A long-term study of aerosol-cloud interactions at a mid-latitude and a a tropical continental site

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Aerosol-cloud interactions



Cloud optical thickness



Motivation

Changes in Cloud Microphysics



Cloud Albedo Change

Goal

Clarify how aerosol and meteorological properties impact the cloud radiative forcing, using ground-based observations.

Previous approaches

Microphysical responses



Proposed approach



Methodology

- Coincident ground-based measurements of clouds, aerosol and meteorological properties from ARM deployments were used.
- Ice crystals and precipitation were avoided by selecting only low nondrizzling clouds.
- The measurements were taken at 1-minute resolution.



Measurements and retrievals





Properties analyzed

RELATIVE CLOUD RADIATIVE EFFECT



Non-dimensional measure for the surface cloud radiative effect.

AEROSOL INDEX



PROXY FOR TURBULENCE

$$w'^2 = [w - w_0]^2$$

 W_0 is the mean vertical velocity at the cloud base within 1 hour from each measurement.

DECOUPLING INDEX

$$D_{i} = \frac{h_{CB} - LCL}{h_{CB}}$$
Indicates how
well-mixed the
boundary layer
is.

LOWER TROPOSPHERIC STABILITY



Statistical Distributions: SGP x MAO



How do different properties influence the rCRE?



Aerosol x LWP signals on rCRE



Case study 1: prcRE,Ai Positive



Case study 1: prcRE,Ai Positive

Jan-09-2006



Case study 2: prcRE,Ai Negative



Case study 2: prcRE,Ai Negative

Apr-26-2006



Correlation between correlations

Are we actually seeing the LWP signal instead of the aerosol signal in rCRE?



N = 323 days

N = 77 days

Usually, if the aerosol index and LWP are correlated positively (negatively), the correlation between rCRF and aerosol index is positive (negative). Summary

1) The influence of aerosol on cloud radiative forcing is weak

 macroscopic cloud properties and dynamics play a much larger role in cloud RF compared to microphysical effects.

2) Microphysical metrics to estimate aerosol-cloud interaction are very uncertain.

3) We propose looking at aerosol indirect effects using higher-order properties like rCRE, LWP, fc, Cloud albedo.

Thank you!

Obrigada!







