

Interactive comment on “Data assimilation in integrated hydrological modeling using ensemble Kalman filtering: evaluating the effect of ensemble size and localization on filter performance” by J. Rasmussen et al.

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Thank you for your comments which we have tried to address point-by-point.

- Comment: The first point is the clarity and consistency between results shown in different figures. Results shown in Figure 4 seem not to be consistent (much higher) with those shown in figures 3, 4, 6, and 8. Many of the figures contain more than one figure. The authors should identify each of the two figures as figure 3a and figure 3b for example. See Specific comments for clarity comments on figures. Also, many errors

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in figure notations have been found and an entire review of figure notations has to be done.

Modifications: Figures 3, 4 and 6 have been split into a and b. The notation of the figures has been checked and corrected.

- Comment: A second issue is why the authors do not simulate the same ensemble size for each case. In figure 4, we can see that 8 obs were performed for 25, 50, 100, and 200 members. 0 and 2 obs were not performed with 25 members and 35 obs was not performed with 200 members. Conclusion of 35 obs could be different if tested with 200 members.

Response: We agree that simulating the same ensemble sizes in all cases would increase the consistency of the figures in the paper. However, we do not believe that presenting the results of 0 obs and 2 obs with 25 ensemble members will add useful information to the figures, as the results presented show that using 50 ensemble members is too little. Likewise, using 200 ensemble members for the 35 obs adds little information as the results show that little change is caused by going from 50 to 100 ensemble members. We believe that the information contained in the figures represents the information needed to support the discussion and the conclusion of the paper and therefore we have not expanded the text on this issue.

Modifications: None.

- Comment: Another concern is about the description of the assimilation scheme used. Authors specified that an asynchronous assimilation was used, but no specification about the assimilation windows was specified Does this assimilation window have an impact on results?

Response: We agree that a description of the assimilation window is very important. However, tests (unpublished) have shown that the length of the assimilation window is insignificant in terms of RMSE, and we believe that including a study of the assimilation

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window in the paper would not be beneficial. The paper investigates ensemble size and performance in the particular catchment with the particular model and conditions (e.g. observation frequency), and is not intended to investigate the relationship between ensemble size and performance in all integrated hydrological model scenarios.

Modifications: The following description of the assimilation window is added to section 2.6: “The states and parameters are updated every time groundwater head observations, i.e. every 28 days, and the daily discharge observations available in between updates are assimilated asynchronously. Tests have shown that the length of the assimilation window is of little importance and therefore no other assimilation window was tested“.

- Comment: Figure 1: What are the two triangles in the figure? Not specified in the legend.

Response: The two triangles were intended to show the locations of reference points for evaluating the improvement in stream flow. However, as this study was omitted from the final version of the paper, the triangles no longer serve a purpose.

Modifications: The triangles have been removed.

- Comment: Figure 3: Does figure 3a is for adaptative localization? Does figure 3b is for parameters a and $b = 2$? This is not clear.

Response: We agree that the figure is not clear.

Modifications: The figure and caption has been changed to clarify content of the figure.

- Comment: Figure 4: The figure 4b is unreadable.

Modifications: The figure has been changed to improve the readability.

- Comment: Figure 5: In legend, Add no localization and adaptative localization instead or incl Local (if it is really adaptative localization that was used).

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Modifications: Changed.

- Comment: Figure 8 : Difficult to read, please improve.

Modifications: The figure has been redesigned.

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