8. OVERARCHING AND SUPPORTING ACTIVITIES

Grant-No. AWI_PS122_00

8.1 Logistic & Safety

Gaute Hermansen[2], Trude Hohle[2], Hans Honold[2], Henning Kirk[1] (only Leg1a), Bjela König[1], Verena Mohaupt[1], Olaf Stenzel[1], Thomas Sterbenz[2], Audun Tholfsen[2], Christian Zoelly[2]

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Objectives

The main objective was the overall safe conduction of the expedition. Further, emergency procedures were to be developed and conducted.

For MOSAiC a specific safety concept based on the AWI safety standards as well as project specific needs and experiences from previous drift expeditions had been developed by B. König and V. Mohaupt. During Leg 1, this concept was to be implemented and – if necessary – adapted to the situation on site.

Work at sea

A safety briefing, including specific information about MOSAiC as well as general field safety and polar bear safety and awareness was mandatory for all participants before departure in Tromsø, to ensure a good level of general safety awareness and knowledge.

Once in the ice, conditions on the floe needed to be assessed and feasibility of rules and regulations needed to be verified. If required, the safety concept was adapted to match conditions. Expedition participants were informed directly as well as via corrections to the MOSAiC handbook. The science team was a consulted body during this process.

Current check of work safety standards was carried out by B. König. Necessary measures were taken if required and participants were briefed accordingly.

An incident report was developed. Analysis of incidents during Leg 1 as well as a questionnaire with all participants at the end of the expedition was carried out. Necessary measures were taken if needed.

The logistic team in general was the controlling body for the predefined safety rules and standards during the expedition. The main tasks were carrying out bridge watch, stern watch and polar bear watches on the ice. Further duties were the management of infrastructure and the distribution and maintenance of safety equipment including rifles and flare guns for polar bear protection.

The general responsibility for vehicles and vehicle maintenance (snow scooter, ARGO and Pistenbully) was in the hands of T. Sterbenz. An introduction regarding safe use of snow scooters and basic technical knowledge was required for all participants.

Mandatory refresh courses for weapon handling were held on site for all potential polar bear guards among participating scientists. Proper weapon handling was checked throughout the expedition. Regular maintenance of weapons and weapon equipment was carried out.

A tripwire fence as an early warning system was installed along the ‘spine’ (ridge with main power line and main road connecting the main worksites) for approximately 1km length.

The bridge watch was in charge of coordination and monitoring of the teams on the ice. In case of events (cracks, bad weather, polar bears, breaks ups) the logistic bridge watch was managing and advising the teams and inform and consult the cruise leader if needed. All actions were carried out in cooperation with the nautical officer on watch.

A key element for the logistic bridge watch was the use of the fixed installed infrared cameras. They did not only help regarding polar bears but also to obtain a general overview of the flow and teams on the ice. Set up and maintenance were carried out by B. König.

In case of polar bear encounters members of the logistic team – in consultation with the Cruiseleader – took measures to scare the animal(s) away.

According to the developed emergency concept, a member of the logistic team, together with the officer on watch would be in charge of a potential medical evacuation.

An exercise of such situation was carried out to assess the concept in terms of flaws and allow optimization in close contact with the ship’s management.

Organisation and management of freight and cargo issues was undertaken in close cooperation with the ships management by V. Mohaupt.

The logistic team assisted during the build-up, field trips and logistic operations (evacuation or moving of equipment) and took responsibility in maintenance of infrastructure (power lines, roads, shelters, ice holes, bridges).

Preliminary (expected) results

Not applicable

Data management

Not applicable

References

Not applicable

8.2 Data Support

Peter Gerchow[1], Antonia Immerz[1], Johannes Käßbohrer[2], Franziska Nehring[2]

(not on board:) Mohammad Ajjan[1], Norbert Anselm[1], Jan Bein[1], Benny Bräuer[1], Tilman Dinter[1], Amelie Driemel[1], Tobias Düde[1], Janik Eilers[1], Frank Oliver Glöckner[1], Michael Günster[1], Antonie Haas[1], Nico Harms[1], Sebastian Immoor[1], Roland Koppe[1], Herbert Liegmahl-Pieper[1], Ana Macario[1], Siegfried Makedanz[1], Jörg Matthes[1], Lukas Minnemann[1], Martin Petri[1], Hans Pfeiffenberger[1], Stefan Pinkernell[1], Henrik Plünnecke[1], Daniela Ransby[1], Steven Rehmcke[1], Angela Schäfer[1], Christian Schäfer-Neth[1], Jens-Michael Schlüter[1], Stefanie Schumacher[1], Ralf Spettnagel[1], Angelo Steinbach[1], Andreas Thiele[1], Frauke Thiele-Wolff[1], Malte Thoma[1],

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Andreas Walter[1], Philipp Weidinger[1], Stephan Frickenhaus[1]

Objectives

General accessibility of data requires a central data storage and a common meta data concept. All sensors and sampling devices used in scientific events during the MOSAiC expedition shall therefore be registered in SENSORWeb and all device operations performed during the expedition logged in the ships station book, the DSHIP ActionLog. A predefined structure on the MOSAiC central storage further ensures that data can be found in an organized manner, also after the expedition. In this way all subsequent sample analyses can then be referenced to the original sampling event. A full description of the data management concept in MOSAiC can be found in the MOSAiC Data Policy (see APPENDIX).

Work at sea

Two data supporters accompany every leg of MOSAiC. Their task is to ensure the functionality of the IT infrastructure provided on *Polarstern* which shall facilitate early data sharing among the MOSAiC consortium starting with fellow scientists on each respective leg. Since most of the infrastructure both in hard and software were first introduced in MOSAiC a main part of the data support task targets at the training of scientists in the concepts of the MOSAiC data management, adaptation of concepts to specific scientific workflows where necessary and the supervision of appropriate entry of meta data into the system and early upload of data to the central storage.

During the transfer and setup phase the data team consisted of four people, two of which left with the return of *Akademik Fedorov*. The enlarged team at the beginning of the cruise helped accelerate the setup and finetuning of the infrastructure on board *Polarstern* and on the ice.

The support tasks during leg PS122/1 included ensuring the reliable functionality of the central storage, creating backups of uploaded data on a regular basis to be manually transferred to the AWI after the leg. Further a network on the central floe, enlarging the *Polarstern* network was setup to enable connectivity of instruments on the ice to the ships network. This was done by deploying fibre optic cables between the ship and the main cities, Ocean City, Remote Sensing and Met City (see Figure 8.2.1). A radio link was setup to connect the ROV site to the network since the distance between the site and the main power hub exceeded the length of the provided cables. This turned out to be a more adequate solution as the ROV site underwent several migrations in the first three months. Due to several breakups of the floe, at the end of leg PS122/1 only Ocean City was connected by cable to reduce the repeated effort to repair the delicate cables. Other main measurement sites relied on the installation of radio links. Assistance was also provided to scientists when connecting their instruments to the network.

