Integrating models of greenhouse gas production from soils at multiple scales

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The mobilization, decomposition, and respiration of soil carbon represents the second largest greenhouse gas (GHG) fluxes of the terrestrial biosphere, and is critical to understand across pore to core to ecosystem scales. This poster integrates recent PNNL research on how models can effectively simulate the interaction of temperature, water, and soil carbon processes at multiple scales.

At pore scales, reactive transport models (RTM) for simulating biogeochemical reaction network and kinetics under variable water saturation conditions are being developed in the framework of our previously developed unified multi-scale modeling. The RTMs are being used to evaluate how pore-scale hydrological connectivity affects soil organic matter degradation and GHG release in soils, and to derive functional relationship between GHG flux and water saturation at the macroscopic scale.

At larger scales, models typically have use multiple pools governed by first-order kinetics to simulate GHG soil production, and historically have been parameterized via expert tuning. Modern data integration techniques, however, can be used to robustly and reproducibly integrate data from laboratory and field experiments with predictive models. This not only provides formal parameterizations, but also quantifies the level of support for competing model structures provided by the data; when combined with *a priori* scientific understanding, this can be used to select the ‘best’ model at a particular temporal or spatial scale. In a sample analysis of this type, we consider models with varying number soil carbon pools and connections between those pools, and use data from soil incubation experiments encompassing a range of soil types and durations.