

Response to Referee 2

We would like to thank the referee for the time and effort put into reviewing the manuscript. We greatly appreciate the constructive comments, with which we in general agree. With this response, we aim to address the issues raised in the review and propose changes to the manuscript accordingly. We believe that the implementation of such changes will considerably improve the overall quality of the revised version of the manuscript.

Comment 1

In the Introduction the authors made a quite tricky statement when comparing empirical to synthetic approaches in vulnerability assessment: Their main argument is that the relatively scarcity of observed damage makes it difficult to derive vulnerability functions from empirical data, and to validate and calibrate them. In contrast, they state that a synthetic, expert-driven approach may be better because the issue of data availability is solved. My concern about this statement is that also experts may be wrong, and – on the other hand – also the empirical models available make usually a statement about uncertainties (see e.g., Kreibich et al. 2010 for commercial buildings exposed to river flooding, Thielen et al. 2008 for residential buildings exposed to river flooding, or Totschnig and Fuchs 2013 for residential buildings and guest houses exposed to torrential flooding). According to my opinion it is rather the assumed normal distribution with respect to the degree of loss which makes these empirical models susceptible to computational errors, but empirical models are not per se unsuitable in this context. Empirical models are rather suitable to explain observed damages, but of course not necessarily to explain the influence of different buildings parameters that may have led to these losses. Also synthetic models based on expert assumptions or other assumptions are prone to failure – if the assumptions made are not entirely suitable to explain certain system behaviour (subjectivity in evaluation).

We agree with the Reviewer that a better explanation regarding the comparison of expert-based models with respect to empirical models is necessary. We did not mean that the former are always better or more correct than the latter. Instead, we highlighted the limitations of empirical (data-driven) models when data are scarce, as well as the lack of transparency (and therefore of understanding) of the damage mechanisms. In the revised paper we will rephrase some sentences in the introduction paragraph to better explain that in some cases empirical models are suitable while in others synthetic models could be adequate.

We also agree that synthetic models can fail when expert assumptions are not entirely suitable to explain certain system behaviour, and will add this consideration in the revised version of the paper.

Comment 2

The three bullet points mentioned in the Introduction, page 2, lines 30ff. are not exclusively valid for synthetic models, but also for empirical models. Papathoma-Köhle et al. (2015) have nicely shown this with their “Loss assessment tool for landslides”.

We thank the Reviewer for referring us to the paper by Papanthoma-Kohle et al., which has been added to the references. The three bullet points will be moved up in the introduction paragraph and it will be made clear that they can also be valid for empirical models.

Comment 3

In Fig. 3, the observed damage is plotted against the modelled damage. This Figure shows that the synthetic approach presented in the manuscript also has to deal with larger uncertainties, and tends to overestimate smaller losses and to underestimate larger losses. This can be also observed by lots of empirical approaches, and makes the initial statement that only empirical models have the challenge of extrapolation and transferability to other case studies than there were developed. So here I suggest that the authors should also weak their arguments in the Introduction section accordingly.

We agree with the Reviewer that also the synthetic model can be affected by large errors as it is shown by Fig. 3. As mentioned in the first comment, the introduction will state more clearly that also synthetic models are characterized by unavoidable limitations.

Comment 4

The structure of the manuscript is a bit difficult to follow: some of the paragraphs provided in the Results section (e.g., those on validation and sensitivity analysis) should be split: the methodological part should go to the Methods section. This will increase the accessibility of the text.

We will take the suggestion of the Reviewer and reorganize the paper structure, such that the description of the model will contain everything related with the methodological aspects. Regarding this topic, please refer to the second paragraph of the response to Referee 1 - Comment 1 as well.

References

Papathoma-Köhle, M., Zischg, A., Fuchs, S., Glade, T., & Keiler, M. (2015). Loss estimation for landslides in mountain areas—An integrated toolbox for vulnerability assessment and damage documentation. *Environmental Modelling & Software*, 63, 156-169.