

Abstract

Despite several independent observational studies, a comprehensive picture on the aerosol vertical distribution and its spatial gradients has not yet evolved over the Indian subcontinent. The present study analyses around 10 years (June 2006 to December 2016) of version 3 level 3 CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) spaceborne lidar (light detection and ranging) retrieved night time, cloud free vertical extinction profiles (at 532 nm) of composite aerosol, and its major species (dust, polluted dust and smoke) to understand the three-dimensional distribution of aerosols over India. The shape and vertical extent of the extinction profiles varied in space and time. The vertical extent of the aerosol distribution is shallower in the colder seasons compared to that of warmer seasons, which could potentially be due to suppressed convection during colder months. Meridional gradients are observed in the near-surface extinction coefficients (increasing towards north of India). Polluted dust (defined as a mixture of dust and smoke) emerged as the dominant aerosol species over most parts of the study region. Over the north western and central India, dust aerosols contributed the most to the aerosol optical depths and extinction profiles during the summer and monsoon months. Smoke aerosols prevailed over the southern and north eastern parts of India, which are attributed to biomass, agricultural burning, and long-range transport. Boundary layer aerosol optical depths (AOD) contributed to columnar AOD significantly during post-monsoon and winter, while the elevated-AOD had almost an equal share in columnar AOD during the summer and monsoon seasons.

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