ELISABETH MANN BORGESE - Reports

Baltic Sea Long-term Observation Programme / Deep Baltic II

Cruise No. EMB293

03. – 23. May 2022

Rostock – Rostock

BMP / DeepBaltic II

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Table of Contents

1 Cruise Summary 3
1.1 Summary in English 3
1.2 Zusammenfassung 3

2 Participants 4
2.1 Principal Investigators 4
2.2 Scientific Party 4
2.3 Participating Institutions 4

3 Research Program 5
3.1 Description of the Work Area 5
3.2 Aims of the Cruise 5
3.3 Agenda of the Cruise 5

4 Narrative of the Cruise 8

5 Data Processing and Quality Assurance 12
5.1 CTD 12
5.2 VMADCP 150kHz 14
5.3 ScanFish towed CTD 14
5.4 Moorings 15
5.5 Microstructure Profiler (MSS) 17
5.6 Plankton Sampling 18
5.7 Long Term Investigations of CH_4, N_2O and CO_2 Distribution 18
5.8 Surface Water N_2, O_2 and Ar Measurements 18
5.9 Underway Measurements 20

6 Preliminary Results 21
6.1 Meteorological Conditions 21
6.2 Sea Surface Temperature, Salinity and Chlorophyll-a Distribution 23
6.3 Surface water N2, O2 and Ar MIMS-observations 26
6.4 Observations at Main Stations 27
6.5 Baltic Thalweg Transect 29
6.6 Southern Gotland Basin Transect 34
6.7 Gotland ScanFish Transect 36
6.8 Gulf of Bothnia 37

7 Ship's Meteorological Station 38

8 Station Lists EMB293 38
8.1 Overall Station List 38
8.2 ScanFish Deployment List 44
8.3 Mooring deployment list 44

9 Data and Sample Storage and Availability 45

10 Acknowledgements 46

11 References 46

1 Cruise Summary

1.1 Summary in English

The cruise EMB293 was carried out in frame of the Baltic Sea long term observation program and the project DeepBaltic 2, a follow up of the Maria S. Merian cruise MSM99 in February/March 2021. The work program of EMB293 consisted of field data acquisition for the national environmental monitoring in the German EEZ, which is performed in context with the Helsinki Commission (HELCOM) and federal programs to evaluate the status of coastal regions in North and Baltic Sea (BMLP). This work package is based on contract between the Federal Maritime Agency (BSH) and IOW as administrative agreement since 1991. The second work package is part of IOW's Baltic Sea long-term observation program, related to the institutes research foci "changing ecosystems", "basin-scale ecosystem dynamics" and to a smaller extent for "small- and mesoscale processes". The central task is a continuously ongoing data collection of time series at key stations spanning from the western to central Baltic Sea, initiated since 1969. Since 1997 it is complemented by permanent moorings in the Eastern Gotland Basin. The gathered data are the back bone of research on the natural variability of the ecosystem, anthropogenic influences and the impact of climate change on the Baltic Sea. This long term observation program was extended during the cruise to the Bothnia Bay and Bothnian Sea, where also two moorings were recovered, which were deployed during the MSM99. The overall weather conditions during the cruise were characterized by moderate wind and sunny conditions. Thus, the intended scientific program of the cruise could be fully completed and some extra stations were worked. The gathered data depict a high resolution snapshot of the spring conditions in the Baltic in a year without a larger salt water inflow during winter. The majority of the work was performed along the Thalweg of the Baltic from the Darss Sill to the Bothnian Bay.

1.2 Zusammenfassung

Die Expedition EMB293 wurde im Rahmen des Ostsee Langzeitbeobachtungsprogramms und der Projektes DeepBaltic 2 durchgeführt, das eine Nachfolgeexpedition der Maria S. Merian Reise MSM99 im Februar/März 2021 darstellt. Das wissenschaftliche Programm beinhaltet die Felddatenerfassung für die nationale Umweltüberwachung in der deutschen AWZ, die im Rahmen der Helsinki-Kommission (HELCOM) und des nationalen Programmes zur Zustandsbewertung von Küstenregionen in Nord- und Ostsee (BMLP) durchgeführt wird. Dieses Arbeitspaket basiert auf einem Vertrag zwischen dem Bundesamt für Seeschifffahrt und Hydrographie (BSH) und dem IOW als Verwaltungsvereinbarung seit 1991. Das zweite Arbeitspaket der Expedition ist Teil des Ostsee-Langzeitbeobachtungsprogramms des IOW, das Teil der IOW Forschungsschwerpunkte "Ökosysteme im Wandel", "Ökosystemdynamik im Beckenmaßstab" und in geringerem Umfang "kleine und mesoskale Prozesse" ist. Zentrales Element des Programmes ist eine seit 1969 initiierte, kontinuierlich durchgeführte Datenerhebung von Schlüsselparametern an Stationen in der westlichen und zentralen Ostsee. Seit 1997 wird das Programm durch permanente Verankerungen in der Gotland See ergänzt. Die gewonnenen Daten bilden die Basis der Forschung zur natürlichen Variabilität des Ostsee-Ökosystems, zu anthropogenen Einflüssen und zu den Auswirkungen des Klimawandels auf die Ostsee. Das Langzeitbeobachtungsprogramm wurde während dieser Expedition auf den

Bottnischen Meerbusen ausgedehnt, wo auch zwei Verankerungen geborgen wurden, die während der Expedition MSM99 ausgebracht worden waren.

Die Wetterbedingungen während der Expedition waren durch mäßigen Wind und überdurchschnittliche Sonnenscheindauer gekennzeichnet. So konnte das vorgesehene wissenschaftliche Programm der Reise vollständig umgesetzt und einige zusätzliche Stationen bearbeitet werden. Die gesammelten Daten stellen eine hochauflösende Momentaufnahme der Frühjahrsbedingungen in der Ostsee in einem Jahr ohne größeren Salzwasserzufluss in vorangegangenen Winter dar. Der Großteil der Arbeiten wurde entlang des Talweges der Ostsee von der Darßer Schwelle bis zur Bottenwiek durchgeführt.

2 Participants

2.1 Principal Investigators

Name	Program	Institution
Mohrholz, Volker, Dr.	Hydrography	IOW
Kuss, Joachim, Dr.	Marine Chemistry	IOW
Dutz, Jörg, Dr.	Biology	IOW

2.2 Scientific Party

Name	Discipline	Institution
Mohrholz, Volker, Dr.	Phys. Oceanogr. / Chief Scientist	IOW
Beier, Sebastian	Phys. Oceanogr.	IOW
Heene, Toralf	Phys. Oceanogr.	IOW
Rehse, Nina R.	Phys. Oceanogr.	IOW
Donath, Jan	Phys. Oceanogr. / Instrumentation	IOW
Otto, Stefan, Dr.	Marine Chemistry	IOW
Dierken, Madleen	Marine Chemistry	IOW
Schöne, Susanne	Marine Chemistry	IOW
Iwe, Sören	Marine Chemistry / Trace gases	IOW
Fechtel, Christin	Biology	IOW
Hehl, Uwe	Biology	IOW

2.3 Participating Institutions

IOW Leibniz-Institute for Baltic Sea Research Warnemünde, Germany

3 Research Program

3.1 Description of the Work Area

Data collection covered the western, central and northern Baltic from the Kiel Bight to the Gotland Basin, and further on to the Bothnian Bay. The majority of stations was located along the thalweg transect of the Baltic Sea. The possible northwestern pathway of saline water from the Bornholm Basin to the western Gotland Basin was not sampled, since there were no indications of a larger inflow of saline water from the North Sea during the previous winter.

A core area of the cruise was the Eastern Gotland Basin (EGB). Along its southern rim an east-west transect of CTD stations was worked, in order to gather information about the cross basin distribution of hydrographic parameters in the largest basin of the Baltic proper. Additional CTD casts were carried out at some key stations in the western Gotland Basin, namely in the Karlsö Deep. Unfortunately, the Landsort Deep could not be covered since the Swedish Marine Forces did not granted access to this station. An overview of the locations of CTD stations, mooring positions, and the cruise track is given in Figure 3.1. A station list is given in Table 8.1.

3.2 Aims of the Cruise

The cruise EMB293 was carried out as a joined cruise of the environmental monitoring program of the Federal Maritime and Hydrographic Agency (BSH), the Baltic Sea long term observation program of the Leibniz-Institute for Baltic Sea Research Warnemünde (IOW) and the DeepBaltic Project. It was the third 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. For this purpose hydrographic, chemical and biological data where gathered along the Baltic thalweg transect. The major focus was on the state of ecosystem during spring conditions when the first phytoplankton bloom is close to its peak. Since no larger baroclinic inflows were observed during the previous winter, the observations will deliver undisturbed data about the onset of the seasonal stratification.

For the first time during the recent years the observations along the Baltic thalweg were extended into the northern Baltic, the Bothnian Sea and the Bothnian Bay. The aim was to gather a comprehensive picture of the hydrographic conditions along the entire salinity gradient of the Baltic, and to collect data about turbulent mixing at the time when the thermal stratification in the upper layer is established. These observation are carried out as part of the DeepBaltic project.

A further goal of the cruise were the recovery of two moorings that were deployed one year ago with the Maria S. Merian cruise MSM99 also in frame of the DeepBaltic project.

Additionally, three moorings should be deployed for the CABLE project in the northern Gotland Basin.

3.3 Agenda of the Cruise

The three main work packages were subsequently conducted. We started with the BSH environmental monitoring program in the western Baltic, which was continued with the IOW's Baltic Sea long term observation program in the southern and central Baltic Sea. Both consist mainly of CTD casts, water sampling for nutrient analysis, trace gas measurements and net sampling of phytoplankton and zooplankton. At one station a sediment core was taken.

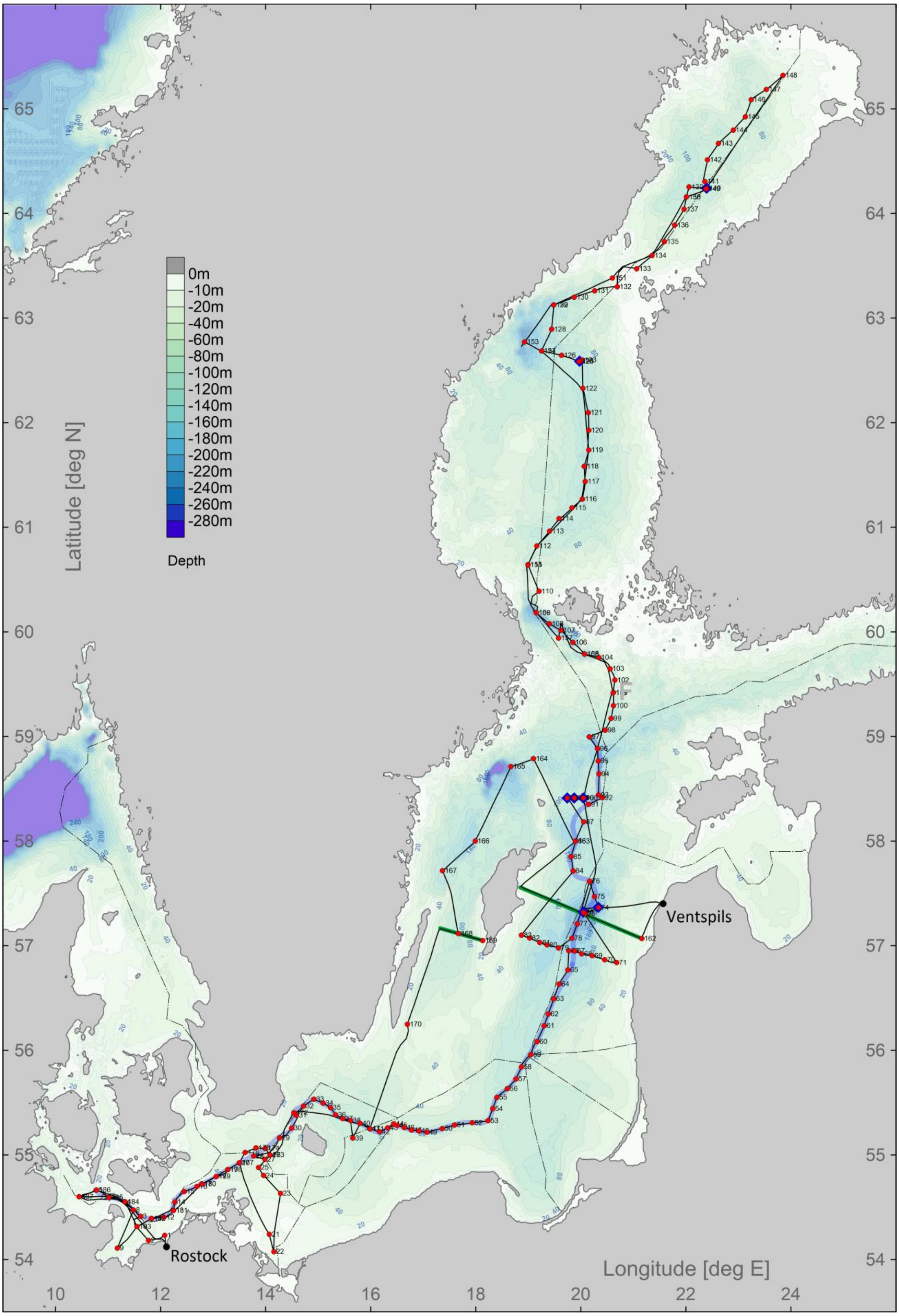

Figure 3.1 Map of stations and ship track of cruise EMB293 from 03. – 23. May 2022. Red dots and black labels indicate the positions and names of CTD stations. The green lines depict the ScanFish transects. Blue diamonds mark the location of moorings in the eastern Gotland basin, the Bothnian Sea, and the Bothnian Bay.

The station work is complemented by the mooring maintenance in the eastern Gotland Basin. The cruise was also used for a first test of a new measurement system for nitrogen and oxygen gas concentration in surface waters to obtain information about nitrogen fixation and oxygen production by phytoplankton.
After performing the major part of the long term observations in the western and central Baltic, the work was continued with the third work package in the Bothnian Sea and Bothnian Bay. Here CTD and MSS casts were performed and two moorings of the Deep Baltic Project were recovered.
Additionally, in central Baltic the CABLE project moorings were deployed.
Some CTD stations were repeated on the way back to Rostock to gather further data for the long term observation program.

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

At stations and transects:

- CTD SBE 911+ with rosette water sampler (CTD)
- Microstructure profiler (MSS)
- Oceanographic moorings (Moor)
- Towed CTD ScanFish (SCF)
- Phytoplankton nets (APNET)
- Zooplankton net (WP2)
- Secci desk (SD)
- Frahm corer

(The abbreviations in brackets indicate the device short names used in the DSHIP data base)

Continuous measurements:

- Vessel mounted ADCP 150kHz Ocean Surveyor (only at selected transects)
- Underway measurements of surface water properties
- Ship weather station
- Nitrogen and oxygen gas measurement in surface water
- TRIOS radiation sensor system

4 Narrative of the Cruise

Date	***Time [UTC]***	***Task***
02.05.2022		Loading of equipment, preparing devices for the cruise
03.05.2022	05:00	Embarking of scientific crew
	06:00	Safety instructions
	06:30	Departure from port Rostock-Marienehe, weather predictions for the next two days are good. Low wind speed, sunny weather.
	07:35	Start of station work in the western Baltic, with station TF_O5 off Warnemünde.
	08:00	Safety drill
	20:00	Reaching the western most station TF0360 in the Kiel Bight. The weather is still calm and sunny.
04.05.2022		Continuation of station work in the Mecklenburg Bight. Clear sky and 2Bft wind speed
	12:45	Observations at MarNet station Darss Sill. No active inflow signature found in CTD data. Clear sky but increasing fog near the sea surface
	14:50	Reaching station TF0115 at the western rim of the Arkona Basin
	17:30	Work on central station TF0113 in the Arkona Basin. Relatively low bottom salinity of appr. 18g/kg
	19:00	Change of intended course due to military exercises in the area north of Rügen island
	19:30	Station TF0123 cancelled due to closing of the area for military exercises
05.05.2022	00:40	Observations at MarNet station OderBuoy in the Pomeranian Bight. Clear sky and weak winds.
	05:00	Continuation of station work in the southern and eastern Arkona Basin
	12:30	Station TF0110 has been shifted from its original position into german waters, since the approval for work in Swedish waters is still pending
	14:00	The stations TF0103, TF0104, and TF0105 in Swedish waters were cancelled due to still pending work permit
	15:30	Station work was continued at station TF0145. Its position was shifted to the east into Danish waters.
	18:50	Station TF0142 position was shifted to the east into Danish waters.
06.05.2022		Continuing station work along the Baltic Thalweg transect.
	06:20	Start work on central station TF0213 in the Bornholm Basin. Weather conditions are still good, with cloudy sky and low wind speed. Bottom salinity of appr. 15.2g/kg, H_2S is present in bottom waters.
	10:00	Swedish research permit was granted. Some stations cannot be worked, among them the Landsort Deep.
	12:20	Passing the Slupsk Sill towards the Slupsk Furrow. No active bottom water overflow was detected on the sill.
	22:00	Passing the eastern edge of the Slupsk Furrow and turning to Northeast

Date	***Time [UTC]***	***Task***
		towards the eastern Gotland Basin
07.05.2022		Continuing station work along the Baltic Thalweg transect toward the Gotland Basin
	06:00	Station TF0265 close to the Russian EEZ. Cloudy sky, but still weak winds from Southeast.
	11:45	Reaching the southern rim of the eastern Gotland basin. Patches of slightly oxygenated bottom water. No H2S in bottom water present.
	16:30	Start station work on the eastern part of the southern Gotland basin transect
08.05.2022	02:30	Station work at the central station TF0271 in the eastern Gotland basin. Sunny sky and low wind speed.
	07:40	Mooring Gotland Central successfully released. All devices recovered without damage. After maintenance the sediment trap was redeployed.
	11:40	Mooring Gotland Northeast successfully released. All devices recovered without damage. The mooring was replaced by a prepared spare mooring.
	13:30	Continuing station work along the Baltic Thalweg transect
	21:00	Continuing station work on the eastern part of the southern Gotland basin transect
09.05.2022	06:40	Continuing station work along the Baltic Thalweg transect. The weather is still good, with sunny sky and moderate wind speed of 4Bft.
	14:35	Mooring CABLE M2 successfully deployed at the western most position of the CABLE mooring array
	16:16	Mooring CABLE M3 successfully deployed. Wind is slightly increasing to 5-6 Bft.
	18:00	Continuing station work along the Baltic Thalweg transect.
10.05.2022	02:00	The planned ARGO float (fr_7900587) recovery was cancelled due to missing communication of the float and high sea state
	02:30	Start station work along the northern extension of Baltic Thalweg transect. The wind speed remained at 5-6Bft.
	15:20	CTD stations in the Aland Deep. Bottom water is well oxygenated in contrast to the conditions in the northern Gotland Basin.
	18:30	Station at Aland deep. Well ventilated bottom layer in 290m depth. Traces of benthos fauna in CTD camera.
11.05.2022		Continuing station work in the southern part of the Bothnian Sea. The wind speed decreased during the night to 8m/s.
	03:30	First deployment of microstructure profiler at station TF0604. The surface temperature in the southern Bothnian Sea is above the temperature of density maximum.
		Continuing station work, northward along the deep channel in the eastern part of the Bothnian Sea. Sunny sky and low wind speed.

