SSF Ocean Flagship Programme – recognizing the current status of oceanic research in the Svalbard region and neighbouring European Arctic

Final report

Editors: Eva Falck, Ragnheid Skogseth, Hanne Sagen, Agnieszka Beszczynska-Möller, and Torill Hamre

The Ocean Flagship was established by three organizing institutes, NERSC, UNIS, and IOPAN in 2015. Svalbard Science Forum (SSF), a part of the Research Council of Norway, has funded the Flagship for two years. The Ocean Flagship is open to all partners actively involved in ocean research in the Svalbard region and more generally, in the neighbouring European Arctic. The main goal of the SSF Ocean Flagship is to serve as a platform for sharing knowledge and experience and exchanging up-to-date information about all aspects of current and planned ocean observing activities, in particular short- and long-term moored and mobile platforms and repeated field campaigns.

During the project period, the Ocean Flagship has arranged two workshops; the first in June 2015, in Sopot, Poland, where the current state and future opportunities for oceanic research cooperation in the Svalbard region and neighbouring European Arctic were discussed. Twenty scientists (plus four participating remotely) attended the workshop. A report from this workshop was prepared and delivered by Beszczynska-Möller and Sagen (http://ocean-flagship.nersc.no). The second workshop was held in October 2016 in Os, Norway with twenty one participating scientists (plus one giving a presentation remotely). The goals for this second workshop were to identify and discuss challenges, needs, gaps, data management, and possible solutions in terms of observing system, available and desired instrumentation, field operation logistics, future plans and opportunities for collaborative actions, including future projects and funding opportunities.

The Ocean Flagship covers all components of *in situ* observing system for the ocean around Svalbard including moorings, landers, and bottom anchored buoys. Mobile platforms, both drifting (surface and ice buoys and floats) and navigated (gliders and autonomous underwater vehicles) are also included. Mooring field operations (deployments, recoveries) and repeated ship-based surveys are also addressed in terms of providing synoptic ocean observations with extensive spatial coverage and resolution.

The goals of the SSF Ocean Flagship programme were:

- Strengthening of the ocean component in the Svalbard Integrated Observing System (SIOS) and the Arctic component of EuroGOOS – the Arctic ROOS (http://arctic-roos.org);
- Enhancing the collaboration between groups of researchers from different institutions and countries, working on variability of physical and biological ocean environment around Svalbard and in the European Arctic and facing similar scientific and logistical challenges;
- Optimal exploiting of available oceanic platforms (moorings, drifting platforms, autonomous vehicles), instruments and data sets for monitoring, long-term measurements and process studies in the ocean around Svalbard and beyond;
- Long-term use of new observing technologies for improved spatial and temporal coverage in ocean observations with an emphasis on multifunctional and multidisciplinary platforms (e.g. ice-tethered platforms, gliders, moorings);
- Increasing coherence and complementarity in the long-term ocean observations to address the key questions about the Arctic climate change and related feedbacks and effects on the ocean environment;
- Improving access to and foster further development of the shared infrastructure for the long-term ocean observations in the Svalbard region;
- Establishing a joint, state-of-the art web-based platform for exchanging the information about deployed platforms, short- and long-term plans for moored infrastructure, available field cruises for mooring operations, search and rescue opportunities for lost moorings and vehicles, metadata and data sharing;
- Addressing potential joint solutions for the logistic challenges (storage, work space, transportation, and pier capacity) in Longyearbyen in connection to ocean field measurements.

The overall work was divided into three main activities; the initial workshop to collect information and build the partnership, development of the web portal, and the final workshop to identify gaps in the observing system and provide recommendations for further collaboration and multidisciplinary research.

The overall applied tasks to be accomplished by the SSF Ocean Flagship during the two years of funding were:

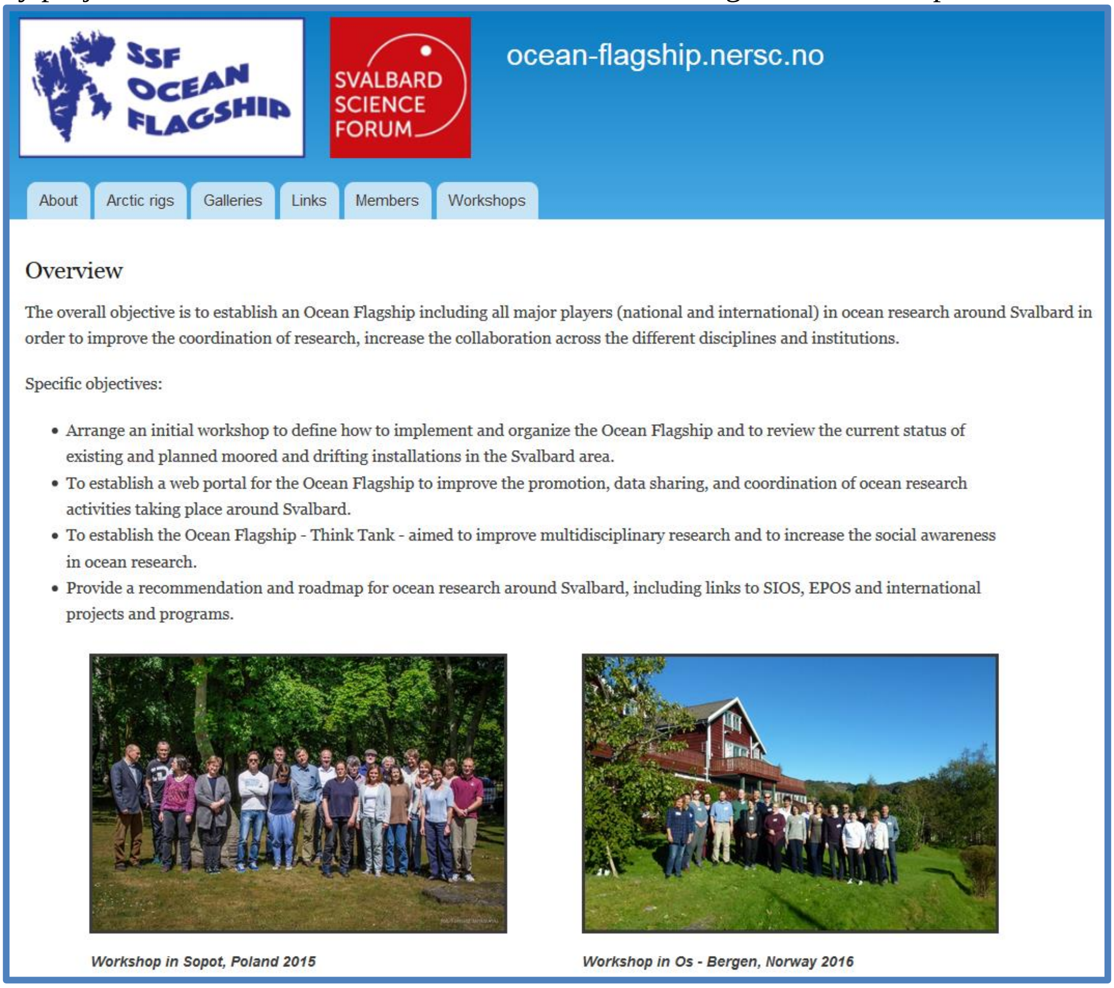
1. *To gather geographical and technical information about the current status and tentative plans for ocean observations by moored, bottom, and drifting platform in the Svalbard region and in the European Arctic.*
2. *To get an overview, as detailed as possible, on deployed and available instrumentation, including the design/build of a platform. To get overview of field operations (deployments and recoveries) and available ships for potential co-using, in particular in emergency situations or for complementary activities.*

These two tasks were covered during the first workshop in Sopot. The workshop provided an overview of on-going activities, long-term observations, and repeated measuring campaigns, as well as current and foreseen national and international projects, involving ocean observations in the Svalbard region and the neighbouring European Arctic. This overview and information can be found in the first SSF Ocean Flagship report delivered to SSF (http://ocean-flagship.nersc.no).

