

## **2014 EOS Aura Science Team Meeting**

### **Aerosol Remote Sensing from OMI Observations: An Overview**

**Omar Torres**

*NASA GSFC*

**Changwoo Ahn**

*SSAI*

**Hiren Jethva**

*GESTAR-USRA*

*15-18 September 2014, College Park, MD*

# OMI Near-UV Aerosol Algorithm (OMAERUV)

**Purpose:** Retrieval of Aerosol Single Scattering Albedo and Absorption Optical Depth

**Measurements:** Radiances at 354 and 388 nm.

**Physical Basis:** Radiative interaction between particle absorption and molecular scattering in the UV.

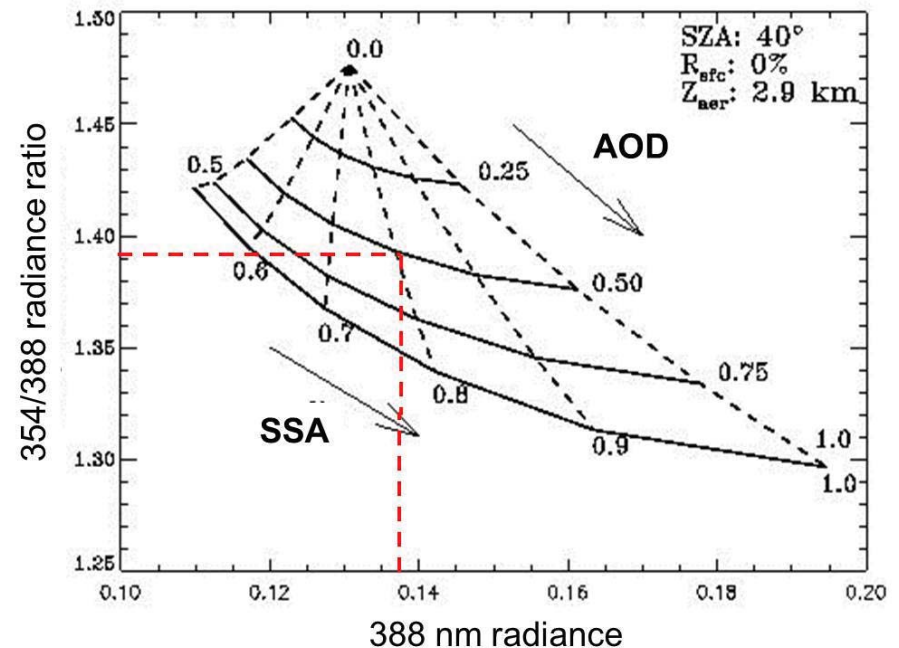
*In spite the sensor's coarse resolution for aerosol retrieval, valuable information on particle absorption can be derived from OMI near UV observations.*

## Retrieval Products:

- AOD and SSA (388 nm)
- Absorbing Aerosol Index

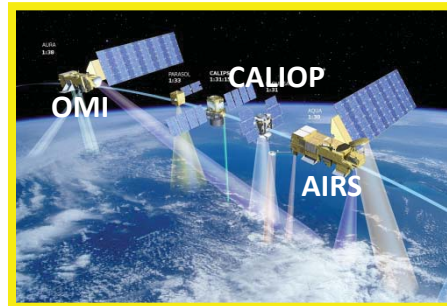
## Inversion Scheme:

For a given aerosol type and ALH, satellite measured radiances at 354 and 388 nm are associated with a set of AOD and SSA values.

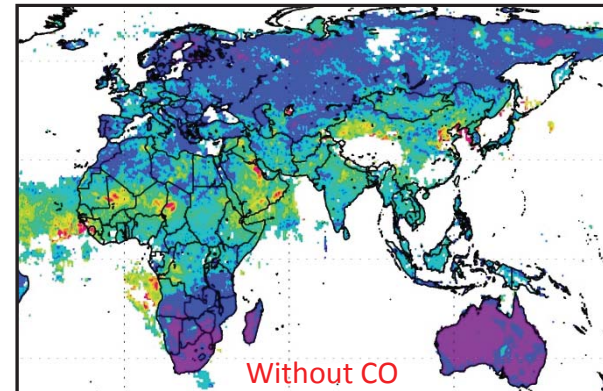


## Combined use of OMI, CALIOP and AIRS observations in OMAERUV Aerosol Retrieval

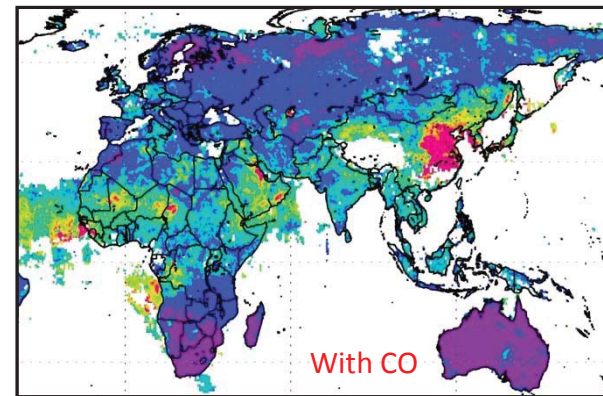
OMAERUV uses a CALIOP-based Aerosol Layer Height Climatology and real-time AIRS carbon monoxide data for aerosol type identification [Torres et al., 2013]



