METEOR-Berichte

Oxygen variability and tropical Atlantic circulation

Cruise No. M119

September 8 – October 12, 2015,
Mindelo (Cape Verde) – Recife (Brazil)

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1 Summary

R/V METEOR cruise M119 was a joint effort of the Kiel Collaborative Research Centre SFB 754 ("Climate - Biogeochemistry Interactions in the Tropical Ocean") involving the BMBF joint project RACE and the German-French-African Cooperative Project AWA. The first part of the cruise focused on the oxygen minimum zone (OMZ) of the Eastern Tropical North Atlantic (ETNA). The main goal was the quantification of ventilation processes including lateral and vertical mixing and oxygen advection (SFB SP A3 and A4). Other foci of this cruise were the role of zooplankton and particles for oxygen consumption and biogeochemical cycles (SFB SP B8), the study of epi- and mesopelagic communities of macrozooplankton and micronekton (a project of the Cluster of Excellence "Future Ocean"), and the quantification of N_2 fixation. All hydrographic and current data were acquired as planned (with some reduction of the number of CTD stations along 23°W), including the successful recovery of all moorings. At the equator, the cruise additionally focused on the equatorial current system, its interannual to decadal variability and its role in the zonal transport of heat, freshwater, and oxygen (BMBF RACE, SFB 754). The long-term mooring at the equator and 23°W was successfully recovered and redeployed. At the western boundary of the South Atlantic off Brazil, a special focus was placed on the transport variability of the North Brazil Undercurrent (NBUC) and the Deep Western Boundary Current (DWBC) on timescales from intraseasonal to decadal (BMBF RACE). The mooring array at 11°S at the continental slope off the Brazilian coast was successfully recovered and redeployed.

Zusammenfassung

Die wissenschaftlichen Arbeiten auf dem Fahrtabschnitt M119 waren Teil des SFB 754, des BMBF Verbundprojektes RACE und des deutsch-französisch-afrikanischen Verbundprojekts AWA. Der erste Teil von M119 konzentrierte sich auf die Sauerstoffminimumzone (OMZ) des tropischen Nordostatlantiks. Hauptziel hier war die Quantifizierung der Ventilationsprozesse, d.h. laterale und diapyknische Vermischung sowie Sauerstoffadvektion (SP A3 und A4). Die Rolle von Zooplankton und Teilchen für den Sauerstoffverbrauch und biogeochemische Zyklen (SP B8), die Verteilung, das Vorkommen und die Diversität von Zooplankton im Bereich der Sauerstoffminimumzone (Projekt des Exzellenzclusters „Ozean der Zukunft") und die Bestimmung von N_2 Fixierung im Ozean waren weitere Schwerpunkte. Alle hydrografischen und Strömungsmessungen konnten wie geplant durchgeführt werden (bei geringfügiger Reduzierung der Anzahl der CTD Stationen entlang 23°W). Das schließt insbesondere die erfolgreiche Aufnahme aller Verankerungen mit ein. Am Äquator konzentrierten sich die Arbeiten zusätzlich auf das äquatoriale Stromsystem, auf seine zwischenjährlichen bis dekadischen Schwankungen (mit Hilfe von Langzeitverankerungen) und auf seine Rolle für den zonalen Transport von Wärme, Frischwasser und Sauerstoff (BMBF RACE, SFB754). Die Langzeitverankerung am Äquator bei 23° W konnte erfolgreich geborgen und wieder ausgelegt werden. Am westlichen Rand des Südatlantiks vor Brasilien konzentrierten sich die Arbeiten auf Transportschwankungen des Nordbrasilunterstroms (NBUC) und des tiefen westlichen Randstroms (DWBC) auf intrasaisonalen bis dekadischen Zeitskalen. Das Verankerungsarray bei 11°S am Kontinentalabhang vor Brasilien konnte erfolgreich geborgen und wieder ausgelegt werden.

2 Participants

Name	Position/Discipline	Institute
1. Brandt, Peter, Prof. Dr.	Chief Scientist	GEOMAR
2. Fernández Carrera, Ana, Dr.	N/C Fixation	GATECH
3. Fried, Nora	CTD watch, salinometer, optodes, moored ADCPs	GEOMAR
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5. Hahn, Tobias	O_2, underway O_2 and total gas pressure, CTD watch	GEOMAR
6. Hench, Kosmas	UVP, water biogeochemistry	GEOMAR
7. Hoving, Hendrik Jan Ties, Dr.	Towed camera	GEOMAR
8. Hummels, Rebecca, Dr.	Moored ADCPs, current meter, CTD watch (MSS)	GEOMAR
9. Kisjeloff, Boris	CTD watch, optodes, MicroCATs	GEOMAR
10. Köhn, Eike	CTD watch (MSS), MicroCATs	GEOMAR
11. Krahmann, Gerd, Dr.	CTD, LADCP	GEOMAR
12. Martens, Wiebke	CTD watch, CTD technique, MicroCATs	GEOMAR
13. Niehus, Gerd	Moorings, *release*	GEOMAR
14. Papenburg, Uwe	Moorings, current meters, ADCPs	GEOMAR
15. Rentsch, Harald	Meteorology	DWD
16. Rohleder, Christian	Meteorology	DWD
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18. Schütte, Florian	CTD watch (MSS), shipboard ADCP	GEOMAR
19. Subramaniam, Ajit, Dr.	Bio-optics, phytoplankton	LDEO
20. Tuchen, Franz Philip	CTD watch (MSS), moored profiler	GEOMAR
21. Turner, Katherine	Salinometer, CTD watch	GEOMAR
22. Tyaquiçã, Pedro	CTD watch, Moorings	UFPE
23. Vandromme, Pierre, Dr.	UVP, multinet	GEOMAR
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UFPE Lab. Oceanografia Física Estuarina e Costeira, Depart. Oceanografia da Universidade Federal de Pernambuco, Av. Arquitetura, s/n, 50740-550 - Cidade Universitária Recife-PE, Brazil, http://www.ufpe.br/docean/index.php

3 Research Program

The research program of R/V METEOR cruise 119 (M119) consisted of hydrographic and current observations to study tropical circulation, water mass pathways, ventilation of the eastern tropical North Atlantic (ETNA) oxygen minimum zone (OMZ) along the 23°W meridian between the Cape Verdean islands (about 15°N) and 5°S and along the 11°S and 5°S sections off Brazil. This program was accompanied by a dedicated study of the zooplankton ecophysiology and particle distribution, towed camera observations of epi- and mesopelagic communities of macrozooplankton and micronekton, underwater light measurements, and incubation experiments and water sampling for estimating N_2 fixation. Several long-term moorings were replaced during the cruise that are aimed at the study of biogeochemical cycles (CVOO), the variability and supply of oxygen (11°N, 5°N), the variability of the equatorial current system (equator), and the variability of the western boundary current system (11°S). Station work along the 23°W, 11°S, and 5°S sections included measurements with a CTD/lowered ADCP (LADCP) /Underwater Vision Profiler (UVP), a microstructure probe and a zooplankton multinet. In addition, underway measurements of currents with the two vessel-mounted ADCPs (VMADCPs) and hydrographic measurements with thermosalinograph, optode, and gas tension device (GTD) were performed.

4 Narrative of the Cruise

(Peter Brandt)

R/V METEOR departed from Mindelo on September 8, 2015 at 9:00 and headed north between the Cape Verdean islands of São Vicente and Santo Antão. The recovery of the CVOO (Cape Verde Ocean Observatory) mooring north of São Vicente was the first activity of the cruise. It was followed by stations with the CTD-rosette system, zooplankton multinet stations, microstructure stations, and towed camera stations. An underwater video profiler (UVP) was alternately attached to the CTD-rosette and the towed camera system. Additional instrumentation at the CTD-rosette included a LADCP system (up- and downward looking 300 kHz ADCPs) and a fluorometer. Collected water samples were used for measuring oxygen, nutrients, chlorophyll-*a* (Chl-*a*) and salinity, as well as incubation experiments for estimating carbon and nitrogen fixation rates. Some of the CTD/O_2 stations were also used to calibrate different moored instruments, including MicroCATs, optodes and Mini-TD (temperature-depth) loggers. These instruments were either just recovered or to be deployed in the morning of September 10, when the CVOO mooring was successfully redeployed. In between the two aforementioned mooring operations we deployed another mooring in the morning of September 9. This mooring consists of a newly developed underwater winch with profiler, allowing physical and biogeochemical measurements with a complex sensor package between the parking depth of the winch at about 140m depth and the sea surface, where satellite communication allows real-time data transfer. Due to a malfunctioning of the winch, the winch system had to be recovered on September 10 after the CVOO mooring deployment. The remainder of the winch mooring, including an upward looking ADCP at 160 m, is still in place to be regularly recovered during our next cruise into the tropical Atlantic.

The measurements along 23°W, including 51 CTD-O_2/LADCP/UVP stations between 15°N and 5°00'S, were a main focus of our cruise. Other measurements included rates of carbon and nitrogen fixation, nutrient concentration, and chlorophyll concentration. In addition, spectro-radiometer measurements were typically performed around noon to infer the underwater light in the upper 100 m. Several underway systems were used for continuous along-track measurements throughout the cruise: i) two VMADCPs with a frequency of 38 kHz and 75 kHz measuring horizontal velocities in the upper 600 and 1000 m, respectively, ii) the thermosalinograph measuring near-surface temperature and salinity, and iii) oxygen and total gas tension measurements in a throughflow box. The work along the 23°W section started on September 11 and ended on September 26. The spatial resolution of CTD station work was 30’ in latitude north of 2°N and south of 2°S and 20’ in latitude between 2°N and 2°S. Stations north of 5°N were performed down to 1300 m, and full-depth profiles were taken between 5°N and 5°S. Zooplankton multinet and towed camera stations were performed within the latitudinal range of the OMZ of the tropical North Atlantic every 2° and 1° in latitude, respectively, with some additional stations near the equator.

On September 13 and 14, we departed from the 23°W section to recover and redeploy the SFB754 mooring at 21°13’W, 11°02’N which corresponds approximately to the center of the OMZ. At this location, the OSTRE (Oxygen Supply Tracer Release Experiment) was carried out in November 2012, and the tracer distribution was surveyed most recently during M116. During the night from September 12 to 13, while approaching the mooring position, a malfunctioning of a fire sea water pump resulted in a flooding of the control box of the central hydraulic system of the ship. The severe damage to the hydraulic system of the ship did not allow for any scientific measurements except for microstructure profiling which uses its own winch system. Thus microstructure measurements were carried out for about one day, which will allow a better comparison of the diapycnal diffusivities derived from the tracer release experiment and the microstructure measurements. After the provisional repair of the hydraulic system of the ship, the mooring equipped with a series of oxygen, temperature and salinity sensors, as well as a 75 kHz Longranger (LR) ADCP for velocity measurements in the upper 800 m, was successfully recovered on September 13. Unfortunately, the LR ADCP developed a water leak just after its deployment 1.5 years ago, and no relevant data was recorded by this instrument. Other moored instrumentation worked as planned. As the hydraulic system of the ship could not be completely repaired with the material and replacement parts on board, it became evident that the cruise time of M119 had to be reduced by one day to allow for proper repairs of the hydraulic system during the port stay in Recife after the cruise. With this information, we decided to reduce the number of CTD stations by reducing the resolution near the equator compared to previous cruises and to terminate the 23°W section already at 5°S.

On the afternoon of September 18, we arrived at the next mooring at 23°W, 5°N. Similar to the mooring at 11°N, this mooring was equipped with a series of oxygen, temperature and salinity sensors as well as a LR ADCP. The mooring was recovered successfully, yielding almost complete datasets. After performing CTD, multinet, towed camera and microstructure stations during the night, the mooring was redeployed in the morning of September 19 to continue observations of long-term variability at the southern rim of the OMZ.

The last mooring along the 23°W section was recovered at the equator on September 22. This mooring is part of the international PIRATA program where upper ocean currents, including the Equatorial Undercurrent, are measured using an upward looking 150 kHz ADCP installed at a depth of about 210 m. Directly below is a downward looking LR ADCP, and several single-point current meters are located between 750 and 1000 m. Between 1000 m and 3500 m, a moored profiler travels up and down the mooring wire every 6 days, measuring velocity, temperature and salinity. All instruments worked well, specifically delivering full-depth velocity measurements for a period of about 1.5 years. This mooring is a long-term effort beginning in 2002 aimed at identifying equatorial current variability on intraseasonal, seasonal, interannual and decadal time scales.

After completion of measurements along 23°W on September 26, R/V METEOR headed southwest toward the western boundary off Brazil. During the transit, three Argo floats provided by the BSH (Bundesamt für Seeschifffahrt und Hydrographie) were deployed as part of the German Argo program. At a test CTD station along the transit aimed at testing the CTD system, we noticed a failure of one flash lamp of the UVP. The UVP could not be repaired and a new electronic board was requested to be installed during the port call in Recife, hopefully allowing the use of the UVP during the next cruise, M120. CTD station and mooring work along 11°S commenced on September 28. Along this section, 4 current meter moorings were recovered and redeployed, one PIES (inverted echo sounder with pressure sensor) was recovered (deployed in July 2013 during M98), and data from two PIES (deployed in May 2014 during M106) were acoustically transferred to the ship via separate acoustic modems attached to the PIES. One bottom pressure sensor that was also deployed in July 2013 during M98 could not be recovered. We were not able to establish an acoustic connection to the single release, and we had to conclude that the system is either no longer in place or is not able to respond to the release command. With the deployment of the fourth mooring off Brazil on October 4, the mooring work during M119 ended very successfully: all moorings (except the singe bottom pressure sensor) were recovered, and mooring deployments went very smoothly without problems. In between and following the mooring work, a total of 22 surface-to-bottom CTD stations and 16 microstructure stations, typically taking 3 profiles per station, and one 12-h station were carried out. Some CTD stations were again used for calibration of moored instruments. Water samples were taken for calibration of salinity and oxygen sensors of the CTD system as well as for incubation experiments for nitrogen fixation studies. The CTD section along 11°S was completed on October 6, and R/V METEOR thereafter headed north toward the westernmost station of the 5°S section.

Along the last section of the cruise along 5°S, a total of 14 surface-to-bottom CTD stations and 9 microstructure stations with acquisition of typically 4 profiles per station were carried out. The section was completed on October 10. After finishing the last CTD cast at the easternmost station of the 5°S section, R/V METEOR turned westward to repeat the ADCP measurements along the 5°S section.

The ship arrived at the port of Recife, Brazil on October 12, 2015 at 8:00, one day earlier than the originally planned arrival time (Fig. 4.1).

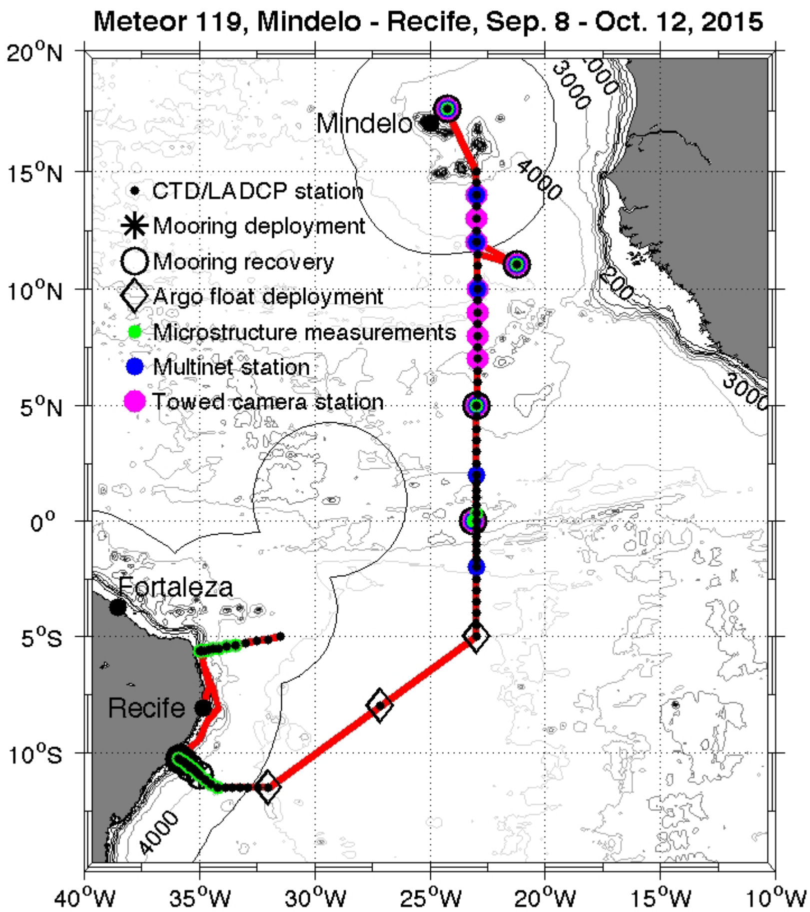

Fig. 4.1. Ship track of R/V METEOR cruise M119 (red line) with locations of CTD/LADCP (black dots) and multinet stations (blue dots), mooring deployments (stars) and recoveries (circles), Argo float deployments (diamonds), microstructure measurements (green dots), and towed camera stations (purple dots). Also included are the exclusive economic zones of Cape Verde and Brazil (black lines). Depth contours are drawn at 6000, 5000, 4000, 3000, 2000, 1000, 500, 200, and 50 m.

5 Preliminary Results

In the following, a detailed account of the types of observations, the methods and instruments used as well as some of the early results are given.

5.1 CTD system and oxygen measurements and calibration

5.1.1 CTD system and calibration

(Gerd Krahmann, Wiebke Martens)

During M119, 91 profiles of pressure (P), temperature (T), conductivity (C) and oxygen (O) were recorded. 64 of these CTD-O_2 profiles ranged to the bottom, the remaining profiles ranged to 1300 m or shallower. We used a Seabird Electronics (SBE) 9plus system, attached to the water sampler carousel, and recent Seabird Seasave software (V7.23.2). The SBE underwater unit had, in addition to its own pressure sensor, two parallel sensor sets for T, C, and O. Additionally a Wetlabs Turbidity/Chl-a Fluorescence sensor was used on all casts, a Wetlabs

Transmissometer was used on all but the first three casts, and a PAR sensor was installed on the casts shallower than 2000 m in the first half of the cruise (see Table 7.3). Problems with the water sampler and later with the temperature sensors led to some changes of the SBE underwater unit and the temperature sensors.

