Hydrology and Earth System Sciences Discussions

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Reply on RC2

Simon Ricard et al.

Author comment on "Producing reliable hydrologic scenarios from raw climate model outputs without resorting to meteorological observations" by Simon Ricard et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-264-AC2, 2022

[RC2 comment: This manuscript seeks to provide a new framework that can use regional climate model projections (CORDEX) to provide reliable hydrological projections. This framework aims to avoid using meteorological forcing data. Although it is an important topic, I feel most of the claimed goals are not well supported.]

We acknowledge that the presentation of a novel methodological framework can raise doubts and suspicions. Our intention with this paper is to provide as much arguments as possible supporting the idea that the framework could be useful to hydrologist assessing the impact of climate change on water resource in a situation where meteorological observations are rare. We are fully aware that the scope of the paper only provides a proof of concept and a partial validation. We are confident however that further work will be conducted to provide a more in-depth comparison with more conventional hydroclimatic modelling approaches.

[RC2 comment: Although the meteorological data is not used, it still requires streamflow observations. I agree that it still uses less data than "conventional" approaches. However, regions with poor meteorological data are less likely to have reliable streamflow observations as well. Therefore, the benefit of this approach is questionable.]

We do not fully agree with comment raised by RC2. An example, in Northern Québec, streamflow data are available at the outlet of some large catchments while almost no meteorological stations are located on the watershed, providing large uncertainty related to precipitation and 2m temperature. Other meteorological fields such as solar radiation, air moisture, and wind speed are also often missing in remote portions of Canada. We believe, in such cases, that the implementation of an asynchronous modelling framework would provides notable benefits in comparison to a conventional modelling approach.

[RC2 comment: Following my comment above, I think the missing part is: under what meteorological forcing data uncertainty levels the proposed framework is more advantageous? For instance, if we have only one precipitation but good streamflow gauges (not sure if that is realistic), the proposed framework outperforms the conventional approaches.]

A comparison could be proposed running both frameworks with intentionally degraded input forcing data. The performance of the asynchronous framework could thus be compared to a conventional modelling approach in relation to an increased scarcity of meteorological observations. The paper rather aimed to compare the performance and projected changes resulting from simulated hydrologic scenarios. We believe both comparison schemes are complementary. The one proposed by RC2 could definitively be investigated in future works.

[RC2 comment: The description of the method requires more details. For instance, in line 170: which parameters are calibrated to minimize nCRPS?]

As stated in section 3.3, the calibration is performed using the same objective function, calibration period, and configuration of the optimization algorithm. Thanks to your comment, we realized that we didn't specify that the same model parameters are calibrated in both frameworks. We commit to clarify this point in the relevant section. However, we think that presenting individually every parameter for each model and their role would make this section wordy, without bringing key information to the study. We commit to add to the manuscript that the reader should refer to the model references in Table 3 for additional information regarding the model parameters.

[RC2 comment: When we are using regional climate model projections/simulations, we tend to be more interested in the long-term statistics, e.g., trends, standard deviations etc. However, only long-term climatology is discussed.]

The analysis is restricted to long term climatology for brevity of the paper. Long term statistic such as trends and standard deviations could be added to the paper and discussed.

[RC2 comment: In the title, "scenarios" and "climate models" make me automatically think about climate change and long-term trends. However, these perspectives are not discussed and/or validated. I would suggest the authors to modify the title and the manuscript to avoid any confusions.]

We believe that the title fits the scope of the paper. We would like if the reviewer could highlight better the confusing elements. Since future climate and hydrologic conditions cannot be directly validated, a diversity of sound methods validated over the reference historic conditions appears to us as the best compromise to attribute confidence in hydrologic scenarios.

[RC2 comment: Finally, I think it should present the optimized parameters to see if they are physically reasonable.]

We did not include a detailed description of the parameter values because the physical interpretation of the global conceptual hydrological model parameters is difficult. Only few parameters could be related to measurable physical quantities. Additionally, the calibration algorithm (the Shuffle Complex Evolution) requires the specification of an upper and lower bound. The parameter values will necessarily lie within the bounds that are forced. Therefore, parameters cannot get a value that is of an order of magnitude different from the ones obtained with a "regular calibration".

Finally, one should expect the parameter values obtained from an objective function that does not consider the temporal correlation to differ from the ones found with a more traditional score like RMSE or KGE. This makes the comparison of the two sets of parameters complex as the same hydrologic model is expected to behave in a different way in an asynchronous fashion.