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Towards a new generation of C and N biogeochemistry models by incorporating more detailed microbial traits and physiological processes

This presentation will discuss how we have explicitly incorporated the effects of microbial activities on soil organic matter decomposition into a biogeochemistry model, the Terrestrial Ecosystem Model. Specifically, we will discuss how we have revised an existing Q10-based heterotrophic respiration algorithm, by incorporating the algorithms of Dual Arrhenius and Michaelis-Menten kinetics and microbial-enzyme interactions. The microbial physiology enabled model was then applied to quantify historical and future carbon dynamics of forest ecosystems in the conterminous United States and the Arctic. Our model simulations for the forest ecosystems in the United States demonstrate that the revised model better simulate historical ecosystem carbon dynamics. Another research effort has been made to incorporate a microbial dormancy into an explicit microbial-enzyme decomposition algorithm. The model was then used to examine soil carbon dynamics with and without representation of microbial dormancy. The model was finally extrapolated to global temperate forest ecosystems. Our study shows that the dormancy model consistently produced a better match with field-observed heterotrophic soil carbon effluxes than the no dormancy model. Currently, we are developing more detailed microbial physiologically based soil C and N models that shall improve the quantification of the land ecosystem C and N dynamics and their feedbacks to the global climate system.

Biography

Qianlai Zhuang has completed his PhD from the University of Alaska at Fairbanks and Postdoctoral studies at the Ecosystems Center of the Marine Biological Laboratory at Woods Hole MA. He has published more than 120 peer-reviewed papers. His research focuses on advancing C and N biogeochemistry modeling. To date, he has modeled the impacts of permafrost dynamics, fire disturbances, aerosol and ozone and hydrological dynamics on C and N dynamics of both land and aquatic ecosystems. He has extensively used these models to study the climate change effects on C and N dynamics and their feedbacks to the climate system.

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