Response to the Referee comments on the article "Regional seismic risk assessment based on ground conditions in Uzbekistan".

Many thanks to the two reviewers for reviewing our article in detail and expressing their feedback.

Authors answered fully all the comments and questions posed. The manuscript has been modified accordingly. We have corrected all your comments. The following is the corrected comments.

Reviewer #1:

1. The article discusses the outcomes of developing GIS-platforms for seismic risk assessment in Uzbekistan. The significance of this publication is unquestionable. Nevertheless, in the reviewer's view, the authors have not effectively organized the information pertaining to the initial data used for risk assessments, nor have they adequately described the process for determining the final risk values. The text of the article is poorly structured, containing many introductory sentences, while there are no descriptions of specific stages of development of new maps. The article does not reveal the novelty of taking into account the ground conditions indicated in the title. The described changes in ground conditions accounting (135) are not used further and are not described. Furthermore, there are numerous inaccuracies within the article's text, tables and figures provided do not adhere to the standards expected in scientific publications.

Answer: We have corrected all reviewer's remarks and changed the structure of the article and eliminated the ambiguities.

2. Table 1 is redundant. The text suggests that it includes events with magnitudes greater than or equal to 7, which does not align with the table's actual content. Additionally, there is no information regarding the type of magnitude used, and inconsistencies exist in the spelling of the same names. The date of the event 1924 is not provided.

Answer: In the table there are earthquakes with the same name, but these events took place in the same place at different times. We included dates in the table

3. The title of the second section should be changed to “Data and methods”

Answer: Corrected

4. 101-102 - missing references.
5. 102 – The principle of division of the territory into 12 districts is not described. There is also no description of the division into sub-regions and sections.

Answer: we have removed 12 districts from the text. The map itself is divided into 14 districts by lithologic composition.

6. Figure 1 should be modified. Only the demonstration areas and the legend should be shown. All information about the map should be given in the figure caption.

Answer: Done

7. Figure 2 - see comments on Figure 1.

Answer: Corrected

8. Figure 3 is not referenced in the text, and the panels within the figure remain undescribed. The panels essentially replicate maps found in other figures.

Answer: We corrected the numeration and inconsistencies

9. Figure 4 - see comments on Figure 1. Figure 4 may be shown in conjunction with Figure 2. In this case it will be convenient for the reader to compare them

10. The color code of intensity in Fig. 2 and Fig. 4 must be the same.

Answer: Corrected

11. Changes in the definition of intensity should be described in more detail. For example, by presenting a table of area for one and the other seismic hazard maps.

Answer: Ratios between seismic hazard map and seismic hazard map considering ground conditions in percentage.

12. GESI_Program - missing references

Answer: Corrected

13. “Damage characteristics of buildings” - table it.

Answer: We have included table.

14. 240 - The vulnerability functions used should be cited. If they are presented in Fig. 5, this should be indicated. The article does not specify (except for Fig. 5) the ratio of peak acceleration and macroseismic intensity used. A correspondence table or conversion formula (with references) is needed

Answer: We have included the citation on vulnerability function. We have included a conversion equation with reference.

15. 252 “GESI_Program and experimental data of Sh. Khakimov” - missing references

Answer. We have corrected the references

16. 305, Figure 9 - PGA needs to be in m/s^2 as on Figure 5. The grading of the PGA in Fig. 8 is not clear. It would seem that it should coincide with the one in Fig. 5 and, accordingly, with the intervals corresponding to the seismic intensity values.; EMS-98 - missing references

Answer. We have corrected the figure and included the reference.

17. Since administrative divisions are difficult to present to the general reader, the information in Figure 11 should either be presented in the form of a map or population numbers should be given instead of/along with the names of administrative divisions. see comments on Figure 9

Answer: Figure 11 shows the distribution of residential buildings in areas with different seismic impacts within the administrative districts of Uzbekistan. We have redrawn it to show the distribution of residential buildings by regions of Uzbekistan.

