ELISABETH MANN BORGESE-Berichte

Baltic Sea Long-term Observation Programme

Cruise No. EMB328

02.11.2023 – 14.11.2023
Rostock-Marienehe (Germany) – Rostock-Marienehe (Germany)
BalticObs.

Michael Naumann. Jens Faber. Johann Ruickoldt. Lars Kreuzer. Ines Hand. Madlen Dierken. Nelly J. Bimberg. Christin Fechtel. Harshada Sakpal. Alexandra Dürwald. Laura Catalina Torres Martin. Frank Pohl. Uwe Hehl. Mareike Floth-Petersen

Chief Scientist
Dr. Michael Naumann
Leibniz-Institute for Baltic Sea Research Warnemünde

2023

Table of Contents

1. Cruise summary

1.1 Summary in English

This campaign of measurements is the fifth one in a series of five annual cruises to study the spatial and temporal variations of the Baltic Sea ecosystem. The work programme consisted of field data acquisition for the national environmental monitoring in the German EEZ as contract work for the Federal Maritime Agency (BSH). The second work package is part of IOW's Baltic Sea long-term observation program. performed since 1969 by this institute and its predecessor. The data acquired are the back bone of research on the natural variability as well as anthropogenic influences and are used for the regular national and international assessments of the state of the Baltic Sea (HELCOM 2023. NAUMANN et al. 2024).

During this expedition 80 stations (89 CTD casts. water sampling for hydrochemical and hydrobiological parameters and six scanfish transects) were measured from the western to the central Baltic Sea. The usually performed dense grid of vertical CTD casts along the so called "thalweg transect" was measured partly by scanfish profiles of 240 NM in total from the Bornholm Gat to Eastern Gotland Basin. Four moorings were maintained in the Eastern Gotland Basin. The cruise was performed in mostly appropriate weather conditions. All 13 days showed conditions mostly below 6 Bft (mean: 7.6 m/s; 4 Bft). Only 5 hours of 7 Bft occurred. From November 8th-9th we stayed 18 hours anchored at the bay of Östergarn (Gotlands eastern shoreline) "waiting on weather" because of larger swell from southsouthwestern direction. Nearly all of the planned work programme were realised.

1.2 Zusammenfassung

Die Messkampagne ist die Dritte von fünf jährlichen Expeditionen zur Erfassung der räumlich-zeitlichen Variabilität des Ökosystems Ostsee. Das wissenschaftliche Programm beinhaltet die Felddatenerfassung für die nationale Umweltüberwachung in der deutschen AWZ. basierend auf einem Vertrag mit dem Bundesamt für Seeschifffahrt und Hydrographie (BSH). Das zweite Arbeitspaket ist Teil des Ostsee-Langzeitbeobachtungsprogramms des IOW. das kontinuierlich seit 1969 vom Institut und seines Vorgängerinstituts durchgeführt wird. Die gewonnenen Daten bilden die Basis der Forschung zur natürlichen Variabilität sowie anthropogenen Einflüssen und werden für regelmäßige nationale und internationale Bewertungen des Umweltzustandes der Ostsee verwendet (HELCOM 2023. NAUMANN et al. 2024).

Im Verlauf der Expedition wurden 80 Stationen (89 CTD casts. Wasserbeprobung für hydrochemische und meeresbiologische Parameter sowie 6 Scanfish Transekte) im Gebiet von der westlichen Ostsee bis in die zentrale Ostsee gemessen und beprobt. Das „Thalweg Transekt", gewöhnlich erfasst durch eine dichte Abfolge von vertikalen CTD's, wurde im Teilbereich vom Bornholm Gatt bis in das östliche Gotland Becken mit Scanfish-Profilen von insgesamt 240 NM gemessen. Zusatzlich wurden vier Langzeit-Verankerungen im östlichen Gotland Becken gewartet. Die Expedition war hauptsächlich von guten Witterungsverhältnissen geprägt. Alle 13 Seetage hatten Arbeitsbedingungen von meistens unter 6 Bft Wind (Mittelwert: 7.6 m/s; 4 Bft) und nur 5 Stunden hatten eine Windstärke von 7 Bft. Am 8.-9. November führte hohe Dünung aus Südsüdwest zu Ausfallzeiten von 18 Stunden, die in der Bucht von Östergarn (Ostküste Gotlands) vor Anker liegend abgewettert wurden. Fast das gesamte geplante Arbeitsprogramm konnte umgesetzt werden.

2. Participants

2.1 Principal Investigators

Name	Institution
Naumann. Michael. Dr. (Physical Oceanography)	IOW
Mohrholz. Volker. Dr. (Physical Oceanography)	IOW
Kuss. Joachim. Dr. (Marine Chemistry – nutrients)	IOW
Waniek Joanna J.. Prof. (Marine Chemistry)	IOW
Kremp. Anke. Dr. (Marine Biology – phytoplankton)	IOW
Dutz. Jörg. Dr. (Marine Biology – zooplankton)	IOW

2.2 Scientific Party

Name	Discipline	Institution
Naumann. Michael. Dr.	Physical Oceanography/chief scientist	IOW
Faber. Jens. Dr.	Physical Oceanography	IOW
Ruickoldt. Johann	Instrumentation group	IOW
Kreuzer. Lars	Marine Chemistry	IOW
Dierken. Madlen	Marine Chemistry	IOW
Bimberg. Nelly Johanna	Marine Chemistry	IOW / Leipzig University
Fechtel. Christin	Biological Oceanography	IOW
Sakpal. Harschada (2.-4.11.)	Marine Chemistry	IOW
Dürwald. Alexandra. Dr. (2.-4.11.)	Biological Oceanography	Greifswald University
Torres Martin. Laura Catalina (2.-4.11.)	Biological Oceanography	Greifswald University
Pohl. Frank (2.-4.11.)	Biological Oceanography	IOW
Hehl. Uwe (4.-14.11.)	Biological Oceanography	IOW
Floth-Petersen. Mareike (4.-14.11.)	Marine Chemistry	IOW

2.3 Participating Institutions

IOW	Leibniz Institute for Baltic Sea Research Warnemünde. Germany
EMAU	Ernst Moritz Arndt University Greifswald. Germany
LU	Leipzig University. Germany

3. Research Program

3.1 Description of the Work Area

The area under investigation of the cruise EMB328 covered the western to central Baltic from the Kiel Bight to the Northern Gotland Basin. An overview of the locations of CTD stations and the cruise track is given in Figure 3.1. A station list is given in Table 7.1.

The majority of stations is located along the thalweg transect of the Baltic Sea (stations: EMB328_14 to EMB340_42 and the scanfish profiles EMB328_56 to EMB328_67) describing the hydrographic. hydrochemical and biological conditions in all basins on the pathway of saltwater inflows from the North Atlantic (Fig. 5.15 to Fig. 5.19). These inflows are the solely source for ventilation of the deep basins (MATTHÄUS et al. 2008). During this cruise the transect was measured partly by scanfish profiles from Bornholm Gat to Eastern Gotland Basin (240 NM) instead of the usual succession of dense vertical CTD measurements of every 1 NM distance. Using this technique, we lost the lowermost 2-3 m of data in the bottom water avoiding touch downs of the device, but we gain much more horizontal resolution in this area (Fig. 5.15 to Fig. 5.19). In the centre of the Eastern Gotland Basin and Western Gotland Basin two permanently planned west-east transects of scanfish profiles had to be skipped due to timely reasons and swell from southern direction. They are intended to gather information about the cross basin distribution of hydrographic parameters in the main basin of the Baltic proper. These perpendicular transects of high-resolution measurements contributes to the understanding of small-scale processes on the basin wide dynamics.

3.2 Aims of the Cruise

The performed meteorological. hydrographic. hydrochemical and hydrobiological sampling and measurements lead to an assessment of the actual autumn situation of the Baltic Sea ecosystem from Kiel Bight to the Northern Gotland Basin. EMB328 is the fifth cruise in the year 2023 of five annually expeditions.

In the frame of the COMBINE Programme of the Helsinki Commission (HELCOM). national monitoring demands to evaluate the status of Germany’s coastal regions in North and Baltic Sea (BMLP) are conducted as contract work for the Federal Maritime and Hydrographic Agency (BSH) in German territorial waters and the Exclusive Economic Zone as well as bordering sea areas of Denmark and Sweden in the western Baltic Sea. Due to scientific interests, analysing variations and trends of the Baltic ecosystem as a whole, the IOW extends the investigated sites by its long-term observation programme. Stations in Danish, Swedish, Polish and Latvian territorial waters and their respective Exclusive Economic Zones are continuously sampled within this programme since the year 1969.

The acquired data are used for regular national and international assessments of the state of the Baltic Sea (e.g. HELCOM 2023. NAUMANN et al. 2024). are analysed in numerous publications and provide the scientific basis for measures to be taken for the protection of the ecosystem Baltic Sea.

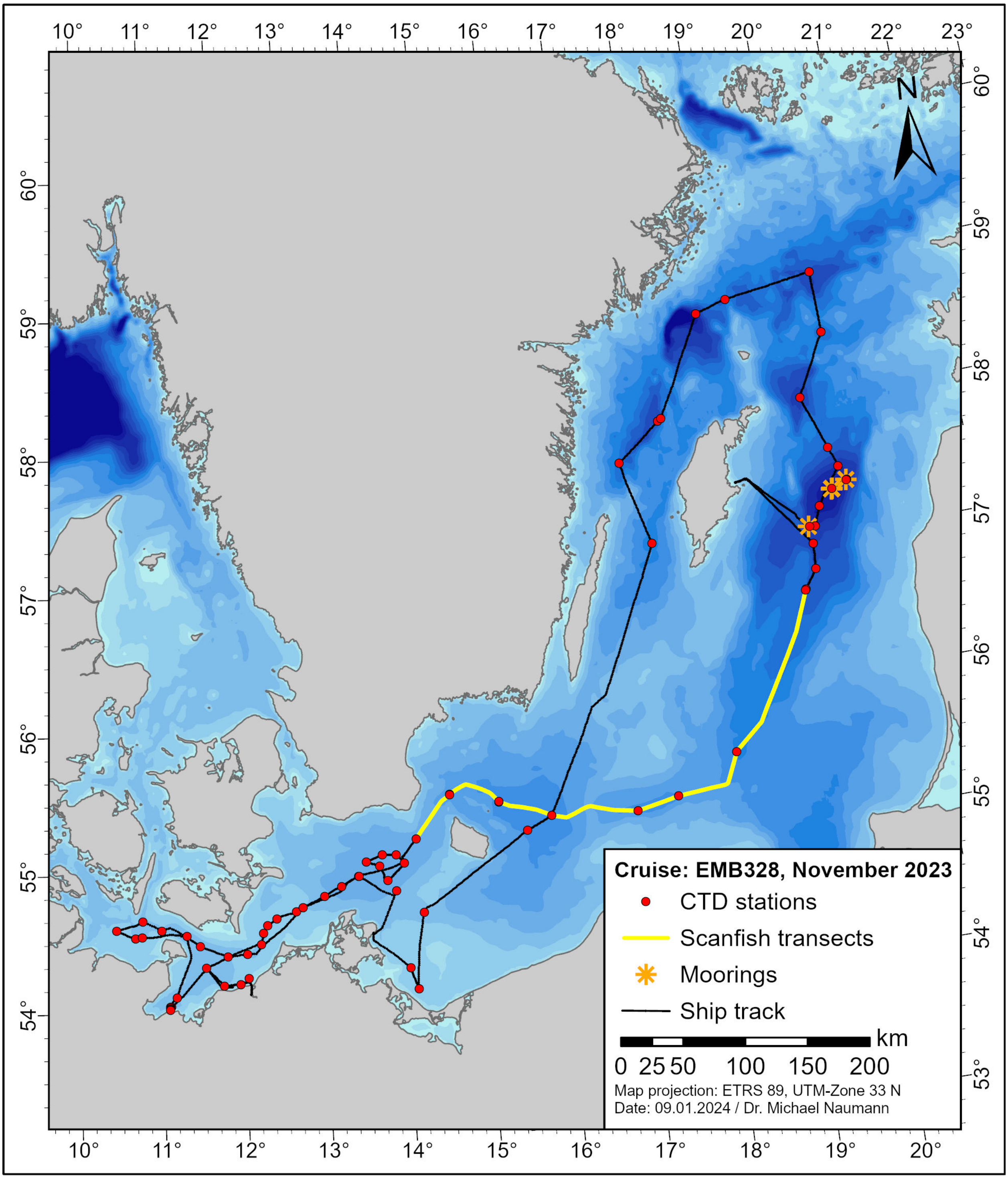

Fig. 3.1 Track chart of RV ELISABETH MANN BORGESE and map of stations of cruise EMB328 from 2. November – 14. November 2023. CTD stations are marked by red points, Scanfish transects as yellow lines, moorings as orange asterisk and ship track as black line. The bathymetry basemap was interpolated as 200x200 m grid from the dataset SEIFERT et al. 2008).

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 Sea and took first measurements and sampling at key stations of the Mecklenburg Bight, Lübeck Bight, Kiel Bight, Kadet Trench, Darss Sill, Arkona Basin and Oder Bank (November 2nd – 5th). From November 5th onwards up to

November 12th we continued with the IOW's Baltic Sea long-term observation program starting in the Bornholm Basin and turning clockwise around the isle of Gotland. Usually we turn antcklockwise and follow the deepwater pathway of inflows through the central Basins, but the windy weather forecast for the Eastern Gotland Basin and the goal to have calm /appropriate conditions for mooring work in this region forced us to turn first to the stations in the Western Gotland Basin. We started the thalweg transect from northern direction at station EMB328_42 at November 7th. November 8th to 10th we measured and sampled the Eastern Gotland Basin and maintained four permanent moorings (Table 7.4 and appendices). From 140 m to 50 m water depth we continued the thalweg transect in southwestern direction by scanfish profiles (Table 7.3), only interrupted by vertical CTD's at key stations for chemical and biological water sampling (EMB328_57, 59, 60, 62, 64, 66). At the end of the cruise we measured the key stations in the Arkona Basin, Darss Sill, Kadet Trench and Mecklenburg Bay a second time as repetitional sampling after more than a week as part of the national monitoring program (November 13th).

Both programs consist mainly of CTD casts, water sampling for nutrient analysis, trace gas measurements and net sampling of phytoplankton and zooplankton, described below in detail.

The standard measurements

The work on the stations usually started with a CTD cast and programmed sampling during the down cast on standard depth levels for chemical and biological parameters. Manual releases in near-bottom waters and close to the sea surface completed the sampling. At key stations for example the Bornholm Deep, Gotland Deep and so on multiple CTD casts followed on demand to meet the additional water sample requirements. A detailed list of all CTD measurements are given in Table 7.1. At these key stations. water sampling was carried out for dissolved oxygen. basic dissolved inorganic nutrients. total nutrient concentrations. as well as net sampling for phytoplankton and zooplankton species were carried out. Moreover. determinations of chlorophyll and the depth of visibility by means of a Secci disk were also done. For the detailed list of sampling see Table 7.2.

Additional programme:

Long-term observation of the microbiological habitat of the redoxcline

Insights into the changes of the microbial food web of the redoxcline is obtained by well resolved sampling of the range of the redoxcline at Gotland Deep (TF0271) and Landsort Deep (TF0284) stations on each monitoring cruise. During this cruise TF0284 could not be sampled for reasons of permissions. Therefore, in the redoxcline as well as 6 depths above and below, respectively, in depth intervals of 2 m samples were taken by CTD/water sampling bottles and prepared for microbiological analysis (FISH and DNA) and determination of pigments (Responsible scientist: Prof. Klaus Jürgens).

UV-Filter

Sampling of ten stations in the western Baltic Sea for the PhD Thesis "Identification of UV Filter enrichment areas in the Baltic Sea - Investigation of transport processes and long-term sinks in water and sediment" done by Harshada Sakpal and supervised by Prof. Detlef Schulz-Bull (IOW). Dr. Kathrin Fisch (Julius Kühn-Institut. Berlin) and Dr. Marion Kanwischer (IOW). Water samples were taken at the surface. ChlAmax. and bottom layer for the following stations. 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 was used to analyze the UV Filters. The samples were filtered using Chromabond cartridges on board and further, extracted and analyzed using LC-MS/MS at Julius Kühn-Institut, Berlin.

eDNA sampling

Sampling for building up an eDNA-archive of samples for analysis of metazoan and microorganisms. The water sampling was done at 11 stations in the western Baltic by Alexandra Dürwald, Laura C. Torres Martin (Greifswald University), supervised by Matthias Labrenz (IOW). Water samples were taken at the surface (2 l) and bottom (2 l) and filtered with mesh sizes of 0.45 µm Filter (Whatman). 0.45 µm filter from Sartorius and 0.2 µm (Isopore) and stored in Eppendorf safe-lock tubes and freeezed to -20 °C.

TOC sampling in surface sediments

At station EMB328_38 two Frahmlot cores of seabed sediments up to 60 cm depth were taken for analyzing the total organic contend of the upper 10-20 cm. It is part of a mapping program of the central Baltic basins (Responsible scientist: Dr. Matthias Moros).

Sustainability and mitigation

The marine environment was less disturbed by performed scientific tasks during this cruise. No sampling in marine protected areas was done. Only sensor measurements and water sampling in the water column for chemical and biological parameters were performed. No chemicals were released in the water column (e.g. tracer experiments), no devices were lost (marine trash) and no hydroacoustic measurements were performed (underwater noise).

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)
- Towed CTD Scanfish MKIII (SCF)
- Phytoplankton net, 10 µm mesh size (PLA)
- Zooplankton Apstein net, 55 µm mesh size (APNET)
- Zooplankton net, 100 µm mesh size (WP2)
- Secci desk (SD)

Continuous measurements:

- Underway measurements of surface water properties
- Ship weather station

This ship based data set consists of one minute averages of: time (UTC), latitude and longitude, ships heading, depth, air pressure, wind direction, wind speed, air temperature, humidity, global radiation, infrared radiation, surface conductivity, surface salinity, surface water temperature, surface chlorophyll-a fluorescence, surface turbidity.

4. Narrative of the Cruise

This paragraph is aimed to give an impression of the work on board during the campaign. It is a day by day report that includes the weather conditions and sea state. All times are given in UTC.

Wednesday, 1st November 2023: Loading and transport of equipment started at 07:00. Depacking was finished around 11:30 and all devices and laboratories were prepared at 15:30.