Besides trainings and assistance in using the provided infrastructure with all its components including fileserver, virtual machines, the sensor registry SENSORWeb and the DSHIP ActionLog, large focus of leg PS122/1 data support was also put into refining the discussed meta data workflow for specific scientific activities such as the coring events, the logging of buoy deployments and other continuously measuring instruments. This was done in joint sessions with data representatives of every team.

Synchronizing scientific events performed on the ice and logged with the Floe Navi tablet was part of the daily tasks of a data supporter.

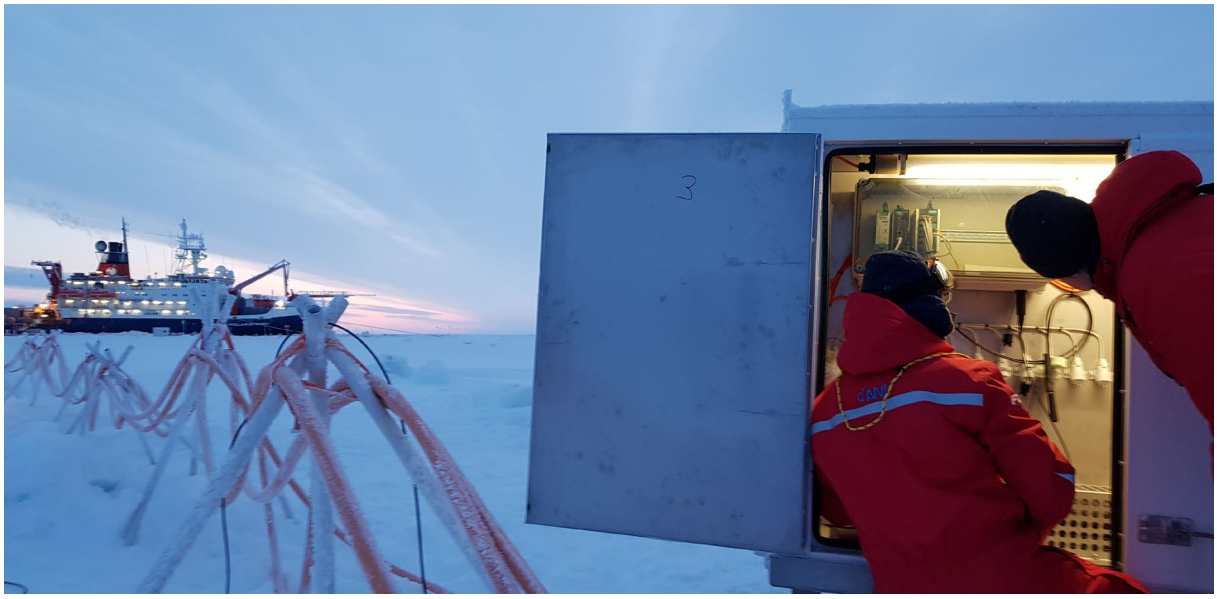

Fig.8.2.1: Connecting Ocean City to the Polarstern network via fibre optic cable.

Preliminary results

An expedition leg is subdivided into so-called Science Activities in DSHIP, which in turn are composed of numerous device operations. In MOSAiC the weekly schedule for scientific work is represented by weekly incrementing Science Activities. For leg PS122/1 the following Science Activities were defined:

- Science Activity 0: Continuously measuring instruments always running on *Polarstern* (e.g., Ferrybox, Thermosalinograph, etc.) and therefore normally logged by the system administrator.
- Science Activity 1: All continuously measuring or sampling instruments that are deployed on *Polarstern* or the ice for MOSAiC (i.e., buoys, radars, sediment traps amongst others)
- Science Activity 2: All discrete sampling devices or short-term measurements during the transit and setup phase with *Polarstern*.
- Science Activity 3: All discrete sampling or measurement efforts performed during the cruise with *Akademik Fedorov*.
- Science Activity 4 - 11: Discrete sampling or short-term measurement events performed within the scope of the weekly scientific schedule starting with Science Activity 4 on 24.10.2019 Generally, a new Science Activity starts at 00:00 UTC every Monday. The last Science Activity of leg PS122/1 ended at 09:00 UTC on 13.12.2019 with the begin of leg PS122/2.

A total of 1326 Device Operations comprising one or more Actions were logged during leg PS122/1.

Altogether, approximately 25 Terabytes of data were uploaded to the MOSAiC Central Storage on *Polarstern*, 22 TB of which are (quasi) raw data and will undergo further processing in the near future. Figure 8.2.2 visualizes the data increase both in numbers of files and data volume during the PS122/1.

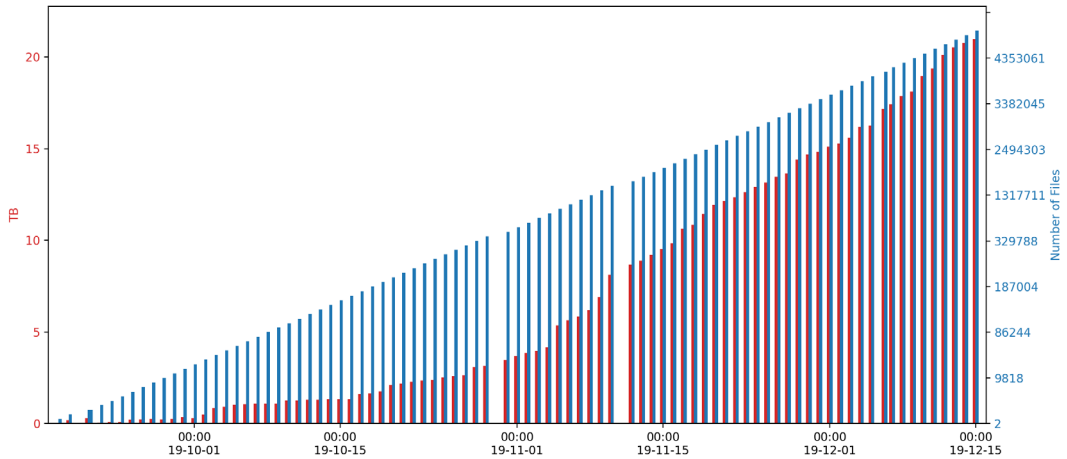

Fig.8.2.2: Data increase on the MOSAiC Central Storage during leg PS122/1. Increase of data volume is depicted by red bars, growing numbers of files are represented by blue bars.

References

Immerz A and Ransby D (2019) IT-Unterstützung der Arktisexpedition MOSAiC (IT support of the Arctic Expedition MOSAiC) , Fachgruppentagung 2019 - Informatik und Nachhaltigkeit, Bremerhaven, 11 May 2019 - 12 May 2019 .

