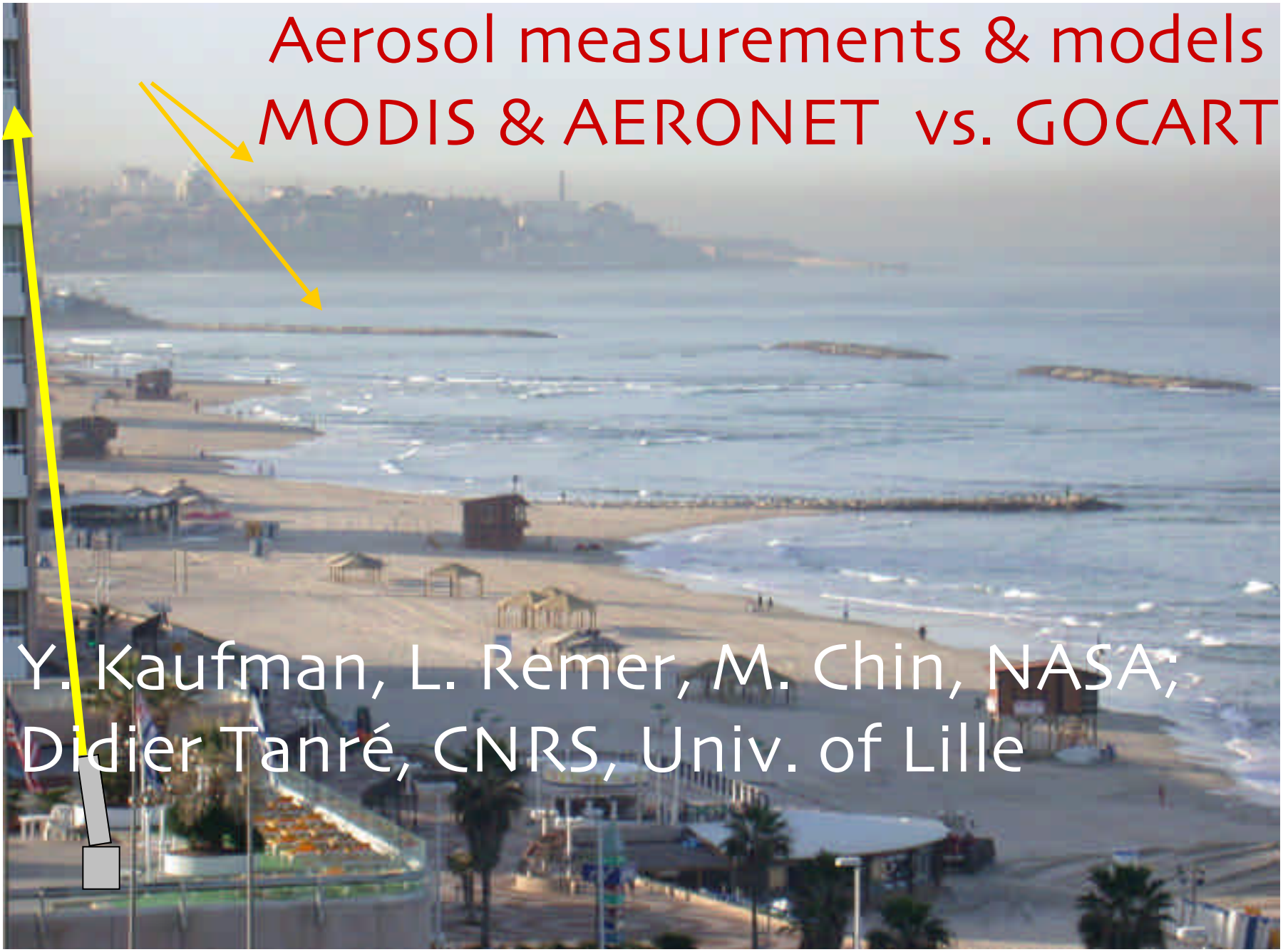

Aerosol measurements & models
MODIS & AERONET vs. GOCART
Y. Kaufman, L. Remer, M. Chin, NASA;
Didier Tanré, CNRS, Univ. of Lille

Products:

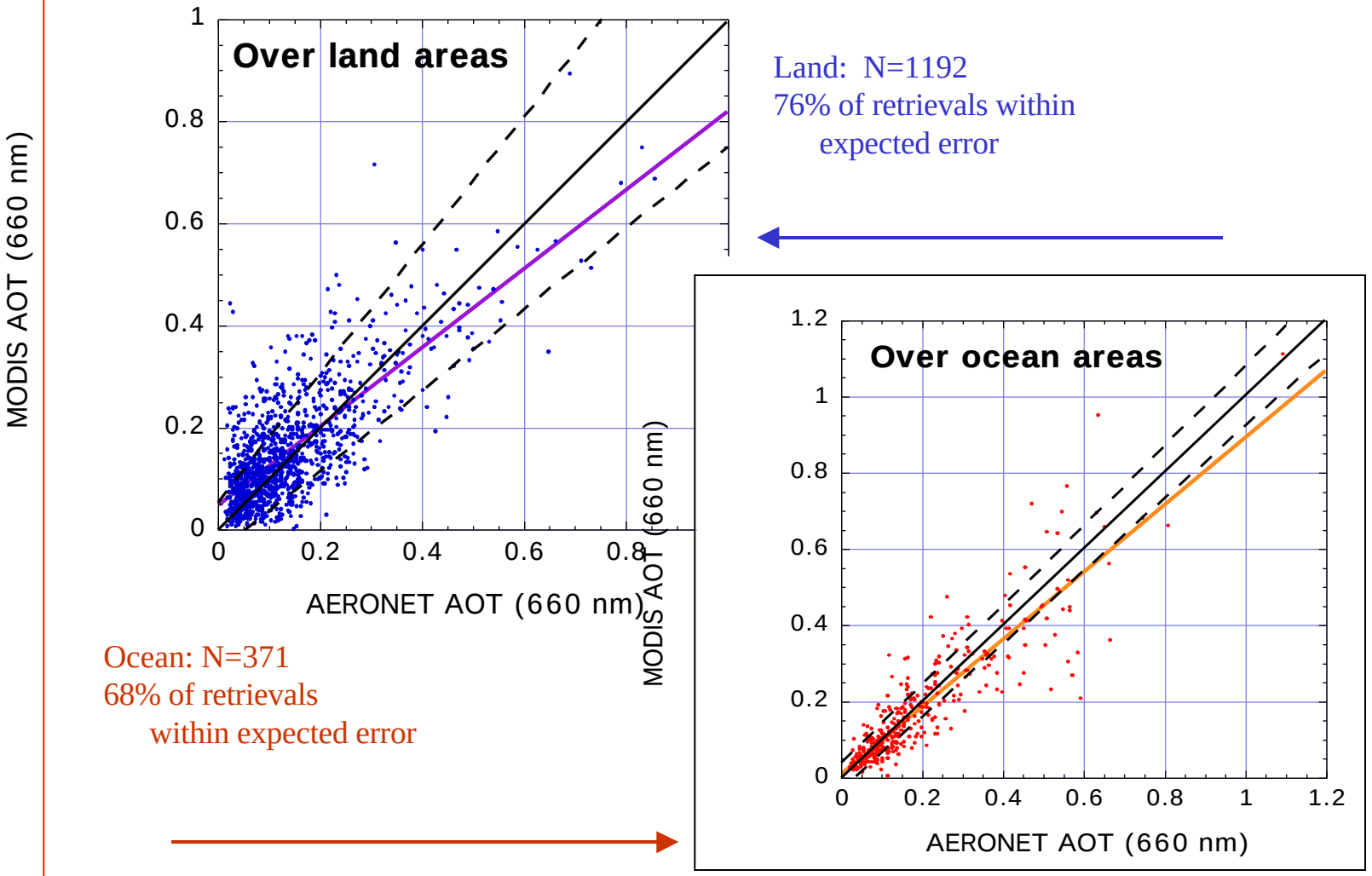
MODIS - ocean: **Aerosol optical thickness**
fraction in fine mode
Effective radius
spectral flux at TOA

MODIS - land: **Aerosol optical thickness**
~ fraction in fine mode

AERONET: **Aerosol optical thickness**
fraction in fine mode
size distribution
absorption/scattering

MODIS vs. AERONET (Aug 2000 to Nov. 2001)

