Response to Reviewer 1 Comments

This study provides a unique millennium-scale perspective on land-use change (LUC) emissions in China, addressing critical gaps in reconstructing historical LUC data and updating contemporary emissions modeling. While the data and modeling are not perfect at this point, the study has made great improvements to LUC data since the 1000s, and updated carbon densities for current biomass and soil. The manuscript is well-structured and easy to follow, but its contributions and methodological choices require further clarification to strengthen its impact. I would recommend publication after revisions.

Response: Thank you for this comment and your recognition of our manuscript. Your comments enable us to pinpoint issues within the manuscript accurately and provide us with guidance for improvement. I am glad to have such an opportunity to communicate with you. We have carefully revised the manuscript according to your comments and suggestions. For detailed revisions to the manuscript text, please refer to the revised draft where changes are highlighted in red font.

Thanks again for your help in improving the manuscript.

Major Concerns:

Point 1. The study's novelty should be explicitly contextualized. Why is a millennium-scale analysis of LUC emissions critical, given the inherent uncertainties in pre-industrial data? How does this long-term perspective enhance our understanding of anthropogenic impacts on carbon cycling, even when CO2 levels were relatively stable before industrialization? China's uniquely long historical record enables this work, but how might its findings inform global LUC emission estimates, particularly for regions with limited historical documentation?

Response: Thank you for this comment.

Your comment is very important for improving our manuscript. According to your suggestions, we have made the necessary revisions in the introduction to address why we chose the past millennium, what makes this period special, the significance of conducting research over such a long time scale, and whether the results can provide insights or references for other countries and regions. Please refer to lines 71–84 in the main text, where the revised content is marked in red. The revised excerpt is as follows:

"Although most global and regional studies on land-use change focus on the post-industrial era or the past three centuries, China's intensive and extensive land-use activities date back at least a millennium, thus representing a unique historical trajectory (He et al., 2025, 2023). From approximately AD 1000 (coinciding with the Northern Song Dynasty), ecological degradation in China showed a marked rise. This degradation was manifested through multiple pathways: accelerated erosion on the Loess Plateau, recurrent floods in the lower Yellow River Basin, large-scale lake siltation and disappearance in northern China, and progressive soil erosion coupled with natural vegetation loss in the southern hill regions (Wu et al., 2020; Chen et al., 2012). Such millennial-scale land-use transitions would have generated substantial carbon emissions, particularly from deforestation. However, the relatively stable pre-industrial global CO_2 concentrations likely obscured these regionally significant anthropogenic carbon fluxes because localized emissions in areas such as China could have been offset by concurrent carbon sinks elsewhere. Additionally, the full trajectory or specific stages of historical land-use change in China can serve as a "historical analogue" for other developing countries. For many countries and regions, systematically revealing the processes and mechanisms of land-use change and associated carbon emissions—driven by long-term population growth and policy shifts—can help overcome the limitations associated with a lack historical records and reliance on static assumptions."

Point 2. Regarding LUC data: It is challenging, if not impossible, to validate the LUC over the past millennium. The "reliability assessment" of historical LUC data needs elaboration. How does this assessment validate the reconstructed data, given the absence of direct validation methods for pre-industrial periods? Clarify whether this approach evaluates internal consistency, cross-references with alternative proxies (e.g., tax records), or quantifies uncertainty ranges. Please explicitly state what distinguishes the LUC dataset in this study from prior publications by He et al. Is the novelty in data synthesis, spatial resolution, or integration of new historical sources (e.g., tax records)?

Response: Thank you for this comment.

Reliability assessment has always been an unavoidable yet unverifiable aspect of historical land-use reconstructions, as the actual historical conditions cannot be fully known and can only be reconstructed using proxy data. Therefore, the reliability of such reconstructions is typically evaluated by examining the data sources, the rationality of the reconstruction methods, and the degree to which the results align with historical records, historical events, or similar datasets. In response to this issue, a dedicated subsection—2.3.2 Reliability assessment of long-term land-use change data—has been included in this manuscript. This section briefly outlines the above-mentioned aspects to indirectly demonstrate the reliability of the reconstructed data.