Date	*Time [UTC]*	*Task*
12.05.2022	00:00	MSS transect through the local deep at station TF0603, where the mooring DB2 was deployed during the Merian cruise in March 2021
	06:35	Mooring DB2 was successful recovered. No loss of devices and all devices have measured as intended.
	07:30	Continuing station work in the northern part of the Bothnian Sea.
	19:30	Reaching “The Quark”, the shallow sill between Bothnian Sea and Bothnian Bay
13.05.2022		Continuing station work in the southern Bothnian Bay after passing The Quark during the night. Surface temperature and salinity dropped significantly
	09.00	Mooring DB1 was successful recovered in the central Bothnian Bay. No loss of devices and all devices have measured as intended.
	09:30	Continuing station work in the Bothnian Bay towards north. Weather is still calm and sunny, but with cold air temperatures.
14.05.2022	00:30	Arriving the northern most station of the cruise. No ice.
	01:00	Turning to the south for MSS stations in the southern Bothnian Bay.
	08:20	Performing two MSS stations in the central Bothnian Bay to obtain data about convective driven mixing in the surface layer. Almost no wind and cloudy sky.
	13:30	Continuation of southward transit to The Quark
	18:40	Passing the sill between Bothnian Bay and Bothnian Sea
15.05.2022	00:00	Continuation of station work with CTD and MSS south of The Quark. The wind has increased to about 10m/s
	09:30	End of station work in the northern Bothnian Sea. Start transit to the Aland Sea. Clear sky and moderate wind speed
	23:45	Start of station work with MSS stations in the Aland Sea. Wind has increased to 12m/s
16.05.2022		Continuation of station work with CTD and MSS in the Aland Sea.
	04:50	CTD station at the Aland deep. Max depth of CTD profiling during the cruise was reached with 300m.
	09:50	Start of MSS transect across the deep channel south of Aland Island. Wind speed remained at 6Bft.
	18:45	End of MSS transect. Wind speed decreased to 4Bft
17.05.2022	02:40	Performing MSS station in the northern Gotland basin. The wind has increased to 5-6Bft
	05:00	Start transit to mooring position CABLE M4
	11:00	Performing CTD at mooring position
	13:20	Mooring Cab_M4 successful deployed. Start transit to TF0271, central station of the eastern Gotland Basin
	18:40	Start station work at TF0271 with combined profile of CTD and MSS for MSS field calibration.
18.05.2022	00:05	End of station work at TF0271, and start transit to the port of Ventspils

Date	***Time [UTC]***	***Task***
	06:00	Arriving the port of Ventspils, Latvia
	08:30	Bunkering of fuel, and fresh food
	11:30	Leaving the port of Ventspils and heading south to the start point of ScanFish transect 1
	12:00	Problems with internal IT net of the ship. Partial failure of the network, dship data not available
	13:30	Network issue fixed
	14:07	Start of ScanFish zonal transect through the Eastern Gotland Basin
19.05.2022		Continuation of ScanFish zonal transect
	03:50	End of ScanFish transect through the Eastern Gotland Basin
	08:15	MSS station at Farö Deep. Calm winds and high cloud cover
	10:30	Transit to the western Gotland Basin
	16:00	Start station work in the western Gotland Basin with station TF0283
	18:10	Since work at Landsort Deep was not allowed, at the nearest possible station nGB-1 a CTD profile was performed
20.05.2022	00:00	Continuation of station work in the western Gotland Basin with station TF0240
	07:40	End of station work in the western Gotland Basin. Transit to ScanFish transect 2 at southern tip of Gotland.
	09:20	Start ScanFish transect 2 at the southern tip of Gotland
	15:00	End of ScanFish transect 2 near Öland. Heading south for transit to Bornholm Basin. Low wind speed, but cloudy sky.
	15:30	Barbeque on deck, celebration of cruise scientific success
21.05.2022	04:00	Start station work at station TF0213 in the Bornholm Basin. The wind has increased to 5Bft. Complete cloud cover and persistent rain.
	08:45	End of station work at TF0213. Start transit to the Arkona Basin
	14:15	Passing the Bornholmgat (station TF0142)
	18:00	Start station work in the Arkona Basin
	22:05	Arriving the central station TF0113
22.05.2022		Continuation of station work in the Arkona Basin Low wind speed and cloud covered sky, but no rain
	02:30	Start station work at the Darss Sill and the Belt Sea
	06:00	Packing of scientific equipment that will not be used at the remaining stations
	16:45	Working the last station of the cruise TF0360 in the Kiel Bight
	17:30	End of scientific work of cruise EMB293
		Heading towards Rostock port
23.05.2022	06:00	Arrival at port Rostock-Marienehe
	08:00	Unloading of scientific equipment
	11:00	Disembarking of scientific crew, end of cruise EMB293

5 Data Processing and Quality Assurance

A station name and a station number were assigned to all stations, where scientific equipment was used. The station name, also referred as position alias, identifies a geographical position. The station number is an alphanumerical value that is incremented for each new station. Each device deployment is indicated by numerical extension of the station number. The station number was applied according the station number rules of the DSHIP. For the cruise EMB293 the first station number is EMB293_1.

5.1 CTD

The CTD-system "SBE 911plus", SN-1385, (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
- CDOM fluorescence
- PAR
- SPAR

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. 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. Fluorescence and turbidity are measured with a downward looking WET Labs fluorimeter. 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.xmlcon) was written which contains the complete parameter set, especially sensor coefficients used for the conversion of raw data (frequencies) to standard output format.

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”. Additionally, a self contained SUNA nitrate sensor was mounted on the rosette frame. 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 0.5m 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 and/or hydrogen sulfide samples were taken first, followed by water samples for salinity, nutrients and water for several biogeochemical analyses.

Field 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”,
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, and no SPM samples were taken during the cruise.

Table 5.1: Type and serial numbers of mounted CTD sensors

Sensor	***Type***	***SN***	***Last calibration***
Pressure	Digiquartz	1385	02.05.2019
Temperature 0	SBE 3	5261	21.12.2021
Temperature 1	SBE 3	5120	21.12.2021
Conductivity 0	SBE 4	4811	21.12.2021
Conductivity 1	SBE 4	4718	21.12.2021
Oxygen 0	SBE 43	1732	21.01.2022
Oxygen 1	SBE 43	1735	21.01.2022
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	22019	28.09.2010
PAR sensor	Biospherical Licor Chelsea	70256	08.12.2009
SPAR	SPAR/Surface Irradiance	6307	27.02.2017
CDOM fluorometer	WET Labs		

5.2 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 TCP/IP 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 on selected transects along the cruise track. The following configurations were used for data acquisition in the western and central Baltic.

Table 5.2: Configuration of 150kHz VMADCP

Command	*Parameter*	*Value*
WP	Broad band pings	1 ping/ens
WN	number of depth cells	65
WS	bin length	4m
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	2s
	time between pings	1s
	heading alignment	0 deg
	heading bias	0 deg
	short term average	60s
	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.

5.3 ScanFish towed CTD

Two high resolution hydrographic transects with the ScanFish towed CTD (SF) were performed in the eastern Gotland Basin and the western Gotland Basin. The ScanFish 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, turbidity and Chlorophyll-a fluorescence. The details of the used sensors are given in Table 5.3. For test purposes a downward looking 600kHz ADCP was mounted at the lower side of the ScanFish. Hydrographic data are transmitted via a multi-conductor cable and stored in the lab on a computer disc. The instrument was be deployed over the stern of the ship and was operated with a separate winch, 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 about 6 knots, the undulation depth is steered from the lab. Control commands are transmitted via the cable.

Table 5.3: Type and serial numbers of CTD sensors mounted on ScanFish

Sensor	***Type***	***SN***	***Calibration date***
Pressure	Digiquartz	0973	10.12.2010
Temperature 0	SBE 3	5356	16.06.2021
Temperature 1	SBE 3	1699	29.04.2019
Conductivity 0	SBE 4	1349	27.10.2021
Oxygen 0	SBE 43	1473	03.06.2021
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	3274	unknown

5.4 Moorings

During the cruise a number of mooring operations were performed. Two moorings of the IOW long term observation program were maintained in the Eastern Gotland Basin (GONE, GOC). Three moorings were deployed for the CABLE Project in the northern Gotland Basin (Cab_M2, Cab_M3, Cab_M4). And two mooring in the Bothnian Sea and Bothnian Bay were recovered (DB1, DB2). Details of the moorings and the mooring operations at the certain positions (see Figure 3.1) are described below and in Table 8.3.

GONE (Long Term Mooring Gotland Northeast)

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 is operated since 1997 and provides also the data basis for the "Hagen-Curve" of deep water temperatures in the eastern Gotland basin. The GONE mooring consists of a bottom mounted currentmeter Nortek Signature 250kHz, a MicroCat thermosalinometer SBE37, three RBR temperature recorders, and 3 PME oxygen optodes. The sketch of the mooring is depicted in left panel of Figure 5.1. On 08.05.2022 11:40 UTC the GONE mooring (deployment 41) was successful recovered after 7 month of operation. The mooring (deployment 42) was redeployed after maintenance on the same day at 12:04 UTC.

GOC (Long Term Mooring Gotland Central)

The GOC mooring is located in the center of the eastern Gotland Basin and is also part of IOWs long term observation program. The mooring consist of a sediment trap, and at five additional levels MicroCat thermosalinometer SBE37 combined with PME oxygen optodes. They cover the deep water range between 140 and 240m. The mooring collects data about the downward flux of organic material into the deep water layer, and hydrographic data to detect the temporal variation and trends in the deep water and bottom layer. The mooring was successful recovered (deployment BF) on 08.05.2022 08:28 UTC. After the exchange of all devices with fresh calibrated instrument the mooring was redeployed an hour later at 09:33 UTC (deployment BF).

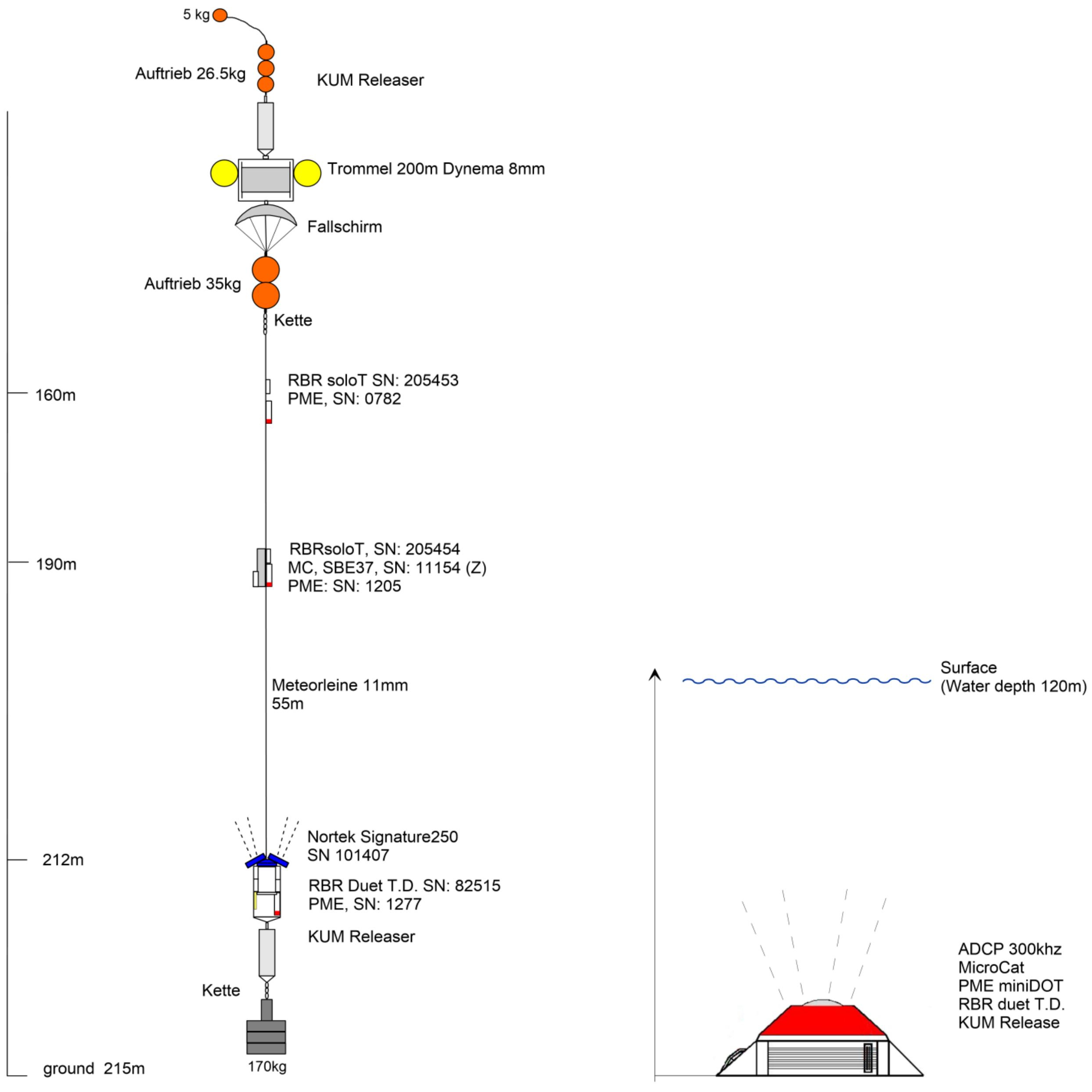

Figure 5.1 Sketch of the GONE mooring deployment 42 (left) and the ADCP bottom shield of Cab_M4 mooring (right). A similar design was used for the other moorings described above.

Cab_M2, Cab_M3, Cab_M4 (CABLE project moorings)

The three moorings CaB_M2, CaB_M3 and CaB_M4 are the western part of a larger east – west transect of moorings in the Gotland Basin north of the Farö Deep operated in frame of the Central Baltic Sea Circulation Experiment project (CABLE). The mooring transect consist of 9 moorings which are all equipped with a bottom mounted ADCP for current measurements in the entire water column. The purpose of the mooring array is to gather 6 months of high resolution current data to investigate the water exchange between the eastern Gotland Basin and the northern Baltic Sea. The moorings Cab_M2 and Cab_M3, provided by the IOPAN in Gdynia and the GEOMAR in Kiel were successfully deployed on 09.05.2022 at 14:35 and 16:00 UTC, respectively. The mooring Cab_M4 operated by the IOW was deployed some days later on 17.05.2022 at 11:20 UTC. The recovery of the moorings is planned for September and November 2022.

DB1 and DB2 (DeepBaltic)

The moorings DB1 and DB2 were deployed during the Maria S. Merian cruise MSM99 in March 2021 in the Bothnian Sea and the Bothnian Bay. These mooring were equipped with a bottom mounted ADCP 600kHz to obtain high resolution data of bottom currents. The aim was to provide information, whether strong bottom currents will contribute to the formation of so called contourites in layered mud/silt sediments of deep basins in the northern Baltic. Both moorings were recovered successfully on 12.05.2022 at 6:00 UTC (DB2) and on 13.05.2022 at 8:30 UTC (DB1).

5.5 Microstructure Profiler (MSS)

In the central and northern Baltic microstructure measurements were carried out to obtain data about turbulent mixing during the onset of the seasonal thermal stratification. In total 387 MSS profiles were performed.

The MSS 90-S (serial number 055) 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 of pressure, temperature, conductivity and oxygen concentration, a turbidity sensor, and a vibration control sensor. Additionally to the standard pressure sensor with 1000dbar range a second pressure sensor with 250dbar was mounted. At locations shallower than 250m this sensor is used because of its higher accuracy.

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. The profiler was balanced with negative buoyancy, which gave it a sinking velocity of about 0.5 m/s. It was deployed with a winch at the reeling. The profiler 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 the 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 sensors were calibrated before the cruise in the IOW calibration lab. Additionally, the MSS was mounted to the CTD at station TF0271 to perform a combined cast for field calibration of the MSS oxygen optode and conductivity sensor.

Table 5.4: Sensor configuration and field calibration of MSS55

Sensor	Serial number	Sensor distances Offset [mm]	Field calibration slope	Field calibration offset	profiles
P1000 (1000m)		230	0.995	0.75	All
P250 (250m)		215	-	-	All
Shear1	iow_6224_01	0	0.000795	-	001-216
	iow_6225_01	0	0.000668	-	217-387
Shear2	iow_6223_01	0	0.000681	-	All
NTC		0	-	-	All
Temp (PT100)		135	-	-	All
Cond		140	0.9984075	-0.0685334	All
Oxygen		115	-	-	All
Turbidity		120	1	0.05	001-340; 353-387
			1	-0.495	341-352

5.6 Plankton Sampling

Plankton sampling was performed by means of a rosette sampler (combined with CTD) as well as with a small phytoplankton net (PLA, APNET) 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.

5.7 Long Term Investigations of CH_4, N_2O and CO_2 Distribution

Sampling for simultaneous CH_4, N_2O and CO_2 observation was carried out in frame of an extension to the long term data collection program at the four central stations of the Arkona Basin, the Bornholm Basin, the Eastern Gotland Basin and the Farö Deep. The sampled stations are indicated in Table 8.1 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 $HgCl_2$-solution to prevent microbiological activity and stored dark.

5.8 Surface Water N_2, O_2 and Ar Measurements

The concentrations of N_2, O_2 and Ar in surface water were measured by coupling a membrane-equilibrator with a mass spectrometer (membrane-inlet mass spectrometry, MIMS) as shown in Figure 5.2.

The approach is based on the equilibrium of atmospheric gases between the water and the gas phase, which are separated by a gas permeable membrane. Surface water is pumped continuously through the membrane-equilibrator, at a flow rate of 2 L/min, while the air in the gas phase of the equilibrator is analyzed by a mass spectrometer (MS) for the N_2, O_2 and Ar mole fractions. Every hour the MS is calibrated against standard air by switching the position of the 2-position-

valve (2P valve). The gas flow into the vacuum system of the mass spectrometer (~$3 \cdot 10^{-6}$ mbar) through the capillaries is approximately 10 µL/min.
A filter cartridge with a pore size of 5 µm is used to prevent the membrane from clogging. With the help of a manometer (P_1) the increase in pressure can be monitored, which indicates the need of changing the filter. Another sensor (P_2) is used to measure the total pressure of the gas phase in the membrane-equilibrator. Furthermore the water temperature is measured before and after the membrane (T_1 and T_2) using temperature probes.
The partial pressure of a gas *i* in the gas phase of the membrane-equilibrator (p_i^{equi}) is calculated from the mole fraction of the respective gas component (x_i), the total pressure of the gas phase (p_{total}), and the partial pressure of water (p_{H2O}), which assumed to be at saturation level for the given temperature and salinity. The relationship is given by the following equation:

$$p_i^{\mathrm{equi}} = x_i \cdot (p_{\mathrm{total}} - p_{\mathrm{H2O}})$$

Finally the concentration of the dissolved gas (c_i) is calculated according to a modified form of Henry's Law using the Bunsen coefficient (β) and the molar gas volume (V_{m}):

$$c_i = \frac{p_i^{equi} \cdot \beta_i}{V_m}$$

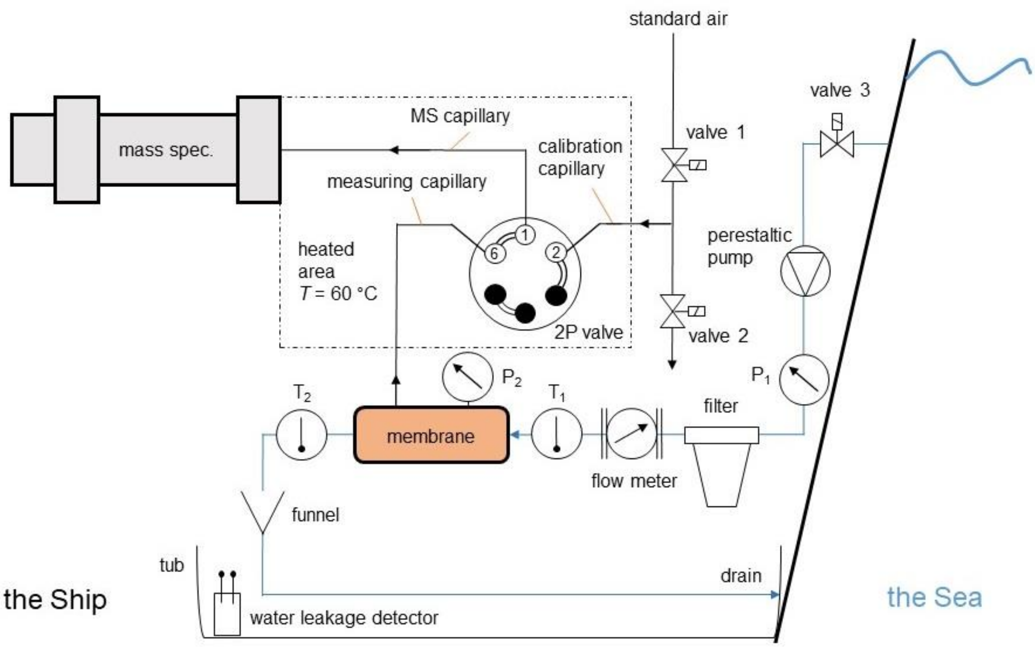

Figure 5.2: Sketch of the MIMS-setup for the EMB 293 cruise

This cruise was used to do first tests of the system on the Baltic Sea. In addition to normal operation of the MIMS-system, two different membrane types and different filter setups were assessed and the effect of particle induced clogging in the membrane on the equilibration time was examined. To verify the accuracy of the MIMS-data, headspace samples were taken on the following stations and measured subsequently: TF0113, TF0271 (x2), BoB-1, TF0602, DB0108, TF0213.

