More Than Ten Years of SeaWiFS Aerosol Data Reveal Trends

Photo taken from Space Shuttle:
Fierce dust front over Libya

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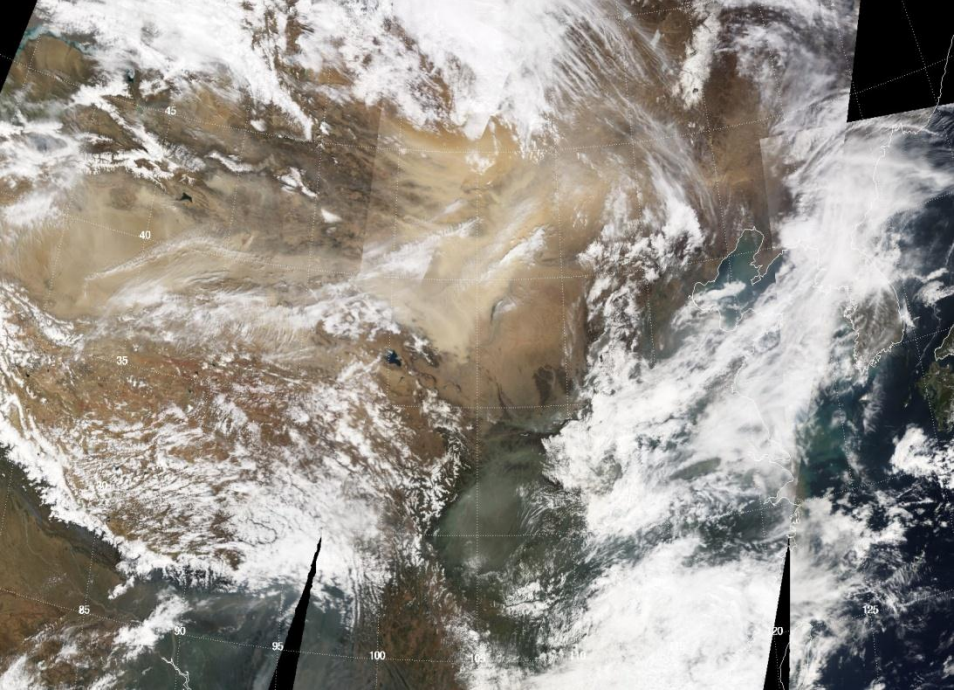
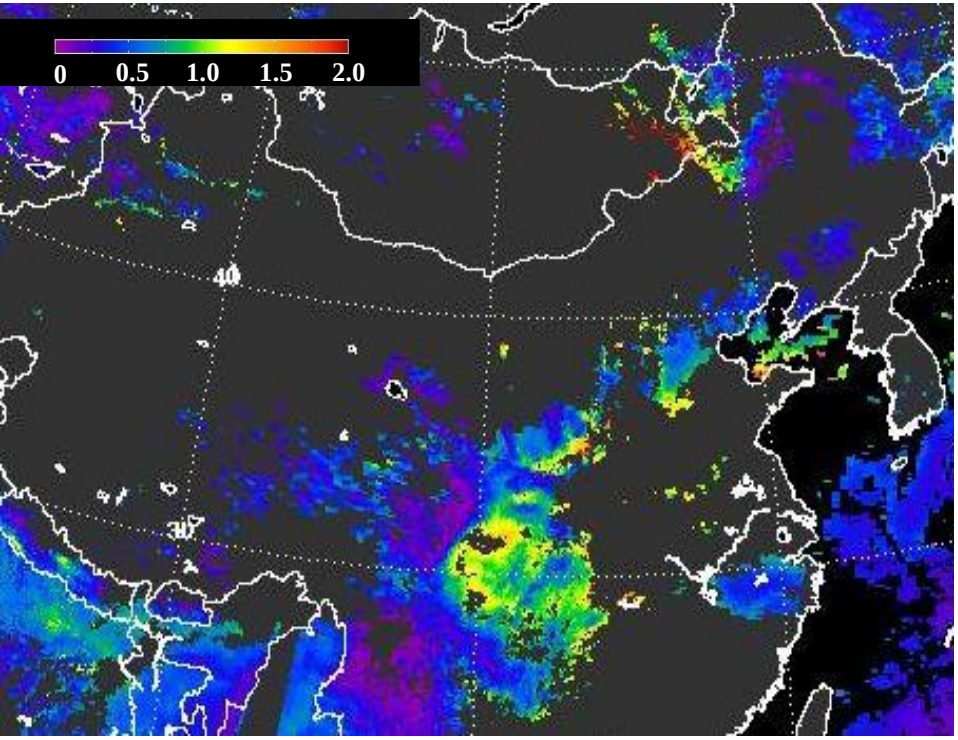
6 April 2001

