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Biogeosciences Discussions

Interactive comment on "Influence of hydrological fluxes on bio-geochemical processes in a peatland" *by* N. Bougon et al.

Anonymous Referee #1

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Influence of hydrological fluxes on bio-geochemical processes in a peatland

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General comment: Bougon et al. presents an experimental approach to isolate the physical and chemical factors that might influence the chemical trends in nitrate and sulfate that they observed in their field site. Overall, I agree that such type of experiments are required to obtain better understanding of biogeochemical processes in such complex environment, however, I have some concerns about missing data, some of the interpretation, and its documentation. The topic of this manuscript is definitely appropriate for publication in Biogeosciences. I recommend that the authors give a clearer and more extensive description of the hydrogeology at the field site together with an extended presentation of their microbiological results. The manuscript also

needs some improvement in the descriptive and interpretative issues, which are listed below.

Specific comments:

Title- I think the word fluxes is not appropriate for this work (and title). The authors do not provide the data to interpret their results in term of fluxes. I suggest to use hydrological conditions instead of hydrological fluxes. Introduction- The Introduction reviews the literature only until 2004, although many studies were done on the impact of hydrological conditions (including fluxes) on biogeochemical processes since then. It also lack the specific discussion about the main focus of this manuscript- past studies that tested systems that were under variable saturated conditions (e.g.,Day and Megonigal, 1993; Phipps and Crumpton, 1994; Spieles and Mitsch, 1999; Ishida et al., 2006). Toward the end of the Introduction, the authors state that their aim is to distinguish between physical and chemical conditions on microbial activity. A few sentences later (Material and Methods), the authors mentioned that this will be done using a batch experiments, that will "reproduce their field observations". Although, their laboratory experiments were designed and performed nicely, I don't think that they could relate their results to physical conditions (degree of saturation or fluxes), although the samples were taken from different hydrological regimes. This key point should be more clearly stated throughout the text (title, methods, results and discussion).

Page 4833, section 2.1.2 and Figure 1- I didn't find the description and Figure 1 clear enough to understand the hydrogeological conditions in the field site. There is a clay layer mentioned in the text here (and also later), which is not in the sketch. Since clay layer is a major feature that control the flow in subsurface system it should be described more thoroughly. Also, I didn't understand X sign on the arrow in the sketch of site G, under low-water period. Also, the authors use here the word, river (line 19), while in line 5 they were using the word stream. I suggest using one term in the entire manuscript.

Page 4834, lines 1-10. In the first line the authors mentioned that "field tests" were

BGD

6, C572–C576, 2009

done in order to estimate the hydraulic conductivity. I understand that slug tests were performed in the clay piezometers but it is not clear what kind of tests the authors were using in the peat piezometers. The results from these tests, including data on how the differentiation between horizontal and vertical hydraulic conductivy was done ? are not reported later on in the text although this is critical for linking the biochemical results to fluxes (only the total hydrologic budget is reported in Table 1).

Page 4835, line 6, typo mistake in the word "throw".

Page 4835, lines 14-17. Text is not clear.

Page 4836, line 11. What is "hydraulic meaning" of intermediate situation ?

Page 4836, line 14. Did the experiments were not conducted with the same ratio ? how this might affected the results ?

Page 4836, line 25 and Page 4837, line 17. Figure 3 is mentioned here, before Figure 2.

Page 4837, line 19. Typo mistake after the word sterilized there are 3 dots ?

Page 4837, line 17. The reference mentioned here, Bougon et al. 2007, is not in the reference list).

Results Page 4838, lines 12-13. The authors stated that " The hydrogeological gradients Inducing river fluxes towards the peat were therefore of limited duration". Figure 2, however, shows that for site G the water level in the stream was always higher than that in the adjacent piezometers. My understanding is that hydraulic gradients are therefore from the river to the banks at all time ? This is a key point for the whole hypothesis and understanding of the manuscript! To my opinion, whole section 3.1.1 should be reconsidered. A key issue here is how fluxes were calculated and the reader has no information about the horizontal and vertical gradients and hydraulic conductivities.

Page 4840, line 7. Auterives, 2008, is not in the reference list.

BGD

6, C572–C576, 2009

Page 4840, line 10. The authors stated that "Oxygenation of peat groundwater is promoted by deeper groundwater flow into the sand, and water renewal". Is this means that there is an upward flow from the sand to the peat ? If this is the case, where is the recharge to sand aquifer occurs ? Once again, the hydrogeological patterns are not clear.

Page 4840, line 15. Where are the higher concentrations, close or far from the stream ?

Page 4841, lines 7-13. The way/format of presenting theses text is not clear.

Page 4842, lines 8-9. The impact of the initial pore water chemical seems to be very important, and it was nicely addressed. Why it is not addresses similarly in the nitrate data although it looks like it has an impact as well (nitrate concentrations over 1 in Figure 4). ?

Page 4843, lines 16-17. Sentence is not clear.

Page 4843, line 24. Stating here that nitrate removal is due to denitrification is not clear to me especially when this is thoroughly discussed only later on, especially with additional data from Figure 6.

Page 4844, line 12. There should be some references mentioned here. The observed reductions here are interpreted as denitrification, although significant decrease in nitrate concentrations was also observed under aerobic conditions. The authors tried to addressed this and explain it by previous observation (such as anaerobic micronisches). I was wondering why the authors didn't use the "classical" Acetylene Inhibition Method to specifically quantify denitrification ?

Section 4.2 Nice discussion.

Section 4.3 Once again, I think the hydrological conditions, including fluxes and stream-peat connections are not presented clearly in order to understand their link to the observed water chemistry, and spatial variability.

BGD

6, C572–C576, 2009

Page 4847, line 7. What are "shallow fluxes"?

End of page 4847 and beginning of page 4848. The authors mentioned toward the end of the text that there is additional data on the microbial community in the study site. I understand that this is a subject of another paper by the authors but I still think that some information should appear also in this manuscript because this is a key issue. The differences that were observed between the peat sites could arise from differences in microbial community structure or simply due to differences in biomass. Any conclusive evidence should be based also on the microbial data (whether you present it in this paper of in another). Summarizing it in 2 sentences toward the end of the discussion is simply not enough (moreover, the reference is not in the reference list ?).

References

Day FP, Megonigal JP. 1993. The relationship between variable hydroperiod, production allocation, and belowground organic turnover in forested wetlands. Wetlands 13: 115-121. Ishida CK, Kelly JJ, Gray KA. 2006. Effects of variable hydroperiods and water level fluctuations on denitrification capacity, nitrate removal, and benthic-microbial community structure in constructed wetlands. Ecological Engineering 28: 363-373. Phipps RG, Crumpton WG. 1994. Factors affecting nitrogen loss in experimental wetlands with different hydrologic loads. Ecological Engineering 3: 399-408. Spieles DJ, Mitsch WJ. 1999. The effects of season and hydrologic and chemical loading on nitrate retention in constructed wetlands: A comparison of low- and high-nutrient riverine systems. Ecological Engineering 14: 77-91.

Interactive comment on Biogeosciences Discuss., 6, 4829, 2009.