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Review and rebuttal of the paper

Short-term effects of a summer flash flood on the physiochemical water quality in a restored river

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Editor handling the paper: Jeremy Bricker

The reviewers remain anonymous.

Round 1

Reviewer G (comments given in Word doc)

General comment: Dear editor,

Please find attached my review of "Short-term effects of a summer flash flood on the physiochemical water quality in a restored river". My suggestion is that minor revisions are required. I have commented on the article throughout in the attached word document, please find my concerns and suggestions there.

Overall, it is a well structured, written, and executed article and study. The results are both timely and highly relevant to the journal. Some extra details are required from the authors to allow the reader better understand the data obtained during the study, specifically in the methods and results section. I have outlined these specifically in the attached document.

General response: Thank you for the comments. I believe that your comments helped me to improve my paper substantially, making the methods and results more clear by giving more details, rephrasing, and adding a supporting table.

Spelling mistakes corrected for

Introduction

Comment 1: Half, not halve

Methodology

Study area and description of flood event

Comment 2: This section needs some kind of description of the flood, when did it happen, why did it happen, over what period, how much rain was there, is this normal, was there any other factor than rain,how much terrestrial land was impacted, some information to out the flood into context. -> **I added a paragraph with a description of the flood.**

Data collection

Comment 3: More description needed, how many samples were collected, how much volume per sample, from how many locations (periodic but good to know). Currently difficult to discern what is data from continuous measurement sites and what is from water samples collected by the authors-> **I added some information in the text.**

Comment 4: to

Comment 5: What units were these measured and reported in? **-> I added units in text (chapter data collection).**

Comment 6: Which one on the map is this? -> I **added symbol referred to on map in between brackets.**

Comment 7: Provide a link and last date of access -> **Done.**

Comment 8: How were these samples collected? Grab samples? How much volume? Were they filtered or acidified? -> **I added this information.**

Comment 9: This is very vague, can you provide some information for how many sampling times there are? **-> I made this more clear in text.**

Lab analysis

Comment 10: This section needs a lot more information and description. Currently it is difficult to follow what was done exactly and on what samples (e.g., between dissolved and particulate phase) **-> I rewrote this part, going more into detail on the analysis.**

Comment 11: Filtering?

Comment 12: what volume? **-> I gave a more detailed explanation in file.**

Comment 13: What samples? **-> Water samples, made more clear in text.**

Comment 14: what is this reference? **-> The year when norm was legislated, made more clear in text that this is not a reference.**

Comment 15: Were any controls included to account for weight and carbon found in filters? **-> Yes, explained better in text.**

Comment 16: Filtering and how much? **-> Volumes added in text.**

Comment 17: This set up needs more explanation, how much volume was used, was there headspace, was it on filtered or non-filtered sample, how was oxygen measured, how many times was it measured, were there replicates, how many, how many samples was this done for. Currently it is unclear how these address the question of assessing flash flood (Pg 4 L27) **-> I added detailed information.**

Comment 18: Concentration (mg L) or % **-> In mg/l, adapted in text.**

Comment 19 : Not data analysis, should be in a different section **-> I moved this part to data collection.**

Comment 20: converted

Comment 21: why? Can you give a justification? **-> I explained why subtracting ammonium/ammonia is the correct way to do it + transformation to organic matter because we can then analyse each N-component individually (added in text).**

Comment 22: Should be in a different section, not data analysis **-> I transferred this part to lab analysis.**

Data analysis

Comment 23: These are the sampling locations where continuous measurements were taken place in Figure 1? **-> No, I made this more clear in the text.**

Comment 24: This is the reference period, define it here as so to avoid confusion later. Also, seeing this data is useful to show that the flood is different from the reference period. Also, summer should be defined somewhere. What do you mean by summer? Is it exact dates each year? If so, what are those dates? **-> The reference period and summer are defined. Mean discharges of reference period are given and compared to study period.**

Comment 25: mean values of what? **-> Mean values of all distinguished parameters, now written more clearly in text.**

Comment 26: Needs more explanation of how this shows recovery, what dates do the mean values of summer 2021 cover and how different are they from the June 21 - September 23 dates mentioned above? Is this meant top be 2020?

