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Atmospheric Pollution and Emission Sources in South Asian Urban Region

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Rapid urbanization, and lack of efficient monitoring and control of pollution, along with phenomena like Asian Brown Haze or prolonged episodes of winter fog, makes the South Asian atmospheric chemistry a very complex one. The anthropogenic aerosols released from this region are projected to become the dominant component of anthropogenic aerosols worldwide in the next 25 years (Nakicenovic and Swart, 2000). The region is one of the most densely populated in the world, with present population densities of 100-500 persons km^{-2}. There are six big cities, namely, Delhi, Dhaka, Karachi, Kolkata, Lahore, and Mumbai, each housing a population around or above 10 million. There is now a real concern about the sustainability of the region's ability to support the population due to air pollution, loss of biodiversity and soil degradation. Therefore, we conducted several extensive campaigns over last 10 years in Lahore, Karachi, and Islamabad in Pakistan to (1) chemically characterize the aerosols ($PM_{2.5}$ mass, concentrations of trace elements, ions, black and organic carbon), and gaseous pollutants (concentrations of NH_3, SO_2, HONO, HNO_3, HCl and $(COOH)_2$, and (2) identify the major emission sources in this region.

Exceedingly high concentrations of all species, relative to major urban areas of US and Europe, were observed. Concentrations of $PM_{2.5}$, BC, Pb, SO_4^{2-}, NH_4^+, HONO, NH_3 respectively, up to 476, 110, 12, 66, 60, 19.6 and 50 μgm^{-3} were observed in these cities, which were far in excess of WHO and US EPA air quality standard (Biswas *et al.*, 2008). We use air parcel back trajectories, intercomponent relationships and meteorological observations to explain chemistry and emission sources of aerosol constituents. Carbonaceous aerosols contributed up to 69% of the $PM_{2.5}$ mass (Husain *et al.*, 2007). Source apportionment was conducted using positive matrix factorization. The analysis has classified six emission sources of aerosol components, namely, industrial activities, wood burning, secondary aerosols, metal processing, vehicular emissions, and crustal and road dust. Findings of our study will play a vital role in adopting a strategy to regulate emissions, and to mitigate the long-term climate change in the region.

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