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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The influence of conceptual model structure on model performance: a comparative study for 237 French catchments" *by* W. R. van Esse et al.

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The authors thank Dr Juraj Parajka for his positive and constructive comments on the manuscript. We explain below how we will modify the text to account for his comments.

General comments

1) The part of the story related to the comparison of fixed and flexible model structure is not clear to me. Is the intention to test two tools (models)- one having the option to test different structures and one having just a fixed one? Or to examine factors controlling the performance of different structures in general? I do not see a clear difference

between particular model structure within the "flexible" approach and the GR4H "fixed" structure.

Reply: In this study, our main intention is to compare two modelling approaches: the "fixed" approach where the modeller uses a single predefined model structure, versus the "flexible" approach, where the modeller can choose from a number of alternative model structures. As representative examples of these two modelling approaches, we selected the GR4 model and SUPERFLEX framework.

We agree that any particular model structure within SUPERFLEX is, in itself, not much different from the GR4 model structure and could also be individually considered as a fixed model structure. However, GR4 is a well-tested structure that was developed on large catchment sets to improve its generality and average performance, which was not the case for the SUPERFLEX structures. Besides, GR4 is quite widely used in France, where the test catchments originate. So we found it interesting and relevant to use the GR4 model as an example of a fixed structure. On the other hand, the SUPERFLEX structures are built to differ in a controlled way, which enables meaningful model comparison.

The comparisons reported in this paper provided interesting insights into the differences between the two approaches, and helped investigate whether the relative performance of the fixed and flexible model structures could be dependent on catchment characteristics.

These two objectives will be better explained in the "Scope" part of the introduction.

2) I would suggest to extend the results section (instead of a brief description in the discussion) and to show in more detail the factors controlling the (in)consistent and poor model performance. This part is very interesting and highly relevant for recent Panta Rhei decade.

Reply: We agree that the identification of the cause(s) of model failure and inconsis-

tencies can greatly help in the process of model improvement and is consequently of major practical interest. However, we found it quite difficult to clearly identify the reasons for model failure and/or inconsistency. This would require a deeper investigation of each individual catchment, which was not an objective of this study, where we instead focused on a very large number of catchments. However, as explained in the paper, the information considered in this study suggests some possible sources of failures, including (1) large differences in climate conditions between calibration and validation periods in catchments with a large groundwater contribution; (2) flashy flow in response to extreme rainfall events; and (3) influences/errors in flow measurements, particularly during low-flow conditions. This aspect has been investigated in more detail in the master thesis of Van Esse (2012). As suggested by the reviewer, we will incorporate these findings into the manuscript.

3) For a more direct comparison with other studies, it would be interesting to indicate how to translate the CR1-CR4 criterion to a commonly used volume error and Nash-Sutcliffe efficiency.

Reply: The combined CR1-CR4 criterion is an aggregation of four criteria including the Nash-Sutcliffe criterion and the volume bias. We preferred to use this comprehensive criterion to get a more general overview of model performance. Although the aggregation inherent in the CR1-CR4 criterion hides the differences between the individual four criteria, we found that similar differences between model performance could be observed in the distinction between poor and good models. This will be briefly commented on in section 2.4.2.

Specific comments

1) Table 2: Some of the names of classification categories are potentially misleading. For example, I would suggest to use "larger" catchments instead of large (as 600km2 is relatively small to some e.g. 100000km2 catchment). Why not to use the Aridity instead of Wetness Index?

Reply: This is a good point. We agree with the reviewer and will use a relative terminology to avoid confusion.

In the literature, two definitions of the aridity index are used: either the ratio between mean potential evapotranspiration and mean precipitation, or the inverse. Here we used the second option and referred to it as the “Wetness index” (which increases with precipitation) (see section 2.2). Following the suggestion of the other reviewer, we will change that to “Humidity index”.

2) p.6, l.20: this sentence is not clear: "water might be lost to potential evapotranspiration."

Reply: We meant that, in the summer period, potential evapotranspiration is high, and hence, in conditions of high water availability, actual evapotranspiration will also be high. The sentence will be clarified.

3) Discussion: It would be interesting to provide some comments, how to select a right model structure for particular climate/catchment conditions.

Reply: We agree that, from a Prediction in Ungauged Basins (PUB) perspective, finding a correspondence between catchment types and model structure is of particular interest. Following the two reviewers’ comments, this issue was investigated further, and a new sub-section will be added to report the results of these investigations. Unfortunately, it was quite difficult to find fully convincing relationships.

Cited references:

Van Esse, W. (2012). Demystifying hydrological monsters. Can flexibility in model structure help explain monster catchments? Master Thesis, University of Twente, The Netherlands; Irstea, France; Centre de Recherche Public – Gabriel Lippmann, Luxembourg, 100 p.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 5457, 2013.