Aerosol Properties over Bright-Reflecting Source Regions: The Deep Blue Algorithm and its Applicability to MODIS

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MODIS Visible & NIR Bands: superimposed on the GOME spectral reflectance taken over the Sahara.
Flowchart for Deep Blue Algorithm

Radiances
412, 490, 670 nm

3x3 Pixels Spatial Variance at 412 nm

412/490 Absorbing Aerosol Index

NO RETRIEVAL

Yes

Cloudy?

No

412 nm Surface Reflectivity (0.1°x0.1°)

Dust Model

Surface Reflectance Determination

490, 670... nm Surface Reflectivity (0.1°x0.1°)

Smoke Model

Aerosol Type

Mixed Aerosols

Maximum Likelihood Method

Aerosol Optical Thickness + Ångström Exponent
MODIS/Aqua 412 nm (nadir)

SeaWiFS 412 nm (nadir)

SeaWiFS 670 nm (nadir)

MODIS/Aqua 650 nm (nadir)

Surface Reflectance Data Base - Sep 2004
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
Aerosol Properties in Radiance Simulations

<table>
<thead>
<tr>
<th>Aerosol Model</th>
<th>( \tau_{412} )</th>
<th>( \tau_{470} )</th>
<th>( \tau_{490} )</th>
<th>Refractive Index 412 nm</th>
<th>Refractive Index 490 nm</th>
<th>( \omega_0 ) 412 nm</th>
<th>( \omega_0 ) 490 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust</td>
<td>1.00</td>
<td>1.00</td>
<td>1.55 – 0.020i</td>
<td>1.55 – 0.008i</td>
<td>0.91</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Smoke</td>
<td>1.30</td>
<td>0.92</td>
<td>1.55 – 0.022i</td>
<td>1.55 – 0.026i</td>
<td>0.90</td>
<td>0.89</td>
<td></td>
</tr>
</tbody>
</table>

- Aerosol layer: 1-km thick, peaked at 3 km height with a Gaussian distribution
- For mixed aerosol types:

\[
R_{\text{mixed}} = aR_{\text{dust}} + (1-a)R_{\text{smoke}}
\]
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 UAE² (Aug.-Sep. 2004)
Comparisons With AERONET Sun Photometer Measurements (August - September 2004)

Harmim, UAE

Mezaira, UAE
6 April 2001

**Current MODIS retrievals:**
Aerosol Optical Thickness

**New MODIS Deep Blue:**
Aerosol Optical Thickness

MODIS *Red-Green-Blue* with Rayleigh scattering removed
- Use MODIS pre-launch polarization coefficients from MCST and GSFC ocean group.
- Generate lookup tables for Stokes parameters and simulate correction factors.
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;
  – Continue to refine MODIS *Deep-Blue* retrievals, with polarization correction due to scanning mirror.