

Interactive comment on “Influence of soil parameters on the skewness coefficient of the annual maximum flood peaks” by A. Gioia et al.

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General comments

The paper continues the series of efforts to estimate the annual maximum flow discharge distribution analytically this time exploiting the theoretically derived distribution model of floods TCIF (Gioia et al., 2008), which is based on two different threshold mechanisms associated respectively to ordinary and extraordinary events. The focus of the paper is the sensitivity analysis of TCIF probability density function (pdf) performed in order to analyze the effects of climatic and geomorphologic parameters on the skewness coefficient. In particular, the analysis was conducted investigating the influence on skewness of TCIF of physical factors such as rainfall intensity, soil infiltration capacity, and basin area, in order to provide insights in catchment classification and process conceptualization.

The subject matter of the paper is clearly relevant for publication in HESS, dealing with issues relevant to regional flood frequency analysis and in particular to prediction in ungauged and poorly gauged basins. In fact, the works on relations of the moment ratios of the annual peak flow distribution with physiographic catchment characteristics which have been continued for at least the last fifty years basing on regression technique have not produced satisfactory results. They lead to the conclusion that a regression analysis should not be accepted unless a physical relationship can be established. It's a pity that already classical method of Gradex has not been mentioned.

To estimate the upper quantiles, which is the main task of FFA, the reliable estimate of the three first moments are much more important than the knowledge of the form of the "true" pdf. Therefore, works on building physically based models of pdf of annual maximum discharge is a promising way to get the desirable relationships of the moment ratios with physical factors.

The wish to reconcile complexity of runoff process and the requirement to get mathematically tractable and relatively simple form of pdf, results in a very strong simplifications and a reader should be aware of it. To avoid misunderstanding, I suggest to change the title of the paper to "Influence of the TCIF annual maximum flood peaks model" or shortly "Influence of the TCIF model." .

Looking from the other side a reader finds the description of the TCIF model and its analysis difficult to follow. Definitely the readability and clarity of the manuscript should be improved. Too much information makes the paper of indigestible.

Although the precise "rainfall–runoff" model would be, the statistical modeling of its input process remains an open problem. Dealing with TCIF model, the interest would be in sensitivity of the skewnees and the coefficient of variation of TCIF model to rainfall intensity parameters, i.e. of Weibull distribution in this case. Simulation experiments show that series of thousands of years are necessary to stabilize the skew estimate statistics. Therefore the only hope is credited to development of GCM and in particular to improvement of spatial and temporal downscaling of rainfall process prediction.

I am happy to recommend this study for publishing in HESS after a revision.

Specific comments 1. Prior to a reading the paper, I considered the skewness of annual maximum rainfall distribution as the dominated factor for the AM peak flow skewness value.

Then I have learned from the TCIF analysis that the runoff mechanism can increase the rainfall intensity skewness even more than three times (see Table 9 as example). The fact of an increase does not surprised me as being in agreement with various concepts of causes of inverse-power distribution in nature (e.g. Strupczewski et al., 2010) but its high rate is amazing. Is it realistic, or is it the feature of TCIF distribution only? It is the novelty being in the contrary to McCuen and Smith (2008) findings (recalled in Introduction p.5562, line 28 till p.5563, line 3).

2. A great number of variables and parameters scattered all over the paper discourages from studying it. The list of all variables, parameters and acronyms would be very helpful.

3. Describing the properties of a pdf by means of moments and moment ratios one usually starts from the mean then variance and coefficient of variation and so on. What about to start from lower order moments of TCIF? In fact, the IF (but not TCIF) models' relationship between the coefficient of variation (C_v) of the annual flood series was subject to Jacobellis et al. (2002) paper.

4. p.5564, lines 3-4. Please explain why in Gamma distribution the β is named the scale parameter but not "the shape parameter" and the a_L and a_H the position parameters instead of "the scale parameter". Compare p.5569 l. 13.

