Global Aerosol Distribution and Trends from the 14-year NASA OMI Aerosol Record

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OMAERUV Product

Products:

- UV Aerosol Index (UVAI)
- Aerosol Optical Depth (AOD)
- Aerosol Single Scattering Albedo (SSA)
- Above-cloud Aerosol Optical Depth (ACAOD)

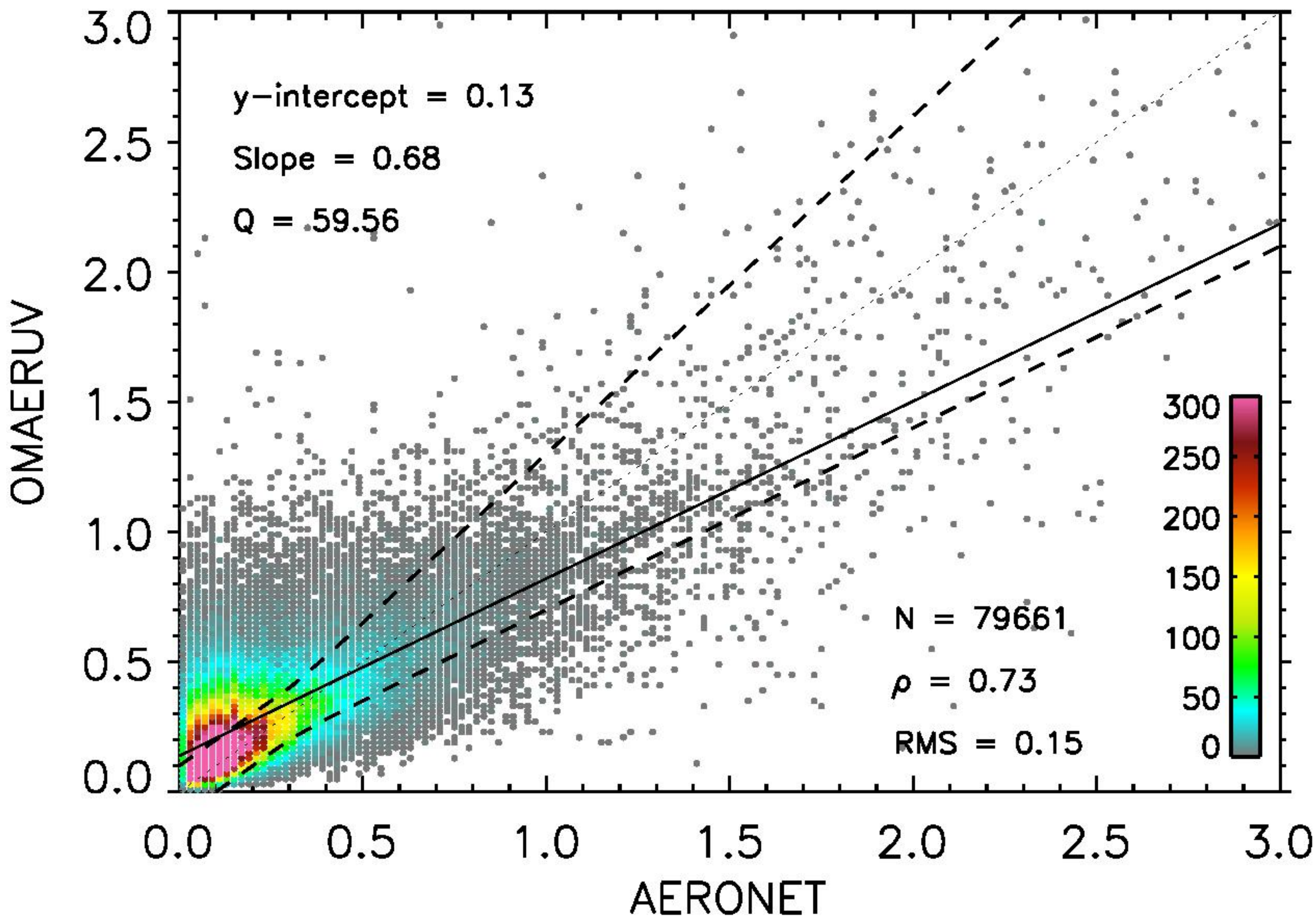
Retrievals are done at 388 nm but also reported at 354 and 500 nm

Major Algorithm Upgrades (Torres et al., AMT, 2018)

- Mie UVAI
  Eliminates cross-track angular dependence
  Significantly reduces large negative values associated with cloud effects
  Accounts for Sun glint effects

