Washington University in St. Louis

School of Engineering & Applied Science

Energy, Environmental & Chemical Engineering

EECE Department Seminar

Friday, March 17, 2017

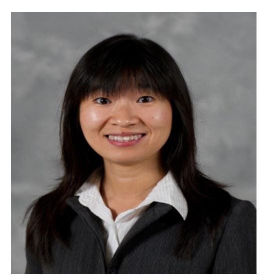
11:00am

Brauer Hall, Room 12

Chemical characterization and water solubility of organic aerosols in the southeastern United States

ABSTRACT

Secondary organic aerosol (SOA) constitutes a substantial fraction of fine particulate matter (PM) and has important impacts on climate and human health. The extent to which human activities alter SOA formation from biogenic emissions in the atmosphere is highly uncertain. Southeastern US is an ideal location for studying anthropogenic-biogenic interactions due to high natural emissions and the proximity to anthropogenic pollution sources. We conducted multiple ambient measurements in the greater Atlanta area and Centreville in rural Alabama with a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) during different seasons, as part of the Southeast Oxidant and Aerosol Study (SOAS), post-SOAS study, and Southeastern Center for Air Pollution and Epidemiology (SCAPE) study. We also developed a novel system for direct and online characterization of water-solubility of aerosols by coupling a Particle Into Liquid Sampler (PILS) to the HR-ToF-AMS. Based on integrated laboratory and field measurement results, we provide direct observational evidence on the magnitude of anthropogenic influence (SO_2, NO_x) on biogenic SOA formation. We show that isoprene-derived SOA is directly mediated by the abundance of sulfate, where 1 mg/m^3 decrease in sulfate can result in 0.23-0.42 mg/m^3 decrease in isoprene-derived SOA. Anthropogenic NO_x is shown to enhance nighttime SOA formation via nitrate radical oxidation of monoterpenes, resulting in the formation of condensable organic nitrates. We find that the majority of OA is water-soluble in both rural and urban sites. The water-solubility of OA factors, resolved with Positive Matrix Factorization analysis of AMS data, is directly investigated for the first time and is found to exhibit different degrees of solubility. Taken together, these comprehensive chemical characterizations of aerosols in the southeastern US demonstrate that anthropogenic sulfate and NO_x can mediate 43-70% of total OA (29-49% of total PM_1) in summer. The water-solubility of OA factors provides insights for interpretation of different OA subtypes and improves understanding of the complex OA sources in the atmosphere.



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Dr. Nga Lee (Sally) Ng is an assistant professor in the School of Chemical & Biomolecular Engineering and the School of Earth & Atmospheric Sciences at the Georgia Institute of Technology. She earned her doctorate in Chemical Engineering from the California Institute of Technology and was a postdoctoral scientist at Aerodyne Research Inc. Dr. Ng's research focuses on the understanding of the chemical mechanisms of aerosol formation and composition, as well as their health effects. Her group combines laboratory chamber studies and ambient field measurements to study aerosols using advanced mass spectrometry techniques. Dr. Ng serves as a co-editor of *Atmospheric Chemistry and Physics* and a member of the Editorial Board of the *Journal of Aerosol Science.* Dr. Ng's research contribution has been recognized by the Sheldon K. Friedlander Award and the Kenneth T. Whitby Award from the American Association for Aerosol Research, the EPA Early Career Award, the Health Effects Institute Walter A. Rosenblith New Investigator Award, and the NSF CAREER Award.

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