3. *To identify gaps and overlaps in the ocean observing system and to seek opportunities for joint actions and shared infrastructure. To identify any redundant elements that might be better distributed by agreements between partners and to recognize which gaps in the observing system could be minimized by redistribution of existing means.*
4. *To disseminate information about on-going and planned ocean observing activities and research programs in the Svalbard maritime region and foster collaboration for establishing new joint initiatives and research networks.*

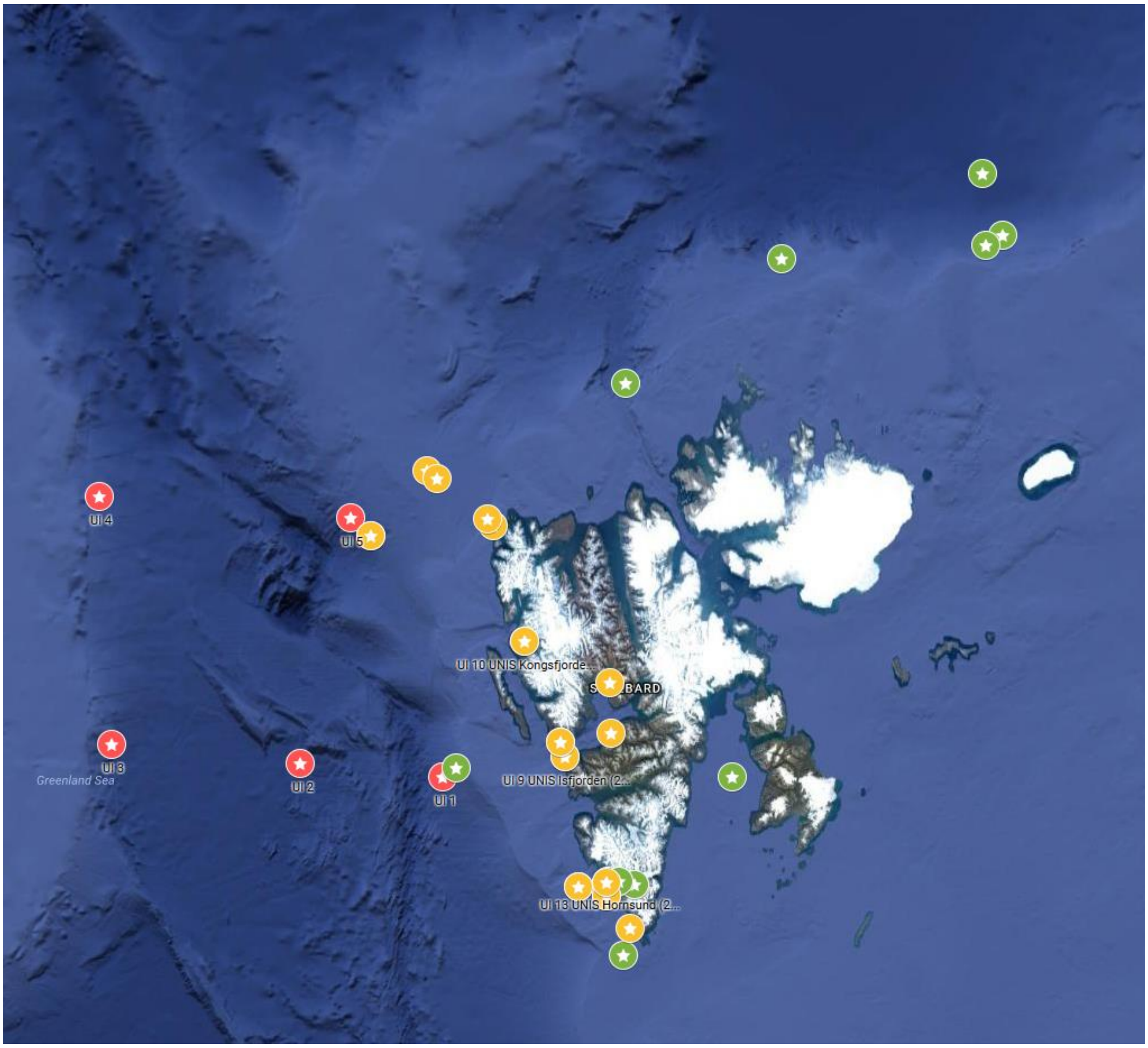
These two latter tasks were the aims of the second workshop and are presented below in this second and final SSF Ocean Flagship report and in the presentations available at the project website.

The main objective of the SSF Ocean Flagship web portal was to establish an online site for improving promotion, data sharing, and coordination of ocean research activities taking place around Svalbard. A major element of the web site has been to provide access to the reports from the workshops organized in the project, which can be reached from the home page. These reports describes some past, ongoing, and planned research activities in this region, conducted by project members and invited ocean scientists attending these workshops.



The home page of the SSF Ocean Flagship web portal

Instrumentation (oceanographic, biogeochemical, acoustic, and seismic sensors) and platforms (moorings, landers, drifting platforms, and gliders) worth of tens of millions Norwegian kroner are deployed in the ocean around Svalbard. One of the main goals of the Ocean Flagship project was to collect and disseminate information about the on-going research activities involving ocean observations. Therefore, the second major element of the web portal was to provide a map of some recent/current ocean moorings, as well as contact information for these:



For each ocean mooring, a table below the map contains selected metadata, such as mooring ID, deployment date, positions, and contact person. This enables the reader to get an overview of what kind of parameters are measured at different locations, and contact information for the owner of a mooring. As such it can be seen as a proof of concept for a web portal where scientists planning field experiment in the Svalbard region can find information about existing and upcoming infrastructure that may be possible to utilize in their research. Further development of the Ocean Flagship web portal should be done in collaboration with other ongoing projects and initiatives that compile and make available online metadata about and data from ocean mooring in the Svalbard region and surrounding ocean areas. This will enable a follow up of the Ocean Flagship project to collaborate with and leverage from related activities, and ensure that the web portal and its underlying components are compliant with established standards for metadata and data search and retrieval.

The following is based on discussions and presentations from the second Svalbard Science Forum Ocean Flagship workshop held on October 4-5th, 2016, at the Bjørnefjorden Gjestetun, Os, Norway.

Participants at the second Ocean Flagship workshop (photo Brian Dushaw), held on October 4-5 2016, at Bjørnefjorden Gjestetun in Os (outside Bergen), Norway.

Participating institutions in the second workshop: **Norway**: Nansen Environmental and Remote Sensing Center (NERSC), University Centre in Svalbard (UNIS), University of Bergen (UiB), University of Tromsø the Arctic University of Norway (UiT), Institute of Marine Research (IMR); Svalbard Integrated Arctic Earth Observing System (SIOS), Svalbard Science Forum (SSF); **Poland**: Institute of Oceanology PAS (IOPAN); **Germany:** Alfred Wegener Institute in Helmholz Centrum for Polar and Marine Research (AWI); **France**: Laboratory of oceanography and climate (LOCEAN); **Italy**: National Institute of Oceanography and Experimental Geophysics (OGS-OCE).

During the workshop time was given to the participants to discuss gaps in the ocean observing system and data management. The participants were divided into four groups and after the split discussions the different groups presented their results in plenum.

Gap analysis

The following questions were discussed:

What are the main gaps in 1) Geographical coverage; 2) Technology; 3) Parameters; 4) Research?

Below is a summary of the presentations from the groups.

Geographical coverage:

The eastern side of Svalbard is the most under-sampled area and more efforts should go into studying this region since the water originating there continues into Storfjorden and further along the west coast of Svalbard and hence influence the slope-shelf-fjord exchange. Much more sea ice is present on the eastern side of Svalbard even though the ice cover has decreased. Little is known about the exchange with water from the Arctic Ocean in this area.

Storfjorden has still many unresolved research questions regarding the fate of water produced there, such as the progress of the overflow plume from the Storfjorden polynya and also the fate of the dense water with more influence of Atlantic Water in recent years.

The region North of Svalbard is also an area that needs to be investigated more extensively than today. Especially the Yermak Plateau and its slopes, the marginal ice zone, and the transition regions from the shelf into the deeper Arctic Ocean are those areas where the most important yet least know oceanic processes take place. For instance, the Yermak Branch of the West Spitsbergen Current is still not fully understood and its path into the deeper Arctic Ocean is not known today.

The western side of Svalbard is the easiest accessible and most studied. But much more has been done in the deep Fram Strait compared to the shelf areas which in recent years have shown decreasing presence of sea ice and at the same time more influence of Atlantic Water. The AWI/NPI moorings have been operational since 1997 covering the deep and shallow water along the 78°50'N. It is, however, important to extend the standard hydrographic and current meter sections towards land to capture the shelf circulation and the shelf-ocean boundary conditions.

One major point was that **winter data** are needed everywhere.

Technology:

One main point from all groups was **larger battery capacity and lifetime**. Another was the need of **simple, cost efficient, but robust technology**, such as inexpensive moorings or remotely controlled autonomous platforms. More standardization between the manufacturers would also be good so that one could integrate instrumentation from different companies. To operate and make use of data from floats and gliders one need several developments. First of all improved methods for **detection of sea ice** at the surface are required to avoid damage of surfacing instruments. Second, a underwater **geo-positioning system** is needed to enable positioning of the data from floats, profilers and gliders, and to support navigation of the gliders/AUV during operations under ice. Make **autonomous systems able to communicate with each and to surface for satellite communication**. This would enable intelligent autonomous operations where AUV gets/gives information from satellites (or drones or ships) to underwater installations.

