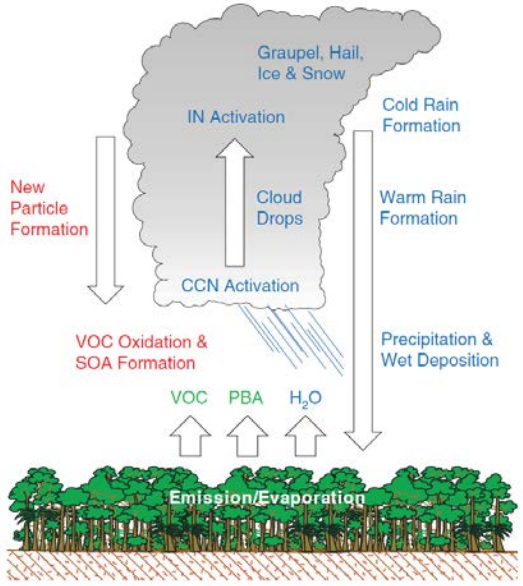
GoAMAZON

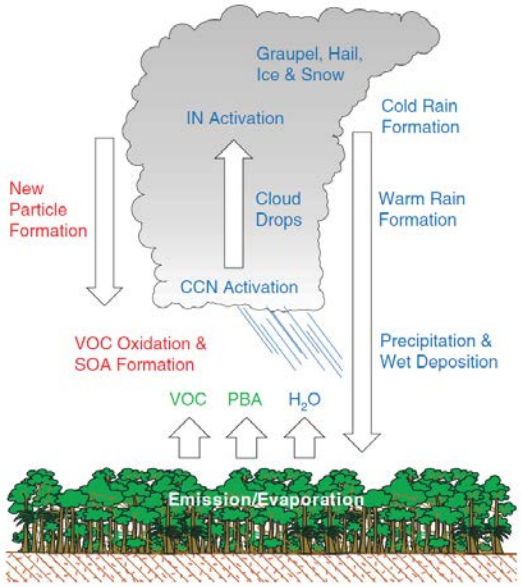
Cloud-Aerosol-Precipitation Interaction (CAPI) Topics

Graham Feingold (representing CAPI)



Pöschl, Martin, et al., *Science*, 2010

Cloud Systems



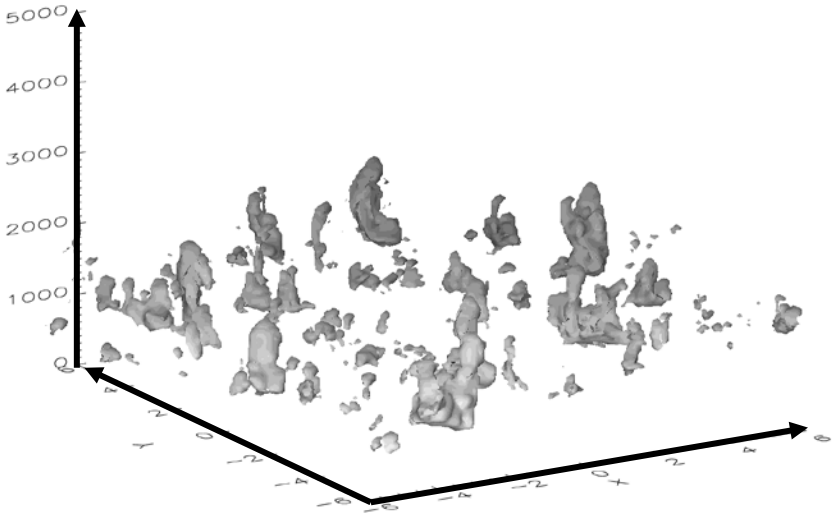
- *Detailed processes*
- *Feedbacks between components*
- *System wide behavior*

