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The Expedition PS151 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2025

Edited by
Karen H. Wiltshire, Peter Croot and Angelika Dummermuth

with contributions of the participants

HELMHOLTZ

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Titel: Einsatz eines Expendable Thermograh (XBT)
(Foto: Angelika Dummermuth, AWI))

Cover: Launch of an Expendable Thermograh (XBT))
(Photo: Angelika Dummermuth, AWI))

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PS151

13 November – 12 December 2025

Bremerhaven – Walvis Bay

Chief scientist
Karen H. Wiltshire

Co Chief scientist
Peter Croot

Coordinator
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Contents

1. ÜBERBLICK UND EXPEDITIONSVERLAUF

Karen Wiltshire [1], Angelika Dummermuth [2]   [1] IE.TCD, [2] DE.AWI

Die Transitfahrt startete am 13.11.2025 in Bremerhaven und endete am 12.12.2025 in Walvis Bay. Die Fahrt stand im Zeichnen der Ausbildung von Nachwuchswissenschaftler:innen mit Fahrtteilnehmenden aus 24 Nationen. Eine internationale Gruppe von 25 Nachwuchswissenschaftler:innen wurde während dieses Trainingsprogrammes in Wissen und Techniken der Ozeanographie geschult. Dabei standen Methoden der Probennahme, die Aufarbeitung der Proben und der Umgang mit erhobenen Daten im Fokus. Als weitere Aufgaben während der Transitfahrt wurden chemische und physikalische Messungen zum Gas,- Energie- und Massenaustausch zwischen Ozean und Atmosphäre durchgeführt. Beobachtungsmethoden und Unterwegs-Messungen spielten dabei eine wichtige Rolle. Zudem bekamen die Stipendiaten eine Einführung in die Physik des Klimasystems, internationale Klimaverhandlungen, sowie die Ziele der UN Ozeandekade. Auf dem sogenannten Nord-Süd-Atlantik-Training-Transekt (North-South-Atlantic Transect = NoSoAT) erhielten sie Einblicke in die Meereswissenschaften und führten Kurzprojekte zu den Wechselwirkungen zwischen Ozean, Atmosphäre und Klima sowie Vergleiche zwischen Beobachtungen und Klimasimulationen durch. Die kritische Auseinandersetzung mit Wissenschaft wurde in philosophischen Diskussionen beleuchtet. Die Stipendiaten lernten die praktische Wissensvermittlung sowie Wissenschaftskommunikation u. a. durch Kooperation mit Bildungseinrichtungen und die Beiträge in den sozialen Medien. Über Videoverbindung wurde den Schülerinnen und Schülern das Trainigsprogramm sowie Arbeiten und Leben an Bord von *Polarstern* vermittelt. Die Eindrücke von der Fahrt und das Bewusstsein für das Meer und den Klimawandel wurden somit direkt ins Klassenzimmer getragen.

Das Trainingsprogramm war ein gemeinsames Projekt zwischen dem Alfred-Wegener-Institut, dem Trinity College Dublin (TCD), Partnership for Observation of the Global Oceans (POGO), SeaNetwork, der University of Galway, der Shahjalal University of Science and Technolog und dem Irischen Wetterdienst (Met Éireann). Das Trainigsprogramm wurde durch die Nippon Foundation und POGO gefödert. Es ist als Aktivität der UN Ocean Decade gelistet.

Am 12.12.2025 lief *Polarstern* in Walvis Bay ein und damit endete die Expedition. Am 13.12.2025 wurde das Traingsprogramm sowie die vorläufigen Ergebnisse bei einem Kooperationsworkshop mit der Universität von Namibia präsentiert.

ITINERARY

The expedition started on 13 November 2025 in Bremerhaven and ended on 12 December 2025 in Walvis Bay. The mission was characterised by the training of young scientists with participants from 24 nations. An international group of 25 young scientists were trained in the knowledge and techniques of oceanography during this training programme. The programme focused on sampling methods, sample processing and the handling of collected data. Further tasks during the transit cruise included chemical and physical measurements of gas, energy and mass exchange between the ocean and atmosphere. Observation methods and en route measurements played an important role. The trainees also received an introduction to the physics of the climate system, international climate negotiations and the goals of the UN Ocean Decade. On the so-called North-South Atlantic Training Transect (NoSoAT), they gained insights into marine science and carried out short experiments on the interactions between the ocean, atmosphere and climate as well as comparisons between observations and climate model simulations. The critical examination of science was highlighted in philosophical discussions. The trainees learnt about practical knowledge transfer and science communication through cooperation with educational institutions and social media contributions, among other things. Students based in different schools and universities were introduced to the mission of PS151 as well as work and life on board *Polarstern* via video link. The impressions of the voyage and awareness of the sea and climate change were thus brought directly into the classroom.

The training programme was a joint project between the Alfred Wegener Institute, Trinity College Dublin (TCD), Partnership for Observation of the Global Oceans (POGO), SeaNetwork, the University of Galway, Shahjalal University of Science and Technology and the Irish Meteorological Service (Met Eíreann). The training programme was funded by the Nippon Foundation and POGO. NoSoAT OceanCapX is listed as an UN Ocean Decade activity.

Polarstern arrived in Walvis Bay on 12 December 2025, marking the end of the expedition. On 13 December 2025, the training programme and the preliminary results of the expedition were presented at a cooperation workshop with the University of Namibia.

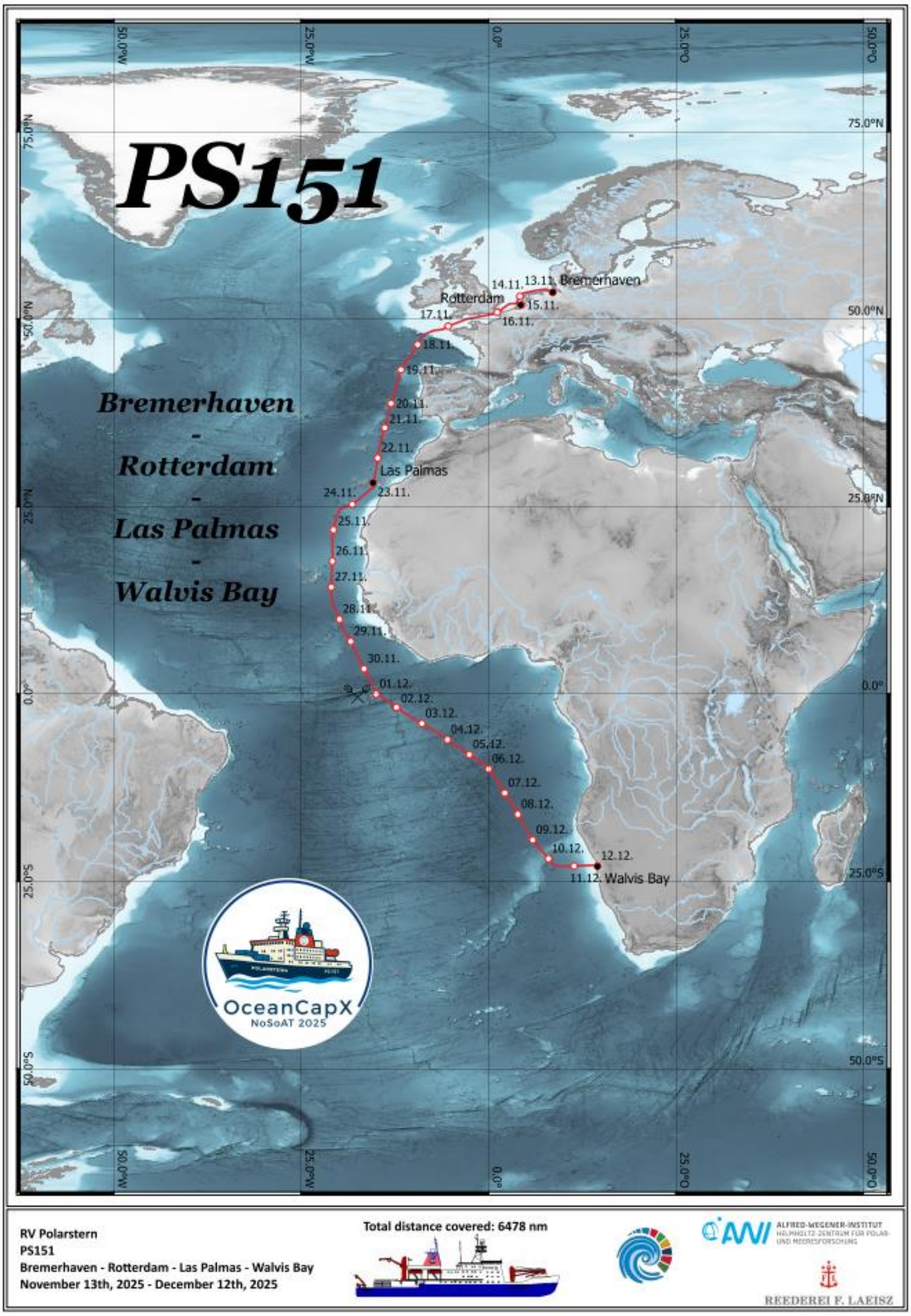

Fig. 1.1: Fahrtroute von Bremerhaven nach Walvis Bay (Karte von J. Pliet).
Siehe https://doi.pangaea.de/10.1594/PANGAEA.990216 für eine Darstellung des master tracks in Verbindung mit der Stationsliste für PS151.

Fig. 1.1: Cruise track from Bremerhaven to Cape Town (map by J. Pliet).
See https://doi.pangaea.de/10.1594/PANGAEA.990216 to display the master track in conjunction with the station list for PS151.

WEATHER CONDITIONS DURING PS151

Patrick Suter, Anne Wiese DE.DWD

Bremerhaven - Rotterdam

Polarstern left Bremerhaven on 13 November 2025 with the evening high tide. At that time, a gale was located west of the Bay of Biscay. Its frontal system extended into the German Bight. When the ship left port, the wind was weak to moderate (3 to 4 Bft) from southwest. As the frontal system moved south and *Polarstern* headed west, the wind shifted over north to northeast to east by the morning of 14 November, increasing to 5 Bft and then to 7 to 8 Bft by noon. Gusts of severe gale-force reached up to 9 Bft. These represented the wind maximum of the expedition (max. 10' average: 18.5 m/s = 36 KT = 8 Bft, gust: 21.2 m/s = 41 KT = 9 Bft). From late afternoon, the wind decreased to around 6 Bft. The significant wave height rose temporarily to almost 3 m with a wind-driven wind sea of 2.5 m. Sheltered by the Dutch coast, the wind sea subsided slightly as the ship entered the Southwestern North Sea. The swell was initially around 1.5 m from north to northwest, then from the afternoon onwards only from north. When *Polarstern* left the harbour, it was very cloudy but initially still dry with good visibility. By morning, persistent rain had set in along the front, resulting in moderate to occasionally poor visibility. Towards evening, the intensity of the rain decreased, leaving only light rain or drizzle, and visibility improved to around 10 km.

Upon arrival in Rotterdam on the evening of 14 November, the easterly wind quickly decreased to 3 to 4 Bft due to land protection. The waves also subsided near land. Still under the influence of the frontal system, the day in Rotterdam was grey and overcast during bunkering. With occasional light rain or drizzle, visibility was temporarily between 2 and 4 km, especially at night and again in the afternoon, otherwise visibility was moderate to good.

Rotterdam - Las Palmas

Late in the evening of 15 November, *Polarstern* started again from Rotterdam with northeasterly winds of around 3 Bft. The above-mentioned low-pressure system had moved further southeast towards Cape Finisterre. With a high-pressure zone south of Iceland at the same time, a fresh to strong (5 to 6 Bft) northeasterly current developed between these pressure systems, into which *Polarstern* entered again after leaving the protection of land. Due to the ageing front, at night and during the day in rain showers, visibility was moderate to poor. The sea state was mostly 1 m wind waves and 1 m swell from north to northeast. Passing through the Strait of Dover, a weak swell from southwest also set in. During the night to 17 November in the English Channel, the wind blew at often 6 Bft. Due to the weakening and southeasterly shift of the low towards the Iberian Peninsula and the simultaneous approach of a ridge from the high-pressure system near Iceland, the northeasterly to northerly flow gradually decreased to 4 Bft by the night to 18 November. As the wind decreased, the wind-driven waves also decreased to 0.5 m. However, the swell remained at around 1.5 m from northeast and southwest to west. There was no precipitation and the sun made a few appearances for the first time on this trip.

On 18 November, the Bay of Biscay showed its calm side. Due to the high-pressure ridge passing over the ship, the wind was only light. Because of the subsidence inversion caused by the high pressure and the moisture trapped beneath it from the front of the previous days, the stratocumulus cloud cover was quite dense and the sun rarely appeared. However, visibility was good throughout. The significant wave height of around 1 m consisted mainly of swells from the north to northwest and northeast to east.

From 19 November, the high-pressure system moved from western Ireland to the Azores, while at the same time a gale moved from Scotland across the Netherlands and northern Germany to the southern Baltic Sea. In the course of this, another gale formed over the Mediterranean. Due to the gradient between the high-pressure system in the west and the low-pressure systems in the east, the wind initially blew from north, then from northeast, mostly at 5 to 6 Bft. However, the wind fluctuated between 4 and 6 Bft. The air mass became unstable below the subsidence inversion, resulting in a mix of sun and clouds. With the humidity still present, there were occasional light showers. Visibility was mostly good, only occasionally dropping to moderate visibility during showers. As progressing southwards, the lows increasingly lost their influence and, from 21 November, *Polarstern* was on the southeastern flank of the Azores high. The fairly strong gradient was then maintained by a surface trough along the African coast. The northeasterly wind then fluctuated between 5 and 7 Bft with occasional stormy gusts (8 Bft). Subsequently, the wind decreased again to 5 to 6 Bft from the northeast to east until reaching Gran Canaria. From 19 November, the sea state also gradually increased. At the beginning, the wind sea and swell from northerly directions were each about 1 m. By 21 November, the sea state had increased to a significant wave height of around 3 m, with the wind sea then measuring about 1.5 m, at times 2 m, and the swell 2.5 m.

Upon arrival in Las Palmas on the morning of 23 November, the wind died down under the protection of the island. This marked the end of PS151/1 in Las Palmas (Spain). *Polarstern* will continue on to Walvis Bay (Namibia) in the second section (PS151/2).

The air pressure fluctuated between 1,004 hPa (14 November) and 1028.5 hPa (17 November) during the voyage. Until the exit from the English Channel, the air temperature remained at around 10 °C and rose gradually to 21 °C by the time the ship reached Las Palmas.

2. NORTH SOUTH ATLANTIC TRANSECT OCEAN CAPACITY EXCHANGE (NOSOAT | OCEANCAPX)

Karen Helen Wiltshire[1*], Peter Croot[2], , Ximena Aguilar Vega[3], Anna Bergmann[4] Oisin Boersma[5], Marthe Claußen[4], Alejandra Castillo Ramirez[6], Cristina Claver[7], Angelika Dummermuth[4], Inga Vanessa Kirstein[4], Peter Lemke[4], Subrata Sarker[8], Tido Semmler[9], Caio Ribeiro[10], Norman Sieroka[11,12], Gérard Zinzindohue[13]

not on board: Eva-Maria Brodte[4], Sebastian Primpke[4], Sandra Tippenhauer[4]

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PS-GPF 21-2_063

Outline

In the framework of the UN Ocean Decade "The Science We Need for the Ocean We Want" (https://www.oceandecade.org/) *Polarstern* provided an educational platform to train an international group of trainees in advanced techniques of oceanographic, meteorological and climate observations and analyses on latitudinal transects (Brodte et al., 2025; Krug et al., 2025). In addition, natural climate variability, global warming and international climate negotiations were part of the teaching portfolio. Participants learnt how to take samples, how to process them and how to deal with the resulting data. The following standard sampling procedures were applied: CTD Rosette with 12 l Niskin bottles, Underway CTD profiler (towed), Plankton-Nets, FerryBox, thermosalinograph, expendable bathythermograph (XBT). Causes of natural climate variability and anthropogenic climate change were discussed. The trainees learnt practical knowledge transfer and science communication through cooperation with educational institutions and social media contributions The berths have been advertised world-wide and the applications were reviewed by an international team.

Objectives

Aim of the expedition was to chart and characterize different water bodies and their biological, chemical and physical properties along a North-South Atlantic transect, as to be an international training exercise for capacity building in oceanography and climate. An international group of 25 trainees was trained in basic oceanographic principles including seagoing methods and sampling associated with these. For the first time, in addition to 20 trainee berths, we also offered five berths for training of future trainers.

The cruise track crossed coastal, shelf and open Atlantic Ocean waters. Specifically, participants learnt how to sample and analyse the ocean properties, also as "Ground Truthing" information for Remote Sensing information and how to communicate scientific results to the general public and school kids. The trainees were divided into groups of four, which rotated between the five main disciplines, which were Climate and Atmosphere, Oceanography, Modelling, Observation Methods and Underway Sampling as well as Outreach and Philosophy (Fig. 2.1).

Intended study objectives include:

- Differentiation of different water masses using biological parameters temperature, salinity, oxygen etc.
- Localization and sampling of the thermocline and other water inclusions
- Detection of salinity gradients and turbidity
- Measurements of atmospheric properties
- Studies of climate physics, the warming trends in the ocean and comparison to climate models
- Understanding of Ocean and Climate Modelling
- Introduction to the philosophy of the ocean, the international climate negotiations and outreach of scientists to the public

Each group rotation lasted five days and included an average of two stations per rotation. At the end of each rotation, trainees were given a project day set aside to work on preparing the evening presentation and the hand over to the following group.

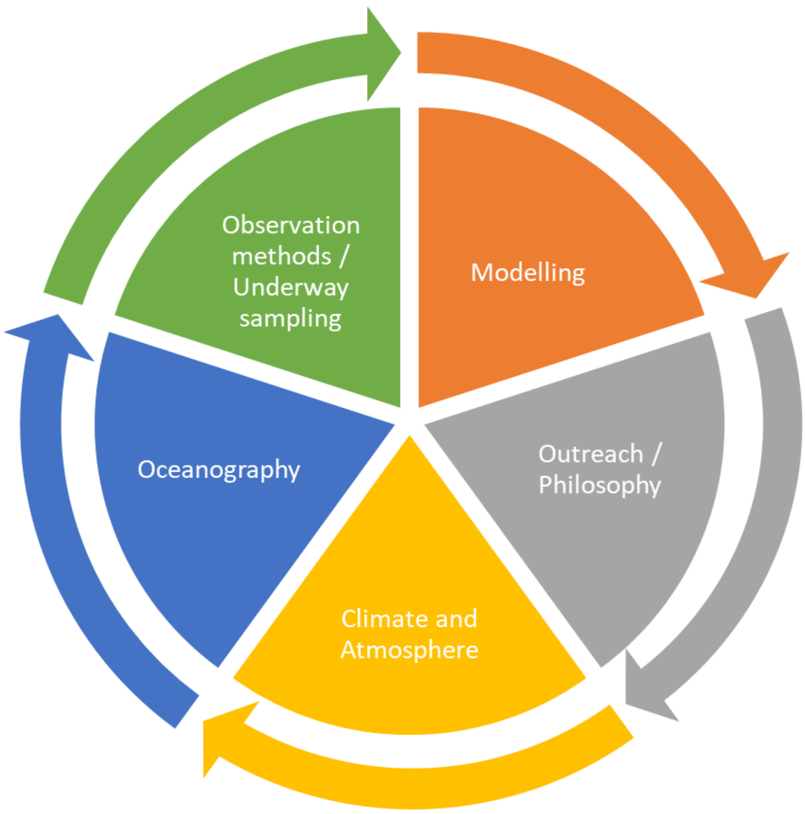

Fig. 2.1: Rotation scheme of the trainees during the PS151 expedition

In the following, the five different modules will be explained in detail.

