

## Reviewer 1

This review is concerned with the article titled “Estimation of emergency costs for earthquakes and floods in Central Asia based on modelled losses”, it is divided into three categories, namely, general comments, specific comments and technical comments.

### **General comments:**

The article titled “Estimation of emergency costs for earthquakes and floods in Central Asia based on modelled losses” clearly reflects the contents of the paper, and the abstract provides a concise, complete and unambiguous summary of the work done and the results obtained. They both are pertinent, and easy to understand. It is well-written, and well-structured. It is concise and technically precise in clearly delivering the idea, methodology and the results. It has descriptive high-quality figures and informative tables. It is well-referenced with proper credit attributed to previous and/or related works, and the authors clearly indicate each of their contributions. This manuscript is a part of a larger project, and there are other articles associated with it as indicated in the text and references. Thus, this article deals specifically with the methodology and, it is a high quality work. The manuscript contributes a new and interesting methodology to estimate the total emergency costs (which is a sum of the first response costs and cost of debris removal taking into account the population density and building characteristics) for natural hazards such as earthquakes and floods; tailored to five countries of Central Asia. It utilizes the latest earthquake hazard and flood models as well as exposure and vulnerability models specific to these countries of interest. Estimating such emergency costs is extremely important for comprehensive disaster risk management strategies. Thus, this manuscript has excellent scientific significance, scientific quality and presentation quality.

We thank the reviewer for the positive comments on our manuscript, and have considered all the specific, technical and grammatical corrections in the revised version of the manuscript. Below, we are providing in blue our reply to each of the points indicating how the comments were addressed.

### **Specific comments:**

The readers would greatly benefit if the authors could provide some clarity/elaboration on the following points. (An annotated pdf is provided to highlight the same).

1. There are certain instances where the authors write “debris removal”, and some instances where it is “debris disposal” and some instances where it is “debris removal and disposal”. It would help reduce the ambiguity if there could be a uniform usage of these term(s). For instance, on (Page 3, Line 85), (Page 4, Line 146), (Page 9, Line 310), (Page 10, Line 318).

In the revised version of the manuscript, we have homogenized this term into debris removal and disposal, to indicate that the costs the manuscript aims to quantify aims to cover these two activities.

2. From where/how were the values presented in Table 1, column “mean damage ratio (MDR)” obtained? (Is it related to a different article within the scope of the larger project in which the expected losses were calculated and then these values were calibrated to be associated with the respective DS’s?)

Within the framework of this project, region specific earthquake and flood vulnerability functions were developed (see Coccia et al., 2023 and Salgado-Gálvez et al., 2023 in this SI for more details). The MDR’s associated to each of the DS’s are consistent with those used in the vulnerability modelling. We have clarified this matter in the revised version of the manuscript.

3. Page 4, Line 129. What does CR stand for/represent?

*CR* indicates the cost per capita is assigned to the first response costs. We have rephrased the explanation of this parameter in the revised version of the manuscript to avoid misunderstandings.

4. How were the values presented in Table 2, column “Cost of emergency services” obtained?

The values shown in Table 2 and used in our analysis are based on data published after the occurrence of emergencies in various countries where aggregated emergency costs, and the type of building damage (e.g., the number of collapsed, uninhabitable and/or damaged buildings) were estimated. We considered data from CENAPRED (2018) for the 2017 Mexico earthquakes as our primary source, as the GDP (per capita) of the region where the largest shock occurred is more similar to the one of the Central Asia region, if compared to the US or other European countries where most other detailed emergency cost data are from. An explanation about this choice has been included in the revised version of the manuscript.

5. How were the DI estimations carried out after knowing the building type and MI, given in Table 3?

DI was taken as a percentage of MI for a given DS and building type. The percentages are, when available, based on HAZUS but are a weighed sum the of structural and non-structural components, since our model only computes a single DS on the building. The weights of the sum were taken as the percentage that each structural and non-structural components represent of the total MI. A discussion about this has been added in the revised version of the manuscript.

#### Technical corrections:

Below is a list to minor grammatical, typographical errors in the text provided. (An annotated pdf is provided to highlight the same).

##### 1. Grammatical errors/corrections:

- a. Page 3, Line 86

Current sentence: "...population that lives **on** each damaged building."

Correct sentence: ""...population that lives **in** each damaged building."

Sentence corrected in the revised version of the manuscript.

- b. Page 2, Line 58

Current sentence: "for the Whittier Narrows earthquake, and **for** 31% for the Loma Prieta earthquake"

Correct sentence: "for the Whittier Narrows earthquake, and 31% for the Loma Prieta earthquake"

Sentence corrected in the revised version of the manuscript.

