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Spatio-temporal variability in atmospheric abundances of EC, OC and WSOC over Northern India

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ABSTRACT

The atmospheric abundances of elemental carbon (EC), organic carbon (OC) and water-soluble organic carbon (WSOC) have been measured in aerosol samples collected during wintertime (December–March) from selected sites (urban, rural and high-altitude) in northern India. A characteristic feature of their abundance pattern, at urban sites, is reflected in the OC/EC ratios (range: 2.4–14.5, Av=7.8 $\pm$ 2.4, n=77) indicating dominant contribution from biomass burning sources (wood-fuel and agriculture waste). This is in sharp contrast to the OC/EC ratios at a rural site (range: 2.1–4.0, Av=3.1 $\pm$ 0.6, n=7) influenced by emissions from coal-fired industries. The long-term measurements made from a high-altitude site ($\sim$2000 m amsl) reveal significantly lower abundances of EC and OC; suggesting that boundary layer dynamics (during wintertime) play an important role in efficient trapping of pollutants within the Indo-Gangetic Plain (northern India). The WSOC/OC ratios are fairly uniform ($\sim$0.35) in aerosols over urban sites but relatively enhanced contribution of WSOC and higher ratios ($\sim$0.5) at a high-altitude site emphasizes the significance of secondary organic aerosols. The comprehensive data set on EC, OC and WSOC/OC ratios from northern India is crucial to improve model parameterization of carbonaceous aerosols for atmospheric scattering and absorption of solar radiation on a regional scale.

1. Introduction

Atmospheric aerosols, derived from natural and anthropogenic sources, play an important role in balancing the Earth's radiation budget by scattering and absorbing the solar radiation. The naturally occurring aerosol species (e.g. sea salt, SO_4^{2-} from volcanic eruptions) scatter the solar radiation and cause a cooling effect. On the other hand, elemental carbon (EC) and organic carbon (OC) emitted from anthropogenic sources (biomass burning, vehicular exhausts and fossil-fuel combustion) have direct impact on air quality and regional to global scale climate (Dey & Tripathi, 2008; Menon, Hansen, Nazarenko, & Luo, 2002; Venkataraman, Habib, Eiguren-Fernandez, Miguel, & Friedlander, 2005; Yang, He et al., 2005; Yang, Jian et al., 2005). In addition, anthropogenic aerosols have an indirect effect on atmospheric radiative forcing by acting as cloud condensation nuclei (CCN) (Haywood & Boucher, 2000).

The Indo-Gangetic Plain (IGP), extending from north to east, is one of the most polluted regions in northern India with characteristic emissions from small scale industries, vehicular traffic and biomass burning (wood-fuel and agriculture waste). During the winter season (December–March), northern India experiences severe cold, fog and hazy weather

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