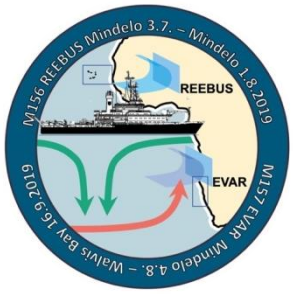
Dr. Stefan Sommer
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
Wischhofstr. 1-3
D-24148

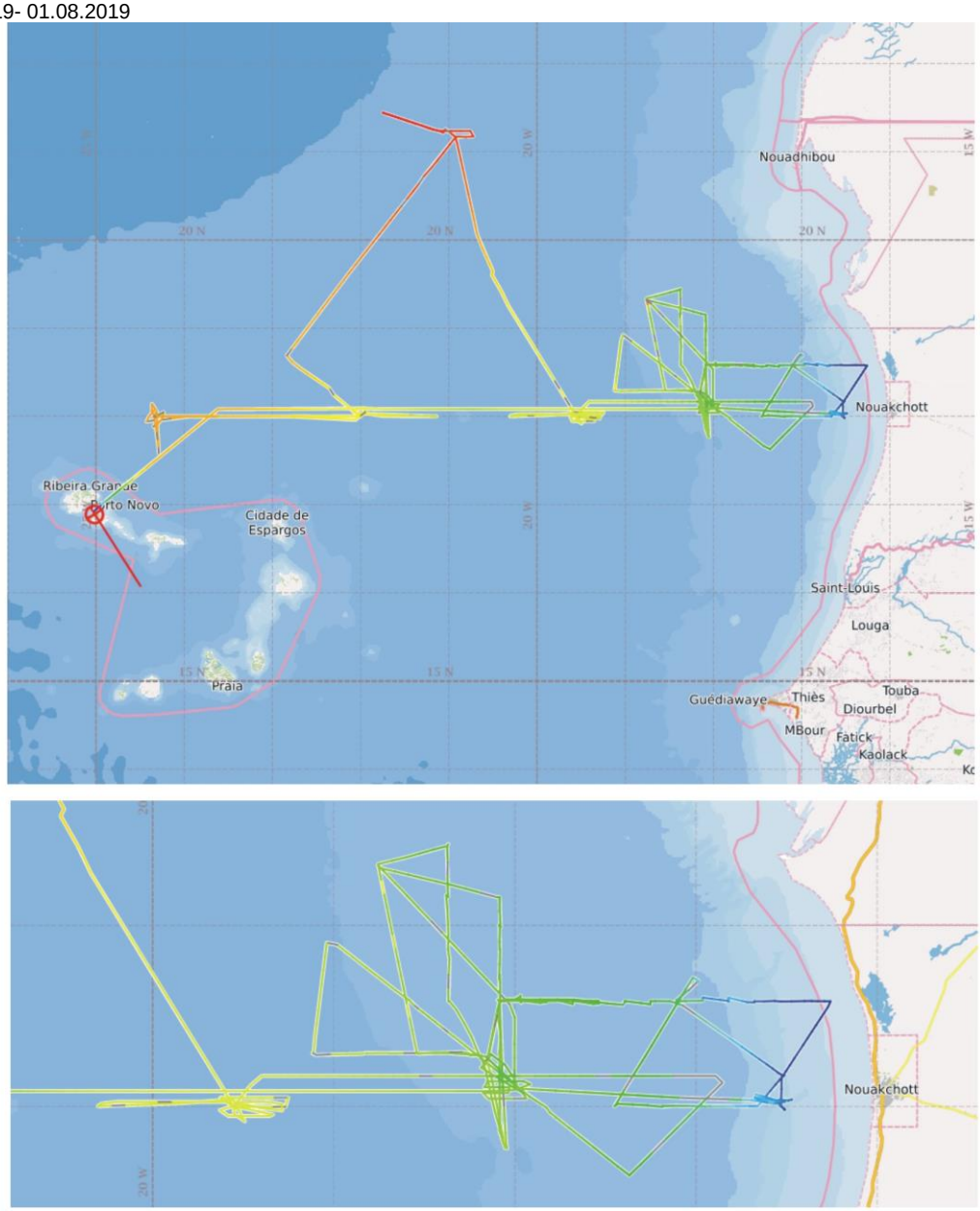
Phone: +49 431 600 2119 Fax: +49 431 600 2928
Email: ssommer@geomar.de

Short Cruise Report
RV METEOR M-156
Mindelo (Cape Verde) - Mindelo (Cape Verde)
03.07.2019 - 01.08.2019
Project: *Role of Eddies in the Carbon Pump of Eastern Boundary Upwelling Systems, REEBUS*

Chief Scientist: Stefan Sommer
Captain: Rainer Hammacher

REEBUS





FS METEOR
Cruise M156
Mindelo - Mindelo
03.07.2019 - 01.08.2019

Ship track during Meteor cruise M156 off Cape Verde Islands and Mauritania

Objectives

The overarching goal of the RV METEOR cruise M156 to the Mauritanian upwelling area off West Africa and Cape Verde was to obtain a better quantitative understanding of the dynamics of mesoscale eddies with particular focus to CO_2 source/sink mechanisms and the biological carbon pump in eastern boundary upwelling areas as well as their effects to the oligotrophic periphery including the deep-sea floor.

