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Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Uncertainties on mean areal precipitation: assessment and impact on streamflow simulations" *by* L. Moulin et al.

L. Moulin et al.

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1 Detailed answers to the comments of referee 1

Thank you to referee 1 for the accurate and helpfull review of our manuscript. In this author comment, we list how each of the remarks provided by the referee was adressed. The comments made by the referee will be refered as RC and printed in bold ; the authors comments and answers as AC. In a general authors comment, we summarise the main changes that were applied in the paper with respect to the main criticisms.

Referee 1 made two main comments/suggestions for improving the paper and noticed minor typing errors.

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1.1 First point : On the choice of the temporal correlation coefficient

11a. **At Section 4.2 (p. 2081-2) the authors address the issue of validating the temporal dependence error model. A central role here is played by examination of Figure 6, which is difficult to be read due to small symbols and characters.**

Wrong pictures were included in Fig.6 of original manuscript (see below 11c). Thus, a new version of Figure 6 has been proposed in which we increased size of both symbols in legend and characters. The caption has also been changed in order to make reading easier. See figure in the final response paper.

11b. **I expected use of normalised rainfall errors here, in parallel to Table 3.**

As observed by Referee 1, representation of normalised and non-normalised errors does not give the same kind of information. It is important to check if the distributions of simulated and empirical non-normalised errors accumulated over several hours are consistent. It's why in Fig.6 the choice was made to represent non-normalised errors (representation of normalised errors would give information partially redundant with Table 3).

11c. **It is not clear enough here how Figure 6 is used to justify the choice of a temporal correlation equal to 0.6.**

As mentionned in section 1.2 and 1.3 in the general comments, an error was made : the wrong figure was included in the manuscript (wrong raingauge and wrong temporal correlation coefficient). It was corrected.

11d. **Moreover, I do not understand why it is necessary to use a correlation coefficient which ”slight underestimates” (Line 22-23 p. 2082) the observed quantiles. I would have expected here a correlation parameter able to fit the observed quantiles.**

We agree that the original manuscript was not clear enough on this topic. A misunderstood is made on the intentions of the authors. We try to get a correlation coefficient able to fit the observed quantiles but many reasons lead us to chose a compromise coefficient which has been shown to sometimes slightly underestimate observed quantiles. These reasons are the choice of very simple and pragmatic tools (as a climatologic variogram, error modelling with a Gaussian model, and so on) that produces sometimes bias or under/over-estimations and the fact that this temporal coefficient depends also on topology of the network, on the size of the considered domain, on the cells’dimension, and on the speed of advection compared with working time step (1 hour) and network resolution.

11e. **The authors should also justify in a more thorough way and discuss the possibility to use a spatially uniform correlation parameter. This choice plays an essential role later in the study, and should therefore clearly evaluated.**

The choice of a spatially uniform correlation parameter was a condition to extrapolate error model for point rainfall to error model for MAP with an hypothesis of linearity. ρ has many reasons not to be uniform (please, see section 1.3 in the general comments). However, when it is computed on each of 40 raingauges it appears not to vary so much – and the values of ρ do not present a spatial structure. A mean value of 0.6 enables to approximate quantiles distributions of error on the most of test raingauges.

1.2 Question 2 : Concerning the uncertainties of streamflows

12a. **At Section 5.2.2 (p. 2087, lines 15-25) the authors comment on results reported in Table 5, which gives the percentage of measured discharges comprised between the 90% confidence limits. The percentages are given for measured discharges exceeding various thresholds and accounting for measurement uncertainty. The authors note that i) this percentage increases with increasing the threshold used for the analysis, and that ii) For the smallest catchments (Rieutord, Chambon-sur-Lignon), the simulated 90% confidence interval contains almost 90% of the measured streamflow values when a tolerance factor of 20% is considered (Table 5). However, examination of Table 5 does not support completely the last conclusion, which is correct only for the smallest and the largest basins when Qobs > Q10. In the other cases, percentages are all less than 90.0%. The authors should discuss these aspects, (. . .)**

That is true. Please, see the response in general comments (Section 1.5). The text had been written based on preliminary results which were slightly different from the results presented in Table 5 (with other confidence intervals). In the revised manuscript the discussion has been reformulated and nuances have been introduced in the text.

12b. **Moreover, it is not clear how measurement uncertainties were estimated and accounted for in this analysis.**

In a very pragmatic way, we wanted to estimate if uncertainties on MAP could explain a significant part of total uncertainty/error on modeled (simulated or forecasted) streamflows, in particular for high values (intense floods). Tolerance of 20% could correspond to the uncertainty on values of streamflow for a significant flood ; but we do not pretend that it is error/uncertainty on “measured” streamflow. Error on flood peak values

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has not been precisely estimated but according to forecating operationnal services on these flash flooding catchments, the error can be of this magnitude and it also does reflect the tolerance they can accept on the modelled streamflows.

1.3 Minor corrections

All minor modifications suggested by referee 1 were taken into account.

- **Pag. 2076, line 5:. "stationnary" should be "stationary".** → Corrected.
- **Pag. 2080, line 15: " is an weighted..." should be "...is a weighted..."** → Corrected.
- **Figure 6 Is difficult to read, please increase size of symbols and characters** → In new version of Figure 6, we increased size of both symbols in legend and characters.
- **Figure 10 Figure colours do not match caption's indication** → Corrected.
- **Figure 11 Not mentioned in the text, please remove it.** → Removed.
- **Table 1 report runoff coeff as P/Q; it should be Q/P.** → Corrected.

References

Datin, R. : Outils operationnels pour la prevision des crues rapides : traitements des incertitudes et integration des previsions meteorologiques. Developpements de TOPMODEL pour la prise en compte de la variabilite spatiale de la pluie. Application au bassin versant de l'Ardeche. PhD Thesis, Institut National Polytechnique de Grenoble, Grenoble, 369 pp., 1998.

Table 1. For each one of the three studied catchments, number of raingauges contained in the catchment area (col. 3) and the corresponding density (col. 4) are computed. The same computations (col. 5 & 6) are made for the total number of raingauges contained in the catchment or whose the distance to the catchment is less than the range of variogram (25 km). In the last column the normalised theoretical error standard deviation computed with all the available network is indicated.

	Area (km^2)	Nb rain gauges in	Density ($1/km^2$)	Nb raingauges in range	Density ($1/km^2$)	Normalised error St Dev (mm/h)
Rieutord	62	2	1/31	17	1/4	0.283
Chambon	139	3	1/46	21	1/7	0.209
Bas-en-B	3234	32	1/101	40	1/81	0.130

Kirstetter, P.E., Delrieu, G., Boudevillain, B. and Obled, C. : Towards an error model for radar quantitative precipitation estimation in the Cévennes-Vivarais region, France, Adv. Water Resour., submitted, 2008.

Villarini, G. and Krajewski, W. F.: Empirically-based modeling of spatial sampling uncertainties associated with rainfall measurement by rain gauges, Adv. Water Resour., 31, 1015–1023, 2008.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2067, 2008.

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