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Short Cruise Report
R/V METEOR M186/2

Las Palmas, Spain – Walvis Bay, Namibia
03.01.2023 – 22.01.2023
Chief Scientist: Dr. Holger Auel
Captain: Detlef Korte

Objectives

Marine ecosystems are strongly affected by climate change and ocean acidification. At the same time, biological production and trophic interactions in the pelagic realm impact the carbon cycle and, hence, provide a feedback to the global climate system. Particularly, zooplankton organisms play a key role in the biological carbon pump in the ocean and, thus, for the global carbon cycle. They represent the principal trophic link from phytoplankton to higher trophic levels, such as fish and top-predators. Via feeding, fecal pellet production, respiration and vertical migration, zooplankton and micronekton contribute to the active carbon transport from the surface layer of the ocean into the deep sea.

Zooplankton constitutes a highly diverse community of protistan and metazoan consumers, which differ morphologically, taxonomically and functionally. Their body sizes vary by many orders of magnitude. Zooplankton responds quickly to environmental changes, as it is fast-growing, short-lived and - as passive drifters - directly affected by changes in hydrography and ocean currents. As such, they are good indicators for ecosystem health and status, and their biodiversity is central to the functioning of marine ecosystems.

Recently, scientific interest has shifted to functional traits and life-cycle strategies of pelagic organisms in order to structure the high biodiversity and to link biodiversity to ecosystem functioning such as the role of zooplankton in marine food webs and its effect on the biological carbon pump.

The aim of AtlanTIC was to study and quantify the productivity, trophic interactions and functional biodiversity of pelagic communities throughout the Atlantic Ocean across different climate zones, nutrient regimes (from oligotrophic sub-tropics to the highly productive Benguela upwelling system) and ocean basins along the cruise track of M186/2. The cruise track extended from the Canary Islands (northern sub-tropical Atlantic in winter) via tropical waters and the southern sub-tropical Atlantic during austral summer to regions affected by the Benguela Current upwelling system off Namibia. We studied how differences in pelagic community structure, functional biodiversity, biological productivity, and trophic interactions affect ecosystem functioning, in particular the role of the ocean as sink or source for atmospheric carbon in the global carbon cycle.

The second major aim of AtlanTIC was student training for the Universities of Bremen and Hamburg in state-of-the-art methods in marine research. Students/Trainees learnt how to collect data and samples at sea, how to process, analyse and interpret the results. The cruise offered a unique opportunity for hands-on training in an interdisciplinary setting.

Narrative

On Tuesday, 3rd of January 2023, the research and training cruise M186/2 started at 09:00 a.m., when we left Las Palmas on Gran Canaria in southerly direction. With mainly sunny weather and blue skies, light north-easterly trade winds pushed us forward.

This cruise leg is focused around the AtlanTIC project, which studies the productivity, trophic interactions, and functional biodiversity of pelagic communities in different regions of the Atlantic Ocean and their impact on the carbon cycle. At the same time, it provides training to marine biology students from the Universities of Bremen and Hamburg in state-of-the-art methods at sea.

For that purpose, AtlanTIC used the transit of the research vessel METEOR from Las Palmas (Gran Canaria, Spain) to Walvis Bay (Namibia) for station work and sampling along the cruise track. The expedition passed through different geographic and climatic regions from the oligotrophic, subtropical North Atlantic in winter via the tropics and the subtropical South Atlantic in summer to the highly productive coastal upwelling system of the Benguela Current off Namibia. Nine scientists and technicians, one Ph.D. candidate and 14 students from the Universities of Bremen and Hamburg as well as from the Thünen-Institute for Sea Fisheries and from the Federal German Maritime and Hydrographic Agency (BSH) participated in the cruise.

We used the first two days at sea to set up the laboratories and to prepare the plankton nets and sampling equipment. In addition, we received a safety at sea introduction and a security drill. On Thursday, 5th of January, we sampled the first two stations in the region between the Canary Islands and the Cape Verde Islands.

At each station, we deployed a CTD sensor connected to a rosette water sampler in order to measure depth profiles of temperature, salinity, dissolved oxygen concentration, light, and chlorophyll fluorescence. On the way back to the surface, we collected water samples from discrete depth layers. Afterwards, we deployed several plankton nets with different mouth openings and mesh sizes in order to sample different plankton size classes from unicellular phytoplankton algae to small zooplankton animals in the millimetre- to centimetre-scale. Our largest net, the Isaacs-Kidd-Midwater-Trawl (IKMT) with a mouth opening of seven square metres and 4.5 mm mesh size is towed behind the vessel and catches larger crustaceans and small mesopelagic fishes.

