PROJECT INFORMATION

Project title:	**Coupling microbial and rhizosphere dynamics within the land model LM4.1**
Project ID:	301
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PROJECT DESCRIPTION

The first generation of soil organic matter (SOM) decomposition models like CENTURY have been criticized for their first-order kinetics that do not properly represent the processes of SOM decomposition and stabilization in response to climate change. Emerging soil biogeochemistry models including microbial dynamics and soil physicochemical properties have been proved to estimate soil organic carbon (SOC) concentrations more accurately. Other emerging models have also emphasized the critical role of rhizosphere dynamics and associated priming effects for projecting future global C cycling.

We have been developing a new soil biogeochemistry model by integrating the state-of-the-art features of two emerging models: 1) microbial dynamics and soil physicochemical properties of the MIcrobial-Mineral Carbon Stabilization model (MIMICS) and 2) rhizosphere dynamics of the Carbon, Organisms, Rhizosphere, and Protection in the Soil Environment model (CORPSE). This new model is coupled with the dynamic vegetation model Perfect Plasticity Approximation (PPA), developed by scientists in the Pacala Lab, Department of Ecology and Evolutionary Biology at Princeton University.

We have learned from a previous SOC model evaluation study that in situ observations of ICP Forests would be valuable datasets to force and evaluate the newly developed model. The model consists of 1 layered, 2 aboveground litter pools (i.e., leaf and coarse wood) and multiply layered, 2 soil pools (i.e., bulk and rhizosphere). The model requires 4 C inputs: leaf, wood, and root litterfalls and root exudate. We would be able to estimate wood and root litterfalls by using ICP Forests's in situ observations of leaf litterfall (Litterfall) and other published references. C:N ratios of litterfall (Needles and Leaves) would be used to estimate lignin:N ratios of litterfall, which in turn would be used to partition C inputs based on different litter quality (metabolic vs. structural). The model requires 2 hydrological inputs of soil temperature and moisture for simulating SOC decomposition (Meteorological Measurements). Clay content of soil (Soil Solid Phase) would be used for simulating physicochemical protection of SOC from mineral surfaces. Other variables (e.g., bulk density, pH, BS, silt content, etc) would be used to investigate alternative versions of SOC protection formulas. Aboveground litter stock, SOC, and DOC observations (Soil Solid Phase & Soil Solution) would be used to evaluate model results.

In addition, Growth and Yield, LAI, Assessment of Ground Vegetation / Biodiversity, and Phenological Observations would be used to evaluate consistency of the dynamic vegetation model which would ultimately provide inputs to the soil model. Also, these observations would be used as inputs to the soil model to evaluate the propagation of uncertainty in simulated vegetation and soil states. Finally, C dynamics within the model would be coupled with N dynamics. All soil and deposition N observations (Soil Solid Phase, Soil Solution, and Deposition) would be used to force and evaluate the coupled C-N model.