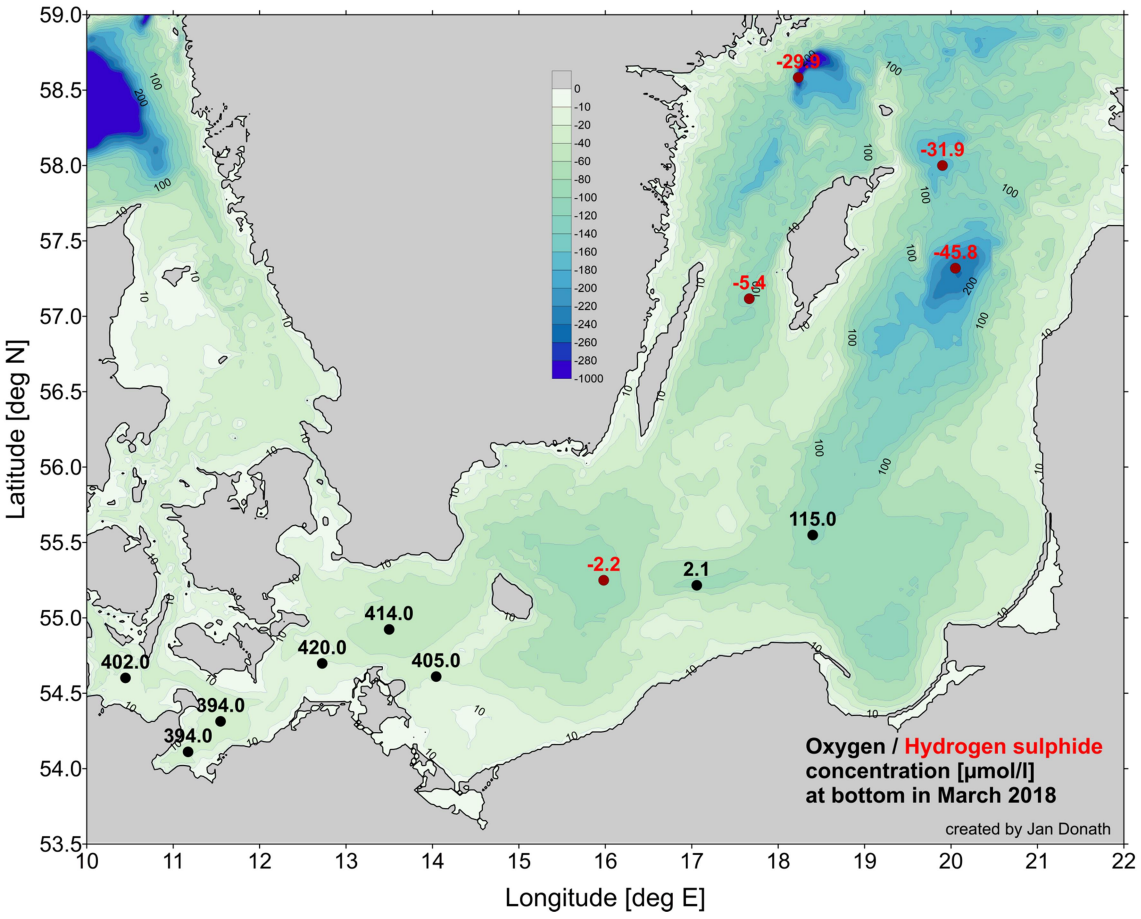

Figure 15: Distribution of oxygen (black labels) and hydrogen sulphide concentrations (red labels) near bottom at main stations of the long term observation program.

Baltic thalweg transect

The majority of the stations worked during the cruise EMB179 were aligned along the thalweg transect from the Danish straits, through the western Baltic Sea, and further towards the northern Gotland basin. This transect supplies an excellent overview about the hydrographic and environmental state of the entire Baltic Sea. The transect was worked from 19th to 24th March. The transect depict the typical patterns of early spring conditions and the signatures of eastward spreading saline waters between the Bornholm Basin and the entrance to the eastern Gotland Basin (Figure 16 and Figure 17).

The temperatures in the surface layer of the western Baltic were extremely low at about 1.2°C in the Belt sea and 2°C in the Arkona Basin. Higher SST's of about 2.5°C were found in the Eastern Gotland basin. The thickness of the well mixed upper water layer increases eastward from about 50 m in the Bornholm Basin to nearly 70m in the eastern Gotland basin. In the northern Gotland basin the surface mixed layer thickness slightly decreases to about 60m. In the western Baltic the temperatures were below the temperature of maximum density. In the eastern Gotland Basin the SST was above the temperature of maximum density. Here the first heating of surface layer during spring will stabilize the surface water by the onset of thermal stratification. In the northern and western Gotland Basin the temperature of the surface mixed layer was also below the temperature of density maximum.

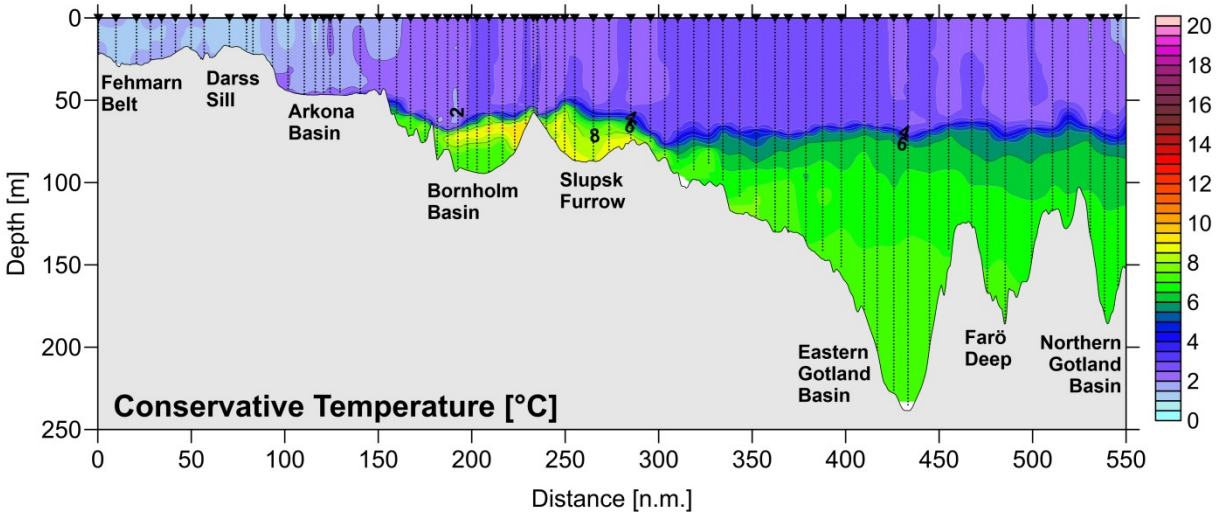

Figure 16: Distribution of temperature along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 19.03. - 23.03.2018.

