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Natural Hazards and Earth System Sciences
Discussions



# *Interactive comment on* "A data-based comparison of flood frequency analysis methods used in France" *by* K. Kochanek et al.

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A data-based comparison of flood frequency analysis methods used in France

by

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The answer to the Prof. John England

The authors would like to thank kindly Professor John England for the valuable hints and critics. We hope that the alterations made to the text with the answers stated in this document will satisfy the Reviewer.



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Interactive Discussion

Discussion Paper

General comments This is a very nice paper, that is relevant to both researchers and practitioners. The authors have provided interesting data-based comparisons of ïňĆood frequency techniques used in France, with the aim of discerning the best methods based on predictive performance. Overall, this is a good paper with appropriate methods, data and references. The topic and content is appropriate for NHESS, and I recommend that it be published. In my opinion, there are a couple of minor areas that should be improved prior to publication; these include data set details, descriptions of the homogeneous regions (noting effects on regionalizing GEV shape parameter), and some notes on potential future work. There are also some very minor technical corrections that should be made.

SpeciïňĄc comments Page 4449, line 8: you should clarify what is meant by "best FFA methodology" – is it optimal predictive performance (least bias) with the FF reliability criterion? Is it the "easiest" to implement by practitioners (e.g described in a manual and standard software)? Answer: By best methodology we understand best performance of a particular implementation according to the indices described in section 2.3. The suitable explanation will be added to the text.

Comment: Page 4450, lines 5-515 (ExtraFlo project): you should clarify here the purpose of FFA and the ranges of quantiles that are needed in France. This should be obvious, but some readers of NHESS may not be as familiar. Is it for peak ïňĆows Q and quantiles Q_0.99, Q_0.98, Q_0.96, Q_0.50?. Methods presented focused only on Q_0.99, but there is a mention (line 5, p 447) about dams and nuclear powerplants. Methods that are compared here do not appear to be suitable (by themselves) to estimate Q_0.999 without considering multiple methods (such as SCHADEX), so some caveats would be in order here.

Answer: The Reviewer is right. We will add a short definition of the FFA to the manuscript (Abstract and Introduction). We will also discuss in the introduction the variety of FFA applications in France, and the resulting wide range of target return periods. Indeed, small return periods (∼10 years) are sometimes needed for secondary



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infrastructures or for disaster declarations. Hazard mapping typically uses 100-year return periods, while some civil engineering structures (large dams, nuclear power plants) may require 103-104 target return periods. In this paper, we mostly focus on the 10-100 year range. We have not shown any calculations concerning Q0.999 since the input data we have are not long enough to justify such extrapolations, and moreover the data-based comparison framework is not powerful enough to draw conclusions for such large quantiles. This is discussed in section 4.3.

Comment: Page 4451, lines 25-25: you should also point out here sampling variability (record length N) as an additional factor to the parent distribution.

Answer: We maintained equal length of the datasets for all implementations to keep them competitive to each other. We will add a clarifying sentence to the text to state that this ranking holds for one given record length.

Comment: Page 4452, lines 8-9: additional information on the SHYREG model would be useful here. It is critical that the results shown are based on rainfall presumably from the 1987 paper, or was it updated? Can you mention the gridded rainfall and scale, and 1359 stations that are the key inputs? Do these rainfall record lengths vary in time and space? Are they somewhat coincident in time with the daily streamïňĆows? If these precipitation records input to SHYREG are short (say 20 years), how does this help your ïňĄnal conclusions about LOC_SHY?

Answer: We will add more details on SHYREG in the revised version. More specifically, we will mention the following points: âĂć The rainfall database used in SHYREG is fully described in the following paper: Arnaud, P., Lavabre, J., Sol, B., Desouches, C., 2008. Regionalization of an hourly rainfall-generating model over metropolitan France for flood hazard estimation. Hydrological Sciences Journal, 53(1): 34-47. This database comprises 2812 daily raingauges with at least 20 years of data over the period 1977-2002. This database is used for regionalizing the parameters of the rainfall generator (for each season, these 3 parameters are: the average number of storms –



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the average storm intensity – the average storm duration). Regionalized parameters are available on a 1x1 km grid. âĂć Rainfall and runoff records will be coincident every time the runoff record spans the period 1977-2002: this is often the case, as the French gauging network mostly expanded during the 1960's. âĂć Regarding the relative shortness of the precipitation record, we will refer to the following article: Carreau, J., L. Neppel, P. Arnaud, and P. Cantet (2013), Extreme rainfall analysis at ungauged sites in the South of France: comparison of three approaches, Journal de la Société Française de Statistique, 154(2), 119-138. This study demonstrated that the parameters of the rainfall generator are stable with respect to the reference period used for estimation/regionalisation. This is mostly due to the fact that these parameters represent averages over many storms (average number, intensity and duration): they are therefore much less sensitive to sampling variability than more extreme characteristics.

