Examination of Microwave Backscatter of Freshwater Lake Ice using Polarimetric Decomposition

CONNOR MCRAE-PHARO[1] AND GRANT GUNN[1]

ABSTRACT

Polarimetric decomposition is an invaluable technique for analyzing microwave signals reflected off freshwater ice features. In this study, we utilize Radarsat 2 quad-pol captures to investigate backscatter from two lakes: Old Crow Lake in the Yukon and Noel Lake in the Northwest Territories, each representing a contrast in morphometries (shallow and deep, respectively). The contrast in depth is designed to present two unique ice compositions, accounting for the presence and absence of tubular bubbles at the ice-water interface. Polarimetric decomposition allow for the identification of the dominant scattering mechanisms that occur for ice with and without tubular bubbles. Results showed that the ice was characterized by dominant single-bounce scatter, regardless of morphometry, followed by orders of magnitude weaker volume-scattering signal and a slight to nonexistent double-bounce signal. These findings have important implications for remote sensing applications, such as opening the prospect of freshwater ice thickness retrieval as interferometry performs with higher confidence with single bounce interactions. Overall, the application of polarimetric decomposition of freshwater ice backscatter shows promise as a valuable tool for understanding the relative contribution of the physical properties of the ice to radiative transfer and can be used to improve our current methods of ice and climate monitoring in the cryosphere.

[1] Department of Geography and Environmental Management, University of Waterloo, Waterloo, ON, Canada

Corresponding author: cmcraeph@uwaterloo.ca