Soil Respiration in a Temperate Agroecosystem

The annual global soil respiration flux to the atmosphere is estimated to be ten times greater than the flux of carbon from fossil fuel combustion (Schlesinger and Bernhardt 2013), and soil respiration rates are increasing as a consequence of climate change (Jian et al. 2018). As soils warm, soil carbon is expected to be lost due to higher heterotrophic respiration rates from microbes, but the magnitude of this response is not well quantified (Bond-Lamberty et al. 2018). Similarly, soil respiration from roots increases under warmer temperatures in the short-term, but it is not yet known whether the response will acclimate over the long-term (Tjoelker 2018). As such, measuring soil respiration and its components is critical to improving our understanding of how ecosystem carbon cycling will respond to global change factors.

A CFLUX-1 Automated Soil CO_2 Flux System shown in early December 2018 after snowfall.

We used four CFLUX-1 systems to measure soil respiration from late October to early December 2018 in a recently harvested maize (*Zea mays* L.) field at the University of Illinois Energy Farm in central Illinois, USA. The systems were programmed to close for two minutes at one-hour intervals, at which time the soil CO_2 flux was measured. Soil temperature and soil moisture at 2 cm soil depth were measured via the Stevens HydraProbe concurrently with soil respiration and stored to the CFLUX-1 systems. The average and standard error of all four chambers were calculated for each hour. The systems were connected to an outdoor wireless network, which allowed the instruments to be monitored and adjusted remotely via any internet connection.

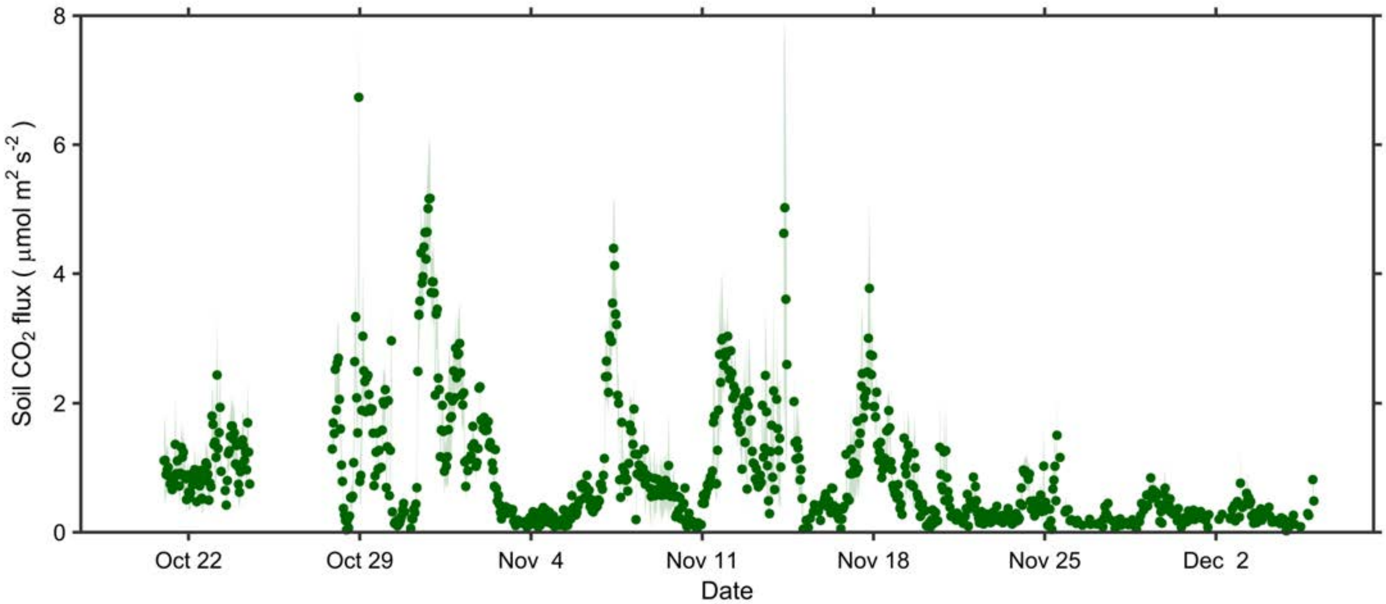

Fig. 1: **Hourly soil respiration in a maize field in central Illinois. Light-colored shading shows the standard error of the mean for four CFLUX-1 chambers.**

Soil respiration rates were typically highest in early November and lowest in early December ***(Fig 1***). Clear patterns in soil temperature and soil moisture were also noticeable, with warmer and wetter conditions occurring in early November and cooler conditions occurring in mid and late November (***Fig. 2***). Higher soil respiration rates were often observed under warm and moist conditions, whereas lower rates were more typically seen under cool and dry conditions (***Figs. 3*** and ***4***).