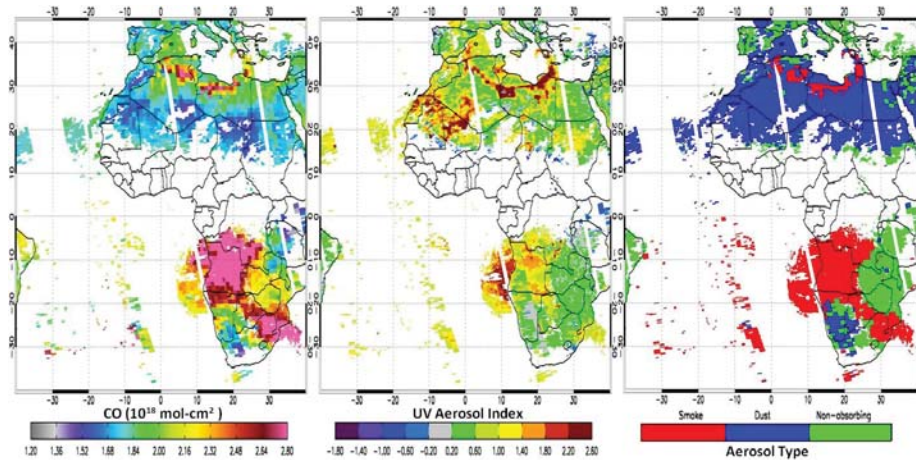
AOD June 2007 Monthly average



Without CO



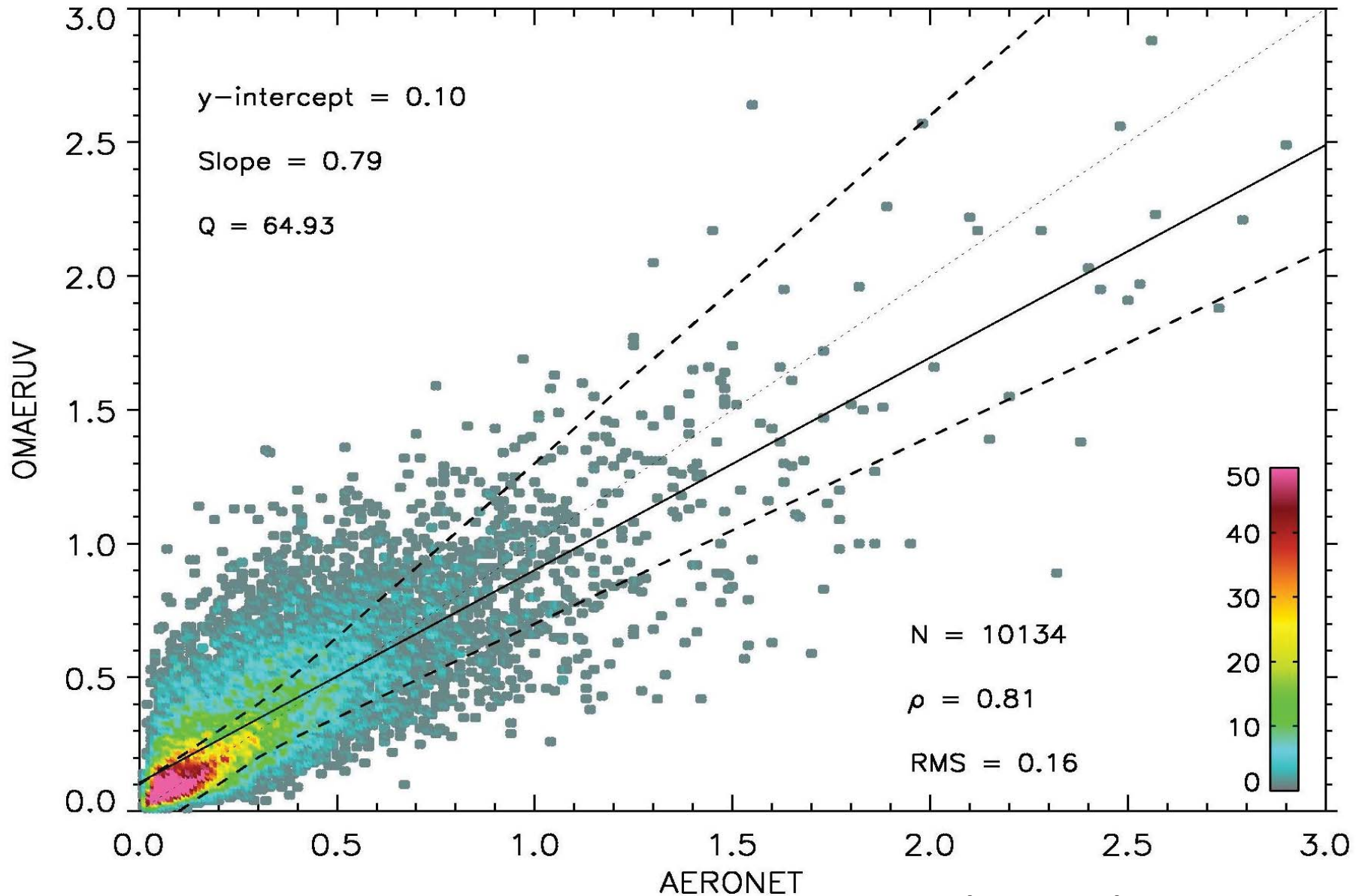
With CO



The combined use of AI and CO allows the identification of smoke layers over arid areas.

AIRS CO allows the identification of heavy aerosol loads over China, and other regions, otherwise undistinguishable from cloud contamination.

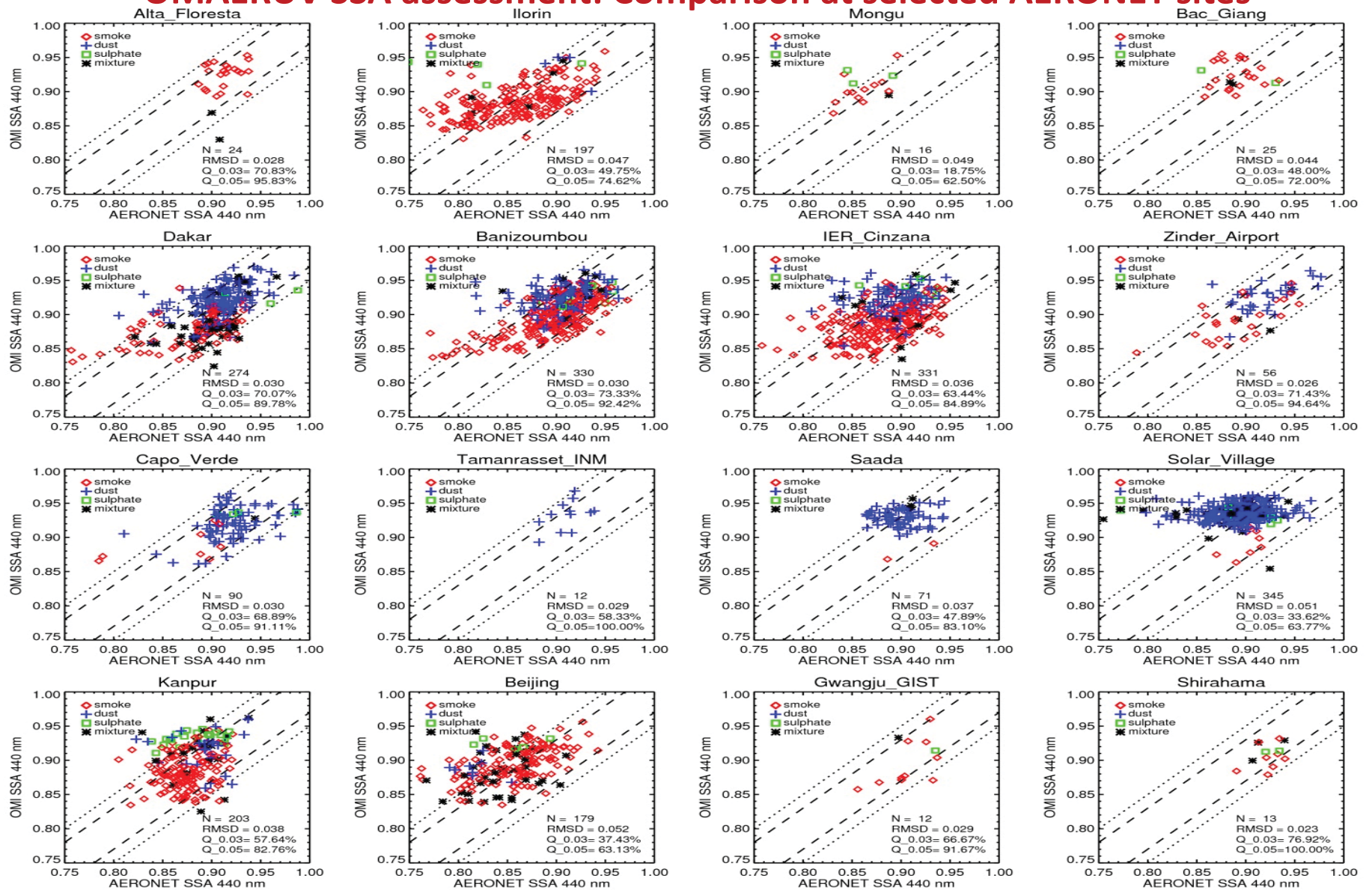
## OMAERUV AOD Validation: The Global Picture



Ahn, C., O. Torres, and H. Jethva (2014), Assessment of OMI near-UV aerosol optical depth over land, *J. Geophys. Res. Atmos.*, 119, 2457–2473, doi:[10.1002/2013JD020188](https://doi.org/10.1002/2013JD020188).



