

Present-day Aerosol Climatology in the NASA GEOS-5 AGCM

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7th AeroCom Meeting
Reykjavik, Iceland
9 Oct 2008

Outline

1. Intro to NASA GEOS-5
2. Intro to GOCART on-line aerosol module
3. Preliminary Year 2000 Aerosol Climatology

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NASA GEOS-5 Model

GEOS-5 is the Goddard Earth Observing System model, Version 5

- GEOS-5 is a system of models integrated using ESMF
- Finite-volume dynamical core [Lin and Rood, 1996; 1997]
- RAS convection scheme
- Chou and Suarez [1994; 1996] radiation scheme
- Can run at multiple resolutions; here, $2.0^\circ \times 2.5^\circ$, 72 vertical levels
- Meteorology: GCM, "replay", and forecast modes.
- Aerosols prescribed or on-line (GOCART aerosol module); can directly interact with radiation. No indirect effects currently.

GEOS-5 AGCM

**Finite-Volume
Dynamical
Core**

[Lin & Rood, 1996; 1997]

Column Physics

GWD

Turbulenc
e

Moist
Processes
[RAS convection]

Surface

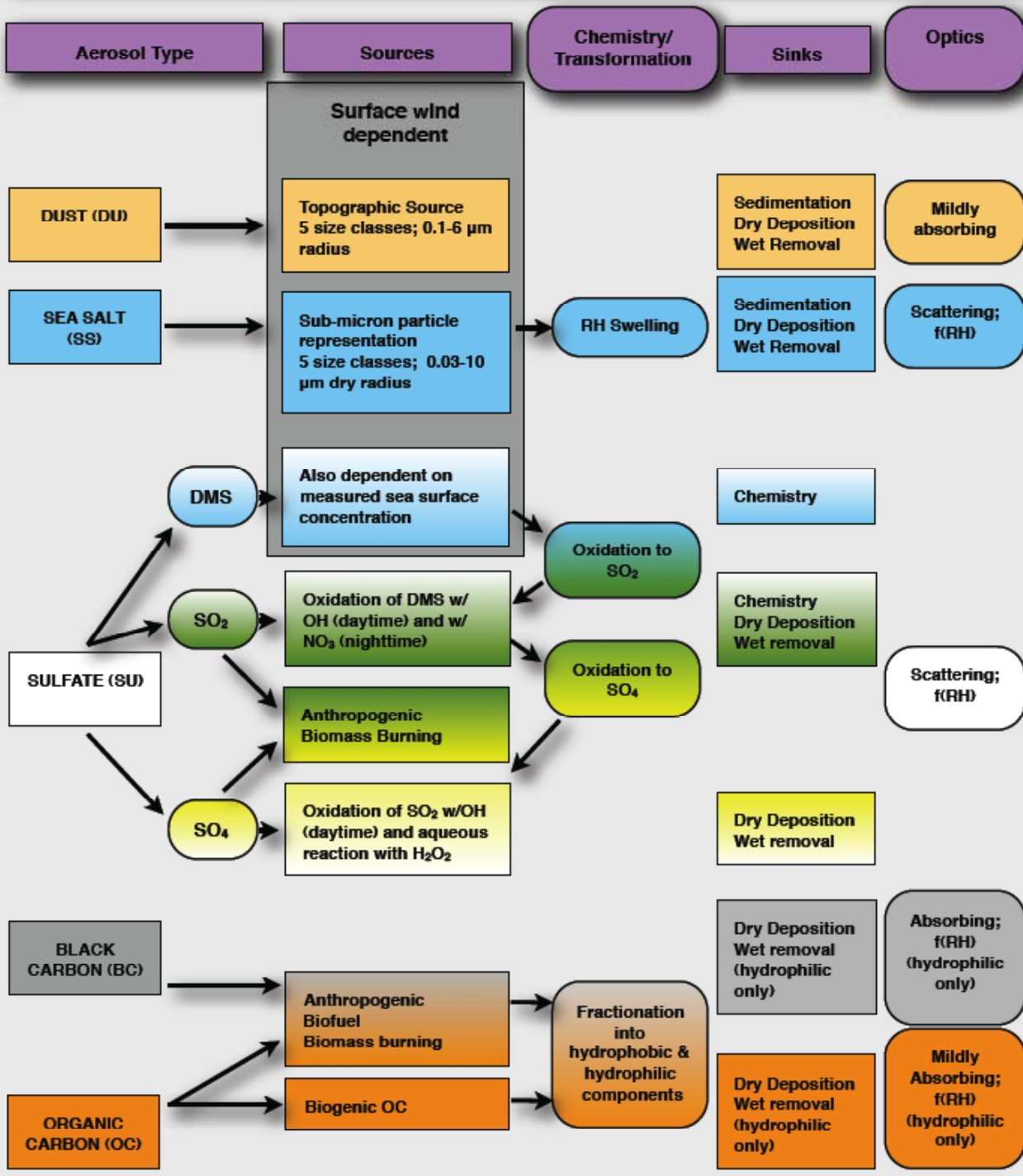
Radiation
[Chou & Suarez,
1994;1996]

**Chemistry/
Aerosols**

GOCART on-line aerosol
module or prescribed

GEOS-5 on-line GOCART Aerosol Module

On-line GOCART Aerosol Module



- A version of the Goddard Chemistry, Aerosol, Radiation, and Transport Model (**GOCART**) [Chin et. al., 2002] embedded in GEOS-5 AGCM.

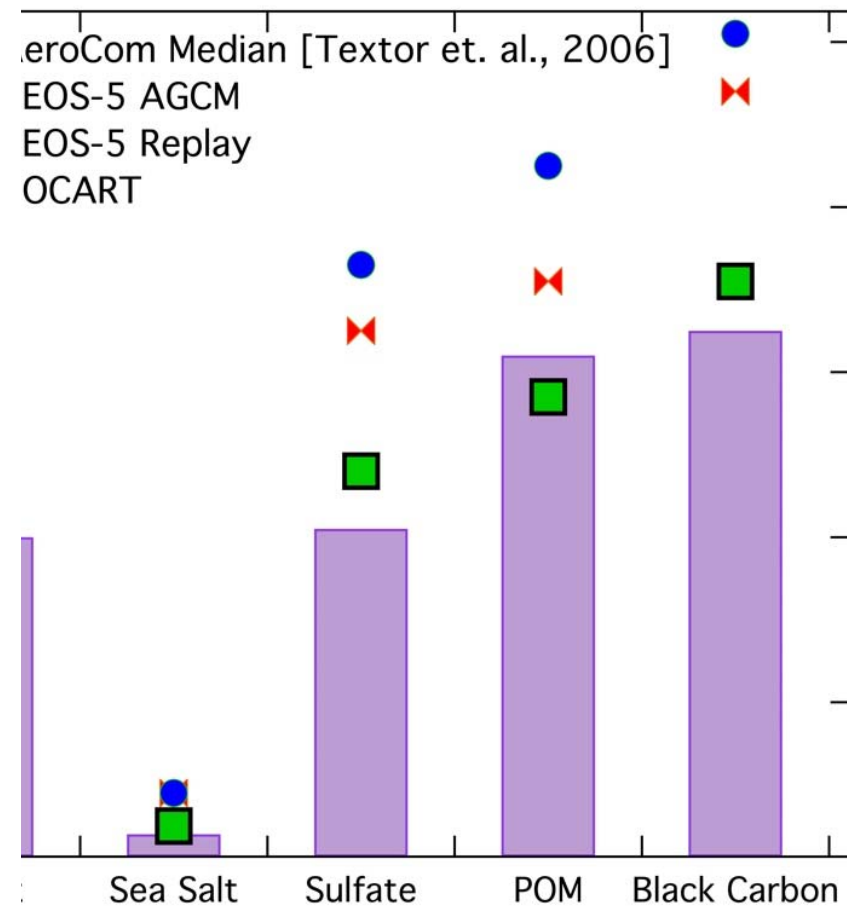
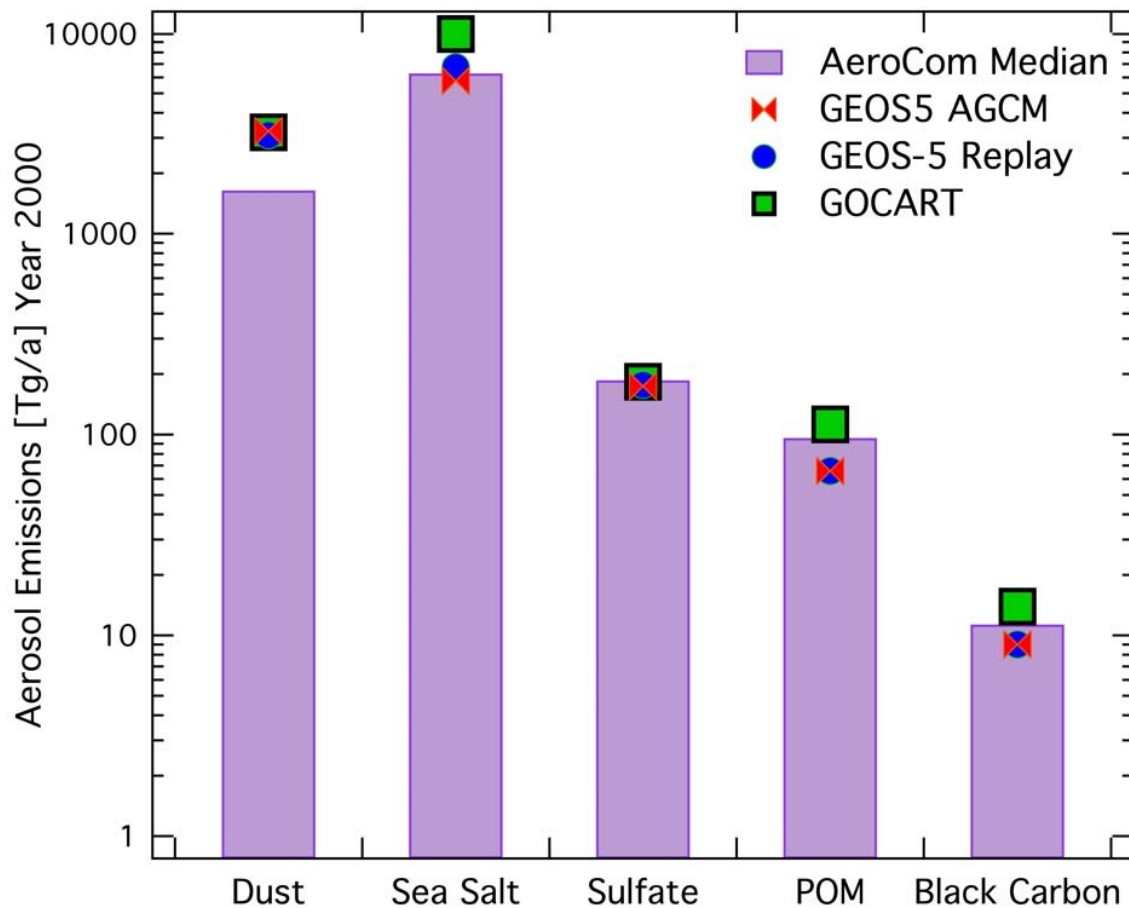
- Treatment of major tropospheric aerosols (dust, sea salt, sulfate, black and organic carbon) including sources, sinks and chemical transformations.

