8. OVERARCHING AND SUPPORTING ACTIVITIES

Grant-No. AWI_PS122_00

8.1 LOGISTIC & SAFETY

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Objectives

The main objective of the team was to provide infrastructure, equipment and skills for a safe and successful field work. In cooperation with the ship, a structure has to be organized, that guaranties fast and efficient help in any case of emergencies on the ice.

The beforehand developed safety concept for this expedition was transferred already during Leg 1 into practical routines and procedures. Although some changes and adaptions have been made during Leg 2, this safety concept was the basis of our work.

Work at sea

In order to familiarise all participants with this safety concept and its rules, a mandatory safety briefing, including specific information about MOSAiC as well as general field safety, polar bear safety and awareness was held before departure in Tromsø. Further steps of preparation were a communication training during the transfer on board Kapitan Dranitsyn and a weapon handling refresher on site. A brief introduction in the proper use of the snow mobiles was given by H. Laubach, our responsible person for all vehicles (snow mobiles, ARGO, Pistenbully), generators and other engines.

As a minimum, a logistic bridge- and stern watch was established and covered by the logistics team whenever needed. These two positions ensured a safe environment next to the ship, a complete overview of all activities on the ice, the ability to monitor specific activities by keeping a close contact. In case of special events (cracks, bad weather, polar bears, break 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. The nautical officer in charge together with the stern watch form the standby rescue team. The workability of the SAR concept has been demonstrated within two successfully driven exercises. Fortunately, no real case happened during the entire Leg 2.

The same is true for the polar bear appearance: it is one of the fundamental tasks of the logistics team to chase away bears that start to occupy our site, but Leg 2 was free of encounters, that would have needed such an action.

A further basic task was it to participate into the daily planning of the upcoming activities, to check their feasibility in terms of needed gear and safety aspects and to organize the distribution of the resources involved from logistics side.

The apparently overall highest work load resulted from frequently joining the various science teams within the CO as well as outside and in particular on remote excursions. In order to allow the groups to concentrate on their scientific work, the task then was not only bear guarding, but furthermore advise and assisting the group leader regarding safety and wellbeing of the group.

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. During Leg 2 however, several technical problems took many resources of the team.

The installed trip wire system was maintained regularly and extended to a total length of 1100m. Due to little ice motion within the CO it stayed intact. No bear crossed it during Leg 2.

In order to improve the illumination in the surroundings of Ocean City, Remote Sensing and MET City, two additional lamp masts, each spreading light in 120° sectors, have been installed.

The logistic team was responsible for the distribution and maintenance of safety and field equipment such as weapons, flare guns for polar bear protection as well as communication devices. With the cold temperatures several electronic devices and mechanical parts refused to work or caused problems when exposed to the cold. This happened to important communication devices, aiming gear like red-dot sights (taken out of service) and lamp switches and also to the flare gun pouches which became too stiff to be handled in an adequate way. Another task was the maintenance of the roads, flags, power and data lines as well as the scouting of new paths in case of break ups.

The runway construction and maintenance were the biggest single infrastructure project. Due to dynamic sea ice, the strip along the port side of Polarstern was the only possible location. Although at the beginning it was supposed just to become a 500m runway for medevac flights, it was then extended to preliminary 1000m to become the main runway for the upcoming airborne campaigns and staff exchange. The knowledge at the beginning about needed techniques was very poor and though building up the runway was a learning phase at the same time.

Even though the CO suffered no break-up event during Leg 2 preparations for such a case were done. In cooperation with the responsible scientist of the cities specific measures were discussed, mobile bridges were manufactured and a common power break was used to have a test run in setting up power generators.

One of the administrative on-site challenges of such a big project is to retrieve and then to keep precise knowledge what equipment and instruments are available at all and where are they stored. Documentation of this was done by J.J. Hansen.

Preliminary (expected) results

Not applicable

Data management

Not applicable

References

Not applicable

Special requirements on notations:

Not applicable

Images

Not applicable

8.2. Data Support

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Not on Board[1]: Norbert Anselm, Tilman Dinter, Janik Eilers, Peter Gerchow, Antonia Immerz, Sebastian Immoor, Roland Koppe, Martin Petri, Jörg Matthes, Angelo Steinbach, Andreas Thiele[1]

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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.

