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Biogeosciences Discussions

Interactive comment on "Technical Note: A comparison of two empirical approaches to estimate in-stream nutrient net uptake" *by* D. von Schiller et al.

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General Comments

The manuscript by von Schiller et al. is an informative comparison of two methods for understanding net nutrient uptake in streams. The authors compare nutrient uptake estimates using a mass balance and a stream spiraling technique. They find that the estimates of the two approaches diverge as nutrient concentrations in the stream increase and the ratio of nutrient concentration upstream and downstream increases. This has important implications for where and over what length scales these techniques should be used, and this study can be used to identify these conditions.

One question that comes to mind involves the conductivity correction applied with the spiraling method (Eqn 2). This is basically meant to account for groundwater inputs, I believe. If so, then this should be explicitly discussed. Without it, the spiraling method is a measure of net change, as opposed to net uptake. The mass balance approach is a net uptake approach because it accounts for groundwater explicitly (though uncertain) as shown in equation 1. The conductivity correction was previously applied to streams with wastewater point sources (Marti et al 2004), where the assumption behind the dilution factor (both of Cl and nutrient) is reasonable. But does it apply in non-point source dominated systems? Is this correction valid in the study reaches, and more importantly, in general (e.g. streams with low nutrient entering a high nutrient input reach, or stream nutrients that might be elevated in groundwater such as NH4)?

The method comparison focuses on two study streams, but a sensitivity analysis is performed to try and evaluate the two techniques over a broader range of conditions (Figure 3). This is helpful, but I think could be done in a more mechanistic way that might be more generally applicable. One of the findings is that the two methods diverge depending on average water concentration and the ratio Ntop:Nbottom. The ratio is defined by the length scale, in combination with the intensity of net biological activity and residence time. The ratio will be greater the longer the reach, the more intense the biology, and the longer the residence time. Can you provide recommendations about when and where each technique is appropriate (e.g. needed length scale and net biological activity)? A sensitivity analysis that varies net uptake and length could provide a more mechanistic understanding of where the techniques are comparable (expanding on Figure 3).

The length scale is relevant for understanding why some headwater streams seem to have no net uptake (Brookshire). One issue is that the measurement of net uptake can be below detection in individual reaches (yet greater than 0). Over short enough length scales, this is almost guaranteed. However, if the length scales are increased, low net uptake rates, which are undetectable in shorter reaches, can start to make an impact.

It seems that the results you have may be used to evaluate this issue.

The greatest uncertainty using the mass balance approach is the groundwater nutrient concentration (Ngw). The authors account for the uncertainty by applying a range of Ngw, assuming between 0.5 and 2x the stream concentration. I wonder, however, if this range in Ngw is sufficient. The assumption is based on results from Walker Branch (Roberts and Mulholland 2007), a pristine stream and watershed. But other systems could have considerably greater Ngw relative to stream water (a pristine stream flowing into an agricultural field), or streams with high nutrients could have much lower input concentrations (an agricultural stream flowing into a forested area). To make the method comparison more generalized, a broader range of Ngw I think is needed (perhaps 10x higher and lower) and sensitivity over the entire range determined. A graphic showing this would helpful (with Ngw on the x-axis). It seems that this would be the greatest unknown, so knowing sensitivity to this measure is critical.

Specific:

7530.8-11 I don't understand what is meant by the statement that starts: "...the deviations from the fitted model can be treated as a measurement of uncertainty ....". Can you clarify?

7534.1-7. Can you include the derivations in supplemental material? Would be helpful.

7535.14-30, I like the discussion about groundwater uncertainty. But none of the graphics show the relationship between Ngw and U. Can you create a graphic with Ngw on the x-axis?

7536.10-13. This says SP is more reliable than MB for NH4, but doesn't Figure 4 suggest the opposite.

7534-7535. The uncertainty analysis indicates that CI for NH4-Usp is greater than for Umb, in contrast to nitrate. I think this could be highlighted more and explained in more detail to understand why this is the case.

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Interactive Comment

7532.12. The methods state that dilution is accounted for using ambient conductivity. This technique was originally applied to wastewater point sources, where the assumption behind the dilution factor (both of Cl and nutrient) is reasonable. But does it apply in non-point source dominated systems? In what cases is this assumption invalid? Can you clarify?

Technical

7529.16 delete "of"

7534.24 delete "of"

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