METEOR-Berichte

Trans-Atlantic Equatorial cruise II

Cruise No. M181

April 17 – May 28, 2022
Cape Town (South Africa) – Mindelo (Cape Verde)
TRATLEQ 2

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Table of Content

1 Cruise Summary

1.1 Summary in English

The Transatlantic Equatorial Cruise II (TRATLEQ II) was an interdisciplinary cruise focusing on upwelling in the tropical Atlantic. Main topics were the physical forcing of upwelling, its importance for biological production and plankton communities, associated chemical cycles, as well as the current system setting the background conditions for the downward carbon export. TRATLEQ II is the second cruise extending over the whole equatorial section from the eastern to the western boundary. In contrast to the first cruise (TRATLEQ I) that took place shortly after maximum equatorial upwelling (M158, Sep./Oct. 2019), TRATLEQ II was aimed to cover the period before to onset of enhanced equatorial upwelling. TRATLEQ II is a contribution to the GEOMAR research program OCEANS, the EU project TRIATLAS, the „Make Our Planet Great Again" project by R. Kiko and the BMBF cooperative project BANINO.

Beside the equatorial Atlantic, another study area was the coastal upwelling off Angola, where the same techniques were applied to better understand the functioning of this tropical upwelling system. A particular focus was on the export flux of carbon to mesopelagic and bathypelagic depths associated with particle flux and diel vertical zooplankton migration. Physical ocean dynamics are studied by hydrographic, current and microstructure measurements. The measurements were aimed to improve our understanding of upper ocean mixing processes and to quantify ventilation and water mass exchange between the western and the eastern boundary. The measurement program also includes the service of the long-term mooring off Angola, 11°S.

1.2 Zusammenfassung

Die „Transatlantische Äquatoriale Forschungsfahrt II" (TRATLEQ II) konzentrierte sich mit interdisziplinären Arbeiten auf ein besseres Verständnis von ozeanischem Auftrieb. Der Fokus lag dabei auf dem physikalischen Antrieb des Auftriebs, seiner Bedeutung für die biologische Produktivität und die Planktongemeinschaften, den mit ihm verbundenen chemischen Umsatzraten, sowie dem Strömungssystem, das die Hintergrundbedingungen für den Kohlenstoffexport in die Tiefe setzt. TRATLEQ II war die zweite Fahrt, die sich über den gesamten atlantischen Äquator vom östlichen bis zum westlichen Rand erstreckt. Im Gegensatz zur ersten Fahrt (TRATLEQ I), die kurz nach maximalem äquatorialem Auftrieb stattfand (M158, Sep./Okt. 2019), hat TRATLEQ II den Zeit-raum vor dem Einsatz des äquatorialen Auftriebs erfasst. TRATLEQ II trägt zum GEOMAR Forschungsprogramm OCEANS, zum EU-Projekt TRIATLAS, zum „Make Our Planet Great Again" Projekt von R. Kiko und zum BMBF Verbundprojekt BANINO bei.

Neben dem äquatorialen Atlantik wurde auch das Küstenauftriebsgebiet vor Angola untersucht. Ein besonderer Schwerpunkt war die Untersuchung des Kohlenstoffexports in größere Tiefen aufgrund von Teilchentransport und täglicher vertikaler Zooplanktonmigration. Die physikalische Ozeandynamik wurde mit hydrographischen, Strömungs- und Mikrostrukturmessungen studiert. Diese Messungen dienen dem besseren Verständnis oberflächennaher Vermischungsprozesse und sollen eine Quantifizierung der Ventilation und des Wassermassenaustauschs zwischen westlichem und östlichem Rand erlauben. Das Messprogramm beinhaltete auch den Tausch der Langzeitverankerungen vor Angola bei 11°S.

2 Participants

2.1 Principal Investigators

Name	Institution
Brandt, Peter, Prof.	GEOMAR
Kiko, Rainer, Dr.	GEOMAR

2.2 Scientific Party

No.	Name	Discipline	Institution
1	Brandt, Peter, Prof.	PO, chief scientist	GEOMAR
2	Bam, Wokil, Dr.	CO, thorium	WHOI
3	Czeschel, Rena, Dr.	PO, CTD, LADCP, VMADCPs	GEOMAR
4	Damke, Paula	PO, CTD, salinometer	GEOMAR
5	Deulofeu Capo, Ona	BO, DOM, cDOM, POC, POP, prokaryots	ICM
6	Dölger, Emma	CH, oxygen	GEOMAR
7	Fernández Carrera, Ana, Dr.	BO, nitrogen fixation, nutrients, C uptake	IOW
8	Gasser, Beat, Dr.	BO, thorium	IAEA
9	Gómez Letona, Markel	BO, DOM, cDOM, POC, POP, prokaryots	ULPGC
10	Hans, Anna Christina	PO, CTD, drifter, buoy	GEOMAR
11	Imbol Koungue, Rodrigue Anicet, Dr.	PO, CTD, mooring	GEOMAR
12	Jordan, Tine	BO, UVP, multinet, zooplankton	LOV/GEOMAR
13	Körner, Mareike	PO, CTD, microstructure, MVP	GEOMAR
14	Krahmann, Gerd, Dr.	PO, CTD, LADCP, salinometer	GEOMAR
15	Müller, Mario	PO, CTD, technique, MVP	GEOMAR
16	Navarro Ariza, Wendy Paola, Dr.	PO, marine radar, drifters	HEREON
17	Olbricht, Hannah	PO, CTD, technique, microstructure	GEOMAR
18	Prigent, Arthur, Dr.	PO, CTD, surface drifter	GEOMAR
19	Roch, Marisa	PO, CTD, salinometer	GEOMAR
20	Rupf, Franziska	PO, CTD, microstructure	GEOMAR
21	Sarmiento L., Airam Nauzet	BO, AZFP, Multinet	ULPGC
22	Schmidt, Ina	BO, nitrogen fixation, nutrients	IOW/GEOMAR
23	Steckhan, Luisa	CO, N_2O, underway trace gases	GEOMAR
24	Stelzner, Martin	ME, weather	DWD
25	Subramaniam, Ajit, Prof.	BO, bio-optics, phytoplankton	LDEO
26	Theileis, Anton	BO, technique, PISCO	GEOMAR
27	Witt, René	PO, CTD, technique, mooring	GEOMAR
28	Bittencourt, Liana Pacheco	Observer	Brazilian Navy

PO: Physical Oceanography, CO: Chemical Oceanography, BO: Biological Oceanography, ME: Meteorology

2.3 Participating Institutions

DWD	Deutscher Wetterdienst, Germany
GEOMAR	GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
HEREON	Helmholtz-Zentrum Hereon, Geesthacht, Germany.
IAEA	International Atomic Energy Agency, Monaco, France.
ICM	Institute of Marine Sciences, CSIC, Barcelona, Spain
IOW	Leibniz-Institut für Ostseeforschung Warnemünde, Rostock, Germany.
LDEO	Lamont Doherty Earth Observatory at Columbia University, USA.

LOV	Laboratoire d'Océanographie de Villefranche, France.
ULPGC	University of Las Palmas de Gran Canaria, Spain.
WHOI	Woods Hole Oceanographic Institution, Woods Hole, USA.

3 Research Program

3.1 Description of the Work Area

The research program of TRATLEQ II (Fig. 3.1) covered two main research areas that are 1) the tropical Angolan upwelling system (tAUS) and 2) the equatorial Atlantic. Focus areas were the 11°S section off Angola and the whole equatorial section from 2°E to 44°45'W. Additional measurements were performed underway and at a few CTD stations along the cruise track from Cape Town to 11°S and from 11°S to the first station on the equatorial section at 2°E. No measurements could be performed in the territorial waters of Namibia, the Democratic Republic of the Congo and Equatorial Guinea. The work in tAUS was during the main downwelling season with low biological productivity. The equatorial section covered the region of the Atlantic cold tongue that represents the equatorial upwelling system east of 23°W and the western equatorial Atlantic characterized by warmer surface waters and deeper mixed layer depths. The equatorial upwelling was in its weakest phase before its onset with the whole equatorial Atlantic covered by warm surface waters close to 28°C.

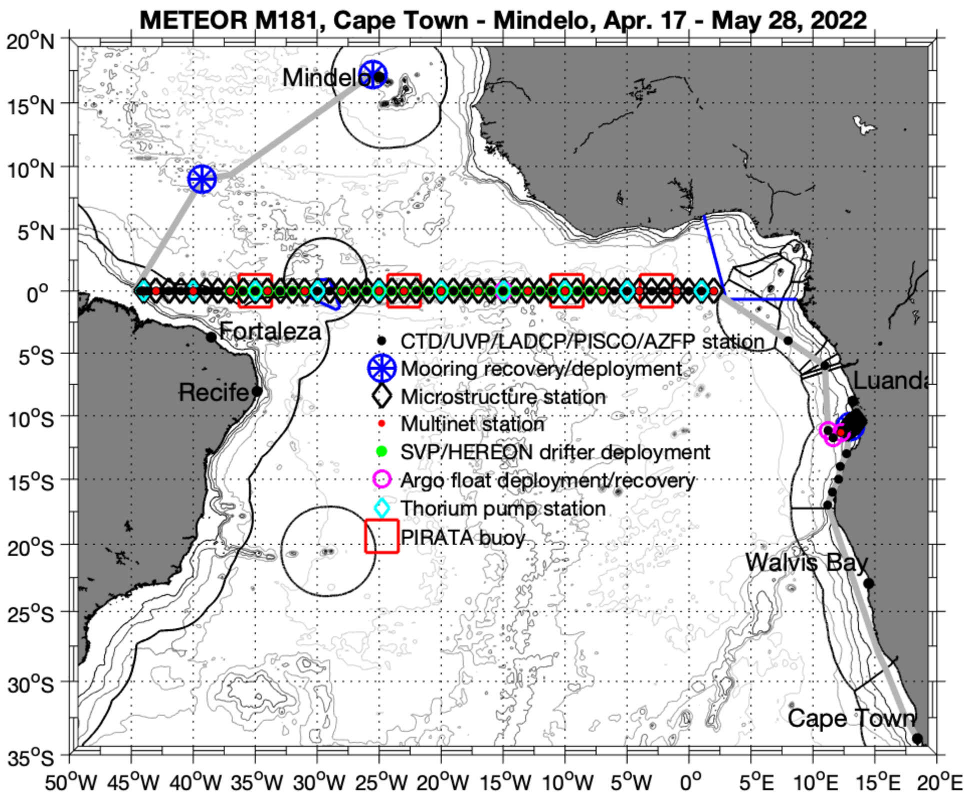

Fig. 3.1 Bathymetric map with cruise track of R/V METEOR cruise M181 (grey solid line) including locations of CTD/UVP/LADCP/PISCO/AZFP stations, mooring recoveries and redeployments, microstructure and multinet stations, thorium pump stations and locations of drifter and float deployments. Territorial waters of different countries are marked with thin black solid lines. High-risk area for piracy in the Gulf of Guinea and the environmentally protected area of Saint Peter and Saint Paul archipelago are marked by blue lines.

3.2 Aims of the Cruise

TRATLEQ II was an interdisciplinary cruise focusing on upwelling in the tropical Atlantic, its physical forcing, its importance for biological production and plankton communities, associated chemical cycles, as well as on the current system setting the background conditions for the downward carbon export. Similar to TRATLEQ I carried out in September/October 2019, this cruise covers the whole equatorial section from the eastern to the western boundary and from the surface to the bottom. A general aim of the two research cruises, which were carried out during two different phases of the equatorial upwelling system (warm and cold phase), was to assess the status of the southeast and equatorial Atlantic marine ecosystem, to identify its physical drivers and the impact of climate variability and change. A central question was which role does circulation and mixing play for the development of phytoplankton and zooplankton communities and specifically how variable (regionally and seasonally) is the export flux of carbon to mesopelagic and bathypelagic depths associated with particle flux and diel vertical zooplankton migration.

3.3 Agenda of the Cruise

The measurement program of TRATLEQ II included the section work along 11°S off Angola with the mooring service at 10°50'S, 13°E and along the equator starting at 2°E outside of the exclusive economic zone of Equatorial Guinea and ending at 44°45'W on the Brazilian shelf. Additional mooring and instrument recoveries were performed on request on the way to Mindelo, Cape Verde. Observations along the sections included full-depth station work with the CTD system measuring temperature, salinity, pressure, oxygen, nutrients (NOx), turbidity, fluorescence, current velocity with the lowered acoustic Doppler current profilers (LADCP), particle size classes and plankton composition with an underwater vision profiler 5 (UVP5) and the Plankton Imaging with Scanning Optics system (PISCO), as well as backscatter measurements with an acoustic zooplankton and fish profiler (AZFP). Additional station work was carried out with a microstructure profiler measuring turbulent dissipation rates in the upper 120 m, a Hydrobios Multinet Midi for the collection of zooplankton samples in the upper 1000 m, an underwater pump system for thorium measurements, and a spectroradiometer for incoming and outgoing surface radiation. Water samples from the CTD rosette were analyzed for numerous variables including salinity, oxygen, nutrients, N_2O, thorium, dissolved and particulate organic matter, and prokaryotic community. N_2-fixation and primary production rates were determined through incubation of collected seawater. Underway measurements were performed with a Longranger 75-kHz ADCP for velocities in the upper 600 m (the usually used shipboard 75-kHz Ocean Surveyor ADCP failed during the previous cruise and could not be repaired in time), a marine radar for surface currents, the thermosalinograph for near-surface temperature and salinity, the CLASS - a dual laser spectrofluorometer for chlorophyll and phycoerythrin fluorescence, a Planktoscope - an imaging microscope to identify phytoplankton and small zooplankton, and along several sections at the eastern boundary a moving vessel profiler for the continuous measurements of temperature, salinity, and chlorophyll in the upper 25 m. A set of surface drifters (18 15-m SVP and 44 1-m HEREON drifters) and 4 Argo floats were deployed during the cruise as well. With regard to the original cruise proposal all proposed work could be performed except underway measurements of CO_2, N_2O and CO that could not be carried out due to technical problems on board and the usage of the infrared camera that became not available for installation in the CTD rosette.

4 Narrative of the Cruise

On Easter Sunday, 17 April 2022, R/V Meteor departed from the harbor of Cape Town, South Africa at about 18:00. The departure was delayed by a few hours because of the late delivery of scientific equipment including instrumentation needed during our cruise. After the previous cruise this instrumentation had accidentally been packed into containers leaving for Germany and we were lucky that the containers had not yet been cleared by South African customs. All cruise participants arrived well in Cape Town and after an additional COVID-19 test in Cape Town were allowed to go onboard R/V Meteor. Luckily, all cruise participants stayed negative throughout the cruise. Our Angolan observer did not receive his passport with visa for Portugal in time and thus was not able to attend the cruise.

As we had allowance for measurements in the EEZ of South Africa, we switched on the underway measurements after leaving the port of Cape Town. Underway sampling included measurements of temperature, salinity, fluorescence intensity, upper ocean velocity and X-band radar measurements. Unfortunately, the planned underway measurements of trace gases could not be carried out due to a major failure of the trace gas analyzer. Despite various attempts (on-site and remotely), the problem could not be solved and therefore the system had to be disassembled. In order to still acquire information on surface concentrations of nitrous oxide (N_2O) in surface waters, discrete seawater samples were collected regularly (every 6 h) from the ship's seawater supply system (~2 m depth).

We also used the time to test the performance of the Longranger 75-kHz ADCP that was installed in the moon pool during the port stay in Cape Town. Typically, we are relying on the shipboard velocity measurements with the two Ocean Surveyors (75-kHz OS and 38-kHz OS) providing excellent data during previous cruises. Unfortunately, the 75-kHz OS instrument that provides higher vertical resolution data than the 38-kHz OS, failed during cruise M180 and could not be repaired in time. As our focus was on high-resolution velocity measurements near the surface, we decided to use a Longranger 75-kHz ADCPs that had to replace the 38-kHz OS that is normally in the ship's moon pool. Tests showed that the newly installed instrument delivers reliable data, particularly in the upper 250 m. The performance in the deeper layers is, however, reduced compared to the 75-kHz OS.

Measurements had to stop in the Namibian EEZ as we did not submit an application for measurements. The reason was that Namibian authorities required port stops in Namibia before and after a measurement program within the EEZ of Namibia for which no time was reserved in the cruise proposal. On April 21 at 13:00 UTC, we arrived at the EEZ of Angola, where we started our measurement program along the continental slope using the moving vessel profiler (MVP) measuring continuously between CTD stations located on every full degree of latitude. On April 23 at 09:00 UTC, we arrived at the location of our long-term current-meter mooring off Angola. It has been maintained continuously since July 2013. The mooring was recovered without problems and redeployed during the next day. In between station work with CTD and microstructure probe was carried out. Additionally, a freely drifting surface buoy was deployed that measured temporal high-resolution velocity on the shelf for about 1.5 days. After the mooring deployment, we started continuous microstructure measurements close to the coast at 25 m water depth while the ship was heading in an offshore direction. The microstructure measurements were interrupted by regular CTD stations along our long-term hydrographic and velocity repeat section. After the recovery of the drift buoy in the morning of April 25, CTD and microstructure station work continued along the section. Upon reaching the deep ocean with more than 2000 m water depth, we deployed a set of three Argo floats on behalf of the German Hydrographic Office (BSH) and recovered a special biogeochemical Argo float. The recovered Argo float had a UVP installed and was deployed about one year ago during R/V Sonne cruise SO283. Work along the 11°S section ended on April 26 at 15:00 UTC.

On the way toward the equator, we used the MVP to measure the near surface stratification associated with the run-off of the Congo River. Two additional CTD stations within the Congo plume and measurements with the drift buoy complemented the measurement program at the eastern boundary. Measurements were stopped, while passing the EEZs of the Democratic Republic of the Congo and Equatorial Guinea as we did not receive allowance for measurements by these countries.

On April 30 at 03:00 UTC, we arrived at the equator at 2°E just outside of the high-risk area for piracy defined by the German Federal Police Sea. There we started the main work along the trans-Atlantic equatorial section. Work at 2°E included a Zooplankton Multinet station, a CTD station, measurements with the spectroradiometer, MSS measurements and the deployment and recovery of the drift buoy including a 1200-kHz ADCP for near surface velocity shear measurements. Subsequently the station work along the equator was organized as follows: every degree in longitude we had our standard full depth CTD station followed by an MSS station. Additionally, every three degrees in longitude we had a multinet station and every five degrees we had an additional shallow CTD to fulfill the extended need for water samples together with an in-situ pump station for thorium probes. Along the equator we deployed 62 near-surface drifters and one Argo float. We had two different drifters on board, the standard SVP drifters, which drift with the water at 15 m depth and HEREON drifters measuring the velocity in the upper meter. Pairs of drifters were deployed about every 1° longitude between 7°W and 37°W with a reduced resolution toward east and west. The combined drifter data allow us - also in comparison to the surface velocity of the marina radar and the uppermost bin of the shipboard ADCP at about 17 m - to assess the vertical shear of the flow field close to the surface.

While the CTD and data transfer via the cable was very reliable throughout the whole cruise, we had to change the winch several times mostly due to spooling problems. As during the previous cruise, the CTD wire had broken and the attached CTD was lost, a new wire had been spooled onto the winch in the port of Cape Town. In general the new cable on winch #3 worked very well. However, after the deepest station (about 6000 m) in the Romanche Fracture Zone on May 8, the cable was not spooled evenly on the winch drum and we had to switch to winch #12. After some tests and re-spooling, the winches were changed a few times, but finally we decided to use winch #12 until the end of the measurement program. For the multinet and the in-situ pumps, we used winch #2 throughout the cruise without any problems.

Approaching the western boundary starting at 38°W, we decreased the distance between stations to 30’ longitude and close to the continental slope we decreased it further down to 5’ longitude to capture the very narrow boundary currents. Almost at the end of the measurement program after the CTD station at 42°W on May 19 at 09:00 UTC, we noted cracks in the glass of the PISCO system on both sides with some water inside the instrument. The instrument had to be removed from the CTD rosette and was not operable anymore. The last CTD station on the equator at 44°15’W was finished on May 20 at 16:00 UTC. We continued the section along the equator until 44°45’W doing particularly underway velocity measurements to capture also the shallow part of the North Brazil Current. After finishing the equatorial section, we headed north-eastward toward the final destination, the port of Mindelo, Cape Verde. On request of GEOMAR colleagues, we recovered on the way to Mindelo a drifting surface buoy that had become detached from its anchor about two months ago, a malfunctioning wave glider, and the underwater elements of the surface buoy that was still in place at its original mooring position close to the Cape Verdean Island of Santo Antão. We arrived in the port of Mindelo on May 27 at 17:00 UTC.

5 Preliminary Results

5.1 Hydrographic observations

5.1.1 CTD system, oxygen measurements, and calibration
(Gerd Krahmann)

5.1.1.1 CTD-Rosette system

During M181 a total of 91 CTD-profiles and 1906 water samples were collected. The rosette system was installed in a Seabird Rosette System frame for 24 bottles. Most casts were made with 22 bottles installed, except casts made for the calibration of MicroCATs. Depth profiles up to a maximum pressure of 6069 dbar were performed. Deeper profiles were not possible due the maximum depth rating of installed instruments of 6000 m. For the majority of stations, the full water column was sampled. Data acquisition was done using Seabird Seasave software version 7.26.7. Preprocessing was done with SBE Data Processing 7.26.7.

The first CTD profile was collected at instrument test station #1. It was determined that all regular sensors (P,T,S,O) recorded data with sufficient accuracy and no errors were detected. These sensors provided high quality reliable data throughout the cruise. The Chl-fluorescence and turbidity sensor FLNTU manufactured by Wetlabs provided inconsistent and noisy readings during all CTD casts. While the turbidity data appears to be totally unusable, the fluorescence data might be partially usable, albeit with unusually low readings and with a high noise level. A full-depth PAR sensor was attached to the CTD and delivered good measurements throughout the cruise. Concurrent measurements from a Ship-PAR sensor were fed into the CTD deck unit starting with CTD cast 4.