During mid-summer the MIMS will be installed on the voluntary observing ship (VOS) Finnmaid for direct and continuous measurements of nitrogen (N_2) deficits in the surface water attributable to nitrogen fixation.

5.9 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 DSHIP3 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 DSHIP3 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 30 minutes averages of:

- time (UTC)
- latitude and longitude
- ships heading
- depth
- air pressure
- air temperature
- humidity
- global radiation
- infrared radiation
- Surface conductivity
- Surface salinity (SSS)
- Surface water temperature (SST)
- Surface chlorophyll-a fluorescence
- Surface turbidity
- Wind direction
- Wind speed

6 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.

6.1 Meteorological Conditions

The meteorological conditions during the cruise were characterized by a by relatively calm weather, interrupted by shorter periods of enhanced wind speed. However, bad weather that hampers the scientific work did not occur. It was the typical situation for May and late spring.

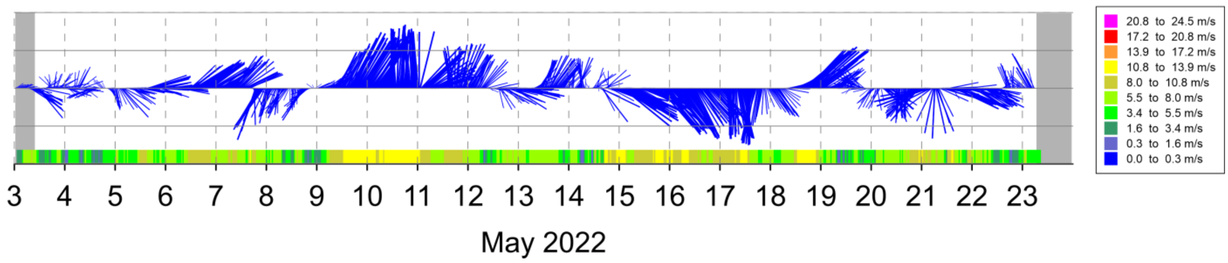

Figure 6.1 Stick plot of wind vector measured by the ship weather station of FS Elisabeth Mann Borgese. The grey shaded areas indicate periods when the ship was in port.

The cruise started with calm and sunny days. The mean wind speed ranged between 3 and 8 ms^{-1} with mostly westerly wind direction. On 8th May it changed to northeasterly winds. During that time the ship operated in the eastern Gotland Basin. Between the 9th and 11th May the wind speed increased to 6Bft with southerly directions. This period was followed by some days with weak westerly winds. On 15th May the wind speed increased again to about 10 ms^{-1}. Afterwards from 19th May till the end of the cruise moderate wind with changing directions were observed (Figure 6.1 and Figure 6.2).

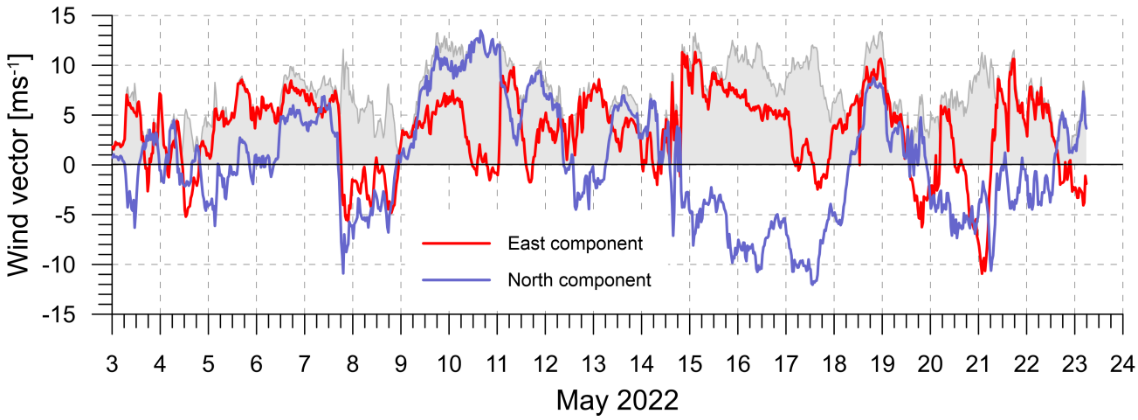

Figure 6.2 Wind vector east and north measured by the ship weather station of FS Elisabeth Mann Borgese (30 min averaged values).

The air temperature in the western Baltic was slightly below the long term average for May. Mean values of 10°C were observed. On the way to the eastern Gotland Basin the air temperature dropped subsequently to about 7°C (Figure 6.3). As expected the temperature decreased further while the ship moved northward through the on the Gulf of Bothnia. The lowest air temperature of 2°C was detected at the northern end of our cruise track in the Bothnian Bay. However, no rests of sea ice was seen there. On the way back to the southern Baltic the air temperature increased towards the south. The general behavior of air temperature was mainly controlled by the latitude. Changes in weather, and the daily cycle were of minor impact.

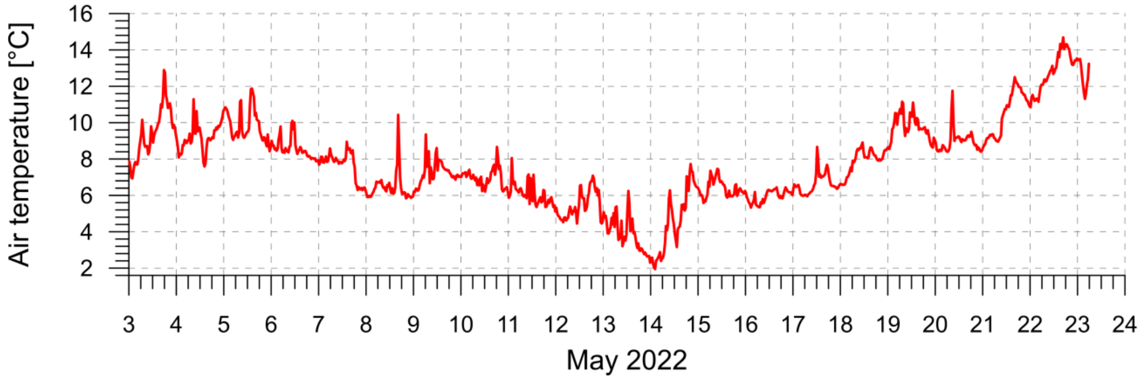

Figure 6.3 Air temperature measured by the ship weather station of FS Elisabeth Mann Borgese (30 min averaged values).

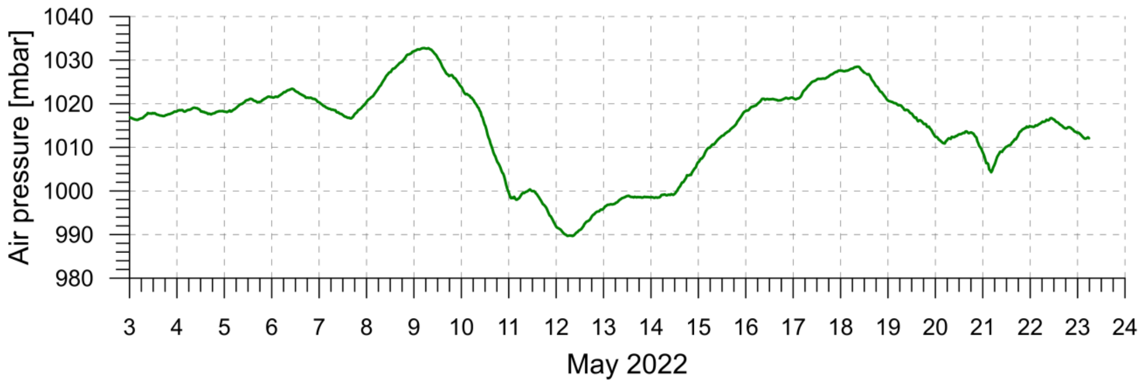

Figure 6.4 Air pressure measured by the ship weather station of FS Elisabeth Mann Borgese (30 min averaged values).

The air pressure variations during the cruise show two different time scales, the typical time scale of passing low and high pressure systems of 1 to 3 days duration, and a slow variability of about 10 days. During the first week of the cruise the air pressure was relatively stable with 1020mbar. The air pressure maximum of 1034mbar was observed on 9th May before the onset of stronger winds. In the following three days the air pressure decreased continuously till it reached the minimum of 990mbar. Between the 12th and 18th May the air pressure increased again, and reached the second maximum of 1028mbar. In the last days of the cruise air pressure was on a lower level and changed between 1000 and 1020mbar.

The humidity was relatively high, but typical for the spring season varying between 70 and nearly 95% (Figure 6.5). In the northern Baltic cooling by the cool surface water caused occasionally the formation of fog in the morning hours. Rain was rare during the entire cruise. Only on 21st May longer lasting rainfalls were observed. Then for some hours the humidity increased to 100%.

The global radiation was strongly related to latitude and the cloud coverage. In the first days of the cruise the nearly clear sky caused high values of global radiation of about 800Wm^{-2}. Between the 7th and 14th May the cloud coverage increased significantly and thus the global radiation dropped to daily peak values of 600 to 750Wm^{-2}. The maximum global radiation of 830Wm^{-2} was observed at noon on the sunny 18nd May, when the ship was in port of Ventspils. During the cruise the long wave radiation ranged between 270 and 380 Wm^{-2} (Figure 6.6).

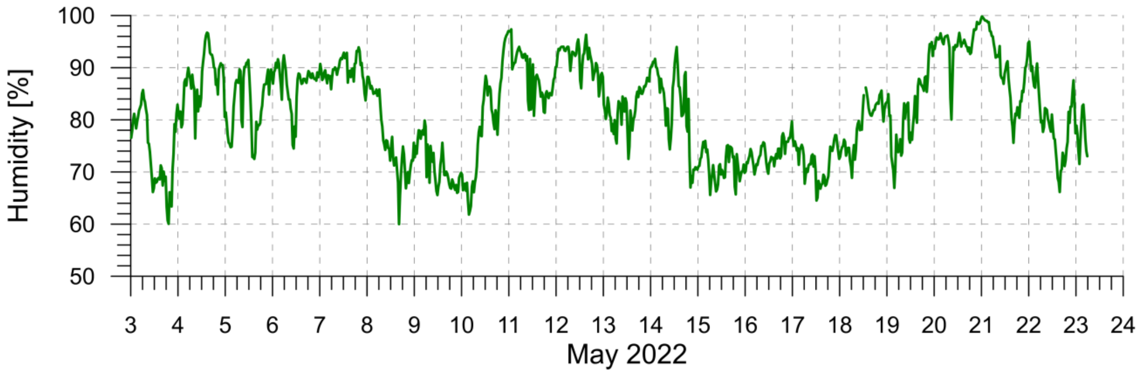

Figure 6.5 Air humidity measured by the ship weather station of FS Elisabeth Mann Borgese (30 min averaged values).

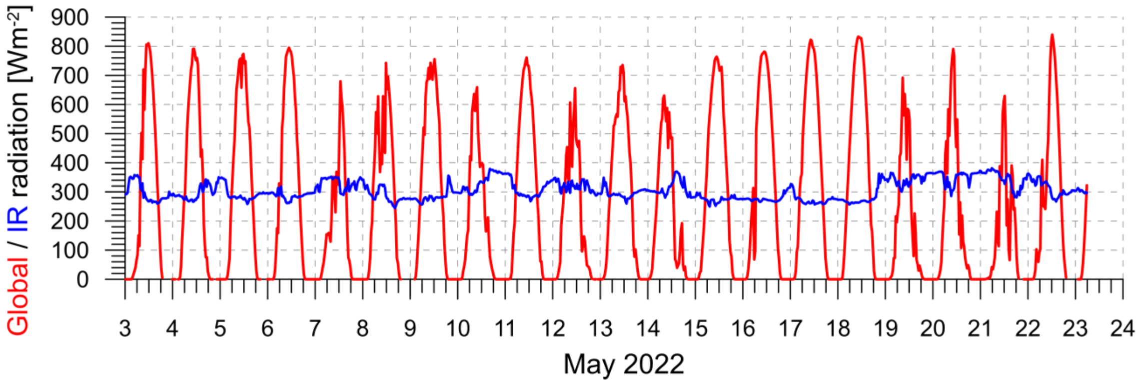

Figure 6.6 Global and infrared radiation measured by the ship weather station of FS Elisabeth Mann Borgese (10 min averaged values).

6.2 Sea Surface Temperature, Salinity and Chlorophyll-a Distribution

Sea surface temperature, salinity and chlorophyll-a fluorescence distributions in the investigation area were compiled from data gathered with the Surface water Monitoring Box (JSMB). The distributions shown in Figure 6.7 and Figure 6.10 are based on unvalidated data. Unfortunately, the turbidity sensor of the JSMB delivered only unreliable data, that not compared to the surface readings of the CTD.

The sea surface temperatures (SST) in the entire Baltic were close to the climatological mean value for May. In the Kiel Bight and in the Mecklenburg Bight the SST was slightly above 10°C in the first days of May. Here, the observed saline surface waters indicate the transition zone between Baltic and North Sea (Figure 6.7). Generally, the SST and the sea surface salinity (SSS) decreased along the way from the western Baltic towards the Bothnian Bay. In the Arkona Basin SSTs were about 9.5°C and SSS about 8.0gkg^{-1} in the beginning of the cruise on 4th May. In the eastern Gotland basin SST and SSS of 6.0°C and 8.0gkg^{-1} were observed, respectively. Further north SST and SSS changes were most pronounced at the sills between the larger Basins. The mean SST in the Bothnian Sea and the Bothnian Bay were about 3.5°C and 1.0°C respectively. The mean salinity in theses basins were about 5.5 and 3.0gkg^{-1} (Figure 6.8 and Figure 6.9). In contrast to the rest of the Baltic, in the Bothnian the SST was well below the temperature of maximum density, which is important for the onset of seasonal stratification. Here the heating of the surface will force vertical convection, until the temperature of maximum density is reached. Thus the ventilation of deeper layers in the Bothnian Bay was still ongoing. On the way back towards the western Baltic the SST was significantly higher than in the beginning of the cruise. Thus, the observations of SST for the first and the second half of the cruise are displayed separately in Figure 6.7.

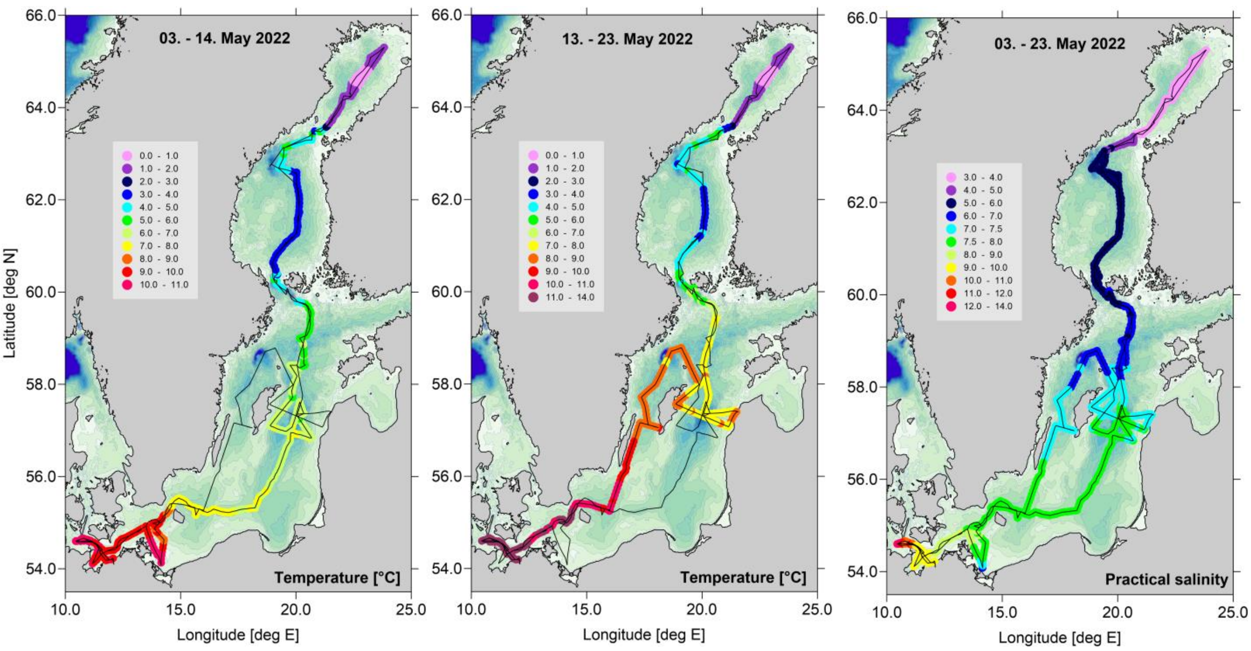

Figure 6.7 Surface temperature distribution during the first (left) and the second half (middle) of the cruise EMB293 along the cruise track in the Baltic. Surface salinity distribution of entire cruise (right). Based on 30 min averaged values.