Day 1, Thursday, 2nd November 2023: Mecklenburg Bight – Lübeck Bight - Fehmarnbelt
Embarking of the scientific crew was done between 06:30. Departure of the peer Rostock-Marienehe and start of the cruise was in time at 07:00 (8 Local) followed by safety instructions 07:45 to 08:15. At 08:15 -08:50 started the station work at TF005 two nautical miles northerly of Warnemünde. The weather situation in the Mecklenburg Bay was 10.5 °C air temperature, 999 hPa air pressure, 83 % humidity, cloudy and southeasterly wind of 130°, 10-11.5 m/s (5 Bft) with a sea state of 1 m swell. The sea surface temperature was around 11 °C. It followed a westward directed routeing for measurements at the stations TF0018, TF0012 in the Mecklenburg Bay. The wind conditions increased during the afternoon to 12-14 m/s (6 Bft), gusts up to 18 m/s (8 Bft) with 1.5 m sea state. During the evening a CTD transect from North to South was measured at the Telemetry array in front of the cliff section at the northwestern coastline of Boltenhagen. At 21:10 the key station TF0022 of the Lübeck Bight was measured. Afterwards we turned northwards to the Fehmarnbelt.

Day 2, Friday, 3rd November 2023: Kiel Bight – Mecklenburg Bight – Kadet Trench
At 00:45 we reached the key station at the Fehmarnbelt (TF0010) and went to the stations in the Kiel Bight (TF0014, TF360). The key station Kiel Bight – TF0360 was measured and sampled for phytoplankton and benthic fauna between 05:30 to 07:10. At Kiel Bight the weather conditions in morning (08:30) were sunny, air pressure of 981 hPa, air temperature of 10 °C and 74 % humidity. The sea surface temperature showed 11 °C and surface salinity of 19.5 g/kg. Strong winds of 14-15 m/s (7 Bft) blew from southsoutheastern direction (160°) with sea state of 1-1.5 m swell. Later, two stations in the west of Fehmarn were sampled by Frahmlot and grab sampler for the BMBF project “MGF Ostsee”, before we went back to the Fehmarnbelt to get benthic-fauna samples at TF0010 under daylight conditions, which we delayed in the night before (14:10 to 15:10 UTC). The weather situation at the Fehmarnbelt (14:15) was: sunny to cloudy, air pressure of 984 hPa, air temperature of 11 °C and 73 % humidity, 11 °C sea surface temperature, 10 m/s wind (5 Bft) from SSW (205°) and a sea state of 1 m. From now onwards our so called “thalweg transect” to the central Baltic basins had started. The stations TF0013 and TF0017 in central Mecklenburg Bight followed. At 19:30 we reached the Kadet Trench and measured the stations TF0041, TF0046, TF0083, TF0033 up to midnight.

Day 3, Saturday, 4th November 2023: Darss Sill – Arkona basin
Station TF0001 at the Darss Sill was sampled from 00:05 to 00:30 in the night. Next Station TF0002 is the position of the autonomous platform MARNET Darss Sill where we did a reference CTD and dissolved oxygen samples for quality management of these platform, where sensor packages a mounted in seven discrete depths. In addition, we had to check with the spotlights of our ship if the solar cells and wind generators are in good condition after the storm and storm flood

October 20th, where swell up to 4.5 m hit this station. Three out of six cells left and one wind generator out of two was damaged. This information was very valuable for our colleagues of the MARNET team, which are one cruise after us for maintenance of these permanent stations. Afterwards we reached the western part of the Arkona basin and measured the following stations: TF0030 (03:10-4:35) as key station with chemical and biological sampling, TF0115 (05:50), TF0114 (07:10) and key station TF0113 of the central basin (08:25-10:00). The weather conditions at 08:30: cloudy, air temperature 8.4 °C, air pressure of 986 hPa, 81 % humidity, 10 °C sea surface temperature. salinity of 8.2 g/kg. 9-10 m/s wind (5 Bft) from SSW (210°) and a sea state of 1.5 m swell. Next station was TF0112 at the southern slope of the Arkona basin (12:20). The wind forecast for the afternoon showed increasing winds up to 7-8 Bft. We stopped our programme and went a bit earlier than planned to Saßnitz harbour at the eastern coastline of Rügen island for personal exchange. The weather conditions at 13:00 in the southern Arkona basin: cloudy, air temperature 9.2 °C, air pressure of 987 hPa, 76 % humidity, 11 °C sea surface temperature, salinity of 8.5 g/kg, 9 m/s wind (5 Bft), single gusts up to 7 Bft from southern direction (195°) and a sea state of 1.50 m swell. At 15:30 we reached Saßnitz harbour.
Exchange of scientific crew at 17:00: A. Dürwald, L. Torres Martin, H. Sakpal, F. Pohl left like planned and I. Hand was a bit ill. Our colleagues M. Floth-Petersen and U. Hehl came onboard for planned mooring work in the eastern Gotland basin. Because of strong southeasterly winds up to 17 m/s we stayed in Saßnitz for the night.

Day 4, Sunday, 5th November 2023: Oder Bank – Bornholm basin
Departure of Saßnitz harbour /Rügen island at 07:00 with routeing southeastwards to Oder Bank. The weather conditions at Oder Bank (08:00): cloudy, air temperature 9.1 °C, air pressure of 977 hPa, 89 % humidity, 10 °C sea surface temperature, salinity of 8.4 g/kg, 9-10 m/s wind (5 Bft) from southsoutheastern direction (170°) and a sea state of 1 m swell. At 09:15 we reached station TF0160 close to the island Greifswalder Oie for a CTD measurement and grab sampling for benthic fauna analysis and afterwards station OB-Boje (MARNET station Oder Bank) for a reference CTD at the autonomous platform and water sampling for analaysis of UV-filters. Afterwards we turned northwards for sampling at the Rönne Bank. The weather conditions at 14:30 showed an air temperature of 10.7 °C, air pressure of 979 hPa, 86 % humidity, 10 °C sea surface temperature, salinity of 8.2 g/kg, 6-7 m/s wind (4 Bft) from southeastern direction (156°) and a sea state of 0.75 m swell. Station TF0152 at the Rönne Bank was reached at 15:15 and a CTD measurement and grab sampling for benthic fauna was done. Afterwards we left that region with routeing northeast to the Bornholm basin. Station TF0214 at the central deep part of the Bornholm basin was reached at 22:30. Hydrogen sulphide was found at water sampling close to the sea floor (90 m water depth).

Day 5, Monday, 6th November 2023: Bornholm basin – Western Gotland basin
The key station TF0213 – Bornholm Deep was reached at 01:00 for CTD and intense sampling of nutrients and phytoplankton. Multiple net sampling was done in three different mesh sizes for sampling of zooplankton. Because of a forecast of strong winds during the next two days we decided to move northwards in the western Gotland basin, where appropriate weather conditions were predicted. A longer transit began. The weather conditions at 09:30 in the northern part of the Bornholm basin were as follows: cloudy, air temperature 9.9 °C, air pressure of 989 hPa, 93 %

humidity, 9 °C sea surface temperature, salinity of 7.5 g/kg, 8-9 m/s wind (5 Bft) from western direction (260°) and a sea state of 1 m swell. During the day fog occurred. At 17:30 we reached the Karlsö Deep (key station TF0245) in the south of the western Gotland basin and took water samples for chemical parameters. Later on station TF0242 in central part was measured by CTD at 22:40.

Day 6, Tuesday, 7th November 2023: Western Gotland basin – Northern Gotland basin
Moving on northwards in the Western Gotland basin we reached station OCWG-1 at 01:15. where we have taken two sediment cores with the Frahmlot for project work in the geology department. Closeby, we sampled key station TF0240 for nutrient parameters. ammonium and hydrogen sulphide (02:45-03:45). As well we did CTD comparison measurements. The next station would have been the Landsort Deep of 460 m water depth (key station TF0284), but Swedish authorities didn’t give us the permission for this station in their inner territorial waters this time. We turned our routeing to Northeast and entered the northern Gotland basin and measured the stations nGB-1 (08:45), TF283 (11:15). The weather situation at 12:00 was sunny to cloudy, 8.5 °C air temperature, 1000 hPa air pressure, 82 % humidity. The sea surface temperature was 9.5 °C and surface salinity 6.9 g/kg. The wind blew with 8-9 m/s (5 Bft) from western direction (260°) and formed a sea state of 1-1.5 m swell. At 16:15 we reached the northernmost station of this expedition TF0282. The wind and sea state conditions calmed slightly down during the afternoon. At 18:00 wind decreased to 4 Bft and sea state was about 1 m. We turned southwards and started the “thalweg” transect through the central basins from the North. Station TF0285 was measured at 20:05 and we reached the Faro Deep (key station TF286) at 23:00 taking two CTD casts for several chemical parameters (nutrients. ammonium. hydrogen sulphide and trace gases).

Day 7, Wednesday, 8th November 2023: Eastern Gotland basin
After midnight we reached the Eastern Gotland basin and measured the northerly stations TF0270 (3:40) and TF0276 (5:00). The daylight conditions were used for mooring work. At 07:00-07:30 the GODESS mooring (protocol see attachment 12.1) was deployed at its planned position two nautical miles easterly of key station Gotland Deep (TF0271). The weather in the eastern Gotland Basin at 08:00 was cloudy, air pressure of 1005 hPa, air temperature of 9.6 °C and 89 % humidity. The sea surface temperature showed 10.5 °C and surface salinity of 7.3 g/kg. Moderate winds of 7-8 m/s (4 Bft) blew from southwestern direction (228°) with sea state of 1-1.5 m swell. Afterwards the mooring Gotland Northeast (GONE) at the eastern slope of the basin was recovered (08:30-09:25) before we went back to the Gotland Deep for recovering the mooring Gotland Central (GOCE) at lunchtime (10:15-11:00). Maintenance of these moorings was done at the deck. In the meantime, we moved 2 NM westwards to the Gotland Deep key station TF0271 and measured three CTD’s for chemical and biological parameters, did 3 plankton nets and a Secchi depth measurement (11:25-12:35). At 13:30 to 14:05 mooring Gotland Central was deployed again at its position and afterwards 8 NM northeastward the mooring Gotland Northeast (14:50-16:30) (protocol see attachments 12.2 and 12.3). A CTD profile was done for comparison and quality management of the mounted sensors at GONE before we went back to the Gotland Deep. The weather conditions during the afternoon stayed calm with marginal changes to the morning. Relatively warm temperatures, sunshine to cloudy conditions were perfect for working at the deck. After sunset station work continued at TF271 with 5 CTD’s for sampling of hydrogen sulphide,

nutrients, trace gasses and microbiological samples from 17:00 to 21:00. Heading southwards, station TF0275 was measured close to midnight (23:00).

Day 8, Thursday, 9th November 2023: Eastern Gotland basin

Station TF275 followed (00:00-01:00) and hydrogen sulphide sampling and CTD sensor comparison was done for ensure data quality. Afterwards we stayed in that area and moved slightly eastwards to the position of mooring Gotland Southwest. After sunrise a CTD was done (06:30) for comparison to the sensor data of the mooring before recovery started at 07:00. The weather conditions in the eastern Gotland basin stayed calm with windspeeds around 8 m/s (5Bft) from 221° (SW) showing some first white caps. The swell was the same like the day before (1-1.5 m) but of longer wave length. Air temperature was 9 °C, 1006 hPa air pressure and 86 % humidity. Sunny to cloudy conditions continued and sea surface temperature showed 10 °C and a salinity of 7.2 g/kg. Maintenance and deployment of Gotland SW was done at 09:10 (protocol see attachment 12.4). Stormy weather from the south was predicted in the afternoon, swell already increased hours before during lunchtime. The windy situation in the southern Baltic (Slupsk furrow to Bornholm basin) of the last days led to increasing swell. It forced us to leave the investigation area to move to a sheltered bay at the eastern coastline of Gotland island (isle of Östergarn). Waiting on weather we anchored at 13.30. Laboratory work of numerous samples from the Gotland Deep station last night were measured during the waiting period.

Day 9, Friday, 10th November 2023: Eastern Gotland Basin

During the night, even in the shadow of Östergarn we felt some swell. We stayed anchored up to 07:00 and we left in south eastern direction to the stations at the eastern slope of the Eastern Gotland basin. The weather at 08:30 reaching open water conditions are as follows: 9.3 °C air temperature, 998 hPa air pressure and 93 % humidity, cloudy, 9.4 °C sea surface temperature and a salinity of 7.1 g/kg. The wind conditions were 12-15 m/s (6 Bft) from southsouthwestern direction (203°) with a sea state from last night's storm of 1.5-2.5 m. We reached out first station TF0273 at 12:55 did CTD calibration measurements and a profile. Next stations in southwards direction were TF0274 (15:25) and TF0260 (17:10). At 18:00 we continued with scanfish measurements and started a profile (SF1 eGB) to the south of the eastern Gotland basin (76 NM) up to midnight. First, we had to solve some technical issues. but from 19:30 onwards we took continuous measurements.

Day 10, Saturday, 11th November 2023: Eastern Gotland Basin – Slupsk Channel

Scanfish profiling continued in southward direction at the eastern slope of the Eastern Gotland basin. The wind and sea state conditions calmed down during the night. At 05:00 wind was around 2 m/s (2 Bft) from 198° (SSW) and 1-0.5 m swell. Air temperature showed 8.8 °C, air pressure 1001 hPa and 81 % humidity. Sea surface temperature had 9.8 °C and surface salinity was around 7.4 g/kg. At 6:20 the first profile ended at station TF0259, the key station of the southern part. CTD measurements, water sampling and net sampling was done. Afterwards scanfish profile 2 to central parts of the Slupsk channel was started at 07:30. At 14:00 we took a break to measure station TF267 a vertical CTD to the seafloor. During scanfish profiling we miss the lowest 2-3 m to the seafloor, but at station TF259 we measured bottom near small amounts of dissolved oxygen as well as hydrogen sulphide and we wanted to check the bottom near water in the Slupsk Channel.

Afterwards we measured again scanfish to the end of profile the SF2 eGB-SC up to 17:10. At 17:20 we reached the key station of the Slupsk Channel TF0222 for sampling of chemical parameters. During the day we had very calm weather, sometimes glassy sea state of less than 0.5 m. The 18:00 weather situation was around 2 m/s (2 Bft) from 34° (NE) and air temperature of 9.4 °C, air pressure 1004 hPa and 61 % humidity. Sea surface temperature had 12.2 °C and surface salinity was around 7.6 g/kg. We started the next scanfish profile (SF3 SC-BB) to the Bornholm Deep at 18:00. At midnight we reached the key station Bornholm Deep and the scanfish profile SF3 ended there at 00:02.

Day 11, Sunday, 12th November 2023: Bornholm basin – Arkona basin

Station work at TF0213 – Bornholm Deep began at 00:10. One CTD cast for sampling of nutrient and hydrogen sulphide was done. Several net samples for zooplankton were taken with three mesh sizes (1x plankton net. 4x WP2. 3x Apstein). Scanfish profile SF4 – BB has started in western direction at 02:50 and ended at station TF0200 in northeast of Christansö island at 06:30. Station work at TF200 followed (sampling: nutrients. hydrogen sulphide). Below 80 m hydrogen sulphide was found. Scanfish profiling continued in western direction from 07:23 onwards (SF5 BB-BG). A very calm sea state continued. Profile SF5 BB-BG ended at station TF0140 in the north of the Bornholm gat at 11:25, where we took a CTD with nutrient sampling. Originally, we planned to measure the stations in the Bornholm Gat with CTD. because nutrient sampling was intended every second station (contract work - BSH monitoring). We got no Swedish permission to stop at station TF0142 because of high traffic, which is located in the sea lane. We decided to measure another scanfish profile to gather at least high resolution hydrographic data, but we had to skip nutrient sampling at station TF0142. Profile SF6 BG was measured from station TF0140 to TF0145 in the northeastern Arkona Basin (12:25 – 16:35). All in all, 240 nautical miles were measured by scanfish profiles during the last 46 hours from eastern Gotland basin to the entrance of the Arkona basin. In the eastern to central part of the Arkona Basin the following station were measured during the evening hours: TF0145 (16:35), TF0109 (18:40, chemical, biological sampling). TF0103, TF0104, TF0105 (20:10 – 00:00. all with water sampling for nutrients). The weather conditions at 21:00 were: air temperature of 7 °C, air pressure of 1007 hPa and 86 % humidity. The sea surface temperature showed 11.7 °C and surface salinity of 7.8 g/kg. Moderate winds of 6 m/s (4 Bft) blew from northern direction (360°) with sea state of 0.5 m swell.

Day 12, Monday, 13th November 2023: Arkona Basin – Mecklenburg Bight

During the early morning hours, we turned southwards and again eastwards to measure the stations TF0122 (01:00) and AB-Boje (04:00, reference for MARNET station) to be back at daylight conditions back at TF0109 to take samples of benthic organisms (06:30-07:45). The weather conditions at 09:00 in the southeastern Arkona basin were: sunny, air temperature of 7.7 °C, air pressure of 1008 hPa and 87 % humidity. The sea surface temperature showed 10.85 °C. Moderate winds of 5 m/s (3 Bft) blew from southwestern direction (210°) with sea state below 0.5 m swell. Later on, we turned westwards and repeated the stations TF0113 (10:00), TF0030 (13:50), TF0046 in the Kadet Trench (17:10) and TF0012 in the Mecklenburg Bight (20:30). CTD measurements and biological water sampling and plankton net sampling was done as contract work for the national monitoring of the Federal Maritime Agency (BSH). During the late afternoon the wind conditions increased rapidly. The weather conditions at 18:00 in the Mecklenburg Bight were:

heavy rainfall, air temperature of 7.0 °C, air pressure of 997 hPa and 80 % humidity. The sea surface temperature showed 11.65 °C. Strong winds of 16-17 m/s (7 Bft) blew from southeastern direction (125°) with sea state of 1 m swell. During the night went into the cover of the cliff sections of Kühlungsborn and turned eastwards to reach Rostock in the morning hours.

Day 13, Tuesday, 14th November 2023: Mecklenburg Bight
Stormy conditions continued during the night in the Mecklenburg Bight. Around 03:00 a front of over 20 m/s with heavy rainfall occurred on our route back. The weather conditions at 05:00 were: rainfall, air temperature of 9.2 °C, air pressure of 991 hPa and 92 % humidity. The sea surface temperature showed 10.086 °C and a surface salinity of 14.27 g/kg. The wind situation decreased temporarily to 10-11 m/s (5-6 Bft) with strong gusts from Westsouthwest (247°). The sea state was 0.5-1 m swell in the cover of the cliff with sideoffshore wind direction. At 04:55 we measured station RNH_NE at the artificial reeve Nienhagen and test park for ocean technologies (Fraunhofer – Digital Ocean Lab) as reference CTD. Afterwards we had a short transit to the harbor Rostock-Marienehe (07:00). In the time frame 07:00 to 11:00 deinstallation. unloading of scientific equipment and disembarking of scientific crew was done. End of cruise EMB328 at 11:00. Later on, equipment was depacked and stored in the institute in Warnemünde and IOW storage at Marienehe up to 13:30 UTC.

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. CTD data is quality checked and validated within two weeks after the cruise. The aim of this section is to give a first impression on the collected data set. An advanced data analysis will be integrated follow after all validated data sets are available.