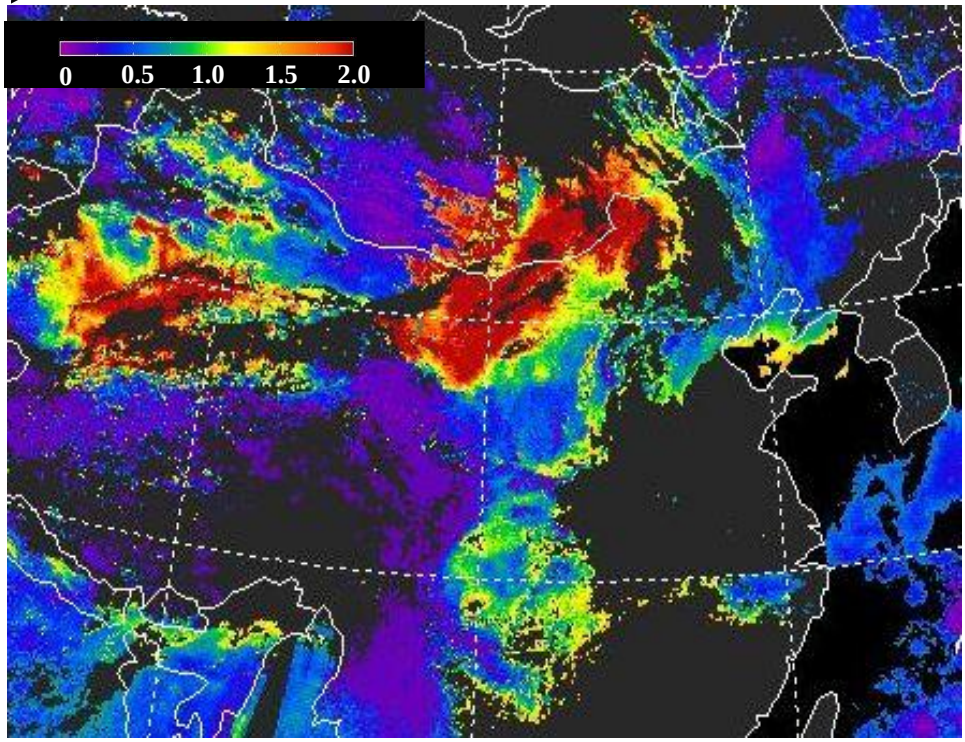


MODIS *Red*-*Green*-*Blue* with Rayleigh scattering removed

Current MODIS *retrievals:*
Aerosol Optical Thickness



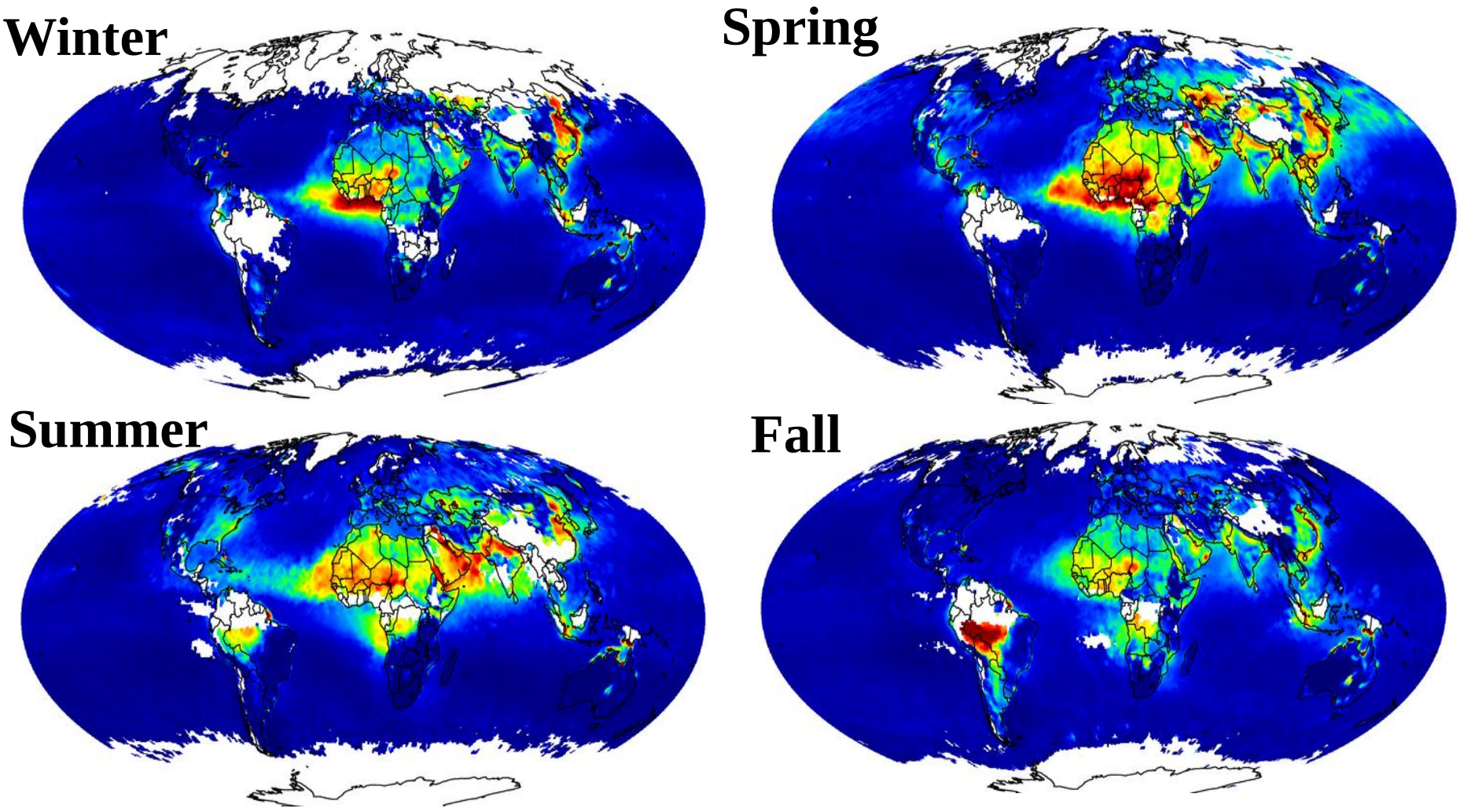
New MODIS *Deep Blue:*
Aerosol Optical Thickness



Recent Progress on Deep Blue Aerosol Algorithm in SeaWiFS and MODIS C6

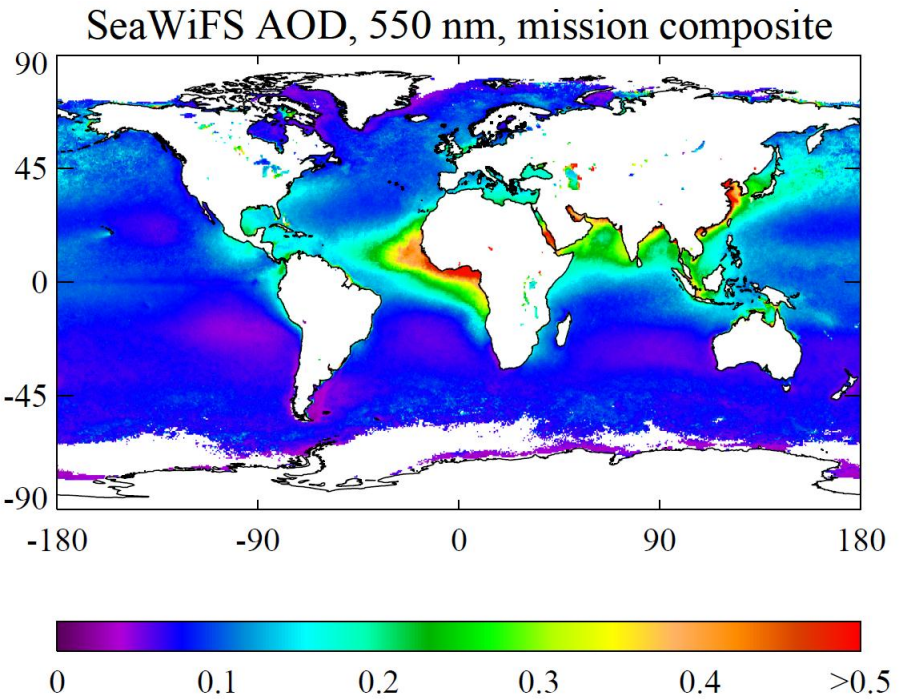
- ***Expand coverage from arid and semi-arid regions into vegetated (SeaWiFS & MODIS C6) areas as well as oceans (SeaWiFS only)***
- ***Moving away from the static surface reflectance data bases***
  - **implemented dynamic surface reflectance determination into *Deep Blue* algorithm;**
  - **include changes in vegetation using NDVI.**
- ***Improve cloud screening scheme to distinguish heavy haze from clouds***

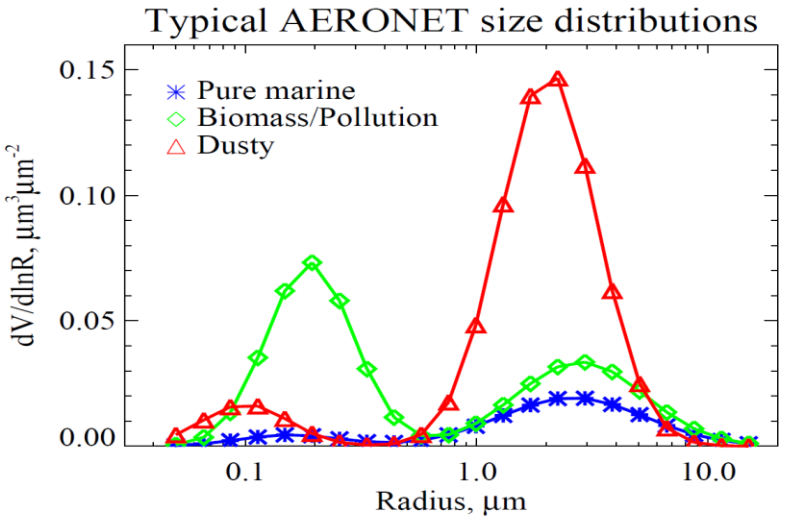
SeaWiFS 2004-2009 Seasonal 550nm AOT Maps



SeaWiFS Ocean Aerosol Retrieval (SOAR) algorithm

- **Uses 3 bands to simultaneously retrieve AOD at 550 nm, and aerosol volume partitioned between fine and coarse modes**
- **Aerosol microphysical models drawn from AERONET analysis**
- **Quality flags to identify suitable retrievals**
  - **Clouds, sea-ice, strong glint, turbid water, poorly-fit points removed**





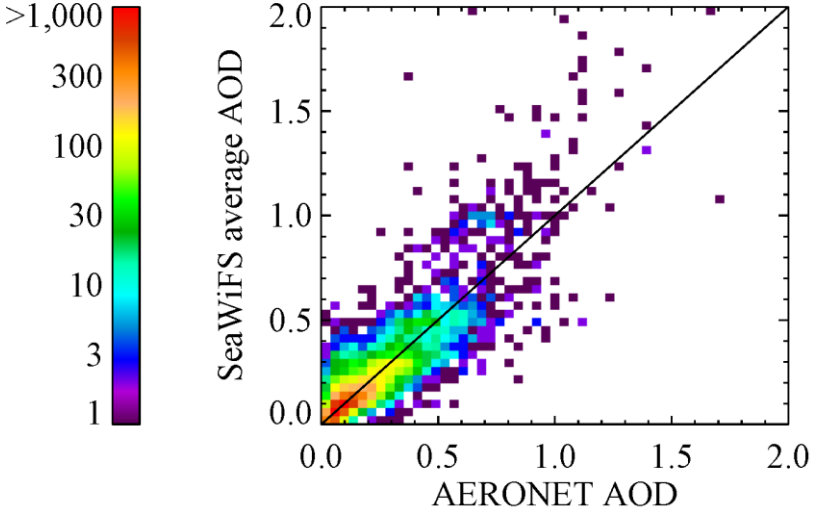
•References:

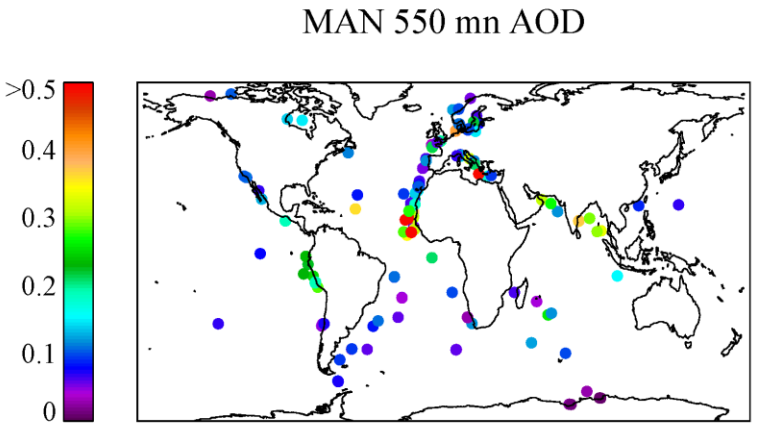
–Sayer, A. M., A. Smirnov, N. C. Hsu, B. N. Holben, A pure marine aerosol model, for use in remote sensing applications, *J. Geophys. Res.*, submitted

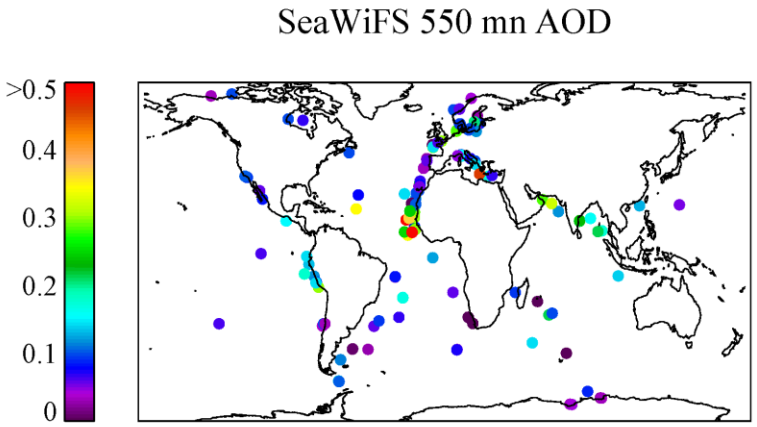
–Sayer, A. M., N. C. Hsu, C. Bettenhausen, Z. Ahmad, B. N. Holben, A. Smirnov, G. E. Thomas, J. Zhang, SeaWiFS Ocean Aerosol Retrieval (SOAR): algorithm, validation, and comparison with other datasets, *J. Geophys. Res.*, submitted

SeaWiFS Ocean Aerosol Retrieval (SOAR) algorithm

- **Compare with ground based measurements**
  - **AOD validated well against AERONET and MAN, uncertainty ~ ±0.03±15%**
  - **Size quantitative for high AOD; caution at low AOD**





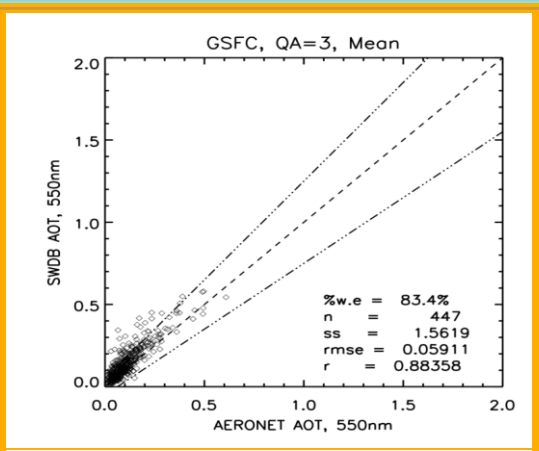


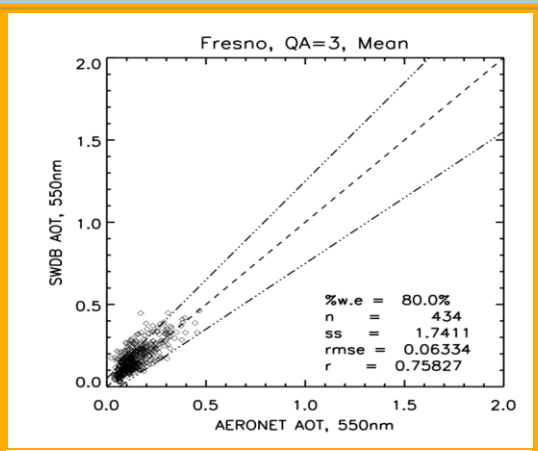
SeaWiFS Comparisons with AERONET AOT over Land