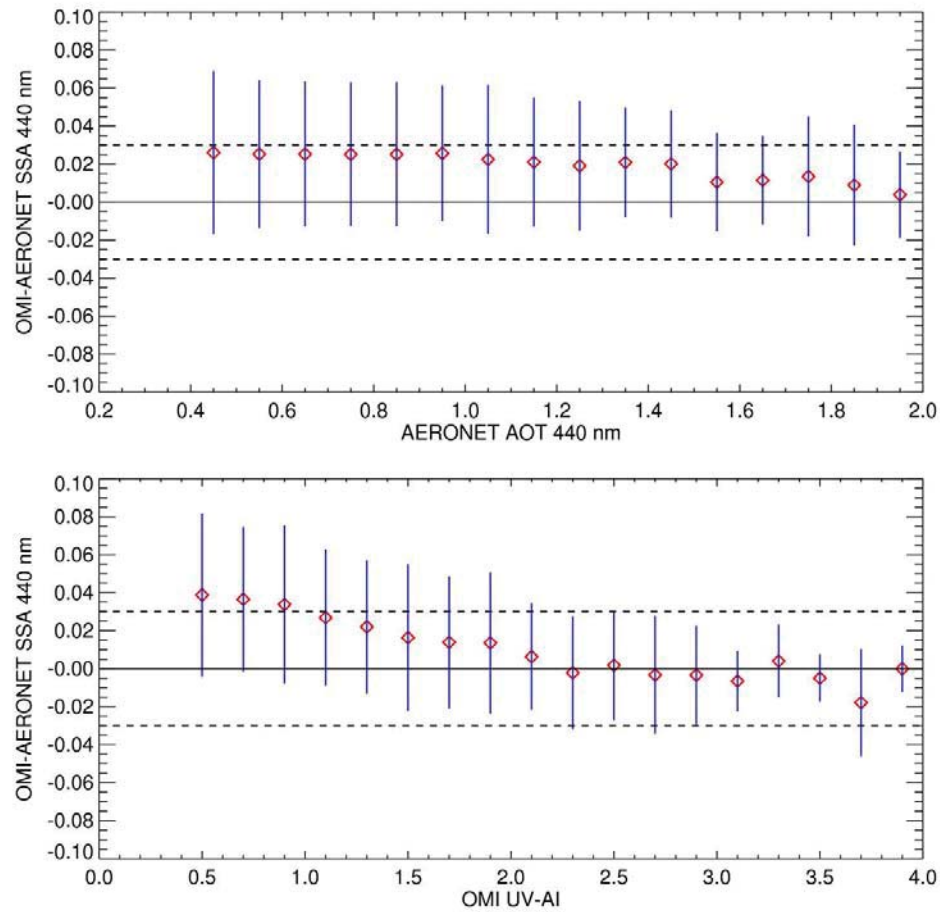
# OMAERUV SSA assessment: Comparison at selected AERONET sites



51% (75%) of matched pairs agree within 0.03 (0.05)

Jethva, H., O. Torres, and C. Ahn (2014), Global assessment of OMI aerosol single-scattering albedo using ground-based AERONET inversion, *J. Geophys. Res. Atmos.*, 119, doi:10.1002/2014JD021672.

