Geoscientific Model Development Discussions

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Comment on gmd-2021-103

Anonymous Referee #3

Referee 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-RC3, 2021

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.

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).

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.

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.

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?

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.

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.

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.