

# MODIS Aerosol Algorithm

## Validation, Updates and First Look at Aqua

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Oleg Dubovik  
Zia Ahmad  
Richard Kleidman

## Validation

### Updates Implemented:

- extension over land

### Updates to be Delivered :

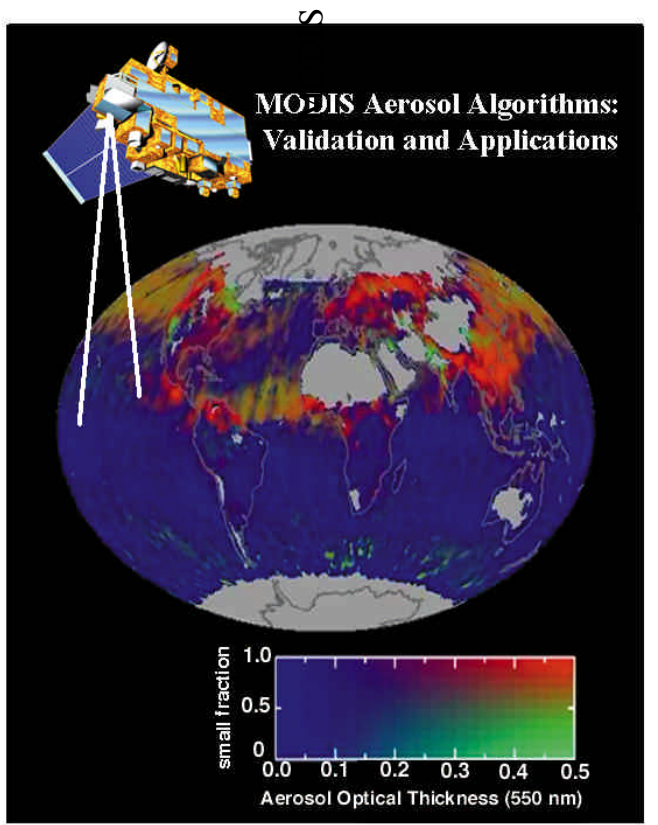
- sediment mask
- adjustments to cloud mask
- dust replacement (over glint!)
- new land models

### On the horizon:

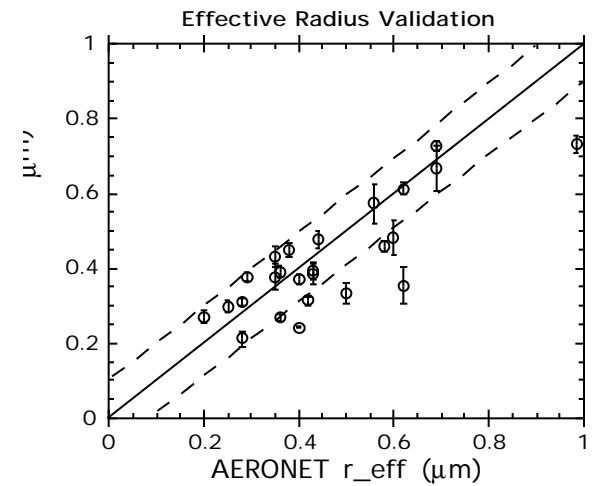
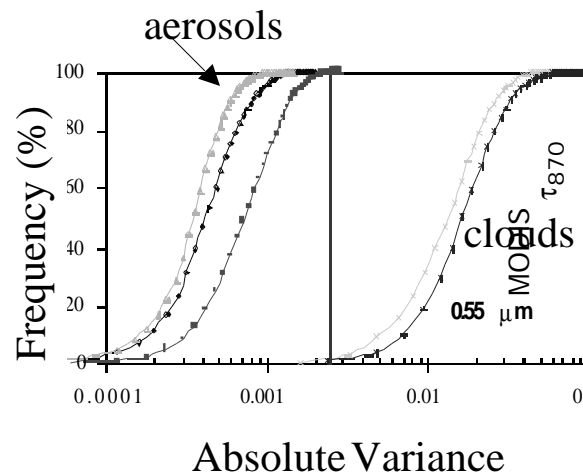
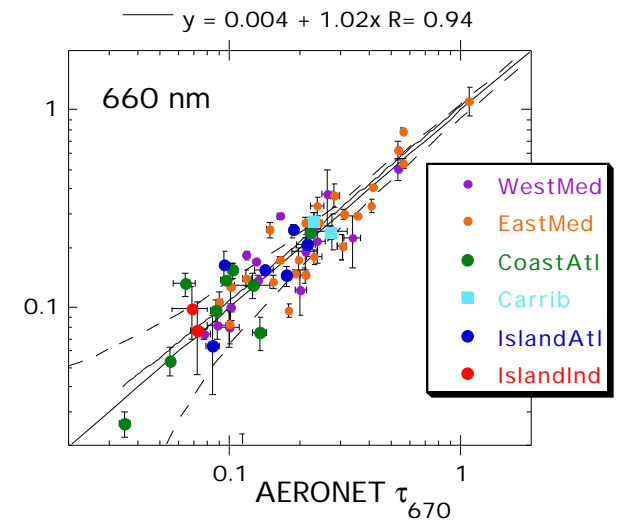
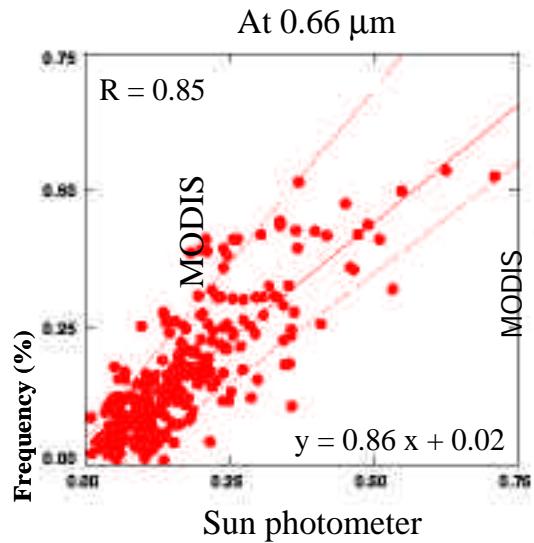
- non-spherical dust models

First looks at Aqua

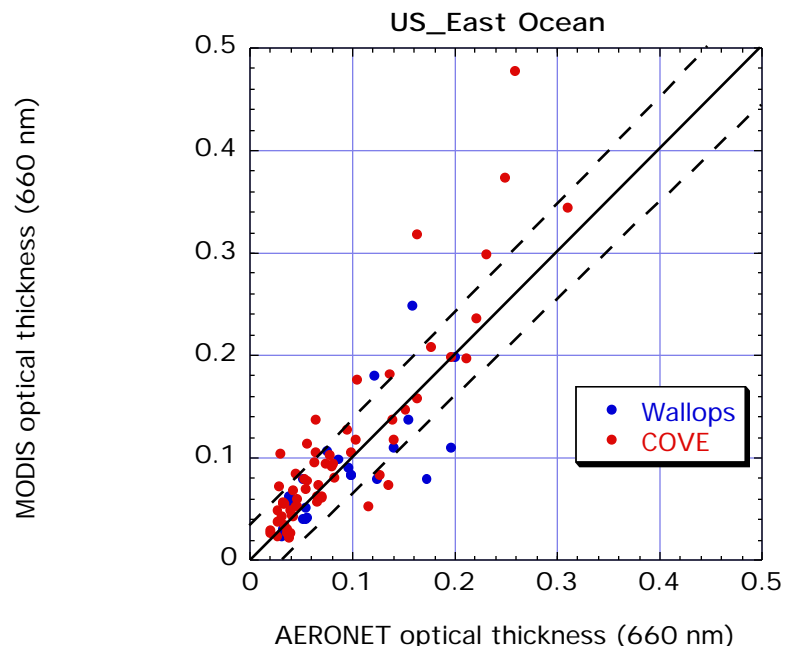
# GRL special section



Ichoku et al. (2002)  
Martins et al. (2002)  
Chu et al. (2002)  
Remer et al. (2002)



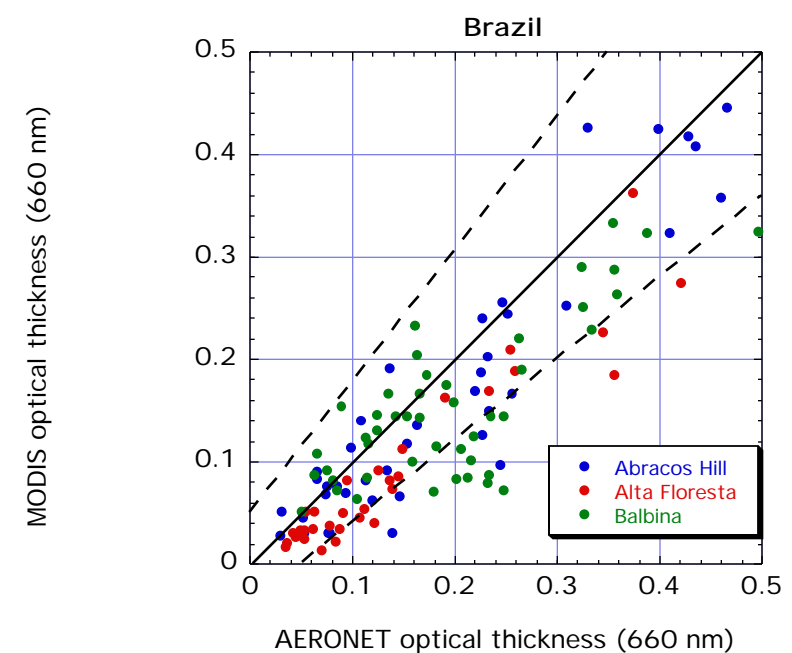
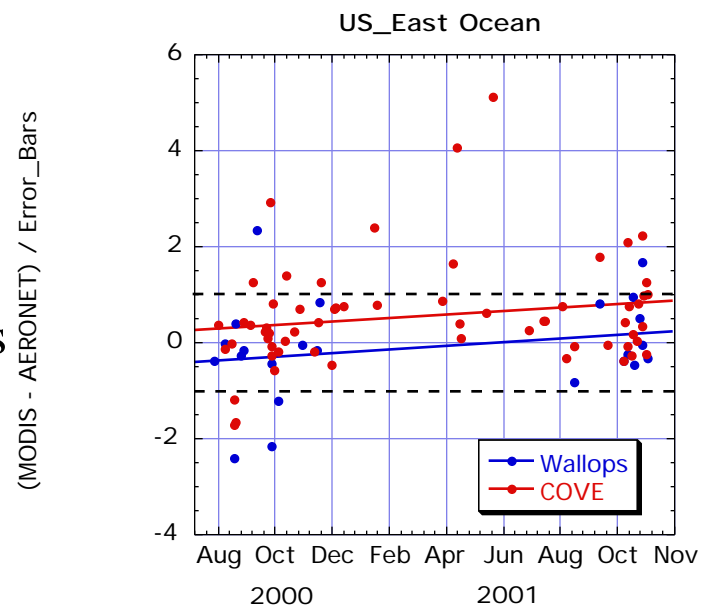
fraction  
 $\tau$



