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Latitudinal variations of snow properties using airborne passive microwave and in-situ infrared reflectance data over Eastern Canada

A. Langlois (1), L. Brucker (2), A. Royer (1), M. Fily (2), G. Picard (2), L. Arnaud (2), C. Derksen (3), K. Goïta (1), A. Walker (3), P. Cliche (1)

(1) Centre d'Applications et de Recherches en Télédétection, Université de Sherbrooke, Québec, Canada, (2) Laboratoire de Glaciologie et Géophysique de l'Environnement, CNRS-Université de Grenoble, France, (3) Climate Research Branch, Meteorological Service of Canada, Toronto, Ontario, Canada.

Snow thermophysical properties are known to be sensitive to climate variability and change and are of primary importance for hydrological and climatological processes in northern regions. Specifically, spatial and temporal variations of snow extent and thickness are good indicators of warming climate, and better tools are required to assess those changes from space. Previous studies looking at the linkages between passive microwave brightness and snow properties had reasonable success over flat and vegetation-free surfaces, but lingering uncertainties remain with regards to the role of snow grain size distribution in the extinction of the signal. New adequate methods to characterize snow grains *in-situ* are required to assess the variations observed in the measured and predicted brightness temperatures.

A latitudinal transect study was conducted northern Québec, Eastern Canada in February 2008. Gridded sampling of snow properties was conducted in three areas (8 x 14 km) of boreal forest, taïga and tundra. Similar sampling also occurred along a north-south helicopter transect with a spatial sampling resolution of 40 km from 50 to 58° N encompassing the gridded areas. Coincident airborne passive microwave brightness temperatures were measured at 19 and 37 GHz in both vertical and horizontal polarizations both along the transect and at the three sites. On the ground, two methods were

developed to calculate snow specific surface area (SSA). The first method makes use of an infrared digital camera which measures the reflectance between 823 and 1000 nm. The reflectance is converted into SSA using the calibration curve established at SLF, Davos. The second method uses a 1.3 nm laser diode mounted on an integrating sphere, which also allows the measurement of the reflectance in the infrared region. Both methods are related and allow the calculation of snow SSA, which is expected to provide great improvement for microwave emission modeling. Using the latitudinal information of snow properties and brightness temperatures, snow multi-layered thermodynamic models (CROCUS and SNOWPACK) information will be coupled to microwave emission models (MEMLS and HUT), in order to enhance the brightness temperature predictions widely used in regional snow studies. This paper presents the results of the ground campaign as well as some preliminary modeling results.

Keywords: Latitudinal transect, passive microwave, snow grain, specific surface area, infrared reflectance, snow metamorphism model, microwave emission model, brightness temperature simulation.