Aerosol acidity: the underappreciated driver of particle formation and its impacts on health, climate and ecosystems

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Abstract

Particle pH is a critical but poorly constrained quantity that affects many aerosol processes and properties, including composition, concentrations, nutrient availability and toxicity. Sulfate is often the main acid component that drives pH of atmospheric particles and is neutralized to varying degrees by gas phase ammonia. Reductions in SO_2 emissions, combined with constant ammonia levels from agriculture and livestock have lead to the expectation that aerosol acidity will progressively decrease over time. This expectation has guided policy in the US and Europe. Using chemically comprehensive data sets, combined with thermodynamic analysis reveals a very different view of aerosol acidity. We show that aerosol in many regions of the world is highly acidic (pH between 0 and 2) and will continue to remain so despite continued reductions in sulfate. This counterintuitive realization carries profound implications for aerosol processes in pristine and polluted atmospheres. The remainder of the talk will focus on two such implications: *i*) the bioavailability of trace nutrients in dust aerosol and its impact on ecosystem productivity , and, *ii*) the impact of pH prediction biases in regional and global aerosol model simulations.

Short Bio

Athanasios Nenes received a Ph.D. in Chemical Engineering from the California Institute of Technology. His research focuses on atmospheric chemistry, aerosol-cloud interactions, air quality and biogeochemical cycles, through a combination of theory, instrument development, measurement and modeling. Prof. Nenes is an author in more than 230 peer-reviewed manuscripts. Prof. Nenes is developer of the ISORROPIA aerosol thermodynamic equilibrium codes, and co-inventor of the Continuous Flow Streamwise Thermal Gradient CCN chamber and Scanning Flow CCN Analysis. He has received numerous distinctions, such as a European Research Council Consolidator Grant (2016), the Robert W. Vaughan Lectureship, California Institute of Technology (2014), the American Geophysical Union Ascent Award (2012), the Henry G. Houghton Award, American Meteorological Society (2009), the Kenneth T. Whitby and Sheldon K Friedlander Award Awards from the American Association for Aerosol Research (2011, 2005), a NASA New Investigator Award (2004) and a US NSF CAREER Award (2004).