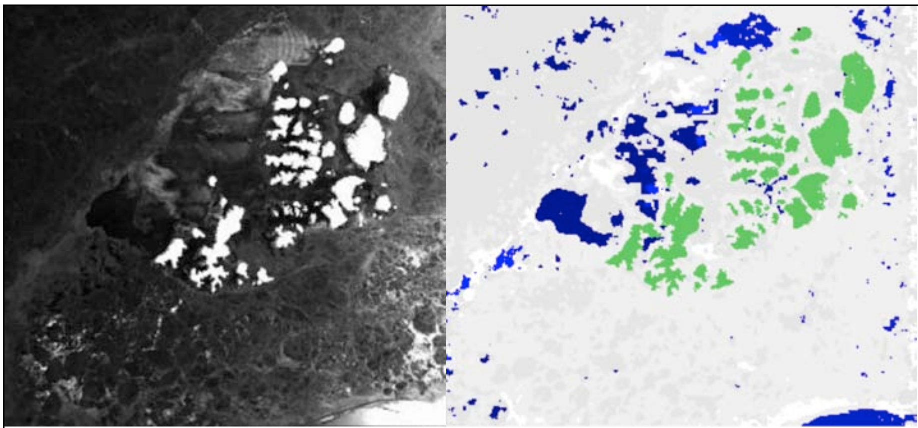
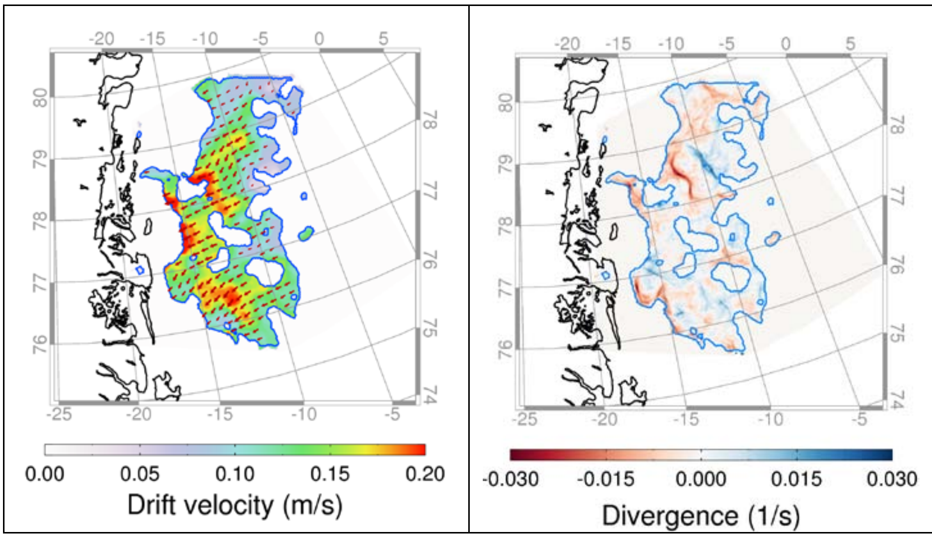
Sea Ice Downstream Services for Arctic and Antarctic Users and Stakeholders

Collaborative project under FP7-SPACE 2011-2013

Sea ice information on regional scale from Synthetic Aperture Radar (SAR)