This would make sense for results when you compare 2021 data to 2020 (e.g., for discharge data Pg 5 L14 **-> I improved the explanation. The control value was calculated for the reference period (explained in methods). When the control value was reached or surpassed in the summer of '21, normalization/restoration was reached.**

Comment 27: From the description above it is currently unclear that you have collected data to do so **-> I improved the explanation in data collection and in the last paragraph of data analysis.**

Comment 28: These should be above rather than in data analysis **-> I moved this part to data collection.**

Results

Comment 29: What are the typical summer levels on Figure 2 and how do you define typical summer levels? **-> I changed typical to 'average' from the reference period and added estimated return period of the peak discharge during the flood (with source).**

Comment 30: Did you calculate this? **-> I removed 2020 values since I considered them to be unnecessary information.**

Comment 31: Do you have data to show this? **-> I added a source.**

Comment 32: remove repeating words

Comment 33: O2 L-1 **-> I changed the unit to O2 L-1 and maintained consistent in text.**

Comment 34: What are these ranges and how are they determined to be standard? **-> These ranges were based on min/max in reference period, indicated in text.**

Comment 35: What dates was this? Is this the exact date with peak discharge? **-> 23rd of July, added in text.**

Comment 36: When is this? **-> The reference period is now clearly indicated in methods**

Comment 37: What are these means? Show the reference data (link it to the figure, as such it is not clear that it is there) or provide the numbers (means) when making such statements **-> Table with reference data included.**

Comment 38: Explanatory variable of what? There is no model or regression included where explanatory variables are appropriate **-> This was a term used mistakenly.**

Comment 39: Why is this included, what is the justification for including it? It is not mentioned in the methods that you have applied this trendline to your data or why? **-> Included to improve visualisation, as points are sometimes scattered. Added in methods.**

Comment 40: Is normalization based on coming to mean levels over the reference period? Is seasonality considered at all? For example, id DOC at week 6 after the flood similar to the mean DOC over the entire summer period from the reference period, or is it similar to DOC levels during the reference period years at the date in which week 6 in Figure 5 occurred? Normalization and the approach taken should be included in the Methods section as it becomes quiet important in the results and discussion of the paper **-> Normalization was based on mean levels of complete reference period. Seasonality (within summer) is not considered, as this does not seem relevant when looking at only one season. Explained more in depth in methods.**

Comment 41: I would suggest removing this from your timeline as it does not occur along it **-> I removed it from the timeline.**

Comment 42: This section needs more description. When describing increases and decreases it is unclear what is increasing/decreasing compared to what. Is this a comparison of upstream to in meander, or downstream to in meander? It is unclear from the text what is meant **-> From upstream to downstream. Added in text.**

Comment 43: Where did this increase occur? **-> From upstream to downstream. Added in text.**

Comment 44: I aa confused as to what this unit refers to, is the concentration 0.18 mg N L-1 per 500 m section? **-> This was indeed very confusing. I adapted it to mg N L-1 per km and changed the notation type.**

Comment 45: Why slight? It is half of that from the reference section and statistically significant **-> Slight was indeed unnecessary, removed from text.**

Comment 46: $p < 0.05$ **-> Adapted.**

Comment 47: Need to define what the letters in the plots signify (statistical significance?) **-> I added an explanation in the figure description.**

Comment 48: What is the sample number for each nitrogen species in the reference, and a and b meanders? Difficult to understand the spread of the data and without the known sample size for each the mean, min, and max are not very helpful to interpret the data. Also, what is the justification for selecting min and max, rather than using boxplots with interquartile ranges, standard deviation, or 95% confidence intervals? I would suggest that any of these three would provide more information and allow for better understanding of the data, particularly boxplots with the raw data points included. This is true for all meander figures (Fig 6-10) **-> I used this approach as observations per location were very limited for this analysis (n = 7).**

Comment 49: Reference and meander a nitirite data is the exact same, is this correct? **-> This is correct. Meander section 1 is located directly downstream of the reference section, resulting in an overlapping data point (downstream reference and upstream meander 1).**

Comment 50: Statistically significant, to call it marginal is misleading **-> I agree, adapted.**

Comment 51: Decline needs to be defined, a decline from upstream to downstream? **-> From upstream to downstream. Added in text.**