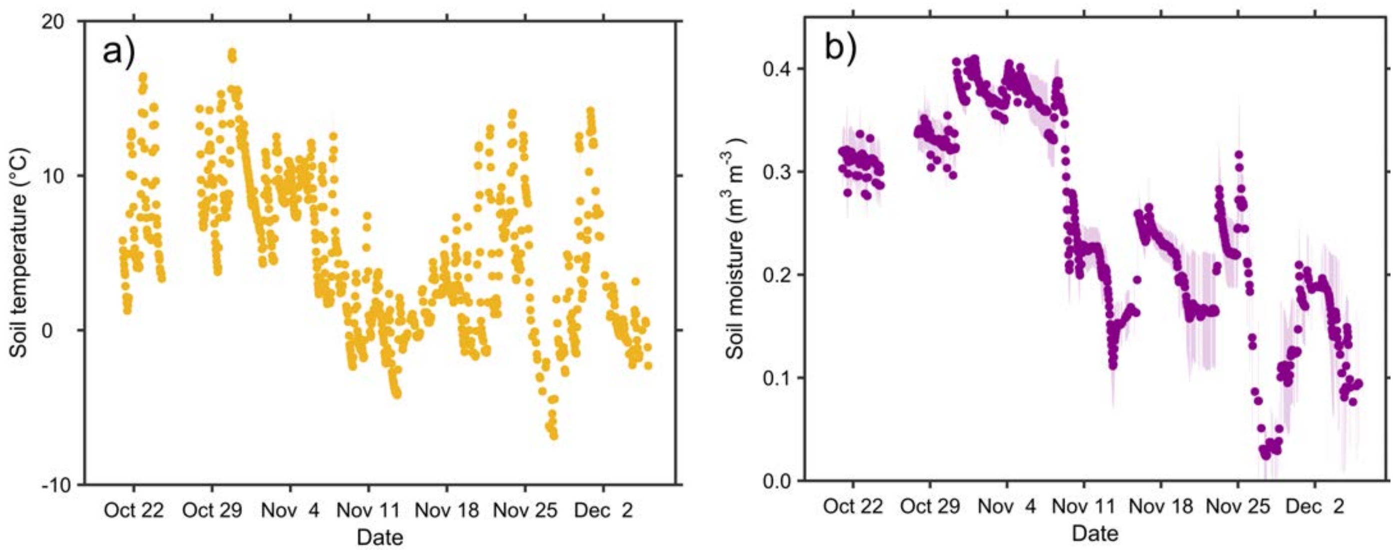

Fig. 2: **Hourly soil temperature (a) and volumetric soil moisture (b) as measured at approximately 2 cm deep with the Stevens HydraProbe. Shaded areas show the standard error of the mean of the measurements taken at each of the four chambers.**