N=86

77%

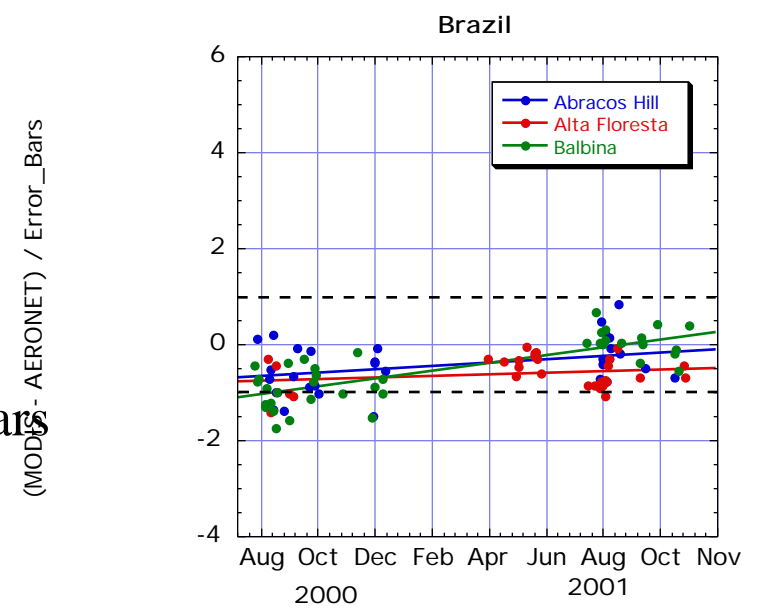
within error bars

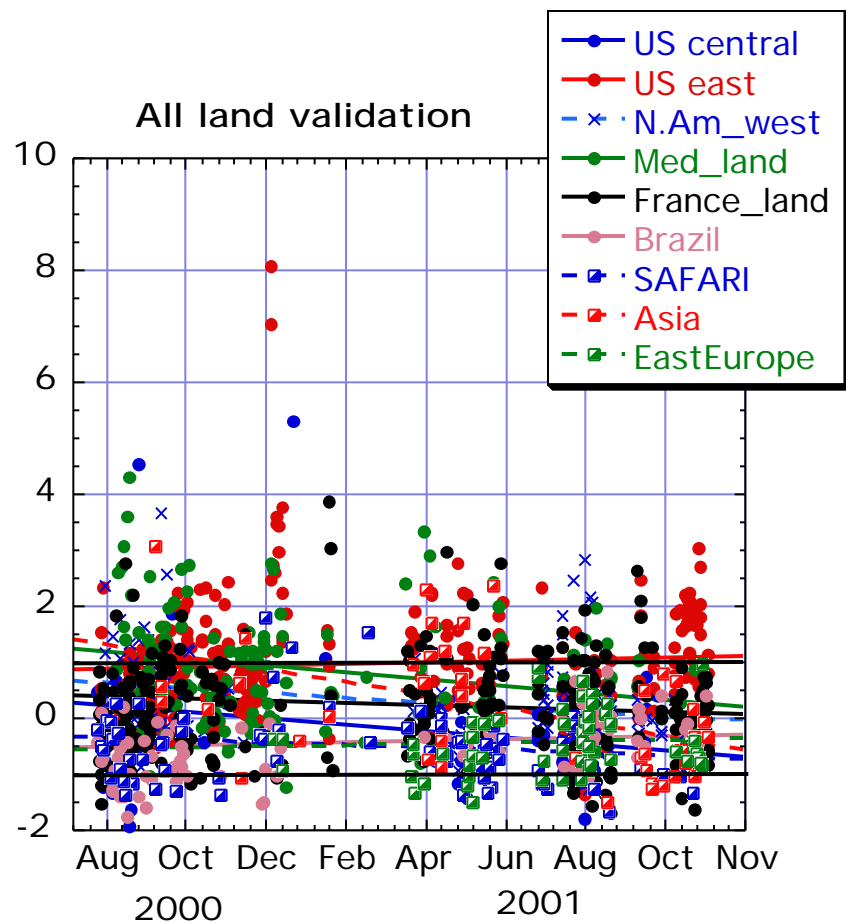


N = 102

82%

within error bars



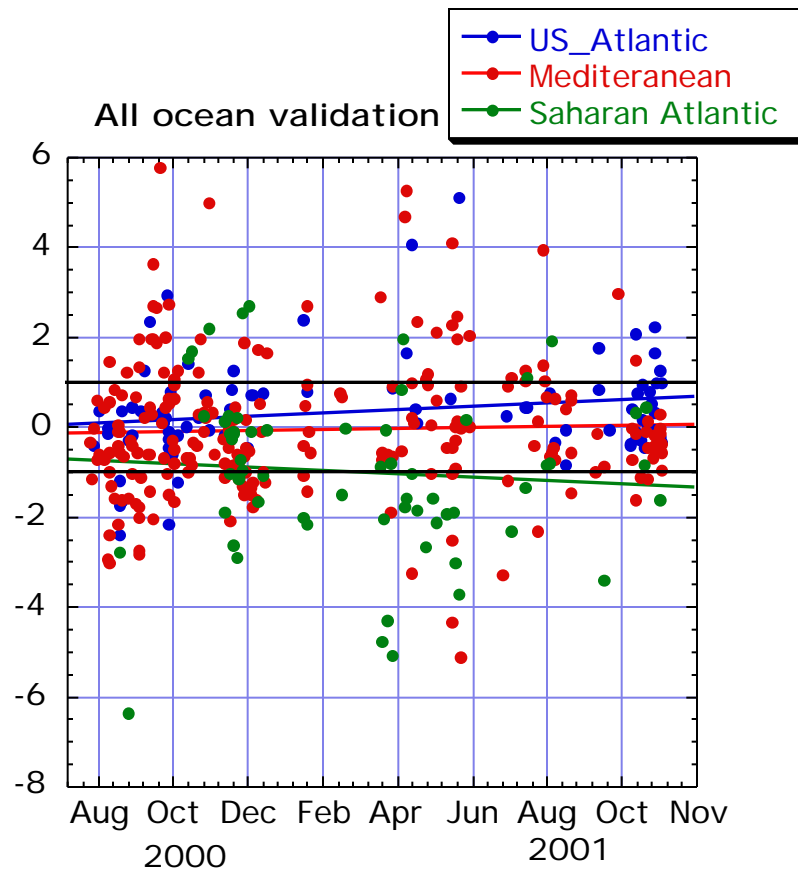


	N	within error
France_land	332	77%
US east	282	56%
NA_west	168	85%
Med_land	139	60%
Brazil	102	82%
US central	100	72%
SAFARI		89
East_Europe	58	84%
Asia	45	64%

AERONET data from stations operated by the following PI's:  
 B. Holben, C. McLain (SIMBIOS), D. Tanré

Analysis by R. Levy and L. Remer

(MODIS - AERONET) / ERROR\_BAIRS

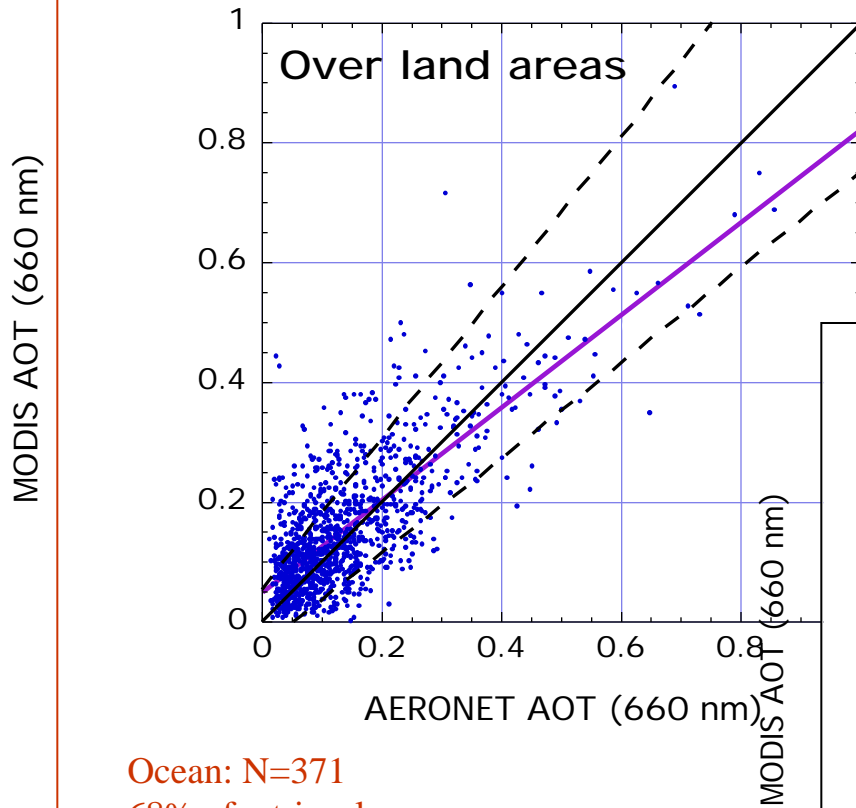


	N	within error
Med_ocean	222	59%
US_Atlantic	86	77%
Saharan	63	37%

AERONET data from stations operated by the following PI's:  
B. Holben, C. McLain (SIMBIOS), D. Tanré

