Overview of the 2003 Canadian AMSR-E Snow Water Equivalent Validation Campaign

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EXTENDED ABSTRACT

Passive microwave snow water equivalent (SWE) retrieval algorithms are influenced by a number of land cover and snowpack state variables that are present at a range of scales. Because of the relatively low levels of naturally emitted microwave energy, grid cell dimensions for resampled spaceborne passive microwave brightness temperatures are large (10 to 25 km). A single passive microwave derived SWE estimate, therefore, integrates multiple land and snow cover conditions into a single measurement. Multi-scale brightness temperature datasets with coincident ground measurements are therefore required to quantify the impact of spatially heterogeneous land cover and snowpack properties on passive microwave SWE retrievals.

The purpose of this abstract is to briefly describe new multi-scale research datasets acquired in Saskatchewan, Canada during February 2003 as a contribution to the NASA EOS Advanced Multichannel Spaceborne Radiometer (AMSR-E) validation program. There were two phases to the measurement campaign. First, airborne passive microwave datasets were acquired for flight lines over both open prairie and boreal forest environments (Figure 1). 6.9, 19, 37, and 85 GHz radiometers were flown onboard the National Research Council (NRC) Twin Otter aircraft. Coincident ground sampling was conducted to derive 'ground-truth' SWE for calibration segments of each line. The distributed nature of these flight lines will allow regional scale evaluation of AMSR-E data for a range of land cover and snowpack conditions.

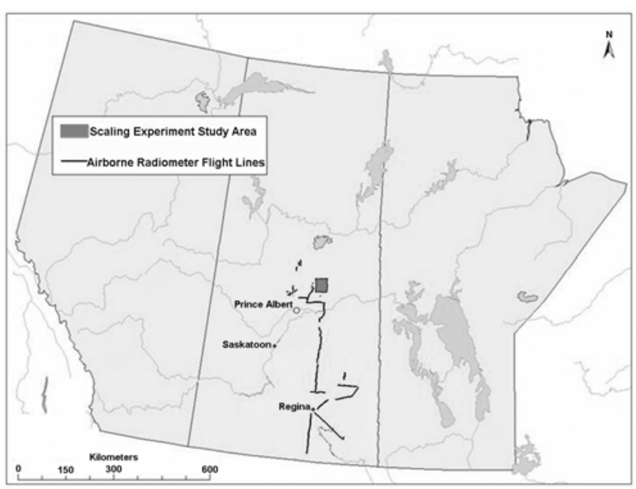

Figure 1: Overview of experiment flight lines.

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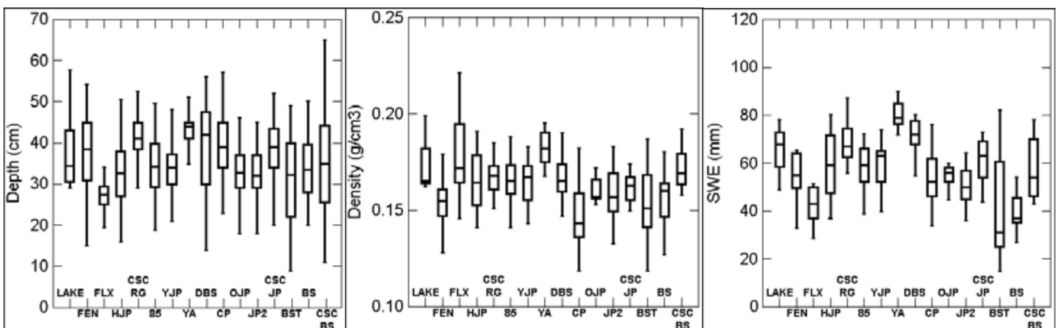
The second phase of the campaign involved the acquisition of multi-scale passive microwave brightness temperature datasets, acquired from ground, tower, and airborne radiometers, as well as two spaceborne sensors (AMSR-E – 10 km resolution; Special Sensor Microwave/Imager – SSM/I – 25 km resolution) for a 25 by 25 km study area centred at the Old Jack Pine Boreal Ecosystem Research and Monitoring Site (BERMS). To best address scaling issues, the airborne data were acquired at two flying heights (hence two radiometer footprint sizes: approximately 100 and 200 m resolution) over an intensively spaced grid of flight lines (see Figure 1). A coincident ground sampling program characterized *in situ* snow cover using a land cover sensitive sampling scheme. These measurements illustrate the variability in SWE, depth, and density that can be found between forest stands and land cover types (Figure 2), and all within a single SSM/I grid cell. Frequency distributions of the various SWE datasets (passive microwave derived and *in situ*) indicate that large footprint spaceborne passive microwave SWE retrievals fall into the centre of the normally distributed *in situ* measurements. The small footprint airborne passive microwave SWE estimates match the range and variability of the *in situ* measurements, showing that passive microwave SWE retrievals can capture local scale SWE variability if the spatial resolution is sufficiently high.



