

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
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Reply on RC2

Christopher Spence et al.

Author comment on "Assessing runoff sensitivity of North American Prairie Pothole Region basins to wetland drainage using a basin classification-based virtual modelling approach" by Christopher Spence et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-102-AC2>, 2022

Reviewer #2

Overall, the subject matter, methodological approach, and results of this paper address relevant scientific questions within the scope of this journal. The authors present an interesting modeling application towards better understanding complex landscape hydrological processes.

It is unclear the actual spatial extent of the modeling study. I suggest including more maps in text and in supplemental material to orient the reader through the complex methods. It is clear the Cold Regions Hydrological Modelling platform (CRHM) has been developed and published in many different publications, but it would be helpful to include a spatial visualization of routing pathways of surface water, spatial orientation, and size of wetlands relative to stream networks and how these watershed characteristics change under different drainage scenarios. These details are currently lacking or hard to find, despite the major conclusions of the paper directly relating to these aspects.

We can add a new figure (Figure X - included here as a .pdf) that includes a spatial visualization of the routing among the HRUs, including the relative size and locations in the virtual wetland complex in the no drainage scenario and a 30% wetland loss scenario. This new figure would have a caption: "Panel a) illustrates the runoff routing among the HRUs showing the non-wetland and wetland catenas, where the latter includes routing runoff from the non-contributing portion of the basin through a wetland complex. The relative sizes and locations of the wetlands in this complex are conveyed by the squares in panel a). Panels b) through e) illustrate an example of the complex under a 30% drainage scenario (the removal of 30% of wetland area) which would be substituted into the wetland catena in panel a). Panel b) is the small to large scenario; c) the large to small; d) the top to bottom and; e) the bottom to top."

Another point of clarity is to standardize use of stream discharge, streamflow depth, and runoff. These different terms are used throughout interchangeably and makes the findings hard to follow.

Yeah. This is our mistake. We will remove all use of the word "discharge" when we really mean "runoff". Furthermore, because streamflow is often expressed as volume per time, and "streamflow depth" is kind of misnomer, we will adopt the term "runoff" throughout as we present all our results as depths in mm.

Overall, interesting conclusions are made but more effort could be made to distill the major findings and move some method and results information into supplemental material.

Thank you for the suggestion. We appreciate the desire to keep a manuscript succinct. We feel it is important to provide all the relevant material in the main body of the paper.

Below are specific editorial suggestions regarding text, tables, and figures.

L63 this half of the sentence does not say anything. Consider removing or re-writing

We feel it important to note that wetland loss is not evenly spread through time or space, so we can re-write it. "Rates of wetland loss are not the same everywhere, and some regions and periods have experienced very high rates of loss (Li et al., 2018).

L71 replace "numerous depressions" with an order of magnitude (i.e., millions) estimate of number of basins

We will replace this with millions.

L80-109 this paragraph can be distilled and shortened to focus on how this information describes the system and problems

We will shorten and focus on processes important for assessing response to wetland drainage as suggested.

L110 This sentence is confusing and repetitive, consider re-writing

Will fix.

L143 These objectives are a perfect spot to set the tone on standardizing language in regards to stream response variables of interest (streamflow, runoff, discharge) and then keep consistent after that

We will change it to "runoff" throughout, as explained in a response to an earlier comment.

L195-210 this section would be much easier to follow and would allow for better interpretation of results if there were at least one map showing the distribution of wetlands and runoff preferential flowpaths under different drainage scenarios. I find it hard to visualize what this looks like in virtual model space.

Please see our response to the first major comment above.

L293 More details about the drainage scenarios are needed to better understand what is being manipulated in the model relative to the hydrologic responses.

Please see our response to the first major comment above.

L307-315 This text would be easier to understand with a visual figure as well.

Could be in the supplemental material

Please see our response to the first major comment above.

Fig 1. The weather station sites are very hard to see. Make bigger and more contrasting to the background

We will change this, and other aspects of the map in response to Reviewer #1's comments.

Fig 2. Include slope and intercept of regression model in caption. Also, make sure it is noted why the simulated depression storage is an order of magnitude larger than the observed pond depth. Consider changing units on one y-axis so you are comparing mm to mm or cm to cm

It is not the absolute magnitude we are comparing here, but the year-to-year variation in two terms – one modelled and one observed – that represent surface water storage on the landscape. For this reason we feel that changing the units would not necessarily help; it may confuse the situation by implying that the order of magnitude should be the same between the two terms. We have added the slope and intercept of the model in the caption.

Fig 3. This figure does not say that much and could be moved to the supplemental material

We respectfully disagree. Because it is so difficult to evaluate a virtual basin model we feel it is important to have these results front and centre in the paper. Reviewer #1 requested the numbers that make up this figure available in a table. This table has been added.

Table 4. In L416-418 you show that there is low deviation between drainage scenarios. To simplify this information consider moving this whole table to the supplemental material and only present the average and sd for each site

We do not wish to include a supplemental section to the paper so we will reduce this large table as suggested to only present the average and standard deviation for each site.

Figure 4. Similar to Table 4 suggested edits. Take average of all 4 scenarios and only visualize that in the main text. Move whole figure to supplemental. This figure is hard to pull details out of. Also, in the caption include the time period that is modeled and the units of discharge depth. Discharge depth is mentioned in the caption, but the figure shows Annual streamflow (mm).

We admit there is a lot in the figure, which we feel needs to be shown and available in the main text. Because each of the box and whisker plots already includes the variation among the 30 year simulation period, it would be problematic to average the four scenarios into one box plot as well, and retain the information about variability throughout the simulation period. We require the 30 year box and whisker plot to demonstrate a few key characteristics of each drainage scenario that are discussed in the text (e.g., dry years remain dry even if there is lots of wetland drainage). We would like to retain the figure as is, and will update the caption and axis labels as suggested.

Figure 5. add "median" "wet" and "dry" labels above the top panel next to each corresponding black vertical line.

Will do.

Table 5. This information is confusing. Maybe because I do not think about 1:42 as a flood size very often.

Granted it is. To simplify things we have removed the 1:42 year flood from the table. The message remains the same even if only the median flood is discussed; that we could not identify a threshold below which the high streamflow of the year was not impacted by any wetland drainage. We will try to clarify these points in Section 3.4 too.

Figure 6. This could be consolidated into one panel with the bottom panel's y-axis range. Right now the y-axis labels seem to be wrong and missing median and max labels.

Will update as suggested.

Figure 8. Different y-axis labels. Standardize runoff or streamflow and be consistent

Will fix as suggested.

L548 needs a new section title since this analysis and Fig. 9 talk about a different topic.

We respectfully disagree. The content is not quite extensive enough to warrant its own section. The topic does have to do with the role of climate on the response of hydrological connectivity and runoff to wetland drainage.

Please also note the supplement to this comment:

<https://hess.copernicus.org/preprints/hess-2022-102/hess-2022-102-AC2-supplement.pdf>