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Precipitation retrieval by means of passive-microwave satellite observations and cloud model simulations: Impact of ice microphysics parameterization

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Most physically-based passive-microwave (MW) satellite precipitation algorithms make use of cloud-radiation databases (CRD's) to guide the retrieval calculations through relaxation or Bayesian solution schemes. A typical CRD is composed of numerous detailed microphysical cloud profiles obtained from cloud resolving model (CRM) simulations, coupled with the simulated upwelling brightness temperatures (T_B's) that are computed by applying radiative transfer (RT) schemes to the CRM profiles for frequencies and polarizations associated to the satellite MW radiometer measurements in use. 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) and the Advanced Microwave Sounding Unit (AMSU) that are presently flown, 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 constructive to perform

modeling experiments assessing the impact of CRM ice microphysical parameterizations on the simulated high-frequency upwelling T_B's, the generated CRD's and the precipitation retrievals.

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.