Underwater unit SBE5 was used for profiles 1-55, while underwater unit SBE3 with pressure sensor #82991 was used for profiles 56-91. Primary and secondary conductivity sensors remained unchanged during the entire cruise (primary: #3425, secondary: #3959). Oxygen sensors remained nearly unchanged during the entire cruise (primary profile 1-89: #1302, primary profile 90 and 91: #2600, secondary: #2686). The temperature sensors were however changed a few times (primary profile 1 to 54: #4875, primary profile 55 to 91: #2120, secondary profile 1-50 and 55-91: #4051, secondary profile 51: #4831, secondary profile 52-54: #2120). The changes in the temperature sensors about halfway through the cruises were caused by subtle but persistent differences between the two temperature sensors used in the first 50 profiles. A difference of up to 0.006 degrees was found immediately below the mixed layer when the CTD encountered colder waters. By swapping temperature sensors one by one we figured that sensor #4875 was the problematic one, even though this sensor was the one most recent with the manufacturer for calibration (November 2014). After the discovery of the temperature differences we found that the same problem had already existed on cruise M116 where the same sensors were used as initially on M119. As the temperature difference is well beyond the specifications of the manufacturer, a special report on this will be written and sent to the manufacturer for comment.

The calibration of the conductivity and oxygen sensor followed the established paths. Conductivity was calibrated using a linear relation in P, T and C. Some 400 water samples were for the conductivity calibration and analyzed using a Guildline Autosal salinometer. The resulting rms salinity misfit was between 0.001 and 0.0015 for the different sensor pairings after removal of the most deviating 33% of samples.

Oxygen was calibrated using a relation linear in T and O, and quadratic in P. Winkler titration of 490 bottle samples led to a relation with an rms misfit of 0.65 µmol/kg (33% of bottle values removed). An example section of salinity and oxygen is shown in Fig. 5.1.

Further sensors were attached to the carousel and recorded, but were not calibrated: a fluorescence and turbidity sensor (Wetlabs), and a Photosynthetically Active Radiation (PAR) sensor (Biospherical). The latter could only be used on casts less than 2000 m deep.

An altimeter that had previously been serviced at the manufacturer did not work during the entire cruise. Bottom approaches were done solely based on the echo sounder depth. This usually worked well but was problematic on the slopes of the continental shelf where several profiles were terminated early.

5.1.2 Oxygen Winkler measurements

(Tobias Hahn)

Observing and understanding the concentration of dissolved oxygen in the ocean is one of the key objectives of the SFB754. While the CTD system is capable of measuring dissolved oxygen in the ocean at high vertical resolution, the sensors need to be carefully calibrated. Thus high quality reference observations are essential.

Oxygen measurements

A total amount of 731 discrete water samples were taken from selected depths of 79 CTD casts for oxygen measurements by Winkler titration. Samples were taken with 100 ml WOCE bottles with well-defined volumes (calibrated flasks) in order to calibrate the SBE43 oxygen sensors attached to the CTD. It was ensured that the sample bottles were flushed with at least 3 times its volume and the samples were free of air-bubbles. At each CTD cast, at least one duplicate from one of the Niskin bottles was taken in order to quantify sampling and titration uncertainties. Additionally 36 water samples were analyzed from the underway system (see chapter 5.5.5 for further details) to calibrate and verify the underway oxygen sensors.

Oxygen was determined by Winkler titration within a maximum of 13 hours after sampling following standard protocols (Langdon, 2010). The concentration values were reported in $\mu mol \cdot L^{-1}$. The precision of the Winkler-titrated oxygen measurements (1σ) was $0.32\ \mu mol \cdot L^{-1}$ based on 24 duplicates and 72 triplicates, and $0.38\ \mu mol \cdot L^{-1}$ for the underway samples based on 18 duplicates, respectively.

Measurement setup

The following reagents were used during this cruise:

- sulfuric acid (50%)
- zinc iodide starch solution (500 mL, Merck KGaA)
- stock solution: sodium thiosulfate pentahydrate (49,5 $g \cdot L^{-1}$); stock solution was diluted by a factor of 10 to create the working solution (0.02 $mol \cdot L^{-1}$)
- fixation solution: manganese(II)chloride (600 $g \cdot L^{-1}$), sodium iodide (600 $g \cdot L^{-1}$) and sodium hydroxide (320 $g \cdot L^{-1}$)
- standard solution: potassium hydrogen diiodate (0,325 $g \cdot L^{-1}$, homemade)

Titrations were performed within the WOCE bottles using a 20 mL Piston Burette (No. 00692888) TITRONIC universal from SI Analytics GmbH. Dosing accuracy reported by the company is 0.15%, referred to the nominal volume, indicated as a measurement uncertainty with a confidence level of 95%. The iodate standard was added with a 50 mL Piston Burette (No. 00693159) TITRONIC universal SI Analytics GmbH. 1 mL of the fixation solutions (NaI/NaOH and $MnCl_2$) were dispensed with a high precision bottle-top dispenser (0.4 - 2.0 mL, Ceramus classic, Hirschmann).

Titration procedure

The titration procedure for each measurement was the following:

1) Switch on Piston Burettes and clear the system (dosing tubes) from air bubbles
2) Determine factor of the thiosulfate working solution by titrating the homemade standard between 3 to 5 times on a daily basis
3) Measure the actual Winkler samples
4) Analyze the reagent blank at the beginning and the end of the research cruise

Note: 66 invalid oxygen samples due to possible sampling (air bubble entry during fixation), storing (air bubble), measuring failures and erroneous bottle factors (bottle 58, 83 and 91; in total 28 invalid samples) were recorded. Results derived from those measurements were not considered in the final data evaluation. With respect to the amount of duplicates and triplicates, 497 valid oxygen data points were used for the calibration of the CTD system.

5.1.3 Thermosalinograph

During the ship’s maintenance in summer 2015 a new thermosalinograph system had been installed. The new setup consists of two independent Seabird systems. These can be run in an alternating mode in which each system measures for a preset number of hours while the other is being cleaned, or both can be run in parallel to permanently check the consistency of systems.

On R/V METEOR the approach is to run them in parallel. Unfortunately it was discovered shortly after leaving port that one of the systems did not operate properly. The remaining system ran throughout the whole cruise. The comparison of the thermosalinograph temperatures with CTD temperatures from 5 m depth showed a very good agreement with no significant offset. The thermosalinograph’s salinities did however not agree as well with the CTD’s. We found a difference of about 0.09 PSU at the beginning of the cruise which reduced in an approximately linear trend down to about 0.02 PSU. It is unclear what caused such a large offset in the beginning and such a large drift over only 30 days.

5.2 Current observations

5.2.1 Vessel-mounted ADCP

(Florian Schütte, Katherine Turner)

Underway-current measurements of the upper ocean were performed continuously throughout the entire cruise track using two VMADCPs: a 75kHz RDI Ocean Surveyor (OS75) mounted in the ship’s hull, and a 38kHz RDI Ocean Surveyor (OS38) placed in the moon pool. Both Ocean Surveyor instruments worked well throughout the cruise. The OS38 was aligned to zero degrees (relative to the ship's center line) in order to reduce interference with the OS75, which was aligned to 45 degrees.

The OS75 instrument was run in the more precise but less robust broadband mode. It was configured with 100 bins of 8 m, pinging 37.5 times per minute, with a range of 550 m. Conversely, the OS38 instrument ran in narrow band mode and used 55 bins of 32 m, pinging 20 times per minute, with a range of 1000 m. During the entire cruise, the SEAPATH navigation data was of high quality. To avoid acoustic interference, the Doppler log and Parasound and EM75 echosounders were off whenever possible. The 12kHz echosounder EM122 was used as it delivered high quality bathymetry data without detectable interference. A remaining strong interference, which affected and at times destroyed the OS75 data, came from the bow thruster that was used during ship standstills.

Post processing of the data was carried out separately for each instrument. Accounting for a time shift of the heading and position data recorded by the SEAPATH device relative to the raw OS data allowed for a significant reduction in the scatter of the calibration angles and amplitude factors. The applied shifts, as well as mean misalignment angles and amplitude factors with the associated standard deviations, are summarized in Table 5.1.

OS	Mode	Heading shift	Position shift	Misalignment angle ± Standard deviation	Amplitude factor ± Standard deviation
75	BB	+8.5 sec.	-0.5 sec.	-1.0931° ± 0.3913°	1.0081 ± 0.0100
38	NB	-3.0 sec.	-0.5 sec.	-0.2940° ± 0.5735°	1.0050 ± 0.0082

Tab. 5.1 Heading and position shift (positive/negative: shift to later/earlier time), mean misalignment angle ± standard deviation, and amplitude factor ± standard deviation, and amplitude factor ± standard deviation after optimizing post-calibration of OS raw data.

5.2.2 Lowered ADCP

(Gerd Krahmann)

During the entire cruise the CTD system was equipped with a LADCP setup based on two Teledyne RDI ADCPs. The setup consisted of an up-looking and a down-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. A battery pack was mounted below the up-looking slave instrument (initially SN #20507). Both ADCPs were connected to the battery case, which - at least initially - was also the connection point for the data interface cable. In the initial setup, the down-looking master instrument was SN #20508. (Note that LADCP profile numbers were kept the same as the CTD profile numbers, as some CTD cast numbers and profiles do not exist as LADCP casts, when the LADCP system did not work).

During the first twelve profiles the described setup worked fine. During profile 13, the up-looking instrument #20507 developed an error and did not operate correctly. For unknown reasons the instrument had ‘forgotten’ its internal calibration parameters for the compass and beam deviations. Since it is not possible to calibrate the compass at sea, the instrument was removed from the CTD and replaced by #11436. This second setup remained unchanged until the end of the cruise.

During the cruise, new software was developed to control the start, stop, download, and erase cycles of the two LADCP systems. This software simplifies the control of the LADCPs which was previously arranged in a complicated and error-prone Windows/Virtual-Linux setup. It also introduces several setup and consistency checks and allows e.g. for parallel downloads and upload to backup servers.

Data processing took place during the cruise using the GEOMAR LADCP processing software V10.21, which includes both shear and inversion methods to derive an absolute velocity profile. As additional data were necessary for the processing, the corresponding pre-processed CTD files containing pressure, temperature and salinity profiles as well as time and navigation data were used.

Overall, the TRDI instruments resulted in reasonable to good deep ocean velocity profiles when processed in conjunction with the observations of the VMADCPs and when coming close enough to the seafloor to obtain TRDI bottom track data (an example section is presented in Fig. 5.1). Nevertheless, the generally adverse conditions for LADCP in the open tropical South Atlantic Ocean (too few scatterers) lead to a few profiles with high uncertainties.

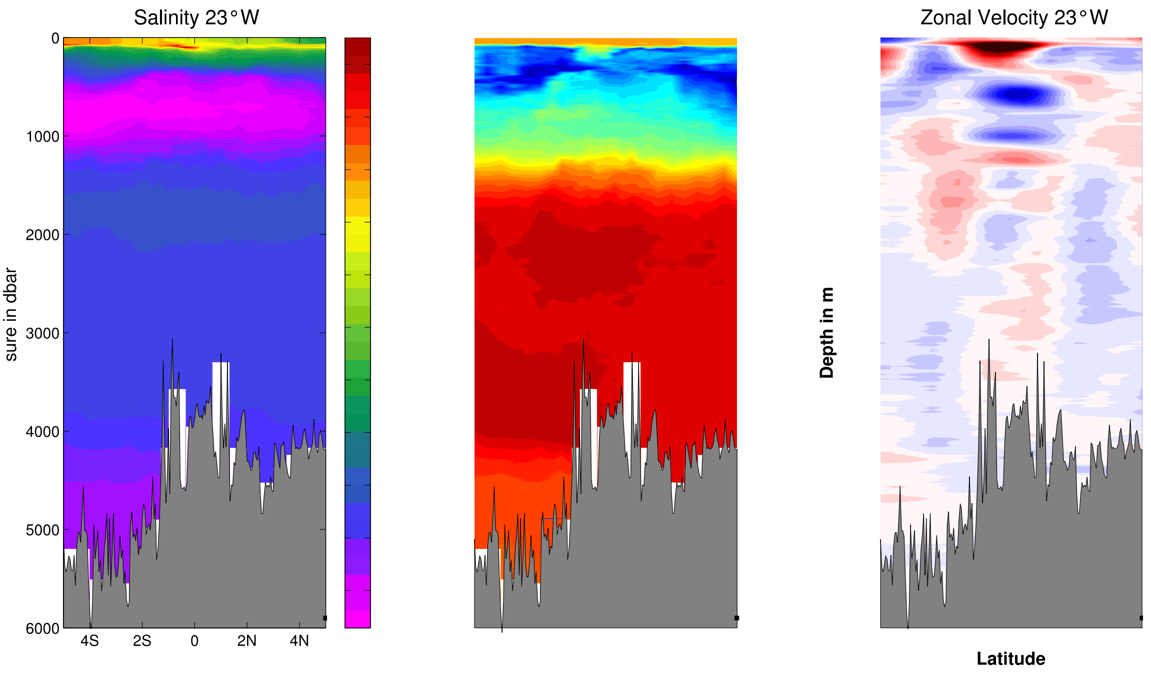

Fig. 5.1 Salinity (left panel), oxygen (middle panel), and zonal velocity (right panel) along the 23°W section between 5°N and 5°S.

5.3 Mooring operations

5.3.1 Instrument performance

(Johannes Hahn, Rebecca Hummels, Peter Brandt)

During M119, several long-term moorings were replaced that are aimed at the study of biogeochemical cycles (CVOO), the variability and supply of oxygen (11°N, 23°W; 5°N, 23°W), the variability of the equatorial current system (equator, 23°W), and the variability of the western boundary current system (4 moorings along approximately 11°S). Overall the moored instruments recovered during M119 worked very successful (Tab. 5.2).

sensor type / mooring	**T (%)**	**C (%)**	**P (%)**	**U,V (%)**	**O_2 (%)**	**other (%)**
KPO_1128	87.2	100	90.6	94.1	50.0	66.7
KPO_1127	96.5	100	100	0	92.6	-
KPO_1126	90.9	100	94.1	100	80.7	-
KPO_1125	99.5	98.9	100	91.5	100	-
KPO_1108	-	-	0	-	-	-
KPO_1109	-	-	100	-	-	-
KPO_1134	-	-	100	-	-	-
KPO_1135	-	-	100	-	-	-
KPO_1129	100	100	100	100	-	-
KPO_1130	100	100	100	99.0	-	-
KPO_1131	100	100	100	92.3	-	-
KPO_1132	100	95.1	100	100	-	-
all moorings	**94.3**	**99.6**	**95.9**	**92.9**	**84.3**	**66.7**

Tab. 5.2 Instrument performance as given as the ratio of the amount of acquired good data relative to the amount of maximum obtainable data in percent for each mooring and measured parameter. Mooring locations as well as deployment and recovery dates are given in the Table 7.2.1.

Here we calculate the instrument performance for each mooring and sensor type (T temperature; C conductivity; P pressure; U,V zonal, meridional velocity; O2 oxygen; other – other parameters) as the ratio of the amount of acquired good data relative to the amount of maximum obtainable data. This calculation was performed for the following instrument types with measured parameters in brackets: Mini-TD (T, P), MicroCAT (T, C, P), O2-Logger (T, O2), ADCP (U, V), RCM (P, U, V), Argonaut (U, V), Aquadopp (P, U, V), moored profiler M-CTD MMP (T, C, U, V), PIES (P), other (other parameters).

Very good instrument performance was obtained for temperature, conductivity and pressure sensors. Current meters and oxygen sensors performed well with minor exceptions. A summarized description over the performance of all instrument types is given in the following. Details are shown in Table 7.2.2.

Mini-TDs: Out of the four Mini-TDs, two instruments had a complete and clean data record. One instrument was lost during the mooring period and the pressure sensor of another one failed after about 76% of the mooring period.

MicroCATs: 45 of the 48 MicroCATs performed completely, whereas the other three devices had a bad conductivity cell for 18 hours, 14 hours and 2.5 months, respectively.

O_2-loggers: 13 of the 20 O_2-loggers performed with a complete and clean data record. Three O_2-loggers worked almost completely with data coverage of better than 99%, and two O_2-loggers stopped working during the mooring period with data coverage of 42% and 46%, respectively. Two instruments didn’t provide any data due to instrument loss and a corrupt SD card, respectively.

Single point current meters: All 15 Aquadopps worked completely. Two out of three Argonauts worked completely, and the sensor of the third device failed during the deployment period, resulting in 52% of data. Four of the six RCMs worked completely, and for the other two instruments the rotor failed after 58% and 94% of the deployment period, respectively. In five of the six RCMs the fin was installed on the wrong side, which needs to be carefully corrected in post processing.

ADCPs: Seven of the nine ADCPs worked completely. One ADCP performed with one broken beam and the instrument stopped working during the deployment period with 76% data coverage. One ADCP didn’t provide any data due to water leakage.

Moored Profiler: The McLane moored profiler, deployed in mooring KPO_1125, worked almost completely over the entire deployment period. It covered the entire profiling range between 3500m and 1000m, where the upper limit was not reached during a few profiles, providing a data coverage of 97%.

Other instruments: The sediment trap did not turn the bottles at all and only bottle 1 was filled at the end of the deployment period. The fluorometer and the SAMI (CO_2 sensor) performed well whereas the status of the Acoustic Recorder is unknown so far.

MicroCATs and O_2-loggers performed with a sampling interval of one hour or less. Particularly in the OMZ regime (KPO_1125, KPO_1126, KPO_1127), the sampling interval was set to 5min exclusively to record the internal wave field. Single point current meters and ADCPs performed with a sampling interval of two hours. The McLane moored profiler operated (upcast and subsequent downcast profile) every 4 days.

Mooring dynamics and mooring deployments

In the previous deployment period (July 2013 to May 2014, recovered during R/V METEOR cruise M106), the upward looking LR ADCPs in the two coastal moorings off Brazil had a strong inclination due to the combined effect of very strong currents (NBUC) and mooring elements (two MicroCATs) installed above the LR ADCPs. Hence, the mooring design was changed for the recent mooring period with LR ADCPs as top elements and no MicroCATs above, resulting in strongly reduced inclination angles of the LR ADCPs (Fig. 5.2).

In general, moorings deployed in the strong western boundary current regime off Brazil showed much larger depth excursions than the moorings in the moderate to sluggish flow regime in the ETNA. The near-surface elements in the moorings off Brazil had regular vertical displacements of about 40m. Additionally, several dive events were observed throughout the mooring period of up to 400m on time scales of weeks. In contrast, dynamics of the ETNA moorings were very much reduced and only one single dive event with about 100 m depth change occurred for mooring KPO_1126.

All moorings were deployed successfully (see Table 7.2.3) with one exception. A malfunction of the near-surface winch with profiler in mooring KPO_1156 was detected one day after deployment and this part of the mooring was recovered immediately whereupon a mechanical malfunction of the locking mechanism between winch and profiler was detected, very likely a consequence of the general deployment procedure of the winch-profiler-system.

