

ELISABETH MANN BORGESSE-Berichte

Hydrochemical and biological monitoring of the Baltic Sea in the framework of the EU's marine strategy directive (MSFD) and the Baltic Monitoring Programme (BMP) of HELCOM

Cruise No. EMB346

06.08.2024 – 20.08.2024,
Rostock (Germany) – Rostock (Germany)
BMP



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2024

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1 Cruise Summary

1.1 Summary in English

The monitoring is carried out in the framework of the COMBINE Program of the Helsinki Commission (HELCOM), of the Bund-Länder-Messprogramm (BLANO) and of the long-term data program of the IOW. A series of regular short-term cruises are conducted by the Leibniz Institute for Baltic Sea Research (IOW) that serve to monitor the hydrographic, chemical and biological situation in the western, central and northern Baltic Sea. The results provide the scientific basis at the assessment of the environmental state of the Baltic Sea and for the understanding of climatic and anthropogenic forcing of environmental changes.

The cruise in August investigates the summer conditions, especially regarding the extent of cyanobacteria blooms. During the expedition, research was conducted at 113 stations from the western Baltic Sea to the northern Baltic Sea via the major Basins. Despite the interruption of the station work due to bad weather conditions, the full planned program was achieved. At selected stations, nutrient concentrations and various biological parameters describing the phyto- and zooplankton taxonomic composition and abundance were determined. The results show that the surface water temperature was very warm and above the long-term average. The salinity distribution was typical with higher values in the bottom water of the western Baltic Sea. A small inflow of warm water was recorded in the western Bornholm Basin. Additional samples were taken for UV-filter substances, eDNA bioarchives and for the determination of radionuclides.

1.2 Zusammenfassung

Die Reise EMB346 erfolgte im Rahmen des COMBINE Programms der Helsinki Kommission (HELCOM), des Bund-Länder-Messprogrammes Nord- und Ostsee (BLANO) und des Langzeitprogramms des Leibniz Institut für Ostseeforschung in der zentralen Ostsee. Sie ist Teil von fünf jährlich durchgeführten Fahrten und beschreibt die hydrographische, chemische und biologische Situation in der westlichen, zentralen und nördlichen Ostsee. Die Daten bilden die Basis zur Erforschung des langzeitlichen Einflusses von Klimaveränderung und anthropogener Aktivität auf die Ökosystemdynamik und den Umweltzustand der Ostsee.

Die Beprobung erfolgte auf insgesamt 113 Stationen entlang eines Schnittes von der Kieler Bucht in die zentrale und nördliche Ostsee und diente der Erfassung der Situation während der Sommermonate mit besonderer Berücksichtigung von Cyanobakterien-Blüten. An ausgewählten Stationen wurden daher Proben zur Nährstoffverfügbarkeit und zur Beschreibung der Zusammensetzung und Abundanz der pelagischen Gemeinschaften (Phyto- und Zooplankton) gewonnen. Trotz einiger Unterbrechung der Arbeit aufgrund schlechter Wetterbedingungen konnte das volle Fahrtprogramm absolviert werden. Erste Ergebnisse weisen auf eine Stagnationsphase hin. Kleine, warme Einströme wurden im Bornholmbecken und dem südlichen Gotlandbecken beobachtet, die jedoch keinen Einfluss auf die Bedingungen im Tiefenwasser hatten. Das Oberflächenwasser war außergewöhnlich warm. Neben dem regulären Programm wurden Proben zur Bestimmung von UV-Filtersubstanzen oder Radionukliden gewonnen und die im Frühjahr begonnen Arbeiten zur Erstellung eines eDNA Bioarchives fortgesetzt.

2 Participants

2.1 Principal Investigators

Name	Institution
Dutz, Jörg, Dr.	IOW
Mohrholz, Volker, Dr.	IOW
Kuss, Joachim, Dr.	IOW
Kanwischer, Marion,, Dr.	IOW
Welsch, Norma, Dr.	UGW
Schmied, Stefanie A.K., Dr.	BSH

2.2 Scientific Party

Name	Discipline	Institution
Dutz, Jörg, Dr.	Biol. Oceanography / Chief Scientist	IOW
Faber, Jens, Dr.	Phys. Oceanography / Scientist	IOW
Müller, Jann	Chem. Oceanography / PhD student	IOW
Renzelmann, Henri	Phys. Oceanography / Student	IOW
Kreuzer, Lars	Chem. Oceanography / Technician	IOW
Burmeister, Christian	Biol. Oceanography / Technician	IOW
Jakobs, Manuel	Chem. Oceanography / Intern	IOW
Köhn, Josef	Phys. Oceanography / Technician	IOW
Sakpal, Harshada	Chem. Oceanography / PhD student	IOW
Torres, Laura	Biol. Oceanography / PhD student	UGW
Merz, Jonathan	Biol. Oceanography / Student	UGW
Klostermann, Birgit	Chem. Oceanography / PhD student	IOW

2.3 Participating Institutions

IOW	Leibniz Institute for Baltic Sea Research Warnemünde
UGW	University of Greifswald
BSH	Bundesamt für Seeschifffahrt und Hydrographie (BSH)

3 Research Program

3.1 Description of the Work Area

The area under investigation of the cruise EMB346 covered the western and the central Baltic from the Kiel Bight to the northern Gotland Basin. The majority of stations were located along a transect that aims at describing the hydrographic conditions in all basins on the pathway of saltwater inflows from the North Atlantic and the change in biodiversity associated with the gradient in salinity from mesohaline to oligohaline surface water (Hernroth & Ackefors 1979). The deep inflows are the solely source for ventilation of the deep basins (Matthäus et al. 2008).

3.2 Aims of the Cruise

The cruise contributes to the international environmental monitoring program of the Helsinki Commission (HELCOM) carried out by the Leibniz-Institute for Baltic Sea Research in Warnemünde (IOW). Within the German Exclusive Economic Zone (EEZ), monitoring is conducted on behalf of the Federal Maritime and Hydrographic Agency (BSH). In the central Baltic Proper, long-term data is collected by the Leibniz Institute for Baltic Sea Research Warnemünde (IOW). The monitoring program was initiated in 1979 and run by the IOW's predecessor institute and is continued by the IOW since 1992 in the framework of the COMBINE Program of the Helsinki Commission (HELCOM). The acquired data will be used for the regular national and international assessments of the state of the Baltic Sea (e.g. HELCOM 2018) and the assessment of long-term trends in the hydrographical and biological data.

The summer cruise is of particular scientific interest for the study of the distribution, abundance and impact of cyanobacteria blooms in the western and the central Baltic Sea. With regard to eutrophication effects and the impact of climatic change on the pelagic ecosystem, their effect in combination with the expected annual temperature maximum and potential heatwaves as further stressors of the dynamics and production of the heterotrophic zooplankton compartment is of particular interest.

Additional program:

- In the framework of the Create Project, sampling for the establishment of an eDNA Bioarchive and for proteomic investigations were conducted (responsible scientist: Dr. Norma Welsch, UGW, Prof. M. Labrenz, IOW)
- Sampling for the identification of accumulation areas for UV-filter substances (Dr. M. Kanwischer, IOW)
- On various stations, a new system for the measurement of seawater alkalinity was tested (Prof. G. Rehder, IOW)
- Samples for the determination of radionuclides were taken on behalf of the BSH (Dr. S. Schmied, BSH)
- In the framework of the Interreg Project EMPEREST, sampling for per- and polyfluoride Alkyl-substances (PFAS) in the water of the western Baltic Sea was conducted (Dr. M. Kanwischer, IOW)
- For the analysis of the long-term changes in the population dynamics of key copepod species in the Bornholm Basin, zooplankton nets (Apstein, mesh size 50 μm , WP-2 mesh size 100 μm) were deployed to quantitatively sample nauplii and copepodites (responsible scientist Dr. J. Dutz, IOW).

3.3 Agenda of the Cruise

The cruise had various foci and goals. First, the work enclosed the environmental monitoring program in the western Baltic Sea (Kiel Bight-Arkona Basin, Fig. 3.1, map 1). The second focus was the IOW's Baltic Sea long term observation program in the central Baltic Sea (Fig. 3.1, map 2), that included sampling along the Thalweg-stations. Finally, high-resolution observations of the hydrographic situation perpendicular to the Thalweg-transect were done in the eastern and the western Gotland Sea. Data acquisition was carried out using the following devices and measuring platforms. At stations and transects the CTD SBE 911+ with rosette water sampler

(CTD), the towed ScanFish (SCF), Secchi disk, phytoplankton- and zooplankton nets were deployed. In addition, continuous underway measurements of the surface water properties and seawater pH were done. An overview of the sampled stations is provided in Fig. 3.1 and Table 7.1. Responsible marine research conducted regarding sampling and use of biological material. Pelagic sampling limited to the needs for analyses and experiments. Nets were carefully rinsed with freshwater in between net hauls to avoid transfer of organisms to non-native areas.