Acoustic mooring systems, as in the Fram Strait, are an example of multipurpose system. This system can be used for observing the ocean and as an underwater geo-positioning system. However, moorings in the arctic regions do not yet have access to satellites communication. Technology for surface access for moorings and other kinds of **underwater data transfer** would be an advantage and would make mooring data useful for operational oceanography. **Near-real time data** for operational use (e.g. for natural hazards, forecast models) are badly needed. However, the only secure and robust technology for real time two-way communication in the Arctic region is cabled nodes. This is expensive technology, but would serve several stakeholders needs e.g. operators, research and warning system for geo-hazards. There is also a need for better and more **biogeochemical sensors**.

Parameters:

First and foremost all kind of **winter data**, since most sampling is aliased to summer measurements. More **local weather stations** (wind, radiation, etc.) are needed for air-ice-sea interaction and other detailed process studies on e.g. mixing, polynyas, or slope-shelf-fjord exchanges. **Biogeochemical data**, such as dissolved oxygen, nutrients, pCO_2, total alkalinity, pollutants, etc., are scarse in time and space compared to physical parametres. S**urface data** are a prerequisite to study air-sea fluxes, and more data on **ocean currents** are required to address circulation and oceanic transport. The ship ADCP measurements are insufficient in most places since the ADCP cannot measure deeper than some hundred meters. LADCP should be used on all CTD casts to cover the full depth. More data on sea ice thickness, snow thickness, freeboard, and other **ice parameters** (in situ) are strongly wanted and measurements on permafrost in offshore areas are needed.

Research:

More research is still needed in the area around Svalbard (especially north and east of Svalbard). One major point is better knowledge about the **seasonality** (need more winter data). Other important area of research are the origin of and transports by the **coastal current** and its link to the sea ice cover east of Svalbard, the **Atlantic Water** pathways, oceanic heat and volume transports, heat fluxes from the Atlantic Water to the ice and atmosphere, and **slope-shelf and shelf-fjord exchanges**.

To follow the effects of a warming climate in the Arctic on the above mentioned processes a continuation of the long-term monitoring in the area is badly needed. This could be assisted with **more autonomous systems going around Svalbard.** More linkage between different spheres are needed to be studied, e.g. land and ocean, especially **glacier-ocean interactions**. How will melting of land-ice affect crustal stress distribution and thus seismicity? Small (turbulence) and mesoscale processes (e.g. eddy transports and fjord dynamics) must be investigated more extensively and so should **the impact of pollution** (fish nets, micro plastics, oil spills, etc.) on the environment. **Permafrost in offshore areas** should be looked at and how thawing of permafrost and exposure of slopes will affect slope stability. Ocean–ice numerical models need better resolution.

Discussions on data management

The following questions were discussed:

1. Where do we submit our data for storage and dissemination?
2. How easy is it to get access to data in the current data repositories?
3. How can in-situ marine researchers be motivated to register data?
4. The future of Ocean Flagship – how to continue and extend our collaboration in ocean research?

Below is a summary of the presentations from the groups.

Where do we submit our data for storage and dissemination?

The main answer was national e-infrastructures/data repositories, such as the Norwegian Marine Data Centre (NMDC), NorStore, and the National Oceanographic Data Centre (Italy). Most countries have a national data base, but it is not always functional, which leads to storage at local institutions (e.g. IOPAN in Poland), which again leads to problem of long-term data archive. Large projects usually have a clear data management plan indicating where the data should go.

How easy is it to get access to data in the current data repositories?

It is generally easy to get access to data if you can define the geographical area and time period that you're interested in, but sometimes hard to find where to look for desired data types. More difficult when you have to search among multiple repositories and obtain data in different formats. The following repositories were mentioned:

- Coriolis: (European Argo branch) easy! You can get raw data or quality controlled, and derived products (e.g. gridded fields)
- NORMAP: for science it’s very easy. SIOS builds a lot on NORMAP.
- NMDC: easy, by the contact person, quite difficult in some cases (some data types).
- IOPAN: By personal contact - know people.
- PANGAEA (AWI) - need to know what to search for.
- ICES - is used sometimes, some requirement to submit data there.

Sometimes it is hard to even know where to go to look for data, so a “Data base of data bases” would be helpful, where it is possible to get a list of data repositories that might hold the kind of data needed or suggested, perhaps with a ranking system.

How can in-situ marine researchers be motivated to register data?

The main answer for this question from all the groups was that data should be published in good quality data centres/infrastructures (analogous to highly ranked journals) and citable DOI should be given for all data. One should take into account that simple reporting\data formatting that is not very time consuming would encourage data submission. Other points were:

- One should get credit for submitting data, and treat a good data set on an equal basis as a good publication.
- One should motivate leadership and funding agencies to recognize the value of collected data (in particular long term time series). Today there is no recognition for collecting data from high level administration. What we need is long time series, but you can't get funding for this (usual justification is "we fund research, not monitoring").
- It should be compulsory to submit data.
- One could put requirements when funding a proposal, active/good record of data submission could serve as a selection criterion in future proposals.
- Journals could require access to data in publication.

There should be more focus on getting more data into the data repositories, rather than the quality of the interface etc. Also this shouldn't be done by scientists but by engineers etc. Hire people to collect data, prepare them, and put them out/into the public domain.

The future of Ocean Flagship – how to continue and extend our collaboration in ocean research?

All agreed that it is valuable to meet like this, and a good way to build a network, exchange information, and establish collaborations. Land-based observatories seem more coordinated than the marine side. If continued, it should be made more international – for example rotate membership in the organizing committee. One Norwegian partner is needed (if based on Norwegian funding), but other organizing partners could vary from year to year (and the location). This could attract new, different people in attendance each time, and widen the group. But it is important to keep it as a simple forum for direct communication between people doing *in situ* ocean measurements in the Svalbard area.

Presentations at the workshop.

To disseminate information about on-going and planned ocean observing activities and research programs in the Svalbard maritime region several presentations were given during the workshop. The presentations were divided into three themes covering observational techniques, infrastructures, and data management. A summary of each presentation is given below.

4. October

Jørgen Berge (UiT): "*Marine observatories and observational techniques - from the last ten years and into the future*"

The talk was divided into two parts:

1) Marine observatories (Kongsfjorden & Rijpfjorden)
2) Ice tethered platforms

The Kongsfjorden mooring time series dates back to 2002. Kongsfjorden is located on the west coast and influenced by Atlantic Water (AW), a change to more inflow of AW since 2005/06. Influx of new fish species to the fjord has been observed in years with relatively high winter temperatures. Rijpfjorden is a north facing fjord with Arctic waters and quite different climate. The mooring here serves as core infrastructure for marine biology projects and field work studies. The plan is to continue these two moorings at least for 10 more years. SIOS long term observational programme will be part of this if funded (2018 – 2027).

The Arctic Ocean is in general under sampled, especially during the polar night, the sea ice is diminishing, and there is a growing need to increase studies. An ice tethered observational platform was employed in the Arctic Ocean pack ice in 2015 as part of the project Arctic ABC (Arctic Ocean ecosystems - Applied technology, Biological interactions and Consequences in an era of abrupt climate change, 2015-2019). The aim of the project is to develop autonomous under ice tethered observatories (ITO) that will provide optical and acoustic data from the Arctic Ocean drift ice ecosystem, including during the polar night.

The observatories will be able to operate in ice and open water, and will have real-time satellite-communication ability. The biological aspect of the project is to assess direct and indirect impacts of continued reduction of the Arctic sea ice cover on the Arctic ecosystem. The focus is on exploring biological coupling processes between sea ice and the ocean, faunal migration patterns, degree of dependence on multiyear sea ice, and adaptations to the Arctic sea ice habitat.

Another project including ice tethered observational platform is ICE-POPEs (**ICE** tethered **P**latform-cluster for **O**ptical, **P**hysical and **E**cological **s**ensors). Test platforms will be employed on an ice float in Kongsfjorden in January 2017 and on fast ice in March 2017 in Van Mijenfjorden, and later moved up to Rijpfjorden using drones to collect data. In 2018/19 the plan is to deploy them in the pack ice in the Arctic Ocean (deploy them as a cluster, but each POPE is its own unit) and pick them up in the Fram Strait with a research vessel. The data collected during ICE-POPEs will give a unique insight into the ecology in the polar night.

Jenny Ullgren (NERSC): "*A voyage in the Fram Strait in summer 2016 with two small unmanned sailboats (SailBuoy)*"

The project Iskantseilas –"Ice edge voyage" (Measurements in the polar ocean with unmanned vehicles) is an industrial research project. The SailBouy is easy to deploy and can operate in 3-20 m/s winds. It can handle big waves, flip over and flip back again, and communicates with satellites. Only surface parameters can be measured and there is a problem when there is no wind present but only currents. The SailBuoy can be out for 10 weeks with a working speed of a few knots. It runs on solar and wind energy.
The goal of the project is to make a detailed description of the fine scale distribution of water masses and plankton in the polar ocean through the use of innovative measurement techniques. During a research cruise on board Norwegian Coastguard vessel KV Svalbard in June-July 2016 two SailBuoys were deployed for the "Ice edge voyage" project. One of the SailBouys was designed to collect echo-sounder data and the other to measure ocean acidification. The data from all sensors seem to be of high quality and will in the near future be calibrated against water samples, CTD-profiles (XCT), and satellites images.