Horizontal Gradients in

- land surface
- aerosol (heating)
- temperature, moisture

Vertical gradients in

- aerosol
- temperature, moisture



GoAMAZON Objectives

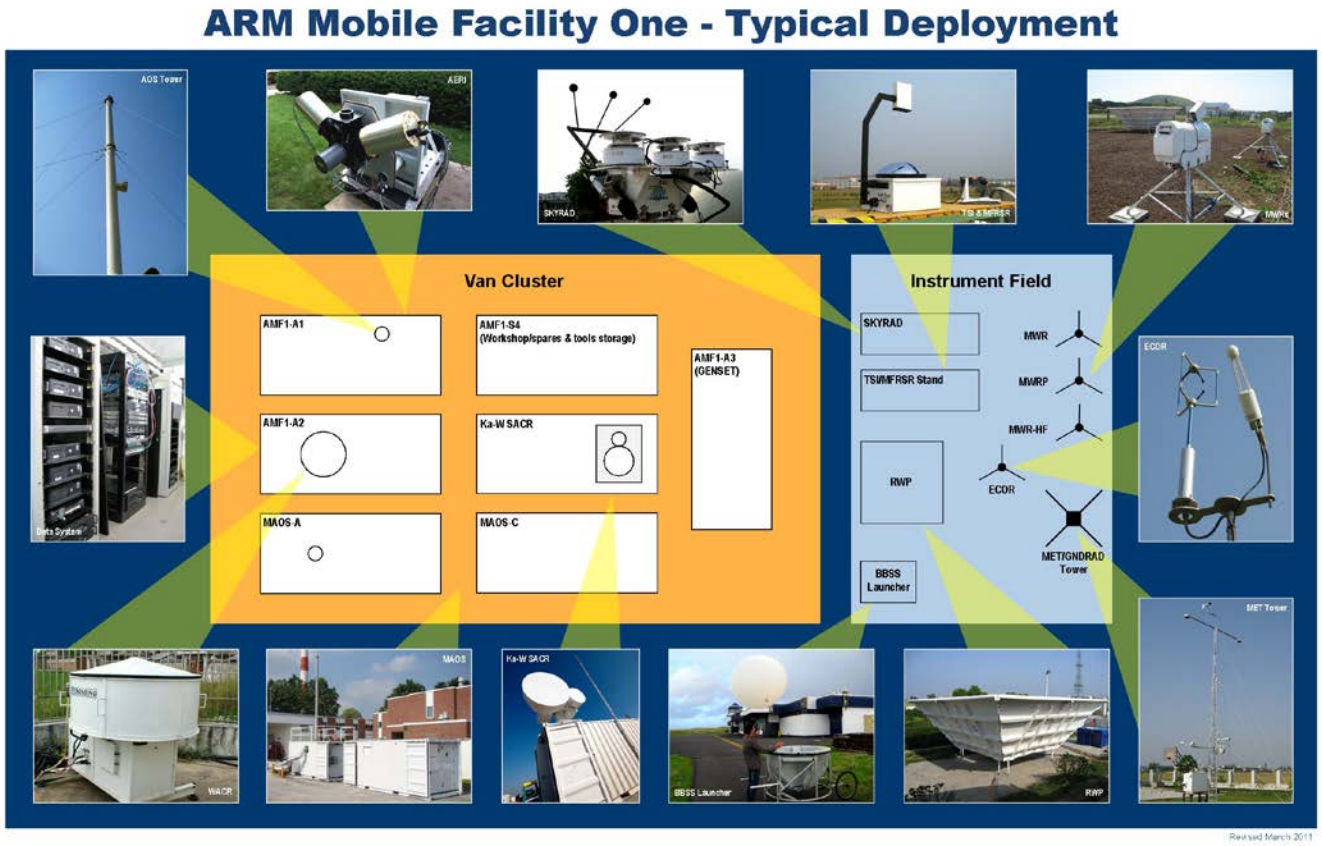
1. Aerosol effects on scattered cumulus
   - *emphasis on aerosol radiative effect by biomass burning*
2. Aerosol effects on deep convective clouds
   - *precipitation*
3. Improvement of parameterization of aerosol-cloud interactions in climate models