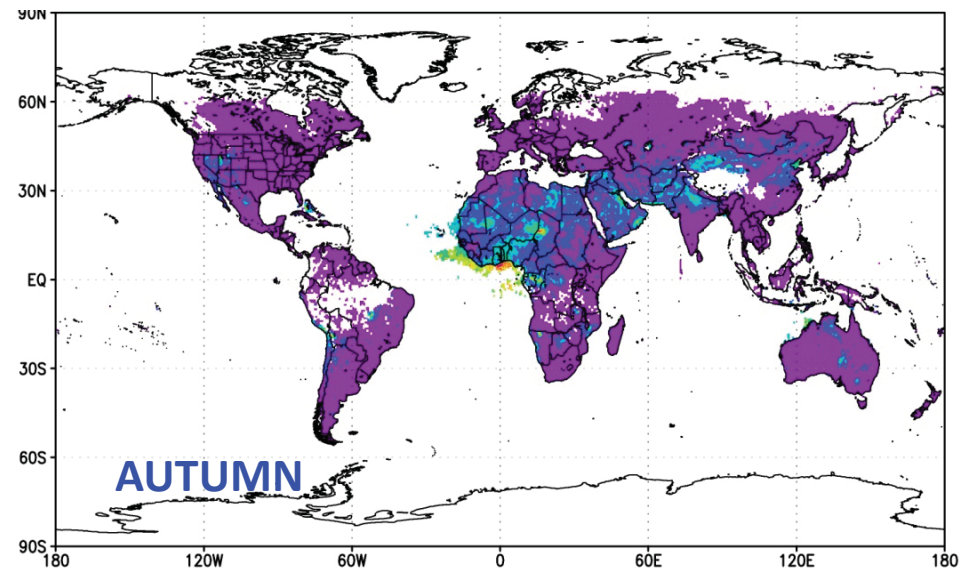
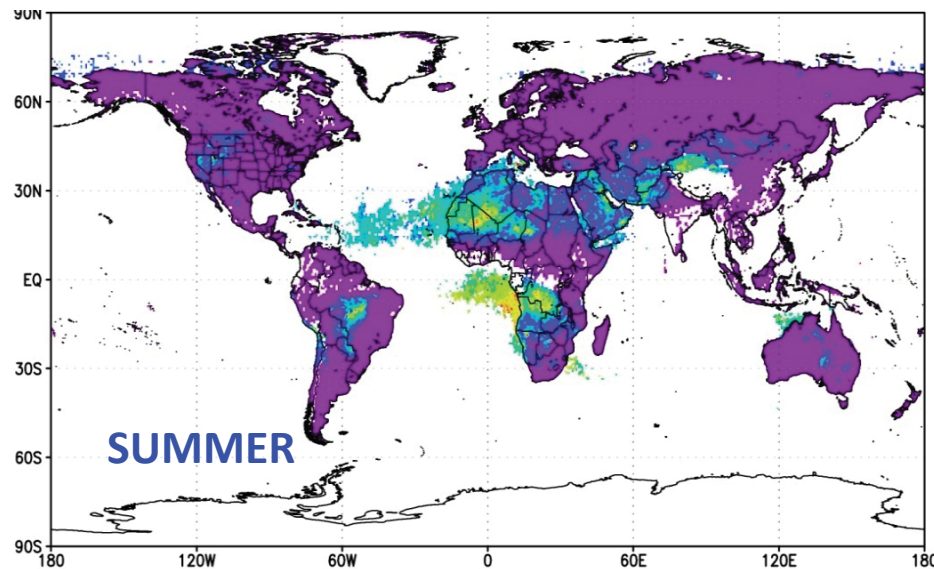
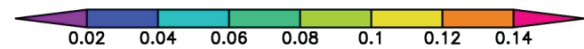
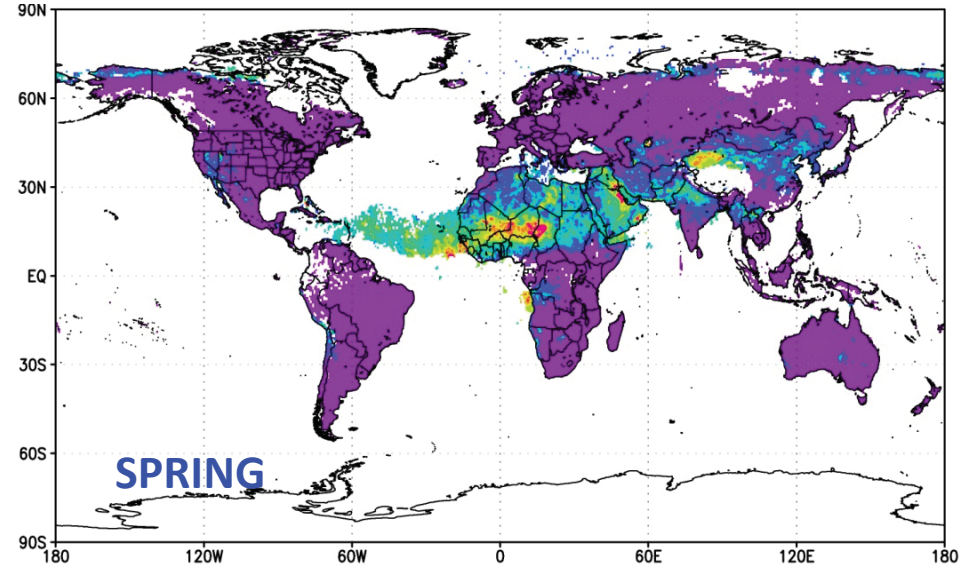
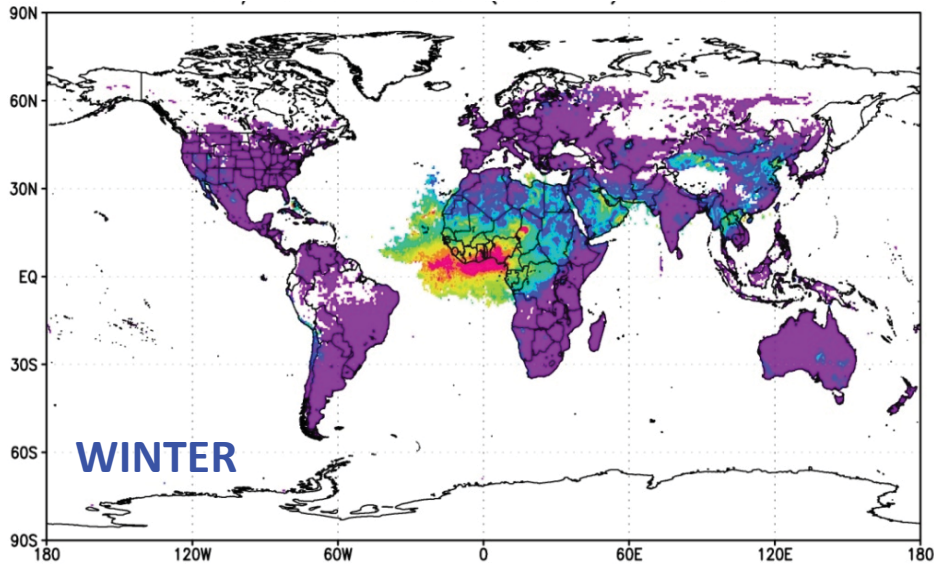
# OMI versus AERONET Global Composite



- OMI and AERONET are within their expected uncertainties ( $\pm 0.03$ ) for  $AOD > 0.4$  and  $UV-AI > 1.0$
- Closer agreement for larger aerosol loading