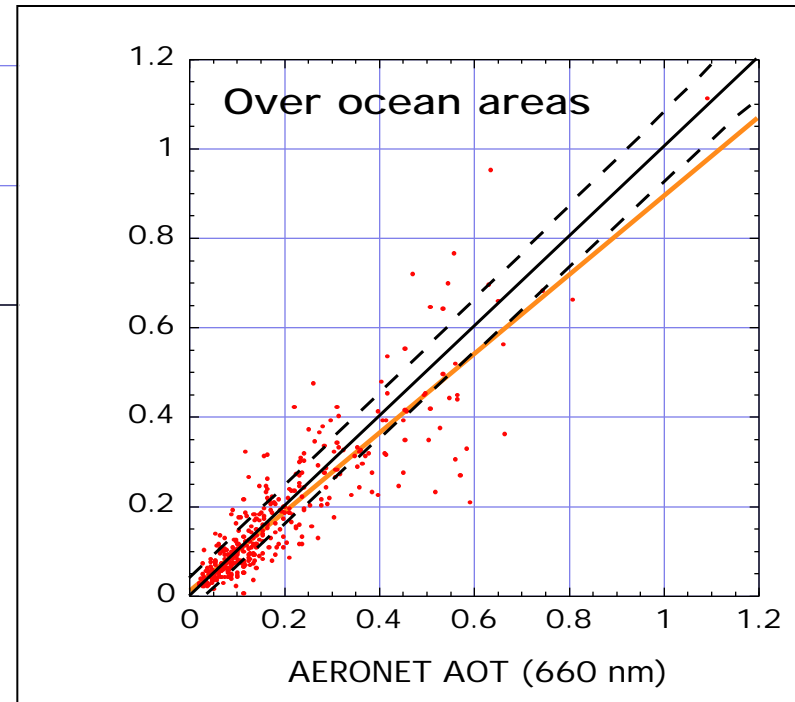
Analysis by R. Levy and L. Remer

## Validation of Aerosol Optical Thickness

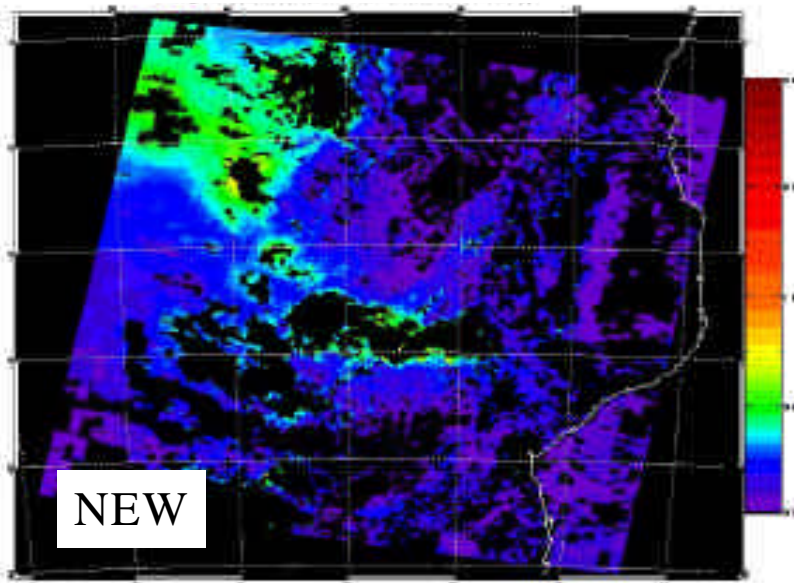
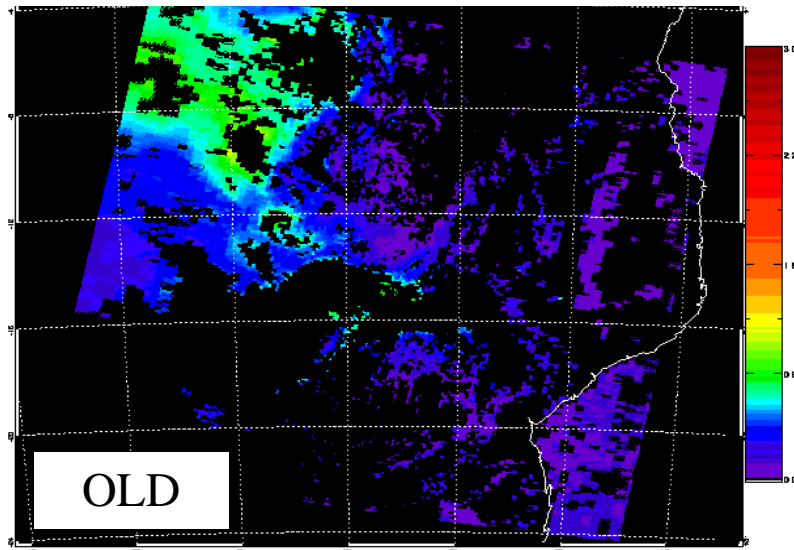


Land: N=1192  
76% of retrievals within  
expected error

Ocean: N=371  
68% of retrievals  
within expected error



Year 2000 Day 233 Time 0835  
Location: southern Africa, east coast



Land algorithm: “dark targets”

But how dark is “dark” ?

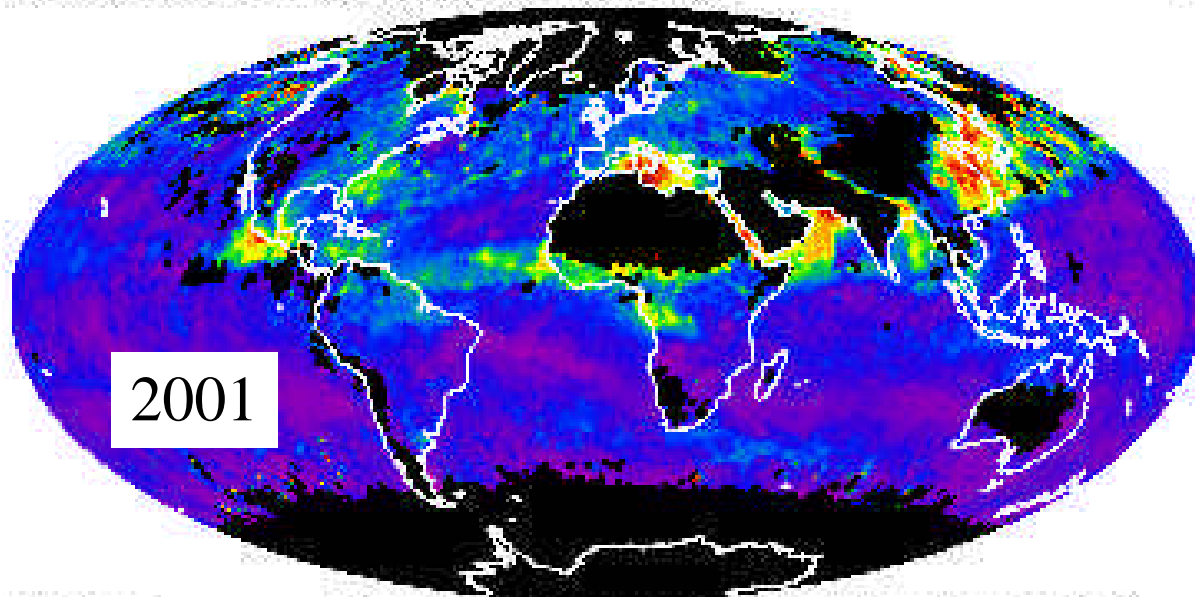
Following a suggestion by E. Vermote, we increase the  $\rho_{2.1}$  threshold from 0.25 to 0.40 at nadir (and even higher at larger view angle). From the extended threshold, we derive in the blue and extrapolate to the red.

In this example the new version increases the number of retrievals over land from 7060 to 17,849. For the 285 granules collected over southern Africa during the SAFARI campaign, V3.1.0 increases the number of land retrievals by 130%.



