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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.

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Review of the article: ON THE ROLE OF THE RUNOFF COEFFICIENT IN THE MAPPING OF RAINFALL TO FLOOD RETURN PERIODS By A. Viglione, R. Merz, and G. Blöschl Reviewer: Attilio Castellarin

GENERAL COMMENTS

The manuscript is an interesting and useful follow-up to the study by Viglione and Blöschl (2009) on the relationships between the recurrence intervals of rainstorms, T_P, and corresponding floods, T_Q. This is a central topic in hydrology and a critical problem for the prediction of design floods in ungauged basins. The scientific literature reports only sparse indications on the subject. Viglione and Blöschl (2009) addressed

the role of storm duration, whereas this study focuses on the role of the runoff coefficient. Together, these two complementary studies represent a significant advance in this field, providing very useful indications.

I consider the manuscript to be of broad international interest and suitable for the journal. The methodologies are well described and the mathematics seems correct. The manuscript is well written and to the point. I only have a few specific comments on this manuscript, which I consider being a very good paper and for which I recommend: publication after minor revisions.

SPECIFIC COMMENTS

1) RANDOMNESS OF THE RUNOFF COEFFICIENT

I sincerely believe that the approach adopted by the Authors to investigate the role of the runoff coefficient, r_c, is a very sensible one. It is also perfectly appropriate for dealing with the problem at hand. I also like the structure of the analysis, which adopts schematizations of increasing complexity to represent the randomness of r_c (i.e., two values with assigned probability or continuous beta distribution; same as above but controlled by a threshold event rainfall volume).

My only concern is relative to the degree of randomness that is present in the simple scheme adopted by the authors. The variability of event runoff coefficients for a given basin reflects the physical characteristics of the catchment and also its climate (see e.g., Gottschalk and Weingartner, 1998). The Authors point out that this variability should describe the antecedent soil moisture state of the catchment. Nevertheless, modelling the randomness of rainfall and runoff coefficient independently of one another, as done in section 4.1, could lead to inaccurate results. For instance, a mean or low value of r_c could be adopted in the MC simulations for the rainfall-runoff modelling of a rainstorm that follows closely in time other significant rainfall events of the synthetic series. This necessarily impacts the simulated flow peak, and could have also implications on the resulting annual flood series.

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The utilization of a conditional probability for runoff coefficients is clearly out of the scope of this study. But the Authors could improve the discussion of this point.

2) EVENT RAINFALL OR ANTECEDENT RAINFALL?

The threshold behaviour of runoff coefficients (see section 4.2) is analysed in the study with respect to event rainfall volume. Merz and Blöschl (2009) show that antecedent soil moisture conditions control runoff coefficients to a higher degree than event rainfall. The Authors decided to model the antecedent conditions by means of r_c random variability (see previous point). The antecedent soil moisture conditions could also be roughly approximated by the 5 (or 10, or 30) day antecedent rainfall depth (see e.g. Merz and Blöschl, 2009). A threshold behaviour could have been modelled with respect to the antecedent rainfall volume from the syntethic series.

Even though I doubt that this modelling strategy would have changed the main outcomes of this study significantly, a discussion of this point would enrich the presentation of the results.

3) WHAT RUNOFF COEFFICIENT GIVES A 1:1 CORRESPONDENCE OF T_P AND T_Q?

In my opinion, the way in which the manuscript is structured and, in particular, the current organization of subsections 4.1.3 and 4.2.3 may be misleading, in the sense that it probably stresses a relatively marginal problem. Is it really important to know what runoff coefficient results in a 1:1 correspondence of T_P and T_Q?

Viglione and Blöschl (2009) and this manuscript clearly point out that the main hypothesis of the design storm procedure is an oversimplifying assumption, which is scarcely applicable even for a "simplified world";. From an engineering viewpoint, I believe that the step forward is the identification of the T_P that should be used in a design storm approach to obtain the desired T_Q for an average (or median) r_c value. In the best case scenario, a few empirical r_c values are available for the basin of interest, corre-

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sponding to observed peak flows (or annual floods). In this case the estimation of the mean or median of the r_c parent distribution (or the distribution of the flood producing runoff coefficients) is viable, whereas the 10% or 90% quantile could only be guessed.

4) DISTRIBUTION OF RUNOFF COEFFICIENTS, p. 637, 638, Fig. 3

I would suggest to refer to CV_c (instead of standard deviation or variance) throughout the text (equations 2 and 3, and examples on p. 638). This would be consistent with the information reported on Fig. 3.

5) Please check "practise" on p. 638

6) Line 5 on p. 639, the median is expressed by a unclear notation, which should be explained. Moreover, is the notation really useful?

7) From line 5 on p. 645 - "If a continuous deterministic relationship (...) (not shown here) (...)";. I think that showing some of these results would enrich the presentation.

8) Fig. 2, panel e) - the ratio for the central case is 2, as reported, or 1?

9) Fig. 4, panel b) - the envelope line does not seem to describe the results of the Monte Carlo simulation as effectively as in panels d) and f), and it is not an envelope. Please check its correctness.

10) Caption of Fig. 8 - please include "(T_Q = 100 years)" after "slices" as in caption of Fig. 9.

REFERENCES

Gottschalk, L. and Weingartner, R. (1998) Distribution of peak flow derived from a distribution of rainfall volume and runoff coefficient, and a unit hydrograph, J. Hydrol., 208, 148-162.

Merz, R. and Blöschl, G.: A regional analysis of event runoff coefficients with respect to climate and catchment characteristics in Austria, Water Resour. Res., 45, W01405,

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Viglione A., Blöschl G. (2009) On the role of storm duration in the mapping of rainfall to flood return periods, Hydrology and Earth System Sciences , 13(2), 205-216.

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