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Short Cruise Report
RV METEOR cruise M189

Walvis Bay (Namibia) - Walvis Bay
16th April - 13th May 2023
Chief Scientist: Dr. Marcus Dengler
Captain: Rainer Hammacher

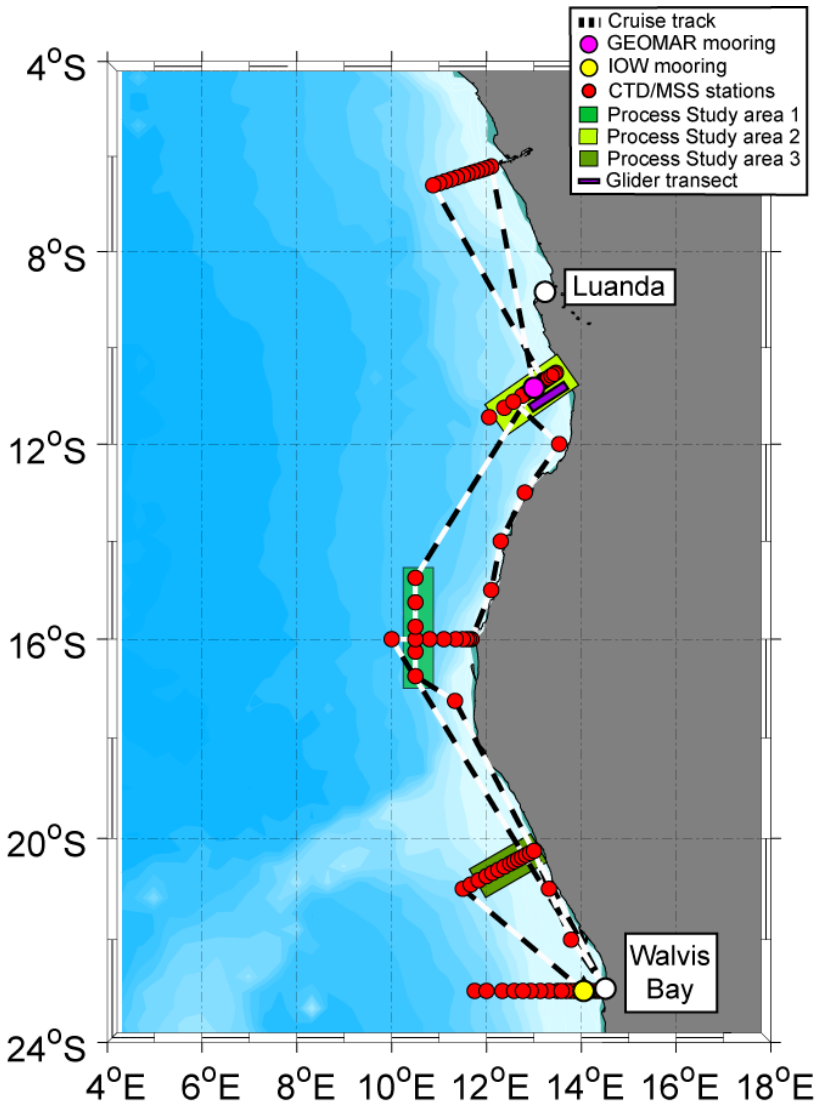

Fig.1: Bathymetric map with cruise track of R/V METEOR cruise M189 (dashed black and white line) including locations of CTD/MSS stations, mooring recoveries and redeployments, and glider transects. Regions in which process studies were carried out are also marked.

Objectives

The objective of the physical - biogeochemical measurement program during RV METEOR cruise M189 was to measure the variability of the circulation and the coastal upwelling off Angola and Namibia. The cruise focused on processes relevant to coastal upwelling, greenhouse gas production and emission, and biological productivity. Physical processes that were investigated include oceanic forcing by the wind, the role of tide-generated internal waves and the turbulent mixing they cause, the role of freshwater inputs, and dynamic processes associated with the Angola-Benguela Front. Projects related to the cruise are the BMBF collaborative project "Benguela Niños: Physical processes and long-period variability (BANINO)" and the EU collaborative project “Tropical and South Atlantic climate-based marine ecosystem predictions for sustainable management (TRIATLAS)”. Within BANINO the ocean observing system off the coast of Southwest Africa is extended to measure and understand the variability of coastal upwelling on time scales from weeks to decades. In TRIATLAS, we are studying the current state of the ecosystem in the Southern and tropical Atlantic to better predict future changes.

The work program included servicing of moorings, hydrographic and velocity sections, upwelling process studies with high-resolution sampling of hydrography, turbulence, biogeochemical parameters and autonomous measurements by ocean gliders (Fig. 1). Additionally, continuous sampling of velocity in the upper water column and trace gas concentrations, temperature and salinity in the surface waters was carried out. Long-term oceanographic moorings measuring the variability of the eastern boundary circulation and hydrography at 11°S and at 23°S in a water depth of 1500m and 100m, respectively, were serviced and reinstalled at the same position. Hydrographic sections (CTD/O_2) and water samples were taken along 5 predominately zonal sections at 6°S, 11°S, 16°S, 20°S and 23°S (Fig. 1) and along one meridional section cutting through a mesoscale cyclonic eddy in the Angola-Benguela frontal region at 10.5°E. Parameters measured by sensors attached to the CTD-rosette include temperature, salinity, pressure, chlorophyll, turbidity, nitrate and particle detection using an underwater vision profiler. All CTD/O_2 stations were accompanied by microstructure measurements to sample the strength of ocean turbulence in the upper water column. Water samples were taken for the analysis of a variety of parameters including salinity, oxygen, nutrients (NH^{4+}, NO^{3-}, NO^{2-}, PO_3^{4-}, SiO_2), trace gases (N_2O), Sulfur (SO_3), microbial abundances and single cell activity. A 4-day-long upwelling process study was carried out at 11°S. For this experiment, short-term moorings measuring velocity and hydrography were installed along a section perpendicular to bathymetry and three ocean gliders were deployed sampling hydrography, turbidity, oxygen and chlorophyll. Additionally, the gliders were carrying sensor package to sample nitrate, turbulence or particles using an underwater vision profiler. Repeated high-resolution profiles of turbulence and hydrography across the continental slope and shelf were taken along the section. Process studies were also carried out at 20°S, where an 18-hour microstructure station was taken at about 200m water depth, and along 10.5°E where high-resolution hydrography using a moving vessel profiler was collected while surveying through a mesoscale eddy.

