Aerosol-Cloud-Lightning Interactions

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Thunderstorms that produce lightning are common over continental regions, especially in the warmer seasons. Their lightning is created by separation of charge in re-bounding collisions between ice and large ice particles such as hail or graupel. The charge separated in each collision depends on the sizes of the colliding particles and also on the liquid water content in mixed-phase conditions. The number of re-bounding collisions is curbed by wet growth of hail and is boosted by ice numbers determined by aerosol activation. Such quantities, which determine total charge separated, are predicted to be sensitive to aerosol conditions of composition and loading.

In the presentation, a cloud-resolving model with hybrid bin/bulk microphysics and a semi-prognostic aerosol component is described. Simulations of thunderstorms observed in a field campaign ('STEPS') over the US High Plains in summer-time are compared with aircraft observations. Sensitivity tests are shown revealing the microphysical mechanisms for the effects from extra soluble and insoluble aerosol particles on lightning. Liquid water content, controlled by the aerosol activation, is found to be a crucial parameter for the aerosol-cloud-lightning interaction.