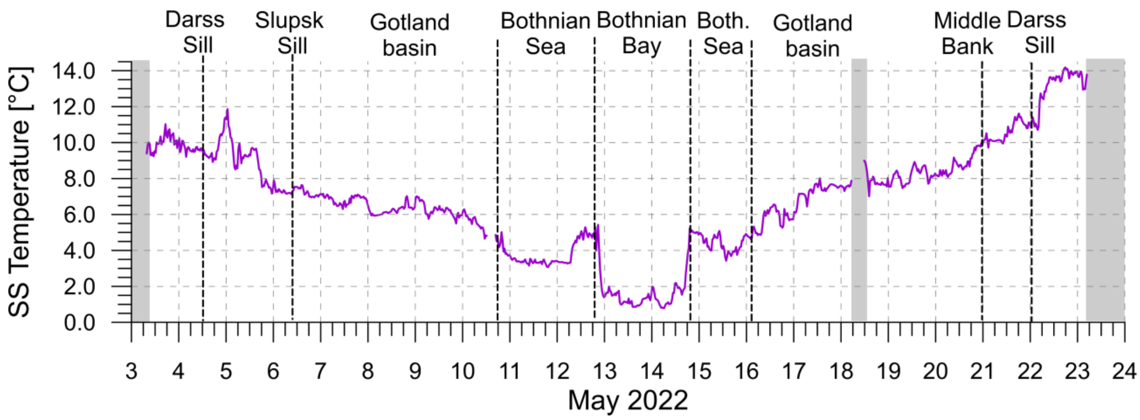

Figure 6.8 Surface temperature measured with the ship thermosalinograph of FS Elisabeth Mann Borgese. The gray shaded area indicates the range below the density maximum at the sea surface.

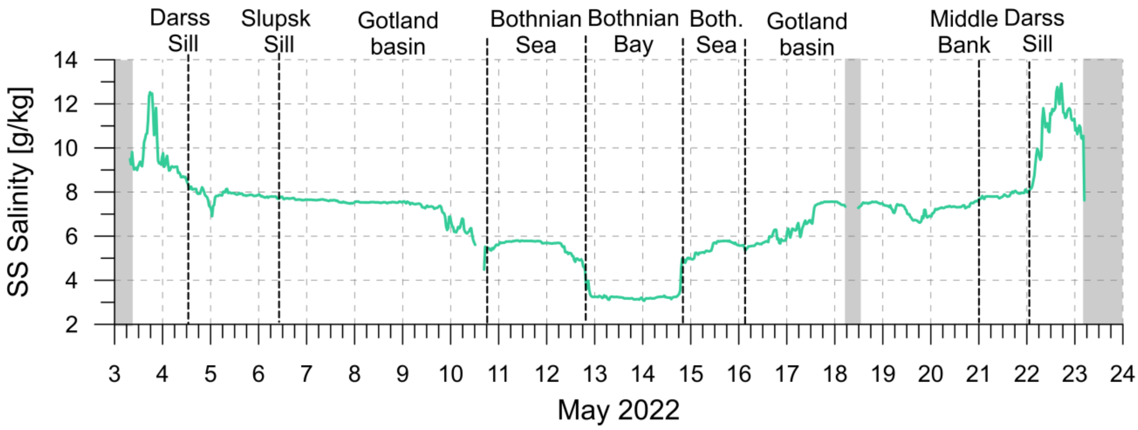

Figure 6.9 Surface salinity measured with the ship thermosalinograph of FS Elisabeth Mann Borgese.

The surface distribution of Chlorophyll-a fluorescence depict a puzzling signal (Figure 6.10). Generally, the Chlorophyll-a fluorescence decreased during the first half of the cruise from the western Baltic towards the Bothnian Bay. However, there were hotspots all along the cruise track, namely on the coast of Mecklenburg, east of Rügen island, in the northern Gotland Basin, in the Aland sea and The Quark. Some of these hotspots vanished on the way back to the western Baltic. The time series of Chlorophyll-a fluorescence (Figure 6.11) depict regular peaks or maxima around midnight of the local time. The reason for this behavior is not understood jet. Possible explanations may be fluorescence quenching during daylight or vertical moving phytoplankton.

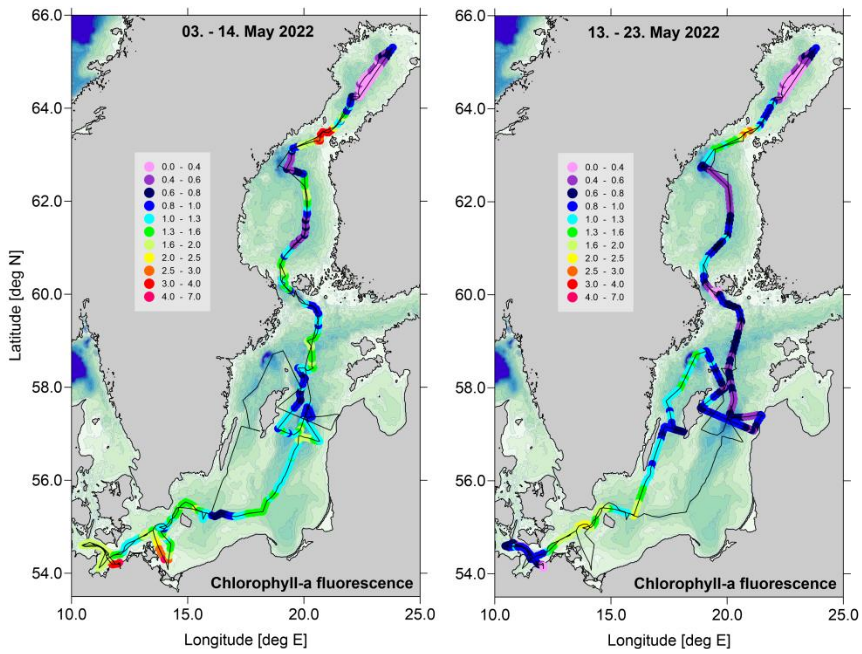

Figure 6.10 Surface chlorophyll-a fluorescence distribution during the first (left) and the second half (right) of the cruise EMB293 along the cruise track in the Baltic (30 min averaged values).

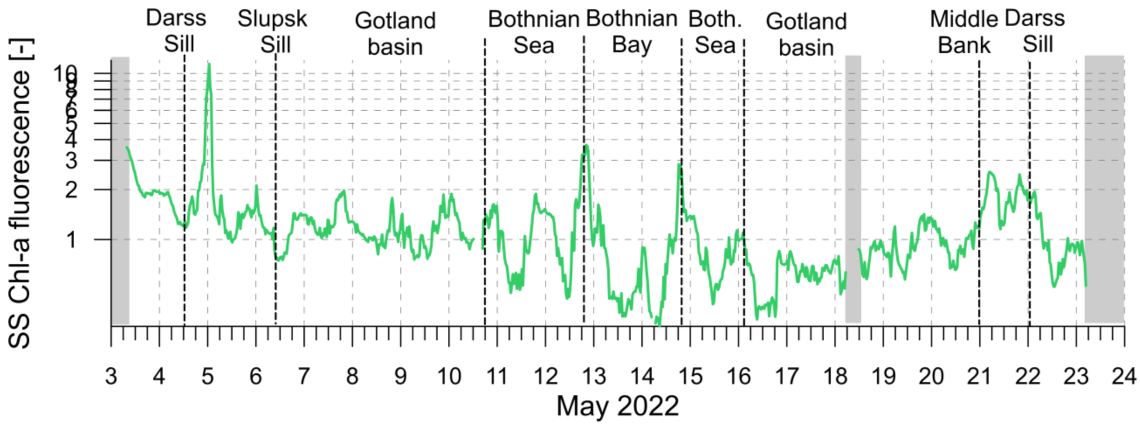

Figure 6.11 Surface chlorophyll-a fluorescence measured with the flow through fluorometer of FS Elisabeth Mann Borgese.

6.3 Surface water N2, O2 and Ar MIMS-observations

The overall performance of the MIMS-system has satisfied the expectations and after clarifying some initial difficulties with the tightness of the tubing's, the measurements went on without any further problems.

Two membrane modules were tested: the Liquicell MiniModule-1.7x8.75 series and the Permselect PDMSXA-1.0. It turned out that the latter one is not suitable for the use as a membrane-equilibrator since a huge amount of water vapor condensed at the gas side. This is not only a big problem for the mass spectrometric measurements, but it also falsifies the data of the pressure sensor. The filter cartridge with a pore size of 5 µm had to be changed after the pressure in front of it was bigger than 2.3 bar (maximum pressure for tubing's), which was the case after 45 to 55 hours operating time.

The change in equilibration time over the cruise has yet to be finally evaluated, but it seems that the filter setup worked well, and particle induced clogging of the membrane is a minor problem in a time interval of about one week. Also the results of the accuracy verification with the headspace samples can only be achieved in the home laboratory, because precise weighing on board is not possible.

The concentration distribution for N_2 and Ar, in the selected regions (compare Figure 6.12), is in relation to each other nearly similar. The values are matching well with the sea surface temperature and salinity, whereby the lower concentrations are located around the Gotland deep. More higher concentrations are located within the Gulf of Bothnia, where the sea surface temperature and the salinity have smaller values.

The pattern of the O_2 concentration is different because it is not only controlled by physical processes but also by biological processes like photosynthesis and respiration. In order to that the highest oxygen concentrations can also be seen around the Gotland deep, because of the spring bloom, which is associated with primary production. It can also be seen that the bloom has not really started yet in the Gulf of Bothnia, where the O_2 concentration is again more linked to the sea surface temperature and salinity.

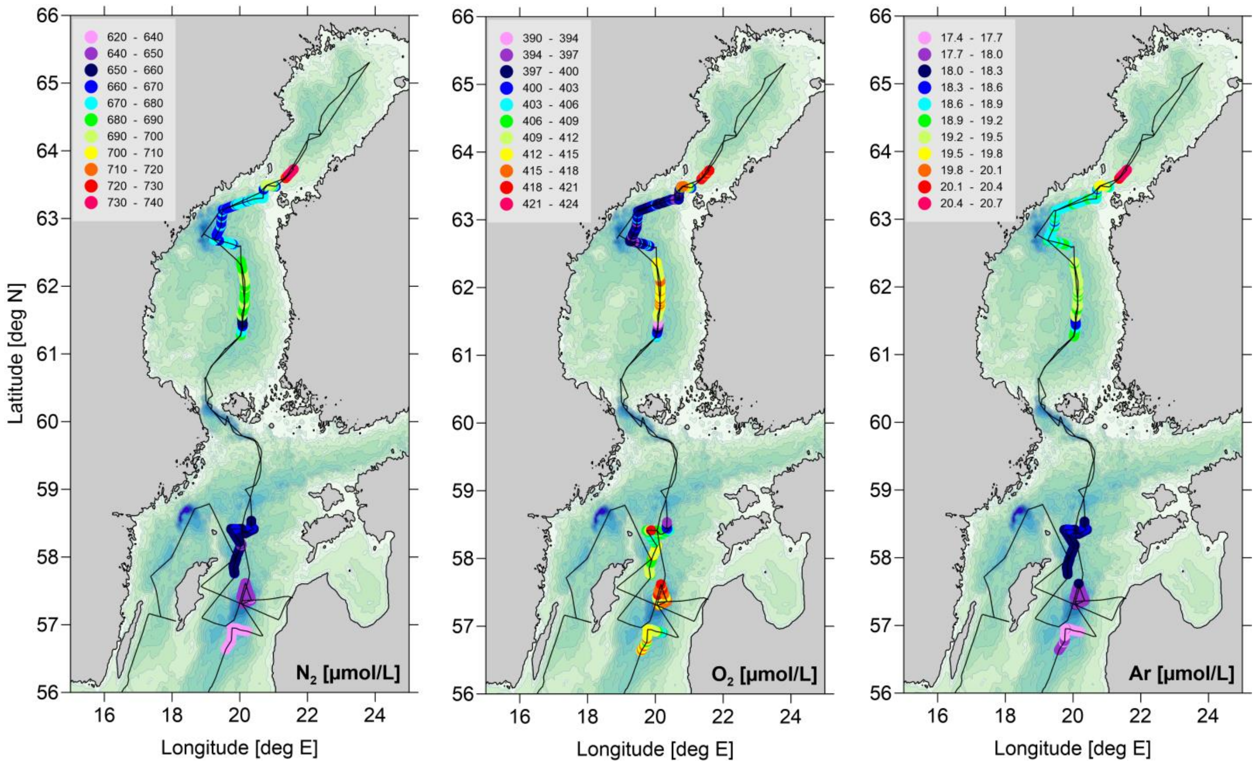

Figure 6.12 Concentrations of dissolved nitrogen (left), oxygen (middle) and Argon (right) in surface water at some locations in the eastern Gotland basin and the Gulf of Bothnia (based on preliminary MIMS data, 07.-09.05.2022 and 11.-12.05.2022).

6.4 Observations at Main Stations

The following tables list the surface (Table 6.1) and bottom values (Table 6.2) of the most important hydrographic and chemical parameters measured at the main stations of the Baltic long term observation program. For positions of the particular stations refer to Figure 3.1 and Table 8.1. 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:

$\mu mol\ l^{-1}\ H_2S$ * -0.0448 = negative oxygen equivalent $ml\ l^{-1}\ O_2$

$\mu mol\ l^{-1}\ O_2$ * 0.0224 = $ml\ l^{-1}\ O_2$

Table 6.1 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 03.05.2022	TF0360 EMB293_6	1 *(151)*	10.80	12.24	341 *(335)*	0.03	0.01	6.9
Meckl. Bight 04.05.2022	TF0012 EMB293_10	1 *(251)*	9.79	9.05	354 *(349)*	0.08	0	13.1
Darss Sill 04.05.2022	TF0030 EMB293_17	1 *(426)*	9.24	8.01	- *(368)*	0.22	0.03	11.4
Arkona Basin 04.05.2022	TF0113 EMB293_20	2 *(501)*	8.51	7.81	374 *(372)*	0.31	0	12.6

Bornholm Deep 06.05.2022	TF0213 EMB293_41	1 *(1126)*	7.10	7.68	397 *(388)*	0.32	0.00	12.5
Slupsk Furrow 06.05.2022	TF0222 EMB293_49	2 *(1351)*	7.09	7.60	412 *(395)*	0.24	0	9.6
SE Gotland Basin 07.05.2022	TF0259 EMB293_55	2 *(1501)*	7.06	7.54	408 *(396)*	0.06	0.01	9.0
SC Gotland Basin 07.05.2022	TF0260 EMB293_64	2 *(1776)*	6.57	7.52	446 *(425)*	0.28	0	15.9
Gotland Deep 08.05.2022	TF0271 EMB293_72	1 *(2052)*	5.96	7.42	436 *(423)*	0.25	0.05	16.2
Farö Deep 09.05.2022	TF0286 EMB293_86	2 *(2551)*	6.33	7.19	436 *(425)*	0.17	0	12.2
Landsort Deep Not measured	TF0284	-	-	-	-	-	-	-
W Gotland Basin 19.05.2022	TF0240 EMB293_166	2 *(4476)*	8.20	6.79	387 *(376)*	0.18	0	13.5
Karlsö Deep 20.05.2022	TF0245 EMB293_168	2 *(4526)*	8.22	7.21	377 *(372)*	0.26	0	15.5

Table 6.2 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 03.05.2022	TF0360 EMB293_6	17 *(153)*	6.18	17.22	317 *(311)*	0.15	0.16	5.5
Meckl. Bight 04.05.2022	TF0012 EMB293_10	23 *(254)*	5.78	16.54	280 *(279)*	0.29	0.74	12.1
Darss Sill 04.05.2022	TF0030 EMB293_17	22 *(429)*	6.20	13.24	- *(271)*	0.37	0.35	12.8
Arkona Basin 04.05.2022	TF0113 EMB293_20	46 *(507)*	5.50	17.53	244 *(238)*	0.53	0.90	16.4
Bornholm Deep 06.05.2022	TF0213 EMB293_41	88 *(1135)*	8.17	15.27	7 / **0.1** *(2)*	3.80	7.46	67.0
Slupsk Furrow 06.05.2022	TF0222 EMB293_49	89 *(1357)*	7.95	13.58	31 *(29)*	3.08	6.83	63.5
SE Gotland Basin 07.05.2022	TF0259 EMB293_55	87 *(1507)*	6.80	11.65	40 *(51)*	2.75	3.51	54.3
SC Gotland Basin 07.05.2022	TF0260 EMB293_64	141 *(1784)*	7.24	12.45	**26** *(1)*	5.15	0.05	76.8
Gotland Deep 08.05.2022	TF0271 EMB293_72	235 *(1986)*	7.22	12.89	**47** *(0)*	6.30	0.15	93.3
Farö Deep 09.05.2022	TF0286 EMB293_86	190 *(2538)*	7.21	12.16	**23** *(0)*	4.90	0.12	74.0
Landsort Deep Not measured	TF0284	-	-	-	-	-	-	-
W Gotland Basin 19.05.2022	TF0240 EMB293_166	171 *(4485)*	6.18	10.45	**17** *(1)*	4.05	0.14	68.0
Karlsö Deep 20.05.2022	TF0245 EMB293_168	107 *(4533)*	6.04	10.25	**18** *(1)*	4.28	0.12	70.5

The spatial distribution of bottom oxygen conditions derived from water bottle samples is given in Figure 6.13. The bottom water in the Bornholm basin was not completely anoxic, although small amounts of H2S were detected. At station TF0271 oxygen and H2S were present concurrently. As in the recent years nearly the entire central Baltic, east of the Slupsk Furrow was covered by anoxic bottom waters, enriched with free hydrogen sulphide. Only at the entrance to the eastern Gotland Basin oxic bottom water was observed in a small plume of inflowing saline water, originated from smaller inflows in autumn and winter 2021/22.

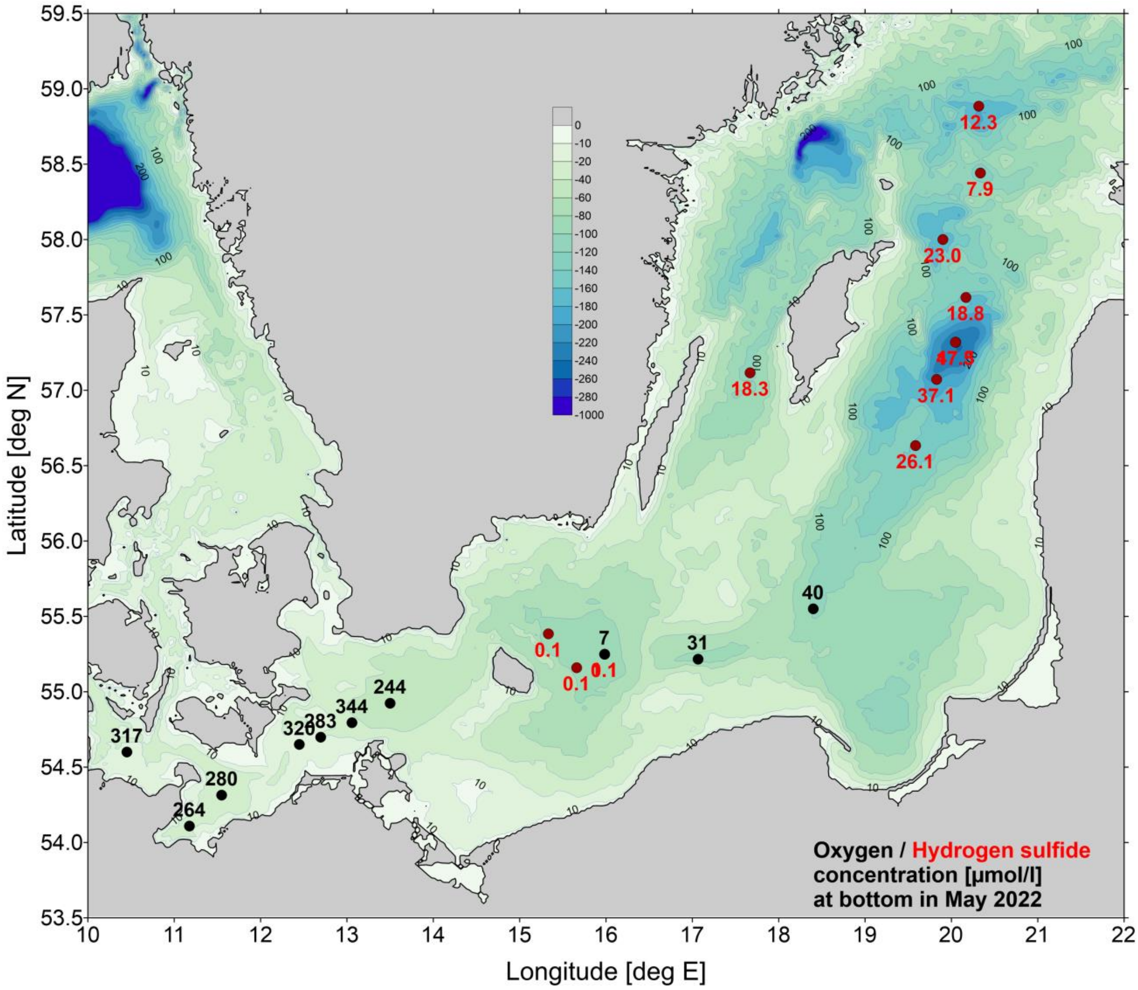

Figure 6.13 Distribution of oxygen (black labels) and hydrogen sulfide concentrations (red labels) near bottom at main stations of the long term observation program.