Relevant revisions can be found in lines 221–229, 254–258, and 275–277 of the manuscript, and have been marked in red font.

Point 3. Regarding carbon density assumptions: The assumption of static carbon densities over millennia is problematic. While the authors update current biomass and soil densities, pre-industrial carbon stocks likely shifted due to CO2 changes, climatic variability, ecological succession, and human management. Discuss how these dynamics might bias emission estimates and propose strategies to address this in future work (e.g., coupling with DGVM outputs). The carbon density updates in the current work only scratched the surface of the issue, by improving the densities of "current" times. In GCB2024, there are four book-keeping models used, why do you choose H&N or H&C model (I assumed, you did not specify)? Is it because of spatial resolution or any particular features that match well with your current data, like using LUC "state" instead of LUC "transition"? The other three seem to incorporate dynamic carbon densities to some extent (for instance including DGVM biomass data), but also with higher spatial resolution that may not match the provincial level in this study. I would suggest clarifying the rationale in the Methods, AND further discussing the uncertainties in the Discussions. This is not to deemphasize this work, but to urge future improvements.

Response: Thank you very much for your comments. Your feedback is professional, rigorous, and highly valuable for the further revision of our manuscript. It also provides insightful directions for potential future improvements, and we sincerely appreciate it.

First, following your suggestion, we have further clarified the origin of the bookkeeping method used in our study and the rationale for selecting this model in the Methods section (Section 2.3.1). Please refer to lines 192–197 in the manuscript, which have been highlighted in red for easy identification. The revised excerpt is as follows:

"The bookkeeping method (a statistical model) proposed by Houghton and Castanho (2023) was employed to estimate the annual carbon emissions caused by land-use changes in China from 1000 to 2019. Due to data limitations, long-term historical land-use reconstructions in China are primarily constrained to land-use "states" (e.g., total cropland or forest area at national/provincial levels for specific years) rather than spatially explicit land-use transitions. This characteristic, combined with the provincial-level spatial resolution of our data, makes such reconstructions inherently compatible with the bookkeeping model adopted here (Houghton and Castanho, 2023)."

In Section 4.3 Uncertainty Analysis, we provide a detailed discussion on static versus dynamic carbon density, the potential uncertainties associated with using static carbon density values, and directions for future improvements. Specific revisions were made in lines 565–573 of the main text and have been marked in red font. The excerpt is as follows:

"Although modern soil carbon densities were moderately adjusted by incorporating a large-scale soil sampling survey dataset from the post-1949 period in China, pre-industrial carbon stocks likely varied due to shifts in atmospheric CO_2 concentrations, climate fluctuations, ecological succession, and human land management. Vegetation and soil carbon densities were not static over the past millennium. Therefore, using static values to represent historical carbon densities may fail to capture temporal dynamics, thereby introducing uncertainties. Potential biases include overestimating human contributions if climate-driven increases in carbon density are ignored and overestimating modern carbon uptake if long-term baseline declines in carbon stocks are not included. Future studies should explore coupling DGVMs (e.g., LPJ or ORCHIDEE) to simulate combined impacts of historical climate, CO_2 levels, and human activities on carbon density."

Point 4. About uncertainty quantification: The current "uncertainty" section (4.3) primarily discusses limitations rather than quantifying uncertainties. Incorporate a robust quantitative analysis (e.g., Monte Carlo simulations) to assess how data gaps (e.g., historical LUC, carbon density variability) propagate into emission uncertainties. This will enhance the study's rigor and reproducibility. The 4.3 section is not technically an "uncertainty analysis", it is simply discussions of limitations and possible future work.

Response: Thank you for your insightful comments on the uncertainty quantification. We fully agree that the original Section 4.3 focused more on qualitative discussions of limitations and future work, rather than providing a rigorous quantitative uncertainty analysis. To address this, we have implemented the following key revisions.

