Response to Reviewers' Comments # 3

We sincerely thank the reviewer for the constructive comments and helpful suggestions, which have significantly improved the clarity and quality of the manuscript. In response, we have carefully revised the text and updated the relevant figures to enhance the overall presentation and ensure clearer understanding of the results. We hope the revised manuscript meets the expectations and is now suitable for publication.

Reply to Reviewer #3:

The study compiles an extensive earthquake catalog (1905–2023) using multiple reliable sources (KMA, ISC, JMA) and ensures consistency through magnitude conversion. It offers a robust seismicity assessment by applying four declustering methods and using Stepp's method and CUVI for completeness analysis. The research highlights earthquake clustering in South-eastern Korea, aiding seismic hazard and risk assessments, and provides a strong foundation for microzonation and engineering applications. Its well-structured methodology enhances clarity and reproducibility. However, certain aspects require further point-by-point explanations:

Q 1. More recent literature on earthquake catalogs of the Korean Peninsula could be added to the introduction section to clarify how this study stands out in comparison.

Reply: Thank you for your valuable comment. We would like to clarify that a literature review discussing previous catalog works in Korea were already been included in the original manuscript. Please refer to line 49 for a detailed description. Our study aimed to prepare a homogeneous earthquake catalog encompassing the entire Korean Peninsula, which distinguishes it from earlier efforts that were either region-specific or limited in scope or methodology. In addition to the detailed descriptions and the updated catalog have been provided as electronic supplementary material. This is intended to support a better understanding of seismic activity in the region and contribute to future research in seismic hazard. For ease of reference, the relevant sentences from the manuscript are again provided below:

"Studies on earthquake catalogs in Korea have been conducted over several decades, with significant contributions from Li (1986), Kim and Gao (1995), and Lee (1999). Since the Korea Meteorological Administration (KMA) has strengthened its national seismological observation network, recent efforts have focused primarily on estimating historical earthquakes (Lee & Yang, 2006; Seo et al., 2010). Seismic hazard studies in Korea typically use earthquake data from the KMA database (Han & Choi, 2008; Kyung et al., 2016). Ideally, a comprehensive earthquake catalog should be compiled by integrating earthquake data from all available sources, not just regional ones. Recent seismic hazard research by Park et al. (2021) identified this issue and incorporated instrumental earthquake catalogs from the KMA, JMA, and the China Earthquake Administration (CEA) for their analysis. However, their database was limited to South Korea, and their primary focus was on seismic hazard studies rather than catalog details. By contrast, our study aimed to prepare a homogeneous catalog encompassing the entire Korean Peninsula. In addition, detailed descriptions and an updated catalog are provided as electronic supplementary material, intended to aid in understanding seismic activity in the region and to enhance earthquake-related research and preparedness efforts."

Q 2. **Figure 3 and 4, M represents various types of magnitude scales. If the magnitudes scales could be defined by separate colours it would be better.**

Reply: In accordance with the comment, Figures 3 and 4 have been modified in the revised manuscript. Different types of magnitude scales are now represented using distinct colors to improve clarity and visual interpretation. The modified figures are included in the revised manuscript. For the convenience, the modified figures are also provided below.

