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RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

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SUMMARY

The overall objective of SIDARUS is to develop and implement a set of sea ice downstream services in the area of Marine Safety, Marine and coastal environment, and Climate and seasonal forecasting. The products to be developed are high-resolution sea ice and iceberg products from SAR, sea ice albedo, sea ice thickness, sea ice habitat conservation and ice forecasting.

The aim of this document is to show how the products developed by SIDARUS have been presented in the project's web portal at <http://sidarus.nersc.no>. The products included in the portal include:

- High-resolution ice edge mapping by Synthetic Aperture Radar (SAR)
- Sea ice drift on regional scale from Synthetic Aperture Radar (SAR)
- Sea ice albedo from optical sensors
- Sea ice thickness from satellite radar altimeter and passive microwave data
- Animal ARGOS tracking - Polar Bears
- Sea ice forecasting in the Barents and Kara Seas
- Iceberg detection and forecasting in the Antarctica

SIDARUS CONSORTIUM

Participant no.	Participant organisation name	Short name	Country
1 (Coordinator)	Nansen Environmental and Remote Sensing Center	NERSC	NO
2	Alfred Wegener Institute for Polar and Marine Research	AWI	DE
3	Collecte Localisation Satellites SA	CLS	FR
4	University of Bremen, Institute of Environmental Physics	UB	DE
5	University of Cambridge, Department of Applied Mathematics and Theoretical Physics	UCAM	UK
6	Norwegian Meteorological Institute, Norwegian Ice Service	Met.no	NO
7	Scientific foundation Nansen International Environmental and Remote Sensing Centre	NIERSC	RU
8	B.I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus	IPNASB	BR

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LIST OF REFERENCES

D8.3 “Final report on integration and validation”, WP8, SIDARUS project

D9.11 “Report on demonstration no. 1 and service utility”, WP9, SIDARUS project

LIST OF ABBREVIATIONS

ASAR	Advanced Synthetic Aperture Radar
AVISO	Archiving, Validation and Interpretation of Satellite Oceanographic data
CNES	French Space Agency
DUACS	Developing Use of Altimetry for Climate Studies
GIS	Geographic information system
GMES	Global Monitoring for Environment and Security
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NRT	Near Real Time
SAR	Synthetic Aperture Radar
SARAL	Satellite with ARgos and ALtiKa
SSALTO	Segment Sol multimissions d'ALTimétrie, d'Orbitographie et de localisation précise
SSH	Sea Surface Height
SWH	Sea Wave Height

1 Introduction

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 with new satellite-derived sea ice products, ice forecasting from regional models and validation of sea ice products using non-satellite data. The demand for improved sea ice information in the Arctic and Antarctic by many user groups is growing as a result of climate change and its impact on environment and human activities.

During the project, the following products have been developed:

1. High-resolution ice edge mapping by Synthetic Aperture Radar (SAR)
2. Sea ice drift on regional scale from Synthetic Aperture Radar (SAR)
3. Sea ice albedo from optical sensors
4. Sea ice thickness from satellite radar altimeter and passive microwave data
5. Animal ARGOS tracking - Polar Bears
6. Sea ice forecasting in the Barents and Kara Seas
7. Iceberg detection and forecasting in the Antarctica

Examples of all product types have been demonstrated to users at meetings and workshops, and through dissemination material such as brochures. Product examples have also been disseminated through the project web portal at <http://sidarus.nersc.no>. This document describes the structure and products currently included in the web portal.

2 Web portal structure

2.1 Overview

The SIDARUS web portal is designed to give readers easy access to information about the project and the products available. From the main menu to the left (Figure 2.1), the user can select a topic of interest, e.g. publications and other dissemination material (Figure 2.2) or products and services (Figure 2.3). Each topic can have one or more subtopics, which are easily accessed by clicking on the subtopic title in the left hand menu.