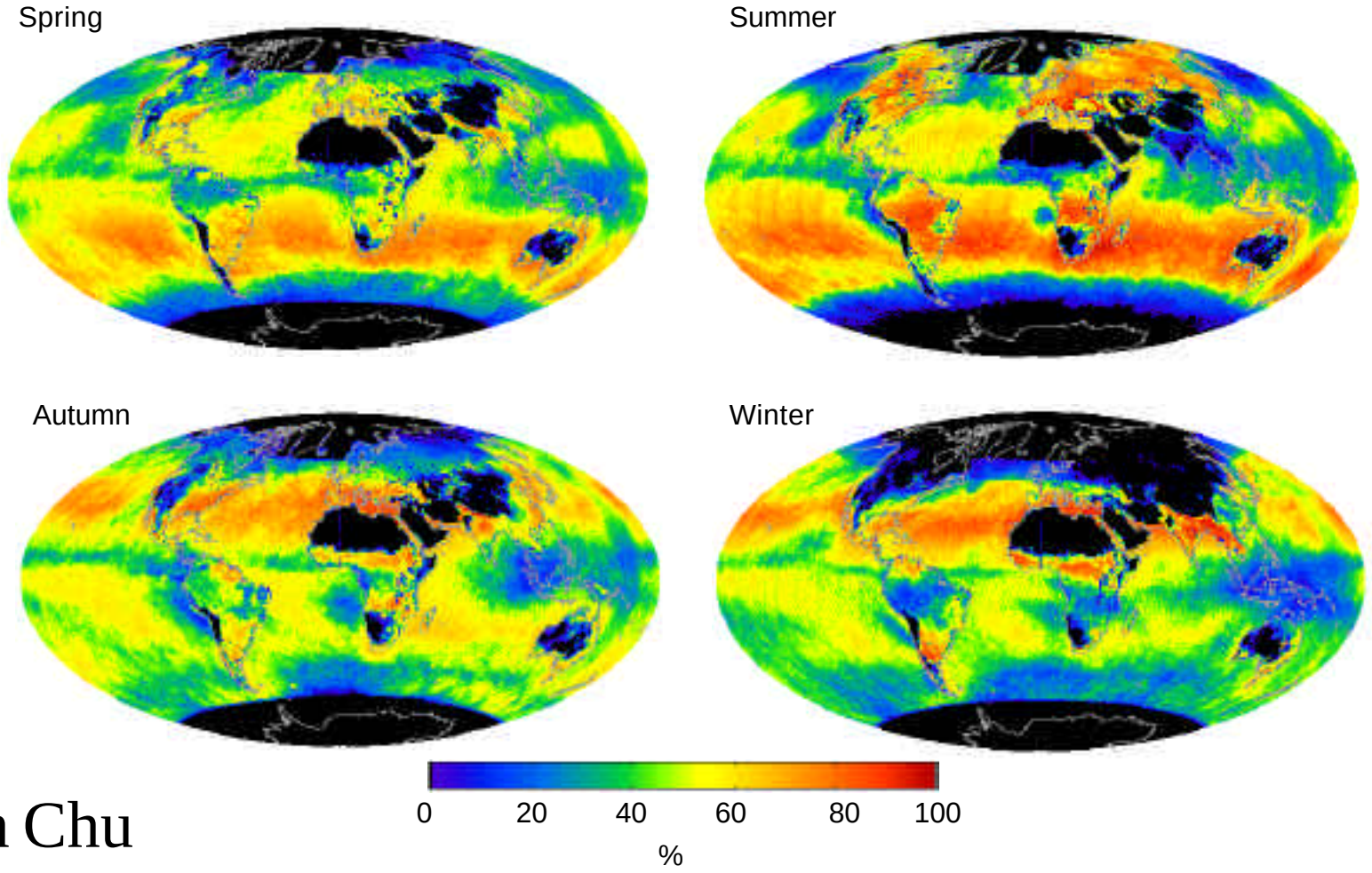
Validation of Aerosol Optical Thickness



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

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

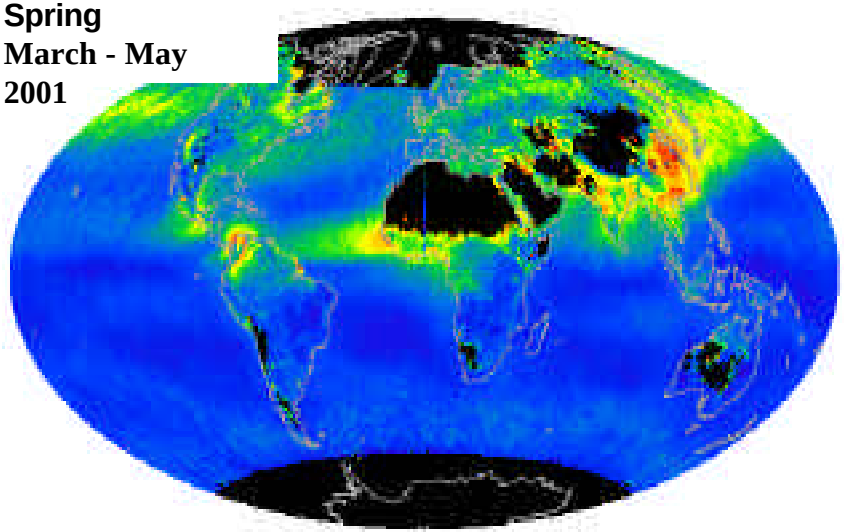
Rob Levy & Lorraine Remer



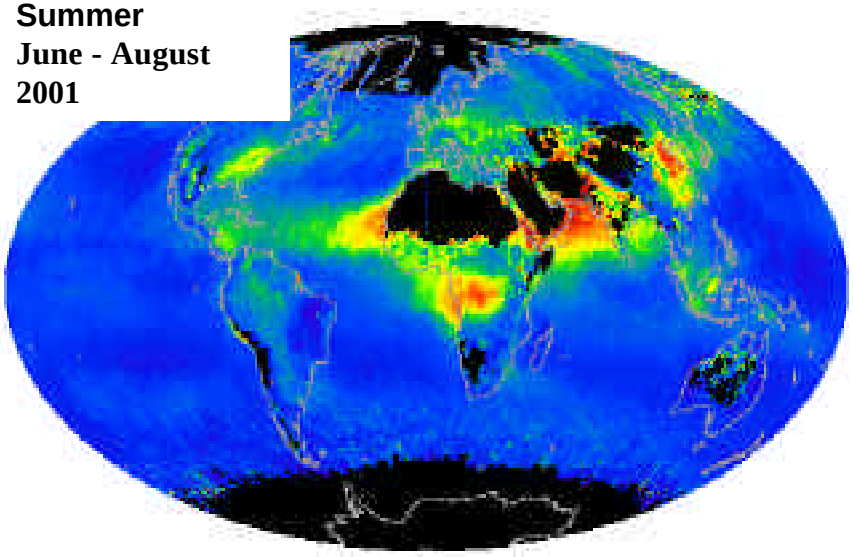
Allen Chu

Frequency of aerosol retrievalsin a 1° ∞ 1° grid box - **spring (March - May 2001), summer (June - August 2001), autumn (September - November 2001), and winter (December 2000 - January 2001).**

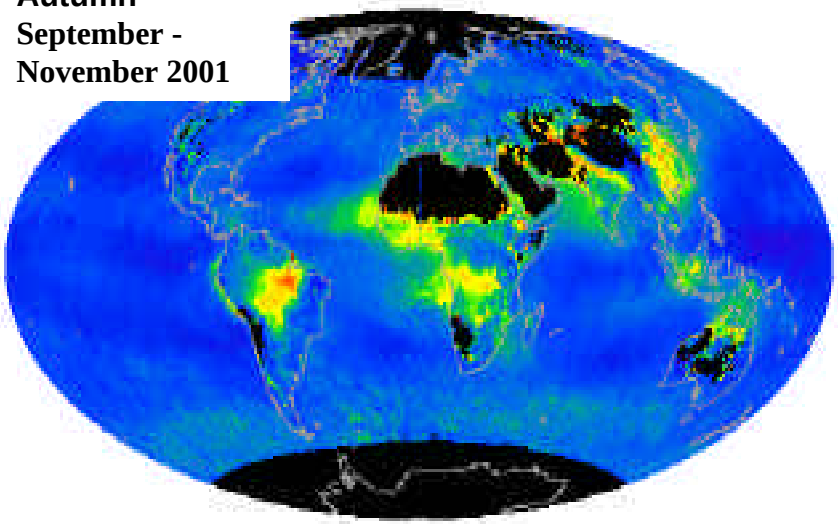
Spring
March - May 2001



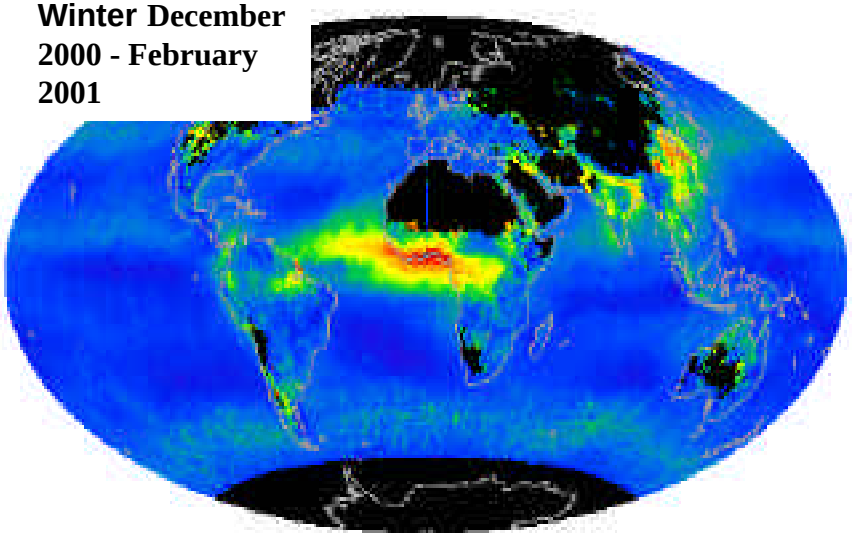
Summer
June - August 2001

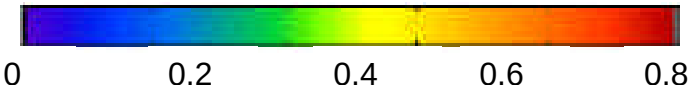


Autumn
September - November 2001



Winter December 2000 - February 2001





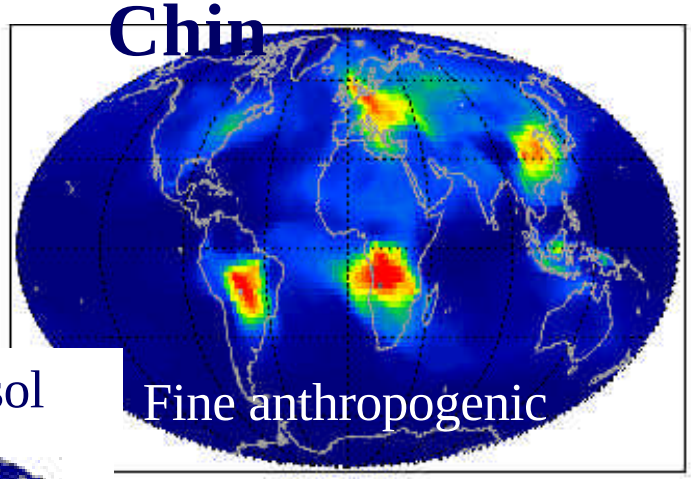
Average optical thickness

Can we “fingerprint” the anthropogenic factor, and ….

