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Hydrology and Earth System Sciences Discussions

Interactive comment on "Correcting the radar rainfall forcing of a hydrological model with data assimilation: application to flood forecasting in the Lez Catchment in Southern France" *by* E. Harader et al.

Anonymous Referee #2

Received and published: 4 May 2012

General comments:

The submitted paper by Harader et al. (2012) presents a study on discharge data assimilation (DA) to an event-based, distributed, parsimonious hydrological model. A Kalman filter-type of DA method is used to correct for uncertain precipitation inputs derived from weather radar rainfall estimates and the uncertainty is quantified using event-based multipliers. This topic fits into the scope of HESS, in particular to the special issue on data assimilation for operational forecasting. However, there are couple

of major issues which need to be explained better and elaborated more in detail before accepting it as a full publication in HESS.

Major comments:

1. My first concern is about the definition of **R** matrix (Eq. 27) using β_{obs}. Can you please justify your approach and add some references to your method? It seems to me that by doing this you completely eliminate discharge observation error. Because if I understand it well, the observation error will become smaller for higher discharges. However, it is common in many hydrological DA applications to assume heteroscedastic property of discharge observation error. Please, can you comment on this?

2. P.3545 L.19–22 Can you better justify your approach to define **B** matrix. It is not completely clear to me. Furthermore, I would appreciate citing some literature you used for deriving your DA method.

3. Do you think that the residuals between observed and background discharges in Fig. 8 are caused only by the uncertain precipitation? Can you actually apply DA to correct for input uncertainty when your model is not able to represent the hydrological response of your catchment properly? How confident are you in your hydrological model when it is unable to simulate consecutive peaks (P.3549)?

4. To get better understanding of your DA method, I would suggest adding a short example, in which you carry out "synthetic experiment". By doing this simplification you can verify the applicability of your DA method to identify some true precipitation multipliers.

5. I am completely missing a section, where you would discuss and confront your results with other similar hydrological DA applications.

6. Finally, I agree with Referee #1 that the overall wording including punctuation needs to be significantly improved. Some suggestions are listed below.

Minor comments

1. P.3532 L.1–3: Please, rephrase the whole sentence to make really clear to the reader that you update only rainfall multipliers.
2. P.3532 L.7: How do you define "outer loop"?
3. Results should not be in introduction, please remove sentences P.3532 L.11–14.
4. Figs. 1 and 2 contain a lot of duplicated information. I suggest that you merge those 3 maps together and plot only the most relevant information. For example, you do not carry out any analyses with Mosson catchment so you do not need to plot it at all.
5. Furthermore, you mention two times "orographic precipitations or rainfall" in the manuscript but I did read anything about the altitude differences in the region.
6. P.3533–3534: I am not sure whether the detailed information on the Karst system needs to have its own subsubsection. You do not carry out any analyses of the simulated model storages, therefore I would reduce it significantly to 1–2 sentences and place it directly after P.3533 L.17. Your main interest is in identifying the rainfall multipliers.
7. P.3534 L.14: Do you mean actual or potential evapotranspiration?
8. I think that socio-economical aspects fit better into the introduction, so I suggest moving P.3534 L.21–25 on a suitable place there.

9. P.3536 L.7–8: Mention as well the very small magnitude of the observed peak as a possible reason for large MFB.
10. P.3536 L.19–20: Add references to 1) SCS-derived runoff production function and 2) Lag and 3) Route transfer functions.
11. P.3537 L.21: Please, specify the units of A. I guess this A is not in m^2 as further written on P.3538 L.19, otherwise the dimensions would not fit in between equations (3) and (4).
12. I agree with Referee #1 and I would suggest reducing the content of the whole subsubsection 2.2.1.
13. P.3541 L.1: Denominator in the Nash-Sutcliffe model efficiency is NOT the variance of the measured discharge, check e.g. Montanari et al. (2009). And please remove as well the multiplier of 100, because later on you do not express NS as [%] but as [-]. Correct corresponding Eq. 16 as well.
14. How did you generate Fig. 5? Which kind of data did you use?
15. Eq. (27): What is Q_i? Should it be $Q_{obs,i}$? And I am missing definition of t_f.
16. In general, I do not understand why you use "reanalysis" or "re-analysis". Is not it better to use simply "analysis"? And what is the difference between "forecast" and "pseudoforecast"?
17. P.3546 L.17 What do you mean exactly by "batch parameters"? Why are they averaged over time? So are they time-dependent or time-independent? And are the those of V_0, w, ds or K_0 (P.3547 L.7–8)?
18. Please consider rephrasing the whole paragraph P.3546 L.11–19. For example "Watershed constants" into "watershed parameters", etc.

