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Modification of Goddard Cumulus Ensemble to Double-moment Microphysics Scheme: idealized and real cases study

Abstract

This study aims to modify Goddard Cumulus Ensemble microphysics (GCE) scheme, which is the widely used scheme for simulations and forecasts around the world, from single-moment to double-moment scheme. The upgraded scheme predicts the mixing ratios of seven species hydrometeors, and total number concentrations of hydrometeors in warm-rain processes. To examine the performance of GCE double-moment scheme (GCEDM), it was evaluated and compared to different microphysics schemes by: 1) an idealized 3D squall line test; 2) a warm-rain processes dominant real case over Taiwan. For the 3D idealized test, the result of accumulated rainfall is less in GCEDM, but the features of the dynamic, thermodynamic, and rainfall rate are similar as GCE single-moment scheme (GCESM). In addition, when calculating the total number concentration, GCEDM shows the capability to present more diversity of rain droplet sizes in both convective and stratiform regions toward reality, and this is similar as other double-moment schemes. On the other hand, the performance of quantitative precipitation forecast showed that, the GCEDM is had better forecast skill compared to the GCESM, especially for the warm-rain situation in heavy rainfall region.

Keyword

Bulk scheme, Microphysics