

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 on line at
<http://modis-atmos.gsfc.nasa.gov/> under References

Aqua validation in **Ichoku et al. (2005)**, also available
on line.

AOT550

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Fine mode fraction

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

2001 2002 2003 2004

From Terra.

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

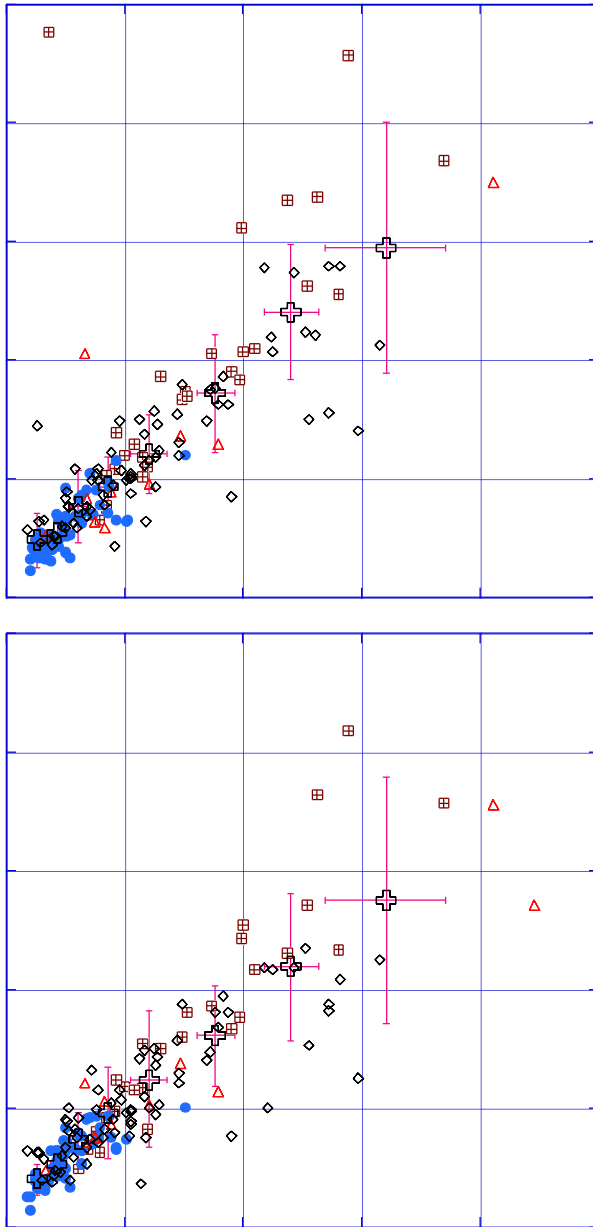
0.10

0.60 Most apparent at
low AOT.

0.45

Also, there is an
offset between
Aqua and Terra

0.30



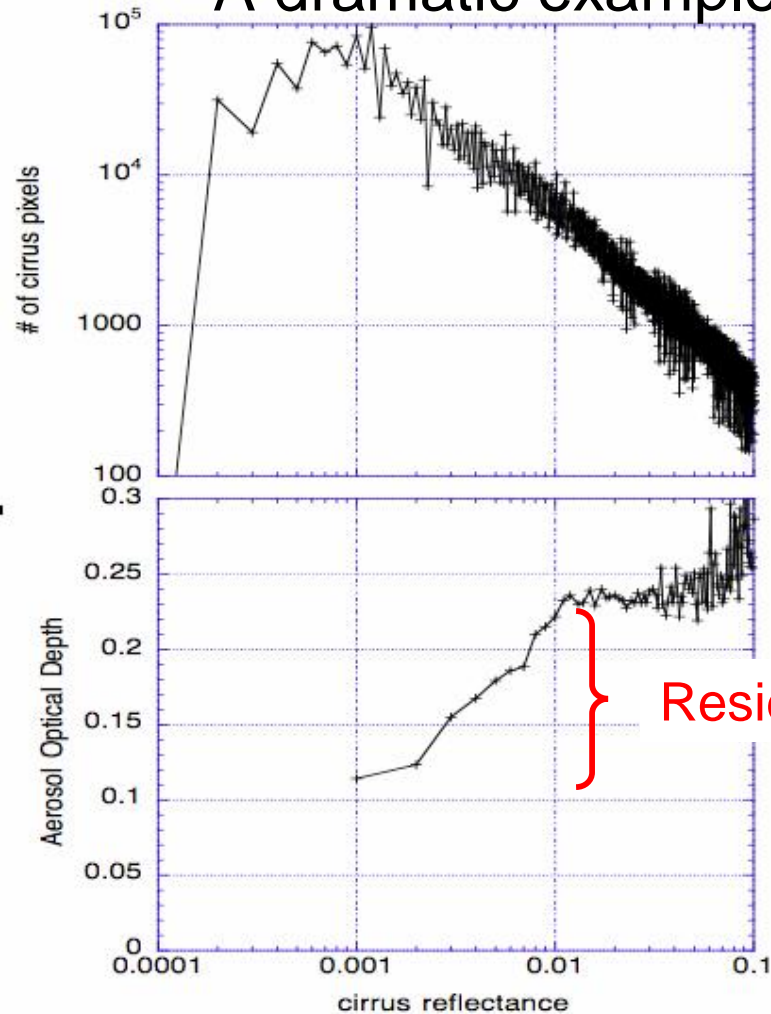
Comparison of monthly
mean ocean AOT values.

