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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Decision tree analysis of factors influencing rainfall-related building damage" *by* M. H. Spekkers et al.

M. H. Spekkers et al.

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We thank the reviewer for his valuable comments on the discussion paper. Our response:

RC1: *Title: why is only "building" included in the title (implying property damage), when also content is studies? The authors could consider excluding the word building, or including the word content.*

AC1: Good suggestion. We would like to change the title to "Decision tree analysis of factors influencing rainfall-related building structure and content damage".

RC2: *Page 2265: here I would include not only the notion that there is little research on urban flood damage, but also that most research has focused almost exclusively on flood damage related to large scale flooding of river basins and coasts. This is on the one hand because the problem at these scales is possibly larger, but also because information and data on impacts from urban flooding is very rare, as well as appropriate methods to analyse these. This justifies more research into this area. The authors should add these considerations*

AC2: We agree with the reviewer. His remark (slightly rephrased) will be added to the text at line 8 on page 2265 as follows: "A possible explanation for this is that the adverse consequences at the scales of river catchments are possibly larger than at the urban scales. Moreover, information and data on impacts from urban flooding are rare, as well as appropriate methods to analyse these."

RC3: *Page 2266: please change text to "cover the whole of the Netherlands"*

AC3: OK.

RC4: *Page 2267: "In The Netherlands, almost all buildings are insure" What the authors probably mean here, is that all privately owned buildings. Other residential buildings owned by corporations are not always insured, e.g. housing unions may be selfinsured.*

AC4: The reviewer is right. We will add "privately owned" before "buildings" in line 26 on page 2267.

RC5: *Page 2268: Coverage of water-damage is not really relevant for a bank loan, as a property would almost never become severely damage or a total loss because of rainfall. If a bank requires property insurance, than this is because of the are and wind cover included in the policy, not because of the water damage cover, as the authors state now in the text on pages 2267–2268. Please correct this.*

AC5: With "property insurance" in line 1 on page 2268 we do mean the entire package that includes all kind of risks, as correctly explained by the reviewer. To be more clear, line 26 on page 2267 and line 1 on page 2268 will be rewritten to: "In the Netherlands, almost all privately owned buildings are insured for property damage that may result from a wide range of risks, such as fire, hail, rainfall and storms. Such insurance is commonly obliged in the case of a mortgage."

RC6: *Page 2271: "The housing stock in the reference year 2011 was use" does this not refer to the National Building Register, from page 2272, rather than to the topographical data? Please check*

AC6: It is part of the section on topographic variables. But it may be unclear to the reader that building locations were used to derive topographic variables. We will add the following after line 22 on page 2271: "Building locations were derived from the National Building Register (Table 1) using a reference data of 31 December 2011.". Line 25 will be removed.

RC7: *Page 2272: Can you please explain here that ownership structure in fact simply consists of the share of homeowners?*

AC7: This is helpful suggestion. The term proposed by the reviewer better describes the variable than "ownership structure". We prefer, however, to use "fraction" rather than "share". We will change "ownership structure" to "fraction of homeonwers" in the entire paper. We will also change "house owners" to "homeowners" as this is a more commonly used term.

RC8: *Page 2275: It is mentioned that the property and content loss databases could not be linked. But why would one want to do this? Probably, what is meant that it is not possible to link the two sets of damages to the policyholders, or to the same set of variables.*

AC8: Good point. We will delete line 17–18 on page 2275 as it does not add anything here. We start the next sentence with "A total number (...)". In the discussion we will add the following to address this point: "It was not possible to link content and property databases to individual policyholders. As a consequence we cannot derive models that describe total damage per policyholder."

RC9: *Page 2276: Please explain why only claim frequency was considered I the global regression analysis. I suspect this was because the claim size regressions are more complicated, as explained earlier in the paper, and as shown by other research.*

AC9: Similar remark was made by the other reviewer (see RC3 by other reviewer). Our primary focus was on a global regression model for claim frequency, because only trees could be derived for claim frequency and not for claim size. Moreover, other research has indeed shown that claim size was less predictable compared to claim frequency (Spekkers et al., 2013b). We agree with the other reviewer that it is good scientific practice to also report claim size results. See our reply to RC3 by the other

reviewer on claim size results.

RC10: *Page 2277: I am not sure what influence the authors infer from the negative correlation here, apart from that the occupants of the buildings are likely different. Another explanation for the negative correlation between household income and real-estate value and claim frequency for property, is that more expensive houses are better maintained and/or newer (see also effect of age2), and income also is related to better maintenance. The authors later also conclude there may be a relation between real estate value and construction quality (page 2280–81).*

AC10: This is a interesting hypothesis made by the reviewer, which we would like to include in the paper. The following will be added to line 16 on page 2277: "Another explanation could be that more expensive houses are better maintained or have better construction quality and are, therefore, less prone to flooding. Moreover, income is probably related to better maintenance, thereby indirectly affecting the claim frequency."

