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WINTER PARTICULATE POLLUTION AND SOURCE APPORTIONMENT IN CENTRAL INDIA

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Aerosols play an important role in climate change, precipitation, and health hazards (Brunekreef & Holgate, 2002; Ramanathan & Carmichael, 2008). Particulate matter is the most serious pollutant in various cities of Asian countries like India and China mainly due to huge coal burning (Menon *et al.*, 2002). The severe winter particulate pollution is observed in several urban parts of the central India due to emissions of steel and cement industries, rice mills, thermal power plants, etc. The sampling campaigns of particulate matters) in the winter (December, 2006 - February, 2007) were carried out in Raipur city (latitude: 21°24'N and longitude: 81°63'E), one of the most industrialized parts of India, to characterize the ambient mass concentrations of coarse particulate matter (PM_{10}) and their sources. Fifteen coarse particulate matter (PM_{10}) and three suspended particulate matter (SPM) samples from 15 different locations of Raipur city were collected. Techniques i.e. thermal method, proton induced X-ray emission spectrophotometry and ion chromatography were used for monitoring the species i.e. carbons, trace elements and water soluble ions, respectively.

The mass concentrations of PM_{10} and SPM in the ambient air ranged from 221 - 760 and 1150 - 1577 μg m^{-3} with mean values of 435±85 and 1331±250 μg m^{-3}, respectively. The mean mass concentration ratio of $[PM_{10}]/[SPM]$ was found to be 0.33. The PM_{10} concentration in Raipur city in the winter exceeded the limit of 50 μg m^{-3} by a factor of eight.

The mass concentrations of OC_{10} and EC_{10} ranged from 20 – 153 and 11 - 114 μg m^{-3} with mean values of 51±17 and 41±15 μg m^{-3}, respectively. The mean mass concentration ratio of $[EC_{10}]/[EC_{SPM}]$ and $[OC_{10}]/[OC_{SPM}]$ was found to be 0.6 and 1.4, respectively.

The total mass concentrations of nine trace elements (i.e. Al, P, Ti, Cr, Mn, Fe, Cu, Zn and Zr), $\sum PM_{10}TE_9$ and $\sum SPMTE_9$ ranged from 23.2 - 105.4 and 73.7 - 119.2 μg m^{-3} with mean values of 42.2±10.5 and 101±27 μg m^{-3}, respectively.

The sum of total mass concentrations of the water soluble ions (i.e. Cl^-, NO_3^-, SO_4^{2-}, NH_4^+, Na^+, K^+, Mg^{2+} and Ca^{2+}), $\sum PM_{10}WSI_8$ and $\sum SPMWSI_8$ ranged from 34.6 - 114.4 and 25.2 - 47.4 μg m^{-3} with mean values of 64±11 and 34.4±13 μg m^{-3}, respectively. All ions have higher concentrations in the coarse fraction. Among them, the mass concentrations of Ca^{2+} were the highest whereas the mass concentrations of NH_4^+ were the smallest.

Species like Ca, Al, Fe, and sulphate contributed significantly and their mass concentrations ranged from 11.5 – 31.0, 6.5 – 20.3, 14.0 – 78.0 and 8.5 – 38.4 μg m^{-3} with mean values of 10.9±1.9, 20.6±3.5, 27.5±8.0 and 17.4±4.1 μg m^{-3}, respectively.

The highest mass concentrations of PM_{10} or EC_{10} and OC_{10} or WSI_{10} were observed in the industrial area and surroundings, respectively, probably due to difference in the origin.

The coarse particulates are accompanied by high fractions of elemental carbon (8.6%), organic carbon (11.2%), trace elements (9.7%) and water soluble ions (15.5%). The total mass concentration of the carbons, trace elements and water soluble ions in the PM_{10} and SPM includes 45.0 and 17.6%, respectively. The uncertainty in the PM_{10} and SPM accounts 55.0 and 82.4%, respectively. Four sources: anthropogenic, mineral, cement plants and secondary source for emission of the following species OC, BC, K, Mg, SO_4^{2-}, NO_3^- and Cl^-; trace elements, Na/Ca; and NH_4^+, NO_3^- and SO_4^{2-} were apportioned by the principal component analysis (PCA) model.

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