Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2018-332-RC1, 2019

Geoscientific Model Development Discussions

Open Access

Interactive comment on "Modular Assessment of Rainfall-Runoff Models Toolbox (MARRMoT) v1.0: an open- source, extendable framework providing implementations of 46 conceptual hydrologic models as continuous space-state formulations" *by* Wouter J. M. Knoben et al.

P. Kraft (Referee)

philipp.kraft@umwelt.uni-giessen.de

Received and published: 6 March 2019

Standard questionaire

1. Does the paper address relevant scientific modelling questions within the scope of GMD? Does the paper present a model, advances in modelling science, or a modelling protocol that is suitable for addressing relevant scientific questions

within the scope of EGU? *Yes*

2. Does the paper present novel concepts, ideas, tools, or data? *Yes*
3. Does the paper represent a sufficiently substantial advance in modelling science? *Yes, but needs improvement (see general comment)*
4. Are the methods and assumptions valid and clearly outlined? *Mostly (see general comment)*
5. Are the results sufficient to support the interpretations and conclusions? *Yes*
6. Is the description sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? In the case of model description papers, it should in theory be possible for an independent scientist to construct a model that, while not necessarily numerically identical, will produce scientifically equivalent results. Model development papers should be similarly reproducible. For MIP and benchmarking papers, it should be possible for the protocol to be precisely reproduced for an independent model. Descriptions of numerical advances should be precisely reproducible. *New software is completely accessible as free software. The methodology is well described*
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? *Yes, with few exceptions (see specific comments)*
8. Does the title clearly reflect the contents of the paper? The model name and number should be included in papers that deal with only one model. *Yes*
9. Does the abstract provide a concise and complete summary? *Yes*
10. Is the overall presentation well structured and clear? *Yes*
11. Is the language fluent and precise? *Yes, as far as I can tell (not a native speaker)*

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? *Not really – see specific comments*

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? *Ch. 5.3.3 needs more details*

14. Are the number and quality of references appropriate? *Yes*

15. Is the amount and quality of supplementary material appropriate? For model description papers, authors are strongly encouraged to submit supplementary material containing the model code and a user manual. For development, technical, and benchmarking papers, the submission of code to perform calculations described in the text is strongly encouraged. *The supplemental material is outstanding*

General Comments

The authors have completed a great task: translating 46 model structures into a clean system, where equations and solver are separated and suitable to be used with an implicit solver scheme is a great accomplishment. I tried quite a while ago something similar for only a few models with CMF, which has a similar base structure as MARMMoT. I gave up to mimic existing models, since the abundant mixture of model code, flux equation and ad hoc solution schemes in existing models makes it extremely difficult and tiring to translate them into a clear set of ordinary differential equation. This translation of existing models into a common scheme is a new feature of MARMMoT that is not available for more abstract model building frameworks like SUPERFLEX, CMF and SUMMA.

For this reason, I would be very happy to see this study published and I agree with the authors concerning the great potential of such a unified model collection for future studies. However, for future applications, the users must know how much the newly constructed models really resemble the original work. The authors state, that they needed to make assumptions, changed processing orders and smoothed discontinuities to make existing models fitting into the new structure, but the discussion about the effects of these changes in chapter 5.3.3 is shallow and not covered by data. If I use "m_37_hbv_15p_5s", how similar are the results compared with the original HBV-96? What kind of quality control did you use to ensure the correctness of the translation? From my experience with abstract model formulations in CMF even extremely small changes can lead to suprising strong changes of the overall behavior, therefore I deem a more detailed discussion on the effects needed for a better article. The perfect solution would be to include a graph of RMSE (MARMMoT vs. original model result) for good parameter sets. If this requires too much work, I would at least expect such a comparison for 2 or 3 strongly changed models and for 1 or 2 lightly changed models in combination with an additional column in table 1, that indicate the deviation from the original model code for models.

Another concern that I have stems from the following: Deviations between equation implementations in code and their published version in "math" can easily differ – the authors suffered from this problem themselves. Hence I would be very interested if they found differences between model publication and implemented model code in their list of original models and how they dealt with such differences. And finally, what kind of quality control measures they took, to ensure that their implementation is in fact equivalent to the original implementation und does not differ strongly by new bugs or the correction quirks from the original model.

Specific Comments

P 3 L 14: FARM does not fit into this listing, please remove

P 3 L 18: CMF falls for this comparison rather into the same category as SUPERFLEX, since you can build conceptual models as well as physical models and things in between. A reference for a “SUPERFLEX”-like usage of CMF is Jehn et al. 2018 https://doi.org/10.5194/hess-22-4565-2018

P 3 L 32: The benefits of MARMMoT are explained a bit too enthusiastic – especially the “best practice” part about the solvers, in comparison to the discussion on that topic. I would also expect a clear note about the boundaries of MARMMoT’s scope (eg. only lumped models, no internal ET calculation etc.)

P 5 L 5: Implicit schemes can fail if the time step size is too large for the non-linear solver to converge. How does the solver in MARRMoT deal with this? Is there an internal dynamic time step?

P 5 eq. 2: The equation is wrong, must be changed to $Q_o = Q_i \left(1 - \Phi\left(S, S_{max}\rho_s, \varepsilon\right)\right)$ (see source code: eg. infiltration_3.m:21,23,25 interflow_11.m:23,25,27), otherwise the names inflow and outflow do not make sense. An adhoc implementation of this equation shows that the parameter $\varepsilon = 5$ does not prevent $S > S_{max}$. A longer discussion on that can be found at this gist: https://gist.github.com/philippkraft/aae02d23fbdad62f98a413ab04fe6d83

P 11 L 7: Implicit solvers are usually error controlled. Which kind of tolerances (relative and absolute) are used in the solver? And how does the solver react, if a solution within the error boundaries is not found? I understand the text, that at least fsolve can return values with an unspecific error tolerance (I guess in situations where some convergence criteria are missed)

P 11 L 23ff: Since the comparability of the MARMMoT functions with the original model is the major feature of this study, I would expect a discussion on this topic that is deeper, completer and more explicit. See general comment.

Table 1: Add columns that indicate the type and level of deviation between the original source and the implementation in MARMMoT (eg. spatial generalization, change of solution order, introduction of smoothing functions, generalization of timestep, etc)

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-332, 2019.