DEPARTMENT OF CHEMISTRY AND ENVIRONMENTAL SCIENCE
SEMINAR SERIES
FALL 2023

WEDNESDAY, OCTOBER 18, 2023
TIERNAN HALL – LECT. HALL 1
1:00PM-2:20PM

GUEST SPEAKER

Dr. Jiajue Chai, Ph.D.
Assistant Professor
State University of New York College of Environmental Science and Forestry
(SUNY ESF)
Syracuse, NY

TOPIC

Isotopically quantifying the fates of atmospheric reactive nitrogen species

ABSTRACT

Atmospheric reactive nitrogen (RN) species including nitrogen oxides (NO_x= NO+NO_2), nitrous acid (HONO), nitric acid (HNO_3), ammonia (NH_3) and particulate nitrate (pNO_3^-) have significant implication for air quality, climate as well as human and ecosystem health. Understanding RN — the sources, chemical transformations as well as sinks — is a first order question in atmospheric chemistry. Stable isotopic composition analysis provides a unique tool to tracking these species and holds promise for constraining and quantifying their budgets. HONO, of particular interest, is a major daytime precursor of hydroxyl radical (OH) that influences the atmospheric oxidative capacity and determines the lifetime of many trace gases. However, its budget remains poorly constrained due to huge uncertainties associated with various emission sources and secondary production mechanisms. Recently, I developed and validated the first method and instrumentation for quantification of the isotopic composition N ($^{15}N/^{14}N$) and O ($^{18}O/^{16}O$ and $^{17}O/^{16}O$) of HONO. By integrating the HONO method with our validated methods for other major RN species, we have successfully deployed our instrumentation in multiple field campaigns to simultaneously characterize the isotopic composition of HONO, NO_x, NO_2, HNO_3 and pNO_3^- associated with various sources (e.g., vehicular, soil and biomass burning emissions) and secondary chemistry under the influence of differing meteorological conditions.

In this talk, I will discuss our isotopic approach, and focus on the utilization of the N isotopes to distinguish HONO among sources, as well as the combination of concentration measurements and N and O isotopic analysis to constrain potential mechanisms for RN cycling and oxidation chemistry in the atmosphere in both the lab and the field under a variety of environments. The improved quantification of HONO budget will advance our ability to better predict ozone (O_3) and secondary aerosols (SA) in various environments, ultimately contributing to promotion of O_3 and SA mitigation strategy and policy.

BIO

Dr. Jiajue Chai is an atmospheric chemist, with special interests in tracking sources, atmospheric processes and sinks of reactive nitrogen species, and quantitatively understanding their implications for air quality, climate, and human and ecosystem health. To address these

questions, his research brings together a novel set of skills including instrumentation, analytical methods, theory and modeling to investigate atmospheric chemistry in both the laboratory and field. Ultimately, his research findings will improve prediction and mitigation of the air quality and climate change. After receiving his Ph.D. in environmental and physical chemistry from ESF, he moved to Brown University and completed his postdoctoral training in combustion chemistry and stable isotopes chemistry, first at the School of Engineering and then at the Department of Earth, Environmental and Planetary Sciences. He then became an Assistant Professor of Research at the Brown University's Institute for Environment and Society in 2020. In 2023, he moved back to ESF as an assistant professor to continue his research in atmospheric chemistry in diverse environmental settings. In particular, he was a key member of the NASA Achievement Award in recognition of his contribution to the NOAA and NASA led field campaign named “Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ)”. Dr. Chai has so far been awarded four NSF grants, with foci on laboratory investigation, field observations and numerical simulations relevant to air quality.

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