Optical\_Depth\_Land\_And\_Ocean\_Mean\_Mean

1

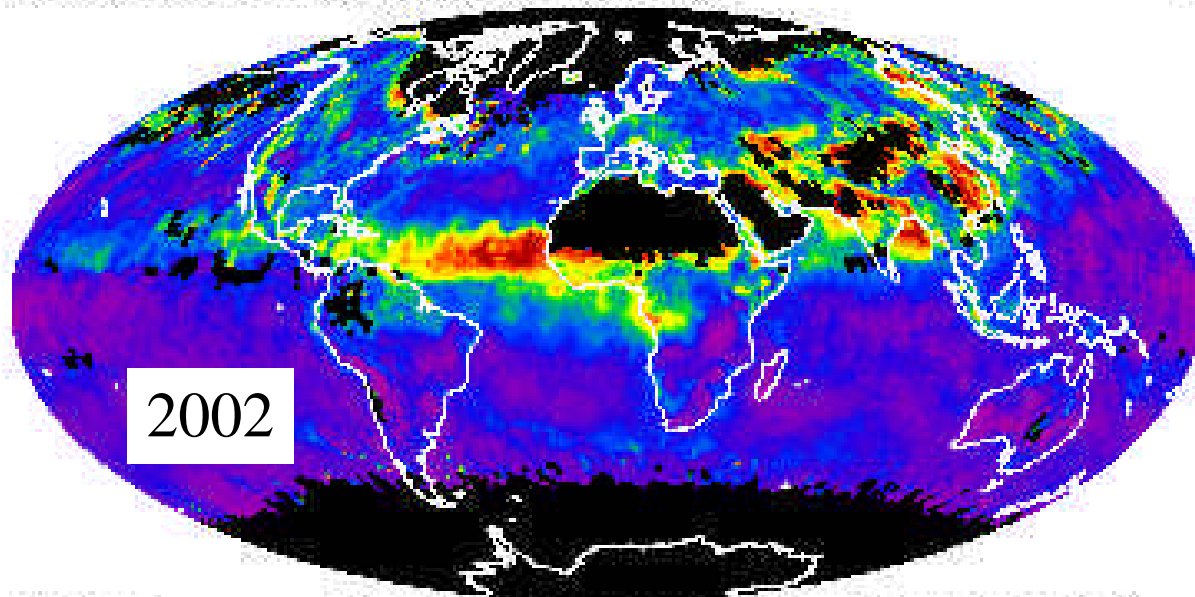


Eight day means.  
Same dates,  
Different years

MODIS/Terra: MOD06\_E3.A2001137.003.2001262062906.hdf \*non

Optical\_Depth\_Land\_And\_Ocean\_Mean\_Mean

1

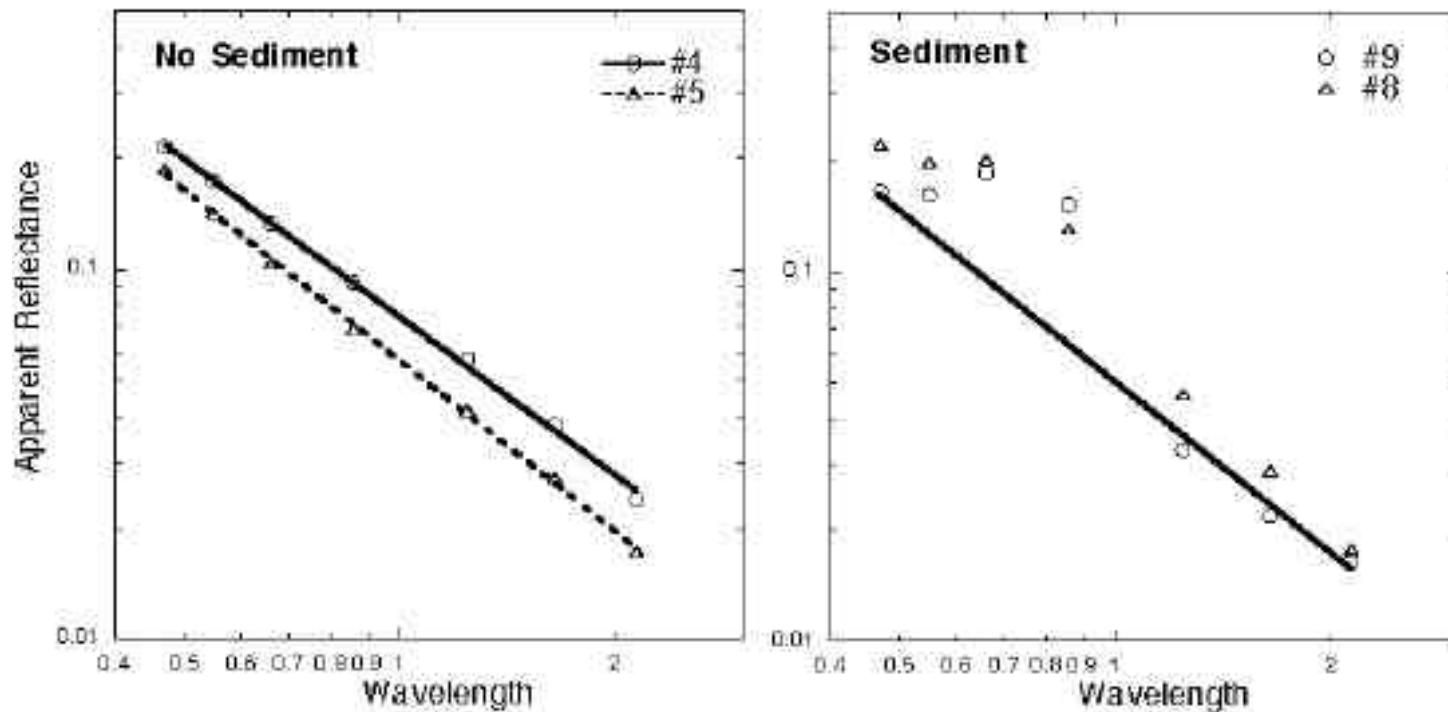


Images cropped from  
MODIS Atmospheres web site  
Created by P. Hubanks

MODIS/Terra: MOD06\_E3.A2002137.003.2002152011302.hdf \*non

# Sediment Mask

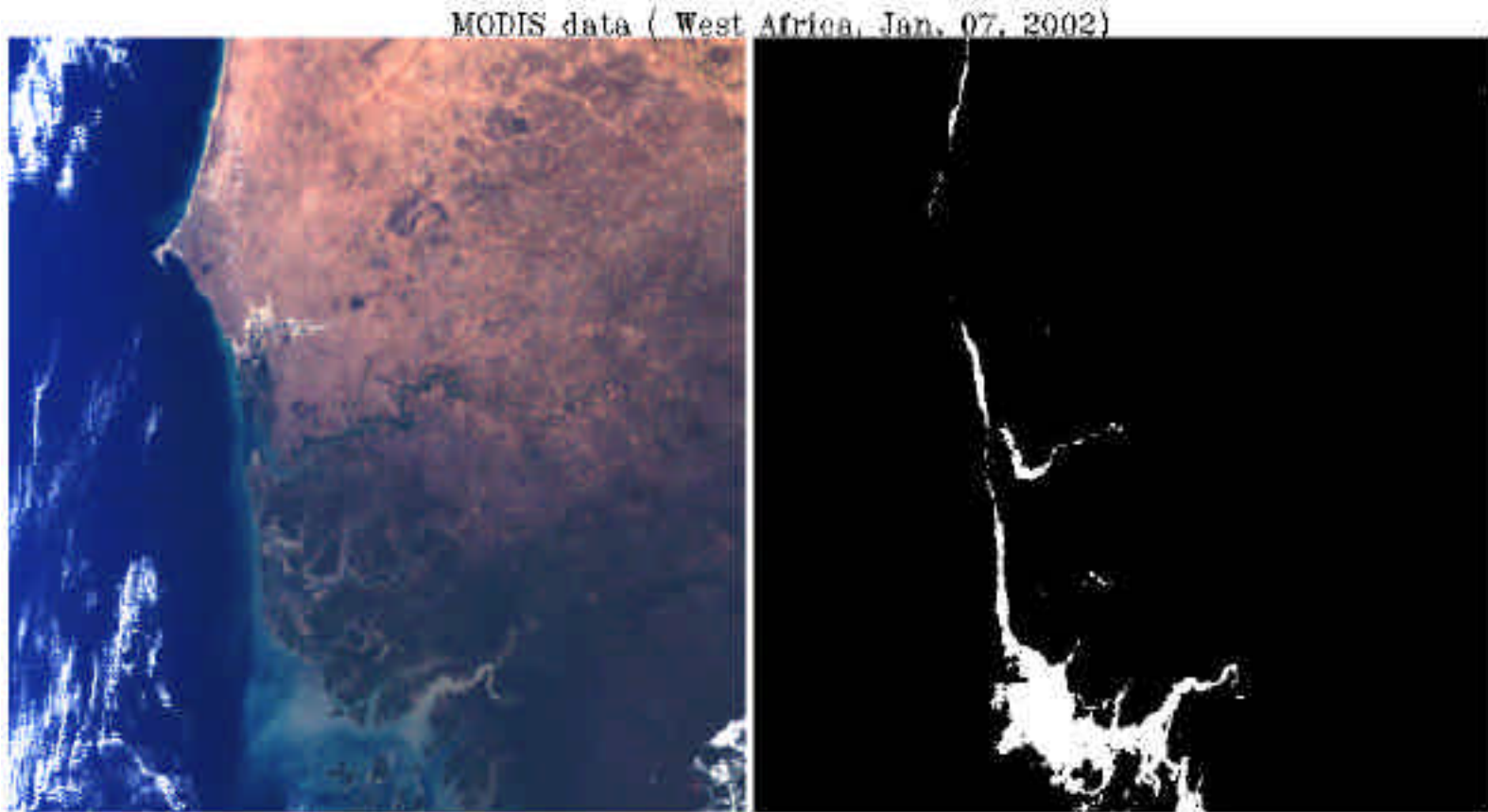
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Li et al., submitted to IEEE TGARS

# Sediment Mask

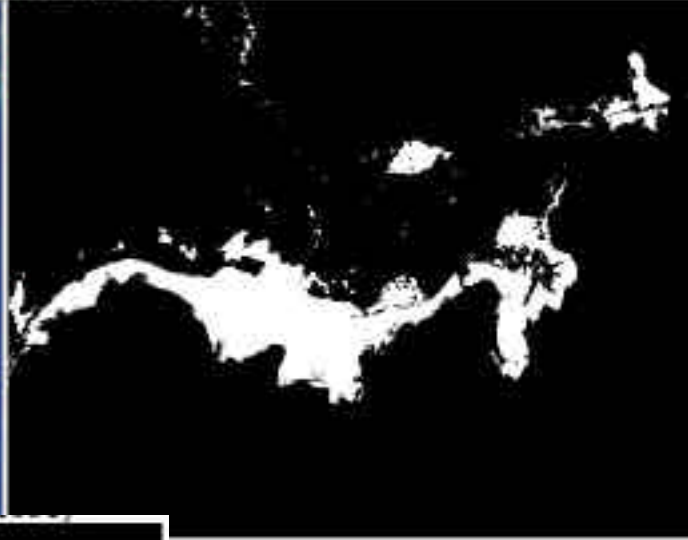
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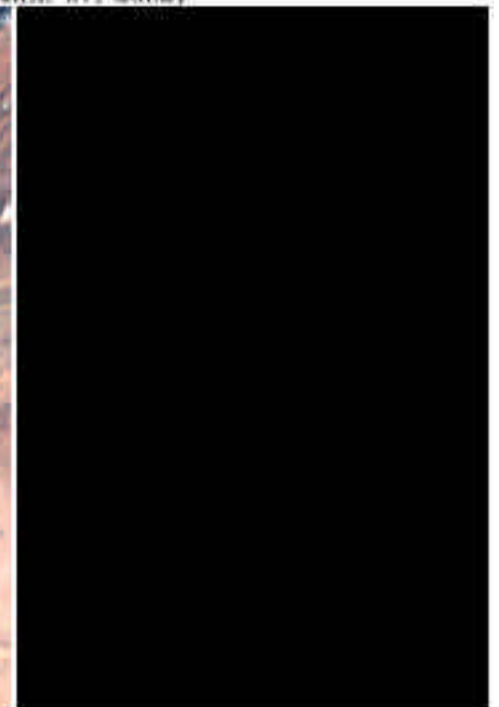
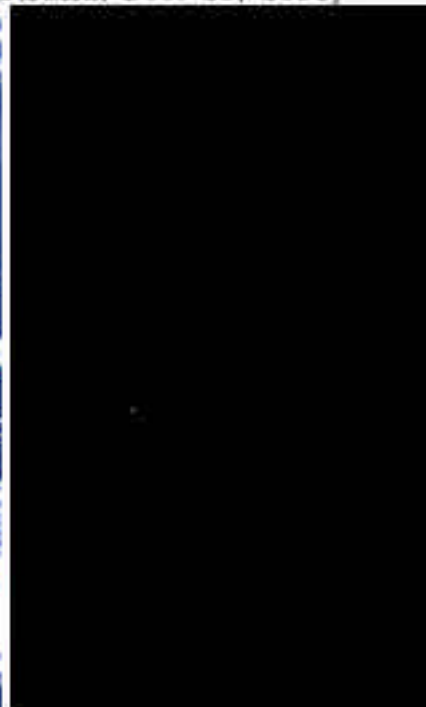
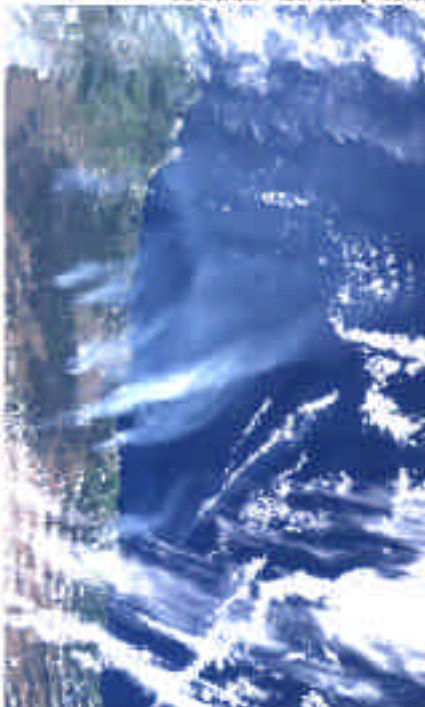
Li et al. submitted to IEEE TGARS

