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Improved Odin-SMR retrieval scheme of cloud ice mass in the upper tropical troposphere

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Ice clouds in the upper tropical troposphere are a main uncertainty in the prediction of the future climate. Traditional observation sensors (operating in the visible, infrared, or millimetre wave regions) are not well-suited for cloud ice mass observations. Odin-SMR (Sub-Millimetre Radiometer) is a passive limb-sounding radiometer operating at around 500 GHz, and is in operation since 2001. A first simple retrieval scheme, observations, and comparisons of cloud ice mass from Odin-SMR to similar instruments and climate models have been published. For example, the mean cloud ice mass from Odin-SMR has been shown to be in between the results of AURA-MLS and CloudSAT.

Two major retrieval uncertainties have been identified, the so called beam filling effect, and uncertainties in cloud particle size distribution (PSD). The beam filling effect arises from cloud inhomogeneity and non-linear radiative transfer effects. The PSD affects the measured signal, but the retrieval scheme of Odin-SMR primarily relies on a single frequency band. Therefore, in order to retrieve cloud ice masses from the measurements, it is necessary to make assumptions of the PSD.

In order to better address these retrieval uncertainties, a more detailed retrieval scheme is here presented. The retrieval scheme is based on combining: 1) 2-D cloud structure data from the CloudSat radar, 2) a Fourier transform algorithm program to generate stochastic 3-D cloud structures, 3) cloud microphysics data, 4) atmospheric data from ECMWF, 5) a radiative transfer Monte Carlo forward model (ARTS), 6) a Bayesian retrieval algorithm. Obtained results and comparison to other instrument results are

also presented.