Arctic Sea Ice Research - Arctic-Roos

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1.0 INTRODUCTION

IPY Operational Oceanography for the Arctic Ocean and adjacent seas is short For ´Title of Proposed Activity IPY Arctic GOOS´, which is led by the Nansen Environmental and Remote Sensing Center/Mohn Sverdrup Center, Norway. Other countries involved in the activity include Sweden, Finland, Russia, Denmark, Iceland, UK, France, Faroe Islands, Germany, Poland, USA. Location of Field Activities is Arctic. IPY themes addressed the current state of the environment, change in the Polar Regions, exploring new frontiers and the Polar Regions as vantage points.

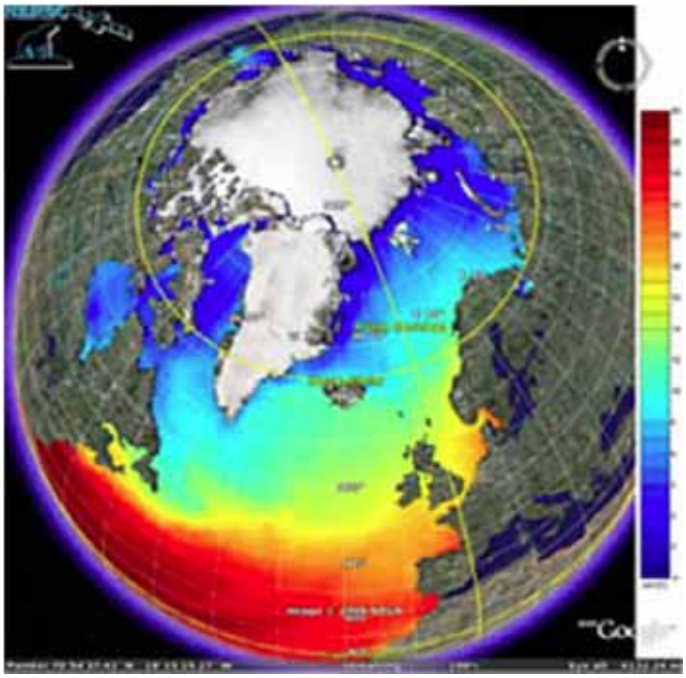
An Arctic Regional Ocean Observing System **(**Arctic ROOS) has been established by a group of 14 member institutions from nine European countries working actively with ocean observation and modeling systems for the Arctic Ocean and adjacent seas.

Arctic ROOS will promote, develop and maintain operational monitoring and forecasting of ocean circulation, water masses, ocean surface conditions, and sea ice and biological/chemical constituents.

One of the goals of Arctic ROOS is to contribute to the legacy of IPY, maintaining cost-effective and useful observing systems after the end of IPY.

Arctic ROOS intends to include more members from countries outside of Europe and become a GOOS Regional Alliance for the Arctic. Arctic ROOS has established a secretariat at the Nansen Environmental and Remote Sensing Center in Norway.

Arctic ROOS is a contribution to the IPY project no. 379: "IPY Operational Oceanography for the Arctic Ocean and adjacent seas" coordinated by Prof. Ola M. Johannessen. The project was submitted in 2005 and endorsed by IPY in 2006



2.0 SUMMARY OF THE ACTIVITY

The Arctic climate of the 20th century has undergone major fluctuations, which are characterized by a significant warming in the last two decades. The warming predicted for the high Arctic is 3_4 _C in winter during the next 50 years, more than twice the global average, while the ice cover is predicted to be reduced by ~80% during summer and ~20% during winter. This suggests that the Arctic may be where the most rapid and dramatic climate changes take place during the 21st century, with major ramifications for mid-latitude climate.

The sea ice cover has over the last 2-3 decades decreased by ~10%, and the ice thickness has decreased up to 40% during summer. Other observed changes include a warming of the Atlantic water in the Arctic Ocean, increased precipitation in the Arctic regions and higher river discharge into the Arctic ocean. During the last decades detected changes include a significant freshening of the deep North Atlantic Ocean, warming in the deep water of the Nordic Seas and a decrease of deep overflow in the Faroe Bank Channel. The oceanic fluxes of heat and freshwater between the North Atlantic, Nordic Seas and Arctic Ocean are key components of the high-latitude climate system.

