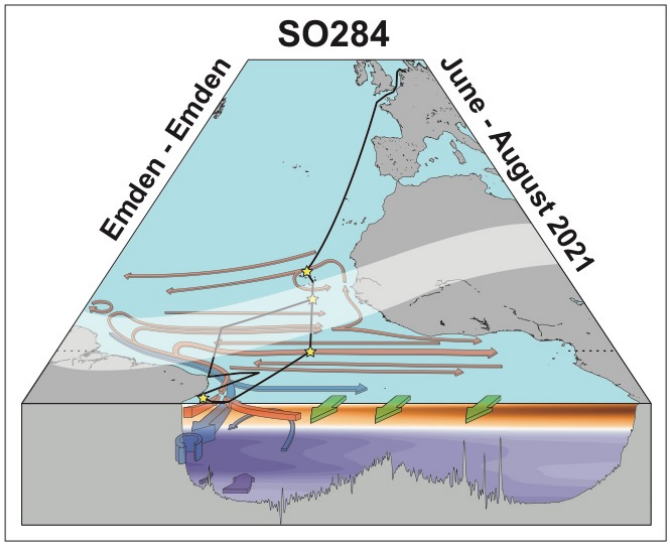
SONNE-Berichte

Tropical Atlantic Circulation and Climate: Mooring Rescue

Cruise No. SO284

June 27 – August 16, 2021
Emden (Germany) – Emden (Germany)



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2021

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1 Summary

R/V Sonne cruise SO284 was set up to rescue long-term moorings in the central and western tropical Atlantic. During the cruise the Cape Verde Ocean Observatory (CVOO), the equatorial mooring at 23°W (in cooperation with the international PIRATA program), and the western boundary current mooring array at 11°S off Brazil were recovered and re-deployed ensuring the continuity of long-term observations of tropical circulation, water-mass distribution, and biogeochemical parameters. SO284 is also based on a cruise proposal for the measurement of the western boundary circulation that included hydrographic and current measurements along repeat sections at 11°S, 5°S, and 35°W. CTD measurements along these sections included biochemical measurements using water samples of the CTD rosette and optical measurements for particle counts and phyto- and zooplankton identification with an underwater vision profiler (UVP). The physical oceanography program additionally included a study of upper ocean mixing processes using an autonomous glider and a freely drifting buoy. SO284 is a contribution to the GEOMAR research program OCEANS, to the EU projects TRIATLAS, NextGEMS, and EuroSea, and to the „Make Our Planet Great Again“ project by R. Kiko.

In addition to the oceanographic measurements, a set of atmospheric measurements was performed during SO284. The region of key interest was the Atlantic Intertropical Convergence Zone (ITCZ), which plays a central role for the tropical weather and climate and structures the large-scale circulation. The thermodynamic and dynamic state of the atmosphere was measured by frequent radiosonde launches, providing atmospheric profiles with high vertical resolution extending from the surface through the lower stratosphere. These measurements were complemented by continuous measurements of the atmospheric boundary layer and lower free troposphere, including optical measurements of water vapor, aerosol, precipitation, wind speed and direction as well as cloud base height. The atmospheric measurements specifically address the question of how convective scale processes in the atmosphere, and their coupling to the ocean, shape the ITCZ. The collected data will help to prepare the strategy for more extensive measurements of the ITCZ planned for the BOW-TIE Cruise in 2023/4 and for airborne measurements in Aug 2024 through MPI/DFG/DLR led Tropical-Ocean and Organized Convection Field study. In addition, the data will serve as a benchmark to the first international inter-comparison of global storm-resolving models (DYAMOND, Stevens et al., 2019) and support the EU Project NextGEMS.

Zusammenfassung

Die FS Sonne-Forschungsfahrt SO284 wurde zur Rettung von Langzeitobservatorien im zentralen und westlichen tropischen Atlantik ins Leben gerufen. Während SO284 wurden das CVOO (Cape Verde Ocean Observatory), die äquatoriale Verankerung bei 23°W (in Zusammenarbeit mit dem internationalen PIRATA-Programm) und das Verankerungsarray im westlichen Randstrom bei 11°S vor Brasilien geborgen und neu ausgelegt. Damit konnte die Kontinuität von Langzeitbeobachtungen der tropischen Zirkulation, der Wassermassenverteilung und biogeochemischer Parameter gewährleistet werden. SO284 basiert auch auf einem Fahrtvorschlag für die Messung der westlichen Randstromzirkulation vor Brasilien, der hydrographische und Strömungsmessungen entlang von Wiederholungsschnitten bei 11°S, 5°S und 35°W umfasste. CTD-Messungen entlang dieser Abschnitte umfassten auch biochemische

Messungen mit Hilfe von Wasserproben der CTD-Rosette und optische Messungen zur Partikelzählung und zur Identifizierung von Phyto- und Zooplankton mit einem UVP (Underwater Vision Profiler). Das physikalische Ozeanographie-Programm umfasste zusätzlich eine Untersuchung von Vermischungsprozessen im oberen tropischen Nordatlantik mit einem autonomen Gleiter und einer frei treibenden Boje. SO284 ist ein Beitrag zum GEOMAR-Forschungsprogramm OCEANS, zu den EU-Projekten TRIATLAS, NextGEMS und EuroSea sowie zum Projekt „Make Our Planet Great Again“ von R. Kiko.

Zusätzlich zu den ozeanographischen Messungen wurde während SO284 eine Reihe von atmosphärischen Messungen durchgeführt. Das Hauptinteresse galt der atlantischen intertropischen Konvergenzzone (ITCZ), die eine zentrale Rolle für das tropische Wetter und Klima spielt und die großräumige Zirkulation beeinflusst. Der thermodynamische und dynamische Zustand der Atmosphäre wurde durch regelmäßige Radiosondenaufstiege gemessen, die hochaufgelöste atmosphärische Profile von der Meeresoberfläche bis in die untere Stratosphäre lieferten. Ergänzt wurden diese Messungen durch kontinuierliche Messungen der atmosphärischen Grenzschicht und der unteren freien Troposphäre, unter anderem durch optische Messungen von Wasserdampf, Aerosol, Niederschlag, Windgeschwindigkeit und -richtung sowie der Höhe der Wolkenbasis. Diese Messungen sollen zur Beantwortung der Frage, wie konvektive Prozesse in der Atmosphäre und ihre Kopplung mit dem Ozean die ITCZ formen beitragen. Die gesammelten Daten werden außerdem dazu beitragen, die Strategie für umfangreichere Messungen der ITCZ vorzubereiten, die für die Kampagne BOW-TIE im Jahr 2023/4 und für flugzeuggestützte Messungen im August 2024 im Rahmen der vom MPI/DFG/DLR geleiteten Feldstudie über den tropischen Ozean und organisierte Konvektion geplant sind. Darüber hinaus werden die Daten als Referenz für den ersten internationalen Vergleich Globaler Sturmauflösender Modelle (DYAMOND, Stevens et al., 2019) dienen und das EU-Projekt NextGEMS unterstützen.

2 Participants

2.1 Principal investigators

Name	Institution
Brandt, Peter, Prof.	GEOMAR
Windmiller, Julia, Dr.	MPI-M

2.2 Scientific party

No.	Name	Discipline	Institution
1	Brandt, Peter, Prof.	PO, Chief scientist	GEOMAR
2	Windmiller, Julia, Dr.	ME, Co-chief scientist	MPI-M
3	Begler, Christian	PO, Mooring lead, glider, buoy	GEOMAR
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5	Imbol Koungue, Rodrigue Anicet, Dr.	PO, CTD, moored ADCPs	GEOMAR
6	Kamm, David	PO, CTD, salinometer	GEOMAR
7	Körner, Mareike	PO, CTD, vmADCPs, glider	GEOMAR
8	Maia Pacheco, Mariana	PO, CTD, underway, nutrients	GEOMAR
9	Martens, Wiebke	PO, CTD technique, MC	GEOMAR
10	Menzel, David	PO, CTD, salinometer	GEOMAR
11	Olbricht, Hannah	PO, AQD, releases, moorings	GEOMAR
12	Roch, Marisa	PO, CTD, MC, underway	GEOMAR
13	Schütte, Florian, Dr.	PO, CTD analysis, glider, mooring processing	GEOMAR
14	Tuchen, Franz Philip, Dr.	PO, CTD, LADCP, MMP	GEOMAR
15	Brockmann, Inga	CO, N_2O, CH_4, O_2	GEOMAR
16	Wittlinger, Xaver Anselm	CO, N_2O, CH_4	GEOMAR
17	Franke, Henning	ME, Radio sondes, GPS based CWV	MPI-M
18	Quaglia, Ilaria	ME, Radio sondes, Ceilometer	MPI-M
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21	Engelmann, Ronny, Dr.	ME, OCEANET Container	TROPOS
22	Skupin, Annett, Dr.	ME, OCEANET Container	TROPOS
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24	Lehmke, Jonas	ME, Aerosols	FUB
25	dos Anjos, Felippe Augusto Affonso	Observer	Brazilian Navy

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

2.3 Participating institutions

FUB	Freie Universität Berlin, Department: Geosciences, Institute for Space Sciences, Berlin, Germany
GEOMAR	Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
IWES	Fraunhofer Institute for Wind Energy Systems, Department: Wind Farm Planning, Bremerhaven, Germany
MPI-M	Max- Planck- Institut für Meteorologie (MPI-M), Hamburg, Germany
TROPOS	Leibniz-Institut für Troposphärenforschung e.V., Leipzig, Germany

3 Research program

3.1 Description of the work area

The research program of SO284 covered large parts of the central and western tropical Atlantic (Fig. 3.1). Focus areas were 1) the western boundary region off Brazil with two zonal sections along 11°S, and 5°S and one meridional section along 35°W and 2) the region of the intertropical convergence zone (ITCZ), located between 5°N and 15°N during July and August, extending from northern Brazil to Northwest Africa. Additional long-term moorings were serviced north of the Cape Verdean Island São Vicente and at the equator, 23°W. An upper ocean mixing process study was carried out in the tropical North Atlantic in the Guinea Dome area located between the Cape Verde archipelago and the equator. Radiosonde launches were most frequent within and around the ITCZ between 15°N and the equator, but covered the whole area from about 25°N to 12°S. Meteorological and oceanographic underway measurements were carried out along the cruise track within the Exclusive Economic Zones (EEZs) of Brazil and Cape Verde and outside of the EEZs of other countries.

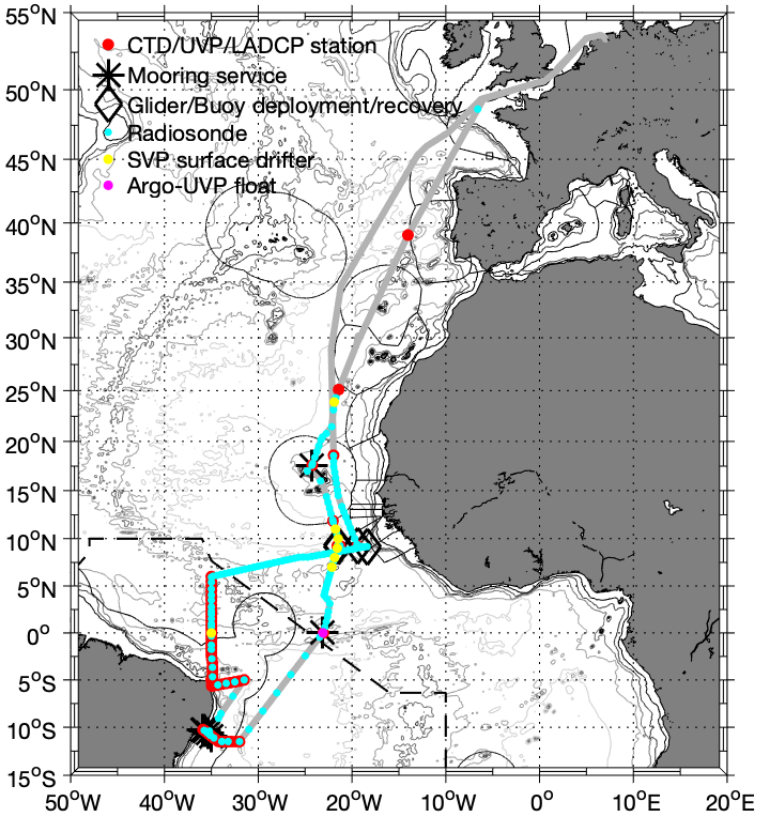

Fig. 3.1. Bathymetric map with cruise track of R/V Sonne cruise SO284 (grey solid line) including locations of CTD/UVP/LADCP stations, mooring recoveries and re-deployments, glider or buoy deployments/recoveries, radiosonde launches and locations of drifter and float deployments. Territorial waters of different countries and the SAR area of Brazil are marked with thin black solid and dashed lines, respectively.

3.2 Aims of the cruise

The aim of the R/V Sonne cruise SO284 was to recover and service oceanographic moorings in the central and western tropical Atlantic in order to enable the continuity of long-term observational programs and to avoid a loss of devices and data due to the COVID-19 pandemic. It

is based on a cruise proposal to investigate the western boundary current system off Brazil and has been expanded to include an atmospheric component to investigate the intertropical convergence zone. The aim of the western boundary current measurements is to identify long-term water mass and velocity changes in comparison to previous measurements. In addition, upper ocean mixing processes are studied in the tropical North Atlantic to better understand the mixed layer heat and freshwater budgets as well as diapycnal transports of tracers. The atmospheric component focuses on the question of how convective scale processes in the atmosphere, and their coupling to the ocean, shape the large-scale structure of the Atlantic ITCZ. Aim of the cruise was to collect data and improve our understanding 1) of the role of convective wind-gusts in shaping the near surface winds and maintaining the air and sea-surface temperature in the inner ITCZ, a region often marked by weak winds and 2) how air-mass boundaries shape this region and determine its dynamics, e.g. its spatial shift, and how the ITCZ maintains a sharp gradient in the vertically integrated humidity field at its edge. Collected data will help preparing more extensive shipboard and airborne measurements of the ITCZ planned for the upcoming years. They are aimed as a benchmark to the first international inter-comparison of global storm-resolving models.

3.3 Agenda of the cruise

The measurement program of SO284 included the service of the CVOO. Moored instrumentation at this location included velocity, temperature, salinity, pressure and oxygen sensors as well as among others a sediment trap. South of the Cape Verde archipelago at about 9°N, an upper ocean mixing study was planned, using a freely drifting buoy with an ADCP and additional temperature, salinity, oxygen, and a nutrient sensor as well as an autonomous glider with a microstructure probe attached. As planned, the two platforms were deployed at the beginning and recovered at the end of the cruise. Next point in the cruise plan was the service of the equatorial mooring at 23°W. This mooring is aimed to measure the variability of the equatorial current system and to address together with previous mooring data the interannual and decadal variability of the equatorial velocity field. The service of the mooring array at 11°S off Brazil finally allows to continue the boundary current transport time series. These boundary currents are part of the thermohaline and wind-driven circulation. They contribute to the Atlantic meridional overturning circulation (AMOC), the subtropical cell (STC) and the wind-driven equatorial gyre circulation. The measurement program included section work along 11°S, 5°S and 35°W off Brazil. Observations along the sections included full-depth station work with the CTD system measuring temperature, salinity, pressure, oxygen, nutrients, turbidity, fluorescence (i.e. chlorophyll-a), current velocity with the lowered acoustic Doppler current profilers (LADCP), and particle size classes and plankton composition with an underwater vision profiler 5 (UVP5). Water samples were analyzed for salinity, oxygen, nutrients, N_2O, and methane. Underway measurements were performed with the two shipboard ADCPs for velocities in the upper 1000 m, the thermosalinograph for near-surface temperature, salinity and fluorescence, and a throughflow system for near-surface N_2O, and methane. With regard to the original cruise proposal all proposed work could be performed.

The atmospheric measurement program focused on the ITCZ and consisted of two main parts: continuous underway measurements and regular radiosonde launches. The underway measurements were used to obtain detailed measurements at the surface and in the lower troposphere. For this purpose, measurements of temperature, humidity, pressure, wind speed and

direction, precipitation rate (disdrometer), short- and long-wave radiation (pyranometer, pyrgeometer) and water vapor/aerosol profiles (Raman lidar) as well as horizontal and vertical wind profiles (wind lidar) were taken at the surface. These were complemented by vertically integrated measurements of water vapor and liquid water (microwave radiometer) and aerosols (Pandora-2s/microtops). These data are used to study the mean atmospheric conditions and their variability within and at the edge of the ITCZ, as well as the local imprint of deep convection. All underway measurements ran from the time we left the EEZ around the Canary Islands at about 25°N until we re-entered the French EEZ. In addition to the underway measurements, 156 radiosondes were launched to obtain vertical profiles extending from the surface to the lower stratosphere with high vertical resolution. The radiosondes measured temperature, pressure, humidity, wind speed and direction. Radiosonde launches were limited to the tropics and were conducted at varying frequencies, with radiosondes launched every two hours in the core area of the ITCZ (roughly between 5°N and 10°N) and less frequently outside the ITCZ. Six radiosondes were launched to validate the wind measurements from the Aeolus satellite.

4 Narrative of the cruise

After a 10-day quarantine due to the COVID-19 pandemic, the cruise participants of cruise SO284 arrived on June 26, 2021 at the R/V Sonne in the port of Emden. After everything had been properly stowed on board over the next 24 hours, R/V Sonne departed from the harbor of Emden on Sunday, June 27 at about noon. SO284's first station was a radiosonde launch on June 29 at the exit of the English Channel. First measurements with the CTD were conducted when leaving the EEZ of Portugal on July 1 and later on July 5 after passing the EEZ around the Canary Islands. Both CTD stations were used to calibrate moored instrumentation to be deployed later. Regular radiosonde measurements 3 to 4 hours apart started at 24°18.5'N while approaching the Cape Verdean islands. Whenever possible, we tried to have radiosonde measurements during Aeolus satellite overpasses. The first simultaneous radiosonde launch was on July 6. The first surface drifter as part of the international SVP (Surface Velocity Program) drifter program was deployed on July 7. Drifters were provided by NOAA AOML, Miami, USA.

North of the Cape Verdean island of São Vicente, an interdisciplinary observatory, the Cape Verde Ocean Observatory (CVOO), was installed for the first time in 2006 and since then continuously serviced. CVOO was recovered in the morning of July 7 followed by a CTD station for measuring hydrographic parameters, currents and biological parameters in the whole water column. In the afternoon, CVOO was re-deployed by using fresh instruments that were partly calibrated during CTD casts during the previous days. After the end of the work at CVOO, we had to depart from our original cruise track to head to the port of Mindelo, where one of the ship's crew members had to disembark because of medical issues.

Radiosonde work continued with launches every 3 hours while approaching the ITCZ. However, due to a temporarily malfunctioning antenna system, some of the radiosondes planned on July 7 and 8 could not be launched according to schedule. On July 9, we had another CTD cast for calibration of instruments to be deployed during the next day. Within the ITCZ, we had planned to have an upper ocean mixing study. By using an autonomous glider and a freely drifting surface buoy, we want to understand wind-induced surface current fluctuations. Such events are generated quite rarely but result due to the associated strong mixing into sea surface cooling and upward nutrients supply associated with enhanced biological productivity. The plan was to combine the

wind-mixing study with a mixing study near a seamount. Mixing near seamounts is mostly due to tide-topography interaction. We had chosen the Annan Seamount, which is a volcanic cone that piles up from about 4500m in the deep ocean to 200m below the surface. Due to fishing boats anchoring at the top of the Annan seamount, we decided to deploy the glider and the drift buoy somewhat outside of the area of their possible line-fishing activity. During the following days, we steered the glider around and across the seamount to measure the mixing activity with a microstructure probe attached to the glider. The drift buoy started drifting eastward stronger than expected due to a well-developed northern branch of the North Equatorial Countercurrent.

Marked by the onset of heavy rain, the northern edge of the ITCZ reached the location of the research vessel during our station work at the seamount. This allowed us to ideally capture the time-evolution of this event. South of 8°N the frequency of radiosonde measurements was increased, with launches every 2 hours, to capture the high variability in cloud formation and high-precipitation events. South of about 4°N, when having left the ITCZ the frequency of radiosonde launches was reduced and measurements were taken every 3 hours.

At the equator, 23°W we had to service our next long-term mooring. Here, equatorial currents have been measured since December 2001, initially as part of the international PIRATA program. Since 2006, the mooring has been operated by GEOMAR - still in cooperation with PIRATA. The work at the equator started with a CTD station during the night. In the morning of July 13, the equatorial mooring was recovered without problems. The mooring deployment was started directly afterward beginning with a drift test of the ship. Mooring deployment was again without problems and the submerge of the top element after the anchor drop could be observed. The last station work at the equator, 23°W was the deployment of a biogeochemical Argo float including an underwater vision profiler and an SVP drifter.

After finishing the work at the equator, R/V Sonne headed toward the western boundary section off Brazil at about 11°S. Radiosondes were launched every 12 hours. The first CTD station of the 11°S section was on July 16. Distance between CTD stations was initially 30 nm and decreased toward the coast. On July 18, we arrived at the first mooring of the mooring array across the western boundary current. The mooring was successfully recovered and, after recovery of the next mooring in the morning of July 19, again re-deployed. On July 20, we recovered the two shallowest moorings at the continental slope as well as two PIES (pressure inverted echo sounders). Two new PIES were deployed at the same positions to allow a continuous time series. During the nights between the mooring deployments, we completed the CTD and ADCP section toward the coast. CTD casts were used for instrument calibration and test of the mooring releases to be deployed. On July 21, we had three mooring deployments and started with the shallowest one closest to the coast. With the deployment of the second and third mooring, we finished the very successful mooring work during SO284. The main aim of the cruise, the mooring rescue in the central and western tropical Atlantic, was fulfilled.

