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The Expedition PS107 of the Research Vessel POLARSTERN to the Fram Strait and the AWI-HAUSGARTEN in 2017

Edited by

Ingo Schewe

with contributions of the participants

HELMHOLTZ
GEMEINSCHAFT

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Titel: Polarstern unter einem Regenbogen (Foto: Jana Bäger, Alfred-Wegener-Institut, 16. August 2017)

Cover: Polarstern under the rainbow (Photo: Jana Bäger, Alfred Wegener Institute, 16th August 2017)

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PS107

(ARK-XXXI/2)

23 July 2017 – 19 August 2017

Tromsø - Tromsø

Chief scientist
Ingo Schewe

Coordinator
Rainer Knust

Contents

1. ÜBERBLICK UND FAHRTVERLAUF

Ingo Schewe AWI

Die wissenschaftlichen Arbeiten während der Expedition PS107 widmeten sich im wesentlichen der Fortführung der Langzeitbeobachtungen am LTER (Long-Term Ecological Research) Observatorium HAUSGARTEN mit Untersuchungsgebieten westlich von Spitzbergen und am Kontinentalhang vor Ost-Grönland (Abbildung 1.1). Sehr erleichtert wurden alle Arbeiten während der Expedition durch die diesjährigen, sehr ruhigen Witterungsbedingungen sowie die nur lockerere Eisbedeckung, so dass alle vor der Expedition geplanten Verankerungsarbeiten und Geräteeinsätze realisiert werden konnten. Die Arbeiten stellten einen weiteren Beitrag zur Sicherstellung der Langzeitbeobachtungen am LTER Observatorium HAUSGARTEN dar, in denen der Einfluss von Umweltveränderungen auf ein arktisches Tiefseeökosystem untersucht und dokumentiert wird. Diese Arbeiten wurden auch in diesem Jahr in enger Zusammenarbeit der HGF-MPG Brückengruppe für Tiefsee-Ökologie und -Technologie, der PEBCAO-Gruppe (Phytoplankton Ecology and Biogeochemistry in the Changing Arctic Ocean) des AWI und der Helmholtz-Hochschul-Nachwuchsgruppe SEAPUMP (Seasonal and regional food web interactions with the biological pump) durchgeführt. Die Expedition wurde außerdem genutzt, um eine Reihe von Geräten, Sensoren und Verankerungen des HGF Infrastruktur-Projektes FRAM (Frontiers in Arctic marine Monitoring) auszutauschen. Das FRAM Ozean-Beobachtungs-System ermöglicht eine ganzjährige Beobachtung von Ökosystemen im Arktischen Ozean von der Meereisdecke bis zum Meeresboden. Eine Komponente ist dabei ein Netz von stationären Verankerungen in der Framstraße, welche ganzjährig Daten zur Erdsystem-Dynamik, Klimavariabilität und den Veränderungen in den Ökosystemen sammelt. Damit erfüllt es nationale und internationale Aufgaben hin zu einem besseren Verständnis, welche Auswirkung Veränderungen in den Meeresströmungen und Wassermassenverteilungen sowie der Rückgang des Meereises auf die Funktion der marinen Ökosysteme in der Arktis haben. Der Einsatz bereits existierender und neu entwickelter Sensoren und Beobachtungs-Plattformen erlaubt die synchronisierte Erfassung von wichtigen Parametern zur Untersuchung physikalischer, chemischer und biologischer Prozesse im Ozean.

Kurzzeitig unterbrochen wurden die Arbeiten zu den Langzeitstudien in diesem Jahr für die Realisierung eines kleinen komplementären Programms zur Untersuchung von mesoskaligen Prozessen, an einem der typischen Frontensysteme in der zentralen Framstrasse. Zur hochauflösenden Erfassung des Frontensystems kamen neben einer geschleppten CTD und dem AUTOFIM die bordeigenen Sensoren der *Polarstern*, sowie der neue Web-GIS basierte Ice-Viewer – um eine derartige Front überhaupt erst einmal aufzuspüren - zum Einsatz. Ergänzt wurde dieses wissenschaftliche Programm durch Untersuchungen zur Sensitivität von arktischem Zooplankton auf potentielle Temperaturveränderungen und ob sich ökophysiologische Effekte bis auf die Ebene von Zooplankton-Gemeinschaften niederschlagen.

Insgesamt leisten die Erkenntnisse und Arbeiten der Expedition PS107 Beiträge zu verschiedenen nationalen und internationalen Forschungs- und Infrastrukturprojekten (INTAROS, FRAM, SIOS, OceanSITES) sowie dem Forschungsprogramm PACES II (Polar Regions and Coasts in the changing Earth System) des AWI. Im Arbeitspaket WP4 (Arctic sea ice and its interaction with ocean and ecosystems) des PACES-II Programms werden die mit dem Rückgang des Meereises verbundenen Ökosystemverschiebungen im Pelagial und im tiefen Ozean ermittelt und quantifiziert, und Rückkopplungsprozesse auf zeitliche und räumliche Prozesse untersucht.

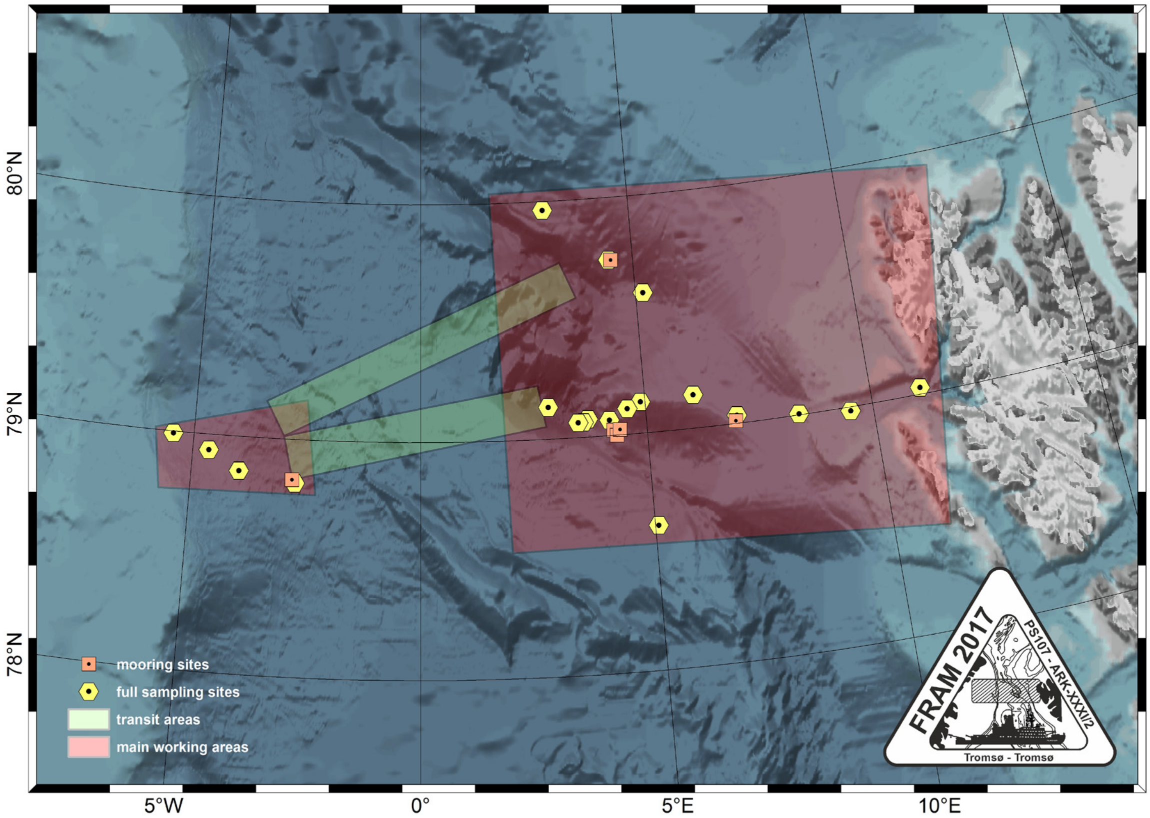

Abb. 1.1: Haupt-Arbeitsgebiete und HAUSGARTEN Stationen während PS107. Siehe https://doi.pangaea.de/10.1594/PANGAEA.881581 für eine Darstellung des master tracks in Verbindung mit der Stationsliste.

Fig. 1.1: Main working areas and sampling sites during PS107. See https://doi.pangaea.de/10.1594/PANGAEA.881581 to display the master track in conjunction with the list of stations.

SUMMARY AND ITINERARY

The scientific work during expedition PS107 substantially supported the time-series studies at the LTER (Long-Term Ecological Research) observatory HAUSGARTEN, where we document Global Change induced environmental variations on a polar deep-water ecosystem. The work was mainly carried out in research areas westerly off Svalbard and at the East-Greenland continental slope (Fig. 1.1). Due to the calm weather situation as well as the scattered ice conditions this year working on board was very easy. On the whole the expedition PS107 was extremely successful. All mooring and station work was carried out as previously planned prior to the expedition. This expedition supported extensively the time-series studies at the LTER (Long-Term Ecological Research) observatory HAUSGARTEN, where we document Global Change induced environmental variations on a polar deep-water ecosystem. This work is carried out in close co-operation between the HGF-MPG Joint Research Group on Deep-Sea Ecology and Technology, the PEBCAO Group (Phytoplankton Ecology and Biogeochemistry in the Changing Arctic Ocean) at AWI and the Helmholtz Young Investigators Group SEAPUMP (Seasonal and regional food web interactions with the biological pump), representing a joint effort between the AWI, the MARUM - Center for Marine Environmental Sciences, and the University of Bremen. The expedition was also dedicated to accomplish installations for the HGF infrastructure project FRAM (Frontiers in Arctic marine Monitoring). The FRAM Ocean Observing System aims at permanent presence at sea, from ocean surface to the deep-sea, for the provision of near real-time data on Earth system dynamics, climate variability and ecosystem change. It serves national and international tasks towards a better understanding of the effects of change in ocean circulation, water mass properties and sea-ice retreat on Arctic marine ecosystems and their main functions and services. FRAM implements existing and next-generation sensors and observatory platforms, allowing synchronous observation of relevant ocean variables as well as the study of physical, chemical and biological processes in the ocean. Experimental and event-triggered platforms complement the observational platforms.

We shortly interrupted our long-tern studies for realizing a complementing programme with the aim to investigate mesoscale processes along one of those typical frontal systems in the central Fram Strait. For high resolution surveying of the frontal system we used besides the Underway-CTD and the AUTOFIM system the on-board sensors of *Polarstern* as well as the new web-GIS based Ice-Viewer, for - first of all - tracing such kind of front. The scientific programme was complemented by investigations for the sensitivity of Arctic zooplankton to potential temperature changes and its effects on ecophysiological level as well responses of the zooplankton community. In any case, also for our long-term investigations in this area it is of exceptional importance to get a holistic picture of processes within the different ecosystems. It will become most exciting when all analyses in our home laboratories will be accomplished and we will start to join all puzzle pieces to get them into the context of results from former years.

As a whole all those insights and operations of the expedition PS107 mean a contribution to various national and international research- and infrastructure-projects like INTAROS, SIOS, OceanSITES as well as to AWIs own research programme PACES-II (Polar Regions and Coasts in the changing Earth System).

2. WEATHER CONDITIONS DURING PS107

Jens Kieser, Juliane Hempelt DWD

23.7.2017: In the evening of the 23rd of July *Polarstern* left Tromsø heading towards the research area 'HAUSGARTEN' within the Fram Strait. The cruising area was situated under a high pressure zone extending from the Barents Sea to the sea area of Iceland. Mostly light winds were blowing from northerly or easterly directions. Due to the cold water of the fjords the air temperature was not much higher than 10°C. Visibility was good.

24./25.7.2017: On 24 July research vessel *Polarstern* passed the axis of the high pressure zone mentioned above. After a period of light motion of air in the morning winds increased to 4 or 5 Bft and shifted to southwesterly directions as the cruising area got between the high pressure zone and a trough over the Greenland Sea. Initially fog was present, later low level clouds dominated. Air temperature dropped from 12°C to 6°C.

From the trough mentioned above a low was moving eastward across Svalbard on the 25th. Associated low level clouds influenced the cruising area. Afterwards the ridge of an Iceland high passed the Fram Strait eastward. Light to moderate winds shifted to north for a while. Fog patches were present. The temperature of air declined further on from 8°C to -1°C. Water temperatures about 7°C were measured at first but later we reached an area where water temperatures of 0°C were present.

26.-28.7.2017: During the following days the working area in the 'HAUSGARTEN' was influenced by a low that moved from the sea area north of Greenland to the Barents Sea. In front of the low southerly winds were temporarily blowing strong (6 Bft). On 27 July winds shifted from southwest to north and strengthened up again to 5 Bft. Low level clouds with light drizzle or grain dominated. Due to the presence of fog patches visibility was remarkably reduced. An exception was the 27th when the sky was clear for a longer time. At first air temperatures between 0°C and 4°C were measured, later -2°C to 1°C. Significant wave heights of more than 0.5 m were not observed.

29.7.-4.8.2017: During the following days till 4 August a series of weakly pronounced high pressure ridges and low pressure troughs crossed the working area 'HAUSGARTEN' eastward. Mostly light to moderate winds blew from variable directions. Air temperatures between -3°C and +2°C and water temperatures between -1°C and +3°C were measured. Foggy and sunny phases alternated as well as good and poor visibilities. Significant wave heights of more than a half meter were scarcely reached.

5.8./6.8.2017: On 5 August a weakly pronounced low pressure system established over the southern Fram Strait, while north of the working area a high pressure zone built. Due to the constellation of the pressure fields northeasterly to easterly winds result over the working area, temporarily reaching 6 Bft. Mist or fog dominated. The temperature of the ambient air was -2°C to 0°C. The significant wave height didn't exceed 0.5 m.

7.8.-9.8.2017: On 7 August the low pressure system moved slowly to the northern Fram Strait where it gradually filled. Simultaneously a trough was building southward from the Arctic Ocean along the coast of Greenland. The working area was situated at the eastern flank of the trough within an extensive southerly or southwesterly air current carrying moist air into the working area. An overcast sky with low clouds was present. Visibility was reduced by fog, drizzle and freezing drizzle. A southerly or southwesterly wind was blowing mostly at 4 Bft, interrupted by periods of light winds. The temperature of the air varied between -2°C and +1°C, the temperature of water between -1°C and +1°C. Sea state was marginal.

10.8.-13.8.: The general weather situation started to change on 10 August. At first a high pressure ridge crossed the research area, while a low pressure system formed over the Norwegian Sea and Iceland. Initially wind was blowing light to moderate from south or southeast. On 11 August wind turned to northeast and freshened up. An intense cyclone embedded within the low pressure system mentioned above was located over the central Norwegian Sea on 12 August. At this time a secondary low developed over southern Sweden. Winds of 5 Bft were observed nearly during the entire 12 August. At this time cloud conditions changed between nearly overcast periods, short sunny moments and foggy episodes. Temperatures around the freezing point were observed.

On the 13^{t}h we cruised in a more eastern area where water temperatures of 6°C to 8°C were measured. Air temperature increased a bit and visibility improved significantly. A light to moderate wind blew from north. From the southeast a swell with significant height of 3 m propagated into the research area.

14.8.-16.8.: On 14 August an intense cyclone was still located over the northern Norwegian Sea. It was weakening, while the secondary low mentioned above moved across the Barents Sea and took over the role of the new central low. The cruising area got on the northeasterly edge of the low pressure area and wind shifted to north or northwest. It increased again up to 5 Bft. The north-northwesterly wind carried a cooler air mass into the research area close west of Spitzbergen. Temperatures dropped from 7°C to 0°C in the afternoon of the 14th. Simultaneously the visibility became poor. Water temperatures about 7°C or 8°C were measured further on.

On 15 August the low pressure system over the Barents Sea temporarily lost its influence on the cruising area. *Polarstern* cruised close west of Svalbard and later inside of the archipelago. Wind calm down for a while, as a weak intermittent high influenced the cruising area. In the evening of the 15th a new low approached from the Fram Strait. The low passed *Polarstern* and Spitzbergen in the morning of 16 August. At the rear of the low wind increased considerably. Strong to near gale force winds (6-7 Bft) from west later from northwest blew. In the exit of the fjord west of Spitzbergen *Polarstern* steamed through rough sea with significant wave heights up to 4 m. During the 16th rain and drizzle occurred over the fjords near Longyearbyen and showery precipitation in the evening when we left Spitzbergen. Inside the fjords temperatures between 4 and 8°C were measured.

17.-19.8.: At first strong northwesterly winds blew on the edge of a low pressure system centered over the Kara Sea. The air mass was relatively dry and cool with temperatures between 3°C and 6°C. During the night to the 18th *Polarstern* crossed a high pressure zone extending between a high over Greenland and a further high over Eastern Europe. Afterwards we sailed on the northern edge of a low pressure area located over the Norwegian Sea and Scandinavia. Wind veered to east and increased to 6 Bft. Visibility was good. Northwest of the Fjords near Tromsø air temperatures about 11°C were reached corresponding with the sea surface temperatures. During the passage from Spitzbergen to Norway significant wave heights between 2 and 3 m were observed. Wind calm down as we entered the fjords near Tromsø. In the morning of 19 August *Polarstern* reached Tromsø with light winds and temperatures between 12°C and 15°C.

For further statistics see attached Figs. 2.1 – 2.5.

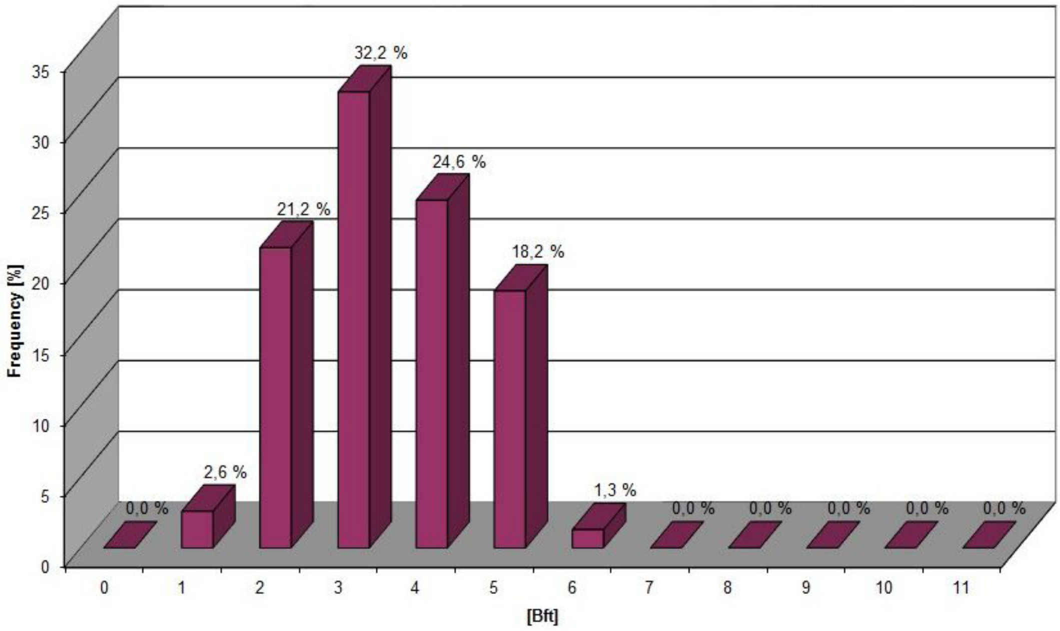

Fig. 2.1: Distribution of wind force during PS107

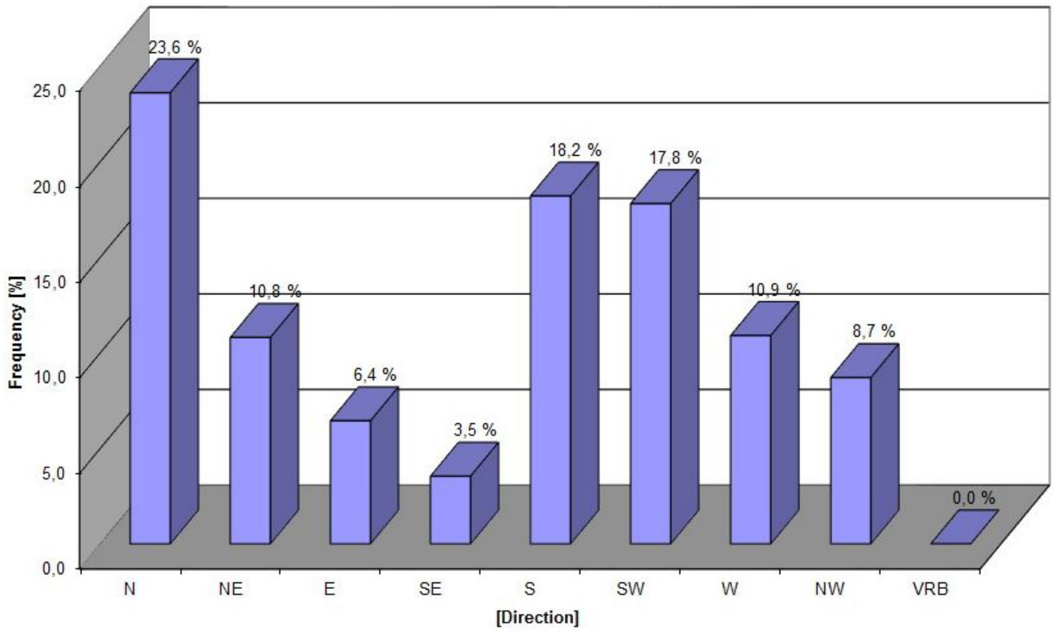

Fig. 2.2: Distribution of wind direction during PS107

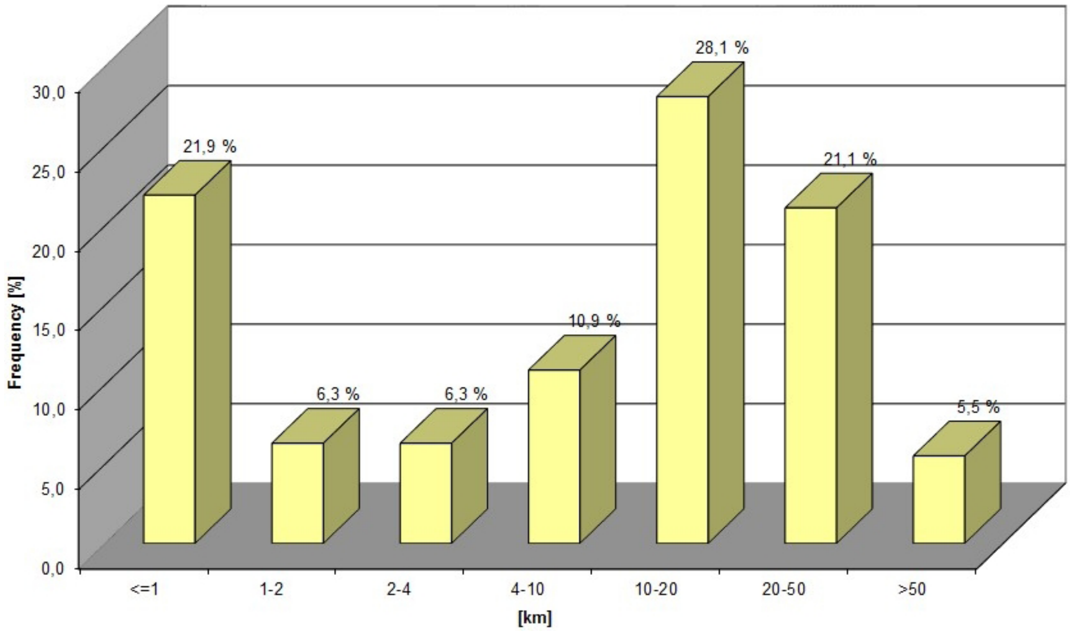

Fig. 2.3: Distribution of visibility during PS107

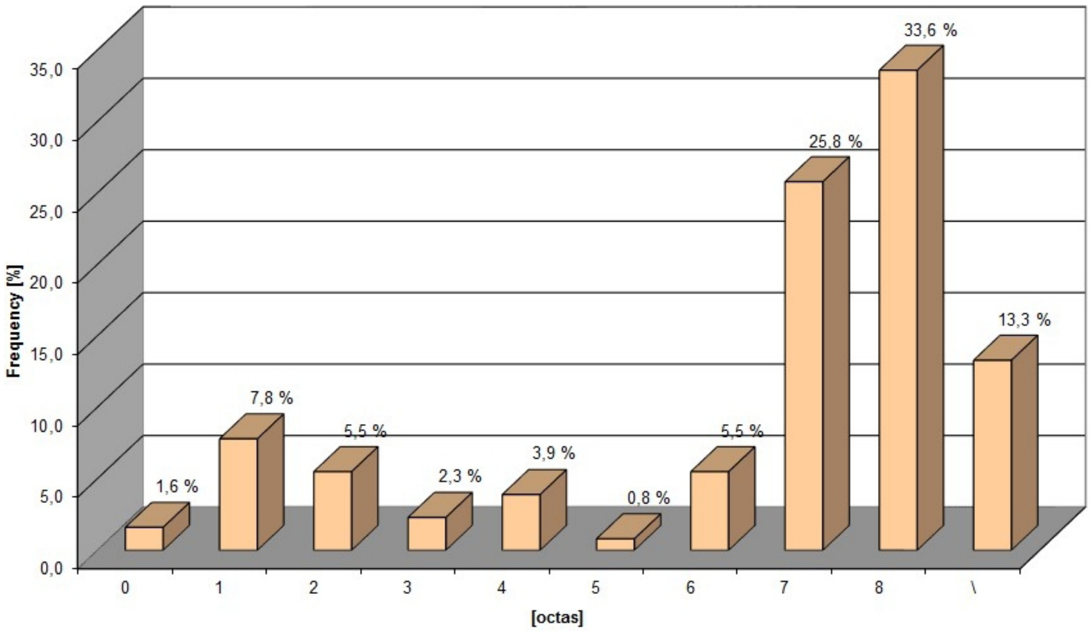

Fig. 2.4: Distribution of cloud coverage during PS107

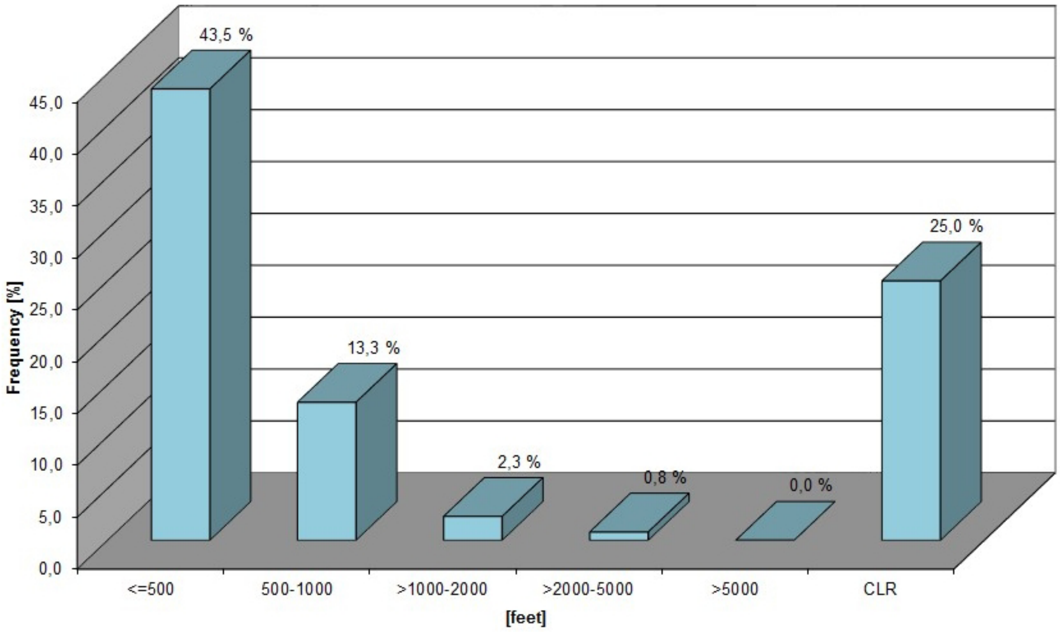

Fig. 2.5: Distribution of ceiling during PS107

3. MEASUREMENTS OF ATMOSPHERIC WATER VAPOR, AEROSOL AND THIN CLOUDS USING FT SPECTROSCOPY IN THE INFRARED

Philipp Richter Universität Bremen
not on board: Mathias Palm, Christine Weinzierl,
Justus Notholt, Matthias Buschmann

Grant No. AWI_PS107_03

Objectives

This project is embedded in the project AC3, which aims at understanding the enhanced warming in the Arctic. Clouds and atmospheric feedback are believed to play a major role.

We used mobile FTIR spectrometers onboard the *Polarstern* cruise PS106 (ARK XXXI/1, ARK XXXI/2) and PS107 (ARK XXXII) in the Arctic to study the geographical and temporal distribution of H_2O, HDO, thin clouds and aerosol in the Arctic. Together with the same suite of measurements at the AWIPEV research base in Ny-Ålesund, Spitsbergen the measurements will allow us to assess the representatively of the supersite in Ny-Ålesund for the Arctic.

a) Measurements of columnar H_2O and HDO

Solar absorption spectroscopy in the infrared can be used to determine the distribution of many infrared trace gases in the atmosphere. In particular it is possible to measure H_2O in high quality (Palm, 2008) and the isotopic composition H_2O in the troposphere (Schneider, 2006). The isotopic ratio of H_2O and HDO can be used to study the history of the sampled air parcels (Frankenberg, 2009).

b) Measurements of properties of aerosol layers and thin clouds

Emission spectroscopy in the infrared can be used to study the composition of aerosols and properties of thin clouds (Rathke, 2000a; Rathke, 2000b). Since the self-emission of the atmosphere is measured, those measurements are independent of an external light source like moon or sun.

Work at sea

Two FTIR instruments are housed in a custom build container for measurements in emission and solar absorption mode. The measurements were performed whenever weather conditions permited, i.e. clear sky for solar absorption measurements and dry conditions (no precipitation) for emission measurements. The performance of the measurements requires manual operation and oversight; therefore two participants took over to cover most of day and night.

Preliminary (expected) results

1. Low altitude resolution profiles of H_2O and HDO and their ratio will be derived from the solar absorption measurements. A trajectory model will be used to track the path of the air-parcels measured.

2. The structure of radiation emitted from the atmosphere is analyzed to derive properties like the optical depth, the mean radius, and chemical composition of particles contained in clouds or aerosol layers.

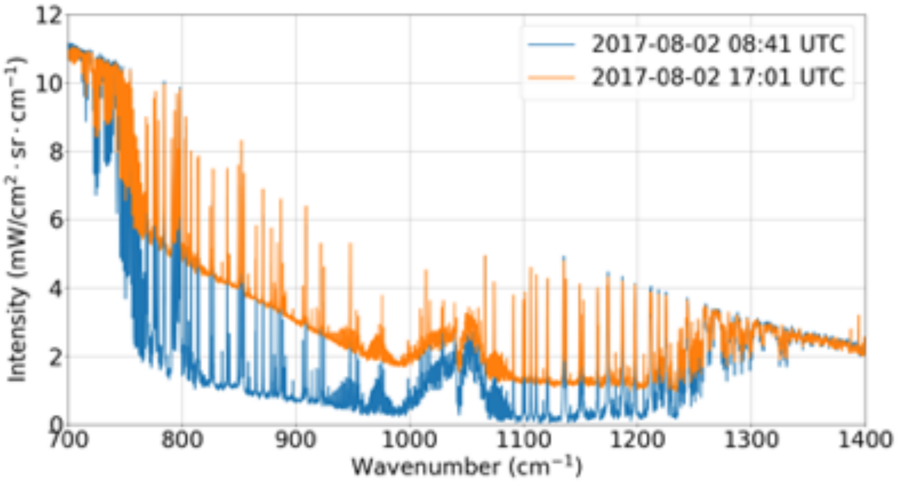

Fig. 3.1: Spectra recorded on the 2nd of August 2017 at two different conditions: cirrus (blue) and altocumulus (orange)

Fig. 3.1 shows two spectra recorded in emission mode for different conditions: cirrus clouds to clear sky (08:41, blue color) and a thin cloud layer of altocumulus at an altitude of around 4,830 m (17:01, orange colour). The imminent effect of a thin cloud is the attenuation of the radiation coming from above and adding radiation, a baseline, due to its temperature. The shape of the baseline contains information about the liquid water path, the optical depth and the mean radius of the droplets in case of water clouds. If there is an effect due to ice is subject of a PhD study.

Tab. 3.1: Measurements taken during PS 107

Date	Measurement in mode
24.07.2017	Emission
25.07.2017	Emission
26.07.2017	Emission
27.07.2017	Emission, Absorption
29.07.2017	Emission
30.07.2017	Emission, Absorption
31.07.2017	Emission, Absorption
01.08.2017	Emission, Absorption
02.08.2017	Emission, Absorption
04.08.2017	Emission, Absorption
05.08.2017	Emission

Date	Measurement in mode
06.08.2017	Emission
07.08.2017	Emission
08.08.2017	Emission
09.08.2017	Emission
10.08.2017	Emission
11.08.2017	Emission

Data management

The obtained data will be made available to the project partners via the database PANGAEA and made available for the public after publication or 5 years at most.

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4. PHYSICAL OCEANOGRAPHY OF FRONTS IN FRAM STRAIT

Wilken-Jon von Appen[1], Laura Hehemann[1], Vibe Schourup-Kristensen[1], Claudia Wekerle[1]

[1]AWI

Grant No. AWI_PS107_04

Objectives

Physical changes in the polar oceans caused by climate change, such as the sea-ice retreat in the Arctic Ocean or the increase in wind forcing in the Southern Ocean, will impact oceanic dynamics, particularly on scales of ~1–10 km (“submesoscale”). Those motions produce the largest vertical water velocities and are most effective at regulating the upper ocean vertical density gradients (“stratification”), thereby directly driving the light and nutrient availability to plankton in the upper 50 m.

Vertical motions in the ocean are important for primary production because they move both phytoplankton and nutrients into and out of the euphotic layer. Specifically, in post-bloom summer conditions, vertical upward nutrient transport from depth into the euphotic layer can sustain phytoplankton growth. It is thus crucial to determine what conditions are conducive to vertical motions. Large scale organized motions lead to advective transport where properties are moved along with the same water mass for significant distances. Small scale random motions (turbulent mixing), on the other hand, lead to turbulent transport where properties are consecutively transferred between adjacent water masses. Thus both vertical advective transports and vertical turbulent transports (mixing) can change the phytoplankton and nutrient distributions.

A fundamental scale in physical oceanography is the Rossby radius, which is the horizontal scale over which horizontal oceanic motions are roughly uniform. The first baroclinic Rossby radius Rd = NH/f decreases with the Coriolis parameter f, which is related to the Earth’s rotation, while it scales linearly with the stratification N and the water depth H. If horizontal motions are confined to the mixed layer depth hML rather than the full water depth H, they have a horizontal scale of the mixed-layer Rossby radius RML = NhML/f. Mesoscale motions with horizontal scales comparable to Rd, which ranges from ~100km in low latitudes to as little as ~5 km in the polar oceans (von Appen et al., 2016), tend to be associated with weak advective vertical velocities. In contrast, submesoscale motions, with horizontal scales of RML, which ranges from ~10 km in low latitudes to ~1 km in the polar oceans, can lead to large advective vertical velocities (Thomas, 2008) such as in frontal. Thus submesoscale motions can drive large vertical advective property transports. Submesoscale motions can also strongly affect stratification and thereby either increase or decrease vertical turbulent property transports (Klein and Lapeyre, 2009).

For these reasons, the cruise attempted to sample submesoscale fronts, where such vertical motions are expected to be especially strong, with consequences for biology and the redistribution and mixing of Atlantic Water and Polar Water in Fram Strait.

Work at sea

CTD

All information on CTD casts are provided in Tables 4.1 - 4.4.

Tab. 4.1: List of CTD casts. Comments to individual casts are given in Tab. 4.2

Station name	Station # PS107/	Latitude	Longitude	Max depth [m]	*In-situ* pumps	Salt	Config.	Comments
S-III	002/01	78° 36.151' N	005° 01.517' E	2293	X	X	1	
S-III	002/04	78° 36.258' N	005° 00.248' E	10			1	X
S-III	002/13	78° 36.496' N	005° 03.325' E	251			1	
HG-IV	006/03	79° 03.864' N	004° 10.865' E	2404	X	X	1	X
HG-IV	006/08	79° 03.905' N	004° 10.087' E	100			1	X
HG-V	007/01	79° 03.198' N	003° 44.980' E	1500		X	1	
HG-VI	008/01	79° 02.788' N	003° 36.351' E	250			1	X
Front	010/04	78° 58.610' N	002° 29.658' E	500			1	
Front	012/03	78° 56.689' N	002° 42.102' E	500			1	
Front	014/01	78° 55.622' N	002° 51.016' E	506			1	X
Front	016/03	79° 00.273' N	002° 17.015' E	500			1	
Front	018/03	78° 59.153' N	002° 45.347' E	1500		X	1	X
HG-VII	019/01	79° 03.561' N	003° 28.918' E	1500		X	1	X
HG-IX	020/01	79° 07.407' N	002° 49.132' E	5513	X	X	1	X
HG-IX	020/08	79° 08.013' N	002° 50.686' E	400			2	X
Station 0°E	021/01	78° 57.856' N	000° 00.228' E	1500		X	2	
Station 0°E	021/05	78° 57.706' N	000° 02.377' E	300			2	
EG-IV	022/01	78° 49.000' N	002° 48.039' W	2530	X	X	2	X
EG-IV	022/06	78° 49.129' N	002° 43.015' W	251			2	
EG-III	024/01	78° 51.345' N	003° 56.499' W	1944		X	2	X
HG-EGC mooring	025/01	78° 49.867' N	002° 47.511' W	250			2	X
EG-II	028/01	78° 56.019' N	004° 38.088' W	1507		X	2	X
EG-I	029/01	78° 59.693' N	005° 28.411' W	944	X	X	2	X
Auel I	030/01	79° 18.089' N	001° 59.776' W	1500		X	2	X
Auel II	031/01	79° 26.035' N	000° 00.160' E	1500		X	2	X
Auel III	032/01	79° 34.928' N	002° 00.709' E	1500		X	2	
N-IV	033/01	79° 44.256' N	004° 26.102' E	2560		X	2	X
N-IV	033/06	79° 43.632' N	004° 30.175' E	250			2	
N-V	034/01	79° 58.189' N	002° 54.400' E	2563	X	X	2	
N-V	034/05	80° 00.019' N	002° 56.414' E	250			2	
N-III	036/01	79° 35.268' N	005° 10.327' E	2720	X	X	2	X
HG-III	037/01	79° 06.491' N	004° 35.961' E	1876		X	2	
HG-II	042/01	79° 07.845' N	004° 54.174' E	1503		X	2	X
HG-II	042/05	79° 07.872' N	004° 54.353' E	200			2	X
HG-I	043/01	79° 08.385' N	006° 05.448' E	1247	X	X	2	X
HG-I	043/05	79° 09.165' N	006° 06.915' E	250			2	
SV-IV	044/03	79° 02.044' N	007° 00.111' E	1268		X	2	X
SV-III	045/01	79° 00.270' N	008° 21.819' E	740		X	2	X
SV-II	047/01	78° 58.974' N	009° 30.484' E	220			2	
SV-I	048/01	79° 01.755' N	011° 06.101' E	272			2	

Tab. 4.2: Comments to individual CTD casts

Station name	Comment
PS107/002/04	For Holger Auel's group.
PS107/006/03	T and S profiles have many spikes from 100 to 700 meters during downcast. Approximately 0.1 ml/L difference between the oxygen sensors. Upcast of T and S less spiky.
PS107/006/08	Beam transmission error. Value from 0 to 100 meters app. -1.3. At 100 meters, value equals 90.
PS107/008/01	Beam transmission error. Value ~-1.3.
PS107/014/01	Beam transmission error. Value ~-1.3. Last bottle closed after CTD was brought on deck and then back in the water. Extra CTD cast file for last bottle, named PS107_014_01_bottle24.hex.
PS107/018/03	Beam transmission reasonable after CTD was below 320 meters.
PS107/019/01	Beam transmission worked after 300 meters.
PS107/020/01	Conductivity2 and oxygen sensors broken during the cast.
PS107/020/08	Beam transmission calibration coefficients questionable. Jump in transmission at 100 meters depth of upcast. Both altimeter and beam transmission show spikes at 100 meters. Fluorescence -0.01 at depth.
PS107/022/01	Some difference in oxygen sensors between up- and downcast (~2nm drift of ship).
PS107/024/01	On upcast, all profiles have strange loop from 350 to 400 meters, but then return to profile from downcast. At the same depths the two sensors have large differences.
PS107/025/01	Cast for HG-EGC mooring.
PS107/028/01	Altimeter has many false readings during upcast.
PS107/029/01	Oxygen sensor disturbed after pumping. Irregular upcast profile with large difference to downcast. Does, however, have same profile shape as downcast. Sensors may be damaged, but were not changed.
PS107/030/01	Cast for Holger Auel's group. Oxygen looks reasonable again.
PS107/031/01	Cast for Holger Auel's group.
PS107/032/01	Cast for Holger Auel's group.
PS107/033/01	Beam transmission larger in upcast than downcast.
PS107/036/01	Sensor test carried out before the cast leading to two log sheets and two data files for cast; one for sensor test and one for standard CTD cast. Name of datafile for sensor test: PS107_036_01_PAR_sensor_test.hex. Difference in temperature: T2-T1=0.001 for downcast and 0.000 for upcast. During upcast, CTD was taken to 50 meters, and then again lowered to 100 meters before bottle 2 and 3 were closed.
PS107/042/01	Testing of CTD-ADCP. Interference with altimeter signal leading to large errors in altimeter. Close to the bottom (~30 m) the altimeter works as usual.
PS107/042/05	Water samples for Holger Auel's group.
PS107/043/01	Difference between sensors larger in upcats than downcast
PS107/044/03	LADCP on during cast leading to interference with altimeter. Altimeter works from ~50 meters above bottom.
PS107/045/01	Upcast salinity noisy.