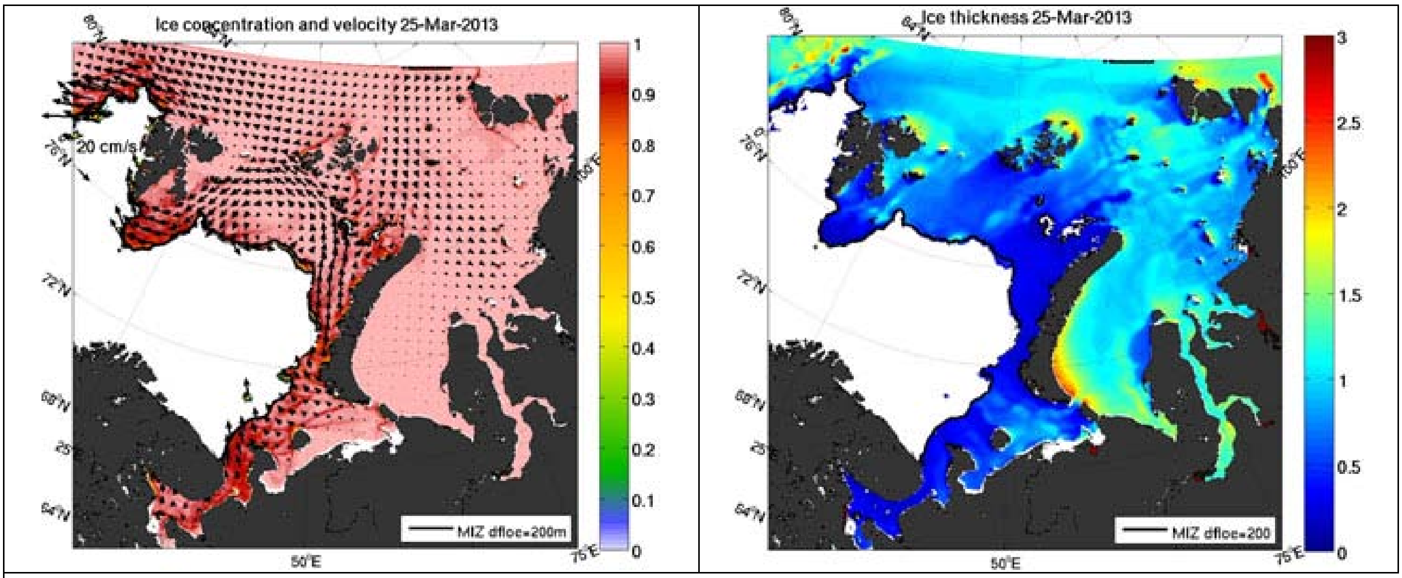


Ice water discrimination from RADARSAT-2 images in Franz Josef Land archipelago on 03 April 2013. Left: ScanSAR wide swath image in dual polarization, HH and HV. Right: classified image using classification algorithm, where bright grey is sea ice, blue is water and green is land. The products are produced every day and are available on http://web.nersc.no/project/maires/catalog.php



An ice drift product can be calculated from a pair of spatially overlapping SAR images from 16 September 2012. The left figure shows a drift field in the Fram Strait calculated from a pair of Radarsat-2 images, where the velocity magnitude is shown in colours. A technique called backmatching is used to identify areas where the ice drift retrieval algorithm yields consistent results. Regions without consistent ice drift vectors are not mapped. Right: Calculated ice motion vectors can be used to derive ice divergence and convergence fields. ©AWI

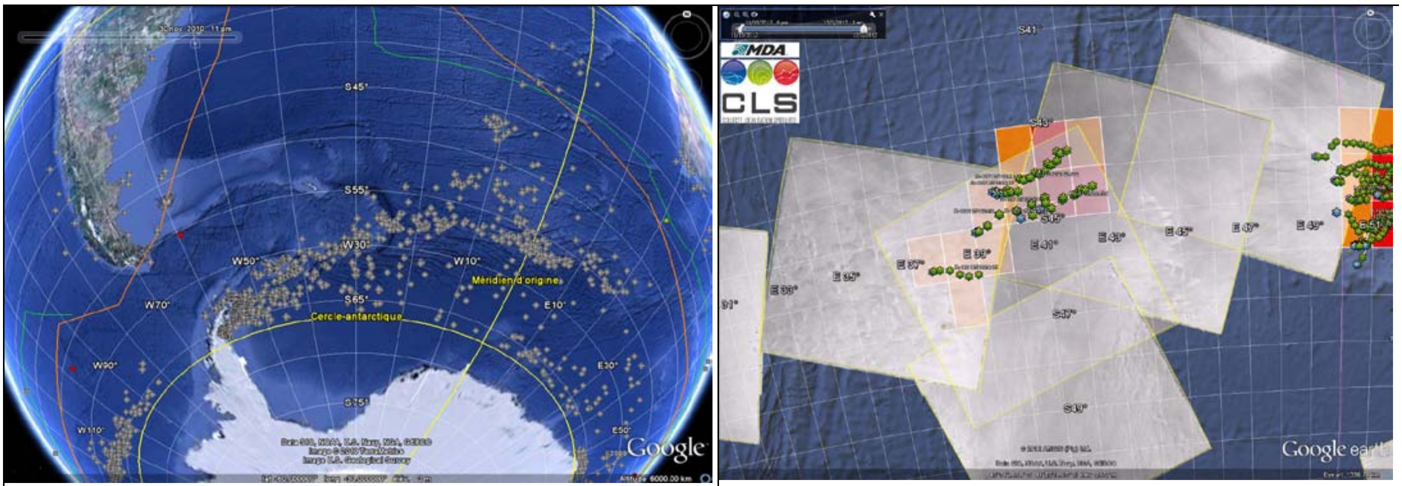
Sea ice forecasting in the Barents and Kara Seas