6.5 Baltic Thalweg Transect

During the cruise 72 CTD stations 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. And thus, it is worked as standard transect of the IOW long term observation program. Since the weather conditions were excellent during cruise the transect could be worked as a continuous sequence of stations, starting on 3rd May in the Belt Sea and finished at 10th May in the northern Gotland Basin. It supplies a quasi synoptic picture of the hydrographic patterns along the Thalweg.

The gathered data depict the typical late spring conditions (Figure 6.14 and Figure 6.15). The temperature in the upper layer shows the developing of the seasonal thermocline along the entire transect. The temperatures in the surface layer of the western Baltic were at a normal level for May at about 10°C in the Belt Sea and 9.2°C to 9.8°C in the Arkona Basin. The sea surface temperatures (SST) decreasing towards east and north. A SST of about 7.5°C was found in the Bornholm basin. The SST in the eastern Gotland Basin dropped to 6.0 at the station TF0271, and below 6°C further north. The seasonal thermocline was well established along the entire thalweg transect. The thickness of the warm surface water layer increases eastward from about 7 m in the Belt Sea to 15-20m in the eastern Gotland basin. Below the surface layer the water column was covered by cold intermediate winter water down to 60-70m in all basins east of the Darss Sill. The core temperature of the winter water layer decreases eastward whereas its thickness slightly increases. In the Bornholm Basin the coldest water with a temperature of 4.6°C was found at 51m depth. The temperature minimum in the Eastern Gotland basin was found at 50m with 3.7°C. Below the halocline the water temperature increased to 6 to 8°C. The highest temperature of 8.8°C was observed in the deep water of the western Bornholm Basin. The temperature maximum of 7.26°C in deep water of the eastern Gotland Basin was found at 172m. The bottom water temperature in the Gotland deep was 7.22°C. The vertical temperature gradient observed below 120m was extremely weak.

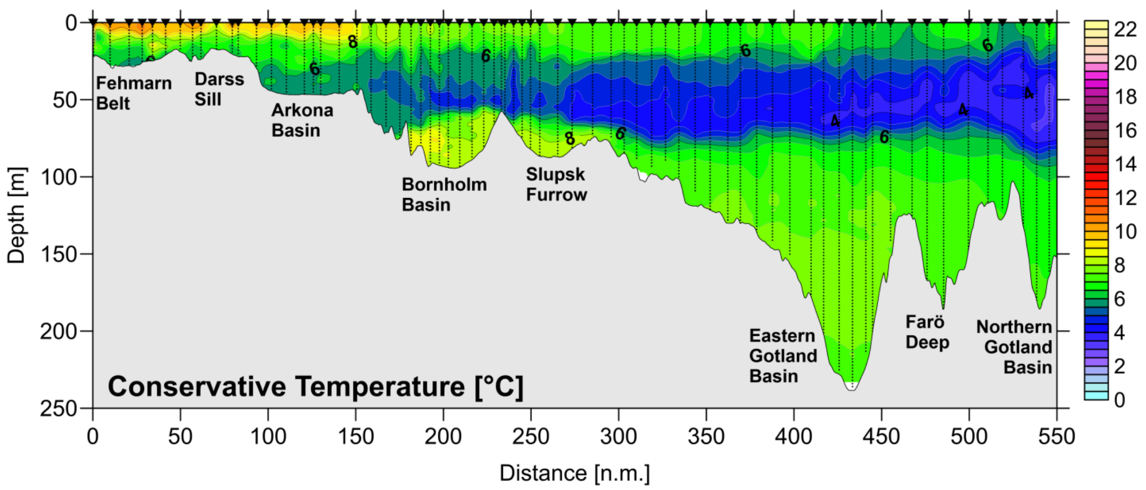

Figure 6.14 Distribution of conservative temperature along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.05. - 10.05.2022.

Since summer 2021 only baroclinic and weak barotropic inflows were observed in the western Baltic (http://doi.io-warnemuende.de/10.12754/data-2018-0004). The mean salinity of the inflowing water was high enough to replace the deep and bottom water of the Bornholm Basin. Due to their distinct temperature, the warm waters of the inflows are seen in the temperature distribution (Figure 6.14). The inflow waters filled the Bornholm Basin below the sill depth of the Slupsk Sill. Some amount of this water has passed the Slupsk Sill and covers the bottom layer of the Slupsk Furrow. Their further spreading towards the Gotland Basin cannot be detected from the temperature distribution, since the water that leaving the Slupsk Furrow

eastward had nearly the same temperature as the upper halocline water in the Gotland basin. However, the event like overflow of the sill at the eastern rim of Slupsk furrow formed small plumes. One is seen in the salinity distribution, and some more in the patterns of oxygen concentration. Due to their low salinity of around 12 g/kg this water is sandwiched in the upper halocline layer of the eastern Gotland basin at a depth range between 100 and 130m. The deep and bottom layer of the eastern Gotland basin is covered by high saline waters from the recent inflow series. In the Gotland Deep bottom salinity of 12.9gkg^{-1} was observed. The bottom salinity here decreased continuously in the recent time because of missing high density inflows.
The spatial distribution of salinity along the thalweg transect (Figure 6.15) depicted similar features as the temperature distribution, except the seasonal surface stratification. No active inflow of saline water was seen in the Fehmarn Belt area, but some remaining high saline bottom water patches from previous inflow. The bottom salinity was about 27gkg^{-1} at the westernmost station of the transect (TF0361). Another patch of dense saline water covered a 5 to 10m thick bottom layer in the Arkona basin, with maximum bottom salinity of 17.5gkg^{-1} at the central station TF0113. The low temperature of the water body indicates that it originates from an small inflow in early spring.
The halocline in the central Baltic was found at a depth between 65m in the southern Gotland Basin and 80m in the northern Gotland Basin. The vertical salinity gradient of the halocline decreases towards northern end of the transect.

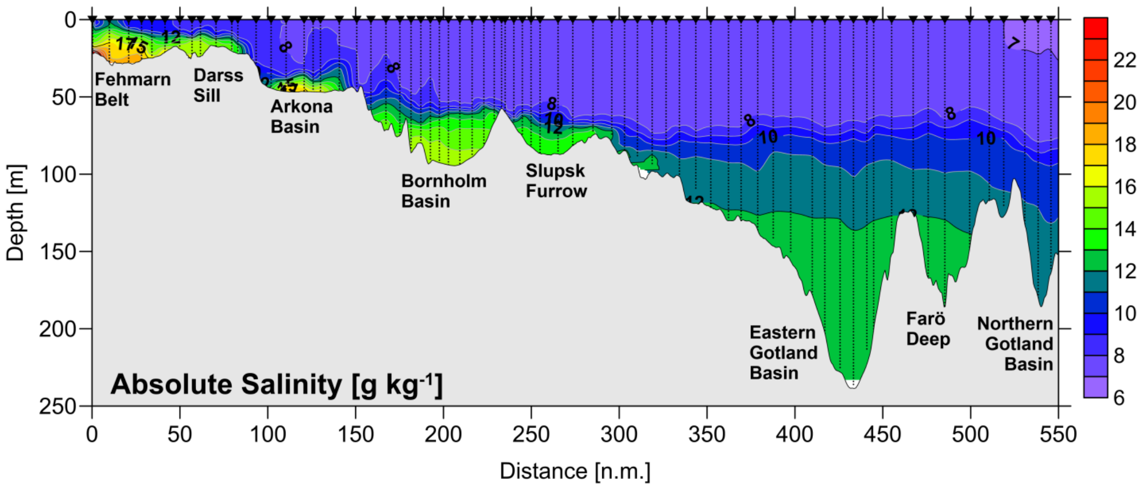

Figure 6.15 Distribution of Absolute salinity along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.05. - 10.05.2022.

The oxygen distribution along the central transect is shown in Figure 6.16. 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 also the deep water in the Bornholm basin. At station TF0213 a 10m thick bottom layer nearly free of oxygen was found where 7.2 µmol/kg oxygen, and 0.09 µmol/kg H_2S were detected concurrently. The inflow water spreads eastward in the halocline of the Bornholm Basin. After passing the Slupsk Sill it forms the new bottom water in the Slupsk Furrow.

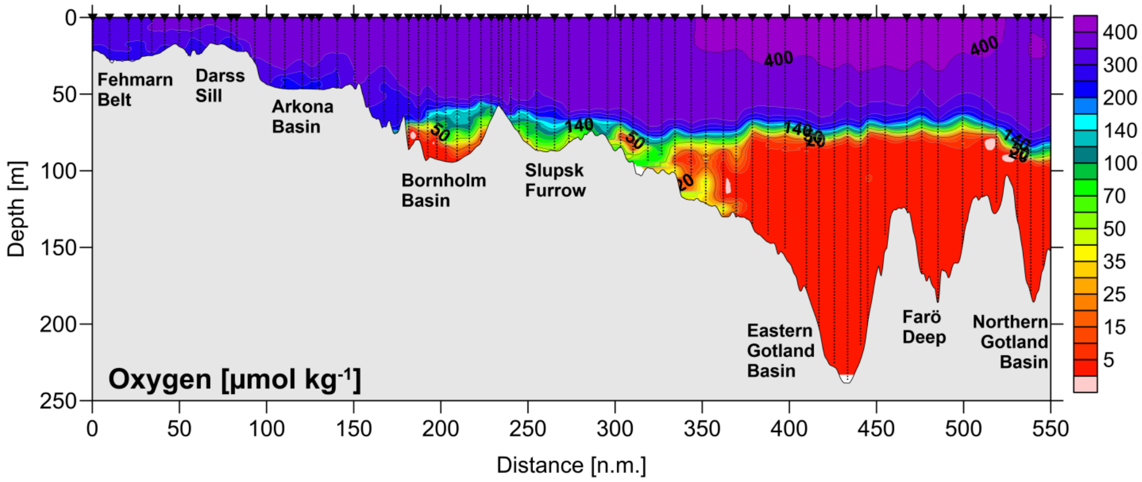

Figure 6.16 Distribution of oxygen concentration along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.05. - 10.05.2022.

Here the deep water oxygen concentrations ranged between 30 and 120 µmol kg^{-1}. Between the eastern outlet of the Slupsk Furrow and the eastern Gotland Basin (EGB) the small plumes of saline inflow water are also visible in the oxygen distribution. Their moderate oxygen concentrations are in contrast to the ambient anoxic water. Generally, in the eastern Gotland Basin the oxygen concentrations below the halocline decreased rapidly to values below 5 µmol kg^{-1}. At depth below 100m oxygen was exhausted, and free hydrogen sulfide was detected in water samples. In the Faro deep and the northern Gotland Basin the anoxic waters start also at the lower halocline at about 80m depth.
The surface layer of the Baltic is well ventilated, due to wind induced deep mixing during the winter season and the oxygen supply by enhanced primary production of the spring bloom. Lower temperatures in the eastern and northern Gotland basin lead to enhanced oxygen concentrations above 400 µmol kg^{-1} in the surface layer.

Compared to the conditions in March 2022 the chlorophyll-a fluorescence along the transect was rather weak. This indicated that the peak of the spring bloom was over before the cruise started (Figure 6.17). Chlorophyll-a fluorescence maximum was detected in the western Baltic in a subsurface layer at about 20m depth. From the Bornholm Basin to the Faro Deep the Chlorophyll-a fluorescence was evenly distributed in the surface layer above the seasonal thermocline. In the eastern Gotland Basin a second chlorophyll-a fluorescence maximum was detected in a layer between 60 and 80m depth, just at the halocline. Here the florescence was higher than in the surface layer. It seems that this signal is caused by inactive phytoplankton from the former peak of the spring bloom. Possibly the majority of this biomass consists of diatoms that were sinking to greater depth because the onset of stratification and calm weather of reduced the turbulence in the surface layer.

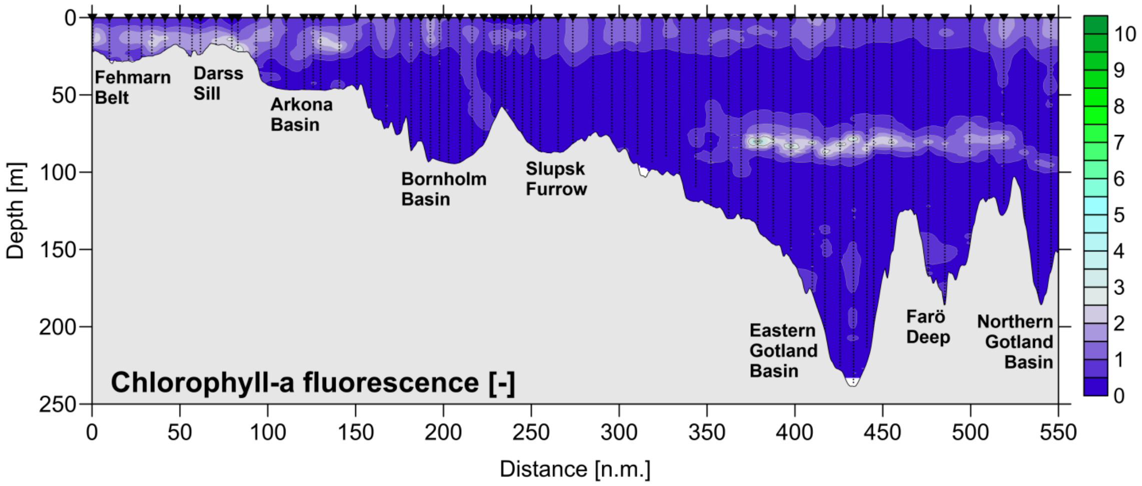

Figure 6.17 Distribution of Chlorophyll-a fluorescence along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.05. - 10.05.2022.

The turbidity distribution in the Fehmarn Belt and Darss Sill area is correlated to the pattern of high saline water. East of it the turbidity depicts enhanced values in the bottom waters of the Arkona Basin, The Bornholm and the eastern Slupsk Furrow. The highest turbidity values were observed in the bottom layer at the entrance to the eastern Gotland Basin where the patches of oxygenated water were found. In the eastern Gotland Basin the patches of higher turbidity indicate the depth level of the redoxcline between 80 and 160m. (Figure 6.18).

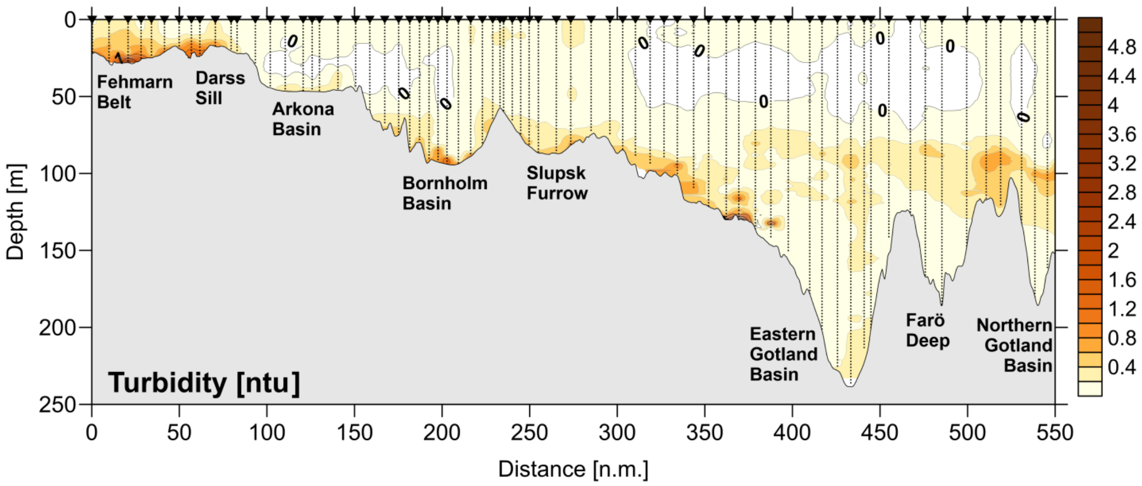

Figure 6.18 Distribution of turbidity along the talweg of the Baltic Sea from the Kiel bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.05. - 10.05.2022.

Temporal changes of the hydrographic conditions are illustrated in Figure 6.19 that depicts the vertical profiles for key hydrographic parameters at the station TF0271 in the center of the eastern Gotland basin for the 8th and the 17th May 2022. Most significant changes in this short period were the increase in surface temperature by 1.8K and the strong reduction of the Chlorophyll-a fluorescence in the secondary maximum at the halocline.

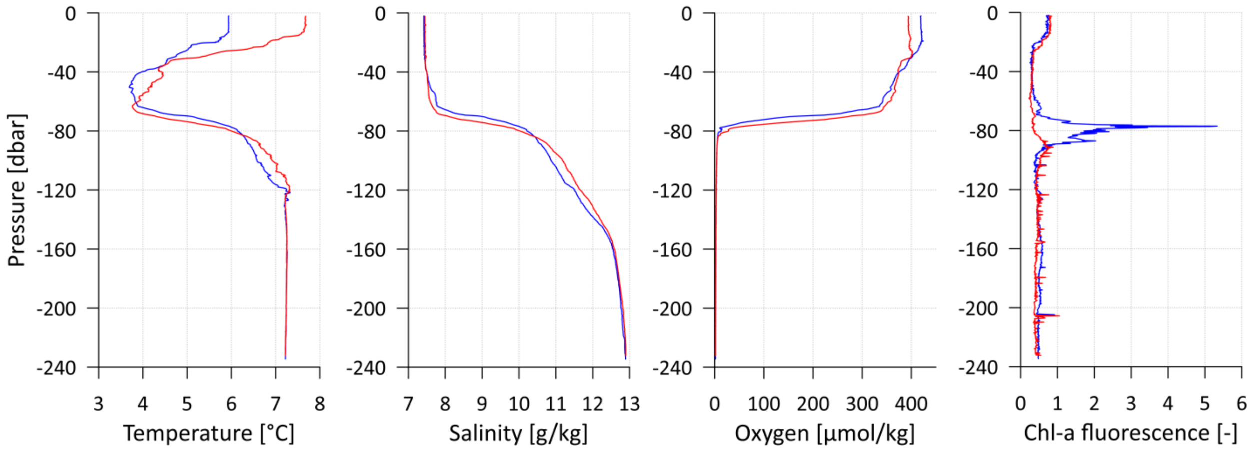

Figure 6.19: Vertical profiles of key hydrographic parameters at Gotland Deep station TF0271 gathered on 8th May (blue) and nine days later on 17th May 2022 (red).