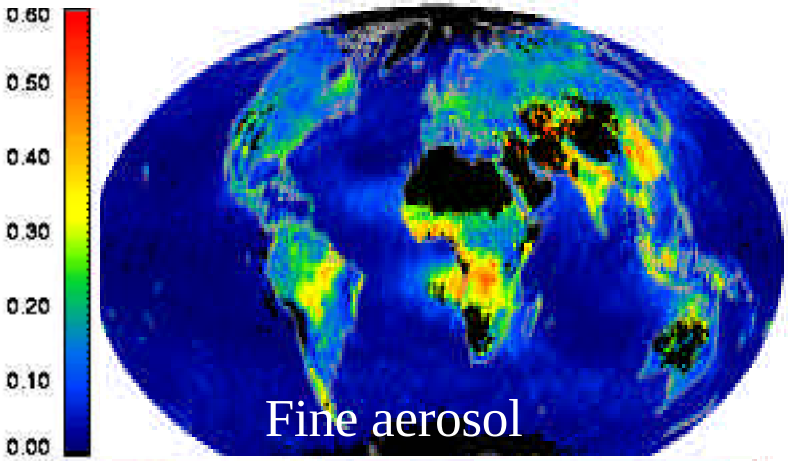
Estimate the aerosol forcing on climate to change ?

