

Interactive comment on “Improvement of an index oriented methodology for consequence analysis of natural hazards: application to the Upper Guil Catchment (Southern French Alps)” by Benoît Carlier et al.

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Comment n° 1: “The title represents the content of the paper, however, it could sound a lot more attractive (and more suitable) if the word “improvement” would be replaced with “Upgrading” or Extend/Expand”. Moreover, the term “consequence analysis” shows the inconsistency in using the terms within the entire paper. “Consequence analysis” in the title is considered the same as “vulnerability assessment” and “potential damage” in the text”.

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Response to comment n° 1: We have taken the comment into account and changed the title of the paper. As recommended we also harmonised the terms used throughout the paper.

Comment n° 2: Clarifications of hazard type, intensity and scenarios: some basic information is missing from the text. Which type of hazard is addressed in the study? The PDI was originally developed for landslides. Nevertheless, the area under study is susceptible to torrential flooding, rock fall, debris flow and avalanches (page 3, line 80 and page 4, line 85-86) and, apparently, the questionnaire was about all hazards. There is a discussion in the literature about vulnerability being hazard or non-hazard related. Physical vulnerability is considered usually hazard related and the social not. This discussion is very relevant to the paper and I strongly believe that it has to be included in the introduction (page 2, paragraph 2). Moreover, the question that often has to be answered when doing vulnerability assessment is “vulnerability to what?”. The issue of intensity in vulnerability studies is a challenging one. How can we include the intensity of a processes within the vulnerability assessment? For example, why do you use indicators such as wall>1,5m? (Figure 5) What if the height of the flood or debris (we still do not know which type of hazard is considered here) is less than 1m? Are you considering a specific scenario before conducting the analysis? And if yes, which one? Please include the issues of including intensity in the assessment of vulnerability and explain clearly how you include it in this study.

Response to comment n°2: We have taken the comment into account and addressed the lack of information on hazard type and scenario. The scenario considered is now cited in the abstract (line 18) and in the introduction (line 116-117). Detailed information is provided in section 2.3: “Flood hazard mapping” (line 254 to 268). Moreover, a discussion on vulnerability assessment was added to the introduction (line 52 to 106).

Comment n° 3: Incomplete literature review: There is some reference to similar studies in the paper, however, there are more studies that focus on the combination of social and physical vulnerability for a number of hazard types and are not referred to in the pa-

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per. For example, Armas and Gavris (2013) combine social and economic vulnerability with housing quality and Chang et al (2015) use vulnerability indicators considering the economic, social, built and natural capital. Moreover, institutional vulnerability indicators have been used by Rogelis et al (2016). Additionally, the studies regarding social vulnerability assessment listed in Table 1 are rather old. Studies like the one of Cutter (2003) should definitely be included but only 4 out of 12 studies listed in Table 1 were carried out in the last 5 years. A discussion on the use of indicators in general and other alternatives is crucial for the paper. The authors begin to do so in page 2 (paragraph 2) but more benefits and limitations of using indicators should be added from the following publication: Papathoma-Köhle, M., Gems, B., Sturm, M., Fuchs, S. 2017. Matrices, curves and indicators: a review of approaches to assess physical vulnerability to debris flow. *Earth-Science reviews*, 171, 272-288. Finally, references to other methods of assessing physical vulnerability (e.g. vulnerability curves), in my opinion, also absolutely necessary.

Response to comment n°3: In accordance with the referee comment, the literature review was completed with recent studies. All the papers mentioned were included and discussed. In addition the discussion on the use of different methods to assess vulnerability was completed according to the referee comment (line 82 to 106)

Comment n° 4: The theoretical background of the paper is rather weak. Different terms are used to describe the same concept throughout the text (see comment 1). This is also evident by statements such as “it was necessary to reassess vulnerability and risk in the area” (page 4, line 90) and “social and institutional vulnerability index” (page 4, line 116). The authors do not conduct risk assessment and they do not assess institutional vulnerability. What is institutional vulnerability anyway and which would be the relevant indicators?

Response to comment n°4: We have taken the comment into account and homogenised the terms used in the text. We modified the text in order to conduct a risk analysis (see fig. 11 A and B). Following the referee comments, we chose to ignore

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institutional vulnerability in this paper.

Comment n° 5: Serious scale issues: the scale used in the study is not clear from the beginning. The social vulnerability index seems to be calculated at community level. However, the PDI is calculated at building level. These two, however, are added in a last step. In my opinion, this needs to be thoroughly discussed in the discussion section and the loss of information and associated uncertainties have to be outlined.

Response to comment n°5: In accordance with the referee comment, we developed the discussion on scaling issues in the third paragraph of the “Conclusions and perspectives” part (line 378, to 393).

Comment n° 6: The aim of the study and the end users of the method are not clearly demonstrated within the paper. Tangible examples of the usefulness of the maps should be more evident and should highlight the importance of the method.

Response to comment n°6: In accordance with the referee comment we clarified the objectives of the study. A first indication on the use of the produced map is given line 116. Other information are given in the “Conclusions and perspectives” part (line 366 to 378 and 395 to 399).