On July 23, we arrived at the most offshore CTD station of the section along 5°S. The section consisted of 13 CTD/UVP/LADCP stations (one station had to be restarted because of an erroneous oxygen sensor). On July 25, the 5°S section ended about 12nm before the Brazilian city of Natal, which we could already guess at the horizon. Not far from the place, just around the northeast corner of Brazil, the meridional section along 35°W started at the same day. The 35°W section crosses the equator and thus captures the shallow and deep equatorial current system. Distance between CTD stations varied between 30 nm and 7 nm. Shorter distances are aimed at

measuring boundary currents and the focused flow along the equator. Altogether, we did 33 CTD stations between 5°S and 6°N within about 5 days. CTD sensors including lowered ADCP, UVP, altimeter worked very well during all the CTD station work. We only had to exchange one oxygen sensor and the fluorescence sensor for measuring Chlorophyll. The frequency of radiosonde launches was increased north of the equator, with measurements every 6 hours. After arriving in the main rain belt of the ITCZ on July 31, R/V Sonne headed back toward the deployment sites of the glider and the surface drift buoy. During that transect along the main axis of the ITCZ, radiosondes were launched every two hours.

Meanwhile, the drift buoy had an extremely fast drift toward Africa. After discussion with the German Research Fleet Coordination Centre, we decided to submit a diplomatic application to allow the recovery in the EEZ of either Senegal, Guinea-Bissau or Guinea. Finally, due to the help of the Coordination Center and the German embassies, we got the allowance for Guinea-Bissau. The drift buoy could be recovered finally in the EEZ of Guinea-Bissau in the late night of August 3. Next morning, on August 4, the glider that was steered outside the EEZ of Guinea-Bissau was recovered using the work boat of R/V Sonne. A final CTD station for the calibration of the instrumentation at the buoy and the glider was carried out at the same position. Measurements continued with radiosonde launches. The last radiosonde was launched on August 6 at about 18°34'N. The station work ended on the same day with a test CTD in preparation for the next cruise SO285 using the CTD system of R/V Sonne with a UVP newly installed within the CTD rosette. Meteorological and oceanographic underway measurements continued until we reached the EEZ of France at 47°N, 9°43'W. We arrived at the port of Emden on August 16 at 09:00 UTC.

5 Preliminary results

5.1 Hydrographic observations

5.1.1 CTD system, oxygen measurements, and calibration

(Florian Schütte)

CTD-Rosette system

During SO284 a total of 75 CTD-profiles and 1174 water samples for sensor calibration were collected. The rosette system was installed in a Seabird Rosette System frame for 24 bottles. But most casts were made with 22 bottles installed (because of the mounted LADCP), except the casts made for the calibration of MicroCATs (where few bottles had to be uninstalled). For nearly all stations, the full water column was sampled down to 20 m above the seafloor (except for 6 casts). The maximum depth reached was 5015 m. Data acquisition was done using Seabird Seasave software version 7.26.7.121 and preprocessing (datcnv, wildedit, filter) was done with GEOMAR-developed Matlab routines mimicking SBE Data Processing 7.26.7.121. The Matlab routines detect and correct time gaps in Seabird's records and use an improved outlier detection.

The first CTD profile (profile #1) was conducted at around 39°N off the EEZ of Portugal to test if all sensors recorded data with sufficient accuracy and no errors occurred. One additional CTD profile (profile #76) was conducted with the R/V Sonne CTD to test the sensors and the newly installed UVP5 for the following cruise. This profile has not been handled by the regular processing. It will not be submitted to global archives as the data is fully uncalibrated.

Strong noise in the fluorescence sensor appeared on the downcast of profile #15. Since the turbidity measurements were not affected (which is a measurement of the same instrument) we assumed a defect cable as the cause. But to be sure we changed the Fluorometer and the cable from

profile #16 to the end. Unfortunately, a wrong coefficient was set for the Fluorometer from profile #16 to profile #61 (which was later corrected in post-processing at GEOMAR). As data from the primary oxygen sensor became more and more noisy, we decided to change the cables of the oxygen sensors after CTD profile #32. On the downcast of CTD profile #33 strong noise appeared on both oxygen sensors and the profile was aborted at around 200 m depth. The cable was exchanged again and the primary oxygen sensor (#1302) was removed and replaced by a dummy for CTD profile #34. From CTD profile #35 onwards a new oxygen sensor (#2686) (plus a new cable) was installed. All other sensors provided reliable, high-quality data throughout the cruise. The exact configuration of the CTD system can be found in Table 5.1. Additionally, two self-recording LADCPs, a self-recording, self-powered UVP5 and a self-recording nutrient sensor were attached to the water sampler. They are described separately in this cruise report. Preliminary fully processed but uncalibrated CTD data, 5-dbar binned, was sent in near real time to the Coriolis Data Centre in Brest, France, (via email: codata@ifremer.fr) for integration in the databases to be used for operational oceanography applications and the WMO supported GTS/TESAC system.

Table 5.1. *Summary of CTD system SBE #9 configuration used during SO284.*

	CTD system SBE 911
Pressure sensor	#410
T primary	#5806
T secondary	#5807
C primary	#3300
C secondary	#4062
O2 primary	#1302 (Profile: 1-33) / #2686 (Profile: 35-75)
O2 secondary	#2669
PAR Sensor	#70714
Altimeter	#42299
Fluorometer	#2928 (Profile: 1-15) / #3332 (Profile: 16-75)

CTD-conductivity calibration

Overall, 327 calibration points were obtained by sampling for salinity. Salinity samples were taken by the CTD watch in 'Flensburger' bottles, which have been proven to be ideal for storing salinity samples. The measurements with one of GEOMAR's OPTIMARE Precision Salinometers (OPS) are described in section 5.1.2. A simple outlier removal method was applied that discarded the 33% samples with the largest deviations between CTD and bottle samples prior to calibration. The projection of data taken during the bottle stops of the upcast to the data from the downcast was done using the WOCE recommendations by searching within a 30-dbar pressure interval for similar potential temperatures. The conductivity calibration of the downcast data was performed using a 1st order linear fit with respect to temperature, pressure and conductivity (Table 5.2). The calibration results in a salinity RMS-misfit for the downcast of order 0.002636 psu for the primary and 0.002625 psu for the secondary sensor. The upcast calibration surpasses these values with a RMS-misfit of 0.002424 psu for the primary and 0.002437 psu for the secondary sensor.

During post-processing a suspicious difference between calibrated CTD salinities and salinometer readings and historical data was found for all deep-water samples. This suggests that the salinometer readings were systematically too high by about 0.004 psu. As such a change is unlikely to be real all salinometer readings were lowered by 0.004 psu and the calibration coefficients

recalculated. We plan to run extensive tests during the upcoming cruise M181 on FS Meteor which will sample again in the same region. From these tests we expect to be able to decide whether the ad hoc correction of the salinometer readings is warranted or not. Until then the CTD salinity from SO284 has to be considered preliminary.

Table 5.2. *End of cruise salinity and pressure summary of downcast calibration information for the two CTD systems used during SO284.*

	CTD system SBE 911	CTD system SBE 911
Sensor pair	Cond. Primary #3300	Cond. Secondary #4062
RMS misfit after calibration - salinity	0.0026361	0.0026254
Polynomial coefficients - conductivity	Offset: 0.0081425 P1: 1.8526e-07 T1: 0.0029479 C1: -0.0028694	Offset: +0.0071809 P1: 1.773e-07 T1: 0.0002506 C1: -0.0025422
Pressure sensor correction (deck-offset)	-0.32	-0.32

Oxygen calibration

Overall, 420 calibration points were obtained by sampling for oxygen. The CTD oxygen downcast for CTD systems was again calibrated using the least-deviating 66% of the joint data pairs between downcast CTD sensor value and Winkler-titrated oxygen. For the calibration a correction linear in temperature and oxygen, quadratic in pressure plus and additional term depending on the product of pressure and oxygen was fitted (Table 5.3) for each sensor. Note, that the primary oxygen sensor was changed at CTD profile #35 and no primary oxygen sensor was installed during CTD profile #34. The calibration resulted in an RMS-misfit for the downcast of 0.9165 µmol kg^{-1} / 0.8675 µmol kg^{-1} (profiles 1-33 / profiles 35-75) for the two different primary oxygen sensor (#1302 / #2686) and 0.9797 µmol kg^{-1} for the secondary oxygen sensor (#2669).

Table 5.3. *End of cruise downcast oxygen summary of calibration information for the CTD system SBE 911 used during SO284.*

	Oxygen Sensor #1302 / #2686	Oxygen Sensor #2669
Sensor pair	primary	secondary
RMS misfit after calibration - oxygen	0.91645 µmol kg^{-1} / 0.86753 µmol kg^{-1} (profiles 1-33 / profiles 35-75)	0.97965
Polynomial coefficients - oxygen	Offset: -1.2178 / -4.345 P1: 0.002933/ 0.003902 P2 : -3.4497e-07/ -6.9357e-07 T1: 0.23717/ 0.34136 O1: 0.015326/ 0.011364 P*O : 4.6585e-06/ -1.2219e-05 (profiles 1-33 / profiles 35-75)	Offset: -1.7127 P1: 0.0015584 P2: -3.8021e-07 T1: 0.30458 O1: 0.022471 P*O: 1.5911e-05

5.1.2 Conductivity measurements

(David Menzel und David Kamm)

In order to calibrate the conductivity sensors of the CTD system, the conductivity of 327 water samples were measured using the GEOMAR OPTIMARE Precision Salinometer (OPS), first

#020, later #010. The instruments have been tested for several years both in GEOMAR laboratories and on prior research cruises (see e.g., cruise report of R/V Maria S. Merian MSM60). Before measuring the conductivity of the water samples with the OPS, the bottled water samples had to be degassed to remove gas micro-bubbles, which would deteriorate the OPS instrument performance. Degassing was done after warming the sample bottles in a water bath at a temperature of about 40°C. After approximately one hour the bottles were removed from the bath. The bottles were opened shortly to release the gas. Afterwards the sample bottles were stored for around 24 hours to cool down to lab temperature, before the measurement could begin.

During the first day of measuring, a continuously decreasing salinity was observed while measuring most of the water samples. Therefore, the instrument was not able to obtain an averaged value for the respective probes. This issue could only be improved by extensive rinsing of the system with distilled water and a 20% Mucasol solution after each sample. Thus, it was decided to continue the measurements with another OPS (OPS #010). After also cleaning OPS #010 with distilled water and the Mucasol solution, it allowed for reliable measurements until the end of the cruise.

5.1.3. Oxygen Winkler measurements

(Inga Brockmann)

For the calibration of the oxygen sensor of the CTD, discrete samples were taken from every station at selected depths. The sample collection occurred bubble free in 100 mL flasks. Immediately after the sampling the samples were treated with manganese chloride solution and sodium iodide added sodium hydroxide solution and analysed within 12 hours after the fixation using the Winkler method. For this the precipitated hydroxides were dissolved with 1 mL sulphuric acid and directly titrated with sodium thiosulfate solution to a light-yellow colour. Then a zinc-starch solution was added, and the titration continued until the blue colour disappeared. In total 420 samples out of 75 CTD stations were sampled. Regularly, new calibration factors were determined, see Table 6.6.

5.1.4 Thermosalinograph

(Mariana Maia Pacheco, Florian Schütte)

Underway measurements of sea surface temperature (SST) and sea surface salinity (SSS) were continuously done by the ship dual thermosalinograph (TSG). One inlet is located at the portside (TSG1) while the other inlet is at the starboard side (TSG2). The parallel system worked well and continuously until July 27, when the TSG1 stopped working due to a malfunctioned computer, which could not be repaired during the cruise. Thereafter only the TSG2 was used. Data gaps due to the missing data logging of TSG1 or to the washing cycle of TSG2, when TSG1 was not running, was filled with underway water SSS measurements as described in section 5.6.4 (after removing an offset mean error of 0.3818). Additional data gaps were due to switching off scientific measurements when approaching Mindelo on July 8 and in the EEZ of Equatorial Guinea on August 3 to 4. SSS and SST measured by the TSG system was calibrated with CTD measurements, with a resulting RMS-misfit in SST of 0.0671°C and a resulting RMS-misfit in SSS of 0.091. For each CTD station, the closest depth to the TSG water sucking point depth (4.4 m) was chosen for calibration. SSS was also verified using the salinometer, with resulting RMS-misfit of 0.020.

Additionally, to the temperature and salinity measurements also a fluorescence sensor was installed in both TSGs that were not further evaluated.

5.2 Current observations

5.2.1 Vessel mounted ADCP

(Mareike Körner)

Underway-current measurements of the upper ocean were performed continuously throughout nearly the entire cruise using two Vessel Mounted Acoustic Doppler Current Profilers (vmADCPs): a 75kHz RDI Ocean Surveyor (OS75) and a 38kHz RDI Ocean Surveyor (OS38) mounted in the ship's hull. We had no allowance for ocean measurements in European waters and for the territories of Guinea-Bissau. Therefore, we first switched on both vmADCPs on July 01 at 19:57 UTC after leaving the EEZ of Portugal. The instruments then ran for ~12 h until we reentered the EEZ of Portugal (Madeira) on July 02 at 07:49 UTC. This period was used to test the settings of the vmADCPs and check for interferences with the echo sounders EM122, EM710 and EK60. This test revealed that the clearest vmADCP signal is achieved by just using the EM122. Thus, the EM710 and EK60 were not used during the cruise. After leaving the EEZ of Spain (Canary Islands) on July 05 at 08:12 UTC both vmADCPs were switched on. They were switched off for a short period when arriving at the port of Mindelo (July 08, 00:37-04:39 UTC). Additionally, we had to switch off the vmADCPs during our buoy recovery in the EEZ of Guinea-Bissau between August 03, 21:04 UTC and August 04, 07:17 UTC. The measurements were stopped before entering the EEZ of France on August 13, 03:40 UTC.

Overall, both Ocean Surveyor instruments worked well throughout the cruise. The OS38 and OS75 were aligned to zero degrees relative to the ship's center line. Both instruments ran in narrowband mode. The OS75 instrument was configured with 100 bins of 8 m size and a blanking distance of 8 m. It had a measurement range of 700 m to 800 m. The OS38 used 55 bins of 32 m size and a blanking distance of 16 m. The range was between 1300 m and 1500 m. Initially the OS38 was configured with 50 bins. However, we changed the setting on the July 06 at 08:53 UTC to 55 bins. During the entire cruise, navigation data from the ship's inertial measurement unit (IMU) Seapath was of high quality.

Post processing of the data was carried out separately for each instrument. The applied mean misalignment angles and amplitude factors with the associated standard deviation are summarized in Table 5.5

Table 5.5. *Vessel mounted ADCP calibration*

OS	Mode	Misalignment angle ± std	Amplitude factor ± std
38	NB	-0.2941 ± 0.72935	1.004 ± 0.010656
75	NB	-0.1506 ± 0.72272	1.0015 ± 0.01061

5.2.2 Lowered ADCP

(Franz Philip Tuchen, Christian Begler)

During the whole cruise the CTD/Rosette system was equipped with a lowered ADCP setup based on two Teledyne RDI ADCPs. The setup consisted of an upward-looking and a downward-

looking 300kHz instrument. These two instruments were mounted inside the CTD rosette with especially manufactured frames protecting the instruments and allowing zero obstruction of the acoustic beams. The LADCP system worked without trouble during the whole cruise with #24535 as the downward-looking instrument and #24497 as the upward-looking instrument for all 75 CTD/LADCP profiles (CTD profile #76 was a test station for the ship's CTD system without our LADCP system). During the cruise we used a software, which controlled via Bluetooth the start, stop, download, and erase of the cycles of the two LADCP systems (ladcp_tool_1.9c developed at GEOMAR). A newly developed energy supply system that draws energy for the ADCPs from the CTD system using rechargeable batteries worked well throughout the cruise.

Occasionally, the download rate was very slow (<1kB/s). One possible reason was found to be the music system in the hangar of R/V Sonne that is transmitting at the same Bluetooth frequency (2.4 GHz). For profiles #40, #44, #59, #69 and #75 data from the upward-looking LADCP and for profiles #48 and #49, data from the downward-looking LADCP could not be downloaded through the automatized "Stop and download" routine of the ladcp_tool_1.9c after the CTD station, possibly due to problems of the transmission via Bluetooth. For profile #55 the automatic download of the upward-looking LADCP was not completed. We recommend to always check that the size of both files (XXXUP000.000 and XXXDN000.000) is the same and also equal to the size of the original files on the LADCP systems. Data from these profiles were later manually downloaded from the LADCP system via Bluetooth without further problems. After profile #59 no connection to the upward-looking LADCP could be established. When changing the connection cable from the LADCP to the communication/battery housing pot, a connection was possible and no related problems occurred during the following CTD stations.

Data processing took place during the cruise using the GEOMAR LADCP processing software version 12.0, which includes both shear and inversion methods to derive an absolute velocity profile. As additional data are necessary for the processing, the corresponding pre-processed CTD files were used containing pressure, temperature and salinity profiles as well as vessel-mounted ADCP data, time and navigation data. The altimeter (Valeport 500 #42299) installed in the CTD rosette worked very well. Standard maximum depth of the profiles was 20 m above the bottom allowing generally to obtain TRDI bottom track data. Overall, the LADCP instruments of Teledyne RDI instruments delivered very good deep-ocean velocity profiles.

5.3 Drifter and floats

(Anna Christina Hans)

During SO284, 8 SVP (Surface Velocity Program) drifters and 1 Argo float were deployed. The individual ID-numbers as well as deployment positions and dates are given in Tables 6.3.1 and 6.3.2.

In cooperation with Laboratoire d'Océanographie de Villefranche, France (Rainer Kiko, Edouard Leymarie) we deployed one BGC ARVOR float designed for the Argo program (Table 6.3.2). The float was equipped with a pumped CTD, an oxygen optode and a Wetlabs ECO FLbb2k Fluorometer–Scattering Sensor, acquiring profiles in the upper 2000 m of the ocean. Additionally, an Underwater Vision Profiler 6 (Hydroptic) was attached to the float. Prior to deployment, auto-tests were conducted which were all successful. The float was then deployed manually with a crane over the starboard side. While moving slowly forward with the ship, the float slightly touched the

ship's hull after its release from the crane hook. Nevertheless, the float is working as expected. At the position of deployment, a CTD profile was conducted (profile #6).

In cooperation with NOAA/AOML, USA (Shaun Dolk) we deployed 8 GDP (Global Drifter Program) SVP drifters equipped with temperature sensors and GPS positioning system, produced by the Lagrangian Drifter Lab at Scripps. They were deployed manually especially at high value locations, i.e. at locations with a currently low number of drifters (Table 6.3.1), and are meant to follow the currents at 15 m depth thanks to a 'holey sock' drogue. Further, they activate themselves when in contact to sea water, so no prior actions were necessary.

5.4 Mooring operations

(Franz Philip Tuchen, Mareike Körner, Christian Begler)

The mooring operations are summarized in table 5.6.

***Table 5.6**. Mooring operations during SO284*

SO284 Mooring Recoveries					
Mooring	**ID**	**Latitude**	**Longitude**	**Deployment Date**	**Recovery Date**
CVOO	KPO_1216	17° 36.25'N	24° 15.00'W	19-Nov-2019	07-Jul-2021
23W 0N	KPO_1210	00° 00.20'N	23° 06.80'W	12-Oct-2019	13-Jul-2021
K1	KPO_1211	10° 16.00'S	35° 51.70'W	30-Oct-2019	20-Jul-2021
K2	KPO_1212	10° 22.80'S	35° 40.80'W	31-Oct-2019	20-Jul-2021
K3	KPO_1213	10° 36.50'S	35° 23.60'W	01-Nov-2019	19-Jul-2021
K4	KPO_1214	10° 56.40'S	34° 59.60'W	02-Nov-2019	18-Jul-2021
PIES-300m	KPO_1203	10° 13.62'S	35° 51.40'W	30-May-2018	20-Jul-2021
PIES-500m	KPO_1204	10° 13.96'S	35° 51.68'W	30-May-2018	20-Jul-2021

SO284 Mooring Deployments					
Mooring	**ID**	**Latitude**	**Longitude**	**Deployment Date**	**Recovery Date**
CVOO	KPO_1242	17° 36.59'N	24° 14.95'W	07-Jul-2021	
23W 0N	KPO_1237	00° 00.60'N	23° 06.97'W	13-Jul-2021	
K1	KPO_1238	10° 15.98'S	35° 51.67'W	21-Jul-2021	
K2	KPO_1239	10° 22.90'S	35° 40.71'W	21-Jul-2021	
K3	KPO_1240	10° 36.55'S	35° 23.46'W	21-Jul-2021	
K4	KPO_1241	10° 56.36'S	34° 59.40'W	19-Jul-2021	
PIES-300m	KPO_1243	10° 13.60'S	35° 52.40'W	20-Jul-2021	
PIES-500m	KPO_1244	10° 14.00'S	35° 51.70'W	20-Jul-2021	

5.4.1 Instrument performance

(Marisa Roch, Rodrigue Anicet Imbol Koungue)

The mooring recovery during the R/V Sonne cruise SO284 was a great success and all the moorings were recovered as planned. Regarding the mooring instruments, the CVOO mooring (KPO-1216) was missing its upper part of the slack. This part of the mooring including two MicroCATs was torn off the mooring already shortly after the deployment in November 2019 and found in January 2020 northeast of Santo Antão. One pressure sensor of a MicroCAT seems to

have failed for some time period and later the calibration cast showed troubles with the pressure sensor as well. Besides, on one of the optodes a mussel was living on the sensor and lead to anomalous high oxygen values. The remaining instruments of the mooring gave full records.

