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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Assessment of physical vulnerability of buildings and analysis of landslide risk at the municipal scale – application to the Loures municipality, Portugal" *by* C. Guillard-Gonçalves et al.

Anonymous Referee #2

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Overall quality of the discussion paper ("general comments");

This study intends to perform a semi-quantitative assessment of physical vulnerability to landslides of buildings at the municipality of Loures (in Portugal) and an analysis of landslide risk computed as the product of the vulnerability by the economic value of the buildings and by the landslide hazard. It is really appreciable the effort made by the Authors and the topic is of high value for the scientific community and within the scope of the Journal. As a general comment, from the one side, the scientific ap-

proach is convincing and is appreciable the test of generalization process performed by the Authors but, from the other side, the main topic of the research is not totally original. Moreover, an important weak point may undermine the foundations of the research; from my understanding, vulnerability is a really site-specific parameter and, for this reason, the contribution of researchers from different European countries, by the proposed questionnaires, is questionable. In more detail, the conceptual scheme is clear but how much the questionnaires submitted to a pool of European experts may really limit the subjectivity of the vulnerability assessment remains an open question. Vulnerability depends on the architectural and structural characteristics of the buildings (potentially affected by a landslide) that change from site to site, from nation to nation, being strongly site-specific. Moreover, the Authors run up against the important problem of uncertainty given that many parameters taken into account in the risk analysis are source of uncertainty. How much this uncertainty really "controls" the final result (considering each factor composing risk) is not well documented. The English sounds good (but I'm not a native speaker) although some expressions give the impression to be ambiguous and confusing; they have to be rephrased. The paper cen be considered for publication after major revisions.

Individual scientific questions/issues ("specific comments");

Paragraph 1. Page 5550: line 1-2. "Vulnerability is thus difficult to assess and the vulnerability models that have been proposed have a non-negligible uncertainty". I'm wondering if this paper provides some solutions and answers concerning uncertainty given that the Authors suffer the same problems that affected previous vulnerability and risk studies: lack or limited data, generalization and approximation processes, qualitative data, proxies, etc..

Paragraph 3.1. Page 5553: line 10-11. "... the landslides in the study area were slow, very slow or extremely slow ". Probably, it would be better to add also the type of landslides.

Subparagraph 3.1.1. Page 5554: line 4. "... and four scenarios in which the building location is on the foot of the slide". I would like to know if the buildings may be impacted laterally, by the displaced material, supporting dynamic pressures against the walls or, more simply, the buildings only support different vertical displacements affecting their structural components.

Subparagraph 3.1.1. Page 5554: line 10-13. The Authors state: "Physical vulnerability assessment is often based on historical records and on expert judgments and is largely subjective. To reduce this subjectivity, we decided to ask the opinion of a pool of experts". What's the difference between "expert judgments" and "the opinion of a pool of experts"? Are "opinions" so different from "Judgments" really to move from a qualitative to a semi-quantitative vulnerability and risk assessment? From my understanding, contributions from local experts may be even more valuable than European experts' given the skills, experience and expertise they gained in many years of research in the Loures study area: they may provide useful information concerning the damaging events and the degree of loss experienced by the exposed elements in the past. The same is true for the European experts but in their study areas.

Paragraph 3.2. Page 5557: line 5. Is EV a sort of market value of the buildings? If this is the case, isn't available a national Portuguese database and/or (web)service able to provide it directly? For this reason, it could be useful to know if the Authors are referring to the market value or to the (re)construction value of buildings affected by landslides to perform vulnerability assessment. In the former case, each parameter of the formula is needed for calculation; in the latter case, only ACC is needed.

Subparagraph 3.3.1. Page5558: line 15. "Assuming that future landslides would have similar characteristics to the past ones ...". It's a matter of fact that this (old) sentence is becoming more and more questionable with each passing day.

Subparagraph 3.3.1. Page 5558: line 19-21. "In this study, the landslides were considered all together in order to know the probability associated to each Scenario". This

sentence is questionable. The types of landslide considered in the study are too different from each other to be considered all together. Different models (and analysis) for different landslide types.

Subparagraph 3.3.1. Page 5559: line 3. "... We considered that the height-to-depth ratio is 0.5". Why do the Authors choose this value? Please, provide some more information to strengthen this choice. It is an important source of uncertainty.

Subparagraph 3.3.1. Page 5559: line 4-5. "... which is based on some landslides studied in the field whose depth is known". Please, provide references to strengthen the sentence.

Subparagraph 3.3.2. Page 5559 line 10-11. "The susceptibility was mapped using a bi-variate statistical method called Information Value Method (Yin and Yan, 1988) ". Why did the Authors decide to apply this modeling technique? It's a very (too) simple direct method. Moreover, is there any evidence that this method is proper to model deep-seated landslides? Given the well-known skills and expertise of the Authors in landslide susceptibility/hazard assessment, the reader is expecting something more efficient than a simple Information Value Method.

