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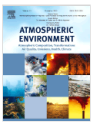

# The characteristics of $PM_{2.5}$ in Beijing, China

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## Abstract

Weekly $PM_{2.5}$ samples were simultaneously collected at a residential (Tsinghua University) and a downtown (Chegongzhuang) site in Beijing from July 1999 through September 2000. The ambient mass concentration and chemical composition of the $PM_{2.5}$ were determined. Analyses included elemental composition, water-soluble ions, and organic and elemental carbon. Weekly $PM_{2.5}$ mass concentrations ranged from 37 to 357 μg/$m^3$, with little difference found between the two sites. Seasonal variation of $PM_{2.5}$ concentrations was significant, with the highest concentration in the winter and the lowest in the summer. Spring dust storms had a strong impact on the $PM_{2.5}$. Overall, organic carbon was the most abundant species, constituting no less than 30% of the total $PM_{2.5}$ mass at both sites. Concentrations of organic and elemental carbon were 35% and 16% higher at Tsinghua University than at Chegongzhuang. Ammonium, nitrate and sulfate were comparable at the sites, accounting for 25–30% of the $PM_{2.5}$ mass.

## Keywords

$PM_{2.5}$; Beijing; Chemical composition; Organic carbon; Elemental carbon; Sulfate; Nitrate; Urban aerosol; Seasonal variation; Emissions

## 1. Introduction

The combination of high population density and rapid industrialization in China has inevitably led to an increase in emissions. These emissions have exacerbated the air pollution problems in large and medium size cities resulting in visibility reduction and health concerns. Ambient aerosols are largely responsible for the visibility deterioration seen in different areas (Chan et al., 1997; Christoforou et al., 2000). The health impact of particles has come into question due to epidemiological studies reporting an association between fine particle concentration and hospital admission records (IIASA (2000a) and IIASA (2000b); WHO Regional Office For Europe; UN Economic Commission For Europe, 1999). It has also been suggested that aerosols reduce agricultural crop yields due to reduced sunlight.

Relatively little data is available on fine particle concentrations or their composition in China. Winchester studied $PM_{2.0}$ at the Great Wall near Beijing in the late 1970s and found comparable elemental profiles to background aerosols in remote areas of the world (Winchester et al., 1981). A great deal of change has taken place since then and ambient particulate sampling studies have been conducted in a variety of cities. For instance, the urban air quality in Wuhan in the 1980s was shown to have an impact on the pulmonary function in children (He et al., 1993) and a local smelter was identified as the primary source of PM (Zelenka et al., 1994). A study in a coal mining region at Yungang demonstrated the local transport and dry deposition of carbonaceous particles (Christoforou et al., 1994). More recently, a study in Dongying, Jinan, Qingdao, Beijing and Shanghai showed that most of the ambient particle mass was in the submicron size range (Davis and Guo, 2000). A joint study sponsored by the USEPA (Wei et al., 1999) determined the concentration of $PM_{10}$ and fine particles in Lanzhou, Chongqing, Wuhan,