By trapping coastal waters of upwelling origin and transporting them westwards into the open ocean, eddies play an important role in the lateral mixing and transport of physical-biogeochemical properties and thereby modulate biological productivity and material fluxes to the seabed. The cruise is embedded into a series of three REEBUS cruises.
Specific aims of the different working groups were as follows:

Physical oceanography

- Determine the spatial and temporal variability of eddy-associated mixing processes and quantify diapycnal fluxes of solutes and particles within and at the periphery of eddies;
- Investigate internal wave - eddy interactions and its contribution to elevated mixing within and at the periphery of eddies.

Pelagic biogeochemistry

- Assess vertical and horizontal transport pathways of different carbon species in and around different eddy types and life stages;
- Estimate the air-sea gas exchange of CO_2 as well as net community production and oxygen utilization in the surface and subsurface layer at different life stages of eddies;
- Determine the production and microbial utilization of dissolved and non-sinking organic matter to estimate nutrient remineralization and microbial CO_2 fluxes in different eddy types. Deliver a high-resolution description of vertical concentration gradients for a variety of DOM components and for non-sinking organic matter, (transparent exopolymer particles (TEP), coomassie stainable particles (CSP)) and bacteria; assess the potential utility of chromophoric DOM and fluorescent DOM components as tracers for eddy dynamics and vertical DOC fluxes; evaluate the potential biological availability of DOM in surface and OMZ waters based on molecular compound analysis and bio-assays;
- Estimate primary production, exudation and heterotrophic recycling as well as respiration of organic matter within and around eddies.

Biological Oceanography

- Conduct differential analyses of protistan and bacterial plankton community structures and species turnover patterns in relation to eddy dynamics on vertical and horizontal scales using DNA metabarcoding.
- Conduct shipboard experiments to assess the effect of eddies on microplankton biomass and community assembly.
- Determine benthic microbial community structures and species turnover patterns alongside the zonal eddy corridor. While DNA metabarcoding will allow the proportion of inactive organisms sinking down from the water column to be identified, RNA metabarcoding will identify the indigenous part of the benthic microbial communities.

Benthic biogeochemistry and geology

- Quantify the rain rate of organic matter to the seabed and organic matter burial in sediments underneath the eddy passage; decipher the origin of organic matter reaching the seabed (shelf versus open ocean); map the regional distribution of benthic organic matter fluxes alongside the zonal eddy corridor.

Narrative

At the 2nd July scientists arrived in the morning and during afternoon hours onboard of RV METEOR. The harbour time was used to load the ship and establish the laboratories. At the 3rd of July at about 18:30 the RV METEOR left Mindelo (Sao Vicente, Cape Verde) during good weather conditions. After a short transit, we arrived at the western station E1 of the zonal transect at 18° N where station work started at 02:30, Figure 1.

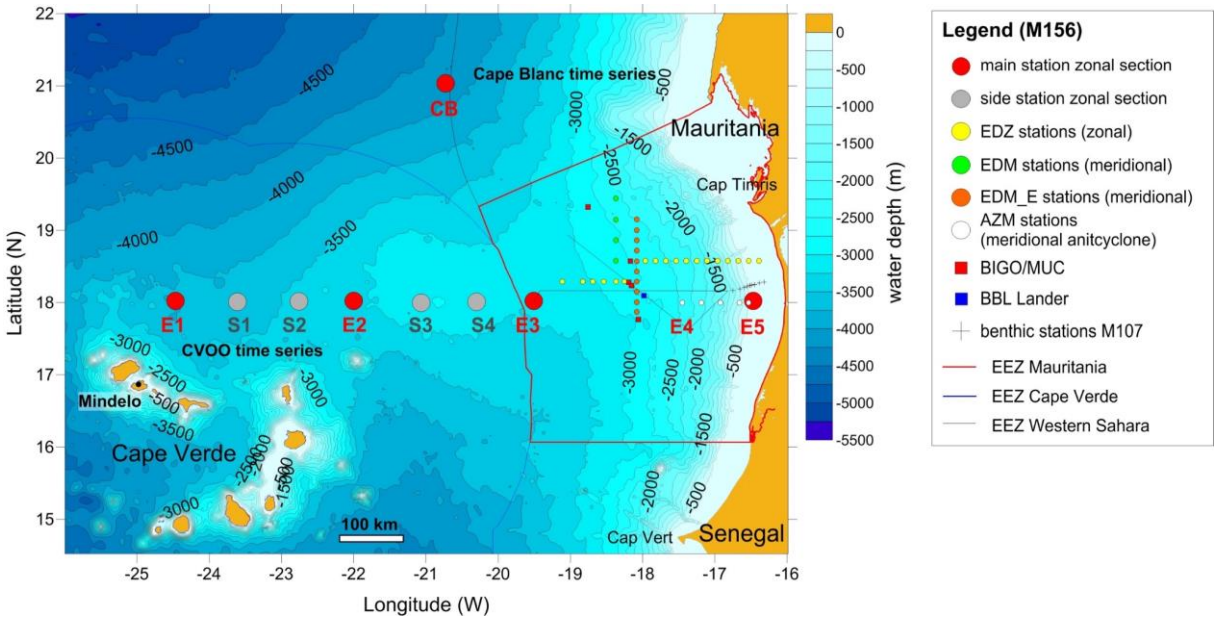


Figure 1: Map showing the sampling scheme during cruise M156 off Cape Verde Islands and Mauritania. It further includes benthic stations from a previous METEOR cruise, M107.

