Dust properties derived from MFRSR data in Niamey

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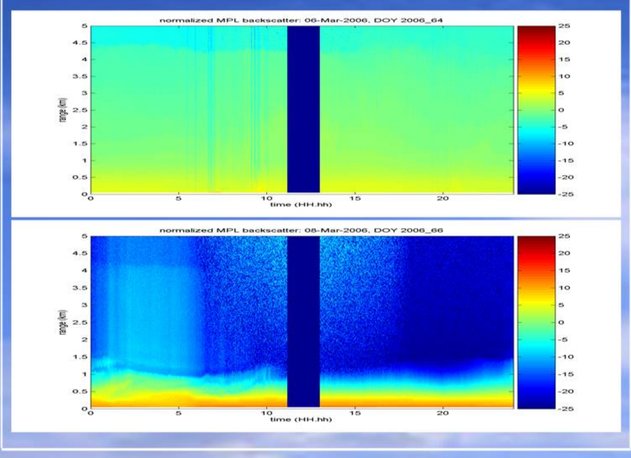
ARM

Motivation

- **Saharan dust is the main source of dust over the globe; its radiative effect has long been the subject of intensive studies.**
- **Aerosol radiative forcing is a function of aerosol optical depth (AOD), single-scattering albedo (SSA) and asymmetry parameter (AP).**
- **How large is the temporal/spectral variability of aerosol optical properties (AOD, SSA, AP) under a variety of conditions (clean vs dust storm)?**

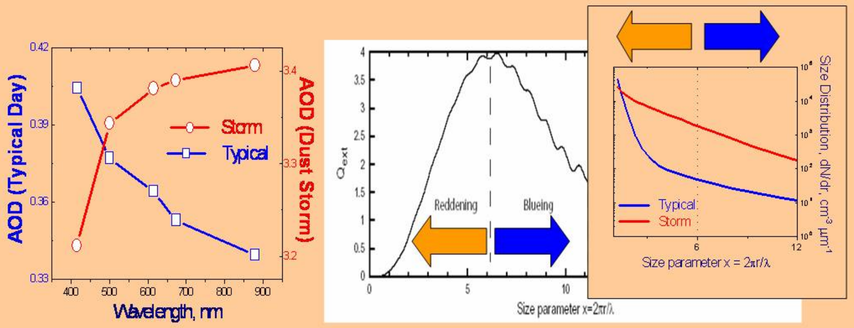
MPL images for typical day (top) and dust storm (bottom)



Summary

- **We estimated the AOD, SSA and AP of Saharan dust from MFRSR data by using an updated version of our retrieval technique (*Kassianov et al.*, 2005).**
- **AOD evolves strongly during dust storm (from 0.3 to 3.4). Spectral dependence of AOD is determined mostly by the mean size of aerosol particles. Spectral behavior of SSA suggests that Saharan dust includes various clays, such as kaolinite (blue-absorbing aerosol).**
- **Calculated broadband fluxes are comparable (~10%) to those obtained from measurements (not shown).**

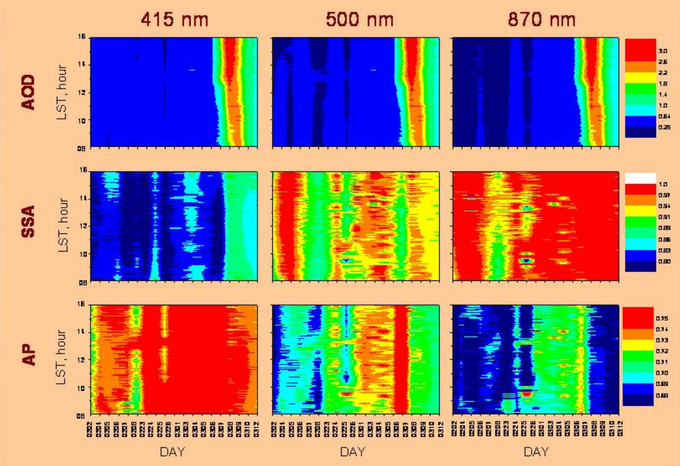
MFRSR-derived AOD : Spectral variability



AOD can increase (Storm) or decrease (Typical) with wavelength
Mean aerosol particle size (R): Typical: R < 1 μm; Storm: R > 1 μm

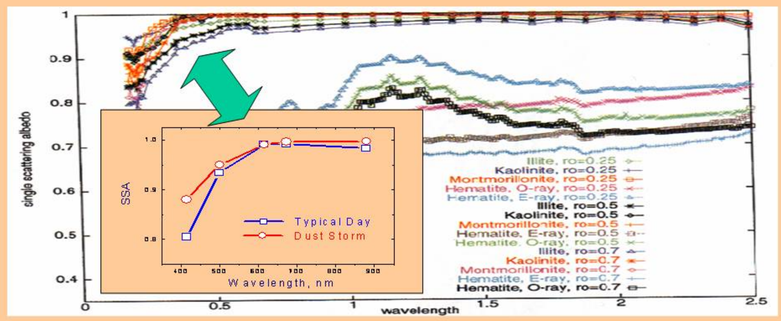
Optical Properties: Day-to-Day variability

The MFRSR-derived AOD, SSA, AP as function of day (horizontal axis) and daytime (vertical axis) for three wavelengths (415, 500 and 870 nm).



MFRSR-derived SSA : Spectral variability

SSA from Sokolik and Toon (white background), MFRSR data (brown background)



For clays (e.g., kaolinite), SSA increases with wavelength
Is presence of clays in dust responsible for spectral behavior of SSA?

Measurements

- **The ARM Mobile Facility (AMF) with sophisticated instruments was placed in Niger.**
- **The AMF measurements include spectral irradiances at five wavelengths (415, 500, 615, 673, 870 nm). These irradiances (both direct and diffuse components) are provided by MFRSR.**
- **Surface AMF measurements are accompanied by aircraft and satellite observations.**

TSI images for typical day (left) and dust storm (right)

Approach

- **Collect data during 2 months (clean, dust storm).**
- **Derive properties of Saharan dust by using the spectral value of direct and diffuse irradiances at five wavelengths (MFRSR measurements).**
- **Perform radiative closure experiments by using MFRSR-derived properties of dust and available spectral and broadband values of the surface albedo from satellite (MODIS) and ground-based data.**

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Reference: Kassianov, E. I., J. C. Barnard, and T. P. Ackerman, 2005: Retrieval of aerosol microphysical properties by using surface MFRSR data: Modeling and observations, *JGR*.

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