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Biogeosciences Discussions

Interactive comment on "Carbon balance of surfaces vs. ecosystems: advantages of measuring eddy covariance and soil respiration simultaneously in dry grassland ecosystems" *by* Z. Nagy et al.

Anonymous Referee #2

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Overall, the topic of the paper "Carbon balance of surfaces vs. ecosystems" is relevant to the scope of Biogeosciences, and certainly methodological improvements in chamber design made by the authors would be welcomed, especially for grassland ecosystems as the authors mention. In this paper, the authors appear to have three objectives: 1) To develop and test an open chamber method for measuring soil surface flux. 2) To compare soil chamber surface flux to flux estimated by the gradient method. 3) To compare soil flux to ecosystem flux.

For objective 1, while the chamber design has clear benefits (small footprint, small

pressure differentials), the author's calibration tests did not go below 3.5 micro-moles/m2/s, which in general is the range (0-3.5) that the authors were measuring in the field. A more complete calibration of the system and some estimate of error, including the minimum detection limit, are critical to the interpretation of the surface flux measurements.

For objective 2, the comparison of gradient vs. chamber flux at different locations may never yield comparable results because of spatial heterogeneity. The gradient method is also subject to several sources of error that the authors would need to consider. The gradient equation can yield significant error without interpolation and with empirical estimates of D . Further the use of only 3 depth intervals over which to calculate the gradient lends itself to significant discrimination error unless gradients in CO2 and D are small. Because of these serious limitations, I would suggest omitting this comparison in a revised manuscript.

Finally, for objective 3, trying to scale up 4 chamber measurements to be an accurate representation of the eddy flux measurement is problematic because of the small area sampled. This is exacerbated by the fact that only natural gaps were sampled, which are not representative of the tower footprint. Rather than having a very long continuous record for this study, it would have been beneficial for the authors to have a shorter but more spatially extensive measurements of chamber based soil efflux.

As was mentioned by reviewer 1, the grammar and structure of the paper make it difficult to read and follow. I would recommend that the authors include more data to meet objective 1) and re-evaluate their remaining objectives to avoid making tenuous comparisons.

Specifc Comments Section 2.4.1 – The use of the Chebyshev function for the calibration device has no theoretical basis. In fact the paper by Pumpanen has the correct exponential equation for flux calculation.

Section 3.1 – While I agree that the calibration curve should pass through the origin,

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the authors have no experimental evidence to support this. With an over-pressuring of their system it may be that it passes below the origin, depending on soil diffusivity.

Section 3.3 – It may be useful for the authors to attempt to use the inversion method of Kohler et al. (2010) to see if their empirical diffusion estimates methods differ significantly from those gained by inversion of the CO2 profile. Also it would be interesting to know if the downward flux of CO2 was due to gas phase diffusion or water phase transport and chemical partitioning.

Section 4.2 – When comparing the methods, the authors give no information on the potential errors associated with each. Additionally there a multiple reasons why the gradient method may be over estimating fluxes, including discretization error, non-steady state effects (not only due to rain) and the empirical calculation of diffusivity. This is again, where an idea of the relative errors for each method might in fact show that the three concur.

References

An inverse analysis reveals limitations of the soil-CO2 profile method to calculate CO2 production and efflux for well-structured soils, B. Koehler, E. Zehe, M. D. Corre, and E. Veldkamp, Biogeosciences, 7, 2311-2325, 2010

Interactive comment on Biogeosciences Discuss., 8, 941, 2011.