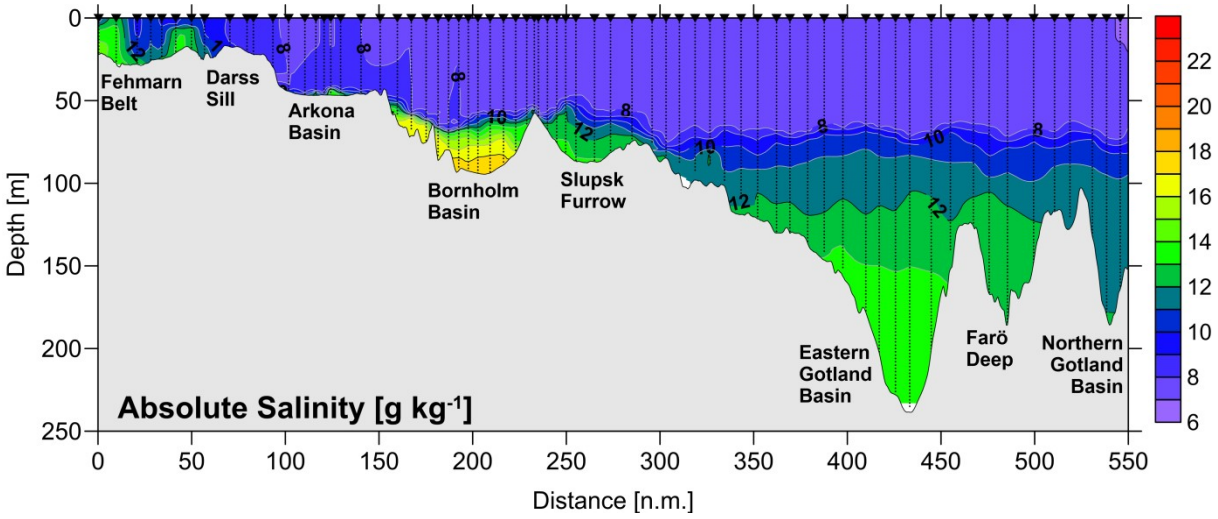

Figure 17: Distribution of Absolute salinity along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 19.03. - 23.03.2018.

In October and November 2017 a series of weak barotropic inflows was observed in the western Baltic. These inflow events transported about 75km³ well oxygenated, saline water with about 1.5 Gt salt into the Baltic. However, the mean salinity of the inflowing water was only about 16g/kg. Due to their distinct temperature, the warm autumn inflows are seen in the temperature distribution (Figure 16). The inflow waters filled the intermediate water layer of the Bornholm Basin and the bottom water layer in the Slupsk Furrow. Parts of this water has passed the eastern sill of Slupsk Furrow and spreading eastward to the eastern Gotland Basin. The event like overflow of the sill formed several plumes. Due to their low salinity below 12 g/kg this water will be sandwiched in the intermediate water layer of the eastern Gotland basin at a depth range between 100 and 120m. The deep and bottom layer of the eastern Gotland basin is still covered by the high saline waters from the recent inflow series between December 2014 and February 2015.

The oxygen distribution along the central transect is shown in Figure 18. Due to the series of minor inflow events the western Baltic is well ventilated. However, the density of the inflow water was not high enough to replace the deep water in the Bornholm basin. There the oxygen concentration was low, with first signs of hydrogen sulfide in the near bottom layer. The Slupsk Furrow depict deep water oxygen concentrations of about 120 µmol l^{-1}. In the eastern Gotland Basin (EGB) the oxygen concentrations below the halocline decreased rapidly to values of 20 µmol l^{-1}. In the southern part of the EGB the inflow waters of the inflows in autumn 2017 ventilated the halocline layer till 140m depth. In the major part of the EGB the dissolved oxygen concentrations below the halocline were at about 10 µmol l^{-1} and below. At depth below 140m oxygen was exhausted.
The surface layer of the Baltic is well ventilated, mainly due to wind induced deep mixing during the winter season. The beginning spring bloom west of Bornholmgat and the low temperatures lead to enhanced oxygen concentrations above 400 µmol l^{-1} in the surface layer.

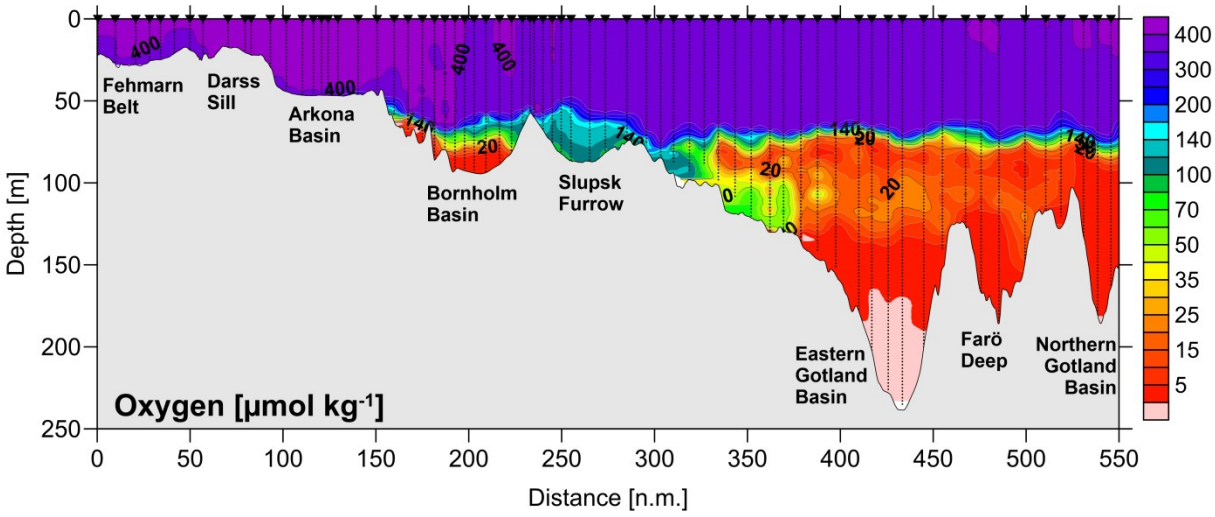

Figure 18: Distribution of oxygen concentration along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 19.03. - 23.03.2018.

The chlorophyll-a fluorescence data gathered along the transect indicate that the spring bloom has already started in the Danish Straits and the western Arkona Basin (Figure 19). In the eastern and northern Gotland Basin the chlorophyll-a fluorescence values were still low.
The turbidity in surface water is correlated to the pattern of the Chlorophyll-a fluorescence. Below the thermocline the turbidity depicts enhanced values in anoxic waters and near the bottom. The highest turbidity values were observed in the bottom layer of Fehmarn Belt, on the Darss Sill, and the Arkona Basin (Figure 20).

