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Title: Black carbon emission and climate change in central India

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Background

In central India, the natural resourced materials i.e. minerals and coal are deposited enormously. Thereby, several sponge iron, steel, cement and thermal power plants are running by emitting effluents into the environments. During winter period (December-January), the ecosystem becomes blackish due to accumulation of the carbonaceous aerosols in the ambient air [1]. The black carbon (BC) is a combustion derived particles and adsorbed several chemical speciesemitted during the burning processes. Two types of chemical species are emitted: species which are inherent in the materials i.e. metals, halides, etc., and others synthesized during the burning processes i.e. ammonia, nitrate, sulfate, polycyclic aromatic hydrocarbons (PAHs), etc.

In this work, distribution of black carbon (BC), organic carbon (OC), metals, Cl^-, SO_4^{2-} and polycyclic aromatic hydrocarbons (PAHs) in the ambient particulate matters(PM_{10}), building roof dust, surface soil and sediment of the most industrialized city ($21^\circ 8' 24'' N$ & $81^\circ 22' 48'' E$), Raipur, CG, India during winter 2009-10 is described. The most toxic PAHs i.e. phenanthrene (Phe), anthracene (Ant), fluoranthene (Fla), pyrene (Pyr), benz[a]anthracene (Baa), chrysene (Cry), benzo[b]fluoranthene (Bbf), benzo[k]fluoranthene (Bkf), benzo[a]pyrene (Bap), dibenz(a,h)anthracene (Dba), benzo(ghi)perylene (Bgh) and indeno(1,2,3-cd)pyrene (Ind) were selected for the investigation in this work.Their correlations with the BC, and their phase partition are discussed.

Experimental

Ten samples each of PM_{10}, building dust, surface soiland sediment samples were collected during period, December, 2009 – January, 2010from different locations of Raipur city. The dust, soil and sediment samples were dried, crushed and particles of mesh size ≤ 0.1 mm were sieved out.Techniques i.e. PIXE, TXRF, IC and HPLC were used for the analysis of the chemical species.

Results and discussion

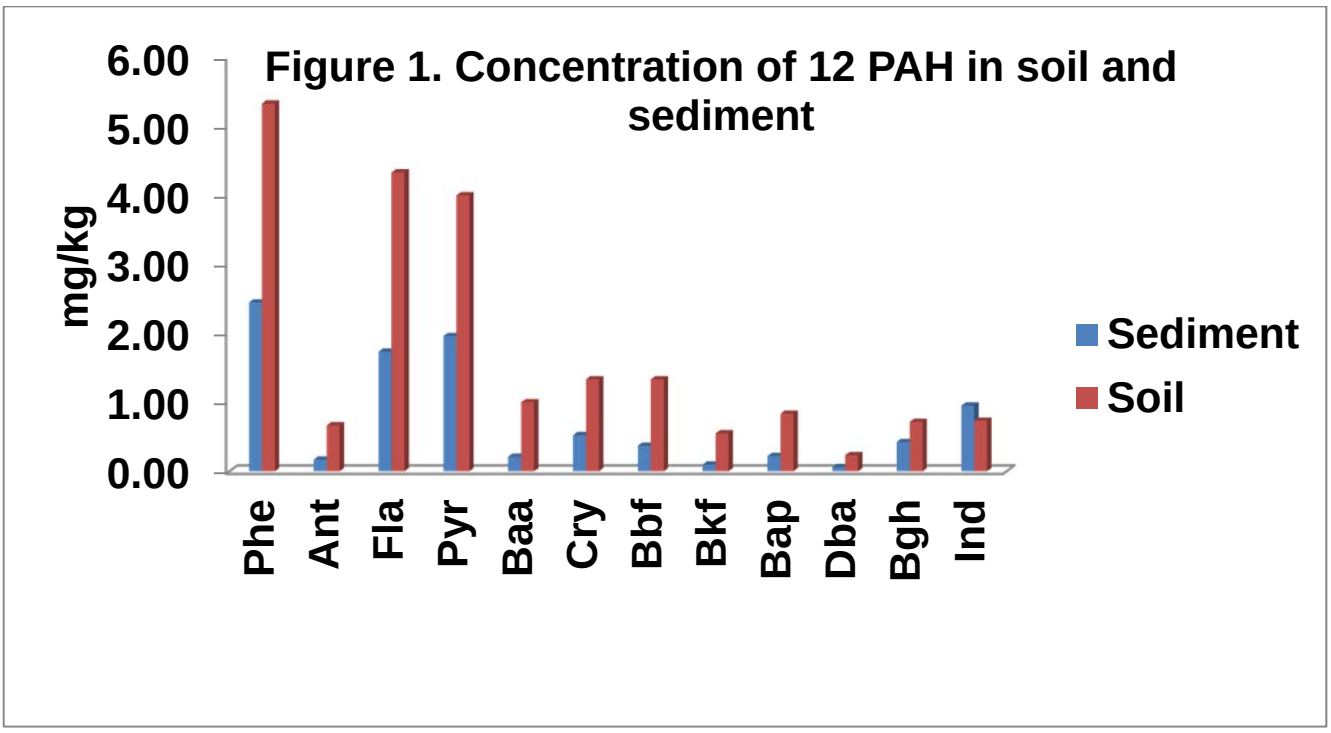
The concentration of 14 species in the PM_{10}, building dust, surface soil and sediment of Raipur city is summarized in Table 1.