The support tasks during leg PS122/2 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 network consisted of two fiber optic cable connections. One between the *Polarstern* and MET City and another between Polarstern and Ocean City. A radio link was setup to connect the Remote Sensing site to the network since its fiber optic cable was recovered during the big shearing event on leg PS122/1. A second radio link was also established to connect a Thermistor Chain near the logistics area to the ships network. (see Figure 8.1).

Assistance was also provided to scientists when connecting their instruments to the network.

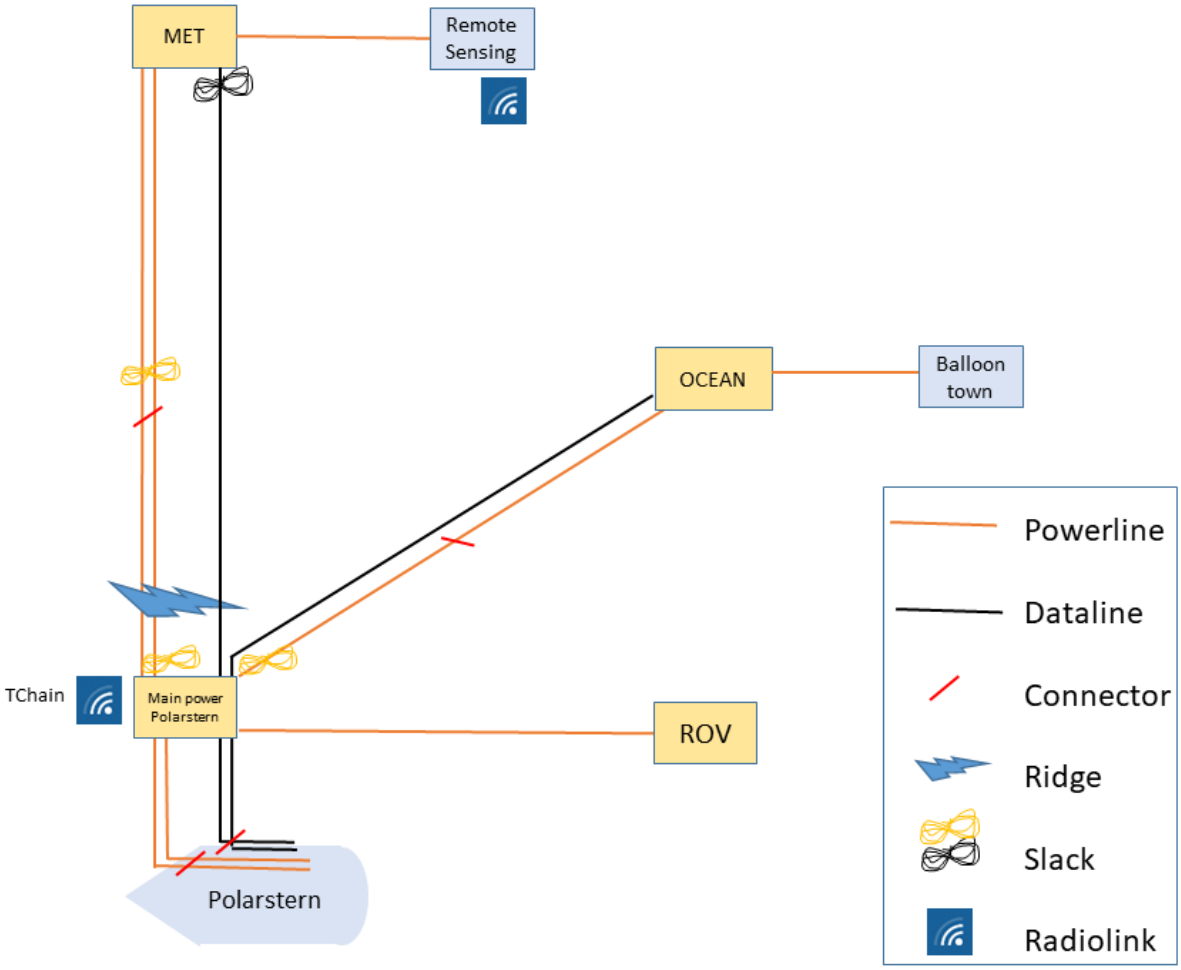

Fig. 8.1: Network and Powerline Map

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 PS122/2 data support was also put into the management of the meta data of specific scientific activities such as the coring events, the logging of buoy deployments and other measuring instruments as well as relations between device deployments and the related data/sample analysis. 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: Checkup on the Power and Network Hub in MET City. Photo: Folke Mehrtens

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 PS122/2 the following Science Activities were defined:

- Science Activity 0: Continuously measuring instruments always running on *Polarstern* (e.g. Ferrybox and Thermosalinograph) and therefore normally logged by the system administrator.
- Science Activity 13: All measurements or deployments during the transit phase of the Leg PS122/2 participants with IB Kapitan Dranitsyn.
- Science Activity 14: All continuously measuring or sampling instruments that are deployed on Polarstern or the ice for MOSAiC (i.e. buoys, radars or sediment traps)
- Science Activity 15 - 26: Discrete sampling or short-term measurement events performed within the scope of the weekly scientific schedule starting with Science Activity 15 on 13.12.2019 Generally, a new Science Activity starts at 00:00 UTC every Monday. The last Science Activity of leg PS122/2 ended at 09:00 UTC on 24.02.2020 with the begin of leg PS122/3. However, the Leg 2 team continued to carry out scientific observations until their departure on March 6, and logged them as PS122/3 activities.

A total of 1348 Device Operations comprising one or more actions were logged during leg PS122/2.

Altogether, 34 Terabytes of data were uploaded to the MOSAiC Central Storage on *Polarstern*.

8.3 Media

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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 podcast with the expedition leader in German language and with selected participants in English.

On leg 2 there was no specialized photographer on board, therefore the communication manager also documented the work via photo/video/audio material.

UFA film crew

The German production company UFA produces a 90 minutes documentary about the entire MOSAiC Expedition. The Film is going to be shown on German TV at the end of 2020. There are other formats for German TV and there are other international programs in development as well. All scientific fields of the expedition shall be explored in the 90 minutes film. The viewer shall get an experience of the complex processes of the Arctic climate system as well as the global influences of the Arctic for the climate in other regions of the world.

NOAA / CIRES

NOT AVAILABLE

Work at sea

AWI

Documenting leg 2 involved nearly 80 active photo-shooting days in polar night. Thematically they included research work of scientists, logistical challenges and life on board of *Polarstern*. National and international media outlets have used MOSAiC photo and video database for reporting about the expedition. In German language, a podcast with chief scientist Christian Haas was recorded and edited. International and national phone interviews of scientists and *Polarstern* crew members (many of them during Christmas and New Year), live-calls (e.g. with the Arctic Basecamp during the World Economic Forum in Davos), and media requests have been managed onboard from *Polarstern*. Additionally, the CIRES education project was supported by answering students' questions from the #askmosaic campaign.

UFA film crew

For each science field explored, a competent and charismatic expert was portrayed. Besides the scientific aspects, the social community and private spaces, as well as life on board *Polarstern* were of interest. We celebrated and documented Christmas and New Years and asked questions of larger contexts that lay beyond the professions of our protagonists.

It is the darkness that makes leg 2 and shooting period a unique one. It accompanied us through the whole three months and this darkness won't be there in the other legs of MOSAiC. It influenced all images acquired outside and created a special atmosphere that we tried to visualize.

NOAA / CIRES

NOT AVAILABLE

Preliminary (expected) results

AWI

Preliminary media responses to the MOSAiC expedition leg 2:

There were more than 1,157 articles about the MOSAiC expedition in the period between December 16 and March 3. Around 759 million people heard, read or saw media reporting about the expedition in this timespan.

Social media followers in numbers:

Instagram @mosaic_expedition: 13,003 by March 6 2020 (in comparison: 10,604 follows by December 19, 2019)

Twitter : 8306 by March 6 2020 (in comparison: 6,918 followers by December 19 2019)

Blogpost on follow.mosaic-expedition.org has 3,000-4,000 daily visitors, with the following monthly visits: December: 104,000, January: 106,000, February: 99,000

National and international media highlights:

International media included CNN, The New York Times, National Geographic Spain. Additionally, Russian media reported a lot about the departure of the support icebreaker Kapitan Dranitsyn from Tromsø in the end of November. In Germany the following lead media reported on MOSAiC: Süddeutsche Zeitung, Tagesschau, Tagesspiegel, Zeit.

UFA

During our filming on *Polarstern* we decided to focus on the following protagonists:

Team Remote Sensing: Julienne Stroeve, Vishnu Nandan, Rasmus Tonboe and Markus Huntemann.

Team ECO: Giulia Castellani und Robert Campbell

Team BGC: Ellen Damm

Team ICE: Martin Schneebeli und Matthias Jaggi

Chief scientist Christian Haas,

Captain Stefan Schwarze

The polar night, the ice and scenes within the confines of the lonely *Polarstern* are dramatically relevant and contrasting visual elements that became our strongest protagonist after all. We believe that with these images the film is going to tell a story about a modern yet offset, almost science fiction-like expedition that might also share traits with Fridtjof Nansen.