To train the students in state-of-the-art methods in marine research, they were fully integrated in the AtlanTIC project work on board. They learnt how samples and data are collected at sea and how results are analysed and interpreted. For that, students worked in small teams on topics such as physical oceanography, phytoplankton production and biodiversity, micro- and mesozooplankton biodiversity, macrozooplankton and mesopelagic fish as well as seabird and marine mammal surveys.

On the 6th and 7th of January, we passed the waters near Cabo Verde, where we saw the first groups of flying fish. Regularly, we also found large amounts of *Sargassum* drifting seaweed at the ocean surface. These macroalgae usually occur in the western North Atlantic and share their name with the Sargasso Sea south of Bermuda. However, in recent years, their distribution and abundance have changed so that drifting algal mats occur now more often in the eastern Atlantic.

On Sunday, the 8th of January, we started station work at our third station at 06:00 a.m. in order to deploy the IKMT net still at darkness, when many marine creatures are in the upper layers of the water column. At sunrise, they retreat to greater depths to avoid predators.

The opposing requirements of darkness for the IKMT trawls and sunlight for the CTD casts, determined the timing of station work and structured the sequence of gears at all following regular stations. We always started at 06:00 a.m. before sunrise with an IKMT trawl, followed by a multiple opening/closing net haul for mesozooplankton (200 µm mesh size) down to 600 m maximum sampling depth and another multiple opening/closing net haul for microplankton (55 µm mesh size) down to 100 m maximum sampling depth, before ending station work with a CTD cast at daylight. In parallel to the CTD, a small Apstein net was deployed manually twice at each station to collect additional phytoplankton and microzooplankton from the upper 10 m for taxonomic and bio-chemical analyses.

This regular daily sampling scheme continued during the second week of the cruise from Monday, 09th of January, to Friday, 13th of January. On Monday, we experienced for the first time a higher swell of more than three metres, but it did not affect our research activities. On Thursday, 12th of January 2023, in the evening, we crossed the equator. On the southern hemisphere, days are longer during the austral summer. In addition, on our south-easterly course, sunrise came slightly earlier each day. Therefore, we had to advance the ship’s clock twice by one hour during the cruise to adjust time on board and station work to the earlier sunrise.

At stations 11 and 15, we deviated slightly from our regular sampling scheme. At those two stations, we did not deploy the IKMT, but used the saved time for deeper hauls with the multiple opening/closing net down to 1500 m maximum sampling depth.

In addition to our station work for the AtlanTIC project, on behalf of the Federal German Maritime and Hydrographic Agency (BSH) we deployed eight Argo floats along the cruise track, four in the northern hemisphere and four in the southern hemisphere.

Moreover, we conducted experimental work in the laboratories on board. This included measurements of phytoplankton primary production in a rotating incubator with water from the chlorophyll maximum, community respiration, and photosynthetic fitness of phytoplankton algae with a Fast Repetition Rate Fluorometer. In addition, fecal pellet and egg production by copepods were measured at most stations with short-term incubations of three to four hours for fecal pellet production and 24 hours for egg production.

Station work ended on Thursday, 19th of January 2023, at 19:00 local time with the deployment of the final Argo float. In total, we sampled 13 stations with our regular sampling programme and deployed eight Argo Floats. Due to the very good weather conditions during the entire cruise, we had more station time available than the one day originally approved.

The last two days of the cruise were used for packing the expedition equipment, cleaning of labs, writing reports, and presentation of results of the student project groups. The cruise ended in Walvis Bay in the morning of Sunday, 22nd of January 2023.

Acknowledgements

Originally, the research and training cruise AtlanTIC was proposed jointly by the Universities of Bremen and Hamburg in early 2020 in response to a specific call for proposals by LDF for the transfer voyage M176/2. Due to the covid-19 pandemic, M176/1 was cancelled. Thereafter, AtlanTIC was again included in the cruise schedule as MSM104/2, but had to be cancelled again on very short notice due to the outbreak of the then new omikron virus variant in southern Africa in November 2021. Therefore, we are very grateful to LDF that the AtlanTIC project could now be realised during M186/2 on board of R/V Meteor. Captain Korte and the entire crew welcomed us very friendly on board. We would like to thank them for their very professional, competent and helpful support, which contributed significantly to the scientific success of the cruise. We are grateful to DFG for funding.