(1) In the Methods section of the manuscript, we have added subsection 2.3.4, 'Uncertainty assessment,' which elaborates on how we utilized Monte Carlo simulations to assess the uncertainty in carbon emission results. For the full description, please refer to lines 351-362 of the main manuscript. An excerpt is provided below:

"To evaluate the uncertainty in estimating carbon emission fluxes, this study employed Monte Carlo simulations with 1000 iterations. The uncertainty primarily stems from two key parameters: carbon density and land-use change area. For the carbon densities in the forest (aboveground, belowground, and soil) and grassland (aboveground, belowground, and soil) components, the mean and standard deviation were calculated based on input sample data. During the simulations, values for these densities were randomly sampled from normal distributions parameterized based on these statistics measures. Regarding the land-use change area, the original input value for the annual conversion area of each land-use type served as the mean for its sampling distribution, with the standard deviation set to 10% of this mean. Values were then randomly sampled from a normal distribution defined by these parameters in each iteration. Subsequently, in every iteration, the annual carbon emission flux was re-estimated using the parameters sampled in that specific iteration. After aggregating the results from all iterations, the minimum and maximum simulated carbon emission flux values for each year were used to define the uncertainty interval for that year's estimates."

(2) In subsection 4.3, 'Uncertainty analysis,' we plotted the Monte Carlo simulation results as Figure 10 and subsequently analyzed them. For full details, please refer to lines 540-551 of the main text. An excerpt is provided below:

"This study employed Monte Carlo simulations (1000 iterations) to systematically assess the uncertainty in annual carbon emission flux estimates (Fig.11). The results revealed that the average annual uncertainty interval, which was derived from the maximum and minimum simulated carbon emissions, was 18.75 Tg C. This interval exhibited significant interannual variation, ranging from a minimum of 3.77 Tg C to a maximum of 143.67 Tg C. Such variation indicates that the uncertainty in the estimation results increased in years characterized by substantial fluctuations in land-use change data. Overall, the Monte Carlo simulations effectively highlighted the impact of parameter uncertainty on carbon emission estimates and provided a quantitative basis for evaluating the credibility of the carbon flux results. To further constrain parameter variability, future efforts should focus on improving the resolution of measured carbon density data and the reliability of land-use data."

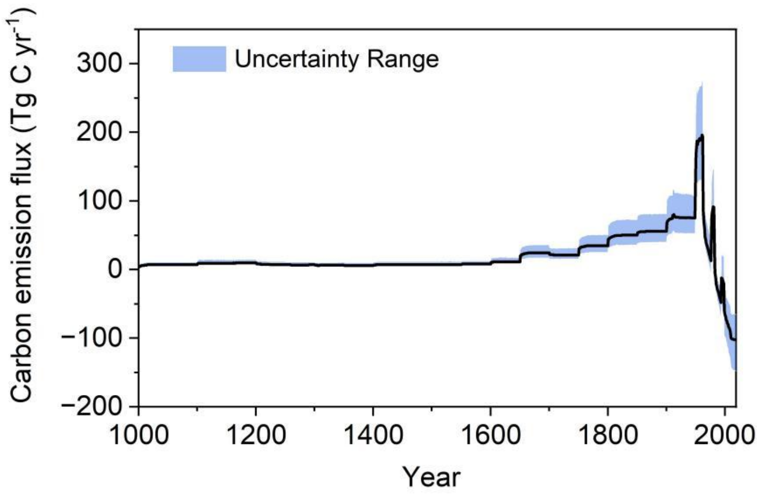

Figure 10. Uncertainty in annual carbon emissions from land-use change

Minor points:

Point 5. "China": this needs to be better defined in this study! You used the current mainland China as the country boundary, and merged the 30+ provinces into 25 regions. I understand your reasoning for compromising here, but you must make this crystal clear in the Abstract and Methods. In Fig. 1, you may also cite specific studies for each map for different dynasties.

