What to expect from the Collection 6 MODIS aerosol products (over land)

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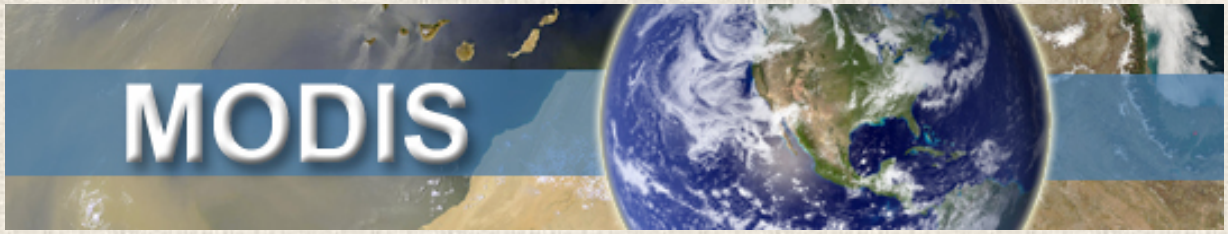
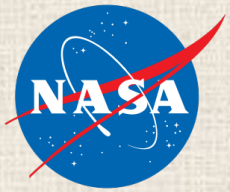


New and Updated Aerosol Products

MODIS 3 KM, MAIAC and VIIRS

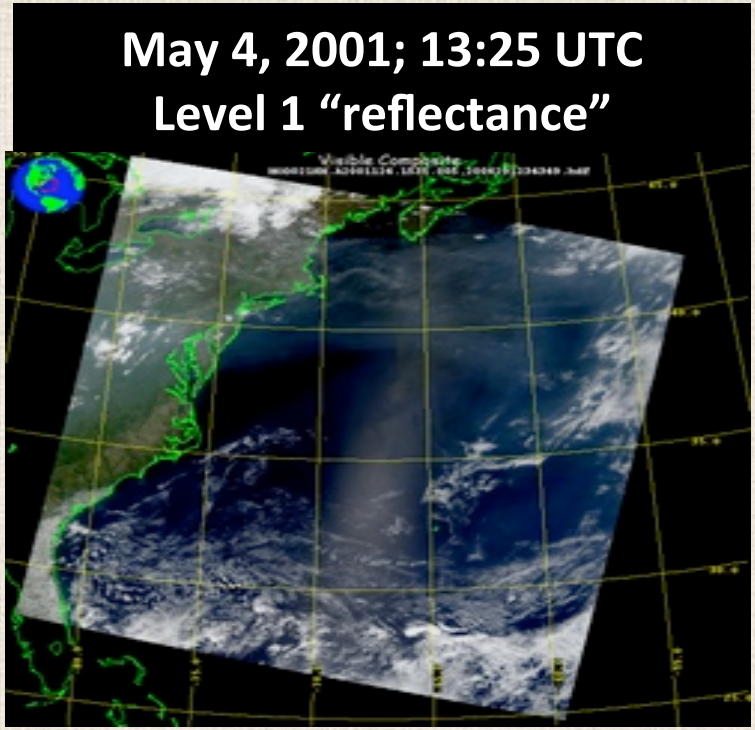
TCEQ Training Course
February 24 – 27, 2014

ARSET - The NASA Applied Remote SEnsing Training Program

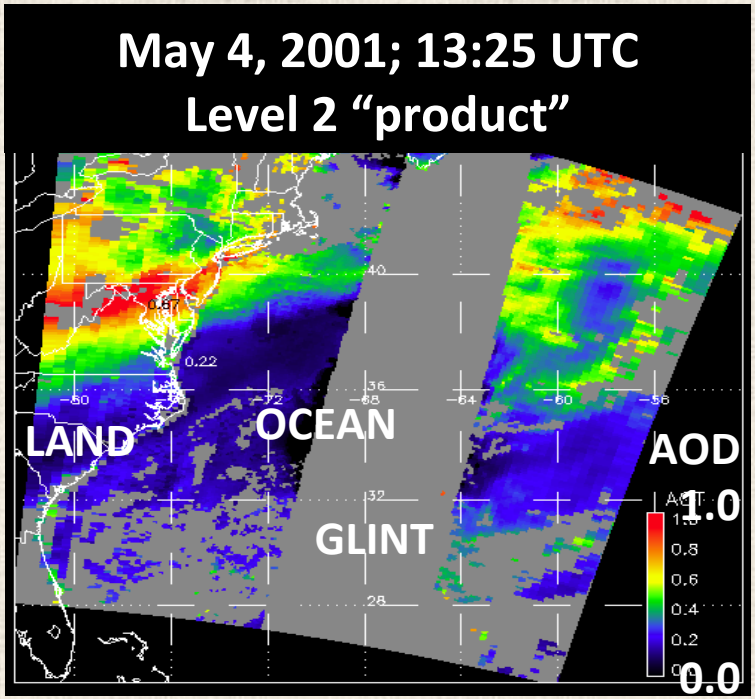


Aerosol retrieval from MODIS

What MODIS observes



Attributed to aerosol

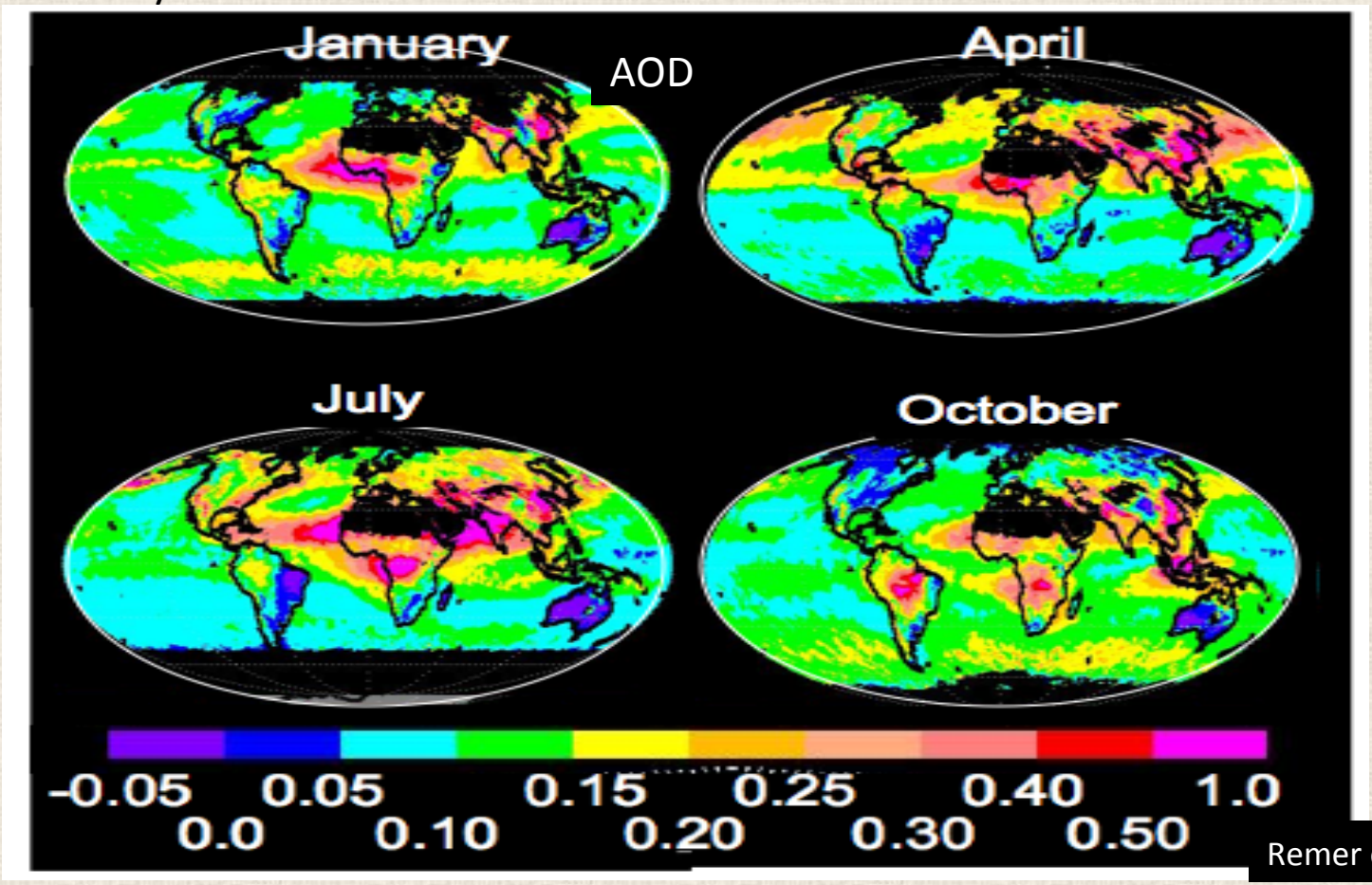


There are many different "algorithms" to retrieve aerosol from MODIS

1. Dark Target – 10 and 3 KM
2. Deep Blue – 10 KM
3. MAIAC – 1 KM
4. Regional Retrievals
5. Ocean color/atmospheric correction

A MODIS view of global aerosol system (over dark targets) Collection 5

As envisioned by Y. Kaufman and D. Tanré
And produced by the MODIS-aerosol team at NASA GSFC

