Biogeosciences Discussions

Biogeosciences Discuss., author comment AC1
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Reply on RC1

Masihullah Hasanyar et al.

Author comment on "How much do bacterial growth properties and biodegradable dissolved organic matter control water quality at low flow?" by Masihullah Hasanyar et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-333-AC1, 2022

Dear sir, madame,

First of all, I would like to thank the anonymous reviewer for its kind attention to our article and the time that they allocated to read it and provided us with comments and suggestions for enhancing our paper. Hereafter are our answers to the 4 comments raised by the reviewer.

Comment #1:

It is not clear whether the sensitivity results will hold if there will be source-sink terms for organic matter.

Response #1:

Each of the three sensitivity analyses is conducted with varying total organic matter (TOC) sources between 1 to 10 mgC/L (Fig. 7-8). Therefore, the source term is well-considered, and adding a new source will not change the results.

As for the organic matter sink, since we had designed the study under a situation where the system shall not be depleted of organic matter and dissolved oxygen at any moment as it is our goal to see how the parameters behave in their presence, this study cannot stand under a sink term that would lead to depletion, especially of organic matter. Indeed, in a depleted environment, the influence of the organic parameters cannot be studied.

To summarize, the fact that we conducted many numerical experiments under various organic matter conditions already answers the reviewer's concern. The answer to the effect of a poor or rich environment on organic matter is already largely discussed throughout the paper.

Comment #2:

No attention is paid to the radiation effects of the bacteria population that is most

pronounced at low flows

Response #2:

We would like to thank you for bringing up this point. Indeed, our model currently lacks this process and it is something that needs to be incorporated into the model source code. However, its implementation and reanalysis of the work will take far more time than the review period of this article. Moreover, experimental data on the subject needs to be found in order to conduct a sensitivity analysis. This specific question may be the subject of further research. For now, we will mention this limitation of our approach in the discussion section of the paper.

Comment #3:

The role of the hyporheic exchange in bacteria population dynamics at low flows is ignored and can be substantial.
Response #3:

The contribution of groundwater to downstream rivers is well known to be negligible with respect to the discharge of those rivers (Strahler order > 6). Our case study mimics such rivers, especially the Seine river crossing the Paris urban area. For such a system, Pryet et al. (2015) provide estimates of aquifer contribution to the Seine River. More specifically, the hyporheic exchange rate is very limited in this area, with a maximum value of 0.005 m3.s-1.km-1, which corresponds to a maximum of 1 m3.s-1 over a 200 km stretch of downstream river. With respect to the actual discharge of the Seine river of 80 m3/s, it is quite clear that this process is not relevant to account for in our study. However, the reviewer is correct that if studying headwater streams functioning, the hyporheic exchanges would be of primary importance.

Comment #4:

The introduction of constant parameters to simulate the repartitioning is a gross simplification. Monitoring data show that the ratios vary.

Response #4:

Without any doubt, the organic matter partitioning parameters vary with time. However, from a sensitivity analysis point of view, we need to keep them constant during the simulation period so that the influence of their increment could be studied on the model total variance and then ranked using the Sobol criteria. That is why we have 360,000 (N(2D+2)) parameter combinations where each parameter value is changed within its variation range given in Table 1 but unchanged during the simulation period to study their impact on model output. Fortunately, the concept of time-varying parameters has been addressed in our data assimilation study (https://doi.org/10.1016/j.envsoft.2022.105382) which is the second step after the sensitivity analysis as I have explained in the discussion subsection "Consequences of the results on data assimilation (DA) strategy". In that work, we had estimated the time evolution of parameters thanks to observation data and new work is underway to test an automatic detection of boundary conditions organic matter content using data assimilation. To our knowledge, this would be a major step forward for the modeling of the water quality of downstream river systems.

Reference:

Pryet, A., Labarthe, B., Saleh, F., Akopian, M., and Flipo, N. (2015) Reporting of stream-aquifer flow distribution at the regional scale with a distributed process-based model, Water Resour. Manage., 29, 139-159. doi: 10.1007/s11269-014-0832-7