Title: **Pore to Core: Linking Soil Organic Carbon Protection Mechanisms to Ecosystem CO2 Fluxes in Response to Varying Antecedent Soil Moisture Conditions**

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Project Abstract: The persistence of soil organic carbon in soils is a function of an integrated set of protection mechanisms, encompassing physical occlusion, chemical composition, and microbial competencies. Understanding how these three mechanisms intersect to protect carbon has been the focus of several years of research on this project; we have focused particularly on how antecedent drought and flood change the chemical forms and distribution of carbon through soil pores. These changes to pore-scale carbon chemistry and accessibility have then been assessed through the microbial production of carbon dioxide at the soil core scale.

We have used these experiments to improve our representations of carbon dioxide emissions from soils in response to extreme wetting and drying, with specific attention given to physical controls on microbial proximity to substrate and diffusion limitations. These findings have both informed process-rich simulation models and conceptual models of the contributions of physical occlusion and chemical composition to C longevity.

The third major leg of this project has been a series of data syntheses. These have, over the duration of this project, examined the importance of moisture, temperature, and geographic location to overall carbon fluxes, and assessed the fidelity of process models at a variety of spatial and temporal scales. These analyses have drawn connections between regional carbon distribution, carbon dioxide fluxes, and core-scale experimental conditions.

We summarize our advances toward a process-rich understanding of how SOC is decomposed as a result of pore-scale changes in SOC physical protection under varying antecedent moisture conditions.