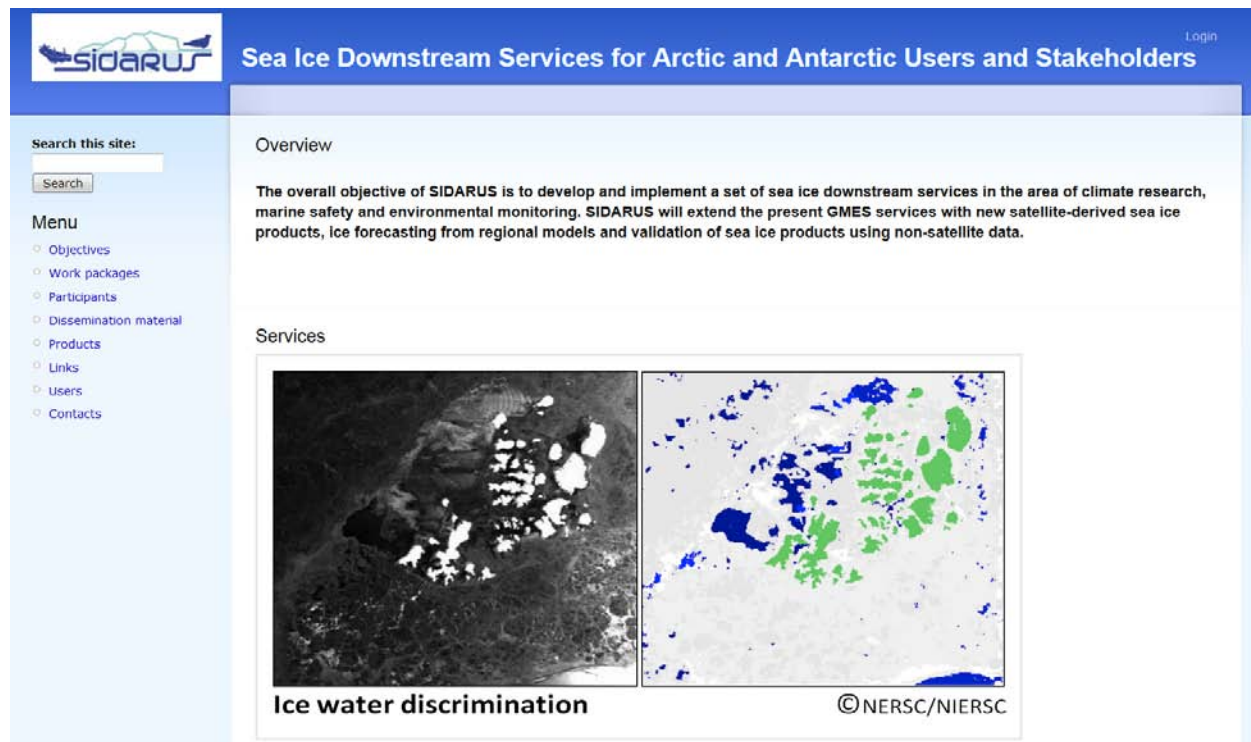


Figure 2-1 The SIDARUS web portal – home page

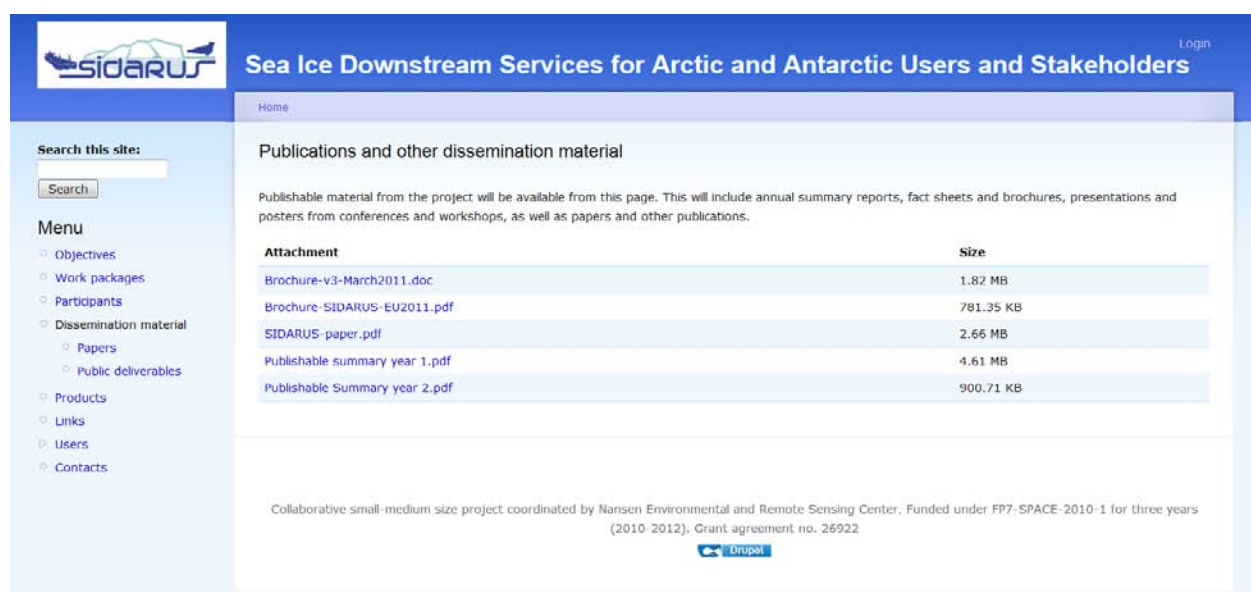
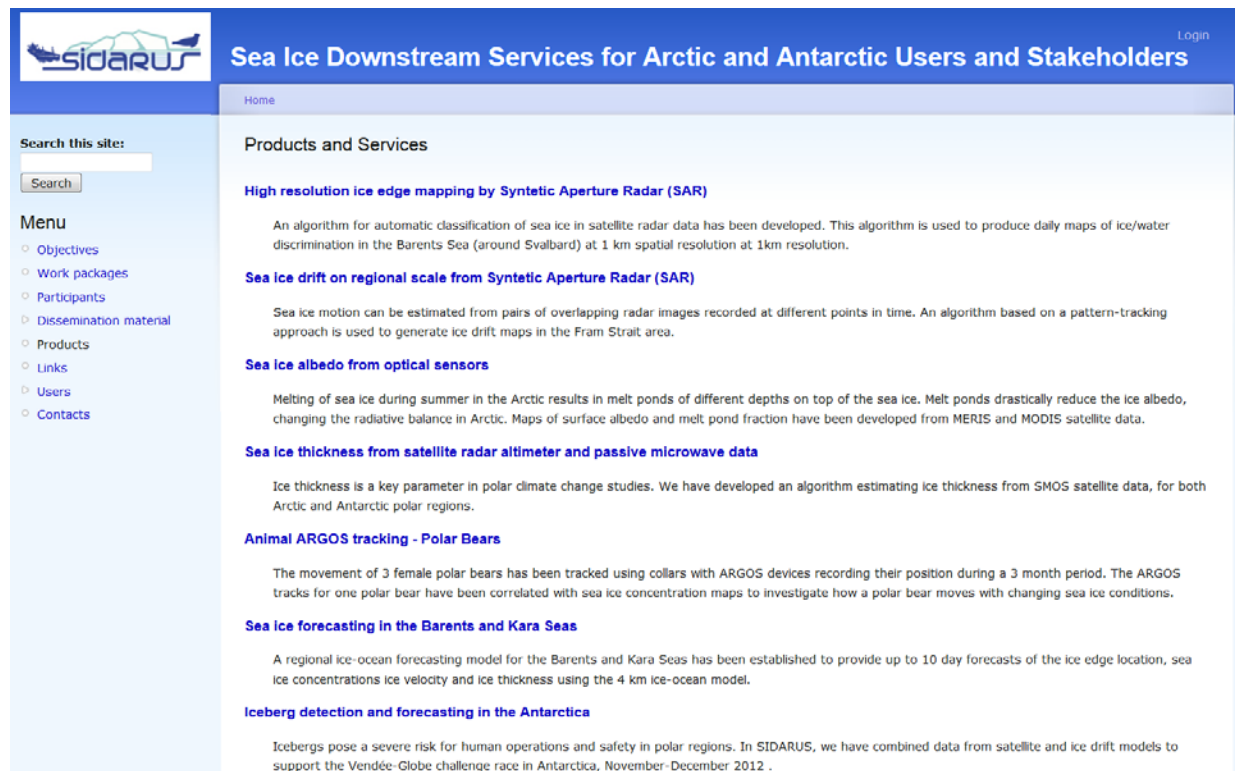


Figure 2-2 The SIDARUS web portal – dissemination material



Figur 2-3 The SIDARUS web portal – produkts and services page

2.2 Structure for products and services

For each product there is a web page describing it and providing examples of the product (Figure 2.4). If there is an online service providing e.g. updated and/or archived products, the link is added to this page.



