

Interactive comment on “A Multi-Objective Ensemble Approach to Hydrological Modelling in the UK: An Application to Historic Drought Reconstruction” by K. A. Smith et al.

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Authors Response to Anonymous Referee 1

The authors responses are given in a bold typeface.

General Comments

This manuscript is a thorough evaluation and description of a new modeled dataset reconstructing historical flows in the UK. The authors do a good job outlining both the utility and limitations of the dataset they have created. This article makes very good use of graphics to convey complex information about a large number of data points; I

C1

especially like Figure 2. Overall, this is a high-quality paper, with just a few areas that require clarification (see "Specific Comments") or technical corrections (see below).

RESPONSE: We thank the reviewer for their kind words on the manuscript, and are pleased they valued our use of graphics.

Specific Comments

Lines 358-360: The statement about selecting a “best” simulation rather than extracting a mean or median from the ensemble appears to be a very strong statement based only on some qualitative examples. The authors could just say that selecting a “best” simulation is SOMETIMES more accurate than using an ensemble mean. Otherwise, if the authors wish to back up their statement, I think they would need to do a more thorough analysis comparing both LHS1 and the ensemble means (or medians) to the observations.

RESPONSE: Thank you for this comment, we agree completely and will amend the manuscript to indicate that this is a qualitative and possibly case specific statement. E.g. “This indicates that selecting the “best” simulation where a deterministic result is needed is more appropriate, in these cases, than extracting a mean or median from the ensemble.”

Lines 477-479: I don't quite follow the meaning of the sentence “They concluded that . . . eliminate the influence of different PET inputs on runoff simulation.” Does this mean that PET is not an important variable in predicting runoff? Does it mean that the hydrologic models have low sensitivity to small errors in PET? Please clarify.

RESPONSE: This statement implies that the calibration of a hydrological model can eliminate some of the uncertainties that may be derived from the quality of the PET data. PET is a very important variable in predicting runoff, but using poorer quality temperature data PET instead of very high spatial and temporal resolution data is unlikely to significantly affect the streamflow output, as the

C2

calibration of the hydrological model can implicitly account for such errors. The authors will amend these few sentences to be clearer. E.g. "Tanguy et al. (2018) considered the impact of poorer quality and lower density of temperature data on the derivation of the PET dataset that was employed in this study and concluded that, whilst PET is an important variable for predicting runoff, the influence of degraded PET input that result from low quality temperature data on runoff simulation can be limited by the adequate calibration of hydrological models (Bai et al., 2016; Seiller and Anctil, 2016). Thus, the Tanguy et al. (2018) PET dataset is considered suitable for use in hydrological models, especially if they are calibrated to this dataset."

Technical Corrections

Lines 70-73: These sentences are a little confusing, because it is unclear whether you mean the same thing by "hydrological models" and "rainfall-runoff models." Are you saying that your methods are different from those used by Caillouet et al (2017) in France, or that Caillouet et al (2017) is a rare example of the type of analysis you have done for the UK?

RESPONSE: Yes, we mean the same thing by hydrological and rainfall-runoff models. We have replaced references to "rainfall-runoff models" with "hydrological models" for consistency. We mean the latter – That studies such as this, and Caillouet et al (2017), using meteorological data with hydrological models, are rare; Caillouet et al also used a hydrological model to reconstruct flows, but: they used reanalysis data as climate input data where we have used observed data; our calibration and uncertainty analyses methods are different; and our drought event extraction techniques also differ.

Lines 75-6: "They can be used . . . prior to observational network" is an incomplete sentence. Please revise.

RESPONSE: We consider this a complete sentence, but have amended it for clarity:

C3

ity: "They can be used to extend flow records back in time, creating very long sequences that extend back beyond the initiation of the observational network"

Line 125: It is not necessary to state that the catchments are shown in Figure 1, as this was already stated on line 123.

RESPONSE: We have removed this sentence.

Line 193: Please also define "LHS500" in the methods section before using it here. At present, it is not defined until line 212.

RESPONSE: The Sentence has been corrected to: "The upper and lower daily limits of the 500 top ranking parameterisations (see Section 3.4 for details on the ranking process) were used to calculate . . ."

Line 225: Please provide more information about what the Tweedie distribution is.

RESPONSE: Readers may refer to the Svensson et al paper if they are further interested in the distribution, however, the final sentence of this paragraph has been amended to state: "The Tweedie distribution, which is a flexible three-parameter distribution that has a lower bound at zero, has been shown to perform effectively for UK river flows, across a wide range of near-natural Benchmark catchments (Svensson et al., 2017)."

Line 323: Add an apostrophe at the end of "models."

RESPONSE: This has been added

Line 518: Change "catchments" to "catchment's"

RESPONSE: This has been added

Line 523: Change "This contributions" to "The contributions"

RESPONSE: This has been corrected

We thank the reviewer for highlighting these technical errors.

C4

