ELISABETH MANN BORGESE-Berichte

Baltic Sea Long-term Observation Programme

Cruise No. EMB314

15. – 28. March 2023

Rostock – Rostock

BMP

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1 Cruise Summary

1.1 Summary in English

The cruise EMB314 was carried out in frame of the Baltic Sea long term observation program. The work program 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. The overall weather conditions during the cruise were characterized by moderate to occasionally strong winds and cloudy conditions. The intended scientific program of the cruise could be fully completed and few extra stations were worked. The majority of the work was performed along the Thalweg of the Baltic from the Darss Sill to the Northern Gotland Basin. The gathered data depict a snapshot of the early spring conditions in the Baltic in a year without a Major Baltic Inflow.

1.2 Zusammenfassung

Die Expedition EMB314 wurde im Rahmen des Ostsee Langzeitbeobachtungsprogramms. 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. Die Wetterbedingungen während der Expedition waren durch mäßigen bis zeitweise starken Wind und meist starke Bewölkung geprägt. Das vorgesehene wissenschaftliche Programm der Reise wurde vollständig umgesetzt und einige zusätzliche Stationen bearbeitet. Dabei wurde der Großteil der Messungen entlang des Talweges der Ostsee von der Darßer Schwelle bis zur nördlichen Gotlandsee durchgeführt. Die gesammelten Daten stellen Momentaufnahme der zeitigen Frühjahrsbedingungen in der Ostsee in einem Jahr ohne großen Salzwassereinbruch dar.

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
Rehder, Gregor, Prof.	Trace gasses	IOW
Labrenz, Matthias, Prof.	eDNA	IOW

2.2 Scientific Party

Name	Discipline	Institution
Mohrholz, Volker, Dr.	Phys. Oceanogr. / Chief Scientist	IOW
Heene, Toralf	Phys. Oceanogr.	IOW
Köhn, Josef	Phys. Oceanogr. / Instrumentation.	IOW
Kreuzer, Lars	Marine Chemistry	IOW
Schöne, Susanne	Marine Chemistry	IOW
Klostermann, Birgit	Marine Chemistry	IOW
Blanke, Marit V.	Marine Chemistry	UHRO
Fechtel, Christin	Biology	IOW
Heins; Anneke, Dr.	Microbiology	MPI
Zielinski, Oliver, Prof.	Dir	IOW

Prof. Oliver Zielinski and Dr. Anneke Heins were disembarked on 16th and 17th March respectively, after their planned tasks on board were finished.

2.3 Participating Institutions

IOW	Leibniz-Institute for Baltic Sea Research Warnemünde, Germany
UHRO	University of Rostock, Germany
MPI	Max Planck Institute for Marine Microbiology Bremen, Germany

3 Research Program

3.1 Description of the Work Area

Data collection covered the western and central Baltic from the Kiel Bight to the northern Gotland Basin. The majority of stations was located along the thalweg transect of the Baltic Sea, crossing the Arkona basin, the Bornholm Basin, and the Slupsk Furrow. 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 and the Landsort Deep. An overview of the locations of CTD stations, mooring positions, and the cruise track is given in Fig. 3.1. A station list is given in Table 7.1.

3.2 Aims of the Cruise

The cruise EMB314 was carried out as a joined cruise of the Baltic Sea long term observation program of the Leibniz-Institute for Baltic Sea Research Warnemünde (IOW) and the environmental monitoring program of the Federal Maritime and Hydrographic Agency (BSH). It was the second cruise in a series of five expeditions performed annually.

The data acquired are used for the regular national and international assessments of the state of the Baltic Sea, and provide the scientific basis for measures to be taken for the protection of the Baltic Sea ecosystem. 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 early spring conditions during the onset of first phytoplankton bloom after the deep mixing in winter. Since no larger baroclinic inflows were observed during the previous winter, the observations will also deliver data about the ongoing stagnation period in the deep Baltic basins.

A further goal of the cruise was the recovery of two moorings that were deployed ten month ago in frame of the CABLE project. The gathered data of these moorings will contribute to the better understanding of the circulation between the northern Baltic and the eastern Gotland Basin.

3.3 Agenda of the Cruise

The work packages of the cruise 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. The station work is complemented by the mooring maintenance in the eastern Gotland Basin. Additionally, in northern Gotland basin two moorings of the CABLE project had to be recovered.

In the eastern and western Gotland basin zonal ScanFish transects were planned, that deliver high resolution hydrographic data of the upper 140m. On the way back to Rostock some CTD stations were repeated to gather further data for the long-term observation program.

Two extra sampling programs were conducted for eDNA sampling in German waters, and for trace gas long term observations at the Baltic main stations in the Arkona Basin, the Bornholm basin, the Eastern Gotland basin, and in the Faro Deep.

The marine environment was less disturbed by performed scientific tasks. No sampling in marine protected areas was carried out. Mainly sensor measurements and water sampling in the water column for chemical analysis were done. High frequency hydro acoustic measurements were done by a current profiler along the ship track and at mooring systems. These moorings are installed in the deep anoxic part of the eastern Gotland Basin. Due to the high frequency (>150kHz) of the used devices Marine mammals were not affected by these measurements

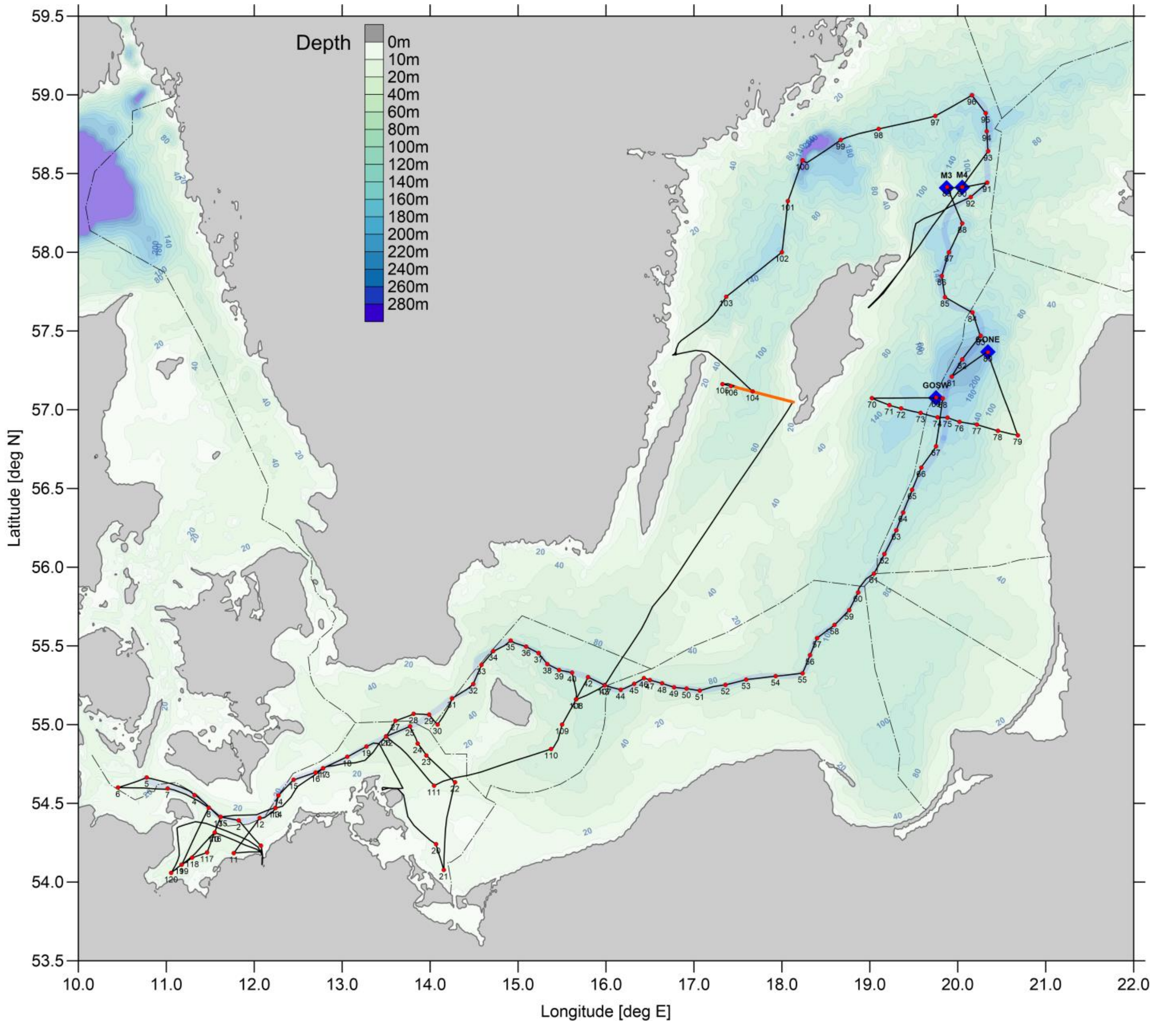

Fig. 3.1 Map of stations and ship track of cruise EMB314 from 15. – 28. March 2023. Red dots and black labels indicate the positions and names of CTD stations. The red line depicts the ScanFish transect in the western Gotland basin. Blue diamonds mark the location of moorings in the eastern Gotland basin.

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

At stations and transects:

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

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

Continuous measurements:

- Vessel mounted ADCP 300kHz Ocean Surveyor (at selected transects)
- Underway measurements of surface water properties
- Ship weather station

4 Narrative of the Cruise

On 14th March 2023 the final preparations for the cruise started with the loading of scientific equipment and with installing the lab devices on the ship in port of Rostock. On the next morning at 7am all participants have embarked. After the safety instructions the ship left the port at 8am. The weather predictions for the next two days announced moderate winds and air temperatures about 5°C. After the safety drill we started the scientific work at the test station off Warnemünde. During the following 24 hours the planned stations in the Fehmarn Belt and the Kiel Bight were worked. The wind speed decreased during the night. On the next morning we called the port of Warnemünde for disembarking of a scientific crew member. After leaving the port at 11am the scientific work was restarted immediately with a station off Kühlungsborn. From there we went eastwards to continue with the stations along the Baltic thalweg transect. In the late evening the Darss Sill was reached. The southerly wind has increased to 6 to 7 Bft. During the night the sea state reached a level that did not allow a safe CTD operation in the central Arkona basin. Therefore, the initially planned sequence of stations was change to work first the southernmost stations in the Pomeranian Bight, where the wind fetch was much shorter.
Unfortunately, the wind did not calm down as soon as expected. We decided to go into the Tromper Wiek for shelter and to drop off another scientific crew member who has already finished the planned eDNA program in the German waters. At noon we left the Tromper Wiek towards the Oder Buoy station in the southern Pomeranian Bight, where we started the station work in the early afternoon. From there we continued the measurements towards the central Arkona Basin. The weather conditions improved during the evening, and the wind decreased to 4 to 5 Bft.

Shortly, after midnight we reached the central station of the Arkona basin TF0113. Here an extended program was performed. Afterwards we continued the station work along the Baltic

Thalweg transect towards the central Baltic. The wind was further decreasing to 3 to 4 Bft. The sky was cloud covered, but no rain occurred. We found the Arkona Basin well mixed down to 35 to 40m. Only a very thin saline bottom layer was observed. The Bornholmgat was passed around noon of the 18th March. The stations in the traffic separation area were performed without any interference with other ships. During the afternoon and the evening we continued the CTD observations in the northern Bornholm basin. The CTD mounted camera occasionally depicted concentrations of sprat below the halocline and near bottom. At two a clock we arrived at the central station of the Bornholm Basin TF0271. Here trace gas sampling was done and several phytoplankton and zooplankton nets were deployed. In the morning the wind nearly vanished and dense fog covered the sea surface. At 9am we passed the Slupsk Sill. No active overflow of dense water towards the Slupsk Furrow was observed. Till the late afternoon we performed the CTD station along the Thalweg transect in the Slupsk Furrow, and passed its eastern end. The fog lasted the entire day. In the late evening we reached the southern tip of the Gotland Basin. Here anoxic conditions were observed below 80m depth.

During the night and the morning of the 20th March we worked the stations along the Thalweg transect in the southern Gotland basin. As on the previous day the sea was covered with fog. The wind speed was very low with 2 to 3 Bft. Shortly after noon we reached the mooring position GOSW at the southern rim of the eastern Gotland basin. The slowly increasing wind speed lifted the fog considerably so that the planned mooring operation could be performed. We recovered the mooring GOSW-05 successfully and without loss of devices by using the spare release. The first releaser did not worked properly because of a technical issue on the rope drum. After maintenance of the mooring and exchange of devices we redeployed the mooring at the same position. Then we were going to the westernmost station of the southern Gotland transect and started the station work along the transect towards the Latvian coast. The wind has further increased during the evening. The transect was completed on the morning of 21st March near the Latvian coast. We turned towards northwest to steam to the GONE mooring position. This mooring was deployed in May 2022 and had to be maintained. We arrive at the mooring position at half past nine. The wind was low, but there was still some swell from northerly directions. The mooring could be released with the main release and showed soon up at the surface. After recovery we changed the measuring devices and performed the maintenance of the mooring. All devices gathered data and have worked as expected. The mooring was deployed again at the same position.

The work in the eastern Gotland basin was continued at the central station TF0271, which we arrived in the early afternoon. Here an extended observation and sampling program was done. At all we did six CTD casts to collect the required water for lab analysis. We finished the station at seven in the evening. Later on we continued our station work along the Thalweg transect towards the northern Gotland Basin.

During the night the wind was increasing and reached 5Bft in the morning. We resumed the station work along the Thalweg transect at five and went to the position of the CABLE project mooring M5, where we arrived at eight. The wind and wave conditions were at the edge. However, we decided to try the mooring recovery, since the weather predictions for the next days were not promising. The acoustic release of the mooring did not worked properly. Thus, we tried to dredge the ground rope of the mooring. This was successful with the second trial. The mooring was recovered using the ground rope. All devices were saved. After a CTD cast we proceeded to the second CABLE project mooring M4 some miles east of M3. The mooring M3 was released successful and was recovered with all devices. The wind speed was slowly increasing. We performed another two CTD stations of the Thalweg transect. Due to the strong winds and high sea state we stopped the station work and decided to steam to the start point of the first ScanFish transect at the east coast of Gotland Island. In the afternoon the visibility was strongly decreasing because of fog. In the late evening we arrived at Gotland where we got shelter from the further increasing wind. After discussing the weather prediction we decided to cancel the planes ScanFish transect for the next morning, to ensure that we could cover at least all CTD station of the Long-term Observation Program.

