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Characteristics and sources of black carbon and organic carbon in topsoil from different functional zones of Beijing, China

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Considering human activities are the most direct and important factors leading to the accumulation and loss of soil black carbon (BC), a detailed understanding of soil BC in different functional zones and reasonable soil management are the keys to determine whether soil is the carbon source or carbon sink. In this study, carbon concentrations and isotope compositions of black carbon (BC%, $\delta^{13}C_{BC}$) and organic carbon (SOC, $\delta^{13}C_{SOC}$) were determined in topsoil from different functional zones (roadside grass verges, parks, residential areas, mines, arable lands, woodlands and wastelands) in urban and suburban of Beijing, China. SOC% in urban area (averaging 1.67%) is higher than in suburban areas (averaging 1.05%). BC is not evenly distributed across different functional zones, but is more concentrated and variable in urban areas (0.11%-2.43%, averaging 0.73%) than in suburban areas (0.03%-0.70%, averaging 0.18%). The ratios of BC% to SOC% in suburban areas (0.04-0.40) are smaller than in urban areas (0.15-0.98). The $\delta^{13}C_{BC}$ of topsoil (-26.35‰ to -20.85‰) reflects that coal combustion has a strong impact on soil BC accumulation in Beijing. The carbon isotope differences between organic carbon and black carbon of the suburban and urban topsoil are positive (averaging +0.56‰) and negative (averaging -0.41‰), respectively. It suggests that urban areas are seriously influenced by human activities which lead to a large amount of fossil fuel combustion, but suburban areas have received a uniform deposition of atmospherically-transported finer BC aerosols.