# Sediment Mask

MODIS data ( Mississippi Delta, Mar. 05, 2001)

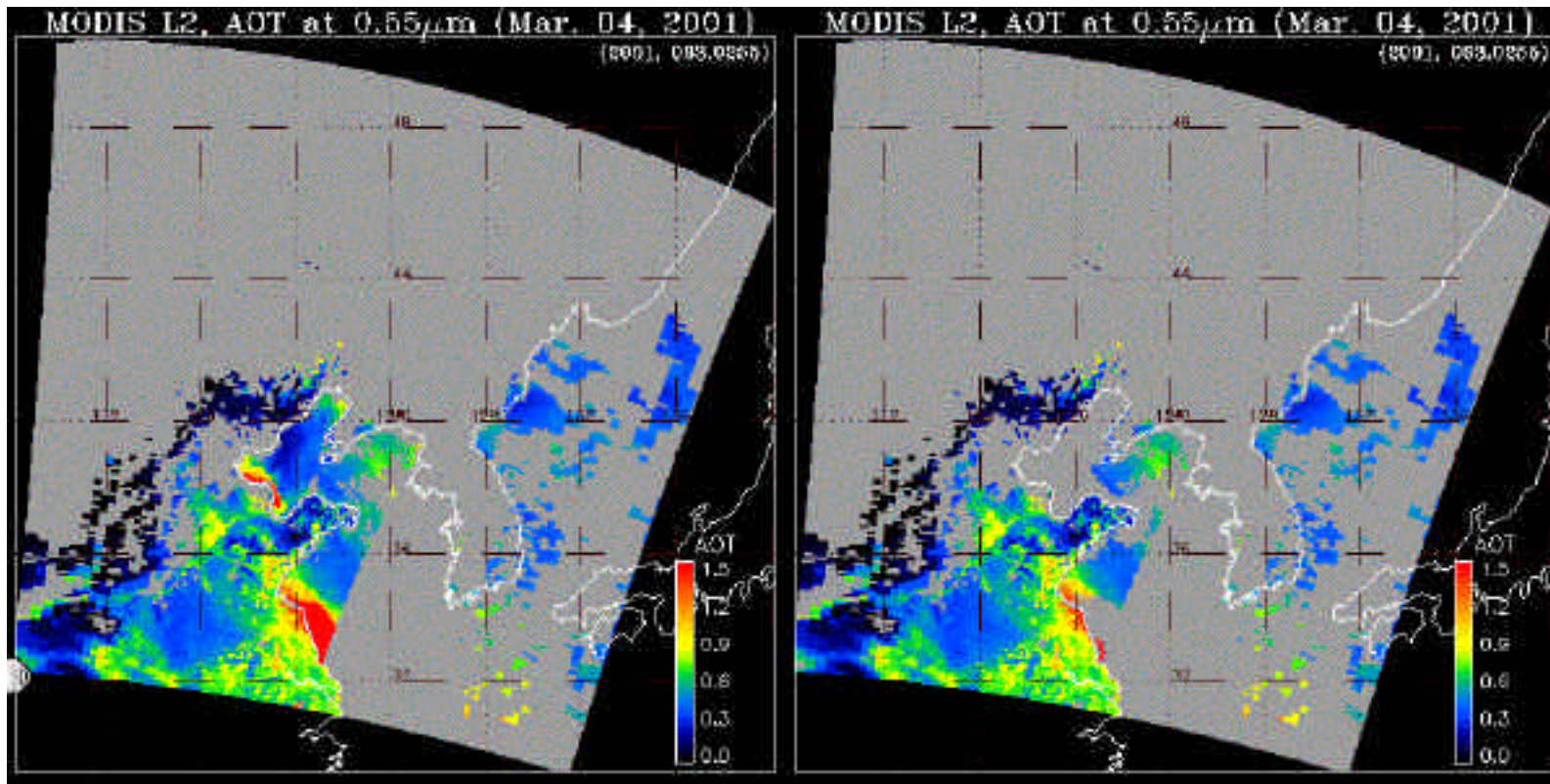


Jan. 07, 2002)



operational

new sediment mask



Updates: Cloud mask for aerosol retrievals

**spatial variability**

before: 3x3 window advances as a block

now: 3x3 window advances every pixel

**high AOT cutoff**

before: fill value for  $AOT > 5.0$

now: threshold on  $\rho_{0.47}$ , not AOT

**regaining retrievals in dust**

before: lost high dust values

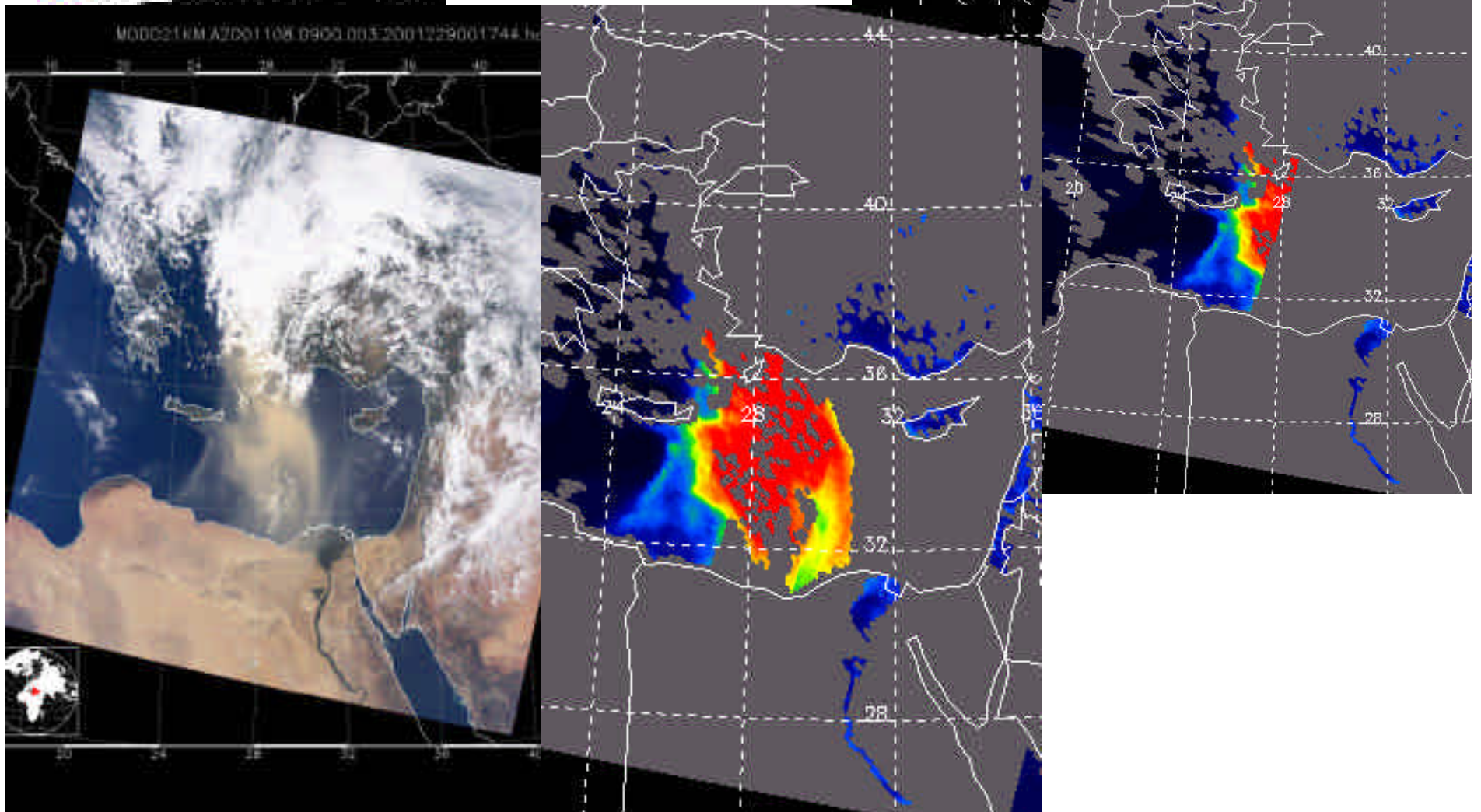
now:  $\rho_{0.47}/\rho_{0.66}$  separates dust from clouds