Not collocated in time!

True validation of aerosol
long term statistics?

Kaufman et al. (2005)
with Richard Kleidman

A dramatic example



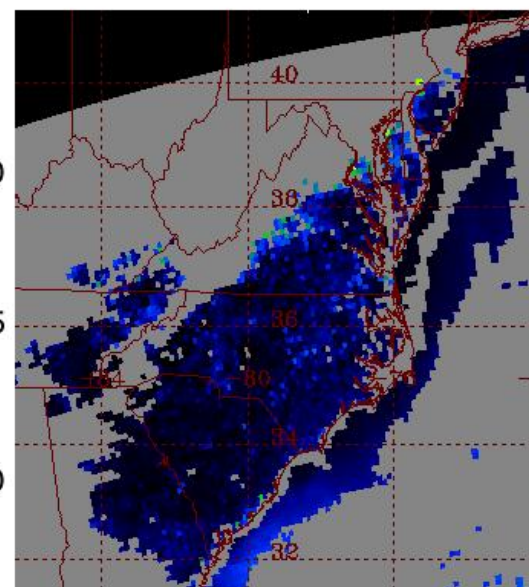
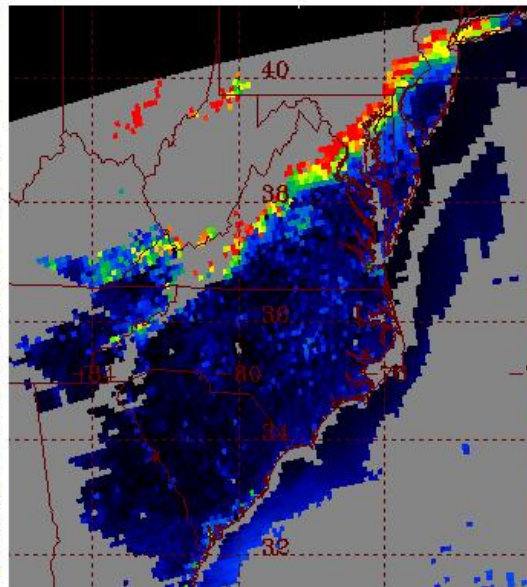
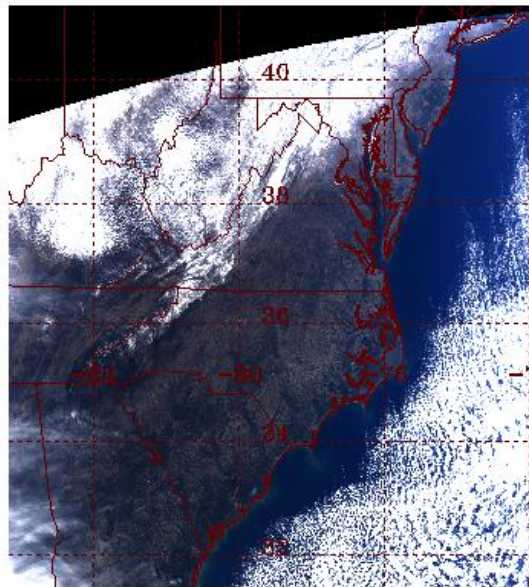
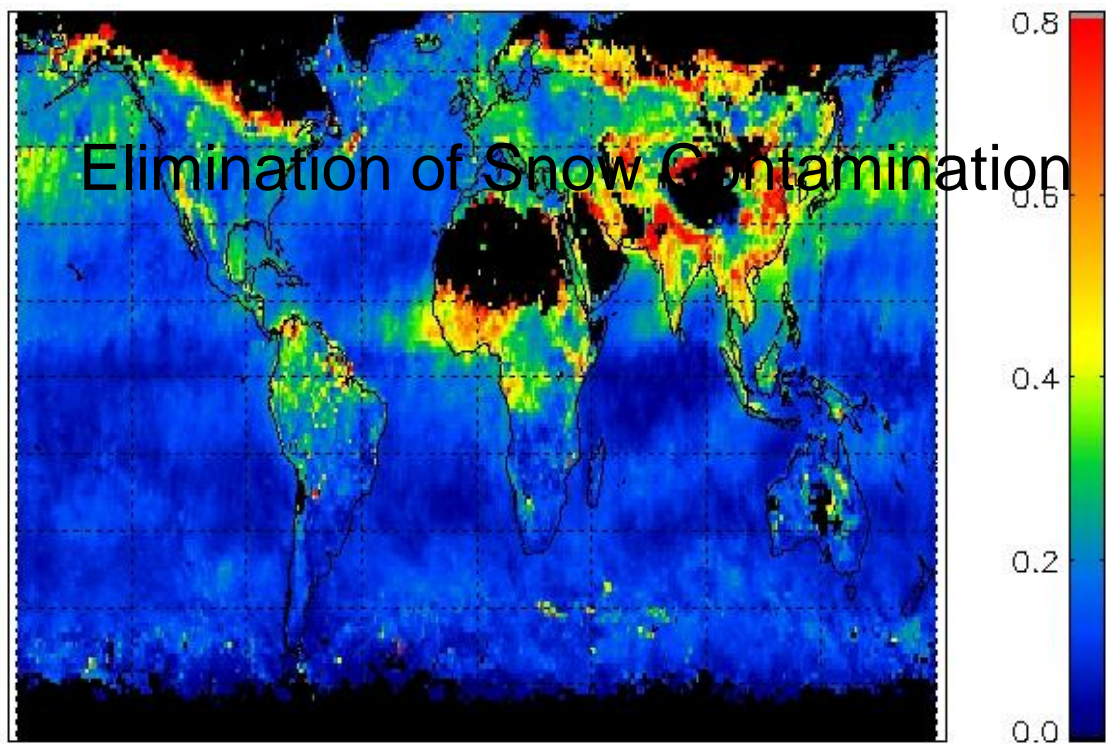
Over global oceans,
residual cirrus reflectance
increases AOT by
 0.015 ± 0.003 at $0.55 \mu\text{m}$