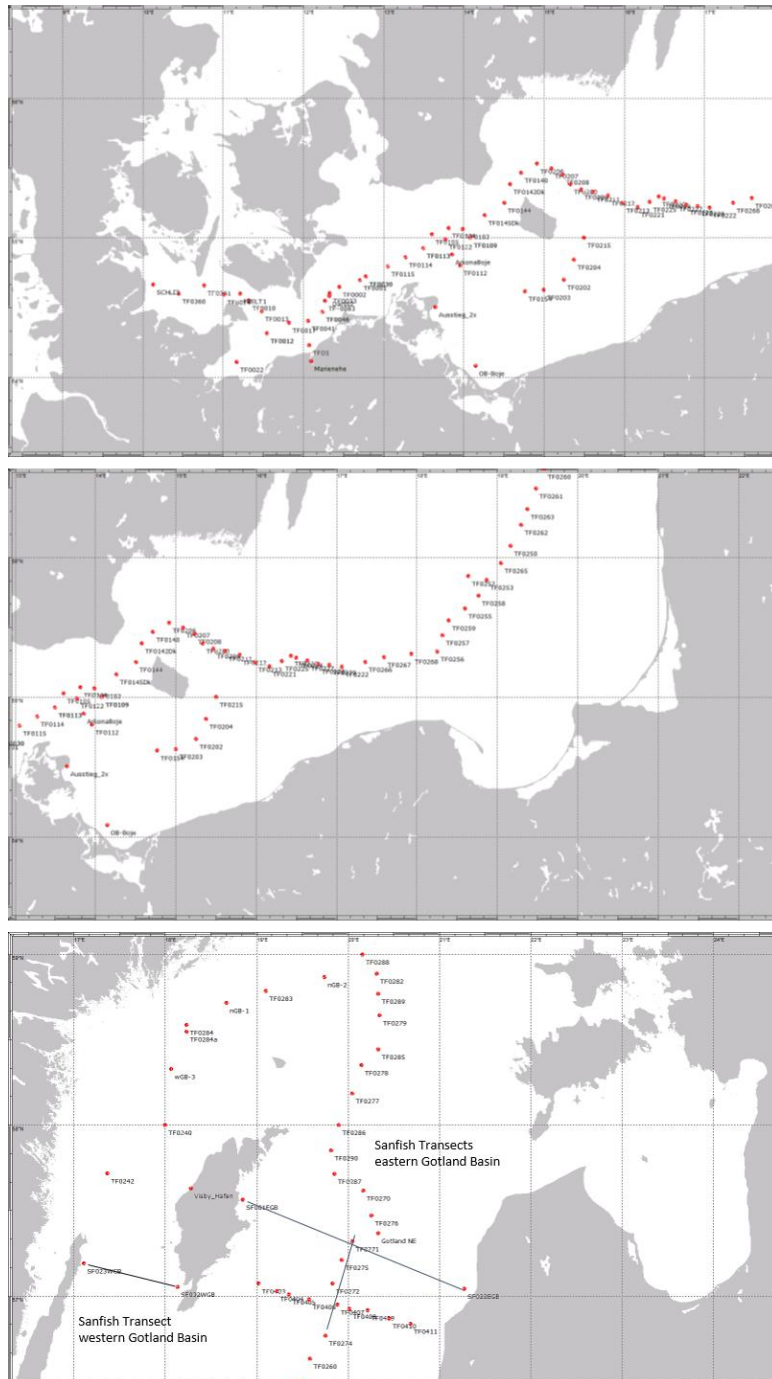


Fig. 3.1 Track chart of R/V ELISABETH MANN BORGESE Cruise 346. Upper panel: stations in the western Baltic Sea including the Kiel Bight, the Bay of Mecklenburg and the Arkona Basin, mid panel: stations in the southeastern Baltic Sea including the Bornholm Basin and the southern Gotland Basin, lower panel: stations in the northeastern Baltic Sea including then northern Gotland Basin.

4 Narrative of the Cruise

The preparation for the cruise EMB346 started with the loading of the equipment and the installation of sampling devices during the 5th of August from 07:30 to 19:00. Four scientist spend the night on board EMB. The rest of the scientific crew was embarking in the morning of the 6th of August at 07:30. Following the safety instructions, RV ELISABETH MANN BORGESE left the harbor at 09:00 in the morning at sunny, calm and already very warm weather (wind 2.7 m/s E, air temperature 20.1°C, pressure 1014.3 hPa). Shortly after the ship passed by Warnemünde, the first station was reached (TF05, 10:00). Here, the CTD was successfully tested and water samples for the analyses of eDNA, proteomics and the identification of chemical UV-filter enrichment areas were taken. Large patches of cyanobacteria were visible on the surface.

After a short tribute horn blow at the sea funeral of a former colleague of the IOW, EMB started to sail direction Fehmarn Belt and Kiel Bight where the next stations were located. In between two CTD casts at TF0010 and TF0361, the ship had a short stop in the Fehmarn Belt (FBELT 1) to take samples for the measurement of radionuclides at station. In the early evening, hydrographical and chemical conditions were determined at station TF0360 in the Kiel Bight. Additional samples were taken for the analysis of the phyto- and zooplankton composition later in the laboratory. In the evening, RV ELISABETH MANN BORGESE sailed further westwards for another radionuclide sample (station SCHLEI). Then, we turned eastwards where the hydrographical measurements continued along the ‘Thalweg’ into the Bay of Mecklenburg during the night (TF0014, TF0013). During the first day, weather was sunny with air temperatures above 20 °C, while the wind stayed calm (5.3-9.0 m/s, E-SE). The hydrographical measurements during the first day indicated that the surface water temperature was high and were close to 20°C at all stations.

During the 7th August 2024, sampling continued in the Bay of Mecklenburg. Samples for the measurements of UV-filter substances were taken at the southernmost station in the Lübeck Bight (TF0022). The program continued with two stations including diverse sampling for fungi, phytoplankton and zooplankton biodiversity (TF0012, TF0046) and a series of hydrographical stations (TF0017, 0041, 0083, 0033, 0002). At several of these stations, samples for UV substances, proteomics and e-DNA were also taken. The warm weather with calm wind (air T >20°C, 3-4 m/s, E) continued. The water temperature was still close to 20°C and large areas covered with dense cyanobacteria aggregates at the surface were observed that reflected the low salinity in the surface water. In the evening, our station at the Darss Sill was reached (TF0030) and sampling of the hydrography, chemistry and biodiversity continued into the Arkona Sea during the night and early morning (TF115, 114, 113, 104, 103, 109). The water temperature was still close to 20°C at the surface; the largest aggregates of cyanobacteria at the surface disappeared, but their concentration in the water column was still high making net sampling difficult.

In the morning of the 8th August 2024, we sailed to Sassnitz for a crew exchange after the finishing of hydrographical and biochemical measurements at station TF0112. The teams taking samples for measurements of UV- filter substances, proteomics and e-DNA left the ship, and one member of the CTD team was exchanged. RV ELISABETH MANN BORGESE sailed back to the Arkona Sea where the series of hydrographical and chemical measurements continued over the Bornholm Gatt into the Bornholm Basin overnight and in the morning of the 9th August

2024 (TF0145DK, 144, 142, 140, 206, 207, 200, 209, 212). While the weather was still warm (20°C), the wind already increased and changed the direction from east-southeast to west. Due to the an approaching front with winds of larger than 15 m/s and wave heights of 2.5 m, it was decided to leave the schedule sampling programme direction east and sail instead northwards to find shelter and proceed the cruise in opposite direction (around Gotland and then southwards in the eastern Gotland Basin. Nevertheless, we managed to sample station TF213 in the central Bornholm Basin. In addition to the regular measurements of hydrographical and chemical conditions, plankton samples were taken for monitoring purposes. In addition, several Apstein (50 µm) and WP-2 (100 µm) nets were taken to support the analysis of the long-term changes in the population dynamics of key copepod species in the Bornholm Basin by quantitative samples for nauplii and copepodites. RV ELISABETH MANN BORGESE left the Basin after the sampling at 14:00 and headed northwards close to Oland in the western Gotland Basin. The ship arrived there at the 10th of August in the early morning and stayed on the position until the bad weather had passed (57°14,70'N; 17°11,43'E).

The work resumed in the morning of 11th August with the western Gotland Basin Scansfish transect when the weather had sufficiently calmed down. Strong wind was still blowing from west (10-15 m/s); the air temperature dropped to 15.8°C while the surface water was still warm (>18°C). The Scansfish transect started with a CTD cast at station SF025WGB and was directed eastwards to the southernmost tip of the island of Gotland. The deployment stopped at 13:30 and RV ELISABETH MANN headed north to resume the CTD measurements along the Thalweg. Strong winds (12.6 -13.1 m/s, west) prevailed and air temperatures rose to 19.2 °C. During the night, stations TF0242, Tf0240 and wGB-3 were sampled for hydrographical parameters.

In the early morning of the 12th August 2024, intense hydrographical, chemical and biological measurements were started at station TF0284. In total four CTD casts were performed for vertical profiles of temperature, salinity, oxygen, hydrogen sulfide, pH, CO₂, turbidity, phytoplankton and Chl_a. At the redoxcline, additional samples were taken for molecular work. Work was finished at noon, and RV ELISABETH MANN continued the sampling along the Thalweg in the northern part of the Gotland Basin during the rest of the day and the night (nGB-1, TF0283, nGB-2, TF0288, TF0282, TF0289). During the day, the wind was blowing from northwest (6.9-7.4 m/s) and the weather was sunny with few clouds only (19.1°C, 1011.2 hPa). In the night, the scientific crew witnessed incredible northern lights and a dozen of shooting stars (see attachment).

The day of the 13th August started with ideal weather for the continuation of the program. The eastern Gotland Basin got increasingly under the influence of a high-pressure cell from the west. The wind decreased to 3-4 m/s (NW), it was sunny and the air temperature was already 18.3°C in the morning. RV ELISABETH MANN continued the sequence of CTD casts along the Thalweg direction south: TF0279, TF0285, TF0278, and TF0277. The vertical profiles on these stations showed a perfect sequence of a mixed surface layer with temperatures around 18° that was sharply separated from the colder intermediate layer and the anoxic deep water. In the afternoon, we continued the sequence of CTD casts and some additional water bottles for comparison of the oxygen sensors with the determination by the Winkler method at stations TF0268, TF0290, TF0287, TF 0270, TF0276 and Gotland NE.

In the night to the 14th of August, intense hydrographical, chemical and biological measurements were started at station TF-0271. In total six CTD casts were done for the vertical

profiles of temperature, salinity, oxygen, hydrogen sulfide, pH, CO₂, turbidity, phytoplankton and Chl_a. At the redoxcline, samples were taken for molecular work. The first results showed an deepening of the redoxcline from 80 m to 120 m in comparison to the northern Gotland Basin. This deepening is probably related to the last larger inflow of oxygen rich water into the Baltic Sea in winter. Station work was finished in the late morning, and RV ELISABETH MANN sailed further south to perform more CTD casts at stations TF0275, and TF0272. In the afternoon, the program was changed from a Scanfish transect to a series of CTD casts along a transect perpendicular to the Thalweg. This was done in order to investigate the change of the redoxcline depth in more detail (TF403 to 411). The calm weather persisted throughout the day although it got more cloudy and wind changed direction from north to south in the evening (18.3-19.2 °C, 1.7-3.4 m/s, 1018.6 hPa).

On the 15th August, two Scanfish profiles were conducted during the day and overnight. The first one was provided the detailed vertical structure and the position of the redoxcline in a south to north transect (station TF0274 to station TF0271, 01:58-08:25). The second transect was again perpendicular to the Thalweg north of the first transect (SF022EGB to SF001EGB,). Both transects lasted the whole day until the morning of the 16th. The morning started already with warm temperatures (19.8°C) and moderate winds from southeast (7.8 m/s, 1015.0 hPa). The wind changes to southwest direction in the turn of the day (7.3-7.8 m/s, 21.8°C, 1014.0 hPa).

