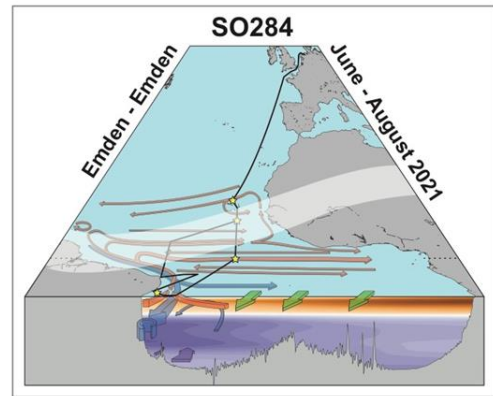


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Short Cruise Report

R/V SONNE, cruise SO284

Emden, Germany - Emden, Germany
27th June - 17th August 2021

Chief Scientist: Prof. Dr. Peter Brandt
Co-Chief Scientist: Dr. Julia Windmiller
Captain: Tilo Birnbaum

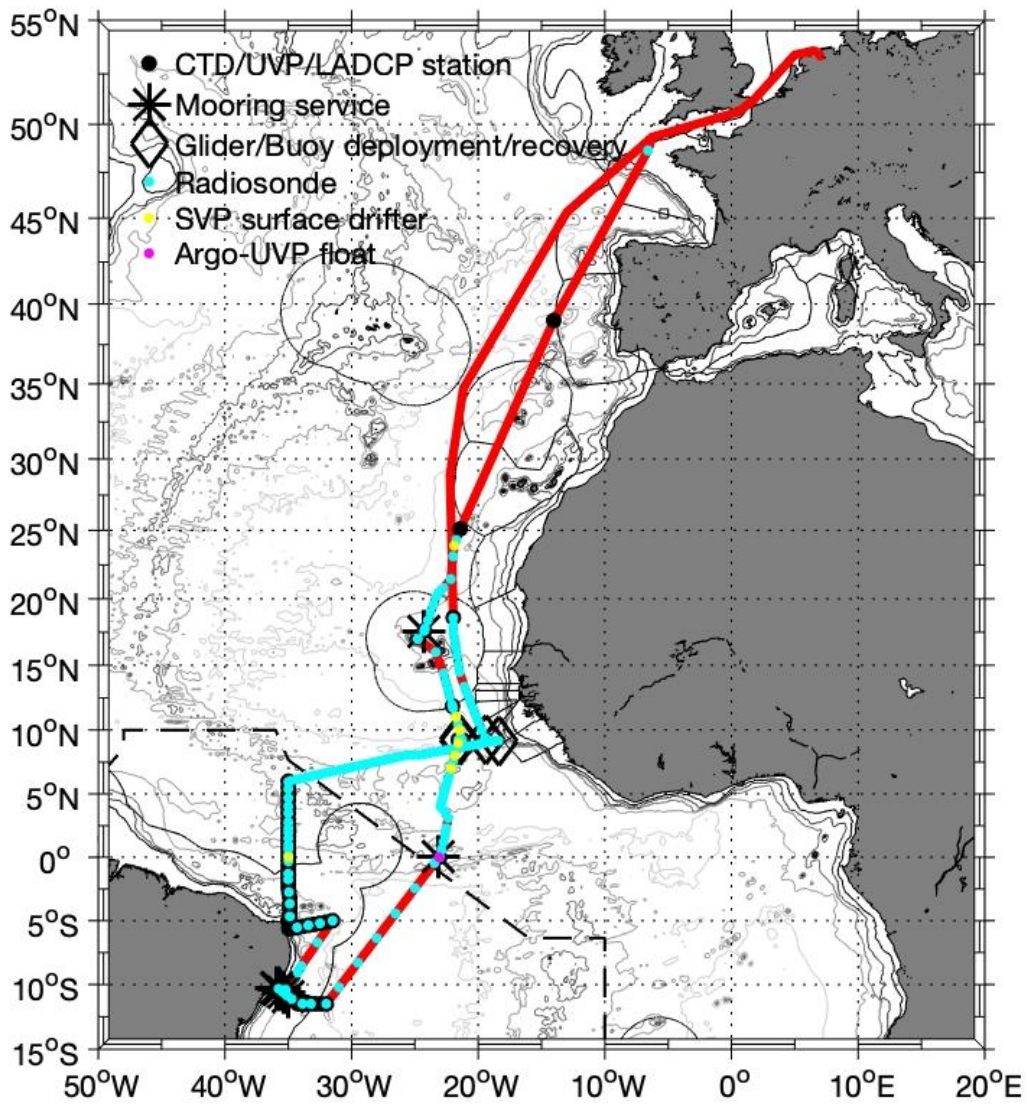


Fig.1: Bathymetric map with cruise track of R/V SONNE cruise SO284 (red solid line) including locations of conductivity-temperature-depths (CTD), underwater vision profiler (UVP), lowered acoustic Doppler current profiler (LADCP) stations, mooring recoveries/deployments, radiosonde stations, SVP surface drifter and Argo float releases, glider and surface drift buoy deployments and recoveries. Also marked are the EEZ of countries passed and locations.