The exact configuration of the CTD system can be found in Table 5.1. Additionally, two self-recording LADCPs, a self-recording, self-powered UVP5, a self-recording nutrient sensor (OPUS or SUNA), a self-recording, self-powered AZFP, and a self-recording, self-powered PISCO were attached to the water sampler. They are described separately in this cruise report.

Table 5.1 Summary of CTD system SBE #9 configuration used during M181.

	CTD system SBE#9
Pressure sensor	# 615
T primary	# 4875
T secondary	# 4831
C primary	# 2512
C secondary	# 2537
O2 primary	SBE 43 # 1312
O2 secondary	SBE 43 # 2590
PAR Sensor	# 70714
Altimeter	# 42299

Processed preliminary CTD data, 5-dbar binned, was sent in near real time to the Coriolis Data Centre in Brest, France, (via email: codata@ifremer.fr) for integration in the databases to be used for operational oceanography applications and the WMO supported GTS/TESAC system.

5.1.1.2 CTD-conductivity calibration

Overall, 171 calibration points were obtained by sampling for salinity. Salinity samples were taken by the CTD watch in 'Flensburger' bottles, which proved to be reliable for storing salt samples over extended times. The limited amount of bottle cases brought along required the washing and reuse of eight boxes. Measurements are described in section 5.1.2. Due to the large number of samples a simple outlier removal method was applied that discharged the largest 33% deviations between CTD and bottle samples prior to calibration. The projection of data taken during the bottle stops of the upcast to the data from the downcast followed World Ocean Circulation Experiment standards and was done by searching within a 30-dbar pressure interval for similar potential temperatures. For the critical loop edit velocity 0.01m/s was used. The final CTD data set is composed from the primary set of sensors for all but the last profiles, though the differences between sensor pairs were marginal. During the last profile oxygen readings at depth made by the primary sensor are slightly off, possibly by particles sucked into the sensor.

The conductivity calibration of the downcast data was performed using a 1^{st} order linear fit with respect to temperature, pressure and conductivity (Table 5.2).

The calibration results in a salinity RMS-misfit for the downcast of order 0.00180 for the primary and 0.00205 for the secondary sensor. The upcast calibration surpasses these values with an RMS-misfit of 0.00171 for the primary and 0.00185 for the secondary sensor.

Table 5.2 End of cruise salinity and pressure summary of downcast calibration information for the CTD system.

	CTD system SBE#9	CTD system SBE#9
Sensor pair	primary	secondary
RMS misfit after calibration - salinity	0.00180	0.00205
Polynomial coefficients - conductivity	Offset: 0.007077 P1: +1.363e-7 T1: +0.00024681 C1: -0.0026752	Offset: +0.0076675 P1: +1.6126e-7 T1: +0.00026648 C1: -0.0029069
Pressure sensor correction (decks-offset)	0.00	0.00

5.1.1.3 Oxygen calibration

The CTD oxygen downcast for CTD systems is calibrated by using the best 66% of the joint data pairs between downcast CTD sensor value and Winkler-titrated oxygen (Section 5.1.3). For the calibration a correction polynomial depending on pressure, temperature, oxygen and the product of pressure and oxygen was fitted (Table 5.3). A total of 221 oxygen data points were used, which resulted in an RMS-misfit for the downcast of 1.4007 µmol kg^{-1} for the primary SBE43 and 1.3937 µmol kg^{-1} for the secondary SBE43. The upcast calibration surpassed these values with an RMS-misfit of 1.2029 µmol kg^{-1} for the primary SBE43 and 1.1801 µmol kg^{-1} for the secondary SBE43.

Table 5.3 End of cruise downcast oxygen summary of calibration information for the CTD system.

	Oxygen Sensor #1312	Oxygen Sensor #2590
Sensor pair	primary	secondary
RMS misfit after calibration - oxygen	1.4007	1.3937
Polynomial coefficients - oxygen	Offset: 4.4455 P1: -0.0022235 T1: -0.022865 O1: 0.029645 P*O: 2.2127e-5	Offset: 8.1729 P1: -0.010384 T1: -0.1633 O1: 0.012685 P*O: 5.8211e-5

5.1.2 Conductivity measurements

(Marisa Roch, Paula Damke)

In order to calibrate the conductivity sensors of the CTD system, the conductivity of 171 water samples was measured using mainly the GEOMAR OPTIMARE Precision Salinometer (OPS) SN 010. However, in the beginning the measurements started with OPS SN 020. Those measurements started to drift away due to unknown reasons. Therefore, the OPS SN 010 was set up and subsequently yielded satisfying measurements.

Prior to measuring the conductivity with the OPS, the bottle samples have to be degassed to remove gas micro-bubbles as the OPS is sensitive to gas bubbles in probes. Salinity samples were taken with Flensburger bottles from the CTD. Once a box of bottles was full, the bottles were taken into a warm water pool of about 40°C for an hour. Then the bottles were shortly opened to degas. Afterwards the sample bottles were brought to the salinity lab where their conductivity could be measured after 24 hours of cooling down to the lab temperature.

The measurement procedure always started by rinsing with old substandard seawater and a test measurement, in order to figure out whether the measurements were stable. This was then followed by the actual standardization with the IAPSO Standard Seawater and a new substandard measurement. Afterwards the measurements of the samples were started. After every tenth sample bottle another substandard was measured. This was done to test whether the instrument is drifting. Mostly the substandard measurements yielded reasonable results. The ending of a measurement series was again followed by another substandard and finalized by re-measuring the remaining Standard Seawater from the standardization in the beginning, which was expected to be slightly higher (0.001-0.002) than the original standard measurement.

At the same time, a comparison between the OPS and Guideline Autosal 7 was done, as in previous cruises deviations between the OPS and Autosal instruments were observed. In order to do that, double samples were taken at each CTD during the 11°S section off Angola. For the Autosal instrument, the data transmission to the computer did not work. Thus, the measurements were collected in handwritten protocols. The Autosal measures the K15*2 and from this the actual salinity can be calculated. The Autosal is sensitive to the room temperature. The instrument's water bath temperature has to be 3-4°C warmer than the surrounding room temperature. At first, the temperature difference between the room and the water baths in the instrument was too small. Hence, the Autosal did not deliver constant measurements. Once the water bath's temperature was set correctly, one of the light bulbs that is heating the water bath broke and had to be exchanged. Whenever something is changed for the Autosal, it needs 24 hours to adapt before the measurements can be continued. In the end, the measurements were fine. However, the number of bottles of the IAPSO Standard Seawater used for standardization did not allow double samples for the entire cruise. Therefore, at some point, the conductivity measurements proceeded with the OPS 010 only.

In addition to the salinity samples from the CTD, several samples from the thermosalinograph (TSG) were also measured. As the OPS 020 showed reasonable values again, both OPTIMARE salinometers were used for the TSG samples.

5.1.3. Oxygen Winkler measurements
(Emma Dölger)

Discrete samples from selected depths were analyzed for oxygen at the majority of the stations. Bubble free samples were taken in 100 ml ground flasks, treated with alkaline sodium iodide and manganese chloride solutions and analyzed within twelve hours after fixation using the Winkler method. In short, the precipitated hydroxides were dissolved with 1 ml sulphuric acid and the liberated iodine was then titrated to a light-yellow color using sodium thiosulfate. Thereafter, a zinc starch solution was added and the titration continued until the blue color disappeared. During the entire cruise five sodium thiosulfate bottles were prepared and used. For each bottle the calibration factor was determined using an OSIL iodate standard, see Table 5.4. In total 309 niskin bottles from 62 CTD profiles were sampled. The respective measurements were used to calibrate the profiling sensor of the CTD.

Table 5.4 Calibration factors of sodium thiosulfate bottles.

Date	Factor
20 April 2022	0.993377483
25 April 2022	0.992720053
02 May 2022	0.992720053
09 May 2022	0.996677741
17 May 2022	0.993377483

5.1.4 Thermosalinograph
(Franziska Rupf)

Underway measurements of sea surface temperature (SST) and sea surface salinity (SSS) were continuously done by the ship's dual thermosalinograph. One inlet is located at the portside (TSG1) while the other thermosalinograph's inlet is at the starboard side (TSG2). The parallel system worked well throughout M181, except for data gaps in the port temperature and salinity data as well as the starboard salinity data along the coast of South Africa. Due to the switch off of scientific measurements in the EEZ of Namibia, Equatorial Guinea and the Democratic Republic of the Congo there are no measurements for these areas either. SSS and SST measured by the TSG system was calibrated with CTD measurements at 5 m, with a resulting rms in SST of 0.01 °C and a resulting rms in SSS of 0.003.

5.1.5 Moving Vessel Profiler

(Mareike Körner, Arthur Prigent)

The Moving Vessel Profiler (MVP) was used for underway profiling of upper ocean temperature, salinity, depth, and chlorophyll. The system, a MVP30-350 manufactured by AML Oceanographic, consisted of a winch with 450 m of 4-conductor tow cable, a winch frame with an outrigger and an attached sheave, and a tow fish. The MVP was installed on the rear port side of the working deck and the MVP controller and laptop were set up in the pulser station. The controller was receiving NMEA position, and ship speed data from R/V METEOR's central data acquisition unit.

The towed fish carried an AML Micro CTD package (SN 9068) composed of conductivity, temperature and pressure Xchange sensors as well as a chlorophyll sensor. One advantage of the MVP system is that the profiling data are continuously visualized and recorded on a laptop on board the research vessel while the system is in use. The nominal operating depth of the MVP depends on the vessel speed. As we used the MVP while steaming with ~11kn the profile depth was around 27 m.

In total 1444 profiles were recorded with the MVP. Information about the different deployments can be found in Table 7.3. We used the MVP when we entered Angolan waters to measure between CTD stations on our way to the 11°S section. On 22 April 2022 we had to pause using the MVP due to issues with the cable. The cable was twisted and the isolation was damaged. We had to cut 125 m of cable. Additionally, we lowered the MVP while the ship stopped to disentangle the cable. After the repairs and after completing the 11°S section we used the MVP for continuous profiling on our way to the equator while staying outside of the EEZs where we had no allowance for measuring.

5.2 Current observations

5.2.1 Vessel mounted ADCP

(Rena Czeschel, Peter Brandt)

Initially it was planned to use both Vessel Mounted Acoustic Doppler Current Profilers (VMADCPs) on RV Meteor during the cruise: a 75-kHz RDI Ocean Surveyor (OS75) mounted in the ship's hull providing measurements in the upper 800 m depth with a high vertical resolution, and a 38-kHz RDI Ocean Surveyor (OS38) placed in the moon pool providing measurements in the upper 1600 m depth but with a lower vertical resolution. Unfortunately, the deck unit of the OS75 broke down during M180 and could not be replaced in time. The easily accessible OS38 was then replaced by a 75-kHz RDI Long Ranger ADCP (LR75) to ensure high resolution current measurements in the upper ocean, which was one important goal during M181. Deep current measurements to the bottom had to be ensured by the lowered ADCPs attached to the CTD rosette.

The LR75 that is usually used for moorings, was installed in the moon pool and tested in the EEZ of South Africa. First tests showed that likely due to backward lobes of the LR75 and associated reflections in the moon pool, the bins close to the transducers were seriously degraded (compared to the OS38). Eventually acoustic noise in the moon pool was successfully reduced by two plastic foam mats fixed with ropes and cable ties on the backside of the LR75. As these mats significantly improved the uppermost bins, we stuck with the plastic foam mats during the whole cruise. They might improve the measurements of the OS38 as well, which remains to be tested.

On 13 May 2022, the LR75 had to be taken up from the moon pool, because the first bin did not show reliable underway measurements anymore. It turned out that the foam mat had come loose. The foam mat was then tightly fixed by two tension belts which worked well for the rest of the cruise.

One serious problem of the LR75 is its weak beamforming compared to the OS38, which causes errors in the current velocities in along-ship direction. The errors appear in case of strongly backscattering layers causing a widening of the beam, which results in a pattern of alternating positive/negative bias above and below the backscatter layer. The error increases with increasing ship speed and with the strength of the reflecting material (such as diurnal vertical migrating zooplankton). The effect is stronger in the along-ship direction than in the across-ship direction. Therefore, only the underway data of the upper 250 m depth are reliable as well as the station data of the upper 700 m depth.

Overall, the LR75 worked well throughout the cruise until the end of the equatorial section with the exception described above. After the end of the equatorial section, the LR75 was replaced by the OS38. Foam mats were again fixed with tension belts on the backside of the OS38 to reduce backscatter noise.

The LR75 continuously performed underway-current measurements of the upper ocean throughout the entire cruise except for the territorial waters of Namibia, Democratic Republic of Kongo, Equatorial Guinea, where we had no allowance for ocean measurements. For the territories of Namibia, we had to stop the record of the VMADCP measurements from 18 April, 19:15 UTC to 21 April, 12:51 UTC. For the territories of the Democratic Republic of Kongo measurements were stopped from 27 April, 15:24 to 17:13 UTC. For the territories of Equatorial Guinea, we had to stop the record of the VMADCP at the end of the coastal section from 28 April, 20:46 UTC to 30 April, 00:10 UTC. The OS38 also worked well until the end of the cruise.

The LR75 was aligned at 45 degrees relative to the ship's center line. It ran in narrowband mode and was configured with 100 bins of 8 m length and a blanking distance of 4 m, pinging 32 times per minute and reaching a range of 600 m (underway) and 700 m (on station).

The OS38 was aligned at 0 degree relative to the ship's center line. It ran in broadband mode and was configured with 100 bins of 16 m length and a blanking distance of 8 m, pinging 21 times per minute and reaching a range of 1000 m. During the entire cruise, the SEAPATH navigation data was of high quality. No interference with the 12-kHz echosounder EM122 that delivered high quality bathymetry data was detected.

Post processing of the data was carried out and the applied mean misalignment angles and amplitude factors with the associated standard deviations are summarized in Table 5.5.

Table 5.5 Vessel mounted ADCP calibration.

period	ADCP	Mode	Misalignment angle ± std	Amplitude factor ± std
21 April 2022 - 13 May 2022	LR75	NB	0.1706 ° ± 0.4881 °	0.9960 ± 0.0109
13 May 2022 - 21 May 2022	LR75	NB	0.2177 ° ± 0.3842 °	0.9943 ± 0.0081
21 May 2022 - 27 May 2022	OS38	BB	-0.1696 ° ± 0.4220 °	1.0043 ± 0.0067

5.2.2 Lowered ADCP

(Gerd Krahmann)

During the whole cruise the CTD/Rosette system was equipped with a lowered ADCP setup based on two Teledyne RDI ADCPs. The setup consisted of an upward looking and a downward looking 300-kHz instrument. These two instruments were mounted inside the CTD rosette with especially manufactured frames protecting the instruments and allowing zero obstruction of the acoustic beams. The LADCP system worked without trouble with SN #24535 as downward-looking master instrument and #24497 as upward-looking slave during the whole cruise. During the cruise we used a software, which controlled the start, stop, download, and erase of the cycles of the two LADCP systems (ladcp_tool_1.9.3f developed at GEOMAR).

A recently developed energy supply system that draws energy for the ADCPs from the CTD system using rechargeable batteries worked perfectly well throughout the cruise.

Data and command transmission between the LADCPs and the LADCP control computer was done using the GEOMAR-developed cable-free connection system. This system is based on commercially available ZigBee wireless data transfer modules. ZigBee modules are available for different operating frequencies. They most commonly use the free 2.4 GHz and 900 MHz bands. Initially our system was based on the 2.4 GHz modules, but this resulted in frequent data transmission dropouts and low transmission rates, in particular when Wifi (operating on the same 2.4 GHz band) usage was high in the vicinity of the CTD-LADCP setup. We later replaced the 2.4 GHz modules with 900 MHz modules which resulted in more stable connections and higher data transfer rates. Nevertheless, we still encountered occasional data transfer problems which required extra downloads initiated by hand.

Data processing took place during the cruise using the GEOMAR LADCP processing software V11.1, which includes both shear and inversion methods to derive an absolute velocity profile. As additional data are necessary for the processing, the corresponding pre-processed CTD files were used containing pressure, temperature and salinity profiles as well as time and navigation data.

The instruments of Teledyne RDI instruments delivered very good deep-ocean velocity profiles when processed in conjunction with the observations of the vessel-mounted ADCP (VMADCP) and when coming close enough to the seafloor to obtain TRDI bottom track data.

5.3 Drifter, floats and drift buoy

(Arthur Prigent, Anna Christina Hans, Wendy Paola Navarro Ariza)

5.3.1 Surface drifters and floats

During M181, different types of drifters and floats were deployed. This includes 44 HEREON (surface) drifters (Table 7.4.1), following the top first meter currents. Simultaneously, two types of Surface Velocity Program (SVP) drifters were deployed (Table 7.4.2): 10 Global Drifter Program (GDP) SVPB buoys measuring the SST as well as the sea-level air pressure and 8 GDP SVP buoys measuring the SST only. These drifters are aimed to follow the currents at 15 m depth thanks to a 'holey sock' drogue. In addition to these drifters following the currents at 1 m and 15 m depth, 4 Arvor-I floats designed for the Argo program were deployed (Table 7.4.3). These profiling floats are measuring temperature, salinity and pressure of the upper 2000 m of the ocean. Finally, one Argo float deployed during SO283 (04/05/2021 10:05 at -10.98˚N 12.78˚E), NKE

PROVOR_V with a UVP6, a backscattering meter, an optode and an ECO sensor (fluorometer) mounted on it was recovered off the coasts of Angola (Table 7.4.4).

The deployment procedures differed for each type. The batteries of the HEREON drifters were connected and their GPS was activated, then the drifters were lowered by a rope at the back of the ship. The SVP drifters were simply thrown in the water as they activate themselves when in contact to sea water. The Argo floats were tested, activated and then deployed using the crane.

5.3.2 Drift buoy

In addition, to the surface drifters, a drift buoy was deployed 11 times at the locations listed in Table 7.4.5. The drift buoy was designed to measure upper ocean current velocities. During the different deployments, it was equipped with different ADCPs. The type of the ADCP and its configuration is listed in Table 7.4.6. Furthermore, a GPS antenna was attached to the buoy. The GPS antenna provided positional data via iridium during the drifts. The ADCPs worked well during the deployment periods. The data were saved in earth coordinates for the 1200-kHz and 600-kHz ACDPs while the data were saved in beam coordinates for the 300-kHz ADCP. The transducers were located about 0.4 m below the sea surface. The drift buoy was lowered in the water using the crane and then released to drift freely. Only during deployment 7, the drift buoy was kept attached to the ship.

5.4 Mooring operations

(Rodrigue Anicet Imbol Koungue, Hannah Olbricht, Mario Müller)

Mooring work during M181 consisted of the servicing of the long-term mooring at the Angolan continental slope at 11°S (Tables 5.6, 7.5). This mooring consists of a Longranger 75-kHz ADCP measuring the strength of the Angola Current as well as hydrographic measurements. Temperature and salinity measurements will be used in combination with the bottom pressure from the PIES to calculate basin-wide density gradients between Brazil and Angola.

On request of our GEOMAR colleagues, we recovered on the way to Mindelo a freely drifting surface buoy (KPO_1247 on GEOMAR 4 on 23 May). The underwater elements of the surface buoy were still in place at its original mooring position close to the Cape Verdean Island of Santo Antão and were recovered on 27 May.

Table 5.6 Mooring operations during M181.

M181 Mooring Recoveries					
Mooring	**New ID**	**Latitude**	**Longitude**	**Deployment Date**	**Recovery Date**
13°E 11°S	KPO_1235	10° 50.05'S	12° 59.93'E	04 May 2021	23 Apr. 2022
VeGas	KPO_1247	17° 11.23'N	25° 36.27'W	26 Feb. 2022	27 May 2022
VeGas	KPO_1247	07° 33.32'N	41° 08.32'W	26 Feb 2022	22 May 2022

M181 Mooring Deployments					
Mooring	**New ID**	**Latitude**	**Longitude**	**Deployment Date**	**Recovery Date**
13°E 11°S	KPO_1246	10° 49.87'S	12° 59.90'E	24 Apr. 2022	
PIES-1200m	KPO_1248	10° 50.46'S	13° 00.25'E	25 Apr. 2022	

5.4.1 Instrument performance

(Rodrigue Anicet Imbol Koungue)

The Angolan mooring (KPO_1235) was successfully recovered on the 23 April 2022. All recovered instruments gave full records except for one Optode and one rotor current meter 11 (RCM 11) which most probably had a set up problem during their deployment, leading to a lower overall instrument performance for all measured parameters (Table 5.7). A summarized description over the performance of all instrument types is given in the following.

Micro-CATs: All 5 Micro-CATs on the 11°S mooring located at about 305 m, 505 m, 705 m, 952 m and 1202 m were collected during the M181 cruise and produced good and clean records with a sampling internal of 30 min.

Oxygen sensors: 2 optode loggers were located on the Angolan mooring at about 305 m and 505 m. Due to a wrong model instrument setting, no data were recorded by the shallow optode throughout the mooring period. However, the deep optode performed well and provided a clean record.

Single point current measurements: The Angola mooring was equipped with 3 RCMs 11 (nominal depths of 654 m, 852 m and 1051 m). All the RCMs 11 performed well and provided complete and clean records except the one at 654 m in which a battery failure occurred and no data were recorded. The RCMs 11 performed with a sampling interval of one hour.

ADCPs: The ADCP located on the Angolan mooring at 11˚S performed well and provided a complete and clean record.

