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Aging of atmospheric black carbon aerosol during the haze evens in the North China Plain

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Black carbon (BC) aerosols play an important role in modifying the PBL meteorology and severity of haze pollution through its radiative effect (Ding et al. 2016). The radiative effect of BC strongly depends on its mixing state or coating thickness, which is subject to the aging process in the atmosphere (Cheng et al. 2006, 2008). North China Plain (NCP) is one of the areas where both severe haze and high abundance of BC have been reported. By using a single particle soot photometer (SP2) and complimentary measurements, we investigated the aging of BC during several severe haze events in the North China Plain during our winter campaign in 2018. We calculated the size-resolved mixing state and aging rate of BC in the ambient air under different pollution levels. Our results show a fast aging of BC especially during the haze events with high concentrations of air pollutants and condensable vapors. The occurrence of fog episodes in the campaign enables us to analyze the BC-droplet interactions, especially the effect of aerosol size and coating thickness on its activation and removal, which is key for understanding the aerosol-cloud and aerosol fog interactions. Moreover, we find that most coated BC particles can be classified to a “core-shell” type while only a small fraction of BC-containing particles is in an “attached” type. It suggests that the traditional Core-Shell model should still be applicable for modeling the radiative properties of BC in the North China Plain. Based on the Mie model calculation, we determined their absorption enhancement factor of BC due to the aging process and discussed its implication to the formation of severe haze.

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