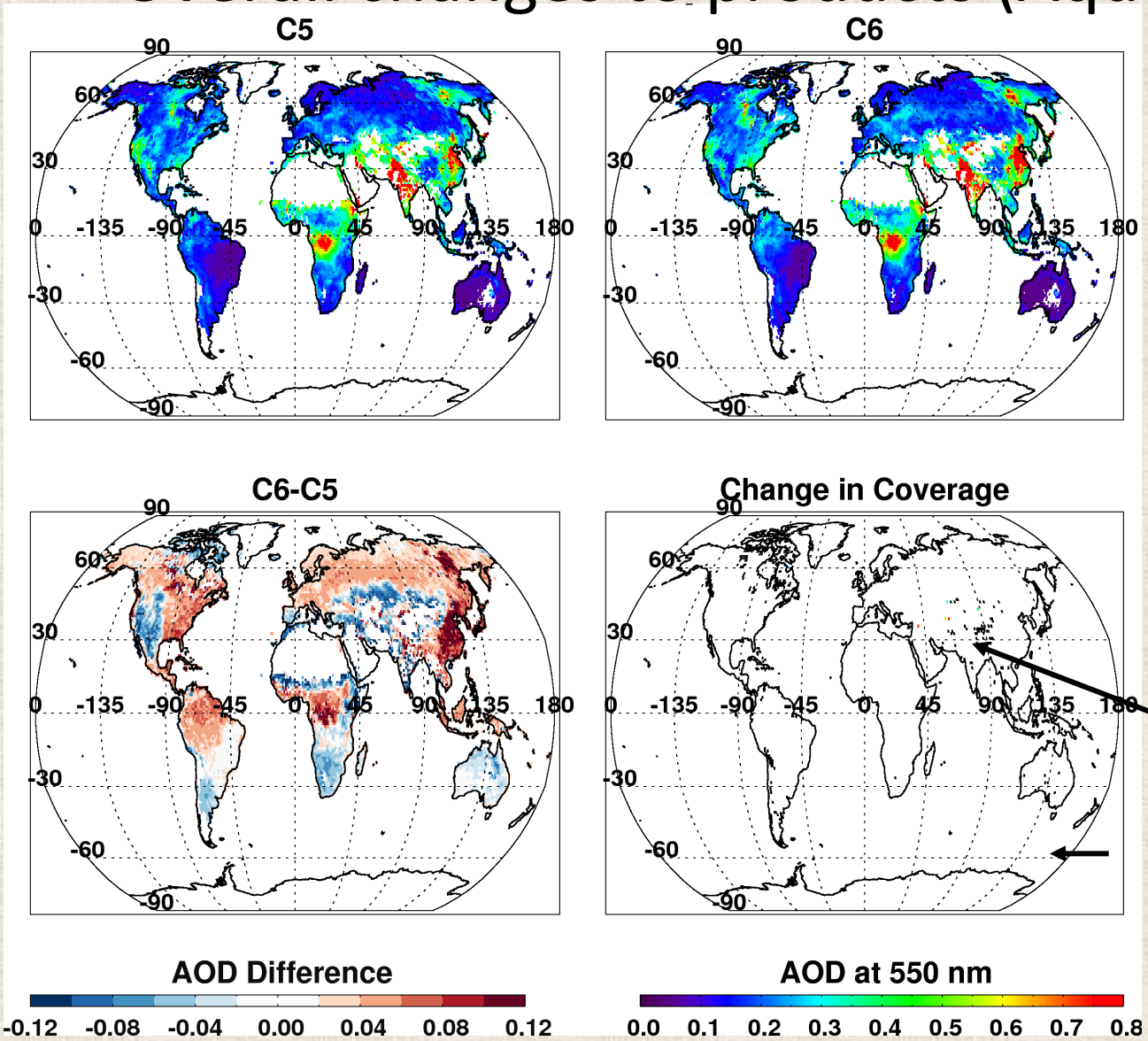


Remer et al, 2008

We have two sophisticated sensors (aboard Terra and Aqua), with stable orbits, excellent calibration teams and validated aerosol retrievals.

Changes to Aerosol over land
C6 compared to C5

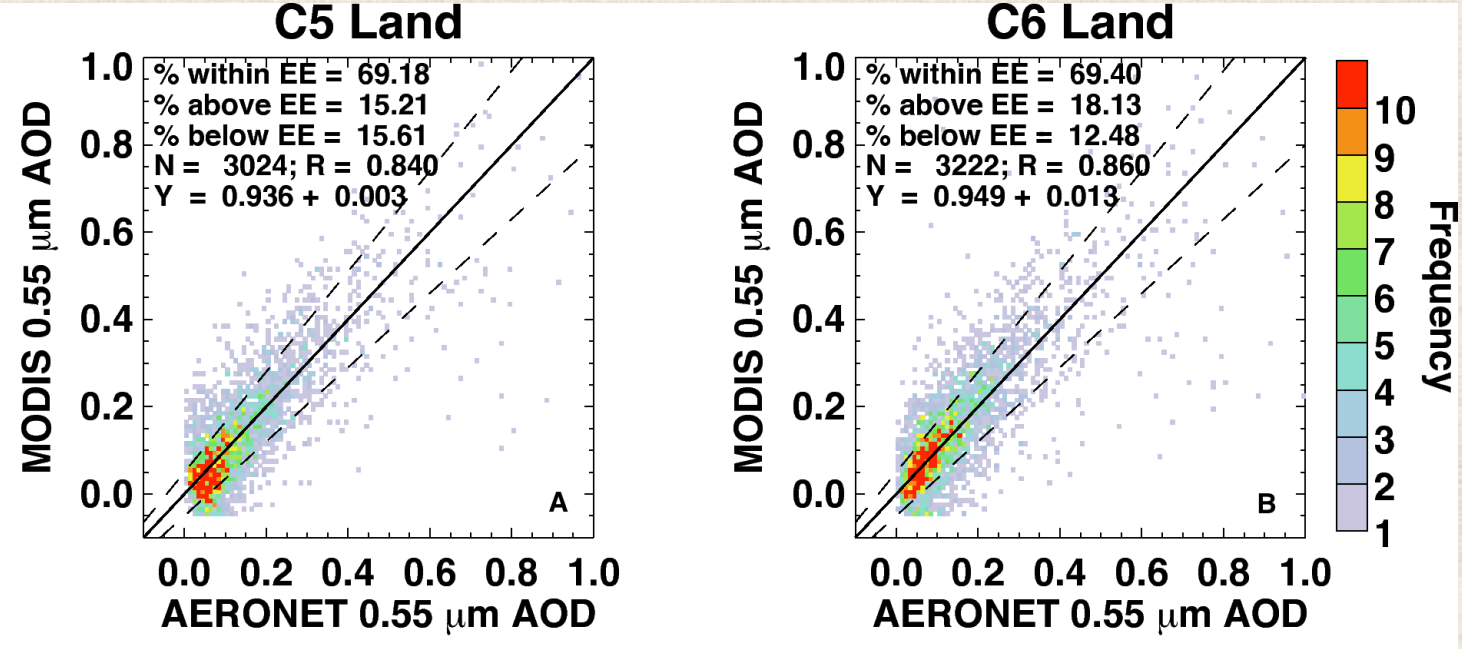
Dark target over land
Overall changes to products (Aqua, Jul 2008)



- Overall decrease of AOD in semi-arid
- Overall increase over vegetation
- Strong increase over Eastern Asia

- Slight change in coverage here and there

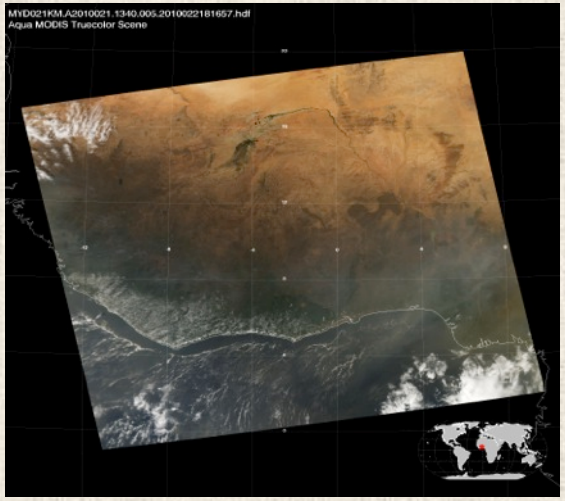
Comparison with AERONET



- Aqua for 8 months (Jan + July, 2003, 2008 and 2010; Apr + Oct 2008).
- Overall, not much change over land (slope, intercept, correlation)
- 8% more valid points to compare with (3222 versus 3024).
- More “spread out” along 1-1 line near zero.

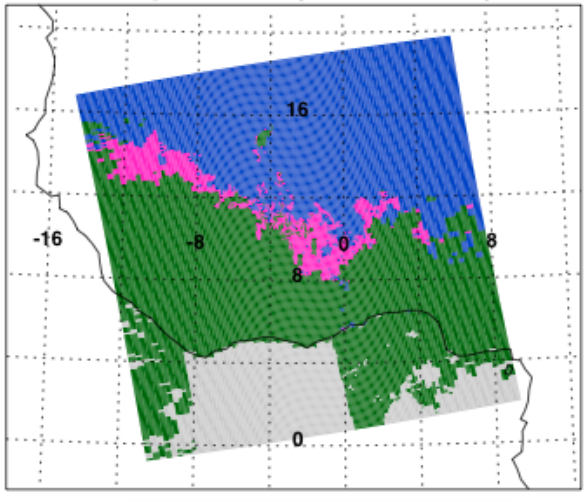
The Dark/Deep merge

Jan 21 2010 at 13:40 UTC

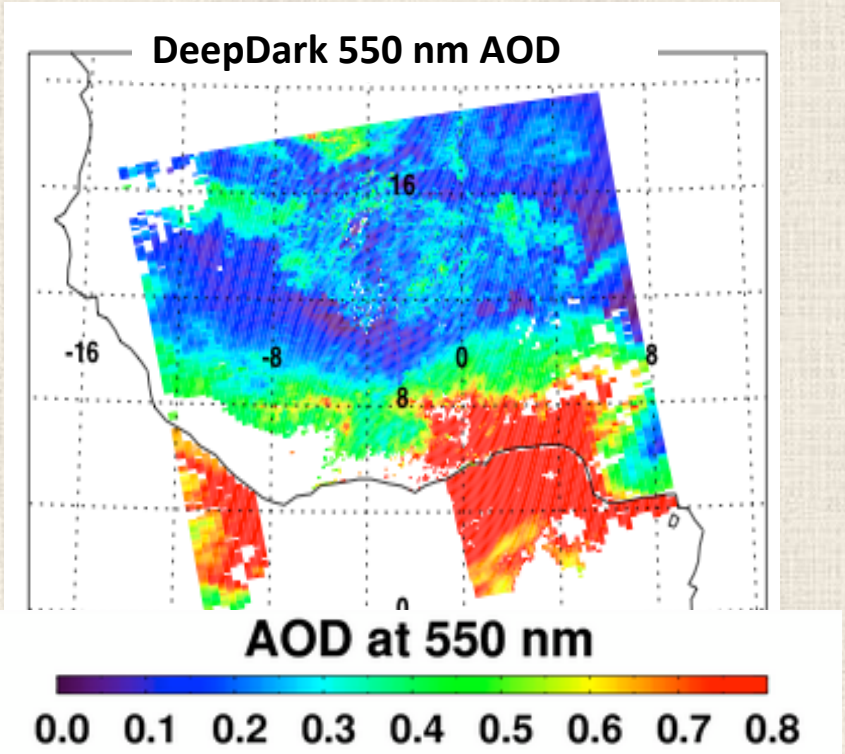


- **Dark, bright, and transitional regions are identified by a vegetation index**
- **In Dark regions, value from dark-target retrieval is used**
- **In bright regions, value from deep-blue is used**
- **In transition regions, AOD is merged, dependent on QA of retrievals**