The equatorial mooring (KPO-1210) gave almost full records except from a conductivity sensor from one MicroCAT and the oxygen sensor of the McLane moored profiler failed shortly after the deployment in 2019. Additionally, the battery of the McLane moored profiler was empty already in May 2021 few months before the mooring recovery. Also, the upward looking 150-kHz Quartermaster ADCP of the equatorial mooring showed strange velocity recordings. A first inspection of the instrument hint toward a faulty compass. This problem has to be further analyzed back at GEOMAR in Kiel.

All four Brazilian moorings (KPO-1211, KPO-1212, KPO-1213, KPO-1214) located at 11˚S gave full records for all instruments. A summarized description over the performance of all instrument types is given in the following. Details are shown in Table 5.7.

Mini-TD: 1 Mini-TD at the CVOO mooring (KPO-1216) with a temporal resolution of one hour and a depth of 40 m performed well and throughout the mooring. Also, the Mini-TD at KPO-1210 located at 211 m performed well and provided complete and clean records.

MicroCATs: Ten MicroCATs at the CVOO mooring (KPO-1216) performed well and provided complete and clean records with a temporal resolution of either 10 or 15 minutes. One MicroCAT at 70 m performed well in temperature and conductivity but the pressure sensor seems to be damaged for some time period. The upper two MicroCATs in the slack (-225 m and -210 m) were torn off the mooring. These two are the reason for the smaller percental coverage at CVOO. Four MicroCATs were recovered from the equatorial mooring KPO-1210 which all performed well and provided clean and complete records except from the conductivity sensor of the MicroCAT at 830 m. Here, the conductivity was measured much too low throughout the entire time period. Four MicroCATs from K1 (KPO-1211), six from K2 (KPO-1212), five from K3 (KPO-1213), and five from K4 (KPO-1214) were recovered and provided full and clean records. Even though for two MicroCATs the cellguard was either loose or missing completely, this does not seem to have an influence on the data record.

Oxygen sensors: One oxygen sensor (120 m) at the CVOO mooring performed well and provided clean records throughout the full time series. The second oxygen sensor around 40 m measured much higher values at the end of the record which might be due to a mussel which grew on the sensor. Two oxygen loggers at the equatorial mooring performed well and provided a clean and complete record.

Single point current measurements: All Aquadopps (three at CVOO, three at the equator, 23°W, one at K1, four at K2, six at K3, and six at K4) performed well and provided complete and clean records.

ADCPs: In general, all the ADCPs deployed during the previous cruises (M158 and M159) were recovered successfully and they provided complete and clean records. However, the 150-kHz Quartermaster from the equatorial mooring (23˚W) has likely a faulty compass that has to be checked further.

McLane Moored Profiler: The McLane moored profiler (equipped with a CTD, an ACM as well as an optode oxygen sensor), deployed in mooring KPO-1210, almost completely captured its whole measurement range between 880 m and 3320 m during the first 19 months of its deployment. Unfortunately, the optode oxygen sensor failed shortly after the deployment and no

oxygen data could be retrieved. When deployed in October 2019, the profiler was supposed to record data until August 2021. However, in May 2021 - about 1.5 months before its recovery during research cruise SO284 in July 2021 - the battery of the profiler ran out of power after a series of profiles that took longer than usual. In total, the MMP reached a data coverage of 90.7% for temperature, conductivity, pressure and current velocity measurements and is providing a pair of upcast and downcast profiles every 5 days.

Table 5.7. *Instrument performance by sensor type and mooring*

sensor type / mooring	T (%)	C (%)	P (%)	U,V (%)	O_2 (%)	other (%)
KPO_1216	99.5	84.6	98.7	100	87.2	-
KPO_1210	99.6	78.1	98.9	98.4	66.7	-
KPO_1211	100	100	100	99	-	-
KPO_1212	100	100	100	99.9	-	-
KPO_1213	100	100	100	100	-	-
KPO_1214	100	100	100	99.9	-	-
KPO_1203_pies300m	100	-	100	-		-
KPO_1204_pies500m	100	-	100	-		-
all moorings	**99.9**	**93.8**	**99.7**	**99.5**	**77**	-

5.4.2 Calibration of moored instruments

(Franz Philip Tuchen)

CTD/O_2 cast calibrations were performed for all Aquadopps, Mini-TDs, MicroCATs and O_2 loggers either as pre- or post-deployment calibrations (CTD casts 1, 2, 4, 5, 7, 16, 19, 26, 54, and 75) by attaching the instruments to the CTD frame. During each upcast, 5-6 calibration stops were done over the whole profile range (depths chosen at low gradient-regimes for the respective parameters). Each stop had a duration of at least 5 min in order to ensure equilibrium at the calibration points. Additionally, acoustic releaser tests were performed at CTD casts 2 (releasers deployed in KPO-1237 and KPO-1242), 11 (KPO-1238 and KPO1241), and 26 (KPO-1239 and KPO-1240). Onboard lab calibrations were conducted for all oxygen loggers in water-filled beakers of 0% and 100% O_2-saturated water at two different temperatures (~6°C and ~22°C) following the Aanderaa optode manual.

5.5 Mixing study in the tropical North Atlantic

(Mareike Körner, Peter Brandt, Christian Begler)

5.5.1 Glider

During SO284 one autonomous glider system (IFM14) manufactured by Teledyne Webb Research was deployed and recovered. The glider was equipped with a set of build-in sensors: a CTD, an Aanderaa optode to measure dissolved oxygen and a Wetlabs combined CHL-a fluorescence and turbidity sensor, and equipped with full lithium battery packs. Additionally, IFM14 carried a Rockland-Scientific-Microrider (MR-1000 S/N 057). A microrider is a microstructure profiler to infer the turbulent dissipation rate and diapycnal diffusivity. The microrider itself consists of two fast temperature sensors (T1=2092 & T2=1395) and two shear sensors (S1=2331 with a sensitivity of 0.0614 & S2=2332 with a sensitivity of 0.0626).

The glider was deployed at 09°16.132'N, 021°26.977'W on July 10 at 09:40 UTC using the work boat of R/V Sonne. The track of the glider is visible in Figure 5.1. At the beginning of the mission the glider was programmed to measure close to the seamounts. After one crossing over a seamount, we programmed it to circle several seamounts at the 1500m isobath line. Afterwards, the glider was programmed to follow the drift buoy in order to measure the upper ocean characteristics during a predicted near inertial wave event. We programmed the glider such that it stayed clear of the territory of Guinea-Bissau. The glider was recovered at 09°16.355'N, 019°25.432'W on August 08 at 09:07 UTC. The communication with the glider worked well during the whole deployment. Upon recovery we discovered that the microrider did not measure during the whole mission. It stopped working on July 27 at 21 UTC. The reason for the malfunction was a leakage at the bulkhead connector at the glider.

5.5.2 Drift buoy

Additionally, to the glider a drift buoy was deployed at 09°00.036'N, 021°34.296'W on July 07 at 17:27 UTC. The drift buoy was designed to measure the characteristics of the mixed layer as well as the upper ocean current velocities. For that it was equipped with two MicroCATs (10686 & 10688), two optodes (1467 & 1470), one SUNA (761) and a 600kHz ADCP (10067). The ADCP instrument was configured with 40 bins of 2 m and a blanking distance of 1 m. Furthermore, a GPS receiver was attached to the buoy and recorded the buoy position every 5 minutes. Additionally, an ARGOS position beacon and GPS receiver with automated Iridium-SBD transmission was installed, to track the path of the buoy during the whole drift.

The drift buoy was deployed with the idea that it would stay in the deployment region. However, the buoy started drifting unexpectedly fast towards the east. As it was foreseeable that it would enter the territory of Guinea-Bissau, we applied for authorization to recover the buoy. This was granted on July 30. We recovered the buoy at 09°10.526'N, 018°20.817'W on August 04 at 01:21 UTC. The entire track of the drift buoy is shown in Fig. 5.1.

The ADCP worked well during the whole deployment period. The measured velocities are visible in Figure 5.1. There were no problems with the MicroCAT measurements. The optodes measured during the whole deployment period. However, the lower optode shows a steep decline in oxygen concentration for 5 days. Afterwards, the oxygen levels jump back to reasonable values. The behavior was probably due to biofouling which fell off. The SUNA did not measure at all. The reason for the failure of the SUNA is not discovered yet.

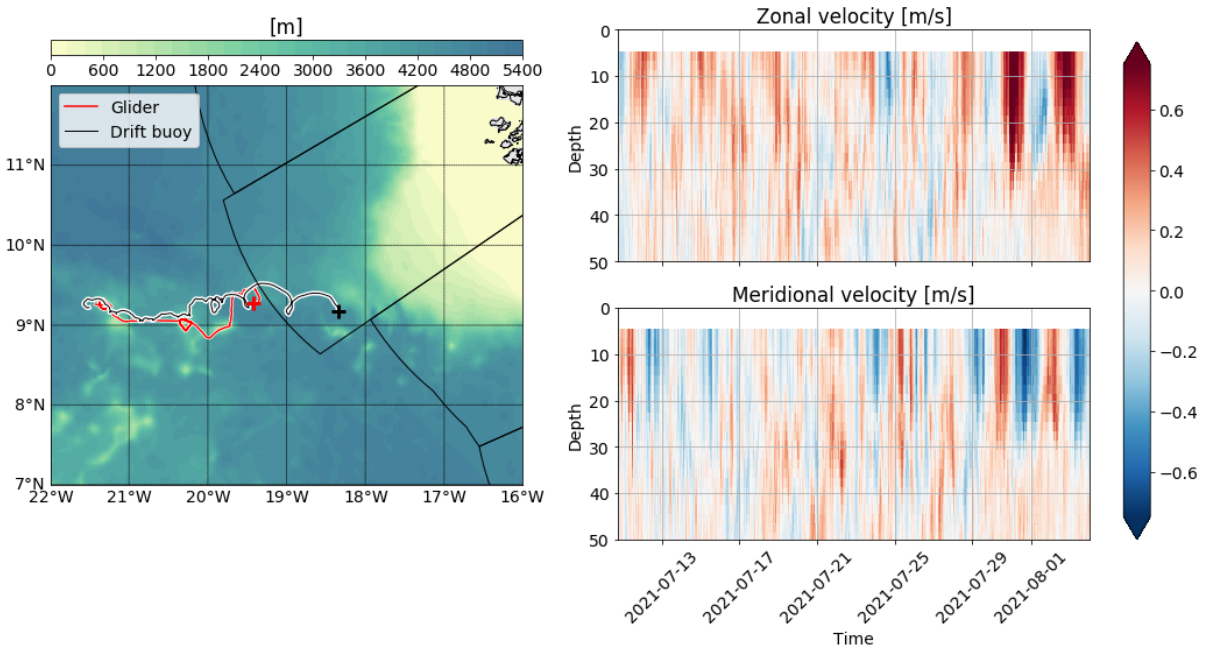

Fig. 5.1. (left) Bathymetric map of the eastern tropical North Atlantic with the glider track (red) and the buoy track (black). The thin solid black lines display the EEZs. (right) Measured velocity by the ADCP attached to the drift buoy.

5.6 Biogeochemical measurements

5.6.1 Underwater Vision Profiler

(Franz Philip Tuchen, Florian Schütte)

During all CTD casts, an Underwater Vision Profiler 5 HD (UVP5 HD; serial number 205) was operated on the CTD rosette. The instrument consists of one down-facing HD camera in a 6000 dbar pressure-proof case and two red LED lights which illuminate a 1.24 L-water volume. During the downcast, the UVP5 takes 20 pictures of the illuminated field per second. For each picture, the number and size of particles are counted and stored for later data analysis. Furthermore, images of particles with a size > 500 µm are saved as separate "Vignettes" - small cut-outs of the original picture – which allow for later, computer-assisted identification of these particles and their grouping into different particle, phyto- and zooplankton classes. Since the UVP5 was integrated in the CTD rosette, fine-scale vertical distribution of particles and major planktonic groups can be related to environmental data. In total 76 UVP5 profiles could be obtained. During the cruise we used the ImageJ software version 1.41o and Zooprocess software version 7.40 to download and process the UVP5 data. All data have been copied both to an external hard drive and to the scientist server of which another backup is saved. On two occasions, data could not be downloaded because no connection to the hard drives of the UVP5 was possible. However, a simple restart of the UVP-laptop solved the problem. Further, computer-assisted analysis of the approximately 478000 raw images taken with the UVP5 will be done in the home laboratory in order to reveal fine-scale distribution patterns of particles and zooplankton. The UVP5 worked well throughout the entire cruise during all 76 CTD profiles. During CTD profile #75 the lowering routine of the CTD rosette was repeated and led to the UVP recording one short profile (UVP profile #75) and one full-depth profile (UVP profile #76). At the end of the cruise the UVP5 was installed onto the R/V Sonne CTD system that will be used during the following cruise SO285. The last CTD station #76 (UVP

profile #77) of research cruise SO284 was carried out using the R/V Sonne CTD rosette attached with the UVP5 in order to test the CTD system for the next cruise. The test of the CTD sensors and the UVP5 was successful and without any complications.

5.6.2 Nutrient measurements

(Anna Christina Hans, Xaver Anselm Wittlinger)

A total of 372 samples were collected for nutrient analysis from CTD casts. The samples were filtered and then collected in 14 ml polyethylene sampling tubes and immediately frozen for later analysis using an autoanalyzer. The focus of the nutrient sampling was to calibrate a miniature UV spectrometer (type OPUS manufactured by TriOS) which was attached to the CTD during most casts. The spectrometer measures in situ the absorption of UV light by seawater. From comparison with the absorption of clear water and water with a known concentration of nitrate, the nitrate concentration in the seawater sample can be derived. The calibration will be finalized once the frozen nutrient samples have been analyzed. Apart of the calibration, at two CTD stations (Profile 5 and 75) nutrients were sampled on higher depth intervals, to define the nutricline at the deployment/recovery site of the drifting buoy (see 5.5 Glider and Drift Buoy).

There were 57 more nutrient samples collected at CTD 3 at the CVOO mooring site. The sampling followed the procedure stated above, without filtering. For the sampled depths, see Table 6.5. All samples will be brought back to Kiel in the same cooling box to ensure comparability of possible occurring warming during the transport.

5.6.3 Biogeochemistry of nitrous oxide (N_2O) and methane (CH_4)

(Inga Brockmann, Xaver Anselm Wittlinger)

During SO284 we aimed to assess the air-sea fluxes and dynamics of selected greenhouse gases in the mixed layer of the tropical Atlantic as well as their water column distribution. In combination with other oceanographic measurements, we want to investigate the impact of physical processes on trace gas distribution. To this end we carried out extensive sampling both from surface waters (CH_4 once to twice a day, N_2O up to 4 times a day) and the water column (13 stations surface mixed layer to bottom and later surface mixed layer to 500 meters) to measure the concentrations of dissolved N_2O and CH_4. The samples were poisoned with mercury chloride directly after sampling. The measurements of the gases will take place at the Chemical Oceanography Department of GEOMAR in Kiel.

5.6.4 Underway biochemical measurements

(Xaver Anselm Wittlinger, Damian L. Arévalo-Martínez)

Underway measurements of the climate-relevant trace gases carbon dioxide (CO_2) and methane (CH_4) were conducted continuously in surface waters (~ 4.4 m depth) by means of a prototype Ferrybox-like system developed in Kiel (B_2-Sensors). Briefly, surface seawater was drawn on board using the vessel's clean water supply system and then conducted through two 100 L cooling boxes adapted to function as flow-through boxes that dampen strong temperature changes. The first box contained the trace gas system which is based on the combination of a permeable membrane unit and two spectroscopic sensors for detecting CO_2 and CH_4 at high resolution.

Ancillary measurements of sea surface temperature, salinity, pressure, dissolved oxygen, total gas tension were conducted by means of submersible sensors submerged in the second box. In order to cross-check the CO_2 measurements, a HydroC CO_2 sensor (Konsberg Maritime) was installed in a third, 50 L coolbox which was connected to the same water supply. Comparison samples for CH_4 were collected as described in section 5.6.3.

5.7 Hydrosweep, topography

(Peter Brandt)

During SO284, the shipboard multibeam echo sounder EM-122 recorded ocean depth continuously without failing. The EM-122 had to be switched off in the EEZ of Brazil as no allowance for such measurements were asked for in the diplomatic application.

5.8 Meteorological measurements

5.8.1 Weather during SO284

(Henning Franke)

After leaving the port of Emden on June 27, SO284 encountered no significant weather events during the first week of transit towards the measurement area. In the early morning of July 04, SO284 entered the Northern hemispheric (NH) trade wind zone northwest of the Canary Islands at around 30°N, 19°W. While heading towards Cape Verde throughout the next days, SO284 experienced fresh and steady northeasterly trade winds. Additionally, the NH trades were characterized by a strong boundary layer inversion, which resulted in a pronounced marine stratocumulus layer. The days from the July 06 to 09 were further characterized by some Saharan dust in the lower and middle troposphere. In the late evening of July 09, slightly south of Cape Verde at around 10°N, 21°W, SO284 left the NH trades and entered the ITCZ. Consequently, on July 10 and the morning of July 11, SO284 experienced multiple strong rain showers. SO284 left the ITCZ during July 11 at around 4°N, 22°W.

After crossing the equator on July 13, SO284 got into the influence of the southern hemispheric (SH) trades. Consequently, the following two weeks, which included the mooring work off the coast of Brazil as well as the 5°S section, were characterized by moderate to fresh southeasterly winds and overall fair-weather conditions. However, the stratification within the SH trades was more unstable than the one within the crossed portion of the NH trades; causing the frequent formation of short rain showers, especially close to the coast of Brazil.

At the end of the 35°W section, SO284 reentered the ITCZ from its southern edge in the evening of July 30 at approximately 5°N, 35°W. SO284 then took an east-northeasterly course towards 9°N, 19°W, staying within the ITCZ for the next four days until the evening of 03 August. During that time, SO284 experienced frequent but mostly weak deep convective rain showers, especially during August 01 and August 02. On those days, SO284 was influenced by a tropical depression, which also caused fresh to strong southwesterly winds with gusts up to 7 Bft.

On August 04 and 05, SO284 performed one last meridional crossing of the ITCZ from South to North, starting within the Southern edge of the ITCZ at around 9°N, 19°W and ending northeast of Cape Verde at around 17°N, 22°W. During this crossing of the ITCZ, the convective activity was weak and no rain showers were observed.

After leaving the ITCZ, SO284 entered the NH trades again during its course back home towards Emden. The weather within the trades was characterized by gentle to fresh northeasterlies and overall cloudy conditions due to more or less intense shallow cumuli. SO284 left the NH trades in the morning of August 09 between the Canary Islands and the Azores at approximately 31°N, 21°W. While heading towards Emden during the remaining days, the weather has been overall fair and SO284 did not encountered any significant weather event.

5.8.2 Radiosondes

(Julia Windmiller, Magda Katharina Stolla)

During SO284 a total of 156 radiosondes were launched from the working deck. The radio sounding system in use consisted of Vaisala radiosondes of type RS41-SGP, Helium-filled balloons with parachutes (Totex TA200-No.088), a launching station and a data-acquisition system (Vaisala Sounding Processing Subsystem SPS311G). The Vaisala RS41-SGP is a standard meteorological radiosonde and includes sensors for temperature, humidity and pressure as well as a GPS receiver and telemetry transmitter. The parachutes reduce the speed of the falling sondes, increasing the amount of data received during the descent. The MW41 sounding system was used for processing, archiving and relaying of the received data. A list of all radiosonde launches, including the start time, start location and their maximum height can be found in Table 6.7.

The first radiosonde was launched on June 29 to test the sounding system. The sonde reached a height of almost 25km and ascent and descent were measured though with a few data gaps due to low signal strength. While overall the data quality from the radiosondes was high, there were some difficulties with the signal strength, in particular in the beginning of the cruise due to a faulty antenna. Initially, our measurement program was set up in such a way that the sounding was terminated once the connection to the sonde was lost too long to correctly calculate the wind properties. This led to a few radiosondes which were only measured up to heights of 15km or less. To receive at least the temperature, pressure and humidity measurements, the setup was changed to continue collecting the data even when wind-data could no longer be deduced. This led to a couple of soundings in degraded mode, as indicated in Table 6.7, before the data quality could be significantly improved by the construction of a second antenna. Overall, the average height reached by the radiosondes was 22km. Launching frequencies varied between one launch every 12 hours (south of the equator) to one launch every two hours (within the ITCZ).

Preliminary, high-resolution radiosonde data of both ascend and descend has been send in near real time via the OceanOPS program and the DWD to the Global Telecommunication System (GTS) in order to facilitate its assimilation in operational numerical weather prediction by meteorological service centers worldwide.

5.8.3 Oceanet-atmosphere container

(Ronny Engelmann, Annett Skupin)

Objectives

Measurements of the atmospheric state above the ocean are rare when compared to land-based stations, and are of great interest for atmospheric research. The mobile facility OCEANET-Atmosphere is an ongoing observational initiative of TROPOS for aerosol and cloud profiling as well as radiation budget measurements in maritime environments onboard research vessels since

2007 (Kanitz et al., 2013, Bohlmann et al., 2018). One of the key focusses for TROPOS lies on heterogeneous ice formation processes in different areas of the world (e.g., Kanitz et al, 2011) and their radiative impact. Especially the influence of Saharan dust particles on cloud-evolution are of interest during this cruise.

