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Aerosol impacts on radiative and microphysical properties of clouds and precipitation formation

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Abstract

Through modifying the number concentration and size of cloud droplets, aerosols have intricate impacts on radiative and microphysical properties of clouds, which together influence precipitation processes. Aerosol-cloud interactions for a mid-latitude convective cloud system are investigated using a two-moment aerosol-aware bulk microphysical scheme implemented into the Weather Research and Forecasting (WRF) model. Three sensitivity experiments with initial identical dynamic and thermodynamic conditions, but different cloud-nucleating aerosol concentrations were conducted. Increased aerosol number concentration has resulted in more numerous cloud droplets of overall smaller size, through which the optical properties of clouds have been changed. While the shortwave cloud forcing is significantly increased in more polluted experiments, changes in the aerosol number concentration have negligible impacts on the longwave cloud forcing. For the first time, it is found that polluted clouds have higher cloud base heights, the feature that is caused by more surface cooling due to a higher shortwave cloud forcing, as well as a drier boundary layer in the polluted experiment compared to

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