Residual cirrus reflectance

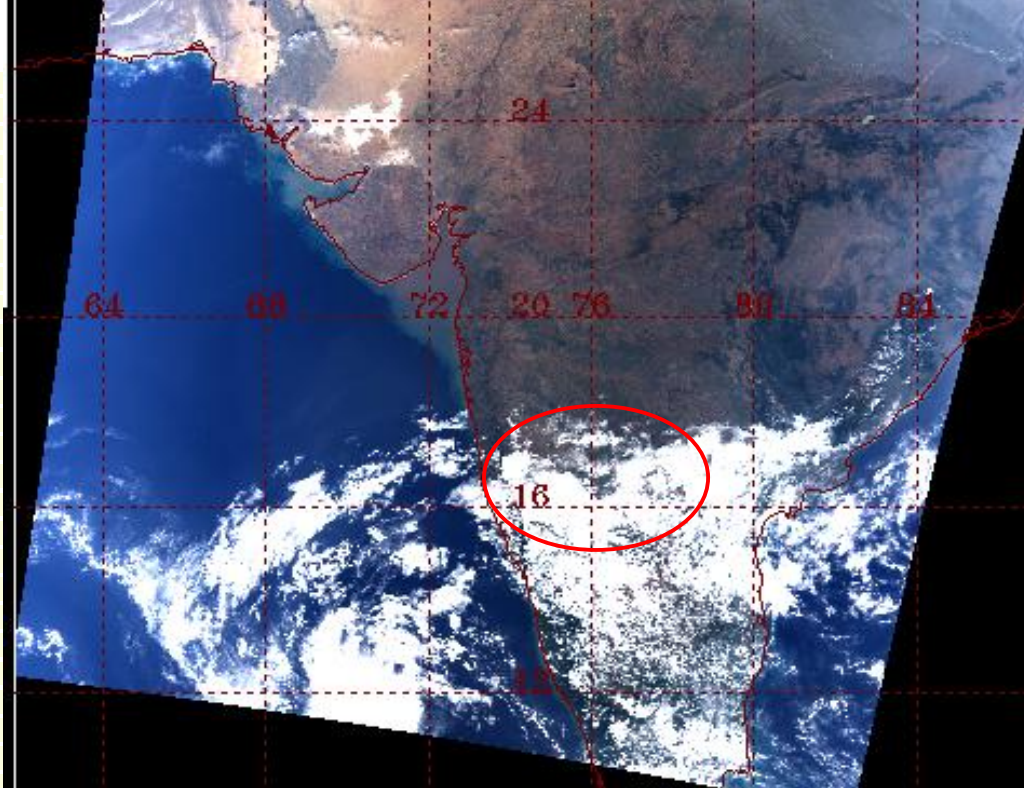
Algorithm retrieves when
cirrus reflectance < 0.01

Kaufman et al. (2005)
with Rong-Rong Li

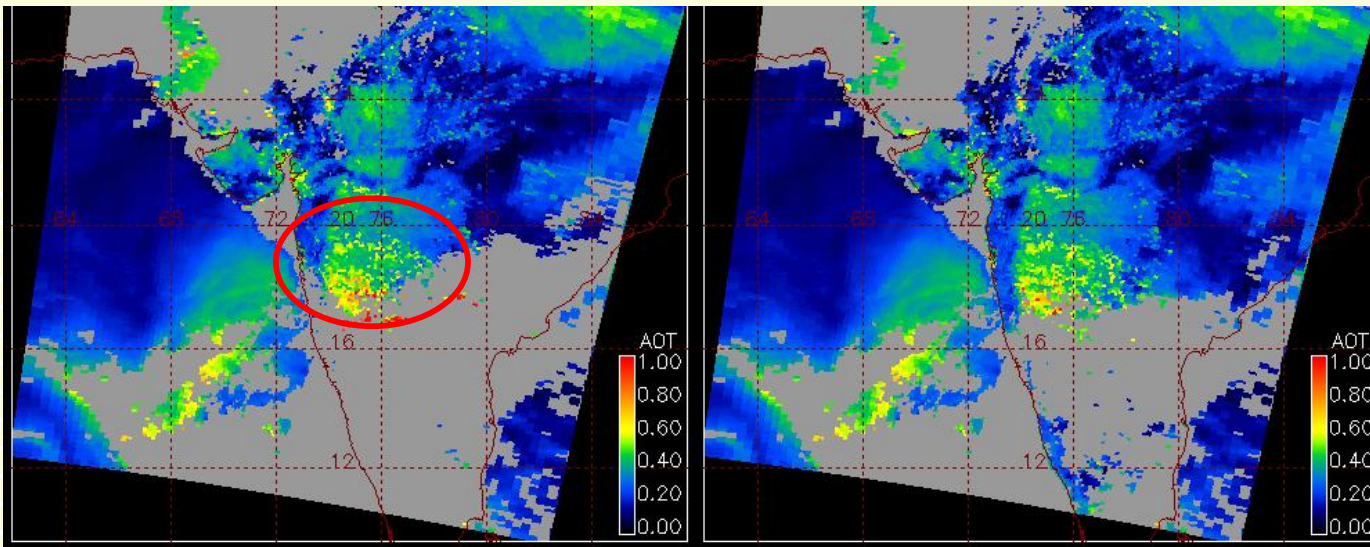
Collection 005



Li et al. (2005)