Teilnehmerliste

1.	AUEL	Holger	Fahrtleiter / *Chief Scientist*	UniHB
2.	HAGEN	Wilhelm	*Zooplankton Ecophysiology*	UniHB
3.	KOPPELMANN	Rolf	*Biological Oceanography*	UniHH
4.	MARTIN	Bettina	*Phytoplankton Production*	UniHH
5.	HERRFORD	Josefine	*Physical Oceanography, CTD*	UniHH
6.	EBERLE	Sabine	*Phytoplankton Measurements*	UniHH
7.	SELL	Anne	*Mesopelagic Fish, IKMT*	TI-SF
8.	LUDWIG	Kim Ellen	*Mesopelagic Fish, IKMT*	TI-SF
9.	BARRING	Sarah	*Student: Zooplankton*	UniHB
10.	DAHM	Malena	*Student: Phytoplankton*	UniHB
11.	KLIEM	Susanne	*Student: Physical Oceanography*	UniHH
12.	LOHNER	Hanna	Student: Macrozooplankton	UniHH
13.	MUELLER	Nina	*Student: Zooplankton*	UniHH
14.	NISBET	Aki	*Student: Zooplankton*	UniHB
15.	ORLANDI	Niccolò	*Student: Seabirds & Marine Mammals*	UniHB
16.	PANKOKE	Linnea	*Student: Phytoplankton*	UniHB
17.	RITTINGHAUS	Hanna	*Student: Zooplankton*	UniHB
18.	ROBITSCHKO	Hanna	*Student: Mesopelagic Fish*	UniHH
19.	SCHMOELE	Saskia	*Student: Seabirds & Marine Mammals*	UniHB
20.	STOEBKE	Jette	*Student: Physical Oceanography*	UniHH
21.	WILLMER	Joy	*Student: Phytoplankton*	UniHB
22.	ZIMMERMANN	Jan	*Student: Macrozooplankton*	UniHH
23.	KRETZSCHMANN	Lisett	*Mesopelagic Fish, IKMT*	BSH
24.	RAEKE	Andreas	*Weather Technician*	DWD

