

Demonstration of SAR data for sea ice monitoring in the Northern Sea Route

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Implementation of satellite SAR data for sea ice monitoring in the Northern Sea Route was initiated in August 1991, when ERS-1 SAR images were transmitted onboard the French vessel L' Astrolabe during her voyage from Europe to Japan. In 1993 Nansen Centres in Bergen and St. Petersburg together with Murmansk Shipping Company started extensive campaigns to demonstrate use of SAR data for supporting the navigation in ice, and during the 1993/1994-winter season several hundreds of ERS-1 SAR images were transmitted to the Marine Operational Headquarters and to the nuclear icebreakers operating along the Siberian coast. This demonstration was continued in summer 1995 for supporting the voyage of the Kandalaksha vessel through the whole Northern Sea Route from Japan to Murmansk. These campaigns proved that SAR data significantly enhance the sea ice monitoring, but the spatial coverage of the Northern Sea Route couldn't be provided with only narrow-swath images. In 1996 the ESA and the Russian Space Agency initiated the cooperative ICEWATCH Project, aimed at utilizing various remote sensing data for sea ice monitoring, and the use of SAR data onboard the icebreakers were continued. The RADARSAT ScanSAR improved the possibility of mapping large areas of sea ice, compared to ERS. The demonstration conducted onboard the icebreaker Sovetsky Soyuz in summer 1997 showed, that the most important sea ice parameters could be derived from these images during summer conditions. ScanSAR data are found particularly important for supporting icebreaker operations during the winter 1997/1998 between Murmansk and the Yenisey River, where year-round ship navigation is implemented. In summer 2003 and winter 2004 ENVISAT ASAR wide swath images were used for supporting navigation in the Kara Sea in combination with visible AVHRR NOAA images. Before this latest demonstration the technology of data presentation to the end-user was improved using Electronic cartographic navigation systems, where both satellite images and ice maps were presented as an additional information layers. A series of demonstration campaigns clearly prove that high-resolution light- and weather independent SAR images, transmitted onboard icebreakers in near real time, can be effectively used for selecting icebreaker route in sea ice, increasing the convoy speed by a factor of two in heavy ice conditions. The major sea ice parameters could be derived from SAR images, and signatures of various sea ice types and features have been studied and verified during these field campaigns. The high latitude telecommunication systems are main "bottleneck" in using SAR images onboard the icebreakers.