Investigation of RADARSAT-2 and TERRASAR-X data for river ice classification

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Abstract

To date, monitoring of river ice through remote sensing has mainly focused on the use of monopolarized and multipolarized C-band radar data. Using backscatter and texture from different polarizations, classification schemes are used to produce quite reliable ice maps of general ice classes. However, to improve the accuracy of the ice type classifications, a series of river ice studies have been also undergone to assess the potential information gain from polarimetric SAR data from aerial survey.

In this paper, classifications (Hierarchical, Wishart and Support Vector Machine) using polarimetric parameters are developed to identify five conditions: open water, frazil, intact thermal ice, intact frazil ice and consolidated ice. Classification algorithms are tested on the newly available full-pol C-band RADARSAT-2 and dual-pol X-band TERRASAR-X data to investigate the potential of this new imagery. These images are acquired in winter 2009 over the St-François River (Southern Quebec) and the Koksoak River (Northern Quebec). Ground photos and ice cores from the same days as the satellite overpass are used to establish training as well as validation sites for the ice cover classification.

An electromagnetic model is improved to simulate the fully polarimetric response of a river ice cover. The total backscattering information, which is contained into a covariance matrix representation, is investigated to understand the interactions of the radar signal with the ice cover. The best polarimetric parameters are chosen by investigating the results of the model and by calculating separability for two classes using the bhattacharyya and Khi^2 distances.

Confusion matrices are computed to compare the classification results achieved by C and X band as well as full-pol vs dual-pol vs single polarization. The Support Vector Machine algorithm shows a greater adaptability to various datasets. Preliminary results show that using dual-pol data increases by 13.4% the final classification producer accuracy over single-pol data. Furthermore, the accuracy gain is 16% when using full-pol over single-pol data.