Biogeosciences Discuss., 5, S1585–S1588, 2008
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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.

Received and published: 1 September 2008

Interactive comment on “Peatlands and the carbon cycle: from local processes to global implications – a synthesis” by J. Limpens et al. Anonymous Referee #3 Received and published: 12 May 2008

General comments I found this paper very informative and important. If had students studying peatland carbon cycling or greenhouse effect associated with land use in general, I would use material from this article in teaching. Even as a result of symposium, where scientist meet by change, it covers fairly well peatland ecosystems and is increasing (or keeping) the role of peatlands in greenhouse gas effect and carbon balance important. This is important in current situation, when ’peatlands are not explicitly included in global climate models and therefore in predictions of future climate change (IPCC, 2007)’; as authors point out.

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Interactive Discussion
Discussion Paper

I like the way how carbon degradation in waterlogged systems is introduced. Article is not only concentrating to CO2 and CH4 but also dissolved organic carbon is included and role of alternative electron acceptors in addition to oxygen is also clearly expressed in text. Even lack of oxygen leads to CH4 fluxes and carbon storage in peatlands, including sulphur cycle as a part of carbon cycle is similarly important. Authors also are also keeping in mind that proceses of peatlands may be changing as they may be destabilized by global warming and changes in land use, and affect then also their surroundings. Article is also well organized according to important aspects in peatland atmosphere interactions.

Specific comments The article is delineated so that arctic tundra is not included, even subarctic wetlands are. This delineation is probably OK with large scale estimates, but for small scale processes the same factors as driving forces are important. So this delineation is somewhat artificial.

Response: good point – we are faced with the problem of not making the focus of the paper even broader than it already is. As a compromise we removed the remark in the introduction about the exclusion of permafrost wetlands and have added some lines, for example under Perturbations, relating to permafrost degradation.

There is some points, which may need some additional comments and references in order to give a clearer picture of the whole peatland processes. Even the aim of the article is to synthesize the main findings of the symposium, I feel that article benefits from a bit wider scale of peatland knowledge. As the title is ’Peatlands and the carbon cycle: from local processes to global implications - a synthesis’ It might be helpful to reader to explain the terms ombrotrophy and minerotrophy, as water source largely determines the functions on peatlands and ties peatlands to hydrology of surrounding areas, and is also included in ’ways forward’ as one goal to determine from peatlands. There is no estimate of areas of peatlands in general or in their different uses, except of this 3% of land surface’. By this way a reader not familiar with peatlands will get lost.

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Interactive Comment

Response: we added a short paragraph to the introduction to give a bit more background on peatlands. The inserted text reads: Peatlands are wetlands with an organic soil layer of at least 30 cm, which may extend to 15-20 m depth with an estimated mean between 1.3-2.3 m for northern peatlands (Clymo et al. 1998, Turunen et al., 2002). Peatlands cover about 4.16 Œ106 km2 worldwide, with 80% of the peatland area situated in temperate-cold climates in the northern hemisphere, particularly in Russia, Canada and the USA. The remaining peatlands are found in tropical-subtropical climates, particularly in south-east Asia (Joosten, 2004, Global Peatland Database). Despite covering less than 3% of the Earth’s land surface, boreal and subarctic peatlands store between 270 and 370 Tg C (1 Tg = 1012 g) as peat (Turunen et al., 2002), which would amount to 34-46% of the 796 Tg C currently held in the atmosphere as CO2 (IPCC 2007).

To introduce concepts such as the distinction between two peat layers (biologically active vs inactive) and ombotrophy vs minerotrophy we added an additional section to the introduction which reads: The necessity of focusing on processes becomes clear when we consider the large variation in peatland types. Peatlands comprise many different ecosystems (Rydin and Jeglum, 2006) with and without a tree and/or moss layer. Fortunately, there are some unifying concepts that apply across different peatland types although Sphagnum-dominated peatlands are the most studied compared to other peatland types. The redox potential is decisive for many biogeochemical processes in the peat, and this is largely governed by the position of the water table. The upper peat layer (about 5-40 cm) is unsaturated with water and oxic during the growing season and supports most biological activity, whereas the layer below is waterlogged and anoxic. The oxic-anoxic boundary shifts as a result of water table fluctuations. Another key distinction is made on the dominant water source influencing the organic soil layer. Peatlands that receive most of their water from precipitation are referred to as ombrotrophic peatlands or bogs, whereas peatlands that are mainly fed by water that has been into contact with the mineral soil are referred to as minerotrophic peatlands or fens.

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I am sure that peatland restoration mentioned here is only a minor player in carbon balance, CH4 and POC fluxes compared to peatland usage to agriculture, forestry, peat harvesting and as water reservoirs.

Response: We re-arranged the perturbation section under the captions land use change, climate change and restoration. The text under the latter caption was reduced by a number of lines in order to give a more balanced overview. We wanted to retain a section devoted restoration however, because of the money and research-effort involved in restoration of peatlands.

I do not understand the function of natural peatland pipe (figure 3); or then I have never seen one, and see it only as a rare exception.

Response: we have expanded the text to explain about the distribution of peatland pipes (more common than you would think) and their function. The text reads now: The occurrence of pipes is not related to slope gradient, although some topographic variation in the subsoil is necessary. Pipes have been reported for subarctic continental peats (Gibson et al., 1993; Carey and Woo, 2000), southern hemisphere patterned mires (Rapson et al., 2006) and some tropical peatlands (Buytaert et al., 2006). The effect of macropores and pipes on water and C flow can be substantial. Baird (1997) and Holden et al. (2001) showed that over 30% of runoff in fens and blanket peats in the UK moves through macropores, resulting in water and nutrients being transferred between deep and shallow layers of the peat profile. There is even a theory that pipes can explain some of the additional degassing from bog pools that does not seem to be accounted for by bog pool size alone. Many drained peat pools have been found to have a natural peat pipe on their floor or wall (Rapson et al., 2006). Interactive comment on Biogeosciences Discuss., 5, 1379, 2008. S513

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