In the early morning the wind was decreasing so that we could resume our station work along the Thalweg transect. We finished the observations at this transect in the early afternoon of the 23rd March. The sunny weather from the morning has turned again to foggy conditions with low visibility. We turned towards the western Gotland basin where we started with station work in the afternoon. Shortly before midnight we reached the Landsort Deep (TF0284). Here at the deepest part of the Baltic an extended sampling program was conducted. During this night we were lucky enough to see bright polar lights lasting from midnight till the sunrise. This was completely unexpected and quite unusual for this latitude. During the 24th March we continued the station work in the western Gotland basin till the early afternoon. Then the wind increased again to 7Bft. Thus, we decided to seek shelter near the Swedish coast where we arrived in the evening. On the next morning we steamed to station TF0245 where we performed a CTD profile. Afterwards we started the ScanFish transect in the western Gotland basin between Öland and Gotland. Due to technical problems with the DSL connection to the ScanFish we interrupted the transect right after beginning. The issue could be fixed and we restarted the ScanFish measurements shortly after lunch. The wind and wave conditions were good with 5Bft and 1 meter wave height. The transect was finished at four in the afternoon. This was also the end of the planned observations in the western Gotland basin, and we started immediately the transit back to the Bornholm basin.

In the night from 25th to 26th March we changed to daylight saving time. The local time was then UTC + 2hours. The wind decreased temporary to 4 Bft. At eight in the next morning we started with station work at the main station of the Bornholm basin (TF0271). This was the first of 5 stations that have to visit twice during the cruise. We had planned to work the transect south of Bornholm via the shallow connection between the Bornholm Basin and the Arkona Basin. However due to rapidly increasing wind speed we had to stop the station work along this transect after station TF0204 southeast of Bornholm. We started to travel strait to station TF0150 east of the island of Rügen where we arrived at about 9pm. The wind has reached strength of 7Bft and the significant wave height was about 1.5 to 1.8m. After performing the station we went to the central station in the Arkona Basin TF0113 and started with station work right after midnight. The wind was slowly decreasing during the morning.

We continued the station work at the Darss sill and the Belt Sea. The weather became more calm and sunny. In the afternoon we finished the scientific work of EMB314 with a short CTD transect in the Mecklenburg Bight. In the evening after short snow showers the wind was increasing again to 7-8Bft. We were seeking shelter near the coast of Fehmarn before we did the transit to Rostock in the early morning of 28th March. At 8am we arrived at the Pier in Marienehe. After custom procedure we were packing and unloading the scientific equipment. The cruise was finished with the disembarking of scientific crew in the late afternoon of 28th March.

5 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.

5.1 Meteorological Conditions

The meteorological conditions during the cruise were characterized by a by windy weather conditions, interrupted by shorter periods of low wind speed. Three times the wind was too strong for safe device operations and hampered the scientific work. It was a normal situation for March and early spring.

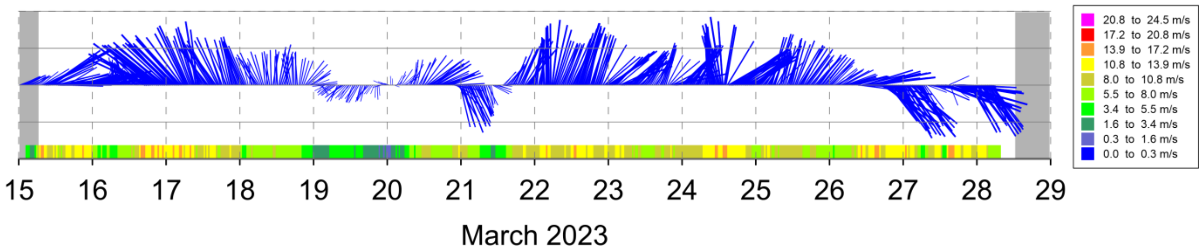

Fig. 5.1 Stick plot of wind vector measured by the ship weather station of RV ELISABETH MANN BORGESE. The grey shaded areas indicate periods when the ship was in port.

The cruise started with a windy, but sunny day. The mean wind speed ranged between 8 and 13 ms^{-1} with mostly westerly wind direction. On 17th March a first stormy period with south east winds lead to a short interruption of the work in the Arkona Basin. During the following three days the winds decreased rapidly. During that time the ship operated along the Thalweg transect towards the eastern Gotland Basin. On the afternoon at 21st March the wind speed increased to 6-7 Bft with southerly directions. The days till the 25th March were characterized by high wind speed with only short periods of decreased wind speed. After a calm night on 26th March again high wind speed hampered the station work. Till the end of the cruise the wind speed remained at a high level (Fig. 5.1 and Fig. 5.2).

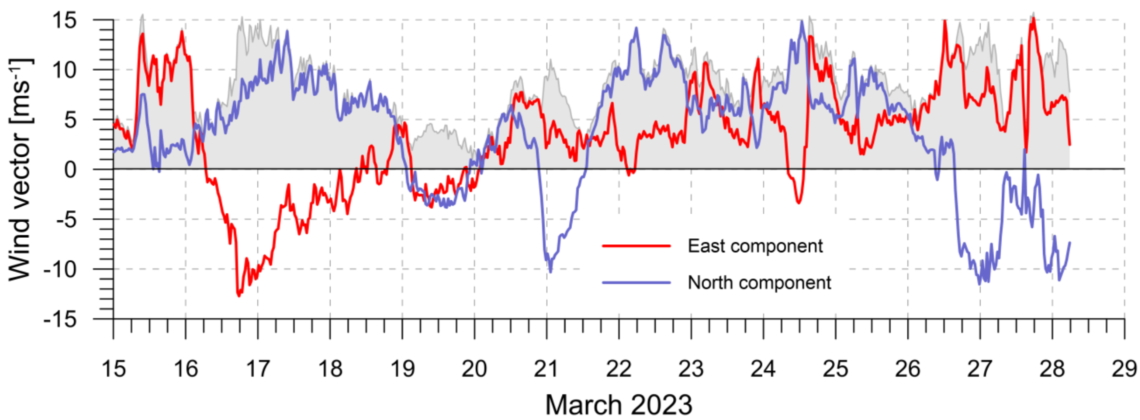

Fig. 5.2 Wind vector east and north measured by the ship weather station of RV ELISABETH MANN BORGESE (30 min averaged values).

The air temperature in the western Baltic was below the long-term average for late March. Values of 4 to 6°C were observed during the day. In the nights the air temperature dropped to 1 to 2°C. On the way to the eastern Gotland Basin the air temperature increased temporary to about 6-7°C (Fig. 5.3), and decreased again when the ship reached the eastern Gotland Basin. On the way to the western Gotland Basin and back to the southern Baltic the air temperature increased only slightly to mean temperatures of 4°C. The general behavior of air temperature was mainly controlled by the day and night cycle and the sequence of passing pressure systems.

Fig. 5.3 Air temperature measured by the ship weather station of RV ELISABETH MANN BORGESE (30 min averaged values).

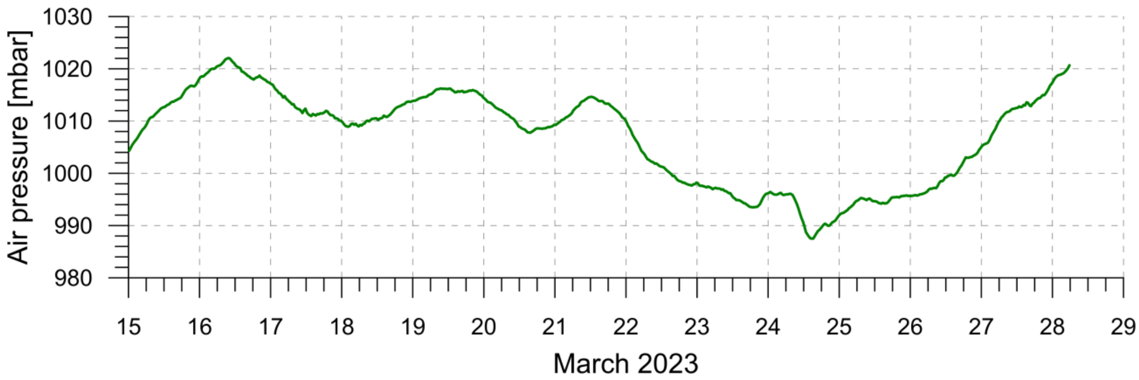

Fig. 5.4 Air pressure measured by the ship weather station of RV ELISABETH MANN BORGESE (30 min averaged values).

The air pressure variations during the cruise were characterized by a period of high pressure during the first week of the cruise followed by some days show low air pressure. Superimposed to this general pattern the variability is controlled by the typical time scale of passing low- and high-pressure systems of 1 to 3 days duration. The air pressure maximum of 1022mbar was observed on 16th March before the onset of stronger winds. In the following three days the air pressure remained at a level around 1010mbar. Between the 22nd and 24th March the air pressure dropped rapidly, and reached its minimum of 987mbar on 24th March. In the last days of the cruise air pressure was slowly increasing.

The humidity was relatively high, but typical for the early spring season varying between 60 and nearly 95% (Fig. 5.5). Remarkably was the high humidity near 100% when the ship was operating in the eastern and western Gotland basin. Here the evaporation and cooling by surface water caused frequently the formation of fog that lasts often till the late afternoon. Rain was rare during the entire cruise.

The global radiation was strongly related to the cloud coverage. In the first days of the cruise the sky was relatively open, and the sunny conditions led to higher values of global radiation of about 450 to 550Wm^{-2}. Between the 18th and 24th March the cloud coverage increased rapidly and on some days the cloud coverage was at 100%. Thus, the global radiation dropped to daily peak values of 150 to 400Wm^{-2}. Despite of the increasing wind the cloud coverage decreased fom 25th March onwards. The maximum global radiation of 700Wm^{-2} was observed at noon on the sunny 27nd March, when the ship was operating in the Mecklenburg Bight. During the cruise the long wave radiation ranged between 280 and 380 Wm^{-2} (Fig. 5.6).

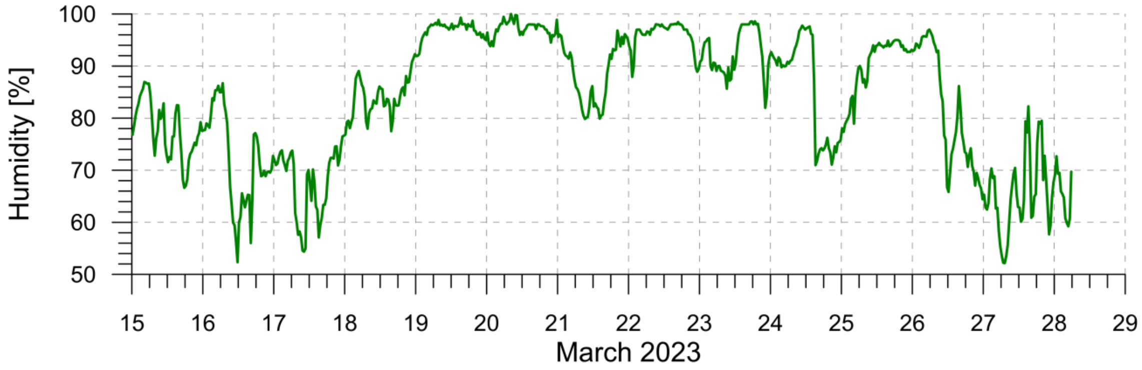

Fig. 5.5 Air humidity measured by the ship weather station of RV ELISABETH MANN BORGESE (30 min averaged values).

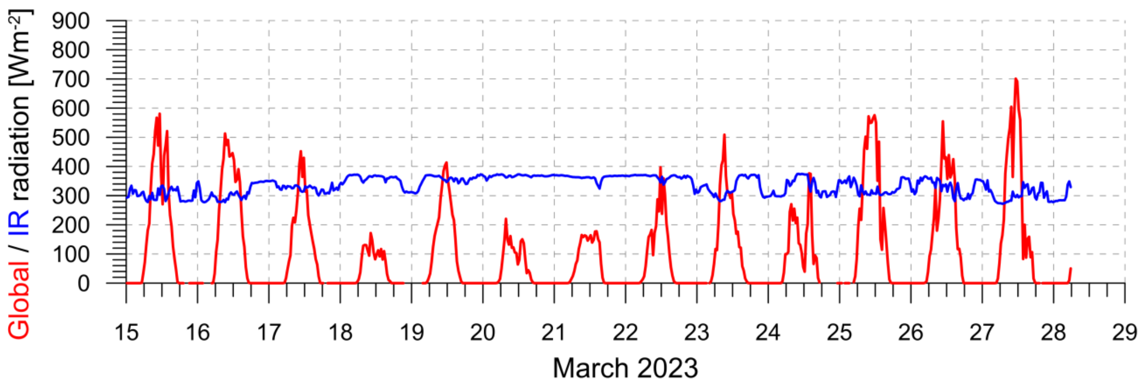

Fig. 5.6 Global and infrared radiation measured by the ship weather station of RV ELISABETH MANN BORGESE (10 min averaged values).

5.2 Properties of Surface Waters

Sea surface temperature, salinity, chlorophyll-a fluorescence and turbidity distributions in the investigation area were compiled from data gathered with the Surface water Monitoring Box (JSMB). The distributions shown in Fig. 5.7 and Fig. 5.10 are based on unvalidated data. The sea surface temperatures (SST) in the western and central Baltic were close to the climatological mean value for March. From the Kiel Bight and the Mecklenburg Bight in the west to the Arkona basin the SST was remarkably constant at about 4°C in the begin of the cruise. Exceptions were areas close to the coast in the Mecklenburg Bight and the Pommeranian Bight a lower SST of 3.5°C was observed.

In the Bornholm Basin the SST depict slightly increased variability around a mean level of 4°C. (Fig. 5.7). The SST decreased slowly from the Slupsk Sill along the Thalweg towards the central Baltic. In the eastern Gotland basin SST amounts to 3°C and dropped further to about 2°C in the northern part of the western Gotland basin. In western and central Baltic the SST was above the temperature of maximum density, which is important for the onset of seasonal stratification. Further the heating of the surface will lead to the onset of seasonal stratification that stops the ventilation of deeper layers by thermal convection. On the way back the SST was slightly higher in the western Baltic than in the beginning of the cruise. The surface salinity (SSS) depicted its maximum of 19g/kg in the Belt Sea in the transition zone to the North Sea. The SSS dropped rapidly to about 9g/kg at the Darss Sill. No indication for an active saline inflow was found. The SSS gradient from the Darss Sill to the Gotland basin followed the known shape. The minimum surface salinity was observed in the western Gotland basin with about 6.5g/kg.

