Norwegian Meteorological Institute

Sea Ice and Iceberg Monitoring and Product Development at the Norwegian Ice Service

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Team

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Overview

Sea ice monitoring for maritime safety in Norway began in 1933, with **satellite remote sensing of sea ice being used since 1970** with the creation of the Ice Service at the Norwegian Meteorological Institute and the use of TIROS infrared imaging. Since then, the Ice Service has continued to monitor the waters around Svalbard and the Barents Sea, using **new sensor technologies such as synthetic aperture radar** as they became available.

With the increasing traffic in this area of the Arctic, **demand for increased resolution and information content has grown**, and with this the involvement of the Ice Service in research activities to make full use of the wide range of satellite sensor data that is available, and **develop new techniques using technologies such as artificial intelligence and deep learning**, to maximize the information that can be derived from it. This includes interacting and **taking into account the needs of a wide range of different maritime users**.

We present here some of our recent projects, including Norwegian Research Council funded CIRFA and Digital Sea Ice, the Horizon 2020 ExtremeEarth, ARCSAR, KEPLER, and Arctic-PASSION, and Ice Watch APP.
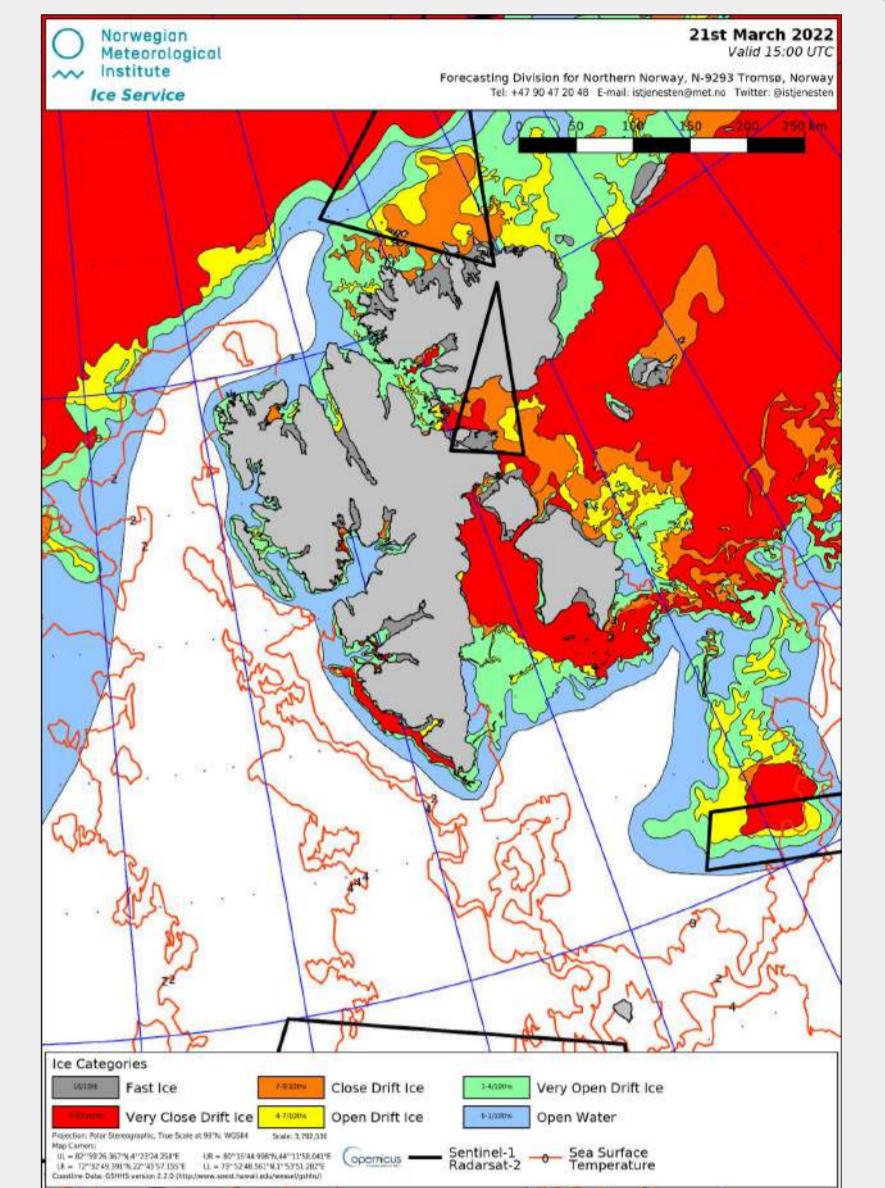
KEPLER
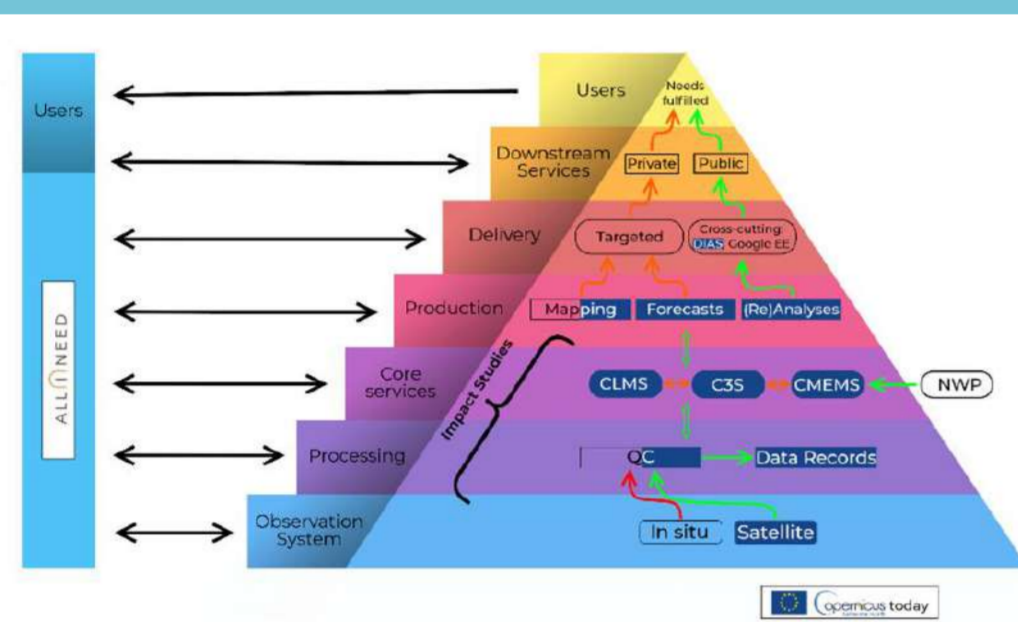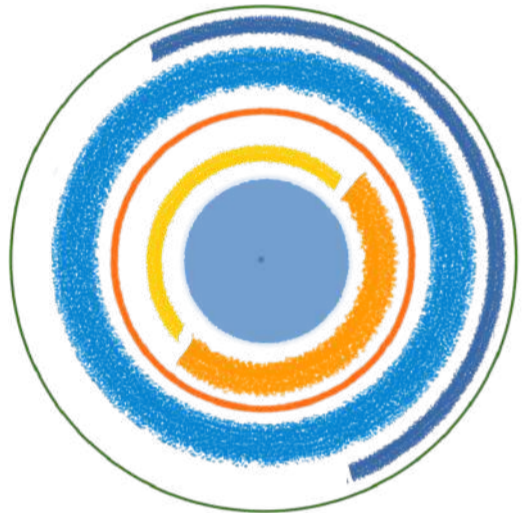
Coordinated by the Ice Service, KEPLER Investigated user requirements and developed a roadmap for the evolution of European Copernicus Earth observing programme for the Polar Regions.
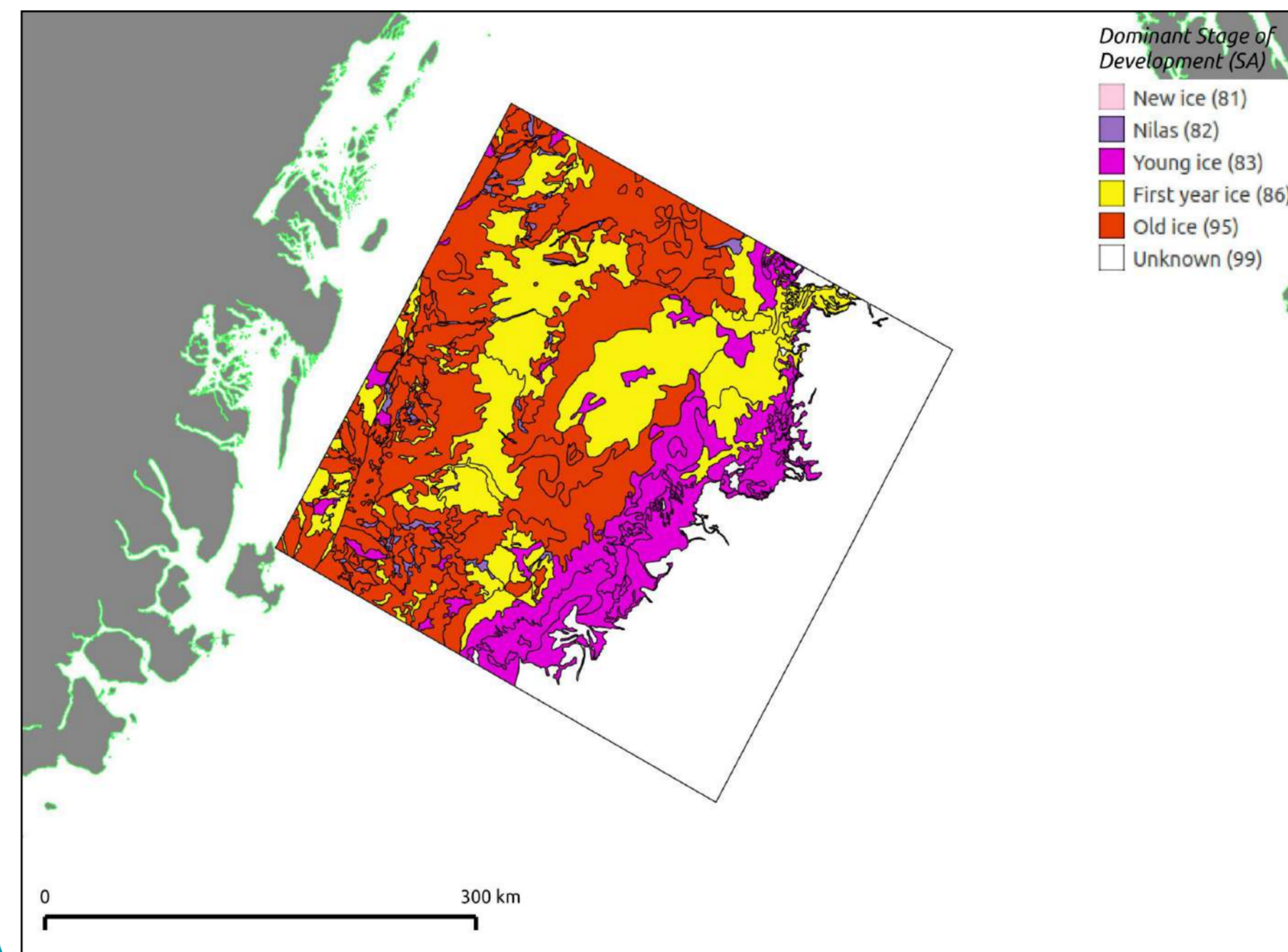
CIRFA
CENTRE FOR INTEGRATED REMOTE SENSING AND FORECASTING FOR ARCTIC OPERATIONS

