Title: Laboratory and Field Studies of Processes Impacting Reactive Nitrogen Oxide Fluxes to and from Soil

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Project Abstract:

Nitrogen (N) cycle processes play a crucial role in regulating the overall abundance of oxidized inorganic nitrogen in terrestrial ecosystems, and are responsible for initiating the subsequent loss of soil N via volatilization and leaching. This poster will outline our laboratory's effort to understand the sources and sinks of reactive nitrogen oxides (NO, NO_2, HONO) with the ultimate goal of improving how fluxes of reactive nitrogen oxides are represented in chemical-transport models. In this presentation we will share results of a field campaign carried out in 2021 that aimed at studying the emissions of reactive nitrogen oxides from soil and freshly senesced leaves in the autumn. We revealed that the leaves some deciduous tree species become sources of NO in forested regions when nitrogen that is not reabsorbed during senescence is released to the atmosphere. In addition, we will present results of a new study of the mechanism of HONO release from soil clay mineral surfaces at the molecular level. Specifically, the surface acidity of the kaolin mineral dickite was probed using scanning conductance ion microscopy (SICM) for the first time. Steps and edges consisting of incompletely coordinated aluminum hydroxide groups were found to be likely reactive sites that are responsible for the release of nitrite as HONO to the atmosphere at soil pH well above the pK_a of nitrous acid. Furthermore, we found that the basal planes of dickite exhibited a persistent negative charge, which was surprising given the anisotropic structure of dickite. To explore this observation we initiated a study of the structure of kaolin mineral surfaces and will present results on the first use of crystal truncation rod (CTR) diffraction to study kaolin mineral surfaces. These results open up a new realm of possibilities for studying reactions on clay mineral surfaces that impact atmosphere-soil exchange of atmospherically-relevant gases.