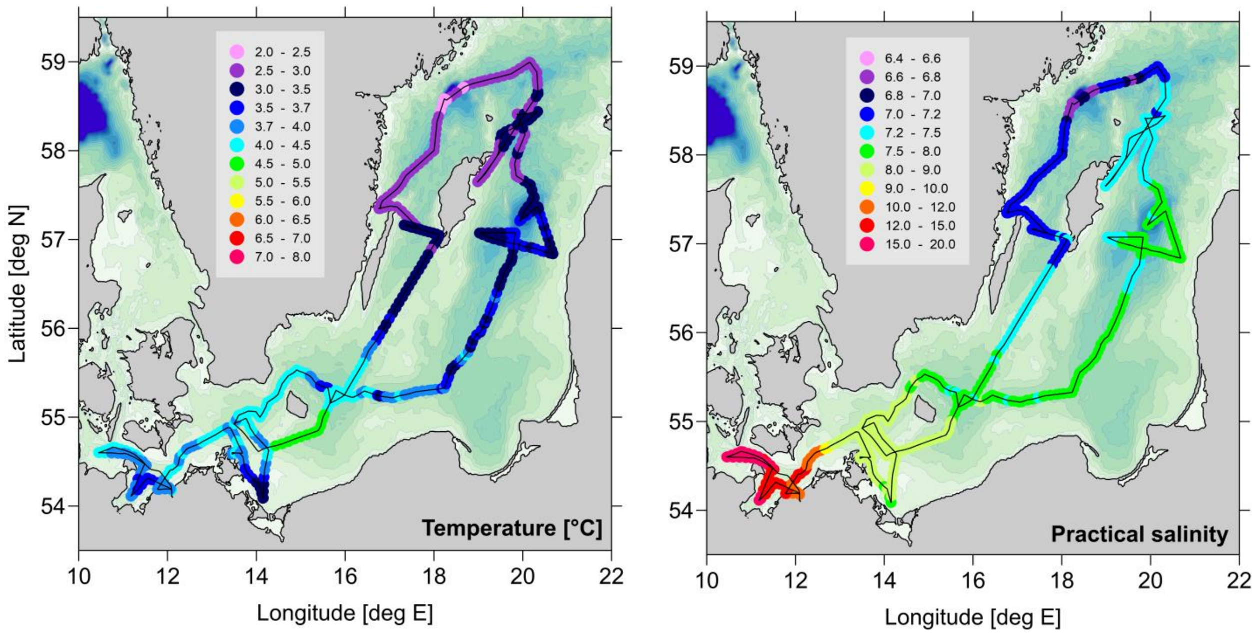

Fig. 5.7 Surface temperature distribution (left) and surface salinity distribution of cruise EMB314 (right). Based on 30 min averaged values.

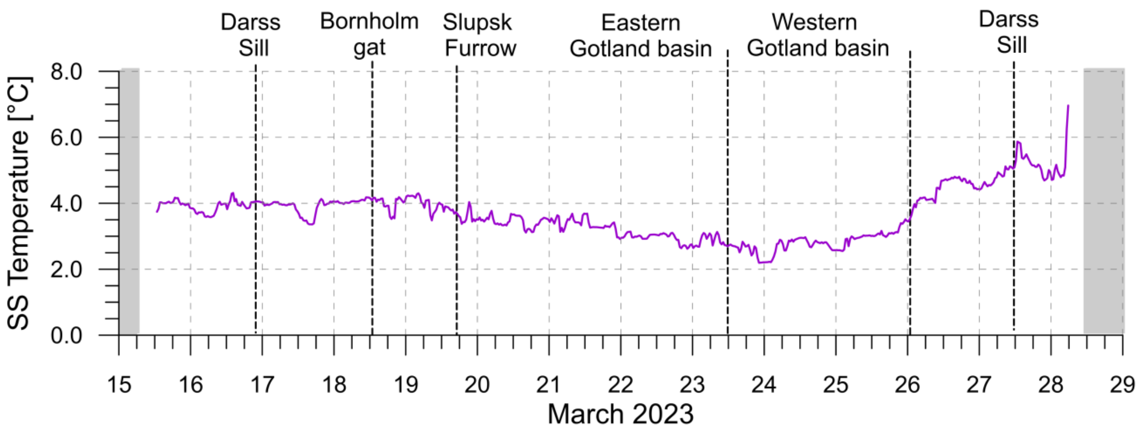

Fig. 5.8 Surface temperature measured with the ship thermosalinograph of RV ELISABETH MANN BORGESE. The gray shaded area indicates the range below the density maximum at the sea surface.

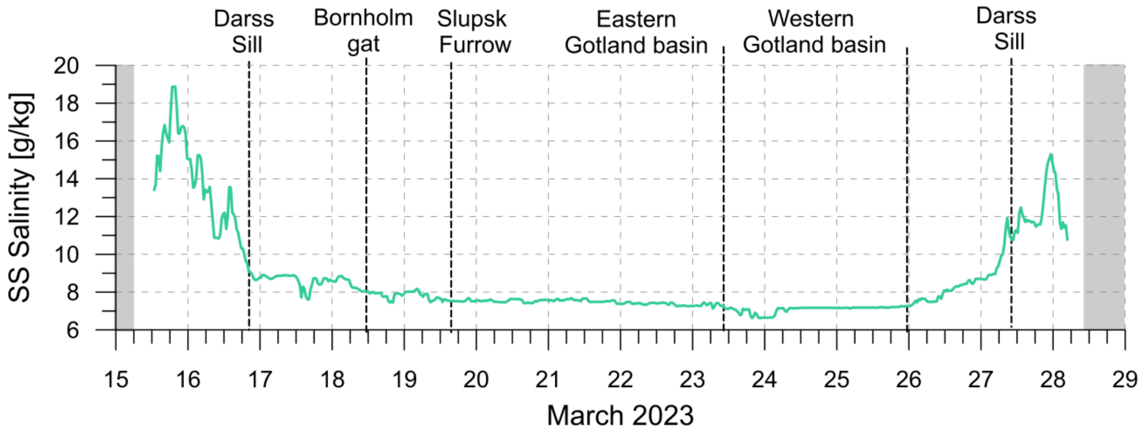

Fig. 5.9 Surface salinity measured with the ship thermosalinograph of RV ELISABETH MANN BORGESE.

The surface distribution of Chlorophyll-a fluorescence depicts a typical signal (Fig. 5.10). Generally, the Chlorophyll-a fluorescence decreased from the western Baltic towards the northern Gotland basin. Hotspots with high Chlorophyll-a fluorescence were observed in the Kiel Bight and of the island Usedom in the Pomeranian Bight. This indicates that the spring bloom in the western Baltic has already started, whereas east and north of the Bornholm Basin no start of the spring bloom was detected. Only near the Landsort deep in the western Gotland basin slightly enhanced Chl-a fluorescence was detected. On the way back to Rostock also in the northern Bornholm Basin enhanced Chl-a fluorescence was observed. The surface turbidity distribution depicted a similar pattern, mainly controlled by the phytoplankton distribution.

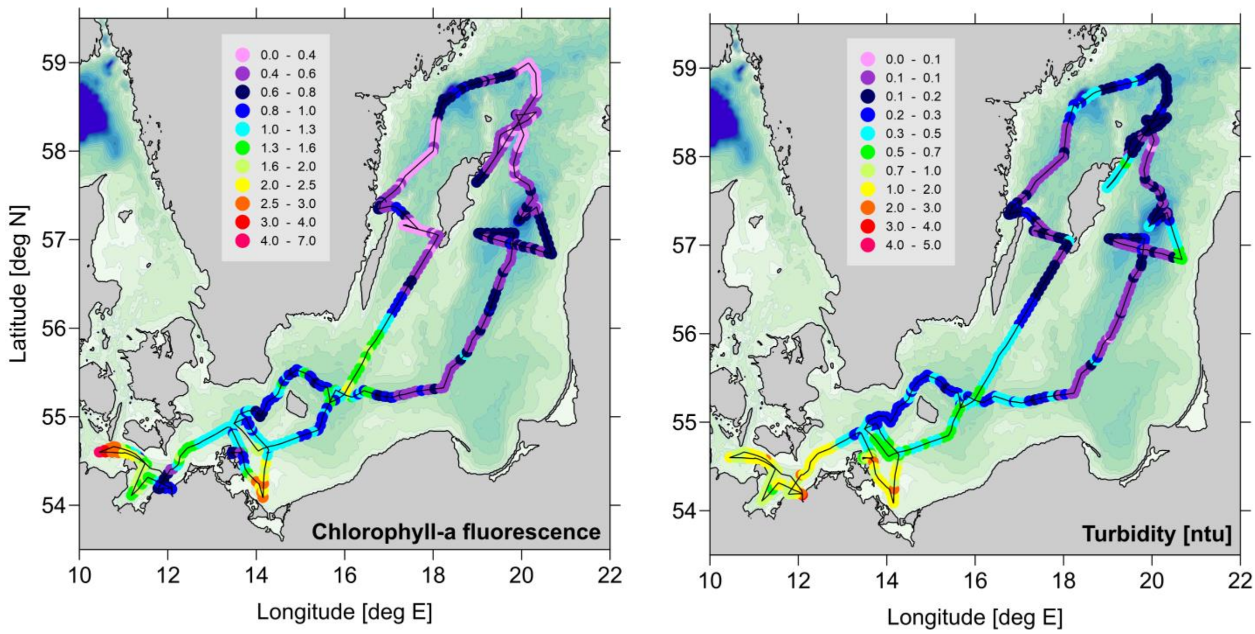

Fig. 5.10 Surface chlorophyll-a fluorescence distribution (left) and distribution of surface turbidity (right) along the cruise track of EMB314 in the Baltic (30 min averaged values).

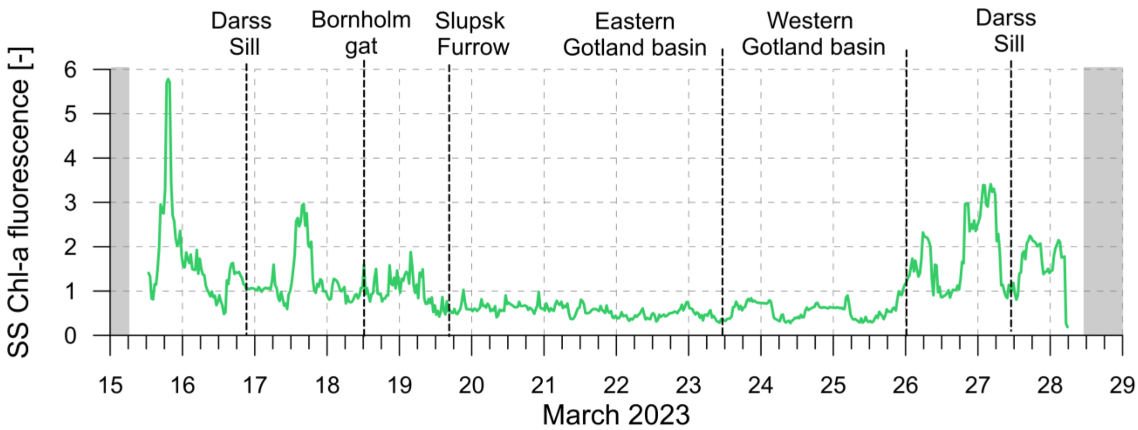

Fig. 5.11 Surface chlorophyll-a fluorescence measured with the flow through fluorometer of RV ELISABETH MANN BORGESE.

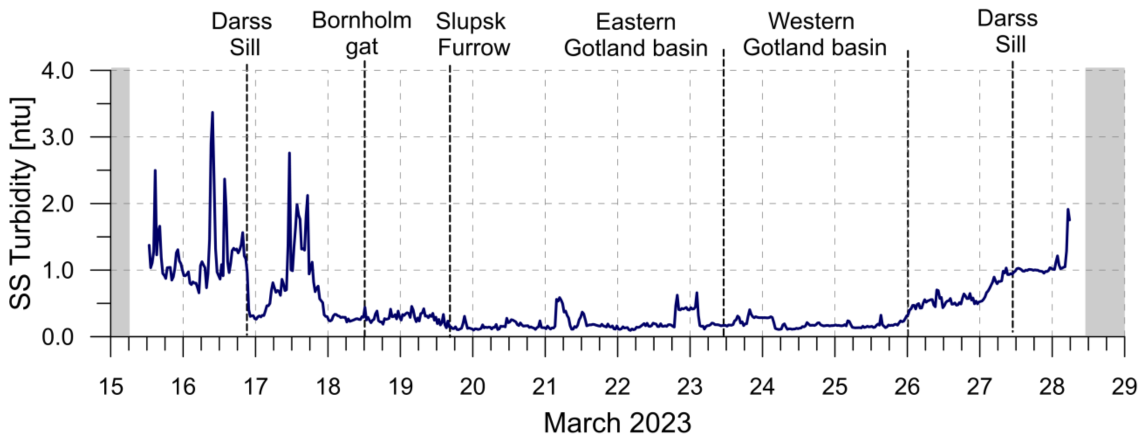

Fig. 5.12 Surface turbidity measured with the flow through fluorometer of RV ELISABETH MANN BORGESE.

5.3 Observations at Main Stations

The following tables list the surface (Table 5.1) and bottom values (Table 5.2) 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 Fig. 3.1 and Table 7.1. 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:

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

µmol l^{-1} O_2 * 0.0224 = ml l^{-1} O_2

The nutrient concentrations at the surface were consistent with the observed Chl-a fluorescence in surface water. In the Kiel Bight, where the highest Chl-a fluorescence was found, nitrate and phosphate were at the detection limit. The rest of the western Baltic depicted reduced nitrate and phosphate concentrations at the surface. High surface concentrations were found in the central Baltic where the spring bloom has not started at the time of the cruise.