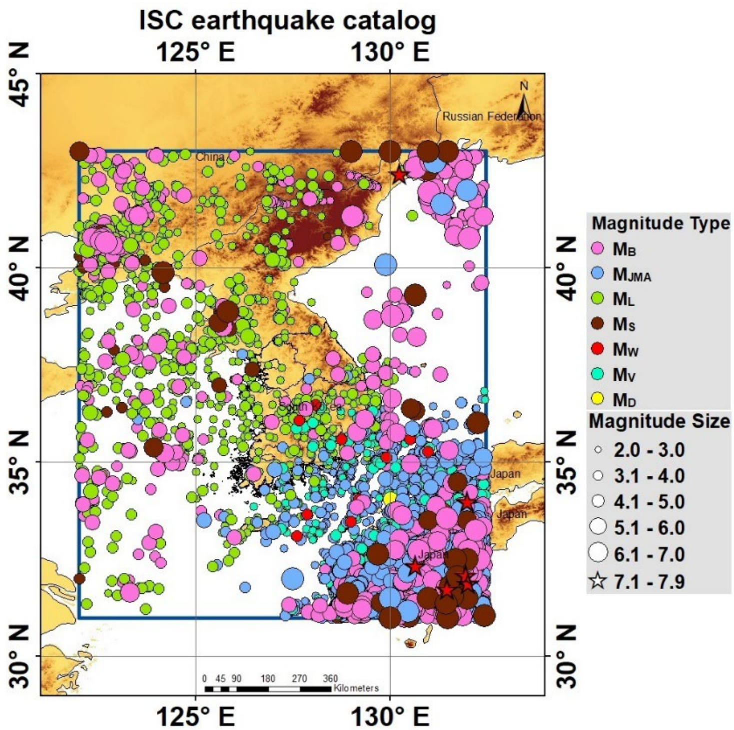

Figure 3: Seismicity distribution of earthquake locations from the International Seismological Centre (ISC) bulletin. In this figure, different magnitude scales, including M_b, M_{JMA}, M_s, M_W, M_L, M_D and M_V are represented using distinct colors.

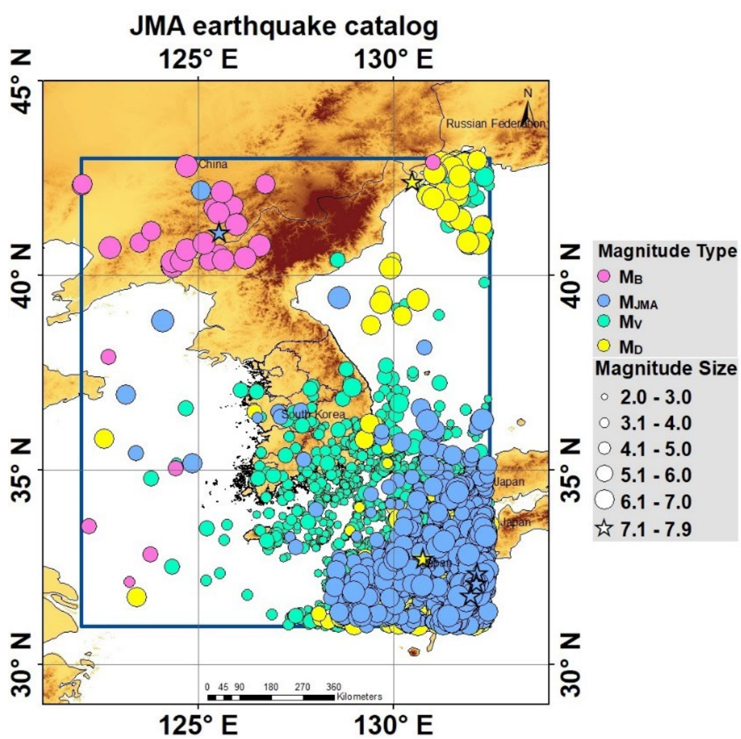

Figure 4: Seismicity distribution of earthquake locations from the Japan Meteorological Agency (JMA) source. In this figure, different magnitude scales, including M_b, M_{JMA}, M_D and M_V are represented using distinct colors.

<u>Q 3.</u> **Annual reporting of earthquakes with magnitude (all types) ≥2.0 in the study region from the three major agencies: ISC, KMA and JMA database can be shown in a comparative plot for better understanding of the event counts and temporal variation.**

Reply: We have plotted the annual earthquake counts (M ≥ 2.0) for the three agencies namely KMA, JMA, and ISC in a comparative plot, allowing direct visualization of the temporal variation and differences in reported events across agencies. This figure has been added to the revised manuscript in Section 3.2. The figure is also provided here for reference purposes.

