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IMPORTANCE OF ADIABATICITY IN EVALUATING AEROSOL INDIRECT EFFECT BY GROUND-BASED REMOTE SENSING

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ABSTRACT

Aerosol indirect radiative forcing of climate change is considered the most uncertain forcing of climate change throughout the industrial period. Our previous study (Kim et al., JGR, 2003) indicates that the day-to-day variation of the cloud drop effective radius (re) determined from the ground-based remote sensing at the Southern Great Plains site is weakly associated with the variation in aerosol loading as characterized by light-scattering coefficient at the surface. In this work, we extend the previous study by examining the relationship of aerosol cloud interactions with adiabaticity (ratio of the observed liquid water path (LWP) to the corresponding adiabatic LWP). The correlation between aerosol light scattering coefficient and effective radius is much greater in adiabatic clouds with little entrainment and mixing than in subadiabatic clouds. Adiabaticity is thus an important factor that determines the cloud optical depth, but of course much less important than the cloud physical thickness (or LWP). The sensitivity of re to adiabaticity is almost comparable to the sensitivity to cloud thickness and cloud drop number concentration, which is indicative of importance of adiabaticity in understanding aerosol indirect effects. The effects of entrainment and mixing processes on the relationship of re to adiabaticity are examined using a combination of observations and analytical framework.