GOCART Model - M. Chin

MODIS



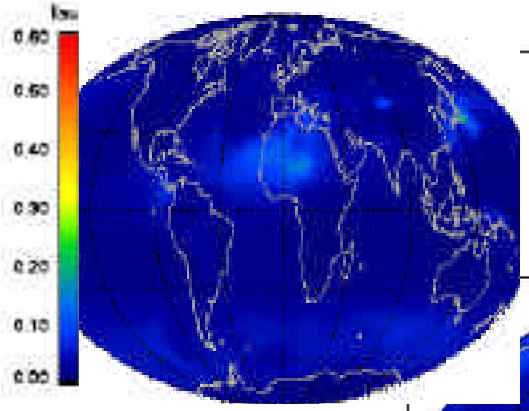
Fine anthropogenic

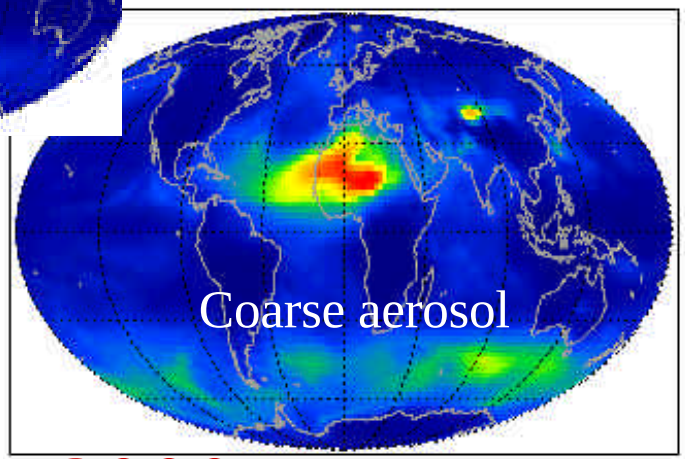


Fine aerosol

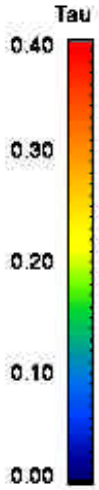
0.0 **0.2** **0.4**

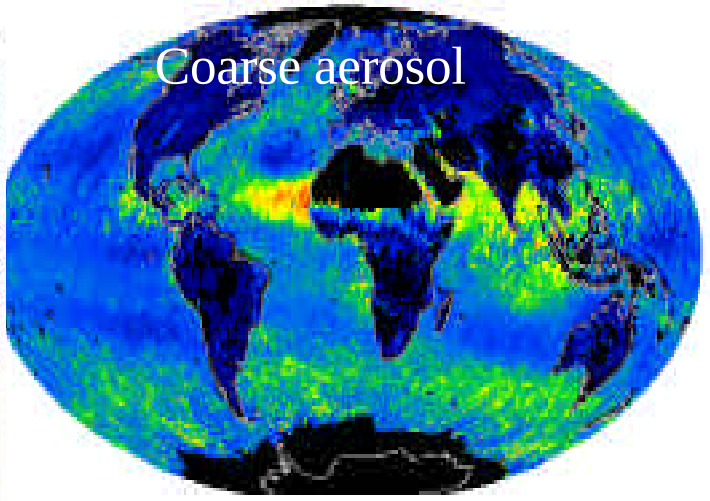
Natural fine aerosol





Coarse aerosol



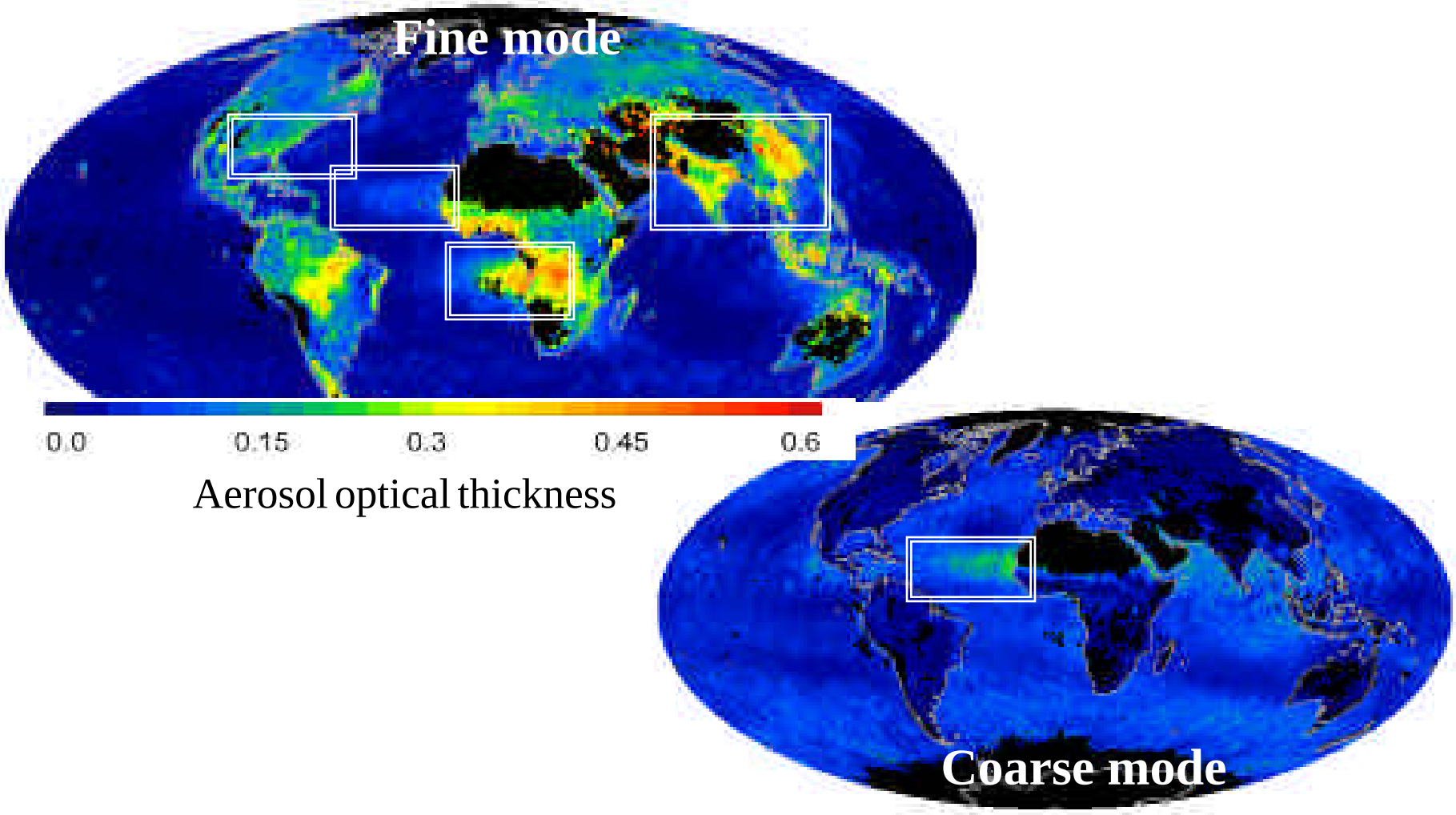


Coarse aerosol

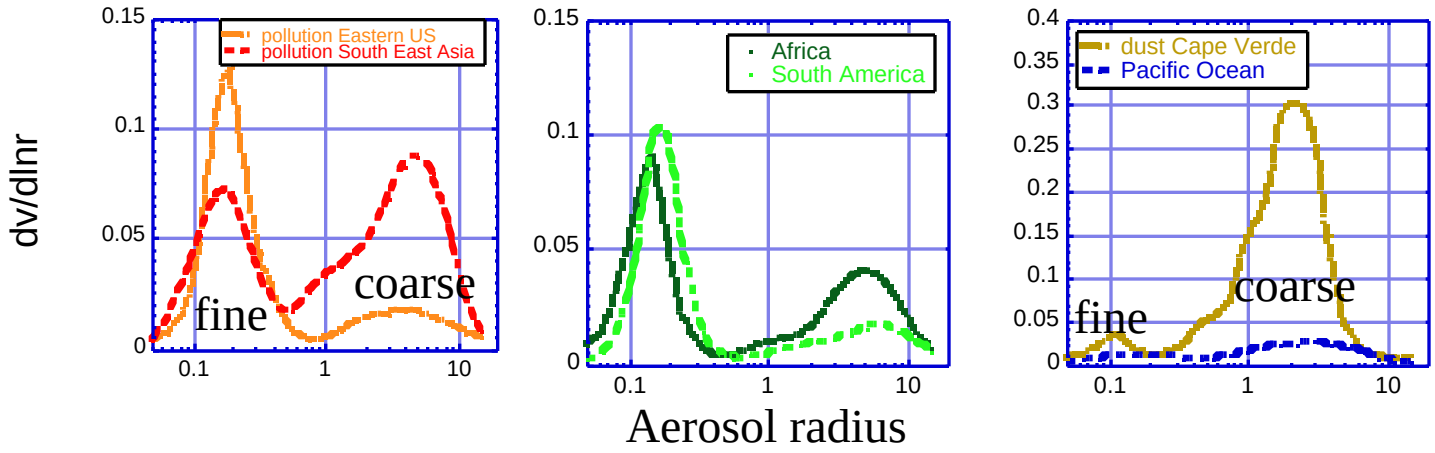
September 2000 - _Kaufman, Tanré, Boucher, A new satellite view of aerosols in the climate system, review for Nature, Sept. 2002

Global results - September 2000

Modis monthly composite aerosol fine and coarse mode & aerosol forcing of climate



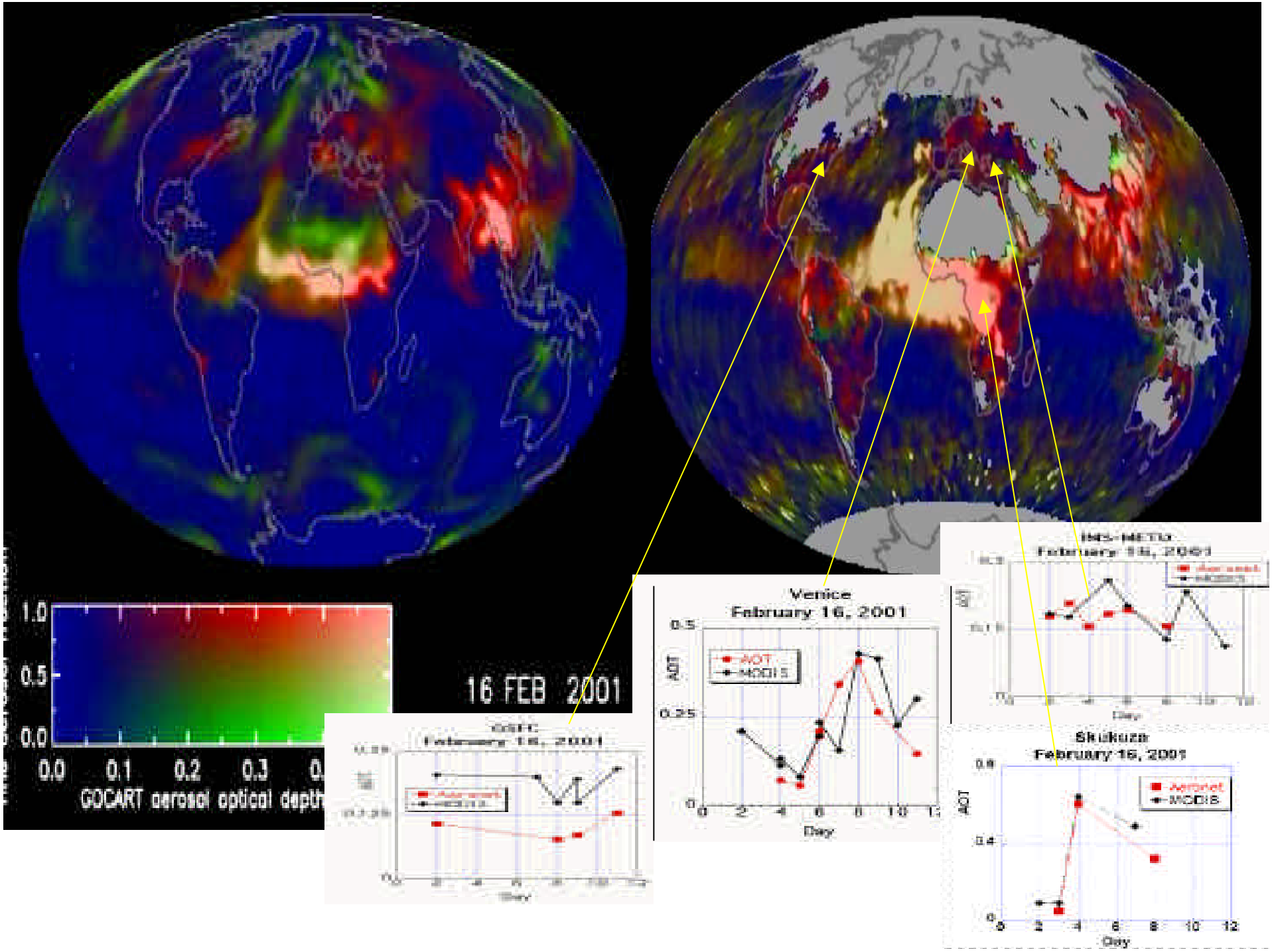
Aerosol AERONET climatology (Dubovik et al.,JAS 2002)