The project is developing the satellite data processing tools and algorithms to provide new pilot services on sea ice, icebergs, oil spills and polar lows. The Ice Service provides training data for Machine Learning models that will enhance mapping.

EXTREME EARTH

Artificial Intelligence and Big Data technologies are becoming essential to make full use of petabytes of satellite data available from the Copernicus programme.

In this project we helped with automating sea ice mapping, and developed datasets essential for training Machine Learning models.

Dominant Stage of Development (SA)
New ice (81)
Nilas (82)
Young ice (83)
First year ice (86)
Old ice (95)
Unknown (99)

0   300 km

ARCSAR
Arctic and North Atlantic Security and Emergency Preparedness Network

The remote and hostile environment of the Arctic creates challenges for search-and-rescue (SaR), and emergency response.

ARCSAR brings together SaR practitioners and information providers, including the Ice Service, to understand what tools and services are needed for effective response in an increasingly busy region.

ARCTIC PASSION

Climate change is affecting the Arctic and improved monitoring is needed to help us understand these changes and their implications.

Arctic-PASSION integrates monitoring systems to provide new information systems. As part of the project we will develop new AIS-based navigational support systems to help increase vessel routing efficiency and to help mitigate the effects on marine ecosystems.

Digital Sea Ice _(Multi-scale integration and digitalization of Arctic sea ice observations and prediction models)_