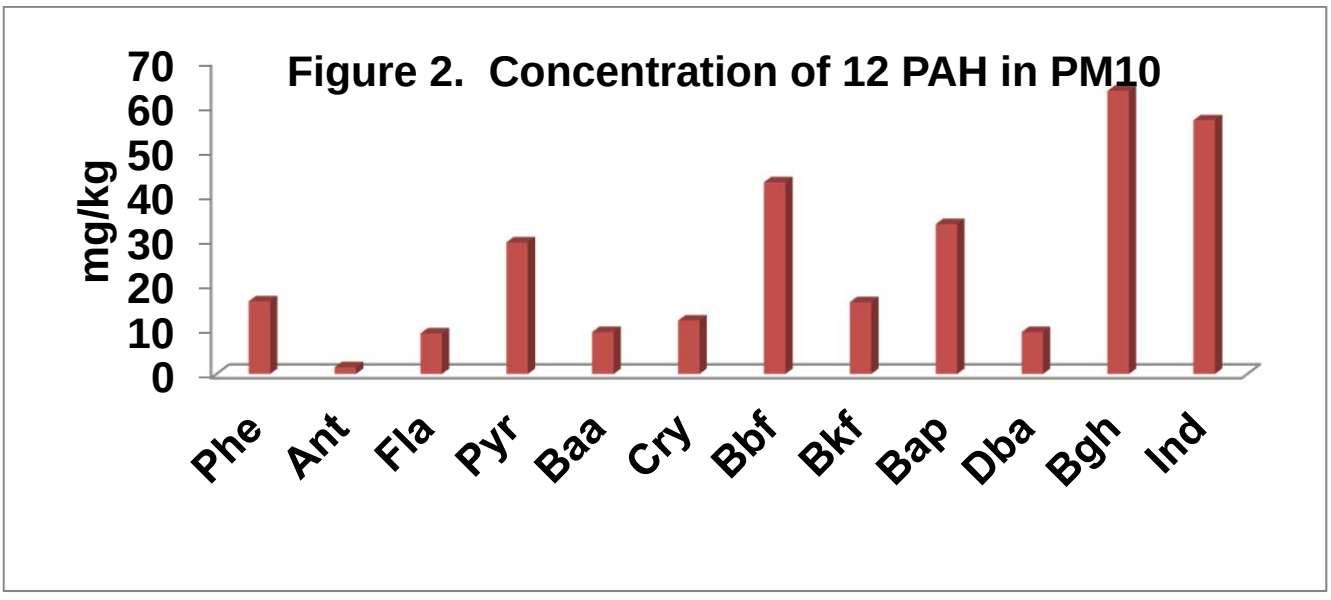
Table 1. Description of chemical species content in ecosystem of central India, mg kg^{-1}