- Dust, sea salt, and DMS emissions have a **wind dependency**.

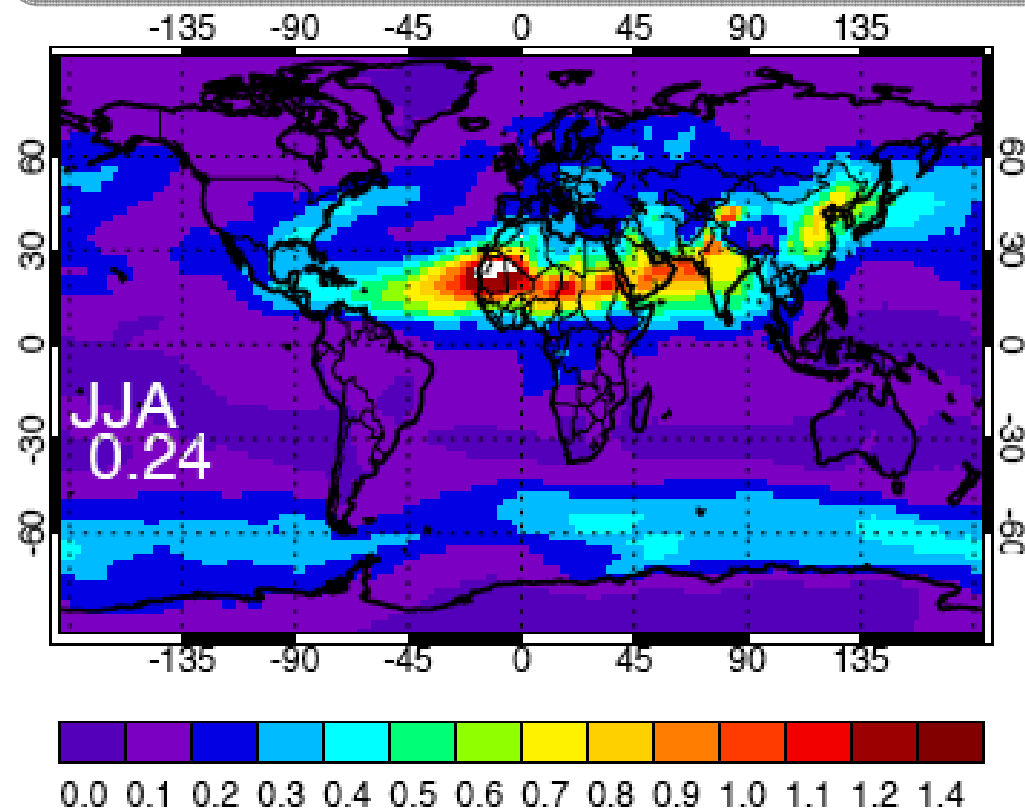
- Optical properties (with exception of dust) from OPAC; dust uses OPAC except in visible, where optical properties based on AERONET measurements are used. **Externally mixed aerosols.**

Aerosol Distributions in GEOS-5

- On-year run (year 2000), climatological SSTs [Rayner et. al., 2006]
- Emissions the same for GEOS-5 AGCM and Replay (except wind-dependent dust and sea salt)
- GOCART data from AeroCom website; AeroCom median from Textor et. al. [2006]



JJA GEOS-5 AGCM Aerosol Optical Depth (AOD)

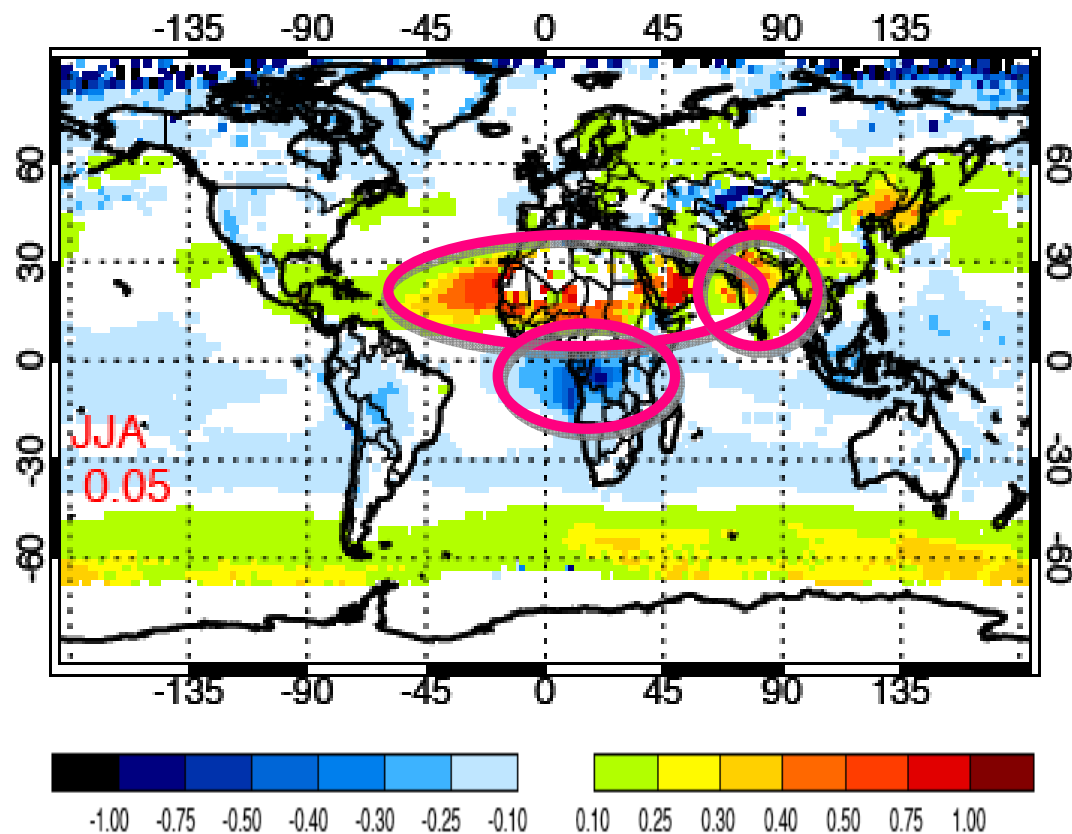


GEOS-5 AGCM:

