

Review of “The global water resources and use model WaterGAP v2.2d: Model description and evaluation” by Müller Schmied et al.

This paper describes the global hydrological model WaterGAPv2.2d and evaluates its outputs. Overall, the paper is well written and a comprehensive model description that will be useful to a wide array of environmental scientists. There is a clear description of the model updates from WaterGAP 2.2 and each of the model components is well described. It is great to see all the model outputs being made available and there is some interesting model evaluation. Overall my comments are relatively minor revisions, however, I have a couple of broader comments on calibration and I do think the paper is too long and that section 7 and 8 need to be significantly shortened or removed.

General Comments

Summary Table. The description of each of the model components is generally very clear and comprehensive. However, it would be useful to have a summary table of parameters, stores and fluxes for each of the models. See for example Table 1 in Brauer et al (2014) (doi:10.5194/gmd-7-2313-2014). This would be useful for a reader to refer to, provide a central place where a lot of the acronyms in the paper can be found (there are a lot of acronyms!) and be very helpful as a summary when comparing models in model intercomparisons. If it cannot fit in the main paper, this would still be useful in an appendix or supplementary info.

Calibration. There are a lot of correction factors applied to the outputs for each basin before a suitable result (defined here as +/-10% of the long term mean annual flow) is obtained. Figure 4 is interesting but the results are not analysed in section 4.9.3 – where do the authors think the major errors are coming from (input data, model process representation) and how does this vary spatially? Given the significant correction factors for a lot of basins, it warrants a discussion on how appropriate the model outputs are for future conditions when you assume that these correction factors remain stationary over time (when in reality they could change depending on what errors they are accounting for!) and the fact that you correct to the mean but do not consider extremes (so how appropriate the model results may be for floods/droughts). It would also be useful to make these correction factors available as part of the standard model outputs (if they are not already).

Model Application. Section 7 and 8 do not add to the paper and both need to be significantly shortened or removed. Currently, the paper is very long and while the material before this is very relevant, the results presented in Section 7 do not provide any new information or significant results to the reader. Section 8 could also be significantly shorter. If these sections were shortened then you could expand a little on the interesting discussion of the future model developments that you discuss in the conclusion and perhaps link this in with broader developments in the GHM community. Furthermore, it would make the paper shorter and more readable for readers.

Code and Data Availability. I understand the difficulties with making the code open source. Do you have a timeline of when it will be made open source and how it will be made open source (for example on a platform like GitHub?).

Appendices and Supplementary Information. It would be worth thinking about whether some of your appendix materials (particularly Appendix D) may be better placed in supplementary material rather than the appendix of the paper.

Minor Comments

Abstract L9. I would replace ‘can be done’ with ‘can be achieved’

Introduction L11. This opening sentence is too long – it needs rewriting.

Introduction L28. What do you mean by ‘proper simulation’?

Introduction L43. It would be good to have some specific references here of where this variant of the model has been used.

Section 3.2.2 L180. Can you provide a reference or website for the Environmental Data Explorer?

Section 4.6 L415. Can you add the specific version of the GRanD database you are using?

Section 4.6 L416. I think ‘Sect. E’ should be ‘Appendix E’?

Section 4.9.1 L621. “to avoid that average water resources are misrepresented” – this isn’t clear as written, can you be more specific?

Section 4.9.1 L634. One of the key outcomes from Coxon et al (2015) was that the discharge uncertainty varied significantly between gauging stations and over the flow range. It may be worth adding a sentence somewhere in the paper stating that you recognise that the discharge uncertainty is unlikely to be stationary in space and time but there are no further data to better constrain the uncertainties at these gauging stations so a representative value of +/-10% is used.

Section 6.4.1. Missing ‘h’ from ‘withdrawals’ in title

Figure 5. I wasn’t sure whether the NSE and logNSE values presented in Figure 5 were calculated based on all the monthly country data or were a median value for each country? It is not clear how it was calculated for these variables.

Section 6.4.2 L785. “is rather satisfying” – I would remove this and just present the results

Section 6.5. Can you attribute some of these improvements in model performance to specific changes made to the model?

Conclusions. An additional development here could be improving the lakes/wetlands and reservoir regulation as you noted this being a limiting factor to good model performance in North America/Canada?