

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC2  
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## **Review report for manuscript nhess-2020-417**

Anonymous Referee #2

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Referee comment on "Improving flood damage assessments in data-scarce areas by retrieval of building characteristics through UAV image segmentation and machine learning – a case study of the 2019 floods in southern Malawi" by Lucas Wouters et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-417-RC2>, 2021

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### **General comments**

The study "Improving flood damage assessments in data scarce areas by retrieval of building characteristics through UAV image segmentation and machine learning – a case study of the 2019 floods in Southern Malawi" seeks to improve the characterization of building features to supplement data to serve as input for flood damage assessment in data scarce regions. In this way, the paper attempts to improve physical vulnerability assessment to floods in regions where data are sparse: a very important and timely study which is well within the scope of NHESS. I appreciate the efforts of the authors, especially regarding the challenges of working in data-scarce areas. However, there are a number of key aspects that the paper lacks/does not sufficiently address. Therefore, these aspects have to be tackled so that the paper can be considered for publication in NHESS.

Firstly, based on my field experience, a roof type (in this case, Metal and Thatched) is not enough for a vulnerability classification. For example, buildings with Thatched roofs can have either a mud or unburnt bricks, or even burnt bricks as wall material, which in this case plays a more important role for flood vulnerability. What have the authors done to make a further differentiation in terms of building wall material and linking this as the main determinant for damage curve selection? Also, the sensitivity analysis performed does not accommodate a differentiation for building types; only upper and lower damage bounds are used based on curves from metal and thatched buildings respectively. Several studies have shown how damage curves are building-type dependent. Therefore, what is the relevance of the sensitivity analysis? What does it really communicate in terms of damage uncertainty for regional building types. I doubt if this sensitivity approach is ideal for the case study region considering data scarcity.

Secondly, the paper seeks to 'improve flood damage assessment' as captioned in the title. However, the procedure implemented for deducing damage curves (the 'aggregated'

curves) for different building types is unclear and should be better addressed.

Furthermore, I strongly suggest to separate data and methods. The present form of the manuscript does not clearly separate the two making it difficult to follow. Under the new data section, clearly define the different data layers that are used (satellite data and damage curves), the case study region and also the flood event. These are the core input of the study and deserve separate subsections for clarity.

Also, I will recommend that the authors look at findings from more recent literature on flood damage modelling (or physical vulnerability assessment) in data-scarce areas and discuss similarities or otherwise.

Other comments to different sections of the manuscript are provided below.

## **Specific Comments**

### **Abstract**

line 17: The phrase 'structural building characteristics' may be misleading. 'Structural' would usually refer to a more complex assessment of the construction technique (e.g. load transfer mechanism, wall compressive/tensile strength, foundation form). For this study, the authors looked at building characteristics (wall material, building size, roof type). Please also adapt in other parts of the manuscript.

### **Introduction**

line 29: Mention specifically how it can support risk reduction

line 35: the sentence says 'much work', therefore you should provide more than one reference

line 35: Information is available but it is not sufficient. I would rephrase the sentence into: Unfortunately, 'sufficient' information...

line 39: Give example of such studies. Two references should do.

line 41: Rephrase sentence for clarity

line 43-45: Rephrase for clarity

line 66: I would avoid the use of terms like 'accurately' or at least report on model performance and what metric was used to measure it. Admittedly, a lot of progress has been made in flood damage estimation. However, even in data-rich regions, uncertainties still persist in loss prediction.

line 82: Sentence unclear

line 96: Please reformulate the sentence for smooth transition. The later part of the introduction focuses more on remote sensing techniques. The sentence 'From the above it is clear that exposure and vulnerability components are underrepresented' does not simply fit.

## **Data and methods**

The information provided in lines 108 – 119 can be streamlined. It contains some general information that should be avoided in a data/methods section.

lines 121 – 125: Repetition

line 123: The paper title reads 'improvement of damage assessment'. Therefore, the stage-damage curves used is a key component on which the results of this studies relies on. You have to clearly outline what data was used and how it was generated. If it is from another study, it should be properly cited and at least briefly mention the input data

line 80: ...building elements? Please be consistent with the term.

line 80: Not an information for data/methods. Can be deleted

line 137 – 140: Provide a reference on the responsible agency that compiled the data on

people affected and damages. (this cannot be the volunteers - correct me if i am wrong). And the term 'volunteers' should be more clearly defined. Are they community residents? Workers from the red cross? please specify.

Also, where there no local media that reported the event, number of affected persons or incurred damages?

Figure 1: Under vulnerability, damage curves are used which normally combines data on hazard and building type. You have to define what you refer to as 'vulnerability'

line 169: What is the total number of buildings in this region? What kind of sampling technique was implemented (random or systematic) and why? Also, why are 50 buildings considered representative of building types?

line 171: why are these considered as flood vulnerability parameters? where their selection based on previous studies, expert-knowledge, author knowledge or due to their simplicity for integration into a satellite-based rapid vulnerability assessment? Please clarify these.

Figure 2: Include the North arrow.

line 190: Segmentation 5m<sup>2</sup>. Typo?

line 302: Be more explicit and avoid vague comments. State what building typologies are within the area and state the type of buildings that the damage curves (used in your study) were aggregated from.

line 304: A sentence or two on the method used in the CAPRA library and input data should be provided. What information specifically was deduced from Maiti (2007) for the adjustments. Be specific.

line 315: These type of sentence should be avoided. Properly communicate what was done in this step. What is the local distribution of the regional building type? How where the curves aggregated?

## **Results**

line 340: Based on my field experience, a roof type (in this case, Metal and Thatched) is not enough for a vulnerability classification. For example, buildings with Thatched roofs can have either a mud or unburnt bricks, or even burnt bricks as wall material, which in this case plays a more important role for flood vulnerability. What have the authors done to make a further differentiation in terms of building wall material and linking this as the main determinant for damage curve selection?

line 367: Copier ref...Typo?

line 360: The difference is substantial enough to alter the actual damage especially given that stage-damage curves primarily depend on water depth at building locations. What is your take on this?

line 360: Since the flood occurred in 2019, it is likely that the residents of the study area will remember very closely the flood depth in their houses. Did the authors attempt to interview the residents, in this way integrating community-based approaches (e.g. citizen science). Such data extraction methods are becoming more popular in data-scarce regions.

line 362: What is the RMSE between the observed and modelled flood depth?

line 423: Why is this the first time the ERN data base is mentioned? Did I miss the earlier reference...

line 426: The sensitivity analysis does not accommodate a differentiation for building types; only upper and lower damage bounds are used based on curves from metal and thatched buildings respectively. Several studies have shown how damage curves are building-type dependent. Therefore, what is the relevance of the sensitivity analysis? What does it really communicate in terms of damage uncertainty for regional building types. I doubt if this sensitivity approach is ideal for the case study region considering data scarcity.

line 431: There are more recent studies discussing this... One or two references will do.

line 433: Check more recent studies

## Discussion

line 442: 'uncovered several important factors in ...flood damage estimation'. Maybe I missed this but the current structure of the manuscript makes it difficult to assess the contributions or novel aspects. See also a recent research on flood damage modelling in data-scarce areas dealing with comparable building types and discuss relevant similar findings or otherwise (Malgwi MB, Schlögl M, Keiler M (2021): Expert-based versus data-driven flood damage models: a comparative evaluation for data-scarce regions (<https://doi.org/10.1016/j.ijdr.2021.102148>))

line 480: typo