ELISABETH MANN BORGESE–Berichte

Baltic Sea Long-term Observation Programme

Cruise No. EMB361

18 March – 2 April 2025,

Rostock – Sassnitz – Nynäshamn (Sweden) – Rostock

HELCOM/long-term

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2025

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1 Summary

1.1 Summary in English

The cruise of r/v ELISABETH MANN BORGESE No. 361 was done in the frame of the HELCOM monitoring and the IOW long-term observation of the Baltic Sea from March 18th to April 2nd 2025. In the first days, the weather was sunny and cold, later often misty conditions with some rain dominated. The wind was characterized by a mostly moderate breeze but increased to a strong breeze on 22nd, 23rd, 27th and 28th March with strong gusts up to 18.8 m/s. The daily mean air and surface water temperature ranged from 3.3 to 6.5 °C and 3.9 to 7.3°C, respectively. The sea showed usually a low wave height. However, in the Western Gotland Sea in the second strong breeze phase, uncomfortable 1.5 m wave height were reached on our track. We completed 89 stations, including 5 repetition stations, with three mooring recoveries, refurbishment and re-deployment. We covered a route of 1920 n.m., with 280 n.m. used for four ScanFish transects. We stopped in Sassnitz for a disembarkation of three scientists and embarked one scientist. In Nynäshamn four Swedish scientists (SMHI, Stockholm University) embarked for one day for a comparison measurement of hydrogen sulphide on Landsort Deep station, and foodstuff was supplemented. Chlorophyll concentrations were usually measured at low concentration in surface water, only in the western Baltic Sea, especially in the Odra Bight and in the northern Western Gotland Sea the chlorophyll_a concentration reached 1.2 and 0.8 µg L^{-1}, respectively. High values of around 8 µg L^{-1} chlorophyll_a were caused by a diatom and dinoflagellate bloom between 10 and 15 m depth in the Landsort Deep area. The deep water of the Słupsk Furrow was investigated by CTD casts and ScanFish as significant oxygen concentration of around 90 µmol L^{-1} was measured there.

1.2 Zusammenfassung

Die Reise des F/S ELISABETH MANN BORGESE Nr. 361 wurde im Rahmen des HELCOM Monitorings und der IOW Langzeit Überwachung der Ostsee vom 18. März bis 2. April 2025 durchgeführt. In den ersten Tagen herrschte sonniges und kaltes Wetter, später überwogen diesige und auch regnerisch Tage. Der Wind lag meistens im Bereich einer mäßigen Briese, nahm aber am 22., 23., 27. und 28. März auf eine starke Briese zu und erreichte Böen bis 18.8 m/s. Die mittleren Tagestemperaturen lagen zwischen 3.3 und 6.5 °C in der Luft und von 3.9 bis 7.3°C im Oberflächenwasser. Es wurden 89 Stationen absolviert, mit 5 Wiederholstationen und drei Verankerungen, die geborgen, überarbeitet und wieder verankert wurden. Wir legten eine Strecke von 1920 n.m. zurück, wobei 380 n.m. für vier ScanFish Schnitte verwendet wurden. Wir hielten vor Sassnitz, um 3 Wissenschaftlerinnen auszubooten und eine Wissenschaftlerin an Bord zu nehmen. In Nynäshamn wurden vier schwedische Wissenschaftlerinnen (SMHI, Stockholmer Universität) für eine Vergleichsmessung von Schwefelwasserstoff auf der Station Landsorttief für einen Tag an Bord genommen und Nahrungsmittel gebunkert. Die Chlorophyll Konzentrationen im Oberflächenwasser waren normalerweise sehr niedrig, nur in der westlichen Ostsee, besonders aber in der Oder Bucht und im Norden der westlichen Gotlandsee wurden Chlorophyll_a Konzentrationen von 1.2 bzw. 0.8 µg L^{-1} erreicht. Hohe Werte von etwa 8 µg L^{-1} Chlorophyll_a wurden von Diatomeen und Dinoflagellaten zwischen 10 und 15 m Tiefe im Gebiet um das Landsorttief verursacht. Das Tiefenwasser der Słupsker Rinne wurde anhand von CTD- und ScanFish-Profilen untersucht, da hier etwa 90 µmol L^{-1} Sauerstoff gemessen wurden.

2 Participants

2.1 Principal Investigators

Name	Institution
Kuss, Joachim, Dr. (Marine Chemistry)	IOW
Mohrholz, Volker, Dr. (Hydrography)	IOW
Dutz, Jörg, Dr. (Zooplankton)	IOW
Kremp, Anke, Dr. (Phytoplankton)	IOW

2.2 Cruise Participants

Name	Discipline	Institution
Kuss, Joachim, Dr.	Marine Chemistry, Chief Scientist	IOW
Michels, Emil	Phys. Oceanogr., CTD & ScanFish	IOW
Heene, Toralf	Phys. Oceanogr., CTD, ScanFish, Moor.	IOW
Sadkowiak, Birgit	Marine Chemistry, Nutrients, Hydr. Sulf.	IOW
Otto, Stefan	Marine Chemistry, Nutrients	IOW
Schöne, Susanne	Marine Chemistry, Oxygen	IOW
Fechtel, Christin	Biol. Oceanogr., Plankt. and Microbiol.	IOW
Hehl, Uwe	Biol. Oceanogr.,Mooring	
Babooram, Sita	Phys. Oceanogr., CTD, ScanFish, Moor.	IOW
Benterbusch, Heike	Biol. Oceanogr., microbiology	IOW
Oppler, Jonna	Biol. Oceanogr., microbiology	IOW
Grote, Johanna	Biol. Oceanogr., Plankton	IOW
Menke, Laura	Biol. Oceanogr., Plankton	IOW
Johansson, Sara	Hydrogen sulphide	SMHI
Nilsson, Madeleine	Hydrogen sulphide	SMHI
Dahlgren, Malin	Hydrogen sulphide	Stockh. Uni
Mattsson, Elizaveta	Hydrogen sulphide	Stockh. Uni

2.3 Participating Institutions

IOW	Leibniz Institute for Baltic Sea Research Warnemünde
SMHI	Swedish Meteorological and Hydrological Institute
Stockh. Uni	Stockholm University

3 Research Programme

3.1 Description of the Work Area

The working area for IOW's contribution to the HELCOM monitoring comprised German territorial waters with the German Exclusive Economic Zone and bordering sea areas. Therefore, basic hydrographic data, major nutrients, phytoplankton and zooplankton parameters were determined. Moreover, the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) extends the investigated sites by its long-term observation programme of the Baltic Sea. This contributes with additional stations in the Belt Sea, the Arkona Sea, and the Bornholm Sea, as well as with station work in the eastern and western Gotland Sea. Sampling in the frame of a DAM (Deutsche Allianz Meeresforschung) initiative to establish an archive of eDNA samples and a one-day joint venture of groups from IOW, SMHI and Stockholm University were done for an analytical comparison of hydrogen sulphide measurements were added to the cruise's work programme. Therefore, an extra harbour entry in Nynäshamn enabled the logistics and additional CTD-rosette casts were done to provide water samples for these projects. However, a major focus is always on the Thalweg transect, which reflects the main path of inflowing North Sea water via the Belt Sea, Arkona Sea, Bornholm Sea, along the Słupsk Furrow to the Eastern Gotland Basin and further to the northern and western Gotland Sea, bringing episodically haline oxygen rich water to the central basins. This happened also in late autumn 2024 (Kube, 2025) and during winter 2024/2025 that was investigated by a ScanFish transect (towed undulating CTD) from the Bornholm Deep to the southern Gotland Basin. ScanFish was used to obtain data of salinity, temperature, oxygen, chlorophyll and turbidity at high resolution along the Thalweg, in addition to the regular transverse transects in the western and Eastern Gotland Sea. CTD stations and ScanFish transects are shown in the map (Fig. 3.1). The list of stations and activities is given in Chapter 6.

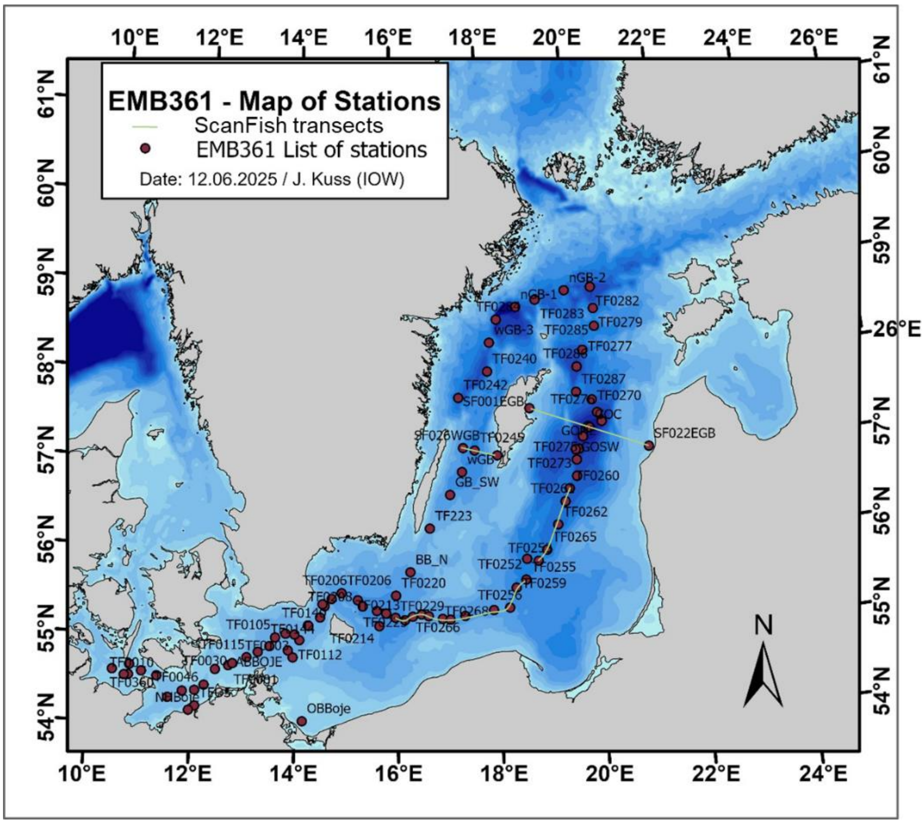

Fig. 3.1 Map of stations (red dots) and ScanFish transects (SF waypoints, green lines) of the cruise EMB361 from 18th March – 2rd April 2025; for clarity, a couple of station names are not shown; for the details of the sampled stations see list of stations in Chapter 6.

3.2 Aims of the Cruise

The cruise EMB361 was carried out as a joined cruise of the environmental monitoring programme of the Federal Maritime and Hydrographic Agency (BSH) and the Baltic Sea long-term observation programme of the IOW. It was the second cruise in 2025 as one of five expeditions performed annually. The acquired data are used for the regular national and international assessments of the state of the Baltic Sea, and provide the scientific basis for measures to be taken for the protection of the Baltic Sea ecosystem. The hydrographic and hydrochemical conditions as well as the development of phytoplankton and zooplankton abundances are investigated. Microbial habitats, ocean acidification and greenhouse gases were additionally studied in the frames of the long-term observation of the Baltic Sea and by projects. A special focus of the long-term observation is always the occurrence or absence of inflow events that both have major consequences for the state of the Baltic Sea hydrochemistry and the ecosystem.

3.3 Agenda of the Cruise

The work on the stations usually started with a CTD cast and already programmed sampling on standard depth levels and manually released samplings in near-bottom and surface waters. Then other CTD casts were carried out to meet the additional water sample requirements on the respective stations. Net sampling and depth of visibility determinations by means of a Secci disk were done on selected stations. For details see list of stations in Chapter 6.