A regional ice-ocean forecasting model for the Barents and Kara Seas has been established to provide up to 10 day forecasts of the ice edge location, sea ice concentrations ice velocity and ice thickness using the 4 km ice-ocean model.

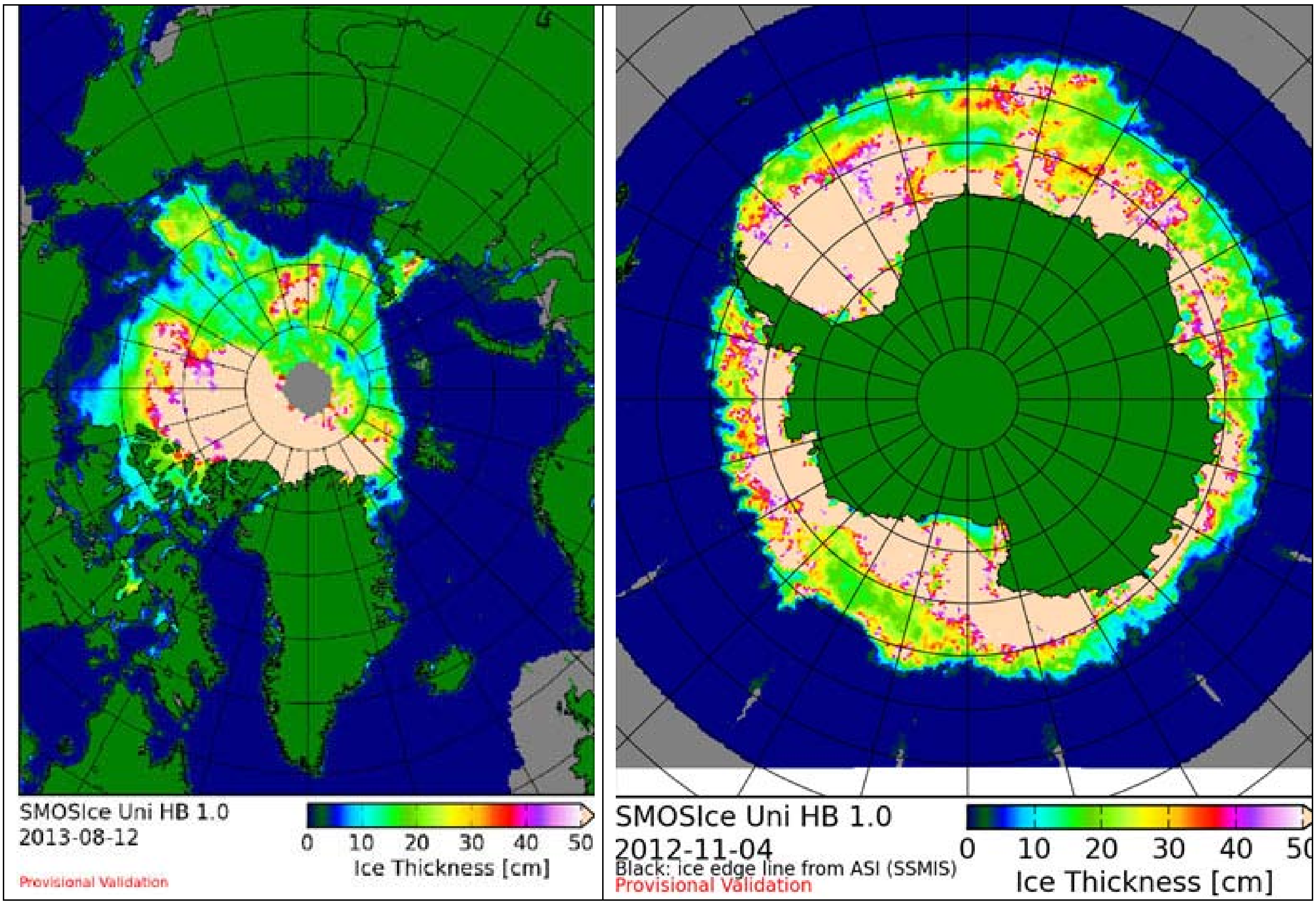
This model is nested to the TOPAZ modelling system providing ice-ocean forecasts for the North Atlantic and Arctic. The model results are available at *http://topaz.nersc.no/Knut/IceForecast/Barents/* ©NERSC