Sea Ice Downstream Services for Arctic and Antarctic Users and Stakeholders

Login

Home

Search this site:

Menu

- Objectives
- Work packages
- Participants
- Dissemination material
- Products
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Ice edge mapping

High-resolution ice edge mapping by Synthetic Aperture Radar (SAR)

An automatic procedure for Radarsat-2 data processing and daily mapping of ice in the Barents Sea (around Svalbard) at 1 km spatial resolution has been developed and run autonomously. Radarsat-2 data available within the MyOcean2 project are downloaded from the GMES Data Warehouse (DWH) to a server at NERSC, uncompressed and processed first at Level 2 (image-per-image ice/water classification) and then at Level 3 (daily maps generation). We use data from Radarsat-2 received in ScanSAR Wide (SCW) mode at dual-polarization, i.e. HH (horizontally transmitted and horizontally received) and HV (horizontally transmitted, vertically received).

A non-linear scheme for classification of Radarsat-2 data has been developed. The processing allows us to identify three classes: ice, calm water and rough water at 1 km spatial resolution. The raw sigma0 data in HH and HV polarization is used for computing texture characteristics in a moving window using a Gray Level Co-occurrence Matrix (GLCM). A neural network is applied at the next step for processing array of the most informative texture characteristics and ice/water classification. An example of ice-water discrimination is shown in Figure 1. During the course of the project, the classification algorithm was modified to use Support Vector Machine (SVM) techniques. An example of ice-water discrimination using the new algorithm is shown in Figure 2.

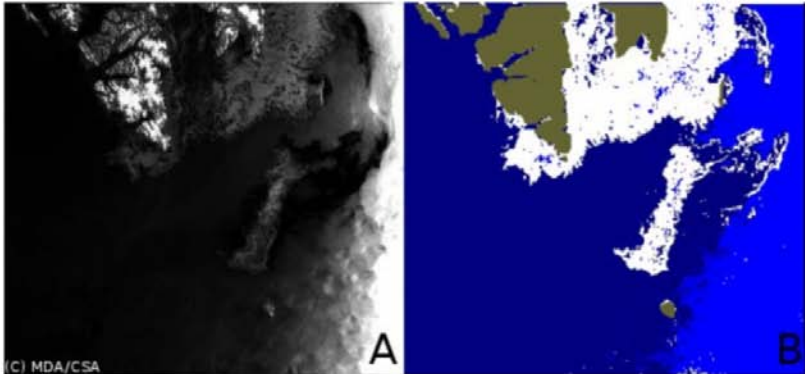


Figure 2-4 The SIDARUS web portal – individual product page

3 Product examples

3.1 High-resolution ice edge mapping by Synthetic Aperture Radar (SAR)

An automatic procedure for Radarsat-2 data processing and daily mapping of ice in the Barents Sea (around Svalbard) at 1 km spatial resolution has been developed and run autonomously. Radarsat-2 data available within the MyOcean2 project are downloaded from the GMES Data WareHouse (DWH) to a server at NERSC, uncompressed and processed first at Level 2 (image-per-image ice/water classification) and then at Level 3 (daily maps generation). We use data from Radarsat-2 received in ScanSAR Wide (SCW) mode at dual-polarization, i.e. HH (horizontally transmitted and horizontally received) and HV (horizontally transmitted, vertically received).

