

Interactive Comments and Responses on “Sub-daily runoff simulations with parameters inferred at the daily time scale” by J. E. Reynolds et al.

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I found that the paper addressed an interesting issue for flood estimation in developing country, here there is limitation of rainfall data.

Reply: Thank you for your positive evaluation of our paper in general.

There are some issues that make me confused. I would like to ask the followings:

- The measure of fit: modified Nash Sutcliff (X_2) is used as performance evaluation which is $X_2 = R_{eff}/(R_{eff,max}) > 0.9$. What value of $R_{eff,max}$ for this particular case study? in case if $R_{eff,max} = 0.4$? $R_{eff} = 0.36$. X_2 will be 0.90. According to your assumption, it will be accepted. However, it would not be accepted due to poor matching. Could you please clarify the need of X_2 ?

Reply: Thank you for your comment and sorry that we failed to make it clearer in our original submission. The threshold value to retain the F behavioural parameter sets was chosen to be 0.90 in this study. Assuming, a specific run gave a $V_E < 0.1$, $R_{eff} = 0.36$ and $R_{eff,max} = 0.40$, then X_1 , X_2 and F would have been 1, 0.90, 0.90 respectively. If that was the case, then this parameter set would have been accepted given the way the membership functions were defined herein. However, parameter sets that gave poor fitting as the previous example were not retained in this study. The Nash–Sutcliffe efficiencies of the parameter sets retained as behavioural in MC_{EE} and MC_{EED} ranged from 0.63 to 0.81 (refer to Table 2 in our original submission).

- Are $MC_{EED,Q24}$ and MC_{EED} validated and calibrated against daily flow or sub daily?

To my understand daily flow was used for $MC_{EED,Q24}$ as it was said in description of experiment 2 (paragraph 1, page 7446), and for MC_{EED} - "When those (MC_{EED}) used to simulate daily runoff,...." - ph 5 - page 7450.

Reply: Thanks for asking. MC_{EED} conditioned and validated against observed 1-, 3-, 6-, 12- and 24-hourly runoff data. $MC_{EED,Q=24h}$ conditioned and validated only against daily runoff.

When we wrote "*When those (MC_{EED}) used to simulate daily runoff*" in ph 5 - page 7450, we were referring on using the MC_{EED} parameter sets inferred at sub-daily time scales to simulate daily runoff (refer to Fig. 6e).

However, in the conclusion (point 3) states that the parameter set can be used for flood forecasting. To my understanding, the hydrograph of flood flow and daily flow are much different. Therefore, the results tested against daily flow can not be applied for flood flow.

Reply: You are of course right that instantaneous flows differ from daily values. To forecast floods sub-daily (e.g., hourly) time data are needed, but normally daily data are more commonly available. What we try to show in the study is whether the parameter sets inferred at daily step were able to reproduce the flow dynamic at finer time scales. Our answer to this question is yes. In the revised version of our

manuscript, we will make it clear that the generality of the conclusion needs to be proved by more studies involving more models and catchments.

Furthermore, daily flow are average value of subdaily flow and much more stable than flood flow. Therefore, if we simulate the sub-daily flow (at different time step: 1; 3; ...24), and then take the average to calculate the daily flow for validation and calibration. I guess they will be not much different. That's why the parameter sets did change much in these simulations.

Reply: We agree. You are right; upscaling (aggregation) is easier and will normally give similar results. Our purpose is show the ability of downscaling (disaggregation), i.e., ability of the model using parameter values obtained at daily step to simulate flow at sub-daily or hourly step. In the study we also did cross scale comparison as you mentioned in your comment.

- The main concept of Euler method is to evaluate errors associated with time step. However, both accepted simulations MC_EED,Q24 and MC_EED used only time step of 1 hour. Which step in the modelling process the Euler concept is applied in?

Reply: The time step used to run the model for MC_{EED,Q=24} and MC_{EED} was 1 h. The 1-hourly simulations were then aggregated to the time scale of interest for modelling comparison.

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