Document: Supplemental File 2 – Correction for shading effects on soil temperature and moisture

Article Title: Maize and prairie root contributions to soil CO2 emissions in the field
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For each sampling period we graphed the CO_2 flux of each cropping system versus 7cm soil temperature and fit an exponential function (**Eqn. SF2.1a**) using the non-linear least squares function in R (Lenth, 2016). We allowed the α parameter, the equivalent of the intercept, to vary according to shade treatment. The fitted β parameter was used to calculate a Q_{10} (**Eqn. SF2.1b**) for each crop in each sampling period, which is a common metric used to represent the magnitude and direction of the response of a variable to temperature changes (Lloyd and Taylor, 1994).

Eqn. SF2.1 Exponential function used to describe CO_2 as a function of soil temperature under each shade

a. $$\boldsymbol{R = \alpha \cdot e^{\beta T}}$$

b. $$\boldsymbol{Q_{10} = e^{10\beta}}$$

where $\boldsymbol{R}$ was CO_2 flux in µmol m^{-2} sec^{-1} ; $\boldsymbol{T}$ was temperature in Celsius; **α** was a fitted parameter unique for each shade treatment; **β** was a fitted parameter unique for each crop x sampling period used to calculate $\mathbf{Q_{10}}$. A $\mathbf{Q_{10}}$ value greater than 1 indicated an increase in soil temperature coincided with an increase in CO_2 flux. For all instances showing a $\mathbf{Q_{10}}$ >1, we used each shade's unique fitted equation (Eqn. SF2.1a) to extrapolate that shade treatment's flux at the mean soil temperature under the full sun treatment. If the calculated $\mathbf{Q_{10}}$ was <1, no flux adjustments were made. As an example, data from P on June 1 2012 (Figure SF1.1a) warranted temperature correction, while on July 29 2012 (Figure SF1.1b) no adjustments were made.

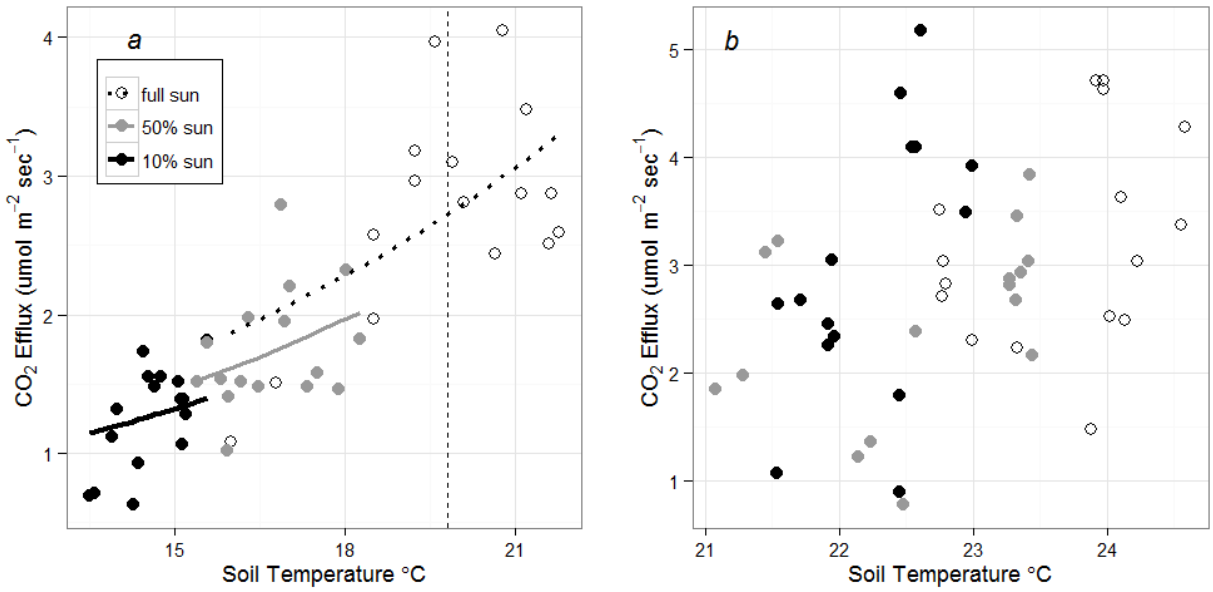

Fig SF2.1 Un-fertilized prairie CO_2 flux grouped by amount of available light versus 7cm soil temperature; **a**- June 1 2012, fluxes were adjusted to correct for effect of shading on soil temperature; each light regime's data with associated fitted equation used for adjustment; vertical dotted line is mean soil temperature under full sun; **b**-July 29 2012, no adjustments were made

The semi-continuous measurements taken July 8-10 2012 had only two replications, which made temperature correction statistically difficult and unreliable. Additionally, normal measurements taken immediately following the semi-continuous measurements did not warrant temperature correction, so semi-continuous flux measurements were not adjusted. Dates of temperature corrections along with original and adjusted are presented in Table ST2.1.

Table ST2.1 Summary of original and adjusted CO_2 effluxes (µmol CO_2 m^2 sec^{-1}) for prairie (P), fertilized prairie (PF), and continuous maize (CC) cropping systems.

			Percent Shaded		
Year	**Crop**	**Date**	**0**	**50**	**90**
2012	P	June 1	†2.75 / 2.72	1.74 / 2.35	1.26 / 2.12
		June 12	4.28 / 4.21	1.95 / 2.29	0.93 / 1.31
		June 24	4.70 / 4.26	3.20 / 2.48	2.74 / 3.99
	PF	June 1	3.07 / 3.04	1.81 / 2.30	1.12 / 2.30
		June 12	3.20 / 3.17	0.87 / 1.08	0.74 / 0.95
		June 24	3.84 / 4.26	1.39 / 2.48	4.59 / 3.99
2013	P	June 3	2.41 / 2.41	2.30 / 2.40	1.78 / 1.90
		June 13	3.20 / 3.17	2.49 / 2.80	1.56 / 1.94
		June 29	3.79 / 3.78	3.13 / 3.47	2.00 / 2.29
		July 27	2.92 / 2.86	2.40 / 2.73	1.18 / 1.66
		Aug 1	4.70 / 4.68	3.49 / 3.73	3.30 / 3.56
	PF	June 13	2.07 / 2.92	2.32 / 2.89	1.75 / 2.43
		June 18	4.05 / 4.05	3.21 / 3.31	2.39 / 2.49
	CC	June 13	1.14 / 1.14	0.87 / 0.92	0.65 / 0.71

† Original value / adjusted value

At constant temperatures, soil CO_2 flux is expected to be highest near field capacity, and decline in either wetter or drier conditions (Wan and Luo, 2003). We observed no consistent effect of shading on 5 cm soil moisture, nor did we see any significant relationship between CO_2 flux and soil moisture.

References

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