5.3.2 Instrument calibration for Mini-TDs, MicroCATs and optodes

(Johannes Hahn)

CTD-O_2 cast calibrations were performed for all Mini-TDs, MicroCATs and optodes either as pre- or post-deployment calibrations (CTD casts 001, 002, 009, 012, 013, 014, 015, 017, 028, 037, 040, 060 and 083). During each cast, 8 calibration stops were done on average over the whole profile range, each stop lasting at least 4 min (Mini-TDs and MicroCATs) and 2.5 min (optodes), respectively, in order to ensure equilibrium at the calibration points. However, we found that 4 min calibration stops are not long enough to particularly equilibrate the conductivity sensor of the MicroCATs in the warmer environment of the upper few hundred meters of the water column, which might be the result of the thermal mass effect.

Additionally, onboard lab calibrations were conducted for all optodes in water-filled beakers of 0% and 100% O_2-saturated water at two different temperatures (~5°C and ~22°C) following the Aanderaa optode manual.

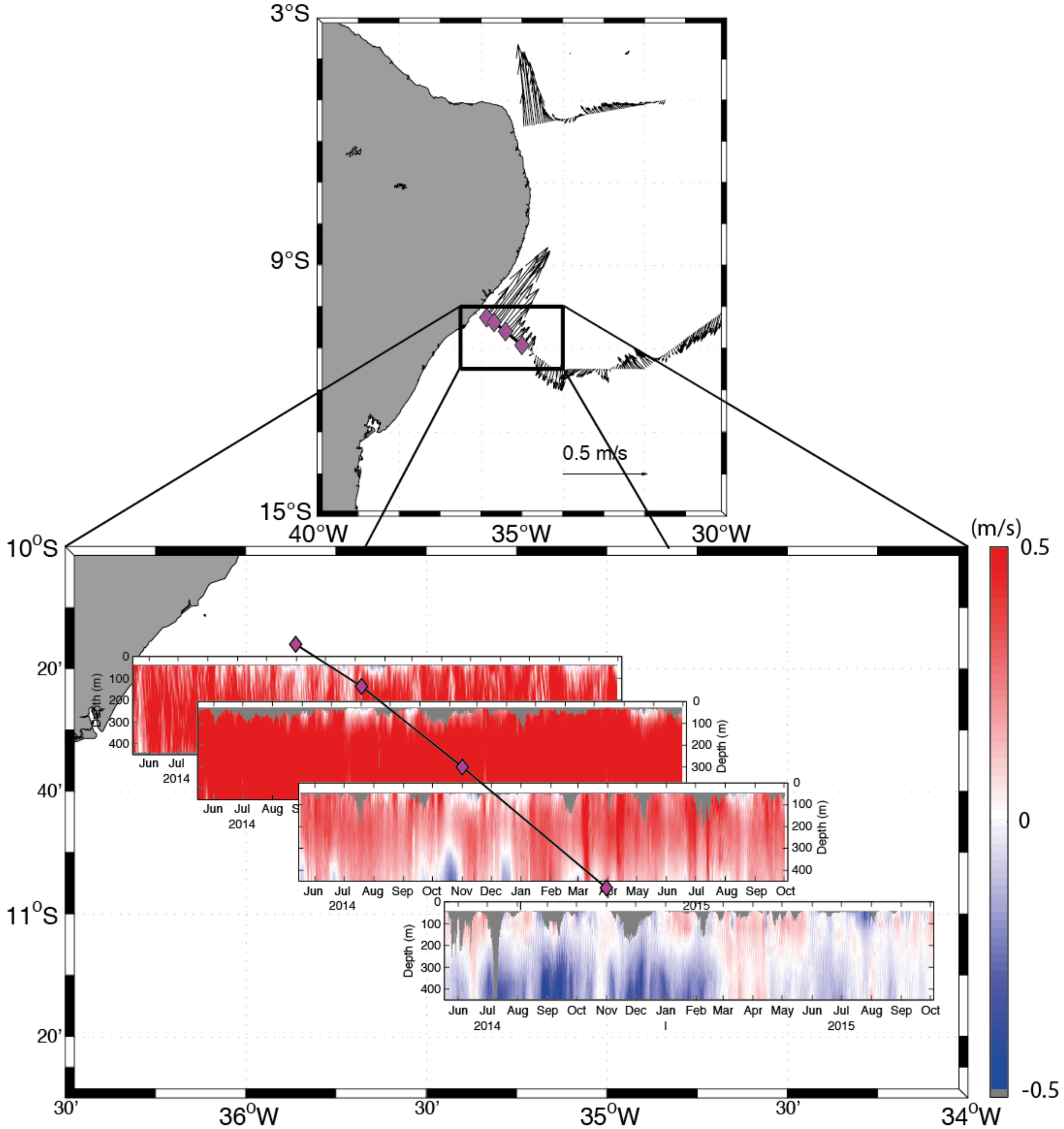

Fig. 5.2 Time series of along-shore velocities of the upper 450 m (lower panel) acquired at the continental slope at 11°S off Brazil at the four mooring positions (squares). Also included in the upper panel are current vectors along the nominal 5°S und 11°S sections averaged over the upper 400 m.

5.4 Shipboard microstructure measurements

(Florian Schütte, Rebecca Hummels)

A MSS90-D microstructure profiler (#032) of Sea and Sun Technology was used to infer turbulent dissipation rate and diapycnal diffusivity, aimed at calculating diapycnal fluxes of oxygen and nitrous oxide (N_2O). The loosely tethered profiler was equipped with 3 airfoil shear sensors and a fast thermistor, as well as some common CTD sensors: pressure, conductivity, temperature and turbidity sensor. The sink velocity of the profiler was adjusted to 0.55 m/s. In total, 171 profiles to maximum depth of 945m were recorded on 31 ship stations (Table 7.4). Most stations consisted of at least 3 microstructure profiles following a CTD cast with oxygen and/or N_2O sampling, some stations were occupied for a longer period of time (e.g. 11°N, 21.5°W; 0°N, 23°W; 11°S, 36°W). 40 % of the profiles were obtained in selected places on or near 23°W, another 40% covered the 11°S-section off Brazil, and the remaining 20% were recorded on the 5°S-section off Brazil. After profile 27, the communication between deck unit and microstructure probe broke upon return to the surface, due to severe damage to the cable. After the removal of the damaged part of the cable, reducing the overall length by about 300m, the system worked without any other failures.

5.5 Biochemical and biological measurements

5.5.1 *In situ* particle and zooplankton sampling

(Pieter Vandromme, Kosmas Hench, *PIs: Rainer Kiko*, *Helena Hauss*)

During cruise M119, the particles and the zooplankton were measured *in situ* using the Underwater Video Profiler 5 (UVP5) and the Multinet (MN). The UVP5 is an *in situ* camera system developed at the Laboratory of Oceanography of Villefranche-sur-mer (LOV) and designed to be part of the CTD/Rosette ensemble. It is composed of a main compartment containing the camera, processor and battery. At 50 cm in front of the camera, two lights are flashing in the red wavelength to illuminate a volume of a 0.88L in the focus zone of the camera. During a downcast, the camera is able to take pictures at a rate up to 10/sec, all images taken are directly analyzed within the camera, through an identification of all objects as area of contiguous pixels, giving direct information on particle abundance and size. Furthermore, all objects larger than 33 pixels, corresponding to an equivalent spherical diameter (esd) of 660µm, are saved for further processing and classification. The UVP5 gives high-resolution data on the particle abundance and size from 60µm esd and allows their classification into groups from a size of 660µm. Largest particles and plankton observed are in the order of a few centimeters. The MN is a zooplankton sampling net with a mesh of 200µm and an opening mouth of 0.25 m^2. The MN corresponds of the association of 5 of these nets which can open and close at predetermined depths. During cruise M119, the depths were set at 1000m to 600m depth for the first net, then from 600 to 300m depth, from 300 to 200m, from 200 to 100m and finally from 100m to the surface for the last net.

The UVP5 was deployed at the CVOO station and during the entire 23°W transect in association with both the CTD/Rosette and the Pelagios (see chapter 5.5.3). Unfortunately, a failure of a light component inside the instrument prevented its further use off Brazil. A total of 60 deployments were made with the UVP5 for a total of about 150km of water column photographed. A transect showing the abundance of particles obtained by the UVP5 is shown in Fig. 5.3. Images from the UVP5 are now classified according to general categories such as aggregates, fecal pellets, trichodesmium, rhizarians, copepods and jellyfish.

The MN was deployed a total of 14 times, which represents 70 samples. Among these, the MN was deployed day and night at the 4 mooring stations which will allow the observation of zooplankton diel vertical migration. The MN samples are now being analyzed in Cape Verde by Elizandro Lopez using the ZooScan technology; the samples are scanned on a flatbed scanner and further analyzed and sorted using image analysis in a similar fashion as the images from the UVP5.

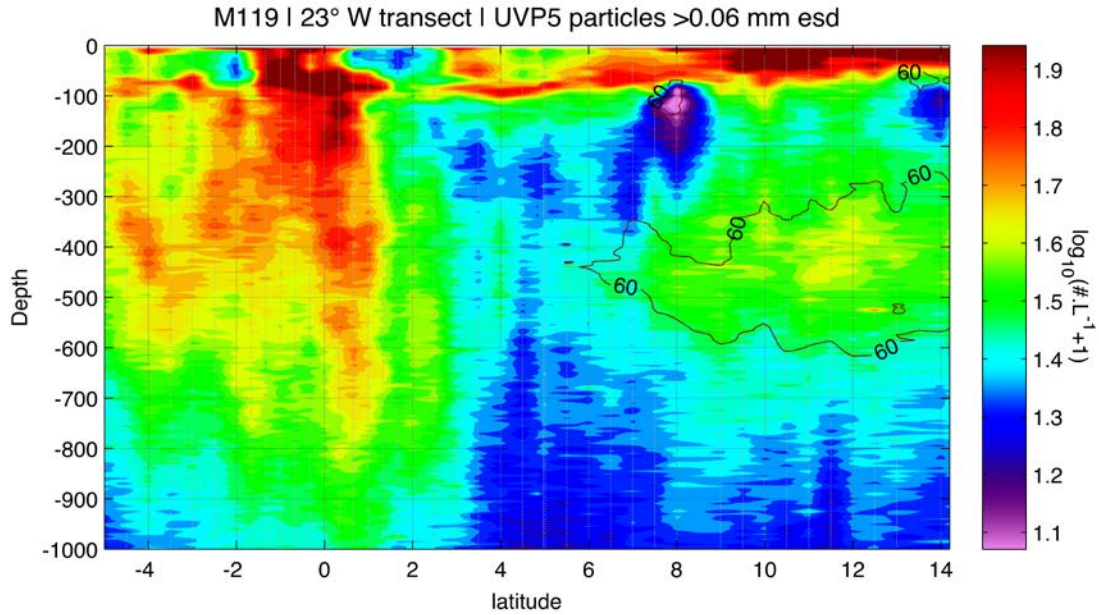

Fig. 5.3 Distribution of all particles larger than 60µm esd in the upper 1000 m along 23°W. The isoline of 60 µmol/kg of oxygen measured by the CTD is shown in black.

5.5.2 Biogeochemistry Measurements

(Ajit Subramaniam, Ana Fernández Carrera, Francie Rudminat)

Size-fractionated N_2 fixation and carbon uptake of the planktonic community were estimated following a dual $^{15}N_2$ and ^{13}C-bicarbonate tracer technique (Montoya et al. 1996) at 30 stations (Table 7.5). At each station, triplicate 4.4-L, clear polycarbonate bottles (Nalgene) were filled from 1 to 4 depths, directly from the CTD-rosette. After removing all air bubbles, 3 ml of $^{15}N_2$ (98 atom%, SerCon) and 250 µL of ^{13}C-bicarbonate were injected to each bottle. The 24-hour incubation was carried out on-deck in a system of re-circulating water simulating *in situ* PAR levels, using a combination of blue and neutral density screens/meshes.

Particles for defining the natural abundance of carbon and nitrogen isotopes were collected at each sampling depth by passing 2–17 L of water through pre-combusted (450ºC for 4h) 47 mm GF/F filters under gentle pressure. The abundance of carbon (C) and nitrogen (N) stable isotopes in incubated and natural abundance samples will be measured by continuous-flow isotope-ratio mass spectrometry (CF-IRMS) using a Micromass Optima interfaced to a Carlo Erba elemental analyzer (CE NC2500). The stability of the instrument and the contribution of any blank to our measurements will be checked using a size series of elemental (methionine) and isotopic (peptone) standards in each analytical run (Montoya et al. 1996).

Samples were collected for analysis of High Performance Liquid Chromatography for estimating phytoplankton pigment concentrations from the upper 100m at the stations indicated in Table 7.5. 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 frozen in liquid nitrogen till analysis. The samples will be analyzed following the method of (Van Heukelem and Thomas 2001) at the NASA GSFC sample analysis facility.

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

Samples were collected for analysis of inorganic nutrients - nitrate+nitrite, soluble reactive phosphorus, and silicate from several depths in the upper 200m. About 15mL of seawater was frozen and transported back to Georgia Institute of Technology for analysis using a Lachat QuikChem 8000 flow-injection analysis system (Lachat Instruments, Loveland CO, USA) and following JGOFS methods described by (Knap 1996).

The in-water light field was studied using a multichannel free falling spectroradiometer (Satlantic Micropro) that measured downwelling irradiance at 14 wavelengths and upwelling radiance at 7 wavelengths. This data was used to calculate the attenuation of light in the water column and depth of the euphotic zone.

In addition to the measurements described above, a total of 21 stations including additional stations off the coast of Brazil (Table 7.6) were sampled for N_2-fixation measurements, using the method of Mohr et al. (2010) who found that injecting the $^{15}N_2$-gas bubble directly into the incubation bottles could lead to an underestimate rates of N_2-fixation due to an overestimation of the dissolved tracer concentration in the incubation bottle, as the gas bubble does not attain equilibrium with the surrounding water.

At each of the 21 stations, triplicate 4.4-L, clear polycarbonate incubation bottles (Nalgene) were completely filled from four depths (up to 200m), directly from the CTD-rosette. 100 ml were replaced with previously filtered, degassed and $^{15}N_2$-enriched (5 ml/l $^{15}N_2$ gas (98%, Cambridge Isotope Laboratories)) seawater as described by Mohr et al. (2010). For preparation of the $^{15}N_2$-solution surface seawater (10 m) was used for sample depths above the nutricline, while deeper water (around 100 m) was used for sample depths below the nutricline. For C-fixation measurements 1 ml of $NaH^{13}CO_3$ (0.2 mol/l; SIGMA-Aldrich, 99 atom% ^{13}C, sodium carbonate) were added to each bottle. The bottles were then incubated for 24 hours in an on-deck incubator system as described above. The deepest sample (100/200 m) was always incubated in a dark cooling room (4°C).

For natural isotope abundance in particulate organic carbon and nitrogen at sampled depths, 2 L of seawater was directly filtered onto pre-combusted 25 mm GF/F filters under gentle pressure (<200 mbar).

Furthermore samples for DNA/RNA analysis were collected by filtering of seawater through 0.22 µm polyethersulfone membrane filters (Millipore) at reduced pressure (<200 mbar). As the flow rate was very slow, filtration was stopped after a maximum of 20 minutes to prevent disturbance of filtered material. The exact volumes were determined and recorded for each sample. They ranged from 450 to 800 ml. Filters were transferred into 2 ml cryovials, covered with RNA later for RNA stabilization, and immediately frozen at -80 °C.

5.5.3 Pelagic *in situ* camera observation system

(Hendrik Jan Ties Hoving, *PIs: Uwe Piatkowski*, *Arne Körtzinger*)

Most sampling for larger pelagic organisms in the Atlantic Ocean has been performed with nets. While nets are suitable for collection and quantifying certain pelagic fauna, they underestimate the abundance of fragile gelatinous macrozooplankton since members of this group will not be sampled or come up in the net damaged beyond recognition. Underwater surveys with optical techniques (e.g. ROVs, plankton recorders) have revealed fauna that are not sampled by nets, and during M119 we used a novel optical method to determine the vertical distribution, abundance and diversity of macrozooplankton and (micro)nekton, in particular in relation to the oxygen minimum zone. We performed pelagic transects with a recently developed ocean observation instrument *Pelagios* (Pelagic *in situ* observation system, Fig. 5.4). This system consists of an aluminum frame with a forward looking HD video camera, a CTD and oxygen sensor, batteries and LED lights (Fig. 5.3). During M119, an underwater vision profiler (UVP5) was also attached underneath the Pelagios for quantification of mesozooplankton and particles (see section about mesozooplankton and particles). Pelagios was deployed at 14 stations, mostly along the 23W transect (Table 7.7). Deployments consisted of horizontal transects where the system was towed at approximately 1 knot for 10-15 minutes at depths between 50 and 700 meter, starting at the shallowest depth. This resulted in > 20 hours of video in which fishes, squids, crustaceans, and a wide variety of gelatinous zooplankton were observed. This video will be annotated to quantify the pelagic fauna in their physical and chemical environment and to determine the ecological zonation of the oxygen minimum zone of the eastern tropical Atlantic.

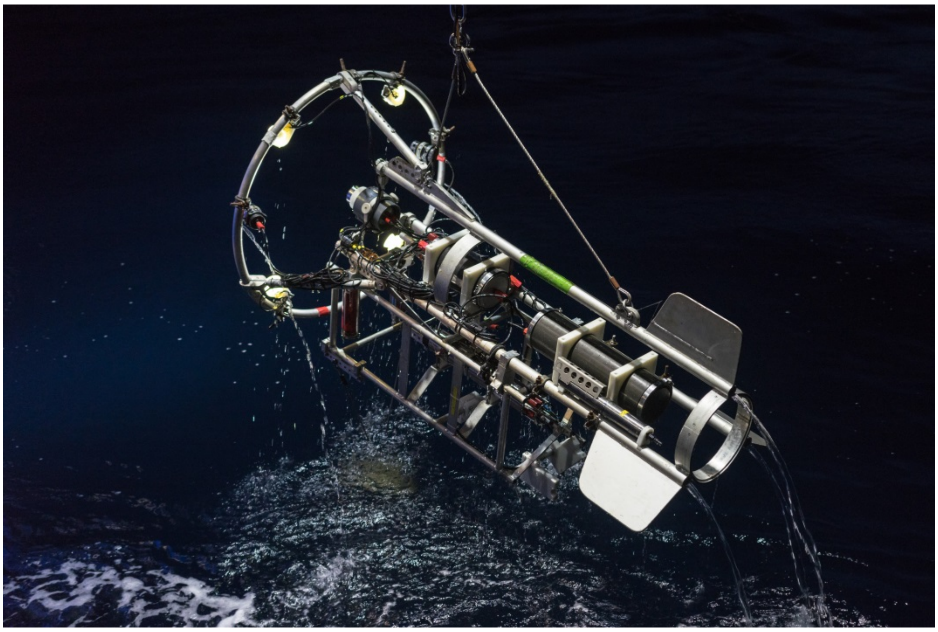

Fig. 5.4 The *Pelagios* being retrieved after a transecting mission in the pelagic ocean of the eastern tropical Atlantic (Photo Christian Rohleder).

