

## ***Interactive comment on “Moving beyond traditional model calibration or how to better identify realistic model parameters: sub-period calibration” by S. Gharari et al.***

### **Anonymous Referee #2**

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#### General comments

The paper presents a parameter estimation framework based on calibration of multiple sub-periods. The approach consists of two steps. First, each sub-period is calibrated using multiple objectives. The sub-period Pareto-optimal solutions are then used to define an objective function for each sub-period (defined as distance to the Pareto front), which are subsequently optimised.

The suggested framework may be seen as an extension of a traditional multi-objective calibration framework; extended with a temporal dimension by considering each calibration objective in time. Thus, one could formulate the calibration problem as one

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multi-objective optimisation problem that includes all objectives, rather than the two-step approach proposed in the paper. The two step approach results in two simpler multi-objective optimisation problems that may be easier to interpret than the full multi-objective optimisation problem. However, by defining two steps some dimensions are collapsed in the optimisation process, and the effect of this is not clear. One could actually also define a two-step approach that first considers each objective individually in the different sub-periods, and subsequently defines a distance to the Pareto front for each objective that are then optimised. I think a discussion of these aspects should be included in the paper to better understand the suggested approach and the motivation behind it.

## Detailed comments

Page 1889, l. 6. What is the difference between multi-objective and multi-criteria? In general, the multi-objective calibration problem may be defined with respect to (i) multiple variables, (ii) multiple response modes (e.g. high flow and low flow), and (iii) multiple sites (in case of distributed model output).

Page 1890, l. 6. How is distance defined? In the application example Euclidian distance of the objective functions is used. However, this distance measure will be sensitive to the magnitudes and units of the objective functions. Some transformation is needed to obtain a consistent distance measure (see e.g. Madsen, 2000).

Page 1894, l. 5-10. The objective functions do not explicitly define high flow and low flow performance. Performance measures for flows above a “high flow threshold” and below a “low flow threshold” would be more consistent.

Page 1897, l. 15. What is “normalized cumulative frequency”? I expect you mean cumulative distribution function (cdf).

Page 1898, l. 10-12. I think the results are quite similar with the multi-year calibration results. Please elaborate.

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Page 1898, l. 14-16. I don't think the results strongly support this statement. Obviously parameter estimates will be very different when based only on one year of data. Larger records are needed to investigate the performance of the proposed framework compared with the traditional calibration approach.

Page 1899, l. 24 – Page 1900, l. 5. I don't think this is a particular feature of the proposed method. A traditional calibration approach will also put less emphasis on few storms that are not well represented in the precipitation record in the optimisation.

Figure 1. Not clear what this figure illustrates.

Figure 7a. Partly same information as in Figure 4.

Figure 10. Not clear what this figure illustrates and is not discussed in the text.

The written English should be improved.

References:

Madsen, H., 2000, Automatic calibration of a conceptual rainfall-runoff model using multiple objectives, *J. Hydrol.*, 235, 276-288.

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