Deep Blue Retrievals of Aerosol Properties over Bright-Reflecting Source Regions from MODIS and SeaWiFS

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Why Do We Study Aerosols?

- **Climate Forcing**: requires aerosol properties near source regions to achieve a complete picture of aerosol information from source to sink;

- **Carbon Cycle**: tracks iron sources from windblown dust for stimulating plankton growth in the open ocean;

- **Aerosol Transport Modeling**: needs accurate and realistic dust source locations; and

- **Visibility and Adverse Health Effects**: demands timely atmospheric turbidity information over affected regions.
MODIS Visible & NIR Bands: superimposed on the GOME spectral reflectance taken over the Sahara
**Flowchart for Deep Blue Algorithm**

1. **Radiances**
   - 412, 490, 670 nm

2. **3x3 Pixels Spatial Variance at 412 nm**
   - 412/490 Absorbing Aerosol Index

3. **Cloudy?**
   - Yes → **NO RETRIEVAL**
   - No → **Surface Reflectance Determination**

4. **Surface Reflectance Determination**
   - 490, 670... nm Surface Reflectivity (0.1°x0.1°)
   - 412 nm Surface Reflectivity (0.1°x0.1°)

5. **Aerosol Type**
   - **Dust Model**
   - **Smoke Model**

6. **Aerosol Optical Thickness**
   - Mixed Aerosols

7. **Maximum Likelihood Method**
   - Aerosol Optical Thickness + Ångström Exponent
Surface Reflectance Data Base - Sep 2004

MODIS/Aqua
412 nm (nadir)

SeaWiFS
412 nm (nadir)

MODIS/Aqua
650 nm (nadir)

SeaWiFS
670 nm (nadir)
Aerosol Optical Thickness Retrieved from Deep Blue Algorithm:
Dust plumes in Africa

Feb 25, 2000

Feb 26, 2000

Feb 27, 2000

Cloud

τ_a

Bodele Depression Plume

Algeria/Niger Plume

Single Scattering Albedo

Wavelength (nm)
Satellite Near Real Time Support for NASA AMMA Experiment

- Intensive dust activities over North Africa in the summer 2006
- Saharan dust particles found convoluted with cyclones in the Atlantic

August 20, 2006
Tracking Movements and Evolutions of Aerosol Plumes

MODIS/Terra – 12 September 2004

MODIS/Aqua

Terra AOT
10:30 AM LST

Aqua AOT
1:30 PM LST
The dust (coarse particles) front pushes the polluted air mass (fine particles) over both water and land on this day. Compared reasonably well with AERONET retrievals in UAE^2 (Aug, Sep, 2004).
Comparisons With AERONET Sun Photometer Measurements (August - September 2004)

Harmim, UAE

Mezaira, UAE
6 April 2001
MODIS *Red-Green-Blue* with Rayleigh scattering removed

*Current MODIS retrievals: Aerosol Optical Thickness*

*New MODIS Deep Blue: Aerosol Optical Thickness*
Perfect Dust Storm
7 April 2001
Asian Dust Outbreak
6 April 2001

➢ Deep Blue Algorithm:
• Cloud mask works very well
• Aerosol retrievals indicate dust storms originated from Gobi and Inner Mongolia regions
• Single scattering albedos are quite different between these two regions
Summary

• **It works!**
  – *Deep-Blue Algorithm well* for SeaWiFS and MODIS measurements (… as well as future MODIS-like sensors);
  – Compared *well* with surface/aircraft products;
  – Separate dust *well* from other anthropogenic sources.

• **We expect:**
  – Implement *Deep-Blue Algorithm* for MODIS *underway*;
  – Produce MODIS *Deep-Blue* products over bright-reflecting surfaces, and to be integrated into operational MODIS product stream;
  – *Deep-Blue products* will be part of MODIS collection 5 for *Aqua* and scheduled to be released to the public in January 2007.