Tab. 4.3: CTD rosette configuration 1

	Type	Serial number	Calibration date
CTD	SBE911+	485	
CTD sensor	SBE3 T0 (primary)	2460	20-Dec-16
CTD sensor	SBE4 C0 (primary)	2055	22-Nov-16
CTD sensor	SBE9+ pressure	485	04-Feb-14
CTD sensor	SBE3 T1 (secondary)	2417	20-Dec-16
CTD sensor	SBE4 C1 (secondary)	2054	22-Nov-16
Oxygen	SBE43	880	03-Aug-10
Altimeter	Benthos PSA916	1228	23-Mar-09
Fluorometer	WETLabs ECO-AFL/FL	1670	11-Dec-09
Transmissometer	WETLabs C-Star	946	31-Jan-06
Rosette	SBE Carousel (24x12L)	-	-
Winch	EL31	-	-

Tab. 4.4: CTD rosette configuration 2

	Type	Serial number	Calibration date
CTD	SBE911+	937	
CTD sensor	SBE3 T0 (primary)	5101	13-Dec-16
CTD sensor	SBE4 C0 (primary)	3290	13-Dec-16
CTD sensor	SBE9+ pressure	937	20-Nov-12
CTD sensor	SBE3 T1 (secondary)	5112	13-Dec-16
CTD sensor	SBE4 C1 (secondary)	3570	13-Dec-16
Oxygen	SBE43	467	28-Dec-16
Altimeter	Benthos PSA916	47768	23-Mar-09
Fluorometer	WETLabs ECO-AFL/FL	1853	26-May-10
Transmissometer	WETLabs C-Star	1220	02-Apr-09
Rosette	SBE Carousel (24x12L)	-	-
Winch	EL31 + EL32*	-	-

*: Winch EL31 was used until station PS107/021/05. Winch EL32 was used from station PS107/022/01 onwards.

UCTD

The winch for the underway CTD (UCTD) (serial number: 0204) was first mounted to the stern of the ship on the port side. A loop, created by splicing, was added to the end of the Kevlar line and was checked between UCTD casts in case of wear; it was re-spliced a few times when the loop appeared worn or burnt. Before the first cast and between each cast, the batteries were charged (3 hours) while the UCTD was sitting in a flask-container holding milliQ water and a few drops of Triton X-100. This was important, because, if the UCTD was dry, the conductivity sensor would have an offset during the first downcast.

To begin data gathering, the UCTD was connected to the computer using the command line terminal programme: UCTDterm. The data was processed following Ullman and Herbert (2014). After each transect, the data was removed from the UCTD to allow space for further data acquisition.

During the casts the ship speed exceeded no more than 7 knots and the target depth for each UCTD cast was approximately 200 m. A transect began with the removal of the start plug (to begin data capture) and was directly released from the stern of the ship into the water. Each cast had an 80-second drop time where the UCTD could descend until the target depth. The UCTD was wheeled in by the winch for approximately 4 minutes until it reached a distance of 5-10 m from the stern of the ship. The process was repeated for the length of each profile. In areas of sparse ice, the ship could maneuver around the ice floes, but when the ice became increasingly difficult to navigate, it was necessary to remove the UCTD from the water for a period of time until the ice concentration was thin enough to continue. When the ship went through and broke the ice, the ice tended to wrap around the ship leaving no clear path for the UCTD. This was extremely problematic for the thin Kevlar line and could result in easily damaging the UTCD. In situations of complete ice coverage, the ship captain would inform the deck crew in enough time to wind in the winch and pull the UCTD on deck. This occurred multiple times throughout the profiles, for a duration of anywhere from 5–20 min.

There were 6 transects in total, conducted at two target areas. Table 4.5 shows the station profile numbers, date/time, depth and location with each cast transect. The first target area was for a UCTD campaign that was carried out approximately 5 nm southwest of central Hausgarten heading towards an ocean front. The complete campaign ran from July 29, 2017 at a latitude of 78°00.91’N and a longitude 2.0351°0.91’E, until July 31, 2017 at a latitude of 78°00.97’N and a longitude of 2.0647°0.97’E. Fig. 4.1 shows the map of the casts for each transect across the front (A, B, C, and E). The second target area was for a transect running across the West Spitsbergen Current from central Hausgarten directly east to the most eastern station (SV-1). The complete transect was carried out from August 11, 2017 at a latitude of 79°00.05’N and a longitude of 3.6026°0.05’E and ended on August 14, 2017 at a latitude of 79°00.02’N and a longitude of 10.898°0.02’E. Fig. 3 shows the map of the casts for each transect (1 – 7) that was carried out between Hausgarten stations.

A problematic issue was with the data storage itself. The UTCD failed to record a long transect (D) of three hours that repeated the transect A. After a series of tests conducted afterwards, the issue was determined to be only intermittent and could not be pin-pointed. Fortunately, the UCTD collected data for the remaining transects.

Tab. 4.5: UCTD casts

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
1	29-Jul-2017 10:54:58	78°00.91'N	2°0.95'E	126	Front_transect A
2	29-Jul-2017 10:58:14	78°00.92'N	2°0.93'E	191	Front_transect A
3	29-Jul-2017 11:03:00	78°00.92'N	2°0.91'E	190	Front_transect A
4	29-Jul-2017 11:07:51	78°00.92'N	2°0.88'E	196	Front_transect A
5	29-Jul-2017 11:12:32	78°00.93'N	2°0.85'E	202	Front_transect A
6	29-Jul-2017 11:17:15	78°00.93'N	2°0.82'E	204	Front_transect A
7	29-Jul-2017 11:22:04	78°00.93'N	2°0.79'E	199	Front_transect A
8	29-Jul-2017 11:26:44	78°00.94'N	2°0.76'E	210	Front_transect A
9	29-Jul-2017 11:31:26	78°00.94'N	2°0.74'E	213	Front_transect A
10	29-Jul-2017 11:36:12	78°00.94'N	2°0.71'E	212	Front_transect A
11	29-Jul-2017 11:41:14	78°00.95'N	2°0.68'E	210	Front_transect A
12	29-Jul-2017 11:46:10	78°00.95'N	2°0.66'E	212	Front_transect A
13	29-Jul-2017 11:51:10	78°00.96'N	2°0.64'E	214	Front_transect A
14	29-Jul-2017 11:56:10	78°00.96'N	2°0.61'E	201	Front_transect A
15	29-Jul-2017 12:09:57	78°00.97'N	2°0.53'E	215	Front_transect A
16	29-Jul-2017 12:15:01	78°00.98'N	2°0.51'E	214	Front_transect A
17	29-Jul-2017 12:19:52	78°00.98'N	2°0.48'E	211	Front_transect A
18	29-Jul-2017 12:24:44	78°00.98'N	2°0.45'E	210	Front_transect A
19	29-Jul-2017 12:29:33	78°00.99'N	2°0.42'E	213	Front_transect A
20	29-Jul-2017 12:34:20	78°00.99'N	2°0.40'E	213	Front_transect A
21	29-Jul-2017 12:39:11	78°01.00'N	2°0.37'E	212	Front_transect A
22	29-Jul-2017 12:44:05	78°01.00'N	2°0.34'E	215	Front_transect A
23	29-Jul-2017 12:49:02	79°00.00'N	2°0.31'E	215	Front_transect A

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
24	29-Jul-2017 12:54:03	79°00.01'N	2°0.28'E	215	Front_transect A
25	29-Jul-2017 12:58:58	79°00.01'N	2°0.25'E	213	Front_transect A
26	29-Jul-2017 13:03:47	79°00.02'N	2°0.23'E	217	Front_transect A
27	29-Jul-2017 13:08:43	79°00.02'N	2°0.20'E	216	Front_transect A
28	29-Jul-2017 13:13:31	79°00.02'N	2°0.17'E	216	Front_transect A
29	29-Jul-2017 13:18:22	79°00.03'N	2°0.14'E	220	Front_transect A
30	29-Jul-2017 13:23:30	79°00.03'N	2°0.11'E	221	Front_transect A
31	29-Jul-2017 13:28:18	79°00.04'N	2°0.08'E	226	Front_transect A
32	29-Jul-2017 20:40:44	79°00.01'N	2°0.42'E	205	Front_transect B
33	29-Jul-2017 20:45:42	79°00.00'N	2°0.45'E	207	Front_transect B
34	29-Jul-2017 20:50:40	79°00.00'N	2°0.48'E	208	Front_transect B
35	29-Jul-2017 20:56:02	78°01.00'N	2°0.51'E	203	Front_transect B
36	29-Jul-2017 21:00:42	78°00.99'N	2°0.54'E	208	Front_transect B
37	29-Jul-2017 21:05:20	78°00.99'N	2°0.57'E	204	Front_transect B
38	29-Jul-2017 21:21:33	78°00.98'N	2°0.65'E	214	Front_transect B
39	29-Jul-2017 21:26:11	78°00.97'N	2°0.68'E	207	Front_transect B
40	29-Jul-2017 21:30:45	78°00.97'N	2°0.71'E	210	Front_transect B
41	29-Jul-2017 21:35:30	78°00.97'N	2°0.74'E	215	Front_transect B
42	29-Jul-2017 21:40:25	78°00.96'N	2°0.77'E	186	Front_transect B
43	29-Jul-2017 22:15:05	78°00.97'N	2°0.86'E	224	Front_transect B
44	29-Jul-2017 22:20:04	78°00.98'N	2°0.83'E	219	Front_transect B
45	29-Jul-2017 22:25:11	78°00.98'N	2°0.80'E	223	Front_transect B
46	29-Jul-2017 22:30:26	78°00.98'N	2°0.77'E	220	Front_transect B
47	29-Jul-2017 22:35:27	78°00.99'N	2°0.75'E	213	Front_transect B

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
48	29-Jul-2017 22:44:53	78°00.99'N	2°0.69'E	250	Front_transect B
49	29-Jul-2017 22:51:19	78°01.00'N	2°0.65'E	206	Front_transect B
50	29-Jul-2017 22:56:01	79°00.00'N	2°0.62'E	207	Front_transect B
51	29-Jul-2017 23:00:57	79°00.01'N	2°0.59'E	208	Front_transect B
52	29-Jul-2017 23:20:59	79°00.01'N	2°0.49'E	206	Front_transect B
53	29-Jul-2017 23:25:09	79°00.01'N	2°0.51'E	219	Front_transect B
54	29-Jul-2017 23:30:01	78°01.00'N	2°0.53'E	213	Front_transect B
55	29-Jul-2017 23:34:42	78°00.99'N	2°0.55'E	219	Front_transect B
56	29-Jul-2017 23:39:18	78°00.99'N	2°0.56'E	220	Front_transect B
57	29-Jul-2017 23:43:54	78°00.98'N	2°0.58'E	213	Front_transect B
58	29-Jul-2017 23:49:05	78°00.98'N	2°0.60'E	82	Front_transect B
59	30-Jul-2017 04:40:15	78°00.98'N	2°0.36'E	204	Front_transect C
60	30-Jul-2017 04:44:49	78°00.98'N	2°0.39'E	206	Front_transect C
61	30-Jul-2017 04:49:30	78°00.98'N	2°0.42'E	213	Front_transect C
62	30-Jul-2017 04:54:22	78°00.97'N	2°0.45'E	211	Front_transect C
63	30-Jul-2017 04:59:19	78°00.97'N	2°0.48'E	218	Front_transect C
64	30-Jul-2017 05:04:12	78°00.96'N	2°0.50'E	216	Front_transect C
65	30-Jul-2017 05:09:08	78°00.96'N	2°0.54'E	217	Front_transect C
66	30-Jul-2017 05:14:06	78°00.96'N	2°0.57'E	220	Front_transect C
67	30-Jul-2017 05:31:52	78°00.94'N	2°0.66'E	220	Front_transect C
68	30-Jul-2017 05:39:54	78°00.94'N	2°0.71'E	226	Front_transect C
69	30-Jul-2017 05:44:33	78°00.93'N	2°0.73'E	220	Front_transect C
70	30-Jul-2017 06:10:31	78°00.92'N	2°0.69'E	220	Front_transect C
71	30-Jul-2017 06:15:45	78°00.92'N	2°0.66'E	219	Front_transect C

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
72	30-Jul-2017 06:20:57	78°00.93'N	2°0.63'E	122	Front_transect C
73	30-Jul-2017 06:35:18	78°00.94'N	2°0.54'E	174	Front_transect C
74	30-Jul-2017 06:39:00	78°00.94'N	2°0.52'E	212	Front_transect C
75	30-Jul-2017 06:44:01	78°00.94'N	2°0.49'E	214	Front_transect C
76	30-Jul-2017 06:49:03	78°00.95'N	2°0.46'E	212	Front_transect C
77	30-Jul-2017 06:54:02	78°00.95'N	2°0.43'E	163	Front_transect C
78	30-Jul-2017 06:58:03	78°00.96'N	2°0.40'E	219	Front_transect C
79	30-Jul-2017 07:02:56	78°00.96'N	2°0.37'E	216	Front_transect C
80	30-Jul-2017 07:07:50	78°00.96'N	2°0.35'E	214	Front_transect C
81	30-Jul-2017 07:12:44	78°00.97'N	2°0.32'E	213	Front_transect C
82	30-Jul-2017 07:17:38	78°00.97'N	2°0.29'E	214	Front_transect C
83	31-Jul-2017 01:16:40	79°00.04'N	2°0.52'E	225	Front_transect E
84	31-Jul-2017 01:21:34	79°00.04'N	2°0.55'E	218	Front_transect E
85	31-Jul-2017 01:26:25	79°00.04'N	2°0.58'E	219	Front_transect E
86	31-Jul-2017 01:31:15	79°00.03'N	2°0.61'E	240	Front_transect E
87	31-Jul-2017 01:36:36	79°00.03'N	2°0.65'E	222	Front_transect E
88	31-Jul-2017 01:41:19	79°00.03'N	2°0.68'E	205	Front_transect E
89	31-Jul-2017 01:52:02	79°00.02'N	2°0.73'E	218	Front_transect E
90	31-Jul-2017 02:10:06	79°00.01'N	2°0.82'E	210	Front_transect E
91	31-Jul-2017 02:14:52	78°01.00'N	2°0.85'E	220	Front_transect E
92	31-Jul-2017 02:20:06	78°00.99'N	2°0.88'E	210	Front_transect E
93	31-Jul-2017 02:24:57	78°00.99'N	2°0.91'E	209	Front_transect E
94	31-Jul-2017 02:29:46	78°00.98'N	2°0.94'E	209	Front_transect E
95	31-Jul-2017 02:34:42	78°00.98'N	2°0.97'E	211	Front_transect E

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
96	31-Jul-2017 02:39:40	78°00.97'N	3°0.01'E	219	Front_transect E
97	31-Jul-2017 02:44:35	78°00.97'N	3°0.04'E	232	Front_transect E
98	11-Aug-2017 17:23:11	79°00.05'N	3°0.65'E	125	WSC_transect 1
99	11-Aug-2017 17:26:10	79°00.05'N	3°0.68'E	180	WSC_transect 1
100	11-Aug-2017 17:30:44	79°00.05'N	3°0.73'E	176	WSC_transect 1
101	11-Aug-2017 17:35:12	79°00.06'N	3°0.77'E	195	WSC_transect 1
102	11-Aug-2017 17:40:10	79°00.06'N	3°0.82'E	197	WSC_transect 1
103	11-Aug-2017 17:45:10	79°00.06'N	3°0.87'E	194	WSC_transect 1
104	11-Aug-2017 17:50:06	79°00.07'N	3°0.92'E	197	WSC_transect 1
105	11-Aug-2017 17:55:18	79°00.07'N	3°0.97'E	190	WSC_transect 1
106	11-Aug-2017 18:00:10	79°00.07'N	4°0.02'E	192	WSC_transect 1
107	11-Aug-2017 18:05:05	79°00.08'N	4°0.07'E	190	WSC_transect 1
108	11-Aug-2017 18:10:01	79°00.08'N	4°0.12'E	196	WSC_transect 1
109	11-Aug-2017 18:15:07	79°00.08'N	4°0.17'E	182	WSC_transect 1
110	11-Aug-2017 18:19:58	79°00.09'N	4°0.22'E	186	WSC_transect 1
111	11-Aug-2017 18:24:53	79°00.09'N	4°0.27'E	188	WSC_transect 1
112	11-Aug-2017 18:29:53	79°00.09'N	4°0.32'E	175	WSC_transect 1
113	11-Aug-2017 18:34:44	79°00.09'N	4°0.36'E	184	WSC_transect 1
114	11-Aug-2017 18:39:41	79°00.10'N	4°0.42'E	187	WSC_transect 1
115	11-Aug-2017 18:44:35	79°00.10'N	4°0.46'E	206	WSC_transect 1
116	11-Aug-2017 18:48:43	79°00.10'N	4°0.50'E	198	WSC_transect 1
117	12-Aug-2017 08:56:48	79°00.13'N	4°0.91'E	210	WSC_transect 3
118	12-Aug-2017 09:01:28	79°00.13'N	4°0.95'E	186	WSC_transect 3
119	12-Aug-2017 09:06:44	79°00.13'N	5°0.00'E	184	WSC_transect 3

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
120	12-Aug-2017 09:11:44	79°00.13'N	5°0.05'E	183	WSC_transect 3
121	12-Aug-2017 09:35:31	79°00.13'N	5°0.25'E	181	WSC_transect 3
122	12-Aug-2017 09:40:30	79°00.13'N	5°0.30'E	179	WSC_transect 3
123	12-Aug-2017 09:45:42	79°00.13'N	5°0.35'E	181	WSC_transect 3
124	12-Aug-2017 09:50:44	79°00.13'N	5°0.41'E	186	WSC_transect 3
125	12-Aug-2017 09:55:32	79°00.13'N	5°0.46'E	187	WSC_transect 3
126	12-Aug-2017 10:00:24	79°00.13'N	5°0.50'E	188	WSC_transect 3
127	12-Aug-2017 10:05:17	79°00.13'N	5°0.55'E	188	WSC_transect 3
128	12-Aug-2017 10:10:07	79°00.13'N	5°0.60'E	190	WSC_transect 3
129	12-Aug-2017 10:14:59	79°00.14'N	5°0.65'E	189	WSC_transect 3
130	12-Aug-2017 10:19:57	79°00.14'N	5°0.70'E	188	WSC_transect 3
131	12-Aug-2017 10:24:55	79°00.14'N	5°0.75'E	191	WSC_transect 3
132	12-Aug-2017 10:29:50	79°00.14'N	5°0.80'E	194	WSC_transect 3
133	12-Aug-2017 10:34:46	79°00.14'N	5°0.85'E	197	WSC_transect 3
134	12-Aug-2017 10:39:40	79°00.14'N	5°0.90'E	197	WSC_transect 3
135	12-Aug-2017 10:44:38	79°00.14'N	5°0.95'E	193	WSC_transect 3
136	12-Aug-2017 10:49:35	79°00.14'N	6°0.01'E	192	WSC_transect 3
137	12-Aug-2017 10:54:30	79°00.14'N	6°0.06'E	195	WSC_transect 3
138	13-Aug-2017 06:22:47	79°00.14'N	6°0.14'E	203	WSC_transect 4
139	13-Aug-2017 06:27:39	79°00.13'N	6°0.17'E	182	WSC_transect 4
140	13-Aug-2017 06:33:00	79°00.13'N	6°0.22'E	185	WSC_transect 4
141	13-Aug-2017 06:37:59	79°00.12'N	6°0.25'E	178	WSC_transect 4
142	13-Aug-2017 06:43:09	79°00.12'N	6°0.29'E	178	WSC_transect 4
143	13-Aug-2017 06:48:10	79°00.11'N	6°0.33'E	184	WSC_transect 4

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
144	13-Aug-2017 06:53:01	79°00.10'N	6°0.37'E	185	WSC_transect 4
145	13-Aug-2017 06:57:51	79°00.10'N	6°0.40'E	186	WSC_transect 4
146	13-Aug-2017 07:02:48	79°00.09'N	6°0.44'E	182	WSC_transect 4
147	13-Aug-2017 07:07:52	79°00.09'N	6°0.48'E	180	WSC_transect 4
148	13-Aug-2017 07:12:59	79°00.08'N	6°0.52'E	178	WSC_transect 4
149	13-Aug-2017 07:18:03	79°00.07'N	6°0.56'E	179	WSC_transect 4
150	13-Aug-2017 07:23:06	79°00.07'N	6°0.60'E	179	WSC_transect 4
151	13-Aug-2017 07:28:07	79°00.06'N	6°0.64'E	180	WSC_transect 4
152	13-Aug-2017 07:33:04	79°00.05'N	6°0.68'E	181	WSC_transect 4
153	13-Aug-2017 07:38:04	79°00.05'N	6°0.72'E	192	WSC_transect 4
154	13-Aug-2017 07:43:31	79°00.04'N	6°0.76'E	184	WSC_transect 4
155	13-Aug-2017 07:48:27	79°00.04'N	6°0.80'E	186	WSC_transect 4
156	13-Aug-2017 07:53:23	79°00.03'N	6°0.84'E	188	WSC_transect 4
157	13-Aug-2017 07:58:22	79°00.02'N	6°0.88'E	190	WSC_transect 4
158	13-Aug-2017 21:29:55	79°00.03'N	7°0.02'E	193	WSC_transect 5
159	13-Aug-2017 21:35:03	79°00.03'N	7°0.07'E	190	WSC_transect 5
160	13-Aug-2017 21:40:46	79°00.03'N	7°0.13'E	190	WSC_transect 5
161	13-Aug-2017 21:46:13	79°00.03'N	7°0.19'E	188	WSC_transect 5
162	13-Aug-2017 21:51:21	79°00.03'N	7°0.24'E	187	WSC_transect 5
163	13-Aug-2017 21:56:25	79°00.03'N	7°0.29'E	183	WSC_transect 5
164	13-Aug-2017 22:01:22	79°00.03'N	7°0.34'E	236	WSC_transect 5
165	13-Aug-2017 22:08:18	79°00.03'N	7°0.41'E	212	WSC_transect 5
166	13-Aug-2017 22:14:26	79°00.02'N	7°0.47'E	185	WSC_transect 5
167	13-Aug-2017 22:19:18	79°00.02'N	7°0.51'E	187	WSC_transect 5

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
168	13-Aug-2017 22:24:14	79°00.02'N	7°0.56'E	189	WSC_transect 5
169	13-Aug-2017 22:29:20	79°00.02'N	7°0.61'E	187	WSC_transect 5
170	13-Aug-2017 22:34:19	79°00.02'N	7°0.66'E	188	WSC_transect 5
171	13-Aug-2017 22:39:21	79°00.02'N	7°0.71'E	189	WSC_transect 5
172	13-Aug-2017 22:44:22	79°00.02'N	7°0.76'E	190	WSC_transect 5
173	13-Aug-2017 22:49:26	79°00.02'N	7°0.81'E	188	WSC_transect 5
174	13-Aug-2017 22:54:27	79°00.02'N	7°0.86'E	186	WSC_transect 5
175	13-Aug-2017 22:59:22	79°00.01'N	7°0.90'E	187	WSC_transect 5
176	13-Aug-2017 23:04:23	79°00.01'N	7°0.95'E	191	WSC_transect 5
177	13-Aug-2017 23:09:25	79°00.01'N	8°0.00'E	187	WSC_transect 5
178	13-Aug-2017 23:14:26	79°00.01'N	8°0.05'E	189	WSC_transect 5
179	13-Aug-2017 23:19:27	79°00.01'N	8°0.10'E	186	WSC_transect 5
180	13-Aug-2017 23:24:26	79°00.01'N	8°0.15'E	187	WSC_transect 5
181	13-Aug-2017 23:29:25	79°00.01'N	8°0.20'E	187	WSC_transect 5
182	13-Aug-2017 23:34:26	79°00.01'N	8°0.25'E	191	WSC_transect 5
183	14-Aug-2017 14:38:58	79°00.00'N	8°0.38'E	194	WSC_transect 6
184	14-Aug-2017 14:44:02	79°00.00'N	8°0.43'E	188	WSC_transect 6
185	14-Aug-2017 14:49:08	79°00.00'N	8°0.48'E	179	WSC_transect 6
186	14-Aug-2017 14:54:03	79°00.00'N	8°0.53'E	183	WSC_transect 6
187	14-Aug-2017 14:59:04	78°01.00'N	8°0.58'E	183	WSC_transect 6
188	14-Aug-2017 15:04:06	78°01.00'N	8°0.63'E	178	WSC_transect 6
189	14-Aug-2017 15:08:56	78°01.00'N	8°0.68'E	186	WSC_transect 6
190	14-Aug-2017 15:14:00	78°01.00'N	8°0.73'E	185	WSC_transect 6
191	14-Aug-2017 15:18:54	78°01.00'N	8°0.78'E	185	WSC_transect 6

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
192	14-Aug-2017 15:23:53	78°00.99'N	8°0.83'E	184	WSC_transect 6
193	14-Aug-2017 15:28:50	78°00.99'N	8°0.88'E	187	WSC_transect 6
194	14-Aug-2017 15:33:49	78°00.99'N	8°0.93'E	187	WSC_transect 6
195	14-Aug-2017 15:38:43	78°00.99'N	8°0.98'E	187	WSC_transect 6
196	14-Aug-2017 15:43:39	78°00.99'N	9°0.03'E	201	WSC_transect 6
197	14-Aug-2017 15:49:14	78°00.99'N	9°0.08'E	195	WSC_transect 6
198	14-Aug-2017 15:54:29	78°00.99'N	9°0.13'E	185	WSC_transect 6
199	14-Aug-2017 15:59:19	78°00.99'N	9°0.18'E	184	WSC_transect 6
200	14-Aug-2017 16:04:11	78°00.99'N	9°0.23'E	187	WSC_transect 6
201	14-Aug-2017 16:08:59	78°00.99'N	9°0.28'E	187	WSC_transect 6
202	14-Aug-2017 16:13:47	78°00.98'N	9°0.32'E	189	WSC_transect 6
203	14-Aug-2017 16:18:51	78°00.98'N	9°0.37'E	185	WSC_transect 6
204	14-Aug-2017 16:23:40	78°00.98'N	9°0.42'E	185	WSC_transect 6
205	14-Aug-2017 16:28:31	78°00.98'N	9°0.47'E	186	WSC_transect 6
206	14-Aug-2017 20:13:41	78°00.98'N	9°0.51'E	201	WSC_transect 7
207	14-Aug-2017 20:18:08	78°00.98'N	9°0.54'E	190	WSC_transect 7
208	14-Aug-2017 20:23:15	78°00.98'N	9°0.59'E	182	WSC_transect 7
209	14-Aug-2017 20:28:39	78°00.99'N	9°0.65'E	171	WSC_transect 7
210	14-Aug-2017 20:34:03	78°00.99'N	9°0.71'E	175	WSC_transect 7
211	14-Aug-2017 20:39:00	78°00.99'N	9°0.76'E	223	WSC_transect 7
212	14-Aug-2017 20:46:38	78°00.99'N	9°0.84'E	178	WSC_transect 7
213	14-Aug-2017 20:51:22	78°00.99'N	9°0.89'E	181	WSC_transect 7
214	14-Aug-2017 20:56:13	78°00.99'N	9°0.94'E	183	WSC_transect 7
215	14-Aug-2017 21:01:10	78°01.00'N	9°0.99'E	200	WSC_transect 7

No.	Date/time [UTC]	Latitude	Longitude	Profile depth [m]	Transect name
216	14-Aug-2017 21:06:48	78°01.00'N	10°0.04'E	179	WSC_transect 7
217	14-Aug-2017 21:11:39	78°01.00'N	10°0.09'E	181	WSC_transect 7
218	14-Aug-2017 21:16:43	79°00.00'N	10°0.14'E	212	WSC_transect 7
219	14-Aug-2017 21:23:16	79°00.00'N	10°0.21'E	180	WSC_transect 7
220	14-Aug-2017 21:28:19	79°00.00'N	10°0.26'E	183	WSC_transect 7
221	14-Aug-2017 21:33:26	79°00.01'N	10°0.32'E	181	WSC_transect 7
222	14-Aug-2017 21:38:32	79°00.01'N	10°0.37'E	184	WSC_transect 7
223	14-Aug-2017 21:43:23	79°00.01'N	10°0.42'E	183	WSC_transect 7
224	14-Aug-2017 21:48:23	79°00.01'N	10°0.47'E	184	WSC_transect 7
225	14-Aug-2017 21:53:22	79°00.01'N	10°0.52'E	185	WSC_transect 7
226	14-Aug-2017 21:58:19	79°00.01'N	10°0.57'E	182	WSC_transect 7
227	14-Aug-2017 22:03:11	79°00.01'N	10°0.61'E	182	WSC_transect 7
228	14-Aug-2017 22:08:04	79°00.02'N	10°0.66'E	184	WSC_transect 7
229	14-Aug-2017 22:12:58	79°00.02'N	10°0.71'E	184	WSC_transect 7
230	14-Aug-2017 22:18:02	79°00.02'N	10°0.76'E	181	WSC_transect 7
231	14-Aug-2017 22:22:55	79°00.02'N	10°0.81'E	180	WSC_transect 7
232	14-Aug-2017 22:27:55	79°00.02'N	10°0.87'E	182	WSC_transect 7
233	14-Aug-2017 22:32:58	79°00.02'N	10°0.92'E	180	WSC_transect 7

Vessel Mounted ADCP

Processing of the ship ADCP raw data was carried out with the Matlab package OSSI (Ocean surveyor sputum interpreter) Version 1.7. Determination of heading correction parameters was based on the time period 24 Jul – 30 Jul 2017. The following parameters were chosen: misalignment = 0.9, ampfactor = 1.02, tr_depth = 11 and pg_threshold =25. Note that water depths during this time period were deeper than 200 m. An averaging interval of 60 s was used for the data processing.

The processed ship ADCP data is saved in four matlab-files:

PS107_1_hc.mat: time period 24 Jul 2017 06:37 - 31 Jul 2017 14:33

PS107_2_hc.mat: time period 31 Jul 2017 19:36 - 14 Aug 2017 00:23

PS107_4_hc.mat: time period 14 Aug 2017 04:45 - 14 Aug 2017 06:29

PS107_6_hc.mat: time period 14 Aug 2017 06:33 - 15 Aug 2017 14:51

Problems on 14 Aug occurred due to synchronization of data from the sADCP computer to an external hard drive. If another program than VMDAS accesses the file to which VMDAS writes currently collected data, e.g. if a file synchronization tool accesses it, VMDAS produces an error and stops data acquisition. This results in lost data and ought to be avoided. Only when realized by e.g. the Labor ELO and manually restarted, does the raw data acquisition continues. VMDAS finishes writing to a file after the file size has been reached. During PS107, this was 10 MB (setting MaximumFileSize=10 in file VMDAS configuration). Then the 10 MB file can be accessed by another programme, e.g. for file synchronization. In the future, for near real time data analysis, we plan to access files much faster. Maximum file size then has to be set to e.g. 1 MB. Then it should be assured that synchronization problems don't occur. VMDAS settings used during PS107 are provided in Table 4.6.

Tab. 4.6: VMDAS settings during PS107

```
;---------------------------------------------------------------------------
\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     150 Khz Ocean Surveyor
; Setup name:    for Polarstern in 6/2014
; Setup type:    Low resolution, long range profile (Narrowband)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 12Jun2014
;---------------------------------------------------------------------------
/
; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 115200 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), 100 (NN) 4 meter bins (NS),
; 2 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)
WP000
```

```
NP001
NN080
NS0400
NF0400
;WV390

; Disable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)
BP000
;BX12000

; output velocity, correlation, echo intensity, percent good
ND111100000

; Ping as fast as possible
TP000000

; Since VmDas uses manual pinging, TE is ignored by the ADCP
; and should not be set.
;TE0000000

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor,  pitch or roll being used, no salinity sensor, use internal
transducer
; temperature sensor
EZ1011101

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees).
; Ignored here but set in VmDAS options.
;EA00000
; Set transducer depth (decimeters)
ED00110

; Set Salinity (ppt)
ES35

;set external triggering and output trigger; no trigger
CX0,0

; save this setup to non-volatile memory in the ADCP
CK
```

WaMoS

The wave radar system on *Polarstern* uses radar reflectance from surface waves to determine the ocean surface current velocity and direction. For the first part of the cruise until August 10, 2017, the ship was in sea-ice covered regions where surface waves were dampened by the sea-ice. Only from August 10, 2017 onwards there had been sufficient surface roughness for WaMoS to be able to determine the current velocity. The data was screened according to significant wave height and otherwise saved during PS107.

Salinometer

Water samples were taken from depths >1,000 m at the stations marked “salt” in Table 4.1. These samples were then run on the Optimare Precision Salinometer SN006 to determine their salinity. The standard protocol developed by the Physical Oceanography of Polar Seas group at AWI was followed.

Preliminary (expected) results

In order to learn about the structure of a submesocale front in Fram Strait, we consulted at satellite radar imagery. An image from July 26, 2017 revealed a nearly straight line of sea-ice of almost 50 km length and only 500 m width. *Polarstern* moved to the front and then occupied 6 parallel cross-frontal sections (Fig. 4.1) with a total of 97 UCTD casts.

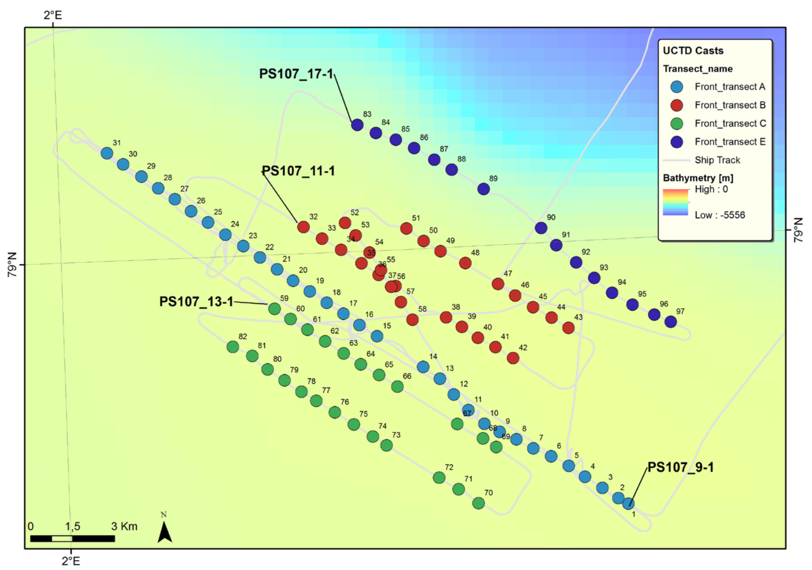

Fig. 4.1: Locations of UCTD casts during frontal survey. The four transects (A, B, C, E) are marked in the legend.

The UCTD measurements from the frontal survey showed that the along-front changes were much weaker than the cross-front changes. It also revealed denser Atlantic Water in the center of the front at 200 m depth than on either side of the front. A strong (exceeding 0.5 m/s) geostrophic along-front jet was also observed with the vessel mounted ADCP. Fig. 4.2 shows the temperature and density distribution in 6 parallel cross-front sections.

In order to detect possible frontal zones in the West Spitsbergen Current and in order to continue annual surveys of the WSC as they had been undertaken in previous years by AWI, we occupied a long transect from roughly 3.5°E to 11°E near 79°N (Fig. 4.3). The section, which is comprised of 136 UTCD casts, can be seen in Fig. 4.4 and agrees well with the climatological situation in August (e.g. von Appen et al., 2016), but it also reveals a strong front between 5°E and 6°E with raised isopycnals. This provides a different view to the traditional lower resolution sampling.

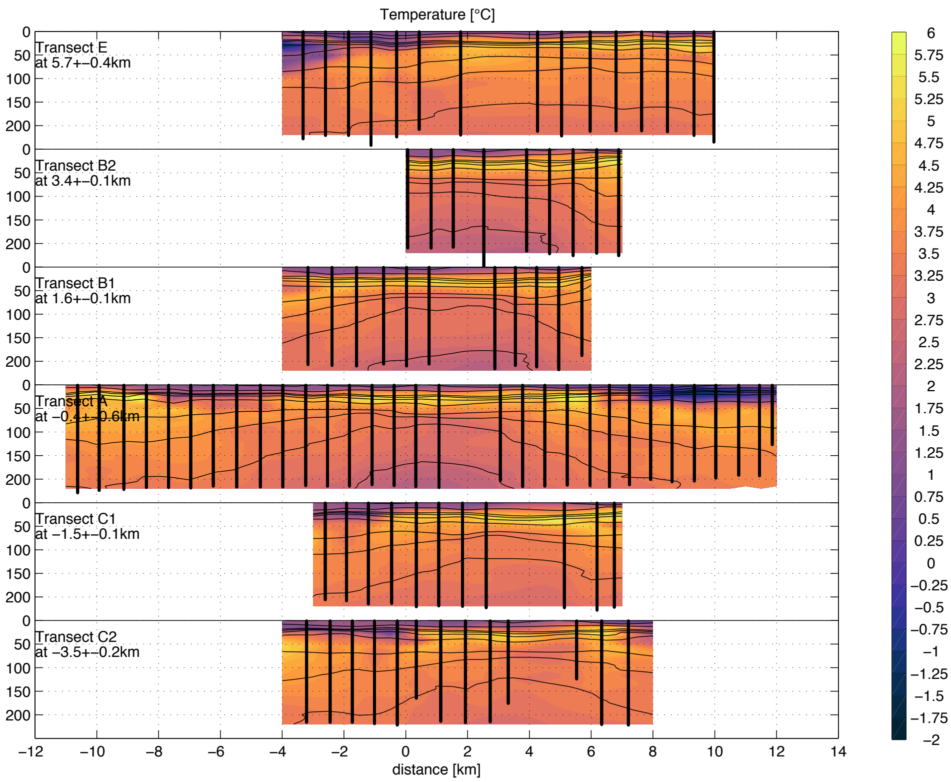

Fig. 4.2: Temperature in °C (color) and density in kg/m³ (contour lines) of the cross-frontal transects (transects A, B, C, E)

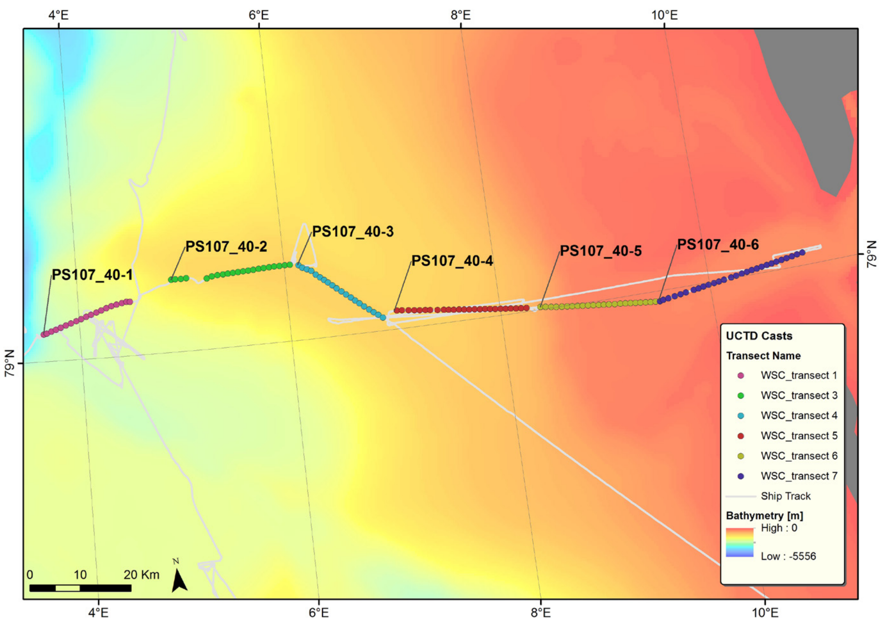

Fig. 4.3: Locations of the UCTD casts during the high-resolution transect across the West Spitsbergen Current

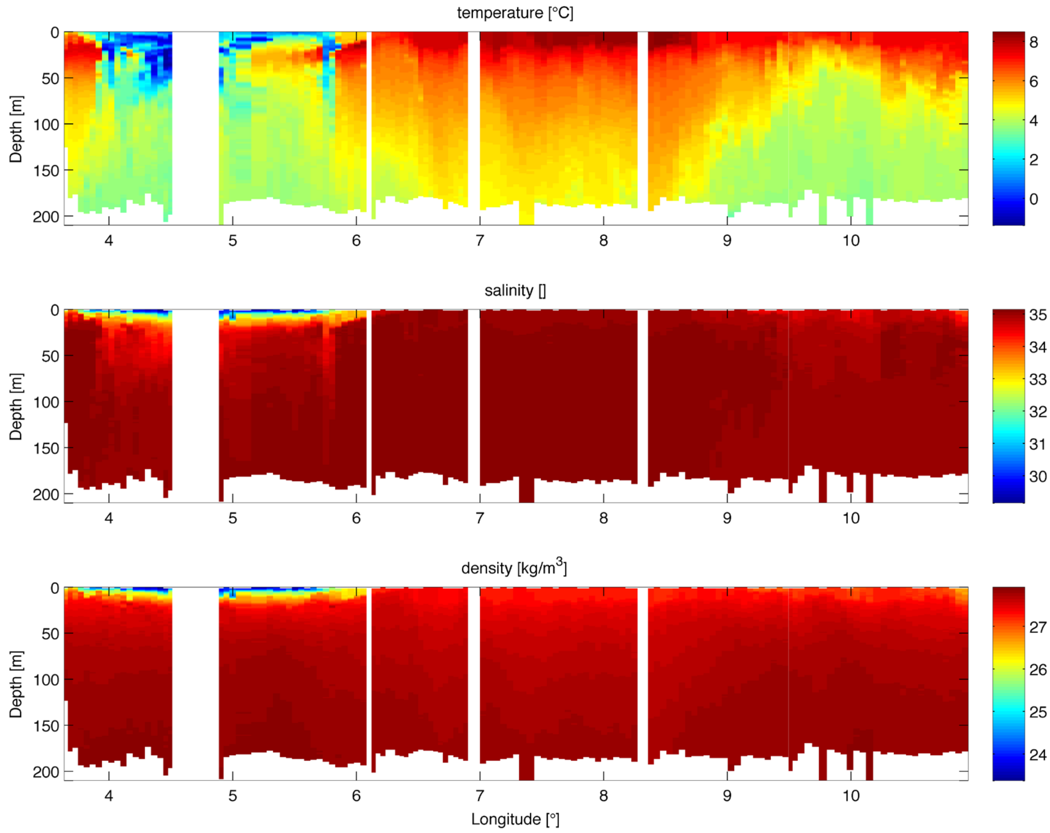

Fig. 4.4: Temperature, salinity, and density plot of the section across the West Spitsbergen Current from 3.5° E to 11° E

Data management

The raw data collected on PS107 is archived at Pangaea. When the data has been processed, the processed data will be made available on Pangaea as well.