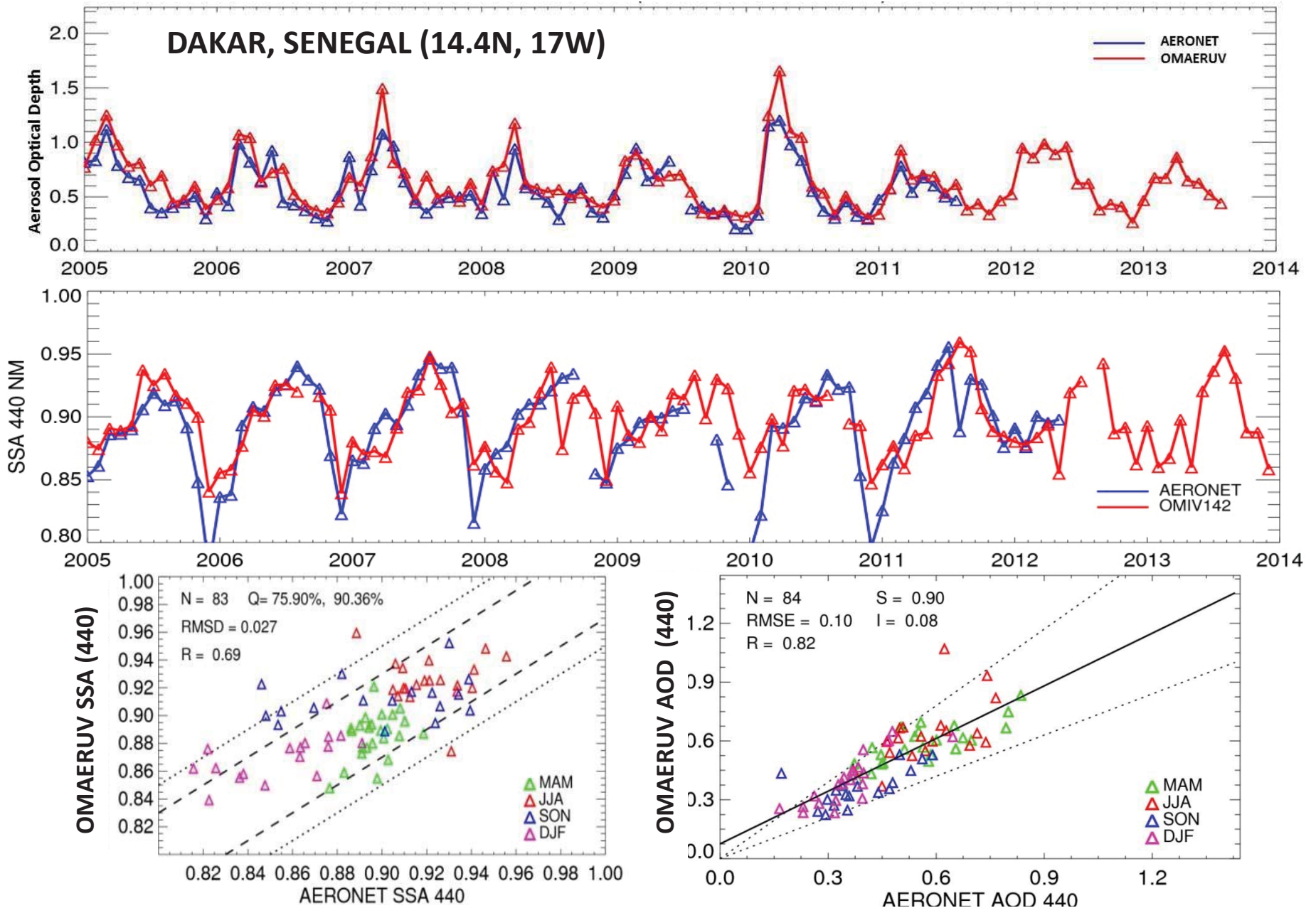


# 2007 AOD Global Seasonal Average Maps



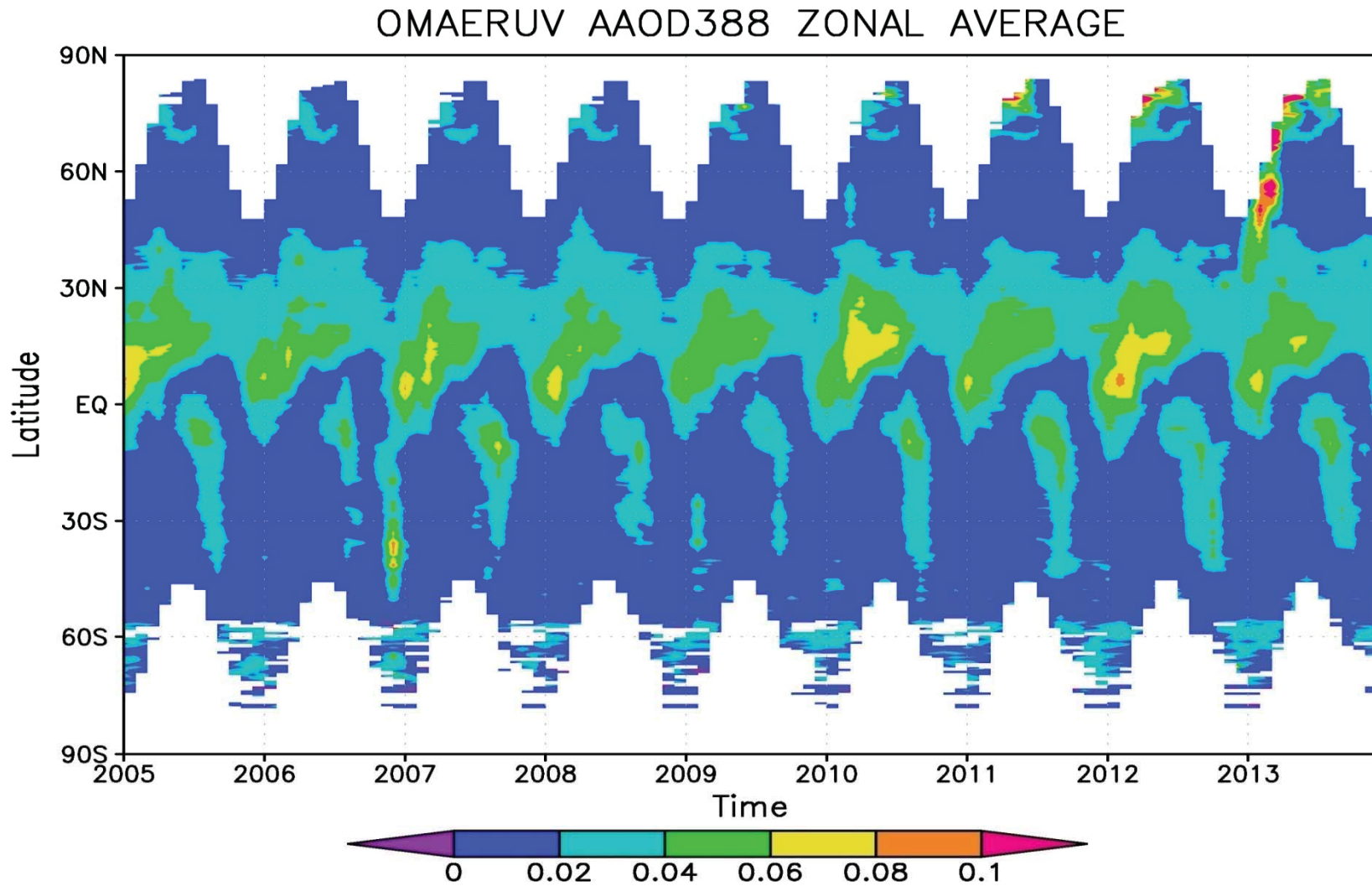
# Validated long-term record of OMAERUV Aerosol Optical Depth and Single Scattering Albedo