Water from selected water layers was sampled in German territorial and EEZ waters for a DAM initiative to establish an eDNA sample archive and to investigate the metabolic pathways of microorganisms and metazoans by a metagenomic and metaproteomic approach. The opportunity of a visit of Nynäshamn was used for a joint venture with four Swedish scientists (SMHI, Stockholm University) to compare the analytical methods and results of hydrogen sulphide determinations by joint water sampling at Landsort Deep station on 27th March.

Measures are taken to conduct responsible marine research to protect species, habitats, threatened and declining features. Our sampling in the Baltic Sea does not cause any noticeable changes in the ecosystem. No intentional sampling of any threatened features of the marine ecosystem takes place. The amount of sampled biota is small and the sampling strategy is designed to answer a number of questions on the same samples. Our working program will not affect any other research conducted concurrently in the same region. No toxic or harmful substances are released into the environment. All chemical waste is collected on-board and brought back to the home laboratory for disposal.

CTD and Sampling

The CTD-system "SBE 911plus" (Seabird-Electronics, USA) was used to measure the variables: Pressure, Temperature (2x SBE 3), Conductivity (2x SBE 4), Oxygen concentration (2x SBE 43), Chlorophyll-a fluorescence (683 nm), Turbidity, Photosynthetic active radiation in water (PAR), and above the sea (SPAR). The Rosette water sampler was equipped with 13 Free Flow bottles of 5 L volume each. The CTD sensors were checked during the cruise by comparison measurements. In detail, for temperature a high precision thermometer SBE RT35 was used. Salinity samples were taken for measurement after the cruise by means of a salinometer. Slope and offset of the oxygen sensors SBE 43 are determined by daily comparison with Winkler titration.

Nutrients

Nitrate, nitrite, phosphate, and silicate were analysed using standard colorimetric methods by means of an autoanalyser (FlowSys, Alliance-Instruments, Ainring, Germany) and ammonium was determined manually as indophenole blue (Grasshoff *et al.*, 1999) from unfiltered water on-board. Total and total dissolved nitrogen and phosphorous samples as well as particulate and dissolved organic matter samples were prepared and stored deep frozen for digestion and analysis in the IOW nutrients and natural organic matter labs, respectively.

Oxygen and hydrogen sulphide

Oxygen was analysed by Winkler titration and hydrogen sulphide was determined by spectrophotometry after its conversion to methylene blue (Grasshoff *et al.*, 1999). To continue the oxygen profiles in anoxic waters and for comparison, H_2S concentration was converted to negative oxygen values according to its reduction capacity: $H_2S + 2\ O_2 \rightarrow H_2SO_4$. During CTD casts the SBE 43 sensors (duplicate installation) recorded oxygen values that are validated by daily Winkler titration from 3 water sampling bottles released according to a specific time-regime, each by triplicate analysis.

Plankton sampling

Plankton sampling was performed by means of the rosette sampler (combined with CTD) as well as with a small phytoplankton net and the zooplankton nets WP2 and Apstein. Samples were taken in a tight follow up of depths levels in order to get representative data from the water column. The traditional method to estimate water transparency/primary production by means of a Secci disk is also applied here. (Responsible scientists: Dr. Anke Kremp, Dr. Jörg Dutz).

Long-term observation of the microbial habitat of the redoxcline

Insights into the redoxcline microbial food web is obtained by well resolved sampling in the range of the redoxcline at Gotland Deep and Landsort Deep 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. (Responsible scientist: Prof. Dr. Klaus Jürgens)

Long-term investigations of CH_4, N_2O, CO_2 and the marine carbonate system

Sampling for simultaneous CH_4 and N_2O observation is carried out on 4 stations (TF0113, TF0213, TF0271, TF0286) in the frame of an accompanying project for long term data collection. All samples were taken in septum-sealed 250 mL water bottles and fixed with 200 µL saturated $HgCl_2$-solution to prevent microbiological activity and stored dark. On the same stations and depths also samples were taken for the analyses of carbon dioxide, total inorganic carbon, total alkalinity and pH for their long-term observation. These samples were fixed by the same method and were also stored dark. In case of hydrogen sulphide presence, these samples were fixed with 500 µL saturated $HgCl_2$-solution. (Responsible scientist: Prof. Dr. Gregor Rehder).

Establishment of an eDNA-archive and Metaproteogenomic analyses (DAM project)

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 µm or a 0.45 µm filter to obtain respectively bacterial and metazoan DNA (CREATE project). All samples are frozen directly and stored at -20 °C and are available for further processing like DNA extraction and sequencing.

For metaproteogenomic analyses, surface water samples of 60 L were taken by a CTD-Rosette system. Subsequently, the water was filtered through 10 µm, 3 µm and 0.2 µm filters, respectively. Filters were stored at -80 °C. Macro- and microalgae were found on the 10 µm and 3 µm filters and bacteria were harvested on the 0.2 µm filter 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).

Just a Surface water Monitoring Box (JSMB)

The JSMB system (Krüger and Ruickoldt, 2021) is used for continuous measurements of temperature, salinity, conductivity, calculated sound velocity, real sound velocity, Chl_a, turbidity and optional many more parameters in a seawater flow pumped from below the ship's hull. The measurement ranges, the accuracy or alternatively the sensitivity of the measurements are as follows: conductivity with a range of 0 to 70 mS/cm, and an accuracy of 0.003 mS/cm, temperature (-3 to 35 °C, 0.002 °C), salinity (2 to 42, 0.005), sound velocity (1375 to 1625 m/s, 0.025 m/s), turbidity (0 to 25 NTU, 0.013 NTU sensitivity), and chlorophyll_a (0 to 50 µg L^{-1}, 0.025 µg L^{-1} sensitivity). The system was used during transect for recording of these parameters in surface water that was pumped from below the ship's hull. Preliminary data of temperature, salinity, chlorophyll_a and turbidity are shown in Figure 5.2 (Responsible scientists: Robert Mars, Johann Ruickoldt).

ScanFish

An undulating CTD-system with fluorometer and oxygen sensor was tugged on selected transects. The ScanFish is a towed platform in wing shape allowing to accumulate CTD data of the water column in an undulating manner from the surface close to the bottom. It offers a payload to accommodate a pumped Seabird CTD application consisting of a Seabird SBE911+ probe, temperature (SBE3), conductivity (SBE4) (salinity) and oxygen (SBE43) sensor. Additionally, a Wetlabs FLNTU is installed for chlorophyll and turbidity recording. The central ScanFish controller supports DSL data transfer protocols and speed, making it very flexible to interface with additional sensors and devices (Responsible scientists: Martin Kolbe, Emil Michels).

4 Narrative of the Cruise

This paragraph aims at giving an impression of the work on board during the campaign. It is a day by day report that includes the forecasted weather and sea condition as predicted by the Deutscher Wetterdienst, DWD (2025) for the respective days.

Tuesday, 18 March 2025: The weather forecast predicted for the Belts and Sound westerly winds of 4 bft, which were expected to shift to a south-western direction and decrease to 3 bft at a sea state of 0.5-meters wave height. Early morning the air temperature was clearly below 0°C but after passing the mole of Warnemünde it increased to about 4 to 5 °C. The first day was sunny at a relatively flat sea. The first station TFO5 was accomplished by a CTD cast with sensor measurements of conductivity, temperature, depth, oxygen, fluorescence and turbidity and water sampling for the determination of several chemical parameters. It was used as a test station for the

CTD and the lab work. After sampling from the water bottles was completed, a security exercise followed to support the theoretical introduction with some practise. Then we headed to the next station TF0012 in north-western direction. The comprehensive work programme included water sampling by two CTD casts for oxygen Winkler determinations, the nutrients nitrate, nitrite, phosphate, silicate, ammonium, total nitrogen and total phosphorous as well as for the dissolved and particulate natural organic matter. Moreover, sampling for an eDNA archive as well as to investigate bacteria's metabolic activity by examination of metagenomics and metaproteomics required a whole CTD of 60 L surface water. The depth of visibility was determined by the traditional Secci disk. As well, net catches for phytoplankton and zooplankton samples were done. On station TF0014 a CTD cast and on two nearby stations each a multicorer haul was done in the afternoon, to compare sediments inside and outside of a marine protected area in the Fehmarn Belt region. The stations TF0014, the laborious TF0360 with many water samples for chemical parameters, and the TF0361 just for a CTD cast followed.

Wednesday, 19 March 2025: The weather forecast predicted wind from west to southwest of about 3 bft, for a time light and variable winds and a sea 0.5 -meter wave height. TF0010 with a CTD cast and nutrients, oxygen and a eDNA sample was done after midnight. Moreover, on this station the first comparison measurements of oxygen, salinity, temperature, and pressure was done to secure the correctness and stability of the sensors, or in case of deviations, to adjust the sensor reading at least after the cruise. Then just a CTD profile without water sampling followed on TF0017 and a cast with sampling for inorganic nutrients and a Winkler oxygen determination on TF0041. In the morning the weather was sunny with calm winds, but only about 3.5 °C air and 5°C water temperature were measured. On the TF0046 in the Cadet Channel one CTD cast for nutrients, chlorophyll enrichment on filters and net hauls for phytoplankton as well as zooplankton samples were carried out. The shallow Darss Sill between the western Baltic Sea and the Baltic Proper with the stations TF0002 and TF0001 was done after breakfast. On TF0001 at the autonomous MARNET station *Darss Sill*, Winkler oxygen determination is done in respective sensor depths of the pile for comparison and additional nutrient measurements. The biological work at station TF0030 comprises phytoplankton net hauls and sampling for chlorophyll in combination with inorganic nutrients determination and oxygen samples for Winkler titration on selected depths. The depth of visibility was determined by the traditional Secci disk. Similarly, on TF0115 and TF0114 in the evening, CTD casts with inorganic nutrients and oxygen measurements were on the schedule. The major station TF0113 was accomplished in the afternoon by water sampling for the inorganic nutrients including ammonium, total nitrogen and total phosphorous as well as for the dissolved and particulate natural organic matter analyses. Moreover, sampling for an eDNA archive as well as to investigate bacteria's metabolic activity was subsequently carried out. Then we headed south in direction of the MARNET station *Odra Bank* later in the evening.

Thursday, 20 March 2025: The weather for the Western Baltic was forecasted with light and variable winds, for a time southwest of about 3 bft, later coastal fog patches at a sea state of 0.5 -meter wave height were expected. After the transit from the Odra buoy to the central Arkona Sea the TF0112 was completed right after midnight by two CTD casts for oxygen and inorganic nutrients and the microbiological samples for the eDNA archive, moreover, a complete rosette of 60 L water for the bacterial metabolic activity determinations was taken. Afterwards another CTD cast followed for the second comparison measurements of the sensors. Then the TF0109 was completed by a CTD cast for inorganic nutrients and oxygen determinations and a biological programme of 2 net hauls with the small phytoplankton net and two casts with a WP2 net for zooplankton samples followed. Next was the MARNET station *Arkona Basin* with the semi-submersible platform for oxygen comparison measurements at 7 and 40 m depth for the respective sensors mounted at the platform. We headed south-east to reach Sassnitz harbour in the morning to bring three persons of the scientific party to the harbour by the work dinghy and pick up one person to support the biological work on the second part of the cruise. In north-eastern direction the stations TF0105, TF0104, and TF0103, with a CTD and water sampling for inorganic nutrients and oxygen were done in the afternoon. In the evening the stations TF0145, TF0144, and the TF0142 between Bornholm and Sweden followed later in the evening by a respective CTD cast on each and sampling for Winkler oxygen and inorganic nutrients determinations. Further on, a CTD cast on TF0140 combined with the third CTD sensor comparison was done. The TF0206 north of Bornholm was next with a CTD cast and one oxygen Winkler determination. Then another cast without water samples was done on TF0208.

