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Hydrology and Earth System Sciences Discussions

Interactive comment on "Evaluation dam overtopping risk based on univariate and bivariate flood frequency analysis" *by* E. Goodarzi et al.

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Review of: "EVALUATION DAM OVERTOPPING RISK BASE ON UNIVARIATE AND BIVARIATE FLOOD FREQUENCY ANALYSIS"

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The paper presents a comparison between two statistical methods to assess the risk of dam overtopping: a univariate approach and a bivariate one are applied to a test case, for which a relatively extended series of discharge observations is available. The second is recognized as the most comprehensive and conservative.

Indeed, the utilization of methods based on multivariate statistics represents a chal-

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lenging research topic in many branches of hydrology, and the paper potential audience would be wide. Nevertheless, I think that this work cannot be published in an international journal. In short, the reasons can be summarized in these terms: i) the general organization of the manuscript needs a significant improvement, ii) methodologies do not appear to be technically sound and iii) English grammar, terminology and notations must be corrected in many parts.

Hoping to be useful for the work revision and enrichment, let me point out some deficiencies that I believe crucial for this paper:

i - Paper organization:

i.1 - The description of the employed methods is too concise or confuse and does not form an organic whole, so that the understanding of the analysis development is made quite difficult. For example: variables and their measure units must be stated before they are used (equation 1), a description of the procedure that leads to the hydrographs in figure 2 must be added (subsection 6.2), explanations in subsections 5.1, 5.2 and 7 are extremely poor, distribution fitting methods are not explained;

i.2 - The case study is not sufficiently delineated (especially the reservoir routing aspect);

i.3 - As a matter of fact, results and their potential implications are not critically discussed;

i.4 - The research background could be significantly improved:

i.4.a - Bearing in mind their present popularity and their capabilities, copula functions must be explicitly mentioned and equation (1) should be interpreted in view of this approach (Nelsen, R. B., 2006. An introduction to copulas, second ed. Springer, New York);

i.4.b - When previous research concerning the assessment of flood frequencies and routing storage performances are illustrated (page 9759), I suggest to cite the

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analytical-probabilistic technique, by which peak rate distributions relying on both runoff volume and direct discharge duration have already been derived (see for example: Guo, Y., and Adams, B. J. (1998). "Hydrologic analysis of urban catchments with event-based probabilistic models: 2. Peak discharge rate." Water Resour. Res., 34(12), 3433-3443, doi:10.1029/98WR02448; Guo, Y., and Adams, B. J. (1999). "An analytical probabilistic approach to sizing flood control detention facilities." Water Resour. Res., 35(8), 2457-2468, doi:10.1029/1999WR900125).

ii - Technical soundness:

ii.1 - The role played by the discharge coefficient as uncertainty variable is not clear;

ii.2 - The suitability of the bivariate distribution (1) to fit observed data must be demonstrated by test statistics; to do this I suggest to see Genest's work (Genest, C., Rémillard, B., Beaudoin, D., 2009. Goodness-of-fit tests for copulas: a review and a power study. Insur. Math. Econ. 44 (2), 199-213, doi:10.1016/j.insmatheco.2007.10.005);

ii.3 - The runoff volume is the most important flood quantity when a routing process is considered. In figure 7, the hydrograph derived from the univariate procedure is compared to those obtained by the bivariate approach. It is evident that, in the first case, the flood volume is much smaller than in all the others. Therefore, the comparison of the two methods seems to be inappropriate, and the greater severity of floods derived from the bivariate approach is quite obvious. In my opinion, hydrographs should be constructed by using homogeneous criteria.

ii.4 - The estimation of the return period in a multivariate framework still represents a very sensitive issue and requires caution. Recently, the utilization of the 'AND' and 'OR' return periods underwent several critics. In consideration of the research advances, their use should be avoided. A discussion of this topic can be found in: Salvadori G., De Michele C. (2010). Multivariate multiparameter extreme value models and return periods: A copula approach. Water Resour. Res., 46, W10501, doi:10.1029/2009WR009040. In this paper, a first attempt to properly define a multi-

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variate return period is proposed.

ii.5 - Evidencing the risk value variability between E-3 and E-14 is meaningless (figures from 8 to 13), as well as using such a precision level in table 5, 6 and 7.

iii - Corrections:

iii.1 - Notations must be corrected: for example equations (4) and (5) have the same parameters, when it is obvious that they have different measure units; moreover, the symbol of the location parameters of such Gumbel distributions is also used as reliability index in (17), while the scale parameter is redefined as risk in (16);

iii.2 - Table 2: probably the second column refers to the standard deviation;

iii.3 - Table 3: references to the tested hypotheses lack.

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