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Characteristics and sources of PM2.5-bound carbonaceous aerosols in the Yangtze River Delta, China

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Abstract:An investigation of atmospheric fine particle (PM2.5) from Shanghai, Nanjing and Ningbo in the Yangtze River Delta was conducted during Nov 2014 and Aug 2015. Organic species, including 16 polycyclic aromatic hydrocarbons (PAHs), 10 nitro-PAHs and C8 to C40 n-alkanes, and stable carbon isotopes OC (δ13COC) and EC (δ13CEC) were used to evaluate carbonaceous aerosols' spatiotemporal variations and identify their potential sources. The averaged concentrations of total PAHs and n-alkanes in Shanghai, Nanjing and Ningbo were 16.5 and 101.1 ng m-3, 21.1 and 128.2 ng m-3, 33.0 and 241.1 ng m-3, respectively, while the mean concentrations of 10 nitro-PAHs was 2.02, 2.37 and 2.70 ng m-3. Seasonal variations of organic compounds were listed in the following order: winter > autumn > spring > summer. N-alkanes detected in PM2.5 were characterized by odd carbon number preference, with a unimodal peak shape. The maximum carbon number (Cmax) was C29, followed by C27 and C31. According to diagnostic ratios and principle components analysis (PCA) methods, vehicle emissions and coal burning were the dominant sources of PAHs. The ratios of 2-nitrofluoranthene to 1-nitropyrene were larger than 5, indicating that atmospheric transformation from PAHs was a major source of nitro-PAHs. Meanwhile, primary emissions tracers i.e. 1-nitropyrene (the mean concentration of 0.024 ng m-3 in all cities) was observed, suggesting primary contribution of motor vehicle exhaust to the fine particulate organic aerosols. In addition, isotope abundances (δ13COC=-24.6 ± 0.8‰ and δ13CEC = -23.9 ± 1.4‰ and EC/TC ratio (0.2 < EC/TC < 0.5) in Shanghai demonstrated that fossil fuels (e.g. motor vehicles) were the most important source for carbonaceous PM2.5. We further focus on radiocarbon (14C) analysis and gas/particle partitioning of organic tracers on different size particles.
Keywords: organic tracers; stable carbon isotopes; spatiotemporal variations; sources apportionment; Yangtze River Delta