Friday, 21 March 2025: The weather forecast for the Southern Baltic expected wind from southwest to west of 4 to 5 bft, at times misty at a sea of 1.5-meter wave height. TF0200, TF0211, TF0214, and TF0212 in direction of the Bornholm Deep were each fulfilled by a CTD cast. Then one of the major stations, Bornholm Deep TF0213 was scheduled for seven o'clock in the morning. However, the CTD didn't get in operation mode. Some checks were done to fix the issue and in the meantime the net catches for phytoplankton and zooplankton were carried out. Then comprehensive investigations of the electronics were done to identify the causes of the failure. Finally, we decided to use the spare CTD as replacement. However, this was operated over the steer of the ship via the A-crane and sampling was then done on the afterdeck. As the sea was calm this was fulfilled by two CTD casts to take the important water samples for determinations of nitrate, nitrite, phosphate, silicate, ammonium, total and total dissolved nitrogen and phosphorus, as well as oxygen, greenhouse gases carbon dioxide, methane, dinitrogen oxide (CO_2, CH_4, and N_2O). Hydrogen sulphide was not detected in bottom waters. The CTD connection to the cable was decided to be replaced by a new one that required however some time to embed the wires in the synthetic resin and to harden the new connection. In the meantime and to secure an adequate resolution of the Thalweg transect, the ScanFish was deployed and pulled via the Słupsk channel until the TF0259 in the next morning.

Saturday, 22 March 2025: The weather was expected with winds from east to northeast of 5 to 6 bft. And a sea of 2.5 -meter wave height. Reaching the station TF0259 water sampling for biological and chemical analyses were on the schedule. An adequate profile was obtained by using the re-established CTD rosette system. However, water sampling was still hindered by electronic problems. Some further investigations until the next station revealed that the releaser unit of the water sampling bottle needed to be exchanged as well. Then the individual release of water sampling bottles by the deck unit was possible and done on TF0255, but no usual programming of sampling depths was enabled. To have some time to also fix this issue, the ScanFish was deployed on the next station TF0253 and the Thalweg transect was continued by this undulating CTD, towed by the ship at about 6 kn ship speed.

Sunday, 23 March 2025: Wind was forecasted from east of 4 to 5 bft, for a time increasing to 6 bft, later shifting northeast with local shower squalls at a sea for of up to 2-meter. At midnight nice greenish polar light could be seen at the northern horizon at a clear sky. In the morning, the sun shined bright at 4°C air temperature and a strong breeze. Overnight the stations TF0261, TF0260, TF0274, TF0273, TF0272 and TF0275 could be done by fully operated CTD casts. Subsequently we headed further North until the TF0271 in the Eastern Gotland Sea were continued by CTD casts with just a temperature, salinity, oxygen, chlorophyll and turbidity profile recording. For the morning, the major station Gotland Deep TF0271 was on schedule with seven CTD casts, net hauls with the small net and of course a Secci depth determination. It included 4 CTDs for chemical parameters and gases, a surface water CTD for phytoplankton, a CTD with 13 water sampling bottles for the redoxcline, aimed at microbiological investigations and one CTD was taken just for making filling solution of sediment trap sampling bottles. After the station work was completed we headed northeast to the first mooring *Gotland Northeast* (GONE) for its recovery. The mooring was released shortly after one o'clock and recovered on deck within half an hour. After refurbishment and exchange of instruments the deployment started, but unfortunately the crane was blocked by a shackle and had to be repaired first. After two and a half hours the mooring was well deployed in time. We then headed in south-eastern direction to reach the station SF018EGB close to the Latvian coast. We started the next ScanFish transect at about 18:00 o'clock across the Eastern Gotland Basin until the coastal water of Gotland.

Monday, 24 March 2025: The weather forecast expected wind first from eastern direction of 3 to 4 bft, otherwise light and variable winds, shifting southwest by increasing to 5 bft at a sea of 1.5-meter wave height. The ScanFish was recovered 4:40 o'clock, followed by a CTD cast for comparison purposes with the ScanFish sensors. It was done early in the morning to be in time in the centre of the basin for the recovery and deployment of two moorings. After 4 hours transit to the centre of the basin, the recovery of the mooring *Gotland Southwest (GOSW)* was on the schedule. The releaser was activated at about 9:00 o'clock and a few minutes later, a buoy package was visible at the sea surface nearby the ship. The buoys, lines, instruments and finally the mooring weight with an ADCP was retrieved that the mooring was on deck half an hour later. The redeployment began after a short break for exchange of the instruments and some refurbishment. It ended at about 9:30 o'clock after a final CTD for this site. Then we headed in north-eastern direction to exchange the *Gotland Central (GOC)* mooring. We arrived at the mooring site and activated the releaser at 1:00 o'clock pm. The recovery buoys were hooked up and pulled onboard and lines, physical oceanographic instruments, a sediment trap with a number of floats were retrieved from the water. The *GOC* mooring was completely recovered at 1:46 o'clock in the afternoon. After some cleaning, refurbishment and exchange of instruments as the time series sediment trap it was ready for re-deployment. It started 5 minutes to two o'clock by heaving the mooring weight outboard and was finished 25 minutes later. Then we continued the station work by CTD casts on TF0276 in the afternoon. Until midnight we completed as well TF0270 by a Winkler oxygen measurement in 10 m depth as comparison value, and a bottom water hydrogen sulphide profile to monitor the current oxygen/hydrogen sulphide status of the bottom water of the region and finally TF0287 was done just by a CTD cast.

*Tuesday, 25 March 2*025: The weather for the Central Baltic was forecasted with wind from southwest of 5 bft, then shifting northwest to north, abating, at times misty, at a sea 1.5-meter wave height. We started in the morning the major station Fårö Deep (TF0286) that required two CTD casts with all nutrient parameters, sampling for natural organic matter and greenhouse gases analyses. The necessary conservation of the gas samples and the filtration for dissolved organic and total matter determinations of carbon, nitrogen, and phosphorus took almost one hour. At a cloud covered sky with some rain in the afternoon and 4°C air temperature, we continued the station work in the northern Gotland Sea, basically by CTD casts on stations TF0277, TF0285 and additionally, by sampling for an oxygen comparison. Then TF0279, TF0282, nGB-2, TF0283 and nGB-1 were completed until midnight, by measuring H_2S bottom profiles on TF0282 and TF0283.

Wednesday, 26 March 2025: The weather forecast for the Central Baltic Sea was south-westerly winds of about 3 bft, for a time shifting north, later locally 5 bft, at times misty with fog patches at a sea of first 1-meter wave height. Early in the morning it was dense fog but later the visibility improved but it started to rain. After breakfast, we began the work on the Landsort Deep station TF0284 with the maximum depth in the Baltic Sea of 459 m and an ambitious sampling schedule and many parameters of nutrients and oxygen/hydrogen sulphide, as well as microbiological samples from the redoxcline range, and a Secci depth determination. Afterwards we headed in north-western direction to reach Nynäshamn.

Thursday, 27 March 2025: The weather forecast for the Central Baltic was wind from southwest of 4 to 5 bft, shifting slowly south, later decreasing to about 3 bft. After the arrival of two Swedish teams from SMHI and Stockholm University, we left the sunny port at 8:10 o'clock in the morning. The weather turned worse with wind between 6 and 7 bft with some rain at a cloud covered sky. The transit to the station was used for discussion of the methods and to develop a sampling scheme. The agreement was to sample from the same bottle of triplicate sample as well as triplicate samples from a dedicated sampling bottle for each group. At 10:20 we started the upper CTD cast with 80 and 150 m. As the CTD was on deck, the sampling was carried out and prepared for the analytics. For CTD sensor checks, we did again a comparison measurement afterwards. After lunch the second CTD cast for the deep water samples was started and in each of 300 and 400 m, respectively, 4 bottles were closed. The sampling was done in structured order and could be well accomplished. Then we finished the station by a final hose sample. It was done by the Stockholm University team to get a representative biological sample of the water column between surface and 20 m depth. On station the conditions turned to rough sea conditions and the transit back to the harbour was appreciated. At a quarter past four we were back in the harbour. We said goodbye to the Swedish guest scientists who disembarked after the ship was moored at the quay. In the evening a barbeque brought the scientists and the crew together on the afterdeck for dinner. The occasion was to wish the first officer good luck for the future and to thank him for the excellent work on r/v ELISABETH MANN BORGESE, because he would leave the ship after this cruise to become master on another German research vessel.

Friday, 28 March 2025: The weather was expected with wind from southwest of 4 bft, for a time increasing to 5 bft, later shifting to southern direction, at times misty, with a sea at times with 1.5-meter wave height. We left the harbour of Nynäshamn at 9:00 o'clock at a cloud covered sky and calm winds in the archipelago. The first station of the day was the wGB-3 for just a CTD cast after noon. Then the TF0240 was accomplished with sampling for nutrients with ammonium included, and an oxygen/hydrogen sulphide profile. In the meantime, the wind increased and reached 7 bft in the evening. Consequently, the waves grew higher, especially at wind from south enabling a large fetch. About three hours later the TF0242 followed by just recording a CTD profile, before we headed to the ScanFish transect that was planned to begin close to the southern tip of the island of Gotland.

Saturday, 29 March 2025: The weather forecast was wind from southern direction with 3 to 4 bft, light and variable winds later, at times misty with fog patches and a sea of 1-meter wave height. The first station of the ScanFish transect SF032WGB was reached after midnight. We began with a CTD cast for sensor comparison between CTD and ScanFish. At about one o'clock the ScanFish was deployed and tugged until the station SF026WGB and was recovered at five o'clock and secured on deck. In the morning the sea was clearly sedated with sunshine. Then we headed to the Karlsö Deep station TF0245 for a CTD cast with water sampling for nutrients with ammonium and an oxygen/hydrogen sulphide profile. Then we completed wGB-1 before we did a longer transect to the Eastern Gotland Basin to investigate some stations for water sampling that were only covered by the ScanFish transect in the first week of the cruise.

Later of the day, misty conditions with fog patches were present. The next CTD cast was done on station TF0262 at seven o'clock in the evening for sensor profile and a bottom water oxygen/ hydrogen sulphide sample. A layer of several meters thickness with significant oxygen concentration one meter above ground was identified, but none was found in the water close to the bottom. Then we headed south to reach the final station of the day TF0252 for a CTD cast only.

Sunday, 30 March 2025: Weather forecast expected for the Southern Baltic wind from south to southwest of 4 to 5 bft, for a time increasing a little, shifting north, shower squalls, at a sea state for a time with 1.5-meter wave height. After midnight the important station TF0259 was fulfilled by a CTD cast with sampling for nitrate, nitrite, phosphate, silicate and ammonium as well as oxygen/hydrogen sulphide analyses according to Winkler (1888) and Fonselius et al. (1999), respectively. Then we had to adjust the time on-board to the Central European summer time. The TF0268 and the TF0266 followed by just a CTD profile, however interestingly showing oxygenated water layer in the bottom range. The location of the next station TF0222 reflects the middle of the Słupsk Furrow, with CTD cast and water sampling as on last major station TF0259. In the might bottom layer still 90 µmol L^{-1} oxygen was determined. The TF0229, TF0227 and TF0225 reflect the transfer from the Słupsk Furrow to the Bornholm Basin. But we stopped at TF0225, completed a CTD cast with a sensor comparison measurement, deployed the ScanFish and headed backwards again through the Słupsk Furrow by Scanfish to get a higher resolved recording of the oxygen situation in bottom water there. In the meantime, the sky was cloud covered with light rain. However, waves were relatively small compared to the nearby Arkona Sea where the wind was significantly stronger. The ScanFish was recovered around midnight at TF0268, and a final CTD for comparison finished the transect through the Słupsk Furrow.