In the morning of the 16th August 2024, RV ELISABETH MANN sailed for the small town of Slite at the east coast of Gotland to bunker fresh supplies. Work resumed in the afternoon when we sailed southwards to station TF0260 to resume the work on the Thalweg. In the night, CTD casts and measurements of bottom water oxygen/hydrogensulfide concentrations were done at stations TF0261, 0262, 0250, 0265 and continued during the morning of the 17th August 2024 at stations TF0253, 0252, 0258 and 0255. While the wind directions has further changed to west-northwest and increased from 4.6 to 7.3 m/s, the working conditions remained favorable with warm temperatures and sunny-cloudy conditions (19.1°C, 1011.0-1014.3 hPa). During the night and morning, dense aggregations of the moon jelly (*Aurelia aurita*) could be seen in the water of the southern Gotland Basin. Around noon, two additional stations were done with CTD casts and plankton nets (TF0259, 0257) before RV ELISABETH MANN turned westwards for hydrographical measurements along the Slupsk Channel (TF0256, 0268, 0267, 0266, 0222) and the eastern Bornholm Basin (TF0229, 0228, 0227, 0224, 0226, 0225 and 0221) during the evening and the night.

Station TF0213 was reached in the morning of the 18th August 2024. The sampling program included hydrographical, chemical measurements and plankton sampling with the WP-2 and Apstein nets to again support the long-term analysis of population dynamics of key copepod species in this basin. The weather conditions were still favorable with moderate winds and warm temperatures (19.4°C, 1009.1 hPa, 7.2-8.0 m/s, cloudy). The abundance of *Aurelia aurita* has obviously declined, although the species was regularly seen in the telemetry unit of the CTD and from the ship. Before lunch, RV ELISABETH MANN BORGESE turned southwest to determine the hydrographical conditions in the southern Bornholm Basin (TF0215, 0204, 0154) and to take samples for the identification of chemical UV-filter and their concentration close to the Oder estuary, which turned out to be a hot spot for these substances in previous cruises in the evening. This station could not be sampled in the beginning of the cruise due to bad weather conditions.

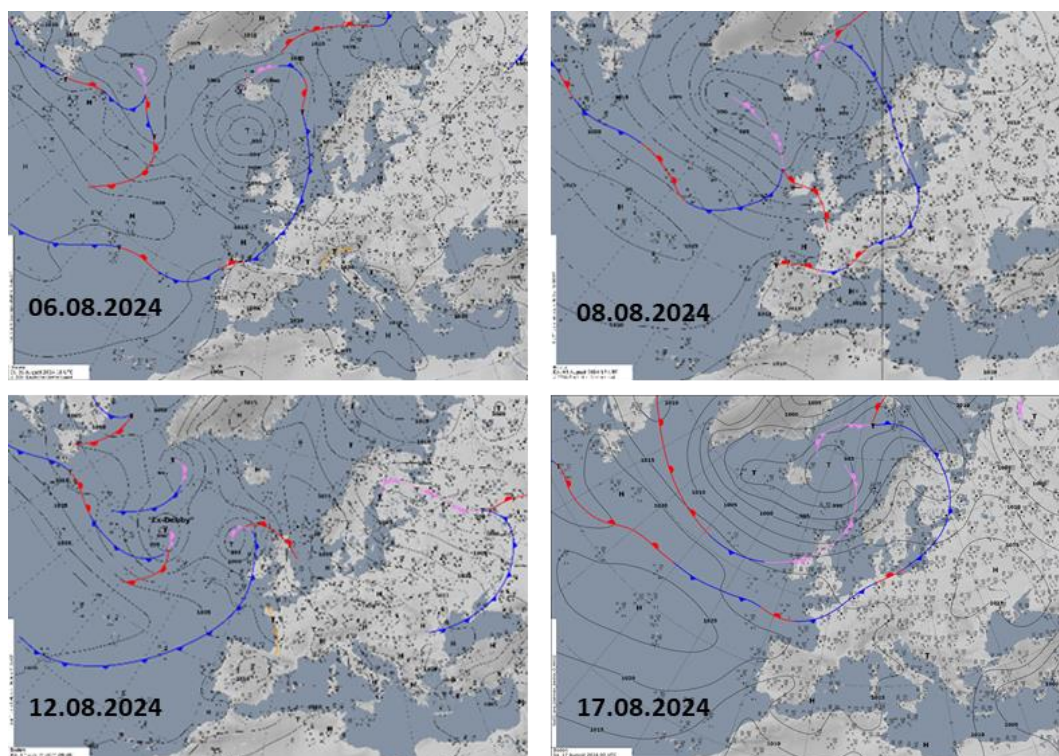


Fig. 5.1 Weather conditions during the cruise EMB346 on the 06.08.2024, 08.11.2024, 12.08.2024 and 17.08.2024. All figures provided the Deutscher Wetterdienst (www.dwd.de).

In the night, RV ELISABETH MANN BORGESE sailed north to the Arkona Sea. Here, the measurements for the BSH were resumed at stations TF109, TF0113, TF001: At Station AB-Boje, a CTD profile was taken in comparison to the long-term mooring anchored at this station. Afterwards, the station work continued at station TF0030, TF0064 and TF0012. These were the last stations with STD measurements and sampling for Chla and zooplankton. After finishing at station TF0012, RV ELISABETH MANN BORGESE returned to the harbor in Rostock-Marienehe, where the ship arrived at 08:00 in the morning of the 20th August 2024.

The unloading of the scientific equipment took place directly afterwards.

5 Preliminary Results

The following results are only preliminary and not comprehensive, since they are based in most cases on unevaluated raw data or are descriptive. Their presentation aims at providing a first overview and general evaluation of the hydrographic and chemical data. A final assessment requires the advanced analysis of data and samples and their validation

5.1 Meteorological Conditions

A high-pressure cell located in the western Baltic Sea determined the weather conditions during the beginning of the cruise (Fig. 5.1). The weather was characterized by ideal working conditions with calm winds (< 5 m/s, east) and warm temperatures ($> 20^{\circ}\text{C}$) during the 6-8th August 2024. A large, fast moving low-pressure cell located at the Faroe Islands influenced the weather during the following days (8-10th August 2024) and a cold frontal system passing eastwards brought stormy winds (> 15 m/s). The temperature dropped to 16.4°C in the southwestern Baltic Sea. As a result, the wave height exceeded more than 2.5 m, and therefore we decided to sail northwards to seek for shelter at the coast east of Øland. The forecast of persistent unfavorable weight

heights in the southeastern Gotland Basin forced us to change the cruise plan and sail northwards in order to conduct the sampling program along the Thalweg in the opposite direction that originally planned.

In the beginning of the second week, the harsh weather calmed slowly down. The work resumed at still strong winds (12-15 m/s) and wave heights of 2m. Sailing around the island of Gotland, the cruise of RV ELISABETH MANN became increasingly under the influence of a high-pressure cell located in northern France that moved eastwards. This cell influenced widely the weather in the Baltic Sea and resulted in calm wind and warm air temperatures during 12-15th August 2024. A low-pressure zone northeast of Island and a frontal system influenced the weather during the weekend of the 16th-18th August across the Baltic Sea. It slowly moved eastwards and replaced the high-pressure zone. Nevertheless, calm winds from west dominated and continued to provide further ideal working conditions.

5.2 Observations at Main Stations and the Baltic Thalweg Transect

5.2.1 CTD Measurements

The most important hydrographic and chemical parameters at the main stations of the investigation are summarized in Tables 5.1 and 5.2 as well as Figures 5.2 and 5.3. The position for these stations is provided in Figure 3.1.

The surface temperature (SST) and salinity (SSS) showed a west-east gradient typical for the Baltic Sea (Fig. 5.2). Nevertheless, surface temperatures were high in all areas and above the long-term climatological. In most shallow areas such as the Kiel Bight, the Bay of Mecklenburg and the Stolpe Channel, it exceeded 20°C but ranged between 19-20°C in the deeper areas of the Bornholm and Gotland Basins. Only at the Landsort Deep, the surface temperature was in the range of the long-term values (16.9°C). In contrast, the surface salinity was in the range of the long-term observations. Typical for summer, it is lower in the western areas of the Baltic Sea (Kiel Bight-Bay of Mecklenburg: 10.0 – 11.3 PSU). From the Darss Sill onwards, a strong influence of the Baltic Proper with a salinity smaller than eight PSU was visible.

The deep-water conditions typically diverged from the surface distribution of the hydrographical variables (Tab. 5.2). The Fehmarn-Belt, Bay of Mecklenburg and the Arkona Basin, showed a warm, saline water with a salinity > 27 PSU at the bottom and less warm and saline at intermediate depths. The transport of the deep water into the Bornholm Basin was associated with a reduction of the salinity. It formed a warm layer (10-12°C, 12-14 PSU) at the top of the halocline in the western areas of the Basin. The salinity of this core was not elevated above the usual, though. Further east, the typical layering of cold, brackish water (~4°C, 8-11 PSU) above the warmer, more saline bottom water occurred (6-8°C, > 11 PSU).

Nearly the entire central Baltic was covered by anoxic bottom waters, enriched with free hydrogen sulphide (Gotland, Farö, Landsort Deeps, Fig. 5.2, Tabs. 5.1, 5.2). The deep water in the Bornholm Basin was hypoxic (< 20 µmol O₂/L). In contrast, the deep water in the Stolpe channel and the southern slope of the eastern Gotland Basin displayed oxygen levels above 50 µmol O₂/L, indicating a recent transport of oxygen rich water into the central Baltic Sea.

