

# 13<sup>th</sup> AeroCom Workshop

## *Assessment of OMI decadal record on aerosol absorption*

**Omar Torres**

*NASA GSFC*

**Hiren Jethva**

*GESTAR-USRA*

**Changwoo Ahn**

*SSAI*

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# Ozone Monitoring Instrument (OMI)

An international project: Holland, USA, Finland

Nadir solar backscatter spectrometer  
-270-500 nm

-13X24 km footprint

-2600 km swath width

-Launched on 07-15-04

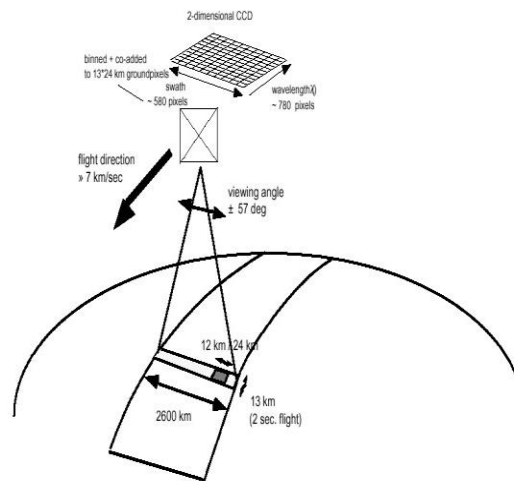
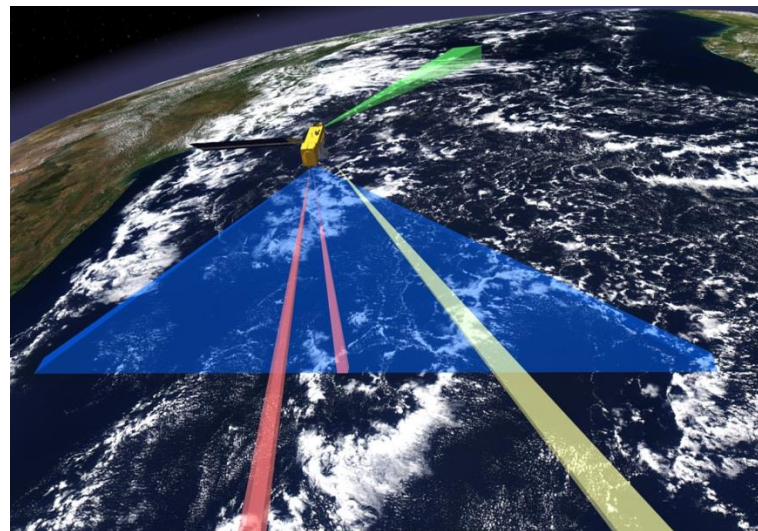


Figure 2.1 Measurement principle of OMI.

Courtesy of Fokker Space

One of four sensors on the  
EOS-Aura platform  
(OMI,MLS, TES, HRDLS)

Retrieval Products:

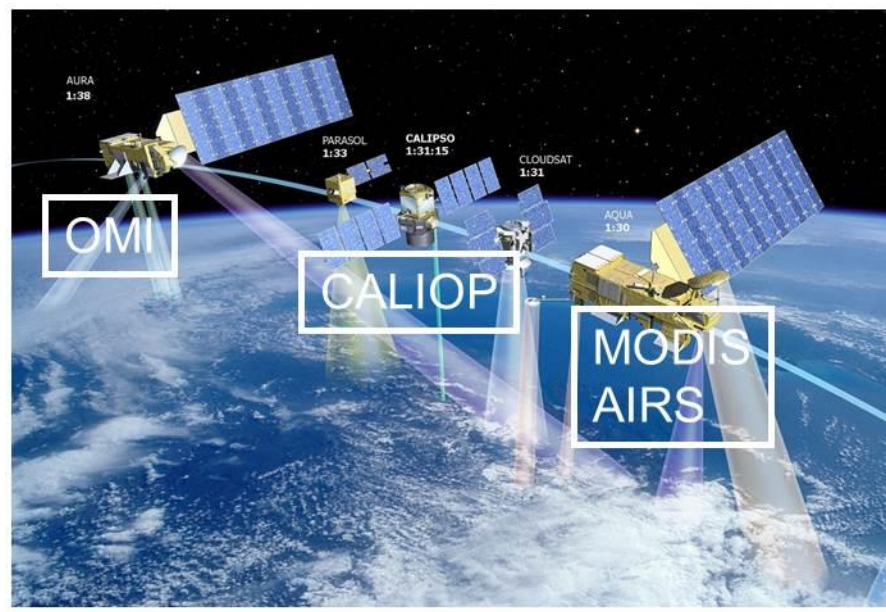
Radicals: Column  $O_3$ ,  $NO_2$ ,  
 $BrO$ ,  $OCIO$

$O_3$  profile

Tracers: Column  $SO_2$

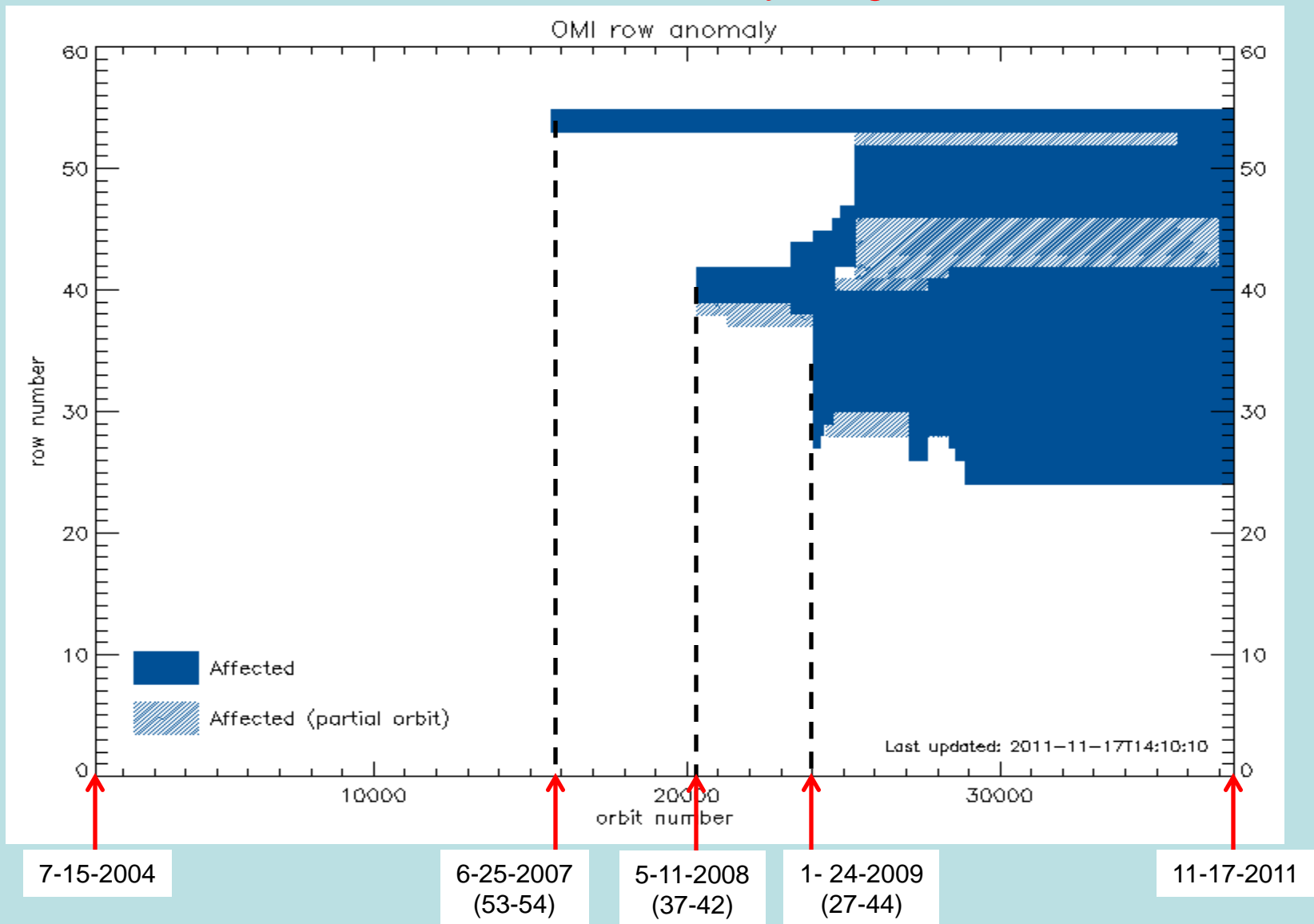
Cloud top pressure

**Aerosols**



*OMI flies on the A-train*

# OMI Status: Row Anomaly Progression



As of Nov 17-2011, 29 rows (1 thru 24 and 56-60) out of 60 remain unaffected. Currently OMI achieves global coverage in 2 days.

