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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "On the role of building value models for flood risk analysis" *by* Veronika Röthlisberger et al.

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Authors' responses to reviewer #2

We would like to thank reviewer 2 for the constructive feedback to our manuscript. We much appreciate all comments and suggestions and will adopt most of them without reservation. Please find below all reviewer's comments and the authors' replies.

RC2_1: The title is interesting, I like it. However I feel like the connection between the content of the paper and the title isn't very good yet. The role of building value models in flood risk analysis gets very little attention compared to building value models in general. Could you either come up with a new title or reframe the abstract, introduction and conclusion a bit so the link between the paper and the title is better.

RC2_6: In this paper a clear separation is made between exposure and vulnerability. This is common in the literature. However, exposure values can also be combined with the vulnerability in flood risk analysis, for example in an absolute damage functions. This has the advantage that you only need one model rather than an exposure value model and then a model to estimate the damage fraction to be multiplied by this exposure value. An example of this setup is Wagenaar et al. (2017) which used Machine Learning methods and damage data to directly estimate the damage. These estimates are based on both hazard and exposure characteristics. Implicitly such models therefore also include an exposure valuation model. Could you discuss the benefits of the two step approach taken in this study (exposure value separated from vulnerability)?

ARto_ RC2_1 and ARto_ RC2_6: We will take up these highlighted issues in the manuscript. Accordingly, in section 1 (introduction), more attention will be paid to the role of building value models in flood risk analyses and on alternative approaches (models using absolute damage functions). Section 4 (conclusions) and the abstract will be revised accordingly.

RC2_2: On Page 9, line 20 you state that attached buildings are counted as one building, this is quite different from other models that I know. Maybe this is why you find the extreme values so important? I can imagine uniform models perform really bad because of this. This also makes the building stock of a particular area very important for the model performance with a uniform value. Maybe discuss this assumption behind the paper a bit better because it could make the results not applicable to other areas.

ARto_ RC2_2: Our study clearly shows that there is a high correlation between the volume and the reconstruction costs of a building. Provided that there is a spread in the volume of a particular building stock, models that consider the building volume (M2, M4, M5) outperform models that do not consider the building volume (M3 and M5). The reviewer is right, that the difference between the two model groups increases with the spread of the building volumes of a particular building stock. However, as long as there is any spread in the building volumes the models that do not consider the

building volume underestimate the values in flood areas with comparable high buildings volumes as well as overestimate the values in flood areas with comparable low building volumes. Thus, our results on differences between the models are valid for any area with buildings of different volumes. We will highlight this aspect in more detail in the new version of the manuscript.

RC2_3: If I understand it correctly you first determined which model performs best for the places that have good data available. Then you compare the other models to this best "benchmark" model for the whole country. Why do you take this two-step approach? Why not just compare everything to the available insurance data points and make your judgment on this?

ARto_ RC2_3: One purpose of our study is the comparison of exposure figures at the national scale, including their spatial and statistical distribution. For this reason, we not only compare the results in (the fragmented area of) the eight Cantons with comprehensive insurance data sets but for entire Switzerland. However, we agree with the reviewer that the main statements / conclusions are the same for the eight Cantons as for entire Switzerland.

RC2_4: How accurate is the insurance data that the benchmark model was picked on? Are these values also based on a model or are these expert estimates? If expert estimates, do these experts have some valuation model that they apply? My worry is that the insurance data has artificial relationships in it (based on their valuation model) and that this study is just recreating the valuation model of the insurance companies. In that case the model that is closest to the currently applied insurance models performs best. Can you please discuss to what extend this is a possibility?

ARto_ RC2_4: As much as we are informed by our data providers (i.e., the insurance companies), insurance values are object-specific estimates by experts that are (a, for new buildings) based on documented construction costs (invoices) or (b, for older buildings) based on on-site inspection and validation. In general, these insurance values

are highly confident and not publicly available. To fill the gap regarding building values in exposure (and risk) models, we create and compare models, which use publicly available data. It is possible, that insurance companies implicitly use comparable models based on similar parameters. However, even if such models were used by some companies, they are not published and hence a comparison with our approaches is not possible. In our paper, we will add that insurance values of buildings which are used in our study are based on object-specific estimates by experts / employees of the insurance companies to make this clearer.

