Biogeosciences Discuss., 12, C3081–C3086, 2015
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Biogeosciences Discussions

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12, C3081–C3086, 2015

Interactive Comment

Interactive comment on "Simultaneous high C fixation and high C emissions in *Sphagnum* mires" *by* S. F. Harpenslager et al.

S. F. Harpenslager et al.

S.Harpenslager@science.ru.nl

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Dear Sir/Madam,

We thank you for your critical review of our manuscript and for raising some highly interesting points relating our study. We feel that these have considerably improved our manuscript. Please find our responses to all points raised by Referent #2 below. Furthermore, please find a revised version of our manuscript attached as a pdf, in which all revisions are indicated in blue. The supplementary figure mentioned in the response to point 2 has been attached to our Author response as well.

Yours sincerely, on behalf of all authors,

Sarah Faye Harpenslager

Interactive comment on "Simultaneous high C fixation and high C emissions in Sphagnum mires" by S. F. Harpenslager et al.

Anonymous Referee #2

Received and published: 1 June 2015

These authors grew different kinds of Sphagnum in the lab under conditions of rather high alkalinity. They tested 4 different types of Sphagnum. Only one type grew well, one did quite poorly, and two grew a bit. The one that grew well produced significant acidity resulting in the titration of the bicarbonate in the media water and subsequent release of CO2. The authors make the point that even with growth and organic matter formation, such a system may serves as a CO2 emitter. They suggest that the conditions under which they grew the moss represent a pioneering stage for Sphagnum and that when this acid producing moss moves into an environment with high alkalinity similar results may occur. They cite examples from the literature when CO2 emission from mires has been detected. In general, I think that these results are important, as many researchers probably have not considered such a mechanism. I do have a couple of suggestions for the authors.

We thank Referee #2 for pointing out the relevance of our work. Furthermore, we thank this referee for his/her interesting points raised about our manuscript. We feel that the processing of these points has considerably improved the clarity of our manuscript.

1. Please right away in your introduction where you cite the CO2 fluxes, say what convention you are using. Do negative fluxes indicate CO2 uptake by the surface? Or emission.

We agree that mentioning the convention used in our study early on improves the clarity of our paper. We have changed this in the revised version of our manuscript by inserting "With all presented values of C fluxes, positive values represent net C losses to the atmosphere, whereas negative values represent net storage of C in growing peat throughout the manuscript" in line 39 on page 3.

2. Could you explore the relationship between biomass production and acid production a bit more? Is this a linear relationship or what? How does this work? I don't mean to suggest doing more experiments, but just see if you can find more on this in the Literature.

We thank the reviewer for raising this issue. In literature, we have found that the acidification rate of Sphagnum species is dependent on the availability of nutrients (Kooijman and Paulissen, 2006). From this, we hypothesised that there should also be a relationship with biomass production. We therefore checked our own data and found a clear linear relationship between pH within the vegetation and biomass increase, which is a valuable addition to the manuscript. We have included the existence of this linear relationship in our Results section and added this graph as a Supplementary Figure.

3. All the acid produced by mosses, where does this end up? If mosses grow and grow, they continue to produce H+ right? Eventually does this acid migrate some place, to some more alkaline surface water and result in more CO2 emission, thus cancelling out the carbon sequestration of mosses?

This is a very interesting point. In Sphagnum dominated fens and bogs, the acid produced by the mosses lower pH, which can be as low as pH 3.5. Furthermore, these systems will show an outflow of acid water, which, when running into more buffered surroundings, may indeed result in the reaction we presented in our manuscript, leading to higher CO2 emissions in these areas. Including this flux could have implications for the C sink function of peatlands, which we speculated on in the final part of our conclusion in the revised manuscript.

4. So is the carbon that is fixed into moss tissue from the water? The Total inorganic carbon? Or is it from the air? If the former, and the groundwater has ancient CO2, say from limestone dissolution, could this result in ancient appearing moss? 14C –wise?

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To determine the exact carbon source that Sphagnum uses for photosynthesis, we would have needed to introduce isotope labelled C into the medium. From previous research, however, it has become clear that although part of the C used by Sphagnum will be derived from the air, ambient CO_2 concentrations are not high enough to meet the C requirements of Sphagnum (Smolders et al., 2001), which means that they need an additional C source. It is therefore not surprising to learn that Sphagnum utilises both previously respired CO_2 (Rydin and Clymo, 1989) and soil-derived CO_2 from decomposition processes (Turetsky and Wieder, 1999) for C fixation. Apart from the COÂň2 in the air, C was present in our system as TIC (HCO_3^- and CO_2) in the soils and as TIC in the treatment water. In our case, however, we cannot distinguish between the different sources of C that Sphagnum may have used, and we therefore just cannot calculate how much of the fixed C is derived from the atmosphere based on our results.

