Seasonal Variations in the Altitude Distribution of Aerosols and Characteristics of the Elevated Layers over Trivandrum (8.5ºN, 77ºE)

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Knowledge of the altitude distribution of aerosols is essential for estimating their impact on the radiative heating of the atmosphere and understanding the influence of long-range transport in regulating the atmospheric aerosol loading. Aerosol distribution over southeastern parts of the Arabian Sea is characterized by a pronounced aerosol plume off the west coast of India during the winter and pre-monsoon seasons while the mineral dust from the Arabian Desert often reach up to this region during the Asian summer monsoon season. Dual-polarization Micropulse lidar (MPL) observations of the altitude profiles of the aerosol backscatter coefficient (βa) and linear depolarization ratio (LDR) over Trivandrum (8.5°N, 77°E), a station located in the southwest coast of Peninsular India, are used to investigate the vertical distribution of aerosols and identify the potential aerosol types during different seasons. During the winter and pre-monsoon seasons, the altitude profiles of β_a and LDR reveal two distinct aerosol layers persisting between 0-2 km and 2-4 km. The elevated layer comprising of significant amount of non-spherical aerosols, with LDR in the range of 0.08-0.2, is prominent whenever highly polluted conditions prevail over the region. The back-trajectory analysis shows that this layer appears only when the advection of dry airmass occurs from the northern parts of the Indian subcontinent and north Arabian Sea. High relative humidity (80-97%) and low values of LDR (<0.05) associated with the layer between 0-2 km suggest that the particulates in this layer could be hygroscopically grown and are mostly spherical in nature. During the highly polluted conditions, aerosols tend to increase the diurnal mean atmospheric radiative heating rate by ~0.8 K/day at 500 m and 0.3 K/day at 3 km, which are about 80% and 30% of the respective radiative heating in the aerosol-free atmosphere. An elevated layer of highly non-spherical aerosols with LDR in the range of 0.1 to 0.3 is present in the altitude band of 1-3.5 km during the July-August months, which contributes about 30-50% of the column AOD. This layer is clearly associated with the long-range transport of mineral dust from the Arabian Desert region. In contrast, the altitude region below 1 km comprises of highly spherical aerosols during the summer monsoon season.