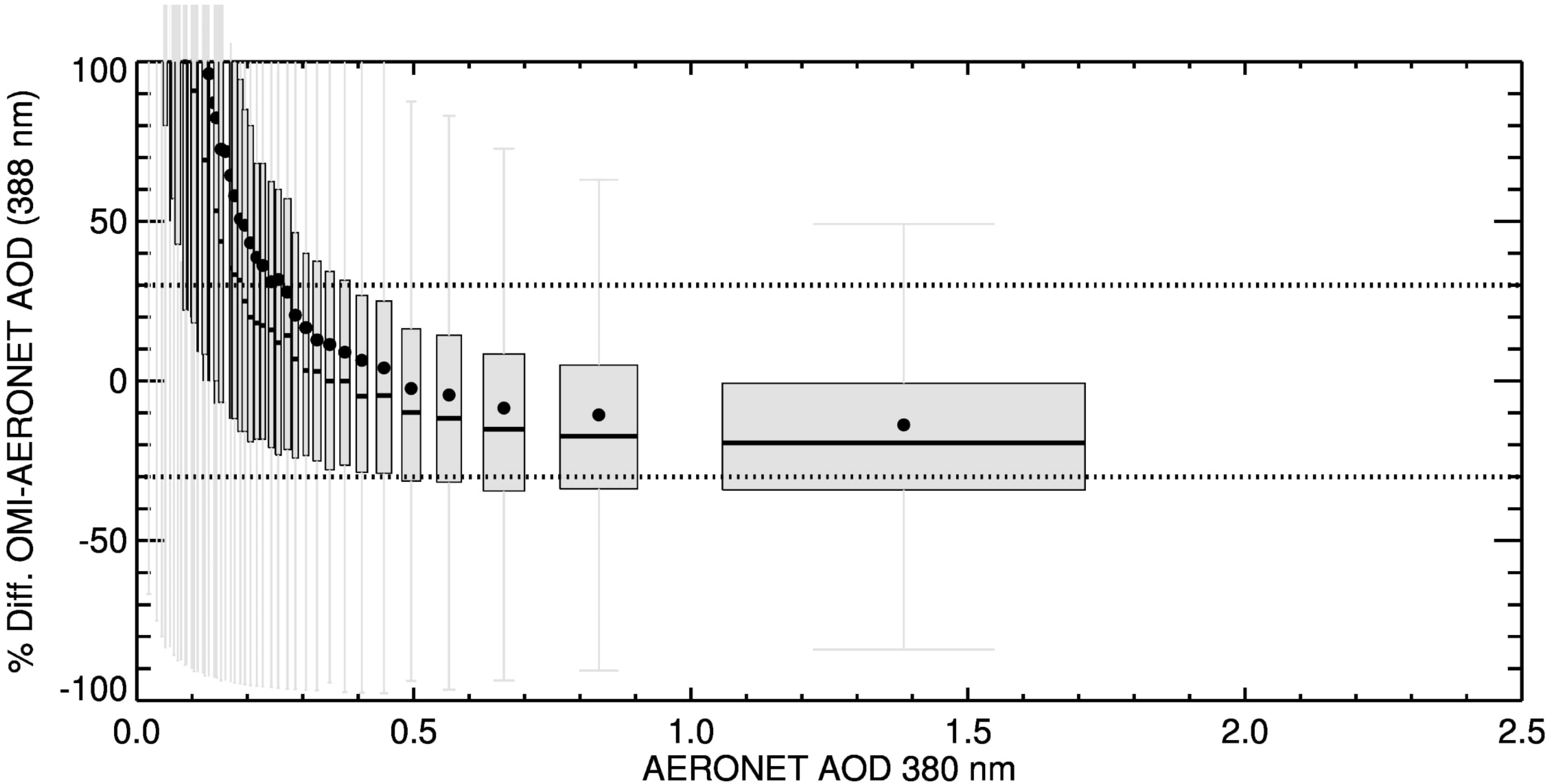
- Dust aerosols modeled as non-spherical particles
  Observation-based aspect ratio for near-source regions
  Reduced aspect ratio (closer to 1) over oceans.

AOD validation using AERONET v3 data set



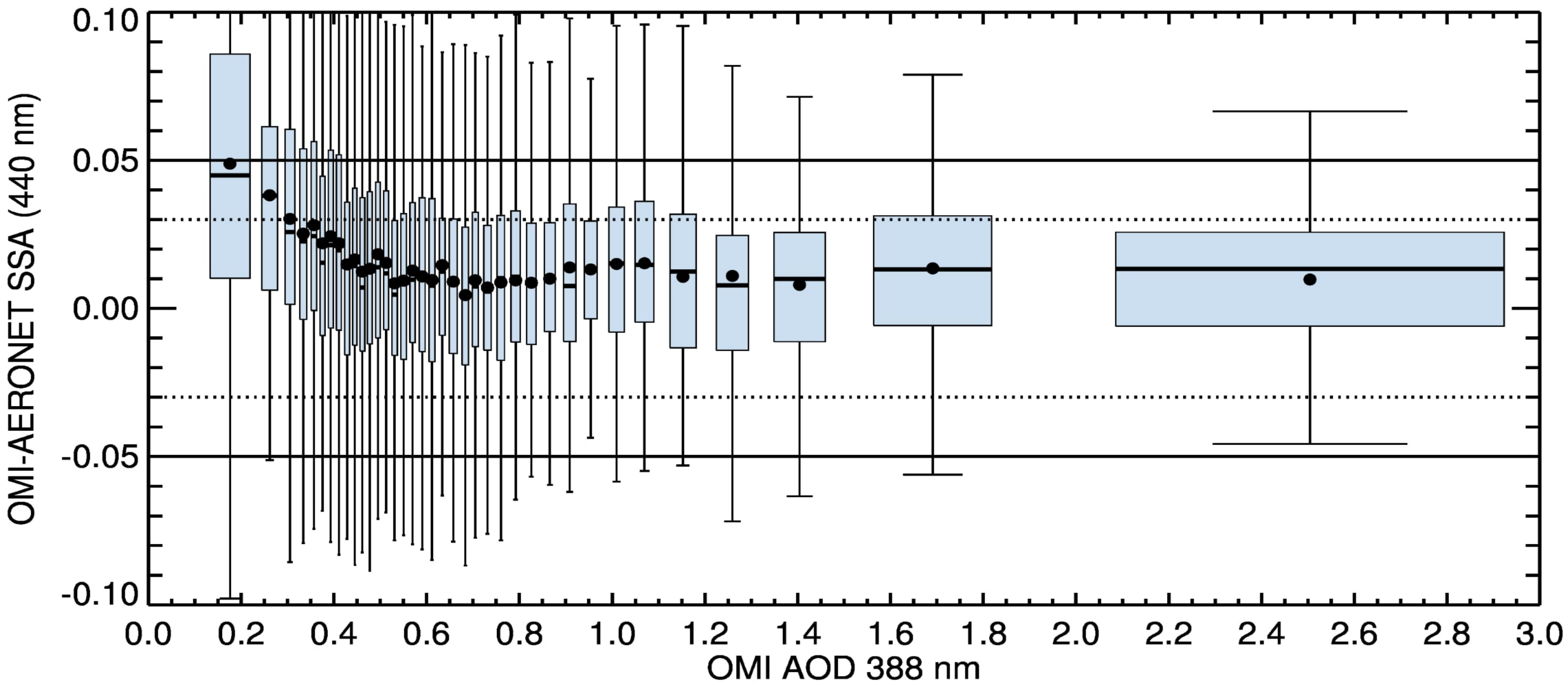
Scatter density plot of 648 AERONET sites for Jan 2005 – July 2019

AOD validation using AERONET v3 data set (2)



- Thick horizontal lines within each box represent median
- Dots are for mean values
- Grey boxes represent 25 to 75 percentile range of the data
- Whiskers (thin vertical lines) are 1.5 times the inter-quartile range (75-25 percentile)
- The width of the box equals standard deviation of data sampling

