

Results from the MODIS aerosol product:

Overview and recent criticisms

Lorraine Remer

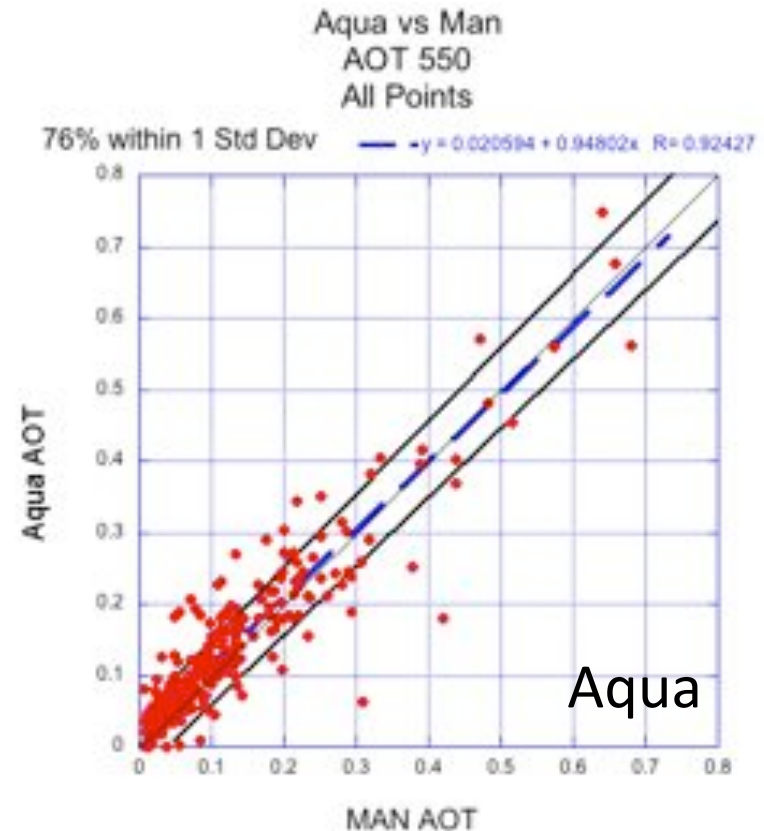
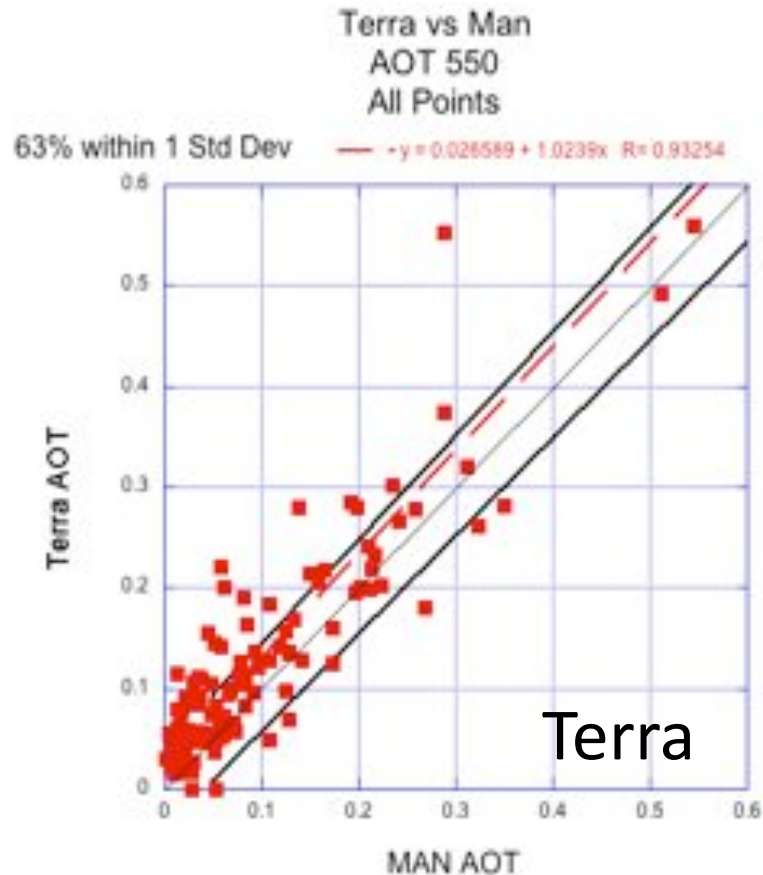
Shana Mattoo, Robert Levy, Richard Kleidman, Ralph Kahn

Calibration

Calibration

Calibration

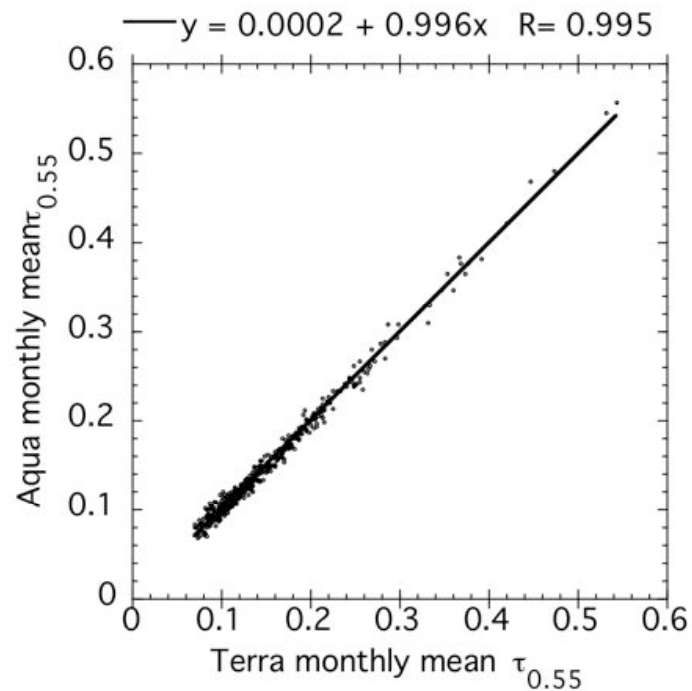
Aerosols over ocean



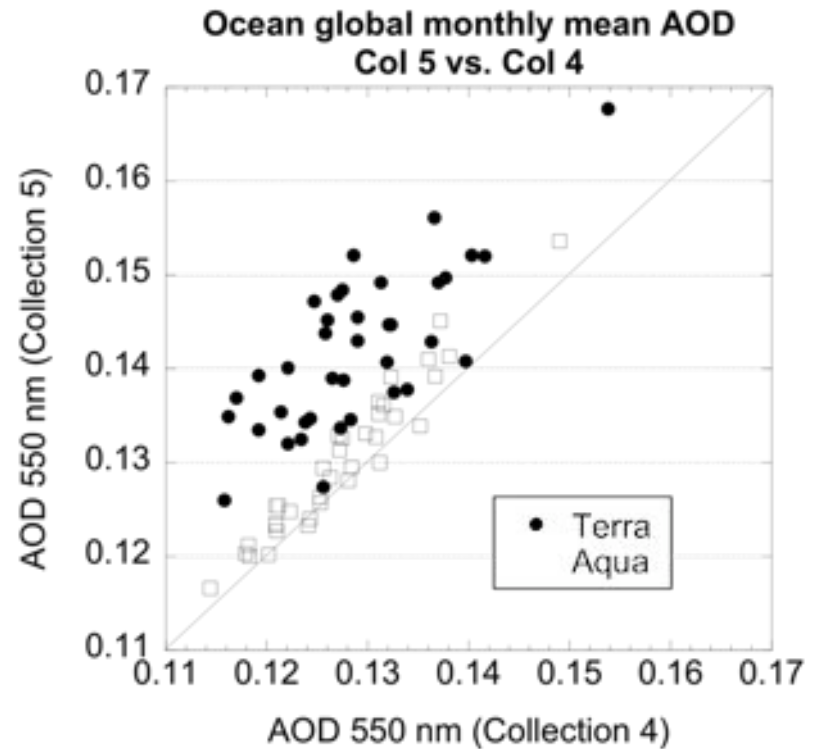
Over open ocean: Aqua has lower offset than Terra

Using the Marine Aerosol Network (MAN) from Smirnov et al. (2009)

Kleidman et al. (in prep)



