

Dr. Marcus Dengler
GEOMAR Helmholtz-Zentrum für Ozeanforschung
Wischhofstraße 1-3
D – 24148 Kiel

Tel.: 0431 600 4107
Fax: 0431 600 4101
email: mdengler@geomar.de

Short Cruise Report
R/V METEOR M217/1
Walvis Bay (Namibia) – Walvis Bay
12th February – 7th March 2026
Chief Scientist: Dr. Marcus Dengler
Captain: Detlef Korte

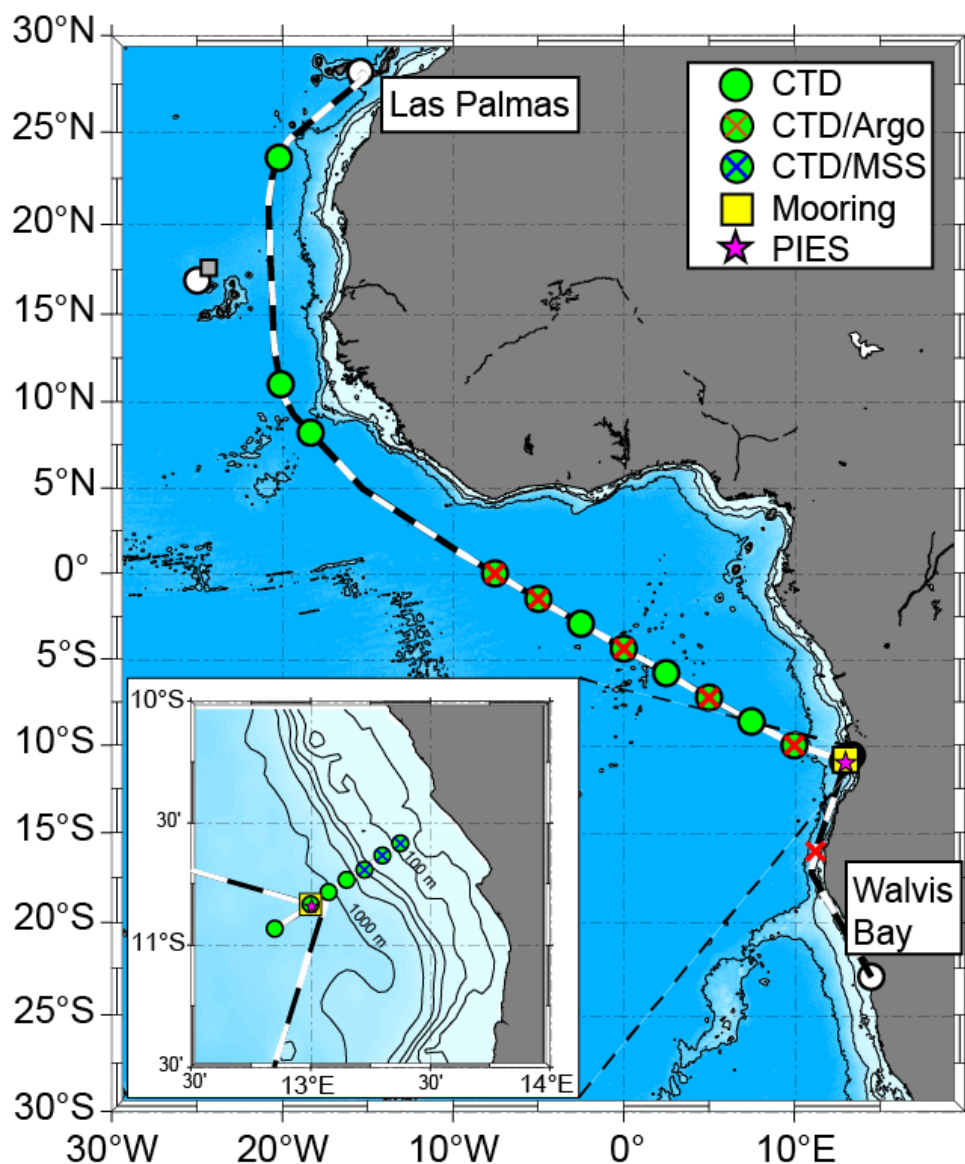


Fig.1: Bathymetric map with cruise track of R/V METEOR cruise M217/1 (dashed black and white line) including locations of conductivity-temperature-depth (CTD, green circles), microstructure (MSS, blue crosses), Argo float release (red crosses), mooring (yellow square) and pressure inverted echo sounder (PIES, magenta asterisk) recovery and redeployment stations.