Comment n° 7: Mapping: the maps in figures 7 and 8 are difficult to read and interpret. Who can use them and how? Is it necessary to map the results in this case or would a table showing the scores for each municipality be enough?

Response to comment n°7: We have taken the comment into account and replaced the maps by a table (Fig. 10).

Comment n° 8: The study on the risk perception sounds very interesting. More information on the questionnaire (questionnaire as appendix?) is desirable since this study apparently has not been published individually somewhere else. Some important information should be also included here, for example, what is your confidence level with such a small sample (around 70%?). Is the sample 5% for each municipality? (prob-

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ably not). How did you manage to have a representative view of the socio-economic characteristics?

Response to comment n°8: In accordance with the referee comment more information on the questionnaire is given in section 2.2 (line 229 to 240). The questionnaire is in appendix.

Comment n° 9: Some aspects of the methodology are not clear: -Are all the indicators equally important or did you weight them as well? -Why three indices to make a SIVI when all three are dependent from more or less the same variables? -EaR-C: are (ok, the old farmer houses in some mountain areas have very thick walls and might be stronger). Is this what you mean? (Fig.5) -which score do you give a building which has more than one of the characteristics listed under Ear-D? -Score 0 needs to be discussed. Are you 100% sure that these buildings will not be damaged at all? This brings us back to the discussion about the intensity. A building that is more than 50m away from the torrent will NOT be damaged. For which event are we talking about? -the Cemetery and the Car park in EaR-J are not buildings. -why very important indicators regarding participation, existence of information campaigns and insurance are not considered in the Preparedness, Crisis management and Recovery indices? -why are winter activities (0,8) more “vulnerable” than summer activities?

Response to comment n°9: We have taken the comment into account and modified the text (section 2.2, line 186 to 210) and the figures (Fig. 3, 6, 7 and 10) accordingly. Now there is only 1 social indicator instead of 3. To select relevant criteria and avoid redundancy we use a Principal Component Analysis (PCA). Weights were assigned through an expert weighting with regard to the PCA realised. We consider that older houses are more robust than new ones. To get more details on the weights assigned, we kindly invite you to read the following papers: Puissant, A., Malet, J.P., Maquaire, O.: Mapping landslide consequences in mountain areas: a tentative approach with a semi-quantitative procedure, SAGEO, 1-16, 2006.; Puissant, A., Van Den Eeckhaut, M., Malet, J.P., Maquaire, O.: Landslide consequence analysis: a region-scale indicator-

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based methodology, Landslides, 1-16, DOI: 10.1007/s10346-013-0429-x, 2013. There were problems with EAR-D and we decided to delete this criteria for the present paper. In accordance with the referee comment we changed our weights from 0 to 0.1 to avoid null values (Fig. 4 and 7). In addition, we replaced the EAR-F by a new criteria based on the areas previously impacted by flood (EAR-H area affected by floods; Fig. 3 and 4). Cemetery and car parks were deleted from our building database. These elements are now in our “land-uses” database (Fig. 3 and 4). Following the referee comments, we chose to ignore institutional vulnerability in this paper. As a consequence, the mentioned indicators are not especially relevant for our analysis. In the studied area, winter tourism activities bring more money to the communities than summer tourism activities. Moreover, winter tourism infrastructures are globally more expansive than summer tourism infrastructures (ex: ski resort).

Comment n° 10: Not clear what is the difference between CV and AV and why comparing them. Is it necessary and why you do not refer to it before page 9? Please consider it as part of the methodology and explain clearly what is the difference between the two approaches. Why “Classic” and not “Universal” or “General”?

Response to comment n°10: With regards to the referee comment n° 9, we introduced significant changes in our method. We simplified our social indicator and deleted the text on the difference between AV and CV.

Comment n° 11: Since you present a new methodological approach you should be critical with it at the end. Were there any limitations and assumptions? Which indicators are missing? What are the sources of uncertainty? What are the benefits of the methodology and what are the drawbacks? How can it be improved in the future?

Response to comment n°11: We have taken the comment into account and developed the advantages and limitations of our method in the “Conclusions and perspectives” part (line 366 to 399).

Comment n° 12: The main aim of the paper is the combination of a physical damage

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index with the social vulnerability. Yet, there is no discussion about the added value of this action. Why is it important to combine them? What are the interactions or relationship between the two faces of vulnerability?

Response to comment n°12: We have taken the comment into account and modified the text accordingly. A discussion on the interest of combining social and physical vulnerability together is made in the introduction (line 52 to 81) and the conclusion and perspectives (line 366 to 378).

Comment n° 13: Last but not least, there is a fair amount of grammatical mistakes and typos. The text should be revised if possible by a native speaker.

Response to comment n°13: Following the referee comment, the text was reviewed by a professional translator.

Please also note the supplement to this comment:

<https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-323/nhess-2017-323-AC3-supplement.zip>

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2017-323>, 2017.