An additional focus is on ESA's Aeolus wind mission. OCEANET data will also support the CAL/VAL activities of this lidar satellite within the EVAA project and within ESA's "Tropical campaign 2021". Aeolus is a polar-orbiting satellite. By minor adjustments of the cruise track measurements during 6 co-located overpasses in the close vicinity of R/V Sonne could be performed.

Work at sea

The OCEANET container of TROPOS was installed on Deck 9. Power and LAN were connected and setup of the instruments on the container's roof was already performed in Emden. Also, the calibration of HATPRO with liquid nitrogen (LN2) was performed before departure. It was found by precise temperature measurements that the LN2 on board was not very pure. The measured boiling temperature was 79.15 K instead of 77.14 K for pure LN2. The maximum of the adjustable calibration value in the HATPRO software was 78.8K, however, so that a calibration offset of 0.3 K should be assumed during further data analysis.

Since leaving the EEZ of Spain on July 5 continuous measurements with

- the multi-wavelength Raman depolarization lidar Polly-XT (Engelmann et al., 2016),
- the microwave radiometer HATPRO,
- the vertically stabilized wind lidar Litra,
- the disdrometer Parsivel²,
- a total-sky imager,
- a pyranometer and a pyrgeometer,
- and a basic DWD weather station (T, p, relative humidity) were performed.

During the cruise, all instruments had to be monitored for operation and several maintenance and calibration tasks were performed. Additionally, for the duration of high solar elevation the Raman lidar had to be shut off to avoid direct sunlight hitting the telescope mirror. Water-vapor Raman lidar measurements were also performed during daytime. For these daytime measurements a neutral-density filter was placed manually in front of the 407-nm channel of the lidar on a daily basis.

In contrast to earlier cruises, a stabilized wind lidar (Litra) was deployed 2 m behind the OCEANET container on Deck 9 for the first time at sea. A major objective on board was to implement the correction of the ship's heave for the measured vertical velocities. The exact location of Litra was determined to be [6.979 m (fwd.), 6.899 m (stb.), 19.777m (hgt)] with respect to the ship's IMU (inertial measurement unit, Seapath). Unfortunately, the ships time server was not forwarded to the lidar's PC until July 18 which resulted in a time drift of 8 to 11 seconds with respect to the IMU. Thereafter an imprecise time server (192.168.40.14, +/- 2 sec offset) was used until August 06. Only thereafter this issue was identified and the time server was again switched to a GPS Trimble (192.168.40.120).

In addition to the technical setup and maintenance of the OCEANET instrumentation an automatic profile retrieval algorithm for Polly-XT (Picasso) was operated to observe online data and aerosol profiles. This automatic dataset will be reanalyzed later according to PollyNET standards (Baars et al., 2016).

Also, the original total-sky imager failed during the cruise. As a newer version of such a camera was already available in the container, this modern version (Vivotek camera) was finally installed and operated continuously. Full-sky images are taken every 15 s with a fisheye lens and at the end of each day mp4 movies were generated.

Preliminary results

During SO284 the Saharan air layer west of North-Africa was crossed twice. As an example, Figure 5.2 shows the 1064-nm range-corrected lidar signal during the second crossing on the way back from Cape Verde to Emden. From August 05 to 08 Saharan dust could be observed with the Raman lidar between 1 and 6.5 km height.

After leaving the dust region, several faint aerosol layers between 1 and 4 km height were observed as well. According to the prevailing forest fire situation in the northern hemisphere at the time, these layers most likely originated from Californian wildfire smoke a few days earlier. Further in-depth analysis of the optical properties of these layers are required after the cruise.

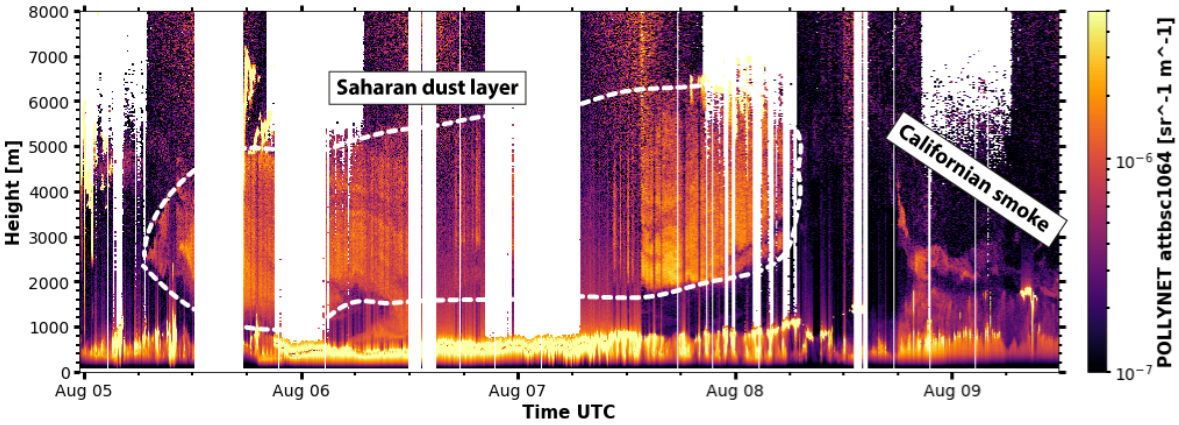

Fig. 5.2. Attenuated backscatter coefficient at 1064 nm from August 05 to 09. From time to time, the signal attenuation from low liquid-water clouds covered the view to the lofted aerosol layers.

The lidar Polly-XT is also equipped with a Raman channel for the detection of water vapor. In combination with the temperature profiles from the regular radiosoundings it was possible to derive profiles of relative humidity on a few-minutes resolution with the assumption that the variability of the absolute water vapor drives the relative humidity while the temperature at greater altitudes changes much slower (Guangyao et al., 2018). Such profiles as shown in Figure 5.3 for early July 29 are a good additional source for in-depth analysis of cloud development within the ITCZ.

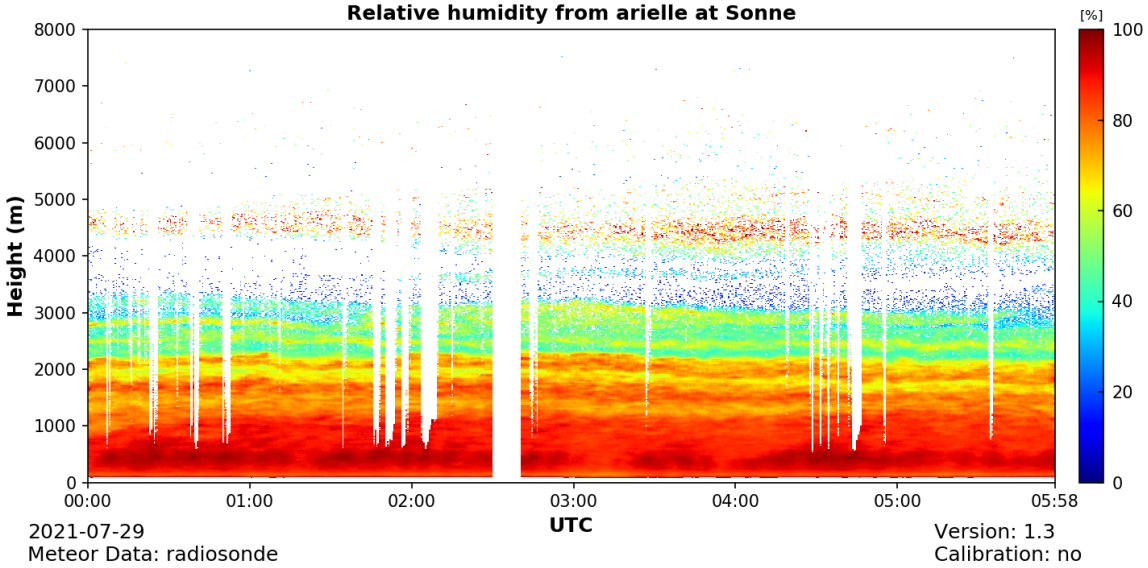

Fig. 5.3. Time-height cross section of the relative humidity on July 29, derived from Polly-XT with the assumption of a constant temperature profile from the radiosonde.

Additional to the lidar, the OCEANET platform also operated a microwave radiometer HATPRO to derive integrated water vapor and liquid-water path above R/V Sonne with a resolution of 1 sec. These data will be used for further studies of the cloud evolution during the cruise.

Data management

The raw data from the OCEANET platform are stored in the remote-sensing data server at Leipzig. The Polly-XT lidar data and quicklooks will be processed and made available through PollyNET (http://polly.tropos.de). After final processing the other individual datasets will be published within PANGAEA.

5.8.4 Onboard meteorological measurements

(Julia Windmiller, Thomas Ruhtz)

The standard meteorological measurements on board ran continuously and measured wind speed and direction, surface pressure, humidity, air temperature and water temperature. With the exception of water temperature, all other variables were additionally measured by two small weather stations, one attached to the wind lidar and the other to the OCEANET container, which form part of the respective data sets. These measurements are complemented by the routinely collected longwave and shortwave radiation measurements, which are also available from the OCEANET pyranometer and pyrgeometer measurements.

5.8.5 Wind lidar measurements

(Hugo Rubio)

Measurements of the 3D wind vector were provided by means of the Fraunhofer IWES Ship Lidar System, which comprises the following main components:

- a vertical profiling Doppler lidar device of the type Windcube WLS7 v2, developed by the manufacturer Leosphere. This instrument is the primary measurement sensor and provides

real-time and statistical (10-min averaged) wind data at 12 height levels between 60 m and 270 m above the sea level (ASL),

- a combination of an xSEns MTi-G attitude and reference sensor and a Trimble SPS361 satellite compass. These sensors retrieve high-resolution motion information, used to take the ship movement effects out of lidar measurements,
- a weather station from the manufacturer Vaisala to record atmospheric data including, air temperature, humidity, pressure, and precipitation.

The lidar device has a sampling resolution of 0.7 s per line-of-sight (LoS) measurement, retrieving the radial component of the wind speed at four azimuth directions along a cone with a half-opening angle of 28°, followed by a fifth vertical beam. The 3-dimensional wind vector is calculated after each LoS measurement using a Doppler beam swinging (DBS) technique.

The measuring system was installed on Deck 10, with an average elevation above the sea level of approximately 20 m. The complete system is fixed to the ship structure using strap ties to prevent any possible displacement. Furthermore, to avoid any possible disturbance of the laser beams caused by the vessel's structures, the lidar north is positioned with an offset of 48° (measured clockwise) with regards to the ship's bow.

After leaving the EEZ zone of Spain on the 5th of July, the system was turned on and started measuring continuously. However, a malfunction of the GPS antennas from the Trimble compass was detected, causing data gaps in the retrieval of the ship heading (yaw) signal in the first days of the campaign. On the 7th of July, GPS antennas were relocated to impede any interference from the ship´s radar, and the problem was solved. After this, the lidar system worked without further issues until the 13th of August, when we entered the EEZ of France and switched off the system. The data availability has been calculated between the 7th of July and the 13th of August, indicating the percentage of valid raw observations according to the carrier-to-noise ratio (CNR). A CNR threshold value of -22 dB has been considered, excluding LoS measurement with CNR below this limit and resulting in a total lidar raw availability of 99.9% and 98.5% at 100 m and 220 m height ASL, respectively.

5.8.6 Pandora measurements

(Thomas Ruhtz)

The Pandora-2s system combines the MaxDOAS measurement technique with Sun photometry. A number of trace gases such as NO_2, O_3, H_2O and SO_2 can be measured by this type of instrument. In addition, aerosol measurements such as Aerosol Optical Depth (AOD) and Angstrom coefficient are possible with the sun-photometer mode. More than 100 instruments around the world are part of the Pandonia Network initiated by ESA and NASA. The mobile version is still under development. A predefined schedule of measurements can be flexibly configured by the user. During the SO284 cruise a modified standard automatic mode for Day & Night (Sun and Moon) was tested to perform Almukantar and principle plane measurements. The information of the ship's IMU Seapath was used to perform the attitude control and later combined with regular fast sun searches. A delay and offset of the NTP time server relative to the Navigation system did disturb the regulation and correct attitude control. A correct time and fast on time navigation information is mandatory for a correct calculation of the sun and ship position and direction relative to the measurement direction. On future cruises this should be taken into account and

improved. The navigation and attitude data were collected during the cruise and will be used for post processing and correction of the measurements.

During the cruise of SO284 the Pandora-2s MaxDOAS measurements were taken at the following days:

June 17 – 30	SO284 Harbor system tests in Emden
June 27 – July 05	SO284 System tests and attitude control tests
July 05 – July 29	SO284 SO284_sun_moon_sky_hsmAOAU (continuous mode)
July 29 – August 09	SO284 SO284_sun_moon_sky_hsmAOAUFQ (continuous mode with additional sun searches)

5.8.7 Microtops

(Thomas Ruhtz, Jonas Lehmke)

Atmospheric aerosol was sampled with a MICROTOPS (NASA) instruments. Sun-photometer samples provide data on atmospheric aerosol and water vapor. For aerosol loads the atmospheric attenuation (only at cloud-free views into the sun) is recorded at solar spectral regions without trace-gas absorption. The exponential decay coefficient (vertically normalized) is called the aerosol optical thickness (AOT) or depth (AOD). With AOD data simultaneously sampled at different solar wavelengths, an estimate on the typical aerosol size can be extracted via the Angstrom parameter (defined by the negative slope in ln[wavelength]/ln[AOD] space). Values larger than 1.0 indicate a dominance of smaller (submicron) particles (e.g. fossil fuel burning, wildfires). Values smaller than 0.5 indicate a dominance of larger (supermicron) particles (e.g. sea-salt [spray], transported mineral dust). Microtops measurements were taken mostly during cloud free conditions in the following periode: July 05 – August 09.

5.8.8 Ceilometer CHM-15k

(Julia Windmiller, Thomas Ruhtz)

Underway measurements of cloud base height were continuously done by the CHM 15k ceilometer by G. Lufft Mess- und Regeltechnik GmbH. The instrument is based on a Nd:YAG solid state laser at a wavelength of 1064 nm and has a measuring range of up to 15 km. The measurements were taken at a temporal resolution of 10s and a range resolution of 15m. The ceilometer was placed on deck 9 with clear view to the sky and worked well and continuously throughout SO284 within the EEZs of Brazil and Cape Verde and outside of the EEZs of other countries (July 05 – August 09). When used in combination with a sun photometer it is also possible to derive aerosol extinction profiles from this data set, providing complementary information for the installed MaxDOAS device.

6 Station Lists and Tables SO284

6.1 Station list

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
SONNE (SO284)	GEOMAR	2019		[UTC]	[°]	[°]	[m]	
1	BLN 1	29.06.	Radio Sonde	14:09	48°39.18'N	006°35.57'W		
2	CTD 1	01.07.	CTD	20:31-22:00	39°00.03'N	014°01.94'W	4345	**CTD** station (1000 m) test, optode calibration
3	CTD 2	05.07.	CTD	09:25-12:41	25°05.92'N	021°25.36'W	4573	**CTD** station (3500 m) MC calibration and releases
4	BLN 2	05.07.	Radio Sonde	16:48	24°18.50'N	021°43.71'W		
5	DRIFT 1	05.07.	Surface Drifter	18:54	23°53.73'N	021°53.75'W		
6	BLN 3	05.07.	Radio Sonde	22:40	23°07.45'N	021°58.98'W		
7	BLN 4	06.07.	Radio Sonde	06:29	21°27.87'N	022°10.39'W		**Aeolus Overpass**
8	BLN 5	06.07.	Radio Sonde	10:42	20°47.97'N	022°43.79'W		
9	BLN 6	06.07.	Radio Sonde	13:44	20°26.75'N	023°08.26'W		
10	BLN 7	06.07.	Radio Sonde	16:42	20°09.18 'N	023°19.00 'W		
11	BLN 8	06.07.	Radio Sonde	19:42	19°33.43'N	023°32.31'W		
12	BLN 9	06.07.	Radio Sonde	22:45	18°57.86'N	023°45.65'W		
13	BLN 10	07.07.	Radio Sonde	01:39	18°23.00'N	023°58.61'W		
14	BLN 11	07.07.	Radio Sonde	04:45	17°45.87'N	024°12.35'W		
15	KPO 1216 (CVOO)	07.07.	Mooring	07:20-11:38	17°36.40'N	024°14.98'W	3600	**Mooring** recovery
16	BLN 12	07.07.	Radio Sonde	07:50	17°36.01'N	024°15.43'W		
17	CTD 3	07.07.	CTD	11:39-14:11	17°36.30'N	024°15.06'W	3600	**CTD** station (20 m above bottom)
18	BLN 13	07.07.	Radio Sonde	14:15	17°36.18'N	024°15.50'W		
19	KPO 1242 (CVOO)	07.07.	Mooring	14:27-20:56	17°36.40'N	024°14.98'W	3600	**Mooring** deployment, including drift test
20	BLN 14	07.07.	Radio Sonde	19:41	17°35.49'N	024°16.30'W		
21	BLN 15	08.07.	Radio Sonde	04:48	17°00.35'N	024°45.94'W		
22	BLN 16	08.07.	Radio Sonde	13:44	16°00.21'N	023°21.21'W		
23	BLN 17	08.07.	Radio Sonde	22:47	14°22.39'N	022°43.54'W		
24	BLN 18	09.07.	Radio Sonde	01:46	13°46.29'N	022°33.60'W		
25	BLN 19	09.07.	Radio Sonde	04:45	13°10.86'N	022°23.69'W		
26	BLN 20	09.07.	Radio Sonde	07:43	12°35.66'N	022°14.09'W		
27	BLN 21	09.07.	Radio Sonde	10:50	11°57.50'N	022°03.71'W		
28	CTD 4	09.07.	CTD	11:30-12:50	11°51.62'N	022°01.87'W	3600	**CTD** station (1000 m) SUNA, Optodes, miniTD, MC calibration

29	BLN 22	09.07.	Radio Sonde	13:39	11°43.08'N	021°59.84'W		
30	BLN 23	09.07.	Radio Sonde	16:48	11°05.01'N	021°47.03'W		
31	DRIFT 2	05.07.	Surface Drifter	17:17	10°59.86'N	021°45.57'W		
32	BLN 24	09.07.	Radio Sonde	19:47	10°29.59'N	021°37.06'W		
33	DRIFT 3	09.07.	Surface Drifter	22:13	09°59.88'N	021°28.71'W		
34	BLN 25	09.07.	Radio Sonde	22:53	09°52.32'N	021°25.69'W		
35	BLN 26	10.07.	Radio Sonde	01:44	09°16.18'N	021°20.42'W		
36	CTD 5	10.07.	CTD	04:52-08:14	09°16.13'N	021°33.72'W	4360	**CTD** station (1000 m) SUNA, Optodes, miniTD, MC calibration
37	BLN 27	10.07.	Radio Sonde	04:57	09°16.13'N	021°33.73'W		
38	BLN 28	10.07.	Radio Sonde	07:49	09°16.12'N	021°33.73'W		
39	IFM14	10.07.	Glider	09:09-14:57	09°16.14'N	021°27.04'W		**Glider** deployment with work boat
40	BLN 29	10.07.	Radio Sonde	10:45	09°16.63'N	021°26.79'W		
41	BLN 30	10.07.	Radio Sonde	13:44	09°15.87'N	021°16.92'W		
42	DRIFT 4	10.07.	Drift buoy	15:52-16:10	09°13.35'N	021°30.50'W		**Drift buoy** deployed
43	BLN 31	10.07.	Radio Sonde	16:43	09°08.65'N	021°32.04'W		
44	DRIFT 5	10.07.	Surface Drifter	17:27	09°00.03'N	021°34.30'W		
45	BLN 32	10.07.	Radio Sonde	19:41	08°33.94'N	021°41.78'W		
46	DRIFT 6	10.07.	Surface Drifter	22:38	08°00.35'N	021°51.42'W		
47	BLN 33	10.07.	Radio Sonde	22:51	07°57.94'N	021°52.11'W		
48	BLN 34	11.07.	Radio Sonde	00:45	07°36.18'N	021°58.34'W		
49	BLN 35	11.07.	Radio Sonde	02:47	07°12.08'N	022°05.24'W		
50	DRIFT 7	11.07.	Surface Drifter	03:46	07°00.41'N	022°08.57'W		
51	BLN 36	11.07.	Radio Sonde	04:44	06°49.20'N	022°11.77'W		
52	BLN 37	11.07.	Radio Sonde	06:44	06°25.83'N	022°18.44'W		
53	BLN 38	11.07.	Radio Sonde	08:39	06°04.92'N	022°24.42'W		
54	BLN 39	11.07.	Radio Sonde	10:41	05°43.66'N	022°30.48'W		
55	BLN 40	11.07.	Radio Sonde	12:41	05°23.35'N	022°36.27'W		
56	BLN 41	11.07.	Radio Sonde	14:38	05°03.87'N	022°41.82'W		
57	BLN 42	11.07.	Radio Sonde	16:37	04°44.05'N	022°47.47'W		
58	BLN 43	11.07.	Radio Sonde	18:44	04°22.61'N	022°53.56'W		
59	BLN 44	11.07.	Radio Sonde	20:43	04°01.92'N	022°59.45'W		
60	BLN 45	11.07.	Radio Sonde	22:42	04°03.32'N	022°58.70'W		
61	BLN 46	12.07.	Radio Sonde	00:44	03°57.11'N	022°55.75'W		