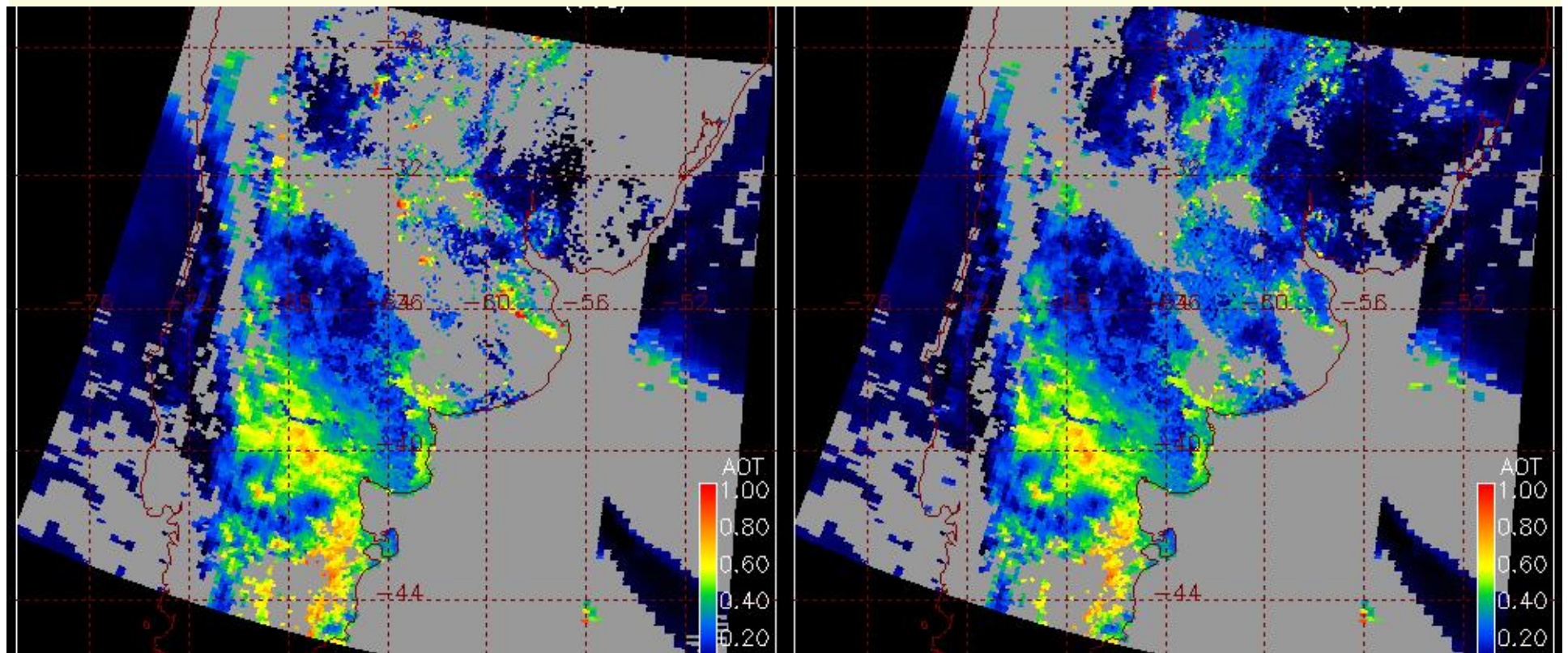


New over land cloud
Mask logic
implemented



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

New Land Inversion Coming

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

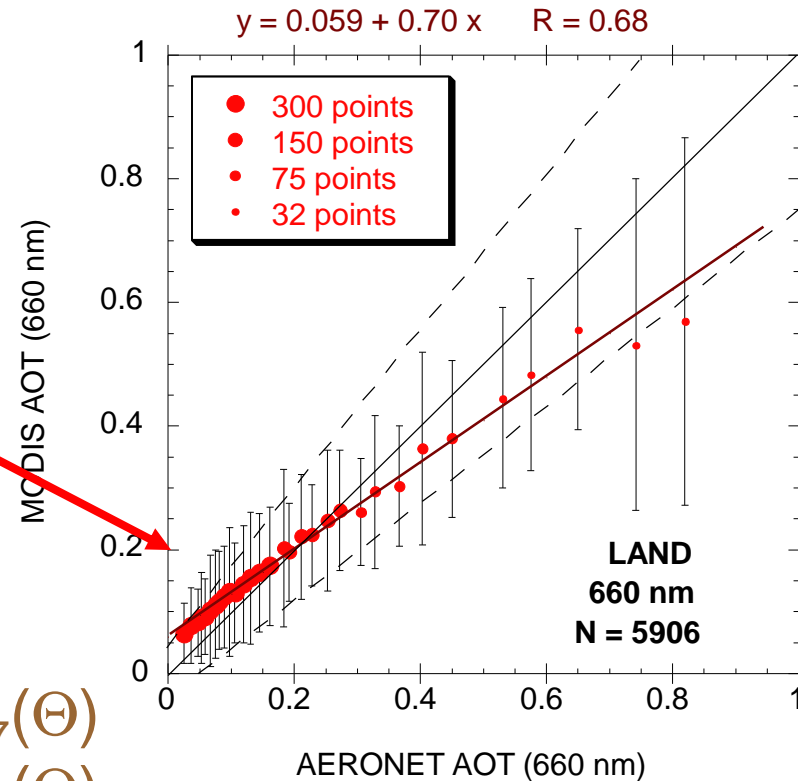
RESULT: (1) no difference to AOT retrieval
(2) major improvement to Fine Mode Fraction (FMF)

