Insights on major aerosol types and vertical distribution over a South Asian (SA) and South East Asia (SEA) megacities New Delhi and Kuala Lumpur using multiple satellite products

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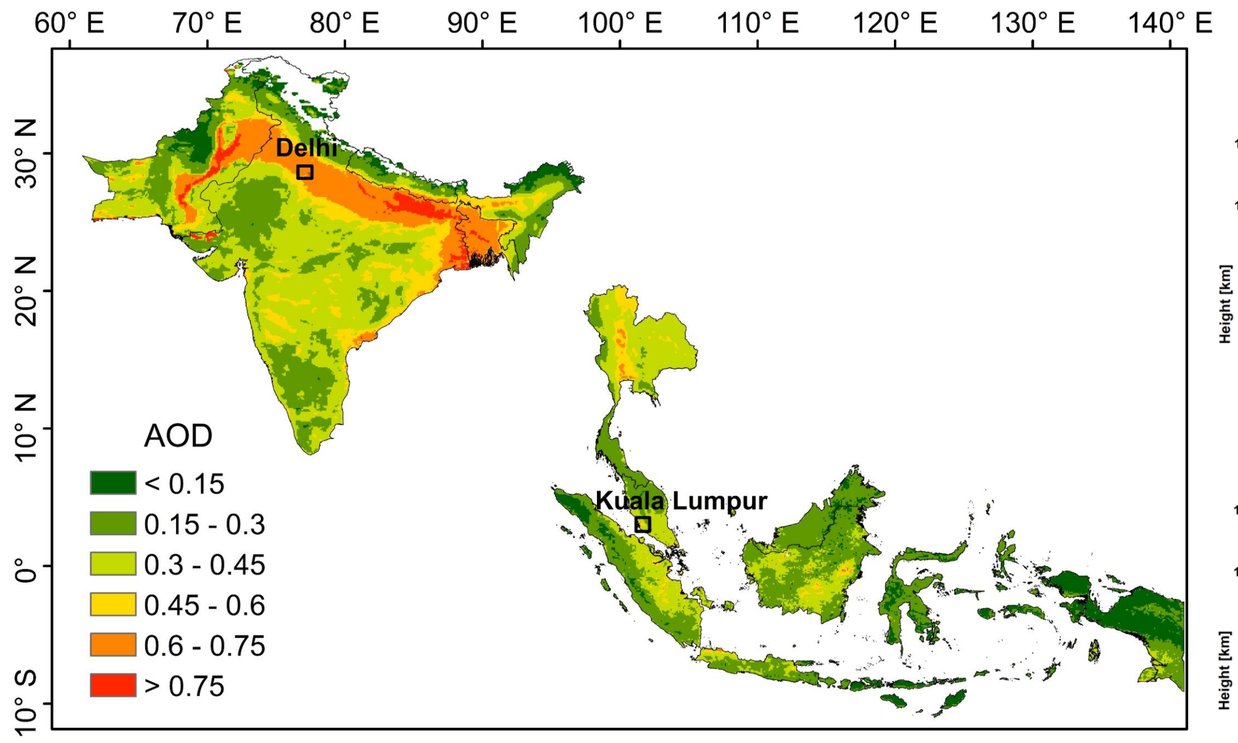
Overview

- Both South Asia (SA) and Southeast Asia (SEA) regions are affected by huge biomass burning and forest fire leading to regional haze especially during winter over SA and North East Monsoon (NEM) and South West Monsoon (SWM) over SEA.
- High spatial and seasonal variation of aerosol loading and aerosol types is found over SA and SEA primarily due to the prevalence of heterogeneous sources and meteorological conditions.
- Understanding the spatial and temporal distribution of aerosol and their optical and microphysical properties is a key point to identify the aerosol sources and their impact on the local and regional air quality.
- The importance of understanding the vertical distribution of aerosols is important to trace their transport, sources and other climatic implications.
- Utilizing data from multiple satellite sensors such as MODIS, OMI CALIPSO and MISR, the spatial and temporal distribution of aerosol loading and aerosol types and their trend have been examined over the two megacities- New Delhi, in South Asia and Kuala Lumpur in Southeast Asia.

