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# Linking Agricultural Soil Microbiomes to Space-Based Nitrogen Detection

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Agricultural production occupies over half of the U.S. total land area, and management generally adds large amounts of nitrogen (N) to the environment. Microbial N-cycling processes are known to produce reactive N species (N2O, NH3, NOx), but their precise contribution to flux is not known. Studies examining this relationship often find inconsistent results, particularly when evaluating climate smart agricultural (CSA) management practices. CSA practices aim to enhance agricultural adaptation to climate change while maintaining agricultural productivity, and specific management choices can vary depending on the region and cash crop. Assessments of these practices often include the modeling of gas flux and abiotic soil properties, but these models frequently overlook the determining impact that the soil microbiome composition and activity have on the flux of N-containing species, and how this can change in response to land management.

Here, we aim to explore how microbial N transformations regulate the flux of reactive N under conventional and CSA management in regions where reactive N flux is high. We conducted soil sampling across six states in NH3 hotspot regions selected using NASA satellite data, employing a ‘top down’ approach to effectively describe N emissions and evaluate current nutrient management models. Within each hotspot location, a field under prevailing (PRE) agricultural treatment for the region was sampled, along with a CSA aspirational (ASP) version and a nearby riparian (RIP) site. We characterized the microbial community composition and abundance to quantify N-cycling communities and will pair this analysis with soil protein assays and N cycling gross activity rate. Gross nitrification and ammonification will be measured using soil mesocosms and isotope dilution techniques with simultaneous N2O gas chromatography measurements to evaluate the microbial contribution of these processes to N gas flux. Elevated N inputs in PRE treatments are expected to stimulate nitrification and N2O production by increasing substrate availability. ASP treatments are expected to have greater organic matter accumulation, which will translate to higher extractable protein. In sites associated with livestock operations, gross ammonification rates are expected to be elevated, and we also expect to see large pools of nitrate resulting from cattle excreta.