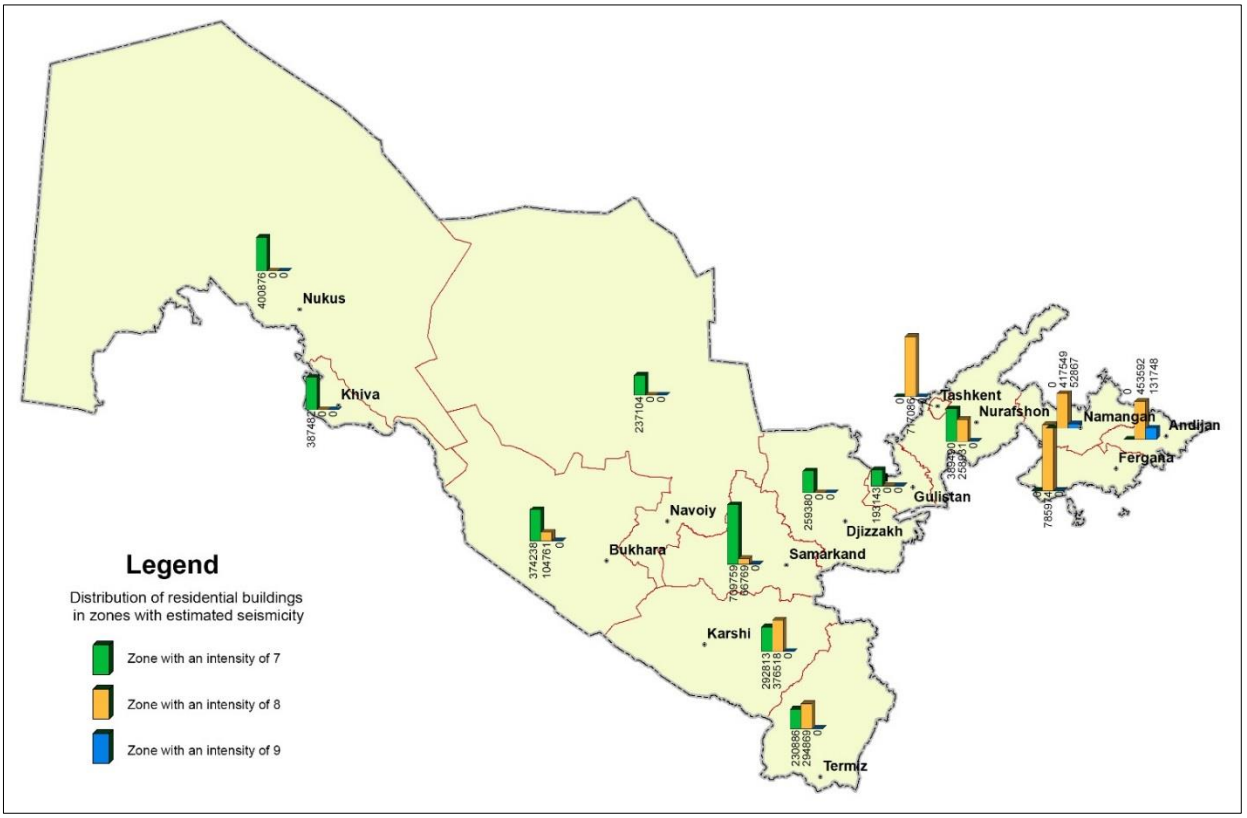


Fig. 11: Distribution of residential buildings by regions in Uzbekistan

18. 335-340 - Technical information is redundant. If the database is open, a link to it should be provided. If it is closed for public access, this should also be indicated.

Answer: We have removed unnecessary technical information, redrawn, and included Figures 12 and 13 in the text.

To assess the seismic risk within the context of the administrative districts of the Republic of Uzbekistan, it is necessary to take into account the share of the housing stock across all administrative districts, considering zones with different intensities. Figure 10 shows the share of residential buildings in Uzbekistan with different parameters of seismic vibrations (based on the OSR-2017 map with a probability of 90%). Considering spatial distribution of residential buildings by zones with different seismicity (based on the OSR-2017 map with a probability of 90%), it can be seen that southern and eastern parts of the country having an estimated seismicity of 8 and the most eastern part, which is Ferghana valley, has seismicity of 9 (Fig. 11). Cadastral value of residential buildings by administrative areas is also an important information for developing maps of seismic risk, as well as for the government that implementing policies for increasing the seismic resilience of buildings and structures. Figure 12 shows the cadastral value of housing stock within the Republic of Uzbekistan and its administrative areas.

19. 360-390 The section provides a map of seismic risk. It is not clear what the authors meant by "Probable seismic damage" in the title of the paragraph. Since the title of the article contains new seismic hazard estimates, seismic risk estimates based on the previous seismic hazard map should be given for comparison.

Answer: The seismic risk map is calculated only considering the ground conditions

Reviewer #2:

1. Line 25-26. As of January 1, 2022, the permanent population of Uzbekistan reached 35 271 276 people. Currently, approximately half of all Uzbekistan citizens (17.9 million people) live in urban areas and 17.4 million people live in rural areas (Please add reference).

We have added the reference to the reference list.