Species	PM_{10}	Building dust	Soil	Sediment
BC	102000	93000	85400	87400
OC	66000	27000	219	1490
K	9640	2400	4929	6730
Mg	3647	1250	81	946
Ca	69700	22200	436	11070
Al	86370	82300	8280	10500
Fe	92180	89400	40200	59500
Mn	3265	6500	1140	1200

Cr	417	101	104	168
Cu	120	96	32	44
Zn	837	294	312	106
Cl^-	9930	1660	198	206
SO_4^{2-}	55400	11300	362	1590
PAHs	330	48	21	9.2

The highest content of all species was observed in the PM_{10}. Six species i.e. BC, OC, Ca, Al, Fe and SO_4^{2-} showedsignificant content in the PM. Three insoluble species i.e. BC, Al and Fe exhibited remarkably high content in the dust. Among them, BC showed the highest content in all four phases unlikely to the OC. The OC content was reduced remarkably in the soil and sediment may be due to hydrophobic nature. Among, 12 PAHs, the concentration of lighter compounds was decreased in the soil and sediment, Figures 1-2..





The contents of 14 species in the PM and dust are fairly correlated (r = 0.79). Whereas, their contents from the soil to sediment are well correlated (r = 0.97).

The whole ecosystem (i.e. air, water, soil and sediment) was contaminated with species i.e. Fe, Mn, Pb, As, Cl^-, SO_4^{2-}, PAHs, etc. beyond the permissible limits. The most soluble species i.e. Cl^- and SO_4^{2-} was observed to be percolated in the groundwater with lowering of pH values. In addition, they also tend to make soluble the bed rock by increasing the conductance value remarkably.

Conclusions

The black carbon is a main culprit for the climate change (i.e. increasing load of chemical species in the ecosystem, water quality degradation, increasing prevalence rate of air borne diseases, etc.) in the coal burning sites of country like India.

References:

[1] N. K. Jaiswal, PhD thesis: Studies on black carbon pollution in Chhattisgarh, Pt. RavishankarShukla University, Raipur, India, 2010.

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BLACK CARBON EMISSION AND CLIMATE CHANGE IN CENTRAL INDIA

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BACKGROUND

In central India, the natural resourced materials i.e. minerals and coal are deposited enormously. Thereby, several sponge iron, steel, cement and thermal power plants are running by emitting effluents into the environments. During winter period (December- January), the ecosystem becomes blackish due to accumulation of the carbonaceous aerosols in the ambient air [1]. The black carbon (BC) is a combustion derived particles and adsorbed several chemical species emitted during the burning processes. Two types of chemical species are emitted: species which are inherent in the materials i.e. metals, halides, etc., and others synthesized during the burning processes i.e. ammonia, nitrate, sulfate, polycyclic aromatic hydrocarbons (PAHs), etc.

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EXPERIMENTAL

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The OC content was reduced remarkably in the soil and sediment may be due to hydrophobic nature. Among, 12 PAHs, the concentration of higher compounds was decreased in the soil and sediment, Figure 1-2.