Remer et al. (2006)
Collection 4



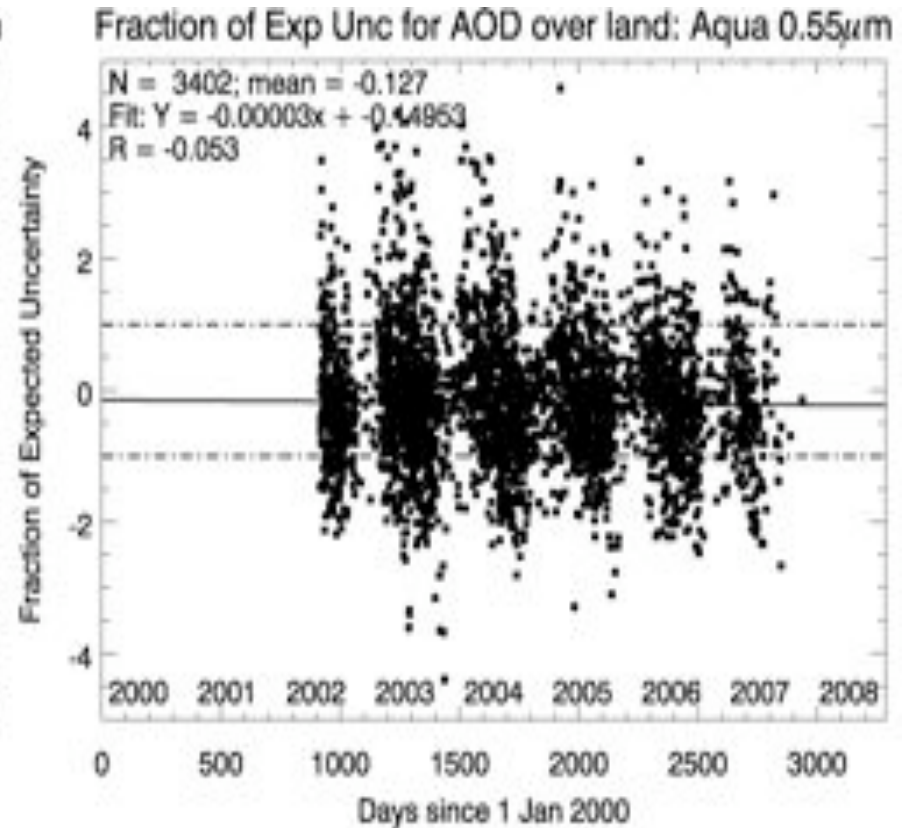
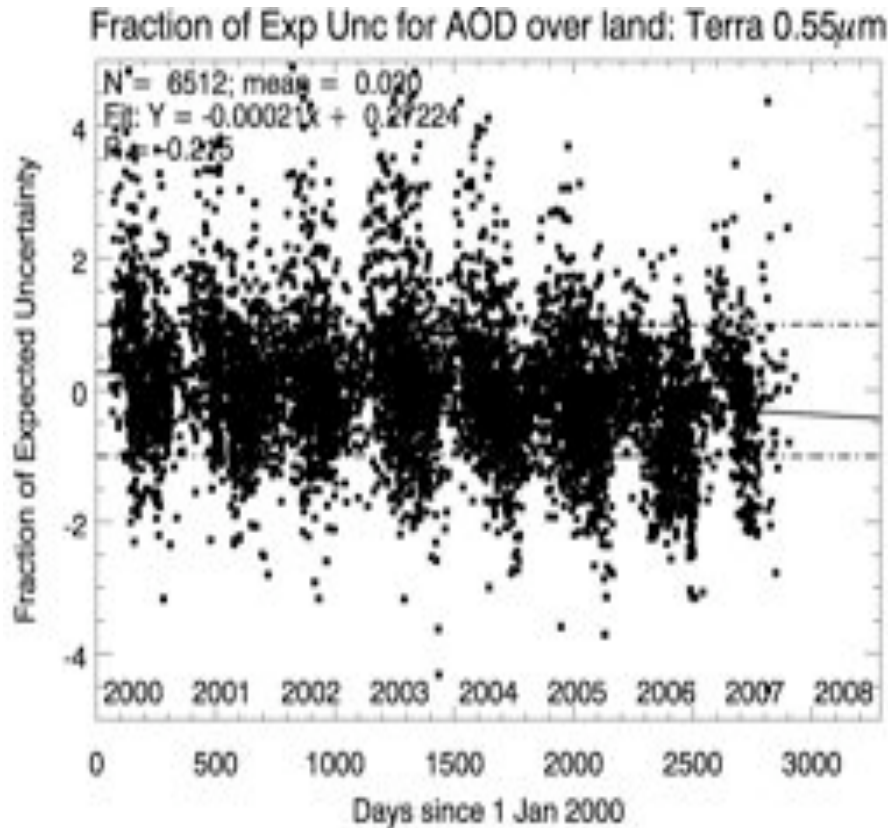
Remer et al. (2008)
Collection 5

The difference between Terra and Aqua in Collection 5 traced to calibration changes to Terra.

Measure of difference between MODIS and AERONET

Terra over land

Aqua over land



MODIS-AERONET differences
decrease during the
Terra mission over land

But not during the Aqua mission

Levy et al. (in prep)

Explanation: Calibration changes.

1. Over **ocean**: Changes from Collection 4 to Collection 5 in the **870 nm channel** (Band 2) in Terra, caused Terra AOD to be 0.015 too high over open ocean.

Land does not use the **870 nm channel** and is not affected.

MAN data set provided concluding evidence.

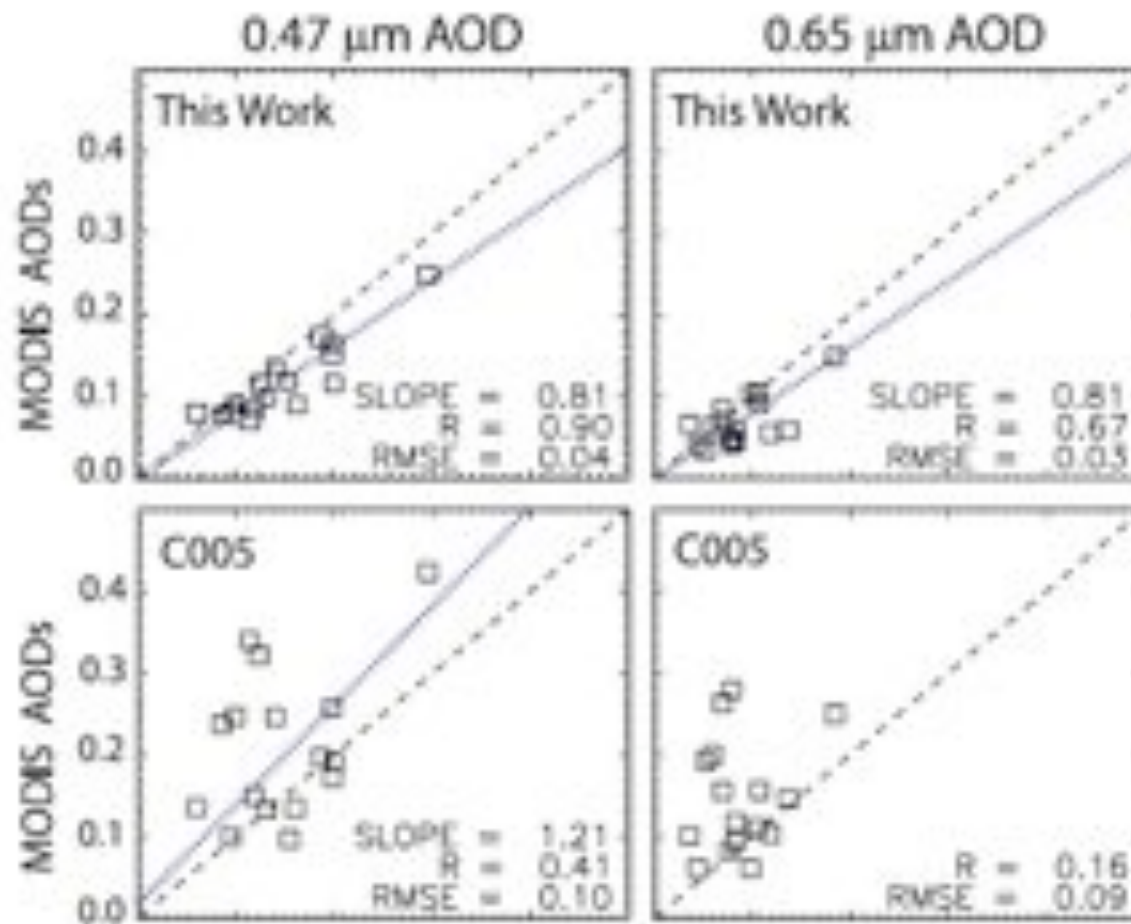
2. Over **land**: Drift in the **466 nm channel** (Band 3) in Terra, causes the drift in the MODIS – AERONET time series.

