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Corrigendum to "Vegetation and elevation influence the timing and magnitude of soil CO$_2$ efflux in a humid, topographically complex watershed" published in Biogeosciences, 12, 2975–2994, 2015

J. W. Atkins[1], **H. E. Epstein**[1], **and D. L. Welsch**[2]

[1]University of Virginia, Department of Environmental Sciences, Charlottesville, Virginia, USA
[2]American Public University System, Charles Town, West Virginia, USA

Correspondence to: J. W. Atkins (jeffatkins@virginia.edu)

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In the article "Vegetation and elevation influence the timing and magnitude of soil CO$_2$ efflux in a humid, topographically complex watershed," by Atkins et al. (2015) (Biogeosciences, 12, 2975–2994, 2015), water-filled pore space (WFPS) was calculated by multiplying the volumetric soil moisture (m^3 m^{-3}) by the soil porosity (m^3 m^{-3}). This is incorrect. Volumetric soil moisture should be divided by soil porosity. Equation (5) from Atkins et al. 2015 should be corrected to the following:

$$\mathrm{WFPS} = \frac{\theta}{\Phi}. \tag{1}$$

Recalculating WFPS correctly results in an increase in the effect of WFPS on fluxes.

The natural log of flux measurements above 11 °C for all years was regressed against T_{SOIL} (Fig. 1b), showing a significant positive relationship with soil temperature ($r^2 = 0.119$; $y = 0.096 \times -0.010$). From the linear model (Fig. 1b) where the natural log of flux measurements above 11 °C for all years was regressed against T_{SOIL}, the residuals were then regressed against WFPS. The residuals from the $\ln(F_{\mathrm{SOIL}})$ values above 11 °C show a significant negative relationship ($r = -0.28$) with WFPS (Fig. 1c), but this explains only marginally more of the variance ($r^2 = 0.06$).

Water-filled pore space (WFPS)

WFPS tracked well with precipitation across the years, with 2010 having the lowest values of WFPS and 2011 having the highest values of WFPS. WFPS in 2011 was significantly greater than either 2010 or 2012 ($F_{2,633} = 16.06$; $p = < 0.0001$; Table 1). During 2010, when precipitation was lower than average, an apparent elevation effect on WFPS is observed, with high elevation (HIGH) plots exhibiting significantly lower WFPS measurements than either low elevation (LOW) or mid-elevation (MID) plots (Fig. 2e). During 2011 and 2012, under extreme and moderate moisture regimes, this elevation effect is not evident. During 2010, each vegetation treatment is significantly different from each other, but in 2011 and 2012, when there is more moisture in the system, shrub plots (SHRUB) are the only that statistically differ from the others.

Discussion

There is greater separation among vegetation classes in the recalculated data. Plots located beneath shrubs are drier than plots located in forest gaps or beneath the forest canopy. For all years, plots beneath shrubs showed greater soil CO$_2$ fluxes (Atkins et al., 2015). This is attributable to differences in soil chemical and physical properties. Decreased soil moisture allows for greater diffusion of soil CO$_2$ through the soil matrix, thus contributing to the observed greater magnitude of fluxes. Decreased soil moisture can also lead to greater soil CO$_2$ production in this system. Correct recalculation of the WFPS strengthens the findings of Atkins et al. 2015 and provides clear elucidation of the mechanisms driving the landscape variance of surface soil CO$_2$ fluxes.

Table 1. Statistical table from repeated measures mixed-model ANOVA. For all comparisons by elevation, vegetation and year, $n = 633$; $\mathrm{d}f = 2633$. For elevation by year and vegetation by year comparisons, $n = 633$; $\mathrm{d}f = 4633$.