Climate and Atmosphere

The aim of this module was to understand the climate system, its various components and their interactions. It provided theoretical aspects, exercises with respect to the surface energy balance, meteorological measurements and their analysis. The module was grouped into two parts a theoretical and a practical part. In the theoretical part trainees learnt how to calculate the earths energy balance and how key aspects such as albedo influence earths surface temperature. Furthermore, the trainees learnt how water can store energy in the form of latent heat and how this energy can be calculated. Trainees also learnt how energy and matter is transported within the atmosphere and between the surface and the atmosphere. The practical part taught the trainees about various athmospheric measurement techniques. Particular focus was laid on handheld radiation measurements (global radiation and photosynthetically active radiation) where trainees learnt how to calibrate sensors and conducted a self developed experiment using the sensors. The experiments ranged from albedo measurements of different surfaces to sensor inclination experiemts. The measurements were later linked to the theoretical framework provided, for example by using the measured albedo as input to the calculations of earths energy budget. A further highlight linking theory and practice together was the practical radiosonde accend that provided a hands-on experience to learn about the vertical structure of the atmosphere.

Oceanography

In the oceanography module the trainees were introduced to different sampling concepts, sampling planning, sampling techniques, sampling devices, measurement techniques and accuracy, and common oceanographic instrumentation. The gears the trainees were trained in were CTD sensor packages and rosette. A specific interest was on the investigations of the hydrographic regime including temperature, salinity and depth measurements coupled with additional sensors to provide information on fluorescence, turbidity and oxygen. Water samples from different depths were recovered via Niskin bottles in a rosette frame and filtered for quantitative determination of chlorophyll-a concentration and determination of nutrients. This set of activities was based around the planning, acquisition and analysis of CTD data collected at 11 stations along the expedition track between Bremerhaven and Walvis Bay (Fig. 2.2). In addition, students were introduced to basic concepts pertaining to the carbon system in the ocean and undertook some measurements of some carbon system parameters in the water column.

Observation methods and underway sampling

In this module trainees were provided with hands-on experience in key oceanographic sampling and data collection techniques used to monitor marine environments. The primary focus was to familiarize trainees with the deployment and data retrieval of Argo floats and Expendable Bathythermographs (XBTs). In addition, bucket sampling methods have been trained, as well as measuremetns of PAR, turbidity and albedo. Through practical training and application, participants understood the significance of these methods in understanding ocean conditions, marine ecosystems, and their implications for climate research. The module focused on practical applications of Argofloats, which are used to monitor temperature, salinity, and currents, and XBTs for obtaining high-resolution temperature profiles. The module also included training in data management, focusing on the integration of real-time data collection and the use of oceanographic software for analysis. In addition to these, participants engaged in phytoplankton community sampling to assess distribution patterns.

Modelling

In the module trainees were introduced to the basics of numerical climate modelling of the different components of the earth system (atmosphere, ocean, cryosphere, land). Achievements during the last few decades and challenges in the climate modelling realm were dealt with. Basic concepts such as modelling of the quantities on a grid point scale and parameterizations of sub-grid scale processes were explained. Furthermore, recent advances in simulating important aspects of the climate system, such as the Atlantic Meridional Overturning Circulation (AMOC), which is responsible for large amounts of heat being redistributed across the Atlantic Ocean, were discussed. This included novel modelling techniques that have been developed in the last years and those which are planned to be developed. It also included better representation of the big ice sheets of Greenland and Antarctica in climate models, which is still a challenge for the climate modelling community, although progress has been made. Understanding the IPCC process (Intergovernmental Panel on Climate Change) to which climate modellers are contributing was another important aspect. Challenges in the communication of the results to policymakers and stakeholders, as well as challenges in translating the knowledge into action, were discussed in this context.

An important aim of this module was to not only provide the students with a background and understanding of climate modelling but also to provide the students with the opportunity to get hands-on training on analysing climate modelling results and comparing these results with observations taken during this and previous similar Atlantic transect research cruises. Challenges of comparing grid box results with point observations (both in space and in time) were discussed.

Outreach and Philosophy

In this module trainees were introduced to the principles of science communication, practical tools for target group-specific communication, especially for social media. Another focus was on outreach activities especially with educational institutions and the general public in order to increase the global awareness of climate and ocean issues as well as the capacity development worldwide. As a new approach the “Dance of the Carbon Cycles” was part of the portfolio.

Conducting scientific research is one – and indeed a very important – way of engaging with the ocean. But human existence encompasses more than that, and our relationship with the ocean, with water and even with ships is also shaped by other cultural and individual experiences, both old and new. This part of the module explored precisely these dimensions. Philosophy is essentially an activity. Therefore, besides inputs and lectures also intensive discussions – a first and important opportunity to demonstrate your own “response-ability” were held. In order to gain a more comprehensive picture of our complex relationship with the ocean, also other creative activities were included.

Work at sea

CTD Rosette Sampling

Several hours prior to arriving on station, students were introduced to the basics of CTD operation on the *Polarstern*. They learned how to identify the different sensors on the CTD rosette and how to set and check a Niskin bottle prior to deployment. Trainees were taught how to plan their bottle sampling strategy on the upcast, prior to deployment, based on the expected locations of the different water masses anticipated to be encountered at that location. All deck and winch room operations during deployment were explained to the students prior to beginning the station and they were taught the basic operations of the Seabird CTD software, the event logger on the *Polarstern* and the AWI’s Manage CTD programme for post processing of the data into Ocean Data View (ODV). Students took water samples for dissolved gases, salinity, nutrients and phytoplankton from the Niskin bottles for use in other sections of the modules. At the completion of the station the students cleaned the CTD.

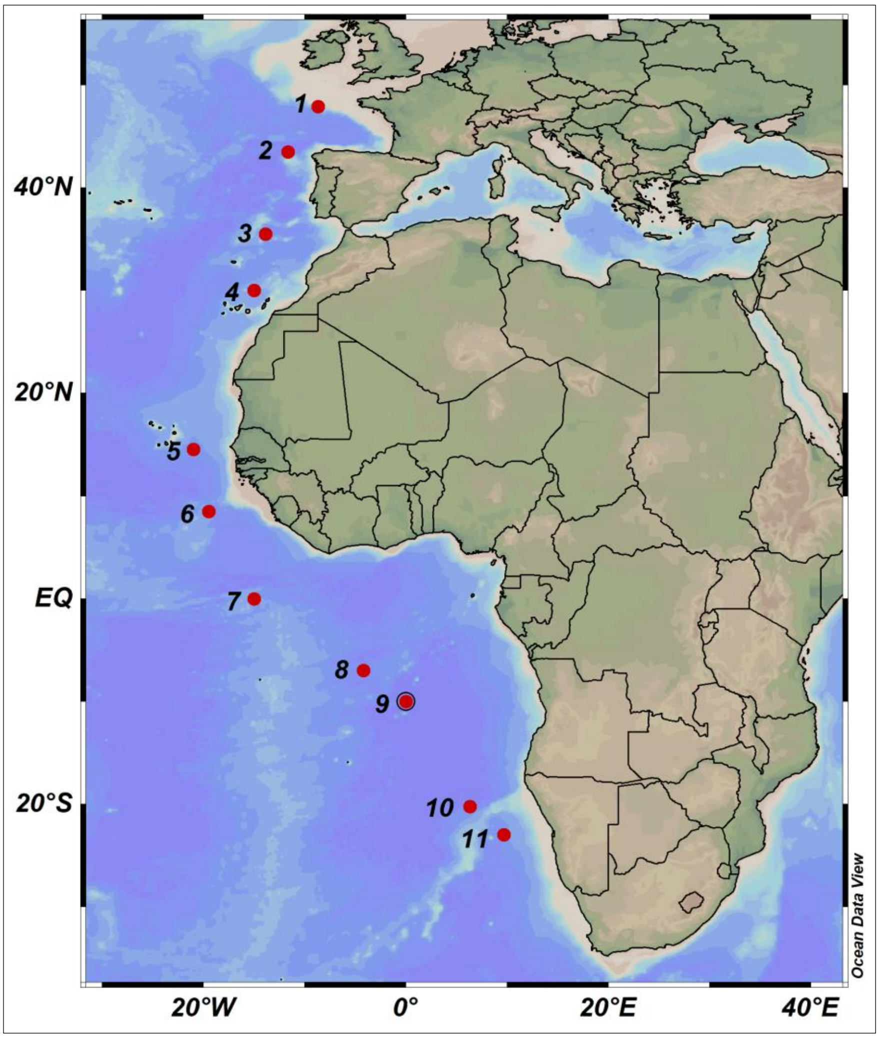

Fig. 2.2: Locations of CTD Stations along the transect

Water mass identification

Students were introduced to the basics of water mass identification using temperature, salinity and oxygen for the main water masses found along the expedition track. Salinity measurements for control and post-cruise calibrations were made onboard. Focus was on detection of North and South Atlantic Central Water (NACW, SACW), Mediterranean Outflow Water (MOW) and Antarctic Intermediate Water (AAIW), North Atlantic Deep Water (NADW) and Antarctic Bottom Water (AABW) as we move further south (Fig. 2.6).

Dissolved nutrients and pigment analysis

In this section of the module, trainees were introduced to sampling, sample processing and preservation for consecutive dissolved nutrient analysis and pigment analysis of samples in the photoactive layer. Samples analysis will take place on land. A complete list of samples taken at different stations and depth is presented in Table 2.1.

Tab. 2.1: Complete list of samples for dissolved nutrients

Station number	Date	Depth [dbar]	Canister number	Niskin Bottle	Sample_ ID	Sample_replicate
PS151_004	19.11.2025	5001.3	1	1	1025	PS151_004_02_1025_01
PS151_004	19.11.2025	5001.3	1	1	1025	PS151_004_02_1025_02
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PS151_004	19.11.2025	750	3	13	1037	PS151_004_02_1037_01
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PS151_004	19.11.2025	500.6	4	14	1038	PS151_004_02_1038_01
PS151_004	19.11.2025	500.6	4	14	1038	PS151_004_02_1038_02
PS151_004	19.11.2025	200.2	5	15	1039	PS151_004_02_1039_01
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PS151_004	19.11.2025	150.2	6	16	1040	PS151_004_02_1040_02
PS151_004	19.11.2025	119.4	7	17	1041	PS151_004_02_1041_01
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PS151_010	22.11.2025	2500	1	2	1074	PS151_010_01_1074_02
PS151_010	22.11.2025	831	2	10	1082	PS151_010_01_1082_01
PS151_010	22.11.2025	831	2	10	1082	PS151_010_01_1082_02
PS151_010	22.11.2025	150.5	3	14	1086	PS151_010_01_1086_01
PS151_010	22.11.2025	150.5	3	14	1086	PS151_010_01_1086_02
PS151_010	22.11.2025	119.7	4	15	1087	PS151_010_01_1087_01
PS151_010	22.11.2025	119.7	4	15	1087	PS151_010_01_1087_02
PS151_010	22.11.2025	95.6	5	18	1090	PS151_010_01_1090_01
PS151_010	22.11.2025	95.6	5	18	1090	PS151_010_01_1090_02
PS151_010	22.11.2025	60.5	6	20	1092	PS151_010_01_1092_01
PS151_010	22.11.2025	60.5	6	20	1092	PS151_010_01_1092_02
PS151_010	22.11.2025	30.8	7	22	1094	PS151_010_01_1094_01
PS151_010	22.11.2025	30.8	7	22	1094	PS151_010_01_1094_02
PS151_010	22.11.2025	10.6	8	24	1096	PS151_010_01_1096_01
PS151_010	22.11.2025	10.6	8	24	1096	PS151_010_01_1096_02
PS151_014	27.11.2025	4240	1	2	1098	PS151_014_01_1098_01

Station number	Date	Depth [dbar]	Canister number	Niskin Bottle	Sample_ ID	Sample_replicate
PS151_014	27.11.2025	4240	1	2	1098	PS151_014_01_1098_02
PS151_014	27.11.2025	751	2	10	1106	PS151_014_01_1106_01
PS151_014	27.11.2025	751	2	10	1106	PS151_014_01_1106_02
PS151_014	27.11.2025	300	3	14	1110	PS151_014_01_1110_01
PS151_014	27.11.2025	300	3	14	1110	PS151_014_01_1110_02
PS151_014	27.11.2025	100.5	4	17	1113	PS151_014_01_1113_01
PS151_014	27.11.2025	100.5	4	17	1113	PS151_014_01_1113_02
PS151_014	27.11.2025	51	5	20	1116	PS151_014_01_1116_01
PS151_014	27.11.2025	51	5	20	1116	PS151_014_01_1116_02
PS151_014	27.11.2025	30	6	22	1118	PS151_014_01_1118_01
PS151_014	27.11.2025	30	6	22	1118	PS151_014_01_1118_02
PS151_014	27.11.2025	11	7	24	1120	PS151_014_01_1120_01
PS151_014	27.11.2025	11	7	24	1120	PS151_014_01_1120_02
PS151_016	28.11.2025	4487.5	1	2	1122	PS151_016_01_1122_01
PS151_016	28.11.2025	4487.5	1	2	1122	PS151_016_01_1122_02
PS151_016	28.11.2025	800.5	2	7	1127	PS151_016_01_1127_01
PS151_016	28.11.2025	800.5	2	7	1127	PS151_016_01_1127_02
PS151_016	28.11.2025	201	3	14	1134	PS151_016_01_1134_01
PS151_016	28.11.2025	201	3	14	1134	PS151_016_01_1134_02
PS151_016	28.11.2025	121	4	15	1135	PS151_016_01_1135_01
PS151_016	28.11.2025	121	4	15	1135	PS151_016_01_1135_02
PS151_016	28.11.2025	80.5	5	17	1137	PS151_016_01_1137_01
PS151_016	28.11.2025	80.5	5	17	1137	PS151_016_01_1137_02
PS151_016	28.11.2025	50.5	6	20	1140	PS151_016_01_1140_01
PS151_016	28.11.2025	50.5	6	20	1140	PS151_016_01_1140_02
PS151_016	28.11.2025	30.5	7	22	1142	PS151_016_01_1142_01
PS151_016	28.11.2025	30.5	7	22	1142	PS151_016_01_1142_02
PS151_016	28.11.2025	10	8	24	1144	PS151_016_01_1144_01
PS151_016	28.11.2025	10	8	24	1144	PS151_016_01_1144_02
PS151_019	01.12.2025	3751.3	1	2	1146	PS151_019_01_1146_01
PS151_019	01.12.2025	3751.3	1	2	1146	PS151_019_01_1146_02
PS151_019	01.12.2025	1500.1	2	5	1149	PS151_019_01_1149_01
PS151_019	01.12.2025	1500.1	2	5	1149	PS151_019_01_1149_02
PS151_019	01.12.2025	499.5	3	11	1155	PS151_019_01_1155_01
PS151_019	01.12.2025	499.5	3	11	1155	PS151_019_01_1155_02
PS151_019	01.12.2025	80.1	4	17	1161	PS151_019_01_1161_01
PS151_019	01.12.2025	80.1	4	17	1161	PS151_019_01_1161_02
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PS151_019	01.12.2025	45.3	5	20	1164	PS151_019_01_1164_02
PS151_019	01.12.2025	30.6	6	22	1166	PS151_019_01_1166_01
PS151_019	01.12.2025	30.6	6	22	1166	PS151_019_01_1166_02
PS151_019	01.12.2025	10.3	7	24	1168	PS151_019_01_1168_01
PS151_019	01.12.2025	10.3	7	24	1168	PS151_019_01_1168_02
PS151_026	06.12.2025	5588.4	1	2	1194	PS151_026_01_1194_01
PS151_026	06.12.2025	5588.4	1	2	1194	PS151_026_01_1194_02
PS151_026	06.12.2025	2000	2	3	1195	PS151_026_01_1195_01
PS151_026	06.12.2025	2000	2	3	1195	PS151_026_01_1195_02
PS151_026	06.12.2025	1000	3	7	1199	PS151_026_01_1199_01
PS151_026	06.12.2025	1000	3	7	1199	PS151_026_01_1199_02
PS151_026	06.12.2025	800.9	4	11	1203	PS151_026_01_1203_01
PS151_026	06.12.2025	800.9	4	11	1203	PS151_026_01_1203_02
PS151_026	06.12.2025	100.3	5	17	1209	PS151_026_01_1209_01
PS151_026	06.12.2025	100.3	5	17	1209	PS151_026_01_1209_02
PS151_026	06.12.2025	60.2	6	20	1212	PS151_026_01_1212_01
PS151_026	06.12.2025	60.2	6	20	1212	PS151_026_01_1212_02
PS151_026	06.12.2025	29.8	7	22	1214	PS151_026_01_1214_01

Station number	Date	Depth [dbar]	Canister number	Niskin Bottle	Sample_ ID	Sample_replicate
PS151_026	06.12.2025	29.8	7	22	1214	PS151_026_01_1214_02
PS151_026	06.12.2025	10	8	24	1216	PS151_026_01_1216_01
PS151_026	06.12.2025	10	8	24	1216	PS151_026_01_1216_02
PS151_023	04.12.2025	4724.7	1	2	1170	PS151_023_01_1170_01
PS151_023	04.12.2025	4724.7	1	2	1170	PS151_023_01_1170_02
PS151_023	04.12.2025	2000	2	3	1171	PS151_023_01_1171_01
PS151_023	04.12.2025	2000	2	3	1171	PS151_023_01_1171_02
PS151_023	04.12.2025	800	3	9	1177	PS151_023_01_1177_01
PS151_023	04.12.2025	800	3	9	1177	PS151_023_01_1177_02
PS151_023	04.12.2025	499.7	4	11	1179	PS151_023_01_1179_01
PS151_023	04.12.2025	499.7	4	11	1179	PS151_023_01_1179_02
PS151_023	04.12.2025	75	5	17	1185	PS151_023_01_1185_01
PS151_023	04.12.2025	75	5	17	1185	PS151_023_01_1185_02
PS151_023	04.12.2025	45	6	20	1188	PS151_023_01_1188_01
PS151_023	04.12.2025	45	6	20	1188	PS151_023_01_1188_02
PS151_023	04.12.2025	30	7	22	1190	PS151_023_01_1190_01
PS151_023	04.12.2025	30	7	22	1190	PS151_023_01_1190_02
PS151_023	04.12.2025	10	8	24	1192	PS151_023_01_1192_01
PS151_023	04.12.2025	10	8	24	1192	PS151_023_01_1192_02
PS151_030	09.12.2025	4705	1	1	1217	PS151_030_01_1217_01
PS151_030	09.12.2025	4705	1	1	1217	PS151_030_01_1217_02
PS151_030	09.12.2025	2000	2	5	1221	PS151_030_01_1221_01
PS151_030	09.12.2025	2000	2	5	1221	PS151_030_01_1221_02
PS151_030	09.12.2025	600.5	3	8	1224	PS151_030_01_1224_01
PS151_030	09.12.2025	600.5	3	8	1224	PS151_030_01_1224_02
PS151_030	09.12.2025	420.5	4	10	1226	PS151_030_01_1226_01
PS151_030	09.12.2025	420.5	4	10	1226	PS151_030_01_1226_02
PS151_030	09.12.2025	120.5	5	16	1232	PS151_030_01_1232_01
PS151_030	09.12.2025	120.5	5	16	1232	PS151_030_01_1232_02
PS151_030	09.12.2025	60	6	20	1236	PS151_030_01_1236_01
PS151_030	09.12.2025	60	6	20	1236	PS151_030_01_1236_02
PS151_030	09.12.2025	30	7	22	1238	PS151_030_01_1238_01
PS151_030	09.12.2025	30	7	22	1238	PS151_030_01_1238_02
PS151_030	09.12.2025	10	8	24	1240	PS151_030_01_1240_01
PS151_030	09.12.2025	10	8	24	1240	PS151_030_01_1240_02

Ocean heat content

A specific research interest was to quantify the ocean heat content (OHC) and was therefore an important tool to be trained on. Combining data obtained during this expedition with that from previous expeditions for the same locations, students examined changes in the oceanic heat content of the water column to examine the evidence for an increase in temperature in surface and intermediate waters of the Atlantic. This work also crosslinked with related themes in the climate module.

