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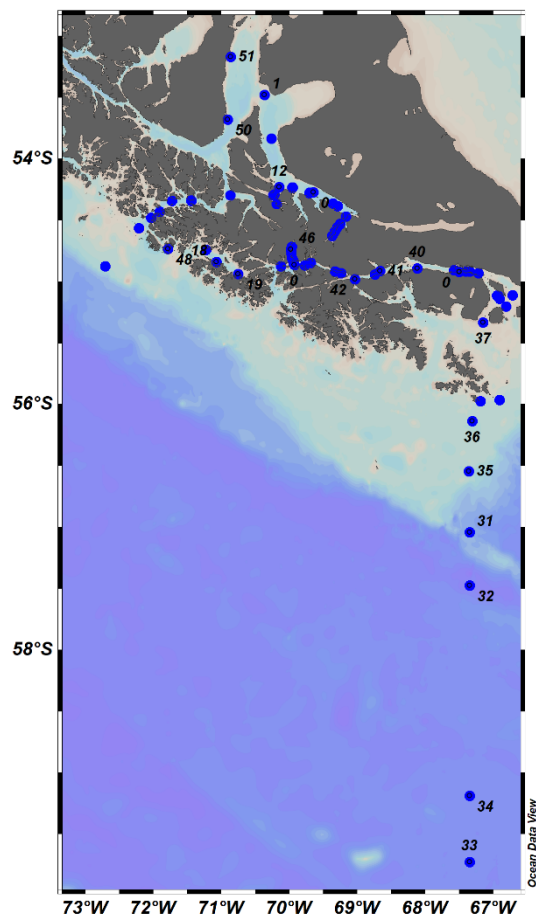
Short Cruise Report
RV METEOR
Cruise M179/2

Punta Arenas (Chile) - Montevideo (Uruguay)

15.01.2022 - 20.02.2022

Chief Scientist: Dr. Bernd Krock

Captain: Detlef Korte



Objectives

The goal of FjordFlux is to describe major flux of organic matter (OM) in the Patagonian Cold Estuarine System (PCES) with special focus on fjord systems including the Beagle Channel (BC) under summer ice melt conditions for the understanding of marine ecosystem functioning. FjordFlux aimed at obtaining spatially resolved information of the current environmental state of the BC region impacted by increasing climate change and anthropogenic pressure. The spatial information of chemical and biological signals will support the efforts to establish a marine terrestrial long-term observation in the BC (DynAMo, BMBF: LAT16STRUC-039). The program combined physical hydrography to record spatial patterns of coastal runoff within the Cordillera Darwin Icefield with the analysis of chemical signatures to determine terrestrial and marine sources of macro/micro nutrients, OM, freshwater mixing, and the distribution of greenhouse gases in surface waters of the BC and the adjacent Cape Horn Current and fjords. The effect of local flux patterns on planktonic and benthic community composition and functionality was surveyed in fjords, differing in their state of deglaciation and adjacent areas. The cruise followed 26 years after the Victor Hensen Magellan-BC expedition, which serves as baseline to detect the current state of change.

Specifically, standard CTD profiles were carried out complemented by an underway sensor system (conductivity, temperature, turbidity, chlorophyll-a fluorescence, and dissolved oxygen sensors) provided high resolution surface water information. Apparent optical properties were determined vertically, using a hyper-spectral light profiler. For horizontal coverage, three above-surface radiometers provided high resolution data of water colour, which is related to optically active substances. Inherent optical properties (IOPs) were measured continuously using sensors attached to the underway measurement system and discreetly at the cruise stations. The greenhouse gases (GHG) N₂O and CH₄ were measured continuously and posteriorly in discrete seawater samples by head-space gas chromatography. Geochemical parameters such as nutrients, PON/POC, DOC/DON, DOM were determined at all stations. In addition, eleven large volume surface water samples (600 L) for the identification of siderophores and chromatographic separation of DOM were pumped on board and stored in IBC tanks. Water for the determination of trace elements (Δ Fe, Δ Si) was collected underway from the sea surface (3 m depth) with a tow fish. High-resolution data on the plankton community were collected with phytoplankton net tows. Additionally, field samples were collected for the quantification of planktonic key taxa, bacteria and viruses as well as for metagenomic analysis. Additionally, net tow samples were sampled to quantify phycotoxin content and composition and microbial community composition via metagenomics. In order to specify the functional relationship between phytoplankton and key nutrients, incubation experiments were carried out underway, testing effects of micro- and macronutrients on phytoplankton characteristics and water chemistry. In addition, meso- and macrozooplankton abundance, biomass, viability, elemental and fatty acid composition were studied in the PCES. Along the ship track macrozooplankton biomass was estimated using the on-board multi-frequency echo sounder and will be validated with the plankton surveys. Additionally, zooplankton respiration, grazing, faecal pellet production, and egg production rate was assessed on-board. In addition to planktonic parameters, the benthic community structure, functional biodiversity in meltwater influenced fjord habitats were assessed. Macrobenthic infauna was collected along the length axis of the selected fjords and adjacent areas. Four replicated samples were taken per station with a multibox corer (MBC). The material was sieved and fixed. Postcruise, macrobenthic specimens will be sorted, identified to the lowest possible taxonomic level and counted. Macrobenthic epifauna was recorded by an innovative towed camera platform integrating an additional acoustical device (ROVOS). The ROVOS was deployed at PCES stations between and this towed system maintained continuous direct communication via a fibre optic cable with the vessel.