# OMI Near-UV Aerosol Algorithm (OMAERUV)

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

**Measurements:** Radiances at 354 and 388 nm (13 x 24 km<sup>2</sup>)

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

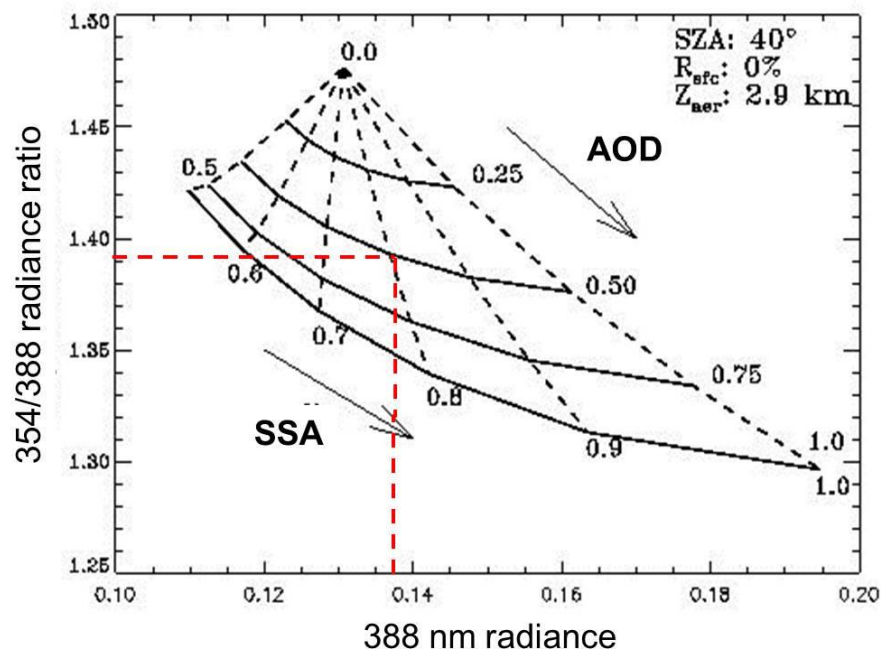
*In spite the sensor's coarse resolution for aerosol retrieval, valuable information on particle absorption can be derived from OMI near UV observations.*

## Retrieval Products:

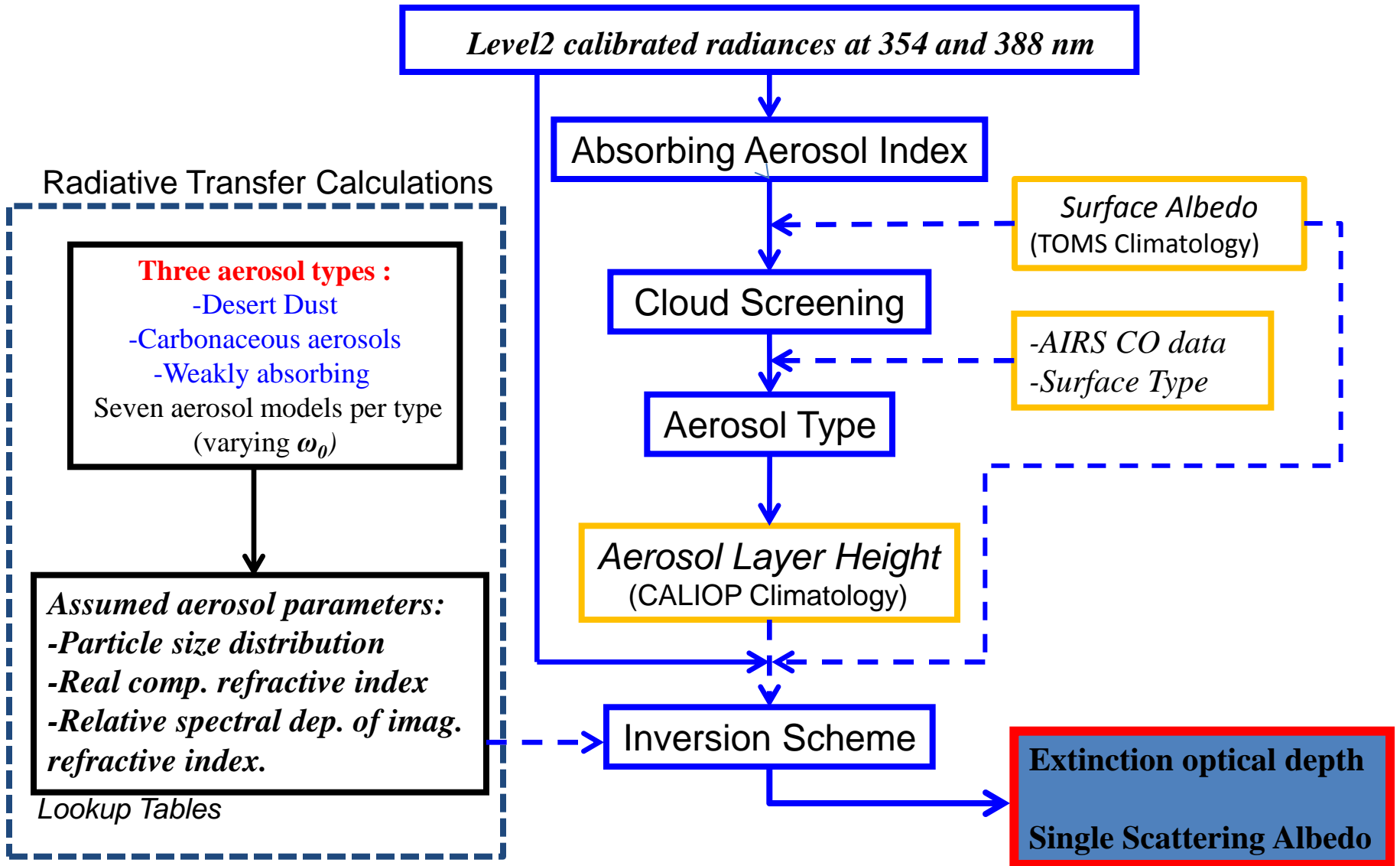
- AOD and SSA (388 nm)
- Absorbing Aerosol Index

## 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.



# OMAERUV Retrieval Procedure



**Retrievals over the ocean only account for the presence of desert dust and carbonaceous aerosols.**

## Aerosol Type Identification in OMAERUV

The presence of weakly (or non) absorbing aerosols is assumed if  $AAI < 0.8$  (land only)

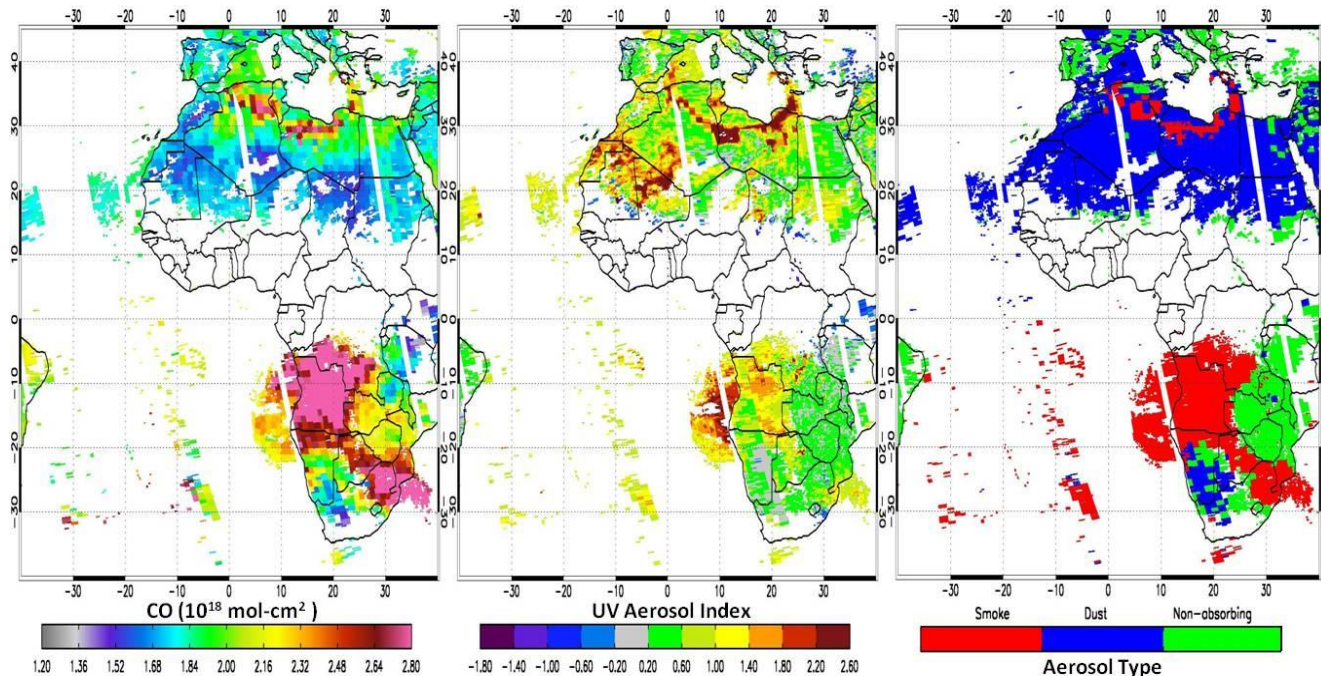
If  $AAI > 0.8$  the aerosol load is assumed to be either carbonaceous or desert dust aerosols.

At the two near UV channels (354 and 388 nm) there is no information to differentiate smoke from dust.

External CO information from Aqua-AIRS is used to select either smoke or dust.