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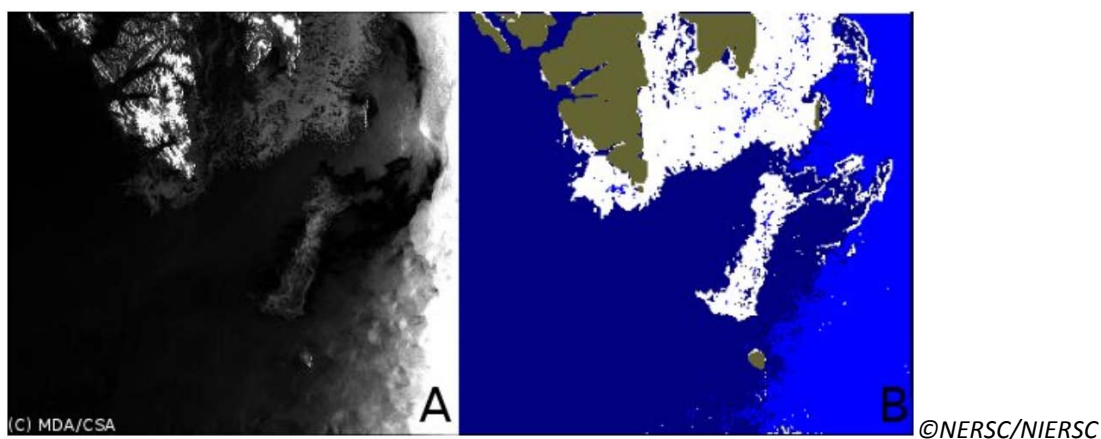


Figure 3-1 An example of Radarsat-2 image (A) classification (B) into ice (white), calm water (dark blue) and rough water (blue). Greenish color masks land (Svalbard on top and Bear Island near bottom on this image).

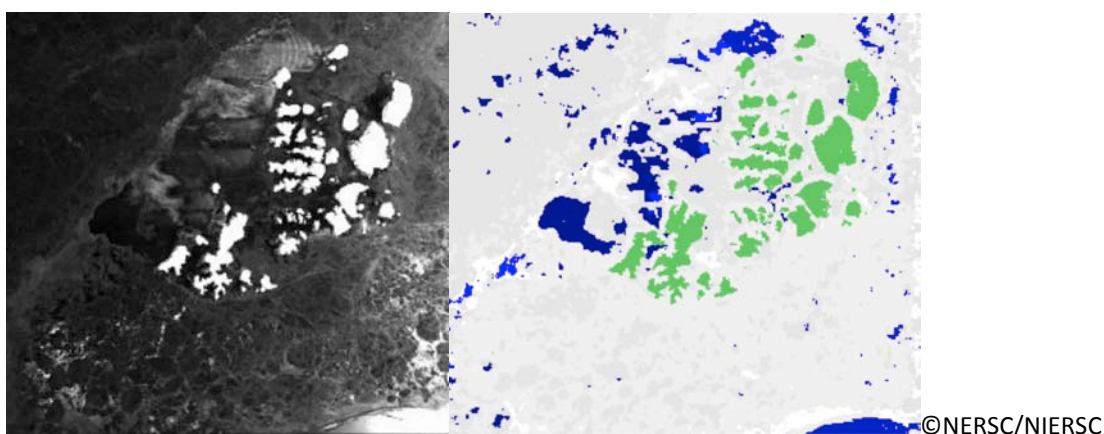


Figure 3-2 Ice water discrimination from Radarsat-2 images in Franz Josef Land archipelago on 03 April 2013. Left: ScanSAR wide swath image in dual polarization, HH and HV. Right: classified image using classification algorithm, where bright grey is sea

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

Sea ice motion can be estimated from a set of two radar images recorded at different points in time. In this project, we have focused on using a pattern-tracking approach to determine the displacement of structures in the sea ice. Figure 3.3 (left) shows an example of ice drift calculated from a pair of spatially overlapping SAR images from 16 September 2012. A technique called back matching is used to identify areas where the ice drift retrieval algorithm yields consistent results. Regions without consistent ice drift vectors are not mapped. The estimate ice motion vectors can be used to derive ice divergence and convergence fields (Figure 3.3 (right)).