Table 5.1 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 15.03.2023	TF0360 EMB314_6	1 *(151)*	4.14	18.73	379 *(367)*	0.02	0.0	12.4
Meckl. Bight 16.03.2023	TF0012 EMB314_10	1 *(276)*	3.58	13.17	379 *(372)*	0.37	1.98	16.7
Darss Sill 16.03.2023	TF0030 EMB314_17	1 *(526)*	4.01	8.95	378 *(378)*	0.42	1.55	16.6
Arkona Basin 18.03.2023	TF0113 EMB314_26	2 *(826)*	3.99	8.73	390 *(381)*	0.40	1.30	15.5
Bornholm Deep 19.03.2023	TF0213 EMB314_43	1 *(1276)*	4.23	7.91	390 *(380)*	0.54	1.55	15.6
Slupsk Furrow 19.03.2023	TF0222 EMB314_51	2 *(1526)*	3.86	7.56	390 *(385)*	0.60	1.85	15.8
SE Gotland Basin 19.03.2023	TF0259 EMB314_57	2 *(1676)*	3.43	7.40	384 *(378)*	0.62	2.83	16.7
SC Gotland Basin 20.03.2023	TF0260 EMB314_66	2 *(1926)*	3.37	7.37	393 *(383)*	0.51	2.43	15.2
Gotland Deep 21.03.2023	TF0271 EMB314_82	1 *(2402)*	3.26	7.38	390 *(380)*	0.56	2.84	15.0
Farö Deep 22.03.2023	TF0286 EMB314_87	2 *(2626)*	3.13	7.38	389 *(380)*	0.54	3.01	17.1
Landsort Deep 23.03.2023	TF0284 EMB314_100	2 *(3026)*	2.20	6.55	409 *(396)*	0.63	3.27	20.7
W Gotland Basin 24.03.2023	TF0240 EMB314_102	2 *(3112)*	2.59	6.87	400 *(384)*	0.55	3.05	17.8
Karlsö Deep 24.03.2023	TF0245 EMB314_104	2 *(3151)*	2.94	7.08	393 *(383)*	0.59	2.89	16.9

Table 5.2 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 15.03.2023	TF0360 EMB314_6	17 *(153)*	4.23	19.81	352 *(345)*	0.06	0.0	12.3
Meckl. Bight 16.03.2023	TF0012 EMB314_10	23 *(279)*	4.33	17.91	326 *(319)*	0.62	5.17	21.2
Darss Sill 16.03.2023	TF0030 EMB314_17	22 *(538)*	3.79	9.52	- *(374)*	0.41	1.46	14.8
Arkona Basin 18.03.2023	TF0113 EMB314_26	46 *(832)*	4.78	18.64	289 *(285)*	0.81	4,23	17.4
Bornholm Deep 19.03.2023	TF0213 EMB314_43	87 *(1285)*	8.67	16.57	82 *(75)*	1.19	8.62	46.7
Slupsk Furrow 19.03.2023	TF0222 EMB314_51	89 *(1532)*	9.15	13.86	118 *(107)*	1.97	6.86	44.1
SE Gotland Basin 19.03.2023	TF0259 EMB314_57	87 *(1682)*	6.59	10.77	**17** *(1)*	3.48	0.0	59.0

SC Gotland Basin 20.03.2023	TF0260 EMB314_66	141 *(1934)*	7.22	12.31	**119** *(0)*	5.30	0.0	81.5
Gotland Deep 21.03.2023	TF0271 EMB314_82	235 *(2336)*	7.23	12.81	**153** *(0)*	6.50	0.0	100.5
Farö Deep 22.03.2023	TF0286 EMB314_87	189 *(2613)*	7.17	12.05	**119** *(0)*	4.00	0.0	68.5
Landsort Deep 23.03.2023	TF0284 EMB314_100	437 *(2987)*	6.47	10.79	**45** *(0)*	4.90	0.0	67.5
W Gotland Basin 24.03.2023	TF0240 EMB314_102	161 *(3110)*	6.08	10.31	**48** *(0)*	4.00	0.0	71.5
Karlsö Deep 24.03.2023	TF0245 EMB314_104	107 *(3158)*	5.95	10.13	**62** *(0)*	3.95	0.0	69.0

The spatial distribution of bottom oxygen conditions derived from water bottle samples is given in Fig. 5.13. The bottom water in the western Baltic was well oxygenated. Bottom oxygen concentration in the Bornholm basin and Slupsk Furrow was considerable reduced. There the bottom water is a mixture of older anoxic deep water and oxygenated saline water from the summer and autumn inflows of the preceding year.

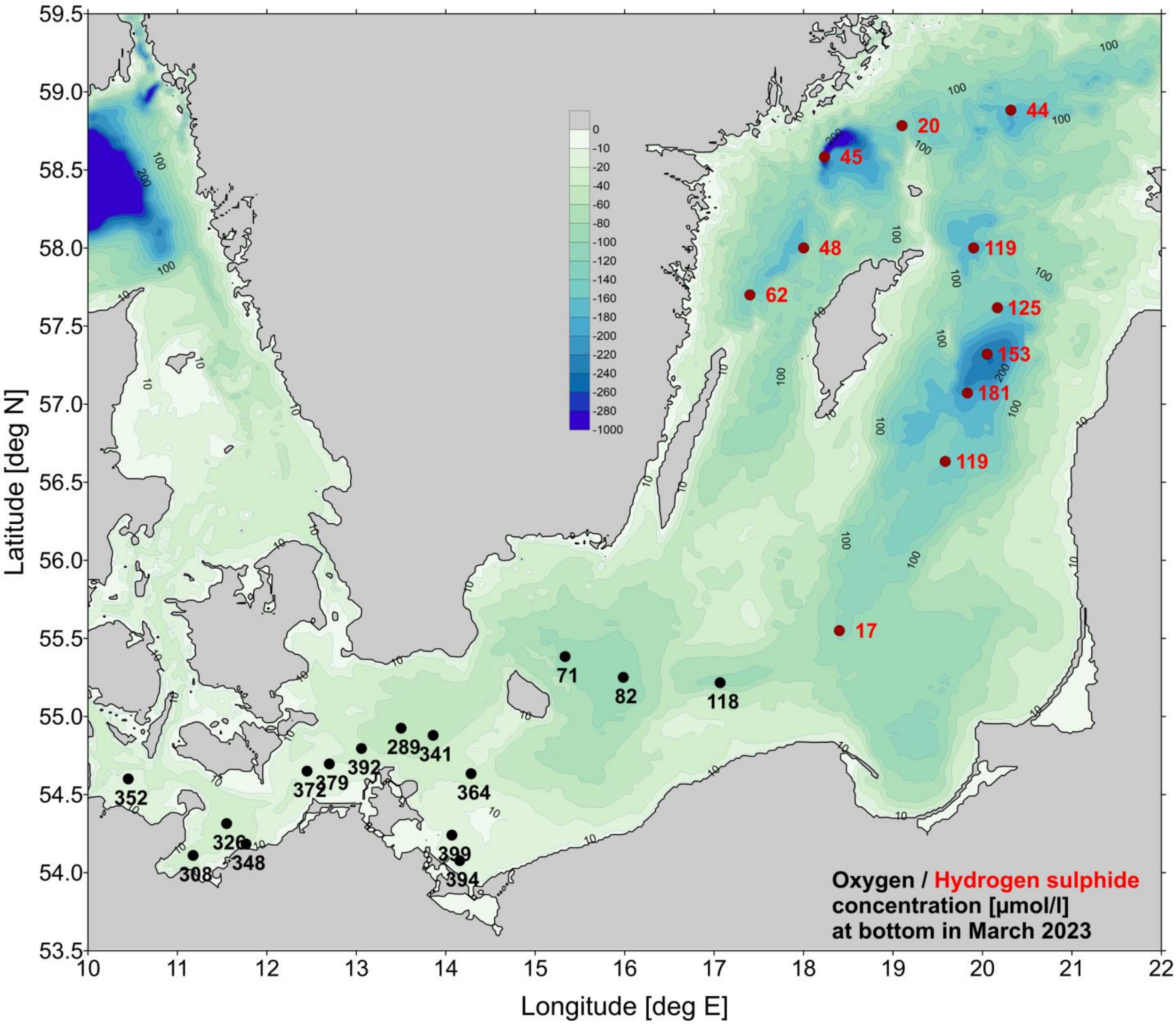

Fig. 5.13 Distribution of oxygen (black labels) and hydrogen sulfide concentrations (red labels) near bottom at main stations of the long-term observation program.

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. The highest values of hydrogen sulphide were observed in the eastern Gotland basin. Denitrification has removed all nitrate from this water bodies, which were enriched with phosphate and silicate. The small amounts of inflowing saline water from did either not reached the bottom layer or its oxygen content was used up before these water masses reached the central Baltic.

5.4 Baltic Thalweg Transect

During the cruise 71 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. With few short interruptions the transect was worked as a continuous sequence of stations, starting on 15th March in the Belt Sea and finished at 23rd March in the northern Gotland Basin. It supplies a quasi-synoptic picture of the hydrographic patterns along the Thalweg.

The gathered data show the typical early spring conditions (Fig. 5.14 and Fig. 5.15). The temperature in the upper layer depicted no vertical gradient down to the permanent halocline. Thus, the developing of the seasonal thermocline has not started along the transect. The temperatures in the surface layer of the western Baltic were at a normal level for March at about 4.2°C in the Belt Sea and 4.0°C in the Arkona Basin. The sea surface temperatures (SST) decreasing towards east and north. SST of about 4°C was found in the Bornholm basin. The SST in the eastern Gotland Basin dropped to 3.1°C at the station TF0271, and below 3°C further north. Below the halocline the water temperature increased to 6 to 8°C. The highest temperatures were observed in the halocline water of the Bornholm Basin and at the bottom of the Slupsk Furrow with about 90.1°C.

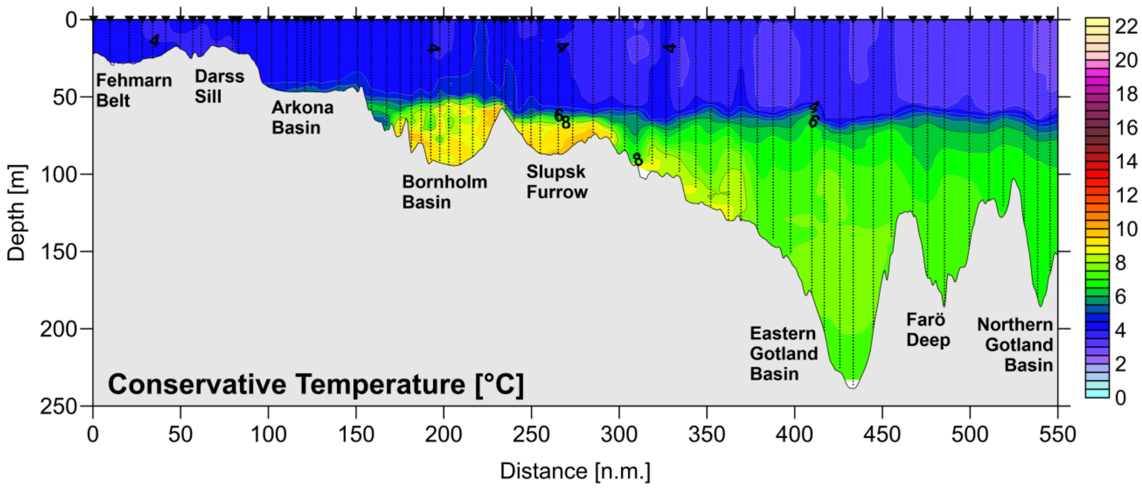

Fig. 5.14 Distribution of conservative temperature along the talweg of the Baltic Sea from the Kiel bight to the northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 15.03. - 23.03.2023.

The temperature maximum in the eastern Gotland Basin was found at 134m with 7.27°C. Towards the bottom the temperature decreased very little and was constant at 7.23°C in a 15m thick bottom layer of the Gotland deep. Between the eastern sill of the Slupsk Furrow and the southern edge of the Eastern Gotland Basin a warm bottom water plume was observed. This water mass originates from the warm barocline summer/autumn inflows of the previous year 2022.

Since summer 2022 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 from summer and autumn 2022 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 (Fig. 5.14). They were mixed up with colder water from inflows in winter. The saline inflow waters filled the Bornholm Basin till the sill depth of the Slupsk Sill. The major part of the warm saline water has passed the Slupsk Sill and covers the bottom layer of the Slupsk Furrow. Further spreading towards the Gotland Basin can be seen also in the higher salinity of the bottom layer between the Slupsk Furrow and the Eastern Gotland Basin, as detected from the temperature distribution.

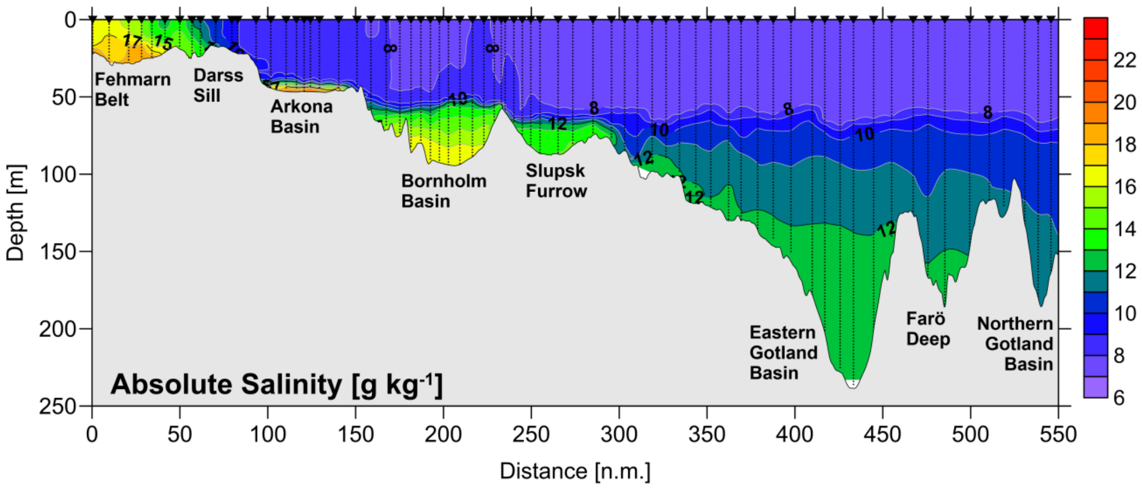

Fig. 5.15 Distribution of Absolute salinity along the talweg of the Baltic Sea from the Kiel bight to the northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 15.03. - 23.03.2023.

The event like overflow of the sill at the eastern rim of Slupsk furrow formed small plumes, seen in the salinity distribution and in the patterns of oxygen concentration. Due to their low salinity of around 12 g/kg this water will be sandwiched in the upper halocline layer of the eastern Gotland basin. The deep and bottom layer of the eastern Gotland basin is covered by high saline waters from recent inflow series. In the Gotland Deep bottom salinity of 12.8gkg^{-1} was observed. The bottom salinity here decreased slowly, but continuously in the recent time because of the lack of high-density inflows.

