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Biogeosciences Discussions

Interactive comment on "Mimicking floodplain reconnection and disconnection using ^{15}N mesocosm incubations" *by* N. Welti et al.

Anonymous Referee #2

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This paper describes a mesocosm experiment in which nitrogen transformation processes are studied in floodplain sediments originating from two sites; a restored channel site and a disconnected backwater pool. It is generally known that an increased connectivity between floodplains and stream water has positive effects on stream water quality due to an enhanced denitrification activity. High denitrification activity may however result in hot spots and hot moments of nitrous oxide N2O emission from these floodplain soils, as nitrous oxide is one of the end products of the denitrification process. With this research the authors want to elucidate if recent floodplain restoration efforts lead to an increased or decreased N2O/N2 ratio. Furthermore they studied the effects of increased nitrogen and carbon availability/(quality?) on denitrification, DNRA and anammox activity. N assimilation in bacterioplankton and benthic bacterial production were also taken into account.

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Interactive Discussion

Discussion Paper

The authors observed that cores from disconnected nitrate depleted sites had lower denitrification activity and higher N2O/N2 ratio's compared to cores from connected sites. Addition of DOC from stream water reduced the N2O/N2 ratio in the backwater pool cores, whereas addition of floodplain-derived carbon increased the N2O/N2 ratio in the connected cores. Addition of nitrate did not change the denitrification activity or N2O/N2 ratio. The number of studies on nitrogen transformation processes from river restoration projects is still limited and high spatial and temporal variability in process rates often hampers our understanding of responses of these microbial processes to changes in nitrate availability, flood duration and flood frequency at the plot and field scale. The described meso-cosmsetup designed to study these changes under controlled conditions with 15N tracer techniques therefore seems to be an excellent approach. The study is complete and well described and findings especially on DOC effects are definitely worth publishing. There are however some issues in this paper that have to be considered; One of my major concerns with the paper is that the design of the experimental setup with triplicate cores in mesocosms connected to one reservoir is suboptimal as the cores (n=3) with equal treatments are in fact pseudoreplicates. Furthermore the selection of only two sites (connected vs disconnected) which differ in many other aspects (apart from connectivity; soil texture, macrophyte presence) is somewhat dangerous. This aspect of different texture is only introduced in the discussion. Soil texture differences need to be added to the site description. The possible nitrous oxide production from nitrification activity was not mentioned or taken into account in this experiment. In this setup with relatively high water through-flow (residence time 2h, flow rate of 5 l h-1) with oxygenated (air bubbled) water, nitrification might not be a negligible process. If this setup will be used again isotope-enriched compounds including 18O for H2O or NO3 or 15N labelled NO3 or NH4 respectively will allow insight in the role of nitrification. In some flooding experiments it was found that floodwater intrusion into the soil is limited if soils are water saturated at the time of flooding. How is the contact between overlying floodwater and the soil? How realistic is complete mixing and a water residence time of only 2 hours for these soil cores?

The main findings of this paper are in accordance to the authors hypotheses, however some aspects are somewhat surprising. Contrary to earlier findings by Bastviken et al (2005, 2007) where high macrophyte biomass significantly increased denitrification activity, in this study denitrification activity was found to be lower in sites with high macrophyte coverage. Furthermore denitrification did not increase in these sites with nitrate addition, indicating that nitrate limitation is not the main reason for low denitrification in these sites. Additionally earlier studies indicated a strong effect of soil texture on denitrification activity with higher denirification and lower nitrous oxide emissions from finer textured sediments. Here, in this study the opposite results are found.

Perhaps I'm misunderstanding this aspect, but the paper concludes that based on the mass balance estimate biomass assimilation by algae and bacteria was estimated to be the main biological mechanism of N retention. However it is also stated all unaccounted nitrogen loss was attributed to biomass assimilation. It is possible then to state that it is the main mechanism or is just a lot of N missing in the mass balance?

Minor comments:

page 4135, Line 19: rising nitrate concentrations

page 4137,Line 27 more heterogenous carbon pool present due to addition of the Danube water. This hypothesis is not clear, please explain. What do you mean by more heterogenous?

page 4154 line 7 autotrophs are generally assumed to prefer ammonium than nitrate. Give a reference to this statement. In fact in many ecosystems nitrate is the preferred nitrogen source as ammonium uptake might result in internal acidification.

Add more general information on site characteristics to Table 1, pH and soil texture. Figure 5 is not very clear in black and white.

Interactive comment on Biogeosciences Discuss., 9, 4133, 2012.