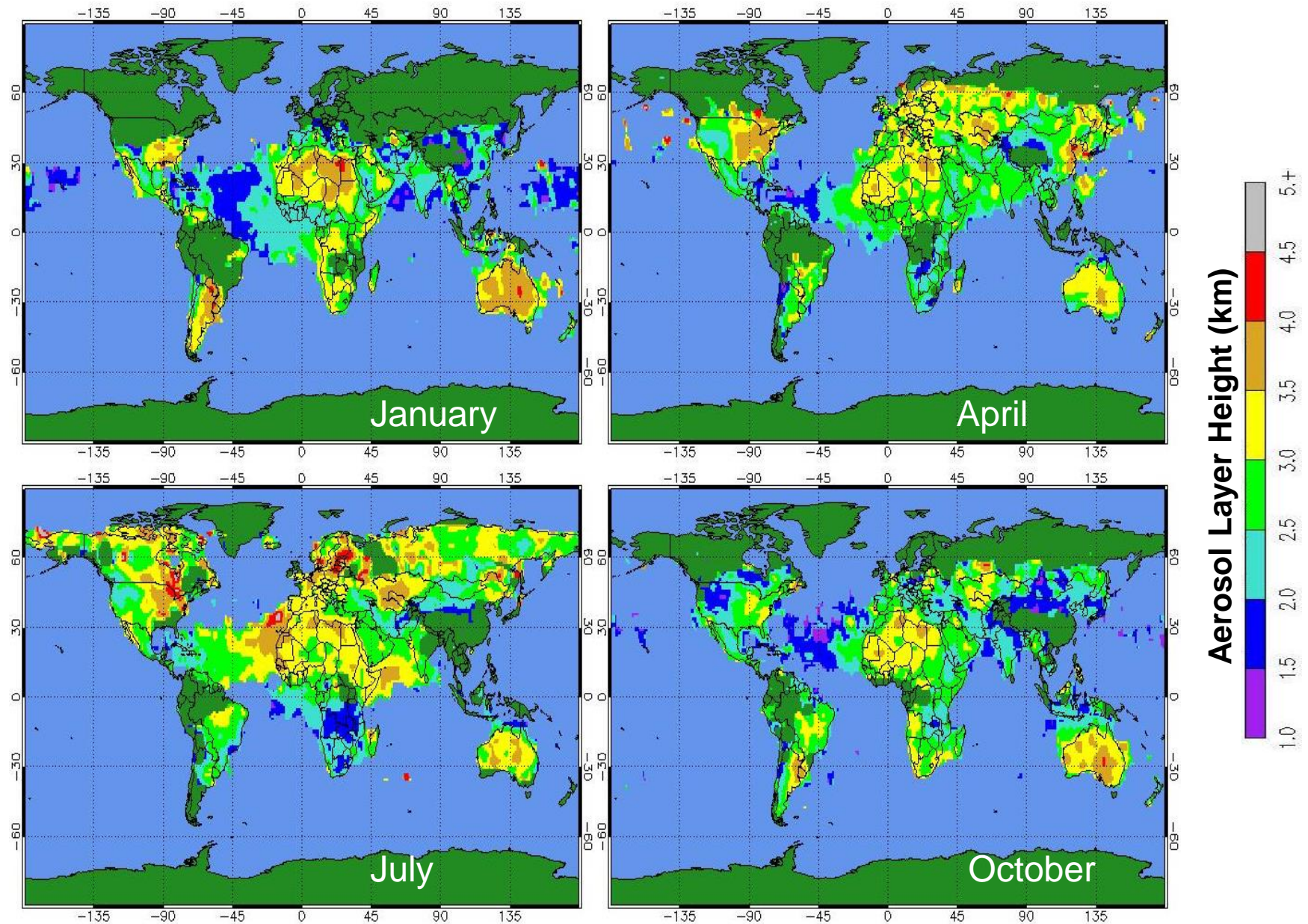
If  $CO \geq CO_0$  smoke type is selected.

If  $CO < CO_0$  dust type is selected.

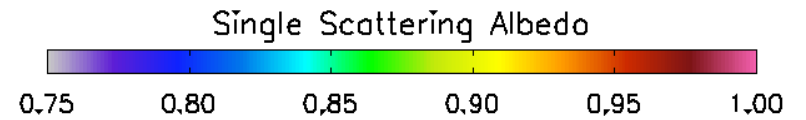
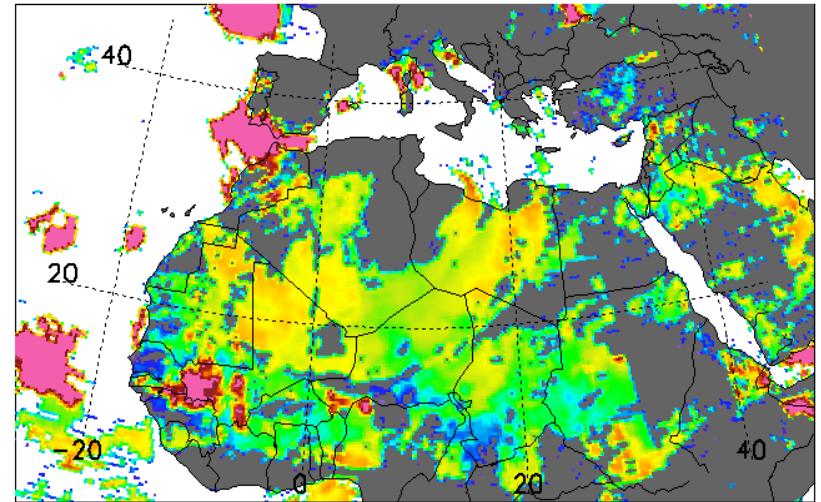
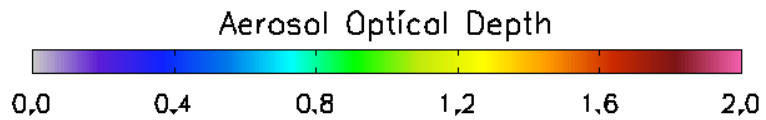
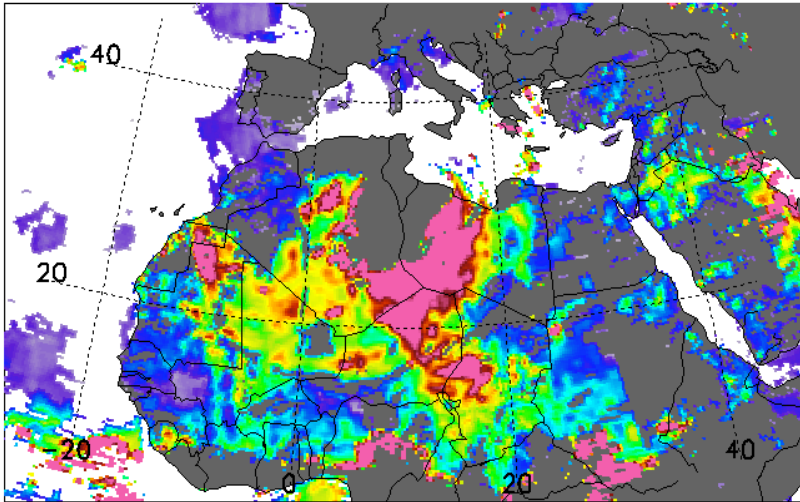


*The combined use of AI and CO allows the identification of smoke layers over arid areas.*

