Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2018-381-RC2, 2019

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Comparing the efficiency of hypoxia mitigation strategies in an urban, turbid tidal river, using a coupled hydro sedimentary–biogeochemical model" *by* Katixa Lajaunie-Salla et al.

Anonymous Referee #2

Received and published: 24 April 2019

——————— General comments ———————

This study by Lajaunie-Salla et al., presents the potential efficiency of several mitigation measures to limit hypoxia in estuarine zones based on a 3D biogeochemical modelling approach.

I found this study interesting, appropriate for NHESS, even if very site-centred and essentially descriptive. My general position is that the authors did not take advantage of the powerful tool they have developed. I listed several issues that must be addressed

before further consideration. In particular, -> many hypotheses for the different scenarios are unjustified, such as using WWTP point sources time series of two different years without changing timeseries for other parameters (e.g. river flow), or such as considering point sources chemical composition during storm events (overflow reduction) being similar to the one observed the rest of time (would WWTP efficiency remain stable?). These issues are maybe correctly considered, but are not clearly explained in the text.

-> No information on upstream C, N, P loads forcing while they could be absolutely crucial in this study.

-> discussion of the results is almost absent from the manuscript, with a poor analysis of the processes involved.

On the other hand, the results from the different scenarios should help stakeholders decide what are the best options to determine cost-effective measures and mitigate hypoxia in tidal zones. Therefore, I recommend major revision of this manuscript before it can be considered for final publication in NHESS.

——————— Major and technical comments ———————

Lines 24-28: please consider a different order for the paper highlights, going from highest level of importance to lower levels. For instance, I'd rearrange bullet points with order 1-3-2-4-5

Lines 30-42: My opinion is that there is an optimum in the number of abbreviations used to maximise clarity in the text, and this optimum is outreached with the use of abbreviations for words such as WS for "watershed", ST for "spring tide", WW for "wastewater" ,. . . I recommend to remove abbreviations for the following: neap tide, spring tide, watershed, wastewater which, in the end, are not so much used throughout the text.

Line 45: please, include in this sentence why we should expect rising hypoxia in coastal areas, supported by references to previous studies.

Lines 49-51: same as above, please, mention rising temperatures, lower summer low flows in temperate watersheds and higher nutrient loads near coastal areas due to urbanization to explain why we should expect rising hypoxia. It is good to also explain in plain language why does hypoxia occur, it makes things clear for everyone, and explains why a complex model is needed to investigate the response to different management scenarios.

Lines 67-83: First paragraph of Introduction should be reorganized with first the broader messages (e.g. "Hypoxia is a major environmental issue, . . .etc") narrowed down with more specific messages (e.g. "In macrotidal estuaries, the DO consumption by heterotroph processes is exacerbated by. . .etc"). I also think it could be more synthetic by merging several sentences together.

Line 80: Why don't you also mention diffuse nutrient loads and primary producers' biomass developed in the upstream network?

Line 81: What does "For that reason, . . ." refer to? Please, revise and be more specific.

Lines 87-92: It would be much clearer to give percentages of N and P load reduction due to these WWTP improvements or implementations. I believe this information appears in the cited papers.

Line 141-142: The increased by how much? Why did Etcheber et al. took 110 m3.s-1 as a threshold?

Line 148: which value of discharge is used as a critical threshold? This is too vague.

Line 154: are these releases so "continuous"? Is there any kind of seasonality or other temporal cycles in these point sources?

Lines 154-155: is this 1.5% reached during low-flow condition? How does C, N and P point sources from Bordeaux area compare to upstream loads? This seems like a crucial information to give.

Line 167: Even if description and validation of the model are extensively described in another publication, a brief description on how it performs has to be given. This would provide trust on the results for the reader's point of view. This has to be done for the reference simulation and placed at the beginning of the Results section.

Line 175: how are temporally distributed the C, N and P inputs from upstream river network? Some strong hypotheses must have been done on this part, and they have to be clarified.

