Hydrology and Earth System Sciences Discussions

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Comment on hess-2021-467

Anonymous Referee #2

Referee comment on "Analysis of high streamflow extremes in climate change studies: how do we calibrate hydrological models?" by Bruno Majone et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-467-RC2, 2021

This paper calibrates a 12-parameter conceptual hydrologic model (HYPERStreamHS) for the 9850-km2 upper Adage River Basin (Italy), using observed data and bias-corrected data of three regional climate models (EURO-CORDEX), for the 1982-2010 reference period. The model is parameterized for the climate model data using (i) the Kolmogorov Smirnov (KS) statistic for the empirical distribution functions of annual extremes and (ii) flow duration curves. The KS test is subsequently used to test if the observed and simulated extremes are drawn from the same probability distribution. The paper also plots the parameter ranges of the 200 best solutions and models future streamflow extremes.

General comments

(1) The first key weakness of the research is that the authors calibrate 12 parameters of a conceptual hydrologic model using just 29 annual daily stream flow extremes. This is, of course, a terrible over-parameterization. The effect of over-parameterization on the streamflow simulations needs to be quantified.

(2) The second key weakness is that there is no evaluation (validation) of the parameterized models with an independent data series. How can we call this reliable and accurate? (Highlights, l.18-19)

(3) Why not present the characteristics (figure, table) of the rainfall extremes of the observations and the climate models?

(4) It is not surprising that the KS test for comparing the empirical distributions of observed and modeled annual flow extremes will give a better result for the model

optimized for these extremes with the KS statistic than for the models optimized with the flow duration curves or with the NSE. However, we can also understand that the KS test has its limitations (see Figure 3), so please present in this light.

(5) The paper is written in a wild wild way. We find Methods in the Introduction, Methods in the Results and Discussion, Introduction in the Results and Discussion, no specific research objectives in the Introduction, inexact language, superfluous text and many repetitions.

(6) In summary, the paper needs to be completely restructured and rewritten in a concise and quantitative manner. Uncertainties stemming from the two key weaknesses (1 and 2 above) need to be quantitatively addressed, metrics and p-values of section 4.1 and 4.2 should be summarized together in one clear table. Expressions such as statistical coherence, forward simulations, extrapolations, 100% confidence bands (!?) need to be defined in the Methods and possibly reworded.

Specific comments (non exhaustive)

l.8: error prone

RC: Please quantify. The majority of your models are accepted, according to your KS p-value.

l.39 Much less ?

l.57: iii) due to the impossibility of obtaining totally unbiased climate simulations there is no a-priori guarantee that simulations fed by climate models produce samples (e.g. time series of simulated annual streamflow maximum) that are statistically coherent with observations.

RC: Your approach cannot address this problem either.

l.61: by directly targeting

RC: non-scientific language

l.64-73: These are Methods

l.66: are constrained to maximize the chances ?

l.67: Statistical coherence

RC: Please define statistical coherence or use another expression.

l.75: Do we really need six references for “goal-oriented”?

l.102: Section 2.2

RC: It would make more sense to present this after Section 2.4

l.111: A similar definition has been introduced for observed streamflow.

RC What writing style is this?!

l.113-119: State your null hypothesis and condense this text.

l.120-125: Does this need a numbered Section?

l.121: daily average

RC: average daily

l.135-158: The efficiency criteria are without the max and min.

l.138: sensitive ?

l.146: repetition

l.162-166: RC: Please condense.

l.171: adaptation ?

l.172: for comparison purposes in order to extrapolate

RC: Now what is it?

l.181: portion ?

l.288: parametric errors,

RC: Without comma and what do you mean? All models are simplifications of reality.

l.233: provide an assessment ?

l.244: the correction used in the reference period 1989-2010 is extended to the period 1980-2010

RC: This is not clear. Is this done by you and if so how?

l.253-257: RC: Methods

l.260: On the other hand

RC: Which other?

l.278: cast ?

l.279-284: RC: Introduction

l.311: coined here as Hydrological Calibration on Extremes (HyCoX)

RC: Repetition

l.326-335: RC: Methods and Introduction

l.370: Fig 3

RC: It will be easier to follow if all metrics and p-values are presented together in Table 2.

l.373: Forward ?

l.377: the 90% confidence interval of the observed ECDF

RC: of the fitted extreme value distribution function?

l.407: Extrapolation ?

l.418: 100% confidence bands ?!

l.429: Furthermore, we verified a-posteriori that the optimal parameters are inside the range of variation.

RC: The methods are unclear. Is this “range of variation” (please use a better expression) for the 40,000 simulations? How can the optimal parameter fall outside the range?

l.440: The differences observed in the optimal value of model parameters are due to structural errors in the GCMs and RCMs

RC: Really? And now we use these errors to make an erroneous hydrologic model, without any independent model validation. One can understand that there are two modelling approaches each with assumptions and uncertainties. So please stick to quantitative evidence.

l.446: Furthermore, our approach provides an answer to the need of reducing uncertainty in climate change impact assessments

RC: Please quantify your uncertainty reduction.

l.452: Marked dashes ?

l.490-594: RC: Please be concise. Answer your research objectives, which you should have stated in the Introduction.