Narrative

With little delay, RV METEOR left the harbor of Walvis Bay, Namibia in sunny weather under pilotage and tug assistance in the morning of April 16th and set out for the working area of Namibia. The original plan was to start research in Angolan waters. Although a research permit for Angola had been received, an additional exemption of import tax was requested, for the processing of which at least five working days have to be calculated.

Without this exemption we were not allowed to enter Angolan waters. Instead, we started our work program by deploying a surface drifter having acoustic Doppler current profiler attached at 50m depth off the Namibian coast at 23°S six hours after departure. In the following days, 22 conductivity-temperature-depth (CTD) stations were occupied along the 23°S section that were mostly followed by microstructure stations (MSS) where profiles of ocean turbulence were collected. Additionally, a long-term mooring measuring ocean currents and hydrography and a sediment trap was successfully recovered and redeployed in a water depth of 135m at 23°S. The surface drifter was recovered and the 23°S section was completed three and a half days later on April 19th, 22:30 UTC.

After about 18 hours of steaming, measurements along a section perpendicular to the coast at 20°S were taken. The section works here began again with the deployment of a surface drifter at a water depth of 200m in the afternoon of April 20th. Altogether, 14 CTD stations were taken along the 20°S section. Unfortunately, the microstructure profiler system malfunction at the beginning of the section work. It took 9 hours to re-terminate the MSS cable and to replace the microstructure winch on the gunwale at the vessel's stern. The MSS data collected at the CTD stations inshore of the 200m were thus not collected right after the CTD stations but during a later period. After completing the 20°S section, a process study on diapycnal mixing by non-linear internal waves was conducted by taking an 18-hour MSS time series station in the vicinity of the drifter position. The drifter was recovered in the early afternoon on April 23rd. Three CTD stations at shallow depth between 21°S and 23°S completed our work in Namibian waters.

RV METEOR returned to the harbor of Walvis Bay to clear customs and immigration at 9 am local time on April 24th. Additionally, we received scientific instruments to measure surface trace gas concentrations that were sent by air freight from Nijmegen, Netherlands but did not make it to Walvis Bay prior to our first departure. After leaving port in the early evening, sampling with underway instrumentation was not possible before leaving Namibian territorial waters. In the morning of April 26th, two hours before entering Angolan territorial waters, the requested exemption from the temporary import and export tax for RV METEOR was granted by the Angolan General Tax Administration (AGT). Fortunately, it was not limited to 10 days as we had feared.

This allowed the continuation of our measurement program in Angolan waters. With wind and waves from astern, RV METEOR changed course to sample the currents and stratification in the Angola-Benguela Frontal Zone on a meridional section along 10.5°E. This section cut through a cyclonic mesoscale eddy that had developed in the Angola-Benguela front in mid-March. The section was completed on Thursday afternoon, April 27th and we set course for the coastal region off Angola at 11°S. The elevated water and air temperatures and the decreasing winds north of 15°S led to an abrupt change of clothing of all cruise participants and a busy working deck. In the evening, we celebrated the mid-cruise festival with a barbecue on deck.

The main study area in Angolan waters at 11°S was reached on Friday afternoon, April 28th. CTD and MSS measurements were taken along a section perpendicular to the coast during the night. In the next morning on April 29th, two landers equipped with acoustic Doppler velocity profilers and a mooring were deployed along the upper continental slope and shelf at 11°S, slightly south of our main CTD section at 11°S. Additionally, three gliders with different auxiliary sensors were released at the upper continental slope and 12 surface drifters with shallow drogues (Hereon drifter) were deployed in water depth shallower than 450m. The short-term moorings and the gliders were deployed for nearly 10 days to sample the physical and biogeochemical processes associated with coastal upwelling in tropical Angolan upwelling region. CTD and MSS stations along the 11°S were continued for the rest of the day until we headed north just after midnight to take a section at 6°S. CTD and MSS sampling along the 6°S section was started in the morning of May 1st and completed 25 hours later. Hydrographic data using the Moving Vessel Profiler

(MVP) was collected while returning to the 11°S section. Unfortunately, the cable of the MVP broke after 9 hours of sampling leading to a termination of MVP measurements.

CTD and MSS sampling along the 11°S section was continued starting in the afternoon of May 3rd. The long-term mooring KPO 1246 deployed at a water depth of 1200m to record the variability of the boundary current circulation in the tropical Angolan upwelling region (Fig. 1), which has been maintained for almost 10 years by GEOMAR in collaboration with the Instituto Nacional de Investigação Pesqueira in Luanda, was recovered in the afternoon of May 4th. After the mooring recovery, glider ifm14 was retrieved. The lamp of the Underwater Vision Profiler that was attached to the glider for the first time during a see-going experiment, had become loose. The glider was not redeployed. We completed the 11°S section three hour later at 21:00 UTC.

The upwelling process study at 11°S was started with a high resolution MSS transect from a water depth of 450m to 50m. Altogether, 107 profiles were collected until the next morning. After recovering a drifter, MSS data were collected from the rubber boat in very shallow waters (~25m water depth). In the evening of May 5th, an MVP section from a water depth of 50m to 450m along the 11°S section was started. At about 20:00 UTC, we noticed that glider ifm13 had not surfaced at the predicted position, but about 8 nautical miles to the southeast. The station work was discontinued and RV METEOR headed for the last known position of the glider. At first, our search was unsuccessful, we could neither find an AIS signal, nor small fishing boats by means of ship radar in the area. Renewed position reports of the glider shortly after midnight indicated that it was already in the roadstead off the town of Porto Amboim, about 10 nautical miles south of the 11°S section. After continuing the MVP section work until the morning of May 6th, th position of the glider was visited first with RV METEOR and later with the rubber boat. Thanks to the very accurate GPS information, we were able to quickly locate the fishing boat, about 8 m long, among the many boats anchoring there. The fishermen were very cooperative and both sides were very happy about an exchange deal in which we got back our intact instrument for ship's paint, oilskins, sunglasses and some supplies from the store of the first steward. In the afternoon, as a precautionary measure, the remaining glider ifm09 was retrieved and the long-term mooring (KPO 1272) was redeployed at 1200m water depth. Over the night until the next morning, further turbulence measurements were carried out in shallow waters along the 11°S section, which completed the process study at 11°S.