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



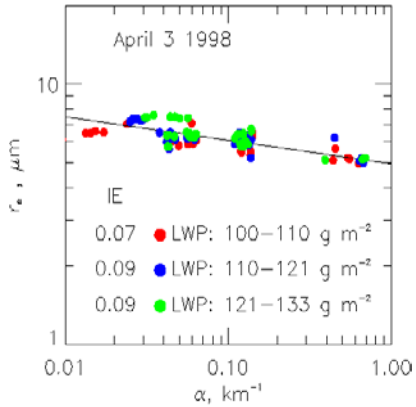
Aircraft:
G-1
HALO

Satellites:
Polar orbiting
Geostationary

Brazilian Instruments

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

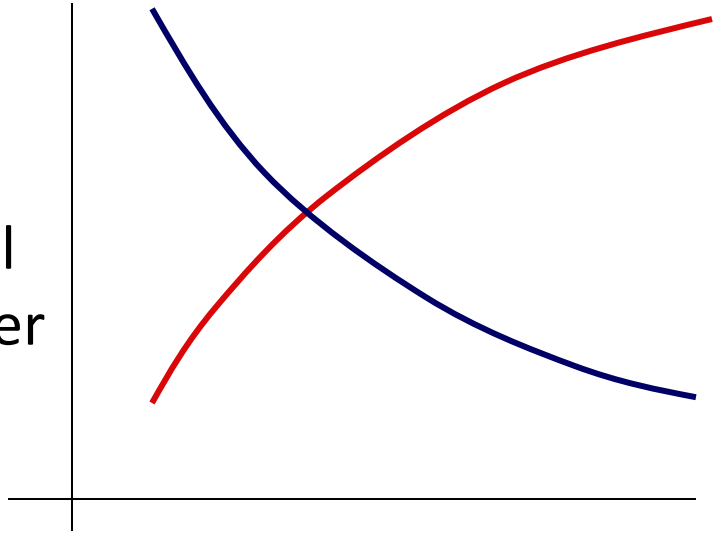


Feingold et al. 2003

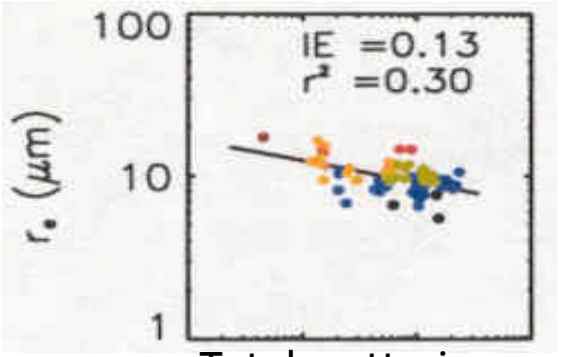
N_d

r_e

Cloud μphysical parameter



Aerosol Parameter (N_{ccn}, N_a, extinction)