8.3 Media

Esther Horvath[1], Sebastian Grote[1], Amy Richman[2], Matthew Shupe[2], Philipp Grieß[3], Jakob Stark[3], Nikolaus von Schlebrügge[3], Marlene Göring[4], Shannon Hall[5], Martha Henriques[6]

(not on board:) Katharina Weiß[1], Anne Gold[2]

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[6]COM.BBC

Objectives

AWI

Comprehensive set of communication activities before, during and after the expedition, including web formats, regular service for news and other daily reporting formats, social media activities, photo and video documentation, exhibition, virtual reality formats, a planetarium show.

During each leg, the communication manager coordinates media and outreach requests from shore to ship and vice versa, and ensures a constant service and flow of information to media and the communication departments of participating organizations. Communication managers also create the blogposts for follow.mosaic-expedition.org and social media channels. This person also produces a weekly podcast with the expedition leader in German language and with selected participants in English.

The photographer's responsibilities include creating a professional pool of photo/video/audio material during his/her leg and in all conditions that will be made available to the public and also serve a variety of communications needs.

CIRES

One of CIRES' objectives for public engagement, and in fulfillment of the education outreach requirement of grant funding supporting MOSAiC, is a documentary planetarium film production about MOSAiC that communicates the scale and scope of the science and adventure of the expedition. As per instructions to make the sea ice the central protagonist of the planetarium production, the objective was to 1) film Arctic landscape and Arctic climate system content for dome projection; and 2) use an artistic practice as a methodology for investigating research questions related to systems theory, narratives of loss and elemental philosophy within a semiological framework of climate change representation and communication. The scope of the objectives expanded to include filming shot lists requested by CIRES' social media team and shot lists requested by the education outreach team, content meant for both the Google Expeditions VR/360 experiential learning and content meant for traditional non-360 viewing. In addition, the objectives included filming the Atmosphere team and generating content that could be used for promotional purposes, bio pictures, etc., for professional and personal use. Finally, the scope of the objectives expanded to include being the point person, ie: scheduling, coordinating, doing the test phone calls and filming interviews of Matt and Markus as requested by the communications and social media teams.

UFA film crew

The aim is to make a captivating, professionally produced, long-form film documentary production, covering the entire expedition with two film professionals on board.

Work at sea

AWI

Documenting the entirety of Entire Leg 1 involved 95 recorded, active photo-shooting days, which included finding the floe, setup of the scientific camp, research work of scientists, logistical challenges and life on board of *Polarstern*. National and international media outlets have used MOSAiC photo database for reporting about the expedition. As one example, photo documentary made the cover of The New York Times twice and has also been published four times in NYT print and online. During the expedition several photo selections were edited for the MOSAiC photo database, for a MOSAiC photo book and for different media outlets. On a weekly bases, in German language, a podcast with Markus Rex was recorded and edited. In addition, several podcast interviews, in English, were recorded with Verena Mohaupt. International and national phone interviews, live-calls, media requests have been managed onboard from *Polarstern*.

CIRES

To fulfill the objectives of the planetarium production the scientist participants of MOSAiC Leg 1 were followed out into the field and around the ship (in labs) in order to document and capture their scientific work, process and instrumentation (on and off board) with equipment designed for 360/VR and dome projection and equipment designed for non-360 viewing. This work included interview questions designed as self-reflexive explorations into the nature of scientific discourse and scientific methodologies within an Arctic framing. Every few days filming transitioned between the planetarium objectives, the social media and education (Google Expedition) objectives, Atmosphere team objectives and personal objectives. In addition, over the course of the expedition new project ideas emerged that stemmed from personal research questions that can also be used to support education outreach goals. In total, three large paintings and drawings depicting the Arctic landscape were made and the scientists onboard were asked to identify their science and corresponding climate system processes on the painting. Two of these posters were collaborations with the scientists, while the third is a personal reflection and interpretation. Similar collaborative projects emerged with different

scientists onboard. A collaboration with Marc Oggier led to a film which began on *Polarstern* and screened on the Dranitsyn. Through this collaboration and other projects, the challenges and questions pertaining to the planetarium production were workshopped and thought through and the necessary filming strategy adjustments were implemented. The work at sea also included coordinating, scheduling, doing the test phone calls and filming interviews with Matt and Markus. In total two Insta 360 Pro cameras, two Insta 360 One cameras, a Canon 5DMIV and a Sony A7III, in addition to three sound recording devices, were used to capture content. The polar night and cold temperatures posed the greatest challenges to the equipment.

UFA film crew

UFA film crew followed the entire Leg 1, including the preparation phase in Tromsø.

During Leg 1a, cinematographer Jakob Stark filmed onboard of *Polarstern* with producer Philipp Griess while Nikolaus von Schlebrügge documented the setup of the distributed network onboard of *Akademik Fedorov*. After Philipp Griess left on Akademik Fedorov, Nikolaus von Schlebrügge joined *Polarstern*.

Leg 1b was documented by Jakob Stark and Nikolaus von Schlebrügge. The film crew covered the entire Leg 1 including finding the floe, setup of the research stations, scientific work, daily challenges, interviews...etc.

Nearly every day, the team followed their main protagonists on the vessel or on the ice floe.

