Changes in stratiform clouds of mesoscale convective complex introduced by dust aerosols

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Abstract

Aerosols influence the earth's climate through direct, indirect, and semi-direct effects. There are large uncertainties in quantifying these effects due to limited measurements and observations of aerosol-cloud-precipitation interactions. As a major terrestrial source of atmospheric aerosols, dusts may serve as a significant climate forcing for the changing climate because of its effect on solar and thermal radiation as well as on clouds and precipitation processes. Latest satellites measurements enable us to determine dust aerosol loadings and cloud distributions and can potentially be used to reduce the uncertainties in the estimations of aerosol effects on climate. This study uses sensors on various satellites to investigate the impact of mineral dust on cloud microphysical and precipitation processes in mesoscale convective complex (MCC). A trans-Atlantic dust outbreak of Saharan origin occurring in early March 2004 is considered. For the observed MCCs under a given convective strength, small hydrometeors were found more prevalent in the dusty stratiform regions than in those regions that were dust free. Evidence of abundant cloud ice particles in the dust regions, particularly at altitudes where heterogeneous nucleation of mineral dust prevails, further supports the observed changes of clouds and precipitation. The consequences of the microphysical effects of the dust aerosols were to shift the size spectrum of precipitation-sized hydrometeors from heavy precipitation to light precipitation and ultimately to suppress precipitation and increase the lifecycle of cloud systems, especially over stratiform areas.