5. p.5564, Eq.(4). The sign of multiplication but not the addition should be between the two CDFs of L and H-type floods' driving mechanisms. Eq. (4) can be found in the quoted paper Iacobellis et al. (2011) as Eq.(A17) and has been copied in erroneous form. Here the sensitivity analysis of the pdf (5) is made modeling rainfall intensity by Exponential distribution which is the limiting case among other distributions of Weibull distribution. Replacing wherever necessary Weibull by Exponential distribution greatly simplifies the notation making the algebra more digested. Also the classification into two categories of flood's driving mechanisms (frequent and rare response) can mislead a reader, who could identify frequent as low and rare as high peak flood flow.

6. p.5565, line 14 and p. 5568 line 10. There is "Assuming the rainfall intensity Gumbel distributed $k = \dots$ ". The rainfall intensity is considered Weibull distributed (p. 5564, line 2) with the shape parameter k . So $k =$ gives the Exponential distribution but not Gumbel. In fact, one can get Gumbel distribution for annual maximum rainfall intensity based on the (Poisson/Exp)

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POT model.

7. p. 5571, lines 1–6 There is “The growth curve depends on scale factor”. The growth curve K_x (Eq.16) is for the dimensionless rescaled data. Therefore its parameters are dimensionless as well, e.g. the moment ratios C_V, C_S, \dots .

There is “The coefficient of variation of such distributions, controlling the scale factor, . . . “. The coefficient of variation is dimensionless therefore it can not control the scale factor.

8. p.5571. In accordance with the title of the paper, one expects a demonstration of dependence of the skewness coefficient of TCIF distribution on the soil parameters. It is done by Tables 5-9 while a large majority of results is reported in the form of growth curve probability plots (Figs 1–13) and each of them is characterized by the same mean annual number of flood events Λ_q . Authors claim that the coefficient of variation of TCIF distribution mainly depends on the mean annual number of flood events Λ_q . If so the probability plot for a fixed value of Λ_q would allow the (indirect, i.e. visual) identification of skewness of TCIF distribution. The Λ_q value is not given in Figures but it can be computed from Eq. (4) putting the mean annual number of rainfall events $\Lambda_p=21$. It is not convenient for a reader, if accepted it calls for explanation. Anyhow the plots (Figs 1–13) allows to assess the TCIF’s sensitivity of upper quantile values to the soil parameters which is the main interest of FFA.

1. What is a reason to use the plots instead of tables which seems to be more compact and gives the values of the skewness coefficient C_S .
2. It is worth to show that the statement “the coefficient of variation of POT and in particular TCEV distributions depends mainly on the mean annual number of flood events Λ_q ” (p.5571, lines 3–8) is acceptable for TCIF and in general for TCEV. It easy to show that it is holds for TCEV if the magnitude distributions of the both variables are identical in terms of a function and parameter values and the threshold is a small value, e.g. for (POT/EXP) model:

$$C_V = \frac{\pi}{\sqrt{6} [(\ln \lambda_q + C) + (\varepsilon/\beta)]}$$

where β is the Exp distribution parameter and ε is the threshold value while C is the Euler

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constant.

9. p. 5574–5576. Conclusions. It would be convenient for a reader if every conclusion is referred to respective Tables or Figures.

Technical corrections 1..5570, line 6. “varies ”instead of “aries’ .

2. Tables 5-10. Incomplete titles “standard of skewness” does not make any sense. By the way, although the origin of the SD values of skewness displayed in Tables 5 to 10 is explained (page 5572 lines 4 to 7), still reading such small values in separation from the text can make illusion (Figs 1–13) that thanks to TCIF the skewness of AM distribution is totally under control.

Reference W.G. Strupczewski, K. Kochanek, I. Markiewicz, E. Bogdanowicz, V.P. Singh (2011) On the tails of distributions of annual peak flow. *Hydrology Research*, **42**, 2-3, 171-192.

Please also note the supplement to this comment:

<http://www.hydrol-earth-syst-sci-discuss.net/8/C3329/2011/hessd-8-C3329-2011-supplement.zip>

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