(https://countrymeters.info/ru/Uzbekistan#population_densit).

2. Line 27. … earthquakes with a magnitude of M ≥ 7 (Please indicate the type of magnitude)

We have used the Local Magnitude Scale M_L.

3. In the Lines 27-29 the sentence : At the territory of Uzbekistan and adjacent regions, both during the historical period and recent years, earthquakes with a magnitude of M ≥ 7 and an intensity at the epicentre I0 reaching 9–10 according to the MSK-64 scale have been recorded (Table 1). It is confusing since the data constitute Table 1 are with also smaller magnitudes than 7 even 5… Please explain. I guess this is not even the full earthquake catalog of Uzbekistan but some extract…

Yes, it does not encompass the entire earthquake catalog. We have utilized the earthquake catalog available at the Institute of Seismology in Uzbekistan. Our objective was to carefully curate a selection of the most impactful earthquakes from various locations over the past century. This effort aims to illustrate that Uzbekistan is indeed prone to seismic activity.

4. Line 28. … have been recorded (Table 1) (Are all of those earthquakes stated in Table 1 are really instrumentally recorded? Even the historical ones? Please clarify.)

We have added asterisk to distinguish historical earthquakes.*

3. Line 29-35. The geological structure of Uzbekistan is very diverse, but the territory basically consists of two tectonic structures of the Tien Shan orogenic region and Turan plate. The current state of relief in the territory of Uzbekistan was preceded by long difficult stages. In the territory of Uzbekistan, tectonic movements are actively continuing nearly everywhere. In the geological history of Uzbekistan, roughout all stages of development, in particular, in the formation of the modern structural plan, faults, especially zones of deep faults, played an important role. These faults transect the entire Earth's crust, often penetrate into the mantle and are the natural boundaries of large structural elements. (Please add reference/s in relation to statements about contemporary geology and tectonic of territory of Uzbekistan).

We have added the reference in relation to statements about contemporary geology and tectonic of the territory of Uzbekistan (V.I. Ulomov et al., 1990).

5. Line 32. The current state of relief in the territory of Uzbekistan was preceded by long difficult stages. (What does that mean? Please revise the sentence and explain better).

The sentence was there due to improper translation into English. We have removed it.

6. Line 35. These faults influence disaster preparedness and risk reduction activities. (Please rewrite as faults cannot influence any activities. Maybe seismic conditions is better term…).

Yes, you are right. Thank you for pointing it out. We have corrected it.

7. Line 35-39. One of the challenges in assessing seismic risk is considering the determination of soil conditions in the modification of seismic effects on the Earth's surface. Therefore, one of the tasks of this study is to investigate the geological environment and the patterns of seismic wave propagation through it. This is because this effect is directly dependent on the structure and depth of the geological and lithological differences of the rock formations comprising it. (Please revise, improve English)

Thank you for your comment. We have revised the paragraph and improved English.

8. Line 40. Table 1. Date format to be extracted year, day, month in separate columns. Name? What that means? Name of the closest site to the epicenter or maybe region? Please explain and include the explanation in the text. For M please indicate type of magnitude (ML, Mw… or other).

We have corrected the name of table columns accordingly.

9. Line 44-61. Repetitions of sentences noted. Mistakes in some references (ex. Trendafiloski and Milutin (2004)… should be Milutinovic…). Missing new and state of the art refences and worldwide initiatives in the domain of seismic risk (ex. GEM initiative or similar). In this part it is necessary to include references focused on the Central Asia Region and on national level with proper comments from the authors.

We have removed repetitions, corrected the references and added recent literature.

10. Line 66. Is the risk assessment comprising only residential building portfolio? Please clarify and explain.

For our study we use the database of the cadastral agency of Uzbekistan, and it has only residential buildings and their cost estimation, which is necessary for seismic risk assessment

11. Line 70-73 The developed seismic risk analysis algorithm used the capabilities of GIS, combining data on the spatial distribution of seismic hazards, vulnerability of buildings, geographical location of residential buildings, and values, i.e., cadastral value of buildings at risk of damage and loss, in a layer-by-layer manner. (Need revision and better explanation).

We revised that part and removed unclear explanations.

12. Line 73. GESI_Program (https://iisee.kenken.go.jp/net/saito/gesi_program/index.html). What was the idea of using this „quite old“ nearly 25 years old tool despite existence of other state-of-the-art tools and softwares for seismic risk calculations (ex. Open Quake, HAZUS, Selena, CAPRA, ELER, and others…)? Please explain.