Objectives

The expedition program integrated the scientific objectives of four individual projects spanning physical, chemical, and biogeochemical research. The primary objectives of the cruise were to expand the ocean observing system in the eastern tropical Atlantic and to investigate the physical and biogeochemical processes associated with upwelling off the southwestern coast of Africa.

Within the research project “Boundary Circulation off Angola and Benguela Niños (BOCABENO)” we are investigating the physical processes responsible for the variability of the eastern boundary circulation and upwelling off Angola on timescales ranging from sub-seasonal to decadal. Additionally, the influence of the changing mean state of the southeastern tropical Atlantic on Benguela Niño and Niña events is studied in terms of their frequency, strength, location, and impacts, as well as their predictability.

The “Persistent Organic Pollutants in the Marine Environment of the Equatorial East Atlantic and Western Mediterranean” (POPEAM) project aims at determining the concentrations of “contaminants of emerging concern” in the surface waters and the atmosphere above. Contaminants of emerging concern are substances which have been released into the environment recently, or are only now recognized as environmental pollutants despite having been released since years or decades. They encompass flame retardants, pesticides, personal care products and industrial chemicals. This dataset will allow to characterize the exchange of these substances between the ocean and the atmosphere.

The “Global Sea–Air Exchange Flux of Nitrogen Oxides and Greenhouse Gases (FluxNG)” project aims to quantify the exchange of trace gases between the ocean and atmosphere in the eastern tropical Atlantic. The project comprises continuous measurements of nitrogen oxides and the greenhouse gases carbon dioxide (CO₂), methane, and nitrous oxide in the marine boundary layer, surface ocean, and upper water column. A particular focus is placed on assessing the influence of regional oceanographic processes, including coastal upwelling and Benguela Niño events, on trace gas distributions and associated air–sea fluxes.

As part of the underway program of the Walvis Bay Moorings (WBM) project, the influence of the biological carbon pump on the marine carbonate system was investigated. In the eastern tropical Atlantic, the carbonate system is strongly modulated by freshwater inputs arising from both precipitation and river discharge. Its characterization is based on measurements of surface water CO₂ concentrations, as well as determinations of dissolved inorganic carbon (DIC) and total alkalinity (TA). In addition, suspended particulate matter was sampled to assess the composition of non-sinking particles. These observations aim to improve the understanding of biogeochemical cycling processes in the eastern tropical Atlantic.

Narrative

The scientific team consisting of 24 researchers and technicians from seven institutions in three countries boarded R/V METEOR in the port of Las Palmas on Wednesday, February 11, 2026. The plan was to leave port the next day in the morning and to begin the scientific program six hours later. Unfortunately, five containers, four of them containing scientific equipment, were delayed. The container vessel WEC Mondriaan that had brought our containers from Hamburg to Las Palmas, finally arrived in Las Palmas port on Sunday, February 15. Severe storms and the associated high seas off Portugal and north-western Spain prevented it from continuing its journey along the Portuguese coast for more than a week, causing a delayed arrival of 12 days. Unfortunately, we have once again found that the uncertainty in shipping schedules has increased significantly in the last few years. For future shipments of equipment and provisions, a larger time margin should be allowed for. Due to the limited time available, a

deployment of a surface buoy off the Cabo Verde Island Mindelo planned to be carried out during the cruise was cancelled. Instead, the German Research Fleet Coordination Centre allocated ship time for the deployment in the successive R/V Meteor cruise M219.

