Electromagnetic Models for Passive Microwave Remote Sensing of Snow and Application to Experimental Data

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Several electromagnetic models have been described in the literature for modeling radiometric signatures of snow-covered terrains. Understanding how each model simulates the radiometric behavior of a snowpack, exploring the conditions under which the different models display the best agreement can provide insights for developing retrieval techniques, as well as possible model improvements.

In this study, we use four widely-used electromagnetic models to simulate the brightness temperatures of six different snow classes at different frequencies and observation angles. The snow classes considered here account for a majority of the types of snow occurring in the northern hemisphere. The models considered are the following: a model based on Dense Media Radiative Transfer Theory, a model based on the Strong Fluctuation Theory, the Helsinki University of Technology (HUT) model and the Microwave Emission of Microwave Layered Snowpacks (MEMLS) of the Institute of the Applied Physics, Berne.

We discuss the different approaches taken by each model, the required input parameters and the sensitivity of the electromagnetic quantities involved (e.g., brightness temperatures, extinction coefficient) to the input parameters. We compare the brightness temperatures simulated by means of the electromagnetic models for the six classes and analyze the causes of the observed differences.

Finally, we drive all four models with snow parameters derived from recent field data (e.g., the NASA Cold Land Processes experiment) and evaluate the outputs against observed brightness temperatures observations.