Brian Dushaw (NERSC): *"Ocean Acoustic Tomography in Fram Strait: Past Paths and Future Directions"*

The presentation on ocean acoustic tomography in Fram Strait consisted of five parts:

1. Sound speed as a proxy variable for temperature
2. Internal waves and mesoscale effects on acoustic propagation: the tomography forward problem
3. A study of moored/point and acoustic tomography/integral observations of Fram Strait by objective maps
4. Time series of temperature in Fram Strait from 2008-9 DAMOCLES tomography
5. 2011-2012 ACOBAR, UNDER-ICE and Future Directions

A pilot acoustic tomography program in Fram Strait during 2008-2009 measured a year-long record of acoustic travel times along a 130 km range acoustic path crossing the West Spitsbergen Current. Individual ray arrivals were not observed. Rather, the arrival patterns consisted of a single, stable, broad arrival pulse of about 100 ms duration. Travel time variations of +/-0.15 s recorded the vigorous mesoscale environment of the region and the seasonal cycle. To estimate ocean temperature from the tomography data an inverse scheme employed a high-resolution ocean model for Fram Strait as the reference ocean. The information from the tomographic measurements is primarily average temperature. Estimated temperatures, averaged over 0-1000 m depth and over range, had a mean of 1.11°C and variations of +/-0.33°C; the uncertainty of the tomography estimates was about 60 m°C.
Agreement with an alternate inverse approach based on EOFs and a Markov Chain Monte Carlo inversion scheme relying on a matched-peak approach was excellent, indicating a robust estimate for ocean temperature. The inverse estimates for average temperature agreed with the equivalent estimates from hydrographic sections obtained along the acoustic path at the start and end of the program. Among other deficiencies, the ocean model greatly underestimated the

intensity of the mesoscale fluctuations and exhibited a warm bias of about 0.38°C in section-averaged temperature.

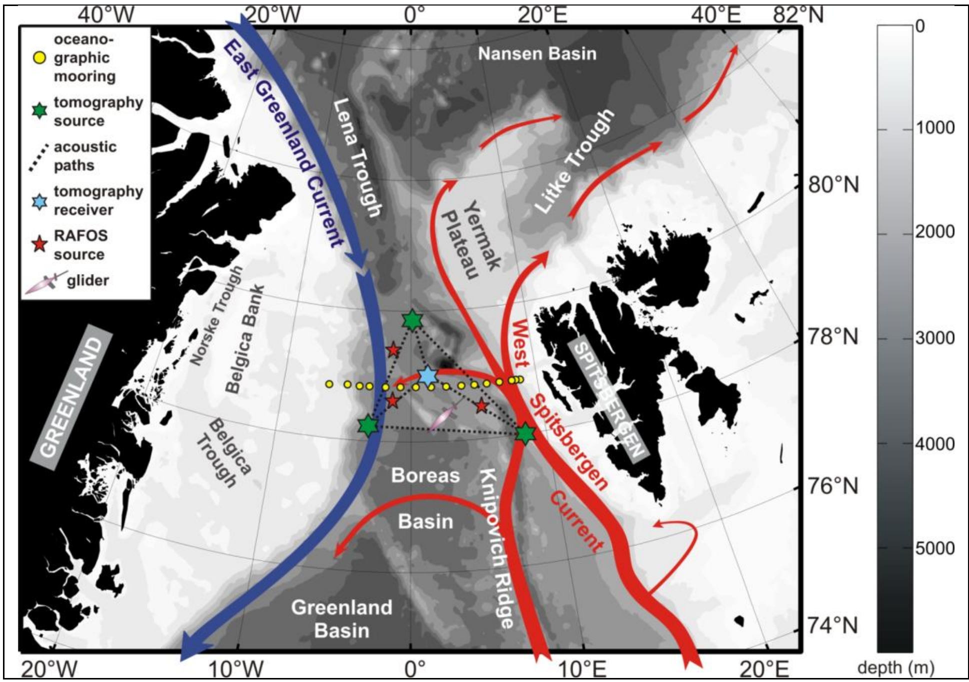
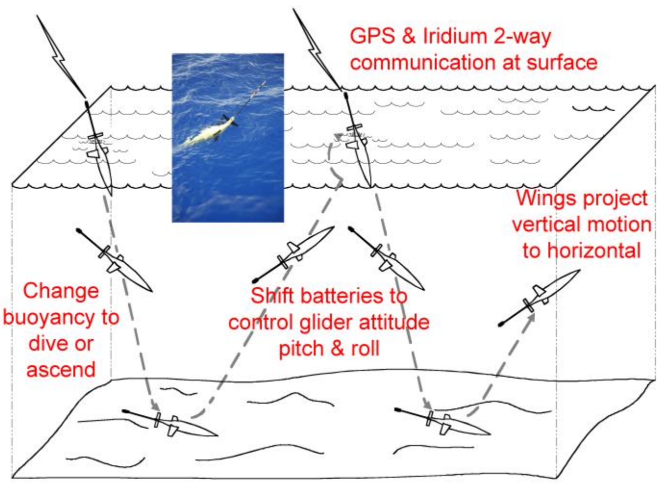


Figure displays the ACOBAR acoustic multipurpose acoustic system. The system was composed by three acoustic transceivers (green stars) and a stand-alone vertical acoustic receiver array (blue star). The yellow dots indicate the positions of the 17 oceanographic moorings maintained by AWI and NPI.

Additional tomography data were obtained in 2010-2012 on three acoustic paths during a follow on experiment these data are processed and inverted to timeseries of depth-range ocean temperature. In the UNDER-ICE experiment acoustic travel times are measured along eight sections. These data will be processed and analysed in the same way. Tomographic measurements in the Fram Strait offer unique large-scale temperature observations for observing changes in the ocean, to validate models and ultimately be used as constraints for ocean models through data assimilation. It is anticipated that constraining ocean models with acoustic measurements will lead to more accurate estimates of the circulation and transports in the Fram Strait.

Kjetil Våge (UiB): "*High latitude glider operations (NACO)*"

The Norwegian Atlantic Current Observatory (NACO) is a national research infrastructure facility for gliders to monitor the Norwegian Atlantic Current (since 2011). The core idea of the NACO proposal was monitoring with gliders at key locations. The aim is to build-up competence and service to research projects and is run by UiB (GFI) with IMR and REC as partners. The NACO glider infrastructure consists of six Seagliders (deep) and 3 Slocums. The distance covered since 2012 is more than 40 000 km. They have been applied to projects in the Norwegian Sea, Faroe-Shetland Channel, Iceland Sea, Svalbard, coastal and fjord areas, and a fresh water lake. The gliders can dive to 1000 m and



have a 5-6 km horizontal resolution. Time per dive is 8-9 hours and the velocity is 15-20 km/day. They can operate for 9-10 months and are equipped with temperature, salinity, dissolved oxygen, and other sensors. They communicate through GPS and Iridium 2-way. Gliders must be ballasted for local densities. Sharp stratification near surface could be a problem. Gliders also have problems with sea ice, since they need to surface after each dive. There will be a coordinated field campaign/experiment winter 2017-18, close to the ice edge, where ice avoidance algorithms will be used. As the glider ascends it will monitor the temperature, and if it is close to freezing the glider will dive again until finding safer place to surface. More information about the gliders can be found on http://naco.gfi.uib.no/.

Benjamin Rabe (AWI) (on Skype): "*Ice-ocean-atmosphere buoys in the Arctic Ocean: new initiatives from AWI/Germany and scientific applications*"

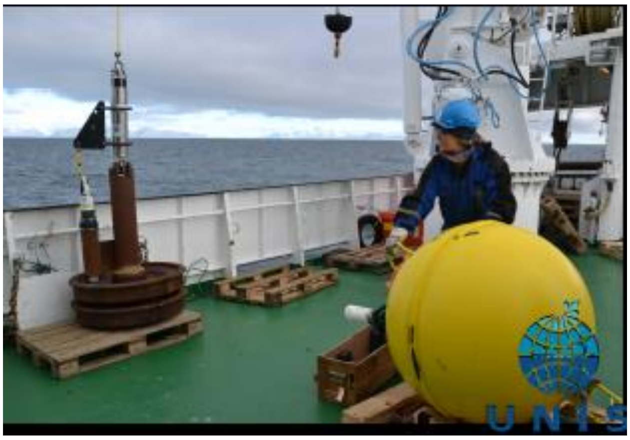
The processes and parameters related to the atmosphere-snow-ice-ocean interface are an important research area. Arctic autonomous drifting buoys are needed to get more data and a better understanding of these processes. Building on the "Frontiers in Arctic Marine Monitoring" (FRAM) project (2014-2021) infrastructure funding by AWI ("Multidisciplinary Ice-based Distributed Observatory", MIDO) and contributions by international collaborators will allow deploying a minimum of four ice tethered CTD profilers each year in the central Arctic/Transpolar Drift. This will be done within a network of buoys for ice-ocean-atmosphere observations, with multi-disciplinary observations (physics, biochemistry, biology), including multi-buoy arrays on single ice floes.

