

## Poster #114

### Benchmarking and Improving Microbial-Explicit Soil Biogeochemistry Models

Will Wieder<sup>1,2</sup>, Melannie Hartman<sup>2</sup>, Ben Sulman<sup>3</sup>, Steve Allison<sup>4</sup>, Jim Randerson<sup>4</sup>, Hua Wally Xie<sup>4</sup>, Rich Phillips<sup>5</sup>, Adrienne Keller<sup>5</sup>, Matthew Craig<sup>5</sup>, and Stuart Grandy<sup>6</sup>

<sup>1</sup> University of Colorado, Boulder

<sup>2</sup> National Center for Atmospheric Research

<sup>3</sup> Princeton University

<sup>4</sup> University of California, Irvine

<sup>5</sup> Indiana University

<sup>6</sup> University of New Hampshire

Contact: Will Wieder [wieder@colorado.edu]

Consideration of new insights into factors controlling the decomposition and formation of soil organic matter (SOM) will facilitate efforts to improve confidence in soil biogeochemical projections under global change scenarios. A new generation of models is beginning to integrate these processes, but concurrent efforts to create the analytical tools necessary to characterize and improve these models remain poorly developed. We describe three objectives that focus on data synthesis, parameter estimation, and the development of a soil biogeochemical testbed that can be used to investigate global SOM dynamics.

Our first objective is to synthesize a global data set relating plant input chemistry to SOM properties. Mounting research emphasizes the potential importance of litter quality in influencing the stability and chemistry of SOM. Accordingly, many soil models make predictions about how differences in litter quality drive soil C dynamics. Yet, evidence for evaluating hypotheses about litter quality effects on SOM is mostly limited to laboratory experiments and individual field studies. Our goal is to develop a data set that can be used not only for validating global-scale models, but also for evaluating our emerging hypotheses about how plant litter chemistry affects SOM chemistry.

The second objective of our work is to develop tools that facilitate parameter estimation and their associated uncertainties in a cross-site Bayesian data assimilation framework. This objective aims constrain key aspects of microbial physiology and interactions with the physicochemical soil environment that are difficult to quantify. Using observations from a recent meta-analysis we generated posterior predictions for conventional and microbial-explicit models, providing a new level of Bayesian statistical rigor to soil biogeochemical model comparisons. Moreover, with relatively few examples of Bayesian analyses of complex ODEs, our contributions open the door to for others to take advantage of these powerful statistical modeling and data analysis tool.

Our third objective is to develop a testbed to compare, evaluate and improve the representation of global-scale soil biogeochemical models. The testbed provides a computationally tractable, numerically consistent framework to begin exploring the effects of different model structures and parameterizations on soil carbon stocks and fluxes. Preliminary results indicate that the three soil models implemented in the testbed adequately represent global soil C stocks, but project divergent soil C trajectories over the 20th century. We contend that accelerated advancements in soil science, ecosystem biogeochemistry and global modeling will be facilitated by developing tools for evaluating structural, forcing and parametric uncertainties in soil biogeochemical models.