**dust over glint**

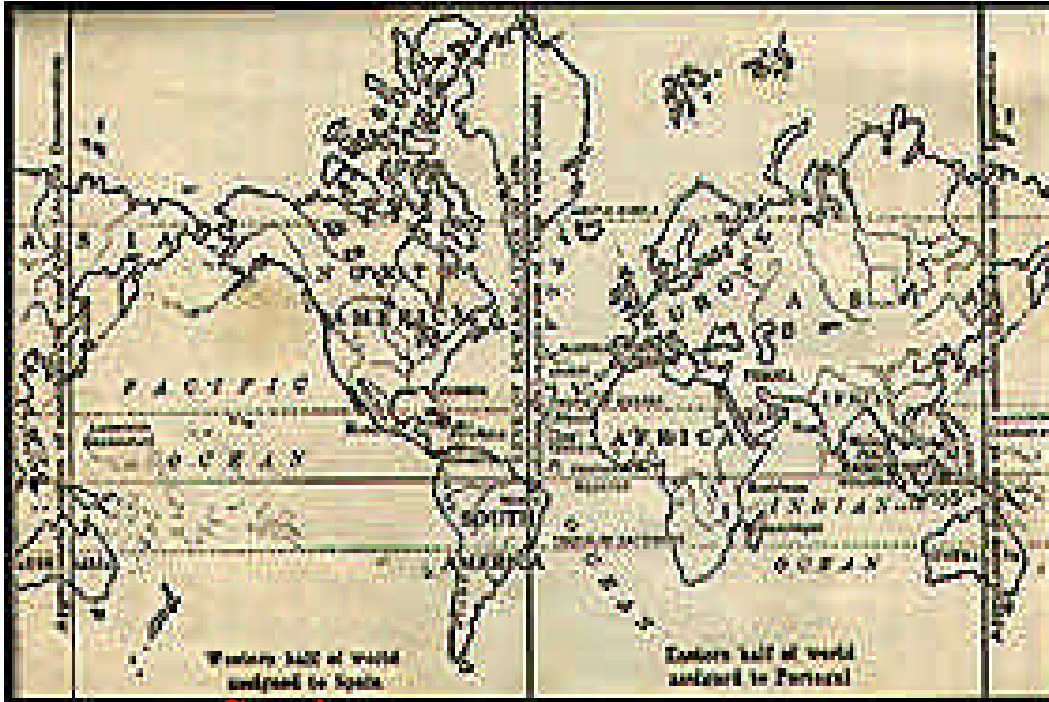
before: no retrievals over glint

now:  $\rho_{0.47}/\rho_{0.66} < 0.95$  we retrieve heavy dust over glint

# Retrieving heavy dust over glint



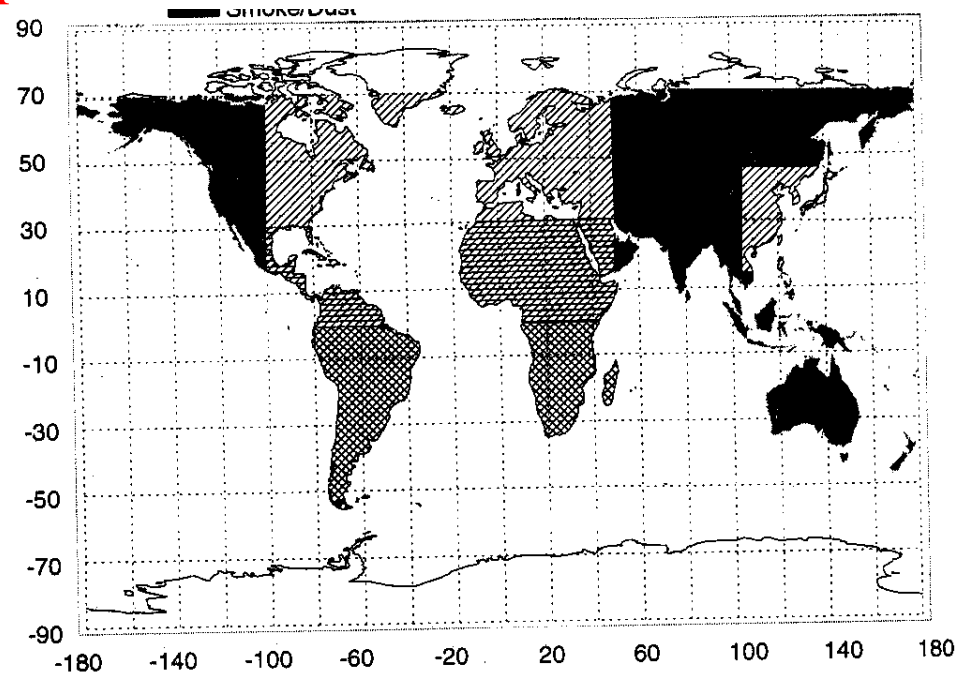
J.V. Martins et al., in preparation



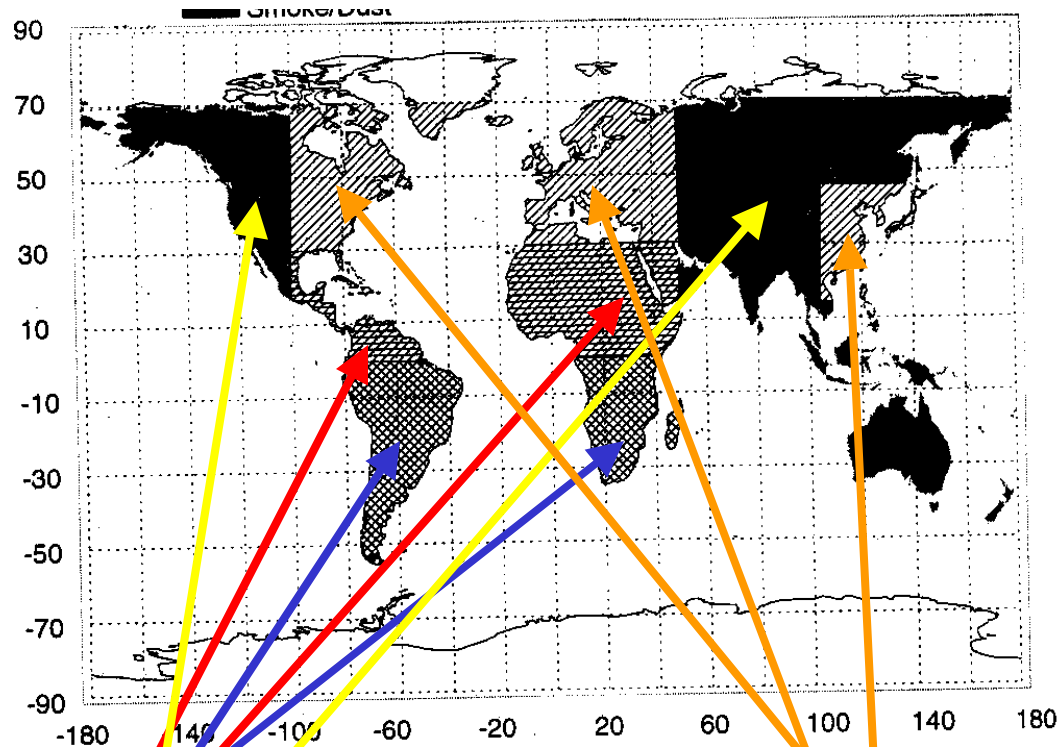
In 1493 C.E., Pope Alexander VI divided the world with an arbitrary line.

Spain Portugal

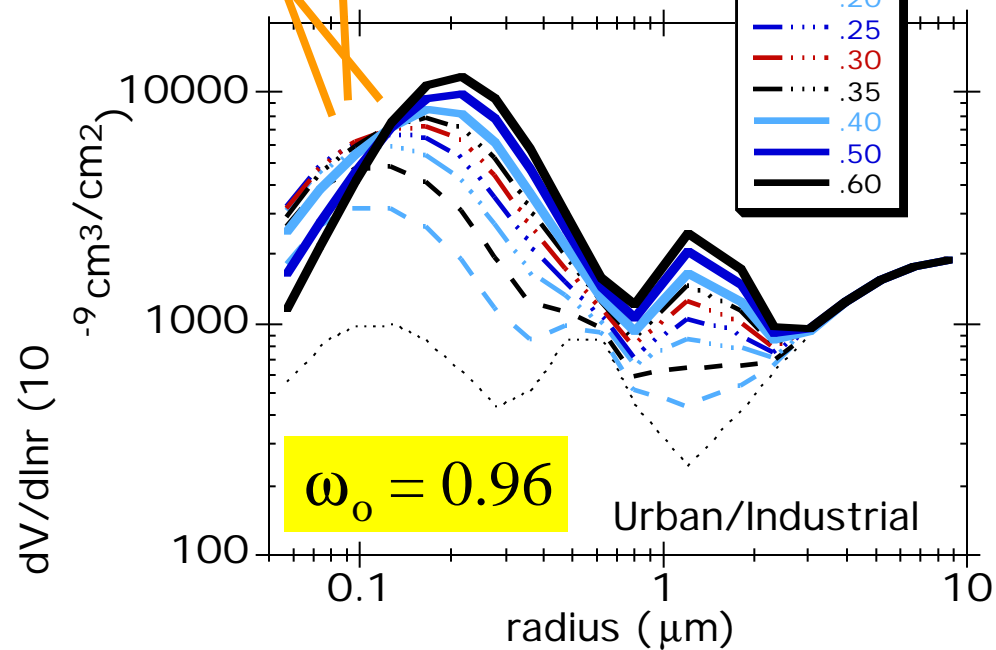
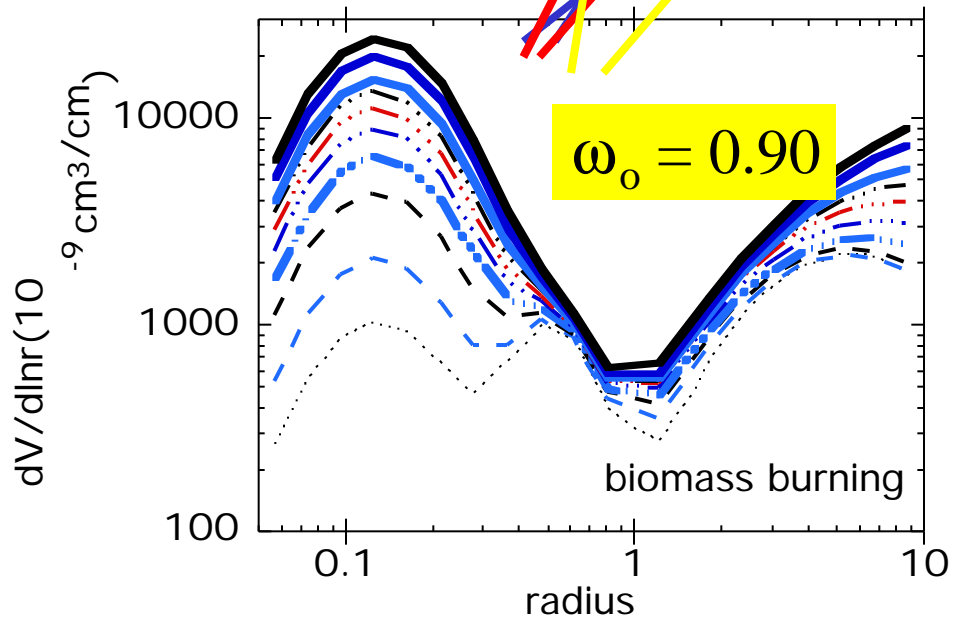
In 1995, Yoram Kaufman divided the world again, with many arbitrary lines.