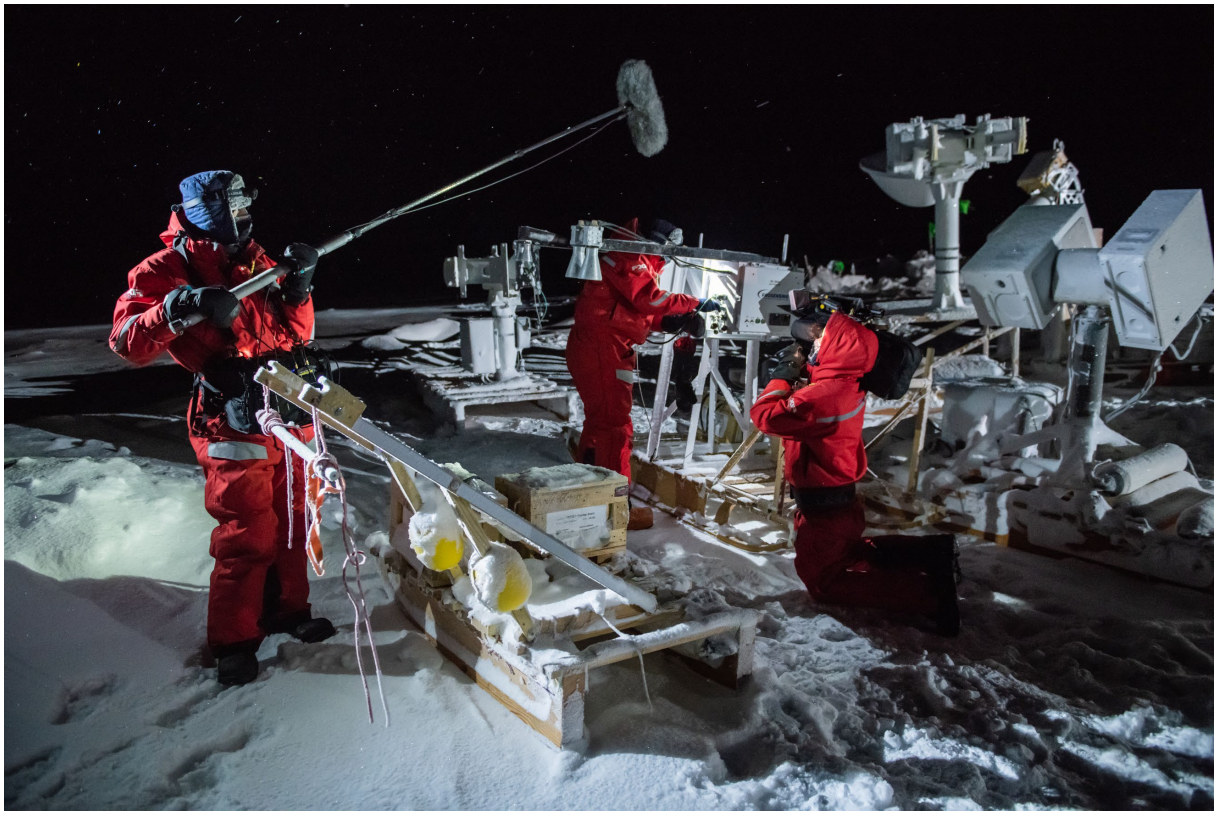

Fig.8.3.1: Jakob Stark (r) and Nikolaus von Schlebrügge (l) follow the sea ice physicist Stefan Hendricks at the Remote Sensing Site. Photo by Esther Horvath

Journalists on board:

Marlene Göring has been writing for GEO, GEOLino, Stern and PM.

Shannon Hall has reported for different media outlets.

Martha Henriques published on BBC online.

Preliminary results

AWI

Photos of Leg 1 will be uploaded to the MOSAiC photo database under a Creative Commons license in January 2020.

Preliminary media responses to the MOSAiC expedition starting phase:

There were more than 3200 articles about the MOSAiC expedition in the period between September 15 and October 15. Around 2 billion people heard, read or saw media reporting about the expedition by mid-October.

Social media followers in numbers:

Instagram @mosaic_expedition : 10604 follows by December 19, 2019

Twitter : 6918 followers by December 19, 2019

Blogpost on follow.mosaic-expedition.org has 4000-6000 daily visitors

National and International media highlights:

Science

The biggest Arctic expedition in history is launching for the North Pole

Hoarfrost covers the snow where researchers cross a lagoon in Utqiagvik, Alaska, on April 9. The researchers are among a group gathered to prepare for the upcoming year-long MOSAiC expedition that will collect data on Arctic climate and ecosystems. (Bonnie Jo Mount/The Washington Post)

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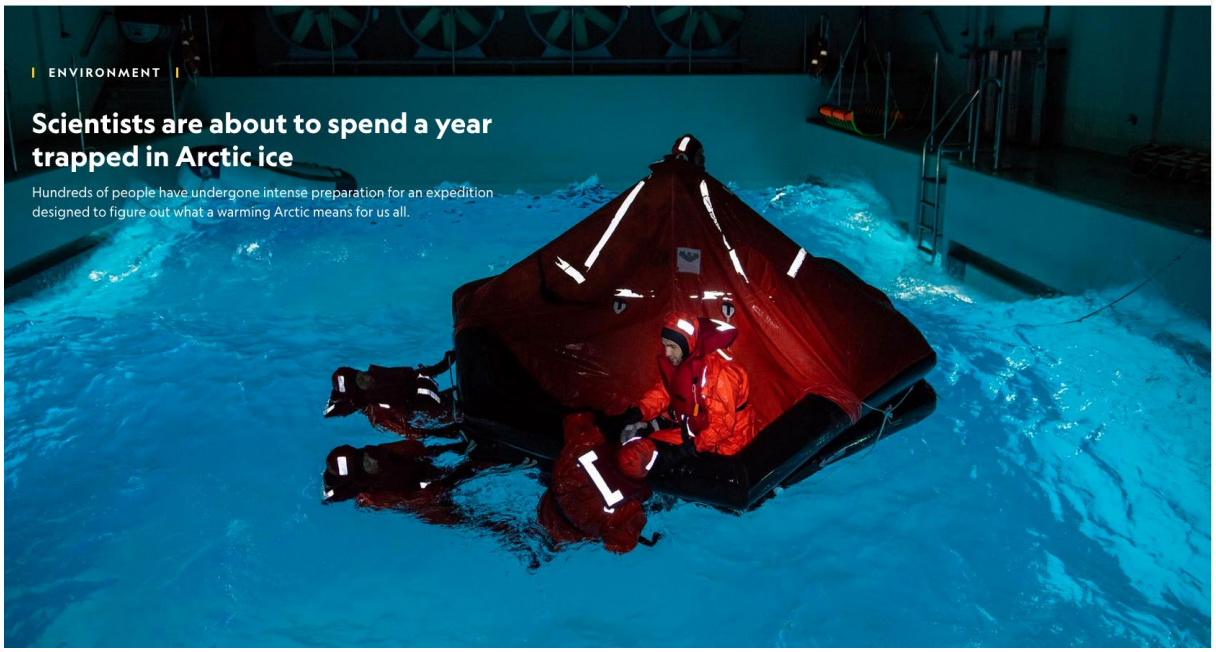

ENVIRONMENT

Scientists are about to spend a year trapped in Arctic ice

Hundreds of people have undergone intense preparation for an expedition designed to figure out what a warming Arctic means for us all.

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The icebreaker *Polarstern*, seen here operating in Antarctica in 2013, is being prepared to be locked into Arctic sea ice for more than a year. ALFRED WEGENER INSTITUTE/STEFAN HENDRICKS

Arctic researchers will lock this ship in ice for a year to study the changing polar region

