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Interactive comment on "Flood Vulnerability Assessment of Urban Traditional Buildings in Kuala Lumpur, Malaysia" *by* Dina D'Ayala et al.

Dina D'Ayala et al.

kai.wang@ucl.ac.uk

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In the following find enclosed comments of reviewer #1 and the authors responses. We thank the reviewer for the thorough reading of the paper and the request for clarifications which have resulted in substantial changes to the manuscript. As a result we believe that the clarity of the manuscript is much improved.

The authors develop a ïňĆood vulnerability method for the assessment of traditional residential buildings in Kuala Lumpur. The study includes a survey of 163 buildings using different building-level vulnerability parameters. This is a very interesting topic that contributes to the recent increase in studies looking at flood vulnerability, damages and mitigation measures at a building level, and it ïňĄts very well within the scope of

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Discussion paper

NHESS. In my view, the paper would beneïňĄt from an improved explanation of the methods, mainly the parameter selection and valuation, and the ïňĄndings regarding the vulnerability index (as discussed in more detail below).

Broad comments –L. 185: what is the proportion and how was it determined?

We thank the reviewer for highlighting this statement. At the outset of flood map development, we intended to remove an appropriate portion of gross rainfall to account for the volume of water that storm drains could accommodate. After researching what an appropriate proportion should be, we discovered that there is no clear design standard of drainage in use across the city. We also discovered several media reports stating that urban drainage in the city was ineffective. As a result, we made the decision to use the gross rainfall estimates, without adjusting them, rather than calculating a net rainfall amount to use in the modelling. We have adjusted the manuscript to correct the method description.

- Section 2.4: I miss a link between (some of) the parameters mentioned in table 2 and the way they impact a building's ïňĆood vulnerability. For example, I understand how footprint inïňĆuences damages, but how does it link to vulnerability of a building? How does the surface condition link to the vulnerability of a building? The surface condition (permeability / inïňĄltration rate) is commonly perceived as part of the hazard rather than vulnerability (e.g. Liu et al(2014))? It would be good to explain how each of the selected parameters contribute to vulnerability and how you differentiate the extent to which they contribute to vulnerability for each of these parameters.

Response: In this study, the vulnerability assessment consider the building characteristics and its surrounding environment as a system. The surrounding environment, such as surface condition and drainage system, are closely related to the local permeability and runoff, and impact on the height of water in the case of flooding. These parameters were considered in the vulnerability as current flood models are based on general land use, but they do not consider the immediate surrounding, at the scale of the building, hence do not include local difference of surfacing and permeability, for instance, which might affect the propensity for vulnerability especially to flash flooding. Text has been edited to include a comprehensive description of the reason for inclusion of the various parameters.

- Section 2.5 (Table 3): many ïňĆood building studies differentiate between 1 storey and 2 storeys (e.g Deniz et al. (2016); Englhardt et al. (2019)). Is it realistic to differentiate between an inundation depth up to 3 storeys and 4 storeys or more? Especially because you state that "the maximum inundation depth due to ïňĆash ïňĆood for a 100-year return period is around 0.2m".

Response: We agree that the difference between 1 storey and 2 storeys is more significant in terms of the damage to fabric and content. However building with more storeys impose higher pressure on ground and are more susceptible to post-flood subsidence, especially in condition of floodplains and superficial foundations. The flood hazard does not consider only flash flood but also riverine floods. The text has been changed to better explain how the parameter number of storey is considered in this study.

- Section 3.1 could be improved by expanding the analysis of the index. E.g. L. 415 states that a normal distribution can be observed from ïňĄg 7a. This is not clear and needs to be elaborated on in the text as well as in the ïňĄgure and its caption. L. 417 states that the total VRi follows a lognormal distribution, while in ïňĄg 8 it follows a normal distribution. Next, the caption of 7 mentions "VI", should this then be "VR"?

Response: The total VI follows a quasi-normal distribution (as shown in figure 8). However the density probability function (or cumulative distribution) of VI follows a LogNormal distribution as shown in figure 7b. The distribution of each parameter has been clarified in Figure 7a and 7b. This portion of the paper has been redrafted to clarify these and other aspects of the description of the index. Throughout the VR and VI have been checked and appropriately referred.

