Poster #9-21

The Berkeley Lab Terrestrial Ecosystem Science SFA on Belowground Biogeochemistry: Five Years of Deep Soil Warming

Margaret S. Torn[1*], Eoin Brodie[1], Peter Nico[1], Bill J. Riley[1], Cristina Castanha[1], Rachel C. Porras[1], Jennifer L. Soong[1], Ricardo E. Alves[1], and Zhou Lyu[1].

[1] Lawrence Berkeley National Laboratory, Berkeley, CA;

Contact: mstorn@lbl.gov

BER Program: TES
Project: Berkeley Lab TES SFA on Belowground Biogeochemistry
Project Website: https://tes-sfa.ornl.gov/

In the Berkeley Lab Terrestrial Ecosystem Science SFA, we conduct basic research on the role of soils in terrestrial biogeochemistry and the Earth system. Our goals are to improve process-level understanding of ecosystem-climate interactions and to develop next-generation predictive capacity suitable for Earth system models. Current SFA research is centered around a set of field, laboratory, and model experiments to characterize how biotic and abiotic processes influence soil carbon cycling, and how they may shape ecosystem responses to a warming climate. We are conducting a field experiment in a well-drained coniferous forest in which we are warming the whole soil profile (+4ºC) and adding ^{13}C-labelled litter at different soil depths. We are using the experiments to evaluate the influence of soil depth, mineralogy, biota, and climate on soil carbon dynamics, and applying the results and observations to inform model structures and parameters. We are using experimental data from the deep soil warming, incubations, and other studies to guide model development in a reactive transport framework (BeTR; Tang et al. 2013), and integrating this into the DOE E3SM land model (ELM). This poster will present biogeochemistry results from the Blodgett Forest whole soil warming experiment over its first five years. Research on microbiology, mineralogy, and modeling are in posters by Alves, Nico, and Lyu respectively.

During the first two years of the experiment, warming increased CO_2 respiration by 35% (Hicks Pries et al. 2016). After five years of warming (spanning both wet and drought years), soil respiration averaged 30% higher compared to the control plots with no trend in the effect size. During some of the hot, very dry summer months however, the warmed plots had lower soil respiration than the controls (a negative warming response). Warming also increased the amount of dissolved organic matter in both shallow and sub-soils, but in surface soils this effect decreased over time. In contrast, there was no effect of warming on dissolved nitrogen in the soil leachate. Our soil respiration and leachate data over five years of whole-soil warming suggest that CO_2, dissolved organic carbon, and dissolved nitrogen, and their response to warming, are decoupled over time and with depth.

Hicks Pries, C.E., C. Castanha, R. Porras, and M.S. Torn. 2017. The whole soil carbon flux in response to warming. Science 2017; eaal1319 DOI: 10.1126/science.aal1319