NOAA / CIRES

NOT AVAILABLE

Data management

AWI

The produced photo and video material will be uploaded to the media libraries multimedia.awi.de/mosaic (photos), and multimedia.awi.de/mosaicvideo (videos). All material will be made available under a creative commons license to support all MOSAiC partners as well as journalists.

8.4 MICROPLASTIC SAMPLING

Anja Sommerfeld[1], Jürgen Graeser[1] [1]AWI

Objectives

NOT AVAILABLE

Work at sea

The water filter procedure uses a self-built pump system on large stainless-steel filters (diameter 30cm and pore size 10µm). The set-up is shown in Figure 8.4.1. Prior to sampling the filters were flushed with 50 l seawater. On each filter usually 500 l of seawater were sampled. Before removing and storing the filter, it needed to by dried. Therefore, the filter set-up is changed a bit to squeezing out the water. The filter are stored in glass XXX. For each sampling day, two filters were used, meaning the whole procedure was performed twice. As comparison sometimes, a black filter that was not treated by the filtration process was stored.

Water was filtered three times during Leg 2 in approximately three weeks cycle. First, we continued to use Ocean City as sampling site like Leg 1 did. However, Ocean City was occupied every day during Leg 2. Therefore, and because of the bigger hut, ROV city (11 o´clock to *Polarstern*) was the new sampling site.

A list of all microplastic water filter samplings is given in Table 8.4.1.

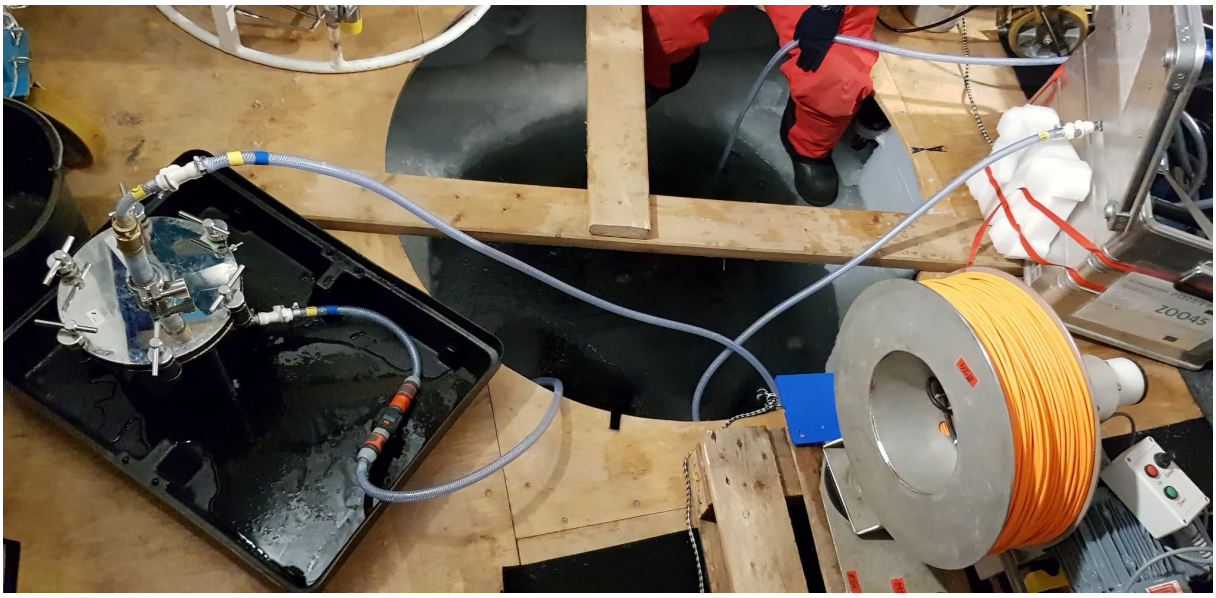

***Fig. 8.4.1**: Water filtration set-up for microplastic. The filter unit on the left site with the tubes coming through the pump (in the box on the right hand site) and into the water.*

***Tab. 8.4.1**: List of all microplastic water filter samplings during leg 2.*

Device operation	Sampling Number	Date	Sampling site
PS122/2_18-40	12	02.01.2020	Ocean City
PS122/2_18-41	13, blank	02.01.2020	Ocean City
PS122/2_18-42	14	02.01.2020	Ocean City
PS122/2_21-17	15	20.01.2020	ROV City
PS122/2_21-18	16	20.01.2020	ROV City
PS122/2_24-11	17	10.02.2020	ROV City
PS122/2_24-12	18, blank	10.02.2020	ROV City
PS122/2_24-13	19	10.02.2020	ROV City

Preliminary (expected) results

NOT AVAILABLE

Data management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX).

