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High-resolution sampling and analysis of air particulate matter in the Pear River Delta region of Southern China: source apportionment and health risk assessment

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Hazardous air pollutants, such as trace elements in particulate matters (PM), are known or highly suspected to cause detrimental effects on human health. To understand the sources and associated risks of PM to human health, hourly time-integrated major trace elements in size-segregated coarse (PM10-2.5) and fine (PM2.5) particulate matter were collected and examined in an industrial city of Foshan in the Pearl River Delta region, China. Receptor modeling of the dataset by positive matrix factorization (PMF) was used to identify six sources contributing to PM2.5 and PM10 concentrations at the site. Dominant sources included industrial coal combustion, secondary inorganic aerosol, motor vehicles and construction dust along with two intermittent sources, biomass combustion and marine aerosol. The biomass combustion source was found to be a significant contributor to peak PM2.5 episodes along with motor vehicles and industrial coal combustion. Conditional probability function (CPF) was applied to estimate the local source effects from wind direction using the PMF-resolved source contribution coupled with the surface wind direction data. Health exposure risk for hazardous trace elements (Pb, As, Cr, Ni, Zn, V, Cu, Mn, Fe) and source-specific values were estimated. The total hazard quotient (total HQ =HI) of PM2.5 was 2.09, which is two times higher than the acceptable limit (HQ = 1). The total carcinogenic risk was 3.37*10-3 for PM2.5, which was three orders higher than the acceptable limit (i.e. 1.0*10-6). Among the selected trace elements, As and Pb posed the highest non-carcinogenic and carcinogenic risks for human health, respectively. In additional, our results showed that industrial coal combustion source was the dominant non-carcinogenic and carcinogenic risks contributor, highlighting the need for stringent control of this source. This study can provide new insight for policy makers to prioritize sources in air quality management and health risk reduction.