# CALIOP-based Aerosol Height Climatology



## Sample Retrieval (March 9, 2007)

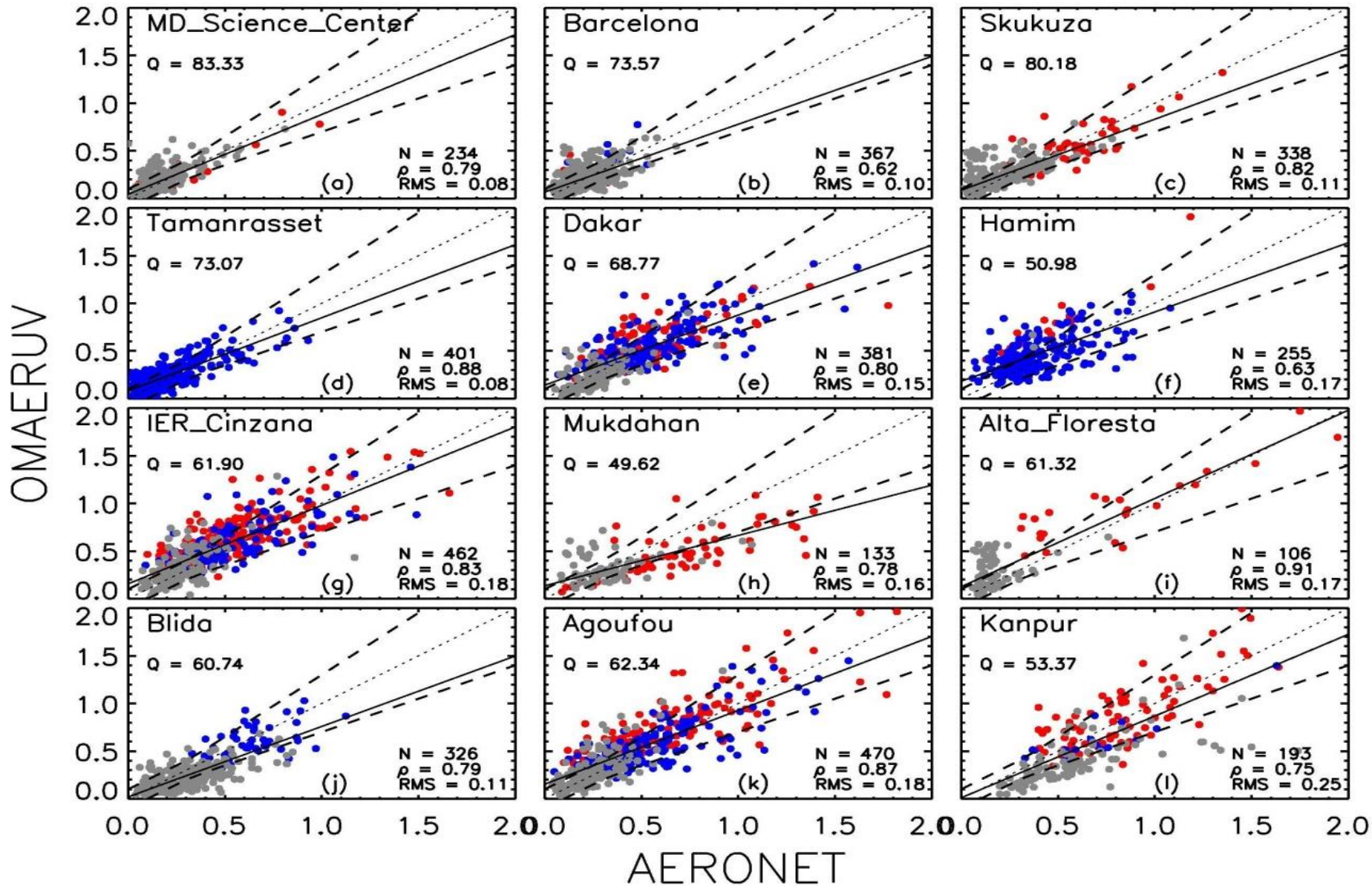




# AOD Validation

*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-AERONET AOD Comparison at representative sites

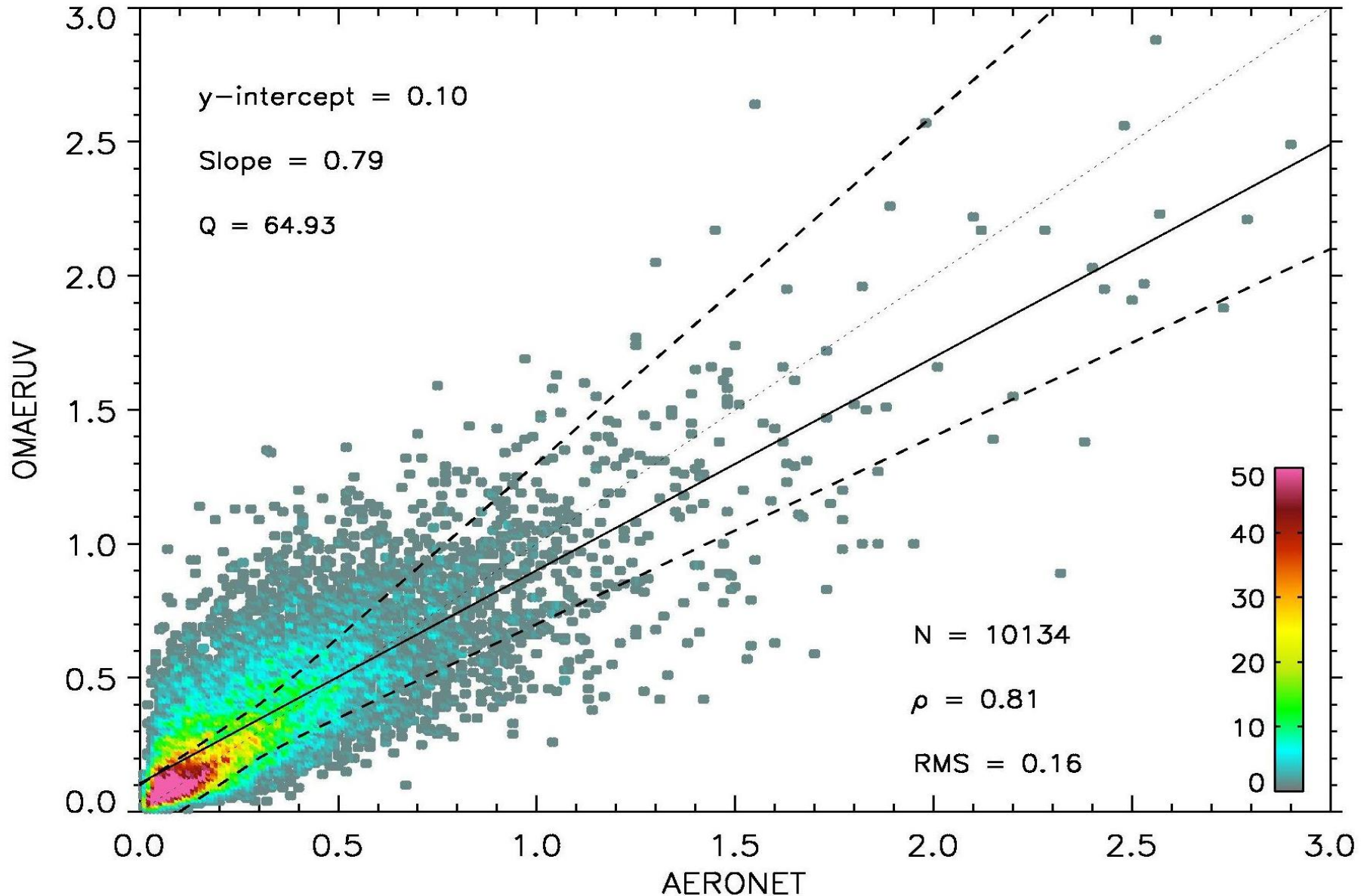


Desert Dust

Carbonaceous Aerosols

Urban Industrial Aerosols

## OMAERUV AOD Validation: The Global Picture



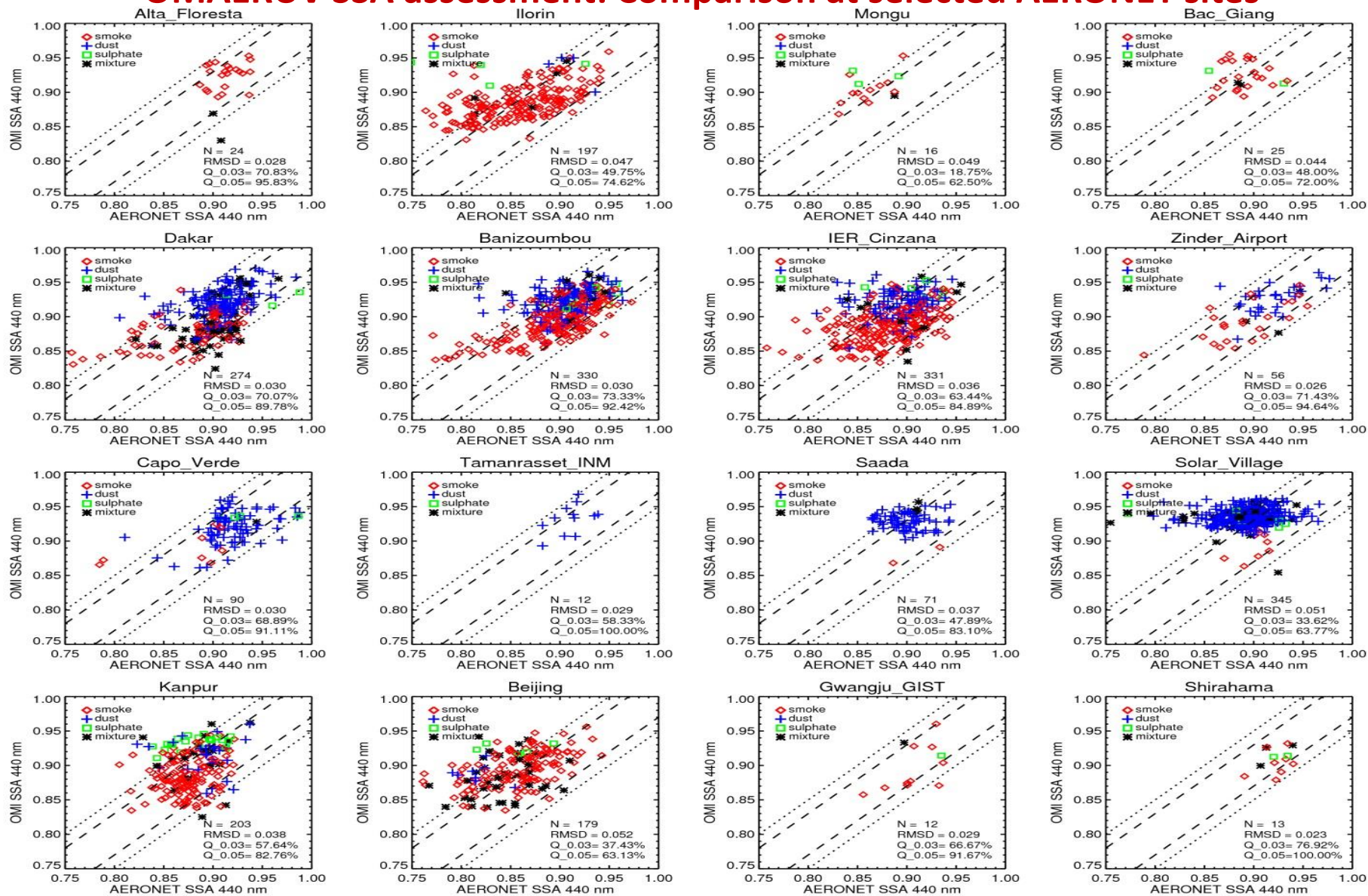
Number of pairs per 0.02 AOD bin. Maximum pair density (50 to 110) shown in pink.