The working program of the cruise was based on two major observing objectives. The first objective was an intense benthic/pelagic sampling program within the zonal eddy passage at 18°N. This corridor, included five main stations (E1 to E5) in different water depths and distances from the Mauritanian coast. The stations were investigated to reveal zonal gradients in organic matter degradation and burial in the seabed, which in turn could potentially be linked with changes in eddy primary- and export production. In between the main stations side stations were specified for further biological and biogeochemical water column investigations. Beside the 18°N transect another main station was located further north (21°10'N 20°55'W) close to the Cap Blanc time series station (CB) at a water depth of about 4190 m. For this site an extended data set of particle flux from the sea surface to seafloor is available and will help to interpret our in situ flux measurements at the main stations E1 to E3. For the shallow station E5 in situ flux measurements became available during RV MERIAN cruise MSM17 and RV METEOR cruise M107 (both cruises Kiel SFB 754) and can be related to the measurements conducted during this cruise. The second observing objective represented the detailed investigation of an individual eddy to investigate physical, biogeochemical and biological processes. The investigated eddy was identified during the cruise. On board was a diverse team of 27 scientists from 2 different institutions (GEOMAR Kiel, TU Kaiserslautern), covering different disciplines including physical- and biogeochemical oceanography, microbiology, protozoology and sea floor monitoring. During the day-time we typically deployed the Multiple Corer (MUC) to obtain undisturbed sediment cores and the two BIGO-type lander (Biogeochemical Observatory) for in situ flux measurements at the seafloor. The benthic flux measurements comprise measurements of the total oxygen uptake, which is indicative for the carbon turnover as well as the exchange of nutrients inside the two flux chambers in each BIGO. Ex situ measurements on board of the RV METEOR included O_2 micro-profiling and incubation experiments to complement the in situ flux measurements. Onboard incubations were further conducted to i. study the food web in the water column (TU KL) as well as for microbiological rate measurements. At night and during early morning hours, we typically deployed the CTD water sampling rosette (CTD) for the measurement of physical properties and nutrients, a Marine Snow Catcher (MSC) to retrieve particles from the water column, and a microstructure CTD (MSS) for turbulence measurements. We further deployed a Glider for autonomous and continuous measurements of physical parameters, currents, oxygen as well as nitrate. The water column investigations were complemented by the deployment of a Lagrangian surface drifter (LD) and a wave glider for biogeochemical measurements.

Furthermore, seafloor imaging was conducted at each main station and the eddy site using the towed camera system OFOS (Ocean floor Observation System). The obtained images will be related to high resolution bathymetrical maps and side scan images. During all activities, the shipboard ADCP was used for current measurements. A BBL Lander (Benthic Boundary Layer Lab) was deployed from the 22.07. to 30.07.19 at the location, where a detailed eddy study was conducted. This lander was equipped with an upward looking ADCP, sediment trap and a camera system. After finishing the investigations at E1 and E2 at the 09.07.2019, we headed towards an ADCP transect between positions ED-1 (18°40.5'N 22°50.57' W) and ED-2 (19°37.5'N 22°7.5'W), where currents along an anticyclonic eddy structure were measured. At the 10th of July station work at the CB station started with the deployment of the BIGO Lander. At the beginning of the cruise we had severe problems to release the lander from the launching unit. Fortunately, we had the possibility to replace the electronic releaser with a conventional gas releaser, enabling successful lander deployment. Subsequently station work was continued with deployments of the CTD, MSC, MUC and seafloor mapping. At Friday 12th of July we finished station work at the CB station and headed south towards the station E3 at the 18°N zonal transect, where we arrived in the morning hours at the 13th of July and started with the deployment of the MUC. During the transit, we had a science meeting to discuss the details of the sampling strategy of the eddy. Stationwork at E3 was finished at Monday 15th July after retrieval of the BIGO lander and we addressed the second observing objective of the cruise to study a cyclonic eddy in greater detail. The location of the eddy was identified with support from scientists at GEOMAR (F. Heukamp, J. Karstensen, M. Dengler) who provided us with a daily update of satellite images allowing to locate a suitable eddy. The center the cyclonic eddy was about at 18°30'N 018°5'W. The extension of the eddy covered the main station E4 and several side stations whose positions in contrast to the original planning were shifted by 10 nm miles to the North. First activities, comprised current measurements transect across the eddy to better constrain its edges and center. At the 16th July, we conducted a 24 h side scan observation, which allowed us to determine the placement of the BIGO and BBL lander.At the 20th July, we observed and sampled an open ocean red tide formed by the ciliate *Mesodinium rubrum*. Its occurrence was probably trigged by enhanced nutrient availability due to the deposition of Sahara dust, whether its occurrence can be further related to the eddy remains speculative. The intense investigation of the selected eddy continued until the 28th July. Subsequently, the RV METEOR headed towards the coastal main station E5 including several stations (AZM, cf. Figure 1) along a zonal transect through an anticyclonic eddy, which just developed close to the coast. At the 30th July, the RV METEOR travelled towards Mindelo. On our way back the recovery of the BBL Lander and light measurements at the sea surface concluded the station work. During the entire cruise the weather conditions were fine allowing stationwork at all time. We arrived in the harbour of Mindelo at the 1st of August at around 08:00. In the afternoon Stefan Sommer presented first results of the cruise at the Ocean Science Center Mindelo (OSCM). After a successful cruise the scientific crew of M156 left RV METEOR at the 2nd of August 2019.

