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Impacts of Anthropogenic Aerosols on Springtime Mesoscale Convective Systems over Southern China

Lijuan Zhang[1] and Tzung-May Fu[2,3]
[1]Department of Atmospheric and Oceanic Sciences, School of Physics, Peking University, beijing, China (ljzhang2015@pku.edu.cn)
[2]School of Environmental Science and Engineering, Southern University of Science and Technology, Shenzhen, Guangdong Province, China (fuzm@sustech.edu.cn)
[3]Shenzhen Institute of Sustainable Development, Southern University of Science and Technology, Shenzhen, Guangdong Province, China (fuzm@sustech.edu.cn)

Precipitation over Southern China for the month of April, which is largely associated with mesoscale convective systems (MCSs), has declined significantly in recent decades. It is unclear how this decline in precipitation may be related to the concurrent increase in anthropogenic aerosols in the atmosphere over this region. Using observation analyses and model simulations, we showed that anthropogenic aerosols significantly reduced MCS occurrences by 21% to 32% over Southern China in April, leading to less and weaker rainfall. Half of this MCS occurrence reduction was due to the direct radiative scattering and the indirect enhancement of non-MCS liquid cloud reflectance by aerosols, which stabilized the regional atmosphere. The other half of the MCS occurrence reduction was due to the microphysical and dynamical responses of the MCS to aerosols. The model simulations showed that the higher levels of aerosols and the resulting increase in liquid cloud droplets both enhance the scattering of sunlight, cool the surface, and stabilize the lower atmosphere. As a result, the occurrence of strong convective systems is suppressed, leading to decreased rainfall in April over Southern China. Our results demonstrated the complex effects of aerosols on MCSs via impacts on both convective systems and non-convective cloud systems in the regional atmosphere.