Elevation	F	p
F_{soil}	3.44	0.0326*
WFPS (0–12 cm)	57.94	< 0.0001*
Soil temp (12 cm)	170.76	< 0.0001*
Vegetation		
F_{soil}	37.58	< 0.0001*
WFPS (0–12 cm)	108.01	< 0.0001*
Soil temp (12 cm)	52.79	< 0.0001*
Elevation by vegetation		
F_{soil}	2.47	0.0436*
WFPS (0–12 cm)	19.50	< 0.0001*
Soil temp (12 cm)	9.55	< 0.0001*
Year		
F_{soil}	1.40	0.2464
WFPS (0–12 cm)	16.06	< 0.0001*
Soil temp (12 cm)	1.66	0.1918
Elevation by year		
F_{soil}	3.17	0.0134*
WFPS (0–12 cm)	5.92	0.0001*
Soil temp (12 cm)	1.02	0.3945
Vegetation by year		
F_{soil}	2.96	0.0192*
WFPS (0–12 cm)	2.04	0.0878
Soil temp (12 cm)	5.46	0.0003*

Table 2. Least-squares means of dynamic environmental variables. Error terms indicate standard error.

Year	Class	F_{SOIL} (µmol CO_2 m^{-2} s^{-1})	WFPS (m^3 m^{-3})	T_{SOIL} (°C)
2010	Low	4.69 ± 0.687	0.337 ± 0.022	16.29 ± 0.656
2010	Mid	6.13 ± 0.691	0.373 ± 0.022	14.90 ± 0.656
2010	High	6.32 ± 0.668	0.256 ± 0.022	15.30 ± 0.654
2011	Low	4.75 ± 0.571	0.449 ± 0.018	16.61 ± 0.520
2011	Mid	4.82 ± 0.561	0.503 ± 0.017	15.31 ± 0.519
2011	High	4.76 ± 0.551	0.452 ± 0.017	15.54 ± 0.518
2012	Low	4.45 ± 0.722	0.363 ± 0.023	15.08 ± 0.659
2012	Mid	4.04 ± 0.702	0.426 ± 0.023	13.93 ± 0.658
2012	High	4.71 ± 0.681	0.345 ± 0.022	13.98 ± 0.656
2010	Open	4.54 ± 0.685	0.363 ± 0.022	15.67 ± 0.656
2010	Shrub	7.48 ± 0.674	0.272 ± 0.022	15.42 ± 0.655
2010	Canopy	5.11 ± 0.674	0.332 ± 0.022	15.39 ± 0.655
2011	Open	4.02 ± 0.562	0.505 ± 0.017	16.31 ± 0.519
2011	Shrub	5.63 ± 0.559	0.399 ± 0.017	15.38 ± 0.518
2011	Canopy	4.68 ± 0.557	0.499 ± 0.017	15.76 ± 0.518
2012	Open	3.77 ± 0.698	0.429 ± 0.022	14.86 ± 0.656
2012	Shrub	5.12 ± 0.705	0.300 ± 0.023	13.98 ± 0.658
2012	Canopy	4.31 ± 0.697	0.405 ± 0.022	14.15 ± 0.657
	Low	4.61 ± 0.431	0.383 ± 0.012	15.99 ± 0.356
	Mid	4.99 ± 0.427	0.434 ± 0.012	14.71 ± 0.356
	High	5.25 ± 0.418	0.351 ± 0.012	14.94 ± 0.355
	Open	4.09 ± 0.425	0.432 ± 0.012	15.61 ± 0.355
	Shrub	6.07 ± 0.424	0.324 ± 0.012	14.93 ± 0.355
	Canopy	4.69 ± 0.423	0.412 ± 0.012	15.10 ± 0.355
2010		5.71 ± 0.634	0.322 ± 0.021	15.50 ± 0.652
2011		4.78 ± 0.525	0.468 ± 0.016	15.82 ± 0.516
2012		4.36 ± 0.647	0.378 ± 0.021	14.36 ± 0.653

