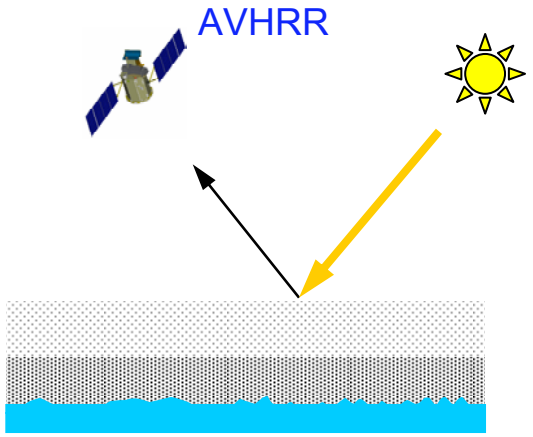
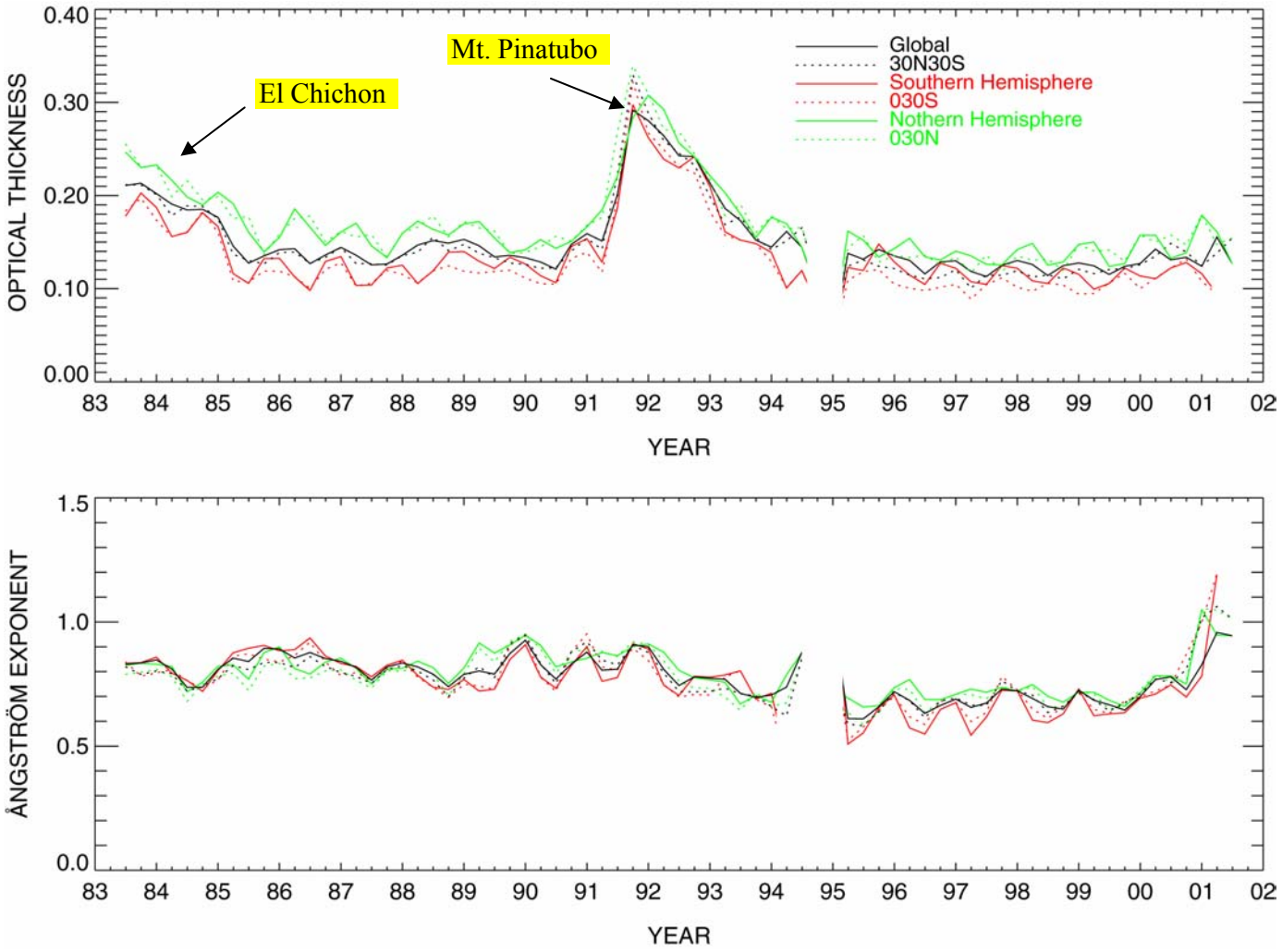
Global Aerosol Climatology Project

Analyses of AVHRR data

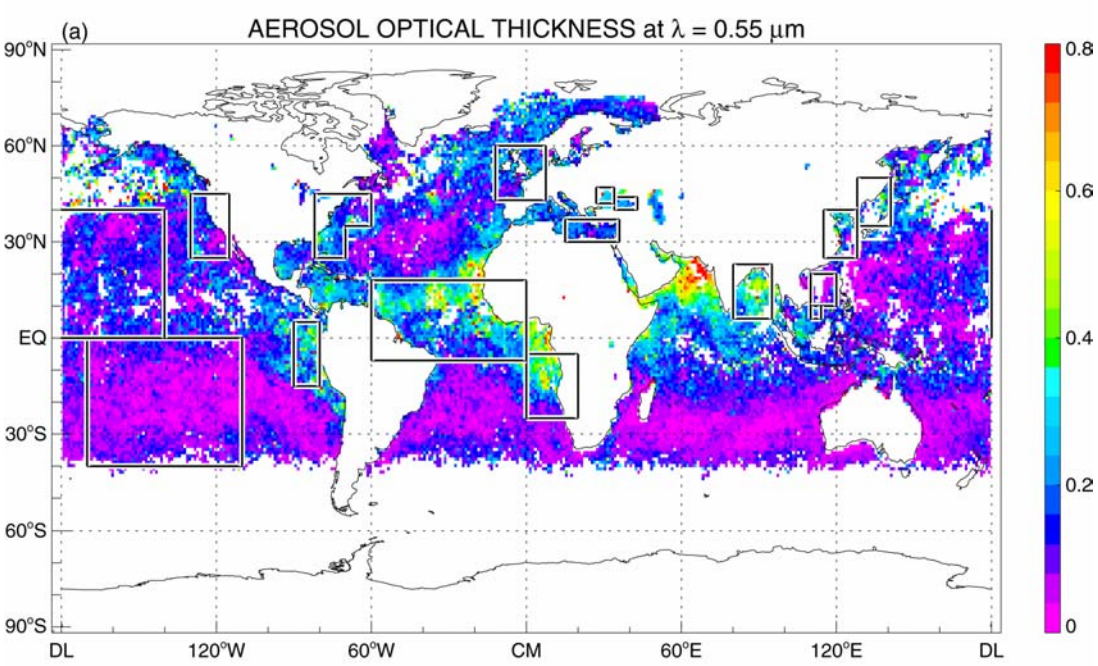
1. Two spectral channels (0.63 and 0.83 micrometers).
2. One viewing angle per pixel.
3. All model parameters are fixed except the total (column) aerosol optical thickness and the Angstrom parameter.
4. Simple look-up table approach.
5. State-of-the-art radiative transfer model.
6. The longest available satellite record.