Particularly important is the need for better snow depth and snow properties data. Snow measurements are important to interpret remote sensing signals and for fresh water signals. Snow depth and properties dominate the surface processes and it is hard to model snow. For this snow buoys are an excellent tool, they record snow depth and surface (atmospheric) temperatures. So far there have been 39 deployments in polar waters, 13 are still active, the longest record is 1177 days, and six new ones have been ordered for 2016. IMBs (ice mass balance buoys) are another effective tool for atmosphere-snow-ice-ocean interface research. There are still some technology issues with these instruments. The plan is to develop an open source platform to include also other sensors in the future. More ice-tethered bio-optical buoys (IBOB), which measure fluorescence of Chl a and Coloured Dissolved Organic Matter (CDOM) in and just under the sea-ice, will also be used. Further future plans are to use wind mills and solar panels in conjunction with IMBs, and to put weather beacons on snow buoys.

Long-term prospect: the aims of MIDO are to integrate measurements from the same ice floe of atmosphere, snow, sea ice, and upper ocean, using snow buoys/polar weather stations, sea ice mass balance buoys, ice-tethered bio-optical buoys, and upper ocean bio-profilers. Expeditions with AWI (FRAM/MIDO) participation: PS101 (Sep. 2017), NABOS (2017), 2018 still pending, TransARC III (2019), MOSAiC 2019/20 (Multidisciplinary drifting observatory for the study of Arctic climate). This latter is a big international concept and the buoys will be a part of this as well. MIDO will hopefully lead to a long-term concept for central Arctic buoy observations.

Frank Nilsen (UNIS): "*UNIS marine infrastructure – existing, planned and wanted*"

Main research focus is on the Atlantic Water transport towards the Arctic and its intrusions onto the shelf together with effect studies on the shelf and in the fjords. At the moment UNIS have two moorings at the mouth of Isfjorden, one at the southern side since August 2005 and one at the northern side since August 2015. The moorings capture the inflowing water and the transformed water masses leaving Isfjorden. The Isfjorden Observatory System, a mooring inside Isfjorden, near Svalbard Airport, was deployed in September 2016 and is connected to land by a cable. The Svalbard Environmental Protection Fund have funded the project "Blir det is på Isfjorden i år?" which is a collaboration between Aanderaa Instruments AS, UNIS, and Svalbard Environmental Protection Fund. The data will be freely available on http://aanderaaeng1.cloudapp.net/AADI_DisplayProgram/setups/hc_unis/default.aspx. The mooring collects real time data of temperature, salinity, and oxygen at several depths (between 20 and 60 m), in addition to full depth current profile including surface layer (indicate ice/no ice), fluorescence and PAR at 20 m depth, and bottom pressure.



During the projects REOCIRC and AWAKE-2 additional moorings with bottom pressure sensors and current meters were positioned at the Yermak Plateau and on the shelf outside Hornsund (2014-2016). The objective was to study Absolute Dynamic Topography of the WSC by taking advantage of advances in satellite geometry (GOCE) and altimetry, and providing ground truth for satellite gravity solutions (GRACE).

Enabling technology for mapping and monitoring of extreme environments is essential in future management and utilization of the Arctic areas. Arctic conditions require a high degree of autonomy to reduce operation time, weather dependency, and enabling measurements in all seasons. UNIS is eager to try out new technology and method development in their student courses (e.g. gliders, AUVs, drones). This winter one course will use a Slocum glider (from NACO) and a Remus AUV (from NTNU) in Isfjorden and SUMOs (Small Unmanned Meteorological Observer) over land and sea.

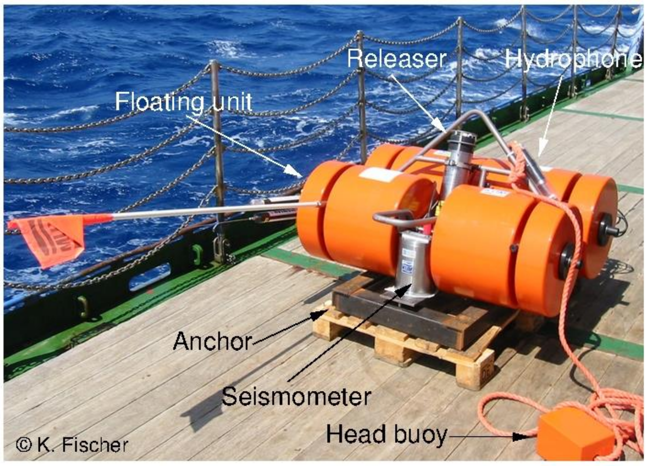
Mathilde Sørensen (UiB): "*Natural hazards in the Arctic (EPOS)*"

Natural hazards may be divided into two categories: Direct events (e.g. earthquakes, landslides/submarine slides, snow avalanches, volcanic eruptions, extreme meteorological events, and floods) and triggered events (e.g. tsunamis, landslides/submarine slides, snow

avalanches, (volcanic) earthquakes). These events are a problem when they interact with human infrastructure. Climate change effects may cause thawing of permafrost, melting of land ice, and changes in sea ice cover. To record seismicity in the Arctic there exist a land based station network around the Arctic Ocean, but missing stations in the ocean. One can use bottom pressure data from the ocean if sampled frequent enough.
The EPOS (European Plate Observing System) project is a long-term plan for the integration of research infrastructures for solid Earth Science in Europe. 25 countries in Europe participate, and a wide range of disciplines are represented. The goal is to bring all data together and make it available through an e-infrastructure. Following an initial 4-year with a preparatory phase project (EPOS-PP) funded by EU-FP7, EPOS has now started its implementation phase (EPOS-IP) which is funded by Horizon2020, and thereafter an operational phase will follow. Parallel with this, Norwegian National EPOS Consortium (NNEC), which was established in 2009, has developed the EPOS-Norway Project. The EPOS-N consists of three components:

1. E-infrastructure
2. Improved observations in the Arctic
3. Solid earth science forum

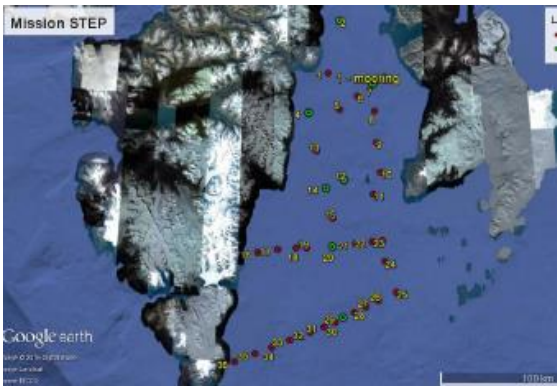
One main object during EPOS-N is to improve observations in Nordland, on Svalbard, and on Jan Mayen. Monitoring of natural hazards is part of the new INTAROS project starting in 2017.



The main goals during this project are to merge all available seismometer data from existing stations, to extend monitoring to offshore areas, and combine with data from local populations. The expected outcomes are improved monitoring of natural hazard events, better understanding of challenges in a changing climate, data for improved weather forecasting and climate models. In addition it will be laying foundation for interdisciplinary work, and involvement of, and awareness building among local populations.
Natural hazards are expected to become more significant in the Arctic in the future. There are still large monitoring gaps in the Arctic region but some of these gaps will be filled in the near future.

Frédéric Vivier (LOCEAN): "*The STeP program.*"

The Storfjorden Polynya is a perfect candidate polynya for an international observatory and has been investigated for more than 20 years. For LOCEAN it started with the OPTIMISM monitoring program in 2011, which consisted of physical oceanography surveys of the polynya and development of a regional high-res configuration NEMO+ LIM numerical model. There were three summer campaigns from small sailboats, sometimes in difficult conditions. Five years of mooring data in the core of the polynya were achieved.

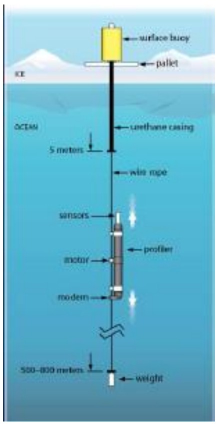


The STeP program (Storfjorden Polynya

Multidisciplinary Study) has now changed from a physical oceanography survey program to a multidisciplinary international survey program. Biogeochemistry is included and looks at the impact of brine enriched dense water formation on biogenic fluxes, particulate fluxes, and greenhouse gases and their exchanges with atmosphere and sediments. Two joint moorings (T, S, V + pCO2, O2, pH, sediment trap with automatic water sampler) were deployed in Storfjorden during a STeP cruise in summer 2016. Ship time to recover/redeploy the mooring is requested to French oceanographic fleet for summer 2017 and summer 2018 (response in December). It is important to continue this long-time monitoring.
Future plans are to couple the NEMO+LIM with the biogeochemical model PISCES and validate it with in-situ data. The goal is to better predict dense water formation in ESM. There is a clear will to pursue this monitoring program/survey on the long run.

