Automated Ice-Water Classification on Large Northern Lakes Using RADARSAT-2 SAR Imagery

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Changes to the timing and duration of ice cover on lakes throughout the northern landscape has been established as an indicator of climate change and variability. These changes are expected to have implications for both human and environmental systems. In addition, monitoring the extent and timing of ice cover is required to enable more reliable weather forecasting across lake-rich northern latitudes.

Currently the Canadian Ice Service (CIS) monitors over 130 lakes using RADARSAT-2 SAR (synthetic aperture radar) and optical imagery. These images are visually interpreted, with total lake ice cover reported weekly as a fraction out of ten. An automated method of classifying ice and water in SAR scenes would allow for more detailed records of ice extent to be delivered in an efficient way.

Our research group has developed the Iterative Region Growing using Semantics (IRGS) algorithm. This method separates homogeneous regions in an image using a hierarchical watershed approach, then merges like regions into classes. These classes are then labeled using a support vector machine classifier, employing SAR grey-level co-occurrence backscatter and texture features. This method has been successfully tested in the classification of sea ice with up to 96% accuracy.

In this research, we have used IRGS for ice-water classification in RADARSAT-2 scenes of Great Bear Lake and Great Slave Lake. An accuracy assessment has been performed on the classification results, comparing outcomes with user generated reference data as well as the ice fraction reported by CIS at the time of image acquisition. The results from IRGS have also been plotted in a 3-year time series in order to visualize the evolution of freeze-up and break-up, and compare it with temperature data as well as the reported fraction from CIS. These results demonstrate the potential of this automated method to provide detailed and reliable lake ice cover information for researchers and government.