

Interactive comment on “Nitrate retention and removal in Mediterranean streams with contrasting land uses: a ¹⁵N tracer study” by D. von Schiller et al.

D. von Schiller et al.

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We would like to express our gratitude to the referee for providing helpful comments and suggestions that we think have clearly improved the manuscript. The referee's comments are repeated here and our responses are inserted after each comment.

General comments

Land-use 8211; Overall I had a hard time buying the 8220; land-use gradient 8221; presented here. No hypotheses were presented to evaluate what human impacts might

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have on nitrogen uptake and export. Land-use categories (i.e. cover, etc.) should be presented in Table 1 so that readers can have a better sense of whether or not land-use drives observed patterns, or whether it is more related to discharge or depth. I recommend the authors present the hypotheses they were trying to test when designing the study, with measurements made logically following from them.

Answer: We agree with the referee. It is not correct to refer to a gradient when there are only three streams. We have removed the term `gradient` from the text of the manuscript and have avoided phrases referring to changes or differences along gradients. The streams were categorized as forested, urban and agricultural based on the type of land use bordering the study reach. Although the catchments drained by the study streams were mostly forested, especially at the valley heads, there was urban and agricultural development next to the streams. This type of forest-dominated catchments with mixed land uses near the streams is characteristic of the study region. We have added a few sentences on this aspect in the introduction and methods section of the revised manuscript. In addition, we have changed the title and other parts of the revised manuscript to further clarify this aspect. We have also created a new figure (Fig. 1), which includes geographic and land use characteristics of the study streams. Although this study was mainly exploratory, the general hypothesis was that we would see changes in retention and removal pathways of nitrate in response to changes in stream physical and chemical characteristics derived from the influence of adjacent land use areas. Interestingly, although the streams showed relatively small differences in catchment land use and stream physical, chemical and biological characteristics, these differences determined great changes in the retention and removal of nitrate. We have changed parts of the introduction to be clearer in the presentation of the expectations of this study.

Export; I had a difficult time understanding the export part of the story; I did not understand why export was log transformed and related to time post injection (the

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units of slope are $\mu\text{gN/s}\cdot\text{h}$) 8211; some detail is warranted to better explain this. From my calculation ($\text{EXP}((1/\text{Sw})\cdot\text{reach length})$) 90

Answer: The suggestion by the referee on how to calculate export is interesting; however, we must notice that the export we calculate is the export of the retained N within the reach. According to comments by two of the referees, we have changed the way we present the N export data in the Fig. 6 of the revised manuscript. We have also added some modifications in the text to clarify these results.

Respiration 8211; I recommend adding reaeration coefficients to Table 1. ER for the agricultural stream seems very high, especially for such a shallow stream. This doesn't jibe with the biomass standing stocks and DOC concentrations. Why is ER so high? Do you have measures of BOD?

Answer: As suggested by two of the referees we have added the oxygen reaeration rates to Table 1 of the revised manuscript. Unfortunately, we do not have measures of BOD, which may have helped with the interpretation of the results. The fact that the stream was drying out during the period of study (it dried out completely about two weeks after the end of the 15N addition) could partially explain the obtained result. At conditions of low flow and slow water velocity the contribution of respiration in the hyporheic zone may have been enhanced. Unfortunately, our data do not allow us to test this hypothesis.

Biomass sampling 8211; p. 3314 states that biomass samples were collected at 48 h post injection, but Figure 3 says the samples were collected 24 h post injection. Please correct. Also how much error is associated with sampling at x time post-injection give high regeneration rates? This is mentioned briefly in the discussion, but I wonder if some sort of correction can be made. How does the differential timing of biomass measurement in the agricultural stream (assuming biomass was measured during the

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first post-injection sampling) affect your results and interpretation?

Answer: We think there was a misunderstanding by the referee. There were two separate samplings of primary uptake compartments: samples for the analysis of the ^{15}N content (former Fig. 3, new Fig. 4) were collected 24 h after the end of the addition (7h in the agricultural stream), whereas samples for the estimation of standing stocks were collected 48 h after the end of the addition. This is explained in detail in the Methods section. Given the high regeneration rates observed in these streams, there may be an error associated to the time passed between the end of the addition and the sampling time, which may contribute to underestimate actual rates of ^{15}N uptake by these compartments. To correct for this loss of ^{15}N we would have needed to sample the primary uptake compartments over time after the addition end in order to calculate an independent regeneration rate. Unfortunately, this was not done. In this sense, the assimilatory uptake data calculated for the agricultural stream (sampled 7h after the addition was stopped) were probably closer to actual assimilation than those for the forested and the urban stream, which had more time to regenerate the retained N (i.e., they were sampled 24 h after the addition was stopped). This issue is more appropriately addressed in the discussion of the revised manuscript.