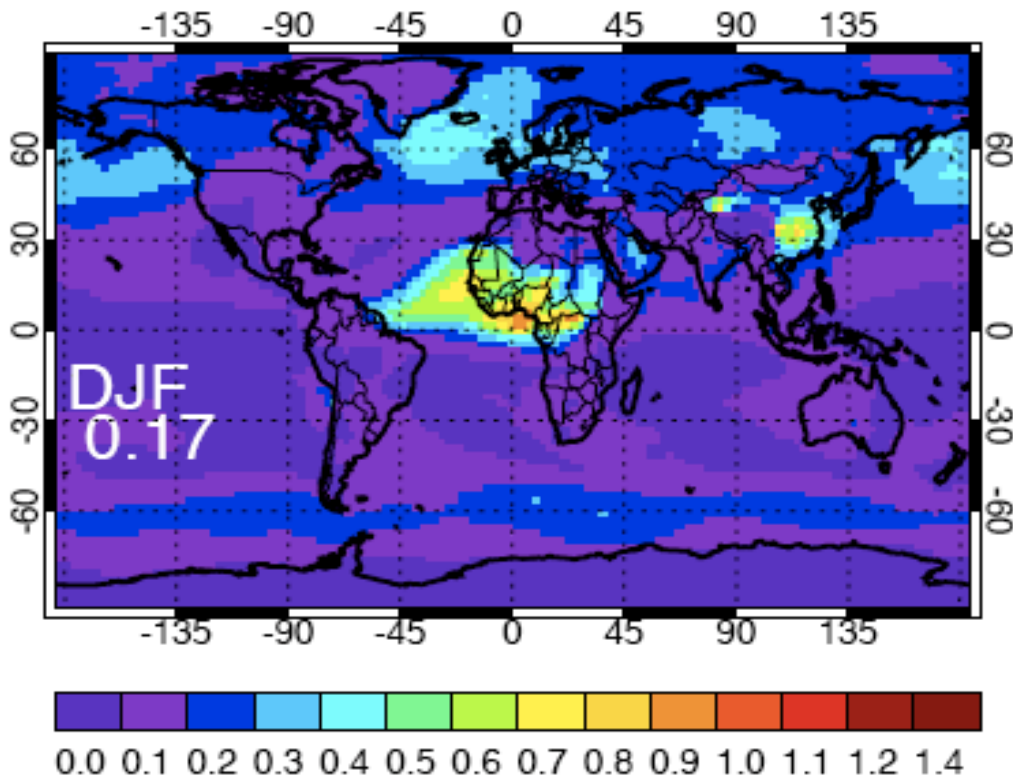
- $2^\circ \times 2.5^\circ$ Resolution
- Year 2000 Emissions
- Climatological SSTs
- 3-month spin up

Model Bias:

- Model - MODIS Terra
- MODIS (2000-2007) Avg.



DJF GEOS-5 AGCM Aerosol Optical Depth (AOD)

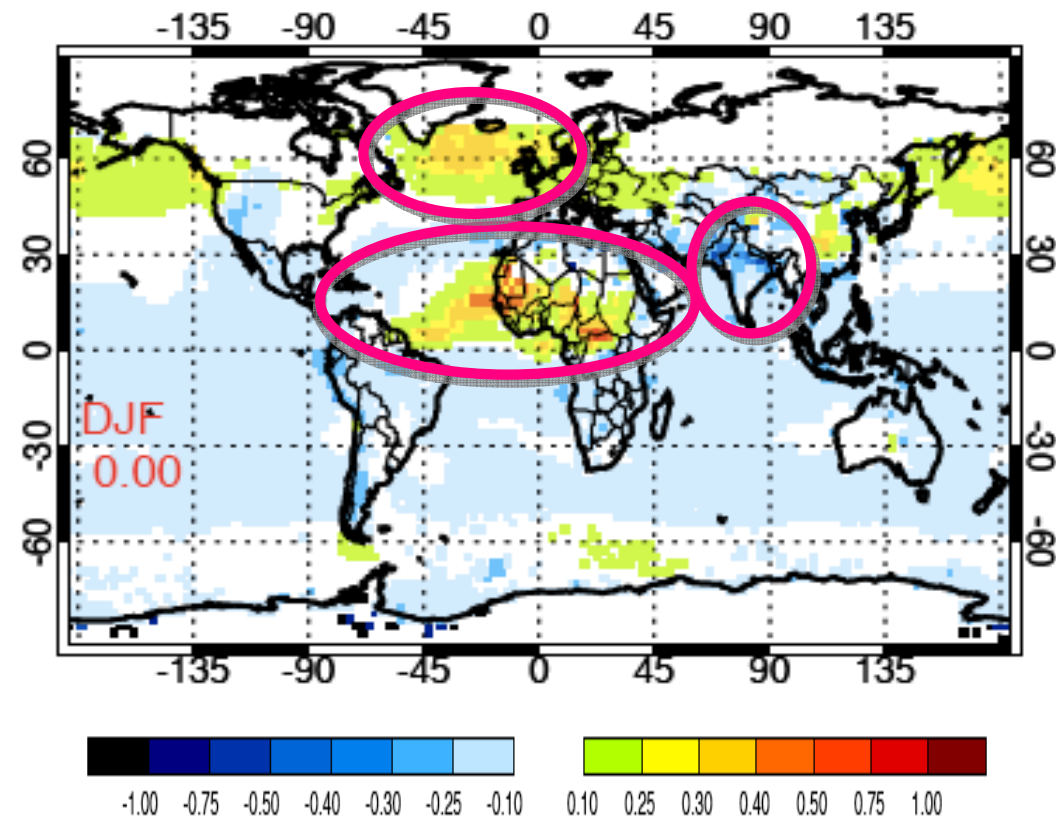


GEOS-5 AGCM:

- 2° x 2.5° Resolution
- Year 2000 Emissions
- Climatological SSTs
- 3-month spin up

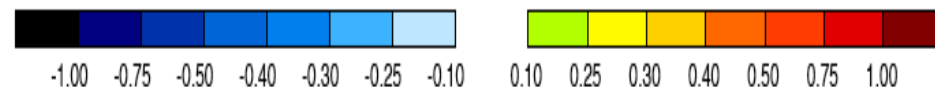
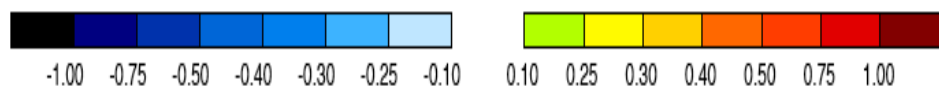
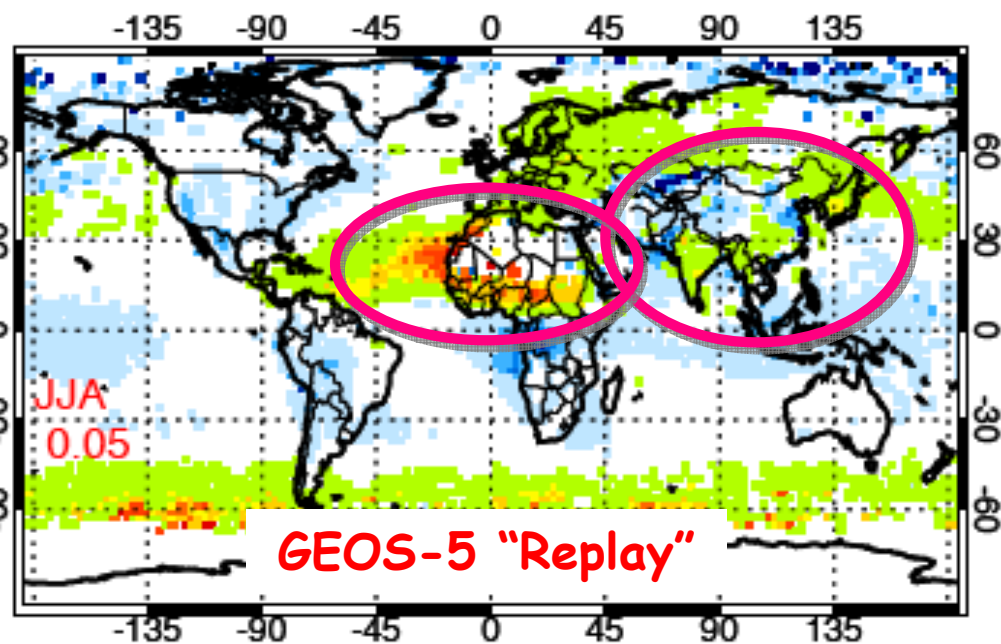
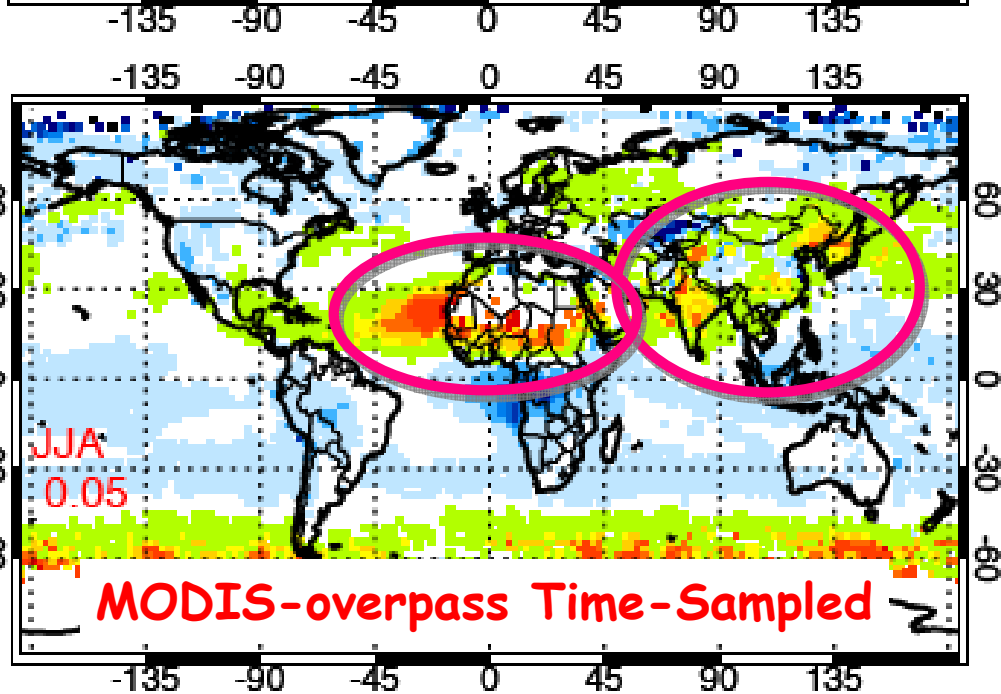
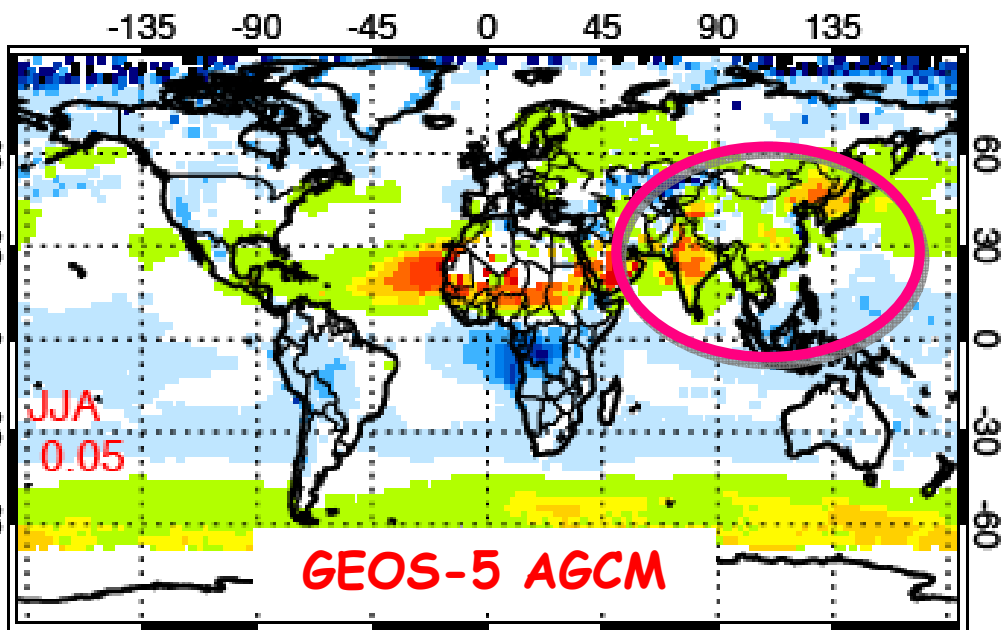
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Time-sampling and Replay Mode Reduce Biases Regionally