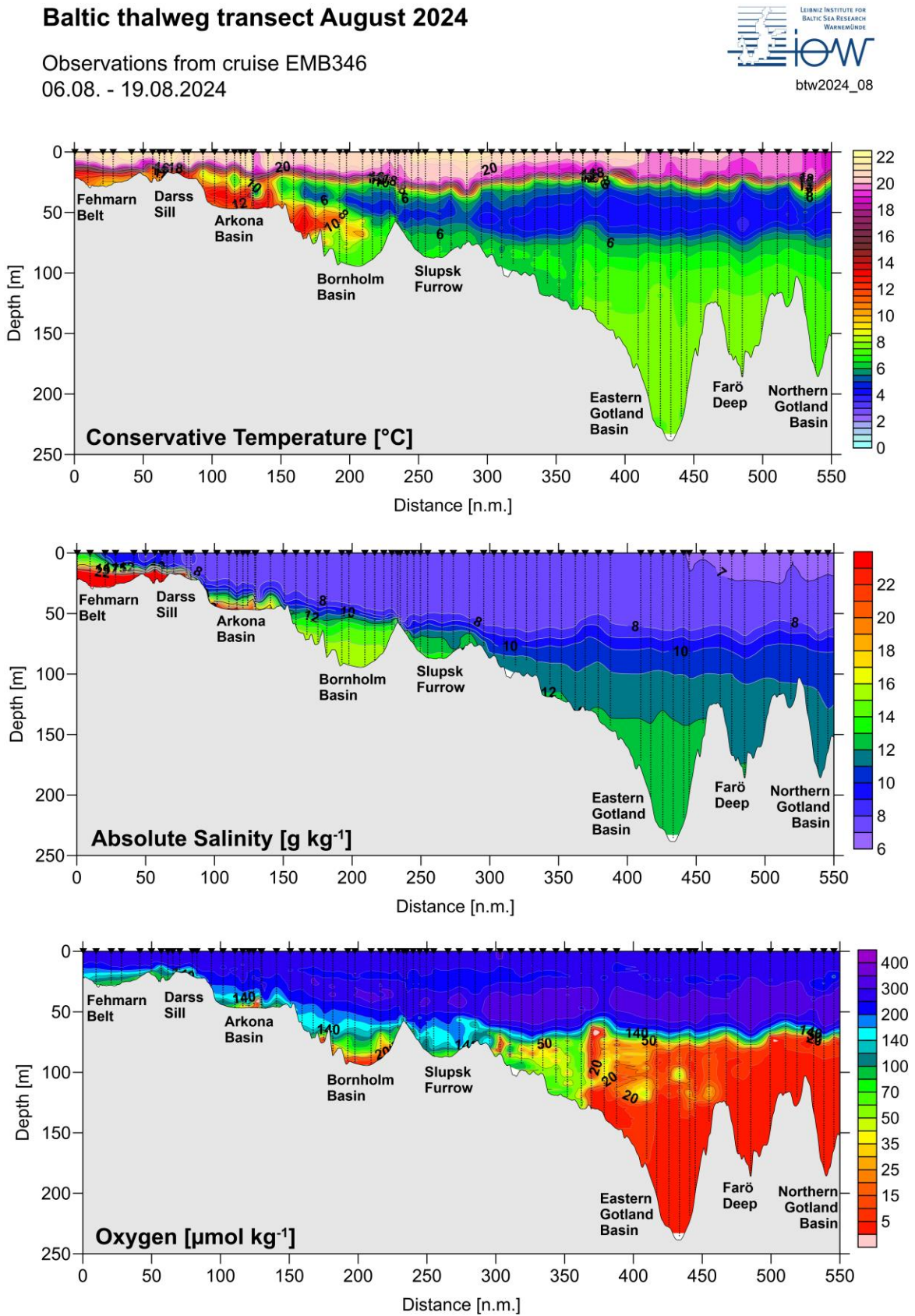


Fig. 5.2 Distribution of temperature (°C), salinity (PSU) and oxygen concentrations (ml/L) along the Thalweg transect of the Baltic Sea from the Kiel Bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data collected during the cruise EMB346 from the 06.08. -19.08.2024.

Baltic thalweg transect August 2024

Observations from cruise EMB346
06.08. - 19.08.2024

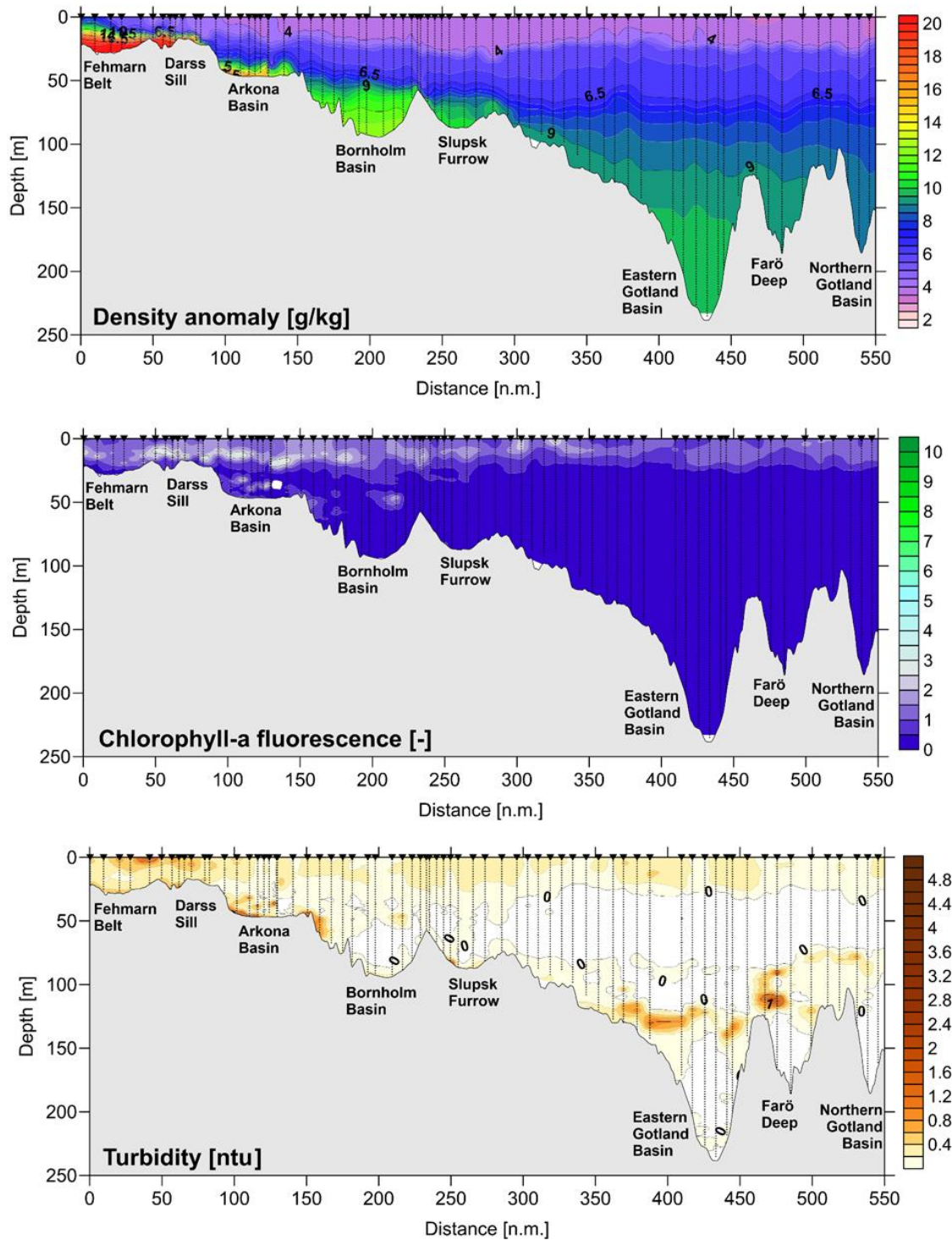


Fig. 5.3 Distribution of seawater density (g/kg), chlorophyll fluorescence and turbidity (NTU) along the Thalweg transect of the Baltic Sea from the Kiel Bight to the eastern Gotland Basin. The figure is based on the preliminary CTD data collected during the cruise EMB346 from the 06.08. -19.08.2024.

Table 5.1 Surface water layer (about 3 m depth) - hydrographic and hydrochemical properties at main stations.

Area	Station No. IOW	Temp °C	Sal. g/kg	O ₂ (sensor) µmol/L	O ₂ (titration) µmol /L	PO ₄ [µM]	NO ₃ [µM]	SiO ₄ [µM]
Kiel Bight	TF0360	20.40	11.31	274.9	271.7	0.00	0.04	3.4
Bay of Mecklenburg	TF0012	20.78	10.00	280.5	293.8	0.00	0.08	8.7
Darss Sill	TF0030	20.31	7.92	277.9	282.8	0.01	0.31	7.7
Arkona Basin	TF0113	19.94	7.34	278.0	282.2	0.00	0.04	4.9
Bornholm Deep	TF0213	19.77	7.21	280.7	286.5	0.01	0.08	3.1
Stolpe Channel	TF0222	20.34	7.11	284.4	287.7	0.01	0.00	12.5
SE Gotland Basin	TF0259	20.01	7.05	284.8	301.1	0.03	0.00	12.2
Gotland Deep	TF0271	19.49	7.31	272.1	275.7	0.03	0.14	7.8
Farö Deep	TF0286	19.32	7.11	278.8	282.3	0.00	0.03	10.7
Landsort Deep	TF0284	16.92	6.14	283.7	286.8	0.02	0.06	13.5

Table 5.2 Deep water layer - hydrographic and hydrochemical properties at main stations. Hydrogen sulphide was converted into negative oxygen equivalents (Conversion factors: µmol l⁻¹ H₂S * -0.0448 = negative oxygen equivalent ml l⁻¹ O₂).

Area	Station No. IOW	Temp °C	Sal. g/kg	O ₂ (sensor) µmol/L	O ₂ (titration) µmol/L	PO ₄ [µM]	NO ₃ [µM]	SiO ₄ [µM]
Kiel Bight	TF0360	10.37	27.96	85.5	104.4	0.53	0.11	21.9
Bay of Mecklenburg	TF0012	9.53	27.63	31.7	44.9	1.16	5.63	49.6
Darss Sill	TF0030	12.55	21.11	115.3	100.3	0.59	2.05	20.2
Arkona Basin	TF0113	11.48	21.74	47.2	70.0	1.30	5.59	41.0
Bornholm Deep	TF0213	7.13	15.66	18.6	19.0	1.51	8.88	56.2
Stolpe Channel	TF0222	6.31	13.06	68.7	73.9	1.83	7.96	45.8
SE Gotland Basin	TF0259	6.07	11.79	67.3	50.8	2.30	4.26	47.4
Gotland Deep	TF0271	7.33	12.13	4.7	-385.8	7.00	0.63	109.5
Farö Deep	TF0286	7.28	12.44	4.7	-284.4	5.45	0.00	95.0
Landsort Deep.	TF0284	6.86	10.96	3.3	-108.8	4.30	0.00	74.8

5.2.2 Nutrients and Chlorophyll

The concentrations of phosphate and nitrate in the surface water were low ($< 0.31 \mu\text{M}$, Table 5.1). This is expected for the summer period when nutrients are depleted following the spring phytoplankton bloom. In contrast, silicate was not depleted and show high values especially in the Gotland Basin. In contrast, all nutrient concentrations in the bottom water here high (Table 5.2). In agreement with the low nutrient concentrations, Chlorophyll a fluorescence was below 3 units. In the western Baltic Sea, surface values were generally higher because of the shallowness of the area that allows for vertical mixing by winds and lateral transport. In the central Baltic Sea, the concentrations were below 1.5 units.