References

Koch BP, Dittmar T (2006) From mass to structure: An aromaticity index for high-resolution mass data of natural organic matter. Rapid communications in mass spectrometry, 20, 926-932.

8.5 FLOE NAVI

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Objectives

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 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 relatively simpler location tracking.

Work at sea

AIS Basestations:

The FloeNavi system was taken over from leg1 with six working base stations, located at the power hut in the logistic area, met city, remote sensing, ocean city, ROV hut and the watchtower. The basestation at the Watchtower was the only one required regular maintenance since it was on battery power lasting about two weeks. The battery was depleted on 18 December and was not replaced at that time because of a damaged connector. It was put out to the dark site on 24 December in order to be able to find the site after snow is blown over the skidoo tracks and for days with bad visibility. After relocation of the ROV site right next to the watchtower, the ROV FloeNavi basestation removed as well on the 24 December and was redeployed on the 31 December. The new position of the ROV basestation then permanently replaced the battery powered basestation at the watchtower as they are approximately in the same location. The basestation at the dark site was showing positional changes in the first week of January due to a lead opening along the way to the dark site. Finally, the battery was depleted on the 7 January and the whole basestation was replaced with another spare basestation while the antenna was kept at the site. On 19 January, the basestation was exchanged again with the previous one to avoid downtime of the dark site location AIS signal. Without an additional basestation for a direct exchange a downtime of 2 days would be expected due to the long charging process.

The basestation in the logistic area at the power hut, which was brought further away from Polarstern during leg1 was found to still give less accurate positions compared to the other base station with a larger scatter in the reported location. Probably the vicinity of the ship is still an issue for the GPS of the AIS.

