LATITUDINAL VARIATIONS OF SNOW PROPERTIES USING PASSIVE MICROWAVE DATA OVER NORTH EASTERN CANADA

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Abstract.

Snow thermophysical properties are known to be sensiti 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 asse 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 vegetation and snow grain size stribution in the extinction of the signal. Of particular relevance, new adequate methods to characterize snow grains *in-situ* are required to assess the variations observed in the measured and predicted brightness temperatures.

A 1200-km latitudinal transect study was conducted over northern Québec, Eastern Canada in February 2008, spanning from southern boreal forest towards northern taiga and tundra during the International Polar Year project 'Variability and Change in the Canadian Cryosphere'. Detailed gridded sampling of snow and vegetation properties was conducted in three areas (8 x 14 km) of boreal forest, taïga and tundra respectively. Similar ampling 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 (916', 1800' and 9160' altitude) and spaceborne (AMSR-E) passive microwave brightness temperatures were extr 18 and 36 GHz in both vertical and horizontal polarizations both along the transect and at the three sites. The effect of forest fraction and transmissivity (obtained from stem volume measurements) is analyzed and corrected emissivity values are obtained. Results show that the normalized brightness temperature difference decreases with increasing snow depth (i.e. snow water equivalent – SWE) until a threshold is reached where the microwave emission does not come from the snow-soil interface (increasing volume scattering with respect to depth-SWE). Field observations suggest the threshold to be between 250 to 300 mm of SWE. Using the latitudinal information of snow properties and brightness temperatures, snow multi-layered thermodynamic models (CROCUS, SNTHERM and SNOWPACK) information will be coupled to microwave emission models (MEMLS and HUT), in order to enhance the brightness tempera ure 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, forest fraction, SWE, microwave emission model, brightness temperature simulation.