RC11: *Page 2279: Regarding the claim size data: can you please explain how these were treated before concluding that there is no acceptable tree? For instance, how were temporal changes in insurance conditions (maximum cover, deductibles) treated? These may have severe influences on claim sizes, and should be considered before constructing statistical models with the claim size data. Finally, were only average claim sizes considered? Or also the median, for instance?*

AC11: We acknowledge that more explanation is required here. The following will be added to the discussion: "Attempts were made to built trees for average claim size and log-transformed average claim size. The latter was done to approximate normal distribution as distributions of average claim size are skewed to the right. For

both cases, it was not possible to develop statistically acceptable trees for average claim size. Median instead of average claim sizes were not considered. In many insurance schemes, deductibles may affect claiming behaviour of people and cause censoring of small claim sizes; however, insurance policies related to present database (i.e. water-related risks) do not have deductibles. There may be other changes in insurance policies (e.g., changes in damage causes that are covered) that may have affected claim sizes through time and caused failures to derive models. These were not accounted for in present study, because this type of information was not readily available for all insurers in the database."

RC12: *Page 2279/Table 6: I am surprised that the topographic variables do not play a role at all, especially for content claims. What does this imply for management of rainfall discharge (sewerage), and can the authors include policy implications for reducing damage by improving sewerage systems? It would be interesting to test variables related to the sewer system. Although these data are not available country-wide, a test location to assess the effects, and possible scope for reducing losses by improving discharge capacities. Can the authors please discuss this?*

AC12: Interesting point. We too expected some correlations here. To elaborate on this a bit more, the following will be added to the discussion: "Topographic variables were not found to be important factors. There may be several explanations for this. One explanation relates to the aggregation of the topographic variables. Within a district, presence of buildings at locally higher as well as lower elevations may averaged out topographic variability. Another explanation may be that buildings and/or sewers in hilly areas have been more adapted to floods, i.e., people retrofitting their houses after severe floods."

RC13: *Page 2281: Another important use of these study results for insurance*

companies is the better assessment of risk premiums in The Netherlands, and also the quicker assessment of actual damages, and also to raise appropriate capital (not too much, not too little) in the event of large losses.

AC13: These are indeed relevant for insurers. We would like to add the reviewer comment, slightly rephrased, to the discussion (line 9, page 2281): "Besides that, results help insurers to better assess risk premiums in the Netherlands and to raise the right amount of capital in the case of severe events with large damages.

RC14: *Page 2283: I wonder whether the authors have a point here (and elsewhere) that the district size in some cases may be too large for this analysis. I do not think this necessarily true. Also, the authors could have analysed this aspect, by including a variable on the size of districts. Now this is more or less speculation. For instance, could drainage/sewer system variables not have an important potential effect (see also above under my point regarding Page 2279)? Moreover, variables on soil type are not included either. Would sand versus clay soils not also have an influence, as well as for instance the share of soil sealed in urban areas?*

AC14: The point we want to make here is that sizes of convective rain cells (in the order of 0.5–5 km in length) can be much smaller than district sizes (up to 10 km). As a consequence, not all policyholders may be exposed to the same amount of rainfall, which we now assume. Still, we agree with the reviewer that also other variables should be checked before drawing any conclusions on the effect of district size. We would like to add the following examples of explanatory variables mentioned by the reviewer to line 29 on page 2281: soil type, percentage of impervious surface.

RC15: *Page 2284: I do not agree with the conclusion that claim size effects cannot be*

assessed because of district size problems. The authors cannot rule out the possibility that a smaller district size (if it was possible to construct these from the data, using 6-digit postal codes) does not lead to more randomness and noise, and therefore similar or even worse results for claim size (and possibly also claim frequency). Also, as a number of variables are not included, in particular related to soil and sewerage (see my comments above), it is not possible to conclude this now. Also in the abstract this conclusion should be revised.

AC15: This remarks relates to AC28 by the other reviewer. In our response to AC28 by the other reviewer, we propose the following changes to line 10–12 on page 2284 and line 21–23 on page 2264 (abstract): "It was not possible to develop statistically acceptable trees for average claim size. It is recommended to investigate explanations for the failure to derive models. This includes the inclusion of other explanatory factors that were not used in present study, an investigation of the variability in average claim size at different spatial scales and the collection of more detailed insurance data that allows to distinguish between the effects of various damage mechanisms to claim size."

The reviewer argues that variables related to soil and sewerage may be of any importance for claim size. We do believe that these variables may be relevant for the probability of occurrence of a claim (i.e., sandy soil provides better infiltration, resulting in less flooding and, thus, less claims), but we do not see how, for example, soil type should effect claim size. What kind of damage mechanism is underlying this hypothesis?

RC16: *Table 3: Which inflation correction of Statistics Netherlands is used exactly? Consumer price index?*

AC16: Yes. We will add this to the caption of Table 3: "The average inflation per

year for the Netherlands is used (second column), based on the consumer price index."

RC17: *Figure 3, Figure 6: The text in these figures would be better readable if the font size was increased.*

AC17: See updated version of Fig. 3 in the supplement to this document. Figure 6 (and 9) will probably be readable in two column journal format.

References

Spekkers, M. H., Kok, M., Clemens, F. H. L. R., and Ten Veldhuis, J. A. E.: A spatial analysis of rainfall damage data using C-band weather radar images, in: International Conference of Flood Resilience, Exeter, UK, available at: http://repository.tudelft.nl/view/ir/uuid:f0c17744-0609-4e93-b2fe-c5b8a24b7e4a/, 2013b.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/2/C1359/2014/nhessd-2-C1359-2014-supplement.pdf

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