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

Suresh Tiwari
Indian Institute of Tropical Meteorology, India

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.

smbtiwari@tropmet.res.in