PURDUE UNIVERSITY | Environmental and Ecological Engineering

EEE Research Seminar
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Location: POTR 234 (Fu Room)

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New Particle Formation in the Upper Atmosphere

Abstract
The major remaining uncertainty in climate projections stems from the aerosol-cloud-climate interactions in the atmosphere. Therefore, an accurate representation of aerosol particles and clouds is the foundation of any effort to forecast long-term climate change. Aerosol formation in the upper atmosphere is particularly important because it may account for at least a third of global cloud condensation nuclei (CCN). Additionally, this process serves as a natural analog for climate interventions that involve introducing particles into the stratosphere. However, the precursor vapors and the mechanisms that drive aerosol formation at high altitudes remain poorly understood.
This talk will present results that illustrate how laboratory experiments can help to fill this knowledge gap. Using experiments performed in the CERN CLOUD chamber, we show that nitric acid, sulfuric acid and ammonia form particles synergistically, at rates orders of magnitude faster than those from conventional ternary H2SO4 nucleation. The importance of this mechanism depends on the availability of ammonia, which has recently been observed at unexpectedly high levels in the upper troposphere over the Asian monsoon region. Once particles are formed, the co-condensation of ammonia and abundant nitric acid alone is sufficient to drive rapid particle growth to CCN sizes with only trace sulfate. Our model simulations further confirm that ammonia is efficiently convected aloft during the Asian monsoon, driving rapid multi-acid HNO3–H2SO4–NH3 nucleation in the upper atmosphere and producing efficient ice nucleating particles (INPs) that spread across the mid-latitude Northern Hemisphere.

Bio
Mingyi Wang is an Assistant Professor in the Department of Geophysical Sciences at the University of Chicago. Wang's research provides novel approaches to constrain atmospheric chemistry and aerosol microphysics, addressing pressing societal needs such as science-based policy making, aerosol forcing prediction, and climate intervention assessment. Prior to joining UChicago, he was a Schmidt Science Postdoctoral Fellow in chemical engineering at Caltech. He received his Ph.D. in atmospheric chemistry from Carnegie Mellon University. Wang's research has been published in *Nature*, *Science*, *Nature Chemistry*, *Nature Geoscience*, *Nature Communications*, and *Science Advances*, and has been recognized with awards such as the Sheldon K. Friedlander Award from the American Association for Aerosol Research.