This is a pilot project for Uzbekistan, and we wanted to avoid complications and keep the methodology simple and straightforward. Moreover, we had experience using GESI before. Therefore, we used this comparatively old tool for this study. In further studies and projects, we are going to use more modern tools, including software that was listed by you.

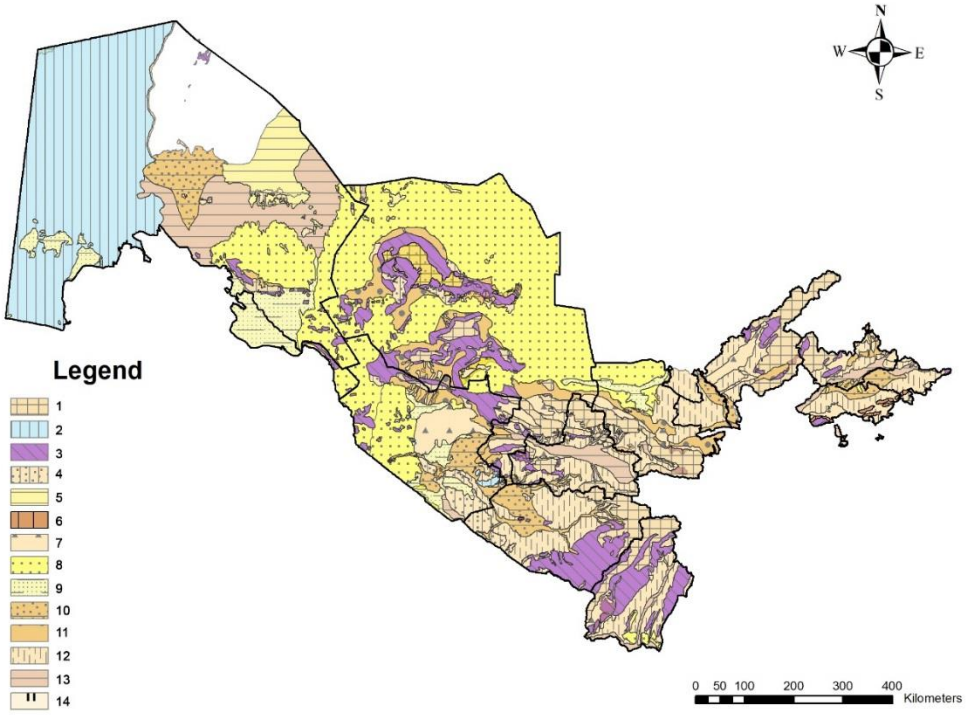
13. Line 87-93. Please include the web site links to the mentioned institutions in the footnote.

We have added the web site links to the mentioned institutions in the footnote.

14. Line 101-101. Please refer the mentioned works of G.A. Mavlyanov, A.I. Islamov, P.M. Karpov, S.M. Kasymov, R.F. Kirsanova, A.M. Khudaibergenov, M.Sh. Shermatov, K.P. Pulatov in correct manner and include them in reference list

We have revised the mentioned works in a correct manner and included them in the reference list

15. Line 105 Figure 1. Please add reference related to this figure/map



We have added the reference to the figure/map.

16. Line 132. Please explain term “average soil” and relate it so soil category.

We removed the confusing term and explained our methodology with other words.

Line 107-120. Please support with the references.

We have added the reference.

17. Chapter 2.2. Is very confusing. Must be rewritten as a whole, better explained and accordingly referenced.

We have revised chapter 2.2, added references and tried to provide a better explanation of our work.

18. Line 173 - 175. Vulnerability functions for the identified structural building types within the territory of the Republic of Uzbekistan were developed using the "GESI_Program", which is a computer program based on the assessment of structural damage under 175 specified seismic events (see Fig. 5). (Please explain how they are developed?)

To establish vulnerability functions in the 'GESI_Program,' several parameters are considered: type of construction material, design quality, construction quality, seismic strength. Following this, the 'GESI_Program' will calculate the vulnerability functions.

19. Line 182. The vulnerability index for the city of Tashkent in the experiment did not exceed 10% of the total (Probably this is result of RADIUS project. Please add reference for this statement).

We have added the reference for this statement.

20. Line 191-193. As of February 1, 2021, at the republican level, 7,135,881 residential buildings were analyzed and systematized with a total area of 4.4 billion square meters. These buildings were categorized by their structural types and aggregated by administrative regions (By whom? By this research or?)

It was done by the employees of the Institute of Seismology (Uzbekistan). We have added this information to the text.

21. Line 195, Table 2. It is stated that the buildings are classified according to structural types, which is not true but according to material of structural system (Please explain and clarify).

