GoAMAZON

Cloud-Aerosol-Precipitation Interaction (CAPI) Topics

Graham Feingold (representing CAPI)

Pöschl, Martin, et al., Science, 2010
Cloud Systems

- Detailed processes
- Feedbacks between components
- System wide behavior

Horizontal Gradients in
- land surface
- aerosol (heating)
- temperature, moisture

Vertical gradients in
- aerosol
- temperature, moisture
GoAMAZON Objectives

1. Aerosol effects on scattered cumulus
   - emphasis on aerosol radiative effect by biomass burning
2. Aerosol effects on deep convective clouds
   - precipitation
3. Improvement of parameterization of aerosol-cloud interactions in climate models

CAPI Objectives

1. Improved understanding and treatment of
   - aerosol effects on shallow and deep cumulus clouds
   - aerosol effects on precipitation
   - Aerosol absorption
2. Physically based/consistent estimates of ACI in GCMs based on observations and cloud resolving models or LES
Aerosol-Cloud-Precipitation Issues

Requires solid knowledge of the aerosol lifecycle, the cloud lifecycle, and the interacting system.

**ARM Mobile Facility One - Typical Deployment**

- **Aircraft:**
  - G-1
  - HALO

- **Satellites:**
  - Polar orbiting
  - Geostationary

- **Brazilian Instruments**

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**Revised March 2011**
Aerosol-Cloud-Precipitation Issues

Traditional ASR/ARM focus has been on combining remote measurements of aerosol and cloud to provide metrics for aerosol-cloud interactions (ACI) in a column.

\[ N_d \quad r_e \]

\( N_{dcn}, N_a, \text{extinction} \)

Feingold et al. 2003

Garrett et al. 2004
Aerosol-Cloud-Precipitation Issues

Traditional ASR/ARM focus has been on combining remote measurements of aerosol and cloud to provide metrics for aerosol-cloud interactions (ACI) in a column

1. Useful, but consider a broader view!
2. ACI occurs in a constantly readjusting environment
   - Monitor and understand the thermodynamic environment!
3. Consider potential for aerosol-induced changes in cloud field properties
   - Cloud fraction, depth, organization, cloud size distribution, distances between clouds
Land-surface Drivers

a. Preference for shallow cumulus over deforested areas vs. undisturbed forest (ASTER, Aug 29 2006)

b. Shallow cumulus across the Amazon basin with the exception of the rivers (MODIS, Sep 3, 2009)
Aerosol gradient drivers

Absorbing aerosol suppresses clouds

- Stabilization
- Suppression of surface fluxes
- Microphysical influences on droplets
Deep convective clouds

• Aerosol-induced convective “invigoration”
  – Satellite studies see higher cloud tops in polluted conditions
  – Many models show it too; when, why, why not?
  – Relevant timescales?

• Does the nature of precipitation change?
  – Spatial distribution, intensity
  – Shifts in PDF of rainrates (observed and modeled)

• Role of shear?

• What can we learn about wet scavenging?

• Crucial roll for scanning precipitation radar (pending NSF approval)