**65 % of evaluated data agree within expected uncertainty (larger of 0.1 or 30%)**

# SSA Evaluation

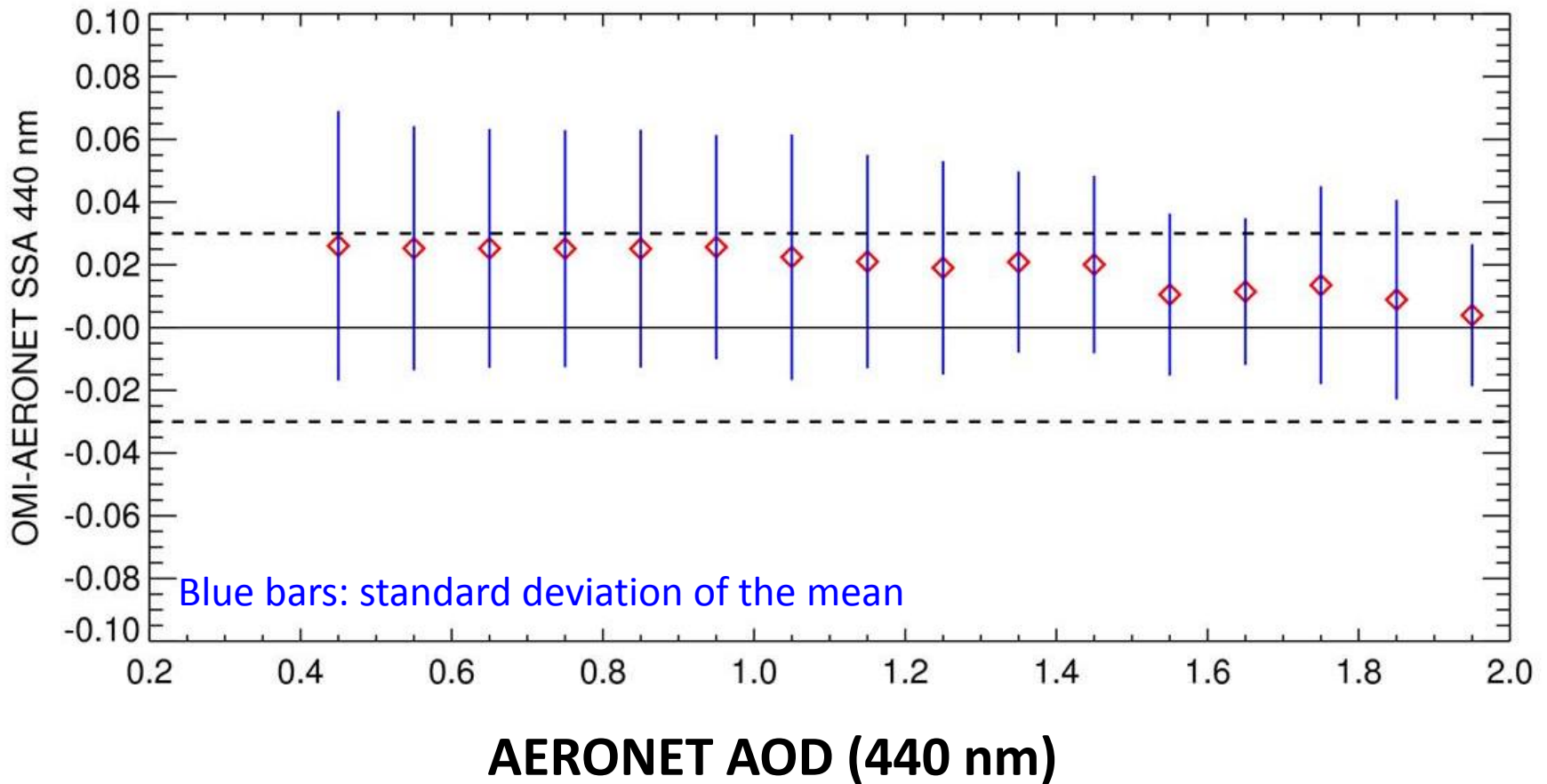
*Jethva, H., O. Torres, and C. Ahn (2014), Global assessment of OMI aerosol single-scattering albedo using ground-based AERONET inversion, J. Geophys. Res. Atmos., 119, doi:10.1002/2014JD021672.*

# OMAERUV SSA assessment: Comparison at selected AERONET sites



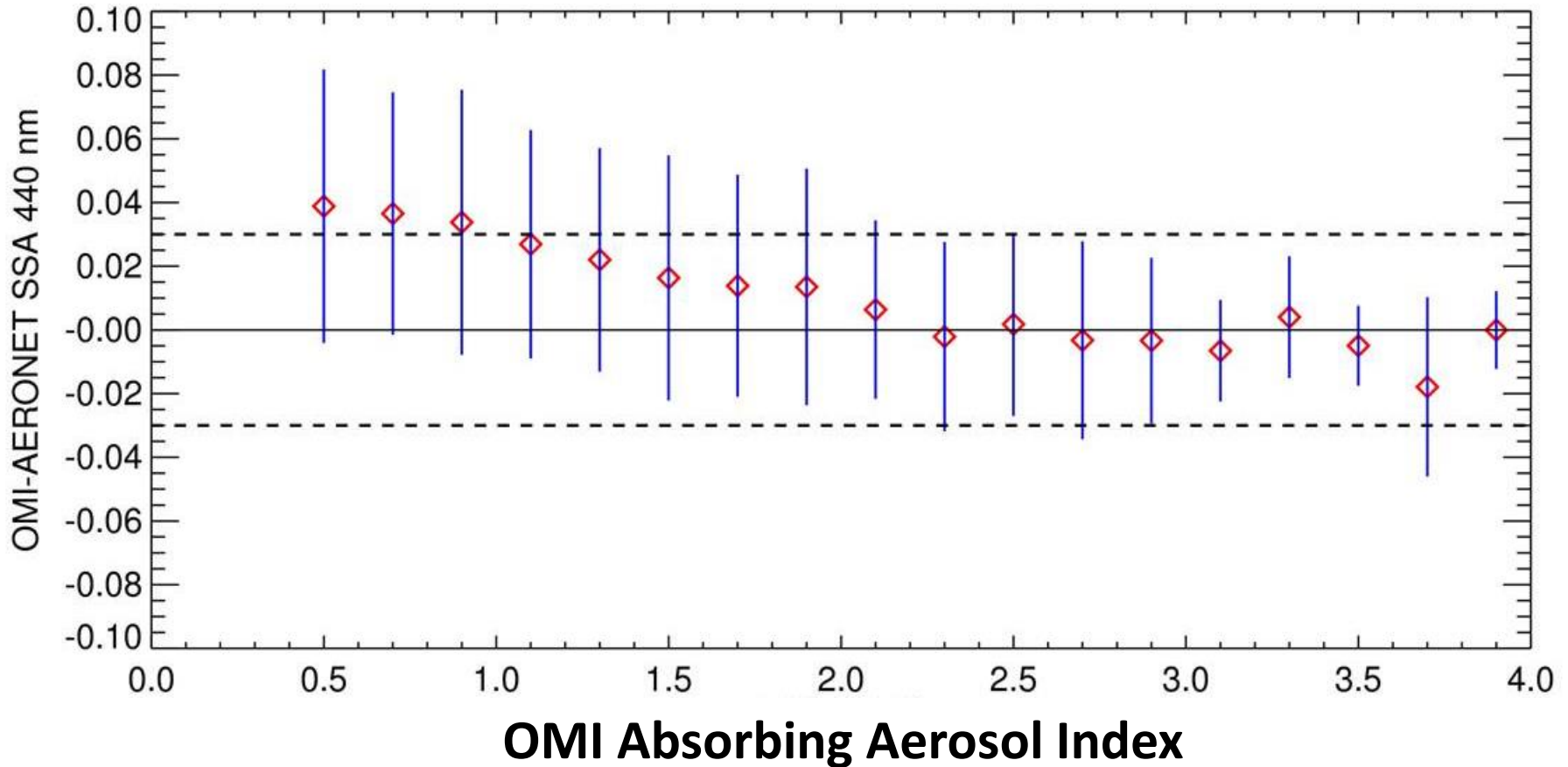
51% (75%) of matched pairs agree within 0.03 (0.05)

## OMI versus AERONET Global Picture



- **OMI's retrieved SSA is generally larger than AERONET's.**
- **Retrievals agree with each other within AERONET's stated uncertainty ( $\pm 0.03$ ) for  $AOD > 0.4$**
- **Closer agreement for larger aerosol loading.**