Monday, 31 March 2025: For the Southern Baltic northerly winds of about 3 bft, first shower squalls, morning coastal fog patches at a sea of 0.5-meter wave height. After the ScanFish transect to the eastern end of the Słupsk Furrow, we headed back to the first repetition station in the Bornholm Sea TF0213. The Bornholm Deep station was basically focussed on the biological work to identify the change since the first visit on this cruise. In the morning fog patches and a calm sea was present. So, 4 WP2 and 3 Apstein net hauls were carried out for zooplankton and the small net for phytoplankton sampling. Water sampling for an oxygen profile and nutrients analysis was also done. Later in the evening the TF0113 in the Arkona Sea was on schedule after several hours transit from the Bornholm Sea. One net catch for phytoplankton and two WP2 hauls for zooplankton samples were done, a few oxygen samples were taken and a final comparison measurement for the CTD with Winkler oxygen, salinity, temperature and pressure determinations was also accomplished. Then around midnight the TF0030 was completed by a CTD cast and two oxygen determinations.

Tuesday, 01 April 2025: The weather forecast expected wind from northern direction of about 3 bft, shifting northeast, for a time light and variable winds, later fog patches, at a sea state of 0.5-meter wave height. On a sunny morning, we completed the TF0046 west of Darss Sill by the biological programme and again some oxygen Winkler determinations. So the TF0012 with a biological programme similar to the other repetition stations before was completed with an oxygen determination. Then a new station NHBoje in relative shallow waters, a recently installed measuring system located at an artificial reef was supported by a CTD cast for comparison purposes, which was done in the afternoon. Afterwards, we entered Rostock harbour and docked at the pier of Rostock-Marienehe at about 16:00 o'clock.

Wednesday, 02 April 2025: In the morning of 2nd April after the customs clearance, all the lab stuff that was stowed in a small container was carried from board at once and loaded on the Institute's lorry. Also the valuable samples, either in appropriate cooling or freezing boxes and data were taken from board to the Leibniz Institute for Baltic Sea Research Warnemünde.

5 Preliminary Results

The results presented in the following sections are preliminary and many samples taken are to be analysed and interpreted during the next weeks and months. The aim of this section is to give a first impression of the actual state of the western and central Baltic Sea in the second half of March. An advanced data analysis will follow when the validated data set is available.

5.1 Meteorological Conditions

In the beginning of the cruise (18th-19th March) the weather situation (Deutscher Wetterdienst, 2025) was characterized by a high pressure system over central Europe that built up after a cold front and moved from the German Bight across Germany to the northern Balkans, bringing cold polar air from the north and lead to moderate frost at night. From March 20, very mild air reached Central Europe from the south-east between a high-reaching cyclone over south-western Europe and the high over the Balkans. The low over Central Europe slowly moves across Germany towards Eastern Europe until March 25. The high-altitude low and the associated high-altitude trough follow with a delay. Later, a weak cold front spreads to the northwest. After March 26, the high-reaching anticyclone extended behind the cold front near the British Isles from the west to eastern Central Europe and formed a high-pressure bridge. As it progressed, a small-scale Atlantic low shifted towards France and the North Sea, causing a temporary drop in air pressure. From March 29, after the trough had passed, a high-pressure system west of the Bay of Biscay controlled the cyclonic north-westerly situation. At its edge, another small-scale low together with an occlusion were steered from the northwest towards Germany.

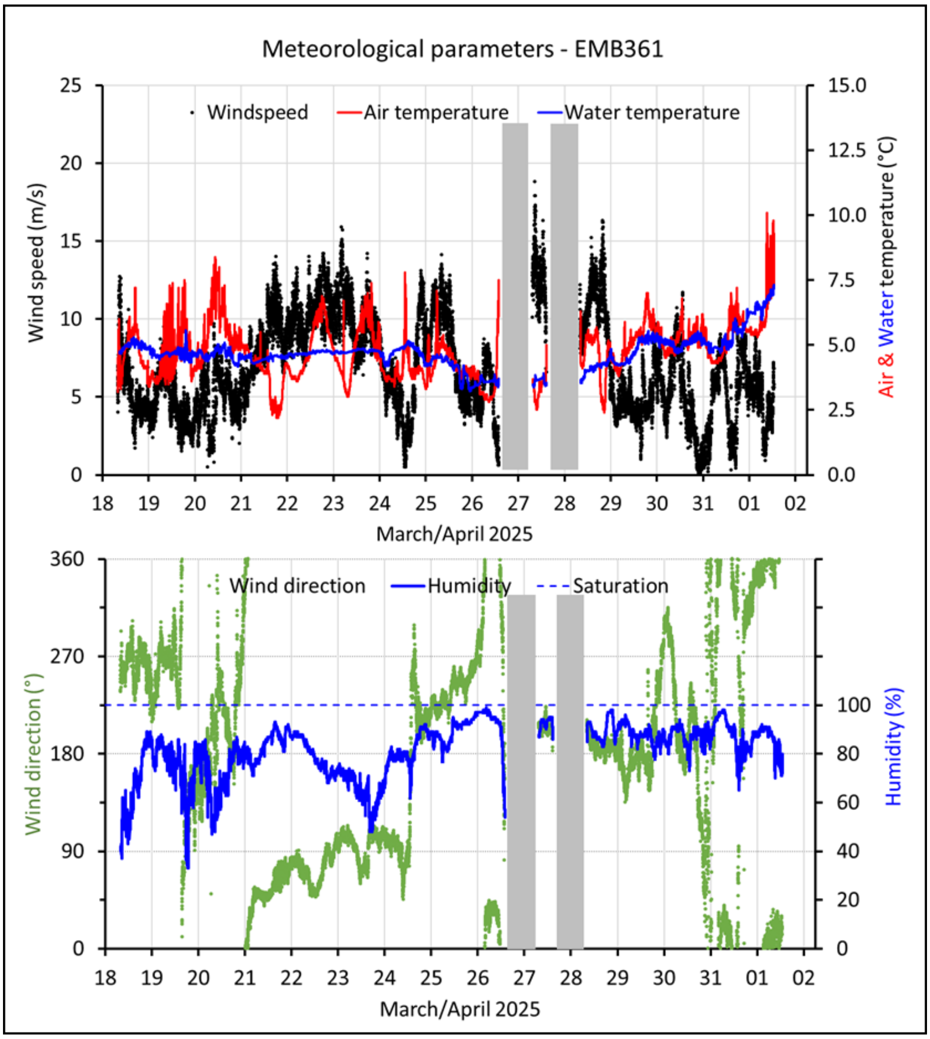

Fig. 5.1 Surface water temperature (JSMB-thermosalinograph), air temperature, and wind speed (upper panel) as well as humidity and wind direction (lower panel) measured on-board by the automatic weather station of the DWD; the times in Nynäshamn (Sweden) are shaded grey.

On land we still had winter conditions on 18th March with temperatures above the ground below the freezing point in the early morning. After reaching the open sea, the air temperature in 10 m height had adapted to the water temperature of about 5 °C. The first three days were characterized by a gentle to fresh breeze, an average water temperature of 4.8 °C, and an air temperature of 5.0 °C. After a short stop in front of Sassnitz, we headed to the northern Arkona Sea and further to the Bornholm Sea at a fresh breeze and high wind gusts up to 16 m/s from eastern direction between the 22nd to 23rd March. Then the wind calmed down to a moderate breeze that enabled to do mooring operations in the Eastern Gotland Basin on 24th March, at however lower air and water temperatures of about 4 °C. Subsequently we moved further north to investigated the northern Gotland Sea at 3.6 °C water temperature and air temperature decreased to 3.3 °C on 27th March with gusts of up to 8 bft wind. However, we entered the harbour of Nynäshamn on 26th evening and left it on 27th for the intercalibration exercise on Landsort Deep station until the afternoon. The next days were characterized by a gentle breeze and increasing air and water temperatures until the western Baltic Sea of finally average 6.5 °C. On the way back we passed again Slupsk Furrow to complete the stations that were missed on the first half of the cruise.

Surface water processes are often closely coupled to prevailing weather conditions. Strong winds could hamper the development of blooms by deep mixing, but sunny periods with low wind cause warming and stabilization of surface water that usually help to start the spring bloom. Chlorophyll concentrations were usually measured at low concentration in surface water, only in the Odra Bight and in the northern Western Gotland Sea the chlorophyll_a concentration reached 1.2 and 0.8 µg L^{-1}, respectively. This was also visible in the partial decline of major nutrients in surface water that will be discussed later (paragraph 5.3.1). However, large areas didn't show clear signs of a beginning spring bloom in March 2025 (Fig. 5.2). The local development of the spring bloom was clearly indicated by the elevated chlorophyll_a concentration also illustrated in the Thalweg panel (Fig. 5.6, middle).

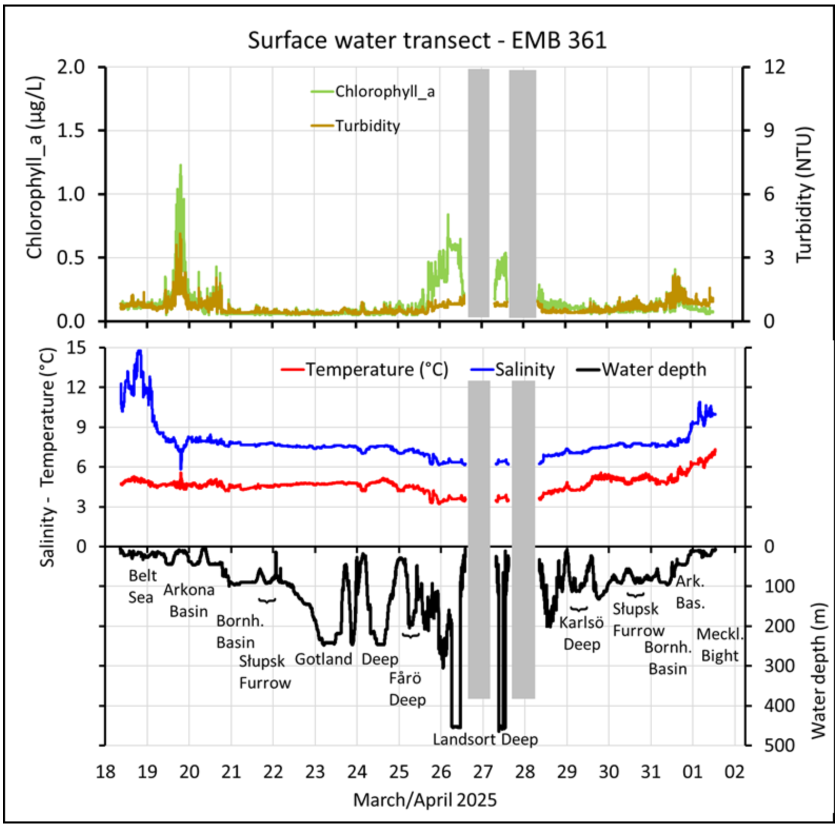

Fig. 5.2 Recording of chlorophyll and turbidity data, compared to temperature and salinity in surface waters with the corresponding water depth and sea area during the cruise EMB361 of r/v *ELISABETH MANN BORGESE* from March 18th to April 2nd 2025; the time periods of the stays in Nynäshamn (Sweden) is shaded grey.

5.2 Baltic Thalweg Transect

For an overview of the hydrographic and the hydrochemical state of the Baltic Proper during the cruise EMB361, data of the CTD casts along the Thalweg from the Kiel Bight to the eastern

Gotland Sea, further to the northern and the western Gotland Sea were combined to contour plots of salinity, temperature and oxygen for the time span of the cruise (Fig. 5.3, with a small map of the selected stations in the upper panel). In addition, two transects were transverse versus the thalweg in the eastern and Western Gotland Basins, with the Gotland Deep and the Karlsö Deep stations, respectively, in their centres (see map, Fig. 3.1).