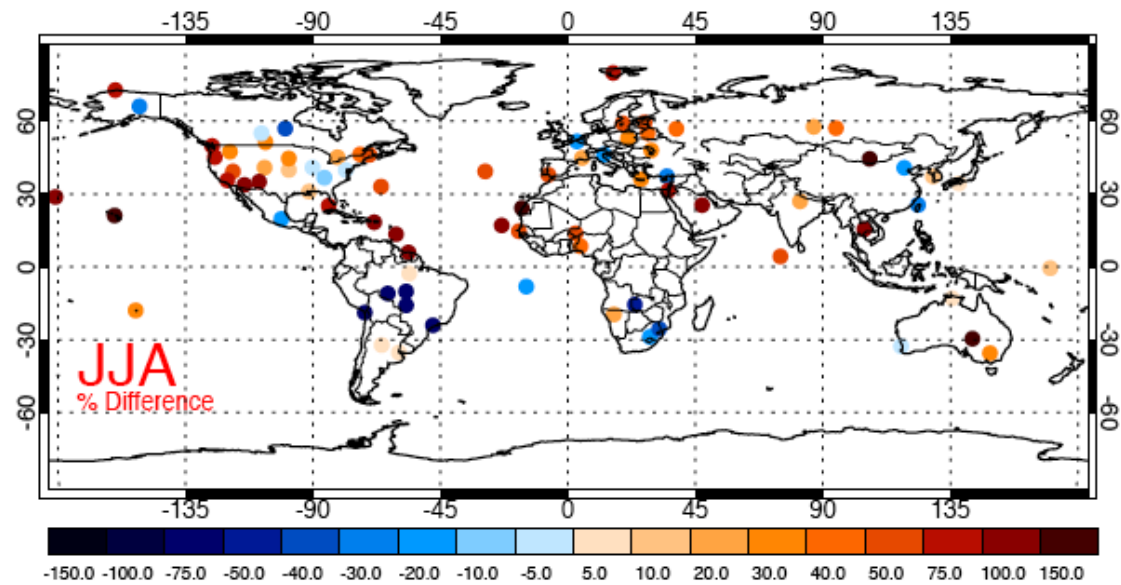
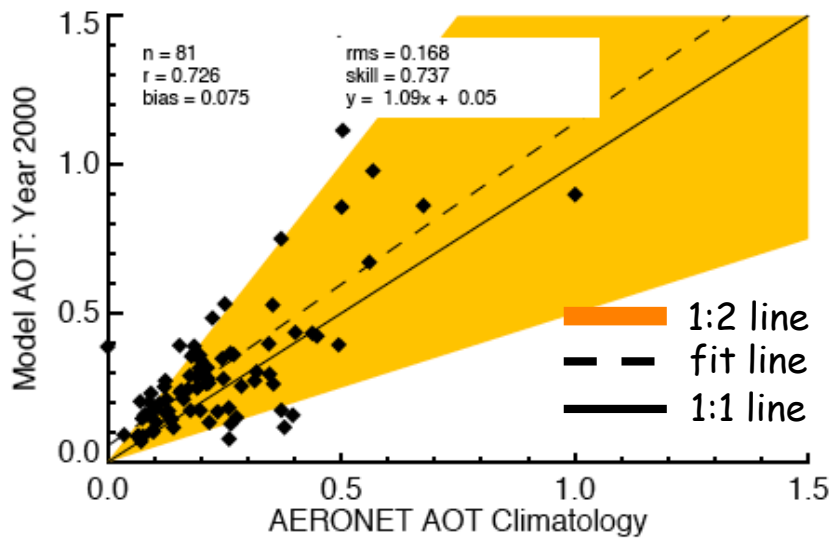
- Can reduce some model bias by sampling model based on MODIS overpass times
- Differences in wind speed impact dust in AGCM versus replay mode



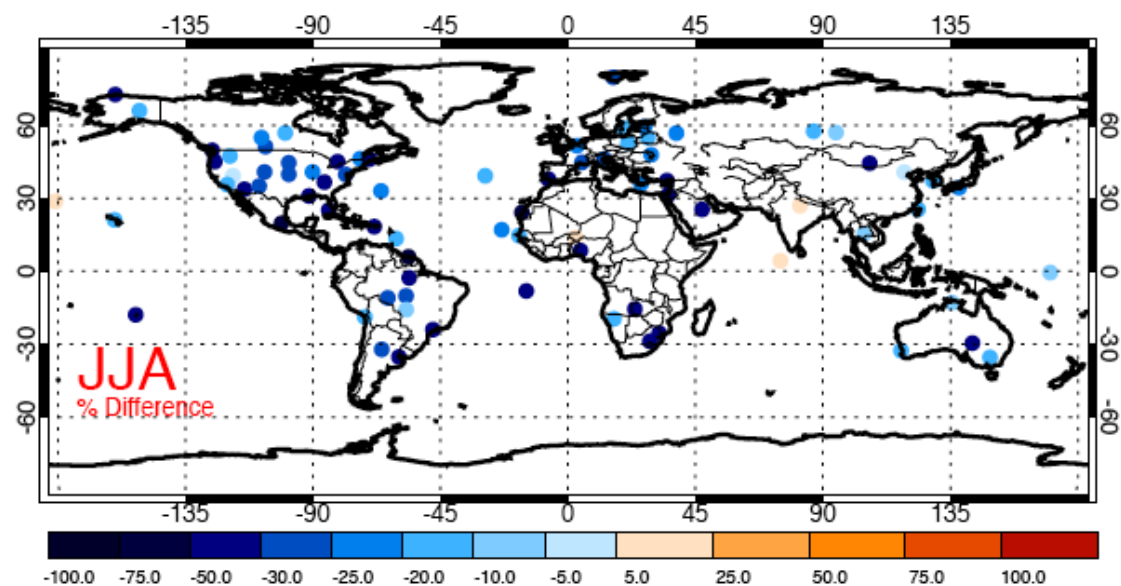
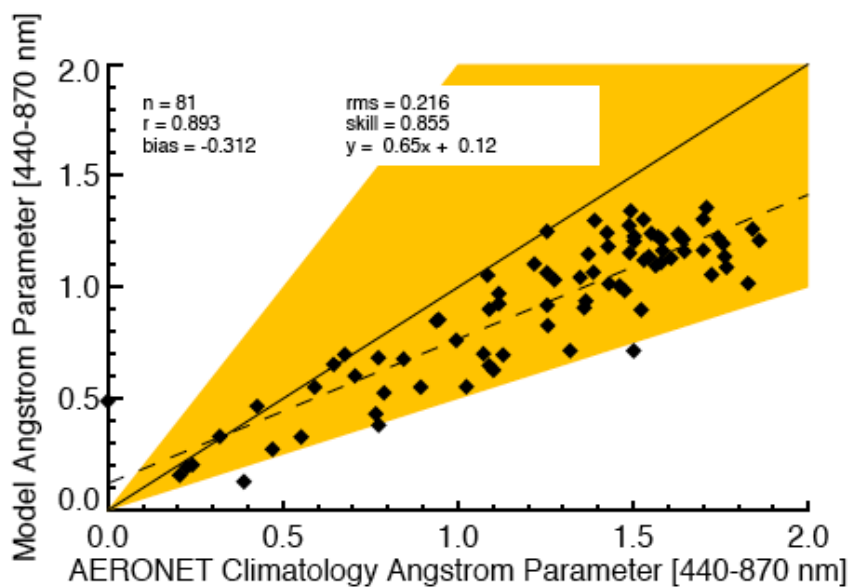
Comparison to AERONET Summer Climatology

