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Discussions

Interactive comment on "On the quest for a pan-European flood frequency distribution: effect of scale and climate" *by* J. L. Salinas et al.

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Something went wrong with the formatting in answers 3 and 4, here is the corrected version.

3) I am not fully convinced by the simulation strategy adopted to construct Figure 1b (page 6329-6330). In fact, I find it not completely correct to mix together data from samples with highly different record lengths, because this tends to hide the fact that the sample variability is expected to be much larger in smaller samples. I try to explain my point with an example. Consider a set of catchments with L-cs values around 0.3 C2088(expected L-ck=0.2 for the GEV). Suppose to be in a rather extreme situation, where this subset of basins is made up of 100 catchments where the sample size is 10,

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and other 10 basins where the sample size is 100. The 100 shorter samples have been actually sampled from a GEV, and their observed L-ck will thus be distributed around the expected value 0.2, with a large variability because the sample size is small. The 10 longer samples have in contrast been extracted from another parent distribution, and have their L-ck values distributed around 0.33 with small variability. The simulation will likely not recognize that these 10 series have not been sampled from a GEV, because values of L-ck around 0.33 are included in the range of L-ck values typical of the smaller samples. The null hypothesis that the parent is a GEV would therefore be mistakenly accepted, while it would have been falsified rather easily by separating the samples based on their sample size; in this case, in fact, L-ck values around 0.33 would have been recognized as rather unlikely for GEV samples with L-cs=0.3 and size 100. As an alternative simulation strategy the Authors could consider the following: (i) take one catchment at a time, with its own sample length n, L-cs and L-ck; (ii) generate 50000 samples of size n from a GEV with the same L-cs as the considered sample; (iii) compare the observed L-ck with the distribution of the 50000 L-ck values obtained from the simulation, for example by finding z=P(L-ck), where P() is the empirical cumulative distribution function of the L-ck obtained from the simulation; (iv) repeat this procedure for each available catchment to obtain a sample of 4015 z values, which could be tested for uniformity to verify the hypothesis that each and every sample has been extracted from a GEV. Different z samples could also be obtained by binning the data based on their L-cs value, as done in Figure 1b. This procedure has the problem that sample L-cs values are used as population values, but this is the same hypothesis adopted when applying the method of L-moments to estimate the GEV parameters, and it is thus well supported in the hydrological practice. Moreover, other ancillary hypotheses, as the choice of the distribution of the L-cs and of the sample size (page 6329, line 15-20), may be avoided with this procedure.

Authors' response to 3)

The authors thankfully acknowledge the detailed comment of the reviewer on

this very technical aspect of the paper. The important influence of the sample length on the sample L-moments dispersion was underestimated and somehow mistreated. Only on the estimation of the averaged L-moment-ratios, the series length was taking into account by weighting each value proportionally to the sample length. Additional Monte Carlo simulations have been carried out, in order to correctly address the effect of sample length in the analysis; two strategies have been applied: a) The analysis requested by the referee, i.e. Âń(i) take one catchment at a time, with its own sample length n, L-cs and L-ck; (ii) generate 50000 samples of size n from a GEV with the same L-cs as the considered sample; (iii) compare the observed L-ck with the distribution of the 50000 L-ck values obtained from the simulation, for example by finding z=P(L-ck), where P() is the empirical cumulative distribution function of the L-ck obtained from the simulation; (iv) repeat this procedure for each available catchment to obtain a sample of 4015 z values, which could be tested for uniformity[...]Âż. These simulations try to test the hypothesis that all stations have been drawn from a GEV distribution, based on their local properties. Three new figures are added to show the results of this analysis. b) Following a similar approach as in the previous version of the manuscript, simulations for the regional behavior of Europe have been performed, but this time stratifying the database in series length classes (under 25yr, 25-50yr, 50-75yr, above 75yr) to clearly assess the the influence of sample length on the L-moment-ratio variability. These simulations investigate the L-Ck dispersion with varying sample lengths, as compared with the one present in the database. Figure 1b) is substituted by a similar one, with the simulation results stratified by length classes. Both a) and b) lead to the overall same result, the rejection of the GEV as a single pan-European flood frequency distribution. For more details, see new text in the corrected manuscript.

4) In the part of the paper where the controls on the flood frequency curve are investigated, I think some very relevant controls are still missing, in particular regarding the effect of basin elevation and temperature (through snow accumulation and melting) on *flood formation. Some of the comments reported in the discussion, in particular regarding small-size basins, do not seem to consider the fact that small basins are rather frequently situated at high elevation, and these high-elevation basins typically behave very differently of the low-elevation catchments with similar size. For example, the CV is typically smaller in mountain basins, due to the peak-attenuation effect of snow accumulation and melting. Considering also the mean catchment elevation, along with the catchment area and mean annual precipitation, would help disentangle some of the relations between statistical and morpho-climatic descriptors obtained in Figures 4-7.*

Authors' response to 4)

The authors agree with the reviewer. There are many other significant controls on the flood regimes. In the time of the analysis, only the elemental catchment attributes mean annual precipitation (MAP) and catchment size were available, and actually goes exactly in line with the simplified nature of the approach. From the flood time series, only the L-Cv, L-Cs and L-Ck are available, not the data themselves. From the catchment descriptors, only MAP and area were available as they are more easily and more directly obtainable (results from the survey described in Section 2). Usually mean/median catchment elevation requires additional treatment of the DEM and are not always directly available. Nevertheless, it is true that the interrelationship between elevation, catchment size, temperature and snow effects will be very strong, particularly in the given database, where the presence of mountain catchments in significant. The inclusion of elevation, together with some parametrization of land-use will be very encouraging research direction in better understanding the relationships between the statistical properties of flood regimes and morpho-climatic characteristics. An explicit reference to this research outlook is included in the conclusion of the Part 2 manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 6321, 2013.