Air/Sea Gas exchange - Trace Gas analysis

Students were introduced to the concepts of Air/Sea gas exchange and learned how to take samples for dissolved gases in seawater. Discrete samples were taken from the Niskin bottles on the CTD rosette for dissolved gas (e.g., O_2, CO_2) sampling and collected in gas-tight glass bottles. Samples were analyzed onboard using a Hiden Membrane Inlet Mass Spectrometer (MIMS) (Krogh and Gill, 2014). The MIMS is also able to measure other gases such as Ar, N2 and DMS (Nemcek et al., 2008; Tortell et al., 2011; Tortell et al., 2012).

O_2/Ar ratios as tracer of net community production

The data collected using the Hiden MIMS were examined for O_2/Ar ratios as a measure of net community production (Kaiser et al., 2005; Li and Cassar, 2016). The data for O_2 were compared to that measured directly in the water column via the CTD's oxygen sensor. Data for the oxygen isotope (^{16}O, ^{17}O and ^{18}O) content of dissolved O_2 were also collected at each station.

Other climate relevant gases - $\delta^{13}C$ of CO_2, DMS and CH_4

The MIMS was also setup to gather data for several other climate relevant gases (DMS and CH_4) including the major isotopologues of CO_2 (m/z 44 $^{12}C^{16}O_2$; m/z 45 $^{13}C^{16}O_2$; m/z 46 $^{12}C^{18}O^{16}O$) (Nemcek et al., 2008; Tortell et al., 2011; Tortell et al., 2012). A final calibrated dataset from PS151 will be made available via Zenodo by the end of 2026 (https://doi.org/10.5281/zenodo.17865739).

Flow cytometry - picoplankton abundance

Water samples were collected for shipboard analysis of picoplankton abundance using an Accuri C6 flow cytometer. Students were instructed in how to run samples on the flow cytometer and how to differentiate microbial populations across the water column. A particular focus was placed on the determination of the abundance of key picoplankton species such as *Prochlorococcus* and *Synechococcus*. Bacteria were enumerated using the Nucleic acid stain SYBR Green (Marie et al., 1997, Marie et al., 2001). Raw flow cytometry files collected during PS151 using the Accuri C6 are available on request from Zenodo: https://doi.org/10.5281/zenodo.17841394. A final processed data set including the relevant identifiable phytoplankton species (Thyssen, 2022).

ARGO float deployment

During the PS151 cruise, four Argo floats were deployed on behalf of the Federal Maritime and Hydrographic Agency of Germany (BSH).

XBT deployment and data retrieval

During the PS151 mission, the temperature profiles were obtained using Expendable Bathythermograph (XBT) probes. Trainees learned how to setup for an XBT deployment from a moving ship, including communicating with the ship's crew for a safe and successful release of the XBT probe. The XBT probe weres launched regularly every second day en-route., the positions of the XBT stations are identified in Figure 2.3. The students learned how to download the data and to load it into oceanographic software such as Ocean Data View (ODV). These data were analyzed and compared with the reanalysis data (ORAS5: Zuo et al., 2019, GLORYS: Jean-Michel et al., 2021) and results of various climate model simulations during the Modelling module.

Phytoplankton communities' distribution along the Atlantic

The thriving phytoplankton communities in the Atlantic Ocean are very diverse and have a big impact on the ecology and food chain of their home waters. As such, it is of great interest to achieve a better understanding of their distribution and species richness. Therefore, samples were taken with different methods (bucket, planktonnet) and analyzed (characterization of phytoplankton populations through pigment analysis; estimation of phytoplankton cells abundance quantitatively, obtainment of highly resolved biooptic chlorophyll-a *in situ* measurements with a BBE fluorescence probe). The analyzing of the samples will be done in different ways. One of these is to simply analyse them under a regular microscope, the other is to use the Uthermöhl method on an inverted microscope, which will be done later on land.

Bucket Sampling

Depending on the sea conditions, a bucket sample was taken daily. In addition to measuring temperature, pH (WTW), oxygen (WTW), and chlorophyll (BBE), surface water was filtered for subsequent nutrient analyses and HPLC. The nutrient analyses and HPLC are carried out on land after the expedition.

PAR, turbidity and albedo measurements

These measurements were taken, during the phytoplankton and fluorescence sampling. Their goal was to characterize the underwater and surface light environment, which plays a central role in primary production and energy balance at the air-sea interface. Students measured Photosynthetically Active Radiation (PAR) both above and below the water surface using Handheld PAR sensors. More specifically measurements included measuring incoming and reflected PAR above the water surface and a deployment of a spherical light sensor to a depth of 15 metres to estimate light attenuation in the water. Trainees learnt how the ratio of incoming and reflected radiation can be used to calculate albedo and how the attenuation of underwater light intensity to that above the surface can serve as a proxy for turbidity and allows estimation of the diffuse attenuation coefficient (Kd). In addition to the PAR measurements Kd was also estimated from Secchi disk measurements that were performed shortly after the light profile measurements. Through these experiments the trainees were able to explore how variations in turbidity, water colour, and sea-state conditions can influence the surface reflectance and light penetration into the water body. The trainees learned how to calculate ocean surface albedo (fraction of solar radiation reflected by sea surface) and explored how variations in turbidity, water colour, and sea-state conditions can influence the surface reflectance.

Outreach and Philosophy

During the expedition trainees learned how to communicate scientific knowledge through onboard seminars, presentations and various outreach activities. Outreach activities included videoconference with educational institutions ranging from primary school to university with six different countries: Bangladesh, Great Britain, Germany, Portugal, Mexico and Namibia. Trainees shared their onboard experiences, and awareness of the oceans and climate change were transferred directly to the classroom. Other outreach activities included creating content for different social media channels (LinkedIn, Instagram) and the *Polarstern* App. In addition, the traines were introduced to the Dance of the Carbon Cycles initiated by Prof. Laurence Gill, Chair of Environmental Engineering at Trinity College Dublin in a preparatory workshop on 12 November 2025 in Bremerhaven. Trainees practised the dance performance on board in order to present it on the cooperation workshop with the University of Namibia (UNAM) on 13 December 2025 in Swakopmund, Namibia and spread the idea worldwide.

Preliminary (expected) results

Oceanography

The expedition from Bremerhaven to Walvis Bay covered an enormous geographic range as we transit through temperate and sub-tropical regions. During the transect, participants were trained in the principles of oceanographic interactions and their impacts on climate.

Water Masses Encountered on the North South Atlantic Transect

Identifying water masses is essential for assessing changes in the ocean interior, particularly in climate-relevant properties such as heat content and salinity. Changes in the spatial extent of water masses can significantly affect ocean heat content without overall warming or cooling. Therefore, understanding the properties and circulation of water masses is crucial for identifying long- and short-term trends, including rising water temperatures.

Four main water mass categories are distinguished: surface, central, intermediate, as well as deep and bottom waters. Following each CTD cast, the trainees used measured and derived values for pressure [dbar], potential temperature θ [°C] (Fig. 2.3), salinity (Fig. 2.4), oxygen concentration [mg l-1] (Fig. 2.5), and potential density anomaly σ0 [kg m-3] to differentiate the water masses (Fig. 2.6*)*. Potential temperature (θ) was used, as *in situ* temperature (T) increases with depth due to compression, allowing water masses to be traced independently of depth. Other important water mass characteristics, such as nutrients (silicate, nitrate, and phosphate), will be analyzed later on land.

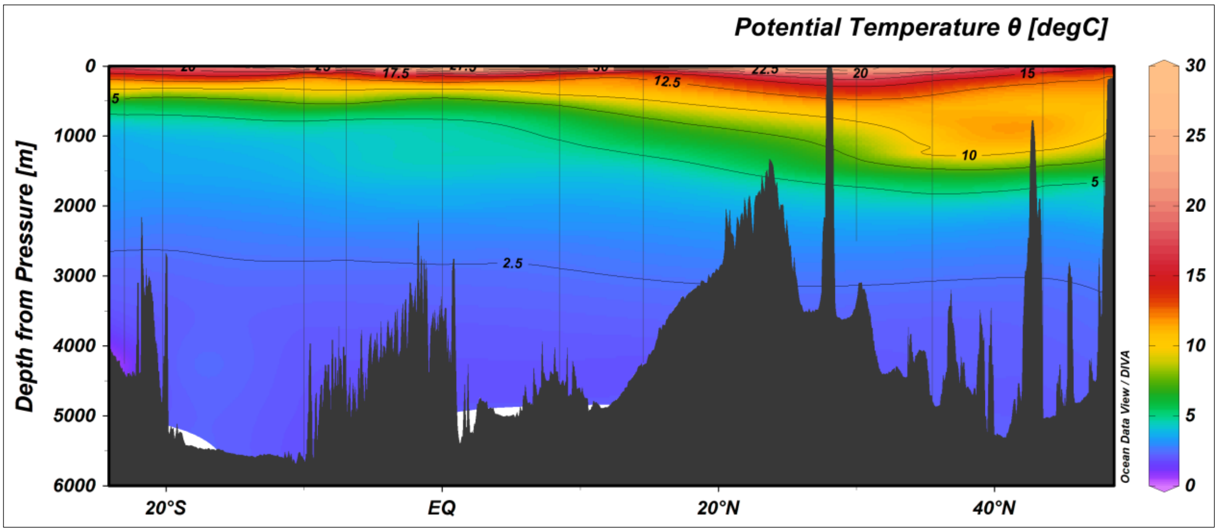

Fig. 2.3: Temperature distribution based on CTD profiles taken along the North-South-Atlantic transect. The data from the 11 stations were strongly extrapolated using DIVA gridding.

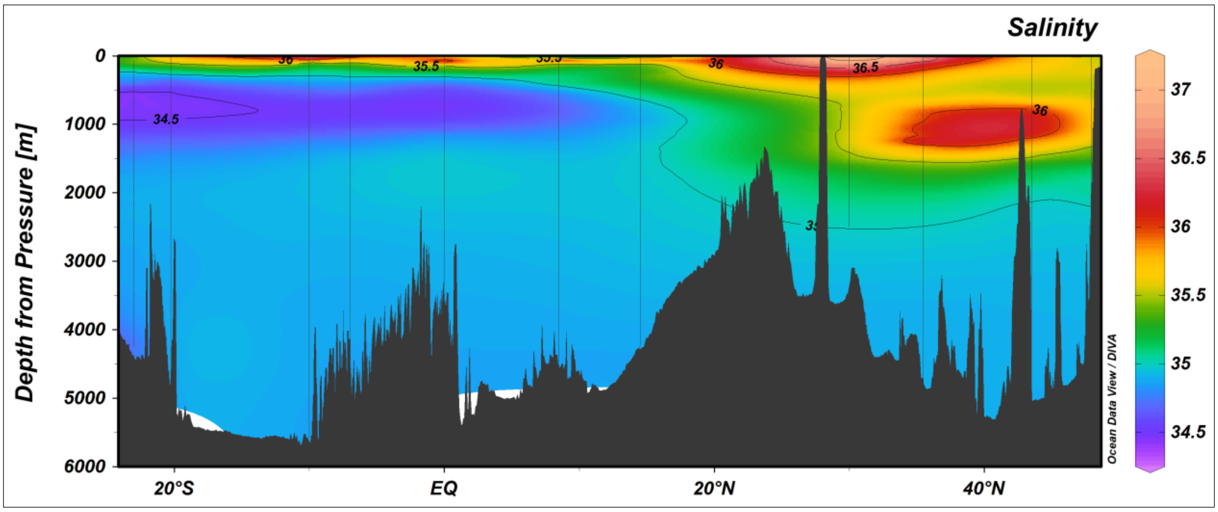

Fig. 2.4: Salinity distribution based on CTD profiles taken along the North-South-Atlantic transect. The data from the 11 stations were strongly extrapolated using DIVA gridding.

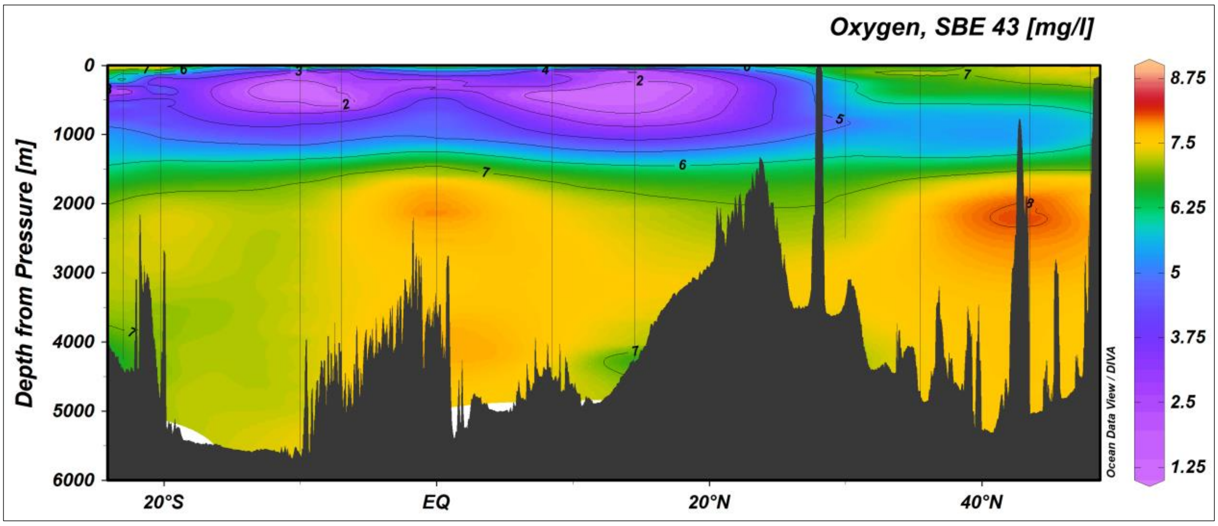

Fig. 2.5: Oxygen distribution based on CTD profiles taken along the North-South-Atlantic transect. The data from the 11 stations were strongly extrapolated using DIVA gridding.

As depicted in the T-S plot (Fig. 2.6) six main water masses were observed along the North-South Atlantic Transect during PS151. North and South Atlantic Central Water (NACW, SACW), Mediterranean Outflow Water (MOW) and Antarctic Intermediate Water (AAIW), North Atlantic Deep Water (NADW) and Antarctic Bottom Water (AABW).

The NACW is one of the two main water masses in the upper Atlantic Ocean and is found between a range of 100 – 1,000 m depth. The SACW can be found in the same depth as NACW and represents the other main water mass in the upper Atlantic Ocean. In comparison to its northern counterpart, the SACW can be slightly colder and less saline. A typical difference is the oxygen concentration, which is lower in the SACW than in the NACW.

Off the European and North African coast in approximately 1,000 m depth, the warm and saline MOW has been identified (Fig. 2.6). Also, at 1,000 m depth, Antarctic Intermediate Water AAIW is observed south of 14.5 °N, where it forms a fresh and cold tongue (Fig. 2.6). Along the entire transect, NADW is present at depths of approximately 2,000–5,500 m and is identifiable by a salinity maximum. Temperature and salinity vary only slightly throughout this depth range but change at fronts with MOW and AAIW (Fig. 2.6). At the southernmost station of the transect (23 °S) colder waters, with a relatively low salinity at depths of 4,000 m and below, are an indication of AABW.