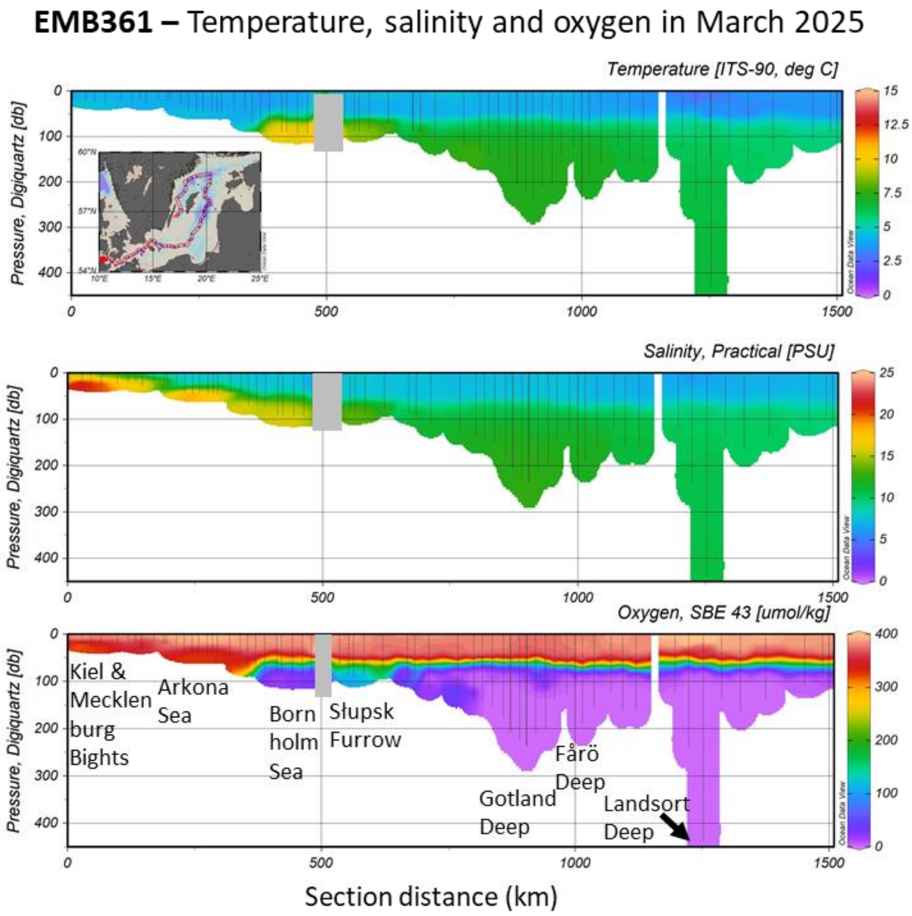

Fig. 5.3 Temperature, salinity and oxygen (without H_2S) along the Thalweg of the Baltic Sea from the Kiel Bight via the Arkona Sea, the Bornholm Sea, the eastern and northern to the western Gotland Sea (18 Mar – 29 Mar 2025). The elevated oxygen concentration in the bottom water of the Słupsk Furrow is indicated by the light-blue colour. The figure is based on the preliminary data of the CTD casts (vertical grey lines) by using ODV 5 (Schlitzer, 2018); the region at 500 km is shaded grey due to likely incorrect data.

The weather conditions strongly influenced the surface water conditions and the mixed layer depth. In the western Baltic Sea, strong salinity gradients between 15 and 8 in surface water and 21 to 17 in the Kiel Bight and the Arkona Basin bottom water, respectively, hindered a complete mixing to the bottom at the time of the cruise (Fig. 5.3). Corresponding temperatures were 0.5 °C higher in the bottom water compared to surface water in the Belt Sea, but were similar in the Arkona Basin. The mixed layer in the Arkona Basin was thus restricted to about 25 m and the bottom water to 5-10 m thickness. Further east in the Bornholm Sea a deeper mixed layer of about 40 m depth prevailed at a temperature of approximately 4 °C until the southern part of the Eastern Gotland Basin. Then the mixed layer depth increased in northern direction and reaches a depth of approximately 65 m in the northern Gotland Basin. In the northern part of the Western Gotland

Basin some cold water patches of below 3 °C and a salinity of 6.5 to 6.2 were measured. Further south in the western basin, the temperature reached 3.3 °C at a salinity of slightly below 7.0.

A relative warm and oxygen poor water body occupied the deep water of the Bornholm Sea at that time with a temperature between 9 and 10 °C (Fig. 5.3). Further on in the Słupsk Furrow, the deep water temperature dropped by about 1.5 °C and oxygen was significantly higher with approximately 90 µmol L^{-1}. However, this oxygenated water that originated from inflows already observed in February 2025 (Naumann, 2025) was restricted to the range of the Słupsk Furrow in March 2025. Only weak signs of lateral intrusions were recorded at the slope of the southern part the Eastern Gotland Basin (Fig. 5.3, lower panel).

5.3 Development of Baltic Sea Water Masses – Comparison to Previous Cruises

5.3.1 Surface Water Nutrients, Salinity and Temperature

On selected stations that are assumed to represent certain Baltic Sea areas, surface water temperature, salinity and nutrient data is given and compared to the values from last year (Table 5.1). Surface water temperatures was lower and salinity was higher in the western Baltic Sea in March 2025 compared to March 2024. In other investigated areas a higher temperature was observed in March 2025 even up to 1°C higher in the southern Eastern Gotland Basin. Corresponding salinity values were higher in March 2025 compared to March 2024 from the Kiel Bight until the southern part of the Eastern Gotland Basin und slightly smaller or alike in the Gotland Basin. For an impression of the development of the spring bloom surface water in 2025, nutrient measurements from February 2025 were added for comparison (Naumann, 2025). The western part of the study area, Kiel Bight and Mecklenburg Bight until Darss Sill showed a depletion of nitrate since February which is accompanied by a clear decline of phosphate at that time. This supported exhausting primary production in that area already mid-March. Further on in the Arkona Basin, an extensive nitrate consumption was determined, but phosphate concentration was still in the range of normal winter values. Another area with a clear evidence of an advanced spring bloom is the Landsort Deep site (Fig. 5.6), which already showed a depletion of nitrate and a major decline of phosphate. Surprisingly, a significant decline of silicate since February as seen west of Darss Sill was not seen at Landsort Deep site, despite the fact that beside dinoflagellates, major amounts of diatoms were found in surface water at Landsort Deep (Fig. 5.4). However, silicate concentration is difficult to interpret as silicate goes with salinity but also rivers could be important silicate contributors. So, slightly cooler and fresher water (Fig. 3.1) from a meltwater source could be an explanation for the apparent winter silicate concentration at this location.

Table 5.1 Surface water temperature, salinity and major nutrients of Baltic Sea areas during this cruise (March 2025) are compared to March last year and the winter nutrient values of February 2025.

Area \ Year	Temperature [°C]		Salinity [psu]		Phosphate [µmol L^{-1}]			Nitrate [µmol L^{-1}]			Silicate [µmol L^{-1}]		
	Mar 2024	**Mar 2025**	**Mar 2024**	**Mar 2025**	**Mar 2024**	**Feb 2025**	**Mar 2025**	**Mar 2024**	**Feb 2025**	**Mar 2025**	**Mar 2024**	**Feb 2025**	**Mar 2025**
Kiel Bight (TF0360)	4.95	4.28	13.3	14.8	0.06	0.69	0.10	0.11	4.81	0.00	5.1	22.6	6.3
Meckl. Bight (TF0012)	4.74	4.32	9.2	12.5	0.22	0.54	0.11	0.21	3.26	0.00	12.0	16.6	10.0
Darss Sill (TF0030)	4.50	4.02	7.64	8.56	0.32	-	0.25	1.37	-	0.00	16.6	-	15.3
Arkona Basin (TF0113)	4.01	4.02	7.45	7.88	0.37	0.49	0.63	1.22	3.37	0.93	18.8	16.5	19.5
Bornh. Deep (TF0213)	3.68	3.92	7.26	7.80	0.41	0.80	0.90	0.46	3.05	2.45	16.7	21.2	23.5
Slupsk Furrow (TF0222)	3.66	4.50	7.27	7.77	0.49	0.85	0.75	1.40	3.35	1.28	17.2	21.0	21.0
SE Gotl. Basin (TF0259)	3.62	4.72	7.31	7.55	0.54	0.85	0.64	3.24	3.22	2.11	18.1	20.9	17.9
SC Gotl. Basin (TF0260)	3.30	4.16	7.56	7.49	0.64	-	0.60	3.02	-	2.94	18.1	-	16.6
Gotland Deep (TF0271)	3.47	4.19	7.60	7.52	0.61	0.58	0.61	3.04	3.40	3.01	17.3	16.0	17.0
Fårö Deep (TF0286)	3.02	3.91	7.46	7.30	0.61	0.71	0.54	3.48	4.41	3.39	17.7	22.2	16.3
Landsort Deep (TF0284)	2.43	2.97	6.91	6.36	0.60	0.57	0.21	3.42	3.47	0.00	18.6	16.5	17.5
W Gotl. Basin (TF0240)	2.51	3.55	6.99	6.89	0.60	0.66	0.61	3.60	3.28	2.71	19.2	19.5	20.1
Karlsö Deep (TF0245)	3.33	3.65	7.07	7.07	0.65	0.69	0.60	3.00	2.73	2.52	20.0	19.4	18.2

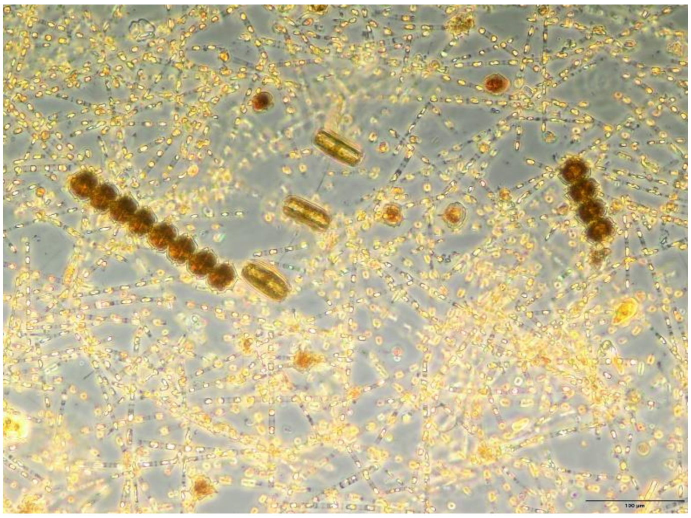

Fig. 5.4 Surface water net catch from Landsort Deep site, indicating blooms of *Skeletonema marinoi* (Diatom) and *Peridiniella catenata* (Dinoflagellate) accompanied by a *Thalassiosira* sp. (Diatom); Foto: Susanne Busch.

5.3.2 Deep Water Salinity, Temperature and Oxygen

The salinity, temperature and the oxygen concentration of the bottom water layer measured in March 2025 is shown in comparison to data from the cruises in March 2024 (Table 5.2). The inflow activity with recent inflows autumn/winter 2024/2025 showed clear elevated salinity at slightly higher temperature between Darss Sill and the southern Eastern Gotland Basin. Whereas in the central Gotland Sea a slow freshening seemed to basically continue in the bottom water. The inflow activity is best identified by the oxygen concentration of deep water, but due to the fact that inflows occur often in batches, no simple picture of change can be expected. So in the western Baltic Sea, investigated sites show clearly oxygenated bottom water in March 2025 above 300 µmol L^{-1}. From Bornholm Deep, the oxygenated water seemed to have moved further down the Thalweg, as here an almost anoxic condition was measured on this cruise. Słupsk Furrow was less oxygenated compared to the situation in 2024 after the medium size Inflow in 2023, but showed considerable 95 µmol L^{-1}. In the southern part of the Eastern Gotland Basin the highest oxygen concentration of 44 µmol L^{-1} in about 90 m of March 2023, 2024 and 2025 was measured on this cruise (Table 5.2). The map of bottom water oxygen concentrations on selected stations revealed weak oxic conditions until 56 °N in the eastern basin (Fig. 5.5) and gives an impression of the vanishing influence of inflows with increasing depth and distance from the source.

Table 5.2 Bottom water temperature, salinity and oxygen of Baltic Sea deeps of this cruise (March 2025) compared to the cruise in March 2023 and 2024.

