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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "The influence of expertise on rockfall failure probability assessment – an original experimentation" *by* A. Delonca et al.

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Dear Referee,

My two co-authors and I acknowledge the two reviewers for their work and their valuable comments. They have allowed us to significantly improve the quality of our paper. In the following we present a response to their comments. If we are allowed to submit a revised manuscript, we also will include in the final document the specific comments made in the pdf document attached by the reviewer #1.

On a general way, it seems that for both reviewers, the objective of the paper is unclear.

The objective of the study is to consider different methods of rockfall hazard assessment, and evaluate the differences in terms of levels of rockfall hazard. The levels of rockfall hazard considered in the study correspond to classical rockfall hazard levels: very low, low, moderate, high (Copons et al, 2008; Bauer, 2011; OFEFP, 1997). These levels are commonly used to build hazard maps, for risk management in urban areas. Thus, it is possible to compare these levels, obtained using different methods. Moreover, the influence of the level of expertise on the result, and so on the obtained hazard levels, is also investigated. The objective of the paper is not to evaluate the "true" level of rockfall hazard, but to compare the evaluation process, considering different levels of expertise and different methods. This general objective has been clarified in the introduction to the paper. Moreover, the comments of both reviewers helped us to improve the clarity of the entire paper.

Reviewer #1 and #2: Both reviewers made comments regarding the concepts and vocabulary used in the paper. In particular, according to them, the concepts of "probability" and "susceptibility" should be clarified. Reviewer #1: A major point of review as far as it concerns the methodological concepts used in this work has to do with the definition of the probability of a rockfall. It is not clearly described in the paper whether this term refers to a spatial or temporal probability of occurrence. The interpretation of the probability as a term depends on the uncertainties that are taken into account for its definition. As a result, probabilities referring to different types of uncertainties cannot be compared, because they represent different values. This point is not clear in this paper and probability concepts are mixed. Reviewer 2: Several descriptors are used for the temporal likelihood of rockfall failures (occurrence probability, temporal probability, susceptibility to failure and failure probability, Tables 1 to 7). This is quite confusing: a) Susceptibility is assessed in the manuscript using both spatial conditioning factors and those related to (potential) temporal occurrence. This does not follow internationally accepted standards (e.g. as the defined by JTC-1 in Fell et al., 2008), in which susceptibility corresponds to the volume and spatial distribution (i.e. size and spatial probability) of potential landslides. Although it is expected that landsliding will occur

more frequently in the most susceptible areas, in the susceptibility analysis, time frame is explicitly not taken into account (Fell et al., 2008). b) In page 9, occurrence probability and temporal probability for applying LPC method are defined as addressing the questions if a rockfall will occur (will the rockfall occur?) and when will the rockfall occur (as the annual frequency of occurrence), respectively. The difference is not clear to me. They provide the same type of information, because a null temporal frequency means a null occurrence probability (the rock fall will not occur). The words used for describing the "temporal probability" (imminent, very short term) does not suggest annual probability but time expected to failure, which is a different random variable. Could you clarify this issue? Time to failure is more difficult to be estimated than annual probability even when monitoring data are available. c) Use of failure probability for a hazard matrix (Tables 5 and 7) can be misleading. A high failure probability means a high temporal probability of occurrence, which typically lowers when landslide size increases. Hazard level increases with both temporal probability and landslide size.

Response:

Indeed, the concepts, as presented in the paper, may seem unclear. In the current version of the paper, we use the following concepts:

- "rockfall failure probability" (line 21, page 2), which refers to the probability that a rock became unstable;

- "occurrence probability" (LPC method), which answers the question "will the rockfall occur?";

- "temporal probability" (LPC method), which answers the question "when will the rockfall occur?";

- "susceptibility to instability" (LPC method), which is the combination of the occurrence probability and the temporal probability;

- "occurrence probability" (SMR-based method), which is a combination of the SMR

value and the site activity.

To simplify and clarify the reading of the paper, we propose to modify the vocabulary. As presented by Fell et al. (2008), the hazard is a condition with the potential for causing an undesirable consequence. The description of landslide hazard should include the location, volume, classification and velocity of the potential landslides and any resultant detached material, and the probability of their occurrence within a given period of time.

