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Biogeosciences Discussions

Interactive comment on "Effects of long-term flooding on biogeochemistry and vegetation development in floodplains – a mesocosm experiment to study interacting effects of land use and water quality" *by* A. M. Banach et al.

Anonymous Referee #3

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The manuscript by Banach et al. describes a mesocosm experiment designed to investigate the effect of long-term flooding on the biogeochemistry and vegetation of river floodplains. To evaluate the role of (former) land use practices and the chemical composition of the river water on the response of the system to long-term flooding, mesocosms were constructed with sods obtained from two sites with different land-use history – a hayfield and a pasture – and flooded with water with elevated concentrations of either nitrate or sulphate or the combination of both for a period of nine months. The authors focus on the effect of artificial flooding on both vegetation development and

microbially mediated processes as reflected by soil and water chemistry. With this combined approach, they gain valuable data for a comprehensive understanding of the changes in the soils as a result of flooding. Flooding events during summer are expected to increase in intensity and frequency as a result of global climate change. The question of how to meet the challenges coming along with more frequent flooding of river plains is of both ecologic and economic importance, which is clearly described in the introduction of this paper.

Specific comments:

There are three major aspects that the authors should pay attention to or comment on:

(i) It is not clear in the manuscript why such a long period of inundation was chosen, and to what extent this is representative of or related to the expected naturally occurring summer flood scenarios. More background information of this experimental approach would also help to evaluate the suitability of the mesocosm design for the goals of this study.

(ii) Display and description of the results of the statistical analysis: In their study, the authors created a comprehensive set of chemical data and did a thorough statistical analysis of the potential correlation and interaction between different parameters. However, due to the high number of parameters and treatments involved, it is sometimes rather difficult for the reader to follow the main results of the statistical analysis. This could be improved by a graphical display of the most important correlations and relationships or by summarizing results in a flow scheme or model of the observed dynamics. The tables containing the results of statistical analysis could be provided as supporting material.

(iii) Discussion of the effects of flooding, land-use history and water quality on the species composition of the vegetation: The authors emphasize the role of plant species composition for both soil chemistry (oxidized rhizosphere) and soil structure (subsidence versus land accretion through peat formation). Here, the authors should explain

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in more detail the key features of the plant functional groups (herbs, grasses, Carex) with regard to the expected response to flooding, and if the results obtained in this study agree with their expectations. The discussion of changes in plant species composition is mostly restricted to functional groups, although the raw data for a more profound analysis are available (table 2). The information about how individual species were affected could be used in a statistical analysis employing methods such as Canonical Correspondence Analysis to point out more precisely which parameters might be responsible for changes in a particular group or species. Finally, they should comment on to what extent vegetation development may have been influenced by the rather small size of the mesocosms (limitation to root development and coexistence of species) and by the isolation of the mesocosms from their natural situation. Nine months of flooding is a long period, and not all of the original species can be expected to adapt to these conditions by natural plasticity. Under natural conditions, regeneration from the seed bank or input of plant fragments or diaspores supplied by the river water would also contribute to changes in species composition, where especially the second factor is excluded in the mesocosm experiment. For several species, regeneration via these mechanisms would also take more time than one season. This should be commented on.

p. 3268, l. 10-11: As mentioned above, it should be explained in more detail why the creation of permanently flooded wetlands along rivers was studied instead of choosing a design more similar to natural conditions of flood regime with episodic inundation.

p. 3269, l. 17-18: Does “natural light and temperature conditions” mean that diurnal and seasonal changes of light and temperature were adjusted to in-situ conditions? This should be explained in more detail.

p. 3269, l. 24-25: Was the water exchanged once in a while? What was the total amount of N and P added to the sods via inundation with artificial river water?

p. 3271, l. 25-26: Why was vegetation harvested twice during the experiment? Please

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explain.

P. 3276, l. 18-20: It seems strange that biomass of flooded plants from the pasture was comparable to Cm, while the pasture plots were only covered by 39% compared to 93% in the corresponding control Cm. This should be explained.

p. 3279, l. 27: "Unexpectedly, the presence of high concentrations of nitrate in the surface water did not prevent P mobilization, as is known to occur in fens related to blocking of Fe reduction by the presence of this more favourable electron acceptor." What could be the explanation for the observed discrepancy?

p. 3280, l. 5-10: The authors should discuss in more detail by which mechanisms they expected vegetation to adapt to long-term flooding, and why herbs were the most sensitive to flooding.

p. 3280, l. 23: "It was, however, clear that land use was the main determinant for the development of target (Carex) vegetation. . ." What could be the mechanisms underlying this relationship?

Table 2: Is "average abundance" given in number of individuals or in percent cover?

Technical comments:

Check references in the text for tables 4b, 5a, 5b, 6a, 6b. Such table numbers cannot be found among the tables in the manuscript.

Interactive comment on Biogeosciences Discuss., 6, 3263, 2009.