References

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von Appen W-J, Schauer U, Hattermann T & Beszczynska-Möller A (2016) Seasonal cycle of mesoscale instability of the West Spitsbergen Current. Journal of Physical Oceanography. 46, 4, 1231–1254.

5. MOORING WORK OF THE FRAM PROJECT IN LTER HAUSGARTEN

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Grant No. AWI_PS107_05

Objectives

Ongoing climate change will impact marine ecosystems in a variety of ways, and polar environments are believed to be particularly sensitive to these changes. Increasing atmospheric CO2 concentration will lead to a reduction of ocean pH, which is expected to exert a significant impact on marine calcifying organisms. Reductions in sea-ice cover and warming of water masses will modify ocean stratification and restrict the supply of nutrients to the euphotic zone. Taken together with anticipated changes in light conditions, net phytoplankton growth is expected to change with important ramifications for Arctic ecosystem structure and biogeochemical fluxes. In particular the quantity of photosynthetically produced organic matter exported from the surface ocean is likely to change under these conditions.

These changes have clear implications for the sequestration of atmospheric CO2 and the structure and function of benthic ecosystems that principally rely on this energy source from the pelagic. Considering the importance of these processes, reliably detecting the effects of climate change and understanding the influence of anthropogenic forcing on Arctic ecosystems is a clear priority. As part of our efforts to observe and detect long-term changes in Arctic Ocean ecosystems, we deployed a network of fixed- point moorings in the Fram Strait. On the one hand these moorings reflect a continuation of the well-established and long-term efforts of monitoring particle flux in the Fram Strait as part of the LTER Observatory HAUSGARTEN. In addition to this, new mooring arrays were designed to sample biogeochemical and physical properties in the upper water column to link with particle flux observations. These arrays include autonomous water samplers and autonomous particle samplers that are capable of collecting discrete samples with weekly resolution and preserving them for detailed analysis upon recovery. This work is part of the Frontiers in Arctic marine Monitoring (FRAM) infrastructure project.

To determine the transfer of organic matter from the upper productive layer in the water column to the bottom of the ocean, measurements of settling particles are performed by means of year-round moored sediment traps that provide information on the quantity and seasonality of vertical particle flux. The moorings are also equipped with current meters (RCMs) and self-recording CTDs, to gain information on the hydrographic conditions in the study area. Results obtained by these instruments are of major importance for the interpretation of the results derived by the sediment traps, as the settling particles can be transported over long distances before arriving at the seabed.

To determine the seasonal changes in nutrient concentrations in the euphotic zone, water samplers were deployed in 2016 (PS99.2) and also on the current cruise (PS107) at approximately 20 m and 80 m depth. In total, 24 discrete samples will be taken with weekly to monthly resolution (depending on season) to follow the biological drawdown of nutrients. The moorings are also equipped with a physical and biogeochemical sensor package including SBE37-SMP-ODO (temperature, salinity, oxygen), SAMI pH, SAMI pCO_2, Wetlabs PAR (photosynthetically active radiation), Wetlabs Ecotriplet (Chlorophyll and CDOM fluorescence plus scattering), SUNA Deep Nitrate, current meters, and Acoustic Doppler Current Profilers. The combination of these sensors and the water samplers, in combination with the deployment of a profiling winch facilitates the assessment of seasonal stratification and nutrient concentrations above and below the pycnocline. The nutrient drawdown enables an estimate of new production. Furthermore, the samples will be used for DNA sequencing to examine seasonal changes in bacterial community structure. The particle samplers collect and preserve filters for DNA extraction and sequencing that together with the fluorescence sensors allow us to track the progression of phytoplankton biomass and community composition over different seasons. These efforts give us a novel year-round description of biological, chemical, and physical processes in the Fram Strait.

In addition, water samplers were deployed at ~80 m water depth in the anticipated cores of the West Spitsbergen and East Greenland Currents. Together with detailed measurements of physical parameters, these samples will be used to measure the nutrient composition of water masses flowing into and out of the Arctic Ocean through the Fram Strait.

Work at sea

6 moorings and one bottom lander were recovered on PS107 and redeployed in a similar configuration (Table 5.1) for planned recoveries in 2018. The mooring work was successful without major complications.

As part of the cruise several moorings were deployed in the Fram Strait, to combine physical and biological autonomous observations. The HG-EGC-4 and HG-N-FEVI-35 moorings were redeployed in the same configuration as in 2016. In addition we recovered and deployed four out of six moorings comprising two triangular cluster arrays that combine physical and biogeochemical measurements in the eastern part of the Fram Strait at the existing HG-IV and F4 stations. The HG-IV-FEVI-36 mooring was redeployed configured with three sediment traps and a McLane RAS 500 water sampler at 80 m and an upward looking ADCP at 400m. Additionally, larval samplers and recruitment surfaces were added at four depths on three moorings (Fig. 5.1). Two near-surface moorings were also recovered and deployed at HG-IV (HG-IV-S-2) and F4 (F4-S-2) that were equipped with McLane RAS 500 water samplers and McLane PPS particle samplers at 20 m (Fig. 5.2). Furthermore, biogeochemical sensor packages were attached to these frames that included the following: SBE37-SMP-ODO (temperature, salinity, oxygen), SAMI pH, SAMI pCO2, Wetlabs PAR (photosynthetically active radiation), and Wetlabs Ecotriplet (Chlorophyll and CDOM fluorescence and scattering), SUNA Deep Nitrate. In addition to the traditional and near surface moorings the third components of these triangular cluster arrays are surface profiling winches. One of these moorings, HG-IV-SWIPS-2017, is equipped with a CTD sensor package (Fig. 5.3).

Tab. 5.1: Overview of mooring recoveries and deployments on PS107

Name	Longitude		Latitude		Deployment time					Recovery time					Depth	Deployment station	Recovery station
	Degrees	Minutes	Degrees	Minutes	Year	Month	Day	Hour	Minute	Year	Month	Day	Hour	Minute	Meters		
Recoveries																	
HG-IV-FEVI-34	4	19,97 E	79	0,00 N	2016	7	11	17	47	2017	7	27	6	9	2612	PS99/072-1	PS107/003-2
HG-IV-S-1	4	15,71 E	79	1,38 N	2016	7	11	7	37	2017	7	27	4	20	2542	PS99/070-1	PS107/003-1
HG-IV-SWIPS-2016	4	24,30 E	79	1,40 N	2016	7	12	16	2	2017	7	27	12	9	2480	PS99/076-1	PS107/005-1
F4-S-1	6	57,89 E	79	0,71 N	2016	7	10	7	31	2017	8	13	8	57	1223	PS99/067-1	PS107/044-1
HG-N-FEVI-33	4	29,42 E	79	44,19N	2016	7	5	7	35	2017	8	8	5	57	2641	PS99/055-6	PS107/033-8
HG-EGC-3	2	47,63 W	78	49,86N	2016	6	30	15	10	2017	8	3	9	57	2535	PS99/048-7	PS107/023-1
Lander-2016	4	6,72 E	79	4,68 N	2016	7	12	17	50	2017	7	27	9	56	2494	PS99/077-1	PS107/004-1
Deployments																	
HG-IV-FEVI-36	4	20,02 E	79	0,00 N	2017	8	11	6	4						2609	PS107/038-1	
HG-IV-S-2	4	15,71 E	79	1,36 N	2017	8	11	8	14						2599	PS107/038-2	
HG-IV-SWIPS-2017	4	24,31 E	79	1,39 N	2017	8	11	12	12						2535	PS107/038-4	
F4-S-2	6	57,86 E	79	0,70 N	2017	8	15	10	16						1260	PS107/049-1	
HG-N-FEVI-35	4	31,44 E	79	44,49N	2017	8	9	16	37						2692	PS107/035-1	
HG-EGC-4	2	47,53 W	78	49,86N	2017	8	4	13	3						2589	PS107/025-2	
Lander-2017	4	6,74 E	79	4,68 N	2017	8	11	14	23						2493	PS107/038-7	

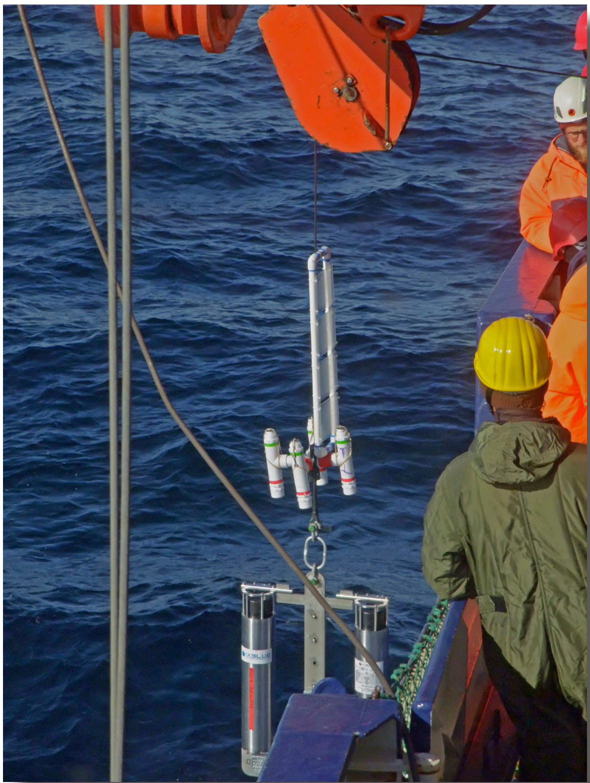


Fig. 5.1: Larval samplers and recruitment surfaces attached to 3 moorings in 4 depths

Fig. 5.2: Recovery of the 20 m biogeochemical sensor and sampler package on F4-S-1. The instruments spent one year in the euphotic zone.

Fig. 5.3: SWIPS system before deployment in HG-IV-SWIPS-2017. The yellow body is the winch and storage unit. The orange body is the profiler.

The biological and chemical sensors as well as the water and particle samplers that were recovered on PS107 had been programmed in German summer time and not UTC. All of the sensors and samplers deployed on PS107 were programmed in UTC with the exception of the water sampler on HG-EGC-4 which was programmed in German summer time.

The sampling schedules of the samplers and the sediment traps are archived together with the sensor raw data of the instruments recovered on PS107 on Pangaea.

During PS107 the two shallow moorings deployed in 2016 during the PS99 cruise, containing McLane Remote Access Sampler 500 (RAS), McLane PPS particle samplers, Microcat CTDs, SAMI pHs, SAMI pCO_2, Wetlabs PARs (photosynthetically active radiation) and Wetlabs EcoTriplets (CDOM, Clorophyll and fluorescence) were recovered.

The SAMI pH, recovered at F4-S-1 stopped measuring due to low battery after 10 months and 1 week. Since the necessary cable was missing on board, the data recovered at HG-IV-S-1 was not downloaded from the SAMI pH during the cruise.

The SAMI pCO_2 sensors, recovered at F4-S-1 and HG-IV-S-1 measured for 365 days in an interval of 1 hr.

The Wetlabs PAR, recovered at F4-S-1 did not collect any data while in water. There must have been a problem with it being turned on. When recovered, its batteries were drained. When replacing the batteries on board, it started its programmed duty cycle. The Wetlabs PAR, recovered at HG-IV-S-1 worked as programmed from deployment until recovery in an interval of 1 hr and 2 sec. This is different from a planned 1 hr interval and highlights that the instrument programming necessary for the Wetlabs sensors is highly counter-intuitive.

The Wetlabs Triplets, recovered at F4-S-1 and HG-IV-S-1 was programmed for 1,000 cycles with an interval of 1hr. The 1,000 cycles where accomplished after 41 days.

When recovered, the batteries were drained. After replacing the batteries, the sensors started running their programmed duty cycles.

All of the sensors encountered bio-fouling on their housings. However, and the copper anti-fouling protections and wipers worked well.

All recovered sensors were manually cleaned from bio-fouling and the SAMI sensors were flushed with de-ionized water.

As part of the cruise, the two shallow moorings F4-S-1 and HG-IV-S-1 were replaced by two new moorings F4-S-2 and HG-IV-S-2, which will be recovered in 2018. The new moorings have the same configuration as 2016 but in addition, 2 SUNA nitrate sensors are attached to the RAS samplers, equipped with external batteries. At F4-S-2 the nitrate sensor is equipped with an anti-fouling cage to protect the optical chamber. At HG-IV-S-2 the nitrate sensor is equipped with a so called “bio-wiper” which also prevents bio-fouling. Both sensors were calibrated on board and tested with a standard nitrate concentration of 8 µMol. The measuring interval of both sensor was set to 3 hr.

The SUNA pH sensors were tested in sea-water on board and the deployment interval was set to 3hr. The reason for the longer interval is the drained battery encountered during the previous deployment. Furthermore, the sensors were flushed with de-ionized water before deployment.

The SUNA pCO2 sensors were set to the same interval as 2016 of 1 hr and were flushed with de-ionized water.

The performance of the recovered and deployed RAS water samplers and the PPS particle samplers is documented in Table 5.2.

Tab. 5.2: Performance of the RAS water samplers and the PPS particle samplers

	Instrument	Serial Nr.	AWI Nr.	Mooring	Expedition	Depl. Date	Comments
Deployment	RAS	14128-04	76384	EGC-4	PS107, 2017	04.08.17	Back up battery was installed, board was reconstructed for that (by Ullrich Hoge). Board spare parts and battery housing from RAS 13380-01 were used for it/ Programmed by using German summer time.
	RAS	14128-08	76386	F4S-2	PS107, 2017	15.08.17	Back up battery was installed, board was reconstructed for that (by Ullrich Hoge)/ Leaking sample containers had to be exchanged (20x)
	RAS	13464-02	74915	Fevi-36	PS107, 2017	11.08.17	Back up battery was installed, board was reconstructed for that (by Ullrich Hoge)/ Pump was exchanged due to low flow rates, pump 14128-09 was installed finally
	RAS	14333-02	78392	HG-4-S-2	PS107, 2017	11.08.17	Back up battery was installed, board was reconstructed for that (by Ullrich Hoge)/ Sample bag in Port 30, 33, 35, 37 have 2 mL inside instead of 700 µl/ 2 sample container were broken (new device!)
	PPS	14128-03	76380	F4S-2	PS107, 2017	15.08.17	Back up battery was installed, board was reconstructed for that (by Ullrich Hoge)/ Controller of this device was put back in (recovered from HG-4-S-1, see recovery list below)
	PPS	14333-01	78393	HG-4-S-2	PS107, 2017	11.08.17	Back up battery was installed, board was reconstructed for that (by Ullrich Hoge)/ Port valve (14333-01) was exchanged because of leaking (inner spring slightly corroded). Port valve 14128-02 was used (new device!)

	Instrument	Serial Nr.	AWI Nr.	Mooring	Expedition	Rec. Date	Comments
Recovery	RAS	14128-09	76389	HG-4-S-1	PS99, 2016	27.07.17	Needs testing of sample container if leaking (all containers marked with "X" are leaking)/ has broken pump from 13464-02 installed, needs repairing
	RAS	14128-07	76385	Fevi-34	PS99, 2016	27.07.17	Needs testing of sample container if leaking (all containers marked with "X" are leaking)
	RAS	14128-08	76386	EGC-3	PS99, 2016	03.08.17	Sample container are leaking / no back up battery
	RAS	14128-05	76388	F4S-1	PS99, 2016	13.08.17	Sample of port 39 was not taken, needs testing of sample container if leaking
	PPS	14128-02/-03	76381	HG-4-S-1	PS99, 2016	27.07.17	Controller and pump were from PPS14128-03, port valve and frame from 14128-02/ Needs cleaning due to HgCl traces, port valve 14333-01 was installed after recovery for transwport but is broken!
	PPS	14128-01	76382	F4S-1	PS99, 2016	13.08.17	Port valve is broken (leaking) / no back up battery/ Needs cleaning due to HgCl traces

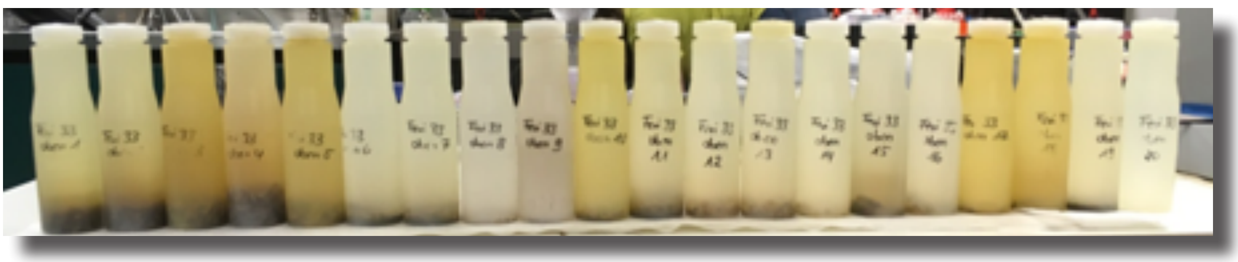
Notes	RAS	13380-01					Board was broken, so running the port valve was not working for every port. Needs new electronics. Could not bei deployed
	Port valve	14386					PPS port valve not completly sealed, pulls in air (new spare part!)

The SWIPS winch performed the first water column profiles from 140 m to 15 m depth in fall and winter. After initially performing two planned profiles 3 days apart, the system went on a hiatus from mid July 2016 to mid November 2016. Then it performed another 17 profiles in winter. Then the system fatally failed due to salt-water leakage at the slip-ring. The data was stored on the winch system, but the profiler dragged all of the cable out from the winch and then sheared the cable through and got lost at sea.

The cups of the sediment traps recovered are shown below and the trap performance is described.

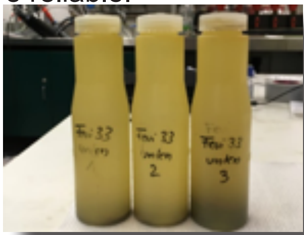
FEVI-33-Oben

All cup rotated as planned. Since the last cup was planned to rotate into position after the recovery date, bottle #19 was open during recovery and bottle #20 had not recovered.



FEVI-33-Unten

The rotation system had stalled at bottle #3, which was still open during recovery. Therefore, only bottle #1 and #2 are reliable.

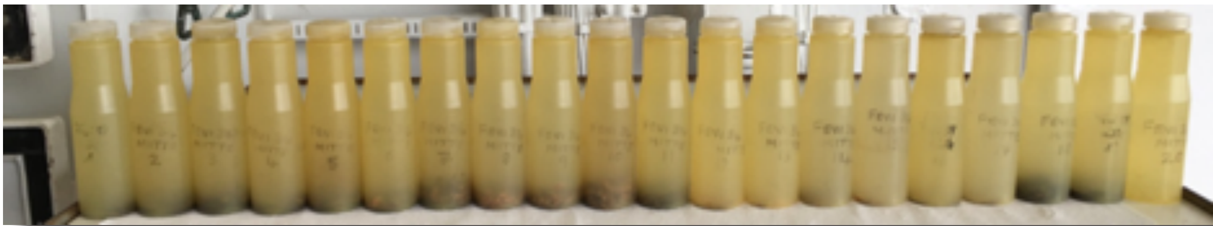


FEVI-34-Oben

All cup rotated as planned. Since the last cup was planned to rotate into position after the recovery date, bottle #19 was open during recovery and bottle #20 had not recovered.

FEVI-34-Mitte

All cup rotated as planned. Since the last cup was planned to rotate into position after the recovery date, bottle #19 was open during recovery and bottle #20 had not recovered.

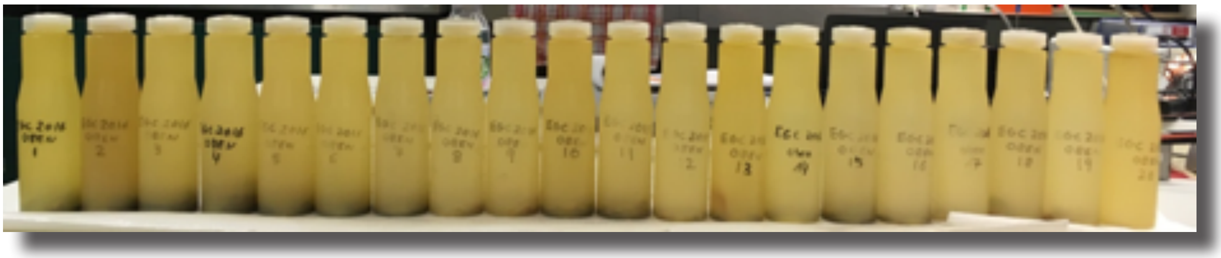


FEVI-34-Unten

The rotation system had stalled at bottle #5, which was still open during recovery. Therefore, only bottle #1 through #4 are reliable.

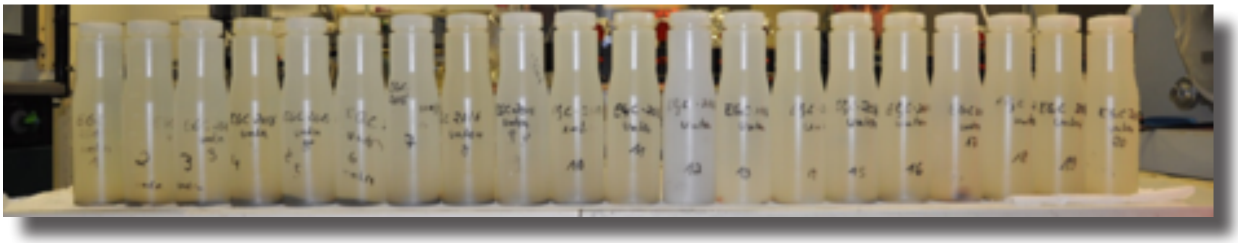
EGC-3-Oben

All cup rotated as planned. Since the last cup was planned to rotate into position after the recovery date, bottle #19 was open during recovery and bottle #20 had not recovered.



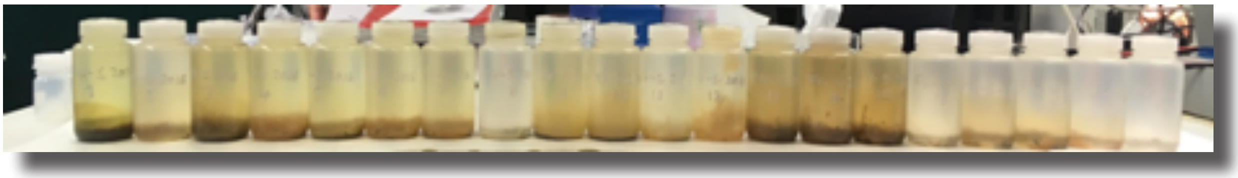
EGC-3-Unten

All cup rotated as planned. Since the last cup was planned to rotate into position after the recovery date, bottle #19 was open during recovery and bottle #20 had not recovered.



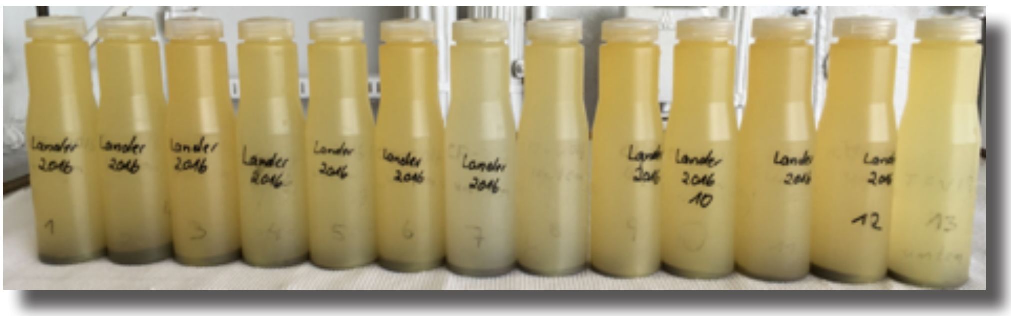
F4S-1

All cups rotated as planned and the trap was recovered with the funnel position at the empty hole.



LANDER

All cups rotated as planned and the trap was recovered with the funnel position at the empty hole.



Preliminary (expected) results

The data present an unprecedented dataset characterizing the seasonal progression of physical, biological, and chemical parameters in the Arctic Ocean with the marked absence of year-round fluorescence data. This documents the onset of stratification in the water column and how this is related to salinity and temperature. It also allows to follow the development of the phytoplankton bloom and to look at the seasonal phenology of dominant eukaryotic and bacterio plankton groups. Nutrient inputs to the surface layer and the ensuing biological consumption will allow us to estimate the magnitude of new production. By comparing the fluxes measured in sediment traps, we can estimate the fraction of production exported out of the surface layer and the dominant mechanisms characterizing this export.

The preliminary physical/biogeochemical time series from the HG-IV and F4 clusters are shown in Figs 5.4-5.7. The temperature and salinity profiles taken by the SWIPS winch on HG-IV-SWIPS-2016 are shown in Figs 5.8 - 5.9.

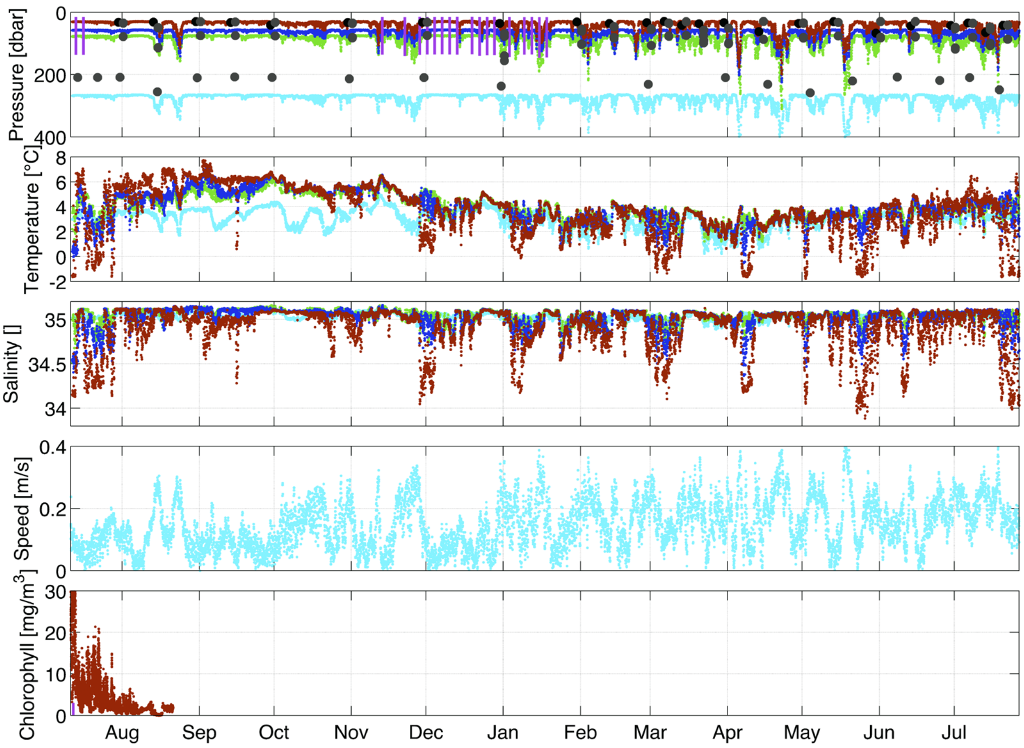


Fig. 5.4: Pressure, temperature, salinity, water speed, and chlorophyll concentration values at the HG-IV cluster in 2016-2017. The red, blue, green, cyan pressure time series show where the respectively colored time series are measured. The black dots superimposed on the pressure time series show the time/pressure of particle samples. The gray dots above 180 m superimposed on the pressure time series show the time/pressure of water samples. The gray dots below 180 m superimposed on the pressure time series show the time/pressure when the sediment trap rotated between cups. The vertical magenta lines superimposed on the pressure time series show the time/pressure of CTD profiles taken by the SWIPS system. All sensor values are factory calibrated and non-final.

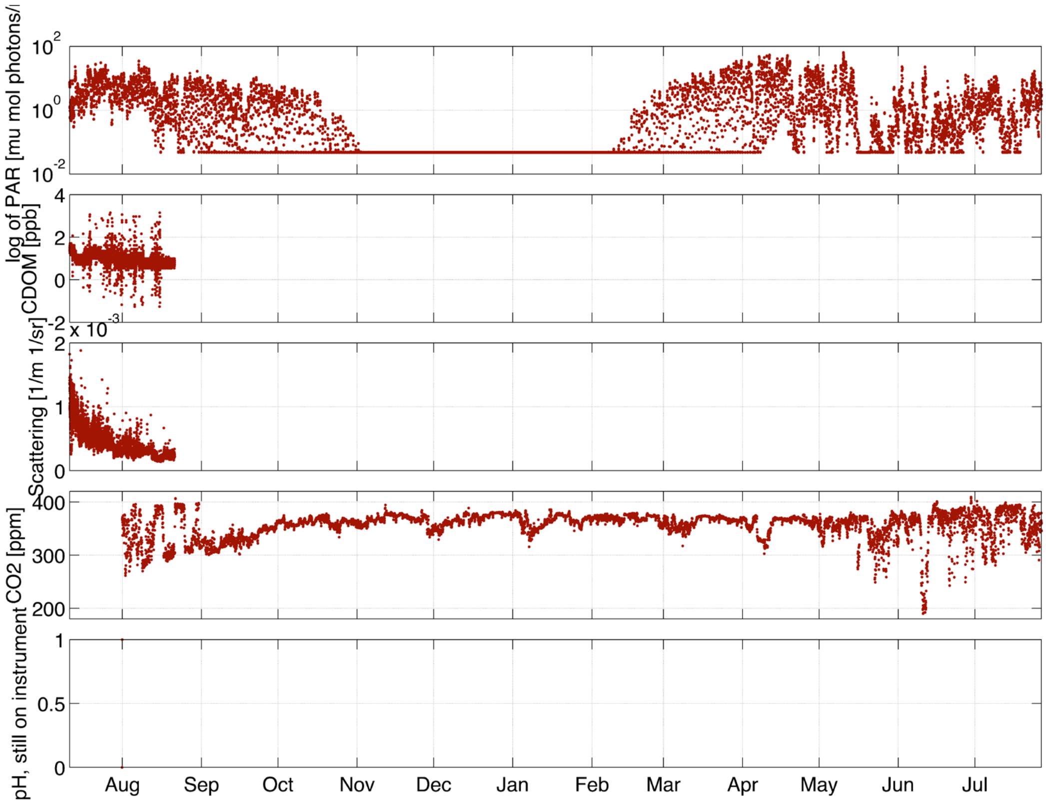


Fig. 5.5: PAR, CDOM, scattering, CO_2, and pH values at the HG-IV cluster in 2016-2017 at the depth of the red pressure time series in Fig. 5.4. All sensor values are factory calibrated and non-final.

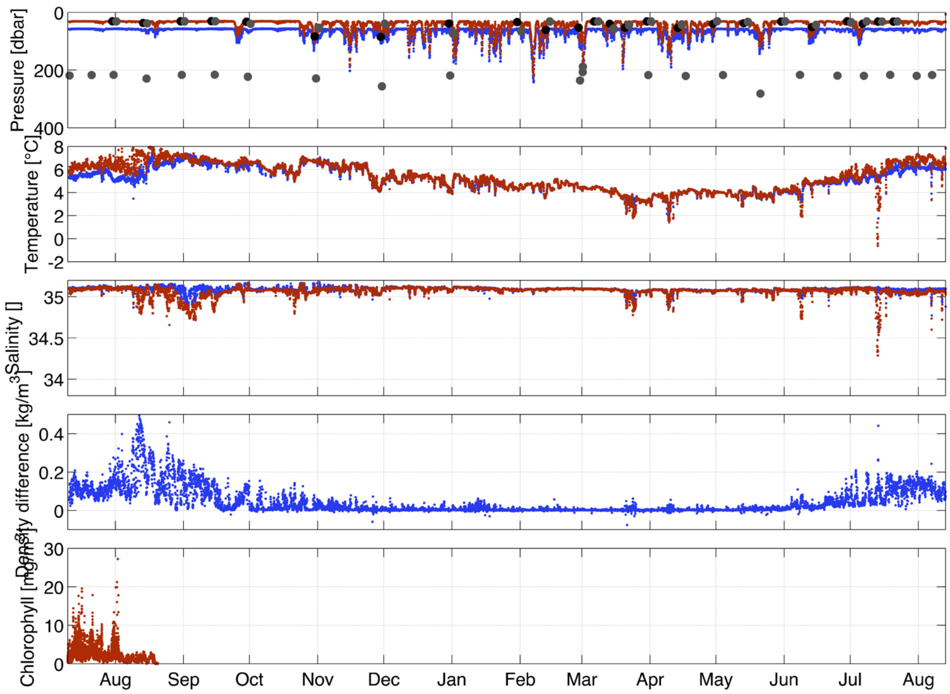


Fig. 5.6: Same as Fig. 5.4, but for the F4 cluster, where only one mooring of the cluster was recovered in 2017

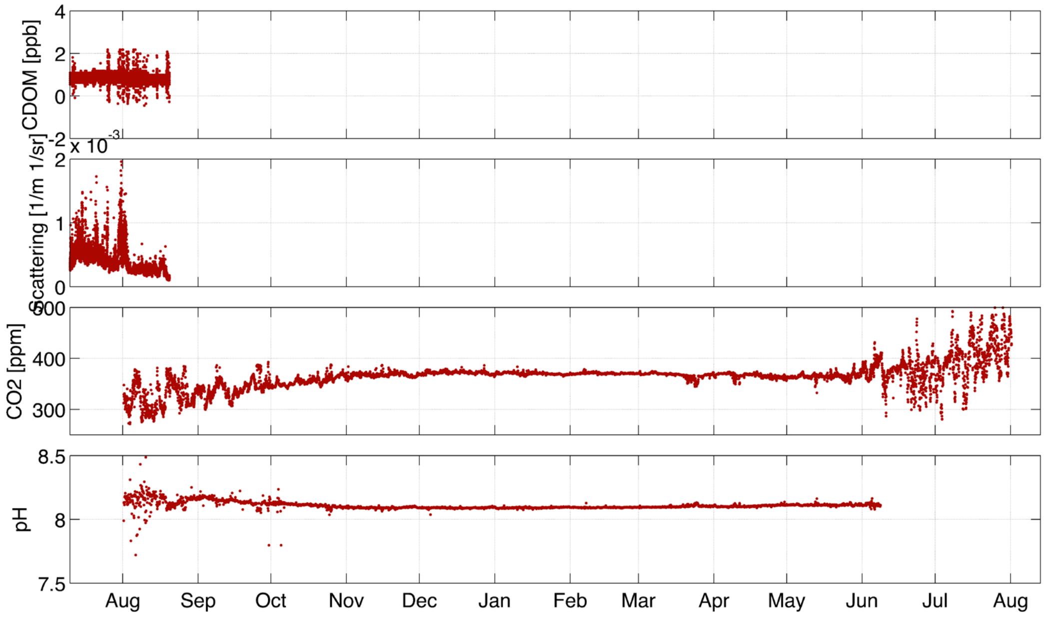


Fig. 5.7: Same as Fig. 5.5, but for the F4 cluster

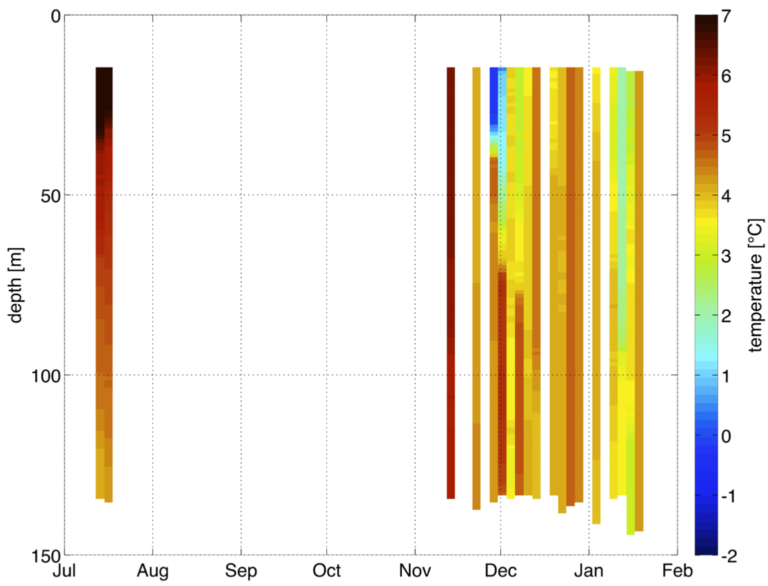


Fig. 5.8: Temperature profiles between July 2016 and February 2017 at HG-IV-SWIPS-2016

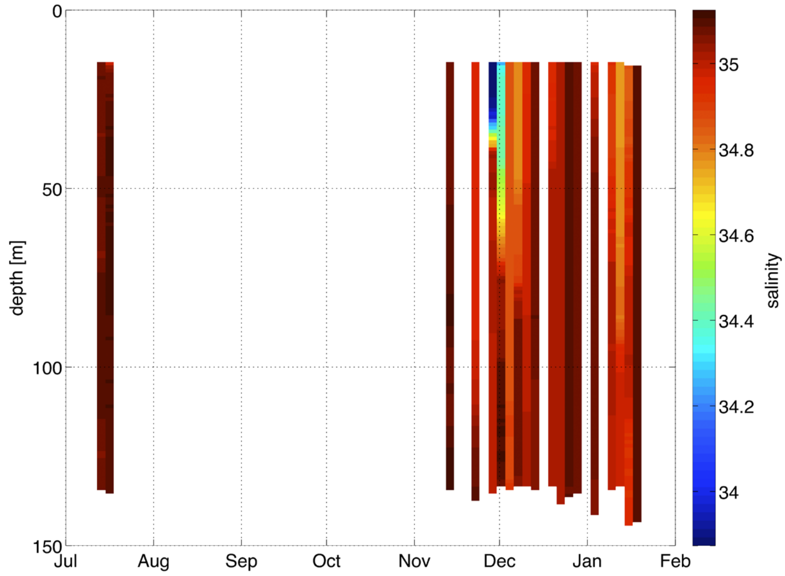


Fig. 5.9: Same as Fig. 5.8, but for salinity

Data management

The raw sensor data and sample schedules collected on PS107 are archived at Pangaea. The sensor configuration of the recovered and deployed moorings is documented on sensor.awi.de. When the data has been processed, it will be made available on Pangaea as well. The unrestricted availability from Pangaea will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

6. PELAGIC FOOD WEB: INTERACTIONS WITH THE BIOLOGICAL PUMP

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Grant No. AWI_PS170_06

Objectives and scientific program

Our main objective during the cruise was to study the controlling mechanisms for attenuation and export of organic carbon flux through the water column. This was done by detailed investigations of particle dynamics in relations to plankton community structure and aggregate composition. We did this by looking at both large and small scale, i.e. on a whole water perspective using *in-situ* optics and drifting traps on short time-scale or by using our BioOptical Platform for long-term patterns in aggregate size-distribution and abundance. The small scale studies were done on individual aggregates collected in from different depths through the water column.

Work at sea and first preliminary results

a) In-situ long-term monitoring of abundance, size-distribution, sinking velocity of settling aggregates

During the *Polarstern* cruise PS99-2 we re-deployed the prototype of the BioOptical Platform (BOP) on the FEVI-34 mooring at the HG-IV station. We developed the BOP system to be able to follow aggregate dynamics at high temporal resolution at different seasons throughout a whole year. BOP uses an *in-situ* camera system to determine daily size-distribution, abundance and size-specific sinking velocities of settling particles at one particular depth throughout one year (during the FEVI-34 deployment it was at 1,200 m). This is done by having a settling cylinder where particles sink through. At the bottom part of the settling cylinder we have attached a perpendicular camera system that records 5 minutes image sequences daily. At the bottom of the settling cylinder we attached a rotation table with 20 collection cups so each cup could be placed under the settling column for a pre-determined collection period (Fig. 6.1, Table 6.1). The cups are filled with a viscous gel which preserves the size and three dimensional structures of particles sinking into the gel. This makes it possible to identify and quantify different particle types as well as their compositions.

The BOP system was based on a modified sediment trap (KUM GmbH) where the collection funnel was replaced with a polycarbonate cylinder to avoid that the settling particles were sliding/rolling down the sides of the funnel, which may alter their physical structure. The polycarbonate cylinder has an inner diameter of 35 mm and functions as a settling cylinder that excludes ocean currents while the particles settling through it (Fig. 6.1). The camera system placed at the lower part of the settling cylinder consisted of an industrial camera (Basler), a fixed focal length lens (Edmund Optics) and a single board computer including a SSD hard disc and custom made power and time management circuitry. The images were illuminated by a custom made visible light source providing backlight. The whole camera system was powered by a Li-Ion battery (24V, 1670Wh, SubCTech GmbH) (Fig. 6.2).

Fig. 6.1: The old BOP system deployed during PS99-2 and recovered during PS107 with the polycarbonate settling column and camera illumination switched on (left image) and the rotation table with collection cups (right image). The large cups are for long collection periods and the small black cup are filled with viscous gel for short period collection.

Recovery of the BOP at FEVI-34, HG-IV (deployed during PS 99-2)

During this cruise (PS107), we recovered the BOP system at the FEVI-34 mooring at station HG-IV (PS107_3-2) on the 27 July 2017. The cups had all rotated through to the last cup and all contained material. From this we could confirm that the BOP system was able to capture settling particles at all seasons.