5.1 Meteorological Conditions

The weather conditions during the cruise were generally appropriate and only one time gap of "waiting on weather" of 18 hours (Eastern Gotland Basin) occurred during these 13 days from November 2nd to November 14th. At November 4th we went a bit earlier into Sassnitz harbor for personal exchange due to increasing wind, but compensated the "lost" sampling later on during the cruise. In chapter 4 are daily notes of the conditions described once or two times a day in the different subregions of the ship track.
The wind conditions are shown in figure 5.1 with a stick plot for an overview of the development windspeed and wind direction as well as a colour bar of the windspeed. Southern wind directions dominated (mean: 189° SSE) and wind strength was mostly below 6 Bft (Fig. 5.1 – blueish, greenish and yellow colours) with a mean windspeed of 7.6 m/s; 4 Bft). Only 5 hours of 7 Bft occurred in the Mecklenburg Bight at November 2nd, 3rd and 13th, but led not to "waiting on weather".

The air temperature ranged between 6.5 °C at the end of the cruise (November 13th) to 13.1 °C at the beginning, both in the area Mecklenburg Bight (Fig. 5.2). The mean air temperature during the cruise was about 9.4 °C and the graph shows no larger fluctuations during the cruise.

Air pressure varied from 977.5 hPa (November 5th) to 1007.6 hPa (November 13th) and the cruise was generally under low pressure conditions with a mean of 995.3 hPa (Fig. 5.3). The humidity was generally high with in mean 84.2 % and ranged between 63-100 % (Fig. 5.4).

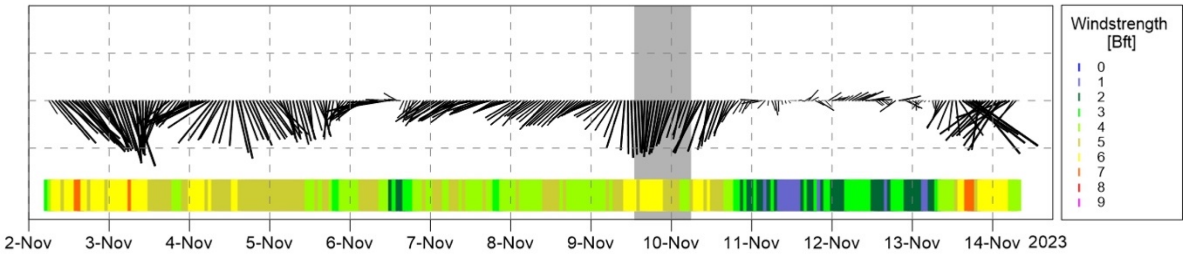

Fig. 5.1 Stick plot of wind vector measured by the ship weather station of RV ELISABETH MANN BORGESE (hourly mean values). The grey shaded areas indicate periods when the ship was waiting on weather.

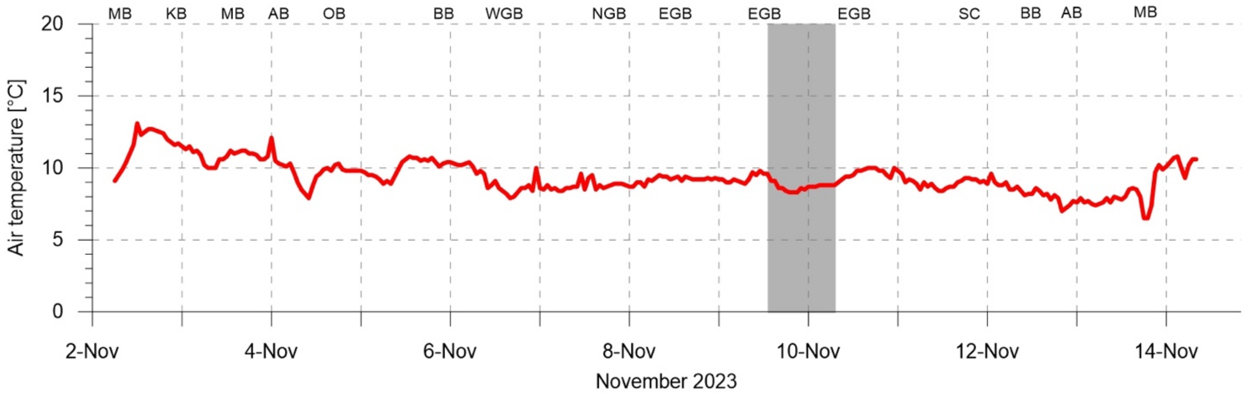

Fig. 5.2 Air temperature measured by the ship weather station of RV ELISABETH MANN BORGESE (hourly mean values). The grey shaded areas indicate periods when the ship was “waiting on weather”. Abbreviations for the main sea area of each day are marked on top (KB – Kiel Bight, MB – Mecklenburg Bight, AB – Arkona Basin, BB – Bornholm Basin, EGB – Eastern Gotland Basin, NGB – Northern Gotland Basin, WGB – Western Gotland Basin).

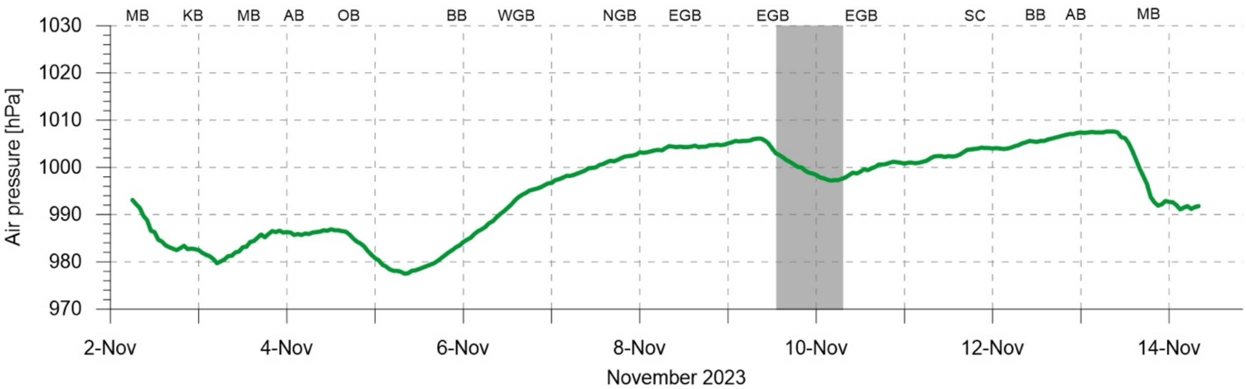

Fig. 5.3 Air pressure measured by the ship weather station of RV ELISABETH MANN BORGESE (hourly mean values). The grey shaded areas indicate periods when the ship was “waiting on weather”. Abbreviations for the main sea area of each day are marked on top.

Fig. 5.4 Air humidity measured by the ship weather station of RV ELISABETH MANN BORGESE (hourly mean values). The grey shaded areas indicate periods when the ship was "waiting on weather". Abbreviations for the main sea area of each day are marked on top.

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. 5.5 to Fig. 5.12 are based on unvalidated data.

At the beginning of the cruise the sea surface temperatures (SST) ranged in the western to southern Baltic (Kiel Bight, Mecklenburg Bight, Arkona Basin, Oder Bank, Bornholm Basin) between 11-13 °C and decreased in the Western Gotland Basin to a minimum of 8.7 °C (November 7th) (Fig. 5.7, Fig. 5.5). At the Northern Gotland Basin the SST was above 10 °C up to 11 °C decreasing slightly in the Eastern Gotland Basin to values around 10 °C. In the Slupsk Channel a fluctuation between 10-12 °C occurred. Within a week a cooling of around 1-2 K from 10-11 °C (November 6th) to 9-10 °C (November 12th) is visible in Bornholm Basin and in the Arkona Basin to Mecklenburg Bight a cooling of 2-3 K up to the end of the cruise (Fig. 5.7). The SST increased in the Warnow rivermouth on the way to the harbor Rostock-Marienehe again to 13-14 °C (maybe influenced by the city of Rostock) compared to the coastal waters of the Mecklenburg Bight with values of 10-11 °C. In Addition, Table 5.1 provides an overview of hydrographic and hydrochemical parameters measured at key stations of all subareas of this cruise.

The surface salinity (SSS) depicted its maximum of 19.4 g/kg (November 3rd) in the Kiel Bight and Belt Sea west of Fehmarn in the transition zone to the North Sea (Fig. 5.6. Fig. 5.8). In the Mecklenburg Bight, between the Fehmarn Belt and the Darss Sill, surface salinities of 17-10 g/kg were detected at the beginning of the cruise and a drop to around 8-9 g/kg at the end (Fig. 5.8). The Arkona Basin and the western part of the Pomeranian Bight depicted SSS values between 8-9 g/kg, which is in the usual range for these subregions. The eastern located areas from Bornholm Basin till the Western Gotland Basin depicted lower SSS values of about 7.5-6.7 g/kg (Fig. 5.6, Table 5.1). An SSS of 6.7 g/kg in the northern part of the Western Gotland Basin is the lowest value of the cruise. The Northern and Eastern Gotland Basin showed values 7.3-6.9 g/kg. At the end of the cruise the Arkona Basin showed a slightly lowered SSS by around 1 g/kg.

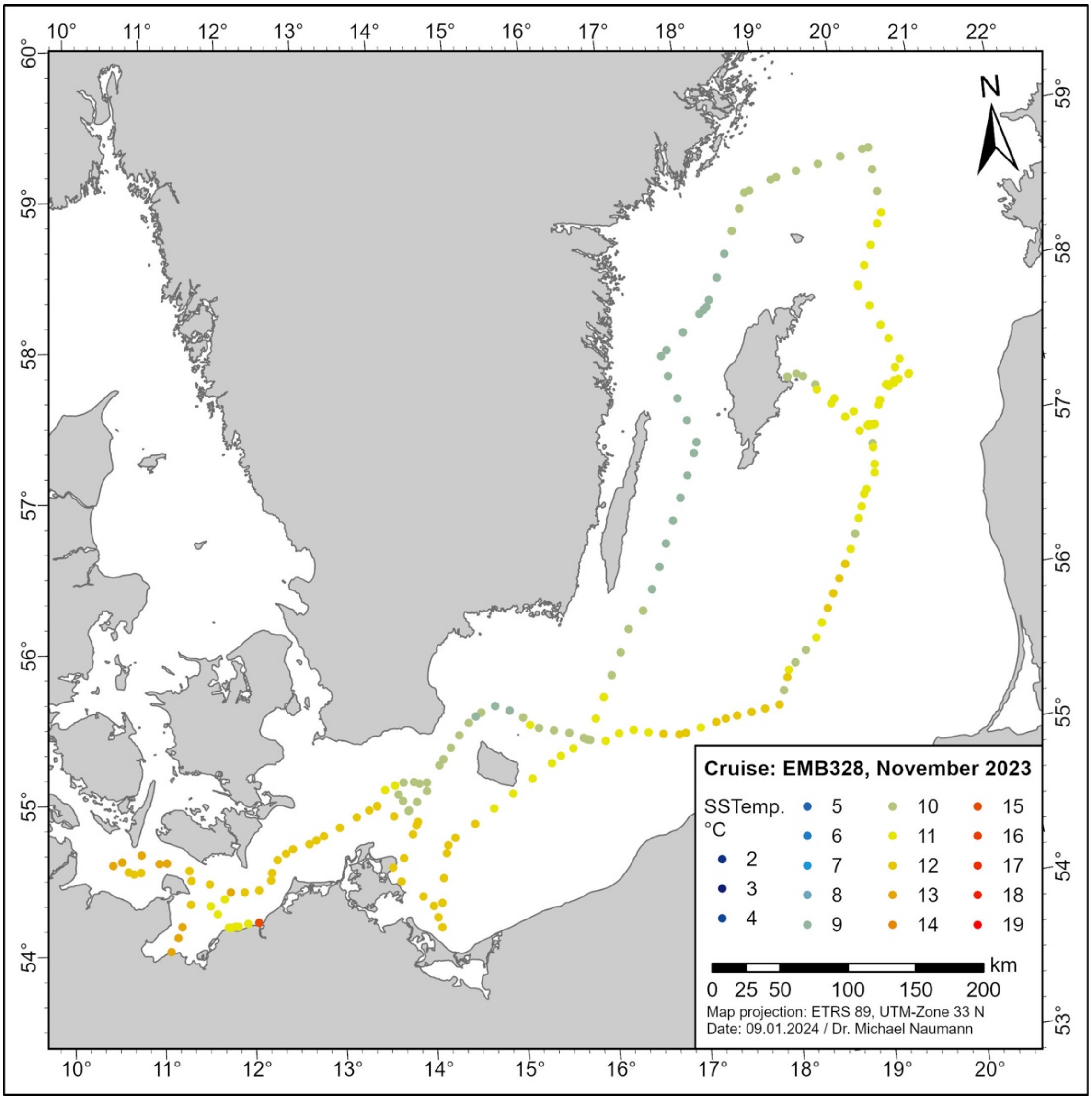

Fig. 5.5 Sea surface temperature distribution along the cruise track of EMB328 measured with the ship thermosalinograph (1 hour averaged values).

The surface distribution of chlorophyll-a fluorescence and turbidity depicts a sensory information about the biological activity of plankton in the surface water (Fig. 5.9. Fig. 5.10. Fig. 5.11. Fig. 5.12) despite our water sampling at key stations and extensive time-consuming laboratory analysis. The fluorescence sensor shows values between 0.3-2.4 along the cruise track. From the Western Baltic Sea up to the Bornholm Basin higher fluctuation between 0.8-2.4 are measured compared to the central Baltic basins which show lower and more or less constant values below 0.8. The maximum chlorophyll-a fluorescence values were measured as a short peak of 2.4 at November 5th at the northern part of the Oder Bank (Fig. 5.11).

The surface turbidity distribution was generally low along the cruise track ranging from 3-0.7 ntu. Two short peaks of values up to 9 ntu occurred in the beginning of the cruise from the Arkona Basin into the Bornholm Gat (November 4th – 5th), in the same region of higher chlorophyll-a fluorescence fluctuations. This slightly increased values compared to the other regions show a bit more activity in the surface layer, but generally the biological activity is low in this season (Fig. 5.10).

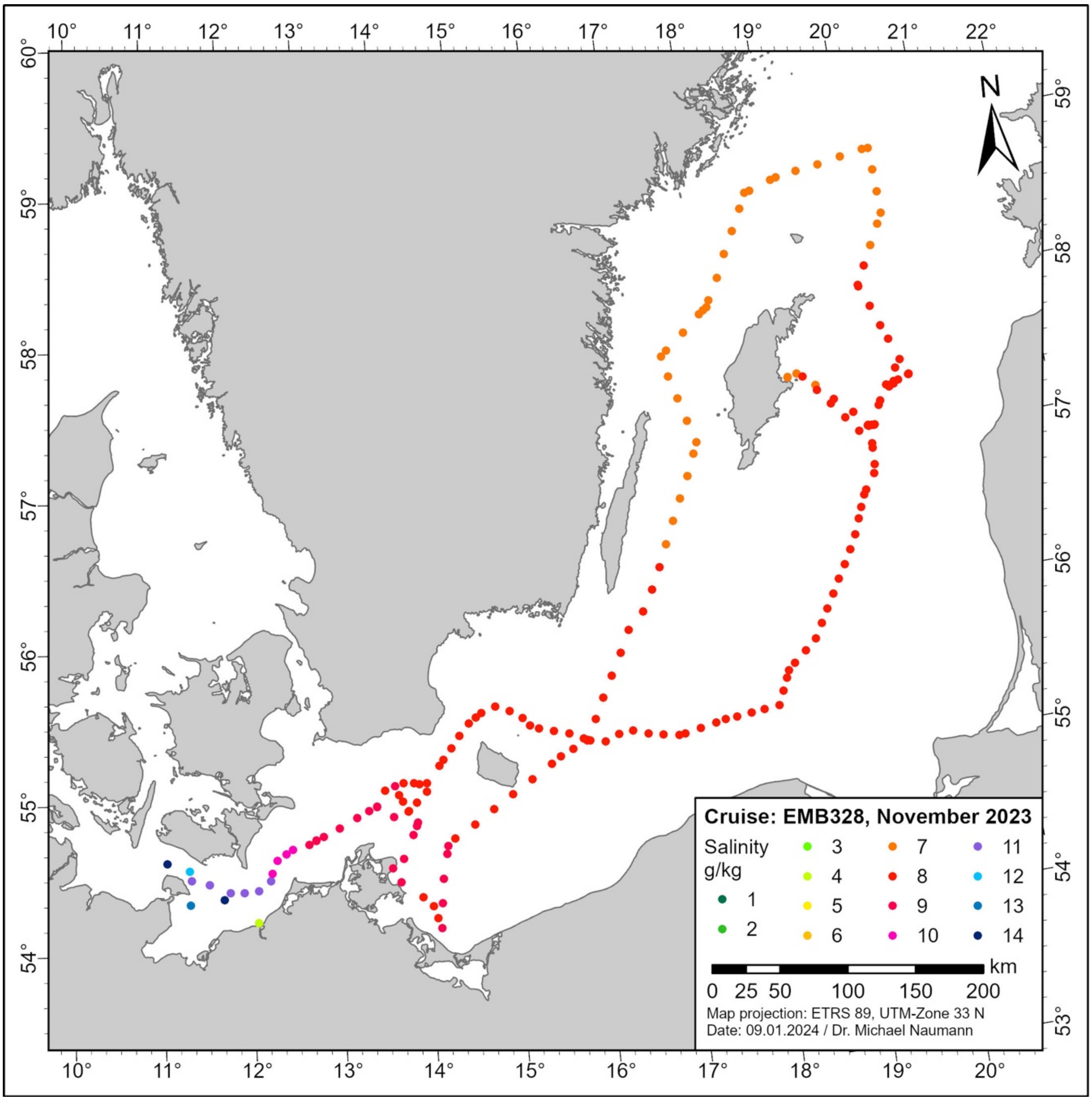

Fig. 5.6 Surface salinity distribution along the cruise track of EMB328 measured with the ship thermosalinograph (1 hour averaged values).