5.5.4 Squid sampling

(Hendrik Jan Ties Hoving)

During M119, along the 23°W section, we used jiggs on fishing lines to opportunistically collect squid (*Sthenoteuthis pteropus*). The length, (approximate) weight and maturity stage was recorded and stomach contents of these specimens were preserved in 70% ethanol. A tissue sample was taken for DNA analysis. The stomach content samples will be analyzed in Kiel to determine the diet of these squid and to determine their trophic position in the food web of the pelagic ecosystem of the eastern tropical Atlantic. The samples from M119 will be combined with squid specimens collected during M116 and MSM49. All the material will be analyzed as part of an ongoing MSc project.

5.5.5 Chemical underway measurements of oxygen and total gas tension

(Tobias Hahn, *PI: A. Körtzinger*)

Underway (UW) measurements of surface water oxygen concentration (O_2), total gas tension (GTD), temperature and salinity were carried out in a flow-through box. A submersible pump and a MicroCAT (SBE37-IM, SN# 37IM60039-7957, Sea-Bird Electronics Inc., Bellevue, USA) were installed in the ship's moon pool at approximately 6 m depth. The pump supplied a continuous flow of surface water to the underway instruments in the through-flow box, as well as a to a bypass for discrete water sampling.

The following sensors were operated: Oxygen optodes (model 4330/3830, SN# 1082/529, Aanderaa Data Instruments AS, Bergen, Norway; model HydroFlash O_2, SN# DO-1014-005, Kongsberg Maritime Contros GmbH, Kiel, Germany), GTD Pro gas tension sensor (SN# 22-019-06, Pro Oceanus Inc., Bridgewater, Canada; turbulent water flow and mixing was ensured through an extra SBE5M pump (SN#051137)) and conductivity sensor (model 4319, SN# 772, Aanderaa Data Instruments AS, Bergen, Norway). Temperature was obtained from the optodes as well as the MicroCAT at the water intake. Note that the used temperature and conductivity sensors are independent of the thermosalinograph system (see chapter 5.1.3).

Duplicates (36 discrete oxygen and 20 discrete salinity samples) were taken from the bypass to validate and partly (oxygen optodes) or fully (conductivity sensor) calibrate these UW measurements. Both types of samples were measured onboard using Winkler titration and the salinometer, respectively (see chapter 5.1.1 and 5.1.2 for further details).

The UW measurements in the flow-through box were started on September 8th at 1:36 pm and stopped on Oct 11th 2015 at 12:57 pm (both UTC).

5.5.6 Instrument test of Contros optodes

(Tobias Hahn, *PI: A. Körtzinger*)

Besides the underway performance test of a novel Contros Hydro Flash O_2 optode (see chapter 5.5.5), optical oxygen measurements with this new optode (DO-1014-003, Kongsberg Maritime Contros GmbH, Kiel, Germany) were carried out on 12 CTD casts (9, 10, 12, 27, 28, 32, 36, 46-49 and 91) in order to characterize its performance. All CTD profiles were used to determine the response signal during the up- and downcast of the CTD. Therefore, the optodes were attached on the near-bottom of the CTD rosette frame as closely as possible to the inlet of the SBE43 oxygen sensor for comparison. All data during each CTD cast were logged internally every 1-2 s with the optode using the power supply of a manufacturer customized battery module. Problems with data logging occurred during the casts 36, 45 and 91 because the cold temperature in the deep ocean decreased the power supply of the battery module below the necessary threshold.

For determination of the long-term stability performance, two other optodes (model: HydroFlash O_2, DO-1014-001 and DO-1014-004) were attached to the CVOO mooring (KPO 1143). Therefore, a lab calibration was conducted at warm and cold temperature conditions with 0% and 100% oxygen saturation at each temperature. Subsequently, these two optodes were attached to the CTD rosette during profile 2 for an *in-situ* calibration. The starting time of the two optodes for moored observations was set to Sep 10th 2015 at 8:58 UTC few hours before the mooring was finally deployed.

5.6 Multibeam echosounder

(Florian Schütte)

The 12-kHz multibeam echosounder EM122 was used to continuously record bathymetry and water column backscatter during the cruise. The system pinged at 10-second intervals with a bin size of 8m. There was no interference with the 38kHz and 75kHz ADCP systems. The data were mainly taken to study the bathymetry of the seamount ridge north of the equator along 23°W. The backscatter data could also be used to infer the possibility of studying the characteristics of zooplankton abundance and migration.

6 Ship`s meteorological station

(Harald Rentsch)

8th -13th September: Mindelo – northern Cape Verdes, then heading S

At the start of M119 on 8th September 2015, the weather was dominated by a steering high pressure system near the Azores and steady northeasterly trade winds, with cloudy skies, a small chance of precipitation, northeasterly winds at 4-5 Beaufort (Bft), maximum wave heights 2 m on average, not exceeding 2.5 m. Daytime temperatures reached nearly 26°C, and 24°C at night. The next day a weak tropical wave reached our working area near 17°36'N 24°18'W, without any major effect: cloud coverage increased slightly, no rain, and northeasterly winds at 18 knots or less, seas less than 1.5 m. Nighttime temperatures not below 25°C.

The wind field changed significantly on 11th September while we approached the Intertropical Convergence Zone (ITCZ: main zone ~11°N to ~8°N): the northeasterly trade winds abated, cloud cover became more convective, and rain probability increased until we left the ITCZ.

On 12th September the northeasterly trade winds stopped, veering slowly to southeasterly, then southerly directions. Winds were initially 5 Bft, decreasing to Bft 3, and swell was near 1.5 m. During the night of 13th September, sheet lightning was observed for the first time on this cruise in the far distance from the ship, followed by light rain near the ship in the early morning.

14th -20th September: southern Cape Verdes, heading S along 23°W towards 4°N

On Monday, 14th September, R/V METEOR sailed through the calm area of the ITCZ near a tropical low at 09°N 22°W which could potentially become a tropical storm. Station work took place in calm seas, swell below 1 m. Some isolated, partly heavy showers, including thunderstorms, near the vessel during the evening hours. The cumulative precipitation of all events on the ship was nearly 40 l/m^2 over 12 h.

The next day, on the backside of this tropical wave, the easterly winds were up to Bft 5 (Bft 4 on average), and swell up to 2.5 m. The ship exited the ITCZ southbound on 17th of September (south of 7°N). On 18th September, a weak disturbance approached from east, with cumulus clouds and light showers far from the ship, followed by 3 hours of heavy rain aboard the ship. The winds were southerly, 2 to 3 Bft, and a southeasterly swell around 1.5 m.

On 20th September, we sailed already south of the high humidity zone, with high cloud coverage and dry southwesterly winds up to 5 Bft. The waves did not exceed 2 m, and no precipitation.

21st -27th September: between 3°N and 6°S heading along 23°W

On Monday, 21st September, R/V METEOR had reached the central SE-trade wind zone, and winds were 4–5 Bft throughout the day. Sea surface temperature (SST) was measured near 28°C but the maximum of air temperature (Tmax) was only 25.8°C, already significantly cooler than the days before.

On 22nd and 23rd September (start of spring in the southern hemisphere), mostly broken clouds covered the sky, at times virga was seen on the horizon. The winds slowly increased to 5 Bft along our southerly track, and swell was near 2.5 m. At the end of the week (26th September), sunshine prevailed but temperatures did not exceed 25°C. Very little change in winds and seas over the next few days, southeasterly, 5 to 6 Bft, wave heights only 2.5 m, scattered, variable broken clouds, mostly dry.

28th September -04th October: station work nearby the eastern coast of Brazil

This leg of the cruise was dominated by the steering influence of a nearly stationary high-pressure system in the southern Atlantic, producing steady southeasterly trade winds. On 28th September, the winds were mainly from ESE near 5 Bft, average wave height 2 m. During the week the winds turned towards E-NE, variable 4+ to 5+ Bft. Occasionally rain showers near the vessel, very little precipitation registered on the ship, some on 30th September in the morning. During 1st-4th October, ESE swell around 1.5 m, and wave heights about 2 m.

05th -12th October: station work near the eastern coast of Brazil

Near the end of our expedition the weather was characterized by northeasterly winds of 5 Bft, seas around 2 m, and swell near 1 m from ENE. The daily routine consisted of broken convective clouds in the afternoon and weak isolated rain showers in the vicinity of the ship (seen on 5th and 8th October). By mid-week, the winds turned ESE and abated to 3 Bft. The fair and dry weather, in connection with southeasterly winds of 4-5 Bft, accompanied the ship until its arrival in Recife (Brazil) on 12th October

7 Lists M119

7.1 Station list

Station No. M119_ Ship/Science		Latitude	Longitude	Time	Work
683-1	KPO_1128	17°36.354’N	24°14.976’W	08.09. 15:00-20:30	**Mooring** recovery
684-1	CTD_1	17°37’N	24°20’W	08.09. 21:10-00:10	**CTD** station (3598m/bottom)
685-1	MN_1	17°37’N	24°22’W	09.09. 00:30-02:20	**Multinet**
686-1	CTD_2	17°37’N	24°21’W	09.09. 04:00-05:00	**CTD** station (1000m)
687-1	MSS_1	17°37’N	24°21’W	09.09. 05:40-06:20	**Microstructure**
688-1	MN_2	17°36’N	24°19’W	09.09. 06:40-07:40	**Multinet**
689-1	KPO_1156	17°36.27’N	24°18.82’W	09.09. 08:50-13:50	**Mooring** deployment
690-1	SR_1	17°36’N	24°18’W	09.09. 14:20-14:40	**Spectroradiometer**
691-1	MN_3	17°36’N	24°18’W	09.09. 14:50-16:00	**Multinet**
692-1	CTD_3	17°36’N	24°18’W	09.09. 16:20-18:40	**CTD** station (3598m/bottom)
693-1	KPO_1156	17°36.27’N	24°18.82’W	09.09. 19:00-19:40	**Mooring** acoustic comm.
694-1	TC_1	17°36’N	24°18’W	09.09. 22:00-23:20	**Towed Camera**
695-1	KPO_1143	17°36.40’N	24°14.98’ W	10.09. 07:00-13:40	**Mooring** deployment
696-1	KPO_1156	17°36.27’N	24°18.82’W	10.09. 14:20-15:30	**Mooring winch** recovery
697-1	CTD_4	15°00’N	23°00’W	11.09. 06:00-06:50	**CTD** station (1000m)
698-1	CTD_5	14°30’N	23°00’W	11.09. 09:40-10:40	**CTD** station (1300m)
699-1	SR_2	14°30’N	23°00’W	11.09. 10:50-11:00	**Spectroradiometer**
700-1	CTD_6	14°00’N	23°00’W	11.09. 13:50-14:50	**CTD** station (1300m)
701-1	MN_4	14°00’N	23°00’W	11.09. 15:00-16:10	**Multinet**
702-1	TC_2	14°00’N	23°00’W	11.09. 16:40-18:50	**Towed Camera**
703-1	CTD_7	13°30’N	23°00’W	11.09. 21:50-22:50	**CTD** station (1300m)
704-1	CTD_8	13°00’N	23°00’W	12.09. 02:00-02:50	**CTD** station (1300m)
705-1	TC_3	13°00’N	23°00’W	12.09. 03:50-06:30	**Towed Camera**
706-1	CTD_9	12°30’N	23°00’W	12.09. 09:40-11:00	**CTD** station (1300m) Calibration auf Optodes/MCs
707-1	SR_3	12°00’N	23°00’W	12.09. 14:10-14:30	**Spectroradiometer**
708-1	CTD_10	12°00’N	23°00’W	12.09. 14:50-15:50	**CTD** station (1300m)
709-1	MN_5	12°00’N	23°00’W	12.09. 16:00-17:10	**Multinet**
710-1	TC_4	12°00’N	23°00’W	12.09. 17:30-19:10	**Towed Camera**
711-1	MSS_2	11°02’N	21°15’W	13.09. 08:40- 14.09. 04:50	**Microstructure**
712-1	KPO_1127	11°02.216’N	21°13.290’W	14.09. 06:40-10:30	**Mooring** recovery
713-1	SR_4	11°02’N	21°13’W	14.09. 10:50-11:00	**Spectroradiometer**
714-1	CTD_11	11°02’N	21°13’W	14.09. 11:10-11:40	**CTD** station (200m)
715-1	MN_6	11°02’N	21°13’W	14.09. 11:50-12:40	**Multinet**
716-1	TC_5	11°02’N	21°13’W	14.09. 12:50-14:20	**Towed Camera**
717-1	KPO_1142	11°02.216’N	21°13.290’W	14.09. 15:30-19:50	**Mooring** deployment
718-1	CTD_12	11°02’N	21°15’W	14.09. 20:20-21:40	**CTD** station (1300m)
719-1	MN_7	11°02’N	21°15’W	14.09. 21:50-22:50	**Multinet**
720-1	TC_6	11°02’N	21°15’W	14.09. 23:00-01:30	**Towed Camera**
721-1	SR_5	11°30’N	22°57’W	15.09. 11:20-11:40	**Spectroradiometer**
722-1	CTD_13	11°30’N	22°57’W	15.09. 11:40-13:00	**CTD** station (1300m)
723-1	CTD_14	11°00’N	22°57’W	15.09. 17:20-18:40	**CTD** station (1300m)
724-1	CTD_15	10°30’N	22°57’W	15.09. 21:50-23:20	**CTD** station (1300m)
725-1	CTD_16	10°00’N	22°57’W	16.09. 02:30-3:20	**CTD** station (1300m)
726-1	MN_8	10°00’N	22°57’W	16.09. 03:40-4:30	**Multinet**
727-1	TC_7	10°00’N	22°57’W	16.09. 04:50-7:10	**Towed Camera**
728-1	SR_6	09°30’N	22°57’W	16.09. 10:20-10:30	**Spectroradiometer**
729-1	CTD_17	09°30’N	22°57’W	16.09. 10:30-12:00	**CTD** station (1300m)
730-1	SR_7	09°00’N	22°57’W	16.09. 15:30-15:40	**Spectroradiometer**
731-1	CTD_18	09°00’N	22°57’W	16.09. 15:50-16:50	**CTD** station (1300m)
732-1	TC_8	09°00’N	22°57’W	16.09. 17:20-19:40	**Towed Camera**
733-1	CTD_19	08°30’N	22°57’W	16.09. 22:40-23:40	**CTD** station (1300m)
734-1	CTD_20	08°00’N	22°57’W	17.09. 03:00-03:50	**CTD** station (1300m)
735-1	TC_9	08°00’N	22°57’W	17.09. 04:30-07:30	**Towed Camera**
736-1	CTD_21	07°30’N	22°57’W	17.09. 10:30-11:50	**CTD** station (1300m)

Station No. M119_ Ship/Science		Latitude	Longitude	Time	Work
737-1	CTD_22	07°00'N	22°57'W	17.09. 15:00-16:00	**CTD** station (1300m)
738-1	TC_10	07°00'N	22°57'W	17.09. 16:40-18:30	**Towed Camera**
739-1	CTD_23	06°30'N	22°57'W	17.09. 21:20-22:20	**CTD** station (1300m)
740-1	CTD_24	06°00'N	22°57'W	18.09. 01:20-2:10	**CTD** station (1300m)
741-1	CTD_25	05°30'N	22°57'W	18.09. 05:20-6:20	**CTD** station (1300m)
742-1	TC_11	05°00'N	22°57'W	18.09. 09:20-11:40	**Towed Camera**
743-1	MN_9	05°00'N	22°57'W	18.09. 11:50-12:40	**Multinet**
744-1	SR_8	05°00'N	22°57'W	18.09. 12:50-14:00	**Spectroradiometer**
745-1	CTD_26	05°00'N	22°57'W	18.09. 13:00-14:10	**CTD** station (1300m)
746-1	KPO_1126	05°01.0'N	23°00.0'W	18.09. 14:40-17:30	**Mooring** recovery
747-1	CTD_27	05°00'N	23°00'W	18.09. 18:10-20:40	**CTD** station (4199m/bottom)
748-1	TC_12	05°00'N	23°00'W	18.09. 21:00-23:30	**Towed Camera**
749-1	MN_10	05°00'N	23°00'W	18.09. 23:40-00:30	**Multinet**
750-1	CTD_28	05°00'N	23°00'W	19.09. 00:50-02:10	**CTD** station (1300m) Calibration of optodes
751-1	MSS_3	05°00'N	23°00'W	19.09. 03:20-06:10	**Microstructure**
752-1	KPO_1141	05°01.0'N	23°00'W	19.09. 06:30-12.50	**Mooring** deployment
753-1	CTD_29	04°30'N	23°00'W	19.09. 16:20-18:50	**CTD** station (4140m/bottom)
754-1	CTD_30	04°00'N	23°00'W	19.09. 21:30-00:10	**CTD** station (4212m/bottom)
755-1	CTD_31	03°30'N	23°00'W	20.09. 02:50-5:30	**CTD** station (4380m/bottom)
756-1	CTD_32	03°00'N	23°00'W	20.09. 08:10-11:10	**CTD** station (4641m/bottom)
757-1	SR_9	02°30'N	23°00'W	20.09. 14:00-14:10	**Spectroradiometer**
758-1	CTD_33	02°30'N	23°00'W	20.09. 14:20-17:10	**CTD** station (4540m/bottom)
759-1	CTD_34	02°00'N	23°00'W	20.09. 19:50-22:30	**CTD** station (4328m/bottom)
760-1	MN_11	02°00'N	23°00'W	20.09. 22:40-23:30	**Multinet**
761-1	CTD_35	01°40'N	23°00'W	21.09. 01:20-04:00	**CTD** station (4119m/bottom)
762-1	CTD_36	01°20'N	23°00'W	21.09. 05:50-08:50	**CTD** station (4717m/bottom)
763-1	SR_10	01°00'N	23°00'W	21.09. 10:50-11:10	**Spectroradiometer**
764-1	CTD_37	01°00'N	23°00'W	21.09. 11:20-14:10	**CTD** station (3220m/bottom)
765-1	CTD_38	00°40'N	23°00'W	21.09. 16:00-18:30	**CTD** station (3898m/bottom)
766-1	CTD_39	00°20'N	23°00'W	21.09. 20:20-22:50	**CTD** station (3913m/bottom**)**
767-1	MSS_4	00°20'N	23°00'W	21.09. 23:30-04:50	**Microstructure**
768-1	KPO_1125	00°00.20'N	23°06.80'W	22.09. 6:30-11:10	**Mooring** recovery
769-1	SR_11	00°00'N	23°06'W	22.09. 11:20-11:30	**Spectroradiometer**
770-1	CTD_40	00°00'N	23°06'W	22.09. 11:40-12:50	**CTD** station (800m) Calibration of Optodes
771-1	MN_12	00°00'N	23°06'W	22.09. 13:00-13:50	**Multinet**
772-1	TC_13	00°00'N	23°06'W	22.09. 14:10-16:30	**Towed Camera**
773-1	MSS_5	00°00'N	23°06'W	22.09. 16:40-19:30	**Microstructure**
774-1	CTD_41	00°00'N	23°06'W	22.09. 20:00-22:30	**CTD** station (3952m/bottom)
775-1	MN_13	00°00'N	23°06'W	22.09. 22:40-00:30	**Multinet**
776-1	TC_14	00°00'N	23°06'W	23.09. 00:50-02:50	**Towed Camera**
777-1	MSS_6	00°00'N	23°06'W	23.09. 03:10-05:40	**Microstructure**
778-1	KPO_1141	00°00.20'N	23°06.80'W	23.09. 08:00-11:40	**Mooring** deployment
779-1	MN_14	00°00'N	23°06'W	23.09. 12:10-13:10	**Multinet**
780-1	CTD_42	00°20'S	23°00'W	23.09. 16:50-19:40	**CTD** station (4610m/bottom)
781-1	CTD_43	00°40'S	23°00'W	23.09. 21:50-00:10	**CTD** station (3560m/bottom)
782-1	CTD_44	01°00'S	23°00'W	24.09. 02:00-04:50	**CTD** station (4120m/bottom)
783-1	CTD_45	01°20'S	23°00'W	24.09. 06:50-10:00	**CTD** station (4850m/bottom)
784-1	CTD_46	01°40'S	23°00'W	24.09. 12:10-15:20	**CTD** station (4920m/bottom)
785-1	CTD_47	02°00'S	23°00'W	24.09. 17:30-18:10	**CTD** station (200m)
786-1	MN_15	02°00'S	23°00'W	24.09. 18:20-19:20	**Multinet**
787-1	CTD_48	02°00'S	23°00'W	24.09. 19:30-22:30	**CTD** station (5230m/bottom)
788-1	CTD_49	02°30'S	23°00'W	25.09. 01:40-5:30	**CTD** station (5780m/bottom)
789-1	CTD_50	03°00'S	23°00'W	25.09. 08:10-12:10	**CTD** station (5520m/bottom)
790-1	SR_12	03°30'N	23°00'W	25.09. 15:00-15:10	**Spectroradiometer**
791-1	CTD_51	03°30'S	23°00'W	25.09. 15:20-19:00	**CTD** station (5490m/bottom)
792-1	CTD_52	04°00'S	23°00'W	25.09. 21:50-01:40	**CTD** station (5820m/bottom)
793-1	CTD_53	04°30'S	23°00'W	26.09. 04:40-08:10	**CTD** station (5160m/bottom)

