ABSTRACT

Project Title: COLLABORATIVE RESEARCH: Assessing Long-Term Plant and Soil Responses to Altered Rainfall Timing and Elevated Temperature in Grassland Ecosystems

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Temperature and precipitation are critical drivers for grassland ecosystems. Climate change predications for the Central Plains include elevated temperatures and more variable and extreme precipitation patterns, with increased frequency of large precipitation events and extended droughts. Our research addresses these aspects of climate change, and their interactions, with a unique experiment featuring simultaneous manipulations of precipitation and temperature in intact native grassland. Our goals are to (1) assess cumulative plant and soil responses to long-term manipulations of rainfall timing and temperature, with emphasis on belowground community and ecosystem responses, and (2) identify the consequences of these responses for ecosystem function under a future climate characterized by elevated temperatures and more extreme patterns of precipitation.

Warming and more extreme rainfall patterns alter the soil environment, resulting in short- and long-term changes in a suite of ecological processes. Assessing longer-term responses has been difficult, due to slow rates of change and lag times in some critical responses, particularly belowground. We seek support to extend a long-term climate change experiment, with new measurements focused on the following questions: How have long-term changes in rainfall regimes affected soil communities, soil processes, and their interactions with key ecosystem processes? How has belowground structure and function responded to elevated temperatures, and to what degree does increased temperature interact with rainfall patterns to modify these responses? Have longer-term (>10 yr) trajectories of change continued at the same rate as initial responses? Or are non-linear responses occurring as ecological thresholds are crossed?

Field research will take place at Konza Prairie Biological Station (KPBS), an NSF-funded LTER site in northeastern Kansas. Sample processing and analysis will take place at Kansas State and Colorado State Universities.

We will continue a long-term field experiment in which rainfall timing and temperature are simultaneously manipulated in native grassland to determine how key ecosystem attributes and processes are altered by interactions between multiple climate change factors. New measurements will address cumulative belowground responses to long-term climate manipulations, while continuing climate change treatments and measurements in support of related aboveground studies. Concurrent above- and belowground studies will provide detailed mechanistic explanations for observed soil and plant responses, and address important linkages between soil biota and ecosystem processes in response to altered rainfall and temperature.

The research will provide detailed information on responses of temperate grasslands to predicted climate changes, including more extreme rainfall regimes and elevated temperatures. Expected deliverables include: new data on belowground responses to altered precipitation and temperature; research support and data sharing with related DOE projects, and with ecosystem modeling efforts; web dissemination of results; peer-reviewed publications and presentations.