RC2_5: The conclusion states that M1 and M3 underestimate the exposure values. This sounds like a bias in the model. Is this bias not simply a problem with the parameter values rather than a problem with the model itself? If you would just increase the parameters values wouldn't that get rid of the entire bias? Or I think I probably misunderstood what you meant by this sentence so please try to explain this a bit better.

ARto_ RC2_5: The found underestimation of exposure values by M1 and M3 means that buildings exposed to flood are in general bigger than the overall building stock. Thus, as the found correlation between volume and replacement costs suggests, these larger buildings in the flood plains have higher replacement values and are underestimated by M1 and M3 which do not consider the building size. We will add this comment to section 3.4 (overall discussion of the five models).

Minor comments

RC2_Min1: Page 1, line 24. Please explain how risk management focuses on extreme exposure values. I'm a bit skeptical about this so please convince me.

ARto_ RC2_Min1: In Switzerland, as well as in other countries, decisions of public investments into flood reduction measures are based on quantitative cost-benefit analyses. This implies that areas (i.e. floodplains) with a high flood risk (high hazard probability, high exposure, and high vulnerability) are prioritized over others. As exposure is one important factor of risk analysis, our study contributes to priority setting in

flood risk management, although further intersections with hazard and vulnerability are required in a further step.

RC2_Min2: Page 5, line 28. Please explain what a hexagon is in this context.

ARto_ RC2_Min2: A hexagon is a 2D geometrical feature with six edges and six sides of equal length. Here, we used hexagons to divide the total area into smaller entities with equal size and shape. With this procedure, we addressed the modifiable area unit problem MAUP (see Röthlisberger et al. 2017).

Röthlisberger, V., Zischg, A.P., Keiler, M., 2017. Identifying spatial clusters of flood exposure to support decision making in risk management. Science of The Total Environment 598, 593–603.

RC2_Min3: Page 12, line 19. Please explain homoscedastic.

ARto_ RC2_Min3: In this context, homoscedastic means that the factors (of differences between exposure value based on model M2 (or M4 or M5) and the direct application of insurance values) are not dependent on the exposure value, the "variance of the factors" are the same for hexagons with low and high exposure values.

RC2_Min4: Figure 1 and the data selection section (2.4.2) are currently difficult to understand. Please start with why data selection is required and then lead the reader along figure 1 explaining at every step why each action is carried out.

ARto_ RC2_Min4: We will revise the section 2.4.2, see also our comment "ARto_ RC1_2" in the response to reviewer #1.

RC2_Min5: Establish a clear definition of building value in the introduction. You mention it is replacement value later on but maybe move that to the introduction. Also a good definition of replacement value is important and useful (can also be a reference). This seems quite relevant for this paper.

ARto_ RC2_Min5: We will define this precisely in the introduction section.

RC2_Min6: In section 2.2 please explain that in your definition of exposure only buildings are included that can actually flood. I also know definitions of exposure in which any building is included.

ARto_ RC2_Min6: We will revise section 2.2. accordingly.

RC2_Min7: In 2.4.1 a whole list of abbreviations is introduced at once. This is difficult to follow and makes the text a bit of a puzzle (especially on the first read). So I would choose not to use abbreviations in this case.

ARto_ RC2_Min7: We keep the abbreviations because they link the text with the figures (especially Fig.1).

RC2_Min8: Page 6, line 12-18. Please explain better why this approach is required. I don't get why you need the entire benchmarking next to the validation on insurance data.

ARto_ RC2_Min8: please refer to our comment "ARto_ RC2_3" above.

RC2_Min9: Page 12, line 30. MEA is I think MAE

ARto_ RC2_Min9: The reviewer is right, we will revise it accordingly.

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