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SNOW MICROWAVE REMOTE SENSING OF ANTARCTICA: COMPARISON BETWEEN MEASUREMENTS AND MODELING (ABSTRACT)

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Because of its great size, the Antarctic Ice Sheet represents a considerable fresh water resource. Furthermore, it interacts with the global climate and its old ice contains information on past climate. Past and ongoing research indicates that several polar snow properties can be mapped by their microwave signature. Microwave radiation has an advantage over visible and infrared radiation in its ability to sense snow surface conditions down to some depth, even through clouds.

The satellite data that we used for this study came from the Scanning Multichannel Microwave Radiometer (aboard the satellite Nimbus 7, 1978–86). As a first step, we compared ground data with the SMMR data. The polarization differences are affected by the stratification of snow (number and nature of layers); large polarization ratios correspond to strong stratification, mainly for the lower frequencies. The frequency gradients are linked to the grain sizes as determined from detailed stratigraphies. As a second step, we develop a microwave snow emissivity model. The model is based on the solution of Maxwell's equations through strong fluctuation theory (A. STOGRYN; IEEE Trans. Geosci. Remote Sens., **GE-24**(2), 220, 1986). A numerical solution is required when snow characteristics change with depth. The snow is considered isothermal with horizontal stratification, isotropic inside each stratum, and with smooth interfaces.

We first carried out a sensitivity study. As observed through the comparison SMMR data — ground measurements, when the number of layers over the two first meters increases, the polarization difference increases: the lower the frequency, the higher the difference (A. SURDYK and M. FILY; Ann. Glaciol., **17**, 161, 1993).

Then simulated results were used to help with the interpretation of SMMR data. The spatial distribution of the microwave signatures over Antarctica reveals three areas with typical spectral signatures. These areas are identified from the point of view of snow characteristics through a ground data set (A. SURDYK and M. FILY; Ann. Glaciol., **17**, 161, 1993). As expected, the model reproduces well the effect of the stratification on the observed polarization differences (A. SURDYK and M. FILY; J. Geophys. Res., **100**(C5), 8837, 1995). The strong gradient of emissivity *versus* frequency observed on one of the test sites is not completely understood. Depth hoar layers were found at that place. Depth hoar characterized by faceted and cup-shaped, coarse snow grains, seem to have a particular scattering behavior compared with that of the usual grains. When those coarse grains are replaced by fine grains, the model results are closer to the measured data. The presence of crusts, the roughness at the snow-ice interfaces, and crystal orientation may also have significant effects. Details about these results will be found in A. SURDYK and M. FILY (J. Geophys. Res., **100**(C5), 8837, 1995).

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