Line 182: where did the point sources fluxes data originate from? What is the temporal frequency of this data? Which hypotheses were formulated to compute them?

Line 187: what was the level of Q recorded then?

Line 189: is it safe to use WWTP data of another year than the one simulated in the reference with no change in other parameters like river discharge? We should expect temporal dynamics during storm events to be unrelated to discharge variations in the estuarine zone. Please, develop this aspect to justify your choice since it seems not appropriate to me.

Line 190: was it then considered that these fractions were fully treated by WWTPS? I think I understand that the volume of waste water from these wastewater SO were simply transferred to the volume of WWTP inputs into the river. Loads and volumes are very different quantities. . . This has to be clarified and justified: could the WWTPs absorb and treat up to 50% of these overflow volumes during storm events with the same efficiency as non-storm days?

Line 199: why were these two locations chosen specifically? It is certainly interesting to study, but it has to be explained why and what can be expected from such a measure.

Lines 205-206: again, these choices have to be justified. What is the basis of such scenarios? Same applies for other scenarios listed.

Line 220: how was this rate computed given all the different processes included?

Please, detail this point, especially since this metric is then used as a key indicator to assess mitigation measures.

Lines 220-221: even if you refer to another publication describing extensively the model, the reader might appreciate more information on the model. This sentence mentions the concept of grid cells ("in front of Bordeaux"), but this was not mentioned before. Please, specify size of grid cells in model description, as well as time resolution. Also, it would be helpful to clearly associate Kilometric Points in the text for the river stretches chosen for further analysis. How many grid cells were used?

Line 225 and following paragraph: In the end, these simulations show that waste water overflow discharged during storm events have a minor impact on the estuarine hypoxia. In the data used, what is the temporal variability of the overflow versus total point sources load ratio? What is the summer average of this ratio? This would help characterize these episodic events and might show right away the priorities to stakeholders.

Line 238: Again, is it safe to consider loads during storm events coming out of WWTPS to have similar characteristics as the rest of the time (such as "enriched in ammonia")? This is a critical assumption that needs solid clarification.

Line 245 and following paragraph: Can we consider that, if relocating point sources further downstream could help solve hypoxia in the estuarine zone it would significantly increase coastal eutrophication? This point is, to my view, absolutely crucial: are we not simply moving the problem to a different place and environment? Please, address this point in the Discussion based on available literature.

Line 274 and following paragraph: Is there a big difference if we release the water from the upstream depending on the tidal variations? Do we want to flush the water (when tidal current goes downstream) or dilute estuarine zone (when tidal current goes upstream)? Would this make any difference?

Line 296 and following paragraph: Generating such an event would increase water velocity and would likely erode river bed sediment, remobilizing nutrients and generating more turbidity. Does the model take this into account? I see nothing on the water-sediment processes in the study. Please, clarify this aspect and justify your choices.

Line 344: If we expect lower low flows with longer summer droughts, can we really hope to "reduce water use for agricultural practice"?

Line 349: Do we actually know enough to determine which one of the proposed management decisions would be the best? Could your whole approach be transformed into a simple decision-tree to help local stakeholders take actions? This relates to the prediction capacity of the model used. A model can sometimes show good reproducible results (strong validation) but low prediction capacity under clearly different conditions. This has, to my view, to be discussed.

Line 351: In the end, would this combined approach have the best efficiency to effective cost ratio?

———————— Minor comments ————————

Line 24: "limit" instead of "limits"

Line 49: "Future climate conditions. . ." instead of "The future climatic conditions. . ."

Line 81: remove space before comma

Line 86: "suffering from" instead of "undergoing"?

Line 88: ". . .in the 1980s" instead of "in 1980s"

Line 89: same for "in 1990s"

Line 96: EPA also exists in the US and other countries. It is confusing since cases in Europe are presented just above, but examples in Canada and Japan are mentioned afterwards. . . Please be more specific.

