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Estimating Snow Accumulation from Microwave Remote Sensing Data

S. Linow (1), W. Dierking (1), and W. Rack (2)

(1) AWI, Climate Sciences, Bremerhaven, Germany (stefanie.linow@awi.de), (2) Gateway Antarctica, University of Canterbury, New Zealand

One of the major factors of uncertainty in the determination of the mass balance of polar ice sheets and the corresponding sea level contribution is the quantification of snow accumulation, mainly because field data from polar regions is available only for few, relatively small regions.

Microwave remote sensing is a well established method to gather data with a large spatial and temporal resolution from regions that are otherwise difficult to access. Since it is also independent of solar illumination and cloud cover, it is convenient to use microwave remote sensing to obtain data on the polar ice sheets. Various different approaches exist to determine snow accumulation from microwave remote sensing data. Results, however, still have large uncertainties and suffer from technical limitations.

This study will focus on the Antarctic ice sheet. Methods for snow accumulation retrieval initially developed for the Greenland ice sheet are adapted to allow a larger range of initial parameters, such as snow density and temperature, in order to match Antarctic conditions.

A combined snow microstructure / radiative transfer model is used to simulate microwave backscatter σ^0 and brightness temperatures T_B: in the area considered in this study the signals received by both active and passive radar systems come from within the snow volume. Hence, it is necessary to model snow properties realistically over the depth the sensors can resolve. These snow properties are then used as an input for a multi-layer radiative transfer model.

The synthetic signals are compared to satellite data and inversion techniques are used to retrieve snow accumulation. Results are then validated against data measured during past and recent field campaigns.

The future aim of this study is to further improve both the snow microstructure model and scattering model in order to increase the accuracy of snow accumulation data obtained by microwave remote sensing.