In the morning of May 7th, the two lander and the short-term mooring were recovered and RV METEOR took course to 16°S. On the way, CTD profiles were taken along the 100m isobath. The zonal section along 16°S was started on May 9th at 4:00 UTC. Altogether, 10 CTD profiles were collected along the section. Additionally, an MSS station was sampled in the evening of May 9th, during which different MSS protection cages were used to test their impact on the system’s noise level. The section was completed in the morning of May 10th. As the meteorologist on board were forecasting elevated winds, we decided for an early arrival in the harbor and thus headed towards Walvis Bay. While steaming in southern direction, wind and swell gradually increase, peaking at 5 to 6 Bft., gusting to 7 Bft., and 3.5 m of significant swell as we enter the harbor on May 12th, 11:00 UTC.

Acknowledgements

We are grateful to Capitan Hammacher and his crew for the excellent collaboration and the pleasant working atmosphere during the cruise. The crew of RV METEOR greatly contributed to the success of the cruise. The ship time of RV METEOR was provided by the German Science Foundation (DFG) within the core program METEOR/MERIAN. Financial support was provided by the German Federal Ministry of Education and Research as part of the BANINO (03F0795A) project and by the EU H2020 under grant agreement 817578 TRIATLAS project.

List of Participants

No.	Name	Discipline	Institution
1	Dengler, Marcus, Dr.	PO, chief scientist	GEOMAR
2	Krahmann, Gerd, Dr.	PO, CTD processing, glider, moorings, MVP processing	GEOMAR
3	Arévalo-Martínez, Damian L., Dr.	CO, trace gases, sulphur, nutrients	RU
4	Imbol Kongue, Rodrigue Anicet, Dr.	PO, CTD, moorings, vmADCP processing	GEOMAR
5	Söder, Jens, Dr.	PO, drifter, moorings, MSS	IOW
6	Awo, Founi Mesmin, Dr.	PO, CTD, MSS, MVP	UCT
7	Körner, Mareike	PO, CTD, MSS processing, MVP vmADCP processing	GEOMAR
8	Aroucha, Léo Costa	PO, CTD, MSS, thermosalinograph	GEOMAR
9	Reese, Nina	PO, CTD, MSS	IOW
10	Begler, Christian	PO, moorings, glider	GEOMAR
11	Nielsen, Martina	PO, moorings, logistics	GEOMAR
12	Stockmayer, Vera	PO, CTD, MSS, MVP, air-sea heat fluxes	GEOMAR
13	Mock, Leon	PO, CTD, MSS, MVP, oxygen, UVP	GEOMAR
14	Friedrich, Berit	PO, CTD, MSS, MVP salinometer	GEOMAR
15	Perschon, Justus	PO, CTD, MSS, MVP, salinometer	GEOMAR
16	Melzer, Hannah	PO, CTD, MSS, MVP, satellite retrievals	GEOMAR
17	Pöhnl, Denise	PO, CTD, MSS, MVP, oxygen	GEOMAR
18	Eisnecker, Paula	CO, trace gases, sulphur	GEOMAR
19	Henning, Philip	PO, MVP, glider	GEOMAR
20	Wölker, Yannick	PO, CTD, MSS, MVP. drifter	GEOMAR
21	Mrozowska, Marta Agnieszka	PO, CTD, MSS, MVP, drifter	NBI
22	Jacobsen, Mats	BO, DNA/RNA, POM, PP	SDU
23	Otte, Frank	ME	DWD
24	Elsässer, Antje	ME	DWD

Abbreviations:
PO – Physical Oceanography, CO – Chemical Oceanography, BO – Biological Oceanography, ME – Meteorology, CTD – conductivity temperature-depth measurements and water sampling, MSS – microstructure sonde, MVP – moving vessel profiler, POM – particulate organic matter, PP – primary productivity, UVP –underwater vision profiler, vmADCP – vessel-mounted acoustic Doppler current profiler.

Institutes:

DWD	Deutscher Wetterdienst, Germany
GEOMAR	GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
IOW	Leibniz-Institut für Ostseeforschung Warnemünde, Rostock, Germany.
NBI	Niels Bohr Institute, Copenhagen, Denmark
RU	Radboud Universiteit, Nijmegen, Netherlands
SDU	University of Southern Denmark, Odense, Denmark
UCT	University of Cape Town, Rondebosch, South Africa

