Sources and characteristics of light-absorbing organic aerosol in Beijing, China

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Organic aerosol (OA) constitutes a substantial fraction of fine particle and plays an important role in human health and climate. Some OA has been found light-absorbing (brown carbon). Globally, brown carbon is particularly abundant and of great concern in several countries, such as South Africa, Indian and China. In some studies, biomass burning has been regarded as the most important source of brown carbon and has been considered in several modeling studies of radiative forcing. However, knowledge of sources and chemical compositions of these light-absorbing OA and its associated light absorbing properties such as efficiency still remains very limited in China. Here, state-of-the-art dual carbon isotope (^{14}C and ^{13}C) measurements are performed on both total OA and water-soluble OA to investigate fossil and contemporary source contributions. High performance liquid chromatography equipped with a UV/Vis absorbance detector and followed by a time-of-flight (TOF) mass spectrometer system (LC/DAD-ESI-HR-TOFMS) is also applied to determine the elemental compositions of complex light-absorbing organic compounds in Beijing. With these advanced techniques, sources and chemical composition of light-absorbing organic compounds in PM2.5 samples in Beijing during winter and summer have been determined. Our results show significant higher light absorbing water-soluble OA in winter compared to summer. Radiocarbon analysis reveals that fossil source accounts for about 60% of OA in winter in Beijing. Dual-carbon-isotope signatures confirm the significant contribution from fossil sources (coal and liquid fossil fuel) and LC/DAD-ESI-HR-TOFMS identifies light absorbing OA to molecular level. Our results not only clearly identify the importance of fossil source contribution to light-absorbing OA, but also quantify its contribution in different seasons. These findings and results provide important information for modeling radiative forcing of organic aerosol in China in the future.