# Satellite SAR Remote Sensing of Great Lakes Ice Cover Using RADARSAT Data

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During winter months, cloud cover over the Laurentian Great Lakes impairs the use of satellite imagery from passive sensors operating in the visible, near infrared, and thermal infrared spectra for ice cover monitoring and analysis. The all-weather, day/night viewing capability of satellite Synthetic Aperture Radar (SAR) makes it a unique and valuable tool for Great Lakes ice identification and mapping if data analysis techniques and capability to use SAR data in an operational setting are developed. RADARSAT, an operational satellite carrying a SAR operating at 5.3 GHz (C-Band) with a horizontal polarization, was successfully launched in 1995. This study explores algorithms to use RADARSAT SAR data for Great Lakes ice cover classification and mapping.

To assess the utility of RADARSAT SAR data for Great Lakes ice analysis, a data set for Lake Superior has been established covering the period from 15 to 21 March 1996. This data set includes RADARSAT ScanSAR data, AVHRR imagery, U.S. Coast Guard Side Looking Airborne Radar (SLAR), and ground (*in situ*) data consisting of ice charts, photographs and video taken from the USCGC MACKINAW, a Coast Guard ice breaker, and from a Coast Guard helicopter. Meteorological data from selected ground stations are also included. Color photographs and video along with ice charts and GPS data were obtained along the ship track and over the study areas from altitudes ranging from approximately 200 to 400 m. Ice thickness was obtained by measurements and visual examinations enroute. RADARSAT data from the Gatineau readout station in Canada were received at the National Ice Center (NIC) in Suitland, Maryland via a link between the U.S. and Canadian Ice Centers and forwarded to the Great Lakes Environmental Research Laboratory. Two ScanSAR scenes of Lake Superior were used in this analysis.

The SAR images are displayed and analyzed using commercial and government-developed image processing software . Photographs were used with the ice charts and field notes to interpret and analyze ice types and patterns seen in the SAR data. Since the SAR data are geocoded, observed ice types and features can be located and identified in the imagery. Preliminary analysis using supervised classification (level slicing) and statistical (clustering) techniques indicates that different ice types in the ice cover can be identified and mapped. In addition, wind has a strong influence on the backscatter from open water. However, further research needs to be conducted on the repeatability and automation of classification and interpretation from scene to scene.