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Hydrology and Earth System Sciences Discussions

Interactive comment on "Model-based analysis of nutrient retention and management for a lowland river" *by* D. Kneis et al.

Anonymous Referee #3

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Important note: The topic of this research is outside my field of specialization, and my background knowledge related to water quality/nutrient issues is limited, so some of the specific criticisms made in this review may, in fact, be incorrect.

GENERAL COMMENTS: The paper gives a good overview of the problems facing scientists/land managers involved in the prediction of the future nutrient dynamics of river/lake systems - particularly in response to changing nutrient pollution management. They also succeed in highlighting the important impact of sediment retention/release of nutrients upon seasonal nutrient behaviour and upon efforts to improve water quality in the medium- to long-term. While their final verdict, that none of the tested management scenarios have a sufficient impact on improving outflow water quality with respect to nitrogen and phosphorus in the medium term (by 2015),

seems reasonable, I am not sure that the modeling methodology used is appropriate for demonstrating this in an objective way. I am also unsure that novelty (in the form of new methods, findings or hypotheses) has been demonstrated.

SPECIFIC COMMENTS: 1. The most fundamental problem I see with the manuscript relates to the assumptions made in relation to internal uptake/release of nutrients - particularly the assumption that the rate of P release by sediments is constant. It is concluded (L315-319) that internal uptake/release of nutrients has a crucial impact upon current water quality, and future scenarios for water quality. Within the manuscript (L134-7), it is acknowledged that the importance of internal uptake/release upon predictions was suspected or known in advance, yet (on L140-1) a proper incorporation is considered to be beyond the scope of the present study! If these processes were known to be (and subsequently demonstrated to be) so crucial, why are they handled in such a rudimentary way by the model? And, to what degree are the conclusions a direct consequence of these simplifying assumptions? I think it is insufficient to say that a more detailed handling of the sediment compartment will be added in subsequent modeling work (L329-30) when it was known from the onset of the current work how important it would be.

2. Bearing in mind the above comment, I am unsure what has been achieved in this study, other than presenting a model and finding it to be insufficient for the problem being investigated. The authors do not highlight any novel aspects of their study: has water quality modeling been conducted in this river/lake system previously? Is this the first time that this type of model has been applied to this type of system? Are the results different from expectations/previous predictions? If any of these are correct, then they should be highlighted, and the focus of the paper modified to reflect this.

3. Overall, I was concerned by the lack of detail used in describing the modeling methods used in this study - particularly considering that no reference is given in relation to the TraM model (at least none that I could find). The manuscript is quite short, so I feel that a more complete description of modeling methods (and assumptions) could

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help flesh out the paper and make it more self-contained (rather than having to seek external references to understand how each element of the model works, and any inherent assumptions used). This is also a major issue with respect to the reproducibility of results.

TECHNICAL COMMENTS: There are some grammatical errors, but for the most part the text is understandable. For that reason, I have tried to restrict my grammatical comments only to those passages which are (or have the potential to be) hard to understand.

1. Abstract, L10: "It was observed/estimated/predicted"?

2. P2, L35-37: The sentence beginning "First, the relevance..." is hard to understand. I suggest rewording, and clarifying what you mean by 'evaluating' (or do you mean 'analysing'?).

3. P2, L44: Suggested rewording: "Today the lakes act as a net sources of P, which is typical behaviour following a reduction in nutrient loads in the inflow."

4. P2, L48: Rewording "... retention at high temporal resolutions..."?

5. P3, L55: "well-mixed"

6. P4, L88: "...monitored biweekly..."

7. P5, L135: Sentence beginning "This is necessary..." is hard to understand. I suggest that the sentence finishes with "... net phosphorus export (Fig. 3), and thus P release will also decrease."

8. P5, L142: Who is requesting 2003-2015 simulations? If this is relevant, it should be mentioned in the introduction why this choice (i.e. 2003-2015) was made, and the specific application/need for these forecasts.

9. P6, L172-5: This paragraph is hard for me to understand - please clarify if possible. Are you saying that immediate P export from the sediments might not show up in

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outflow for a long time, due to a combination of stratification, algal uptake, etc. (to explain overestimation of P in outflow in 2003/4)? And, conversely, in 2000 the algal uptake is less than simulated, such that P in outflow is underestimated? I don't think you should refer to export from the sediments as "net export" (L 175) if this is the case, since net export with respect to the lake should (in my opinion) refer simply to the difference between inflow and outflow concentrations/loads. Please elaborate on this if necessary. I also think the first sentence "Against this backdrop..." should be re-written, since you ARE speculating!

10. P8, L244: "interpreted: as we would expect, ..."

11. P8, L 262: What do you mean "taking into account possible enhancements in P elimination"? This is a very vague statement.

12. P9, L275-6: You make an assumption in this study that the P export rate from lake sediments is constant. If, instead, export rate alter in response to changing P concentrations in the overlying water column, how do you anticipate your results would change? From my understanding (maybe incorrect), the sediments act like a buffer, and a reduction in water column P concentrations will increase the net P export rate from sediments. If so, then the impact of scenario P2 upon altering Havel River P concentrations will be even lower than your prediction. This makes the last sentence of the paragraph misleading; the relatively low impact upon Havel River P concentration is not DUE to your assumption - if anything, your assumption actually hides (or minimizes) this buffering behaviour. I think you need to give a clearer explanation of the impact of your assumptions upon predictions throughout the paper. The assumption of constant P export rates from sediment is also bound to have an impact upon your seasonal predictions, and so should also be discussed in this context (eg. L277-282).

13. P9, L283-286: You should be more specific; management measures will not sufficiently reduce summer TP concentrations IN THE SHORT TERM (i.e. where the explanation you give in L141-157 for assuming constant P export rates from sediments

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remains reasonable). Presumably, progressive stripping of P from sediments in response to reduced external loads should eventually achieve the desired reduction in TP - but obviously not in the timeframe simulated (2003-2015). Again, the assumption of a constant P export rate from sediments prevents you from assessing how long it would actually take to achieve TP reductions in the Havel River (although you can get a simple estimate by extrapolating the rate of reduction in the estimated size of the sediment P store over the simulation period, can't you?).

14. P10, L311: I'm not sure I agree that N retention in the river system is "for free". From s3.2, you identify two sources of N loss: denitrification and sedimentation. From your own statements, provided P levels are sufficient, denitrification may be conducted by blue-green algae. Presumably blue-green algal blooms have a cost (whether ecological, or in terms of recreational/water supply use). If instead N is lost to sedimentation, I'm assuming this accumulates in a similar way to P in the sediments? Is there a consequence to ongoing accumulation of N in lake sediments?

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