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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Potential and limitations of risk scenario tools in volcanic areas through an example in Mount Cameroon" *by* P. Gehl et al.

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Dear Alicia Felpeto,

We thank you for your comments formulated here and in earlier stages of this review, as they led to improvements in the manuscript. Please find below some responses to your questions/comments.

1. Relevance of the contribution of the authors and adaptation of the seismic risk scenario toolbox

The main goal of this paper is less to describe the various additions that have been made to the existing toolbox than to address the different challenges and potential

solutions that stand in the way from transposing approaches used in seismic risk scenarios to the field of volcanic risk. In practice, we started from the original seismic risk toolbox and we identified what was missing to reach that goal, before implementing a first set of recipes. Our contribution was therefore to we design and adapt an object-oriented based software initially developed for seismic risk scenario designs and to extend its capabilities to take account of existing damage functions in the field of risk assessment. We also think that our critical assessment of what can be expected from this types of tools (Discussion) can be useful in future damages assessment studies.

Regarding the detailed list of remarks, please find a few detailed explanations below:

(1) Aggregation of successive damages: the computation of successive damages (in the sense that some vulnerability models based on intermediate damage states would be used) is currently not undertaken in the tool, although this could be readily integrated in the present architecture. We proposed here to use an inventory removal strategy: this feature constitutes a small yet important step towards the proper computation of multi-event scenarios. Therefore one first advantage is actually the flexibility of the tool to update the functions as soon as they could become available. Figure 6 has been slightly modified in order to make the procedure clearer. However, this figure is very focused on explaining how damages are updated for linear and area-like objects. The general approach remains the general flowchart presented in Figure 1.

(2) Vulnerability models: In the application to Mount Cameroun, three different types of vulnerability models have been actually used (binary, deterministic intensity-damage matrices and fragility functions). We agree that the use of the fragility functions seems very limited and that the models we input in the case-study seem to do very little justice to the general framework approach. However, it should be kept in mind that the lack of probabilistic vulnerability models (i.e. fragility functions) for all types of adverse events and all types of exposed elements was the limiting factor here. The proposed method has no limitation in terms of the vulnerability models used, yet it is the actual models that are still missing (with the noticeable exception of tephra fall and earthquake vul-

nerability models). This prevents from using only probabilistic functions for instance. We believe that this very simple and probably incomplete application serves also the purpose to show what can be done using the current available vulnerability models. This may also highlight the efforts that should still be undertaken in order to be able to design more accurate scenarios.

(3) Impact on crops and cultivated areas: Here, as you noticed, we just added another asset, following the same architecture as for built areas. However this constitutes nonetheless an important feature because damages to crops during volcanic eruptions is of paramount important to communities exposed to volcanic risk in Mount Cameroon. We believe that this paper can show that considering the impact on crop is relatively straightforward and should be done systematically. It should also encourage the development of adequate vulnerability models for vegetation, which is a field in which much experiments and development is needed.

2. Description of the volcanic scenario

The scenario provided in this article is based on the eruption of 1922, but hypothesizing that the eruption occurs on another flank of the volcano. The plausibility of this scenario has been confirmed by field surveys. The sequence of the hypothesized events is now provided in the article and in Figure 9. However, we would like to add that this paper is focused on the methodological aspects of risk scenario tools developments rather than the acute description of the scenarios themselves (the last involve the communication policies of the responsible authorities). Moreover, the definition of the eruption scenario is not the main purpose of this article. On the contrary, we focus on the capacity to evaluate the potential damages using semi-automatic tools. Since this topic has been much developed in the field of seismic risk recently (e.g. Sedan et al 2013), we believe it is time to address this scientific topic in the field of volcanic risk as well.

3. Scenario results

The new version of the article published in NHESSD includes a completed table pro-

viding a better understanding of the ratio of intact/damaged components (consideration of intact assets). Regarding the built area, the proportion of collapsed roofs is at first due, in this particular scenario, to the complete destruction of the buildings (see building damage table) due to other adverse events such as landslide, lava flow, and so forth – which automatically implies the destruction of the roofs (since they are part of the destroyed buildings). Then, again in this particular scenario, when the impact of the tephra fall is assessed, an additional proportion of destroyed roofs is given by the fragility functions from expressing the collapse probability with respect to tephra load: therefore no intermediate damage state has been used in this simple application. This example illustrates the importance of considering an inventory removal strategy in order to prevent destroyed components to be counted twice in the global damage assessment. We added some clarifications in the manuscript to discuss the meanings of the results in Table 2.

4. References

We agree that some of the literature quoted in this paper is based on very recent or still on-going projects, which are still in the process of producing peer-reviewed publications. However, we think it is important to refer to the authors of previous studies (even unpublished in scientific journals), which helped us to set up this overall approach for estimating damages. To respond to this comment: we added an Appendix (A to C) summarizing some key results which we gathered from previous studies (e.g. Thierry et al., 2006) to set up the basic material used in the approach presented in this paper. We also added a more precise link has been added to the reference of Franchin et al. (2011) in order to help the reader finding the report more easily. Moreover an additional reference to the SYNER-G methodology (Franchin & Cavalieri, 2013 – book chapter) has been added.

Thank you for the time you dedicated to this review,

Best regards

Pierre Gehl and Gonéri Le Cozannet

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 1, 1081, 2013.