Table 5.7 Instrument performance by sensor type and mooring.

sensor type / mooring	T (%)	C (%)	P (%)	U,V (%)	O_2 (%)	other (%)
KPO_1235	81.0	100	100	75.0	50.0	0
all moorings	**81.0**	**100**	**100**	**75.0**	**50.0**	**0**

5.4.2 Calibration of moored instruments

(Rodrigue Anicet Imbol Koungue)

CTD/O_2 cast calibrations were performed for all MicroCATs and optode loggers either as pre- or post-deployment calibrations (CTD casts 1, 19 and 57) by attaching the instruments to the CTD frame. During each up cast, 6-8 calibration stops were done over the whole profile range (depths chosen at low gradient-regimes for the respective parameters). Each stop had a duration of at least 5 min in order to ensure fully adjusted measurements at the calibration points. Additionally, releaser tests were performed at CTD cast 1. Onboard lab calibrations were conducted for all O_2 loggers in water-filled beakers of 0% and 100% O_2-saturated water at two different temperatures (~5°C and ~24°C) following the Aanderaa Optode manual.

5.5 Shipboard microstructure measurements

(Mareike Körner)

A MSS90-DII microstructure profiler (#073) of Sea and Sun Technology was used to infer turbulent dissipation rate and diapycnal diffusivity, aimed at calculating turbulent fluxes of oxygen, heat, momentum, nutrients, and nitrous oxide (N_2O). The loosely tethered profilers are equipped with 3 airfoil shear sensors (#134, #135, #133) and a fast thermistor, as well as some common CTD sensors: pressure, conductivity, temperature and turbidity sensor. The fall rate of the profilers was adjusted to about 0.55 m/s.

In total, 380 profiles to a maximum depth of 255 m were recorded on 63 MSS stations. Most stations consisted of 3 microstructure profiles following a CTD/LADCP/UVP5/AZFP cast. Off the coast of Angola, we performed a high resolution MSS section by continuously measuring profiles while steaming to the next CTD station with 1 kn. A list of all profiles is given in Table 7.6.

The sensors worked fine throughout the cruise and performed well. However, we had to shorten the cable twice. The first time was during MSS station 11 (24 April 2022, ~20:00 UTC) where the sensors were not sending data anymore. We recovered the MSS Probe and realized that the cable insulations were torn. We cut ~5 m of cable. Afterwards the instrument was working fine again. During the middle of the equator transect we noticed that the cable insulation just above the probe was getting thin again. Thus, we cut another 1m of cable to ensure that the instrument is working. The MSS was working fine till the end of the cruise.

5.6 X-band Radar

(Wendy Paola Navarro Ariza)

During TRATLEQ II a coherent-on-receive X-band marine radar developed at the Helmholtz-Zentrum Hereon was installed on the RV Meteor above the bridge. The radar was operated 24/7 without any failure during the entire cruise, except for the territorial waters of Namibia, Democratic Republic of Kongo and Equatorial Guinea, where we had no allowance for ocean measurements. For Namibia, we switched off the radar from 18 April, 18:00 UTC to 21 April, 13:00 UTC. For the territorial waters of the Democratic Republic of Kongo the radar was stopped on 27 April, from 15:00 to 17:30 UTC. For Equatorial Guinea, the radar was turned off from 28 April, 20:30 UTC to 30 April, 00:30 UTC. Furthermore, the instrument was switched off for short periods, when the crew was working within the vicinity of the radar.

Hereon marine radar was operated in its rotational mode acquiring radar backscatter intensity images within a range of 3.2 km around the vessel every 2 s at a resolution of 7.5 m in range and 0.9° in azimuth. Therefore, the radar image sequences are analyzed with respect to surface wave properties such as wavelength and phase velocity, where the surface current vector results from the difference of the observed phase velocity to that given by the linear dispersion relation of surface gravity waves. The radar images collected during the cruise will be utilized to observe ocean surface features, such as signatures of internal waves, current shear, surface slicks and fronts. Furthermore, these images will be utilized to retrieve surface current fields with a resolution of approximately 500 m. All of the post processing of this extensive radar dataset will be undertaken by the Radar Hydrography Department of Helmholtz-Zentrum Hereon with particular focus on the observation of internal waves along the Angolan coast close to the shelf as well as investigation of the diurnal change of near surface current shear within the equatorial waters. During the cruise, it was possible to identify internal waves in the coast of Angola on 24 April at 13:00 UTC and also in Brazilian waters on 19 May at 10:48 UTC. Some spots of sargassum accumulation were also identified in the radar images collected between 14 to 21 May.

5.7 Biochemical measurements

5.7.1 Underwater Vision Profiler

(Tine Jordan)

During all regular CTD casts, an Underwater Vision Profiler 5 HD (UVP5 HD; serial number 205) was operated on the CTD rosette. The instrument consists of one down-facing HD camera in a 6000-dbar pressure-proof case and two red LED lights which illuminate a 1.24 L-water volume. During the downcast, the UVP5 takes 20 pictures of the illuminated field per second. For each picture, the number and size of particles are counted and stored for later data analysis. Furthermore, images of particles with a size > 500 µm are saved as a separate "Vignettes" - small cut-outs of the original picture – which allow for later, computer-assisted identification of these particles and their grouping into different particle, phyto- and zooplankton classes. Since the UVP5 was integrated in the CTD rosette and interfaced with the CTD sensors, fine-scale vertical distribution of particles and major planktonic groups can be related to environmental data. In total 90 UVP5 profiles could be obtained. At each station with a water depth < 6000 m a full-depth profile was obtained. Further, computer-assisted analysis of the approximately 700000 images taken with the UVP5 will be done in the home laboratory in order to reveal fine-scale distribution patterns of particles and zooplankton.

5.7.2 Plankton imaging with PISCO

(Anton Theileis)

The PISCO is a prototype system for in situ observations of zooplankton. It was developed at the GEOMAR Helmholtz Centre for Ocean Research Kiel and was used on this cruise for the first time in a deep ocean environment up to 6000 m depth. PISCO was integrated in the CTD rosette, and active during all regular CTD profiles until CTD 81 when cracks appeared on both glass windows and water got into the camera. After this the PISCO got dismounted from the CTD rosette and couldn't be used anymore. During the 81 profiles 1.076.000 raw images were recorded. Furthermore, a training dataset from the images was created during the cruise, consisting of 4000 Images with 14000 annotated objects, for further image analysis. The camera itself works like a focused shadowgraph, consisting of a light tube and a camera tube, so it basically records the shadows of the objects. As a novelty a high-speed tunable lens is applied, which makes it possible to focus through a very large sample volume (7.5 cm diameter x 50 cm length "depth-of-field") during a single exposure of 16 µs duration. The optical setup is also optimal for recording transparent organisms, e.g., most gelatinous zooplankton. The system uses a 5120x5120 Monochrome Image Sensor, with a pixel resolution of 12 μm/pixel, achieving an effective maximum optical resolution of ~10.8 LP/mm. This makes it possible to identify and taxonomically classify organisms in the size range from ~300 µm up to several cm (limited by the size of the window) (Fig. 5.1). The camera takes 4 pictures per Second, corresponding to a sample volume of ~8 liter per second during vertical profiles with 1m/s. Detailed analysis of the collected image data will be done back at GEOMAR in Kiel. The aim is to provide data on zooplankton abundance and biomass, its taxonomic composition, and vertical distribution and variability for each of the 81 profiles. Data will also be quantitively compared and combined with data from the UVP5 (see above) and net catches (multi net, see below). This will provide a holistic view of zooplankton communities and their role in the pelagic food web and particle fluxes along the equator.

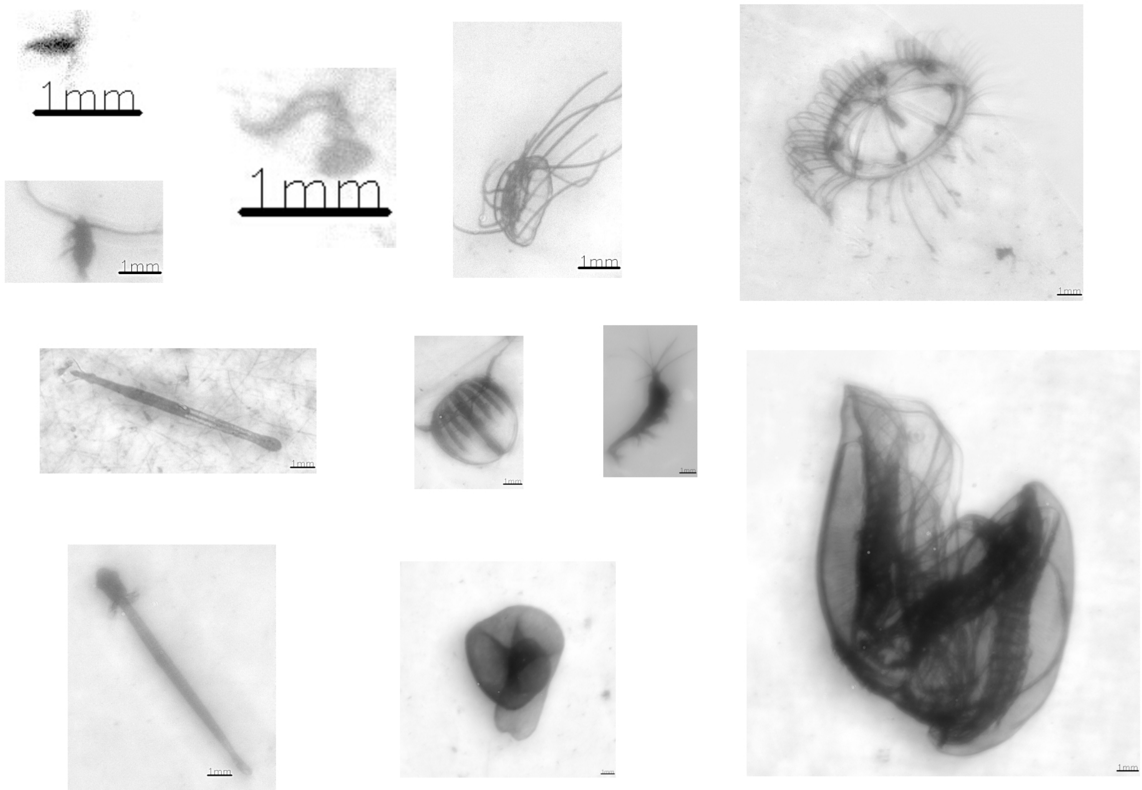

Fig. 5.1 Different zooplankton species captured with PISCO during M181.

5.7.3 Plankton imaging with PlanktoScope

(Ana Fernández Carrera)

The PlanktoScope is an open-hardware, open-software modular throughput microscope developed with the final aim of providing citizen scientists with a high-quality instrument for deepening our knowledge of the ocean (https://www.planktoscope.org/). Plankton samples at surface were taken from the ship's clean seawater supply passing a volume of 100 to 300 L of water through a 21 µm hand net, subsequently concentrated to 150-300 mL and sieved through a 200 µm mesh before analysis in the PlanktoScope. Therefore, the size range of plankton pictured by the instrument was 21 to 200 µm. Samples were taken in 46 stations in Angolan and equatorial waters and one station in the northern subtropical gyre of the Atlantic on the transit to Cape Verde (Table 7.7). Postprocessing of the raw images was done using the Morphocut module included in the instrument OS for extracting the individual organism images (Fig. 5.2). Accurate taxonomic classification will be done ashore in Ecotaxa (https://ecotaxa.obs-vlfr.fr/) to genus level whenever possible.

Fig. 5.2 Unicellular organisms captured with the PlanktoScope during M181: A) puff colony of *Trichodesmium*; B) chain of diatom *Hemiaulus* and trichome of *Trichodesmium*; C) diatom *Cylindrotheca*; D) dinoflagellate *Ceratium*; E) dinoflagellate *Ornithocercus*; F) protozoan belonging to *Radiolaria*.

5.7.4 Acoustic Zooplankton and Fish Profiler

(Airam Nauzet Sarmiento Lezcano)

The Acoustic Zooplankton and Fish Profile (AZFP) was used for monitoring the presence and abundance of zooplankton and fish within the water column by measuring acoustic backscatter. This instrument was mounted on the CTD rosette with the 4 transducers (38, 125, 200 and 455 kHz) oriented towards the side of the rosette. Due to the rosette modifications, the transducers plate was changed compared to previous cruises. This modification allowed us to be able to comfortably move the transducers when we did the calibration. The AZFP was configured to measure during down- and upcast, in order to obtain the highest number of detections. The transducers were calibrated at an equatorial station at 25°W. In order to obtain the calibration data, the sideward-looking transducers were rotated within the CTD rosette frame to look downward. The target sphere (a tungsten sphere) was deployed several metres below the transducers to detect as many sphere echoes as possible to analyze the effect of the beam pattern in the echo as well. The Echoview software was used to check the data collected and with MATLAB software, to get some preliminary results. A total of 78 profiles were collected (23 casts along the eastern boundary, mainly in Angolan waters and 55 along to the equator). The depth range was variable, reaching a maximum depth of about 6000 m. During the 11°S section off Angola and along the equator, the receiver of the 38-kHz transducer was not working. However, the three other frequencies were recording during all sections to obtain the zooplankton vertical distribution of different organisms in the water column and estimate their abundance and biomass.

5.7.5 Multinet

(Tine Jordan, Airam Nauzet Sarmiento Lezcano)

A Hydrobios® Multinet Midi with an aperture of 0.25 m^2 and 5 net bags (mesh size 200 µm) was deployed at 18 stations for vertically stratified hauls with sampling depths 1000-600 m, 600-300 m, 300-200 m, 200-100 m, and 100-0 m (Table 7.8). Some large organisms such as fish and decapods were removed from the sample, photographed, frozen in liquid nitrogen and stored at -

80 ºC. These samples will be analyzed in the home laboratory for Electron Transport System activity to estimate the respiration. Also, for migratory species we will obtain the carbon flux between surface layer (0-100 m) and deep layer (600-1000 m). In total, we fixed 92 samples in 100-ml Kautex bottles with a 4% formaldehyde in seawater solution. They will be scanned and analyzed in the home laboratory using automated imaging software allowing taxonomical classification and biomass estimation.

5.7.6 Nutrient measurements

(Ajit Subramaniam, Gerd Krahmann)

A total of 466 samples were collected for nutrient analysis (NO_2, NO_2+NO_3, PO_4, SiO_4) from CTD casts. The samples were collected in 14 ml polyethylene sampling tubes and immediately frozen for later analysis using an autoanalyzer. While the focus of the nutrient sampling was to define the nutricline, samples from deeper depths were also collected to both serve as reference measurements and to study long term change.

Two miniature UV spectrometers (types OPUS manufactured by TriOS and deep SUNA manufactured by Satlantic/Seabird) were attached to the CTD during all casts. The SUNA (#345) which has a maximum depth rating of 2000 m was used for the shallow CTD casts up to 24. Thereafter the OPUS (#71F9) with a maximum depth rating of 6000 m was used. Additionally, the SUNA was attached to the multinet frame during some of the multinet casts.

The spectrometers measure in situ the absorption of UV light by seawater. From comparison with the absorption of clear water and water with a known concentration of nitrate, the nitrate concentration in the seawater sample can be derived. During and after cruise M158 and M159 a joint processing toolbox for OPUS and SUNA spectrometers had been developed at GEOMAR. This toolbox was applied here to data from both instruments. The processing again confirmed a higher noise level in the data of the OPUS compared to the SUNA which is caused by a different type of UV lamp.

The NO_x (NO_2 + NO_3) concentrations resulting from the processing still require a calibration comparable to that of the CTD's conductivity and oxygen sensors. The calibration will be finalized once the frozen nutrient samples have been analyzed.

5.7.7 Biogeochemistry of nitrous oxide (N_2O)

(Luisa Steckhan, Damian Leonardo Arévalo-Martínez)

During TRATLEQ II, we aimed to investigate the zonal variability of N_2O sea-air-fluxes along the equator and to assess the role of variable primary production and sinking organic matter for the cycling of N_2O throughout the water column. To this end, we carried out extensive water sampling both from surface waters (every 6 h) and the water column (14 stations spanning surface mixed layer to bottom) in order to measure concentrations of dissolved N_2O. The focus of the data analysis from this cruise will be set on the comparison of N_2O concentrations and sea-air flux dynamics during upwelling vs. non-upwelling conditions by using data from TRATLEQ I (R/V Meteor cruise M158 in September-October 2019), as well as two previous cruises in the same region (R/V Maria S. Merian cruises MSM18-2 and MSM18-3 in May-July 2011). Moreover, we conducted CTD sampling for N_2O measurements during the 11°S section off the Angolan coast (8 stations). This section has been occupied during the R/V Meteor cruises M98, M148 and M158 (2013, 2018 and 2019 respectively), and the combined data set will be used to assess the variability in cross-shore gradients of N_2O at the eastern boundary of the South Atlantic beyond the influence of classical coastal upwelling settings. The measurements of N_2O concentrations will take place at the Chemical Oceanography Department of GEOMAR, and the data will be analyzed within the context of a master thesis.

5.7.8 N_2 Fixation, Primary productivity

(Ana Fernández Carrera, Ajit Subramaniam)

Size-fractionated N_2 fixation and carbon uptake (>10 and 10-0.3 µm) of the planktonic community were estimated at 38 stations using a dual $^{15}N_2$ and ^{13}C-bicarbonate tracer technique (Hama et al. 1983, Montoya et al. 1996) in Angolan waters, along 0°N and in the subtropical gyre (Table 7.7). At each station, triplicate 4.5-L clear polycarbonate bottles (Nalgene) were filled from three depths, directly from the CTD-rosette, spiked with 3 ml of $^{15}N_2$ (98 atom%, Cambridge Isotopes) and 250 µL of ^{13}C-bicarbonate (0.2M), and subsequently incubated 24 hours on-deck in a system of re-circulating water simulating in situ PAR levels by neutral density mesh bags. Incubations were terminated by sequentially filtering the whole volume of the bottle though 10 and 0.3 µm pore size filters. The particles for estimating natural abundance of stable carbon (C) and nitrogen (N) isotopes at time zero were also collected at each sampling depth by passing 4.5 L of water through pre-combusted (450ºC for 4h) 25 mm Advantec GF-75 filters under gentle pressure. The abundance of C and N isotopes in incubated and natural abundance samples will be measured ashore by continuous-flow isotope-ratio mass spectrometry (CF-IRMS). The rates will be calculated using the equations provided by Hama et al. (1983) and Montoya et al. (1996).

5.7.9 HPLC, flow cytometry, CLASS

(Ajit Subramaniam, Ina Schmidt)

Samples were collected for enumerating bacterial, cyanobacterial, and picoeukaryote abundance (Table 7.7) and frozen in liquid nitrogen until analysis ashore using a BD Influx flow cytometer following the methods described in (Duhamel et al. 2014).

Phytoplankton functional groups will be determined by High Performance Liquid Chromatography (HPLC) of samples collected throughout the upper 100m at the stations indicated in Table 7.7. Three liters of water were collected from the Niskin bottles fired at various depths in the euphotic zone and filtered through a GF/F filter. The filters were flash frozen in liquid nitrogen and then stored in -80°C till analysis. The samples will be analyzed following the method of van Heukelem and Thomas (2001) at the NASA GSFC sample analysis facility.

Underway and depth profile phytoplankton chlorophyll and phycoerythrin fluorescence (Fig X) were measured using the Custom Laser Analytical Spectroscopic System (CLASS), a dual Laser spectrofluorometer (Chekalyuk and Hafez, 2008). The CLASS also measures variable fluorescence (Fv/Fm) and fluorescence of dissolved organic matter (fDOM).

5.7.10 Spectroradiometry and ocean optics

(Ajit Subramaniam, Ina Schmidt)

A hyperspectral radiometer was used to measure downwelling irradiance and upwelling radiance to estimate remote sensing reflectance at the sea surface using the Sky Blocked Approach (Lee et al. 2013) at all stations that were sampled between 9 AM and 4 PM local time (Table 7.9).

5.7.11 Organic matter

(Markel Gómez Letona, Ona Deulofeu Capo, Javier Arístegui)

Sampling and analysis: The sampling for the study of the organic matter consisted in samples for Total Organic Carbon (TOC), Particulate Organic Carbon and Nitrogen (POC & PON) and Chromophoric Dissolved Organic Matter (CDOM). Samples for these variables were collected at 63 profiles at 12 depths, from surface to bottom, including the 11ºS section off Angola, the Congo river outflow plume and the equatorial section, for a total of 537 samples.

TOC samples were collected in topaz bottles and were distributed into high density polyethylene bottles after rinsing (10 ml, 2 replicates per depth). Samples were stored at -20ºC and will be analyzed after the cruise. Samples for POC & PON were filtered through precombusted (450ºC, 6h) glass microfiber GF/F filters. The total amount of filtered seawater was 864 L. Upon filtration, filters were placed in individual, precombusted aluminum paper envelopes and stored at -20ºC. POC & PON samples will be analyzed after the cruise.

CDOM samples were collected in topaz bottles for in situ analysis with an Ocean Optics USB2000+UV-VIS-ES Spectrometer alongside a WPI liquid waveguide capillary cell (LWCC). Samples from the upper 200 meters of the water column were prefiltered using precombusted (450ºC, 6h) glass microfiber GF/F filters to avoid light dispersion by particles. For each sample, absorbance was measured across a wavelength spectrum between 178 nm and 878 nm, performing a blank measurement prior to each sample using ultrapure milli-Q water. Data processing was performed as follows:

1. Data files (samples and blanks) were cropped so as to only preserve wavelengths between 250 and 700 nm.
2. Blank correction: blank spectra were subtracted from sample spectra.
3. Dispersion correction: the average absorbance between 600 and 700 nm was subtracted from the whole spectra.

After processing, absorbance was transformed into absorption following the definition of the Napierian absorption coefficient:

$$a_\lambda = 2.303 \cdot \frac{Abs_\lambda}{L}$$

Where, for each wavelength λ, the absorption coefficient a_λ is given by Abs_λ (the absorbance at wavelength λ), L (the path length of the cuvette, in meters; the LWCC has a length of 0.9982 m) and 2.303, the factor that converts from decadic to natural logarithms.