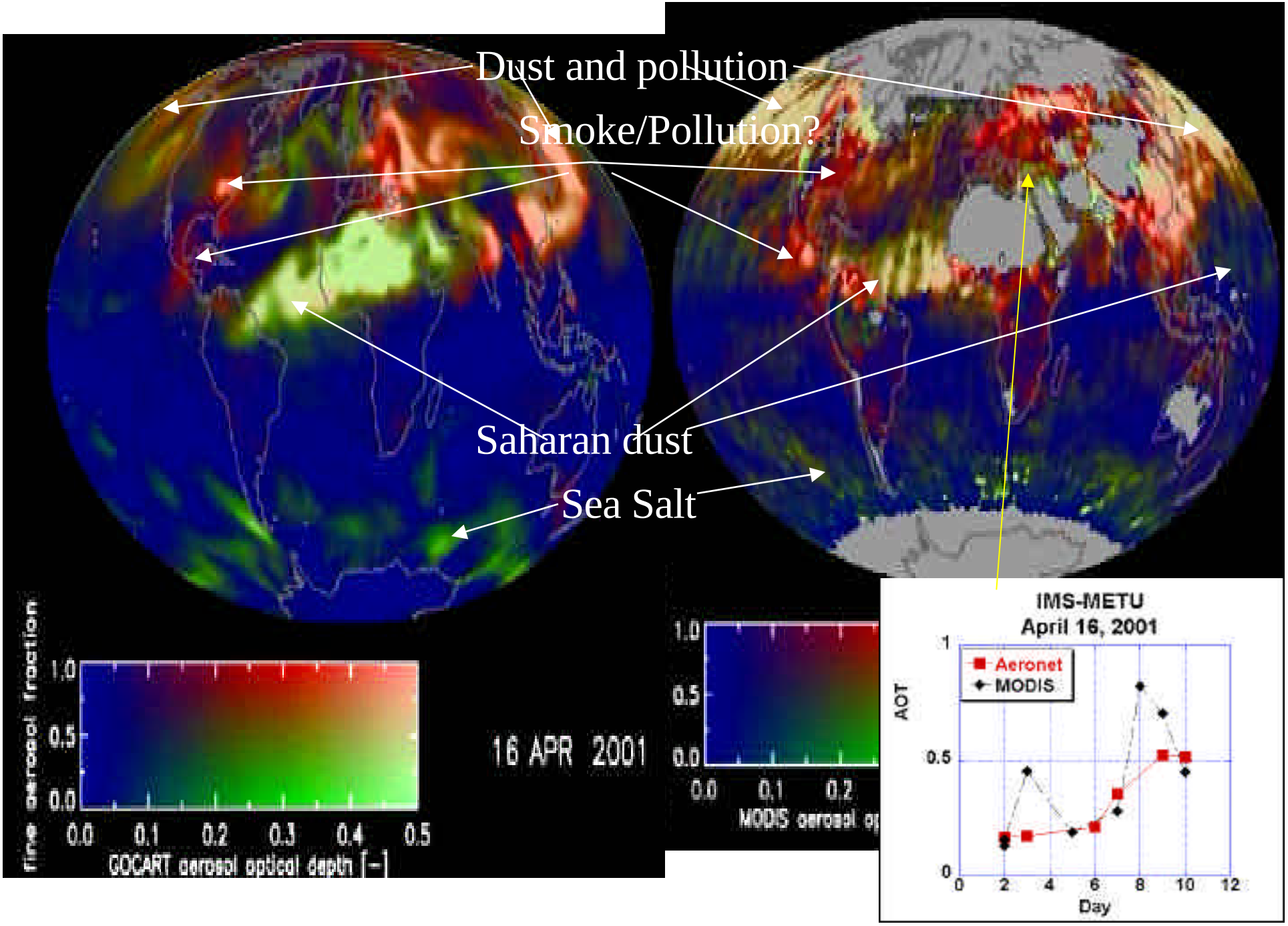


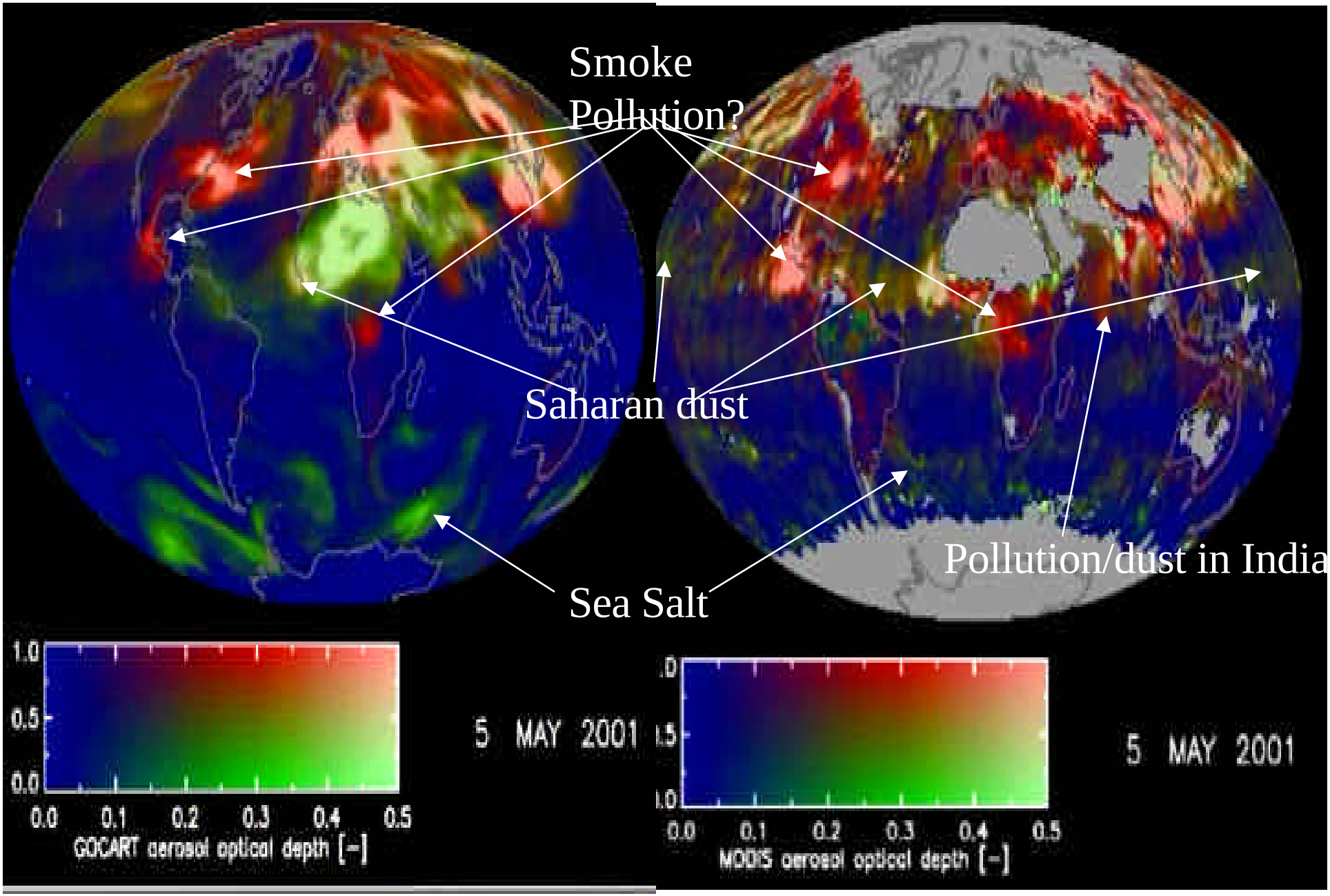
Analysis\ Aerosol type	**Regional pollution aerosol**				**Biomass Burning**		**Dust**	**Oceanic**
A. AERONET analysis	East. US	Euro -pe	S-E Asia	Cen. Amer.	Boreal Forest	Trop. Forest	Savanna Africa-S.A.	Sahara – Saudi Arabia	Pacific Oceans
Time of the year	June-September		Jan.-April	Jan.-Dec.	June-November			January-December	Jan.-Dec.
Average AOT	- - -0.20 - -		0.20	0.30	0.25 – 0.45		0.25 – 0.5	- - 0.2 – 0.4- -	0.06
AOT – fine mode	- - -94% - -		95%	90%	- - - 95%- - -		- - - 92%- - -	- - - -25% - - -	67%
Single scattering albedo	0.97	0.94	- - -0.88 - - -		- - - 0.93- - -		0.88	- - - 0.95- - -	0.98%

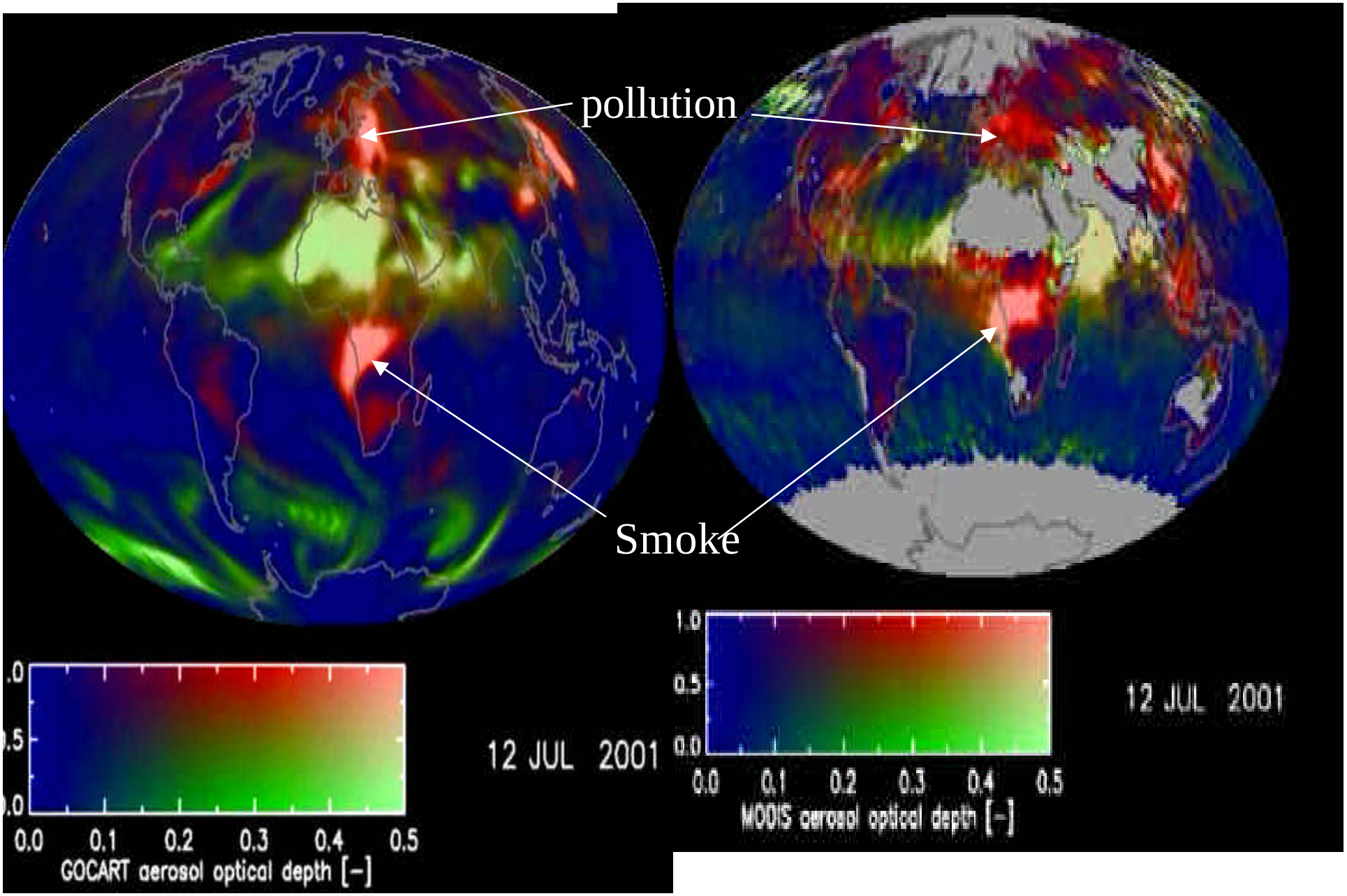
B. Analysis of MODIS ocean data for Sept. 2000	North Atlantic 60-105W 20-45N	S-E Asia 70-140E 5-40N	South Africa 15W-30E 0-20S	West Africa 15-50W 10-25N
Average AOT	0.18	0.24	0.31	0.30
AOT – fine mode	41%	44%	66%	33%
ΔF_{TOA} Wm^{-2}	**-8**	**-10**	**-10**	**-17**$_9$
ΔF_{SUR} Wm^{-2}	**-10**	**-23**	**-30**	**-23**