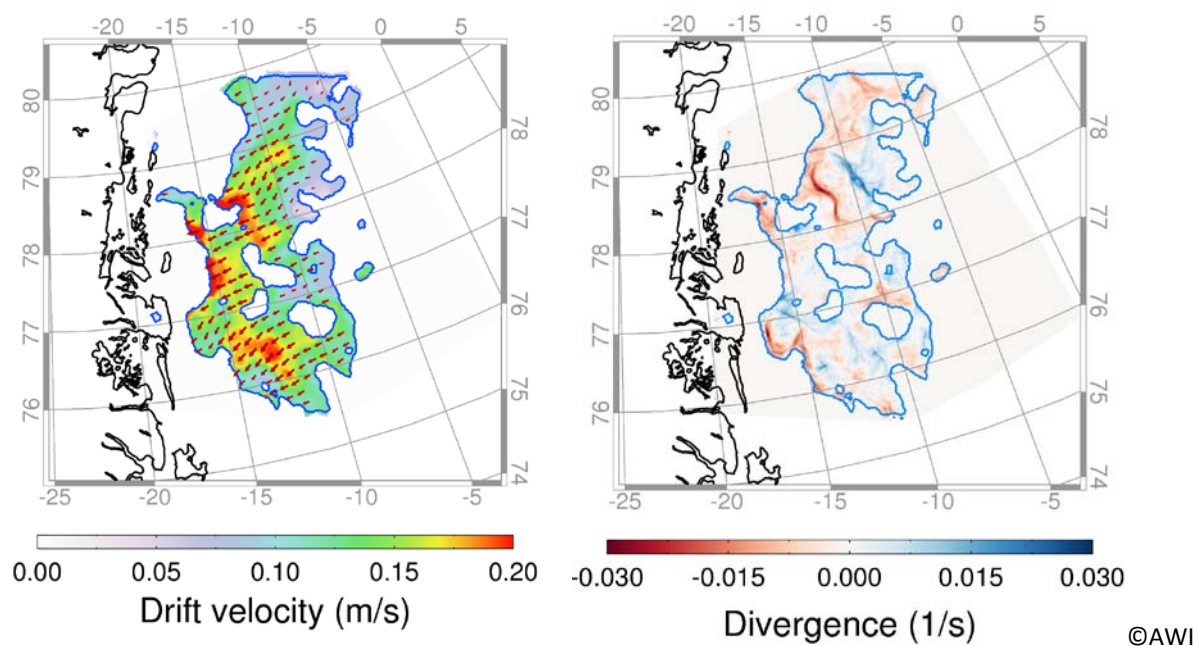
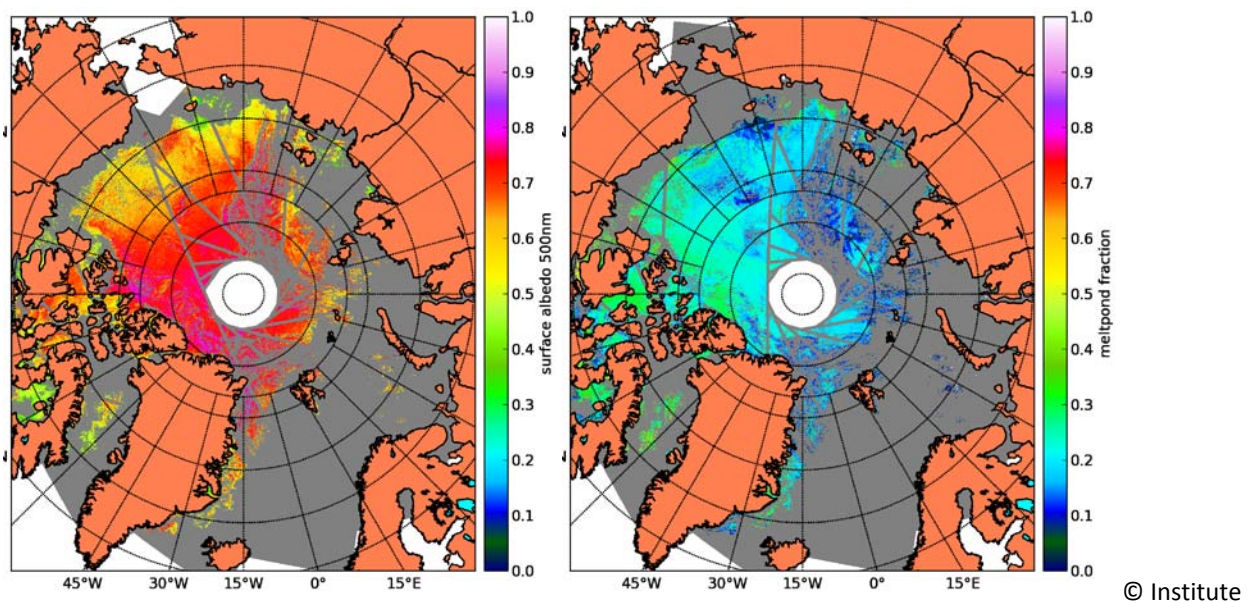