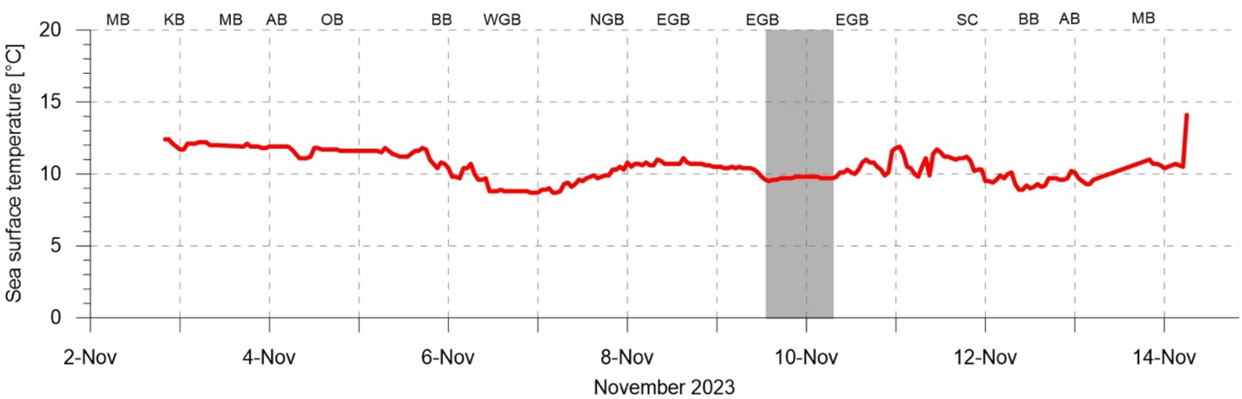

Fig. 5.7 Surface temperature measured with the ship thermosalinograph of RV ELISABETH MANN BORGESE (1 h averaged values). The grey shaded area indicate periods when the ship was waiting on weather. Abbreviations for the main sea area of each day are marked on top.

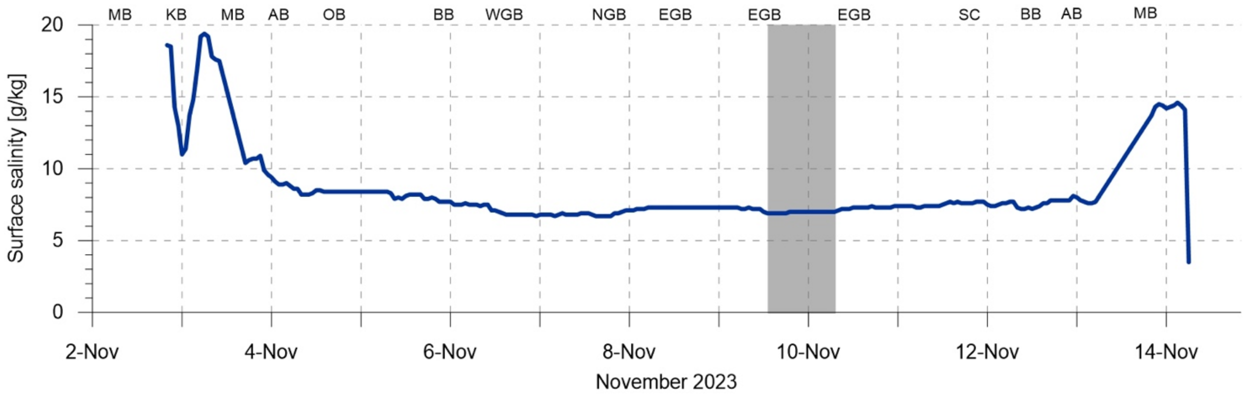

Fig. 5.8 Surface salinity measured with the ship thermosalinograph of RV ELISABETH MANN BORGESE (1 h averaged values). The grey shaded area indicate periods when the ship was waiting on weather. Abbreviations for the main sea area of each day are marked on top.

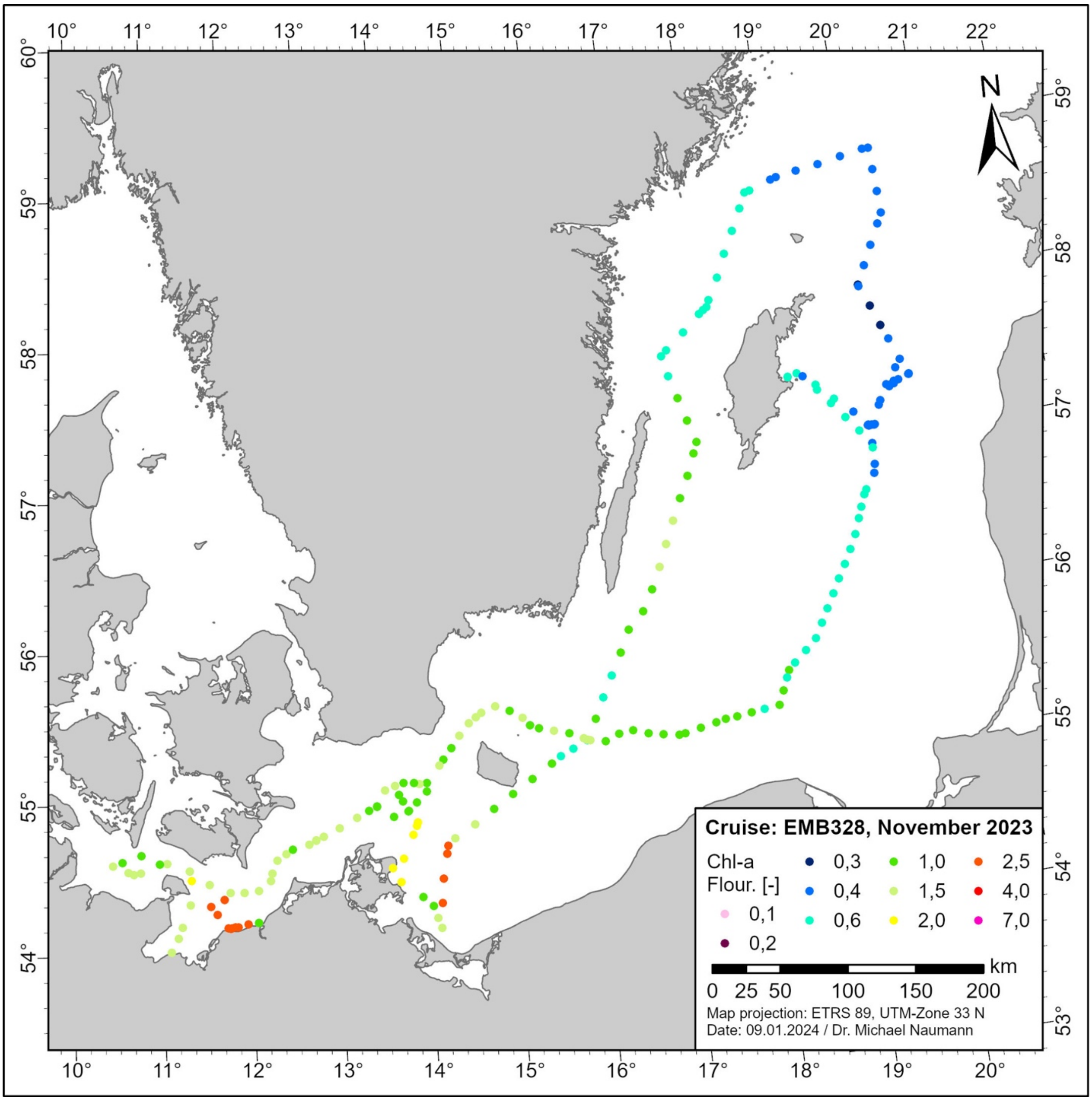

Fig. 5.9 Surface chlorophyll-a fluorescence along the cruise track of EMB328 measured with the ship thermosalinograph (1 hour averaged values).

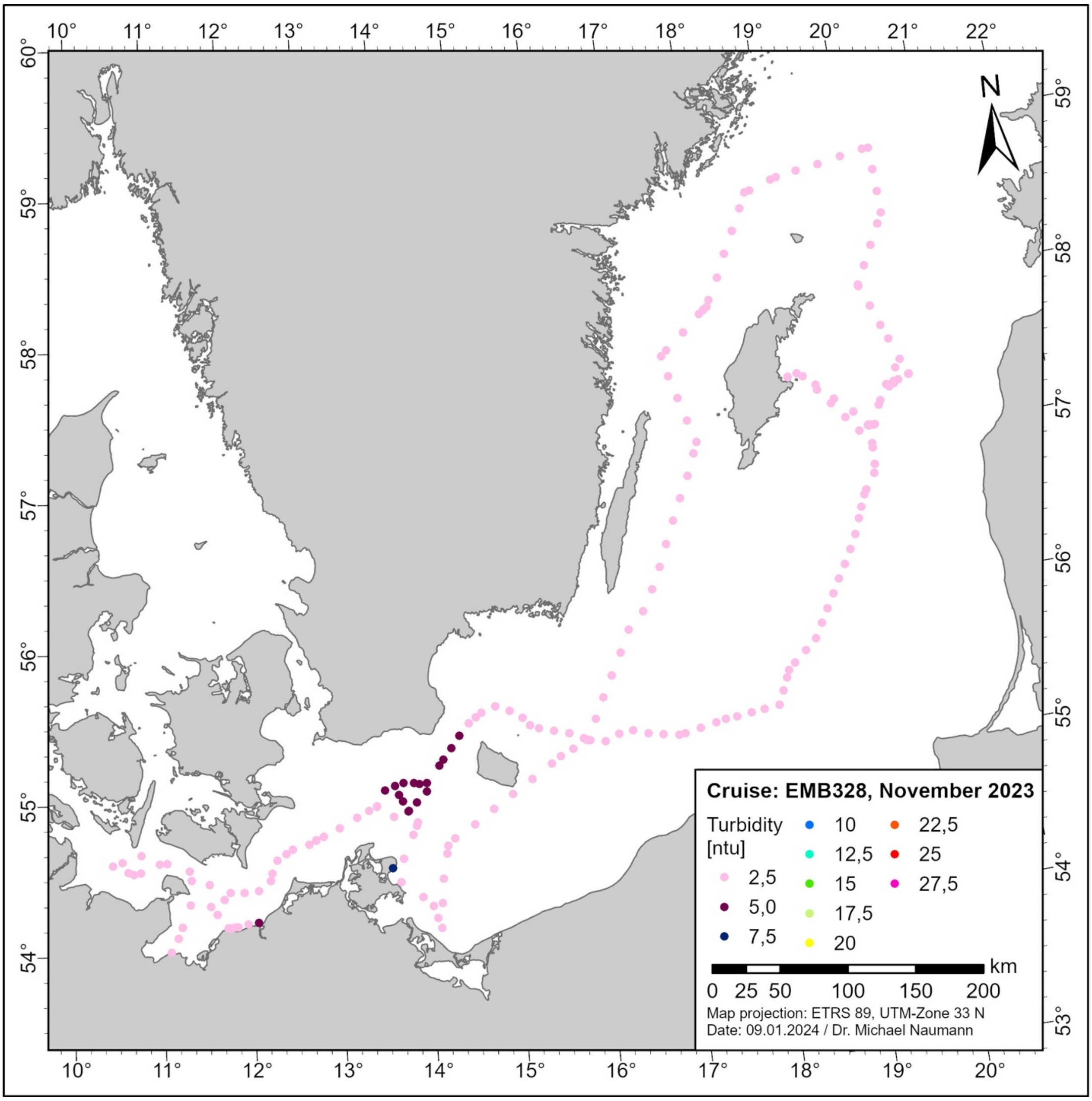

Fig.5.10 Surface turbidity along the cruise track of EMB328 measured with the ship thermosalinograph (1 hour averaged values).

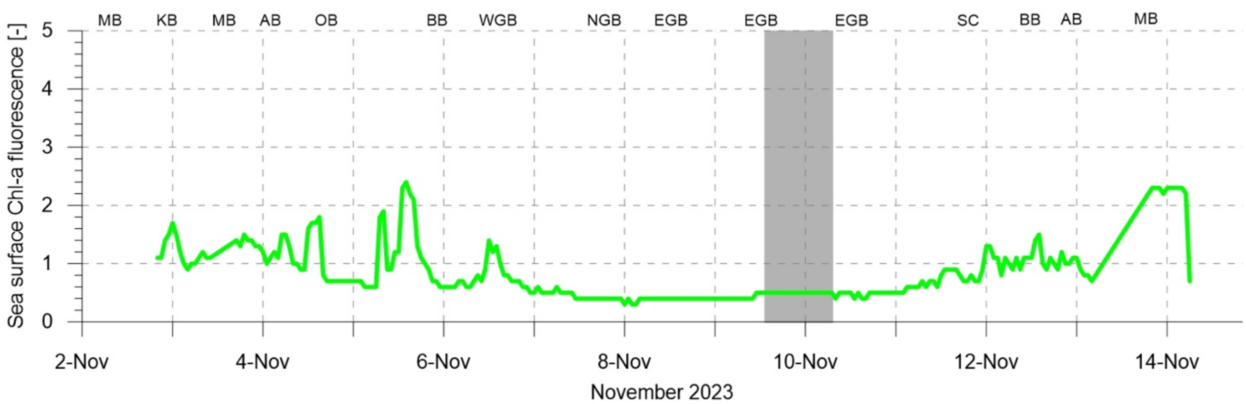

Fig.5.11 Surface chlorophyll-a fluorescence measured with the flow through fluorometer of RV ELISABETH MANN BORGESE (1 h averaged values). The grey shaded area indicate periods when the ship was waiting on weather. Abbreviations for the main sea area of each day are marked on top.

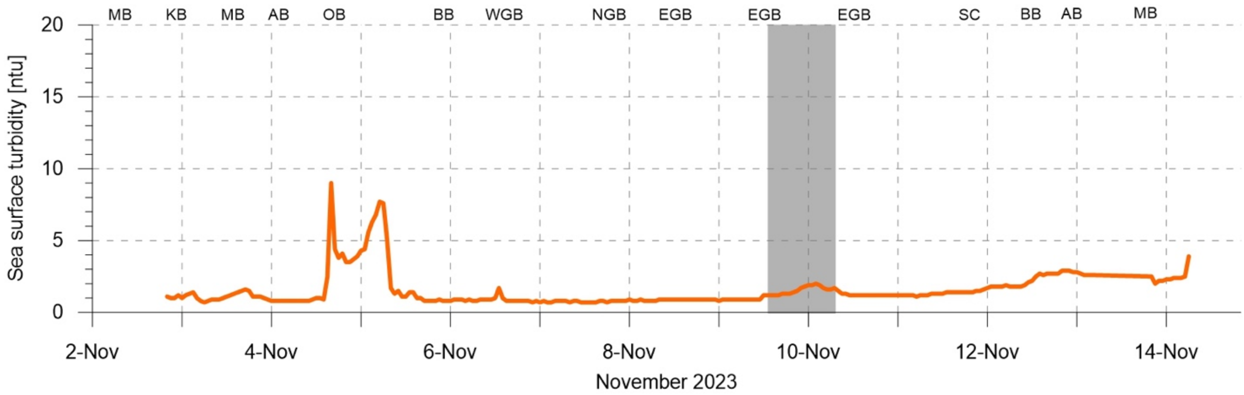

Fig.5.12 Surface turbidity measured with the flow through fluorometer of RV ELISABETH MANN BORGESE (1 h averaged values). The grey shaded area indicate periods when the ship was waiting on weather. Abbreviations for the main sea area of each day are marked on top.

5.3 Observations at key 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 key stations of the Baltic long term observation program. For positions of the particular stations refer to Fig. 5.13 and Table 7.1.

The physical conditions of the surface water layer are described in chapter 5.2 and dissolved oxygen showed in all subregions high concentrations and ranged between 281 µmol/l at Lübeck Bight (SST 11.85 °C) and 337 µmol/l at the Karlsö Deep (SST 8.26 °C). The nutrient concentrations depicted the typical for autumn in the surface water and start to increase compared to the low levels in summertime due to biological activity. The phosphate concentrations ranged between 0.29 µM at the Gotland Deep to 0.80 µM at the Lübeck Bight. In general, the Western Baltic showed higher values than the southern and central parts. Compared to usual winter-maxima the recent values are at 50-60 % at the central part and on 80-90 % in the western part. Nitrate concentrations at the surface are as well lowered, ranging between 0.06-1.75 µM and reaching usual winter maxima above 3.5 µM. Silicate concentrations are at 60-80 % of the winter-maxima and ranged from 10.8 µM (Gotland Deep) to 15.7 µM (Bornholm Deep).

The bottom water concentrations of nutrients are controlled mainly by the vertical position of the redox cline and the oxygen conditions. In the Arkona Basin and the Slupsk Furrow the nitrate bottom concentration were with values of 6.91 µM and 7.15 µM much higher compared to values below one in the Western Baltic and the central basins (Table 5.2). The only exception was the Mecklenburg Bight with 4.41 µM. In the central Baltic Basins around the isle of Gotland nitrate is zero in the near bottom layer and bound in the surface sediments due to hypoxic conditions in the deep water. Phosphate showed low values between 0.48 µM 1.32 µM in the western part, slight increased values up to 3.31 µM in the Bornholm Basin and Slupsk Channel and high values above 4 µM under hypoxic conditions in the central part. Silicate stayed nearly constant under stagnation conditions in the bottom near water of the central basins compared to measurements in spring 2023.

The spatial distribution of bottom oxygen conditions and hypoxia /hydrogen sulphide is derived from laboratory analysis from water samples and given in Fig. 5.13. The hydrographic highly dynamic conditions from Kiel Bight to Mecklenburg Bight and Darss Sill showed oxygen concentrations between 208-299 µmol/l in near bottom waters. The deep water conditions from Arkona Basin to the central basins are influenced by inflow activity from the North Sea or stagnation periods. The latest larger inflow activity was in 2017, but smaller inflow pulses delivered oxygenized water masses more frequent into the Arkona Basin and Bornholm Basin in the meantime. The oxygen concentration of 151 µmol/l is low for the usual status of the Arkona Basin and the Bornholm Deep showed hypoxia close to anoxia with 2 µmol/l. The Slupsk Furrow was oxic with 63 µmol/l and at the southwestern part of the Eastern Gotland Basin oxygen concentrations fall again below the hypoxic limit with 43.77 µmol/l and at all other stations of the deep basins around Gotland anoxic conditions with hydrogen sulphide concentrations between 182.4 µmol/l H2S (Karlsö Deep) and 256.7 µmol/l H2S (Gotland Deep) were found.

Table 5.1 Sea surface water values (1-5 m water depths) of main hydrographic and hydrochemical properties at the key stations. Location of selected key stations see Fig. 5.13.

Area /Date	Station Name /No.*	Sampl. Depth [m]	Temp. [°C]	Sal. [g/kg]	O_2 (sensor) [µmol/l]	PO4 [µM]	NO3 [µM]	SiO4 [µM]
Kiel Bight /2023-11-03	TF0360/014	0.76	11.65	19.45	284	0.77	0.51	13.30
Lübeck Bight / 2023-11-02	TF0022/010	0.76	11.85	18.58	281	0.80	0.70	14.30
Meckl.Bight /2023-11-02	TF0012/003	1.6	11.18	12.97	309	0.47	0.20	14.10
Darss Sill /2023-11-04	TF0001/025	6.67	11.27	8.94	309	0.44	0.19	14.10
Arkona Basin /2023-11-04	TF0113/029	1.45	10.43	8.23	314	0.45	0.17	14.80
Bornholm Deep /2023-11-06	TF0213/035	1.15	9.27	7.55	324	0.47	0.06	15.70
Stolpe Channel /2023-11-11	TF0222/060	0.8	10.58	7.60	316	0.38	0.77	13.80
SE Gotland Basin /2023-11-11	TF0259/057	1.39	9.93	7.47	323	0.40	0.86	14.20
Gotland Deep /2023-11-08	TF0271/047	1.5	10.19	7.30	318	0.29	1.26	10.80
Farö Deep /2023-11-07	TF0286/044	1.92	10.38	7.18	314	0.34	1.75	11.30
Landsort Deep / no permission	TF0284/014	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled
Karlsö Deep /2023-11-06	TF0245/036	0.94	8.26	6.86	337	0.33	0.13	13.10

Table 5.2 Deep-water layer (near bottom depths) of main hydrographic and hydrochemical properties at the key stations. Location of selected key stations see Fig. 5.13.