The camera system captured 5 min of images every second day from the 11 July 2016 and until 18 March 2017, which resulted in 122 days of image sequences. This premature end of image sequence collections was caused by earlier drainage of the Li-battery due to failure on the power module manager (PMM). We have replaced the PMM on all BOP systems and should not have these issues any longer.

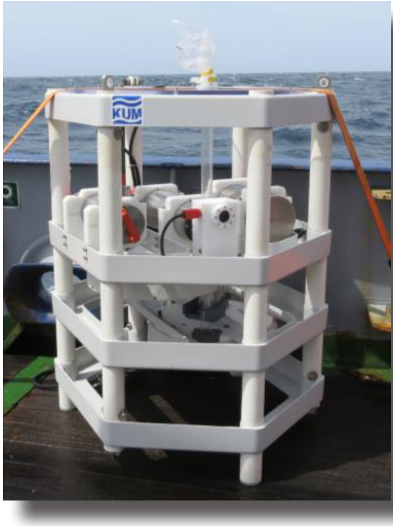
Tab. 6.1: Programming of the of the BOP system deployed during PS99-2 and recovered during PS107. Periodical measurements by the camera system for 5 minutes every second day and opening times for each of the 20 gel cups.

CUP [#]	Date [YYYY-MM-DD]	Time [HH:MM:SS]	Remarks
	2016-07-11	12:00:00	Camera: auto start, 1 image per second for 5 minutes, auto shutdown, THIS PROCEDURE WILL BE REPEATED EVERY SECOND DAY WITHOUT END DATE
21	--	--	Empty hole for the deployment
1	2016-07-14	00:05:00	Trap: First gel cup
2	2016-08-15	00:05:00	Trap: Next gel cup
3	2016-08-18	00:05:00	Trap: Next gel cup

CUP [#]	Date [YYYY-MM-DD]	Time [HH:MM:SS]	Remarks
4	2016-08-31	00:05:00	Trap: Next gel cup
5	2016-09-02	00:05:00	Trap: Next gel cup
6	2016-09-30	00:05:00	Trap: Next gel cup
7	2016-10-02	00:05:00	Trap: Next gel cup
8	2016-10-31	00:05:00	Trap: Next gel cup
9	2016-11-02	00:05:00	Trap: Next gel cup
10	2016-12-24	00:05:00	Trap: Next gel cup
11	2016-12-27	00:05:00	Trap: Next gel cup
12	2017-02-28	00:05:00	Trap: Next gel cup
13	2017-03-02	00:05:00	Trap: Next gel cup
14	2017-03-31	00:05:00	Trap: Next gel cup
15	2017-04-02	00:05:00	Trap: Next gel cup
16	2017-04-17	00:05:00	Trap: Next gel cup
17	2017-04-20	00:05:00	Trap: Next gel cup
18	2017-05-04	00:05:00	Trap: Next gel cup
19	2017-05-07	00:05:00	Trap: Next gel cup
20	2017-05-10	00:05:00	Trap: Last gel cup
21	2017-08-07	00:05:00	Empty cup hole for recovery

Deployment of the BOP system at FEVI-36 (deployed during PS107)

We deployed a new version of the BOP system, which was equipped with two rotating tables and capable of collecting sinking particles in 40 gel-cups (Fig. 6.2). The camera system was similar to that described above. We deployed the BOP system on the FEVI-36 mooring at station PS107_38-2 on the 11 August 2017 at 79°00.01’N and 04°20.02’E. Please see further information about the mooring under the mooring cruise report. We timed the cup openings according to the deep ocean sediment traps on the same mooring, but ensured that we would have several gel cups with only three days of opening period at each collection period of the deep ocean sediment traps (Table 6.2). This was to ensure that we would not have particles falling on top of each other, which would prevent of from doing image analyses on the particles collected in the gel traps. We programmed the camera for measurements of particle type, size-distribution, abundance, and sinking velocities to switch on daily at 12:00 (UTC) and capture one image every four seconds for 31 minutes.



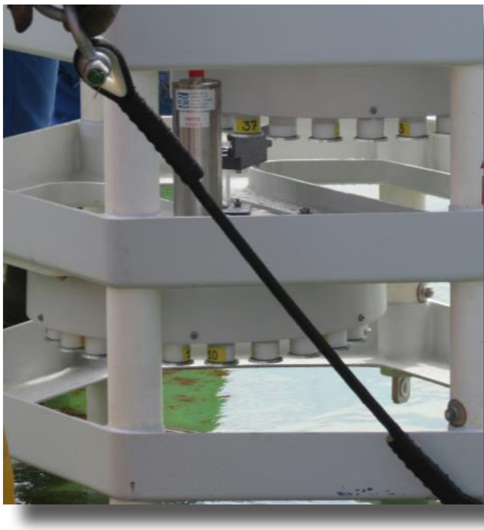


Fig 6.2: The new BOP system with the polycarbonate settling column (left image) and the two rotation tables (right image)

Tab. 6.2: Programming schedule for the deployment of the BOP system [TIME, event number, date, time, rotation table].

TIME; 1; 12-08-2017/00:00:00; 1	TIME; 21; 03-02-2018/00:00:00; 1
TIME; 2; 21-08-2017/00:00:00; 1	TIME; 22; 03-02-2018/00:10:00; 2
TIME; 3; 24-08-2017/00:00:00; 1	TIME; 23; 28-02-2018/00:10:00; 2
TIME; 4; 31-08-2017/00:00:00; 1	TIME; 24; 03-03-2018/00:10:00; 2
TIME; 5; 03-09-2017/00:00:00; 1	TIME; 25; 31-03-2018/00:10:00; 2
TIME; 6; 10-09-2017/00:00:00; 1	TIME; 26; 03-04-2018/00:10:00; 2
TIME; 7; 13-09-2017/00:00:00; 1	TIME; 27; 15-04-2018/00:10:00; 2
TIME; 8; 20-09-2017/00:00:00; 1	TIME; 28; 18-04-2018/00:10:00; 2
TIME; 9; 23-09-2017/00:00:00; 1	TIME; 29; 30-04-2018/00:10:00; 2
TIME; 10; 30-09-2017/00:00:00; 1	TIME; 30; 03-05-2018/00:10:00; 2
TIME; 11; 03-10-2017/00:00:00; 1	TIME; 31; 15-05-2018/00:10:00; 2
TIME; 12; 15-10-2017/00:00:00; 1	TIME; 32; 18-05-2018/00:10:00; 2
TIME; 13; 18-10-2017/00:00:00; 1	TIME; 33; 31-05-2018/00:10:00; 2
TIME; 14; 31-10-2017/00:00:00; 1	TIME; 34; 03-06-2018/00:10:00; 2
TIME; 15; 03-11-2017/00:00:00; 1	TIME; 35; 15-06-2018/00:10:00; 2
TIME; 16; 30-11-2017/00:00:00; 1	TIME; 36; 18-06-2018/00:10:00; 2
TIME; 17; 03-12-2017/00:00:00; 1	TIME; 37; 30-06-2018/00:10:00; 2
TIME; 18; 31-12-2017/00:00:00; 1	TIME; 38; 03-07-2018/00:10:00; 2
TIME; 19; 03-01-2018/00:00:00; 1	TIME; 39; 15-07-2018/00:10:00; 2
TIME; 20; 31-01-2018/00:00:00; 1	TIME; 40; 18-07-2018/00:10:00; 2
	TIME; 41; 31-07-2018/00:10:00; 2

b) Marine snow catcher

We deployed 26 marine snow catchers (MSC) to collected *in-situ* formed marine snow.

Fig. 6.3: The marine snow catcher was deployed via the ship's winch system and lowered to a specific depth, whereafter it was closed by a messenger weight and releaser. After recovery the MSC was positioned up-right on deck to allow the particles to settle to the bottom part of the MSC.

The MSCs consisted of a 100 l cylindrical water sampler with a particle collection tray at the bottom (Fig. 6.3, Table 6.3). The MSCs were deployed with a winch to the target depth and closed via a release mechanism that was activated with a drop weight. The closed MSCs were placed on deck for a few hours to allow the collected particles to sink to the collection tray at the lower part of the MSCs. We gently drained the water from the 100 l cylinder and removed the collection tray, which now contained the settling particles.

We used the collected aggregates to determine their size-specific sinking velocities, microscopical observations of the aggregate composition, and made filtrations for DNA. The sinking velocities were determined using a video setup in a temperature controlled cooling room. The aggregates were individually placed in an aquarium with a length and depth of 10 cm and a height of 25 cm. The aquarium was closed with a lid to avoid evaporation and convection in the aquarium. The lid had a small hole that allowed us to place individual aggregates at the top part of the aquarium. We made stack images of individual aggregates from each station using a microscope. These images provide a detailed semi three dimensional composition of the aggregates (Fig. 6.4).

Tab. 6.3: Deployments of the marine snow catcher with information about station name, MSC number, date of deployment, time for deployment, latitude, longitude, and deployment depth.

Station name	MSC #	Date	Time [UTC]	Latitude	Longitude	Depth [m]
PS107_2-2	MSC 1	26.07.2017	01:30	78°36.22'N	05°00.53'E	60
PS107_2-3	MSC 2	26.07.2017	01:48	78°36.24'N	05°00.48'E	60
PS107_6-4	MSC 3	27.07.2017	20:48	79°03.88'N	04°10.71'E	100
PS107_6-4	MSC 4	27.07.2017	21:13	79°03.87'N	04°10.52'E	50
PS107_10-2	MSC 5	29.07.2017	16:30	78°58.63'N	02°29.51'E	100
PS107_12-1	MSC 6	30.07.2017	00:36	78°56.67'N	02°41.87'E	50
PS107_14-3	MSC 7	30.07.2017	13:09	78°55.54'N	02°51.16'E	100
PS107_16-1	MSC 8	30.07.2017	20:44	79°00.24'N	02°16.38'E	100
PS107_18-1	MSC 9	31.07.2017	03:54	78°59.20'N	02°45.00'E	100

Station name	MSC #	Date	Time [UTC]	Latitude	Longitude	Depth [m]
PS107_19-2	MSC 10	31.07.2017	14:13	79°03.54'N	03°29.04'E	50
PS107_20-4	MSC 11	01.08.2017	09:11	79°07.94'N	02°50.00'E	100
PS107_20-4	MSC 12	01.08.2017	09:27	79°08.00'N	02°50.22'E	50
PS107_22-2	MSC 13	03.08.2017	01:22	78°48.84'N	02°44.13'W	100
PS107_22-2	MSC 14	03.08.2017	01:40	78°48.81'N	02°44.31'W	50
PS107_29-2	MSC 15	06.08.2017	02:01	78°59.82'N	05°28.97'W	60
PS107_29-3	MSC 16	06.08.2017	02:16	78°59.81'N	05°28.97'W	100
PS107_33-2	MSC 17	07.08.2017	21:21	79°44.06'N	04°31.53'E	100
PS107_33-2	MSC 18	07.08.2017	21:34	79°43.92'N	04°32.18'E	50
PS107_42-2	MSC 19	11.08.2017	22:59	79°07.85'N	04°54.14'E	100
PS107_42-2	MSC 20	11.08.2017	23:13	79°07.85'N	04°54.13'E	50
PS107_43-3	MSC 21	12.08.2017	16:02	79°08.48'N	06°06.33'E	100
PS107_43-4	MSC 22	12.08.2017	16:15	79°08.53'N	06°06.01'E	50
PS107_45-4	MSC 23	14.08.2017	03:08	79°00.22'N	08°22.25'E	100
PS107_45-5	MSC 24	14.08.2017	03_23	79°00.27'N	08°22.20'E	50
PS107_48-4	MSC 25	15.08.2017	01:05	79°01.65'N	11°05.76'E	100
PS107_48-4	MSC 26	15.08.2017	01:17	79°01.66'N	11°05.66'E	50

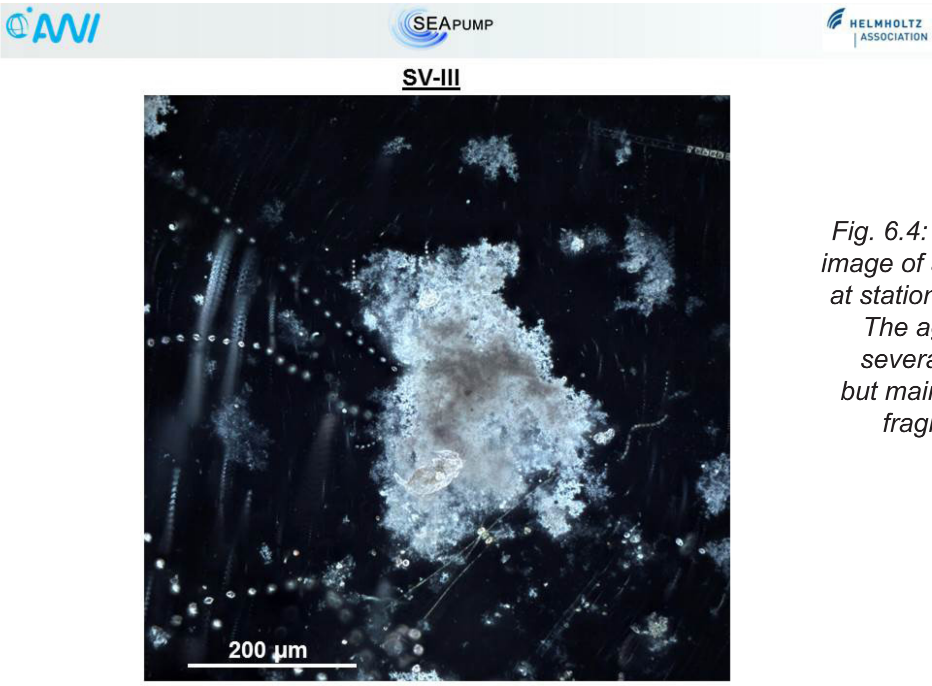


Fig. 6.4: Example of a stacked image of an aggregate collected at station SV-III near Svalbard. The aggregate contained several chains of diatoms but mainly consisted of small fragments of diatoms.

c) Drifting sediment traps

We used an array of free-drifting sediment traps to measure the export fluxes at 100 m, 200 m, and 400 m depth (Table 6.4, Fig. 6.5). Each collection depth had a trap station that consisted of four cylindrical collection tubes with a gyroscopical attachment (Fig. 6.5). Three of the four collection cylinders at each depth were used to collect samples for biogeochemical measurements of total dry weight, particulate organic carbon, particulate organic nitrogen, particulate inorganic carbon, and silica. The fourth trap cylinder at each depth was equipped with a viscous gel that preserved the structure, shape and size of the fragile settling particles (Fig. 6.6). After recovery of the drifting trap, the samples for bulk fluxes were frozen for later analysis in the home laboratory. The particles collected in the gel traps were photographed with a digital camera on board and frozen for further detailed investigations in the home laboratory. The image analyses of the gel traps will be used to determine the composition, abundance and size distribution of the sinking particles.

We deployed the drifting trap six times during the PS107 cruise. The drifting array consisted of a surface buoy equipped with an Iridium satellite unit the provided trap positions every 10 minutes with a resolution of two minutes, we used two benthos floats for buoyancy and 14 small buoyancy balls were placed between the surface buoy and the two benthos floats to act as wave breakers and thereby reducing the hydrodynamic effects on the sediments traps. The trap cylinders were mounted to a sediment station with gimbal mounts ensuring that they were maintaining a vertical position in the water column. Each cylinder was 1 m tall and had a diameter 10.4 cm, which resulted in a collection area of 84.95 cm^2.

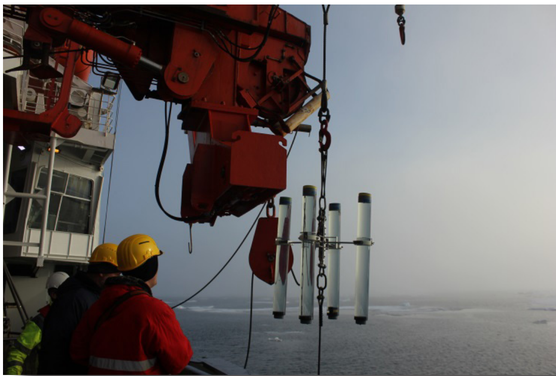


Fig. 6.5: Images of the free-drifting sediment trap close to the ice edge at East-Greenland (left). One of the trap stations with the four sediment trap cylinders (right).

Tab. 6.4: Deployments of the free-drifting sediment trap with information about station name, date of deployment, time for deployment and recovery, as well as latitude and longitude for deployment and recovery (see comments). The recovery of FDF10 did not get any ship's station number.

Station name	Date	Time [UTC]	Latitude	Longitude	Comments
PS107_6-2	27-07-2017	15:49	79°03.86'N	4°12.65'E	Deployment FDF9
PS107_6-14	28-07-2017	16:55	78°57.08'N	4°21.00'E	Recovery FDF9
PS107_10-1	29-07-2017	15:46	78°58.34'N	2°29.85'E	Deployment FDF10
No Station #	30-07-2017	09:13	78°59.02'N	2°52.95'E	Recovery FDF10
PS107_14-2	30-07-2017	12:39	78°55.64'N	2°51.78'E	Deployment FDF11
PS107_18-6	31-07-2017	09:52	79°08.59'N	3°11.99'E	Recovery FDF11
PS107_22-8	03-08-2017	13:20	78°49.08'N	2°44.56'V	Deployment FDF12
PS107_26-1	04-08-2017	15:25	79°01.24'N	3°00.09'V	Recovery FDF12
PS107_33-10	08-08-2017	13:19	79°44.05'N	4°34.00'E	Deployment FDF13

Station name	Date	Time [UTC]	Latitude	Longitude	Comments
PS107_35-2	09-08-2017	18:49	79°54.19'N	5°23.23'E	Recovery FDF13
PS107_44-2	13-08-2017	10:58	79°01.98'N	6°57.81'E	Deployment FDF14
PS107_46-1	14-08-2017	10:12	79°01.75'N	6°22.76'E	Recovery FDF14

Four of the six trap deployments were equipped with gel traps. These were at HAUSGARTEN central stations (HG-IV), the East-Greenland station (EG-III), the HAUSGARTEN North station (N4), and the Svalbard station (SV-III). We deployed two further drifting trap during a survey of front system between the HAUSGARTEN central region and the East-Greenland stations. However, since we needed to deploy two drifting trap directly after each other, we only had two collection cylinders at each collection depth and decided use both collection cylinder for biogeochemical analyses in order to have enough material.

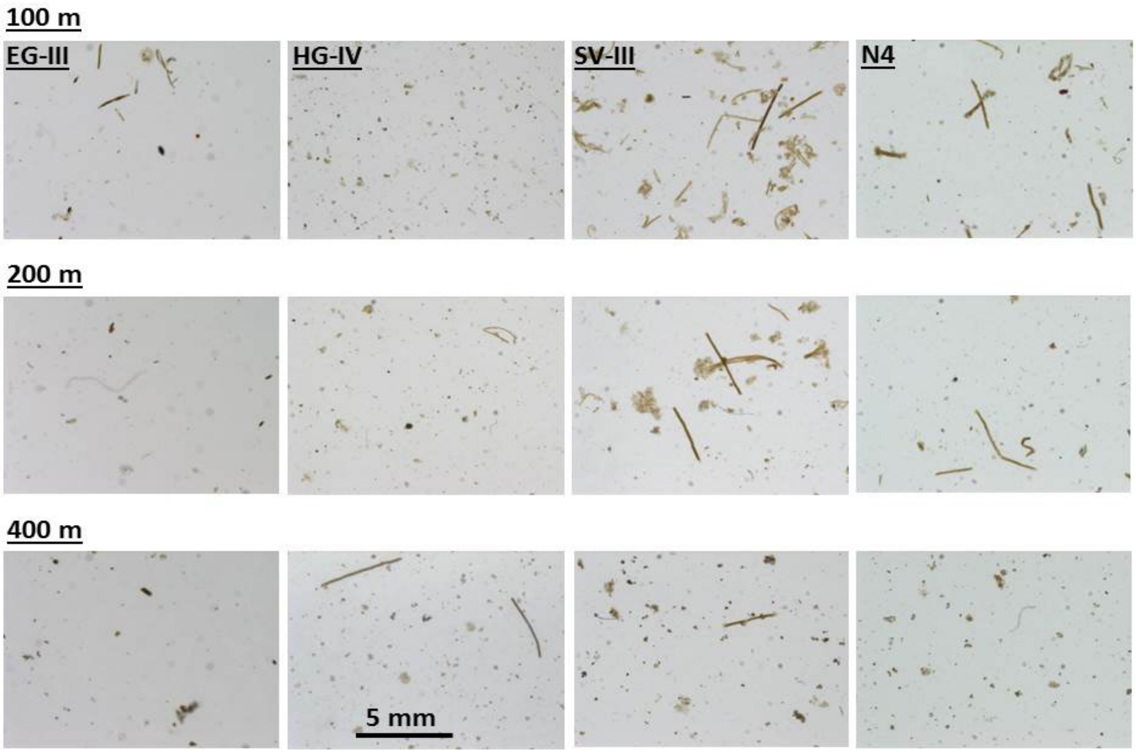


Fig. 6.6: Examples of the particles collected in the gel traps at 100 m, 200 m, and 400 m at the four stations: East-Greenland (EG-III), Central Hausgarten (HG-IV), Svalbard station (SV-III), and the northern station (N4).

The gel trap collections showed that the composition of sinking particles were different at the four stations (Fig. 6.6). At the East-Greenland station (EG-III) we mainly collected copepod fecal pellets at 100 m, while the most frequent particles were dense amphipod fecal pellets at the two deeper depths. At the central HAUSGARTEN station, we mainly observed small dense aggregates composed of degraded fecal pellets and few copepod and krill fecal pellets at the deeper depths (200 m and 400 m). The differences between the HAUSGARTEN central station (HG-IV) majority of the settling particles consisted of marine snow and fecal pellets. Both the northern station (N4) and the station close to Svalbard (SV-III) had many copepod and krill fecal pellets sinking through 100 m and 200 m depths, while the 400 m traps mainly showed small aggregates composed of degraded fecal pellets (Fig. 6.6).

d) Vertical profiles with the In Situ Camera system

The In Situ Camera (ISC) consisted of an industrial camera with removed infrared filter (from Basler) with backend electronics for timing, image acquisition and storage of data and a fixed focal length lens (16 mm Edmund Optics). Furthermore a DSPL battery (24V, 38Ah) was used to power the system (Fig. 6.7).

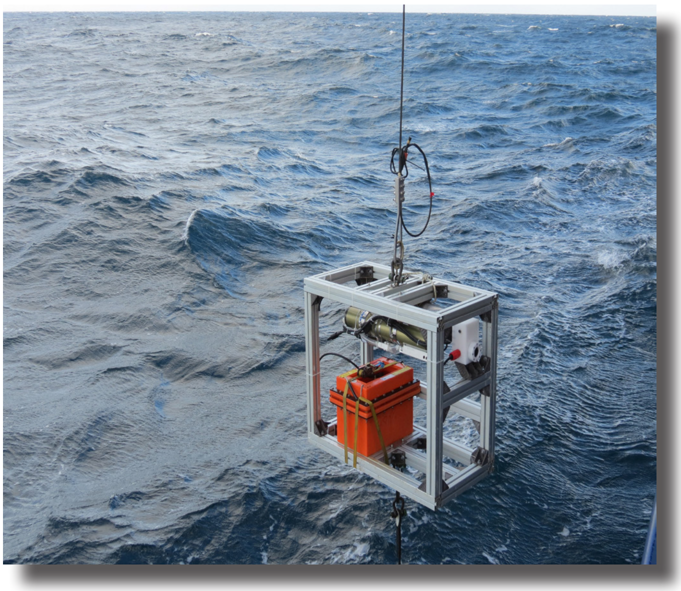


Fig. 6.7: Deployment of the In Situ Camera (ISC), consisting of an industrial camera and lens with electronics, an infrared light source, the DSPL battery and a Seabird SBE19 CTD.

A single board computer was both used as the operating system for the infrared camera and to acquire the images from the camera and send them to a SSD hard drive where they were stored. The illumination was provided by a custom made light source that consisted of infrared LEDs which were placed in an array in front of the camera. The choice of the infrared illumination was done to avoid disturbing the zooplankton that potentially would feed on the settling particles. With this geometrical arrangement of the camera and the light source we obtained shadow images of particles through the water column. We captured 2 images per second and lowered the ISC with 0.3 meters per second (lowest possible speed of winch).

Sampling: we made 24 vertical profiles with the IR-Camera. Profile 01 (just to10 m) was used for calibration. We had some hardware issues during the sixth profile, which led to data loss during this profile. However, we could fix the problem quite fast and so we could repeat this profile. On the camera frame also a Seabird SBE19 CTD was mounted. With a, better correlation of depth and images can be achieved. During the whole cruise both instruments were used in standalone mode and data was then afterwards correlated with Matlab.

With that we got 22 successful profiles (9 x 500 m, 1 x 730 m, 1 x 900 m, 11 x 1,000 m,). An overview of all measured profiles can be found in Table 6.5.

Tab. 6.5: List of stations where the *in-situ* Camera (ISC) was deployed in the profiling mode (Wdepth is water depth and Pdepth is profile depth).

Profile No.	Station No	Date	Start Time	Lat	Lon	Water depth [m]	Profile depth [m]
0	PS107_2_12	26/07/2017	09:40:17	78°36.548‘N	005°02.924‘E	2344	10
1	PS107_2_12	26/07/2017	09:48:30	78°36.548‘N	005°02.924‘E	2344	1000
2	PS107_6_5	27/07/2017	21:25:00	79°03.837‘N	004°10.442‘E	2469	1000
3	PS107_5_15	28/07/2017	17:31:58	78°56.872‘N	004°20.961‘E	2680	500

Profile No.	Station No	Date	Start Time	Lat	Lon	Water depth [m]	Profile depth [m]
4	PS107_10_3	29/07/2017	16:44:40	78°58.613'N	002°29.448'E	2429	500
5	PS107_12_2	30/07/2017	00:49:18	78°56.678'N	002°41.943'E	2399	500
6	PS107_14_4	30/07/2017	13:22:40	78°55.544'N	002°51.177'E	2382	500
7	PS107_14_7	30/07/2017	15:30:54	78°55.793'N	002°51.298'E	2376	500
8	PS107_16_2	30/07/2017	21:00:27	79°00.140'N	002°15.190'E	2459	500
9	PS107_18_2	31/07/2017	04:15:46	78°59.218'N	002°44.715'E	2405	500
10	PS107_18_7	31/07/2017	10:35:17	79°09.052'N	003°11.087'E	5256	500
11	PS107_20_3	01/08/2017	07:02:42	79°07.979'N	002°49.726'E	5574	1000
12	PS107_22_3	03/08/2017	01:52:14	78°48.740'N	002°44.603'W	2603	1000
13	PS107_24_2	03/08/2017	23:26:00	78°51.309'N	003°56.362'W	1993	1000
14	PS107_27_1	04/08/2017	16:25:59	79°01.884'N	003°00.401'W	2419	500
15	PS107_28_2	05/08/2017	05:05:17	78°56.001'N	004°38.070'W	1555	1000
16	PS107_29_4	06/08/2017	02:31:29	78°59.764'N	005°28.986'W	977	900
17	PS107_33_3	07/08/2017	21:43:31	79°43.824'N	004°32.585'E	2779	1000
18	PS107_35_3	09/08/2017	19:17:38	79°45.188	005°24.409'E	1599	1000
19	PS107_42_3	11/08/2017	22:24:49	79°07.835'N	004°54.169'E	1542	1000
20	PS107_43_5	12/08/2017	16:27:14	79°08.696'N	006°05.562'E	1295	1000
21	PS107_44_5	13/08/2017	13:58:40	79°02.018'N	007°00.026'E	1308	1000
22	PS107_45_3	14/08/2017	01:43:03	79°00.229'N	008°21.867'E	759	730
23	PS107_46_2	14/08/2017	10:49:34	79°01.830'N	006°22.141'E	1389	500

Data management

When the data has been finally processed, it will be made available on Pangaea. The unrestricted availability from Pangaea will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

7. PELAGIC FREE-LIVING AND PARTICLE-ASSOCIATED BACTERIAL AND ARCHAEAL COMMUNITIES IN FRAM STRAIT

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[3]MARUM

Grant No. AWI_PS107_07

Outline and objectives

Long-term studies at the LTER HAUSGARTEN observatory in the past two decades have revealed changes in pelagic microbial communities, *e.g.* shifts in the phytoplankton community from diatom-dominated towards *Phaeocystis*-dominated communities (Soltwedel et al., 2015). But no baseline has been established yet for bacterial and archaeal communities, in order to assess temporal changes in their structure and function as a result of changing environmental conditions. In the framework of the FRAM project, a Molecular Microbial Observatory is currently established. Within this framework, the collected samples will be used to study the composition and function of bacterial and archaeal communities of different water masses in the Fram Strait (Soltwedel et al., 2013). The work is coordinated with and linked to the sampling of eukaryotic microbial communities (see Chapter 8). In addition, samples for bacterial and archaeal community structure were collected as part of an interdisciplinary effort to understand the extent of meso-scale water column dynamics (see Chapter 4).

Sinking particulate organic matter (POM) plays a major role in linking pelagic and benthic ecosystems (De La Rocha and Passow, 2007). Sinking particles get quickly colonized by microbial communities and degraded on their way through the water column, eventually reaching the seafloor. Characterizing colonization patterns and the composition and function of bacteria and archaea on sinking particles will thus help to better understand organic matter export in different regions of Fram Strait. Our main objective during the expedition was to better understand the effect of “seed” free-living microbial communities from different water masses, on the colonization and degradation patterns of POM. An experimental set-up was complemented by sample collection of natural particles using Marine Snow Catcher (see Chapter 6).

Work at sea

Water samples for bacterial and archaeal community structure analyses will be obtained using 12L Niskin bottles housed on a rosette equipped with SBE conductivity–temperature–depth (CTD) sensors. Triplicates from each sample will be filtered using peristaltic pumps through a 0.22 µm Sterivex© filter (see Table 7.1). During the sampling of meso-scale water structures, the sampling was conducted in fractionated filtration through 5 or 3 µm nylon filters for particles-associated fraction and then 0.22 µm for the free-living fraction (see Table 7.2). Same filtration set-up was used for the Marine Snow Catcher sampling (see Table 7.3).

The particle incubation experiment was conducted for periods of 11 days each time, using freshly sampled water from distinct North Atlantic waters (AW) that were collected at station S3 from 60 m depth, and the surface Polar waters (PSW) that were collected at station EG1 from 60 m depth. In parallel to the water collection using niskin bottles, the same water masses were sampled using Marine Snow Catcher (MSC) for natural occurring particle-associated communities on marine aggregates.

Tab. 7.1: Water column samples for DNA extractions and total prokaryotic cell counts, collected at LTER HAUSGARTEN stations. DNA samples were filtered on 0.22 µm Sterivex© filters and stored at -20°C. For fluorescence *in-situ* Hybridization (FISH), samples were fixed using 2 % formaldehyde, filtered on 0.22 µm membranes and stored at -20°C.

Date	Station	Site	Latitude	Longitude	Sampled depths [m]
26.07.2017	PS107_2	S3	78° 36.59‘ N	005° 03.85‘ E	10,15,25,35,100,1000,2293
27.07.2017	PS107_6	HG4	79° 03.91‘ N	004° 11.16‘ E	10,25,30,40,55,100,300,1000,2400
01.08.2017	PS107_20	HG9	79° 07.90‘ N	002° 50.20‘ E	10,20,35,50,100,1000,2500,5500
02.08.2017	PS107_21	0E	78° 57.97‘ N	000° 00.18‘ E	10,22,35,50,100,1000
03.08.2017	PS107_22	EG4	78° 48.85‘ N	002° 44.22‘ E	10,20,40,50,100,1000,2500
05.08.2017	PS107_28	EG2	78° 56.00‘ N	004° 38.36‘ W	10,35,45,50,100,1000
06.08.2017	PS107_29	EG1	78° 59.50‘ N	005° 27.20‘ W	10,35,40,50,100,1000
07.08.2017	PS107_33	N4	79° 44.26‘ N	004° 25.33‘ E	10,20,25,35,50,100,1000,2500
08.08.2017	PS107_34	N5	79° 57.79‘ N	002° 55.99‘ E	10,20,30,40,100,1000,2500
12.08.2017	PS107_42	HG2	79° 07.84‘ N	004° 54.00‘ E	10,25,40,50,100,1000
12.08.2017	PS107_43	HG1	79° 08.48‘ N	006° 05.59‘ E	10,20,35,50,100,1000,1200
13.08.2017	PS107_44	SV4	79° 02.01‘ N	007° 00.18‘ E	10,20,30,50,100,1000
14.08.2017	PS107_45	SV3	79° 00.28‘ N	008° 21.84‘ E	10,25,40,50,100,740
14.08.2017	PS107_47	SV2	78° 59.00‘ N	009° 30.45‘ E	10,15,20,50,100
15.08.2017	PS107_48	SV1	79° 01.78‘ N	011° 06.04‘ E	10,35,40,50,100

Tab. 7.2: Water column samples for DNA extractions and total prokaryotic cell counts, collected during the meso-scale water structure survey. DNA samples were sequentially filtered on 5 or 3 and 0.22 µm filters and stored at -20°C. For fluorescence *in-situ* Hybridization (FISH), samples were fixed using 2% formaldehyde, filtered on 0.22 µm membranes and stored at -20°C. Marine Snow Catcher samples were collected in the noted stations.

Date	Station	Site	Latitude	Longitude	Sampled depth [m]
29.07.2017	PS107_10	T1	78° 58.60‘ N	002° 29.60‘ E	10,20,50,100,200,400 (MSC at 100 m)
30.07.2017	PS107_12	T2	78° 56.70‘ N	002° 42.00‘ E	10,30,50,100,200,400
30.07.2017	PS107_14	T3	78° 55.63‘ N	002° 51.06‘ E	10,30,50,100,200,400 (MSC at 100 m)
31.07.2017	PS107_16	T4	78° 00.36‘ N	002° 17.02‘ E	10,30,50,100,200,400 (MSC at 100 m)
31.07.2017	PS107_18	T5	78° 59.22‘ N	002° 45.06‘ E	10,25,50,100,200,400

Tab. 7.3: Marine Snow Catcher samples for DNA extractions, collected at LTER HAUSGARTEN stations. The samples were sequentially filtered on 5 or 3 and 0.22 µm filters and stored at -20°C.

Date	Station	Site	Latitude	Longitude	Sampled depth [m]
26.07.2017	PS107_2	S3	78° 36.59‘ N	005° 03.85‘ E	60
01.08.2017	PS107_20	HG9	79° 07.90‘ N	002° 50.20‘ E	100
03.08.2017	PS107_22	EG4	78° 48.85‘ N	002° 44.22‘ W	100
06.08.2017	PS107_29	EG1	78° 59.50‘ N	005° 27.20‘ W	60
07.08.2017	PS107_33	N4	79° 44.26‘ N	004° 25.33‘ E	100
12.08.2017	PS107_42	HG2	79° 07.84‘ N	004° 54.00‘ E	100
12.08.2017	PS107_43	HG1	79° 08.48‘ N	006° 05.59‘ E	100
14.08.2017	PS107_45	SV3	79° 00.28‘ N	008° 21.84‘ E	100
15.08.2017	PS107_48	SV1	79° 01.78‘ N	011° 06.04‘ E	100

Data management

Post-cruise data archival will be hosted by the information system PANGAEA at the World Data Centre for Marine Environmental Sciences (WDC-MARE), which is operated on a long-term base by the Alfred Wegener Institute Helmholtz-Centre for Polar and Marine Research (AWI), Bremerhaven and the Center of Marine Environmental Sciences (MARUM), Bremen. Scientific data retrieved from observations, measurements and home-based data analyses will be submitted to PANGAEA either upon publication or with password protection as soon as the data is available and quality-assessed. This includes also biological data, for most of which parameters are already defined in PANGAEA. Molecular data will be deposited in public repositories such as NCBI and ENA. Biological samples will be stored deep frozen or fixed at the Max Planck Institute for Marine Microbiology (MPIMM) in Bremen. One of the three replicates from each sample will be used for the long term biological archive of the Molecular Observatory at the Alfred Wegener Institute Helmholtz-Centre for Polar and Marine Research (AWI), Bremerhaven.

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8. FUNCTIONAL GLYCOMICS OF ALGAL BLOOMS IN THE ARCTIC OCEAN

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Grant No. AWI_PS107_08

Objectives

Marine algae are contributing to half of the global photosynthetic carbon fixation (Falkowski et al., 1998; Field et al. 1998), producing substantial quantities of reduced carbon compounds such as polysaccharides, lipids and proteins. Many algal species do not grow continuously, but in temporary blooms (Teeling et al., 2016) limited by nutrients, grazing predators and viral infections (Valiela et al., 1997). During this algal blooms, organic matter (OM) is released, which can subsequently trigger blooms of planktonic bacteria with a successions of distinct bacterial clades over time (Teeling et al., 2016, 2012). The remineralization of algal biomass by heterotrophic bacteria is an important step in the marine carbon cycle, but so far little is known about the key degraders and their enzymatic pathways.

Algal polysaccharides

Polysaccharides are composed of long chains of monosaccharides linked by glycosidic bonds. Marine algae contain large amounts of polysaccharides, ranging from 4 – 76 % of the dry weight depending on seasonal variations and algal species (Kraan, 2012). Polysaccharides physically support the thallus, have storage properties (Kraan, 2012) or are secreted as exudates. Algal polysaccharides serve as energy source for heterotrophic bacteria in form of dissolved organic matter (DOM) or they spontaneously aggregate into particles, which sink into deeper water layers (biological pump) and can serve as habitat and food source for bacteria (Passow, 2002; Verdugo et al. ,2004). One very abundant polysaccharide is laminarin, a linear β-1,3 glycan of brown algae consisting of ~ 20 to 30 glucose residues with β-1,6-linked side chains (Kraan, 2012).

Polysaccharide-degrading bacteria

Bacteria utilizing polysaccharides posses proteins specialized for carbohydrate degradation, such as sugar transporter, transcriptional regulators, and carbohydrate-active enzymes (CAZymes) including polysaccharide lyases (PL), glycoside hydrolyases (GH), carbohydrate esterases, and glycosyl transferases (Lombard et al. 2014). In the phylum Bacteroidetes, CAZymes are frequently organized in large operon like structures (Thomas et al., 2011), termed polysaccharide utilization loci (PUL) (Sonnenburg et al., 2010).

During *Polarstern* cruise PS107 (ARK-XXX1/2), we collected particulate organic matter (POM) from filtered seawater to obtain vertical profiles of laminarin concentration during an algal bloom in the Arctic Ocean by using carbohydrate active enzymes (CAZYmes) from marine heterotrophic bacteria (Becker et al., 2017). This novel method allows an accurate quantification of this important polysaccharide and therefore, serves further insights into the marine carbon cycle.

Work at sea

During the *Polarstern* cruise PS107 (ARK-XXX1/2), we took water samples by using Large Volume Water Transfer Systems(WTS-LV), also known as *in-situ* pumps, in order to obtain vertical profiles of laminarin concentration. The *in-situ* pumps were successfully deployed at seven stations (Table 8.1) in the Artic HAUSGARTEN area. The pumps were attached to the CTD rope (Fig. 8.1) and filtered approximately 300 L in 90 minutes onto 142 mm GF/F glass microfiber filters with a pore size of 0.7 µm in five different depths (surface, chlorophyll maximum, 300 m, 1,000 m, sea floor). The filters were frozen at -20°C, since we were not able to analyse them on board. Additionally, water samples were collected with a CTD/rosette water sampler at the corresponding depths of the *in-situ* pumps and stored at -20°C. To identify key heterotrophic bacteria and to study their enzymatic pathways for algal polysaccharide utilization, surface water obtained with a CTD/rosette was sampled for later DNA extraction and for fluorescence *in-situ* hybridization (FISH) in the laboratory in Bremen. FISH samples were fixed with formalin for 1 h at room temperature (RT), filtered onto 0.22 µm polycarbonate (PC) filters (Millipore) and stored at -20°C. Samples for DNA extraction were filtered onto 10 µm PC filters, 3 µm and 0.22 µm, flash frozen in liquid nitrogen and stored at -80°C.

Tab. 8.1: Deployment of *in-situ* pumps in the HAUSGARTEN area during cruise PS107

Date	Station		Latitude	Longitude	Sampling depth
27.07.2017	PS107/02-1	HGIV	78°36,487'N	05°00,480'E	Surface, Chlmax, 300 m, 1,000 m, bottom
31.07.2017	PS107/06-1	HGIX	79°7,196'N	4°11,159'E	Surface, Chlmax, 300 m, 1,000 m, bottom
02.08.2017	PS107/020-1	EGIV	78°49,255'N	02°49,254W	Surface, Chlmax, 300 m, 1,000 m, bottom
05.08.2017	PS107/029-1	EGI	78°59,387'N	05°28,609'W	Surface, Chlmax, 90 m, 300 m, bottom
08.08.2017	PS107/034-1	N5	78°58,377'N	02°55,592'E	Surface, Chlmax, 300 m, 1,000 m, bottom
10.08.2017	PS107/036-1	N3	79°35,236'N	05°10,328'E	Surface, Chlmax, 300 m, 1,000 m, bottom
12.08.2017	PS107/043-1	HGI	79°08,406'N	06°05,305'E	Surface, Chlmax, 300 m, 1,000 m, bottom

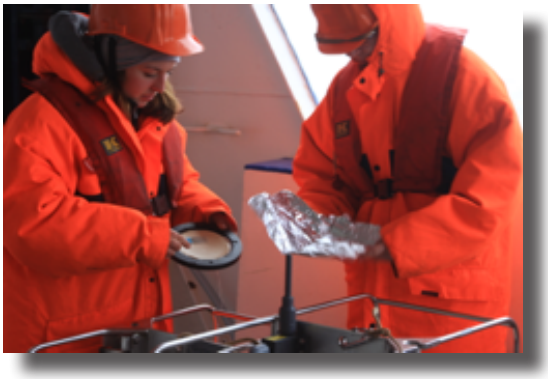
Preliminary (expected) results

For the quantification of laminarin in particulate organic carbon (POC), we will extract the polysaccharide from the filters and determine the concentration using CAZymes from marine heterotrophic bacteria (Becker et al., 2017). The data will be compared to the samples taken in 2016 during *Polarstern* cruise PS99.2. We expect high polysaccharide concentrations in the euphotic zone and a decrease with depth (Fig. 8.2).