Stationlist

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
METEOR	GEOMAR			[UTC]	[°N]	[°W]	[m]	
M189_01-1	CTD 1	16.04.	CTD	14:12	22° 59.963'S	013° 29.968'E	240	to bottom -10m
M189_02-1	Drifter 1	16.04.	Drifter	16:00	23° 00.270'S	013° 31.894'E	205	IOW drifter deployment
M189_03-1	CTD 2	16.04.	CTD	17:08	22° 59.941'S	013° 37.889'E	151	to bottom -10m
M189_04-1	MSS 1	16.04.	MSS	17:36	23° 00.038'S	013° 37.687'E	151	3 profiles to bottom
M189_05-1	CTD 3	16.04.	CTD	19:58	23° 00.074'S	013° 42.436'E	153	to bottom -10m
M189_06-1	MSS 2	16.04.	MSS	20:28	22° 59.670'S	013° 42.525'E	151	3 profiles to bottom
M189_07-1	CTD 4	16.04.	CTD	22:37	22° 59.930' S	013° 47.909' E	149	to bottom -10m
M189_08-1	MSS 3	16.04.	MSS	23:02	22° 59.926' S	013° 47.857' E	148	3 profiles to bottom
M189_09-1	CTD 5	17.04.	CTD	00:32	22° 59.971' S	013° 52.988' E	147	to bottom -10m
M189_10-1	MSS 4	17.04.	MSS	00:54	23° 00.006' S	013° 52.982' E	147	3 profiles to bottom
M189_11-1	CTD 6	17.04.	CTD	02:21	22° 59.993' S	013° 58.111' E	142	to bottom -10m
M189_12-1	MSS 5	17.04.	MSS	02:43	23° 00.108' S	013° 58.177' E	143	3 profiles to bottom
M189_13-1	CTD 7	17.04.	CTD	04:39	23° 02.049' S	014° 03.133' E	135	to bottom -10m
M189_14-1	MSS 6	17.04.	MSS	04:59	23° 02.143' S	014° 03.241' E	135	3 profiles to bottom
M189_15-1	CTD 8	17.04.	CTD	06:36	22° 59.863' S	014° 08.018' E	133	to bottom -10m
M189_16-1	MSS 7	17.04.	MSS	07:05	22° 59.969' S	014° 08.013' E	125	3 profiles to bottom
M189_17-1	CTD 9	17.04.	CTD	08:37	22° 59.948' S	014° 13.050' E	111	to bottom -10m
M189_18-1	MSS 8	17.04.	MSS	08:50	22° 59.854' S	014° 13.049' E	111	3 profiles to bottom
M189_19-1	CTD 11	17.04.	CTD	10:20	22° 59.970' S	014° 18.038' E	85	to bottom -10m
M189_20-1	MSS 9	17.04.	MSS	10:37	23° 00.014' S	014° 18.042' E	84	3 profiles to bottom
M189_21-1	Mooring 1	17.04.	Mooring	12:39	22° 59.679' S	014° 03.393' E	138	LTMB mooring recovery (28)
M189_22-1	Mooring 2	17.04.	Mooring	14:36	23° 01.235' S	014° 01.989' E	136	recovery of sediment trap
M189_23-1	CTD 12	17.04.	CTD	19:42	22° 59.950' S	013° 29.931' E	240	to bottom -10m
M189_24-1	MSS 10	17.04.	MSS	20:03	22° 59.968' S	013° 30.041' E	238	3 profiles to 200m
M189_25-1	CTD 13	17.04.	CTD	22:19	22° 59.945' S	013° 19.972' E	355	to bottom -10m
M189_26-1	MSS 11	17.04.	MSS	22:48	22° 59.924' S	013° 19.853' E	355	3 profiles to 200m
M189_27-1	CTD 14	18.04.	CTD	00:56	23° 00.036' S	013° 09.909' E	326	to bottom -10m
M189_28-1	MSS 12	18.04.	MSS	01:18	23° 00.090' S	013° 09.761' E	324	3 profiles to 200m
M189_29-1	CTD 15	18.04.	CTD	03:33	23° 00.068' S	012° 59.806' E	510	to bottom -10m
M189_30-1	MSS 13	18.04.	MSS	03:59	23° 00.260' S	012° 59.753' E	515	3 profiles to 200m
M189_31-1	CTD 16	18.04.	CTD	06:44	23° 00.370' S	012° 45.241' E	1015	to bottom -10m
M189_32-1	MSS 14	18.04.	MSS	07:14	23° 00.517' S	012° 45.660' E	1001	3 profiles to 200m
M189_33-1	CTD 17	18.04.	CTD	10:20	23° 00.151' S	012° 29.706' E	1646	to bottom -10m
M189_34-1	MSS 15	18.04.	MSS	11:50	23° 00.545' S	012° 29.891' E	1638	3 profiles to 200m
M189_35-1	CTD 18	18.04.	CTD	15:07	23° 00.044' S	012° 15.205' E	2273	to bottom -10m
M189_36-1	MSS 16	18.04.	MSS	16:14	23° 00.227' S	012° 15.543' E	2253	3 profiles to 200m
M189_37-1	CTD 19	18.04.	CTD	19:31	23° 00.193' S	011° 59.983' E	2703	to bottom -10m
M189_38-1	MSS 17	18.04.	MSS	20:35	23° 00.621' S	012° 00.338' E	2690	3 profiles to 200m
M189_39-1	CTD 20	19.04.	CTD	00:08	23° 00.000' S	011° 44.996' E	2986	to bottom -10m
M189_40-1	MSS 18	19.04.	MSS	01:10	23° 00.002' S	011° 45.025' E	2983	system malfunctioned
M189_41-1	Drifter 2	19.04.	Drifter	11:47	23° 08.146' S	013° 23.902' E	319	IOW drifter recovery
M189_42-1	Mooring 3	19.04.	Mooring	15:51	22° 59.343' S	014° 03.062' E	136	LTMB mooring deployment (29)
M189_43-1	Mooring 4	19.04.	Mooring	16:53	23° 01.362' S	014° 02.181' E	140	deployment of sediment trap
M189_45-1	CTD 21	19.04.	CTD	19:09	23° 00,003' S	013° 57,971' E	141	to bottom -10m
M189_46-1	CTD 22	19.04.	CTD	21:48	22° 59,984' S	014° 22,067' E	41	to bottom -10m
M189_47-1	MSS 19	19.04.	MSS	21:59	22° 59,933' S	014° 22,168' E	37	5 profiles to bottom
M189_48-1	Drifter 3	20.04.	Drifter	17:02	20° 25,372' S	012° 39,485' E	205	IOW drifter deployment
M189_49-1	CTD 23	20.04.	CTD	18:06	20° 27,727' S	012° 34,968' E	265	to bottom -10m
M189_50-1	MSS 20	20.04.	MSS	18:25	20° 27,897' S	012° 34,925' E	267	1 profile to 200m
M189_51-1	CTD 24	20.04.	CTD	20:09	20° 30,207' S	012° 29,982' E	295	to bottom -10m
M189_52-1	MSS 21	20.04.	MSS	20:22	20° 30,313' S	012° 30,012' E	295	MSS malfunctioned
M189_53-1	CTD 25	20.04.	CTD	21:43	20° 33,875' S	012° 22,564' E	309	to bottom -10m
M189_54-1	MSS 22	20.04.	MSS	21:56	20° 33,875' S	012° 22,600' E	309	MSS malfunctioned
M189_55-1	CTD 26	20.04.	CTD	23:10	20° 37,476' S	012° 15,036' E	366	to bottom -10m