By Eli Kintisch | Aug. 20, 2019 , 3:55 PM

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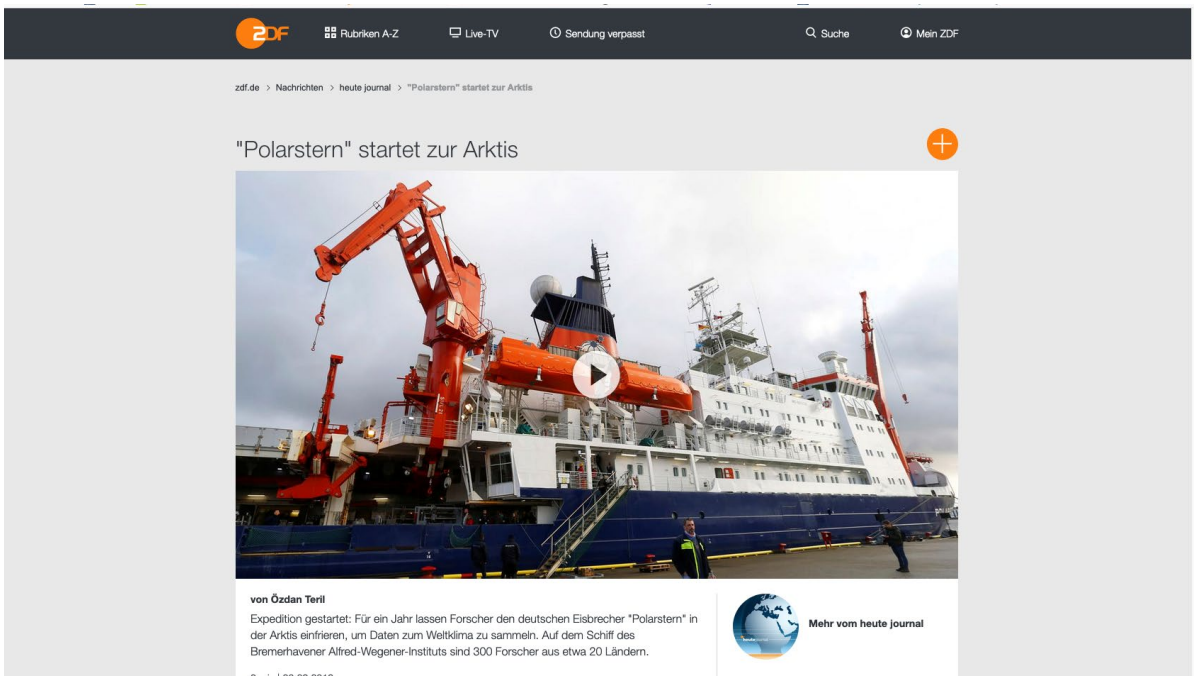

CIRES

Preliminary results suggest that Leg 1 of MOSAiC is best represented in dome projection format as the “set-up” phase of the expedition. Given the timeframe of finding the floe and set up of the scientific research stations on the ice, the best 360 content covers this phase of leg 1, which happened before the onset of the polar night. The obtained footage will be an important contribution to the planetarium production and Google Expeditions focused on MOSAiC.

UFA

The plan with the documentary is to produce a tv series for international channels.

Data Management

AWI

2,6 Terra Byte photo and video material has been produced.

CIRES

Footage (data) was organized daily by date and equipment. An Excel document was used to keep track of the content filmed, equipment, location, people, etc., broken down by day. In total there was approximately 15 TB of raw footage taken of Leg 1. Selected, edited footage that is appropriate for broader release will be uploaded to the MOSAiC media archive for use by the community under a Creative Commons license.

8.4 General Coring

Marc Oggier[1], Allison Fong[2], Robert Rember[1] Jian Ren[3], Jessie Creamean[4], Nikolai Kolabutin[5], Egor Shimanchuk[5], Ruibo Lei[6], Marcel Nicolaus[2], Antonia Immerz[2], Michael Angelopoulos[2], Lei Wang[7], Katarina Abrahamsson[8], Josefa Verdugo[2]

(Not on board:) Mats Granskog[9], Philipp Assmy[9], Rolf Gradinger[10], Donald Perovich[11], Clara Hoppe[2], Hauke Flores[2], Ellen Damm[2], Brice Loose[12], Daiki Nomura[13], Melissa Chierici[14], Agneta Fransson[9], Jeff Bowman[15]

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[4]EDU.CDU
[5]RU.AARI
[6]CN.PRIC
[7]CN.BNU
[8]SE.GU
[9]NO.NPOLAR
[10]NO.UIT
[11]EDU.DARTMOUTH
[12]EDU.URI
[13]JP.AC.HOKUDAI
[14]NO.IMR
[15]EDU.UCSD

Objectives

- Generate data sets of co-located physical, geochemical, and biological properties from discrete sea ice samples.
- Generate parallel time-series from both multi year and first year ice types to document the evolution of ice properties over an annual cycle.
- Determine how changes in snow pack impact temperature and flux regimes across sea ice and the upper ocean.
- Measure the concentrations of macro and micronutrients in snow, ice, and the underlying seawater.
- Describe the microstructure of sea ice to better interpret density, porosity, and brine and microbial community distributions.
- Map distributions of geochemical and biological properties in vertical space to understand interactions across the snow and sea surface interfaces.

Work at Sea

Ice core work involved the acquisition of a large set of cores at both the first-year ice (FYI) and second-year ice (SYI) sites (Figures 8.4.1 and 8.4.2). Table 8.4.1 summarizes the list of cores collected during the common coring program as function of the site. Mostly 9cm diameter cores were acquired using a Kovacs Ice Drilling Equipment Inc. Mark II ice corer, except for the CT and density cores which were collected with a 7cm Kovacs Mark III ice corer. At each site, a snow pit (temperature, density profile, snow water equivalent and snow micropen measurement, see SNOW SECTION) was made prior to coring. Then, the temperature core was acquired first, and temperature was measured at 0.1m intervals from the colder to warmer part of the core within 5 minutes after collection. Temperature probes Testo 720 from the ECO Team were used to measure all temperatures. However, for the first common coring event at the FYI site, an RTD temperature probe from the BGC team was used. Cores collected for ICE and ECO properties were acquired and sectioned in the field. Sections were placed immediately into sealed bags or containers. We used headlights with red filter during the collection and sectioning of cores for ECO team, and a tent was used to shelter the core from the environment during handling in the field. Cores acquired for BGC were placed into a plastic sleeve and brought back onboard to be processed later in labs.

Acquisition of ice cores in the field typically took 2-4 hours, with both teams working in parallel at each site. Despite differences of 20-30 cm in ice thickness between the two sites, the SYI team processed cores in the field in nearly the same amount of time as the FYI team. When it was not possible to collect cores at both sites, due to weather or ice floe deformation events, FYI collection was prioritized. Additionally, a prioritized list of cores for collection was determined among the teams for instances when coring sessions may be shortened due to weather conditions or extenuating circumstances.