Data management

The data will be available for cruise participants upon request and uploaded on the PANGAEA database after data processing.

A



B

Fig. 8.1: Deployment of the in-situ pumps at the CTD rope (A) and storage of filters after filtration (B)

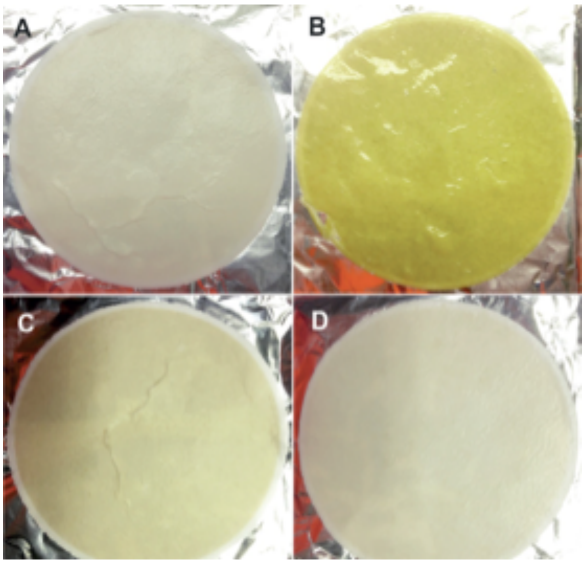


Fig. 8.2: Filtered POC from surface (A), chlorophyll maximum (B), 300 m (C) and seafloor at ~5,350 m (D) at station HG-IX

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9. PLANKTON ECOLOGY AND BIOGEOCHEMISTRY IN A CHANGING ARCTIC OCEAN (PEBCAO)

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Grant No. AWI_PS107_09

Background and Objectives

The project PEBCAO (Plankton Ecology and Biogeochemistry in a Changing Arctic Ocean) is focused on the plankton community and the microbial processes relevant for biogeochemical cycles of the Arctic Ocean. This research focus is acknowledging that the Arctic Ocean has gained increasing attention over the past years because of the drastic decrease in sea ice and increase in temperature, which is about twice as fast as the global mean rate. In addition, the chemical equilibrium and the elemental cycling in the surface ocean will alter due to ocean-acidification. These environmental changes will have consequences for the biogeochemistry and ecology of the Arctic pelagic system. The effects of changes in the environmental conditions on the polar plankton community can only be detected through long-term observation of the species and processes. Our studies on plankton ecology have started in 1991 and sampling has been intensified by the PEBCAO-team since 2009 in the Fram Strait at ~79°N. Since then our studies are based on combining a broad set of analysed parameters. This includes e.g. classical bulk measurements and microscopy, optical measurements and satellite observations, molecular genetic approaches, or cutting edge methods for zooplankton observations to study plankton ecology in a holistic approach.

Over the past eight years we have compiled complementary information on annual variability in plankton composition, primary production, bacterial activity or zooplankton composition (Nöthig et al., 2015). Previous assessments in the observation area indicated that protist composition in the WSC changed in the summer months. A dominance of diatoms was replaced by a dominance of *Phaeocystis pouchetii* and other small pico- and nanoplankton species. Our recent regular annual observations in Fram Strait suggest that TEP concentration in the observation area could be correlated with *Phaeocystis pouchetii* abundance (Engel et al., 2017). These data were complemented by our molecular genetic investigations that provided new insights into eukaryotic microbial community composition with special emphasis on the contribution of pico- eukaryotes to plankton communities (Metfies et al., 2016).

Biogeochemistry and phytoplankton

Climate induced changes will impact the biodiversity in pelagic ecosystems. At the base of the food web, we expect small algae to gain more importance in mediating element and matter turnover as well as matter and energy fluxes in future Arctic pelagic systems. In order to examine changes, including the smallest fractions, molecular methods are applied to complement traditional microscopy. The characterization of the communities with molecular methods is independent of cell-size and distinct morphological features. The assessment of the biodiversity and biogeography of Arctic phytoplankton will be based on the analysis of ribosomal genes with next generation sequencing technology, Automated Ribosomal Intragenic Sequence Analysis (ARISA), and quantitative PCR. Besides molecular methods the set of parameters investigated includes classical bulk measurements (e.g. chlorophyll a, POC/N, biogenic silica) and microscopy.

Automated sampling for molecular analyses

Marine phytoplankton distribution displays high spatial heterogeneity or “patchiness”. As a consequence, comprehensive observation of marine phytoplankton requires sampling with high spatial and temporal resolution. The latter is a labour intensive task and requires high amounts of ship time. The newly developed **auto**mated **fil**tration system for **m**arine microbes (AUTOFIM) has high potential to reduce the described effort related to adequate sampling of marine phytoplankton. It is coupled to the ships pump system and allows filtration of a sampling volume up to 5 litres. In total 12 filters can be taken and stored in a roundel. Prior to the storage a preservative can be applied to the filters to prevent degradation of the sample material, that can be used for molecular or biochemical analyses. Filtration can be triggered after defined regular time intervals or remote controlled from a scientist. Alternatively, filtration could be event-triggered if the filtration system would be operated in connection with the FerryBox System, an *in-situ* measurement device for the monitoring of oceanographic parameter (temperature, salinity, pH etc.) installed on-board *Polarstern*. AUTOFIM (Fig. 9.1) provides the technical background for automated high resolution collection of marine samples for molecular analyses (Metfies et al., 2016). During expedition PS92 of RV *Polarstern* to the Arctic Ocean in summer 2015, AUTOFIM was used for the first time to collect samples from the upper water column at a depth of ~ 10 m, which is the depth of the inlet of the ships water pump system.

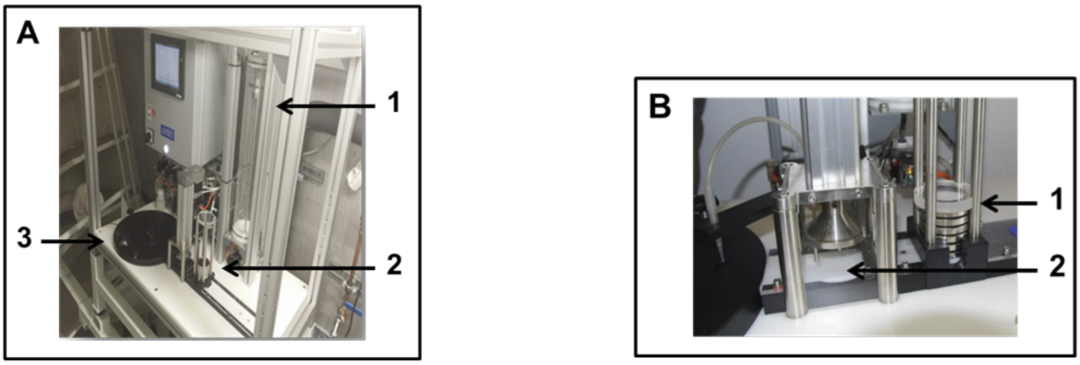

Fig. 9.1 A: AUTOFIM installed on board RV Polarstern (1: Sample reservoir; 2: Filtration; 3: Archive for preserved filters. B: Filtration-module (1: Filter stacker; 2:Filtration cap).

Optical methods for continuous data on phytoplankton community structure and colored dissolved organic matter (CDOM)

The distribution and composition of phytoplankton and CDOM in the Fram Strait are influenced by different environmental factors such as the water masses exchanges between the Arctic and Atlantic basins, the intensity of phytoplankton blooms and the riverine outflow. At this cruise we focused on collecting a high spatial and temporal resolved data set on phytoplankton biomass and composition, particulates and CDOM at the surface and for the full euphotic zone in the Fram Strait by taking continuous optical measurements which directly give information on inherent and apparent optical properties (IOPs, and AOPs, respectively). These will be validated by direct biological and chemical analysis of frequently taken water samples in order to derive information on abundance and composition of phytoplankton, other particulates and CDOM,. The whole large data set on phytoplankton and CDOM and the measurements of optical properties by radiometers at stations will also be used to validate the new Sentinel-3 sensor OLCI level-2 ocean products for high latitudes.

Bacterioplankton

The bioreactivity of particulate and dissolved organic matter is determined by its biochemical composition and diagenetic state. The loss of organic matter within and below the euphotic zone is mainly mediated by the degradation activity of heterotrophic bacteria, colonizing sinking particles and their surroundings. Hence, bacterial activity co-determines the efficiency of carbon export to the deep ocean. Furthermore, bacterioplankton plays a fundamental role at the basis of microbial foodwebs. Dissolved organic matter is almost exclusively accessible for bacterial cells that make it available for higher trophic levels by the production of bacterial biomass. Effects of increasing temperature and decreasing pH on bacterial communities and their activity are thereby of outstanding importance, but yet hardly considered. Studies conducted in the past decades revealed strong physiological responses of marine bacteria to changing temperature and pH, but their relevance for biogeochemical cycles in the future ocean is only poorly investigated.

Zooplankton

Many zooplankton species are associated with a specific water mass. For example, the boreal copepod *Calanus finmarchicus* is transported northward with the North Atlantic current whereas the sibling species *C. glacialis* inhabits Arctic water masses. Rising water temperatures and altered hydrographical conditions could therefore result in a shift in the zooplankton species composition in the Fram Strait and the Arctic ocean. Zooplankton might also be affected by a decrease in seawater pH due to uptake of anthropogenic carbon dioxide (ocean acidification). This could have severe consequences for the ecosystem functioning. To detect the impact of climate change on pelagic ecosystems of the Arctic, we studied the zooplankton community composition and depth distribution in the HAUSGARTEN area during PS99.2 and compare these with previous studies from the same area.

Work at sea

Samples for a large variety of parameters have been collected in the area of the ‘deep-sea long-term observatory HAUSGARTEN’ of the Alfred-Wegener-Institute located in the Fram Strait including the frontal zone separating the warm and cold water masses originating from the West Spitsbergen current and the East Greenland current. Sampling was accomplished by the PEBCAO team from CTD casts, sampling with the automated filtration device AUTOFIM and by net hauls is summarized in tables 9.1-9.3 .

Biogeochemistry (AG Engel)

We sampled seawater of 5-6 depths by a CTD/rosette sampler at the HAUSGARTEN area to determine the impact of microbial processes on the cycling of organic matter. Samples have been taken for dissolved biogeochemical parameters. Samples for dissolved organic carbon/ total dissolved nitrogen (DOC/TDN) and Total Alkalinity (TA) were filtered over 0.7 µm GMF syringe filters and stored at 4°C. Amino Acids and carbohydrates were samples for the dissolved fractions (DAA, DCHO, filtered over 0.45 µm Acrodisc filters) and particulate fraction (PAA, PCHO, filtered onto pre-combusted GFF filters) and stored frozen at -20°C. Concentrations will be determined by the use of IC and HPLC at GEOMAR in Kiel, respectively. At selected stations (HG-I, EG-III, N-V) a size fractionation resulted in PAA and PCHO samples for two phytoplankton size fractions (>10 µm and 10 - 0.47 µm) and bacterioplankton (<0.47 – 0.2 µm).

Additionally, samples for transparent exopolymer particles (TEP) and Coomassie stainable particles (CSP) were taken and stored at -20°C until analysis by photometry and microscopy back at GEOMAR. Bacteria and phytoplankton abundance will be determined using flow-cytometry. Samples were taken from CTD water and stored at -20°C .

Tab. 9.1: Sample List (Biogeochemical parameters sampled from CTD casts)

	Ship Station	DOC/ TDN	TA	DAA/ DCHO	TEP/ CSP	Bact/ Phyto	PAA/ PCHO	Chl.*a*/POC/N/ bSi	TPP
HG-I	43	x	x	x	x	x	x*	x	x
HG-II	42	x	x	x	x	x	x	x	x
HG-III	37	x	x	x	x	x	x	x	x
HG-IV	6	x	x	x	x	x		x	x
HG-V	7	x	x	x	x	x		x	x
HG-VI	8	x	x	x	x	x		x	x
HG-VII	19	x	x	x	x	x		x	x
HG-IX	20	x	x	x	x	x		x	x
S-III	2	x	x	x	x	x		x	x
N-III	36	x	x	x	x	x	x	x	x
N-IV	33	x	x	x	x	x	x	x	x
N-V	34	x	x	x	x	x	x*	x	x
SV-I	48	x	x	x	x	x	x	x	x
SV-II	47	x	x	x	x	x	x	x	x
SV-III	45	x	x	x	x	x	x	x	x
SV-IV	44	x	x	x	x	x	x	x	x
EG-I	29	x	x	x	x	x	x	x	x
EG-II	28	x	x	x	x	x	x	x	x
EG-III	24	x	x	x	x	x	x*	x	x
EG-IV	22	x	x	x	x	x	x	x	x
Station 0°	21	x	x	x	x	x		x	x
Front 1	10	x	x	x	x	x		x	
Front 2	12	x	x	x	x	x		x	
Front 3	14	x	x	x	x	x		x	
Front 4	16	x	x	x	x	x		x	
Front 5	18	x	x	x	x	x		x	
Transect 1	30	x	x	x	x	x	x		
Transect 2	31	x	x	x	x	x	x		

DOC: dissolved organic carbon; TDN: total dissolved nitrogen; TEP: transparent exopolymer particles; CSP: *Coomassie* stainable particles; TA: total alkalinity; DCHO: dissolved carbohydrates; DAA: dissolved amino acids; Bac: bacterial cell numbers; Phyto: phytoplankton cell numbers; PCHO: particulate carbohydrates; PAA: particulate amino acids; * stations where size fractionation for PCHO/PAA occurred. Chl.*a*: chlorophyll *a*; POC/N/bSi: particulate organic carbon, nitrogen & biogenic particulate silica; TPP: total phosphorus. In addition, Seston (TPM, total particulate matter) samples were taken at stations where sediment trap moorings were deployed (HG-IV, N4, EG-IV). Here particulate parameters were taken down to close above bottom. Samples for microscopy have been taken at all Chl.*a* stations for the upper 50 – 100m.

Phytoplankton (AG Nöthig and AG Metfies)

Seawater samples were taken at 6-12 depths by a CTD/rosette sampler in the HAUSGARTEN area to determine the impact of microbial processes on organic matter cycling. The water from the rosette was filtered for analyzing biogeochemical parameters such as chlorophyll *a (unfractionated, and fractionated on 10 µm, 3 µm and 0.2 µm)*, seston, particulate organic carbon and nitrogen (POC/N), and particulate biogenic silica (PbSi) as well as total particulate phosphorus (TPP). In addition, samples were collected for microscopy to determine phyto- and protozooplankton abundance. Furthermore, samples were collected from the top 100 m depth for molecular analyses in order to assess differences in the phytoplankton community composition and cellular activity by 18S meta-barcoding and meta-transcriptome analyses. Samples for 18S meta-barcoding analyses were fractionated by three filtrations on 10.0µm, 3.0µm and 0.2 µm filters. One additional archive sample was collected from every depth by filtration on 0.2 µm to provide a sample for future analyses methods. All samples were preserved, refrigerated or frozen at -20°C or -80°C for storage until analyses in the home laboratories (AWI, Bremerhaven).

Automated sampling for molecular analyses

During this cruise we used AUTOFIM on *Polarstern* in order to assess its applicability on board ships and to carry out filtrations with high spatial resolution in parallel to underway surveys of the physical oceanography. On one hand we collected water samples by AUTOFIM and a CTD/rosette sampler (5 depths) at 20 stations in Atlantic Water, polar water and on the Svalbard shelf. Samples were collected with AUTOFIM in parallel to the CTD/rosette sampler in order to evaluate to what extent the protist community composition in the AUTOFIM sample is representative for the protist community in the photic zone at the same sampling site. In addition we used AUTOFIM to collect samples regular intervals of 15-20 min in parallel to 10 transect studies of the underway CTD. All samples were filtered and preserved or frozen at 20°C for further molecular genetic analyses in the home laboratory.

Tab. 9.2: Sampling for Molecular Analyses (AUTOFIM: samples automatically collected for molecular analyses on a 0.4 µm filter; DNA Euk: DNA of eukaryotes; RNA Euk: samples collected a 3°C on an 0.2 µm filter; Archiv Filter: samples collected on an 0.2 µm Sterivex-filter.)

Station	AUTOFIM	DNA Euk	RNA Euk	Archive Filter
HG-I	X	X	X	X
HG-II				
HG-III				
HG-IV	X	X	X	X
HG-V				
HG-VI				
HG-VII				
HG-VIII				
HG-IX	X	X	X	X
N5	X	X	X	X
N4	X	X	X	X
N3				

Station	AUTOFIM	DNA Euk	RNA Euk	Archive Filter
EG-I	X	X	X	X
EG-II	X	X	X	X
EG_III	X	X	X	X
EG-IV	X	X	X	X
SV-IV	X	X	X	X
SV-III	X	X	X	X
SV-II	X	X	X	X
SV-I	X	X	X	X
S3	X	X	X	X

Optical methods for continuous data on phytoplankton community structure and colored dissolved organic matter (CDOM) (AG Bracher)

We continuously ran an *in-situ* hyperspectral transmission and absorption meter (AC-s, WETLabs) during the cruise for underway surface water sampling. The instrument was mounted to the surface seawater supply with a membrane and operated in flow-through mode with a time-programmed filter to allow alternating measurements of the total and CDOM+water beam attenuation and absorption (IOPs) of seawater (Fig. 9.2). Flow-control and a debubbler system ensured water flow through the instrument with no air bubbles.

To validate the AC-s measurements, we took regularly (every 3 hours) surface water samples from the AC-S outflow for pigment analysis (further processed with High Performance Liquid Chromatography (HPLC) back at AWI) and the absorption of particulate matters, phytoplankton and CDOM. The absorption of the bulk particulate matters and phytoplankton were directly measured on board using Quantitative Filter Technique Integrating Cavity Absorption Meter (QFT-ICAM) (Fig. 9.3) and CDOM absorption with Liquid Waveguide Capillary Cell system (LWCC, WPI) (Fig. 9.4).

In addition to the underway programme, a second AC-s instrument was mounted on a steel frame together with a pressure sensor and a set of hyperspectral radiometer (RAMSES sensor, TRIOS) and operated successfully during 17 CTD stations. The frame was veered down to 140 m at a speed of 0.1 m/s with stops every 5 m and heaved with a continuous speed of 0.1 m/s to allow a better collection of radiometric data. For the validation of both devices we further took samples at 5 water depths (surface, DCM, Below DCM, 75 m and 100 m) for HPLC pigment analysis, absorption of particulate matters and phytoplankton and CDOM absorption and fluorescence at 26 CTD stations in the Fram Strait. Besides, we mounted a third RAMSES sensor on the monkey deck during the whole cruise for continuous spectrally resolved measurements of down welling irradiance in air (bottom of atmosphere irradiance). The RAMSES underwater radiance and irradiance data corrected by the in-air RAMSES incoming irradiance data will be used to calculate Remote Sensing Reflectance (R_{RS}). The *in-situ* R_{RS} data obtained under clear sky will be used to validate the ESA-Sentinel-3 OLCI imaging spectrometer R_{RS} data which are used to derive information on surface biogeochemistry (phytoplankton, other particulates and CDOM). All RAMSES R_{RS} data will be used to optimize models linking those to the inherent optical properties (measured by the AC-s) and to the geophysical quantities derived from those. In addition also the chlorophyll-a (chl-a) data obtained from the HPLC measurements will be used to validate the ESA-Sentinel-3 OLCI imaging spectrometer chl-a.

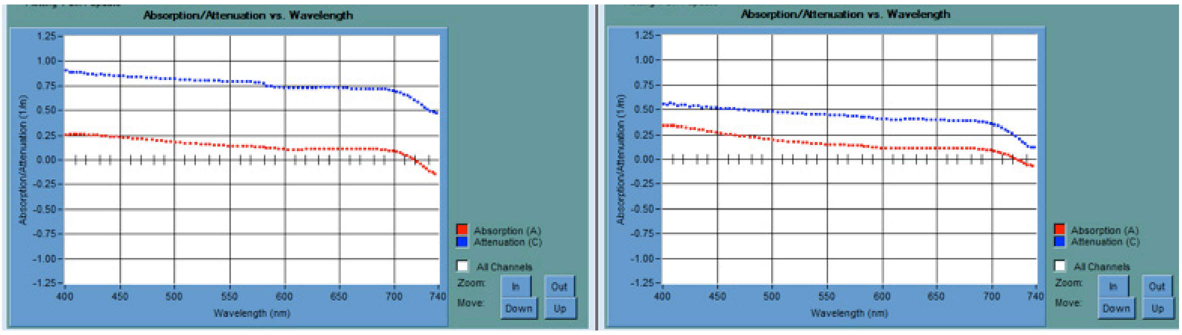

Fig. 9.2: Examples of absorption (red) and attenuation (blue) spectra acquired with the AC-S instrument

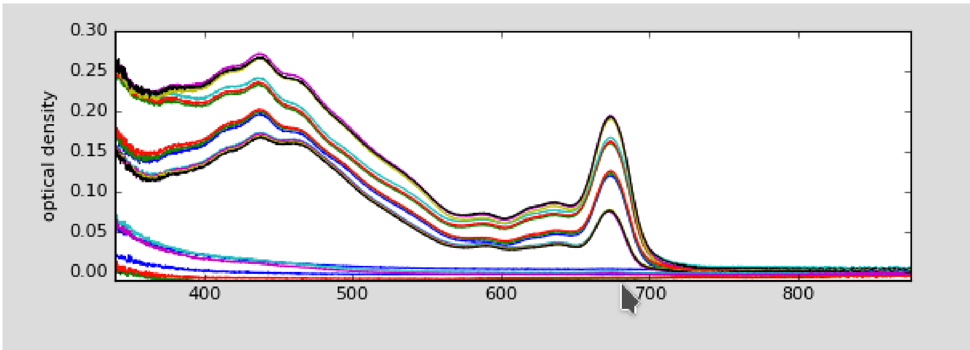

Fig. 9.3: Examples of absorption spectra of particulate matters (with peaks) and non-algal particles (without peaks) measured with the QFT-ICAM technique. The colors indicate different sample measurement.

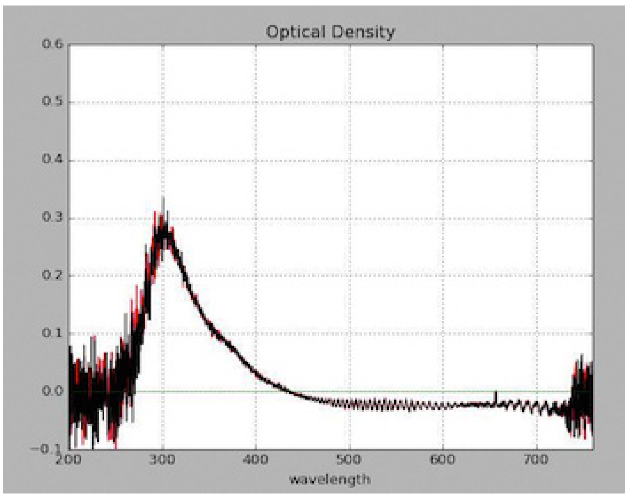

Fig. 9.4: Example of a typical CDOM absorbance spectrum obtained with the LWCC instrument

Tab. 9.3: Bio-optical parameters sampled at PS107 stations. HPLC: High Pressure Liquid Chromatography; CDOM: Coloured Dissolved Organic Matter; PAB: Particulate absorption; RAMSES: upwelling and downwelling radiation in the water.

Station	HPLC pigments	PAB	CDOM absorption	CDOM fluorescence	RAMSES
HG-I	x	x	x	x	x
HG-II	x	x	x	x	x
HG-III	x	x	x	x	
HG-IV	x	x	x	x	x
HG-V	x	x	x	x	
HG-VI	x	x	x	x	
HG-VII	x	x	x	x	x
HG-IX	x	x	x	x	x
S-III	x	x	x	x	x
N-III	x	x	x	x	x
N-IV	x	x	x	x	x
N-V	x	x	x	x	x
SV-I	x	x	x	x	x
SV-II	x	x	x	x	x
SV-III	x	x	x	x	x
SV-IV	x	x	x	x	x
EG-I	x	x	x	x	
EG-II	x	x	x	x	x
EG-III	x	x	x	x	x
EG-IV	x	x	x	x	x
Station 0°	x	x	x	x	x
Front 1	x	x	x	x	
Front 2	x	x	x	x	
Front 3	x	x	x	x	
Front 4	x	x	x	x	
Front 5	x	x	x	x	

Zooplankton (AG Niehoff)

Mesozooplankton community composition and depth distribution were investigated at 11 HAUSGARTEN stations, 2 transit stations at the 0° meridian as well as 5 stations during a frontal zone study (see chapter 4; Fig. 4.1), using three different devices. For analyzing the large-scale zooplankton distribution in the upper 1,500 m of the water column, we used a MultiNet which was equipped with 5 nets of 150 µm mesh size. The MultiNet was towed vertically at 11 stations (Fig. 9.5) to sample five different depths layers (1,500-1,000-500-200-50-0 m). The samples were then immediately preserved in formalin buffered with hexamethylentetramine. To analyse the small-scale distribution of zooplankton species in the upper 1,000 m of the water column, a combination of the optical plankton recorder LOKI (Lightframe On-sight Key species Investigation) and the acoustic device AQUAscat was deployed at 18 stations (Fig. 9.5). LOKI was taking pictures of zooplankton organisms and particles at a rate of 18 frames per second while being towed vertically through the water column. Simultaneously, depth, temperature, conductivity, oxygen content and fluorescence were recorded to relate the zooplankton abundance to the environmental conditions. The AQUAscat was mounted to the upper part of the LOKI frame, facing sideward and recording the acoustic backscatter at 0.5, 1, 2 and 4 mHz.

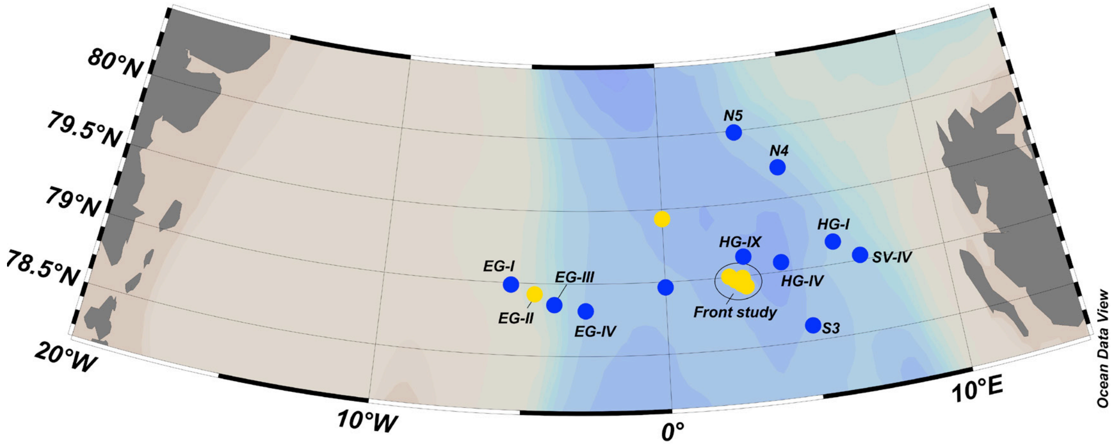

Fig. 9.5: Mesozooplankton sampling stations in the Hausgarten area. Blue dots: MultiNet + LOKI/ AQUAscat casts. Yellow dots: LOKI/AQUAscat casts.

Preliminary/expected results

Most samples will be analysed in home laboratories at AWI in Bremerhaven (biogeochemical parameters, phytoplankton abundance and molecular biology, zooplankton community composition and distribution), respectively GEOMAR in Kiel (bacterioplankton).

Zooplankton

Zooplankton abundances as roughly estimated during preservation of the Multinet samples were generally highest in the eastern part of the Fram Strait, where the relatively warm Atlantic water masses of the West Spitsbergen current prevail, and lowest in the western part, which is influenced by the cold polar water masses of the East Greenland current. At all stations, the zooplankton community was dominated by calanoid copepods. In the Atlantic domain, the boreal species *Calanus finmarchicus* was often found in large numbers from the surface down to 1,000 m depth, whereas its sibling species, the Arctic *C. hyperboreus*, was mainly found below 1,000 m. In the polar domain of the Fram Strait, *C. hyperboreus* was also found at the surface, however, in relatively low numbers. The polar species *C. glacialis* was only present close to the East Greenland shelf. Other mesozooplankton taxa that occurred regularly were chaetognaths, ostracods, amphipods, euphausiids and jellyfish.

During the frontal study, LOKI/Aquascat casts down to 500 m water depth were conducted at the centre of the frontal feature, at its rim and outside of it. A first evaluation of the LOKI pictures showed that total zooplankton abundances were about twice as high in the centre as compared to the outside.

Detailed analyses of the MultiNet samples will be done later on at the AWI laboratories using a ZooScan and a stereo microscope. LOKI data and AQUAscat profiles will be analysed at the AWI laboratories and at Polar Scientific Ltd, Scotland, respectively.

Data management

Analyses of i.e. net or sediment trap samples, require tedious and time-consuming processing (species identification and enumeration) and, therefore, these analyses will take longer than chemical measurements. Thus, depending on the parameter as well as on the methods used for the analyses, it will take up to three years to complete our analyses. As soon as the data sets are available, other cruise participants may request and use them. When the data are to be published, they will also be submitted to the PANGAEA Data Publisher for Earth & Environmental Science and are then open for external use.

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10. SENSITIVITY OF ARCTIC ZOOPLANKTON TO TEMPERATURE CHANGE: FROM ECOPHYSIOLOGICAL EFFECTS TO COMMUNITY RESPONSE

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Background and objectives

In the Arctic marginal seas, such as Fram Strait, closely related zooplankton sister species of polar vs. boreal-Atlantic origin occur sympatrically. It is expected that the polar representatives will be replaced by boreal-Atlantic congeners in the course of global climate change and warming. In order to better understand the dynamics and potential effects of this shift in species composition, species-specific sensitivities of polar vs. boreal-Atlantic species to temperature increase were determined experimentally and with molecular genetic methods.

The Arctic Ocean and adjacent ice-covered seas are the areas most rapidly and strongly affected by global warming over the coming decades. Climate models predict a rise in air temperature in the Arctic by 3 to 6°C over the coming 50 years. The temperature increase will be similar throughout the year, but with stronger effects during the summer season, when it will result in a longer and more intense melting period of the sea ice. This changes the extent, thickness and seasonal coverage of sea ice, strongly affecting not only ice-associated biota, but also pelagic communities beneath the ice.

Zooplankton are particularly suitable as indicators of environmental change due to their rapid response (generally short life-cycles), direct coupling to physical forcing (relatively passive drifters) and the fact that they are not subject to targeted harvesting, which could bias or obscure other environmental impacts. In the North Atlantic, a northward shift of several hundred kilometers of the distribution ranges of many zooplankton species has been observed with more southerly species replacing northerly relatives at higher latitudes.

Climate change induced impacts on species composition also occur in Arctic marine ecosystems. Repetitive analyses of zooplankton community structure demonstrate substantial changes in species composition and biodiversity between the 1990s and 2006, both in Fram Strait and in Svalbard fjord systems. Boreal-Atlantic species have shifted in distribution further north and now dominate plankton communities in Fram Strait. For instance, in the AWI Hausgarten sediment trap time series from 2000 to 2012, the boreal-Atlantic amphipod *Themisto compressa* only occurred from 2004 onwards. Until 2010 only older individuals were present, whereas in 2011 the presence of ovigerous females and recently hatched juveniles provided first evidence of reproductive success of this southern invader at high-Arctic latitudes.

Such changes in species composition will have a strong impact on secondary production of Arctic seas, pelagic-benthic coupling processes and sedimentation rates, in particular as most of the boreal-Atlantic species are smaller and have a lower lipid content than their polar relatives. This has profound consequences for marine food chains in the Arctic. Often the larger, more lipid-rich polar species are the preferred prey for fish and seabirds.

Different components of polar food webs will react differently to climate change and increasing Atlantic inflow. Based on model calculations, a mismatch in the timing of the phytoplankton bloom and the seasonal ascent of the dominant copepod *Calanus hyperboreus* from its hibernation depth could disrupt pelagic food chains and lead to a system dominated by microzooplankton that would not support higher trophic levels and fisheries. In contrast, other studies predict an increased zooplankton production and a better food supply for pelagic fish in conjunction with warmer sea surface temperatures. Thus, present predictions are still highly controversial and the effects of an increasing Atlantic inflow on pelagic biodiversity and productivity represent key questions for future ecological research in the Arctic. Further studies on the physiological and ecological response of key species to ocean warming and an increasing Atlantic inflow are needed to assess and forecast potential impacts of global change on marine pelagic ecosystems in Arctic seas.

During PS107, our research focused on the ecophysiology, gene activity and gene regulation of polar vs. boreal-Atlantic zooplankton sister species in order to establish at which temperature thresholds changes in zooplankton species composition will occur and what consequences they will have. In detail, we worked on the following research questions:

- How do polar and boreal-Atlantic zooplankton sister species differ in their temperature tolerance and thresholds?
- How do they differ in gene activity and gene regulation during incubations at increasing ambient temperatures?
- How do polar and boreal-Atlantic zooplankton sister species differ in lipid content, fatty acid composition and, hence, nutritional value for potential predators?
- To what extent are the different pelagic species dependent on ice algal primary production, which will diminish in the course of global warming?
- To what extent are novel eDNA sampling and analytical techniques applicable and suitable for studies on mesozooplankton distribution in the Arctic?
- How did mesozooplankton species composition in Fram Strait change over the past 20 years?

Work at sea

Mesozooplankton was sampled by stratified vertical hauls down to 1,500 m with opening and closing nets (Hydro-Bios MultiNet, 150 µm mesh size) at 17 stations. At most stations, standard depth intervals of 1,500-1,000-500-200-50-0 m were sampled to allow comparison with previous data and integration with samples collected by AWI colleagues. Macrozooplankton such as amphipods was collected by double oblique tows with a Bongo net (500 and 330 µm mesh size). Usually two successive Bongo net casts were conducted: first a shallow cast with 60 m maximum wire length and equipped with an under-water camera, thereafter a deep cast with 450 m maximum wire length. Sampling concentrated on two transects across Fram Strait at 79°N coinciding with the majority of the HAUSGARTEN stations and slightly north in order to cover the different hydrographic regimes.

Specimens of the target species were sorted immediately after the catch in a temperature-controlled lab container and used for respiration and feeding experiments onboard, incubations at increasing ambient temperatures or genetic and biochemical analyses in the home labs. The remains of the samples were preserved in formaldehyde, ethanol or RNA later for later quantitative analysis of species composition and abundance.

To establish species-specific temperature sensitivities, more than 120 respiration measurements were conducted onboard with polar and boreal-Atlantic zooplankton species at different ambient temperatures (0°C, 4°C, 8°C). Individuals were placed in gas-tight incubation bottles, filled with filtered and oxygenated sea water, and kept in a water bath in a temperature-controlled incubator usually for 24 hours. Respiration rates were recorded by high resolution optode respirometry throughout the incubation at different temperatures. In parallel, additional specimens were incubated at the same temperatures over several days in order to study differences in gene activity and gene regulation between polar and boreal-Atlantic zooplankton and potential responses in gene regulation to increasing ambient temperatures. The transcriptomic analyses will be performed in cooperation with the University of the Algarve.

In order to investigate whether the gene expression under thermal stress varies between the Atlantic *Themisto abyssorum* and the genuine Arctic *T. libellula* and within each species across its geographical range, we carried out experiments where specimens were exposed to either a gradual increase in temperature or a “heat shock”. Additional molecular genetic analyses of gene expression (transcriptomics) in the home lab will show which genes are most important for temperature acclimation in these species and whether gene expression differs interspecifically, i.e. between sister species and/or intraspecifically, i.e. between different geographic populations of the same species.

In order to establish differences in lipid content, composition and nutritional value, individuals of polar and boreal-Atlantic zooplankton species were collected and deep-frozen at 80°C onboard for determination of dry mass and lipid content at Bremen University. A quantitative assessment of the different caloric and nutritional value of polar vs. boreal-Atlantic zooplankton will help to better understand the effects of shifts in zooplankton species composition on higher trophic levels such as fish and seabirds and for the structure and secondary production of Arctic marine ecosystems in general.

In cooperation with colleagues at AWI (Barbara Niehoff, Nicole Hildebrandt), long-term changes in mesozooplankton abundance, distribution and species composition over the past 20 years will be studied. For that purpose, comparative data are available from the same region of Fram Strait collected in 1997 (ARK XIII), 2006 (MSM 02/4), and 2016 (PS100).

Preliminary (expected) results

Description of Bongo net tows at stn. HG-IV

Two bongo net casts were carried out in the vicinity of a fin whale group aggregating and feeding during an entire day near the station HG-IV. The EK60 echosounder indicated the presence of big swarms of possibly euphausiids at a depth of 170-250 m at station HG-IV, at 1.5 nm southeast of that station, in the vicinity of the whales feeding, where the Bongo hauls were carried out, the echosounder showed smaller swarms forming around 200-300 m and between 200 m and the surface. The organisms recovered with the bongo tows showed a clear bathymetric segregation with *Themisto libellula* as only dominant taxon at the surface haul (0-60 m) and *Calanus finmarchicus*, some *Thysanoessa inermis* and chaetognaths in the deeper haul (0-450 m), where *T. libellula* was much less abundant. The video recordings of the shallow haul did not show any presence of swarming euphausiids.

Mesozooplankton eDNA sampling and analysis

In order to establish whether novel environmental DNA (eDNA) sampling and analytical techniques would be applicable and suitable for studies on Arctic mesozooplankton, field sampling of *in-situ* eDNA was combined with an experimental approach to study eDNA excretion by zooplankton and eDNA degradation at different water temperatures. Water samples were taken at twelve stations from five different depths by means of a rosette water sampler attached to the CTD sonde and filtered to bind eDNA to a 0.2 µm cellulose filter. In addition, different densities of zooplankton species were incubated on board in 10 L buckets at different temperatures and their eDNA excretion monitored over several days. Thereafter, animals were removed from the buckets and the degradation of eDNA further monitored for several more days. Samples will be analysed by quantitative PCR and sequencing at the University of Bremen. Already during the cruise, a proof of principle was achieved. Zooplankton eDNA could be extracted from filters, and a PCR with specific primers showed positive results.

Data management

Data and samples to be collected during the cruise will be analysed by the cruise participants and collaborating scientists. They will also provide material for thesis projects at the Universities of Bremen and the Algarve. The results will be published within three to five years after the cruise. Geo-referenced data sets will be archived and made publicly accessible via the PANGAEA database, jointly operated by MARUM and AWI. DNA sequence data to be obtained from molecular genetic analyses will be archived and published in GenBank. Quantitative plankton samples preserved in formaldehyde or ethanol will be stored at BreMarE, Bremen University.

11. HAUSGARTEN: IMPACT OF CLIMATE CHANGE ON ARCTIC BENTHIC ECOSYSTEMS

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Grant No. AWI_PS107_11

Objectives

The Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (AWI) established the LTER (Long-Term Ecological Research) observatory HAUSGARTEN to detect and track the impact of large-scale environmental changes in the transition zone between the northern North Atlantic and the central Arctic Ocean, and to determine experimentally the factors controlling deep-sea biodiversity. Since 2014, this observatory has been successively extended within the frame of the HGF financed infrastructure project FRAM (Frontiers in Arctic marine Monitoring) and currently covers 21 permanent sampling sites on the West-Spitsbergen and East-Greenland slope at water depths between 250 and 5,500 m. Regular sampling as well as the deployment of moorings and different free-falling systems (bottom-lander) which act as local observation platforms, has taken place since the observatory was established back in 1999.

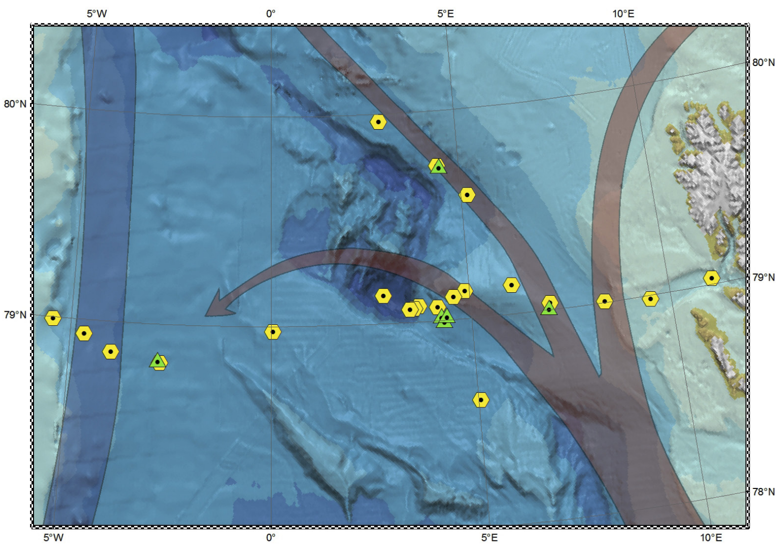

Fig. 11.1: Permanent sampling sites of the LTER Observatory HAUSGARTEN in Fram Strait (yellow markers: benthic sampling sites; green triangles: mooring sites; thick red arrows: North Atlantic Current)

During the *Polarstern* expedition PS107 investigations of the deep-sea benthos were conducted at all HAUSGARTEN stations (Fig. 11.1). The research programme covered ecosystem compartments from smallest benthic bacteria up to large epifauna within the benthic deep-sea realm. Benthic investigations comprised biochemical analyses to estimate the input of organic matter from phytodetritus sedimentation and to determine the activity and biomass of the small benthic biota. Further sediments were retrieved to study the composition of small sediment-inhabiting organisms (meiofauna). Results from these studies will help to describe the eco-status of the benthic system.

