

TES Lab Research

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

Vanessa Bailey (vanessa.bailey@pnnl.gov) - Pacific Northwest National Laboratory (PI), Ben Bond-Lamberty; Chongxuan Liu (Co-PIs).

The spatial separation of soil organic carbon (SOC), microbes, and extracellular activity is an important mechanism of SOC protection in soils and is difficult to represent in predictive models at any scale. Our overarching science objective is to develop the mechanistic understanding of how soil carbon in protected locations is metabolized as a result of pore-scale changes in SOC bioavailability, and to test that understanding for improving the predictive power of ecosystem models. We address this objective by integrating modeling, observations, and experiments. Analyses of global- and ecosystem-scale models are used to identify field sites where pore- to core-scale research can impact model uncertainty by describing SOC metabolism and greenhouse gas (GHG) fluxes. By studying intact soil cores from these sites, we investigate the key species of SOC transported when soil pore connectivity is altered by increasing water content, and the mechanisms by which such protected carbon is mobilized and mineralized. The resulting mechanistic understanding will be used to develop pore-scale reaction networks to describe SOC transformation, and pore- to core-scale reactive transport models to describe SOC distribution and movement affecting net greenhouse gas fluxes. These experimental data and mechanism-based models will be used to test and improve ecosystem-scale models. Such a pore to core to ecosystem-scale analysis and understanding could underpin new mechanistic models of C transformation and transport in soils, improve the predictive power of larger-scale models, and address important Terrestrial Ecosystem Science Program goals.