Better Land Surface Characterization

Currently

$$s_{470}^{470} = 0.25 \quad 2130$$

$$s_{660}^{660} = 0.50 \quad 2130$$



For 006

$$0.47 = m_{0.47}(\Theta) * 2.1 + b_{0.47}(\Theta)$$

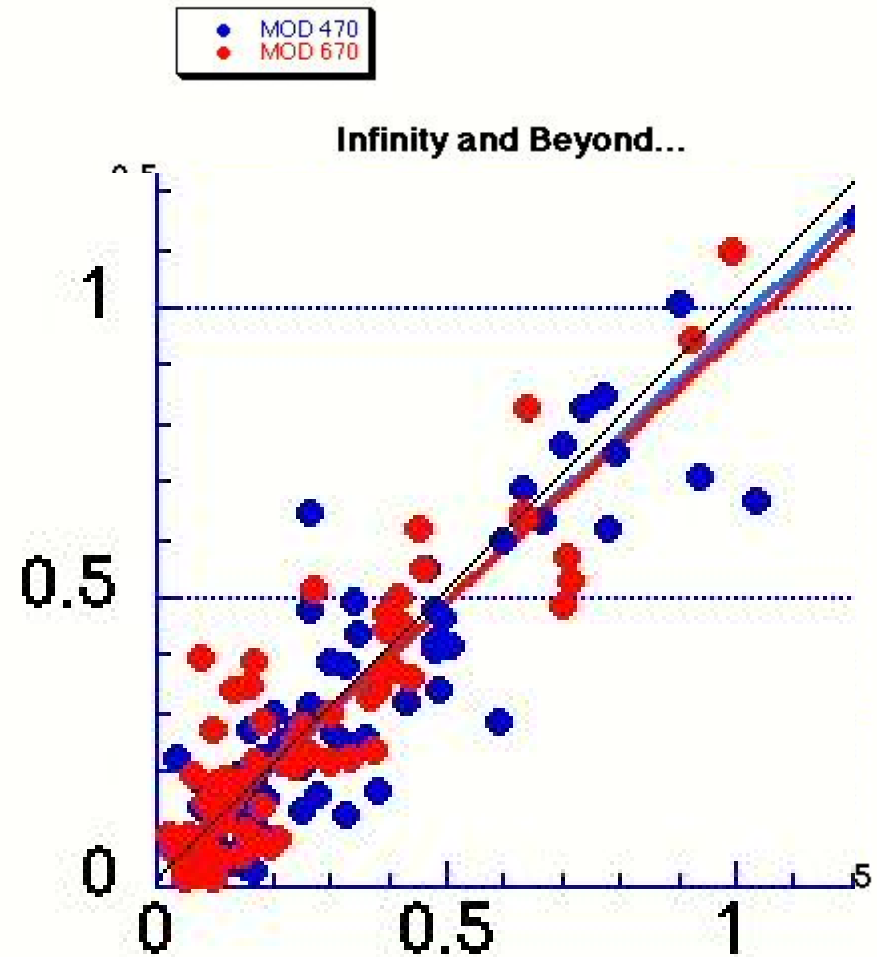
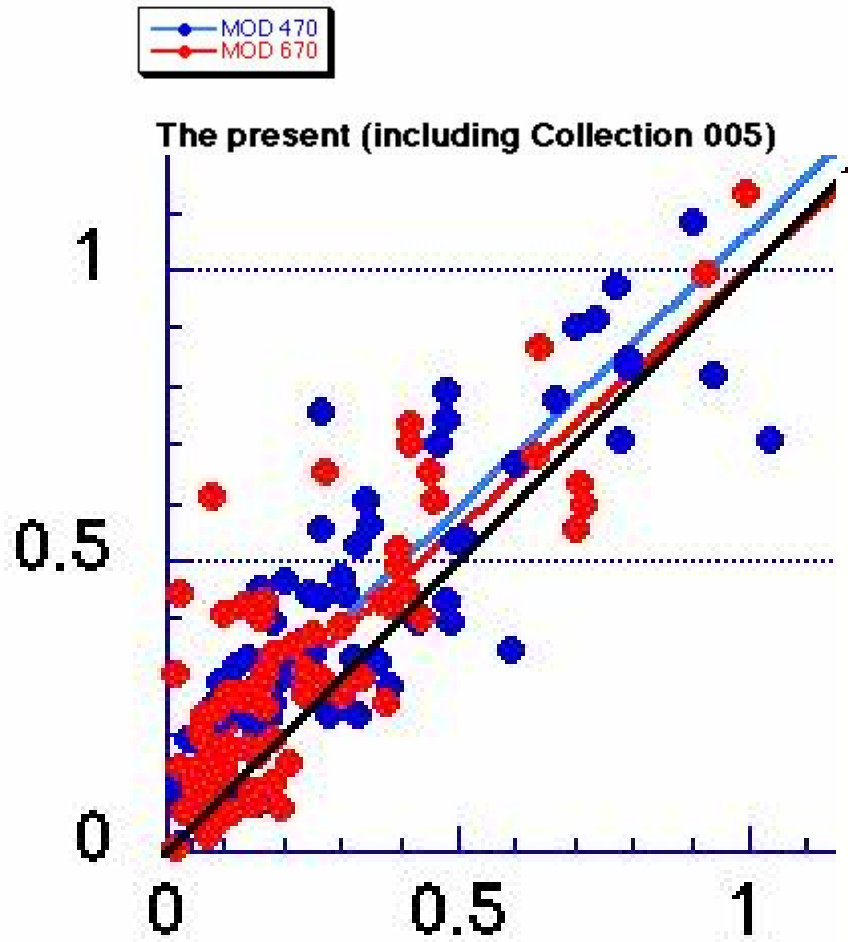
$$0.66 = m_{0.66}(\Theta) * 2.1 + b_{0.66}(\Theta)$$