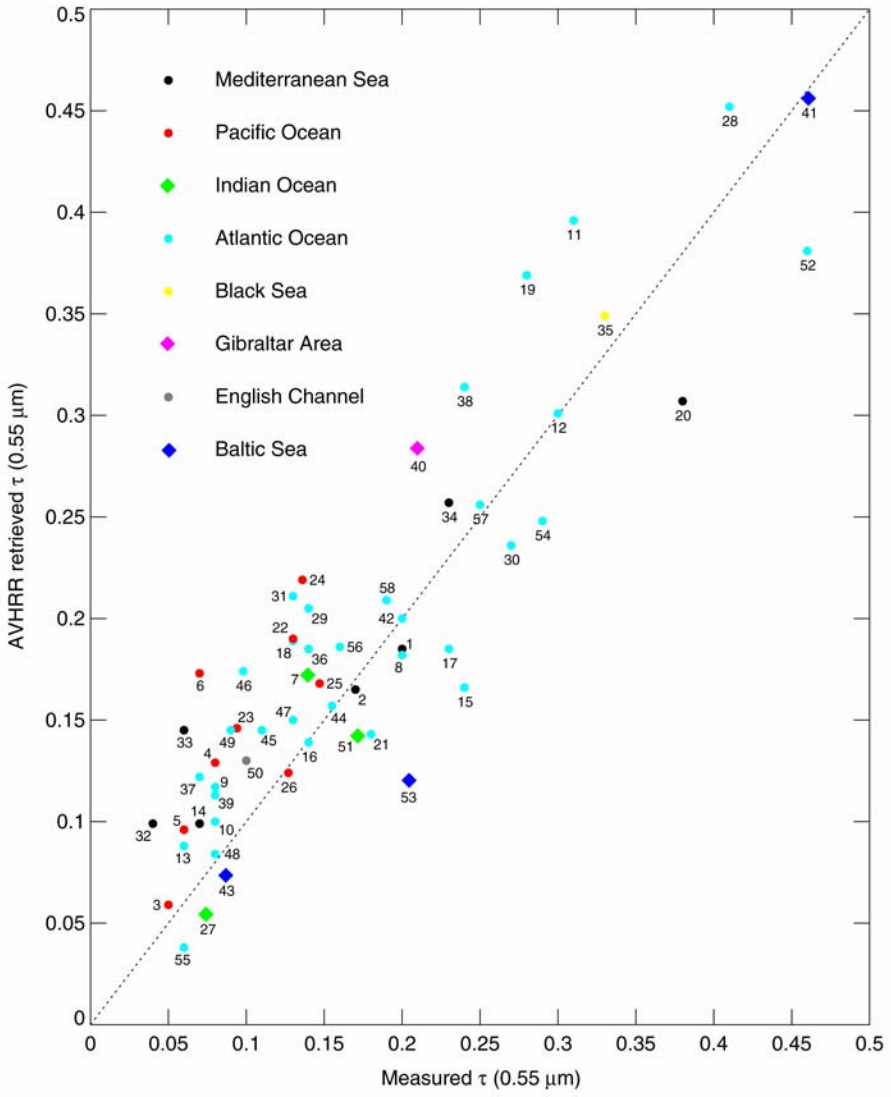
Global long-term record



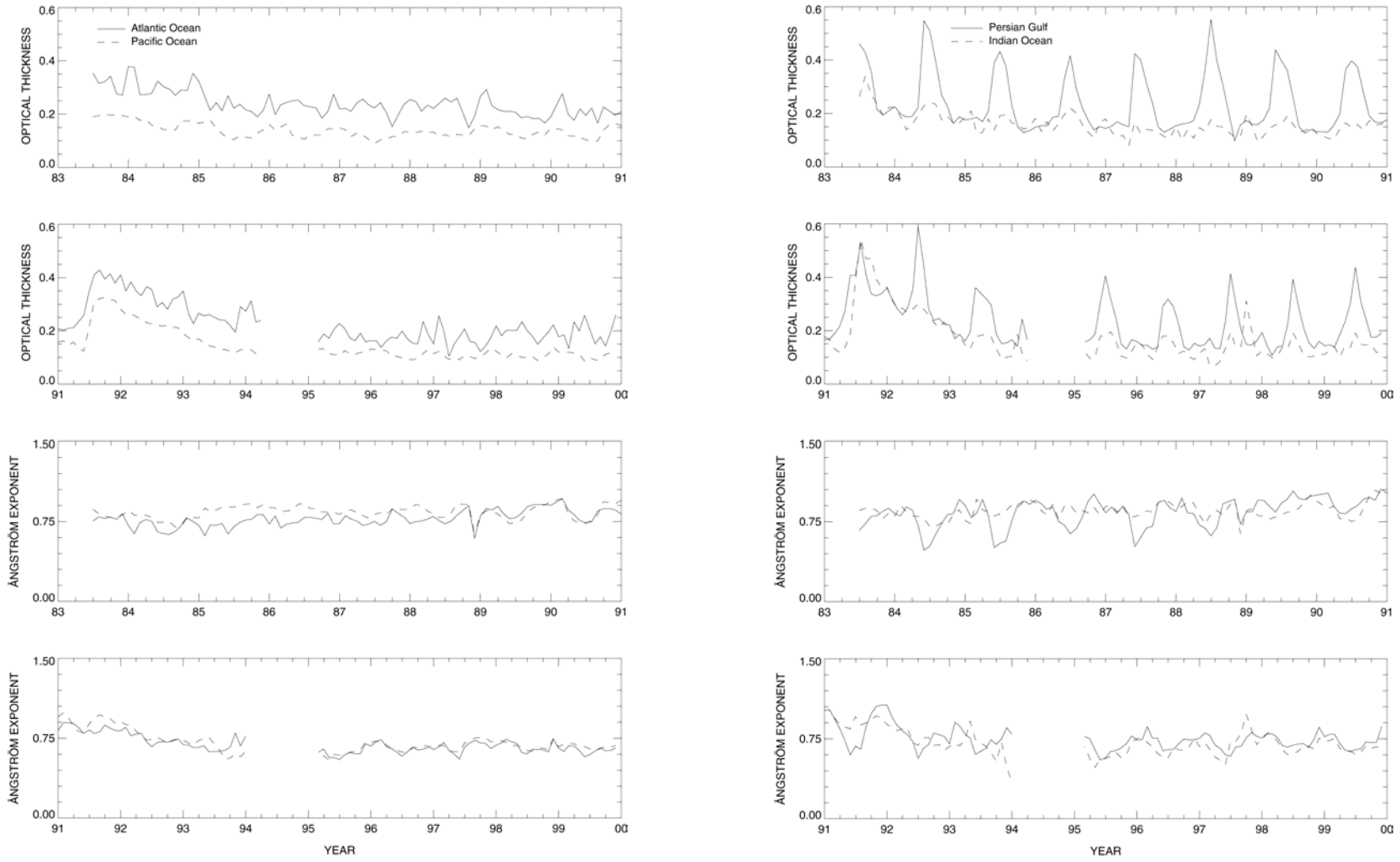
Regional long-term record

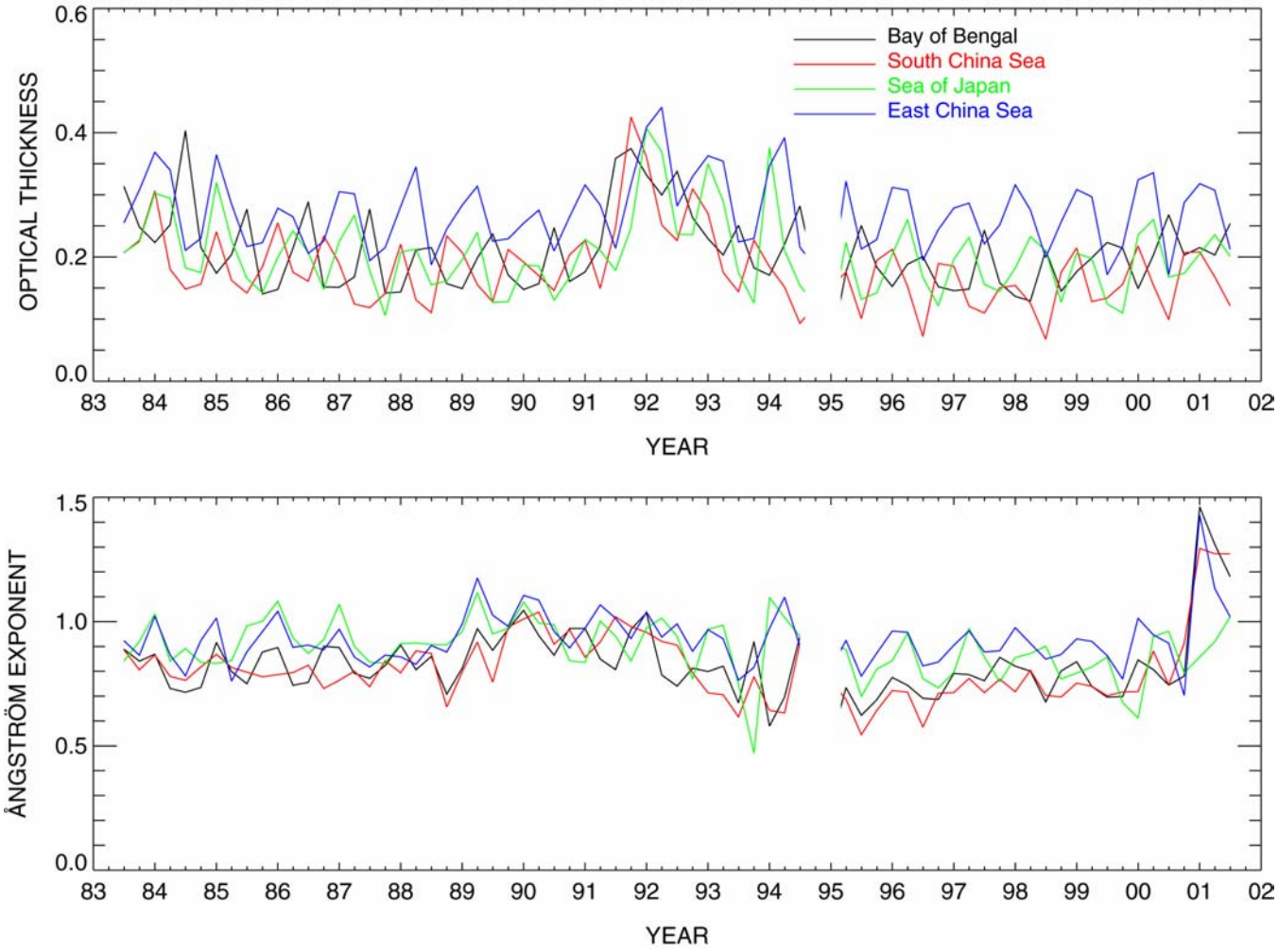


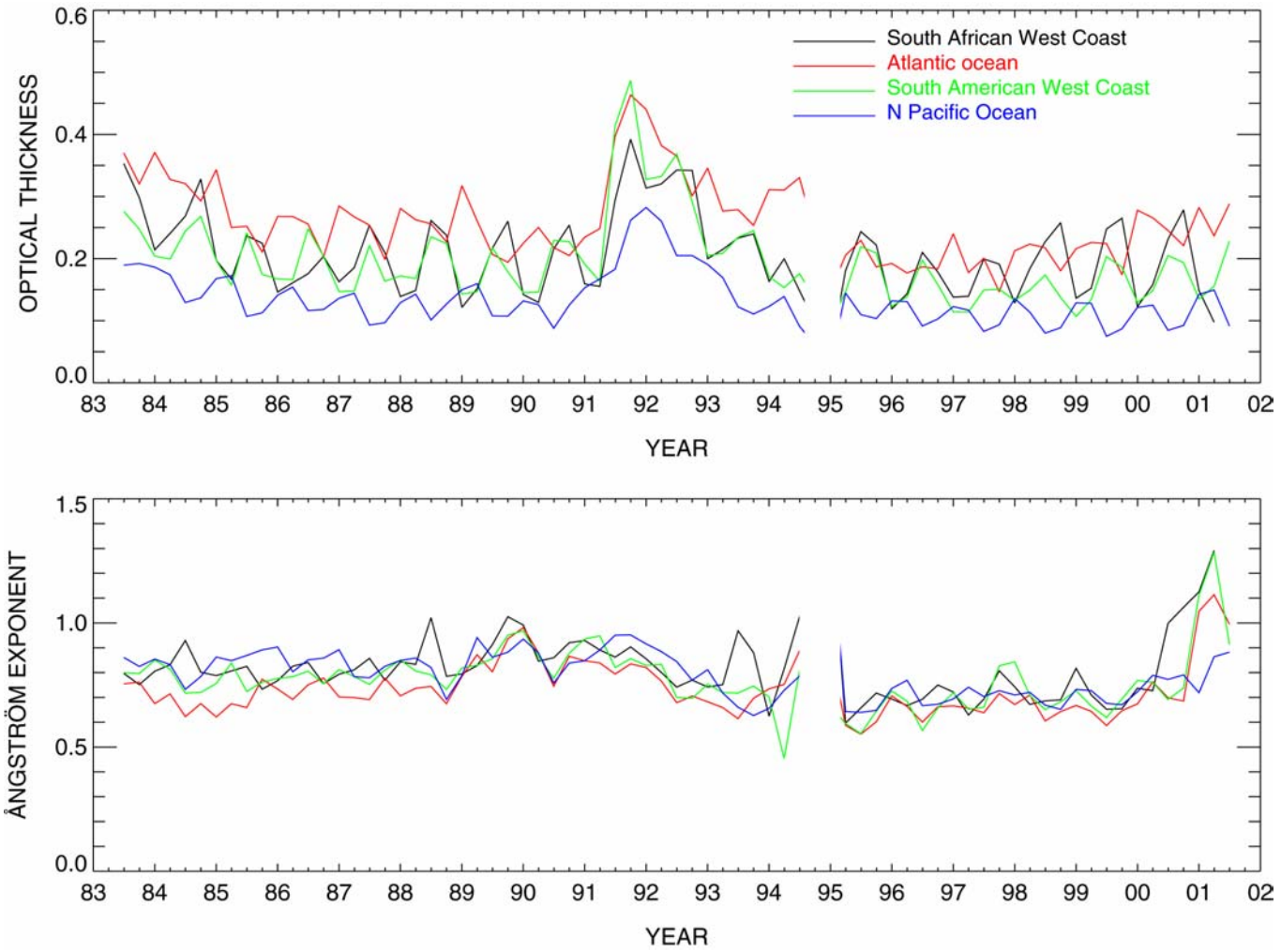
Bay of Bengal
South China Sea
Sea of Japan
East China Sea
African West Coast
Atlantic Ocean
South America West Coast
Eastern Mediterrenian Sea
US East Coast
US West Coast
Southern Pacific Ocean
Northern Pacific Ocean
European West Coast
Eastern Black Sea
Western Black Sea