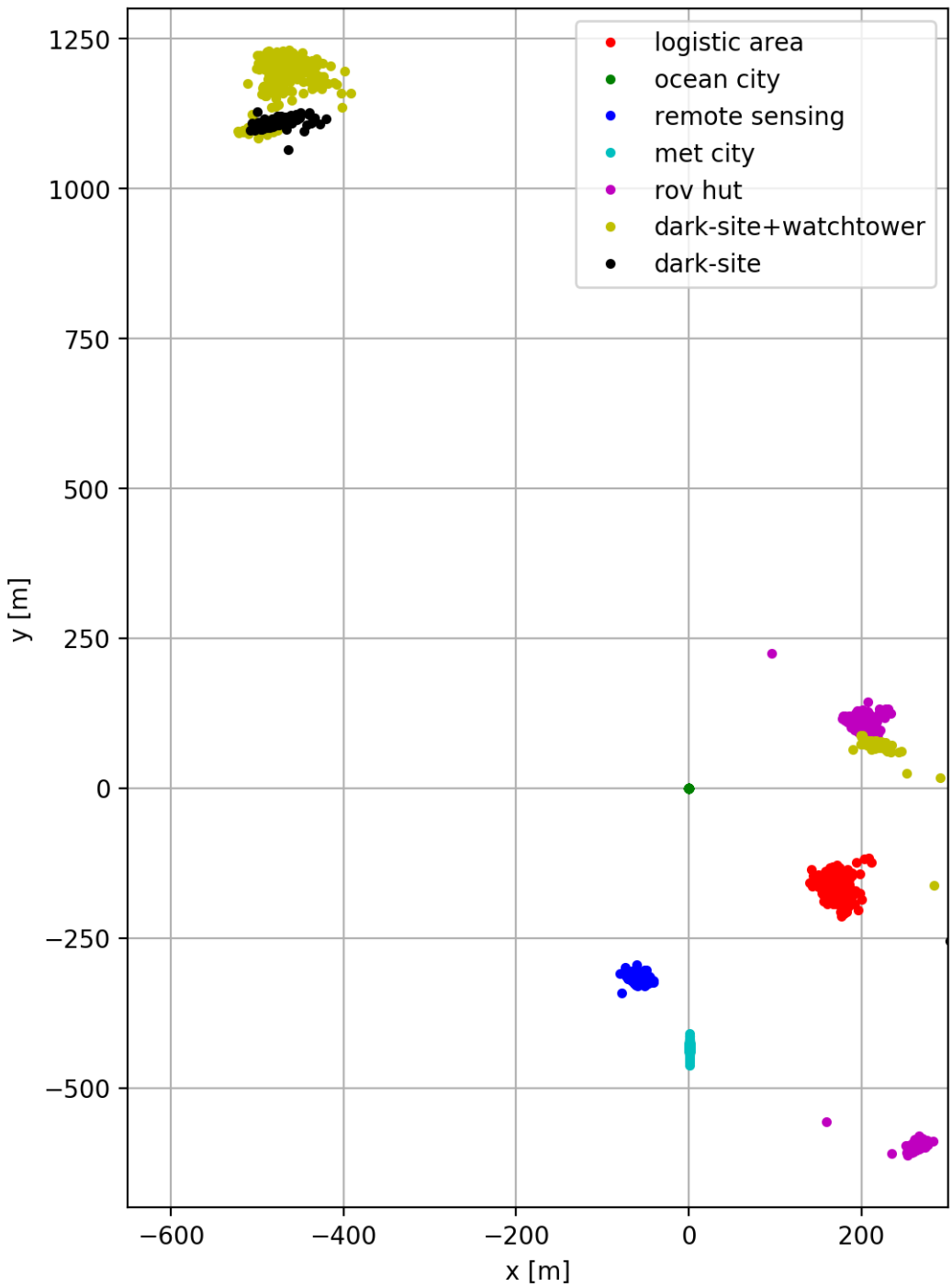

Illustration 8.6.1 Floenavi AIS basestation locations during leg 2 time period in a polar stereographic projection. Ocean City is (0,0) and Met City spans the y-axis

A map of the reported positions by the AIS basestations (time resolution resampled to 1h) using Ocean city as origin and Met city as y-axis is shown in fig 8.6.1

Even on the re-sampled data, the accuracy of the coordinates reported by the AIS basestations seems limited. The smallest spread of about 10-20m is seen in Remote sensing and ROV city while a larger spread was visible in the AIS at the dark site because of deformation. The

basestation at the logistic area shows a larger spread compared to the other basestations in the central observatory. Noteworthy deformation in order of the accuracy of the AIS GPS was only seen on the way to the dark site during leg 2. All other divergences must be attributed to the accuracy of the AIS GPS. The two ROV AIS locations are due to the change of location of the ROV tent.

The fixed stations and their details used during leg 2 are given in the table **8.6.1**.

Table 8.6.1: Overview FloeNavi AIS basestation locations

Station Name:	MMSI:	Location:	Status at the end of leg 2:
B03	211003812	ROV site power hub	Plugged to the hub
B04	211003813	Watchtower and Dark Site	retreated
B05	211003814	Dark Site	Battery supplied
B06	211003820	logistic power hub	Plugged to the power hub
B07	211003821	Ocean City power hub	Plugged to the power hub
B08	211003822	Remote Sensing site hut	Plugged into huts power
B09	211003823	Met City power hub	Plugged to the power hub

In summary, the 6 basestations worked as expected and only the connectors and antennas needed basic small repairs on exchange.

experience:

In leg 2 some scientists were using the FloeNavi tablets and mobile AIS stations to log their measurements (time and location), in order to synchronize this information later with the DSHIP to create a device operation. Since only the logging feature of the FloeNavi system was operational, the system was only introduced to scientist to log measurements. It was most suitable to be carried in a pulk since it's 3 parts were not easy to carry otherwise. At 15 December an update was available for the FloeNavi system to fix the mapping features and grid. The firmware update was tested on 18 December with creating waypoints onboard of Polarstern at the with the two basestations of ROV and logistics area. The firmware coordinate system was working flawlessly on this task and all basestations were shown on the correct positions. After preparation of a new MySQL database on the server, unfortunately the synchronization procedure crashed the application on the tablet so that no deployment of the app to the other tablets were possible. Another small test was done where the tablet was connected to the transponder while no correct location was fixed, a report about this issue and potential improvements to the app was reported back.

The FloeNavi tablets turned out to be robust and working also in low temperature conditions of -30 °C, however it was reported by users that it is hard to use them at these temperatures as they only react comfortable when using bare hands. The supplied pen was not usable in these conditions as the tablets did not register the input from the tip.