NAME: Elise Pendall
ORGANIZATION: University of Wyoming
PROGRAM AFFILIATION: TES
ABSTRACT TITLE: Ecosystem phenology, restoration, and carbon cycling responses at the Prairie Heating and CO2 Enrichment Experiment

ABSTRACT: The Prairie Heating and CO2 Enrichment (PHACE) experiment has been ongoing since 2006 in native grassland near Cheyenne, Wyoming. Climate change has multiple, interacting effects on ecosystem processes that will influence future grassland sustainability. Prior results showed that plant biomass has responded to future climate conditions by increasing growth, especially of C4 plants, and in years of average or low precipitation. Net carbon losses have been observed consistently on elevated CO2 + warming plots. Elevated CO2 and warming increase plant community greenness and the potential for CO2 uptake early in the growing season, but have a generally negative effect later in the growing season. However, the magnitude and direction of greenness responses to climate treatments appears to be mediated by seasonal precipitation inputs.

A sub-experiment has allowed us to assess grassland recovery from disturbance. Restoration success might depend on selection of species most suitable for environmental conditions of the future. Our initial assessment of establishment from seed in bare sub-plots showed a slight advantage of species from warmer and wetter regions of North American grasslands compared to species common to southeastern Wyoming, but no differences were observed among PHACE treatments.

Elevated CO2 increased belowground biomass and root mass loss rates while elevated CO2 plus warming produced roots that were longer, thinner, heavier and had greater surface area than in ambient conditions. Results from the PHACE experiment support findings from our recent metaanalysis of 110 studies across all ecosystems, which indicated that elevated CO2 significantly increased root length (+26.0%), root diameter (+8.4%), and fine root biomass (+27.7%). Microbial communities from elevated CO2 exhibited an increased ability to decompose soil organic matter (SOM) compared with those from ambient CO2 plots, and microbes from warming plots exhibited increased thermal sensitivity for respiration. These microbial physiology responses may help explain observed net C losses with elevated CO2 and warming. Overall, our first-year results provide insights that will improve predictions of how grassland ecosystems will mediate future climate-carbon feedbacks.