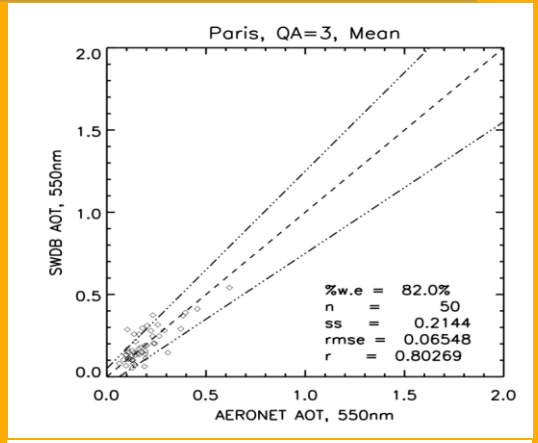
Urban Pollution

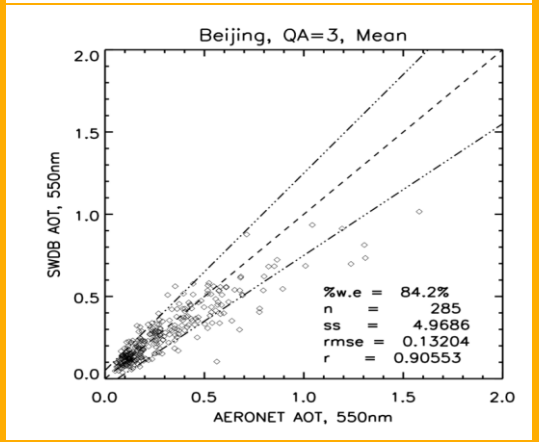
Urban Pollution, Dust, Smoke

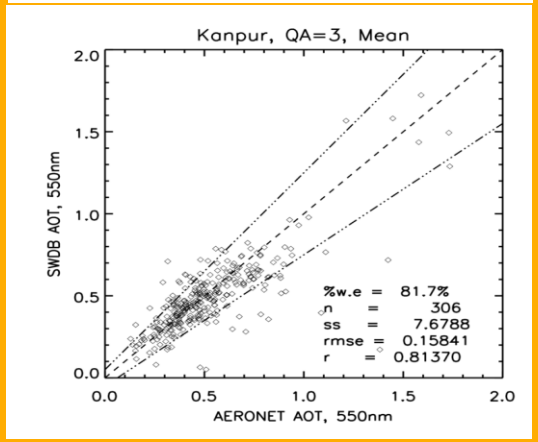
Sahel

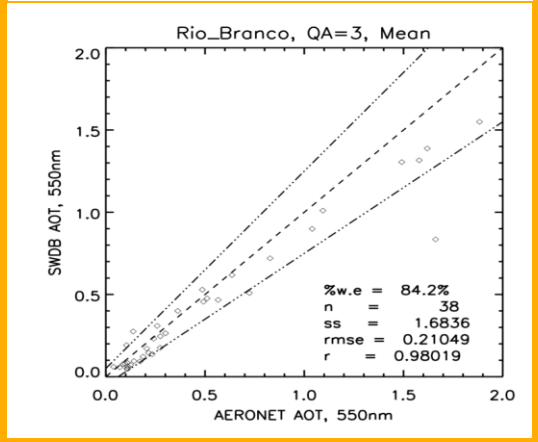


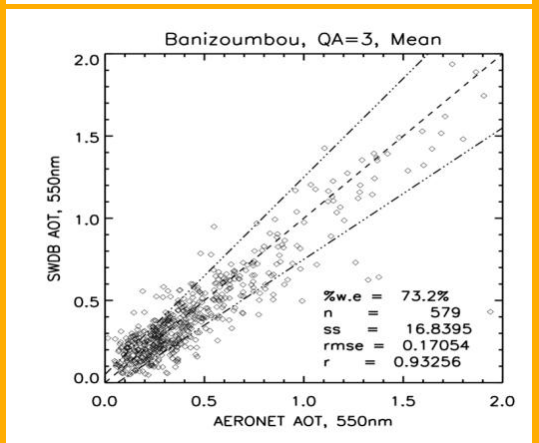


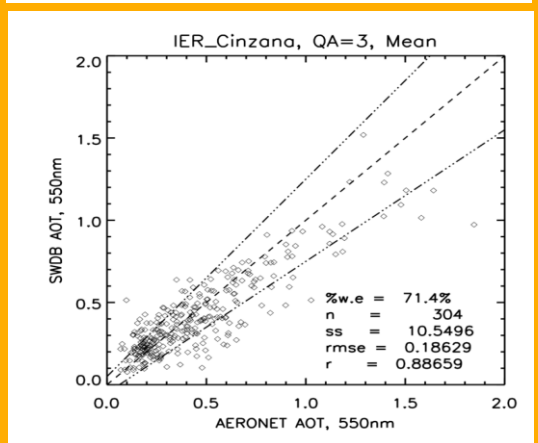


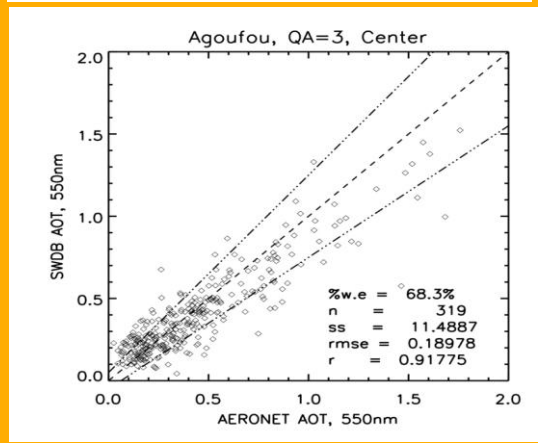






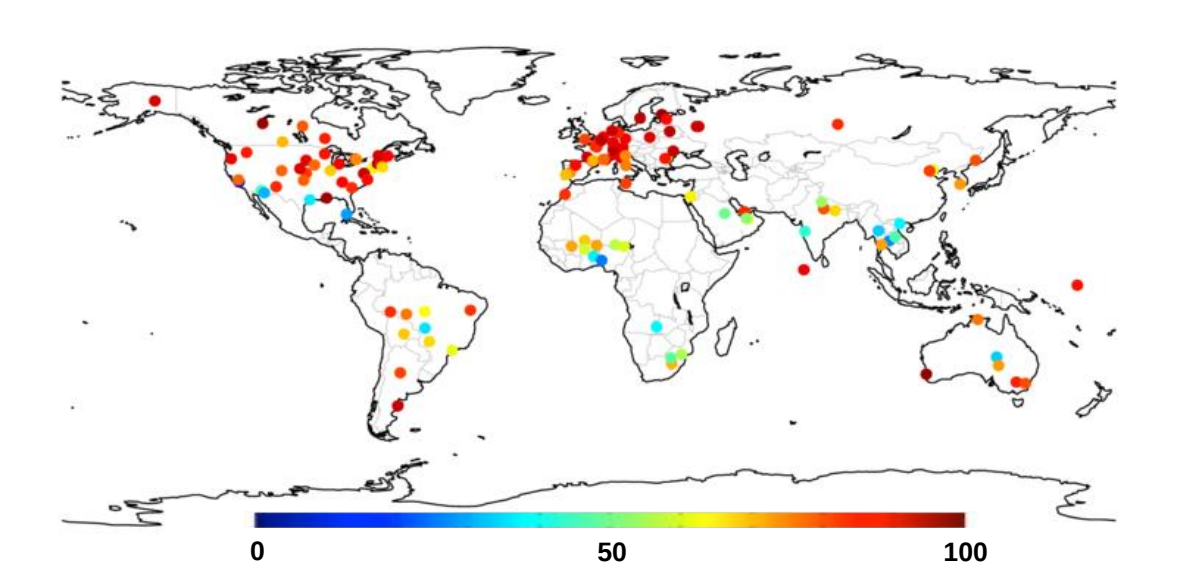


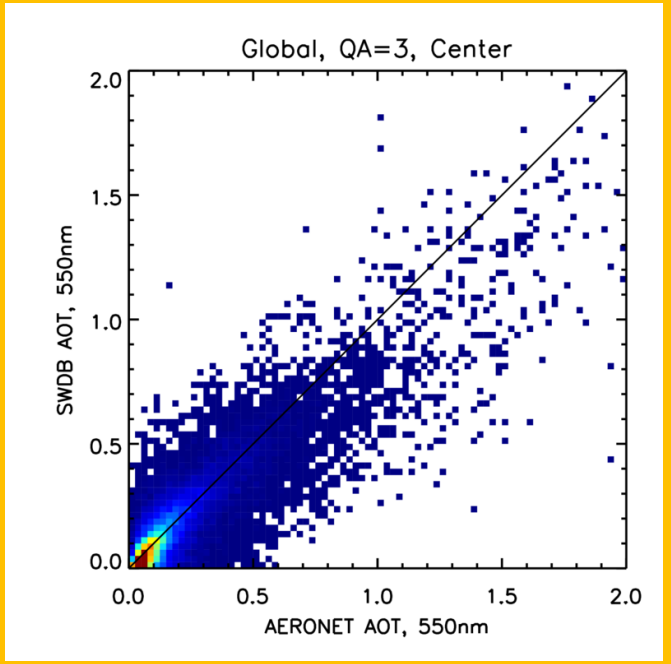


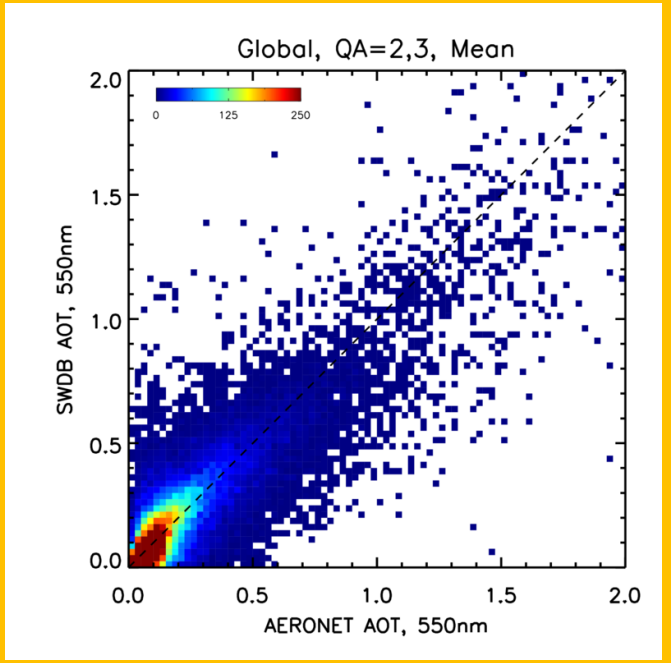


