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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Quantification of climate change impact on dam failure risk under hydrological scenarios: a case study from a Spanish dam" *by* Javier Fluixá-Sanmartín et al.

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These are the Authors' replies to comments from Dr. Charles Rougé (Referee #1), received and published on 14 June 2019.

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

1) The main reason we haven't included a detailed description of the parameters driven the calibration/validation of the hydrological model is that we didn't want to overwhelm the reader with too much information. However, remarks of Referee #1 are very appro-

priate and will be taken into account when presenting the calibration in Section 5.2.1.

Figure 6 was displayed that way to be clearly readable, but also to present the hydrological data that was available for this article. For instance, the Barco de Ávila gauging station contains only 2 periods with valid data: - From 01/01/1971 to 01/07/1989. - From 01/10/2011 to 30/09/2015. Indeed, the x-axis in Figure 6 starts the 1st of October 2011 (first date of the 2011-2015 data period for the Barco de Ávila station) and ends the 30th of September 2015 (last date of hydrological data). This will be made clearer in the revised version.

The authors agree that a peak magnitudes analysis would benefit the clarity of the paper. The revised version will contain an evaluation of the relation between the discharge peak magnitudes in the model and in the observation series.

Results shown in Figure 7 do not correspond to the correct version of the model used. Instead, they correspond to a version where the seasonal maximum storage limitation was not yet implemented in the model and hence, they are invalid. The authors want to excuse for this mistake and will update a new figure with the correct series, in which the 2001 simulated levels do not exceed the observed ones.

2) (i) The authors agree with the remarks of Referee #1 regarding the uncertainty on the Gumbel distribution's parameters. A sensitivity analysis of the parameters would highlight how results are dependent on the pre-defined choices made. However, it is important to understand the computation cost with which we are dealing: a complete simulation, from the definition of the Gumbel distribution to the calculation of the dam risk, has an average duration of 24 hours. Thus, the computation duration of a sensitivity analysis (which entails several simulations for each case) applied to the ensemble of the 163 climatic models used would be incompatible with the publication deadlines imposed by the NHESS journal. However, the authors suggest performing this sensitivity analysis to the Base Case (present situation) and analyse the effect on its risk results; this would give an idea on how the other cases would react.

(ii) In this case, the annual maxima method has been arbitrary chosen among the different methods available. This has been selected since is a well know technique worldwide. Please refer to the previous author's comment for the convenience of applying a sensitivity analysis.

(iii) This is one of the main limitations of working with daily precipitation data: it is difficult to establish IDF relations when no sub-daily data is available. Thus, in order to deal with this issue, the option chosen was to rely on pre-defined formulations. Indubitably, the study could benefit from a more detailed analysis capable of producing a time-dependent relation for each climate model. However, this exceeds the scope of the paper. Nonetheless, a clarification of these issues and a justification of the method chosen will be included in the revised version of the paper.

Moreover, the effect on risk of gate performance deterioration is displayed in Figure 13. In this figure, the effect of each risk component (Previous pool level, Gate performance, Floods and Social consequences) has been isolated. It is however true that no clear explanation is presented in the text. This will be amended in the revised version of the paper.

3) We agree this is a key and complex aspect in the exploitation of such results. Although a certain general increase of the risk can be extracted from the results, it is difficult to directly define unequivocal recommendations for dam owners and managers. Different factors play important roles when assessing risk management action plans: Are risk acceptable in present situation? And in future scenarios? What are the risk reduction measures envisaged? How long should we wait until we implement them? What is the efficiency of each of these measures? What criteria should we follow to prioritize them? These are relevant questions that can be mentioned (but not resolved) in the paper. Thus, we will make sure that a more complete overview of the problem is introduced, which will help contextualize the usefulness of such approach. It is worth mentioning that this is a line of research that the authors are currently following: comprehensive decision-making support based on future changes in dam

risk. We invite Referee #1 and readers in general to track the authors' supplementary articles that explain next steps of the overall methodology and that are under review in other journals.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-141/nhess-2019-141-AC1-supplement.pdf

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