

## ***Interactive comment on “The transferability of hydrological models under nonstationary climatic conditions” by C. Z. Li et al.***

**Anonymous Referee #1**

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This manuscript describes a study on the transferability of model parameters between periods with different weather conditions (wet/dry). This is an important issue and this study could potentially make a valuable contribution. Here a differential split sample approach is used, which is a suitable approach that would deserve much more use in hydrology. While there are not too many studies following the suggestion by Klemes, the authors might find it useful to relate their study to the few studies using a differential split sample test (e.g. Andreassian et al, 2009; Seibert, 2003). This manuscript could make a good contribution, but needs a significant improvement before publication.

I see a crucial issue, which largely influences the results and conclusions. This is the use of the model efficiency to evaluate model performance. Since the efficiency is using

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the variation in the observed flow to normalize the simulation errors, efficiency values increase with increasing flow variability and thus flow. This means that we get higher efficiency values for the ‘wet’ than for the ‘dry’ periods even if the simulation errors might not differ. Importantly this also affects the conclusion that the transfer from dry to wet results in better simulations than the transfer from wet to dry. This conclusion is counter-intuitive and, as I would argue, a result of the different normalization. This issue needs to be addressed by, for instance, using a different objective function or model performance evaluation.

It is not clear how the authors aggregated the results from 60 catchments with 100 parameter sets each. This needs to be described and motivated more clearly as results can be quite different depending on the aggregation procedure. Are the lower efficiency values in Fig 5, for instance, all from a few catchments or all from the poorer performing parameter sets?

Table 5 presents potentially interesting results which would motivate a deeper analysis. I find the discussion in section 4.3 not easy to follow and I also do not see directly, how the change of parameter values is related to parameter uncertainties. I think parameter uncertainty should be evaluated separately as this would help to interpret the observed changes in parameter value distributions.

I found the section results and discussion very confusing to read, especially because not only results and discussion are mixed, but also some additional methods are introduced. I strongly recommend splitting results and discussion and to move any method descriptions to the methods section.

Minor issues:

What do you mean by the last sentence in the abstract? How should the differential split sample test help to reduce uncertainties? This is something you have addressed in the manuscript, have you?

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I do not understand what the authors mean by the percentages on p8711. From the text I understand that these are the percentages of the long-term mean values. From the values however, these seem rather to be the deviations from the long term mean. The equations for the objective functions are not needed here, they are common knowledge.

There are several language issues and I would recommend the authors to get professional help. Besides grammatical/spelling errors this also refers to awkward formulation such P8703, 14; hydrological models can hardly be described as being important for predicting climate change scenarios.

Please consider formulating the objective functions so that both have the same value for a perfect fit, Fig 5 with better models on the top on the one side and better models on the bottom for the other side, is quite confusing.

Figure 5 and 6, as well as 7 and 8 basically show the same information, which additionally is given in Tables 3 and 4. One presentation for each case would be enough; I do not see the need to show the same info in three versions.

Andreassian, V., Perrin, C., Berthet, L., Le Moine, N., Lerat, J., Loumagne, C., Oudin, L., Mathevet, T., Romas, M.-H., Valery, A., 2009. Crash tests for a standardized evaluation of hydrological models. *Hydrol. Earth Syst. Sci.* 13, 1757–1764.

Seibert, J., 2003. Reliability of model predictions outside calibration conditions, *Nordic Hydrology*, 34: 477-492.

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