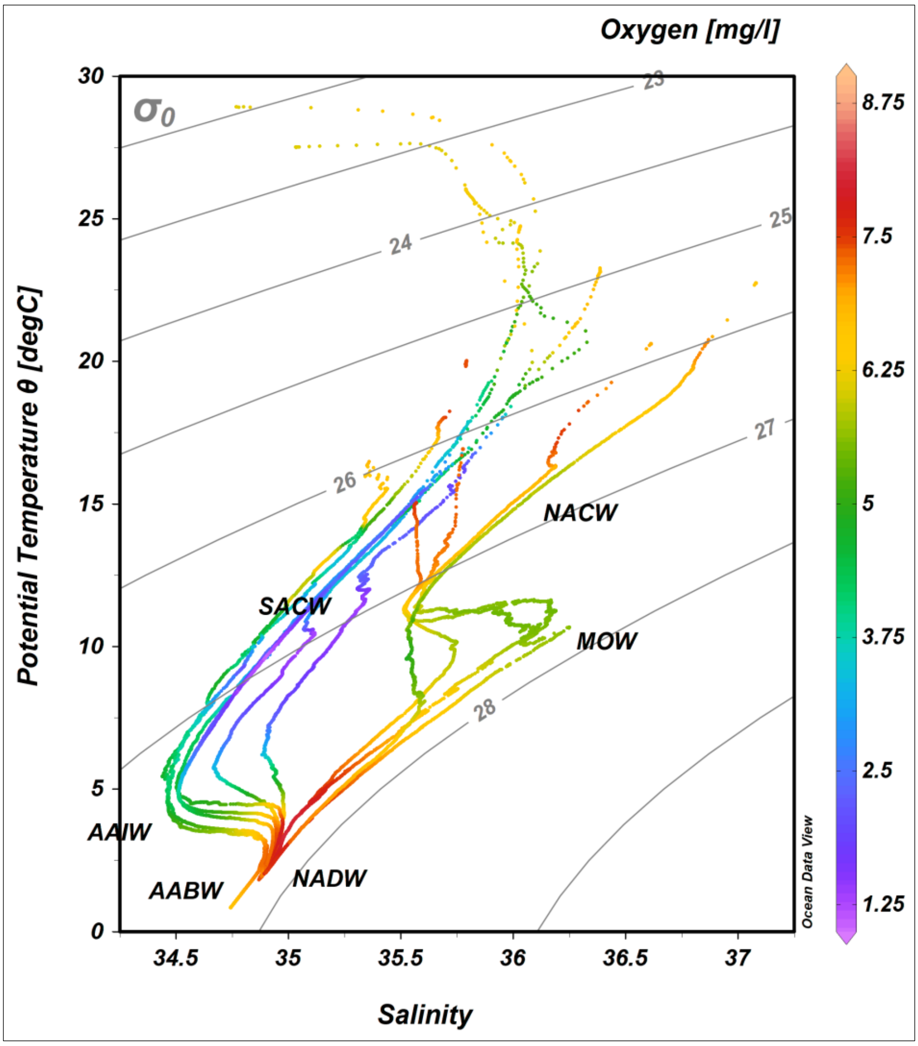

Fig. 2.6: T-S Plot and oxygen concentration [mg/l] of CTD data along the North-South-Atlantic Transect (11 stations). Six different water masses are indicated.

Flow cytometry

The flow cytometry analysis revealed depth-dependent patterns in both the composition and abundance of the microbial and phototrophic communities. Overall, bacteria represented about 60% of the detected particles, with *Prochlorococcus* representing the largest fraction of photosynthetic cells in all the samples. In the surface waters, *Prochlorococcus* and *Synechococcus* occurred in similar proportions, but often at the deep chlorophyll maxima *Prochlorococcus* was the dominant population, indicating the overall oligotrophic nature of the waters of the central Atlantic. (Fig. 2.7).

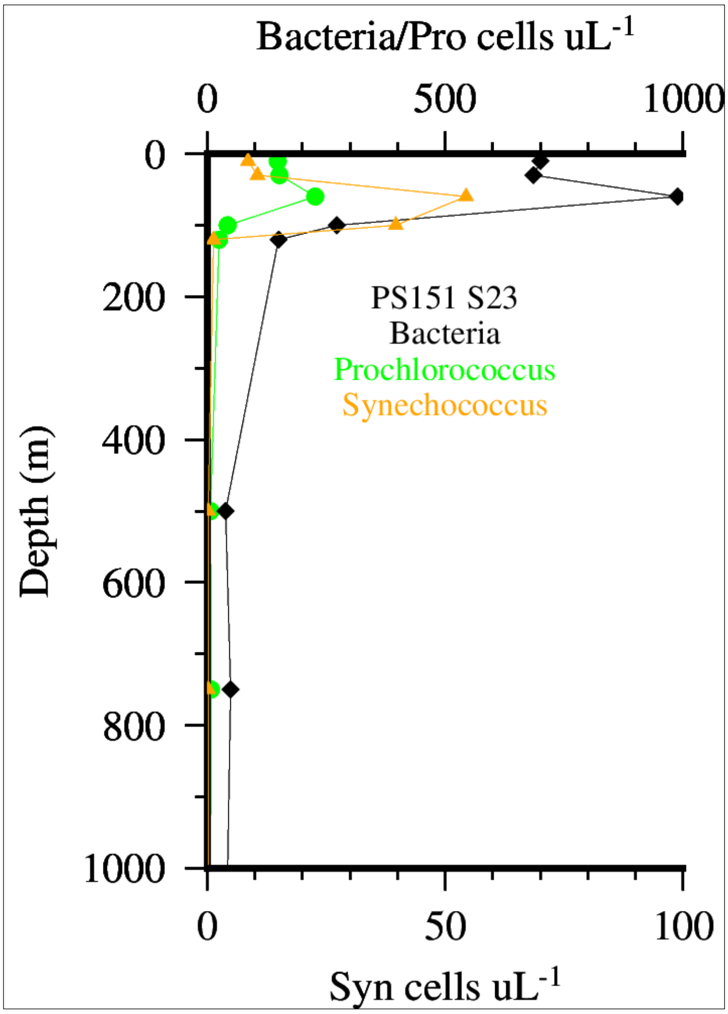

Fig. 2.7: Example vertical profile, from station 23, of the abundance of bacteria (as identified by staining with SYBR Green), Prochlorococcus and Synechococcus as determined by shipboard flow cytometry.

Ocean heat content

During the PS151, temperature profiles collected from *Polarstern* were compiled. Figure 2.8 and Table 2.2 summarize the number of profiles (up to 700 m depth) available for each sampling year and the total number of profiles analyzed for the Ocean Heat Content (OHC) analysis. Data for 2015, 2016, and 2025 were obtained from the NoSoAT cruises, while the remaining data were collected from various *Polarstern* cruises. In total, 207 profiles were selected up to 700 m depth for the OHC analysis. The NoSoAT cruise data (2015, 2016, and 2025) show a relatively homogeneous spatial distribution of sampling locations. In contrast, data from the other years are not homogeneously distributed. Since this study focuses on the eastern Atlantic, all observations from previous *Polarstern* cruises that fall outside this region were excluded. Additionally, NoSoAT data from 2019 and 2022 were not considered for the OHC analysis up to 700 m because these cruises were conducted in June and September, respectively. Most of the data from years other than 2015, 2016, and 2025 are concentrated in the Northern Hemisphere, and the number of sampling sites varies substantially between years. These factors make the interannual comparison of OHC more complex.

Temperature profile distribution

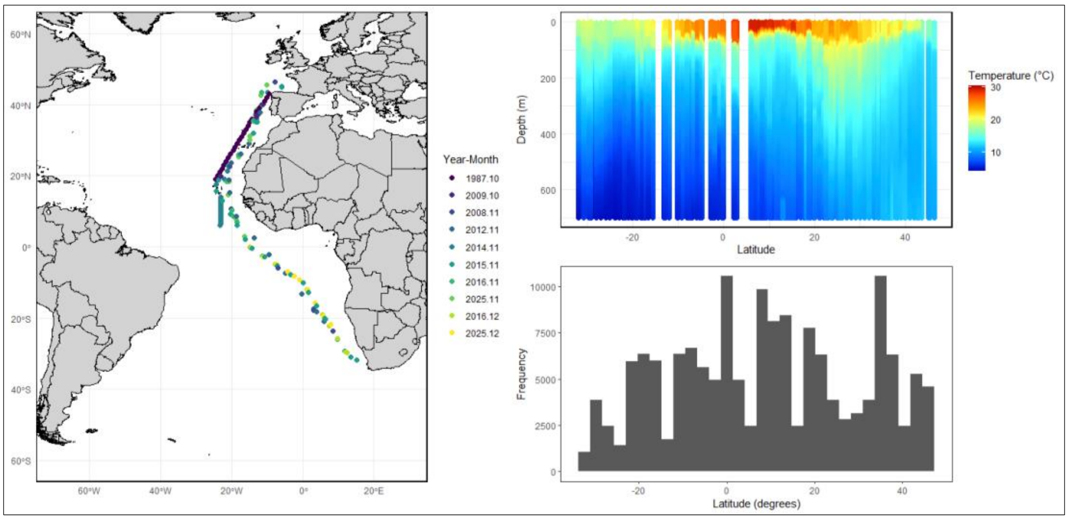

Fig. 2.8: Distribution of sampling locations in the eastern Atlantic Ocean across multiple years. The left panel shows the spatial distribution of CTD and XBT sampling points collected between October and December from 1987 to 2025. The top-right panel illustrates thevertical temperature distribution up to 700 m depth, combining observations from all years (1987–2025). The bottom-right panel presents the latitudinal distribution of sampling sites across different latitudes.

Tab. 2.2: Distribution of CTD and XBT profiles used in this study, considering measurements up to 700 m depth for the period 1987–2025

Serial	Year	Number of CTD and XBT profiles (up to 700m)
1	1987	24
2	1993	40
3	2008	10
4	2009	5
5	2012	14
6	2014	20
7	2015	36
8	2016	26
9	2025	32
	Total	207

Latitudinal variation of Ocean Heat Content at the Eastern Atlantic

The latitudinal variation of OHC, obtained by integrating temperature data up to 700 m depth in the eastern Atlantic Ocean, is shown in Figure 2.9. A clear and significant spatial trend in OHC is observed across the region. OHC increases from the Southern Hemisphere (from ~30° S), reaches a maximum between 20° N and 30° N, and then decreases north of 30° N latitude. The vertical distribution of temperature and the corresponding latitudinal variation of OHC across the eastern Atlantic Ocean for different depth ranges (700–1,800 m, 1,800–3,000 m, and 700–3,000 m) are shown in Figure 2.10. This analysis reveals a similar spatial pattern to that observed for OHC integrated over the upper 700 m, with OHC increasing from the Southern Hemisphere (from ~30° S), peaking between 20° N and 30° N, and decreasing north of 30° N.

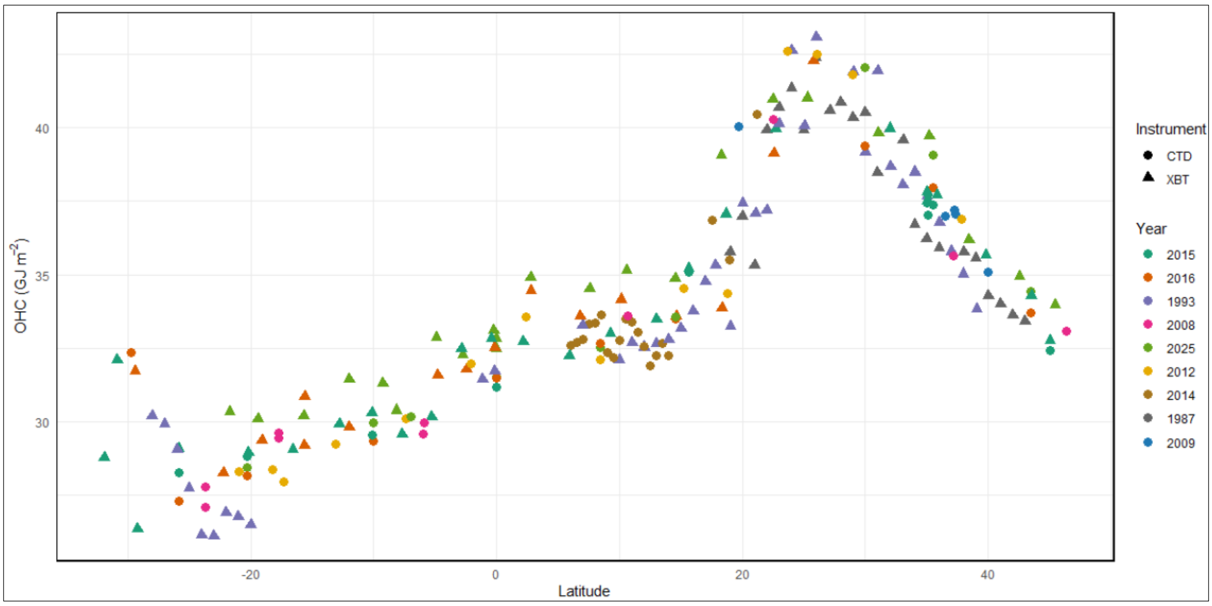

Fig. 2.9: Latitudinal variation of OHC (GJm-2) integrated up to 700 m depth in the eastern Atlantic Ocean across different sampling years.

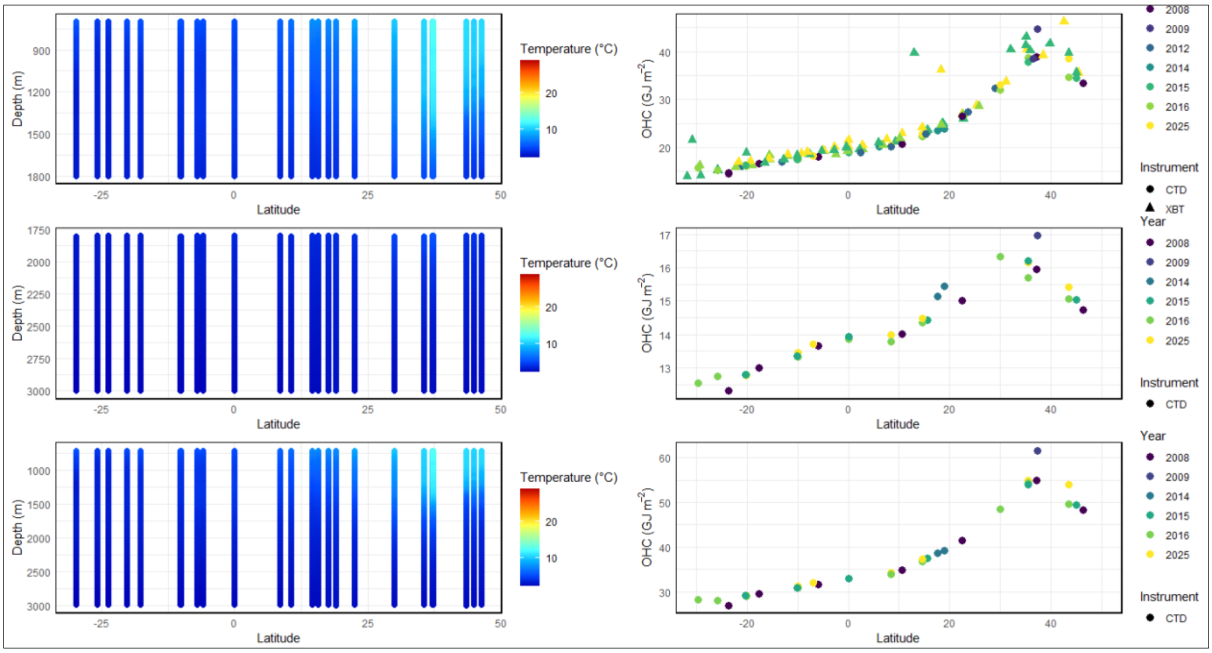

Fig. 2.10: Vertical distribution of temperature and latitudinal variation of OHC across the eastern Atlantic Ocean. The left column shows the vertical temperature distribution for three depth ranges (700–1,800 m, 1,800–3,000 m, and 700–3,000 m). The right column presents the corresponding latitudinal variation of OHC derived from each of these depth ranges.

ARGO floats

During the PS151 cruise, four Argo floats were successfully deployed to support autonomous oceanographic observations. All platforms were ARVOR floats equipped with pressure, temperature and conductivity sensors, operating via the IRIDIUM transmission system. The floats are owned by BSH, Germany. Float WMO 1902775 (serial no. AI2600-25DE003) was launched on 01 December 2025 at 0.0316°N, 14.974°W and had completed six profiling cycles, with its most recent profile recorded on 21 January 2026. Float WMO 3902672 (serial no. AI2600-25DE004) was deployed on 04 December 2025 at 4.1958°S, 6.9812°W and reached cycle 5, with the last profile dated 15 January 2026. A second float at the same location, WMO 1902776 (serial no. AI2600-25DE005), was launched on 06 December 2025 and also completed five cycles, with its latest profile obtained on 16 January 2026. The fourth float, WMO 6990722 (serial no. AI2600-25DE006), was deployed on 09 December 2025 at 20.2504°S, 6.357°E and recorded its most recent profile on 19 January 2026, completing five cycles. Data from these Argo floats (cruise PS151) are available at https://fleetmonitoring.euro-argo.eu/ (Fig. 2.11).

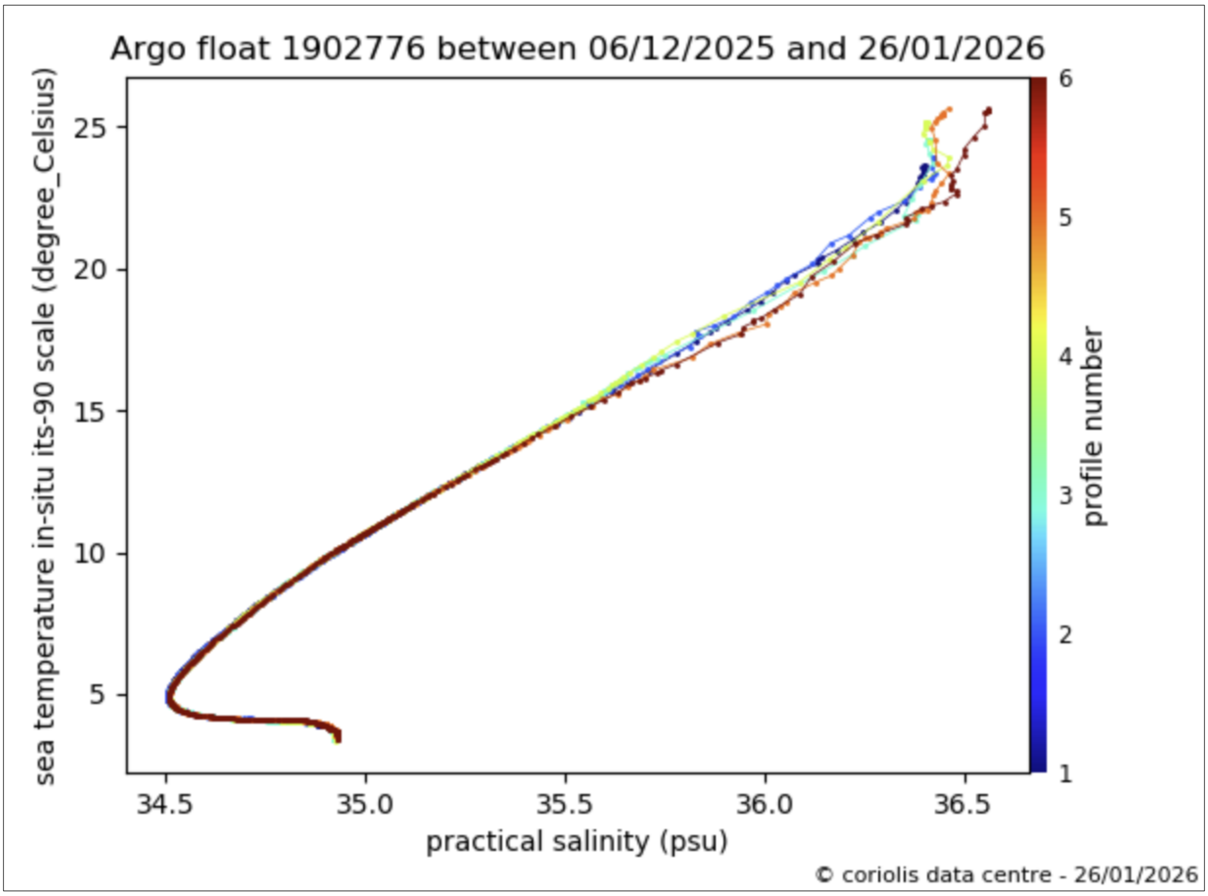

Fig. 2.11: T/S diagram showing the temperature and salinity profiles measured by the four Argo floats deployed from PS151. Data are derived from https://fleetmonitoring.euro-argo.eu/.

