2.115 Mixing State of Black Carbon in the Outflow of Urban Beijing: Implications for Light Absorption Enhancement.

Early Career Scientist

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Abstract:

Black carbon (BC) is the dominant aerosol absorber of solar radiation in the atmosphere. BC plays a major but highly uncertain role in both regional air pollution and global climate change, including light absorption and acting as ice and cloud nuclei. Previous researches demonstrated that the coatings on BC can enhance its light absorption, but the amplification depends on the mixing state, which is further influenced by emission sources and aging process in the atmosphere.

An intensive field campaign was conducted at Changping (40.14°N, 116.11°E), a reginal site approximately 45km northwest of downtown Beijing. In order to characterize the mixing state of BC in the urban outflow, a coupled system of Scanning Mobility Particle Sizer and Single Particle Soot Photometer (SMPS-SP2) was established to determine the refractory BC (rBC) core mass and accurate coating thickness in a wider range than SP2 only methods. The mass size distribution of rBC cores peaked at 172 nm, indicating a certain extent of biomass burning effect. The BC-containing particles were moderately coated, and the median coating thickness was 28 nm. During the pollution episodes, the coatings on BC were observed to become thicker as the level of pollution increased. This was proven to be efficient in enhancing the light absorption as large as a factor of 1.6, which substantially decreased the surface heat flux and depressed the development of PBL. This further enhanced the air pollution and established a positive feedback loop, which consequently accelerated the aging of BC. This study revealed the microphysical state of BC in the urban outflow and its effect on the light absorption, possibly providing some important constraints for models to evaluate BC's role in both regional air pollution and global climate change.