From the a_λ spectra, several specific wavelengths of interest were considered, mainly a_λ at 254 and 325. Furthermore, spectral slopes between wavelengths of interest were estimated following Helms et al. (2008) for the wavelength ranges of 275-295 and 350-400 nm.

Preliminary results: CDOM results obtained during TRATLEQ II present similar global patterns as the CDOM results obtained during TRATLEQ I. Surface waters show an overall decrease in a_{254} from east to west in the equatorial Atlantic, suggesting a decrease in DOM related to lower productivity in the western basin. The spectral slope between 275-295 nm ($S_{275\text{-}295}$), which is inversely related to the average molecular weight of CDOM, also shows similar zonal changes.

a_{254} decreased with depth from surface waters, where most of the primary production occurs, to the ocean's interior. Nonetheless, patterns among the low values of the dark ocean can also be discerned, mostly related to the different water masses present in the equatorial region. Minimum a_{254} values were measured between ~700-1000 m depth and are associated to the Antarctic

Intermediate Water (AAIW). Similar vertical gradients could be identified $S_{275-295}$, suggesting low concentrations of CDOM that presents higher average molecular weight, potentially related to the microbial reworking of DOM. This result would agree with the fact that the AAIW is an older water mass than the surrounding waters. Below the AAIW, higher values of a_{254} were registered in the North Atlantic Deep Water (NADW), although the eastern basin presented lower values than the western. Finally, in the bottom of the western basin, another minimum of a_{254} was present, a signal associated to the Antarctic Bottom Water (AABW).

5.7.12 Prokaryotes

(Markel Gómez Letona, Ona Deulofeu Capo, Javier Arístegui)

Sampling for the study of the prokaryotic community consisted of three types of samples: flow cytometry, DNA and BioOrthogonal Non-Canonical Amino acid Tagging (BONCAT).

Flow cytometry samples for the quantification of prokaryotic abundance were taken in the same 52 profiles as the organic matter samples, for a total of 436 samples. Samples were distributed into cryovials (1.7 ml), fixed with paraformaldehyde (PFA) and stored at -80ºC. At each depth, two replicates were taken. Flow cytometry analysis will be performed after the cruise.

DNA filtrations were carried out at 23 profiles in the equatorial section, all of them located in international waters. In each profile samples were collected at 8 depths, from surface to bottom, including the main water masses. Samples were prefiltered through a 200 µm mesh and subsequently filtered through 2 sets of polycarbonate filters (3 µm and 0.2 µm) using a peristaltic pump. Thus, the total number of DNA samples was 336 (with a filtered volume of seawater of 724 L). Upon filtration, filters were placed in individual, autoclaved Eppendorf vials and stored at -80ºC. After the cruise, DNA extraction and sequencing will be performed to study the taxonomic diversity of the prokaryotic community.

BONCAT incubations, which allow the evaluation of single cell activity of prokaryotes, were performed at 5 stations: 2ºE, 5ºW, 15ºW, 23ºW and 35ºW. At each station, incubations were carried out at 4 depths: surface (~5 m, 9 ml), oxygen minimum zone (OMZ, variable depth, 9 ml), mesopelagic (~700 m, 45 ml) and bathypelagic (~3000 m, 45 ml). For each depth, 2 replicates and 1 control were performed. Controls were fixed prior to incubation with PFA, and homopropargylglycine (HPG) was subsequently added to all samples to yield a 2-3 µM final concentration. All samples were incubated at dark close to in situ temperature, but incubation times differed: surface samples were incubated for 3h, OMZ samples for 5h, and lower mesopelagic and bathypelagic samples for 8h. Incubations were finalised with addition of PFA and filtered through 0.2 µm polycarbonate filters 6 – 10 h after fixation. Filters were labelled and stored at -80ºC and will be analysed after the cruise.

Bloomers experiment: Bloomers are prokaryotes that suddenly dominate the community for a short period in a localized environment. They are also called conditionally rare taxa because they change from being part of the rare biosphere to predominating the community. Their role in microbial communities is still under discussion, but they are believed to contribute to microbial diversity disproportionately to their relative abundances, suggesting an important role of bloomers in structuring microbial communities over time. More importantly, during the bloom events, they can support a relevant part of the whole community function. However, the factors that drive these events are still unclear. During the cruise we tested the following hypothesis: bloomers respond to specific carbon sources. Therefore, based on the carbon sources available in the environment we will find different blooming prokaryotes.

Experimental setup: water from 1000m depth at 0.0º N 24º W was filtered by 200 µm mesh and amended with different compounds: acetate, pyruvate, amino acids (tryptophan and methionine), humic acids and a control (without any addition). For each treatment, 4 L of water were prepared and then distributed into 1 L culture bottles (per triplicate). Water was incubated in darkness for 120 hours at 7ºC, close to *in situ* conditions.

Collected samples: flow cytometry samples were collected, as previously described, every 12 hours to monitor prokaryotic abundances during the experiment. Samples for DNA, TOC, and inorganic nutrients were collected at initial and final times. DNA filtrations were carried out to compare the initial community composition with the final one. Samples were filtered through polycarbonate filters (0.2 µm) using a peristaltic pump. Upon filtration, filters were placed in individual, autoclaved Eppendorf vials and stored at -80ºC. After the cruise, DNA extraction and sequencing (16S rRNA V4-V5 region) will be performed to identify the bloomers that have been grown for each treatment. Samples for TOC analyses were collected as previously described and samples for inorganic nutrients were collected in 20ml tubes and frozen immediately at -20ºC. Inorganic nutrients concentrations will be determined spectrophotometrically with an Alliance Evolution II autoanalyzer according to standard procedures after the cruise. Additionally, CDOM was analysed at times 0, 72 and 120 hours.

5.7.13 Thorium measurements

(Beat Gasser, Wokil Bam)

Thorium measurements were used as an indirect method for estimating the vertical flux of particulate organic carbon (POC) in the water column. This export of organic matter produced in the euphotic layer can be determined by measuring the natural radionuclide thorium 234 (^{234}Th) and its parent radionuclide uranium 238 (^{238}U). ^{234}Th shows high reactivity with particles, while it's long-lived parent ^{238}U has a conservative behavior and remains soluble in seawater. The "scavenging" of ^{234}Th onto particles produced in the euphotic zone and exported through sedimentation causes a separation between daughter and parent nuclide. The resulting disequilibrium between the two nuclides is used to calculate the flux of particulate organic carbon out of the productive ocean surface layer (see Rutgers van der Loeff et al., 2006, Buesseler et al., 2006 and references herein).

Total ^{234}Th was measured in 4 L samples obtained from Niskin bottles of the CTD-rosette casts. In each sample, ^{234}Th was co precipitated with $MnCl_2$ following the addition of a solution of $KMnO_4$. The precipitate was then filtered onto a 25 mm micro quartz filter (QMA), which was dried and then mounted on a sample holder in order to measure ^{234}Th through its beta decay on a Risø low level beta multicounter system with 5 individual Geiger Muller counters.

From a total of 35 CTD-rosette casts, 29 ^{234}Th profiles were obtained along the equator between 2° E and 44° W. Per profile, some 15 depths between the surface and mostly 500 m depth were sampled. Approximately, every 5° longitude, samples from 3 to 4 depths below 500 m were also taken.

Integration of the deficit of ^{234}Th relative to its parent radionuclide ^{238}U generally observed in the productive surface layer yields the ^{234}Th flux, from which the POC flux can be estimated by using the POC/^{234}Th ratio on sinking particles.

To measure this ratio particles were sampled with in situ pumps. During M181, we used 6 such pumps (4 from McLane Research Laboratories and 2 from Challenger Oceanic) to sample 2 size classes of particles at 6 depths at a time. Sampling depths between the surface and 500 m were chosen such that the resulting profiles represent as well as possible the depth variability of the POC/^{234}Th ratio. 4 pumps were deployed in the productive surface layer down to 150 m and 2 pumps below this depth. We obtained 10 pump profiles evenly distributed every 5° longitude between 1° East and 44° West (Table 7.10).

Each pump was equipped with two filters in sequence, a first prefilter made of Nitex tissue with a mesh size of 50µm to sample the large size settling particles, and a micro quartz filter (QMA, 1 µm nominal size) of 142 mm (McLane) and 293 mm (Challenger) diameter to sample the suspended small particles. The large particles collected on the prefilter were rinsed off with filtered (0.2 µm) seawater and filtered on a 25 mm QMA filter, and the small particles from the QMA filters were subsampled by punches, one on the 142 mm and 18 punches on the 293 mm filters. Punches and rinsed particles were mounted on sample holders for beta counting as was done for the ^{234}Th precipitate. Since the measurement of the beta activity is nondestructive, ^{234}Th beta activity and the carbon content can be measured on the same particles.

Finally, water samples for measuring the ^{238}U concentration were also taken from Niskin bottles of the CTD-Rosette. Although ^{238}U can be calculated from the salinity, the seawater samples were taken at 6 stations in order to verify that calculation. The measurement of ^{238}U itself will be done back in the laboratory by ICP-MS.

6 Ship´s Meteorological Station

(Martin Stelzner)

On Sunday evening, 17 April 2022, RV Meteor left the port of Cape Town. At the beginning of the voyage, RV Meteor was under the influence of an almost stationary Atlantic subtropical high, whose centre was located near 37°S 005°E. At the same time, a trough from the Intertropical Convergence Zone (ITCZ) extended along the African west coast southwards to the southern part of Namibia. This trough became weather-dominating for RV Meteor after only two days. Initially, the wind came from the southeast with 3 to 4 Bft. The significant wave height was 2 m with a swell from the south. Under the influence of the trough, the wind changed slightly to southerly directions. In the remaining two days of the transit along the coast of Angola northwards to the first research area wind and sea state remained constant. Temporary exceptions were local low-pressure areas within the trough, which caused weak wind from different directions at times.

On 21 April 2022, RV Meteor reached the first station at the border between Angola and Namibia in fog. At the beginning of the day the fog quickly dissipated. At this most westerly point of both Angola and Namibia, a wind field built up during the course of the day, which caused the southerly wind to temporarily increase to up to 7 Bft. At the same time, a swell coming from the southwest with waves up to 3 m high reached this area of the Atlantic. As RV Meteor was under land protection in the lee of the coast, this swell hardly affected the research area. The swell remained at 1 to 1.5 m. For the next 7 days, continuing north along the coast of Angola, the weather remained unchanged.

On 27 April 2022, RV Meteor reached the northern point of the coast of Angola. From there, the 2 1/2-day transit to the equator at 2°E began. During this period, the wind, unchanged with mostly 3 Bft, came from southeast to south. The significant wave height remained at 1 m with a swell from south-southwest. By reaching the equator in the morning hours of 30 April 2022, RV Meteor entered the area of the ITCZ. Now the second part of this expedition began: a transect along the equator to the west with about 2° geographical longitude per day. The wind came constantly from south to southeast with mostly 3 to 4 Bft. The significant wave height increased to 1.5 to 2 m with a swell from south to southeast. These weather conditions continued for the following two weeks.

On 12 May 2022, RV Meteor meanwhile at 26°W, the previous dominant 1.5 m swell from the southeast was combined with a second swell of 1 m from the north. One day later, the wind shifted to an east-southeasterly direction with unchanged 3 to 4 Bft for the next 48 hours. From 17 May 2022 onwards, the northerly 1 m swell slowly became the dominant swell with the weak wind, which shifted to north to northeast on 19 May 2022 for another 48 hours.

In the afternoon of 20 May 2022, RV Meteor reached the most westerly and thus last equatorial station of this voyage in weak winds and 1 m swell. After finishing the research work at this station, the 7-day transit towards Cape Verde began. Initially weak wind from variable directions shifted to southeast again on 21 May 2022. In the further course, with crossing of the ITCZ, the wind shifted over east to a constant northeast trade wind, which blew with 3 to 4 Bft from 23 May 2022 onwards. The significant wave height with the prevailing north to northeast swell increased to 1.5 m during the week. Under unchanged weather conditions, but now on the south-eastern edge of an Azores high, RV Meteor reached the last station close north-west of Cape Verde on 27 May 2022. The expedition M181 ended in the port of Mindelo in the late afternoon.

7 Station Lists M181

7.1 Station list

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
METEOR (M181)	**GEOMAR**	**2022**		**[UTC]**	**[°]**	**[°]**	**[m]**	
M181_1	MVP 1	21.04.	MVP	13:10-14:55	17°14.05‘S	011°16.54‘E		**MVP** test station and underway
M181_2	CTD 1	21.04.	CTD	15:09-17:48	17°00.00‘S	011°11.00‘E	1250	**CTD** test station (to bottom), moored instrument calibration
M181_3	DRIFT test	21.04.	Drift buoy	15:31-15:49	17°00.00‘S	011°11.00‘E		**Drift buoy** test during CTD station
M181_4	MVP 2	21.04.	MVP	17:59-23:21	17°00.00‘S	011°11.00‘E		**MVP** underway
M181_5	CTD 2	21.04.	CTD	23:57-00:16	16°00.00‘S	011°34.00‘E	869	**CTD** station (to bottom)
M181_6	MVP 3	22.04.	MVP	00:31-06:09	16°00.00‘S	011°34.00‘E		**MVP** underway
M181_7	CTD 3	22.04.	CTD	06:25-06:52	15°00.00‘S	012°04.00‘E	430	**CTD** station (to bottom)
M181_8	MVP 4	22.04.	MVP	07:18-09:50	14°57.00‘S	012°04.00‘E		**MVP** underway
M181_9	CTD 4	22.04.	CTD	12:37-13:07	14°00.00‘S	012°12.00‘E	496	**CTD** station (to bottom)
M181_10	MSS 1	22.04.	MSS	13:17-13:56	14°00.00‘S	012°12.00‘E		**MSS** test station
M181_11	CTD 5	22.04.	CTD	20:36-21:19	13°00.00‘S	012°43.00‘E	946	**CTD** station (to bottom)
M181_12	KPO1235	23.04.	Mooring	09:16-10:43	10°50.00‘S	013°00.00‘E	1230	**Mooring** recovery
M181_13	CTD 6	23.04.	CTD	11:12-12:17	10°50.00‘S	013°00.00‘E	1227	**CTD** station (to bottom)
M181_14	RM 1	23.04.	Spectro-radio-meter	11:19-11:41	10°50.00‘S	013°00.00‘E		**RM** into the water during CTD station
M181_15	MSS 2	23.04.	MSS	12:25-13:25	10°50.00‘S	013°00.00‘E		**MSS** station
M181_16	DRIFT 1	23.04.	Drift buoy	15:54	10°36.00’S	013°21.00‘E		**Drift buoy** deployment
M181_17	CTD 7	23.04.	CTD	16:10-15:24	10°36.00’S	013°21.00‘E	110	**CTD** station (to bottom)
M181_18	MSS 3	23.04.	MSS	16:35-17:01	10°36.00’S	013°21.00‘E		**MSS** station
M181_19	CTD 8	23.04.	CTD	17:40-17:57	10°38.00’S	013°18.00‘E	125	**CTD** station (to bottom)
M181_20	MSS 4	23.04.	MSS	18:06-18:36	10°38.00’S	013°18.00‘E		**MSS** station
M181_21	CTD 9	23.04.	CTD	19:18-19:40	10°40.00’S	013°15.00‘E	220	**CTD** station (to bottom)
M181_22	MSS 5	23.04.	MSS	19:50-20:29	10°40.00’S	013°15.00‘E		**MSS** station
M181_23	CTD 10	23.04.	CTD	21:19-21:50	10°42.00’S	013°12.00‘E	436	**CTD** station (to bottom)
M181_24	MSS 6	23.04.	MSS	22:02-22:51	10°42.00’S	013°12.00‘E		**MSS** station
M181_25	CTD 11	23.04.	CTD	23:29-00:16	10°44.00’S	013°09.00‘E	705	**CTD** station (to bottom)
M181_26	MSS 7	24.04.	MSS	00:24-01:31	10°44.00’S	013°09.00‘E		**MSS** station
M181_27	CTD 12	24.04.	CTD	02:05-03:05	10°46.00’S	013°06.00‘E	944	**CTD** station (to bottom)
M181_28	MSS 8	24.04.	MSS	03:14-04:08	10°46.00’S	013°06.00‘E		**MSS** station
M181_29	CTD 13	24.04.	CTD	04:49-05:49	10°48.00’S	013°03.00‘E	1160	**CTD** station (to bottom)
M181_30	MSS 9	24.04.	MSS	05:57-06:40	10°48.00’S	013°03.00‘E		**MSS** station
M181_31	KPO1246	24.04.	Mooring	08:34-10:23	10°50.00‘S	013°00.00‘E	1230	**Mooring** deployment
M181_32	RM 2	24.04.	Spectro-radio-meter	15:02-15:14	10°28.00’S	013°33.00‘E		**RM** station
M181_33	CTD 14	24.04.	CTD	15:22-15:32	10°28.00’S	013°33.00‘E	24	**CTD** station (to bottom)

M181_34	MSS 10	24.04.	MSS	15:40-19:10	10°28.00'S	013°33.00'E		**MSS** station
M181_35	CTD 15	24.04.	CTD	19:28-19:41	10°30.00'S	013°30.00'E	50	**CTD** station (to bottom)
M181_36	MSS 11	24.04.	MSS	19:58-20:12	10°30.00'S	013°30.00'E		**MSS** station, stopped with broken connection
M181_37	MSS 12	24.04.	MSS	21:17-00:05	10°30.00'S	013°30.00'E		**MSS** station
M181_38	CTD 16	25.04.	CTD	00:22-00:35	10°32.00'S	013°27.00'E	63	**CTD** station (to bottom)
M181_39	MSS 13	25.04.	MSS	00:49-03:32	10°32.00'S	013°27.00'E		**MSS** station
M181_40	CTD 17	25.04.	CTD	03:58-04:13	10°34.00'S	013°24.00'E	91	**CTD** station (to bottom)
M181_41	MSS 14	25.04.	MSS	04:33-06:14	10°34.00'S	013°24.00'E		**MSS** station to drift buoy
M181_42	DRIFT 1	25.04.	Drift buoy	07:04	10°27.50'S	013°22.60'E		**Drift buoy** recovery
					10°34.00'S	013°24.00'E		ADCP section
M181_43	KPO1248	25.04.	PIES	10:33	10°50.46'S	013°00.25'E	1224	**PIES** deployment
M181_44	CTD 18	25.04.	CTD	11:34-12:41	10°55.00'S	012°52.50'E	1260	**CTD** station (to bottom)
M181_45	RM 3	25.04.	Spectro-radio-meter	11:43-12:00	10°55.00'S	012°52.50'E		**RM** into the water during CTD station
M181_46	MSS 15	25.04.	MSS	12:50-13:52	10°55.00'S	012°52.50'E		**MSS** station
M181_47	CTD 19	25.04.	CTD	14:49-16:20	11°00.00'S	012°45.00'E	1432	**CTD** station (to bottom), moored instrument calibration
M181_48	MSS 16	25.04.	MSS	16:32-17:11	11°00.00'S	012°45.00'E		**MSS** station
M181_49	CTD 20	25.04.	CTD	20:35-22:08	11°20.00'S	012°15.00'E	2285	**CTD** station (to bottom)
M181_50	MSN1	25.04.	MSN	22:24-01:14	11°20.00'S	012°15.00'E		**Multinet** station
M181_51	Argo 1	26.04.	Float	01:27	11°20.00'S	012°15.00'E		**Argo float** deployment
M181_52	CTD 21	26.04.	CTD	05:54-06:23	11°45.00'S	011°38.00'E	3461	**CTD** station (to 150m)
M181_53	Argo 2	26.04.	Float	06:32	11°45.00'S	011°38.00'E		**Argo float** deployment
M181_54	Argo 3	26.04.	Float	10:47-11:01	11°10.00'S	011°13.00'E		**Argo float** recovery
M181_55	CTD 22	26.04.	CTD	11:20-13:40	11°10.00'S	011°13.00'E	3694	**CTD** station (to bottom)
M181_56	RM 4	26.04.	Spectro-radio-meter	11:44-12:17	11°10.00'S	011°13.00'E		**RM** into the water during CTD station
M181_57	Argo 4	26.04.	Float	14:41	11°10.00'S	011°13.00'E		**Argo float** deployment
M181_58	MVP 5	27.04.	MVP	06:42-15:13	08°06.50'S-06°30.60'S	011°04.10'E-010°59.60'E		**MVP** underway until EEZ of DRC
M181_59	MVP 6	27.04.	MVP	17:16-18:10	06°09.20'S-06°00.00'S	010°57.50'E-010°58.00'E		**MVP** underway after leaving EEZ of DRC
M181_60	DRIFT 2	27.04.	Drift buoy	18:18	06°00.00'S	010°58.00'E		**Drift buoy** deployment
M181_61	CTD 23	27.04.	CTD	18:26-18:51	06°00.00'S	010°58.00'E	1445	**CTD** station (200 m)
M181_62	DRIFT 2	27.04.	Drift buoy	19:24	06°01.40'S	010°56.80'E		**Drift buoy** recovery
M181_63	MVP 7	27.04.	MVP	19:34-14:08	06°00.00'S-04°00.00'S	010°58.00'E-008°00.00'E		**MVP** underway
M181_64	DRIFT 3	28.04.	Drift buoy	14:08	04°00.00'S	008°00.00'E		**Drift buoy** deployment
M181_65	RM 5	28.04.	Spectro-radio-meter	14:18-14:34	04°00.00'S	008°00.00'E		**RM** into the water before CTD station
M181_66	CTD 24	28.04.	CTD	14:27-14:51	04°00.00'S	008°00.00'E		**CTD** station (200 m)
M181_67	DRIFT 3	28.04.	Drift buoy	15:03	04°00.00'S	008°00.00'E		**Drift buoy** recovery
M181_68	MVP 8	28.04.	MVP	15:17-20:42	04°00.00'S-03°25.20'S	008°00.00'E-007°07.80'E		**MVP** underway until EEZ of EG