Response: Thank you for this comment. I fully agree with your proposal. Revised.

Clear research scope and fundamental units can significantly enhance the manuscript's readability. I have explicitly defined our study area and provincial-level units in both the Abstract (Lines 21-23) and Methods section (Section 2.1 Study Area - Lines 112-115), with additional clarification on the sources of historical territorial and administrative boundaries data provided in Line 124.

For detailed revisions to the manuscript text, please refer to the revised draft where changes are highlighted in red font.

Thank you once again!

Point 6. L171: regarding the bookkeeping model, did you use the Houghton model, or simply used their structure and data? This can be made more explicit.

Response: Thank you. Revised.

The computational structure of Professor Richard A. Houghton's bookkeeping model is relatively simple, as shown in Equation 3. The distinctive feature of this method lies in its parameterization of disturbance-response curves. These curves define the long-term carbon release and sequestration patterns by different vegetation types and their associated soils following land-use conversions, which constitutes the core mechanism of carbon accounting. We obtained region-specific parameters for China from Professor Richard A. Houghton for implementing this carbon budget calculation.

In Section 2.3.1 (Bookkeeping Method), we have explicitly clarified this point by citing that the disturbance-response curves were sourced from Houghton and Castanho (2023). The modifications in the manuscript are located in Lines 211-212 and are highlighted in red font. Since the values of the disturbance-response curves are derived from existing literature rather than our own analysis, they have been compiled in Appendix Table B2.

Point 7. L200: "local expert and knowledge", delete "and"?

Response: Thank you. Revised.

Thank you once again for your help—not only did you improve the overall logic and readability of our work, but you also took the time to pay close attention to the details of the manuscript. We are especially grateful!

Point 8. L206: using tax records is a great idea, but how does this help this particular study? Any quantitative evidence?

Response: Thank you for this comment.

In this study, the cropland data covering dozens of time slices over the past millennium are primarily reconstructed based on historical tax records from successive Chinese dynasties. This approach is fundamentally different from the global datasets and serves as strong support for the higher reliability of our data. It has been well-documented that land-use reconstructions based on region-specific historical records tend to be more accurate than large-scale simulations, especially in regions with rich documentary evidence, such as China.

To address the issue of data reliability, we have explicitly described the sources and general reconstruction processes of historical cropland, forest, and grassland data in Section 2.3.2 (“Reliability assessment of long-term land-use change data”). This section aims to show that the dataset used in our study is currently the only one in China that covers major land-use types over a long time span with high reliability. Therefore, we have deliberately dedicated substantial space in the manuscript to explain the basis and credibility of our data in detail, in order to enhance the confidence of reviewers and readers. (Line 219-279)

Regarding the suggestion to provide quantitative evidence, this manuscript focuses on the application of our reconstructed land-use datasets. The quantitative procedures of the data have been comprehensively presented in a series of previous publications by our team. These key references have been listed in Table 1 for readers and reviewers to trace and examine if needed.

Do you agree with our response? If you have any questions, please raise them again. We will continue to make targeted modifications in the second round. Thank you once again!

Point 9. L224: this is out of context, what exactly is “inverted S-shaped” relationship?

Response: Thank you for raising this question. I completely agree with you—without having read the cited reference, it is indeed difficult to understand what the "inverted S-shaped" relationship specifically refers to.

To improve readability, we have added an explanation of the "inverted S-shaped" relationship. The corresponding revision has been made in lines 254–258 of the main text, and the changes are marked in red. The revised content is as follows:

“The “inverted S-shaped” curve reflects the dynamic relationship between historical population size and deforestation. In the early stages, when the population is relatively small, forest resources are plentiful and the rate of deforestation remains slow. As the population grows, deforestation accelerates rapidly, resulting in a significant loss of forest cover. Eventually, despite the population continuing to increase, the scarcity of remaining forests causes the rate of deforestation to slow down. ”

Point 10. L243: cite the data used.