Iceberg detection and forecasting in the Antarctica



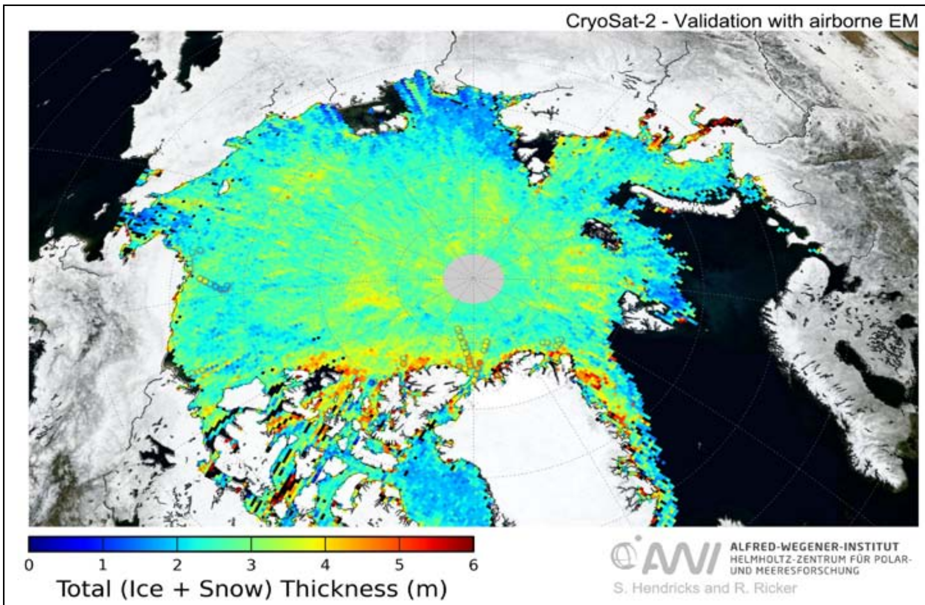
Example of iceberg detection in the Atlantic South Ocean in November 2010. Iceberg detection is based on a combination of Jason-1 and -2 altimeter and Envisat (detections below 66°S not shown). Drift of SAR- detected icebergs is predicted using the global ocean prediction model provided by MyOcean (http://www.myocean.eu/). The service is supporting the Vendée-Globe challenge race (http://www.vendeeglobe.org/en/). ©CLS.

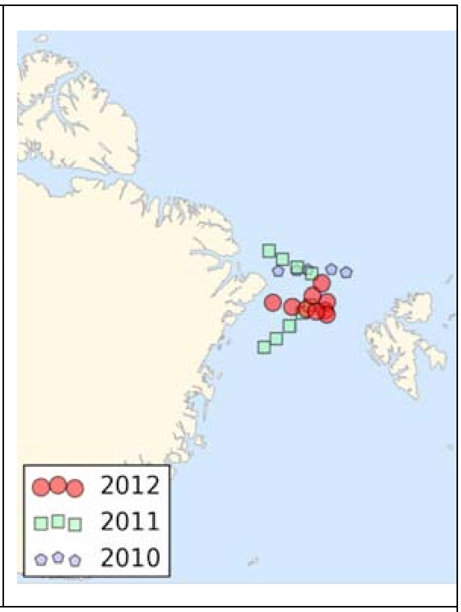
Sea ice thickness in Arctic and Antarctic from L-band passive passive microwave data



