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S. Fuchs, M. Keiler, A. Zischg: The hostel or the warehouse? Spatiotemporal exposure assessment for natural hazards

In the paper an amazing and outstanding data set containing the total building stock in Austria is analysed with regard to exposure to mountain hazards (torrential floods and avalanches) and river floods. The main aim is to investigate whether rising disaster losses can be attributed to land use development and growing exposure of assets.

The paper is well-structured and well-written. Due to the uniqueness of the data set (apart from a flood exposure analysis for the Netherlands, to my knowledge, such detailed data have not been analysed for an entire country) and the multi-hazard perspective of the investigation the paper should be considered for publication. The analysis is well done. However, a few amendments should be made before the paper can be published. In particular, the discussion section should be revised and extended. In the current version too many results are repeated and too few explanations for the findings are provided. Furthermore, the results are rarely compared with the results of the mostly local studies that were mentioned in the introduction; some topics are completely missing. To be more precise, I would suggest following a similar structure for each aspect. An aspect could be e.g. the exposure of the total stock building to natural hazards. The discussion could then be structured as follows:

- What was the average outcome of the analysis?
- Which regional differences were found? Which regions were above average, which ones below (Min/Max)? Why?
- Which differences occurred with regard to the different hazards? – floods, torrential processes, avalanches and multiple hazards – in general and in the regions – How can these patterns be explained?
- Are there comparable local studies? Are the results consistent? If not – any explanation?
- How certain/uncertain is the analysis?
- What are the implications of the results?

In addition, the following aspects should be discussed:

- For the flood exposure analysis the 100-year flood was taken, while the analysis of the mountain hazards is based on events with return periods of 150 years. You should discuss how this difference may influence the results and what role the chosen return period could play. Would the outcome be very different if you investigated the 300-year events?
- Furthermore, the differences between the hazards should be reflected with the land use regulations that are in place. This is briefly mentioned on p. 2436, line 6/7, but it is hardly understandable. Provide some more information (in section 4, not only in section 5).
- The exposure of people is not discussed well. Please add.
- I like the very rough estimate on the exposure of the building stock until 2100. However, no removal of buildings is considered. In a timeframe of 100 years, it is likely that a given percentage of buildings will be destroyed. At least, this aspect should be mentioned. Furthermore, the numbers demonstrate well that – besides prevention by spatial planning – other risk reduction measures are needed to decrease exposure. Protective measures are

mentioned. I feel a reduction of vulnerability and the role of object-based mitigation measures, retrofitting etc. should also be discussed.

Some minor aspects are:

The title should make clear that the data are from Austria and the meaning of the first part of the title is hard to understand. I suggest: “Spatiotemporal exposure analysis of Austrian buildings to multiple hazards”.

Abstract: In its current version, the abstract is lacking important information and there is (too much) focus on the results. You should start with a sentence explaining the problem and your aim. In addition, the data base that was used should be mentioned and the methods should be briefly described.

p. 2421, line 11-13: I do not agree with the description of Fig. 1. I can’t detect a decrease of 60 % between 1960 and 2000.

p. 2422, line 3 and 4: rephrase (the relative clause doesn’t make sense)

p. 2422, 13 and 21 (and several other lines): I’m not a native speaker, but I don’t like the phrase “endangered area”. In the context of natural hazards, I would suggest “hazard-prone area” or more specific “flood-prone area”.

p. 2424, line 4/5: eHORA is not unique. In fact, after the 2002-flood, the German ZÜRS-system served – in many aspects – as a prototype for HORA. Meanwhile, the information content of HORA is, however, much larger than the information provided by ZÜRS.

Section 2.2: Some information on the building classification shown in Tab. 3 and Fig. 2 should be provided. What is a pseudo-building? Give some examples for “other buildings”.

Section 2.3: The methods that are referred to in the second paragraph (line 16 to 24, p. 2425) should be briefly described. The same holds for the population register (line 11 and 12, p. 2426).

Section 3.1; Fig. 3 and presentation of the results in the text: The legend is not well readable and I was wondering whether the mean number of buildings is really a good indicator.

Section 3.2; Fig. 4 and presentation of the results in the text: In the figure caption, the explanations for the sub-figures a) to e) are missing. Please add.

p. 2430, line 18: “both curves” is not well referenced. Which two curves are meant?

Section 5: Of course, the provision of object data enables detailed analyses. However, I feel that some of the conclusions presented on p. 2436/2437 are not well supported by the performed analyses, but by a general preference of the authors to conduct object-based analyses. For example, in many cases the hazard information is uncertain and does actually not legitimate an object-based, precise analysis (or an object-based presentation of the analysis, also due to data privacy). The building values are still estimated and contain huge uncertainties as well. The allocation of investments to areas with higher assets at risk might lead to social injustice (richer regions are better protected than poorer regions). In addition, this could also be regarded as a kind of reward for

mismanagement in former land use planning procedures. And I don't find the proof in the paper that such an allocation of money could not be done by an assessment based on aggregated land data.

Table 1 and 2: Why is Fuchs and Zischg (2013) given as source? I thought the data were provided by the Austrian building register.

Figure 2: The colours of the dashed lines for river and torrential flooding have to be swapped.

Figure 4: see above; the font is too small; why were "non-exposed buildings" considered in Fig. 4a, while the red line in Fig. 4b refers to "Total amount of buildings". This should be consistent in both figures. Ideally, the information for both categories should be provided.

Despite my critical comments I am really looking forward to a revised version of the paper.