DeepDark Algorithm Flag

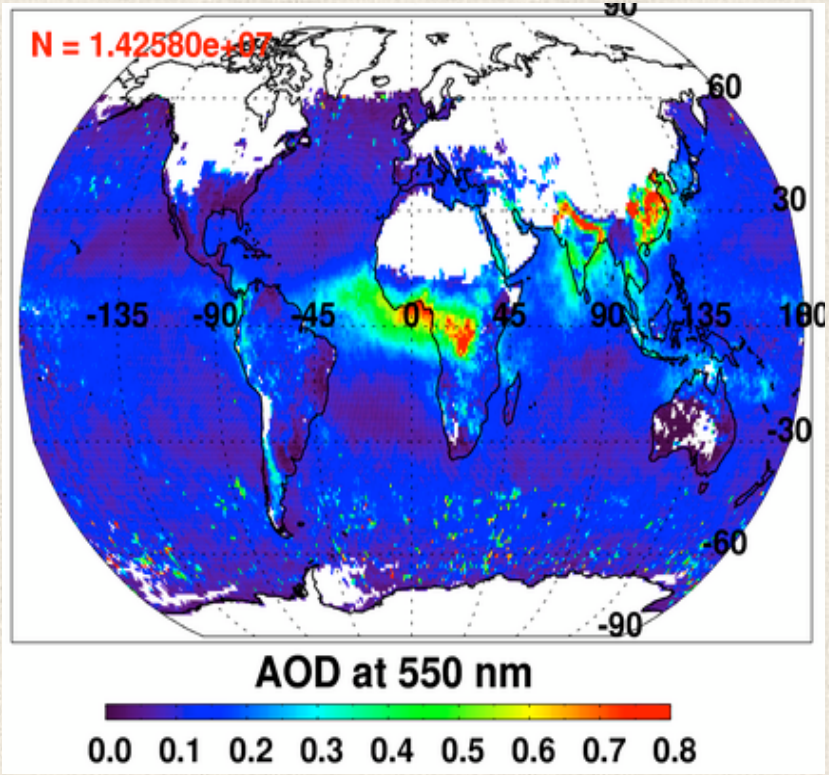


DeepDark 550 nm AOD

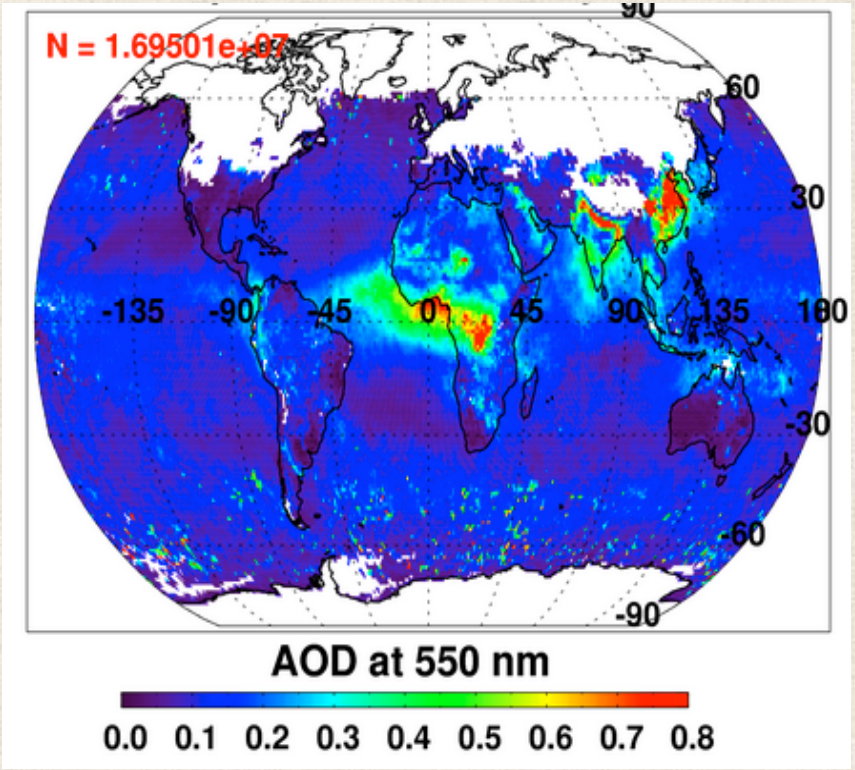


Monthly mean AOD for Aqua, January 2010

Dark Target AOD



DeepDark AOD

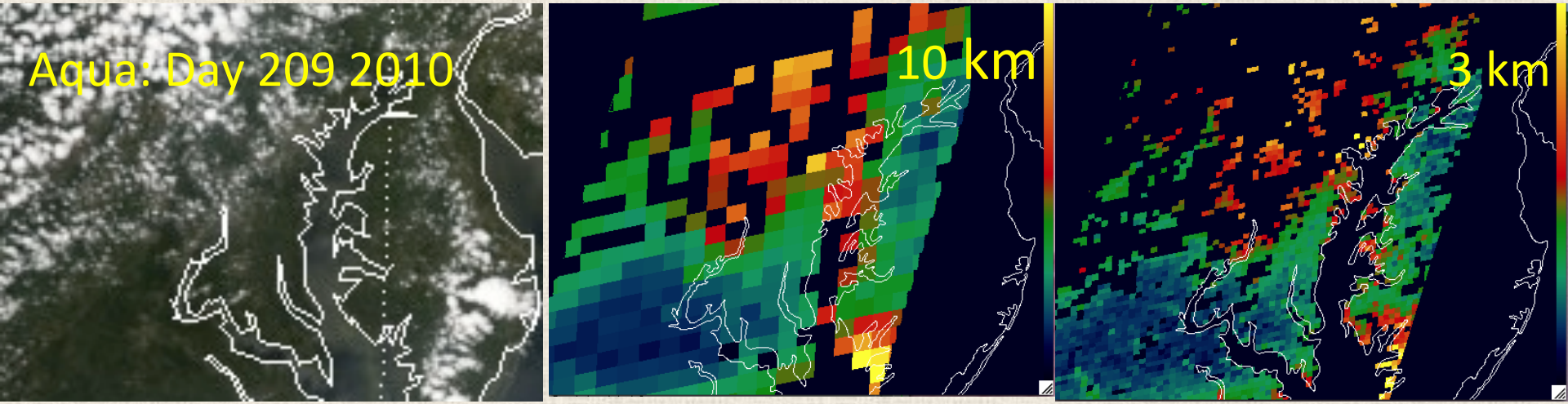


Merging deep blue & dark target produces best global coverage

- **Deep blue is land-only; need dark target for oceans**
- **Deep blue introduces coverage over desert areas**
- **Still no coverage over snow (see: most of Northern Hemisphere).**

MxD04_3K (a new 3 km aerosol product)

- Driven by air quality community,
- Maybe also some applications to aerosol/clouds.
- Currently Dark target only

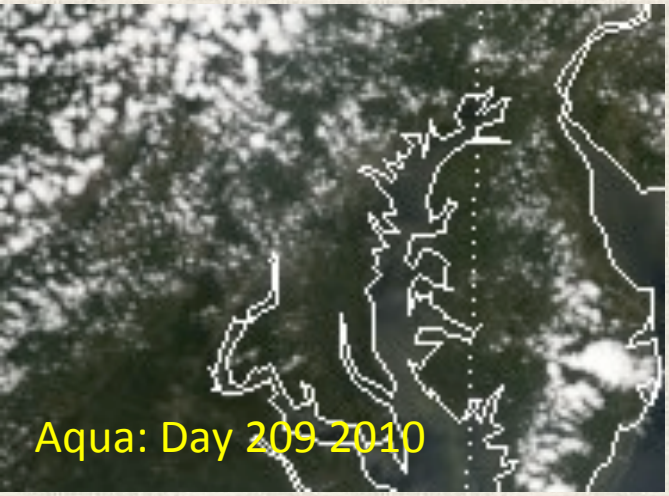


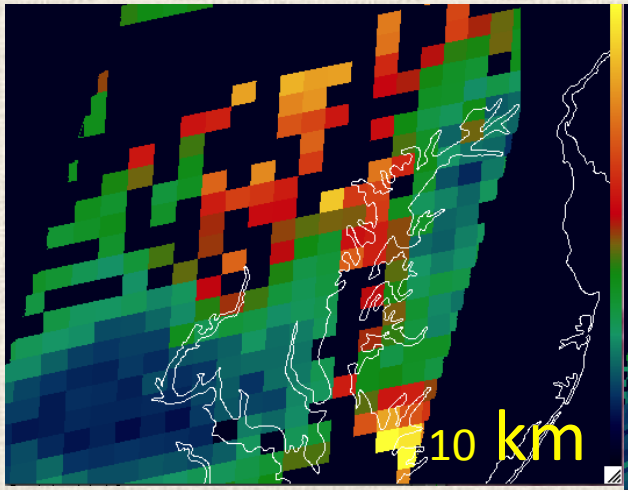
MODIS 3 km product (operational for C006)
Aqua processing to begin soon

