Empirical Relationship between Entrainment Rate and Microphysics in Cumulus Clouds
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References

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1 Background
- Entrainment of dry air into clouds is essential to warm-rain initiation and cloud feedbacks in climate models.
- Entrainment rate is critical for convection and cloud microphysics.
- But how cloud microphysics are affected by entrainment rate is poorly understood.

2 Data and Approach
(1) Droplet Size distributions in cumulus clouds observed by Cloud and Aerosol Spectrometer (CAS) during RACORO.
(2) Temperature, water vapor, vertical velocity.

3 Relationships

Entrainment rate is estimated for each growing cumulus cloud with aircraft observations during RACORO with the approach developed by Lu et al. [2012b].

These relationships suggest that homogeneous mixing dominates in the growing cumulus clouds during RACORO.

4 Droplet Spectra

Larger entrainment rate corresponds to an increase in small droplets and a decrease in big droplets, affirming the dominance of homogeneous mixing.

5 Conclusions
- Entrainment rate is estimated for each individual growing cumulus cloud with aircraft observations during RACORO.
- Homogeneous mixing dominates in these shallow cumulus clouds.

Figure 1. Schematic diagram of the mixing fraction Approach used to estimate entrainment rate [Lu et al., 2012a].

Figure 2. Relationships between microphysical properties binned according to entrainment rate (\(\lambda\)) in 186 growing cumulus clouds during RACORO.

Figure 3. Cloud droplet size distributions as a function of entrainment rate (\(\lambda\)) in 186 growing cumulus clouds during RACORO.