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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Technical note: "Bit by bit": A practical and general approach for evaluating model computational complexity vs. model performance" *by* Elnaz Azmi et al.

Anonymous Referee #2

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Summary: As the title suggests, the authors present a practical approach to evaluate model computational complexity vs. model performance.

Comments: this is suitable technical note. I however wouldnot so easily agree with the authors' claim that their approach is a general approach if they mean in terms of its theoretical underpinning. General perhaps in terms of how easily it can be applied. Nonethess this is an interesting article that readers can learn from and apply the methodology in diverse settings. Following are my comments in detail.

- How max parsimony + max performace -> max generalizability? Theoretical rigor behind the claim in missing

- Concept of information loss assumes full specification of the data generating process, which often is not the case in hydrological modeling. Please elaborate further how this is dealt with

- In this context thinking of models as compression algorithms of data is shallow in its treatment of what complexity means in terms of learning from patterns, especially when patterns are generated from complex data generating process. I can understand the concept being a good one in describing model complexity appropriately when we know the data generating process and are playing with its approximations and trading that off with information loss incurred by the approximations. So the authors claim of universality is overdone in real world hydrological systems, perhaps it may work in Shannon's communication systems.

- Related to the above, it is for this reason that synthetic cases may be easier to demonstate. Author's claim to universality should first provide a rigorous theoretical treament that has not even been provided in the WRR paper that the authors allude to.

- That is the reason why the authors attempt to extend it to real world case studies is not constructive unless the error model of the residuals is completely specified (or known).

- I am not at all clear how computational complexity is linked to inference. This is where the paper lost me in its attempt to connect this paper to their earlier WRR paper. Here while authors talk about inference without reference to predictive performance, no clear theory on how computational complexity is linked to generalizability is given.

- Even if 'generalization' laws have been found, how good they are depend on how well they hold on unseen data, i.e. predictive uncertainty

- I was totally lost in the philosophical arguments at the end of the introduction paper. Please delete, it appears to have been placed to impress the reader. I am reacting to it in quite an opposite manner

- the way Prob for entropy measure has been calculated is in itself a model that depends on the choice and number of bins. That has implications for how well Prob has been estimated from limited data in terms of how such frequency estimates converge to true Prob (ie it has its own complexity challengs) that the approach so very much relies on. Perhaps this can be discussed in bit more detail.

Finally two major comments:

- the authors should show predictive performance to demonstrate generalizability. Or validation, even if in narrative form, by comparing their conclusions with what other authors, not linked to information theory applied to water, have said.

- the authors again need to place their finding in the landscape of other complexity studies, especially in modeling MOPEX catchments, in hydrology. How do their conclusions regarding complexity compare with the narrative presented here? This will only add value to an already large literature set of hydrological model complexity, esp wrt to streamflow..

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