Area /Date	Station Name /No.*	Sampl. Depth [m]	Temp. [°C]	Sal. [g/kg]	O_2 (titration) [µmol/l]	PO4 [µM]	NO3 [µM]	SiO4 [µM]
Kiel Bight /2023-11-03	TF0360/014	16.9	12.28	20.68	256	1.08	1.40	19.70
Lübeck Bight / 2023-11-02	TF0022/010	21.6	12.84	19.53	246	1.07	2.63	20.50
Meckl.Bight /2023-11-02	TF0012/003	23.1	12.95	19.15	208	1.20	4.41	23.60
Darss Sill /2023-11-04	TF0001/025	19.4	11.50	9.37	299	0.48	0.59	15.10
Arkona Basin /2023-11-04	TF0113/029	45.2	14.59	17.71	151	1.32	6.91	27.30
Bornholm Deep /2023-11-06	TF0213/035	87.4	9.20	15.44	2	3.31	1.15	67.50
Stolpe Channel /2023-11-11	TF0222/060	89.3	10.23	13.49	63	2.04	7.70	47.10
SE Gotland Basin /2023-11-11	TF0259/057	87.4	7.23	11.38	3.59 / H2S: 2.6	3.16	0.50	57.20
Gotland Deep /2023-11-08	TF0271/047	233.3	7.22	12.72	H2S: 256.7	7.15	0.00	112.00
Farö Deep /2023-11-07	TF0286/044	190.2	7.27	12.05	H2S: 185.9	4.65	0.00	75.00
Landsort Deep / no permission	TF0284	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled
Karlsö Deep /2023-11-06	TF0245/036	107.3	5.91	10.10	H2S: 182.4	3.55	0.00	62.00

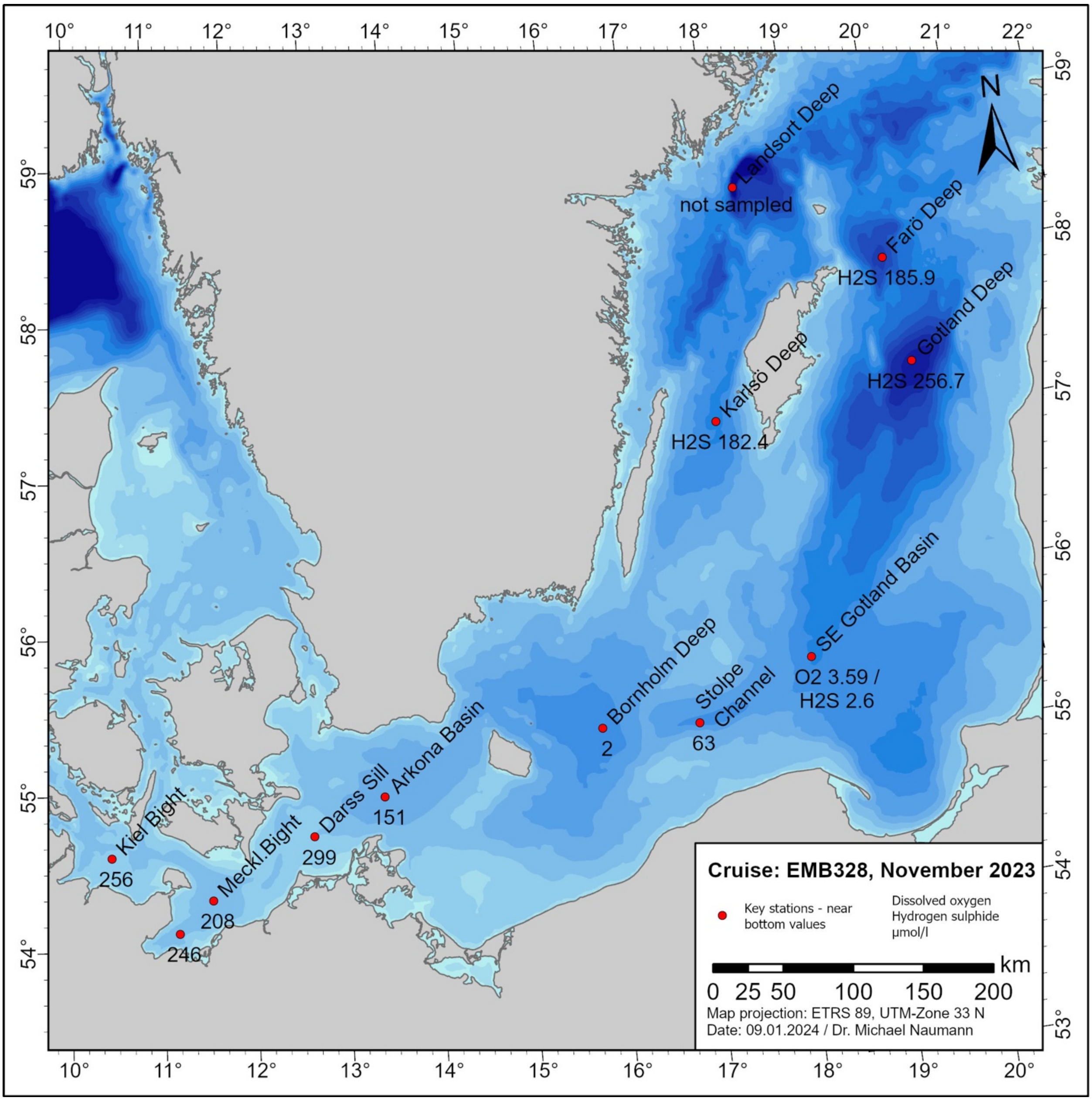

Fig. 5.13 Distribution of dissolved oxygen and hydrogen sulfide concentrations in the near bottom layer at key stations of the long-term observation program (table 5.2).

5.4 Baltic Thalweg Transect

During the cruise 31 CTD stations and 6 scanfish profiles were aligned along the thalweg transect from the Mecklenburg Bight, in the western Baltic Sea, towards the central Baltic (Fig. 5.14). This transect supplies an excellent overview about the hydrographic and environmental state of the Baltic Sea. And thus, it is worked as standard transect of the IOW long term observation program. The CTD measurements were done as continuous sequence of stations, beginning at November 3rd (TF0360) to November 12th (profile SF-6). A timely interruption of 2 days (November 6th-7th) occurred due to the decision for sampling the Western Gotland Basin first to reach the Gotland Deep at appropriate weather for mooring work. The data supplies a quasi-synoptic picture of the hydrographic patterns along the thalweg.

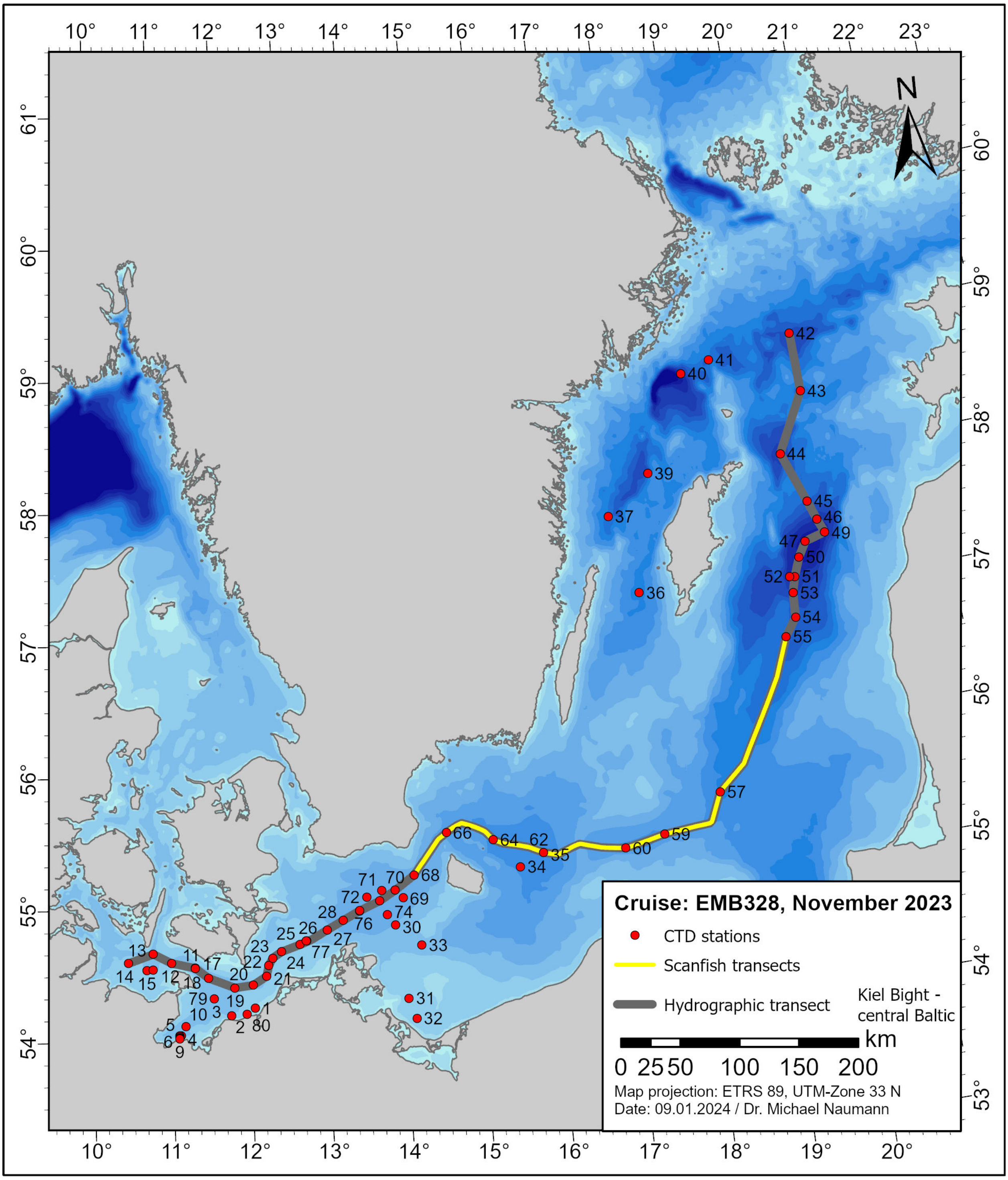

Fig. 5.14 Location of measured CTD stations (table 7.1) and the "Thalweg"-transect crossing all deep basins on the pathway of saltwater inflows (hydrographic parameters visualized as cross sections in Fig. 5.15 – 5.19).

The observations show the autumn conditions in the western to central Baltic (Fig.5.15 to Fig. 5.19). The temperature in the upper layer (above the permanent halocline) depicted only a low horizontal gradient from warmer waters of 12-11 °C in the Southwest to 9-10 °C in the Northeast. It shows the cooling in autumn from surface temperatures of 20-18 °C in summer was more or less equal all over the area. The situation in the uppermost part of the surface water layer (SST) was described in chapter 5.2. but the cross section figure 5.15 delivers a complete view of the water column. Below the halocline the deep water temperature showed increased values from Kiel Bight to Arkona Basin, the former summer water and in the central Baltic the stagnant conditions after the last larger inflow. In the deep water of the Bornholm Basin to Slupsk Furrow and southwestern part of the Eastern Gotland Basin warm water of barocline summer inflows are propagating. Deep water temperatures increased from March to November by 1 K from 8.67 °C to 9.20 °C at the Bornholm Deep and 19.15 °C to 10.23 °C at the Slupsk Furrow. The Gotland Deep, Farö Deep and Landsort Deep near bottom temperatures stayed constant, with no signs of arrival of new water bodies in the lowermost meters of the water column.

The salinity distribution (Fig. 5.16) shows nearly the same pattern of gradients like temperature. In the surface water a horizontal gradiant 19.4 g/kg at Kiel Bight to 6.7 g/kg at the Northern Gotland Basin. The surface salinity reduction is driven by freshwater runoff with increasing influence to the Northeast, the most distal areas from the entrance to the North Sea / North Atlantic. In contrast the deep water conditions are steered by lateral inflow activity and shows the same horizontal gradiant, but on higher salinity level. In addition, a strong vertical salinity gradiant characterizes the Baltic Sea with its permanent halocline. In comparison to the deep water temperature (Fig. 5.15), the parameter salinity shows the same pattern of propagation of these warm baroclinic summer inflows from the Bornholm Basin to the entrance of the Eastern Gotland Basin by salinities between 16-12 g/kg. The deep water salinities at key stations in central basins around Gotland were stagnant compared to the situation in March 2023 (cruise EMB314). For example the Gotland Deep showed a near bottom salinity 12.81 g/kg in March and 12.72 g/kg in November (Tab. 5.2), Farö Deep showed at both times 12.05 g/kg and the Karlsö Deep changed from 10.13 g/kg to 10.10 g/kg.

The oxygen distribution along the transect is shown in Fig. 5.17. The baroclinic summer inflows ventilated the deep water of the Slupsk Sill and southern part of the Eastern Gotland Basin; but these areas stayed hypoxic with concentrations of 63 µmol/l at the Slupsk Furrow, for example. Stagnation in the central basins was ongoing. Near bottom waters were not ventilated and stayed euxinic with hydrogen sulphide concentration of 256.7 µmol/l at the Gotland Deep (153 µmol/l H2S in March 2023). Farther north in the Farö Deep and Northern Gotland Basin hydrogen sulphide concentration stayed as well constant compared to the beginning of this year. Figure 15.13 shows an aerial overview of near bottom dissolved oxygen and hydrogen sulphide concentrations.

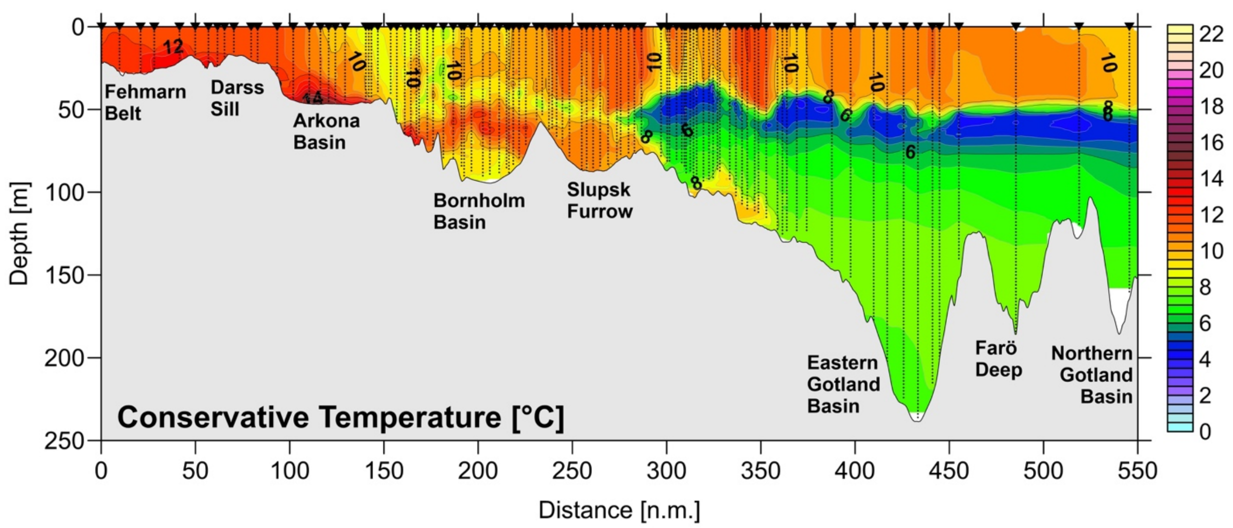

Fig. 5.15 Distribution of conservative temperature along the thalweg of the Baltic Sea from the Kiel bight to the Northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.11.-13.11.2024.

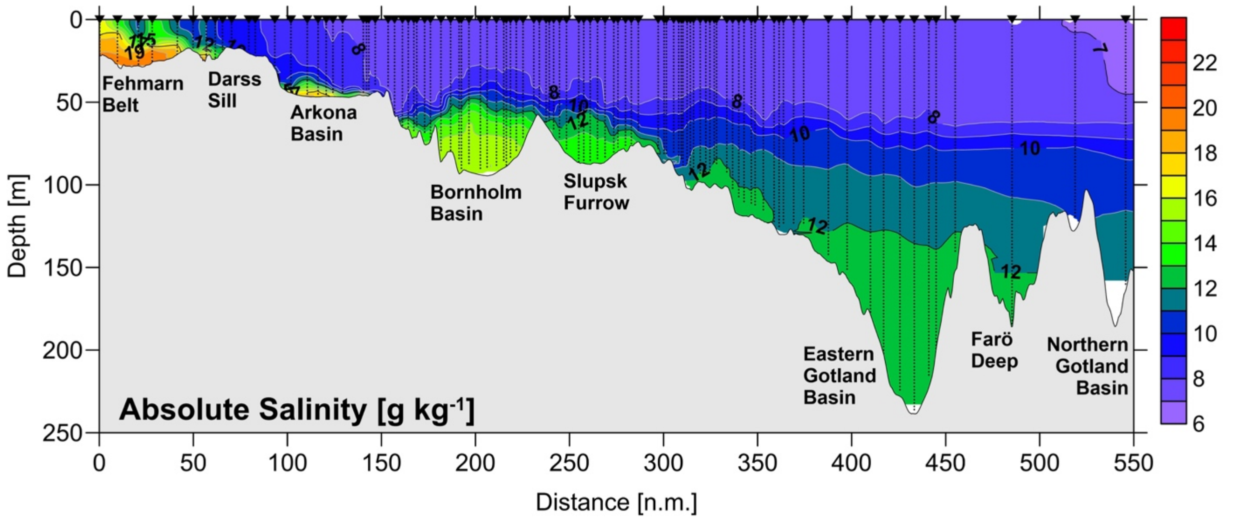

Fig. 5.16 Distribution of absolute salinity along the thalweg of the Baltic Sea from the Kiel bight to the Northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.11.-13.11.2024.