## OMI versus AERONET Global Picture (2)



- **The level of agreement improves with increasing AAI**
- **Retrievals agree with each other within AERONET's stated uncertainty ( $\pm 0.03$ ) for AAI > 1.0**
- **Best agreement ( $\pm 0.01$ ) for AAI > 2.0.**

## OMAERUV SSA evaluation using SKYNET observations (unpublished results)



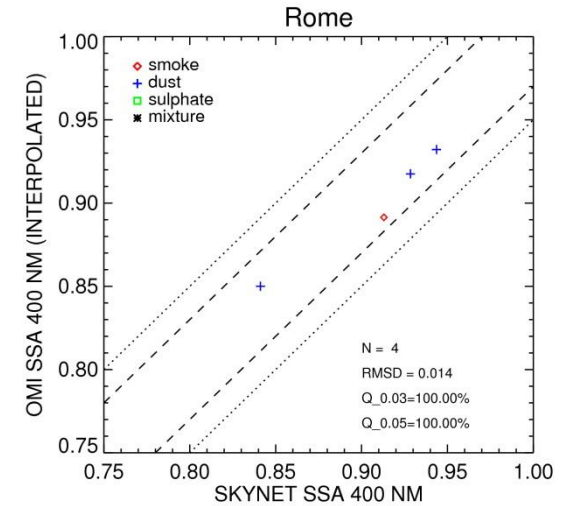
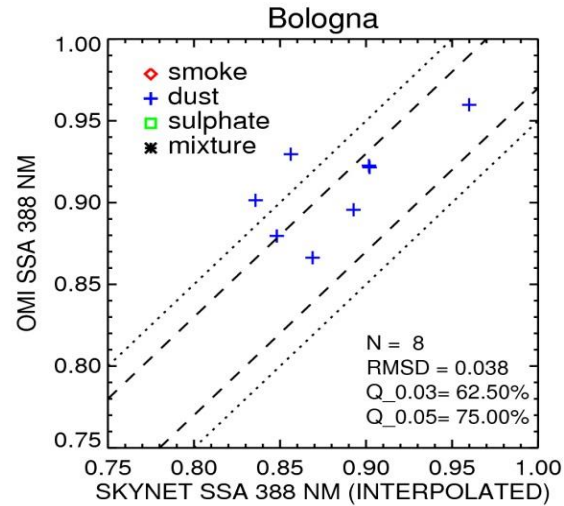
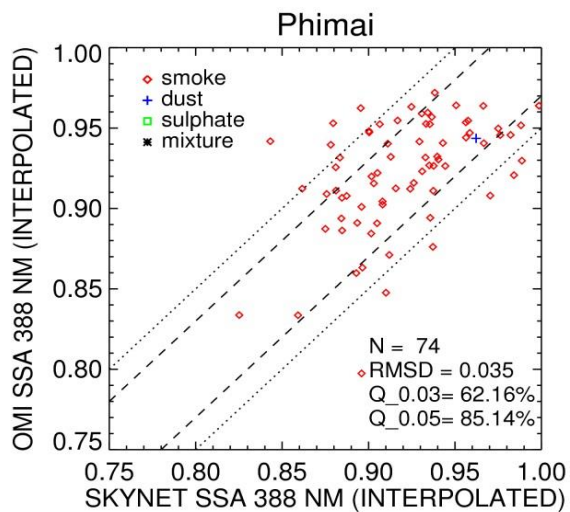
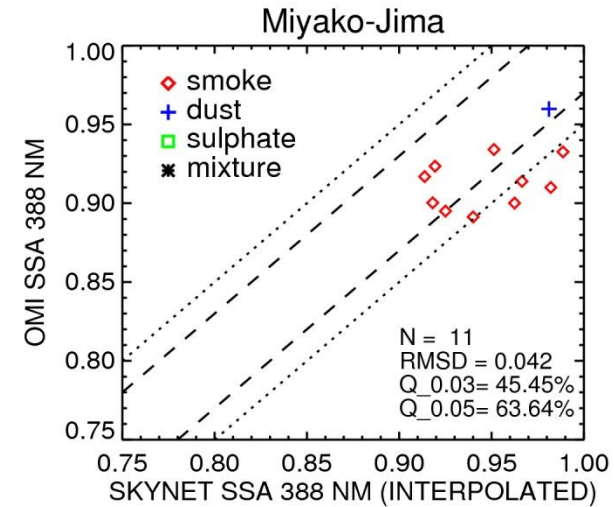
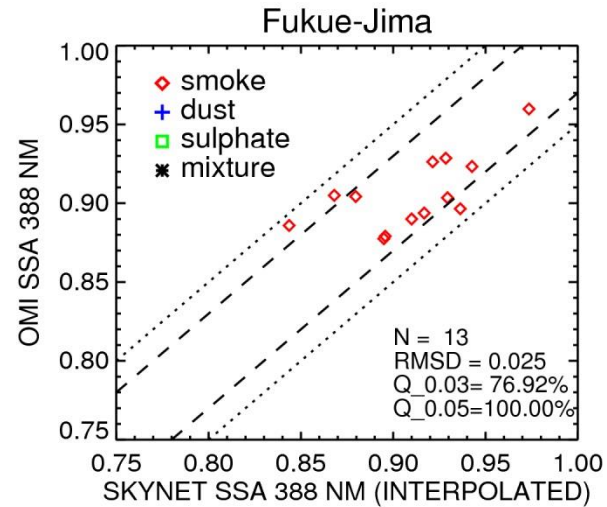
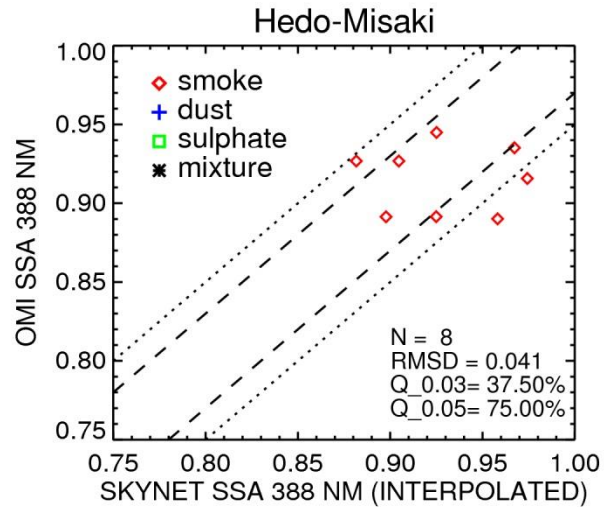
SKYNET is a Japanese sky radiometer network (Chiba University) that uses sky-radiance measurements to derive aerosol particle size and optical properties (similar to AERONET).

Aerosol absorption properties are derived at **340, 380, 400, 500, 670, 1020 nm**.

Observing sites in Japan, China, Thailand, Mongolia, South Korea, India, Europe.



