

Nat. Hazards Earth Syst. Sci. Discuss., author comment AC1
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Reply on RC1

David P. Callaghan and Michael G. Hughes

Author comment on "Assessing flood hazard changes using climate model forcing" by
David P. Callaghan and Michael G. Hughes, Nat. Hazards Earth Syst. Sci. Discuss.,
<https://doi.org/10.5194/nhess-2022-84-AC1>, 2022

Reviewer 1 corrections involved changing figures, please see supplement pdf for these figures.

The fact that the hydrology model was a flow routing model (no infiltration) could have perhaps been introduced earlier in the text and Figure 1.

Will correct. The rainfall-runoff routing model is introduced in the first section of section 2, which has been modified to explicitly state the infiltration is taken into account in the climate models by adding at line 81, "models that use rainfall less than that used by processes (e.g., infiltration)". Additionally, within the introduction where the hydrology model is briefly introduced, we change "ROR-style hydrology model" to "flow routing model using rainfall runoff (or excess rainfall) style hydrology model".

What is the "bias correction" in the regional models correcting and how big do these biases get?

Will correct. Bias correction scales the climate projections for the past to improve the fit with historic observations thereby accounting for systematic errors in the projections. The creators of the NARCLIM projections had undertaken bias correction for daily precipitation but not for daily or hourly runoff. Since the bias correction process is detailed and not central to this article, we provided a citation to an article that addresses this question. The change to address this comment is adding the following text after the first time "bias-corrected daily precipitation" occurs (line 101) of "(corrected to observed precipitation distribution; see e.g. Evans et al. 2021). While NARCLIM 1.0 selected CMIP3 GCMs, NARCLIM 1.5 selected CMIP5 GCMs from the unsampled space within NARCLIM 1.0, all with similar temperature increases but spanning the range of precipitation changes from no change to moderate decrease to large decrease (Nishant et al., 2021)."

Evans, J. P., Di Virgilio, G., Hirsch, A. L., Hoffmann, P., Remedio, A. R., Ji, F., Rockel, B., and Coppola, E.: The CORDEX-Australasia ensemble: evaluation and future projections, *Climate Dynamics*, 57, 1385-1401, [10.1007/s00382-020-05459-0](https://doi.org/10.1007/s00382-020-05459-0), 2021.

Nishant, N., Evans, J. P., Di Virgilio, G., Downes, S. M., Ji, F., Cheung, K. K. W., Tam, E., Miller, J., Beyer, K., and Riley, M. L.: Introducing NARCLIM1.5: Evaluating the Performance of Regional Climate Projections for Southeast Australia for 1950–2100, *Earth's Future*, 9, e2020EF001833, <https://doi.org/10.1029/2020EF001833>, 2021.

I see that LISFLOOD is used for very large domains. Perhaps a sentence or two explaining why the hydrologic model is still warranted would fit.

We added the following explanation at the start of section "2.3 Implementation of LISFLOOD hydraulic model" near line 217.

"The LISFLOOD model was limited to the region covering the Gywdir River Floodplain of 8,100 km². LISFLOOD could have been applied across the entire catchment, removing the need for including a hydrology model. While this may be useful in particular situations, for the river valley being investigated, that would require a LISFLOOD model grid covering 2.8 times more area, leading to significant additional computational resources. Consequently, the ROR-style hydrology model provides a trade-off between computational resources and framework complexity."

Figure 2. The colours of the bathymetry and the associated colour bar have me believing that the catchment is stepped.

Changed colour scheme to remove stepped appearance. New figure is shown in supplement pdf.

Figure 2. What are the white patches? Could they be important?

The white patches are areas that have been leveed off for farming purposes. This has been included in the figure caption by adding "The white areas within the hydraulic model grid are grid points surrounded by levees and are unavailable to convey water."

Line 278. The words "flow", "flow rate" and "discharge" are all used in this paper. Is discharge required?

We have changed to discharge throughout the manuscript.

Line 231 and elsewhere. The word "constrain" is new to me in model development lingo.

The word "constrained" was used in the normal English sense, to mean this model was calibrated to existing calibrated hydraulic models. We addressed this comment by adding to the first occurrence of constrain, the following "(to previously calibrated hydraulic models)"

Figure 5 & 6. Wherever differences are plotted, I like the colour scheme to centre around white, with +ve value an increasing shade of red and -ve values a decreasing shade of blue, otherwise it is rather ambiguous.

The colour scheme was changed as suggested, please see supplement pdf.

How many 1D structures were there in the original MIKE models and how big were they? I know we are doing comparisons here but we are also going to the effort of using a hydraulic model

There were no 1D structures in the original MIKE models. This has now been explicitly stated by adding "(channel links without hydraulic structures)" when introducing these MIKE models on line 233.

Please also note the supplement to this comment:

<https://nhess.copernicus.org/preprints/nhess-2022-84/nhess-2022-84-AC1-supplement.pdf>