The different water masses observed during the cruise can be clearly identified using its temperature, salinity and oxygen signature. Figure 6.20 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

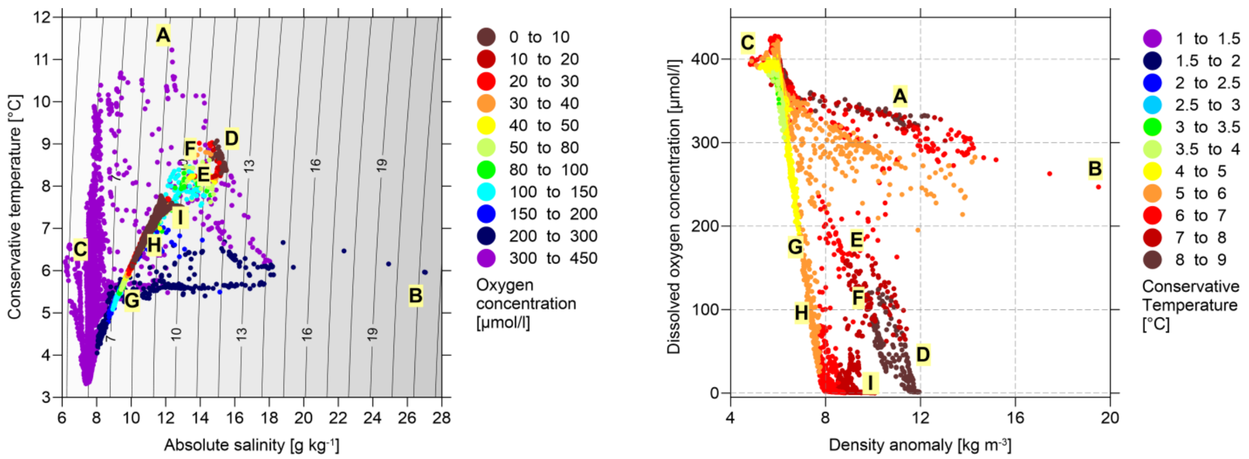

Figure 6.20 TS-diagram (left) and Oσ-diagram (right) of the Baltic transect. The capital letters indicate the different water masses (see text).

6.6 Southern Gotland Basin Transect

At the southern rim of the Eastern Gotland Basin (compare Figure 3.1) a zonal transect was performed between 7th and 9th May. It depicts the conditions at the entrance of the Eastern Gotland Basin. The surface water properties show the beginning thermal stratification of late spring. The SST ranges between 6 and 7°C. Below the seasonal thermocline at about 20m the core temperature of the winter water layer was close to 4°C. The deep water layer, separated by a pronounced pycnocline, was covered by warm and salty waters of 7°C and 10 to 12gkg^{-1} salt, respectively (Figure 6.21). There were no signs of saline intrusions that can be caused by inflowing saline water from larger inflow events western Baltic. Along the entire section only weak horizontal gradient were observed.

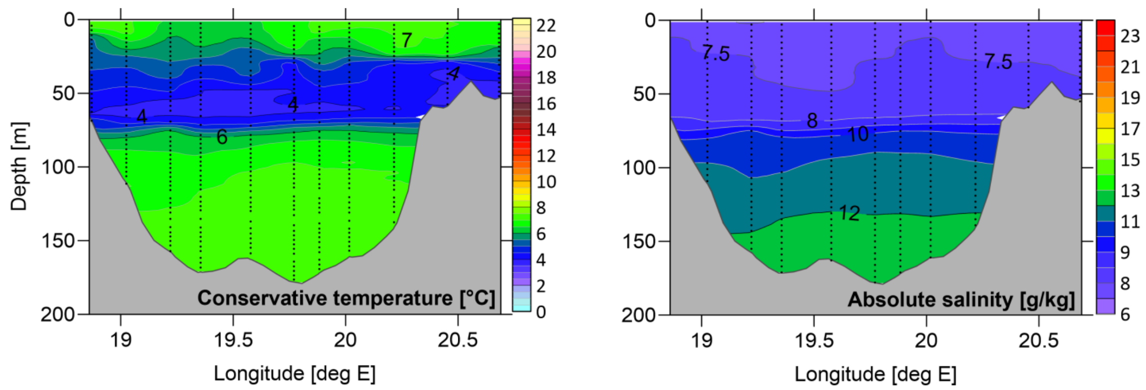

Figure 6.21 Temperature and salinity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 07.05. and 09.05.2022).

The concentration follows the overall density stratification. The surface layer is slightly oversaturated due to the phytoplankton spring bloom. The winter water layer is well oxygenated. At the halocline at about 75m depth the oxygen concentration dropped rapidly to values below 5 µmol kg^{-1} at 100m. The deep water was anoxic below 110m depth. The Chlorophyll-a fluorescence values in the surface layer were generally low, indicating that the spring bloom was almost at the end. A second layer of high Chlorophyll-a fluorescence was found in and direct below the halocline (80 to 100m depth). This indicates the accumulation of dying biomass from the spring bloom (Figure 6.22).

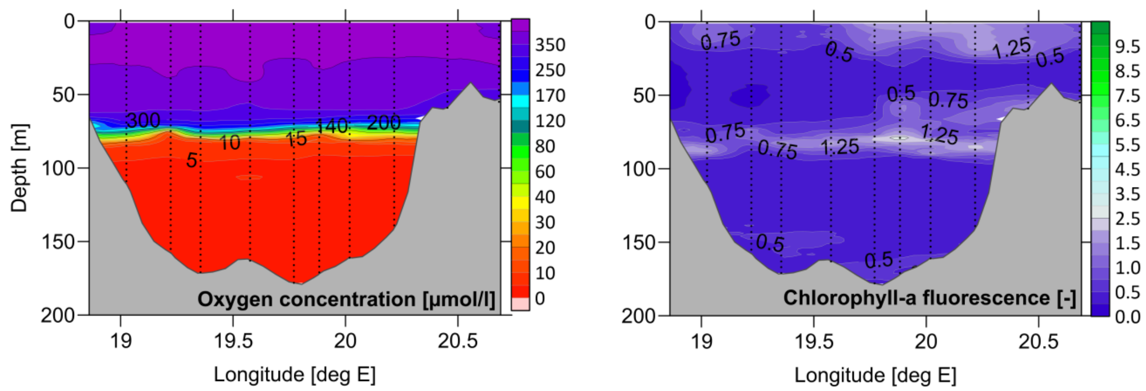

Figure 6.22 Dissolved oxygen and Chlorophyll-a fluorescence distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 07.05. and 09.05.2022).

6.7 Gotland ScanFish Transect

In frame of IOWs long term observation program two ScanFish transects were performed across the western and the eastern Gotland basin crossing the Klintsbank and the Gotland deep. These cross sections provide a spatially high resolution distribution of hydrographic conditions in the central Baltic. These data will not discussed in detail here, but the temperature and the chlorophyll-a fluorescence are depicted in Figure 6.23 and Figure 6.24 to illustrate the high variability on scales, smaller than the usual CTD grid distance of 5 to 10 nautical miles.

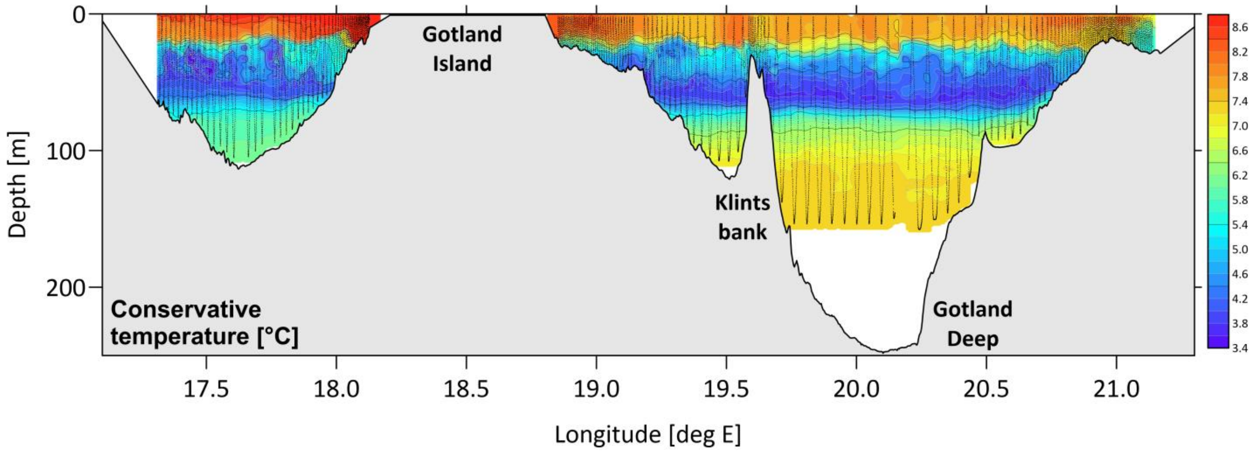

Figure 6.23 Temperature distribution along the two ScanFish transects across the western and eastern Gotland basin.

Surprisingly the highest temperature variability was not found in the surface layer, but in the intermediate winter water. The reason for it might be small scale eddies or current bands. This is supported by the variability of depth of the surface mixed layer, which changes on short distances between 20 and 30m. The winter water temperature variability was most pronounced in the western Gotland basin. A patchy structure in chlorophyll-a distribution was expected, but the high accumulation of Chlorophyll-a fluorescence in the mostly anoxic halocline was somewhat unusual on the first view.

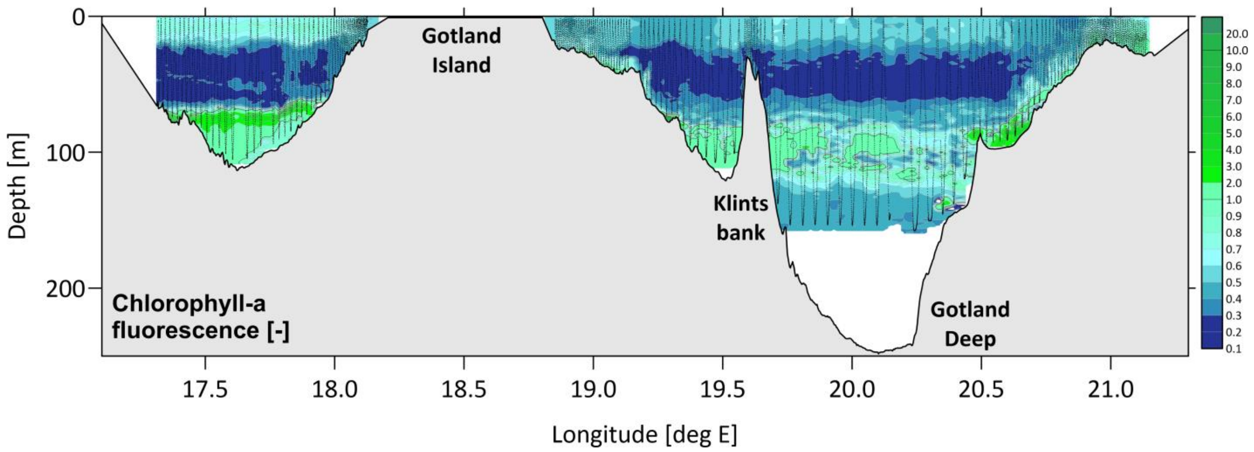

Figure 6.24 Chlorophyll-a fluorescence distribution along the two ScanFish transects across the western and eastern Gotland basin.

6.8 Gulf of Bothnia

One of the major aims of EMB293 cruise was the extension of the thalweg transect, that usually ends in the northern Gotland Basin, to the northern Baltic. About 50 CTD and 10 MSS stations were performed in the Gulf of Bothnia, which consists of the Bothnian Sea and the Bothnian Bay. Both basins are separated by a shallow sill The Quark. The observations were carried out between the 10th and the 17th May. Here the CTD data along the transect are briefly discussed. Due to their location in higher latitude and the long distance to the western Baltic temperature and salinity are significantly lower than in the Baltic proper. The surface temperature in the Bothnian Sea was about 4°C and 1.5°C in the Bothnian Bay (Figure 6.25). In the latter the surface temperature was well below the temperature of maximum density. Thus, in contrast to the rest of the Baltic the warming of the surface layer cause vertical convection and ventilation of the deeper layers in the Bothnian Bay.

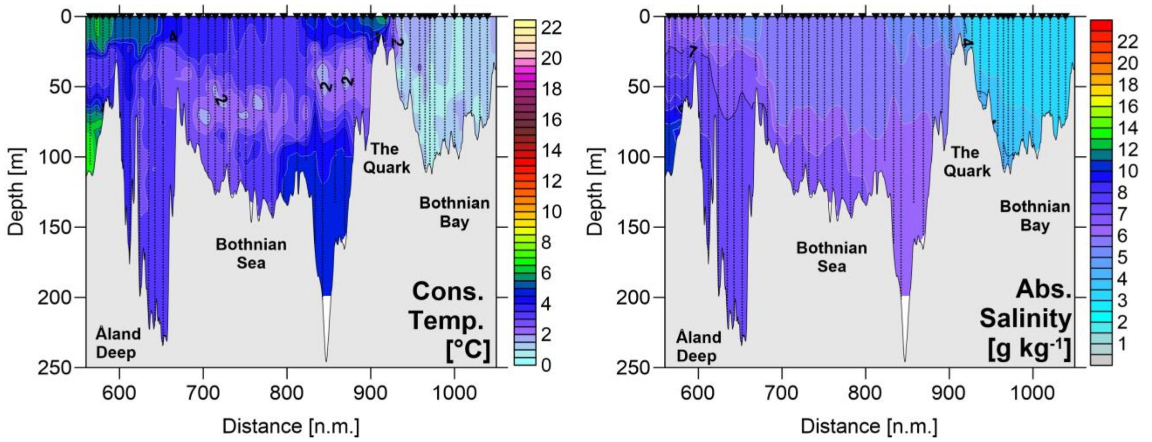

Figure 6.25: Temperature and salinity distribution along the thalweg transect from the Aland Deep to the Bothnian Bay (based on preliminary CTD data, 10.05. and 14.05.2022).

In the Bothnean Sea a pronounced winter water layer was found between 40 and 80m depth. The deepest parts were covered by warmer and saltier water. The stratification in the Bothnian Sea depicts large similarities to that of the Baltic Propper. The salinity distribution showed in both basins the typical patterns of estuarine circulation.

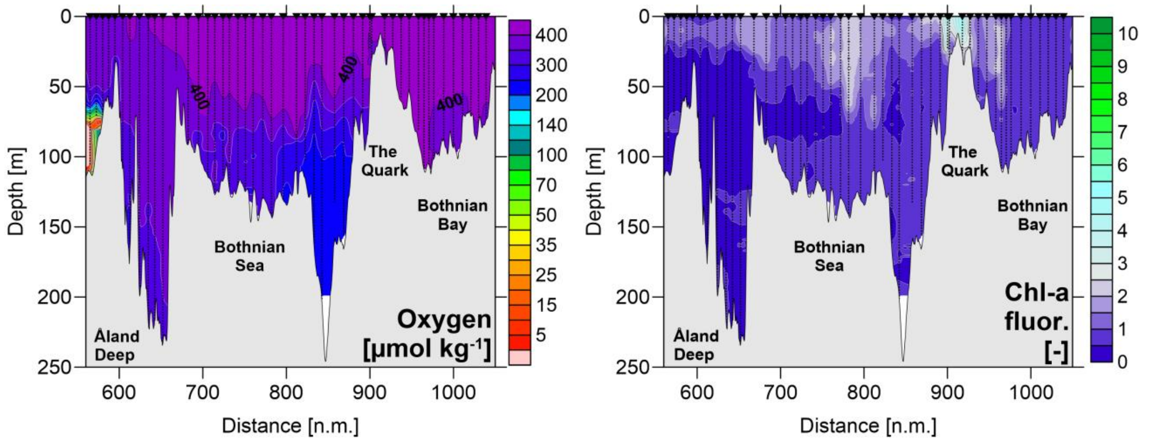

Figure 6.26: Dissolved oxygen and Chlorophyll-a fluorescence distribution along the thalweg transect from the Aland Deep to the Bothnian Bay (based on preliminary CTD data, 10.05. and 14.05.2022).

The deep water in the basins is formed by the surface water of the next adjacent basin with higher salinity. Due to the short distances, the ventilation of deep water is quite effective compared to the Gotland Basin. Even in the deepest parts with 200m water depth and more the oxygen concentration exceeded 200µmol/kg. Surface oxygen concentrations were found well above 400 µmol/kg (Figure 6.26). The distribution of Chlorophyll-a fluorescence indicate the onset of spring bloom. The highest values were observed in the shallow areas of The Quark, which depict also the highest surface temperatures and a beginning thermal stratification. Although a detailed data analysis will follow after the cruise, it appears necessary to extend the long term observation program to the northern Baltic, at least occasionally, to gather a comprehensive picture of the ecosystem state.

7 Ship's Meteorological Station

Not applicable on EMB. The meteorological conditions during the cruise are described in section 6.1, based on data of the automatic weather station of the ship.

8 Station Lists EMB293

8.1 Overall Station List

Table 8.1 list all stations and deployments carried out during the cruise EMB293. Standard sampling consisted of a single CTD cast. Nutrient samples at fixed standard depth were taken at selected stations, indicated by N. At some stations a number of additional chemical and biological samplings were performed. These tasks are indicated in the last column of Table 8.1.