Highest salinity along the thalweg was observed in the Fehmarn Belt with a bottom salinity above 18gkg^{-1}. However, this was no active inflow of saline water. A patch of dense saline water bottom water of 5m thickness was found in the Arkona basin, with maximum bottom salinity of 18.6gkg^{-1} at the central station TF0113. The low temperature of the water body indicates that it originates from a small inflow in late winter. The halocline in the central Baltic was found at a depth 65m in the southern Gotland Basin and at 60m in the western Gotland Basin (Landsort Deep). The vertical salinity gradient of the halocline decreases towards northern end of the transect.

The oxygen distribution along the central transect is shown in Fig. 5.16. Due to the series of minor inflow events in autumn and winter the western Baltic was well ventilated. The density of these inflow waters was high enough to mix up and replace the deep water in the Bornholm basin. The bottom layer is covered by a 10 to 20m thick water body with about 70 µmol/kg dissolved oxygen. The winter inflow water spreads eastward in the halocline of the Bornholm Basin and passes the Slupsk Sill. It forms the forms the warm, well oxygenated bottom water layer in the Slupsk Furrow with oxygen concentrations between 80 and 110 µmol kg^{-1}.

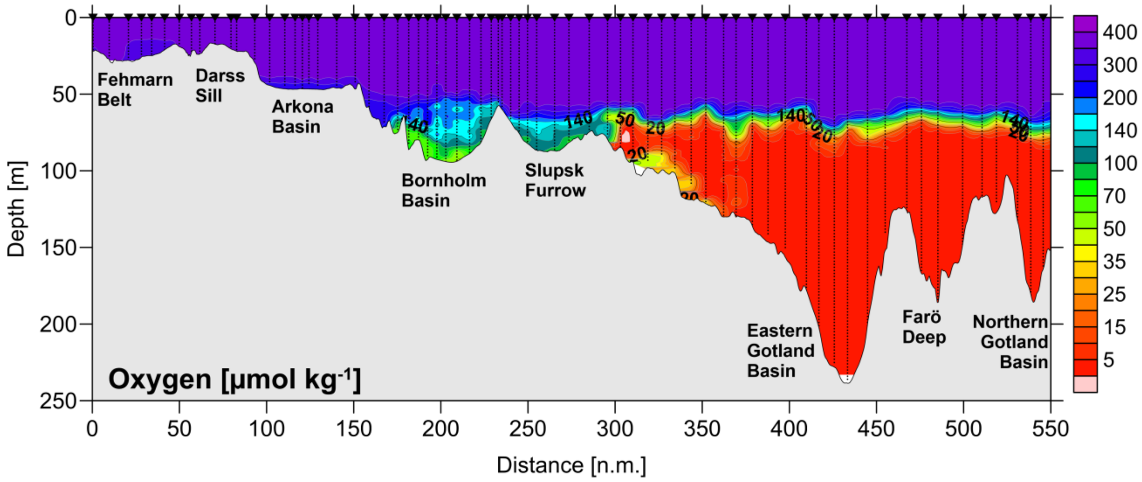

Fig. 5.16 Distribution of oxygen concentration along the talweg of the Baltic Sea from the Kiel bight to the northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 15.03. - 23.03.2023.

The eastward traveling saline bottom plume between the eastern outlet of the Slupsk Furrow and the eastern Gotland Basin (EGB) is also visible in the oxygen distribution. Their higher oxygen concentrations are in contrast to the ambient anoxic water. However, due to mixing with ambient water and ongoing oxygen consumption, the oxygen concentration in the small plumes decreasing rapidly.

In the Eastern Gotland Basin the oxygen concentrations below the halocline decreased rapidly to very small values, and below 75m depth oxygen was exhausted. Free hydrogen sulfide was detected in deeper water samples. In the Faro deep and the northern Gotland Basin the anoxic waters start also at the lower halocline at about the same depth as in the Gotland Deep.

The surface layer of the Baltic is well ventilated, due to wind induced deep mixing during the winter season. The oxygen concentration near the surface is in balance with the atmosphere since the spring bloom has not started at the time of the cruise.

Compared to the long term mean for March the chlorophyll-a fluorescence along the transect was rather weak in 2023. This indicated that the spring bloom has not started jet (Fig. 5.17). Chlorophyll-a fluorescence maximum was detected in the western Baltic in a subsurface layer at about 20m depth in the Fehmarn Belt. This patch consists of saline North Sea water. From the Bornholm Basin to the Faro Deep the weak Chlorophyll-a fluorescence decreases in the surface layer above the halocline. No Chlorophyll-a fluorescence was detected below this layer.

The high turbidity distribution in the Fehmarn Belt and Darss Sill area is confined to the pattern of high saline water. East of it the turbidity depicts slightly enhanced values in the bottom waters of the Arkona Basin, the Bornholm Basin and the eastern Slupsk Furrow. In the Eastern

Gotland Basin high turbidity were found at the interfaces between oxic and anoxic water, where the turbidity patches indicate the depth level of the redoxcline between 80 and 100m. (Fig. 5.18).

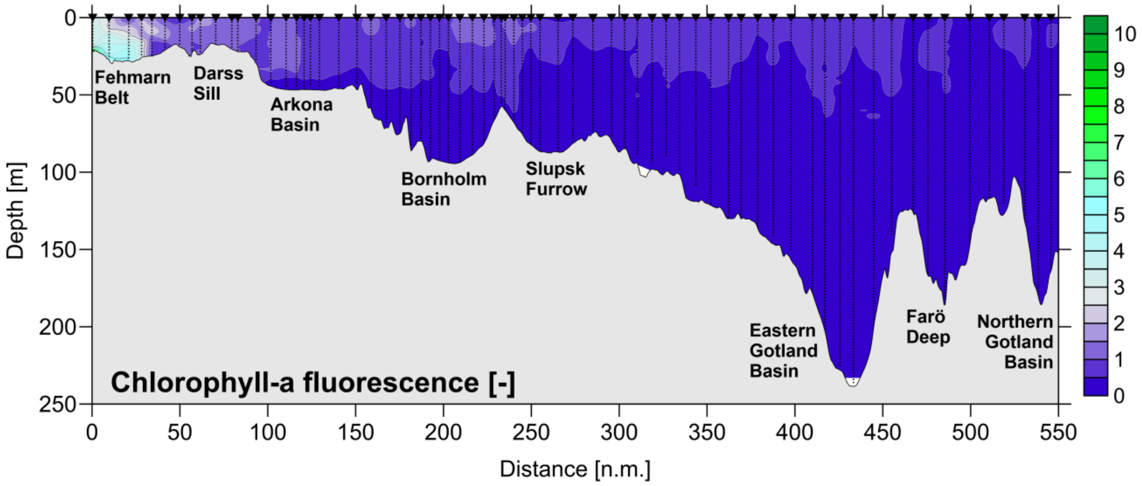

Fig. 5.17 Distribution of Chlorophyll-a fluorescence along the talweg of the Baltic Sea from the Kiel bight to the northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 15.03. - 23.03.2023.

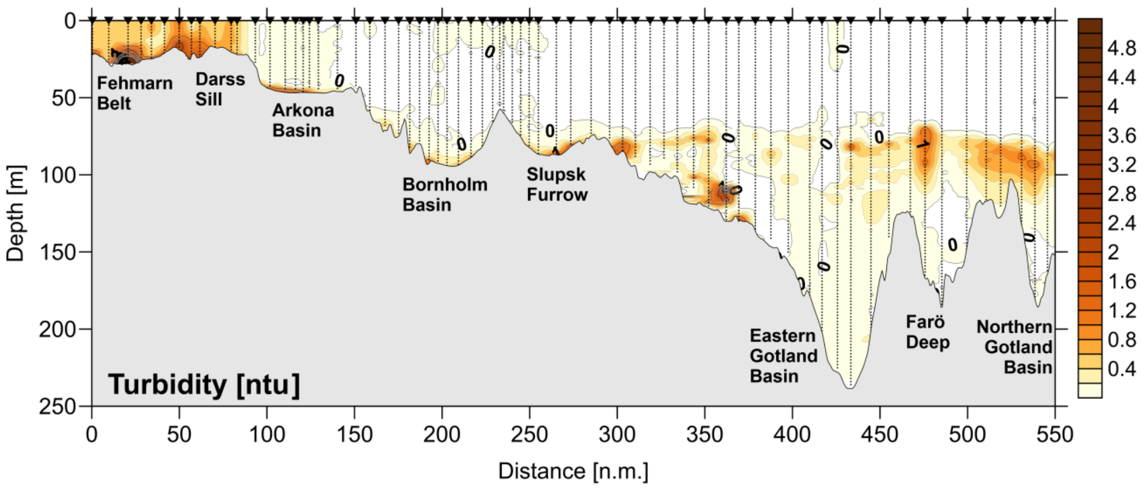

Fig. 5.18 Distribution of turbidity along the talweg of the Baltic Sea from the Kiel bight to the northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 15.03. - 23.03.2023.

Fig. 5.19 depicts the vertical profiles of temperature, salinity and oxygen concentration at the main stations in the central Baltic. The surface water temperature decreases from 3.1°C in the eastern Gotland basin to 2.2°C at the Landsort Deep (A). At the Gotland Deep, The Farö Deep and the Karlsö Deep the surface layer is well mixed down to the local halocline. The surface layer at the Landsort Deep is covered by cooler and fresher water originating from fresh water input at the Swedish coast. There a secondary pycnocline was found at 20m depth (B). The current hydrographic conditions in the deep water of the central Baltic were established in the course of inflow events since December 2014. Since 2017 no fresh saline water has reached the deep water. The temperatures and the salinities at all stations are considerably higher than average (C). Recent inflows hava only reached the halocline layer down to 150m depth, indicated by the higher temperature variability in this layer (D). The oxycline was found between

60m and 80m depth. The deep-water layer is characterized by the long-lasting stagnation and euxinic conditions.

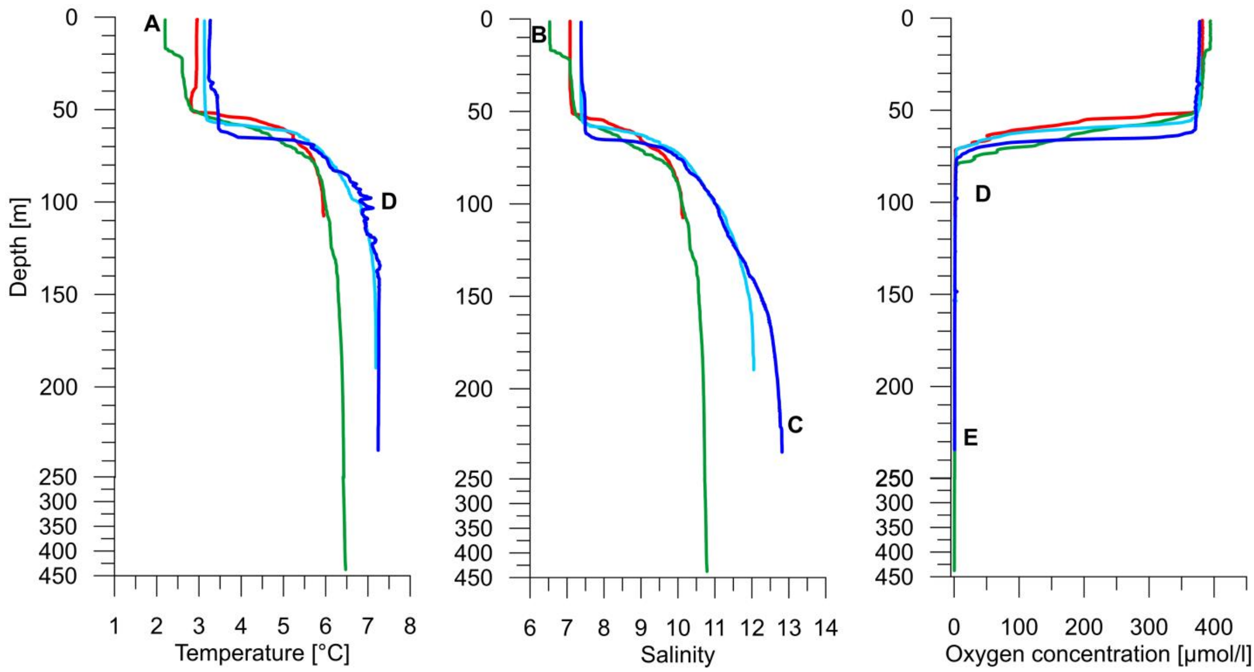

Fig. 5.19 Vertical profiles of temperature, salinity and oxygen concentration (CTD data) at the main stations in the central Baltic. Gotland Deep TF0271 (blue), Farö Deep TF0286 (cyan), Landsort Deep TF0284 (green), and Karlsö Deep TF0245 (red).

The different water masses observed during the cruise can be clearly identified using its temperature, salinity and oxygen signature. Fig. 5.20 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

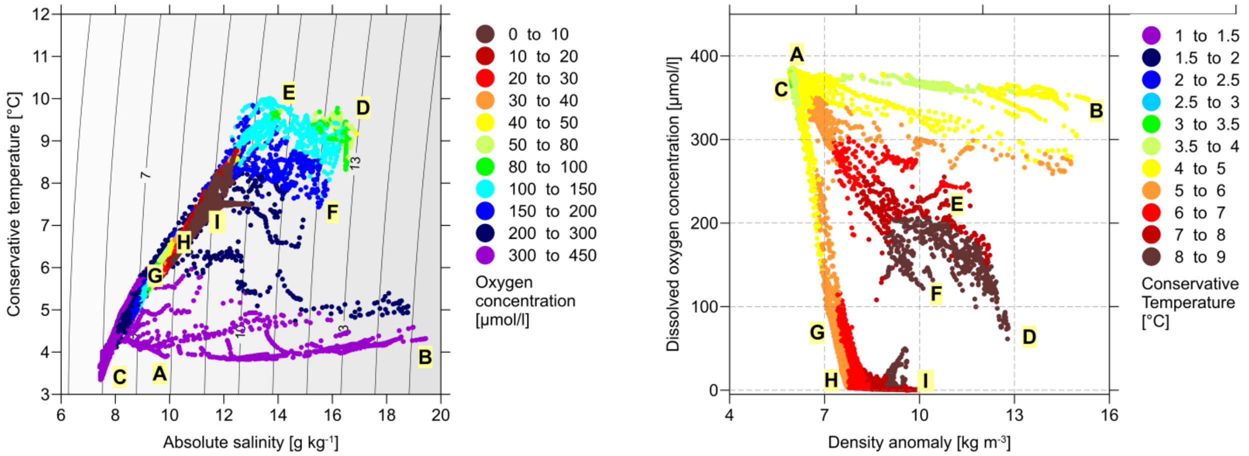

Fig. 5.20 TS-diagram (left) and Oσ-diagram (right) of the Baltic transect. The capital letters indicate the different water masses (see text).

