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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 influence of conceptual model structure on model performance: a comparative study for 237 French catchments

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Overview

The paper explores the effects of model structure on model performance for fixed and flexible model structures, and for a variety of catchment types across 237 French catchments. They conclude that flexible model structures perform better on average, com-

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pared to the one well-tested fixed structure that they tried. They identified particular elements of the models which contributed to good model performance, and particular types of catchments for which better model performance is expected. They identified some model structures which were consistently outperformed by other model structures. They did not conclude that any particular model structure was more suited to some types of catchments than others. I found the paper an interesting read, and think that it answers some interesting questions.

Main points

1. 5459L22 “Several examples of fixed models’ failures have been described in the literature” It would also be useful to cite the work using diagnostic signatures to infer model structure, since these papers can be used to infer that some model structures are inconsistent with observed hydrological responses (inconsistency between data and model structure is a type of model failure). Some recent examples I am familiar with are Euser et al (2013) and McMillan et al (2011).

2. 5459L27 “Given that model structural errors are often a first-order source of uncertainty,” This statement needs some clarification, referencing or further argument to support it. My (admittedly highly selective) personal experience is that the greatest contribution to uncertainty in model output is from uncertainty in precipitation amount, and the second greatest is from the conceptualisation and quantification of subsurface (‘slow’) flow characteristics. Of course the authors may have quite a different view, and I would encourage them to explain briefly why they see model structural errors as so important.

3. 5462L5 Are any of the 237 catchments significantly influenced by lakes or snow fields? If not, this would be helpful to state. It would also help with interpretation of the scope of the classification proposed here. As an example, in cold climates with mainly winter precipitation, we expect low winter runoff coefficients (precipitation is mainly stored as snow) and high summer runoff coefficients (river water sourced mainly from

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summer melt). This would confound the interpretation of seasonal runoff coefficients in terms of groundwater.

4. 5462L8 There is potential redundancy in using both permeability and the ratio of seasonal runoff coefficients. I would expect both of these to contain information on groundwater dominance. Do the authors have evidence to show that they are distinct, and therefore both needed?

5. 5462L16 Where you say "when runoff compared to rainfall is high in summer," do you mean relatively high in comparison to winter? I guess the wording is difficult, because the highest values of the ratio are only 0.24. Or are you presuming a particular type of climate seasonality for all 237 catchments? (e.g. wet winters and dry summers?)

6. 5463L22 "Potential evapotranspiration is systematically corrected with a calibrated ratio to fulfil the water balance." I have several questions about this. Does this means of correction imply that there may be interdependence between Ce and other parameters? (since the water balance depends on actual ET, and actual ET depends on both the PET and the model parameters). Does this correction mean that the rainfall data is assumed to be more reliable than the PET data? Does it also mean that there is no significant inflow or outflow of groundwater across the catchment boundaries, or that the groundwater flux parameter (F for GR4J) is known?

7. 5468L25 "the lag-function and the interception and riparian zone reservoirs do not increase model performance on average, which questions their usefulness." That must surely depend on the purpose of the modelling. If the purpose of the model is to evaluate the impact of changing the vegetation from trees to grass, then having an interception reservoir may be extremely useful, even if it is not as accurate as other models. On the other hand if the purpose of the model is to generate synthetic flow data, then I agree those features may not be at all useful.

8. 5469L11- In discussing Figure 4 or later in the Discussion section, it may be useful to refer to place these results in the context of the recent paper by Parajka et al (Parajka,

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J., Viglione, A., Rogger, M., Salinas, J. L., Sivapalan, M., and Blöschl, G.: Comparative assessment of predictions in ungauged basins – Part 1: Runoff hydrograph studies, Hydrol. Earth Syst. Sci. Discuss., 10, 375-409, doi:10.5194/hessd-10-375-2013, 2013.)

9. 5469L25 "Figure 4c shows that model structures with two reservoirs in series (SF03–SF07) perform better on impermeable catchments than on semi-permeable or permeable catchments." Yes, but does a different model structure do a better job for semi-permeable or permeable catchments?

10. 5470L8 Does the classification by RC_S/W lead to markedly different conclusions than the classification by permeability? It is interesting that for SF04-07 the contrast between impermeable/permeable in Fig 4c is almost identical to the contrast between groundwater/direct runoff in Fig 4d.

11. 5474 The Conclusion does not comment on the relationship between catchment properties and selection of appropriate model structure(s), and this leaves me wondering how to apply the authors' findings. What did the authors conclude from their assessment of Figure 4c/4d? Are some model structures better suited to some types of catchment than others? Given a new catchment, how would the authors select a model structure? What more needs to be done to answer this question?

Minor points

12. 5458L16 "disturbances in low flow measurements." Not sure what this means

13. 5459L12 "apply it on his case study" I would say "apply it on their case study"

14. 5462L8 I think the Wetness Index would be better termed Humidity Index or Aridity Index (its reciprocal), to avoid potential confusion with Topographic Wetness Index.

References:

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McMillan, H., M. Clark, W. Bowden, M. Duncan, R.Woods (2011). Hydrological field data from a modeller's perspective: Part 1. Diagnostic tests for model structure. Hydrological Processes: 25(4): 511-522

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