Empirical Relationship between Entrainment Rate and Microphysics in Cumulus Clouds

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1 Background

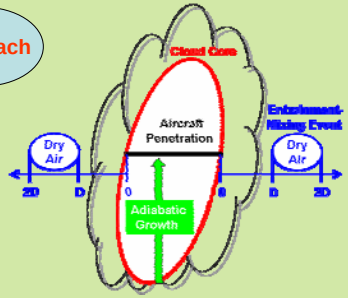
- Entrainment of dry air into clouds is essential to warm-rain initiation and cloud feedbacks in climate models.
- Entrainment rate is critical for convection and cloud microphysics.
- But how cloud microphysics are affected by entrainment rate is poorly understood.

2 Data and Approach

Data

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

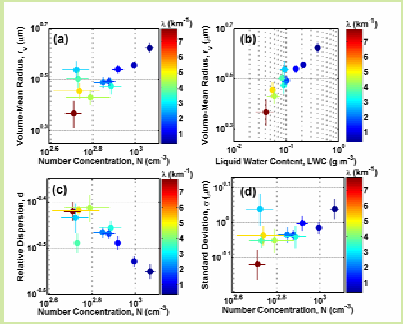
Approach



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

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

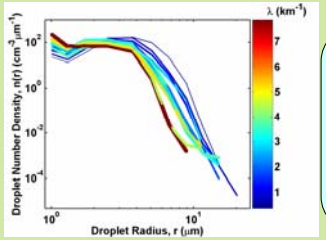
3 Relationships



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

Figure 2. Relationships between microphysical properties binned according to entrainment rate (λ) in 186 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.

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

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.

* References

Lu, C., et al., 2012a, *GRL*, 39, L20812.
Lu, C., et al., 2012b, *GRL*, 39, L04802.

* Acknowledgement

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