Objectives

The aim of the R/V SONNE cruise SO284 is 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 work is also part of the EU TRIATLAS program „Tropical and South Atlantic climate-based marine ecosystem predictions for sustainable management“.

The physical oceanography program was composed of the service of long-term moorings including the Cape Verde Ocean Observatory (CVOO) north of Sao Vicente, the equatorial mooring at 23°W, and the mooring array at about 11°S off Brazil. Additional to the mooring service that could successfully completed, full-depth hydrographic and currents sections across the continental slope were taken off Brazil along the zonal sections at 11°S and 5°S and the meridional section at 35°W. In the tropical North Atlantic in between the Cape Verde archipelago and the equator an upper ocean mixing study was carried out that included the deployment of an autonomous operating glider with a microstructure probe attached and a freely drifting buoy with an acoustic Doppler current profiler. Both platforms were deployed at the beginning of the cruise and successfully recovered at the end of the cruise. The oceanographic measurement program was complemented by the release of 8 SVP surface drifters and one biogeochemical Argo float with an underwater vision profiler.

The meteorological program during SO284 focused on the thermodynamic and dynamic state of the Atlantic Intertropical Convergence Zone (ITCZ). The key question addressed is how convective scale processes in the atmosphere, and their coupling to the ocean, shape the large-scale structure of the ITCZ. The measurement program 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 of key atmospheric parameters such as wind speed and direction, humidity, temperature, pressure and precipitation. All underway measurements ran from the time we left the Canary Islands EEZ 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. 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.

Narrative

After a 10-day quarantine due to the corona-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 port of Emden on Sunday, June 27 at about noon. First station of SO284 was a radiosonde launch on June 29 at the exit of the English Channel. First measurements with the CTD were 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 hour 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 drifter program was deployed on July 7. Drifters were provided by NOAA AOML, Miami, USA.

North of the Cape Verdean Island of São Vicente, we arrived at the position of an interdisciplinary observatory, the Cape Verde Ocean Observatory (CVOO), which was installed 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 redeployed 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 a crew member had to disembark because of medical issues.

Radiosonde work continued with launches every 3 hours while approaching the Intertropical Convergence Zone (ITCZ) but, due to a temporarily malfunctioning antenna system, some of the radiosondes 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 pile 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 with stronger than expected northern branch of the North Equatorial Countercurrent.

Marked by the onset of heavy rain, the northern edge of the ITCZ reached our position 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 radiosonde launches were reduced with measurements 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 programme. 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 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. First CTD at 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 redeployed. On July 20, we recovered the two most shallow 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 station of the section along 5°S. The CTD section consisted of 13 CTD 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 this position, 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 to measure boundary currents or 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 had only to exchange one oxygen sensor and the fluorescence sensor for measuring Chlorophyll. 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 towards the deployment sites of the glider and the surface drift buoy while radiosondes were launched every two hours.

Meanwhile the drift buoy had an extremely fast drift towards 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 allowance for Guinea-Bissau. The drift buoy was finally recovered in the EEZ of Guinea-Bissau about during late night on July 3. Next morning, on July 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. Radiosonde launches were continued until we arrived at 18°30'N on August 6. The last station of the cruise was a CTD test-station on the same day in preparation of the next R/V SONNE cruise SO285. The measurement program ended with the stop of the continuous underway measurements at the entry of the EEZ of France. We arrived at the port of Emden on August 16 at 09:00 UTC.

Acknowledgements

We are grateful to Tilo Birnbaum and his crew for the excellent collaboration. The crew of R/V SONNE greatly contributed to the success of the cruise. 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.

List of Participants

	Name, degree	Discipline, function	Institute
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
4	Hans, Anna Christina	PO, CTD, AQD, Optodes	GEOMAR
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 ₂ O, CH ₄ , O ₂	GEOMAR
16	Wittlinger, Xaver Anselm	CO, N ₂ O, CH ₄	GEOMAR
17	Franke, Henning	ME, Radio sondes, GPS based CWV	MPI-M
18	Quaglia, Ilaria	ME, Radio sondes, Ceilometer	MPI-M
19	Stolla, Magda Katharina	ME, Radio sondes	MPI-M
20	Rubio, Hugo	ME, Wind Lidar	IWES
21	Engelmann, Ronny, Dr.	ME, OCEANET Container	TROPOS
22	Skupin, Annett, Dr.	ME, OCEANET Container	TROPOS
23	Ruhtz, Thomas, Dr.	ME, Aerosols, Microtops	FUB
24	Lehmke, Jonas	ME, Aerosols	FUB
25	dos Anjos, Felipe Augusto Affonso	Observer	Brazilian Navy

Abbreviations: PO – Physical Oceanography, CO – Chemical Oceanography, ME – Meteorology, ADCP – acoustic Doppler current profiler, CTD – conductivity-temperature-depth measurements and water sampling, LADCP – lowered ADCP, AQD – Aquadopp moored current meter, MC – MicroCAT moored conductivity-temperature-depth sonde, MMP – McLane moored profiler, CWV – Columnar Water Vapor.

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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	22:42	04°03.32'N	022°58.70'		

			Sonde			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'	3400	CTD station (20m

						W		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	04:42	07°33.71'N	027°52.28'		

			Sonde			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