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Multi-Sensor Remote Sensing of Atmospheric Aerosols over Indo-Gangetic Plains

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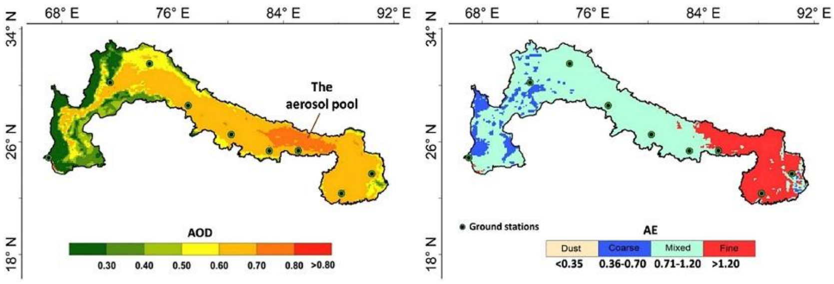
Aerosol characteristics over South Asia is complex due to strong transition in its source strength and associated meteorology. The high-resolution ground-based measurement of aerosol characteristics is hence challenging attributed to its larger geographical extent, varying topography and seasonal fluctuations in meteorological conditions. A combination of passive and active satellite-based remote sensing has been extensively exploited from last two decades to overcome such measurement limitations. We identified aerosol characteristics over the South Asian region using Moderate resolution imaging spectroradiometer (MODIS) sensor onboard Terra Satellite to investigate columnar aerosol properties.

Analysis highlighted the existing spatial and temporal gradients in aerosol loading patterns. The long-term spatial analysis identifies a region of aerosol pool in the eastern part of IGP with exceptionally high aerosol load. Overall, stations located at the central and lower IGP are characterized with high aerosol loading while comparatively low AOD are noted over stations at upper part. A strong seasonality in aerosol loading and types is also witnessed, with high aerosol optical depth and dominance of fine particulates during post-monsoon and winter seasons. We evaluate the spatial and seasonal pattern of the trends across IGP and quantify in terms of changes in AOD and particle size. A sharp variation in aerosol types is noted over different regions, with the upper IGP mainly dominate by coarser particles, while the central and lower IGP exhibit the dominance of mixed and fine aerosols[1]. The spatial inconsistencies in the distribution of aerosol types is primarily attributed to seasonal variations in particle source strength and to regional meteorology. Further, aerosol hotspots are not always associated with urban centres but translates across the region. Within the last decade, the monotonic trend in aerosol loadings reveals a uniform positive trend (i.e. increasing AOD), with different level of significance.



Decadal (2006-2015) variation of averaged AOD and Angstrom Exponent over IGP.

Further, we classified the aerosol types dominating over the region using other optical parameters like Aerosol Index retrieved by Ozone Monitoring Instrument (OMI) coupled with size parameter (Angstrom Exponent, AE) derived by MODIS. Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) based aerosol vertical profiles suggested the significant contributions of smoke aerosols with strong seasonal and altitudinal attributes. Highly absorbing smoke aerosols were found to be prevalent throughout the year, more abundantly between October and February. Such abundance of smoke at a higher altitude across the different seasons indicate the trans-boundary and convective transfer of smoke aerosols from the surface of Earth.

References

[1] Kumar, M., Parmar, K.S., Kumar, D.B., Mhawish, A., Broday, D.M., Mall, R.K. and Banerjee, T., 2018. Long-term aerosol climatology over Indo-Gangetic Plain: Trend, prediction and potential source fields. Atmospheric environment, **180**, pp.37-50.