Used gears:	CTD	- CTD probe with rosette water sampler
	SD	- Secci disk
	PLA	- Phytoplankton net
	WP2	- WP2 net for Zooplankton sampling
	MSS	- Microstructure profiler for turbulence and mixing study
	SCF	- ScanFish undulating CTD deployment

Additional sampling program on selected stations:

CC	- Comparison measurements for CTD data quality assurance
Moor	- Mooring maintenance for IOW long term observation program
N	- Nutrient sampling (NO_3, NO_4, NH_4, PO_4, SiO_4, O_2)
HS	- H_2S sampling
TG	- Trace gas sampling (CH_4, N_2O and CO_2)
eDNA	- environmental DNA sampling

Table 8.1: List of stations and gears

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB293_1-1	TFO5	CTD	03.05.2022 07:31	54° 13.87'N	012° 04.57'E	9.3	eDNA, N
EMB293_1-2	TFO5	SD	03.05.2022 07:33	54° 13.88'N	012° 04.52'E	9.4	
EMB293_2-1	TF0018	CTD	03.05.2022 09:10	54° 10.98'N	011° 46.13'E	17.1	
EMB293_3-1	TF0011	CTD	03.05.2022 11:48	54° 24.77'N	011° 37.03'E	22.1	
EMB293_4-1	TF0010	CTD	03.05.2022 13:25	54° 33.09'N	011° 19.23'E	25.4	eDNA, N
EMB293_5-1	TF0361	CTD	03.05.2022 16:00	54° 39.90'N	010° 46.67'E	21.3	
EMB293_6-1	TF0360	CTD	03.05.2022 17:51	54° 36.00'N	010° 27.05'E	15.2	N
EMB293_6-2	TF0360	SD	03.05.2022 17:52	54° 36.00'N	010° 27.05'E	15.1	
EMB293_6-3	TF0360	WP2	03.05.2022 17:55	54° 35.99'N	010° 27.03'E	15.1	
EMB293_6-4	TF0360	PLA	03.05.2022 18:23	54° 36.00'N	010° 26.99'E	15.2	
EMB293_7-1	TF0014	CTD	03.05.2022 20:36	54° 35.69'N	011° 00.93'E	25.8	eDNA
EMB293_8-1	TF0013	CTD	03.05.2022 22:48	54° 28.40'N	011° 29.07'E	23.6	
EMB293_9-1	TF0022	CTD	04.05.2022 02:04	54° 06.56'N	011° 10.53'E	20.3	N
EMB293_10-1	TF0012	CTD	04.05.2022 04:25	54° 18.91'N	011° 32.99'E	21.8	eDNA, N
EMB293_10-2	TF0012	SD	04.05.2022 04:28	54° 18.92'N	011° 32.99'E	21.7	
EMB293_10-3	TF0012	PLA	04.05.2022 04:30	54° 18.91'N	011° 33.00'E	21.7	
EMB293_10-4	TF0012	WP2	04.05.2022 04:52	54° 18.89'N	011° 33.02'E	21.6	
EMB293_10-5	TF0012	WP2	04.05.2022 04:57	54° 18.89'N	011° 33.02'E	21.7	
EMB293_10-6	TF0012	WP2	04.05.2022 05:03	54° 18.88'N	011° 33.02'E	21.7	
EMB293_11-1	TF0017	CTD	04.05.2022 06:30	54° 23.46'N	011° 49.48'E	19.1	
EMB293_12-1	TF0041	CTD	04.05.2022 07:47	54° 24.34'N	012° 03.95'E	16.1	N
EMB293_13-1	TF0046	CTD	04.05.2022 09:00	54° 28.21'N	012° 14.63'E	25.6	eDNA, N
EMB293_13-2	TF0046	SD	04.05.2022 09:00	54° 28.21'N	012° 14.62'E	25.5	
EMB293_13-3	TF0046	WP2	04.05.2022 09:02	54° 28.21'N	012° 14.59'E	25.6	
EMB293_13-4	TF0046	PLA	04.05.2022 09:19	54° 28.20'N	012° 14.52'E	25.7	
EMB293_13-5	TF0046	PLA	04.05.2022 09:24	54° 28.19'N	012° 14.50'E	25.6	
EMB293_14-1	TF0083	CTD	04.05.2022 10:12	54° 32.99'N	012° 16.50'E	22.7	
EMB293_15-1	TF0002	CTD	04.05.2022 11:27	54° 38.99'N	012° 26.99'E	14.7	eDNA, N
EMB293_16-1	TF0001	CTD	04.05.2022 12:44	54° 41.86'N	012° 41.71'E	17.9	eDNA, N
EMB293_17-1	TF0030	CTD	04.05.2022 13:29	54° 43.39'N	012° 46.97'E	19.8	eDNA, N, CC
EMB293_17-2	TF0030	PLA	04.05.2022 13:31	54° 43.40'N	012° 46.98'E	19.8	
EMB293_18-1	TF0115	CTD	04.05.2022 14:58	54° 47.71'N	013° 03.46'E	27.0	eDNA, N
EMB293_19-1	TF0114	CTD	04.05.2022 16:14	54° 51.59'N	013° 16.59'E	42.5	N
EMB293_20-1	TF0113	CTD	04.05.2022 17:27	54° 55.47'N	013° 29.98'E	45.2	eDNA, N, CC
EMB293_20-2	TF0113	SD	04.05.2022 17:30	54° 55.46'N	013° 30.03'E	45.0	
EMB293_20-3	TF0113	PLA	04.05.2022 17:33	54° 55.46'N	013° 30.05'E	45.0	
EMB293_20-4	TF0113	WP2	04.05.2022 17:47	54° 55.49'N	013° 30.05'E	45.0	
EMB293_20-5	TF0113	WP2	04.05.2022 17:55	54° 55.50'N	013° 30.02'E	44.9	
EMB293_20-6	TF0113	WP2	04.05.2022 18:02	54° 55.51'N	013° 30.01'E	45.0	
EMB293_20-7	TF0113	CTD	04.05.2022 18:21	54° 55.47'N	013° 30.02'E	45.0	TG
EMB293_20-8	TF0113	WP2	04.05.2022 18:33	54° 55.47'N	013° 30.05'E	45.0	
EMB293_21-1	TF0160	CTD	04.05.2022 23:19	54° 14.40'N	014° 04.14'E	11.3	
EMB293_22-1	OBBOJE	CTD	05.05.2022 00:40	54° 04.55'N	014° 09.26'E	11.6	
EMB293_23-1	TF0152	CTD	05.05.2022 04:30	54° 38.00'N	014° 17.00'E	28.3	eDNA
EMB293_24-1	TF0112	CTD	05.05.2022 06:30	54° 48.19'N	013° 57.53'E	38.0	eDNA, N, CC
EMB293_25-1	ABboje	CTD	05.05.2022 07:39	54° 52.77'N	013° 51.70'E	43.2	
EMB293_26-1	TF0109	CTD	05.05.2022 09:11	54° 59.98'N	014° 05.09'E	45.7	N
EMB293_26-2	TF0109	SD	05.05.2022 09:14	55° 00.01'N	014° 05.05'E	45.7	
EMB293_26-3	TF0109	PLA	05.05.2022 09:15	55° 00.01'N	014° 05.04'E	45.7	
EMB293_26-4	TF0109	WP2	05.05.2022 09:27	54° 59.99'N	014° 05.05'E	45.7	
EMB293_26-5	TF0109	WP2	05.05.2022 09:34	54° 59.98'N	014° 05.03'E	46.1	

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB293_27-1	TF0110	CTD	05.05.2022 10:24	54° 57.49'N	013° 59.11'E	45.0	
EMB293_27-2	TF0110	FC	05.05.2022 10:42	54° 57.50'N	013° 59.05'E	45.1	
EMB293_27-3	TF0110	FC	05.05.2022 10:58	54° 57.50'N	013° 59.06'E	45.0	
EMB293_27-4	TF0110	FC	05.05.2022 11:12	54° 57.50'N	013° 59.05'E	45.0	
EMB293_27-5	TF0110	FC	05.05.2022 11:31	54° 57.50'N	013° 59.05'E	45.0	
EMB293_28-1	TF0122	CTD	05.05.2022 12:50	54° 59.34'N	013° 46.29'E	45.0	eDNA
EMB293_29-1	TF0145	CTD	05.05.2022 15:25	55° 09.76'N	014° 15.73'E	44.6	N
EMB293_30-1	TF0144	CTD	05.05.2022 16:55	55° 15.41'N	014° 29.47'E	42.5	
EMB293_31-1	TF0142	CTD	05.05.2022 18:47	55° 22.73'N	014° 35.09'E	63.6	N
EMB293_32-1	TF0140	CTD	05.05.2022 19:54	55° 27.97'N	014° 43.18'E	68.0	N
EMB293_33-1	TF0206	CTD	05.05.2022 21:03	55° 31.99'N	014° 54.97'E	75.4	
EMB293_34-1	TF0207	CTD	05.05.2022 22:09	55° 29.74'N	015° 05.58'E	84.6	
EMB293_35-1	TF0208	CTD	05.05.2022 23:09	55° 27.18'N	015° 14.04'E	91.8	
EMB293_36-1	TF0200	CTD	06.05.2022 00:07	55° 23.02'N	015° 19.99'E	90.9	N, HS
EMB293_37-1	TF0209	CTD	06.05.2022 01:03	55° 20.80'N	015° 28.00'E	93.4	
EMB293_38-1	TF0211	CTD	06.05.2022 02:07	55° 19.77'N	015° 36.95'E	95.3	
EMB293_39-1	TF0214	CTD	06.05.2022 03:37	55° 09.60'N	015° 39.63'E	93.6	N, HS
EMB293_40-1	TF0212	CTD	06.05.2022 05:05	55° 18.11'N	015° 47.83'E	94.4	
EMB293_41-1	TF0213	CTD	06.05.2022 06:19	55° 14.96'N	015° 59.03'E	89.3	N, HS
EMB293_41-2	TF0213	SD	06.05.2022 06:22	55° 14.99'N	015° 58.95'E	89.3	
EMB293_41-3	TF0213	PLA	06.05.2022 06:25	55° 15.00'N	015° 58.95'E	89.3	
EMB293_41-4	TF0213	WP2	06.05.2022 06:48	55° 14.97'N	015° 59.03'E	89.0	
EMB293_41-5	TF0213	WP2	06.05.2022 06:58	55° 14.93'N	015° 59.02'E	89.4	
EMB293_41-6	TF0213	WP2	06.05.2022 07:08	55° 14.89'N	015° 59.04'E	89.3	
EMB293_41-7	TF0213	WP2	06.05.2022 07:16	55° 14.90'N	015° 58.99'E	89.3	
EMB293_41-8	TF0213	WP2	06.05.2022 07:25	55° 14.94'N	015° 59.03'E	89.8	
EMB293_41-9	TF0213	CTD	06.05.2022 07:39	55° 14.99'N	015° 58.99'E	89.3	TG
EMB293_41-10	TF0213	WP2	06.05.2022 07:55	55° 15.00'N	015° 58.97'E	89.3	
EMB293_41-11	TF0213	APNET	06.05.2022 08:20	55° 15.02'N	015° 59.02'E	89.2	
EMB293_41-12	TF0213	APNET	06.05.2022 08:40	55° 15.03'N	015° 58.95'E	89.3	
EMB293_42-1	TF0221	CTD	06.05.2022 09:49	55° 13.28'N	016° 10.07'E	82.0	
EMB293_43-1	TF0225	CTD	06.05.2022 10:49	55° 15.51'N	016° 19.33'E	64.6	
EMB293_44-1	TF0266	CTD	06.05.2022 11:40	55° 17.79'N	016° 25.96'E	56.1	
EMB293_45-1	TF0224	CTD	06.05.2022 12:19	55° 16.96'N	016° 30.05'E	60.4	
EMB293_46-1	TF0227	CTD	06.05.2022 13:13	55° 15.68'N	016° 38.43'E	65.3	
EMB293_47-1	TF0228	CTD	06.05.2022 14:09	55° 14.21'N	016° 46.46'E	76.1	
EMB293_48-1	TF0229	CTD	06.05.2022 15:01	55° 13.75'N	016° 54.94'E	85.0	
EMB293_49-1	TF0222	CTD	06.05.2022 15:57	55° 13.00'N	017° 04.04'E	90.7	N
EMB293_50-1	TF0266	CTD	06.05.2022 17:25	55° 15.13'N	017° 21.63'E	88.6	
EMB293_51-1	TF0267	CTD	06.05.2022 18:42	55° 17.20'N	017° 35.69'E	83.6	
EMB293_52-1	TF0268	CTD	06.05.2022 20:39	55° 18.41'N	017° 55.93'E	74.3	
EMB293_53-1	TF0256	CTD	06.05.2022 22:08	55° 19.58'N	018° 14.16'E	77.5	
EMB293_54-1	TF0257	CTD	06.05.2022 23:23	55° 26.47'N	018° 19.31'E	86.3	
EMB293_55-1	TF0259	CTD	07.05.2022 00:37	55° 33.01'N	018° 24.06'E	89.3	N
EMB293_55-2	TF0259	PLA	07.05.2022 00:37	55° 33.01'N	018° 24.06'E	89.4	
EMB293_56-1	TF0255	CTD	07.05.2022 02:05	55° 37.99'N	018° 36.05'E	94.6	
EMB293_57-1	TF0258	CTD	07.05.2022 03:23	55° 43.63'N	018° 45.91'E	91.8	
EMB293_58-1	TF0253	CTD	07.05.2022 04:35	55° 50.42'N	018° 52.04'E	101.4	CC
EMB293_59-1	TF0265	CTD	07.05.2022 06:10	55° 57.57'N	019° 02.88'E	111.5	
EMB293_60-1	TF0250	CTD	07.05.2022 07:30	56° 05.02'N	019° 10.03'E	124.3	
EMB293_61-1	TF0262	CTD	07.05.2022 09:00	56° 14.13'N	019° 18.21'E	132.1	
EMB293_62-1	TF0263	CTD	07.05.2022 10:14	56° 20.80'N	019° 22.74'E	134.3	

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB293_63-1	TF0261	CTD	07.05.2022 11:44	56° 29.53'N	019° 28.96'E	143.6	
EMB293_64-1	TF0260	CTD	07.05.2022 13:12	56° 38.02'N	019° 35.04'E	145.0	N, HS
EMB293_65-1	TF0274	CTD	07.05.2022 14:42	56° 46.08'N	019° 45.18'E	154.6	
EMB293_66-1	TF0273	CTD	07.05.2022 16:22	56° 57.08'N	019° 46.20'E	184.3	
EMB293_67-1	TF0407	CTD	07.05.2022 17:23	56° 56.99'N	019° 52.95'E	177.5	
EMB293_68-1	TF0408	CTD	07.05.2022 18:21	56° 55.29'N	020° 01.01'E	166.8	
EMB293_69-1	TF0409	CTD	07.05.2022 19:34	56° 54.28'N	020° 12.94'E	146.1	
EMB293_70-1	TF0410	CTD	07.05.2022 20:55	56° 51.95'N	020° 27.08'E	60.5	
EMB293_71-1	TF0411	CTD	07.05.2022 22:08	56° 50.29'N	020° 40.88'E	55.0	
EMB293_72-1	TF0271	CTD	08.05.2022 02:30	57° 19.18'N	020° 03.00'E	241.5	N, HS
EMB293_72-2	TF0271	PLA	08.05.2022 02:31	57° 19.18'N	020° 02.99'E	241.4	
EMB293_72-3	TF0271	CTD	08.05.2022 03:39	57° 19.19'N	020° 03.03'E	242.0	
EMB293_72-4	TF0271	SD	08.05.2022 03:51	57° 19.21'N	020° 02.96'E	241.4	
EMB293_72-5	TF0271	CTD	08.05.2022 04:54	57° 19.21'N	020° 03.03'E	241.4	
EMB293_72-6	TF0271	CTD	08.05.2022 05:34	57° 19.20'N	020° 03.06'E	241.4	
EMB293_72-7	TF0271	CTD	08.05.2022 06:09	57° 19.19'N	020° 02.99'E	241.4	
EMB293_72-8	TF0271	CTD	08.05.2022 06:35	57° 19.20'N	020° 03.00'E	241.4	
EMB293_72-9	TF0271	CTD	08.05.2022 06:44	57° 19.19'N	020° 02.99'E	241.4	CC
EMB293_72-10	TF0271	CTD	08.05.2022 07:06	57° 19.18'N	020° 02.96'E	241.4	TG
EMB293_73-1	MoorGOC	MOOR	08.05.2022 07:48	57° 18.34'N	020° 04.92'E	245.7	Moor
EMB293_73-2	MoorGOC	CTD	08.05.2022 08:32	57° 18.41'N	020° 04.89'E	245.7	
EMB293_73-3	MoorGOC	MOOR	08.05.2022 09:15	57° 18.40'N	020° 04.90'E	246.1	Moor
EMB293_74-1	MoorGONE	CTD	08.05.2022 10:34	57° 21.84'N	020° 20.33'E	220.0	
EMB293_74-2	MoorGONE	MOOR	08.05.2022 11:08	57° 21.89'N	020° 20.39'E	219.2	Moor
EMB293_75-1	TF0276	CTD	08.05.2022 12:58	57° 28.17'N	020° 15.59'E	208.6	
EMB293_76-1	TF0270	CTD	08.05.2022 14:31	57° 37.00'N	020° 10.04'E	145.0	HS
EMB293_77-1	TF0275	CTD	08.05.2022 17:53	57° 12.57'N	019° 55.84'E	231.4	
EMB293_78-1	TF0272	CTD	08.05.2022 19:25	57° 04.28'N	019° 49.78'E	209.1	HS
EMB293_79-1	TF0406	CTD	08.05.2022 21:00	56° 58.76'N	019° 34.59'E	167.1	
EMB293_80-1	TF0405	CTD	08.05.2022 22:18	57° 00.47'N	019° 21.24'E	177.1	
EMB293_81-1	TF0404	CTD	08.05.2022 23:15	57° 01.73'N	019° 13.19'E	161.4	
EMB293_82-1	TF0403	CTD	09.05.2022 00:26	57° 04.40'N	019° 01.47'E	114.3	
EMB293_83-1	TF0402	CTD	09.05.2022 01:23	57° 06.00'N	018° 52.22'E	69.6	
EMB293_84-1	TF0287	CTD	09.05.2022 06:40	57° 42.90'N	019° 51.24'E	129.3	
EMB293_85-1	TF0290	CTD	09.05.2022 07:58	57° 51.03'N	019° 48.87'E	173.6	
EMB293_86-1	TF0286	CTD	09.05.2022 09:27	58° 00.01'N	019° 54.11'E	195.7	HS
EMB293_86-2	TF0286	SD	09.05.2022 09:54	57° 59.96'N	019° 53.97'E	195.7	
EMB293_86-3	TF0286	CTD	09.05.2022 10:29	57° 60.00'N	019° 54.04'E	195.7	TG
EMB293_87-1	TF0277	CTD	09.05.2022 12:07	58° 11.01'N	020° 03.10'E	162.9	
EMB293_88-1	CAB_M02	MOOR	09.05.2022 14:35	58° 24.73'N	019° 44.60'E	91.8	
EMB293_88-2	CAB_M02	CTD	09.05.2022 14:38	58° 24.70'N	019° 44.57'E	91.4	
EMB293_89-1	CAB_M03	MOOR	09.05.2022 16:00	58° 24.75'N	019° 52.55'E	118.7	
EMB293_89-2	CAB_M03	CTD	09.05.2022 16:18	58° 24.69'N	019° 52.53'E	118.3	
EMB293_90-1	TF0278	CTD	09.05.2022 17:25	58° 24.80'N	020° 03.06'E	116.0	
EMB293_91-1	CAB_M02	CTD	09.05.2022 18:19	58° 21.09'N	020° 08.89'E	121.3	
EMB293_92-1	CAB_M02	CTD	09.05.2022 19:40	58° 24.85'N	020° 24.63'E	133.4	
EMB293_93-1	TF0285	CTD	09.05.2022 20:23	58° 26.52'N	020° 20.19'E	124.1	HS
EMB293_94-1	TF0279	CTD	09.05.2022 22:00	58° 38.52'N	020° 20.78'E	166.0	
EMB293_95-1	TF0289	CTD	09.05.2022 23:15	58° 46.02'N	020° 19.88'E	200.0	
EMB293_96-1	TF0282	CTD	10.05.2022 00:27	58° 53.03'N	020° 19.07'E	165.9	HS
EMB293_97-1	TF0288	CTD	10.05.2022 02:00	58° 59.81'N	020° 09.63'E	143.7	
EMB293_98-1	DB0101	CTD	10.05.2022 03:30	59° 03.59'N	020° 27.83'E	134.0	