Based on this definition (Fell et al. (2008)):

- the term "rockfall hazard"âĂĺis used when referring to the level of hazard (previously called "rockfall failure probability"). It corresponds to the combination of the occurrence probability, the temporal probability and the intensity (volume). We propose to define this vocabulary at the end of the introduction;

- the terms "occurrence probability" and "temporal probability" are not modified into the paper. However, their definitions are modified. The occurrence probability refers now to the question "can the rockfall occur?", and not "will the rockfall occur?". Moreover, as noted by reviewer #2, the temporal probability is defined as the time expected to failure. In other words, the temporal probability is defined by the probability that the failure occurs before an expected delay. It is a parameter particularly hard to evaluate, even when monitoring data are available. However, it is a key parameter in the evaluation of rockfall hazard. We decide to introduce this term in the same way as in the LPC method guidelines (Laboratoire des Ponts et Chaussées, 2004 – in French), as presented in Table 2.;

- the term "susceptibility" is removed, as it is not coherent with the definition proposed by Fell et al (2008). To replace it, the term "predisposition to instability" is used. It corresponds to the combination of: (1) the occurrence probability and the temporal probability, when dealing with the LPC method, and (2) the SMR value and the site activity, when dealing with the SMR-based method. Then, the predisposition to the instability is coupled to the volume to evaluate the hazard level (the news terms will be

used in Table 5 and 7). Using this terminology, it is clearer that both rockfall hazards assessed using the LPC method and the SRM-based method can be compared, because is compared a combination of the predisposition to the instability and the volume in both cases.

Please note that in the study proposed here, the spatial probability is not evaluated. This choice has been made as initial assumption to simplify the analysis, in particular for the students. We believe that it does not remove the relevance of the study.

To go further, we propose to modify the current title into "Influence of expertise on rockfall hazard assessment using empirical methods". This title clarifies the fact that the objective of the paper is not to determine the "true" rockfall hazard, but to investigate the evaluation process considering two different methods, and different levels of expertise. The comparison realized in this study does not allow the best method to be highlighted. It leads to a better understanding of the rockfall hazard assessment process with different levels of expertise, considering two different approaches. This point will be discussed further in the discussion part of the paper.

Reviewer #1:

"The quantification of the probabilities misses explanation."

Response:

In the paper, the probabilities are not quantified for any of the methods. In the LPC method, the parameters and the probabilities are not quantified. In the SMR-based method, only the SMR value is evaluated and quantified. However, to evaluate the predisposition to instability, the SMR value is combined to the activity level, which is not quantified.

In part 3 "Results", the level of rockfall hazard is coded (from 1 to 3). This quantification of the values is used for the statistical analysis. This point will be better explained in part 3 "Results", lines 13 to 18.

"An extensive state of the art on the topic of the calculation of rockfall probability is missing. I believe that before proceeding with some specific points, a general review of the methodological concepts should be made respectively. The methodologies and the results should be better explained and some of the conclusions at the discussion should be checked to make sure that they are coherent with the results. "

Response:

As explained previously, the concepts used in the paper have been clarified. A new definition of the hazard is provided, and the entire paper is now based on this new definition. The different concepts are presented Figure 1. We believe that a better presentation of the concepts will help the reader to better understand the results themselves. Moreover, a better explanation of the objective of the paper will also help for that.

"The English language would need a thorough review as well. "

Response:

The paper has been reviewed by the American Journal Expert (AJE) support team to check the English quality of the paper before submission. However, we have carefully reviewed the language of the paper one more time. Based on the modifications proposed, we hope that you will be agreed to let us submit a revised version of the manuscript. We truly think that this revised version is clearer, and highlights the relevance of the study.

We will be looking forward to be hearing about your decision.

Best Regards,

The Authors

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Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2015-318/nhess-2015-318-AC1-supplement.pdf

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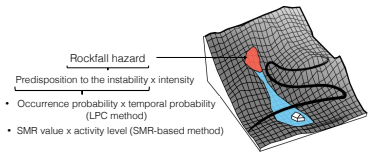

Figure 1. Concepts used in the paper

Fig. 1.