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Biogeosciences Discussions

Interactive comment on "Methanotrophy potential versus methane supply by pore water diffusion in peatlands" *by* E. R. C. Hornibrook et al.

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This paper reports the results from a thorough and nicely-designed study of some of the factors controlling methane emissions from peatlands. Peatlands are the largest natural source of atmospheric methane and it is important that we are able to predict future emissions using physically-based models (for use in coupled climate - land surface models). These models are still very much 'works-in-progress'; and it is clear we need to know more in particular about methane transport through peat and the role of the unsaturated zone in emissions of methane to the atmosphere. The authors provide new insights into the processes responsible for the transport and consumption of methane in a range of peatland sites in Wales. Their key finding is that low-affinity methanotrophic bacteria are able to consume all of the methane that diffuses through

the pore water upwards towards the water table. Their finding is based on a sound experimental design and a sound interpretation of the data yielded by the experiment. However, there are some relatively minor aspects of the paper that would benefit from improved explanation or a small amount of additional material. With minor revision, I recommend that the paper is published. Detailed comments are given below.

The description of the research sites is terse. It is difficult for the reader to compare the sites with those used by other research groups, making it difficult to put the flux rates presented by the authors into a wider context. For example, it would have been useful to have known more about the degree of decomposition of the peat/litter in the upper few decimetres. It would also have been useful to have known more about the plant species at each station. The authors note that station 1 at Cors Caron and Blaen Fign contained a greater cover of Sphagnum than station 2, which in each case contained a greater cover of vascular plants. Without giving more detail, this information is of little use to the reader. A range of different microhabitats on ombrotrophic bogs contain a high cover of Sphagnum (e.g. hollows dominated by Sphagnum cuspidatum Ehrh. ex Hoffm., lawns dominated by Sphagnum magellanicum Brid. and low hummocks dominated by Sphagnum capillifolium (Ehrh.) Hedw.). The litter laid down by these different species of Sphagnum may differ in its properties as a medium through which oxygen diffuses and as a mechanical retainer of biogenic gas bubbles. In addition, given the large differences observed between measured flux rates and estimated rates of pore-water diffusion, it would be interesting to know the details of the vascular plants (species and abundance) that were responsible for the relatively high rates of methane emissions from the bog surfaces enclosed by the chambers at station 2 at each site.

I would like to have seen the pore-water data presented by the authors put into the context of data presented in other recent studies. A short paragraph should suffice.

On page 2621, line 23, the authors note that "Chamber measurements that exhibited erratic pulses (i.e. ebullition) were excluded from the flux analysis because it could not be determined exclusively whether the events were natural or induced during sample

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collection." The authors seem to have taken great care to avoid being near their chambers during sample collection (via a 4-m Tygon tube) so it is not immediately clear why they think the ebullition events were possibly caused by disturbance. I think it would be useful if they could provide more detail on why they excluded the ebullition events, what proportion of their dataset these events comprised, and how their results and conclusion may have changed if ebullition had been accounted for. In this respect it is interesting to note the findings from the study of Tokida et al. (2007a). Tokida et al. (2007a) measured methane efflux using two chambers placed on a temperate bog dominated by Sphagnum spp. but also containing vascular plants such as Eriophorum vaginatum L. and Rhynchospora alba (L.) Vahl.. High-frequency measurements of efflux were taken using the chambers every 1.5 - 2 hours over four days when atmospheric pressure varied but showed a general fall from 1017 - 1000 hPa. Over this period, ebullition contributed 50-64 percent of the total methane efflux. However, during individual events, ebullition losses exceeded the other losses combined by one to two orders of magnitude.

Minor comments:

Flora is used quite often to denote, it seems, 'plant species'. This can lead to some odd expressions like "vascular flora" (are not all flowering plants vascular?).

Page 2610, line 20, "eliminate a key zone". The English here is a little awkward; I recommend rewording the sentence.

Page 2612, line 2, "of complete attenuation of". The English here is a little awkward; I recommend rewording the sentence.

Page 2622, line 7. "impacted". Better word such as affected?

Page 2623, line 18. Should "less depleting" be "less depleted"?

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