Site Name	Description	Site Name	Description
LAKE	Small lake	DBS	Disturbed black spruce
FEN	Open fen	CP	Mixed forest: pine, spruce, aspen
FLX	Clear-cut (2002)	OJP	Mature jack pine
HJP	Jack pine regrowth (1994)	JP2	Mature jack pine
CSC RG	Jack pine regrowth (1995)	CSC JP	Mature jack pine
85	Jack pine regrowth (1985)	BST	Black spruce and tamarack
YJP	Jack pine regrowth (1975)	BS	Mature black spruce
YA	Young aspen	CSC BS	Mature black spruce

Figure 2: Variability in surface measurements of depth, SWE, and density. All sites are located within the scaling study area identified in Figure 1. The upper and lower bounds of the box represent the first and third quartiles of the dataset distribution, the center line depicts the median, and the vertical lines extend to the maximum and minimum values.

A suite of micrometeorological variables from seven tower sites within the study area were also acquired to aid the interpretation of the passive microwave brightness temperatures by providing key variables such as soil moisture, and soil, snow, air, and tree temperature. Land and forest cover datasets including land cover type, canopy closure, and forest stem volume were also obtained from the Canadian Forest Service. Subsequent analysis of these collective datasets will advance our understanding of important scale and process issues related to the remote estimation of SWE from passive microwave data.

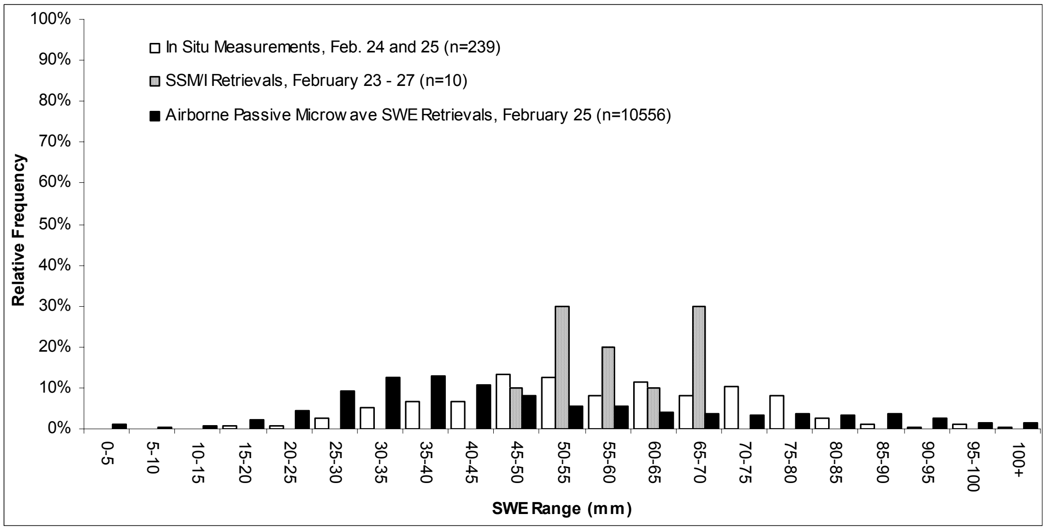


Figure 3: Frequency distributions of the various SWE datasets. All passive microwave SWE estimates were derived from the coniferous forest algorithm described in Goita et al. (2003). See Figure 1 for study area.

REFERENCES

Goita, K., Walker, A, and Goodison, B. 2003. Algorithm development for the estimation of snow water equivalent in the boreal forest using passive microwave data. *International Journal of Remote Sensing* **24**(5): 1097-1102.

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