Reviewer 1:

1. **I congratulate the authors for the improvement of the quality of the manuscript "Quantifying the potential benefits of risk-mitigation strategies on future flood losses in Kathmandu Valley, Nepal". The authors addressed most of the comments and this is reflected in the clarity and coherence of the manuscript. The introduction is much clearer and highlights the research gaps the study is covering. The new figures and sections, such as the study area and the discussion section provide a more appropriate structure. Nevertheless, I have some final remarks that could be considered as moderate or minor comments.**

Many thanks for your overall positive assessment of our manuscript and your insightful additional comments, which are addressed in detail below.

2. **Comment 1: I believe the added figures (and the new updated versions of previous figures) help the reader to better understand the context and the key messages of the study. However, according to the new figures I would suggest to slightly restructure the sections as follows:**

   2. Study area (instead of 2.1). In this section Figure 2 and Figure 3 would become Fig. 1 and Fig. 2. I recommend the authors to include some additional information about the basins' properties, climate and flood typology or references where this information is available.

   3. Materials and methods (instead of 2). I believe the figure (currently Figure 1) showing the overview of the flood risk modeling approach used in this study is really helpful. In my opinion, it is more appropriate for the manuscript readability if it is followed directly by the subsections that constitute the boxes/buckets of the scheme (i.e.: Hazard modeling, Modeling present and future exposure, Modeling flood vulnerability). Please update LL 113-114, section numbers, and Figure numbers if the manuscript is restructured as suggested.

Thank you for your comment, which we have addressed by making the following modifications to the manuscript:

- *We have restructured the sections as per your suggestions (i.e., Section 2 is now "Study area", Section 3 is now "Materials and methods", etc.) and updated the numbering of the sections and figures accordingly.*
- *We have added more information about the Bagmati river basin (marked in **bold**) to the first paragraph of section "2. Study area" (L101-106), as follows:*

"This study focuses on Kathmandu Valley, Nepal, which is surrounded by the Himalayan mountains and lies within the Bagmati river basin. ***The Bagmati river is 170 km in length, originates north of Kathmandu Valley at an altitude of 2690 m, and flows south through Nepal to reach the Ganges in India. Climatically, the Bagmati river basin can be divided into three regions: subtropical climate (elevations lower than 1000 m), warm temperate climate (elevations between 1000 m and 2000 m), and cool temperate climate (elevations higher than 2000 m; Dhital et al., 2013). The annual average and monsoon average rainfall***

of its catchment area are 1800 mm and 1500 mm respectively, and the mean temperature varies between 10°C and 30°C (Dhital et al., 2013).”

References:

1. *Dhital, Y. P., Tang, Q., and Shi, J.: Hydroclimatological changes in the Bagmati River Basin, Nepal, J. Geogr. Sci., 23, 612–626, 2013.*

- *We have updated Figure 3 by renaming the three main steps included in the scheme to match the name of the sections used in the main text. Each step name now also specifies the corresponding section number.*

