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Coupling WRF Double-Moment 6-class (WDM6) microphysics scheme to RRTMG radiation scheme in Weather Research Forecasting (WRF) model

Soo Ya Bae and Song-You Hong
KIAPS, Numerical model team, Korea, Republic Of (sy.bae@kiaps.org)

Radiative fluxes are mainly affected by the amount and radius of hydrometeors. Since a double-moment microphysics scheme predicts the number and volume concentrations, the effective radius of hydrometeors is easily calculated. However, WDM6 does not include the computation process for the effective radius of hydrometeors. To examine the effect of the effective radius in WDM6 on RRTMG radiative flux and meteorological phenomena in the WRF model, we adapt the method of calculating effective radius of cloud, ice, and snow in WDM6, then link between WDM6 and RRTMG schemes. For cloud, we develop the equation based on cloud size distribution used in WDM6. The shape of ice is assumed to be simple bullet and the number concentration and maximum dimension of ice are calculated with ice mixing ratio (Hong et al., 2004). Under these ice characteristics of WDM6, we adopt the equation of Mitchell et al. (1996), which is only as a function of maximum dimension of ice, to effective radius equation of ice. For snow, diameter is the same with the inverse of the slope parameter of snow. The slope parameter takes into account air temperature as well as snow mixing ratio. The effective radius of modified WDM6 is found to be smaller than that of simulation using Thompson's equations except for clouds. The combined package of the WDM6-RRTMG reduces the amount of hydrometeors, which leads to the increase of shortwave reaching ground. A comparison of simulated precipitation with TRMM (Tropical Rainfall Measuring Mission) Multi-satellite Precipitation Analysis (TMPA) observation shows better agreement when the WDM6-RRTMG with the hydrometeor linkage is introduced.