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Responses of Soil Respiration in Agriculture and Prairie Environments Using High-Resolution Soil CO_2 Data

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Soil carbon is the largest active terrestrial sink in the carbon cycle, and its potential feedbacks play an important role in climate change. Understanding how the combinations of factors such as plants, temperature, and moisture affect soil CO_2 production is essential to our understanding of potential feedbacks in different ecosystems and management regimes. We aim to understand which factors were most important to CO_2 production in the Midwest's agricultural and prairie landscapes using high-resolution (hourly) soil CO_2 datasets. Carbon dioxide sensors were installed in Nebraska and Illinois at four depths (20, 60, 110, and 180 cm) in both restored prairie and agricultural soils as part of the Critical Interface Network (CINet). Plants play an important role in determining peak CO_2 concentrations and production and specifically that plant cover is often a better predictor of soil CO_2 concentrations than temperature. Additionally, physical factors play a role in how storm events affect soil CO_2 as they frequently lead to short-term drops in concentration and production followed by a prolonged increase. Finally, we observed that prairie soils have a higher rate of CO_2 production than agricultural soils, likely due to the diverse and perennial plant species compared to harvested row crops. These findings highlight the importance of the broader environmental conditions when determining how soil CO_2 responds to local conditions and that climate-induced feedbacks will likely depend on environmental factors such as plant community and within soil factors such as temperature and moisture to be accurately predicted.