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Biogeosciences Discussions

Interactive comment on "Annual carbon balance of a peatland 10 yr following restoration" *by* M. Strack and Y. C. A. Zuback

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Again we thank the reviewer for the thorough review of the manuscript and helpful comments. We have broken down the comment into sections and respond to each. The original reviewer comment is given first with our response following.

1. This paper presents a careful and comparison of annual C balance in terms of CO2 and CH4 exchange by chamber between a natural open peatland, a "restored" (or just rewetted?) and an "unrestored", abandoned peat extraction plot.

The study site is rewetted and restored. Ditches at the restored site have been blocked but the site has also been restored by applying donor plant material, straw mulch and fertilizer and recontouring the peat surface. This is all described in the Introduction and

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Study Site section of the manuscript.

2. Chambers were located in various microsites found in the sites with aim to get the within-site variability covered in the uncertainty of the overall mean estimate. Although the chamber methods may have their constraints in pursuing a credible extrapolation of C balance for the whole site, they still persist well in describing the roles of vegetation patterns or microtopography in the developing mosaic of C balances. Ideally, both eddy covariance and chamber studies could be employed. When that has been possible, the results from both approaches have proved well comparable. I thus a bit disagree with Referee #2 in that the chambers would not represent the state of the art technology. Here the methodology has been used in a manner well comparable to other literature. The strength of the chamber approach is that they give useful information on the relationships between e.g. GEP vs. vascular plant cover and NEE vs. water table depth (Fig 3). Is it possible to utilize more of the strengths and show more data on the microsite level and analyze the key components of the vegetation/microsite pattern with respect to the restoration phase, i.e. the role of high diversity?

We agree that the chamber method is useful for gaining process based information and examining microsite differences. We have looked into some of these relationships by examining between microsite controls on C fluxes (e.g. vegetation cover, water table; see Figure 3 in the manuscript). While we agree that there could be value in exploring these controls even further, since the central goal of the manuscript was a comparison of annual C balance between the restored, unrestored and natural sites these additional analyses would lengthen the manuscript and potentially distract the reader from the main findings. As such we suggest no further additions at this time.

3. Uncertainty management is not simple. Since the gross photosynthesis and ecosystem respiration seasonal estimates are derived using the transfer function approach commonly applied in chamber studies, the within-site variance estimate should in a strict sense combine the model error and inter-plot variances. Now the variability is characterized by standard deviation derived from plot-wise seasonal integrals only.

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The variability between plots at each site is high and generally greater than model error. However, we can add some additional information on the model error and agree that this is important information for the reader.

4. The main finding of this study is that under a dry spell, the C balance in the rewetted site is no worse in net C release that what was measured in the undrained natural site. At the same time the abandoned site released more C than either the natural or the restored one. The results are well presented, but could reveal even more of the microsite variability. We agree that there is a lot of additional interesting exploration that could be completed exploring variability between study plots to reveal microsite variability. However, as outlined above, since we present here data for CO2, CH4 and DOC flux, we felt that additional information would overwhelm the reader and go beyond the main goal of the manuscript which is an intersite carbon balance comparison.

5. Caution should be added to the ultimate interpretation of the results. The authors deduce from those results that the restoration methods taken here would result in near natural C balance functions within ten years. I agree with Referee #2 in that such conclusion may be premature. Given that the water table stays lower than in the natural site, and that the low net release may be due to differences in the palatability of the decomposing peat between the natural conditions with plenty of fresh organic matter in the acrotelm layer exposed by the drought, the rewetted system may still be well in the middle in restoring the C balance functionality. Modification of the final statement in the Conclusions might be needed. Otherwise the reasoning is sound.

We agree with this comment and as given in our response to reviewer 2 we suggest changing this sentence to “These results suggest that, although the hydrological processes and rates of CH4 efflux from the restored site are still intermediate between an unrestored and natural system, peatland restoration resulted in a large reduction in annual carbon loss from the system resulting in a carbon balance more similar to the natural peatland.”

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6. Page 17219, line23. Language: : : : remain lower than *in* undisturbed peatlands : : : ?

This will be corrected

7. Page 17219, line 24. Language: : : : compared *to*the natural site.

This will be corrected

8. Table 2. Show also n for each average and S.D. estimate.

Standard deviation is already given in this table in brackets beneath each value (as noted in the table footnote). We will add n.

Interactive comment on Biogeosciences Discuss., 9, 17203, 2012.