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Hydrology and Earth System Sciences Discussions

Interactive comment on "On the role of the runoff coefficient in the mapping of rainfall to flood return periods" *by* A. Viglione et al.

A. Viglione et al.

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We already answered to the main points of the review of Eric Gaume. Here we report the changes made to the manuscript in relation to his suggestions (when not otherwise indicated, line numbers refer to the original manuscript).

1) Return periods (i.e. probability of exceedence or distribution function values) can not strictly speaking be attributed to rainfall events and floods but to some of their characteristics: peak discharges, average intensity over a given duration (IDF curves)... Misnomers as flood or rainfall return periods should not be reproduced in scientific papers which role is to clarify problems and not to add to the general confusion.

The following text has been added after line 13 page 632: "When analysing occurring storms, the storm return period is defined as the return period which would be assigned to the storm event if it were used as input to the design storm procedure. It is indeed the maximum return period that can be assigned to a rainfall event when considering different aggregation levels, i.e., the return period read off the IDF curve for the aggregation level corresponding to the main burst of the storm, and hence equal to TP."

2) What is almost certain is that the runoff coefficient to be considered in the rational formula has a general tendency to grow with the return period a does generally not exceed 1: see discussion on this issue in a recently published paper in HESS (Gaume, 2006).

We decided not to refer to the "rational formula" in our paper for the reasons explained in our first response to E. Gaume. We are aware that the two methods (design storm and rational formula) are 'related' but a discussion of these relationships would require a lot of space and, in our opinion, would not contribute to better clarify our results.

3) P628, Line 1: "rainfall return period" and "flood return period" remove these vague notions and be more precise on what exactly are the studied statistical variables.

See response to the first point above.

4) P628, Line24: "typically performed using the design storm". It is typical in urban hydrology where runoff coefficients can be considered as constant, but not when they vary in rural catchments. If it is a common practice in some countries, should it be considered as judicious? Apparently no, according to the manuscript. Please describe somewhere the design storm procedure and especially which characteristics of the storms are considered to select this design storm: certainly not its average intensity as it is the case in the paper.

The explanation of the design storm procedure in section 2 has been improved and some more references have been added, so that should not be confused with the rational formula.

5) P629, Line 1: The return period of a storm does not exist strictly speaking. Please be more precise. Lines 1-9: equality between return periods hold if the right characteristic of the rainfall event is considered and if the runoff coefficient is constant. This has been often verified and is at the origin of the rational formula.

See points 1 and 2 above.

6) P632, L1-2: No, the storm duration has no relation with the aggregation level!!! This corresponds to a wrong application of the design storm method based on IDF curves! Errors, if they exist, should not be propagated. Same remark for lines 17-21.

We do not suggest to use tIDF=tr, we just say that this is done many times in practice (see lines 22-26 p. 631 and lines 1-2 p. 632): "...rainfalls from the IDF curves do not represent complete storms but are from intense bursts within these storms. The storm duration tr may hence differ from the aggregation level tIDF used to read off the intensity from the IDF curve". In our simplified world, however, it is consistent to use tIDF=tr because: "In the case of block rainfall, as assumed here, the total rainfall event and the main burst are indeed identical, so the aggregation level used to evaluate the return period of a storm is equal to the duration of that storm" (lines 18-21 p. 632).

To state more clearly how the IDF curves are calculated, we added the following lines after line 18 page 631: "Using the wording of Koutsoyiannis et al. (1998), the problem of the construction of the IDF curves is not a problem of statistical analysis of a single random variable, as it includes two variables, intensity and aggregation level. Nor is it a problem of two random variables, because tIDF is not a random variable. It consists of the study of a family of random variables, the maximum-annual average intensities of rainfall over different time intervals tIDF."

7) P633, L5: provide a precise definition of the response time of a linear reservoir, if necessary, recalling the equation of the reservoir.

See eq. (A7) in the appendix.

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8) P633, L9-12: This choice does neither seem consistent with the design storm procedure, nor with the IDF curves (see general comments).

See points 1 and 6.

9) P634, L11: This Tr seems to be the characteristic time that should be used to compute the return period of the event according to what I think is the design storm procedure.*

It is, but in the design storm procedure, differently from the rational formula, tr* has not to be chosen a-priori.

10) P638, L7: deltac and sigmac have not been defined.

see P637, L10-17

11) P638, L7-24: the explanations are very complex. What comes out is that in the dry system, the return period of the rare events is controlled by the return period of the runoff coefficient rather than the return period of the rain event intensity. This is typically a case where the design storm procedure will be inefficient.

We agree with the first part of the referee's comment, i.e., the rarity of an event is related to the rarity of occurrence of rc. We added the sentence "In dry systems the effect of the event runoff coefficient on the flood return period is larger than in wet systems" after line 20 page 638. We also agree on the fact that in dry catchments the design storm procedure is more difficult to apply. One has to choose a runoff coefficient (or, in the real world, the initial condition of the catchment) and close values of rc can result in very different values of TQ/TP (see e.g. the inter-line spacing of fig. 5a). We added the following lines referring to Fig. 5 after line 3 page 639: "The spacing between these lines is a measure of the sensitivity of the design storm method to the choice of the runoff coefficient. In the dry system, the result of the design storm method changes a lot for small variations of rc, much more than in the wet case. Moreover, once the design rc is chosen, the ratio TQ/TP for the dry case is not a constant but highly depends on the desired TQ. In the wet case of Panel (c) this dependence is much weaker. This is a general result: in dry systems, great emphasis should be given to the correct choice of the design runoff coefficient when applying the design storm method, much more than in wet systems."

12) P639, L15-20: The back-computation of runoff coefficients is a very interesting approach.

This is possible in the simplified world analysed in the paper.

13) P640, L1-5: The fact that r1:1 is greater than the median value is very interesting, but is it still the case if the return periods are correctly computed?

The return periods are correctly computed (see points 1 and 6 above).

14) P640, L20: Part 4.2.1 is mostly descriptive and the results obtained quite complex. Various phenomena are interplaying which are difficult to separate on figure 8. In particular, the rainfall event volume is not independent on its duration which may explain the two peaks in figures 8.b, d, f. It is not independent on the rainfall intensity neither which may explain the shape of figures 8 a, c, e. By the way, do the lines correspond to analytical results in figure 8.

These considerations are correct. Note that storm duration and storm intensities are correlated (equation (A4-A6)). We added the the following lines referring to Fig. 8 after line 9 page 641: "The shapes of the two graphs are due to the fact that the rainfall event volume depends on the rainfall intensity, which explains the subdivision between rc1 and rc2 in Panel (a), and on its duration, which explains the two peaks in Panel (b)". The lines correspond to the analytical results except for the segment joining the under-threshold/over-threshold situation.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 627, 2009.