Author's response

Dear editor,

First of all, we would like to thank the editor for their 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.
Please find hereafter our point by point reply to comments, including the changes brought to the revised manuscript mentioned.

1) Please include some lines of reasoning why and how a purely model-based approach is actually capable of addressing the research questions. The paper does not include comparison of whatever model output is created with even a single observed data point. This is a severe limitation that should be acknowledged right from the beginning and then again in the discussion.

Response: C-RIVE is a C implementation of the RIVE model. RIVE model was developed in the 90's (Billen et al. 1994, Garnier et al., 1995). The model is community centered and explicitly describes micro-organisms such as phytoplankton and heterotrophic bacteria. The physiological parameters of those communities were determined through multiple lab experiments. Both the model and its parameterisations were coupled in two river water quality models : RIVERStrahler and ProSe, which were both validated on real case applications in multiple river basins over the world such as in the Mosel river (Germany) (Garnier et al., 1999), in the Scheldt river (Belgium and Netherlands) (Billen et al., 2005, Thieu et al., 2009), in the Day-Nhue river (Vietnam) (Luu et al., 2021), in the Seine river (France) (Raimonet et al., 2015, Vilmin et al., 2015, Vilmin et al., 2016 ,Garnier et al., 2020), in the Somme river (France) (Thieu et al., 2009, Thieu et al., 2010), in the red river system (China and Vietnam) (Quynh et al., 2014), in the Danube river (Romania and Bulgaria) (Garnier et al., 2002), in the Zenne river (Belgium) (Garnier et al., 2013), and in the Lule and Kalix rivers (Sweden) (Sferratore et al., 2008).

This is added in the CRIVE subsection 2.1 of Methods.

2) The paper is very long and not very accessible. This has two reasons: First, some text can simply be shortened without much loss of information. I make a few suggestions below (there are several more places) where I urge you to search for briefer expressions. Second, the technical sections are very long. I have already suggested to move parts of the methods into a supplementary document. You may deem this inappropriate. If so, please provide a justification.

Thanks for the two proposals on shortening the paper. First we rephrased and shortened the paragraphs based on your suggestions below and at other parts as well. Then, we shortened the methods section by moving some of its parts to the supplementary material and rephrased its paragraphs. This included equations already published in other articles and those equations proposed in this study but were somehow redundant in the article. We also combined Fig. 1 and 2 into one figure demonstrating all related processes. The results and discussion parts were

similarly reworded. As a result, the number of pages (abstract to conclusion) reduced from 26 to 18 pages.

In response to your specific comments. Lines numbers correspond to that of the track change manuscript:

33: too long sentence that should be broken apart: (34: done)

38. Sentences that can clearly be shortened due to redundant content. Whole paragraph is overly long. (41: whole paragraph is shortened and reworded)

50: Reword, double negation in "lack" and "inability"? Sentence unclear. The whole paragraph needs to be shortened. (55: whole paragraph is shortened and reworded, the message is made clear)

58: Please shorten paragraph, partly redundant. Last sentence is too long. (63: shortened and reworded)

60: Please reconsider the word "repartition". This feels very French to me, maybe better "partitioning"? Applies throughout the manuscript. You later also use the word "share". (repartition replaced with partitioning in all over the manuscript)

69: Whose functioning? (81: corrected to "the functioning of the Sobol sensitivity analysis")

70: Rather "inter-parameter"? Shorten sentence. Be more specific about "hiding effect". (81: shortened and reworded accordingly)

71: Rather "simulation period" (73: reworded the whole paragraph)

73: Please express briefer. Here "We address three research questions" would also do it without any information loss. (84:edited accordingly)

75: Suggest "parameters for bacterial physiology" (87: growth and yield rates) suggested

78: "," missing after "(BDOM)" (90, edited accordingly)

79: meaning of "hierarchy" is unclear (91: importance ranking) added

81: meaning of "against the background of.." is unclear. (removed)

83: Why "Finally,"? (the whole paragraph is merged with the paragraph before the research questions)

89: First sentence superfluous. Shorten whole paragraph, please. (101: whole paragraph shortened)

90: I think the "goal" of a study cannot be to "use a method". Please reword. (103: whole paragraphed shortened and reworded)

136/137: Please provide units for K_rea. I think the proper expression for both D_s and K_rea would be as a "(vertical) velocity" and not a (dimensionally unclear) "coefficient". (edited accordingly and moved to the supplementary material line 12/13)

163: what is "CSO"? (It is the abbreviation of combined sewer overflow as mentioned in line 34, in the caption of figure 1 and in)

102: what is a particle filter? Maybe better to first introduce ProSe, then ProSe-PA. There are some lines of explanations in the discussion (around line 599) that could be moved here. (The ProSe-PA subsection is removed during the overhauling of the methods section because we are modeling using C-RIVE which is one of the libraries of ProSe-PA. So the particle filter remains defined at the previous location)

280: Move information to figure legend. (It was already mentioned in the figure legend as well, so to avoid repetition, removed from the text)

622: This really does not seem to be a sound and safe conclusion to draw from this study! There is absolutely zero comparison to observation data. (We agree, this paragraph was an opinion about future implications of data assimilation after adding BDOM among assimilable parameters, therefore, we removed it from the text as it doesn't add value to the text)

Figure 1: the "cyan" coloring will hardly be printable and remain visible. (A new figure combining figures 1 and 2 is created where the cyan coloring changed to blue)

Figure 3: Maybe not really needed? Or consider as a sub-panel in Figure 1? (Actually, we need to keep it because it helps some readers who are interested in figures to better understand our case study).

References

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