Agnieszka Beszczynska-Möller (IOPAN): "*INTAROS: The ocean component*"

INTAROS is a project funded by the European Commission 2016-2021 (5 years) starting in December 2016. The main objective is to build an efficient integrating Arctic Observation System by extending, improving, and unifying existing systems in the different regions of the Arctic. The ocean component in INTAROS is based on *in situ* observing systems. The main goals are to improve critical gaps in the existing observing systems and to build additional capacity of pan-Arctic monitoring. The main activities planned under INTAROS for ocean observatories are to develop and integrate autonomous and robust *in situ* systems for year round measurements of key variables and to deploy mature and new sensors and *in situ* platforms in selected reference sites and distributed observatories.
There will be three phases: 1) Development of new technology, integration, finding solution (months 1-18), 2) Implementation and dedicated fieldwork (months 19-48), and 3) Preparation and delivery of data (months 19-54). The specific ocean components are:
Task 3.1 **Coastal Greenland**: Ocean moorings with freshwater focus in NE Greenland, surface pCO2 and ocean acidification in the Greenland coastal zone, multidisciplinary acoustic observatory in Young Sound with passive acoustics.
Task 3.2 **North of Svalbard towards the deep Nansen Basin**: Array of multidisciplinary moorings with profiling instruments and point measurements of ocean physical variables, a suite of biogeochemical measurements and sampling, novel pCO2 and pH sensors for carbon system variables, combined ADCP-echo sounders for currents and zooplankton, upward-looking sonars, bottom pressure recorders, passive acoustics recorders for ocean soundscape in the Arctic, and ocean bottom seismometers for solid earth processes and geo hazards.
Task 3.3 **Fram Strait**: Extension of the Hausgarten observatory with experimental autonomous system for impacts of ocean acidification on benthic biology. Real-time measurements of pCO2 and pH, monitoring of carbon cycle parameters in Kongsfjorden, and directional acoustic systems to monitor benthic species and dynamics of sea ice and icebergs in Kongsfjorden.

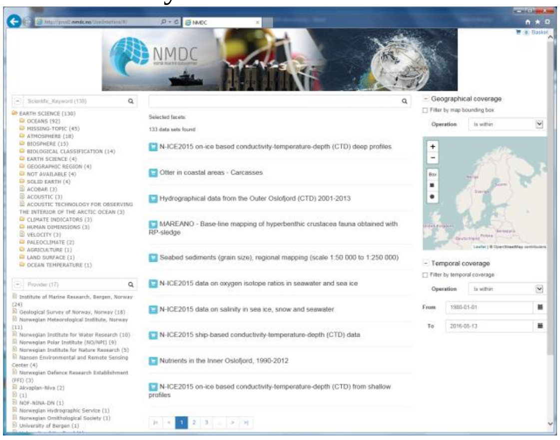


Task 3.4 **Distributed systems for ocean and sea ice**: Ice-tethered platforms for measurements of ocean physical variables and with biogeochemical sensors for multidisciplinary measurements, sea-ice mass balance buoys clustered with ITPs and standalone, measurements of snow properties and ABL observations from SOOs, quadrocopter measurements of broadband and surface albedo, novel sensors for Ferry Boxes (ocean acidification and carbonate chemistry, inherent optical properties, micro plastic sampler), endurance glider lines in the open water Arctic regions, BioArgo floats in Baffin Bay.

5. October

Terry Hannant (IMR): "*Norwegian Marine Data Centre (NMDC)*"

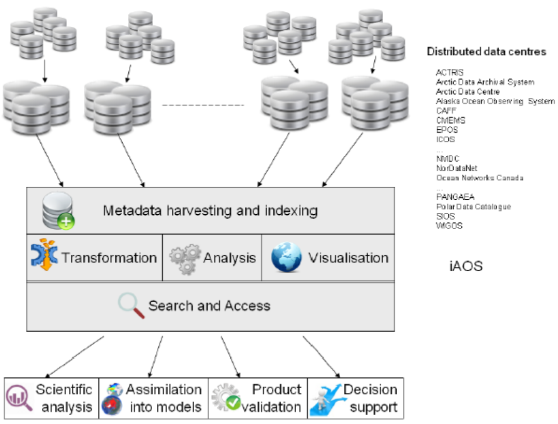
The main objective for NMDC is to serve the marine science community with seamless access to marine datasets covering waters of Norwegian interests (website: http://nmdc.no/). The Institute of Marine Research is the coordinator of this project and has 16 national partners. There are eight work packages: Project administration, System design, Data format and flow, Data storage, Data catalogue, Applications, Data availability, and Dissemination and Sustainability.



The main components are: Centralized metadata catalogue - all metadata are searchable from the same place. Distributed metadata providers - each partner provides metadata through their own infrastructure or via another partner's infrastructure. Distributed data providers - each partner can use their own infrastructure. Public REST api for 3rd party users - Accessible on the central node. Data catalogue web application - Shows all the metadata in the centralized catalogue - Possible to search and download data.
The main challenges are to encourage metadata provider to supply meaningful metadata attributes, the diverse institutions have varying expectations to agree on common approach, to ensure that each data provider has a data policy for sharing data (NLOD [Norwegian], CC BY 4.0) and to change existing mindset to encourage data sharing.
Future direction for the project will be verification of data set links, collect selected datasets into single download file, support sub setting of datasets for download for large datasets, provide permalinks for search results (so that you for example can periodically check for updates), and provide digital object identifier (DOI).

Torill Hamre (NERSC): "*INTAROS – integrated Arctic Observing System (Data Management)*"

INTAROS is a project funded by the European Commission 2016-2021 (5 years) starting 1 December 2016. The main objective is to build an efficient integrating Arctic Observation System by extending, improving, and unifying existing systems in the different regions of the Arctic. Data management is interwoven in the INTAROS work plan and in 6 of 7 work packages there is focus on data management, with WP 5 (Data integration and management) only concerning data management. The aims of WP5 is to integrate multidisciplinary and distributed data repositories into a scalable and resilient Pan-Arctic observing system, to offer seamless access to observations and derived parameters, provide a set of tools for data analysis, and transformation and visualization of spatiotemporal datasets.

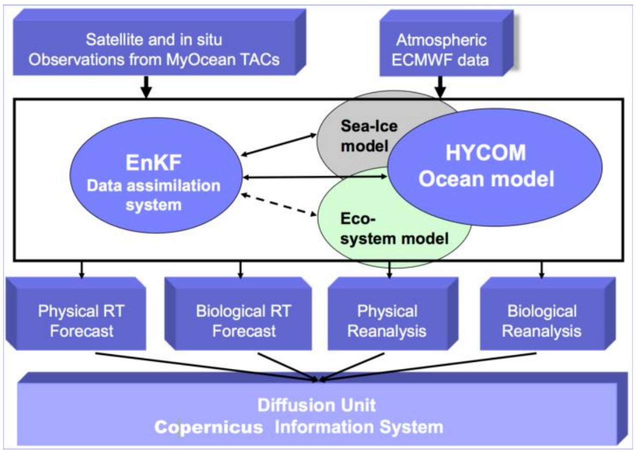


The approach will be to build on present observing systems developed over several years and operated with funding from countries and international agencies to ensure that the iAOS is maintained as a sustainable platform. And to leverage on existing

data repositories for storage and curation of new data collected during INTAROS and provide seamless access to distributed data repositories through a common ICT platform with embedded processing and analysis tools.
Specific objectives are to provide the underlying infrastructure for the Integrated Arctic Observing System (iAOS) and associated tools for IT management and support. Provide a framework to ease the discovery and retrieval of data from existing spatial data infrastructures. Develop new geo-statistical methods for interpolation of spatiotemporal data sets, provide a set of tools for data analysis, transformation, and visualization. And to process new observations from WP2-4 and store the generated datasets in an iAOS enabled repository.
INTAROS will have a strong focus on data integration and management, from initial planning to implementation in iAOS, in line with international standards on quality and metadata. iAOS will integrate a range of existing data repositories and infrastructures, and build a layer on top for unified search and discovery, browsing and downloading, processing and analysing. Recommendations from the design and implementation of iAOS will feed into the Roadmap for SAOS (Sustainable Arctic Observing System).