Acknowledgements

We very much thank Captain Rainer Hammacher, the officers and the entire crew of RV METEOR for their excellent support. They created a very professional working environment and contributed a lot to the success of this cruise. The friendly atmosphere aboard is greatly acknowledged. We thank the Ministère des Pêches et de l'Ecconomie Maritime (République Islamique de Mauritanie) and the Instituto Maritimo Portuàrio-IMP (Cabo Verde) for their support and the allowance to conduct research in Mauritanian and Cape Verdian waters. We very much would like to acknowledge the support of the German Ministry of Foreign Affairs.
We would also like to express our gratitude to the Geschäftsstelle des Gutachterpanels Forschungsschiffe (GPF) and the Leitstelle Deutsche Forschungsschiffe (Hamburg) for their valuable support. The ship time of RV METEOR and financial support for the logistics of the cruise was kindly provided by the German Research Council, DFG. The project REEBUS is funded by the German Ministry for Education and Research, BMBF.

Participants

	Name	Discipline	Institution
1.	Sommer, Stefan	PI, Lander, Geochemistry	GEOMAR
2.	Adam, Nicole	Microbiology	GEOMAR
3.	Becker, Kevin	Pelagic Biogeochemistry	GEOMAR
4.	Bill, Nicolas	Geochemistry	GEOMAR
5.	Breiner, Hans-Werner	Protozoan Biology	TU KL
6.	Bunsen, Frauke	Physical Oceanography	GEOMAR
7.	Dale, Andrew	Geochemistry	GEOMAR
8.	Devresse, Quentin	Pelagic Biogeochemistry	GEOMAR
9.	Dilmahamod A. Fehmi	Physical Oceanography	GEOMAR
10.	Domeyer, Bettina	Geochemistry	GEOMAR
11.	El Abed, Jemal	Observer	IMROP
12.	Hahn, Johannes	Physical Oceanography	GEOMAR
13.	Kampmeier, Mareike	Seafloor Monitoring	GEOMAR
14.	Katzenmeier, Sven	Protozoan Biology	TU KL
15.	Klüver, Tanja	Pelagic Biogeochemistry	GEOMAR
16.	Link, Rudolph	Physical Oceanography	GEOMAR
17.	Paulsen, Melf	Pelagic Biogeochemistry	GEOMAR
18.	Petersen, Asmus	Lander Mechanics	GEOMAR
19.	Rickert, Esther	Pelagic Biogeochemistry	GEOMAR
20.	Roa, Jon	Pelagic Biogeochemistry	GEOMAR
21.	Rudloff, Daniel	Physical Oceanography	GEOMAR
22.	Scheidemann, Lindsay	Pelagic Biogeochemistry	GEOMAR
23.	Schmidt, Thilo	Geochemistry	GEOMAR
24.	Schott, Thorsten	Seafloor Monitoring	GEOMAR
25.	Schüssler, Gabriele	Microbiology	GEOMAR
26.	Schumacher, Mia	Seafloor Monitoring	GEOMAR
27.	Stelzner, Martin	Bordwetterwarte	DWD
28.	Surberg, Regina	Microbiology	GEOMAR
29.	Türk, Matthias	Lander Electronics	GEOMAR

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Wischhofstrasse 1-3, 24148 Kiel, Germany, E-mail: ssommer@geomar.de

TU KL University of Kaiserslautern, Faculty of Biology, Department of Ecology, Gottlieb-Daimler-Str. Building 14, 67663 Kaiserslautern, Germany

IMROP Institut Mauritanien de Recherche Océanographiques et des Pêches, Nouakchott, Mauritania

DWD Deutscher Wetterdienst Geschäftsfeld Seeschifffahrt Bernhard-Nocht-Straße 76 20359 Hamburg / Germany e-mail: seeschifffahrt@dwd.de Internet: www.dwd.de

