

Research Highlight

Two new instruments enabled the first measurements of atmospheric aerosol number distributions during nucleation events down to one molecule. The Cluster CIMS (chemical ionization mass spectrometer) was used to measure sulfuric acid vapor and neutral molecular clusters that contained up to four sulfuric acid molecules. The DEG SMPS (scanning mobility particle spectrometer operated with a 1-nm diethylene glycol condensation particle counter as detector) measured mobility distributions down to 1 nm. These measurements are providing new insights into the earliest stages of nucleation and growth in the atmosphere.

New particle formation (NPF) can lead to enhanced concentrations of cloud condensation nuclei (CCN) and therefore may affect climate. NPF is a two-step process. Nucleation leads to the production of stable nuclei (particles) that must then grow to a size large enough to serve as CCN before they are lost by coagulation with preexisting particles. Atmospheric observations show that nucleation rates and growth rates are much higher than would be predicted with existing models. There is a need to understand the nucleation and growth mechanisms so that these processes can accurately be represented in regional and global models. The development of nucleation and growth models will require measurements of the smallest particles and molecular clusters, as they are formed and grow. This work describes the first such measurements that have been reported.

Although the Cluster CIMS and DEG SMPS employ entirely different measurement principles, number distribution functions measured with these instruments in the ~1-nm range where they overlap are in surprisingly good agreement. We are using measurements with these instruments to study the processes responsible for nucleation and growth in the atmosphere and in laboratory chamber studies.

Reference(s)

Jiang J, J Zhao, M Chen, J Scheckman, BJ Williams, FL Eisele, and PH McMurry. 2011. "First measurements of neutral atmospheric cluster and 1-2 nm particle number distributions during nucleation events." *Aerosol Science and Technology*, 45, doi:10.1080/02786826.2010.546817.

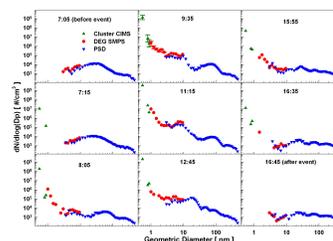
Jiang J, M Chen, C Kuang, M Attoui, and PH McMurry. 2011. "Electrical mobility spectrometer using a diethylene glycol condensation particle counter for measurement of aerosol size distributions down to 1 nm." *Aerosol Science and Technology*, 45, doi:10.1080/02786826.2010.547538.

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Working Group(s)

Aerosol Life Cycle



Number distributions measured during a nucleation event in Atlanta on August 23, 2009. Data were measured using the Cluster CIMS (green), the DEG SMPS (red), and conventional aerosol instrumentation (blue).