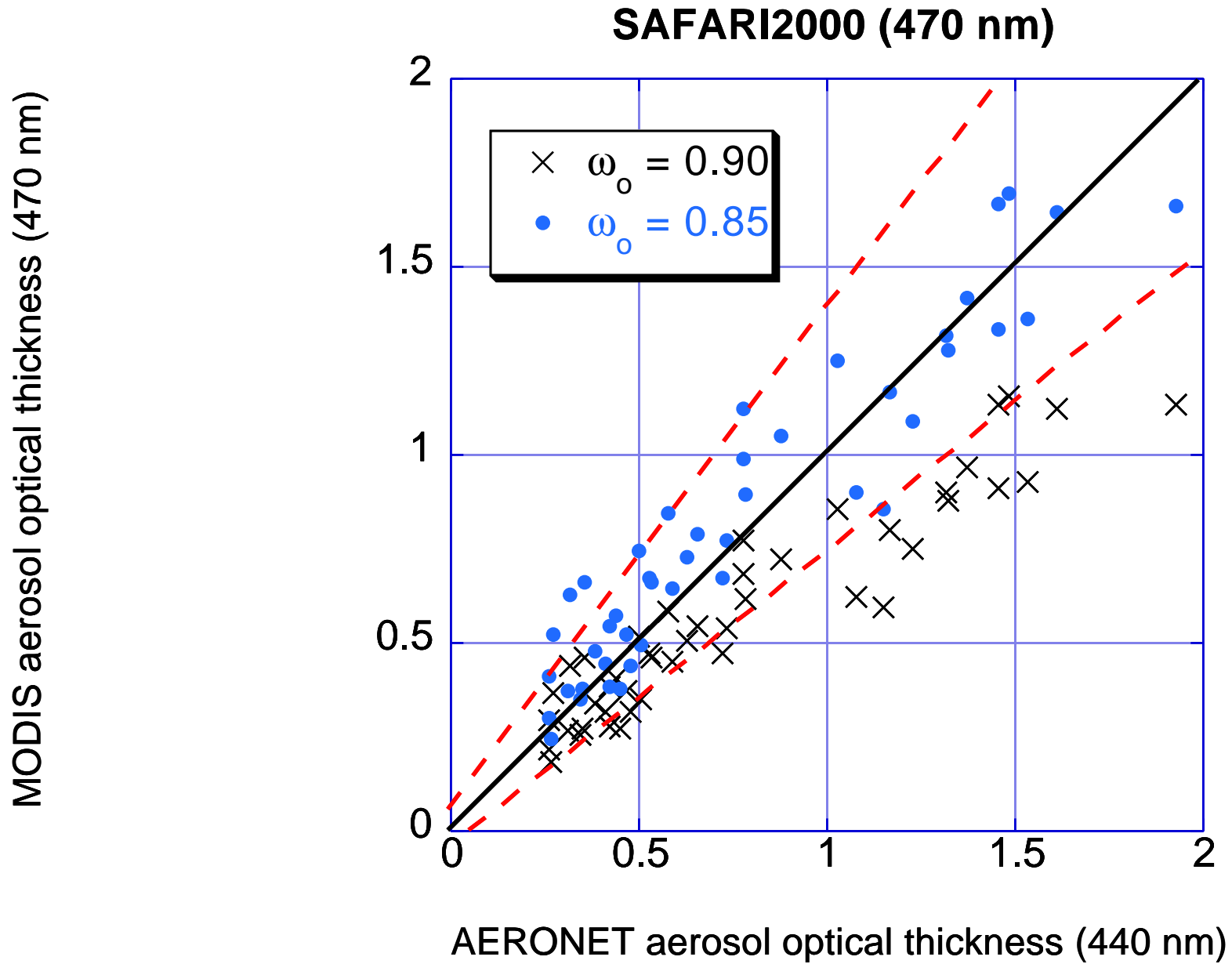






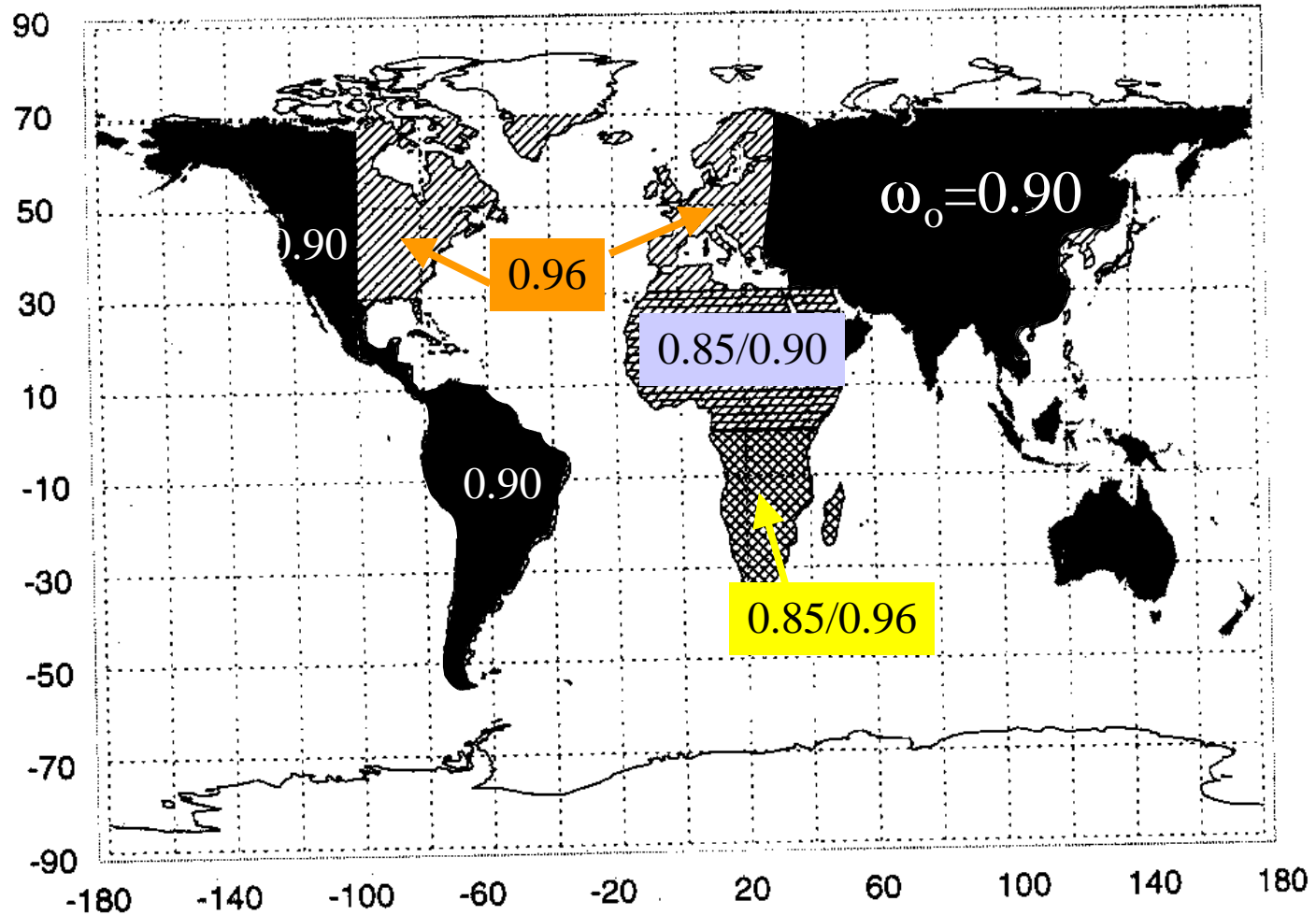
Operational  
aerosol  
models  
(1995 knowledge)





# New Aerosol Models based on 2002 information

AERONET and Dubovik et al. (2002)