Jiping Xie (NERSC): "*COPERNICUS; the Arctic node*" (Changed to: COPERNICUS, the TOPAZ system in the Arctic Ocean)

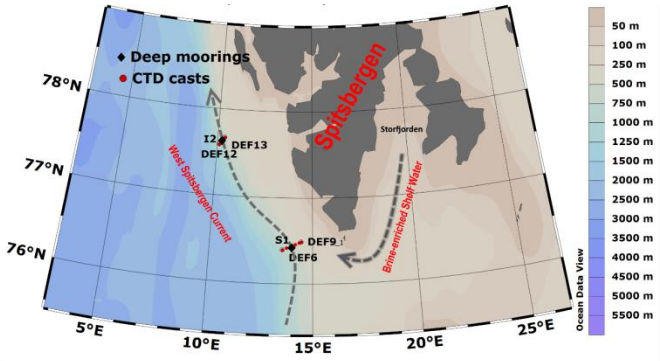
Data assimilation is needed to improve models. The TOPAZ system has been developed over 15 years, and is now used for operational forecasts. The reanalysis part takes place at NERSC and forecast at Met.no. The model used at NERSC is a HYCOM combined with sea ice model. The horizontal resolution is 2.16 km and provides nesting boundary for some high-resolution models. Ensemble Kalman filtering (EnKF) is used with 100 model members with different initial states to get perturbed states. During the forecast state, error covariance Kalman gain is calculated, to see how much innovation (difference between model and observation) can be integrated.



TOPAZ4 is a coupled ocean and sea ice data assimilation system using EnKF with 100 members. The quantitative assessment of the reanalysis in 1993-2013 shows a good stability for the EnKF settings, and demonstrates the ability to provide physically consistent error estimates. Two parallel Observing System Experiment (OSE) runs have also been performed with one assimilating the sea ice thickness from the SMOS-Ice dataset. The results suggest that the SMOS-Ice is a good complementary data set that can be safely included in the TOPAZ system.
Future plans are to assimilate more sea ice thickness observations from satellite data (SMOS + CryoSat-2), to blacklist the observations rejected by data assimilation and communicate the list to their providers for further inspection, to test an observation-based mean dynamic topography (RIO2013), and to double the horizontal and vertical resolutions (58 hybrid layer and 5 km horizontal resolution).

Vedrana Kovacevic (OGS-OCE): "*Ongoing observational activities offshore SW Spitsbergen*"

OGS and CNR-ISMAR (Italy), in collaboration with several international partners, have conducted observations in the deep layers of the SW offshore region to study currents and thermohaline variability on multiannual and seasonal scales. The oceanographic activity in the southwestern offshore area of Spitsbergen was started in 2014 during PREPARED (Eurofleets2 Initiative) with the objective to study currents and bottom thermohaline properties. For this purpose three moorings (S1, I1, and I2) were deployed. In 2015, during a RV Helmer Hanssen cruise in June, two of the moorings (S1 and I2) were recovered and redeployed, but the recovery of the third mooring (I1) was not successful. In 2016 (RV POLARSTERN PS99.1 Cruise) both the moorings deployed in 2015 were recovered but only one redeployed (S1).

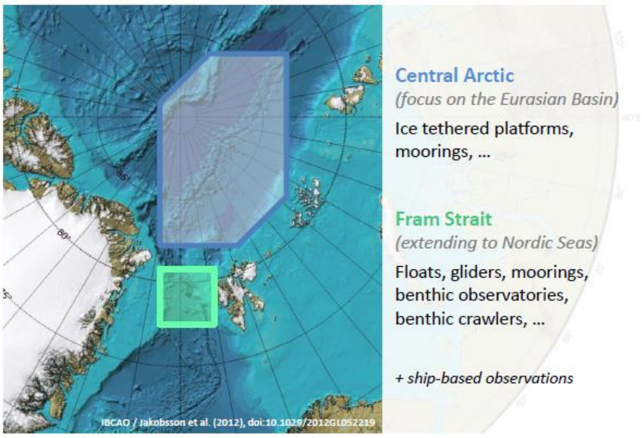


The moorings S1 (outside Hornsund) and I2 (outside Isfjorden) are equipped with current meters and sediment traps. During the cruises CTD casts (T, S, O2, TUR) were taken along the western coast of Spitsbergen and water sampling was done for later analyses of pH, AT, DO, DIC, H2S, CO2, CH4, and DIZ. The moorings are also part of a small project DEFROST (Deep Flow Regime Off Spitsbergen) under the PNRA Italian Arctic and Antarctic Research Programme.

Plans for the future is the wish to consolidate a partnership for summer 2017 to recovery of mooring S1 (and I1?) on board already established cruises, seek for and to strengthen two-fold collaboration - inviting all of you who are interested to work on future paper on the time series at S1 and I2 contributing your own data and your expertise - offering our achievement to integrate/complement with your own ongoing research. To stimulate and look for those who might be interested in collaborating on the extension of the mooring time series in the future or immediately after the summer 2017. Moorings secure until 2017 but not thereafter.

Thomas Soltwedel (AWI): "*The FRAM Ocean Observing System*" **presented by A. B.-Möller**

The FRAM project (FRontiers in Arctic marine Monitoring) is a big infrastructure network funded by the Helmholz group. The goal is to have sustained multidisciplinary, year-round surface to seafloor observations in the changing Arctic to address variability and trends in physical and chemical conditions, and ecosystem response. The aims and key tasks are: 5 or 7 year strategic investment (25 MEUR) to implement a distributed observatory infrastructure in the Fram Strait and in the central Arctic (start August 2014), long-term operation by AWI for a minimum of 20 years, develop and implement cutting edge technology, and establish procedures for data assimilation.

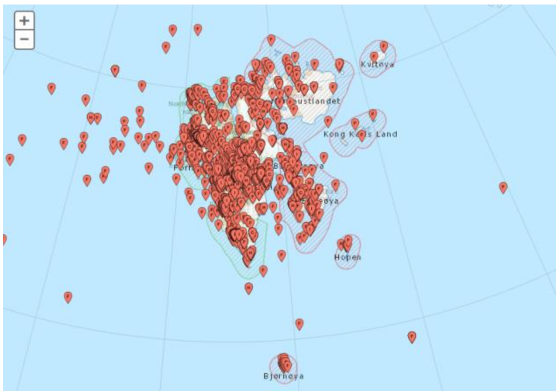


The project will build on existing infrastructure, integrate the existing AWI time-series programs (HAUSGARTEN, HAFOS), and extend the scientific scope as well as spatial and temporal coverage. Tasks addressed during the first two years were hiring people, select and purchase state of the art instruments and sensors, develop and improve systems, test systems under laboratory conditions and at test sites, instrument deployments and tests in the Fram Strait and Central Arctic, installation of a through-flow system on RV Polarstern, and develop procedures and tools for data dissemination and product generation. Novel observation platform will come later.

The working areas are (1) the Fram Strait, extending south to the Nordic Seas and (2) the Central Arctic (with focus on the Eurasian Basin). The instruments deployed so far are polar area weather stations (PAWS), ice-tethered bio-optical buoys (ITBOB), surface water moored devices, profiling winch (designed from scratch and built by AWI engineers, seems to work!), LOKI, AUV, sediment traps, acoustic recorders from Develogic, free-falling systems, towed camera systems (ocean floor observing systems), and benthic crawler.

Margrete Keyser (SSF): "*The Research in Svalbard (RiS) Database (Svalbard Science Forum)*"

The Svalbard Science Forum (SSF) is a secretariat under the Research Council of Norway, placed in Longyearbyen. Three people work there. The mandate of SSF was given in 2011 by the Ministry of Research and Education. The objectives were increased cooperation, increased coordination of activities, open sharing of data, reduced environmental impact – of research in the Svalbard area. The SSF main tasks are information activities (e.g.a list of bodies one may need to apply to, to conduct field research in Svalbard), funding opportunities (Arctic Field Grant and Svalbard Strategic Grant), providing meeting places, and the functioning of the Research in Svalbard (RiS) database. RiS is owned in a partnership with Kings Bay and the Governor of Svalbard.



The Research in Svalbard database (RiS) offers open access to all relevant information in one place (http://researchinsvalbard.no). It is a valuable tool for coordination and cooperation for those carrying out research in Svalbard and a place to search for information about activity in the field. RiS contains information about projects, researchers, fieldwork, metadata, and publications. Anyone can search the database without being logged in. Find others working on similar topics (logistical planning), choose period, ongoing projects ("in work") – find out fieldwork dates, etc. It is mandatory to register all research projects requiring authorisation pursuant to the Svalbard Environmental Protection Act or which will be carried out in Ny-Ålesund or Hornsund via the RiS database. Svalbard-related research projects receiving funding from the Research Council of Norway are also required to register in RiS. All other research projects with a connection to Svalbard are strongly encouraged to register in the database.

Also booking of services in Ny-Ålesund and application for permits is done through the RiS portal. If the governor receives applications from outside the RiS portal it will be sent back, you need to do it through the RiS portal, to force them to register.

