

Interactive comment on “Antecedent flow conditions and nitrate concentrations in the Mississippi River Basin” by J. C. Murphy et al.

Anonymous Referee #2

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The manuscript “Antecedent flow conditions and nitrate concentrations in the Mississippi River Basin” presents and discusses a statistical analysis of the variation of riverine nitrate concentrations depending on antecedent flow conditions at a range of 8 sites within a large-scale river basin. A previously developed and separately published regression model is used to predict riverine nitrate concentrations. Concentration anomalies, i.e. predicted deviations from long-term observations, are investigated for systematic bias depending on river flow conditions.

The manuscript is generally well-written and clear, and the study topic is relevant for publication in HESS, with the novel aspect of the study in my opinion lying mainly in the large scale of the study area: on the one hand, such basin sizes require the development/use of integrating measurement proxies, here river flow conditions for soil

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moisture, on the other the conclusions drawn from such studies can lead to insights not easily inferable at smaller scales, here the effect of river eutrophication on marine environments. However, the study in my opinion in some parts lacks a necessary consideration of just these large-scale issues, starting with the introduction, which focuses on smaller-scale experiments, but also later on when the – partly weak – correlations are presented and discussed.

In my opinion, the m/s would very much benefit from revisiting some of the points raised by the authors themselves in the conclusions on page 11469. Investigating e.g. some simple relationships between catchment properties and nitrate measurements as well as regression results could reveal some clues on where the statistical relationships actually could imply causality, but I would like to leave the decision if such an extension is necessary for acceptance of a revised m/s to the editor.

I also suggest the following comments to be addressed in a revised submission:

1. In the second and third paragraph of the introduction section, introduction and study area description are mixed. I suggest moving relevant study area parts (incl. table references) down to the second section. Also, please consider adding a few lines on general climate and physiography of the basin, to draw a more holistic picture of the conditions in the basin for readers unfamiliar with the region early on in the m/s. Later explanatory sentences in the results section may then be shortened/deleted.
2. No clear rationale is given why the authors chose one year to describe antecedent flow conditions (p. 11455). Was this decision based on testing conceptual considerations? How does dam storage and the basin size in general influence storage and release cycles?
3. The authors reflect on catchment heterogeneity and its influence on the flushing response in the conclusions (p. 11464, l. 23ff), but there is no further investigation on the spatial origin of runoff under different flow conditions. As an example, one could e.g. hypothesize that under low flow conditions, stream water actually consists largely

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of water stored for around a decade in the subsurface, and the previous year has little causal connection on riverine nutrient concentrations.

4. I wonder about point source pollution in these catchments, do the authors have information regarding the relevance of nitrate sources besides those from agricultural practice? In large catchments with considerable human population, these types of sources could have an impact on river concentrations and, moreover, contribute intermittently and have a deteriorating impact on long-term regression models.

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