Chemical characterization of submicron aerosol in summertime Beijing: a case study in southern suburb in 2018

*Tianzeng Chen[1], Qingxin Ma[1,2,3], Hong He[1,2,3]

1. State Key Joint Laboratory of Environment Simulation and Pollution Control, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China, 2. Center for Excellence in Regional Atmospheric Environment, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen 361021, China, 3. University of Chinese Academy of Sciences, Beijing 100049, China

Atmospheric particulate matters have a crucial impact on climate change, visibility and human health. In this study, a detailed characteristic of summertime PM_1 was real-time measured in south suburb of Beijing from 16th August to 16th September 2018. Averaged PM_1 concentration of 24.1 ±18.0 $\mu g\ m^{-3}$ was observed, consisting of OM (50.8%), SO_4^{2-} (16.0%), BC (13.2%), NO_3^- (10.2%), NH_4^+ (9.2%), and Cl^- (0.6%). There was an accumulation mode with a peak diameter of ~500 nm for all the species (except BC), and OM was additionally characterized by a smaller mode of < 100 nm. Elemental analysis of OM showed that the diurnal variations of H/C, O/C, N/C, and S/C were correlated to the photochemical and aqueous-phase process. Four organic factors including one hydrocarbon-like (HOA) and three oxygenated (LO-OOA, SV-OOA and MO-OOA) organic aerosol factors were identified by positive matrix factorization (PMF) analysis. The contributions of these factors varied with PM_1 concentration and their average values were 31%, 30%, 14%, and 25%, respectively. Contribution of HOA was RH-independent but decreased with the increasing PM_1 concentration, while OOA factors were a combined result of RH and O_x ($=O_3+NO_2$), revealing the important role of photochemical and aqueous-phase process in OA evolution. The contribution of SV-OOA with the highest S/C increased significantly with RH, indicating a certain number of S-containing organics. Our results also showed that secondary OA was the dominant species, as well as increased with the pollution level, implicating VOCs and NO_x should be controlled to relieve the secondary OA pollution.

Keywords: Submicron aerosol, HR-ToF-AMS, Photochemical process, Aqueous-phase process, Positive matrix factorization

