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Simulation study of precipitating clouds from geostationary orbits with passive microwaves

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Precipitation is highly variable in space and time and therefore difficult to observe on a global scale with an adequate areal and time resolution. Beside the various possiblities of deriving precipitation from ground-based, airborne, and low frequency spaceborne observation systems, remote sensing in the sub-millimeter region seems to be promising. However, for the development and testing of retrieval algorithms for precipitation from observed brightness temperatures in sub-millimeter frequency region only very few observations are available. Due to this lack of measurements, we utilize the non-hydrostatic mesoscale cloud model Méso-NH and a radiative transfer model to create a test bed of realistic brightness temperatures that can be used to evaluate retrieval algorithms.

The model Méso-NH predicts the evolution of the mixing ratio of the cloud droplets, the rain drops, the pristine ice crystals, the snowflakes and graupel, which is relevant for this study since precipitating clouds encompass this great variety of hydrometeors. The model is used to provide simulations of several precipitating events representative for mid- and high-latitudes that represent the high variability of natural events in this region.

With the model output of Méso-NH, radiative tranfer calculations with a one-dimensional model for the radiative transfer in the microwave region (MWMOD) are performed. By utilization of the T-matrix method by Mishchenko this model is capable of considering multiple scattering by nonspherical particles which is necessary when either ice clouds at high frequencies or melting particles at even moderate to high frequencies are considered. With the model brightness temperatures are simulated at frequency bands up to 425 GHz currently investigated for possible use for Meteosat

Third Generation (MTG).

After the realistic brightness temperatures have been simulated and a sufficiently large test bed has been created the relation of the simulated brightness temperatures to precipitation properties, contents and phase is described. With this, the potential for precipitation retrieval from observation in the millimetre and sub-millimetre range is investigated.