Anonymous Referee #1, 06 Aug 2026

General Assessment

This is a high-quality manuscript that is well suited for publication in *Earth System Science Data*. It presents an up-to-date monthly CO_2 emission dataset for Japan and provides a comprehensive description of the underlying data sources, accounting methodology, and the differences among alternative estimation approaches. The authors have made commendable efforts to explain the possible origins of discrepancies between different methods, and the entire workflow—from data collection to emission estimates—is presented in a transparent and reproducible manner. I particularly appreciate the authors' careful treatment of the underlying data and the thorough documentation of the inventory development process.

Overall, I recommend publication in *Earth System Science Data* after only minor revisions.

Thank you for your encouraging comments and helpful suggestions.

Comments

1. Discussion and presentation of uncertainties

The authors discuss the sources of uncertainty and report that *"The uncertainty for total emissions in each month is estimated to be ±3% at 2 standard deviations (95% confidence interval), given the uncertainties in the NIR are also given at 2 standard deviations."* From my perspective, this uncertainty appears remarkably small, particularly at the monthly timescale.

I encourage the authors to provide a more detailed discussion to justify why such a low uncertainty is reasonable. In addition, it would be valuable to assess the robustness of the uncertainty estimates using approaches other than the conventional root-sum-of-squares method, if possible, so that the results can be cross-validated.

Furthermore, have the authors considered adding uncertainty ranges to some of the emission time series? Displaying the uncertainty ranges directly on the figures would provide readers with a more intuitive understanding of the confidence range and make it easier to judge whether differences among various estimates are statistically meaningful. In my opinion, strengthening the uncertainty analysis and presentation would represent the most important improvement to this manuscript.

The uncertainty is indeed remarkably small due to two reasons.

- The uncertainties in official annual data for Japan are very low by international standards, given that a large portion of Japanese emissions are in the energy sector, where detailed and precise statistics are kept. Retrospective revisions to the data are rare and minor, also providing confidence in the low uncertainty.

Monthly statistics are documented in the same method as annual statistics, thus the small uncertainty also extends to monthly data.

- The stated uncertainty in the paper only covers values that could be quantified with accessible data. It is possible that tertiary stocks, which are not accounted for in the uncertainties here, result in temporal misalignment of emissions comparable to the current uncertainty level, but we have no method to quantify this at the moment. We also cannot include uncertainties resulting from emission activities that are unidentified, although we believe these are unlikely to lead to large discrepancies.

We have reiterated these points in the Discussion section. While alternative methods to estimate uncertainty are possible, the uncertainty in the current study is dominated by the statistical discrepancy of coal, already present in the official annual data, so such methods will likely result in similar values of uncertainty irrespective of the method taken.

We agree with the importance of displaying uncertainties in time series, but for the specific figures in the manuscript, we believe this will not be appropriate:

- The comparison of monthly aggregated annual data values to official published annual values (Fig. 2 – Fig. 7) are intended as presentations of the uncertainties themselves through the discrepancies, so it does not make sense to add uncertainty ranges here.
- Overall, the uncertainties are small, so they will be difficult to discern in the figures, and they do not vary substantially over time, hence will likely not be informative to the reader when shown in the figures.

2. Comparison with other inventories

In Figure 12, I suggest that the authors first present the absolute emissions from all inventories before comparing their relative differences. Showing only the relative differences makes it difficult for readers to appreciate the baseline magnitude of each inventory.

We had decided not to add a figure showing the absolute emissions since the large number of datasets, the high intra-annual variations, and the high correlation between them makes the figure undecipherable and confusing (figure below). Instead of adding this figure in the text, we opt to add a figure showing emissions just from our dataset for the same period, while also adding the full comparison figure in Appendix L.

