Biogeosciences Discuss., 6, S926–S929, 2009
www.biogeosciences-discuss.net/6/S926/2009/

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.

E. Falge (Editor)

efalge@mpch-mainz.mpg.de

Received and published: 29 April 2009

The paper addresses relevant scientific questions, as the dependence of carbon fluxes and evapotranspiration on northern temperate peatland and adjacent forest ecosystems on water table depth is an important topic with potential impact on climate management strategies of peatlands. The results and conclusions of the paper are substantial for more insight in controlling factors of fluxes over peatlands. Nevertheless, there are several basic concerns since analysis and discussion on the background of former studies are rather limited. Thus, I recommend the authors to make major revisions needed for acceptance.

1. Title (and abstract) should reflect the fact that fluxes from wetland, bog, fen, and forest ecosystems were analyzed. I would like to see more emphasis on (eventually

contrasting) results for the different 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 results and measured ER against water table depth.

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.

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.

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. The authors may find some useful insights on the effects of soil temperature, soil moisture, and water table on CO2 fluxes, and evapotranspiration in:

BGD

6, S926–S929, 2009

Interactive Comment

Kurbatova J., Li C., Varlagin A., Xiao X., Vygodskaya N., Modeling carbon dynamics in two adjacent spruce forests with different soil conditions in Russia (2008) Biogeosciences, 5 (4), pp. 969-980. Krishnan P., Black T.A., Barr A.G., Grant N.J., Gaumont-Guay D., Nesic Z., Factors controlling the interannual variability in the carbon balance of a southern boreal black spruce forest (2008) Journal of Geophysical Research D: Atmospheres, 113 (9), art. no. D09109. Grondahl L., Friborg T., Christensen T.R., Ekberg A., Elberling B., Illeris L., Nordstrom C., Rennermalm A., Sigsgaard C., Sogaard H., Spatial and Inter-Annual Variability of Trace Gas Fluxes in a Heterogeneous High-Arctic Landscape (2008) Advances in Ecological Research, 40, pp. 473-498. Ball T., Smith K.A., Moncrieff J.B., Effect of stand age on greenhouse gas fluxes from a Sitka spruce [Picea sitchensis (Bong.) Carr.] chronosequence on a peaty gley soil (2007) Global Change Biology, 13 (10), pp. 2128-2142. Hendriks D.M.D., Van Huissteden J., Dolman A.J., Van Der Molen M.K., The full greenhouse gas balance of an abandoned peat meadow (2007) Biogeosciences, 4 (3), pp. 411-424. Yurova A., Wolf A., Sagerfors J., Nilsson M., Variations in net ecosystem exchange of carbon dioxide in a boreal mire: Modeling mechanisms linked to water table position (2007) Journal of Geophysical Research G: Biogeosciences, 112 (2), art. no. G02025. 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 (2006) Journal of Geophysical Research G: Biogeosciences, 111 (4), art. no. G04011 Glenn A.J., Flanagan L.B., Syed K.H., Carlson P.J., Comparison of net ecosystem CO2 exchange in two peatlands in western Canada with contrasting dominant vegetation, Sphagnum and Carex (2006) Agricultural and Forest Meteorology, 140 (1-4), pp. 115-135. Syed K.H., Flanagan L.B., Carlson P.J., Glenn A.J., Van Gaalen K.E., Environmental control of net ecosystem CO2 exchange in a treed, moderately rich fen in northern Alberta (2006) Agricultural and Forest Meteorology, 140 (1-4), pp. 97-114. Vourlitis G.L., Harazono Y., Oechel W.C., Yoshimoto M., Mano M., Spatial and temporal variations in hectare-scale net CO2 flux, respiration and gross primary production of arctic tundra ecosystems (2000) Functional Ecology, 14 (2), pp. 203-214. Vourlitis

BGD

6, S926–S929, 2009

G.L., Oechel W.C., Eddy covariance measurements of CO2 and energy fluxes of an Alaskan tussock tundra ecosystem (1999) Ecology, 80 (2), pp. 686-701. Vourlitis G.L., Oechel W.C., Landscape-scale CO2, H2O vapour and energy flux of moist-wet coastal tundra ecosystems over two growing seasons (1997) Journal of Ecology, 85 (5), pp. 575-590. Fowler D., Hargreaves K.J., Macdonald J.A., Gardiner B., Methane and CO2 exchange over peatland and the effects of afforestation (1995) Forestry, 68 (4), pp. 327-334

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.

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

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.

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