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Stationsliste

Station	Date / Time UTC	Device	Latitude	Longitude
M186/2_1-1	05.01.2023 08:25	Multiple opening/closing net (55 µm, 100 m)	22° 36,121' N	020° 39,877' W
M186/2_1-2	05.01.2023 08:50	CTD	22° 36,069' N	020° 39,900' W
M186/2_1-3	05.01.2023 08:56	Apstein Net	22° 36,054' N	020° 39,896' W
M186/2_1-4	05.01.2023 08:59	Apstein Net	22° 36,052' N	020° 39,908' W
M186/2_1-5	05.01.2023 09:58	Multiple opening/closing net (200 µm, 600 m)	22° 36,088' N	020° 39,979' W
M186/2_1-6	05.01.2023 10:49	Isaacs-Kidd Midwater Trawl (small)	22° 36,235' N	020° 39,112' W
M186/2_2-1	05.01.2023 17:55	CTD	21° 30,539' N	020° 41,521' W
M186/2_2-2	05.01.2023 18:04	Apstein Net	21° 30,541' N	020° 41,518' W
M186/2_2-3	05.01.2023 18:07	Apstein Net	21° 30,541' N	020° 41,517' W
M186/2_2-4	05.01.2023 18:56	Multiple opening/closing net (55 µm, 100 m)	21° 30,541' N	020° 41,516' W
M186/2_2-5	05.01.2023 19:38	Multiple opening/closing net (200 µm, 600 m)	21° 30,541' N	020° 41,518' W
M186/2_2-6	05.01.2023 20:22	Isaacs-Kidd Midwater Trawl (small)	21° 30,851' N	020° 40,892' W
M186/2_3-1	08.01.2023 06:13	Isaacs-Kidd Midwater Trawl (small)	11° 43,626' N	020° 11,285' W
M186/2_3-2	08.01.2023 07:15	Multiple opening/closing net (200 µm, 600 m)	11° 44,374' N	020° 10,353' W
M186/2_3-3	08.01.2023 07:56	Multiple opening/closing net (55 µm, 100 m)	11° 44,373' N	020° 10,351' W
M186/2_3-4	08.01.2023 08:18	CTD	11° 44,373' N	020° 10,351' W
M186/2_3-5	08.01.2023 08:25	Apstein Net	11° 44,371' N	020° 10,350' W
M186/2_3-6	08.01.2023 08:28	Apstein Net	11° 44,372' N	020° 10,351' W
M186/2_4-1	09.01.2023 06:27	Isaacs-Kidd Midwater Trawl (small)	08° 30,496' N	018° 46,422' W
M186/2_4-2	09.01.2023 07:52	Multiple opening/closing net (200 µm, 600 m)	08° 31,591' N	018° 45,705' W
M186/2_4-3	09.01.2023 08:36	Multiple opening/closing net (55 µm, 100 m)	08° 31,481' N	018° 46,054' W
M186/2_4-4	09.01.2023 08:58	CTD	08° 31,446' N	018° 46,321' W
M186/2_4-5	09.01.2023 09:04	Apstein Net	08° 31,449' N	018° 46,387' W
M186/2_4-6	09.01.2023 09:09	Apstein Net	08° 31,442' N	018° 46,455' W
M186/2_5-1	10.01.2023 06:26	Isaacs-Kidd Midwater Trawl (small)	05° 45,603' N	016° 48,871' W
M186/2_5-2	10.01.2023 07:51	Multiple opening/closing net (200 µm, 600 m)	05° 44,323' N	016° 47,764' W
M186/2_5-3	10.01.2023 08:28	Multiple opening/closing net (55 µm, 100 m)	05° 44,323' N	016° 47,764' W
M186/2_5-4	10.01.2023 08:50	CTD	05° 44,323' N	016° 47,764' W
M186/2_5-5	10.01.2023 08:55	Apstein Net	05° 44,321' N	016° 47,764' W
M186/2_5-6	10.01.2023 08:58	Apstein Net	05° 44,323' N	016° 47,764' W
M186/2_5-7	10.01.2023 10:02	Floater	05° 44,247' N	016° 47,658' W
M186/2_6-1	10.01.2023 15:39	Floater	04° 59,472' N	016° 11,527' W
M186/2_7-1	11.01.2023 05:30	Isaacs-Kidd Midwater Trawl (small)	03° 21,050' N	014° 38,128' W
M186/2_7-2	11.01.2023 06:51	Multiple opening/closing net (200 µm, 600 m)	03° 18,857' N	014° 37,748' W
M186/2_7-3	11.01.2023 07:24	Multiple opening/closing net (55 µm, 100 m)	03° 18,884' N	014° 37,750' W
M186/2_7-4	11.01.2023 07:44	CTD	03° 18,904' N	014° 37,752' W
M186/2_7-5	11.01.2023 07:48	Apstein Net	03° 18,908' N	014° 37,752' W
M186/2_7-6	11.01.2023 07:53	Apstein Net	03° 18,908' N	014° 37,752' W
M186/2_7-7	11.01.2023 10:20	Floater	03° 18,902' N	014° 37,752' W
M186/2_8-1	11.01.2023 14:47	Floater	02° 48,651' N	014° 03,937' W
M186/2_9-1	12.01.2023 05:27	Isaacs-Kidd Midwater Trawl (small)	01° 09,628' N	012° 21,095' W
M186/2_9-2	12.01.2023 06:50	Multiple opening/closing net (200 µm, 600 m)	01° 07,685' N	012° 20,694' W
M186/2_9-3	12.01.2023 07:26	Multiple opening/closing net (55 µm, 100 m)	01° 07,686' N	012° 20,693' W
M186/2_9-4	12.01.2023 07:47	CTD	01° 07,686' N	012° 20,694' W
M186/2_9-5	12.01.2023 07:53	Apstein Net	01° 07,685' N	012° 20,693' W
M186/2_9-6	12.01.2023 07:56	Apstein Net	01° 07,685' N	012° 20,694' W
M186/2_9-7	12.01.2023 08:00	Apstein Net	01° 07,685' N	012° 20,694' W
M186/2_10-1	13.01.2023 05:28	Isaacs-Kidd Midwater Trawl (small)	01° 14,326' S	009° 46,720' W
M186/2_10-2	13.01.2023 06:50	Multiple opening/closing net (200 µm, 600 m)	01° 15,883' S	009° 46,653' W
M186/2_10-3	13.01.2023 07:26	Multiple opening/closing net (55 µm, 100 m)	01° 15,882' S	009° 46,649' W
M186/2_10-4	13.01.2023 07:49	CTD	01° 15,872' S	009° 46,627' W
M186/2_10-5	13.01.2023 07:55	Apstein Net	01° 15,872' S	009° 46,626' W
M186/2_10-6	13.01.2023 08:00	Apstein Net	01° 15,872' S	009° 46,626' W
M186/2_11-1	15.01.2023 13:04	CTD	07° 41,461' S	004° 20,023' W
M186/2_11-2	15.01.2023 13:12	Apstein Net	07° 41,461' S	004° 20,022' W
M186/2_11-3	15.01.2023 13:14	Apstein Net	07° 41,462' S	004° 20,023' W
M186/2_11-4	15.01.2023 15:06	Multiple opening/closing net (200 µm, 1500 m)	07° 41,461' S	004° 20,023' W
M186/2_11-5	15.01.2023 16:12	Multiple opening/closing net (55 µm, 100 m)	07° 41,461' S	004° 20,023' W