SeaWiFS Aerosol Retrievals over Land

Global Statistics of the Comparisons of SeaWiFS with AERONET AOT



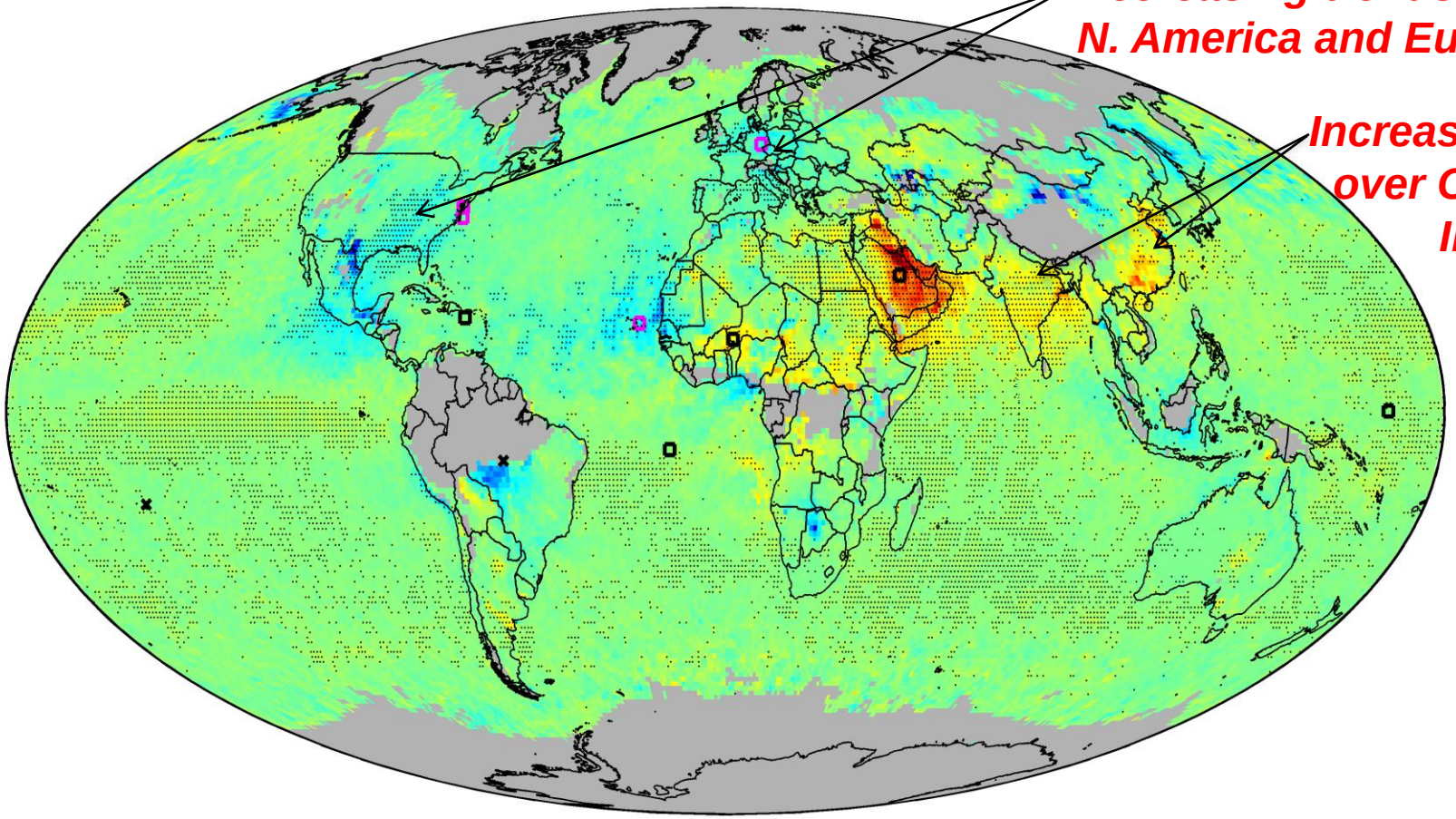




- Over land, the expected error is ±0.05±0.20*AOT.
- Among the land only data, 73.4% of the QA=3 data and 71.2% of the QA=2,3 fall into the expected error range.

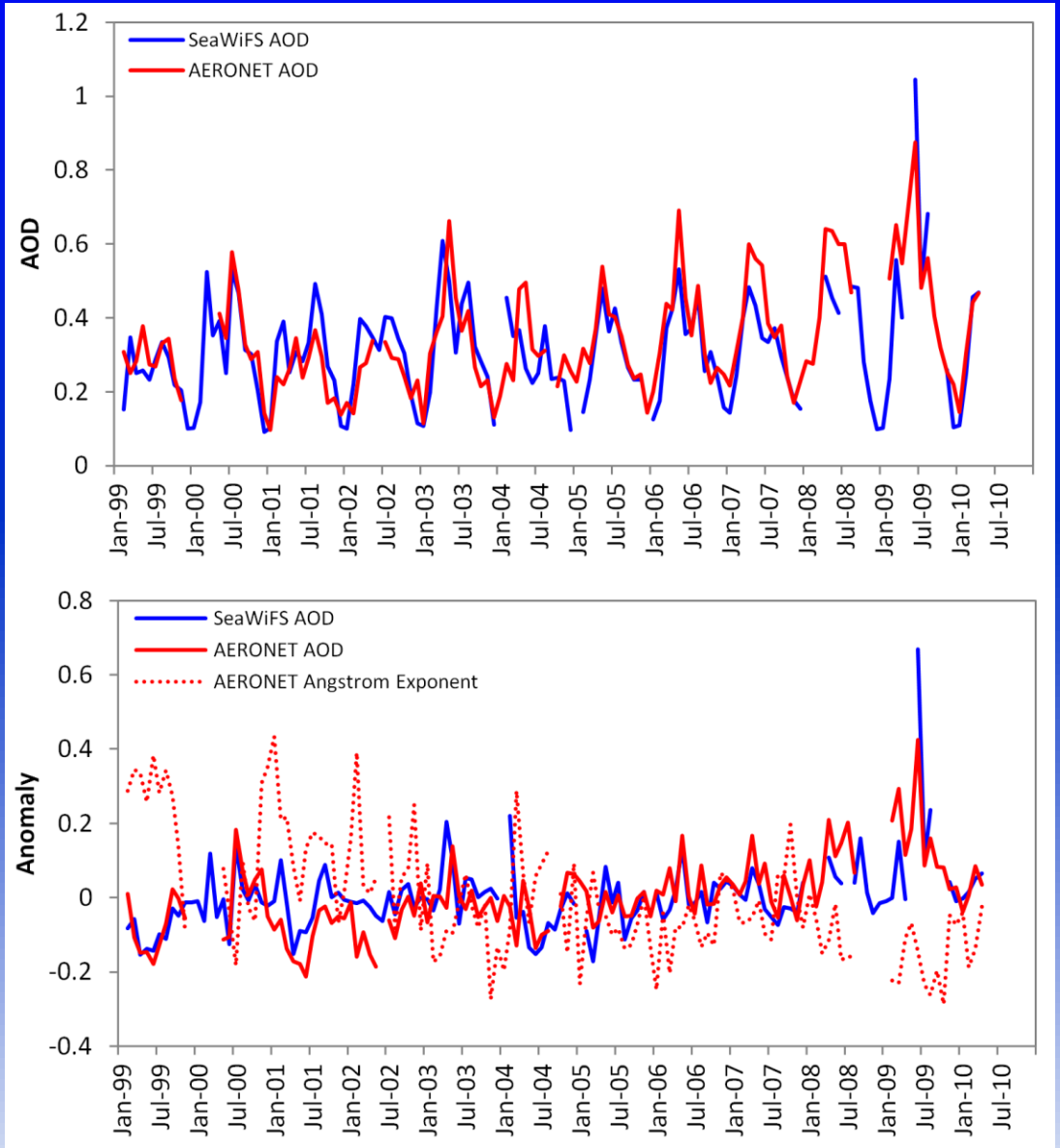
Global AOD Trend (1998-2010)

Unit – AOT/year
Symbol denotes where trend is statistically significant at 95% significance level