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB293_99-1	DB0102	CTD	10.05.2022 04:39	59° 10.40'N	020° 34.61'E	108.6	
EMB293_100-1	AD-1	CTD	10.05.2022 05:46	59° 17.67'N	020° 37.24'E	72.2	
EMB293_101-1	AD-2	CTD	10.05.2022 06:50	59° 25.13'N	020° 37.06'E	77.5	N
EMB293_101-2	AD-2	CTD	10.05.2022 07:08	59° 25.11'N	020° 36.90'E	77.2	CC
EMB293_102-1	AD-3	CTD	10.05.2022 08:03	59° 32.31'N	020° 38.88'E	92.5	
EMB293_103-1	AD-5	CTD	10.05.2022 09:13	59° 38.90'N	020° 33.31'E	55.4	
EMB293_104-1	DB0103	CTD	10.05.2022 10:30	59° 45.33'N	020° 20.41'E	190.6	
EMB293_105-1	DB0104	CTD	10.05.2022 11:50	59° 47.35'N	020° 04.24'E	192.9	N
EMB293_106-1	DB0105	CTD	10.05.2022 13:17	59° 53.96'N	019° 50.86'E	204.3	
EMB293_107-1	DB0106	CTD	10.05.2022 15:00	60° 00.87'N	019° 37.31'E	225.7	
EMB293_108-1	DB0107	CTD	10.05.2022 16:23	60° 04.62'N	019° 24.01'E	235.1	
EMB293_109-1	TF0605	CTD	10.05.2022 18:06	60° 11.00'N	019° 09.02'E	299.9	N
EMB293_110-1	DB0201	CTD	10.05.2022 20:50	60° 23.25'N	019° 12.26'E	35.4	
EMB293_111-1	DB0108	CTD	10.05.2022 22:54	60° 38.55'N	018° 59.58'E	93.7	
EMB293_112-1	DB0109	CTD	11.05.2022 00:33	60° 49.28'N	019° 09.75'E	98.6	
EMB293_113-1	DB0110	CTD	11.05.2022 02:10	60° 57.74'N	019° 24.28'E	122.0	
EMB293_114-1	TF0604	CTD	11.05.2022 03:35	61° 04.97'N	019° 35.04'E	127.1	N
EMB293_114-2	TF0604	MSS	11.05.2022 04:03	61° 04.94'N	019° 34.89'E	127.9	
EMB293_115-1	DB0111	CTD	11.05.2022 07:32	61° 11.14'N	019° 49.89'E	117.5	
EMB293_115-2	DB0111	CTD	11.05.2022 07:53	61° 11.10'N	019° 49.80'E	116.9	CC
EMB293_116-1	BS-7	CTD	11.05.2022 09:00	61° 16.19'N	020° 01.84'E	130.7	
EMB293_117-1	DB0112	CTD	11.05.2022 10:31	61° 26.28'N	020° 05.07'E	131.3	
EMB293_118-1	BS-9	CTD	11.05.2022 11:52	61° 34.97'N	020° 03.94'E	128.6	
EMB293_119-1	BS-10	CTD	11.05.2022 13:20	61° 44.35'N	020° 09.02'E	128.6	N
EMB293_119-2	BS-10	MSS	11.05.2022 13:41	61° 44.34'N	020° 09.00'E	127.9	
EMB293_120-1	DB0113	CTD	11.05.2022 17:18	61° 55.64'N	020° 09.03'E	135.0	
EMB293_121-1	BS-11	CTD	11.05.2022 18:45	62° 05.78'N	020° 08.45'E	148.1	
EMB293_122-1	DB0114	CTD	11.05.2022 20:36	62° 19.63'N	020° 02.45'E	143.7	
EMB293_123-1	MSS_1	MSS	11.05.2022 22:46	62° 35.95'N	020° 01.48'E	117.9	
EMB293_124-1	TF0603	CTD	12.05.2022 03:20	62° 35.20'N	019° 58.70'E	192.9	N
EMB293_125-1	Moor_DB2	MOOR	12.05.2022 06:03	62° 35.18'N	019° 58.10'E	227.1	
EMB293_126-1	DB0115	CTD	12.05.2022 07:44	62° 38.64'N	019° 38.05'E	110.8	CC
EMB293_127-1	DB0116	CTD	12.05.2022 09:21	62° 41.16'N	019° 15.12'E	165.5	
EMB293_128-1	DB0119	CTD	12.05.2022 11:16	62° 53.53'N	019° 26.76'E	137.7	
EMB293_129-1	DB0118	CTD	12.05.2022 13:10	63° 07.56'N	019° 29.00'E	160.7	N
EMB293_130-1	DB0117	CTD	12.05.2022 14:50	63° 11.88'N	019° 52.40'E	95.0	
EMB293_131-1	BS-13	CTD	12.05.2022 16:24	63° 15.67'N	020° 15.66'E	70.4	
EMB293_132-1	DB0207	CTD	12.05.2022 18:09	63° 17.95'N	020° 41.53'E	21.0	
EMB293_133-1	BS-17	CTD	12.05.2022 20:31	63° 28.27'N	021° 03.82'E	29.7	
EMB293_134-1	DB0209	CTD	12.05.2022 22:01	63° 35.82'N	021° 21.48'E	26.9	
EMB293_135-1	Bob-1	CTD	12.05.2022 23:23	63° 43.80'N	021° 35.47'E	59.6	N
EMB293_135-2	Bob-1	MSS	12.05.2022 23:40	63° 43.82'N	021° 35.39'E	58.2	
EMB293_136-1	DB0121	CTD	13.05.2022 03:05	63° 53.28'N	021° 47.01'E	60.5	
EMB293_137-1	DB0122	CTD	13.05.2022 04:35	64° 02.37'N	021° 57.90'E	85.7	
EMB293_138-1	Bob-2	CTD	13.05.2022 05:43	64° 09.43'N	022° 00.61'E	112.1	
EMB293_139-1	Bob-3	CTD	13.05.2022 06:44	64° 15.13'N	022° 03.63'E	112.1	
EMB293_140-1	Moor_DB1	CTD	13.05.2022 08:09	64° 14.47'N	022° 23.63'E	112.9	
EMB293_140-2	Moor_DB1	MOOR	13.05.2022 08:28	64° 14.44'N	022° 23.63'E	113.6	
EMB293_141-1	TF0602	CTD	13.05.2022 09:36	64° 18.35'N	022° 21.57'E	110.0	N
EMB293_141-2	TF0602	MSS	13.05.2022 09:58	64° 18.29'N	022° 21.45'E	109.3	
EMB293_142-1	Bob-8	CTD	13.05.2022 13:29	64° 30.80'N	022° 24.66'E	99.3	
EMB293_143-1	Bob-12	CTD	13.05.2022 15:03	64° 40.16'N	022° 37.27'E	96.1	

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB293_144-1	DB0123	CTD	13.05.2022 16:33	64° 47.81'N	022° 54.08'E	78.7	N
EMB293_145-1	DB0124	CTD	13.05.2022 17:55	64° 55.49'N	023° 07.77'E	83.6	
EMB293_146-1	Bob-15	CTD	13.05.2022 19:22	65° 05.28'N	023° 14.62'E	95.2	
EMB293_146-2	Bob-15	MSS	13.05.2022 19:50	65° 05.20'N	023° 14.29'E	91.4	
EMB293_147-1	DB0125	CTD	13.05.2022 22:54	65° 11.11'N	023° 31.99'E	75.4	
EMB293_148-1	DB0126	CTD	14.05.2022 00:28	65° 19.14'N	023° 50.95'E	21.3	
EMB293_149-1	DB0213	MSS	14.05.2022 08:20	64° 14.05'N	022° 23.04'E	110.0	
EMB293_150-1	BoB-2	MSS	14.05.2022 11:26	64° 09.41'N	022° 00.63'E	112.1	
EMB293_151-1	DB0208	CTD	14.05.2022 19:41	63° 22.88'N	020° 36.05'E	29.1	
EMB293_152-1	DB0118	MSS	14.05.2022 23:29	63° 07.49'N	019° 29.12'E	162.9	
EMB293_153-1	DB0221	CTD	15.05.2022 05:48	62° 46.31'N	018° 55.69'E	208.6	
EMB293_154-1	DB0116	MSS	15.05.2022 07:29	62° 41.09'N	019° 15.11'E	165.7	
EMB293_155-1	DB0108	MSS	15.05.2022 23:42	60° 38.49'N	018° 59.63'E	93.8	
EMB293_156-1	TF0605	CTD	16.05.2022 04:48	60° 10.94'N	019° 09.01'E	300.0	
EMB293_156-2	TF0605	MSS	16.05.2022 05:45	60° 11.01'N	019° 08.87'E	299.1	
EMB293_157-1	AS_2b	MSS	16.05.2022 09:50	59° 56.48'N	019° 34.56'E	76.1	
EMB293_158-1	DB0104	MSS	16.05.2022 21:15	59° 47.25'N	020° 04.32'E	195.1	
EMB293_159-1	AD-2	MSS	17.05.2022 02:40	59° 25.05'N	020° 36.93'E	72.9	
EMB293_160-1	Cab_M04	CTD	17.05.2022 10:55	58° 24.70'N	020° 03.01'E	117.0	CC
EMB293_160-2	Cab_M04	MOOR	17.05.2022 11:18	58° 24.75'N	020° 02.98'E	116.4	
EMB293_161-1	TF0271	CTD	17.05.2022 18:41	57° 19.17'N	020° 02.84'E	241.5	N, HS
EMB293_161-2	TF0271	CTD	17.05.2022 19:39	57° 19.19'N	020° 02.99'E	242.1	
EMB293_161-3	TF0271	MSS	17.05.2022 20:25	57° 19.18'N	020° 02.98'E	241.6	
EMB293_162-1	SF021EGB	SCF	18.05.2022 14:07	57° 04.15'N	021° 09.71'E	27.4	
EMB293_163-1	TF0271	MSS	19.05.2022 08:15	57° 59.96'N	019° 53.98'E	195.8	
EMB293_164-1	TF0283	CTD	19.05.2022 16:00	58° 47.25'N	019° 05.97'E	138.5	HS, CC
EMB293_165-1	nGB-1	CTD	19.05.2022 18:10	58° 42.75'N	018° 40.10'E	244.5	
EMB293_166-1	TF0240	CTD	19.05.2022 23:47	58° 00.02'N	017° 59.34'E	176.9	N, HS
EMB293_167-1	TF0242	CTD	20.05.2022 02:58	57° 42.99'N	017° 22.02'E	142.1	
EMB293_168-1	TF0245	CTD	20.05.2022 07:10	57° 06.95'N	017° 40.14'E	110.0	N, HS
EMB293_168-2	TF0245	CTD	20.05.2022 07:29	57° 06.98'N	017° 40.03'E	110.0	CC
EMB293_169-1	SF032WGB	SCF	20.05.2022 09:20	57° 03.04'N	018° 07.96'E	9.6	
EMB293_170-1	TF0223n	CTD	20.05.2022 21:04	56° 14.98'N	016° 41.84'E	56.5	
EMB293_171-1	TF0213	CTD	21.05.2022 04:05	55° 14.99'N	015° 58.98'E	89.3	N, HS
EMB293_171-2	TF0213	PLA	21.05.2022 04:07	55° 14.99'N	015° 58.98'E	89.5	
EMB293_171-3	TF0213	SD	21.05.2022 04:12	55° 15.00'N	015° 59.01'E	89.8	
EMB293_171-4	TF0213	CTD	21.05.2022 04:27	55° 15.00'N	015° 59.03'E	89.7	CC
EMB293_171-5	TF0213	WP2	21.05.2022 04:47	55° 15.00'N	015° 59.02'E	89.3	
EMB293_171-6	TF0213	WP2	21.05.2022 04:57	55° 14.99'N	015° 59.01'E	89.6	
EMB293_171-7	TF0213	WP2	21.05.2022 05:07	55° 15.01'N	015° 59.00'E	90.0	
EMB293_171-8	TF0213	WP2	21.05.2022 05:14	55° 15.01'N	015° 58.97'E	89.5	
EMB293_171-9	TF0213	WP2	21.05.2022 05:23	55° 15.01'N	015° 58.99'E	89.7	
EMB293_171-10	TF0213	APNET	21.05.2022 05:42	55° 15.01'N	015° 58.98'E	89.3	
EMB293_171-11	TF0213	APNET	21.05.2022 06:01	55° 15.02'N	015° 59.04'E	89.3	
EMB293_171-12	TF0213	APNET	21.05.2022 06:20	55° 15.01'N	015° 59.03'E	89.9	
EMB293_171-13	TF0213	MSS	21.05.2022 06:48	55° 15.12'N	015° 59.13'E	89.6	
EMB293_172-1	TF0142	CTD	21.05.2022 14:16	55° 24.24'N	014° 32.21'E	58.9	
EMB293_173-1	TF0109	CTD	21.05.2022 18:00	54° 59.98'N	014° 05.10'E	46.1	
EMB293_174-1	TF0103	CTD	21.05.2022 19:00	55° 03.77'N	013° 59.45'E	44.6	N
EMB293_175-1	TF0104	CTD	21.05.2022 19:54	55° 04.08'N	013° 48.84'E	43.9	N
EMB293_176-1	TF0105	CTD	21.05.2022 21:01	55° 01.47'N	013° 36.65'E	44.1	N
EMB293_177-1	TF0113	CTD	21.05.2022 22:04	54° 55.50'N	013° 30.05'E	45.0	

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB293_177-2	TF0113	PLA	21.05.2022 22:07	54° 55.50'N	013° 30.03'E	44.6	
EMB293_177-3	TF0113	WP2	21.05.2022 22:26	54° 55.50'N	013° 30.02'E	44.8	
EMB293_177-4	TF0113	WP2	21.05.2022 22:30	54° 55.50'N	013° 30.02'E	45.0	
EMB293_178-1	TF0114	CTD	21.05.2022 23:43	54° 51.60'N	013° 16.67'E	42.6	
EMB293_179-1	TF0115	CTD	22.05.2022 01:05	54° 47.70'N	013° 03.55'E	27.3	
EMB293_180-1	TF0030	CTD	22.05.2022 02:32	54° 43.35'N	012° 47.12'E	20.1	
EMB293_180-2	TF0030	PLA	22.05.2022 02:33	54° 43.36'N	012° 47.11'E	20.0	
EMB293_181-1	TF0046	CTD	22.05.2022 05:55	54° 28.15'N	012° 14.71'E	24.6	
EMB293_181-2	TF0046	WP2	22.05.2022 05:57	54° 28.17'N	012° 14.65'E	25.4	
EMB293_181-3	TF0046	PLA	22.05.2022 06:15	54° 28.20'N	012° 14.55'E	25.7	CC
EMB293_182-1	TF0017	CTD	22.05.2022 08:18	54° 23.51'N	011° 49.42'E	19.3	
EMB293_183-1	TF0012	CTD	22.05.2022 09:47	54° 18.91'N	011° 33.08'E	21.7	
EMB293_183-2	TF0012	PLA	22.05.2022 10:05	54° 18.89'N	011° 32.99'E	21.9	
EMB293_183-3	TF0012	CTD	22.05.2022 10:07	54° 18.89'N	011° 32.99'E	21.9	
EMB293_183-4	TF0012	SD	22.05.2022 10:10	54° 18.89'N	011° 32.99'E	21.7	
EMB293_183-5	TF0012	WP2	22.05.2022 10:24	54° 18.90'N	011° 32.97'E	21.7	
EMB293_184-1	TF0010	CTD	22.05.2022 12:24	54° 33.07'N	011° 19.24'E	25.3	
EMB293_185-1	TF0014	CTD	22.05.2022 13:56	54° 35.66'N	011° 00.90'E	24.7	
EMB293_186-1	TF0361	CTD	22.05.2022 15:15	54° 39.87'N	010° 46.69'E	21.4	
EMB293_187-1	TF0360	CTD	22.05.2022 16:45	54° 35.98'N	010° 27.03'E	15.0	
EMB293_187-2	TF0360	PLA	22.05.2022 16:46	54° 35.98'N	010° 27.03'E	15.0	
EMB293_187-3	TF0360	CTD	22.05.2022 17:01	54° 35.99'N	010° 27.00'E	15.1	
EMB293_187-4	TF0360	WP2	22.05.2022 17:18	54° 35.97'N	010° 26.97'E	15.1	
EMB293_187-5	TF0360	WP2	22.05.2022 17:22	54° 35.97'N	010° 26.95'E	15.1	

8.2 ScanFish Deployment List

Table 8.2 List of ScanFish deployments during the cruise EMB293

Deployment		time	Latitude	Longitude	Depth	Remarks
EMB		[UTC]	[UTC]	No.	[m]	
EMB293_162-1	begin	18.05.2022 14:15:00	57°04.283'N	21°08.659'E	27	EGB transect
	end	19.05.2022 03:45:04	57°34.039'N	18°50.903'E	17	max depth 150m
EMB293_169-1	begin	20.05.2022 09:20:28	57°03.036'N	18°07.962'E	10	WGB Transect
	end	20.05.2022 15:00:00	57°10.362'N	17°19.070'E	64	max depth 96m

8.3 Mooring deployment list

Table 8.3 List of mooring deployments during the cruise EMB293

Name	Latitude	Longitude	Deployed	Recovered	Depth	Remarks
			[UTC]	[UTC]	[m]	
GOC_BF	57°18.339'N	20°04.921'E	*11.11.2021 12:00*	08.05.2022 08:28	245	Main release was successful, All devices recovered
GOC_BG	57°18.407'N	20°04.886'E	08.05.2022 09:33	*Nov 2022*	246	No ground rope
GONE_41	57°21.999'N	20°20.499'E	*11.11.2021 11:00*	08.05.2022 11:40	210	Main release was successful, All devices recovered
GONE_42	57°22.028'N	20°20.490'E	08.05.2022 12:04	*Nov 2022*	219	No ground rope

Name	Latitude	Longitude	Deployed	Recovered	Depth	Remarks
			[UTC]	[UTC]	[m]	
CABLE_M2	58°24.740'N	19°44.610'E	09.05.2022 14:30	*Nov 2022*	92	No ground rope
CABLE_M3	58°24.727'N	19°52.561'E	09.05.2022 15:55	*Nov 2022*	121	with ground rope
DBBS (DB2)	62°35.180'N	19°58.080'E	*14.03.2021 16:23*	12.05.2022 06:00	221	Main release was successful, All devices recovered
DBBB (DB1)	64°14.320'N	22°23.300'E	*13.03.2021 16:40*	13.05.2022 08:30	115	release was successful, All devices recovered
CABLE_M4	58°24.743'N	20°02.873'E	09.05.2022 14:30	*Nov 2022*	120	with ground rope

9 Data and Sample Storage and Availability

All data gathered will be stored on a data repository in the IOW immediately after the cruise. The processed and validated data will be stored in the ODIN data base (https://odin2.io-warnemuende.de). According to the IOW data policy and to facilitate the international exchange of data, all metadata will be made available under the international ISO 19115 standards for georeferenced metadata. Date from German waters will be stored additionally in the BSH data base.
The access to the data itself will be restricted for three years after data acquisition to protect the research process, including scientific analysis and publication. After that period the data becomes openly available to any person or any organization who requests them, under the international Creative Commons (CC) data license of type CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/). For further details refer to the IOW data policy document.

Table 9.1 Overview of data availability

Type	Database	Available	Free Access	Contact
Hydrographic data	ODIN	01.08.2022	01.06.2025	volker.mohrholz@io-warnemuende.de
Nutrient samples	ODIN	01.08.2022	01.06.2025	joachim.kuss@io-warnemuende.de
Biological samples	ODIN	01.10.2022	01.06.2025	joerg.dutz@io-warnemuende.de

The underway sampling data set of navigation, meteorological and surface water sensors will be public available shortly after the cruise from the DSHIP webpage of the BSH (http://dship.bsh.de).

10 Acknowledgements

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