

Interactive comment on “Quantifying nutrient fluxes in Hyporheic Zones with a new Passive Flux Meter (HPFM)” by Julia Vanessa Kunz et al.

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Vanessa Kunz and coworker present in the manuscript "Quantifying nutrient fluxes in Hyporheic Zones with a new Passive Flux Meter (HPFM)" a novel technique to measure horizontal water fluxes and nutrient fluxes in hyporheic zones. Without doubt this is an exciting technique to answer unsolved questions about transport and turnover in hyporheic zones. Up to now the lack of adequate techniques hindered in-depth investigations of transport and turnover in this important transition zone.

Major comment

My major concern about this method is its impact on subsurface flow paths and flow velocities. As a consequence the calculated loads might be misleading. Since the device will be placed in sediments with different hydraulic conductivities, its hydraulic conduc-

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tivity will sometimes be larger than that of the rest of the sediment and sometimes smaller. In cases where the hydraulic conductivity is lower than that of the surrounding sediment most flow paths will bend around the device instead of passing it. As a consequence there will be much less uptake of nutrients and smaller flow rates. In the opposite case flow will be "sucked" into the device. Nutrient uptake and flow rates will be overestimated. This question could have been addressed in a lab experiment with a box filled with different sediment types with known horizontal flow and a HPFM placed in the center of the box. Alternatively, modelling would also be a method to address this problem. Even without additional investigations it is necessary to carefully discuss this shortcoming and even mention it in the abstract.

Minor comments

In general the paper is very well written and I could only identify a few typing and grammatical errors. The only section of less quality is the abstract. I had the feeling that this was written in a hurry after finalizing the rest of the manuscript. However, as most central part of the manuscript it deserves more care to assure the high quality of the rest of the manuscript. The introduction is well written but relatively long. You might consider to slightly shorten it. The material and methods section is also relatively long and sometimes a bit confusing. Consider to improve its structural elements. The results section is short. The discussion is very well written and of optimum length. The same applies to the conclusions section.

The left part of Fig. 2 can be removed. I do not see any need for this figure and it is so small that it is impossible to see anything here. I recommend referring to another paper where such a map has been included instead of this one here.

P2L24ff: "In stagnant waters, such as lakes, the transport of dissolved nutrients to the sediments is dominantly controlled by diffusion. Therefore, surface water concentrations of nutrients are a good predictor for uptake processes and potential limitations (Dillon and Rigler, 1974; Jones and Bachmann, 1976)." Both sentences are completely

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wrong. Diffusion is only a relevant transport process over very short distances but not in a water body or as transport process from a lake to its sediment. Diffusion is a relevant process in the diffusive boundary layer above the sediment surface. In the water body there are many active transport processes such as wind- and temperature-induced transport. You can also discuss this with the people at UFZ Magdeburg involved in lake physics. Transport of nutrients to the sediment occurs mainly in particulate (and not in dissolved) form. In lake sediments many different advective transport processes occur in addition to diffusion, for example groundwater discharge, wave- or seiches-induced pore water transport in the sediment and bioturbation. The latter is especially relevant in shallow lakes. For example, for Lake Müggelsee in Berlin it is well-known that chironomids pump the entire water body through the sediment once a week. Referring to the second of the above cited sentences: Nutrient concentrations in surface waters of lakes are mainly controlled by processes in the water column. For example SRP concentrations are controlled by the very efficient uptake of SRP by plankton during the growing season. That is the reason why SRP concentrations even in eutrophic lakes are usually low during the summer.

In the introduction I would expect a paragraph about hyporheic flow and methods to measure hyporheic flow. The HPFM aims on measuring water and nutrient fluxes but the introduction solely focusses on nutrient fluxes. Please add something about determination of hyporheic flow. For example the heat pulse sensor of Lisa Angermann could be mentioned here but also other methods. I know that the HPS did not work at your site but nevertheless you can mention that there is a device that can be used in finer sediments.

In general I think you consider the sediment only as a sink and not of a source of nutrients. For example in line 11 on page 1 you write "nutrient removal" although the hz is sometimes a source. Besides a temporary storage (e. g. uptake and later release of nutrients) the transport of particulate organic matter to the sediment surface should also be considered. Once this organic material is buried it can release nutrients

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as a consequence of mineralization processes. Keep this in mind throughout your manuscript.

The sediment description on page 8 is quite poor. It would be great to know a little bit more about the grain distribution or hydraulic conductivity of the sediment.

P12L19ff "1) In stagnant waters, such as lakes, the transport of dissolved nutrients to the sediments is dominantly controlled by diffusion. Therefore, surface water concentrations of nutrients are a good predictor for uptake processes and potential limitations (Dillon and Rigler, 1974; Jones and Bachmann, 1976)." I do not see the usefulness of this device. I think there is always much more small scale variability in hyporheic zones than assumed. Even in channels. I would recommend placing two alternating HPFMs in the sediment instead and place them with a small depth variation. In that case you will end up with the same spatial resolution but you can assure that flow and nutrient fluxes match to each other. Also, in the entire paper I have not understood the motivation for the separated HPFMs.

Summarizing, I recommend accepting the manuscript after minor revision.

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Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/bg-2016-334/bg-2016-334-RC3-supplement.pdf>

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-334, 2016.

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