Poster #9-5

Improving our Understanding, Quantification, and Contextualization of Dryland Feedbacks to Climate Change

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Due to their large spatial extent and high responsiveness to climate variability, 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 interact to affect dryland feedbacks to climate remains notably poor. In particular, while the data we do have suggest a strong potential for drylands to cross climate thresholds and for climate-induced changes in drylands to create large feedbacks to future climate, we need significant improvement in our quantification of dryland feedbacks, as well as 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 drylands 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 (0-2 mm) soil climate conditions, which would be incorrectly estimated using deeper traditional soil sensors. Our data show how biocrust CO_2 fluxes are partitioned into net primary productivity and respiration, how these discrete fluxes are differentially affected by climate, and how they are quantitatively and temporally related to CO_2 exchange for the site's vascular plants. The data also show the strong role of biocrust community composition in affecting ecosystem energy balance. Taken together, these data represent a step forward in our understanding of and capacity to forecast how dryland organisms, coupled biogeochemical cycles, and energy fluxes will respond to a range of future climates across a diverse biome.