Response: Thank you for this comment. Revised (Lines 275–277).

Point 11. L270: Fig 3. The whole study is at the provincial level, why do you use gridded data here in the map? What data are they? What criteria did you use to separate west vs. east of China, or to draw the “forest-grassland boundary”? Over 1000 years, did this boundary move at all?

Response: Thank you for this comment.

First, the historical land-use data used in this study is a composite of multiple datasets covering three main categories: cropland, forest, and grassland. Taking into account factors such as spatial-temporal resolution and data operability, we chose the provincial level as the basic unit of calculation.

Figure 3 illustrates the historical land-use change transition rules. Here, we use two gridded maps of forest and grassland data to better convey the information in spatial form. These maps help to visually distinguish forest-dominated and grassland-dominated regions. The two maps are derived from: *He, F., Yang, F., and Wang, Y., 2025. Reconstructing forest and grassland cover changes in China over the past millennium. Science China Earth Sciences, 68(1): 94–110.* They represent the spatial distribution of forests and grasslands in AD 1000 at a 10 km resolution.

The basis for dividing China into western and eastern regions follows: *Su, D.X. The regional distribution and productivity structure of the Chinese grassland resources. Acta Agrestia Sinica, 1994, 2: 71–77.* This study was primarily used to distinguish grassland types, dividing the country into regions primarily comprising the northern temperate zone and the Tibetan Plateau in western China, and nonzonal secondary grasslands in eastern China. Later, the following two studies built upon this division and further classified the "northern temperate zone and the Tibetan Plateau in western China" as zonal grasslands, defining it as the grassland-dominated western region, while the eastern part was historically forest-dominated: *Yang, F., He, F., and Li, S., 2020. Spatially explicit reconstruction of anthropogenic grassland cover change in China from 1700 to 2000. Land, 9(8): 270. He, F., Yang, F., and Wang, Y., 2025. Reconstructing forest and grassland cover changes in China over the past millennium. Science China Earth Sciences, 68(1): 94–110.*

This is the origin of the regional division used in this study.

Finally, we acknowledge that this regional division does not represent a strict boundary. As you rightly pointed out in your comments, the boundary between forests and grasslands may have shifted over the past millennium. However, both our study and the aforementioned literature use this broad division to determine whether a given provincial unit was generally forest-dominated or grassland-dominated. Therefore, even though the boundary may have changed over time, the impact on determining provincial-level affiliation is minimal.

The above explains the details of the data we used, as well as all the background we could think of in response to your comments. We hope this clarifies your concerns. If you have any further questions, we would be happy to provide additional explanation and make further revisions in the next round of responses. Once again, thank you for your thoughtful and constructive comments, which have been instrumental in improving the academic quality of our manuscript.

Point 12. L290: the whole argument about shifting ag. in China is not strongly supported. This happens in Africa and S. America, but it is not as common in China. What does recent remote sensing suggest? It would be more convincing to show some direct evidence than simply claim "…has been recorded extensively in Chinese historical documents."

Response: Thank you for this comment.

Shifting agriculture is an ancient form of agricultural production that was historically widespread. Today, it is mainly found in lowland and hilly areas of tropical rainforest regions, such as those mentioned by the reviewer—Africa and South America. In China, however, this form of cultivation has virtually disappeared since the founding of the People's Republic, as it is a highly extensive and inefficient mode of production. Currently, we have not found any studies that detect this type of agriculture in China using remote sensing data. Therefore, from a data perspective, it is difficult to obtain empirical support for its presence today.

However, from a different angle, because shifting agriculture is such an old production method, if we extend the timeline to several hundred or even a thousand years and broaden the source materials to include historical documents and related scholarly works, we can easily find references to shifting agriculture. In China, it is known as "slash-and-burn" farming. There are numerous historical records about it, although, to our knowledge, no studies besides our own provide detailed quantitative estimates of its extent.