The five containers were finally cleared by port customs at 14:30 local time on Monday, 16 February and delivered to the R/V METEOR. Immediately after the containers arrived, unpacking and stowing began, so that we were able to set sail at around 20:00 local time, four and half days behind schedule. As the time frame for our research permit for Spanish territorial waters had expired, underway sampling began after leaving the Spanish exclusive economic zone at 2:00 on 18 February. The vessel-installed thermosalinograph, the deep-sea multi-beam echo sounder (EM122) and both vessel-mounted acoustic Doppler current profiler (vmADCP) were started, while other underway observatories were still being set up.

We reached the position of our first station at 23°37' N, 20°12' W at 8:00, where a conductivity-temperature-depth (CTD) cast and water samples to a depth of 1300 m were taken. Unfortunately, the Niskin bottles 9 to 23 could not be closed during the first cast due to problems with the CTD system's carousel. A second CTD cast to 400 m depth was successfully completed to collect the water samples from the upper 400 m that had failed during the earlier cast. Sampling by the remaining underway instruments was started, including trace gases, atmospheric persistent organic pollutants, TA, DIC and surface radiance and irradiance.

R/V METEOR steamed at speeds between 11.5 and 12 knots for the next three days. The cruise track was chosen to take the shortest route to Angolan territorial waters but avoiding the exclusive economic zone of the other coastal states on the way. At 11°N, 20°W, a CTD cast was taken to sample hydrography and chemical and biogeochemical parameters in the centre of the oxygen minimum zone in the eastern tropical North Atlantic. This region had been sampled excessively during previous cruises between 2008 and 2019 as part of the observational programme of the Collaborative Research Centre (SFB 754) "Climate-Biogeochemistry Interactions in the Tropical Ocean".

Following another CTD station at 8°N, 18°W, R/V METEOR crossed the equator into the Southern Hemisphere shortly after midnight on 25 February. During the transit from 8°N, maximum ship speed had to be reduced because the elevated surface water temperatures, exceeding 29°C, limited the cooling capacity of the diesel engines.

The CTD station on the equator at 7.5°W marked the start of a hydrographic section extending to 10°S. Along this section, comprehensive hydrographic observations were conducted, including water sampling and the deployment of Argo floats. Water samples were analysed for organic pollutants, trace gases, nutrients, dissolved oxygen, TA, DIC, suspended particulate matter, and salinity. Owing to the large volume of water required for the sampling programme, two CTD casts were carried out at every second station.

With an average station spacing of approximately 180 nautical miles, this section represented the primary sampling effort for the POPEAM project and the marine carbonate system investigations. From a physical oceanographic perspective, the sampled water masses constitute the source waters of the Angola Current, which transports them into the tropical Angolan and northern Benguela upwelling regions.

In addition, five Argo floats, four of them equipped with oxygen sensors, were deployed along the section (Fig. 3.1). Their deployment locations were selected by the Bundesanstalt für Schifffahrt und Hydrographie to improve the spatial coverage of the global Argo observing network. The final station of the section, located at 10°S, 10°E, was completed during the afternoon of 2 March.

On Monday afternoon, R/V METEOR entered Angolan territorial waters. We had received the research permit for Angola just in time before the weekend on Thursday, 26 February. The German Embassy in Luanda, the German Research Fleet Coordination Centre and, in particular, Dr Filomena Vas Velho, Director of the Instituto Nacional de

Investigação Pesqueira e Marinha (INIPM) in Luanda, provided us with excellent support during the approval process. We have been working closely with Filomena Vas Velho and other INIPM staff since 2013, as evidenced by numerous joint publications on circulation and upwelling off Angola. Two employees of the institute were also participating in the M217/1 cruise.

In Angolan waters, R/V METEOR proceeded to the location of a current meter mooring at 10°50'S, 13°W. The mooring had been deployed on 6 May 2022, nearly two years and ten months before its scheduled recovery during this cruise. The mooring position was reached at 08:30 on 3 March. Following a successful acoustic release, the mooring surfaced as planned, and all instruments were recovered within two hours.

