Poster #111

Carbon and Energy: Climate-Induced Community Shifts and Dryland Feedbacks to Future Climate

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Due to their large spatial extent and responsiveness to climate fluctuation, drylands are suggested to play a dominant role in determining the inter-annual variability and overall trend of the land carbon sink. Nevertheless, our understanding of how different climatic drivers will interact to affect dryland climate feedbacks remains notably poor. While the data we do have suggest a strong potential for drylands to exceed climate thresholds and to span climatic pivot points, and for climate-induced changes to community composition to create large feedbacks to future climate, we are still missing key components of potential feedbacks and still lack a quantitative framework for predicting such change across drylands. Here we present data from a variety of timescales that show how different climate drivers (e.g., increased temperature and multiple altered precipitation treatments) affect the community composition, carbon cycling, and energy balance of a dryland on the Colorado Plateau, USA. Using automated CO_2 flux data from climate manipulation plots, a series of mesocosm studies, and novel soil microclimate sensors we developed for this purpose, we show substantial exchange of CO_2 between the atmosphere and dryland soils (including biological soil crusts) that is strongly controlled by surface soil climate conditions that would not be detected using traditional soil sensors. Our data highlight how these biocrust CO_2 fluxes are partitioned into net primary productivity and respiration, how these discrete fluxes are differentially affected by increased temperature, and how they are temporally and spatially decoupled from the fluxes of vascular plants. The data also show the strong role of biocrust community composition in determining CO_2 exchange, as well as in affecting ecosystem energy balance. In particular, our data suggest a large potential for climate- and land use-induced changes to biocrust community composition to strongly and negatively affect radiative forcing, with global implications for future climate. To scale these data, we are now developing new remote sensing methods that we hope will help the assessment of biocrust communities across spatial scales previously believed impossible. Taken together, these data represent a significant step forward in our understanding of and capacity to forecast how dryland organisms, biogeochemical cycles, and energy fluxes will respond to a range of future climates across a diverse biome.