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Biogeosciences Discussions

Interactive comment on "Partitioning of soil CO₂ efflux in un-manipulated and experimentally flooded plots of a temperate fen" *by* S. Wunderlich and W. Borken

Anonymous Referee #1

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General comments: This manuscript presents results on the CO2 emission over two years from small plots in a minerotrophic fen, under natural and experimentally flooded conditions during the growing season, and uses 14C to identify the sources of the emitted CO2. The conclusions reached are that flooding to a water level 5 to 10 cm above the peat surface compared to about 10 cm beneath the surface, reduces CO2 emission by 30 to 40%, as might be expected, and that rhizosphere respiration contributed between one third and one half of soil respiration, with a slight reduction upon flooding. Untangling the sources of emitted CO2 is not an easy task, and the authors have used a variety of techniques to establish this. This is a rather complex site, driven by local conditions, and the fact that the plots were drained for three years, before being

flooded, so it is a system in transition.

My specific comments follow by page and line number: 5291, 16 Pretty slow rate of C accumulation in this system (despite what is probably a high NPP) – which is shallow and of a high bulk density at depth; my estimate is that it has accumulated only 10 g C/m2/yr over the top 60 cm or 8000 years. I have problems with the application of the water. On 5291, l 20, the plots appear to be 7 x 5 m, or 35 m2 and on 5292, l 15, 50 to 70 m3 of water were added daily to the flooded plots. This results in a daily input of between 140 and 200 cm (!). Yet on 5299, l4, it is stated that the daily irrigation was 20 cm. In both cases (please clarify which is correct), this results in a considerable input of chemicals into the plots – essentially eutrophication. In addition, with a stream DOC concentration of 15 mg/L, a large amount of potentially degradable DOC is being added – between 3 and 15 g/m2/day, depending on the amount of water added. Furthermore, this water is likely to be at least partially oxygenated. All these might contribute to an increase in CO2 production and emission (assuming the produced CO2 was not washed out of the plots by percolating water, unlikely given the low pH), even though the water table was raised. I think it would be appropriate to exclude the possibility of aeration by flooding, and it seems that other papers in this series cast some light on this issue (Estop-Aragones, Reiche etc.). 5304, l25 alludes to the oxic nature of the irrigation water. I ask that the authors clarify the amount of water added, comment upon the effect of the added nutrients and DOC and on whether the flushing water created a partially aerobic environment in the surface layers of the peat. 'Flooding' is usually connected to just a higher water table without nutrient additions, or oxygenated water, whereas this may not be the case here. It may affect the interpretation of the results such as why the change CO2 emission was small, compared to what might have been expected from other studies in which the water table was simply raised. 5298, l 10 I would have thought the flooded plots would be a bit warmer than the controls during the growing season (given that you are adding water and increasing the thermal conductivity) but the pattern is reversed by about 1oC, further contributing to a lowered CO2 emission. 5300, l 15 I find it a bit surprising that the HR cores have

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such a large variability in 14CO2 values: they must be quite a mixed bag of source C. Can you ascribe error estimates to the various sources of CO2, given this variability in HR, and would such an error estimate affect whether there are significant differences? 5301, l 26 I do not think this is a 'long-term' effect, under normal usage. 5303, l 25 The variable responses to flooding are to be expected, given the variation in water table manipulation, vegetation patterns and the relative decomposability of the surface layer of the peat (in your case probably low decomposability): looking for a magical generalization about the influence of water table may be elusive. The paper appears to be free of technical/typographical errors.

Interactive comment on Biogeosciences Discuss., 9, 5287, 2012.