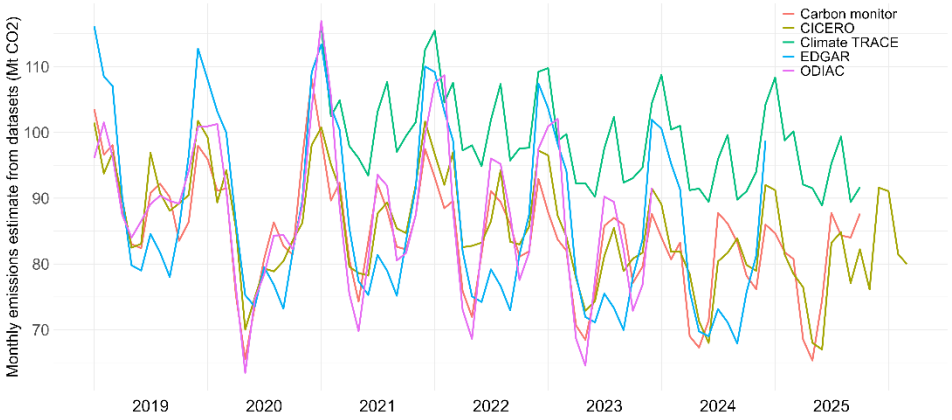


Figure 1 Monthly emissions estimate with absolute value shown for all datasets

In addition, the recently released MEIC-global-CO_2 inventory also provides monthly CO_2 emissions with approximately a two-year reporting lag. The authors may consider including this inventory in the comparison.

We appreciate the proposal to include the MEIC-global-CO_2 inventory. We could not find the documentation of the monthly data methods (Xu et al. (2024) referenced in the data mentions monthly data to "be developed in the future"), and as such, we cannot include this dataset in the comparison section, since the purpose of this section is to discuss the methodological differences. We have instead touched on the dataset in our literature review section (Sect 1.3).

3. Manuscript organization

Although the detailed methodological descriptions and comprehensive comparisons are valuable, the manuscript is currently rather lengthy. As a reader, it is sometimes difficult to quickly locate the most relevant information.

I therefore suggest moving part of the detailed methodological descriptions and some of the extended discussions to the Supplementary Information or Appendix, allowing the main text to place greater emphasis on the key findings and conclusions. This would substantially improve the readability of the paper.

We have moved the detailed description of the data sources (the bulk of Sect. 2.4) to the Appendix and adjusted the text to align with this.

4. Treatment of international aviation

I would appreciate further clarification on how fuel consumption associated with international aviation is treated in the inventory. Since this can influence the definition of national emissions, a brief explanation of the accounting approach would be helpful.

Treatment of international aviation emissions is detailed in the “International bunker fuel” section in Section 2.4.1 (which has been moved to the Appendix). Japan, following the IPCC guidelines, excludes international aviation emissions from territorial emissions, while separately reporting the annual total emissions from Bonded Export and Bonded Import (fuel used for international transport, produced domestically or directly imported, respectively) in their NIR. We follow the official treatment in our analysis and exclude these emissions. We clarified that international transport includes international aviation and maritime transport.

Anonymous Referee #2, 21 Aug 2026

This manuscript develops a low-lag monthly CO_2 emission dataset for Japan using primarily official monthly activity data. The data sources, estimation methods, data processing, and uncertainty assessment are described in detail. The resulting dataset is valuable for timely emission monitoring, policymaking, public awareness, and independent verification, and generally meets the quality requirements of *Earth System Science Data*. However, several minor issues should be addressed to improve the clarity and readability of the manuscript. Therefore, I offer the following comments and suggestions.

Thank you for your helpful and encouraging comments.

1. The manuscript is somewhat lengthy and could be streamlined to improve readability. In particular, the detailed descriptions of other datasets in Sect. 3.6 partly overlap with the Introduction, and some of these methodological details could be shortened or moved to the Appendix. The discussion of potential applications could also be condensed, allowing the main text to focus more clearly on the construction, evaluation, and key findings of the dataset.

   We have moved the detailed description of the data source (bulk of Sect. 2.4) to the Appendix, and adjusted the text to align with this. We have left Sect. 3.6 since these are analysis results, but we made sure to avoid substantial overlap with other sections.

