October 7, 2020

Dear Editor, Dear Reviewers:

Please find described in this answer letter our replies and summarized changes made to the manuscript *nhess-2020-213*. In addition to the comments and suggestions raised by reviewers, we have carefully checked the manuscript again, and while doing so, moved all Figures from the end of the manuscript to within the body of text. We have also revised Figure 4 to improve readability. In the following, please find our detailed answers to the reviewers:

Comments by RC1

1. Comment: *Excellent article, standard structure but very efficient. Well done.*

   Reply: Thank you very much for this positive feedback.

Comments by RC2

1. Comment: *Since the paper uses random forests by Breiman (2001), this latter work should necessarily be cited, to my view.*

   Reply: This is indeed an unfortunate omission. We have included the reference to Breiman as suggested (cf. line 102).

2. Comment: *Moreover, some basic information on random forests (see e.g., the review paper by Tyralis et al. 2019) should be provided (e.g., in an Appendix). This could be made by emphasizing the appealing properties of the utilized variants for the application of interest (see again the review paper by Tyralis et al. 2019). More generally, I feel that it would be particularly relevant to answer key questions like the following ones: Why are random forests selected in Scheuer et al. (2018) and herein? Could they be replaced by other machine learning algorithms?*

   Reply: Thank you for this comment. We agree that it is very useful to include more detailed information on random forests in particular, and machine learning in general. However, we also feel that care is needed not to overstretch the scope of the manuscript. Trying to find a balance between these two points of view, we have included a statement on the advantageous properties of random forests as suggested (ll. 104–106), and also included additional references—the review of Tyralis et al. as well as Hastie et al.—for further reading (l. 106). We additionally emphasize that the random forest model used could be replaced by other methods of statistical learning (ll. 334–335), as has been pointed out. However, while doing so, we have refrained to go too in-depth to remain within the intended scope of the publication, which we see more on the application side of an existing model, and less so on discussing the optimal approach to creating said model. However, we emphasize a clear reference to the Scheuer et al. (2018) paper as the fundamental base of the current applied manuscript.

3. Comment: *It should also be noted that several references provided in Scheuer et al. (2018), such as Liaw and Wiener (2002), and Ishwaran et al. (2008, 2011), seem to be relevant in this paper as well. Currently, only the R package spdep is cited in the manuscript, while all the exploited R packages should be cited.*

   Reply: Thank you for this very valid point. The random forest that is re-use in the presented case study has been trained and evaluated using the *randomForestSRC* package described in *Ishwaran et al., 2008*. We have revised the manuscript so that the relevant R packages are included in the text, and we have added the citations accordingly (l. 184).

4. Comment: *A short summary (additionally to lines 110–113) of the experiments carried out by Scheuer et al. (2018) could built some extra confidence in the use of the pre-trained random forest model. This summary could again be given in an Appendix.*

   Reply: Fair point. Similar to your comment above, we agree that additional information may be beneficial. Following your suggestion, we have therefore included a statement on the overall performance of the model as published in Scheuer et al., 2018—cf. ll. 186–190. To keep the scope of the manuscript within feasible limits (also looking at cost of publication), we refrained from in-depth paraphrasing due to the level of detail and explanation required.

5. Comment: *Furthermore, basic information on selected machine learning concepts could be provided. This information could be particularly important, given the technical character of the manuscript. The reader could also be referred to several specialized books (e.g., Hastie et al. 2009; James et al. 2013; Witten et al. 2007), for further information.*

   Reply: As we will not be able to realistically provide a comprehensive review on machine learning methods within the scope of this manuscript, we followed your suggestion to refer the reader to the respective literature (ll. 106).

6. Comment: *The abstract could be revised to better reflect the novelty of the work. For instance, it could start with lines similar to the following: "The most common approach to assessing natural hazard risk is by investigating the willingness to pay in the presence or absence of such risk. In this work, we propose a new (also indirect) approach to the problem, i.e., through residential choice modelling".*

   Reply: Thank you for this suggestion. We have revised the abstract accordingly.

7. Comment: *Some hints on how the title should be perceived could also be provided in both the abstract and the introductory section. For instance, one could think that the paper is about forecasting (which is not the case).*

   Reply: We agree with your comment in that the case study presented it is not about a direct forecast per-se. However, we are convinced that the identification of previous and by extension ongoing trends may be a suitable proxy to forecast. The elicited trends reveal shifts of or reinforcements in spatial patterns that we consider a relevant contribution to explore the spatiotemporal dynamics of vulnerability and exposure. To emphasize our understanding, we have rephrased the abstract as suggested (l. 9) and, additionally, have emphasized this also in the introduction more clearly (l. 99).

8. Comment: *Finally, there are very few typos in the manuscript. For instance, in Figure 2(b) the right big box (including 16 cells in the INSPIRE grid and 256 cells in the SHU grid) is larger by four cells in the INSPIRE grid than the one marked in the middle sub-figure of Figure 2. Another example exists in Table 2, in which "pensioner" should be replaced with "pensioners".*

   Reply: Thank you for this comment. Unfortunately, these errors went unnoticed. We have changed the Figure in question accordingly and have also corrected the mentioned typos. The manuscript additionally underwent another round of careful proof-reading.

Sincerely,

Sebastian Scheuer, corresponding
author