62	BLN 47	12.07.	Radio Sonde	02:46	03°38.99'N	022°41.10'W		
63	BLN 48	12.07.	Radio Sonde	06:12	03°07.58'N	022°22.39'W		**Aeolus Overpass**
64	BLN 49	12.07.	Radio Sonde	10:44	02°17.79'N	022°31.22'W		
65	BLN 50	12.07.	Radio Sonde	13:41	01°45.48'N	022°36.95'W		
66	BLN 51	12.07.	Radio Sonde	16:43	01°11.75'N	022°45.21'W		
67	BLN 52	12.07.	Radio Sonde	19:47	00°36.47'N	022°54.21'W		
68	BLN 53	12.07.	Radio Sonde	22:42	00°03.57'N	023°02.59'W		
69	CTD 6	12.07.	CTD	23:09-01:42	00°00.05'S	023°03.43'W	3902	**CTD** station (20m above bottom)
70	BLN 54	13.07.	Radio Sonde	04:42	00°00.06'S	023°03.43'W		
71	KPO 1210	13.07.	Mooring	07:00-12:32	00°00.00'N	023°06.80'W	3930	**Mooring** recovery
72	BLN 55	13.07.	Radio Sonde	10:49	00°01.04'S	023°05.53'W		
73	KPO 1237	13.07.	Mooring	13:00-19:35	00°00.00'N	023°06.80'W	3930	**Mooring** deployment, including drift test, monitor submerge
74	BLN 56	13.07.	Radio Sonde	16:45	00°01.75'S	023°03.24'W		
75	FLOAT	13.07.	Argo float	19:50	00°00.16'N	023°05.92'W		**Argo float with UVP**
76	DRIFT 8	13.07.	Surface Drifter	19:56	00°00.12'N	023°06.27'W		
77	BLN 57	13.07.	Radio Sonde	22:43	00°26.56'S	023°27.26'W		
78	BLN 58	14.07.	Radio Sonde	10:44	02°26.41'S	024°59.31'W		
79	BLN 59	14.07.	Radio Sonde	22:47	04°26.22'S	026°31.41'W		
80	BLN 60	15.07.	Radio Sonde	10:41	06°22.28'S	028°00.87'W		
81	BLN 61	15.07.	Radio Sonde	22:46	08°17.58'S	029°30.07'W		
82	BLN 62	16.07.	Radio Sonde	10:43	10°13.20'S	030°59.98'W		
83	CTD 7	16.07.	CTD	18:50-22:35	11°30.00'S	032°00.00'W	5030	**CTD** station (20m above bottom) MC, AQD calibration
84	BLN 63	16.07.	Radio Sonde	22:42	11°30.00'S	032°00.00'W		
85	CTD 8	17.07.	CTD	01:04-04:09	11°30.00'S	032°27.00'W	4703	**CTD** station (20m above bottom)
86	CTD 9	17.07.	CTD	06:28-08:40	11°30.00'S	032°53.00'W	3505	**CTD** station (20m above bottom)
87	CTD 10	17.07.	CTD	10:30-13:13	11°30.00'S	033°13.00'W	4283	**CTD** station (20m above bottom)
88	BLN 64	17.07.	Radio Sonde	10:40	11°30.00'S	033°13.00'W		
89	CTD 11	17.07.	CTD	15:03-18:18	11°30.00'S	033°33.00'W	4953	**CTD** station (20m above bottom)
90	CTD 12	17.07.	CTD	20:05-22:57	11°30.00'S	033°53.00'W	4623	**CTD** station (20m above bottom)
91	BLN 65	17.07.	Radio Sonde	22:49	11°30.00'S	033°53.00'W		
92	CTD 13	18.07.	CTD	00:49-03:42	11°30.00'S	034°13.00'W	4581	**CTD** station (20m above bottom)
93	CTD 14	18.07.	CTD	05:30-08:29	11°18.80'S	034°28.20'W	4639	**CTD** station (20m above bottom)
94	CTD 15	18.07.	CTD	10:17-13:06	11°07.60'S	034°43.90'W	4255	**CTD** station (20m above bottom)

95	BLN 66	18.07.	Radio Sonde	10:47	11°07.60'S	034°43.90'W		
96	KPO 1214	18.07.	Mooring	14:58-18:49	10°56.40'N	034°59.60'W	4110	**Mooring** recovery
97	CTD 16	18.07.	CTD	18:49-21:56	10°56.40'N	034°59.60'W	4110	**CTD** station (20m above bottom)
98	BLN 67	18.07.	Radio Sonde	22:54	10°51.40'S	035°05.60'W		
99	CTD 17	18.07.	CTD	22:57-01:27	10°51.40'S	035°05.60'W	3968	**CTD** station (20m above bottom)
100	CTD 18	19.07.	CTD	02:21-04:56	10°46.40'S	035°11.60'W	3882	**CTD** station (20m above bottom)
101	KPO 1213	19.07.	Mooring	08:48-12:39	10°36.50'S	035°23.60'W	3520	**Mooring** recovery
102	BLN 68	19.07.	Radio Sonde	10:43	10°35.55'S	035°24.51'W		
103	KPO 1240	19.07.	Mooring	15:58-20:33	10°56.40'S	034°59.60'W	4110	**Mooring** deployment, including drift test
104	CTD 19	19.07.	CTD	22:41-00:37	10°41.40'S	035°17.60'W	3685	**CTD** station (20m above bottom)
105	BLN 69	19.07.	Radio Sonde	22:48	10°41.40'S	035°17.60'W		
106	CTD 20	20.07.	CTD	02:28-05:10	10°36.50'S	035°23.60'W	3520	**CTD** station (20m above bottom)
107	CTD 21	20.07.	CTD	06:11-08:35	10°32.00'S	035°29.30'W	3214	**CTD** station (20m above bottom)
108	KPO 1212	20.07.	Mooring	10:00-13:50	10°22.80'S	035°40.80'W	2290	**Mooring** recovery
109	BLN 70	20.07.	Radio Sonde	10:41	10°22.80'S	035°40.80'W		
110	KPO 1211	20.07.	Mooring	15:35-17:29	10°16.00'S	035°51.70'W	900	**Mooring** recovery
111	KPO 1204	20.07.	Mooring	18:00-19:01	10°13.965'S	035°51.68'W	517	**PIES** recovery
112	KPO 1203	20.07.	Mooring	19:01-19:42	10°13.625'S	035°51.40'W	320	**PIES** recovery
113	KPO 1243	20.07.	Mooring	19:54	10°13.60'S	035°52.40'W	309	**PIES** deployment
114	KPO 1244	20.07.	Mooring	20:14	10°14.00'S	035°51.70'W	506	**PIES** deployment
		20.07.	ADCP		10°14.20'S	035°54.20'W	70	**ADCP** section start
115	CTD 22	20.07.	CTD	21:04-21:37	10°14.60'S	035°53.60'W	228	**CTD** station (20m above bottom)
116	CTD 23	20.07.	CTD	21:57-22:43	10°15.30'S	035°52.60'W	520	**CTD** station (20m above bottom)
117	CTD 24	20.07.	CTD	23:02-00:11	10°16.00'S	035°51.70'W	895	**CTD** station (20m above bottom)
118	BLN 71	21.07.	Radio Sonde	00:53				
119	CTD 25	21.07.	CTD	01:00-02:31	10°19.50'S	035°46.10'W	1711	**CTD** station (20m above bottom)
120	CTD 26	21.07.	CTD	03:33-05:37	10°22.80'S	035°40.80'W	2284	**CTD** station (20m above bottom)
121	KPO 1238	21.07.	Mooring	08:32-09:38	10°16.00'S	035°51.70'W	900	**Mooring** deployment, including drift test
122	BLN 72	21.07.	Radio Sonde	10:41	10°19.45'S	035°43.51'W		
123	KPO 1239	21.07.	Mooring	11:01-13:15	10°22.80'S	035°40.80'W	2290	**Mooring** deployment
124	CTD 27	21.07.	CTD	14:25-16:19	10°27.40'S	035°34.90'W	2868	**CTD** station (20m above bottom)
125	KPO 1240	21.07.	Mooring	17:34-21:16	10°36.50'S	035°23.60'W	3520	**Mooring** deployment, including drift test
126	BLN 73	21.07.	Radio Sonde	22:44	10°24.21'S	035°13.04'W		
127	BLN 74	22.07.	Radio Sonde	07:30	09°04.26'S	034°14.58'W		**Aeolus Overpass**
128	BLN 75	22.07.	Radio Sonde	10:44	08°33.23'S	033°58.57'W		
129	BLN 76	22.07.	Radio Sonde	22:39	06°43.35'S	032°41.87'W		
130	CTD 28	23.07.	CTD	10:37-13:20	05°00.00'S	031°30.00'W	4699	**CTD** station (20m above bottom)

131	BLN 77	23.07.	Radio Sonde	10:44	05°00.00'S	031°30.00'W		
132	CTD 29	23.07.	CTD	16:09-19:07	05°07.00'S	032°00.00'W	4617	**CTD** station (20m above bottom)
133	CTD 30	23.07.	CTD	21:45-00:35	05°12.30'S	032°30.00'W	4606	**CTD** station (20m above bottom)
134	BLN 78	23.07.	Radio Sonde	22:42	05°12.30'S	032°30.00'W		
135	CTD 31	23.07.	CTD	03:19-06:11	05°17.70'S	033°00.00'W	4568	**CTD** station (20m above bottom)
136	CTD 32	24.07.	CTD	08:28-11:20	05°21.70'S	033°25.00'W	4489	**CTD** station (20m above bottom)
137	BLN 79	24.07.	Radio Sonde	10:44	05°21.70'S	033°25.00'W		
138	CTD 33	24.07.	CTD	13:38-13:56	05°26.60'S	033°50.00'W		**CTD** station (stopped because of failed oxygen sensors)
138	CTD 34	24.07.	CTD	14:31-17:20	05°26.60'S	033°50.00'W	4323	**CTD** station (20m above bottom)
139	CTD 35	24.07.	CTD	19:11-21:51	05°30.20'S	034°10.00'W	4125	**CTD** station (20m above bottom)
140	BLN 80	24.07.	Radio Sonde	22:37	05°31.68'S	034°18.25'W		
141	CTD 36	24.07.	CTD	23:12-02:07	05°32.70'S	034°24.00'W	3765	**CTD** station (20m above bottom)
142	CTD 37	25.07.	CTD	03:25-05:47	05°34.80'S	034°36.00'W	3371	**CTD** station (20m above bottom)
143	CTD 38	25.07.	CTD	06:50-08:37	05°36.60'S	034°46.00'W	2640	**CTD** station (20m above bottom)
144	CTD 39	25.07.	CTD	09:33-11:11	05°38.00'S	034°54.00'W	1525	**CTD** station (20m above bottom)
145	CTD 40	25.07.	CTD	11:47-13:03	05°38.30'S	034°56.00'W	688	**CTD** station (20m above bottom)
146	CTD 41	25.07.	CTD	13:33-14:25	05°38.40'S	034°57.40'W	350	**CTD** station (20m above bottom)
					05°38.70'S	034°58.80'W		**ADCP** section end
147	CTD 42	25.07.	CTD	17:30-18:04	05°02.00'S	035°01.0'W	376	**CTD** station (20m above bottom)
148	CTD 43	25.07.	CTD	19:04-19:46	04°55.00'S	034°55.00'W	800	**CTD** station (20m above bottom)
149	CTD 44	25.07.	CTD	20:32-21:23	04°48.00'S	034°53.00'W	1100	**CTD** station (20m above bottom)
150	CTD 45	25.07.	CTD	22:12-23:57	04°40.00'S	034°53.00'W	2800	**CTD** station (20m above bottom)
151	BLN 81	25.07.	Radio Sonde	22:46	04°40.00'S	034°53.00'W		
152	CTD 46	26.07.	CTD	01:21-03:34	04°25.00'S	034°53.00'W	3400	**CTD** station (20m above bottom)
153	CTD 47	26.07.	CTD	05:46-08:06	04°00.00'S	034°53.00'W	3600	**CTD** station (20m above bottom)
154	CTD 48	26.07.	CTD	09:55-12:28	03°40.00'S	034°53.00'W	3500	**CTD** station (20m above bottom)
155	BLN 82	26.07.	Radio Sonde	10:42	03°40.00'S	034°53.00'W		
156	CTD 49	26.07.	CTD	15:09-17:39	03°10.00'S	034°53.00'W	3800	**CTD** station (20m above bottom)
157	CTD 50	26.07.	CTD	20:00-22:44	02°45.00'S	034°57.00'W	3900	**CTD** station (20m above bottom)
158	BLN 83	26.07.	Radio Sonde	22:44	02°45.00'S	034°57.00'W		
159	CTD 51	27.07.	CTD	00:34-03:05	02°25.00'S	035°00.00'W	3900	**CTD** station (20m above bottom)
160	CTD 52	27.07.	CTD	04:59-07:31	02°05.00'S	035°00.00'W	4100	**CTD** station (20m above bottom)
161	CTD 53	27.07.	CTD	09:19-12:00	01°45.00'S	035°00.00'W	4100	**CTD** station (20m above bottom)
162	BLN 84	27.07.	Radio Sonde	10:42	01°45.00'S	035°00.00'W		

163	CTD 54	27.07.	CTD	13:35-16:56	01°28.00'S	035°00.00'W	4300	**CTD** station (20m above bottom) MC, AQD calibration
164	CTD 55	27.07.	CTD	18:01-20:46	01°18.00'S	035°00.00'W	4400	**CTD** station (20m above bottom)
165	BLN 85	27.07.	Radio Sonde	19:58	01°18.00'S	035°00.00'W		**Aeolus Overpass**
166	CTD 56	27.07.	CTD	22:25-01:13	01°00.00'S	035°00.00'W	4400	**CTD** station (20m above bottom)
167	CTD 57	28.07.	CTD	03:03-05:58	00°40.00'S	035°00.00'W	4500	**CTD** station (20m above bottom)
168	CTD 58	28.07.	CTD	07:46-10:34	00°20.00'S	035°00.00'W	4500	**CTD** station (20m above bottom)
169	BLN 86	28.07.	Radio Sonde	10:44	00°20.00'S	035°00.00'W		
170	CTD 59	28.07.	CTD	12:23-15:35	00°00.00'S	035°00.00'W	4500	**CTD** station (20m above bottom)
171	DRIFT 9	28.07.	Surface Drifter	15:44	00°00.40'N	034°59.90'W		
172	BLN 87	28.07.	Radio Sonde	16:43	00°12.46'N	035°00.00'W		
173	CTD 60	28.07.	CTD	17:34-20:27	00°20.00'N	035°00.00'W	4500	**CTD** station (20m above bottom)
174	CTD 61	28.07.	CTD	22:12-01:05	00°40.00'N	035°00.00'W	4500	**CTD** station (20m above bottom)
175	BLN 88	28.07.	Radio Sonde	22:40	00°40.00'N	035°00.00'W		
176	CTD 62	29.07.	CTD	02:56-05:17	01°00.00'N	035°00.00'W	3600	**CTD** station (20m above bottom)
177	BLN 89	29.07.	Radio Sonde	04:50	01°00.00'N	035°00.00'W		
178	CTD 63	29.07.	CTD	07:10-09:43	01°20.00'N	035°00.00'W	4000	**CTD** station (20m above bottom)
179	BLN 90	29.07.	Radio Sonde	10:48	01°32.06'N	035°00.00'W		
180	CTD 64	29.07.	CTD	11:34-14:07	01°40.00'N	035°00.00'W	4000	**CTD** station (20m above bottom)
181	CTD 65	29.07.	CTD	16:00-18:41	02°00.00'N	035°00.00'W	4200	**CTD** station (20m above bottom)
182	BLN 91	29.07.	Radio Sonde	16:48	02°00.00'N	035°00.00'W		
183	CTD 66	29.07.	CTD	20:26-23:05	02°20.00'N	035°00.00'W	3600	**CTD** station (20m above bottom)
184	BLN 92	29.07.	Radio Sonde	22:38	02°20.00'N	035°00.00'W		
185	CTD 67	30.07.	CTD	00:54-03:55	02°40.00'N	035°00.00'W	3600	**CTD** station (20m above bottom)
186	BLN 93	30.07.	Radio Sonde	04:42	02°47.74'N	035°00.00'W		
187	CTD 68	30.07.	CTD	05:48-08:14	03°00.00'N	035°00.00'W	3800	**CTD** station (20m above bottom)
188	CTD 69	30.07.	CTD	10:47-13:15	03°30.00'N	035°00.00'W	4000	**CTD** station (20m above bottom)
189	BLN 94	30.07.	Radio Sonde	10:52	03°30.00'N	035°00.00'W		
190	ADCP	30.07.	ADCP	15:44-17:26	04°00.00'N	035°00.00'W		**ADCP** test, compass test of moored instruments
191	BLN 95	30.07.	Radio Sonde	16:42	04°00.00'N	035°00.00'W		
192	CTD 70	30.07.	CTD	20:15-22:26	04°00.00'N	035°00.00'W	3500	**CTD** station (20m above bottom)
193	BLN 96	30.07.	Radio Sonde	22:40	04°01.60'N	035°00.00'W		
194	CTD 71	31.07.	CTD	01:13-03:41	04°30.00'N	035°00.00'W	3900	**CTD** station (20m above bottom)
195	BLN 97	31.07.	Radio Sonde	04:40	04°40.19'N	035°00.00'W		

196	CTD 72	31.07.	CTD	06:24-09:06	05°00.00'N	035°00.00'W	3700	**CTD** station (20m above bottom)
197	BLN 98	31.07.	Radio Sonde	11:04	05°23.79'N	035°00.00'W		
198	CTD 73	31.07.	CTD	11:44-14:24	05°30.00'N	035°00.00'W	3900	**CTD** station (20m above bottom)
199	BLN 99	31.07.	Radio Sonde	16:47	05°56.88'N	035°00.00'W		
200	CTD 74	31.07.	CTD	17:12-19:50	06°00.00'N	035°00.00'W	4200	**CTD** station (20m above bottom)
201	BLN 100	31.07.	Radio Sonde	20:41	06°02.24'N	034°49.74'W		
202	BLN 101	31.07.	Radio Sonde	22:39	06°07.21'N	034°24.66'W		
203	BLN 102	01.08.	Radio Sonde	00:44	06°13.43'N	033°58.52'W		
204	BLN 103	01.08.	Radio Sonde	02:40	06°18.72'N	033°34.32'W		
205	BLN 104	01.08.	Radio Sonde	04:43	06°24.40'N	033°08.36'W		
206	BLN 105	01.08.	Radio Sonde	06:45	06°30.05'N	032°42.63'W		
207	BLN 106	01.08.	Radio Sonde	08:49	06°36.06'N	032°15.25'W		
208	BLN 107	01.08.	Radio Sonde	10:46	06°41.76'N	031°49.28'W		
209	BLN 108	01.08.	Radio Sonde	12:45	06°47.56'N	031°22.85'W		
210	BLN 109	01.08.	Radio Sonde	14:42	06°53.30'N	030°56.67'W		
211	BLN 100	01.08.	Radio Sonde	16:47	06°59.56'N	030°28.14'W		**Aeolus Overpass**
212	BLN 111	01.08.	Radio Sonde	18:43	07°05.25'N	030°02.19'W		
213	BLN 112	01.08.	Radio Sonde	20:45	07°11.15'N	029°35.22'W		
214	BLN 113	01.08.	Radio Sonde	22:49	07°16.99'N	029°08.64'W		
215	BLN 114	02.08.	Radio Sonde	00:43	07°22.37'N	028°44.07'W		
216	BLN 115	02.08.	Radio Sonde	02:42	07°27.97'N	028°18.48'W		
217	BLN 116	02.08.	Radio Sonde	04:42	07°33.71'N	027°52.28'W		
218	BLN 117	02.08.	Radio Sonde	06:44	07°39.46'N	027°26.05'W		
219	BLN 118	02.08.	Radio Sonde	08:49	07°45.32'N	026°59.27'W		
220	BLN 119	02.08.	Radio Sonde	10:48	07°50.91'N	026°33.74'W		
221	BLN 120	02.08.	Radio Sonde	12:54	07°56.92'N	026°06.26'W		
222	BLN 121	02.08.	Radio Sonde	14:46	08°01.74'N	025°42.16'W		
223	BLN 122	02.08.	Radio Sonde	16:55	08°03.83'N	025°12.44'W		
224	BLN 123	02.08.	Radio Sonde	18:44	08°03.39'N	024°45.23'W		
225	BLN 124	02.08.	Radio Sonde	20:41	08°07.58'N	024°17.73'W		
226	BLN 125	02.08.	Radio Sonde	22:43	08°12.33'N	023°51.33'W		
227	BLN 126	03.08.	Radio Sonde	00:43	08°17.07'N	023°24.94'W		
228	BLN 127	03.08.	Radio Sonde	02:44	08°21.90'N	022°58.05'W		
229	BLN 128	03.08.	Radio Sonde	04:47	08°26.73'N	022°31.19'W		