Station List M156

Station #	Date	Time (UTC)	Gear #	Latitude	Longitude	Depth (m)	Remarks
M156-1	04.07.19	03:34	CTD 01	17°59.994'N	24°20.022'W	3680	Nutrients
M156-2	04.07.19	07:34	MSC 01	18°00.005'N	24°20.010'W	3694	
M156-3	04.07.19	07:58	CTD 02	17°59.996'N	24°20.024'W	3696	similar pos. as CTD 01
M156-4	04.07.19	09:22	MUC 01	18°00.004'N	24°20.011'W	3694	2 liner empty
M156-5	04.07.19	12:38	MUC 02	18°00.001'N	24°20.011'W	3714	
M156-6	04.07.19	19:27	BIGO-II 01	18°00.003'N	24°20.010'W	3718	Deployment Problem Telemetry
M156-7	05.07.19	05:56	CTD 03	17°59.966'N	23°36.522'W	3633	Nutrients
M156-8	05.07.19	11:00	MBES 01				
M156-9	05.07.19	18:28	MSS 01	18°00.005'N	24°20.012'W	3716	4 profiles
M156-10	05.07.19	20:00	OFOS 1/2[a]				On deck: 06:35 UTC
M156-11	06.07.19	09:28	CTD 04	17°35.000'N	24°17.000'W	3590	Nutrients
M156-12	06.07.19	14:30	MSC 02	17°59.996'N	24°20.051'W	3714	
M156-13	07.07.19	03:39	CTD 05	17°59.976'N	21°59.969'W	3312	
M156-14	07.07.19	04:55	MSS 02	18°00.062'N	21°59.996'W	3312	Aborted, due to winch
M156-15	07.07.19	05:36	CTD 06	18°00.08'N	21°59.984'W	3315	cable damage
M156-16	07.07.19	09:07	MUC 03	17°59.998'N	22°00.003'W	3315	MUC hitherto op. Prototype-Tememetry
M156-17	07.07.19	14:12	BIGO-II 02	17°59.997'N	22°00.003'W	3559	Deployment, Releaser Problem
M156-18	07.07.19	18:42	MSC 03	18°00.001'N	22°00.005'W	3313	
M156-19	07.07.19	20:39	BIGO-II 03	17°59.999'N	22°00.004'W	3312	Deployment E2
M156-20	07.07.19	23:45	MBES 02				
M156-21	08.07.19	04:58	CTD 07	18°00.016'N	22°47.077'W	3432	Nutrients
M156-22	08.07.19	10:20	CTD 08	17°59.996'N	22°00.008'W	3311	Nutrients
M156-23	08.07.19	13:12	MSC 04	17°59.998'N	22°00.008'W	3315	
M156-24	08.07.19	13:32	MSS 03	17°59.901'N	22°00.014'W	3316	3 profiles
M156-25	08.07.19	15:05	OFOS 03				USBL was used, but position not reliable
M156-26	09.07.19	05:09	CTD 09	17°60.000'N	21°08.005'W	3142	Samples of O2 & Nutrients
M156-27	09.07.19	10:00	MBES 03				
M156-28	09.07.19	13:30	BIGO-II 03	17°59.722'N	22°00.534'W	3316	Recovery
M156-29	10.07.19	15:27	BIGO-II 04	21°10.004'N	20°55.004'W	4195	Deployment failed, releaser
M156-30	10.07.19	22:06	BIGO-II 05	21°10.005'N	20°55.004'W	4197	Deployment, releaser changed CB
M156-31	11.07.19	02:00	MBES 04				
M156-32	11.07.19	09:00	CTD 10	21°26.478'N	21°44.495'W	4410	
M156-33	11.07.19	16:38	OFOS 04				Posidonia 4
M156-34	12.07.19	05:39	CTD 11	21°09.971'N	20°55.019'W	4186	
M156-35	12.07.19	07:25	MSS 04	21°09.978' N	20°55.016'W	4185	3 profiles
M156-36	12.07.19	08:15	MSC 05	21°10.035'N	20°54.982'W	4186	
M156-37	12.07.19	09:00	CTD 12	21°10.037'N	20°54.983'W	4169	Nutrients
M156-38	12.07.19	12:11	MUC 04	21°10.007'N	20°55.004'W	4186	
M156-39	12.07.19	15:21	BIGO-II 05	21°10'N	20°55'W	4186	Recovery
M156-40	13.07.19	11:13	MUC 05	18°00.002'N	19°33.006'W	3228	
M156-41	13.07.19	15:40	BIGO-II 06	18°00.001'N	19°33.006'W	3226	Deployment E6
M156-42	13.07.19	17:25	MBES 05				
M156-43	14.07.19	05:01	CTD 13	17°59.985'N	19°33.005'W	3227	
M156-44	14.07.19	06:05	MSS 05	18°00.066'N	19°32.973'W	3227	3 profiles
M156-45	14.07.19	07:21	MSC 06	18°00.076'N	19°32.933'W	3226	On deck: 07:57 UTC
M156-46	14.07.19	08:11	CTD 14	18°00.076'N	19°33.012'W	3227	Nutrients
M156-47	14.07.19	10:40	WG 01	18°00.163'N	19°32.907'W	3226	Deployment
M156-48	14.07.19	15:00	OFOS 05				
M156-49	14.07.19	23:19	LD 01	18°01.153'N	19°32.766'W	3226	Deployment
M156-50	15.07.19	04:09	CTD 15	18°00.002'N	20°18,012'W	3169	SensorsCalibration, Nutrients
M156-51	15.07.19	09:45	MSC 07	17°59.982'N	19°33.030'W	3228	On deck: 09:53 UTC
M156-52	15.07.19	11:57	LD 01	17°56.442'N	19°30.362'W	3223	Recovery