Phytoplankton communities' distribution along the Atlantic

This part of the module consisted mainly in sample acquisition for further analysis via Uthermöhl Method on land. The main phytoplankton samples were taken with an Apstein 100 Planktonnet, immediately after the CTD cast (Tab. 2.3). Additional samples were taken from CTD bottles from the chlorophyll maximum, which had been identified on the CTD downcast (Tab. 2.4).

Tab. 2.3: Casts of the Planktonnet at the different Stations

Sample	Date	Time	Depth (m)
PS151_2_2	18.11.25	04:00	95
PS151_7_2	21.11.25	14:09	105
PS151_14_3	27.11.25	09:37	102
PS151_16_2	29.11.25	00:05	100
PS151_19_2	01.12.25	13:42	105
PS151_24_1	05.12.25	12:32	103
PS151_26_2	06.12.25	12:08	100
PS151_28_1	08.12.25	07:58	104
PS151_29_1	09.12.25	09:56	101
PS151_31_1	10.12.25	09:27	105

Tab. 2.4: Phytoplankton Bottle Samples from the CTD casts

Station	Date	Bottle	Depth (m)
PS151_2	17.11.25	19	50
PS151_4	19.11.25	20	50
PS151_7	21.11.25	17	90
PS151_10	22.11.25	17	90
PS151_14	27.11.25	18	51
PS151_16	29.11.25	18	50
PS151_19	01.12.25	18	45
PS151_23	04.12.25	18	45
PS151_26	06.12.25	18	60
PS151_30	09.12.25	18	60

Preliminary microscopical inspection on board revealed expected similarities to previous NoSoAT missions along this track. Once again, the Acantharians belonging to the Radiolaria were quite abundant, showing the open ocean nature of the investigated areas. Similarly of the Dinoflagellates *Ceratium*, *Dinophysis* and *Podolampas* were present in almost all of the net samples. The Diatomeae were, as seen on previous missions (Wiltshire et al., 2017; Witshire and Brodte, 2020; Wiltshire and Dummermuth, 2023), not as abundant as the Dinoflagellates, but found in all samples, for example *Planktoniella* or *Chaetoceros*. Also found once again were Silicoflagellates like *Dictyocysta* as well as Coccolithophores and more (Fig. 2.12).

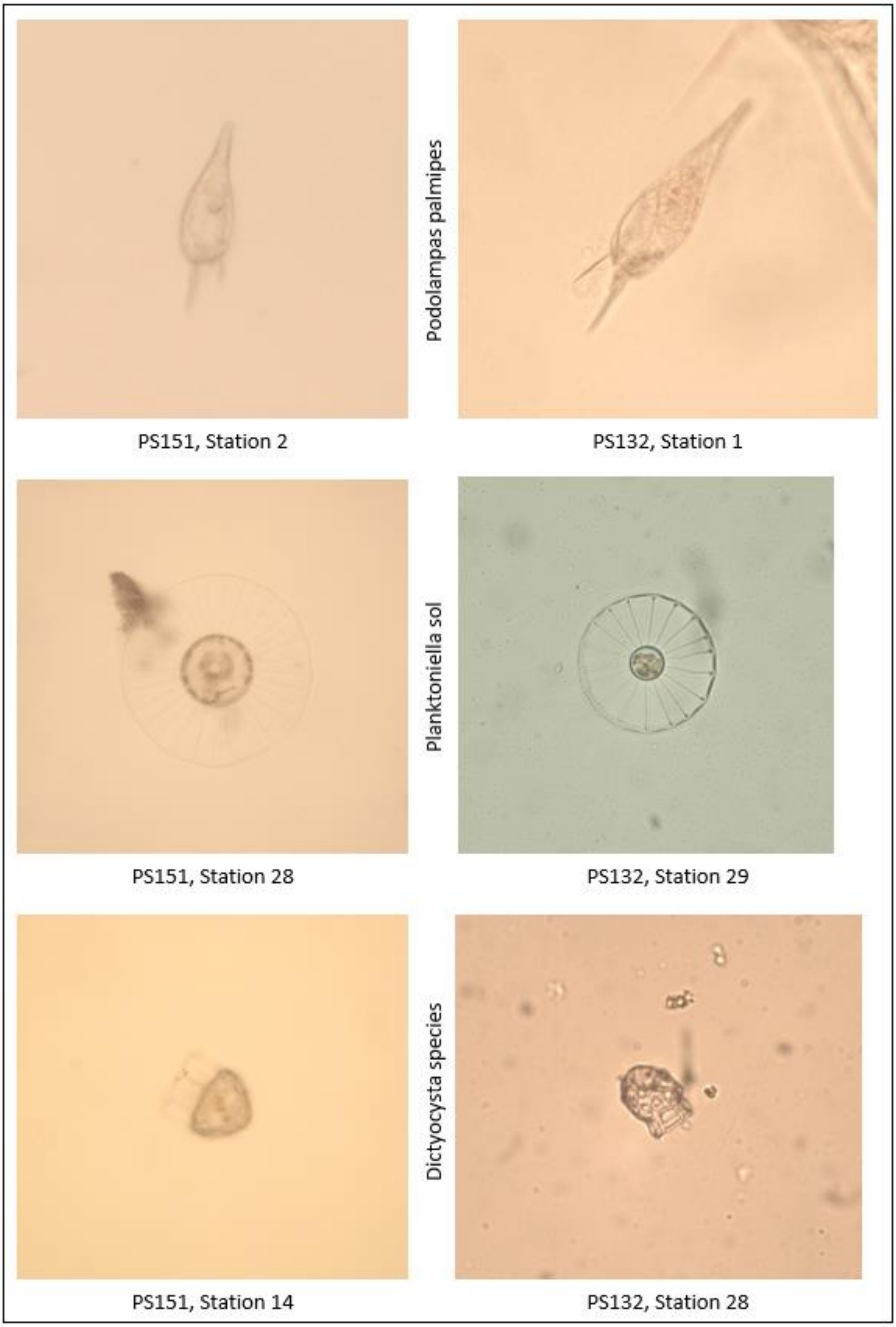

Fig. 2.12: comparable Phytoplankton appearances of PS151 and PS132

Bucket Sampling

During the cruise, 22 bucket samples were taken and measured for temperature, oxygen, pH and chlorophyll. Figure 2.13 and Figure 2.14 exemplarily show the distribution of temperature and oxygen concentration in the surface water over the transect. Figure 2.13 clearly shows that the temperature increases continuously until the equator is reached with a maximum of 29,1°C at a latitude of 7.5 °N and then decreases again. The oxygen concentration reaches its minimum in the warmer regions between 25.3 °N to 2.8 °N (Fig. 2.14).

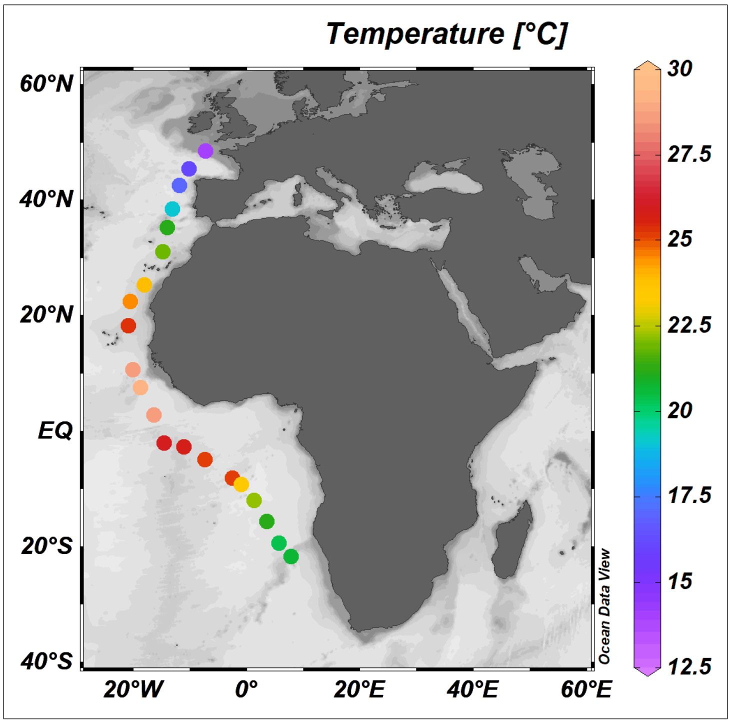

Fig. 2.13: Surface Temperature distribution based on bucket samples taken along the North-South-Atlantic transect.

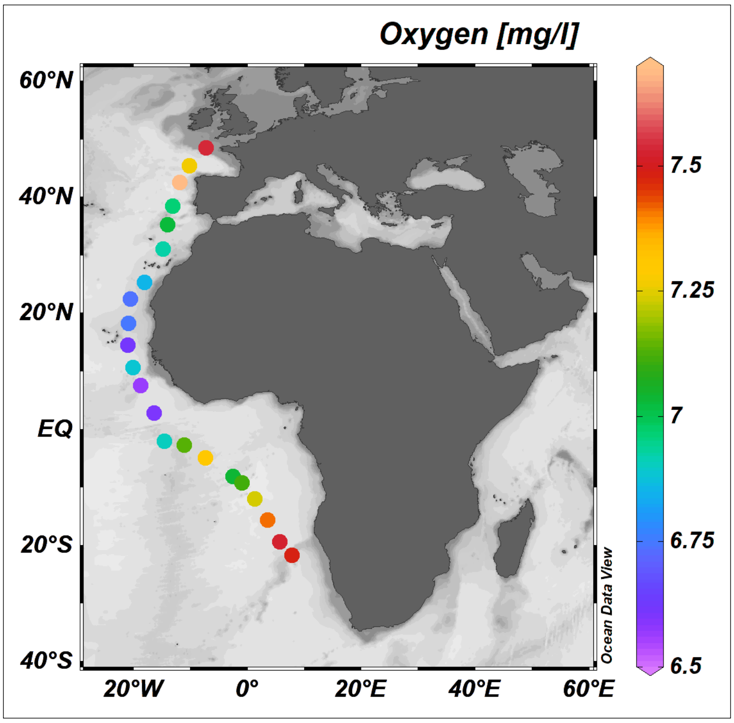

Fig. 2.14: Surface Oxygen distribution based on bucket samples taken along the North-South-Atlantic transect.

PAR, turbidity and albedo measurements

Throughout the PS151 transect, the trainees carried out dynamic activities aimed at learning how to interpret changes in the ocean light field, understanding their effects, and identifying the factors that control variability in ocean colour. Once these concepts were established, PAR light profiles obtained at eight stations were analysed, with profiles extending to a depth of 10 m. From these data, the diffuse attenuation coefficient (K_d) was estimated, yielding values ranging between 0.0801 and 0.101 m^{-1} (Tab. 2.5). Subsequently, the first optical depth was estimated, with values between 9.9 and 12.5 m, as well as the euphotic zone depth, which ranged from 45.5 to 57 m (Tab. 2.5). Ocean colour estimated from surface water photographs remained predominantly within blue tonalities across the sampled stations, with minor variations associated with increased cloud cover. These experiments showed the importance of factors like the suns angle, cloud cover and practical measurement limitation such as the ships shade. Despite only few samples during excellent conditions (i.e., clear sky, sun angle>45°, and calm water) the measurements proved to be vital in adding to the trainees understanding light behaviour in the water and above the water surface.

Tab. 2.5: Ocean light field parameters derived from PAR measurements and ocean colour estimated from surface water photographs

Station	Cloud cover (%)	Sun angle	Kd (m-1)	First optical depth (m)	Euphotic depth (m)	Ocean colour
PS151_7_2	40	34	0.0939	10.6	49.0	
PS151_14_3	40	30	0.101	9.9	45.5	
PS151_19_2	0	68	0.0833	12.0	55.2	
PS151_24_1	100	N/A	0.0833	12.0	55.2	
PS151_26_1	90	72	0.0868	11.5	53.0	
PS151_28_1	100	N/A	0.0801	12.5	57.4	
PS151_29_1	30	68	0.0888	11.3	51.8	
PS151_31_1	50	63	0.0811	12.3	56.7	

Modelling

The Atlantic Ocean has experienced accelerated warming and increased stratification in recent decades, yet the accuracy of climate models and reanalyses in representing these changes across the full water column remains poorly constrained by observations. Using a unique 25-year time series of repeated meridional hydrographic transects from *Polarstern* (CTD and XBT data), in addition to basin-scale temperature and salinity profiles from ARGO floats, we evaluate warming trends in mixed layer depth, deep-ocean (>1000 m), and characterise key water masses in the Atlantic. Track-aligned comparison between *in-situ* observations with CMIP6 models and reanalysis products ORAS5 and GLORYS12v1 reveal systematic biases. CMIP6 models systematically underestimate mixed layer shoaling and upper-ocean stratification since the late 1990s, with deep-ocean warming (detected in observations) being largely absent. GLORYS best represents the warming signals in the upper and deep ocean (further corroborated by *Polarstern* observations), whereas ORAS5 captures the same trend but with dampened variability. Furthermore, models also misrepresent the Mediterranean Outflow Water showing excessive zonal spreading and a southward bias, whereas reanalyses align more closely with observations. These biases imply that current models may be underestimating Atlantic stabilization, with consequences in projecting ocean heat uptake efficiency, air-sea feedbacks, and the evolution of the Atlantic Meridional Overturning Circulation, overall underscoring the indispensable role of long-term ship-based observations for constraining ocean thermal trends and validating climate products.

Outreach

In addition to hands-on scientific training, the participants learned how to translate complex research activities into engaging and accessible stories for non-experts.

Outreach activities involved the interaction with different educational institutions ranging from primary school to university. A lecture on the idea of the expedition and the associated research and measurements in the context of environmental and climate change was given by a trainee or a teacher beforehand of the PS151 expedition. A live videoconference from board of *Polarstern* reconnected the learners giving them the opportunity to ask questions and to get in touch with the participants on board. The videoconferences involved schools from six countries (Bangladesh, Germany, Great Britain, Mexico, Portugal and Namibia). These audiences included over 250 participants from ages between eight and 25 years old.

Training in clear and inspiring science communication, outreach, and knowledge transfer resulted in multiple social media contributions. In total, five posts with #NoSoAT were published on the AWI LinkedIn channel resulting in a reach of 37,200. On the AWI Instagram account three Reals resukted in a reach of 33,200 and four contirbutions in a reach of 4,500. On Facebook nine contributions resulted in a reach of 22,100. Furthermore, seven reals and 24 contributions were published on the Instagram Capacity Exchange account resulting in 77,832 sights, thereof 48% of non-followers. 23 blog posts in the "follow-Polarstern.de" App were published documenting scientific measurements, the training programme and live on board (https://follow-Polarstern.awi.de/) in English and German.

The training in science communication also encouraged the exploration of new formats, resulting in a wide range of creative outputs. Several examples highlight innovative methods that use haptic, aesthetic, and sound-based artistic elements to convey scientific findings about the state of the ocean:

Sculpture – three-dimensional artwork

The trainees transformed temperature and oxygen profiles derived from CTD data into a three-dimensional sculpture created using seawater and other materials (Fig. 2.15). Texture was used to represent varying oxygen concentrations, while colour indicated both depth and chlorophyll levels within the different water masses.

Fig. 2.15: Sculpture of a temperature and oxygen profile at the equator (PS151 Station 19, 0° 0' N, 15° 0' W, 3751m depth). Photo © Angelika Dummermuth, AWI

Poetry

In a poetry workshop, the trainees learned to distil the key messages from their favourite scientific papers, convert them into prompts, and craft poems from them, with each prompt forming the foundation for a verse.

Whispers of water - By Pewah Nghaangulwa & Sergio Cardenas

Water is a living mosaic
colours and shadows breathing beneath the rising sun.
She holds our stories in every tide,
a home our ancestors trusted
long before we spoke of conservation and sustainability.
Even as we disturb her rhythm,
she calls to us still
in whale songs,
in lifting waves,
in birds gliding on her breath.
On the *Polarstern*, hope rose
nations united to rediscover
what water means to our souls.
The ocean is not our enemy;
she is a mother waiting for her children.
Let us rewrite our story with her
honour her,
protect her,
come home to her again.

Science, arts, and philosophy

Based on discussion in the philosophical module (cf. below), the trainees explored theories of water and flow and reflected on the question "What is water to you?". They collected both written statements and drawings (Fig. 2.16), capturing a wide range of personal interpretations.

Fig. 2.16: Collage of drawings by PS151 participants on the question "What is the ocean for you?"

At the end of the expedition a short report on the outreach activities of PS151 was published on the website of the UN Ocean decade (https://oceandecade.org/news/expedition-empowers-ecops-through-innovative-research-and-communications-training/)

Dance of the Carbon Cycles

A highlight of this year's programme was the introduction of "The Dance of the Carbon Cycle," a novel and edutaining activity trained on board to help explain how fossil fuel emissions disrupt the natural balance of carbon on Earth, driving climate change. Through movement, storytelling, and science, the trainees were learning – and embodying – how carbon should circulate, and what happens when human activities overload the system. They share this unique teaching tool with colleagues in Namibia, and the trainees plan to take the "dance" into classrooms and communities worldwide.

Philosophy

In a first step, the philosophy module sharpened the students' critical awareness of their work as scientists (Sieroka et al., 2018). Among the questions discussed were: What counts as science and why? What role do models and metaphors play in science (and where are their limits)? What does it mean to be a responsible scientist?

Subsequently, various aspects of the relationship between humans and the ocean, water, and shipping were presented, discussed, and implemented in small projects. Here are a few examples.

Starting with the seemingly simple question, ‘What is water?’, various levels of human experience and our interaction with nature were examined. Cultural differences became apparent and were often explainable. Interviews with scientists and crew members on board revealed all kinds of specific relationships with different types of water (seawater, drinking water, including drinking water treatment, wastewater treatment, etc.). Some of the respondents' associations with water (as food, as a means of transport, as a chemical substance, etc.) are shown in Figure 2.17.

