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Biogeosciences Discussions

Interactive comment on "Peatlands and the carbon cycle: from local processes to global implications – a synthesis" *by* J. Limpens et al.

J. Limpens et al.

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Interactive comment on “Peatlands and the carbon cycle: from local processes to global implications – a synthesis” by J. Limpens et al. Anonymous Referee #4 Received and published: 15 April 2008

General comments This paper reports on the main findings from a symposium on carbon in peatlands held in Wageningen, the Netherlands, in April 2007. The focus is on the main drivers of carbon fluxes at different scales, and the importance of peatlands in the context of climate change. In general, the paper performs well in synthesizing important peatland carbon processes. It provides a much valuable source to current knowledge both for students and experienced researchers. Although I have some concerns regarding the contents of certain sections, I find it appropriate for BG and recommend it to be accepted after some minor revisions. S344

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Interactive Discussion
Discussion Paper

I believe that the abstract needs to be improved. It does mainly summarize parts of the introduction. I suggest that you include the most important outcomes of the synthesis work: What are the main findings? What aspects constitute the key uncertainties? Which are the most important areas to which future research ought to focus?

Response: We have revised the abstract, and have included the main uncertainties.

It is mentioned in the article that carbon stocks and processes for arctic ecosystems involving permafrost is not covered, which I find unfortunate. The paper would have benefited from the inclusion of e.g. a section under “Perturbations” that summarizes current research on permafrost degradation and its potential for strong feedback effects on global warming. This aspect is also mentioned in the article along with examples from subarctic wetlands, which further addresses its importance.

Response: We re-arranged the perturbation section under the captions land use change, climate change and restoration. Under the caption Climate change, we now deal with both increases in fire frequency and a few lines on permafrost degradation, as suggested.

In the conclusions section (5), some new concepts are taken up. I suggest that they are moved to appropriate previous sections, and that the conclusions section is more briefly and strongly lined out. More specifically, the impact of fires on ozone, temperature, aerosols etc could be moved to fire section (3.4.1), while the effect of vegetation composition on NPP, CO2:CH4 emission ratio could be moved to section 2.2.

Response: we moved the indicated text parts as suggested and rewrote the conclusions section.

A final general comment is about abbreviations such as C, DOC etc. I believe all abbreviations should be explained on their first appearance, and thereafter only the abbreviation could be used. As an example, on page 1383 line 9 DOC is used for the first time without explanation. Then it is written out on line 14 instead. Please review

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all abbreviations for uniformity.

Response: changed as suggested

Specific and technical comments

P1381 L19: Include multiplication sign when using ten to the power of xx. Also on P1395 L12 and L18; P1398 L2; 1399 L7 and L9. P1383 L8: Reference Schrier et al. could be moved to appropriate section (3.2.2) P1383 L18: “extra cellular” change to extracellular

Response: changed as suggested

P1384 and Figure 1: In my opinion this figure contains a lot of information that is not S345 explained in text or caption. Only Fig 1D is explicitly referred to. Text in figure is hard to read in a regular printout. I suggest that all parts of the figure (A-D) should be referred to. I would also like to see a simplification of the figure or a more clarifying caption.

Response: we added in-text references to all parts of the figure and clarified the caption. Caption now reads: Fig. 1. Schematic of (A) small-scale biogeochemical processes, (B) distribution of controls involved in belowground carbon cycling in peatlands, (C) recharging of electron acceptors, redox potential declines from left to right, (D) the regulation and impact of exo-enzymatic activity on decomposition. Abbreviations not explained in text: ER = Ecosystem Respiration, GEP = Gross Ecosystem Production, CH2O = organic matter, kd = decomposition, kh = hydraulic conductivity, Dw = Diffusion). Most uncertainties lie in the process rates and spatio-temporal variability of the controls.

P1385 L1-L3: I suggest including anaerobic conditions to this sentence describing factors causing high methane emissions.

Response: We added local anoxia as an additional factor causing methane emission. The sentence now reads: The emission of CH4 is a function of its rate of produc-

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tion, transport and oxidation. High peat decomposition rates in warm and poorly decomposed peat, local anoxia, provision of substrates by roots, and rapid transport to the surface by ebullition and through conduits, such as vascular plant roots or stems, generally lead to high CH4 emissions (Shannon and White, 1994; Fechner-Levy and Hemond, 1996; Coles and Yavitt, 2004)

P1385 L14: Space character seems to be missing before “production”. P1385 L27: Reference to Fig. 2D erroneous. P1386 L1: Is a hyphen missing in “copper containing”?

Response: changed as suggested

Section 2.2: Many of the factors described in this section may act to increase vascular plant cover at the cost of Sphagnum, such as N deposition and increased CO2 concentration. I suggest including a sentence or paragraph that describes the consequences of this for litter decomposability, heterotrophic respiration, and C sequestration in general.

Response: we added a short paragraph in the beginning of the section. Inserted text reads as follows: In general, decreasing wetness during the growing season as well as increases in N deposition stimulate vascular plant growth at the cost of Sphagnum, with effect sizes greatly depending on the starting conditions. The shift from a Sphagnum dominated to vascular plant dominated vegetation type coincides with increases in litter decomposability (Dorrepaal et al., 2005), heterotrophic respiration (Bubier et al., 2007), hydraulic conductivity (Belyea and Baird, 2006) and a general decline of C-sequestration in the longer term.

P1388 L24: Suggest changing “Where” to “Whereas”, and also include “as a result of increased N deposition” or similar to this sentence. P1390 L7: Correct to “microtopographic”.

Response: changed as suggested

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P1393 L14-15: Lindroth et al. is wrongly cited. This study found that temperature was the main environmental driver for photosynthesis and respiration.

Response: we checked the literature source. Lindroth is correctly cited. There probably is a confusion with another publication in GCB of the same author where they discuss drivers of NEE in a boreal forest. There T was the main control.

Fig. 4 caption: Sentence describing Mer Bleue, change full stop after “raised shrub bog” to comma. Reference year for Roulet et al. should be 2007? P1395 and section 5.1: Tropical peatlands are not as thoroughly studied as are temperate and boreal. The rapid degradation of these ecosystems is of huge importance in a climate perspective. I would suggest including in section 5.1 Ways forward, a point about increasing research efforts in tropical peatlands. S346 Fig. 5: Correct “pant-soil”. Hyphens surrounding water and atmosphere are of different sizes. I suggest to remove them and to write “DOC, POC in water” instead. The thicker arrow on the right hand side may be interpreted to constitute a higher outgoing flux of C gases than the incoming on the left hand side of the figure. P1412 L24 and P1413 L2: Correct “CO2”.

Response: changed as suggested

Interactive comment on Biogeosciences Discuss., 5, 1379, 2008.