Journal: NHESS
Title: **The hostel or the warehouse? Spatiotemporal exposure assessment for natural hazards**
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The objective of the paper is *"to show how detailed property level data can be used to improve the understanding of trends in hazard exposure on a national level, and how this knowledge provides valuable input for local-scale natural hazard risk management".*
To this aim authors make use of several local datasets to derive the spatio-temporal evolution of exposed buildings in Austria.
Despite the paper is well written, supplies all the information which is required to replicate the analysis in other areas, includes significant results, and is of interest for the academic audience, in my opinion the two main research questions are not fully addressed by the authors which mainly limit to describe findings in terms of spatio-temporal evolution of the building stock in Austria.
In the following the main shortcomings are supplied along with specific comments on minor issues that prevent the publication of the paper in the present version.

Major criticisms

The first research question (i.e. to show how detailed property level data can be used to improve the understanding of trends in hazard exposure on a national level) is actually not addressed by the paper. Despite authors state "The results presented confirmed that a spatially inclusive and comprehensive assessment of exposure provides more insights compared to previous studies" such a comparison is not supplied in the paper neither with local-scale studies or studies implementing aggregated data. Such a comparison would increase a lot the significance of the paper; the advantage of using object-based data to analyse national trends is actually the main innovative and promising aspect of the research. Of course major efforts must be balance by improved information.

Also the second research question is not addressed by the paper (i.e. to show how the knowledge of properly level data provides valuable input for local-scale natural hazard risk management). Advantages reported in the conclusions section are general advantages of an object-based approach with respect to aggregated approaches, as corroborated by the fact that several scholars are quoted in the list of benefits. Benefits of object-based approached should be included in the introduction section to stress the importance of the research. In my opinion, the point risen by the authors cannot be considered actually a research question. It is quite evident that more detailed data are the bases for most robust, target decisions and strategies. However, it would be interesting in the paper showing some real evidences of such advantages, starting from results.

The discussion section is actually a continuation of the results section, partly repeating some results and adding some information. I think that the two sections must be merged while the discussion section should focus more on the research question(s).

Specific comments

<u>Title</u>

I think the title should better recall the methodology (i.e. property level analysis) adopted in the paper

<u>Section 1</u>

Pg 2421 line 4 *"A review of Fuchs et al. (2013) has shown that overall conclusions on the dynamics of natural hazards, including floods, landslides and snow avalanches, may be challenging due to the inherent complexity behind data"* → At this stage of the paper it could be sensible to explain/recall such complexity.

Pg 2421 line 23 *"the effects of dynamics in exposure have so far not been studied sufficiently as a possible reason behind the process dynamics shown in Fig. 1"* → This is a very critical point. While correlation between exposure and damage is quite easy to explain, the analysis of the correlation between exposure and the number of events requires a deeper investigation, on how built-up environment influences the natural dynamics of hazard events (e.g. because of soil impermeabilization, less space for rivers, etc.). In the following, the exposure and the number of events are often compared, according to me in a wrong way (see comments to section 4). Is the intention of the authors to deal with this complicated topic? Otherwise exposure should be compared with observed damages along the paper.

Pg 2422 line 5 *"Such – often conceptual – studies related to the temporal dynamics of exposure to mountain hazards include both the long-term and the short-term evolution of risk indicators"* → Not clear please specify

Section 2

Pg. 2424 line 7 *"... on more than 25 000 river km".* It should be interesting to know which is the percentage with respect to the total length of rivers in Austria

Section 3

Pg. 2429 line18 *"It can clearly be shown that snow avalanche hazard is not a major threat in the country, even if individual events occurred leading to considerable economic loss in recent decades"* → what it is shown is that exposure to avalanches is less than exposure to other hazards. No conclusions can be inferred on avalanche hazard.

Pg. 2431 line 4 *"a slight increase in the amount of elements at risk"* → of "new" element at risk?

Section 4

Pg. 2433 line 10 "*a heavy increase in the entire building stock but also in exposed buildings is evident for the last decades (Fig. 4a). This growth of around a factor of six and a factor of four (snow avalanches) supports the suggestion that increased physical and economic exposure may be responsible for occurring losses even if loss data from the European Alps cannot directly support this conclusion: an analysis of destructive torrent events between 1950 and 2008… had shown a decreasing trend related to the overall number"* → Confusion is made here among correlation between exposure and damage, and correlation among exposure and number of events (see comments in section 1). As authors state in the following of the paper "the number of documented hazards as shown in Fig. 1 should not directly be used to draw conclusions on the development of losses and exposure".

Pg. 2434 line 3 "*a time lack between actual planning decisions and their effects on risk becomes evident"* → For a better understanding, it could be useful to know when hazard mapping and hazard oriented land use planning was introduced in Austria. Please, correct "lack" with "lag".

Pg. 2434 line 6 *"the ratio of annual constructions inside endangered areas is already decreasing starting with 1945 by reason of the relatively high amount of non-exposed buildings in Austria (almost 87% of the entire stock)"* → Why "by reason of the relatively high amount of non-exposed buildings in Austria". Not clear, please specify.

Pg. 2434 line 22 *"More precisely, the fewer buildings are exposed in comparison to the entire buildings stock, the longer land-use regulations enacted today will take to show success"* → Not clear, please specify

Section 5

Pg. 2435 line 21. "River flooding regularly causes economic loss of relatively low size per building, but affects larger regions than mountain hazards and may therefore produce a higher cumulative loss. In contrast, mountain hazards occur more locally but affect also human life". This is not evident from the paper, References are required.

Pg. 2435 line 9 *"It has been shown that the repeatedly-stated assumption of increasing losses due to continued population growth and related increase in assets has to be opposed to the local development of building stock"* → is it right? I think that it's the opposite. Data show that both the amount and the economic value of exposed assets are increasing. Even if grow rates are decreasing they are always positive, which means that exposure is increasing. The meaning of the sentence is not totally clear to me, please better explain.

Pg. 2436 line 11 *"It can be concluded that an object-based assessment has clear advantages compared to the traditional aggregated computation: exposure to natural hazards is heterogeneous, and follows small-scale patterns which cannot necessarily be satisfyingly modelled with the common approaches of aggregation".* The point is not "aggregating or not aggregating". Authors aggregate too. The crucial point is the level of detail of original data and the respective accuracy of aggregated data. I think this should be discussed.

Bibliography

I did not check the bibliography at this stage of the review. I reserve to do this in a second time.

Tables

Tables 1 and 2. It is not clear whether presented results come from the present paper or a previous one. In the last case, the discussion and presentation of these results should be reduced in the paper, reminding to the quoted reference.

Figures

Figure 3 is two small and difficult to read.

Figure 4. A caption is missing describing the meaning of the different plots (a,b,c,d,e). This reduces the comprehension of the figure. Figure 4 is too small.