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Biogeosciences Discussions

Interactive comment on "The impact of a declining water table on observed carbon fluxes at a northern temperate wetland" *by* B. N. Sulman et al.

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Response to editor comments:

We would like to thank the editor for her useful and insightful comments. General changes and individual responses to specific concerns follow.

General Changes: We have determined that carbon dioxide fluxes for the last year of the study (2007) did not produce reliable results due to calibration issues. We have therefore removed data from 2007 from the manuscript. We also decided to remove the data from the two alternative wetland sites (South Fork and Wilson Flowage) because we did not have the opportunity to perform enough detailed analysis on those sites to produce results useful for this paper. The discussion section was rewritten to incorporate more previous literature and improve its focus. We investigated the yearly

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average water table correlations with carbon fluxes and determined that using water table averaged over portions of each year when the soil temperature was greater than 0 C were more appropriate than whole-year averages, because they better reflected the processes taking place and produced better correlations.

1. Title (and abstract) should reflect the fact that fluxes from wetland, bog, fen, and forest ecosystems were analyzed. Emphasis on contrasting results for different ecosystems

Response: Title and abstract have been updated to better reflect the focus of the paper on comparing nearby wetland and upland ecosystems.

2. For ER and especially for GEP, the question remains, if some effects of the water table were not identified, because gap filling and partitioning of NEE into ER and GEP might not have included an effect of water availability and/or water table depth (your eq. 5-7). I recommend a test of the residuals between your eq. 5 [ER model] results and measured ER against water table depth.

Response: We tested residuals between modeled and measured ER and NEE, and found no correlation with soil temperature or water table depth. This result was added to section 3.3

3. Some specific effects of water table or soil water availability on ecosystem carbon fluxes or seasonal trends might be obscured by simultaneous changes in soil temperature. Unfortunately, with the exception of Fig. 5 the analysis is a rather monofactorial. Simultaneous changes in soil water/water table and temperature might have some combined effects on fluxes. A detailed multi-factorial analysis of the data would add more information, and make the conclusion more robust. A discussion on the mechanistic relationship and relative importance of water table, soil moisture, and temperature, etc. could be included to strengthen the importance of the results.

Response: We investigated correlations between water table and soil temperature.

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There was no correlation between yearly average temperature and water table, but there was a strong correlation between daily soil temperature variability and water table. This was added to section 3.2. Due to the high correlation and the fact that eddy covariance measurements have a large footprint, we were not able to satisfactorily separate the direct effects of temperature from water table. However, since the changes in soil temperature variability occur only in the soil and are not reflected in air temperature, we conclude that the increase in variability is probably an indirect effect of water table decline. This was added to the discussion section.

4. A little underrepresented were potential effects of microtopography (e.g., Sommerkorn M., Micro-topographic patterns unravel controls of soil water and temperature on soil respiration in three Siberian tundra systems (2008) Soil Biology and Biochemistry, 40 (7), pp. 1792-1802; Sullivan P.F., Arens S.J.T., Chimner R.A., Welker J.M., Temperature and microtopography interact to control carbon cycling in a high arctic fen (2008) Ecosystems, 11 (1), pp. 61-76). In this respect, 1-2 sentences on the representativeness of the water table measurements for the footprint of the eddy covariance measurements would clarify the situation.

Response: A short description of the topography of the wetland site and a comparison to previous studies investigating microtopography was added to the discussion section.

5. Several micrometeorological investigations have been made over wetland and forests using eddy covariance methods. Hence the statement (line 43-44) "Most previous studies of wetland carbon fluxes have used chamber measurements,..." is a little preposterous. In the revised version I expect a more thorough discussion of the presented results on the background of (at least some of) the above studies.

Response: The discussion section was rewritten and the introduction expanded to include more review of previous literature. The suggestions included in the editor comment were very helpful.

6. More appealing conclusions and/or outlook could include remarks on practical water

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table management (for controlling CO2 emission, but also other green house gases). For instance, the paper of Jacobs et al. (2007, Biogeosciences 4, 803-816) studied a grassland site with intermittent changes in water table. Their results indicate a change in source/sink function depending on water table depth (for comparison to your NEE results for 2007), with their site being in the middle of a very wet peatland (sink) and a drained peatland (source). Similar findings can be found in Kurbatova et al. (2008, Biogeosciences 5, 969-980).

Response: Comments on the implications of the results for wetland management were added to the conclusions section.

7. Other missing aspect were effects of the relative role of heterotrophic and autotrophic contribution in ER and potential shifts due to water availability, or species composition related to water tables.

Response: We were unable to separate heterotrophic from autotrophic respiration in our data. However, our future plans to incorporate these results into a model of wetland biogeochemistry would probably allow us to do this (a mention of this was added to the conclusions section). We did not have detailed records of plant species composition beyond biomass in different plant types, so we are unable to present data on plant species changes.

Interactive comment on Biogeosciences Discuss., 6, 2659, 2009.