Ocean does not use the **466 nm channel** and is not affected.

Beware of calibration drift in AOD trends (Land).

Criticisms

(1) We can do this better than you can.

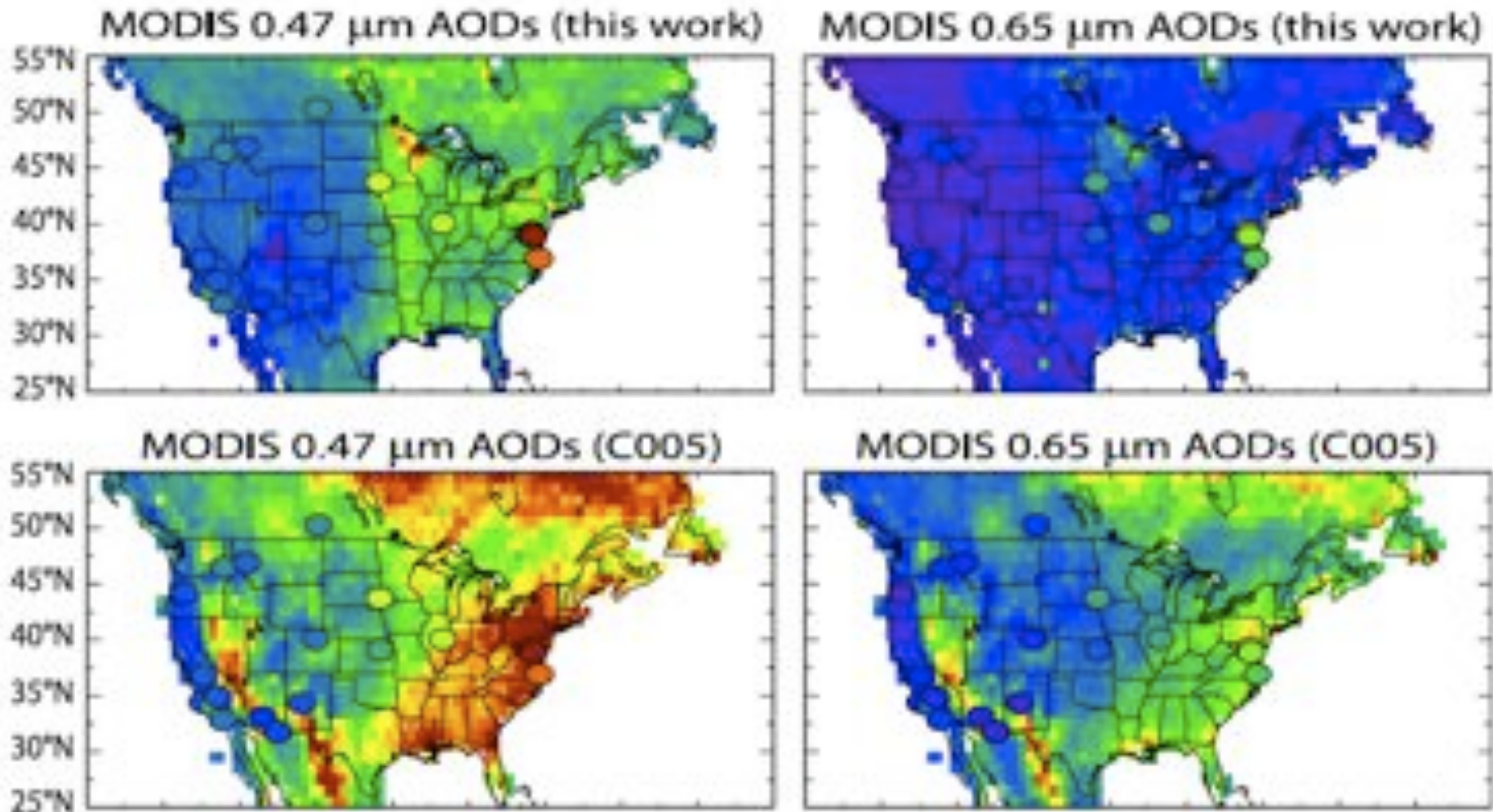


AERONET AODs

July-August 2004

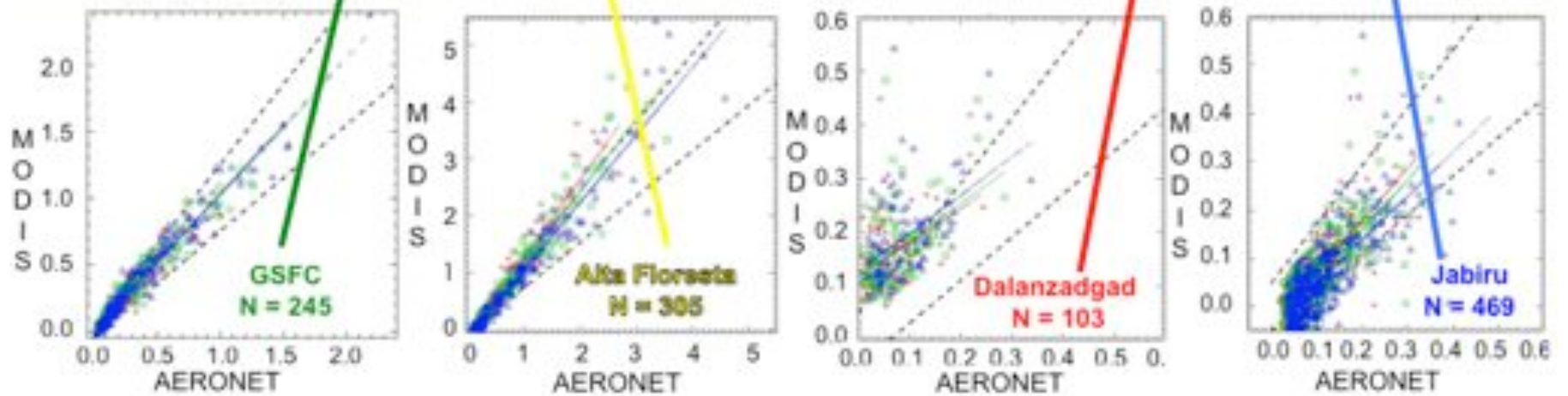
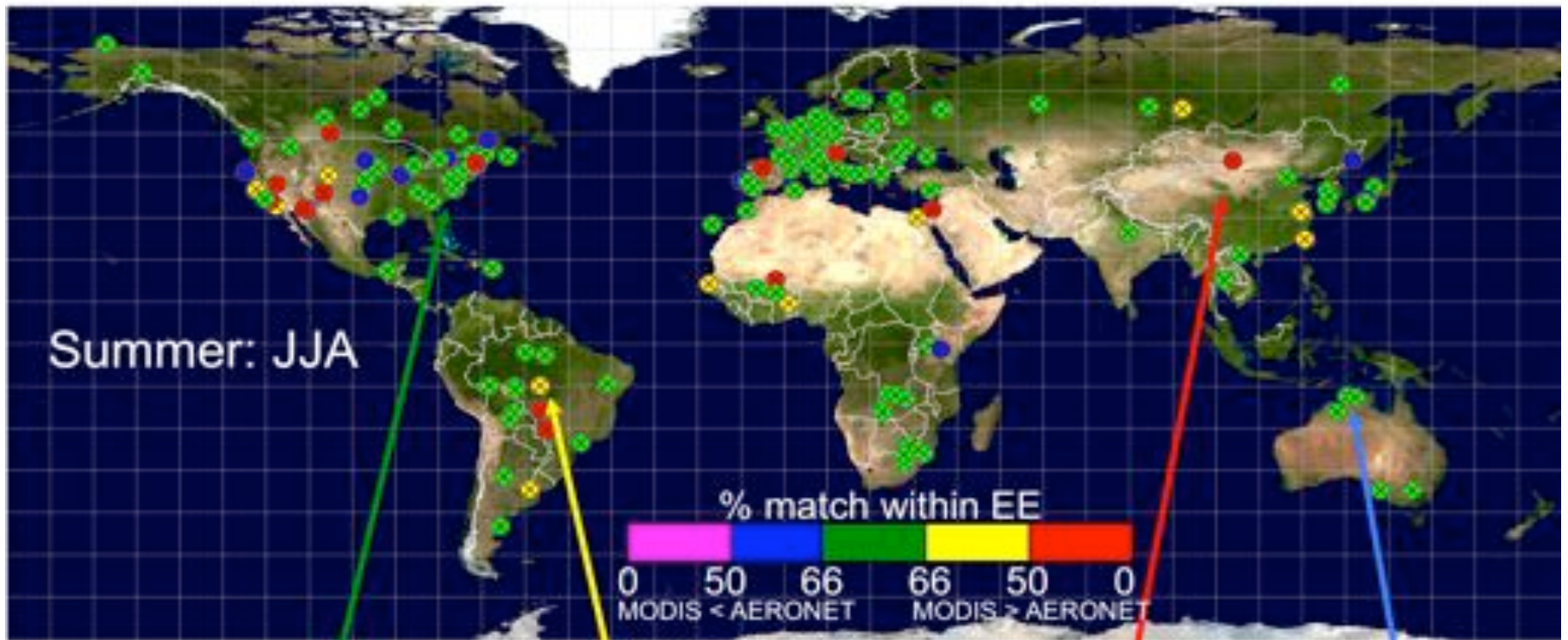
Drury et al., 2008