Station	Date / Time UTC	Device	Latitude	Longitude
M186/2_12-1	16.01.2023 04:30	Isaacs-Kidd Midwater Trawl (small)	08° 52,909' S	002° 48,986' W
M186/2_12-2	16.01.2023 05:52	Multiple opening/closing net (200 µm, 600 m)	08° 54,277' S	002° 47,707' W
M186/2_12-3	16.01.2023 06:25	Multiple opening/closing net (55 µm, 100 m)	08° 54,277' S	002° 47,707' W
M186/2_12-4	16.01.2023 06:42	CTD	08° 54,277' S	002° 47,706' W
M186/2_12-5	16.01.2023 06:51	Apstein Net	08° 54,264' S	002° 47,718' W
M186/2_12-6	16.01.2023 06:54	Apstein Net	08° 54,266' S	002° 47,717' W
M186/2_12-7	16.01.2023 07:25	Floater	08° 54,368' S	002° 47,656' W
M186/2_13-1	17.01.2023 04:47	Isaacs-Kidd Midwater Trawl (small)	11° 05,365' S	000° 01,571' W
M186/2_13-2	17.01.2023 06:59	Multiple opening/closing net (200 µm, 600 m)	11° 08,927' S	000° 02,568' W
M186/2_13-3	17.01.2023 07:32	Multiple opening/closing net (55 µm, 100 m)	11° 08,926' S	000° 02,570' W
M186/2_13-4	17.01.2023 07:53	CTD	11° 08,927' S	000° 02,567' W
M186/2_13-5	17.01.2023 07:58	Apstein Net	11° 08,926' S	000° 02,559' W
M186/2_13-6	17.01.2023 08:01	Apstein Net	11° 08,925' S	000° 02,559' W
M186/2_13-7	17.01.2023 08:15	Apstein Net	11° 08,926' S	000° 02,589' W
M186/2_13-8	17.01.2023 08:36	Floater	11° 08,997' S	000° 02,606' W
M186/2_14-1	18.01.2023 04:48	Isaacs-Kidd Midwater Trawl (small)	13° 12,656' S	002° 34,851' E
M186/2_14-2	18.01.2023 06:55	Multiple opening/closing net (200 µm, 600 m)	13° 16,586' S	002° 34,334' E
M186/2_14-3	18.01.2023 07:30	Multiple opening/closing net (55 µm, 100 m)	13° 16,589' S	002° 34,314' E
M186/2_14-4	18.01.2023 07:48	CTD	13° 16,591' S	002° 34,300' E
M186/2_14-5	18.01.2023 07:52	Apstein Net	13° 16,591' S	002° 34,304' E
M186/2_14-6	18.01.2023 07:55	Apstein Net	13° 16,592' S	002° 34,302' E
M186/2_15-1	18.01.2023 16:03	CTD	14° 03,742' S	003° 31,637' E
M186/2_15-2	18.01.2023 16:10	Apstein Net	14° 03,743' S	003° 31,636' E
M186/2_15-3	18.01.2023 16:12	Apstein Net	14° 03,742' S	003° 31,636' E
M186/2_15-4	18.01.2023 18:06	Multiple opening/closing net (200 µm, 1500 m)	14° 03,743' S	003° 31,636' E
M186/2_15-5	18.01.2023 19:10	Multiple opening/closing net (55 µm, 100 m)	14° 03,742' S	003° 31,638' E
M186/2_15-6	18.01.2023 19:30	Floater	14° 03,823' S	003° 31,644' E
M186/2_16-1	19.01.2023 17:00	Floater	16° 25,480' S	006° 27,407' E