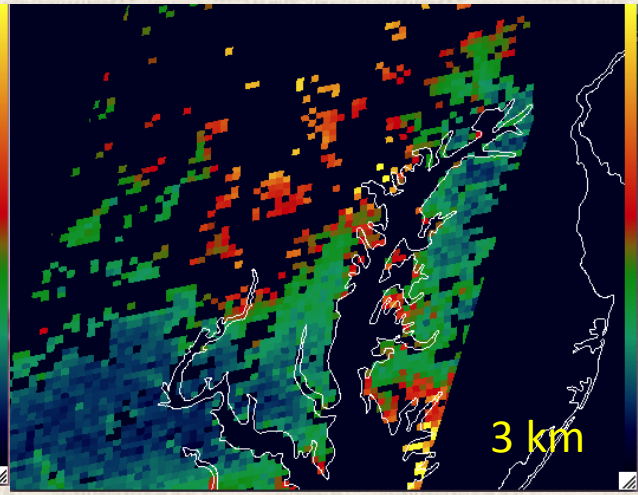
- Algorithm nearly identical to standard "10 km" MODIS retrieval
- Results will be in new files, ***'MOD04_3K'***
- Both MOD04_L2 and MOD04_3K will be available

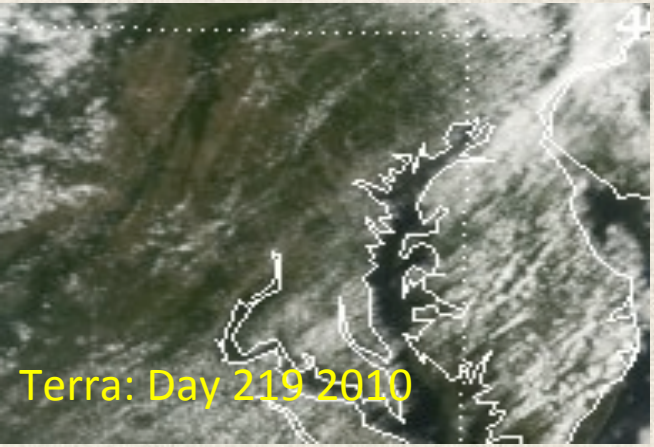
S. Mattoo, L. Munchak, M. Martins, L. Remer, B. Holben, et al

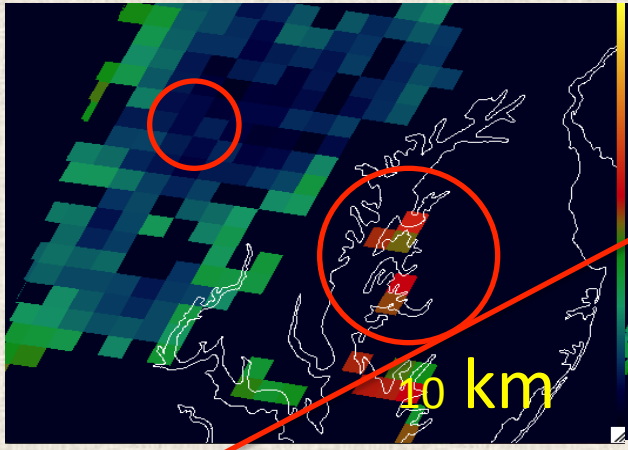
MODIS 3 km product over suburban (MD) landscape (summer 2010)

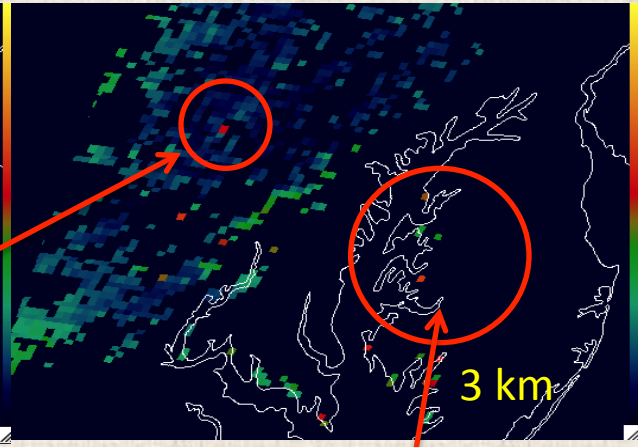






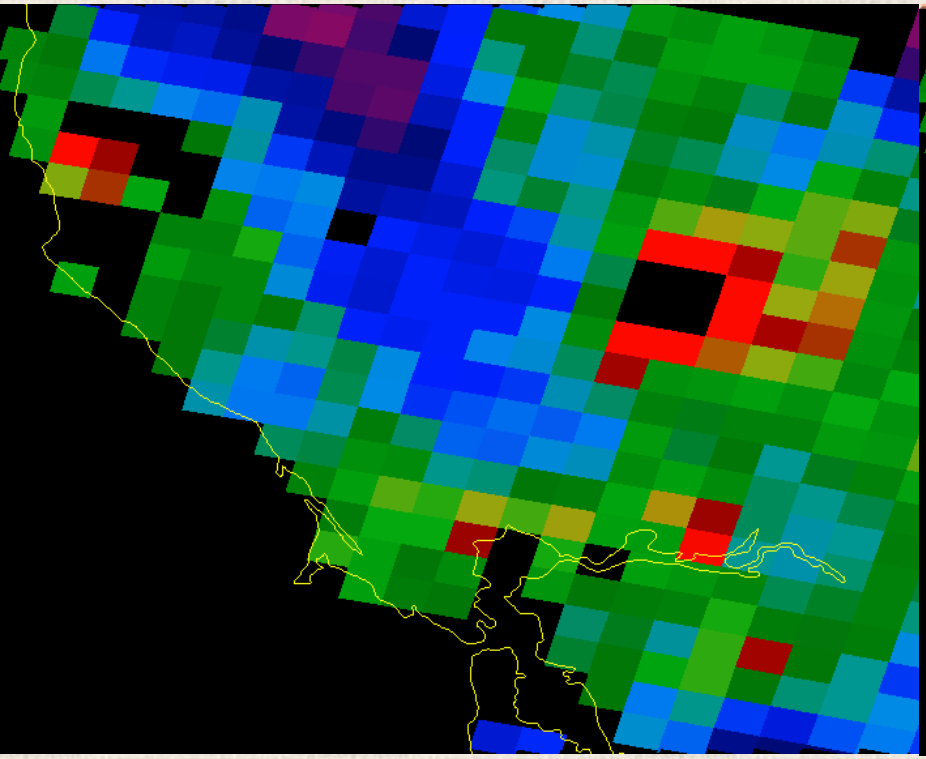


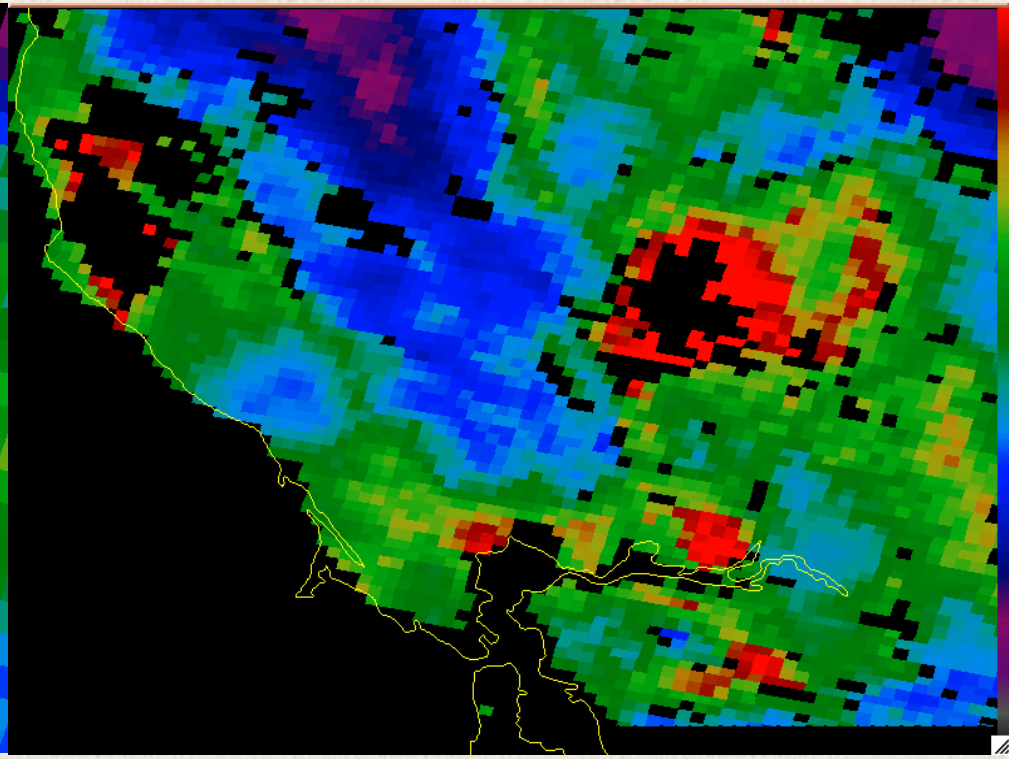




- 3 km mirrors 10 km product (pattern and magnitude)
- 3 km introduces noise, but also can reduce spatial impact of outliers

MODIS 10 KM and 3 KM Products





Some differences are due to smoothing and sampling method.

