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Entrainment and mixing mechanism in monsoon clouds

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Entrainment and consequent mixing impacts the cloud microphysical parameters and droplet size distribution (DSD) significantly which are very important for cloud radiative properties and the mechanism for first rain drop formation. The entrainment and mixing mechanisms are investigated in this study using in situ observations in warm cumulus clouds over monsoon region. Entrainment is discussed in the framework of the homogeneous and inhomogeneous mixing concepts and their effects on cloud droplet size distribution, number concentration, liquid water content and mean radius are described.

The degree of homogeneity increases with droplet number concentration and adiabatic fraction, indicating homogeneous type mixing in the cloud core where dilution is less. Inhomogeneous mixing is found to be a dominating process at cloud edges where dilution is significant. Cloud droplet size distribution (DSD) is found to shift towards lower sizes during a homogeneous mixing event in the cloud core whereas spectral width of DSD decreases due to inhomogeneous mixing at cloud edges. Droplet size spectra suggests that largest droplets are mainly formed in the less diluted cloud core while diluted cloud edges have relatively smaller droplets, so that raindrop formation occurs mainly in the core of the cloud.

The origin of the entrained parcels in deep cumulus clouds is investigated using conservative thermodynamical parameters. The entrained parcels originate from a level close to the observation level or slightly below through lateral edges. Cloud edges are significantly diluted due to entrainment of sub-saturated environmental air which can penetrate several hundred meters inside the cloud before it gets mixed completely with the cloud mass. Less diluted parcels inside the cloud core originates from a level much below the cloud base height. Penetrating downdraft from cloud top is seldom observed at the observation level and strong downdrafts may be attributed to in-cloud oscillation of parcels.