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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Multiobjective sensitivity analysis and optimization of a distributed hydrologic model MOBIDIC" *by* J. Yang et al.

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Dear Reviewer,

We thanks for your comments on our manuscript. These comments will be very valuable to improve this manuscript. Below is our reply to your comments:

1. [line 17, p. 3510] The authors state "a factor can be a model parameter or a group of model parameters". When they say, a "group": do they mean both spatially distributed parameters, and sets of spatially distributed parameters? This could use clarification.

Our reply: It could means both, but the case study refers to the first. We will add "(e.g., a group of distributed model parameters with same parameter name, in this study)"at

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the end of this line.

2. [line 19, p. 3512] The authors' methodology screens out and excludes certain model parameters. The authors should review and cite vanWerkhoven et al (2009), Advances in Water Resources. The van Werkhoven study showed that if the wrong metrics were used for reduction of parameters, the Pareto sets can drastically change.

Our reply: We will cite this paper.

3. [section 3.2] In this section, the review by Efstratiadis and Koutsoyiannis (2010), Hydrological Sciences Journal, should be cited. Additionally there is a typo in the second reference to Kollat and Reed.

Our reply: We will cite this paper and thanks for pointing out the typo.

4. I commend the authors on comparing the results to single objective optimization (equation 6).

Our reply: Thanks.

5. I would recommend some more discussion of Figure 3. Why was it that the factors look like they are appearing in "groups"? I found it difficult to interpret the results of this figure.

Our reply: This phenomenon ("group") exists for SRMSE and MARD, not for WBI. Factors in the same "group" shows similar sensitivity to the objective function. I will add the discussion in the revision.

6. Several comments about the multiobjective calibration: 6a. When the authors say "converged" what do they mean? They do this both for the SOO and MOO results; mathematical convergence to the true optimal solution cannot be proven.

Our reply: For "Converged", we mean it met the stop criteria (e.g., difference in objective functions between two consecutive iterations smaller than a given value) given by the users to let the optimization algorithm know when to stop. This is general practice

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in optimization though the true optimal solution cannot be proven.

6b. The authors claim eNSGAII took more model simulations. This seems like an obvious result – eNSGAII is a population based technique for finding solutions to multiple objective problems. It's like comparing apples and oranges, so to say.

Our reply: It is obvious but it still gives some readers how different these two algorithms are in terms of computational cost.

6c. What were the eNSGAII parameters? Injection rate? Initial population size? This is going to affect the computational efficiency (see 6b).

Our reply: The eNSGAII parameters were set to the recommended values by the developer (Dr. Patric Reed's group), and the initial population were generated with Sobol quasi-random sampling technique to gain a better coverage of parameter space. We will add this in the revised version.

6d. Was the MOO optimization repeated for multiple random seeds? Was the single objective optimization repeated for different starting points? This is standard practice, and if the authors did not do this it may call the optimization results into question. For example, they claim "Nelder-Meld [...] was dependent on starting point" [line 4, p.3521]. This implies that they tried multiple runs, but I'm not sure.

Our reply: The result listed in the paper is based on MOO run from one random seed and SOO run from one starting point. We made the claim "Nelder-Mead [...] was dependent on starting point" [line 4, p.3521] for the reason: comparing with SOO for objective function Eq. 10, the eNSGAII (MOO) obtained a better solution than Nelder-Mead algorithm, and we believe Nelder-Meld algorithm will achieve e-NSGAII's optimal solution when the starting point is close to e-NSGAII's optimal solution. And this was just confirmed with a trial we did for this comment.

6e. If they did NOT try multiple runs, one justification for this is the computational time that the simulation model takes to run. However, this changes the tone of the study a

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bit. Now, the use of eNSGAII is to just get good parameter sets – you can't make as many claims about convergence if you don't repeat the study several times for multiple random seeds.

Our reply: See our reply to 6d and 6a. And for eNSGAII, we used the knowledge from its previous studies (see introduction of eNSGAII in section 3.2).

7. In the results, is there an approach to choose one solution, and navigate the trade-offs? The authors may want to refer to Kollat and Reed, 2007, Environmental Modelling and Software for one possible approach. One criticism of multiobjective calibration is that users can eventually only use one parameter set, so approaches should be designed to try to facilitate that choice of parameters.

Our reply: We will cite the software VIDEO in Kallot and Reed (2007) in Section 3.2. And just a note: this paper shows how MOO result can be converted to SOO result by assigning different weights to these objective functions without further optimization.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 3505, 2014.