Poster# 106

Pore- to Core-Scale Research to Inform Ecosystem-Scale Soil C Biogeochemistry: Effects of Soil Moisture on Heterotrophic Respiration Across Spatial Scales

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Soils store an enormous amount of organic carbon (SOC), but the potential lability of this carbon pool is poorly understood. In particular, our understanding of how soil heterotrophic respiration (R_H) interacts with soil water content (θ) is limited both by sparse observations and the empirical model formulations used by most earth system models. Improved mechanistic models linked to microbial population distribution, substrate access, and hydraulic conductivity are urgently needed. We derived and tested a novel, three-parameter moisture function (f) developed from pore-scale process knowledge and simulations. We tested f against a wide range of published data for different soils, and found that it predicted diverse R_H-θ relationships well. This function represents a mechanistic foundation for understanding how underlying processes affect the R_H-θ relationship in different soils, directly linking the pore-scale mechanisms with macroscale observations. Working at larger spatial scales, we also examined the question of whether changes in global R_H are driving already-observed changes increases in total soil respiration (R_S). Using an expanded global soil respiration database, we document increases in observed R_H:R_S ratios over time, frequently associated with precipitation changes; show this is consistent with multiple complementary lines of evidence; and finds that these trends are robust to sampling variability with respect to ecosystem type, disturbance, measurement methodology, and climate normals. Taken together, these cross-scale model and data analyses emphasize the importance of mechanistic models tightly linked with broad-scale data syntheses.