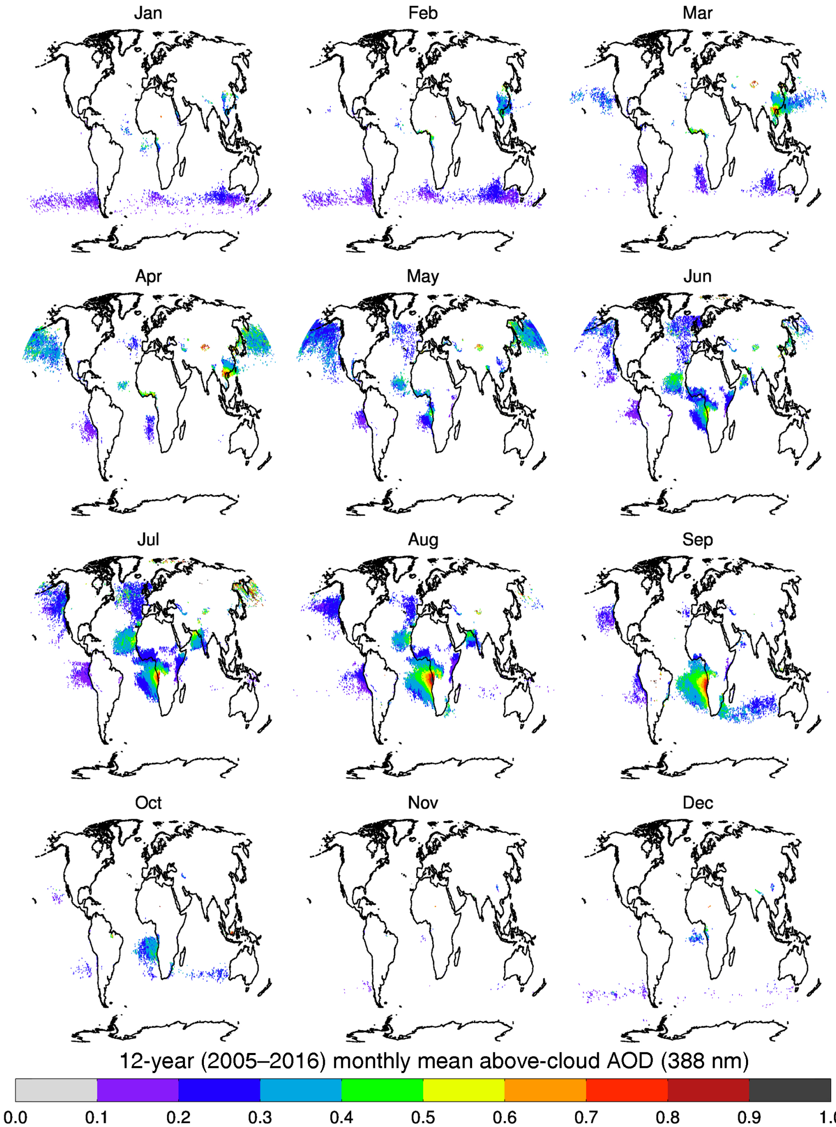
OMI-AERONET SSA comparison using AERONET v3 record

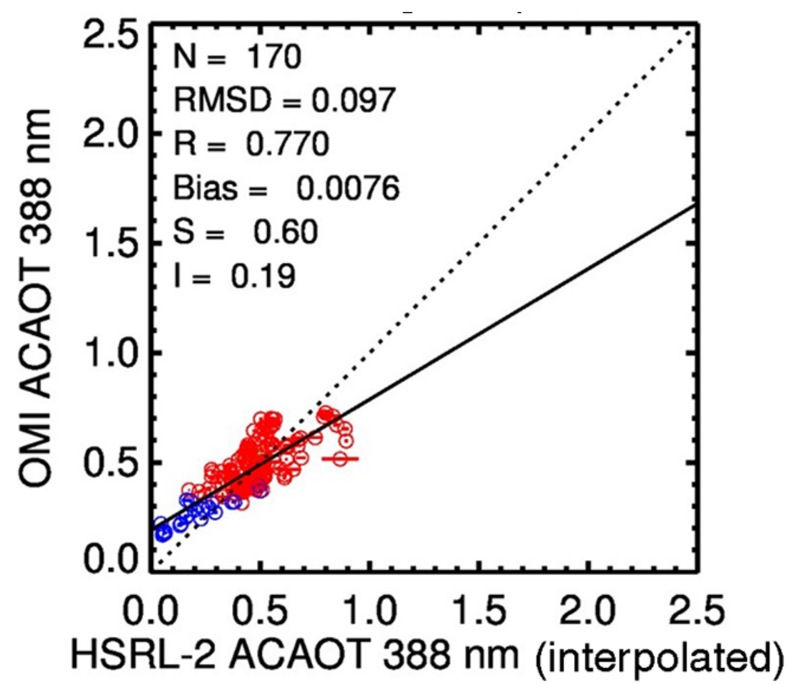


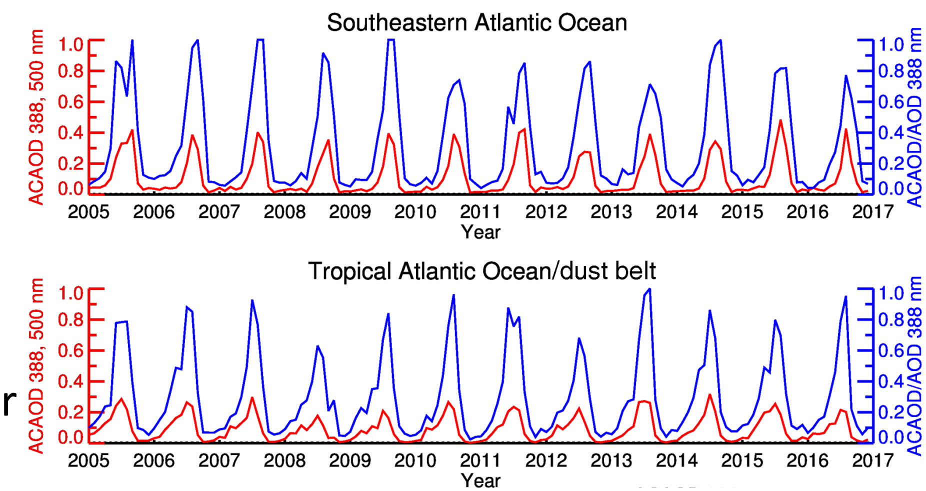
AERONET SSA (440 nm) was converted to 380 nm using OMAERUV spectral model

OMI and AERONET SSA retrievals agree within 0.03 for AOD values 0.3 and larger
Larger differences occur at lower AOD values.