M181_69	DRIFT 4	30.04.	Drift buoy	03:04	00°00.00’S	002°00.00‘E		**Drift buoy** deployment
M181_70	MSN 2	30.04.	MSN	03:15-05:46	00°00.00’S	002°00.00‘E		**Multinet** station
M181_71	CTD 25	30.04.	CTD	06:05-09:01	00°00.00’S	002°00.00‘E	4610	**CTD** station (to bottom)
M181_72	RM 6	30.04.	Spectro-radio-meter	08:18-08:44	00°00.00’S	002°00.00‘E		**RM** into the water during CTD station
M181_73	MSS 17	30.04.	MSS	09:14-09:44	00°00.00’S	002°00.00‘E		**MSS** station
M181_74	DRIFT 4	30.04.	Drift buoy	10:45	00°00.00’S	002°00.00‘E		**Drift buoy** recovery
M181_75	DRIFT 5	30.04.	Drift buoy	16:04	00°00.00’S	001°00.00‘E		**Drift buoy** deployment
M181_76	CTD 26	30.04.	CTD	16:13-19:06	00°00.00’S	001°00.00‘E	4832	**CTD** station (to bottom)
M181_77	RM 7	30.04.	Spectro-radio-meter	16:18-16:35	00°00.00’S	001°00.00’E		**RM** into the water during CTD station
M181_78	ISP 1	30.04.	ISP	19:24-21:14	00°00.00’S	001°00.00‘E		**In situ pump** station
M181_79	MSS 18	30.04.	MSS	21:21-21:45	00°00.00’S	001°00.00‘E		**MSS** station
M181_80	DRIFT 5	30.04.	Drift buoy	22:40	00°00.00’S	001°00.00‘E		**Drift buoy** recovery
M181_81	CTD 27	01.05.	CTD	04:21-04:43	00°00.00’S	000°00.00‘E		**CTD** station (to 200m)
M181_82	MSS 19	01.05.	MSS	04:50-05:19	00°00.00’S	000°00.00‘E		**MSS** station
M181_83	CTD 28	01.05.	CTD	05:38-09:09	00°00.00’S	000°00.00‘E	4935	**CTD** station (to bottom)
M181_84	RM 8	01.05.	Spectro-radio-meter	08:42-08:54	00°00.00’S	000°00.00’W		**RM** into the water during CTD station
M181_85	DRIFT 6	01.05.	Drift buoy	14:34	00°00.00’S	001°00.00’W		**Drift buoy** deployment
M181_86	MSN 3	01.05.	MSN	14:39-15:31	00°00.00’S	001°00.00’W		**Multinet** station
M181_87	CTD 29	01.05.	CTD	15:40-18:47	00°00.00’S	001°00.00’W	4996	**CTD** station (to bottom)
M181_88	RM 9	01.05.	Spectro-radio-meter	16:11-16:33	00°00.00’S	001°00.00’W		**RM** into the water during CTD station
M181_89	MSS 20	01.05.	MSS	18:58-19:25	00°00.00’S	001°00.00’W		**MSS** station
M181_90	DRIFT 6	01.05.	Drift buoy	20:25	00°00.00’S	001°00.00‘W		**Drift buoy** recovery
M181_91	CTD 30	02.05.	CTD	01:42-05:03	00°00.00’S	002°00.00’W	5053	**CTD** station (to bottom)
M181_92	MSS 21	02.05.	MSS	05:18-05:52	00°00.00’S	002°00.00’W		**MSS** station
M181_93	CTD 31	02.05.	CTD	13:49-17:03	00°00.00’S	003°00.00’W	5125	**CTD** station (to bottom)
M181_94	RM 10	02.05.	Spectro-radio-meter	14:25-14:43	00°00.00’S	003°00.00’W		**RM** into the water during CTD station
M181_95	MSS 22	02.05.	MSS	17:14-17:40	00°00.00’S	003°00.00‘W		**MSS** station
M181_96	CTD 32	02.05.	CTD	22:55-02:03	00°00.00’S	004°00.00’W	5146	**CTD** station (to bottom)
M181_97	MSN 4	03.05.	MSN	02:20-03:11	00°00.00’S	004°00.00’W		**Multinet** station
M181_98	MSS 23	03.05.	MSS	03:19-03:50	00°00.00’S	004°00.00’W		**MSS** station
M181_99	CTD 33	03.05.	CTD	09:15-09:38	00°00.00’S	005°00.00’W		**CTD** station (to 200m)
M181_100	MSS 24	03.05.	MSS	09:48-10:12	00°00.00’S	005°00.00’W		**MSS** station
M181_101	DRIFT 7	03.05.	Drift buoy	10:25-15:44	00°00.00’S	005°00.00’W		**Drift buoy** loosely tethered
M181_102	CTD 34	03.05.	CTD	10:35-13:49	00°00.00’S	005°00.00‘W	5159	**CTD** station (to bottom)
M181_103	RM 11	03.05.	Spectro-radio-meter	11:12-11:32	00°00.00’S	005°00.00’W		**RM** into the water during CTD station
M181_104	ISP 2	03.05.	ISP	14:01-15:54	00°00.00’S	005°00.00‘W		**In situ pump** station
M181_105	CTD 35	03.05.	CTD	21:32-00:37	00°00.00’S	006°00.00’W	5005	**CTD** station (to bottom)

M181_106	MSS 25	04.05.	MSS	00:50-01:32	00°00.00'S	006°00.00'W		**MSS** station
M181_107	CTD 36	04.05.	CTD	06:57-10:06	00°00.00'S	007°00.00'W	5147	**CTD** station (to bottom)
M181_108	RM 12	04.05.	Spectro-radio-meter	09:24-09:46	00°00.00'S	007°00.00'W		**RM** into the water during CTD station
M181_109	MSN 5	04.05.	MSN	10:18-11:06	00°00.00'S	007°00.00'W		**Multinet** station
M181_110	MSS 26	04.05.	MSS	11:11-11:43	00°00.00'S	007°00.00'W		**MSS** station
M181_111	DRIFT H1	04.05.	Surface drifter	11:46	00°00.00'S	007°00.00'W		**HEREON** drifter deployment
M181_112	CTD 37	04.05.	CTD	17:05-20:12	00°00.00'S	008°00.00'W	5202	**CTD** station (to bottom)
M181_113	MSS 27	04.05.	MSS	20:23-20:46	00°00.00'S	008°00.00'W		**MSS** station
M181_114	DRIFT H2	04.05.	Surface drifter	20:42	00°00.00'S	008°00.00'W		**HEREON** drifter deployment
M181_115	DRIFT S1	04.05.	Surface drifter	20:45	00°00.00'S	008°00.00'W		**SVP** drifter deployment
M181_116	DRIFT H3	04.05.	Surface drifter	20:48	00°00.00'S	008°00.00'W		**HEREON** drifter deployment
M181_117	CTD 38	05.05.	CTD	01:58-04:34	00°00.00'S	009°00.00'W	4372	**CTD** station (to bottom)
M181_118	MSS 28	05.05.	MSS	04:46-05:17	00°00.00'S	009°00.00'W		**MSS** station
M181_119	DRIFT H4	05.05.	Surface drifter	05:20	00°00.00'S	009°00.00'W		**HEREON** drifter deployment
M181_120	DRIFT H5	05.05.	Surface drifter	10:12	00°00.50'N	009°51.40'W		**HEREON** drifter deployment
M181_121	DRIFT S2	05.05.	Surface drifter	10:14	00°00.50'N	009°51.40'W		**SVP** drifter deployment
M181_122	DRIFT H6	05.05.	Surface drifter	11:21	00°00.00'S	010°00.00'W		**HEREON** drifter deployment
M181_123	DRIFT 8	05.05.	Drift buoy	11:30	00°00.00'S	010°00.00'W		**Drift buoy** deployment
M181_124	CTD 39	05.05.	CTD	11:36-12:00	00°00.00'S	010°00.00'W		**CTD** station (to 200m)
M181_125	MSN 6	05.05.	MSN	12:06-12:56	00°00.00'S	010°00.00'W		**Multinet** station
M181_126	CTD 40	05.05.	CTD	13:14-16:14	00°00.00'S	010°00.00'W	4768	**CTD** station (to bottom)
M181_127	RM 13	05.05.	Spectro-radio-meter	13:22-13:45	00°00.00'S	010°00.00'W		**RM** into the water during CTD station
M181_128	ISP 3	05.05.	ISP	16:24-18:17	00°00.00'S	010°00.00'W		**In situ pump** station
M181_129	MSS 29	05.05.	MSS	18:22-18:51	00°00.00'S	010°00.00'W		**MSS** station
M181_130	DRIFT 8	05.05.	Drift buoy	20:25	00°00.00'S	010°00.00'W		**Drift buoy** recovery
M181_131	CTD 41	06.05.	CTD	00:48-03:18	00°00.00'S	011°00.00'W	3855	**CTD** station (to bottom)
M181_132	MSS 30	06.05.	MSS	03:29-03:59	00°00.00'S	011°00.00'W		**MSS** station
M181_133	DRIFT H7	06.05.	Surface drifter	04:02	00°00.00'S	011°00.00'W		**HEREON** drifter deployment
M181_134	CTD 42	06.05.	CTD	09:14-11:48	00°00.00'S	012°00.00'W	3942	**CTD** station (to bottom)
M181_135	RM 14	06.05.	Spectro-radio-meter	10:42-11:03	00°00.00'S	012°00.00'W		**RM** into the water during CTD station
M181_136	MSS 31	06.05.	MSS	11:56-12:24	00°00.00'S	012°00.00'W		**MSS** station
M181_137	DRIFT H8	06.05.	Surface drifter	12:07	00°00.00'S	012°00.00'W		**HEREON** drifter deployment
M181_138	DRIFT S3	06.05.	Surface drifter	12:09	00°00.00'S	012°00.00'W		**SVP** drifter deployment
M181_139	DRIFT H9	06.05.	Surface drifter	12:11	00°00.00'S	012°00.00'W		**HEREON** drifter deployment
M181_140	CTD 43	06.05.	CTD	17:42-20:20	00°00.00'S	013°00.00'W	4373	**CTD** station (to bottom)
M181_141	MSN 7	06.05.	MSN	20:28-21:13	00°00.00'S	013°00.00'W		**Multinet** station
M181_142	MSS 32	06.05.	MSS	21:16-21:40	00°00.00'S	013°00.00'W		**MSS** station
M181_143	DRIFT H10	06.05.	Surface drifter	21:43	00°00.00'S	013°00.00'W		**HEREON** drifter deployment

M181_144	DRIFT S4	06.05.	Surface drifter	21:45	00°00.00'S	013°00.00'W		**SVP** drifter deployment
M181_145	DRIFT H11	06.05.	Surface drifter	21:46	00°00.00'S	013°00.00'W		**HEREON** drifter deployment
M181_146	CTD 44	07.05.	CTD	03:03-05:25	00°00.00'S	014°00.00'W	3830	**CTD** station (to bottom)
M181_147	MSS 33	07.05.	MSS	05:36-06:05	00°00.00'S	014°00.00'W		**MSS** station
M181_148	DRIFT H12	07.05.	Surface drifter	06:18	00°00.00'S	014°00.00'W		**HEREON** drifter deployment
M181_149	DRIFT H13	07.05.	Surface drifter	11:36	00°00.00'S	015°00.00'W		**HEREON** drifter deployment
M181_150	DRIFT S5	07.05.	Surface drifter	11:37	00°00.00'S	015°00.00'W		**SVP** drifter deployment
M181_151	DRIFT H14	07.05.	Surface drifter	11:38	00°00.00'S	015°00.00'W		**HEREON** drifter deployment
M181_152	DRIFT 9	07.05.	Drift buoy	11:42	00°00.00'S	015°00.00'W		**Drift buoy** deployment
M181_153	CTD 45	07.05.	CTD	11:51-12:15	00°00.00'S	015°00.00'W		**CTD** station (to 200m)
M181_154	ISP 4	07.05.	ISP	12:22-14:18	00°00.00'S	015°00.00'W		**In situ pump** station
M181_155	RM 15	07.05.	Spectro-radio-meter	14:18-14:31	00°00.00'S	015°00.00'W		**RM** station
M181_156	CTD 46	07.05.	CTD	14:37-16:56	00°00.00'S	015°00.00'W	3778	**CTD** station (to bottom)
M181_157	MSS 34	07.05.	MSS	17:04-17:36	00°00.00'S	015°00.00'W		**MSS** station
M181_158	Argo 5	07.05.	Float	17:10	00°00.00'S	015°00.00'W		**Argo float** deployment
M181_159	DRIFT 9	07.05.	Drift buoy	18:50	00°00.00'S	015°00.00'W		**Drift buoy** recovery
M181_160	CTD 47	08.05.	CTD	23:44-01:49	00°00.00'S	016°00.00'W	3315	**CTD** station (to bottom)
M181_161	MSS 35	08.05.	MSS	01:58-02:30	00°00.00'S	016°00.00'W		**MSS** station
M181_162	DRIFT H15	08.05.	Surface drifter	02:32	00°00.00'S	016°00.00'W		**HEREON** drifter deployment
M181_163	DRIFT S6	08.05.	Surface drifter	02:33	00°00.00'S	016°00.00'W		**SVP** drifter deployment
M181_164	DRIFT H16	08.05.	Surface drifter	02:33	00°00.00'S	016°00.00'W		**HEREON** drifter deployment
M181_165	CTD 48	08.05.	CTD	08:11-11:18	00°00.00'S	017°00.00'W	5078	**CTD** station (to bottom)
M181_166	RM 16	08.05.	Spectro-radio-meter	10:32-10:49	00°00.00'S	017°00.00'W		**RM** into the water during CTD station
M181_167	MSN 8	08.05.	MSN	11:29-12:16	00°00.00'S	017°00.00'W		**Multinet** station
M181_168	MSS 36	08.05.	MSS	12:22-13:00	00°00.00'S	017°00.00'W		**MSS** station
M181_169	DRIFT H17	08.05.	Surface drifter	12:33	00°00.00'S	017°00.00'W		**HEREON** drifter deployment
M181_170	CTD 49	08.05.	CTD	18:44-22:29	00°00.00'S	018°03.00'W	6005	**CTD** station (to bottom); water depth should be no deeper than 6000m
M181_171	MSS 37	08.05.	MSS	22:47-23:25	00°00.00'S	018°03.00'W		**MSS** station
M181_172	DRIFT H18	08.05.	Surface drifter	23:00	00°00.00'S	018°03.00'W		**HEREON** drifter deployment
M181_173	DRIFT S7	08.05.	Surface drifter	23:02	00°00.00'S	018°03.00'W		**SVP** drifter deployment
M181_174	DRIFT H19	08.05.	Surface drifter	23:03	00°00.00'S	018°03.00'W		**HEREON** drifter deployment
M181_175	CTD 50	09.05.	CTD	04:42-07:34	00°00.00'S	019°00.00'W	4324	**CTD** station (to bottom)
M181_176	MSS 38	09.05.	MSS	07:44-08:11	00°00.00'S	019°00.00'W		**MSS** station
M181_177	DRIFT H20	09.05.	Surface drifter	08:16	00°00.00'S	019°00.00'W		**HEREON** drifter deployment
M181_178	DRIFT H21	09.05.	Surface drifter	13:41	00°00.00'S	020°00.00'W		**HEREON** drifter deployment
M181_179	DRIFT S8	09.05.	Surface	13:41	00°00.00'S	020°00.00'W		**SVP** drifter

			drifter					deployment
M181_180	DRIFT H22	09.05.	Surface drifter	13:02	00°00.00'S	020°00.00'W		**HEREON** drifter deployment
M181_181	DRIFT 10	09.05.	Drift buoy	13:50	00°00.00'S	020°00.00'W		**Drift buoy** deployment
M181_182	CTD 51	09.05.	CTD	14:10-14:34	00°00.00'S	020°00.00'W		**CTD** station (to 200m)
M181_183	MSN 9	09.05.	MSN	14:45-15:33	00°00.00'S	020°00.00'W		**Multinet** station
M181_184	RM 17	09.05.	Spectro-radio-meter	15:33-15:45	00°00.00'S	020°00.00'W		**RM** station
M181_185	CTD 52	09.05.	CTD	15:50-17:25	00°00.00'S	020°00.00'W	2553	**CTD** station (to bottom)
M181_186	ISP 5	09.05.	ISP	17:32-19:45	00°00.00'S	020°00.00'W		**In situ pump** station
M181_187	MSS 39	09.05.	MSS	19:54-20:23	00°00.00'S	020°00.00'W		**MSS** station
M181_188	DRIFT 10	09.05.	Drift buoy	21:13	00°00.00'S	020°00.00'W		**Drift buoy** recovery
M181_189	CTD 53	10.05.	CTD	02:24-05:21	00°00.00'S	021°00.00'W	5125	**CTD** station (to bottom)
M181_190	MSS 40	10.05.	MSS	05:32-06:01	00°00.00'S	021°00.00'W		**MSS** station
M181_191	DRIFT H23	10.05.	Surface drifter	06:05	00°00.00'S	021°00.00'W		**HEREON** drifter deployment
M181_192	DRIFT S9	10.05.	Surface drifter	06:05	00°00.00'S	021°00.00'W		**SVP** drifter deployment
M181_193	DRIFT H24	10.05.	Surface drifter	06:06	00°00.00'S	021°00.00'W		**HEREON** drifter deployment
M181_194	CTD 54	10.05.	CTD	13:43-16:09	00°00.00'S	022°00.00'W	4154	**CTD** station (to bottom)
M181_195	RM 18	10.05.	Spectro-radio-meter	14:15-14:24 16:09-16:19	00°00.00'S	022°00.00'W		**RM** into the water during and after CTD station
M181_196	MSS 41	10.05.	MSS	16:23-17:04	00°00.00'S	022°00.00'W		**MSS** station
M181_197	DRIFT H25	10.05.	Surface drifter	16:42	00°00.00'S	022°00.00'W		**HEREON** drifter deployment
M181_198	DRIFT S10	10.05.	Surface drifter	16:43	00°00.00'S	022°00.00'W		**SVP** drifter deployment
M181_199	DRIFT H26	10.05.	Surface drifter	16:44	00°00.00'S	022°00.00'W		**HEREON** drifter deployment
M181_200	CTD 55	10.05.	CTD	23:28-01:50	00°00.00'S	023°03.40'W	3912	**CTD** station (to bottom)
M181_201	MSN 10	11.05.	MSN	02:05-02:55	00°00.00'S	023°03.40'W		**Multinet** station
M181_202	MSS 42	11.05.	MSS	02:58-03:23	00°00.00'S	023°03.40'W		**MSS** station
M181_203	DRIFT H27	11.05.	Surface drifter	03:25	00°00.00'S	023°03.40'W		**HEREON** drifter deployment
M181_204	CTD 56	11.05.	CTD	08:26-10:42	00°00.00'S	024°00.00'W	3262	**CTD** station (to bottom)
M181_205	MSS 43	11.05.	MSS	10:52-11:11	00°00.00'S	024°00.00'W		**MSS** station
M181_206	DRIFT H28	11.05.	Surface drifter	11:13	00°00.00'S	024°00.00'W		**HEREON** drifter deployment
M181_207	DRIFT S11	11.05.	Surface drifter	11:14	00°00.00'S	024°00.00'W		**SVP** drifter deployment
M181_208	DRIFT H29	11.05.	Surface drifter	11:14	00°00.00'S	024°00.00'W		**HEREON** drifter deployment
M181_209	RM 19	11.05.	Spectro-radio-meter	11:17-11:28	00°00.00'S	024°00.00'W		**RM** station
M181_210	DRIFT 11	11.05.	Drift buoy	16:54	00°00.00'S	025°00.00'W		**Drift buoy** deployment
M181_211	DRIFT H30	11.05.	Surface drifter	16:56	00°00.00'S	025°00.00'W		**HEREON** drifter deployment
M181_212	MSN 11	11.05.	MSN	17:00-17:50	00°00.00'S	025°00.00'W		**Multinet** station
M181_213	RM 20	11.05.	Spectro-radio-meter	17:14-17:31	00°00.00'S	025°00.00'W		**RM** station during MSN station
M181_214	CTD 57	11.05.	CTD	18:01-20:31	00°00.00'S	025°00.00'W		**CTD** station (to 1000m); 6 calibration stops for