Station No. M119_ Ship/Science		**Latitude**	**Longitude**	**Time**	**Work**
794-1	SR_13	05°00'N	23°00'W	26.09. 11:20-11:30	**Spectroradiometer**
795-1	CTD_54	05°00'S	23°00'W	26.09. 11:40-15:10	**CTD** station (5190m/bottom)
796-1	ARGO_1	05°00'S	23°00'W	26.09. 15:20	**Argo Float** Deployment
797-1	CTD_55	08°00'S	27°09'W	27.09. 15:30-16:00	**CTD** station (500m)
798-1	ARGO_2	08°00'S	27°09'W	27.09. 16:10	**Argo Float** Deployment
799-1	CTD_56	11°30'S	32°00'W	28.09. 18:40-21:50	**CTD** station (5030m/bottom)
800-1	ARGO_3	11°30'S	32°00'W	28.09. 22:00	**Argo Float** Deployment
801-1	CTD_57	11°30'S	32°27'W	29.09. 00:30-03:20	**CTD** station (4760m/bottom)
802-1	CTD_58	11°30'S	32°53'W	29.09. 05:40-07:40	**CTD** station (3490m/bottom)
803-1	CTD_59	11°30'S	33°13'W	29.09. 09:30-12:00	**CTD** station (4280m/bottom)
804-1	CTD_60	11°30'S	33°33'W	29.09. 14:00-17:30	**CTD** station (4963m/bottom)
805-1	CTD_61	11°30'S	33°53'W	29.09. 19:20-22:10	**CTD** station (4617m/bottom)
806-1		11°30'S	34°13'W	30.09. 00:00	**Start ADCP section**
807-1	KPO_1130	10°22.8'S	35°40.8'W	30.09. 08:00-11:50	**Mooring** recovery
808-1	KPO_1129	10°16.0'S	35°51.7'W	30.09. 13:10-14:50	**Mooring** recovery
806-1		10°14.2'S	35°54.2'W	30.09. 15:20	**End ADCP section** (70m)
809-1	KPO_1108	10°13.7'S	35°52.5'W	30.09. 15:40-17:00	**Bott. Pressure Sensor** recovery
810-1	KPO_1134	10°13.58'S	35°52.42'W	30.09. 18:10-21:00	**PIES** communication
811-1		10°14.2'S	35°54.2'W	30.09. 21:30	**Start ADCP sect.** (70m/bottom)
812-1	CTD_62	10°14.6'S	35°53.6'W	30.09. 21:50-22:00	**CTD** station (220 m/bottom)
813-1	MSS_7	10°14.6'S	35°53.6'W	30.09. 22:20-23:20	**Microstructure**
814-1	CTD_63	10°15.3'S	35°52.6'W	30.09. 23:40-00:00	**CTD** station (520 m/bottom)
815-1	MSS_8	10°15.3'S	35°52.6'W	01.10. 00:10-01:50	**Microstructure**
816-1	CTD_64	10°16.0'S	35°51.7'W	01.10. 02:30-03:00	**CTD** station (900 m/bottom)
817-1	MSS_9	10°16.0'S	35°51.7'W	01.10. 03:10-04:30	**Microstructure**
818-1	CTD_65	10°19.5'S	35°46.1'W	01.10. 05:30-06:40	**CTD** station (1760 m/bottom)
819-1	MSS_10	10°19.5'S	35°46.1'W	01.10. 07:00-08:00	**Microstructure**
820-1	KPO_1144	10°16.0'S	35°51.7'W	01.10. 09:30-10:30	**Mooring** deployment
821-1	KPO_1109	10°14.15'S	35°51.9'W	01.10. 11:50-12:50	**PIES** recovery
822-1	KPO_1135	10°13.972'S	35°51.744'W	01.10. 13:20-14:40	**PIES** communication
823-1	KPO_1134	10°13.58'S	35°52.42'W	01.10. 14:50-16:40	**PIES** communication
824-1	KPO_1108	10°13.7'S	35°52.5'W	01.10. 16:50-17:00	**Bott. Pressure Sensor** recovery
825-1	CTD_66	10°22.8'S	35°40.8'W	01.10. 18:30-20:20	**CTD** station (2320 m/bottom)
826-1	MSS_11	10°22.8'S	35°40.8'W	01.10. 20:40-22:10	**Microstructure**
827-1	CTD_67	10°27.4'S	35°34.9'W	01.10. 23:00-00:50	**CTD** station (2880 m/bottom)
828-1	MSS_12	10°27.4'S	35°34.9'W	02.10. 01:00-02:30	**Microstructure**
829-1	CTD_68	10°32.0'S	35°29.3'W	02.10. 04:30-06:30	**CTD** station (3210 m/bottom)
830-1	KPO_1145	10°22.8'S	35°40.8'W	02.10. 08:50-11:10	**Mooring** deployment
831-1	MSS_13	10°32.0'S	35°29.3'W	02.10. 12:50-14:20	**Microstructure**
832-1	KPO_1131	10°36.5'S	35°23.6'W	02.10. 15:10-17:40	**Mooring** recovery
833-1	CTD_69	10°36.5'S	35°23.6'W	02.10. 18:20-20:30	**CTD** station (3520 m/bottom)
834-1	MSS_14	10°36.5'S	35°23.6'W	02.10. 20:50-23:00	**Microstructure**
835-1	CTD_70	10°41.4'S	35°17.6'W	03.10. 00:00-02:10	**CTD** station (3673m/bottom)
836-1	MSS_15	10°41.4'S	35°17.6'W	03.10. 02:20-04:00	**Microstructure**
837-1	CTD_71	10°46.4'S	35°11.6'W	03.10. 05:00-07:20	**CTD** station (3868m/bottom)
838-1	KPO_1146	10°36.5'S	35°23.6'W	03.10. 09:40-12:50	**Mooring** deployment
839-1	MSS_16	10°46.4'S	35°11.6'W	03.10. 14:40-16:30	**Microstructure**
840-1	CTD_72	10°51.4'S	35°05.6'W	03.10. 17:20-20:00	**CTD** station (3960m/bottom)
841-1	MSS_17	10°51.4'S	35°05.6'W	03.10. 20:20-21:50	**Microstructure**
842-1	CTD_73	10°56.4'S	34°59.6'W	03.10. 22:40-01:10	**CTD** station (4096m/bottom)
843-1	MSS_18	10°56.4'S	34°59.6'W	04.10. 01:20-03:10	**Microstructure**
844-1	KPO_1132	10°56.4'S	34°59.6'W	04.10. 07:10-09:50	**Mooring** recovery
845-1	KPO_1147	10°56.4'S	34°59.6'W	04.10. 12:00-15:30	**Mooring** deployment
846-1	CTD_74	11°07.6'S	34°43.9'W	04.10. 17:30-20:10	**CTD** station (4244m/bottom)
847-1	MSS_19	11°07.6'S	34°43.9'W	04.10. 20:30-22:10	**Microstructure**
848-1	CTD_75	11°18.8'S	34°28.2'W	05.10. 00:00-02:50	**CTD** station (4634m/bottom)
849-1	MSS_20	11°18.8'S	34°28.2'W	05.10. 02:50-04:10	**Microstructure**
850-1	CTD_76	11°30.0'S	34°13.0'W	05.10. 06:10-08:50	**CTD** station (4569m/bottom)
851-1	MSS_21	11°30.0'S	34°13.0'W	05.10. 09:10-11:10	**Microstructure**

Station No. M119_ Ship/Science		Latitude	Longitude	Time	Work
		11°30'S	34°13'W	05.10. 11:10	**End ADCP section**
852-1	CTD_77	11°30'S	33°53'W	05.10. 13:10-15:50	**CTD** station (4617m/bottom)
853-1		11°30'S	34°13'W	05.10. 17:30	**Start ADCP section**
		10°14.2'S	35°54.2'W	06.10. 04:40	**End ADCP section** (70m)
854-1	MSS_22	10°14.6'S	35°53.6'W	06.10. 04:50-16:20	**Microstructure along section**
		5°39.0'S	34°57.6'W	07.10. 18:30	**Start ADCP section**
855-1	CTD_78	5°39.0'S	34°57.6'W	07.10. 18:40-19:00	**CTD** station (280m/bottom)
856-1	MSS_23	5°39.0'S	34°57.6'W	07.10. 19:10-20:40	**Microstructure**
857-1	CTD_79	5°38.3'S	34°56.0'W	07.10. 21:00-21:30	**CTD** station (740m/bottom)
858-1	MSS_24	5°38.3'S	34°56.0'W	07.10. 21:40-23:40	**Microstructure**
859-1	CTD_80	5°38.0'S	34°54.0'W	08.10. 00:00-01:00	**CTD** station (1654m/bottom)
860-1	MSS_25	5°38.0'S	34°54.0'W	08.10. 01:30-03:40	**Microstructure**
861-1	CTD_81	5°36.6'S	34°46.0'W	08.10. 04:30-06:10	**CTD** station (2837m/bottom)
862-1	MSS_26	5°36.6'S	34°46.0'W	08.10. 06:50-08:40	**Microstructure**
863-1	CTD_82	5°34.8'S	34°36.0'W	08.10. 09:50-12:00	**CTD** station (3405m/bottom)
864-1	MSS_27	5°34.8'S	34°36.0'W	08.10. 12:40-14:40	**Microstructure**
865-1	CTD_83	5°32.7'S	34°24.0'W	08.10. 15:50-19:00	**CTD** station (3761m/bottom)
866-1	MSS_28	5°32.7'S	34°24.0'W	08.10. 19:10-21:20	**Microstructure**
867-1	CTD_84	5°30.2'S	34°10.0'W	08.10. 23:00-01:30	**CTD** station (4110m/bottom)
868-1	MSS_29	5°30.2'S	34°10.0'W	09.10. 01:40-03:10	**Microstructure**
869-1	CTD_85	5°26.6'S	33°50.0'W	09.10. 05:10-07:50	**CTD** station (4316m/bottom)
870-1	MSS_30	5°26.6'S	33°50.0'W	09.10. 08:00-09:40	**Microstructure**
871-1	CTD_86	5°21.7'S	33°25.0'W	09.10. 12:20-15:10	**CTD** station (4474m/bottom)
872-1	MSS_31	5°21.7'S	33°25.0'W	09.10. 15:30-17:20	**Microstructure**
873-1	CTD_87	5°17.7'S	33°00.0'W	09.10. 20:00-22:30	**CTD** station (4555m/bottom)
874-1	CTD_88	5°17.7'S	33°00.0'W	09.10. 23:00-01:50	**CTD** station (4555m/bottom)
875-1	CTD_89	5°12.3'S	32°30.0'W	10.10. 05:00-08:00	**CTD** station (4589m/bottom)
876-1	CTD_90	5°07.0'S	32°00.0'W	10.10. 11:10-14:00	**CTD** station (4602m/bottom)
877-1	CTD_91	5°00.0'S	31°30.0'W	10.10. 17:00-20:30	**CTD** station (4692m/bottom)
		5°00.0'S	31°30.0'W	11.10. 21:00	**End/Start ADCP section**
		5°39.0'S	34°57.8'W	11.10. 15:30	**End ADCP section**

7.2 Mooring tables

7.2.1 Mooring Operations

M119 Mooring Recoveries					
Mooring	**New ID**	**Latitude**	**Longitude**	**Deployment Date**	**Recovery Date**
V440-06	KPO_1128	17°N 36.35'	24°W 14.97'	20-Apr-2014	8-Sep-2015
21W 11N	KPO_1127	11°N 02.45'	21°W 13.37'	25-Apr-2014	14-Sep-2015
23W 5N	KPO_1126	05°N 01.23'	23°W 00.00'	29-Apr-2014	18-Sep-2015
23W 0N	KPO_1125	00°N 00.00'	23°W 06.80'	04-May-2014	22-Sep-2015
Bottom pressure sensor	KPO_1108	10°N 13.68'	35°W 52.50'	06-Jul-2013	recovery not successful, no response from release
PIES-500m	KPO_1109	10°S 14.15'	35°W 51.91'	06-Jul-2013	01-Oct-2015
PIES-300m	KPO_1134	10°S 13.58'	35°W 52.42'	14-May-2014	no recovery; PIES communication and data download on 01-Oct-2015
PIES-500m	KPO_1135	10°S 13.97'	35°W 51.74'	14-May-2014	no recovery; PIES communication and data download on 01-Oct-2015

Mooring	New ID	Latitude	Longitude	Deployment Date	Recovery Date
K1	KPO_1129	10°S 16.01’	35°W 51.69’	15-May-2014	30-Sep-2015
K2	KPO_1130	10°S 22.87’	35°W 40.77’	15-May-2014	30-Sep-2015
K3	KPO_1131	10°S 36.06’	35°W 24.01’	16-May-2014	02-Oct-2015
K4	KPO_1132	10°S 55.79’	35°W 00.07’	17-May-2014	04-Oct-2015

M119 Mooring Deployments					
Mooring	**New ID**	**Latitude**	**Longitude**	**Deployment Date**	**Recovery Date**
CVW 2015	KPO_1156	17°N 36.27’	24°W 14.82‘	09-Sep-2015	
V440-07	KPO_1143	17°N 36.40’	24°W 14.98‘	10-Sep-2015	
21W 11N	KPO_1142	11°N 02.22’	21°W 13.29‘	14-Sep-2015	
23W 5N	KPO_1141	05°N 01.00’	23°W 00.00’	19-Sep-2015	
23W 0N	KPO_1140	00°N 00.20’	23°W 06.80’	23-Sep-2015	
K1	KPO_1144	10°S 16.00’	35°W 51.70’	01-Oct-2015	
K2	KPO_1145	10°S 22.80’	35°W 40.80’	02-Oct-2015	
K3	KPO_1146	10°S 36.50’	35°W 23.60’	03-Oct-2015	
K4	KPO_1147	10°S 56.40’	34°W 59.60’	04-Oct-2015	

7.2.2 Mooring Recoveries

Mooring Recovery Cape Verde V440-06					**Notes:**	**KPO 1128**
Vessel:	Meteor	M106				
Deployed:	20-Apr	2014	20:42			
Vessel:	Meteor	M119				
Recovered:	08-Sep	2015	~17:00			
Latitude:		17	36.354	N		
Longitude:		24	14.976	W		
Water depth:		3570	Mag Var:	-10.0		

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	-233	~~Devilogics Sat-Trans~~ Xeos-Iridium Watchdog IMEI: 300034013902340	~~PE001~~	**ready**	Transmitting, Replaced with Xeos – Iridium Watchdog IMEI: 300034013902340 (double Benthos) during PS88.2 (06-Nov-2014)
KPO_1128_01	-221	~~Microcat-IM~~ Microcat-IM /p	~~10696~~ 6862	**x**	Replaced with Microcat-IM #6862 during PS88.2 (06-Nov-2014); Microcat #6862: complete and clean record (06-Nov-2014 – 08-Sep-2015)
KPO_1128_02	-206	Microcat-IM /p	2712	**x**	complete and clean record
KPO_1128_03	43	Microcat-IM	961	**x**	complete and clean record
KPO_1128_04	43	O2 Logger (ind. Opt.)	385	**x**	complete and clean record
	50	XEOS Argos Beacon	5481	**x**	signal transmission ok
KPO_1128_05	50	Mini-TD /p	67	**ready**	instrument lost during mooring period
KPO_1128_06	71	Microcat	952	**x**	complete and clean record
KPO_1128_07	71	Fluorometer	2856	**x**	complete record
KPO_1128_08	91	Microcat	1583	**x**	complete and clean record
KPO_1128_09	120	Microcat	1268	**x**	complete and clean record
KPO_1128_10	120	O2 Logger	937	**x**	instrument lost during mooring period
KPO_1128_11	121	SAMI-2	67	**x**	complete and clean record

