

Field Validation Results and Future Plans for Operational Arctic Sea Ice Mapping with Satellite Radars

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Abstract

Satellite radar data acquired by scatterometer and synthetic aperture radar (SAR) are used by the United States National Ice Center, the Canadian Ice Service, and other international ice information centers to identify and map sea ice. Algorithms are developed to use radar data for sea ice mapping with different spatial resolution, temporal resolution, revisit frequency, and coverage. To validate results from sea ice mapping algorithms, a field campaign was carried out in October-November 2001 using the US Coast Guard icebreaker, the Healy, over the Barents Sea around the Svalbard region. Participants were from the Jet Propulsion Laboratory, the National Ice Center, the Naval Research Laboratory, and the Technical University of Denmark. Field observations show that sea ice edge can be detected well by QuikSCAT under various wind conditions. An important result from this experiment is the uncovering of the mystery of the "Svalbard sea ice barrier". The barrier is an elongated sea ice feature (100's of km) that forms extremely rapidly within one day over ocean to the east of Svalbard as seen in the sea ice pattern mapped by QuikSCAT. Such sea ice formation blocks off the sea route of fishing ship in this important fishing region. The answer to the mystery behind the Svalbard sea-ice barrier comes from the bottom of the ocean. A comparison between bottom bathymetry (from ETOPO5 and IBCAO data sets) and the pattern of sea ice formation (from QuikSCAT) in the Barents Sea reveals that sea ice cover conforms very well with the deeper ocean areas in the east region of Svalbard. This is because Arctic waters are governed by the bottom bathymetry, which preferentially restricts the cold water over deeper ocean area. Sea ice, of course, forms preferentially over colder water. In terms of natural hazards to ship navigation, the important implication is that the Svalbard sea-ice barrier will form again and again year after year unless the bottom bathymetry is significantly changed or Arctic temperatures become too warm. Both of those are not likely to happen in the near future, and it is necessary to have daily monitoring of the sea-ice barrier formation. Near-real-time and frequent operational sea ice mapping products from satellite sensor such as QuikSCAT is useful for that. It is also noted that sea ice grows over deeper ocean in the north and east sides of Svalbard because of Arctic waters; and oppositely, sea ice tends not to grow over deeper ocean in the west and the south east side of Svalbard because of warm Atlantic waters. With the recent successful launch of the European Space Agency ENVISAT satellite, future experiments using icebreaker ship are planned over the Arctic to carry out field validation for ice mapping with ENVISAT SAR.