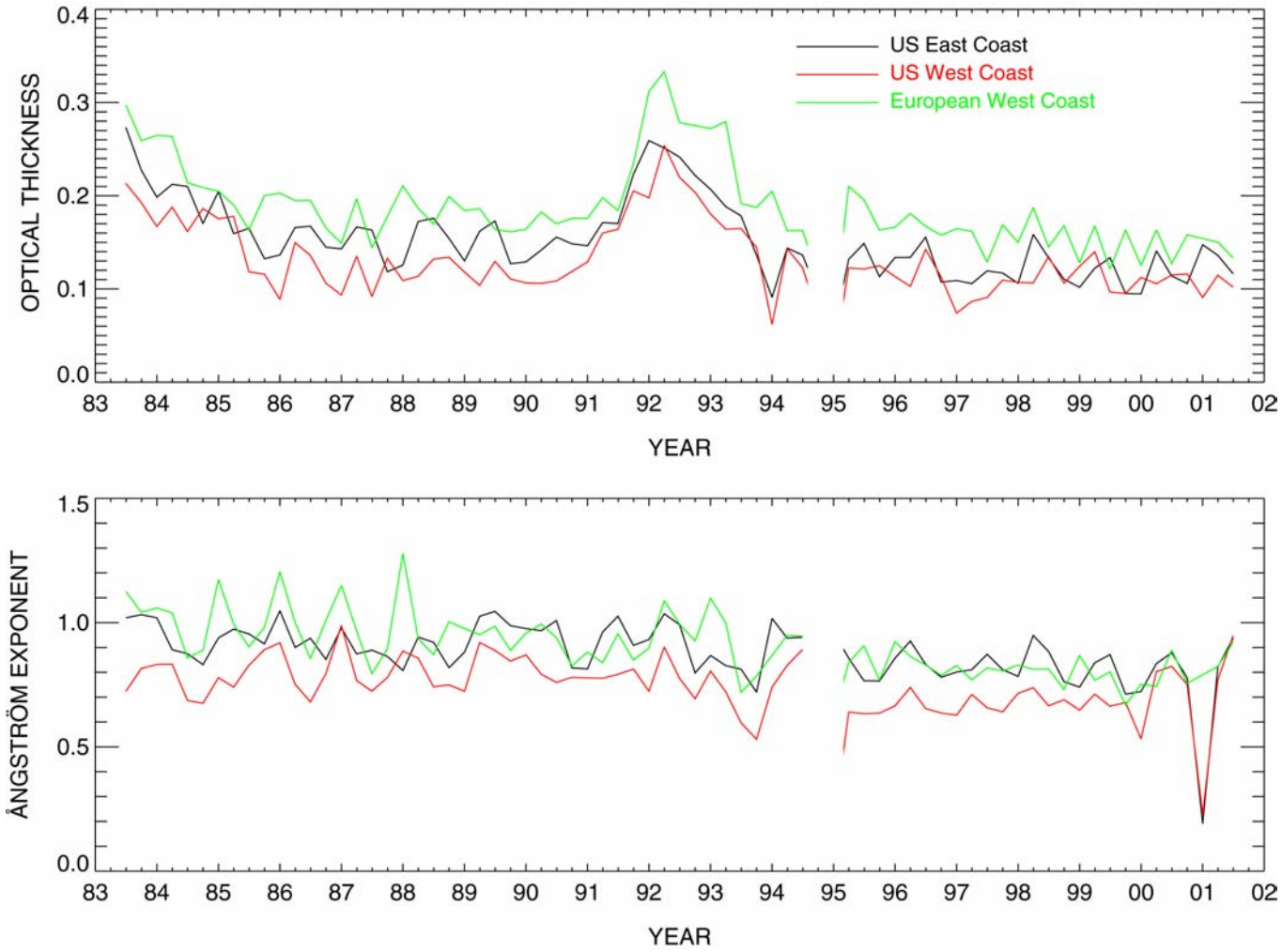

Mediterranean Sea
Pacific Ocean
Indian Ocean
Atlantic Ocean
Black Sea
Gibraltar Area
English Channel
Baltic Sea
AVHRR retrieved τ (0.55 μm)
Measured τ (0.55 μm)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