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1128_12	161	Microcat	1269	**x**	complete and clean record
KPO_1128_13	201	Microcat	1285	**x**	complete and clean record
KPO_1128_14	301	ADCP QM 150 up /p	14910	**x**	presumably 1 beam broken, stopped working 12-May-2015
KPO_1128_15	403	Microcat-IM	3415	**x**	complete and clean record
KPO_1128_16	599	Acoustic Recorder	---	**ready**	status unknown
KPO_1128_17	616	Aquadopp up	26209-36	**x**	complete and clean record
KPO_1128_18	755	Microcat	10709	**x**	complete and clean record
KPO_1128_19	1106	Microcat-IM /p	2488	**x**	complete and clean record
KPO_1128_20	1304	Sediment Trap	910015	**ready**	bottle 9 & 16 missing already before deployment; only bottle 1 was filled after recovery
KPO_1128_21	1316	Aquadopp down	26209-34	**x**	complete and clean record
KPO_1128_22	1500	Microcat-IM /p	3752	**x**	complete and clean record
KPO_1128_23	3014	Aquadopp down	26209-13	**x**	complete and clean record
KPO_1128_24	3548	Microcat-IM /p	10660	**x**	complete and clean record
	3578	Release AR861	1256	Code:	Enable: 08BD / Release: 0855
	3578	Release AR861	1772	Code:	Enable: 0AF0 / Release: 0A55

Mooring Recovery Equatorial Atlantic 21W 11N				**Notes:**	**KPO 1127**
Vessel:	Meteor	M106			
Deployed:	25-Apr	2014	13:45		
Vessel:	Meteor	M119			
Recovered:	14-Sep	2015	07:54		
Latitude:		11	2.456	N	
Longitude:		21	13.375	W	
Water depth:		5079	Mag Var:	-10.3	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	96	Argos SMM 2000	12619	**ready**	signal transmission ok
KPO_1127_01	96	Mini-TD	70	**ready**	complete and clean record
KPO_1127_02	97	O2 Logger	942	**x**	complete and clean record
KPO_1127_03	97	Microcat /p	2265	**x**	complete and clean record
KPO_1127_04	199	O2 Logger	1140	**x**	complete and clean record
KPO_1127_05	199	Microcat /p	10693	**x**	complete and clean record
KPO_1127_06	294	O2 Logger	1461	**x**	complete and clean record
KPO_1127_07	294	Microcat /p	10694	**x**	complete and clean record
KPO_1127_08	396	O2 Logger	938	**x**	complete and clean record
KPO_1127_09	396	Microcat /p	10695	**x**	complete and clean record
KPO_1127_10	498	O2 Logger	1464	**x**	clean record only until 26-Nov-2014 due to too much power supply
KPO_1127_11	498	Microcat /p	10710	**x**	complete and clean record
KPO_1127_12	594	O2 Logger	349	**x**	almost clean record; data missing between 12-Apr-2015 00:00 – 12-Apr-2015 07:45 and 12-Apr-2015 21:55 to 15-Apr-2015 16:25
KPO_1127_13	594	Microcat /p	10711	**x**	complete and clean record
KPO_1127_14	696	O2 Logger	1471	**x**	complete and clean record
KPO_1127_15	696	Microcat /p	10712	**x**	complete and clean record
KPO_1127_16	798	ADCP LR up	3173	**x**	no data, water ingress
KPO_1127_17	803	O2 Logger	1143	**x**	complete and clean record
KPO_1127_18	803	Microcat /p	10713	**x**	complete and clean record
	4361	Release AR861	1549	Code:	Enable: 0A05 / Release: 0A55
	4361	Release AR861	1771	Code:	Enable: 0AEF / Release: 0A55

Mooring Recovery Equatorial Atlantic 23W 5N						**Notes:**	**KPO 1126**
Vessel:	Meteor		M106				
Deployed:	29-Apr		2014				
Vessel:	Meteor		M119				
Recovered:	18-Sep		2015	15:41			
Latitude:			5	1.236	N		
Longitude:			23	0.006	W		
Water depth:			4206	Mag Var:	-13.1		

ID	**Depth**	**Instr. Type**	**s/n**	**Start-up**	**Remarks**
	97	Argos SMM 2000	12617	**ready**	signal transmission ok
KPO_1126_01	97	Mini-TD	34	**ready**	complete record; offset jump of pressure sensor by 2dbar on 22-May-2015;
KPO_1126_02	99	O2 Logger	944	**x**	Before deployment: loggerboard swapped and reprogrammed; clean record until 20-Dec-2014; no data after 21-Dec-2014
KPO_1126_03	99	Microcat /p	3753	**x**	complete and clean record
KPO_1126_04	200	O2 Logger	1138	**x**	complete and clean record
KPO_1126_05	200	Microcat	2934	**x**	complete and clean record
KPO_1126_06	296	O2 Logger	1467	**x**	no data, SD card not readable
KPO_1126_07	296	Microcat /p	2263	**x**	complete and clean record
KPO_1126_08	398	O2 Logger	1133	**x**	almost clean record; bigger data gap of 4h10min on 15-May-2014
KPO_1126_09	398	Microcat	2492	**x**	complete and clean record
KPO_1126_10	500	O2 Logger	1468	**x**	complete and clean record
KPO_1126_11	500	Microcat	2809	**x**	complete and clean record
KPO_1126_12	595	O2 Logger	1144	**x**	complete and clean record
KPO_1126_13	595	Microcat /p	3411	**x**	complete and clean record
KPO_1126_14	697	O2 Logger	1469	**x**	almost clean record; data missing between 12-Apr-2015 00:00 – 13-Apr-2015 20:15
KPO_1126_15	697	Microcat	2617	**x**	complete and clean record
KPO_1126_16	799	ADCP LR up	2627	**x**	complete and clean record
KPO_1126_17	801	O2 Logger	1462	**x**	complete and clean record
KPO_1126_18	801	Microcat	2248	**x**	complete and clean record
	3592	Release RT861	555	Code:	Enable: 020F / Release: 0255
	3592	Release RT661	28	Code:	Enable: 5022 / Release: 5024

Mooring Recovery Equatorial Atlantic 23W 0N						**Notes:**	**KPO 1125**
Vessel:	Meteor		M106				
Deployed:	4-May		2014	13:27			
Vessel:	Meteor		M119				
Recovered:	22-Sep		2015	08:02			
Latitude:			0	0.000	N		
Longitude:			23	6.800	W		
Water depth:			3908	Mag Var:	-15.2		

ID	**Depth**	**Instr. type**	**s/n**	**Start-up**	**Remarks**
	214	Argos SMM 2000	7372	**ready**	signal transmission ok
KPO_1125_01	214	ADCP QM up	14911	**x**	complete and clean record
KPO_1125_02	214	Mini-TD	27	**ready**	complete and clean record
KPO_1125_03	218	ADCP LR dn	2395	**x**	complete and clean record
KPO_1125_04	300	O2 Logger	1134	**x**	complete and clean record

ID	Depth	Instr. type	s/n	Start-up	Remarks
KPO_1125_05	300	Microcat	2472	x	complete record, bad conductivity cell during 17-June-2014–18-Jun-2015 (18 hours)
KPO_1125_06	506	O2 Logger	1135	x	complete and clean record
KPO_1125_07	506	Microcat /p	2485	x	complete record, bad conductivity cell during 28-November-2014 (14 hours)
KPO_1125_08	831	Argonaut	D038	x	signal to noise level bad since 23-Jan-2015
KPO_1125_09	906	Aquadopp	26209-20	x	complete and clean record
KPO_1125_10	983	RCM-8 /p	6122	x	complete record, fin mounted on wrong side (180° compass mismatch)
KPO_1125_11	1000	M-CTD MMP	12201	x	almost complete and clean record with 96.8% data coverage over all profiles
	3634	Release AR861	1548	Code:	Enable: 0A04 / Release: 0A55
	3634	Release RT661	31	Code:	Enable: 5037 / Release: 5039

Mooring Recovery bottom pressure sensor Brasil					**Notes:**	**KPO 1108**
Vessel:	Meteor		M98			
Deployed:	6-Jul		2013	18:57		
Vessel:	Meteor		M119			
Recovered:	**tried to recover on 01-Oct-2015 without success**					
Latitude:	10		13.677	S		
Longitude:	35		52.500	W		
Water depth:	310		Mag Var:	-22.7		
ID	**Depth**	**Instr. type**	**s/n**	**Startup**		
KPO_1108_01	310	Animate 8A SBE26plus	1357	x	not recovered	
		Release Benthos 865A	678	Code:	no response on 01-Oct-2015	

Mooring Recovery PIES Brasil						**Notes:**	**KPO 1109**
Vessel:	Meteor		M98				
Deployed:	06-Jul		2013	11:54			
Vessel:	Meteor		M119				
Recovered:	01-Oct		2015	14:05			
Latitude:			10	14.149	S		
Longitude:			35	51.905	W		
Water depth:			301	Mag Var:	-22.9		
ID	**Depth**	**Instr. type**	**s/n**		**Start-up**	**Remarks**	
KPO_1109_01	501	PIES	123		x	complete and clean record	
					Code:		
					Code:		

Mooring Communication PIES Brasil 300m						**Notes:**	**KPO 1134**
Vessel:	Meteor	M106					
Deployed:	14-May	2014	15:28				
Vessel:	Meteor	M119					
Recovered:	-	-	-				
Latitude:		10	13,580	S			
Longitude:		35	52,420	W			
Water depth:		301	Mag Var:		-22,8		

ID	Depth	Instr. type	s/n	Start-up	Remarks
KPO_1134_01	300	PIES	320	**x**	Telem:66, XPND:70, BEACON:74, RELEASE:0 complete and clean data record transmitted on 01-Oct-2015
KPO_1134_02	300	Develogic Modem	3070	**x**	Address: 0x0031
				Code:	
				Code:	

Mooring Communication PIES Brasil 500m						**Notes:**	**KPO 1135**
Vessel:	Meteor	M106					
Deployed:	14-May	2014	15:53				
Vessel:	Meteor	M119					
Recovered:	-	-	-				
Latitude:		10	13,970	S			
Longitude:		35	51,740	W			
Water depth:		494	Mag Var:		-22,8		

ID	Depth	Instr. type	s/n	Start-up	Remarks
KPO_1135_01	500	PIES	319	**x**	Telem:65, XPND:69, BEACON:73, RELEASE:63 complete and clean data record transmitted on 01-Oct-2015
KPO_1135_02	500	Develogic Modem	3065	**x**	Address: 0x0021
				Code:	
				Code:	

Mooring Recovery NBUC 11°S Array mooring K1						**Notes:**	**KPO 1129**
Vessel:	Meteor	M106					
Deployed:	15-May	2014	15:13				
Vessel:	Meteor	M119					
Recovered:	30-Sep	2015	15:19				
Latitude:		10	16.010	S			
Longitude:		35	51.690	W			
Water depth:		892	Mag Var:		-22.9		

ID	Depth	Instr. type	s/n	Start-up	Remarks
	500	Argos SMM 2000	2267	**ready**	signal transmission ok
KPO_1129_01	500	ADCP LR up	17570	**x**	complete and clean record
KPO_1129_02	503	Microcat /p	6859	**x**	complete and clean record
KPO_1129_03	648	Microcat	2048	**x**	complete and clean record
KPO_1129_04	649	Aquadopp	P26209-24	**x**	complete and clean record
KPO_1129_05	874	Microcat	2245	**x**	complete and clean record
	875	Release AR861	1642	Code:	Enable: 0A87 / Release: 0A55
	875	Release AR861	095	Code:	Enable: 0485 / Release: 0455

Mooring Recovery NBUC 11°S Array mooring K2						**Notes:**	**KPO 1130**
Vessel:	Meteor		M106				
Deployed:	15-May		2014	12:18			
Vessel:	Meteor		M119				
Recovered:	30-Sep		2015	11:10			
Latitude:			10	22.870	S		
Longitude:			35	40.770	W		
Water depth:			2139	Mag Var:	-22.9		

ID	**Depth**	**Instr. type**	**s/n**	**Start-up**	**Remarks**
	505	Argos SMM 2000	2255	**ready**	signal transmission ok
KPO_1130_01	505	ADCP LR up	12538	**x**	complete and clean record
KPO_1130_02	508	Microcat /p	6861	**x**	complete and clean record
KPO_1130_03	654	Microcat	53	**x**	complete and clean record
KPO_1130_04	655	Aquadopp	P26209-21	**x**	complete and clean record
KPO_1130_05	890	RCM-8 /p	8349	**x**	rotor stalled after 01-Sep-2015, fin was mounted on wrong side (180° compass mismatch)
KPO_1130_06	891	Aquadopp	P26209-28	**x**	complete and clean record
KPO_1130_07	1197	Microcat	957	**x**	complete and clean record
KPO_1130_08	1402	Aquadopp	P26209-33	**x**	complete and clean record
KPO_1130_09	1494	Microcat	2246	**x**	complete and clean record
KPO_1130_10	1904	Microcat	3144	**x**	complete and clean record
KPO_1130_11	1905	Argonaut	D329	**x**	complete and clean record
KPO_1130_12	2289	Microcat	1599	**x**	complete and clean record
	2294	Release AR861	1643	Code:	Enable: 0A88 / Release: 0A55
	2294	Release AR861	271	Code:	Enable: 1405 / Release: 1455

Mooring Recovery NBUC 11°S Array mooring K3						**Notes:**	**KPO 1131**
Vessel:	Meteor		M106				
Deployed:	16-May		2014	18:23			
Vessel:	Meteor		M119				
Recovered:	02-Oct		2015	17:30			
Latitude:			10	36.060	S		
Longitude:			35	24.010	W		
Water depth:			3333	Mag Var:	-22.9		

ID	**Depth**	**Instr. type**	**s/n**	**Start-up**	**Remarks**
	497	Argos XEOS	5506	**ready**	
KPO_1131_01	497	ADCP LR up	12530	**x**	complete and clean record
KPO_1131_02	500	Microcat /p	6856	**x**	complete and clean record
KPO_1131_03	652	Microcat	2249	**x**	complete and clean record
KPO_1131_04	656	Aquadopp	P26209-18	**x**	complete and clean record
KPO_1131_05	901	Aquadopp	P26209-19	**x**	complete and clean record
KPO_1131_06	1398	RCM-8 /p	9933	**x**	rotor completely stalled after 05-Mar-2015, fin was mounted on wrong side (180° compass mismatch)
KPO_1131_07	1896	RCM-8 /p	11348	**x**	complete record, fin was mounted on wrong side (180° compass mismatch)
KPO_1131_08	1898	Microcat	2251	**x**	complete and clean record
KPO_1131_09	1899	Aquadopp	P26209-27	**x**	complete and clean record
KPO_1131_10	2406	Aquadopp	P26209-02	**x**	complete and clean record
KPO_1131_11	2799	Microcat	2250	**x**	complete and clean record
KPO_1131_12	3004	Aquadopp	P26209-16	**x**	complete and clean record
KPO_1131_13	3397	Microcat	381	**x**	complete and clean record

ID	Depth	Instr. type	s/n	Start-up	Remarks
	3403	Release AR861	1648	Code:	Enable: 0A8D / Release: 0A55
	3403	Release AR861	1645	Code:	Enable: 0A8A / Release: 0A55

Mooring Recovery NBUC 11°S Array mooring offshore K4					**Notes:**	**KPO 1132**
Vessel:	Meteor	M106				
Deployed:	17-May	2014	19:30			
Vessel:	Meteor	M119				
Recovered:	04-Oct	2015	09:09			
Latitude:		10	55.7900	S		
Longitude:		35	0.070	W		
Water depth:		4008	Mag Var:	-23.0		

ID	Depth	Instr. type	s/n	Start-up	Remarks
	499	Argos XEOS	2264	**ready**	
KPO_1132_01	499	ADCP LR up	17590	**x**	complete and clean record
KPO_1132_02	502	Microcat /p	6857	**x**	complete record, bad conductivity cell from 20-Jul-2015 to end of record
KPO_1132_03	647	Microcat	2279	**x**	complete and clean record
KPO_1132_04	648	Argonaut	D304	**x**	complete and clean record
KPO_1132_05	904	RCM-8 /p	12004	**x**	complete and clean record, fin was mounted on wrong side (180° compass mismatch)
KPO_1132_06	905	Aquadopp	P26209-15	**x**	complete and clean record
KPO_1132_07	1908	RCM-8 /p	10659	**x**	complete and clean record
KPO_1132_08	1909	Microcat	1320	**x**	complete and clean record
KPO_1132_09	1910	Aquadopp	P26209-14	**x**	complete and clean record
	3854	Release AR861	1644	Code:	Enable: 0A89 / Release: 0A55
	3854	Release AR861	975	Code:	Enable: 1816 / Release: 1855

7.2.3 Mooring Deployments

Mooring Deployment CVW 2015					**Notes:**	**KPO 1156**
Vessel:	Meteor	M119				
Deployed:	09-Sep	2015	14:41			
Vessel:						
Recovered:						
Latitude:		17°	36.27’	N		
Longitude:		24°	18.82’	W		
Water depth:		3603	Mag Var:	-9.8		

ID	Depth	Instr. type	s/n	Start-up	Remarks
KPO_1156_01	138	Winch with profiler		**ready**	Winch recovery on 10-Sep-2015 16:00
	161	Release AR661	220	Code:	recovered with winch and profiler on 10-Sep-2015 16:00
KPO_1156_02	163	WH-ADCP up	1972	**x**	
	3567	Release AR661	822	Code:	Enable: 4AA0 / Release: 4AA9
	3567	Release RT661	174	Code:	Enable: 9337 / Release: 9339

Mooring Deployment Cape Verde V440-07						**Notes:**	**KPO 1143**
Vessel:	Meteor		M119				
Deployed:	10-Sep		2015	14:07			
Vessel:							
Recovered:							
Latitude:			17°	36.40’	N		
Longitude:			24°	14.98’	W		
Water depth:			3604	Mag Var:	-9.8		

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	-232	Develogic Sat-Trans	-	**ready**	IMEI 300234063506280
KPO_1143_01	-220	Microcat-IM	2255	**x**	
KPO_1143_02	-206	Microcat-IM /p	1717	**x**	
KPO_1143_03	43	Microcat-IM	2256	**x**	
KPO_1143_04	43	O2 Logger (ind. Opt.)	383	**x**	
	49	XEOS Argos Beacon	5481	**ready**	
KPO_1143_05	49	Mini-TD /p	60	**x**	
KPO_1143_06	70	Microcat-IM	2269	**x**	
KPO_1143_07	70	Fluorometer	1833	**x**	
KPO_1143_08	90	Microcat-IM	1722	**x**	
KPO_1143_09	119	Microcat-IM /p	3413	**x**	
KPO_1143_10	119	O2 Logger	939	**x**	
KPO_1143_11	119	Hydroflash O2 Optode	DO-0615-005	**x**	device labeled as DO-1014-001
KPO_1143_12	119	Hydroflash O2 Optode	DO-0615-012	**x**	device labeled as DO-1014-004
KPO_1143_13	121	SAMI-2	C0048	**ready**	
KPO_1143_14	161	Microcat-IM	1721	**x**	
KPO_1143_15	201	Microcat	921	**x**	
KPO_1143_16	301	ADCP QM 150 up /p	21861	**X**	
KPO_1143_17	402	Microcat	933	**x**	
KPO_1143_18	616	Aquadopp down /p	P25460-2	**x**	
KPO_1143_19	755	Microcat	934	**x**	
KPO_1143_20	1106	Microcat-IM /p	3755	**x**	
KPO_1143_21	1304	Sediment Trap	890006	**ready**	
KPO_1143_22	1316	Aquadopp down	P26209-17	**x**	
KPO_1143_23	1500	Microcat	1319	**x**	
KPO_1143_24	3002	Sediment Trap	940060	**ready**	
KPO_1143_25	3014	Aquadopp down /p	P27523	**x**	
KPO_1143_26	3548	Microcat, pumped /p	10642	**x**	
	3578	Release AR861	1772	Code:	Enable: 0AF0 / Release: 0A55
	3578	Release AR661	839	Code:	Enable: 4AD5 / Release: 4AD6