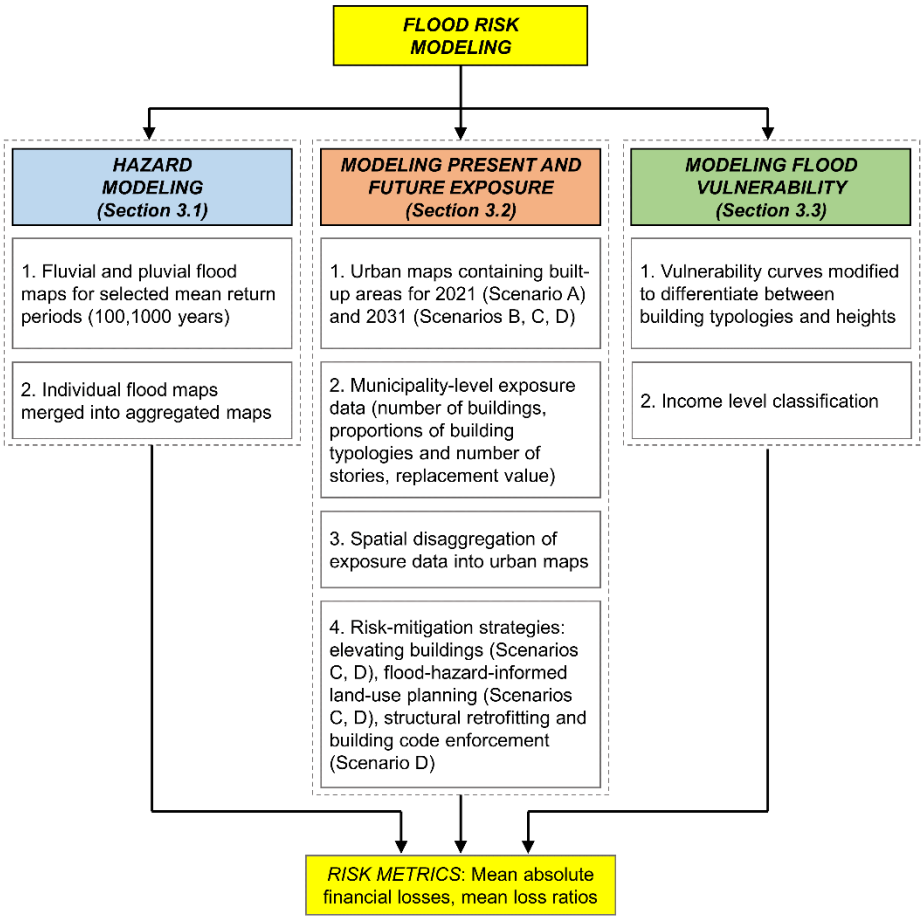

Figure 3. Overview of the flood risk modeling approach used in this study

3. Comment 2: The results section provides a comprehensive view of the affected buildings located in the floodplain for the four scenarios, and the associated losses per district and income level. Although the authors explain the reason why scenario D is associated to higher mean absolute financial losses, I am wondering in the authors could provide any comparative between scenarios C and D regarding earthquake impacts. This could be based on literature and past studies. I believe it is relevant to highlight the benefits of scenario D to give some context for the readers.

Thank you for your comment. To address it, we have added a comparison of Scenarios C and D in terms of potential earthquake impacts for Kathmandu Valley (Mesta et al., 2022a), which

*highlights the benefits of the multi-hazard DRR plan proposed in Scenario D. This additional discussion (in **bold**) (L422-427) is within section "4.2 Losses", and reads as follows:*

"(…) However, it should be noted that risk-mitigation actions implemented in Scenario C would still leave the building stock highly vulnerable to earthquakes, and thus do not completely address multi-hazard risk in the valley, which is left to Scenario D. ***Note that a previous study by the authors (Mesta et al., 2022a) revealed that not implementing seismic risk-mitigation actions for the valley (i.e., analogous to Scenario C in this study) could increase mean absolute financial seismic losses in the future (2031) by more than € 1.7 billion (+20%) relative to equivalent current levels. In contrast, improving the seismic strength of buildings (i.e., similar to Scenario D in this study), could reduce mean absolute financial seismic losses in the future by more than € 1.1 billion (-14%) relative to equivalent current levels.*** *The relative increase in mean absolute financial losses in Scenario D is associated with the larger replacement value of its building stock (due to the structural retrofitting and building code enforcement measures implemented). This highlights a tension between short-term up-front costs (incurred before the occurrence of hazard events) and long-term benefits (after the occurrence of hazard events) associated with holistic DRR measures. In summary, Scenario D demonstrates that, despite a growing population, adequate DRR measures that aim to improve the building stock's quality (for better sustaining both flood and earthquake damage) as well as incentivize urbanization away from flood-sensitive areas can limit (but not reduce) mean absolute financial flood losses in the future."*

References:

1. *Mesta, C., Cremen, G., and Galasso, C.: Quantifying the Potential Benefits of Risk-Mitigation Strategies on Present and Future Seismic Losses in Kathmandu Valley, Nepal, Earthq. Spectra, 2022a.*

4. **Comment 3: The discussion section gives a better idea of the interpretation of the results obtained in the present study. Additionally, listing and commenting the limitations of the study is key to link the outputs to strategies for decision-makers and to highlight the scope of the work and suggest the direction of future studies. However, I missed a paragraph focusing on the obtained results and how these results could help decision-makers. For example, could we extract guidelines for prioritizing action in regions under higher risk? Why are some regions showing much higher positive impacts of DDR measures? Do these regions share any common characteristics that could lead to a step-wise action plan? Or is the present analysis meant to display which regions deserve a more local assessment with a proper analysis of costs? This information would support the statements included in the conclusions (e.g.: LL595-597, LL606-609).**

This is a great comment. We have incorporated your suggestions within an additional final paragraph of the Discussion section, which reads as follows:

L537-L540: "The results obtained in this study provide valuable information for decision makers about drivers of exacerbated future flood risk and can help to support appropriate policy making. The proposed framework could also inform high-level guidelines for identifying potential flood risk hotspots that deserve a more detailed local DRR assessment (e.g., including higher-resolution data/models, a proper analysis of costs, a tailored analysis of DRR measures, etc.)."