Above Cloud Aerosol Optical Depth





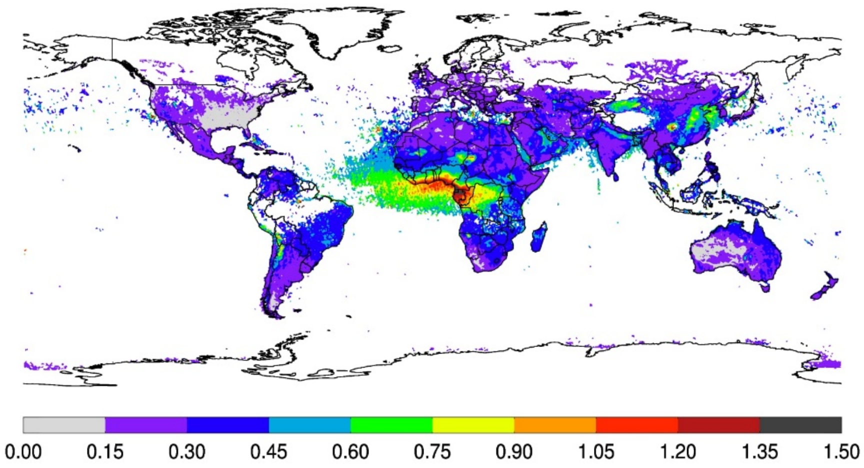


Global distribution of monthly mean above-cloud AOD (388 nm) deduced from the 12-year (2005–2016) OMI observations.

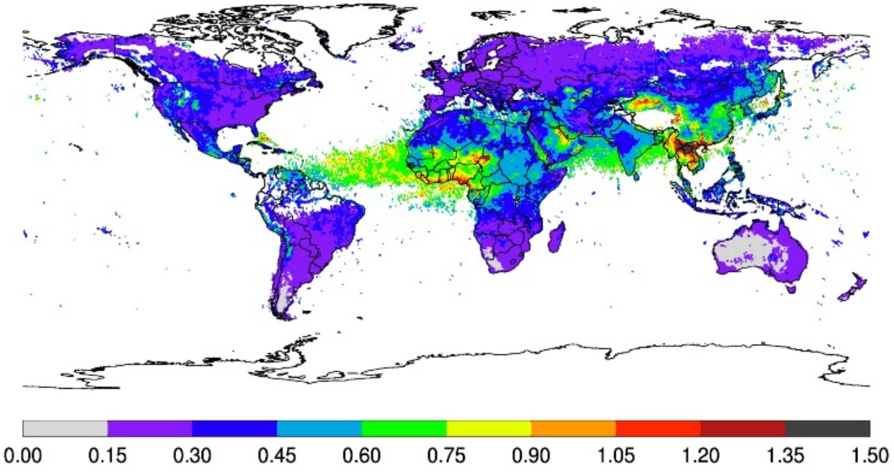
Jethva, H., Torres, O., and Ahn, C.: A 12-year long global record of optical depth of absorbing aerosols above the clouds derived from the OMI/OMACA algorithm, Atmos. Meas. Tech., 11, 5837-5864, https://doi.org/10.5194/amt-11-5837-2018, 2018.

14-year OMI Seasonal AOD climatology

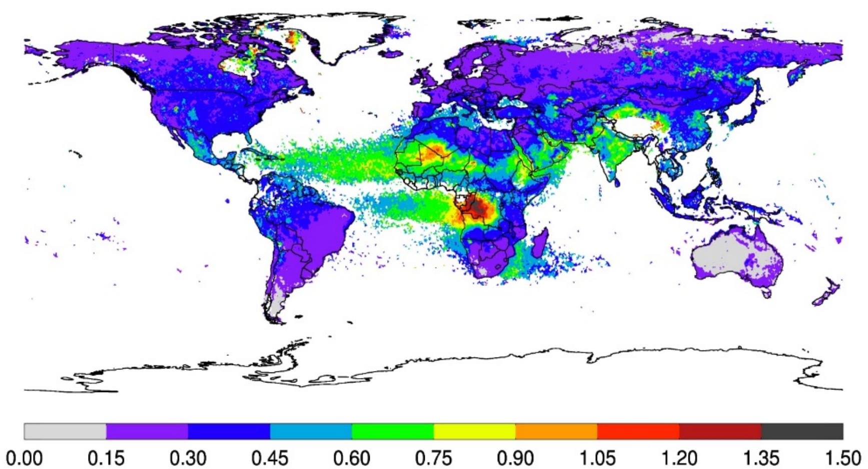
Dec-Jan-Feb Seasonal Climatology AOD388 (2005-2018)



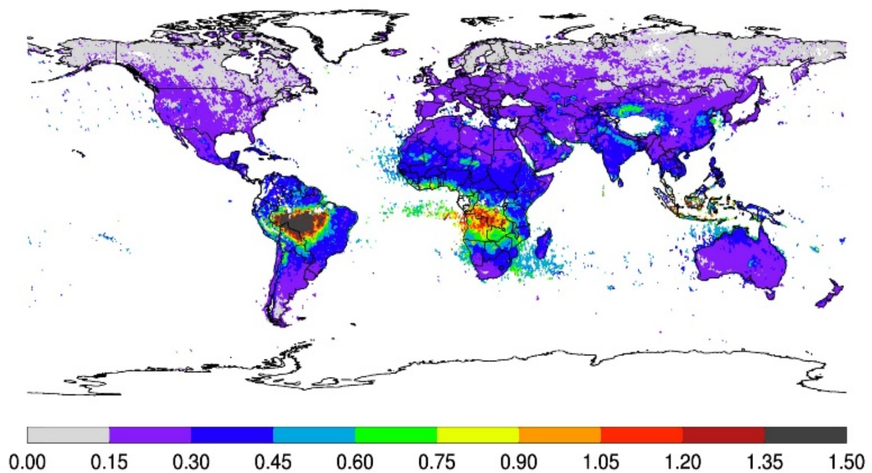
Mar-Apr-May Seasonal Climatology AOD388 (2005-2018)



Jun-Jul-Aug Seasonal Climatology AOD388 (2005-2018)