All of the improvement is in the intermountain west



July –August 2004

Drury et al. (2008)



Levy et al., (in prep)

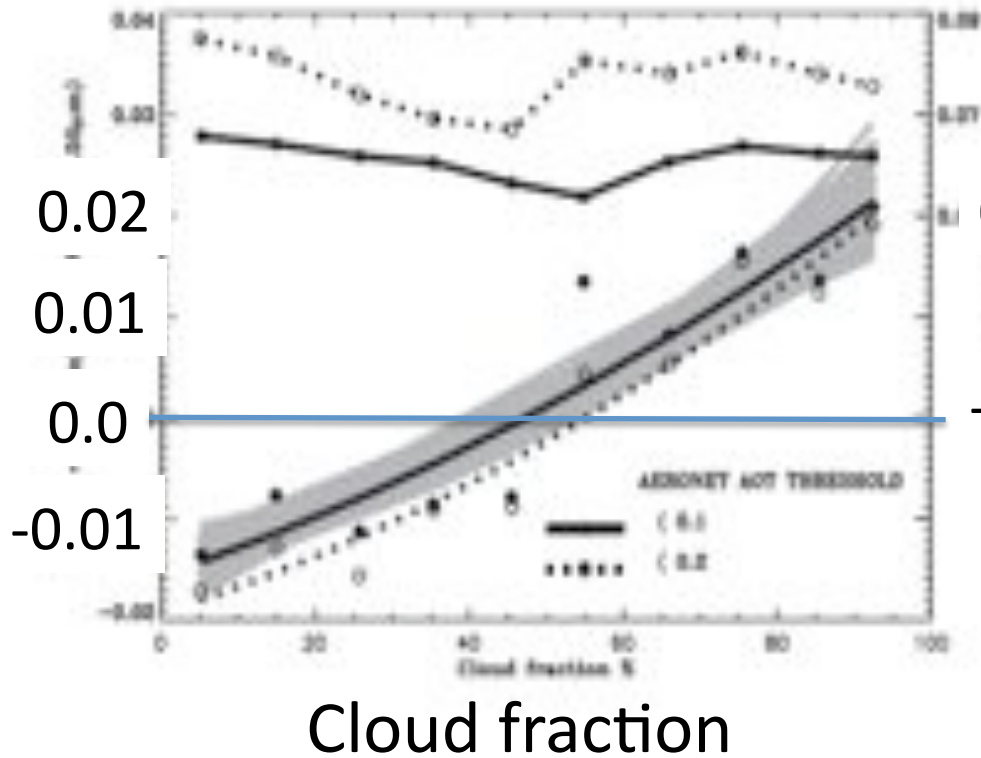
Conclusion:

Any smart graduate student can produce a better aerosol product for their particular interest.

But we are responsible for a global product.

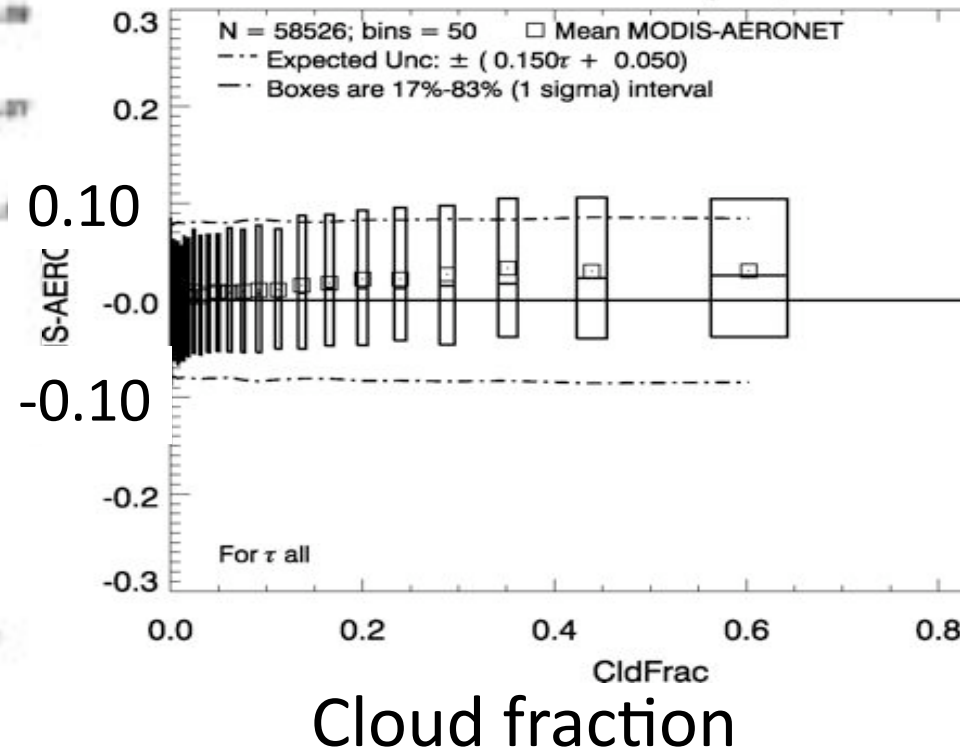
(2) The product is cloud contaminated

ocean



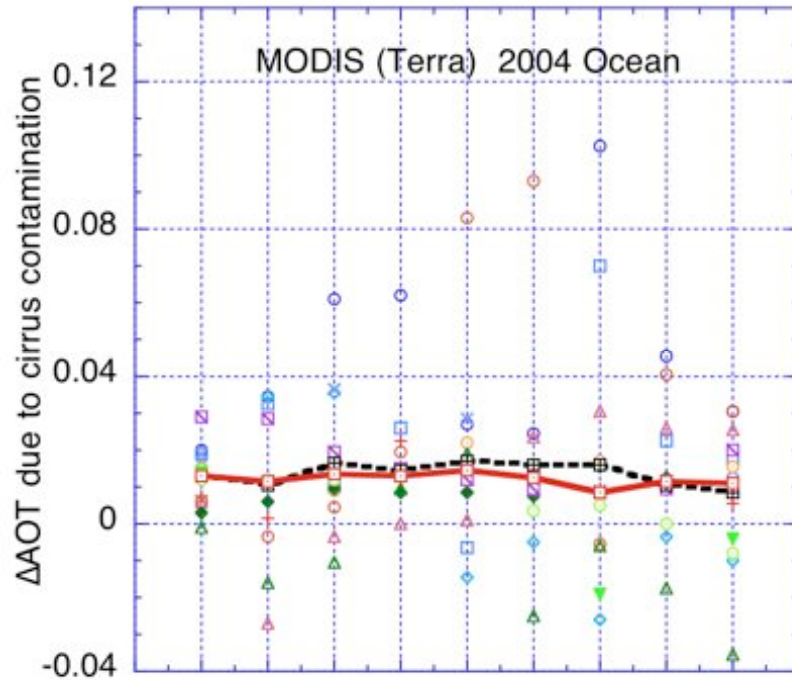
Zhang et al. (2005)

land land: Both 0.55 μ m,QA3



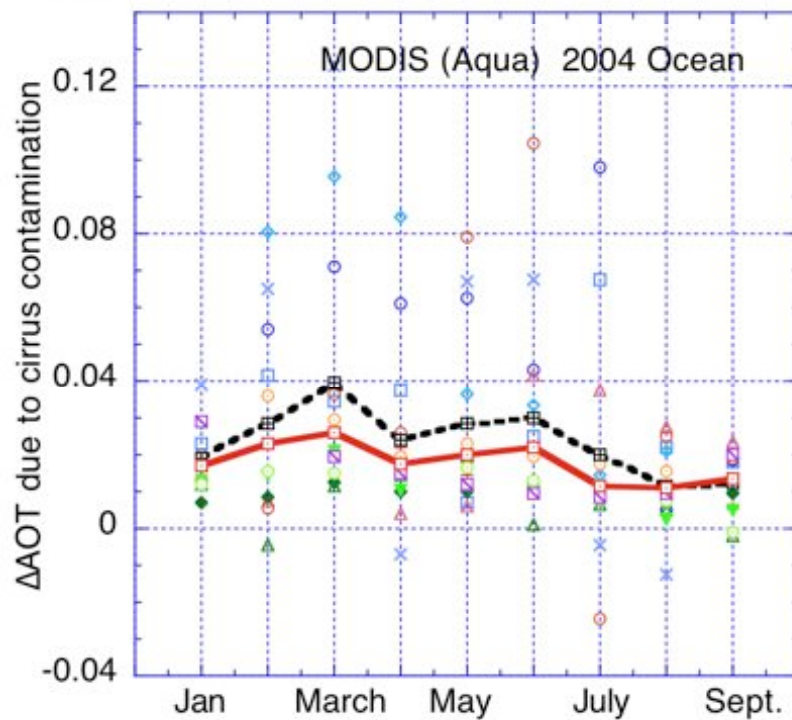
Levy et al. (in prep)

