Convective invigoration: untangling aerosol impacts on deep convection

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Abstract:

Formation and growth of cloud and precipitation particles (“cloud microphysics”) affect cloud dynamics and such macroscopic cloud properties as the mean surface rainfall, cloud cover, and liquid/ice water paths. However, separation the dynamical impact (i.e. convective invigoration) from purely microphysical effects (e.g. increased rainfall due to more efficient conversion of cloudcondensate into precipitation) is difficult using traditional cloud-scale simulations and virtually impossible in observations.
Traditional cloud simulations are not reliable because of the natural variability of a cloud or cloud field that is affected by the feedback between cloud microphysics and cloud dynamics. This is because simulated clouds evolve differently when a change to the cloud microphysics in introduced. A novel modeling methodology, microphysical piggybacking, was recently developed to clearly separate microphysical and dynamical impacts. This talk will illustrate misconceptions concerning aerosol effects, discuss the piggybacking technique, and present model simulations using piggybacking that allow clear separation of dynamical and microphysical effects. The new methodology clearly shows that microphysical effects dominate aerosol impacts on deep convection with dynamical effects playing less significant role. In particular, model results question the postulated dynamical invigoration of deep convection in polluted environments.