Response to Reviewer #2

Overall, Spence et al. did a fantastic job presenting the development and application of a Region-wide hydrological model used to test the sensitivity of Prairie water budgets to changes in precipitation and temperature that are expected in the future. The manuscript is extremely well written and easy to follow with ample justification and explanation of the limitations of their modeling approach. This study also sets the stage for future modeling studies as well.

In the future it would be very interesting to compare seasonality changes with actual GCM outputs rather than using the delta method to enact changes in precipitation and temperature on historical records. These seasonality changes will especially be important for your peak SWE and runoff estimates. Also, in the discussion you allude to the fact that land use and land cover has also been changing. It would be very valuable to use this modeling approach to quantify climate and land-use change synergies and simultaneous combined impacts on hydrology in the future.

We agree with the reviewer. This paper was written as a proof of concept to show that we could use this approach for future sensitivity studies to both land use and climate changes, and not just one at a time. We agree that GCM outputs could be viable driving data, but we have struggled to find good regional climate model data that we have confidence in. We recognize that the delta method is somewhat simple, but it remained the least problematic approach. We can add content discussing this in relevant sections. Also, see our comment regarding gridded climate data in our responses to Reviewer #1.

L115 remove "land management scenarios" as you only looked at responses to changes in precipitation and temperature across one ecoregion.

Thank you for the suggestion but we feel that it is important to mention land management scenarios here as we hope to apply the framework to these in the future, as this reviewer suggests above.

L192 Please explain your wetland complex configuration in a bit more detail. Where does the 46 wetlands come from? In L344-347 the results are presented in the context of wetland density and commenting on the relatively dense drainage networks coupled with small wetland densities. How are the wetland densities dealt with in the model? See the two citations below for very recent evidence that including an areal estimate of wetland depressions within your HRU can improve streamflow discharge estimates like those in Figure 5.

We can do this by citing Pomeroy et al., 2009 and explaining how the configuration was conceptualized with a few sentences at the end of this paragraph.

L366 Please quantify "reasonable simulations of streamflow" using some comparison of means.

We have the data we used to create Figure 5 and will now provide numbers for the four climate stations and include a sentence such as “As with SWE, the CRHM HEG virtual basin model produces reasonable simulations of streamflow. Using Red Deer climate conditions, simulated and observed mean annual streamflow was X and Y. Similarly these values were A, B C, D and E and F for Calgary, Lethbridge and Medicine Hat climate conditions, respectively.”

L368 see previous comment regarding the use of "good agreement"

Please see our response above.

In your data availability statement please provide links to the data

We can do this. We have uploaded climate data inputs, model outputs and model parameter files to the Federated Research Data Repository. The data are still under the verification of a curator. Once verified, the data will be publicly available. We expect this to be before the paper is published, but we already have the doi's that will be used, which we will include.

Rajib, A., Golden, H. E., Lane, C. R., & Wu, Q. (2020). Surface depression and wetland water storage improves major river basin hydrologic predictions. Water Resources Research, 56, e2019WR026561. https://doi.org/10.1029/2019WR026561

Golden, H. E., Lane, C. R., Rajib, A., & Wu, Q. (2021). Improving global flood and drought predictions: integrating non-floodplain wetlands into watershed hydrologic models. Environmental Research Letters.