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## **Comment on nhess-2021-34**

Anonymous Referee #3

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Referee comment on "Review article: A systematic review and future prospects of flood vulnerability indices" by Luana Lavagnoli Moreira et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-34-RC3>, 2021

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### **General comments**

The authors analyze the state-of-the-art on flood vulnerability indices. They assess the different alternatives that have been used in each of the steps that comprise the process of constructing vulnerability indices, pointing out the characteristics and advantages and disadvantages of the methods used so far and highlighting the scientific gaps that remain to be addressed with respect to vulnerability indices.

In general, the manuscript addresses in considerable detail the alternatives used in the different construction steps of vulnerability indices. Above all, I think that the most interesting contribution is the one related to uncertainty and sensitivity analysis and validation, as this is an aspect that needs more effort from the scientific community for its characterization. However, I think it would have been very interesting to also analyze the impact that the decision-making process has on the results obtained, since they usually have implications for flood risk management. Similarly, alternatives to improve the reliability of vulnerability indices are sometimes proposed, but they are explained in little detail in the text (sometimes they are simply mentioned). On the other hand, the methodology used to collect information on vulnerability indicators was not considered in this paper. Indicators are obtained mainly through surveys or consultation of public databases and obtaining the information in one way or another partly conditions the choices that can be made later or, at least, limits the alternatives available at each stage of index construction. I think the authors should consider this for future works. Finally, I would have liked to have found a part of the text discussing the terminology used and how the theoretical framework also determines the methodological choices that are subsequently made when constructing vulnerability indices. The introduction (lines 29-38) gives a brief outline, but I think that this is one of the main challenges facing this field (i.e., standardization of the terminology used and of the concepts to be characterized and included when analyzing vulnerability to floods) and this should have been discussed in more detail.

## **Specific comments**

Line 25: I do not agree with the statement that 'vulnerability is a forgotten aspect in flood risk analysis today'. In fact, as mentioned in the abstract (line 9) and in the introduction (line 29), the characterization of vulnerability is an aspect that, in recent years, has aroused enormous interest within the scientific community due to the paradigm shift we are experiencing with regard to the flood risk analysis and management. On the other hand, I do agree that there is still a long way to go for a truly complete characterization of vulnerability, integrating all its components and dimensions and considering it as a dynamic component of risk (and not a static one, which is how it is usually considered today).

Lines 59-61: It is true that there are no papers questioning the implications of the different choices made when constructing a vulnerability index in the context of flooding, but there are papers that address this issue in general for the construction of vulnerability indices, so I would include some reference here so that the reader is clearer about the context in which the work takes place and the scientific gaps addressed in it (Schmidtlein et al., 2008; Tate, 2012, 2013).

Lines 61-62: As I mentioned before, I would include some references, since there are indeed works that analyze vulnerability from a temporal point of view (as well as spatial), although not really in the context of floods, such as Cutter and Derakhshan (2020) and Cutter and Finch (2008).

Lines 159-163: A distinction is made between works carried out in urban and rural areas; however, there is no definition of what is meant by rural and urban areas. I believe that the criteria considered to differentiate between the two areas should be specified, since they may be different in different parts of the world.

Lines 173-175: This is related to the general comment I made above. These types of variables can be included in vulnerability analyses when the information is obtained through surveys, since they are variables that cannot be measured directly and are very subjective (such as, for example, the one mentioned 'experience with floods'). There are cases in which proxy variables can be included, but they are usually far from the concept to be characterized.

Lines 264-265: I think it would be clearer if a definition or some idea, in a very brief form, about the theoretical framework proposed by Jamshed et al. (2020) is included.

Line 275: The use of Google Trends and, above all, of social networks such as Twitter could be included as additional indicators. However, to mention that the use of these tools could be an alternative to the analysis of the population's risk perception is misleading. Not all areas of the world have access to technology and, therefore, to these types of tools (especially social networks). Therefore, I believe that the simple fact of being able to use them already leaves out of the analysis certain areas of the world, which are also usually the most vulnerable. On the other hand, works analyzing the social perception of flood risk have also been increasing (e.g. Bodoque et al., 2016; Guardiola-Albert et al., 2020). I think it would have been interesting to have mentioned here, even if only briefly, the advances and gaps to be addressed with respect to the social perception of risk and whose advances could help to improve the characterization of vulnerability indicators related to the adaptive capacities of the population.

Line 294: Normally, variables related to population projections are already included among the social indicators of vulnerability indices. I agree that we should try to know how vulnerability will vary in the future, taking into account different scenarios. However, I believe that there is still a lack of knowledge to be able to define with some consistency the scenarios that should be used without their uncertainty invalidating the models themselves.

Lines 306-308: One of the main reasons why the results of vulnerability indices are not validated is because the necessary data are not always available. As mentioned in the article, validation is usually carried out using a secondary database on the number of deaths or the value of economic damages, among others, referring to a specific event or year; however, updated and accurate data on the consequences of floods are rarely available, making it difficult to validate the results.

### **Technical corrections**

Fig. 3: It is difficult to distinguish which bar corresponds to each category because the colors used are very similar. I would have chosen a differentiated color palette and not a range within the same color, such as the one used in blue.

Line 162: The word 'in' is repeated. Delete one of the two words, please.

Line 187: The reference does not have the correct format.

Line 188: Delete the parenthesis after 'e.g.' and before the references.

Line 207: Delete the parentheses before the references.

Line 211: The acronym AHP has not been used before, so it should be defined for the first time here.

Line 215: The acronym ANP should be defined in this line for the first time.

Line 246: The reference should begin with a capital letter after the stop.

Lines 270-271: The sentence 'Therefore, when dealing [...] flood experience (Beringer and Kaewsuk, 2018)' appears to be unfinished.

Line 293: It is necessary to define FRR, as it appears here for the first time in the text.

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