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Interactive comment on "On the asymptotic behavior of flood peak distributions – theoretical results" *by* E. Gaume

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The reviewer makes some useful suggestions concerning the mathematical developments. I think that they are worth a new paper. The comments 3 to 5 reveal some nuances between the points of view of the author and the reviewer on the hydrological variable frequency study issue which are discussed hereafter.

1. The analytical results are presented in detail in part 2 of the paper on simplified modeling hypothesis: the rainfall events are considered as rectangular pulses and the ratio between the event intensity and the peak discharge is a random variable whose distribution does not depend on the rainfall event intensity and duration. Nevertheless, the result is then generalized in part 3 on the basis of theoretical considerations. The numerical results serve as an illustration of the statements of this part 3.

2. The proof proposed by the reviewer is very clever but brings only one part of the solution. It reveals to which large family the asymptotic distribution of Y belongs to,

but does not give any information about its parameters. This paper demonstrates not only that the asymptotic distribution of the peak discharge Y is of the same type as the distribution of the rainfall intensity X but also and mainly, that the shape parameters of both distributions are equal. Given equations (1) and (19), this result may appear relatively obvious, even if the demonstration is a little tricky in the EVI case. I am happy if it is so, because it would be a sign that the target of the paper is reached: to present the rainfall-runoff process in a way that the relation between the rainfall statistical characteristics and the flood peak distribution, or a least the asymptotic distribution, becomes clear.

3. It is the opinion of the author that no general conclusion - independent on the rainfall-runoff dynamics - can be drawn concerning the medium range quantiles of the flood peak distributions. What is clear is that the range of possibilities is large.

4 and 5. I think that I do not share the point of view of the reviewer on the importance of the issue of what is the “real” type of flood peak distributions. Let me explain that point. The paper argues that the peak distribution is probably neither EVI nor EVII (see figure 6): natural phenomena are certainly not limited to the simple existing models. The extreme value theory applies on the tails of the distributions, and nothing is said on the convergence speed. The detection of a curvature of the distribution on limited series (for short return periods) does not necessarily indicate that this tendency persists for large return periods : i.e. that the distribution is of EV II type. It is exactly the case on figure 6: the simulated distributions appear hyper-exponential over certain range of return periods, but the tail is exponential. The distributions are what they are ! I share the opinion of the reviewer on the fact that theoretical approaches are useful and hope that this paper is an illustration for that, but still for theoretical reasoning. I persist in thinking that we can hardly anticipate the shape of flood peak distributions or even rainfall intensity distributions and that the only way to reduce the uncertainty on the estimated quantiles consists in enlarging the studied data sets. Almost all the cited papers are based on the analysis of large data sets. The figure 7 is only shown in the

HESSD

2, S838–S840, 2005

paper to illustrate the fact that the simulated flood peak distribution shapes are realistic. An other paper, focussed on the usefulness of historical data for the estimation of flood quantiles in small Mediterranean watersheds is in preparation.

6. This suggestion could be the focus of a coming paper.

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