M189_56-1	MSS 23	20.04.	MSS	23:33	20° 37,700' S	012° 15,093' E	369	3 profiles to 200m
M189_57-1	CTD 27	21.04.	CTD	01:33	20° 41,225' S	012° 07,501' E	574	to bottom -10m
M189_58-1	MSS 24	21.04.	MSS	01:55	20° 41,313' S	012° 07,555' E	570	2 profiles to 200m
M189_59-1	CTD 28	21.04.	CTD	03:42	20° 45,061' S	012° 00,072' E	780	to bottom -10m
M189_60-1	MSS 25	21.04.	MSS	04:10	20° 45,496' S	012° 00,034' E	787	MSS malfunctioned
M189_61-1	CTD 29	21.04.	CTD	05:43	20° 50,052' S	011° 49.932' E	1101	to bottom -10m
M189_62-1	MSS 26	21.04.	MSS	06:14	20° 50,352' S	011° 49,950' E	1105	MSS malfunctioned
M189_63-1	CTD 30	21.04.	CTD	08:08	20° 55,002' S	011° 40,133' E	1419	to bottom -10m
M189_64-1	MSS 27	21.04.	MSS	08:50	20° 55,419' S	011° 40,374' E	1414	3 profiles to 200m
M189_65-1	CTD 31	21.04.	CTD	11:36	20° 59,990' S	011° 29,973' E	1894	to bottom -10m
M189_66-1	MSS 28	21.04.	MSS	12:24	21° 00,151' S	011° 30,017' E	1895	3 profiles to 200m
M189_67-1	MSS 29	21.04.	MSS	15:31	20° 50,138' S	011° 49,972' E	1100	3 profiles to 200m
M189_68-1	MSS 30	21.04.	MSS	17:31	20° 45,039' S	011° 59,991' E	781	3 profiles to 200m
M189_69-1	MSS 31	21.04.	MSS	19:24	20° 41,392' S	012° 07,846' E	564	3 profiles to 200m
M189_70-1	MSS 32	21.04.	MSS	21:03	20° 37,651' S	012° 15,007' E	369	3 profiles to 200m
M189_71-1	MSS 33	21.04.	MSS	22:49	20° 33,654' S	012° 22,501' E	309	3 profiles to 200m
M189_72-1	MSS 33	22.04.	MSS	00:28	20° 29,999' S	012° 29,987' E	295	3 profiles to 200m
M189_73-1	MSS 34	22.04.	MSS	01:50	20° 27,529' S	012° 34,984' E	266	3 profiles to 200m
M189_74-1	CTD 32	22.04.	CTD	10:32	20° 25,017' S	012° 40,008' E	174	to bottom -10m
M189_75-1	MSS 36	22.04.	MSS	10:48	20° 25,187' S	012° 39,988' E	192	3 profiles to bottom
M189_76-1	CTD 33	22.04.	CTD	12:25	20° 22,489' S	012° 44,983' E	147	to bottom -10m
M189_77-1	MSS 37	22.04.	MSS	12:37	20° 22,558' S	012° 45,019' E	146	3 profiles to bottom
M189_78-1	CTD 34	22.04.	CTD	14:05	20° 20,018' S	012° 49,994' E	132	to bottom -10m
M189_79-1	MSS 38	22.04.	MSS	14:22	20° 20,056' S	012° 49,998' E	132	3 profiles to bottom
M189_80-1	CTD 35	22.04.	CTD	15:48	20° 17,515' S	012° 54,974' E	122	to bottom -10m
M189_81-1	MSS 39	22.04.	MSS	16:00	20° 17,515' S	012° 55,035' E	121	3 profiles to bottom
M189_82-1	CTD 36	22.04.	CTD	17:25	20° 15,009' S	012° 59,967' E	98	to bottom -10m
M189_83-1	MSS 40	22.04.	MSS	17:46	20° 15,201' S	013° 00,069' E	98	3 profiles to bottom
M189_84-1	MSS 41	22.04.	MSS	20:59	20° 15,320' S	012° 32,704' E	199	MSS transect (7)
M189_85-1	MSS 42	22.04.	MSS	23:12	20° 14,655' S	012° 32,112' E	201	MSS transect (10)
M189_86-1	MSS 43	23.04.	MSS	01:50	20° 13,875' S	012° 32,784' E	183	MSS transect (18)
M189_87-1	MSS 44	23.04.	MSS	05:54	20° 12,778' S	012° 32,790' E	173	MSS transect (15)
M189_88-1	MSS 45	23.04.	MSS	09:21	20° 12,876' S	012° 32,938' E	169	MSS transect (8)
M189_89-1	Drifter 4	23.04.	Drifter	11:44	20° 14,717' S	012° 32,171' E	201	IOW drifter recovery
M189_90-1	CTD 37	23.04.	CTD	18:27	20° 59,882' S	013° 18,930' E	99	to bottom -10m
M189_91-1	CTD 38	24.04.	CTD	01:14	22° 00,065' S	013° 46,996' E	104	to bottom -10m
M189_92-1	CTD 39	24.04.	CTD	07:00	22° 40,046' S	014° 13,255' E	101	to bottom -10m
M189_93-1	MVP 1	26.04.	MVP	14:37-16:50	16° 44,401' S	010° 29,990' E	3216	MVP transect at 7kn
M189_94-1	MVP 2	26.04.	MVP	16:55-18:47	16° 29,105' S	010° 29,998' E	3223	MVP transect at 7kn
M189_95-1	CTD 40	26.04.	CTD	19:33	16° 15,203' S	010° 29,804' E	3553	to 1200m depth
M189_96-1	MVP 3	26.04.	MVP	20:20-22:37	16° 15,377' S	010° 29,806' E	3552	MVP transect at 7kn
M189_97-1	MVP 4	26.04.	MVP	22:43-00:47	15° 59,006' S	010° 30,000' E	3606	MVP transect at 7kn
M189_98-1	CTD 41	27.04.	CTD	01:23	15° 44,817' S	010° 29,888' E	3576	to 1200m depth
M189_99-1	MVP 5	27.04.	MVP	02:05-04:17	15° 44,532' S	010° 29,995' E	3575	MVP transect at 7kn
M189_100-1	MVP 6	27.04.	MVP	04:20-06:17	15° 28,745' S	010° 29,997' E	3355	MVP transect at 7kn
M189_101-1	CTD 42	27.04.	CTD	07:02	15° 15,105' S	010° 29,944' E	3460	to 1200m depth
M189_102-1	MVP 7	27.04.	MVP	07:51-09:47	15° 14,000' S	010° 30,000' E	3497	MVP transect at 7kn
M189_103-1	MVP 8	27.04.	MVP	09:47-12:06	15° 00,450' S	010° 29,997' E	3514	MVP transect at 7kn
M189_104-1	MVP 9	27.04.	MVP	12:15-14:26	14° 44,176' S	010° 29,998' E	3610	MVP transect at 7kn
M189_105-1	CTD 43	28.04.	CTD	15:01	11° 04,834' S	012° 37,954' E	1534	to bottom -10m
M189_106-1	MSS 46	28.04.	MSS	15:48	11° 05,520' S	012° 37,963' E	1560	3 profiles to 200m
M189_107-1	CTD 44	28.04.	CTD	18:19	11° 00,232' S	012° 44,065' E	1426	to bottom -10m
M189_108-1	MSS 47	28.04.	MSS	18:56	11° 00,463' S	012° 44,181' E	1432	3 profiles to 200m
M189_109-1	CTD 45	28.04.	CTD	21:17	10° 56,092' S	012° 50,934' E	1366	to bottom -10m
M189_110-1	MSS 48	28.04.	MSS	21:47	10° 56,351' S	012° 50,856' E	1370	3 profiles to 200m
M189_111-1	CTD 46	28.04.	CTD	23:54	10° 51,974' S	012° 56,832' E	1261	to bottom -10m
M189_112-1	MSS 49	29.04.	MSS	00:25	10° 52,074' S	012° 56,630' E	1263	3 profiles to 200m