Mooring Deployment Equatorial Atlantic 21W 11N						**Notes:**	**KPO 1142**
Vessel:	Meteor		M119				
Deployed:	14-Sep		2015	20:46			
Vessel:							
Recovered:							
Latitude:			11°	02.22’	N		
Longitude:			21°	13.29’	W		
Water depth:			5070	Mag Var:	-10.1		

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	96	Argos Beacon	12619	**ready**	
KPO_1142_01	96	Mini-TD /p	48	**ready**	
KPO_1142_02	97	Microcat-IM /p	3754	**x**	

ID	Depth	Instr. type	s/n	Start-up	Remarks
KPO_1142_03	97	O2 Logger	206	x	
KPO_1142_04	199	Microcat-IM	2933	x	
KPO_1142_05	199	O2 Logger	215	x	
KPO_1142_06	294	Microcat /p	10609	x	
KPO_1142_07	294	O2 Logger	216	x	
KPO_1142_08	396	Microcat-IM	2801	x	
KPO_1142_09	396	O2 Logger	375	x	
KPO_1142_10	498	Microcat	2247	x	
KPO_1142_11	498	O2 Logger	379	x	
KPO_1142_12	594	Microcat-IM /p	10696	x	
KPO_1142_13	594	O2 Logger	940	x	
KPO_1142_14	696	Microcat	1550	x	
KPO_1142_15	696	O2 Logger	1074	x	
KPO_1142_16	798	ADCP LR up /p	2330	x	
KPO_1142_17	800	Microcat /p	10709	x	
KPO_1142_18	800	O2 Logger	1463	x	
	4381	Release AR661	220	Code:	Enable: 9151 / Release: 9152
	4381	Release AR861	1771	Code:	Enable: 0AEF / Release: 0A55

Mooring Deployment Equatorial Atlantic 23W 5N					**Notes:**	**KPO 1141**
Vessel:	Meteor	M119				
Deployed:	19-Sep	2015	13:50			
Vessel:						
Recovered:						
Latitude:		5°	01.00’	N		
Longitude:		23°	00.00’	W		
Water depth:		4210	Mag Var:	-13.0		

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	97	Argos Beacon	12617	**ready**	
KPO_1141_01	97	Mini-TD /p	71	x	
KPO_1141_02	98	Microcat-IM /p	2488	x	
KPO_1141_03	98	O2 Logger	147	x	
KPO_1141_04	200	Microcat-IM	2257	x	
KPO_1141_05	200	O2 Logger	148	x	
KPO_1141_06	296	Microcat-IM /p	10694	x	
KPO_1141_07	296	O2 Logger	219	x	
KPO_1141_08	398	Microcat	8945	x	
KPO_1141_09	398	O2 Logger	1461	x	
KPO_1141_10	500	Microcat	8946	x	
KPO_1141_11	500	O2 Logger	1465	x	
KPO_1141_12	595	Microcat-IM /p	10653	x	
KPO_1141_13	595	O2 Logger	1470	x	
KPO_1141_14	697	Microcat	8947	x	
KPO_1141_15	697	O2 Logger	942	x	
KPO_1141_16	799	ADCP LR up /p	1181	x	
KPO_1141_17	801	Microcat /p	6860	x	
KPO_1141_18	801	O2 Logger	1069	x	
	3612	Release AR661	122	Code:	Enable: 6170 / Release: 6179
	3612	Release AR681	1104	Code:	Enable: 0804 / Release: 0855

Mooring Deployment Equatorial Atlantic 23W 0N						**Notes:**	**KPO 1140**
Vessel:	Meteor		M119				
Deployed:	23-Sep		2015	12:42			
Vessel:							
Recovered:							
Latitude:			00°	00.20’	N		
Longitude:			23°	06.80’	W		
Water depth:			3930	Mag Var:	-15.1		
ID	**Depth**	**Instr. Type**		**s/n**	**Start-up**	**Remarks**	
	214	Argos Beacon		7372	**ready**		
KPO_1140_01	214	ADCP QM up /p		14911	**x**		
KPO_1140_02	214	Mini-TD /p		68	**x**		
KPO_1140_03	218	ADCP LR down /p		2627	**x**		
KPO_1140_04	300	Microcat		2248	**x**		
KPO_1140_05	300	O2 Logger		938	**x**		
KPO_1140_06	506	Microcat /p		2717	**x**		
KPO_1140_07	506	O2 Logger		1140	**x**		
KPO_1140_08	831	Argonaut down		D187	**x**		
KPO_1140_09	906	Aquadopp down /p		P26209-34	**x**		
KPO_1140_10	983	RCM-11		477	**x**		
KPO_1140_11	1489	M-CTD MMP		11617	**x**		
	3634	Release RT661		108	Code:	Enable: E962 / Release: E964	
	3634	Release AR861		110	Code:	Enable: 0498 / Release: 0455	

Mooring Deployment NBUC 11°S Array mooring K1						**Notes:**	**KPO 1144**
Vessel:	Meteor		M119				
Deployed:	01-Oct		2015	12:25			
Vessel:							
Recovered:							
Latitude:			10°	16.00’	S		
Longitude:			35°	51.70’	W		
Water depth:			900	Mag Var:	-22.8		
ID	**Depth**	**Instr. Type**		**s/n**	**Start-up**	**Remarks**	
	499	Argos Beacon		2267	**ready**		
KPO_1144_01	499	ADCP LR up /p		2395	**x**		
KPO_1144_02	502	Microcat /p		10710	**x**		
KPO_1144_03	647	Microcat		939	**x**		
KPO_1144_04	648	Aquadopp down /p		P26209-36	**x**		
KPO_1144_05	873	Microcat		910	**x**		
	875	Release AR861		1642	Code:	Enable: 0A87 / Release: 0A55	
	875	Release AR661		188	Code:	Enable: 8181 / Release: 8182	

Mooring Deployment NBUC 11°S Array mooring K2					**Notes:**	**KPO 1145**
Vessel:	Meteor	M119				
Deployed:	02-Oct	2015	13:12			
Vessel:						
Recovered:						
Latitude:		10°	22.80’	S		
Longitude:		35°	40.80’	W		
Water depth:		2320	Mag Var:	-22.9		

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	500	Argos Beacon	2255	**ready**	
KPO_1145_01	500	ADCP LR up /p	2290	**x**	
KPO_1145_02	503	Microcat /p	10711	**x**	
KPO_1145_03	647	Microcat	941	**x**	
KPO_1145_04	648	RCM-11	441	**x**	
KPO_1145_05	885	Aquadopp down /p	P26209-13	**x**	
KPO_1145_06	1190	Microcat	935	**x**	
KPO_1145_07	1394	Aquadopp down /p	P26209-20	**x**	
KPO_1145_08	1486	Microcat	1282	**x**	
KPO_1145_09	1896	Microcat	1286	**x**	
KPO_1145_10	1897	Argonaut down	D185	**x**	
KPO_1145_11	2293	Microcat	1288	**x**	
	2295	Release AR861	1643	Code:	Enable: 0A88 / Release: 0A55
	2295	Release AR661	460	Code:	Enable: 5811 / Release: 5813

Mooring Deployment NBUC 11°S Array mooring K3					**Notes:**	**KPO 1146**
Vessel:	Meteor	M119				
Deployed:	03-Oct	2015	14:36			
Vessel:						
Recovered:						
Latitude:		10°	36.50’	S		
Longitude:		35°	23.60’	W		
Water depth:		3520	Mag Var:	-22.9		

ID	Depth	Instr. Type	s/n	Start-up	Remarks
	500	Argos Beacon	5506	**ready**	
KPO_1146_01	500	ADCP LR up /p	17570	**x**	
KPO_1146_02	506	Microcat /p	10712	**x**	
KPO_1146_03	660	Microcat	922	**x**	
KPO_1146_04	661	Aquadopp down /p	P26209-33	**x**	
KPO_1146_05	906	Aquadopp down /p	P26209-28	**x**	
KPO_1146_06	1403	Aquadopp down /p	P26209-24	**x**	
KPO_1146_07	1900	Microcat	1281	**x**	
KPO_1146_08	1901	Aquadopp down /p	P26209-21	**x**	
KPO_1146_09	2408	Argonaut down	D144	**x**	
KPO_1146_10	2801	Microcat	1285	**x**	
KPO_1146_11	3007	Aquadopp down /p	P26209-19	**x**	
KPO_1146_12	3402	Microcat	1269	**x**	
	3455	Release AR861	1645	Code:	Enable: 0A8A / Release: 0A55
	3455	Release AR861	1648	Code:	Enable: 0A8D / Release: 0A55

Mooring Deployment NBUC 11°S Array mooring offshore K4						**Notes:**	**KPO 1147**
Vessel:	Meteor		M119				
Deployed:	04-Oct		2015	19:12			
Vessel:							
Recovered:							
Latitude:			10°	56.40'	S		
Longitude:			34°	59.60'	W		
Water depth:			4110	Mag Var:	-23.0		

ID	Depth	Instr. type	s/n	Start-up	Remarks
	499	Argos Beacon	7373	**ready**	
KPO_1147_01	499	ADCP LR up /p	12530	**x**	
KPO_1147_02	504	Microcat /p	10713	**x**	
KPO_1147_03	648	Microcat	1682	**x**	
KPO_1147_04	649	Aquadopp down /p	P26209-16	**x**	
KPO_1147_05	904	Aquadopp down /p	P26209-02	**x**	
KPO_1147_06	1907	Microcat	2618	**x**	
KPO_1147_07	1908	Aquadopp down /p	P26209-27	**x**	
KPO_1147_08	2900	Aquadopp down /p	P26209-18	**x**	
KPO_1147_09	3397	Microcat	1583	**x**	
	3854	Release AR661	221	Code:	Enable: 9153 / Release: 9154
	3854	Release AR861	1644	Code:	Enable: 0A89 / Release: 0A55

7.3 CTD station list

Station	CTD cast	Date	Time	Latitude	Longitude	max. d [m]	bottom [m]	Additional measurements				
M119_0684-1	001	2015/09/08	22:10	17° 36.73' N	24° 19.98' W	3601	3621	L	U			
M119_0686-1	002	2015/09/09	04:55	17° 36.76' N	24° 20.82' W	1002	3617	L				N
M119_0692-1	003	2015/09/09	17:18	17° 36.26' N	24° 17.73' W	3592	3611	L				N
M119_0697-1	004	2015/09/11	07:02	14° 59.98' N	23° 00.02' W	1003	2711			P	T	N
M119_0698-1	005	2015/09/11	10:38	14° 29.94' N	23° 00.03' W	1303	4092	L	U	P	T	N
M119_0700-1	006	2015/09/11	14:51	14° 00.01' N	23° 00.01' W	1303	4325	L	U	P	T	
M119_0703-1	007	2015/09/11	22:53	13° 29.97' N	23° 00.04' W	1305	4615	L		P	T	
M119_0704-1	008	2015/09/12	02:54	13° 00.07' N	23° 00.04' W	1302	4902	L	U	P	T	
M119_0706-1	009	2015/09/12	10:39	12° 30.07' N	23° 00.01' W	1301	4982	L	U	P	T	N
M119_0708-1	010	2015/09/12	15:43	12° 00.09' N	22° 59.93' W	1303	5210	L	U	P	T	N
M119_0714-1	011	2015/09/14	12:13	11° 02.39' N	21° 14.62' W	206	5582	L		P	T	N
M119_0718-1	012	2015/09/14	21:23	11° 01.77' N	21° 12.60' W	1303	5079	L	U	P	T	
M119_0722-1	013	2015/09/15	12:42	11° 30.25' N	22° 56.58' W	1304	5152	L	U	P	T	N
M119_0723-1	014	2015/09/15	18:17	11° 00.09' N	22° 56.85' W	1304	5149	L	U	P	T	
M119_0724-1	015	2015/09/15	22:53	10° 30.04' N	22° 57.01' W	1305	5191	L	U	P	T	N
M119_0725-1	016	2015/09/16	03:27	9° 59.93' N	22° 56.85' W	1303	5888	L	U	P	T	
M119_0729-1	017	2015/09/16	11:31	9° 29.55' N	22° 55.38' W	1307	5447	L	U	P	T	N
M119_0731-1	018	2015/09/16	16:55	9° 00.14' N	22° 56.41' W	1304	5046	L	U	P	T	N
M119_0733-1	019	2015/09/16	23:41	8° 30.11' N	22° 56.83' W	1302	4781	L		P	T	N
M119_0734-1	020	2015/09/17	03:57	7° 59.99' N	22° 56.96' W	1304	4398	L	U	P	T	
M119_0736-1	021	2015/09/17	11:29	7° 30.07' N	22° 56.95' W	1302	4416	L	U	P	T	
M119_0737-1	022	2015/09/17	16:03	7° 00.03' N	22° 56.93' W	1202	1314	L	U	P	T	N
M119_0739-1	023	2015/09/17	22:22	6° 30.10' N	22° 57.01' W	1304	2401	L	U	P	T	
M119_0740-1	024	2015/09/18	02:16	5° 59.98' N	22° 56.95' W	1302	4087	L	U	P	T	
M119_0741-1	025	2015/09/18	06:22	5° 30.00' N	22° 56.97' W	1304	4224	L	U	P	T	
M119_0745-1	026	2015/09/18	14:03	4° 58.47' N	22° 57.47' W	1302	4192	L	U	P	T	
M119_0747-1	027	2015/09/18	19:08	5° 00.97' N	22° 59.99' W	4119	4423	L	U		T	
M119_0750-1	028	2015/09/19	01:48	4° 58.48' N	22° 59.68' W	1304	4438	L	U		T	

Station	CTD cast	Date	Time	Latitude	Longitude	max. d [m]	bottom [m]	Additional measurements				
M119_0753-1	029	2015/09/19	17:14	4° 29.76' N	23° 00.00' W	4103	4199	L	U		T	N
M119_0754-1	030	2015/09/19	22:33	3° 59.98' N	22° 59.96' W	4172	4278	L	U		T	N
M119_0755-1	031	2015/09/20	03:45	3° 29.93' N	22° 59.99' W	4304	4465	L	U		T	N
M119_0756-1	032	2015/09/20	09:16	2° 59.93' N	22° 59.93' W	4603	4697	L	U		T	N
M119_0758-1	033	2015/09/20	15:08	2° 29.64' N	23° 00.22' W	4447	-	L	U		T	N
M119_0759-1	034	2015/09/20	20:47	1° 59.94' N	22° 59.99' W	4302	4339	L	U		T	N
M119_0761-1	035	2015/09/21	02:20	1° 39.95' N	23° 00.09' W	4103	4135	L	U		T	N
M119_0762-1	036	2015/09/21	06:54	1° 20.01' N	22° 59.98' W	4673	4795	L	U		T	
M119_0764-1	037	2015/09/21	12:19	0° 59.48' N	23° 00.02' W	3253	5655	L	U		T	N
M119_0765-1	038	2015/09/21	16:59	0° 39.94' N	22° 59.92' W	3852	3976	L	U		T	N
M119_0766-1	039	2015/09/21	21:19	0° 20.00' N	23° 00.00' W	3878	3960	L	U		T	N
M119_0770-1	040	2015/09/22	12:38	0° 00.00' N	23° 06.38' W	803	3937	L	U		T	N
M119_0774-1	041	2015/09/22	21:03	0° 00.05' S	23° 06.03' W	3893	3903	L	U		T	
M119_0780-1	042	2015/09/23	17:51	0° 20.01' S	23° 00.04' W	4572	4841	L	U		T	N
M119_0781-1	043	2015/09/23	22:45	0° 40.03' S	22° 59.98' W	3523	3573	L	U		T	N
M119_0782-1	044	2015/09/24	03:09	0° 59.95' S	22° 59.97' W	4103	4142	L	U		T	N
M119_0783-1	045	2015/09/24	07:29	1° 17.89' S	23° 00.06' W	4813	4563	L	U		T	N
M119_0784-1	046	2015/09/24	13:12	1° 39.91' S	22° 59.94' W	4901	4961	L	U		T	
M119_0785-1	047	2015/09/24	18:30	2° 00.00' S	23° 00.03' W	205	5242	L	U		T	N
M119_0787-1	048	2015/09/24	20:23	2° 00.00' S	23° 00.03' W	5193	5244	L	U		T	
M119_0788-1	049	2015/09/25	02:37	2° 30.10' S	23° 00.00' W	5620	5775	L	U		T	N
M119_0789-1	050	2015/09/25	09:14	3° 00.02' S	23° 00.00' W	5443	5495	L	U		T	N
M119_0791-1	051	2015/09/25	16:15	3° 30.19' S	22° 59.94' W	5404	5578	L	U		T	N
M119_0792-1	052	2015/09/25	22:52	3° 59.94' S	23° 00.05' W	5617	6250	L	U		T	N
M119_0793-1	053	2015/09/26	05:36	4° 29.92' S	23° 00.10' W	5103	5172	L	U		T	N
M119_0795-1	054	2015/09/26	12:38	5° 00.05' S	23° 00.18' W	5150	5198	L			T	N
M119_0797-1	055	2015/09/27	16:27	8° 00.00' S	27° 09.01' W	492	5677				T	
M119_0799-1	056	2015/09/28	20:40	11° 29.96' S	32° 00.06' W	4999	5039	L			T	
M119_0801-1	057	2015/09/29	02:24	11° 30.04' S	32° 27.00' W	4700	4760	L			T	
M119_0802-1	058	2015/09/29	07:24	11° 29.87' S	32° 52.37' W	3476	4041	L			T	
M119_0803-1	059	2015/09/29	11:30	11° 29.93' S	33° 13.06' W	4250	4293	L			T	
M119_0804-1	060	2015/09/29	16:01	11° 30.01' S	33° 33.05' W	4902	4953	L			T	
M119_0805-1	061	2015/09/29	21:18	11° 29.97' S	33° 53.06' W	4581	4631	L			T	
M119_0812-1	062	2015/09/30	23:51	10° 14.78' S	35° 53.75' W	190	189				T	
M119_0814-1	063	2015/10/01	01:37	10° 15.34' S	35° 52.71' W	481	776				T	
M119_0816-1	064	2015/10/01	04:26	10° 16.00' S	35° 51.77' W	843	873	L			T	
M119_0818-1	065	2015/10/01	07:26	10° 19.51' S	35° 46.11' W	1691	1700	L			T	
M119_0825-1	066	2015/10/01	20:29	10° 22.78' S	35° 40.83' W	2281	2302	L			T	
M119_0827-1	067	2015/10/02	01:00	10° 27.37' S	35° 34.83' W	2842	2941	L			T	
M119_0829-1	068	2015/10/02	06:24	10° 31.98' S	35° 29.30' W	3162	3244	L			T	
M119_0833-1	069	2015/10/02	20:08	10° 36.55' S	35° 23.63' W	3501	3524	L			T	
M119_0835-1	070	2015/10/03	01:56	10° 41.38' S	35° 17.63' W	3662	3685	L			T	
M119_0837-1	071	2015/10/03	06:55	10° 46.39' S	35° 11.62' W	3840	3878	L			T	
M119_0840-1	072	2015/10/03	19:17	10° °51.40' S	35° 05.62' W	3933	3975	L			T	
M119_0842-1	073	2015/10/04	00:41	10° 55.95' S	35° 00.08' W	4121	4144	L			T	
M119_0846-1	074	2015/10/04	21:25	11° 07.60' S	34° 43.93' W	4210	4259	L			T	
M119_0848-1	075	2015/10/05	04:02	11° 18.79' S	34° 28.24' W	4599	4645	L			T	
M119_0850-1	076	2015/10/05	10:05	11° 30.07' S	34° 12.93' W	4540	4585	L			T	
M119_0852-1	077	2015/10/05	17:06	11° 30.05' S	33° 52.98' W	4581	4629	L			T	
M119_0855-1	078	2015/10/07	21:36	5° 38.98' S	34° 57.63' W	301	356	L			T	
M119_0857-1	079	2015/10/08	00:00	5° 38.28' S	34° 56.09' W	667	771	L			T	
M119_0859-1	080	2015/10/08	03:01	5° 37.98' S	34° 54.01' W	1400	1442	L			T	