- Comparison of GEOS-5 AGCM AOD and angstrom parameter to AERONET in grid box co-located with site
- Length of climatology varies by site

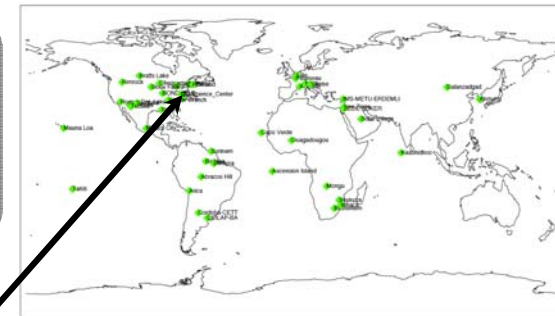
Aerosol Optical Depth



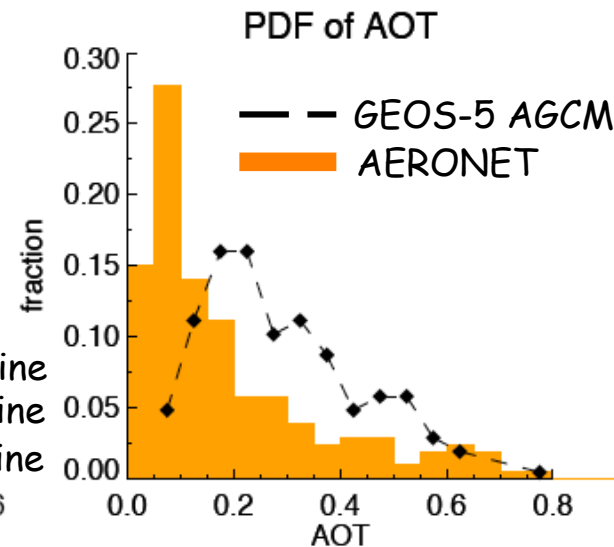
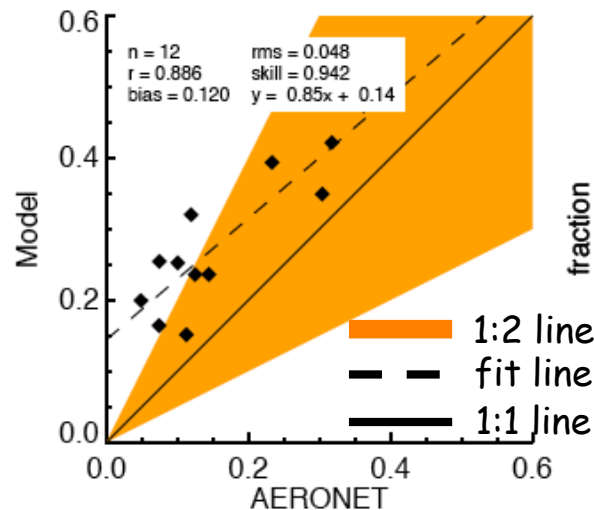
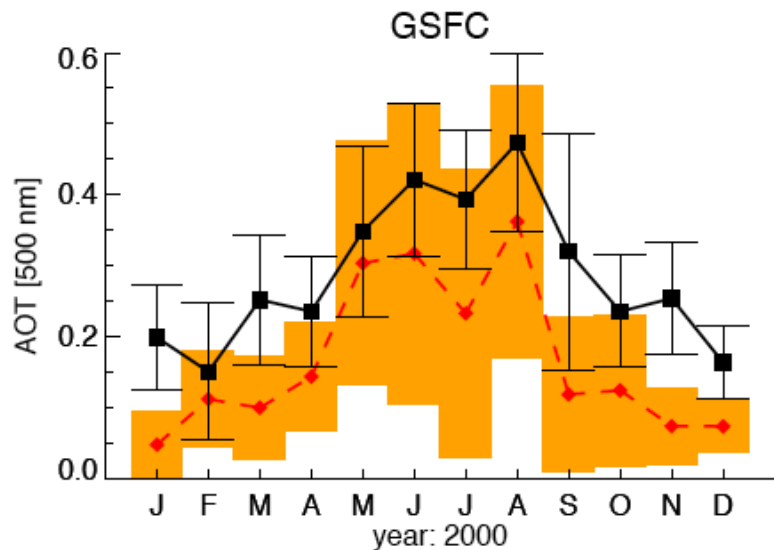
Angstrom Parameter



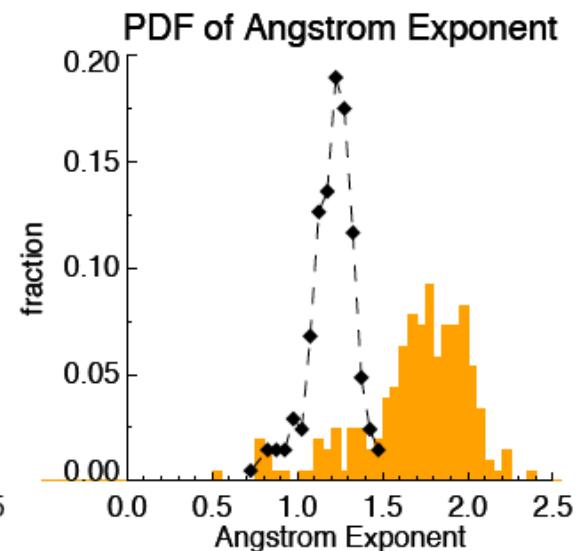
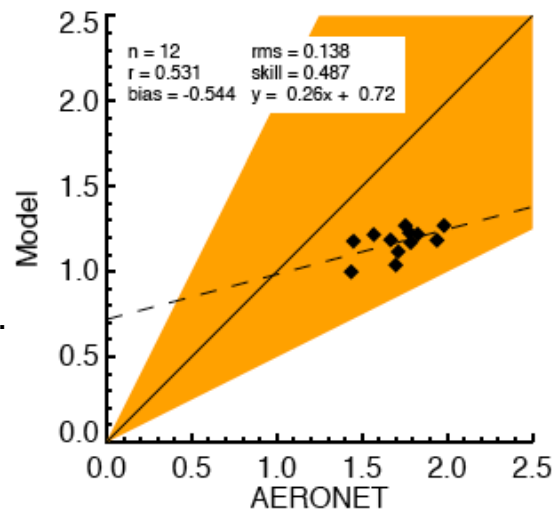
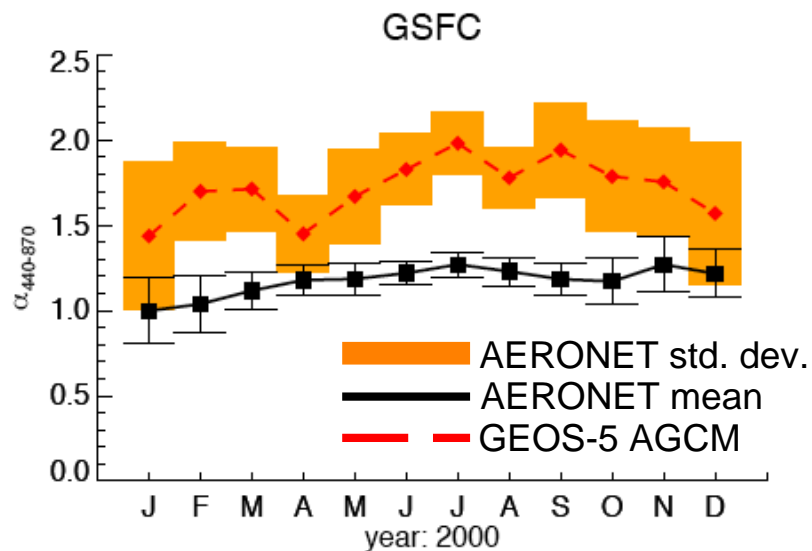
Comparison to AERONET at GSFC: Year 2000 Data