The L-band radiometer on SMOS (Soil Moisture and Ocean Salinity), launched in 2009 has demonstrated capability to derived sea-ice thickness up to values of about 0.5 m. These ice thickness maps show how thin ice grows from the beginning of freezing season to mid-winter. Retrieval algorithms have been developed into an operational service, providing ice thickness maps for both Arctic and Antarctic. Ice thickness fro SMOS are complementary to ice freeboard data from altimeters, which mainly can be used to estimate thickness above 1m. More information is available at https://wiki.zmaw.de/ifm/SMOSIce

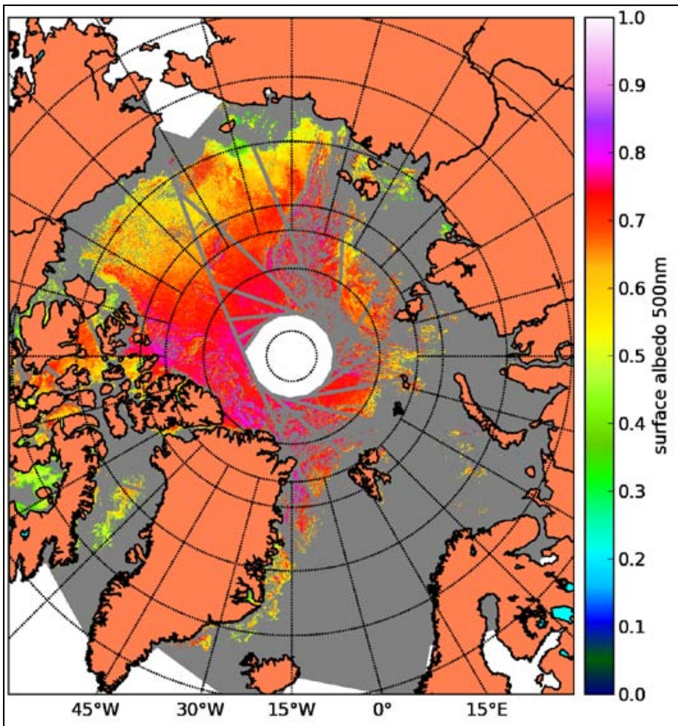
Validation of sea ice thickness in Arctic from CryoSat data