5.5 Southern Gotland Basin Transect

A zonal transect was performed on 20th/21st March at the southern rim of the Eastern Gotland Basin. It depicts the conditions at the entrance of the Eastern Gotland Basin. The surface water properties depict the well mixed late winter condition. The SST ranges between 3 and 7.5°C. The surface salinity is about 7.5 g/kg. The deep-water layer, separated by a pronounced pycnocline, was covered by warm and salty waters of 6 to 7°C and 10 to 12gkg^{-1} salt, respectively (Fig. 5.21). There were only very weak signs of saline intrusions at the eastern rim of the basin, that indicates a patch inflowing saline water from recent inflow events. Along the entire section only weak horizontal gradient were observed.

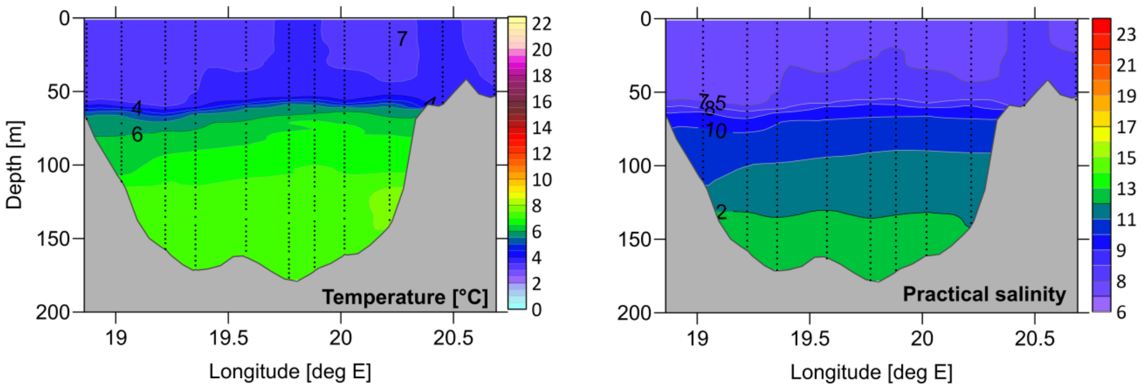

Fig. 5.21 Temperature and salinity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 20./21.03.2023).

The oxygen concentration follows the overall density stratification. The surface layer is saturated due to the balance with the atmosphere. At the halocline at about 55m depth the oxygen concentration dropped rapidly to values below 5 µmol kg^{-1} at 80m. The deep water was anoxic. The little patch of inflowing water in not seen in the oxygen distribution, but is visible as patch of enhanced turbidity. The turbid layer just below the oxycline indicate the transition to the euxinic deep water body (Fig. 5.22).

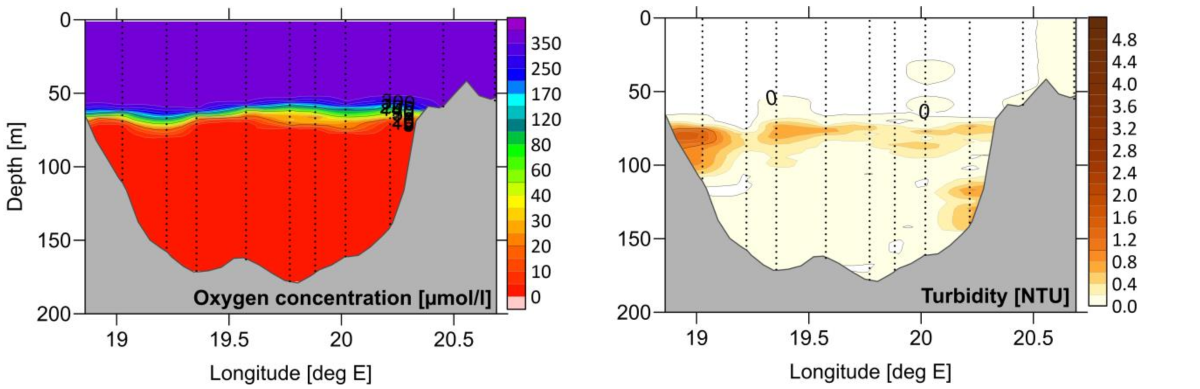

Fig. 5.22 Dissolved oxygen and turbidity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary CTD data, 20./21.03.2023).

Current measurements with the vessel mounted ADCP are shown in Fig. 5.23. Due to the lack of scatter particles data are only reliable above the halocline. The main flow is directed northward at the eastern rim of the basin and southward on the western part. This is consistent with the general circulation pattern in the Eastern Gotland Basin, that is governed by a basin scale cyclonic eddy.

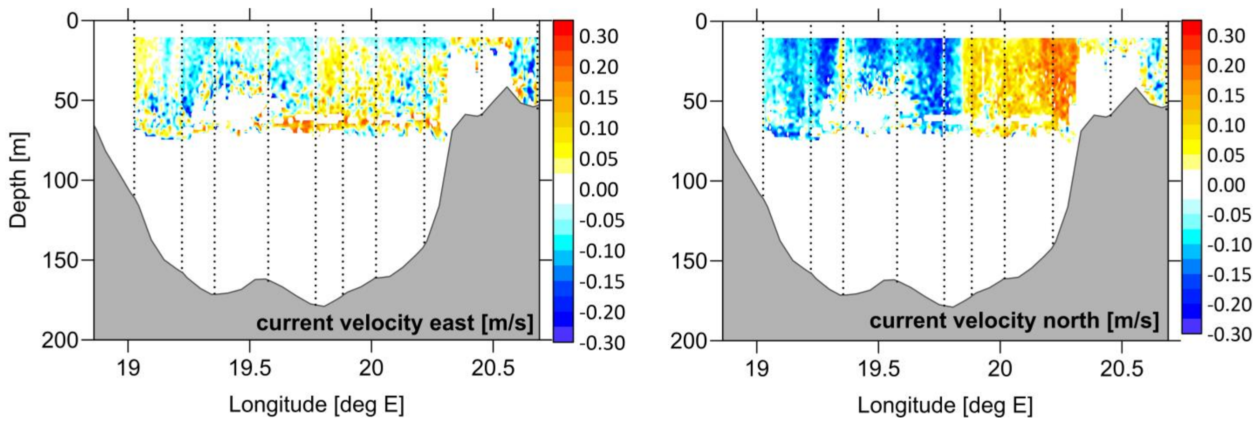

Fig. 5.23 Current velocity distribution along the zonal transect at the southern rim of the Eastern Gotland Basin (based on preliminary VMADCP data, 20./21.03.2023).

5.6 Gotland ScanFish Transect

In frame of IOWs long term observation program usually two ScanFish transects should be performed across the Western and the Eastern Gotland Basin crossing the Klintsbank and the Gotland deep. Unfortunately, the transect through the Eastern Gotland Basin could not worked, due to bad weather conditions. Thus, only data from the western transect between Öland and Gotland were gathered. This cross section provides a spatially high-resolution distribution of hydrographic conditions. These data will not be discussed in detail here, but the main hydrographic parameters are depicted in Fig. 5.24 and Fig. 5.25 to illustrate the high resolution of these observations, smaller than the usual CTD grid distance of 5 to 10 nautical miles. The distribution patterns are governed by the upwelling signal at the slope toward Gotland island, which causes an uplift of the halocline by about 30m.

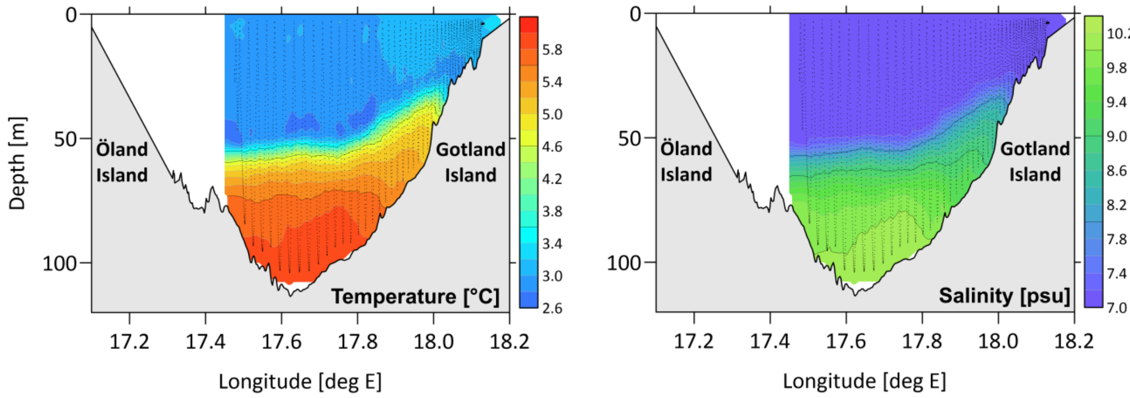

Fig. 5.24 Temperature distribution along the two ScanFish transects across the western and eastern Gotland basin.

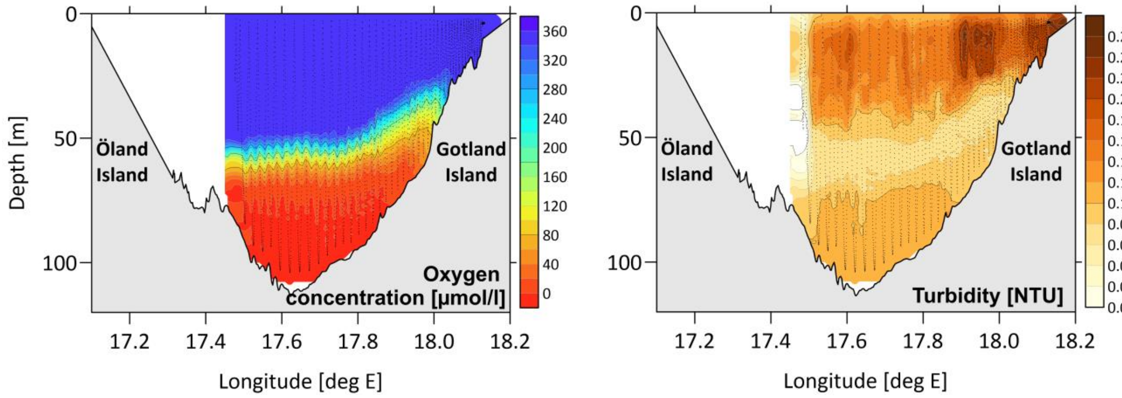

Fig. 5.25 Chlorophyll-a fluorescence distribution along the two ScanFish transects across the western and eastern Gotland basin.

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 7.1 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 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. The analysis of these samples will be performed after the cruise. Thus, no preliminary results of this program are presented here.

5.9 Microbiological Sampling

During the EMB314 cruise, water samples were collected from 14 different German stations. The samples were collected using a CTD (Conductivity, Temperature, Depth) rosette sampler at three different depths (surface, 10 m below surface, and 3 m above seafloor). The water samples were either filtered using a) a 0.22-micron filter to obtain the bacterioplancton fraction for a bioarchive of microorganisms, b) a 0.45-micron filter for a bioarchive of metazoan DNA or c) sequentially filtered through a 10-, 3-, and 0.22-micron filter for proteomics analysis.
Bioarchive for Microorganisms:

Microorganisms play a critical role in the ecosystem, as they are responsible for various biogeochemical processes, including nutrient cycling, carbon fixation, and decomposition of organic matter. Changes in the microbial populations can have significant impacts on the overall health of the Baltic Sea's ecosystem. Especially now, while the Baltic Sea is facing environmental challenges, including nutrient pollution (=eutrophication) and global warming, it is important to monitor the status of this environment to assure its health.

In addition to its environmental importance, the Baltic Sea is a resource for human activities, including fisheries, tourism, and shipping. Monitoring the microbial populations can provide important information on the safety of the seafood harvested from the Baltic Sea, as some microorganisms can cause foodborne illnesses. It can also help identify an increase in pathogen abundance that may impact human health.

Overall, monitoring the microorganisms in the Baltic Sea is important for understanding the health of the ecosystem, identifying potential issues, and developing effective management strategies. The long-term monitoring provided by the bioarchive created during the EMB314 cruise will be a valuable tool for researchers and policymakers working to ensure the sustainability of the Baltic Sea and the human activities that depend on it.

Sampling of metazoan DNA:

In addition to collecting water samples for microbial analysis, the EMB314 cruise also included non-invasive sampling of metazoan DNA, or animals with tissues organized into organs and organ systems. Non-invasive monitoring of metazoans is an important tool in environmental monitoring, particularly in aquatic environments such as the Baltic Sea. This method involves collecting environmental DNA (eDNA) from the surrounding water, which can provide information on the presence of metazoans without the need to capture or harm them.

Traditional methods of monitoring metazoans, such as trawling and netting, are time-consuming, expensive, and may not capture all species present in the ecosystem. Non-invasive monitoring using eDNA can provide a more efficient and (hopefully in the future) more accurate method of monitoring the ecosystem's metazoan biodiversity. Non-invasive monitoring of metazoans using eDNA can provide information on the distribution of rare or elusive species, which may be difficult to detect using traditional monitoring methods. This information can be valuable for conservation efforts, as it can help identify areas of high biodiversity that require protection.

Sampling for Proteomics:

The water samples collected during the EMB314 cruise were also used for the analysis of proteomics. This involves analyzing the proteins present in the water samples that were expressed by the microorganisms at that time. Proteomics analysis can help identify the functional roles of different bacterial species in the Baltic Sea's ecosystem. Understanding these functional roles can provide insights into the overall health and productivity of the ecosystem and help identify potential targets for ecosystem management and restoration efforts.

6 Ship's Meteorological Station

Not applicable on EMB. The meteorological conditions during the cruise are described in section 5.1, based on data of the automatic weather station of the ship.

7 Station Lists EMB314

7.1 Overall Station List

Table 7.1 list all stations and deployments carried out during the cruise EMB314. 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 7.1.