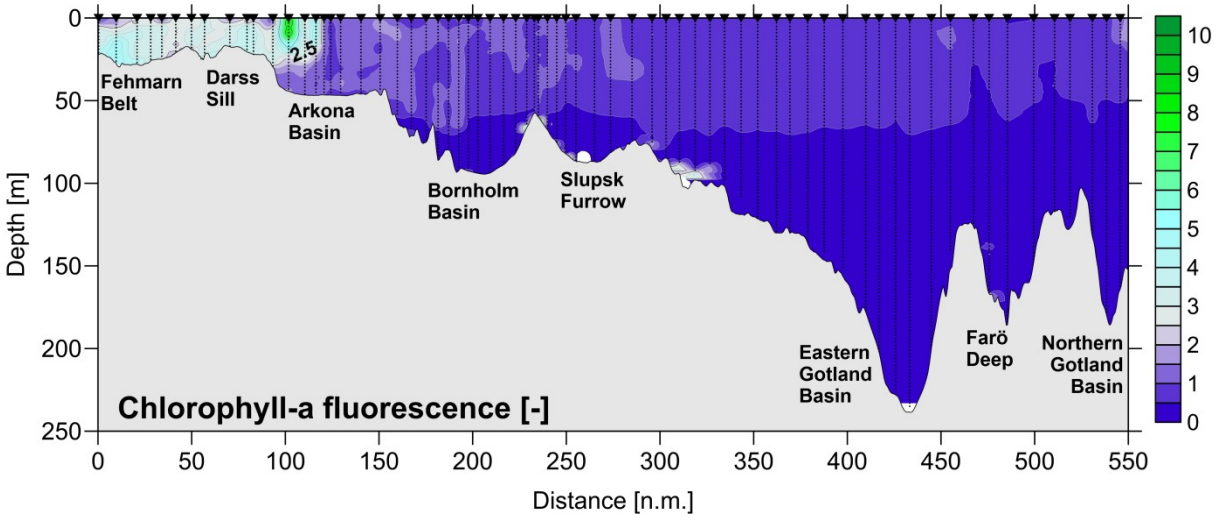

Figure 19: Distribution of Chlorophyll-a fluorescence along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 19.03. - 23.03.2018.

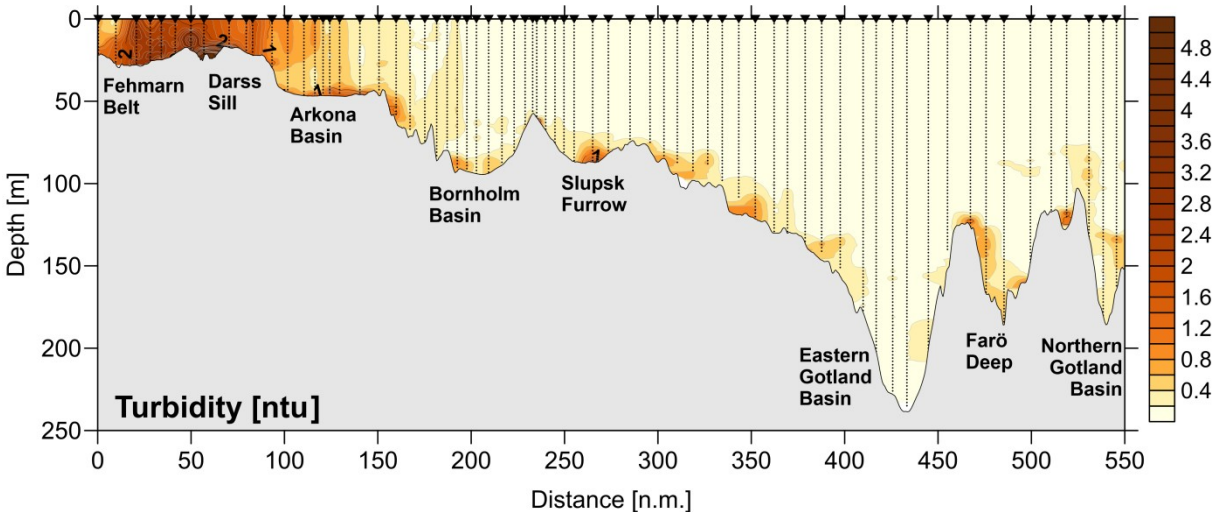

Figure 20: Distribution of turbidity along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 19.03. - 23.03.2018.

Figure 21 depicts the vertical profiles of temperature, salinity and oxygen concentration at the main long term stations in the central Baltic. The surface water temperature decreases from 2.5 in the eastern Gotland basin to 1.2 at the Landsort deep (A). At the Gotland deep and the Karlsö deep the surface layer is well mixed down to the strong halocline at 65m. The upper layer at the Landsort deep depicts some impact of fresh water input from the Swedish coast. There the layer above the main halocline is stratified. The recent inflow events since December 2014 have established the current hydrographic conditions in the deep water of the central Baltic. The temperatures and the salinities at all stations are considerably higher than average. The salinity and temperature in the Gotland deep are close to their ever observed maxima. However, ventilation effect of the MBI in December 2014 was very limited. Soon anoxic conditions were reestablished in the deep water below 140m (E). The Landsort deep was not significantly ventilated by the inflows. The oxycline was found at about 70m depth. In contrast the intermediate layer of the Gotland deep and the Farö deep is slightly ventilated (C) by oxic water bodies, originated from minor inflows.