M189_113-1	CTD 47	29.04.	CTD	03:04	10° 47,842' S	013° 02,659' E	1162	to bottom -10m
M189_114-1	MSS 50	29.04.	MSS	03:36	10° 47,821' S	013° 02,355' E	1161	3 profiles to 200m
M189_115-1	CTD 48	29.04.	CTD	05:34	10° 44,000' S	013° 08,946' E	701	to bottom -10m
M189_116-1	MSS 51	29.04.	MSS	06:02	10° 44,066' S	013° 08,661' E	723	3 profiles to 200m
M189_117-1	ifm13	29.04.	Glider	07:38	10° 41,860' S	013° 11,673' E	448	ifm13 deployment
M189_118-1	ifm14	29.04.	Glider	08:43	10° 41,424' S	013° 10,732' E	483	ifm14 deployment
M189_119-1	CTD 49	29.04.	CTD	09:27	10° 41,053' S	013° 09,894' E	517	to bottom -10m
M189_120-1	MSS 52	29.04.	MSS	09:49	10° 40,654' S	013° 09,931' E	504	3 profiles to 200m
M189_121-1	ifm09	29.04.	Glider	11:42	10° 41,105' S	013° 14,539' E	302	ifm09 deployment
M189_122-1	KPO 1273	29.04.	Mooring	13:02	10° 41,710' S	013° 17,179' E	201	deployment KPO 1273
M189_123-1	Drifter 1	29.04.	Drifter	13:07	10° 41,911' S	013° 17,106' E	209	Hereon drifter deploy
M189_124-1	KPO 1275	29.04.	Lander	14:30	10° 37,151' S	013° 23,457' E	100	deployment KPO 1275
M189_125-1	Drifter 2	29.04.	Drifter	14:42	10° 37,124' S	013° 23,507' E	102	Hereon drifter deploy
M189_126-1	KPO 1274	29.04.	Lander	15:57	10° 33,082' S	013° 30,630' E	52	deployment KPO 1274
M189_127-1	Drifter 3	29.04.	Drifter	16:03	10° 33,035' S	013° 30,733' E	51	Hereon drifter deploy
M189_128-1	CTD 50	29.04.	CTD	16:48	10° 27,910' S	013° 31,913' E	29	to bottom -10m
M189_129-1	MSS 53	29.04.	MSS	16:59	10° 27,973' S	013° 32,057' E	28	20 profiles to bottom
M189_130-1	CTD 51	29.04.	CTD	18:29	10° 30,005' S	013° 29,294' E	49	to bottom -10m
M189_131-1	MSS 54	29.04.	MSS	18:40	10° 30,189' S	013° 29,394' E	49	10 profiles to bottom
M189_132-1	CTD 52	29.04.	CTD	20:00	10° 31,781' S	013° 26,375' E	65	to bottom -10m
M189_133-1	CTD 53	29.04.	CTD	21:01	10° 33,593' S	013° 23,343' E	93	to bottom -10m
M189_134-1	MSS 55	29.04.	MSS	21:17	10° 33,559' S	013° 23,271' E	93	9 profiles to bottom
M189_135-1	CTD 54	29.04.	CTD	22:59	10° 35,683' S	013° 20,380' E	112	to bottom -10m
M189_136-1	MSS 56	29.04.	MSS	23:13	10° 35,563' S	013° 20,356' E	111	6 profiles to bottom
M189_137-1	CTD 55	30.04.	CTD	00:40	10° 37,975' S	013° 17,571' E	132	to bottom -10m
M189_138-1	MSS 57	30.04.	MSS	00:53	10° 38,035' S	013° 17,384' E	133	6 profiles to bottom
M189_139-1	Drifter 4	30.04.	Drifter	02:42	10° 42,062' S	013° 11,766' E	450	Hereon drifter deploy
M189_140-1	CTD 56	01.05.	CTD	06:47	06° 12,569' S	012° 05,733' E	41	to bottom -10m
M189_141-1	MSS 58	01.05.	MSS	06:57	06° 12,583' S	012° 05,559' E	41	5 profiles to bottom
M189_142-1	CTD 57	01.05.	CTD	08:12	06° 14,775' S	012° 00,004' E	66	to bottom -10m
