Poster #171

Towards a Mechanistic Understanding of Land-Atmosphere Interactions of Reactive Oxides of Nitrogen SBR Early Career Award

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Global soils are known to be a major source of oxides of nitrogen to the atmosphere. While these emissions have traditionally be been associated with nitric oxide (NO) and nitrous oxide (N_2O), recent laboratory measurements and satellite-global model comparisons suggest that nitrous acid (HONO) and nitrogen dioxide (NO_2) may also be an important constituent of the N-budget. Unfortunately, the processes controlling these emissions are not understood due to challenges in elucidating details of the relevant abiotic and biogenic processes occurring within the terrestrial environment. This is especially true for soil microbial emissions of reactive nitrogen (e.g., NO, NO_2, and HONO)—gases that directly and indirectly affect climate by controlling the oxidative capacity of the atmosphere, lifetime of greenhouse gases, and formation rate of aerosols. In this presentation, I will discuss recent progress made in understanding the abiotic and biogenic processes that determine the sources and fate of HONO in soil. We developed a full automatic soil chamber array (for soil flux measurements) and field-tested it in a northern hardwood forest during a one-month field campaign at the University of Michigan Biological Station in July 2016. The system also featured a new chemiluminescence detector for ultra-sensitive detection of NO, NO_2, and HONO via a dual-wavelength photodissociation converter, which was also characterized during this time. In addition, flow reactor experiments were conducted in the laboratory to understand the mechanisms associated with the reduction of NO_2 on soil surfaces coated in soil organic matter. Our findings suggest that hydroquinones and benzoquinones, which are interchangeable via redox equilibria, contribute to thermal and photochemical HONO formation, respectively. The results provide further evidence that redox chemistry occurring on soil surfaces is a source of HONO to the nocturnal and daytime boundary-layer. Finally, I will describe kinetics studies using a coated wall flow reactor and surface composition studies using nano-DESI and nanoSIMS [at the Environmental Molecular Sciences Laboratory (EMSL)] to investigate the role that minerals and organic matter play in storing and releasing HONO in soil.