The goal of the project is to build a multiscale digital method and system that integrates regional sea ice forecasting models and local ice-ice/ice-structure numerical models with in-situ, shipboard, and regional Arctic sea ice and environmental observations. The aim is to enable improved spatial and temporal resolution to achieve more precise forecasting of ice conditions in the Arctic – including better understanding of long-term variations in polar ice cover.
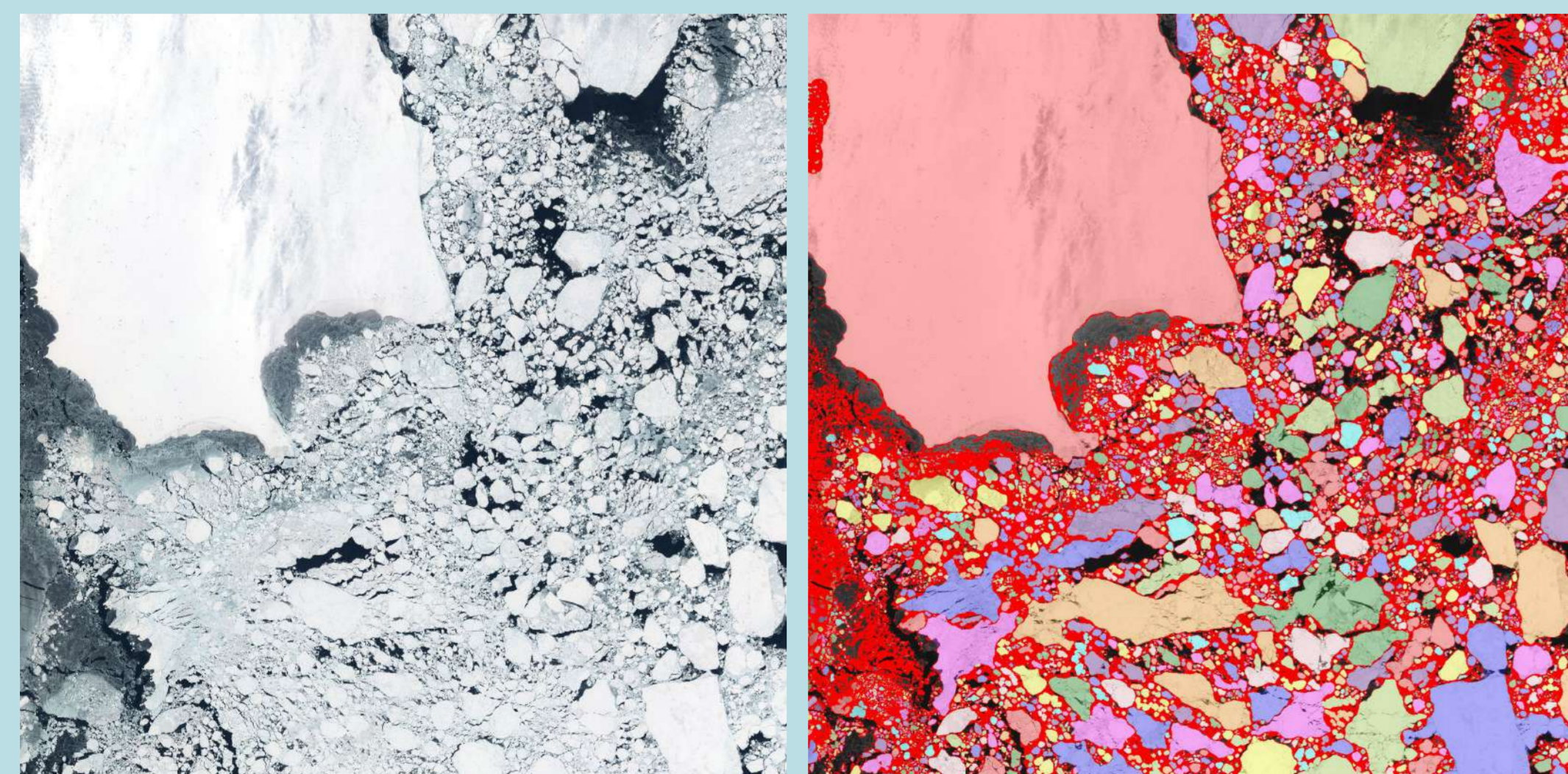
A common methodology to achieve this is the use of AI-based analytics of SAR and optical imagery from satellites, marine radars, and visual and infrared cameras.

As part of the project the Ice Service will lead in developing new sub-kilometer resolution sea ice mapping products for assessing floe size distributions. These will also be used to initialise discrete element models providing regional forecasting of the development of the sea ice cover and its dynamics in unprecedented detail that can be used to support maritime safety applications and provide understanding of climatological processes.

Ice Watch APP

Ice Watch is a programme coordinated by the Ice Service to collate shipboard observations of sea ice and icebergs. Citizen Science is becoming increasingly popular as people seek to understand the natural environment around them.

In collaboration with the Polar Citizen Science Collective, we have developed a mobile phone app to assist with taking photographic observations, and providing a mechanism for users to get expert feedback and the latest satellite images of what they are seeing.

Ice Service Objectives

Our goal is to provide **the next generation of sea ice and iceberg mapping and forecasting** information products **to support maritime safety**. As the Arctic moves towards a warmer, more dynamic state, the hazards to maritime operations are potentially increased for the unwary. We seek to ensure that all our users are provided with **the most accurate and relevant information available**, as **a free and open public service**. To achieve this we engage in **cutting-edge research to greatly increase the spatial resolution and level of detail**. This will take advantage of the current capabilities of the Sentinel satellites of the European Copernicus Space Component and other satellite operators, and explore the potential of new routine technologies such as L-band synthetic aperture radar, ESA Earth Explorers and Copernicus Expansion Missions to deliver new parameters.