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**ABSTRACT TITLE:** Prognosing the niche and activity of microbial functional guilds using trait-based modeling

**ABSTRACT:** Soil biogeochemistry and microbial ecology are tightly coupled through complex microbial communities that mediate the majority of biogeochemical cycles. The structure and function of these microbial communities are shaped by transient physical, chemical and biological interactions. These communities, in turn, affect an array of environmental parameters (e.g., pH, oxygen concentrations, and nitrogen availability) and shape biogeochemical reaction networks related to organic matter breakdown and nutrient cycling. Feedbacks between systems biogeochemistry and the composition of microbial populations has provoked interest in improving representation within ecosystem models of certain microbial functional guilds (i.e., microbes catalyzing the same reaction independent of phylogeny). Trait-based models are promising tools to represent the multidimensional niche of microbial functional groups with their fitness prescribed by their combined traits and trade-offs. This approach allows prediction of the distribution of distinct functional communities along spatial and temporal gradients. Here we describe the development and testing of a trait-based model of autotrophic microorganisms, in particular we focus on the seldom-studied nitrite-oxidizing bacteria (NOB). The NOB catalyze the conversion of $NO_2$ to $NO_3$ and our previous modeling work has shown this group to be important in determining net fluxes of $N_2O$ produced by ammonia-oxidizing organisms. We subsequently mapped the niche of three distinct groups of this functional guild, an oligotrophic autotroph, a copiotrophic autotroph, and a mixotroph, across physicochemical gradients in substrate (nitrite and organic carbon) and oxygen. We will discuss this data here with further reference to the importance of emergent communities in determining the rate of $NO_2$-oxidation.

Looking forward, trait-based models are ideal frameworks for integrating the kind of information readily available from dvanced omic techniques. We provide examples of how this information can be used to (a) directly inform the value of different traits, and (b) weight the initial parameterization of certain traits (e.g., substrate utilization) to specific groups within a functional guild.