Subparagraph 3.3.2. Page 5559: line 19. "Each map was classified as one of four susceptibility classes". Please, provide more information in the text concerning the classification technique applied given that it strictly controls the spatial variability of each susceptibility class.

Subparagraph 4.4.1. Page 5560: line 21. "Out of the 52 questionnaires completed by the experts, ... ". I strongly recommend to refine the analysis by excluding information coming from the European experts' questionnaires. In this way, it is possible to verify how much the results of the analysis change and, above all, how much the questionnaires submitted to a pool of European experts limit the subjectivity of the vulnerability assessment.

Subparagraph 4.4.1. Page 5561: line 4-6. "Most of the experts who had doubts expressed that it was difficult to assess the potential damage caused by a landslide to a building based only on the depth of the landslide slip surface or the height of accumulated material". It's a matter of fact.

Subparagraph 4.3.1. Page 5564: line 21-24. "The landslides that have a maximum probability of occurrence are the 1m deep landslides and the ones with an accumulated material height of 0.5 m, which have a probability of 0.57. The landslides that have a lower probability of occurrence are the 20m deep landslides, with a probability of 0.02". As a general comment, this sentence provides decision makers with some useful and useless information at the same time. Stating that "20m deep landslides have a probability of 0.02" is useful because it provides decision makers with a low probability value (now, we are not considering the level of uncertainty related to this probability value); stating that "1m deep landslides and the ones with an accumulated material height of 0.5 m have a probability of 0.57" is not as useful as before because we are providing decision makers with a probability value that is not able to discriminate between two alternatives: as throwing a coin in the air. It's a value that cannot support a decision (50% of probability of occurrence).

Subparagraph 4.3.1. Page 5565: line 1-2. It sounds like a universal rule governing natural processes.

Subparagraph 4.3.1. Page 5565: line 12-13. "The landslide susceptibility maps are shown in Fig. 12, with the landslides used for computing and for validating the models." The question concerns the modelling technique applied: have the Authors used the entire landslide bodies or only the scarps to run the model? I suppose they have used only scarp areas, where the detachment occurs and where the "critical combination" of different geo-environmental parameters triggers the landslide (the main aim of each landslide susceptibility model is to define the "critical combinatiosn" and find where there occur in the study area).

Subparagraph 4.3.1. Page 5566: line 5-8. "That is why the "High" and "Very high" susceptibility classes, which have the highest probability of occurrence values during the next years are the ones that those involved in civil protection and municipal planning need to focus on." As a general comment, the long-term overview of the urban and spatial planners makes this information very crucial for them. From my understanding, the same could not be true for Civil Protection in its response and rescue activities (short-term overview).

Paragraph 4.4. Page 5567: line 19. "... independently of other aggravating factors like climate change". As stated before, uniformitarianism is becoming more and more questionable and the influence of climate change has to be considered into the analysis given that changes in magnitude and frequency of many natural processes are visible to all.

Paragraph 5. Page 5567. This paragraph is a mix of discussion and conclusions.

A compact listing of purely technical corrections at the very end ("technical corrections": typing errors, etc.).

Paragraph 3.1. Page 5553: line 10. Change "Cruden and Varnes's (1996) classification" in "Cruden and Varnes' (1996) classification".

Paragraph 3.1. Page 5553: line 14. Change "... some data is available" in "... some data are available".

Subparagraph 3.1.2. Page 5555: line 2. Change "... only data provided and used by this geodatabase is the ..." in "... only data provided and used by this geodatabase are the ...".

Subparagraph 3.1.2. Page 5555: line 7-8. Change "... each basic administrative unit - which is the "civil parish" into sections and subsections" in "... each basic administrative unit (which is the "civil parish") into sections and subsections".

Subparagraph 3.1.2. Page 5555: line 15. Change "... the data which is available for..."

in ". . . the data which are available for . . .".

Subparagraph 3.1.3. Page 5556: line 24. Change ". . . to assess the cost/benefice ratio" in ". . . to assess the cost/benefit ratio".

Paragraph 3.2. Page 5557: line 13. Change ". . . (habitation, store or . . .)" in " (residential, store or . . .)".

Subparagraph 4.3.1. Page 5563: line 25. Change ". . . the data obtained by fieldwork is much more . . ." in ". . . the data obtained by fieldwork are much more. . .".

Subparagraph 4.1.2. Page 5563: line 1. Change ". . . different magnitude landslides" in ". . . different landslides magnitude".

Subparagraph 4.3.2. Page 5566: line 11. Change ". . . this data is not available" in ". . . this type of data is not available".

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 5547, 2015.