								AZFP á 15 min, moored instrument calibration
M181_215	ISP 6	11.05.	ISP	20:41-22:46	00°00.00'S	025°00.00'W		**In situ pump** station
M181_216	CTD 58	11.05.	CTD	23:02-00:53	00°00.00'S	025°00.00'W	3206	**CTD** station (to bottom)
M181_217	MSN 12	12.05.	MSN	01:03-01:53	00°00.00'S	025°00.00'W		**Multinet** station
M181_218	MSS 44	12.05.	MSS	01:57-02:32	00°00.00'S	025°00.00'W		**MSS** station
M181_219	DRIFT 11	12.05.	Drift buoy	03:21	00°00.00'S	025°00.00'W		**Drift buoy** recovery
M181_220	CTD 59	12.05.	CTD	08:36-10:41	00°00.00'S	026°00.00'W	3698	**CTD** station (to bottom)
M181_221	RM 21	12.05.	Spectro-radio-meter	10:22-10:37	00°00.00'S	026°00.00'W		**RM** station during CTD station
M181_222	RM 22	12.05.	Spectro-radio-meter	10:46-10:56	00°00.00'S	026°00.00'W		**RM** station
M181_223	MSS 45	12.05.	MSS	10:59-11:18	00°00.00'S	026°00.00'W		**MSS** station
M181_224	DRIFT H31	12.05.	Surface drifter	11:20	00°00.00'S	026°00.00'W		**HEREON** drifter deployment
M181_225	DRIFT S12	12.05.	Surface drifter	11:21	00°00.00'S	026°00.00'W		**SVP** drifter deployment
M181_226	DRIFT H32	12.05.	Surface drifter	11:22	00°00.00'S	026°00.00'W		**HEREON** drifter deployment
M181_227	CTD 60	12.05.	CTD	16:55-18:48	00°00.00'S	027°00.00'W	3323	**CTD** station (to bottom)
M181_228	RM 23	12.05.	Spectro-radio-meter	17:37-17:55	00°00.00'S	027°00.00'W		**RM** into the water during CTD station
M181_229	MSS 46	12.05.	MSS	18:55-19:22	00°00.00'S	027°00.00'W		**MSS** station
M181_230	DRIFT H33	12.05.	Surface drifter	19:06	00°00.00'S	027°00.00'W		**HEREON** drifter deployment
M181_231	DRIFT S13	12.05.	Surface drifter	19:08	00°00.00'S	027°00.00'W		**SVP** drifter deployment
M181_232	DRIFT H34	12.05.	Surface drifter	19:09	00°00.00'S	027°00.00'W		**HEREON** drifter deployment
M181_233	CTD 61	13.05.	CTD	01:08-03:29	00°00.00'S	028°00.00'W	3950	**CTD** station (to bottom)
M181_234	MSN 13	13.05.	MSN	03:40-04:30	00°00.00'S	028°00.00'W		**Multinet** station
M181_235	MSS 47	13.05.	MSS	04:34-05:02	00°00.00'S	028°00.00'W		**MSS** station
M181_236	DRIFT H35	13.05.	Surface drifter	04:43	00°00.00'S	028°00.00'W		**HEREON** drifter deployment
M181_237	DRIFT S14	13.05.	Surface drifter	04:47	00°00.00'S	028°00.00'W		**SVP** drifter deployment
M181_238	CTD 62	13.05.	CTD	11:05-13:25	00°00.00'S	029°00.00'W	3536	**CTD** station (to bottom); APA do Arquipélago de São Pedro e São Paulo
M181_239	RM 24	13.05.	Spectro-radio-meter	11:52-12:09	00°00.00'S	029°00.00'W		**RM** into the water during CTD station
M181_240	MSS 48	13.05.	MSS	13:34-14:00	00°00.00'S	029°00.00'W		**MSS** station
M181_241	CTD 63	13.05.	CTD	20:13-20:37	00°00.00'S	030°00.00'W		**CTD** station (to 200m); APA do Arquipélago de São Pedro e São Paulo
M181_242	ISP 7	13.05.	ISP	20:47-22:52	00°00.00'S	030°00.00'W		**In situ pump** station
M181_243	CTD 64	13.05.	CTD	23:01-01:33	00°00.00'S	030°00.00'W	3854	**CTD** station (to bottom)
M181_244	MSS 49	14.05.	MSS	01:46-02:11	00°00.00'S	030°00.00'W		**MSS** station
M181_245	CTD 65	14.05.	CTD	08:18-10:55	00°00.00'S	031°00.00'W	4235	**CTD** station (to bottom)
M181_246	MSN 14	14.05.	MSN	11:04-11:51	00°00.00'S	031°00.00'W		**Multinet** station
M181_247	RM 25	14.05.	Spectro-radio-meter	11:15-11:35	00°00.00'S	031°00.00'W		**RM** into the water during MSN station

M181_248	MSS 50	14.05.	MSS	11:58-12:18	00°00.00'S	031°00.00'W		**MSS** station
M181_249	DRIFT H36	14.05.	Surface drifter	12:19	00°00.00'S	031°00.00'W		**HEREON** drifter deployment
M181_250	DRIFT S15	14.05.	Surface drifter	12:20	00°00.00'S	031°00.00'W		**SVP** drifter deployment
M181_251	RM 26	14.05.	Spectro-radio-meter	18:18-18:36	00°00.00'S	032°00.00'W		**RM** station
M181_252	CTD 66	14.05.	CTD	18:38-21:35	00°00.00'S	032°00.00'W	4282	**CTD** station (to bottom)
M181_253	MSS 51	14.05.	MSS	21:45-22:07	00°00.00'S	032°00.00'W		**MSS** station
M181_254	DRIFT H37	14.05.	Surface drifter	22:08	00°00.00'S	032°00.00'W		**HEREON** drifter deployment
M181_255	CTD 67	15.05.	CTD	04:10-06:44	00°00.00'S	033°00.00'W	4545	**CTD** station (to bottom)
M181_256	MSS 52	15.05.	MSS	06:59-07:30	00°00.00'S	033°00.00'W		**MSS** station
M181_257	DRIFT H38	15.05.	Surface drifter	07:01	00°00.00'S	033°00.00'W		**HEREON** drifter deployment
M181_258	DRIFT S16	15.05.	Surface drifter	07:02	00°00.00'S	033°00.00'W		**SVP** drifter deployment
M181_259	DRIFT H39	15.05.	Surface drifter	07:03	00°00.00'S	033°00.00'W		**HEREON** drifter deployment
M181_260	RM 27	15.05.	Spectro-radio-meter	13:33-13:47	00°00.00'S	034°00.00'W		**RM** station
M181_261	CTD 68	15.05.	CTD	13:52-16:30	00°00.00'S	034°00.00'W	4563	**CTD** station (to bottom)
M181_262	MSN 15	15.05.	MSN	16:37-17:25	00°00.00'S	034°00.00'W		**Multinet** station
M181_263	MSS 53	15.05.	MSS	17:29-17:52	00°00.00'S	034°00.00'W		**MSS** station
M181_264	DRIFT H40	15.05.	Surface drifter	17:37	00°00.00'S	034°00.00'W		**HEREON** drifter deployment
M181_265	CTD 69	16.05.	CTD	00:06-00:33	00°00.00'S	035°00.00'W		**CTD** station (to 200m)
M181_266	ISP 8	16.05.	ISP	00:43-02:45	00°00.00'S	035°00.00'W		**In situ pump** station
M181_267	CTD 70	16.05.	CTD	02:57-05:34	00°00.00'S	035°00.00'W	4549	**CTD** station (to bottom)
M181_268	MSS 54	16.05.	MSS	05:43-06:09	00°00.00'S	035°00.00'W		**MSS** station
M181_269	DRIFT H41	16.05.	Surface drifter	05:50	00°00.00'S	035°00.00'W		**HEREON** drifter deployment
M181_270	DRIFT S17	16.05.	Surface drifter	05:55	00°00.00'S	035°00.00'W		**SVP** drifter deployment
M181_271	DRIFT H42	16.05.	Surface drifter	05:57	00°00.00'S	035°00.00'W		**HEREON** drifter deployment
M181_272	CTD 71	16.05.	CTD	12:14-14:52	00°00.00'S	036°00.00'W	4532	**CTD** station (to bottom)
M181_273	RM 28	16.05.	Spectro-radio-meter	12:55-13:10	00°00.00'S	036°00.00'W		**RM** into the water during CTD station
M181_274	MSS 55	16.05.	MSS	15:00-15:27	00°00.00'S	036°00.00'W		**MSS** station
M181_275	DRIFT H43	16.05.	Surface drifter	15:06	00°00.00'S	036°00.00'W		**HEREON** drifter deployment
M181_276	CTD 72	16.05.	CTD	21:30-00:10	00°00.00'S	037°00.00'W	4516	**CTD** station (to bottom)
M181_277	MSN 16	17.05.	MSN	00:19-00:49	00°00.00'S	037°00.00'W		**Multinet** station
M181_278	MSS 56	17.05.	MSS	01:16-01:38	00°00.00'S	037°00.00'W		**MSS** station
M181_279	DRIFT H44	17.05.	Surface drifter	01:27	00°00.00'S	037°00.00'W		**HEREON** drifter deployment
M181_280	DRIFT S18	17.05.	Surface drifter	01:39	00°00.00'S	037°00.00'W		**SVP** drifter deployment
M181_281	CTD 73	17.05.	CTD	07:42-10:12	00°00.00'S	038°00.00'W	4451	**CTD** station (to bottom)
M181_282	MSS 57	17.05.	MSS	10:19-10:40	00°00.00'S	038°00.00'W		**MSS** station
M181_283	CTD 74	17.05.	CTD	13:48-16:25	00°00.00'S	038°30.00'W	4379	**CTD** station (to bottom)
M181_284	RM 29	17.05.	Spectro-radio-meter	14:31-14:46	00°00.00'S	038°30.00'W		**RM** into the water during CTD station

M181_285	CTD 75	17.05.	CTD	19:24-21:52	00°00.00'S	039°00.00'W	4319	**CTD** station (to bottom)
M181_286	MSS 58	17.05.	MSS	22:02-22:23	00°00.00'S	039°00.00'W		**MSS** station
M181_287	CTD 76	18.05.	CTD	02:24-03:24	00°00.00'S	039°30.00'W	4199	**CTD** station (to bottom)
M181_288	CTD 77	18.05.	CTD	06:25-06:47	00°00.00'S	040°00.00'W		**CTD** station (to 200m)
M181_289	ISP 9	18.05.	ISP	06:58-08:54	00°00.00'S	040°00.00'W		**In situ pump** station
M181_290	CTD 78	18.05.	CTD	09:05-11:06	00°00.00'S	040°00.00'W	3472	**CTD** station (to bottom)
M181_291	MSN 17	18.05.	MSN	11:13-12:01	00°00.00'S	040°00.00'W		**Multinet** station
M181_292	RM 30	18.05.	Spectro-radio-meter	11:45-12:02	00°00.00'S	040°00.00'W		**RM** into the water during MSN station
M181_293	MSS 59	18.05.	MSS	12:06-12:28	00°00.00'S	040°00.00'W		**MSS** station
M181_294	CTD 79	18.05.	CTD	15:08-17:19	00°00.00'S	040°30.00'W	3901	**CTD** station (to bottom)
M181_295	CTD 80	18.05.	CTD	19:58-22:16	00°00.00'S	041°00.00'W	3824	**CTD** station (to bottom)
M181_296	MSS 60	18.05.	MSS	22:28-22:46	00°00.00'S	041°00.00'W		**MSS** station
M181_297	CTD 81	19.05.	CTD	01:26-03:41	00°00.00'S	041°30.00'W	3902	**CTD** station (to bottom)
M181_298	CTD 82	19.05.	CTD	06:22-08:35	00°00.00'S	042°00.00'W	3866	**CTD** station (to bottom)
M181_299	MSS 61	19.05.	MSS	08:44-09:08	00°00.00'S	042°00.00'W		**MSS** station
M181_300	CTD 83	19.05.	CTD	11:50-14:03	00°00.00'S	042°30.00'W	3693	**CTD** station (to bottom)
M181_301	RM 31	19.05.	Spectro-radio-meter	14:06-14:19	00°00.00'S	042°30.00'W		**RM** station
M181_302	MSN 18	19.05.	MSN	16:41-17:29	00°00.00'S	043°00.00'W		**Multinet** station
M181_303	CTD 84	19.05.	CTD	17:36-19:27	00°00.00'S	043°00.00'W	3136	**CTD** station (to bottom)
M181_304	MSS 62	19.05.	MSS	19:35-20:04	00°00.00'S	043°00.00'W		**MSS** station
M181_305	CTD 85	19.05.	CTD	22:25-00:22	00°00.00'S	043°30.00'W	3472	**CTD** station (to bottom)
M181_306	CTD 86	20.05.	CTD	01:40-03:35	00°00.00'S	043°45.00'W	3254	**CTD** station (to bottom)
M181_307	CTD 87	20.05.	CTD	04:33-06:36	00°00.00'S	043°55.00'W	3100	**CTD** station (to bottom)
M181_308	ISP 10	20.05.	ISP	07:05-09:07	00°00.00'S	044°00.00'W		**In situ pump** station
M181_309	CTD 88	20.05.	CTD	09:38-11:30	00°00.00'S	044°00.00'W	3058	**CTD** station (to bottom)
M181_310	MSS 63	20.05.	MSS	11:38-11:57	00°00.00'S	044°00.00'W		**MSS** station
M181_311	CTD 89	20.05.	CTD	13:03-14:42	00°00.00'S	044°05.00'W	2654	**CTD** station (to bottom)
M181_312	RM 32	20.05.	Spectro-radio-meter	14:45-14:58	00°00.00'S	044°05.00'W		**RM** station
M181_313	CTD 90	20.05.	CTD	15:45-16:58	00°00.00'S	044°10.00'W	1990	**CTD** station (to bottom)
M181_314	CTD 91	20.05.	CTD	17:40-18:28	00°00.00'S	044°15.00'W	1221	**CTD** station (to bottom)
					00°00.00'S	044°45.00'W		**ADCP section**
M181_315	KPO1247	22.05.	Mooring	19:19-19:39	07°33.32'N	041°08.32'W		**Surface Buoy** recovery
M181_316	GEOMAR4	23.05.	WVGL	17:29	08°27.60'N	037°16.60'W		**Wave Glider** recovery
M181_317	RM 33	23.05.	Spectro-radio-meter	17:37-17:49	08°27.60'N	037°16.60'W		**RM** station
M181_318	RM 34	24.05.	Spectro-radio-meter	16:31-16:46	11°01.39'N	034°00.17'W		**RM** station
M181_319	KPO1247	27.05.	Mooring	08:45-09:51	17°11.23'N	025°36.27'W	193	**Mooring** recovery

7.2 CTD Station list

Shp Stn	CTD	Date	Time	Latitude	Longitude	Max. CTD depth	EM 122 depth	Measurements
2	1	2022/04/21	15:08	16°59.933'S	11°10.909'E	1215	1245	L S T U B N M H L P F I K
5	2	2022/04/21	23:31	16°00.007'S	11°33.926'E	852	873	L S C T U B
7	3	2022/04/22	06:25	14°59.995'S	12°04.000'E	412	431	L S C T U B A
9	4	2022/04/22	12:35	14°00.037'S	12°12.026'E	483	488	L S C T U B A N M H L K
11	5	2022/04/22	20:35	13°00.011'S	12°43.027'E	928	941	L S C T U B A
13	6	2022/04/23	11:10	10°50.008'S	13°00.004'E	1207	1226	L S C T U B A N H L K
17	7	2022/04/23	16:04	10°36.018'S	13°20.999'E	100	109	L S T U B A
19	8	2022/04/23	17:39	10°37.968'S	13°18.018'E	116	124	L S T U B A M
21	9	2022/04/23	19:15	10°39.918'S	13°15.048'E	209	217	L S U B A
23	10	2022/04/23	21:15	10°41.964'S	13°12.006'E	422	435	L S T U B A M
25	11	2022/04/23	23:26	10°44.044'S	13°08.976'E	690	694	L S U B A
27	12	2022/04/24	02:03	10°45.991'S	13°06.060'E	926	937	L S U B A M
29	13	2022/04/24	04:45	10°48.017'S	13°03.017'E	1137	1152	L S C U B A
33	14	2022/04/24	15:20	10°28.018'S	13°32.998'E	21	24	L S C T U B A N H L K
35	15	2022/04/24	19:26	10°30.005'S	13°30.006'E	37	46	L S C T U B A M
38	16	2022/04/25	00:18	10°32.003'S	13°27.014'E	55	62	L S C T U B A
40	17	2022/04/25	03:56	10°34.009'S	13°23.988'E	85	90	L S C T U B A
44	18	2022/04/25	11:33	10°55.039'S	12°52.498'E	1348	1365	L S T U B A N H L P F I K
47	19	2022/04/25	14:47	11°00.001'S	12°45.002'E	1395	1419	L S T U B A M
49	20	2022/04/25	20:34	11°19.966'S	12°15.036'E	2269	2309	L S C T U B A
52	21	2022/04/26	05:52	11°44.969'S	11°38.038'E	180	3459	L S U B A M
55	22	2022/04/26	11:21	11°10.084'S	11°12.899'E	3654	3694	L S T U B A N H L P F I K
61	23	2022/04/27	18:25	6°00.188'S	10°57.872'E	208	1443	L S T U B A N M H L P F I K
66	24	2022/04/28	14:24	4°00.032'S	8°00.061'E	201	4059	L S C T U B A N H L P F I K
71	25	2022/04/30	05:58	0°00.007'N	1°59.960'E	4601	4610	L O C T U B A N 2 M D H L P F I K
76	26	2022/04/30	16:12	0°00.026'N	1°00.011'E	4693	4821	L O C T U B A N 2 H L P F I K
81	27	2022/05/01	04:18	0°00.024'N	0°00.014'W	208	2349	L O U B A 2 M D H L P F I K
83	28	2022/05/01	05:35	0°00.026'N	0°00.042'E	4906	9	L O C T U B A N 2 M D I K
87	29	2022/05/01	15:37	0°00.004'N	0°59.958'W	4965	4992	L O T U B A N 2 M D H L K
91	30	2022/05/02	01:46	0°00.013'N	1°59.980'W	5015	5100	L O C T U B A N H L P F I K
93	31	2022/05/02	13:46	0°00.013'S	2°59.993'W	5088	5125	L O C T U B A N M D H L P F I K
96	32	2022/05/02	22:53	0°00.031'N	4°00.106'W	5108	5148	L O C T U B A N 2 M H L K
99	33	2022/05/03	09:15	0°00.010'N	5°00.043'W	201	5158	L O U B A 2 M D H L P F I
102	34	2022/05/03	10:35	0°00.349'S	4°59.821'W	5119	5182	L O C T U B A N 2 M D K
105	35	2022/05/03	21:31	0°00.013'S	6°00.148'W	4972	5393	L O C T U B A N H L P F I K
107	36	2022/05/04	06:55	0°00.013'N	7°00.024'W	5113	5179	L O C T U B A N 2 M D H L K
112	37	2022/05/04	17:02	0°00.005'S	8°00.080'W	5176	5201	L O C T U B A N M D H L P F I K
117	38	2022/05/05	01:55	0°00.005'S	9°00.059'W	4285	4737	L O C T U B N 2 M H L
124	39	2022/05/05	11:34	0°00.072'N	10°00.146'W	201	5073	L O U B 2 H L P F I
126	40	2022/05/05	13:12	0°00.179'N	9°59.952'W	4735	5758	L O C T U B N 2 M D K
131	41	2022/05/06	00:46	0°00.022'N	11°00.058'W	3934	4198	L O C T U B N 2 M H L
134	42	2022/05/06	09:12	0°00.046'N	11°59.987'W	3929	4169	L O C T U B N M D H L P F I K
140	43	2022/05/06	17:40	0°00.062'N	13°00.025'W	4337	4389	L O C T U B N M D H L P F I K
146	44	2022/05/07	03:01	0°00.026'N	14°00.025'W	3759	3895	L O C T U B N 2 M H L
153	45	2022/05/07	11:50	0°00.038'N	15°00.022'W	201	3930	L O U B 2 H L P F I
156	46	2022/05/07	14:31	0°00.181'N	14°59.378'W	3744	3777	L O C T U B N 2 M D K
160	47	2022/05/07	23:43	0°00.012'N	15°59.916'W	3283	3313	L O C T U B N H L P f I K
165	48	2022/05/08	08:10	0°00.019'N	17°00.013'W	5031	5104	L O C T U B N 2 M D H L
170	49	2022/05/08	18:43	0°00.038'N	18°02.996'W	5952	5990	L O C T U B A N 2 M D H L P F I K
175	50	2022/05/09	04:40	0°00.020'N	19°00.006'W	4367	4399	L O C T U B A N M H L P F I K
182	51	2022/05/09	14:08	0°00.004'N	20°00.050'W	203	2597	L O U B A 2 H L P F I
185	52	2022/05/09	15:48	0°00.118'N	19°59.878'W	2519	2556	L O C T U B A N 2 M D K
189	53	2022/05/10	02:19	0°00.031'N	21°00.048'W	5093	5126	L O C U B A N 2 M H L
194	54	2022/05/10	13:39	0°00.012'S	22°00.139'W	4120	4849	L O C T U B A N M D H L P F I K
200	55	2022/05/10	23:26	0°00.001'N	23°03.468'W	3882	3989	L O C U B A N M D H L P F I K
204	56	2022/05/11	08:24	0°00.011'N	24°00.006'W	3916	3953	L O C T U B A N 2 H L
214	57	2022/05/11	17:59	0°00.050'S	25°00.013'W	1004	3192	L O U B A N 2 H L P F I K
216	58	2022/05/11	23:00	0°00.078'S	25°00.010'W	3172	3206	L O C T U B A 2
220	59	2022/05/12	08:33	0°00.002'N	25°59.954'W	3665	3697	L O C T U B A N M D H L P F I
227	60	2022/05/12	16:53	0°00.008'N	26°59.960'W	3291	3324	L O C T U B A N 2 M H L K