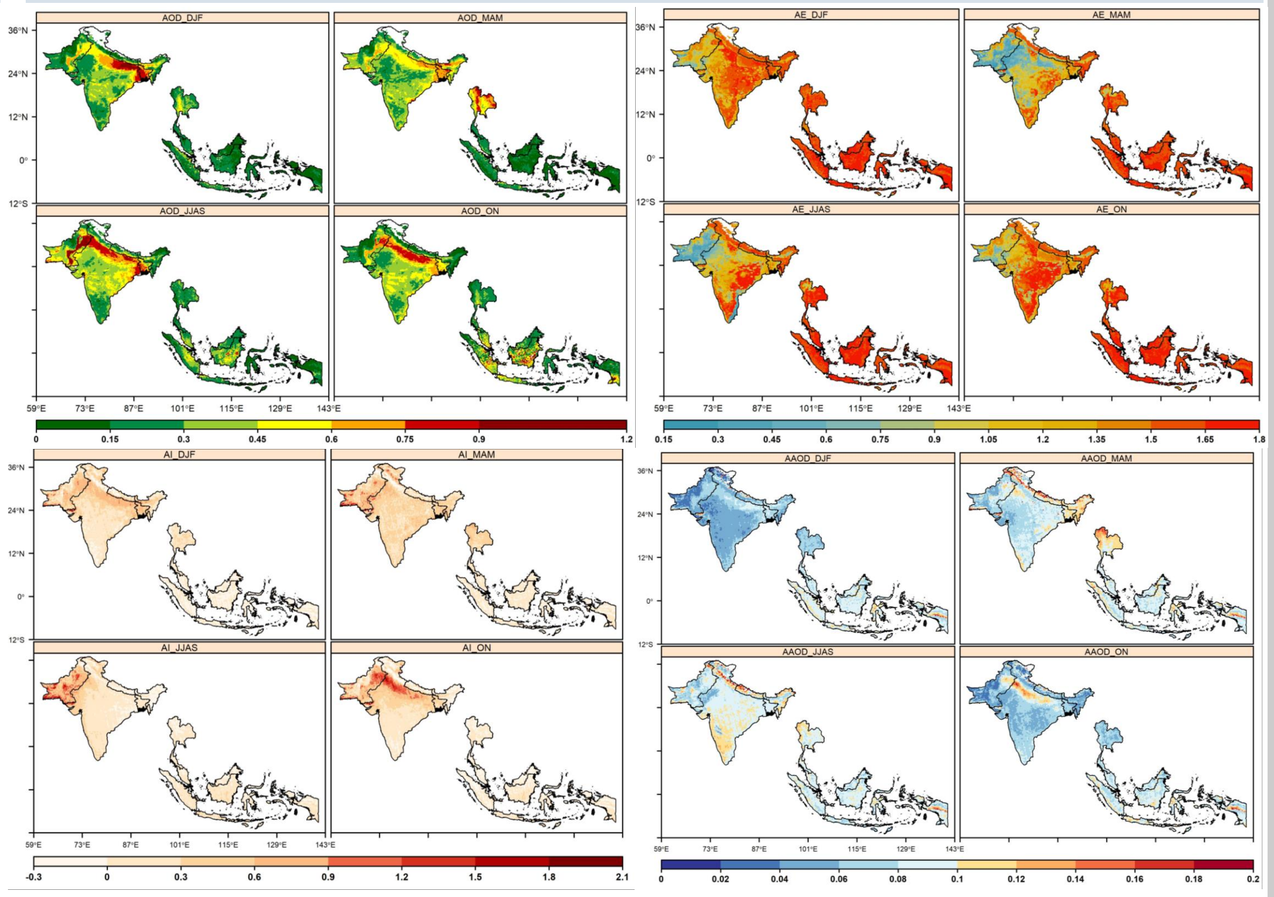


Data and Methods

Instrument	Description	Resolution
MODIS	combined DT and DB AOD at 550nm DB angstrom exponent over land	10km
OMI	Aerosol Index (AI) at 354nm Absorbing aerosol optical Depth (AAOD) at 388nm Single scattering Albedo (SSA) at 388nm	25 km
MISR V23	AOD at 550nm AE 550-860nm cAOD at 550nm fAOD at 550nm mAOD at 550nm AAOD at 550nm	4.4km
CALIPSO V4.2	Extinction Coefficient at 532nm Aerosol subtype	H:5 km V:60m

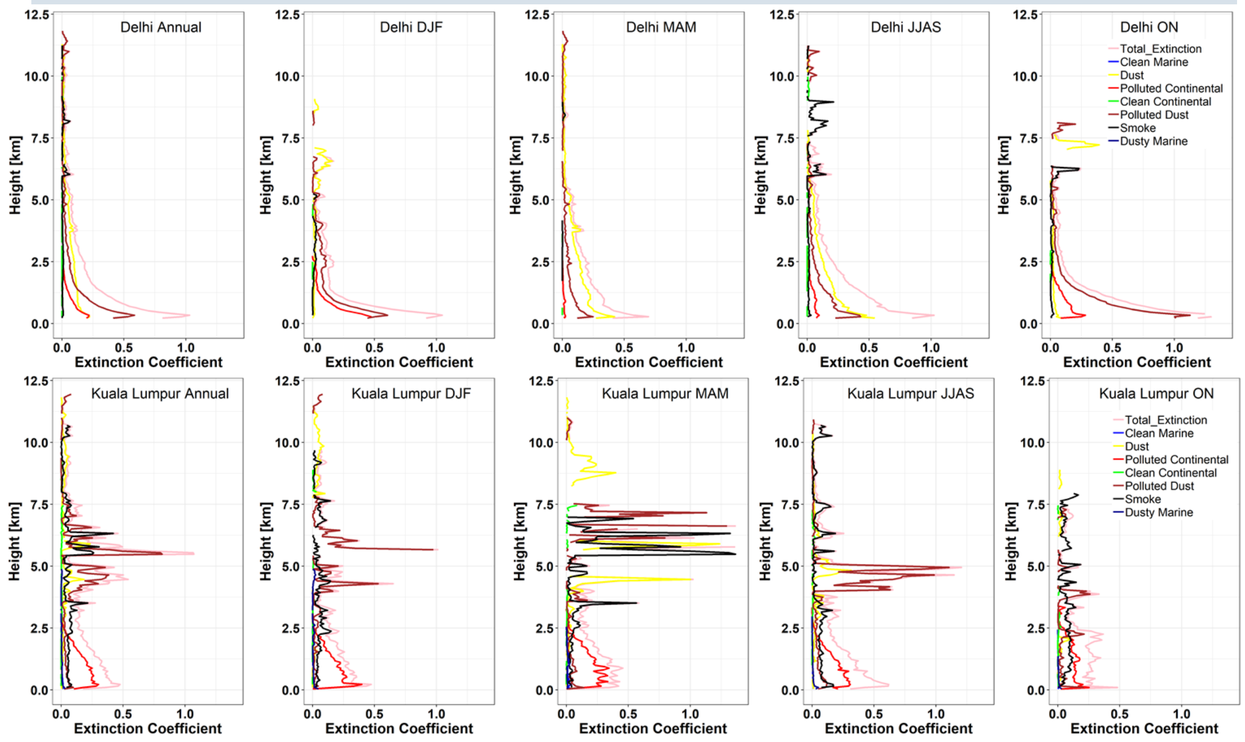
- Aerosol measurements including all the sensors retrieved over Delhi and Kuala Lumpur within a sampling window 1° centered to the city center from 2007 to 2018.
- Multiyear trend of aerosol measurements over the two megacities estimated using nonparametric Mann-Kendall test (MK) and the Theil-Sen slope estimator.
- Vertical distribution of aerosols estimated using CALIPSO vertical profiles that fall within the selected spatial windows (1°) with total 493 and 374 over Delhi and Kuala Lumpur respectively.