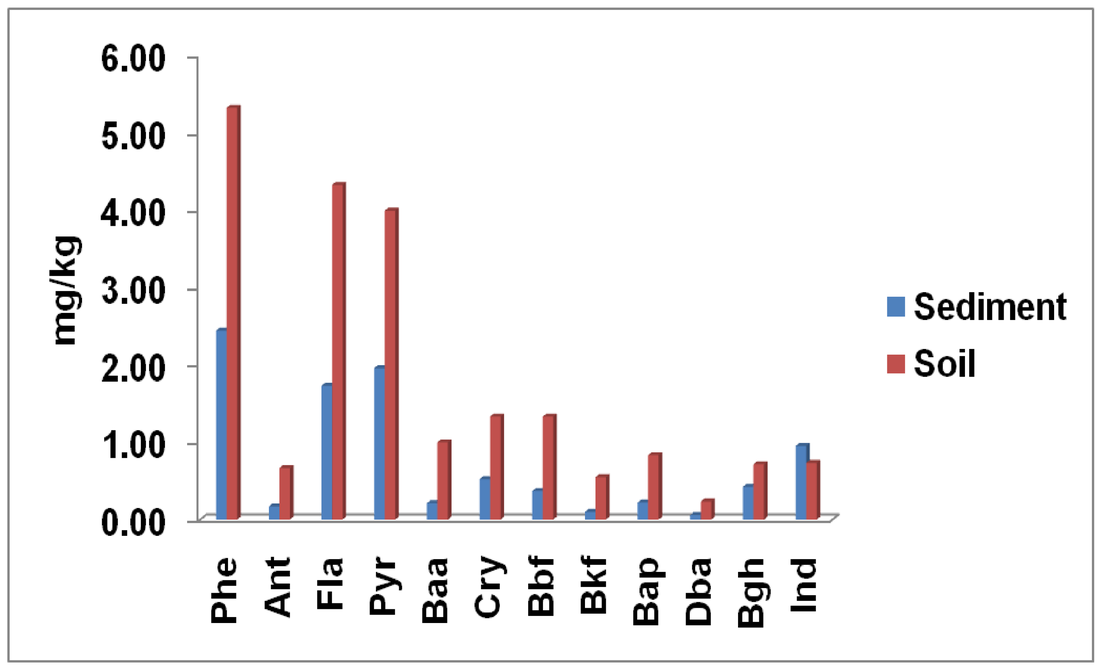

Figure 1. Concentration of 12 PAH in soil and sediment

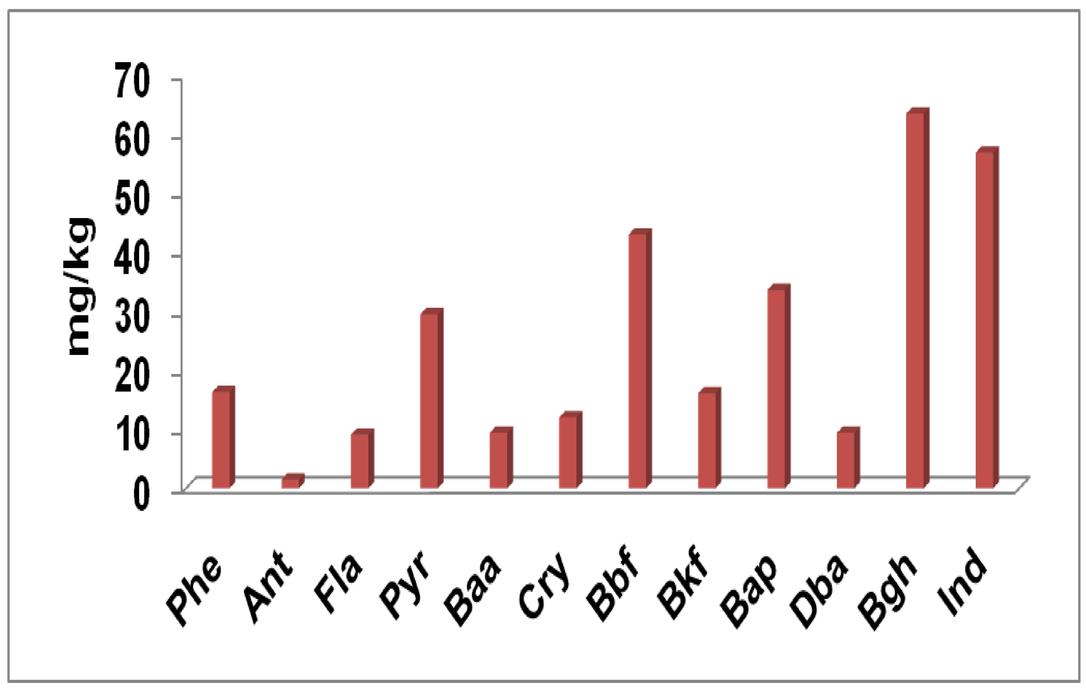

Figure 2. Concentration of 12 PAH in PM_{10}

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