Estimate the influence of aerosols optical properties its radiative effects and seasonal variability in megacity Delhi, India

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Atmospheric aerosols has gained great attention due to its radiative property, which impacts on climate change at local, regional and global scale. Specially, black carbon is a major contributor of climate change, second to CO_2. Continuous and real-time measurements of the mass concentration of particulate matter **(**PM_{10}, $PM_{2.5}$**)** and black carbon (BC) were carried out in CSIR-CRRI, New Delhi. Daily data of aerosol optical depth **(**AOD), angstrom exponent (AE) and single scattering albedo (SSA) were taken from the space-borne satellite MODIS-terra at level 2 for the years 2015, 2016 and 2017. The annual mean concentrations of PM_{10} were observed 193±87, 227±72 and 257±159 μgm^{-3}; $PM_{2.5}$ were 172±92, 187±69 and 217±137 μgm^{-3}; and BC were 4.3±1.8, 4.8±2.1 and 5.8±2.3 μgm^{-3} for the years 2015, 2016 and 2017 respectively. The average annual increment of PM_{10}, $PM_{2.5}$ and BC concentrations were found about 15, 14.3 and 13.8% from year 2015, 2016 and 2017, respectively,**.** The higher concentration were found during winter (1076, 789 and 10 μgm^{-3} of PM_{10}, $PM_{2.5}$ and BC, respectively) and a minimum were found in monsoon season (36, 17 and 2.7 μgm^{-3} of PM_{10}, $PM_{2.5}$ and BC, respectively) whereas, post and pre-monsoon seasons average concentration of PM_{10}, $PM_{2.5}$ and BC were 184±62, 87±43 and 4.7±1.7 μgm^{-3}; and 69±28, 28±16 and 4.4±1.2 μgm^{-3}, respectively. The BC concentration was found significantly high, nearly doubled during cloudy-sky conditions as compared to clear-sky conditions. Seasonal trend decomposition were analysed based on locally weighted regression smoothing technique, and identified marginally decreasing trend (Delhi- 0.0079; Varanasi, 0.0087 DU $year^{-1}$) due to reduction in monsoon time minima and summer time maxima. The aerosol optical properties like, AOD and SSA were found higher in winter but does not show a significant variation for other seasons, whereas AE exhibits significant seasonal variation, higher during winter and post-monsoon, indicative of high concentration of fine aerosols (BC and $PM_{2.5}$) and found lower in pre-monsoon and monsoon, when coarser aerosols (PM_{10}) were in abundant. The percentage contribution of BC to the net atmospheric forcing is varied between 54 to 68% during the years 2015-2017, which is supporting to strong radiative forcing of BC, that causing solar dimming to earth surface and global warming at local and regional scale.

Key words: Black carbon, MODIS, AOD, Angstrom exponent, Single scattering albedo