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Aerosol Radiative Forcing Over Indian Subcontinent for 2000-2021 Using Satellite Observations

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Abstract : Aerosols directly affect Earth's radiation budget by scattering and absorbing incoming solar radiation and outgoing terrestrial radiation. While the uncertainty in aerosol radiative forcing (ARF) has decreased over the years, it is still higher than that of greenhouse gas forcing, particularly in the South Asian region, due to high heterogeneity in their chemical properties. Understanding the Spatio-temporal heterogeneity of aerosol composition is critical in improving climate prediction. Studies using satellite data, in-situ and aircraft measurements, and models have investigated the Spatio-temporal variability of aerosol characteristics. In this study, we have taken aerosol data from Multi-angle Imaging Spectro-Radiometer (MISR) level-2 version 23 aerosol products retrieved at 4.4 km and radiation data from Clouds and the Earth's Radiant Energy System (CERES, spatial resolution=1ox1o) for 21 years (2000-2021) over the Indian subcontinent. MISR aerosol product includes size and shapes segregated aerosol optical depth (AOD), Angstrom exponent (AE), and single scattering albedo (SSA). Additionally, 74 aerosol mixtures are included in version 23 data that is used for aerosol speciation. We have seasonally mapped aerosol optical and microphysical properties from MISR for India at quarter degrees resolution. Results show strong Spatio-temporal variability, with a constant higher value of AOD for the Indo-Gangetic Plain (IGP). The contribution of small-size particles is higher throughout the year, spatially during winter months. SSA is found to be overestimated where absorbing particles are present. The climatological map of short wave (SW) ARF at the top of the atmosphere (TOA) shows a strong cooling except in only a few places (values ranging from +2.5o to -22.5o). Cooling due to aerosols is higher in the absence of clouds. Higher negative values of ARF are found over the IGP region, given the high aerosol concentration above the region. Surface ARF values are everywhere negative for our study domain, with higher values in clear conditions. The results strongly correlate with AOD from MISR and ARF from CERES.

Keywords : aerosol Radiative forcing (ARF), aerosol composition, single scattering albedo (SSA), CERES
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