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Biogeosciences
Discussions

Interactive comment on "QUAL-NET, a high temporal resolution eutrophication model in large hydrographic networks" *by* Camille Minaudo et al.

Anonymous Referee #1

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This manuscript details a new modeling framework that was implemented in the Loire River catchment to simulate biogeochemical transformations and pathways in the water column and river sediments. The model incorporates previously developed systems into a more high temporal resolution framework to look at short-term variations of nutrient dynamics and phytoplankton growth. The results presented show that like previous studies, phosphorus availability dictates phytoplankton growth, and that remineralization of organic phosphorus is an important pathway to support phytoplankton growth in the summer time. In addition, the authors propose that physical transport dictates the distribution of nutrients and TSS in the winter time during high flows, and that in lower flow periods temperature dependent biological reactions become more important. The results presented are interesting and in my opinion worthy of publication, and the mod-

eling system can be useful for future work. There are some substantial omissions and corrections, however, that need to be addressed before the manuscript is accepted for publication. To be forthright, I am not a stream ecologist but do have general knowledge of stream ecology. I am relatively versed in hydrodynamic and biogeochemical modeling and therefore will comment mostly on the quality of the modeling work presented.

In general, the author's propose that downstream physical transport dictates the relatively uniform distribution of model constituents in the winter and that biological processes are much more important in the summer. The transit times are only different by about 1.5 days. In my opinion the difference in time is very small in relation to the time it takes for biological reactions to occur such as organic matter remineralization. Without the authors presenting any reaction rates, especially for P remineralization and uptake, it is hard to judge whether the author's physics vs biology explanation is supported. In addition, the authors neglect to discuss temperature variation in the two seasons and the impact it would have on the reaction rates and phytoplankton growth. I would argue that low temperature and thus reactivity of constituents in the winter months can largely determine the distribution in the reach of the river. A thorough explanation of reaction rates and there relation to transport rates would help address these issues. In addition, the authors could do a model run with constant flow and see if the same patterns emerge. If they do, then their conclusion would be supported.

Another result that needs some more explanation is an important source of phosphorus in summer coming from remineralization. What is the source of the organic matter that is fueling the enhanced release of phosphorus? Is it autochthonous to this river reach, from sediments, from the watershed? More detail on the source of the P needs to be added, because if the reach of the river was in a steady state during summer i.e. recycling from algae, there wouldn't necessarily be algae blooms; the population would be constant in time. The budget diagrams are extremely useful and seem to be underutilized in the manuscript. Highlighting the P budget and the different processes

further in the results section would hopefully aid in clearing up some of the ambiguity associated with the budget.

Lastly, how the sediment and water column interact biologically and chemically needs to be further explained. What is the sediment model and how is it coupled with the water column? What happens to porewater in the stream sediment when it is resuspended during erosion?

In general, the writing style needs to be edited for consistency between sections and grammar. The grammar is at times unclear and incorrect, and therefore needs to be addressed. I recommend having a native English speaker edit this manuscript as there are many small grammatical errors.

Line Comments:

Abstract

Page 1, line 8: sentence is awkward, reword

1,11: insert “that is” before “prone”

1,18: change “or” to “and”

Introduction

1,24: second part of sentence doesn’t make sense

2,27: not all streams will be drier, rainfall may increase in many parts of the world

2,29-30: this is a good point

Study Site

3,13: change “respectively on Figure 1” to “(Fig. 1)”

3,17: remove “some”

3,18: change “were since divided 2.5-fold” to “decreased by 2.5 times”

3,19: “time to time” how often

Methods

4,2: change “dynamic” to “dynamics”

4,3: remove “the” before “phytoplankton”

4,11: Confusing sentence, please revise

4,11-13: How long does a model simulation take and on what platform? More information could be helpful to the reader to see if this is a tool they might want to use in the future

4,16: In figure 2, it seems to me that the deltaT and deltaX are backwards

4,17: what do authors mean “nutrient sources forcing variables”? revise

4,15-25: how do the nutrients get added into the model domain, specifically?

6,15: remove “and” before “analyzer”

6,25: upper vs lower nodes; it confuses me which one is which. I would think “upper” would be connected to one lower node, and “lower” nodes would be connected to two upper. Maybe this is a terminology issue?

6,28: sediment is mentioned again but the manuscript lacks any details about the sediment model. A section that details the sediment model and describes how it is coupled to the water column seems important.

6,29: the sediment initial condition being homogenous is likely ok, but without information about the model itself it is hard to assess the appropriateness of this initialization. Were any tests done to show this was appropriate?

7,5: This sentence is confusing, what doesn’t get transferred downstream? Sediment?

7,14-15: Why were the WWTP locations not known? Surely the coordinates exist?

7,29-30: Was this optimized numerically or by hand (manually)?

Results

9,5: how was the Lagrangian view captured, specifically? How was the water mass tracked?

9,20: change “on” to “in”

9,27: First mention of statistics, how do you calculated bias and error?

10,2: Does the lack of the ability for the model to capture storms complicate the interpretation of the storm flow results in section 4.4?

Page 10: This entire section reiterates information in Table 2, it can probably be summarized in a sentence or two.

10,21: It is interested that DOC varied with flow, and flow is seasonal, but the DOC concentration wasn’t seasonal. Maybe expand on this a little bit more. . .

11,6: In figure 5, it is curious to me that the phytoplankton are growing at night. Shouldn’t primary production go to 0, or is this a different measure of growth?

Discussion

14,9-14:

14,18: “lost due to P-limitation” what do the authors mean by lost? Clarify

15,15-21: Can the authors quantify how sensitive the model was to these parameters? Can the authors speculate how useful this parameterization would be? Similar river systems, similar environments or would the model always have to be recalibrated?

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