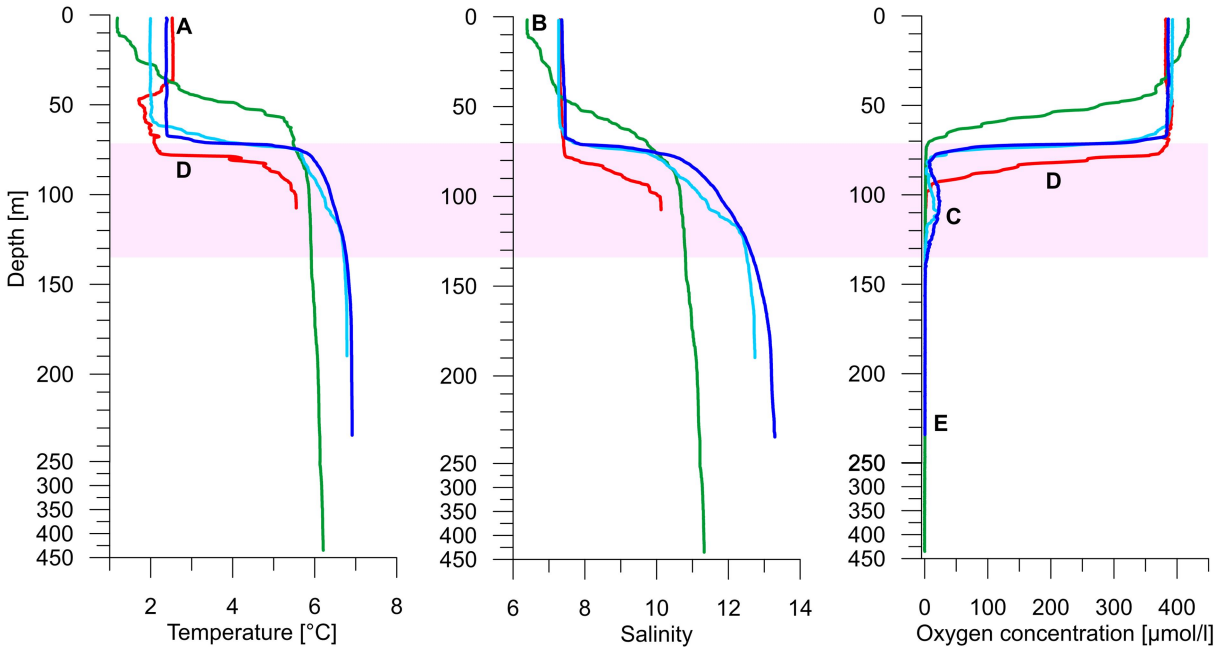

Figure 21: Vertical profiles of temperature, salinity and oxygen concentration (CTD data) at the main stations in the central Baltic. Gotland Deep TF0271 (blue), Farö Deep TF0286 (cyan), Landsort Deep TF0284 (green), and Karlsö Deep TF0245 (red).

The different water masses observed during the cruise can be clearly identified using its temperature, salinity and oxygen signature. Figure 22 gives an overview about the different water masses in two state diagrams. The following water bodies were identified and depicted in the figure:

A - Western Baltic surface water
B – Fehmarn Belt bottom water
C - Central Baltic surface water
D - Bornholm Basin bottom water
E - Bornholm Basin halocline water
F - Slupsk Furrow bottom water
G - EGB halocline water
H - EGB deep water
I - EGB bottom water

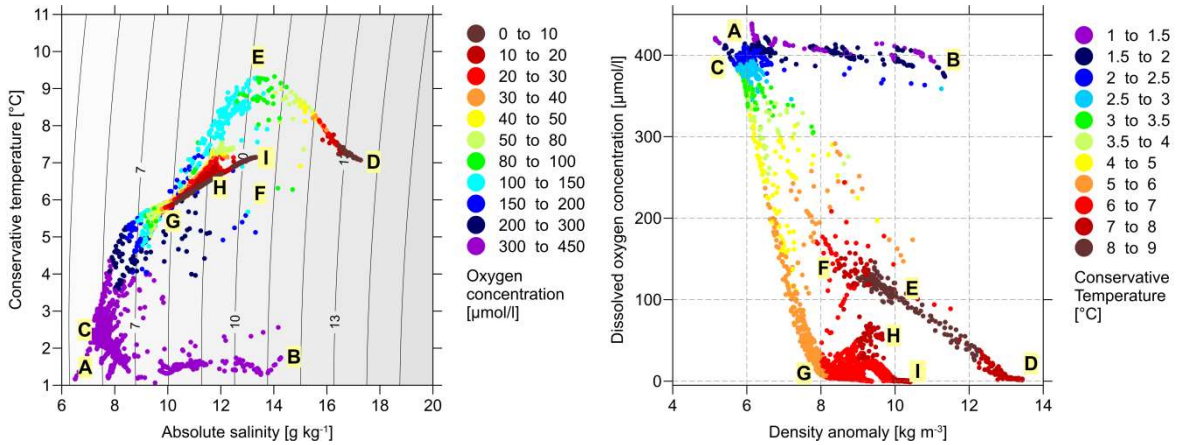

Figure 22: TS-diagram (left) and Oσ-diagram (right) of the Baltic transect. The capital letters indicate the different water masses (see text). The gray arrow in the right panel depicts the transformation path of inflowing saline water.

Southern Gotland Basin Transect

A zonal transect at the southern rim of the Eastern Gotland Basin (compare Figure 1) was performed between 23th and 24nd March. It depicts the conditions at the entrance of the Eastern Gotland Basin. The surface water depicts nearly uniform properties separated from the deep water by an extremely strong pycnocline, which was established by the deep convection during late winter.

Below the halocline at about 65m depth the oxygen concentration decreased rapidly to values below 20 µmol l^{-1} at 130m. Below 120m oxygen concentration dropped again, and is close to zero near bottom.

The inflowing saline water from the autumn 2017 inflows enters the Basin at the eastern slope, visible as a patch of higher temperature and oxygen concentration between 80 and 120m depth.

At the eastern part of the transect the enhanced Chlorophyll-a fluorescence values in the surface layer point to the onset of the spring bloom at the Latvian coast.

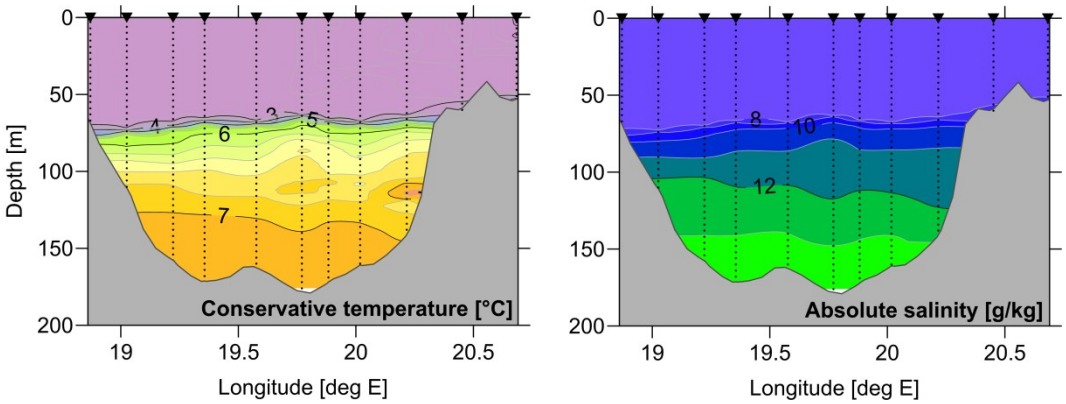

Figure 23: Temperature and salinity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 23.03. and 24.03.2018).