*OMI-AERONET comparison of monthly mean values of AOD and SSA over nine years*

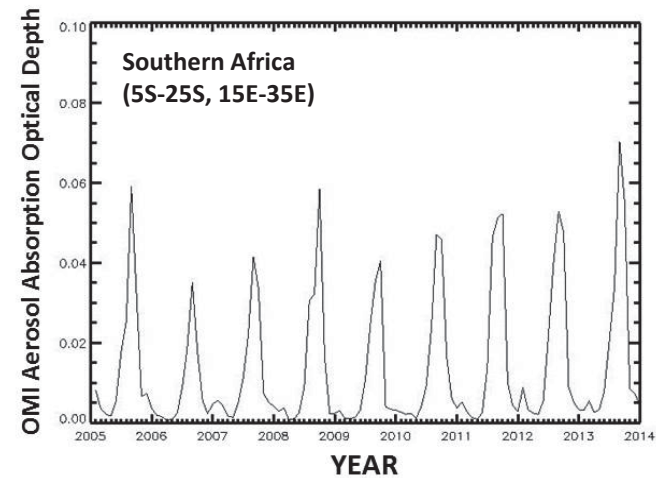
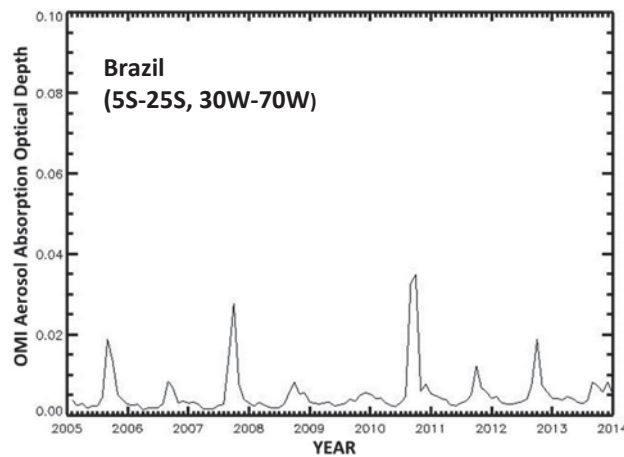
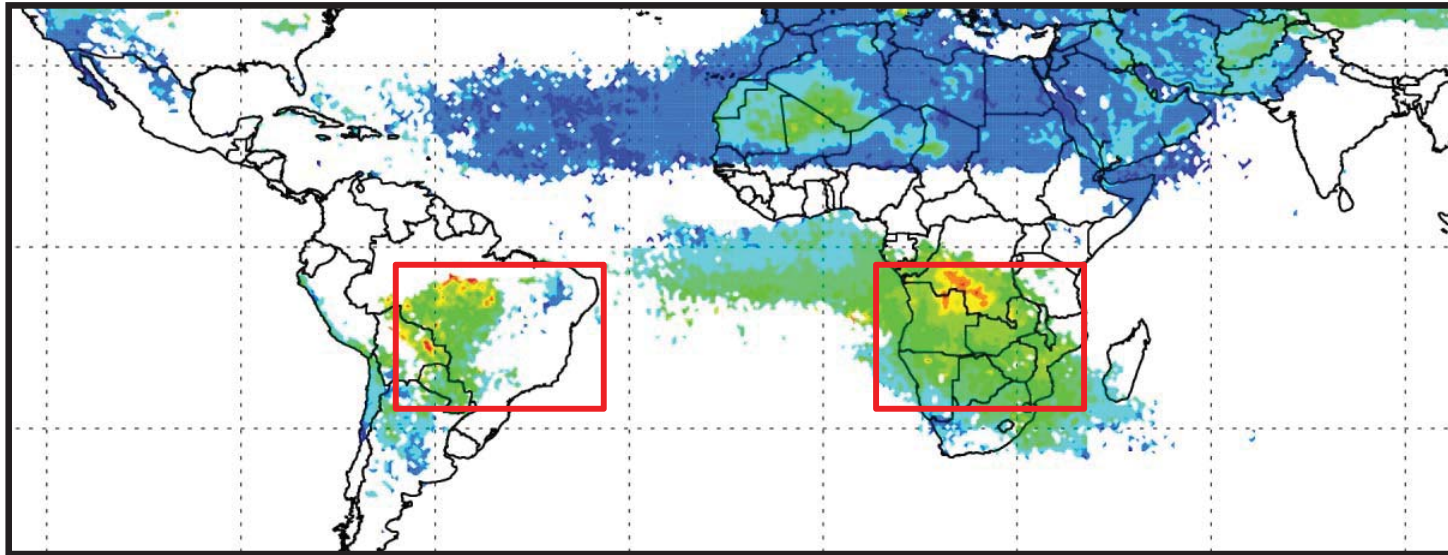




## Nine-year Global record of OMI Aerosol Absorption Optical Depth



## AAOD time series over SH biomass burning regions

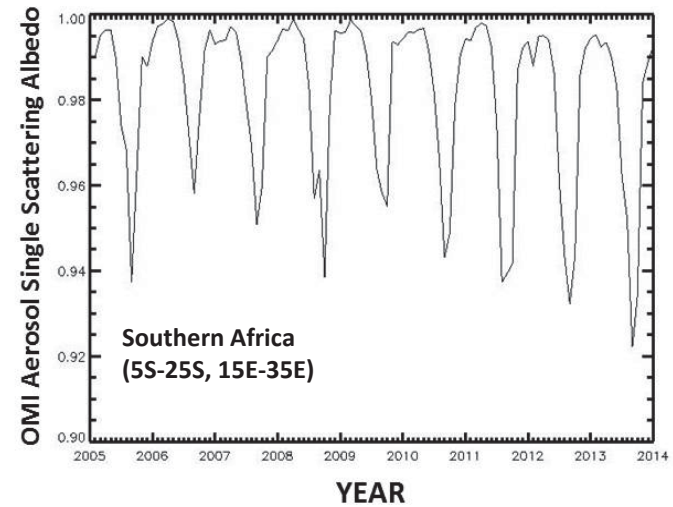
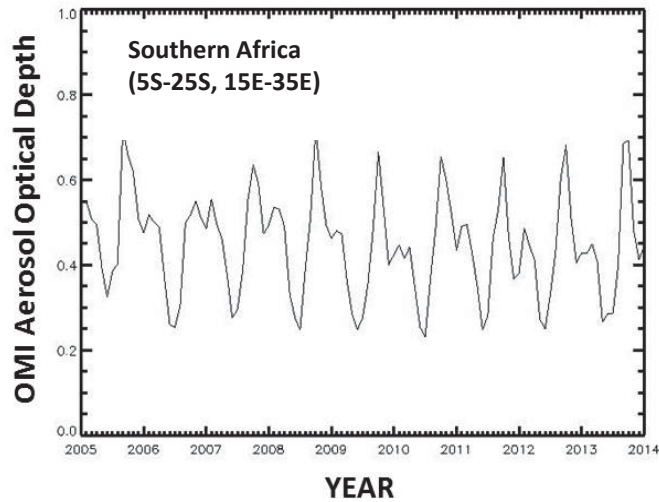


An AAOD increase ( $\sim 0.01/\text{year}$ ) is apparent in Southern Africa

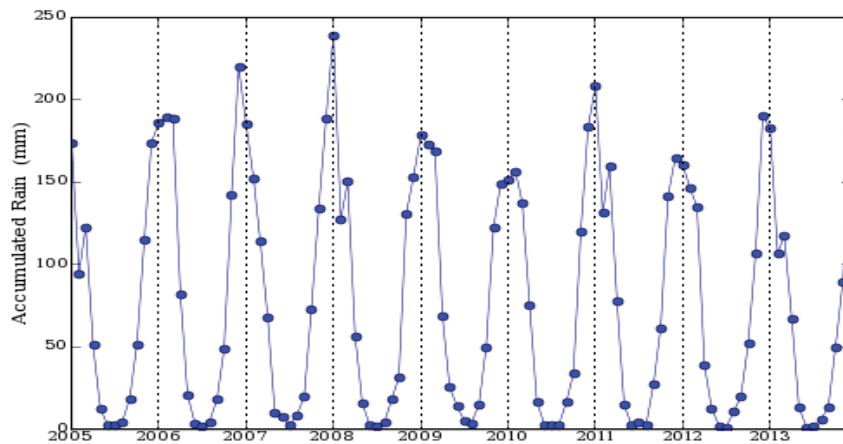
$$\text{AAOD} = \text{AOD}(1 - \text{SSA})$$

Is AOD increasing or SSA decreasing?