Station #	Date	Time (UTC)	Gear #	Latitude	Longitude	Depth (m)	Remarks
M156-53	15.07.19	13:33	BIGO-II 06	17°59.529'N	19°33.159'W	3225	Recovery
M156-54	15.07.19	17:35	ADCP				Sidescan reference
M156-55	16.07.19	13:30	SES 01				
M156-56	17.07.19	19:38	CTD 16	18°17.611'N	19°06.740'W	3115	
M156-57	17.07.19	20:30	MSC 08	18°17.596'N	19°06.806'W	3116	On deck 20:50 UTC
M156-58	17.07.19	20:51	CTD 17	18°17.599'N	19°06.790'W	3214	Nutrients
M156-59	17.07.19	23:54	CTD 18	18°17.602'N	18°49.571'W	3049	Nutrients
M156-60	18.07.19	02:44	CTD 19	18°17.586'N	18°41.477'W	3029	Nutrients
M156-61	18.07.19	05:27	CTD 20	18°17.573'N	18°21.989'W	3029	Nutrients
M156-62	18.07.19	08:00	MUC 06	18°16.911'N	18°11.526'W	2833	
M156-63	18.07.19	14:01	BIGO-II 07	18°16.908'N	18°11.528'W	2833	Deployment (Gas-Releaser)
M156-64	18.07.19	18:04	MSS 07[b]	18°16.649'N	18°14.636'W	2843	3 Profiles
M156-65	18.07.19	19:30	MSC 09	18°17.534'N	18°15.345'W	2856	On deck: 19:35 UTC
M156-66	18.07.19	19:49	CTD 21	18°17.543'N	18°15.309'W	2839	
M156-67	18.07.19	23:43	CTD 22	18°17.587'N	18°32.402'W	2974	Protozoa
M156-68	19.07.19	00:13	MSS 08	18°17.641'N	18°32.397'W	2974	
M156-69	19.07.19	01:27	CTD 23	18°17.572'N	18°32.394'W	2973	
M156-70	19.07.19	02:14	CTD 24	18°17.574'N	18°32.390'W	2974	Nutrients
M156-71	19.07.19	10:25	MUC 07	19°19.756'N	19°45.263'W	2877	
M156-72	19.07.19	14:42	BIGO-I 01	19°19.804'N	18°45.208'W	2874	Deployment
M156-73	19.07.19	20:14	MSS 09	19°26.321'N	18°22.046'W	3294	3 Profiles
M156-74	19.07.19	21:30	MSC 10	19°26.325'N	18°22.208'W	3035	On deck: 21:40 UTC
M156-75	19.07.19	21:57	CTD 25	19°26.35'N	18°22.206'W	2576	Nutrients
M156-76	20.07.19	01:03	MSS 10	19°09.227'N	18°22.040'W	2673	3 Profiles
M156-77	20.07.19	01:57	CTD 26	19°09.798'N	18°22.463'W	2678	Nutrients
M156-78	20.07.19	04:40	CTD 27	18°51.913'N	18°22.086'W	2790	Nutrients
M156-79	20.07.19	07:28	CTD 28	18°34.771'N	18°21.989'W	2817	
M156-80	20.07.19	08:40	MSC 11	18°34.807'N	18°21.988'W	2819	On deck: 08:55 UTC
M156-81	20.07.19	09:00	MSS 11	18°34.833'N	18°21.981'W	2817	3 Profiles
M156-82	20.07.19	11:42	BIGO-II 07	18°16.568'N	18°11.616'W	2835	Recovery
M156-83	20.07.19	15:10	OFOS 06				
Red Tide	20.07.19	18:37		18°16.928'N	18°11.317'W	2830	water sampling bucket
M156-84	20.07.19	20:20	OFOS 07				
M156-85	21.07.19	13:30	BIGO-I 01	19°19.428'N	18°45.382'W	2876	Recovery
M156-86	21.07.19	15:15	Lightsensor 01	19°19.843'N	18°45.321'W	3122	RAMSES
M156-87	21.07.19	19:03	CTD 29	19°09.197'N	18°05.18'W	2497	Nutrients
M156-88	21.07.19	20:20	MSC 12	19°09.198'N	18°05.021'W	2500	On deck: 20:26 UTC
M156-89	21.07.19	21:36	MSS 12	18°59.110'N	18°05.082'W	2614	2 Profiles
M156-90	21.07.19	22:45	CTD 30	19°00.063'N	18°05.028'W	2596	Nutrients
M156-91	22.07.19	00:42	CTD 31	18°51.967'N	18°04.981'W	2626	Nutrients
M156-92	22.07.19	02:53	MSS 13	18°42.297'N	18°05.136'W	2673	3 Profiles
M156-93	22.07.19	03:57	CTD 32	18°43.428'N	18°05.015'W	2663	Nutrients
M156-94	22.07.19	05:59	CTD 33	18°34.783'N	18°04.996'W	2717	Nutrients
M156-95	22.07.19	07:15	MSC 13	18°34.784'N	18°04.996'W	2717	On deck: 07:24 UTC
M156-96	22.07.19	07:31	MSS 14	18°34.838'N	18°04.996'W	2719	3 Profiles
M156-97	22.07.19	08:30	CTD 34	18°34.780'N	18°04.954'W	3790	
M156-98	22.07.19	09:15	CTD 35	18°34.782'N	18°04.953'W	2699	
M156-99	22.07.19	12:15	MSC 14	18°34.782'N	18°04.953'W	2724	On deck: 12:25 UTC
M156-100	22.07.19	14:39	BIGO-I 02	18°14.165'N	18°09.296'W	2823	Deployment, failed
M156-101	22.07.19	20:47	BBL 01	18°05.847'N	17°58.821'W	2829	Deployment
M156-102	22.07.19	23:56	MBES 06				
M156-103	23.07.19	09:35	BIGO-I 03	18°14.238'N	18°09.447'W	2820	Deployment
M156-104	23.07.19	15:13	BIGO-II 08	17°46.198'N	18°03.200'W	2943	Deployment
M156-105	23.07.19	18:53	MSS 15	17°50.925'N	18°04.737'W	2943	
M156-106	23.07.19	19:53	CTD 36	17°51.762'N	18°05.047'W	2874	Gear depth: 1200 m