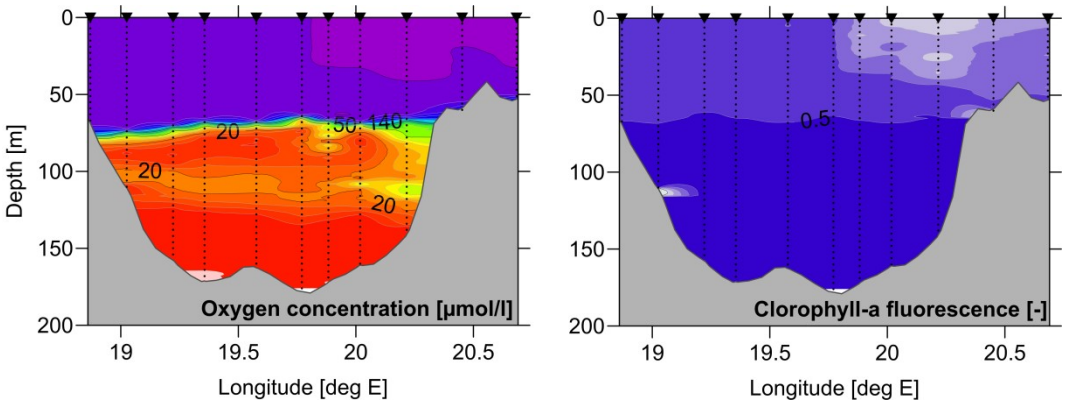

Figure 24: Dissolved oxygen and Chlorophyll-a fluorescence distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 23.03. and 24.03.2018).

4. Stations and deployments

Table 8 list all stations and deployments carried out during the cruise EMB179. Standard sampling consisted of CTD cast with nutrient samples at fixed standard depth. At some stations a number of additional samplings were performed. These tasks are indicated in the last column of Table 8.

Additional sampling program on selected stations:

Cc - Comparison measurements for CTD data quality assurance
De - Sampling for density measurements
MolBio - Molecular biology
Moor - Mooring maintenance for IOW long term observation program
Mpl - Nano and Micro zooplankton sampling
MSS - Microstructure profiler for turbulence and mixing study
Phy - Phytoplankton sampling for BSH monitoring and IOW long term data program
TG - Trace gas sampling (CH_4 and N_2O)
Zoo - Zooplankton sampling for BSH monitoring and IOW long term data program

Table 8: 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 (12.8m)	Begin	19.03.2018	08:03	54°13.89N	12°04.50E	V0001F01	
		End	19.03.2018	08:31	54°13.91N	12°04.50E		
2	TF0011 (24.7m)	Begin	19.03.2018	10:24	54°24.78N	11°37.01E	V0002F01	
		End	19.03.2018	10:40	54°24.91N	11°36.99E		
3	TF0010 (28.0m)	Begin	19.03.2018	11:59	54°33.10N	11°19.21E	V0003F01	
		End	19.03.2018	12:08	54°33.10N	11°19.23E		
4	TF0361 (23.3m)	Begin	19.03.2018	14:08	54°39.43N	10°46.02E	V0004F01	Phy, Zoo, De
		End	19.03.2018	14:20	54°39.47N	10°45.92E		
5	TF0360 (18.2m)	Begin	19.03.2018	15:28	54°35.99N	10°27.00E	V0005F01	
		End	19.03.2018	15:39	54°36.00N	10°26.94E		
6	TF0014 (28.7m)	Begin	19.03.2018	17:40	54°35.69N	11°01.08E	V0006_01	
		End	19.03.2018	18:07	54°35.34N	11°03.51E		
7	TF0013 (25.8m)	Begin	19.03.2018	19:36	54°28.39N	11°29.04E	V0007_01	
		End	19.03.2018	19:54	54°28.31N	11°28.88E		
8	TF0022 (23.0m)	Begin	19.03.2018	22:19	54°06.63N	11°10.55E	V0008F01	Phy, Zoo
		End	19.03.2018	22:39	54°06.68N	11°10.59E		
9	TF0012 (24.2m)	Begin	20.03.2018	00:28	54°18.93N	11°33.06E	V0009F01	Phy, Zoo
		End	20.03.2018	00:39	54°18.88N	11°33.05E		
10	TF0017 (21.8m)	Begin	20.03.2018	01:57	54°23.49N	11°49.48E	V0010_01	
		End	20.03.2018	02:04	54°23.47N	11°49.45E		
11	TF0041 (18.9m)	Begin	20.03.2018	03:07	54°24.33N	12°03.71E	V0011F01	
		End	20.03.2018	03:15	54°24.34N	12°03.65E		
12	TF0040 (13.3m)	Begin	20.03.2018	03:54	54°29.25N	12°03.85E	V0012F01	
		End	20.03.2018	04:04	54°29.28N	12°03.86E		
13	TF0046 (28.3m)	Begin	20.03.2018	05:01	54°28.16N	12°14.34E	V0013F01	Phy, Zoo
		End	20.03.2018	05:37	54°28.50N	12°14.84E		
14	TF0002 (18.4m)	Begin	20.03.2018	06:57	54°38.88N	12°26.89E	V0014F01	
		End	20.03.2018	07:15	54°38.98N	12°26.97E		
15	TF0001 (21.1m)	Begin	20.03.2018	08:16	54°41.70N	12°41.77E	V0015K01 V0015F02 V0015K03 V0015K04	Cc
		End	20.03.2018	09:01	54°42.20N	12°43.67E		
16	TF0030 (22.6m)	Begin	20.03.2018	09:16	54°43.30N	12°46.83E	V0016F01	Phy, Zoo
		End	20.03.2018	09:46	54°43.50N	12°47.16E		