Figure 3-3 Examples of an ice drift product calculated from a pair of spatially overlapping SAR images from 16 September 2012. Left: a drift field in the Fram Strait calculated from a pair of Radarsat-2 images, where the velocity magnitude is shown in colours. Right

3.3 Sea ice albedo from optical sensors

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 (Figure 3.4, left) and melt pond fraction (Figure 3.4, right) have been developed from MERIS spectrometer data and later from MODIS data.



of Environmental Physics, University of Bremen and Institute of Physics National Academy of Sciences of Belarus

Figur 3-4 Surface albedo (left) and melt pond fraction (right) from satellite specrometer data on 12 July 2011. The grey lines show where different swath data from the same day are merged into a Pan-Arctic mosaic.

3.4 Sea ice thickness from satellite radar altimeter and 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 (Figure 3.5). Ice thickness from SMOS is 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>.

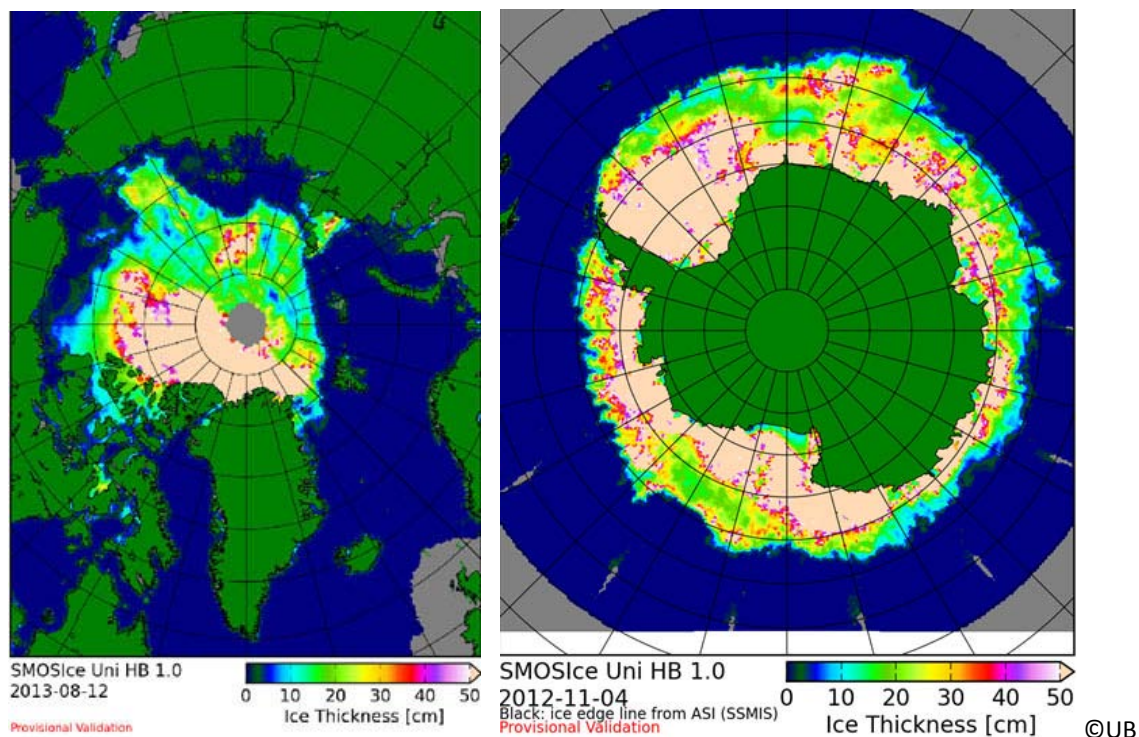


Figure 3-5 Sea ice thickness derived from SMOS data. Left: Arctic sea ice thickness from SMOS, 21 August 2008. Right: Antarctic sea ice thickness from SMOS, 4 November 2012

3.5 Animal ARGOS tracking - Polar Bears

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.