Differences with AERONET increase
with increasing “cloud fraction”



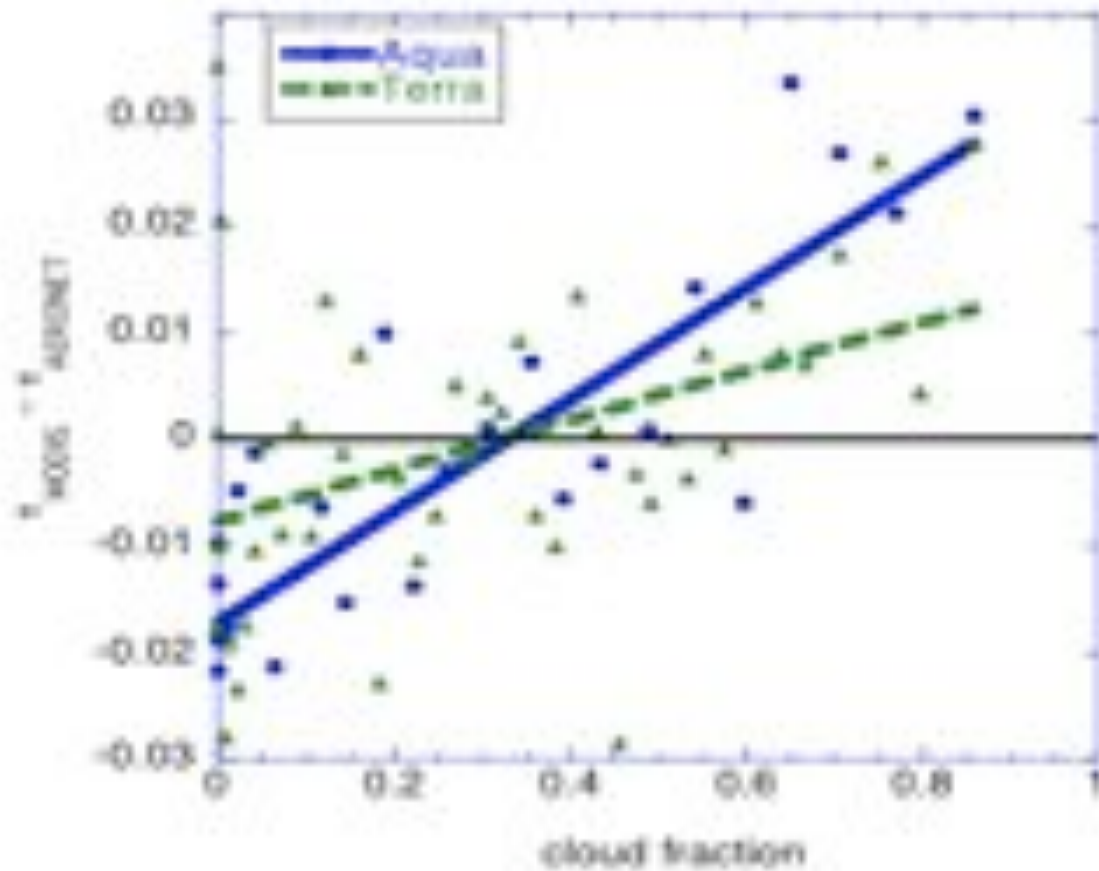
Kaufman et al. (2005)

Global AOD over the oceans is enhanced by 0.015 from thin cirrus contamination.



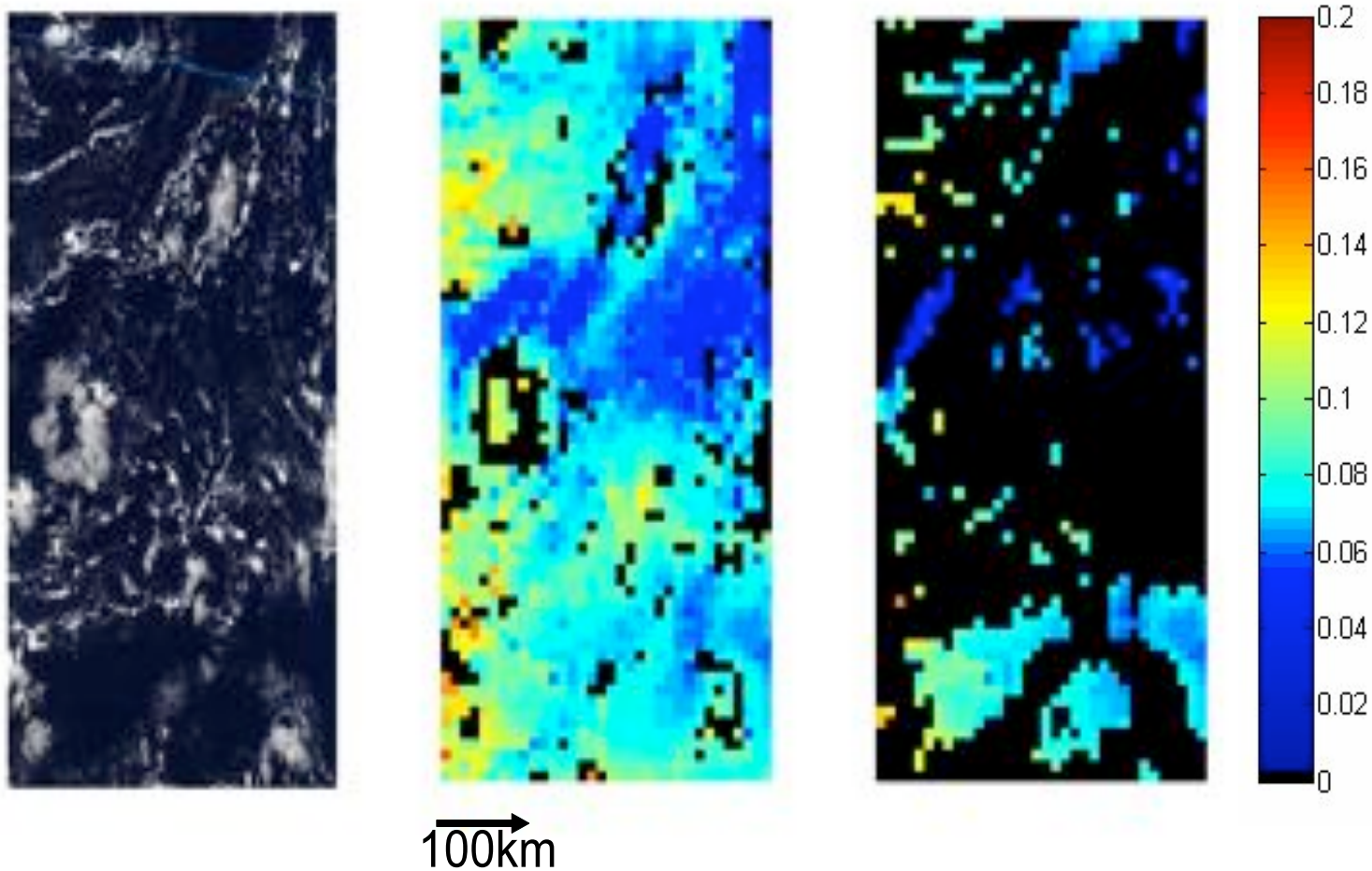
Remer and Kaufman (2006) estimates of global aerosol radiative effects **correct** for this **known** contamination.

