Impact of Aerosols on Convective Clouds and Precipitation

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Aerosols are a critical factor in the atmospheric hydrological cycle and radiation budget. As a major agent for clouds to form and a significant attenuator of solar radiation, aerosols affect climate in several ways. Current research suggests that aerosols have a major impact on the dynamics, microphysics, and electrification properties of continental mixed-phase convective clouds. In addition, high aerosol concentrations in urban environments could affect precipitation variability by providing a significant source of cloud condensation nuclei (CCN). Such pollution effects on precipitation potentially have enormous climatic consequences both in terms of feedbacks involving the land surface via rainfall as well as the surface energy budget and changes in latent heat input to the atmosphere. Basically, aerosol concentrations can influence cloud droplet size distributions, the warm-rain process, the cold-rain process, cloud-top heights, the depth of the mixed-phase region, and the occurrence of lightning.

Recently, many cloud resolution models (CRMs) have been used to examine the role of aerosols on mixed-phase convective clouds. These modeling studies have many differences in terms of model configuration (two- or three-dimensional), domain size, grid spacing (150–3000 m), microphysics (two-moment bulk, simple or sophisticated spectral-bin), turbulence (1^{st} or 1.5 order turbulent kinetic energy (TKE)), radiation, lateral boundary conditions (i.e., closed, radiative open or cyclic), cases (isolated convection, tropical or mid-latitude squall lines) and model integration time (e.g., 2.5 to 48 hours). Among these modeling studies, the most striking difference is that cumulative precipitation can either increase or decrease in response to higher concentrations of CCN. In this presentation, we review past efforts and summarize our current understanding of the effect of aerosols on convective precipitation processes. Specifically, this paper addresses the following topics:

observational evidence of the effect of aerosols on precipitation processes, and results from (CRM) simulations. Note that this presentation is mainly based on a recent paper published in *Geophy. Rev.* (Tao et al. 2012).