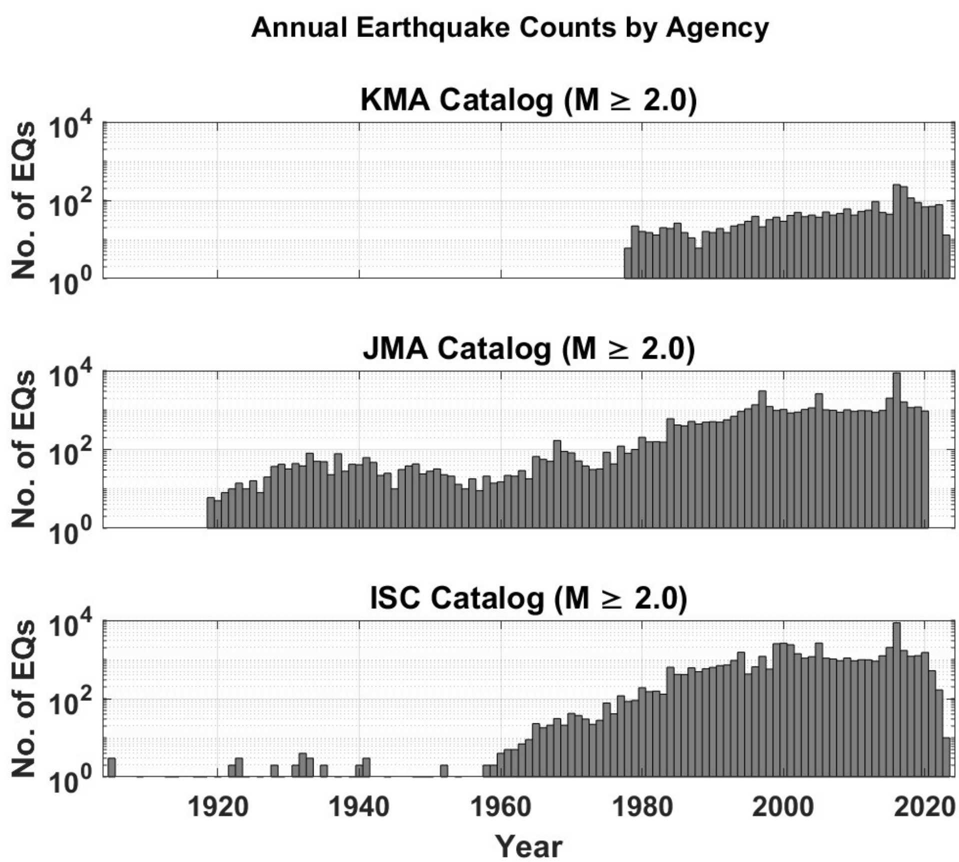

Figure 5: Annual earthquake counts reported by KMA, JMA, and ISC in the Korean Peninsula. The plot allows comparison of temporal variations in seismic reporting among the three agencies.

<u>Q 4.</u> **The study uses several magnitude conversion equations from past research. Were any validations performed on the converted magnitudes to check for biases or inconsistencies?**

Reply: We would like to clarify that the present study did not derive or apply any new magnitude conversion equations. Instead, we have utilized well-established and widely accepted global conversion equations that were specifically developed for the regions or magnitude scales relevant to this study. The validation and evaluation of these equations were thoroughly performed by the original authors in their respective publications. Our study has adopted these published equations as they are, considering their established reliability and recognition within the seismological community.

<u>Q 5.</u> **This study shows a comparison between four different techniques for declustering of the events comprehensively. What do you think? Which one is the best in this case?**

Reply: We sincerely thank the reviewer for raising this thoughtful question regarding the optimal declustering method and its implications for seismic hazard assessment. We fully acknowledge that the choice of declustering technique can significantly influence seismic hazard modeling outcomes. While the primary objective of this manuscript is to contribute to the development of a homogeneous earthquake catalog for the Korean Peninsula and present a systematic comparison of widely used declustering methods, we have included additional analysis to evaluate the practical implications of the declustering choices.

Specifically, we now compare the Gutenberg-Richter parameters (a- and b-values) derived from each of the declustered catalogs, alongside the homogeneous catalog, as a way to assess how the different methods impact seismicity rate estimates. This analysis, will be included in the revised manuscript at Section 7 (Table 5), which will provide insight into the degree to which declustering affects frequency-magnitude distributions. While this analysis provides valuable insight into the sensitivity of seismicity rate estimates to different declustering approaches, we refrain from selecting a single "best" method at this stage. A full evaluation of how these declustering methods affect seismic hazard estimation especially within a Probabilistic Seismic Hazard Assessment (PSHA) framework requires further dedicated analysis involving detailed seismic source modeling and hazard computations, which extends beyond the scope of the present study. We plan to address this critical aspect in a future study, where full PSHA computations will be performed using the different declustered catalogs to assess their influence on hazard results.

The study applies four different declustering techniques to identify mainshocks and remove dependent events. Were foreshocks considered in the declustering process, or does the analysis focus only on aftershocks? If not, could these methods be adapted to distinguish foreshocks as well?

Reply: We would like to clarify that the declustering algorithms applied in this study are commonly employed to distinguish mainshocks from dependent events, which include both aftershocks and foreshocks. All four methods employed including window-based, cluster-based and stochastic based treat dependent events comprehensively and are not limited to aftershocks alone. This aspect is already mentioned in the original submitted manuscript (please refer to lines 328 and 385), where we describe the scope of the declustering techniques. As such, the analysis does not exclude foreshocks; rather, it systematically identifies and removes all dependent events, including both aftershocks and foreshocks, from the mainshock catalog.