Narrative

At the beginning of the cruise two bad news reached us: 1) one of the ten German scientific cruise participants tested positive for covid after arrival in Santiago de Chile, so the whole group was sent into quarantine as direct contacts and 2) shortly before arrival in Punta Arenas we received the diplomatic approval for Chile, which included a research ban for three of the four requested fjords. Both pieces of news necessitated a complete rescheduling of the itinerary, although the new framework (duration of the quarantine and practical implications of the diplomatic approval) were not clear for a long time. On January 14, the embarkation of the South American participants took place as well as a protocolary visit of Mrs. Marie-Josphine Vecchio of the German embassy in Santiago with a two-headed film team on the METEOR. In the talks with Mrs. Vecchio the current situation on board and the problems were discussed, while the film team interviewed the chief scientist of the cruise and cruise participant Dr. Gemita Pizarro for outreach activities. The start of the research cruise was delayed by four days until all cruise participants who had arrived from Germany arrived from quarantine in Punta Arenas and boarded with the exception of one participant who became infected during quarantine. At short notice on January 18, the Chilean Minister of Science, Dr. Andrés Couve, announced a protocol visit to the METEOR for the evening. The minister arrived on board at 19:00 accompanied by his photographer. Immediately after the welcome by Captain Korte, the Minister, Dr. Humberto González, Director of the IDEAL Center, and the cruise director held a three-way conversation on deck regarding the current situation of diplomatic approval. The conversation took place in a very open, factual and trusting atmosphere. After the conversation a short ship tour including the bridge and some laboratories followed. Finally, a group photo was taken with the Minister and all Chilean participants before Captain Korte bid farewell to the Minister.

In the early morning of January 19, the voyage could start in best weather with almost cloudless sky and around noon the first station at the mouth of the Seno Almirantazgo was reached. As expected, the deck work at the first station was still somewhat uncoordinated and took a relatively long time of eight hours. But already on the second day, the next two stations at the head of Bahía Parry, which is characterized by several glaciers ending directly in the fjord, were completed much more smoothly and, above all, faster. After three days, the work was completed in Bahía Parry and continued in Seno Almirantazgo. In the meantime, we received the notice of change from the Chilean Ministry of Foreign Affairs, which lifted all bans on working areas with the exception of Yendegaia Fjord. Thus, the planned work in Bahía Fitton, Canal Gabriel and Seno Garibaldi will be reinstated in the research program according to the original plan. On January 24, after the start of station work in Seno Almirantazgo, a group PCR screening test was positive and all station work was immediately stopped and the affected five individuals were sent to their cabins. However, further individual PCR tests of the five affected scientists after several hours were negative. Since all other group tests were also negative by the evening, the precautionary measures were lifted again and work continued the following morning in Bahía Fitton. Since the German cruise participants had only boarded the ship the evening before departure, the ROV of the benthic group in Canal Cockburn was deployed for the first time after lengthy preparation and installation of the periphery in the CTD laboratory as a command center. Fortunately, the deployment worked right away and provided high quality and impressive film recordings of the benthic fauna at depths of 180 to 300 m. After all technical and administrative problems were solved at the beginning of the cruise, the work could be carried out successfully. At the end of January, the Seno Garibaldi in the Beagle Channel was sampled against an impressive landscape. In order to sample gradients towards the ice edge of the glacier as well as towards terrestrial input, METEOR's zodiac was used to sample parts of the fjord that were inaccessible to RV METEOR due to its size.

