Improving the Understanding and Uncertainty of Snow Radiative Transfer Modeling using Snowpack Information of Varying Complexity

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ABSTRACT

Spatial characterization of snow water equivalent using spaceborne passive microwave remote sensing platforms is critical for understanding the hydrological, meteorological, and mobility environments in regions where quality snow observations are lacking. However, using passive microwave data to determine the amount of snow liquid on the ground remains a significant challenge, especially over mountainous regions with deep snow packs and dense forests. Recently, snow radiative transfer models have been developed to better understand how microwave radiation is affected by various snowpack properties, and to facilitate data assimilation and land model initialization.

One knowledge gap that exists in this area is that the most widely used operational land surface models only provide bulk snow pack information, such as snow depth and snow water equivalent, rather than detailed information about the snowpack stratigraphy and snow grain size. This study attempts to address this knowledge gap by simulating snow brightness temperatures using the Dense Media Radiative Transfer Multi-Layer Model (DMRTML) using various degrees of complexity with respect to the snowpack information used to drive the DMRTML.

The snow and radiometer data used to force and evaluate the DMRTML were collected during the CrustEX and SnowEx field campaigns in central New Hampshire in February 2018 and in Western Colorado in February 2017. Ways to incorporate more complex snow pack information critical to radiative transfer into common land surface models are discussed.

This work shines a light on what level of complexity is required in a snow model and what specific snow characteristics are critical to realistically simulating snow brightness temperatures towards the assimilation of satellite microwave data.

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