Work at sea

Biogenic sediment compounds and meiofauna

Virtually undisturbed sediment samples were taken using a video-guided multicorer (TV- MUC; Fig. 11.2). Various biogenic compounds from these sediments were analysed to estimate activities (i.e. bacterial exoenzymatic activity) and the total biomass (i.e. particulate proteins, phospholipids) of the smallest sediment-inhabiting organisms. Results will help to describe ecosystem changes in the benthal of the Arctic Ocean. Sediments retrieved by the TV-MUC will also be analysed for the quantitative and qualitative assessment of the small benthic biota (meiofauna). The uppermost five centimetres of sediments, retrieved with the MUC, were sub-sampled to analyse parameters indicating the input of organic matter to the seafloor as well as sediment-bound biomass and benthic activity. Additional samples were taken to analyse the abundance and biomass of bacteria as well as meiofauna densities and the diversity patterns of nematodes. Sediment-bound chloroplastic pigments (chlorophyll *a* and its degradation products) represent a suitable indicator for the input of phytoplanktonic detritus to the seafloor, representing the major food source for benthic organisms. They can be analysed with high sensitivity by fluorometric methods. To estimate the potential heterotrophic activity of bacteria, we measured cleaving rates of extracellular enzymes using the model-substrate FDA (fluorescein-di-acetate) in incubation experiments. Bacterial activity and chloroplastic pigments were analysed on board. All other sub-samples were stored for later analyses of various biochemical bulk parameters at the home lab.

Fig. 11.2: Sediment sampling using a video-guided multicorer (TV-MUC)

Fig. 11.3: Giant Box Corer

Spatial and temporal variations in the structure of macrofaunal benthic communities

Samples were collected from 20 stations in the region of Fram Strait (Fig. 11.1). At each station samples were collected by a Giant Box Corer (0.25 m^2 sampling area; Fig. 11.3): two subsamples for macrozoobenthos (20 cm deep samples of 0.1 m^2 surface area, samples sieved on 0.5 mm sieves and fixed with 4 % buffered formaldehyde), 6 subsamples for meiozoobentos (small cores of 10 cm^2 surface area, 5 cm deep): three preserved with 4% formaldehyde and three preserved in ethanol. Moreover, two samples for bacteria (surface sediments collected with a spoon, one samples frozen in -80ºC and one preserved in 10% formaldehyde) and three samples for sediment characteristics (small cores of 10 cm^2 surface area, 5 cm deep samples for grain size and particulate organic carbon (POC) content and 2 cm deep for photosynthetic pigments). Samples for grain size and POC were frozen in -20ºC, while samples for photosynthetic pigments were frozen in -80ºC.

Sample processing: In laboratory all metazoan organisms will be identified to the possible lowest taxonomic resolution, counted, photographed with camera connected to stereomicroscope and measured with use of digital image analysis in LAS v4.2 software. For the polychaete specimens, which were fragmented during the sample sieving, total length of the specimens will be calculated using equations of the regression between the total length and the width of a selected chaetiger (specific to the family or order; Górska et al., manuscript in preparation). Semi-automated image analysis method will be used for nematode measurements (Mazurkiewicz et al., 2016). Individual biovolumes will be converted to dry weight [µg]. Benthic biomass size spectra will be constructed by plotting the total biomass in each size class against the log2-transformed size of a class. Each individual will be classified into log2 size classes based on its dry weight [µg]. Individual biomass data will be used to calculate annual production and respiration of the studied communities. Production/biomass ratio and annual secondary production as well as mass specific respiration rate and respiration for macrofauna will be estimated using the Artificial Neural Network models as proposed by Brey (2012). Meiofaunal production and respiration will be estimated using equations published by Schwinghamer et al. (1986). Also selected sediment samples from box corer will be analysed for environmental parameters including chloroplastic pigments, organic carbon content, total nitrogen, isotopic signatures (δ13C), grain size, water content in sediments will be assessed as an indicator of sediment stability.

Preliminary (expected) results

Biogenic sediment compounds and meiofauna

Comparing the concentrations of sediment-bound Chlorophyll *a* and the potential bacterial esterase activity (Fig. 11.4) along the east-westerly transect, crossing the Fram-Strait, we detected the expected huge differences between both hemispheres. Those are superimposed by a general decrease of values with increasing water as well as sediment depth.

Upcoming analyses of additional parameters at the home laboratory will show whether the observed long-term trends at HAUSGARTEN observatory will continue and to which extend Climate Change induced processes might be responsible for the observed changes within the deep-sea ecosystem.

Spatial and temporal variations in the structure of macrofaunal benthic communities

A first inspection of the collected megafauna on board gave us the opportunity to take some nice preliminary pictures of several common species (Fig. 11.5).

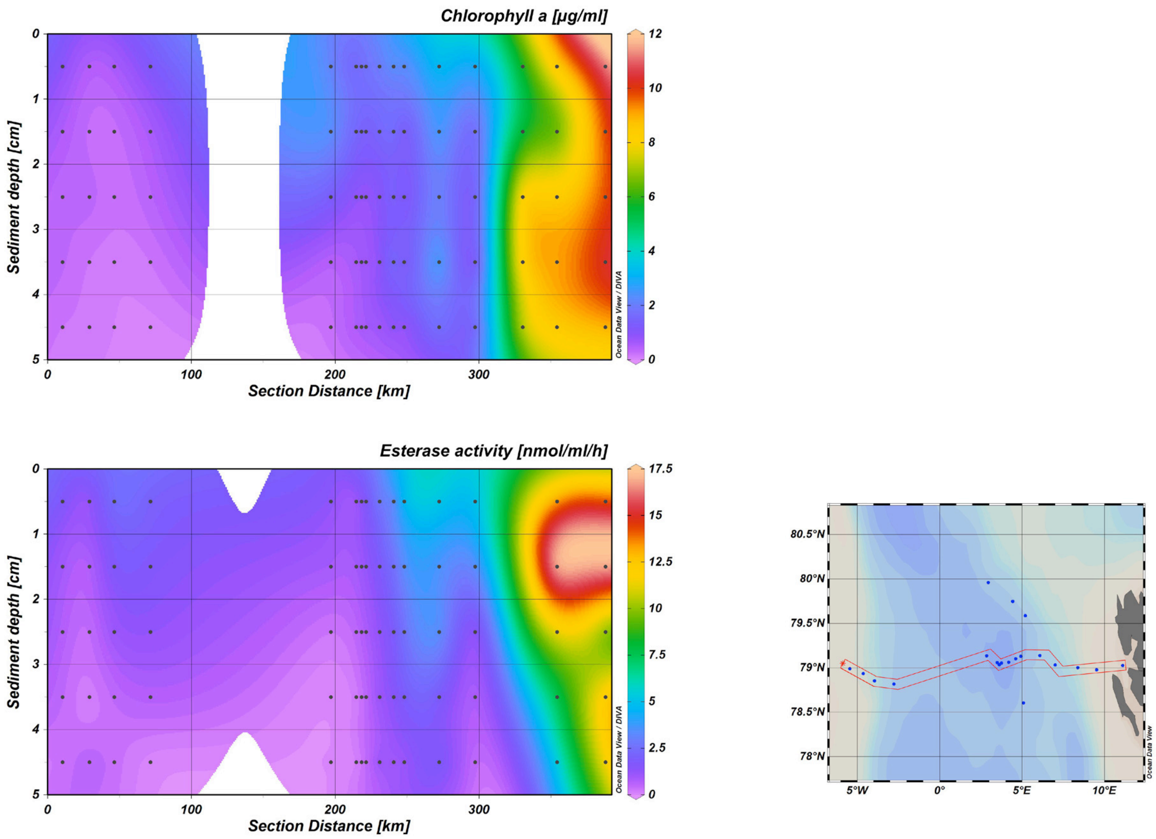

Fig. 11.4: Sediment bound Chlorophyll a and esterase activity in the upper five sediment centimetres across the Fram-Strait (transect shown on map)

Fig. 11.5: Various macrofauna species from box-corer casts (from left to right, top: Amphipoda, Diastylis sp., Ophioridea; middle: Elpidia sp., Chiton, Gastropoda; down: Polychaeta, Polychaeta, Sipunculidea)

Collected material allows us to provide an extensive (in terms of spatial and temporal ranges) assessment of structure (standing stocks and size structure) and function (secondary production, respiration and carbon demand) of the benthic component of the Arctic deep sea ecosystems. It will also provide observations of the current response to the increasing advection of Atlantic water and associated changes in productivity of the subpolar seas and the basis for the future scenarios predictions. The changes in benthic productivity will have further consequences for the carbon flow through the ecosystem and the reintroduction of the detrital carbon into the food webs, as well as sustaining the benthivorous upper trophic levels (fish and sea mammals) that can have societal and economic impacts, especially in the era of the increasing fishing activity in the opening Arctic. Increasing carbon consumption by benthic communities may also impact the levels of carbon burial in deeper sediment layers (organic carbon sequestration) which is considered to be high in the Arctic sediments (Smith et al., 2015) but can vary depending on the rate of consumption by benthic biota.

Data management

Further sample processing will be carried out at home laboratories. Data acquisition from the several types of investigation will be differently time-consuming. The time periods from post processing to data provision will vary from one year maximum for sensor data, to several years for organism related datasets. Until then preliminary data will be available to the cruise participants and external users after request to the senior scientist. The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

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12. FRAM POLLUTION OBSERVATORY: MARINE ANTHROPOGENIC LITTER AND MICROPLASTICS IN DIFFERENT ARCTIC ECOSYSTEMS

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[1]AWI

Grant No. AWI_PS107_12

Objectives and scientific programme

Marine litter has long been on the political and public agenda, as it has been recognized as a rising pollution problem affecting all oceans and coastal areas of the world. There is currently a discrepancy of several orders of magnitude between estimates of global inputs of plastic litter, with figures derived from field measurements highlighting again the question: 'Where is all the plastic?'. Degradation of larger litter items into smaller particles termed 'microplastics' may be one reason for this discrepancy. Another possibility is that certain ecosystem compartments such as water column have not been considered so far with the latest research suggesting that the Arctic is an accumulation area for marine plastic. A newly added component to the open-ocean infrastructure FRAM (FRontiers in Arctic marine Monitoring) allows for the observation of marine litter and microplastics and other pollutants in different ecosystem compartments over long time scales.

The sampling campaign during PS107 has aimed to collect samples from different marine compartments to answer these open questions. Six different sampling campaigns were executed during PS107 to assess the spatial and temporal distribution of macrolitter and microplastic. Photographic surveys undertaken by a towed camera system (Ocean Floor Observation System, OFOS) were done to observe the change of the amount of macrolitter on the seafloor. Analyses of OFOS images obtained previously at the LTER HAUSGARTEN indicates a significant increase of litter on the seafloor between 2002 and 2014 (Bergmann and Klages, 2012; Tekman et al., 2017). Recent evidence suggests high concentrations of microplastics, a degradation product of larger plastic items, in Arctic sediments (Bergmann et al., 2017). The upper layer of sediment was sampled with a Video Multi Corer for further analysis of microplastic particles in deep-sea sediment. *In-situ* pumps were deployed to get filtered water samples from different target depths of the water column. Litter was also recorded floating at the sea surface in the HAUSGARTEN area (Bergmann et al., 2015). A towed neuston microplastic catamaran was used at locations where it was feasible to tow through ice sheets to assess the amount of microplastic particles in surface waters. Visual litter surveys were done to monitor the amount of floating marine litter during the transit from/ to Tromsø and around the Fram Strait. Snow samples were taken on an ice floe to assess the role of athmospheric transport in microplastic distribution at the Arctic. This work contributes to the Pollution Observatory of the infrastructure program FRAM.

Work at sea

Seafloor

Five OFOS (Ocean Floor Observation System) transects were executed at the East Greenland (EGIV) and Hausgarten (S3, HGI, HGIV, N3) stations. 15 sediment samples were taken from multiple corer deployments along the latitudinal and bathymetric transect and frozen in tinfoil for assessments of microplastic concentrations (G. Gerdts) and analysis of other pollutants. Sediment sample from HGII was splitted into layers of 1cm to assess microplastic amounts in the layers. Sea cucumbers (*Elpidia heckeri*), starfish (*Bathybiaster vexilifer*), sea spiders (*Colloscendeis proboscidea*) and some other unidentified organisms found in sediment samples were frozen in glass jars for further analysis of microplastic in their tissues.

Water Column

Five *In-situ* pumps were deployed during deep CTD casts at 8 stations at the East Greenland (EGI, EGIV) and HAUSGARTEN (S3, HGI, HGIV, HGIX, N3, N5) to 5 depths (Near surface, chlorophyll maximum, 300m, 1000m, near seafloor) of the water column. Between 200 and 400 liter of seawater was filtrated during 1 to 2 hours of deployment.

Sea Surface

49 neuston surveys of around 1h duration were conducted to determine densities of floating litter when the ship was in transit to another station or from/to Tromsø or during underway CTD casts. 17 Volunteers took turns in shifts during the transit between Longyearbean and Tromsø. Nine samples (EGI, EGIV, S3, HGI, HGIV, HGIX, N3, N5, SVI) were taken by a neuston catamaran to determine macro- and microplastic concentrations (> 300 µm) at the sea surface. For some areas, high amount of ice sheets prevented to deploy the catamaran in the vicinity of standard HAUSGARTEN station locations. At these areas, the catamaran was deployed at the first feasible location during the transect to the next station where it was possible to tow 2-3 miles without ice sheets. Snow samples were taken during a helicopter flight to an ice floe to assess airborne transport of microplastic in the Arctic.

Preliminary (expected) results

Floating litter was observed during 34 out of 49 transects. 139 floating litter items were recorded. 130 of recorded items were plastic. The distribution of floating litter items was patchy but preliminary results showed that the transects with most items are concentrated in central Fram Strait area. Several macrolitter items was observed in catamaran samples from HGIX and SVI (Fig. 12.1).

Further analysis with (µ-) fourier transform infrared spectroscopy (FTIR) is needed to assess microplastic amounts in catamaran, snow (Fig. 12.2), sediment and *in-situ* pump (Fig. 12.3) samples.

Obvious litter items were observed during the OFOS transect at the central HAUSGARTEN station HGIV (Fig. 12.4). Possible litter items were recorded at all other sampling stations. However standard image analysis is needed to be certain whether those objects are litter items or not.

Fig. 12.1: Photos: (1, 2) Floating litter items. Credit: Kajetan Deja
Photo: (3) Catamaran sample from SVI. Credit: Mine Tekman

Fig. 12.2: Images documenting helicopter-based snow-sampling for microplastic on an ice floe Photo: (1) Sampling area. Credit: Kajetan Deja; Photo: (2) Sampling snow. Credit: Kajetan Deja

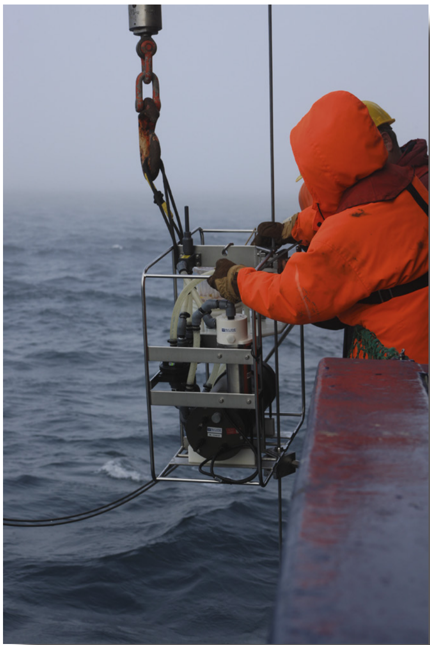

Fig 12.3: Photo: (1) Deployment of in-situ pump for microplastic analysis. Credit: Lennard Frommhold Photo: (2) Taking blank sample onboard. Credit: Mine Tekman

Data management

All OFOS images, videos and metadata will be uploaded to PANGAEA as will be data on microplastic concentration and results from neuston litter surveys. These data will also be uploaded to the online portal 'LITTERBASE' (www.litterbase.org).

Fig. 12.4: Litter items found on the seafloor during the OFOS transect at HGIV (Photos: M. Tekman/OFOS/AWI).

References

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APPENDIX

A.1 PARTICIPATING INSTITUTIONS

A.2 CRUISE PARTICIPANTS

A.3 SHIP'S CREW

A.4 STATION LIST

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

	Address
AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Postfach 120161 27515 Bremerhaven Germany
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard Nocht Str. 76 20359 Hamburg Germany
GEOMAR	GEOMAR Helmholtz Centre for Ocean Research Kiel Wischhofstr. 1-3 24148 Kiel Germany
IOPAN	Institute of Oceanology of Polish Academy of Sciences Powstańców Warszawy 55 81-712 Sopot Poland
MARUM	Zentrum für Marine Umweltwissenschaften der Universität Bremen Leobener Straße 28359 Bremen Germany
MPI-MM	Max-Planck-Institut für Marine Mikrobiologie Celsiusstr. 1 28359 Bremen Germany
UAlg	Universidade do Algarve Campus da Penha 8005-139 Faro Portugal
Uni Bremen	Universität Bremen Bibliothekstraße 1 28359 Bremen Germany

A.2 FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung Discipline
Auel	Holger	Uni Bremen	Scientist	Biology
Bäger	Jana	MPI-MM	Technician	Biology
Deja	Kajetan	IOPAN	Scientist	Biology
Enriquez	Alberto	HeliService	Technician, Helicopter	
Fadeev	Eduard	MPI-MM	Scientist	Biology
Flerus	Ruth	GEOMAR	Scientist	Biology
Frommhold	Lennard	AWI	Engineer	Biology
Gerlach	Nadine	MARUM	Student	Biology
Gischler	Michael	HeliService	Pilot, Helicopter	
Grosse	Julia	GEOMAR	Scientist	Biology
Hagemann	Jonas	AWI	Engineer	Biology
Hargesheimer	Theresa	AWI	Technician	Biology
Havermans	Charlotte	Uni Bremen	Scientist	Biology
Heckmann	Hans	HeliService	Technician, Helicopter	
Hehemann	Laura	AWI	Engineer	Oceanography
Hempelt	Juliane	DWD	Technician	Meteorology
Hildebrandt	Nicole	AWI	Scientist	Biology
Hoge	Ulrich	AWI	Engineer	Biology
Hufnagel	Lili Sanna	Uni Bremen	Student	Biology
Iversen	Morten	Uni Bremen	Scientist	Biology
Jager	Harold	HeliService	Chief Pilot, Helicopter	
Käß	Melissa	AWI	Scientist	Biology
Kieser	Jens	DWD	Scientist	Meteorology
Knüppel	Nadine	AWI	Technician	Biology
Köhler	Eva	Uni Bremen	Student	Biology
Konrad	Christian	Uni Bremen	Engineer	Biology
Krauß	Florian	Uni Bingen	Student	Biology
Kriegl	Michael	Uni Bremen	Student	Biology
LasoPerez	Rafael	MPI-MM	Scientist	Biology
Lemcke	Bianka	AWI	Student	Biology
Liu	Yangyang	AWI	Scientist	Biology

Name/ Last name	**Vorname/ First name**	**Institut/ Institute**	**Beruf/ Profession**	**Fachrichtung Discipline**
Lochthofen	Normen	AWI	Engineer	Biology
Ludszuweit	Janine	AWI	Technician	Biology
Mazurkiewicz	Mikołaj	IOPAN	Scientist	Biology
Metfies	Katja	AWI	Scientist	Biology
Murawski	Sandra	AWI	Technician	Biology
Richter	Philipp	Uni Bremen	Scientist	Physics
Sablotny	Burkhard	AWI	Engineer	Biology
Scheel	Maria	Univ. do Algarve	Student	Biology
Schewe	Ingo	AWI	Chief Scientist	Biology
Schorup-Kristensen	Vibe	AWI	Scientist	Oceanography
Seifert	Miriam	Uni Bremen	Student	Biology
Tekman	Mine	AWI	Scientist	Biology
Töller	Susanne	AWI	Student	Biology
von Appen	Wilken-Jon	AWI	Scientist	Oceanography
Wekerle	Claudia	AWI	Scientist	Oceanography
Wiegmann	Sonja	AWI	Technician	Biology
Zelm	Reinhard	MARUM	Scientist	Biology

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name	Rank
1.	Schwarze, Stefan	Master
2.	Grundmann, Uwe	Chiefmate
3.	Hering, Igor	2nd Mate
4.	Neumann, Ralph Peter	2nd Mate
5.	Langhinrichs, Moritz	Cargomate
6.	Farysch, Bernd	Chief
7.	Grafe, Jens	2nd Eng.
8.	Haack, Michael Detlev	2nd Eng.
9.	Krinfeld, Oleksandr	2nd Eng.
10.	Redmer, Jens	E-Eng.
11.	Christian, Boris	Chief ELO
12.	Frank, Gerhard	ELO
13.	Himmel, Frank	ELO
14.	Hüttebräucker, Olaf	ELO
15.	Nasis, Ilias	ELO
16.	Schmidt, Rüdiger	Ships doc
17.	Loidl, Reiner	Bosun
18.	Reise, Lutz	Carpen.
19.	Becker, Holger	MP Rat.
20.	Brück, Sebastian	MP Rat.
21.	Leisner, Bert	MP Rat.
22.	Löscher, Andreas	MP Rat.
23.	Scheel, Sebastian	MP Rat.
24.	Bäcker, Andreas	AB
25.	Hagemann, Manfred	AB
26.	Wende, Uwe	AB
27.	Winkler, Michael	AB

No.	Name	Rank
28.	Preußner, Jörg	Storek.
29.	Lamm, Gerd	MP Rat
30.	Rhau, Lars-Peter	MP Rat
31.	Schünemann, Maria	MP Rat
32.	Schwarz, Uwe	MP Rat
33.	Teichert, Uwe	MP Rat
34.	Meißner, Jörg	Cook
35.	Silinski, Frank	Cooksm.
36.	Czyborra, Bärbel	Chief Stew.
37.	Wöckener , Martina	Nurse
38.	Arendt, Rene	2nd Stew.
39.	Chen,Dansheng	2nd Stew.
40.	Dibenau, Torsten	2nd Stew.
41.	Duka, Maribel	2nd Stew.
42.	Silinski, Carmen	2nd Stew.
43.	Sun, Yong Sheng	2nd Stew.