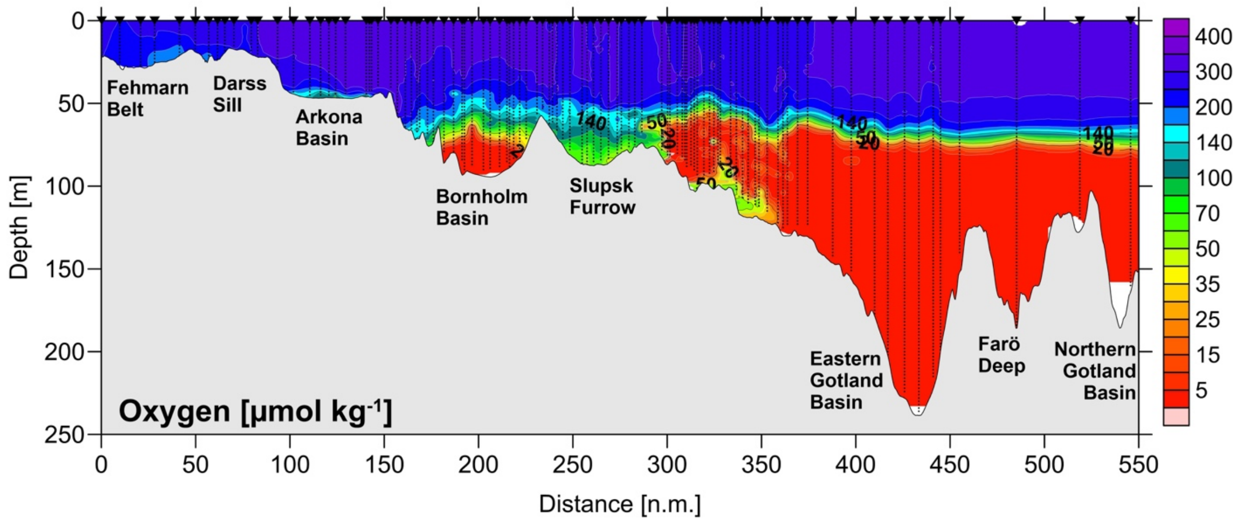

Fig. 5.17 Distribution of dissolved oxygen the thalweg of the Baltic Sea from the Kiel bight to the Northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.11.-13.11.2024.

The chlorophyll-a fluorescence along the transect was very low in the deep water up 1 (Fig. 5.18). In the surface water in the central Baltic showed as well values below 1, already described in chapter 5.2. The Western Baltic showed higher fluctuations and values up to 2.4 from the surface to the halocline in around 15-20 m water depth.

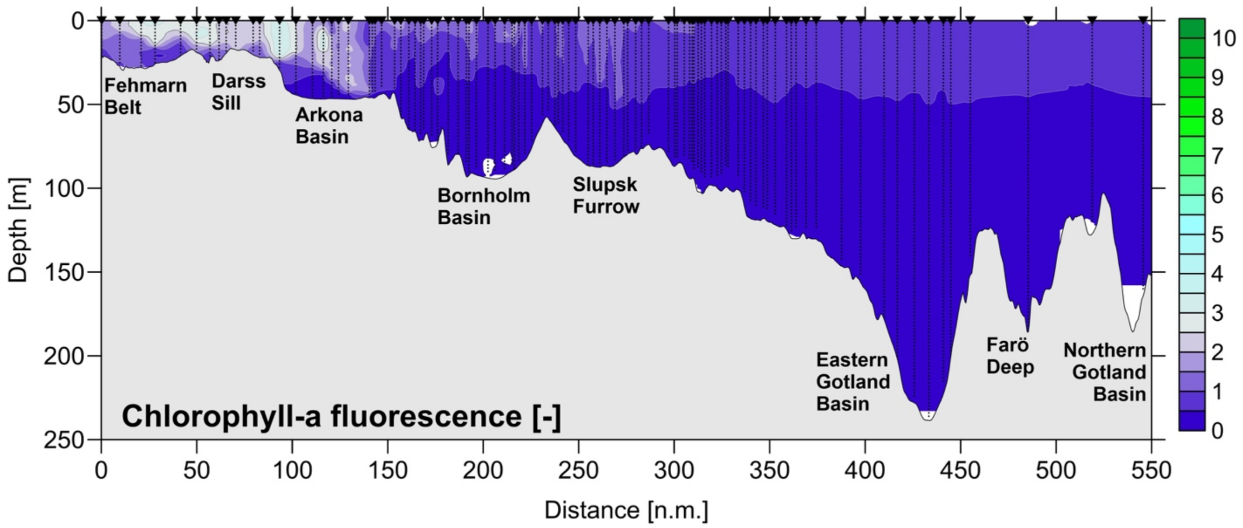

Fig. 5.18 Distribution of chlorophyll-a fluorescence along the thalweg of the Baltic Sea from the Kiel bight to the Northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.11.-13.11.2024.

The turbidity distribution along the transect is shown in figure 5.19 and the surface water (upper 4 m) is shown in more detail in the figures 5.10 and 5.12. The surface values are changing between 3-0.7 ntu and two short peaks up to 9 ntu in the Arkona Basin and Bornholm Gat (see chapter 5.2). The water layer below shows as well turbity values up to 3 ntu and but mostly below 0.6 ntu. Along the lowermost 5-10 m water depth spans a layer of increased values 1-3 ntu from Kiel Bight to the southern entrance of the Eastern Gotland Basin. In the Eastern Gotland Basin this increased values continue in a layer of 60-80 m water depth, the depth below the halocline, where redox processes take part (redoxcline depth). In contrast, in these central deep basins (Eastern Gotland Basin to Northern Gotland Basin) the near bottom layer shows very low levels below 0.6 ntu.

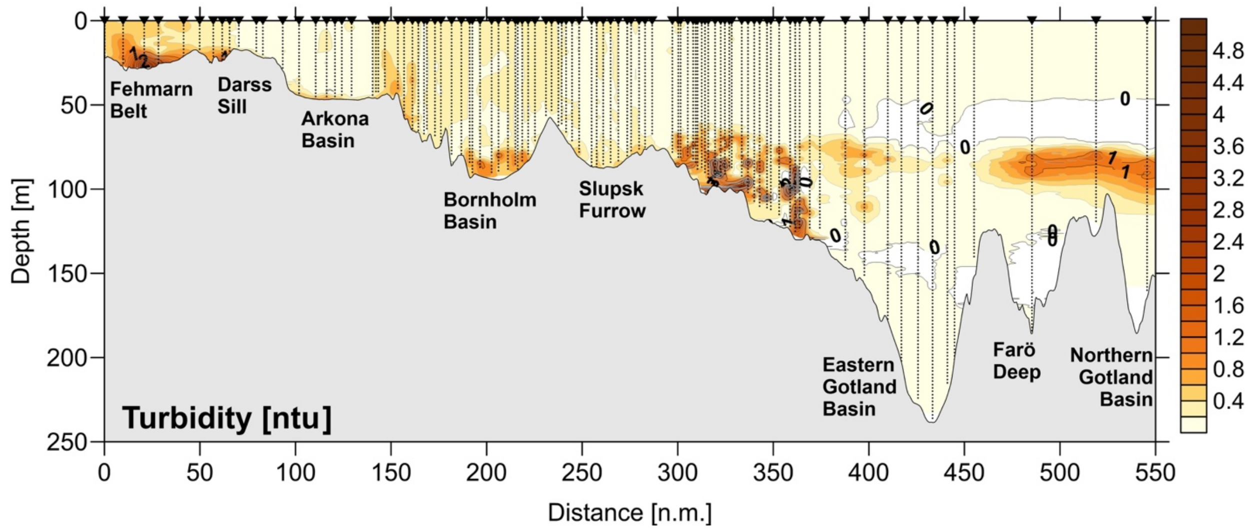

Fig. 5.19 Distribution of turbidity along the thalweg of the Baltic Sea from the Kiel bight to the Northern Gotland Basin. The figure is based on the preliminary CTD data gathered from 03.11.-13.11.2024.

An overview of the hydrographic conditions at six key stations spanning from the Arkona Basin to the central Baltic Sea is given by vertical profiles of temperature, salinity and dissolved oxygen concentration in figure 5.20. These plots shows the main characteristics of the different subregions very impressive. The temperature plot shows the warm surface water (8-11 °C), characterizing the cooling in autumn from summerly surface temperatures above 15 °C. Below the water temperature increases in the Arcona Basin to this summerly temperature level. In all other areas it reduces to the winter values 0f 4-6 °C up to the thermocline, which can be found in depths between 30 m and 70 m depending on the local area. These water depths coincide more or less with the depths of the halocline and oxycline. The salinity plot shows the permanent stratified water column of lower values in the surface layer and higher salinity in the deep water very clear. The general oxygen deficiency and stagnant conditions of the central Baltic deep water is impressive shown at stations Gotland Deep, Farö deep, Landsort Deep and Karlsö Deep. The different water masses observed during the cruise can be clearly identified using its temperature, salinity and oxygen signature (Fig. 5.21). The left temperature – salinity plot shows the different subregions colour coded for a spatial overview, whereas in the right plot dissolved oxygen concentrations are marked by colour.

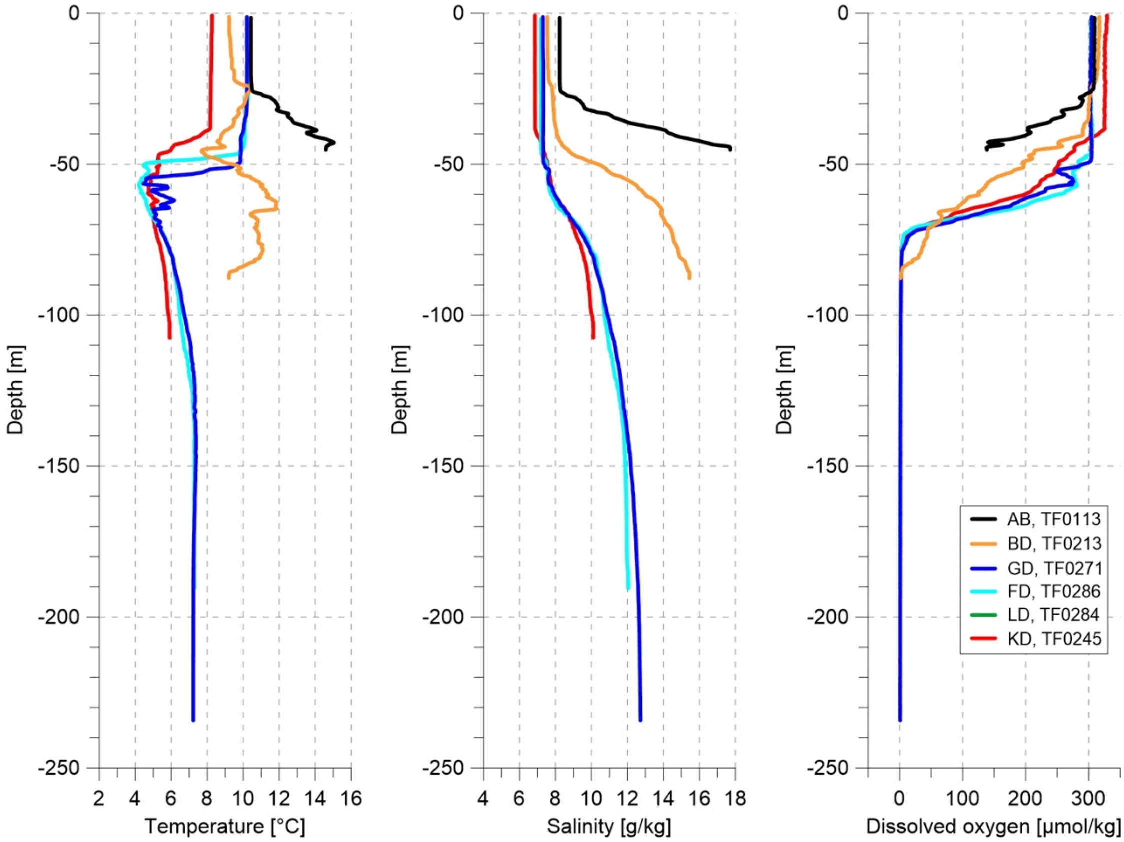

Fig. 5.20 Vertical profiles of temperature. salinity and oxygen concentration (CTD data) at the main stations in the central Baltic. Arkona Basin TF0113 (black), Bornholm Deep TF0213 (orange), Gotland Deep TF0271 (blue), Farö Deep TF0286 (cyan), Landsort Deep TF0284 (green) (at EMB328 no permission, not measured) and Karlsö Deep TF0245 (red).

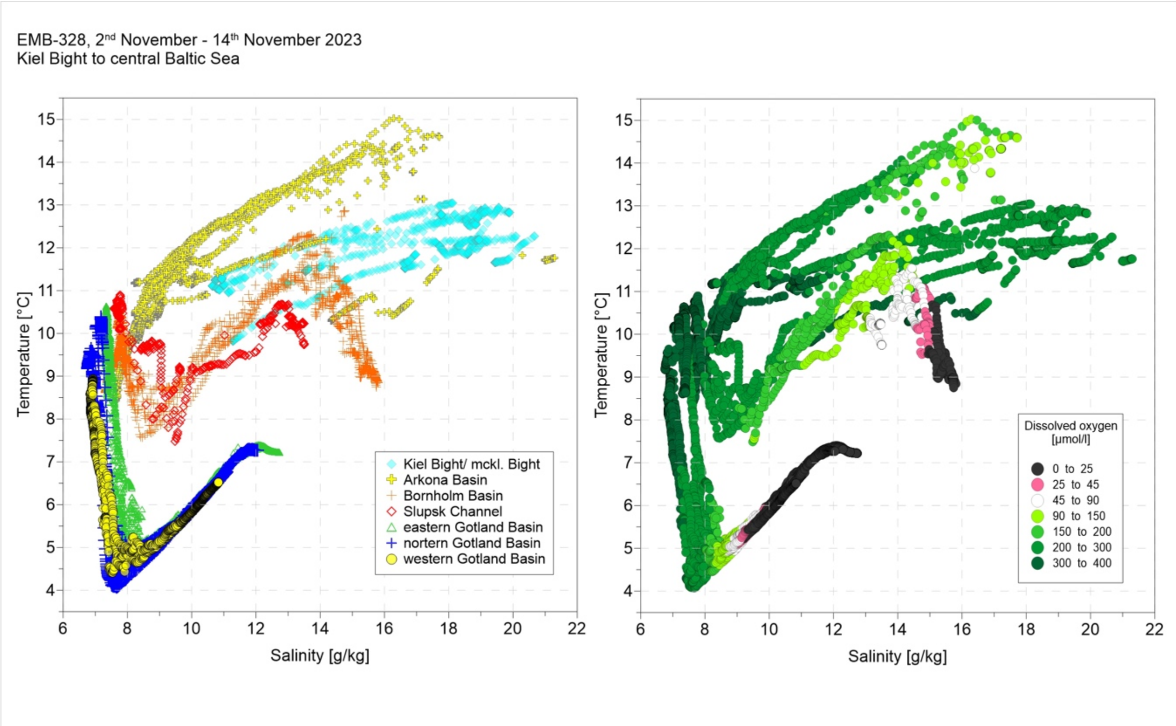

Fig. 5.21 Temperature-salinity diagram of all stations (left). Temperature – salinity values and dissolved oxygen classified in color [µmol/l].

5.5 Biological Investigations

Sampling for phytoplankton as well as chlorophyll analyses were collected from the rosette water sampler from different depths in the euphotic zone from surface to max. 20 m water depths. Additionally phytoplankton net samples were taken. Phytoplankton samples were preserved for later microscopic analyses of the species composition and chlorophyll samples were filtered and deep frozen. The standard zooplankton WP2 net was used to sample mesozooplankton above and below the halocline. Additional Apstein net samples were collected for analyses of small developmental stages of zooplankton. All samples were preserved for later microscopic analyses of the zooplankton community composition. Responsible scientists at IOW are Dr. Anke Kremp (phytoplankton) and Dr. Jörg Dutz (zooplankton).

Insights into the changes of the microbial food web of the redoxcline is obtained by vertical high resolution sampling of the range of the redoxcline at Gotland Deep (TF0271) and Landsort Deep (TF0284a) stations on each monitoring cruise. Therefore, in the redoxcline as well as 6 depths above and below, respectively, in depth intervals of 2 m, samples were taken by CTD/water sampling bottles and prepared for microbiological analysis (FISH and DNA) and determination of pigments. The responsible scientist at IOW is Prof. Dr. Klaus Jürgens.

Water samples for eDNA extraction were taken with the aim of building up a microbiological DNA archive. Samples were taken in the southwestern Baltic Sea at 11 stations. This programme is done in cooperation with the University of Greifswald since 2 years and is planned to continue. The responsible scientist at IOW is Prof. Dr. Matthias Labrenz.