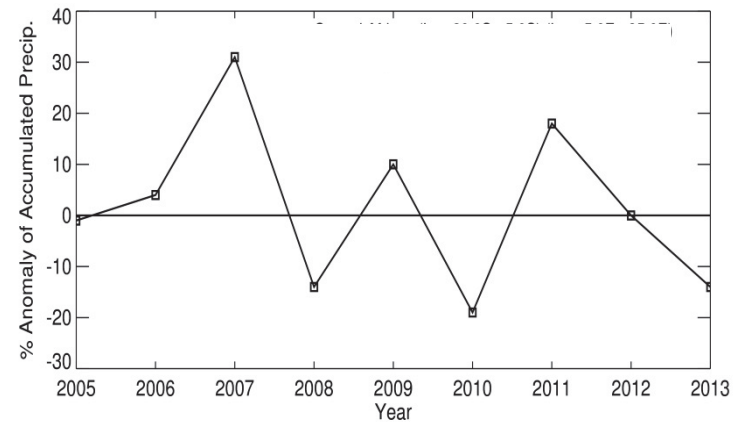
## AOD and SSA time series over SH biomass burning regions



A decrease in the water-content of fuel can produce more absorbing particles



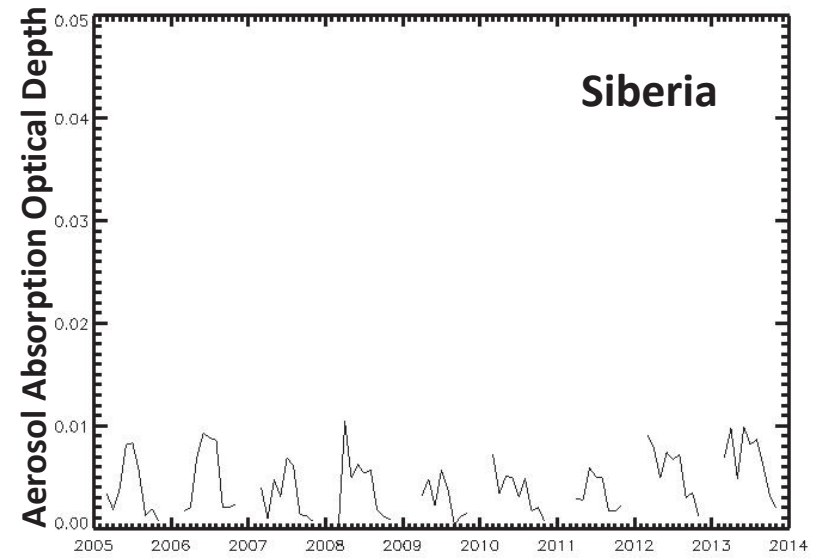
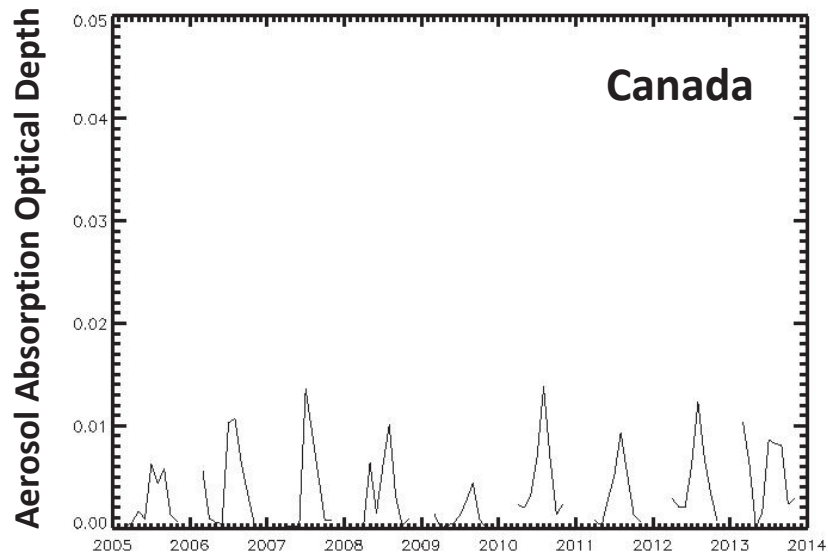
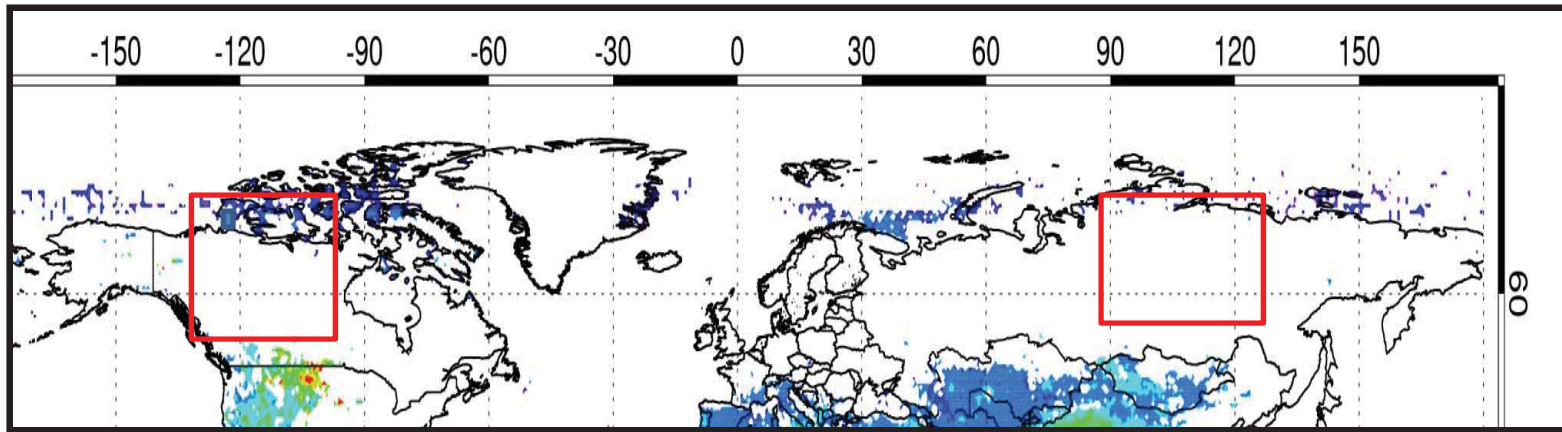
Time series of monthly accumulated rain (TRMM)



May-Oct. Precipitation Anomaly (%)



