Poster #9-31

Using Root and Soil Traits to Forecast Woody Encroachment Dynamics in Mesic Grassland

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Grasslands are a widespread and globally important biome providing key ecosystem services including C storage and regulation of the water cycle. Grasslands face multiple threats, including changes in drought intensity and woody encroachment - a process that results in increased woody plant abundance corresponding with decreased herbaceous plant abundance. The combination of reduced soil moisture and shifts in plant dominance from herbaceous to woody are likely to alter C pools in the soil profile. In order to predict changes in grassland vegetation structure and the associated impacts on C cycling requires greater understanding of changes in soil C pools at multiple soil depths, and the responses of these pools to changes in precipitation. The Land Surface Model (LSM) component of Earth System Models has the ability to capture these dynamic changes in ecosystem function, but lack the data to accurately parameterize these processes at multiple depths within the soil profile.

We have developed a set of objectives that combine observational, experimental and modeling approaches to improve our ability to project ecosystem consequences of shrub encroachment in the US Great Plains region. We propose 3 main objectives: (1) Quantify differences in aboveground (stem and leaf biomass) and belowground C pools (root C, microbial C, bulk soil C) using detailed excavations of entire mixed shrub-grass assemblages. We will subsample portions of the rhizosphere for detailed root physiological and microbial activity measurements; (2) Using rainout shelters built over mature shrub-grass communities, we will experimentally reduce the amount of precipitation. Comparing responses among shrubs and grasses, we will measure differences in source-water use, above and belowground productivity, canopy water stress, soil and microbial C and microbial C-cycling activity, and changes in plant cover and community dynamics; (3) Using a global demographic LSM (CLM FATES), we will forecast the impacts of available water on shrub-grass cover in the central Great Plains region, and the resulting effects of these dynamics on ecosystem services (aboveground production, above- and belowground C budgets). The experiment-modeling framework described here will improve our understanding of interactions and feedbacks between aboveground and belowground processes, by specifically measuring plant-soil-microbial traits at various depths in the soil profile. The details of these coupled interactions will improve the representation of subsurface processes in LSMs and will improve forecasts of dynamic changes in ecosystem structure in grassland ecosystems.