

Interactive comment on “Nitrate sinks and sources as controls of spatio-temporal water quality dynamics in an agricultural headwater catchment” by T. Schuetz et al.

Anonymous Referee #3

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Summary

This study examines nitrogen cycling in an agricultural stream by examining longitudinal patterns of physiochemical and nutrient (nitrate) concentrations over 1.2 km, and measuring groundwater and tributary/pipe contribution to both measurements. The authors conclude that both biological and physical factors affect nitrate sinks and sources, and that these factors change along the stream length and over time. I appreciate the detail in calculation of physical processes which drive N concentrations along the stream, and the inference of biological processes which can be extracted. Despite the amount of effort but into the work however, I am not convinced the authors have gener-

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ated useful insights, expended a sufficient amount of mental energy on interpretation, or accurately placed these results in the context of true amount of temporal variation that occurs on an annual time scale in the stream. My major concerns are explained below, followed by other specific comments.

Major comments

1. Lack of meaningful conclusions or utility of these data. I interpret the authors' primary conclusions as 1) both physical and biological processes affect nitrate concentration, and 2) these factors vary over time. The sentence on P8594 L12-14 is indicative of the limited utility of the results: “Consequently, the impact of certain sub-catchments on total nitrate export changes over time and the spatial changes can be more or less dominant.” Despite the effort, I am not convinced these are novel or practical insights for research in stream biogeochemistry. To be complete frank, I found myself asking ‘what does this add to our field?’ at the point listed above, and at Pg8596 L5-10 and Pg 8597 L15-17. If the authors wanted to measure longitudinal patterns in ‘hot spots’ and ‘hot moments’ of N uptake, there are better methods for tracking nitrate than used here (e.g., isotope enrichment, stable isotopes, or N budgets). This would also offer better advice for restoration or planning (See next comment).

2. Little intellectual effect to explain or speculate on reasons for uptake ‘hot spots’. The authors found that some reaches showed greater N uptake, but offered little explanation as to the physical, chemical, or biological mechanisms for uptake. In order for these data to be useful in ecological restoration or planning as suggested (P8597 L20, as well as Pg8598 L12), the authors must provide greater interpretation as to the reasons for this pattern. Where there some aspects to the biology or geomorphology that the reaches had in common? As written, no speculation or interpretation is given, and therefore these data will be of little practical use.

3. Overstatement of the meaning and magnitude of temporal patterns. The authors indicate this study represents an examination of ‘temporal variations of nitrate contri-

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butions' (Pg 8593 L21). However, I suggest the authors temper this claim. The authors have measured N dynamics across a relatively narrow window of time, during static, base-flow conditions. From my interpretation, this time period was chosen to represent a 'static' environment (i.e., low flow, little precipitation) in order to minimize temporal variation among sampling campaigns. The authors should acknowledge that temporal variation which occurs over the annual scale would be much larger than the relatively small period included here.

4. Restatement of objectives (P 8581 L21-24). I disagree with the wording of objective 1, and I disagree that the authors address objective 2. I suggest rephrase objective 1 as "Can we quantify spatio-temporal patterns of distinct nitrate sinks and sources in a stream?" I don't feel this is a network approach as only 1, small stream was considered. Also, I don't feel the authors measured 'impacts', but instead point out the spatial and temporal patterns. I suggest objective 2 should be deleted. The authors have determined the point sources of nitrate, and that these change with flow and over time. The authors have shown some reaches are N sinks. However, the authors do not determine 'mechanisms and processes' for N sinks (see major comment above), which would require additional biological measurements.

5. An acknowledgement: I must be candid about my lack of experience with the dilution calculations offered by the authors. I followed the authors' logic, but it is not a tool I have used. Thus, I do not offer detailed critiques on these calculations or derivations and will rely on other reviewers to provide those comments.

Specific comments

Pg8578 L14. Correct to "nitrate" (avoid the incorrect plural term 'nitrates').

Pg8580 L25. Remove "." in parenthetical phrase. It is better to be specific or use "e.g.," for a short list.

Pg8582 L 10-12. Edit "...decreasing. A nitrate source does not necessarily increase

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stream nitrate concentration, but always increase total nitrate load."

Pg8583 L9. I am confused by the last sentence of this paragraph. By 'prevents almost completely discharges losses during summer low flows' do the authors mean there is little infiltration?

Pg 8586 L24. The first sentence of section 3.3 is very long. Is there a period missing? Please revise into separate sentences to increase clarity.

Pg 8590 L 25. This paragraph about slope, roughness, and residence time calculations would be more appropriately placed in the methods.

P 8592 L10. Delete "time variant" as the sentence already indicates spatial and temporal distribution.

Pg 8596 L 27-28. This claim is an overstatement and incorrect. There is a vast literature on spatial and temporal patterns in N concentrations and transformations.

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