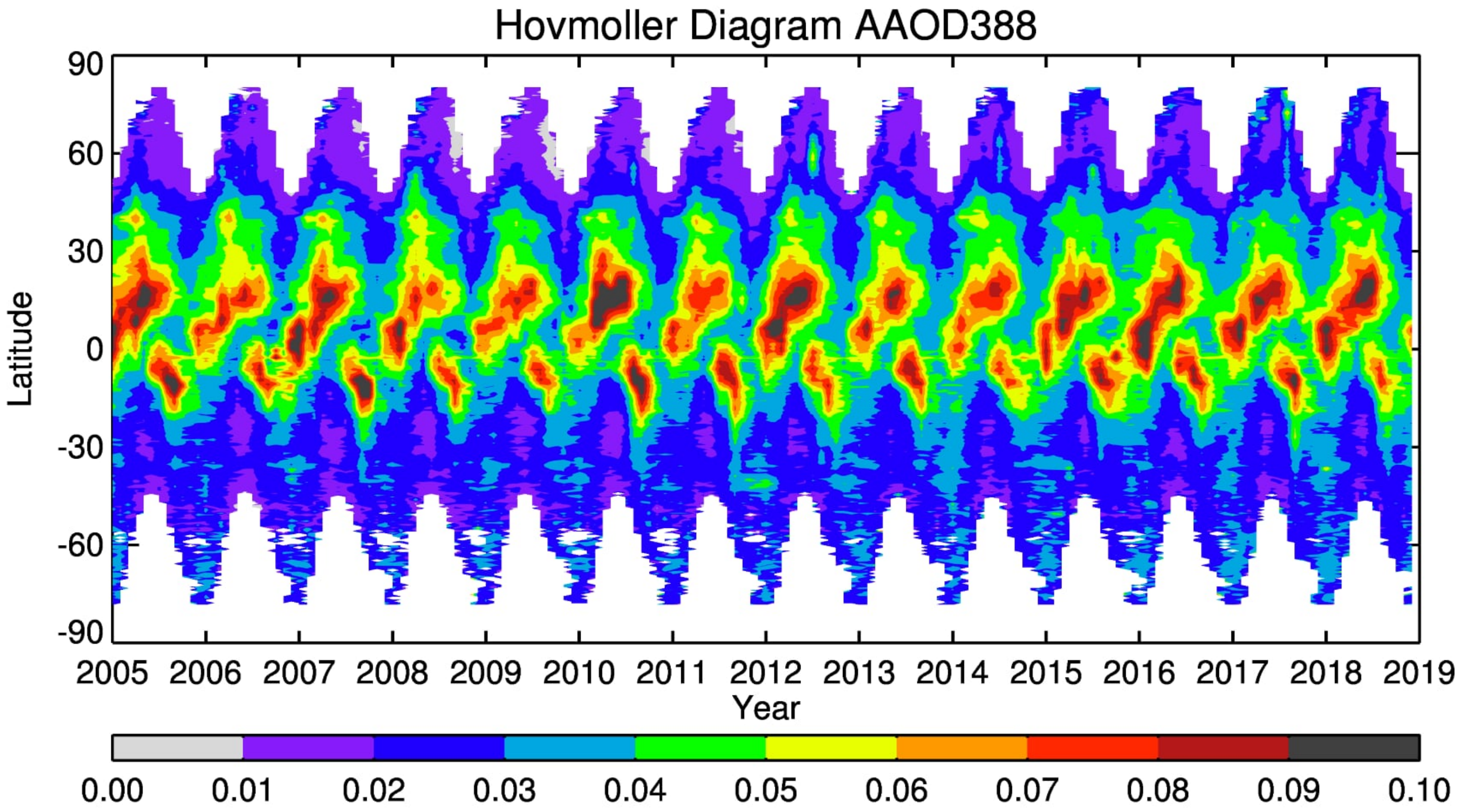


Sep-Oct-Nov Seasonal Climatology AOD388 (2005-2018)

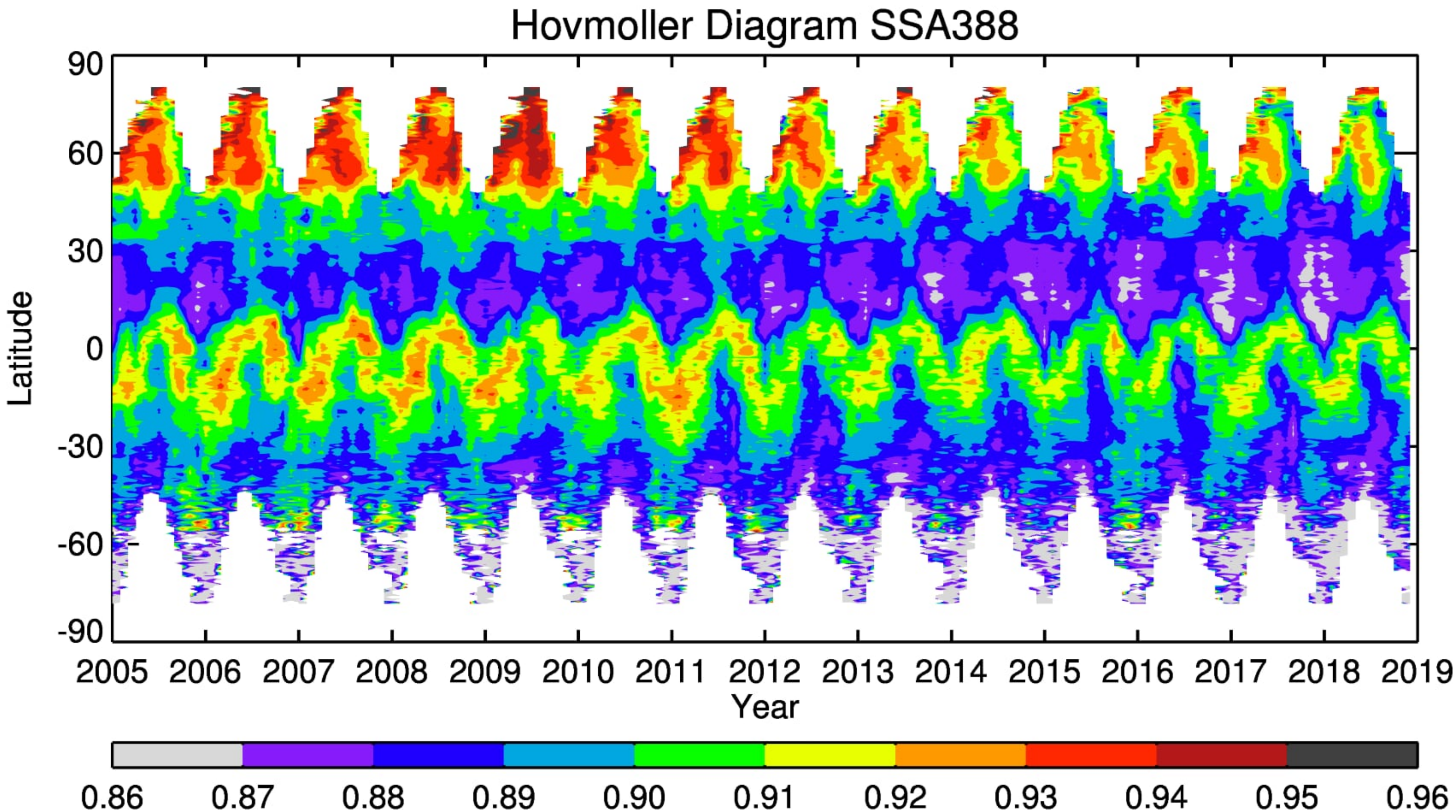


All aerosol types are accounted for over land.
Only desert dust and carbonaceous aerosols are retrieved over the oceans.

