Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12207, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12207
EGU General Assembly 2008

Impact of cloud model ice microphysical parameterization on simulated brightness temperatures to be used within Bayesian schemes for passive-microwave precipitation retrieval from satellite

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Most physically-based Bayesian algorithms for passive-microwave (MW) satellite precipitation retrieval make use of cloud-radiation databases (CRD's), that are composed of numerous detailed microphysical cloud profiles obtained from cloud resolving model (CRM) simulations, coupled with the corresponding simulated upwelling brightness temperatures (T_B's) – which are computed by applying radiative transfer (RT) schemes to the CRM profiles for the same frequencies and polarizations of the measuring satellite-borne MW radiometers. As a consequence, the accuracy of the precipitation retrievals depends on the CRM skill in providing consistent and realistic descriptions of the microphysical structures of precipitating clouds. It is well known that ice microphysics processes are usually oversimplified and even poorly described within the CRM microphysical schemes.

All new-generation satellite-borne MW radiometers – such as the Special Sensor Microwave Imager Sounder (SSMIS) aboard the DMSP satellites, the Advanced Microwave Sounding Unit (AMSU) aboard NOAA satellites, the AMSU Humidity Sounder for Brazil (HSB) aboard the Aqua satellite and the GPM Microwave Imager

(GMI) of the future Global Precipitation Measurement (GPM) mission – operate at several frequencies spanning the range from 10-20 GHz up to about 190 GHz. The higher frequencies (above about 80 GHz), that are more useful for precipitation retrieval over land, are very sensitive to scattering by frozen hydrometeors. Thus, it is helpful to perform modeling experiments to assess the impact of CRM ice microphysical parameterizations on the simulated high-frequency upwelling T_Bs.

In this paper, we perform such an experiment for storms that have been simulated by means of the CRM University of Wisconsin – Non-hydrostatic Modeling System (UW-NMS) using both the recently developed Spectral Habit Ice Prediction System (SHIPS) and the previous bulk ice microphysics parameterization.