Used gears:

CTD	- CTD probe with rosette water sampler
SD	- Secci disk
PLA	- Phytoplankton net
WP2	- WP2 net for Zooplankton sampling
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 7.1 List of stations and gears

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB314_1-1	TFO5	CTD	15.03.2023 08:26	54° 13.90'N	012° 04.52'E	10.0	eDNA, N
EMB314_1-2	TFO5	SD	15.03.2023 08:27	54° 13.90'N	012° 04.52'E	10.0	
EMB314_2-1	TF0017	CTD	15.03.2023 10:28	54° 23.50'N	011° 49.49'E	19.0	
EMB314_3-1	TF0011	CTD	15.03.2023 11:52	54° 24.80'N	011° 37.04'E	22.0	eDNA
EMB314_4-1	TF0010	CTD	15.03.2023 14:02	54° 33.08'N	011° 19.25'E	25.0	eDNA, N
EMB314_5-1	TF0361	CTD	15.03.2023 17:01	54° 39.88'N	010° 46.70'E	22.0	eDNA

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB314_6-1	TF0360	CTD	15.03.2023 18:55	54° 36.01'N	010° 27.06'E	15.0	eDNA
EMB314_6-2	TF0360	PLA	15.03.2023 18:56	54° 36.01'N	010° 27.06'E	15.0	
EMB314_6-3	TF0360	WP2	15.03.2023 19:29	54° 36.00'N	010° 26.99'E	15.0	
EMB314_7-1	TF0014	CTD	15.03.2023 22:07	54° 35.67'N	011° 00.90'E	25.0	eDNA
EMB314_8-1	TF0013	CTD	16.03.2023 00:39	54° 28.29'N	011° 29.06'E	24.0	
EMB314_9-1	TF0022	CTD	16.03.2023 03:41	54° 06.63'N	011° 10.53'E	20.0	N
EMB314_10-1	TF0012	CTD	16.03.2023 06:03	54° 18.86'N	011° 33.00'E	22.0	eDNA, N
EMB314_10-2	TF0012	SD	16.03.2023 06:05	54° 18.85'N	011° 33.01'E	22.0	
EMB314_10-3	TF0012	PLA	16.03.2023 06:06	54° 18.85'N	011° 33.01'E	22.0	
EMB314_10-4	TF0012	WP2	16.03.2023 06:24	54° 18.87'N	011° 32.99'E	22.0	
EMB314_10-5	TF0012	WP2	16.03.2023 06:31	54° 18.88'N	011° 32.99'E	22.0	
EMB314_10-6	TF0012	CTD	16.03.2023 06:42	54° 18.90'N	011° 33.00'E	22.0	
EMB314_11-1	TF0018	CTD	16.03.2023 11:30	54° 11.02'N	011° 46.02'E	18.0	eDNA, N
EMB314_12-1	TF0041	CTD	16.03.2023 13:46	54° 24.42'N	012° 03.79'E	16.0	eDNA, N
EMB314_13-1	TF0046	CTD	16.03.2023 15:00	54° 28.20'N	012° 14.50'E	26.0	eDNA, N
EMB314_13-2	TF0046	SD	16.03.2023 15:01	54° 28.20'N	012° 14.51'E	26.0	
EMB314_13-3	TF0046	PLA	16.03.2023 15:03	54° 28.21'N	012° 14.51'E	26.0	
EMB314_13-4	TF0046	WP2	16.03.2023 15:19	54° 28.22'N	012° 14.52'E	26.0	
EMB314_14-1	TF0083	CTD	16.03.2023 16:37	54° 32.99'N	012° 16.50'E	23.0	eDNA
EMB314_15-1	TF0002	CTD	16.03.2023 17:57	54° 39.00'N	012° 26.93'E	15.0	eDNA, N
EMB314_16-1	TF0001	CTD	16.03.2023 19:28	54° 41.77'N	012° 41.89'E	19.0	N
EMB314_17-1	TF0030	PLA	16.03.2023 20:14	54° 43.40'N	012° 47.01'E	20.0	
EMB314_17-2	TF0030	CTD	16.03.2023 20:16	54° 43.39'N	012° 47.00'E	20.0	eDNA, N
EMB314_17-3	TF0030	CTD	16.03.2023 20:45	54° 43.40'N	012° 46.99'E	20.0	
EMB314_18-1	TF0115	CTD	16.03.2023 22:20	54° 47.70'N	013° 03.44'E	28.0	eDNA, N
EMB314_19-1	TF0114	CTD	16.03.2023 23:57	54° 51.61'N	013° 16.51'E	44.0	N
EMB314_20-1	TF0160	CTD	17.03.2023 14:13	54° 14.42'N	014° 04.12'E	11.0	N
EMB314_21-1	OBBoje	CTD	17.03.2023 15:54	54° 04.61'N	014° 09.31'E	12.0	N
EMB314_22-1	TF0152	CTD	17.03.2023 19:50	54° 38.02'N	014° 16.98'E	29.0	N
EMB314_23-1	TF0112	CTD	17.03.2023 21:50	54° 48.22'N	013° 57.49'E	38.0	eDNA, N
EMB314_23-2	TF0112	CTD	17.03.2023 22:13	54° 48.20'N	013° 57.50'E	39.0	
EMB314_24-1	ABBoje	CTD	17.03.2023 23:10	54° 52.76'N	013° 51.53'E	44.0	N
EMB314_25-1	TF0122	CTD	18.03.2023 00:28	54° 59.37'N	013° 46.30'E	45.0	
EMB314_26-1	TF0113	CTD	18.03.2023 02:01	54° 55.53'N	013° 30.05'E	45.0	N, TG
EMB314_26-2	TF0113	PLA	18.03.2023 02:02	54° 55.53'N	013° 30.05'E	46.0	
EMB314_26-3	TF0113	WP2	18.03.2023 02:29	54° 55.51'N	013° 30.04'E	45.0	
EMB314_27-1	TF0105	CTD	18.03.2023 03:46	55° 01.49'N	013° 36.33'E	44.0	N
EMB314_28-1	TF0104	CTD	18.03.2023 05:04	55° 04.13'N	013° 48.73'E	44.0	N
EMB314_29-1	TF0103	CTD	18.03.2023 06:08	55° 03.82'N	013° 59.27'E	45.0	N
EMB314_30-1	TF0109	CTD	18.03.2023 07:04	55° 00.00'N	014° 05.00'E	46.0	N
EMB314_30-2	TF0109	PLA	18.03.2023 07:04	55° 00.00'N	014° 05.01'E	46.0	
EMB314_30-3	TF0109	WP2	18.03.2023 07:27	54° 59.99'N	014° 05.01'E	46.0	
EMB314_30-4	TF0109	WP2	18.03.2023 07:35	55° 00.00'N	014° 05.01'E	46.0	
EMB314_31-1	TF0145	CTD	18.03.2023 09:11	55° 10.02'N	014° 14.97'E	45.0	N
EMB314_32-1	TF0144	CTD	18.03.2023 10:42	55° 15.41'N	014° 29.45'E	43.0	
EMB314_33-1	TF0142	CTD	18.03.2023 12:09	55° 22.73'N	014° 35.01'E	64.0	N
EMB314_34-1	TF0140	CTD	18.03.2023 13:22	55° 28.04'N	014° 43.08'E	69.0	N
EMB314_35-1	TF0206	CTD	18.03.2023 14:41	55° 32.00'N	014° 54.88'E	76.0	
EMB314_36-1	TF0207	CTD	18.03.2023 15:51	55° 29.74'N	015° 05.58'E	85.0	
EMB314_37-1	TF0208	CTD	18.03.2023 16:55	55° 27.22'N	015° 14.03'E	92.0	
EMB314_38-1	TF0200	CTD	18.03.2023 17:56	55° 23.04'N	015° 19.99'E	91.0	N
EMB314_39-1	TF0209	CTD	18.03.2023 18:56	55° 20.82'N	015° 28.06'E	93.0	
EMB314_40-1	TF0211	CTD	18.03.2023 20:01	55° 19.81'N	015° 36.85'E	95.0	N

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB314_41-1	TF0214	CTD	18.03.2023 21:35	55° 09.61'N	015° 39.60'E	94.0	
EMB314_42-1	TF0212	CTD	18.03.2023 23:03	55° 18.10'N	015° 47.81'E	95.0	
EMB314_43-1	TF0213	CTD	19.03.2023 00:29	55° 15.04'N	015° 59.05'E	89.0	N
EMB314_43-2	TF0213	PLA	19.03.2023 00:30	55° 15.04'N	015° 59.05'E	89.0	
EMB314_43-3	TF0213	WP2	19.03.2023 01:00	55° 15.02'N	015° 59.04'E	89.0	
EMB314_43-4	TF0213	WP2	19.03.2023 01:13	55° 15.01'N	015° 59.03'E	89.0	
EMB314_43-5	TF0213	WP2	19.03.2023 01:22	55° 15.00'N	015° 59.03'E	89.0	
EMB314_43-6	TF0213	WP2	19.03.2023 01:31	55° 15.00'N	015° 59.02'E	89.0	
EMB314_43-7	TF0213	CTD	19.03.2023 01:55	55° 15.00'N	015° 59.01'E	90.0	TG
EMB314_43-8	TF0213	APNET	19.03.2023 02:17	55° 15.00'N	015° 59.00'E	89.0	
EMB314_43-9	TF0213	APNET	19.03.2023 02:38	55° 15.01'N	015° 59.00'E	90.0	
EMB314_43-10	TF0213	APNET	19.03.2023 03:03	55° 15.00'N	015° 58.97'E	90.0	
EMB314_44-1	TF0221	CTD	19.03.2023 04:15	55° 13.29'N	016° 09.97'E	82.0	
EMB314_45-1	TF0225	CTD	19.03.2023 05:18	55° 15.50'N	016° 19.24'E	65.0	
EMB314_46-1	TF0226	CTD	19.03.2023 06:07	55° 17.78'N	016° 25.83'E	57.0	
EMB314_47-1	TF0224	CTD	19.03.2023 06:43	55° 16.99'N	016° 29.98'E	61.0	
EMB314_48-1	TF0227	CTD	19.03.2023 07:38	55° 15.70'N	016° 38.34'E	67.0	
EMB314_49-1	TF0228	CTD	19.03.2023 08:29	55° 14.26'N	016° 46.38'E	76.0	
EMB314_50-1	TF0229	CTD	19.03.2023 09:27	55° 13.71'N	016° 54.89'E	85.0	
EMB314_51-1	TF0222	CTD	19.03.2023 10:22	55° 12.99'N	017° 03.98'E	91.0	N
EMB314_52-1	TF0266	CTD	19.03.2023 11:56	55° 15.13'N	017° 21.51'E	89.0	
EMB314_53-1	TF0267	CTD	19.03.2023 13:20	55° 17.17'N	017° 35.61'E	84.0	
EMB314_54-1	TF0268	CTD	19.03.2023 15:00	55° 18.46'N	017° 55.74'E	73.0	
EMB314_55-1	TF0256	CTD	19.03.2023 16:34	55° 19.57'N	018° 14.03'E	76.0	
EMB314_56-1	TF0257	CTD	19.03.2023 17:49	55° 26.44'N	018° 19.22'E	87.0	
EMB314_57-1	TF0259	CTD	19.03.2023 18:58	55° 32.99'N	018° 23.98'E	90.0	N, HS
EMB314_57-2	TF0259	PLA	19.03.2023 19:02	55° 33.00'N	018° 24.00'E	90.0	
EMB314_58-1	TF0255	CTD	19.03.2023 20:20	55° 37.98'N	018° 35.96'E	95.0	
EMB314_59-1	TF0258	CTD	19.03.2023 21:33	55° 43.63'N	018° 45.92'E	93.0	
EMB314_60-1	TF0253	CTD	19.03.2023 22:42	55° 50.39'N	018° 51.99'E	102.0	
EMB314_61-1	TF0265	CTD	20.03.2023 00:12	55° 57.54'N	019° 02.81'E	112.0	
EMB314_62-1	TF0250	CTD	20.03.2023 01:34	56° 05.00'N	019° 10.02'E	124.0	
EMB314_63-1	TF0262	CTD	20.03.2023 03:08	56° 14.06'N	019° 18.07'E	133.0	
EMB314_64-1	TF0263	CTD	20.03.2023 04:27	56° 20.85'N	019° 22.68'E	135.0	
EMB314_65-1	TF0261	CTD	20.03.2023 05:57	56° 29.50'N	019° 28.90'E	144.0	
EMB314_66-1	TF0260	CTD	20.03.2023 07:25	56° 38.00'N	019° 35.06'E	145.0	N, HS
EMB314_67-1	TF0274	CTD	20.03.2023 09:03	56° 46.07'N	019° 45.14'E	155.0	
EMB314_68-1	TF0272	CTD	20.03.2023 11:33	57° 04.30'N	019° 49.82'E	210.0	moor, HS
EMB314_69-1	MoorGOSW	MOOR	20.03.2023 12:40	57° 04.61'N	019° 45.27'E	217.0	moor
EMB314_69-2	MoorGOSW	MOOR	20.03.2023 13:33	57° 04.53'N	019° 45.14'E	217.0	
EMB314_69-3	MoorGOSW	CTD	20.03.2023 13:48	57° 04.49'N	019° 45.05'E	217.0	
EMB314_70-1	TF0403	CTD	20.03.2023 17:03	57° 04.39'N	019° 01.50'E	115.0	
EMB314_71-1	TF0404	CTD	20.03.2023 18:18	57° 01.73'N	019° 13.30'E	163.0	
EMB314_72-1	TF0405	CTD	20.03.2023 19:22	57° 00.52'N	019° 21.32'E	179.0	
EMB314_73-1	TF0406	CTD	20.03.2023 20:43	56° 58.80'N	019° 34.65'E	169.0	
EMB314_74-1	TF0273	CTD	20.03.2023 21:56	56° 57.05'N	019° 46.24'E	185.0	
EMB314_75-1	TF0407	CTD	20.03.2023 22:57	56° 56.99'N	019° 53.05'E	179.0	
EMB314_76-1	TF0408	CTD	21.03.2023 00:11	56° 55.36'N	020° 01.10'E	166.0	
EMB314_77-1	TF0409	CTD	21.03.2023 01:30	56° 54.30'N	020° 13.01'E	147.0	
EMB314_78-1	TF0410	CTD	21.03.2023 02:52	56° 51.98'N	020° 27.32'E	60.0	
EMB314_79-1	TF0411	CTD	21.03.2023 04:07	56° 50.28'N	020° 40.93'E	55.0	
EMB314_80-1	MoorGONE	MOOR	21.03.2023 08:31	57° 21.89'N	020° 20.59'E	219.0	moor