Spatial-Temporal Distribution of aerosols over SA and SEA



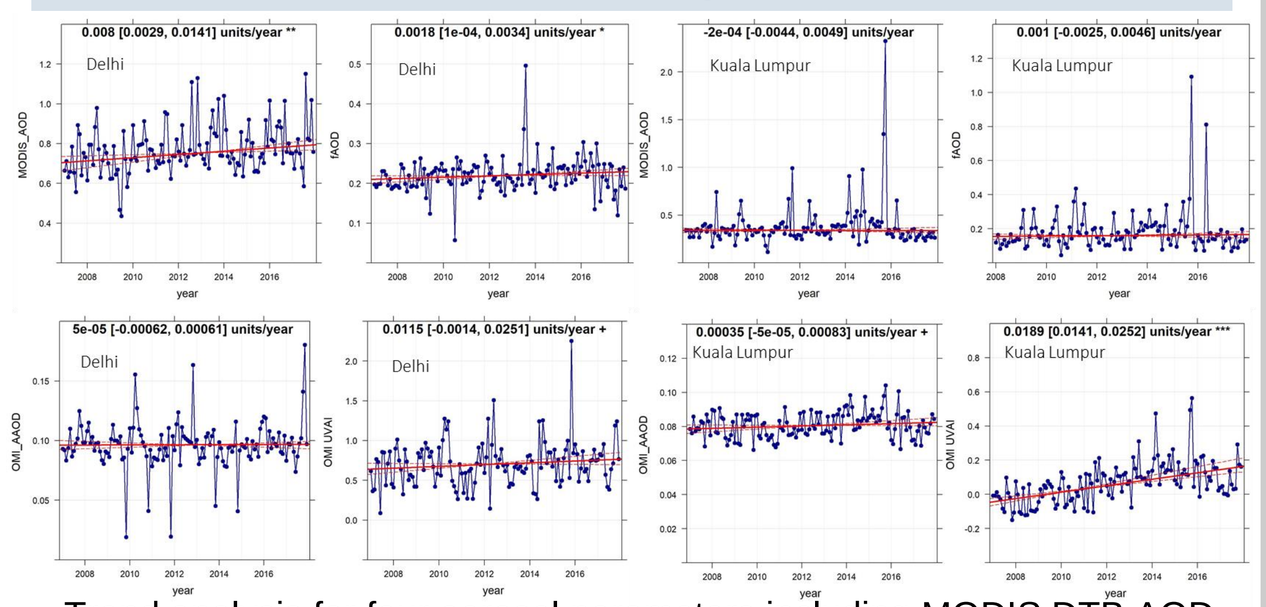
Spatial and seasonal variation of averaged (2007-2018) AOD, AE, AI and AAOD over South and Southeast Asia.

Vertical Distribution of aerosol types



Annual and seasonal vertical distribution of aerosols and their subtypes over Delhi (1st row) and Kuala Lumpur (2nd row)

Trend Analysis



Trend analysis for four aerosol parameters including MODIS DTB AOD, MISR fine mode AOD, OMI AI, and OMI AAOD over Delhi and Kuala Lumpur using the Mann–Kendall test associated with Sen's slope.

Conclusions

- Significant increases of fine absorbing aerosol over New-Delhi and Kuala Lumpur from 2007 to 2018.
- Highest extinction values observed near the surface (0-2.5km) for all aerosol types during all seasons over Delhi, while very high extinction (~1km-1) of polluted dust, smoke and dust observed at higher altitude (4-7.5km) over Kuala Lumpur.