RC1 comments and responses:

The manuscript outlines a methodology for constructing a time-dependent fixed asset model applicable to China. It establishes a model using fixed asset data at the provincial level and further refines it to a more detailed grid level with remote sensing ancillary data. The findings are validated with results from other studies. The methodology is purported to assist in quick post-earthquake loss estimations. The topic is interesting, and the manuscript is well-written. However, it can benefit from some comments I suggest below to improve its clarity and contribution to the field.

Response: Thank you very much for your time and efforts spent on reviewing our manuscript, which is deeply appreciated. And we are really touched by your careful check of the whole manuscript! We have read all your constructive comments and suggestions carefully and tried our best to prepare the initial responses. Hopefully, they can help release the concerns you have on the current version of the manuscript. Our detailed responses are given as follows.

General comment:

The methodology and results seem useful for assessing economic losses due to any hazard, not only due to earthquakes. Even though the introduction includes references about the importance of earthquakes and previous earthquake loss estimations, the methodology and results do not confront loss estimations from past earthquake events. Furthermore, Fig. 2 has no input that one could identify with an earthquake hazard or risk (e.g., ground motion fields, earthquake occurrence rate, or fragility model). The methodology and results focus on modelling the observed economic and demographic growth in the study areas consistently, considering the data quality limitations in terms of spatial resolution and time-frequency. I think the paper can be stronger (and closer to the journal's scope) by adding some statements in the discussion and conclusion about how the methodology and results can help in the loss estimation due to an earthquake event or other natural hazards. It would also be interesting to add to the introduction a review of studies of other natural hazards, such as floods or extreme wind events.

Response: Thank you for further recognizing the applicability of this fixed asset dataset to the risk assessment of other hazards. As to its application to seismic loss estimation, we have an independent paper (Li et al., 2023) demonstrating in detail how this fixed asset data can be combined with intensity maps and damage information of historical earthquakes to regress empirical loss models for different regions in China. In this paper, examples were also provided to demonstrate the loss estimation for recently occurred damaging earthquakes. Therefore, in this paper we limit ourselves to focus on the introduction, disaggregation, and evaluation of this fixed asset dataset. This explanation will be added to the revised manuscript.

Like seismic risk analysis, different scales call for different methods when it comes to assessing flood/wind risks and assessments at different scales have different uses. As explained in Page 2, Lines 34-46 in the manuscript, the fixed asset model developed in this paper is based on the Level 1 data. Based on this level information, the estimated seismic loss is relatively a rough estimation since the input data mainly include demographic data and building-related statistics extracted from the national census. When applicating the developed fixed asset data to other natural hazards (e.g., flood or extreme wind event), the required resolution and attributes of exposed asset will be different.

For flood risk assessment, detailed building attributes (floor area, height) value should be gained to better assess building vulnerability to flood (Röthlisberger et al., 2018; Wouters et al., 2021; Wu et al., 2019). As verified by the comparison of different exposure models for floor risk analysis in Röthlisberger et al. (2018), the estimation of exposed building values should be based on individual buildings rather than on areas of land use types. However, from the fixed asset data developed in this paper, we cannot further derive the floor area and height information even for administrative units, let alone for individual buildings. Therefore, we consider the developed fixed asset data may not be applicable enough for reliable flood risk analysis. Even at grid level, the flood loss estimation results are more sensitive to changes in exposure resolution than seismic loss estimation results. For example, the work of Dabbeek et al. (2021) revealed that when changing the resolution of exposure model from 1km to 8km, the change in final overall loss is less than 5%. In contrast, the work of Bouwer et al. (2009) found that using a 100-m grid instead of a 25-m grid for the same case study area resulted in damage estimates up to 50% higher. In the case of wind risk analysis, studies published in recent years also tend to use building level or even component level exposure data to assess the wind risk (Pandolfi et al., 2022). Such building attributes cannot be derived from our current fixed asset model either. This comparison will be added to the revised manuscript.

Therefore, we consider targeting the application of the developed fixed asset data to seismic loss estimation, for which reasonable estimation performance have been achieved as demonstrated in our another work (Li et al., 2023). In addition, there are already quite a few review articles written by specialists focusing on risk analysis of flood and wind. Among them, De Moel et al. (2015) provided a quite comprehensive overview on the current state, development, assessment characteristics of quantitative flood risk assessments at different scales (supra-national, macro, meso, micro). They also outlined the lessons learnt from current practice and identified future research needs for flood risk assessment. Yu et al. (2023) provides a comprehensive review on the studies related to exposure roughness exposed to wind hazard. Therefore, we will recommend readers to refer to their work for more comprehensive information in the revised manuscript.

Specific comment:

1. The conclusion says the methodology can be extended to more recent years once the data is available. However, considering that the methodology aims to help in quick loss assessment for future earthquake events, can the methodology with the available data today (in 2024) provide a prediction, for example, of the losses after an earthquake event in 2030?

   Response: Thank you for this question. The direct answer is yes. Since the estimation of seismic loss is based on the combination of intensity map, fixed assets affected by the earthquake, and the vulnerability curve of fixed assets, for an earthquake to occur in 2030, we would recommend the use of latest fixed asset map available to assess its seismic loss, as long as the intensity map can be reasonably modelled, and the increased fixed assets from 2024 to 2030 can be added to the fixed asset map for 2030.

2. I suggest mentioning the future availability of grid-level fixed asset data only in the section "code and data availability", as it is done and justified in this version of the manuscript, and only mentioning it in the abstract and conclusion in a later version, when the data is effectively available.

   Response: Thank you for this suggestion. We will remove the expression related to data availability in the abstract and conclusion in the revised manuscript.

Technical corrections

1. Tables 2 and 3, as well as Figs. 5, 7-9: Consider changing the monetary units to billion Chinese yuans, as done in Figs. 11-12

   Response: Thank you for this suggestion. In Tables 2 and 3, the monetary units will be changed to billion Chinese yuan in the revised manuscript. However, in Figs. 5.,7-9, to better demonstrate the spatial locations of clusters of high fixed assets, the upper threshold of fixed asset value in the color bar is set as 243801864, 74247334, 61145222, and 88179937 in Fig. 5, Fig. 7, Fig. 8, and Fig. 9, respectively, which corresponds to the 98% quantile of the grid-level fixed asset value in each figure. These values are all smaller than 1 billion since these values only represent fixed asset in the 1km×1km grids. When the unit in these figures is expressed in billion Chinese yuan, the numbers at grid level will be too small to differentiate the spatial clusters of high fixed assets. Therefore, for better visualization effect, the monetary unit of yuan is a relatively better choice.

2. Fig. 2: There is a typo in one of the charts: “Harmonized” instead of “Harmanized”.

   Response: Thank you so much for your careful check! This error will be rectified in the revised manuscript.

3. Although described in the text, the delta in Eq. 3 has a different meaning than the delta in Eq. 4. I suggest using a different symbol for one of them.

   Response: Thank you so much for this suggestion! We will use κ to replace δ in Eq. (3) in the revised manuscript.

4. Table 1: There is a typo in the 2nd column, 8th row: “Population density data” instead of “Population dentsity data”.

   Response: Thank you again for your so careful check! This typo will be rectified in the revised manuscript.

References mentioned in the responses:

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