$$0.5 < m_{0.66} < 0.6 \quad 0.15 < m_{0.47} < 0.25$$

$$-0.01 < b_{0.66} < 0.01 \quad 0.01 < b_{0.47} < 0.03$$

Scattering angle better parameter than surface type

Better Land Surface Characterization



Robert Levy, in preparation

New Aerosol Models for Collection 006?

Are our original estimates for aerosol models correct?

Now:

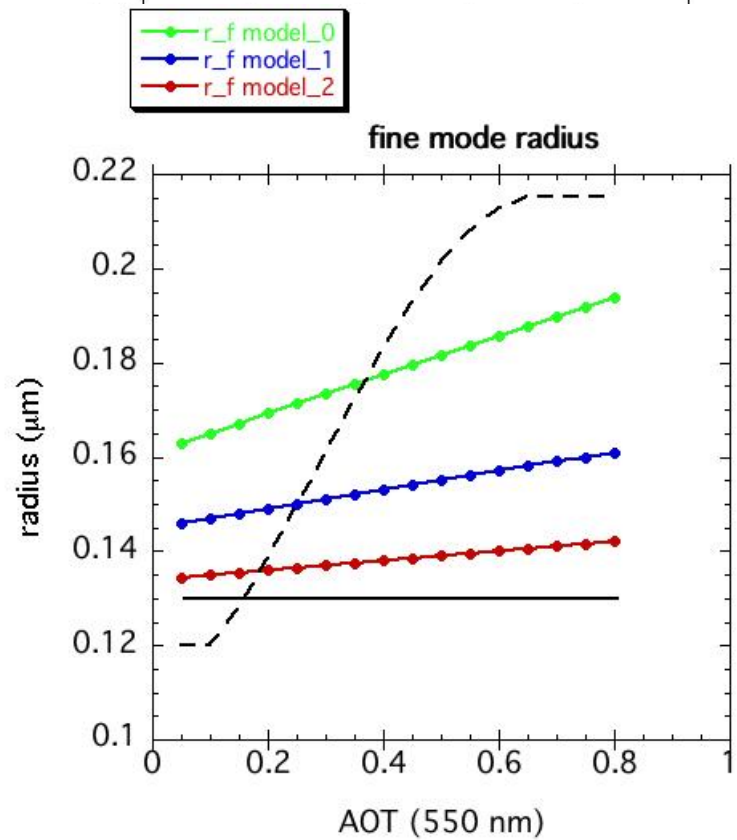
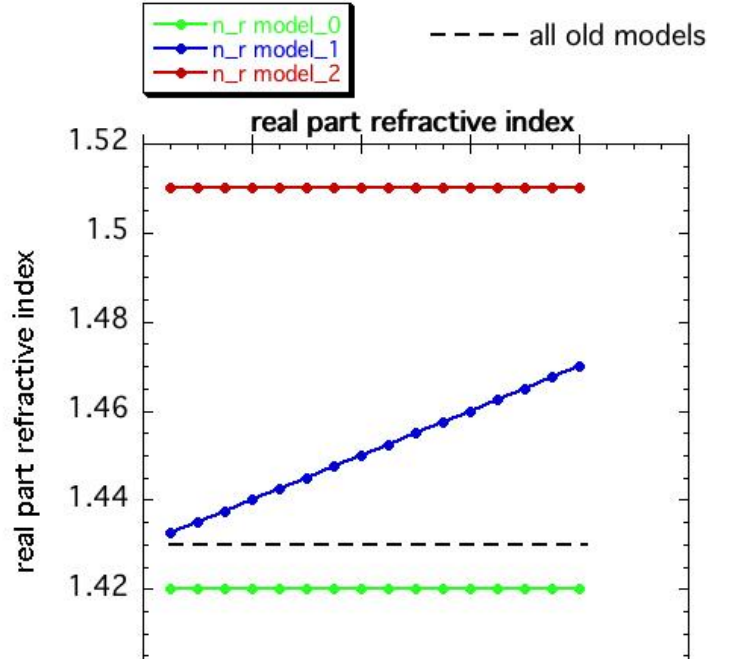
- based on Nakajima inversion
- no retrievals of n_r or ω_o
- less than 25 AERONET sites, (nothing from Asia)
- subjective division of the world

