

Interactive comment on “Multiobjective calibration of the MESH hydrological model on the Reynolds Creek Experimental Watershed” by A. J. MacLean et al.

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We would like to thank Dr. Zehe for the constructive comments and in general, we agree that our manuscript should undergo some revisions to address the concerns. For the comments that are most significant, we provide a response below.

Major point 1). The MESH model does not solve the coupling problem Dr. Zehe points out and we never intended to suggest that the model has solved this problem. We will provide additional detail on the “routing scheme”, change the terminology and acknowledge that the coupling approach in MESH, like other models, is imperfect.

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Major point 2). Clearly, the NASH metric is not a perfect way to assess model performance and as another reviewer pointed, is more questionable with SWE data. We will reconsider our use of the NASH metric in our revised manuscript (new calibration runs are being conducted for the revised manuscript) and investigate the use of a seasonal NASH. For example, Garrick et al. (1978) present a modified NASH criterion that is essentially equivalent to the suggestion by Dr. Zehe.

Major point 3). In terms of considering different calibrations on different processes and state variables (like energy fluxes and soil moisture) we agree that more investigations would be better given the data-rich case study we are modelling. Unfortunately, it is simply beyond the scope of our current manuscript (and current resources) to conduct additional calibrations to more measured data series. The 15 calibration runs we plan to repeat (with a longer calibration period) will take approximately 5+ days each of computation time to complete (although many of these runs will be completed in parallel). Additional runs we are considering in response to reviewer #1 will take a few days to set up, 5+ days each to run and then additional time to interpret and summarize results. Considering a single different calibration scheme would require at least as much time as the additional runs above, more calibration schemes are simply not feasible for us to complete. Instead, we can modify the manuscript to clearly state some of the future modelling/calibration runs that should be conducted for this case study in the future.

Major point 4). As per the comments of other reviewers, details of the model parameters calibrated (ranges, initial values, final values etc.) will be added to the revised manuscript. The results will be presented in a way so as to indicate relative sensitivities of model parameters. Furthermore, we will give some indication as to whether the model parameters are measurable at the point scale. Note that as Dr. Zehe seems to imply, it is practically infeasible to measure physically-measurably parameters at the scale which is simulated (e.g. GRUs covering many km²). As such, calibrating these physically-measurably parameters can be a reasonable approach.

We agree with and believe it is fairly straightforward to address the remaining minor

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technical points made by Dr. Zehe in the revised manuscript and final response.

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