Mapping Hazardous Sea Ice Features With Advanced Capabilities of SAR Satellites

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ABSTRACT

The detection of sea ice features, which are hazardous for marine transportation and offshore operations, is important for Canada since it has the world's longest coastline. The hazardous sea ice features investigated in this work included pressure ridges, rubble fields, hummocks, icebergs and ice islands. The information on sea ice ridges also plays an important role in estimating the total volume of sea ice for the climate science. Previous C-CORE projects supported by the Canadian Space Agency and offshore oil and gas industries have investigated advanced capabilities of Synthetic Aperture Radar (SAR) satellites to detect, characterize and track sea ice features. Validation was performed by comparing SAR results with the results from very high resolution electro-optical imagery.

During the last decade, the new satellite-based SAR techniques including polarimetry, interferometry and high resolution imaging performances became available for sea ice applications. RADARSAT-2 (RS-2) full polarimetric capabilities offered an innovative approach for application of polarimetric decompositions and creating solutions to meet the various requirements for sea ice monitoring. It was demonstrated that full and dual polarimetric data are useful for identifying glacier ice (icebergs and ice islands) in sea ice by applying Pauli decomposition and generating color composite images. High resolution modes of RS-2, such as Spotlight and Ultra-Fine are capable for mapping sea ice deformation features including ridges and rubble fields. Stereo capabilities of RS-2 were investigated with extracting digital elevation models of icebergs in sea ice.

Capabilities of satellites operating in X-band, such as TerraSAR-X/TanDEM-X (TDM) and COSMO SkyMed (CSK), for mapping of ice features were also investigated. The unique single-pass interferometry with TDM data demonstrated advanced performance in extracting icebergs and ice topography. Three-dimensional information is helpful for identification and characterization of icebergs and hummocks. In addition, the techniques of data fusion and tracking using RS-2 imagery and X-band data from TerraSAR-X and CSK demonstrated promising results in identifying hummocks and icebergs in sea ice.