230	BLN 129	03.08.	Radio Sonde	06:44	08°31.33'N	022°05.61'W		
231	BLN 130	03.08.	Radio Sonde	08:43	08°36.00'N	021°39.60'W		
232	BLN 131	03.08.	Radio Sonde	10:40	08°40.33'N	021°14.46'W		
233	BLN 132	03.08.	Radio Sonde	12:46	08°45.10'N	020°47.72'W		
234	BLN 133	03.08.	Radio Sonde	14:43	08°49.57'N	020°23.27'W		
235	BLN 134	03.08.	Radio Sonde	16:44	08°53.96'N	019°58.09'W		
236	BLN 135	03.08.	Radio Sonde	18:46	08°58.69'N	019°33.19'W		
237	BLN 136	03.08.	Radio Sonde	20:46	09°03.11'N	019°08.60'W		
238	BLN 137	03.08.	Radio Sonde	22:46	09°07.41'N	018°44.23'W		
239	DRIFT 10	04.08.	Drift buoy	00:17-01:21	09°10.52'N	018°20.82'W		**Drift buoy** recovered
240	BLN 138	04.08.	Radio Sonde	01:43	09°10.45'N	018°23.40'W		
241	BLN 139	04.08.	Radio Sonde	04:47	09°10.98'N	019°00.85'W		
242	BLN 140	04.08.	Radio Sonde	07:46	09°11.86'N	019°24.42'W		
243	IFM14	04.08.	Glider	08:01-09:07	09°16.35'N	019°25.43'W		**Glider** recovery with work boat
244	CTD 75	04.08.	CTD	10:14-12:02	09°16.35'N	019°25.43'W		**CTD** station (to 1500m depth) MC, Optode calibration
245	BLN 141	04.08.	Radio Sonde	13:44	09°25.51'N	019°28.45'W		
246	BLN 142	04.08.	Radio Sonde	16:49	10°01.15'N	019°43.54'W		
247	BLN 143	04.08.	Radio Sonde	20:01	10°37.08'N	019°58.68'W		
248	BLN 144	04.08.	Radio Sonde	22:44	11°08.06'N	020°11.32'W		
249	BLN 145	05.08.	Radio Sonde	01:45	11°41.97'N	020°24.78'W		
250	BLN 146	05.08.	Radio Sonde	04:42	12°15.19'N	020°38.68'W		
251	BLN 147	05.08.	Radio Sonde	07:44	12°48.16'N	020°52.31'W		
252	BLN 148	05.08.	Radio Sonde	10:47	13°21.06'N	021°05.85'W		
253	BLN 149	05.08.	Radio Sonde	16:44	14°29.63'N	021°28.70'W		
254	BLN 150	05.08.	Radio Sonde	19:23	15°02.25'N	021°33.27'W		**Aeolus Overpass**
255	BLN 151	05.08.	Radio Sonde	22:48	15°43.56'N	021°39.75'W		
256	BLN 152	06.08.	Radio Sonde	01:42	16°18.35'N	021°44.98'W		
257	BLN 153	06.08.	Radio Sonde	04:44	16°53.41'N	021°50.68'W		
258	BLN 154	06.08.	Radio Sonde	07:45	17°26.83'N	021°57.23'W		
259	BLN 155	06.08.	Radio Sonde	10:41	17°59.85'N	021°57.71'W		
260	BLN 156	06.08.	Radio Sonde	13:46	18°33.99'N	021°58.22'W		
261	CTD 76	06.08.	CTD	14:04-14:42	18°35.90'N	021°58.24'W		**CTD** station (to 500m depth) test of Sonne CTD/UVP

6.2 CTD station list

Station Number	Profile Number	Date	Time (UTC)	Latitude	Longitude	Bottom Depth (m)	Profile Depth (m)	Add. Sensors
SO284_2-1	1	01.07.21	20:36:34	39°00.060'N	14°03.235'W	4347	1005	OPLU
SO284_3-1	2	05.07.21	09:32:29	25°09.855'N	21°42.277'W	4576	3506	OPLU
SO284_17-1	3	07.07.21	11:53:02	17°60.503'N	24°25.112'W	3611	3586	OPLU
SO284_28-1	4	09.07.21	11:32:51	11°86.018'N	22°03.118'W	4983	1003	SPLU
SO284_36-1	5	10.07.21	04:54:24	9°26.883'N	21°56.220'W	4362	4323	OPLU
SO284_69-1	6	12.07.21	23:11:13	0°00.143'S	23°05.850'W	3938	3901	OPLU
SO284_83-1	7	16.07.21	18:52:52	11°50.000'S	32°00.020'W	5050	5015	OPLU
SO284_85-1	8	17.07.21	01:08:19	11°50.128'S	32°44.947'W	4804	4766	OPLU
SO284_86-1	9	17.07.21	06:28:22	11°49.952'S	32°88.318'W	3517	3513	OPLU
SO284_87-1	10	17.07.21	10:34:10	11°50.043'S	33°21.592'W	5705	4261	OPLU
SO284_89-1	11	17.07.21	15:07:35	11°49.820'S	33°54.872'W	4974	4925	OPLU
SO284_90-1	12	17.07.21	20:07:55	11°49.833'S	33°88.425'W	4640	4603	OPLU
SO284_92-1	13	18.07.21	00:51:51	11°50.102'S	34°21.607'W	4595	4561	OPLU
SO284_93-1	14	18.07.21	05:32:49	11°32.130'S	34°47.037'W	4656	4620	OPLU
SO284_94-1	15	18.07.21	10:21:39	11°12.718'S	34°73.302'W	4280	4234	OPLU
SO284_97-1	16	18.07.21	18:58:06	10°94.753'S	34°98.685'W	4125	4075	OPLU
SO284_99-1	17	18.07.21	22:57:54	10°85.770'S	35°09.338'W	3996	3947	OPLU
SO284_100-1	18	19.07.21	02:23:34	10°77.587'S	35°19.582'W	3886	3858	OPLU
SO284_104-1	19	19.07.21	22:45:54	10°69.112'S	35°29.352'W	3688	3659	OPLU
SO284_106-1	20	20.07.21	02:32:22	10°61.223'S	35°39.543'W	3527	3493	OPLU
SO284_107-1	21	20.07.21	06:31:28	10°53.338'S	35°48.707'W	4988	3192	OPLU
SO284_115-1	22	20.07.21	21:07:31	10°24.348'S	35°89.345'W	219	203	OPLU
SO284_116-1	23	20.07.21	22:10:57	10°25.502'S	35°87.608'W	523	507	OPLU
SO284_117-1	24	20.07.21	23:06:25	10°26.673'S	35°86.178'W	897	875	OPLU
SO284_119-1	25	21.07.21	01:16:26	10°32.487'S	35°76.797'W	1744	1705	OPLU
SO284_120-1	26	21.07.21	03:35:17	10°37.713'S	35°68.143'W	2321	2268	OPLU
SO284_124-1	27	21.07.21	14:27:00	10°45.317'S	35°58.088'W	4117	2847	OPLU
SO284_130-1	28	23.07.21	10:02:47	5°00.138'S	31°49.963'W	4716	4681	OPLU
SO284_132-1	29	23.07.21	16:13:25	5°10.983'S	32°00.088'W	4628	4589	OPLU
SO284_133-1	30	23.07.21	21:46:51	5°20.467'S	32°49.955'W	4617	4577	OPLU
SO284_135-1	31	24.07.21	03:21:02	5°29.008'S	32°99.883'W	4581	4543	OPLU
SO284_136-1	32	24.07.21	08:29:13	5°36.127'S	33°41.480'W	4501	4466	OPLU
SO284_138-1	33	24.07.21	13:39:33	5°44.225'S	33°83.392'W	4342	171	OPLU
SO284_138-1	34	24.07.21	14:31:42	5°44.227'S	33°83.395'W	4337	4308	OPLU
SO284_139-1	35	24.07.21	19:13:53	5°50.193'S	34°16.620'W	4131	4101	OPLU

SO284_141-1	36	24.07.21	23:15:51	5°54.323'S	34°40.090'W	3778	3746	OPLU
SO284_142-1	37	25.07.21	03:31:32	5°57.382'S	34°59.832'W	4929	3384	OPLU
SO284_143-1	38	25.07.21	06:52:14	5°60.833'S	34°76.678'W	5161	2661	OPLU
SO284_144-1	39	25.07.21	09:36:58	5°63.273'S	34°90.028'W	1447	1513	OPLU
SO284_145-1	40	25.07.21	12:25:13	5°63.835'S	34°93.333'W	738	682	OPLU
SO284_146-1	41	25.07.21	13:36:37	5°64.060'S	34°95.747'W	378	350	OPLU
SO284_147-1	42	25.07.21	17:35:31	5°03.682'S	35°02.442'W	383	364	OPLU
SO284_148-1	43	25.07.21	19:05:38	4°91.677'S	34°91.660'W	834	814	OPLU
SO284_149-1	44	25.07.21	20:34:27	4°79.943'S	34°88.398'W	1019	1007	OPLU
SO284_150-1	45	25.07.21	22:14:59	4°66.770'S	34°88.378'W	2525	2505	OPLU
SO284_152-1	46	26.07.21	01:24:24	4°41.682'S	34°88.687'W	3390	3402	OPLU
SO284_153-1	47	26.07.21	05:51:07	4°00.438'S	34°88.913'W	3574	3541	OPLU
SO284_154-1	48	26.07.21	10:08:47	3°66.617'S	34°88.302'W	3470	3438	OPLU
SO284_156-1	49	26.07.21	15:15:00	3°17.232'S	34°88.633'W	3830	3799	OPLU
SO284_157-1	50	26.07.21	20:02:43	2°74.878'S	34°95.265'W	3881	3849	OPLU
SO284_159-1	51	27.07.21	00:36:46	2°41.810'S	35°00.025'W	3931	3896	OPLU
SO284_160-1	52	27.07.21	05:01:23	2°08.778'S	35°00.422'W	4062	4026	OPLU
SO284_161-1	53	27.07.21	09:20:56	1°74.955'S	35°00.048'W	4124	4088	OPLU
SO284_163-1	54	27.07.21	13:36:30	1°46.677'S	35°00.110'W	4325	4289	OPLU
SO284_164-1	55	27.07.21	18:03:28	1°30.368'S	35°00.088'W	4373	4339	OPLU
SO284_166-1	56	27.07.21	22:28:09	1°00.122'S	35°00.048'W	4415	4384	OPLU
SO284_167-1	57	28.07.21	03:09:02	0°66.868'S	35°00.310'W	4481	4442	OPLU
SO284_168-1	58	28.07.21	07:47:15	0°33.302'S	34°99.852'W	4533	4493	OPLU
SO284_170-1	59	28.07.21	12:24:40	0°00.003'N	34°99.933'W	4563	4523	OPLU
SO284_173-1	60	28.07.21	17:39:17	0°33.207'N	35°00.090'W	4558	4522	OPLU
SO284_174-1	61	28.07.21	22:14:08	0°66.810'N	34°99.983'W	4563	4528	OPLU
SO284_176-1	62	29.07.21	02:59:42	0°99.867'N	35°00.368'W	3590	3557	OPLU
SO284_178-1	63	29.07.21	07:11:53	1°33.148'N	34°99.847'W	4078	4047	OPLU
SO284_180-1	64	29.07.21	11:35:13	1°66.408'N	34°99.860'W	4062	4029	OPLU
SO284_181-1	65	29.07.21	16:01:48	1°99.845'N	35°00.275'W	4211	4184	OPLU
SO284_183-1	66	29.07.21	20:27:31	2°33.332'N	35°00.033'W	4158	4126	OPLU
SO284_185-1	67	30.07.21	00:55:38	2°66.462'N	34°99.875'W	4025	3989	OPLU
SO284_187-1	68	30.07.21	05:53:13	2°99.768'N	35°00.070'W	3819	3785	OPLU
SO284_188-1	69	30.07.21	10:48:39	3°50.040'N	34°99.958'W	3975	3943	OPLU
SO284_192-1	70	30.07.21	20:16:15	4°00.105'N	35°00.102'W	3506	3474	OPLU
SO284_194-1	71	31.07.21	01:14:36	4°49.893'N	35°00.098'W	3890	3859	OPLU
SO284_196-1	72	31.07.21	06:25:42	4°99.993'N	35°00.068'W	4185	3710	OPLU
SO284_198-1	73	31.07.21	11:57:31	5°49.810'N	34°99.953'W	3906	3876	OPLU

SO284_200-1	74	31.07.21	17:13:48	5°99.905'N	34°99.943'W	4240	4206	OPLU
SO284_244-1	75	04.08.21	10:18:26	9°27.380'N	19°42.515'W	4458	1520	OPLU
SO284_261-1	76	06.08.21	14:06:19	18°59.837'N	21°97.063'W	3321	503	U

Abbreviations of additional measurements given in the CTD station list

L	LADCP
U	UVP5
P	PAR light sensor
O	Trios OPUS Nitrate Sensor
S	SUNA Nitrate Sensor

Depth information given in the CTD station list

Profile Depth	maximum depth reached by the CTD
Bottom Depth	bottom depth from shipboard echosounder

6.3 Drifter and float deployments

6.3.1 SVP buoy deployments

WMO	Deployment Date (UTC)	Latitude	Longitude
1301699	05-Jul-2021 18:53	23° 53.406' N	021° 53.903' W
1301700	09-Jul-.2021 17:17	10° 59.862' N	021° 45.574' W
1301702	09-Jul-2021 22:13	09° 59.876' N	021° 28.712' W
1301703	10-Jul-2021 17:27	09° 00.036' N	021° 34.296' W
1301704	10-Jul-2021 22:38	08° 00.347' N	021° 51.422' W
1301705	11-Jul-2021 03:46	07° 00.414' N	022° 08.571' W
1301706	13 -Jul-2021 19:56	00° 00.123' S	023° 06.270' W
1301707	28-Jul-2021 15:44	00° 00.398' N	034° 59.896' W

6.3.2 Argo float deployments

Float serial number	IMEI	WMO	Latitude	Longitude	Self-Test Date (UTC)	Deployment Date (UTC)	CTD#
P53337-21DE001	300025060619160	6904139	00° 00.158'N	023° 05.924'W	13-Jul-2021 19:33	13-Jul-2021 19:49	006

6.4 List of mooring deployments and recoveries

6.4.1 Mooring recoveries

Mooring Recovery: K1					**Notes:**	**KPO_1211**
Vessel:	Meteor	M159				
Deployed:	30-Oct	2019	20:37			
Vessel:	Sonne	SO284				
Recovered:	20-Jul	2021	17:28			
Latitude:		10°	15.993’	S		
Longitude:		35°	51.638’	W		
Water depth:		900	Mag Var:	-22.48		
ID	**Depth**	**Instr. Type**	**s/n**	**Start-up**	**Remarks**	
KPO_1211_01	296	Argos	983	Ready		
KPO_1211_02	296	MicroCat/p	10697	X		
KPO_1211_03	502.6	ADCP LR up /p	2395	X		
KPO_1211_04	504.2	MicroCat /p	10699	X		
KPO_1211_05	649.8	MicroCat	8945	X		
KPO_1211_06	650.3	Aquadopp down/p	40893-1-236	X		
KPO_1211_07	874.5	MicroCat	8946	X		
KPO_1211_08	886.3	Release RT661	28	Code:	Enable: 5022 / Release: 5024	
KPO_1211_09	886.3	Release AR861	107	Code:	Enable: 0495 / Release: 0455	

Mooring Recovery: K2					**Notes:**	**KPO_1212**
Vessel:	Meteor	M159				
Deployed:	31-Oct	2019	13:31			
Vessel:	Sonne	SO284				
Recovered:	20-Jul	2021	13:46			
Latitude:		10°	22.79’	S		
Longitude:		35°	40.71’	W		
Water depth:		2320	Mag Var:	-22.5		
ID	**Depth**	**Instr. Type**	**s/n**	**Start-up**	**Remarks**	
KPO_1212_01	500	Argos	7373	ready		
KPO_1212_02	500	ADCP LR up/p	2290	X		
KPO_1212_03	500	MicroCat /p	10706	X		
KPO_1212_04	650	MicroCat	6860	X		
KPO_1212_05	650	Aquadopp down/p	260	X		
KPO_1212_06	900	Aquadopp down/p	P26209-6	X		
KPO_1212_07	1200	MicroCat	10692	X		
KPO_1212_08	1400	Aquadopp down/p	261	X		
KPO_1212_09	1500	MicroCat	10690	X		
KPO_1212_10	1901	MicroCat	1583	X		
KPO_1212_11	1901	Aquadopp down/p	P26209-3	X		
KPO_1212_12	2294	MicroCat	1682	X		
KPO_1212_13	2306	Release AR861	1649	Code:	Enable: 0A8E / Release: 0A55	
KPO_1212_14	2306	Release RT661	441	Code:	Enable: 8A03 / Release: 8A04	

Mooring Recovery: K3					**Notes:**	**KPO_1213**
Vessel:	Meteor	M159				
Deployed:	01-Nov	2019	12:30			
Vessel:	Sonne	SO284				

Recovered:	19-Jul	2021	12:34		
Latitude:		10°	36.49’	S	
Longitude:		35°	23.34’	W	
Water depth:		3521	Mag Var:	-22.53	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1213_01	500	Argos	5467	Ready	
KPO_1213_02	500	ADCP LR up/p	2627	X	
KPO_1213_03	500	MicroCat /p	10636	X	
KPO_1213_04	650	MicroCat	2472	X	
KPO_1213_05	650	Aquadopp down/p	P25460-2	X	
KPO_1213_06	899	Aquadopp down/p	P26209-29	X	
KPO_1213_07	1400	Aquadopp down/p	P26209-20	X	
KPO_1213_08	1900	MicroCat	2617	X	
KPO_1213_09	1900	Aquadopp down/p	P26209-28	X	
KPO_1213_10	2399	Aquadopp down/p	P26209-18	X	
KPO_1213_11	2800	MicroCat	2485	X	
KPO_1213_12	3003	Aquadopp down/p	P26209-27	X	
KPO_1213_13	3402	MicroCat	2246	X	
KPO_1213_14	2306	Release AR661	221	Code:	Enable: 9153 / Release: 9154
KPO_1213_15	2306	Release AR661	838	Code:	Enable: 4AD3 / Release: 4AD4

Mooring Recovery: K4					**Notes:** **KPO_1214**
Vessel:	Meteor	M159			
Deployed:	02-Nov	2019	13:25		
Vessel:	Sonne	SO284			
Recovered:	18-Jul	2021	18:42		
Latitude:		10°	56.47’	S	
Longitude:		34°	59.41’	W	
Water depth:		4111	Mag Var:	-22.68	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1214_01	500	Argos	7372	Ready	
KPO_1214_02	500	ADCP LR up/p	19398	X	
KPO_1214_03	500	MicroCat /p	10609	X	
KPO_1214_04	650	MicroCat	2934	X	
KPO_1214_05	650	Aquadopp down/p	P24543-1	X	
KPO_1214_06	880	Aquadopp down/p	P26209-16	X	
KPO_1214_07	1382	Aquadopp down/p	P26209-21	X	
KPO_1214_08	1901	MicroCat	10656	X	
KPO_1214_09	1902	Aquadopp down/p	P26209-2	X	
KPO_1214_10	2381	Aquadopp down/p	P26209-18	X	
KPO_1214_11	2882	Aquadopp down/p	P26209-33	X	
KPO_1214_12	3403	Microcat	10639	X	
KPO_1214_13	2306	Release AR661	220	Code:	Enable: 9151 / Release: 9152
KPO_1214_14	2306	Release AR661	839	Code:	Enable: 4AD5 / Release: 4AD6

Mooring Recovery: CVOO-10					**Notes:** **KPO_1216**
Vessel:	Meteor	M159			
Deployed:	19-Nov	2019	17:05		
Vessel:	Sonne	SO284			
Recovered:	07-Jul	2021	11:34		

Latitude:		17°	36.55’	N	
Longitude:		24°	14.84’	W	
Water depth:		3604	Mag Var:	-8.88	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1216_01	-236	XEOS XMA	184082	Ready	-
KPO_1216_02	-225	MicroCat	381	X	
KPO_1216_03	-210	MicroCat/p	1268	X	
KPO_1216_04	46	MicroCat-IM /p	3754	X	
KPO_1216_05	46	O2 Logger (ind. Opt.	385	X	
KPO_1216_06	46	VR2W	124996	X	
KPO_1216_07	48	Mini-TP	60	X	
KPO_1216_08	48	SMM2000/ Argos	11460/11460	Ready	-
KPO_1216_09	70	Fluorometer	034858R	X	
KPO_1216_10	70	MicroCat	10653	X	
KPO_1216_11	90	MicroCat	1722	X	
KPO_1216_12	121	MicroCat /p	10659	X	
KPO_1216_13	121	Optode Logger	219	X	
KPO_1216_14	212	SAMI	C0067	X	
KPO_1216_15	123	ABeck Vane	1	Ready	-
KPO_1216_16	133	Plankton Sampler	-	Ready	-
KPO_1216_17	133	Plankton Sampler	-	Ready	-
KPO_1216_18	162	MicroCat	2801	X	
KPO_1216_19	202	MicroCat-IM/p	10651	X	
KPO_1216_20	303	ADCP	21816	X	
KPO_1216_21	303	Ellipse	J06721-002	X	
KPO_1216_22	401	Plankton Sampler	-	Ready	-
KPO_1216_23	401	Plankton Sampler	-	Ready	-
KPO_1216_24	411	MicroCat /p	10638	X	
KPO_1216_25	620	Aquadopp down /p	P26209-34	X	
KPO_1216_26	746	Plankton Sampler	-	Ready	-
KPO_1216_27	746	Plankton Sampelr	-	Ready	-
KPO_1216_28	756	MicroCat-IM/p	2269	X	
KPO_1216_29	1106	MicroCat/p	10681	X	
KPO_1216_30	1206	ABeck Vane	2	X	
KPO_1216_31	1308	Sediment Trap	930017	Ready	-
KPO_1216_32	1499	Plankton Sampler	-	Ready	-
KPO_1216_33	1499	Plankton Sampler	-	Ready	-
KPO_1216_34	1509	MicroCat-IM	3755	X	
KPO_1216_35	3009	Aquadopp down /p	P27523	X	
KPO_1216_36	3414	ABeck vane	3	Ready	-
KPO_1216_37	3579	Plankton Sampler	-	Ready	-
KPO_1216_38	3579	Plankton Sampler	-	Ready	-
KPO_1216_39	3579	MicroCat /p	10658	X	
KPO_1216_40	3590	Release RT661	110	Code:	Enable: E972 / Release: E974
KPO_1216_41	3590	Release AR861	1771	Code:	Enable: 0AEF / Release: 0A55