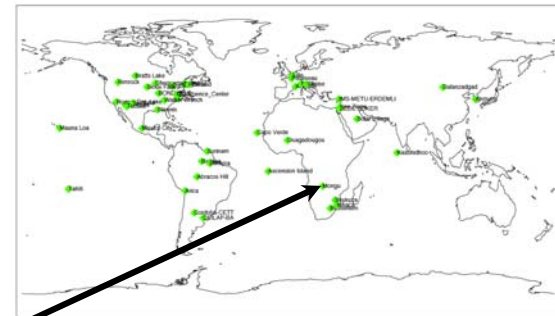
Aerosol Optical Depth



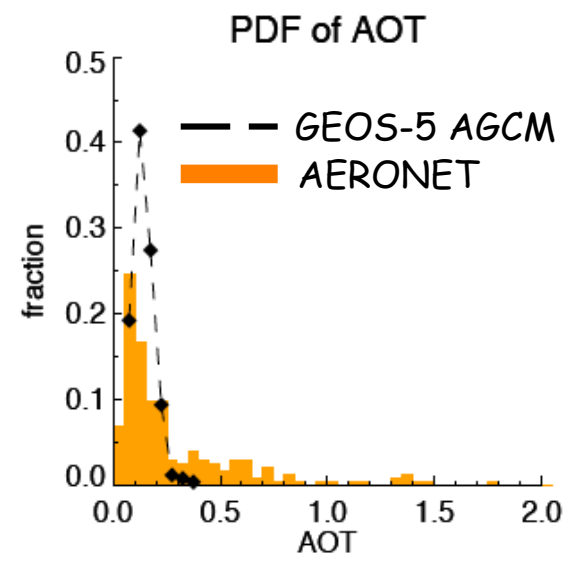
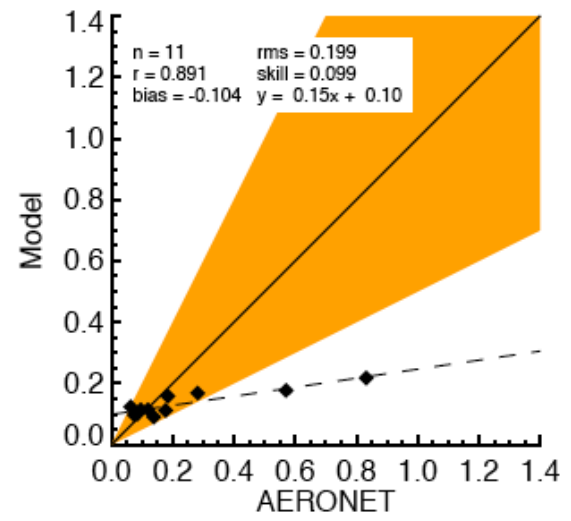
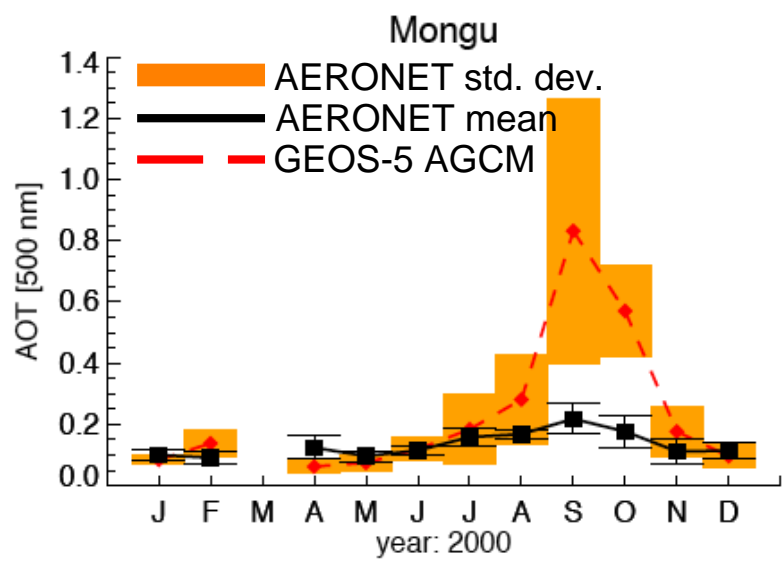
Angstrom Parameter



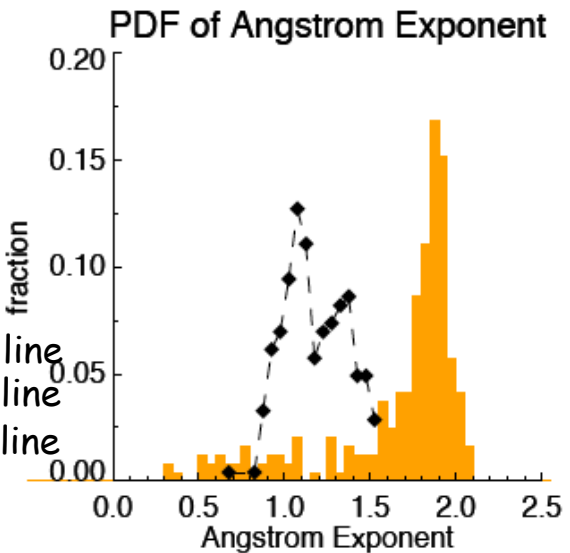
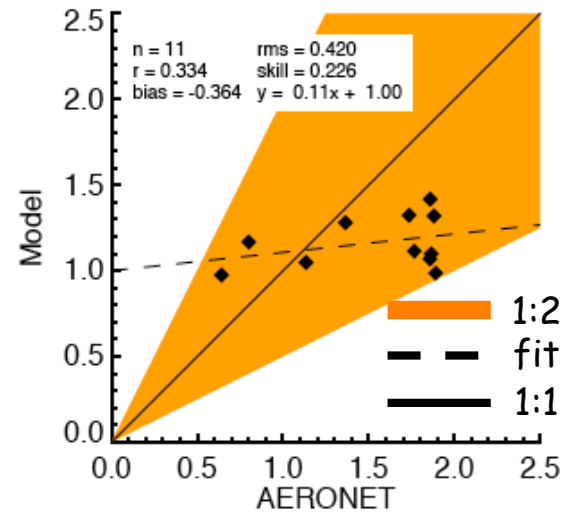
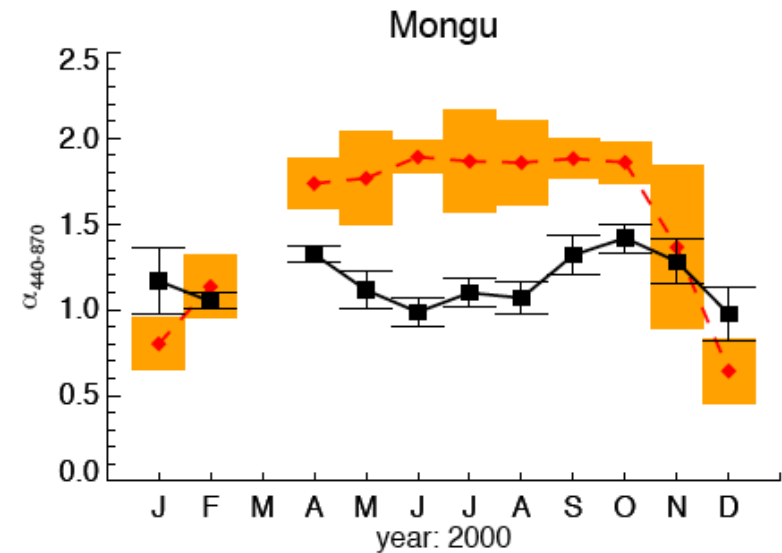
Comparison to AERONET at a biomass burning site: Year 2000 Data