Shifting agriculture is frequently mentioned in historical records and is closely tied to key historical events. Since the mid-Qing Dynasty, the implementation of the "head tax into land tax" (摊丁入亩) policy by the Qing government greatly encouraged population growth. Many scholars describe this as a population explosion. During this period, many displaced people—often referred to as "shelter people" (棚民)—were forced by economic hardship to migrate into previously undeveloped mountainous areas to clear land. In the process, large areas of forest were destroyed, but in fact, very little of this land was converted into permanent farmland. Most of it was temporary cultivation.

Based on this historical background and the records, combined with the reconstructed forest and cropland datasets used in our study, we quantified the area of forest converted to other land. The trend of this change corresponds closely to the historical timeline of "shelter people" expanding into mountainous areas. Therefore, in Figure 5b, we present this data and infer that the primary land-use process responsible was shifting agriculture.

Point 13. Fig. 4-5, did you compare the LUC data with other sources, like LUH2, to examine the differences and causes?

Response: Thank you for this comment.

In Figures 4 and 5, we did not compare our reconstruction results with global datasets such as LUH2, primarily for the following reasons:

To our knowledge, LUH2's long-term historical land-use data largely derives from the HYDE dataset. HYDE is a globally recognized land-use dataset that spans the entire Holocene and includes the historical period covered in our study for China.

Given its widespread application, scholars have long conducted studies to assess the reliability of HYDE data in China. For example:

For cropland in Northeast China over the past 300 years:

Li, B., Fang, X., Ye, Y., & Zhang, X., 2010. Regional accuracy assessment of global land-use datasets: A case study of Northeast China. Science China Earth Sciences, 40(08): 1048–1059.

For traditional agricultural regions:

He, F.N., Li, S.C., Zhang, X.Z., Ge, Q.S., & Dai, J.H., 2013. Comparisons of cropland area from multiple datasets over the past 300 years in the traditional cultivated region of China. Journal of Geographical Sciences, 23(6): 978–990.

For cropland across China over the past millennium:

Zhao, C., He, F., Yang, F., & Li, S., 2022. Uncertainties of global historical land use scenarios in past-millennium cropland reconstruction in China. Quaternary International, 641(20): 87–96.

There are also regional evaluations:

Qinghai–Tibet Plateau:

Li, S.C., He, F.N., Zhang, X.Z., & Zhou, T.Y., 2019. Evaluation of global historical land use scenarios based on regional datasets on the Qinghai–Tibet Area. Science of the Total Environment, 657: 1615–1628.

Xinjiang:

Li, M., He, F., Zhao, C., & Yang, F., 2022. Evaluation of global historical cropland datasets with regional historical evidence and remotely sensed satellite data *from the Xinjiang Area of China. Remote Sensing, 14(17): 4226.*

There are also evaluations of global dataset accuracy for forest and grassland in China:

For forest:

Yang, F., He, F.N., Li, M.J., & Li, S.C., 2020. Evaluating the reliability of global historical land use scenarios for forest data in China. Journal of Geographical Sciences, 30(7): 1083–1094.

For pasture:

He, F., Li, S.C., Yang, F., & Li, M.J., 2018. Evaluating the accuracy of Chinese pasture data in global historical land use datasets. Science China Earth Sciences, 61(11): 1685–1696.

Overall, extensive research has already been conducted to evaluate global datasets such as HYDE, as well as others like PJ, KK10, and SAGE, with a focus on the Chinese region. In Section 2.3.2, “Reliability assessment of long-term land-use change data,” we briefly summarize and cite key literature related to the evaluation of global datasets for cropland, forest, and grassland in China, for the benefit of reviewers and readers.

In light of the substantial body of existing work, we decided not to include a direct comparison with global datasets in this study.

Point 14. Fig. 5: please clarify the meaning of secondary axis. In (a), does the y-axis suggest “changes” or absolute area? Same for (b), absolute or relative area? For (c) and (d), what does the pie suggest, 1000-yr cumulative or annual?? Please be more specific.

Response: Thank you for this comment. Revised.