Despite the exceptionally long deployment period, the majority of the instruments had operated reliably and recorded continuous data throughout the deployment. A nearby bottom pressure sensor equipped with an inverted echo sounder was subsequently released and recovered successfully. Deployed on 25 April 2022, the instrument had also returned a complete bottom pressure time series spanning the entire deployment period.

Following two CTD casts, one at the mooring position and another 10 nautical miles offshore, the current meter mooring was redeployed. Thanks to the efficient support of the ship's crew, the deployment was completed within two and a half hours, just before nightfall. This made it possible to visually track the uppermost buoyancy element after the anchor release until it submerged. Station work at the mooring site concluded with the successful deployment of a bottom pressure sensor.

The remaining ten hours of working time were devoted to a cross-shelf CTD section extending from the continental shelf (approximately 50 m water depth) to the mooring location. The objective of this section was to characterize the water masses of the Angola Current and their physical, chemical, and biogeochemical properties. A total of five CTD casts were completed, each accompanied by microstructure profiles acquired either immediately before or after the CTD station.

At 02:00 on 4 March, while the CTD rosette was being lowered, an able seaman detected damage to the single-conductor cable on winch W3. Several strands of the cable had broken, prompting an immediate halt to the deployment and the careful recovery of the CTD rosette. The rosette was subsequently transferred to winch W2, and, following an additional microstructure profile, the interrupted CTD station was repeated successfully. The final CTD cast of the cruise was completed at 05:30, after which R/V METEOR set course for Walvis Bay.

At noon on 5 March, the final Argo float of the cruise was deployed at 16°S, 11°14'E. Before entering Namibian territorial waters at approximately 18:00 that day, all underway scientific observing systems were shut down, marking the end of the measurement programme.

The remaining two days were devoted to reading out data from the recovered moored instruments, dismantling the scientific installations, and packing the equipment into the containers. On the morning of 7 March, R/V METEOR reached the designated pilot station on schedule at 06:30 local time and berthed alongside the quay in Walvis Bay at approximately 08:30.

For about half of the scientific party, this arrival marked not only the successful completion of the expedition but also their final research cruise aboard R/V METEOR III, bringing an end to a vessel that had served the German marine science community for nearly four decades.

Acknowledgements

The research vessel METEOR has served science exceptionally well over many years and developed a character all its own. The crew's consistently open and supportive attitude towards the scientific participants enabled exceptionally good cooperation on

board. This was characterised by a very pleasant working atmosphere, which contributed significantly to the success of numerous expeditions.

We would like to thank Captain Korte and his crew for their excellent cooperation and the very pleasant working atmosphere on board. The crew of the R/V METEOR played a major role in the very successful work carried out during the research expedition, which was also thanks in no small part to the great commitment of the scientists, technicians and students. The ship time of R/V METEOR was provided by the German Science Foundation (DFG) within the core program METEOR/MERIAN. Financial support for travels and transport was granted by the DFG within the project M217/1 (GPF 24-1/014).

List of Participants

Abbreviations: PO – Physical Oceanography, CO – Chemical Oceanography, BGC – Biogeochemical Oceanography, ME – Meteorology.

CO₂ – carbon dioxide, CTDO – conductivity-temperature-depth-oxygen measurements and water sampling, DIC – dissolved inorganic carbon, MSS – microstructure sonde, SM – suspended matter, TA – total alkalinity, UVP – underwater vision profiler, vmADCP – vessel-mounted acoustic Doppler current profiler.