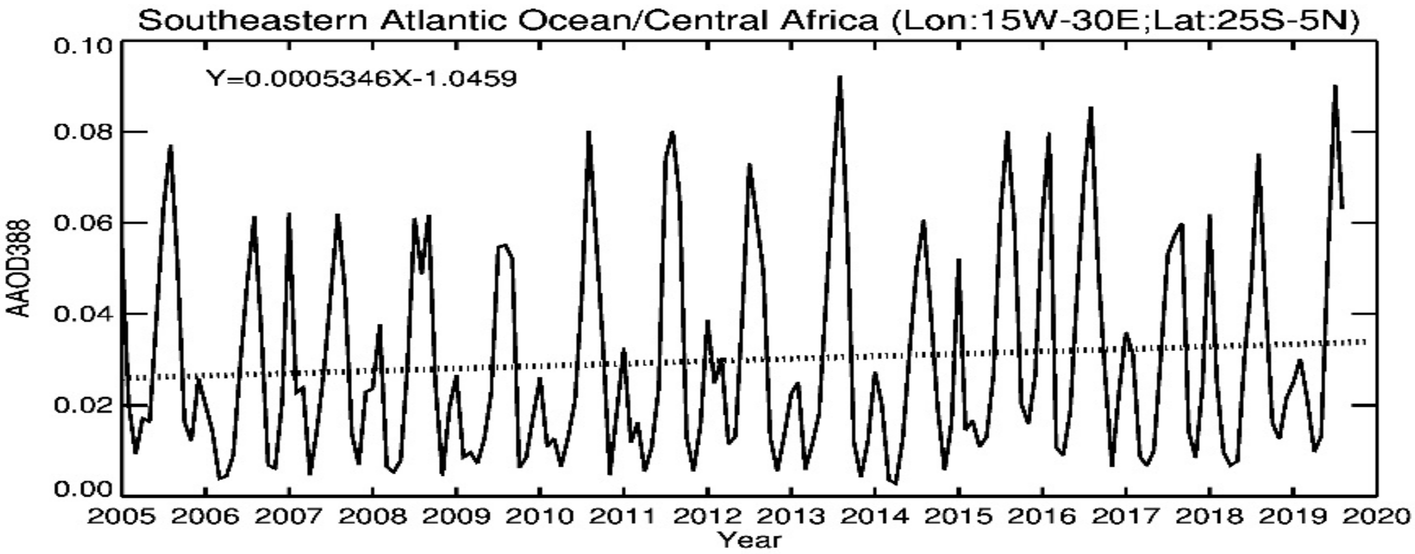
Global 13-year record of OMI Aerosol Absorption Optical Depth

