Forward Modeling of SAR Backscatter during Lake Ice Melt Conditions using the Snow Microwave Transfer (SMRT) Model

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ABSTRACT

Lake ice is a key component of northern landscapes. It plays a critical role in local energy balances and provides crucial socioeconomic services such as travel between communities and transportation of goods during winter months. However, changing climate is impacting the duration of ice seasons and the thickness of ice covers. Additionally, increasing temperatures lead to an increasing number of melt events throughout the season, resulting in the formation of more snow ice and slush layers. The presence of slush layers can pose challenges for mapping lake ice using active microwave data (i.e., synthetic aperture radar) and be a risk to those who use ice cover as an essential travel route. Using radiative transfer modeling we can better understand the connection between these events, lake ice properties, and remote sensing; however, exploration has been limited. This study will focus on Lake Oulujõrvi during the 2020-2021 ice season and use detailed field data collected over three dates. Field data collected in late January and early March are representative of dry conditions, while field data collected in late March shows evidence of increased water content. Snow density, snow depth, microstructure data, and ice thickness data collected during the field campaign will be used to parameterize the Snow Microwave Radiative Transfer (SMRT) model. SMRT will be used to conduct forward modeling simulations of the ice cover during these dates. The focus of these simulations is to understand how changes in snow and ice properties during melt events impact backscatter and how different conditions impact the dominant scattering interface (i.e., ice-water, snow-ice, and ice-air). The results of this modeling will serve as an important basis for further improving the parameterization of radiative transfer models throughout the ice season.

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