Overview of the studies of SOA in fogwater and proposal of field observational research in Asia

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It has been well known that reactions of carbonyl compounds in fogwater are important sources of secondary organic aerosols (SOA) in the atmosphere (Ervens et al., 2013). Specifically, dicarboxylic acids, organosulfates, organonitrates, and imidazoles are water-soluble chemical species are expected to be formed in cloud/fog water. Although fog water chemistry was historically focused on inorganic species such as SO_4^{2-}, NO_3^-, NH_4^+, Ca^{2+}, etc. related to acid deposition, recent interest has been directed toward organic species related to air quality and climate change. In this paper, field observations of organic species in fogwater are briefly reviewed trying to identify and quantify the importance of cloud/fog chemistry for aerosols formation.
Fog and ground based cloud sampling and analysis of organic compounds have been rather intensively performed in United States and Europe with a very limited occasion in Asia (Herckes et al., 2013). In most of these studies, the analyses have been made only for organic carbon mass (OC) rather than chemical species. For the evaluation of the importance of fog chemistry in aerosol formation, identification of organic compounds with high-resolution mass spectrometry (for example Mazzoleni et al., 2010) or other sophisticated instruments are definitely needed.
On the other hand, haze pollution is very serious in many cities in Asia, and it has been well known that they contain very high concentrations of SO_4^{2-}, NO_3^-, and NH_4^+, as well as organic aerosols. The concentrations of reactive carbonyl compounds and inorganic ions in fogwater are expected to be comparable in many areas in Asia. Thus, the formation of organic sulfates and organic nitrogen compounds would be much facilitated, and their concentrations in fogwater may be much higher than in US and Europe.
Field observational research to analyze organic chemical species in fogwater and aerosols simultaneously to quantify the importance of atmospheric aqueous phase reactions would be significant both for understanding fundamental science and quantification of $PM_{2.5}$ for air quality.

References

Ervens D. E. et al., Dissolved organic carbon (DOC) and select aldehydes in cloud and fog water: the role of the aqueous phase in impacting trace gas budgets, Atmos. Chem. Phys., 13, 5117–5135, 2013.
Herckes, P., K. T. Valsaraj, and J. L. Collett Jr., A review of observations of organic matter in fogs and clouds: Origin, processing and fate, Atmos. Res., 132–133, 434–449, 2013.
Mazzoleni L. R. et al., Water-soluble atmospheric organic matter in fog: exact masses and chemical formula identification by ultrahigh-resolution Fourier transform ion cyclotron resonance mass spectrometry, Environ. Sci. Technol., , 44, 3690–3697, 2010.

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