EGU21-3796
https://doi.org/10.5194/egusphere-egu21-3796
EGU General Assembly 2021

Persistent residential burning-related primary organic particles during wintertime hazes in North China: insights into their aging and optical changes

Lei Liu, Jian Zhang, and Weijun Li
Zhejiang University, Department of Atmospheric Sciences, School of Earth Sciences, Hangzhou, China
(liulei5233@zju.edu.cn)

Primary organic aerosol (POA) is a major component of $PM_{2.5}$ in winter polluted air in the North China Plain (NCP), but our understanding on the atmospheric aging process of POA particles and the resulting influences on their optical properties is limited. As part of the Atmospheric Pollution and Human Health in a Chinese Megacity (APHH-Beijing) programme, we collected airborne particles at an urban site (Beijing) and an upwind rural site (Gucheng, Hebei province) in the NCP during 13–27 Nov. 2016 for microscopic analyses. We confirmed that large amounts of light-absorbing spherical POA (i.e., tarball) and irregular POA particles with high viscosity were emitted from the domestic coal and biomass burning at the rural site and were further transported to the urban site during regional wintertime hazes. During the heavily polluted period ($PM_{2.5}$ > 200 μg m^{-3}), more than 60% of these burning-related POA particles were thickly coated with secondary inorganic aerosols (named as core–shell POA–SIA particle) through the aging process, suggesting that POA particles can provide surfaces for the heterogeneous reactions of SO_2 and NO_x. As a result, their average particle-to-core diameter ratios at the rural and urban sites in the heavily polluted period increased to 1.60 and 1.67, respectively. Interestingly, we found that the aging process did not change the morphology and sizes of POA cores, indicating that these POA particles are quite inert in the atmosphere and can be transported long distances. Using Mie theory we estimated that the absorption capacity of POA particles was enhanced by ~1.39 times in the heavily polluted period at the rural and urban sites due to the “lensing effect” of secondary inorganic coatings. We highlight that the “lensing effect” on burning-related POA particles should be considered in radiative forcing models and the governments should continue to promote clean energy in rural areas to effectively reduce primary emissions.