Title: Effects of Photosynthesis on the Timing of Autotrophic and Heterotrophic Respiration Fluxes

Melanie A. Mayes,[1*] Jeffrey D. Wood,[2] Junyi Liang,[1,3] Shikha Singh,[4] Sindhu Jagadamma,[4] Lianhong Gu,[1] Christopher W. Schadt[5]

[1]Environmental Sciences Division & Climate Change Science Institute, Oak Ridge National Laboratory, Oak Ridge, TN;
[2]School of Natural Resources, University of Missouri, Columbia, Missouri;
[3]Department of Grassland Resources and Ecology, College of Grassland Science and Technology, China Agricultural University, Beijing, China;
[4]Department of Biosystems Engineering & Soil Science, University of Tennessee, Knoxville, TN;
[5]Biosciences Division & Climate Change Science Institute, Oak Ridge National Laboratory, Oak Ridge, TN

Contact: (mayesma@ornl.gov)
Project Lead Principal Investigator (PI): Paul J. Hanson
BER Program: TES
Project: TES SFA at Oak Ridge National Laboratory
Project Website: https://tes-sfa.ornl.gov

Project Abstract: Resolving the contributions of heterotrophic and autotrophic respiration are key to improving ecosystem models and predicting future climates. The two kinds of respiration are intimately intertwined, due to the contributions of belowground root tissues and rhizosphere materials, aboveground litter contributions, and root exudates contributing simple organic compounds, all of which fuel microbial decomposition. Of the three components, only root exudates (photosynthate) change over diurnal cycles, but the impact on microbial respiration has not been determined. We will use long-term measurements of canopy sun-induced chlorophyll fluorescence observations as a proxy for canopy photosynthesis, and a 2-year trenching experiment equipped with continuous automated soil CO_2 efflux measurements to isolate heterotrophic from autotrophic respiration in soil at the Missouri Ozark AmeriFlux site in mid-Missouri. Recent studies have identified a 9-12-hour time lag between gross primary production and total soil respiration, but the components of soil respiration have not been deconvolved to understand the direct contribution of photosynthate to microbial respiration. This research will quantify the time lag between canopy photosynthesis and the components of soil respiration, and to determine how the dynamics of soil temperature and moisture, plant phenology, and physiological water stress modulate variations in the time lag, drawing on 2 years of field data. Lab-scale incubation experiments have focused on understanding the sensitivity of heterotrophic respiration to soil moisture. This work will contribute to understanding how above- and belowground processes are linked, and how they together respond to changes in phenology and weather.