Station #	Date	Time (UTC)	Gear #	Latitude	Longitude	Depth (m)	Remarks
M156-107	23.07.19	22:33	CTD 37	17°59.818'N	18°04.933'W	2871	Gear depth: 1200 m
M156-108	23.07.19	23:40	MSC 15	18°00.234'N	18°04.965'W	2869	On deck: 23:46 UTC
M156-109	24.07.19	00:33	MSS 17	18°00.259'N	18°04.962'W	2869	3 Prof., MSS16 not existing
M156-110	24.07.19	02:21	MSS 18	18°07.973'N	18°05.000'W	2660	3 Profiles at about 220dbar
M156-111	24.07.19	03:27	CTD 38	18°08.980'N	18°05.002'W	2600	
M156-112	24.07.19	05:34	MSS 19	18°17.440'N	18°05.002'W	2791	
M156-113	24.07.19	06:33	CTD 39	18°17.603'N	18°05.021'W	2790	
M156-114	24.07.19	08:36	CTD 40	18°26.167'N	18°04.990'W	2768	
M156-115	24.07.19	10:49	LD 02	18°34.785'N	18°05.041'W	2717	Deployment
M156-116	24.07.19	11:49	Glider 01	18°35.054'N	18°05.343'W	2717	Deployment
M156-117	24.07.19	13:40	MUC 08	18°34.800'N	18°05.000'W	2717	
M156-118	24.07.19	17:32	BIGO-I 03	18°13.818'N	18°09.321'W	2820	Recovery
M156-119	24.07.19	20:22	OFOS 08				
M156-120	25.07.19	10:00	MUC 09	17°46.117'N	18°03.184'W	2958	
M156-121	25.07.19	13:32	BIGO-II 08	17°46.102'N	18°02.511'W	2966	Recovery
M156-122	25.07.19	20:01	BIGO-I 04	18°34.742'N	18°05.007'W	2715	Deployment
M156-123	26.07.19	00:25	LD 02	18°36.485'N	17°58.127'W	2654	Recovery
M156-124	26.07.19	01:17	MSS 20	18°33.875'N	17°57.813'W	2675	
M156-125	26.07.19	02:12	CTD 41	18°34.797'N	17°57.999'W	2668	
M156-126	26.07.19	03:30	MSC 16	18°34.796'N	17°57.999'W	2667	On deck: 03:48 UTC
M156-127	26.07.19	04:45	MSS 21	18°33.920'N	17°49.285'W	2599	
M156-128	26.07.19	05:50	CTD 42	18°34.878'N	17°49.331'W	2597	
M156-129	26.07.19	07:59	MSS 22	18°34.018'N	17°40.737'W	2509	
M156-130	26.07.19	08:55	CTD 43	18°34.843'N	17°40.788'W	2504	Nutrients
M156-131	26.07.19	11:16	MSS 23	18°33.872'N	17°32.166'W	2428	
M156-132	26.07.19	12:07	CTD 44	18°34.831'N	17°32.132'W	2418	Nutrients
M156-133	26.07.19	16:11	BIGO-I 04	18°34.631'N	18°04.778'W	2714	Recovery, Eddy center
M156-134	26.07.19	21:03	MSS 24	18°33.842'N	17°23.586'W	2305	
M156-135	26.07.19	22:04	CTD 45	18°34.793'N	17°23.572'W	2346	Nutrients
M156-136	27.07.19	00:11	MSS 25	18°33.748'N	17°15.054'W	2124	
M156-137	27.07.19	01:15	CTD 46	18°34.800'N	17°15.031'W	2146	Nutrients
M156-138	27.07.19	07:00	CTD 47	18°09.960'N	16°30.972'W	182	Nutrients
M156-139	27.07.19	07:40	MSC 17	18°09.979'N	16°30.984'W	182	On deck: 08:00 UTC