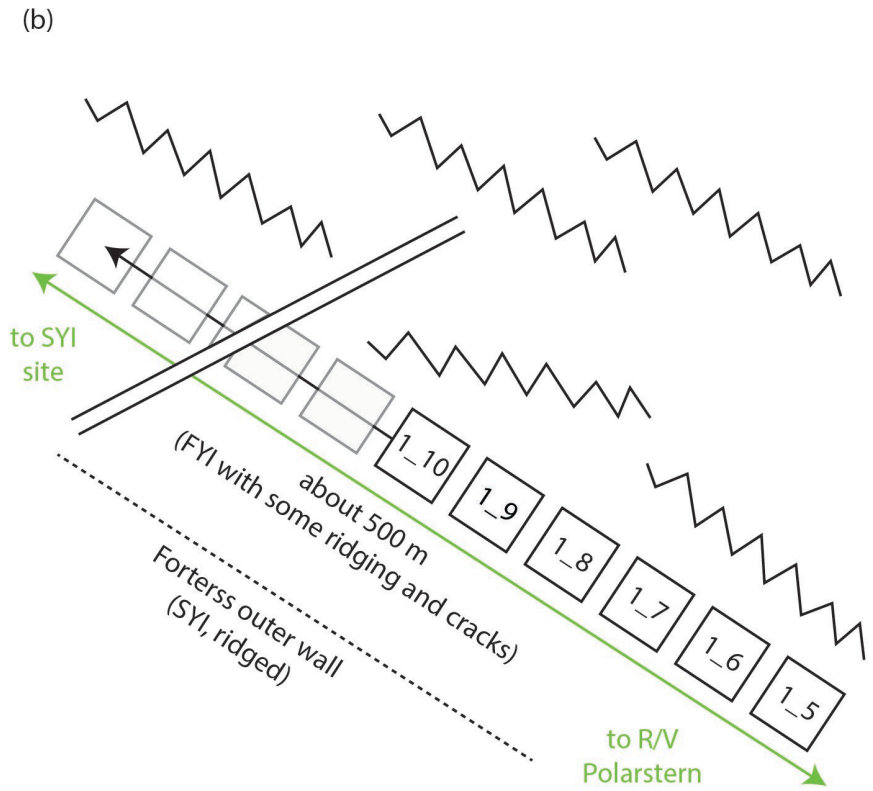

Fig.8.4.1: First year ice site in the dark region (~1.2 km from Polarstern).

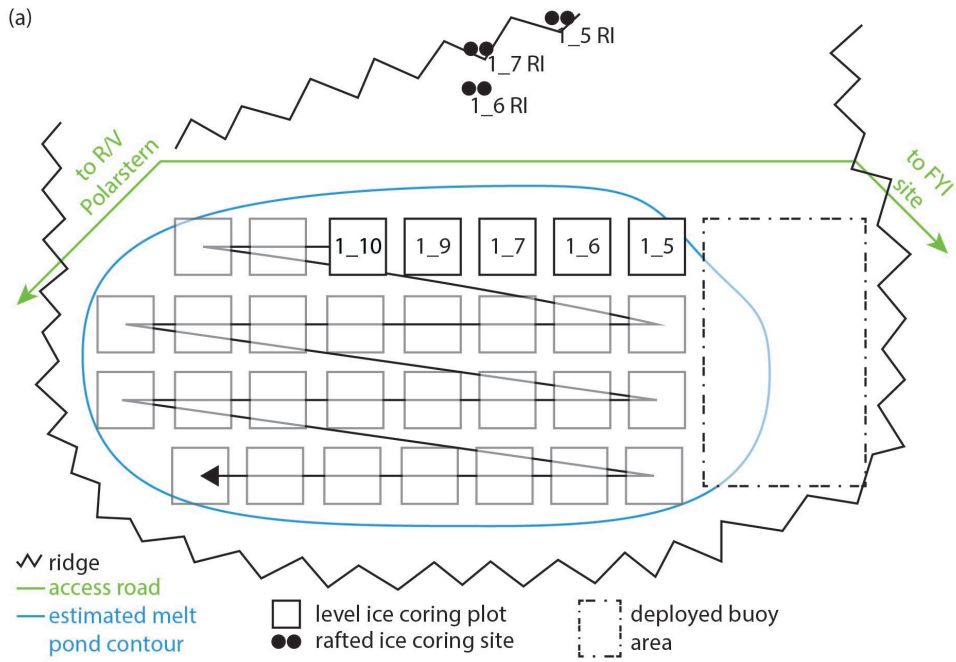

Fig.8.4.2: Second year ice site in the dark region (~1 km from Polarstern).

Tab.8.4.1: List of cores collected during the general coring with the site of collection, team responsible for processing and handling in the field

Core type	Team	Sites	Field handling
Temperature	ICE	FYI/SYI	Measured in the field
Methane	BGC	FYI/SYI	Bagged in the field, sectioned on board
Salinity, isotope & nutrient	ICE/ECO	FYI/SYI	Sectioned in the field, salinity and nutrient measured on board, isotope samples stored for future measurement
HALO	BGC	FYI/SYI	Bagged in the field, sectioned on board
Chlorophyll-a	ECO	FYI/SYI	Sectioned in the field, pooled into Eco Set 1, subsamples processed on board; most samples stored for analysis onshore
Production	ECO	FYI/SYI	Sectioned in the field, pooled into Eco Set 1, subsamples processed on board; most samples stored for analysis onshore
Pigments	ECO	FYI/SYI	Sectioned in the field, pooled into Eco Set 1, subsamples processed on board; most samples stored for analysis onshore
Algae	ECO	FYI/SYI	Sectioned in the field, pooled into Eco Set 1, subsamples processed on board; most samples stored for analysis onshore
Iso	BGC	FYI/SYI	Bagged in the field, sectioned on board
Bromo	BGC	FYI/SYI	Bagged in the field, sectioned on board
Microstructure	ICE	FYI/SYI	Bagged in the field, measured on board
Beryllium	BGC	FYI or SYI alternate	Bagged in the field, XXX
DIC/TA	ECO	FYI/SYI	Bagged in the field, sectioned on board
Archive	ICE	FYI/SYI	Bagged in the field, stored on board
Backup	ICE	FYI/SYI	Bagged in the field, stored on board
DNA	ECO	FYI/SYI	2 Cores; Sectioned in the field, pooled into Eco Set 2, subsamples processed on board; most samples stored for analysis onshore
RNA	ECO	FYI/SYI	Sectioned in the field, pooled into Eco Set 2, subsamples processed on board; most samples stored for analysis onshore
Plastic	ICE	FYI/SYI	Bagged in the field, stored on board
Meiofauna	ECO	FYI/SYI	10 cm bottom section only; sectioned in the field, melted on board; sample stored for onshore analysis
CT	ICE	FYI/SYI	Bagged in the field, bottom 10 cm measured on board, rest stored on board
Density	ICE	FYI/SYI	Sectioned in the field, measured on board

Methane oxidation	ECO	FYI only	Sectioned in the field, XXX on board
Gypsum	ECO	FYI only	Sectioned at 5 cm intervals in the field, melted on board, sample stored for analysis onshore

Preliminary Results

During the common coring, we sampled the first-year ice (FYI) site 6 times, and the second-year ice site (SYI) only 5 times, due to a storm event between November 15-17. In addition, each site was visited 3 times at irregular intervals (See Rob Rember Trace Metal projects/Nutrient), which provided additional salinity and temperature profiles. Table 8.4.2 summarizes the number of ice cores collected during each event (See appendix of device operation for a list of all cores).