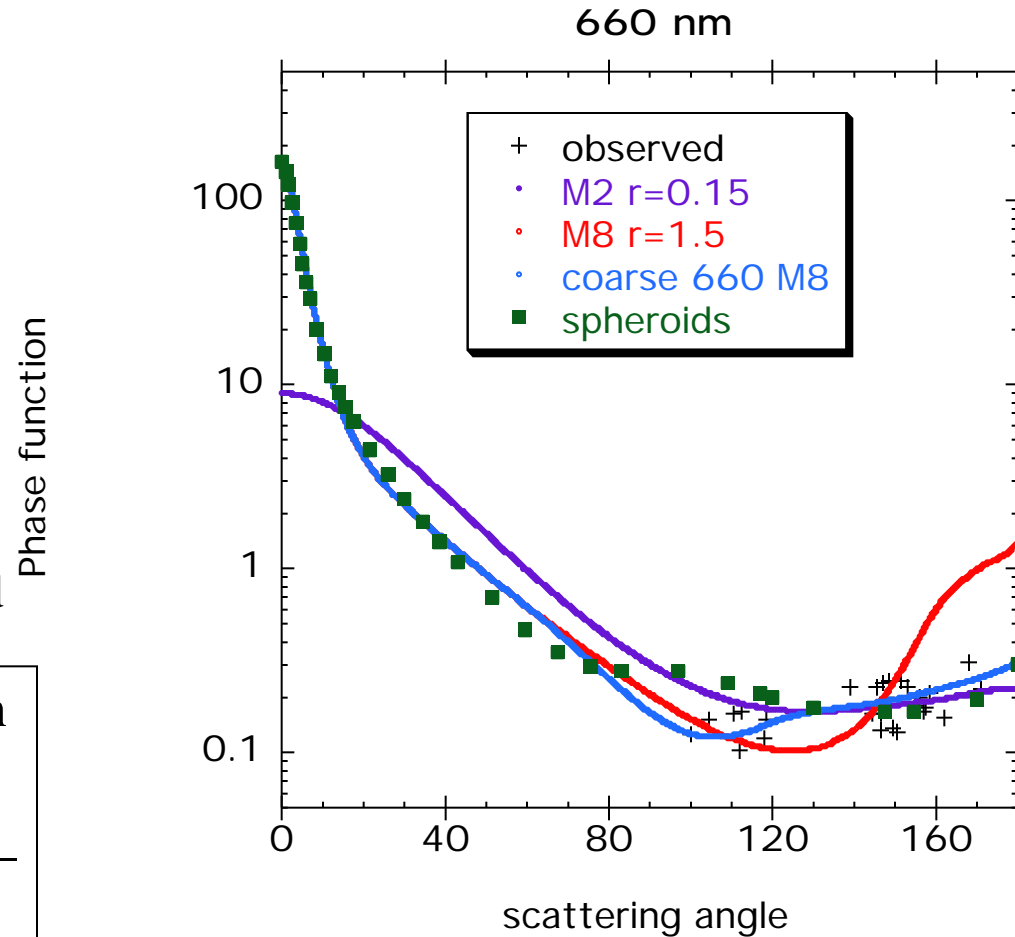


Analysis by L. Remer and D.A. Chu

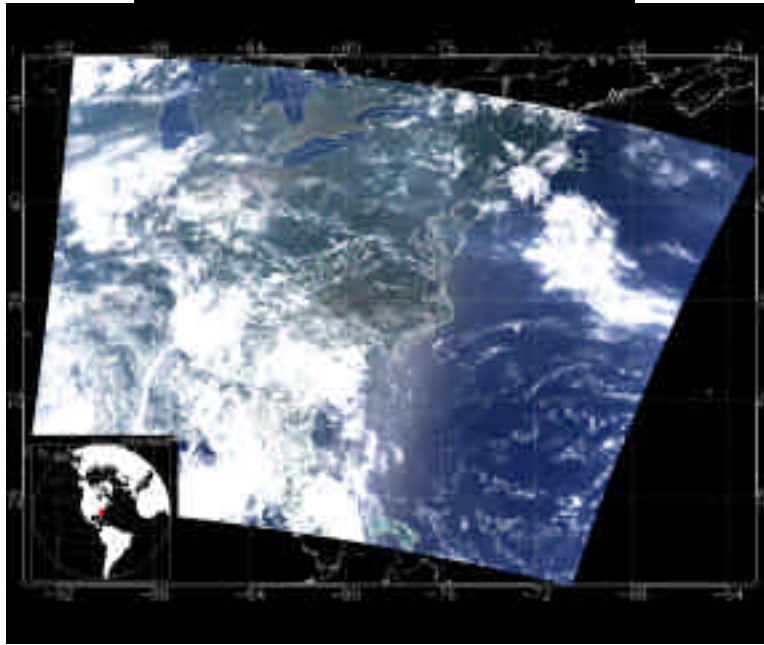
# Retrieving non-spherical dust aerosol

M. Meier and J. Reid

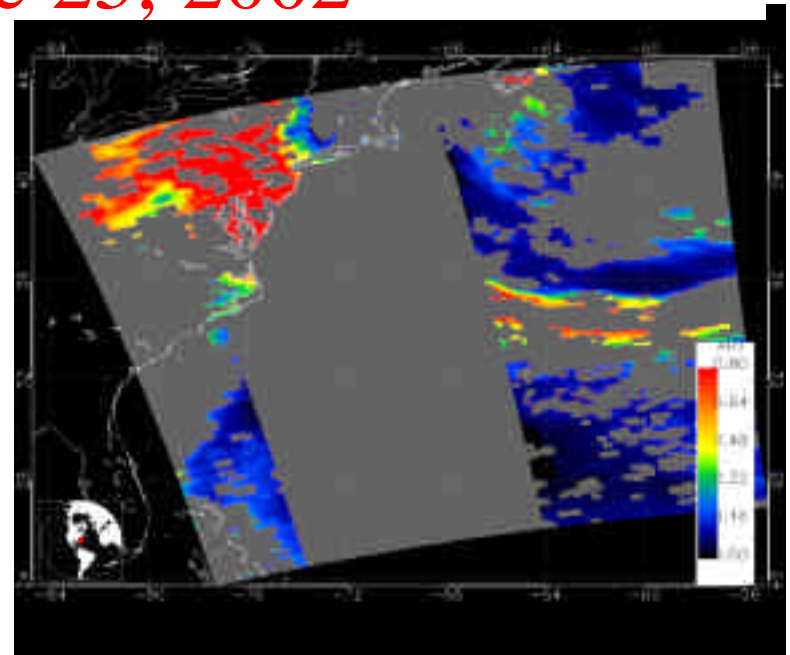
	N	within error
US_Atlantic	86	77%
Med_ocean	222	59%
Saharan	63	37%



Terra: 16:10 UTC

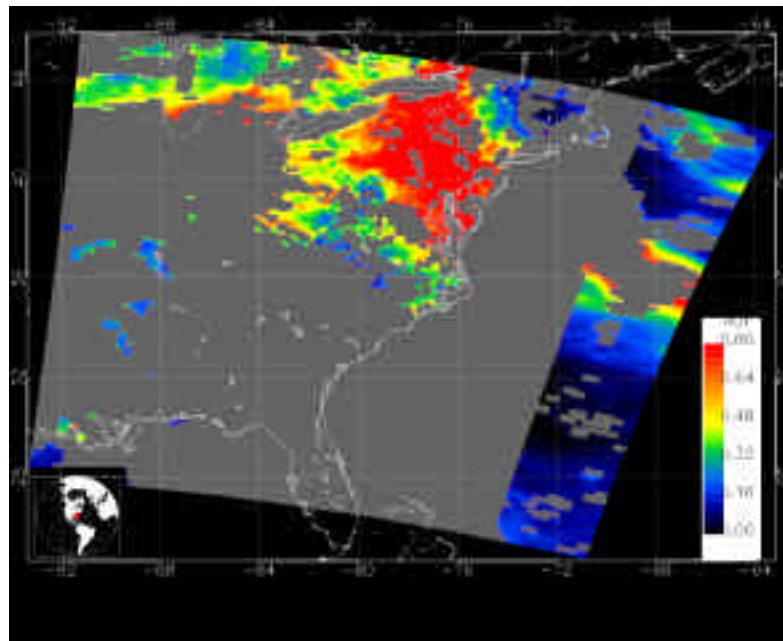


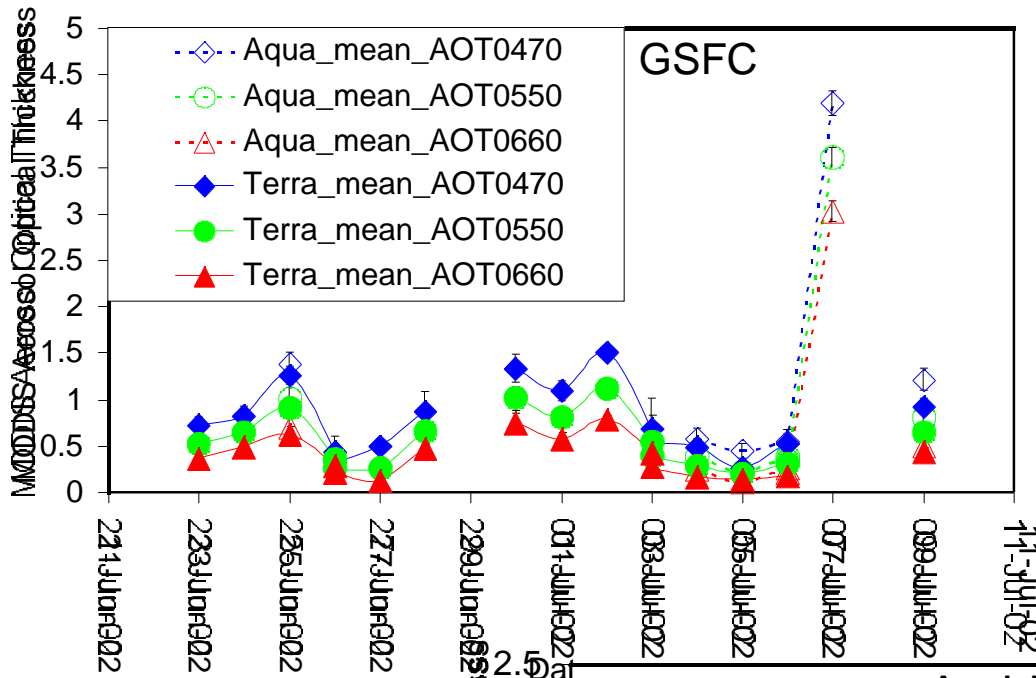
Aqua: 17:45 UTC



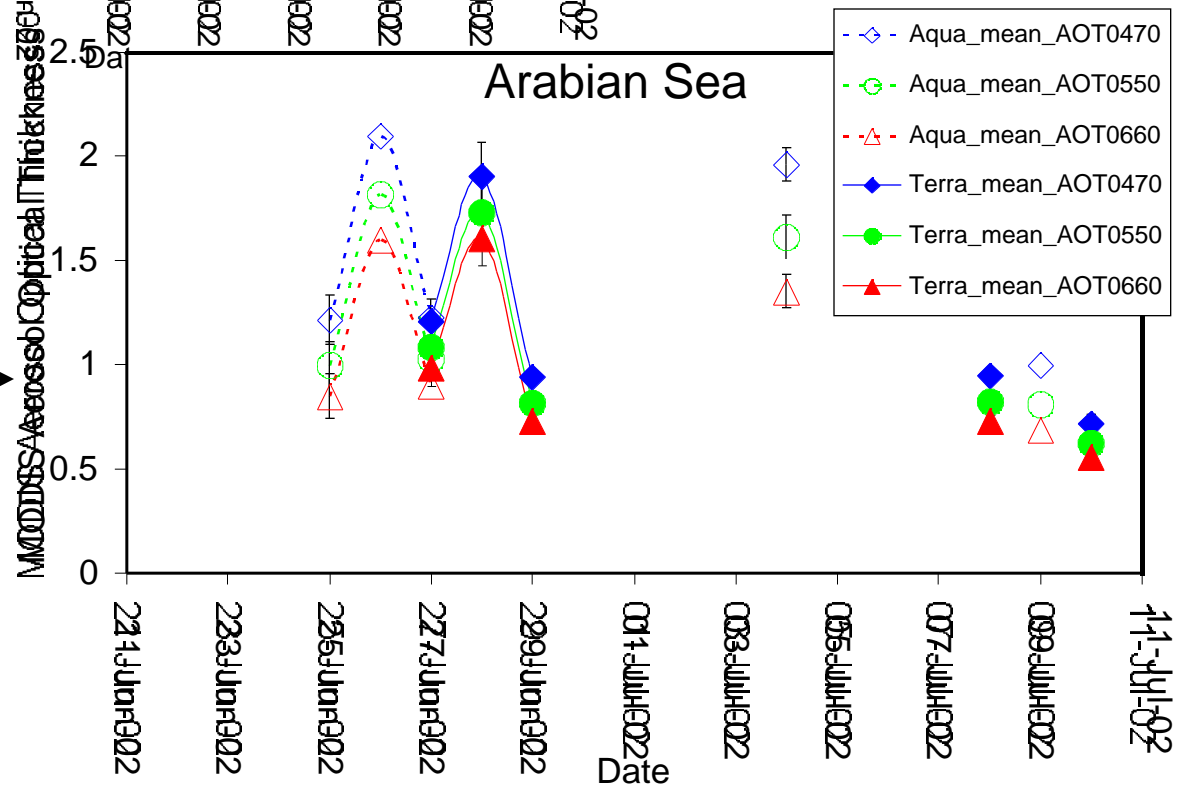
Prepared by  
R. Levy

MODIS: June 25, 2002





MODIS  
Terra & Aqua  
AOT over land



MODIS  
Terra & Aqua  
AOT over ocean

By C. Ichoku (July 2002)

# Summary (page 1)

The primary aerosol products are **valid** within pre-launch error estimations.

First operational retrieval of aerosol over **land**. **First ever**.

Improvement of aerosol over **ocean** retrieval from AVHRR.

$$(\sigma_{\text{AVHRR}}=0.04 \quad \sigma_{\text{MODIS}}=0.02)$$

## Summary (page 2)

No. Not every retrieval is perfect.

Yes. We are making updates.

Some of these changes are to 'fix' small issues: **sediments**

Some of these changes are to 're-call' retrievals: **dust in glint**,  
**extension over land**.

Fine mode/Coarse mode is a significant step forward.

Non-spherical phase functions will be a major innovation, but  
not ready for collection 4.

Qualitatively, **Aqua** looks good.