

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

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General comments:

We thank the reviewer for their constructive comments. We consider the provided ideas a valuable input to improve the manuscript and will revised the manuscript accordingly.

1. We fully understand the reviewer's concern about independence as this was also one of our major concerns in planning the experimental design. However, as the environment also changes naturally (e.g. discharge, temperature), different additions cannot be compared if the interval between them is too long. Thus, we have tried

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to find a compromise for the length of the intervals between the different samplings based on our long-term experiences in nutrient additions experiments. Independence effects were reduced to a minimum through the following considerations and were also checked regularly during the entire experiment:

a) The added material did not induce unnatural concentrations in the stream, but created peaks equal to or below local rain events. As the additions were within the range of the natural variability of the stream, we do not expect any stimulation of biofilm growth through the additions. Biofilm samplings after each addition as well as between additions supported this assumption by showing no systematic change in enzymatic activities over the course of the experiment.

b) Additions were limited to a maximum of two times per week with an interval of at least 48 h between two consecutive samplings, allowing the system enough time to recover. We also observed no systematic change in uptake rates over the course of the experiment, supporting again the assumption that the additions did not stimulate biofilm communities and their metabolism. As we could not identify a stimulation from additional P-PO<sub>4</sub> on the DOM uptake, we conclude that the additional P-PO<sub>4</sub> had no significant impact on the metabolic processes. Regular water analyses also revealed that the system remained P-limited throughout the entire experiment.

c) Regarding the natural environmental changes, we were lucky to accomplish all our experiments during a period of stable weather conditions.

We will add the above mentioned information in the method section and also shortly discuss potential effects of repeated additions as suggested by the reviewer.

2. We understand the concern of the reviewer and will move detailed information on INSBIRE to the supplement material.

a. Thank you for this suggestion. We will keep the graphs as they can provide additional information (e.g. mixtures of distributions become visible through shoulders

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in the curves). However, we will add the confidence intervals and the probability of overlaps.

3. We will take serious effort to improve the language and the structure of the manuscript (e.g. revising the language, paragraph and sentence structure, moving detailed information on the model to the supplement material and structuring the discussion according to the research questions).

a. We appreciate the comment of the reviewer and will revise the manuscript accordingly.

b. We appreciate the comment of the reviewer and will revise the manuscript accordingly.

#### Specific/Technical Comments:

##### Introduction

1. We will revise the manuscript accordingly and provide clear connections between ideas and topics addressed wherever necessary to improve the structure and help readers follow our concepts.

a. We will add more information on DOM composition as suggested.

2. We appreciate the comment of the reviewer and will elaborate a more suitable wording and improve the explanation of the concept.

Line 42: We will revise the sentence as suggested.

Line 43: We differentiate between streams and rivers more accurately.

Line 45-46: We will correct this.

Line 46-47: We agree that the toxicity of pesticides has no direct connection with our research and will remove it to avoid confusion.

Line 48: We will revise the sentence as suggested.

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Line 61: will be changed.

##### Methods

1. Section 2.1: We will add the information.

2. Section 2.2: See comment above.

3. We will move most of section 2.7 to the supplement material and adjust the structure to show the formulas, variables and parameters in context with the research questions in a clear way.

a. The choice of a suitable functions is indeed a difficult part in the analysis and we agree with the reviewer, that the power function is ecologically questionable. Besides the power function, we tested a linear function, a Michaelis-Menten type function, an exponential function and an asymptotic regression function. With some background knowledge, all of those (and more) functions can be used within the INSBIRE approach. We decided to use the power function because those models showed the highest Bayes factors for most additions. The big advantage of the power function is that there is only one parameter to fit, which makes it less prone to over-fitting in complex models. Also, in our experiment, concentrations did not reach uptake limits. In such cases, uptake rate curves often exhibit a power function (such as e.g. the efficiency loss model described by numerous other authors), probably representing as the lower part of a saturation model within a concentration range below saturation and thus naturally met in the system.

b. As our stream was rather small, even small changes in discharge may create quite large differences in the wetted width and thus in the reactive surface area. In fact, the wetted width of our stream ranged between 2.6 and 7.2, so the difference is a factor of 2.8. Thus, wetted width is an important parameter to analyse differences between sampling dates not due to source effects and our results actually show different responses of the various DOM components to changes in wetted width.

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We will use L for litres throughout.

Results 1. We can see the mentioned structural weaknesses and thank the reviewer for the suggestion. We will shift information accordingly during the revision.

2. We will follow the suggestion of the reviewer.

Discussion

1. We will follow the suggestion of the reviewer.

2. We will follow the suggestion of the reviewer and provide introductory sentences to the individual paragraphs/passages.

3. Correct, two components within the same degradation or production process are not interacting; thanks to the reviewer's comment, we have realized that the original phrasing of this statement was unfortunate and much too short to describe the full complexity of this idea. What we actually meant was: Mathematical interactions between two different DOM components given by the model may not necessarily come from real (ecological) interactions, such as in the SRP example described by the reviewer (where one component affects the uptake of the other component); they may originate from a degradation or production process of DOM, in which both components are involved at different stages, so that one component is an intermediate product of the other; unfortunately, we cannot check whether this assumption is true with the applied method of spectroscopic analyses; however, several other authors have found indications that especially DOM components, which increase during the DOM uptake, may actually be degradation products of other (decreasing) DOM components.

We will clarify the paragraph accordingly and explain and use exact terms for mathematical correlations (which do not imply any ecological meaning), ecological interactions, and dependent components occurring at different stages of the same process.

Because of the complexity of the topic, we think, that correlations might not be able to reveal subtle relations (that might be covered by hydrology e.g.) and therefore used a

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multivariate regression.

Line 403-405: We will provide more context. What we meant was that previous studies have shown different uptake velocities for different DOM sources like our study, but the number of such studies is too low and the used leachates and studied systems too diverse to draw any general conclusions about the uptake of different natural and anthropogenic DOM sources (or component mixtures) yet.

Line 403-420: We appreciate the comment from the reviewer and will consider this during the revision.

Line 414: will be corrected

Line 421: will be changed to relationship throughout the text

Line 432: Yes, this should be Figure 6, thank you for the comment.

Section 4.2: From the reviewer's comments, we see a need in better expressing the differences between the uptake velocities of different fluorophores. We do not necessarily see a contradiction, because in some cases, the overlaps do not allow a distinct separation, while in others, there is a clear difference. Additionally, the uptakes of the fluorophores behave differently in relation to other compounds. We will add information on the actual differences and accordingly change the description.

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Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2020-372, 2020>.

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