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

Infinity and beyond?:

- based on Dubovik inversion
- includes retrievals of n_r or ω_o at $AOT > 0.40$
- more than 200 AERONET sites
- objective cluster analysis

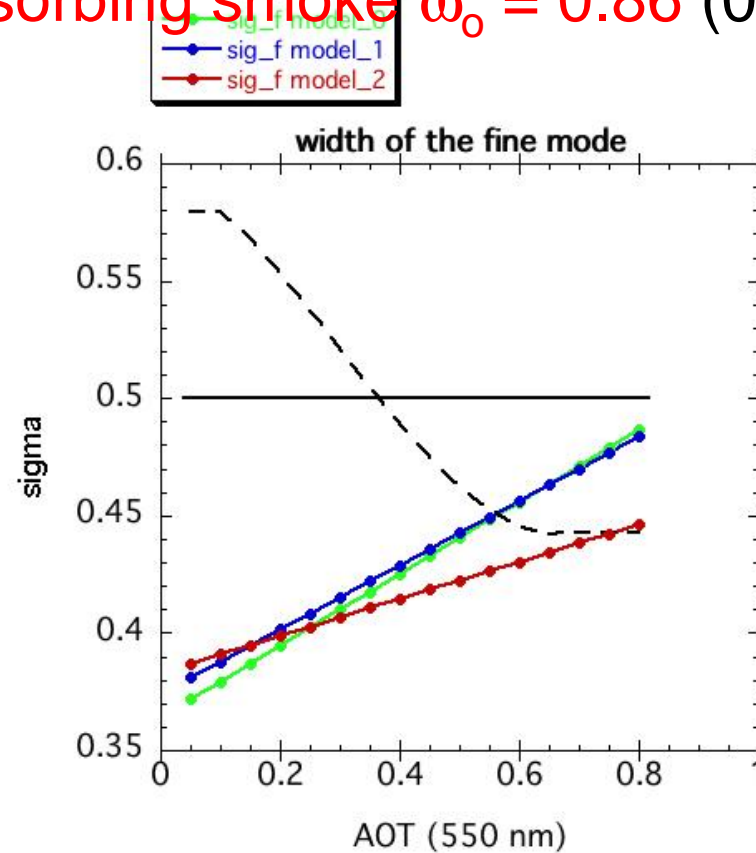
Results: 3 fine mode models and 1 dust



Urban/industrial $\omega_o = 0.95$ (0.96)

Smoke $\omega_o = 0.92$ (0.90)

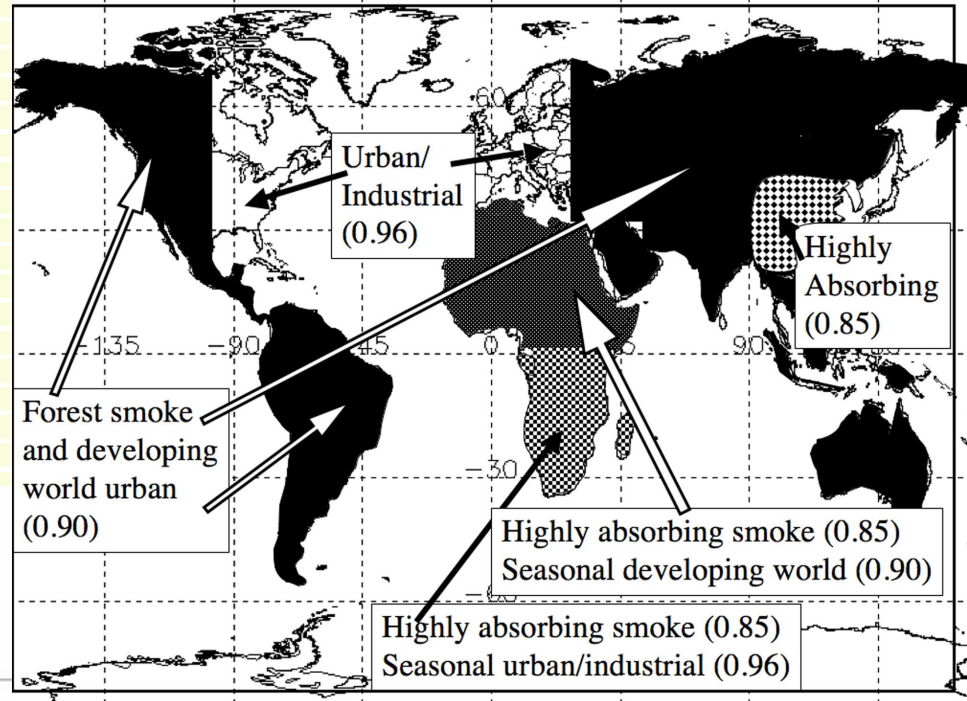
Absorbing smoke $\omega_o = 0.86$ (0.86)