Also, note that a detailed discussion of the results is already provided in the Conclusions section.

5. **Minor comments: L319 Please delete "at least", since it is implied when using "partially".**

We have removed "at least" from the sentence.

6. **L530 Delete "which is now discussed".**

We have removed "which is now discussed" from the sentence.

7. **L569 Instead of "the exact values of absolute losses are not of particular interest or relevance", I would recommend to say "the uncertainty associated to the absolute losses is not within the scope of this study".**

We have replaced "the exact values of absolute losses are not of particular interest or relevance" with "uncertainty associated with the absolute losses is not within the scope of this study".

Reviewer 2:

1. **General comment. Thank you for revising the manuscript. Text, figures as well as discussion improved substantially, in my opinion. In the following, a small list of minor comments:**

Many thanks for your overall positive assessment of our manuscript and your insightful additional comments, which are addressed in detail below.

2. **I find the abstract a bit difficult to read. There are a lot of numbers in the abstract. Maybe it is possible to summarize the findings more beyond the numbers and present the results in a more general and overarching way? Some key numbers certainly are good, but with all the scenarios it is a bit too detailed, I think.**

Thank you for your comment. To improve the readability of the abstract, we have shortened the sentences showing the results for Scenarios B, C, and D by removing the references to each flood occurrence (e.g., we have replaced "(…) mean absolute financial losses for the 100-year and 1000-year mean return period flooding occurrences would respectively increase by 16% and 14% over those of Scenario A" with "(…) mean absolute financial losses would increase by 14%-16% over those of Scenario A.").

We have kept the key results of each scenario in the abstract. Note that we provide the results in terms of mean absolute financial losses and mean loss ratios for Scenario A, but we only provide the relative variations for Scenarios B, C, and D.

*The updated Abstract (with changes marked in **bold**) reads as follows:*

*"**Abstract.** Flood risk is expected to increase in many regions worldwide due to rapid urbanization and climate change if adequate risk-mitigation (or climate-change-adaptation) measures are not implemented. However, the exact benefits of these measures remain unknown or inadequately quantified for potential future events in some flood-prone areas such as Kathmandu Valley, Nepal, which this paper addresses. This study examines the present (2021) and future (2031) flood risk in Kathmandu Valley, considering two flood-occurrence cases (with 100-year and 1000-year mean return periods) and using four residential exposure inventories representing the current urban system (Scenario A) or near-future development trajectories (Scenarios B, C, D) that Kathmandu Valley could experience. The findings reveal substantial mean absolute financial losses (€ 473 million and € 775 million in repair/reconstruction costs) and mean loss ratios (2.8% and 4.5%) for the respective flood-occurrence cases in current times if the building stock's quality is assumed to have remained the same as in 2011 (Scenario A). Under a "no change" pathway for 2031 (Scenario B), where the vulnerability of the expanding building stock remains the same as in 2011**, mean absolute financial losses would increase by 14%-16% over those of Scenario A**. However, a minimum (0.20 m) elevation of existing residential buildings located in the floodplains and the implementation of flood-hazard-informed land-use planning for 2031 (Scenario C) could **decrease the mean absolute financial losses by 9%-13% and the mean loss ratios by 23%-27%**, relative to those of Scenario A. Moreover, an additional improvement of the building stock's vulnerability that accounts for the multi-hazard-prone nature of the valley (by means of structural retrofitting and building code enforcement) for 2031 (Scenario D) would further **decrease the mean loss ratios by 24%-28% relative to those of Scenario A**. The*

largest mean loss ratios computed in the four scenarios are consistently associated with populations of the highest incomes, which are largely located in the floodplains. In contrast, the most significant benefits of risk mitigation (i.e., largest reduction in mean absolute financial losses or mean loss ratios between scenarios) are experienced by populations of the lowest incomes. This paper's main findings can inform decision makers about the benefits of investing in forward-looking multi-hazard risk-mitigation efforts."

3. **Line 105: It reads a bit as if you use four potential present and four potential future scenarios. So in total eight. Maybe rephrase here to avoid any misunderstandings.**

*Thank you for your comment. We have rephrased the sentence in question (with changes marked in **bold**) to avoid any misunderstanding:*

*L94-L95: "The methodology is a scenario-based flood loss estimation approach, using 100-year and 1000-year mean return period flood occurrence maps and **four exposure and vulnerability scenarios representing the current (2021) and potential near-future (2031) development trajectories for the valley**, focusing only on residential buildings."*

4. **The river network in Fig. 2 looks a bit weird with the cutoff stream segments. Maybe you can try to find another data source or delineate the river network yourself?**

Thank you for your comment. Data on the river network comes from OpenStreetMap (OSM), which is the best available source of information for the river network in Kathmandu Valley. OSM information for small streams is incomplete, which explains why some stream segments appear to be cut off in Figure 2. We have added a note in the figure caption to clarify this.