Alder 8211; I find it interesting that N tracer would be detected in the alder roots given its ability to fix N. Does the alder in these sites fix N?

Answer: Yes, alder (*Alnus glutinosa*) is a nitrogen fixer in this region. However, we do not know for sure if under the given conditions of these streams nitrogen fixation was active. All we can say is that alder roots accounted for a significant fraction of nitrate uptake from the stream. Based on our field observations, it is very typical to find alder roots immersed in the water in streams from this region. Nonetheless, as already stated in the discussion, we cannot distinguish which is the mechanism driving the ^{15}N enrichment. We cannot completely rule out that the dissolved N was being taken up by microbial biofilms growing on the roots or indirectly by the trees through water

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transport. This remains an interesting research question to be addressed in future studies. We have added some sentences in the discussion of the revised manuscript to consider these issues.

Editorial comments

p. 3308 l. 15 8211; which gradient?

Answer: We agree with the referee's comment. This has also been put forward by the other referees. Therefore, the term 'gradient'; has been removed and the text of the revised manuscript has been modified accordingly.

p. 3308 l. 24 8211; change 'evidences' to 'demonstrates'; ; 'fast'; compared to what

Answer: Done. We think that N cycling was fast in the study streams, if we consider that much of the dissolved N was retained and regenerated within the study reach in a time scale of hours.

p. 3309 l. 1 8211; I disagree 8211; streams have been viewed as reactive since 1979 (Webster and Patten)

Answer: This sentence has been removed.

p. 3309 l. 19 8211; start new paragraph with 'Removal of NO₃-';

Answer: Done.

p. 3310 l. 2-3 8211; this sentence is redundant with last sentence of 1st paragraph (p.

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3309)

Answer: The sentence has been removed.

p. 3312 I. 23 8211; give model number (e.g. CR800) for data logger to be parallel with description of other equipment

Answer: The model number (CR510) has been added.

p. 3313 I. 11 8211; give filter pore size

Answer: Done.

p. 3313 I. 15-19 8211; recommend move to 8220;sample processing8221; (now called laboratory methods) 8211; I recommend this because I was confused as to how NO3 samples were processed.

Answer: Done.

p. 3313 I. 22-23 8211; delete 8220;two replicates per station8221; as it is redundant with line 20-21

Answer: Done.

p. 3313 I. 29 8211; which stable isotope laboratory?

Answer: We have added sentences like 8220;stored until analysis8221; to avoid having to repeat the name of the stable isotope laboratory many times in the text.

p. 3315 I. 2 - give model number (e.g. CR800) for data logger to be parallel with

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description of other equipment

Answer: Done.

p. 3315 l. 4 8211; what substrate types were considered? More detail needed here

Answer: The substrate types considered have been added to the sentence.

p. 3316 l. 1 - which stable isotope laboratory?

Answer: As already stated, we have added sentences like 8220;stored until analysis8221; to avoid having to repeat the stable isotope laboratory many times in the text.

p. 3316 l. 28 8211; spell out MSU

Answer: Done. We have also spelled out UCDavis.

p. 3317 l. 3 8211; visual inspection? What does this mean? The 1998 version of OTIS has parameter estimation capability 8211; how does this analysis tie to hypotheses?

Answer: In this study we used OTIS instead of OTIS-P. In OTIS, the conductivity breakthrough curve has to be fitted by visual inspection, because it has no statistic parameter estimation capability. However, OTIS has been widely used in the literature and allows for a rapid analysis of transient storage parameters. We also would like to highlight that the transient storage parameter is only used as a descriptive parameter in this study.

p. 3320 l. 4-6 8211; Not clear 8211; why log transform? Units of slope don't seem to be a velocity.

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Answer: Following comments by two of the referees, we have changed the way we present the N export data in the new Fig. 6 of the revised manuscript.

p. 3320 l. 9-10 8211; Delete (empty sentence) 8211; just describe the characteristics and refer to the table in parentheses

Answer: Done.

Interactive comment on Biogeosciences Discuss., 5, 3307, 2008.

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