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Characterization and source apportionment of atmospheric organic and elemental carbon during fall and winter of 2003 in Xi'an, China

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Abstract. Continuous measurements of atmospheric organic and elemental carbon (OC and EC) were taken during the high-pollution fall and winter seasons at Xi'an, Shaanxi Province, China from September 2003 through February 2004. Battery-powered mini-volume samplers collected $PM_{2.5}$ samples daily and PM_{10} samples every third day. Samples were also obtained from the plumes of residential coal combustion, motor-vehicle exhaust, and biomass burning sources. These samples were analyzed for OC/EC by thermal/optical reflectance (TOR) following the Interagency Monitoring of Protected Visual Environments (IMPROVE) protocol. OC and EC levels at Xi'an are higher than most urban cities in Asia. Average $PM_{2.5}$ OC concentrations in fall and winter were 34.1±18.0 μg m^{-3} and 61.9±;33.2 μg m^{-3}, respectively; while EC concentrations were 11.3±6.9 μg m^{-3} and 12.3±5.3 μg m^{-3}, respectively. Most of the OC and EC were in the $PM_{2.5}$ fraction. OC was strongly correlated (R>0.95) with EC in the autumn and moderately correlated (R=0.81) with EC during winter. Carbonaceous aerosol (OC×1.6+EC) accounted for 48.8%±10.1% of the $PM_{2.5}$ mass during fall and 45.9±7.5% during winter. The average OC/EC ratio was 3.3 in fall and 5.1 in winter, with individual OC/EC ratios nearly always exceeding 2.0. The higher wintertime OC/EC corresponded to increased residential coal combustion for heating. Total carbon (TC) was associated with source contributions using absolute principal component analysis (APCA) with eight thermally-derived carbon fractions. During fall, 73% of TC was attributed to gasoline engine exhaust, 23% to diesel exhaust, and 4% to biomass burning. During winter, 44% of TC was attributed to gasoline engine exhaust, 44% to coal burning, 9% to biomass burning, and 3% to diesel engine exhaust.

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