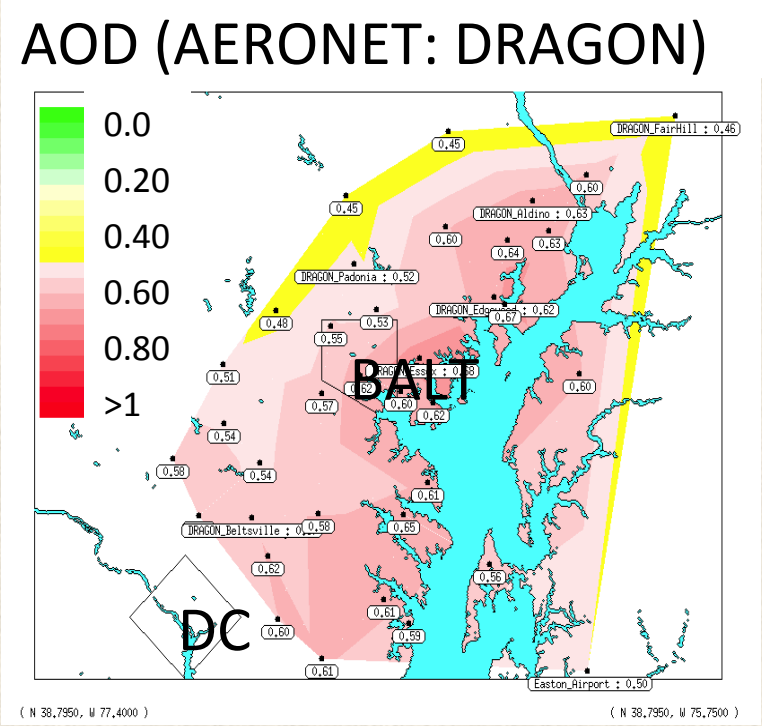
MODIS 3 km product compares with AERONET (DRAGON-2010)

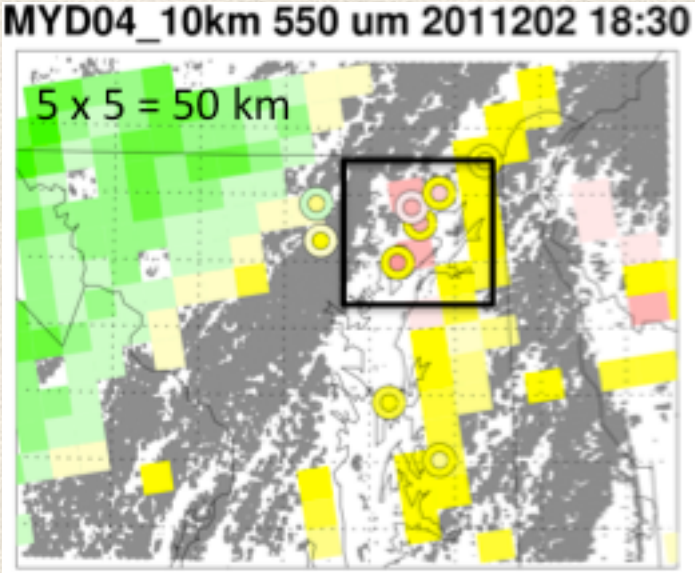
Multiple AERONET sites in Maryland

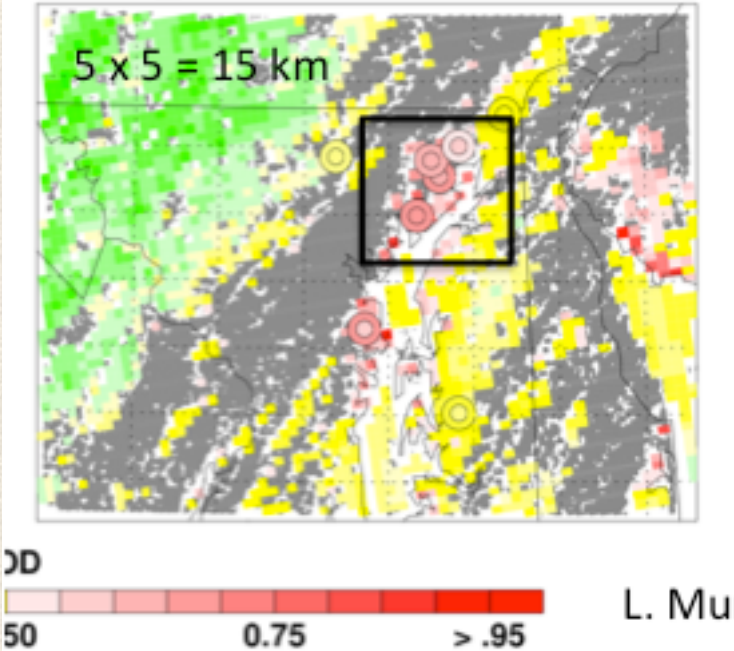
station	AERONET	MODIS 3 km	MODIS 10km
BLTIM	0.29	0.28	0.17
LAUMD	0.26	0.24	0.20
OLNES	0.23	0.22	0.09
RCKMD	0.25	0.33	0.19

- Overall, 3 km mirrors 10 km “validation”.
- 3 km validation sometimes improves with higher resolution matching

MODIS vs DRAGON
July 21, 2011





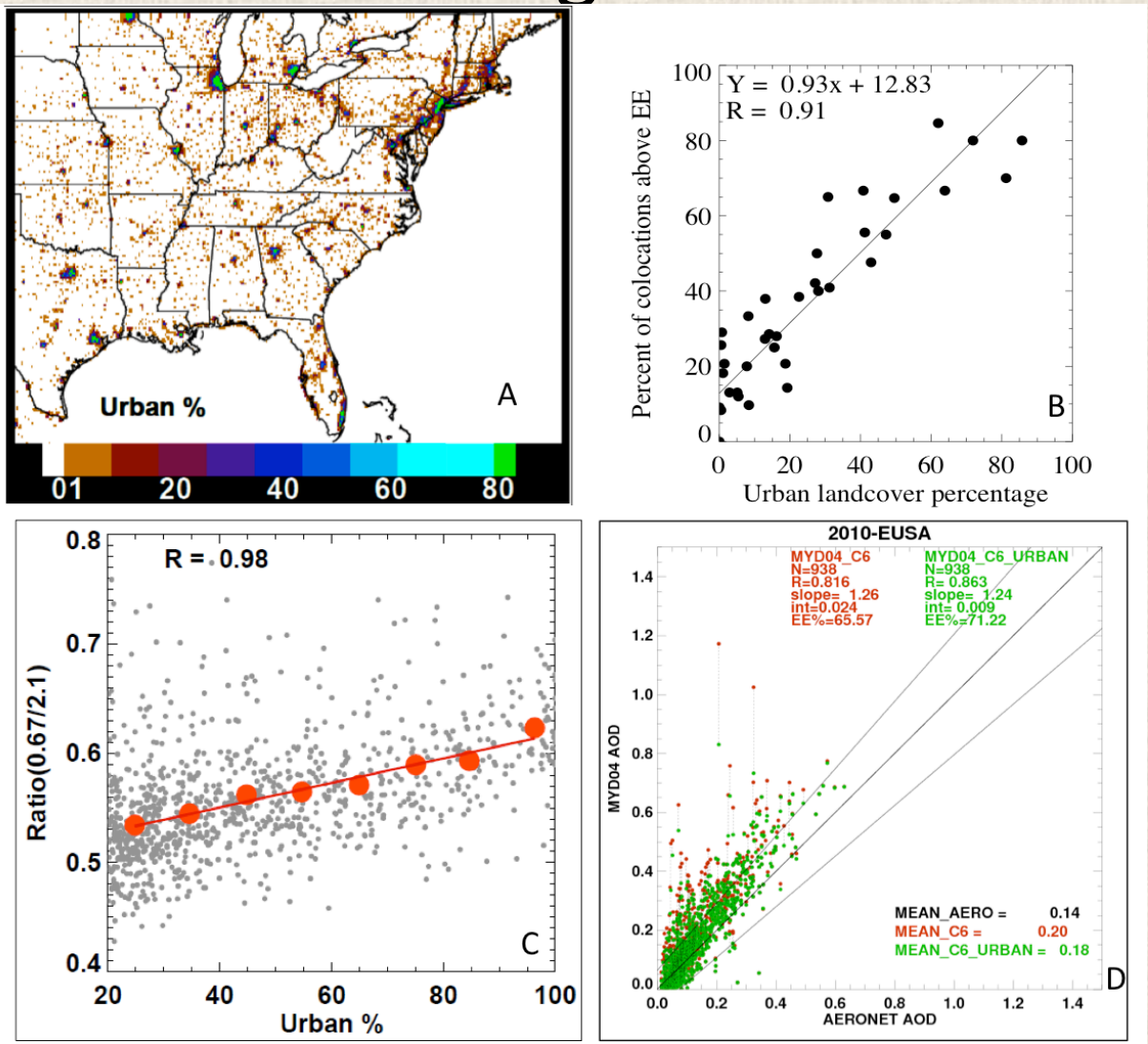


- DRAGON = Many AERONET over Maryland during DISCOVER-AQ, July 2011
- Gray is MODIS-Aerosol cloud mask

- 3km (bottom) resolves Baltimore maxima
- 3km also resolves aerosol over Ches. Bay