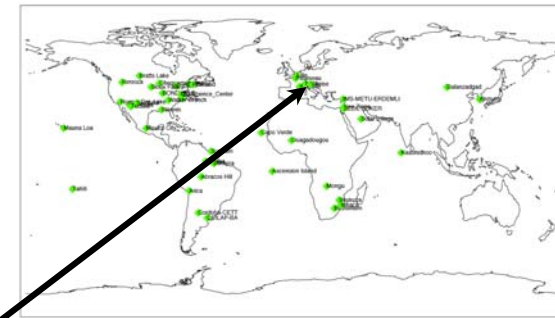
Aerosol Optical Depth



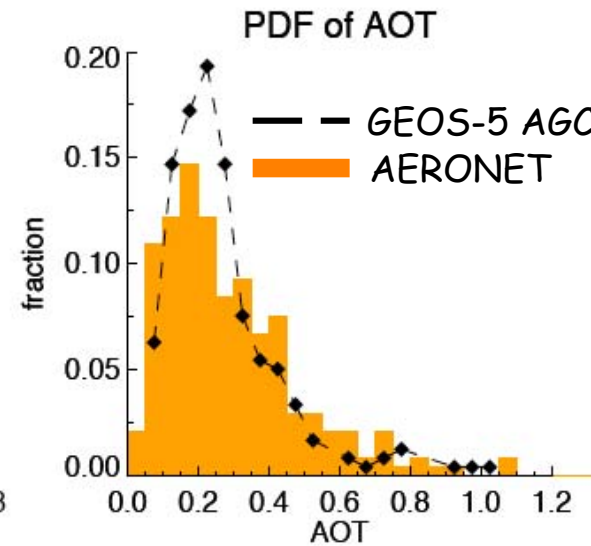
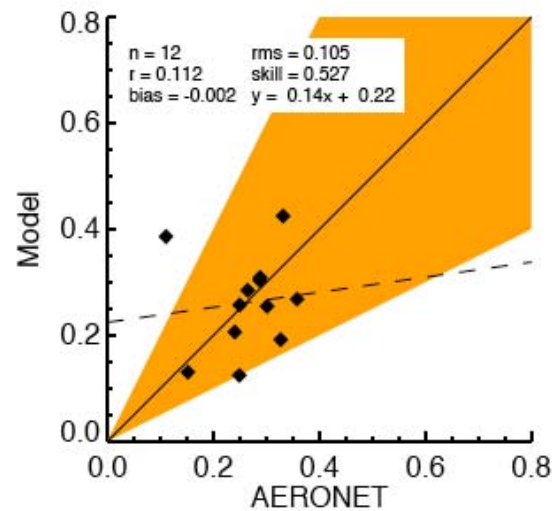
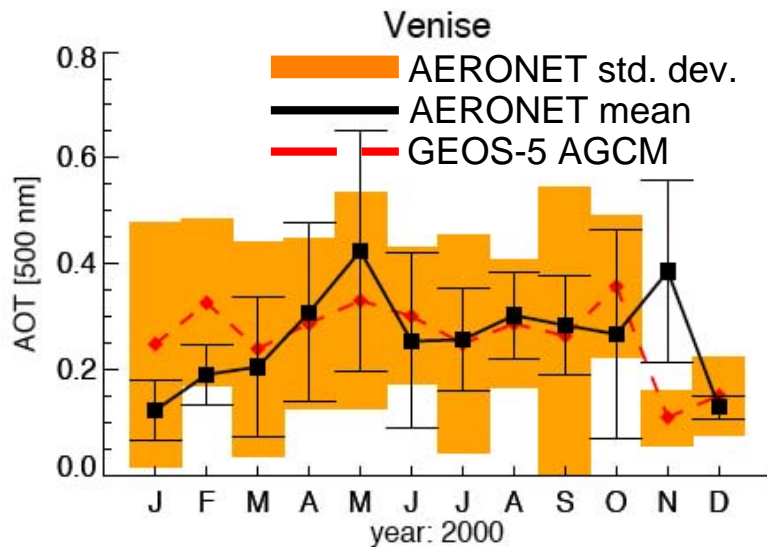
Angstrom Parameter



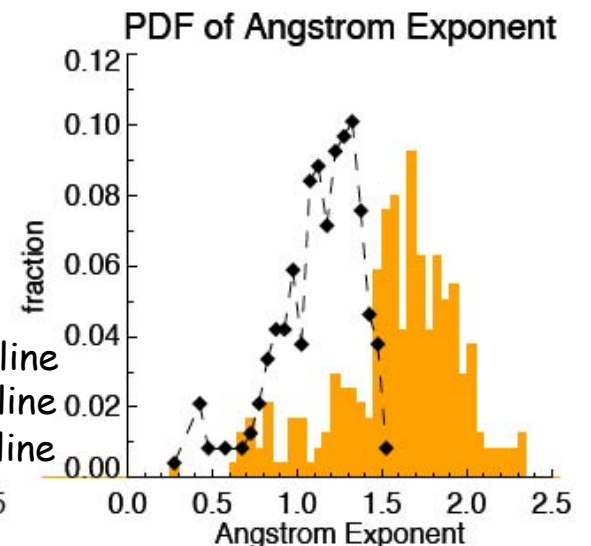
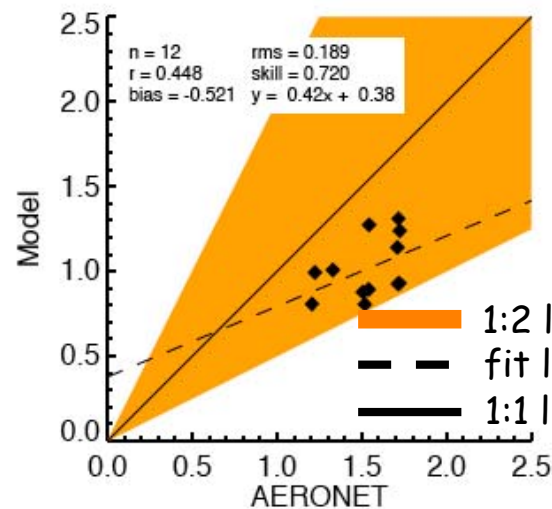
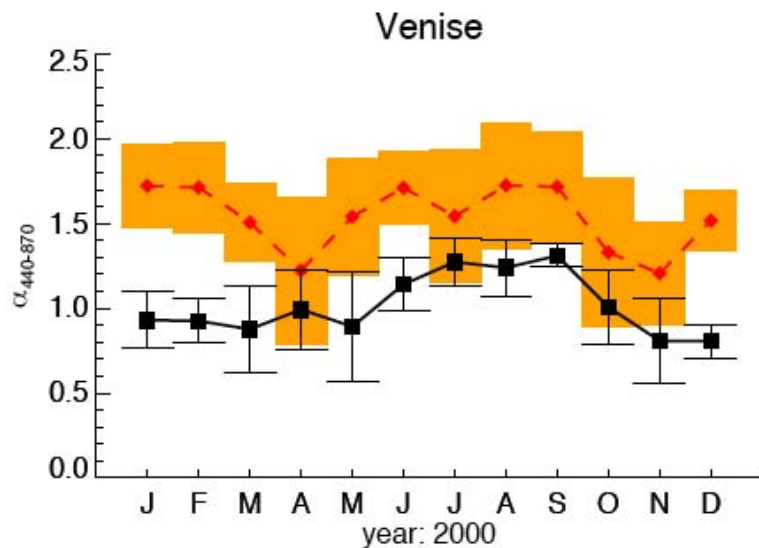
Comparison to AERONET at a European site: Year 2000 Data



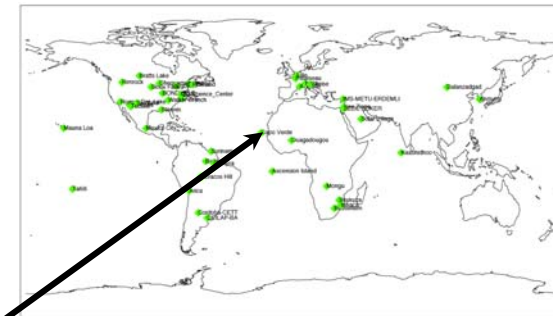
Aerosol Optical Depth



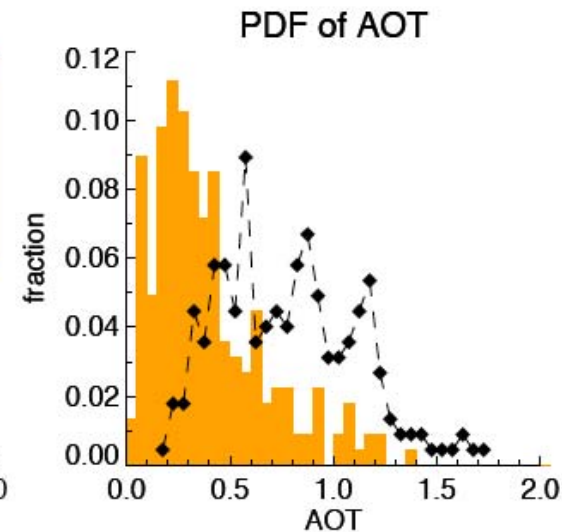
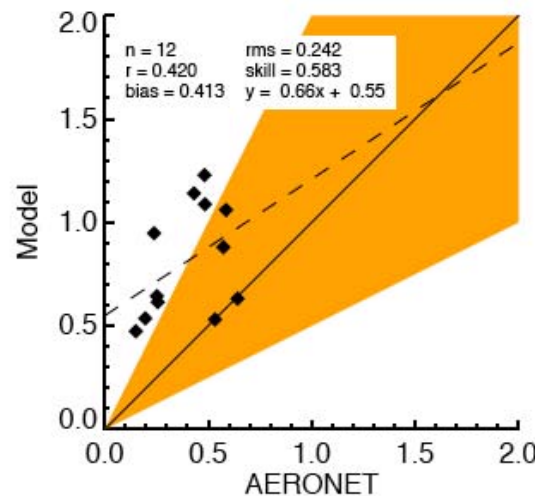
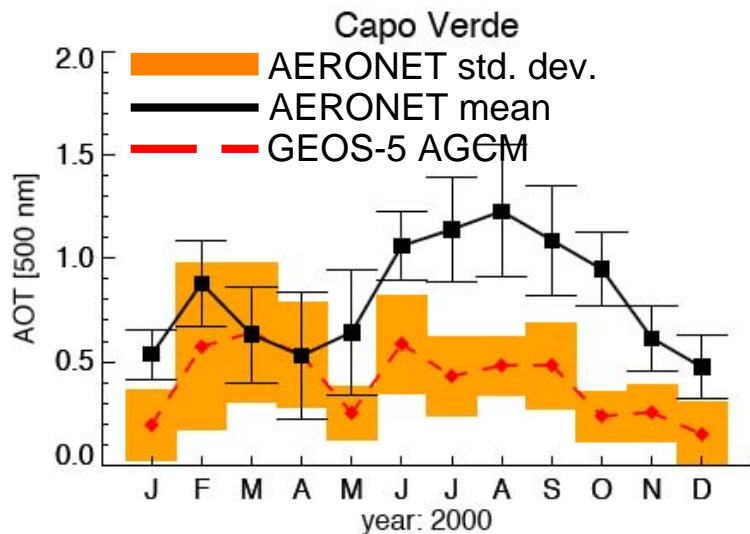
Angstrom Parameter