Stat No.	*Stat.Name (Depth)*		*Date*	*Time [UTC]*	*Latitude*	*Longitude*	*CTD cast(s)*	*Nets & samples*
17	TF0115 (30.3m)	Begin	20.03.2018	10:58	54°47.66N	13°03.47E	V0017F01	
		End	20.03.2018	11:05	54°47.68N	13°03.50E		
18	TF0114 (45.0m)	Begin	20.03.2018	12:06	54°51.56N	13°16.59E	V0018F01	
		End	20.03.2018	12:11	54°51.59N	13°16.54E		
19	TF0069 (46.2m)	Begin	20.03.2018	13:08	55°00.04N	13°17.99E	V0019F01	
		End	20.03.2018	13:15	55°00.06N	13°18.01E		
20	TF0113 (47.3m)	Begin	20.03.2018	14:18	54°55.49N	13°30.08E	V0020F01	Phy, Zoo,
		End	20.03.2018	15:03	54°55.52N	13°29.89E	V0020F02	De
21	TF0123 (44.0m)	Begin	20.03.2018	16:12	54°47.98N	13°38.93E	V0021_01	
		End	20.03.2018	16:16	54°47.98N	13°38.88E		
22	TF0150 (21.8m)	Begin	20.03.2018	18:00	54°36.71N	14°02.55E	V0022F01	
		End	20.03.2018	18:13	54°36.66N	14°02.65E		
23	TF0121 (29.6m)	Begin	20.03.2018	18:58	54°42.42N	13°57.01E	V0023F01	
		End	20.03.2018	19:19	54°42.61N	13°56.77E		
24	TF0112 (40.3m)	Begin	20.03.2018	19:54	54°48.01N	13°57.50E	V0024F01	
		End	20.03.2018	20:15	54°48.20N	13°57.52E		
25	TF0111 (44.6m)	Begin	20.03.2018	20:50	54°53.20N	13°58.08E	V0025F01	
		End	20.03.2018	21:10	54°53.39N	13°58.09E		
26	ABBoje (45.6m)	Begin	20.03.2018	21:39	54°52.77N	13°51.68E	V0026K01	Cc
		End	20.03.2018	22:25	54°54.00N	13°50.46E	V0026F02 V0026K03	
27	TF0122 (47.7m)	Begin	20.03.2018	23:10	54°59.38N	13°46.32E	V0027_01	
		End	20.03.2018	23:15	54°59.38N	13°46.30E		
28	TF0105 (46.5m)	Begin	21.03.2018	00:02	55°01.48N	13°36.47E	V0028F01	
		End	21.03.2018	00:11	55°01.51N	13°36.43E		
29	TF0104 (45.9m)	Begin	21.03.2018	00:54	55°03.88N	13°48.40E	V0029F01	
		End	21.03.2018	01:10	55°04.12N	13°48.87E		
30	TF0102 (44.9m)	Begin	21.03.2018	02:00	55°09.29N	13°56.55E	V0030F01	
		End	21.03.2018	02:15	55°09.38N	13°56.24E		
31	TF0103 (46.7m)	Begin	21.03.2018	03:01	55°03.82N	13°59.43E	V0031F01	
		End	21.03.2018	03:12	55°03.81N	13°59.33E		
32	TF0109 (47.6m)	Begin	21.03.2018	03:51	55°00.04N	14°05.05E	V0032F01	Phy, Zoo,
		End	21.03.2018	04:01	54°59.99N	14°05.03E		
33	TF0145 (46.4m)	Begin	21.03.2018	05:19	55°09.82N	14°15.06E	V0033F01	
		End	21.03.2018	05:38	55°09.99N	14°14.98E		
34	TF0144 (45.6m)	Begin	21.03.2018	06:40	55°15.15N	14°30.05E	V0034F01	
		End	21.03.2018	06:53	55°15.15N	14°30.00E		
35	TF0142 (59.6m)	Begin	21.03.2018	07:59	55°24.23N	14°32.26E	V0035F01	
		End	21.03.2018	08:17	55°24.17N	14°31.99E		
36	TF0140 (69.5m)	Begin	21.03.2018	09:12	55°28.15N	14°43.24E	V0036F01	
		End	21.03.2018	09:36	55°28.01N	14°43.00E		
37	TF0206 (75.8m)	Begin	21.03.2018	10:27	55°32.03N	14°54.82E	V0037_01	
		End	21.03.2018	10:41	55°32.01N	14°54.80E		
38	TF0207 (85.1m)	Begin	21.03.2018	11:29	55°29.79N	15°05.63E	V0038_01	
		End	21.03.2018	11:41	55°29.77N	15°05.60E		
39	TF0208 (91.8m)	Begin	21.03.2018	12:18	55°27.14N	15°14.11E	V0039_01	
		End	21.03.2018	12:31	55°27.19N	15°14.00E		
40	TF0200 (90.7m)	Begin	21.03.2018	13:09	55°22.95N	15°19.82E	V0040F01	
		End	21.03.2018	13:31	55°23.00N	15°19.78E		
41	TF0209 (93.1m)	Begin	21.03.2018	14:17	55°20.79N	15°27.88E	V0041_01	
		End	21.03.2018	14:24	55°20.79N	15°27.91E		
42	TF0211 (94.8m)	Begin	21.03.2018	15:03	55°19.70N	15°36.92E	V0042_01	
		End	21.03.2018	15:25	55°19.81N	15°36.88E		

Stat No.	*Stat.Name (Depth)*		*Date*	*Time [UTC]*	*Latitude*	*Longitude*	*CTD cast(s)*	*Nets & samples*
43	TF0212 (94.4m)	Begin	21.03.2018	16:08	55°18.05N	15°47.92E	V0043F01	
		End	21.03.2018	16:29	55°18.09N	15°47.79E		
44	TF0214 (93.4m)	Begin	21.03.2018	17:26	55°09.66N	15°39.71E	V0044F01	
		End	21.03.2018	17:46	55°09.59N	15°39.63E		
45	TF0213 (89.7m)	Begin	21.03.2018	18:58	55°14.96N	15°59.14E	V0045K01 V0045F02 V0045F03 V0045K04 V0045K05	Phy, Zoo, Cc, De,
		End	21.03.2018	22:04	55°14.97N	15°59.49E		
46	TF0221 (82.4m)	Begin	21.03.2018	22:46	55°13.29N	16°10.07E	V0046F01	
		End	21.03.2018	23:01	55°13.32N	16°10.04E		
47	TF0225 (66.4m)	Begin	21.03.2018	23:43	55°15.43N	16°19.27E	V0047_01	
		End	21.03.2018	23:52	55°15.43N	16°19.23E		
48	TF0226 (57.5)	Begin	22.03.2018	00:32	55°17.74N	16°25.76E	V0048_01	
		End	22.03.2018	00:36	55°17.75N	16°25.76E		
49	TF0224 (61.8m)	Begin	22.03.2018	01:10	55°16.99N	16°30.17E	V0049_01	
		End	22.03.2018	01:22	55°16.98N	16°30.05E		
50	TF0227 (68.5m)	Begin	22.03.2018	01:57	55°15.62N	16°38.25E	V0050_01	
		End	22.03.2018	02:08	55°15.69N	16°38.20E		
51	TF0228 (76.4m)	Begin	22.03.2018	02:45	55°14.18N	16°46.43E	V0051_01	
		End	22.03.2018	02:57	55°14.18N	16°46.32E		
52	TF0229 (84.5m)	Begin	22.03.2018	03:37	55°13.68N	16°54.80E	V0052_01	
		End	22.03.2018	03:50	55°13.72N	16°54.72E		
53	TF0222 (90.8m)	Begin	22.03.2018	04:30	55°13.01N	17°04.15E	V0053F01	
		End	22.03.2018	04:46	55°13.00N	17°04.03E		
54	TF0266 (89.4m)	Begin	22.03.2018	05:50	55°15.17N	17°21.53E	V0054_01	
		End	22.03.2018	06:07	55°15.12N	17°21.36E		
55	TF0267 (84.2m)	Begin	22.03.2018	06:59	55°17.17N	17°35.78E	V0055_01	
		End	22.03.2018	07:17	55°17.15N	17°35.62E		
56	TF0268 (74.2m)	Begin	22.03.2018	08:27	55°18.46N	17°55.95E	V0056_01	
		End	22.03.2018	08:45	55°18.47N	17°55.79E		
57	TF0256 (79.2m)	Begin	22.03.2018	09:54	55°19.62N	18°14.16E	V0057F01	De
		End	22.03.2018	10:21	55°20.65N	18°14.87E		
58	TF0257 (82.5m)	Begin	22.03.2018	11:03	55°26.51N	18°19.28E	V0058_01	
		End	22.03.2018	11:15	55°26.51N	18°19.20E		
59	TF0259 (89.6m)	Begin	22.03.2018	12:03	55°33.04N	18°24.09E	V0059F01 V0059F02	Phy, Zoo,
		End	22.03.2018	12:31	55°32.98N	18°23.97E		
60	TF0255 (94.8m)	Begin	22.03.2018	13:27	55°37.99N	18°36.11E	V0060F01	
		End	22.03.2018	13:40	55°37.97N	18°36.01E		
61	TF0258 (92.3m)	Begin	22.03.2018	14:32	55°43.66N	18°46.00E	V0061_01	
		End	22.03.2018	14:47	55°43.60N	18°45.92E		
62	TF0253 (99.1m)	Begin	22.03.2018	15:37	55°50.46N	18°52.09E	V0062_01	
		End	22.03.2018	15:50	55°50.38N	18°52.03E		
63	TF0265 (109.9m)	Begin	22.03.2018	16:47	55°57.28N	19°02.58E	V0063_01	
		End	22.03.2018	17:19	55°57.48N	19°02.79E		
64	TF0250 (122.5m)	Begin	22.03.2018	18:08	56°04.91N	19°10.09E	V0064F01	
		End	22.03.2018	18:35	56°05.02N	19°09.95E		
65	TF0262 (130.4m)	Begin	22.03.2018	19:33	56°13.96N	19°18.13E	V0065F01	
		End	22.03.2018	19:59	56°14.10N	19°17.99E		
66	TF0263 (132.8m)	Begin	22.03.2018	20:44	56°20.81N	19°22.85E	V0066F01	
		End	22.03.2018	21:24	56°20.97N	19°22.77E		
67	TF0261 (141.8m)	Begin	22.03.2018	22:16	56°29.46N	19°29.07E	V0067_01	
		End	22.03.2018	22:39	56°29.51N	19°28.90E		