All clouds



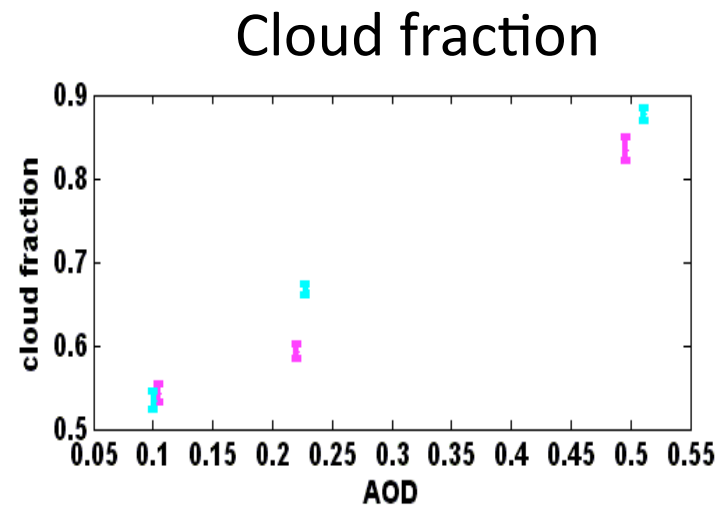
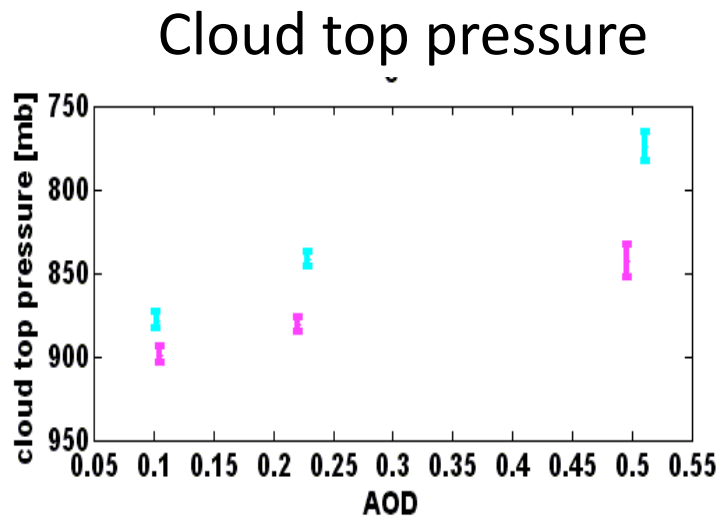
Kaufman et al. (2005)

Very similar conclusions to the Zhang et al. paper
that came out later



Severely restrict data to AOD retrievals where cloud fraction < 20%

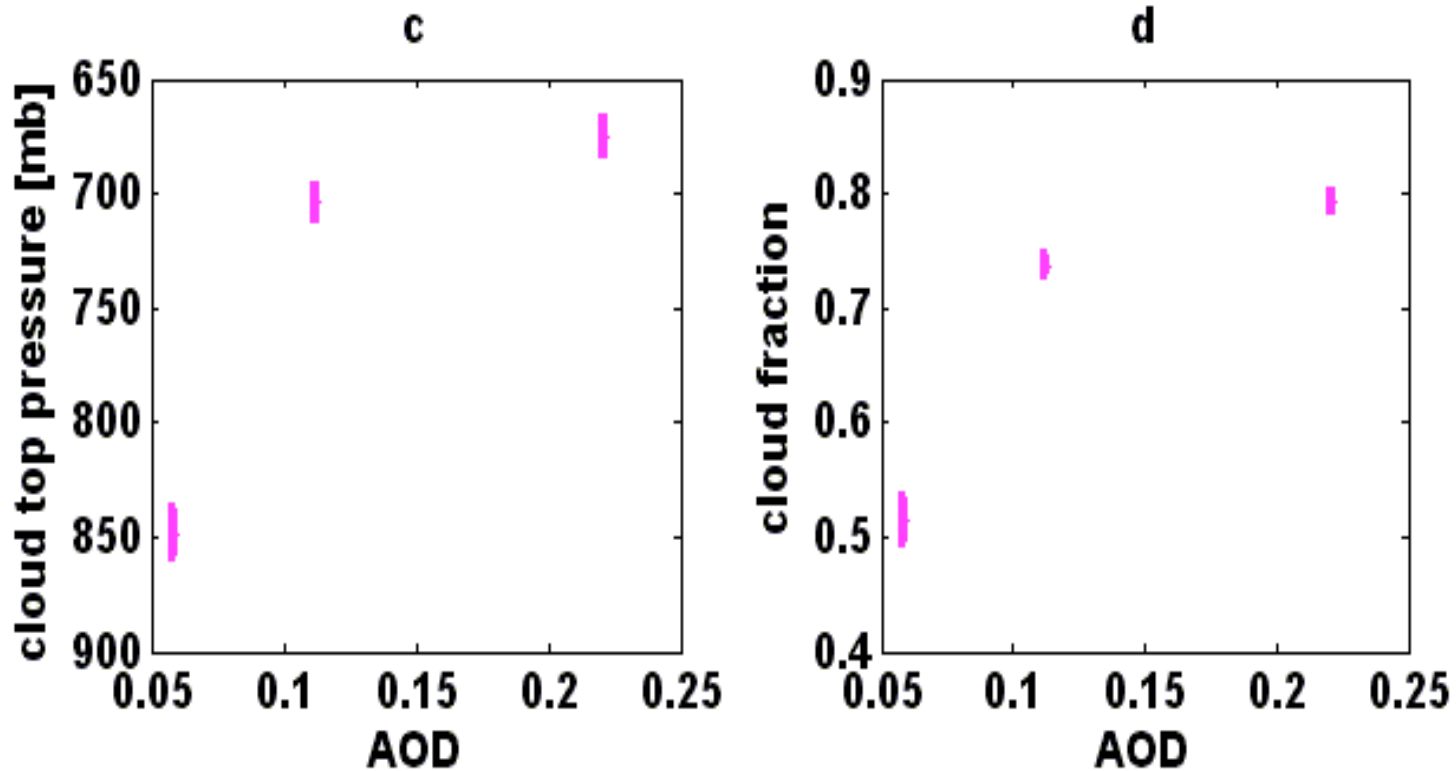
Koren et al. (ACPD)



Both “all data” and “cf < 20%” data sets
Show same relationships with AOD

Koren et al. (ACPD)

Using GOCART AOD with MODIS cloud parameters



Show similar cloud-aerosol relationships as with MODIS AOD

Koren et al. (ACPD)

Conclusion:

There is cloud contamination in the aerosol product.

There is **well-known and well-characterized**
cloud contamination in the aerosol product.

Be smart.

Criticism (3)

01110111

This is good?

There are 10 types of people in the world

Those who understand binary
and those who do not

Quality flags are important

Land

QAC value	N	Mean AOD AERO	Mean AOD MODIS	Regression equation	R	RMS	% in EE
0	10743	0.220	0.222	$y = 0.698x + 0.049$	0.794	0.146	50.34
1	5484	0.177	0.207	$y = 0.990x + 0.020$	0.860	0.114	66.10
2	10710	0.183	0.211	$y = 1.005x + 0.015$	0.872	0.116	67.75
3	58526	0.199	0.198	$y = 0.988x + -0.004$	0.905	0.106	72.60
≥ 1	74720	0.195	0.201	$y = 0.989x + -0.000$	0.896	0.109	71.43
≥ 0	85463	0.198	0.203	$y = 0.952x + 0.005$	0.882	0.116	68.78

QA=3 provides the best retrieval

QA=0 data products should **NOT** be used.