Mooring Recovery Equatorial Atlantic 23W 0N					**Notes:**	**KPO_1210**
Vessel:	Meteor	M158				
Deployed:	12-Oct	2019	13:19			
Vessel:	Sonne	SO248				
Recovered:	13-Jul	2021	12:31			
Latitude:		00°	00.134’	S		
Longitude:		23°	07.016’	W		

Water depth:			3930	Mag Var:	-14.1	
ID	**Depth**	**Instr. Type**		**s/n**	**Start-up**	**Remarks**
KPO_1210_01	211	Argos		2267	ready	
KPO_1210_02	211	ADCP QM up /p		14910	x	
KPO_1210_03	211	Mini-TD /p		55	x	
KPO_1210_04	215	ADCP LR down /p		12530	x	
KPO_1210_05	297	Microcat /p		10709	x	
KPO_1210_06	297	O2 Logger		379	x	
KPO_1210_07	297	UVP6		000004LP	x	
KPO_1210_08	497	Microcat /p		10708	x	
KPO_1210_09	497	O2 Logger		375	x	
KPO_1210_10	829	Microcat		2614	x	
KPO_1210_11	829	UVP6		000002LP	x	
KPO_1210_12	844	Aquadopp up /p		26209-37	x	
KPO_1210_13	3329	MMP		12201	x	
KPO_1210_14	3329	Aquadopp down /p		26209-30	x	
KPO_1210_15	3699	Aquadopp up /p		26209-9	x	
KPO_1210_16	3905	Microcat		2618	x	
KPO_1210_17	3916	Release AR661		351	Code:	Enable: C375 / Release: C376
KPO_1210_18	3916	Release AR861		975	Code:	Enable: 1816 / Release: 1855

Mooring Recovery PIES Brasil 300m					**Notes:**	**KPO_1203**
Vessel:	Meteor		M145			
Deployed:	30-May		2018	23:22		
Vessel:	Sonne		SO284			
Recovered:	20-Jul		2021	19:39		
Latitude:			10°	13.625’	S	
Longitude:			35°	52.400’	W	
Water depth:			320,4	Mag Var:	-22.46	
ID	**Depth**	**Instr. type**		**s/n**	**Start-up**	**Remarks**
KPO_1203_01	320	PIES		320	**x**	Telem:66, XPND:70, BEACON:74, RELEASE:0
KPO_1203_02	320	Develogic Modem		3070	**x**	Adress: 0x0031

Mooring Recovery PIES Brasil 500m					**Notes:**	**KPO_1204**
Vessel:	Meteor		M145			
Deployed:	30-May		2018	23:41		
Vessel:	Sonne		SO284			
Recovered:	20-Jul		2021	19:01		
Latitude:			10°	13.965’	S	
Longitude:			35°	51.684’	W	
Water depth:			517,4	Mag Var:	-22.46	
ID	**Depth**	**Instr. type**		**s/n**	**Start-up**	**Remarks**
KPO_1204_01	517	PIES		319	**x**	Telem:65, XPND:69, BEACON:73, RELEASE:63
KPO_1204_02	517	Develogic Modem		3035	**x**	Adress: 0x0021

6.4.2 Mooring deployments

Mooring Deployment: CVOO (V440-11)			**Notes:**	**KPO_1242**
Vessel:	SONNE	SO284		

Deployed:	07-Jul	2021	20:51		
Vessel:					
Recovered:					
Latitude:		17°	36.595’	N	
Longitude:		24°	14.953’	W	
Water depth:		3604	Mag Var:	-8.88	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1242_01	-215	SBE37IM MicroCat	2261	X	
KPO_1242_02	-199	SBE37IM MicroCat /p	2265	X	
KPO_1242_03	42	SBE37IM MicroCat	2252	X	
KPO_1242_04	42	Optode 4330	383	X	
KPO_1242_05	43	VR2W	112332	X	
KPO_1242_06	46	XMA-11K Argos	2271	Ready	
KPO_1242_07	47	TD-Logger	61	X	
KPO_1242_08	69	SBE37IM MicroCat	2799	X	
KPO_1242_09	69	FLNTUSB	1616	X	
KPO_1242_10	89	SBE37IM MicroCat	2256	X	
KPO_1242_11	119	SBE37IM MicroCat /p	2713	X	
KPO_1242_12	119	Optode 3830	938	X	
KPO_1242_13	120	ABeck Vane	1ab	Ready	
KPO_1242_14	131	SBE37SM MicroCat	3196	X	
KPO_1242_15	196	SBE37SM MicroCat /p	6859	X	
KPO_1242_16	298	QM-ADCP 150kHz	14909	X	
KPO_1242_17	396	SBE37SM MicroCat /p	10635	X	
KPO_1242_18	396	UVP6	000111LP	X	
KPO_1242_19	597	AquadoppDW	45212-1-999	X	
KPO_1242_20	744	SBE37SM MicroCat	1942	X	
KPO_1242_21	744	UVP6	000112LP	X	
KPO_1242_22	1096	SBE37SM MicroCat /p	10700	X	
KPO_1242_23	1196	ABeck Vane	2ab	Ready	
KPO_1242_24	1298	TRAP Bremen		Ready	
KPO_1242_25	1345	AquadoppDW	45212-1-1000	X	
KPO_1242_26	1497	SBE37SM MicroCat /p	10713	X	
KPO_1242_27	2999	AquadoppDW	45212-1-1002	X	
KPO_1242_28	3399	ABeck Vane	3ab	Ready	
KPO_1242_29	3570	SBE37SM MicroCat /p	6855	X	
KPO_1242_30	3586	Release AR661	642	Code:	Enable: 4A83 / Release: 4A84
KPO_1242_31	3586	Release AR861	1256	Code:	Enable: 08BD / Release: 0855

Mooring Deployment: Equator 23W 0N					**Notes:** **KPO_1237**
Vessel:	SONNE	SO284			
Deployed:	13-Jul	2021	19:11		
Vessel:					
Recovered:					
Latitude:		00°	00.06’	N	
Longitude:		23°	06.971’	W	
Water depth:		3930	Mag Var:	-14.1	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1237_01	213	XMA	214435	Ready	
KPO_1237_02	213	QM-ADCP 150kHz	21861	X	

KPO_1237_03	214	TD-Logger	57	X	
KPO_1237_04	217	LR-ADCP 75kHz	17570	X	
KPO_1237_05	299	SBE37SM MicroCat /p	10689	X	
KPO_1237_06	299	Optode 3830	1074	X	
KPO_1237_07	299	UVP6	109	X	
KPO_1237_08	501	SBE37SM MicroCat /p	6858	X	
KPO_1237_09	501	Optode 3830	219	X	
KPO_1237_10	829	SBE37IM MicroCat	7417	X	
KPO_1237_11	829	UVP6	123	X	
KPO_1237_12	849	AquadoppDW	P26209-34	X	
KPO_1237_13	1851	McLane MMP	11617	X	
KPO_1237_14	3324	AquadoppDW	P26209-24	X	
KPO_1237_15	3699	AquadoppDW	P27523	X	
KPO_1237_16	3904	SBE37SM MicroCat	8947	X	
KPO_1237_17	3916	Release AR661	189	Code:	Enable: 8183 / Release: 8184
KPO_1237_18	3916	Release AR861	1104	Code:	Enable: 0804 / Release: 0805

Mooring Deployment: K1					**Notes: KPO_1238**
Vessel:	SONNE	SO284			
Deployed:	21-Jul	2021	09:35		
Vessel:					
Recovered:					
Latitude:		10°	15.988’	S	
Longitude:		35°	51.679’	W	
Water depth:		900	Mag Var:	-22.48	
ID	**Depth**	**Instr. Type**	**s/n**	**Start-up**	**Remarks**
KPO_1238_01	501	SMM-2000 Argos	2267	Ready	
KPO_1238_02	501	LR-ADCP 75kHz	2395	X	
KPO_1238_03	502	SBE37SM MicroCat /p	2485	X	
KPO_1238_04	654	AquadoppDW-IM	P24543-1	X	
KPO_1238_05	654	SBE37IM MicroCat	2934	X	
KPO_1238_06	880	SBE37IM MicroCat	6779	X	
KPO_1238_07	886	Release AR661	235	Code:	Enable: A121 / Release: A122
KPO_1238_08	886	Release AR861	975	Code:	Enable: 1816 / Release: 1816

Mooring Deployment: K2					**Notes: KPO_1239**
Vessel:	SONNE	SO284			
Deployed:	21-Jul	2021	13:04		
Vessel:					
Recovered:					
Latitude:		10°	22.901’	S	
Longitude:		35°	40.711’	W	
Water depth:		2318	Mag Var:	-22.5	
ID	**Depth**	**Instr. Type**	**s/n**	**Start-up**	**Remarks**
KPO_1239_01	501	XMA-11K Argos	5467	Ready	
KPO_1239_02	501	LR-ADCP 75kHz	2330	X	
KPO_1239_03	502	SBE37SM MicroCat /p	10609	X	
KPO_1239_04	650	SBE37IM MicroCat /p	2269	X	
KPO_1239_05	651	AquadoppDW	P26209-18	X	

KPO_1239_06	901	AquadoppDW	P26209-19	X	
KPO_1239_07	1200	SBE37IM MicroCat /p	10656	X	
KPO_1239_08	1401	AquadoppDW	P26209-20	X	
KPO_1239_09	1501	SBE37IM MicroCat /p	10639	X	
KPO_1239_10	1902	SBE37SM MicroCat	2472	X	
KPO_1239_11	1902	AquadoppDW	P26209-37	X	
KPO_1239_12	2296	SBE37SM MicroCat	2618	X	
KPO_1239_13	2306	Release AR661	838	Code:	Enable: 4AD3 / Release: 4AD4
KPO_1239_14	2306	Release AR861	107	Code:	Enable: 0495 / Release: 0455

Mooring Deployment: K3					**Notes: KPO_1240**
Vessel:	SONNE	SO284			
Deployed:	21-Jul	2021	21:14		
Vessel:					
Recovered:					
Latitude:		10°	36.552’	S	
Longitude:		35°	23.463’	W	
Water depth:		3521	Mag Var:	-22.53	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1240_01	499	SMM-2000 Argos	12617	Ready	
KPO_1240_02	499	LR-ADCP 75kHz	2290	X	
KPO_1240_03	500	SBE37IM MicroCat /p	3754	X	
KPO_1240_04	650	AquadoppDW-IM	P26209-6	X	
KPO_1240_05	650	SBE37IM MicroCat	2801	X	
KPO_1240_06	901	AquadoppDW	P26209-27	X	
KPO_1240_07	1400	AquadoppDW	P26209-28	X	
KPO_1240_08	1899	SBE37IM MicroCat /p	10651	X	
KPO_1240_09	1900	AquadoppDW	P26209-29	X	
KPO_1240_10	2398	AquadoppDW	P26209-33	X	
KPO_1240_11	2802	SBE37SM MicroCat /p	10709	X	
KPO_1240_12	3002	AquadoppDW	P25460-2	X	
KPO_1240_13	3401	SBE37SM MicroCat /p	10708	X	
KPO_1240_14	3506	Release AR661	351	Code:	Enable: C375 / Release: C376
KPO_1240_15	3506	Release AR861	1649	Code:	Enable: 0A8E / Release: 0A55

Mooring Deployment: K4					**Notes: KPO_1241**
Vessel:	SONNE	SO284			
Deployed:	19-Jul	2021	20:13		
Vessel:					
Recovered:					
Latitude:		10°	56.369’	S	
Longitude:		34°	59.404’	W	
Water depth:		4111	Mag Var:	-22.6	

ID	Depth	Instr. Type	s/n	Start-up	Remarks
KPO_1241_01	500	XMA	184084	Ready	
KPO_1241_02	500	LR-ADCP 75kHz	1181	x	
KPO_1241_03	501	SBE37IM MicroCat /p	10659	X	
KPO_1241_04	652	AquadoppDW-IM	26209-2	X	
KPO_1241_05	652	SBE37IM MicroCat	1722	X	

KPO_1241_06	903	AquadoppDW-IM	26209-9	X	
KPO_1241_07	1405	AquadoppDW	P26209-16	X	
KPO_1241_08	1905	SBE37IM MicroCat /p	10658	X	
KPO_1241_09	1905	AquadoppDW	P26209-21	X	
KPO_1241_10	2404	AquadoppDW	P26209-30	X	
KPO_1241_11	2908	Aquadopp Induktiv	40893-9-259	X	
KPO_1241_12	3407	SBE37IM MicroCat /p	10638	X	
KPO_1241_13	4091	SBE37IM MicroCat /p	10681	X	
KPO_1241_14	4099	Release AR661	122	Code:	Enable: 6170 / Release: 6179
KPO_1241_15	4099	Release AR861	1771	Code:	Enable: 0AEF/ Release: 0A55

Mooring Deployment: PIES Brasil - 300						**Notes:**	**KPO_1243**
Vessel:	Sonne		SO284				
Deployed:	20-Jul		2021	19:54			
Vessel:							
Recovered:							
Latitude:			10°	13.6’	S		
Longitude:			35°	52.40’	W		
Water depth:			309	Mag Var:	-22.46		
ID	**Depth**	**Instr. Type**		**s/n**	**Start-up**	**Remarks**	
KPO_1243_01	307.5	PIES		75	x	XPND 71; TELEM 67; CLEAR 76; Release 11; Radio Channel 77; 156.875 MHz, 4sec; Flasher 1sec	

Mooring Deployment: PIES Brasil - 500						**Notes:**	**KPO_1243**
Vessel:	Sonne		SO284				
Deployed:	20-Jul		2021	20:14			
Vessel:							
Recovered:							
Latitude:			10°	14.0’	S		
Longitude:			35°	51.70’	W		
Water depth:			515	Mag Var:	-22.46		
ID	**Depth**	**Instr. Type**		**s/n**	**Start-up**	**Remarks**	
KPO_1243_01	513.5	PIES		75	x	XPND 70; TELEM 66; CLEAR 76; Release 16; Radio Channel 77; 156.875 MHz, 4sec	

6.5 Biogeochemical sampling station list

Station Number	Profile Number	Date	Time (UTC)	Latitude	Longitude	Samples taken + corresponding depths	
SO284_17-1	3	07.07.21	11:53:02	17°60.503’N	24°25.112’W	DT, NU, O	Bottom(?)
						DT, NU, O	3500
						DT, NU, O	3000
						DT, NU, O	2000
						DT, NU, O	1500
						DT, NU, O	1000
						DT, NU, O	600
						DT, NU, O	450
						DT, NU, O	350
						DT, NU, O	250
						DT, NU, O	200
						DT, NU, O	150
						DT, NU, O	120
						DT, NU, O	100

						DT, NU, O	80
						DT, NU, O	60
						DT, NU, O	40
						DT, NU, O	20
						DT, NU, O	10
SO284_69-1	6	12.07.21	23:11:13	0°00.143'S	23°05.850'W	N_2O	3954
						N_2O	2017
						N_2O	1005
						N_2O, CH_4	703
						N_2O, CH_4	603
						N_2O, CH_4	401
						N_2O, CH_4	339
						N_2O, CH_4	250
						N_2O, CH_4	201
						N_2O, CH_4	147
						N_2O, CH_4	97
						N_2O, CH_4	58
						N_2O, CH_4	43
						N_2O, CH_4	20
						N_2O, CH_4	10
SO284_87-1	10	17.07.21	10:34:10	11°50.043'S	33°21.592'W	N_2O	4324
						N_2O	2528
						N_2O, CH_4	1006
						N_2O, CH_4	560
						N_2O, CH_4	299
						N_2O, CH_4	132
						N_2O, CH_4	123
						N_2O, CH_4	113
						N_2O, CH_4	59
						N_2O, CH_4	10
SO284_106-1	20	20.07.21	02:32:22	10°61.223'S	35°39.543'W	N_2O	3505
						N_2O	2500
						N_2O, CH_4	1000
						N_2O, CH_4	700
						N_2O, CH_4	450
						N_2O, CH_4	345
						N_2O, CH_4	250
						N_2O, CH_4	130
						N_2O, CH_4	120
						N_2O, CH_4	110
						N_2O, CH_4	50
						N_2O, CH_4	10
SO284_115-1	22	20.07.21	21:07:31	10°24.348'S	35°89.345'W	N_2O, CH_4	202
						N_2O, CH_4	100
						N_2O, CH_4	27
						N_2O, CH_4	9
SO284_117-1	24	20.07.21	23:06:25	10°26.673'S	35°86.178'W	N_2O	879
						N_2O	605
						N_2O, CH_4	403
						N_2O, CH_4	303
						N_2O, CH_4	252
						N_2O, CH_4	201
						N_2O, CH_4	120
						N_2O, CH_4	103
						N_2O, CH_4	93
						N_2O, CH_4	70
						N_2O, CH_4	49
						N_2O, CH_4	9
SO284_130-1	28	23.07.21	10:02:47	5°00.138'S	31°49.963'W	N_2O	4752
						N_2O	2528
						N_2O	1007
						N_2O, CH_4	807
						N_2O, CH_4	604
						N_2O, CH_4	373

						N_2O, CH_4	252
						N_2O, CH_4	201
						N_2O, CH_4	127
						N_2O, CH_4	117
						N_2O, CH_4	106
						N_2O, CH_4	51
						N_2O, CH_4	6
SO284_141-1	36	24.07.21	23:15:51	5°54.323'S	34°40.090'W	N_2O	3795
						N_2O	2527
						N_2O	1008
						N_2O, CH_4	805
						N_2O, CH_4	605
						N_2O, CH_4	367
						N_2O, CH_4	251
						N_2O, CH_4	199
						N_2O, CH_4	125
						N_2O, CH_4	115
						N_2O, CH_4	106
						N_2O, CH_4	70
						N_2O, CH_4	50
						N_2O, CH_4	5
SO284_144-1	39	25.07.21	09:36:58	5°63.273'S	34°90.028'W	N_2O	1524
						N_2O	1007
						N_2O, CH_4	803
						N_2O, CH_4	519
						N_2O, CH_4	404
						N_2O, CH_4	305
						N_2O, CH_4	253
						N_2O, CH_4	206
						N_2O, CH_4	154
						N_2O, CH_4	108
						N_2O, CH_4	98
						N_2O, CH_4	87
						N_2O, CH_4	71
						N_2O, CH_4	50
						N_2O, CH_4	5
SO284_146-1	41	25.07.21	13:36:37	5°64.060'S	34°95.747'W	N_2O, CH_4	350
						N_2O, CH_4	252
						N_2O, CH_4	202
						N_2O, CH_4	152
						N_2O, CH_4	101
						N_2O, CH_4	81
						N_2O, CH_4	63
						N_2O, CH_4	53
						N_2O, CH_4	43
						N_2O, CH_4	5
SO284_157-1	50	26.07.21	20:02:43	2°74.878'S	34°95.265'W	N_2O, CH_4	503
						N_2O, CH_4	402
						N_2O, CH_4	261
						N_2O, CH_4	201
						N_2O, CH_4	150
						N_2O, CH_4	101
						N_2O, CH_4	80
						N_2O, CH_4	50
						N_2O, CH_4	5
SO284_170-1	59	28.07.21	12:24:40	0°00.003'N	34°99.933'W	N_2O, CH_4	504
						N_2O, CH_4	402
						N_2O, CH_4	291
						N_2O, CH_4	152
						N_2O, CH_4	101
						N_2O, CH_4	67
						N_2O, CH_4	53
						N_2O, CH_4	33
						N_2O, CH_4	8

SO284_185-1	67	30.07.21	00:55:38	2°66.462'N	34°99.875'W	N_2O, CH_4	479
						N_2O, CH_4	403
						N_2O, CH_4	302
						N_2O, CH_4	212
						N_2O, CH_4	152
						N_2O, CH_4	101
						N_2O, CH_4	77
						N_2O, CH_4	50
						N_2O, CH_4	5
SO284_196-1	72	31.07.21	06:25:42	4°99.993'N	35°00.068'W	N_2O, CH_4	504
						N_2O, CH_4	402
						N_2O, CH_4	347
						N_2O, CH_4	226
						N_2O, CH_4	101
						N_2O, CH_4	67
						N_2O, CH_4	51
						N_2O, CH_4	25
						N_2O, CH_4	5