Stat No.	*Stat.Name (Depth)*		*Date*	*Time [UTC]*	*Latitude*	*Longitude*	*CTD cast(s)*	*Nets & samples*
68	TF0260 (142.6m)	Begin	22.03.2018	23:39	56°38.00N	19°35.06E	V0068F01	
		End	22.03.2018	23:56	56°38.00N	19°35.07E		
69	TF0274 (152.2m)	Begin	23.03.2018	01:01	56°46.00N	19°45.06E	V0069_01	
		End	23.03.2018	01:08	56°45.99N	19°45.02E		
70	TF0273 (181.0m)	Begin	23.03.2018	02:23	56°57.12N	19°46.24E	V0070_01	
		End	23.03.2018	02:33	56°57.10N	19°46.17E		
71	TF0272 (205.4m)	Begin	23.03.2018	03:24	57°04.25N	19°49.99E	V0071F01	
		End	23.03.2018	04:12	57°04.29N	19°49.82E		
72	TF0275 (226.2m)	Begin	23.03.2018	05:06	57°12.54N	19°55.78E	V0072_01	
		End	23.03.2018	05:42	57°12.91N	19°56.12E		
73a	MoorGOC (240.4m)	Begin	23.03.2018	06:30	57°18.37N	20°04.85E		Moor
		End	23.03.2018	07:10	57°18.37N	20°04.85E		
73b	TF0271 (239.1m)	Begin	23.03.2018	07:22	57°19.11N	20°03.32E	V0073F01	Phy, Zoo,
		End	23.03.2018	09:30	57°19.11N	20°03.32E	V0073F02 V0073F03	De,
73c	MoorGOC (242.0m)	Begin	23.03.2018	09:50	57°18.37N	20°04.85E		Moor
		End	23.03.2018	10:17	57°18.37N	20°04.85E		
73d	TF0271 (237.5m)	Begin	23.03.2018	10:30	57°19.23N	20°02.99E	V0073F04	MolBio,
		End	23.03.2018	11:53	57°19.23N	20°02.99E	V0073F05	TG,
74	GB_B13 (268.0m)	Begin	23.03.2018	12:52	57°16.04N	19°47.78E	V0074_01	
		End	23.03.2018	13:09	57°16.01N	19°47.77E		
75	TF0402 (71.4m)	Begin	23.03.2018	16:08	57°06.11N	18°52.41E	V0075_01	
		End	23.03.2018	16:22	57°05.98N	18°52.23E		
76	TF0403 (113.0m)	Begin	23.03.2018	17:12	57°04.40N	19°01.47E	V0076_01	
		End	23.03.2018	17:28	57°04.43N	19°01.56E		
77	TF0404 (160.2m)	Begin	23.03.2018	18:17	57°01.69N	19°13.37E	V0077_01	
		End	23.03.2018	18:39	57°01.69N	19°13.32E		
78	TF0405 (173.5m)	Begin	23.03.2018	19:05	57°00.50N	19°20.85E	V0078_01	
		End	23.03.2018	19:32	57°00.48N	19°21.33E		
79	TF0406 (165.4m)	Begin	23.03.2018	20:20	56°58.80N	19°34.54E	V0079_01	
		End	23.03.2018	20:43	56°58.82N	19°34.60E		
80	TF0407 (175.2m)	Begin	23.03.2018	21:44	56°56.99N	19°52.80E	V0080_01	
		End	23.03.2018	22:09	56°56.99N	19°53.01E		
81	TF0408 (163.4m)	Begin	23.03.2018	22:40	56°55.37N	20°01.04E	V0081_01	
		End	23.03.2018	22:58	56°55.40N	20°01.11E		
82	TF0409 (144.8m)	Begin	23.03.2018	23:44	56°54.40N	20°12.77E	V0082_01	
		End	23.03.2018	23:58	56°54.32N	20°13.02E		
83	TF0410 (61.6m)	Begin	24.03.2018	00:50	56°52.13N	20°27.04E	V0083_01	
		End	24.03.2018	01:01	56°52.04N	20°27.15E		
84	TF0411 (56.0m)	Begin	24.03.2018	01:53	56°50.36N	20°40.99E	V0084_01	
		End	24.03.2018	01:59	56°50.36N	20°40.98E		
85	GB_B14 (227.8m)	Begin	24.03.2018	04:40	57°12.17N	20°10.25E	V0085_01	
		End	24.03.2018	05:05	57°12.13N	20°10.23E		
86	MoorGNE (212.6m)	Begin	24.03.2018	06:11	57°21.9855N	20°20.7040E	V0086_01	Cc
		End	24.03.2018	07:17	57°22.4359N	20°20.0402E	V0086K02 V0086K03	
87	TF0276 (204.3m)	Begin	24.03.2018	07:58	57°28.2388N	20°15.5780E	V0087_01	
		End	24.03.2018	08:24	57°28.1941N	20°15.5807E		
88	TF0270 (143.0m)	Begin	24.03.2018	09:21	57°37.0394N	20°10.0064E	V0088F01	
		End	24.03.2018	09:58	57°37.7545N	20°07.5770E		
89	TF0287 (125.7m)	Begin	24.03.2018	10:55	57°42.8904N	19°51.6148E	V0089_01	
		End	24.03.2018	11:15	57°42.9042N	19°51.2050E		
90	TF0290 (168.6m)	Begin	24.03.2018	12:15	57°51.0379N	19°49.0138E	V0090_01	
		End	24.03.2018	12:22	57°51.0070N	19°49.0042E		

