Evaluating the impact of aerosols on deep convection and monsoon precipitation simulated by a multi-moment density-predictable bulk microphysics scheme

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The impact of aerosols on convective clouds and precipitation has been extensively evaluated by many numerical studies. Yet, many important microphysical properties of ice-phase hydrometeors that can be influenced by aerosols are still crudely treated in most of current microphysics schemes. A multi-moment four-ice (pristine ice, aggregate, graupel, and hail) bulk microphysics scheme of NTU (National Taiwan University) has been implemented into the WRF (Weather Research and Forecasting) model version 3.5.1 to improve the microphysical representations. The NTU scheme includes four major improvements over current schemes in WRF: (1) hydrometeors' size distribution based on a triple-moment (the zeroth, second, and third moments) closure method, (2) the shapes of pristine ice and snow aggregate evolve in a realistic manner, (3) apparent densities of pristine ice, aggregate, and graupel are allowed to evolve freely, and (4) calculation of fall speeds of frozen particles considered the crystal shape and density. Two field-campaign cases were selected for simulating the impact of aerosols: a deep convection during the MC3E (Mid-latitude Continental Convective Clouds Experiment) in the U.S. and a monsoon precipitation event during SoWMEX/TiMREX (Southwest Monsoon Experiment/Terrain-Influenced Monsoon Rainfall Experiment) in Taiwan. Preliminary results revealed that the NTU scheme is able to capture more realistically the leading features of radar reflectivity and precipitation in these two cases. Also, sensitive comparisons indicated that aerosol effect tends to enhance convective region and alter the initiation of surface rainfall through the influence of ice-particle shape and density. Further evaluations and mechanism analyses will be presented.