A.4 STATIONSLISTE / STATION LIST PS107

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_0_ Underway-1	2017-07-23	15:00	69,6795	18,99655		WST	profile start	
PS107_0_ Underway-1	2017-08-15	14:29	78,3733	10,25428	135	WST	profile end	
PS107_0_ Underway-2	2017-07-24	07:29	72,2652	18,49051		ADCP_150	profile start	
PS107_0_ Underway-2	2017-08-15	14:28	78,375	10,24568	140	ADCP_150	profile end	
PS107_0_ Underway-3	2017-07-24	07:30	72,2661	18,48906		FBOX	profile start	
PS107_0_ Underway-3	2017-08-15	14:28	78,3755	10,24323	142	FBOX	profile end	
PS107_0_ nderway-4	2017-08-15	14:31	78,3672	10,28582	101	WST	profile start	
PS107_0_ Underway-4	2017-08-18	19:12	70,9059	20,89664	205	WST	profile end	
PS107_0_ Underway-5	2017-08-15	14:32	78,364	10,30201	96	PS	profile start	
PS107_0_ Underway-5	2017-08-18	19:12	70,9059	20,89664	205	PS	profile end	
PS107_0_ Underway-6	2017-07-24	07:30	72,2671	18,48764		PCO2_GO	profile start	
PS107_0_ Underway-6	2017-08-15	14:28	78,3763	10,23938	147	PCO2_GO	profile end	
PS107_0_ Underway-7	2017-07-24	07:30	72,269	18,4848		PCO2_SUB	profile start	
PS107_0_ Underway-7	2017-08-15	14:27	78,3775	10,23339	158	PCO2_SUB	profile end	
PS107_0_ Underway-8	2017-08-15	14:32	78,3653	10,29572	100	SVP	profile start	
PS107_0_ Underway-8	2017-08-18	19:12	70,9049	20,89765	205	SVP	profile end	
PS107_0_ Underway-9	2017-07-24	07:27	72,2596	18,4992		TSG_KEEL	profile start	
PS107_0_ Underway-9	2017-08-15	14:28	78,3742	10,24961	138	TSG_KEEL	profile end	
PS107_0_ Underway-10	2017-08-16	20:16	77,8141	12,30305	57	ADCP_150	profile start	
PS107_0_ Underway-10	2017-08-18	19:11	70,9072	20,89532	203	ADCP_150	profile end	
PS107_0_ Underway-11	2017-08-16	20:16	77,8133	12,30614	57	FBOX	profile start	
PS107_0_ Underway-11	2017-08-18	19:13	70,9044	20,89808	201	FBOX	profile end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_0_ Underway-12	2017-08-16	20:17	77,8127	12,30829	57	PCO2_GO	profile start	
PS107_0_ Underway-12	2017-08-18	19:13	70,904	20,89852	203	PCO2_GO	profile end	
PS107_0_ Underway-13	2017-08-16	20:17	77,812	12,31033	57	SVP	station start	
PS107_0_ Underway-13	2017-08-18	19:13	70,9049	20,89765	205	SVP	station end	
PS107_0_ Underway-14	2017-08-16	20:18	77,8096	12,31457	58	TSG_KEEL	profile start	
PS107_0_ Underway-14	2017-08-18	19:12	70,9053	20,8972	202	TSG_KEEL	profile end	
PS107_0_ Underway-15	2017-08-16	20:18	77,8088	12,31634	57	PCO2_SUB	profile start	
PS107_0_ Underway-15	2017-08-18	19:12	70,9059	20,89664	205	PCO2_SUB	profile end	
PS107_1-1	2017-07-24	14:06	73,4827	16,57647	448	LITTER	profile start	
PS107_1-1	2017-07-24	15:17	73,6931	16,19912	429	LITTER	profile end	
PS107_1-2	2017-07-24	16:28	73,8968	15,80763	520	LITTER	profile start	
PS107_1-2	2017-07-24	17:43	74,1193	15,37428	1466	LITTER	profile end	
PS107_1-3	2017-07-25	06:17	76,3449	10,68297	2190	LITTER	profile start	
PS107_1-3	2017-07-25	07:26	76,5434	10,2286	2247	LITTER	profile end	
PS107_1-4	2017-07-25	10:24	77,0709	8,99062	2249	LITTER	profile start	
PS107_1-4	2017-07-25	11:30	77,2608	8,53041	2072	LITTER	profile end	
PS107_1-5	2017-07-25	16:06	77,8984	6,93968	2011	LITTER	profile start	
PS107_1-5	2017-07-25	17:13	78,097	6,42769	1987	LITTER	profile end	
PS107_1-8	2017-07-30	20:15	79,0104	2,24626	2474	LITTER	station start	
PS107_1-8	2017-07-30	21:35	78,9979	2,25081	2453	LITTER	station end	
PS107_1-9	2017-07-31	00:45	79,0302	2,37176	2496	LITTER	station start	
PS107_1-9	2017-07-31	01:50	79,0191	2,72497	2875	LITTER	station end	
PS107_1-10	2017-07-31	11:45	79,158	3,18096	5215	LITTER	station start	
PS107_1-10	2017-07-31	12:30	79,063	3,4768		LITTER	station end	
PS107_1-11	2017-08-01	22:24	79,106	2,66281	5527	LITTER	profile start	
PS107_1-11	2017-08-01	23:47	79,0658	1,87885	2579	LITTER	profile end	
PS107_1-12	2017-08-02	14:30	78,9633	0,07659	2577	LITTER	profile start	
PS107_1-12	2017-08-02	15:39	78,9273	-0,7021	2676	LITTER	profile end	
PS107_1-13	2017-08-02	16:10	78,9164	-0,97876	2673	LITTER	profile start	
PS107_1-13	2017-08-02	17:14	78,8757	-1,57104	2688	LITTER	profile end	
PS107_1-14	2017-08-03	18:31	78,8144	-2,85975	2578	LITTER	profile start	
PS107_1-14	2017-08-03	19:33	78,8421	-3,27344	2419	LITTER	profile end	
PS107_1-15	2017-08-03	19:44	78,8392	-3,36438	2372	LITTER	profile start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_1-15	2017-08-03	20:23	78,8456	-3,64687	2203	LITTER	profile end	
PS107_1-16	2017-08-04	08:49	78,851	-3,85139	2054	LITTER	profile start	
PS107_1-16	2017-08-04	09:55	78,8381	-3,26695	2420	LITTER	profile end	
PS107_1-17	2017-08-04	17:20	79,0423	-3,02079	2404	LITTER	profile start	
PS107_1-17	2017-08-04	18:26	78,9313	-2,90072	2528	LITTER	profile end	
PS107_1-18	2017-08-05	15:30	78,9095	-4,5868	1554	LITTER	profile start	
PS107_1-18	2017-08-05	16:07	78,9309	-4,67058	1526	LITTER	profile end	
PS107_1-19	2017-08-06	14:29	79,0394	-4,51871	1680	LITTER	profile start	
PS107_1-19	2017-08-06	15:35	79,143	-3,61176	2151	LITTER	profile end	
PS107_1-20	2017-08-06	16:23	79,2223	-2,9203	2375	LITTER	profile start	
PS107_1-20	2017-08-06	17:27	79,3006	-1,99846	2573	LITTER	profile end	
PS107_1-21	2017-08-06	22:00	79,3266	-1,90945	2596	LITTER	profile start	
PS107_1-21	2017-08-06	23:05	79,3823	-0,8293	2744	LITTER	profile end	
PS107_1-22	2017-08-07	08:36	79,4974	0,80954	3110	LITTER	profile start	
PS107_1-22	2017-08-07	09:47	79,5436	1,47799	3098	LITTER	profile end	
PS107_1-23	2017-08-07	15:17	79,5884	2,14889		LITTER	profile start	
PS107_1-23	2017-08-07	16:22	79,6535	3,00716	3917	LITTER	profile end	
PS107_1-24	2017-08-08	13:30	79,7352	4,51705	2756	LITTER	profile start	
PS107_1-24	2017-08-08	14:34	79,8023	3,9628	2632	LITTER	profile end	
PS107_1-25	2017-08-08	15:31	79,8755	3,70657	2443	LITTER	profile start	
PS107_1-25	2017-08-08	16:35	79,9378	3,14686	2559	LITTER	profile end	
PS107_1-26	2017-08-12	08:58	79,1316	4,91584	1527	LITTER	profile start	
PS107_1-26	2017-08-12	10:13	79,135	5,63114	1318	LITTER	profile end	
PS107_1-27	2017-08-17	01:00	77,0095	13,39296	209	LITTER	profile start	
PS107_1-27	2017-08-17	02:06	76,8165	13,69526	123	LITTER	profile end	
PS107_1-28	2017-08-17	02:57	76,667	13,92698	214	LITTER	profile start	
PS107_1-28	2017-08-17	04:05	76,4694	14,22882	754	LITTER	profile end	
PS107_1-29	2017-08-17	04:48	76,3496	14,40969	728	LITTER	profile start	
PS107_1-29	2017-08-17	05:59	76,146	14,71377	347	LITTER	profile end	
PS107_1-30	2017-08-17	06:58	75,9793	14,95818	349	LITTER	profile start	
PS107_1-30	2017-08-17	08:19	75,745	15,29967	385	LITTER	profile end	
PS107_1-31	2017-08-17	09:00	75,6287	15,46659	379	LITTER	profile start	
PS107_1-31	2017-08-17	10:00	75,4565	15,71155	310	LITTER	profile end	
PS107_1-32	2017-08-17	11:00	75,2815	15,95724	199	LITTER	profile start	
PS107_1-32	2017-08-17	12:02	75,1021	16,20564	308	LITTER	profile end	
PS107_1-33	2017-08-17	13:00	74,9317	16,4402	273	LITTER	profile start	
PS107_1-33	2017-08-17	14:04	74,7377	16,7034	181	LITTER	profile end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_1-34	2017-08-17	15:00	74,5752	16,92145	180	LITTER	profile start	
PS107_1-34	2017-08-17	16:26	74,3522	17,21702	184	LITTER	profile end	
PS107_1-35	2017-08-17	16:57	74,2813	17,30992	190	LITTER	profile start	
PS107_1-35	2017-08-17	18:04	74,1256	17,5129	205	LITTER	profile end	
PS107_1-36	2017-08-17	19:05	73,9879	17,69099	211	LITTER	profile start	
PS107_1-36	2017-08-17	20:17	73,8227	17,89624	232	LITTER	profile end	
PS107_1-37	2017-08-17	21:00	73,7224	18,00751	291	LITTER	profile start	
PS107_1-37	2017-08-17	22:06	73,5661	18,18011	357	LITTER	profile end	
PS107_1-38	2017-08-17	23:02	73,433	18,3259	461	LITTER	profile start	
PS107_1-38	2017-08-18	00:04	73,2878	18,48357	461	LITTER	profile end	
PS107_1-39	2017-08-18	01:00	73,1571	18,62412	434	LITTER	profile start	
PS107_1-39	2017-08-18	02:11	72,9809	18,8124	427	LITTER	profile end	
PS107_1-40	2017-08-18	03:00	72,8636	18,93665	406	LITTER	profile start	
PS107_1-40	2017-08-18	04:03	72,7243	19,08316	391	LITTER	profile end	
PS107_1-41	2017-08-18	05:01	72,6004	19,21253	369	LITTER	profile start	
PS107_1-41	2017-08-18	06:04	72,4672	19,35036	388	LITTER	profile end	
PS107_1-42	2017-08-18	07:00	72,3551	19,46531	360	LITTER	profile start	
PS107_1-42	2017-08-18	08:08	72,2229	19,60046	324	LITTER	profile end	
PS107_1-43	2017-08-18	08:40	72,1608	19,6639	316	LITTER	profile start	
PS107_1-43	2017-08-18	09:50	72,0128	19,81407	321	LITTER	profile end	
PS107_1-44	2017-08-18	11:00	71,8706	19,95939	309	LITTER	profile start	
PS107_1-44	2017-08-18	12:09	71,7344	20,09188	280	LITTER	profile end	
PS107_1-45	2017-08-18	13:00	71,6316	20,1948	278	LITTER	profile start	
PS107_1-45	2017-08-18	14:03	71,5074	20,31718	275	LITTER	profile end	
PS107_1-46	2017-08-18	15:10	71,3743	20,44764	266	LITTER	profile start	
PS107_1-46	2017-08-18	16:02	71,2758	20,54337	223	LITTER	profile end	
PS107_1-47	2017-08-18	17:02	71,1621	20,6523	195	LITTER	profile start	
PS107_1-47	2017-08-18	18:01	71,0456	20,76381	152	LITTER	profile end	
PS107_1-48	2017-08-18	18:55	70,9421	20,86241	207	LITTER	profile start	
PS107_1-48	2017-08-18	20:02	70,7944	21,00422	242	LITTER	profile end	
PS107_2-1	2017-07-25	20:57	78,6076	5,04684	2345	CTD	station start	
PS107_2-1	2017-07-25	22:18	78,6025	5,02528	2353	CTD	at depth	
PS107_2-1	2017-07-26	01:06	78,6031	5,00927	2355	CTD	station end	
PS107_2-2	2017-07-26	01:27	78,6036	5,00886	2356	MSC	station start	
PS107_2-2	2017-07-26	01:30	78,6037	5,00883	2356	MSC	at depth	
PS107_2-2	2017-07-26	01:40	78,6038	5,00856	2356	MSC	station end	
PS107_2-3	2017-07-26	01:44	78,6039	5,00817	2356	MSC	station start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_2-3	2017-07-26	01:48	78,604	5,00798	2356	MSC	at depth	
PS107_2-3	2017-07-26	01:55	78,604	5,00738	2356	MSC	station end	
PS107_2-4	2017-07-26	02:22	78,6042	5,00418	2357	CTD	station start	
PS107_2-4	2017-07-26	02:24	78,6043	5,00414	2357	CTD	at depth	
PS107_2-4	2017-07-26	02:33	78,6045	5,00352	2357	CTD	station end	
PS107_2-5	2017-07-26	02:57	78,6041	5,00025	2358	LOKI	station start	
PS107_2-5	2017-07-26	03:31	78,6048	4,99207	2362	LOKI	at depth	
PS107_2-5	2017-07-26	04:06	78,6058	4,98328	2364	LOKI	station end	
PS107_2-6	2017-07-26	04:17	78,6062	4,9805	2364	MN_M7	station start	
PS107_2-6	2017-07-26	05:03	78,6073	4,96936	2366	MN_M7	at depth	
PS107_2-6	2017-07-26	05:58	78,6082	4,96194	2367	MN_M7	station end	
PS107_2-7	2017-07-26	06:33	78,6082	5,05798	2340	MN_M7	station start	
PS107_2-7	2017-07-26	07:27	78,6084	5,05656	2340	MN_M7	at depth	
PS107_2-7	2017-07-26	08:16	78,6082	5,05525	2341	MN_M7	station end	
PS107_2-8	2017-07-26	08:35	78,6094	5,05343	2342	BONGO	station start	
PS107_2-8	2017-07-26	08:44	78,6089	5,05321	2342	BONGO	at depth	
PS107_2-8	2017-07-26	08:51	78,6096	5,0528	2342	BONGO	station end	
PS107_2-9	2017-07-26	08:53	78,6098	5,05258	2342	BONGO	station start	
PS107_2-9	2017-07-26	08:59	78,6094	5,05187	2342	BONGO	at depth	
PS107_2-9	2017-07-26	09:06	78,609	5,05168	2342	BONGO	station end	
PS107_2-10	2017-07-26	09:07	78,6088	5,05163	2343	BONGO	station start	
PS107_2-10	2017-07-26	09:12	78,6084	5,05161	2343	BONGO	at depth	
PS107_2-10	2017-07-26	09:18	78,608	5,05171	2342	BONGO	station end	
PS107_2-11	2017-07-26	09:19	78,6079	5,05175	2342	BONGO	station start	
PS107_2-11	2017-07-26	09:25	78,6078	5,05173	2342	BONGO	at depth	
PS107_2-11	2017-07-26	09:31	78,6083	5,05121	2343	BONGO	station end	
PS107_2-12	2017-07-26	09:39	78,6095	5,04993	2344	ISPC	station start	
PS107_2-12	2017-07-26	09:42	78,6097	5,04923	2344	ISPC	at depth	
PS107_2-12	2017-07-26	09:46	78,6093	5,04895	2344	ISPC	station end	
PS107_2-12	2017-07-26	09:47	78,6092	5,04891	2344	ISPC	station start	
PS107_2-12	2017-07-26	10:46	78,609	5,04808	2345	ISPC	at depth	
PS107_2-12	2017-07-26	11:20	78,6093	5,05382	2342	ISPC	station end	
PS107_2-13	2017-07-26	11:34	78,6087	5,05454	2342	CTD	station start	
PS107_2-13	2017-07-26	11:47	78,6083	5,05542	2342	CTD	at depth	
PS107_2-13	2017-07-26	12:08	78,6084	5,05661	2341	CTD	station end	
PS107_2-14	2017-07-26	12:21	78,6085	5,05662	2341	SPR	station start	
PS107_2-14	2017-07-26	13:09	78,6085	5,06437	2339	SPR	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_2-14	2017-07-26	13:29	78,6078	5,06477	2339	SPR	station end	
PS107_2-15	2017-07-26	13:42	78,6078	5,06525	2339	GKG	station start	
PS107_2-15	2017-07-26	14:19	78,6089	5,06657	2339	GKG	at depth	
PS107_2-15	2017-07-26	14:57	78,6083	5,06471	2339	GKG	station end	
PS107_2-16	2017-07-26	15:34	78,6085	5,0653	2339	TVMUC	station start	
PS107_2-16	2017-07-26	16:19	78,6082	5,06782	2338	TVMUC	at depth	
PS107_2-16	2017-07-26	16:55	78,6086	5,06912	2338	TVMUC	station end	
PS107_2-17	2017-07-26	17:21	78,6067	5,07534	2338	NEMICAT	station start	
PS107_2-17	2017-07-26	17:26	78,6017	5,07081	2337	NEMICAT	profile start	
PS107_2-17	2017-07-26	18:05	78,5622	5,047	2320	NEMICAT	profile end	
PS107_2-18	2017-07-26	18:16	78,5587	5,05541	2308	BONGO	station start	
PS107_2-18	2017-07-26	18:20	78,5563	5,06282	2299	BONGO	at depth	
PS107_2-18	2017-07-26	22:01	78,6166	5,01686	2360	BONGO	station end	
PS107_2-19	2017-07-26	18:41	78,5452	5,10325	2249	BONGO	station start	
PS107_2-19	2017-07-26	18:57	78,5364	5,13284	2202	BONGO	at depth	
PS107_2-19	2017-07-26	19:13	78,5272	5,16129	2162	BONGO	station end	
PS107_2-20	2017-07-26	20:24	78,6156	4,94846	2367	OFOS	station start	
PS107_2-20	2017-07-26	21:10	78,6163	4,98085	2365	OFOS	at depth	
PS107_2-20	2017-07-26	21:20	78,6164	4,98646	2365	OFOS	profile start	
PS107_2-20	2017-07-27	00:23	78,617	5,1305	2347	OFOS	profile end	
PS107_2-20	2017-07-27	01:02	78,6197	5,14009	2350	OFOS	station end	
PS107_3-1	2017-07-27	05:00	79,0203	4,26946	2605	MOOR	station start	HG_IV-2016-FEVI-34 recovery
PS107_3-1	2017-07-27	05:57	79,0202	4,28182	2594	MOOR	station end	
PS107_3-2	2017-07-27	06:45	78,9951	4,33965	2617	MOOR	station start	HG_IV-S recovery
PS107_3-2	2017-07-27	08:26	78,9883	4,38936	2608	MOOR	station end	
PS107_4-1	2017-07-27	11:25	79,0734	4,1087	2506	LAND	station end	2016-Longter-Lander reco-very
PS107_4-2	2017-08-11	11:25	79,0233	4,40509	2535	LAND	station end	
PS107_5-1	2017-07-27	12:32	79,0203	4,42096	2539	MOOR	station start	SWIPS-2016 recovery
PS107_5-1	2017-07-27	13:54	79,0176	4,44609	2535	MOOR	station end	
PS107_6-1	2017-07-27	14:31	79,0643	4,1819	2464	BONGO	station start	
PS107_6-1	2017-07-27	14:45	79,0639	4,1837	2464	BONGO	at depth	
PS107_6-1	2017-07-27	14:56	79,0637	4,18152	2467	BONGO	station end	
PS107_6-2	2017-07-27	15:14	79,0641	4,20123	2454	DSTRM	station start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_6-2	2017-07-27	15:48	79,0644	4,20965	2449	DSTRM	station end	
PS107_6-3	2017-07-27	16:31	79,0653	4,18636	2457	CTD	station start	
PS107_6-3	2017-07-27	17:39	79,0644	4,18108	2463	CTD	at depth	
PS107_6-3	2017-07-27	20:32	79,0644	4,17819	2464	CTD	station end	
PS107_6-4	2017-07-27	20:42	79,0648	4,17859	2462	MSC	station start	
PS107_6-4	2017-07-27	20:48	79,0647	4,17857	2463	MSC	at depth	
PS107_6-4	2017-07-27	20:52	79,0646	4,1784	2463	MSC	station end	
PS107_6-4	2017-07-27	20:57	79,0643	4,17843	2464	MSC	station start	
PS107_6-4	2017-07-27	21:00	79,0641	4,17871	2465	MSC	at depth	
PS107_6-4	2017-07-27	21:05	79,0641	4,17753	2466	MSC	station end	
PS107_6-4	2017-07-27	21:10	79,0644	4,17584	2466	MSC	station start	
PS107_6-4	2017-07-27	21:13	79,0645	4,17535	2466	MSC	at depth	
PS107_6-4	2017-07-27	21:17	79,0643	4,17444	2467	MSC	station end	
PS107_6-4	2017-07-27	21:17	79,0643	4,17442	2467	MSC	profile end	
PS107_6-5	2017-07-27	21:24	79,0638	4,17435	2469	ISPC	station start	
PS107_6-5	2017-07-27	22:15	79,0649	4,17039	2468	ISPC	at depth	
PS107_6-5	2017-07-27	22:51	79,0651	4,17045	2467	ISPC	station end	
PS107_6-6	2017-07-27	22:55	79,065	4,17042	2468	LOKI	station start	
PS107_6-6	2017-07-27	23:32	79,0652	4,17025	2468	LOKI	at depth	
PS107_6-6	2017-07-28	00:09	79,0654	4,17162	2466	LOKI	station end	
PS107_6-7	2017-07-28	00:19	79,0654	4,17209	2466	MN_S5	station start	
PS107_6-7	2017-07-28	01:12	79,0652	4,17338	2466	MN_S5	at depth	
PS107_6-7	2017-07-28	02:10	79,0654	4,16994	2468	MN_S5	station end	
PS107_6-8	2017-07-28	02:23	79,0653	4,16887	2469	CTD	station start	
PS107_6-8	2017-07-28	02:29	79,0651	4,16811	2470	CTD	at depth	
PS107_6-8	2017-07-28	02:40	79,0649	4,16608	2473	CTD	station end	
PS107_6-9	2017-07-28	02:58	79,0617	4,16261	2485	NEMICAT	station start	
PS107_6-9	2017-07-28	03:00	79,0605	4,16209	2490	NEMICAT	profile start	
PS107_6-9	2017-07-28	03:45	79,0097	4,13847	2688	NEMICAT	profile end	
PS107_6-9	2017-07-28	03:49	79,0064	4,13794	2693	NEMICAT	station end	
PS107_6-10	2017-07-28	04:43	79,065	4,18321	2459	TVMUC	station start	
PS107_6-10	2017-07-28	05:33	79,0639	4,18462	2462	TVMUC	at depth	
PS107_6-10	2017-07-28	06:15	79,0633	4,19173	2460	TVMUC	station end	
PS107_6-10	2017-07-28	06:16	79,0632	4,19196	2460	TVMUC	profile end	
PS107_6-11	2017-07-28	06:27	79,0636	4,1928	2458	GKG	station start	
PS107_6-11	2017-07-28	07:13	79,0644	4,19785	2452	GKG	at depth	
PS107_6-11	2017-07-28	07:55	79,0658	4,20369	2443	GKG	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_6-12	2017-07-28	09:09	79,0339	4,16364	2624	OFOS	station start	
PS107_6-12	2017-07-28	09:58	79,0338	4,17343	2619	OFOS	profile start	
PS107_6-12	2017-07-28	13:49	79,0654	4,28829	2402	OFOS	profile end	
PS107_6-12	2017-07-28	14:30	79,0603	4,29465	2421	OFOS	station end	
PS107_6-13	2017-07-28	15:03	79,0648	4,29432	2402	SPR	station start	
PS107_6-13	2017-07-28	15:38	79,0635	4,30177	2403	SPR	at depth	
PS107_6-13	2017-07-28	15:52	79,0632	4,30417	2404	SPR	station end	
PS107_6-14	2017-07-28	16:55	78,9513	4,34999	2677	DSTRM	station start	
PS107_6-14	2017-07-28	17:20	78,9491	4,35058	2681	DSTRM	station end	
PS107_6-15	2017-07-28	17:32	78,9479	4,34935	2683	ISPC	station start	
PS107_6-15	2017-07-28	18:02	78,946	4,35281	2687	ISPC	at depth	
PS107_6-15	2017-07-28	18:19	78,9441	4,35542	2692	ISPC	station end	
PS107_7-1	2017-07-28	20:05	79,0532	3,74855	2833	CTD	profile start	
PS107_7-1	2017-07-28	20:08	79,0532	3,74886	2833	CTD	station start	
PS107_7-1	2017-07-28	20:42	79,0533	3,74967	2831	CTD	at depth	
PS107_7-1	2017-07-28	21:13	79,0539	3,74586	2836	CTD	station end	
PS107_7-1	2017-07-28	21:15	79,0539	3,74571	2837	CTD	profile end	
PS107_7-2	2017-07-28	21:16	79,0538	3,74561	2837	MN_S5	station start	
PS107_7-2	2017-07-28	21:18	79,0537	3,74574	2837	MN_S5	profile start	
PS107_7-2	2017-07-28	22:11	79,055	3,7332	2859	MN_S5	at depth	
PS107_7-2	2017-07-28	23:07	79,0553	3,73536	2854	MN_S5	profile end	
PS107_7-3	2017-07-28	23:14	79,0553	3,73557	2854	TVMUC	station start	
PS107_7-3	2017-07-29	00:17	79,0542	3,73774	2850	TVMUC	at depth	
PS107_7-3	2017-07-29	01:09	79,054	3,73835	2849	TVMUC	station end	
PS107_7-4	2017-07-29	01:17	79,0537	3,73783	2850	GKG	station start	
PS107_7-4	2017-07-29	02:05	79,0545	3,74172	2842	GKG	at depth	
PS107_7-4	2017-07-29	02:56	79,056	3,7491	2824	GKG	station end	
PS107_7-5	2017-07-29	03:13	79,0567	3,74862	2823	BONGO	station start	
PS107_7-5	2017-07-29	03:16	79,0584	3,7523	2811	BONGO	at depth	
PS107_7-5	2017-07-29	03:31	79,0637	3,78973	2750	BONGO	station end	
PS107_7-6	2017-07-29	03:59	79,0553	3,83237	2736	BONGO	at depth	
PS107_7-6	2017-07-29	04:22	79,0524	3,77783	2797	BONGO	station end	
PS107_8-1	2017-07-29	04:50	79,0466	3,60409	3354	CTD	station start	
PS107_8-1	2017-07-29	05:03	79,0465	3,60585	3365	CTD	at depth	
PS107_8-1	2017-07-29	05:18	79,0462	3,60919	3296	CTD	station end	
PS107_8-2	2017-07-29	05:29	79,0465	3,61089	3363	TVMUC	station start	
PS107_8-2	2017-07-29	06:26	79,0466	3,61433	3335	TVMUC	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_8-2	2017-07-29	07:27	79,0468	3,61794	3337	TVMUC	station end	
PS107_8-3	2017-07-29	07:44	79,046	3,60018	3434	GKG	station start	
PS107_8-3	2017-07-29	08:48	79,0469	3,6001	3368	GKG	at depth	
PS107_8-3	2017-07-29	09:46	79,0463	3,60323	3360	GKG	station end	
PS107_9-1	2017-07-29	10:54	78,9133	2,95222	2393	CTDTS	station start	
PS107_9-1	2017-07-29	10:58	78,9156	2,93294	2393	CTDTS	profile start	
PS107_9-1	2017-07-29	13:36	79,0403	2,04061	2548	CTDTS	profile end	
PS107_9-1	2017-07-29	13:37	79,0409	2,03551	2549	CTDTS	station end	
PS107_10-1	2017-07-29	15:21	78,9732	2,4955	2424	DSTRM	station start	
PS107_10-1	2017-07-29	15:45	78,9724	2,49731	2424	DSTRM	station end	
PS107_10-2	2017-07-29	16:26	78,977	2,49169	2412	MSC	station start	
PS107_10-2	2017-07-29	16:30	78,9772	2,49181	2430	MSC	at depth	
PS107_10-2	2017-07-29	16:35	78,9772	2,49086	2430	MSC	station end	
PS107_10-3	2017-07-29	16:44	78,9769	2,4908	2430	ISPC	station start	
PS107_10-3	2017-07-29	17:09	78,9757	2,48768	2429	ISPC	at depth	
PS107_10-3	2017-07-29	17:27	78,9747	2,48864	2427	ISPC	station end	
PS107_10-4	2017-07-29	17:39	78,9772	2,49381	2429	CTD	station start	
PS107_10-4	2017-07-29	17:58	78,9768	2,4943	2428	CTD	at depth	
PS107_10-4	2017-07-29	18:12	78,9763	2,4895	2429	CTD	station end	
PS107_10-5	2017-07-29	18:18	78,9761	2,48858	2429	LOKI	station start	
PS107_10-5	2017-07-29	18:35	78,9751	2,48643	2428	LOKI	at depth	
PS107_10-5	2017-07-29	18:53	78,9738	2,48852	2426	LOKI	station end	
PS107_10-6	2017-07-29	18:59	78,9731	2,4896	2425	MN_S5	station start	
PS107_10-6	2017-07-29	19:12	78,9724	2,49308	2424	MN_S5	at depth	
PS107_10-6	2017-07-29	19:24	78,9734	2,50522	2421	MN_S5	station end	
PS107_11-1	2017-07-29	20:34	79,0131	2,38577	2469	CTDTS	station start	
PS107_11-1	2017-07-29	20:43	79,0071	2,42999	2463	CTDTS	profile start	
PS107_11-1	2017-07-29	21:15	78,9796	2,62356	2409	CTDTS	profile end	
PS107_11-1	2017-07-29	21:27	78,9732	2,68561	2389	CTDTS	profile start	
PS107_11-1	2017-07-29	21:52	78,9533	2,83398	2373	CTDTS	profile end	
PS107_11-1	2017-07-29	22:16	78,9734	2,85163	2372	CTDTS	profile start	
PS107_11-1	2017-07-29	23:07	79,0101	2,5502	2471	CTDTS	profile end	
PS107_11-1	2017-07-29	23:24	79,0066	2,50039	2467	CTDTS	profile start	
PS107_11-1	2017-07-29	23:53	78,9728	2,60881	2403	CTDTS	profile end	
PS107_11-1	2017-07-30	00:01	78,9643	2,63381	2397	CTDTS	station end	
PS107_12-1	2017-07-30	00:30	78,9449	2,69782	2399	MSC	station start	
PS107_12-1	2017-07-30	00:36	78,9446	2,69779	2400	MSC	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_12-1	2017-07-30	00:42	78,9445	2,69863	2400	MSC	station end	
PS107_12-2	2017-07-30	00:47	78,9446	2,69905	2399	ISPC	station start	
PS107_12-2	2017-07-30	01:17	78,9442	2,69663	2400	ISPC	at depth	
PS107_12-2	2017-07-30	01:35	78,945	2,70054	2399	ISPC	station end	
PS107_12-3	2017-07-30	01:45	78,9446	2,69966	2400	CTD	station start	
PS107_12-3	2017-07-30	02:04	78,9448	2,7017	2399	CTD	at depth	
PS107_12-3	2017-07-30	02:20	78,9447	2,70142	2399	CTD	station end	
PS107_12-4	2017-07-30	02:30	78,9446	2,70092	2397	LOKI	station start	
PS107_12-4	2017-07-30	02:46	78,945	2,7019	2399	LOKI	at depth	
PS107_12-4	2017-07-30	03:05	78,9456	2,70319	2398	LOKI	station end	
PS107_12-5	2017-07-30	03:13	78,9451	2,69823	2399	MN_M7	station start	
PS107_12-5	2017-07-30	03:28	78,9457	2,7008	2398	MN_M7	at depth	
PS107_12-5	2017-07-30	03:41	78,9465	2,70363	2397	MN_M7	station end	
PS107_13-1	2017-07-30	04:40	78,9824	2,36296	2433	CTDTS	station start	
PS107_13-1	2017-07-30	04:41	78,9818	2,36716	2433	CTDTS	profile start	
PS107_13-1	2017-07-30	05:50	78,9294	2,7619	2398	CTDTS	profile end	
PS107_13-1	2017-07-30	06:14	78,9199	2,67372	2437	CTDTS	profile start	
PS107_13-1	2017-07-30	06:26	78,9296	2,59492	2434	CTDTS	profile end	
PS107_13-1	2017-07-30	06:37	78,9381	2,53061	2427	CTDTS	profile start	
PS107_13-1	2017-07-30	07:24	78,976	2,24992	2451	CTDTS	profile end	
PS107_13-1	2017-07-30	07:24	78,9762	2,24836	2452	CTDTS	station end	
PS107_14-1	2017-07-30	11:16	78,927	2,85065	2380	CTD	station start	
PS107_14-1	2017-07-30	11:34	78,927	2,85027	2379	CTD	at depth	
PS107_14-1	2017-07-30	12:03	78,9264	2,8523	2381	CTD	station end	
PS107_14-2	2017-07-30	12:11	78,9267	2,85276	2380	DSTRM	station start	
PS107_14-2	2017-07-30	12:39	78,9274	2,86315	2379	DSTRM	station end	
PS107_14-3	2017-07-30	13:03	78,9256	2,85127	2382	MSC	station start	
PS107_14-3	2017-07-30	13:09	78,9256	2,85272	2382	MSC	at depth	
PS107_14-3	2017-07-30	13:18	78,9258	2,85287	2382	MSC	station end	
PS107_14-4	2017-07-30	13:22	78,9257	2,85294	2382	ISPC	station start	
PS107_14-4	2017-07-30	13:51	78,9259	2,85253	2382	ISPC	at depth	
PS107_14-4	2017-07-30	14:09	78,9262	2,85358	2381	ISPC	station end	
PS107_14-5	2017-07-30	14:14	78,9266	2,85456	2380	LOKI	station start	
PS107_14-5	2017-07-30	14:31	78,9275	2,85483	2379	LOKI	at depth	
PS107_14-5	2017-07-30	14:50	78,928	2,85532	2378	LOKI	station end	
PS107_14-6	2017-07-30	14:59	78,9282	2,8533	2378	MN_M7	station start	
PS107_14-6	2017-07-30	15:14	78,929	2,85491	2377	MN_M7	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_14-6	2017-07-30	15:26	78,9297	2,85506	2376	MN_M7	station end	
PS107_14-7	2017-07-30	15:30	78,9299	2,85497	2376	ISPC	station start	
PS107_14-7	2017-07-30	15:58	78,9314	2,85594	2375	ISPC	at depth	
PS107_14-7	2017-07-30	16:16	78,9323	2,85814	2374	ISPC	station end	
PS107_15-1	2017-07-30	16:49	78,917	2,91938	2393	CTDTS	station start	
PS107_15-1	2017-07-30	16:49	78,9171	2,91821	2393	CTDTS	profile start	
PS107_15-1	2017-07-30	19:31	79,0424	2,04512	2552	CTDTS	profile end	
PS107_15-1	2017-07-30	19:31	79,043	2,04294	2553	CTDTS	station end	
PS107_16-1	2017-07-30	20:35	79,0053	2,27888	2466	MSC	station start	
PS107_16-1	2017-07-30	20:44	79,004	2,27291	2463	MSC	at depth	
PS107_16-1	2017-07-30	20:48	79,0034	2,27009	2461	MSC	station end	
PS107_16-2	2017-07-30	20:55	79,0023	2,26516	2460	ISPC	station start	
PS107_16-2	2017-07-30	21:31	78,9982	2,25259	2452	ISPC	at depth	
PS107_16-2	2017-07-30	21:49	78,9955	2,24816	2449	ISPC	station end	
PS107_16-3	2017-07-30	22:14	79,0062	2,28373	2470	CTD	station start	
PS107_16-3	2017-07-30	22:32	79,0046	2,28358	2466	CTD	at depth	
PS107_16-3	2017-07-30	22:48	79,0044	2,28234	2465	CTD	station end	
PS107_16-4	2017-07-30	22:57	79,0043	2,28168	2465	LOKI	station start	
PS107_16-4	2017-07-30	23:14	79,0036	2,2796	2462	LOKI	at depth	
PS107_16-4	2017-07-30	23:33	79,0021	2,27881	2459	LOKI	station end	
PS107_16-5	2017-07-30	23:46	79,0028	2,28068	2461	MN_M7	station start	
PS107_16-5	2017-07-30	23:58	79,0014	2,27988	2457	MN_M7	at depth	
PS107_16-5	2017-07-31	00:12	78,9992	2,28007	2452	MN_M7	station end	
PS107_17-1	2017-07-31	01:16	79,0417	2,51485	2615	CTDTS	station start	
PS107_17-1	2017-07-31	01:17	79,0411	2,52048	2604	CTDTS	profile start	
PS107_17-1	2017-07-31	02:49	78,9704	3,05614	2410	CTDTS	profile end	
PS107_17-1	2017-07-31	02:50	78,9698	3,06202	2412	CTDTS	station end	
PS107_18-1	2017-07-31	03:49	78,9869	2,7497	2404	MSC	station start	
PS107_18-1	2017-07-31	03:54	78,9867	2,75001	2404	MSC	at depth	
PS107_18-1	2017-07-31	04:01	78,9863	2,75021	2403	MSC	station end	
PS107_18-2	2017-07-31	04:15	78,987	2,74525	2405	ISPC	station start	
PS107_18-2	2017-07-31	04:42	78,9864	2,74566	2403	ISPC	at depth	
PS107_18-2	2017-07-31	05:02	78,9863	2,74901	2403	ISPC	station end	
PS107_18-3	2017-07-31	05:10	78,9871	2,75049	2405	CTD	station start	
PS107_18-3	2017-07-31	05:46	78,9859	2,75578	2402	CTD	at depth	
PS107_18-3	2017-07-31	06:27	78,9861	2,75752	2403	CTD	station end	
PS107_18-4	2017-07-31	06:27	78,9862	2,75721	2403	LOKI	station start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_18-4	2017-07-31	06:57	78,9869	2,74519	2404	LOKI	at depth	
PS107_18-4	2017-07-31	07:15	78,9872	2,7421	2405	LOKI	station end	
PS107_18-5	2017-07-31	07:25	78,9867	2,74274	2404	MN_M7	station start	
PS107_18-5	2017-07-31	07:39	78,9866	2,74008	2404	MN_M7	at depth	
PS107_18-5	2017-07-31	07:51	78,9864	2,73913	2403	MN_M7	station end	
PS107_18-6	2017-07-31	09:52	79,1431	3,1998	5521	DSTRM	station start	
PS107_18-6	2017-07-31	10:23	79,1494	3,18697	5266	DSTRM	station end	
PS107_18-7	2017-07-31	10:35	79,1509	3,18478	5256	ISPC	station start	
PS107_18-7	2017-07-31	11:02	79,1536	3,18157	5270	ISPC	at depth	
PS107_18-7	2017-07-31	11:22	79,156	3,18053	5244	ISPC	station end	
PS107_19-1	2017-07-31	12:43	79,0586	3,48288	3978	CTD	station start	
PS107_19-1	2017-07-31	13:24	79,0594	3,48196	3969	CTD	at depth	
PS107_19-1	2017-07-31	13:59	79,0593	3,48548		CTD	station end	
PS107_19-2	2017-07-31	14:09	79,059	3,48412		MSC	station start	
PS107_19-2	2017-07-31	14:13	79,059	3,48395	3743	MSC	at depth	
PS107_19-2	2017-07-31	14:18	79,059	3,48377	4000	MSC	station end	
PS107_19-3	2017-07-31	14:34	79,0589	3,48333	3978	SPR	station start	
PS107_19-3	2017-07-31	15:20	79,0592	3,48457	3922	SPR	at depth	
PS107_19-3	2017-07-31	15:33	79,0594	3,48475	3629	SPR	station end	
PS107_19-4	2017-07-31	15:59	79,0584	3,48148	3746	TVMUC	station start	
PS107_19-4	2017-07-31	17:42	79,0598	3,48057	3869	TVMUC	at depth	
PS107_19-4	2017-07-31	18:50	79,0593	3,47197		TVMUC	station end	
PS107_19-5	2017-07-31	19:10	79,0579	3,48046		GKG	station start	
PS107_19-5	2017-07-31	20:16	79,0594	3,47962	4066	GKG	at depth	
PS107_19-5	2017-07-31	21:24	79,0586	3,48069	4014	GKG	station end	
PS107_20-1	2017-07-31	22:42	79,1314	2,83752	5567	CTD	station start	
PS107_20-1	2017-08-01	00:51	79,1234	2,81886	5534	CTD	at depth	
PS107_20-1	2017-08-01	05:36	79,1199	2,77946	5438	CTD	station end	
PS107_20-2	2017-08-01	06:01	79,1342	2,84417	5571	SPR	station start	
PS107_20-2	2017-08-01	06:38	79,1353	2,84441	5571	SPR	at depth	
PS107_20-2	2017-08-01	06:52	79,135	2,84123	5572	SPR	station end	
PS107_20-3	2017-08-01	07:04	79,133	2,82877	5574	ISPC	station start	
PS107_20-3	2017-08-01	08:00	79,1275	2,8277	5556	ISPC	at depth	
PS107_20-3	2017-08-01	08:34	79,1276	2,83755	5556	ISPC	station end	
PS107_20-4	2017-08-01	08:59	79,1309	2,8335	5567	MSC	station start	
PS107_20-4	2017-08-01	09:11	79,1323	2,83333	5571	MSC	at depth	
PS107_20-4	2017-08-01	09:17	79,1327	2,8338	5571	MSC	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_20-4	2017-08-01	09:23	79,133	2,8355	5571	MSC	station start	
PS107_20-4	2017-08-01	09:27	79,1332	2,83702	5571	MSC	at depth	
PS107_20-4	2017-08-01	09:30	79,1334	2,83834	5570	MSC	station end	
PS107_20-5	2017-08-01	09:37	79,1335	2,84211	5570	LOKI	station start	
PS107_20-5	2017-08-01	10:10	79,133	2,84645	5569	LOKI	at depth	
PS107_20-5	2017-08-01	10:46	79,1321	2,84418	5568	LOKI	station end	
PS107_20-6	2017-08-01	10:52	79,1328	2,8449	5569	MN_M7	station start	
PS107_20-6	2017-08-01	11:44	79,1325	2,84367	5568	MN_M7	at depth	
PS107_20-6	2017-08-01	12:42	79,131	2,84065	5566	MN_M7	station end	
PS107_20-7	2017-08-01	12:55	79,1325	2,84205	5569	TVMUC	station start	
PS107_20-7	2017-08-01	14:23	79,1334	2,84453	5570	TVMUC	at depth	
PS107_20-7	2017-08-01	15:55	79,134	2,84416	5570	TVMUC	station end	
PS107_20-8	2017-08-01	16:16	79,1339	2,8452	5570	CTD	station start	
PS107_20-8	2017-08-01	16:37	79,1336	2,84477	5569	CTD	at depth	
PS107_20-8	2017-08-01	16:56	79,1339	2,84439	5570	CTD	station end	
PS107_20-9	2017-08-01	17:12	79,1334	2,84333	5569	GKG	station start	
PS107_20-9	2017-08-01	18:40	79,1341	2,84197	5570	GKG	at depth	
PS107_20-9	2017-08-01	20:12	79,1338	2,83335	5572	GKG	station end	
PS107_20-10	2017-08-01	21:11	79,1438	2,90558	5567	NEMICAT	station start	
PS107_20-10	2017-08-01	21:57	79,1177	2,89292	5518	NEMICAT	station end	
PS107_21-1	2017-08-02	03:13	78,9662	0,00308	2553	CTD	station start	
PS107_21-1	2017-08-02	03:50	78,9643	0,0038	2548	CTD	at depth	
PS107_21-1	2017-08-02	04:26	78,9622	0,00162	2541	CTD	station end	
PS107_21-2	2017-08-02	04:37	78,9627	-0,00044	2542	LOKI	station start	
PS107_21-2	2017-08-02	05:12	78,9627	-0,00143	2542	LOKI	at depth	
PS107_21-2	2017-08-02	05:44	78,9636	-0,0041	2545	LOKI	station end	
PS107_21-3	2017-08-02	05:58	78,9652	-0,00539	2549	MN_M7	station start	
PS107_21-3	2017-08-02	06:48	78,9622	-0,00686	2540	MN_M7	at depth	
PS107_21-3	2017-08-02	07:44	78,9605	-0,00709	2533	MN_M7	station end	
PS107_21-4	2017-08-02	08:03	78,9666	-0,00146	2554	MN_M7	station start	
PS107_21-4	2017-08-02	08:58	78,9645	0,00212	2549	MN_M7	at depth	
PS107_21-4	2017-08-02	09:49	78,965	0,01828	2556	MN_M7	station end	
PS107_21-5	2017-08-02	10:30	78,9624	0,03248	2556	CTD	station start	
PS107_21-5	2017-08-02	10:44	78,9618	0,03961	2558	CTD	at depth	
PS107_21-5	2017-08-02	10:56	78,9614	0,04185	2558	CTD	station end	
PS107_21-6	2017-08-02	11:05	78,9606	0,03894	2555	BONGO	station start	
PS107_21-6	2017-08-02	11:11	78,9602	0,03903	2554	BONGO	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_21-6	2017-08-02	11:18	78,9597	0,0396	2553	BONGO	station end	
PS107_21-6	2017-08-02	11:21	78,9596	0,03936	2552	BONGO	station start	
PS107_21-6	2017-08-02	11:26	78,9593	0,0389	2551	BONGO	at depth	
PS107_21-6	2017-08-02	11:32	78,9592	0,03807	2550	BONGO	station end	
PS107_21-6	2017-08-02	11:37	78,9592	0,03392	2547	BONGO	station start	
PS107_21-6	2017-08-02	11:43	78,9589	0,03331	2546	BONGO	at depth	
PS107_21-6	2017-08-02	11:49	78,9587	0,03377	2546	BONGO	station end	
PS107_21-6	2017-08-02	11:51	78,9586	0,03305	2545	BONGO	station start	
PS107_21-6	2017-08-02	11:58	78,9584	0,03152	2543	BONGO	at depth	
PS107_21-6	2017-08-02	12:05	78,9582	0,03273	2544	BONGO	station end	
PS107_21-7	2017-08-02	12:16	78,9582	0,03433	2545	BONGO	station start	
PS107_21-7	2017-08-02	12:19	78,9594	0,02867	2545	BONGO	at depth	
PS107_21-7	2017-08-02	12:19	78,9594	0,02861	2545	BONGO	profile start	
PS107_21-7	2017-08-02	12:29	78,9637	0,01712	2551	BONGO	profile end	
PS107_21-7	2017-08-02	12:33	78,9656	0,01678	2556	BONGO	station end	
PS107_21-8	2017-08-02	12:40	78,9678	0,01865	2562	BONGO	station start	
PS107_21-8	2017-08-02	12:48	78,9725	0,02533	2573	BONGO	at depth	
PS107_21-8	2017-08-02	12:59	78,977	0,04086	2581	BONGO	station end	
PS107_21-9	2017-08-02	13:18	78,9746	0,04815	2580	SPR	station start	
PS107_21-9	2017-08-02	14:05	78,97	0,07372	2582	SPR	at depth	
PS107_21-9	2017-08-02	14:21	78,9682	0,07304	2581	SPR	station end	
PS107_22-1	2017-08-02	19:55	78,8144	-2,72556	2606	CTD	station start	
PS107_22-1	2017-08-02	21:15	78,8167	-2,80065	2590	CTD	at depth	
PS107_22-1	2017-08-03	00:42	78,8328	-2,88874	2565	CTD	station end	
PS107_22-2	2017-08-03	01:17	78,8141	-2,73408	2604	MSC	station start	
PS107_22-2	2017-08-03	01:22	78,814	-2,73555	2604	MSC	at depth	
PS107_22-2	2017-08-03	01:29	78,8141	-2,73701	2604	MSC	station end	
PS107_22-2	2017-08-03	01:38	78,8137	-2,73776	2587	MSC	station start	
PS107_22-2	2017-08-03	01:40	78,8135	-2,73841	2604	MSC	at depth	
PS107_22-2	2017-08-03	01:45	78,8132	-2,73987	2604	MSC	station end	
PS107_22-3	2017-08-03	01:52	78,8123	-2,74338	2603	ISPC	station start	
PS107_22-3	2017-08-03	03:02	78,8106	-2,75595	2602	ISPC	at depth	
PS107_22-3	2017-08-03	03:41	78,8094	-2,76763	2601	ISPC	station end	
PS107_22-4	2017-08-03	04:00	78,8159	-2,74277	2602	LOKI	station start	
PS107_22-4	2017-08-03	04:35	78,8146	-2,7619	2598	LOKI	at depth	
PS107_22-4	2017-08-03	05:09	78,8141	-2,78222	2595	LOKI	station end	
PS107_22-5	2017-08-03	05:18	78,814	-2,78629	2594	MN_M7	station start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_22-5	2017-08-03	06:08	78,8125	-2,83077	2587	MN_M7	at depth	
PS107_22-5	2017-08-03	07:04	78,8098	-2,88517	2576	MN_M7	station end	
PS107_22-6	2017-08-03	07:56	78,8206	-2,69897	2612	CTD	station start	
PS107_22-6	2017-08-03	08:09	78,8188	-2,71692	2607	CTD	at depth	
PS107_22-6	2017-08-03	08:22	78,8176	-2,7332	2603	CTD	station end	
PS107_22-7	2017-08-03	08:31	78,8172	-2,74669	2601	BONGO	station start	
PS107_22-7	2017-08-03	08:53	78,8195	-2,76917	2596	BONGO	station end	
PS107_22-8	2017-08-03	12:52	78,8165	-2,73325	2603	DSTRM	station start	
PS107_22-8	2017-08-03	13:20	78,8179	-2,74247	2601	DSTRM	station end	
PS107_22-9	2017-08-03	13:44	78,8195	-2,76	2597	SPR	station start	
PS107_22-9	2017-08-03	14:27	78,8205	-2,77493	2594	SPR	at depth	
PS107_22-9	2017-08-03	14:44	78,8204	-2,77995	2593	SPR	station end	
PS107_22-10	2017-08-03	15:08	78,8201	-2,78627	2592	TVMUC	station start	
PS107_22-10	2017-08-03	15:49	78,8193	-2,79723	2590	TVMUC	at depth	
PS107_22-10	2017-08-03	16:30	78,8194	-2,82431	2585	TVMUC	station end	
PS107_22-11	2017-08-03	16:43	78,8191	-2,83555	2582	GKG	station start	
PS107_22-11	2017-08-03	17:26	78,8181	-2,84944	2579	GKG	at depth	
PS107_22-11	2017-08-03	18:14	78,816	-2,86651	2576	GKG	station end	
PS107_22-12	2017-08-03	20:26	78,8453	-3,64207	2206	NEMICAT	station start	
PS107_22-12	2017-08-03	20:27	78,8452	-3,64021	2207	NEMICAT	profile start	
PS107_22-12	2017-08-03	21:02	78,8502	-3,75649	2122	NEMICAT	profile end	
PS107_22-12	2017-08-03	21:03	78,8505	-3,76023	2121	NEMICAT	station end	
PS107_23-1	2017-08-03	10:42	78,835	-2,8414	2579	MOOR	station start	EG_IV_C-3 recovery
PS107_23-1	2017-08-03	12:16	78,8428	-2,87071	2566	MOOR	station end	
PS107_24-1	2017-08-03	21:43	78,8568	-3,95239	1985	CTD	station start	
PS107_24-1	2017-08-03	22:33	78,8558	-3,94164	1992	CTD	at depth	
PS107_24-1	2017-08-03	23:15	78,8554	-3,94017	1993	CTD	station end	
PS107_24-2	2017-08-03	23:26	78,8552	-3,93937	1994	ISPC	station start	
PS107_24-2	2017-08-04	00:22	78,8539	-3,92854	2002	ISPC	at depth	
PS107_24-2	2017-08-04	00:57	78,854	-3,92633	2003	ISPC	station end	
PS107_24-3	2017-08-04	01:06	78,8541	-3,92924	2001	LOKI	station start	
PS107_24-3	2017-08-04	01:44	78,8532	-3,93197	1999	LOKI	at depth	
PS107_24-3	2017-08-04	02:18	78,8525	-3,92664	2002	LOKI	station end	
PS107_24-4	2017-08-04	02:30	78,8528	-3,93243	1998	MN_M7	station start	
PS107_24-4	2017-08-04	03:24	78,851	-3,93344	1996	MN_M7	at depth	
PS107_24-4	2017-08-04	04:25	78,8503	-3,93868	1990	MN_M7	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_24-5	2017-08-04	04:33	78,8509	-3,94137	1988	SPR	station start	
PS107_24-5	2017-08-04	05:17	78,8518	-3,94517	1986	SPR	at depth	
PS107_24-5	2017-08-04	05:34	78,8525	-3,94756	1985	SPR	station end	
PS107_24-6	2017-08-04	05:46	78,8535	-3,95054	1983	TVMUC	station start	
PS107_24-6	2017-08-04	06:21	78,855	-3,95167	1983	TVMUC	at depth	
PS107_24-6	2017-08-04	06:50	78,8558	-3,95185	1984	TVMUC	station end	
PS107_24-7	2017-08-04	07:06	78,856	-3,95339	1983	GKG	station start	
PS107_24-7	2017-08-04	07:39	78,8546	-3,96023	1976	GKG	at depth	
PS107_24-7	2017-08-04	08:16	78,8526	-3,97451	1963	GKG	station end	
PS107_25-1	2017-08-04	10:59	78,8314	-2,79195	2589	CTD	station start	
PS107_25-1	2017-08-04	11:11	78,8311	-2,79184	2589	CTD	at depth	
PS107_25-1	2017-08-04	11:16	78,831	-2,79173	2589	CTD	station end	
PS107_25-2	2017-08-04	11:23	78,831	-2,79081	2589	MOOR	station start	EG_IV-C-4 deployment
PS107_25-2	2017-08-04	13:06	78,8309	-2,79164	2589	MOOR	station end	
PS107_26-1	2017-08-04	15:43	79,0241	-3,00581	2422	DSTRM	station start	
PS107_26-1	2017-08-04	16:06	79,0284	-3,00843	2421	DSTRM	station end	
PS107_26-2	2017-08-04	16:26	79,0314	-3,00668	2419	ISPC	station start	
PS107_26-2	2017-08-04	16:57	79,038	-3,01471	2410	ISPC	at depth	
PS107_26-2	2017-08-04	17:16	79,0418	-3,02205	2405	ISPC	station end	
PS107_27-1	2017-08-04	19:00	78,9186	-2,95575	2515	OFOS	station start	
PS107_27-1	2017-08-04	20:49	78,9095	-2,98157	2513	OFOS	profile start	
PS107_27-1	2017-08-04	23:23	78,8878	-3,04036	2510	OFOS	profile end	
PS107_27-1	2017-08-05	00:02	78,8874	-3,03847	2511	OFOS	station end	
PS107_28-1	2017-08-05	03:40	78,9336	-4,63918	1554	CTDOZE	station start	
PS107_28-1	2017-08-05	04:19	78,9336	-4,6348	1557	CTDOZE	at depth	
PS107_28-1	2017-08-05	04:58	78,9295	-4,63149	1551	CTDOZE	station end	
PS107_28-2	2017-08-05	05:05	78,9334	-4,63464	1556	ISPC	station start	
PS107_28-2	2017-08-05	05:55	78,9296	-4,63157	1551	ISPC	at depth	
PS107_28-2	2017-08-05	06:30	78,9292	-4,62486	1555	ISPC	station end	
PS107_28-3	2017-08-05	07:04	78,9316	-4,64345	1547	LOKI	station start	
PS107_28-3	2017-08-05	07:41	78,926	-4,62997	1548	LOKI	at depth	
PS107_28-3	2017-08-05	08:18	78,9252	-4,63419	1544	LOKI	station end	
PS107_28-4	2017-08-05	08:24	78,9246	-4,63341	1545	MN_M7	station start	
PS107_28-4	2017-08-05	09:21	78,9178	-4,62472	1543	MN_M7	at depth	
PS107_28-4	2017-08-05	10:15	78,914	-4,62347	1534	MN_M7	station end	
PS107_28-5	2017-08-05	10:21	78,9153	-4,61868	1540	SPR	station start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_28-5	2017-08-05	11:11	78,9133	-4,60304	1550	SPR	at depth	
PS107_28-5	2017-08-05	11:25	78,9126	-4,59898	1551	SPR	station end	
PS107_28-6	2017-08-05	11:53	78,9373	-4,63597	1561	TVMUC	station start	
PS107_28-6	2017-08-05	12:22	78,935	-4,63877	1557	TVMUC	at depth	
PS107_28-6	2017-08-05	12:51	78,9329	-4,63559	1556	TVMUC	station end	
PS107_28-7	2017-08-05	13:04	78,9326	-4,62905	1559	GKG	station start	
PS107_28-7	2017-08-05	13:31	78,9338	-4,61854	1569	GKG	at depth	
PS107_28-7	2017-08-05	14:04	78,9359	-4,6129	1576	GKG	station end	
PS107_28-8	2017-08-05	14:17	78,9341	-4,59441	1587	BONGO	station start	
PS107_28-8	2017-08-05	14:21	78,9325	-4,58451	1592	BONGO	at depth	
PS107_28-8	2017-08-05	14:21	78,9323	-4,5838	1592	BONGO	profile start	
PS107_28-8	2017-08-05	14:31	78,9256	-4,58023	1588	BONGO	profile end	
PS107_28-8	2017-08-05	14:34	78,9244	-4,58743	1581	BONGO	station end	
PS107_28-9	2017-08-05	14:39	78,9243	-4,60085	1570	BONGO	station start	
PS107_28-9	2017-08-05	15:00	78,928	-4,58267	1590	BONGO	at depth	
PS107_28-9	2017-08-05	15:18	78,9163	-4,57285	1581	BONGO	station end	
PS107_29-1	2017-08-05	22:07	78,9914	-5,45271	982	CTDOZE	station start	
PS107_29-1	2017-08-05	22:52	78,9949	-5,47351	980	CTDOZE	at depth	
PS107_29-1	2017-08-06	01:46	78,9973	-5,48591	978	CTDOZE	station end	
PS107_29-2	2017-08-06	02:01	78,9971	-5,48286	980	MSC	at depth	
PS107_29-2	2017-08-06	02:04	78,997	-5,48254	980	MSC	station end	
PS107_29-3	2017-08-06	02:12	78,9969	-5,48275	980	MSC	station start	
PS107_29-3	2017-08-06	02:16	78,9968	-5,48278	980	MSC	at depth	
PS107_29-3	2017-08-06	02:22	78,9965	-5,48282	979	MSC	station end	
PS107_29-4	2017-08-06	03:25	78,9914	-5,49014	961	ISPC	at depth	
PS107_29-4	2017-08-06	03:58	78,9885	-5,49925	949	ISPC	station end	
PS107_29-5	2017-08-06	04:10	78,9897	-5,47318	968	LOKI	station start	
PS107_29-5	2017-08-06	04:45	78,9871	-5,47888	960	LOKI	at depth	
PS107_29-5	2017-08-06	05:19	78,9835	-5,48575	948	LOKI	station end	
PS107_29-6	2017-08-06	05:29	78,9897	-5,47563	968	MN_M7	station start	
PS107_29-6	2017-08-06	06:01	78,9879	-5,47638	963	MN_M7	at depth	
PS107_29-6	2017-08-06	06:40	78,9829	-5,4849	948	MN_M7	station end	
PS107_29-7	2017-08-06	06:52	78,9816	-5,49137	941	MN_B7	station start	
PS107_29-7	2017-08-06	07:24	78,9789	-5,50437	926	MN_B7	at depth	
PS107_29-7	2017-08-06	08:01	78,9774	-5,51279	918	MN_B7	station end	
PS107_29-8	2017-08-06	08:05	78,977	-5,51327	917	BONGO	station start	
PS107_29-8	2017-08-06	08:12	78,9767	-5,5126	917	BONGO	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_29-8	2017-08-06	08:17	78,9764	-5,51305	916	BONGO	station end	
PS107_29-8	2017-08-06	08:18	78,9763	-5,51276	916	BONGO	station start	
PS107_29-8	2017-08-06	08:22	78,9761	-5,5127	916	BONGO	at depth	
PS107_29-8	2017-08-06	08:28	78,9754	-5,51425	914	BONGO	station end	
PS107_29-8	2017-08-06	08:28	78,9753	-5,51451	914	BONGO	station start	
PS107_29-8	2017-08-06	08:33	78,9747	-5,51304	914	BONGO	at depth	
PS107_29-8	2017-08-06	08:38	78,9733	-5,51455	909	BONGO	station end	
PS107_29-8	2017-08-06	08:38	78,9733	-5,51459	909	BONGO	station start	
PS107_29-8	2017-08-06	08:42	78,9723	-5,51845	905	BONGO	at depth	
PS107_29-8	2017-08-06	08:47	78,9718	-5,51885	903	BONGO	station end	
PS107_29-9	2017-08-06	09:41	78,9904	-5,45358	980	TVMUC	station start	
PS107_29-9	2017-08-06	10:01	78,9917	-5,45615	981	TVMUC	at depth	
PS107_29-9	2017-08-06	10:21	78,9908	-5,46046	977	TVMUC	station end	
PS107_29-10	2017-08-06	10:33	78,9907	-5,46239	976	GKG	station start	
PS107_29-10	2017-08-06	10:52	78,9905	-5,46557	974	GKG	at depth	
PS107_29-10	2017-08-06	11:12	78,9907	-5,47088	972	GKG	station end	
PS107_29-11	2017-08-06	11:29	78,9836	-5,48349	951	BONGO	station start	
PS107_29-11	2017-08-06	11:32	78,9846	-5,48426	952	BONGO	at depth	
PS107_29-11	2017-08-06	11:32	78,9848	-5,48437	952	BONGO	profile start	
PS107_29-11	2017-08-06	11:42	78,9896	-5,47867	967	BONGO	profile end	
PS107_29-11	2017-08-06	11:46	78,9914	-5,47462	973	BONGO	station end	
PS107_29-12	2017-08-06	11:55	78,9924	-5,47658	972	BONGO	station start	
PS107_29-12	2017-08-06	12:08	78,9847	-5,48882	949	BONGO	at depth	
PS107_29-12	2017-08-06	12:21	78,9793	-5,51734	916	BONGO	station end	
PS107_29-13	2017-08-06	12:58	78,9708	-5,2339	1129	NEMICAT	station start	
PS107_29-13	2017-08-06	12:59	78,9708	-5,22733	1134	NEMICAT	profile start	
PS107_29-13	2017-08-06	13:47	78,9906	-4,96152	1341	NEMICAT	profile end	
PS107_29-13	2017-08-06	13:50	78,9918	-4,94895	1353	NEMICAT	station end	
PS107_30-1	2017-08-06	17:30	79,3006	-1,99625	2573	CTDOZE	station start	
PS107_30-1	2017-08-06	18:06	79,3015	-1,99627	2573	CTDOZE	at depth	
PS107_30-1	2017-08-06	18:43	79,3003	-1,99195	2573	CTDOZE	station end	
PS107_30-2	2017-08-06	18:52	79,2997	-1,99026	2573	MN_M7	station start	
PS107_30-2	2017-08-06	19:48	79,3006	-1,99668	2573	MN_M7	at depth	
PS107_30-2	2017-08-06	20:41	79,3004	-2,00018	2573	MN_M7	station end	
PS107_30-3	2017-08-06	20:49	79,3004	-2,0063	2573	BONGO	station start	
PS107_30-3	2017-08-06	20:52	79,3012	-2,01164	2573	BONGO	at depth	
PS107_30-3	2017-08-06	21:05	79,3064	-1,99855	2573	BONGO	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_30-4	2017-08-06	21:13	79,3078	-2,00158	2572	BONGO	station start	
PS107_30-4	2017-08-06	21:30	79,3146	-2,01028	2571	BONGO	at depth	
PS107_30-4	2017-08-06	21:46	79,3209	-1,99402	2584	BONGO	station end	
PS107_31-1	2017-08-07	00:24	79,434	0,00098	2880	CTDOZE	station start	
PS107_31-1	2017-08-07	01:00	79,4339	0,00266	2880	CTDOZE	at depth	
PS107_31-1	2017-08-07	01:44	79,4334	0,00437	2881	CTDOZE	station end	
PS107_31-2	2017-08-07	01:50	79,4334	0,00406	2881	LOKI	station start	
PS107_31-2	2017-08-07	02:28	79,433	0,00356	2881	LOKI	at depth	
PS107_31-2	2017-08-07	03:02	79,4333	-0,001	2880	LOKI	station end	
PS107_31-3	2017-08-07	03:11	79,4328	-0,00075	2880	MN_M7	station start	
PS107_31-3	2017-08-07	03:59	79,4319	-0,00873	2879	MN_M7	at depth	
PS107_31-3	2017-08-07	04:50	79,4304	-0,01713	2879	MN_M7	station end	
PS107_31-4	2017-08-07	04:57	79,4303	-0,01928	2879	BONGO	station start	
PS107_31-4	2017-08-07	05:02	79,4303	-0,02135	2878	BONGO	at depth	
PS107_31-4	2017-08-07	05:06	79,4301	-0,02214	2878	BONGO	station end	
PS107_31-5	2017-08-07	05:09	79,4298	-0,01972	2873	BONGO	station start	
PS107_31-5	2017-08-07	05:13	79,4298	-0,02094	2879	BONGO	at depth	
PS107_31-5	2017-08-07	05:19	79,4297	-0,02281	2879	BONGO	station end	
PS107_31-6	2017-08-07	05:22	79,4296	-0,02204	2879	BONGO	station start	
PS107_31-6	2017-08-07	05:26	79,4295	-0,02266	2879	BONGO	at depth	
PS107_31-6	2017-08-07	05:31	79,4294	-0,02332	2879	BONGO	station end	
PS107_31-7	2017-08-07	05:32	79,4294	-0,02387	2879	BONGO	station start	
PS107_31-7	2017-08-07	05:36	79,4294	-0,02666	2878	BONGO	at depth	
PS107_31-7	2017-08-07	05:42	79,4294	-0,02974	2877	BONGO	station end	
PS107_31-8	2017-08-07	05:57	79,4339	-0,02344	2874	BONGO	station start	
PS107_31-8	2017-08-07	06:01	79,4358	-0,01914	2873	BONGO	at depth	
PS107_31-8	2017-08-07	06:12	79,4381	0,01294	2875	BONGO	station end	
PS107_31-9	2017-08-07	06:20	79,4384	0,0351	2878	BONGO	station start	
PS107_31-9	2017-08-07	06:33	79,4319	0,04401	2893	BONGO	at depth	
PS107_31-9	2017-08-07	06:54	79,4291	-0,01036	2882	BONGO	station end	
PS107_32-1	2017-08-07	10:50	79,5833	2,00726	2283	CTDOZE	station start	
PS107_32-1	2017-08-07	11:28	79,5821	2,01182	2324	CTDOZE	at depth	
PS107_32-1	2017-08-07	12:07	79,5825	2,00192	2331	CTDOZE	station end	
PS107_32-2	2017-08-07	12:15	79,5828	2,00152	2303	MN_M7	station start	
PS107_32-2	2017-08-07	13:08	79,5848	2,01305	2202	MN_M7	at depth	
PS107_32-2	2017-08-07	14:01	79,5854	2,03462	2341	MN_M7	station end	
PS107_32-3	2017-08-07	14:12	79,5844	2,032	2350	BONGO	station start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_32-3	2017-08-07	14:14	79,584	2,02722	2333	BONGO	at depth	
PS107_32-3	2017-08-07	14:14	79,584	2,02713	2333	BONGO	profile start	
PS107_32-3	2017-08-07	14:24	79,5864	2,00496	2133	BONGO	profile end	
PS107_32-3	2017-08-07	14:29	79,5886	2,00163	2048	BONGO	station end	
PS107_32-4	2017-08-07	14:34	79,5908	2,00372	2014	BONGO	station start	
PS107_32-4	2017-08-07	14:50	79,593	2,0528	2348	BONGO	at depth	
PS107_32-4	2017-08-07	15:08	79,5886	2,10299	2533	BONGO	station end	
PS107_33-1	2017-08-07	19:01	79,7378	4,41932	2623	CTDOZE	station start	
PS107_33-1	2017-08-07	19:56	79,7376	4,43503	2622	CTDOZE	at depth	
PS107_33-1	2017-08-07	21:18	79,7343	4,52255	2769	CTDOZE	station end	
PS107_33-2	2017-08-07	21:17	79,7343	4,52196	2769	MSC	station start	
PS107_33-2	2017-08-07	21:21	79,7343	4,52544	2769	MSC	at depth	
PS107_33-2	2017-08-07	21:26	79,7338	4,53035	2772	MSC	station end	
PS107_33-2	2017-08-07	21:31	79,7327	4,53437	2775	MSC	station start	
PS107_33-2	2017-08-07	21:34	79,732	4,53635	2777	MSC	at depth	
PS107_33-2	2017-08-07	21:38	79,7311	4,53904	2778	MSC	station end	
PS107_33-3	2017-08-07	21:43	79,7304	4,54309	2779	ISPC	station start	
PS107_33-3	2017-08-07	22:50	79,7236	4,57592	2740	ISPC	at depth	
PS107_33-3	2017-08-07	23:25	79,7221	4,57525	2740	ISPC	station end	
PS107_33-4	2017-08-07	23:45	79,7153	4,49285	2816	LOKI	station start	
PS107_33-4	2017-08-08	00:18	79,7154	4,49175	2816	LOKI	at depth	
PS107_33-4	2017-08-08	00:53	79,7164	4,4934	2813	LOKI	station end	
PS107_33-5	2017-08-08	01:02	79,7168	4,49403	2810	MN_M7	station start	
PS107_33-5	2017-08-08	01:54	79,7218	4,49026	2783	MN_M7	at depth	
PS107_33-5	2017-08-08	02:50	79,7259	4,49539	2763	MN_M7	station end	
PS107_33-6	2017-08-08	03:06	79,7261	4,50071	2778	CTDOZE	station start	
PS107_33-6	2017-08-08	03:18	79,7272	4,50292	2775	CTDOZE	at depth	
PS107_33-6	2017-08-08	03:31	79,7287	4,50533	2767	CTDOZE	station end	
PS107_33-7	2017-08-08	03:58	79,7348	4,42676	2646	TVMUC	station start	
PS107_33-7	2017-08-08	04:40	79,7379	4,43842	2620	TVMUC	at depth	
PS107_33-7	2017-08-08	05:27	79,7408	4,45881	2611	TVMUC	station end	
PS107_33-8	2017-08-08	07:37	79,7405	4,54506	2718	MOOR	station start	N4-2016-FE-VI-33 recovery
PS107_33-8	2017-08-08	11:04	79,7188	4,5477	2801	MOOR	station end	
PS107_33-9	2017-08-08	11:26	79,732	4,55094	2773	SPR	station start	
PS107_33-9	2017-08-08	12:12	79,7324	4,55227	2772	SPR	at depth	
PS107_33-9	2017-08-08	12:29	79,7327	4,5572	2771	SPR	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_33-10	2017-08-08	12:54	79,7328	4,56342	2758	DSTRM	station start	
PS107_33-10	2017-08-08	13:19	79,7341	4,56647	2752	DSTRM	station end	
PS107_34-1	2017-08-08	17:04	79,9631	2,92416	2617	CTDOZE	station start	
PS107_34-1	2017-08-08	18:18	79,9698	2,90667	2612	CTDOZE	at depth	
PS107_34-1	2017-08-08	21:14	79,9838	2,95027	2574	CTDOZE	station end	
PS107_34-2	2017-08-08	21:24	79,9864	2,95194	2570	LOKI	station start	
PS107_34-2	2017-08-08	22:01	79,9894	2,97023	2558	LOKI	at depth	
PS107_34-2	2017-08-08	22:37	79,9887	3,0071	2544	LOKI	station end	
PS107_34-3	2017-08-08	22:46	79,9881	3,01304	2543	MN_M7	station start	
PS107_34-3	2017-08-08	23:43	79,9903	3,02619	2535	MN_M7	at depth	
PS107_34-3	2017-08-09	00:41	79,9886	3,01713	2541	MN_M7	station end	
PS107_34-4	2017-08-09	00:58	79,9874	2,99379	2553	MN_M7	station start	
PS107_34-4	2017-08-09	01:52	79,9932	2,95527	2559	MN_M7	at depth	
PS107_34-4	2017-08-09	02:42	79,9996	2,93923	2553	MN_M7	station end	
PS107_34-5	2017-08-09	02:53	80,0003	2,93944	2552	CTDOZE	station start	
PS107_34-5	2017-08-09	03:06	80,0003	2,94023	2551	CTDOZE	at depth	
PS107_34-5	2017-08-09	03:19	80,0004	2,93934	2551	CTDOZE	station end	
PS107_34-6	2017-08-09	03:40	80,0021	2,93752	2550	SPR	station start	
PS107_34-6	2017-08-09	04:20	80,0094	2,8968	2557	SPR	at depth	
PS107_34-6	2017-08-09	04:39	80,013	2,88325	2555	SPR	station end	
PS107_34-7	2017-08-09	05:31	79,9603	2,94669	2606	TVMUC	station start	
PS107_34-7	2017-08-09	06:15	79,9632	2,93398	2610	TVMUC	at depth	
PS107_34-7	2017-08-09	06:56	79,9628	2,92959	2613	TVMUC	station end	
PS107_34-8	2017-08-09	07:05	79,9602	2,94009	2610	GKG	station start	
PS107_34-8	2017-08-09	07:54	79,9624	2,93059	2613	GKG	at depth	
PS107_34-8	2017-08-09	08:41	79,9609	2,92925	2619	GKG	station end	
PS107_34-9	2017-08-09	09:40	79,913	3,241	2548	BONGO	station start	
PS107_34-9	2017-08-09	09:43	79,9126	3,25165	2544	BONGO	at depth	
PS107_34-9	2017-08-09	09:55	79,9115	3,28728	2530	BONGO	station end	
PS107_34-10	2017-08-09	10:09	79,9133	3,3349	2513	BONGO	station start	
PS107_34-10	2017-08-09	10:23	79,9094	3,27362	2538	BONGO	at depth	
PS107_34-10	2017-08-09	10:42	79,9085	3,20039	2566	BONGO	station end	
PS107_34-11	2017-08-09	11:00	79,8879	3,27118	2555	NEMICAT	station start	
PS107_34-11	2017-08-09	11:05	79,8861	3,30864	2540	NEMICAT	profile start	
PS107_34-11	2017-08-09	11:52	79,8857	3,56903	2463	NEMICAT	profile end	
PS107_34-11	2017-08-09	11:55	79,8861	3,58426	2459	NEMICAT	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_35-1	2017-08-09	14:38	79,7288	4,49039	2740	MOOR	station start	N4-FEVI-35 deployment
PS107_35-1	2017-08-09	16:35	79,7413	4,52408	2693	MOOR	station end	
PS107_35-2	2017-08-09	18:49	79,7532	5,38713	1610	DSTRM	station start	
PS107_35-3	2017-08-09	19:12	79,7531	5,40681	1600	ISPC	station start	
PS107_35-3	2017-08-09	20:15	79,7512	5,47086	1576	ISPC	at depth	
PS107_35-3	2017-08-09	20:48	79,7501	5,50512	1565	ISPC	station end	
PS107_35-4	2017-08-09	23:11	79,7339	4,41988	2653	GKG	station start	
PS107_35-4	2017-08-10	00:02	79,7371	4,42819	2628	GKG	at depth	
PS107_35-4	2017-08-10	00:50	79,7418	4,45857	2610	GKG	station end	
PS107_36-1	2017-08-10	02:57	79,5878	5,17223	2778	CTDOZE	station start	
PS107_36-1	2017-08-10	02:58	79,5878	5,17211	2778	CTDOZE	at depth	
PS107_36-1	2017-08-10	03:10	79,5873	5,17282	2778	CTDOZE	station end	
PS107_36-2	2017-08-10	03:12	79,5873	5,17292	2778	CTDOZE	station start	
PS107_36-2	2017-08-10	04:27	79,5881	5,17398	2778	CTDOZE	at depth	
PS107_36-2	2017-08-10	07:42	79,5858	5,17482	2773	CTDOZE	station end	
PS107_36-3	2017-08-10	07:55	79,5868	5,17192	2776	SPR	station start	
PS107_36-3	2017-08-10	08:43	79,5805	5,14016	2812	SPR	at depth	
PS107_36-3	2017-08-10	09:01	79,5777	5,1282	2844	SPR	station end	
PS107_36-4	2017-08-10	09:28	79,5901	5,18793	2776	TVMUC	station start	
PS107_36-4	2017-08-10	10:17	79,5874	5,17608	2777	TVMUC	at depth	
PS107_36-4	2017-08-10	11:05	79,5875	5,1724	2777	TVMUC	station end	
PS107_36-5	2017-08-10	11:16	79,5876	5,17214	2777	GKG	station start	
PS107_36-5	2017-08-10	12:04	79,5879	5,17165	2777	GKG	at depth	
PS107_36-5	2017-08-10	12:52	79,5893	5,17468	2779	GKG	station end	
PS107_36-6	2017-08-10	13:23	79,5621	5,26207	2660	OFOS	station start	
PS107_36-6	2017-08-10	14:04	79,5668	5,26016	2654	OFOS	at depth	
PS107_36-6	2017-08-10	14:18	79,5694	5,25663	2654	OFOS	profile start	
PS107_36-6	2017-08-10	17:40	79,599	5,17437	2782	OFOS	profile end	
PS107_36-6	2017-08-10	18:24	79,6016	5,17083	2784	OFOS	station end	
PS107_36-7	2017-08-10	21:03	79,3315	4,796	2344	NEMICAT	station start	
PS107_36-7	2017-08-10	21:53	79,3158	4,60645	2398	NEMICAT	station end	
PS107_37-1	2017-08-10	23:45	79,1069	4,60422	1923	CTDOZE	station start	
PS107_37-1	2017-08-11	00:29	79,1082	4,59935	1892	CTDOZE	at depth	
PS107_37-1	2017-08-11	01:16	79,1081	4,599	1889	CTDOZE	station end	
PS107_37-2	2017-08-11	01:27	79,1078	4,59615	1900	GKG	station start	
PS107_37-2	2017-08-11	02:02	79,1069	4,59556	1911	GKG	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_37-2	2017-08-11	02:38	79,1038	4,58755	1976	GKG	station end	
PS107_38-1	2017-08-11	04:01	79,0004	4,33416	2609	MOOR	station start	HG_IV-FE-VI-36 deployment
PS107_38-1	2017-08-11	06:05	79	4,33371	2609	MOOR	station end	
PS107_38-2	2017-08-11	06:44	79,0226	4,26293	2599	MOOR	station start	HG-IV-S-2 deployment
PS107_38-2	2017-08-11	08:17	79,0228	4,26217	2599	MOOR	station end	
PS107_38-3	2017-08-11	08:54	79,0224	4,40802	2536	TVMUC	station start	
PS107_38-3	2017-08-11	09:39	79,0227	4,40395	2536	TVMUC	at depth	
PS107_38-3	2017-08-11	10:22	79,0232	4,4038	2535	TVMUC	station end	
PS107_38-4	2017-08-11	10:44	79,0232	4,40224	2536	MOOR	station start	SWIPS-2017 deployment
PS107_38-4	2017-08-11	12:12	79,0232	4,40518	2535	MOOR	station end	
PS107_38-5	2017-08-11	12:29	79,0197	4,44641	2508	BONGO	at depth	
PS107_38-5	2017-08-11	12:30	79,0196	4,44717	2506	BONGO	profile start	
PS107_38-5	2017-08-11	12:40	79,015	4,47481	2510	BONGO	profile end	
PS107_38-5	2017-08-11	12:43	79,0135	4,48427	2514	BONGO	station end	
PS107_38-6	2017-08-11	12:48	79,0115	4,49598	2495	BONGO	station start	
PS107_38-6	2017-08-11	13:04	79,0044	4,53784	2500	BONGO	at depth	
PS107_38-6	2017-08-11	13:20	78,9972	4,57922	2528	BONGO	station end	
PS107_38-7	2017-08-11	14:22	79,0779	4,11215	2494	LAND	station start	2017-Long-term-Lander deployment
PS107_39-1	2017-08-11	15:12	79,0462	3,59754	3375	GKG	station start	
PS107_39-1	2017-08-11	16:12	79,0465	3,60408	3352	GKG	at depth	
PS107_39-1	2017-08-11	17:13	79,0478	3,6206	3257	GKG	station end	
PS107_40-1	2017-08-11	17:22	79,0493	3,64928	3113	CTDTS	station start	
PS107_40-1	2017-08-11	18:55	79,0983	4,55406	2090	CTDTS	station end	
PS107_40-2	2017-08-12	08:55	79,1311	4,90378	1539	CTDTS	station start	
PS107_40-2	2017-08-12	08:57	79,1315	4,90818	1534	CTDTS	profile start	
PS107_40-2	2017-08-12	11:00	79,1398	6,08921	1283	CTDTS	profile end	
PS107_40-2	2017-08-12	11:01	79,1404	6,09192	1284	CTDTS	station end	
PS107_40-3	2017-08-13	06:20	79,1359	6,12828	1275	CTDTS	station start	
PS107_40-3	2017-08-13	06:28	79,1294	6,17485	1268	CTDTS	profile start	
PS107_40-3	2017-08-13	08:01	79,0197	6,9109	1260	CTDTS	profile end	
PS107_40-3	2017-08-13	08:04	79,0168	6,93128	1260	CTDTS	station end	
PS107_40-4	2017-08-13	21:27	79,0338	7,00028	1307	CTDTS	station start	
PS107_40-4	2017-08-13	21:32	79,0331	7,04959	1313	CTDTS	profile start	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_40-4	2017-08-13	23:40	79,0055	8,30545	837	CTDTS	profile end	
PS107_40-4	2017-08-13	23:43	79,0048	8,33547	800	CTDTS	station end	
PS107_40-5	2017-08-14	14:38	79,0049	8,37927	739	CTDTS	station start	
PS107_40-5	2017-08-14	16:34	78,982	9,50975	232	CTDTS	station end	
PS107_40-6	2017-08-14	20:05	78,9831	9,49812	232	CTDTS	station start	
PS107_40-6	2017-08-14	20:13	78,9818	9,51005	231	CTDTS	profile start	
PS107_40-6	2017-08-14	22:40	79,0245	10,99252	330	CTDTS	profile end	
PS107_40-6	2017-08-14	22:41	79,0245	11,00981	327	CTDTS	station end	
PS107_41-1	2017-08-11	19:08	79,1054	4,5986	1945	TVMUC	station start	
PS107_41-1	2017-08-11	19:46	79,1061	4,59159	1926	TVMUC	at depth	
PS107_41-1	2017-08-11	20:18	79,1044	4,58664	1963	TVMUC	station end	
PS107_42-1	2017-08-11	21:13	79,1309	4,90035	1542	CTDOZE	station start	
PS107_42-1	2017-08-11	21:58	79,1308	4,9029	1540	CTDOZE	at depth	
PS107_42-1	2017-08-11	22:46	79,1309	4,90313	1540	CTDOZE	station end	
PS107_42-2	2017-08-11	22:54	79,1309	4,90264	1540	MSC	station start	
PS107_42-2	2017-08-11	22:59	79,1308	4,90236	1541	MSC	at depth	
PS107_42-2	2017-08-11	23:05	79,1308	4,90222	1541	MSC	station end	
PS107_42-2	2017-08-11	23:10	79,1309	4,9022	1541	MSC	station start	
PS107_42-2	2017-08-11	23:13	79,1308	4,90217	1541	MSC	at depth	
PS107_42-2	2017-08-11	23:17	79,1307	4,90225	1542	MSC	station end	
PS107_42-3	2017-08-11	23:25	79,1306	4,90282	1542	ISPC	station start	
PS107_42-3	2017-08-12	00:25	79,1311	4,90283	1540	ISPC	at depth	
PS107_42-3	2017-08-12	01:00	79,1313	4,90471	1537	ISPC	station end	
PS107_42-4	2017-08-12	01:05	79,1314	4,90538	1536	MN_M7	station start	
PS107_42-4	2017-08-12	02:01	79,1313	4,90325	1538	MN_M7	at depth	
PS107_42-4	2017-08-12	02:51	79,1312	4,90031	1541	MN_M7	station end	
PS107_42-5	2017-08-12	03:00	79,1312	4,90424	1538	CTDOZE	station start	
PS107_42-5	2017-08-12	03:11	79,1312	4,90589	1537	CTDOZE	at depth	
PS107_42-5	2017-08-12	03:19	79,131	4,90531	1538	CTDOZE	station end	
PS107_42-6	2017-08-12	03:27	79,1307	4,90407	1541	BONGO	station start	
PS107_42-6	2017-08-12	03:31	79,1306	4,90316	1542	BONGO	at depth	
PS107_42-6	2017-08-12	03:35	79,1306	4,90269	1542	BONGO	station end	
PS107_42-7	2017-08-12	03:38	79,1306	4,90259	1543	BONGO	station start	
PS107_42-7	2017-08-12	03:43	79,1305	4,90244	1543	BONGO	at depth	
PS107_42-7	2017-08-12	03:47	79,1305	4,90264	1543	BONGO	station end	
PS107_42-8	2017-08-12	03:51	79,1305	4,90339	1542	BONGO	station start	
PS107_42-8	2017-08-12	03:55	79,1306	4,90412	1541	BONGO	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_42-8	2017-08-12	04:03	79,1322	4,90818	1529	BONGO	station end	
PS107_42-9	2017-08-12	04:04	79,1322	4,90792	1530	BONGO	station start	
PS107_42-9	2017-08-12	04:08	79,1322	4,90696	1531	BONGO	at depth	
PS107_42-9	2017-08-12	04:15	79,1339	4,91075	1518	BONGO	station end	
PS107_42-10	2017-08-12	04:18	79,1337	4,90955	1521	BONGO	station start	
PS107_42-10	2017-08-12	04:22	79,134	4,9095	1520	BONGO	at depth	
PS107_42-10	2017-08-12	04:28	79,1357	4,91271	1507	BONGO	station end	
PS107_42-11	2017-08-12	04:39	79,1313	4,89816	1542	SPR	station start	
PS107_42-11	2017-08-12	05:18	79,1313	4,90289	1538	SPR	at depth	
PS107_42-11	2017-08-12	05:33	79,1308	4,90159	1542	SPR	station end	
PS107_42-12	2017-08-12	05:42	79,1307	4,90155	1543	TVMUC	station start	
PS107_42-12	2017-08-12	06:08	79,1309	4,90142	1542	TVMUC	at depth	
PS107_42-12	2017-08-12	06:32	79,131	4,90242	1540	TVMUC	station end	
PS107_42-13	2017-08-12	06:44	79,1307	4,90223	1541	GKG	station start	
PS107_42-13	2017-08-12	07:13	79,1311	4,90262	1539	GKG	at depth	
PS107_42-13	2017-08-12	07:41	79,1308	4,90198	1541	GKG	station end	
PS107_42-14	2017-08-12	07:55	79,1312	4,90354	1538	TVMUC	station start	
PS107_42-14	2017-08-12	08:22	79,1311	4,90348	1538	TVMUC	at depth	
PS107_42-14	2017-08-12	08:50	79,1309	4,90231	1540	TVMUC	station end	
PS107_43-1	2017-08-12	11:10	79,1412	6,09348	1286	CTDOZE	station start	
PS107_43-1	2017-08-12	12:02	79,1402	6,09081	1284	CTDOZE	at depth	
PS107_43-1	2017-08-12	14:34	79,1422	6,1016	1289	CTDOZE	station end	
PS107_43-2	2017-08-12	14:44	79,1428	6,10742	1290	SPR	station start	
PS107_43-2	2017-08-12	15:21	79,1422	6,1094	1289	SPR	at depth	
PS107_43-2	2017-08-12	15:38	79,1438	6,10376	1292	SPR	station end	
PS107_43-3	2017-08-12	15:58	79,1414	6,10586	1287	MSC	station start	
PS107_43-3	2017-08-12	16:02	79,1413	6,10557	1287	MSC	at depth	
PS107_43-3	2017-08-12	16:07	79,1412	6,10464	1287	MSC	station end	
PS107_43-4	2017-08-12	16:13	79,1418	6,10139	1288	MSC	station start	
PS107_43-4	2017-08-12	16:15	79,1422	6,10011	1280	MSC	at depth	
PS107_43-4	2017-08-12	16:17	79,1426	6,0989	1289	MSC	station end	
PS107_43-5	2017-08-12	16:27	79,1449	6,0927	1295	ISPC	station start	
PS107_43-5	2017-08-12	17:20	79,1507	6,10579	1310	ISPC	at depth	
PS107_43-5	2017-08-12	17:51	79,1532	6,11299	1318	ISPC	station end	
PS107_43-6	2017-08-12	17:59	79,1528	6,11387	1317	CTDOZE	station start	
PS107_43-6	2017-08-12	18:12	79,1528	6,11524	1317	CTDOZE	at depth	
PS107_43-6	2017-08-12	18:26	79,1521	6,1132	1315	CTDOZE	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_43-7	2017-08-12	18:28	79,152	6,11279	1315	LOKI	station start	
PS107_43-7	2017-08-12	19:10	79,1551	6,11867	1324	LOKI	at depth	
PS107_43-7	2017-08-12	19:44	79,1595	6,12879	1338	LOKI	station end	
PS107_43-8	2017-08-12	20:20	79,1387	6,08493	1282	MN_M7	station start	
PS107_43-8	2017-08-12	21:04	79,1439	6,09125	1292	MN_M7	at depth	
PS107_43-8	2017-08-12	21:52	79,1498	6,09699	1306	MN_M7	station end	
PS107_43-9	2017-08-12	22:22	79,1386	6,07331	1282	TVMUC	station start	
PS107_43-9	2017-08-12	22:44	79,1397	6,07125	1284	TVMUC	at depth	
PS107_43-9	2017-08-12	23:08	79,1401	6,06755	1285	TVMUC	station end	
PS107_43-10	2017-08-12	23:18	79,1398	6,08635	1283	GKG	station start	
PS107_43-10	2017-08-12	23:46	79,1425	6,0836	1289	GKG	at depth	
PS107_43-10	2017-08-13	00:14	79,1431	6,07533	1291	GKG	station end	
PS107_43-11	2017-08-13	00:25	79,1451	6,07739	1295	NEMICAT	station start	
PS107_43-11	2017-08-13	00:29	79,1494	6,08652	1305	NEMICAT	profile start	
PS107_43-11	2017-08-13	01:14	79,2036	6,21332	1471	NEMICAT	profile end	
PS107_43-11	2017-08-13	01:16	79,2054	6,21765	1477	NEMICAT	station end	
PS107_43-12	2017-08-13	02:19	79,134	6,29221	1343	OFOS	station start	
PS107_43-12	2017-08-13	02:48	79,1325	6,26809	1322	OFOS	at depth	
PS107_43-12	2017-08-13	02:58	79,1322	6,26271	1318	OFOS	profile start	
PS107_43-12	2017-08-13	05:54	79,1337	6,12993	1271	OFOS	profile end	
PS107_43-12	2017-08-13	06:16	79,1356	6,1256	1275	OFOS	station end	
PS107_44-1	2017-08-13	09:23	79,0119	6,94896	1254	MOOR	station start	F4-S-1 recovery
PS107_44-1	2017-08-13	10:05	79,0087	6,93211	1236	MOOR	station end	
PS107_44-2	2017-08-13	10:32	79,0329	6,97259	1302	DSTRM	station start	
PS107_44-2	2017-08-13	10:48	79,0332	6,97172	1302	DSTRM	station end	
PS107_44-3	2017-08-13	11:21	79,0336	7,00316	1307	CTDOZE	station start	
PS107_44-3	2017-08-13	11:53	79,0341	7,00186	1308	CTDOZE	at depth	
PS107_44-3	2017-08-13	12:28	79,0338	6,99877	1308	CTDOZE	station end	
PS107_44-4	2017-08-13	12:42	79,0339	7,0037	1308	SPR	station start	
PS107_44-4	2017-08-13	13:30	79,0337	7,00107	1308	SPR	at depth	
PS107_44-4	2017-08-13	13:52	79,0338	7,00224	1309	SPR	station end	
PS107_44-5	2017-08-13	13:59	79,0336	7,00043	1308	ISPC	station start	
PS107_44-5	2017-08-13	14:54	79,034	6,99532	1308	ISPC	at depth	
PS107_44-5	2017-08-13	15:26	79,0335	7,00291	1308	ISPC	station end	
PS107_44-6	2017-08-13	15:26	79,0335	7,00256	1309	LOKI	station start	
PS107_44-6	2017-08-13	16:04	79,0336	6,99975	1308	LOKI	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_44-6	2017-08-13	16:40	79,0341	6,99744	1308	LOKI	station end	
PS107_44-7	2017-08-13	16:54	79,0342	6,99446	1308	LOKI	station start	
PS107_44-7	2017-08-13	17:13	79,0342	6,99921	1309	LOKI	at depth	
PS107_44-7	2017-08-13	17:32	79,0342	6,99924	1309	LOKI	station end	
PS107_44-8	2017-08-13	17:41	79,0343	6,99651	1309	MN_M7	station start	
PS107_44-8	2017-08-13	18:26	79,034	6,99541	1308	MN_M7	at depth	
PS107_44-8	2017-08-13	19:12	79,0337	6,9995	1307	MN_M7	station end	
PS107_44-9	2017-08-13	19:23	79,0338	6,99601	1307	TVMUC	station start	
PS107_44-9	2017-08-13	19:52	79,0339	7,00066	1308	TVMUC	at depth	
PS107_44-9	2017-08-13	20:14	79,0334	7,00175	1307	TVMUC	station end	
PS107_44-10	2017-08-13	20:22	79,0335	6,9985	1306	GKG	station start	
PS107_44-10	2017-08-13	20:54	79,0337	6,99994	1307	GKG	at depth	
PS107_44-10	2017-08-13	21:18	79,0336	6,99659	1306	GKG	station end	
PS107_45-1	2017-08-13	23:52	79,0046	8,36297	760	CTDOZE	station start	
PS107_45-1	2017-08-14	00:16	79,0045	8,36365	759	CTDOZE	at depth	
PS107_45-1	2017-08-14	00:40	79,0047	8,36248	761	CTDOZE	station end	
PS107_45-2	2017-08-14	00:50	79,0044	8,3627	760	SPR	station start	
PS107_45-2	2017-08-14	01:23	79,0047	8,36391	759	SPR	at depth	
PS107_45-2	2017-08-14	01:36	79,0039	8,36452	759	SPR	station end	
PS107_45-3	2017-08-14	01:43	79,0038	8,36445	759	ISPC	station start	
PS107_45-3	2017-08-14	02:27	79,0039	8,36741	754	ISPC	at depth	
PS107_45-3	2017-08-14	02:52	79,0035	8,36959	751	ISPC	station end	
PS107_45-4	2017-08-14	03:03	79,0035	8,37063	750	MSC	station start	
PS107_45-4	2017-08-14	03:08	79,0037	8,37086	751	MSC	at depth	
PS107_45-4	2017-08-14	03:13	79,004	8,37077	751	MSC	station end	
PS107_45-5	2017-08-14	03:20	79,0044	8,37031	752	MSC	station start	
PS107_45-5	2017-08-14	03:23	79,0046	8,36996	753	MSC	at depth	
PS107_45-5	2017-08-14	03:29	79,0047	8,36977	753	MSC	station end	
PS107_45-6	2017-08-14	03:39	79,0042	8,36965	753	MN_M7	station start	
PS107_45-6	2017-08-14	04:06	79,0048	8,36728	756	MN_M7	at depth	
PS107_45-6	2017-08-14	04:34	79,0032	8,36471	760	MN_M7	station end	
PS107_45-7	2017-08-14	04:42	79,0035	8,36516	760	TVMUC	station start	
PS107_45-7	2017-08-14	04:57	79,0043	8,36628	757	TVMUC	at depth	
PS107_45-7	2017-08-14	05:14	79,0037	8,3649	761	TVMUC	station end	
PS107_45-8	2017-08-14	05:26	79,0037	8,36382	762	GKG	station start	
PS107_45-8	2017-08-14	05:44	79,0032	8,36481	760	GKG	at depth	
PS107_45-8	2017-08-14	06:02	79,0035	8,36533	760	GKG	station end	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_45-9	2017-08-14	06:06	79,0033	8,36478	760	BONGO	station start	
PS107_45-9	2017-08-14	06:22	78,9995	8,32684	806	BONGO	at depth	
PS107_45-9	2017-08-14	06:37	79,0036	8,28892	857	BONGO	station end	
PS107_45-10	2017-08-14	06:44	79,006	8,27154	878	BONGO	station start	
PS107_45-10	2017-08-14	07:00	79,009	8,22678	925	BONGO	at depth	
PS107_45-10	2017-08-14	07:19	79,0195	8,22279	939	BONGO	station end	
PS107_46-1	2017-08-14	10:12	79,0291	6,37932	1390	DSTRM	station start	
PS107_46-1	2017-08-14	10:38	79,0299	6,36981	1392	DSTRM	station end	
PS107_46-2	2017-08-14	10:50	79,0305	6,36902	1389	ISPC	station start	
PS107_46-2	2017-08-14	11:22	79,0325	6,36793	1384	ISPC	at depth	
PS107_46-2	2017-08-14	11:41	79,0326	6,36576	1384	ISPC	station end	
PS107_47-1	2017-08-14	16:44	78,9835	9,50781	236	CTDOZE	station start	
PS107_47-1	2017-08-14	16:55	78,9829	9,50807	235	CTDOZE	at depth	
PS107_47-1	2017-08-14	17:09	78,9818	9,50994	231	CTDOZE	station end	
PS107_47-2	2017-08-14	17:18	78,9819	9,50941	231	SPR	station start	
PS107_47-2	2017-08-14	17:52	78,9818	9,51151	232	SPR	at depth	
PS107_47-2	2017-08-14	18:08	78,983	9,50752	235	SPR	station end	
PS107_47-3	2017-08-14	18:09	78,9831	9,50707	235	ISPC	station start	
PS107_47-3	2017-08-14	18:26	78,9829	9,50514	234	ISPC	at depth	
PS107_47-3	2017-08-14	18:34	78,982	9,50764	232	ISPC	station end	
PS107_47-4	2017-08-14	18:40	78,9815	9,50876	231	MN_M7	station start	
PS107_47-4	2017-08-14	18:48	78,9808	9,50939	229	MN_M7	at depth	
PS107_47-4	2017-08-14	19:00	78,9815	9,50862	230	MN_M7	station end	
PS107_47-5	2017-08-14	19:13	78,981	9,50433	228	TVMUC	station start	
PS107_47-5	2017-08-14	19:21	78,9812	9,50675	229	TVMUC	at depth	
PS107_47-5	2017-08-14	19:28	78,9811	9,50662	228	TVMUC	station end	
PS107_47-6	2017-08-14	19:29	78,9811	9,50677	228	GKG	station start	
PS107_47-6	2017-08-14	19:47	78,9809	9,50417	228	GKG	at depth	
PS107_47-6	2017-08-14	19:54	78,9808	9,505	228	GKG	station end	
PS107_48-1	2017-08-14	22:59	79,0297	11,10072	287	CTDOZE	station start	
PS107_48-1	2017-08-14	23:11	79,0293	11,10169	287	CTDOZE	at depth	
PS107_48-1	2017-08-14	23:30	79,0285	11,0984	285	CTDOZE	station end	
PS107_48-2	2017-08-14	23:45	79,028	11,09838	283	SPR	station start	
PS107_48-2	2017-08-15	00:12	79,0275	11,09893	281	SPR	at depth	
PS107_48-2	2017-08-15	00:24	79,0277	11,09567	282	SPR	station end	
PS107_48-3	2017-08-15	00:29	79,0278	11,09399	283	ISPC	station start	
PS107_48-3	2017-08-15	00:47	79,0276	11,09511	282	ISPC	at depth	