L. Munchak

Accounting for Urban bias



More urban --> higher bias

Over MD/DC during DISCOVER-AQ

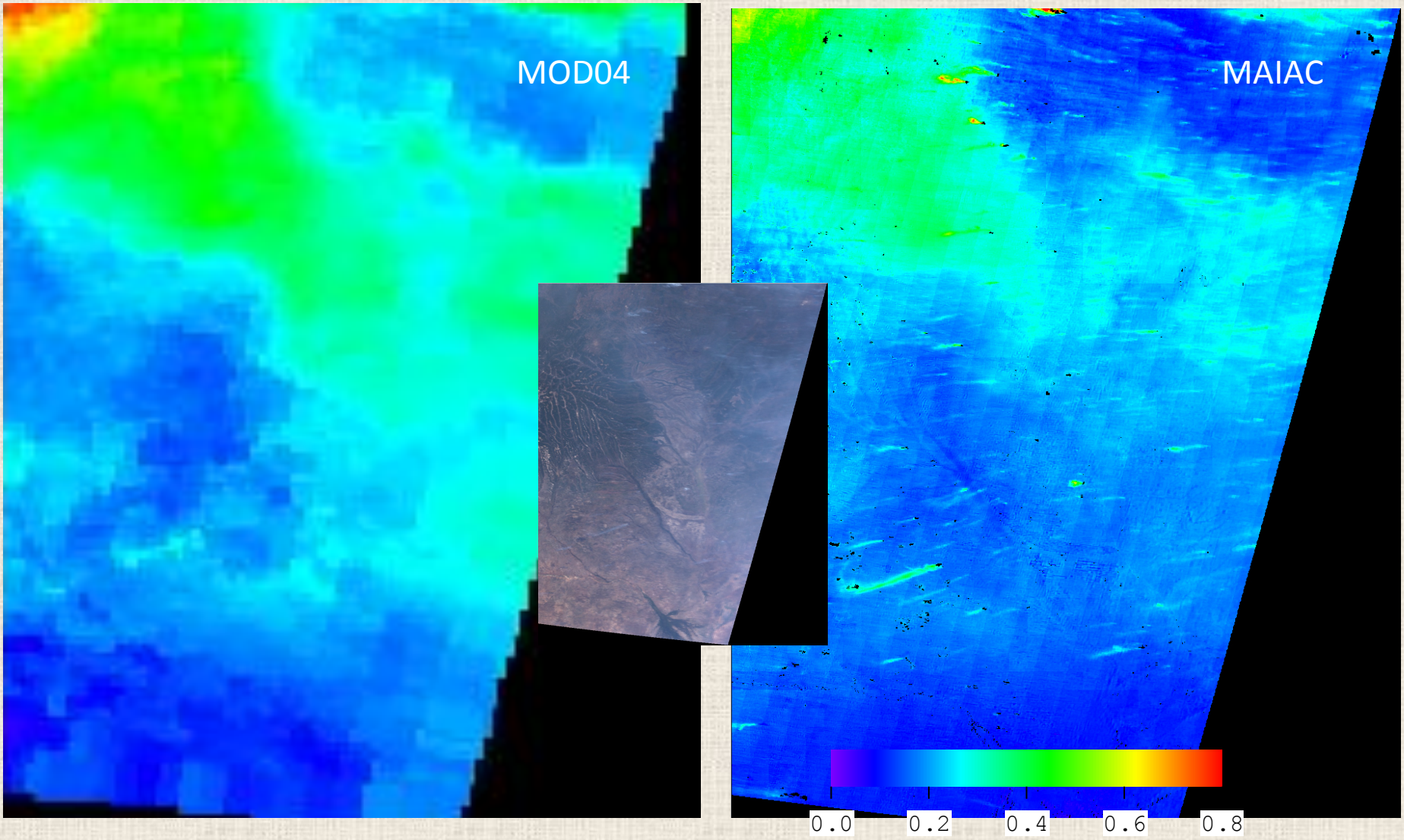
Looking at possible corrections

Applied to E-USA over 2010

- Can we reduce artificial urban hotspots without impacting surrounding rural areas

MAIAC 1 KM MODIS AEROSOL Retrieval

Fires: Zambia, day 205, 2005. 1 km resolution of AOT allows tracing smoke plumes



Introducing VIIRS aerosol products

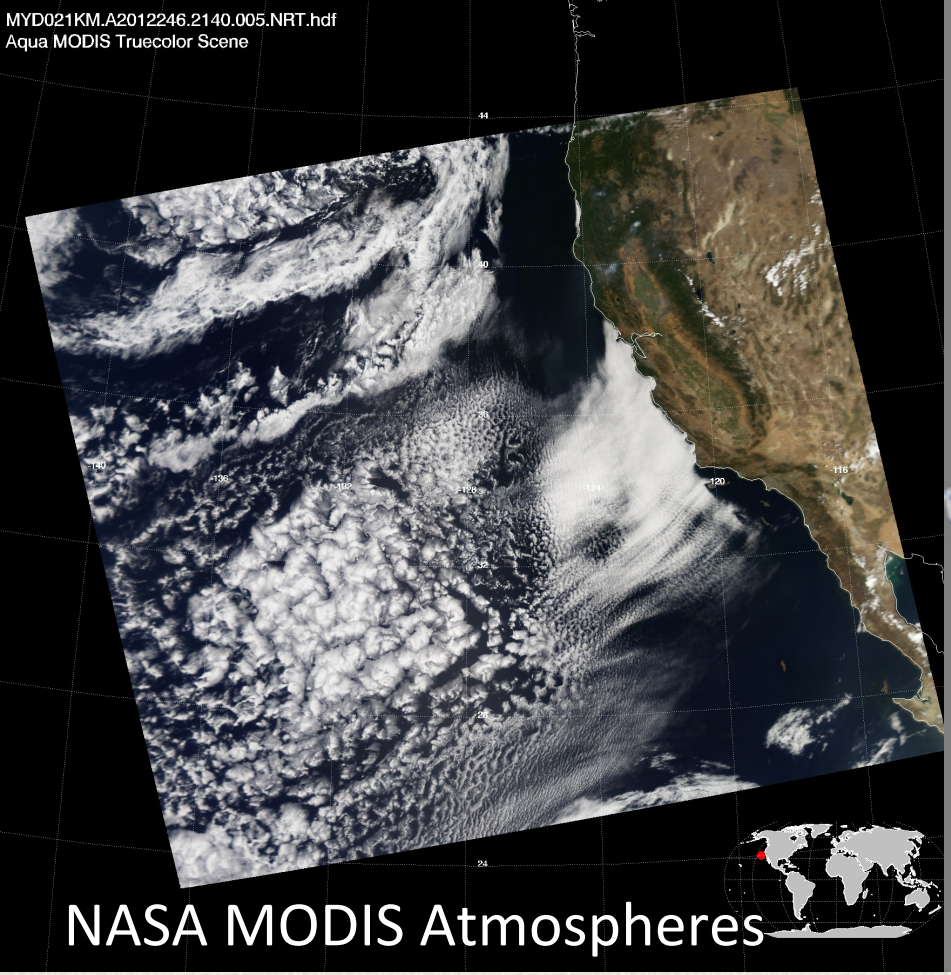
Lorraine A. Remer
JCET UMBC

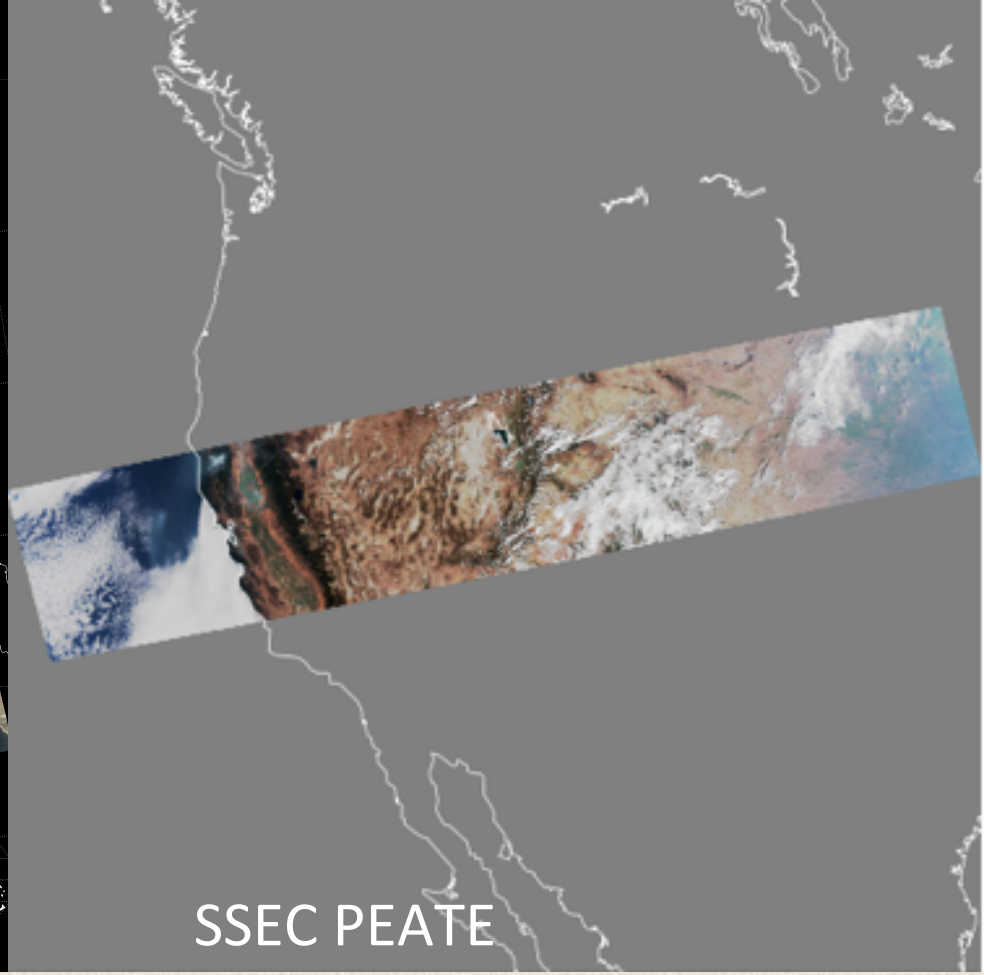
VIIRS Cal/Val Team:

Istvan Laszlo, Co-Chair	(NOAA-STAR)
Shobha Kondragunta, Co-Chair	(NOAA-STAR)
Hongqing Liu	(IMSG NOAA)
Jingfeng Huang	(ESSIC NOAA)
Ho-Chun Huang	(ESSIC NOAA)
Hai Zhang	(IMSG NOAA)
Sid Jackson	(Northrup-Grumann)
Edward Hyer	(NRL)
Min Oo	(SSEC U.Wisc.)
Andrew Sayer	(USRA NASA)
N. Christina Hsu	(NASA-GSFC)
Robert Holz	(SSEC U.Wisc.)

VIIRS is a multiwavelength imager, like MODIS with similar wavelength bands in the aerosol range