No.	Name	Discipline	Institution
1	Dengler, Marcus, Dr.	PO, chief scientist	GEOMAR
2	Coelho, Paulo André de Sousa	PO, CTDO, Oxygen analysis	INIPM
3	Dourado Alves Brito, Camila	CO, CTDO, Organic pollutants	FUP
4	Duerkop, Felix Jakob	PO, CTDO, PIES, Moorings, Floats	GEOMAR
5	Flinspach, Greta Erika	BGC, CTDO, SM	UHH
6	Francisco, José Amaro	PO, CTDO, Salinometer	INIPM
7	Gesinn, Silke	PO, CTDO, Oxygen analysis, UVP	GEOMAR
8	Grolmes, Nele	BGC, CTDO, SM	UHH
9	Heene, Toralf	PO, CTDO, MSS, Moorings	IOW
10	Henning, Philipp	PO, Moorings, Floats, CTDO	GEOMAR
11	Hüge, Fabian	BGC, TA, DIC, CO ₂	ZMT
12	Imbol Koungue, Rodrigue Anicet, Dr.	PO, CTDO, Moorings, Oxygen analysis, vmADCP	GEOMAR
13	Kast, Jakob Luca	BGC, CTDO, SM	UHH
14	Kretzschmann, Lisett	CO, CTDO, Organic pollutants	BSH
15	Lahajnar, Niko, Dr.	BGC, CTDO, SM, Oxygen analysis	UHH
16	Lewe, Julia Isabella	BGC, CTDO, SM	UHH
17	Mohrholz, Volker, Dr.	PO, Moorings, MSS	IOW
18	Pan, Xihao	CO, Trace gases	MPIC
19	Papke, Giulia	BGC, CTDO, SM	UHH
20	Quoß, Solveigh Marie	BGC, CTDO, SM	UHH
21	Rixen, Tim, Dr.	BGC, TA, DIC, CO ₂	ZMT
22	Rizzi, Rafaela	PO, CTDO, Oxygen analysis	FURG
23	Rohleder, Christian Raphael	ME	DWD
24	Schuler, Finn Marvin	PO, CTDO, Salinometer	GEOMAR

BSH	Bundesamt für Seeschifffahrt und Hydrographie, Germany
DWD	Deutscher Wetterdienst, Germany
FUP	Federal University of Paraná, Brazil
FURG	Federal University of Rio Grande, Brazil
GEOMAR	GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
INIPM	Instituto Nacional de Investigação Pesqueira e Marinha, Angola
IOW	Leibniz-Institut für Ostseeforschung Warnemünde, Rostock, Germany.
MPIC	Max-Planck-Institut für Chemie, Mainz, Germany
UHH	Universität Hamburg, Germany
ZMT	Leibniz-Zentrum für Marine Tropenforschung, Bremen, Germany

