Title: “Impact of microphysics on cloud-system resolving model simulations of deep convection and global MMF”

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Abstract: The impact of representation of microphysics on limited-area high resolution (Δx ~ 1 km) cloud system model simulations of deep convection and global multi-scale modeling framework (MMF) is investigated. Limited-area modeling consists of both idealized and real case studies. Idealized simulations are based on the convective-radiative quasi-equilibrium (CRE) mimicking mean Earth conditions following Grabowski (2006, J. Climate, p. 4664). Real case simulations are based on observations from the DOE Atmospheric Radiation Measurement (ARM) Tropical Western Pacific - International Cloud Experiment (TWP-ICE). Sensitivity to aerosol (pristine versus polluted) is tested in the context of different representations of microphysics. It is found that treatment of graupel density and heterogeneous freezing of cloud droplets have a large impact on convective dynamics as well as anvil microphysical and macrophysical properties, and hence cloud radiative forcing. Treatment of rain size distribution, which impacts rain evaporation rate, also has important consequences. In the CRE experiments, it is found that using a two-moment microphysics scheme that predicts both rain mixing ratio and number concentration reduces evaporation relative to a one-moment microphysics scheme predicting mixing ratio only. The resulting differences in low-level cooling lead to much different Bowen ratios (ratio of latent and sensible surface turbulent heat fluxes) in the quasi-equilibrium state. Finally, global MMF simulations using different microphysics parameterizations will be compared.