Evaluation of electromagnetic models for passive microwave remote sensing of snow

Invited

(Session F – Microwave Remote Sensing of Cryosphere)

Marco Tedesco[1] and Edward J Kim[2]

1) *GEST - NASA Goddard Space Flight Center, Greenbelt, MD , USA*

2) *Hydrospheric and Biospheric Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA*

Snow plays a significant role in hydrological, climatological and meteorological processes. It has the largest area extent of any component of the cryosphere (areas of the Earth's land surface where water is frozen either seasonally or permanently), with most of the Earth's snow-covered area located in the Northern Hemisphere, where the mean snow-cover extent ranges from 46.5 million km^2 in January to 3.8 million km^2 in August. Snowfall represents a large part of the overall precipitation, and most of the major river systems at high latitudes and altitudes have their origin and their major sources of water from melting snow. In addition, the amount and timing of snowmelt runoff provides crucial information for the management of water resources, flood prediction, climate change and hydropower management.

Microwaves are sensitive to snow parameters such as mean grain size, wetness and snow water equivalent, and remote sensing can provide measurements over large areas, independently of weather conditions and solar illumination. Electromagnetic models to simulate the brightness temperatures of snow covered terrains have been developed in recent years for supporting the development and improvement of retrieval techniques, for interpreting experimental results, and for understanding the relationships between electromagnetic quantities and snow parameters. These relationships are complex and insights for improvements are difficult without a controlled comparison.

In this study, we compare four electromagnetic models, discussing the different approaches, the required input parameters and the sensitivity to the input parameters (i.e., mean grain size, correlation length, number of layers). The models we consider are: a model based on Dense Media Radiative Transfer Theory, a model based on Strong Fluctuation Theory, the Helsinki University of Technology (HUT) model and the Microwave Emission Model of Layered Snowpacks (MEMLS) of the Institute of the Applied Physics, Berne.

Brightness temperatures collected during the NASA Cold Land Processes Experiment – 1 (CLPX - 1) are simulated by means of the four models using as inputs the values of snow parameters derived from snow pit measurements. Both wet and dry snow conditions are considered. The capabilities of the electromagnetic models to reproduce the recorded brightness temperatures are evaluated and discussed.