Stationlist M217

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
METEOR	GEOMAR	2026		[UTC]	[°N]	[°W]	[m]	
M217/1_1-1	CTD1	18.02.	CTD	8:24	23° 37.316' N	020° 12.252' W	3993	to 1200m depth
M217/1_2-1	CTD2	18.02.	CTD	9:31	23° 37.317' N	020° 12.252' W	3993	to 400m depth
M217/1_3-1	CTD3	21.02.	CTD	1:15	10° 59.999' N	020° 05.852' W	4887	to 1200m depth
M217/1_4-1	CTD4	21.02.	CTD	19:25	08° 12.205' N	018° 20.626' W	4851	to 1200m depth
M217/1_5-1	CTD5	25.02.	CTD	1:28	00° 00.029' N	007° 32.719' W	5153	to 2000m depth
M217/1_6-1	CTD6	25.02.	CTD	3:01	00° 00.124' N	007° 32.694' W	5149	to 600m depth
M217/1_7-1	FLOAT1	25.02.	FLOAT	3:32	00° 00.211' N	007° 32.625' W	5150	ARGO WMO 4903931
M217/1_8-1	CTD7	25.02.	CTD	22:17	01° 29.357' S	004° 59.988' W	5109	to 2000m depth
M217/1_9-1	FLOAT2	25.02.	FLOAT	23:09	01° 29.440' S	004° 59.969' W	5107	ARGO WMO 3902708
M217/1_10-1	CTD8	26.02.	CTD	16:33	02° 56.569' S	002° 30.375' W	5216	to 1200m depth
M217/1_11-1	CTD9	27.02.	CTD	11:06	04° 23.658' S	000° 00.000' W	5478	to 2000m depth
M217/1_12-1	CTD10	27.02.	CTD	12:35	04° 23.659' S	000° 00.000' W	5479	to 600m depth
M217/1_13-1	FLOAT3	27.02.	FLOAT	14:17	04° 22.558' S	000° 01.123' W	5421	ARGO WMO 4903929
M217/1_14-1	CTD11	28.02.	CTD	7:28	05° 49.474' S	002° 29.643' E	5413	to 1200m depth
M217/1_15-1	CTD12	01.03.	CTD	3:07	07° 14.599' S	005° 00.001' E	5186	to 2000m depth
M217/1_16-1	CTD13	01.03.	CTD	4:29	07° 14.599' S	005° 00.000' E	5185	to 600m depth
M217/1_17-1	FLOAT4	01.03.	FLOAT	4:57	07° 14.711' S	004° 59.984' E	5187	ARGO WMO 5907220
M217/1_18-1	CTD14	01.03.	CTD	21:22	08° 37.644' S	007° 29.143' E	4803	to 1200m depth
M217/1_19-1	CTD15	02.03.	CTD	14:59	09° 59.996' S	010° 00.001' E	4363	to 2000m depth
M217/1_20-1	CTD16	02.03.	CTD	16:15	09° 59.997' S	010° 00.002' E	4359	to 600m depth
M217/1_21-1	FLOAT5	02.03.	FLOAT	16:39	10° 00.050' S	010° 00.050' E	4382	ARGO WMO 5907221
M217/1_22-1	MOOR1	03.03.	MOOR	8:35	10° 49.853' S	013° 00.290' E	1223	recovery of KPO 1272
M217/1_23-1	PIES1	03.03.	PIES	10:33	10° 50.379' S	013° 00.393' E	1221	recovery of KPO 1248
M217/1_24-1	CTD17	03.03.	CTD	11:51	10° 50.425' S	013° 00.250' E	1238	to bottom -10m
M217/1_25-1	CTD18	03.03.	CTD	13:57	10° 55.998' S	012° 50.999' E	1390	to bottom -10m
M217/1_26-1	MOOR2	03.03.	MOOR	18:06	10° 50.190' S	012° 59.930' E	1234	deployment of KPO 1332
M217/1_27-1	PIES2	03.03.	PIES	18:29	10° 50.470' S	013° 00.275' E	1221	deployment of KPO 1331
M217/1_28-1	CTD19	03.03.	CTD	21:16	10° 35.006' S	013° 22.509' E	99	to bottom -10m
M217/1_29-1	MSS1	03.03.	MSS	21:37	10° 35.045' S	013° 22.450' E	100	3 profiles to 80m
M217/1_30-1	CTD20	03.03.	CTD	23:12	10° 38.003' S	013° 17.988' E	124	to bottom -10m
M217/1_31-1	MSS2	03.03.	MSS	23:29	10° 38.029' S	013° 17.949' E	125	8 profiles to bottom
M217/1_32-1	CTD21	04.03.	CTD	1:18	10° 41.008' S	013° 13.512' E	350	to bottom -10m
M217/1_33-1	MSS3	04.03.	MSS	1:37	10° 41.078' S	013° 13.401' E	350	3 profiles to 200m
M217/1_34-1	CTD22	04.03.	CTD	2:34	10° 41.580' S	013° 12.690' E	395	to bottom -10m
M217/1_35-1	CTD23	04.03.	CTD	3:47	10° 44.034' S	013° 09.160' E	695	to bottom -10m
M217/1_36-1	CTD24	04.03.	CTD	5:11	10° 47.047' S	013° 04.486' E	1042	to bottom -10m
M217/1_37-1	FLOAT6	05.03.	FLOAT	11:53	16° 02.988' S	011° 14.297' E	2465	ARGO WMO 4903930