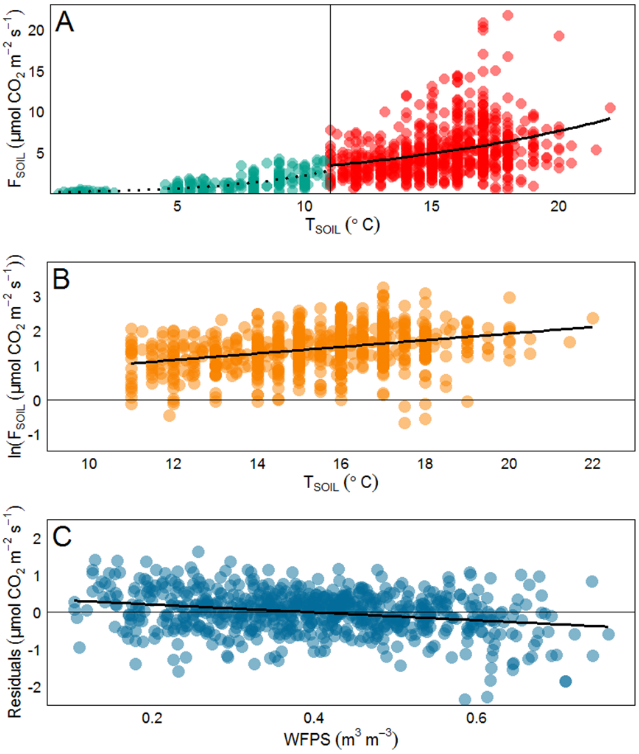

Figure 1. (a) Soil CO$_2$ efflux (μmol CO$_2$ m^{-2} s^{-1}) against soil temperature (°C) at 12 cm with data split at 11 °C. For all data, exponential regression shows an $r^2 = 0.3163$. For flux rate values below 11 °C, $r^2 = 0.434$; for flux rate values above 11 °C, $r^2 = 0.104$. **(b)** Natural log of soil CO$_2$ efflux (μmol CO$_2$ m^{-2} s^{-1}) against soil temperature (°C) at 12 cm for all data above 11 °C. For flux rate values below 11 °C, linear regression gives an $r^2 = 0.12$, $p = << 0.0001$. **(c)** Residuals of the natural log of soil CO$_2$ efflux (μmol CO$_2$ m^{-2} s^{-1}) against water-filled pore space (0–12 cm) for all data above 11 °C. $r^2 = 0.06$, $p = << 0.0001$.

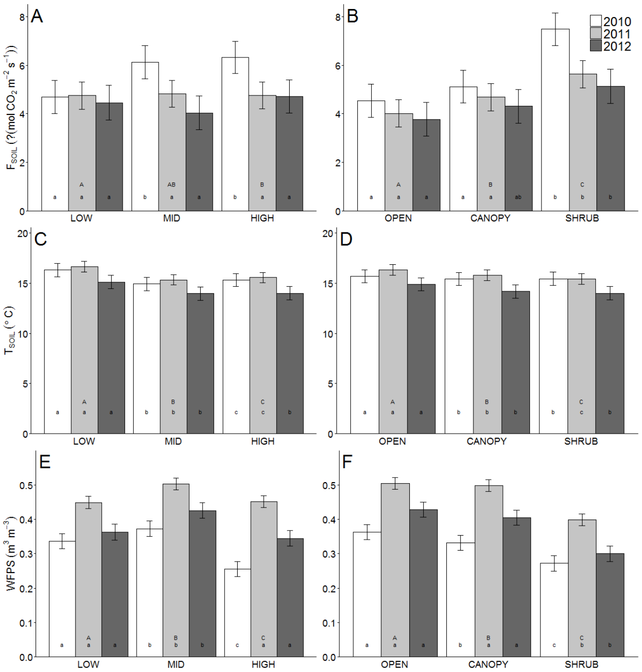

Figure 2. (a, c, e) Least-squares means of soil CO$_2$ efflux (μmol CO$_2$ m^{-2} s^{-1}), WFPS (m^3 m^{-3}), and soil temperature at 12 cm (°C) by elevation. **(b, d, e)** Least-squares means of soil CO$_2$ efflux (μmol CO$_2$ m^{-2} s^{-1}), WFPS (m^3 m^{-3}), and soil temperature at 12 cm (°C) by vegetation. Capital letters indicate difference between elevation classes and lower case letters indicate differences among class levels within years. Bars indicate standard error. Colors indicate sampling year.