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

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 List EMB328

7.1 Overall Station List. 80 CTD Stations. 89 Casts

Date / Time	Station No.	Station Name	Depth	Latitude	Longitude	Gear
[UTC]	EMB	IOW	[m]			
02.11.23 08:23	EMB328_1-1	TF05	10	54° 13.8957' N	012° 04.4356' E	CTD
02.11.23 08:34	EMB328_1-2	TF05	10	54° 13.8947' N	012° 04.4727' E	SD
02.11.23 10:11	EMB328_2-1	TF0018	17	54° 11.0200' N	011° 45.9055' E	CTD
02.11.23 10:52	EMB328_2-2	TF0018	17	54° 10.9950' N	011° 45.9919' E	VVG
02.11.23 10:57	EMB328_2-3	TF0018	17	54° 10.9965' N	011° 46.0015' E	VVG
02.11.23 11:02	EMB328_2-4	TF0018	17	54° 10.9992' N	011° 46.0142' E	VVG
02.11.23 11:08	EMB328_2-5	TF0018	17	54° 10.9921' N	011° 46.0330' E	VVG
02.11.23 11:21	EMB328_2-6	TF0018	17	54° 10.9744' N	011° 46.0455' E	DRG
02.11.23 12:56	EMB328_3-1	TF0012	22	54° 18.9396' N	011° 33.1129' E	CTD
02.11.23 12:57	EMB328_3-2	TF0012	22	54° 18.9324' N	011° 33.1195' E	SD
02.11.23 13:05	EMB328_3-3	TF0012	21	54° 18.9109' N	011° 33.0945' E	PLA
02.11.23 13:26	EMB328_3-4	TF0012	21	54° 18.8430' N	011° 33.0752' E	CTD
02.11.23 13:49	EMB328_3-5	TF0012	22	54° 18.8334' N	011° 33.0731' E	WP2
02.11.23 14:00	EMB328_3-6	TF0012	22	54° 18.8511' N	011° 33.1216' E	WP2
02.11.23 14:05	EMB328_3-7	TF0012	22	54° 18.8620' N	011° 33.1522' E	WP2
02.11.23 14:22	EMB328_3-8	TF0012	22	54° 18.8750' N	011° 33.1975' E	VVG
02.11.23 14:29	EMB328_3-9	TF0012	22	54° 18.8636' N	011° 33.2326' E	VVG
02.11.23 14:34	EMB328_3-10	TF0012	22	54° 18.8631' N	011° 33.2401' E	VVG
02.11.23 14:39	EMB328_3-11	TF0012	22	54° 18.8618' N	011° 33.2464' E	VVG
02.11.23 14:51	EMB328_3-12	TF0012	22	54° 18.9492' N	011° 33.1390' E	DRG
02.11.23 17:31	EMB328_4-1	A3 Boltenhagen	22	54° 02.5873' N	011° 06.4691' E	CTD
02.11.23 18:12	EMB328_5-1	A1 Boltenhagen	24	54° 02.6033' N	011° 05.5100' E	CTD
02.11.23 18:42	EMB328_6-1	B1 Boltenhagen	12	54° 02.0581' N	011° 05.3872' E	CTD
02.11.23 19:15	EMB328_7-1	D1 Boltenhagen	9	54° 01.7981' N	011° 05.3936' E	CTD
02.11.23 19:36	EMB328_8-1	E1 Boltenhagen	7	54° 01.5181' N	011° 05.4046' E	CTD
02.11.23 19:55	EMB328_9-1	F1 Boltenhagen	6	54° 01.2576' N	011° 05.4175' E	CTD
02.11.23 21:03	EMB328_10-1	TF0022	20	54° 06.6210' N	011° 10.4761' E	CTD
03.11.23 00:40	EMB328_11-1	TF0010	25	54° 33.1401' N	011° 19.2156' E	CTD
03.11.23 02:26	EMB328_12-1	TF0014	23	54° 35.6319' N	011° 00.7570' E	CTD
03.11.23 03:50	EMB328_13-1	TF0361	21	54° 39.9708' N	010° 46.6346' E	CTD
03.11.23 05:32	EMB328_14-1	TF0360	15	54° 36.0293' N	010° 26.9772' E	CTD
03.11.23 05:33	EMB328_14-2	TF0360	15	54° 36.0289' N	010° 26.9773' E	PLA
03.11.23 05:55	EMB328_14-3	TF0360	15	54° 36.0063' N	010° 27.0097' E	WP2
03.11.23 06:01	EMB328_14-4	TF0360	16	54° 36.0047' N	010° 26.9983' E	WP2
03.11.23 06:34	EMB328_14-5	TF0360	15	54° 36.0023' N	010° 27.0033' E	VVG
03.11.23 06:38	EMB328_14-6	TF0360	15	54° 36.0028' N	010° 26.9995' E	VVG
03.11.23 06:42	EMB328_14-7	TF0360	15	54° 36.0035' N	010° 26.9852' E	VVG
03.11.23 06:46	EMB328_14-8	TF0360	15	54° 36.0095' N	010° 26.9870' E	VVG

03.11.23 06:57	EMB328_14-9	TF0360	15	54° 35.9844' N	010° 26.9975' E	DRG
03.11.23 08:24	EMB328_15-1	Bio FB2	20	54° 32.5416' N	010° 41.1728' E	CTD
03.11.23 08:50	EMB328_15-2	Bio FB2	20	54° 32.4915' N	010° 41.1848' E	FC
03.11.23 08:58	EMB328_15-3	Bio FB2	20	54° 32.4804' N	010° 41.1869' E	FC
03.11.23 09:02	EMB328_15-4	Bio FB2	20	54° 32.4800' N	010° 41.1893' E	FC
03.11.23 09:06	EMB328_15-5	Bio FB2	20	54° 32.4838' N	010° 41.1804' E	FC
03.11.23 09:13	EMB328_15-6	Bio FB2	20	54° 32.4798' N	010° 41.1720' E	VVG
03.11.23 09:17	EMB328_15-7	Bio FB2	20	54° 32.4813' N	010° 41.1728' E	VVG
03.11.23 09:21	EMB328_15-8	Bio FB2	20	54° 32.4859' N	010° 41.1867' E	VVG
03.11.23 09:25	EMB328_15-9	Bio FB2	20	54° 32.4847' N	010° 41.1797' E	VVG
03.11.23 10:15	EMB328_16-1	Bio FB1	20	54° 32.9124' N	010° 46.1220' E	CTD
03.11.23 10:57	EMB328_16-2	Bio FB1	20	54° 32.8958' N	010° 46.1953' E	FC
03.11.23 11:06	EMB328_16-3	Bio FB1	20	54° 32.8992' N	010° 46.1980' E	FC
03.11.23 11:12	EMB328_16-4	Bio FB1	44	54° 32.8873' N	010° 46.1973' E	VVG
03.11.23 11:19	EMB328_16-5	Bio FB1	20	54° 32.8770' N	010° 46.1928' E	VVG
03.11.23 11:24	EMB328_16-6	Bio FB1	21	54° 32.9082' N	010° 46.1674' E	VVG
03.11.23 11:29	EMB328_16-7	Bio FB1	20	54° 32.9043' N	010° 46.1655' E	VVG
03.11.23 14:06	EMB328_17-1	TF0010	25	54° 33.0496' N	011° 19.2478' E	CTD
03.11.23 14:34	EMB328_17-2	TF0010	25	54° 33.0295' N	011° 19.3237' E	VVG
03.11.23 14:39	EMB328_17-3	TF0010	26	54° 33.0309' N	011° 19.3085' E	VVG
03.11.23 14:45	EMB328_17-4	TF0010	25	54° 33.0245' N	011° 19.3003' E	VVG
03.11.23 14:50	EMB328_17-5	TF0010	26	54° 33.0364' N	011° 19.2837' E	VVG
03.11.23 15:02	EMB328_17-6	TF0010	25	54° 33.0703' N	011° 19.2634' E	DRG
03.11.23 16:10	EMB328_18-1	TF0013	23	54° 28.4049' N	011° 29.0442' E	CTD
03.11.23 16:20	EMB328_18-1	TF0013	23	54° 28.3977' N	011° 29.0427' E	CTD
03.11.23 18:18	EMB328_19-1	TF0017	19	54° 23.5110' N	011° 49.4600' E	CTD
03.11.23 19:35	EMB328_20-1	TF0041	16	54° 24.3902' N	012° 03.7575' E	CTD
03.11.23 20:52	EMB328_21-1	TF0046	25	54° 28.1967' N	012° 14.5533' E	CTD
03.11.23 20:56	EMB328_21-2	TF0046	26	54° 28.2043' N	012° 14.5454' E	PLA
03.11.23 21:17	EMB328_21-3	TF0046	26	54° 28.1891' N	012° 14.5056' E	WP2
03.11.23 21:23	EMB328_21-4	TF0046	25	54° 28.1947' N	012° 14.5024' E	WP2
03.11.23 22:18	EMB328_22-1	TF0083	23	54° 33.0380' N	012° 16.5360' E	CTD
03.11.23 23:11	EMB328_23-1	TF0033	17	54° 36.2800' N	012° 19.9232' E	CTD
04.11.23 00:16	EMB328_24-1	TF0002	15	54° 38.9485' N	012° 26.9964' E	CTD
04.11.23 02:03	EMB328_25-1	TF0001	18	54° 41.7838' N	012° 41.9236' E	CTD
04.11.23 03:01	EMB328_26-1	TF0030	19	54° 43.3822' N	012° 47.0188' E	CTD
04.11.23 03:02	EMB328_26-2	TF0030	20	54° 43.3821' N	012° 47.0196' E	PLA
04.11.23 03:32	EMB328_26-3	TF0030	20	54° 43.3740' N	012° 46.9977' E	CTD
04.11.23 03:50	EMB328_26-4	TF0030	20	54° 43.3863' N	012° 47.0210' E	VVG
04.11.23 03:59	EMB328_26-5	TF0030	20	54° 43.3723' N	012° 47.0209' E	VVG
04.11.23 04:02	EMB328_26-6	TF0030	19	54° 43.3829' N	012° 47.0190' E	VVG
04.11.23 04:06	EMB328_26-7	TF0030	20	54° 43.3807' N	012° 47.0051' E	VVG
04.11.23 04:20	EMB328_26-8	TF0030	20	54° 43.3656' N	012° 46.9840' E	DRG

04.11.23 05:52	EMB328_27-1	TF0115	27	54° 47.7063' N	013° 03.5675' E	CTD
04.11.23 07:10	EMB328_28-1	TF0114	42	54° 51.6168' N	013° 16.6880' E	CTD
04.11.23 08:31	EMB328_29-1	TF0113	45	54° 55.5318' N	013° 30.0248' E	CTD
04.11.23 08:32	EMB328_29-2	TF0113	45	54° 55.5249' N	013° 30.0186' E	PLA
04.11.23 09:00	EMB328_29-3	TF0113	45	54° 55.4820' N	013° 30.0130' E	WP2
04.11.23 09:10	EMB328_29-4	TF0113	45	54° 55.4586' N	013° 29.9920' E	WP2
04.11.23 09:16	EMB328_29-5	TF0113	45	54° 55.4604' N	013° 29.9946' E	WP2
04.11.23 09:38	EMB328_29-6	TF0113	44	54° 55.4383' N	013° 30.0677' E	CTD
04.11.23 12:18	EMB328_30-1	TF0112	38	54° 48.0805' N	013° 57.5308' E	CTD
04.11.23 12:48	EMB328_30-2	TF0112	37	54° 48.1407' N	013° 57.4720' E	CTD
05.11.23 09:39	EMB328_31-1	TF0160	11	54° 14.4355' N	014° 04.0632' E	CTD
05.11.23 09:59	EMB328_31-2	TF0160	11	54° 14.3946' N	014° 04.1178' E	VVG
05.11.23 10:02	EMB328_31-3	TF0160	11	54° 14.3893' N	014° 04.1288' E	VVG
05.11.23 10:04	EMB328_31-4	TF0160	11	54° 14.3851' N	014° 04.1261' E	VVG
05.11.23 10:06	EMB328_31-5	TF0160	12	54° 14.3843' N	014° 04.1187' E	VVG
05.11.23 10:13	EMB328_31-6	TF0160	11	54° 14.3729' N	014° 04.1197' E	DRG
05.11.23 11:39	EMB328_32-1	OBBoje	12	54° 05.1410' N	014° 08.9588' E	CTD
05.11.23 15:24	EMB328_33-1	TF0152	29	54° 38.0281' N	014° 16.9842' E	CTD
05.11.23 15:34	EMB328_33-1	TF0152	29	54° 37.9974' N	014° 17.0068' E	CTD
05.11.23 15:53	EMB328_33-2	TF0152	28	54° 38.0042' N	014° 17.0201' E	VVG
05.11.23 15:57	EMB328_33-3	TF0152	28	54° 38.0047' N	014° 17.0193' E	VVG
05.11.23 16:02	EMB328_33-4	TF0152	28	54° 38.0044' N	014° 17.0108' E	VVG
05.11.23 16:06	EMB328_33-5	TF0152	28	54° 37.9983' N	014° 17.0072' E	VVG
05.11.23 16:14	EMB328_33-6	TF0152	29	54° 37.9835' N	014° 17.0077' E	DRG
05.11.23 22:41	EMB328_34-1	TF0214	93	55° 09.6149' N	015° 39.6163' E	CTD
06.11.23 01:09	EMB328_35-1	TF0213	89	55° 14.9785' N	015° 58.9956' E	CTD
06.11.23 01:16	EMB328_35-2	TF0213	89	55° 14.9468' N	015° 58.9275' E	PLA
06.11.23 01:36	EMB328_35-3	TF0213	89	55° 14.9183' N	015° 58.8563' E	WP2
06.11.23 01:47	EMB328_35-4	TF0213	89	55° 14.9153' N	015° 58.8259' E	WP2
06.11.23 02:00	EMB328_35-5	TF0213	89	55° 14.9253' N	015° 58.8183' E	WP2
06.11.23 02:11	EMB328_35-6	TF0213	89	55° 14.9039' N	015° 58.8554' E	WP2
06.11.23 02:18	EMB328_35-7	TF0213	89	55° 14.9204' N	015° 58.8808' E	WP2
06.11.23 02:35	EMB328_35-8	TF0213	89	55° 14.9512' N	015° 58.8357' E	CTD
06.11.23 02:49	EMB328_35-9	TF0213	89	55° 14.9510' N	015° 58.8156' E	APNET
06.11.23 03:12	EMB328_35-10	TF0213	89	55° 15.0254' N	015° 58.9751' E	APNET
06.11.23 03:34	EMB328_35-11	TF0213	89	55° 15.0151' N	015° 59.0018' E	APNET
06.11.23 17:32	EMB328_36-1	TF0245	110	57° 06.9921' N	017° 40.0414' E	CTD
06.11.23 22:04	EMB328_37-1	TF0242	142	57° 43.0049' N	017° 22.0108' E	CTD
07.11.23 01:25	EMB328_38-1	OCWG-1	200	57° 58.9567' N	017° 57.3434' E	FC
07.11.23 01:56	EMB328_38-2	OCWG-1	200	57° 58.9490' N	017° 57.3306' E	FC
07.11.23 02:50	EMB328_39-1	TF0240	169	58° 00.0041' N	017° 59.9918' E	CTD
07.11.23 08:50	EMB328_40-1	nGB-1	243	58° 42.7474' N	018° 40.2032' E	CTD
07.11.23 11:37	EMB328_41-1	TF0283	139	58° 46.9743' N	019° 05.8878' E	CTD

07.11.23 16:26	EMB328_42-1	TF0282	165	58° 53.0071' N	020° 18.9776' E	CTD
07.11.23 20:03	EMB328_43-1	TF0285	123	58° 26.5590' N	020° 20.0570' E	CTD
08.11.23 00:02	EMB328_44-1	TF0286	195	58° 00.0259' N	019° 54.1332' E	CTD
08.11.23 00:24	EMB328_44-2	TF0286	196	58° 00.0316' N	019° 54.0042' E	CTD
08.11.23 03:43	EMB328_45-1	TF0270	144	57° 37.0344' N	020° 10.0188' E	CTD
08.11.23 05:02	EMB328_46-1	TF0276	208	57° 28.2409' N	020° 15.6080' E	CTD
08.11.23 08:55	EMB328_48-1	GONE	219	57° 22.0450' N	020° 20.4982' E	MOOR
08.11.23 07:32	EMB328_47-1	TF0271	246	57° 19.2018' N	020° 07.8627' E	MOOR
08.11.23 10:29	EMB328_47-2	TF0271	246	57° 18.3994' N	020° 04.8797' E	MOOR
08.11.23 11:29	EMB328_47-3	TF0271	241	57° 19.2105' N	020° 03.0413' E	CTD
08.11.23 11:31	EMB328_47-4	TF0271	241	57° 19.2118' N	020° 03.0249' E	PLA
08.11.23 11:43	EMB328_47-5	TF0271	241	57° 19.2111' N	020° 03.0636' E	SD
08.11.23 11:55	EMB328_47-6	TF0271	241	57° 19.2095' N	020° 03.0489' E	CTD
08.11.23 12:17	EMB328_47-7	TF0271	241	57° 19.1989' N	020° 03.0282' E	CTD
08.11.23 14:02	EMB328_47-8	TF0271	246	57° 18.3777' N	020° 04.8786' E	MOOR
08.11.23 15:23	EMB328_49-2	GONE	219	57° 21.9948' N	020° 20.4977' E	MOOR
08.11.23 15:37	EMB328_49-1	GONE	219	57° 21.9598' N	020° 20.3671' E	CTD
08.11.23 17:29	EMB328_47-9	TF0271	241	57° 19.2123' N	020° 03.0378' E	CTD
08.11.23 18:28	EMB328_47-10	TF0271	241	57° 19.1991' N	020° 03.0070' E	CTD
08.11.23 19:17	EMB328_47-11	TF0271	241	57° 19.1902' N	020° 03.0098' E	CTD
08.11.23 20:00	EMB328_47-12	TF0271	241	57° 19.1870' N	020° 02.9765' E	CTD
08.11.23 20:37	EMB328_47-13	TF0271	241	57° 19.1871' N	020° 02.9720' E	CTD
08.11.23 22:12	EMB328_50-1	TF0275	231	57° 12.6234' N	019° 55.8767' E	CTD
09.11.23 00:09	EMB328_51-1	TF0272	209	57° 04.2749' N	019° 49.8447' E	CTD
09.11.23 07:17	EMB328_52-2	GOSW	217	57° 04.5289' N	019° 45.1721' E	MOOR
09.11.23 08:52	EMB328_52-3	GOSW	213	57° 04.1829' N	019° 45.5886' E	MOOR
10.11.23 13:01	EMB328_53-1	TF0273	184	56° 57.1361' N	019° 46.2541' E	CTD
10.11.23 15:29	EMB328_54-1	TF0274	154	56° 46.0822' N	019° 45.1239' E	CTD
10.11.23 17:18	EMB328_55-1	TF0260	145	56° 38.0246' N	019° 34.9956' E	CTD
10.11.23 17:59	EMB328_56-1	SF1 - eGB	144	56° 37.7294' N	019° 34.7631' E	SCF
10.11.23 19:20	EMB328_56-1	SF1 - eGB	145	56° 31.9218' N	019° 30.5673' E	SCF
11.11.23 06:47	EMB328_57-1	TF0259	89	55° 32.9745' N	018° 24.0782' E	CTD
11.11.23 06:53	EMB328_57-2	TF0259	89	55° 32.9858' N	018° 23.9945' E	PLA
11.11.23 07:28	EMB328_58-1	SF2-eGB to SC	89	55° 32.8436' N	018° 24.0323' E	SCF
11.11.23 08:16	EMB328_58-1	SF2-eGB to SC	86	55° 29.1801' N	018° 21.4018' E	SCF
11.11.23 11:15	EMB328_58-1	SF2-eGB to SC	77	55° 18.9198' N	018° 01.9223' E	SCF
11.11.23 14:00	EMB328_59-1	TF0267	83	55° 17.1808' N	017° 35.8300' E	CTD
11.11.23 14:27	EMB328_58-2	SF2-eGB to SC	84	55° 17.0975' N	017° 35.0443' E	SCF
11.11.23 17:24	EMB328_60-1	TF0222	90	55° 13.0162' N	017° 04.0061' E	CTD
11.11.23 17:50	EMB328_61-1	SF3 - SC to BB	90	55° 12.9905' N	017° 04.1707' E	SCF
12.11.23 00:22	EMB328_62-1	TF0213	89	55° 15.0239' N	015° 58.9707' E	CTD
12.11.23 00:27	EMB328_62-2	TF0213	89	55° 15.0570' N	015° 59.0336' E	PLA
12.11.23 00:44	EMB328_62-3	TF0213	89	55° 15.0651' N	015° 59.1188' E	WP2