Stat No.	*Stat.Name (Depth)*		*Date*	*Time [UTC]*	*Latitude*	*Longitude*	*CTD cast(s)*	*Nets & samples*
91	TF0286	Begin	24.03.2018	13:24	58°00.0998N	19°54.0195E	V0091F01	
	(191.8m)	End	24.03.2018	14:29	58°00.0036N	19°54.0463E	V0091F02	
92	TF0277	Begin	24.03.2018	15:45	58°11.0318N	20°03.0522E	V0092_01	
	(159.9m)	End	24.03.2018	15:53	58°11.0009N	20°03.0292E		
93	TF0278	Begin	24.03.2018	17:00	58°21.0048N	20°09.0339E	V0093_01	
	(120.2m)	End	24.03.2018	17:21	58°20.9876N	20°08.8063E		
94	TF0285	Begin	24.03.2018	18:13	58°26.4708N	20°20.1684E	V0094F01	
	(121.8m)	End	24.03.2018	18:40	58°26.4948N	20°20.0264E		
95	TF0279	Begin	24.03.2018	19:53	58°38.5716N	20°20.8934E	V0095_01	
	(162.8m)	End	24.03.2018	20:18	58°38.5132N	20°20.6593E		
96	TF0289	Begin	24.03.2018	21:07	58°46.0728N	20°20.0773E	V0096F01	
	(211.7m)	End	24.03.2018	21:37	58°45.9937N	20°19.7841E		
97	TF0282	Begin	24.03.2018	22:23	58°53.0205N	20°19.1233E	V0097_01	
	(166.6m)	End	24.03.2018	22:43	58°53.0033N	20°18.9834E		
98	TF0288	Begin	24.03.2018	23:42	58°59.8135N	20°09.6994E	V0098_01	
	(140.6m)	End	24.03.2018	23:49	58°59.8100N	20°09.6348E		
99	TF0283	Begin	25.03.2018	03:56	58°47.0079N	19°06.0379E	V0099_01	
	(117.2m)	End	25.03.2018	04:04	58°47.0010N	19°06.0038E		
100	TF0284	Begin	25.03.2018	07:18	58°34.8554N	18°14.1141E	V0100F01	Phy, Zoo,
	(437.0m)	End	25.03.2018	11:24	58°34.8657N	18°14.0199E	V0100F02 V0100F03 V0100K04 V0100F05 V0100K06 V0100K07 V0100F08	MolBio, De, Cc
101	TF0240	Begin	25.03.2018	15:15	57°59.9829N	18°00.0885E	V0101F01	
	(164.7m)	End	25.03.2018	15:34	57°59.9864N	17°59.9688E		
102	TF0242	Begin	25.03.2018	18:05	57°43.0348N	17°22.0780E	V0102F01	
	(139.6m)	End	25.03.2018	18:45	57°40.9241N	17°24.9684E		
103	TF0245	Begin	25.03.2018	22:10	57°07.0182N	17°40.0674E	V0103F01	
	(110.1m)	End	25.03.2018	22:23	57°07.0152N	17°40.0110E		
104	TF0267	Begin	26.03.2018	08:00	55°17.3723N	17°35.8114E	V0104F01	
	(82.8m)	End	26.03.2018	14:32	55°15.2265N	16°38.8961E	V0104K02	
105	TF0213	Begin	26.03.2018	16:42	55°14.9893N	15°58.9509E	V0105F01	Phy, Zoo,
	(89.7m)	End	26.03.2018	17:51	55°15.0006N	15°59.0183E		
106	TF0113	Begin	27.03.2018	07:10	54°55.5093N	13°29.9919E	V0106F01	Phy, Zoo,
	(47.3m)	End	27.03.2018	07:37	54°55.3385N	13°28.8533E		
107	TF0001	Begin	27.03.2018	10:38	54°41.7679N	12°42.4262E	V0107F01	Moor
	(21.3m)	End	27.03.2018	11:03	54°41.9563N	12°41.8202E		
108	TF0030	Begin	27.03.2018	13:37	54°43.3957N	12°47.0741E	V0108F01	Phy, Zoo,
	(22.8m)	End	27.03.2018	14:02	54°43.3816N	12°47.0352E		
109	TF0046	Begin	27.03.2018	16:15	54°28.1091N	12°14.8631E	V0109F01	Phy, Zoo,
	(28.3m)	End	27.03.2018	17:01	54°28.2239N	12°14.5213E		
110	TF0012	Begin	27.03.2018	19:39	54°18.8296N	11°32.9126E	V0110F01	Phy, Zoo,
	(24.5m)	End	27.03.2018	20:48	54°18.5126N	11°34.0488E		

Table 9: Mooring positions

Name	*Depth*	*Latitude*	*Longitude*	*deployed*	*recovered*	*Comment*
GOC	240	57°18.375'N	20°04.854'E	*20.11.2017 10:40*	23.03.2018 07:09	Sediment trap
						on deck
GOC	242	57°18.375'N	20°04.854'E	23.03.2018 10:16	*Nov 2018*	Sediment trap
OBS 1	20	54°42.008	12 41.703		27.03.2018 11:20	OBS + surface float
OBS 2	20	54°42.027	12°41.669		27.03.2018 -------	OBS not recovered
OBS 3	20	54°42.010	12°41.642		27.03.2018 12:00	OBS + surface float

Table 10: VMADCP deployments

ADCP	*Deployment name*	*Start time*	*End time*	*STA Ensembles*
VMADCP 150kHz Ocean surveyor	EMB179__001_000	20.03.2018 08:27:49	22.03.2018 10:05:49	2979
	EMB179__002_000	22.03.2018 10:07:29	26.03.2018 17:31:30	6205
	EMB179__003_000	26.03.2018 17:32:38	27.03.2018 11:46:38	1095
VMADCP 300kHz Work Horse	EMB179_300_001	19.03.2018 09:18:57	22.03.2018 10:11:27	8746
	EMB179_300_002	22.03.2018 10:11:44	27.03.2018 19:50:14	15558