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Discussions

Interactive comment on "A GIS-based multivariate approach to identify flood damage affecting factors" *by* Barbara Blumenthal et al.

Barbara Blumenthal et al.

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Referee #2: 'The paper introduces a GIS-based multivariate approach 'to identify flood damage factors'. It uses two Swedish cities as case-study locations, concluding that the topographic wetness index (TWI) is the main variable explaining the number and amount of insurance damage for the specific case-study. The study is essentially a very simple sensitivity analysis, on a specific case-study. In my opinion, the paper doesn't introduce any substantial contribution to the field to be published in a highly-regarded journal such as NHESS. There is some value in the particular damage dataset used. However, the analysis method is very simplistic (at undergraduate thesis level) and all the major literature on the topic of flood damage is ignored, for instance, the work by Heidi Kreibich's research group (many papers in the same journal). There is a substan-

tial lack of critical discussion on the obtained results; it is also not clear what a reader should take away from the study and what is the usefulness of the study. The main conclusion is that 'Future studies on this topic should consider implementing TWI as a potential measure in urban flood risk analyses'. However, it is very well-known that the use of TWI has several limitations and that probabilistic flood risk models would require much more advanced proxies, methods and tools (hydrological + hydraulic models; exposure information, damage functions; etc.).'

Authors: We thank the reviewer for the time invested and for valuable comments. We have considered all comments and made changes accordingly. If we for some reason have not been able to accommodate a suggestion an explanation has been provided.

The scope of this study is insured flood loss caused by intense rainfall and the literature review in the Introduction section focused on this topic. Heidi Kreibichs group is citied in the original manuscript on P1L36 in (Merz et al., 2010). Please give us more some specific relevant examples on literature on flood damages caused by intense rainfall we have missed to consider in the manuscript. The relative simplicity of the approach is a consequence of the resolution of the damage dataset at parish level. Our study is an explorative analysis of 13 years of empirical flood damage data collected by an insurance company in Sweden's second and third largest cities. It took us almost a year of negotiation to obtain the damage records. We received quite unexpected results, which we want to share with the research community.

We agree, the sentence 'Future studies on this topic should consider implementing TWI as a potential measure in urban flood risk analyses' cannot stand alone in the abstract and needs some more explanation. Our point is to use TWI/SWI as a first step in urban flood risk assessment to identify flood risk hotspots and then go on with more advanced hydrological/hydraulic modeling at those locations. We will rewrite the abstract, especially the alone standing main conclusion. In the Discussion section, we will clarity that TWI/SWI only can be seen as a rough proxy for flood risk and used as an identification tool.

Comment 1: 'How do the authors discriminate rainfall-induced insurance damage from generic flood insurance damage? I am not convinced that insurance policy/claims have this level of detail.'

Response: The data originates from an insurance database that was specifically created for flood damage. The database contains solely information about damages caused by flooding from rivers, streams, rainfall, groundwater or sewer systems. We clarify this in the Insurance data section.

Comment 2: 'The explicit flood risk of a home or estate does not matter for the price of an insurance policy': what do the authors mean here? This concept doesn't seem to make sense. If there is no link between insurance policy (and claims) and flood risk, why then this study is needed, considering that TWI could be seen as a very (very!) rough proxy for flood risk?'

Response: Yes, that is correct. The Swedish insurance system, at least on the home insurance sector, still works solidary. Furthermore, this study is not aimed at helping insurance companies to adjust their premiums, but to identify flood damage affecting factors related to intense rainfall events.

Comment 3: 'What is the number of insurance damage? Just the number of assets/claims? I am also not convinced by the specific normalization performed in the study. The common flood risk models simply consider loss ratios (repair vs replacement) as the main 'output' variable to be correlated with some local intensity proxy (water depth/velocity, etc).'

Response: Exactly, the number of insurance damage is the number of the insurance payouts in the parishes. Loss ratios require the values of buildings and inventories. The insurance company uses very rough templates in this case and they are not convinced themselves regarding how far those templates reflect the real values. Otherwise, property tax assessment value are available to construct loss ratios. These values however are strongly determined by the market value/the location of the property.

Comment 4: 'Is TWI the same of the SWI? Why do the authors use two different definitions?'

Response: Thank you for this comment. We have replaced TWI with SWI throughout the manuscript as it is de facto the SWI that was used. A description of the index and motivation for its use was added to the topographic wetness section alongside two references. "TWI" was replaced by "SWI" throughout the manuscript. The section "Wetness Index" was reworked. 2 references were added to the list (Böhner et al., 2002; Böhner and Selige, 2006).

Comment 5: 'Rainfall intensity is not part of the PCA performed by the authors simply because 'no rain statistics are available at parish scale'. This is not a good justification as the physics of a given phenomenon should always come first, independently of the available data.'

Response: Thank you for this comment. We agree, that sounds cryptic and needs some more explanation. Rainfall intensity is of course the primary cause of flood damage related to intense rainfall events. We analyzed the role of rainfall intensity the in the examined study areas in Malmö and Gothenburg using linear regression methods (Blumenthal and Nyberg, 2018)(in ref list P9L4) and found considerable high degrees of explanation. Insurance loss caused by floods was exponentially or potentially increasing with rainfall intensity. Furthermore, even if rain statistics would have been available at parish scale, rain intensity had not been suitable as a variable in a PCA. Rain intensity cannot be represented by a medium values or amounts as the other variables used in the PCA. We will develop this topic in section Statistical analysis.

Comment 6: 'It is very surprising that other variables than TWI play such a minor role in explaining flood damage. Some critical discussion on this aspect would have been beneficial.'

Response: We agree, these results were much unexpected and we will further investigate/discuss this.

Comment 7: 'Very poor-quality figures; lots of typos and unclear sentences throughout the manuscript.'

Response: We partly agree with this comment regarding language and spelling mistakes. It is however unclear to the authors what is meant by "very poor-quality figures." Since no other specification is given here regarding e.g. cartographic representation, map layout or plot size, the authors assume the comment refers to figure resolution. It is very common that lower-resolution figure are chosen with the first submission of a manuscript. High-quality figures (300 dpi+) will be presented upon acceptance of the article. The language has been revised throughout the manuscript and spelling errors and formulations were addressed.

Böhner, J., Koethe, R., Conrad, O., Gross, J., Ringeler, A., and Selige, T. Soil regionalisation by means of terrain analysis and process parameterisation. In: Micheli, E., Nachtergaele, F., Montanarella, L. (Ed.): Soil Classification 2001. European Soil Bureau, Research Report No. 7, EUR 20398 EN, Luxembourg, 213-222, 2002.

Böhner, J., and Selige, T.: Spatial prediction of soil attributes using terrain analysis and climate regionalisation. Göttinger Geogr. SAGA-Analyses and Modelling Applications. Abh, (115), 2006.