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Impacts of the high loadings of primary and secondary aerosols on light extinction at Delhi during wintertime

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High emissions of anthropogenic aerosols over Indo-Gangetic Plains (IGP) inspired continuous measurements of fine particles ($PM_{2.5}$), carbonaceous aerosols (BC, OC and EC), oxides of nitrogen (NOx) and estimation of light extinction (b_{ext}) and absorption (b_{abs}) coefficients over Delhi during high pollution season in winter from December 2011 to March 2012. During study period, the mass concentrations of $PM_{2.5}$, BC and NOX were 186.5±149.7μg $^{m-3}$, 9.6±8.5μg m^{-3} and 23.8±16.1 ppb, respectively. The mass concentrations of OC and EC were studied by two different techniques (i) off-line (gravimetric method) and (ii) semi-continuous (optical method) and their mean mass concentrations were 51.1±15.2, 10.4±5.5 μgm^{-3} and 33.8±27.7, 8.2±6.2 μgm^{-3}, respectively during the study period. The ratios of mass concentration of OC to EC in both cases were in between 4 to 5. The source contribution of carbonaceous aerosols in $PM_{2.5}$ estimated over 24 hrs, during day- and night-time where motor vehicles accounted for ~69%, 90% and 61% whereas coal combustion accounted for ~31%, 10% and 39%, respectively. The estimated mean values of bext and babs over the station were 700.0±268.6 and 71.7±54.6 Mm^{-1}, respectively. In day and night analysis, bext is ~37% higher during night-time (863.4Mm^{-1}) than in day-time (544.5 Mm^{-1}). Regression analysis between bext and visibility showed significant negative correlation (r=-0.85). The largest contribution in the light extinction coefficients was found to be due to organic carbon (~46%), followed by elemental carbon (~24%), coarse mode particles (~18%), ammonium sulfate (~8%) and ammonium nitrate (~4%). The individual analysis of light extinction due to chemical species and coarse mode particles indicates that scattering type aerosols is dominated by ~76% over the absorbing type. The aforementioned results suggest that the policy-induced control measures at local administration level are needed to mitigate the excess emissions of carbonaceous aerosols over IGP region which ranks highest in India and elsewhere in worldwide.

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