Comment 52: Figure 9. Also, is this figure referred to in text? If not it should be **-> Not applicable anymore as figure was merged.**

Comment 53: Figure 10, also is it referred to in text? It should be **-> Not applicable anymore as figure was merged.**

Discussion

Comment 54: One key element missing from this section is placing these results in context of the literature. The authors do a good job at describing their data, but it is not known how this data relates to other rivers, both in flood and non flood conditions. As such, thee discussion at times reads a bit like an introduction. Including some examples of how, for example, DOC in the reference period relates to other similarly sized rivers in the region and how the flooded river values then compare to this, would put the results into better context and allow the reader to better understand how flooding impacts riverine chemical signatures **-> There are no good examples of similar sized rivers in the region that suffered similar impact. I did add this in discussion now. However, I tried to compare the results to similar cases in literature to put the results in better context.**

Comment 55: Can you define anoxic conditions for this study? **-> Anoxic conditions were defined as DO values below 0.5 mg L^{-1}.**

Comment 56: Link to data and date when last accessed **-> Added in text.**

Comment 57: Is this for this river, or rivers of a similar size? **-> River studied in cited research, made more clear in text.**

Comment 58: Anoxia is a better term to use here as I think you are describing oxygen free conditions, rather than the biological activity occurring under anoxic conditions. Please ignore if I am wrong **-> Correct, adapted.**

Comment 59: This is not measured and therefore should not be speculated on. You can say something along the lines of conditions present were previously found to lead to NO emissions, however these were not measured in this study **-> I agree, adapted in text.**

Comment 60: Similar to anoxic, the authors should define what they determine hypoxic conditions to be (within what range of O2?) **-> Below 3 mg L^{-1}, added in text in between brackets.**

Reviewer E (comments given in message to editor)

General comment: This research conducted a very detailed study on the effects of a flash flood on water quality in a restored river, Demer river in Belgium. Both quantitative and qualitative analysis was carried out to answer how a flash flood may affect many physiochemical parameters. This paper also attempted to understand the role of restored meanders in the recovery of water quality subsequent of the summer flash flood. It was well written and minor revision was recommended.

General response: Thank you for the comments. They helped me to improve my paper.

Comment 1: Key words could be improved. For instance, Europe is not the key, but restored river could be included. -> **Keywords improved.**

Comment 2: At line 5 and 6 on Page 2, the last sentence can be deleted, for this paper don't discuss much urban effects of the restored river. -> **I agree, sentence removed.**

Comment 3: Give some typical pictures about this river on Figure 1, for example, cross-section of the restored river or other field survey pictures of the river. -> **I added some pictures from the flooded valley.**

Comment 4: At line 27 on Page 3, Data collection commenced prior the flash flood, do we predict the flood time? -> **No this was a coincidence as the project monitoring started then. It was not expected that the flood would be this extreme at that time.**

Comment 5: At line 11 and 12 on Page 11, "These materials originated from decaying terrestrial and riverine plants, CSO's, agricultural runoff, and erosion", is this the general understanding? How about the analyzed restored river? -> **This was the case for the restored river. Only meander and floodplain reconnection are part of this restoration project, pollution sources such as CSO's and agricultural runoff are mostly not considered within this project, although I do recognize the great importance of that, as suggested in the discussion.**

Comment 6: It was shown in Table 1 that multiple dissolved variables demonstrated robust correlations with discharge during summer 2021. According to Figure 3 and Figure 4, multiple dissolved variables reached its peak or nadir several days or even a month after the peak charge. When calculating the correlation coefficients between river discharge and physiochemical parameters, was the time lag taken into consideration? -> **No the time lag was not taken into consideration. Each parameter had a different time lag, and several new rain events made it difficult to correctly estimate this time lag. It was therefore not possible to incorporate this time lag in the correlation analyses.**

Comment 7: At line 18 and 19 on Page 5, it was stated that "The peak discharge occurred on July 21st, marking an official delay of six days following the flash flood event". Is this peak charge referred to that measured at station 'Aarschot Afwaarts' in Figure 2? According to Figure 2, the peak discharge appeared around July 24th. -> **This was indeed a mistake. I solved this.**

Reviewer ? (comments given in Word doc)

General comment: The manuscript is interesting and provides insights into the water quality of the Demer during the 2021 summer flood. Regarding the interpretation of the results, specifically in light of effects on biodiversity, there are several comments that need to be adressed (see attached document).