5.3 Establishment of an eDNA-Archive and Metaproteogenomic Analyses

For a bio-archive of microorganisms and metazoans in the North and the Baltic Sea, biomass is collected by filtering seawater either through a $0.2 \mu\text{m}$ or a $0.45 \mu\text{m}$ filter to obtain respectively bacterial and metazoan DNA (CREATE project). All samples are frozen directly and stored at $-20 \text{ }^\circ\text{C}$ and are available for further processing like DNA extraction and sequencing.

For metaproteogenomic analyses, surface water samples of 60 L were collected by a CTD-Rosette system. Subsequently, the water was filtered through $10 \mu\text{m}$, $3 \mu\text{m}$ and $0.2 \mu\text{m}$ filters, respectively. Filters were stored at $-80 \text{ }^\circ\text{C}$. Macro- and microalgae, found on the $10 \mu\text{m}$ and $3 \mu\text{m}$ filters and bacteria derived from the $0.2 \mu\text{m}$ filter are available for metagenomic and metaproteomic analyses and furthermore for the determination of bacterial metabolic activity. (Responsible scientists: Prof. Dr. Matthias Labrenz, IOW, Dr. Norma Welsch, Uni-Greifswald, Dr. Anneke Heins, MPI-Bremen).

5.4 Radionuclides in the Western Baltic Sea

Sampling to determine radionuclides was carried out in accordance with the “General Administrative Regulation for the Integrated Measurement and Information System for Monitoring Radioactivity in the Environment (AVV-IMIS)” and the associated measurement instructions D-Cs-MWASS-01 of the Control Center D for Seawater, Marine Suspended Matter and Sediment. The AVV-IMIS schedules for quarterly sampling of the surface seawater at selected stations in the Baltic Sea. These samples are examined for their Cs-137 and Sr-90 activity concentration. Since the BSH was unable to carry out sampling of these stations in the third quarter of 2024, the IOW has agreed to carry out the sampling during voyage EMB 346. Two 35-liter barrels were filled with near-surface seawater at four stations using the ship's own seawater pipe. The processing of these samples in the BSH laboratory in Hamburg-Sülldorf has already taken place, but measurements, evaluations and plausibility checks are still pending (Responsible scientist: Dr. S.A.K. Schmied, BSH).

5.5 Identification of Accumulation Areas for UV-filter Substances

The sampling aims to identify enrichment areas for homogeneous or heterogeneous distribution of UV Filters across the coastal areas, bays and the open Baltic Sea. Also, identify the transport processes for the occurrence of UV Filters in the Baltic Sea. Given the importance of seasonal variations in concentrations of UV Filters in the Baltic Sea, this summer cruise will aid in providing crucial information. This is the seventh of eight cruises.

Water samples were taken at the surface, “ChlAmax”, and near bottom layer for the following stations (Tab. 1). The collection of samples from various depths will assist us in determining the variation in distribution of UV Filters in the Baltic Sea at different depths. ChlAmax is being collected specifically to help us correlate the UV Filter concentration in algae and whether they act as a link for UV Filter deposition in sediment.

Solid phase extraction done to analyze the UV Filters. The samples were filtered using Chromabond HLB cartridges on board. Further, extractions and analysis using LC-MS/MS will be carried out at Julius Kühn-Institut, Berlin. Additional samples were taken for Titanium dioxide, as a marker for mineral UV Filters, as a comparison for the organic UV Filters. (Responsible scientist: Harshada Sakpal, Julius Kühn-Institute, Berlin and IOW, Dr. Kathrin Fisch, Julius Kühn-Institute, Berlin, Dr. Marion Kanwischer, IOW, Prof. Detlef Schulz-Bull, IOW).

5.6 Analysis of PFAS Substances

The Interreg Baltic Sea Region program funded project EMPEREST (Eliminating Micro-Pollutants from Effluents for REuse STRategies, <https://interreg-baltic.eu/project/emperest/>) aims at the development of new technologies for the removal of organic micro-pollutants such as pharmaceuticals and in particular perfluorated alkylated substances (PFAS) from wastewater. Moreover, the EMPEREST partner HELCOM aims at the development of methodological recommendations for a harmonized monitoring of PFAS substances in the Baltic Sea region.

In order to increase the number of data for concentrations of PFAS substances in waters of the German EEZ, IOW provided surface water samples from this region to the project partner Prof. Barjenbruch (Technische Universität Berlin, Dpt. Urban Water management).

During cruise EMB346 surface water samples were obtained at similar sites as for the samples for UV filter analysis (Table 1) using the carousel water sampler. Harshada Sakpal conducted the sampling onboard. The 1 L samples were stored in PE bottles and handed over to Prof. Barjenbruch and colleagues after the cruise who forwarded them to an external laboratory for PFAS analysis. (Responsible scientist: Dr. Marion Kanwischer, IOW).

5.7 Biological Sampling

Samples for the investigation of the seasonal and long-term variation of the phytoplankton and zooplankton were collected on selected station for the subsequent analysis in the laboratory. This analysis is time consuming and is initiated once samples were brought to the laboratory. Therefore, preliminary results are not available yet.

6 Ship’s Meteorological Station

Not applicable on RV ELISABETH MANN BORGESSE. The meteorological conditions during the cruise are described in section 5.1.

7 Station List EMB346/2024

7.1 Overall Station List

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
EMB	IOW	2024		[UTC]			[m]	Drahtlänge
EMB346_01-01	TF05	06.08.	ROS/CTD,	08:11	54°13.93'N	12°04.56'E	11	10 m
EMB346_01-02	TF05	06.08.	Secci disk	08:36	54°13.91'N	12°04.53'E	11	
EMB346_02-01	TF0010	06.08.	ROS/CTD	12:59	54°33.13'N	11°19.05'E	26	25 m
EMB346_03-01	FBELT1	06.08.	Water	14:06	54°35.96'N	11°12.93'E	25	for radionuclides
EMB346_04-01	TF0361	06.08.	ROS/CTD	16:09	54°39.54'N	10°46.88'E	20	10 m
EMB346_05-01	TF0360	06.08.	ROS/CTD	17:51	54°36.03'N	10°26.92'E	15	15 m
EMB346_05-02	TF0360	06.08.	Secci disk	18:12	54°36.02'N	10°26.94'E	15	2 x
EMB346_05-03	TF0360	06.08.	Apstein 20	18:16	54°36.02'N	10°26.92'E	15	
EMB346_05-04	TF0360	06.08.	WP-2	18:30	54°36.01'N	10°26.96'E	15	
EMB346_05-05	TF0360	06.08.	WP-2	18:30	54°36.01'N	10°26.96'E	15	1 x
EMB346_06-01	SCHLEI	06.08.	Water	20:01	54°39.99'N	10°07.96'E	17	for radionuclides
EMB346_07-01	TF0014	06.08.	ROS/CTD	23:57	54°35.70'N	11°00.80'E	26	24 m
EMB346_08-01	TF0013	07.08.	ROS/CTD	02:57	54°28.41'N	11°29.01'E	25	23 m
EMB346_09-01	TF0022	07.08.	ROS/CTD	06:15	54°06.61'N	11°10.47'E	20	21 m
EMB346_10-01	TF0012	07.08.	ROS/CTD	08:38	54°18.91'N	11°32.86'E	21	5 m
EMB346_10-02	TF0012	07.08..	Apstein 20	08:40	54°18.91'N	11°32.80'E	21	2 x
EMB346_10-03	TF0012	07.08.	WP-2	08:55	54°18.90'N	11°33.02'E	21	2 x Netze
EMB346_10-04	TF0012	07.08.	ROS/CTD	09:09	54°18.91'N	11°33.00'E	21	2 m
EMB346_10-05	TF0012	07.08.	WP-2	09:27	54°18.91'N	11°32.97'E	21	2 x Netze
EMB346_10-06	TF0012	07.08.	WP-2	09:27	54°18.91'N	11°32.97'E	21	2 x Netze
EMB346_10-07	TF0012	07.08.	Secchi	09:34	54°18.91'N	11°32.96'E	21	
EMB346_10-08	TF0012	07.08.	Secchi	09:34	54°18.91'N	11°32.96'E	21	
EMB346_11-01	TF0017	07.08.	ROS/CTD	11:04	54°23.48'N	11°49.42'E	19	21 m
EMB346_12-01	TF0041	07.08.	ROS/CTD	12:30	54°24.37'N	12°03.66'E	16	17 m
EMB346_13-01	TF0046	07.08.	ROS/CTD	13:51	54°28.22'N	12°14.52'E	25	26 m
EMB346_13-02	TF0046	07.08.	Secchi	13:58	54°28.20'N	12°14.47'E	25	
EMB346_13-03	TF0046	07.08.	Apstein 20	14:00	54°28.20'N	12°14.46'E	25	2 x Netze
EMB346_13-04-5	TF0046	07.08..	WP-2	14:16	54°28.21'N	12°14.54'E	25	2 x Netze
EMB346_14-01	TF0083	07.08.	ROS/CTD	15:13	54°33.01'N	12°16.51'E	22	23 m
EMB346_15-01	DARSS	07.08.	Water	16:10	54°43.87'N	12°18.83'E	18	for radionuclides
EMB346_16-01	TF0033	07.08.	ROS/CTD	18:06	54°36.30'N	12°19.82'E	17	17 m
EMB346_17-01	TF0002	07.08.	ROS/CTD	19:00	54°38.98'N	12°26.95'E	15	16 m
EMB346_18-01	TF0030	07.08.	ROS/CTD	20:46	54°43.43'N	12°46.98'E	20	5 m
EMB346_18-02	TF0030	07.08.	Apstein 20	20:57	54°43.40'N	12°46.98'E	20	2 x Netze
EMB346_18-03	TF0030	07.08.	ROS/CTD	21:09	54°43.42'N	12°46.96'E	20	21 m
EMB346_18-04	TF0030	07.08.	Secchi	21:09	54°43.42'N	12°46.96'E	20	
EMB346_19-01	TF0115	07.08.	ROS/CTD	22:57	54°47.69'N	13°03.56'E	27	28 m
EMB346_20-01	TF0114	08.08.	ROS/CTD	00:20	54°51.60'N	13°16.64'E	42	43 m
EMB346_20-01	TF0114	08.08.	water	00:20	54°51.60'N	13°16.64'E	42	for radionuclides
EMB346_21-01	TF0113	08.08.	ROS/CTD	01:49	54°55.52'N	13°30.00'E	45	45 m
EMB346_21-02	TF0113	08.08.	Apstein 20	01:56	54°55.53'N	13°29.94'E	44	2 x Netze
EMB346_21-03	TF0113	08.08.	WP-2	02:18	54°55.49'N	13°30.04'E	44	2 x Netze
EMB346_21-04	TF0113	08.08.	ROS/CTD	02:47	54°55.49'N	13°29.95'E	44	25 m
EMB346_21-05	TF0113	08.08.	ROS/CTD	02:47	54°55.49'N	13°29.95'E	44	25 m
EMB346_22-01	TF0105	08.08.	ROS/CTD	03:48	55°01.49'N	13°36.40'E	44	44 m
EMB346_23-01	TF0122	08.08.	ROS/CTD	04:52	54°59.32'N	13°46.25'E	45	45 m
EMB346_24-01	TF0104	08.08.	ROS/CTD	05:49	55°04.09'N	13°48.80'E	43	44 m
EMB346_25-01	TF0103	08.08.	ROS/CTD	06:51	55°03.76'N	13°59.31'E	44	44 m
EMB346_26-01	TF0109	08.08.	ROS/CTD	07:57	54°59.98'N	14°05.02'E	45	45 m
EMB346_26-02	TF0109	08.08.	Secchi	07:59	54°59.99'N	14°05.02'E	46	
EMB346_26-03	TF0109	08.08.	Apstein 20	08:01	54°59.99'N	14°05.02'E	45	2 x Netze
EMB346_26-04	TF0109	08.08.	WP-2	08:21	54°59.98'N	14°05.00'E	45	2 x Netze
EMB346_26-05	TF0109	08.08.	WP-2	08:21	54°59.98'N	14°05.00'E	45	2 x Netze
EMB346_27-01	TF0112	08.08.	ROS/CTD	10:17	54°48.18'N	13°57.16'E	37	38 m
EMB346_28-01	TF0145DK	08.08.	ROS/CTD	20:19	55°09.55'N	14°15.76'E	44	45 m
EMB346_29-01	TF0144	08.08.	ROS/CTD	21:56	55°15.40'N	14°29.47'E	42	43 m
EMB346_30-01	TF0142	08.08.	ROS/CTD	23:38	55°23.03'N	14°35.07'E	71	71 m
EMB346_31-01	TF0140	09.08.	ROS/CTD	00:47	55°28.02'N	14°43.03'E	67	67 m