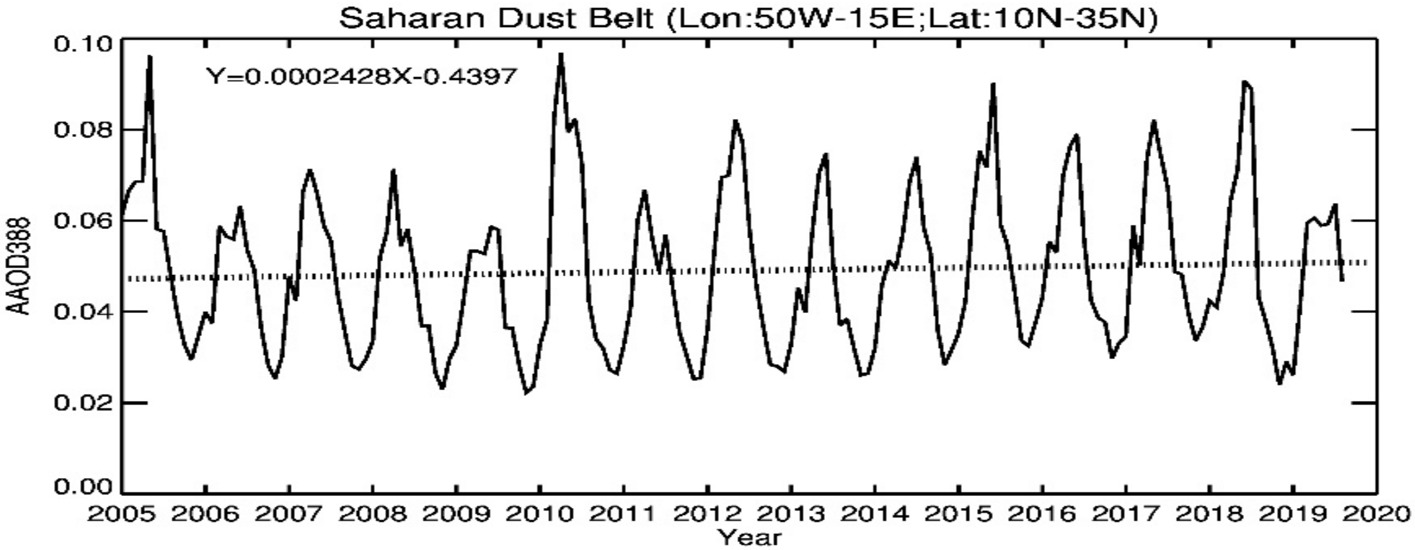


Global 13-year record of OMI Aerosol Single Scattering Albedo

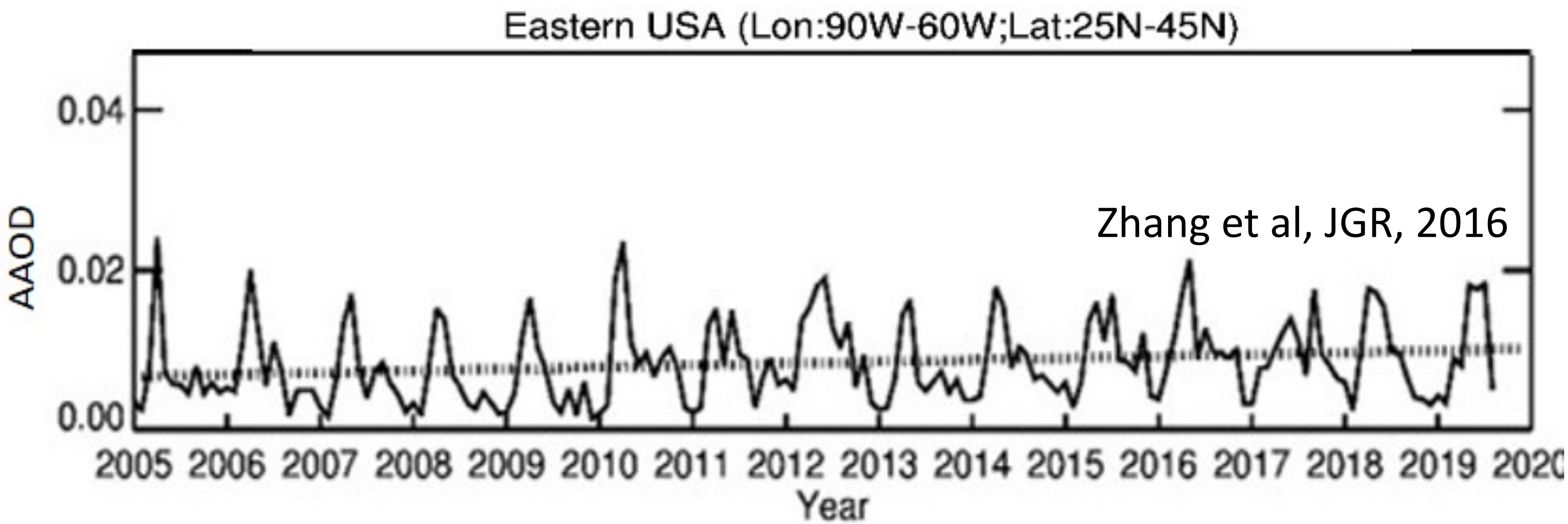


Regional Trend Analysis

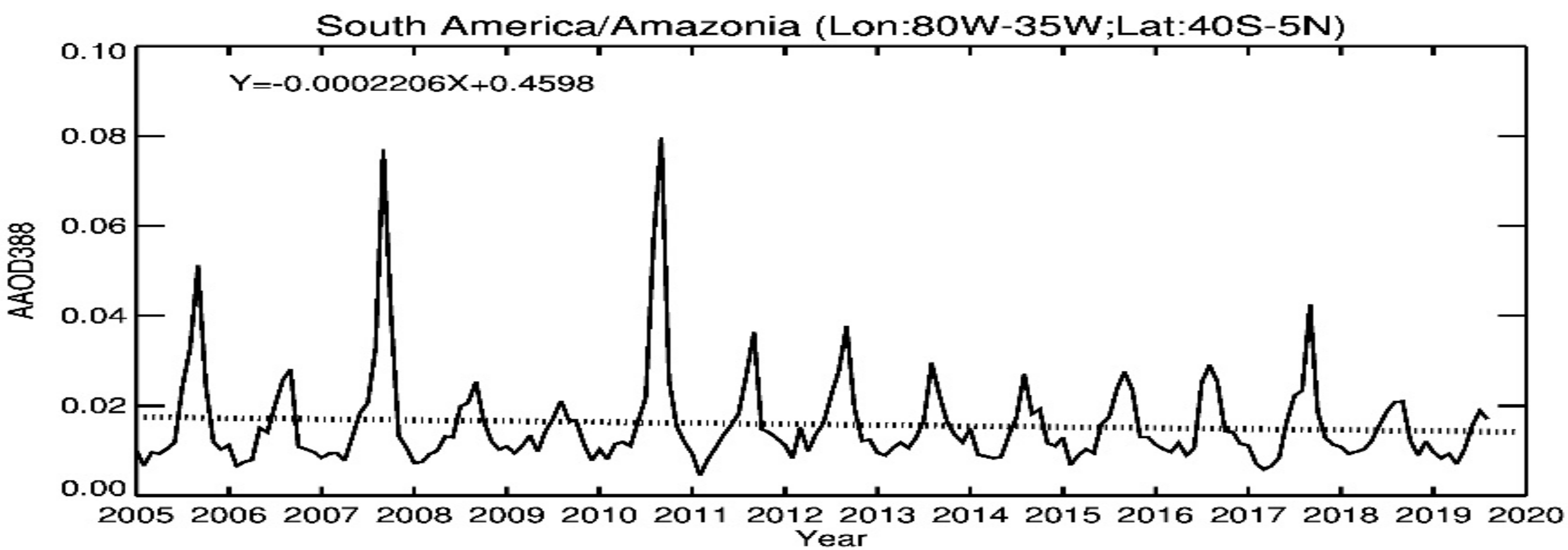




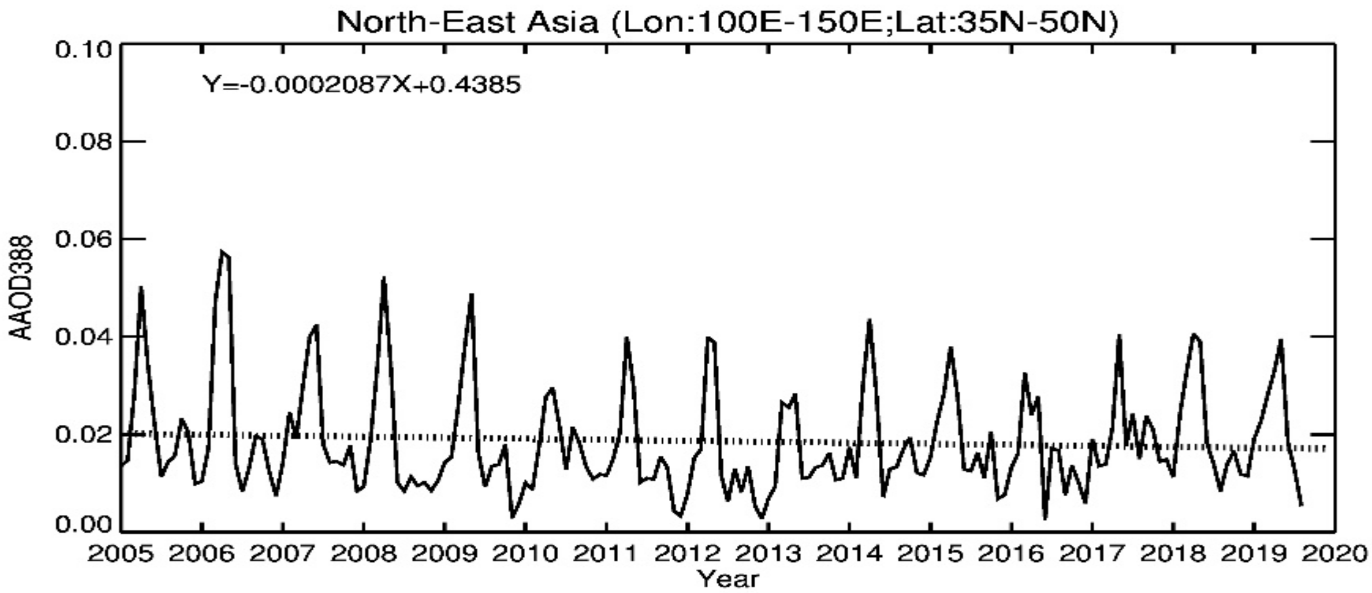
Regional Trend Analysis (2)

