Effect of aerosol on the electrical structure of thunderstorms

Cloud Electrification Processes

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Numerical simulations are performed to investigate the effect of aerosol particles on the charge structure in thunderstorm clouds. A two-dimensional (2-D) cumulus model with electrification scheme including non-inductive and inductive charge separation is used. The concentration of aerosol particles with distribution fitted by superimposing three log-normal distribution function rises from 100 to 5000 cm^{-3}. The results show that increase in the concentration of aerosol particles results in stronger competition between cloud droplets activation and ice crystal formed, leading to reduction of ice crystal concentration, and the upper positive charge coming from non-inductive ice crystal charging will reduce gradually as aerosol concentration transformed from low to high. When aerosol concentration is changed from 100 to 1000 cm^{-3}, more cloud droplets and graupel via inductive charging leads to the middle negative charge and lower positive charge increases. At aerosol concentration of 1000 cm^{-3}, the enhanced lower positive charge are responsible for the reversal of vertical electric field direction in the lower part of thundercloud, resulting in the charge structure in the most vigorous stage of convection development tends to be multilayer with a relative week negative charge arising under upper tripole. Graupel production increases not obviously at aerosol concentration>1000 cm^{-3},but charge separation from inductive charging is reduced, because the environmental electric field produced by upper dipole decrease with aerosol concentration increasing. At high aerosol concentration of 5000 cm^{-3}, the charge structure changes to be an inverted tripole with upper positive charge disappearing, and charge in thundercloud is weaken.