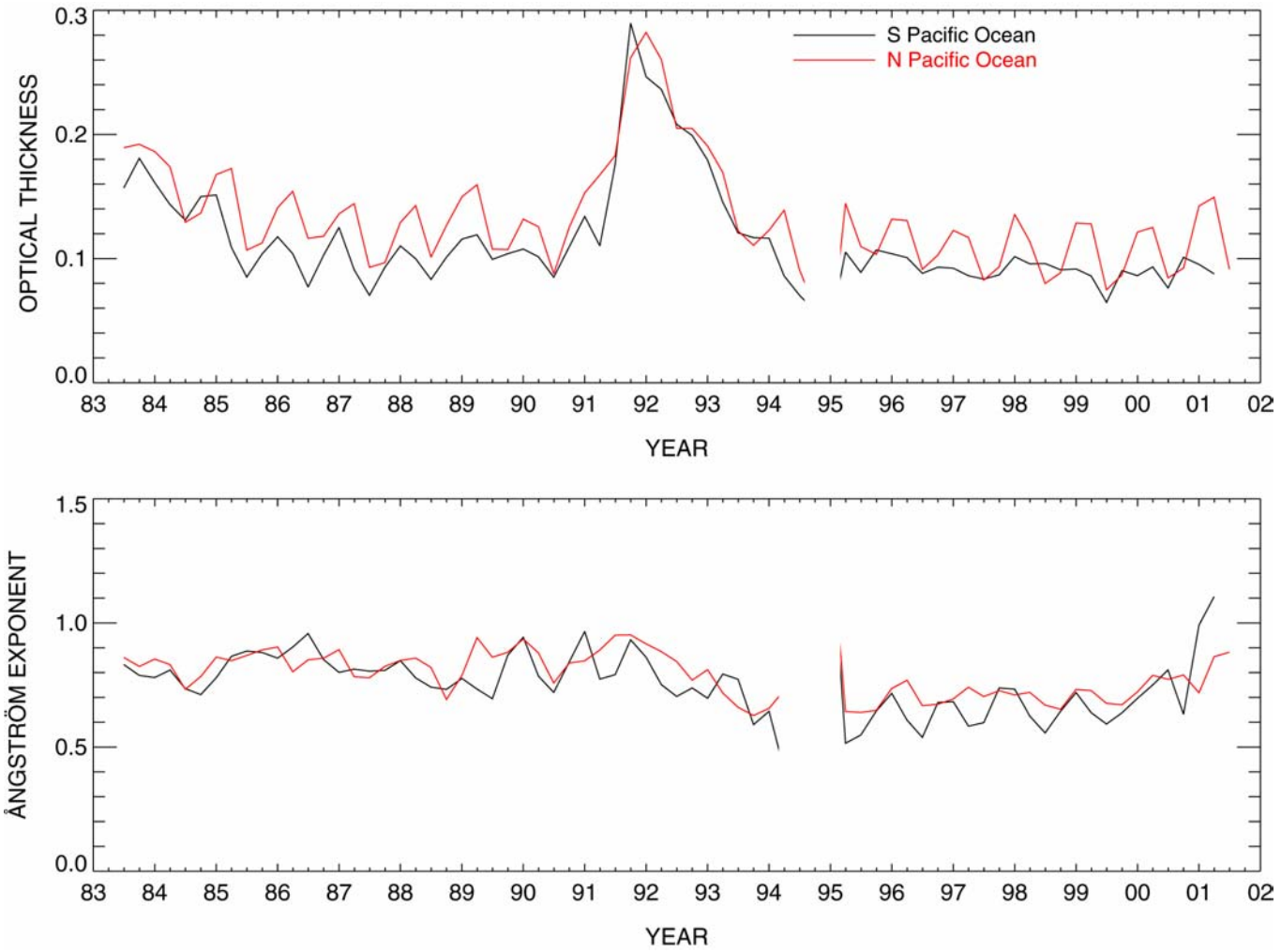
Regional long-term record

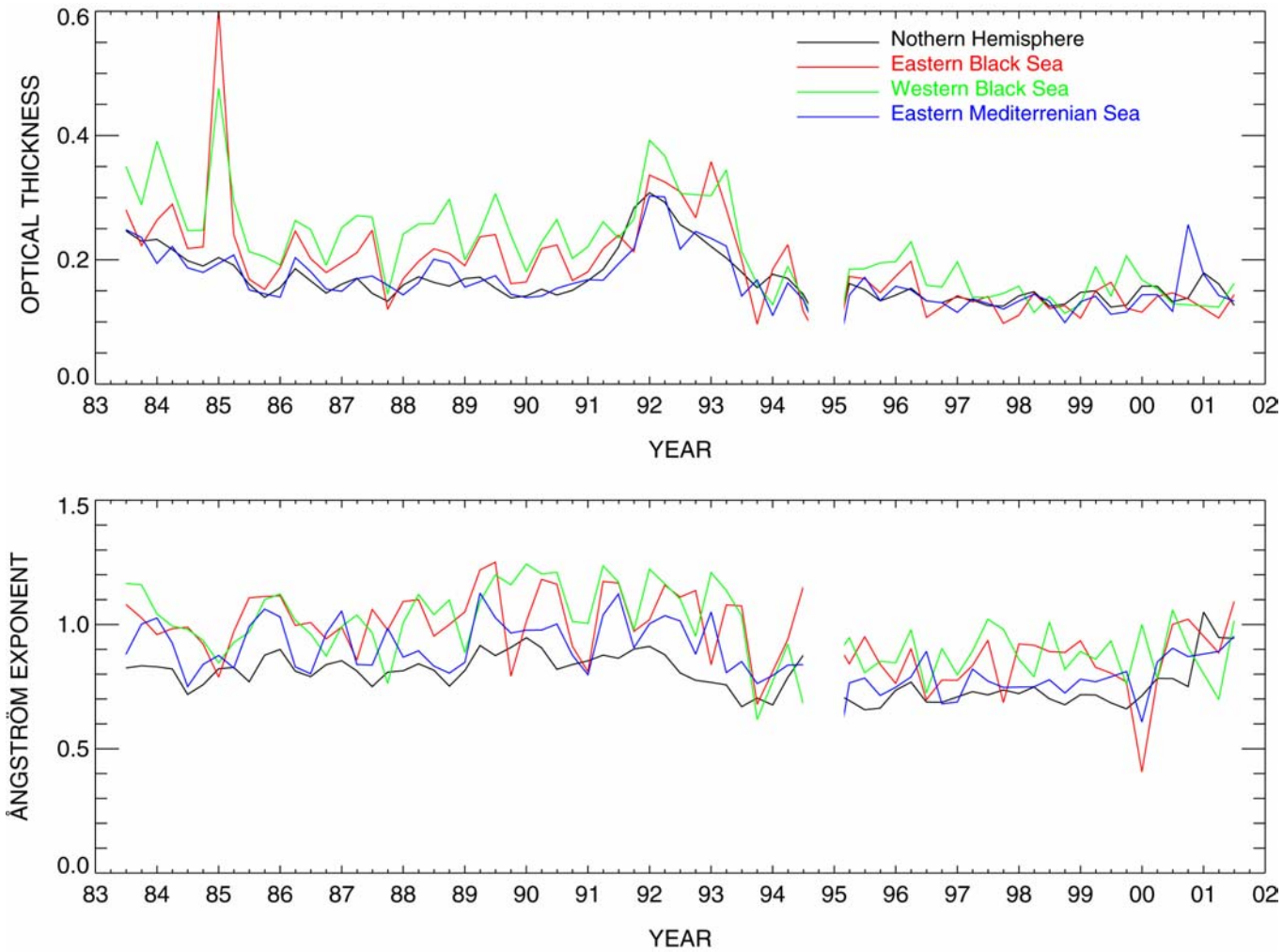



OPTICAL THICKNESS
0.6
0.4
0.2
0.0
Bay of Bengal
South China Sea
Sea of Japan
East China Sea
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR
ÅNGSTRÖM EXPONENT
1.5
1.0
0.5
0.0
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR