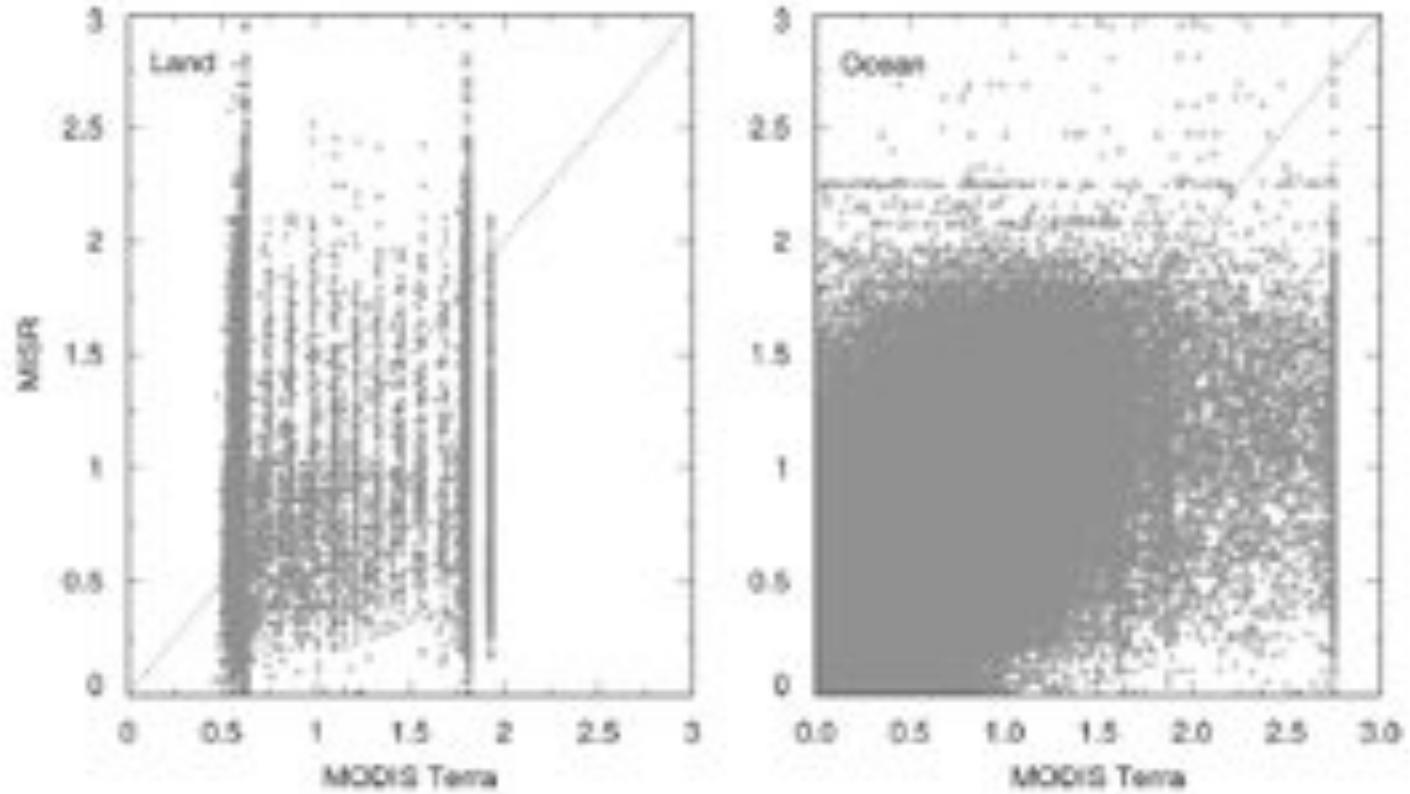
Conclusion:

We will provide a simple integer QA flag

Users should look at these flags

(4) Why do the EOS aerosol sensors
give us different results?

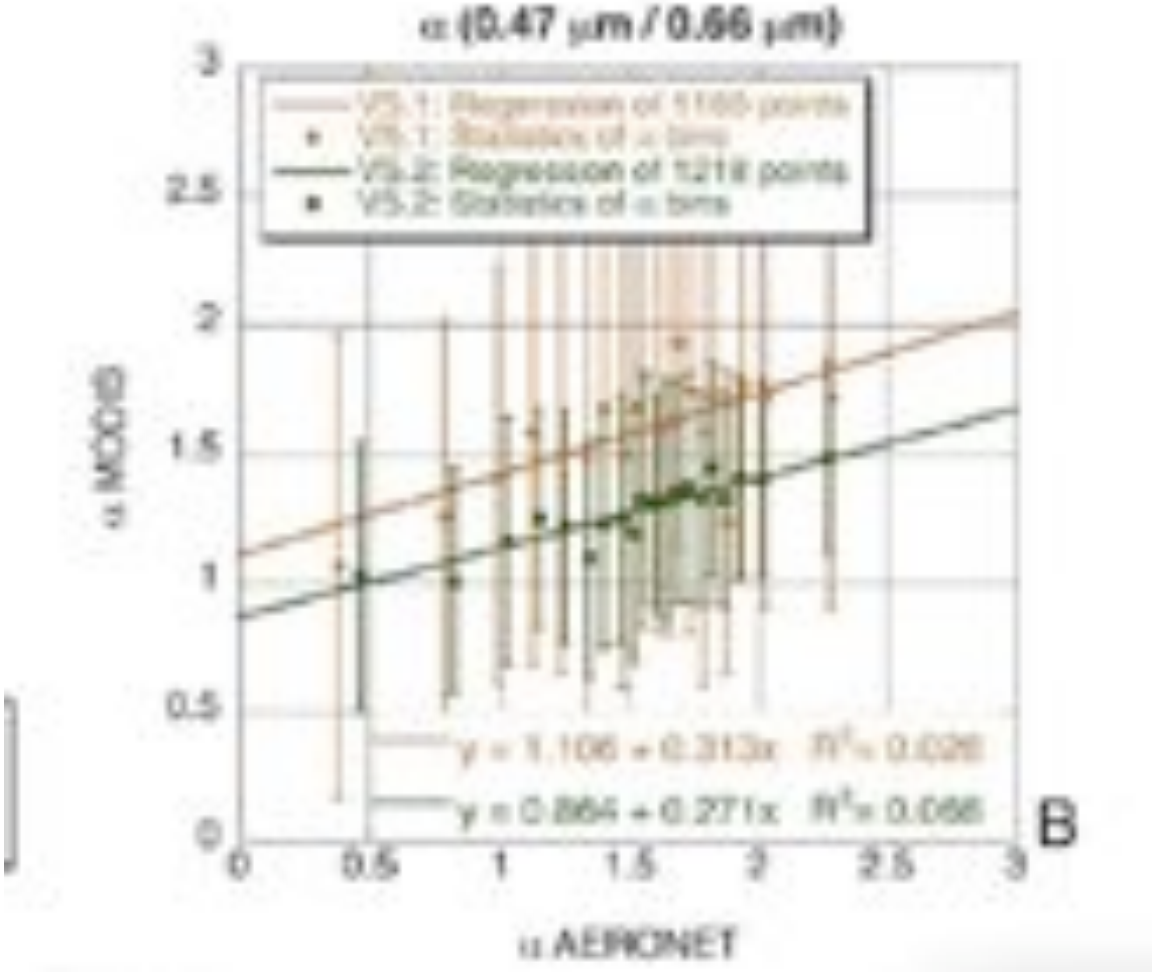
Angstrom Exponent



All QAC. All values of AOD

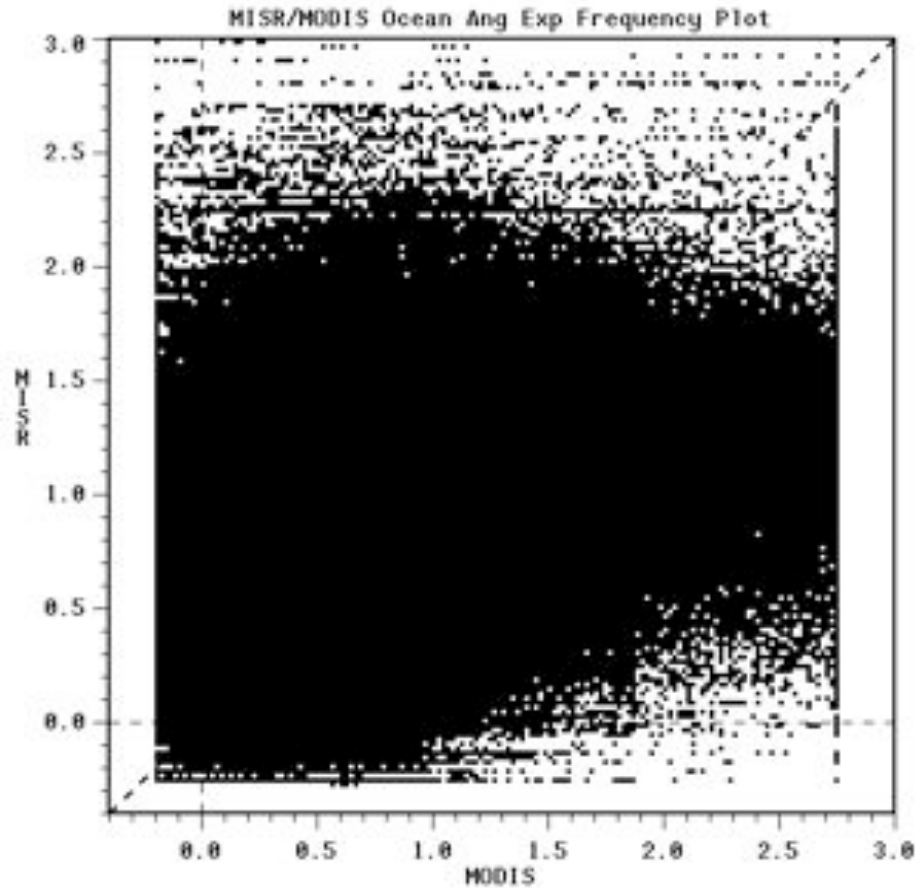
Liu and Mishchenko (2008)