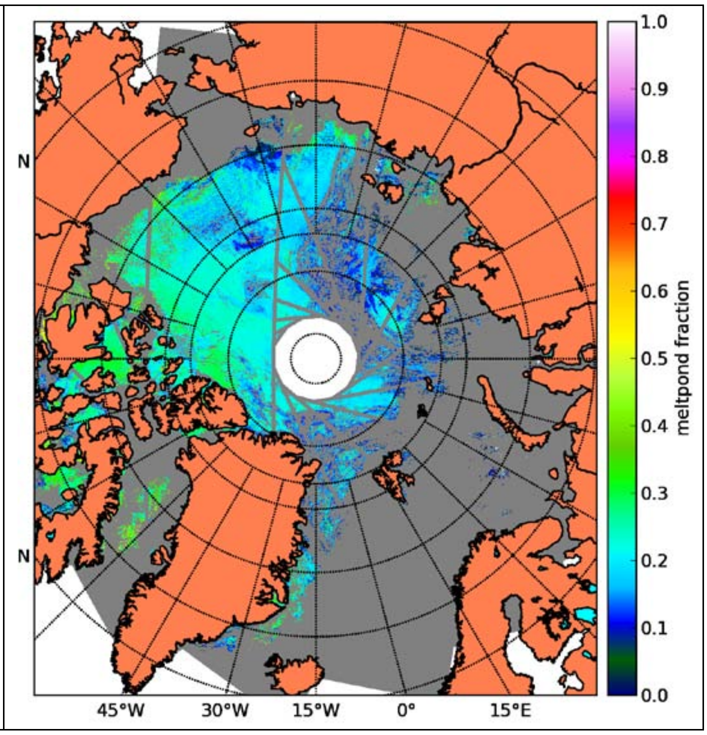




Radar altimeter data from CryoSat-2 can be used to estimate total thickness in the Arctic. The thickness is calculated from ice freeboard data collected by the satellite. The example above shows the monthly mean ice thickness for March 2011. Flightlines of airborne electromagnetic surveys (EM data) from the AWI field campaign PAMARCMIP/CryoVEx 2011 are superimposed. The map to the right shows EM flights in the Fram Strait during validation campaigns. The EM data are compared to the satellite retrievals and used for validation. The data is freely available at http://www.meereisportal.de