Station	CTD cast	Date	Time	Latitude	Longitude	max. d [m]	bottom [m]	Additional measurements				
M119_0861-1	081	2015/10/08	07:28	5° 36.58' S	34° 46.04' W	2641	2692	L			T	
M119_0863-1	082	2015/10/08	12:51	5° 34.82‘ S	34° 35.92‘ W	3395	3394	L			T	
M119_0865-1	083	2015/10/08	18:51	5° 33.03‘ S	34° 23.83‘ W	3701	3777	L			T	
M119_0867-1	084	2015/10/09	02:01	5° 30.37‘ S	34° 10.03‘ W	4002	4049	L			T	
M119_0869-1	085	2015/10/09	08:10	5° 26.59‘ S	33° 50.05‘ W	4280	4349	L			T	
M119_0871-1	086	2015/10/09	15:29	5° 21.64‘ S	33° 25.05‘ W	4444	4512	L			T	
M119_0873-1	087	2015/10/09	22:56	5° 17.68‘ S	33° 00.03‘ W	3731	4611	L			T	
M119_0874-1	088	2015/10/10	01:57	5° 17.68‘ S	33° 00.03‘ W	4520	4556	L			T	
M119_0875-1	089	2015/10/10	07:57	5° 12.28‘ S	32° 30.03‘ W	4561	4608	L			T	
M119_0876-1	090	2015/10/10	14:10	5° 07.02‘ S	32° 00.01‘ W	4560	4619	L			T	
M119_0877-1	091	2015/10/10	20:03	5° 00.04‘ S	31° 29.99‘ W	4651	4746	L			T	

Explanation of additional measurements of CTD station list

L	LADCP
U	UVP
P	PAR
T	Transmissometer
N	N_2 fixation

7.4 MSS station list

Station	MSS Stat.	Date	Time	Latitude	Longitude	max. depth [m]	bottom [m]	Profile numbers
M119_0687-1	01	2015/09/09	06:47	17° 36.81' N	24° 20.98' W	140 - 186	3617 - 3618	001 - 002
M119_0711-1	02	2015/09/13	09:43	11° 01.11' N	21° 13.23' W	441 - 945	5071 - 5079	003 - 027
M119_0751-1	03	2015/09/19	04:28	04° 57.51' N	22° 59.47' W	358 - 465	4195 - 4204	028 - 032
M119_0767-1	04	2015/09/22	00:34	00° 19.70' N	22° 59.73' W	155 - 177	3888 - 3925	033 - 053
M119_0773-1	05	2015/09/22	17:53	00° 01.70' N	23° 06.24' W	151 - 176	3923 - 3936	054 - 061
M119_0777-1	06	2015/09/23	04:18	00° 00.16' N	23° 05.62' W	140 - 153	3937 - 3947	062 - 067
M119_0813-1	07	2015/10/01	00:30	10° 15.04' S	35° 53.69' W	129 - 325	303 - 546	068 - 070
M119_0815-1	08	2015/10/01	02:18	10° 15.61' S	35° 52.80' W	199 - 241	580 - 787	071 - 073
M119_0817-1	09	2015/10/01	05:16	10° 15.73' S	35° 51.75' W	231 - 352	812 - 912	074 - 076
M119_0819-1	10	2015/10/01	09:05	10° 19.45' S	35° 46.20' W	219 - 302	1723 - 1750	077 - 079
M119_0826-1	11	2015/10/01	22:44	10° 22.82' S	35° 40.37' W	311 - 332	2351 - 2396	080 - 082
M119_0828-1	12	2015/10/02	03:02	10° 26.47' S	35° 34.64' W	350 - 394	2859 - 2882	083 - 085
M119_0831-1	13	2015/10/02	14:54	10° 31.93' S	35° 29.21' W	397 - 428	3216 - 3247	086 - 088
M119_0834-1	14	2015/10/02	23:37	10° 36.69' S	35° 22.94' W	396 - 413	3554 - 3577	089 - 091
M119_0836-1	15	2015/10/03	04:23	10° 41.22' S	35° 17.54' W	437 - 480	3694 - 3717	092 - 094
M119_0839-1	16	2015/10/03	17:01	10° 46.38' S	35° 11.42' W	438 - 469	3891 - 3904	095 - 097
M119_0841-1	17	2015/10/03	22:28	10° 51.51' S	35° 05.48' W	370 - 409	3976 - 3996	098 - 100
M119_0843-1	18	2015/10/04	03:30	10° 55.97' S	34° 59.80' W	476 - 516	4134 - 4150	101 - 103
M119_0847-1	19	2015/10/05	00:34	11° 07.55' S	34° 43.78' W	407 - 460	4261 - 4264	104 - 106
M119_0849-1	20	2015/10/05	07:02	11° 18.78' S	34° 28.20' W	358 - 392	4645 - 4649	107 - 109
M119_0851-1	21	2015/10/05	13:16	11° 30.02' S	34° 12.89' W	384 - 460	4586 - 4590	110 - 112
M119_0854-1	22	2015/10/06	07:55	10° 14.53' S	35° 54.13' W	61 - 334	83 - 1720	113 - 138
M119_0856-1	23	2015/10/07	22:08	05° 38.98' S	34° 57.64' W	314 - 427	381 - 465	139 - 142
M119_0858-1	24	2015/10/08	00:47	05° 38.24' S	34° 56.05' W	324 - 345	700 - 781	143 - 146
M119_0860-1	25	2015/10/08	04:32	05° 37.94' S	34° 54.01' W	300 - 335	1510 - 1921	147 - 150
M119_0862-1	26	2015/10/08	09:50	05° 35.73' S	34° 46.63' W	259 - 297	2773 - 2793	151 - 154
M119_0864-1	27	2015/10/08	15:41	05° 34.67' S	34° 35.77' W	293 - 311	3379 - 3386	155 - 158
M119_0866-1	28	2015/10/08	22:15	05° 32.72' S	34° 24.34' W	361 - 383	3766 - 3783	159 - 162
M119_0868-1	29	2015/10/09	04:40	05° 30.10' S	34° 10.06' W	366 - 405	4124 - 4129	163 - 165
M119_0870-1	30	2015/10/09	11:04	05° 26.61' S	33° 50.06' W	468 - 500	4329 - 4332	166 - 168
M119_0872-1	31	2015/10/09	18:29	05° 21.51' S	33° 25.05' W	515 - 581	4488 - 4492	169 - 171

7.5 Biogeochemistry Measurements

Station	CTD	Date	Lat.	Long.	C/N fixation	Natural 13C/15N abundance	Nutrients	HPLC	Flow Cytometry	Light Profile
686	2	9/9/15	17.612	-24.347	-	-	-	Profile	-	x
691	3	9/9/15	17.605	-24.287	Profile	Profile	Profile	Profile	Profile	-
697	4	9/11/15	15.000	-23.000	-	-	Profile	Profile	Profile	-
698	5	9/11/15	14.498	-23.000	Profile	Profile	Profile	Profile	Profile	x
703	7	9/11/15	13.500	-23.001	Surface	Surface	-	-	-	-
706	9	9/12/15	12.500	-23.000	Surface	Surface	Surface	Surface	Surface	
708	10	9/12/15	12.000	-22.998	Profile	Profile	Profile	Profile	Profile	x
718	12	9/14/15	11.030	-21.212	Surface	Surface	Profile	Profile	Profile	x
722	13	9/15/15	11.500	-22.943	Surface	Surface	Profile	Profile	Profile	x
724	15	9/15/15	10.498	-22.947	Profile	Profile	Profile	Profile	Profile	-
729	17	9/16/15	9.500	-22.940	-	-	Profile	-	-	x
731	18	9/16/15	9.008	-22.938	Surface	Surface	Profile	Profile	Profile	x
733	19	9/16/15	8.502	-22.947	Profile	Profile	Profile	-	-	-
737	22	9/17/15	6.998	-22.947	Surface	Surface	Profile	Profile	Profile	-
740	24	9/18/15	6.000	-22.948	Surface	Surface	-	-	-	-
745	26	9/18/15	4.975	-22.958	Profile	Profile	Profile	Profile	Profile	x
753	29	9/19/15	4.496	-23.000	-	-	Profile	Profile	Profile	-
754	30	9/19/15	3.999	-22.999	-	-	Profile	Profile	Profile	-
755	31	9/20/15	3.500	-22.998	Profile	Profile	Profile	Profile	Profile	-
756	32	9/20/15	2.998	-22.998	Surface	Profile	Profile	Profile	Profile	-
758	33	9/20/15	2.493	-23.003	Profile	Profile	Profile	Profile	Profile	x
759	34	9/20/15	1.999	-23.000	-	-	Profile	Profile	Profile	-
761	35	9/21/15	1.665	-23.002	Surface	Profile	Profile	Profile	Profile	-
762	36	9/21/15	1.332	-22.998	Profile	Profile	Profile	Profile	Profile	-
764	37	9/21/15	0.990	-23.000	-	-	Profile	Profile	Profile	x
765	38	9/21/15	0.665	-22.998	Profile	Profile	Profile	Profile	Profile	-
766	39	9/21/15	0.332	-22.999	-	-	Profile	Profile	Profile	-
770	40	9/22/15	0.000	-23.106	Profile	Profile	Profile	Profile	Profile	x
780	42	9/23/15	-0.333	-22.998	Surface	Profile	Profile	Profile	Profile	-
781	43	9/23/15	-0.667	-22.998	Profile	Profile	Profile	Profile	Profile	-
782	44	9/24/15	-0.999	-23.000	-	-	Profile	Profile	Profile	-
783	45	9/24/15	-1.333	-22.983	Surface	Surface	Profile	Profile	-	-
784	46	9/24/15	-1.650	-22.983	-	Profile	-	-	-	-
785	47	9/24/15	-2.000	-23.000	Profile	Profile	Profile	Profile	Profile	-
788	49	9/25/15	-2.500	-22.983	Profile	Profile	Profile	Profile	Profile	-
789	50	9/25/15	-3.000	-23.000	Surface	Profile	Profile	Profile	Profile	-
791	51	9/25/15	-3.500	-22.998	Profile	Profile	Profile	Profile	Profile	x
792	52	9/25/15	-3.998	-23.000	Surface	Profile	Profile	Profile	Profile	-
793	53	9/26/15	-4.498	-23.000	Profile	Profile	Profile	Profile	Profile	-
795	54	9/26/15	-4.999	-23.003	-	-	Profile	Profile	Profile	x

Tab. 7.5 Details of N_2 fixation, C uptake, natural abundance of N/C isotopes, nutrients, flow-cytometry, HPLC, and optical sampling.

7.6 Station list of N_2-fixation

Station	CTD	Date	Latitude	Longitude	M106
703	7	9/11/15	13.500	-23.001	-
708	10	9/12/15	12.000	-22.998	-
711	11	9/14/15	11.040	-21.244	-
723	14	9/15/15	11.002	-22.948	-
731	18	9/16/15	9.008	-22.938	x
737	22	9/17/15	6.998	-22.947	x
745	26	9/18/15	4.975	-22.958	x
754	30	9/19/15	3.999	-22.999	x
756	32	9/20/15	2.998	-22.998	x
759	34	9/20/15	1.999	-23.000	x
766	39	9/21/15	0.332	-22.999	x
773	41	9/22/15	-0.001	-23.100	x
Station	CTD	Date	Latitude	Longitude	M106
780	42	9/23/15	-0.333	-22.998	x
782	44	9/24/15	-0.999	-23.000	x
785	47	9/24/15	-2.000	-23.000	x
789	50	9/25/15	-3.000	-23.000	x
795	54	9/26/15	-4.999	-23.003	x
802	58	9/29/15	-11.498	-32.873	x
834	69	10/2/15	-10.609	-35.393	-
846	74	10/4/15	-11.126	-34.732	-
864	82	10/8/15	-5.565	-34.607	-

Tab. 7.6 Station list of N_2-fixation profiles measured with dissolved bubble method; an x in the right column identifies stations that have also been sampled during M106 in April/May 2014.

7.7 Towed camera (Pelagios) station list

No.	Date	Position	Time (start-end)	Depth range (wire out)	Depth range (MicroCAT)	UVP	Comments
1	8-9-2015	CVOO	21.57-22.57	30-300	28-291	√	CVOO
2	11-9-2015	14°N, 23°W	16.36-18.11	150-600	130-497	√	
3	12-9-2015	13°N, 23°W	03.50-05.46	160-700	158-648	√	
4	12-9-2015	12°N, 23°W	17.32-18.05	75-450	71-402	√	
5	14-9-2015	11°02’N, 21°14’W	13.50-15.00	50-400	48-377	√	Mooring site
6	14-9-2015	11°02’N, 21°13’W	00.02-02.12	50-500	48-464	√	Mooring site
7	16-09-2015	09°59’N, 22°56’W	05.47-7.56	50-500	48-463	√	
8	16-09-2015	08°59’N, 22°56’W	18.15-20.18	50-500	45-461	√	
9	17-09-2015	07°59’N, 22°55’W	5.32-08.04	50-700	48-575	√	
10	17-09-2015	07°00’N, 56°06’W	17.37-19.08	50-650	45-563	√	
11	18-09-2015	04°59’N, 22°57’W	10.19-12.11	58-750	55-624	√	
12	18-09-2015	05°N, 22°59’W	22.00-00.08	50-700	47-598	√	
13	22-09-2015	00°N, 23°W	15.09-17.06	50-700	41-665	√	
14	23-09-2015	00°N, 23°W	01.50-3.32	50-550	45-491	√	

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 M119 are stored at the Kiel data portal, and remain proprietary for the PIs of the cruise and for members of SFB754. Each station is logged as an event file https://portal.geomar.de/metadata/leg/show/326650. All data will be submitted to PANGAEA within 3 years, i.e. by October 2018. 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.

Data	Contact Person	Present Affiliation	Email
CTD/O_2	Dr. Gerd Krahmann	GEOMAR	gkrahmann@geomar.de
VMADCP	Dr. Florian Schütte	GEOMAR	fschuette@geomar.de
LADCP	Dr. Gerd Krahmann	GEOMAR	gkrahmann@geomar.de
Mooring data, MiniTDs, MircoCATs, & optodes	Dr. Johannes Hahn	GEOMAR	jhahn@geomar.de
Current meters	Dr. Rebecca Hummels	GEOMAR	rhummels@geomar.de
Microstructure	Dr. Rebecca Hummels	GEOMAR	rhummels@geomar.de
Towed camera	Dr. Hendrik Jan Ties Hoving	GEOMAR	hhoving@geomar.de
Particles, Zooplankton	Dr. Rainer Kiko	GEOMAR	rkiko@geomar.de
Biogeochemistry	Dr. Ajit Subramaniam	LDEO	ajit@ldeo.columbia.edu
Thermosalinograph	Dr. Gerd Krahmann	GEOMAR	gkrahmann@geomar.de
Underway O_2 and GTD	Tobias Hahn	GEOMAR	thahn@geomar.de
Multibeam echosounder	Dr. Gerd Krahmann	GEOMAR	gkrahmann@geomar.de

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

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10 References

During the cruise we followed the guidelines recently developed by the GO-SHIP group, particularly did we consider the guides for best practices:

Hood, E.M., C.L. Sabine, and B.M. Sloyan, eds. 2010. The GO-SHIP Repeat Hydrography Manual: A Collection of Expert Reports and Guidelines. IOCCP Report Number 14, ICPO Publication Series Number 134. Available online at http://www.go-ship.org/HydroMan.html

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11 Appendix – List of Abbreviations

ADCP	Acoustic Doppler Current Profiler
AWA	Research Project: Ecosystem Approach to the management of fisheries and the marine environment in West African waters
BMBF	Federal Ministry of Education and Research
CTD	conductivity-temperature-depth (system)
CVOO	Cape Verde Ocean Observatory
DFG	German Research Foundation
DWBC	Deep Western Boundary Current
ETNA	Eastern Tropical North Atlantic
GTD	gas tension device
LADCP	Lowered Acoustic Doppler Current Profiler
LR ADCP	Longranger Acoustic Doppler Current Profiler
Mini-TD	Temperature-depth probe
MN	Multinet
NBUC	North Brazil Undercurrent
OMZ	Oxygen Minimum Zone
OS	Ocean surveyor
RACE	Research Project: Regional Atlantic Circulation and Global Change
SFB	Collaborative Research Project
UVP	Underwater vision profiler
VMADCP	Vessel-mounted Acoustic Doppler Current Profiler