Abbreviations of measurements given in the CTD station list

NU	Nutrients
O	Oxygen
CH_4	Methane
N_2O	Nitrous oxide
DT	DIC / TA

6.6 Calibration factors of sodium thiosulfate bottles

Date	Factor
July 01	1,0316368
July 05	1,0004001
July 07	0,99960016
July 09	0,99760574
July 10	1,00120144
July 13	1,00280786
July 16	0,9952229
July 17	0,99641291
July 18	0,99601593
July 19 - 21	0,994826
July 23 - 24	0,98425196
July 25.	0,98077677
July 26	0,98116169
July 27	0,99641291
July 28	0,994826
July 29	0,99443118
July 30	0,994826
July 31	0,99561927
August 04	0,99760574

6.7 Radiosondes

Station Number	Sonde Number	Date	Time (UTC)	Latitude	Longitude	Max. Altitude (m)	Descent available	Comment
SO284_1	BLN 1	29.06.	15:09	48°43.20'N	6°32.3'W	24630	yes	
SO284_4	BLN 2	05.07.	16:47	24°22.57'N	21°42.23'W	24428	no	
SO284_6	BLN 3	05.07.	22:39	23°10.9'N	21°58.54'W	23046	no	
SO284_7	BLN 4	06.07.	06:26	21°31.3'N	22°10.14'W	15170	no	Aeolus Overpass
SO284_8	BLN 5	06.07.	10:42	20°49.32'N	22°42.17'W	17803	no	
SO284_9	BLN 6	06.07.	13:42	20°26.21'N	23°7.21'W	8935	yes	
SO284_10	BLN 7	06.07.	16:42	20°11.35'N	23°18.5'W	18329	no	
SO284_11	BLN 8	06.07.	19:42	19°36.46'N	23°31.8'W	12847	yes	
SO284_12	BLN 9	06.07.	22:45	19°2.21'N	23°43.58'W	15173	no	
SO284_13	BLN 10	07.07.	01:39	18°25.24'N	23°57.42'W	7489	no	
SO284_14	BLN 11	07.07.	04:44	17°47.48'N	24°11.38'W	17370	no	
SO284_16	BLN 12	07.07.	07:50	17°35.52'N	24°16.2'W	15766	no	
SO284_18	BLN 13	07.07.	14:15	17°36.18'N	24°15.5'W	16039	no	
SO284_20	BLN 14	07.07.	19:41	17°35.14'N	24°16.39'W	24551	no	
SO284_21	BLN 15	08.07.	04:48	17°0.58'N	24°48.50'W	11610	no	Degraded Mode
SO284_22	BLN 16	08.07.	13:43	16°4.25'N	23°23.33'W	21766	no	
SO284_23	BLN 17	08.07.	22:46	14°25.52'N	22°44.30'W	14777	no	Degraded Mode
SO284_24	BLN 18	09.07.	01:45	13°50.18'N	22°34.42'W	17321	no	Degraded Mode
SO284_25	BLN 19	09.07.	04:45	13°13.50'N	22°24.41'W	18753	no	Degraded Mode
SO284_26	BLN 20	09.07.	07:43	12°38.29'N	22°14.59'W	23293	no	Degraded Mode
SO284_27	BLN 21	09.07.	10:49	12°1.43'N	22°4.55'W	25588	no	Degraded Mode
SO284_29	BLN 22	09.07.	13:38	11°45.41'N	22°0.32'W	24851	yes	
SO284_30	BLN 23	09.07.	16:48	11°7.8'N	21°47.37'W	25438	no	
SO284_32	BLN 24	09.07.	19:46	10°33.48'N	21°38.14'W	21962	no	
SO284_34	BLN 25	09.07.	22:52	9°56.14'N	21°27.41'W	23050	no	Degraded Mode
SO284_35	BLN 26	10.07.	01:44	9°20.3'N	21°20.13'W	24128	no	Degraded Mode
SO284_37	BLN 27	10.07.	04:56	9°16.6'N	21°33.50'W	22432	yes	
SO284_38	BLN 28	10.07.	07:49	9°16.8'N	21°33.44'W	25297	no	
SO284_40	BLN 29	10.07.	10:44	9°16.20'N	21°26.54'W	24283	no	
SO284_41	BLN 30	10.07.	13:44	9°16.2'N	21°13.42'W	19234	no	
SO284_43	BLN 31	10.07.	16:43	9°13.19'N	21°30.36'W	22649	no	
SO284_45	BLN 32	10.07.	19:40	8°37.41'N	21°40.42'W	23219	no	
SO284_47	BLN 33	10.07.	22:50	8°2.38'N	21°50.46'W	24142	no	
SO284_48	BLN 34	11.07.	00:44	7°39.31'N	21°57.23'W	24324	no	
SO284_49	BLN 35	11.07.	02:46	7°15.48'N	22°4.10'W	23741	no	
SO284_51	BLN 36	11.07.	04:43	6°51.2'N	22°11.15'W	23691	no	
SO284_52	BLN 37	11.07.	06:44	6°28.24'N	22°17.43'W	23777	no	
SO284_53	BLN 38	11.07.	08:38	6°6.46'N	22°23.53'W	21888	no	
SO284_54	BLN 39	11.07.	10:41	5°45.22'N	22°29.59'W	17412	no	
SO284_55	BLN 40	11.07.	12:41	5°25.38'N	22°35.37'W	16897	no	Degraded Mode
SO284_56	BLN 41	11.07.	14:38	5°5.48'N	22°41.16'W	15660	no	Degraded Mode

SO284_57	BLN 42	11.07.	16:37	4°46.24'N	22°46.47'W	17483	no	
SO284_58	BLN 43	11.07.	18:44	4°27.20'N	22°52.13'W	23394	no	Degraded Mode
SO284_59	BLN 44	11.07.	20:42	4°4.44'N	22°58.39'W	23034	no	Degraded Mode
SO284_60	BLN 45	11.07.	22:41	4°3.19'N	22°58.42'W	23875	no	Degraded Mode
SO284_61	BLN 46	12.07.	00:43	3°59.50'N	22°57.23'W	24129	yes	
SO284_62	BLN 47	12.07.	02:45	3°41.57'N	22°43.45'W	24470	no	
SO284_63	BLN 48	12.07.	06:12	3°9.50'N	22°21.59'W	19754	no	Aeolus Overpass and Degraded Mode
SO284_64	BLN 49	12.07.	10:44	2°19.56'N	22°30.50'W	19215	no	Degraded Mode
SO284_65	BLN 50	12.07.	13:41	1°47.23'N	22°36.37'W	23573	no	Degraded Mode
SO284_66	BLN 51	12.07.	16:43	1°15.55'N	22°44.9'W	25604	no	Degraded Mode
SO284_67	BLN 52	12.07.	19:47	0°39.38'N	22°53.25'W	23447	yes	
SO284_68	BLN 53	12.07.	22:41	0°6.45'N	23°1.46'W	23952	yes	
SO284_70	BLN 54	13.07.	04:42	0°0.3'N	23°3.26'W	20413	yes	
SO284_72	BLN 55	13.07.	10:48	0°0.51'N	23°5.35'W	23579	no	
SO284_74	BLN 56	13.07.	16:45	0°1.60'N	23°2.48'W	23548	yes	
SO284_77	BLN 57	13.07.	22:42	0°25.2'N	23°26.5'W	24003	yes	
SO284_78	BLN 58	14.07.	10:43	2°24.21'S	24°57.44'W	24762	yes	
SO284_79	BLN 59	14.07.	22:46	4°23.0'S	26°28.56'W	23762	yes	
SO284_80	BLN 60	15.07.	10:40	6°20.36'S	27°59.34'W	21972	yes	
SO284_81	BLN 61	15.07.	22:45	8°15.2'S	29°28.5'W	24881	yes	
SO284_82	BLN 62	16.07.	10:43	10°11.36'S	30°58.44'W	22504	yes	
SO284_84	BLN 63	16.07.	22:41	11°29.60'S	31°59.59'W	24358	yes	
SO284_88	BLN 64	17.07.	10:39	11°30.1'S	33°12.57'W	22732	yes	
SO284_91	BLN 65	17.07.	22:47	11°29.60'S	33°52.60'W	25526	yes	
SO284_95	BLN 66	18.07.	10:46	11°7.37'S	34°43.56'W	22807	yes	
SO284_98	BLN 67	18.07.	22:53	10°53.54'S	35°3.26'W	25651	yes	
SO284_102	BLN 68	19.07.	10:42	10°35.38'S	35°24.19'W	23712	yes	
SO284_105	BLN 69	19.07.	22:47	10°42.16'S	35°16.51'W	24457	yes	
SO284_109	BLN 70	20.07.	10:40	10°22.45'S	35°41.9'W	23011	no	
SO284_118	BLN 71	21.07.	00:52	10°18.37'S	35°47.34'W	24221	yes	
SO284_122	BLN 72	21.07.	10:40	10°19.14'S	35°43.48'W	16958	yes	
SO284_126	BLN 73	21.07.	22:43	10°26.3'S	35°14.44'W	22893	yes	
SO284_127	BLN 74	22.07.	07:29	9°6.50'S	34°15.51'W	24649	yes	Aeolus Overpass
SO284_128	BLN 75	22.07.	10:43	8°35.7'S	33°59.54'W	22117	yes	
SO284_129	BLN 76	22.07.	22:38	6°51.11'S	32°47.21'W	25292	yes	
SO284_131	BLN 77	23.07.	10:37	4°59.60'S	31°29.59'W	23035	yes	
SO284_134	BLN 78	23.07.	22:41	5°12.17'S	32°29.58'W	23633	yes	
SO284_137	BLN 79	24.07.	10:43	5°21.41'S	33°24.53'W	23511	yes	
SO284_140	BLN 80	24.07.	22:36	5°31.19'S	34°16.16'W	24938	yes	
SO284_151	BLN 81	25.07.	22:45	4°40.3'S	34°53.2'W	24323	yes	
SO284_155	BLN 82	26.07.	10:40	3°39.58'S	34°52.58'W	23157	yes	
SO284_158	BLN 83	26.07.	22:43	2°44.56'S	34°57.9'W	26642	yes	
SO284_162	BLN 84	27.07.	10:42	1°44.59'S	35°0.1'W	20024	yes	

SO284_165	BLN 85	27.07.	19:58	1°18.13'S	35°0.2'W	22402	yes	Aeolus Overpass
SO284_169	BLN 86	28.07.	10:43	0°19.60'N	34°59.55'W	23915	yes	
SO284_172	BLN 87	28.07.	16:43	0°8.42'N	35°0.0'W	23575	yes	
SO284_175	BLN 88	28.07.	22:39	0°40.6'N	34°59.59'W	21850	yes	
SO284_177	BLN 89	29.07.	04:50	0°59.55'N	35°0.13'W	21930	yes	
SO284_179	BLN 90	29.07.	10:47	1°28.18'N	35°0.0'W	25283	no	
SO284_182	BLN 91	29.07.	16:48	1°59.54'N	35°0.10'W	25297	yes	
SO284_184	BLN 92	29.07.	22:37	2°20.0'N	35°0.1'W	22355	yes	
SO284_186	BLN 93	30.07.	04:42	2°45.19'N	35°0.0'W	22097	yes	
SO284_189	BLN 94	30.07.	10:51	3°29.44'N	35°0.16'W	14336	yes	
SO284_191	BLN 95	30.07.	16:41	4°0.4'N	35°0.4'W	25495	yes	
SO284_193	BLN 96	30.07.	22:39	3°59.59'N	35°0.9'W	21482	yes	
SO284_195	BLN 97	31.07.	04:40	4°38.5'N	35°0.9'W	22449	yes	
SO284_197	BLN 98	31.07.	11:03	5°18.3'N	35°0.0'W	23334	yes	
SO284_199	BLN 99	31.07.	16:46	5°53.25'N	35°0.0'W	23722	yes	
SO284_201	BLN 100	31.07.	20:41	6°1.46'N	34°51.56'W	22100	yes	
SO284_202	BLN 101	31.07.	22:39	6°7.16'N	34°26.45'W	21335	no	
SO284_203	BLN 102	01.08.	00:43	6°12.55'N	34°0.55'W	22676	yes	
SO284_204	BLN 103	01.08.	02:39	6°18.15'N	33°36.28'W	21424	yes	
SO284_205	BLN 104	01.08.	04:42	6°23.46'N	33°11.17'W	21909	yes	
SO284_206	BLN 105	01.08.	06:44	6°29.23'N	32°45.43'W	21168	no	
SO284_207	BLN 106	01.08.	08:49	6°35.18'N	32°18.45'W	23042	yes	
SO284_208	BLN 107	01.08.	10:46	6°40.57'N	31°52.59'W	23762	yes	
SO284_209	BLN 108	01.08.	12:45	6°46.55'N	31°25.47'W	25266	yes	
SO284_210	BLN 109	01.08.	14:41	6°52.33'N	31°0.10'W	22462	no	Degraded Mode
SO284_211	BLN 110	01.08.	16:46	6°58.43'N	30°32.1'W	22528	yes	
SO284_212	BLN 111	01.08.	18:42	7°4.40'N	30°4.53'W	21040	yes	Aeolus Overpass
SO284_213	BLN 112	01.08.	20:44	7°10.39'N	29°37.36'W	19023	yes	
SO284_214	BLN 113	01.08.	22:48	7°16.11'N	29°12.23'W	19292	yes	
SO284_215	BLN 114	02.08.	00:42	7°21.52'N	28°46.25'W	19901	no	
SO284_216	BLN 115	02.08.	02:41	7°27.28'N	28°20.50'W	21343	yes	
SO284_217	BLN 116	02.08.	04:41	7°33.13'N	27°54.33'W	20904	yes	
SO284_218	BLN 117	02.08.	06:43	7°38.46'N	27°29.13'W	7354	yes	
SO284_219	BLN 118	02.08.	08:48	7°44.39'N	27°2.24'W	19571	yes	
SO284_220	BLN 119	02.08.	10:47	7°50.14'N	26°36.50'W	22951	yes	Lost connection but reactivated the sounding later
SO284_221	BLN 120	02.08.	12:54	7°56.29'N	26°8.16'W	16001	yes	
SO284_222	BLN 121	02.08.	14:46	8°1.30'N	25°45.22'W	22438	yes	
SO284_223	BLN 122	02.08.	16:55	8°3.29'N	25°17.23'W	22254	yes	
SO284_224	BLN 123	02.08.	18:43	8°3.34'N	24°47.43'W	21340	yes	
SO284_225	BLN 124	02.08.	20:40	8°7.10'N	24°20.2'W	20854	yes	
SO284_226	BLN 125	02.08.	22:43	8°11.58'N	23°53.27'W	5109	yes	
SO284_227	BLN 126	03.08.	00:43	8°16.42'N	23°27.1'W	17199	yes	
SO284_228	BLN 127	03.08.	02:44	8°21.21'N	23°1.11'W	17383	no	

SO284_229	BLN 128	03.08.	04:46	8°26.5'N	22°34.49'W	20185	yes	
SO284_230	BLN 129	03.08.	06:44	8°30.47'N	22°8.40'W	17456	yes	
SO284_231	BLN 130	03.08.	08:43	8°35.21'N	21°43.17'W	18305	yes	
SO284_232	BLN 131	03.08.	10:39	8°39.59'N	21°17.29'W	24199	yes	
SO284_233	BLN 132	03.08.	12:46	8°44.51'N	20°50.17'W	22411	yes	
SO284_234	BLN 133	03.08.	14:42	8°49.13'N	20°26.2'W	22034	no	
SO284_235	BLN 134	03.08.	16:43	8°53.51'N	20°0.10'W	21936	no	
SO284_236	BLN 135	03.08.	18:46	8°58.20'N	19°35.10'W	21763	yes	
SO284_237	BLN 136	03.08.	20:45	9°2.45'N	19°10.36'W	21214	yes	
SO284_238	BLN 137	03.08.	22:46	9°7.1'N	18°46.17'W	21187	yes	
SO284_240	BLN 138	04.08.	01:42	9°10.19'N	18°21.26'W	23515	yes	
SO284_241	BLN 139	04.08.	04:46	9°10.58'N	18°56.48'W	15410	yes	
SO284_242	BLN 140	04.08.	07:45	9°11.0'N	19°23.60'W	21787	yes	
SO284_245	BLN 141	04.08.	13:43	9°21.42'N	19°27.19'W	24962	yes	
SO284_246	BLN 142	04.08.	16:48	9°58.55'N	19°42.36'W	22998	no	
SO284_247	BLN 143	04.08.	20:00	10°32.24'N	19°56.47'W	21977	yes	
SO284_248	BLN 144	04.08.	22:43	11°6.3'N	20°10.30'W	22423	yes	
SO284_249	BLN 145	05.08.	01:44	11°39.48'N	20°24.18'W	23117	yes	
SO284_250	BLN 146	05.08.	04:42	12°12.3'N	20°37.30'W	22899	yes	
SO284_251	BLN 147	05.08.	07:43	12°45.19'N	20°51.9'W	24073	yes	
SO284_252	BLN 148	05.08.	10:47	13°17.29'N	21°4.23'W	22949	yes	
SO284_253	BLN 149	05.08.	16:43	14°26.32'N	21°28.15'W	24934	yes	
SO284_254	BLN 150	05.08.	19:22	14°58.36'N	21°33.2'W	27924	yes	Aeolus Overpass
SO284_255	BLN 151	05.08.	22:47	15°41.38'N	21°39.28'W	22326	yes	
SO284_256	BLN 152	06.08.	01:41	16°15.58'N	21°44.38'W	22324	no	
SO284_257	BLN 153	06.08.	04:43	16°50.4'N	21°49.46'W	22555	yes	
SO284_258	BLN 154	06.08.	07:45	17°24.12'N	21°57.12'W	23099	yes	
SO284_259	BLN 155	06.08.	10:40	17°56.26'N	21°57.40'W	23796	yes	
SO284_260	BLN 156	06.08.	13:45	18°30.29'N	21°58.10'W	25138	yes	

7 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 SO284 are stored at the Kiel data portal, and remain proprietary for the PIs of the cruise and for members of EU-TRIATLAS project. Each station is logged as an event file https://portal.geomar.de/metadata/leg/show/344906. All data will be submitted to PANGAEA within 3 years after the cruise, i.e. by August 2024. 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 7.1. N_2O and CH_4 data will be archived in the MEMENTO database (https://memento.geomar.de).

Table 7.1: Overview of contact persons for the different data sets.

Data Type	Contact Person	Current Affiliation	Email
CTD/O_2	Gerd Krahmann	GEOMAR	gkrahmann@geomar.de
VMADCP	Rena Czeschel	GEOMAR	rczeschel@geomar.de
LADCP	Gerd Krahmann	GEOMAR	gkrahmann@geomar.de
Mooring data	Rebecca Hummels	GEOMAR	rhummels@geomar.de
Thermosalinograph	Florian Schütte	GEOMAR	fschuette@geomar.de
Multibeam echosounder	Colin Devey	GEOMAR	cdevey@geomar.de
Underwater Vision Profiler	Rainer Kiko	GEOMAR	rainer.kiko@obs-vlfr.fr
Nitrous oxide, methane	Hermann W. Bange	GEOMAR	hbange@geomar.de
Radiosondes	Julia Windmiller	MPI-M	Julia.windmiller@mpimet.mpg.de
OCEANET-atmosphere Cont.	Ronny Engelmann	TROPOS	ronny@tropos.de
Onboard meteorology	Julia Windmiller	MPI-M	Julia.windmiller@mpimet.mpg.de
Wind Lidar	Hugo Rubio	FhG-IWES	hugo.rubio@iwes.fraunhofer.de
Pandora-2s	Thomas Ruhtz	FU Berlin	ruhtz@zedat.fu-berlin.de
Microtops	Thomas Ruhtz	FU Berlin	ruhtz@zedat.fu-berlin.de
Ceilometer	Julia Windmiller	MPI-M	Julia.windmiller@mpimet.mpg.de

8 Acknowledgements

We are grateful to Tilo Birnbaum and his crew for the excellent collaboration and the pleasant working atmosphere during the cruise. The crew of R/V Sonne greatly contributed to the success of the cruise. Financial support was provided by the German Science Foundation (DFG), by the EU H2020 under grant agreement 817578 TRIATLAS project and by the German Federal Ministry for Economic Affairs and Energy (BMWi) under grant no. 50EE1721C. Deployment of the Leosphere WindCube was made possible through the CMTRACE Vidi project (project number VI.Vidi.192.050, granted to Dr. Louise Nuijens at TU Delft) financed by the Dutch Research Council (NWO) Talent Programme. We also acknowledge the public support of the conducted basic research through the Max Planck Society.

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10 Appendix – List of abbreviations

ADCP	Acoustic Doppler Current Profiler
AMOC	Atlantic Meridional Overturning Circulation
BMBF	Federal Ministry of Education and Research
CTD	Conductivity-temperature-depth (system)
CVOO	Cape Verde Ocean Observatory
DFG	German Science Foundation
DSOW	Denmark Strait Overflow Water
EEZ	Exclusive Economic Zone
GDP	Global Drifter Program
GPS	Global Positioning System
IMU	Inertial measurement unit
ITCZ	Intertropical Convergence Zone
LADCP	Lowered ADCP
LR ADCP	Longranger ADCP
MMP	McLane Moored Profiler
OPS	OPTIMARE Precision Salinometer
OS38	38kHz RDI Ocean Surveyor
OS75	75kHz RDI Ocean Surveyor
PIES	Pressure inverted echo sounder
PSU	Practical Salinity Unit
R/V	Research vessel
SAR	Search and rescue
SBE	Seabird Electronics
SSS	Sea surface salinity
SST	Sea surface temperature
STC	Subtropical cell
SVP	Surface Velocity Program
TSG	Thermosalinograph
UVP	Underwater vision profiler
VMADCP	Vessel-mounted Acoustic Doppler Current Profiler