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Hydrology and Earth System Sciences Discussions

Interactive comment on "Effects of seasonality on the distribution of hydrological extremes" *by* P. Allamano et al.

Anonymous Referee #1

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The paper shows, by analysing a simplified stochastic model of rainfall extremes, that seasonality can heavily affect design value estimation if it is not accounted for. It also shows that standard goodness-of-fit testing techniques in many cases cannot detect errors due to the negligence of seasonality. The authors find that the magnitude of the bias of estimation of rainfall extremes due to neglected seasonality is larger when peak over threshold (POT) are used than when annual maxima (AM) are used. I really enjoyed reading this paper, which is synthetic, well organised and well written. I therefore strongly recommend the publication on HESS after considering some minor points listed below.

1) While comparing the analytical model and the data analysis I got confused on the

definition of the random variable that is analysed. While the model refers to depths of "rainfall events", for the case study the "daily totals" of precipitation depths (depths for a specified duration = rainfall intensity) are used. When doing the analysis of Section 4, it is assumed that every rainy day (over threshold) corresponds to one event. Wouldn't it be a problem if, for example, the maximum rainfall depths in the region of interest correspond to rainfall durations longer than 1 day? For example, a long storm which exceedes the threshold for many days, would be seen as a series of many storms very close in time. It would be useful to add a couple of lines at the beginning of Section 4 to clarify that the random variable analysed here is not exactly the same random variable of the analytical model and what are the assumptions made.

2) The authors state that the reason behind the better performance of the AM method relative to the POT method probably lies in the greater flexibility of the Gumbel distribution compared to the exponential distribution (those distributions descend from the formulation of the simplified stochastic model of rainfall extremes). This is likely one reason but I would suggest another (more general) one. If the annual maxima happen almost always in the same season (and I guess this is the case for the stochastic model), the AM method works well no matter if seasonality is strong or not (but the estimated alpha_0(AM) and lambda_0(AM) lose their physical significance). POT, instead, by considering all seasons in the analysis, is affected by the fact that the "identically distributed" hypothesis is not satisfied.

Detailed comments:

Page 4792, line 18: is alpha_0 the mean rainfall depth or intensity? I would say depth. If so, the term "intensity" (instead of "depth") is used also elsewhere in the text and has to be checked.

Page 4792, line 18: what does the temporal shift delta represent? If the sinusoids are in phase, then the maximum rainfall depths happen when the storms are less frequent. When they are out of phase, the maximum rainfall depths happen when the storms are more frequent. Specify it with a sentence, so to help the reader.

Page 4793, line 21: add, at the end of the sentence, "which are the values used in our approximation (Eq. 3)" or something like that.

Page 4795, lines 7-8: it is clearer if you call the non-seasonal distribution either "wrong" or "base" in both circumstances (I would use "base").

Page 4796, line 9: why is it interesting to see how RT vary with the parameters lambda_0 and a_alpha? a_alpha defines the degree of seasonality of the storm depths, which is of course of interest here. lambda_0 relates to the number of storms per year. Why is it of interest? Also, looking at Figure 2, RT is highest when there is large seasonality and few storms. Why few storms? If there is an interpretation, it should be added here or in the discussion section.

Page 4796, lines 15-19: is there an interpretation of the change of RT(pot) with delta? If so, it should be added here or in the discussion section.

Page 4798, lines 10-14: it is interesting that for AM the maximum error happens when the number of storms per year is large rather than low, while for POT was the opposite. Is there an explanation for that? If so, it should be added here or in the discussion section.

Page 4799, line 4: see comment (1) above.

Page 4799, line 6: what is the effect of the threshold chosen for the analysis? Would POT with higher threshold work better, approaching the AM performance?

Page 4799, line 21: delta is almost always 0 in the region, meaning that the maximum rainfall depths happen when the storms are less frequent. Is it the case? An interpretation should be added here.

Page 4800, lines 12-16: how would the RT ratios look like if the quantiles were used instead of the return periods? Would the difference between POT and AM be so radi-

cal? Engineers are not so much concerned about the return period to assign to a peak but about the peak value to assign to a return period.

Page 4801, line 20: another reason for the differences observed between POT and AM could be that, if the annual maxima happen almost always in the same season, the AM method works well no matter if seasonality is strong or not. POT, instead, is affected by the fact that the "identically distributed" hypothesis is not satisfied.

Page 4801, line 23: the underestimation of lambda_0(AM) and overestimation of alpha_0(AM) is because the AM analysis assumes the extremes to be identically distributed through the year. So, if the annual maxima happen almost always in the same season, by analysing them and assuming no-seasonality the overestimation of alpha_0 (mean rainfall depth) is to be expected. What about the underestimation of lambda_0?

Page 4805, Fig. 1: according to Eq. (2), delta is in radiant. Shouldn't the temporal shift in Fig. 1 be delta*365/(2pi*n)?

Page 4807, Fig. 3: is the y-axis RT(pot)?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 4789, 2011.