Total scattering

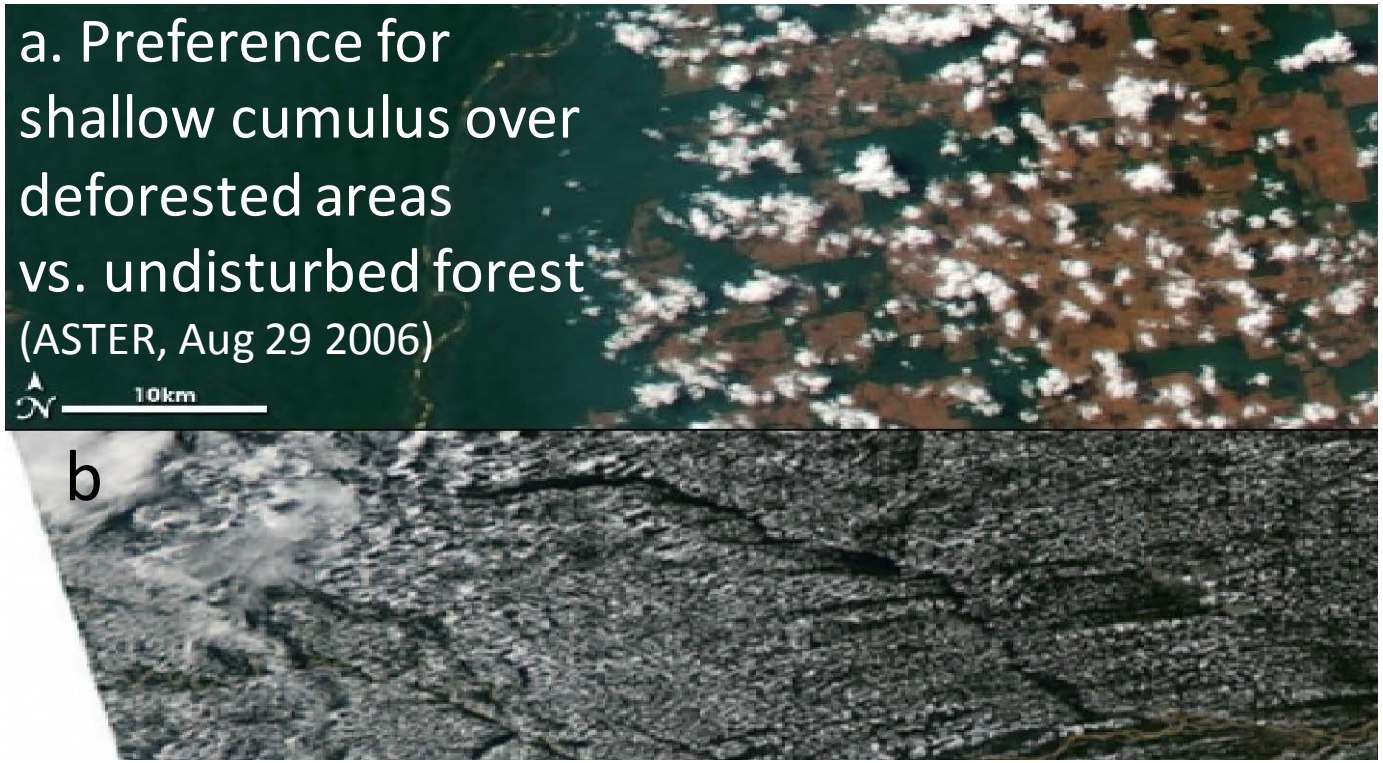
Garrett et al. 2004

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*

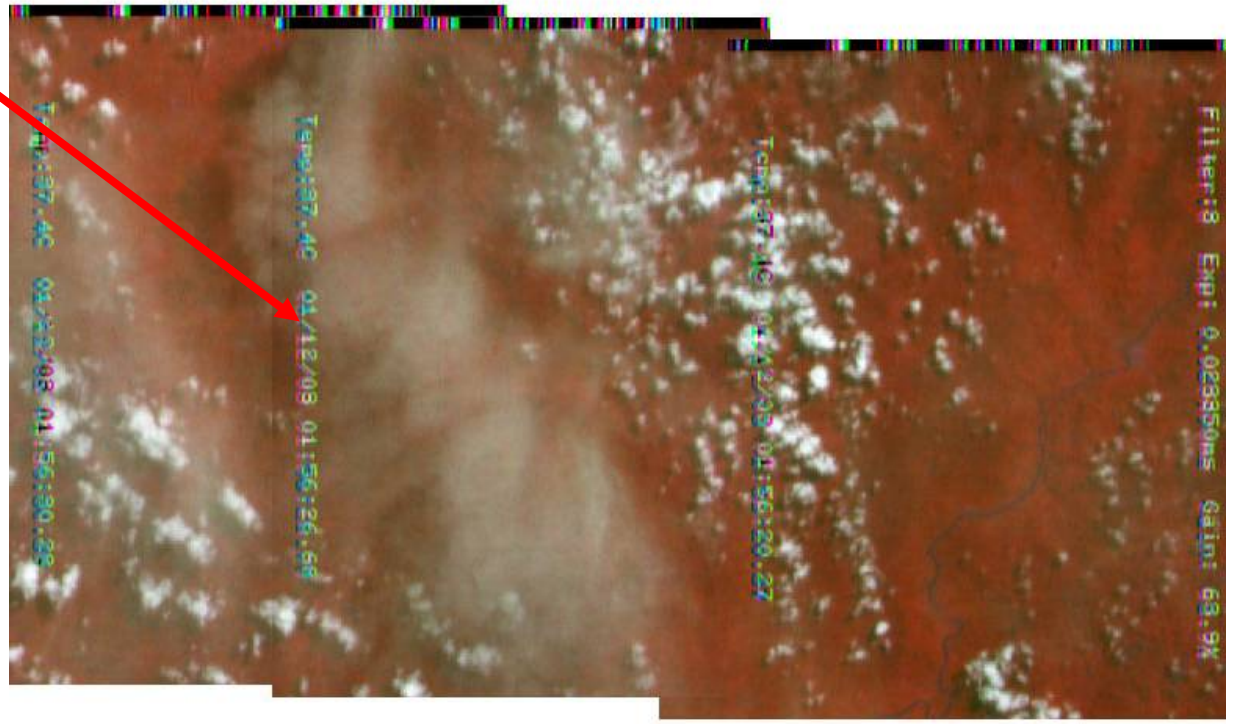
Land-surface Drivers



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

Aerosol gradient drivers

Absorbing aerosol suppresses clouds



Columbia Shuttle
January 2003

- 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)