The recent Arctic Climate Impact Assessment studies have identified a number of severe impacts of Arctic warming on society. Changes in air temperature, precipitation, river discharge, sea ice, permafrost, glaciers and sea level have been documented and further changes are expected in the next decades. The Arctic region is coming under increasing pressure from unsustainable development with pollution and other negative effects on the environment. The exploitation of resources, including sea transportation and offshore operations will be heavily affected by the climate- variability and long-term changes at high

latitudes. The northeast Atlantic, including Greenland and Icelandic waters, the Barents Sea and other Arctic ice edge regions, provides 20% of the world´s fish catch. Ocean temperature is one of the key variables that have influence on fisheries. Various offshore operations in ice-covered waters will increase such as offshore exploration, drilling, oil and gas production, and gas transportation, pipeline deployment in the seabed, and building of terminals in several locations along the Arctic coasts. All these activities will increase the risk of accidents and severe pollution of the fragile Arctic environment.

The Arctic areas have rough weather and ice conditions which require improvement of operational monitoring and forecasting services in order to safeguard all types of marine and coastal operations. The operational services should also include long-term data archiving services to build up statistics of the environmental conditions. Operational services on met-ice-ocean conditions in these areas are extremely important for safe and cost-effective industrial and transport activities as well as for protection of the vulnerable environment.

The overall objective of IPY Arctic GOOS is to develop and implement operational monitoring and forecasting systems in the Arctic Ocean and adjacent seas. The systems will be based on state-of-the-art remote sensing, in situ observations, numerical modeling, and data assimilation and dissemination techniques. The activities will include the development and maintenance of observing system for sea ice and physical, chemical and biological ocean parameters. The observing systems need to include icebergs, potential oil spills, radioactive spreading and other pollutants. In addition to observations, the systems will include numerical modeling and data assimilation for production of short-term forecasts. New models and data assimilation techniques need to be developed where needed. A long-term objective is to develop modeling systems for seasonal prediction of sea ice, hydrographic and current conditions. State-of-the-art climate models will be used to quantify climate change and variability and prediction of future climate changes under greenhouse gas scenarios.

2.1 What is the evidence of inter-disciplinarity in this activity?

The development and implementation of operational services will include the physics of atmosphere, sea ice and ocean, as well as ocean chemistry, biology and lower trophic levels of the marine ecosystems.

2.2 What will be the significant advances/developments from this activity? What will be the major deliverables? What are the outputs for your peers?

The main results of the activities will be operational products related to monitoring and forecasts of: ocean circulation; ocean surface conditions, water mass and sea ice; transport pathways; algae blooms and plankton production and distribution; fish larvae transport, growth and distribution. This information, in turn, will be used for studies of effects on ecosystems such as fish recruitment; contaminant transport, distribution and exposure on plankton and fish larvae, and resulting impact of physics and lower trophic ecosystem changes on higher trophic levels. A web-based Information and Decision Support System for daily updated dissemination of value-added products and data to the marine user community and for collection of feedback on the quality and usefulness of the information.

2.3 Outline the geographical location(s) for the proposed field work.

Locations	Coordinates
Arctic Ocean and adjacent seas	

2.4 Define the approximate timeframe(s) for proposed field activities?

Arctic Fieldwork time frame(s)	Antarctic Fieldwork time frame(s)
04/06 - 09/09	MM/YY - MM/YY
	MM/YY - MM/YY
	MM/YY - MM/YY

2.5 What major logistic support/facilities will be required for this project?

Ice strengthened research ship
Ship recovery of buoys etc.
Helicopters
Rockets

Further details

The field activities will be an extension of the regular hydrographical and marine biological surveys in the Barents, Norwegian, Greenland and Icelandic Seas. These field activities will be enhanced with additional cruises during IPY.