233	61	2022/05/13	01:04	0°00.006'S	27°59.964'W	3916	3949	L O C U B A N M H L
238	62	2022/05/13	11:04	0°00.036'N	28°59.920'W	3466	3808	L O C T U B A N 2 M H L K
241	63	2022/05/13	20:12	0°00.001'N	29°59.878'W	203	3831	L O U B A N 2 H L P F I K
243	64	2022/05/13	22:55	0°00.082'N	29°59.560'W	3819	3854	L O C U B A N 2 M H L
245	65	2022/05/14	08:16	0°00.044'N	30°59.924'W	4185	4253	L O C T U B A N M H L P F I K
252	66	2022/05/14	18:38	0°00.037'S	31°59.740'W	4218	4314	L O C T U B A N 2 H L K
255	67	2022/05/15	04:07	0°00.035'N	33°00.020'W	4509	4589	L O C U B A N M D H L P F I K
261	68	2022/05/15	13:49	0°00.044'N	34°00.002'W	4521	4560	L O C T U B A N M H L P F I K
265	69	2022/05/16	00:04	0°00.055'S	34°59.923'W	252	4544	L O U B A N 2 H L P F I K
267	70	2022/05/16	02:48	0°00.024'S	34°59.958'W	4508	4546	L O C U B A 2 M D
272	71	2022/05/16	12:12	0°00.006'N	36°00.005'W	4497	4546	L O C T U B A N 2 H L
276	72	2022/05/16	21:27	0°00.034'S	36°59.945'W	4480	4515	L O C U B A N M D H L P F I K
281	73	2022/05/17	07:39	0°00.029'S	38°00.006'W	4415	4451	L O C T U B A M D
283	74	2022/05/17	13:46	0°00.010'S	38°30.002'W	4343	4376	L O C T U B A N H L P F I K
285	75	2022/05/17	19:22	0°00.042'S	39°00.127'W	4284	4318	L O C T U B A 2 M
287	76	2022/05/18	01:11	0°00.014'N	39°30.046'W	4161	4198	L O C U B A
288	77	2022/05/18	06:21	0°00.024'N	40°00.116'W	202	3404	L O U B A N 2 H L P F I K
290	78	2022/05/18	08:57	0°00.025'N	40°00.118'W	3391	3432	L O C T U B A 2 M
294	79	2022/05/18	15:07	0°00.067'N	40°30.023'W	3868	3900	L O C T U B A
295	80	2022/05/18	19:56	0°00.070'N	41°00.073'W	3790	3824	L O U B A N M H L P F I K
297	81	2022/05/19	01:30	0°00.082'N	41°30.226'W	3867	3903	L O C U B A
298	82	2022/05/19	06:19	0°00.053'N	42°00.024'W	3829	3865	L O C U A 2 M
300	83	2022/05/19	11:53	0°00.250'N	42°30.233'W	3655	3692	L O C T U A N H L P F I K
303	84	2022/05/19	17:35	0°00.186'N	43°00.268'W	3106	3215	L O C T U A 2 M
305	85	2022/05/19	22:20	0°00.016'N	43°30.128'W	3437	3474	L O C U A
306	86	2022/05/20	01:39	0°00.085'N	43°45.170'W	3213	3262	L O U A
307	87	2022/05/20	04:49	0°00.185'N	43°55.984'W	3061	3096	L O U A
309	88	2022/05/20	09:35	0°00.098'N	44°00.140'W	3022	3059	L O T U A 2 M
311	89	2022/05/20	13:02	0°00.037'N	44°05.200'W	2665	2900	L O T U A N H L P F I K
313	90	2022/05/20	15:43	0°00.067'N	44°10.166'W	1970	2111	L O U A
314	91	2022/05/20	17:38	0°00.140'N	44°15.162'W	1140	1169	L O T U A M

Abbreviations of additional measurements given in the CTD station list

L	LADCP
S/O	SUNA/OPUS
C	Conductivity/Salinity
T	O_2-Titration
U	UVP5
B	PISCO
A	AZFP
N	Nutrients
2	Thorium
M	Organic Matter
D	Prokaryotes DNA
H	HPLC
L	CLASS
P	Primary Production
F	N2 fixation
I	Stable C and N isotopes in particle
K	Planktoscope

7.3 Moving Vessel Profiler deployments

Ship Station	Start Time	End Time	Start Latitude	Start Longitude	End Latitude	End Longitude	Profiles
1	21.04.22 13:10	21.04.22 14:54	17°14.05'S	011°16.54'E	17°00,98'S	011°11.25'E	33
4	21.04.22 17:59	21.04.22 23:21	16°59.31'S	011°11.27'E	16°00,33'S	011°32.75'E	182

6	22.04.22 00:31	22.04.22 06:08	15°59.89'S	011°34.33'E	15°01,57'S	012°03.06'E	190
8	22.04.22 07:18	22.04.22 09:50	14°57.01'S	012°04.39'E	14°28,49'S	012°08.21'E	58
58	27.04.22 06:41	27.04.22 15:13	08°06.49'S	011°04.06'E	06°30,62'S	010°59.56'E	233
59	27.04.22 17:16	27.04.22 18:10	06°09.20'S	010°57.49'E	06°00,29'S	010°57.81'E	23
63	27.04.22 19:33	28.04.22 14:07	06°00.59'S	010°56.44'E	04°00,01'S	008°00.02'E	544
68	28.04.22 15:16	28.04.22 20:42	03°59.29'S	007°58.99'E	03°25.18'S	007°07.75'E	169

7.4 Drifter, float, and drift buoy deployments

7.4.1 HEREON drifter deployments

Buoy ID	**Latitude**	**Longitude**	**Deployment Date (UTC)**
D-121	00°00.495'S	007°00.087'W	04-May-2022 11:45
D-122	00˚00.103'S	008° 00.001'W	04-May-2022 20:42
D-125	00˚00.131'S	007° 59.983'W	04-May-2022 20:48
D-126	00° 00.426'S	008° 59.742'W	05-May-2022 05:19
D-123	00˚ 00.488'N	009° 51.405'W	05-May-2022 10:11
D-124	00˚ 00.092'N	010° 00.073'W	05-May-2022 11:21
D-127	00˚ 00.244'S	010°59.841'W	06-May-2022 04:01
D-128	00˚00.028'S	011˚59.966'W	06-May-2022 12:06
D-129	00˚00.073'S	011˚59.980'W	06-May-2022 12:10
D-131	00˚00.016'N	013˚00.091'W	06-May-2022 21:42
D-130	00˚00.013'N	013˚00.162'W	06-May-2022 21:46
D-132	00˚00.665'S	013˚59.937'W	07-May-2022 06:17
D-133	00˚00.039'N	015˚00.037'W	07-May-2022 11:36
D-135	00˚00.039'N	015˚00.041'W	07-May-2022 11:38
D-134	00˚00.377'S	015˚59.327'W	08-May-2022 02:31
D-136	00˚00.410'S	015˚59.312'W	08-May-2022 02:32
D-137	00˚00.119'S	016˚59.746'W	08-May-2022 12:33
D-138	00˚00.174'S	018˚03.000'W	08-May-2022 23:00
D-139	00˚00.203'S	018˚02.999'W	08-May-2022 23:03
D-140	00˚00.509'S	018˚59.873'W	09-May-2022 08:15
D-141	00˚00.040'N	020˚00.010'W	09-May-2022 13:40
D-142	00˚00.033'N	020˚00.018'W	09-May-2022 13:41
D-143	00˚00.438'S	020˚59.748'W	10-May-2022 06:04
D-144	00˚00.472'S	020˚59.751'W	10-May-2022 06:05
D-145	00˚00.143'S	022˚00.131'W	10-May-2022 16:42
D-146	00˚00.161'S	022˚00.137'W	10-May-2022 16:44
D-147	00˚00.050'S	023˚03.118'W	11-May-2022 03:25
D-148	00˚00.027'S	023˚59.709'W	11-May-2022 11:12
D-149	00˚00.034'S	023˚59.698'W	11-May-2022 11:14
D-150	00˚00.052'S	025˚00.017'W	11-May-2022 16:56
D-151	00˚00.062'S	025˚59.391'W	12-May-2022 11:20
D-152	00˚00.085'S	025˚59.352'W	12-May-2022 11:21
D-153	00˚00.141'S	026˚59.556'W	12-May-2022 19:05
D-154	00˚00.164'S	026˚59.478'W	12-May-2022 19:08
D-155	00˚00.175'S	027˚59.130'W	13-May-2022 04:43
D-156	00˚00.046'N	30˚59.081'W	14-May-2022 12:19
D-157	00˚00.446'S	31˚59.229'W	14-May-2022 22:07

D-158	00˚00.363’N	32˚59.907’W	15-May-2022 07:01
D-159	00˚00.411’N	32˚59.873’W	15-May-2022 07:03
D-160	00˚00.203’N	33˚59.111’W	15-May-2022 17:36
D-161	00˚00.059’N	34˚59.833’W	16-May-2022 05:50
D-162	00˚00.136’N	34˚59.729’W	16-May-2022 05:56
D-163	00˚00.429’S	35˚59.320’W	16-May-2022 15:05
D-164	00˚00.569’S	36˚59.254’W	17-May-2022 01:26

7.4.2 SVP drifter deployments

IMEI	WMO	Program and Platform	Latitude	Longitude	Deployment Date (UTC)
300534062125180	1501765	GDP SVP	00° 00.120‘ N	007° 59.990‘W	04-May-2022 20:45
300534062123870	1501761	GDP SVP	00° 00.487‘ N	009° 51.405‘ W	05-May-2022 10:14
300534062124880	1501764	GDP SVP	00° 00.054‘ S	011° 59.971‘ W	06-May-2022 12:08
300534062123380	1501760	GDP SVP	00° 00.014‘ N	013° 00.136‘ W	06-May-2022 21:46
300534062122880	1501758	GDP SVP	00°00.041‘N	015° 00.037 W	07-May-2022 11:37
300534062123370	1501759	GDP SVP	00° 00.394‘S	015° 59.319‘W	08-May-2022 02:32
300534062023990	1501768	GDP SVPB	00° 00.189‘S	018° 03.000‘W	08-May-2022 23:01
300534062023750	1501766	GDP SVPB	00° 00.035‘N	020° 00.013‘W	09-May-2022 13:41
300534062123880	1501762	GDP SVP	00° 00.463‘S	020° 59.749‘W	10-May-2022 06:05
300534062024550	1501769	GDP SVPB	00° 00.151‘S	022° 00.132‘W	10-May-2022 16:43
300534062024720	1501770	GDP SVPB	00˚ 00.033’S	023˚ 59.702 W	11-May-2022 11:13
300534062023970	1501767	GDP SVPB	00° 00.075‘S	025˚ 59.369‘W	12-May-2022 11:21
300534062124870	1501763	GDP SVP	00° 00.156‘S	026˚ 59.503‘W	12-May-2022 19:07
300534062024940	1501774	GDP SVPB	00° 00.226‘S	027˚ 59.050‘W	13-May-2022 04:46
300534062024800	1501773	GDP SVPB	00° 00.046‘N	030° 59.081‘W	14-May-2022 12:29
300534062024960	1501775	GDP SVPB	00° 00.376‘N	032° 59.898‘W	15-May-2022 07:01
300534062024730	1501771	GDP SVPB	00° 00.121‘N	034° 59.752‘W	16-May-2022 05:55
300534062024770	1501772	GDP SVPB	00° 00.954’S	036° 59.136‘W	17-May-2022 01:39

7.4.3 Argo float deployments

Float serial number	WMO	Latitude	Longitude	Deployment Date (UTC)
AI2600-22DE009	6904212	11˚20.222’S	012˚14.944’E	26-Apr-2022 01:26
AI2600-22DE008	6904213	11˚10.467’S	011° 13.183’E	26-Apr-2022 14:41
AI2600-22DE007	6904214	11˚45.152’S	011° 37.958’E	26-Apr-2022 06:32
AI2600-22DE006	6904215	00° 00.062’N	014° 59.302’W	07-May-2022 17:09

7.4.4 Argo float recovery

Float serial number	WMO	Latitude	Longitude	Deployment Date (UTC)
P53337-20FR001	6903096	11˚09.979’S	011˚12.863’E	26-Apr-2022 10:53

7.4.5 Drift buoy deployments

Drift #	Deployment Latitude	Deployment Longitude	Deployment Date (UTC)	Recovery Latitude	Recovery Longitude	Recovery Date (UTC)
Drift 1	10˚36.010’S	013˚21.008’E	21-Apr-2022 15:54	10˚27.500’S	013˚22.596’E	25-Apr-2022 07:04
Drift 2	06˚00.189’S	010° 57.867’E	27-Apr-2022 18:17	06˚01.357’S	010° 56.801’E	27-Apr-2022 19:23
Drift 3	04˚00.018’S	008° 00.009’E	28-Apr-2022 14:08	03˚59.915’S	008° 00.069’E	28-Apr-2022 15:03

Drift 4	00˚00.002’N	001˚59.986’E	30-Apr-2022 03:04	00˚06.791’N	001˚58.408’E	30-Apr-2022 10:45
Drift 5	00˚00.028’N	001˚00.011’E	30-Apr-2022 16:03	00˚08.207’N	001˚00.276’E	30-Apr-2022 22:39
Drift 6	00˚00.030’N	001˚00.012’W	01-May-2022 14:33	00˚06.422’N	001˚01.716’W	01-May-2022 20:24
Drift 7 (attached to the boat)	00˚00.349’S	004˚59.821’W	03-May-2022 10:24	00˚00.209’S	004˚59.497’W	03-May-2022 15:43
Drift 8	00˚00.071’N	010˚00.149’W	05-May-2022 11:29	00˚03.721’N	010˚09.415’W	05-May-2022 20:24
Drift 9	00˚00.035’N	015˚00.038’W	07-May-2022 11:41	00˚05.201’N	015˚05.620’W	07-May-2022 18:49
Drift 10	00˚00.009’N	020˚00.053’W	09-May-2022 13:50	00˚04.869’N	020˚02.384’W	09-May-2022 13:50
Drift 11	00˚00.048’S	025˚00.018’W	11-May-2022 16:53	00˚02.493’N	025˚03.655’W	12-May-2022 03:20

7.4.6 Drift buoy configuration

Drift	**ADCP (kHz)**	**Bins length (m)**	**Blanking distance (m)**
Drift 1	300	4	1.76
Drift 2	1200	0.50	0.44
Drift 3	600	1	0.88
Drift 4	1200	0.50	0.44
Drift 5	1200	0.50	0.50
Drift 6	1200	0.50	0.50
Drift 7 (attached to the boat)	1200	0.50	0.50
Drift 8	1200	0.50	0.50
Drift 9	1200	0.50	0.50
Drift 10	1200	0.50	0.50
Drift 11	1200	0.50	0.50

7.5 List of mooring deployments and recoveries

7.5.1 Mooring Recoveries

Mooring Recovery PREFACE/SACUS Angola Array mooring					**Notes:**	**KPO_1235**
Vessel:	Sonne	SO283				
Deployed:	4-May	2021	06:42			
Vessel:	Meteor	M181				
Recovered:	23-Apr	2022	10:41			
Latitude:		10°	50.05’	S		
Longitude:		12°	59.93’	E		
Water depth:		1221	Mag Var:	-3.7597		
ID	**Depth**	**Instr. Type**	**s/n**	**Start-up ready**	**Remarks**	
KPO_1235_01	279	Argos Beacon	12616			
KPO_1235_02	305	Microcat	2263	**X**	clean and complete record	
KPO_1235_03	305	Optode	946	**X**	No record	
KPO_1235_04	503	Floatation	Flotec-3	**X**		
KPO_1235_05	502	SMM	2255	**X**		
KPO_1235_06	502	ADCP LR 75 kHz up	17590	**X**	clean and complete record	
KPO_1235_07	505	Microcat	1599	**X**	clean and complete record	
KPO_1235_08	505	Optode	1136	**X**	clean and complete record	
KPO_1235_09	654	RCM	477	**X**	No record	

KPO_1235_10	705	Microcat	2718	**X**	clean and complete record
KPO_1235_11	852	RCM	440	**X**	clean and complete record
KPO_1235_12	952	Microcat	2264	**X**	clean and complete record
KPO_1235_13	1051	RCM	441	**X**	clean and complete record
KPO_1235_14	1202	Microcat	1520	**X**	clean and complete record
KPO_1235_15	1216	Release AR661	821		**Mode**:A **Range**:4AA7 **Release**:4AA8
KPO_1235_16	1216	Release AR861	1549	Code:	**Mode**:B **Range**: 0A05 **Release**:0A55

7.5.2 Mooring Deployments

Mooring Deployment: Pressure inverted echo sounder					**Notes:**	**KPO_1248**
Vessel:	Meteor	M181				
Deployed:	25-Apr	2022	10:33			
Vessel:						
Recovered:						
Latitude:		10°	50.462’	S		
Longitude:		13°	00.252’	E		
Water depth:		1226				

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1248_01	1200	PIES	319	x	

Mooring Deployment PREFACE/SACUS Angola Array mooring					**Notes:**	**KPO_1246**
Vessel:	Meteor	M181				
Deployed:	24-Apr	2022	10:16			
Vessel:						
Recovered:						
Latitude:		10°	49.87’	S		
Longitude:		12°	59.90’	E		
Water depth:		1229	Mag Var:	-3.695		

ID	Depth	Instr. Type	s/n	Start-up Ready	Remarks
KPO_1246_01	279	Argos Beacon	12616		
KPO_1246_02	304	Microcat /p	10706	**X**	P (with Pressure sensor)
KPO_1246_03	304	Optode	939	**X**	
KPO_1246_04		Floatation	Flotec-3		
KPO_1246_05	502	ADCP LR 75 kHz up	12530	**X**	
KPO_1246_06	505	Microcat /p	10692	**X**	P (with Pressure sensor)
KPO_1246_07	505	Optode	942	**X**	
KPO_1246_08	654	Aquadop	P26209-3	**X**	
KPO_1246_09	704	Microcat	1682	**X**	
KPO_1246_10	850	Aquadop	40893-9-260	**X**	
KPO_1246_11	951	Microcat	3753	**X**	
KPO_1246_12	1047	Aquadop	40893-1-236	**X**	
KPO_1246_13	1207	Microcat/p	1719	**X**	P (with Pressure sensor)
KPO_1246_14	1216	Release AR661	821		**Mode**:A **Enable**: 4AA7 **Release**:4AA8
KPO_1246_15	1216	Release AR861	1647	Code:	**Mode**:B **Enable**: 0A8C **Release**:0A55

7.6 Microstructure station list

MSS Station	Ship Station	Date	Latitude	Longitude	Profiles
1	10	22.04.22 13:17	14°00.082'S	012°12.00'E	2
2	15	23.04.22 12:25	10°50.30'S	013°00.11'E	3
3	18	23.04.22 16:35	10°36,10'S	013°20.95'E	3
4	20	23.04.22 18:05	10°38,00'S	013°18.00'E	3
5	22	23.04.22 19:50	10°40.00'S	013°15.00'E	3
6	24	23.04.22 22:01	10°42.00'S	013°12.00'E	4
7	26	24.04.22 00:24	10°44.11'S	013°08.98'E	5
8	28	24.04.22 03:14	10°46.06'S	013°06.00'E	3
9	30	24.04.22 05:56	10°48.07'S	013°02.94'E	4
10	34	24.04.22 15:40	10°28.04'S	013°32.98'E	84
11	36	24.04.22 19:57	10°30.02'S	013°29.99'E	2
12	37	24.04.22 21:16	10°30.18'S	013°29.73'E	48
13	39	25.04.22 00:48	10°32.02'S	013°26.97'E	31
14	41	25.04.22 04:33	10°33.79'S	013°23.93'E	16
15	46	25.04.22 12:50	10°55.09'S	012°52.445'E	5
16	48	25.04.22 16:32	11°00.02'S	012°44.99'E	3
17	73	30.04.22 09:30	00°00.00'S	002°00.00'E	3
18	79	30.04.22 21:29	00°00.00'S	001°00.00'E	3
19	82	01.05.22 05:00	00°00.00'S	000°00.00'E	3
20	39	01.05.22 19:08	00°00.00'S	001°00.00'W	3
21	92	02.05.22 05:27	00°00.00'S	002°00.00'W	3
22	95	02.05.22 17:22	00°00.00'S	003°00.00'W	4
23	98	03.05.22 03:30	00°00.00'S	004°00.00'W	4
24	100	03.05.22 09:55	00°00.00'S	005°00.00'W	3
25	106	04.05.22 01:05	00°00.00'S	006°00.00'W	4
26	110	04.05.22 11:22	00°00.00'S	007°00.00'W	4
27	113	04.05.22 20:30	00°00.00'S	008°00.00'W	3
28	118	05.05.22 04:57	00°00.00'S	009°00.00'W	4
29	129	05.05.22 18:33	00°00.00'S	010°00.00'W	4
30	132	06.05.22 03:40	00°00.00'S	011°00.00'W	3
31	136	06.05.22 12:05	00°00.00'S	012°00.00'W	3
32	142	06.05.22 21:24	00°00.00'S	013°00.00'W	3
33	147	07.05.22 05:47	00°00.00'S	014°00.00'W	3
34	157	07.05.22 17:16	00°00.00'S	015°00.00'W	4
35	161	08.05.22 02:13	00°00.00'S	016°00.00'W	3
36	168	08.05.22 12:37	00°00.00'S	017°00.00'W	7
37	171	08.05.22 23:03	00°00.00'S	018°00.00'W	6
38	176	09.05.22 07:52	00°00.00'S	019°00.00'W	3
39	187	09.05.22 20:04	00°00.00'S	020°00.00'W	3
40	190	10.05.22 05:42	00°00.00'S	021°00.00'W	3
41	196	10.05.22 16:44	00°00.00'S	022°00.00'W	3
42	202	11.05.22 03:06	00°00.00'S	023°00.00'W	3
43	205	11.05.22 10:58	00°00.00'S	024°00.00'W	3
44	218	12.05.22 02:10	00°00.00'S	025°00.00'W	5
45	223	12.05.22 11:05	00°00.00'S	026°00.00'W	3

46	229	12.05.22 19:06	00°00.00'S	027°00.00'W	3
47	235	13.05.22 04:44	00°00.00'S	028°00.00'W	3
48	240	13.05.22 13:42	00°00.00'S	029°00.00'W	3
49	244	14.05.22 01:53	00°00.00'S	030°00.00'W	3
50	248	14.05.22 12:04	00°00.00'S	031°00.00'W	3
51	253	14.05.22 21:52	00°00.00'S	032°00.00'W	3
52	256	15.05.22 07:10	00°00.00'S	033°00.00'W	4
53	263	15.05.22 17:36	00°00.00'S	034°00.00'W	3
54	268	16.05.22 05:50	00°00.00'S	035°00.0.0'W	3
55	274	16.05.22 15:10	00°00.00'S	036°00.00'W	5
56	278	17.05.22 01:23	00°00.00'S	037°00.00'W	3
57	282	17.05.22 10:26	00°00.00'S	038°00.00'W	3
58	286	17.05.22 22:09	00°00.00'S	039°00.00'W	3
59	293	18.05.22 12:12	00°00.00'S	040°00.00'W	3
60	296	18.05.22 22:32	00°00.00'S	041°00.00'W	3
61	299	19.05.22 08:51	00°00.00'S	042°00.00'W	3
61	299	19.05.22 08:51	00°00.00'S	042°00.00'W	3
62	204	19.05.22 19:45	00°00.00'S	043°00.00'W	4
63	310	20.05.22 11:44	00°00.00'S	044°00.00'W	3

7.7 Biogeochemical sampling station list

^{13}C carbon and ^{15}N nitrogen fixation (BNF/PP), flow cytometry (F), HPLC (H), natural abundance of C/N isotopes in particles (PN), Planktoscope (PLS), CLASS (CL), and nutrients (N) sampling list.