Tab.8.4.2: Summary of ice cores collected at the dark site at the first-year ice (FYI) and second-year ice (SYI) location, as well as sampling in a lead. In bold, activities belonging to the general coring

Activity number		Kovacs Mark II, 9 cm corer		Kovacs Mark III, 7 cm corer		Generic sampler (cups)		Snow Pit	Date
		Device Operation	Number of cores collected	Device Operation	Number of cores collected	Device Operation	Number of cores collected	Device Operation	
1_5	**FYI**	4	21	3	2				2019-10-28
	SYI	78	22	79	1				2019-10-28
	SYI rafted	81	2						2019-10-28
1_6	**FYI**	34	23	35	2			147	2019-11-04
	SYI	36	21	37	2			146	2019-11-04
	SYI rafted	10	2						2019-11-04
	FYI, rafted	132	2	N/A	3			124	2019-11-10
1_7	**FYI**	5	23	6	2			130	2019-11-11
	SYI	8	20	9	2			10	2019-11-11
	SYI rafted	7	2						2019-11-11
	LEAD*					140	2		2019-11-11
	FYI	97	5	98	3				2019-11-16
	SYI	53	6						2019-11-16
1_8	**FYI**	2	24	3	2				2019-11-18
1_9	**FYI**	6	22	7	2			3	2019-11-25
	SYI	11	21	12	2			117	2019-11-25
	SYI, rafter	30	2						2019-11-25
	FYI	93	2	94	3				2019-11-30
	LEAD**					116	4		2019-11-30
1_10	**FYI**	19	20	20	2			18	2019-12-02
	SYI	16	21	17	2			11	2019-12-02
	LEAD***	115	5	116	3			114	2019-12-04
* in lead, along Transect North									

** at FYI site
*** in lead, north of Big Block

Data Management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX). Final data products will be stored at the PANGAEA data repository (World Data Center PANGAEA Data Publisher for Earth & Environmental Science (www.pangaea.de)).

References

No references.

8.5 Microplastic sampling

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(not on board:) Ilka Peeken[1], Christian Katlein[1], Thomas Krumpen[1], Martin Löder[4], Christian Laforsch[4], Elisa Bergami[5], Ilaria Corsi[5]

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Objectives

Microplastics (MP) are recognized as a growing environmental threat, even in remote Polar Regions. Concentrations of MP in sea-ice are several orders of magnitude higher compared to the underlying water (Peeken et al. 2018) and no information is available about the entrainment processes of MP occurring at the seawater/sea-ice interface or fragmentation/aggregation processes potentially originating nano-sized particles (NP). MP particles found in sea-ice are very small (~11µm) and given the size of the particles, it is likely that they are incorporated in the Arctic food web through sea-ice planktonic communities. Currently the biological interactions of MP and NP with sea-ice biota and its implications for higher trophic levels are unexplored. Once sea ice is melting, the NP/MP will be released again and since the marginal ice zones are highly productive and also support a large fishery, it is mandatory to understand the advection dynamics of microplastic in the Central Arctic.

During the one-year drift campaign of MOSAIC we want

1. to understand large- and small-scale processes of MP/NP contamination by simultaneously studying the underlying water and sea ice
2. to understand entrainment and transport pathways of Arctic MP/NP in sea ice
3. elucidate the role MP/NP in the diet of the sympagic food web particular during winter.

Work at sea

Water was filtered at four different sampling sites with a self built pump system on large stainless steel filters (diameter 30cm and pore size 10µm). Prior to sampling the filters were flushed with 50 L seawater. On each filter usually 500 L of seawater were sampled. As the main sampling site, Ocean City was chosen. However, this site had to be moved due to the formation of a pressure ridge in the vicinity. One of the weekly sampling dates coincided with the necessary repositioning of the Ocean City tent. Therefore, sampling for this day was performed inside a pop up fishing tent with a small 3kW electric heater in the reopened abandoned ocean city hole. This however proved difficult, since the air temperature was too

low and the filtration unit could not be heated up properly and thus this sampling was not successful. After xxx two filtration sessions were carried out in the newly installed Ocean City 2.

To elucidate any impact on the NP/MP composition coming from the waste water of *Polarstern*, filtration of the grey water was carried out on two following days in the moon pool room, filtering 500 L each. Grey water can be accessed at the moon pool hose via a small outlet hose. Discharge of the sampled grey water could not be done into the general waste water system due to added salt water from the osmosis plant. The salt would cause damage to the waste water facility. The outflow from the filtration unit was therefore released into the lab waste water tank.

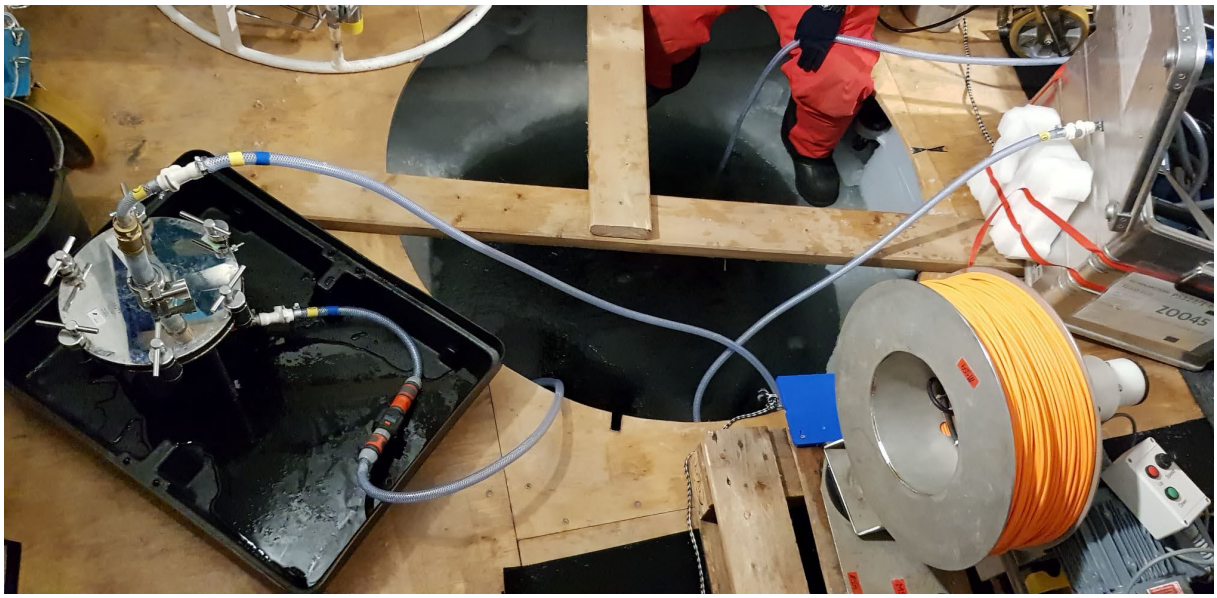

Fig.8.5.1: Microplastics large filtration unit in Ocean City

Fig.8.5.2: Setting up the microplastics large filtration unit in a pop up fishing tent

Fig.8.5.3: Microplastics large filtration unit for grey water sampling at moon pool

Snow microplastic sampling was conducted after snowfall events at A-Pit locations (see snow sub-chapter). During each sampling event, two one-liter jars were filled with surface snow. The jars had been pre-labelled with the label PS122PLAxxxx, where PS122PLA are static letters and xxxx are serial numbers beginning with 0001.