Angstrom Exponent Land

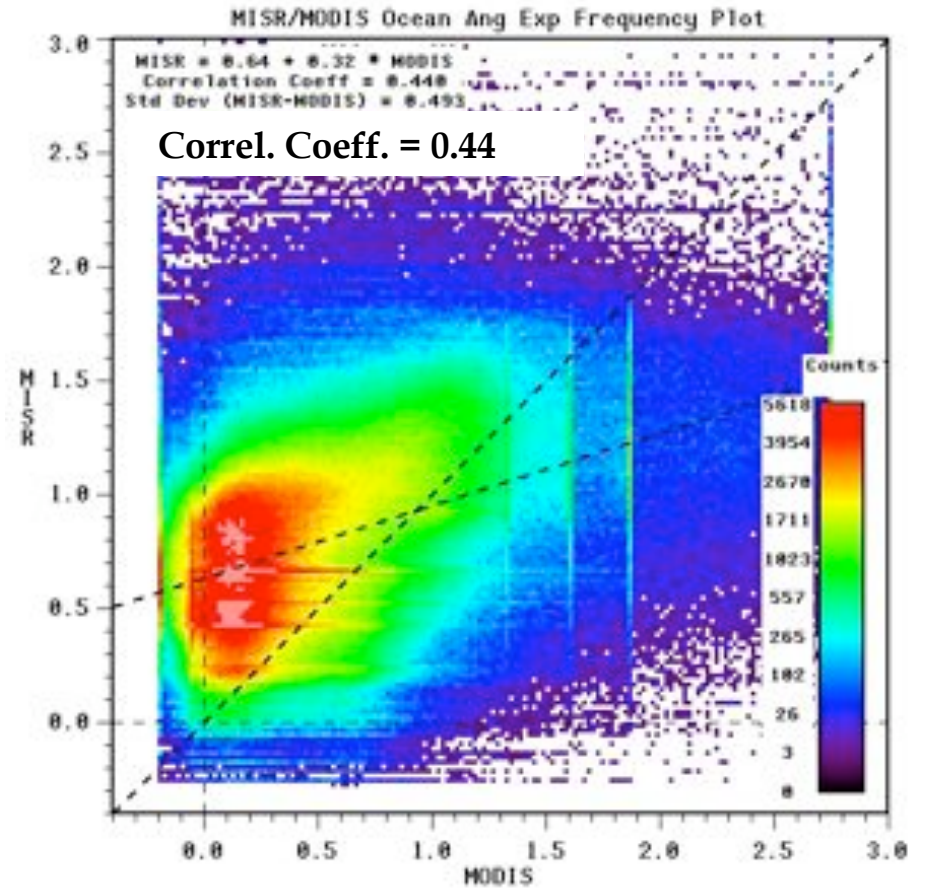


Levy et al. (2007)

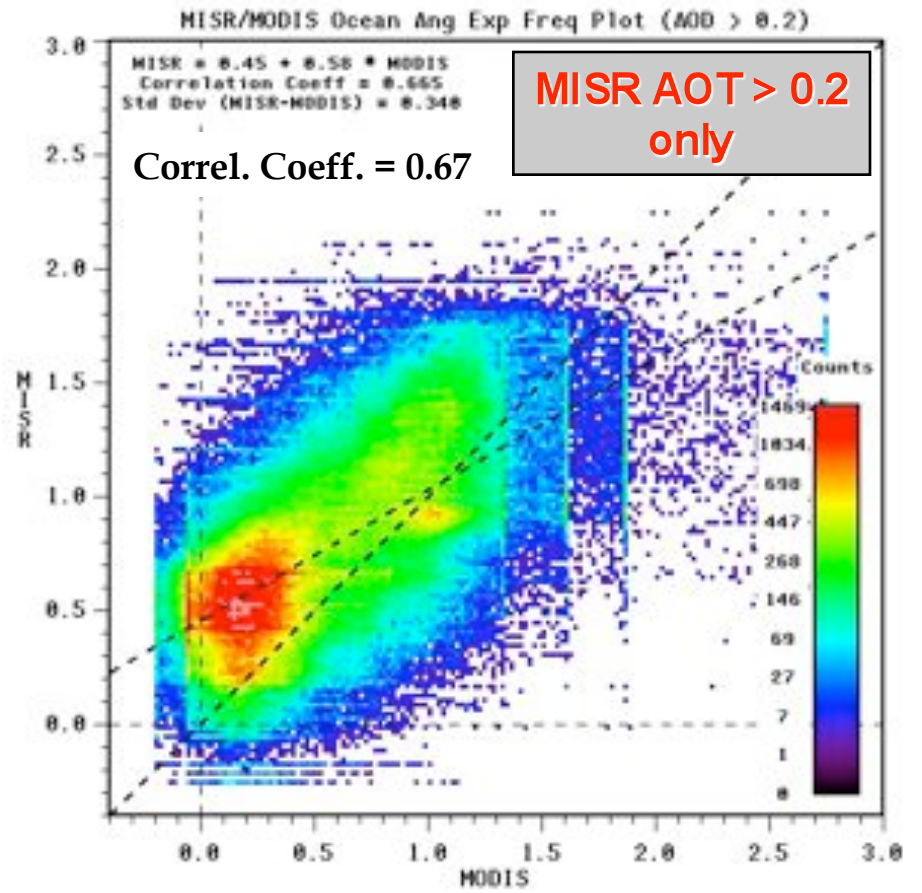
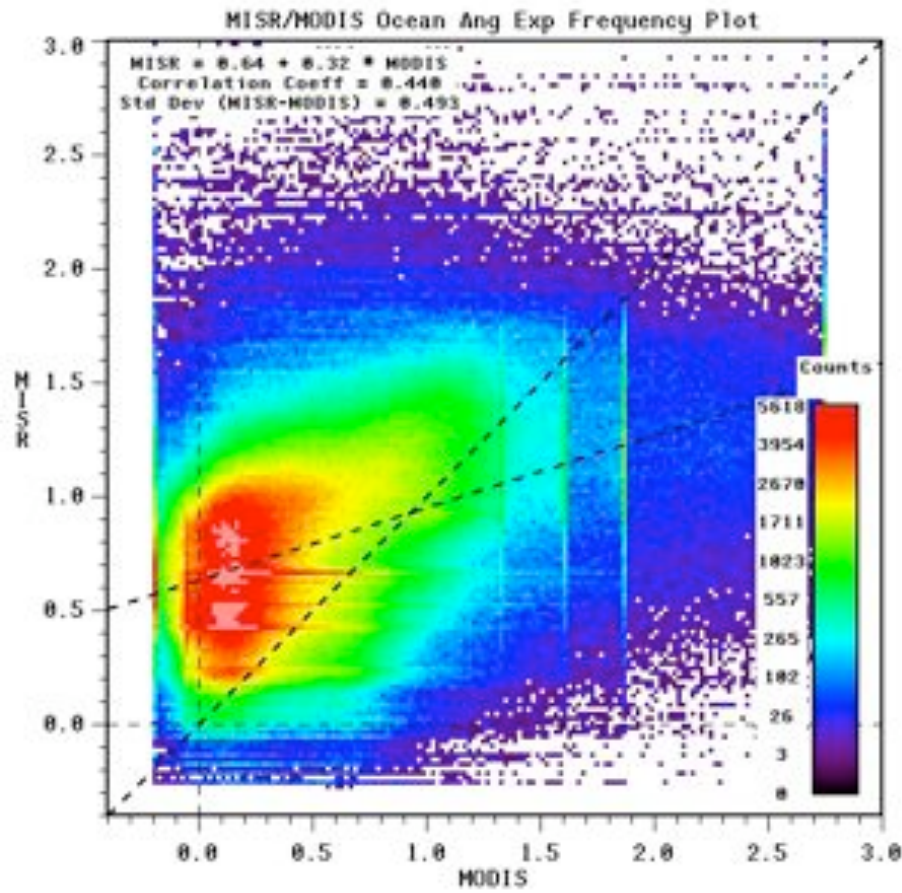
Angstrom Exponent Ocean



Liu and Mishchenko (2008)



Kahn et al. (2009)



Kahn et al. (2009)

Conclusions:

The EOS sensors give us different aerosol results because

- there are inherent limitations in information content
- inherent differences in sampling
- uncertainties introduced by calibration
- limited resources for attacking a global problem
- the real world includes clouds

The MODIS aerosol team acknowledges that

- Documentation and guidance has been insufficient

But users MUST take RESPONSIBILITY also

Be smart