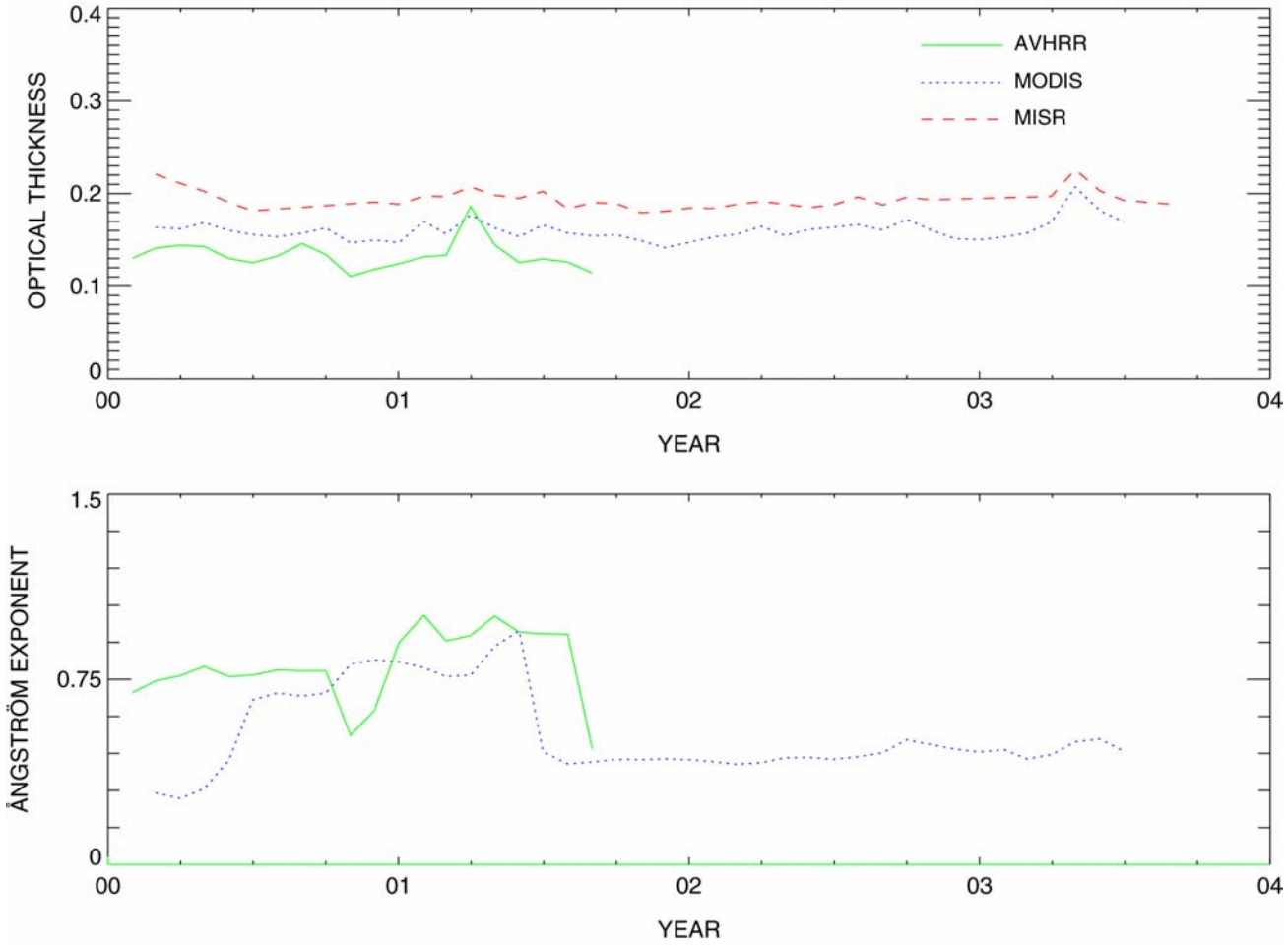

OPTICAL THICKNESS
0.6
0.4
0.2
0.0
South African West Coast
Atlantic ocean
South American West Coast
N Pacific Ocean
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR
ÅNGSTRÖM EXPONENT
1.5
1.0
0.5
0.0
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR


OPTICAL THICKNESS
0.0
0.1
0.2
0.3
0.4
US East Coast
US West Coast
European West Coast
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR
ÅNGSTRÖM EXPONENT
0.0
0.5
1.0
1.5
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR

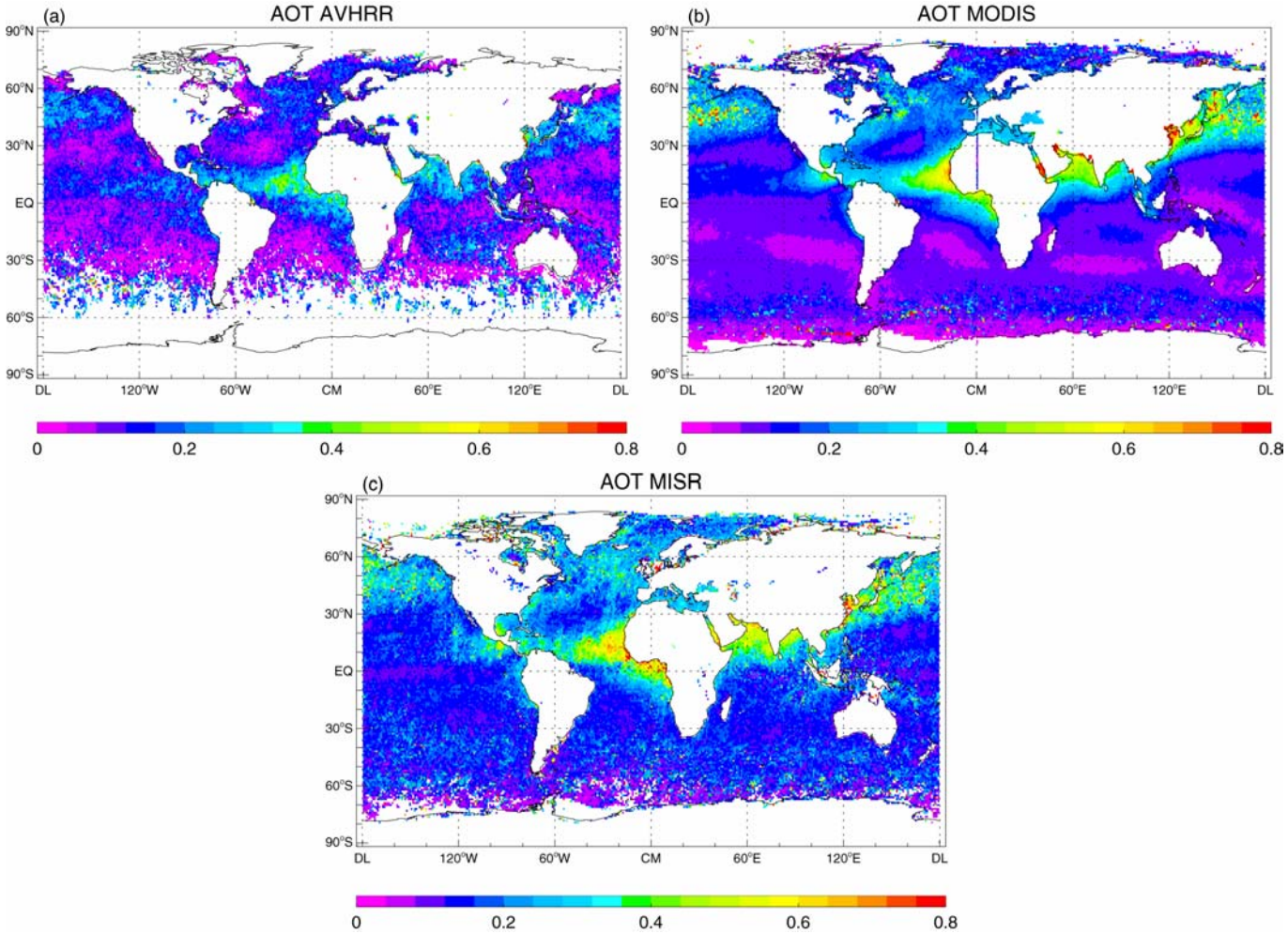

S Pacific Ocean
N Pacific Ocean
OPTICAL THICKNESS
0.3
0.2
0.1
0.0
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR
ÅNGSTRÖM EXPONENT
1.5
1.0
0.5
0.0
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR


OPTICAL THICKNESS
0.0
0.2
0.4
0.6
Nothern Hemisphere
Eastern Black Sea
Western Black Sea
Eastern Mediterrenian Sea
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR
ÅNGSTRÖM EXPONENT
0.0
0.5
1.0
1.5
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
YEAR