19. P.3546 L.7 How did you define “valid” observations?
20. P.3547 L.7–8: How were those parameters calibrated?
21. P.3549 L.11 Are the rating curves for discharge below 300 m^3 s^{-1} reliable?
22. P.3550 L.10 Provide definition of “outer loop”. What is the difference with external loop (P.3573) and “open loop” (often used as a simulation without DA)?
23. To conclusions: Repeat the full names of your shortcuts again (MFB, IE, PH), that people reading only your conclusions understand conclusions independently from the rest of your paper.
24. Table 1: Why is the first and last line in the figure in *italics*?
25. Table 2: Provide explanation for all columns. What is R^2, . . . ?
26. Table 4: Provide explanation for all columns, simply refer to Table 2.

Technical corrections:

1. P.3528 L.9: What do you mean exactly by “it”? Do you relate it to previous sentence or to the following?
2. P.3528 L.12: Please, replace “. . . a constant correction to each event hyetogram” with “. . . a constant hyetogram correction to each event”.
3. P.3528 L.19: Mention “Nash-Sutcliffe efficiency” instead of “Nash” only.
4. P.3529 L.5: Rephrase to “neglecting spatial variability of rainfall”.

5. P.3529 L.14: Replace “such as radar rainfall” with “such as provided by weather radar”.
6. P.3530 L.10: For clarity state “rain gauge”.
7. P.3530 L.20: Correctly “developed”.
8. P.3530 L.26: Write “e.g.” before Aubert et al.
9. P.3531 L.7: Change “non-variational” to “sequential”.
10. P.3532 L.10: Better “between approximately 10 and 400 . . . ”.
11. P.3532 L.9: Correctly “occurring”.
12. P.3532 L.8: Better move “The analysis was carried out for 19 heavy rainfall events occurring within the Lez catchment in Southern France between 1997 and 2008. The 10 events were of variable intensity and had measured peak flows between approximately 10 and 400 m^3 s^{-1} at the watershed outlet.” to P.3531 L.28: after “. . . model.”.
13. P.3532 L.26: Space in between “Lirou, Yorgues”.
14. P.3532 L.26–P.3533 L.5: Remove three sentences “Other tributaries . . . in the South”, because it is not important to the reader when you do not take them into account.
15. P.3533 L.6: Rephrase “before emptying”.
16. P.3534 L.18: Rephrase to “particularly in late summer and fall periods”.
17. P.3535 L.1: Replace “either” with “both”.
18. P.3535 L.2: Replace “or” with “and”.

19. P.3535 L.4: Add a reference to the method used by Meteo-France.

20. For all the summation symbols ($\sum$) in the manuscript, please use the full form: e.g. $\sum_{i=1}^{N}$ that it is clear to the reader, where you start and where you stop summing up.

21. P.3535 L.22: Remove comma between location and i.

22. P.3536 L.3: Replace “along” with “together”.

23. Furthermore, I would prefer “Lez catchment” with small “c”. Any reason for “C”?

24. P.3536 L.20: Remove the whole sentence “Discharges . . . ”.

25. P.3536 L.21–23: Rephrase to “The model was calibrated at hourly time step by Coustau (2011) and Coustau et al (2012)”.

26. P.3541 L.21: Add reference to Nash and Sutcliffe (1970) as well. Additionally I would prefer changing your shortcut from IE to more commonly used NS or NSE. Where does your IE come from?

27. P.3544 L.1: Add to the “control vector” that it is in other words the “posterior”, to be consistent what follows there (a priori).

28. P.3547 L.6: Add reference to “equifinality”.

29. P.3547 L.24 What does the “Hu2” stand for?

30. P.3547 L.24–25: Refer to the location of indicators in Fig. 1.

31. P.3549 L.23 “renalysis” is misspelled.

32. Eliminate detailed description of the used colors for individual lines in figures from the text (e.g. P.3549 L.26–27 & P.3550 L.1–2). Include the description in the figure, EITHER in the caption OR in the figure legend. Please, do not duplicate it as it is e.g. in Figs. 8 and 9.

33. P.3552 L.22 Better replace “efficacity” with “efficiency”.

34. P.3555 L.22 I would be careful with the word “great”.

35. Table 1: Extend the caption of table.

36. Table 3: Change stars into dashes and extend the caption.

37. Figures: 10–15. Size of these figures needs to be INCREASED otherwise it is very difficult to read.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 3527, 2012.