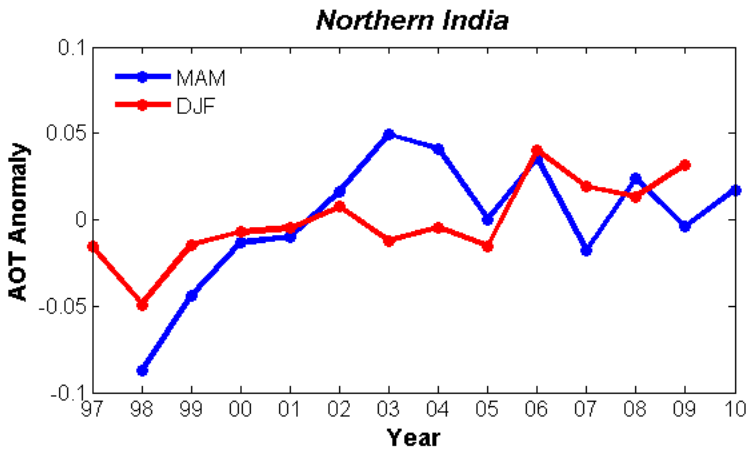


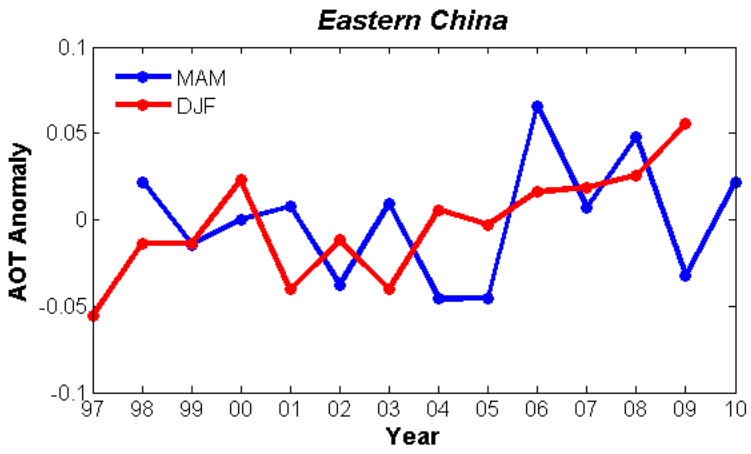
AERONET – Solar Village trend

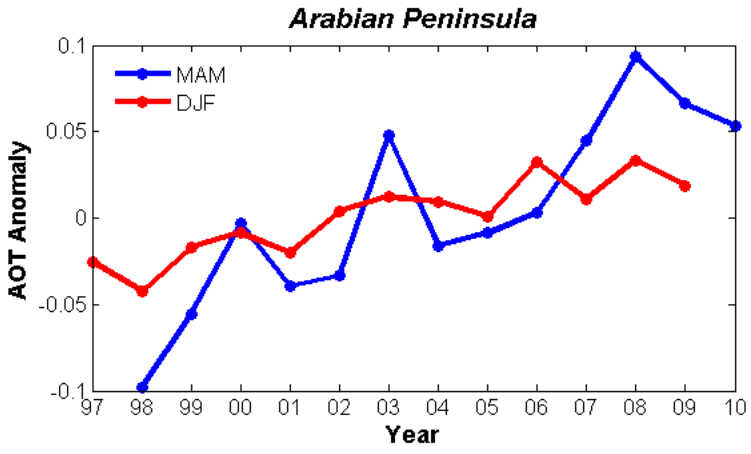
- **Solar Village site also shows increase in AOD (top)**
- **Angstrom exponent similar, or slight decrease (bottom)**
- **Consistent with higher dust activity**
- **Similar magnitude to SeaWiFS trend**

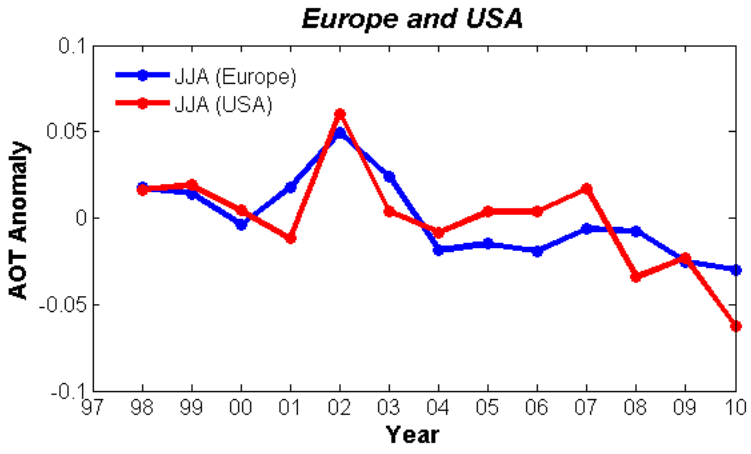


Regional AOD Time Series (1997-2010) for Different Seasons



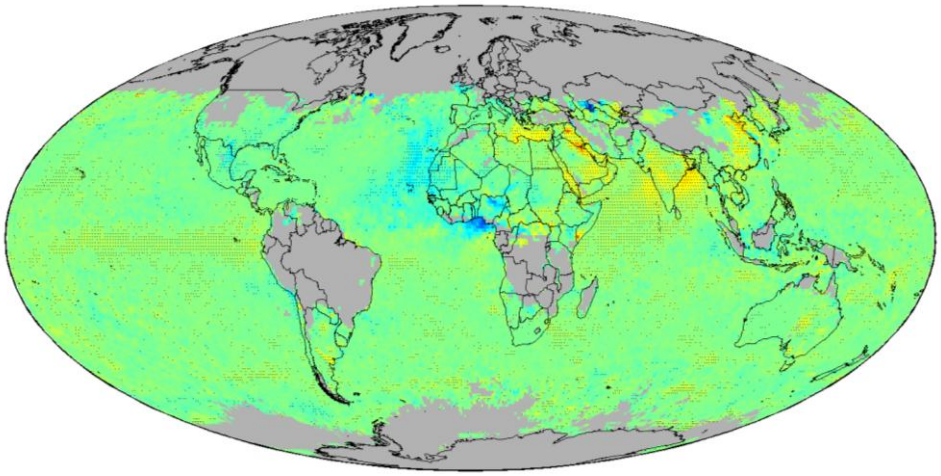




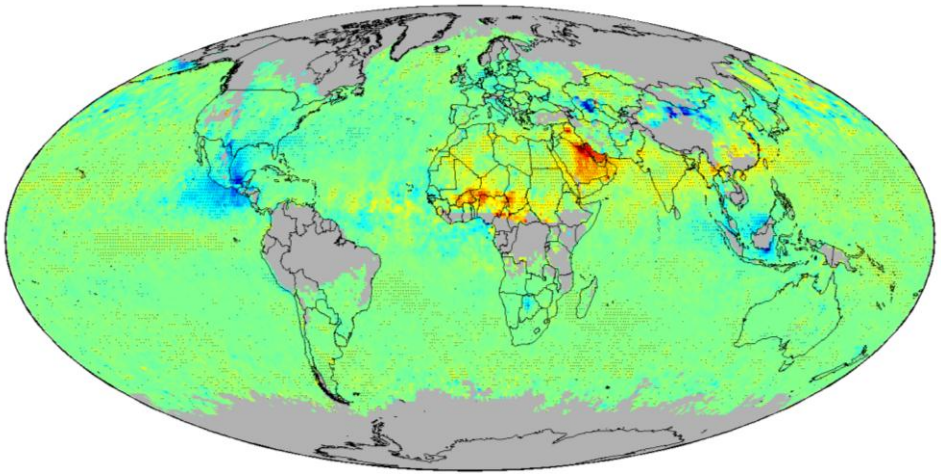


Seasonal AOD Trend (1998-2010)