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
EMB	IOW	2024		[UTC]			[m]	
EMB346_32-01	TF0206	09.08.	ROS/CTD	02:03	55°31.97'N	14°55.00'E	75	74 m
EMB346_33-01	TF0207	09.08.	ROS/CTD	03:06	55°29.72'N	15°05.56'E	84	83 m
EMB346_34-01	TF0200	09.08.	ROS/CTD	04:40	55°22.95'N	15°19.99'E	90	89 m
EMB346_35-01	TF0209	09.08.	ROS/CTD	05:35	55°03.80'N	15°28.00'E	93	92 m
EMB346_36-01	TF0212	09.08.	ROS/CTD	07:15	55°18.15'N	15°47.90'E	94	93 m
EMB346_37-01	TF0213	09.08.	ROS/CTD	08:30	55°15.05'N	15°59.05'E	89	88 m
EMB346_37-02	TF0213	09.08.	Secchi	08:31	55°15.05'N	15°58.99'E	89	
EMB346_37-03	TF0213	09.08.	Apstein 20	08:32	55°15.04'N	15°59.05'E	89	2 x Netze
EMB346_37-04	TF0213	09.08.	WP-2	08:53	55°15.00'N	15°59.99'E	89	5 x Netze
EMB346_37-05								
EMB346_37-06								
EMB346_37-07								
EMB346_37-08								
EMB346_37-09	TF0213	09.08.	Apstein 50	10:34	55°15.01'N	15°58.98'E	89	3 x Netze
EMB346_37-10								
EMB346_37-11								
EMB346_37-012	TF0213	09.08.	ROS/CTD	11:24	55°15.00'N	15°58.98'E	89	87 m
EMB346_38-01	SF025WGB	11.08.	ROS/CTD	06:26	57°09.79'N	17°19.51'E	67	66 m
EMB346_39-01	Transect	11.08.	Scanfish	06:50	57°09.71'N	17°19.34'E	67	Start at SF025WGB
				11:29	57°03.53'N	18°06.66'E	21	End at SF032WGB
EMB346_40-01	SF032WGB	11.08.	ROS/CTD	11:48	57°03.37'N	18°06.40'E	22	23 m
EMB346_41-01	TF0242	11.08.	ROS/CTD	17:30	57°42.99'N	17°22.05'E	141	138 m
EMB346_42-01	TF0240	11.08.	ROS/CTD	21:01	57°59.98'N	18°00.11'E	165	162 m
EMB346_43-01	wGB-3	11.08.	ROS/CTD	23:50	58°19.53'N	18°04.23'E	146	144 m
EMB346_44-01	TF0284	12.08.	ROS/CTD	02:41	58°34.98'N	18°13.85'E	453	439 m
EMB346_44-02	TF0284	12.08.	Secchi	02:42	58°34.97'N	18°13.83'E	458	
EMB346_44-03	TF0284	12.08.	ROS/CTD	04:01	58°35.04'N	18°14.03'E	453	130 m
EMB346_44-04	TF0284	12.08.	ROS/CTD	05:29	58°35.03'N	18°13.98'E	453	20 m
EMB346_44-05	TF0284	12.08.	ROS/CTD	08:29	58°35.03'N	18°13.86'E	453	83 m
EMB346_45-01	nGB-1	12.08.	ROS/CTD	11:56	58°42.75'N	18°40.31'E	253	235 m
EMB346_46-01	TF0283	12.08.	ROS/CTD	16:12	58°47.01'N	19°06.00'E	129	128 m
EMB346_47-01	nGB-2	12.08.	ROS/CTD	20:35	58°51.88'N	19°44.62'E	168	163 m
EMB346_48-01	TF0288	12.08.	ROS/CTD	23:46	58°59.74'N	20°09.71'E	141	139 m
EMB346_49-01	TF0282	13.08.	ROS/CTD	01:12	58°52.98'N	20°18.97'E	165	161 m
EMB346_50-01	TF0289	13.08.	ROS/CTD	02:45	58°45.99'N	20°19.75'E	202	200 m
EMB346_51-01	TF0279	13.08.	ROS/CTD	04:32	58°38.45'N	20°20.68'E	164	160 m
EMB346_52-01	TF0285	13.08.	ROS/CTD	06:27	58°26.49'N	20°20.02'E	123	120 m
EMB346_53-01	TF0278	13.08.	ROS/CTD	08:01	58°20.95'N	20°08.87'E	121	118 m
EMB346_54-01	TF0277	13.08.	ROS/CTD	09:42	58°10.94'N	20°03.78'E	162	158 m
EMB346_55-01	TF0286	13.08.	ROS/CTD	11:32	57°59.99'N	19°54.05'E	196	191 m
EMB346_55-02	TF0286	13.08.	Secchi	11:37	57°53.95'N	19°53.92'E	196	
EMB346_55-03	TF0286	13.08.	ROS/CTD	12:40	58°00.01'N	19°53.92'E	196	25 m
EMB346_56-01	TF0290	13.08.	ROS/CTD	13:59	57°50.98'N	19°48.96'E	172	168 m
EMB346_57-01	TF0287	13.08.	ROS/CTD	15:29	57°42.91'N	19°51.14'E	129	128 m
EMB346_58-01	TF0270	13.08.	ROS/CTD	17:14	57°37.01'N	20°10.06'E	144	140 m
EMB346_59-01	TF0276	13.08.	ROS/CTD	18:50	57°28.20'N	20°15.56'E	207	202 m
EMB346_60-01	GotlandNE	13.08.	ROS/CTD	20:09	57°22.05'N	20°19.82'E	223	217 m
EMB346_61-01	TF0271	13.08.	ROS/CTD	21:57	57°19.18'N	20°02.99'E	241	235 m
EMB346_61-02	TF0271	13.08.	ROS/CTD	22:47	57°19.19'N	20°03.00'E	241	153 m
EMB346_61-03	TF0271	13.08.	ROS/CTD	23:28	57°19.18'N	20°02.96'E	241	85 m
EMB346_61-04	TF0271	14.08.	ROS/CTD	00:03	57°19.19'N	20°02.98'E	241	30 m
EMB346_61-05	TF0271	14.08.	ROS/CTD	01:11	57°19.19'N	20°03.03'E	241	137 m
EMB346_61-06	TF0271	14.08.	ROS/CTD	02:25	57°19.21'N	20°03.01'E	241	30 m
EMB346_61-07	TF0271	14.08.	Apstein 20	02:54	57°19.18'N	20°02.99'E	241	3 x Netze
EMB346_62-01	TF0275	14.08.	ROS/CTD	04:29	57°12.60'N	19°55.81'E	230	225 m
EMB346_63-01	TF0272	14.08.	ROS/CTD	06:06	57°04.29'N	19°49.83'E	209	203 m
EMB346_64-01	TF0403	14.08.	ROS/CTD	10:18	57°04.41'N	19°01.48'E	114	111 m
EMB346_65-01	TF0404	14.08.	ROS/CTD	11:27	57°01.75'N	19°13.36'E	162	158 m
EMB346_65-02	TF0404	14.08.	Scanfish	11:59	57°01.72'N	19°13.33'E	163	Test auf 130 m
EMB346_66-01	TF0405	14.08.	ROS/CTD	13:01	57°00.51'N	19°21.37'E	176	17 m
EMB346_67-01	TF0406	14.08.	ROS/CTD	14:21	56°58.81'N	19°34.51'E	167	163 m
EMB346_68-01	TF0407	14.08.	ROS/CTD	16:00	56°56.99'N	19°52.98'E	177	171 m
EMB346_69-01	TF0408	14.08.	ROS/CTD	17:03	56°55.35'N	20°01.10'E	166	159 m

