

## ***Interactive comment on “Estimating the flood frequency distribution at seasonal and annual time scale” by E. Baratti et al.***

**E. Baratti et al.**

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We are very grateful to the anonymous reviewer for her/his positive judgment about our work and also for suggestions aimed to improve the quality of the paper. The authors' reply is structured as follows, we report all referee's comments (indicated by RC) together with our reply (denoted by AC, Authors' Comment).

RC:

I found the paper to be well-written and the approach interesting; however, the significance of the topic and the new method presented in the manuscript needs further detail for publication in HESS. With respect to this issue, I have included C4616

specific comments below.

1) While the authors do cite other work related to the research on the flood frequency distribution at seasonal scales, further detail is needed about why most of the published literature has focused on the annual series. Why has the seasonal flood not been emphasized in the past? Is it because of record lengths, lack of appropriate methods, or has there not been a need for this analysis? For these reasons, the significance of the authors' contribution is unclear.

AC:

Generally, the flood frequency analysis is carried out by fitting peak flow observations, collected at annual time scale, by using a suitable probability distribution. Nowadays the climate variability on hydrological statistics (and the occurrence of extreme hydrological events) is well known.

Accurate and reliable predictions are becoming extremely important in practical application (e.g. in reservoir operation, the water level should be limited to below the flood control water level during flood seasons; in the river works is important to estimate the flood risk within a given timescale)

The seasonal approach represents a response to the "past", or traditional, flood frequency analysis because is able to capture and better perform the seasonal variation of the hydrological variables.

RC:

2) It might be of value to demonstrate the importance of this new technique by showing the tradeoffs between traditional annual flood frequency analyses versus a seasonal analysis. What new insights are gained by using the seasonal analysis that would have been overlooked in only analyzing the annual peaks? This question lingers to the example - especially the comment on p. 7958, lines 10-12 - where the authors

state that the seasonal distribution is similar to that of the annual. What then were the real gains in the additional seasonal analysis if the result is not much different? Under what seasonal conditions would this method be of value?

AC:

The main goal of this study was to obtain the flood frequency distribution in each user-defined season. In this study, the annual distribution is similar to that of the dominant flood season because the annual maximum observed floods occur during the dominant flood season, since the two observed samples (annual maxima and seasonal maxima observed data) are quite similar.

Theoretically, if we would have chosen different seasons, we would have obtained different seasonal distributions, less similar to the annual maxima distribution.

An example of tradeoffs between traditional annual flood frequency analyses versus a seasonal analysis is shown in Fig. 3, which shows the differences between the traditional (or individual fitting) and the joint-estimation procedure. The figure also highlights the problem of crossing over: for a return period approximately equal to 7-15 yr, the independently fitted flood season distribution (pink dotted line) crosses the independently fitted annual distribution (blue dashed-dotted line). Through the method proposed, the problem of crossing-over is overcome: the probability of one peak value of being exceeded in the entire year is higher than the probability of the same value of being exceeded in one season. We will better clarify this point in the revised manuscript.

RC:

3) I do think the idea presented to express flood timing through directional statistics is quite novel and could have application for flood trend detection. Perhaps this idea might be worth cultivating and presenting further in this manuscript? Could this metric

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be used as a screening method for whether a seasonal analysis of flood peaks is needed? If the authors can provide additional detail about the significance of their work and its advantages over the traditional use of annual peak series, then I do think this manuscript is relevant to HESS and should be published.

AC:

The idea presented to express flood timing through directional statistics can be used as a screening method for whether a seasonal analysis of flood peaks is needed and was used in previous studies (see e.g., Castellarin et al., 2001). Other approaches are also described in the literature, see e.g. Cunderlik et al. (2004), who introduce a new method for the identification of flood seasons based on the directional statistics.

RC:

Editorial comments: Title: Pluralize "scale" p. 7950, line 24: Add "it" before the word "combines" and pluralize "allow" p. 7953, lines 1-3: This phrase, "presents in the second term at the right hand..." does not seem to fit with the rest of the sentence.

A.C:

All these suggestions will be incorporated in the revised manuscript.

## References

Castellarin, A., Burn D.H., and Brath A.: Assessing the effectiveness of hydrological similarity measures for flood frequency analysis, *Journal of Hydrology*, 241, 270-285, 2001.

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Cunderlik, J. M., Ouarda, T. B. M. J., and Bobée B.: On the objective identification of flood seasons, *Water Resour. Res.*, 40, W01520, 2004.

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