M189_143-1	MSS 59	01.05.	MSS	08:31	06° 14,877' S	012° 00,010' E	66	5 profiles to bottom
M189_144-1	CTD 58	01.05.	CTD	09:56	06° 16,626' S	011° 53,966' E	83	to bottom -10m
M189_145-1	MSS 60	01.05.	MSS	10:11	06° 16,630' S	011° 53,916' E	83	5 profiles to bottom
M189_146-1	CTD 59	01.05.	CTD	11:41	06° 18,606' S	011° 47,932' E	107	to bottom -10m
M189_147-1	MSS 61	01.05.	MSS	11:51	06° 18,623' S	011° 47,814' E	108	5 profiles to bottom
M189_148-1	CTD 60	01.05.	CTD	13:25	06° 20,220' S	011° 41,777' E	121	to bottom -10m
M189_149-1	MSS 62	01.05.	MSS	13:37	06° 20,143' S	011° 41,675' E	121	4 profiles to bottom
M189_150-1	CTD 61	01.05.	CTD	15:07	06° 22,250' S	011° 35,898' E	205	to bottom -10m
M189_151-1	MSS 63	01.05.	MSS	15:21	06° 22,355' S	011° 35,853' E	207	3 profiles to bottom
M189_152-1	CTD 62	01.05.	CTD	16:53	06° 24,175' S	011° 29,799' E	354	to bottom -10m
M189_153-1	MSS 64	01.05.	MSS	17:14	06° 24,321' S	011° 29,597' E	358	3 profiles to 200m
M189_154-1	CTD 63	01.05.	CTD	19:12	06° 26,635' S	011° 22,492' E	533	to bottom -10m
M189_155-1	MSS 65	01.05.	MSS	19:32	06° 26,817' S	011° 22,486' E	534	3 profiles to 200m
M189_156-1	CTD 64	01.05.	CTD	21:34	06° 29,169' S	011° 14,856' E	844	to bottom -10m
M189_157-1	MSS 66	01.05.	MSS	22:03	06° 29,292' S	011° 14,645' E	854	3 profiles to 200m
M189_158-1	CTD 65	02.05.	CTD	00:00	06° 31,582' S	011° 07,317' E	1136	to bottom -10m
M189_159-1	MSS 67	02.05.	MSS	00:27	06° 31,688' S	011° 07,204' E	1138	3 profiles to 200m
M189_160-1	CTD 66	02.05.	CTD	02:30	06° 34,244' S	011° 00,137' E	1441	to bottom -10m
M189_161-1	MSS 68	02.05.	MSS	03:04	06° 34,650' S	011° 00,228' E	1441	3 profiles to 200m
M189_162-1	CTD 67	02.05.	CTD	05:16	06° 36,441' S	010° 52,425' E	1672	to bottom -10m
M189_163-1	MSS 69	02.05.	MSS	05:52	06° 36,473' S	010° 52,266' E	1441	3 profiles to 200m
M189_164-1	MVP 10	02.05.	MVP	08:15 - 17:03	06° 37,119' S	010° 51,455' E	1710	MVP transect at 10kn
M189_165-1	CTD 68	03.05.	CTD	15:19	11° 30,325' S	011° 59,988' E	2552	to bottom -10m
M189_166-1	MSS 70	03.05.	MSS	16:17	11° 30,706' S	011° 59,663' E	2529	2 profiles to 200m
M189_167-1	CTD 69	03.05.	CTD	19:13	11° 22,700' S	012° 10,957' E	2423	to bottom -10m
M189_168-1	MSS 71	03.05.	MSS	20:05	11° 22,981' S	012° 10,712' E	2514	3 profiles to 200m
M189_169-1	CTD 70	03.05.	CTD	23:19	11° 14,930' S	012° 22,496' E	1876	to bottom -10m
M189_170-1	MSS 72	04.05.	MSS	00:04	11° 14,815' S	012° 22,564' E	1854	3 profiles to 200m
M189_171-1	CTD 71	04.05.	CTD	02:21	11° 09,729' S	012° 29,867' E	1603	to bottom -10m
M189_172-1	MSS 73	04.05.	MSS	02:56	11° 09,459' S	012° 29,705' E	1614	3 profiles to 200m
M189_173-1	CTD 72	04.05.	CTD	04:56	11° 06,996' S	012° 33,897' E	1496	to bottom -10m