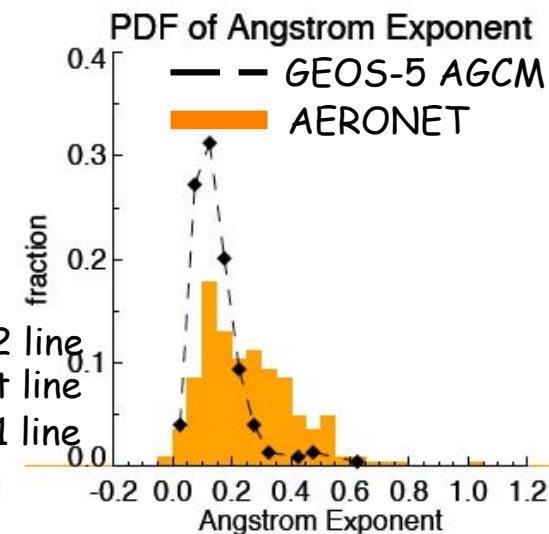
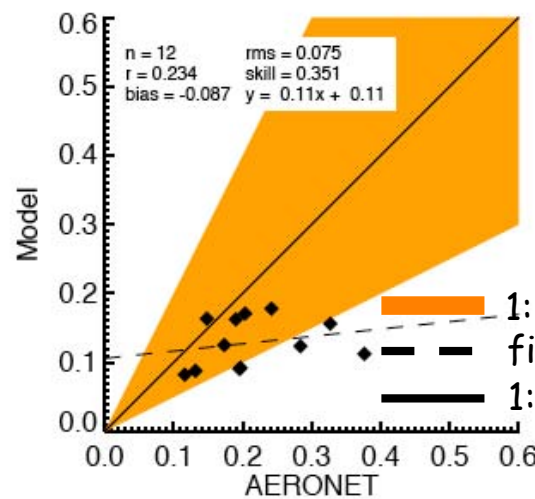
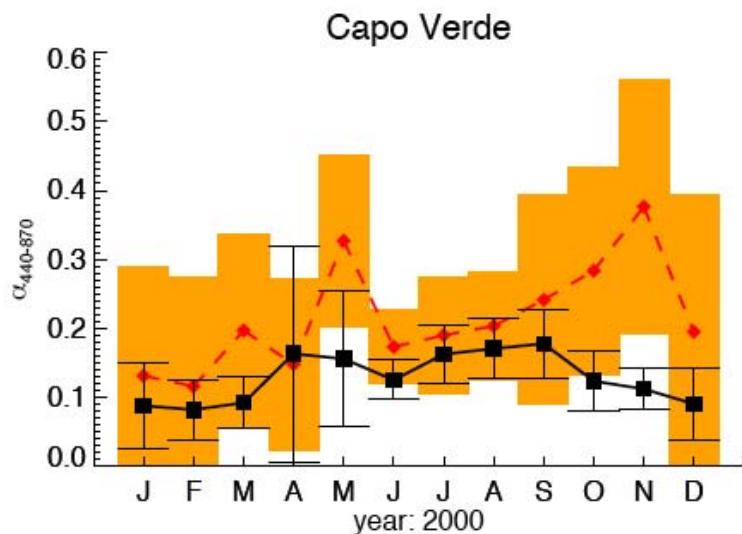
Comparison to AERONET at a dusty site: Year 2000 Data



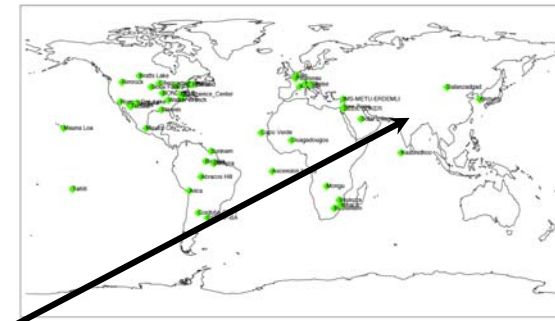
Aerosol Optical Depth



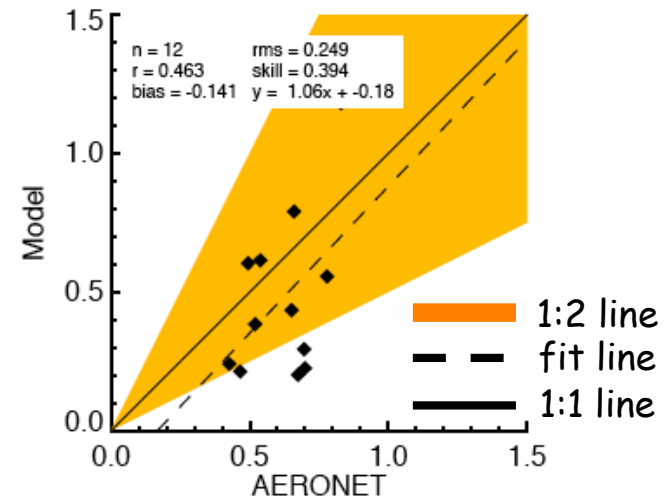
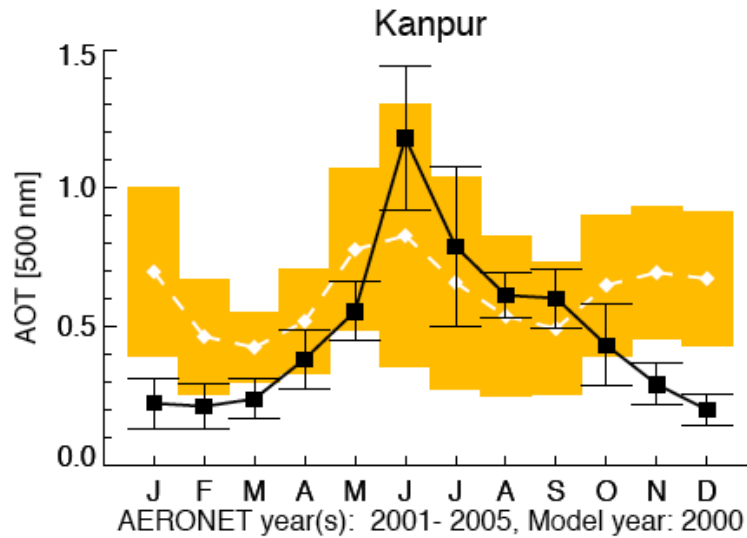
Angstrom Parameter



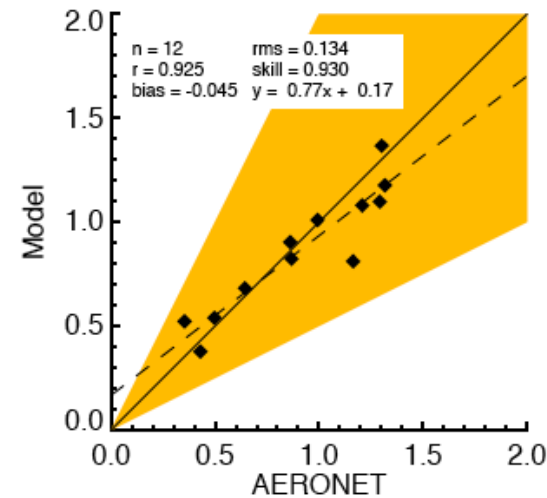
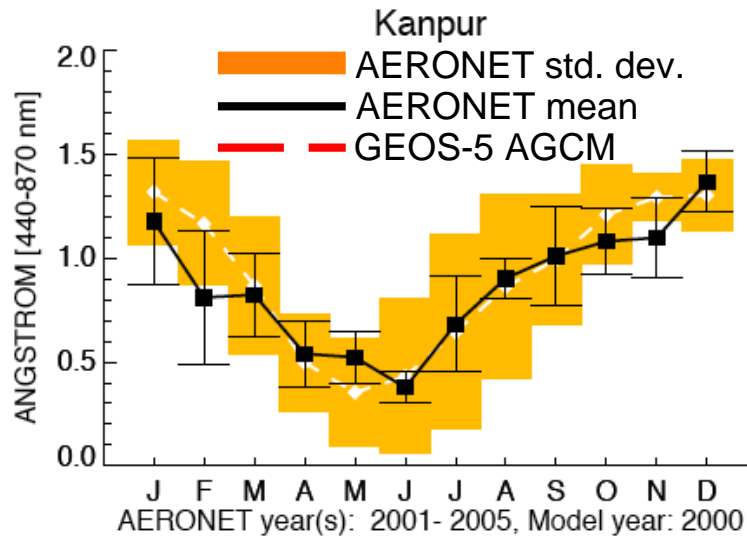
Comparison to AERONET at a S. Asian site: Climatological Data



Aerosol Optical Depth



Angstrom Parameter



Closing Remarks

1. Re-tune dust and sea salt for GEOS-5
2. Examine convective scavenging
3. Examine biomass burning source & emission factors
4. More examination of data (e.g. vertical distributions, absorption)

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