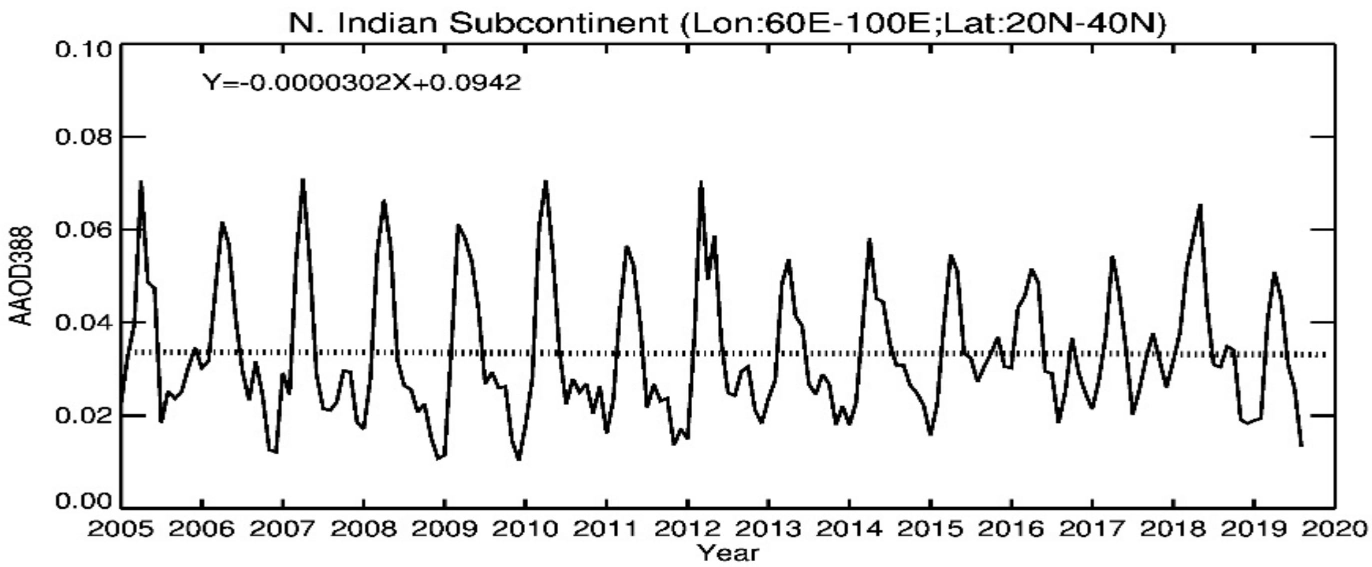


Zhang et al, JGR, 2016



Regional Trend Analysis (3)





Recent Applications of OMAERUV Aerosol Products

Aerosol Effects on OMI trace-gas retrieval products:

Castellanos, P., et al., OMI tropospheric NO_2 air mass factors over South America: effects of biomass burning aerosols, Atmos. Meas. Tech., 8, 3831-3849, 2015

Cooper, M. J., et al. (2019). An observation-based correction for aerosol effects on nitrogen dioxide column retrievals using the Absorbing Aerosol Index, *Geophysical Research Letters*, *46*, ***(Talk by M. Cooper, next session)***

Jung, Y., et al. (2019), Explicit aerosol correction of OMI formaldehyde retrievals, Earth and Space Science, 2019EA000702 (under review) **(Talk by Y. Jung, next session)**

Combined aerosol products and aerosol trend analysis:

Gassó, S. and Torres, O., Temporal characterization of dust activity in the Central Patagonia desert (years 1964–2017), *Journal of Geophysical Research: Atmospheres*, *124*. 2019

Eswaran, K., et al., Multi-satellite retrieval of single scattering albedo using the OMI–MODIS algorithm, Atmos. Chem. Phys., 19, 3307-3324, 2019.

Bahadar Zeb at al Temporal characteristics of aerosol optical properties over the glacier region of northern Pakistan, Journal of Atmospheric and Solar Terrestrial Physics, Volume 186, Pages 35-46, 2019

Zhang, L., et al., What factors control the trend of increasing AAOD over the United States in the last decade?, J. Geophys. Res. Atmos., 122, 1797–1810, doi:10.1002/ 2016JD025472, 2016

Lacagnina, C., et al., Direct radiative effect of aerosols based on PARASOL and OMI satellite observations, *J. Geophys. Res. Atmos.*, *122*, 2366–2388, 2017

Satellite-Modelling Studies:

Buchard, V. et al., Using the OMI aerosol index and absorption aerosol optical depth to evaluate the NASA MERRA Aerosol Reanalysis, Atmos. Chem. Phys., 15, 5743–5760, 2015.

Hammer, M. S. et al., Interpreting the ultraviolet aerosol index observed with the OMI satellite instrument to understand absorption by organic aerosols: implications for atmospheric oxidation and direct radiative effects, Atmos. Chem. Phys., 16, 2507-2523, 2016

Buchard, V. et al, 2017, The MERRA-2 Aerosol Reanalysis, 1980 Onward. Part II: Evaluation and Case Studies, *J. Climate,* **30**, 6851–6872, 2017

Hammer, M. S. et al., Insight into global trends in aerosol composition from 2005 to 2015 inferred from the OMI Ultraviolet Aerosol Index, Atmos. Chem. Phys., 18, 8097–8112, 2018.