Day	Month	Year	Station	CTD cast	Latitude	Longitude	Measurements
21	4	2022	2	1	-17.00	11.18	PN, BNF/PP, PLS,N,H,F, CL
22	4	2022	9	4	-14.00	12.20	PLS,N,H,F, CL
23	4	2022	13	6	-10.83	13.00	PLS,N,H,F, CL
23	4	2022	17	7	-10.60	13.35	N,H,F, CL
23	4	2022	25	11	-10.73	13.00	N,H,F, CL
24	4	2022	33	14	-10.47	13.55	PLS,N,H,F, CL
24	4	2022	38	16	-10.53	13.45	PLS,N,H,F, CL
25	4	2022	44	18	-10.92	12.87	PN, BNF/PP, PLS,N,H,F, CL
25	4	2022	47	19	-11.01	12.75	N
25	4	2022	49	20	-11.20	12.25	N
26	4	2022	55	22	-11.17	11.21	PN, BNF/PP, PLS,N,H,F, CL
27	4	2022	61	23	-6.00	10.96	PN, BNF/PP, PLS,N,H,F, CL
28	4	2022	66	24	-4.02	8.02	PN, BNF/PP, PLS,N,H,F, CL
30	4	2022	71	25	0.00	2.00	PN, BNF/PP, PLS,N,H,F, CL
30	4	2022	76	26	0.00	1.00	PN, BNF/PP, PLS,N,H,F, CL
1	5	2022	81	27	0.00	0.00	PN, BNF/PP,H,F, CL
1	5	2022	83	28	0.00	0.00	PN, PLS,N
1	5	2022	87	29	0.00	-1.00	PLS,N,H,F, CL
2	5	2022	91	30	0.00	-2.00	PN, BNF/PP, PLS,N,H,F, CL
2	5	2022	93	31	0.00	-3.00	PN, BNF/PP, PLS,N,H,F, CL
2	5	2022	96	32	0.00	-4.00	PLS,N,H,F, CL
3	5	2022	99	33	0.00	-5.00	PN, BNF/PP,H,F, CL
3	5	2022	102	34	-0.01	-5.00	PLS,N
4	5	2022	105	35	0.00	-6.00	PN, BNF/PP, PLS,N,H,F, CL
4	5	2022	107	36	0.00	-7.00	PLS,N,H,F, CL
4	5	2022	112	37	0.00	-8.00	PN, BNF/PP, PLS,N,H,F, CL

5	5	2022	117	38	0.00	-9.00	N,H,F, CL
5	5	2022	124	39	0.00	-10.00	PN, BNF/PP,N,H,F, CL
5	5	2022	126	40	0.00	-10.00	PLS,N
6	5	2022	131	41	0.00	-11.00	N,H,F, CL
6	5	2022	134	42	0.00	-12.00	PN, BNF/PP, PLS,N,H,F, CL
6	5	2022	140	43	0.00	-13.00	PN, BNF/PP, PLS,N,H,F, CL
7	5	2022	146	44	0.00	-14.00	N,H,F, CL
7	5	2022	153	45	0.00	-15.00	PN, BNF/PP,H,F, CL
7	5	2022	156	46	0.00	-15.00	PLS,N
8	5	2022	160	47	0.00	-16.00	PN, BNF/PP, PLS,N,H,F, CL
8	5	2022	170	49	0.00	-18.05	PN, BNF/PP, PLS,N,H,F, CL
9	5	2022	175	50	0.00	-19.00	PN, BNF/PP, PLS,N,H,F, CL
9	5	2022	182	51	0.00	-20.00	PN, BNF/PP,H,F, CL
9	5	2022	185	52	0.00	-20.00	PLS,N
10	5	2022	189	53	0.00	-21.00	N,H,F, CL
10	5	2022	194	54	0.00	-22.00	PN, BNF/PP, PLS,N,H,F, CL
11	5	2022	200	55	0.00	-23.06	PN, BNF/PP, PLS,N,H,F, CL
11	5	2022	204	56	0.00	-24.00	N,H,F, CL
11	5	2022	214	57	0.00	-25.00	PN, BNF/PP, PLS,N,H,F, CL
12	5	2022	220	59	0.00	-26.00	PN, BNF/PP, PLS,N,H,F, CL
12	5	2022	227	60	0.00	-27.00	PLS,N,H,F, CL
13	5	2022	233	61	0.00	-28.00	N,H,F, CL
13	5	2022	238	62	0.00	-29.00	PLS,N,H,F, CL
13	5	2022	241	63	0.00	-30.00	PN, BNF/PP, PLS,N,H,F, CL
14	5	2022	245	65	0.00	-31.00	PN, BNF/PP, PLS,N,H,F, CL
14	5	2022	252	66	0.00	-32.00	PLS,N
15	5	2022	255	67	0.00	-33.00	PN, BNF/PP, PLS,N,H,F, CL
15	5	2022	261	68	0.00	-34.00	PN, BNF/PP, PLS,N,H,F, CL
15	5	2022	265	69	0.00	-35.00	PN, BNF/PP, PLS,N,H,F, CL
16	5	2022	276	72	0.00	-37.00	PN, BNF/PP, PLS,N,H,F, CL
17	5	2022	283	74	0.00	-38.50	PN, BNF/PP, PLS,N,H,F, CL
18	5	2022	288	77	0.00	-40.00	PN, BNF/PP, PLS,N,H,F, CL
18	5	2022	295	80	0.00	-41.00	PN, BNF/PP, PLS,N,H,F, CL
19	5	2022	300	83	0.00	-42.50	PN, BNF/PP, PLS,N,H,F, CL
20	5	2022	311	89	0.00	-44.09	PN, BNF/PP, PLS,N,H,F, CL
20	5	2022	315	Pump	0.00	-44.75	PN, BNF/PP, PLS,N,H,F, CL
23	5	2022	317	Pump	8.46	-37.28	PN, BNF/PP, PLS,N,H,F, CL
24	5	2022	318	Pump	11.02	-34.00	PLS,N,H,F, CL
25	5	2022	319	Pump	13.06	-31.31	PLS,N,H,F, CL

7.8 Multinet station list

Ship Station	MultiNet ID	Haul	Latitude	Longitude	Date	Time Start (UTC)	Start Profile (UTC)	End Profile (UTC)
50	MSN-1	1	11°19.999‘S	012°15,008‘E	25.04.22	23:05	-	01:14
70	MSN-2	1	00°00.001‘N	001°59,986°E	30.04.22	03:17	04:30	05:30
86	MSN-3	1	00°00,005‘N	001°00,017‘W	01.05.22	14:39	15:06	15:30
97	MSN-4	1	00°00,002’N	003°59,995’W	03.05.22	02:21	02:45	03:12
109	MSN-5	1	00°00,024’N	006°59,991’W	04.05.11	10:19	10:42	11:14
125	MSN-6	1	00°00,133’N	010°00,051‘W	05.05.22	12:06	12:32	13:00
141	MSN-7	1	00°00,032’N	012°59,88’W	06.05.22	20:28	20:52	21:14
167	MSN-8	1	00°00,022’S	016°59,947’W	08.05.22	11:29	11:53	12:16
183	MSN-9	1	00°00,022’N	019°59,971’W	09.05.22	14:46	15:10	15:30
201	MSN-10	1	00°00,059’N	023°03,308’W	11.05.22	02:07	02:31	02:53
213	MSN-11	1	00°00,051’S	025°00,015’W	11.05.22	17:02	17:28	17:49
217	MSN-12	2	00°00,005’S	025°00,010’W	12.05.22	01:03	01:29	01:53

234	MSN-13	1	00°00,013'S	027°59,668'W	13.05.22	03:41	04:05	04:29
246	MSN-14	1	00°00,092'N	030°59,865'W	14.05.22	11:04	11:27	11:50
262	MSN-15	1	00°00,150'N	033°59,795'W	15.05.22	16:38	17:01	17:24
277	MSN-16	1	00°00,028'S	036°59,924'W	17.05.22	00:19	00:49	01:10
291	MSN-17	1	00°00,024'N	040°00,116'W	18.05.22	11:13	11:38	12:01
302	MSN-18	1	00°00,061'N	043°00,046'W	19.05.22	16:41	17:05	17:28

7.9 Spectroradiometer sampling station list

Ship Station	Date	Julian Date	UTC	Latitude	Longitude
14	4/23/22	113	11:20	-10.8346	13.0009
32	4/24/22	114	15:00	-10.4670	13.5500
45	4/25/22	115	11:45	-10.9173	12.8748
56	4/26/22	116	11:49	-11.1681	11.2150
65	4/28/22	118	14:25	-4.0083	8.0067
72	4/30/22	120	8:20	0.0000	2.0000
77	4/30/22	120	16:20	0.0003	0.0002
84	5/1/22	121	8:45	0.0000	-0.0008
88	5/1/22	121	16:14	0.0000	-0.9991
94	5/2/22	122	14:25	-0.0002	-2.9999
103	5/3/22	123	11:15	0.0006	-4.9968
108	5/4/22	124	9:25	0.0000	-7.0003
127	5/5/22	125	13:25	0.0003	-9.9996
135	5/6/22	126	10:44	0.0008	-11.9990
155	5/7/22	127	14:15	0.0000	-14.9903
166	5/8/22	128	10:45	0.0000	-17.0000
184	5/9/22	129	15:30	0.0000	-19.9990
195	5/10/22	130	16:10	0.0000	-22.0000
209	5/11/22	131	11:10	0.0003	-23.9965
213	5/11/22	131	17:15	0.0000	-25.0002
221	5/12/22	132	10:20	0.0000	-25.9992
222	5/12/22	132	10:46	0.0000	-25.9992
228	5/12/22	132	17:35	0.0000	-26.9993
239	5/13/22	133	11:50	0.0000	-28.9963
247	5/14/22	134	11:16	0.0000	-30.9976
251	5/14/22	134	18:16	0.0000	-31.9985
260	5/15/22	135	13:30	0.0000	-34.0000
273	5/16/22	136	12:55	0.0000	-35.9992
284	5/17/22	137	14:32	0.0000	-38.5000
292	5/18/22	138	11:47	0.0000	-40.0000
301	5/19/22	139	14:05	0.0083	-42.5095
312	5/20/22	140	14:45	0.0035	-44.0958
317	5/23/22	143	17:30	8.4560	-37.2764
318	5/24/22	144	16:30	11.0231	-34.0030

7.10 In situ pumps station list

Ship Station	Event	Date, Time at max depth	Latitude	Longitude	Sampling depth (m)	Pumping time (min.)	Volume pumped (L)
78	ISP 01	30 Apr 2022 20:07	00° 00.008' S	001° 00.026' E	10	40	289
78	ISP 01	30 Apr 2022 20:07	00° 00.008' S	001° 00.026' E	40	40	293
78	ISP 01	30 Apr 2022 20:07	00° 00.008' S	001° 00.026' E	80	40	316
78	ISP 01	30 Apr 2022 20:07	00° 00.008' S	001° 00.026' E	150	40	323
78	ISP 01	30 Apr 2022 20:07	00° 00.008' S	001° 00.026' E	250	60	1211
78	ISP 01	30 Apr 2022 20:07	00° 00.008' S	001° 00.026' E	500	0	2
104	ISP 02	3 May 2022 14:34	00° 00.248' S	004° 59.599' W	10	45	225
104	ISP 02	3 May 2022 14:34	00° 00.248' S	004° 59.599' W	40	45	338
104	ISP 02	3 May 2022 14:34	00° 00.248' S	004° 59.599' W	80	50	424
104	ISP 02	3 May 2022 14:34	00° 00.248' S	004° 59.599' W	150	50	412
104	ISP 02	3 May 2022 14:34	00° 00.248' S	004° 59.599' W	250	48	960
104	ISP 02	3 May 2022 14:34	00° 00.248' S	004° 59.599' W	500	48	1051
128	ISP 03	5 May 2022 17:01	00° 00.163' N	009° 59.974' W	10	40	300
128	ISP 03	5 May 2022 17:01	00° 00.163' N	009° 59.974' W	40	45	335
128	ISP 03	5 May 2022 17:01	00° 00.163' N	009° 59.974' W	80	45	370
128	ISP 03	5 May 2022 17:01	00° 00.163' N	009° 59.974' W	150	45	379
128	ISP 03	5 May 2022 17:01	00° 00.163' N	009° 59.974' W	250	48	969
128	ISP 03	5 May 2022 17:01	00° 00.163' N	009° 59.974' W	500	48	1060
154	ISP 04	7 May 2022 12:55	00° 00.006' N	014° 59.419' W	10	0	0
154	ISP 04	7 May 2022 12:55	00° 00.006' N	014° 59.419' W	40	0	1
154	ISP 04	7 May 2022 12:55	00° 00.006' N	014° 59.419' W	80	0	0
154	ISP 04	7 May 2022 12:55	00° 00.006' N	014° 59.419' W	150	0	0
154	ISP 04	7 May 2022 12:55	00° 00.006' N	014° 59.419' W	250	48	978
154	ISP 04	7 May 2022 12:55	00° 00.006' N	014° 59.419' W	500	48	1054
186	ISP 05	9 May 2022 18:29	00° 00.157' N	019° 59.782' W	10	45	341
186	ISP 05	9 May 2022 18:29	00° 00.157' N	019° 59.782' W	50	45	356
186	ISP 05	9 May 2022 18:29	00° 00.157' N	019° 59.782' W	80	45	376
186	ISP 05	9 May 2022 18:29	00° 00.157' N	019° 59.782' W	150	45	381
186	ISP 05	9 May 2022 18:29	00° 00.157' N	019° 59.782' W	300	48	12
186	ISP 05	9 May 2022 18:29	00° 00.157' N	019° 59.782' W	500	48	1046
215	ISP 06	11 May 2022 21:24	00° 00.078' S	025° 00.010' W	10	55	392
215	ISP 06	11 May 2022 21:24	00° 00.078' S	025° 00.010' W	50	55	392
215	ISP 06	11 May 2022 21:24	00° 00.078' S	025° 00.010' W	80	55	446
215	ISP 06	11 May 2022 21:24	00° 00.078' S	025° 00.010' W	150	50	421
215	ISP 06	11 May 2022 21:24	00° 00.078' S	025° 00.010' W	300	48	965
215	ISP 06	11 May 2022 21:24	00° 00.078' S	025° 00.010' W	500	48	1046
242	ISP 07	13 May 2022 21:41	00° 00.081' N	029° 59.560' W	50	45	363
242	ISP 07	13 May 2022 21:41	00° 00.081' N	029° 59.560' W	120	45	379

242	ISP 07	13 May 2022 21:41	00° 00.081' N	029° 59.560' W	170	50	416
242	ISP 07	13 May 2022 21:41	00° 00.081' N	029° 59.560' W	220	50	421
242	ISP 07	13 May 2022 21:41	00° 00.081' N	029° 59.560' W	270	48	973
242	ISP 07	13 May 2022 21:41	00° 00.081' N	029° 59.560' W	470	48	1062
266	ISP 08	16 May 2022 01:25	00° 00.024' S	034° 59.958' W	10	50	372
266	ISP 08	16 May 2022 01:25	00° 00.024' S	034° 59.958' W	50	50	377
266	ISP 08	16 May 2022 01:25	00° 00.024' S	034° 59.958' W	100	50	419
266	ISP 08	16 May 2022 01:25	00° 00.024' S	034° 59.958' W	150	50	425
266	ISP 08	16 May 2022 01:25	00° 00.024' S	034° 59.958' W	300	48	978
266	ISP 08	16 May 2022 01:25	00° 00.024' S	034° 59.958' W	500	48	1028
289	ISP 09	18 May 2022 07:31	00° 00.025' N	040° 00.116' W	10	50	392
289	ISP 09	18 May 2022 07:31	00° 00.025' N	040° 00.116' W	50	50	394
289	ISP 09	18 May 2022 07:31	00° 00.025' N	040° 00.116' W	100	50	424
289	ISP 09	18 May 2022 07:31	00° 00.025' N	040° 00.116' W	150	50	424
289	ISP 09	18 May 2022 07:31	00° 00.025' N	040° 00.116' W	300	48	974
289	ISP 09	18 May 2022 07:31	00° 00.025' N	040° 00.116' W	500	48	1138
308	ISP 10	20 May 2022 07:37	00° 00.474' N	044° 00.424' W	10	60	449
308	ISP 10	20 May 2022 07:37	00° 00.474' N	044° 00.424' W	50	60	458
308	ISP 10	20 May 2022 07:37	00° 00.474' N	044° 00.424' W	100	60	491
308	ISP 10	20 May 2022 07:37	00° 00.474' N	044° 00.424' W	150	50	425
308	ISP 10	20 May 2022 07:37	00° 00.474' N	044° 00.424' W	300	48	982
308	ISP 10	20 May 2022 07:37	00° 00.474' N	044° 00.424' W	500	48	1044

8 Data and Sample Storage and Availability

In Kiel, a joint data management team is set up to store the data from various projects and cruises in a web-based multi-user-system. Data gathered during M181 are stored at the Kiel data portal, and remain proprietary for the PIs of the cruise and for members of EU-TRIATLAS and the BMBF-BANINO project. Each station is logged as an event file https://portal.geomar.de/metadata/leg/show/344906. All data will be submitted to PANGAEA within 3 years after the cruise, i.e., by May 2025. Preliminary CTD data were submitted to CORIOLIS during the cruise for real time oceanographic analysis and Argo calibration. Contact persons for the different datasets are listed in Table 8.1.

Table 8.1 Overview of contact persons for the different data sets.

Type	Database	Available	Free Access	Contact
CTD/O_2	PANGAEA	May 28, 2023	May 28, 2023	gkrahmann@geomar.de
VMADCP	PANGAEA	May 28, 2023	May 28, 2023	rczeschel@geomar.de
LADCP	PANGAEA	May 28, 2024	May 28, 2024	gkrahmann@geomar.de
Mooring data	PANGAEA	May 28, 2024	May 28, 2024	pbrandt@geomar.de
Microstructure data	PANGAEA	May 28, 2024	May 28, 2024	mdengler@geomar.de
Surface drifter	PANGAEA	May 28, 2023	May 28, 2023	jochen.horstmann@hereon.de
Thermosalinograph	PANGAEA	May 28, 2024	May 28, 2024	mschlundt@geomar.de
Multibeam echosounder	PANGAEA	May 28, 2023	May 28, 2023	cdevey@geomar.de
Nutrients	PANGAEA	May 28, 2024	May 28, 2024	gkrahmann@geomar.de
Underwater Vision Profiler	PANGAEA	May 28, 2024	May 28, 2024	rkiko@geomar.de
Multinet	PANGAEA	May 28, 2024	May 28, 2024	rkiko@geomar.de
AZFP	PANGAEA	May 28, 2024	May 28, 2025	hernandezleon@ulpgc.es

PlanktoScope	EcoTaxa	May 28, 2024	May 28, 2025	ana.carrera@io-warnemuende.de
Nitrous oxide	PANGAEA	May 28, 2024	May 28, 2025	darevalo@geomar.de
HPLC pigments	NASA SeaBASS	May 28, 2024	May 28, 204	ajit@ldeo.columbia.edu
Flow cytometry	NASA SeaBASS	May 28, 2024	May 28, 2024	ajit@ldeo.columbia.edu
Organic matter, prokaryots	PANGAEA / ENA	May 28, 2025	May 28, 2025	javier.aristegui@ulpgc.es
C/N fixation	PANGAEA	May 28, 2025	May 28, 2025	ana.carrera@io-warnemuende.de
C/N isotopes	PANGAEA	May 28, 2025	May 28, 2025	ana.carrera@io-warnemuende.de
PISCO	PANGAEA / EcoTaxa	May 28, 2024	May 28, 2024	jtaucher@geomar.de
Thorium	PANGAEA	May 28, 2024	May 28, 2024	b.gasser@iaea.org

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11 Appendix – List of Abbreviations

AABW	Antarctic Bottom Water
AAIW	Antarctic Intermediate Water
ADCP	Acoustic Doppler Current Profiler
AZFP	Acoustic Zooplankton and Fish Profiler
BMBF	Federal Ministry of Education and Research
BONCAT	BioOrthogonal Non-Canonical Amino acid Tagging
cDOM	Colored Dissolved Organic Matter
CF IRMS	Continuous-Flow Isotope-Ratio Mass Spectrometry
CTD	Conductivity-temperature-depth (system)
DFG	German Science Foundation
fDOM	Fluorescent Dissolved Organic Matter
GDP	Global Drifter Program
HPG	Homopropargylglycine
HPLC	High Performance Liquid Chromatography
ITCZ	Intertropical Convergence Zone
LADCP	Lowered ADCP
MSS	Microstructure system
NADW	North Atlantic Deep Water
NOx	Nutrients
OPS	OPTIMARE Precision Salinometer
OS38	38-kHz RDI Ocean Surveyor
OS75	75-kHz RDI Ocean Surveyor
PAR	Photosynthetically active radiation
PFA	Paraformaldehyde
PISCO	Plankton Imaging with Scanning Optics system
PIES	Pressure inverted echo sounder
POC	Particulate organic carbon
PON	Particulate organic nitrogen
SBE	Seabird Electronics
SSS	Sea surface salinity
SST	Sea surface temperature
SVP	Surface Velocity Program
TOC	Total Organic Carbon
TRATLEQ	Transatlantic Equatorial Cruise
TSG	Thermosalinograph
UVP	Underwater vision profiler
VMADCP	Vessel-mounted Acoustic Doppler Current Profiler