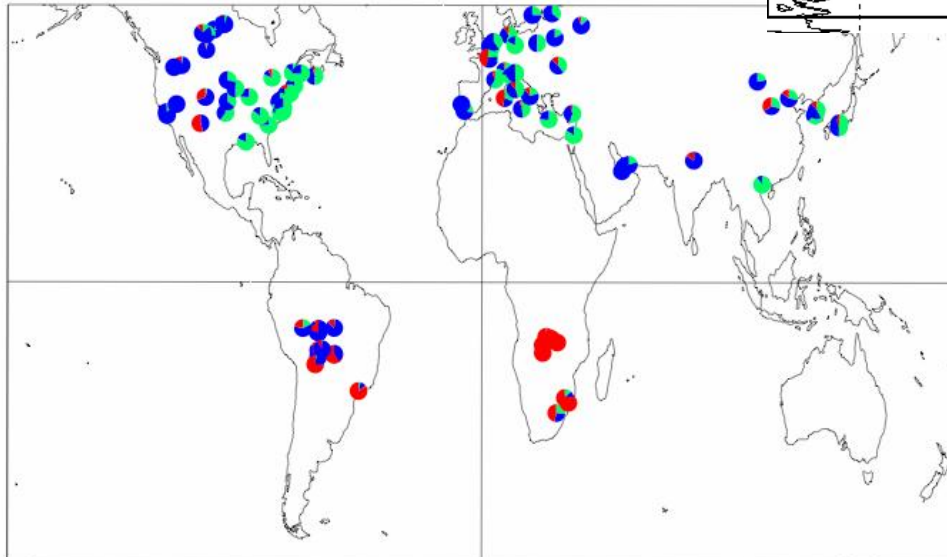
R. Levy

New Aerosol Models for Collection 006?

Subjective Division
004 and 005

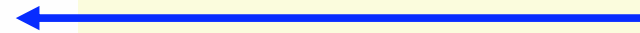


AERONET Cluster



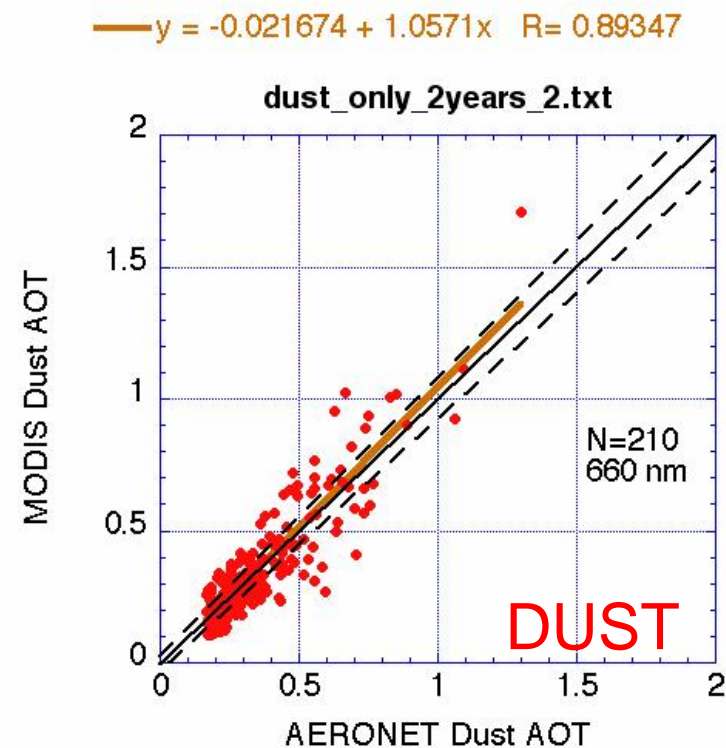
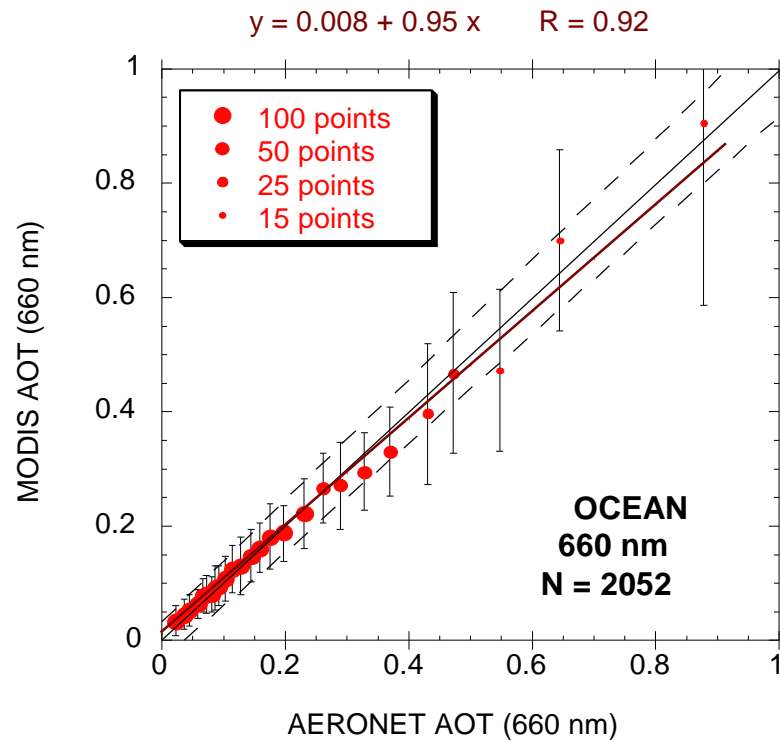
JJA

Objective Clustering
006?



R. Levy

New Ocean Aerosol Models Coming



Nonsphericity will be addressed,
and perhaps additional absorption

Remer, Mattoo, Kaufman, Ahmad, Dubovik

To infinity

And beyond

