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Hydrology and Earth System Sciences Discussions

Interactive comment on "How effective and efficient are multiobjective evolutionary algorithms at hydrologic model calibration?" *by* Y. Tang et al.

Anonymous Referee #3

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General Comments: The overall quality of this paper is excellent. The study contributes a very comprehensive comparative analysis of three, multi-objective evolutionary algorithms (ϵ-NSGAII, SPEA2 and MOSCEM-UA) in the context of hydrologic model calibration. The paper is clear, well written, and it meets the standards I expect for publication in Hydrology and Earth System Sciences (HESS).

Questions: 1) Does the paper address relevant scientific questions within the scope of HESS? YES, the two hydrologic model calibration test cases will be of interest to readers of HESS.

2) Does the paper represent novel concepts, ideas, tools, or data? YES, I believe this

study to be the first comprehensive comparative analysis of this magnitude.

3) Are substantial conclusions reached? YES.

4) Are the scientific methods and assumptions valid and clearly outlined? YES.

5) Are the results sufficient to support the interpretations and conclusions? YES.

6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES.

7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES.

8) Does the title clearly reflect the contents of the paper? 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.

12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? See comment below.

13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? NO.

14) Are the number and quality of references appropriate? YES.

15) Is the amount and quality of supplementary material appropriate? YES.

Specific Comments: 1) p. 2471, line 23-26: The authors mention that ϵ-NSGAII outperforms SPEA2 (in terms of ease of use, reliability, and the provision of more diverse representations of tradeoffs) on a four-objective groundwater monitoring application presented in Kollat and Reed [2005b]. Given the audience of HESS, and the fact that SPEA2 appears to outperform ϵ-NSGAII on the test function suite and the two water-

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shed calibration applications presented in this study, I believe readers of HESS would be interested in the reasons that might account for this. Can the authors provide suggestions (or a few sentences in the discussion section) to provide further explanation? What are the key differences between the applications provided in these two papers?

2) p. 2485: The formulation for the ϵ-indicator and the interpretation function (equation 7 and 8) is a bit confusing. Perhaps the notation for an objective vector, (z^1 or z^2), can be introduced (or distinguished from objective functions, f, and objective values) earlier in the text. (Note: Objective vectors are first mentioned on page 2470, line 26.)

Minor Technical Corrections: 1) There are several places throughout the manuscript where ", which" should be replaced by "that". Some examples include: p. 2469, line 11: Replace "...2002), which" with "...2002) that" p. 2476, line 25: Replace "...2002), which" with "...2002) that" p. 2477, line 19: Replace "...literature, which" has been with "...literature that has been" p. 2478, line 20: Replace "...algorithms which" are with "...algorithms that" are p. 2489, line 22: Replace "...), which" with "...that"

2) p. 2469, line 17: Change multiobjective objective calibration to multi-objective calibration (?)

3) p. 2470, lines 17-19: Remove ", K is the number of objectives" from lines 18 and 19 and insert "K" on line 17 after "...from one to the number of total objectives"

4) p. 2472, lines 12-13: Insert the between "...pre-condition" and "search..."

5) p. 2472, line 8: Remove the "s" from "towards".

6) p. 2477, line 9: "...of the number of **the** decision variables". Remove "**the**".

7) p. 2478, line 21: Insert a comma between "Leaf River" and "8 to 10".

8) p. 2481, lines 810: Are "weighting functions" and "weighting coefficients" the same? If so, perhaps change functions (in line 8) to coefficients? If not, further explain.

9) p. 2481, line 11: Insert "the" between "...of" and "HMLE".

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10) p. 2482, line 9: Insert a comma after "flow", and connect "can not".

11) p. 2484, line 1: change "than" to then.

12) p. 2484, line 15: Remove "we were".

13) p. 2486: move (i.e. ranks of 1 or 2) from line 13 to line 6 after "Each trial run is given a rank"

14) p. 2489-90: For consistency purposes, place Case Study 1: in the header of section 5.1. Likewise change the header in section 5.2 from "Optimization results for the Leaf River study" to "Optimization results for Case Study 2: Leaf River Watershed"; and the header in section 5.3 from "Optimization results for the Shale Hills test case" to "Optimization results for Case Study 3: Shale Hills Watershed" (?).

15) p. 2489-2490, lines 28 1: It's not clear that Figure 6 "verifies that MOSCEM-UA and ϵ-NSGAII have nearly identical runtime performance distributions". Does this refer to the mean performance (solid line) or range of performance? (Note: The mean performance of MOSCEM-UA looks "as similar" to SPEA2 as it does to ϵ-NSGAII.) It is also very difficult to distinguish a significant difference in the range of performance by looking at Figure 6. Perhaps, the easiest solution is to remove this sentence (lines 28 1)?

16) p. 2490, line 20: Change "minutes whereas MOSCEM-UA" to "minutes, MOSCEM-UA".

17) p. 2490, line 24: Change "runtimes we were allotted" to "runtime allotted".

18) p. 2496, line 4: Change "competitive with another" to "competitive with one another".

19) p. 2504, Table 3: Insert two horizontal lines - one separating the single configuration of ϵ-NSGAII from the two configurations associated with SPEA2, and another separating the two configurations of SPEA2 from the four configurations of MOSCEM-

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UA to help emphasize the distinctions (between configurations) as provided in the text. Also, why is 0/50 in bold for T_2, T_3, and T_4?

20) p. 2516, Fig. 7: Should the magnitude of the two horizontal axes (Function Evaluations (x10^4)) in Fig. 7 differ from each other? (Note: Those of Fig. 6 differ from Fig. 7 by one order of magnitude.) Is this a typo?

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 2465, 2005.