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	IOW		[UTC]			[m]	
EMB314_80-2	MoorGONE	MOOR	21.03.2023 09:16	57° 22.01'N	020° 20.49'E	220.0	moor
EMB314_80-3	MoorGONE	CTD	21.03.2023 09:33	57° 22.08'N	020° 20.44'E	220.0	
EMB314_81-1	TF0275	CTD	21.03.2023 12:01	57° 12.61'N	019° 55.82'E	231.0	
EMB314_82-1	TF0271	CTD	21.03.2023 13:34	57° 19.21'N	020° 03.05'E	243.0	N, HS, TG
EMB314_82-2	TF0271	PLA	21.03.2023 13:34	57° 19.21'N	020° 03.06'E	243.0	
EMB314_82-3	TF0271	SD	21.03.2023 14:00	57° 19.22'N	020° 03.01'E	243.0	
EMB314_82-4	TF0271	SD	21.03.2023 14:08	57° 19.21'N	020° 03.00'E	242.0	
EMB314_82-5	TF0271	CTD	21.03.2023 14:37	57° 19.24'N	020° 02.97'E	243.0	
EMB314_82-6	TF0271	CTD	21.03.2023 15:35	57° 19.22'N	020° 03.01'E	242.0	
EMB314_82-7	TF0271	CTD	21.03.2023 16:23	57° 19.17'N	020° 02.97'E	243.0	
EMB314_82-8	TF0271	CTD	21.03.2023 17:16	57° 19.20'N	020° 02.95'E	241.0	
EMB314_82-9	TF0271	CTD	21.03.2023 17:35	57° 19.18'N	020° 02.96'E	243.0	
EMB314_83-1	TF0276	CTD	21.03.2023 19:40	57° 28.20'N	020° 15.66'E	209.0	
EMB314_84-1	TF0270	CTD	21.03.2023 21:16	57° 37.03'N	020° 10.04'E	145.0	HS
EMB314_85-1	TF0287	CTD	21.03.2023 23:06	57° 42.91'N	019° 51.26'E	129.0	
EMB314_86-1	TF0290	CTD	22.03.2023 00:32	57° 51.01'N	019° 49.11'E	170.0	
EMB314_87-1	TF0286	CTD	22.03.2023 02:03	58° 00.04'N	019° 54.06'E	196.0	N, HS, TG
EMB314_87-2	TF0286	CTD	22.03.2023 03:10	58° 00.00'N	019° 53.99'E	196.0	
EMB314_88-1	TF0277	CTD	22.03.2023 04:50	58° 11.03'N	020° 03.08'E	163.0	
EMB314_89-1	CAB_M03	MOOR	22.03.2023 07:08	58° 24.86'N	019° 52.64'E	118.0	moor
EMB314_89-2	CAB_M03	CTD	22.03.2023 08:43	58° 24.50'N	019° 52.30'E	121.0	
EMB314_90-1	CAB_M04	MOOR	22.03.2023 09:54	58° 24.81'N	020° 03.06'E	117.0	moor
EMB314_90-2	CAB_M04	CTD	22.03.2023 10:31	58° 24.72'N	020° 02.98'E	117.0	
EMB314_91-1	TF0285	CTD	22.03.2023 12:02	58° 26.53'N	020° 20.05'E	124.0	HS
EMB314_92-1	TF0278	CTD	22.03.2023 13:46	58° 21.01'N	020° 08.80'E	122.0	
EMB314_93-1	TF0279	CTD	23.03.2023 08:08	58° 38.51'N	020° 20.71'E	166.0	
EMB314_94-1	TF0289	CTD	23.03.2023 09:30	58° 46.04'N	020° 19.80'E	203.0	
EMB314_95-1	TF0282	CTD	23.03.2023 10:52	58° 52.99'N	020° 19.04'E	168.0	HS
EMB314_96-1	TF0288	CTD	23.03.2023 12:23	58° 59.83'N	020° 09.65'E	145.0	
EMB314_97-1	nGB-2	CTD	23.03.2023 14:42	58° 51.94'N	019° 44.68'E	162.0	
EMB314_98-1	TF0283	CTD	23.03.2023 17:31	58° 47.04'N	019° 06.03'E	119.0	HS
EMB314_99-1	nGB-1	CTD	23.03.2023 19:34	58° 42.79'N	018° 40.15'E	241.0	
EMB314_100-1	TF0284	CTD	23.03.2023 22:15	58° 35.00'N	018° 14.05'E	453.0	N, HS
EMB314_100-2	TF0284	CTD	23.03.2023 23:31	58° 35.01'N	018° 13.99'E	456.0	
EMB314_100-3	TF0284	CTD	24.03.2023 00:15	58° 35.03'N	018° 13.99'E	456.0	
EMB314_100-4	TF0284	CTD	24.03.2023 00:44	58° 35.01'N	018° 13.99'E	455.0	
EMB314_101-1	wGM-3	CTD	24.03.2023 04:15	58° 19.56'N	018° 04.13'E	153.0	
EMB314_102-1	TF0240	CTD	24.03.2023 07:11	58° 00.03'N	018° 00.06'E	168.0	N, HS
EMB314_103-1	TF0242	CTD	24.03.2023 10:52	57° 43.03'N	017° 21.96'E	141.0	
EMB314_104-1	TF0245	CTD	25.03.2023 07:13	57° 07.00'N	017° 40.01'E	111.0	N, HS
EMB314_105-1	SF025WGB	CTD	25.03.2023 09:04	57° 09.79'N	017° 19.49'E	68.0	
EMB314_106-1	SF025WGB	SCF	25.03.2023 09:52	57° 09.00'N	017° 25.33'E	71.0	
EMB314_107-1	TF0213	CTD	26.03.2023 06:10	55° 15.01'N	015° 59.05'E	90.0	N
EMB314_107-2	TF0213	PLA	26.03.2023 06:11	55° 15.01'N	015° 59.04'E	90.0	
EMB314_107-3	TF0213	WP2	26.03.2023 06:35	55° 14.99'N	015° 58.98'E	90.0	
EMB314_107-4	TF0213	WP2	26.03.2023 06:47	55° 15.00'N	015° 59.01'E	90.0	
EMB314_107-5	TF0213	WP2	26.03.2023 07:00	55° 14.99'N	015° 59.00'E	89.0	
EMB314_107-6	TF0213	WP2	26.03.2023 07:09	55° 14.99'N	015° 58.99'E	90.0	
EMB314_107-7	TF0213	APNET	26.03.2023 07:28	55° 14.98'N	015° 58.99'E	90.0	
EMB314_107-8	TF0213	APNET	26.03.2023 07:48	55° 14.98'N	015° 59.02'E	90.0	
EMB314_107-9	TF0213	APNET	26.03.2023 08:08	55° 14.98'N	015° 58.98'E	90.0	
EMB314_108-1	TF0214	CTD	26.03.2023 09:55	55° 09.61'N	015° 39.67'E	94.0	

Station No.	Station name	Gear	Date/Time	Latitude	Longitude	Water Depth	Remarks
EMB	**IOW**		**[UTC]**			**[m]**	
EMB314_109-1	TF0215	CTD	26.03.2023 11:42	54° 59.98'N	015° 30.03'E	76.0	
EMB314_110-1	TF0204	CTD	26.03.2023 13:28	54° 50.71'N	015° 22.57'E	69.0	
EMB314_111-1	TF0150	CTD	26.03.2023 18:44	54° 36.68'N	014° 02.63'E	19.0	
EMB314_112-1	TF0113	CTD	26.03.2023 22:54	54° 55.50'N	013° 30.01'E	46.0	
EMB314_112-2	TF0113	PLA	26.03.2023 22:56	54° 55.50'N	013° 30.02'E	46.0	
EMB314_112-3	TF0113	WP2	26.03.2023 23:24	54° 55.50'N	013° 29.97'E	46.0	
EMB314_113-1	TF0030	CTD	27.03.2023 03:30	54° 43.36'N	012° 47.04'E	21.0	
EMB314_113-2	TF0030	PLA	27.03.2023 03:31	54° 43.37'N	012° 47.03'E	21.0	
EMB314_114-1	TF0046	CTD	27.03.2023 06:40	54° 28.21'N	012° 14.50'E	26.0	
EMB314_114-2	TF0046	PLA	27.03.2023 06:41	54° 28.21'N	012° 14.50'E	26.0	
EMB314_114-3	TF0046	WP2	27.03.2023 07:03	54° 28.21'N	012° 14.48'E	26.0	
EMB314_115-1	TF0011	CTD	27.03.2023 10:02	54° 24.81'N	011° 37.03'E	23.0	
EMB314_116-2	TF0012	PLA	27.03.2023 11:08	54° 18.91'N	011° 33.00'E	22.0	
EMB314_116-1	TF0012	CTD	27.03.2023 11:11	54° 18.92'N	011° 32.97'E	22.0	
EMB314_116-3	TF0012	SD	27.03.2023 11:20	54° 18.87'N	011° 32.93'E	22.0	
EMB314_116-4	TF0012	WP2	27.03.2023 11:32	54° 18.87'N	011° 32.89'E	22.0	
EMB314_116-5	TF0012	WP2	27.03.2023 11:39	54° 18.89'N	011° 32.95'E	22.0	
EMB314_117-1	TF0020	CTD	27.03.2023 12:55	54° 11.26'N	011° 27.78'E	21.0	
EMB314_118-1	TF0021	CTD	27.03.2023 14:00	54° 09.29'N	011° 17.67'E	22.0	
EMB314_119-1	TF0022	CTD	27.03.2023 14:50	54° 06.60'N	011° 10.52'E	21.0	
EMB314_120-1	TF0023	CTD	27.03.2023 15:44	54° 03.45'N	011° 03.30'E	21.0	

7.2 ScanFish Deployment List

Table 7.2 List of ScanFish deployments during the cruise EMB314

Deployment		time	Latitude	Longitude	Depth	Remarks
EMB		**[UTC]**	**[UTC]**	**No.**	**[m]**	
EMB314_106-1	begin	25.03.2023 11:21:00	57°08.614'N	17°28.130'E	82	WGB transect
	end	25.03.2023 15:15:00	57°02.904'N	18°07.869'E	11	max depth 95m

7.3 Mooring Deployment List

Table 7.3 List of mooring deployments during the cruise EMB314

Name	Latitude	Longitude	Deployed	Recovered	Depth	Remarks
			[UTC]	**[UTC]**	**[m]**	
GOSW_05	57°04.565‘N	19°45.259E	*10.11.2022 13:37*	20.03.2023 12:56	217	Spare release was successful, All devices recovered
GOSW_06	57°04.514‘N	19°45.106‘E	20.03.2023 13:42	*Nov 2023*	217	No ground rope
GONE_42	57°22.028‘N	20°20.490‘E	*08.05.2022 12:04*	21.03.2022 09:00	210	Main release was successful, All devices recovered
GONE_43	57°22.057‘N	20°20.495‘E	21.03.2022 09:23	*Nov 2023*	219	No ground rope
CABLE_M3	58°24.727’N	19°52.561’E	*09.05.2022 15:55*	22.03.2023 08:26	120	Dredged with ground rope, All devices recovered
CABLE_M4	58°24.743’N	20°02.873’E	*09.05.2022 14:30*	22.03.2023 10:06	118	Release was successful, All devices recovered

8 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 8.1 Overview of data availability

Type	Database	Available	Free Access	Contact
Hydrographic data	ODIN	01.06.2023	01.04.2025	volker.mohrholz@io-warnemuende.de
Nutrient samples	ODIN	01.06.2023	01.04.2026	joachim.kuss@io-warnemuende.de
Biological samples	ODIN	01.10.2023	01.04.2026	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).

9 Acknowledgements

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10 References

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11 Appendix

11.1 Station Labels

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 EMB314 the first station number is EMB314_1.

11.2 CTD-operation

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
- Nitrate concentration (SUNA, OPUS)
- 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 11.1 Type and serial numbers of mounted CTD sensors

Sensor	Type	SN	Last calibration
Pressure	Digiquartz	1385	02.05.2019
Temperature 0	SBE 3	5292	22.11.2022
Temperature 1	SBE 3	4451	22.11.2022
Conductivity 0	SBE 4	2936	14.11.2022
Conductivity 1	SBE 4	4007	22.11.2022
Oxygen 0	SBE 43	1732	21.01.2022

Oxygen 1	SBE 43	1733	02.02.2023
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	2029	28.09.2010
PAR sensor	Biospherical Licor Chelsea	70256	08.12.2009
SPAR	SPAR/Surface Irradiance	6307	27.02.2017
SUNA	SBE		

11.3 VMADCP 300kHz

Since the ships own vessel mounted current meter was actually not operational an 300kHz Acoustic Doppler Current Profiler (VMADCP) (Work Horse, beam angle 20deg), manufactured by RD-Instruments, was mounted downward looking at the ships moon pool. 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 11.2 Configuration of 150kHz VMADCP

Command	Parameter	Western Baltic	Central Baltic
WP	Broad band pings	1 ping/ens	1 ping/ens
WN	number of depth cells	120	80
WS	bin length	1m	2m
WF	blank after transmit	2m	2m
WV	Ambigiuity velocity	6.5m/s	6.5m/s
BP	bottom track	1 ping/ens	1 ping/ens
BX	max bottom distance	300m	260m
WD	data output	u, corr, amp, PG	u, corr, amp, PG
TP	time between pings	0	0
EZ	sensor source	temp	temp
EX	co-ordinates (ENX)	beam	beam
ED	transducer depth	4m	4m
ES	salinity	10	10
Data option dialog of VMDAS software	heading source	Ext. Gyro	Ext. Gyro
	pitch / roll source	Ext. Phins	Ext. Phins
	navigation source	Ext. GPS	Ext. GPS
	time per ensemble	2s	2s
	time between pings	1s	1s
	heading alignment	0 deg	0 deg
	heading bias	0 deg	0 deg
	short term average	60s	60s
	long term average	300s	300s
	data screening	off	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.

11.4 ScanFish Towed CTD

A resolution hydrographic transect with the ScanFish towed CTD (SF) was performed in 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 11.3. 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 11.3 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	1456	20.06.2022
Conductivity 0	SBE 4	1349	27.10.2021
Oxygen 0	SBE 43	1474	14.09.2022
Chl-a fluorescence / Turbidity	WET Labs - FLNTURTD	3274	10.06.2009

11.5 Underway Measurements

The RV 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