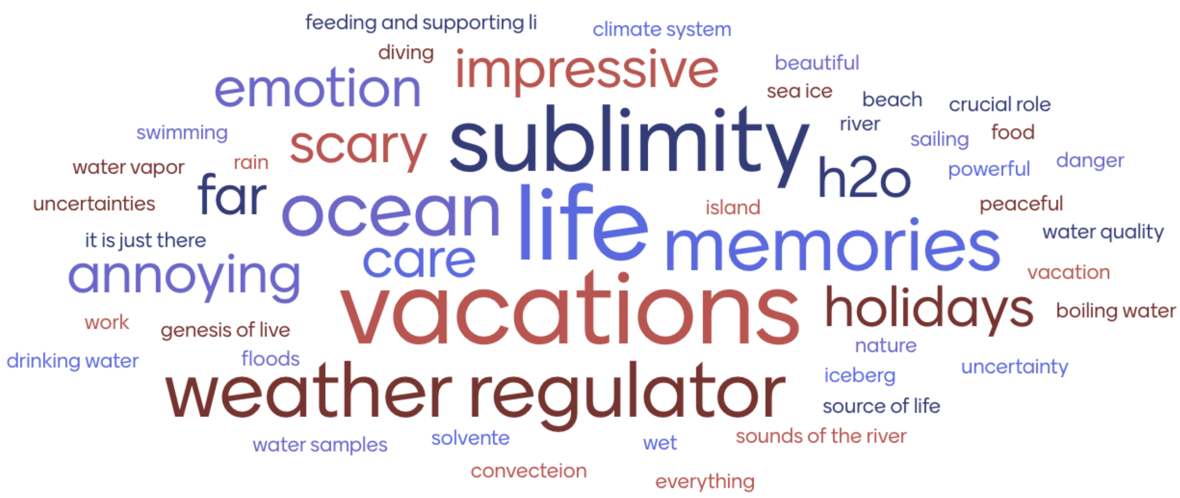

Fig. 2.17: Word cloud for associations with water

The case of water was also used to discuss important questions from the philosophy of science, such as the relationship between microscopic and macroscopic properties, i.e., questions such as ‘How many water molecules are needed to make concepts such as liquidity or density applicable at all?’.

Questions concerning the relationship between humans and the ocean included concepts such as vastness, beauty, and sublimity, which have a long tradition in philosophy and are strongly associated with the ocean as a prime example. We also discussed the conceptual difficulties and historical development of representations of the ocean and the horizon. Here is an ocean-centred representation of the Earth designed by one of the trainees (Sergio Molano Cárdenas) and based on the so-called Spilhaus projection (Fig. 2.18).

Fig. 2.18: Ocean-centred map of the Earth by Sergio Molano Carárdenas.The orange markings indicate the borders and coastlines of the countries participating in the PS151 expedition.

We then discussed the relationship between science, philosophy, and art in more general terms. All three are human endeavours to approach and understand the world around us. After identifying similarities and differences, we took a closer look at literature and music as means of reflecting on the relationship between humans and the ocean, water, and shipping. Here, for example, we discussed the rather complex conceptual background of *Moby Dick*, which can be read as a full philosophy of nature. The trainees then compiled a whole list of sea novels and developed their own categorisation scheme. They did something similar for music and myths. For the latter, they developed categorisation schemes based on the continent of origin, the type of water, and the mythical figures involved. Some of the results are shown in the following diagrammes and the heat map (Fig. 2.19, Fig. 2.20).

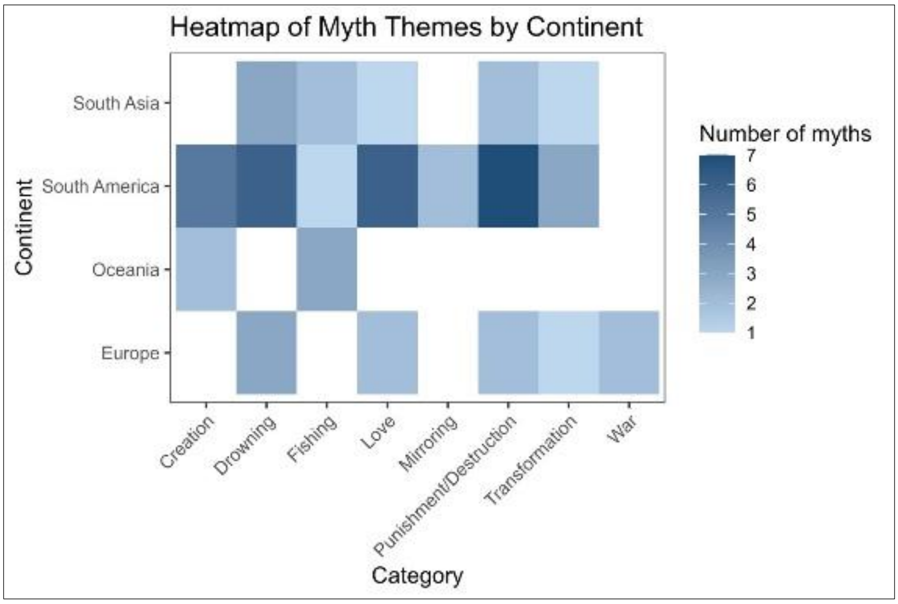

Fig. 2.19: Heat map of myths

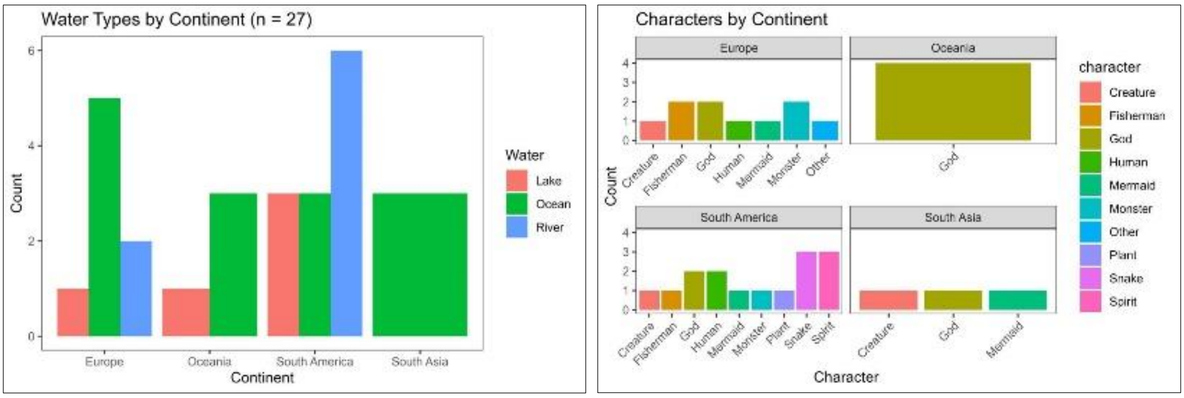

Fig. 2.20: Illustration of water types and characters in myths by continents

Music, sound, and voices for climate action

The discussion about music and sound led to further activities and projects: 'Voices of change' is an audio recording in different languages to engage people for the protection of the ocean.

A group of trainees and teachers began writing a scientific article with the working title 'The voices needed for an ocean wanted'. This article takes a critical look at the slogan of the UN Ocean Decade ('We science we need for the ocean we want'), drawing on the diverse and varied perspectives of those involved in PS151.

Data management

Environmental data will be archived, published and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) within two years after the end of the expedition at the latest. By default, the CC-BY license will be applied.

Any other data will be submitted to an appropriate long-term archive that provides unique and stable identifiers for the datasets and allows open online access to the data.

This expedition was supported by the Helmholtz Research Programme “Changing Earth – Sustaining our Future” Topic 4.

In all publications based on this expedition, the **Grant No. AWI_PS151_01** will be quoted and the following publication will be cited:

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

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References

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

Brodte et al. (2025) The Polarstern Atlantic Transect as a concept for shipboard training on ocean science. ICES Journal of Marine Science. https://doi.org/10.1093/icesjms/fsaf165

Douglas NK & Byrne RH (2017) Achieving accurate spectrophotometric pH measurements using unpurified meta-cresol purple. Marine Chemistry, 190, 66-72, https://doi.org/10.1016/j.marchem.2017.02.004

IPCC (2023) Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115. https://doi.org/10.59327/IPCC/AR6-9789291691647

Kaiser J et al. (2005) A 70-kyr sea surface temperature record off southern Chile (Ocean Drilling Programm Site 1233). Paleoceanography, 20(4), PA4009. https://doi.org/10.1029/2005PA001146

Krogh ET, Gill CG (2014) Membrane introduction mass spectrometry (MIMS): a versatile tool for direct, real-time chemical measurements. J Mass Spectrom. 49(12):1205-13. https://doi.org10.1002/jms.3447

Krug LA, Beckman F, Rees AP, Dummermuth A, Stymiest C, Brodte E-M, Wiltshire KH, Croot P & Seeyave S (2025) All aboard! Providing shipboard technical skills while building capacity in ocean observations. Oceanography 38(1):20–25. https://doi.org/10.5670/oceanog.2025.123

Lellouche J-M, Greiner E, Bourdallé-Badie R, Garric G, Melet A, Drévillon M, Bricaud C, Hamon M, Le Galloudec O, Regnier C, Candela T, Testut C-E, Gasparin F, Ruggiero G, Benkiran M, Drillet Y & Le Traon P-Y (2021) The Copernicus Global 1/12° Oceanic and Sea Ice GLORYS12 Reanalysis. Frontiers in Earth Science, 9:698876. https://doi.org/10.3389/feart.2021.698876

Lewis E, Wallace D & Allison LJ (2026) Program developed for CO_2 system calculations, report, February 1, 1998; Upton, New York. (https://digital.library.unt.edu/ark:/67531/metadc690958/ accessed January 13, 2026), University of North Texas Libraries, UNT Digital Library, https://digital.library.unt.edu; crediting UNT Libraries Government Documents Department.

Li Z & Cassar N (2016) Satellite estimates of net community production based on O 2/Ar observations and comparison to other estimates, Global Biogeochem. Cycles, 30, 735–752. https://doi.org10.1002/2015GB005314

Marie D, Partensky F, Jacquet S & Vaulot D (1997) Enumeration and Cell Cycle Analysis of Natural Populations of Marine Picoplankton by Flow Cytometry Using the Nucleic Acid Stain SYBR Green I. Applied and Environmental Microbiology 63, 186–193. doi: 10.1128/aem63.1.186-193.1997

Marie D, Partensky F, Vaulot D & Brussaard C (2001) Enumeration of Phytoplankton, Bacteria, and Viruses in Marine Samples, Current Protocols in Cytometry. John Wiley & Sons, Inc.

Nemcek N, Ianson D & Tortell PD (2008) A high-resolution survey of DMS, CO2, and O2/Ar distributions in productive coastal waters. Global Biogeochemical Cycles 22. https://doi.org/10.1029/2006GB002879

Sieroka N, Otto VI & Folkers G (2018) Critical Thinking in Education and Research—Why and How? Angewandte Chemie (International Edition) 57(51): 16574-16575. https://doi.org/10.1002/anie.201810397

Thyssen M, Grégori G, Créach V, Lahbib S, Dugenne M, Aardema HM, Artigas L-F, Huang B, Barani A, Beaugeard L, Bellaaj-Zouari A, Beran A, Casotti R, Del Amo Y, Denis M, Dubelaar GBJ, Endres S, Haraguchi L, Karlson B, Lambert C, Louchart A, Marie D, Moncoiffé G, Pecqueur D, Ribalet F, Rijkeboer M, Silovic T, Silva R, Marro S, Sosik HM, Sourisseau M, Tarran G, Van Oostende N, Zhao L & Zheng S (2022) Interoperable vocabulary for marine microbial flow cytometry. Frontiers in Marine Science 9.

Tortell PD, Gueguen C, Long MC, Payne CD, Lee P & DiTullio GR (2011) Spatial variability and temporal dynamics of surface water pCO2, ΔO2/Ar and dimethylsulfide in the Ross Sea, Antarctica. Deep Sea Research Part I: Oceanographic Research Papers.

Tortell PD, Merzouk A, Ianson D, Pawlowicz R & Yelland DR (2012) Influence of regional climate forcing on surface water pCO2, ΔO2/Ar and dimethylsulfide (DMS) along the southern British Columbia coast, Continental Shelf Research, 47, 119-132. https://doi.org/10.1016/j.csr.2012.07.007

Wiltshire KH & Dummermuth A (2023) The Expedition PS132 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2022. Berichte zur Polar- und Meeresforschung = Reports on polar and marine research, Bremerhaven, Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, 771, 46 p. . https://doi.org/10.57738/BzPM_0771_2023

Wiltshire KH& Brodte EM (2020) The Expedition PS120 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2019. Berichte zur Polar- und Meeresforschung = Reports on polar and marine research, Bremerhaven, Alfred Wegener Institute for Polar and Marine Research, 740, 58 p. https://doi.org/10.2312/BzPM_0740_2020

Wiltshire KH Brodte EM, Wilson A & Lemke P (2017) The Expedition PS102 of the Research Vessel POLARSTERN to the Atlantic Ocean in 2016 , Berichte zur Polar- und Meeresforschung = Reports on polar and marine research, Bremerhaven. Alfred Wegener Institute for Polar and Marine Research, 713, 99 p. https://doi.org/10.2312/BzPM_0713_2017

Zuo H, Balmaseda MA, Tietsche S, Mogensen K & Mayer M (2019) The ECMWF operational ensemble reanalysis–analysis system for ocean and sea ice: a description of the system and assessment. Ocean Science, 15, 779–808. https://doi.org/10.5194/os-15-779-2019

3. BATHYMETRIC UNDERWAY MEASUREMENTS

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Grant-No. AWI_PS151_02

Objectives

High-resolution bathymetry data provides accurate knowledge of seafloor topography, and is a principal dataset required to understand many marine processes. It is of particular value when interpreting scientific data in a spatial context. Bathymetric data offers a spatial overview of the general geological setting of an area, as well as geological processes such as erosion, sediment transport and deposition. Even information on tectonic processes can be inferred from bathymetry. Coupling such bathymetric data with high-resolution, sub-bottom profiler data from the top tens of meters below the seabed, provides further information on marine sediment composition and stratigraphy. This can be used to study depositional environments on larger scales in terms of space and time.

Although world maps give the impression that the seafloor is understood in great detail, most of the world's seabeds remain unmapped by hydroacoustic systems. In these uncharted areas, bathymetry is modelled from satellite data with coarser spatial resolutions than what can be achieved with direct measurement techniques. It follows that bathymetric data in these regions lack the detail necessary to resolve small- to meso-scale geomorphological features accurately (e.g., sediment waves, glaciogenic features and small seamounts). Ship-borne multibeam data provide bathymetry information with a spatial resolution sufficient to resolve such features.

The main tasks of the bathymetry/geophysics group on board *Polarstern* during PS151 were:

- Collecting bathymetric data and correcting it for environmental parameters such as sound velocity and systematic errors in bottom detection
- Post-processing and cleaning the data
- Data management and map production

Work at sea

Technical description

During the PS151 campaign, bathymetric surveys were carried out with the hull-mounted multibeam echosounder (MBES) Teledyne Reson HYDROSWEEP DS3. The HYDROSWEEP is a deep-water system capable of continuous mapping and equipped with full swath abilities. It operates on a frequency of ~14 kHz. On *Polarstern*, the MBES transducer arrays are arranged in a Mills cross configuration of 3 m (transmit array) by 3 m (receive array). The combined motion, position (Trimble GNSS), and time data comes from an iXBlue Hydrins system and the signal is directly transferred into the Control Module (CM) of the MBES to carry out real-time motion compensation for pitch, roll and yaw. The CM computes the water depth from the returning signal using a combination of phase and amplitude detection algorithms. The system can technically map a sector of up to 140° with 70° per side. In the deep sea, an angle of ~50° to both sides could be achieved.

Data acquisition and processing

Data was acquired along the majority of the cruise track, between Bremerhaven and Walvis Bay, where diplomatic permits allowed for it. The MBES was operated with Sonar UI and online data visualization was rendered in Teledyne PDS. The collected bathymetry was stored in S7K raw files. Subsequent data processing was performed using Caris HIPS and SIPS. Any maps generated were produced by, exporting the data to Quantum GIS in a GeoTIFF raster format.

Sound velocity profiles

The best bathymetric surveys stem from datasets corrected by CTD (Conductivity Temperature Depth) casts, collected at appropriately spaced intervals. CTD sampling was carried out by the CapOceanX students and instructors on board and included detailed measurements of water sound velocity at different depths. This is essential, as the acoustic signal travels down the water column from the transducer to the seafloor and back to the surface through several different layers of water masses with each a different sound velocity. The sound velocity (SV) is influenced by density and compressibility, both depending on pressure, temperature and salinity. Wrong or outdated sound velocity profiles lead to refraction errors and reduced data quality. The CTD measures conductivity, temperature, and depth in the water column while the ship is on station. From these parameters, the sound velocity is calculated. The sound velocity profiles obtained by the CTD were immediately processed and applied within the MBES for correct beamforming during the survey. Additionally, these profiles were combined/extended with WOA18 (World Ocean Atlas 2018) data to create full ocean depth SV profiles.

Stations

The PS151 Hydrosweep and CTD stations used to apply sound velocity corrections to the multibeam data are listed in Table 3.1.

Tab. 3.1: List of bathymetry related stations during PS151/1

Station Number	Description	Time	Latitude	Longitude
PS151_0_ Underway-9	Multibeam echosounder	Start: 17-11-25 08:39 End: 11-12-25 14:04	Start: 49° 22.650' N End: 22° 55.733' S	Start: 004° 31.252' W End: 011° 48.495' E
PS151_2	CTD	18-11-25 1:24	47° 55.772' N	008° 39.627' W
PS151_4	CTD	19-11-25 6:00	43° 30.161' N	011° 37.527' W
PS151_7	CTD	21-11-25 9:35	35° 29.945' N	013° 51.386' W
PS151_10	CTD	22-11-25 19:10	29° 59.989' N	015° 00.022' W
PS151_14	CTD	27-11-25 5:57	14° 33.168' N	020° 59.232' W
PS151_16	CTD	28-11-25 20:22	08° 28.762' N	019° 28.092' W
PS151_19	CTD	01-12-25 10:18	00° 00.006' S	015° 00.005' W
PS151_23	CTD	04-12-25 21:02	06° 58.719' S	004° 12.024' W
PS151_26	CTD	06-12-25 7:47	09° 59.986' S	000° 00.044' E
PS151_30	CTD	09-12-25 17:37	20° 14.939' S	006° 20.951' E
PS151_32	CTD	10-12-25 23:54	22° 59.944' S	009° 41.875' E

Preliminary results

During approximately 19 days, bathymetric data was collected along a track of 4,856 nm (8,995 km) by the swath bathymetry system. Figure 1.1 shows the generated bathymetry grid over the Atlantic.

Data management

Geophysical and oceanographic data will be archived, published and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (https://www.pangaea.de) within two years after the end of the expedition at the latest. By default, the CC-BY license will be applied. Furthermore, bathymetric data will be provided to the Nippon Foundation – GEBCO Seabed 2030 Project. This expedition was supported by the Helmholtz Research Programme "Changing Earth – Sustaining our Future" Topic 2, Subtopic 3. The data was obtained as part of the project BATHY-LTO.

