Title of proposal: Woody encroachment and carbon storage across regional gradients in precipitation and land use
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Abstract

Woody plant encroachment alters the primary production and carbon balance of rangelands across the central and southwestern U.S. This project examines the carbon balance of eight paired grassland and woody encroached sites and ~30 prairie relics along a rainfall gradient of 200 to 1100 mm. The proposed research will help constrain the changes in soil organic carbon with woody plant encroachment, provide a stronger baseline of historical carbon storage in the region, and aid regional assessments and models in estimating the potential of the region to sequester atmospheric carbon in the future.

The research combines sampling at eight paired grassland and woody sites in New Mexico, Colorado, Texas, and Oklahoma and more than 30 prairie relics in the central U.S. to examine current changes in the regional carbon balance.

The research tests three hypotheses: 1) The consequences of woody plant encroachment for carbon storage vary predictably with precipitation and land use history, with soil organic carbon contents increasing at drier sites and relatively degraded rangelands and decreasing at wetter sites and prairie relics, 2) Across the gradient, belowground productivity will be the highest in prairie relics at the wetter sites, contributing to the net carbon balances observed, and 3) The composition of bacterial and fungal communities will shift most dramatically at the wetter, more productive sites in response to woody plant encroachment and changes in land use, leading to greater changes in soil carbon.

Complete carbon balances above- and belowground will be measured in adjacent grasslands and former grasslands invaded by woody species, including changes in soil carbon and ^{13}C signatures, rangeland productivity, and molecular determinations of the soil microbes that process plant litter into soil organic matter. Supplemental mesocosm experiments will further examine the mechanisms of soil carbon changes.

The project also contributes to a cross-regional model synthesis and validation headed by Chris Kucharik of Wisconsin (another SouthCentral NIGEC P.I.) in an Ameriflux/MODIS-based effort to use field data from across the central U.S. to constrain rates of soil carbon accumulation. The proposed project will improve estimates of how much carbon is currently stored with woody plant encroachment, provide an improved baseline of historical carbon storage in the region, and help determine the amount of carbon that can be sequestered in the future if historical levels of soil carbon are restored.