A gorithm Development for Satellite SAR Mapping of Great Lakes Ice Cover

G. A. Leshkevich
Great Lakes Environmental Research Laboratory
National Oceanic and Atmospheric Administration
2205 Commonwealth Boulevard
Ann Arbor, MI 48105

S. V. Nghiem and R. Kwok
Center for Space Microelectronics Technology
Jet Propulsion Laboratory, MS 300-235
California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109

This study is to develop an algorithm for Great Lakes ice cover mapping using RADARSAT Synthetic Aperture Radar (SAR) data. The all-weather, day-and-night viewing capability of satellite SAR makes it a unique and valuable tool for this purpose. RADARSAT, successfully launched in 1995, is an operational satellite carrying a SAR operating at 5.3 GHz (C-Band) with a horizontal polarization. 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.

A ScanSAR Narrow scene of western Lake Superior was used in this analysis. Photographs were used along with ice charts and field notes to interpret and analyze ice types and patterns seen in the SAR images. A supervised, level slicing classification based on a comparison of brightness or digital values in the SAR scene representing known ice types as identified in the ground. Using photographs, ice charts, and field notes, two ice types (snow ice and new ice) and open water were identified in the computer displayed SAR image and a representative training set, consisting of a range of digital values, for each type was extracted. Preliminary analysis indicates that open water and different ice types can be identified, classified, and mapped in RADARSAT imagery. In addition, wind has a strong influence on the backscatter from open water as observed in other RADARSAT images taken during the cruise. Further research needs to be conducted on the temporal repeatability of interpretation and classification from scene to scene throughout the winter. Other methods including statistical techniques will be investigated for the lake ice mapping. To continue the development and validation of an algorithm for remote sensing of Great Lakes ice using RADARSAT data, we plan to conduct a winter experiment across Lake Superior during the 1997 winter season. The experiment will acquire shipborne polarimetric backscatter data with the JPL C-band scatterometer together with surface-based ice physical characterization measurements and environmental parameters in conjunction with aerial ice reconnaissance. The experiment will be timed to include RADARSAT SAR imaging and AVHRR temperature mapping.