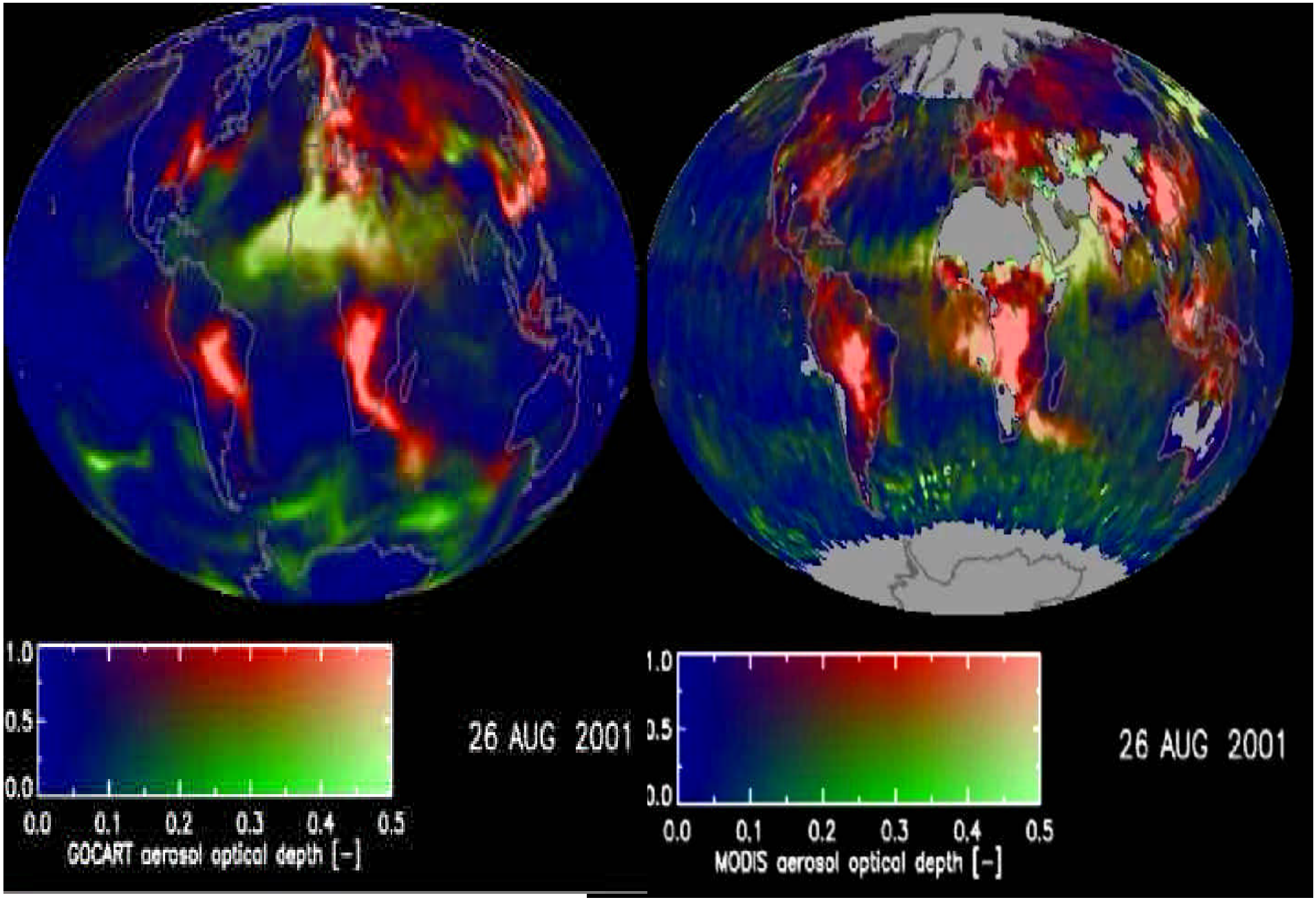
Aerosol transport: **2/16**: Africa --> Europe; **4/16**: China-->USA
5/5: Mexico, Arabian sea--->**7/12:** dust,smoke Africa;
8/26: smoke from South America and Africa


1.0
0.5
0.0
0.0 0.1 0.2 0.3
GOCART aerosol optical depth
16 FEB 2001
Venice
February 16, 2001
AOT
MODIS
Day
Skukuza
February 16, 2001
Aeronet
MODIS
AOT
Day


Dust and pollution
Smoke/Pollution?
Saharan dust
Sea Salt
16 APR 2001
fine aerosol fraction
1.0
0.5
0.0
0.0 0.1 0.2 0.3 0.4 0.5
GOCART aerosol optical depth [-]
1.0
0.5
0.0
0.0 0.1 0.2
MODIS aerosol op
IMS-METU
April 16, 2001
Aeronet
MODIS
AOT
1
0.5
0
0 2 4 6 8 10 12
Day

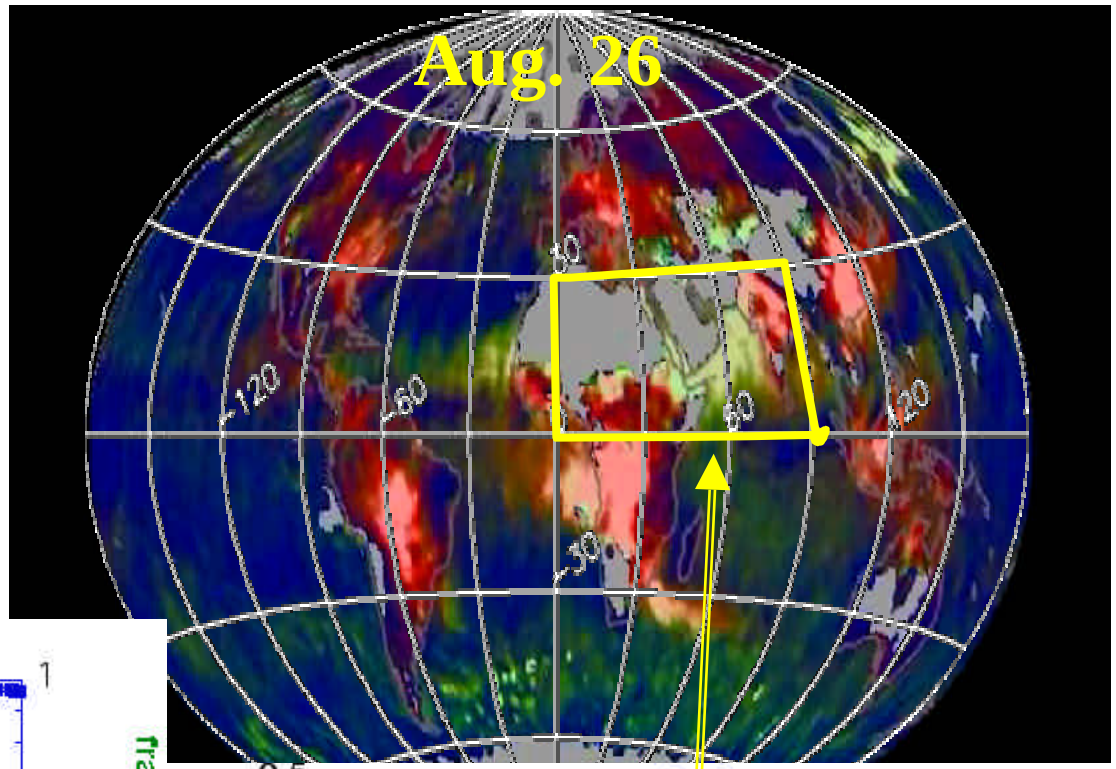

Smoke
Pollution?
Saharan dust
Pollution/dust in India
Sea Salt
1.0
0.5
0.0
0.0 0.1 0.2 0.3 0.4 0.5
GOCART aerosol optical depth [-]
5 MAY 2001
1.0
0.5
0.0
0.0 0.1 0.2 0.3 0.4 0.5
MODIS aerosol optical depth [-]
5 MAY 2001

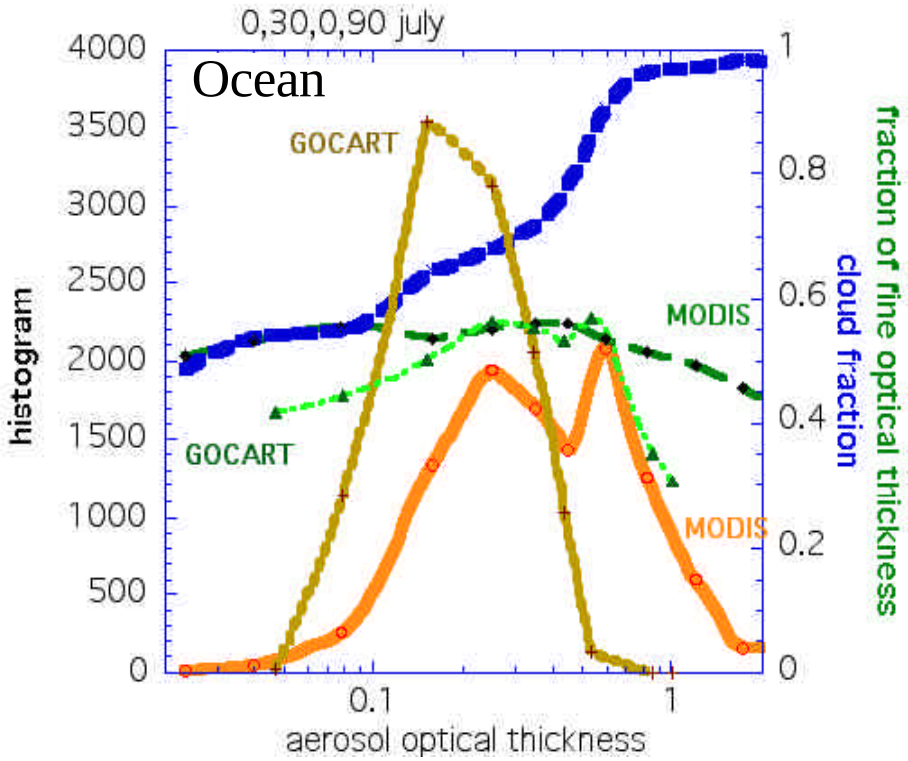

pollution
Smoke
12 JUL 2001
0.0 0.1 0.2 0.3 0.4 0.5
GOCART aerosol optical depth [-]
1.0
0.5
0.0
0.0 0.1 0.2 0.3 0.4 0.5
MODIS aerosol optical depth [-]
12 JUL 2001

