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Understanding sources and atmospheric transformation of ambient aerosols through stable isotope measurements in a polluted city in North India

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During winter-time Indo-Gangetic plain (IGP) is very polluted because of its meteorological conditions, topography, and raised particulate matter (PM) emissions. For understanding contribution of various sources to ambient aerosols stable isotope ratios have been studied. Ambient PM1 and PM2.5 samples were collected during wintertime from Kanpur (central part of IGP). Chemical composition such as water-soluble organic carbon (WSOC), organic carbon (OC), elemental carbon (EC), water soluble inorganic species (WSIS) and stable carbon isotope composition (δ13C) were determined. Air-mass back trajectories arriving at the receptor site suggested predominant origin from north-west direction. Large scale emissions from anthropogenic sources such as vehicular exhaust, industrial emissions and biomass burning and meteorological conditions like low wind speed and low mixing height can be the possible reasons for measured higher PM mass as well as total carbonaceous aerosols (TCA). In total PM1 mass, OC and EC contributed nearly 15% and 0.14 % and in PM2.5 mass, OC and EC contributed nearly 22% and 2% respectively. Ions like NH4+, NO_3-, and SO42- were significantly higher during this time period due to various fog/haze events and stagnant air conditions. Significant variability in OC/EC ratio and WSOC/OC ratio suggested variable aerosol mixing consisting of primary and secondary emission products. In this study, δ13C of TC in both PM1 and PM2.5 were quite comparable. δ13C of samples from some possible sources (coal, gasoline, diesel and bio-diesel) were analysed to ascertain their different characteristics. Large scatter between δ13C and TC content in aerosols indicates the possibility of contribution from multiple sources which indicates that δ13C is an average composition of several carbon sources.