

Interactive comment on “Complex interactions of in-stream DOM and nutrient spiralling unravelled by Bayesian regression analysis” by Matthias Pucher et al.

Anonymous Referee #1

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General Comments:

The manuscript titled “Complex interactions of in-stream DOM and nutrient spiralling unravelled by Bayesian regression analysis” compares instream uptake of DOM differing in source/quality which has been relatively understudied in the literature. The authors pose an interesting research question well within the scope of biogeochemistry. A secondary objective of the manuscript was to refine a statistical model to estimate nutrient uptake that can provide estimates of uncertainty, account for nonlinearity, and allow for the addition of different nutrient fractionations (DOM optical properties here) to examine differences in uptake. The INSBIRE model appears robust and useful, but

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its mathematical/statistical evaluation is outside of my expertise. I appreciate the value in the author’s research, but my opinion is that this manuscript needs major revisions before publication here or elsewhere.

1. My major concern is the lack of independence in the study design. Nutrient/DOC leachate additions were added to the same stream reach several times per week. Subsidies from these additions are going to stimulate periphyton communities increasing their metabolic activity and biomass. More metabolic activity/biomass of bacteria and algae is going to result in faster uptake velocities of DOC and nutrients (e.g., SRP). Thus, I do not think it is entirely fair to compare uptake rates of different leachates between multiple additions that occurred over a few weeks as periphyton communities would have had ample time to use these resource subsidies to increase production and potentially alter subsequent nutrient uptake measurements. Commentary is needed in the methods to justify the study design and in the discussion to address the potential effects of repeated resource subsidies on nutrient uptake rates.

2. While I see the value in the INSBIRE model, I think there is too much commentary on it in the manuscript for this type of journal. I think these sections could be simplified to improve flow and keep the focus of the manuscript on DOM dynamics – as was outlined by the research questions in the introduction. Much of the detailed information could be added to a supplement for interested readers and anyone wanting to use the INSBIRE model in their own research.

a. The used of probability distributions to describe uncertainty is a valuable aspect of Bayesian modelling and INSBIRE. However – while visually appealing – Figures 5 and 6 are hard for the reader to interpret (e.g., how much do they overlap). The use of numerical 95% or 90% credible intervals instead of these distributions would be beneficial to the reader as the degree of overlap can be readily ascertained.

3. This manuscript would greatly benefit from a thorough editorial review to improve sentence structure, clarity, and flow. Some of the more complex sections in the meth-

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ods, results, and discussion were hard to follow making it difficult to understand what was done and provide a comprehensive academic review of the manuscript . I have included some technical corrections below, but level of editing needed is beyond my capacity as a reviewer and my editorial comments are not complete.

a. Paragraphs in the discussion and introduction would benefit from clear introduction and conclusion sentences to define the topic in the body. Clarity in structure would help the reader follow along.

b. Avoid starting sentences with “it”, “these”, “this”, “they” ect. especially when multiple subjects are being referred to. Best to be specific and clear to help the reader follow along.

Specific/Technical Comments:

Introduction

1. The content of the introduction is good, but a thorough editorial review is needed to help the reader follow along and increase the connection between the content/concepts introduced.

a. Could add a bit more information on DOM composition e.g., mixture of labile and recalcitrant compounds to the paragraph on lines 56-69.

2. A better definition of dampening/stimulating effects is needed, and I do not think this is the most appropriate term. Nutrient uptake by stream communities has an upper limit simply due to scaled up enzyme kinetics. Once that uptake rate is reached, it will not increase any further even with increased nutrient concentrations. Your non-linear models are entirely appropriate, but the way that “dampening effects” are defined (line 80: “dampening effects of nutrient concentration on the uptake efficiency”) and referred to throughout the manuscript is not clear to the reader. The lack of clarity here continues in the discussion in the paragraph on “dampening effects”.

Line 42: sentence is vague and could likely be connected to the following sentence to

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add context.

Line 43: relate – is related to; stream and rivers are synonyms maybe differentiate with more context e.g., headwater streams, large rivers

Line 45-46: duplicate references

Line 46-47: DOM influences the toxicity of pesticides has no context and does not relate to your research question, consider removing – also duplicate references

Line 48: “this capacity” – what capacity? Can link to the previous sentence to add context

Line 61: is produced – are produced

Methods

1. Section 2.1 additional commentary – a sentence or two – on the Hydrological Open Air Laboratory would be better than just a citation.

2. Section 2.2 see general comment on experimental design. Increased justification is needed.

3. I think sections 2.6 and 2.7 need to be simplified and organized based on how you presented the research questions in the introduction to make the methods easier to follow. Two models were used to look at 1) random effects of DOM quality and 2) interactions? Clear definition of variables in the interaction models would be helpful.

a. For interactions did you only used the power function with your independent variables? Did you test different functions or just use the power one? I guess the choice of the power function was because it was used in previous studies. I think an exponential function or a logistic function, if you want to go one step further, is more ecologically appropriate.

b. I am confused by the addition of wetted width as an interaction. Sure, more surface

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area might equal more retention of DOM, but all measurements occurred in the same stream with little difference in discharge.

Throughout: units for liters should be L

Results

1. The result section had many method-like statements in it. Some of these statements provided information that was not present in the methods. A clear methods section that follows the research questions presented in the introduction would help to keep the results section as a summary of what was found.

2. Results could be better structured around the 3 research questions from the introduction.

Discussion

1. Discussion could be better structured around the 3 research questions from the introduction

2. Stronger introduction sentences are needed set up what is going to be discussed in each paragraph.

3. “Interactions among different DOM components, which indicate transformations of one substance into another during DOM processing” – an interaction means that the relationship between uptake and concentration of one component is dependent on the concentration of another component. For example, more SRP leads to a more rapid increase in the uptake of a component relative to concentration. The interaction models were difficult to understand, but the above conclusion does not make sense. If DOM was being broken down into different components, the uptake of one component would be positively associated with the concentration of a degradation product. Since all leachate additions differed in composition the concentration of individual components is confounded. Correlations among net uptake of the different components may be better suited to address this.

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Line 403-405: these two sentences contradict each other. Provide more context.

Line 403-420: This paragraph goes back and forth comparing uptake within your study and between your study and others. I suggest sticking with the latter and write a new paragraph for the between leachate differences you observed in your study. This new paragraph will also help transition into the next paragraph.

Line 414: dung allied – manure added

Line 421: relation – relationship

Line 432: should this be Figure 6?

Section 4.2: first paragraph states that there was no major difference in DOM bioavailability indicated by the broad overlap of parameter ranges, but the second paragraph discusses differences in uptake of different DOM components. The two paragraphs contradict each other.

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