M189_174-1	MSS 74	04.05.	MSS	05:34	11° 06,927' S	012° 33,921' E	1493	3 profiles to 200m
M189_175-1	CTD 73	04.05.	CTD	07:52	11° 02,070' S	012° 41,663' E	1457	to bottom -10m
M189_176-1	MSS 75	04.05.	MSS	08:28	11° 02,000' S	012° 41,308' E	1468	3 profiles to 200m
M189_177-1	CTD 74	04.05.	CTD	10:38	10° 57,627' S	012° 47,649' E	1384	to bottom -10m
M189_178-1	MSS 76	04.05.	MSS	11:13	10° 57,225' S	012° 47,304' E	1382	3 profiles to 200m
M189_179-1	CTD 75	04.05.	CTD	13:21	10° 53,821' S	012° 53,822' E	1337	to bottom -10m
M189_180-1	KPO 1246	04.05.	Mooring	14:46	10° 50,264' S	012° 59,632' E	1234	recovery KPO 1246
M189_181-1	Glider 4	04.05.	Glider	17:08	10° 50,823' S	012° 59,498' E	1250	recovery ifm14
M189_182-1	CTD 76	04.05.	MSS	18:58	10° 45,482' S	013° 05,755' E	935	to bottom -10m
M189_183-1	MSS 77	04.05.	MSS	19:25	10° 45,393' S	013° 05,901' E	927	3 profiles to 200m
M189_184-1	MSS 78	04.05.	MSS	21:11	10° 39,830' S	013° 14,757' E	452	MSS transect (11)
M189_185-1	MSS 79	04.05.	MSS	23:18	10° 38,014' S	013° 17,427' E	259	MSS transect (15)
M189_186-1	MSS 80	05.05.	MSS	01:25	10° 35,940' S	013° 20,270' E	113	MSS transect (15)
M189_187-1	MSS 81	05.05.	MSS	03:10	10° 34,290' S	013° 22,554' E	98	MSS transect (18)
M189_188-1	MSS 82	05.05.	MSS	05:11	10° 32,472' S	013° 25,042' E	82	MSS transect (11)
M189_189-1	MSS 83	05.05.	MSS	06:37	10° 31,225' S	013° 26,757' E	61	MSS transect (20)
M189_190-1	MSS 84	05.05.	MSS	08:10	10° 29,968' S	013° 28,483' E	52	MSS transect (17)
M189_191-1	Drifter 5	05.05.	Drifter	11:24	10° 44,907' S	013° 36,609' E	69	Hereon drifter recovery s/n 308
M189_192-1	MSS 85	05.05.	MSS	13:30	10° 27,946' S	013° 31,949' E	29	MSS from rubber boat (8 profiles)
M189_193-1	MVP 11	05.05.	MVP	15:45 - 18:03	10° 27,527' S	013° 32,534' E	26	MVP transect
M189_194-1	CTD 77	05.05.	CTD	18:21	10° 33,979' S	013° 23,315' E	94	to bottom -10m
M189_195-1	MVP 12	05.05.	MVP	18:41 - 19:32	10° 34,344' S	013° 23,225' E	95	MVP transect at 7kn
M189_196-1	CTD 78	05.05.	CTD	19:39	10° 35,979' S	013° 20,637' E	111	to bottom -10m
M189_197-1	MVP 13	05.05.	MVP	19:53 - 20:38	10° 35,939' S	013° 20,972' E	109	MVP transect at 7kn
M189_198-1	MVP 14	06.05.	MVP	01:09 - 02:44	10° 35,932' S	013° 20,550' E	113	MVP transect at 7kn
M189_199-1	Glider 5	05.05.	Glider	21:30	10° 40,414' S	013° 28,989' E	91	ifm13 rescue
M189_200-1	Glider 6	06.05.	Glider	11:40	10° 40,077' S	013° 15,714' E	200	recovery ifm09
M189_201-1	CTD 79	06.05.	CTD	13:37	10° 45,900' S	013° 06,000' E	941	to bottom -10m
M189_202-1	KPO 1272	06.05.	Mooring	17:17	10° 50,072' S	013° 00,010' E	1222	deployment KPO 1272
M189_203-1	CTD 80	06.05.	CTD	18:12	10° 50,925' S	013° 01,074' E	1208	to bottom -10m
M189_204-1	MSS 86	06.05.	MSS	20:39	10° 40,022' S	013° 14,659' E	140	MSS transect (9)
M189_205-1	MSS 87	06.05.	MSS	22:51	10° 37,840' S	013° 17,770' E	126	MSS transect (15)
M189_206-1	MSS 88	07.05.	MSS	01:05	10° 36,130' S	013° 20,222' E	113	MSS transect (18)t
M189_207-1	MSS 89	07.05.	MSS	03:15	10° 34,367' S	013° 22,713' E	98	MSS transect (21)
M189_208-1	MSS 90	07.05.	MSS	05:14	10° 32,920' S	013° 24,783' E	86	MSS transect (24)
M189_209-1	MSS 91	07.05.	MSS	06:05	10° 32,404' S	013° 25,532' E	80	MSS transect (15)
M189_210-1	SLM 1	07.05.	Lander	09:04	10° 32,971' S	013° 30,694' E	52	recovery KPO 1274
M189_211-1	SLM 2	07.05.	Lander	10:46	10° 37,041' S	013° 23,618' E	100	recovery KPO 1275
M189_212-1	Drifter 6	07.05.	Drifter	11:47	10° 35,725' S	013° 22,294' E	100	Hereon drifter s/n 271 recovery
M189_213-1	Drifter 7	07.05.	Drifter	12:30	10° 34,403' S	013° 21,497' E	100	Hereon drifter s/n 276 recovery
M189_214-1	Mooring 8	07.05.	Mooring	13:58	10° 41,647' S	013° 17,196' E	200	recovery KPO 1273
M189_215-1	CTD 81	07.05.	CTD	22:46	11° 59,911' S	013° 32,004' E	101	to bottom -10m
M189_216-1	CTD 82	08.05.	CTD	06:37	12° 59,969' S	012° 48,029' E	169	to bottom -10m
M189_217-1	CTD 83	08.05.	CTD	14:09	14° 00,016' S	012° 18,009' E	122	to bottom -10m
M189_218-1	CTD 84	08.05.	CTD	20:48	14° 59,839' S	012° 06,012' E	220	to bottom -10m
M189_219-1	CTD 85	09.05.	CTD	03:50	15° 59,971' S	011° 40,977' E	72	to bottom -10m
M189_220-1	CTD 86	09.05.	CTD	04:32	16° 00,035' S	011° 37,893' E	118	to bottom -10m
M189_221-1	CTD 87	09.05.	CTD	05:30	16° 00,225' S	011° 34,901' E	812	to bottom -10m
M189_222-1	CTD 88	09.05.	CTD	07:17	16° 00,339' S	011° 30,125' E	1212	to bottom -10m
M189_223-1	CTD 89	09.05.	CTD	09:36	16° 00,182' S	011° 20,819' E	1707	to bottom -10m
M189_224-1	CTD 90	09.05.	CTD	12:15	16° 00,050' S	011° 06,034' E	2560	to bottom -10m
M189_225-1	CTD 91	09.05.	CTD	14:19	16° 00,159' S	011° 06,400' E	2548	to bottom -10m
M189_226-1	CTD 92	09.05.	CTD	18:01	15° 59,978' S	010° 47,973' E	3158	to bottom -10m
M189_227-1	MSS 92	09.05.	MSS	19:12	16° 00,232' S	010° 47,744' E	3175	MSS protection cage tests (12 profiles)
M189_228-1	CTD 93	10.05.	CTD	00:20	16° 00,081' S	010° 29,966' E	3625	to bottom -10m
M189_229-1	CTD 94	10.05.	CTD	04:42	15° 59,959' S	009° 59,921' E	4064	to 1000m depth