12.11.23 00:55	EMB328_62-4	TF0213	89	55° 15.0591' N	015° 59.1602' E	WP2
12.11.23 01:05	EMB328_62-5	TF0213	89	55° 15.0628' N	015° 59.1760' E	WP2
12.11.23 01:21	EMB328_62-6	TF0213	89	55° 15.0647' N	015° 59.0732' E	APNET
12.11.23 01:42	EMB328_62-7	TF0213	89	55° 15.0424' N	015° 59.0046' E	APNET
12.11.23 02:03	EMB328_62-8	TF0213	89	55° 15.0396' N	015° 59.0005' E	APNET
12.11.23 02:29	EMB328_62-9	TF0213	89	55° 15.0360' N	015° 59.0061' E	CTD
12.11.23 02:44	EMB328_63-1	SF 4 - BB	89	55° 15.0752' N	015° 58.8923' E	SCF
12.11.23 06:44	EMB328_64-1	TF0200	90	55° 22.9652' N	015° 19.9881' E	CTD
12.11.23 07:19	EMB328_65-1	SF5-BG	90	55° 23.0733' N	015° 19.9088' E	SCF
12.11.23 11:40	EMB328_66-1	TF0140	68	55° 28.0148' N	014° 43.1028' E	CTD
12.11.23 12:23	EMB328_67-1	SF6-BG	68	55° 27.8650' N	014° 42.8714' E	SCF
12.11.23 16:47	EMB328_68-1	TF0145	45	55° 10.0081' N	014° 15.0013' E	CTD
12.11.23 18:44	EMB328_69-1	TF0109	46	55° 00.0088' N	014° 04.9889' E	CTD
12.11.23 18:47	EMB328_69-2	TF0109	46	54° 59.9911' N	014° 05.0205' E	PLA
12.11.23 19:10	EMB328_69-3	TF0109	46	55° 00.0305' N	014° 04.9653' E	WP2
12.11.23 20:19	EMB328_70-1	TF0103	45	55° 03.7759' N	013° 59.3111' E	CTD
12.11.23 22:11	EMB328_71-1	TF0104	44	55° 04.1122' N	013° 48.7297' E	CTD
12.11.23 23:48	EMB328_72-1	TF0105	44	55° 01.5861' N	013° 36.3948' E	CTD
13.11.23 01:10	EMB328_73-1	TF0122	45	54° 59.3617' N	013° 46.2434' E	CTD
13.11.23 03:12	EMB328_74-1	ABBOJE	44	54° 52.8721' N	013° 51.6703' E	CTD
13.11.23 03:25	EMB328_74-1	ABBOJE	44	54° 52.8654' N	013° 51.6341' E	CTD
13.11.23 03:34	EMB328_74-1	ABBOJE	44	54° 52.8600' N	013° 51.6330' E	CTD
13.11.23 06:31	EMB328_75-1	TF0109 Fortsetzung	46	55° 00.0077' N	014° 05.0136' E	CTD
13.11.23 06:54	EMB328_75-2	TF0109 Fortsetzung	46	54° 59.9866' N	014° 05.0262' E	VVG
13.11.23 07:00	EMB328_75-3	TF0109 Fortsetzung	46	54° 59.9844' N	014° 05.0625' E	VVG
13.11.23 07:05	EMB328_75-4	TF0109 Fortsetzung	46	54° 59.9713' N	014° 05.0329' E	VVG
13.11.23 07:11	EMB328_75-5	TF0109 Fortsetzung	46	54° 59.9752' N	014° 04.9888' E	VVG
13.11.23 07:28	EMB328_75-6	TF0109 Fortsetzung	46	54° 59.9711' N	014° 04.7654' E	DRG
13.11.23 10:05	EMB328_76-1	TF0113	45	54° 55.5526' N	013° 30.0979' E	CTD
13.11.23 10:05	EMB328_76-2	TF0113	45	54° 55.5479' N	013° 30.0910' E	PLA
13.11.23 10:29	EMB328_76-3	TF0113	45	54° 55.5084' N	013° 30.0326' E	WP2
13.11.23 10:34	EMB328_76-4	TF0113	45	54° 55.5024' N	013° 30.0263' E	WP2
13.11.23 14:01	EMB328_77-1	TF0030	20	54° 43.3419' N	012° 46.9714' E	CTD
13.11.23 14:04	EMB328_77-2	TF0030	20	54° 43.3569' N	012° 46.9522' E	PLA
13.11.23 17:11	EMB328_78-1	TF0046	26	54° 28.1818' N	012° 14.4775' E	CTD
13.11.23 17:11	EMB328_78-2	TF0046	26	54° 28.1796' N	012° 14.4810' E	PLA
13.11.23 17:32	EMB328_78-3	TF0046	26	54° 28.1909' N	012° 14.4834' E	WP2
13.11.23 17:40	EMB328_78-4	TF0046	26	54° 28.1903' N	012° 14.5016' E	WP2
13.11.23 20:48	EMB328_79-1	TF0012	22	54° 18.9721' N	011° 33.1228' E	CTD
13.11.23 20:48	EMB328_79-2	TF0012	22	54° 18.9724' N	011° 33.1196' E	PLA
13.11.23 21:08	EMB328_79-3	TF0012	21	54° 18.9117' N	011° 33.0590' E	WP2
13.11.23 21:14	EMB328_79-4	TF0012	22	54° 18.8899' N	011° 33.0326' E	WP2
14.11.23 04:56	EMB328_80-1	NH	12	54° 11.3223' N	011° 57.9495' E	CTD

7.2 Water Sampling – Parameters and Number of Samples

Station No. EMB328_xxx	Station name	O2	H2S	PO4	NO3	NO2	SIO4	NH4	P-Total	N-Total	POM+DOM	CH4_N2O	CO2	DNA-Filter	FISH Filter	P+G	Phyto-net	APSTEIN net	Chlorophyll	Phytoplankton	Zooplankton + Zoo.-DNA	UV-Filter	eDNA	SECCHI [m]
1	TFO5	1		3	3	3	3	3	2	2	2											3	2	4.5
2	TF0018	2		2	2	2	2																2	
3	TF0012	4		4	4	4	4	4	3	3	3			3			3		6	2	3	3	3	3.5
4	A3 Boltenhagen																							
5	A1 Boltenhagen																							
6	B1 Boltenhagen																							
7	C1 Boltenhagen																							
8	D1 Boltenhagen																							
9	E1 Boltenhagen																							
10	TF0022	4		4	4	4	4															3	2	
11	TF0010	1		4	4	4	4															3	2	
12	TF0014																							
13	TF0361																							
14	TF0360	3		3	3	3	3	3	3	3	3			3			3		4	3	2	3		
15	Bio FB2																							
16	Bio FB1																							
17	TF0010																							
18	TF0013	9																					2	
19	TF0017																							
20	TF0041	1		3	3	3	3																	
21	TF0046	1		4	4	4	4							3			3		6	2	2	3	1	
22	TF0083																							
23	TF0033																							
24	TF0002	3		3	3	3	3																2	
25	TF0001	3		3	3	3	3																2	
26	TF0030	1		4	4	4	4										3		5	2			2	
27	TF0115	4		4	4	4	4																2	
28	TF0114	1		5	5	5	5																2	
29	TF0113	7		7	7	7	7	7	4	4	4	7	7	3			3		6	2	3	3	2	5.5
30	TF0112	9		4	4	4	4																2	
31	TF0160	3		3	3	3	3																	
32	OBBOJE																					3		
33	TF0152	13		4	4	4	4																	
34	TF0214		2																					
35	TF0213	10	1	10	10	10	10	10	6	6	6	10	10				3	3	5	2	4			
36	TF0245	6	3	8	8	8	8	8																
37	TF0242		2																					
38	OCWG-1																							
39	TF0240	14	5	10	10	10	10	10																
40	nGB-1		3																					
41	TF0283	1	3																					
42	TF0282	1	3																					
43	TF0285	1	3																					
44	TF0286	8	8	16	16	16	16	16	6	6	6	16	16											

		O2	H2S	PO4	NO3	NO2	SIO4	NH4	P-Total	N-Total	POM+DOM	CH4_N2O	CO2	DNA-Filter	FISH Filter	P+G	Phyto-net	APSTEIN net	Chlorophyll	Phytoplankton	Zooplankton + Zoo.-DNA	UV-Filter	eDNA	SECCHI [m]
45	TF0270	1	3																					
46	TF0276																							
47	TF0271	22	18	34	34	34	34	34	12	12	12	24	20	52	26	52	3		6	2				8
48	GONE																							
49	GONE																							
50	TF0275																							
51	TF0272	9	3																					
52	GOSW																							
53	TF0273	9	3																					
54	TF0274																							
55	TF0260	5	4	9	9	9	9	9																
56	SF1-eGB																							
57	TF0259	7	2	7	7	7	7	7									3		5	2				9
58	SF2-eGB to SC																							
59	TF0267	2																						
60	TF0222	7		7	7	7	7	7																
61	SF3-SC to BB																							
62	TF0213	7	2	7	7	7	7										5	3	6	2	3			
63	SF4-BB																							
64	TF0200	6	2	7	7	7	7																	
65	SF5																							
66	TF0140	9		6	6	6	6																	
67	SF6-BG																							
68	TF0145	1		5	5	5	5																	
69	TF0109	1		5	5	5	5	5	4	4	4			3			3		5	2	1	3		
70	TF0103	1		5	5	5	5																	
71	TF0104	1		5	5	5	5																	
72	TF0105	1		5	5	5	5																	
73	TF0122																							
74	ABBOJE	11																						
75	TF109	1																						
76	TF0113	1															5		6	2	2			5
77	TF0030	1															3		5	2				
78	TF0046	1															3		6	2	1			
79	TF0012	1															5		5	2	2			
80	NH																							
	Samples	216	70	210	210	210	210	123	40	40	40	57	53	67	26	52	48	6	76	29	23	27	28	6
	Stations	49	18	35	79	79	79	13	8	79	79	4	4	6	1	1	14	2	14	14	10	9	0	6

7.3 List – Scanfish Profiles

Profile	Region	Begin [UTC]	Latitude [WGS84]	Longitude [WGS84]	End [UTC]	Latitude [WGS84]	Longitude [WGS84]	Length [NM]
SF1; EMB328_56-1	Eastern Gotland Basin	10.11.23 17:59	56° 37.7294' N	019° 34.7631' E	11.11.23 06:29	55° 33.3721' N	018° 24.7003' E	77
SF2; EMB328_58-1	Eastern Gotland Basin	11.11.23 07:28	55° 32.8436' N	018° 24.0323' E	11.11.23 11:52	55° 17.2712' N	017° 36.9417' E	25
SF2; EMB328_58-2	Eastern Gotland Basin to Slupsk Channel	11.11.23 14:27	55° 17.0975' N	017° 35.0443' E	11.11.23 17:14	55° 13.0286' N	017° 04.1030' E	30
SF3; EMB328_61-1	Slupsk Channel to Bornholm Bsin	11.11.23 17:50	55° 12.9905' N	017° 04.1707' E	12.11.23 00:09	55° 14.8632' N	015° 59.3900' E	38
SF4; EMB328_63-1	Bornholm Basin	12.11.23 02:44	55° 15.0752' N	015° 58.8923' E	12.11.23 06:35	55° 22.8694' N	015° 20.1145' E	23
SF5; EMB328_65-1	Bornholm Basin	12.11.23 07:19	55° 23.0733' N	015° 19.9088' E	12.11.23 11:24	55° 28.2477' N	014° 43.4116' E	24
SF6; EMB328_67-1	Bornholm Basin	12.11.23 12:23	55° 27.8650' N	014° 42.8714' E	12.11.23 16:34	55° 10.1712' N	014° 15.2000' E	24

7.4 List – Mooring Work

Date	Latitude [degree] °N	Longitude [degree] °E	Begin [UTC]	End [UTC]	Water Depth [m]	Action
08.11.23	57° 19.207'	20° 07.845'	07:10	07:35	247	Mooring GODESS. deployment / EMB328_47-1
08.11.23	57° 18.396'	20° 04.895'	10:29	14:05	248	Mooring Gotland central - GOCE. maintenance / EMB328_47-8
08.11.23	57° 22.008'	20° 20.510'	08:55	15:25	211	Mooring Gotland northeast - GONE. maintenance / EMB328_49-2
09.11.23	57° 04.200'	19° 45.600'	07:17	08:55	217	Mooring Gotland southwest - GOSW. maintenance / EMB328_52-3

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 MUDAB 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 Data availability and responsible scientists.

Type	Database	Available	Free Access	Contact

Hydrographic measurements	IOW DB. MUDAB. HELCOM. ICES	January 2024	December 2025	Naumann. Michael. Dr. michael.naumann@io-warnemuende.de
Nutrient measurements	IOW DB. MUDAB. HELCOM. ICES	March 2024	January 2027	Kuss. Joachim. Dr. joachim.kuss@io-warnemuende.de
Phytoplankton measurements	Personal contact	June 2024	February 2027	Kremp. Anke. Dr. anke.kremp@io-warnemuende.de
Zooplankton measurements	Personal contact	June 2024	February 2027	Dutz. Jörg. Dr. joerg.dutz@io-warnemuende.de

9. Acknowledgements

We thank the captain Dirk Thürsam and crew of RV ELISABETH MANN BORGESE as well as the cruise participants of engineers and technicians for their support of this successful cruise. We are also grateful to all other people who help to prepare the cruise. This cruise of HELCOM's Baltic Sea monitoring program. the IOW's long-term measuring program was funded by institutional funds of the IOW and the Federal Maritime and Hydrographic Agency. Hamburg and Rostock.

10. References

HELCOM. 2023. State of the Baltic Sea - Second HELCOM holistic assessment 2016-2021. Baltic Sea Environment Proceedings 194. https://helcom.fi/wp-content/uploads/2023/10/State-of-the-Baltic-Sea-2023.pdf

MATTHÄUS.W.. NEHRING. D.. FEISTEL. R.. NAUSCH. G.. MOHRHOLZ. V.. LASS. H.U.. 2008. The inflow of highly saline water into the Baltic Sea. In: R. Feistel. G. Nausch. N. Wasmund (Eds). State and Evolution of the Baltic Sea. 1952 – 2005. Wiley 2008: 265-309

MOHRHOLZ. V.. 2018. Major Baltic inflow statistics – reviewed. Front. Mar. Sci. 5. 384. doi: 10.3389/fmars.2018.00384

NAUMANN. M.. GRÄWE. U.. MOHRHOLZ. V.. KUSS. J.. KANWISCHER. M.. OSTERHOLZ. H.. FEISTEL. S.. HAND. I.. WANIEK. J.J.: Hydrographic-hydrochemical assessment of the Baltic Sea 2023. Meereswiss. Ber.. Warnemünde 128. doi: 10.12754/msr-2024-0128 (2024).

SEIFERT. T.. TAUBER. F.. KAYSER. B.. 2008. http://www.io-warnemuende.de/topografie-der-ostsee.html (Date of access: 08/03/2015)

11. Abbreviations

Defined in the text.

12. Appendices

Briese Schiffahrts Gmb & Co. KG
Abtlg. Forschungsschifffahrt
FS "Elisabeth Mann Borgese"

VERANKERUNGSPROTOKOLL

Datum:	08.11.2023	**Beginn:**	07:10	**Ende:**	07:35	**UTC**
Gerät:	**Mooring**			**Reise EMB**	**328**	
Code Name:	**GODESS**					
Lottiefe:	247 m					
Wetter: Wind:	240°		6 m/s			
Strömung:	NE		0,3 kn			
Absetzposition: Gerät **Breite:**	57° 19,207'N		(WGS 84, DGPS)			
Länge:	020° 07,845'E					
KrK:	240°					
Grundleine: (Ende) **Breite:**	57° 19,148'N					
Länge:	020° 07,554'E					
KrK:	240°					
Richtung:	250°		(vom Gerät)			
Länge:	315 m					
Oberfläche:	keine					
Bemerkungen:	Releaser an Ende Grundleine					

Kapitän Exp.-Leiter

Verteiler:

EMB
IOW

Fig. 12.1 Positioning of mooring "Gotland Deep Environmental Sampling Station" (GODESS) at the Gotland Deep.

Briese Schiffahrts Gmb & Co. KG
Abtlg. Forschungsschifffahrt
FS "Elisabeth Mann Borgese"

VERANKERUNGSPROTOKOLL

Datum:		08.11.2023	**Beginn:** 13:30	**Ende:** 14:05		**UTC**
Gerät:		**Sinkstofffalle**		**Reise EMB**		**328**
Code Name:		**Gotl. BI-2023-05**				
Lottiefe:		248m				
Wetter:	Wind:	225°	8 m/s			
	Strömung:		0,3 kn			
Absetzposition:	**Breite:**	57°18,393'N	(WGS 84, DGPS)			
Gerät	**Länge:**	020°04,895'E				
	KrK:	226°				
Grundleine:	**Breite:**					
(Ende)	**Länge:**					
	KrK:					
	Richtung:		(vom Gerät)			
	Länge:					
Oberfläche:						
Bemerkungen:						

Kapitän

Exp.-Leiter

Verteiler:

EMB
IOW

Fig. 12.2 Positioning of mooring "Gotland Central" (GOCE) at the Gotland Deep.

Briese Schiffahrts Gmb & Co. KG
Abtlg. Forschungsschifffahrt
FS "Elisabeth Mann Borgese"

VERANKERUNGSPROTOKOLL

Datum:		08.11.2023	**Beginn:** 15:05	**Ende:** 15:25		**UTC**
Gerät:		**GONE-44**		**Reise EMB**		**328**
Code Name:						
Lottiefe:		211m				
Wetter:	Wind:	225°	8 m/s			
	Strömung:		0.5 kn			
Absetzposition:	**Breite:**	57°22,008'N	(WGS 84, DGPS)			
Gerät	**Länge:**	020° 20,510'E				
	KrK:	221°				
Grundleine:	**Breite:**					
(Ende)	**Länge:**					
	KrK:					
	Richtung:		(vom Gerät)			
	Länge:					
Oberfläche:						
Bemerkungen:						

Kapitän

Exp.-Leiter

Verteiler:

EMB
IOW

Fig. 12.3 Positioning of mooring "Gotland Northeast" (GONE) at the northeastern slope of the Eastern Gotland basin.

Briese Schiffahrts Gmb & Co. KG
Abtlg. Forschungsschifffahrt
FS "Elisabeth Mann Borgese"

VERANKERUNGSPROTOKOLL

Datum:		09.11.2023	**Beginn:** 08:35	**Ende:** 08:55	UTC	
Gerät:		GOSW-07 11/23		**Reise EMB**	**328**	
Code Name:						
Lottiefe:		217 m				
Wetter:	Wind:	200°	10 m/s			
	Strömung:	-	-			
Absetzposition:	**Breite:**	57° 04,200'N	(WGS 84, DGPS)			
Gerät	**Länge:**	019° 45,600'E				
	KrK:	204°				
Grundleine:	**Breite:**					
(Ende)	**Länge:**					
	KrK:					
	Richtung:		(vom Gerät)			
	Länge:					
Oberfläche:						
Bemerkungen:						

Kapitän Exp.-Leiter

Verteiler:
EMB
IOW

Fig. 12.4 Positioning of mooring “Gotland Southwest” (GOSW) at the southwestern slope of the Eastern Gotland basin.