2.6 How will the required logistics be supplied? Have operators been approached?

Source of logistic support	Likely potential sources	Support agreed
Consortium of national polar operators		
Own national polar operator		Y
Another national polar operator		
National agency		Y
Military support		
Commercial operator		
Own support		Y
Other		

3.0 STRUCTURE OF THE ACTIVITY

3.1 Origin of the activity
This activity is the start of a new programme that will outlive IPY

3.2 How will the activity be organized and managed? Describe the proposed management structure and means for coordinating across the cluster
The activities of the IPY Arctic GOOS will be organized by a coordinating office at the Mohn Sverdrup Center at Nansen Center. Management and coordination will be at the hands of EuroGOOS.

3.3 Will the activity leave a legacy of infrastructure and if so in what form?
The activities will leave a legacy of modeling and observational systems as well as dissemination systems which will be operated under the Arctic GOOS after IPY.

3.4 Will the activity involve nations other than traditional polar nations? How will this be addressed?
Nations which start to work in the Arctic will be involved. For example, Poland has started to perform regular hydrographical surveys in the Fram Strait. China has started to work in the Arctic. China and other countries will be involved in Arctic GOOS when they start to produce marine data.

3.5 Will this activity be linked with other IPY core activities? If yes please specify
The activities will be linked to several other IPY projects: especially IPY CARE and IAOOS / DAMOCLES and several Canadian IPY projects. IPY Arctic GOOS is focusing on operational systems, while most of the other related IPY projects are focusing on research and development of new observational systems.

3.6 How will the activity manage its data? Is there a viable plan and which data management organizations/structures will be involved?
The data will be managed according to EuroGOOS and GOOS guidelines. The data products and services provided via Arctic GOOS will be openly available to all users.

3.7 How will the activity contribute to developing the next generation of polar scientists, logisticians, etc.?
UNIS (University Centre in Svalbard) is established for academic education in Arctic sciences and logistics. UNIS has students from many countries and all courses are given in English. UNIS plays an important role in educating the next generation of polar scientists and logisticians. UNIS will increase its educational activities during IPY. Also NERSC/Mohn Sverdrup Center, University of Bergen and University of Oslo will contribute to education of polar scientists.

3.7 How will this activity address education, outreach and communication issues outlined in the Framework document?
UNIS has already extensive M Sc and Ph D programmes in ARctic sciences. Several M Sc and PhD programmes in operational oceanography with focus on the Arctic seas have started in the Mohn Sverdrup Center. Other consortium partners have also educational programmes

