Study of the Effects of Dust Radiative and Microphysical Properties on Precipitation and Energy Budget Using A-Train Satellite Measurements and A Cloud Resolving Model

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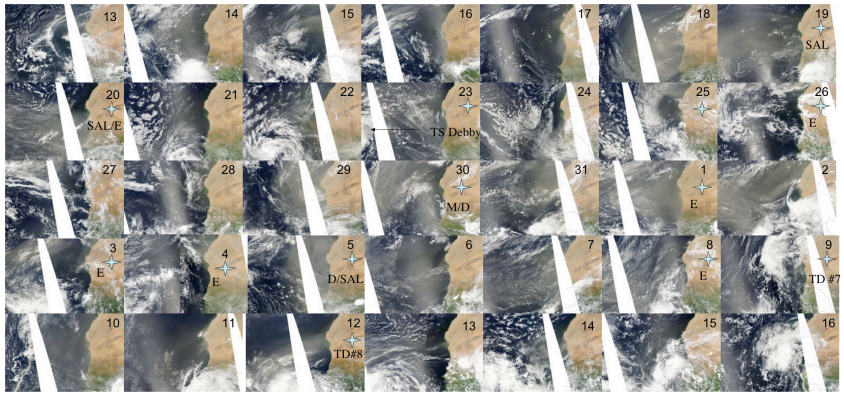
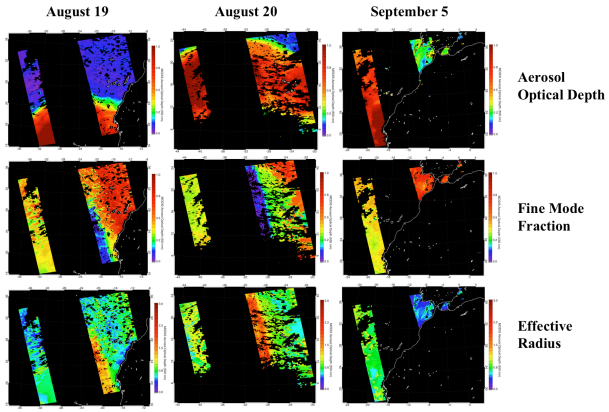
Calendar of MODIS RGB Images (August 15 - September 15, 2006)



MODIS Aerosol Products



Proposed Research

Objectives

The proposed end-to-end simulations on precipitation and energy budget under ambient dusty environment include the following specific objectives:

- Dust radiative and microphysical properties on precipitation to address efficiency of cloud-precipitation processes near the source, during transport, and downwind.
- Dust-cloud interaction in both convective and non-convective clouds to study its impact on cloud lifetime.
- Energy budget analysis in cloud-free condition and region in favor of tropical storm development and intensification.

Approaches

(1) Dust Properties from A-Train (MODIS, AIRS, OMI) Measurements

- Dust aerosol optical depth, fine-mode fraction, and effective radius (MODIS)
- Dust height (MODIS and AIRS)

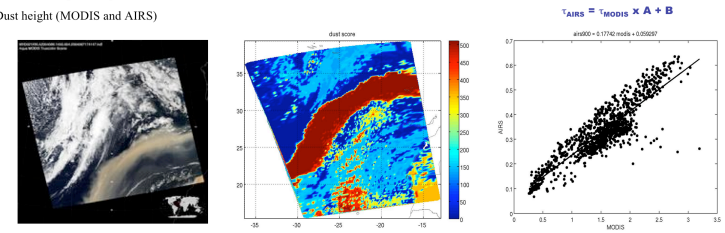


Figure 1. Case study of a dust plume originated from Sahara Desert on March 6, 2006 (left panel: MODIS RGB; middle panel: AIRS dust optical depth; right panel: linear regression AIRS- versus MODIS-derived dust optical depth, for which the intercept (B) that is most sensitive to altitude can be used to derive dust (top layer) height when is set to zero.

- Dust coverage and single scattering albedo (OMI)

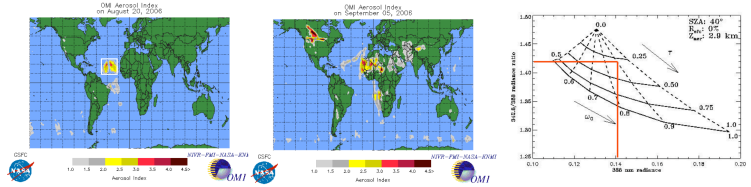


Figure 2. OMI aerosol index for August 20 and September 5, 2006 (left and middle panels). Dust optical depth and single scattering albedo are estimated based upon the ratio of radiances at 343 over that of 388 nm, 388 nm radiance (right panel).

Dust Height Derivation (August 19, 2006)

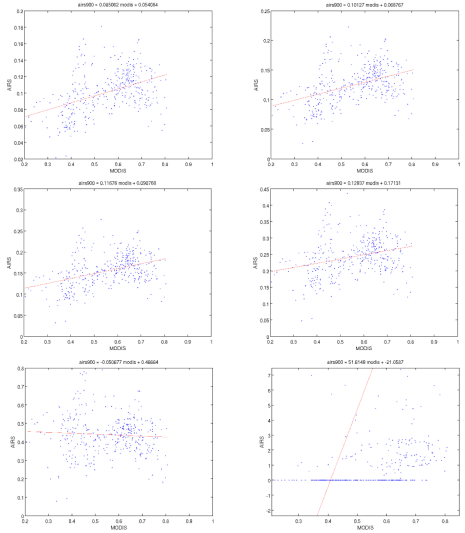


Figure 3. Linear regression of AIRS- VS. MODIS-derived dust optical depths on August 19, 2006. Results are derived assuming the top/bottom layer dust height (mb): 500/600 (top left), 550/650 (top right), 590/690 (middle left), 650/750 (middle right), 700/800 (upper left), and 800/900 (upper right).

(2) GCE Model Simulations (ongoing)

- GCE 2-D model-simulated vertical distributions of cloud water, rain, cloud ice, snow, and graupel.
- Surface rain rate between clean and dirty environments