In the early morning of February 1, the METEOR moored at the pier in Ushuaia, where two media escorts were to be dropped off and the Argentine national observer and three scientists, who were unable to show negative PCR tests due to covid infections they had contracted during embarkation in Punta Arenas, were to come on board. There, the METEOR was detained by the Argentine Coast Guard (Prefectura Naval). This incident was settled on the same day with the mediation of the German Embassy in Buenos Aires and the German Research Fleet Coordination Centre. After the settlement of this incident and the change of personnel, which was completed during the day, RV METEOR still could not sail, because the bureaucratic processing of the formal departure, which became necessary due to the change of pilot in the Chilean Puerto Williams on February 3. In this context, it also became clear that each crossing of the Argentine-Chilean maritime border would require a formal declaration of entry or exit with the physical presence of the METEOR in Ushuaia. Since a total of five working days had already been lost at the beginning of the cruise, no further loss of work was to be accepted and we decided to cancel work in Argentine waters altogether and accordingly moved the southeastern transect into Drake Passage to west of 67 degrees longitude into the Chilean EEZ.

Early in the morning of February 3, off Puerto Williams, the two Chilean pilots who had accompanied us since leaving Punta Arenas were dropped off by pilot boat and two new ones were taken on board at the same time. Due to a favorable weather forecast for the coming days in the area of the Drake Passage, we decided to postpone further work in the estuary of the Beagle Channel and to head south immediately after the last station, where we sampled the first station outside the inland waters of Tierra del Fuego on the morning of February 4. The complete work program was completed except for the benthic work. After one more station, we reached the southernmost point of our cruise at 59°44'S on the morning of February 5. Wind and swell had increased a bit overnight, but still almost all instruments could be used. Around noon on our way north, a low pressure system crossed us, which brought higher swell for a short time, so that in the afternoon only the CTD with crane water bailer was run for safety reasons. But already in the morning of the following day, with sunshine, much calmer sea and decreasing wind, all planned work was realized in the course of the day until just south of Cape Horn. Also in the remaining days up to the last working day on February 13 all work could be accomplished according to plan, without new problems having arisen. After antigen tests had been carried out by a mobile team in the late evening of the previous day and had all delivered negative results, RV METEOR moored at the pier of Punta Arenas in the morning of February 14. Afterwards all South American colleagues and their scientific equipment as well as two German colleagues disembarked. At about 2:00 p.m., the METEOR cast off again and set course for Montevideo, the final port of the cruise. Since the scientific program was completed with the last stop at the roadstead of Punta Arenas, the remaining days at sea were used to thoroughly clean, dry and pack the scientific equipment into the appropriate transport boxes. After these activities were largely completed, cleaning of the laboratories and stowage of the containers began. The whole operation was accompanied by calm seas and sunny weather, so that all the work could be carried out and completed under optimal conditions.

Acknowledgements

We would like to take this opportunity to express our special thanks for the full support of Captain Korte and his entire crew, who always responded to all wishes and requests in a highly professional manner, which contributed decisively to the success of this voyage. In addition, I would like to emphasize the warm and friendly atmosphere on board, which made it very easy for all scientists, but especially for the South American colleagues, to settle in on board and to cope with the hardships of a long research cruise. Furthermore, we especially acknowledge the support of the German Research Fleet Coordination Centre in the preparation of the cruise as well in solving the numerous administrative and logistic problems we had to encounter. Last but not least, we thank the staff of the German Embassy in Santiago de Chile for their engagement with the diplomatic permit of the FjordFlux cruise.

Participant List M179/2

1. Bernd Krock	Chief Scientist	AWI
2. Christian Zurhelle	Marine Chemistry	AWI
3. Marina Arregui	Vitamins, Dissolved Phycotoxins	AWI
4. Claudio Richter	Benthos Communities	AWI
5. Marie Kaufmann	Benthos Communities	AWI
6. Nils Owsianowski	ROV Operation	AWI
7. Sarah Taudien	eDNA	HIFMB
8. Stefan Forster	Sediment Respiration	UHRO
9. Jochen Wollschläger	Flow Cytometry	ICBM
10. Kai Schwalfenberg	CTD Operation	ICBM
11. Michelle Albinus	ACDP	ICBM
12. Claudia Thölen	FerryBox	ICBM
13. Neeske Lübben	Bio-optics	DFKI
14. Humberto González	Fluoroprobe	UACH
15. Ricardo Giesecke	Zooplankton	UACH
16. Leonardo Castro	Zooplankton	UDEC
17. Rodrigo Torres	Trace Metals	CIEP
18. Josefa Verdugo	Green House Gases	UDEC
19. Sandy Tenorio	Green House Gases	UDEC
20. Nicole Trefault	Metagenomics	UMAYOR
21. Patricio Flores	Metagenomics	UMAYOR
22. Gemita Pizarro	Particulate Phycotoxins	IFOP
23. Andrea Malits	Viruses	CADIC
24. Clara Rodríguez	Microbiology	CADIC
25. Andreana Cadaillón	Phytoplankton	CADIC
26. Azul Gilabert	Mesocosms	IADO
27. John Garzón	Biogeochemistry	IADO
28. Mark Wunsch	Outreach	GCM
29. Martin Stelzner	Meteorology	DWD
30. Oliver Sievers	Meteorology	DWD
31. Karina Flores	National Observer (Chile)	SHOA

