University of Calgary Monitors Arctic Sea Ice with Geomatica Radar Suite

Timely information on sea ice is essential for many types of marine operations in polar regions of the Earth. In addition to hazards such as wind and waves, icing of vessels and shorter daylight hours, the presence of ice fields means that polar waters pose a much higher risk to shipping than most other waters. The safety and efficiency of sea transportation, off-shore operations, fisheries, and other marine activities are among the motivation to establish operational sea ice monitoring in Arctic regions. Furthermore, the routine mapping of sea ice is important for scientific and regulatory users in the areas of climate monitoring, environmental protection, and sustainable resource management.

Project scope

In this study, developed by PhD candidates at the University of Calgary, the classification potential of polarimetric parameters derived after Cloude–Pottier decomposition, Touzi decomposition, Freeman–Durden decomposition, normalized radar cross section measurements, phase differences, and statistical synthetic aperture radar correlation measures is evaluated by relating them to three pre-identified sea ice types and wind-roughened open water. A combined approach that constitutes a visual inspection of estimated probability densities of the polarimetric parameters and quantitative analysis using supervised classifications is adopted. Polarimetric parameters are iteratively combined in pairs and triplets to test for their ice type discrimination potential. Sensitivity of polarimetric parameters to radar incidence angle is also examined.

PCI's SAR Polarimetric Workstation

Computation of poalrimetric parameters from Radarsat-2 imagery is not straight forward. No software to date has the capability to process such dataset as well as PCI Geomatics' SAR Polarimetric workstation (SPW). SPW was used to compute these parameters.

A number of radar processing algorithms and filters were used to process Radarsat-2 data using PCI Geomatics' SAR Polarimetric Workstation . More specifically the algorithms were used to compute co- and crosspol linear backscatter, phase differences, intensity ratios, Cloude-pottier decomposition parameters, Freeman-Durden decomposition parameters, Touzi's decomposition parameters, Correlation coefficients, SPAN etc.

Geomatica Radar Suite

The Problem

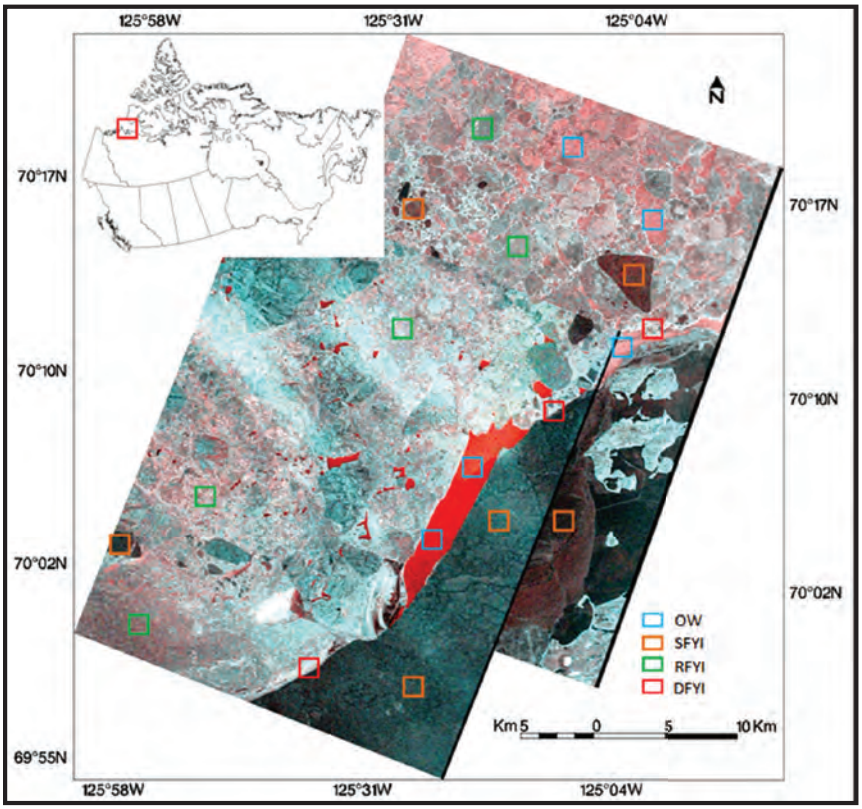
Sea ice can be difficult to study because of the remote and hazardous locations in which is exists.

The Need

Remotely sensed SAR data is one half of the equation. To complete the analysis, SAR processing software with the right algorithms are required.

The Solution

Only PCI Geomatics' SAR Polarimetric Workstation has the capability to process the Radarsat-2 data with the accuracy and efficiency required.



The results demonstrated strong but variable sensitivity of polarimetric parameters to different ice types, which was dependent on radar incidence angle. Results of parameter evaluation demonstrated that no single parameter discriminates significantly (>60%) between all the ice types considered in the study. Combining two low correlated parameters increased the classification accuracy by 10%–22%. Combining the third polarimetric parameter did not necessarily improve the classification results. However, the best classification results were achieved using a combination of three parameters.

FIgure 1: (Left) Map of Canada (top left), overlaid with a red box showing the study area (Amundsen Gulf). In the main window is the mosaic of the Radarsat-2 SAR images used in Study 2 (14 May 2008), overlaid with windows of interest showing sampling areas of different ice types. Color combinations used in the images are HH (red), HV (blue), and VH (green).

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Project Results

Polarimetric signatures of different ice types were analyzed at four radar incidence angles. The results were compared with previous studies to examine the variation of signatures with varying geophysical and SAR parameters. The study was further extended to investigate the potential of polarimetric parameters for ice type discrimination. This was done by analyzing the polarimetric signatures in one and two-dimensional feature spaces and also through a combination of adopted classification algorithms.

The results are published in the following paper:
Gill, J.P.S & Yackel, J.J., "Evaluation of C-band SAR polarimetric parameters for discrimination of first-year sea ice types", Canadian Journal of Remote Sensing, Vol 38, No. 3, PP. 306-323, 2012.

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