Poster# 105

Pore- to Core-Scale Research to Inform Ecosystem-Scale Soil C Biogeochemistry: Drought and Wetting Events Alter Soil Carbon Dynamics

VL Bailey[1], AP Smith[1], Z Fan[1], C Liu[1], and B Bond-Lamberty[1]

[1] Pacific Northwest National Laboratory

Contact: Vanessa Bailey [vanessa.bailey@pnnl.gov]

Droughts and other extreme precipitation events are predicted to increase in intensity, duration and geographic coverage, with uncertain implications for terrestrial carbon (C) persistence and vulnerability. Soil models have difficulty reproducing C dynamics after such extreme events, perhaps due to an inadequate representation of how processes in the interconnected soil pore network interact with abiotic drivers, such as antecedent drought conditions, to alter larger-scale C fluxes. Soil wetting from above (precipitation) results in a characteristically different pattern of pore-filling than wetting from below (groundwater). Building on our previous research demonstrating that different chemical classes of C are associated with particular soil pore size domains, we hypothesized that this differential pore-scale wetting will affect soil C mineralization, especially when soils are rewet following drought conditions. Our findings suggest that classic studies that used field-moist soils under static moisture conditions–upon which predictive models have been parameterized–may constitute a “best-case” scenario. Wetting direction interacted with antecedent drought and physical protection of C to significantly increase the rate and quantities of gaseous C emissions from the soil. These losses may be attributed to broader conditions of bioavailability, driven by C solubilization and transport to microbially colonized and metabolically favorable locations with the soil matrix. Models, which are increasingly microbially-oriented, should treat soil moisture within a three-dimensional framework emphasizing hydrologic conduits for substrate and resource diffusion. As droughts and shifts in precipitation patterns increase, understanding how these events interact at a variety of scales is essential in order to improve predictions of the C sink/source capability of global soils.