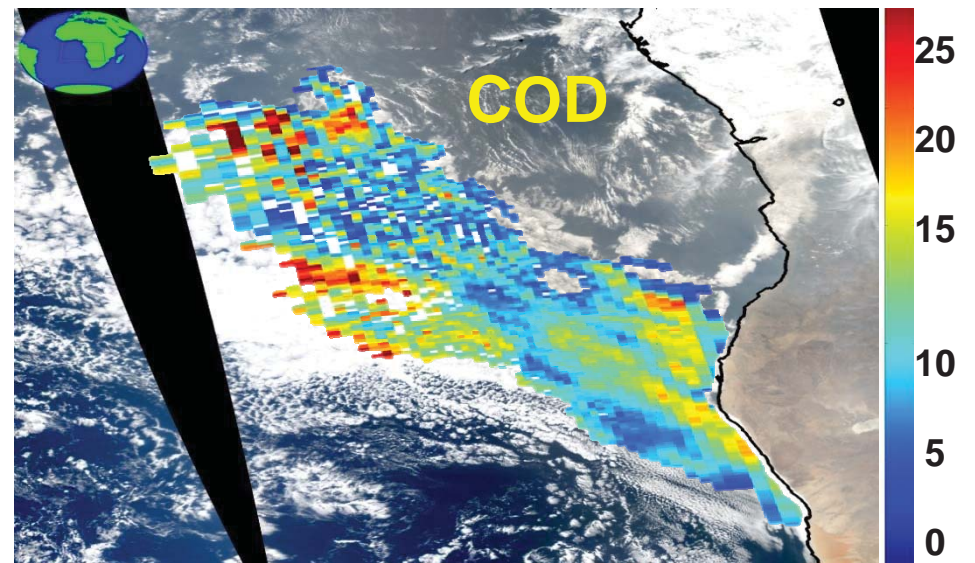
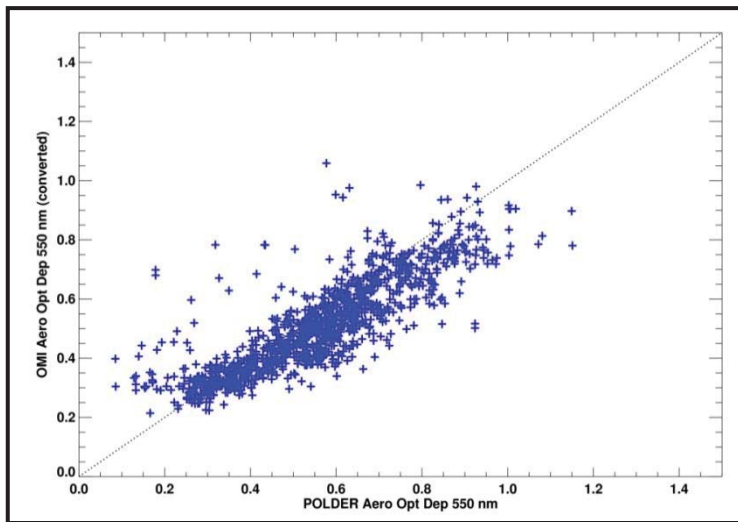
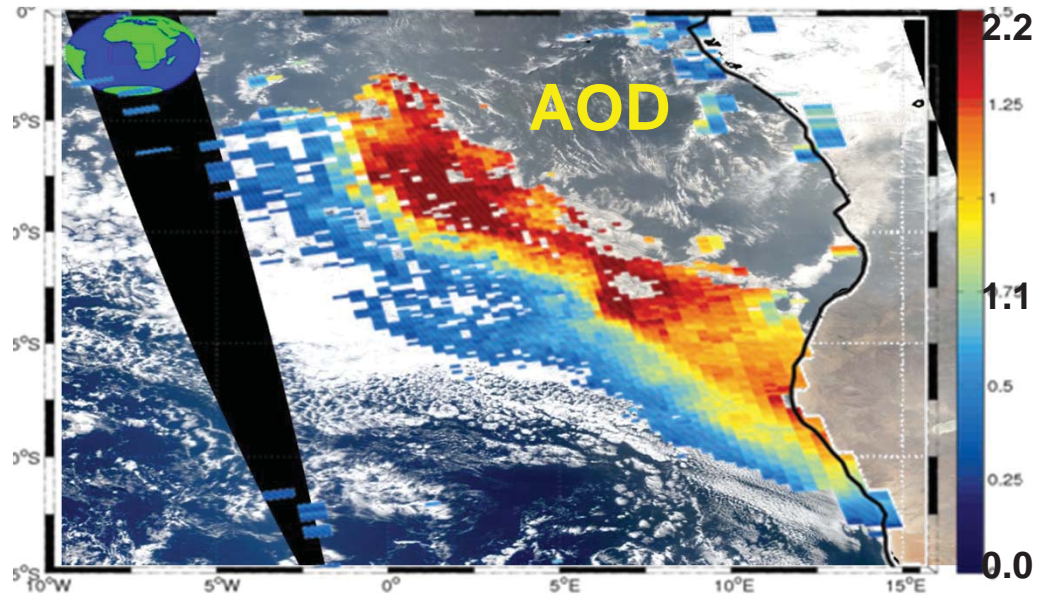
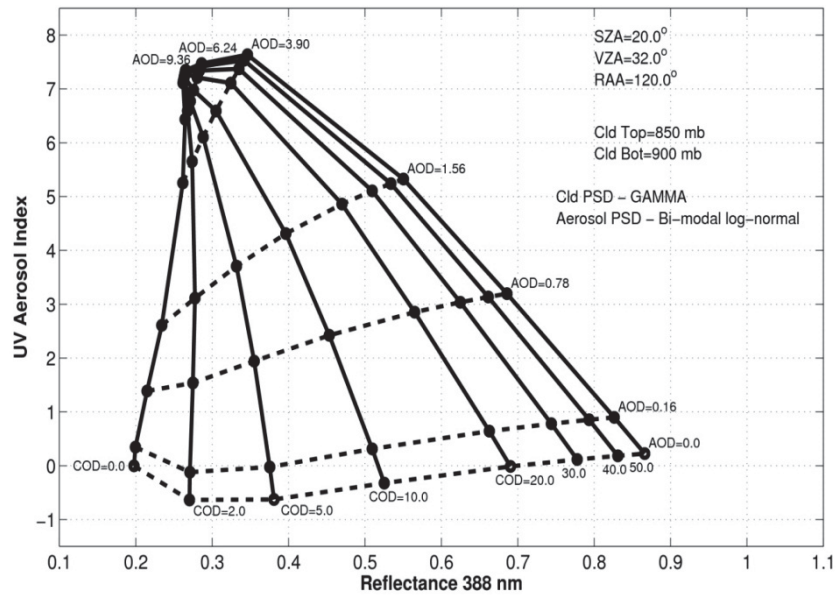
## AAOD time series over NH boreal fires regions



**The observed high latitude NH increase in AAOD is likely associated with increased boreal fire activity in Canada**

# Simultaneous Retrieval of Cloud (COD) and Aerosol (AOD) Optical Depth

## Inversion Scheme



Torres, O, H. Jethva, and P.K. Bhartia, Retrieval of Aerosol Optical Depth above Clouds from OMI Observations: Sensitivity Analysis and Case Studies, *Journal. Atm. Sci.*, 69, 1037-1053, doi:10.1175/JAS-D-11-0130.1, 2012

## Summary

Significant progress on the quantification of aerosol absorption has been achieved during the first decade of OMI operation.

- A ten year data set of 388 nm AOD and SSA has been derived from OMI observations.
- The capability of retrieving aerosols above clouds using UV/VIS observations has been developed.

The decadal OMI AOD and SSA records have been evaluated by direct comparison to independent ground-based AERONET observations.

The OMI SSA and AAOD data sets are the first ever quantitative multi-year records on aerosol absorption from satellite-based observations.

Continuation of the OMI record on aerosol absorption is required for conclusive analyses of global/regional trends.