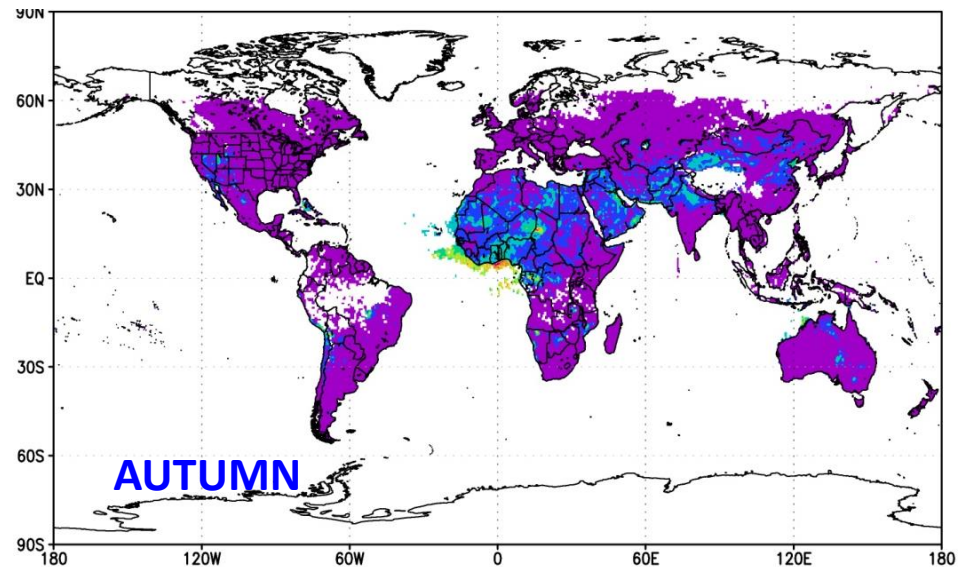
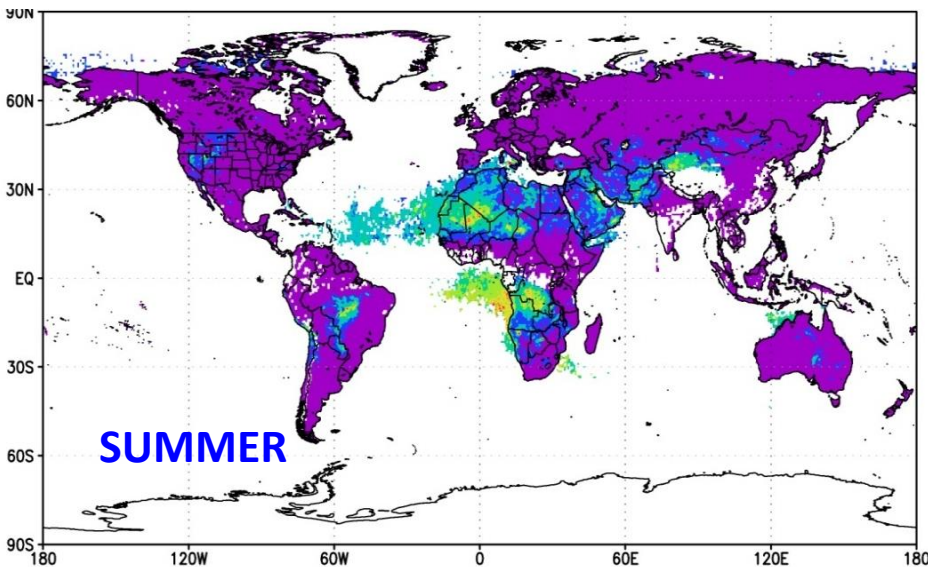
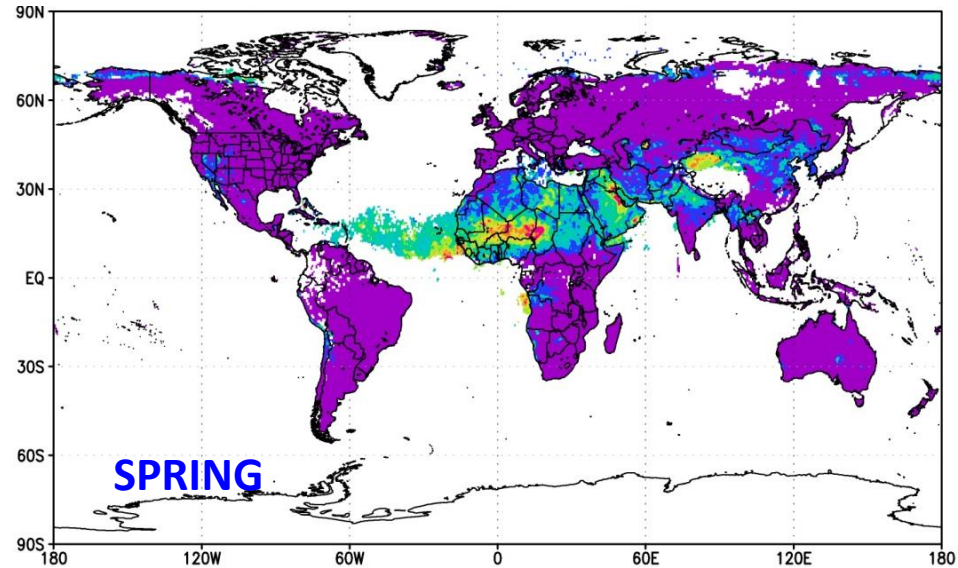
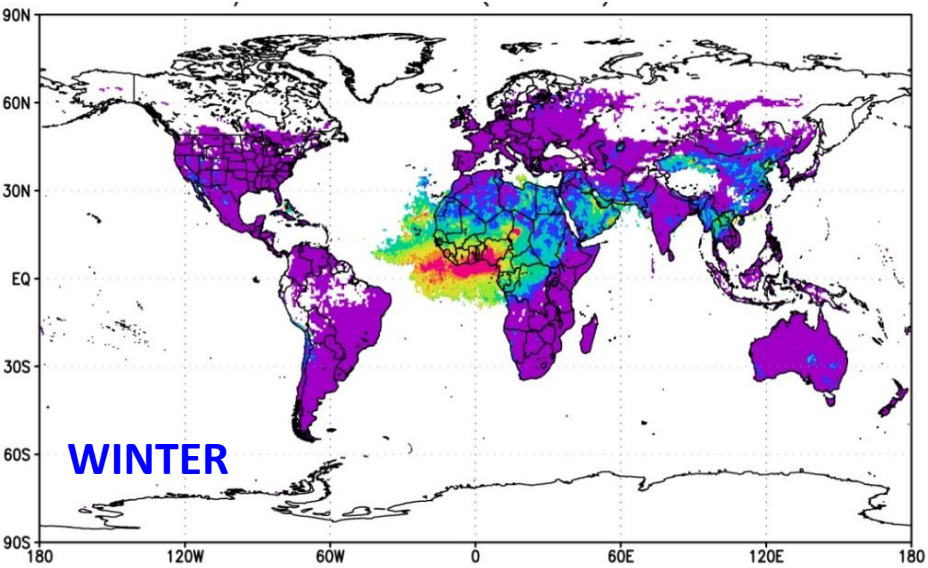
# OMAERUV – SKYNET SSA COMPARISON (2006-2008)