Area \ Year	Depth [m]	Temperature [°C] 2023	2024	2025	Salinity [psu] 2023	2024	2025	Oxygen/H_2S* [µmol L^{-1}] 2023	2024	2025
Kiel Bight (TF0360)	17	4.23	4.54	3.98	19.81	17.73	18.90	352	350	323
Meckl. Bight (TF0012)	23	4.33	4.30	4.23	17.91	18.18	18.10	326	290	356
Darss Sill (TF0030)	22	3.79	4.17	4.13	9.52	10.12	15.81	-	332	348
Arkona Basin (TF0113)	46	4.78	3.75	4.79	18.64	14.14	20.77	289	318	333
Bornh. Deep (TF0213)	87	8.67	6.24	9.39	16.57	15.76	16.14	82	161	11
Slupsk Furrow (TF0222)	89	9.15	7.54	8.90	13.86	13.42	13.98	118	129	95
SE Gotl. Basin (TF0259)	87	6.59	6.75	6.82	10.77	10.69	10.92	-34	5	44
SC Gotl. Basin (TF0260)	141	7.22	7.32	7.25	12.31	12.33	12.07	-238	-45	-202
Gotland Deep (TF0271)	235	7.23	7.23	7.25	12.81	12.68	12.56	-306	-753§	-584
Fårö Deep (TF0286)	189	7.17	7.30	7.23	12.05	11.97	11.93	-238	-272	-212
Landsort Deep (TF0284)	437**	6.47	6.46	6.61	10.79	10.72	10.71	-90	-138	-141
W Gotl. Basin (TF0240)	161	6.08	6.01	6.04	10.31	10.18	10.14	-96	-117	-129
Karlsö Deep (TF0245)	107	5.95	5.85	5.79	10.13	9.95	9.84	-124	-104	-77

* The hydrogen sulphide values are given as negative oxygen equivalents

** Values measured in 2024 on 284a in bottom water at 359 m depth

§ The concentration of H_2S in the Gotland Deep was unprecedented high and require verification.

This is continued with a maximum of oxygen deficit at Gotland Deep site. However, compared to the extreme value of March last year, it improved by approximately 170 µmol L^{-1} oxygen equivalents of hydrogen sulphide. At Fårö Deep the hydrogen sulphide of concentration of 106 µmol L^{-1} as well had slightly improved compared to March 2024 and 2023, but caused still a high oxygen deficit of -212 µmol L^{-1}. Further north and in the western basin, the situation is somehow better at concentrations between -19 and -141 µmol L^{-1} of oxygen equivalents of hydrogen sulphide in Landsort Deep bottom waters (Table 5.2 and Fig. 5.5).

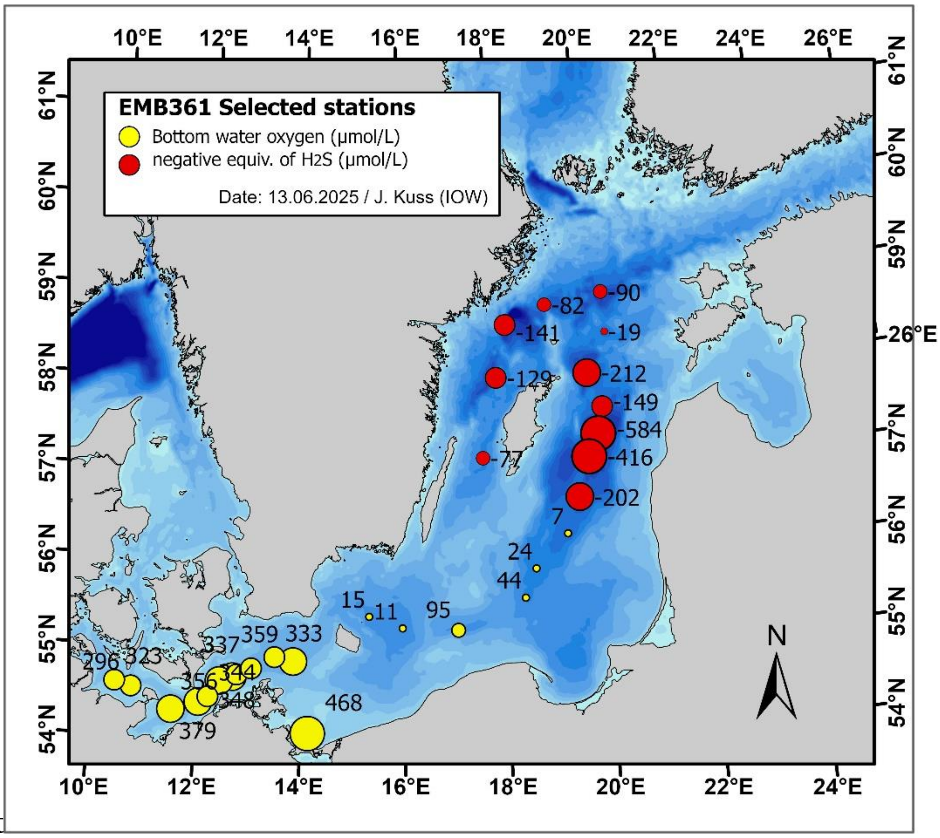

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Fig. 5.5 Oxygen (yellow circles and concentration in µmol L^{-1}) and hydrogen sulphide concentrations (as negative oxygen concentration equivalents as red circles in µmol L^{-1}) in bottom waters of selected Baltic Sea stations.

In this context, it was interesting to also investigate the turbidity zones in intermediate and deeper waters in comparison to low oxygen waters, as it was observed that turbidity often marks the mixing or diffusion zones between sulphidic and oxygenated waters (Fig. 5.6, lower panel). Partly this is caused by precipitation of fine particles of elemental sulphur (Kamyshny *et al.*, 2013) and likely manganese(IV) and iron(III) oxyhydroxides and phosphates play a role too (Dellwig *et al.*, 2010). The elevated turbidity in the bottom waters of the Mecklenburg and Kiel Bights and in the Arkona Sea, as well in the transition area to the Bornholm Basin are likely linked to resuspension of bottom sediments by dynamic water movement. However, in bottom waters of the southern slope of the Eastern Gotland Basin sulphur precipitation from hydrogen sulphide oxidation could have contributed to turbidity maxima. Especially the deep water turbidity maxima detached from bottom waters, as for example at approximately 100 m depth at 840 km along the Thalweg, which are likely remnants of lateral intrusions. As well, the blueish ribbon above the 100 m depth level from Fårö Deep further north could be caused by these lateral intrusions transported within the halocline. Likely some mixing between oxygenated waters with sulphidic waters could as well have caused the even more pronounced turbidity in the Landsort Deep area, but here vertical entrainment during winter or lateral intrusions from other sources could have caused these turbidity zones at partly shallower depth of 80 m.

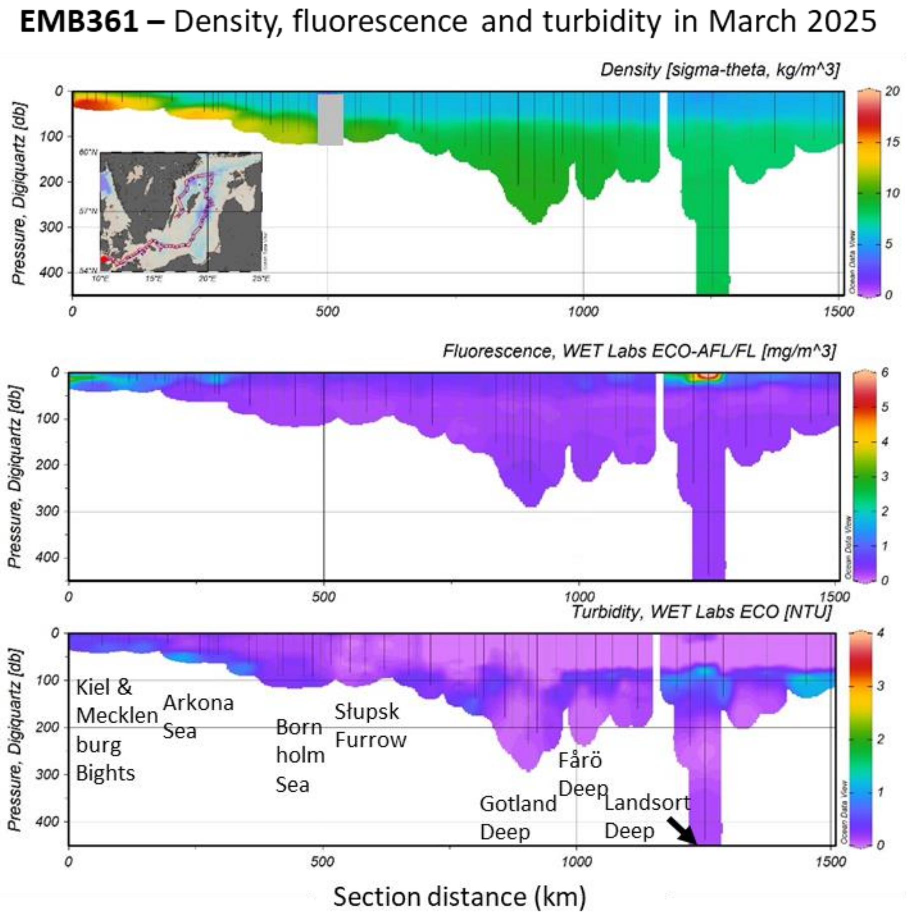

Fig. 5.6 Sensor measurements of density, fluorescence and turbidity along the Thalweg transect (see Fig. 5.3); density in the region at 500 km is shaded grey due to likely incorrect data. High chlorophyll fluorescence in surface water at Landsort Deep site is caused by blooms of diatoms and dinoflagellates. The figure is based on the preliminary data of the CTD casts (vertical grey lines) by using ODV 5 (Schlitzer, 2018).

The density distribution (Fig. 5.6, upper panel) is basically determined by salinity (Fig. 5.3, middle panel), as temperature was low in upper waters in March and did not cause a stabilizing effect on the water column. The elevated chlorophyll_a fluorescence in upper waters is restricted to the transect from the Kiel Bight to the Arkona Sea, but was apparently zero in the Bornholm and the Eastern Gotland Basins. Only in the Landsort area a prominent peak of chlorophyll_a fluorescence is recorded (Fig. 5.6, middle panel) that was confirmed by net catches to be a bloom of diatoms and dinoflagellates as described in section 5.3.1.

5.3.3 Deep Water Nutrients

The nutrient concentration in bottom water of the western Baltic Sea is determined by the changes caused by remineralisation and consumption processes in combination with mixing, inflow and outflow. In March 2025, the spring bloom appeared to have already caused a certain decline of phosphate, nitrate and silicate in the Mecklenburg Bight, the Darss Sill area and in the Arkona Basin. Further east and north along the Thalweg the nutrient concentrations in bottom waters were mostly comparable to previous March campaigns in 2023 and 2024. However, phosphate declined significantly in bottom waters of the Gotland and Fårö Deeps compared to last year, which might be linked to the meanwhile reduced oxygen deficit burden in the bottom water on these stations.

Table 5.3 Bottom water Phosphate, Nitrate and Silicate concentrations (µmol L^{-1}) of selected Baltic Sea areas of this cruise (March 2025) compared to the cruises in March 2023 and 2024.

