Geophysical Research Abstracts
Vol. 18, EGU2016-14654, 2016
EGU General Assembly 2016

Polar firn layering in radiative transfer models

Stefanie Linow (1) and Maria Hoerhold (2)

(1) Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Climate Sciences, Bremerhaven, Germany (stefanie.linow@awi.de), (2) Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Geosciences, Bremerhaven, Germany

For many applications in the geosciences, remote sensing is the only feasible method of obtaining data from large areas with limited accessibility. This is especially true for the cryosphere, where light conditions and cloud coverage additionally limit the use of optical sensors. Here, instruments operating at microwave frequencies become important, for instance in polar snow parameters / SWE (snow water equivalent) mapping. However, the interaction between snow and microwave radiation is a complex process and still not fully understood. RT (radiative transfer) models to simulate snow-microwave interaction are available, but they require a number of input parameters such as microstructure and density, which are partly ill-constrained. The layering of snow and firn introduces an additional degree of complexity, as all snow parameters show a strong variability with depth.

Many studies on RT modeling of polar firn deal with layer variability by using statistical properties derived from previous measurements, such as the standard deviations of density and microstructure, to configure model input. Here, the variability of microstructure parameters, such as density and particle size, are usually assumed to be independent of each other. However, in the case of the firn pack of the polar ice sheets, we observe that microstructure evolution depends on environmental parameters, such as temperature and snow deposition. Accordingly, density and microstructure evolve together within the snow and firn.

Based on CT (computer tomography) microstructure measurements of antarctic firn, we can show that: first, the variability of density and effective grain size are linked and can thus be implemented in the RT models as a coupled set of parameters. Second, the magnitude of layering is captured by the measured standard deviation.

Based on high-resolution density measurements of an Antarctic firn core, we study the effect of firn layering at different microwave wavelengths. By means of a sensitivity study we explore both the linked microstructure-density relation and the layer configuration in the RT model and its impact on model results.