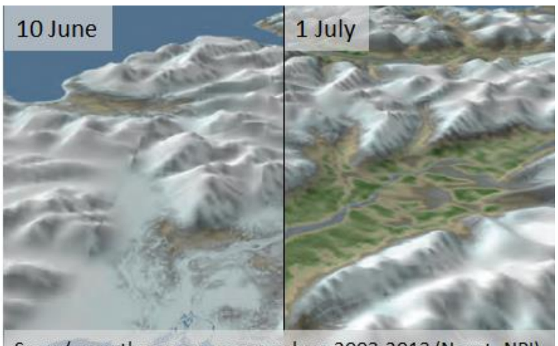
Kristoffer Helgesen Grud (SIOS): "*How can SIOS be useful for marine researcher (data management, integrations towards SIOS data, remote sensing services etc.)?*"

SIOS is a regional observing system for long-term measurements in and around Svalbard addressing Earth System Science questions. It is an international consortium of institutions with relevant research infrastructure in and around Svalbard. Within SIOS, researchers can cooperate to access instruments, acquire data, and address questions that would not be practical or cost effective for a single institution or nation alone. During the preparatory Phase (2010 - 2014), which was financed by the EU (FP7) and coordinated by the Research Council of Norway (RCN), the development of the concepts of SIOS took place. The interim phase (2015 - 2018), which is financed by RCN and in-kind contributions from members and hosted by UNIS, consists of 14 partners. The objectives are the establishment of SIOS-Knowledge Centre and its services, incl. the launch of pilots, and preparation of legal prerequisites for the operational phase, which will start in 2018. SIOS will then be an independent legal organisation with international membership and self-financed.

The SIOS Knowledge Centre (SIOS-KC), already established in Longyearbyen, will be the central hub of SIOS for coordinated services, such as:

Access to the research infrastructure: In-depth information about existing infrastructure and research instruments, trans-institutional access to research instruments within the SIOS observatory (20% of a stations capacity), regular strategic calls, and easier cooperation on major research questions. Added value for the research community will be comprehensive data collection instead of single point data and more relevant research in a larger perspective.

Data management: The SIOS Data management system (SDMS) will be based on open data sharing, with support of discovery, access, transformation, submission, and preservation of SIOS relevant data sets. An accessible data management system will include both space and ground-based data. There will be cross-disciplinary combinations of data and products. Added value for the research community will be better access to data from Svalbard, faster and better implementation of user needs, facilitation of combined data products, and increased interoperability of data for cross-disciplinary research.



Snow/ growth season, mean values 2003-2013 (Norut, NPI)

Utilisation of remote sensing resources: SIOS Remote sensing will provide information from space for ground based research, provides high-quality surface measurements for satellite owners for calibration and validation, and integration of satellite data from different space platforms. Added value for the research community is facilitated combination of ground measurements with remote sensing data, easy access to satellite data from diverse sources, new data products that will strengthen multidisciplinary research

Coordination of logistical services: Information about logistics and advice during the project planning phase (in cooperation with Svalbard Science Forum), logistical services in the field provided by SIOS partners, based on existing infrastructure, and coordination of logistical activities (transport, field camps, etc.). Added value for the research community will be access to lab-space, workshops, and storage facilities, access to logistical equipment, access to safety courses, and assistance in legal issues related to research in Svalbard.

Training and education programmes: The SIOS Training and education programme will be targeted scientists, research technicians, and students. Tailored courses and workshops will be developed, related to infrastructure within the SIOS observatory, and teaching of Earth System Science using established educational structures (Universities/SIOS partners). Added value for the research community will be fostering of a new generation of Earth System Scientists and stimulating the use of research infrastructure in Svalbard.

Concluding remarks

The report from the first workshop in Sopot, Poland, gave a detailed overview of the ongoing activities within ocean research around Svalbard and this overview is therefore not included in this report. During the final phase of the current funding period, the Ocean Flagship "Think Tank" (group work) was established during the dedicated workshop in Os, Norway, including a gap analysis and discussions on data management, where some recommendations were given An update of ongoing and planned future research in the Svalbard area and data management and access was an important part of the workshop presentations.
The continuation and further development of the Ocean Flagship was also discussed, and although everyone agreed that it was very fruitful to meet like this and showed enthusiasm to continue to meet in such a forum like the Ocean Flagship, it takes much work and effort to get funded and to arrange such workshops and many hesitate to take on the responsibility. To continue under SSF a Norwegian institution needs to be in the lead of a new proposal. The most relevant might be SIOS KC, but this is still an open question. If continued, it is recommended to make it more international, for instance with a rotating membership in the organizing committee that could vary from year to year. At the same time the location of the workshop could also change from year to year. This could attract new, different researchers in attendance each time and widen the group. Another solution would be to have an annual workshop in combination with meetings of other projects/programmes such as INTAROS or ArcticROOS, where most of the participants of the Ocean Flagship take part. This would reduce travel time and costs and people could pay themselves for an extra day. If the Ocean Flagship finds a way to continue, it should continue as a limited group for direct communication between researchers from different ocean disciplines, focussing on following up *in situ* observations around Svalbard, and not become too big.

SSF Ocean Flagship 2nd Workshop

Agenda

4 October 2016

9:00 – 9:15 Hanne Sagen: Welcome and practical information.

For each of the following presentation we have allocated 30 minutes including 5 minutes for questions.

9:15 – 12:00 Session I: Observational techniques, developments, and possibilities.

3) Jørgen Berge: "Marine observatories and observational techniques - from the last ten years and into the future."
4) Jenny Ullgren – "A voyage in the Fram Strait in summer 2016 with two small unmanned "sailboats (SailBuoy)."

Coffee

5) Brian Dushaw: "Comments and speculations on the use of ocean acoustic tomography for ocean observation in Fram Strait."
6) Kjetil Våge: "High latitude glider operations (NACO)".
7) Benjamin Rabe (on Skype) – "Ice-ocean-atmosphere buoys in the Arctic Ocean: new initiatives from AWI/Germany and scientific applications. "

12:00-13:00. Lunch

13:00-15:45 Session II: Infrastructures: Observatories – existing planned and wanted

5) Frank Nilsen: "UNIS marine infrastructure – existing, planned and wanted."
6) Mathilde Sørensen: "Natural hazards in the Arctic (EPOS)."

Coffee

7) Frédéric Vivier: "The STeP program."
8) Agnieszka B.-Möller: "INTAROS: The ocean component."

15:45-16:45 Topics for discussion in WG:

What are the main gaps in 1) Geographical coverage; 2) Technology; 3) Parameters; 4) Research

17:15-18:00 Presentation of the Discussion from the WG.

Dinner 19:30

<u>5 October 2016</u>

09:00 – 12:00 Session III: Data management in ocean observing systems

1) Terry Hannant: “Norwegian Marine Data Centre (NMDC).”
2) Torill Hamre: “INTAROS – integrated Arctic Observing System (Data Management).”
3) Jiping Xie: “COPERNICUS; the Arctic node.”

Coffee

4) Vedrana Kovacevic: “Ongoing observational activities off shore SW Spitsbergen”
5) Thomas Soltwedel: “The FRAM Ocean Observing System.”

12:00 -13:00 Lunch

13:00 – 14:00

6) Margrete Keyser: “The Research in Svalbard (RiS) Database (Svalbard Science Forum).”
7) Kristoffer Helgesen Grud: “How can SIOS be useful for marine researcher (data management, integrations towards SIOS data, remote sensing services etc.)?”

14:15 - 15:15 Group discussions on data management

Topics for discussion in WG:

5. Where do we submit our data for storage and dissemination?
6. How easy is it to get access to data in the current data repositories?
7. How can in-situ marine researchers be motivated to register data?
8. The future of Ocean Flagship – how to continue and extend our collaboration in ocean research?

15:30-16:30 Presentation of the Discussion from the WG.

16:30-17:00 Concluding remarks.

Ocean Flagship 2nd Workshop participants 4-5 October 2016:

1. Benjamin Rabe (AWI) – on Skype
2. Waldemar Walczowski (IOPAN)
3. Agnieszka Beszczynska-Möller (IOPAN)
4. Frederic Vivier (LOCEAN)
5. Antonio Lourenco (LOCEAN)
6. Marie-Noelle Houssais (LOCEAN)
7. Vedrana Kovacevic (OGS-OCE)
8. Brian Dushaw (NERSC)
9. Jenny Ullgren (NERSC)
10. Torill Hamre (NERSC)
11. Florian Geyer (NERSC)
12. Hanne Sagen (NERSC)
13. Jiping Xie (NERSC)
14. Kristoffer Helgesen Grud (SIOS)
15. Margrete Keyser (SSF)
16. Terry Hannant (IMR)
17. Kjetil Våge (UiB)
18. Mathilde Sørensen (UiB)
19. Jørgen Berge (UiT/SAMS)
20. Frank Nilsen (UNIS)
21. Eva Falck (UNIS)
22. Ragnheid Skogseth (UNIS)