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Assessing the Vertical Inhomogeneity Impact of Ice Particle Habits in Tropical Cyclones for Microwave Radiative Transfer Simulations

Frozen hydrometeors in tropical cyclones are nonspherical. Moreover, depending on the ambient temperature and ice-supersaturation [1], the vertical inhomogeneity of ice particle habit could exist. Significant efforts have been devoted to studying the nonsphericity effect in microwave radiative transfer [e.g., 2]. However, the vertical inhomogeneity effect has not been addressed so far. In this presentation, we report our preliminary attempts on addressing the vertical inhomogeneity effect of ice habits for the microwave radiative transfer simulations. For simplification, we focus on a "two-habit-layer"scheme; namely, two different ice habits (thin plate and dendrite) are assumed to be above and below the pressure level of 325 hPa according to the Ref. [3].The aforesaid inhomogeneity scheme was implemented into the RTTOV [4], which allows for close examination of the inhomogeneity effect on the radiative transfer process. Four scenarios (thin plate, dendrite, thin plate over dendrite, and dendrite over thin plate) were considered in the simulations at 10 quasi-atmospheric-window channels ranging from 10 to 183GHZ. We found that the vertical inhomogeneity has a clear impact on the brightness temperature (BT) simulations. Specifically, the BTs over different frequency ranges demonstrate different sensitivities with respect to the vertical inhomogeneity. For real case studies, we considered the typhoon Feiyan and several other storms in the Western Pacific basin. The hydrometeor profiles predicted from the GRAPES model were used. The simulated results were compared with observations from the instruments of MWRI, MWHS and MWTS aboard on the Fengyun-3D satellite. We found that the overall performances of the forward radiative transfer simulation over multi-channels can be improved by considering the vertical inhomogeneity of ice habits.

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