

Seasonal variation in the spatial and vertical distribution of aerosol species over the Tropical Asian region

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The aerosol species over the tropical Asian region has large seasonal, spatial, and vertical variation. These aerosol distributions were observed using the Moderate Resolution Imaging Spectroradiometer (MODIS) TERRA and AQUA L3 datasets at an aerosol optical depth (AOD) of 550 μm and using the Copernicus Atmosphere Monitoring Service (CAMS) reanalysis dataset. The seasonal transport in the spatial distribution of aerosol is strongly influenced by the seasonal variation in winds. The annual climatology shows that the aerosol optical depth was more dominant over the Ganges plain, Northeastern regions of India, and central east China. From these regions and from the nearby Arabian Peninsula, the aerosol species are transported to different regions of Asia. In these regions, the contribution of natural aerosols, such as dust aerosols, was found more during the pre-monsoon and southwest summer monsoon seasons. While anthropogenic aerosol species such as organic matter, sulfate, and black carbon were found more in the winter and post-monsoon seasons. Moreover, in the vertical distribution of aerosols, large-scale wind convergence, local strong convection, and orographic forcing were found to be important. In the pre-monsoon season and southwest summer monsoon season, strong dry air transports dust from the Arabian Peninsula, and convection over Indian land plays a significant role in the deep vertical movement of aerosol in the atmosphere. With a large amount of aerosols distributed vertically and spatially, solar radiation is reduced, and radiative aerosol forcing is increased in tropical Asian regions, which influences regional circulation, diurnal variability, and convection processes.

Keywords: aerosol species, seasonal variation, southwest summer monsoon season, direct radiative forcing