In all publications based on this expedition, the **Grant No. AWI_PS151_02** will be quoted and the following publication will be cited:

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (2017) Polar Research and Supply Vessel POLARSTERN Operated by the Alfred-Wegener-Institute. Journal of large-scale research facilities, 3, A119. http://dx.doi.org/10.17815/jlsrf-3-163.

4. LOGISTICS

Brieux Crenan[1], Beate Bahl[2], Andreas Boje[3], Nils Karow[3]; Tim Galdiga[4], Joscha Knobloch[4], Lars Höft[5], Andreas Seidenstücker[6]

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Grant-No. AWI_PS151_03

Objectives

- Test and adjustments of winches and winch control system - Andreas Boje (MacGregor), Nils Karow (MacGregor), Brieuc Crenan (RFL)
- Adjustment of pitch-propeller System- Lars Höft (Rolls Royce), Brieuc Crenan (RFL)
- Automation of pure water system control - Tim Galdiga (AWI), Joscha Knobloch (AWI)
- Network administration - Andreas Seidenstücker (Systema), Brieuc Crenan (RFL)

Work at sea

Test and adjustments of winches and winch control system - Andreas Boje (MacGregor), Nils Karow (MacGregor), Brieuc Crenan (RFL)

During last ship yard several winches have been maintained or overhauled. The correct functionality can be tested on see only, lowering cable until depth of several kilometers. These tests have been executed during PS151 in combination with scientific CTD casts.

After overhaul, an acceptance test should be executed for winch SE32.1/SE32.2. Unfortunately, all test planned during PS151 could not take place due to lack of planned time, some were done only during PS152/1. During this process several errors were detected. A wiring error was fixed, a leakage eliminated and a tachometer was replaced. Furthermore, rubbing brake pads have been adjusted. Additionally, a screw of slip ring got loose and a winch sensor was damaged. The sensor must be replaced. After these repairs, acceptance test could be executed for basic operation.

Further maintenance work was applied during ship yard and cruise for winches GE72.1 and AWI-004. Test of winch GE72.1 was successful, but test of winch AWI-004 was not.

Test of brake of that winch was executed with result, that winch can hold only 1.4 tons Instead of 2 tons.

Communication between winch AWI-004 and operator is established by separate control unit, only. Commands of control unit are not correspondently executed, but yield to unplausible behavior. The error could not be fixed and control unit must be replaced by system from different firm. For that reason, the winch is not operable during complete ANT season.

During ship yard a problem occurred, spooling the new 6 mm stainless steel cable on winch SE32.2. During that operation the cable was corrupted at several locations. Additionally, fabrication errors were detected are suspected along the cable. For this reason, only 1065 meter instead of 3,000 2,850 meters could be spooled on the winch SE32.2. Manufacturer was informed and fabrication errors were claimed is analyzing cable-sample.

Adjustment of pitch-propeller System- Lars Höft (Rolls Royce), Brieuc Crenan (RFL)

After maintenance of all four main engines in ship yard, their settings must be adjusted during operation. Until arriving in harbour of Rotterdam all four engines were successfully set to provide equal power at equal rotation.

Automation of pure water system control - Tim Galdiga (AWI), Joscha Knobloch (AWI)

The pure water system is providing sea water for several scientific sensors on board. The water must directly be analyzed, whereat no physical or chemical changes should appear. So short pipe routing, smooth bending and use of displacement pump instead of rotary pump were established. A wedge-wire filter was installed to separate slush ice from sea water and thus to prevent pipes from ice blocking. In case of slush ice pump must be switched off. Until this cruise, only vent to drain off slush ice was controlled automatically and sea water pump was controlled manually.

During the cruise a new system was established, to control slush ice vent as well as pump digitally. Existing documentation was adjusted to match actual situation. Documentation of new components was provided to laboratory electronic engineer as well.

As on that cruise no ice conditions occurred, the final adjustments must be performed on following cruises. If necessary, more devices and sensors can be added to the control system, like motor driven vents, flow sensors, pressure sensors or fresh water system to flush ice blocking away.

Network administration - Andreas Seidenstücker (Systema), Brieuc Crenan (RFL)

During ship yard the core network router has been replaced by a modern system including a firewall to enhance cyber security aspects. Due to short time in ship yard, only installation of the hardware cluster and cabling could be executed as well as basic functionality tests and settings. Advanced setup as well as fine tuning and validation of the new security rules have been performed during the cruise (Bremerhaven to Las Palmas) in productive expedition conditions while servers and data acquisition systems were up and running, satellite connections were established, sensors were measuring and thus network load was high. All objectives were met: The new cluster is fully operational, tested, documented and crew members could be trained.

Data management

Not applicable

ACKNOWLEDGMENTS

The authors would like to express their deepest thanks and appreciation to the supporting and funding bodies of this expedition. These are the Alfred Wegener Institute Helmholtz-Centre for Polar- and Marine Research, Nippon Foundation (NF), the Partnership for Observation of the Global Ocean (POGO) and SeaNetwork for support and financing. An international training in this magnitude would not be possible without these strong and reliable networks. We are more than grateful for this dedication.

We would like to thank the Met Éireann, Trinity Collegae Dublin, Shahjalal University of Science and Technology, Technical University Braunschweig, Universities of Bremen, Galway, Göttingen and Potsdam for their support by providing knowledge, instrumentation and faculty members. We thank colleagues who supported us land based and thus enabled this expedition.

We want to express special thanks to the captain and the crew for supporting and actively promoting the shipboard training as an important visible international capacity development programme. The trainees and teachers were highly impressed by the professionalism and the welcoming atmosphere on board.

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APPENDIX

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

A.2 FAHRTTEILNEHMER:INNEN / CRUISE PARTICIPANTS

A.3 SCHIFFSBESATZUNG / SHIP‘S CREW

A.4. STATIONSLISTE / STATION LIST

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

Affiliation	Address
AU.aim.gov	Australian Institute of Marine Science PMB no3 Townsville MC 4810 Townsville QLD Australia
BD.SUST	Shahjalal University of Science and Technology Department of Oceanography 4331 Sylhet Bangladesh
BJ.Zinzindohoue	M/ZINZINDOHOUE, AGBANWEME BP 22 Bohicon Benin
BR.FURG	Fundacao Universidade do Rio Grande Jorge Carvalho de Campos Moraes, 93 96201-900 Rio Grande Brazil
BR.UFRGS	Universidade Federal do Rio Grande do Sul Centro de Estudos de Geologia Costeira e Oceânica Av. Bento Gonçalves, 9500 91540000 Porto Alegre Brazil
CH.ETH	ETH Zürich Leonhardshalde 21 8001 Zürich Switzerland
CL.ECOTECNOS	SGS-Ecotecnos Limache 3405 7410000 Viña del Mar Chile
CL.UPV	Universidad del País Vasco Hernando de Magallanes 1047 7570582 Santiago Chile

Affiliation	Address
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DE.AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Postfach 120161 27515 Bremerhaven Germany
DE.BGV	BG Verkehr Seeärztlicher Dienst Brandstwiete 1 20457 Hamburg Germany
DE.DWD	Deutscher Wetterdienst Seewetteramt Bernhard Nocht Str. 76 20359 Hamburg Germany
DE.HEREON	Helmholtz-Zentrum hereon GmbH Max-Planck-Str. 1 21502 Geesthacht Germany
DE.LAEISZ	Reederei Laeisz Bartelstraße 1 27568 Bremerhaven Germany
DE.MACGREGOR	Macgregor GmbH & Co Kg Haderslebener Straße 7 25421 Pinneberg Germany
DE.mtu-solution	Rolls-Royce Solutions GmbH Veritaskai 2 21079 Hamburg Deutschland
DE.SYSTEMA	Systema Gesellschaft für angewandte Datentechnik mbH Baberowweg 7 14482 Potsdam Germany
DE.UNI-Bremen	Universität Bremen Bibliothekstraße 1 28359 Bremen Germany

Affiliation	Address
DE.UNI-Göttingen	Georg-August-Universität Göttingen Bioklimatologie Wilhelmsplatz 1 37073 Göttingen
DE.UNI-Potsdam	Universität Potsdam Am Neuen Palais 10 14469 Potsdam
DE.TUBS	Technical University Braunschweig Universitätspl. 2 38106 Braunschweig Germany
DZ.ENSSMAC	Ecole Nationale Superieure des Sciences de la Mer et de l Amenagement du Littoral Campus Universitaire de Dely Ibrahim Bois des Cars 16000 Algiers Algeria
EG.PSU	Port Said University 451123 Port Said Egypt
ES.AZTI	AZTI Foundation Biotechnology and Molecular Ecology Txatxarramendi Island 48395 Sukarrieta Spain
GH.FCWC.FISH	Fisheries Commission Fisheries Scientific Survey Division P.O.Box BT 62 233 Tema Ghana
IA.ATU	Atlantic Technological University Department of Natural Resources & the Environment ATU Galway City, Old Dublin Road H91 T8NW Galway Ireland
IE.MET	Met Éireann Research & Applications Division 65/67 Glasnevin Hill D09 Y921 Dublin Ireland

Affiliation	Address
IE.TCD	Trinity College Dublin Faculty of Science, Technology, Engineering and Mathematics (STEM) Dublin 2 Ireland
IE.UCC	University College Cork College Road T12 K8AF Cork Ireland
IE.UNI-Galway	University of Galway Earth and Ocean Sciences University Road, H91 TK33 Galway Ireland
IT.OGS	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale Sezione di Oceanografia Borgo Grotta Gigante 42/C 34010 Sgonico Italy
MX.UABC	Autonomous University of Baja California Carr. Transpeninsular 3917 22860 Ensenada Mexico
NA.NNF	Namibia Nature Foundation 6 Hidipo Hamutenya str 13001 Swakopmund Namibia
PT.UALG	Universidade de Algarve Campus de Gambelas 8005-139 Faro Portugal
PT.ULISBOA	Universidade de Lisboa Av. Rovisco Pais 1 1049-001 Lisboa Portugal
TN.CBBC	Center of Biotechnology of Borj-Cedria Laboratory of Bioactive Substances BP 901 Hamman-lif 2050 Ben Arous Tunesia

Affiliation	**Address**
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A.2 FAHRTTEILNEHMER:INNEN / CRUISE PARTICIPANTS

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
On board				
Aguilar Vega	Ximena	UK.STIR	PhD student	Glaciology
Amaral Wasielesky	Ana	IT.OGS	PhD student	Oceanography
Arafat	Esraa	EG.PSU	PhD student	Oceanography
Bahl	Beate	DE.BGV	Other	Logistics
Bellabad	Fahima	DZ.ENSSMAC	PhD student	Other Geosciences
Bergmann	Anna	DE.AWI	Scientist	Biology
Boersma	Oisín Jelle	DE.UNI-Göttingen	PhD student	Meteorology
Boje	Andreas	DE.MACGREGOR	Technician	Logistics
Castillo Ramírez	Alejandra de Jesús	MX.UABC	Scientist	Oceanography
Claußen	Marthe	DE.AWI	Technician	Biology
Claver	Cristina	ES.AZTI	Scientist	Biology
Concolis	Brenna Mei	DE.HEREON	PhD student	Other Geosciences
Cornish	Natalie Rosyln	DE.DWD	Scientist	Geophysics
Crenan	Brieuc	DE.LAEISZ	Inspector	Shipping Company
Croot	Peter	IA.ATU	Scientist	Oceanography
Dâmaso Duarte	Ana Filipa	PT.ULISBOA	PhD student	Other Geosciences
Dos Santos	Sarah Sofia Dias	CV.UTA	Scientist	Biology
Dummermuth	Angelika	DE.AWI	Scientist	Biology
Ewusi	Emmanuel Ofosu Mireku	GH.FCWC.FISH	Scientist	Biology
Fragueiro	María Monserrat	CL.ECOTECNOS	Scientist	Biology
Galdiga	Tim	DE.AWI	Technician	Engineering Sciences
Garcia Ortiz	Tomas Andres	DE.AWI	PhD student	Biology
Gatti	Ludovica Martina	DE.UNI-Potsdam	Student (Master)	other geo sciences
Hähnel	Uwe	DE.MWB	Engineer	Shipping Company

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
On board				
Hossain	Md. Shabit	BD.SUST	Student (Master)	Oceanography
Höft	Lars	DE.mtu-solution	Technician	Shipping Company
Hug	Guillaume	IE.maynoothuniversity	PhD Student	Oceanography
Karow	Nils	DE.MACGREGOR	Technician	Logistics
Kirstein	Inga	DE.AWIt	Scientist	Biology
Knobloch	Joscha Paul	DE.AWI	Engineer	Logistics
Lemke	Peter	DE.AWI	Scientist	Physics
Molano Cárdenas	Sergio Mauricio	BR.UFRGS	PhD student	Geology
Nghaangulwa	Priskilla Patemoshela Ndapewoshali	NA.NNF	Scientist	Biology
OFlynn	Aisling	IE.UCC	Student (Master)	Biology
Pérez López	Benjamín Andrés	CL.UPV	Scientist	Oceanography
Ribeiro	Caio Cesar	PT.UALG	Scientist	Oceanography
Rodrigues	Douglas	BR.FURG	Scientist	Biology
Sarker	Subrata	BD.SUST	Scientist	Oceanography
Sayari	Olfa	TN.CBBC	PhD student	other geo sciences
Seidenstücker	Andreas	DE.SYSTEMA	Other	Data
Sellmaier	Amanda	DE.AWI, DE.TUBS	PhD student	Physics
Semmler	Tido	IE.MET	Scientist	Meteorology
Sieroka	Norman	DE.UNI-Bremen, CH.ETH	Scientist	Physics
Suter	Patrick	DE.DWD	Scientist	Meteorology
Swaraj	Ankit	IE.UNI-Galway	PhD student	Oceanography
Terzin	Marko	AU.aim.gov	PhD student	Biology
van der Marck	Floor	Private	Scientist	Marine Science and Climate Change
Wiese	Anne Jasmin	DE.DWD	Scientist	Meteorology
Wiltshire	Karen	IE.TCD	Chief scientist	Oceanography
Zinzindohoue	Coffi Gerard Franck	Private	Scientist	Oceanography

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Not on board / Not in the field				
Brodte	Eva-Maria	DE.AWI	Scientist	Biology
Dorschel	Boris	DE.AWI	Scientist	Geophysics
Rex	Marcus	DE.AWI	Scientist	Physics

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

No	Dienstgrad	Rank	Nachname / Last name	Vorname / First name
1	Kapitän	Master	Kentges	Felix
2	1. Offizier	Chief Mate	Langhinrichs	Jacob
3	1. Offizier Ladung	Chief Mate Cargo	Janik	Michael
4	2. Offizier	2nd Mate	Hering	Igor
5	2. Offizier	2nd Mate	Rathke	Wulf Jannik
6	Schiffsärztin	Doctor	Gößmann-Lange	Petra
7	Leitender Ingenieur	Chief Engineer	Ziemann	Olaf Hermann August
8	2. Ingenieur	2nd Engineer	Farysch	Tim
9	2. Ingenieur	2nd Engineer	Krinfeld	Oleksandr
10	2. Ingenieur	2nd Engineer	Domann	Franz
11	Schiffselektrotechniker Maschine	Ship Electrotechnical Officer Engine	Zivanov	Stefan
12	Elektroniker Winden	Electrotechnical Engineer Winches	Kliemann	Olaf
13	Elektroniker Netzwerk/Brücke	Electrotechnical Engineer Network/Bridge	Hofmann	Jörg Walter
14	Elektroniker Labor	Electrotechnical Engineer Labor	Hüttebräucker	Olaf
15	Elektroniker System	Electrotechnical Engineer System	Pliet	Johannes Oliver
16	Bootsmann	Bosun	Sedlak	Andreas Enrico
17	Zimmermann	Carpenter	Neisner	Winfried Wolfgang
18	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Klee	Philipp
19	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Burzan	Gerd-Ekkehard

No	Dienstgrad	Rank	Nachname / Last name	Vorname / First name
20	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Fischer	Sascha
21	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Klähn	Anton
22	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Kryszkiewicz	Maciej Waldemar
23	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Siegel	Kilian
24	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Bäcker	Andreas
25	Schiffsmechaniker Deck	Multi Purpose Rating Deck	Röth	Benedikt Konrad
26	Lagerhalter	Storekeeper	Preußner	Jörg
27	Schiffsmechaniker Maschine	Multi Purpose Rating Engine	Rolofs	Nils Christian Timo
28	Schiffsmechaniker Maschine	Multi Purpose Rating Engine	Hänert	Ove
29	Schiffsmechanikerin Maschine	Multi Purpose Rating Engine	Klinger	Dana
30	Schiffsmechanikerin Maschine	Multi Purpose Rating Engine	Schneider	Denise
31	Schiffsmechaniker Maschine	Multi Purpose Rating Engine	Dethloff	Michael
32	1. Koch	1st Cook	Hofmann	Werner
33	2. Köchin	2nd Cook	Hammelmann	Louisa
34	2. Köchin	2nd Cook	Dietrich	Emilia Felizitas Ilse Lieselotte
35	1. Stewardess	1st Steward	Pieper	Daniel
36	2. Steward	2nd Steward	Dibenau	Torsten
37	2. Stewardess	2nd Stewardess	Möhle	Steffi
38	2. Stewardess / Krankenschwester	2nd Stewardess / Nurse	Schwantes	Andrea
39	2. Steward / Wäscherei	2nd Steward / Laundry	Arendt	Rene
40	2. Steward / Wäscherei	2nd Steward / Laundry	Cheng	Qi
41	2. Steward / Wäscherei	2nd Steward / Laundry	Chen	Dansheng
42	Auszubildender Schiffsmechaniker	Apprentice Multi Purpose Rating	Liedtke	Mattes
43	Supern.	Supern.	Samland	Silvia

A.4 STATIONSLISTE / STATION LIST PS151

Station list of expedition PS151 from Bremerhaven – Tromsø; the list details the action log for all stations along the cruise track.
See https://www.pangaea.de/expeditions/events/PS151 to display the station (event) list for expedition PS151.
This version contains Uniform Resource Identifiers for all sensors listed under https://sensor.awi.de. See https://www.awi.de/en/about-us/service/computing-centre/data-flow-framework.html for further information about AWI's data flow framework from sensor observations to archives (O2A).