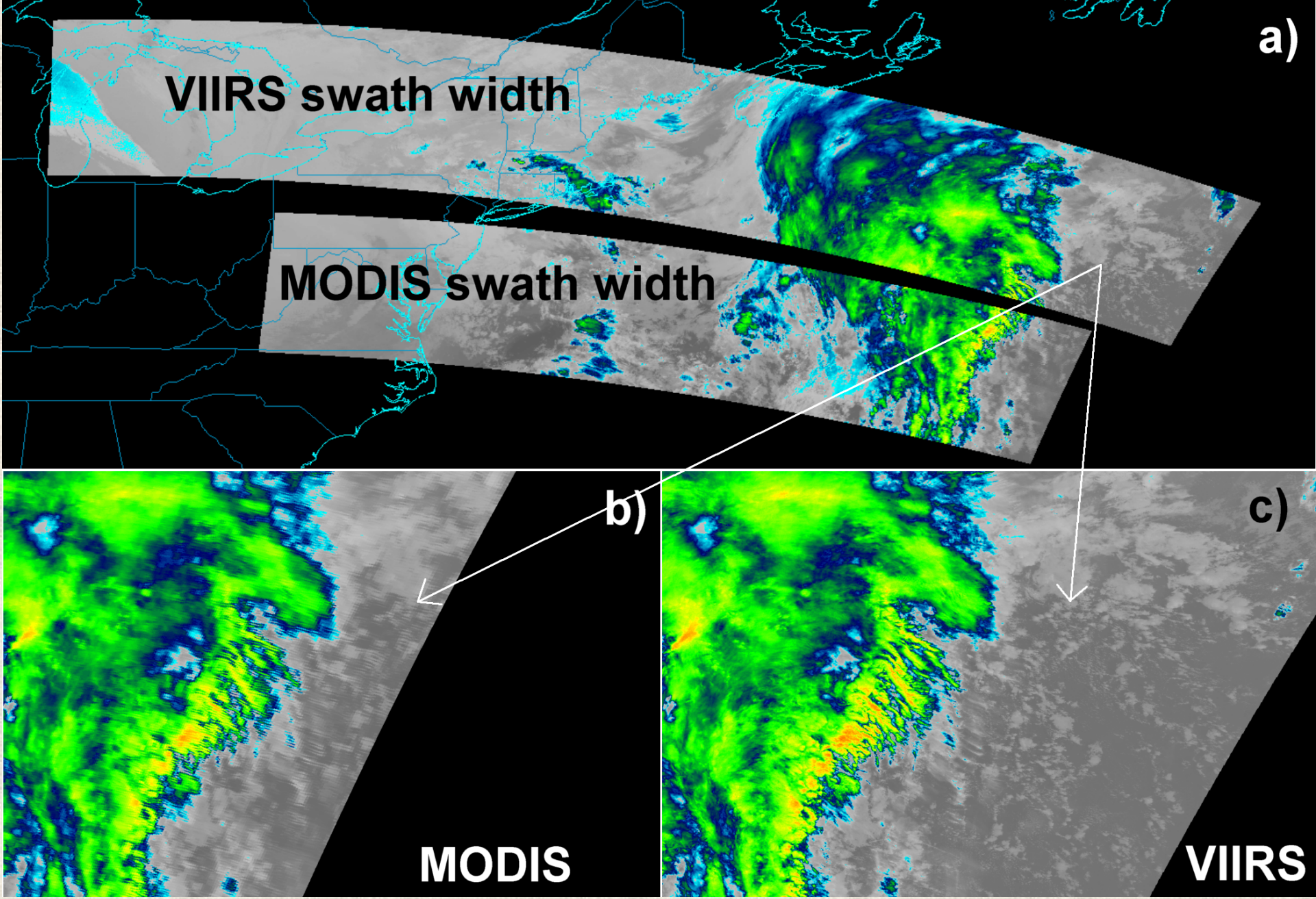
	MODIS	VIIRS
Orbit altitude	690 km	824 km
Equator crossing time	13:30 LT	13:30 LT
Granule size	5 minutes	86 seconds
swath	2330 km	3000 km
Pixel nadir	0.5 km	0.75 km
Pixel edge	2 km	1.5 km



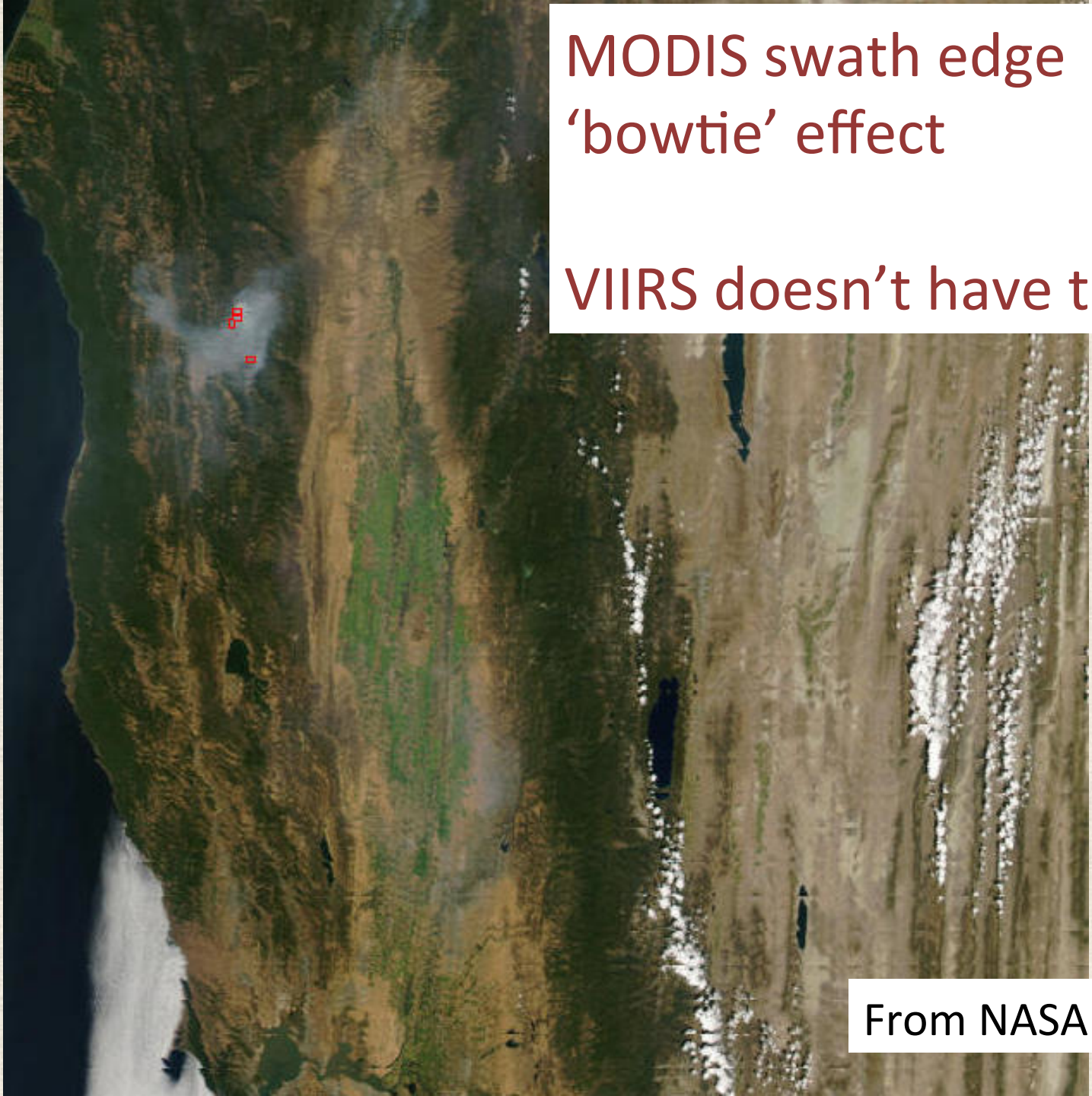


MODIS
0.66 – 0.55 – 0.47 µm
2 Sep 2012
21:40 UTC

VIIRS
0.67 – 0.55 – 0.49 µm
2 Sep 2012
20:24:27.8 UTC



Don Hillger, NOAA



MODIS swath edge ‘bowtie’ effect

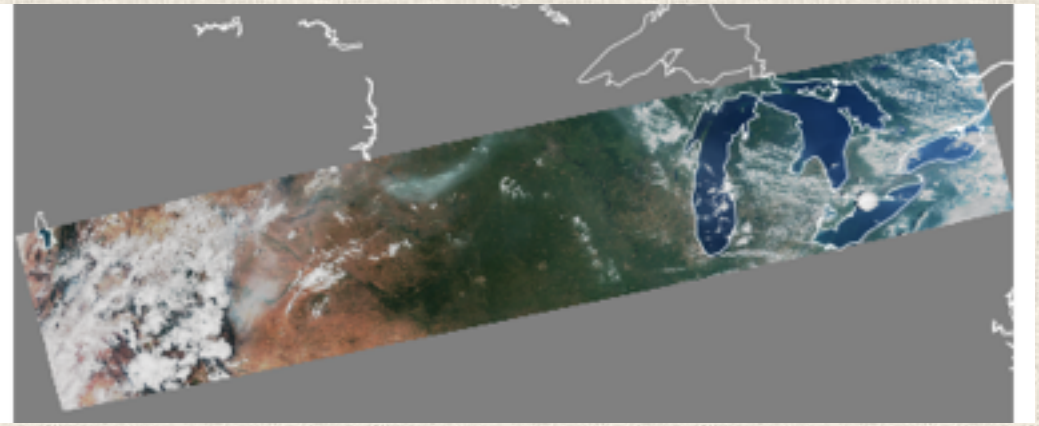
VIIRS doesn’t have this

From NASA LANCE

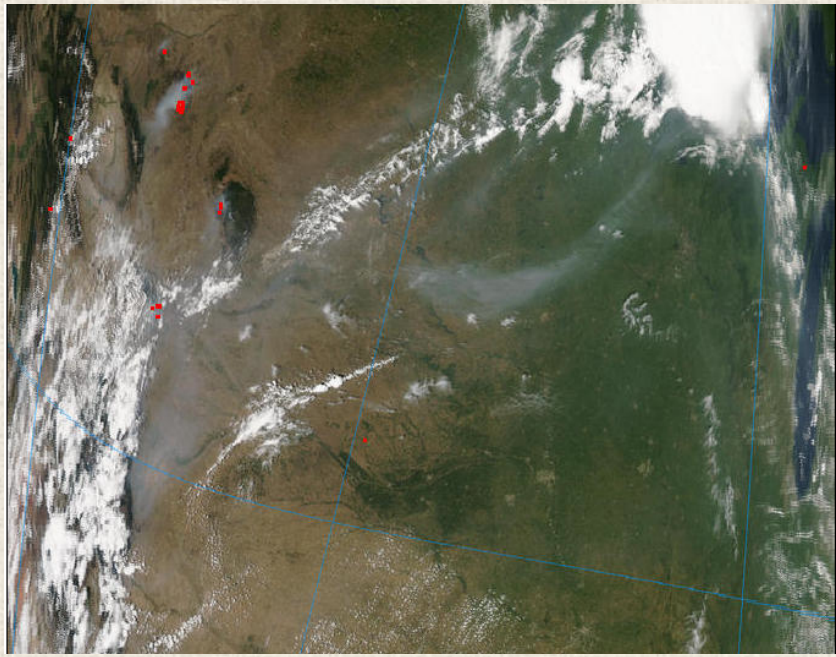
	MODIS	VIIRS
Product resolution nadir	10 km 3 km	6 km 0.75 km
Product resolution edge	40 km 12 km	12 km 1.5 km
Products land	AOT	AOT, ~~Angstrom exponent~~, (suspended matter)
Products ocean	AOT, fine mode fraction	AOT, Angstrom exponent, (suspended matter)

