Geoscientific Model Development Discussions

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Reply on RC3

Robert Schweppe et al.

Author comment on "MPR 1.0: a stand-alone multiscale parameter regionalization tool for improved parameter estimation of land surface models" by Robert Schweppe et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-103-AC3, 2021

We would like to thank the reviewer for her/his time and effort in revising our manuscript and the provided comments. We address her/his comments below. Reviewer comments are *italic*.

Brief summary of the paper

The paper presents descriptions of stand-alone tool that aims to assist hydrologic modelers with parameter regionalization through Mulit-scale Parameter Regionalization method (Samaniego et al., 2010). The paper also provides examples of distributed soil parameters computed with this new tool and applied a few hydrologic and land surface models and their impacts on the water flux (ET) simulations.

Overall comments

First of all, I recognize the great potential of MPR approach for distributed parameter estimation for various environmental models, and because MPR was imbedded into mHM system originally, it is a good to make MPR routine stand-alone routine and make them generic tool so that MPR can be used for the other models. The paper's motivation is clear.

We appreciate that the reviewer fully understands our motivation to write this model description manuscript.

That being said, real challenge in MPR approach is 1) how to determine useful geophysical predictors, 2) how to determine a transfer function for each model parameter and 3) how to determine appropriate scaling operators so that fluxes from various spatial resolutions match over the larger areas. I wished to see how this stand-alone tool could help to tackle those challenges (particularly challenge 2 and 3), and wonder if the authors could discuss more about these. I did see brief statements in line 87-88, page 3– "Emerging methods for the development of TFs do exist (Klotz et al., 2017; Feigl et al., 2020; Merz et al.,2020). MPR provides the interface to link these tools to distributed environmental models". I am really curious how this tool can interface with the tool that optimize transfer function form (if possible).

The reviewer has an excellent understanding of the MPR method and we share the same curiousity. We want to address the questions outlined by the reviewer and to do so, we need a flexible and easy to use implementation of MPR. This implementation is presented

in the current manuscript. It goes beyond the scope of the manuscript to present how this implementation of MPR can be used in a parameter and transfer function optimization. We are working in this direction and will expand the section outlined by the reviewer. First preliminary results can be found in Feigl et al. (2021, only in german).

After I read the paper, I felt the paper is about software design leaving out important MPR concept, probably due to the length of section 3 where lots of technical descriptions of the code are described. Therefore, I would suggest focus more on the capability of this tool for parameter estimation. I think this is the biggest issue for this manuscript.

We would like to thank the author for this comment. As this is a model description manuscript (we submit this manuscript as model description type to GMD), we followed the advice provided by GMD on this type of manuscript (https://www.geoscientific-model-development.net/about/manuscript_types.html#item1, access: Sep 22nd 2021). To our understanding, we provide the very detailed description of the MPR implementation to follow the requirements for this paper type. The concept is introduced in the introduction (l. 48ff.). This paragraph also contains the references to Samaniego et al. (2010, WRR) and Kumar et al. (2013, WRR), which provide a detailed introduction of the MPR concept for readers who are interested.

In summary, I think the author did excellent job developing tool, but the paper itself requires major revisions so hydrologic modelers (who are not likely to be software engineers) could follow better. I would provide some more comments bellow.

Specific comments

I think introduction is overall good.

We would like to thank the reviewer for this comment.

Most descriptions in the section 2 are appropriate except for section 2.4. I am not sure if section 2.4 is really important— especially some lengthy discussions on netcdf (line 188 – 195). Also, some shorter version of the second paragraph (L197 – 205) can be moved to section 3?

Following this comment and the advice from reviewer 2, we moved Section 2.4 into section 3.

Section 3.2. I think it is important to show the parameter estimation needs to consider parameter dependencies, but an example provided here may be over-complex due to lengthy descriptions of requirement of broadcasting array if coordinates in two data array do not match (I am not sure if the user needs to understand this or the tool does this behind scene). My suggestion would be to emphasize parameter dependencies (could be one soil parameter example; e.g., baseflow coefficient may be related hydraulic conductivity, may be helpful) and the tool can provide flexibility to define parameter dependencies.

We will explicitly mention parameter dependencies in Section 3.2. and highlight that MPR allows to account for parameter dependencies. Please see also the attached Figure showing the parameter dependencies.

Section 3.3. I think this is where I have trouble in this paper. This section focuses on the software design. I am not sure if readers (most likely hydrologic modelers) need to understand detailed information on how software works at the code level (e.g., connections between objects). Section 3.3.4 and section 3.3.5 are core part of MPI, so I would think I would replace the current descriptions with the flexibility and capability of

the tool to form transfer function and scaling operators.

We thank the reviewer for this comment. We expect two groups of interested readers. First, model developers for which it is important to know that MPR can be used as a library. For this group, the overview of the different objects in MPR is required. Second, hydrologic modelers for which these details might be not needed. For this group, we will improve the readability by making more references in the text to either Fig. 1 or Fig. 3, which provide an example work flow of MPR, to provide more guidance to the reviewer through these Sections.

Section 4.5. It is important to discuss computational cost associated with use of high-resolution geophysical data over a large domain (e.g., continent or global), but other discussions appear to be unnecessary.

As suggested by the reviewer, we will shorten this paragraph by removing all bullet points but the first one and we will remove the paragraph on compiler compatibility.

References

Feigl, M., Herrnegger, M., Schweppe, R. et al. Regionalisierung hydrologischer Modelle mit Function Space Optimization. Österr Wasser- und Abfallw 73, 281–294 (2021). https://doi.org/10.1007/s00506-021-00766-0

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Please also note the supplement to this comment:
https://gmd.copernicus.org/preprints/gmd-2021-103/gmd-2021-103-AC3-supplement.pdf