M156-140	27.07.19	09:15	MUC 10	18°10.268'N	16°31.028'W	182	
M156-141	27.07.19	13:19	BIGO-II 09	18°10.268'N	16°31.027'W	181	Deployment
M156-142	27.07.19	16:59	CTD 48	18°34.826'N	16°23.431'W	58	Nutrients
M156-143	27.07.19	18:07	CTD 49	18°34.943'N	16°31.988'W	130	Nutrients
M156-144	27.07.19	19:28	MSS 26	18°34.727'N	16°40.624'W	356	
M156-145	27.07.19	20:30	CTD 50	18°34.788'N	16°40.566'W	353	Nutrients
M156-146	27.07.19	22:13	MSS 27	18°35.897'N	16°49.216'W	832	
M156-147	27.07.19	23:23	CTD 51	18°34.794'N	16°49.182'W	890	Nutrients
M156-148	28.07.19	01:15	MSS 28	18°35.867'N	16°57.700'W	588	
M156-149	28.07.19	02:11	CTD 52	18°34.953'N	16°57.720'W	1605	Nutrients
M156-150	28.07.19	04:19	MSS 29	18°34.808'N	17°05.670'W	1841	
M156-151	28.07.19	06:26	CTD 53	18°34.783'N	17°06.358'W	1877	
M156-152	28.07.19	07:35	MSC 18	18°34.793'N	17°06.374'W	1878	On deck: 07:40 UTC
M156-153	28.07.19	13:13	Glider 01	18°41.326'N	16°59.438'W	1256	Recovery
M156-154	28.07.19	13:34	Lightsensor 02	18°41.327'N	16°59.347'W	1253	RAMSES
M156-155	28.07.19	19:35	CTD 54	17°59.994'N	17°26.976'W	2448	Nutrients
M156-156	28.07.19	20:54	MSC 19	17°59.994'N	17°26.976'W	2448	On deck: 20:58 UTC
M156-157	28.07.19	22:37	CTD 55	17°59.990'N	17°11.167'W	2045	Nutrients
M156-158	29.07.19	01:05	CTD 56	17°59.971'N	16°55.393'W	1530	Nutrients
M156-159	29.07.19	02:22	SVP Drifter 01	17°59.866'N	16°55.027'W	1502	
M156-160	29.07.19	03:43	CTD 57	17°59.972'N	16°39.529'W	694	Nutrients
M156-161	29.07.19	05:49	CTD 58	18°10.244'N	16°30.934'W	181	
M156-162	29.07.19	06:45	MSC 20	18°10.246'N	16°30.933'W	181	On deck: 06:52 UTC
M156-163	29.07.19	09:04	BIGO-II 09	18°10.139'N	16°30.794'W	176	Recovery
M156-164	29.07.19	11:45	OFOS 09				
M156-165	29.07.19	15:19	CTD 59	17°59.980'N	16°31.994'W	417	Nutrients
M156-166 & 167	29.07.19	16:30	OFOS 10 a/b				
M156-168	29.07.19	23:06	MBES 07				
M156-169	30.07.19	13:37	Lightsensor 03	18°05.514'N	17°58.764'W	2832	RAMSES
M156-170	30.07.19	14:13	BBL 01	18°05.516'N	17°58.764'W	2830	Recovery
M156-171	31.07.19	13:05	Lightsensor 04	18°05.350'N	22°06.349'W	3316	RAMSES On deck: 13:19 UTC

[a] OFOS survey was splitted in two video data files. USBL was used, but position not reliable.
[b] MSS 06 aborted prior to deployment, hence not listed in the station list.

Abbreviations of the different gears/Measured parameters

Water column

ADCP: ship board current measurements
CTD: (CTD watersampling rosette), physical properties, nutrients
Glider: Physical properties, turbulence, O_2, nitrate
LD: Lagrangian Surface Drifter, biogeochemical properties
Light Sensor: RAMSES, irradiance
MSC: Marine Snow Catcher, particles for biogeochemical analyses
MSS: (Microstructure Sensor): Physical properties and turbulence
SVP Drifter
WG: Waveglider, physical and biogeochemical properties

Benthos

BBL: Benthic Boundary Layer Lander: Seafloor imaging, physical properties, sediment trap
BIGO-1/-2: Biogeochemical Observatory: In situ element fluxes, sediments for biogeochemistry
MBES: Multibeam bathymetrical measurements
MUC: Multiple corer video-guided, sediments for geochemistry and microbiology
OFOS: Ocean Floor Observation System, towed camera system for sea floor imaging
SES: Sidescan, seafloor monitoring