AUTHOR'S RESPONSES TO ANONYMOUS REFEREE #1

These are the Authors' replies to comments from Referee #1, received and published on 21st June, 2018. We use blue color for our replies and black color for Referee's comments.

RESPONSES:

Firstly, we want to sincerely thank Referee #1 for the remarks and recommendations which will undoubtedly improve the quality and scope of the paper.

While introducing floods, the authors state that they are usually characterized through a relation between their peak discharge Q and volume V, and the associated annual exceedance probability. In my opinion, this sentence needs some clarification. In order to define an exceedance probability for a hydrograph (combination of Q and V), a way of comparing two hydrographs is required. In the context of dam safety analysis, this comparison should be made through the maximum water level that the hydrograph attains while it is routed through the reservoir. For some reservoirs, Q is the most relevant variable, while for other V may be the dominant factor. I suggest that the authors add a brief explanation to clarify this issue.

When mentioning Q and V (and their relation with AEP), the authors refer to hydrological variables on which frequency analyses can be applied to estimate the occurrence probabilities of such floods. Further variables (such as the maximum water level that the hydrograph attains while it is routed through the reservoir) depend on the magnitude and frequency of these floods, but also on other factors like the gate performance or the previous reservoir level and thus cannot be directly used to compare 2 hydrographs.

For clarity, the authors suggest the following paragraph:

"*In the hydrological scenario, floods are the initiating event (node) that creates the loads to which the dam is subjected. The probabilities of the emerging branches are defined by the frequecy occurrence linked to the inflow hydrographs (Figure 2 (b)), introducing the temporal component to the risk calculation [consequences/**year**]. These are associated with a given return period (T) or its equivalent annual exceedance probability (AEP).*

Different analyses can be performed to estimate the occurrence probability of these events using deterministic, parametric, probabilistic and stochastic methods (World Meteorological Organization, 2008). Some of them seek relating the magnitude of one or more hydrological variables with T. A widely used approach to characterize this relation is to perform univariate or bivariate frequency analyses of the maximum values of peak discharge (Q_P) and/or volume (V) (Figure 2 (a))."

Regarding the relative influence of Q and V in dam safety, it is clear that this will depend on the characteristics of the dam-reservoir system (a soon to be published work of the authors characterizes the factors affecting this relation). In the approach followed, this influence is revealed when routing the incoming floods through the reservoir (nodes **Maximum pool level** and **Hydrograph (no failure)**).

I also missed a discussion of non-stationary flood frequency analysis. For some dams the hydrological load is mostly estimated through flood frequency analysis. Many studies have been carried out to account for climate change through non-stationary models and a brief discussion of this work would be adequate for a review paper.

The authors agree with Referee #1 about the convenience of including a special mention of non-stationary flood frequency analysis and citing relevant studies dealing with this subject (e.g., Gilroy and McCuen, 2012; López and Francés, 2013).

One more detail: Section 3.14 is titled “Flood routing”. I think “Flood management strategy” may be more appropriate, since the emphasis is not on how you compute the flood wave propagation through the reservoir, but on how you decide how to manage the flood wave to minimize dam risk and downstream damages.

The title "Flood routing" was directly extracted from the document of SPANCOLD (2012) from where the risk modelling approach used in the paper (Figure 1) was taken. Following the title suggested by Referee #1 ("Flood management strategy"), the authors propose to combine both in "Flood routing strategy", which will replace the title of Section 3.1.4 as well as in Figure 1.

REFERENCES

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SPANCOLD: Risk Analysis as Applied to Dam Safety. Technical Guide on Operation of Dams and Reservoirs, Professional Association of Civil Engineers. Spanish National Committe on Large Dams, Madrid. [online] Available from: http://www.spancold.es/Archivos/Monograph_Risk_Analysis.pdf, 2012.

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