Institutes

AWI	Alfred Wegener Institut für Polar- und Meeresforschung (Germany)
CADIC	Centro Austral De Investigaciones Científicas (Argentina)
CIEP	Centro de Investigación en Ecosistemas Patagónicos (Chile)
DFKI	Deutsches Forschungsinstitut für Künstliche Intelligenz (Germany)
DWD	Deutscher Wetterdienst (Germany)
GCM	Green Coast Media (Canada)
HIFMB	Helmholtz Institut Für Marine Biodiversität (Germany)
IADO	Instituto Argentino De Oceanografía (Argentina)
ICBM	Institut für Chemie und Biologie des Meeres (Germany)
IFOP	Instituto de Fomento Pesquero (Chile)
SHOA	Servicio Hidrográfico y Oceanográfico de la Armada (Chile)
UACH	Universidad Austral de Chile (Chile)
UDEC	Universidad de Concepción (Chile)
UHRO	Universität Rostock (Germany)
UMAYOR	Universidad Mayor (Chile)

Station List M179/2

DSHIP	LAT [°S]	LAT ['S]	LON [°W]	LON ['W]	Date	Time [UTC]
1	53	28,6200	70	21,7740	19.01.2022	15:30:00
2	54	35,4670	69	19,9210	20.01.2022	12:05:00
3	54	37,7490	69	22,2030	20.01.2022	17:20:00
4	54	31,6830	69	15,1140	21.01.2022	11:03:00
5	54	33,4980	69	17,6810	21.01.2022	16:52:00
7	54	28,096	69	09,851	22.01.2022	11:02:00
8	54	23,0070	69	17,3950	22.01.2022	16:47:00
9	54	16,7550	69	42,1340	23.01.2022	11:05:00
10	54	13,9590	69	57,1880	23.01.2022	16:21:00
11	54	17,7100	70	14,2890	24.01.2022	11:00:00
12	54	13,7960	70	09,0740	25.01.2022	11:03:00
13	54	21,9510	70	11,0680	25.01.2022	16:55:00
14	54	17,6920	70	51,9770	26.01.2022	12:08:00
15	54	20,3990	71	26,4950	26.01.2022	19:34:00
16	54	25,8000	71	54,4420	27.01.2022	11:03:00
17	54	28,8660	72	01,8880	27.01.2022	17:23:00
18	54	50,3170	71	04,4570	28.01.2022	11:41:00
19	54	56,3260	70	45,4820	28.01.2022	17:55:00
20	54	50,777	69	40,9920	29.01.2022	10:59:00
21	54	55,0020	69	19,4980	29.01.2022	16:41:00
22	54	51,1830	69	55,8420	30.01.2022	11:00:00
23	54	48,7190	69	57,7070	30.01.2022	19:10:00
24	54	42,9580	69	57,9040	31.01.2022	11:26:00
25	54	44,373	69	58,564	31.01.2022	16:41:00
26	54	55,09	67	20,665	02.02.2022	16:27:00
28	54	54,4	67	34,602	03.02.2022	11:55:00
29	54	55,838	67	13,181	03.02.2022	16:19:00
31	57	2,573	67	20,948	04.02.2022	11:48:00
32	57	28,627	67	20,874	04.02.2022	18:06:00
33	59	43,6	67	20,932	05.02.2022	11:11:00
34	59	11,265	67	20,956	05.02.2022	18:14:00
35	56	32,732	67	20,954	06.02.2022	11:57:00
36	56	8,178	67	17,936	06.02.2022	18:19:00
37	55	20,096	67	08,747	07.02.2022	11:01:00
38	55	6,357	66	42,584	07.02.2022	18:34:00
40	54	53,452	68	07,14	08.02.2022	10:59
41	54	54,775	68	40,152	08.02.2022	17:37:00
42	54	58,849	69	02,009	09.02.2022	11:01:00
43	54	55,892	69	14,351	09.02.2022	17:08:00
44	54	50,028	69	56,396	10.02.2022	10:59:00
45	54	47,615	69	58,289	10.02.2022	18:11:00
46	54	44,249	69	58,602	11.02.2022	12:13:00
ZODIAC	54	43,834	69	58,75	11.02.2022	13:46:00
47	54	46,225	69	58,293	11.02.2022	18:08:00
48	54	44,029	71	46,997	12.02.2022	12:10:00
49	54	44,408	71	13,74	12.02.2022	18:34:00
50	53	40,758	70	54,613	13.02.2022	12:02:00
51	53	10,04	70	51,863	13.02.2022	17:20:00