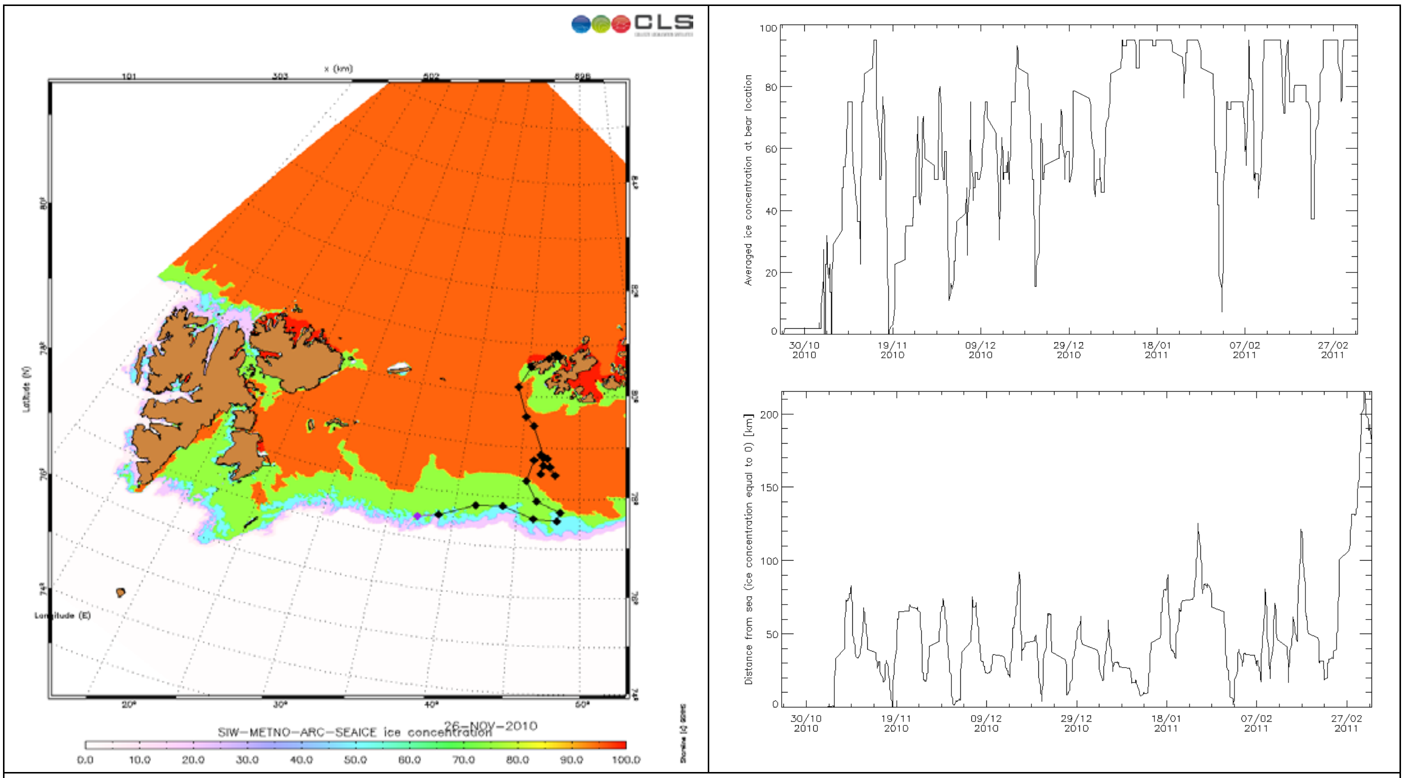
Ice albedo and meltponds in the Arctic





Active melting of snow and ice is observed in Arctic in the summer months. This melting produces the melt ponds of different depths on top of the sea ice. Melt ponds drastically reduce the ice albedo, changing the radiative balance in Arctic. Monitoring the processes of melting, formation of melt ponds and subsequent freezing of melt ponds is an important component of the Arctic climate system. Data products like surface albedo (left figure) and and melt pond fraction (right) have been developed from MERIS specrometer data and later from MODIS data. The examples above are from 12 July 2011. The grey lines show where different swath data from the same day are merged into a Pan-Arctic mosaic. The products are developed by Institute of Environmental Physics, University of Bremen and Institute of Physics National Academy of Sciences of Belarus.

Animal ARGOS tracking



An example of integration of ARGOS data with the products from SIDARUS for sea ice habitat. In October-November 2010, 3 female polar bears have been tagged with Russian collars at the Franz-Joseph Archipelago.
The ARGOS tracks for one polar bear have been correlated with sea ice concentration maps. There is a strong correlation between sea ice pattern and bears' location. When the sea starts freezing in the beginning of November around Franz Joseph Archipelagoes, the bears drift southward. Then they continuously stay nearby the marginal zone until they start to come back on Mid-February.

The overall objective of SIDARUS is to develop and implement a set of sea ice downstream services in the area of climate research, marine safety and environmental monitoring. SIDARUS will extend the present GMES services (Global Monitoring for Environmental and Security) with new satellite-derived sea ice products, ice forecasting from regional models, and validation of sea ice products using non-satellite data. The products are generated for different spatial scales which range from covering the entire Arctic and Antarctic regions to the local surrounding of offshore structures.

Benefits of Our Services

The demand from many user groups for improved sea ice information in the Arctic and Antarctic is growing as a result of climate change and its influence on the polar environment and on socio-economic conditions for marine operations. The presently observed reduction of the Arctic sea ice extent, in particular during the summer months, and an increasing demand for natural resources are key mechanisms driving human activities in these areas. In the Antarctic, ice discharge from several ice shelves which is regarded a significant indicator of climate change, needs to be monitored because the larger number of icebergs represents a serious thread on marine operations in the Southern Ocean. The SIDARUS project will address the needs of users and stakeholders in the area of marine safety, environmental monitoring and climate research.

Products and services

- **High-resolution sea ice and iceberg mapping by SAR**
  - Improvement of SAR-based sea ice classification methods to map details of the ice cover (leads, polynyas, ice types, deformed ice) as well as iceberg detection methods
- **Sea ice albedo from optical sensors**
  - Development of improved parameterization of sea ice albedo based on optical satellite data, required as input for sea ice and climate modelling
- **Sea ice thickness from satellite radar altimeter and passive microwave data**
  - Development and validation of ice thickness retrievals from satellite radar altimeter (CryoSat) and passive microwave data (SMOS), analysis of ice thickness data from field surveys for validation of satellite retrievals.
- **ARGOS tracking of marine mammals combined with sea ice maps**
  - Provision of integrated maps of marine mammal tracks from ARGOSS data together with sea ice maps from satellite data
- **Ice forecasting based on numerical models and satellite data.**
  - Improvement of regional sea ice forecasts for the Barents Sea area from downscaling of MyOcean services; provisions of iceberg forecasts in Antarctic waters by combining SAR detection and numerical ocean forecasting from MyOcean.
- **Provide access to relevant sea ice products from other GMES services.**

Consortium

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- ALFRED-WEGENER-INSTITUT FUER POLAR- UND MEERESFORSCHUNG (AWI) Germany
- COLLECTE LOCALISATION SATELLITES SA (CLS) France
- UNIVERSITAET BREMEN (UB) Germany
- THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE (UCAM) United Kingdom
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