Area \ Year	Depth [m]	Phosphate [µmol L^{-1}]			Nitrate [µmol L^{-1}]			Silicate [µmol L^{-1}]		
		2023	**2024**	**2025**	**2023**	**2024**	**2025**	**2023**	**2024**	**2025**
Kiel Bight (TF0360)	17	0.06	0.15	0.58	0.0	1.0	4.4	12.3	5.0	16.8
Meckl. Bight (TF0012)	23	0.62	0.74	0.41	5.2	6.6	2.4	21.2	17.0	12.5
Darss Sill (TF0030)	22	0.41	0.44	0.22	1.5	2.8	0.5	14.8	14.6	10.1
Arkona Basin (TF0113)	46	0.81	0.78	0.59	4.2	8.8	1.7	17.4	25.5	8.6
Bornh. Deep (TF0213)	87	1.19	1.50	2.11	8.6	7.2	7.2	46.7	38.5	61.0
Slupsk Furrow (TF0222)	89	1.97	1.73	1.73	6.9	7.1	8.4	44.1	44.7	50.1
SE Gotl. Basin (TF0259)	87	3.48	2.94	2.25	0.0	1.4	3.4	59.0	58.4	46.3
SC Gotl. Basin (TF0260)	141	5.30	5.65	4.50	0.0	0.0	0.0	81.5	95.5	72.0
Gotland Deep (TF0271)	235	6.50	6.78	6.07	0.0	0.0	0.0	100.5	111.3	103.0
Fårö Deep (TF0286)	189	4.00	5.03	4.40	0.0	0.0	0.0	68.5	84.0	42.3
Landsort Deep (TF0284)*	437	4.90	3.85	4.05	0.0	0.0	0.0	67.5	64.8	70.0
W Gotl. Basin (TF0240)	161	4.00	3.93	3.95	0.0	0.0	0.0	71.5	69.0	68.5
Karlsö Deep (TF0245)	107	3.95	4.00	3.75	0.0	0.0	0.0	69.0	69.5	64.5

* Values measured in 2024 on 284a in bottom water at 359 m depth

6 Station List EMB361

6.1 Overall Station List

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/ Recovery
r/v *ELISABETH MANN BORGESE*	**IOW**	**2025**		**[UTC]**	**[°N]**	**[°E]**	**[m]**	Max sampl. depth
EMB361_1-1	TFO5	18-Mar	CTD	09:19	54.2309	12.0756	9	11 m
EMB361_1-2	TFO5	18-Mar	SD	09:20	54.3149	11.5502	9	Secci
EMB361_2-1	TF0012	18-Mar	SD	11:45	54.3149	11.5502	22	Secci
EMB361_2-2	TF0012	18-Mar	PLA	11:45	54.3149	11.5501	22	Surface
EMB361_2-3	TF0012	18-Mar	CTD	11:45	54.3150	11.5497	22	23 m
EMB361_2-4	TF0012	18-Mar	WP2	12:05	54.3150	11.5496	22	22 m
EMB361_2-5	TF0012	18-Mar	WP2	12:12	54.3151	11.5493	22	22 m
EMB361_2-6	TF0012	18-Mar	CTD	12:26	54.5949	11.0139	22	5 m
EMB361_3-1	TF0014	18-Mar	CTD	15:25	54.5489	10.7688	25	25 m
EMB361_4-1	MPA-18	18-Mar	CTD	16:43	54.5490	10.7690	20	21 m
EMB361_4-2	MPA-18	18-Mar	MUC	16:58	54.5418	10.6851	20	25 m
EMB361_5-1	oMPA-17	18-Mar	CTD	17:40	54.5421	10.6863	20	21 m
EMB361_5-2	oMPA-17	18-Mar	MUC	17:58	54.6003	10.4504	20	24 m
EMB361_6-1	TF0360	18-Mar	CTD	19:11	54.6003	10.4504	15	16 m
EMB361_6-2	TF0360	18-Mar	PLA	19:11	54.6001	10.4501	15	3x Surface

EMB361_6-3	TF0360	18-Mar	WP2	19:31	54.6653	10.7750	15	15 m
EMB361_7-1	TF0361	18-Mar	CTD	21:11	54.5512	11.3216	22	23 m
EMB361_8-1	TF0010	18-Mar	CTD	23:42	54.3918	11.8261	26	26 m
EMB361_9-1	TF0017	19-Mar	CTD	02:06	54.4066	12.0621	19	20 m
EMB361_10-1	TF0041	19-Mar	CTD	03:12	54.4693	12.2414	16	17 m
EMB361_11-1	TF0046	19-Mar	CTD	04:21	54.4694	12.2409	26	26 m
EMB361_11-2	TF0046	19-Mar	PLA	04:23	54.4693	12.2407	26	3 x Surface
EMB361_11-3	TF0046	19-Mar	WP2	04:41	54.6501	12.4502	26	22 m
EMB361_12-1	TF0002	19-Mar	CTD	06:16	54.6965	12.7031	15	16 m
EMB361_13-1	TF0001	19-Mar	CTD	07:34	54.7235	12.7833	18	19 m
EMB361_14-1	TF0030	19-Mar	CTD	08:14	54.7233	12.7828	20	20 m
EMB361_14-1	TF0030	19-Mar	CTD	08:24	54.7234	12.7826	20	3x Surface, Secci
EMB361_14-3	TF0030	19-Mar	CTD	08:46	54.7952	13.0586	20	5 m
EMB361_15-1	TF0115	19-Mar	CTD	10:04	54.8594	13.2788	27	28 m
EMB361_16-1	TF0114	19-Mar	CTD	11:15	54.9236	13.5024	43	43 m
EMB361_17-1	TF0113	19-Mar	CTD	12:28	54.9235	13.5024	45	45 m
EMB361_17-2	TF0113	19-Mar	SD	12:28	54.9235	13.5024	45	Secci
EMB361_17-3	TF0113	19-Mar	PLA	12:29	54.9237	13.5017	45	3x Surface
EMB361_17-4	TF0113	19-Mar	WP2	12:45	54.9239	13.5011	45	44m
EMB361_17-5	TF0113	19-Mar	WP2	12:55	54.9241	13.5008	45	23m
EMB361_17-6	TF0113	19-Mar	WP2	13:03	54.9242	13.5006	45	44 m
EMB361_17-7	TF0113	19-Mar	CTD	13:13	54.0843	14.1501	43	45 m
EMB361_18-1	OBBoje	19-Mar	CTD	19:14	54.8043	13.9595	13	13 m
EMB361_19-1	TF0112	19-Mar	CTD	23:59	54.8033	13.9591	38	39 m
EMB361_19-2	TF0112	20-Mar	CTD	00:43	55.0005	14.0833	39	8 m
EMB361_20-1	TF0109	20-Mar	CTD	02:18	55.0004	14.0830	46	46 m
EMB361_20-2	TF0109	20-Mar	PLA	02:19	54.9992	14.0824	46	3x Surface
EMB361_20-3	TF0109	20-Mar	WP2	02:49	54.9990	14.0829	46	22 m
EMB361_20-4	TF0109	20-Mar	WP2	02:57	54.8794	13.8595	46	45 m
EMB361_21-1	ABBOJE	20-Mar	CTD	04:28	55.0249	13.6054	44	44 m
EMB361_22-1	TF0105	20-Mar	CTD	12:53	55.0677	13.8140	44	45 m
EMB361_23-1	TF0104	20-Mar	CTD	14:03	55.0634	13.9887	44	44 m
EMB361_24-1	TF0103	20-Mar	CTD	15:01	55.1663	14.2491	45	45 m
EMB361_25-1	TF0145	20-Mar	CTD	16:34	55.2568	14.4903	45	45 m
EMB361_26-1	TF0144	20-Mar	CTD	17:59	55.3837	14.5822	43	42 m
EMB361_27-1	TF0142_DK	20-Mar	CTD	19:11	55.4670	14.7170	72	70 m
EMB361_28-1	TF0140	20-Mar	CTD	20:15	55.5331	14.9156	69	67 m
EMB361_29-1	TF0206	20-Mar	CTD	21:26	55.4527	15.2337	76	74 m
EMB361_30-1	TF0208	20-Mar	CTD	22:59	55.3836	15.3344	92	90 m
EMB361_31-1	TF0200	20-Mar	CTD	23:56	55.3300	15.6156	91	89 m
EMB361_32-1	TF0211	21-Mar	CTD	01:30	55.1597	15.6595	95	93 m
EMB361_33-1	TF0214	21-Mar	CTD	02:54	55.3016	15.7964	94	91 m
EMB361_34-1	TF0212	21-Mar	CTD	04:16	55.2499	15.9824	95	92 m
EMB361_35-1	TF0213	21-Mar	PLA	05:40	55.2499	15.9832	89	3 x Surface
EMB361_35-2	TF0213	21-Mar	SD	05:56	55.2499	15.9828	90	Secci
EMB361_35-3	TF0213	21-Mar	APNET	06:07	55.2501	15.9830	89	87 m
EMB361_35-4	TF0213	21-Mar	APNET	06:31	55.2502	15.9835	89	87 m
EMB361_35-5	TF0213	21-Mar	APNET	07:12	55.2503	15.9825	90	87 m
EMB361_35-6	TF0213	21-Mar	WP2	07:38	55.2506	15.9833	89	86 m
EMB361_35-7	TF0213	21-Mar	WP2	07:51	55.2508	15.9834	89	86 m
EMB361_35-8	TF0213	21-Mar	WP2	08:01	55.2497	15.9818	89	86 m
EMB361_35-9	TF0213	21-Mar	CTD	11:32	55.2505	15.9854	89	87 m
EMB361_35-10	TF0213	21-Mar	CTD	12:31	55.2515	15.9877	89	50 m
EMB361_36-1	TF0213	21-Mar	SCF	13:40	55.2492	15.9789	90	Begin profile
EMB361_37-1	TF0259	22-Mar	CTD	07:10	55.5505	18.3999	90	86 m/SCF End profile
EMB361_37-2	TF0259	22-Mar	PLA	07:13	55.5505	18.3999	90	3x Surface
EMB361_38-1	TF0255	22-Mar	CTD	08:51	55.6331	18.5995	95	92 m
EMB361_38-1	TF0255	22-Mar	SCF	09:04	55.6333	18.6002	95	Begin profile