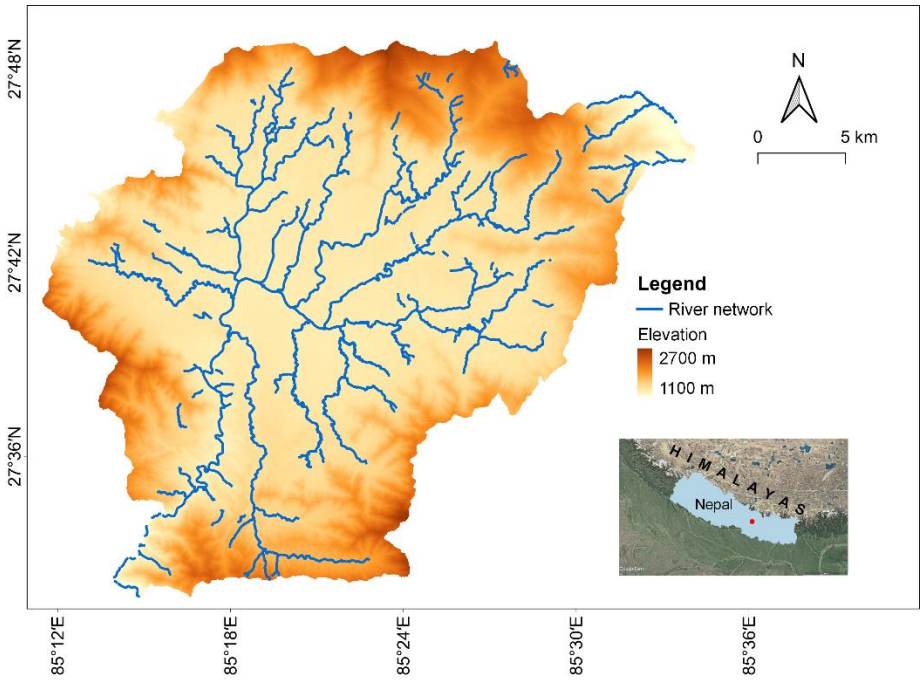

Figure 1. Physical map of Kathmandu Valley. The river network is taken directly from OpenStreetMap (OSM); small streams appear cut off where OSM data are incomplete. Inset map data: © Google Earth.

5. **Line 136: Add version number of the Fathon-Global model.**

Thank you for your comment. We have specified the version number (i.e., 2.0) in the sentence.

6. **Line 154: What do you mean by 'current flood' hazard'? Isn't also the 1000-year flood current flood hazard? Please avoid to phrase as if the 100-year flood is the present and the 1000-year flood the future flood.**

We have removed the phrase "and is intended to represent current flood hazard" from the sentence, to avoid any misunderstanding.

7. **Fig. 12 and 13 a) Those maps are a bit confusing, I think. You show that the mean loss ratio goes down despite increases amount of flooded and damaged building. It goes down because it is the mean ration and there are a lot of new buildings outside the flooded areas, right? So even if there are more damaged buildings the mean loss ration goes down. In scenario B more buildings get flooded and damaged, so it would be better to show this in a map, I think. Maybe you can try to compare the difference of the number of buildings affected or the total damage?**

Thank you for your comment. Indeed, mean loss ratios in some municipalities decrease from Scenario B to Scenario A where future urbanization outside the floodplain is larger than that in it.

*To clarify this point, we have added some lines (marked in **bold**) to the eighth paragraph of section "4.2 Losses", as follows:*

*L461-L463: "In Scenario B, the mean loss ratios show small absolute variations (between -1.0% and +1.2%) compared to Scenario A, since future urbanization continues to occur in both flooded and non-flooded areas. **Some municipalities experience a decrease in mean loss ratio (see Figure 7), where future urbanization outside the floodplain is larger than that within it.**"*

Moreover, we greatly appreciate your suggestion to include a new map in the manuscript showing differences in the number of buildings affected by floods. However, we have decided not to incorporate it because Figures 7 and 8 (section 4.1 "Distribution of buildings in the floodplain") already provide the number of buildings in the floodplain for each scenario; differences between the scenarios can be derived from these maps, so mapping them explicitly would unnecessarily increase the manuscript's length.