Angstrom exponent over land and suspended matter not ready for public use

VIIRS RGB 19:07 UTC

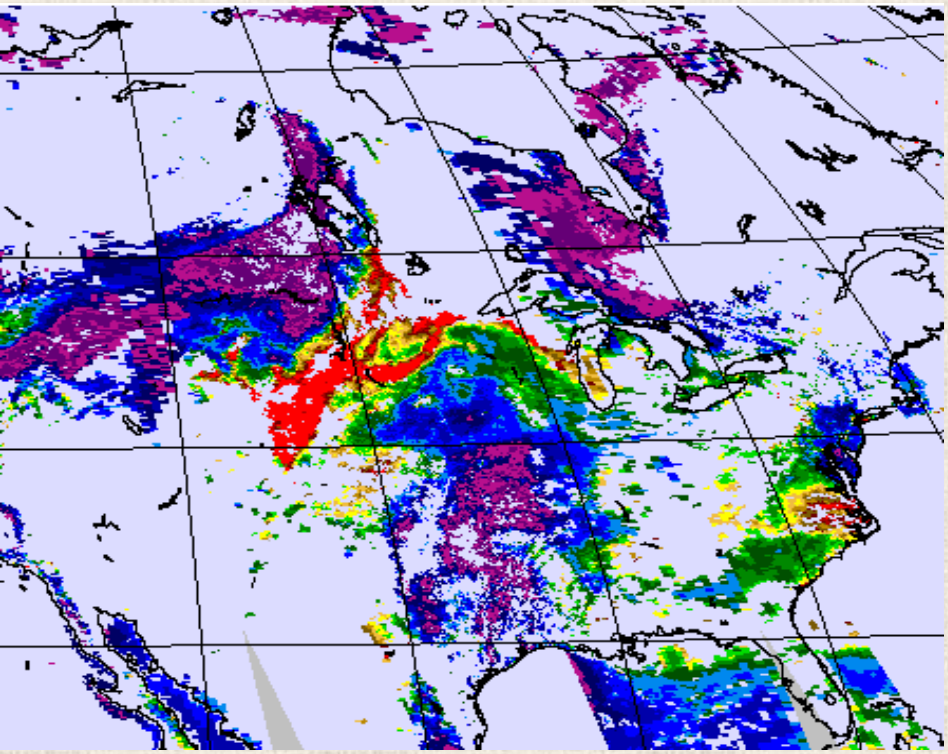


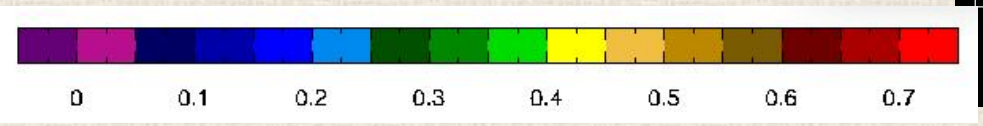
MODIS RGB

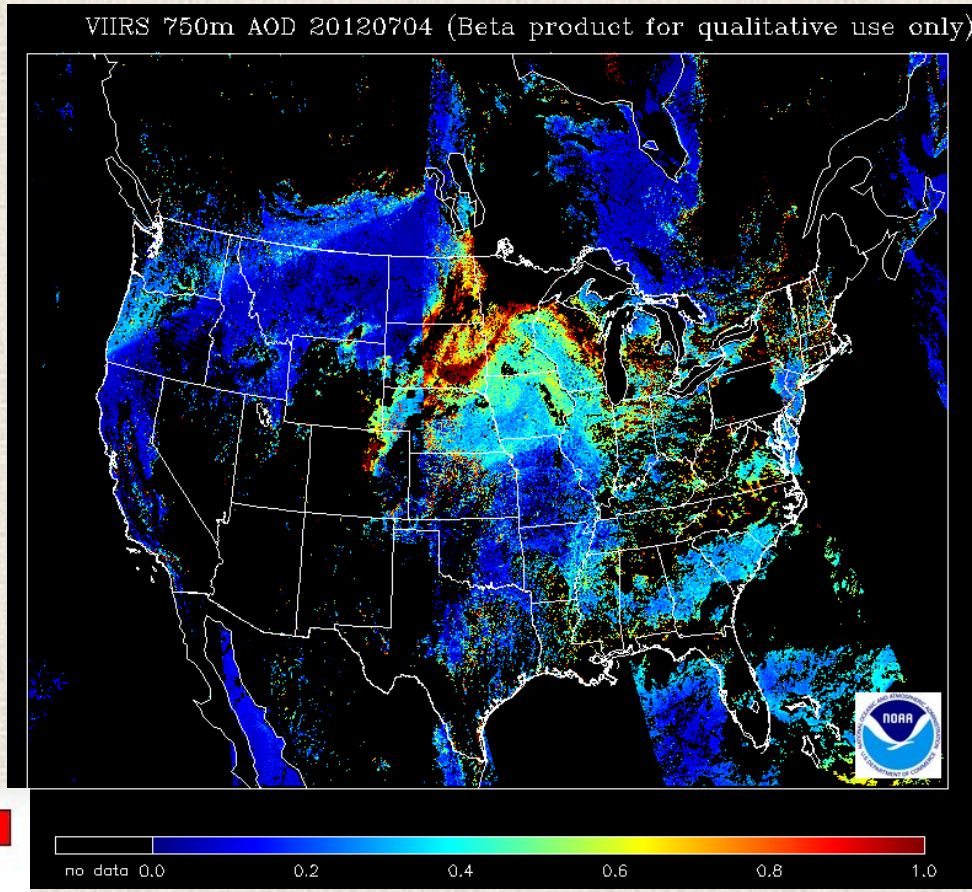


MODIS AOT 550 nm 4 July 2012
Aqua L2 Col51 10 km

VIIRS AOT 550 nm 4 July 2012 IP 750 m

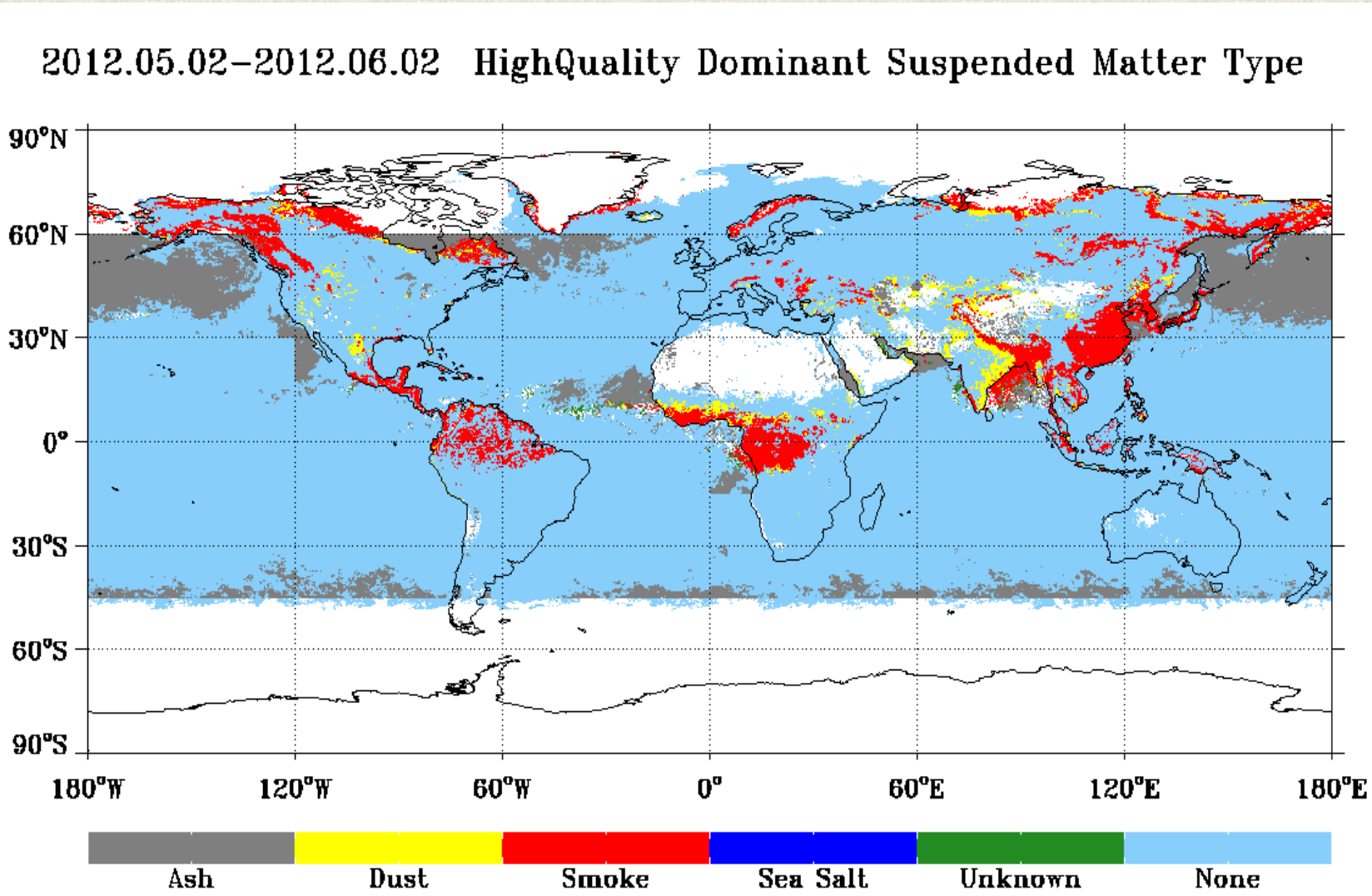






Suspended matter is just another way to say “aerosol type”

Dust, smoke, sea salt, volcanic ash



Kondragunta/Liu

Take home messages:

1. VIIRS and VIIRS aerosol products follow from MODIS heritage
2. Progression of improvement, from Beta to Provisional.
3. Now, Land AOT is very good.
4. Ocean AOT is excellent
5. Suspended matter needs an iteration
6. Use Quality Flags