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NUCLEATION AND GROWTH OF ATMOSPHERIC PARTICLES

P. McMurry, J. Scheckman, M. Titcombe, B. Williams, University of Minnesota
K. Barsanti, F. Eisele, and H. Friedli, University Corporation for Atmospheric Research
C. Kuang, Brookhaven National Laboratory
J. Zhao, University of Colorado
J. Smith, National Center for Atmospheric Research

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Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory
P.O. Box, Upton, NY
www.bnl.gov

ABSTRACT

New particle formation (NPF) in the atmospheric is a two-step process: Nucleation leads to the birth of stable nuclei that subsequently grow to sizes that can be detected and affect the atmosphere's radiative properties. Our group is studying both of these processes. Our nucleation research is largely supported by NSF and involves measurements of neutral molecular clusters formed by nucleation with a new custom-designed mass spectrometer (the Cluster-CIMS) and measurements of nanoparticle size distributions as small as 1 nm with a new aerosol spectrometer (the DEG SMPS). These measurements are providing new insights into aspects of cluster behavior that affect nucleation rates. The U.S. DOE supports our research on nanoparticle growth rates. This research couples physical and chemical measurements of aerosol properties and behavior. The TDCIMS, which enables real-time measurements of composition for freshly nucleated particles as small as 8 nm and was developed with support from DOE, is the most important tool in this work. Our most important discoveries about processes that affect growth rates are summarized in a recent PNAS article (doi:10.1073/pnas.0912127107). In short, this work has shown that alkylammonium-carboxylate salts, formed, for example, by reactions between amines and carboxylic acids, account for 20–50% of the mass of freshly nucleated particles in locations that include Atlanta, Mexico City, Boulder, and Hyytiälä, while sulfates account for only about 10%. These newly discovered compounds help to explain the high growth rates of freshly nucleated particles that have been observed around the globe and help to explain why nucleation is an important atmospheric process, not just a scientific curiosity. Our poster will provide an overview of this work.

This poster will be displayed at ASR Science Team Meeting.