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Interactive comment on "Real time updating of the flood frequency distribution through data assimilation" *by* Cristina Aguilar et al.

Anonymous Referee #2

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Main points

This paper aims to assess whether the use of pre-flood season streamflow data can help forecast the probability of high floods. The paper is well-written, gives a nice review of previous literature, and presents a clear goal. The topic has important scientific contributions and societal implications (ability to improve flood forecasting).

My main comment is that the study could benefit from adding a cross-validation of the method. The current results seem to largely be a description of the pattern found for these two rivers. Adding cross validation could illustrate how identifying this relationship can help inform flood forecasting, as well as demonstrate the utility of this method. For example, what if you select years with anomalously high flows, omit them from the fitting procedure, and then assess how much this method improves prediction of floods

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in these years?

Also, it would be good to provide more rationale for Normal Quantile Transform as this choice likely has a big impact on results since floods generally aren't normally distributed. In addition, since meta-Gaussian models aren't commonly used it hydrology it would be helpful to add some more background on them. For example, why don't these models have fitted slope coefficients? Are these models considered linear models? Are the cross-correlation coefficients modified to ensure residuals have a mean of zero? Readers with a more traditional statistics background will likely be looking for these components of the models.

You present a review of LTP in the introduction and the abstract includes that the approach assumes flood formation is driven in part by "long term perturbations". Usually I think of long term as referring to longer than a year, but later you define "long term stress, like higher than usual rainfall lasting for several months". Can you explain a bit more about how you are defining "long term" and the link with LTP given that 9 months before flood season is the farthest back you look at correlation? And that flows before flood season only have positive correlation with during flood season for the Po river for preceding 3-4 months.

I am also curious how looking at shorter record length impacts the correlation between these variables? The data was de-trended and de-seasonalized - does that mean that the correlations shown in Table 3 are stable even for subsets of the whole record you have for these rivers?

More explanation of how to interpret figure 3 would be good for those of us not familiar with these types of figures. Do the regularity values come from which concentric circle the points fall on?

Model residuals appear homoscedastic but what about normality? Perhaps you can mention that meta-Gaussian models don't require the usual assumption about lack of correlation in residuals, right?

It was unclear to me why was temperature was included in the study. Temperature patterns are discussed in the section on long term persistence, but there isn't an explanation of how temperature relates to the model or goals of the study.

The conclusion section is quite short and could benefit from some additional discussion, perhaps something about the utility of the method for other locations and differing catchment sizes. The abstract notes "The proposed technique may allow one to reduce the uncertainty associated to the estimation of flood frequency" – could you could elaborate on this in the conclusion?

Minor comments

The use of the word "significant" should be clarified (as in the abstract and p 12, line 19). Do you mean statistical significance? At what level?

Abstract Lines 15-17: I think this would be clearer if re-organized, perhaps: "To exploit the above sensitivity to long term perturbations, a Meta-Gaussian model and a data assimilation approach is implemented for updating the flood frequency distribution a season in advance."

Abstract Line 20: A word is missing: I would suggest adding "which" before "occurred (ie, "which occurred" or even "occurring" rather than just "occurred")

P 2 Line 11: an "a" is missing before "long time"

P 2 Line 15: "associated with" more commonly used than ""associated to"

P 4 Line 20 Extra word "on" before "the trend"

P 4 Line 24 I suggest adding a comma after "As stated in the Danube River Basin Management Plan" (since it is a dependent clause)

P 4 Line 25 significantly rather than significant?

Page 9 line 18 "was" after a plural sounds strange – perhaps "We applied directional

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statistics. . .”

P 10, lines 4 This makes it sound like 0.71 is a sort of cut off. Perhaps “H values above 0.5” would be better here, reminding us that that is the cut-off of interest. Or you could say “H values of 0.71 or higher”.

P 11 line 14 You refer to table 2 but I believe you mean table 3

P 11 line 15 I’m not sure what you mean by “we appreciate” here

P 12 line 1 Is it really “A goodness-of-fit test” or more an evaluation that model assumptions about the residuals are met?

P 12 line 13 – again, perhaps “we find” rather than “we appreciate”

P 12 line 19 June is mentioned but not shown on the plots? Was that intentional?

P 13 lines 1-3 The text has: “The anomaly in the low correlation coefficient in March previously explained determines an insignificant change in the estimate with respect to the unconditioned distribution.” But it appears that the line corresponding to march coincides with the line corresponding to January, not to the unconditioned distribution.

Figure 4 – I find it helpful to add a horizontal line at 0 when assessing homoscedasticity of residuals. Though I’m not sure we need to see these plots. Just describing them in the text is probably sufficient.

Figures 5-6 Adding a-f markers to each subplot would help with finding the plot being discussed in the text; add labels to y-axes

Figure 7 add to caption that the quantiles refer to flows higher than usual in the previous month.

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