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
EMB	IOW	2024		[UTC]			[m]	Drahtlänge
EMB346_70-01	TF0409	14.08.	ROS/CTD	18:11	56°54.93'N	20°12.96'E	146	
EMB346_71-01	TF0410	14.08.	ROS/CTD	19:48	56°51.99'N	20°27.24'E	59	58 m
EMB346_72-01	TF0411	14.08.	ROS/CTD	21:05	56°50.32'N	20°40.90'E	48	48 m
EMB346_73-01	TF0274	15.08.	ROS/CTD	01:06	56°46.12'N	19°45.09'E	155	150 m
EMB346_74-01	Transect	15.08.	Scanfish	01:48 08:25	56°46.99'N 57°23.10'N	19°45.23'E 20°04.93'E	154 231	Start at TF0274 End north of TF0271
EMB346_75-01	SF022EGB	15.08.	ROS/CTD	13:27	57°02.48'N	21°16.56'E	18	19 m
EMB346_76-01	Transect	15.08. 16.08.	Scanfish	13:46 03:41	57°02.43'N 57°34.01'N	21°16.08'E 18°51.07'E	18 19	Start at SF022EGB End at SF001EGB
EMB346_77-01	SF001EGB	16.08.	ROS/CTD	04:00	57°34.69'N	18°50.89'E	18	17 m
EMB346_78-01	TF0260	16.08.	ROS/CTD	21:53	56°38.02'N	19°35.04'E	145	141 m
EMB346_79-01	TF0261	16.08.	ROS/CTD	23:32	56°29.51'N	19°28.89'E	143	139 m
EMB346_80-01	TF0263	17.08.	ROS/CTD	01:08	56°20.77'N	19°22.76'E	143	130 m
EMB346_81-01	TF0262	17.08.	ROS/CTD	02:40	56°14.09'N	19°18.11'E	132	127 m
EMB346_82-01	TF0250	17.08.	ROS/CTD	04:04	56°05.00'N	19°10.04'E	124	121 m
EMB346_83-01	TF0265	17.08.	ROS/CTD	05:36	55°57.51'N	19°02.80'E	111	108 m
EMB346_84-01	TF0253	17.08.	ROS/CTD	07:05	55°50.35'N	18°51.94'E	101	98 m
EMB346_85-01	TF0252	17.08.	ROS/CTD	08:25	55°51.99'N	18°38.37'E	113	111 m
EMB346_86-01	TF0258	17.08.	ROS/CTD	09:56	55°43.65'N	18°45.92'E	89	88 m
EMB346_87-01	TF0255	17.08.	ROS/CTD	11:15	55°37.97'N	18°35.99'E	95	92 m
EMB346_88-01	TF0259	17.08.	ROS/CTD	12:33	55°32.98'N	18°24.11'E	89	87 m
EMB346_88-02	TF0259	17.08.	Apstein 20	12:35	55°32.98'N	18°24.10'E	89	
EMB346_89-01	TF0257	17.08.	ROS/CTD	13:48	55°26.50'N	18°19.23'E	86	85 m
EMB346_90-01	TF0256	17.08.	ROS/CTD	15:00	55°19.59'N	18°14.05'E	76	76 m
EMB346_91-01	TF0268	17.08.	ROS/CTD	16:46	55°18.45'N	17°55.78'E	72	74 m
EMB346_92-01	TF0267	17.08.	ROS/CTD	18:11	55°17.18'N	17°35.68'E	83	82 m
EMB346_93-01	TF0266	17.08.	ROS/CTD	19:30	55°15.17'N	17°21.68'E	88	87 m
EMB346_94-01	TF0222	17.08.	ROS/CTD	21:04	55°13.07'N	17°04.04'E	90	89 m
EMB346_95-01	TF0229	17.08.	ROS/CTD	22:23	55°13.73'N	16°54.86'E	84	84 m
EMB346_96-01	TF0228	17.08.	ROS/CTD	23:26	55°14.25'N	16°46.40'E	76	75 m
EMB346_97-01	TF0227	18.08.	ROS/CTD	00:12	55°15.69'N	16°38.37'E	66	66 m
EMB346_98-01	TF0224	18.08.	ROS/CTD	01:07	55°16.96'N	16°30.02'E	59	59 m
EMB346_99-01	TF0226	18.08.	ROS/CTD	01:46	55°17.75'N	16°25.87'E	56	56 m
EMB346_100-01	TF0225	18.08.	ROS/CTD	02:35	55°15.51'N	16°19.23'E	64	63 m
EMB346_101-01	TF0221	18.08.	ROS/CTD	03:42	55°13.32'N	16°09.92'E	82	81 m
EMB346_102-01	TF0213	18.08.	ROS/CTD	06:00	55°15.07'N	15°58.95'E	89	86 m
EMB346_102-02	TF0213	18.08.	WP-2	06:22	55°15.02'N	15°59.04'E	89	85 m, 3 x Netze
EMB346_102-03								
EMB346_102-04								
EMB346_102-05	TF0213	18.08.	Apstein 50	07:09	55°15.00'N	15°58.95'E	89	85 m, 3 x Netze
EMB346_102-06								
EMB346_102-07								
EMB346_103-01	TF0215	18.08.	ROS/CTD	10:25	54°59.09'N	15°29.90'E	75	74 m
EMB346_104-01	TF0204	18.08.	ROS/CTD	11:53	54°50.69'N	15°22.49'E	69	68 m
EMB346_105-01	TF0154	18.08.	ROS/CTD	14:48	54°36.89'N	14°45.88'E	44	43 m
EMB346_106-01	OB-Boje	18.08.	ROS/CTD	19:39	54°05.07'N	14°08.98'E	12	12 m
EMB346_107-01	TF0109	19.08.	ROS/CTD	02:48	55°00.00'N	14°04.94'E	46	46 m
EMB346_108-01	ABBoje	19.08.	ROS/CTD	04:18	54°52.76'N	13°51.43'E	43	42 m
EMB346_109-01	TF0113	19.08.	ROS/CTD	06:10	54°55.51'N	13°29.99'E	44	44 m
EMB346_109-02	TF0113	19.08.	WP-2	06:33	54°55.54'N	13°30.00'E	44	3 x Netze
EMB346_109-03								
EMB346_109-04								
EMB346_110-01	TF0030	19.08.	ROS/CTD	10:12	54°43.39'N	12°47.09'E	19	21 m
EMB346_111-01	TF0001	19.08.	ROS/CTD	10:55	54°41.78'N	12°42.01'E	18	19 m
EMB346_112-01	TF0046	19.08.	ROS/CTD	13:36	54°28.20'N	12°14.65'E	25	26 m
EMB346_112-02	TF0046	19.08.	WP-2	13:52	54°28.19'N	12°14.59'E	25	2 x Netze (10 m, 26 m)
EMB346_113-01	TF0012	19.08.	WP-2	17:16	54°18.94'N	11°33.00'E	21	2 x Netze (10 m, 20 m)
EMB346_113-01	TF0012	19.08.	ROS/CTD	17:36	54°18.94'N	11°33.01'E	22	22 m

7.2 Profile Station List

Station No.	Profile Station No.	Date	Time	Latitude	Longitude	Bottom	Profile numbers
EMB		2024	[UTC]			[m]	
EMB346_01-01	01	06.08.	8:11	54°13.93'N	12°04.56'E	11	CTD_0001_2
EMB346_02-01	02	06.08.	12:59	54°33.13'N	11°19.05'E	25	CTD_0002_2
EMB346_04-01	04	06.08.	16:09	54°39.54'N	10°46.88'E	20	CTD_0003_2
EMB346_05-01	05	06.08.	17:51	54°36.03'N	10°26.92'E	15	CTD_0004_2
EMB346_07-01	07	06.08.	23:57	54°35.70'N	11°00.80'E	24	CTD_0005_2
EMB346_08-01	08	07.08.	02:57	54°28.41'N	11°29.01'E	23	CTD_0008_2
EMB346_09-01	09	07.08.	06:15	54°06.61'N	11°10.47'E	20	CTD_0009_2
EMB346_10-01	10	07.08.	08:38	54°18.91'N	11°32.86'E	21	CTD_0010_2
EMB346_11-01	11	07.08.	11:04	54°23.48'N	11°49.42'E	19	CTD_0012_2
EMB346_12-01	12	07.08.	12:30	54°24.37'N	12°03.66'E	16	CTD_0013_2
EMB346_13-01	13	07.08.	13:51	54°28.22'N	12°14.52'E	25	CTD_0014_2
EMB346_14-01	14	07.08.	15:13	54°33.01'N	12°16.51'E	22	CTD_0015_2
EMB346_16-01	16	07.08.	18:06	54°36.30'N	12°19.82'E	17	CTD_0016_2
EMB346_17-01	17	07.08.	19:00	54°38.98'N	12°26.95'E	15	CTD_0017_2
EMB346_18-01	18	07.08.	20:46	54°43.43'N	12°46.98'E	20	CTD_0018_2
EMB346_19-01	19	07.08.	22:57	54°47.69'N	13°03.56'E	27	CTD_0020_2
EMB346_20-01	20	08.08.	00:20	54°51.60'N	13°16.64'E	42	CTD_0021_2
EMB346_21-01	21	08.08.	01:49	54°55.52'N	13°30.00'E	45	CTD_0022_2
EMB346_21-05	21	08.08.	02:47	54°55.49'N	13°29.95'E	44	CTD_0023_2
EMB346_22-01	22	08.08.	03:48	55°01.49'N	13°36.40'E	44	CTD_0024_2
EMB346_23-01	23	08.08.	04:52	54°59.32'N	13°46.25'E	45	CTD_0025_2
EMB346_24-01	24	08.08.	05:49	55°04.09'N	13°48.80'E	43	CTD_0026_2
EMB346_25-01	25	08.08.	06:51	55°03.76'N	13°48.80'E	44	CTD_0027_2
EMB346_26-01	26	08.08.	07:57	54°59.98'N	14°05.02'E	45	CTD_0028_2
EMB346_27-01	27	08.08.	10:17	54°48.18'N	13°57.16'E	37	CTD_0029_2
EMB346_28-01	28	08.08.	20:19	55°09.55'N	14°15.76'E	44	CTD_0030_2
EMB346_29-01	29	08.08.	21:56	55°15.40'N	14°29.47'E	42	CTD_0031_2
EMB346_30-01	30	08.08.	23:38	55°23.03'N	14°35.07'E	71	CTD_0034_2
EMB346_31-01	32	09.08.	00:47	55°28.02'N	14°43.03'E	67	CTD_0035_2
EMB346_32-01	32	09.08.	02:03	55°31.97'N	14°55.00'E	75	CTD_0036_2
EMB346_33-01	33	09.08.	03:06	55°29.72'N	15°05.56'E	84	CTD_0037_2
EMB346_34-01	34	09.08.	04:40	55°22.95'N	15°19.99'E	90	CTD_0038_2
EMB346_35-01	35	09.08.	05:35	55°03.80'N	15°28.00'E	93	CTD_0039_2
EMB346_36-01	36	09.08.	07:15	55°18.15'N	15°47.90'E	94	CTD_0040_2
EMB346_37-01	37	09.08.	08:30	55°15.05'N	15°59.05'E	89	CTD_0041_2
EMB346_37-12	37	09.08.	11:24	55°15.00'N	15°58.98'E	89	CTD_0042_2
EMB346_38-01	38	11.08.	06:26	57°09.79'N	17°19.51'E	67	CTD_0043_2
EMB346_40-01	40	11.08.	11:48	57°03.37'N	18°06.40'E	22	CTD_0044_2
EMB346_41-01	41	11.08.	17:30	57°42.99'N	17°22.05'E	141	CTD_0046_2
EMB346_42-01	42	11.08.	21:01	57°59.98'N	18°00.11'E	165	CTD_0048_2
EMB346_43-01	43	11.08.	23:50	58°19.53'N	18°04.23'E	146	CTD_0049_2
EMB346_44-01	44	12.08.	02:41	58°34.98'N	18°13.85'E	453	CTD_0050_2
EMB346_44-03	44	12.08.	04:01	58°35.04'N	18°14.03'E	453	CTD_0051_2
EMB346_44-04	44	12.08.	05:29	58°35.03'N	18°13.98'E	453	CTD_0052_2
EMB346_44-05	44	12.08.	08:29	58°35.03'N	18°13.86'E	453	CTD_0053_2
EMB346_45-01	45	12.08.	11:56	58°42.75'N	18°40.31'E	253	CTD_0054_2
EMB346_46-01	46	12.08.	16:12	58°47.01'N	19°06.00'E	129	CTD_0055_2
EMB346_47-01	47	12.08.	20:35	58°51.88'N	19°44.62'E	168	CTD_0056_2
EMB346_48-01	48	13.08.	23:46	58°59.74'N	20°09.71'E	141	CTD_0057_2
EMB346_49-01	49	13.08.	01:12	58°52.98'N	20°18.97'E	165	CTD_0058_2
EMB346_50-01	50	13.08.	02:45	58°45.99'N	20°19.75'E	202	CTD_0061_2
EMB346_51-01	51	13.08.	04:32	58°38.45'N	20°20.68'E	164	CTD_0062_2
EMB346_52-01	52	13.08.	06:27	58°26.49'N	20°20.02'E	123	CTD_0063_2
EMB346_53-01	53	13.08.	08:01	58°20.95'N	20°08.87'E	121	CTD_0064_2
EMB346_54-01	54	13.08.	09:42	58°10.94'N	20°03.78'E	162	CTD_0065_2
EMB346_55-01	55	13.08.	11:32	57°59.99'N	19°54.05'E	196	CTD_0066_2
EMB346_55-03	55		12:40	58°00.01'N	19°53.92'E	196	CTD_0067_2
EMB346_56-01	56	13.08.	13:59	57°50.98'N	19°48.96'E	172	CTD_0068_2

