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Hydrology and Earth System Sciences
Discussions

Interactive comment on "PERSiST: the precipitation, evapotranspiration and runoff simulator for solute transport" *by* M. N. Futter et al.

M. Hrachowitz (Editor)

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Dear Martyn & co-authors,

Thank you very much for your detailed response to the initial reviewer comments. From my view, this helped to clarify many of the concerns. In particular the clearer outline of the objectives was very helpful. As I now understand, the main objective of the paper is to provide a flexible modelling framework that is customized optimized for the use with INCA-family models, which I find in fact a very good idea, given the popularity of INCA and its lack of consistent (i.e. comparable) input information. That for itself can be seen as quite a strong justification of the manuscript, if well argued in the introduction. I am also glad that you were able to significantly reduce the number of free calibration

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parameters and that you made it clearer that you essentially approach calibration as a multi-criteria problem using the runoff of several sub-catchments, which potentially already rejects many parameter sets as unfeasible.

There remain, however, still some points which need more clarification, also due to misunderstandings (mostly in terminology) between you and the reviewers. For example:

(a) Reviewer 1 raised the question in how far Persist is flexible (Comment 3; but also Comment 2 of Reviewer 3). It is one of the baselines of this manuscript but it is not sufficiently documented what can be changed in the model set-up, how this relates to physical characteristics of catchments and what the sensitivities of these different set-ups are. This needs to be made much clearer and more explicit. In comparison, the flexibilities of model structures included in frameworks such as SUPERFLEX or FUSE are well illustrated and documented in the relevant publications and also needs to be shown here (although not necessarily to the same extent). Also: which candidate model structures were tested and which were eventually chosen?

(b) Reply yo Reviewer 1, Comment 8 (relates to the previous point): in my understanding the reviewer related the statement "as simple as possible but no simpler" to the complexity of the model structure and thus to the degrees of freedom (i.e.number of parameters), rather than to the method of solving the given ODEs. That a model is "as simple as possible but no simpler" therefore needs to be shown by increasing/reducing the complexity (degrees of freedom) of this model (which was not done). Only if additional complexity then does not result in significant model improvement - in particular for prediction - it can be inferred that the model "is as simple as possible but no simpler" (e.g. Fenicia et al., 2008, "Understanding catchment behavior through stepwise model concept improvement", WRR)

(c) Reply to Reviewer 3, Comment 1: DYNAMIT is a recently presented flexible, semi-distributed, conceptual, integrated rainfall/runoff-solute transport modelling framework,

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which would nicely fit into the comparison of existing models ("Persist and other models"; Hrachowitz et al., 2013, "What can flux tracking teach us about water age distribution patterns and their temporal dynamics?", Hydrology and Earth System Sciences 17, 533-564).

(d) Editor comment 4: I agree, in the (likely) presence of data and/or model structural errors, no feasible parametrizations may be found. This is, however, not what I meant with my comment. The comment was rather aimed at the fact that a mathematically optimal solution (irrespective of the actual value of the performance measure) is, in the presence of data and/or structural error NOT the hydrologically optimal solution. In other words, we fit our wrong models, which are forced by wrong data to wrong output. How can then the mathematically optimal solution to this problem be the "right" solution? Using multiple calibration objectives and criteria (which you have partly embraced by using several gauging stations) can then help to at least reject the most unrealistic mathematically optimal parameterizations. A further feasibility test for these parameterizations would be to assess their predicitive capability: if a parameterization accepted as feasible during calibration cannot reproduce streamflow in a validation period, it is quite likely that this parameterization is less realistic and only achieves good calibration performance through mere curve fitting rather than correct process representation.

(e) Reply "Persist and other models" I like this summary and ideally Persist should be put into context like this in the revised manuscript as well, highlighting differences and similarities to other approaches. Just a minor note: It is true that chloride is not conservative, but the Shaw et al. (2008) paper was meant to illustrate integrated modelling approaches irrespective of which tracer/solute was used.

Looking forward to a further interesting and fruitful discussion,

Best regards,

Markus Hrachowitz

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 8635, 2013.