Line 100: “sewer network” instead of “outfall”?

Line 136: what is “PK”? Non-French speakers might not know it refers to “Point Kilométrique”. Please, use a different term such as KP for Kilometric Point.

Line 137: please, include Pauillac position in the river reach to compare with “from PK25 to PK-70” in the previous sentence, even if it is clear on Fig. 1.

Line 137: “around Pauillac (Fig.1) downstream the Gironde Estuary” instead of “around Pauillac (Fig.1) at downstream of the Gironde Estuary”

Line 141: “Since the mid-80s,” instead of “Since mid 80s,”

Line 143: “Such a decrease” while you mention an increase just above. . .

Line 152: “Part of the sewage system” instead of “The part of the sewage system”

Line 167: “validation” instead of “avalidation”

Line 170: “The biogeochemical model resolves extensively the processes that. . .” instead of “The biogeochemical model includes all the processes that. . .”

Line 180: “uses” instead of “use”

Line 181: where were the meteorological data measured?

Line 217: please correct English in this sentence.

Line 228: “the largest storm events” or “the largest sewage overflow events” instead of “the largest sewage overflow flow events”

Line 235 and elsewhere in the text: “the contribution of WWTP matter degradation. . .”. It brings confusion to refer to WWTPs outlets when mentioning WWTPs only. Please, revise throughout the manuscript.

Line 236: this sentence is unclear. Please, clarify.

Line 255: please, find a more explicit name for “urban matters”.

Line 259: clarify the changes in the downstream section under such condition.

Line 286: “diluted” instead of “reduced”

Line 301: Please, clarify what decreases by specifying the units after “6.6 to 1.6”

Line 311: is it one or two weeks then? Accurate numbers would help.

Line 335: “threshold” instead of “thereshold”, “degradation is” instead of “degradationis”

Line 338: add a reference to this expected population growth

Line 342: could you provide an estimate of such a cost? Or give examples considering what is done for the Thames estuary?

Line 343: what can of environmental impact are you mentioning? Please, clarify.

Line 344: “purposes” instead of “practice”

Line 357: Please remove “to maintain the best water quality as possible”

Line 368: “the river water” instead of “waters”

———————— Specific comments on Tables on Figures ————————

Table1: abbreviations in the Table must be defined (as a footnote or in Table caption)

Figure 2: Presenting 2a and 2b with log axis would help the reader. With the current graph, it is nearly impossible to identify river discharge values during summer, and compare point sources for the two years of data presented. I would not mix different x-axis in one figure. Figure 2d should be a different figure.

I strongly recommend to add a figure presenting upstream C, N, P river loads and how they compare with point sources from Bordeaux metropolitan point sources.

Figure 3&4: Almost no use is made of the spatial distributions of DO in the text. It is a pity since they show very clear differences between scenarios, and show the interest of using a complex modelling approach. These figures could get much clearer if each

individual transect had an informative label, if P1, P2, P3 appeared on Figure 1, and also if it was mentioned the time associated with these longitudinal transects. Is it an average across the summer period? This has to be clarified. Other comments on these figures: vertical distribution seems quite homogeneous. what is the interest of 3D modelling in this case? Couldn't you simplify a lot the simulations with a 2D approach? Only one colorbar in these graphs is sufficient since they all have the same scale.

Figure 5: What is the interest of showing diel cycles? Wouldn't it be more instructive to extract from these timeseries daily amplitudes and averages for each scenario? It would be nicer to have this figure in a portrait layout.

Figure 6: Almost no use of this figure is made in the text. I recommend extracting metrics that are more informative such as daily averages and amplitudes. Amplitudes are also crucial in a river metabolism point of view.

In any case, only one colorbar in these graphs is sufficient since they all have the same scale. Each individual panel should have an informative label. I also recommend to have this figure in a portrait layout, with enlarged width (along the spatial scale) to identify more clearly the temporal patterns.

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