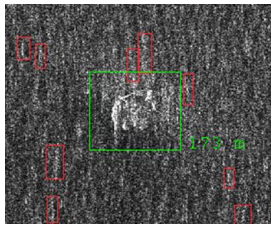
Monitoring of icebergs

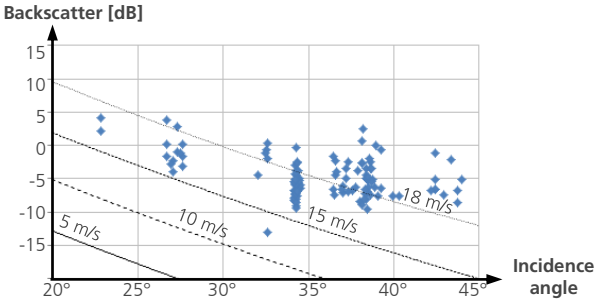
Icebergs are pieces of freshwater ice that have broken off marine glaciers and are floating freely in open water. Though they are striking features in polar waters, they pose a hazard to ships, offshore constructions, and underwater pipelines.

A new processor automatically detects and charts icebergs from SAR image data. By analyzing recurring patterns (i.e. waves) building on former studies on wind and sea state retrievel, icebergs can be discriminated from most false alarms that arise from rough sea and strong winds. This results in a low false alarm rate.

Section of a TerraSAR-X image showing an iceberg in rough sea



Detection (green) and false alarms filtered out (red)



Mean backscatter of 138 manually identified icebergs from a series of TerraSAR-X images in dependence of the local incidence angle (blue dots) and expected backscatter in open water for different upwind speeds (lines).

Near real-time processing

To provide the maritime community with up-to-date information on the ocean and frozen waters as fast as possible after the reception of new SAR image data, software processors developed in Bremen have to fulfil NRT requirements. Colleagues from DLR ground station Neustrelitz are responsible for the integration of software updates into the operational data processing chain.

DLR at a glance

DLR is the Federal Republic of Germany's research centre for aeronautics and space. The organisation also completes research in the areas of energy, transport, security and digitalisation. Acting on behalf of the federal government, the DLR Space Administration designs and implements Germany's space programme, together with national and international partners. DLR is also the umbrella organisation for two project management agencies that promote research.

DLR has approximately 9000 employees at 27 locations in Germany. It also has international offices in Brussels, Paris, Tokyo and Washington D.C.

