

Dear Reviewer, first we want to thank you for your constructive, in-depth and clear questions and comments. Below you can find our answers point-by-point to your comments. We also highlight (where possible) the part of the original submitted manuscript that have been modified to address your comments. In order to facilitate the reading, we added our responses to your comments in red. If changes to the text are proposed, changes are underlined.

1. The authors claim that they propose a risk assessment framework for the city of Venice. However, the study describes a flood damage estimation, for a particular event, using standard methods that are commonly employed in such types of assessments (several examples of such studies are cited in the manuscript). In which way(s) is this framework or method that the authors propose novel and how does it differ from previously proposed frameworks (e.g. the one the IPCC employs)? This needs to be clearly described in the manuscript. My understanding from reading the manuscript is that the study describes a detailed assessment in terms of flood damage estimates for a specific event under a range of scenarios using established methods; this is an important study but does not involve any methodological innovations. If this is the case and I have not missed something, then this should be communicated accordingly in the manuscript.

We thank the reviewer for this critical comment. Indeed, this study uses one specific event to derive damage estimates that can be compared against available damage claim data to calibrate the used framework. To provide a clearer discussion of this aspect, we add the sentence in line 75 (the paragraph from line 69 to line 75 is moved to the methods section based on the comment of the other reviewer): *"This simplification was used as information about (future development of) return periods of the studied storm surge event, and probabilities of barrier failure scenarios are not available. However, the derived development of flood damage estimates as provided in this study could be easily translated into flood risk information by accounting for the probabilistic information."*

The authors agree that the conceptual idea and applied methodology of this work are per se not novel. However, although several studies have focussed on flood risk models for delta cities around the world no such flood risk model is available for Venice as elaborated upon in the manuscript line 60 ff. The present work also adds several novel aspects to flood risk assessment in Venice: detailed hydrodynamic and damage models (incl. cultural damage) and the inclusion of barrier failure scenarios.

2. I am a little concerned regarding the calculation of damages to cultural heritage – although the authors describe very clearly the method used for this calculation, actual damages of world heritage cannot always be substituted simply by higher expensive building costs (and I am not only talking about intangible damages). I'm worried that this calculation of tangible damages leaves a feeling that such damages are possible to address with increased investment, which is not the case. I am not suggesting that what the authors have done is not useful but would propose that they spend a few lines in the discussion to address this point.

Again, we thank the reviewer for this critical and thoughtful comment. We second this concern. Thus, we have developed (but unfortunately not applied) a more holistic conceptual idea about how to assess flood risk of cultural heritage which can be found in the supplementary material. To address the concern regarding the calculation of tangible damages to cultural heritage we added in line 456: *"It is also important to acknowledge that considering an economic value of cultural (world) heritage in terms of increased reconstruction costs does not holistically represent the flood impact on a cultural heritage sites and assets. Firstly, impact on the cultural value is not represented in terms of reconstruction"*

costs. Secondly, it is questionable to what extent cultural heritage value can be restored or reconstructed after being damaged or destroyed. Both aspects are not addressed in the current set-up of the damage model. Transparent and robust cultural heritage decision making should include a wide range of heritage values while recognizing that these can change over time and should be regularly updated (Fatorić and Seekamp 2018)."

3. The model setup, in particular the nesting (e.g. boundary conditions), is not very clearly described.

We thank the reviewer for this comment. To address it, we added the following adjustment in line 149: "Water level time-series from the parent model simulation were extracted at 168 locations inside and around the old-town of Venice. Every nested model is enclosed by a sub-set of these locations, as shown in Fig. 3. Consequently, the water level time-series of the enclosing locations were used as the boundary inputs driving the hydrodynamic simulation for every nested model. As such, the sub-models did not exchange information among each other but were run independently."

4. I find interesting that the authors suggest that the use of the bathtub model results in acceptable damage estimates, as in other studies. Would this mean that we could avoid the computational and time costs related to the application of the hydrodynamic model? Or to what extent would this be possible? Maybe an extra line or two discussing this would be useful (just a suggestion).

We thank the reviewer for this comment. Indeed, it might be a conclusion that could be drawn from the analysis. To make our point more clear, we adjusted line 411 ff: "However, while the current set-up of the hydrodynamic model results in roughly similar damage estimates as the bathtub model, a fully functioning hydrodynamic model may add additional benefits to the flood risk assessment framework as it can account for (changing) physical characteristics explicitly, allow for a proper calibration, and incorporate additional flow path-components such as a 1D sewage system which might lead to different flooding patterns."

Finally, I have listed below some further (secondary) points that would require clarification:

- Line 3: limited information of flood hazard? I would think that this is not the case in Venice?

Thank you for this comment. We rephrased line 2-3 to: "Despite this existence-defining condition, limited scientific knowledge on flood risk of the old-town of Venice is available to support decisions to mitigate existing and future flood impacts."

- What is the return period of the modelled event? This is an important parameter, particularly when assessing risk.

Thank you for this interesting question. While some studies mention that the original event has a return period of 70 to 100 years, we did not account for the return period for multiple reasons: 1) available return period estimates were derived quite a while ago (often under stationary assumptions) and might thus not represent the effective return periods. 2) as we analysed future scenarios as well, it was much more comprehensive to analyse and compare flood damage information than flood risk estimations given that we had no time or resources to analyse changes of return periods over time.

- I can generally understand the use Google StreetView and estate-agent ads for assessing information on buildings. But was this information recent and accurate -

how was this evaluated? Since some of the co-authors are actually based in Venice, this seems like something that could be easily done in the field.

We thank the reviewer for this in-depth question. Timeliness and accuracy of used data was evaluated together with experts (the co-author based in Venice, as well as Dr. A. R. Scorzini who is an expert on damage modelling in Italy). We also implicitly assumed that derived information (mainly physical appearance of exterior and interior of buildings) is rather static over time.

- Line 245: how was it detected, where from?

These observations were detected using GoogleMaps StreetView. It was observed in multiple districts (i.e. San Marco, Dorsoduro, San Polo and Cannaregio). It was only observed at houses that seemed to be used for shopping/economic activities. These observations were discussed and confirmed with the local co-author.

- Although generally well written, the manuscript needs to be checked for some small language errors and some inconsistencies in the use of some terms (e.g. exposure)

Thank you for this comment. We reviewed the manuscript thoroughly and corrected spelling errors. The definition of exposure terminology has been adjusted in line 24 as follows: *“According to the IPCC, flood risk is defined as the combination of a specific hazardous flood event, elements (i.e. infrastructure, people, livelihoods, environment, and cultural, social and economic assets) which might be exposed to a hazard in a certain area, and the vulnerability of these elements, meaning predisposition to be adversely affected \citep{Field.2012}.”*