Station	Date	Time	Latitude	Longitude	Depth (m)	Gear	Action	Comment
PS107_48-3	2017-08-15	00:57	79,0276	11,0957	282	ISPC	station end	
PS107_48-4	2017-08-15	01:00	79,0275	11,09576	282	MSC	station start	
PS107_48-4	2017-08-15	01:05	79,0276	11,09593	282	MSC	at depth	
PS107_48-4	2017-08-15	01:10	79,0276	11,09496	282	MSC	station end	
PS107_48-4	2017-08-15	01:14	79,0277	11,09439	283	MSC	station start	
PS107_48-4	2017-08-15	01:17	79,0277	11,09426	283	MSC	at depth	
PS107_48-4	2017-08-15	01:20	79,0277	11,09424	283	MSC	station end	
PS107_48-5	2017-08-15	01:33	79,0276	11,09485	282	TVMUC	station start	
PS107_48-5	2017-08-15	01:43	79,0275	11,09473	282	TVMUC	at depth	
PS107_48-5	2017-08-15	01:51	79,0276	11,09427	283	TVMUC	station end	
PS107_48-6	2017-08-15	02:02	79,0277	11,09358	283	TVMUC	station start	
PS107_48-6	2017-08-15	02:09	79,0278	11,09269	284	TVMUC	at depth	
PS107_48-6	2017-08-15	02:19	79,0278	11,0921	284	TVMUC	station end	
PS107_48-7	2017-08-15	02:25	79,0278	11,09159	284	GKG	station start	
PS107_48-7	2017-08-15	02:36	79,0278	11,09114	284	GKG	at depth	
PS107_48-7	2017-08-15	02:46	79,0276	11,09066	284	GKG	station end	
PS107_48-8	2017-08-15	03:09	79,0287	11,07704	286	NEMICAT	station start	
PS107_48-8	2017-08-15	03:11	79,0287	11,0695	287	NEMICAT	profile start	
PS107_48-8	2017-08-15	03:58	79,0276	10,79691	330	NEMICAT	profile end	
PS107_48-8	2017-08-15	04:02	79,0276	10,7746	330	NEMICAT	station end	
PS107_49-1	2017-08-15	08:27	79,0127	7,17109	1294	MOOR	station start	F4-S-2 deployment
PS107_49-1	2017-08-15	10:18	79,0117	6,96425	1260	MOOR	station end	

Gear abbreviations	Gear	Comment
ADCP_150	ADCP 150kHz	
BC	Box Corer	
BONGO	Bongo Net	
CTD	CTD aboard RV Polarstern	
CTDOZE	CTD AWI-OZE	
CTDTS	CTD Towed System	
DSTRM	Drifting Sediment-Trap Mooring	
FBOX	FerryBox	
GKG	Box Grab	
ISPC	In-Situ Particle Camera	
LAND	Lander	
LITTER	Litter Survey	
LOKI	Light Frame On-sight Keyspecies wInvestigation Messsystem	
MN_B7	Multinet Big 7 Nets	
MN_M7	Multinet Medium 7 Nets	
MN_S5	Multinet Small 5 Nets	
MOOR	Mooring	
MSC	Marine Snow Catcher	
NEMICAT	Neuston Microplastics Catamaran	
OFOS	Ocean Floor Observation System	
PCO2_GO	pCO2 GO	
PCO2_SUB	pCO2 Subctech	
PS	Parasound	
SPR	RAMSES	
SVP	Sound Velocity Profiler	
TSG_KEEL	Thermosalinograph Keel	
TVMUC	Video Multi Corer	
UCTD	Underway CTD	
WST	Weatherstation	

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