Event label	**Optional label**	**Date/Time**	**Latitude**	**Longitude**	**Depth [m]**	**Gear**	**Action**	**Comment ***
PS151-track		2025-11-13T11:00:00	53.56374	8.55616		CT	Station start	Bremerhaven - Walvis Bay
PS151-track		2025-12-12T05:06:44	-22.85366	14.49249		CT	Station end	Bremerhaven - Walvis Bay
PS151_0_Underway-1		2025-11-13T17:30:00	53.56374	8.55616		SWEAS	max depth	no end action defined in Dship
PS151_0_Underway-2		2025-11-13T17:30:00	53.56374	8.55616		NEUMON	Station start	
PS151_0_Underway-2		2025-12-11T14:04:22	-22.92889	11.80826	2990.2	NEUMON	Station end	
PS151_0_Underway-3		2025-11-16T12:05:05	50.89208	1.12210	24.2	TSG	Station start	
PS151_0_Underway-3		2025-12-11T14:04:22	-22.92889	11.80826	2990.2	TSG	Station end	
PS151_0_Underway-4		2025-11-16T12:05:56	50.89031	1.11875	25.3	TSG	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_0_Underway-4		2025-12-11T14:04:22	-22.92889	11.80826	2990.2	TSG	Station end	
PS151_0_Underway-5		2025-11-16T12:06:45	50.88867	1.11556	25.1	SNDVELPR	Station start	
PS151_0_Underway-5		2025-12-11T14:04:08	-22.92891	11.80749	2991.4	SNDVELPR	Station end	
PS151_0_Underway-6		2025-11-16T13:26:22	50.73787	0.78574	25.6	FBOX	Station start	
PS151_0_Underway-6		2025-12-11T14:04:22	-22.92889	11.80826	2990.2	FBOX	Station end	
PS151_0_Underway-7		2025-11-16T13:27:36	50.73566	0.78057	25.5	pCO2	Station start	
PS151_0_Underway-7		2025-12-11T14:04:08	-22.92891	11.80749	2991.4	pCO2	Station end	
PS151_0_Underway-8		2025-11-17T09:12:50	49.32337	-4.66509	84.2	ADCP	Station start	
PS151_0_Underway-8		2025-12-11T14:04:08	-22.92891	11.80749	2991.4	ADCP	Station end	
PS151_0_Underway-9		2025-11-17T08:39:05	49.37730	-4.52120	80.3	DS3	Station start	Event shows start/end point (date/time & coordinates) of first/last data record using Atlas Hydrographic Hydrosweep DS 3 multibeam echo sounder during cruise PS151

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_0_Underway-9		2025-12-11T13:56:32	-22.92900	11.78230	2990.2	DS3	Station end	Event shows start/end point (date/time & coordinates) of first/last data record using Atlas Hydrographic Hydrosweep DS 3 multibeam echo sounder during cruise PS151
PS151_1-1		2025-11-17T19:40:50	48.47205	-7.30476	148.2	BUCKET	Station start	
PS151_1-1		2025-11-17T19:43:15	48.47139	-7.31072	149.4	BUCKET	Station end	
PS151_1-2		2025-11-17T19:44:11	48.47107	-7.31309	149.4	XBT	Station start	
PS151_1-2		2025-11-17T20:04:57	48.46439	-7.36106	122.7	XBT	Station end	
PS151_1-3		2025-11-17T19:56:56	48.46683	-7.34340	129.9	BUCKET	Station start	
PS151_1-3		2025-11-17T19:57:40	48.46657	-7.34502	130.4	BUCKET	Station end	
PS151_2-1		2025-11-18T02:35:36	47.92981	-8.66076	2018.4	CTD-RO	max depth	
PS151_2-2		2025-11-18T03:57:27	47.92985	-8.66100	2013	WP2	Station start	
PS151_2-2		2025-11-18T04:17:28	47.92954	-8.66155	2029.4	WP2	Station end	
PS151_3-1		2025-11-18T18:30:13	45.45382	-10.20735		BUCKET	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_3-1		2025-11-18T18:33:38	45.44926	-10.20996		BUCKET	Station end	
PS151_3-2		2025-11-18T18:34:41	45.44819	-10.21064		XBT	Station start	
PS151_3-2		2025-11-18T18:43:20	45.43753	-10.21710		XBT	Station end	
PS151_4-1		2025-11-19T08:09:15	43.49952	-11.62919		CTD-RO	max depth	Test; 4993m
PS151_5-1		2025-11-19T15:37:09	42.55372	-11.85243		BUCKET	Station start	
PS151_5-1		2025-11-19T15:39:45	42.54986	-11.85337		BUCKET	Station end	
PS151_5-2		2025-11-19T15:40:27	42.54881	-11.85370		XBT	Station start	
PS151_5-2		2025-11-19T15:49:45	42.53435	-11.85789		XBT	Station end	
PS151_6-1		2025-11-20T13:43:36	38.43404	-13.11297	4596.4	BUCKET	Station start	
PS151_6-1		2025-11-20T13:45:45	38.43112	-13.11392	4597.9	BUCKET	Station end	
PS151_6-2		2025-11-20T13:46:18	38.43036	-13.11415	4597.9	XBT	Station start	
PS151_6-2		2025-11-20T13:54:36	38.41817	-13.11726	4606.3	XBT	Station end	
PS151_7-1		2025-11-21T11:39:46	35.49868	-13.85698	4781.6	CTD-RO	max depth	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_7-2		2025-11-21T14:04:18	35.49916	-13.85622	4782.8	WP2	Station start	
PS151_7-2		2025-11-21T14:45:27	35.49460	-13.85427	4822.6	WP2	Station end	
PS151_7-3		2025-11-21T14:34:08	35.49935	-13.85547	4783.2	SD	Station start	
PS151_7-3		2025-11-21T14:42:25	35.49986	-13.85467	4783.4	SD	Station end	
PS151_8-1		2025-11-21T16:05:17	35.25241	-13.97183	4192.1	BUCKET	Station start	
PS151_8-1		2025-11-21T16:09:31	35.24621	-13.97461	4177.5	BUCKET	Station end	
PS151_8-2		2025-11-21T16:24:36	35.20318	-13.99551	4254.6	XBT	Station start	
PS151_8-2		2025-11-21T16:40:16	35.18094	-14.00729	4257.6	XBT	Station end	
PS151_9-1		2025-11-22T13:57:54	31.07550	-14.85639	3899.5	BUCKET	Station start	
PS151_9-1		2025-11-22T14:00:27	31.07166	-14.85690	3895.3	BUCKET	Station end	
PS151_9-2		2025-11-22T14:01:18	31.07037	-14.85706	3894.8	XBT	Station start	
PS151_9-2		2025-11-22T14:07:27	31.06039	-14.85831	3880.3	XBT	Station end	
PS151_10-1		2025-11-22T20:08:20	29.99676	-15.00062	3271	CTD-RO	max depth	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_11-1		2025-11-24T11:14:48	25.32157	-18.08357		BUCKET	Station start	
PS151_11-1		2025-11-24T11:19:55	25.31573	-18.09045		BUCKET	Station end	
PS151_11-2		2025-11-24T11:20:18	25.31529	-18.09098		XBT	Station start	
PS151_11-2		2025-11-24T11:27:15	25.30756	-18.10013		XBT	Station end	
PS151_12-1		2025-11-25T08:23:21	22.49769	-20.58340	4184.8	BUCKET	Station start	
PS151_12-1		2025-11-25T08:26:40	22.49230	-20.58417	4184.5	BUCKET	Station end	
PS151_12-2		2025-11-25T08:27:15	22.49132	-20.58434	4187.6	XBT	Station start	
PS151_12-2		2025-11-25T08:39:07	22.47199	-20.58798	4182.3	XBT	Station end	
PS151_13-1		2025-11-26T08:31:55	18.29715	-20.82323	3093.8	BUCKET	Station start	
PS151_13-1		2025-11-26T08:35:36	18.29107	-20.82279	3091.4	BUCKET	Station end	
PS151_13-2		2025-11-26T08:36:16	18.28992	-20.82276	3090.3	XBT	Station start	
PS151_13-2		2025-11-26T08:44:54	18.27603	-20.82249	3101.5	XBT	Station end	
PS151_14-1		2025-11-27T07:37:21	14.55553	-20.98509	4248	CTD-RO	max depth	4226m

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_14-2		2025-11-27T09:36:19	14.55578	-20.98609	4248.9	WP2	Station start	
PS151_14-2		2025-11-27T10:07:06	14.55735	-20.98621	4250	WP2	Station end	
PS151_14-3		2025-11-27T09:43:26	14.55606	-20.98609	4248.8	BUCKET	Station start	
PS151_14-3		2025-11-27T09:45:30	14.55625	-20.98596	4249	BUCKET	Station end	
PS151_14-4		2025-11-27T10:07:26	14.55732	-20.98627	4249.8	SD	Station start	
PS151_14-4		2025-11-27T10:13:29	14.55728	-20.98687	4249.3	SD	Station end	
PS151_14-5		2025-11-27T10:21:18	14.55312	-20.98543	4245.7	XBT	Station start	
PS151_14-5		2025-11-27T10:30:43	14.53771	-20.98527	4250.7	XBT	Station end	
PS151_15-1		2025-11-28T08:17:58	10.60886	-20.13727	4858	BUCKET	Station start	
PS151_15-1		2025-11-28T08:25:19	10.59845	-20.13090	4863.3	BUCKET	Station end	
PS151_15-2		2025-11-28T08:25:47	10.59779	-20.13054	4860.4	XBT	Station start	
PS151_15-2		2025-11-28T08:32:51	10.58736	-20.12500	4856.1	XBT	Station end	
PS151_16-1		2025-11-28T22:00:00	8.47979	-19.46727	4494.6	CTD-RO	max depth	4476m

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_16-2		2025-11-29T00:00:36	8.47985	-19.46692	4495.9	WP2	Station start	
PS151_16-2		2025-11-29T00:22:27	8.48027	-19.46604	4496.7	WP2	Station end	
PS151_17-1		2025-11-29T07:15:20	7.59519	-18.78639	4569.7	BUCKET	Station start	
PS151_17-1		2025-11-29T07:21:09	7.58897	-18.79277	4561.3	BUCKET	Station end	
PS151_17-2		2025-11-29T07:21:57	7.58829	-18.79353	4562.7	XBT	Station start	
PS151_17-2		2025-11-29T07:29:07	7.58070	-18.80192	4553	XBT	Station end	
PS151_18-1		2025-11-30T15:32:36	2.81814	-16.42452	4843.4	BUCKET	Station start	
PS151_18-1		2025-11-30T15:37:27	2.81333	-16.43107	4829.3	BUCKET	Station end	
PS151_18-2		2025-11-30T15:38:09	2.81271	-16.43191	4830.7	XBT	Station start	
PS151_18-2		2025-11-30T15:45:09	2.80606	-16.44116	4806	XBT	Station end	
PS151_19-1		2025-12-01T11:53:33	0.00014	-15.00163	3775.3	CTD-RO	max depth	3747m
PS151_19-2		2025-12-01T13:36:45	0.00051	-15.00178	3776	WP2	Station start	
PS151_19-2		2025-12-01T14:04:45	0.00086	-15.00252	3775.8	WP2	Station end	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_19-3		2025-12-01T15:31:27	0.00019	-15.00223	3776.3	XBT	Station start	
PS151_19-3		2025-12-01T15:37:45	0.00010	-15.00215	3775.5	XBT	Station end	
PS151_19-4		2025-12-01T15:45:45	0.00144	-15.00040	3775.4	XBT	Station start	
PS151_19-4		2025-12-01T15:54:36	0.00820	-14.99629	3766.6	XBT	Station end	
PS151_19-5		2025-12-01T15:57:18	0.01112	-14.99482	3766.6	XBT	Station start	
PS151_19-5		2025-12-01T16:03:45	0.01807	-14.99109	328.9	XBT	Station end	
PS151_19-6		2025-12-01T16:07:25	0.02199	-14.98700	3761.8	ARGOFL	Station start	
PS151_19-6		2025-12-01T16:16:43	0.03362	-14.97392	3763.9	ARGOFL	Station end	
PS151_20-1		2025-12-01T19:17:59	-0.20213	-14.62360	4181.8	BUCKET	Station start	
PS151_20-1		2025-12-01T19:20:03	-0.20474	-14.62452	4135.9	BUCKET	Station end	
PS151_20-2		2025-12-01T19:20:58	-0.20577	-14.62490	4109.6	XBT	Station start	
PS151_20-2		2025-12-01T19:27:07	-0.21496	-14.62881	3711	XBT	Station end	
PS151_21-1		2025-12-02T21:05:16	-2.72338	-11.08907	3982.5	BUCKET	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_21-1		2025-12-02T21:09:21	-2.72930	-11.09155	3836.3	BUCKET	Station end	
PS151_21-2		2025-12-02T21:09:54	-2.73016	-11.09196	3821.7	XBT	Station start	
PS151_21-2		2025-12-02T21:15:28	-2.73848	-11.09600	3732.7	XBT	Station end	
PS151_22-1		2025-12-03T22:21:23	-4.87658	-7.42810	4012	BUCKET	Station start	
PS151_22-1		2025-12-03T22:24:57	-4.88170	-7.42999	3992.9	BUCKET	Station end	
PS151_22-2		2025-12-03T22:25:50	-4.88303	-7.43060	3990.9	XBT	Station start	
PS151_22-2		2025-12-03T22:32:03	-4.89269	-7.43479	3979.7	XBT	Station end	
PS151_23-1		2025-12-04T22:37:46	-6.97850	-4.19973	4749.6	CTD-RO	max depth	4722m
PS151_23-2		2025-12-05T00:41:36	-6.97929	-4.19917	4733.7	ARGOFL	Station start	
PS151_23-2		2025-12-05T00:49:09	-6.98186	-4.19473	4646.6	ARGOFL	Station end	
PS151_24-1		2025-12-05T12:31:09	-8.11464	-2.50137	4948	WP2	max depth	no end action defined in Dship
PS151_24-3		2025-12-05T12:52:09	-8.11494	-2.50136		SD	max depth	no end action defined in Dship
PS151_24-2		2025-12-05T12:52:36	-8.11492	-2.50135		BUCKET	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_24-2		2025-12-05T12:58:45	-8.11478	-2.50123		BUCKET	Station end	
PS151_24-4		2025-12-05T13:03:45	-8.11632	-2.49890		XBT	max depth	no end action defined in Dship
PS151_25-1		2025-12-05T23:56:36	-9.25726	-0.99643	5154.6	BUCKET	Station start	
PS151_25-1		2025-12-05T23:59:18	-9.25347	-0.99439	5119.8	BUCKET	Station end	
PS151_25-2		2025-12-06T00:00:09	-9.25251	-0.99355	5116.3	XBT	Station start	
PS151_25-2		2025-12-06T00:08:27	-9.24128	-0.98533	5114.5	XBT	Station end	
PS151_26-1		2025-12-06T09:46:17	-9.99990	0.00007	5615.2	CTD-RO	max depth	5586m
PS151_26-2		2025-12-06T12:04:27	-9.99950	0.00072	5617.7	WP2	Station start	
PS151_26-2		2025-12-06T12:25:36	-9.99972	0.00081	5618.8	WP2	Station end	
PS151_26-3		2025-12-06T12:26:45	-9.99971	0.00083	5619.1	SD	Station start	
PS151_26-3		2025-12-06T12:30:18	-9.99980	0.00094	5616.5	SD	Station end	
PS151_26-4		2025-12-06T12:33:27	-10.00026	0.00286	5616.2	ARGOFL	Station start	
PS151_26-4		2025-12-06T12:38:54	-10.00266	0.01049	5625.4	ARGOFL	Station end	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_27-1		2025-12-07T02:42:24	-11.98108	1.28284	5600.8	BUCKET	Station start	
PS151_27-1		2025-12-07T02:47:08	-11.98673	1.27672	5599.1	BUCKET	Station end	
PS151_27-2		2025-12-07T02:49:08	-11.98781	1.27487	5596.6	XBT	Station start	
PS151_27-2		2025-12-07T02:58:11	-11.99514	1.26381	5600	XBT	Station end	
PS151_28-1		2025-12-08T07:53:37	-15.66410	3.54454	5520.8	WP2	Station start	
PS151_28-1		2025-12-08T08:23:33	-15.66413	3.54435	5521.8	WP2	Station end	
PS151_28-2		2025-12-08T08:24:55	-15.66421	3.54438	5522.8	BUCKET	Station start	
PS151_28-2		2025-12-08T08:28:29	-15.66341	3.54588	5522.4	BUCKET	Station end	
PS151_28-3		2025-12-08T08:29:58	-15.66205	3.54795	5520.1	XBT	Station start	
PS151_28-3		2025-12-08T08:37:28	-15.65567	3.55806	5522.8	XBT	Station end	
PS151_29-1		2025-12-09T09:54:28	-19.39334	5.69111	5162.4	WP2	Station start	
PS151_29-1		2025-12-09T10:15:09	-19.39230	5.69065	5159.1	WP2	Station end	
PS151_29-2		2025-12-09T10:16:09	-19.39224	5.69053	5159.9	SD	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_29-2		2025-12-09T10:19:36	-19.39206	5.69030	5159.9	SD	Station end	
PS151_29-3		2025-12-09T10:20:18	-19.39202	5.69027	5166	BUCKET	Station start	
PS151_29-3		2025-12-09T10:24:36	-19.39184	5.69024	5161.3	BUCKET	Station end	
PS151_29-4		2025-12-09T10:27:54	-19.39101	5.69216	5165	XBT	Station start	
PS151_29-4		2025-12-09T10:35:45	-19.38322	5.70324	5166.3	XBT	Station end	
PS151_30-1		2025-12-09T19:17:48	-20.25008	6.35018	4733.6	CTD-RO	max depth	4698m
PS151_30-2		2025-12-09T21:21:30	-20.25052	6.35013	4732.9	ARGOFL	Station start	
PS151_30-2		2025-12-09T21:33:29	-20.24942	6.35827	4779.7	ARGOFL	Station end	
PS151_31-1		2025-12-10T09:25:47	-21.69955	7.80004	3164.3	WP2	Station start	
PS151_31-1		2025-12-10T09:56:15	-21.69870	7.79846	3169.5	WP2	Station end	
PS151_31-2		2025-12-10T09:56:40	-21.69871	7.79845	3170.2	BUCKET	Station start	
PS151_31-2		2025-12-10T10:00:27	-21.69884	7.79843	3164.5	BUCKET	Station end	
PS151_31-3		2025-12-10T10:04:54	-21.70210	7.80072	3149.3	XBT	Station start	

Event label	Optional label	Date/Time	Latitude	Longitude	Depth [m]	Gear	Action	Comment *
PS151_31-3		2025-12-10T10:12:00	-21.71169	7.80802	3095.9	XBT	Station end	
PS151_32-1		2025-12-11T02:03:14	-22.99976	9.69967	4273.2	CTD-RO	max depth	4250m

**Comments are limited to 130 characters. See https://www.pangaea.de/expeditions/events/PS151 to show full comments in conjunction with the station (event) list for expedition PS151.*

Abbreviation	Method/Device
ADCP	Acoustic Doppler Current Profiler
ARGOFL	Argo float
BUCKET	Bucket water sampling
CT	Underway cruise track measurements
CTD-RO	CTD/Rosette
DS3	Swath-mapping system Atlas Hydrosweep DS-3
FBOX	FerryBox
NEUMON	Neutron monitor
SD	Secchi disk
SNDVELPR	Sound velocity probe
SWEAS	Ship Weather Station
TSG	Thermosalinograph
WP2	WP-2 towed closing plankton net
XBT	Expendable bathythermograph
pCO2	pCO2 sensor

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