- I think it is very important to emphasize that you are calculating the relative vulnerability. I was initially expecting the vulnerability classes to be categories within the range of 110 (the overall possible minimum) to 1100 (the overall possible maximum). Please elaborate in paragraph at L.320 why this decision was made.

Response: The categories in the manuscript were initially derived from the actual range of the samples. This was made to emphasize the differences within the sample as the range close to the two extreme values are not attained. Nonetheless to show the generic value of the approach, we have recast the results within the full theoretical values, i.e. 110 to 1100 for 11 factors, as suggested by the reviewer, to re-categorise the vulnerability classes. This will make it possible to carry out future comparison with other studies using the same approach. The text and table 4 and subsequent diagrams have been changed accordingly.

- The percentages of the sample column of Table 4 do not add up to 100%.

Response: In accordance with the previous comment, we have changed Table 4, and rechecked the numbers. Thanks.

- The abstracts states that: “The paper discusses these in relation to a scenario event of 0.1% Annual Exceedance Probability (AEP), based on hydrological and hydraulic models developed for the Disaster Resilient Cities Project.” However, I can’t ïňĄnd a mention of this in the body of the manuscript.

Response: The abstract has been redrafted to shorten it and the relationship to the mentioned project is explained in the introduction L107 to 110 and in the acknowledgements.

Minor things: - L. 48 “control”: not clear what is meant here.

- L52 “...political negotiation”: these statements look stronger when backed-up with (a) reference(s).

- L. 54 maybe include some examples of “Non-structural measures” that provide “faster ïňĆood mitigation”.

Response: This and the above sentences have been redrafted to provide more explanation and references.

L. 63 “UNDRR”, write the actual name when using the acronym for the ïňĄrst time. Response: Full name has been added.

- L. 81-83: please add page number(s) of the direct quote (or paraphrase). Response: Page number has been added.

- L. 89: it would be good to add a reference for the deïňĄnition of vulnerability. Response: definition added

- Figure 2: maybe crop the high rises from 2b so the focus is on the vernacular house. - It may be nice to add a map (or add it to ïňĄg 2a) showing the locations of the gauges. Response: Modified.

- L. 207: along river network of the study area -> the river network Response: Modified.

- L. 262 (“...by building type”): it would be good to include some references to support this statement. Response: Reference added

- L. 352 “2415 to 4105 RM (525 to 890 C” -> it would be very useful to add the euro value to each mention of an RM value. Response: Thanks. Good suggestion. added throughout

- L. 364: typically ranges Response: Modified.

- L. 408: number of storey -> number of storeys Response: Modified.

- Fig 7a and L. 415: it is unclear from ïňĄgure 7a which of the variables represents the roof height. In general, this ïňĄgure deserves a little bit more explanation and probably best to update the labels with the wording used elsewhere for each of the parameters (same holds for other ïňĄgures such as ïňĄg 10).

Thank you for pointing out the inconsistency. The roof height was not used in this analysis and it has been removed from figure 5, as it was misleading. Attention has been paid to use the same name and same order for all the parameters in all figures and tables.

- L. 424. “and smallest” -> and the smallest Response: Modified.

- L. 424 “The largest VR is 852.5, and smallest is 477.5.” Refer to table 4. Response: Modified.

- L. 461 “3 different scenarios” -> three different scenarios Response: Modified.

- L. 474 “total number of building” -> buildings Response: Modified.

- L. 475. “the total building” -> total number of buildings Response: Modified.

- Fig 11b caption: SAMRT -> SMART Response: Modified.

- L. 478: the -> The Response: Modified.

- L. 483 “without SMART Major losses”->major Response: Modified.

-L.483“concentrate”->concentrated Response: Modified.

-L.487“was assessed to have” ->was found to have Response: Modified.

-Fig12. The doubley-axis is ïňĄne, but may be adjust the colours to improve legibility (e.g. in 12a, the number of ïňĆash-ïňĆooded buildings and the cumulative graph are around a water depth of 0.1- 0.3 are difïňĄcult to decipher). Response: Modified.

- L. 499. Flood has become a major hazard worldwide. -> better to add a reference for this statement. Response: Modified.

- L. 501. The word “dearth” is a bit archaic, maybe better to use “lack of” or “limited” Response: Modified.

L. 533 “varying the % of run off” -> percentage of run off Response: Modified.

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