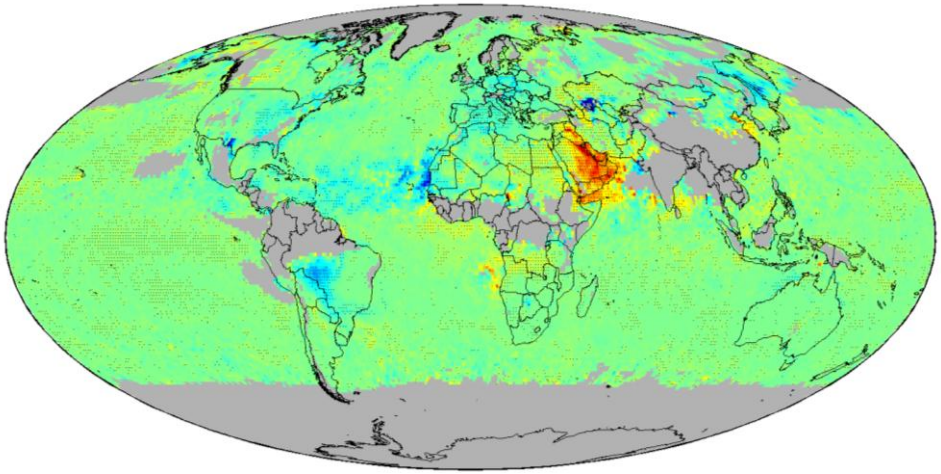
DJF



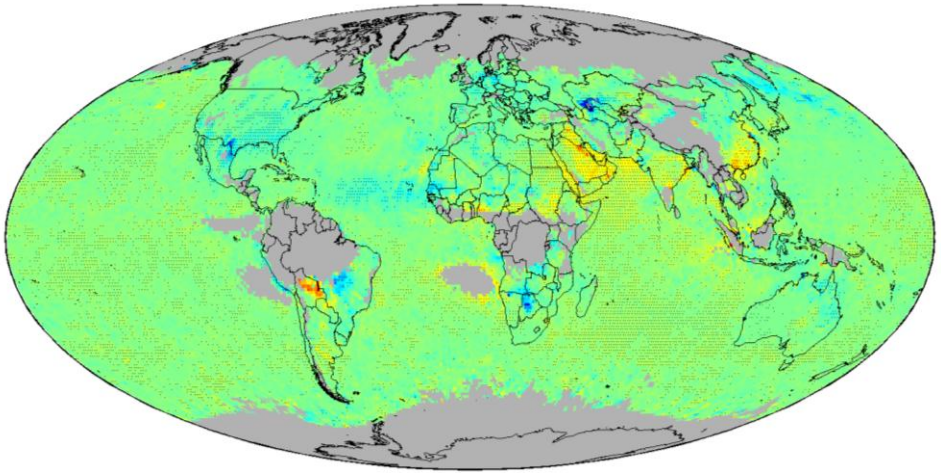
MAM

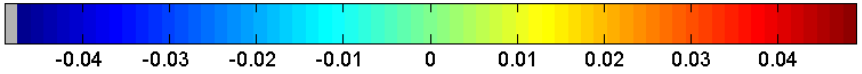


JJA



SON



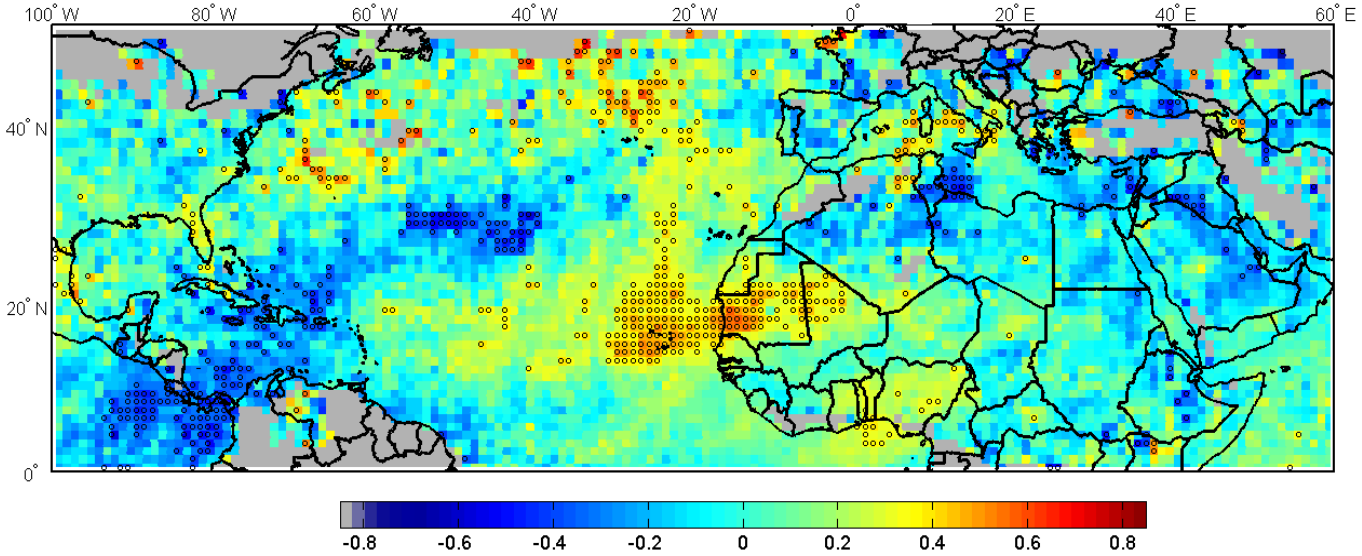


Units AOD/year

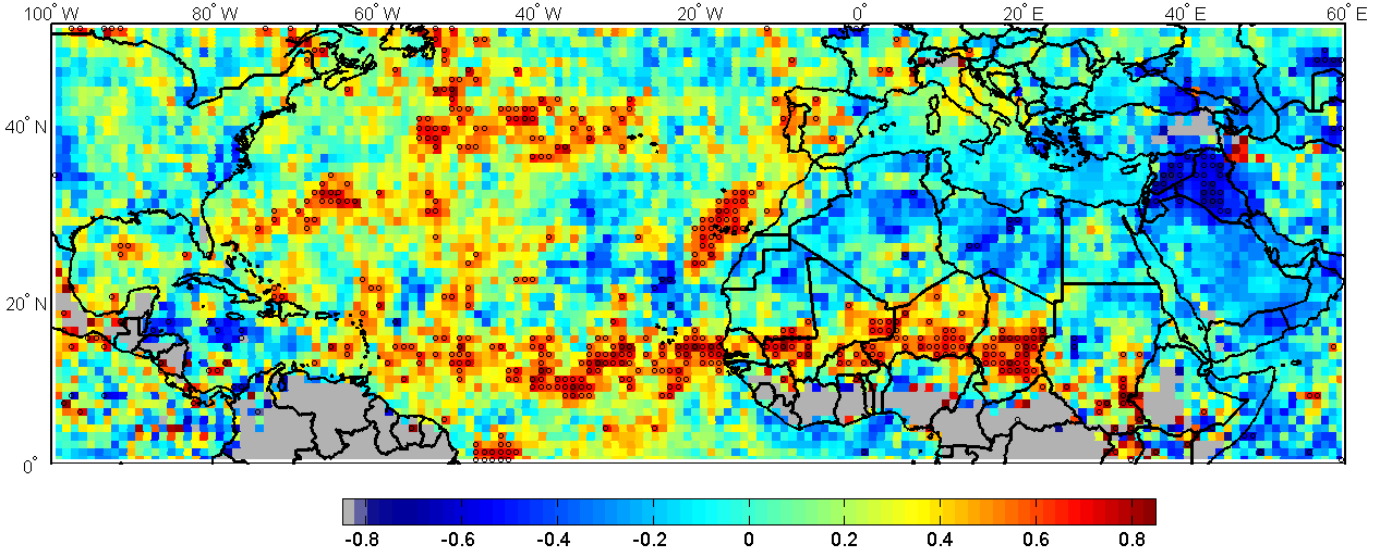
Dots indicate significance at 95% confidence level

Meteorological Factors Influence the Interannual Variability of AOD

Correlation of AOD anomaly and *NAO* Index during winter (DJF) months



Lagged correlation of summertime average (JJA) mean AOD anomaly with winter (DJ) mean *ENSO* Index leading by 6 months

