

***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.**

B. N. Sulman et al.

Received and published: 18 May 2009

Response to anonymous referee #2:

We would like to thank the referee for insightful and constructive comments. Responses to individual concerns and general changes made to the manuscript 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. The discussion section was rewritten to incorporate more previous literature and improve its focus. We investigated the yearly 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

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

reflected the processes taking place and produced better correlations. The title and wording in the paper have been updated to reflect the referee's concern about implying that correlations are proof of "cause and effect."

Specific responses:

1. Discussion section The Discussion section of this paper is too long and not very focused. It could be tightened up into a more coherent argument, rather than the current series of subsections discussing each results section, which leads to some redundancy.

Response: The discussion section has been rewritten and reorganised.

1) Pg. 12, lines 369-376; this section is rather peripheral to the paper and could be dropped

Response: This section was dropped

2)the following section (4.3) on ER and GEP is particularly weak, referring to the Cook et al. 2009 citation in preparation for the increase in biomass is not useful, bringing the data into this paper would greatly strengthen the results and interpretation

Response: The biomass data is now included in the results (section 3.5)

3) The speculation in this section (4.3) about wetland hydrology and carbon feedbacks is too vague, there are many different types of wetlands, and the feedback suggested here would not apply to all wetlands,

Response: This section has been rewritten

4) section 4.4 is confusing, and is not well supported by the annual data presented in most of the figures, what is the explanation for similar WTs in 2006 & 2007 but quite different growing season precipitation?

Response: This section focused on results from 2007, which we have determined were

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



not reliable due to calibration issues. This section was dropped

5) the WUE discussion is suspect (see below), not helpful and sheds little light on process

Response: The WUE calculation was changed to answer the concerns stated below, and the results were compared to a previous wetland study that used the same type of calculation (Humphreys, E. R., Lafleur, P. M., Flanagan, L. B., Hedstrom, N., Syed, K. H., Glenn, A. J., Granger, R.: Summer carbon dioxide and water vapor fluxes across a range of northern peatlands, *J. Geophys. Res.*, 111, G04011, 2006).

6) 4.6 (other wetland sites) should be dropped, although tantalizing, the information is so thin to be useful here is such a brief mention, a more thorough analysis needed to make any real sense of these data.

Response: The data from these sites were dropped. We will perform more analysis in the future to produce more useful interpretations.

2. Include more literature citations the reference to previous wetland literature, especially those studies dealing with drought and WT effects, is rather limited. I would suggest a better summary of this past literature.

Response: The discussion section was rewritten to contain a better review of previous literature, and the introduction was expanded.

3. Expand site descriptions, especially Lost Creek The site description (especially for Lost Creek, since it is the main site of interest) are weak. More detail is needed. For example, what does the soil profile look like; this is extremely important information given the nature of the subject such as the ecosystem respiration.

Response: The site description for Lost Creek was expanded, and a description of the soil was added. We do not have detailed soil core data for the site.

4. Pg. 6, transpiration calculation; it is hard to accept that this calculation of ecosystem

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



transpiration is accurate. The modeling of the substrate aerodynamic (r_d) and soil resistances (r_s) are unsubstantiated and it is not clear how r_d would reflect that change in the canopy that occurred over time. The purpose of these computations is to derive canopy water use efficiency (WUE). As it forms only a small part of the analysis it could be dropped from the paper. The text does not give an adequate explanation of why WUE should behave this way. Also, it is not clear what a yearly value of WUE represents as WUE is a variable that has distinct seasonal and diurnal trends. Alternatively the authors might use the eddy fluxes of evapotranspiration and GEP to compute an ecosystem WUE, however, its interpretation will need considerable thought as the drivers are changing through time in this study. I suggest the former option. If the WUE piece is kept, the description of the calculation on page 10 should move to the methods section.

Response: The attempt to model soil evaporation was dropped, and WUE is now calculated as the ratio between GEP and ET. The results of this calculation are compared to values from different ecosystems reported by Humphreys et al. (2006), who used the same calculation. The description of the calculation was moved to the methods section.

5. Figure 1 and water table time series/averaging The linear fit in Fig. 1 is nonsense, it may help to reinforce the authors' point that WTs are getting deeper with time, but besides being unsupported by any statistical data, it is inappropriate for this time series. In fact, the data seems to show that the deepest growing season WT occurred in the year 2003, this brings into question the issue of using annual data for most of this analysis and begs the question why 2003 does not stand out against the years 2006 and 2007, which are portrayed as the years with lowest WT. On the whole I think that the conclusions reached in this paper about WT effects on C exchange are likely correct, but are not well demonstrated.

Response: The linear fit has been removed and replaced with averages of water table during the period of each year when soil temperature was greater than 0 C. We believe

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

this shows the pattern of declining water table more clearly, and better reflects the portions of the year when water table was most highly correlated with carbon dioxide fluxes.

6. Conclusion section The conclusion section is rather redundant; it could be shortened and more concise.

Response: The conclusion section was changed to focus more on broader implications of the study and the outlook for future work, and less on a summary of the results.

7. More detail about modeling On page 7 a bit more detail could be provided about these modeling procedures, e.g., how large was the moving window for ER and GEP?

Response: More detail was added about the modeling procedures.

8. GEP interactions with Water Table (section 3.5) Pg. 9 / 10, lines 276-291 this discussion of the GEP variable is rather wordy and confusing. It could be improved. As well, the symbols for the plot variables should not occur in this text, they should only appear in the figure captions.

Response: Plot symbols were removed from the text and replaced with descriptions. The section was shortened and clarified. We decided that the plot of half-hourly GEP (Figure 7 in the original manuscript) was not useful and it was removed.

9. Be clearer about dry 2007 growing season – precip vs WT Pg. 10, lines 309-311 the claim here is that 2007 had an unusually dry growing season resulting in abnormally low GEP. However, in much of the data you show (based on annual averages) indicates 2006 had a lower water table. The difference in these facts needs to be clearer, Figure 1 is not detailed enough to determine this difference. The text here refers readers to Sect. 4.4 for an explanation, yet this difference between growing season and the annual averages is still not clear.

Response: The data from 2007 was removed due to calibration problems. The calculations involving annual averages of water table were changed to use just averages of

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



water table from periods when the soil temperature was greater than 0 C, which better reflects the processes affecting carbon fluxes.

10. Make Silvola et al citation more specific – they measured soil CO₂ emission Pg. 11, line 335 the authors should be careful to note that the Silvola et al. 1996 study measured soil CO₂ emission , not ecosystem respiration.

Response: Sentence was updated to be more specific about the study.

11. Look at acclimation of ecosystem to dryer conditions, see Oechel et al. (2000) Pg. 11, lines 337-343 this discussion of the effects of WT draw down, might also consider that some acclimation of the ecosystem may occur after a period of time, such behaviour has been suggested for arctic tundra (see Oechel et al. 2000, Nature).

Response: This was added to the discussion

12. Figures Fig. 2 could benefit from labeling the points on the plot by year. Figs. 4 and 8, the dots in these should not be joined by lines. In fig. 4 it is not clear if the WT data are an annual average.

Response: The figures were updated and the captions made more specific.

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

BGD

6, S1035–S1040, 2009

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