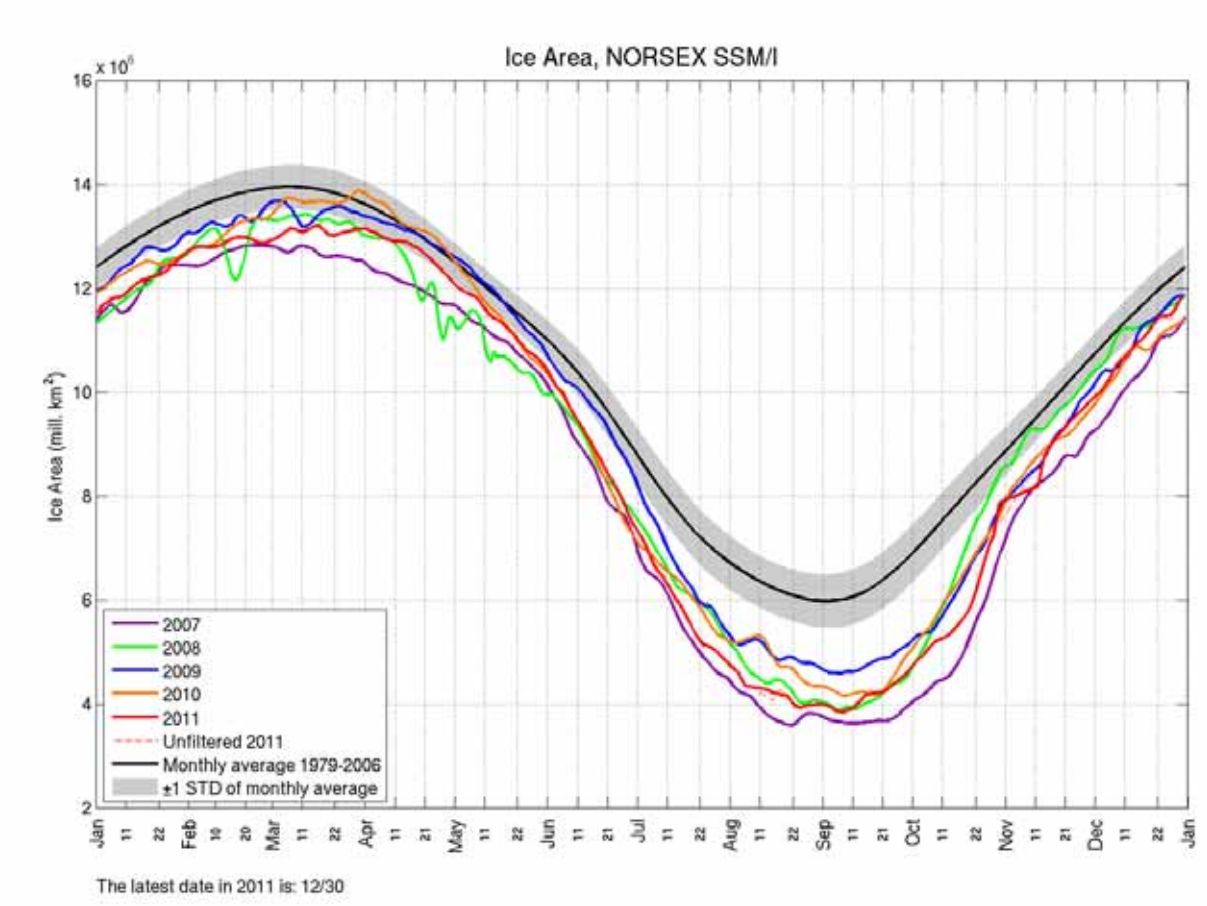
for the Arctic and high latitude oceanography, in particular University of Bergen and University of Oslo. Products and services delivered under Arctic GOOS will be promoted via EuroGOOS and directly to users who can download products via web portals.

3.9 What are the proposed sources of funding for this activity?
Most of the funding will be provided by national IPY programmes and polar programmes. A proposal from the Norwegian team will be submitted to the Norwegian IPY programme by 15 March 2006. Some funding is provided in the EU-funded projects MERSEA IP, and DAMOCLES IP.

3.10 Additional Comments
Arctic GOOS will focus on near real time monitoring by satellites, data assimilation and forecasting using numerical modeling. In situ data from buoys, ships, and other platforms will be used as much as possible depending on the time delay in data delivery. Development of new observing systems will primarily be done in other IPY projects. When new observing systems are installed, or existing observing systems extended to new areas, the data will be used by the Arctic GOOS models. New model development, including validation, will be developed by Arctic GOOS.

4.0 Arctic Sea Ice Monitor and Observation.

4.1 Arctic Ice Area and extent by using SSMI satellite data.
Ice extent is the cumulative area of all polar grid cells of the Northern Hemisphere that have at least 15% sea ice concentration, using the NORSEX algorithm. Ice area is the sum of the grid cell areas multiplied by the ice concentration for all cells with ice concentrations of at least 15%. Ice extent and ice area are calculated for a grid resolution of 25 km. The difference between extent and area for our data is always positive. This difference represents the area of the open water in the pixels partly covered by ice (i.e. ice concentration less than 100%). In other words, ice area takes into account that there is a fraction of open water in pixels with ice concentration above 15 % and below 100 %". Ice extent does not include this effect and thus provides for a higher number of square km than ice area.


Ice Area, NORSEX SSM/I
x 10^6
Ice Area (mill. km^2)
16
14
12
10
8
6
4
2
2007
2008
2009
2010
2011
Unfiltered 2011
Monthly average 1979-2006
±1 STD of monthly average
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
The latest date in 2011 is: 12/30