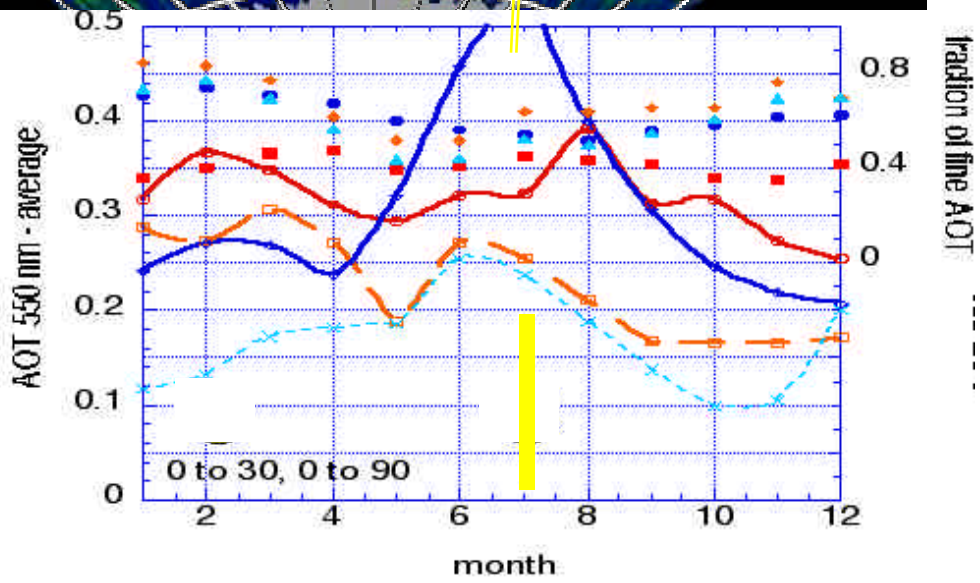

1.0
0.5
0.0
0.0 0.1 0.2 0.3 0.4 0.5
GOCART aerosol optical depth [-]
26 AUG 2001
1.0
0.5
0.0
0.0 0.1 0.2 0.3 0.4 0.5
MODIS aerosol optical depth [-]
26 AUG 2001

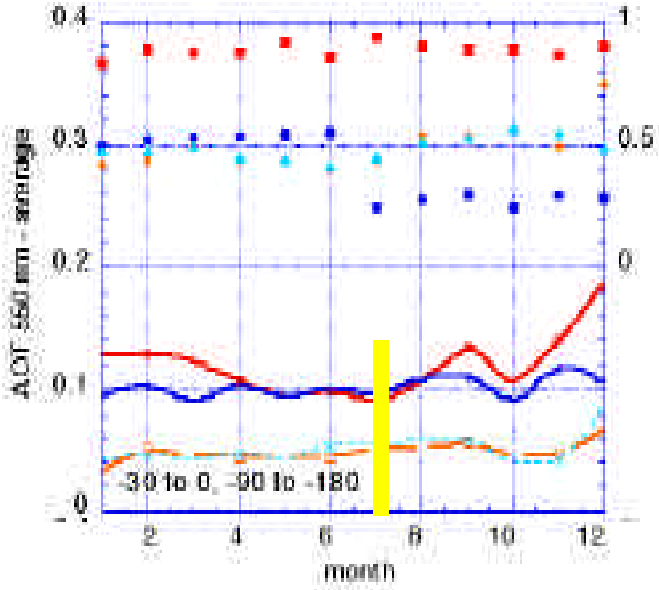
Analysis:

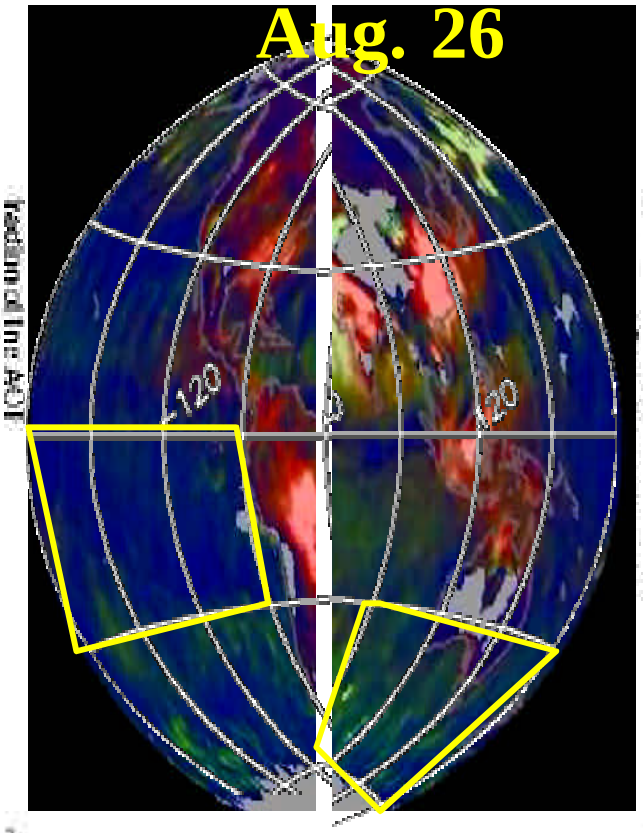
	AOT 550 Average	std	average 10-90%	Weighted by(1-cld)	ratio of fine AOT to total
MODIS Land	0.197	0.13	0.179	0.177	0.62
MODIS ocean	0.175	0.20	0.146	0.132	0.49
GOCART land	0.135	0.08	0.123		0.67
GOCART ocean	0.124	0.07	0.113		0.54

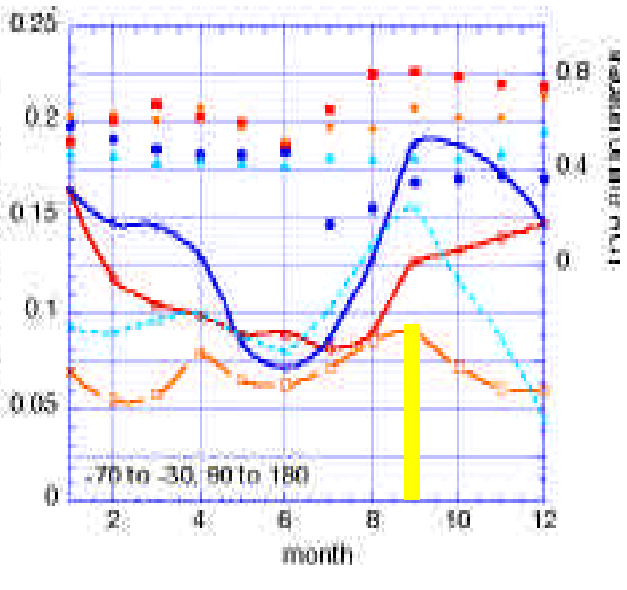

Aug. 26
30
-120
-60
60
120
-30

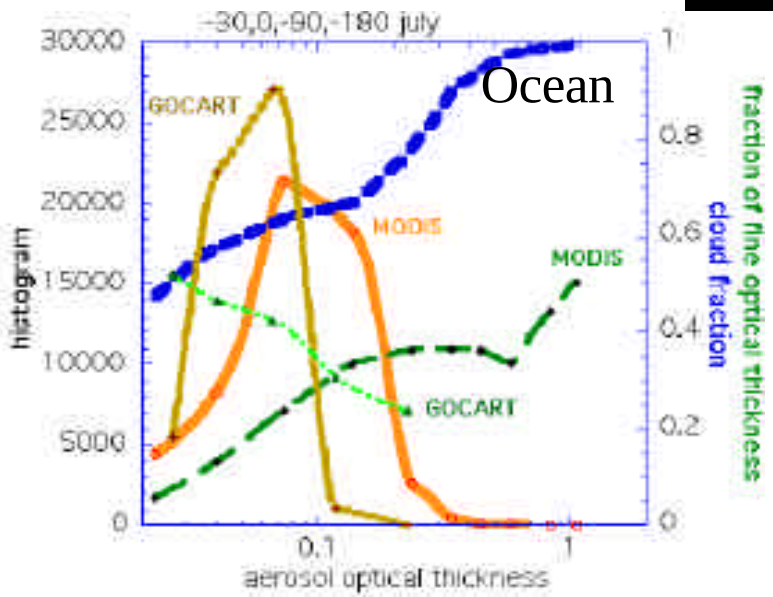

0,30,0,90 july
Ocean
GOCART
MODIS
GOCART
MODIS
histogram
fraction of fine optical thickness
cloud fraction
aerosol optical thickness
4000
3500
3000
2500
2000
1500
1000
500
0
0.1
1
0.8
0.6
0.4
0.2