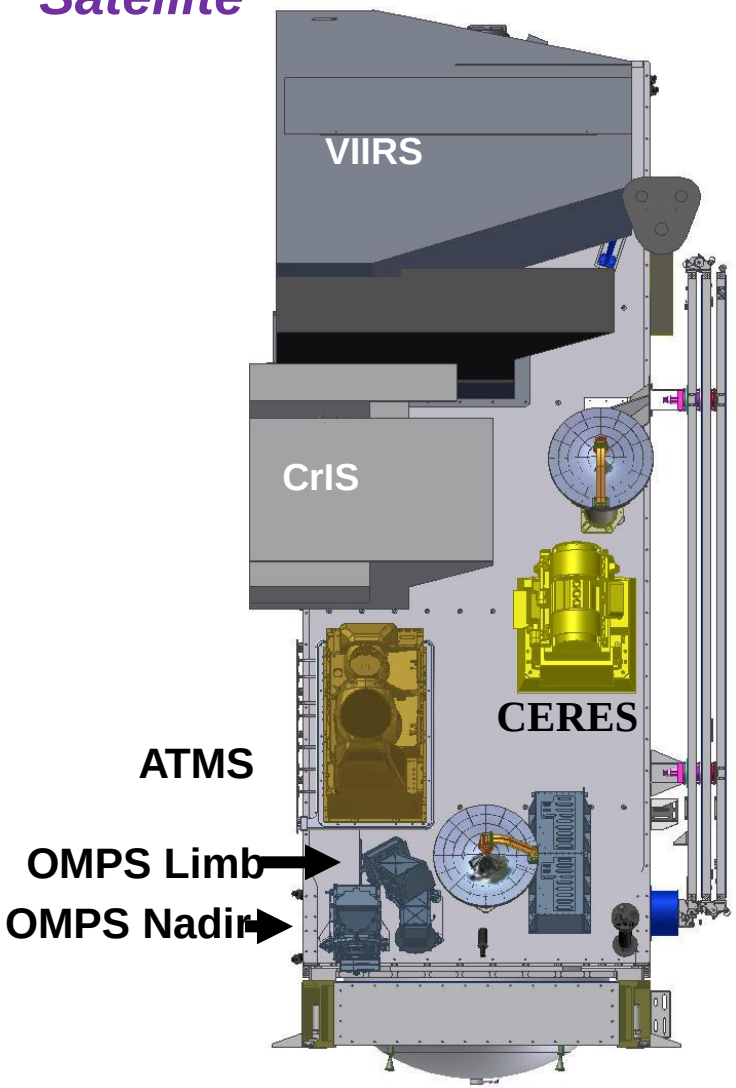


NPP Launch

10/28/2011

VIIRS – Medium resolution Visible& Infra-red Imager

NPP Satellite



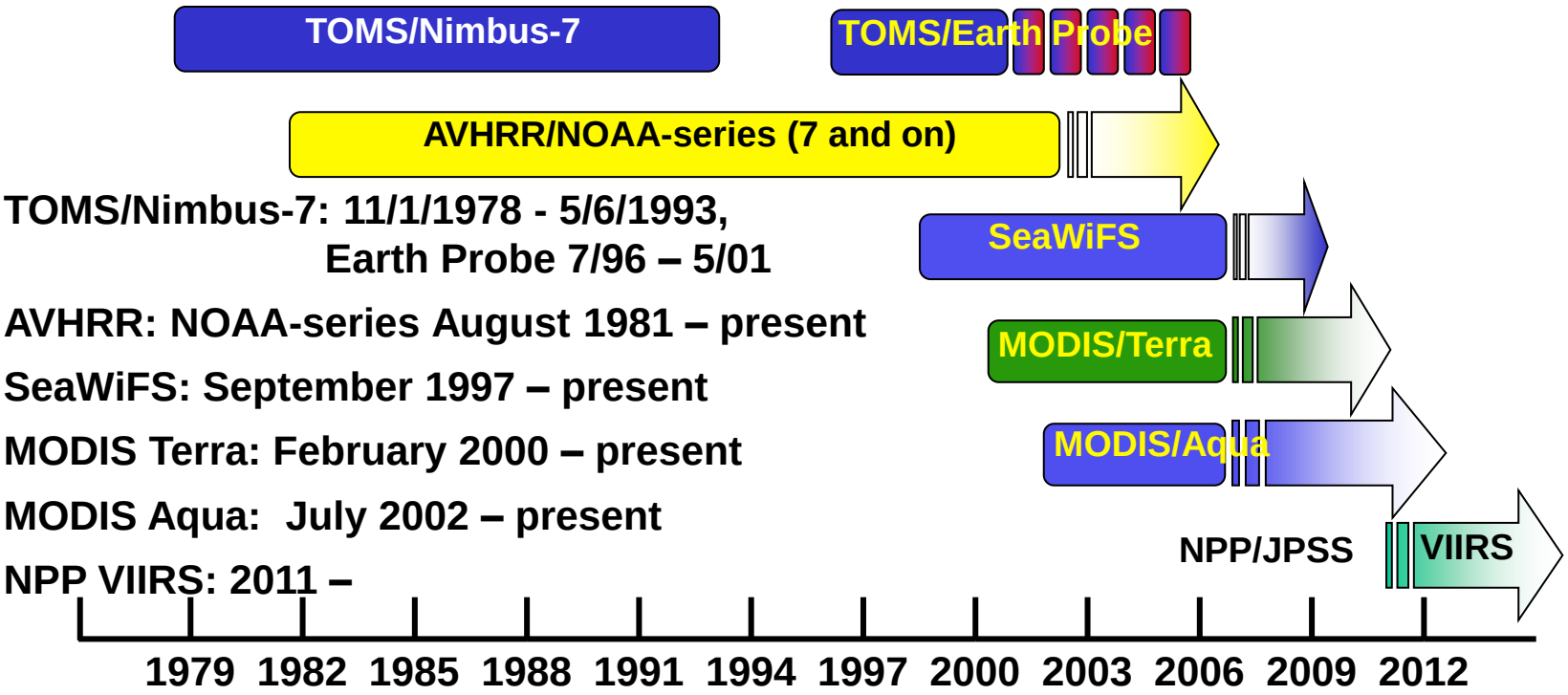
VIIRS 24 EDRs

Land, Ocean, Atmosphere, Snow

Name of Product	Group	Type
Imagery *	Imagery	EDR
Precipitable Water	Atmosphere	EDR
Suspended Matter	Atmosphere	EDR
Aerosol Optical Thickness	Aerosol	EDR
Aerosol Particle Size	Aerosol	EDR
Cloud Base Height	Cloud	EDR
Cloud Cover/Layers	Cloud	EDR
Cloud Effective Particle Size	Cloud	EDR
Cloud Optical Thickness/Transmittance	Cloud	EDR
Cloud Top Height	Cloud	EDR
Cloud Top Pressure	Cloud	EDR
Cloud Top Temperature	Cloud	EDR
Active Fires	Land	Application
Albedo (Surface)	Land	EDR
Land Surface Temperature	Land	EDR
Soil Moisture	Land	EDR
Surface Type	Land	EDR
Vegetation Index	Land	EDR
Sea Surface Temperature *	Ocean	EDR
Ocean Color and Chlorophyll	Ocean	EDR
Net Heat Flux	Ocean	EDR
Sea Ice Characterization	Snow and Ice	EDR
Ice Surface Temperature	Snow and Ice	EDR
Snow Cover and Depth	Snow and Ice	EDR

* Product has a Key Performance attribute

Aerosol Data Record Time Series



Summary

- **Based upon the comparisons with AERONET AOD global observations, the expected error for SeaWiFS is 0.03±15% over ocean and 0.05±20% over land.**
- **SeaWiFS data available at: http://daac.gsfc.nasa.gov/dust**
- **The trend estimates based upon SeaWiFS (1998 – 2010) over dust source regions are showing an increase over Arabian Peninsula. The AOD values decrease over eastern US and Europe, while they increase over China and India.**
- ***Deep Blue* algorithm will be applied to NPP VIIRS to continue consistent time series of EOS-era aerosol products. VIIRS has 1:30 pm equator crossing time and daily global coverage without gaps in the tropic.**