Ice cores for microplastic were collected at first year and second year ice sites on near weekly basis during the common coring activity. Upon return to the vessel the ice core is repackaged in a plastic sleeve within the -15°celsuis ice physics lab container and stored at -20°celsius until further processing. For specific dates refer to the device operation table appendix xxx.

Expected and preliminary results

The aim of this study is to understand the NP/MP contamination of Arctic water, sea ice and biota during a seasonal cycle. These data will allow to access the role of plastic in the Arctic foodweb and will shed light on the entrainment and transport processes of marine litter in the Central Arctic. These data can be used for modelling approaches to assess the role sea ice plays in redistributing NP/MP in the Arctic and beyond. In total ten filters were collected plus three blank filters representing the three different environmental settings of the sampling sites. Two of the filters were taken with the grey water of *Polarstern* to analyze the impact of the regular grey water outlet into the CO area. If conditions allowed, two filters of 500 L each were taken. Filters are kept frozen at -20°C until analysis in the home laboratories.

Data management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX). Final data products will be stored at the PANGAEA data repository (World Data Center PANGAEA Data Publisher for Earth & Environmental Science (www.pangaea.de)).

References

Peeken I, Primpke S, Beyer B, Gütermann J, Katlein C, Krumpen T, Bergmann M, Hehemann L and Gerdts G (2018) Arctic sea ice is an important temporal sink and means of transport for microplastic. Nature Communica

8.6 Floe Navi

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Objective

Keeping track of exact locations on ice floe is crucial to make the sampling/measurement throughout the expedition more efficient and reliable. Standard positioning through GPS receivers is not sufficient for this purpose since the ice floe itself is a moving object with respect to the Earth. Therefore, a more advanced tracking method called FloeNavi was developed to change the reference frame from the Earth to the ice floe on which the studies and experiments are actually performed. The FloeNavi system makes use of the AIS transponders installed on various positions on the floe in order to define a two dimensional reference frame (grids) for a relatively simpler location tracking.

Work at Sea

In the beginning of the expedition when almost no scientific measurements were conducted, four fixed stations were installed to keep track of important locations on the floe. The position of each station was also marked with red flags in order to locate them in case of snow accumulation over the transponders. The x-axis of the grid was established through two fixed stations: one next to *Polarstern* and the other 500 meters away from *Polarstern* at exactly 3 o'clock from its bow. During this time, these stations depended on their batteries which had to be replaced approximately every two weeks. After the first CO facilities were established, the fixed stations were decided to be installed or relocated right next to the power hubs of main cities to ensure their continuous operation, and to keep track of city positions. Therefore, x-axis of the grid was reset over the two different stations; one near *Polarstern* and one next to the Ocean city. Rest of the active stations was also reconfigured according to this scheme.

The events of shearing near the first ROV site and strong winds caused some of the stations to move out of sight or be buried under the snow due to snow drifts. Batteries of these stations also depleted during this period so they stopped sending their location info. Nevertheless, the grid was not lost since there were still at least two active stations on the floe. At this point, recovering these inactive stations was a crucial task, so different excursion groups helped with locating and bringing them back to ship for recharging. Meanwhile, two new stations were quickly reinstalled on new facilities such as Met City and the first Remote Sensing site. They were also directly connected to power hubs to avoid the need for battery charging. When the second ROV site was established, another fixed station was installed next to its power hub as well. The grid was maintained by these five stations for a few weeks.

An outcome of this configuration was that the fixed station next to the *Polarstern* had significant uncertainties with its GPS reception. At first, it was thought that the station transponder was flawed so it had to be replaced with another one. This attempt did not help with the issue, so it was discussed that the large metal body of the ship could be causing these anomalies, so the station had to be moved further away from the vessel at a later time. This stayed low priority due to the high number of active stations.

The most effective event of leg one took place a week after the detection of this anomaly. The floe was hit by a strong storm and a long shear zone developed in the middle of the camp drifting and separating the sides by hundreds of meters. The shear zone separated the western and eastern camp by passing through in between the Ocean City and the first Remote Sensing site, and continuing its way in the front of *Polarstern* to the south. This extreme event separated three fixed stations from the grid in three days. Since the grid had to be maintained by at least two fixed stations, another station had to be installed on the east side of the camp where *Polarstern* was anchored. An additional battery-supplied fixed station was installed near the logistics watch tower on the next day after the drifting event. Unfortunately, one of the VHF antennas of FloeNavi stations was critically damaged after the storm which dropped the number of available stations to six.

When the ice conditions were stabilized, and the camp facilities were reestablished on their new positions, the fixed stations at each main site were reinstalled one by one. After sufficient number of stations were reinstalled, it was safe to move the fixed station near *Polarstern* further away. This resolved the uncertainty issue of the AIS transponder.

Before the end of first leg, five of the remaining stations were installed at every city except the Balloon Town. The fixed stations and their details are given in the Table 8.6.1.

Tab.8.6.1:The fixed Floe Navi stations and their details

Station Name:	MMSI:	Location:	Status:
B03	211003812	ROV site power hub	Plugged to the hub
B05	211003814	Near the logistics watch tower	Battery supplied
B06	211003815	*Polarstern* power hub	Plugged to the hub
B07	211003821	Ocean City power hub	Plugged to the hub
B08	211003822	Remote Sensing site power hub	Plugged to the hub
B09	211003823	Met City power hub	Plugged to the hub

Throughout the leg one, the scientists were asked to take the FloeNavi tablets and Mobile Stations with them whenever they head out to their scientific tasks, and set the sampling or measurement labels on the tablet. These labels were saved into the database in terms of coordinate and time which could later be mapped onto the two dimensional grid of ice floe. The tablet software had some minor problems such as showing the labels on the x-y coordinates which made the process a little tricky. Yet, this did not degrade the performance of the GPS receivers of tablets, so the mapping on an x-y grid could later be implemented manually by means of other scripts.

In summary, most of the seven fixed stations (AIS transponders) were installed and maintained throughout the first leg to keep the established grid. Some of the fixed stations had to be repositioned and/or reinstalled due to either the environmental incidents (strong winds, shearing, leads) or hardware issues such as the limited battery life. Despite all that, the established frame/grid was not lost as there have always been at least two active fixed stations on the floe. The available FloeNavi stations dropped to six after an incident due to storm which critically damaged one VHF antenna.

Preliminary (expected) results

Data management

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References

No references