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The impact of different parameterizations of the compensatory feedback between microphysical processes on squall line development

Jian-Wen Bao (1), Sara A. Michelson (2,1), Evelyn D. Grell (2,1)

(1) NOAA/ESRL/PSD, Boulder, CO, United States (jian-wen.bao@noaa.gov), (2) CIRES/University of Colorado, Boulder, CO, United States

The total local change of a hydrometeor due to parameterized microphysical processes is made of positive and negative terms, indicating that the tendency for a change in one microphysical process is compensated for by the response of another. This means that there is a compensatory feedback between interacting processes governing the production of clouds and precipitation, just like what takes place in nature. The sum of the process terms associated with such a compensatory feedback reduces the impact that individual terms would have if they acted alone.

In this study, the sensitivity of three commonly-used microphysics schemes of various complexity that are available in the Weather Research and Forecasting Model (WRF) to perturbations of individual processes parameterizations are investigated and compared in the simulation of an idealized 2-D squall line. Diagnoses of the parameterized pathways for hydrometeor production microphysics budget analysis reveal that the compensatory feedback between microphysical processes are not the same for each scheme. This compensatory feedback makes the response of a parameterized microphysical process to a given forcing weaker than what would have been expected had the interaction between all the processes not been accounted for. This suggests that if uncertainties exist in all the parameterized terms of a microphysics scheme, this compensatory feedback allows for a great amount of room for the parameterized terms to be tuned to produce the desirable net microphysics effect, such as the net heating.