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Polar Activities

Maritime Safety and Security Lab Bremen

DLR

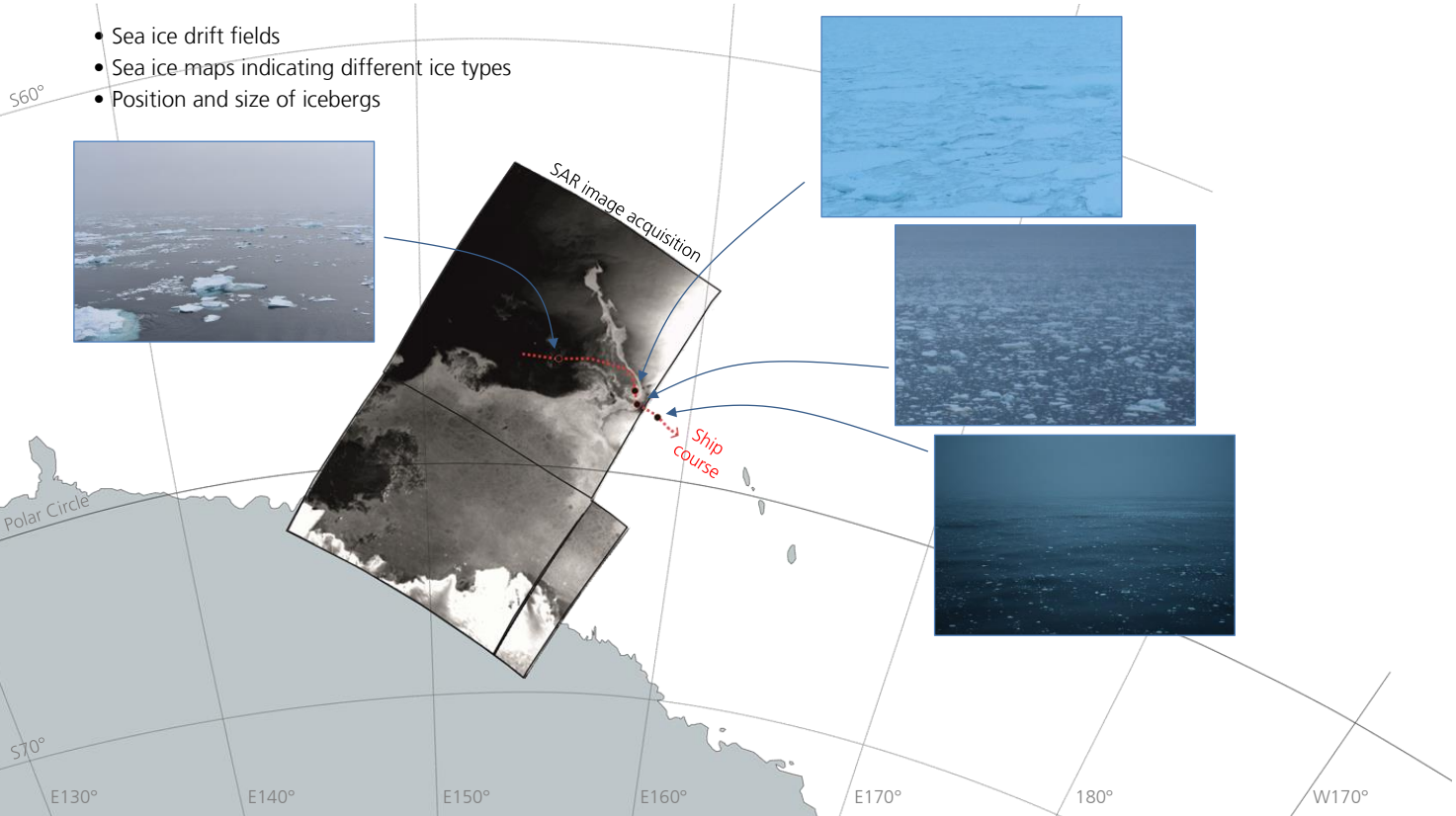
Navigation in polar waters

Sea ice is a subject to constant change. Within just a few hours the wind can turn, shoving sea ice together over kilometres and causing pressure ridges to form – obstacles that are difficult or impossible even for icebreakers to overcome. Synthetic Aperture Radar (SAR) satellites are able to observe small and large scale structures in sea ice – in any weather, through clouds and darkness.

In order to assist ship routing, scientists from the Maritime Safety and Security Lab acquire SAR images along the ship course and provide them to navigators on board in near real-time (NRT), utilizing the operational data processing chain at DLR ground station Neustrelitz. These selected acquisitions already help to anticipate dangerous situations, or avoid unnecessary detours.

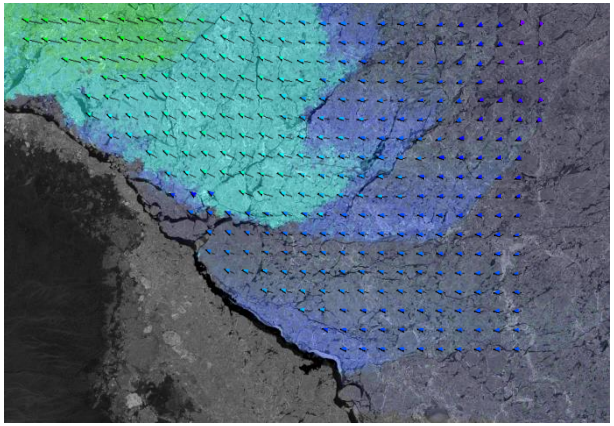
In addition to SAR images, derived information products give a more detailed look into the current ice situation. These products include:

- Sea ice drift fields
- Sea ice maps indicating different ice types
- Position and size of icebergs



Sea ice drift estimation

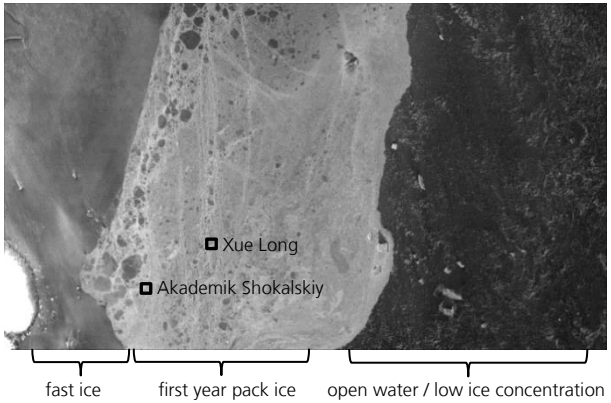
Sea ice drift fields are generated from SAR image sequences of the same or different missions. Due to estimation in sub-pixel space, output drift fields capture very small variations in the ice motion e.g. open water leads that are likely to open up or close.

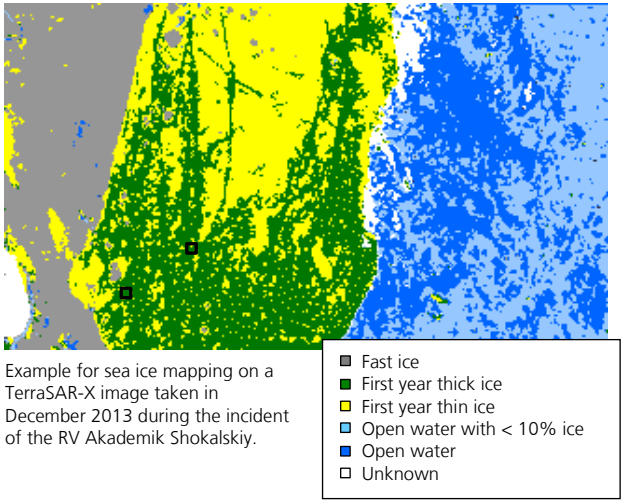


High resolution sea ice drift measured off Prince Patrick Island (Canada)

Sea ice mapping

The processor for sea ice mapping distinguishes between sea ice covered areas and open water, exploiting textural and polarimetric features from SAR data. Sea ice covered areas are analysed more detailed with regard to degree of deformation and subsequently assigned to different sea ice types.





Example for sea ice mapping on a TerraSAR-X image taken in December 2013 during the incident of the RV Akademik Shokalskiy.

◀ Information from space provided to navigators on board the ship in near real-time help to anticipate dangerous situations, or avoid unnecessary detours. This safes time, fuel, and money.