Geophysical Research Abstracts
Vol. 20, EGU2018-18802, 2018
EGU General Assembly 2018

Freezing activity of droplets containing Humic-acid like substances (HULIS)

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Currently, the ice nucleation efficiency of organic materials is not well-recognized. HULIS are important surface-active components of water soluble organic carbon, and their presence may depress the surface tension of droplets, therefore, impacting the cloud droplet formation and the subsequent ice crystallization. In the present study, a recently developed and well calibrated optical droplet cooling array was used to measure the ice nucleating efficiency of droplets containing HULIS derived from ambient particulate matters, in parallel with determination of the surface tension by a drop shape analyzer (DSA-30) and chemical composition by an ESI-Orbitrap mass spectrometry. HULIS was extracted from particles collected in the atmosphere over Beijing using a well-established method (Lin et al. 2010), and then dissolved with Milli-Q water. The HULIS carbon content of each sample was quantified by a total organic carbon analyzer. The experiments showed that 1μl droplets containing HULIS (15.8 - 96.7 mg C/L) froze in the temperature range from -9°C to -22°C, which was well above the pure water background and the typical homogenous freezing temperature (below -38°C). Droplets with higher carbon content (96.7 mg C/L, surface tension 66.3 mN/m) froze at a lower temperature in contrast to those with lower carbon content (15.8-37.8 mg C/L, surface tension 70.2-71.5 mN/m). The freezing activities of mixtures of ammonium sulfate and HULIS and the related chemical composition of the HULIS samples will also be presented.

Lin, P., Huang, X.-F., He, L.-Y., and Zhen Yu, J.: Abundance and size distribution of HULIS in ambient aerosols at a rural site in South China, J. Aerosol Sci., 41, 74-87, doi:10.1016/j.jaerosci.2009.09.001, 2010.