The MODIS Aerosol Algorithms

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And introducing Christina Hsu

Collection 004
Collection 005
Collection 006
and on to infinity!

And beyond
Collection 004

Description and validation of Terra 004 in Remer et al. (2005), appearing in JAS this April. Available online at http://modis-atmos.gsfc.nasa.gov/ under References.

Aqua validation in Ichoku et al. (2005), also available online.
AOT550

Fine mode fraction

From Terra.

AOT retrieval is NOT sensitive to instrument characterization changes, but size retrievals are.

Most apparent at low AOT.

Also, there is an offset between Aqua and Terra
Comparison of monthly mean ocean AOT values.

Not collocated in time!

True validation of aerosol long term statistics?

Kaufman et al. (2005) with Richard Kleidman
Over global oceans, residual cirrus reflectance increases AOT by 0.015±0.003 at 0.55 µm.

Algorithm retrieves when cirrus reflectance < 0.01

Kaufman et al. (2005) with Rong-Rong Li
Collection 005
Elimination of Snow Contamination

Li et al. (2005)
New over land cloud
Mask logic implemented
Negative reflectances at 1.38 μm now permitted

Increases extent of retrievals over land
Collection 006
Deep Blue

Retrievals over bright surfaces coming in 006

Christina Hsu
Now:

- Assume MIR (2.1 µm) is transparent to aerosol: \(_{surf} = \_{obs}\)
- Estimate AOD in blue and red independently
- Calculate angstrom exponent to estimate dust aerosol contribution

For 006 and beyond:

- 2.1 µm is NOT transparent to aerosol: \(_{surf} = \_{obs} - \_{AOD}\)
- Retrieve AOD and FMF in blue, red and MIR simultaneously
- Solution is combination of AOD and FMF that exactly matches the observed reflectance at 0.47 µm, with smallest error at 0.66 µm

RESULT: (1) no difference to AOT retrieval
(2) major improvement to Fine Mode Fraction (FMF)
Better Land Surface Characterization

Currently

\[ s_{470} = 0.25 \quad s_{660} = 0.50 \]

For 006

\[
0.47 = m_{0.47}(\Theta) \times 2.1 + b_{0.47}(\Theta) \\
0.66 = m_{0.66}(\Theta) \times 2.1 + b_{0.66}(\Theta)
\]

\[
0.5 < m_{0.66} < 0.6 \quad 0.15 < m_{0.47} < 0.25 \\
-0.01 < b_{0.66} < 0.01 \quad 0.01 < b_{0.47} < 0.03
\]

Scattering angle better parameter than surface type
Better Land Surface Characterization

The present (including Collection 005)

Infinity and Beyond...

Robert Levy, in preparation
New Aerosol Models for Collection 006?

Are our original estimates for aerosol models correct?

Now:
- based on Nakajima inversion
- no retrievals of $n_r$ or $\omega_o$
- less than 25 AERONET sites, (nothing from Asia)
- subjective division of the world

We ended up with 3 fine mode models and 1 dust.

Infinity and beyond?:
- based on Dubovik inversion
- includes retrievals of $n_r$ or $\omega_o$ at AOT > 0.40
- more than 200 AERONET sites
- objective cluster analysis

Results: 3 fine mode models and 1 dust

R. Levy
Urban/industrial $\omega_o = 0.95$ (0.96)
Smoke $\omega_o = 0.92$ (0.90)
Absorbing smoke $\omega_o = 0.86$ (0.86)
New Aerosol Models for Collection 006?

Objective Clustering 006?

Subjective Division 004 and 005

AERONET Cluster

R. Levy
New Ocean Aerosol Models Coming

Nonsphericity will be addressed, and perhaps additional absorption

Remer, Mattoo, Kaufman, Ahmad, Dubovik
To infinity and beyond.