EMB361_39-1	TF0253	22-Mar	SCF	11:04	55.8352	18.8596	122	600 m
EMB361_40-1	TF0261	22-Mar	CTD	18:09	56.4919	19.4807	144	141 m/SCF End prof.
EMB361_41-1	TF0260	22-Mar	CTD	19:40	56.6331	19.5818	145	140 m
EMB361_42-1	TF0274_	22-Mar	CTD	21:37	56.7675	19.7499	155	150 m
EMB361_43-1	TF0273	22-Mar	CTD	23:37	56.9517	19.7670	184	179 m
EMB361_44-1	TF0272	23-Mar	CTD	01:12	57.0713	19.8279	209	204 m
EMB361_45-1	TF0275	23-Mar	CTD	02:59	57.2103	19.9287	231	224 m
EMB361_46-1	TF0271	23-Mar	CTD	06:02	57.3201	20.0503	241	234 m
EMB361_46-2	TF0271	23-Mar	SD	06:28	57.3201	20.0498	241	Secci
EMB361_46-3	TF0271	23-Mar	CTD	06:48	57.3203	20.0491	241	235 m
EMB361_46-4	TF0271	23-Mar	CTD	07:37	57.3201	20.0498	242	152 m
EMB361_46-5	TF0271	23-Mar	CTD	08:21	57.3200	20.0491	242	22 m
EMB361_46-6	TF0271	23-Mar	PLA	08:22	57.3200	20.0493	242	3x Surface
EMB361_46-7	TF0271	23-Mar	CTD	08:40	57.3201	20.0501	241	85 m
EMB361_46-8	TF0271	23-Mar	CTD	09:19	57.3204	20.0497	241	52 m
EMB361_46-9	TF0271	23-Mar	CTD	09:43	57.3198	20.0500	241	30 m
EMB361_46-10	TF0271	23-Mar	CTD	10:16	57.3199	20.0503	241	120 m
EMB361_47-1	GONE	23-Mar	MOOR	12:05	57.3668	20.3349	221	Hydrophone in water
EMB361_47-1	GONE	23-Mar	MOOR	12:07	57.3669	20.3346	221	released
EMB361_47-1	GONE	23-Mar	MOOR	12:08	57.3669	20.3346	221	at surface
EMB361_47-1	GONE	23-Mar	MOOR	12:09	57.3669	20.3349	221	Hydrophone on deck
EMB361_47-1	GONE	23-Mar	MOOR	12:19	57.3676	20.3412	221	recovered
EMB361_47-1	GONE	23-Mar	MOOR	12:36	57.3671	20.3420	221	on deck
EMB361_47-2	GONE	23-Mar	MOOR	14:03	57.3668	20.3419	219	weight
EMB361_47-2	GONE	23-Mar	MOOR	14:11	57.3667	20.3420	219	deployed
EMB361_47-3	GONE	23-Mar	CTD	14:18	57.3671	20.3429	218	211 m
EMB361_48-1	SF018EGB	23-Mar	CTD	17:03	57.1421	20.8141	46	45 m
EMB361_48-2	SF018EGB	23-Mar	SCF	17:26	57.1412	20.8209	46	Begin profile
EMB361_48-2	SF018EGB	23-Mar	SCF	17:39	57.1475	20.8209	46	1380 m
EMB361_48-2	SF018EGB	23-Mar	SCF	21:00	57.2864	20.1559	46	End profile
EMB361_49-1	SF001EGB	24-Mar	CTD	03:40	57.5649	18.8581	23	23 m
EMB361_50-1	GOSW	24-Mar	MOOR	08:01	57.0695	19.7563	214	Hydrophone in water
EMB361_50-1	GOSW	24-Mar	MOOR	08:04	57.0696	19.7565	214	released
EMB361_50-1	GOSW	24-Mar	MOOR	08:05	57.0696	19.7566	214	Hydrophone on deck
EMB361_50-1	GOSW	24-Mar	MOOR	08:05	57.0696	19.7566	214	at surface
EMB361_50-1	GOSW	24-Mar	MOOR	08:19	57.0693	19.7611	214	Buoy fixed
EMB361_50-1	GOSW	24-Mar	MOOR	08:24	57.0696	19.7598	214	Ground
EMB361_50-1	GOSW	24-Mar	MOOR	08:28	57.0698	19.7600	214	Releaser
EMB361_50-1	GOSW	24-Mar	MOOR	08:37	57.0700	19.7605	214	on deck
EMB361_50-2	GOSW	24-Mar	MOOR	08:54	57.0701	19.7604	214	Weight in water
EMB361_50-2	GOSW	24-Mar	MOOR	09:00	57.0703	19.7602	214	deployed
EMB361_50-3	GOSW	24-Mar	CTD	09:06	57.0705	19.7630	214	207 m
EMB361_51-1	GOC	24-Mar	HySo	12:00	57.3085	20.0776	246	released
EMB361_51-1	GOC	24-Mar	HySo	12:02	57.3085	20.0777	246	on deck
EMB361_51-2	GOC	24-Mar	MOOR	12:13	57.3078	20.0806	246	Buoy
EMB361_51-2	GOC	24-Mar	MOOR	12:46	57.3076	20.0810	246	on deck
EMB361_51-2	GOC	24-Mar	MOOR	13:55	57.3069	20.0813	246	Weight in water
EMB361_51-2	GOC	24-Mar	MOOR	14:20	57.3069	20.0815	246	released
EMB361_51-3	GOC	24-Mar	CTD	14:28	57.3064	20.0836	246	238 m
EMB361_52-1	TF0276	24-Mar	CTD	16:32	57.4701	20.2602	209	202 m
EMB361_53-1	TF0270	24-Mar	CTD	18:09	57.6168	20.1675	144	139 m
EMB361_54-1	TF0287	24-Mar	CTD	19:50	57.7156	19.8536	131	128 m
EMB361_55-1	TF0286	25-Mar	CTD	06:25	58.0000	19.8998	196	190 m
EMB361_55-2	TF0286	25-Mar	SD	06:41	57.9997	19.8999	196	Secci
EMB361_55-3	TF0286	25-Mar	CTD	07:22	57.9993	19.8997	196	25 m
EMB361_56-1	TF0277	25-Mar	CTD	09:05	58.1837	20.0519	163	158 m
EMB361_57-1	TF0285	25-Mar	CTD	11:31	58.4418	20.3360	123	120 m
EMB361_58-1	TF0279	25-Mar	CTD	13:26	58.6420	20.3462	166	160 m

EMB361_59-1	TF0282	25-Mar	CTD	15:33	58.8832	20.3171	165	159 m
EMB361_60-1	nGB-2	25-Mar	CTD	18:02	58.8660	19.7447	166	159 m
EMB361_61-1	TF0283	25-Mar	CTD	20:42	58.7836	19.1010	129	124 m
EMB361_62-1	nGB-1	25-Mar	CTD	22:53	58.7115	18.6697	247	239 m
EMB361_63-1	TF0284	26-Mar	CTD	06:41	58.5836	18.2330	453	439 m
EMB361_63-2	TF0284	26-Mar	SD	06:40	58.5836	18.2330	453	Secci
EMB361_63-3	TF0284	26-Mar	PLA	07:01	58.5832	18.2330	453	3x Surface
EMB361_63-4	TF0284	26-Mar	CTD	07:43	58.5834	18.2338	453	130 m
EMB361_63-5	TF0284	26-Mar	CTD	08:48	58.5837	18.2336	453	12 m
EMB361_63-6	TF0284	26-Mar	CTD	09:15	58.5835	18.2336	453	92 m
EMB361_64-1	TF0284	27-Mar	CTD	09:21	58.5839	18.2346	453	151 m
EMB361_64-2	TF0284	27-Mar	CTD	10:10	58.5831	18.2330	453	5 m
EMB361_64-3	TF0284	27-Mar	CTD	11:20	58.5832	18.2330	453	436 m
EMB361_65-1	wGB-3	28-Mar	CTD	11:24	58.3277	18.0674	153	135 m
EMB361_66-1	TF0240	28-Mar	CTD	13:33	58.0008	18.0006	168	162 m
EMB361_67-1	TF0242	28-Mar	CTD	17:09	57.7174	17.3670	142	137 m
EMB361_68-1	SF032WGB	28-Mar	CTD	23:57	57.0535	18.1332	9	10 m
EMB361_69-1	SF032WGB	29-Mar	SCF	00:10	57.0522	18.1342	80	Begin profile
EMB361_69-1	SF032WGB	29-Mar	SCF	03:00	57.1221	17.6240	80	500 m
EMB361_70-1	SF026WGB	29-Mar	CTD	04:19	57.1442	17.4632	80	78 m/ SCF End prof.
EMB361_71-1	TF0245	29-Mar	CTD	06:44	57.1166	17.6673	111	107m
EMB361_72-1	wGB-1	29-Mar	CTD	09:24	56.8776	17.3898	95	92 m
EMB361_73-1	TF0262	29-Mar	CTD	18:08	56.2346	19.3011	132	125 m
EMB361_74-1	TF0252	29-Mar	CTD	21:44	55.8669	18.6406	114	110 m
EMB361_75-1	TF0259	30-Mar	CTD	00:14	55.5492	18.4007	89	87 m
EMB361_75-2	TF0259	30-Mar	PLA	00:15	55.5492	18.4006	90	3x Surface
EMB361_76-1	TF0268	30-Mar	CTD	03:01	55.3075	17.9302	74	72 m
EMB361_77-1	TF0266	30-Mar	CTD	05:24	55.2525	17.3601	89	84 m
EMB361_78-1	TF0222	30-Mar	CTD	06:51	55.2170	17.0669	91	88 m
EMB361_79-1	TF0229	30-Mar	CTD	07:48	55.2300	16.9137	86	83 m
EMB361_80-1	TF0227	30-Mar	CTD	09:07	55.2619	16.6397	67	65 m
EMB361_81-1	TF0225	30-Mar	CTD	10:34	55.2584	16.3221	65	64 m
EMB361_82-1	TF0225	30-Mar	SCF	11:00	55.2568	16.3215	65	Begin profile
EMB361_82-1	TF0225	30-Mar	SCF	14:21	55.2291	16.9133	65	Break
EMB361_82-1	TF0225	30-Mar	SCF	16:39	55.2726	17.1406	65	Continuation
EMB361_82-1	TF0225	30-Mar	SCF	16:44	55.2688	17.1473	65	250 m
EMB361_82-1	TF0225	30-Mar	SCF	16:53	55.2584	17.1647	65	End profile
EMB361_83-1	TF0268	30-Mar	CTD	22:01	55.3080	17.9351	75	74 m
EMB361_84-1	TF0213	31-Mar	CTD	05:50	55.2507	15.9836	89	87 m
EMB361_84-2	TF0213	31-Mar	PLA	05:53	55.2507	15.9836	89	3x Surface, Secci
EMB361_84-3	TF0213	31-Mar	WP2	06:13	55.2502	15.9831	89	86 m
EMB361_84-4	TF0213	31-Mar	WP2	06:23	55.2499	15.9832	89	86 m
EMB361_84-5	TF0213	31-Mar	WP2	06:35	55.2503	15.9836	89	43 m
EMB361_84-6	TF0213	31-Mar	WP2	06:45	55.2499	15.9834	89	86 m
EMB361_84-7	TF0213	31-Mar	APNET	07:08	55.2499	15.9828	90	87 m
EMB361_84-8	TF0213	31-Mar	APNET	07:32	55.2499	15.9834	90	87 m
EMB361_84-9	TF0213	31-Mar	APNET	07:55	55.2497	15.9829	90	87 m
EMB361_85-1	TF0113	31-Mar	CTD	18:35	54.9241	13.5007	45	44 m
EMB361_85-2	TF0113	31-Mar	PLA	18:38	54.9245	13.5000	45	1x Surface
EMB361_85-3	TF0113	31-Mar	WP2	19:13	54.9249	13.4999	45	36 m
EMB361_85-4	TF0113	31-Mar	WP2	19:20	54.9250	13.5000	45	44 m
EMB361_86-1	TF0030	31-Mar	CTD	22:26	54.7229	12.7836	20	20 m
EMB361_87-1	TF0046	1-Apr	CTD	05:33	54.4699	12.2410	26	26 m
EMB361_87-2	TF0046	1-Apr	SD	05:34	54.4699	12.2410	26	Secci
EMB361_87-3	TF0046	1-Apr	PLA	05:37	54.4699	12.2409	26	Surface
EMB361_87-4	TF0046	1-Apr	WP2	05:52	54.4699	12.2415	26	22 m
EMB361_88-1	TF0012	1-Apr	CTD	08:47	54.3148	11.5506	22	22 m
EMB361_88-2	TF0012	1-Apr	PLA	08:49	54.3148	11.5501	22	1x Surface, 1x Secci

EMB361_88-3	TF0012	1-Apr	WP2	09:06	54.3153	11.5498	22	21 m
EMB361_89-1	NHBoje	1-Apr	CTD	11:11	54.1779	11.9594	9	10 m

CLmax: Maximum rope/cable length
PLA: Small plankton net for manual catches
WP2: Plankton net with closing mechanism and removable net bucket
APNET: Apstein net with cone
CTD: CTD rosette system with Fluorimeter, Oxygen Sensor, Water Sampler, and Camera
SD: Secci disk to determine the depth of visibility
SCF: Undulating CTD with sensor package (ScanFish)

7 Data and Sample Storage and Availability

All data gathered are saved 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) in due time after the cruise. 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.

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 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 7.1 Overview of data availability

Type	Database	Available	Free Access	Contact
Hydrographic data	ODIN	01.06.2025	01.06.2028	volker.mohrholz@io-warnemuende.de
Nutrient data	ODIN	01.10.2025	01.10.2028	joachim.kuss@io-warnemuende.de
Zooplankton data	ODIN	01.04.2026	01.04.2029	joerg.dutz@io-warnemuende.de
Phytoplankton data	ODIN	01.04.2026	01.04.2029	anke.kremp@io-warnemuende.de

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