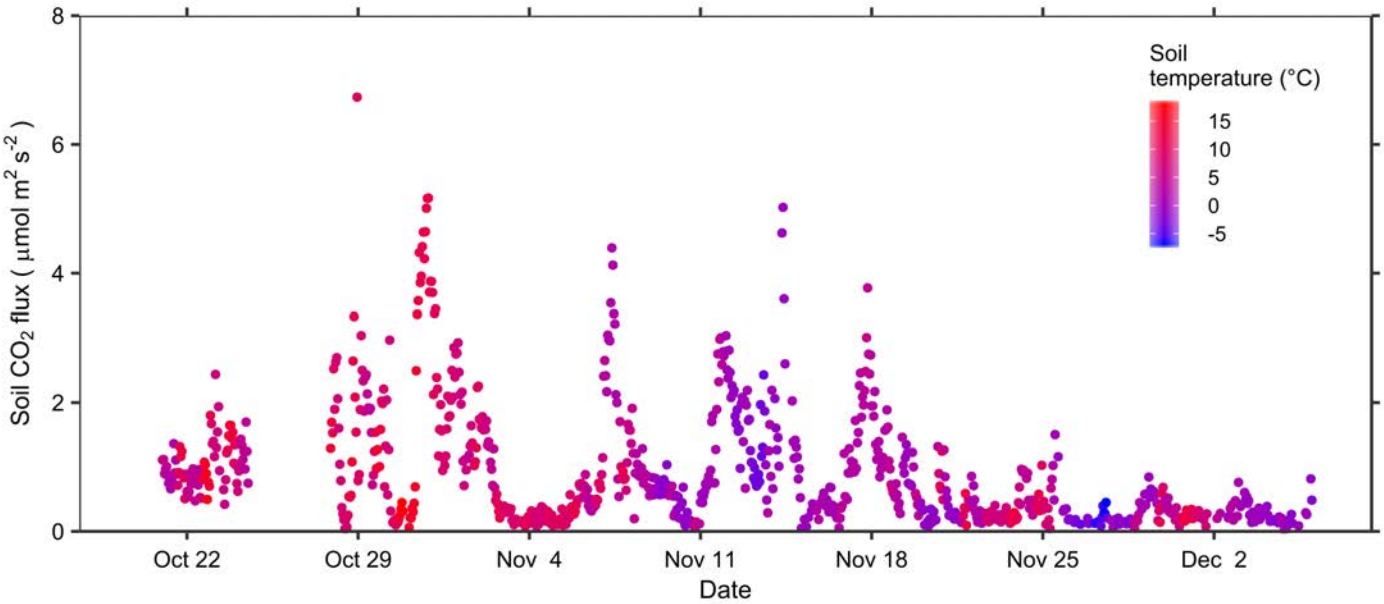

Fig. 3: **Soil respiration rates color-coded by soil temperature.**

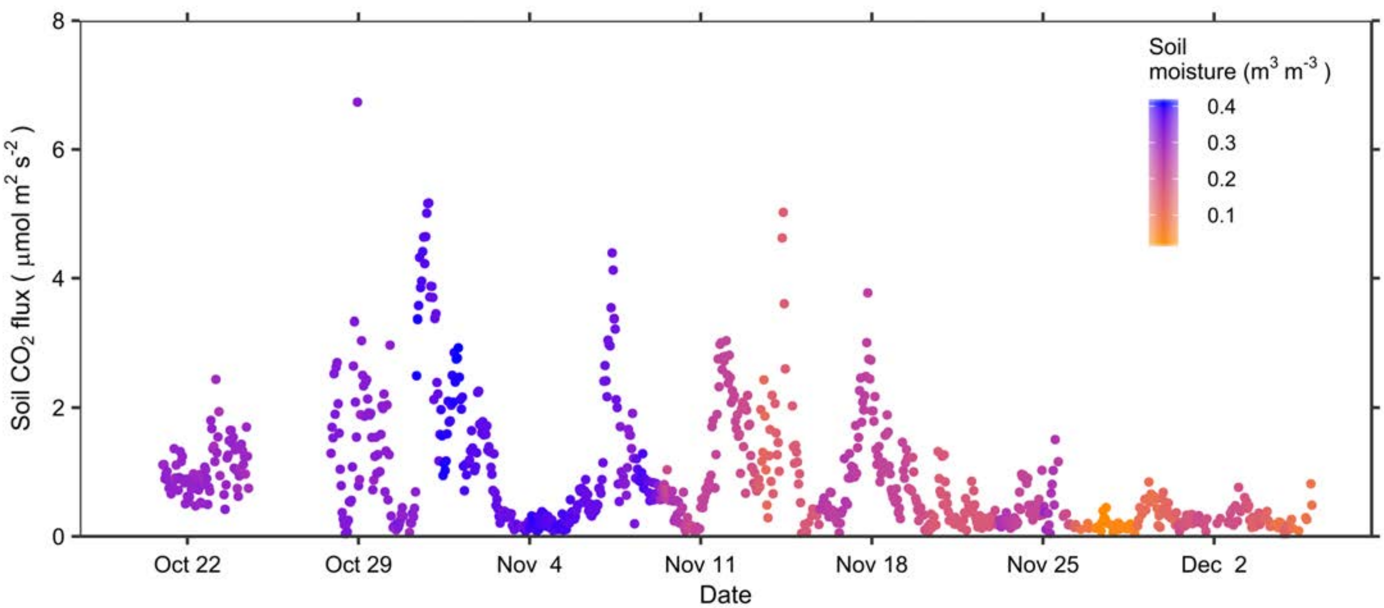

Fig. 4: **Soil respiration rates color-coded by volumetric soil moisture.**

A brisk late fall day in a maize field at the University of Illinois Energy Farm.

References:

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Jian, J.S., Steele, M.K., Day, S.D., Thomas, R.Q. (2018). Future global soil respiration rates will swell despite regional decreases in temperature sensitivity caused by rising temperature. Earth's Future, 6, 1539–1554.

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To learn more about Adam's work:

https://sites.google.com/view/avonhaden/

https://www.life.illinois.edu/delucia/