In lines 374–378, we have added new statements to further clarify what the y-axes in panels (a) and (b) represent and their units. We have also clearly explained the meaning of the pie charts in panels (c) and (d). The revisions are marked in red font.

“(a) Cropland, forest, and grassland areas (absolute values), in units of 106 hectares. (b) Proportions of four land-use types in each period, with all remaining terrestrial cover—excluding the reconstructed cropland, forest, and grassland—classified as other land. (c) Cumulative carbon emissions from land-use changes across different carbon pools. (d) Cumulative carbon emissions from different land-use transitions. In (c) and (d), the two pie charts represent the shares of different carbon pools and land-use transitions in the cumulative carbon emissions over the millennium, respectively."

Point 15. Fig. 6: Does the negative biomass value show carbon sink? Specify in the caption.

Response: Thank you for this comment. Revised. (Line 408)

Point 16. L435: Table3, this table is a summary not "comparison. These estimates cover different time period, so the emissions would be different. No surprise here. Could you compare them across the same or similar time, and include results from this study?

Response: Thank you for this comment.

The studies listed in Table 3 have differences in time periods, and some of the differences in their results are due to this. Therefore, as described in lines 427-428 of this manuscript, they are strictly speaking not comparable.

Given that the data from the studies listed in Table 3 are not open access, we cannot modify their data to obtain consistent time periods across all these studies. However, our data represents annual carbon budgets, and we extracted overlapping time periods from both this study and the existing studies. We compared our results (the last column of Table 3) with those from the existing studies for the same time periods and analyzed the reasons for the differences in the manuscript.

Since Table 3 is quite long, with 7 columns, and our results are in the last column, you may not have noticed this column. The new Table 3 is the result of revisions made in response to the suggestions of another reviewer.

Table 3. Comparison of existing long-term carbon emission estimation results caused by land-use change in China

Region	Land use type	Method	Time period	Previous study (Pg C)	Reference	This study (Pg C)
China	Cropland, Forest, Grassland	Bookkeeping model (Early version)	1700–1980	9.05	Yang et al. (2023)	15.17
China	Cropland	Bookkeeping model (Early version)	1661–1980	3.78	Yang et al. (2019)	16.13
China	Cropland, Forest	Bookkeeping model (Early version)	1700–1949	6.18	Ge et al. (2008)	11.87
Northeast China (Heilongjiang, Jilin, and Liaoning)	Cropland	Bookkeeping model (Early version)	1680–1980	1.45	Li et al. (2014)	3.33
Global	Cropland, Forest, Grassland, Other land	Bookkeeping model (Latest version)	1850–2019	7.36	Houghton and Castanho (2023)	7.72
China	Cropland, Forest	Land ecosystem model	1900–1980	6.90	Yu et al. (2022)	7.07
China	Cropland, Forest	Land ecosystem model	1980–2019	8.90	Yu et al. (2022)	2.25
China	Cropland, Forest, Grassland, Other land	Bookkeeping model (Latest version)	1000-2019	19.61	This study	

Point 17. L476: Is this required? It seems odd with a data availability statement in the middle.

Response: Thank you for this comment.

Since ESSD is primarily a data-focused journal and we are submitting a data description article, according to the journal's template, the Data Availability section is required, and the data must be shared on an open access platform.

Point 18. Appendix A and B: is the information in these tables used in this study? Or do they simply support previous work on LUC data.

Response: Thank you for this comment.

The information in Appendices A and B is used in this study and serves as important supporting data for the results presented in the manuscript. Due to limitations in length, structure, and logical flow, we placed this content in the appendices.

Specifically, Table A1 provides detailed sources for the second and third national land survey bulletins; Table B1 lists soil series in China; Table B2 presents the disturbance response curve parameters; Figures B1–B4 show the sample points for soil carbon density.

Thank you again for your thorough and professional feedback on our manuscript. We truly appreciate your time and expertise. We are open to any additional questions or suggestions in the next round of review and are committed to further improving the paper.