

A long-term study of aerosol-cloud interactions and their radiative effect at mid latitude and tropical continental sites

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Empirical estimates of the microphysical response of cloud droplet size distribution to aerosol perturbations are commonly used to constrain aerosol-cloud interactions in climate models. Instead of empirical microphysical estimates, here macroscopic variables are analyzed to address the influences of aerosol particles and meteorological descriptors on instantaneous cloud radiative effect and albedo of shallow liquid water clouds. Long-term ground-based measurements from the Atmospheric Radiation Measurement (ARM) Program over the Southern Great Plains and Manacapuru are used. A broad statistical analysis was performed, using coincident measurements of low clouds, aerosol and meteorological properties. Two cases representing conflicting results regarding the relationship between the aerosol and the cloud radiative effect were selected and studied in greater detail. Microphysical estimates are shown to be very uncertain and to depend strongly on the methodology, retrieval technique, and averaging scale. For both continental sites studied, the results indicate that the influence of aerosol on shallow cloud radiative effect and albedo is weak and that macroscopic cloud properties and dynamics play a much larger role in determining the instantaneous cloud radiative effect compared to microphysical effects.