Poster #27

Arctic Shrub Expansion, Plant Functional Trait Variation, and Effects on Belowground Carbon Cycling

Jennifer Fraterrigo[1,2,3], Feng Sheng Hu[2,3], Joshua Peschel[4], Ken Tape[5], and Eugenie Euskirchen[6]

[1] Department of Natural Resources and Environmental Sciences, University of Illinois;
[2] Program in Ecology, Evolution, and Conservation Biology, University of Illinois;
[3] Department of Plant Biology, University of Illinois;
[4] Department of Civil and Environmental Engineering, University of Illinois;
[5] Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska Fairbanks;
[6] Institute of Arctic Biology, University of Alaska Fairbanks;

Contact: Jennifer Fraterrigo [jmf@illinois.edu]

High latitude ecosystems store nearly one-half of the global belowground organic C pool in permafrost and overlying soils, which are projected to warm significantly by the end of the 21st century. Warming-driven release of this C could dramatically increase greenhouse gas concentrations in the atmosphere, thereby accelerating the warming. Arctic plant communities are also responding to warming, as evidenced by the widely documented increase in woody-shrub growth and “greening” across much of the Arctic tundra biome. This vegetation shift may offset or amplify warming by altering carbon cycling. The direction and magnitude of shrub effects remain highly uncertain, however, due to limited understanding of the consequences of shrub expansion for belowground carbon cycling and simplification of these relationships in models. The major shrubs expanding in the Arctic (*Betula, Salix,* and *Alnus)* vary widely with respect to aboveground and belowground traits (e.g., tissue production and chemistry, rooting depth, microbial symbionts), and may also exhibit substantial intraspecific variation in these traits in response to environmental conditions. Such variation is likely to have profound implications for soil carbon cycling.

We are investigating how plant functional traits respond to environmental conditions and affect belowground carbon stocks and fluxes. We will test the following hypotheses: (1) Aboveground and belowground plant functional traits are determined primarily by air temperature, but soil characteristics control trait response within a given air temperature range; (2) The response of soil organic carbon cycling to shrub expansion depends on plant functional traits, particularly root traits and microbial symbionts; and (3) Regardless of the dominant species, shrub expansion will interact with physical and chemical processes to increase the amount of stable soil organic carbon in the mineral soil. To test these hypotheses, we are quantifying relationships among aboveground and belowground plant functional traits and carbon stocks and fluxes along edaphic gradients nested within a temperature gradient in the Alaskan tundra. Using this sampling design, we are characterizing aboveground and belowground plant functional trait variation for individual shrub species, determining how aboveground and belowground traits co-vary, and evaluating relationships between plant functional traits and carbon stocks and fluxes. The results of this work will help to improve the parameterization and formulation of the Terrestrial Ecosystem Model, which will be used to evaluate how differences in plant functional traits affect carbon dynamics, and explore approaches to accounting for this variability in models.