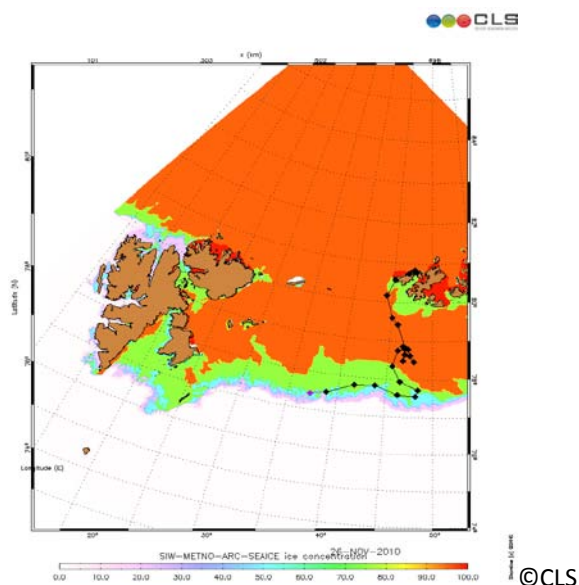


Figure 3-6 Tracking polar bears with the ARGOS system.

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/>.

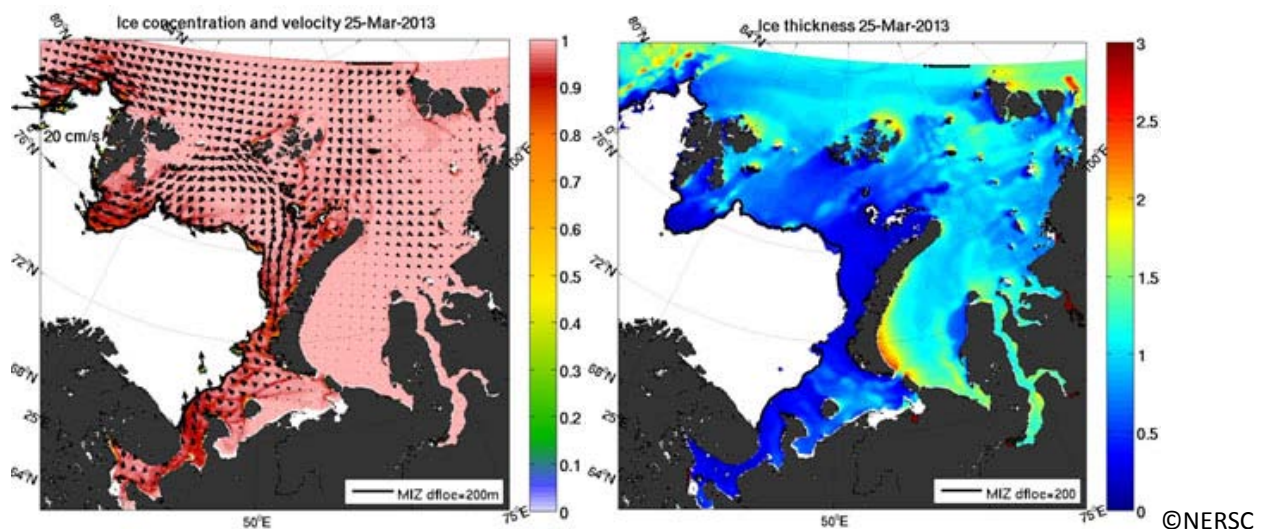


Figure 3-7 Ice-ocean forecasting model for the Barents and Kara Seas.

3.6 Iceberg detection and forecasting in the Antarctica

Figure 3.8 shows an example of iceberg detection in the Atlantic South Ocean in November 2010. In this project, 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 the MyOcean Marine Core Service (<http://www.myocean.eu/>). The SIDARUS service was developed to support the Vendée-Globe challenge race (<http://www.vendeeglobe.org/en/>).



Figure 3-8 Iceberg detection and forecasting in the Antarctica

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