

## Comment on hess-2021-71

Anonymous Referee #2

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Referee comment on "Simulation of long-term spatiotemporal variations in regional-scale groundwater recharge: contributions of a water budget approach in cold and humid climates" by Emmanuel Dubois et al., Hydrol. Earth Syst. Sci. Discuss.,  
<https://doi.org/10.5194/hess-2021-71-RC2>, 2021

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I concur with all of the comments provided by the first reviewer, and thus my comments are a bit more limited as reviewer #1 addressed a lot of my most pressing concerns. As currently written (and acknowledging that the authors are revising the manuscript and may be taking this into account), the contributions of this work are decidedly regional. Efforts made to broaden the applicability will greatly increase the applicability of this work; I think discussing implications of some the simplifications on the results would improve the robustness of this work and demonstrate potential applicability elsewhere. More specific comments on this are provided below. Overall, this was a well written manuscript that I think, with some additional analysis, can provide valuable guidance for estimating potential groundwater recharge in data-scarce regions.

### General Comments:

- In response to reviewer #1, comment 5, you provide a helpful table of how calibration results change with different weights in the objective function. You say that the calibration is "moderately sensitive to the weights" – but what implication does this have for the results? Do these results all fall within the sensitivity analyses? The key question here is does changing the objective function change the GWR estimates and trends? Would your interpretations and conclusions change?
- Further to #1, and in line with reviewer #1's comment 4, what effect does the selection of baseflow separation method have on the results? As you point out in the discussion and in the response to reviewer #1 there can be significant variance in baseflow estimates between different methods. If you selected a different method, would the interpretation change? I acknowledge that these analyses may be time consuming, but I think they speak to the robustness of the approach. These baseflow estimates come with such high uncertainty that I feel they should almost be treated as another parameter – how would your results change if baseflow varied?
- I really appreciate how this work can take trends in baseflow (estimated from

measurements at sparse gage stations) and use that to estimate the spatial distribution of potential groundwater recharge across a watershed. However, I think the manuscript would benefit from a more explicit discussion of the uncertainties that propagate through the workflow. Again, this kind of analysis and discussion really helps to make the results more robust and applicable.

- You compare results from this work to results from previous studies – a lot of them spatially-distributed numerical models. Can you provide some idea of how the spatial distribution of GWR compares between them, as opposed to just the mean/variance/ranges? Are you picking up the same high/low recharge patterns? The same temporal distributions? This is hinted at in section 5.1 but I think a more robust comparison would improve the manuscript.

Minor details:

Line 60-61: It is bizarre that the reference that “acknowledges the lack of representiveness of the daily results....” Is from 2007, yet the reference for the model they are acknowledging is from 2010.

Line 80-81: I think this is needed in a lot of places, not just southern QC!

Line 304-305: So it is associated more with the precip trends than with the soil type?

Section 4.4; 1<sup>st</sup> para: This is a rough paragraph to read. I think a table or graph would be more appropriate.

Line 343-344: “somewhat higher” is almost double.

Line 381-382: awkward sentence structure. Maybe provide range in main sentence text (between 89 and 198) and then average in brackets?

Line 387: It is hard to support that this is the novel contribution when you follow it up with the fact that it is supported by a lot of previous literature. I would consider rephrasing this to highlight the specific contribution beyond what the existing literature provides.

Line 399: This is a regional contribution. While significant to those interested in this region, authors should try to focus on the broader applicability and contributions.

Line 439: I generally try to avoid using unquantifiable terms like “good” – how else can you describe this that can be backed up by the results?

Line 490: ‘work’ instead of ‘word’

Line 515: Could this have been interpreted from trends in baseflow? Or does this work provide additional info that goes beyond that provided by baseflow results alone?

Overall, I enjoyed this manuscript and think that the authors are presenting very interesting methodology that could be broadly applicable. Consistent with reviewer #1, I think with major revisions to broaden the applicability, this work could be acceptable for publication in HESS.