We meant the material of structural system. We have revised this part.

22. Chapter 3.1. Title should be revised and reflect the content.

We have revised the title.

23. Line 286. … individual houses (80.1%) and multi-story residential buildings (19.9%). What means individual houses… only ground floor or? Accordingly, that means multy-story (G+1 up to …) Please clarify.

Individual houses are 1 or 2 story buildings, and residential buildings are buildings, which have many apartments within the building. We have clarified that part in the text.

24. Chapter 3. Data and statistics presented is better also to be shown in spatial (GIS) manner.

We have added a new figure and showed the spatial distribution.

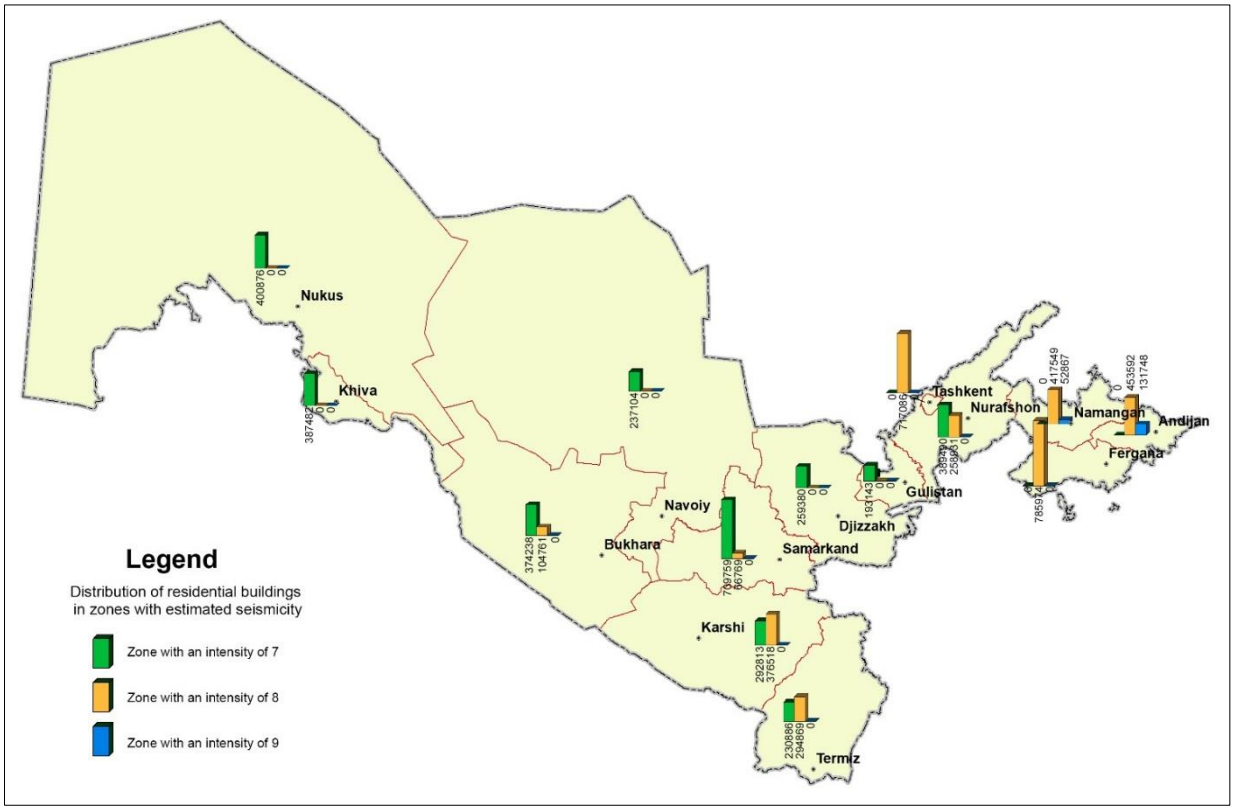


Fig. 11: Distribution of residential buildings by regions in Uzbekistan

25. Chapter 3.2. The whole section needs to be seriously rewritten and better explained.

Since there is a similar information in the next chapter, we removed that chapter.

26. Chapter 3.3. Title… Probable…? You mean probabilistic? Probabilistic seismic damage and risk assessment?
Yes, we meant probabilistic seismic damage and risk assessment. We revised that part.

27. Chapter 3.3. The content should also be seriously rewritten. It is a summary of previous sections. Why only one return period is considered in the study (475 y)?
We chose a return period of T=475 years, as it is commonly used in similar studies in Germany, Italy, and other countries to assess seismic risk. Also, we have revised the chapter.