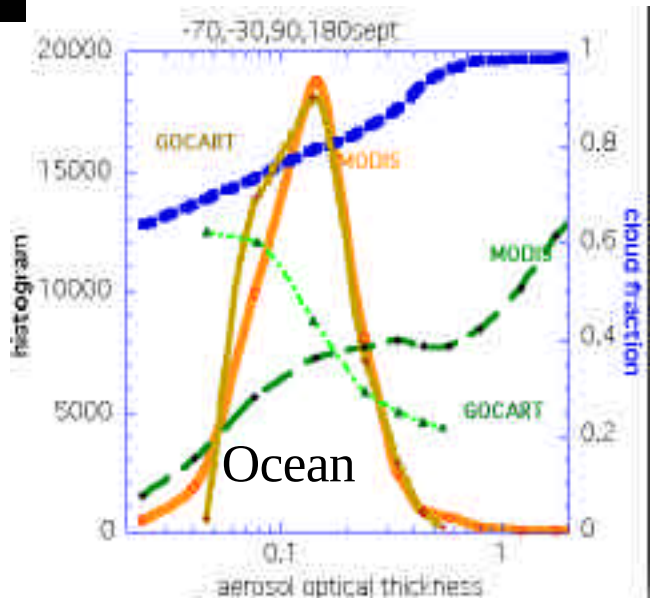

AOT 550 nm - average
fraction of fine AOT
0 to 30, 0 to 90
month
0.5
0.4
0.3
0.2
0.1
0
0.8
0.4
0
2
4
6
8
10
12

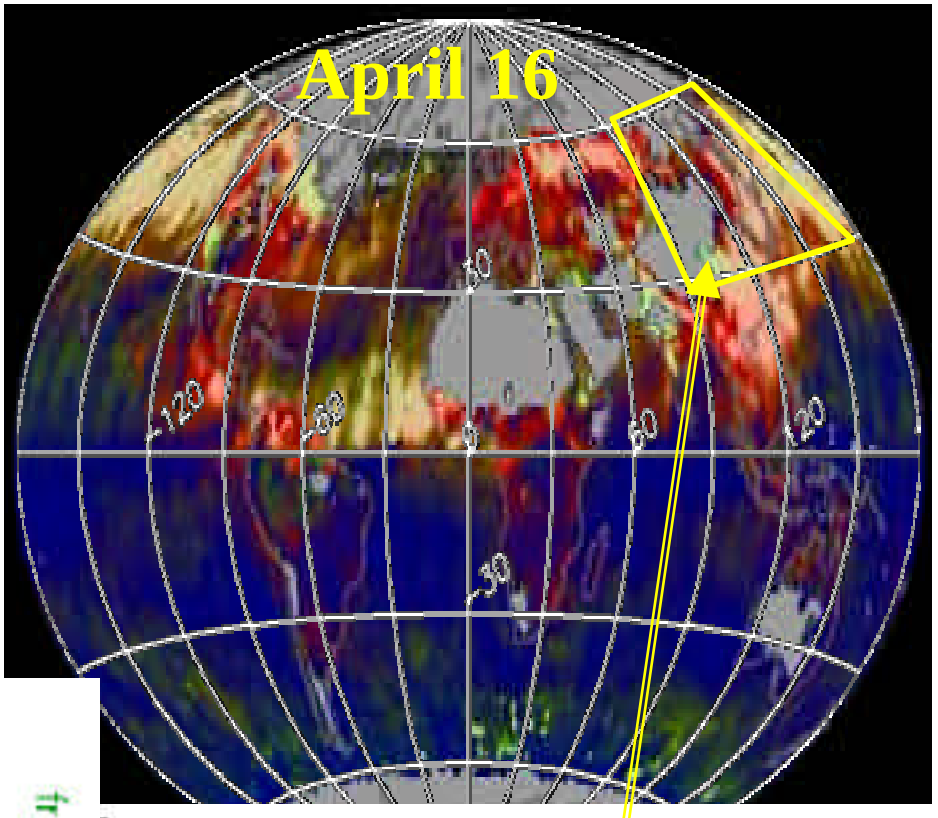

AOT 550 nm - average
fraction of fine AOT
month
-30 to 0, -90 to -180

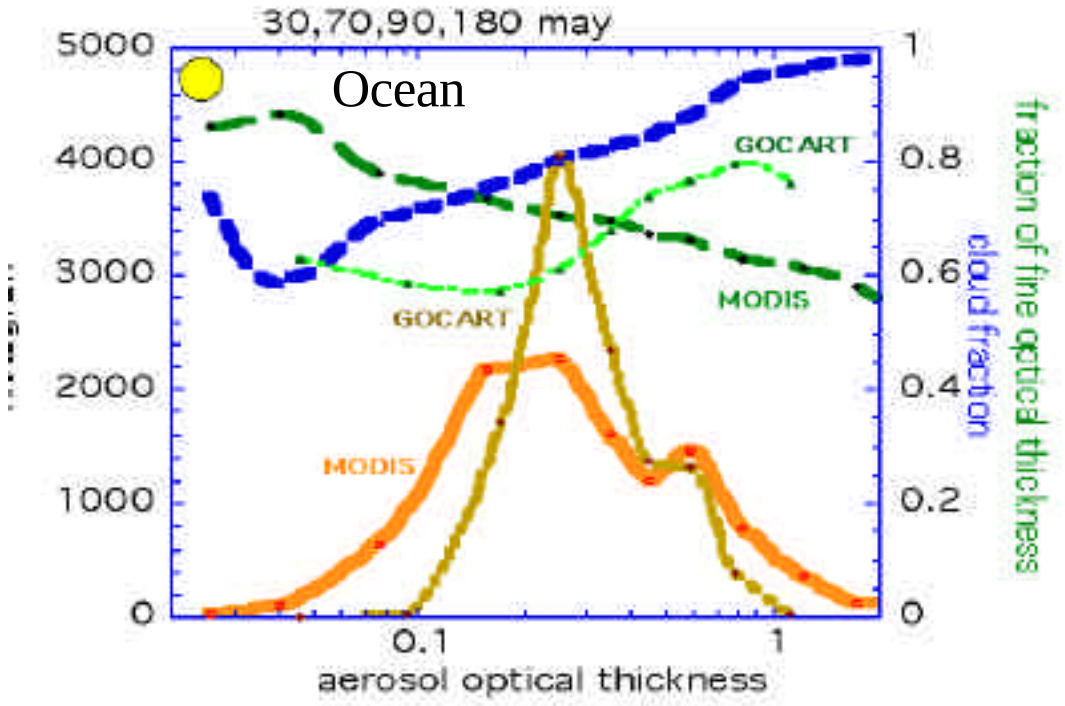

Aug. 26
-120
120

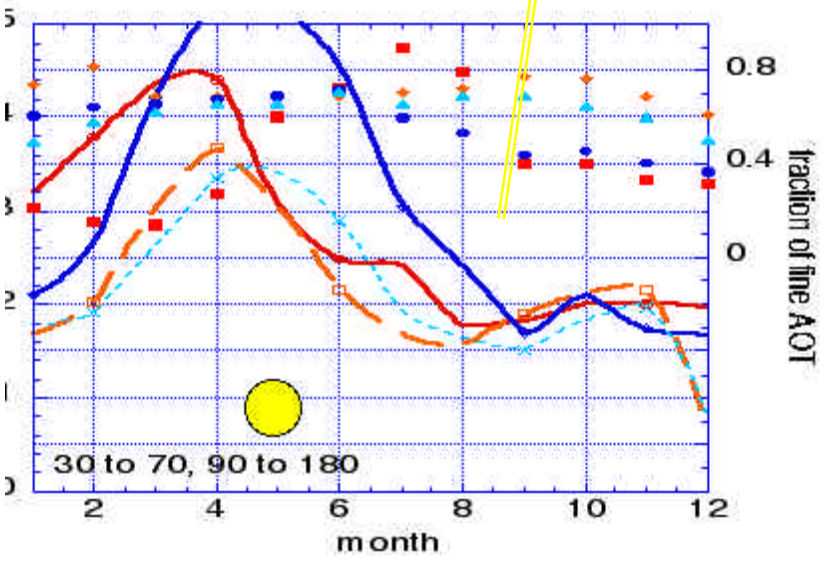

month
-70 to -30, 90 to 180


-30,0,-90,-180 july
Ocean
GOCART
MODIS
MODIS
GOCART
histogram
fraction of fine optical thickness
cloud fraction
aerosol optical thickness


-70,-30,90,180sept
GOCART
MODIS
MODIS
GOCART
Ocean
histogram
cloud fraction
aerosol optical thickness


April 16
-120
-60
0
60
120
30
-30


30,70,90,180 may
Ocean
GOCART
MODIS
GOCART
MODIS
5000
4000
3000
2000
1000
0
1
0.8
0.6
0.4
0.2
0
0.1
1
aerosol optical thickness
cloud fraction
fraction of fine optical thickness


30 to 70, 90 to 180
2
4
6
8
10
12
month
0.8
0.4
0
fraction of fine AOT

Next?

Observational based -

MODIS & AERONET

anthropogenic aerosol global forcing of climate -

in cloud free conditions

- **Aerosol forcing using MODIS+CERES (U. Alabama)**
- **Improve aerosol simulations - GOCART**
- **Use in aerosol assimilation - NCAR**
- **Use in climate models - GISS**