**Preliminary comparison results**

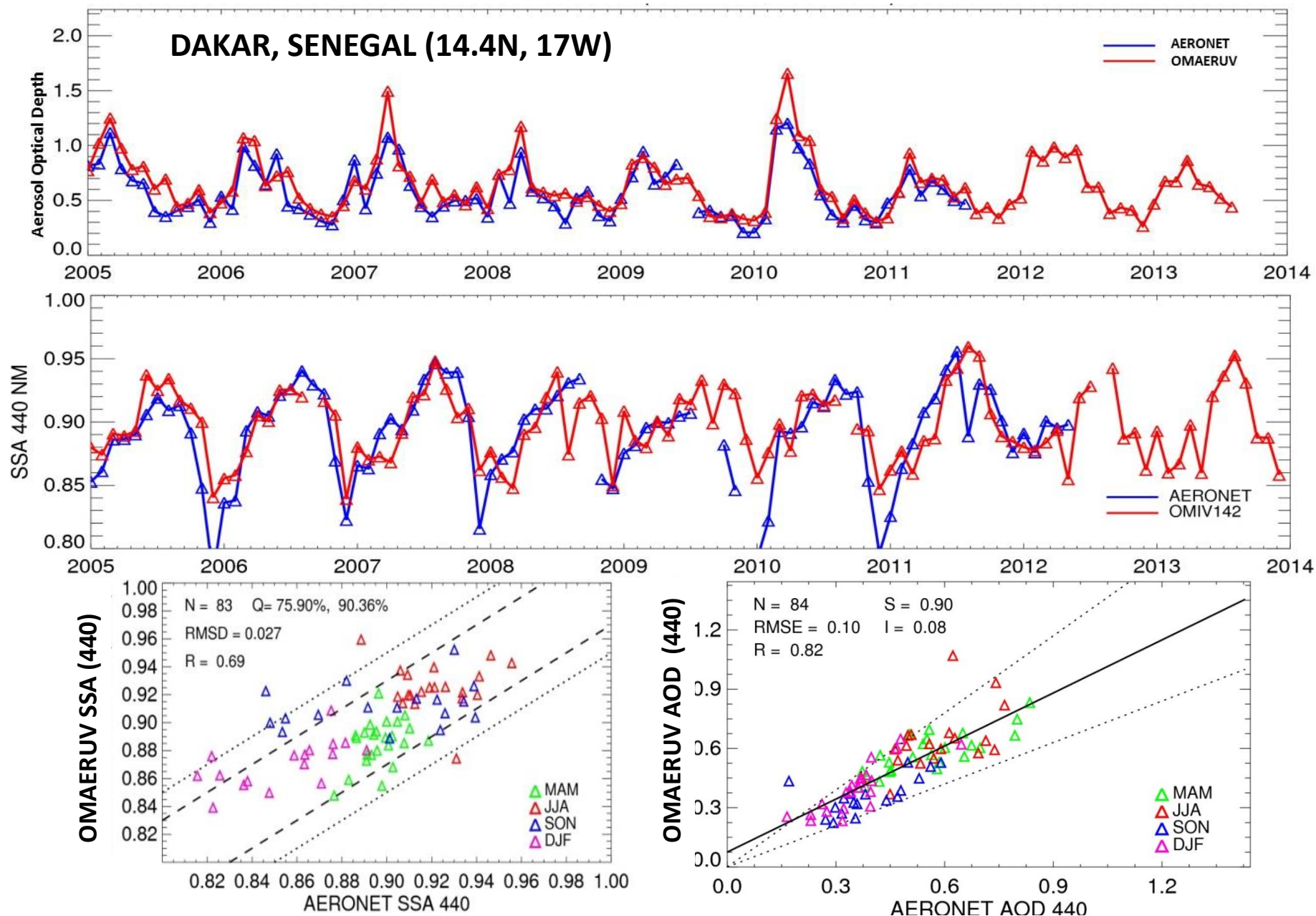
# **OMI Decadal Record**

# 2007 AAOD Global Seasonal Average Maps



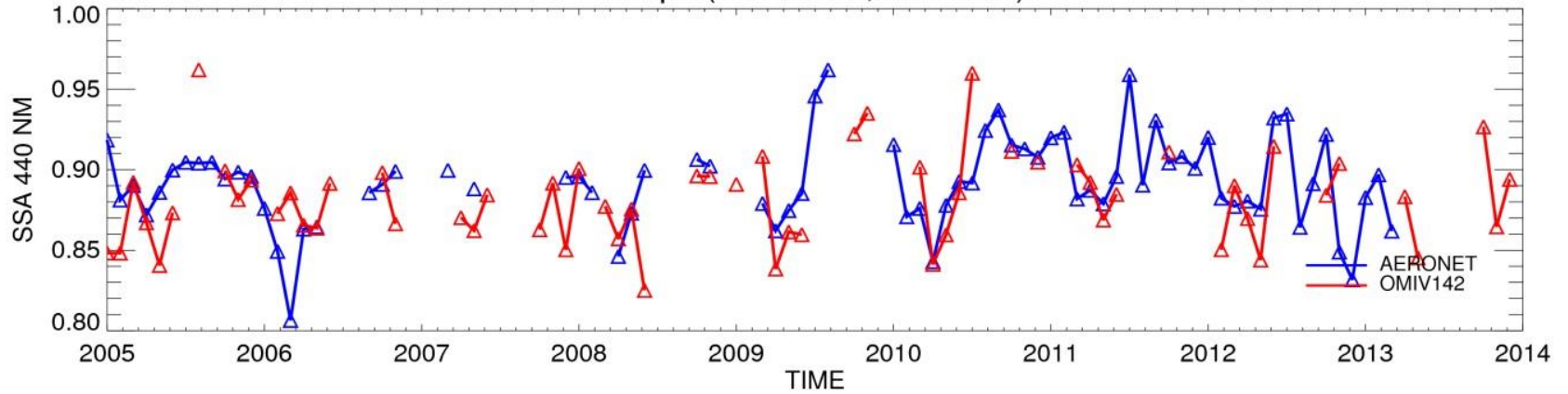
# Assessed long-term record of OMAERUV Aerosol Optical Depth and Single Scattering Albedo

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

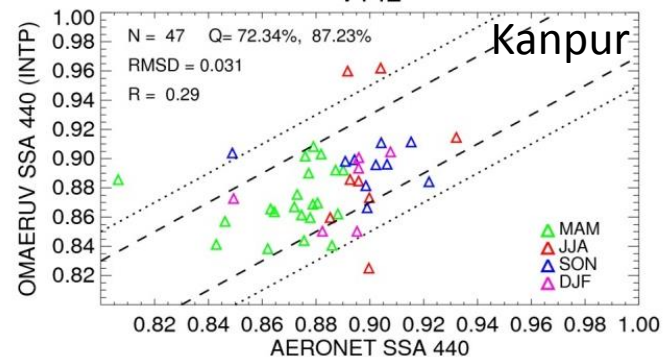
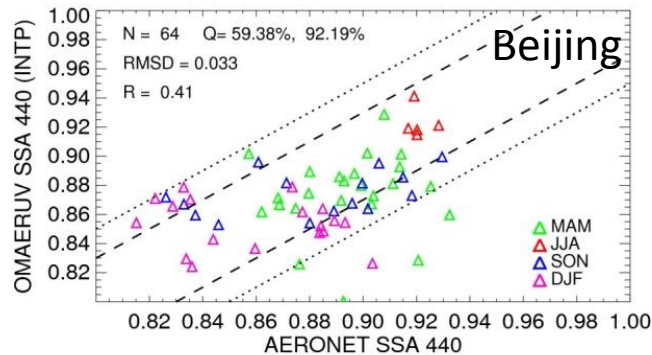
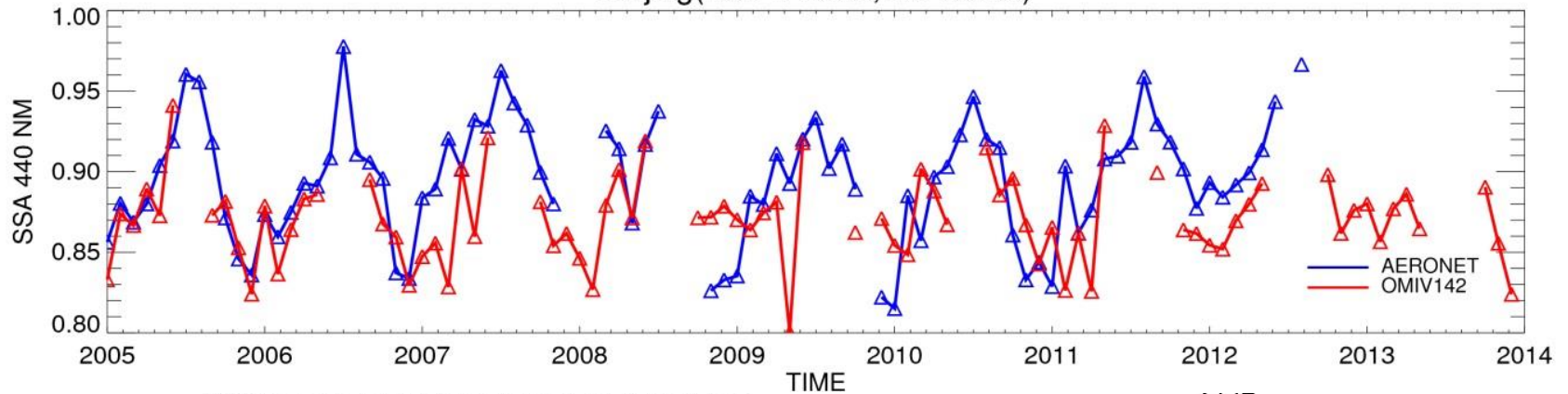


# OMI-AERONET comparison of monthly mean values of SSA over nine years (2)

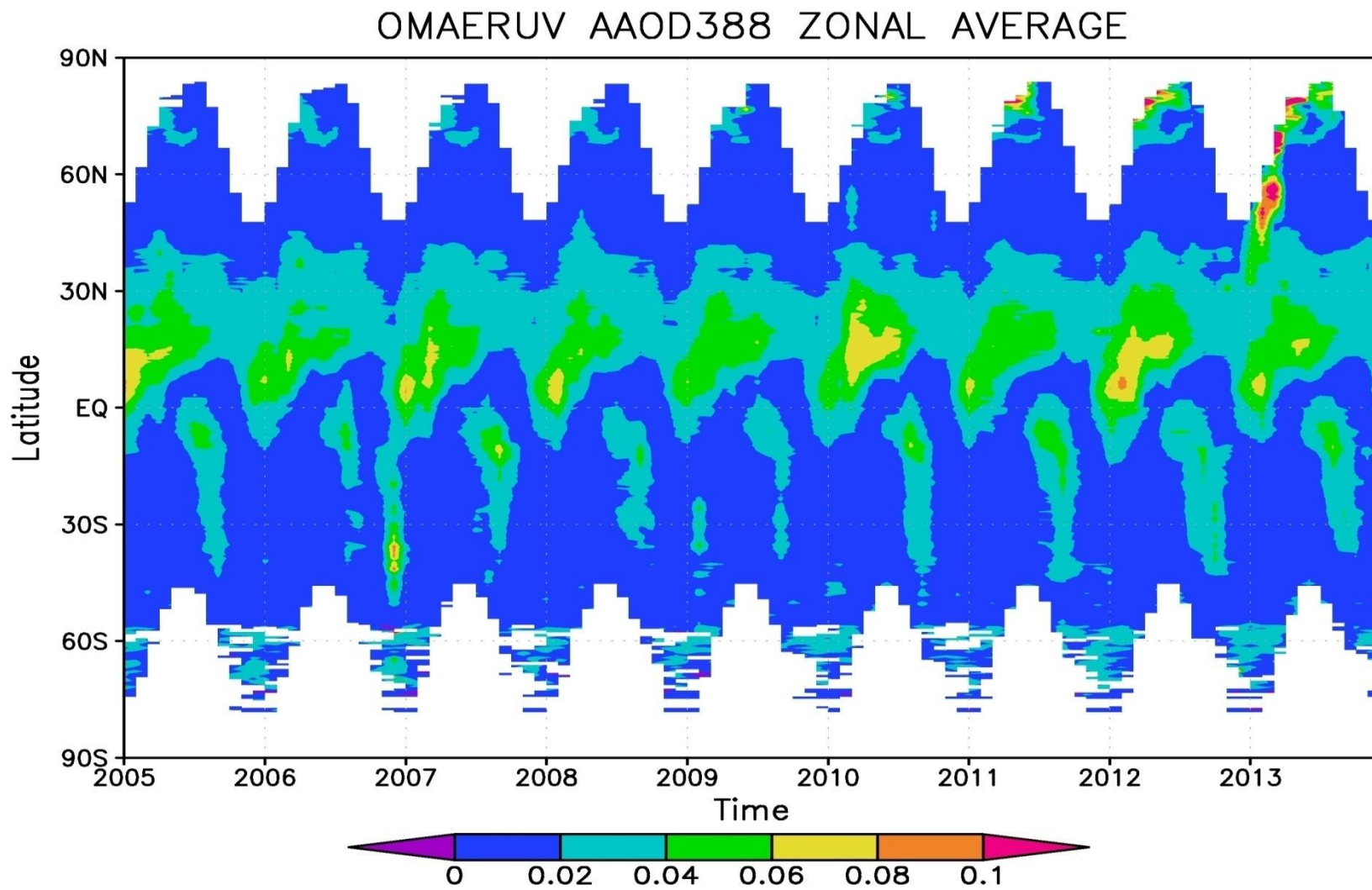
Kanpur(Lon=80.23,Lat=26.51)



Beijing(Lon=116.38,Lat=39.98)



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



# 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 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.