Station No.	Profile Station No.	Date	Time	Latitude	Longitude	Bottom	Profile numbers
EMB		2024	[UTC]			[m]	
EMB346_57-01	57	13.08.	15:29	57°42.91'N	19°51.14'E	129	CTD_0069_2
EMB346_58-01	58	13.08.	17:14	57°37.01'N	20°10.06'E	144	CTD_0070_2
EMB346_59-01	59	13.08.	18:50	57°28.20'N	20°15.56'E	207	CTD_0071_2
EMB346_60-01	60	13.08.	20:09	57°22.05'N	20°19.82'E	223	CTD_0072_2
EMB346_61-01	61	13.08.	21:57	57°19.18'N	20°02.99'E	235	CTD_0073_2
EMB346_61-02	61	13.08.	22:47	57°19.19'N	20°03.00'E	153	CTD_0074_2
EMB346_61-03	61	13.08.	23:28	57°19.18'N	20°02.96'E	85	CTD_0075_2
EMB346_61-04	61	14.08.	00:03	57°19.19'N	20°02.98'E	30	CTD_0076_2
EMB346_61-05	61	14.08.	01:11	57°19.19'N	20°03.03'E	137	CTD_0077_2
EMB346_61-06	61	14.08.	02:25	57°19.21'N	20°03.01'E	30	CTD_0080_2
EMB346_62-01	62	14.08.	04:29	57°12.60'N	19°55.81'E	230	CTD_0082_2
EMB346_63-01	63	14.08.	06:06	57°04.29'N	19°49.83'E	209	CTD_0083_2
EMB346_64-01	64	14.08.	10:18	57°04.41'N	19°01.48'E	114	CTD_0084_2
EMB346_65-01	65	14.08.	11:27	57°01.75'N	19°13.36'E	162	CTD_0085_2
EMB346_66-01	66	14.08.	13:01	57°00.51'N	19°21.37'E	176	CTD_0086_2
EMB346_67-01	67	14.08.	14:21	56°58.81'N	19°34.51'E	167	CTD_0087_2
EMB346_68-01	68	14.08.	16:00	56°56.99'N	19°52.98'E	177	CTD_0088_2
EMB346_69-01	69	14.08.	17:03	56°55.35'N	20°01.10'E	166	CTD_0089_2
EMB346_70-01	70	14.08.	18:11	56°54.93'N	20°12.96'E	146	CTD_0090_2
EMB346_71-01	71	14.08.	19:48	56°51.99'N	20°27.24'E	59	CTD_0091_2
EMB346_72-01	72	14.08.	21:05	56°50.32'N	20°40.90'E	48	CTD_0092_2
EMB346_73-01	73	15.08.	01:06	56°46.12'N	19°45.09'E	155	CTD_0093_2
EMB346_75-01	75	15.08.	13:27	57°02.48'N	21°16.56'E	18	CTD_0094_2
EMB346_77-01	77	16.08.	04:00	57°34.69'N	18°50.89'E	18	CTD_0095_2
EMB346_78-01	78	16.08.	21:53	56°38.02'N	19°35.04'E	145	CTD_0096_2
EMB346_79-01	79	16.08.	23:32	56°29.51'N	19°28.89'E	143	CTD_0099_2
EMB346_80-01	80	17.08.	01:08	56°20.77'N	19°22.76'E	143	CTD_0100_2
EMB346_81-01	81	17.08.	02:40	56°14.09'N	19°18.11'E	132	CTD_0101_2
EMB346_82-01	82	17.08.	04:04	56°05.00'N	19°10.04'E	124	CTD_0102_2
EMB346_83-01	83	17.08.	05:36	55°57.51'N	19°02.80'E	111	CTD_0103_2
EMB346_84-01	84	17.08.	07:05	55°50.35'N	18°51.94'E	101	CTD_0104_2
EMB346_85-01	85	17.08.	08:25	55°51.99'N	18°38.37'E	113	CTD_0105_2
EMB346_86-01	86	17.08.	09:56	55°43.65'N	18°45.92'E	89	CTD_0106_2
EMB346_87-01	87	17.08.	11:15	55°37.97'N	18°35.99'E	95	CTD_0107_2
EMB346_88-01	88	17.08.	12:33	55°32.98'N	18°24.11'E	89	CTD_0108_2
EMB346_89-01	89	17.08.	15:00	55°19.59'N	18°14.05'E	76	CTD_0109_2
EMB346_90-01	90	17.08.	16:46	55°18.45'N	17°55.78'E	72	CTD_0110_2
EMB346_91-01	91	17.08.	18:11	55°17.18'N	17°35.68'E	83	CTD_0111_2
EMB346_92-01	92	17.08.	19:30	55°15.17'N	17°21.68'E	88	CTD_0112_2
EMB346_93-01	93	17.08.	21:04	55°13.07'N	17°04.04'E	90	CTD_0113_2
EMB346_94-01	94	17.08.	22:23	55°13.73'N	16°54.86'E	84	CTD_0114_2
EMB346_95-01	95	17.08.	23:26	55°14.25'N	16°46.40'E	76	CTD_0117_2
EMB346_96-01	96	18.08.	00:12	55°15.69'N	16°38.37'E	66	CTD_0118_2
EMB346_97-01	97	18.08.	01:07	55°16.96'N	16°30.02'E	59	CTD_0119_2
EMB346_98-01	98	18.08.	01:46	55°17.75'N	16°25.87'E	56	CTD_0120_2
EMB346_99-01	99	18.08.	02:35	55°15.51'N	16°19.23'E	64	CTD_0121_2
EMB346_100-01	100	18.08.	03:42	55°13.32'N	16°09.92'E	82	CTD_0122_2
EMB346_101-01	101	18.08.	02:35	55°15.51'N	16°19.23'E	64	CTD_0123_2
EMB346_102-01	102	18.08.	06:00	55°15.07'N	15°58.95'E	89	CTD_0124_2
EMB346_103-01	103	18.08.	10:25	54°59.09'N	15°29.90'E	75	CTD_0125_2
EMB346_104-01	104	18.08.	11:53	54°50.69'N	15°22.49'E	69	CTD_0126_2
EMB346_105-01	105	18.08.	14:48	54°36.89'N	14°45.88'E	44	CTD_0127_2
EMB346_106-01	106	18.08.	19:39	54°05.07'N	14°08.98'E	12	CTD_0128_2
EMB346_107-01	107	19.08.	02:48	55°00.00'N	14°04.94'E	46	CTD_0131_2
EMB346_108-01	108	19.08.	04:18	54°52.76'N	13°51.43'E	43	CTD_0132_2
EMB346_109-01	109	19.08.	06:10	54°55.51'N	13°29.99'E	44	CTD_0133_2
EMB346_110-01	110	19.08.	10:12	54°43.39'N	12°47.09'E	19	CTD_0134_2
EMB346_111-01	111	19.08.	10:55	54°41.78'N	12°42.01'E	18	CTD_0135_2
EMB346_112-01	112	19.08.	13:36	54°28.20'N	12°14.65'E	25	CTD_0136_2
EMB346_113-01	113	19.08.	17:36	54°18.94'N	11°33.01'E	22	CTD_0137_2

8 Data and Sample Storage and Availability

All data 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. Afterwards the data will be delivered to national and international databases (MUDAB, HELCOM, ICES).

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, <https://creativecommons.org/licenses/by/4.0/>) data license of type CC 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	01.05.2025	01.05.2025	volker.mohrholz@io-warnemuende.de
Nutrient data	ODIN	01.05.2025	01.05.2025	joachim.kuss@io-warnemuende.de
Biological data	MUDAB	01.08.2025	01.12.2025	joerg.dutz@io-warnemuende.de

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10 References

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