Title: Pore- to Core-Scale Research to Inform Ecosystem-Scale Soil C Biogeochemistry

Program: Terrestrial Ecosystem Science Program

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The spatial separation of substrate, microbes, and extracellular activity is an important mechanism of soil organic carbon (SOC) protection in soils, and one that is difficult to represent in predictive models at any scale. Macropore networks and their connectivity control microbial access to physically protected C in soils. Under conditions of partial to full water saturation, potentially labile compounds can desorb and diffuse from micropore domains to macropore networks accessible to microorganisms. Therefore, the quality of the SOC in pore waters held with different tensions is a key characteristic needed to differentiate physical and chemical SOC protection mechanisms. The decomposability of this C is needed to determine its potential contribution to net GHG fluxes as the protection mechanism breaks down through changing local environmental conditions.

We have studied intact soil cores collected from the Disney Wilderness Preserve, FL (DWP). Water dynamics in this system, particularly water table rise and fall, appear to be a strong control on the emissions of C-gases and the persistence of soil organic matter. Soils at DWP are dominated by sandy textures, and depending on local topographic position show moderate to high levels of SOM accumulation at the surface. Samples of soil pore water held at two different water tensions were collected from three continuous-depth DWP soil cores (0-30, 30-60, and 60-90 cm), from three transect locations (dry, intermittently wet, and wet). The more tightly held pore waters (500 mb) had significantly more condensed hydrocarbons and tannins compared to the more loosely held water (15 mb), which had significantly more lipids. These differences were consistent for all three transect positions, and all three soil depths. These pore waters were then used as growth substrates for cultivation of selected bacteria (*Streptomyces cellulosae, Cellvibrio japonicus*) and fungi (*Trichoderma reesei*). For all organisms, significantly more CO_2 was respired from the higher-tension pore waters characterized by the more complex C compounds. If mobilized, currently-protected SOC would become biologically available and contribute to greenhouse gas fluxes to the atmosphere.