Comment: Page 4456, lines 17-22: You should explain a bit further some details of the data set. Explain that this data also includes the 364 sites from Renard et al (2008) out of the 1076 sites. Or did you extend these records, improve them in some other way, etc.? In the next paragraph, further describe the hydroecoregions, how they were determined (independent of GEV parameters?), and/or provide (in an expansion of appendix A2) the main predictors (A, E, P10, . . .) for each parameter within each region. Given the large number of regions, it is challenging to reproduce the work without knowledge of what covariates were used in the prediction equations for each region. An added bonus would be to show a map (or table in Appendix) demonstrating how the scale and shape parameters varied within France. This would help explain the L+R_GEV results, and possibly defray any comments that the conclusions shown in the paper (related to the Gumbel and Oceanic regions) were not impacted due to using these ïňĄxed, homogeneous regions and constant shape parameter in each.

Answer: We will improve this description along the lines suggested by the Reviewer. More precisely: âĂć The dataset indeed includes the stations from Renard et al. (2008), but it has been updated by including recent years (until 2012) and many more



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stations. This will be explained. âĂć The detailed description of the hydroecoregions is given in the cited paper (Wasson et al., 2004), but we will include a short summary. These regions are based on topographic, geological and climate (precipitations and temperature) maps. Importantly, they do not directly use any runoff data, and in particular they are hence completely independent from the GEV parameters âĂć Concerning the predictors, we use the same four predictors (A, E, P10, IDPR) for all regions, and for both location and scale parameters. This is explained in appendix A2 but the Reviewer's comments suggests this description may be confusing – we will revise it to clarify that the same four predictors are used in all cases. âĂć Regarding maps of scale/shape parameters: the map for the scale parameter is not very informative because spatial variations are too large for this parameter (and note that the regionalization model does not assume a constant scale, not even a constant coefficient of variation). However, we take the Reviewer's point that a figure describing the spatial variability of the shape parameter may indeed be interesting. We will add such a figure either as a map or as a plot comparing locally- and regionally- estimated shape parameters across regions.

Comment: Page 4463, after line 20: I suggest a short sentence or two on the limitation of using predeïňĄned and ïňĄxed homogeneous regions. Given the constant model for the GEV shape parameter, you might ïňĄnd additional improvements by reïňĄning the regions, or performing additional investigations on the regional GEV parameters in space.

Answer: We agree with the Reviewer, and will therefore add a discussion on this point, especially considering the possibility to use region-of-influence approaches.

Comment: Page 4465, end of conclusions: I suggest a short paragraph outlining potential future work. For example, how would you combine L+R_GEV and LOC_SHY distributions, if they are independent? Could you reïňĄne and improve the regionalization procedures with GEV in France, and thereby see signiïňĄcant improvement in L+R_GEV results?



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Answer: We agree with the Reviewer. The improvement of regionalization procedures is similar to the previous comment and will therefore be added. We also like the suggestion of combining L+R_GEV and LOC_SHY: this would indeed yield an approach using both regional and rainfall information to complement local discharge data. Such a combination has been recently discussed in the literature in a series of papers (the "flood frequency hydrology" papers by Merz and Bloschl (2008a,b) and Viglione et al. (2013)). We will add a discussion on this topic.

Technical corrections Comment: Notations on local league and regional league methods need to be corrected throughout the paper. I suggest you use the notation with an underscore "_" as shown in the ïňĄgures, instead of dashes interspersed in the text, as in "LOC_GUM" rather than "LOCGUM". Ditto for LOC-SHY, LOC_SHY and REG-SHY, REG_SHY. In particular, the notation changes in the text to use underscore in section 3.1, rather than the dashes used earlier.

Answer: Good point. This will be corrected in the text.

Comment: Page 4449, line 6: "ambits" is an unusual choice; perhaps there is a better term.

Answer: Perhaps the word 'limits' will be better.

Comment: Page 4457, line 3: deïňĄne hydroecoregions HER here as used in the legend in Figure 2.

Answer: We will introduce the acronym as suggested.

Comment: Page 4458, line 21: replace "regional" with "local" in the phase "for the regional implementations." as Figure 1 and this section refer to the local league.

Answer: Thank you for spotting this mistake. It will be corrected.

Comment: Page 4466, line 9: replace "and" with "an" in "For the GEV distribution, and . . . ".



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Answer: Thank you for spotting this mistake. It will be corrected.

Comment: Page 4469, line 22: correct reference to ïňĄx the “I.o.” before “Institute of Hydrology”.

Answer: Thank you for spotting this mistake. It will be fixed.

Comment: Figure 3: Correct the terms in the legend to LOC_SHY and REG_SHY from SHYPR

Answer: This will be done, thank you.

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 1, 4445, 2013.