Comparison with MODIS and MISR



Comparison with MODIS and MISR



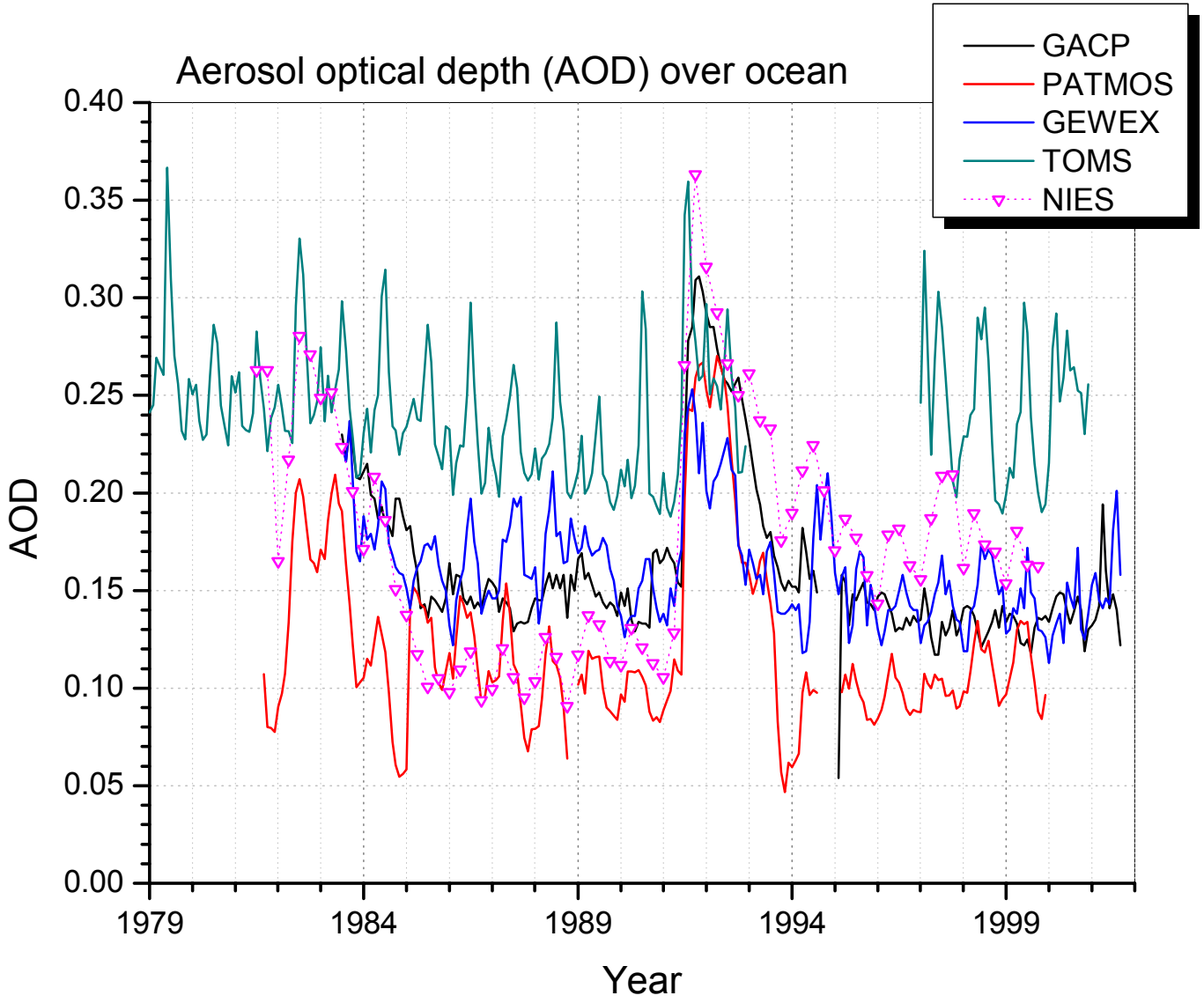
Comparison with MODIS and MISR

- MODIS aerosol optical thicknesses (550nm) compare well with the AVHRR-retrieved values. On average, the AVHRR AOTs are lower than the MODIS and MISR AOTs by approximately 0.03 and 0.06, respectively.
- Comparison of the Angstrom exponent records reveals large fluctuations in the MODIS retrievals. Further analysis is needed.
- A longer overlap of the AVHRR and MODIS and MISR records will facilitate the comparison.

AOD data source, platform and method

Source	Platform	Resolution (degrees)	Method ($\tau_{reference}$ (nm))	Contact
GACP	AVHRR	1.0x1.0	two-channel (550)	Mishchenko and Geogdzhayev
GEWEX	AVHRR + geo-sats.	2.5x2.5	broadband (550)	Laszlo
NIES*	AVHRR	0.5x0.5	two-channel (500)	Higurashi and Nakajima
PATMOS	AVHRR	1.0x1.0	one-channel (630)	NOAA/NESDIS
GSFC	TOMS	1.0x1.0	two-channel (550)	Torres

* National Institute for Environmental Studies, Tsukuba, Japan. Data are available only for January, April, July and October.


Aerosol optical depth (AOD) over ocean
GACP
PATMOS
GEWEX
TOMS
NIES
AOD
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1979
1984
1989
1994
1999
Year

Long-term record

The operational two-channel retrieval algorithm was applied to the re-calibrated AVHRR radiances in order to derive a global climatology of aerosol optical thickness and size over the oceans for the period extending from July 1983 to October 2001.

The global monthly mean optical thickness and Ångström exponent show no significant trends between the periods affected by major volcanic eruptions and oscillate around the average values 0.145 and 0.75, respectively.

The Northern hemisphere mean optical thickness systematically exceeds that averaged over the Southern hemisphere.

The results of AVHRR retrievals during the period affected by the Mt. Pinatubo eruption are consistent with the SAGE retrievals of the stratospheric aerosol optical thickness.

Time series of the aerosol properties computed for four several geographic locations show varying degrees of seasonal variability controlled by local meteorological events and/or anthropogenic activities.

Validation vs ship-borne sunphotometer data

- The comparison of spatial and temporal statistics of the AVHRR results and the ship measurements shows a strong correlation.

- Increasing the diffuse component of the ocean surface reflectance from 0.002 to 0.004 in the AVHRR algorithm produces a better match, with the ensemble-averaged AVHRR-retrieved optical thickness differing by only about 3.6% from the sunphotometer truth and having a small offset of 0.03.

Future plans

GACP is funded by the NASA RSP through September 2006 and includes the following specific tasks:

- Continue to quality check and calibrate AVHRR channel-1 and -2 radiance data.
- Refine AVHRR retrievals over areas dominated by nonspherical mineral aerosols.
- Examine the information content of channel-3A radiances and the potential of a channel-1/3A retrieval algorithm.
- Compare derived aerosol properties over oceans with new satellite data products from MODIS and MISR.

Future plans

- Investigate the potential of AVHRR aerosol retrievals over land areas and compare them with the coincident MODIS and MISR aerosol retrievals.
- Merge the AVHRR and MODIS/MISR data records.
- Combine the aerosol and ISCCP cloud retrieval algorithms, use both for simultaneous operational retrievals of cloud and aerosol properties, and reprocess the entire aerosol dataset using an updated ISCCP radiance calibration and cloud detection procedures (both are expected to be available in 2005).
- Analyze the combined aerosol/ISCCP cloud product to assess the magnitude of the indirect aerosol effect.