- c. Page 4, Line 122

Current sentence: "It is assumed that only people residing **on** buildings..."

Correct sentence: "It is assumed that only people residing **in** buildings..."

Sentence corrected in the revised version of the manuscript.

- d. Page 5, Line 175

Current sentence: "As building physical attributes can vary..."

Correct sentence: "As physical attributes of buildings can vary..."

Sentence corrected in the revised version of the manuscript.

e. Page 8, Line 271

Current sentence: "For Uzbekistan, the relative TERC are considerably lower than **for** the other countries..."

Correct sentence: "For Uzbekistan, the relative TERC are considerably lower than the other countries..."

We consider that the original sentence is correct and no changes were made.

f. Page 10, Line 311

Current sentence: "population that lives **on** each of the damaged buildings..."

Correct sentence: "population that lives **in** each of the damaged buildings..."

Sentence corrected in the revised version of the manuscript.

g. Page 10, Line 312

Current sentence: "which values were obtained..."

Correct sentence: "**for** which values were obtained..."

Sentence corrected in the revised version of the manuscript.

## 2. Typographical errors:

a. Page 2, Line 75 – For the (remove repeated words).

Duplication removed.

b. Page 9, Line 98 – direct (losses?) (missing word).

Corrected in the revised version of the manuscript.

c. Page 6, Line 203 – Equation 3, please check the font of the "v" in the equation.

Corrected in the revised version of the manuscript.

d. Page 7, Line 247 – sere (spelling mistake), Correct word: were?

Corrected in the revised version of the manuscript.

e. Page 7, Line 250 – no (spelling mistake), Correct word: not?

Corrected in the revised version of the manuscript.

f. Page 9, Line 280 – Table 5 (missing word)?

Corrected in the revised version of the manuscript.

g. Page 9, Line 286 – Current word: “floods”, Correct word: flood/floods?

Corrected in the revised version of the manuscript.

h. Page 9, Line 306 – Current word: “considerable”, Correct word: considerably?

Corrected in the revised version of the manuscript.

3. The details of event #3 given in Table 4, column “Date”, do not match the details of the same event in Table 5, column “Event”.

The format for the dates in the two tables were homogenized in the revised version of the manuscript.

4. The heading of the last column of Table 5 is not visible clearly.

The table formatting in all cases was reviewed in the new version of the manuscript.

5. Page 11, Line 363-364 - This reference format does not match the rest of the references (in formatting style). Coccia et al. (2023). Large-scale flood risk assessment in data scarce areas: an application to Central Asia. Natural Hazards and Earth System Sciences. (preprint under review).

The full reference for this publication has been included in the revised version of the manuscript.

## Reviewer 2

This is a welcome contribution to the literature on natural hazards in Central Asia.

We thank the reviewer for the positive feedback on our manuscript. Below, we are providing in blue our reply to each specific comment to indicate how these have been addressed in the revised version of the paper.

In the abstract, reference is made to the use of synthetic events. Elsewhere these are termed 'counterfactual' events. A counterfactual event is an alternative realisation of a historical event. Such events would be useful for scenario analysis. To avoid misunderstanding, the term 'synthetic' should be used consistently in the paper.

In the revised version of the manuscript, we have homogenized the term to synthetic events to avoid the possible misunderstanding pointed out by the reviewer.

My biggest concern over this paper is the treatment of human factors, specifically corruption and mismanagement. There is a significant correlation, first identified by Ambraseys and Bilham in 2011, between earthquake damage and corruption. On the Transparency International Corruption Index, the country rankings are: Kazakhstan 101, the Kyrgyz Republic 140, Tajikistan 150, Turkmenistan 167, and Uzbekistan 121.

These rankings are worse than in other countries which are used for loss cost comparisons.

The challenge of addressing Central Asian loss costs can only be fully met if the pervasive political and socio-economic factors are explicitly assessed. Otherwise, the results will be misleading to risk stakeholders.

We understand and to some point share the concern of the reviewer regarding the relevance of human factors in this field and are aware of the different publications about corruption and disaster/emergency management. However, this aspect is beyond the scope of the paper which main objective is to find a relationship between the direct losses and the total emergency costs.

In the introduction and discussion sections of the revised version of the manuscript, we have added some text regarding this limitation, but indicating that it is a field on which not only past and recent research are available (adding representative references for this), and has relevance in the actual execution of the any plan during the emergency response. For the latter, we have added some references that in our opinion are relevant and reflect what the reviewer correctly pointed out.