General response: Thank you for the comments. I believe that your comments helped me improve the paper. Specifically, integrating figure 2 and 3 allowed for a better comparison and interpretation of the results. However, I was not able to add many insights on how the flash flood affected the biodiversity, as this was not within the scope of this research, and thus also not measured. However, I did mention some sources, where it clearly indicates that fish mortality was a big problem at that time in the studied river.

Comment 1: The effect? The effect on …-> **I agree that this is better, so I changed it in the text.**

Comment 2: How was this data collected? Was it the same/similar? -> **It was indeed similar. I went more into detail about data collection in the methods.**

Comment 3: It would be valuable to gain more insight in the concentrations/levels a longer time period before the summer flood. -> **I agree, but graphs would become very large with a lot of information. As I wish to provide information about a large amount of parameters, I had to minimize the temporal scale. Also, only for the continuously monitored parameters, there was data from before the summer. Sampling by the UA and VMM started at the end of June.**

Comment 4: Turbidity follows some sort of hystereses pattern. Do you think this is due to suspended sediment transport? -> **The first decline is caused by the great dilution with low-turbid rain water. The peak following is due to the great increase in sediment transport, however, the last peak towards September is unexpected. Possibly due to the retreating of floodplain water, bringing in a lot of eroded sediments. Added the hypothesis in discussion.**

Comment 5: I would like to see figure 2 integrated into figure 3 with the same scale to allow for a proper comparison. -> **I agree that this improves comparison. I added the discharge in the background for each individual plot, also in figure 3.**

Comment 6: What where the criteria to conclude normalization? -> **I explained it more in depth and included a table with descriptive statistics for the reference period, which serve as criteria of normalisation.**

Comment 7: Could you add the individual datapoints (instead of min mean and max). Moreover, how was sampling time included in the analyses? Interpretation: how do the upstream and instream compare from a location/use perspective? Same pressures present? -> **I adapted the graphs to boxplots with individual datapoints. Sampling time was not included in this subchapter, as the goal here was to compare parameters upstream and downstream of three studied sections to see whether any significant declines or inclines could be observed. I do not entirely understand the comment with regards to the location/use perspective, but the same pressures are present at all sections, however, there is a sewage overflow located directly upstream of the reference section, thus furthest away from section B. This is indicated on the map, and discussed in the discussion.**

Comment 8: Ideally It would be valuable to include monitoring data to show the impact the water quality change had on the community. Currently, throughout the manuscript severa references are made to

impacts on biodiversity but this hypothesized impact is not shown for the Demer. Including such data would place the changes in water quality into a broader perspective. -> **I agree but this was not the scope of this research. However, I did add some references where the impact on biodiversity is explained, but I do not go into detail about it.**

Comment 9: But no data is presented to support this statement. -> **See above.**

Round 2

Reviewer A:

General comment: This research conducted a very detailed study on the effects of a flash flood on water quality in a restored river, Demer river in Belgium. The authors have revised the manuscript to address the questions raised by the reviewers. Minor revision was recommended before publishing.

Comment 1: In Section 3.1, the correlation relationship between discharge and physiochemical parameters were analysed. The correlation between discharge and some physiochemical parameters were explained in the discussion section 4.1, but not the correlation between the physiochemical parameters. Can the authors briefly explain the correlation between the physiochemical parameters and the underlying mechanism?

Comment 2: On line 20 of Page 2, "rivers current incapacity" should be "rivers' current incapacity"

Comment 3: On line 42 of Page 2, "The research was conducted in a downstream segment of the Demer river," should be "The research was conducted in a downstream segment of the Demer river."

Recommendation: Accept Submission

Reviewer B:

I am satisfied with the response of the author to comments made on the manuscript. I suggest the manuscript be accepted in its current form. I commend the authors on their good work, congratulations all.

Recommendation: Accept Submission

Reviewer C:

The authors have adequatly adressed my comments raised during the review phase. Due to the lack of data the statistical underpinning of results remains difficult. Overall the manuscript provides valuable information on the effect of the extreme flood on the abiotic conditions in the Demer.

Recommendation: Accept Submission