5. I note that the tables contain CO_2 concentration and HCO_3 concentration. Please give total inorganic carbon too, just for ease of comparison, in the table.

We have added TIC concentrations to Table 2 in the revised manuscript, according to the referee’s suggestion.

6. Interesting in the moss pore water, why was the pH higher in the pore water without the moss>? How are the moss values in Table 2 obtained, when the 4 mosses used behaved so differently?

Since the soils were floating on top of the surface water, we cannot distinguish between the water layer that stood in (indirect) contact with the different moss species. Furthermore, our sediments contained two soil moisture cups to take pore water samples, which were pooled to minimise the effect of variation within the soil. All data from Table 2 is therefore derived from pooled samples of water layer or pore water of moss-covered or bare peat soils. All pore water was sampled from the middle of the aquarium. The differences that we found in pH between soils with moss and without moss might be explained by the higher intrusion of O_2 into sediments without mosses,

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leading to oxidation of reduced sulphur and concomitant acid production.

References

Kooijman, A. M., and Paulissen, M. P. C. P.: Higher acidification rates in fens with phosphorus enrichment, Appl Veg Sci, 9, 205-212, 2006.

Rydin, H., and Clymo, R. S.: Transport of Carbon and Phosphorus-Compounds About Sphagnum, Proc R Soc Ser B-Bio, 237, 63-84, 1989.

Smolders, A. J. P., Tomassen, H. B. M., Pijnappel, H. W., Lamers, L. P. M., and Roelofs, J. G. M.: Substrate-derived CO2 is important in the development of Sphagnum spp., New Phytologist, 152, 325-332, 2001.

Turetsky, M. R., and Wieder, R. K.: Boreal bog Sphagnum refixes soil-produced and respired (CO2)-C-14, Ecoscience, 6, 587-591, 1999.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/12/C3081/2015/bgd-12-C3081-2015-supplement.pdf

Interactive comment on Biogeosciences Discuss., 12, 4465, 2015.

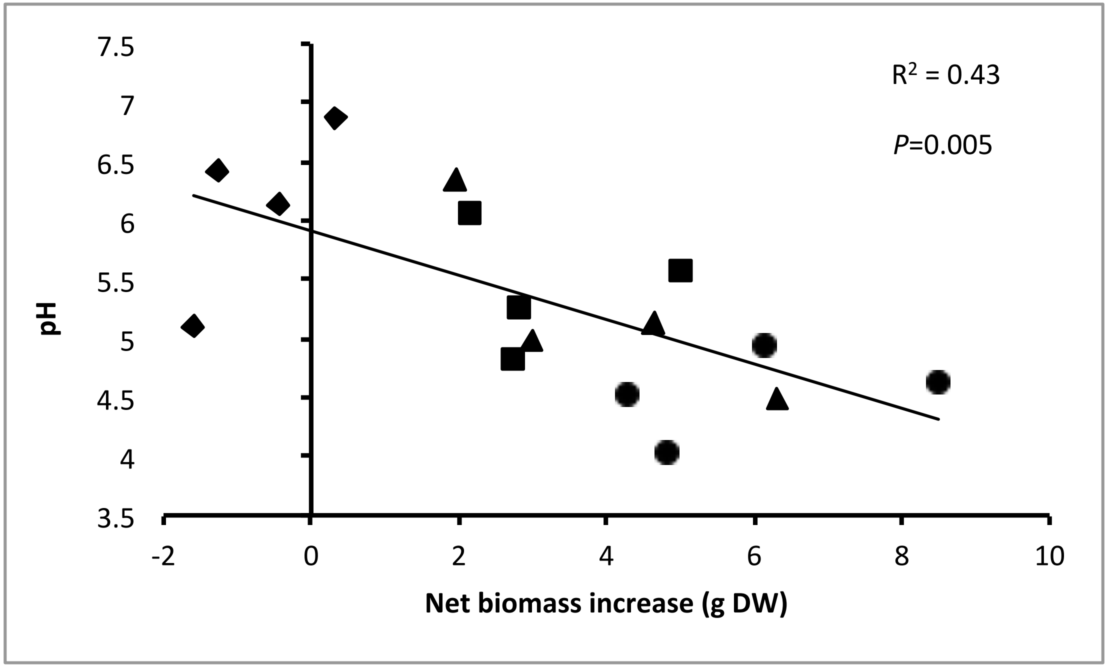

Fig. 1.

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