2. Table 1 lists refinery feedstocks among the secondary fuels with available trade, stock, and consumption data, whereas Sect. 3.5.1 states that refinery feedstocks are excluded from this study due to the lack of reliable monthly data. Please clarify this apparent inconsistency and revise Table 1 or the corresponding text accordingly.

   Thank you for pointing this out. We have revised Table 1 to match the text.

3. Before presenting the relative differences in Figure 12, I suggest first showing the absolute monthly emissions from the different datasets. This would provide readers with a clearer view of their overall emission levels, trends, and seasonal patterns before interpreting the relative discrepancies.

   We had decided not to add a figure showing the absolute emissions since the large number of datasets, the high intra-annual variations, and the high correlation between them makes the figure undecipherable and confusing (figure below). Instead of adding this figure in the text, we opt to add a figure showing emissions just from our dataset for the same period, while also adding the full comparison figure in Appendix L.

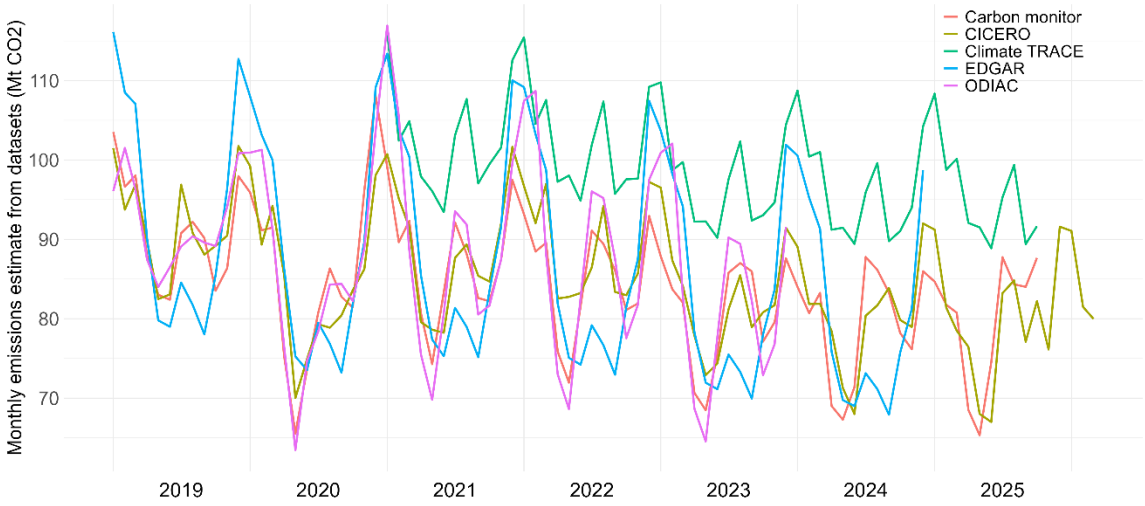


Figure 1 Monthly emissions estimate with absolute value shown for all datasets

4. Although some differences in emission coverage are discussed in Sect. 3.6, I suggest adding a brief table, perhaps in the Appendix, summarizing the emission scope of all datasets compared. This would help clarify whether the total emissions compared across datasets are directly comparable.

   We added a table in the Appendix summarizing the designed scope of the datasets.

5. Please carefully check the manuscript for formatting, cross-reference, and reference-list errors. For example, “see 50Appendix F” appears in the Introduction, “Figure 8Figure 8” appears in Sect. 3.1, and several incomplete references such as “Figure)” remain. The reference list also contains several formatting inconsistencies, including duplicated punctuation, a duplicated DOI prefix for Min and Choi (2024), and incomplete page ranges for some journal articles. Please carefully proofread and standardize the manuscript and reference list according to the journal format.
   Thank you for pointing these out. These seem to have been inserted during the PDF conversion process. We fixed these errors and made sure to unlink automatic revisions.

6. The presentation of several figures should be improved for clarity and consistency. In particular, the labels and text in some figures are too small to read clearly (e.g., Figures 10 and 12), and Figure C1 uses different line colors without a corresponding legend. Please check the figures throughout the manuscript and improve their readability and presentation where necessary.

   The figures have been revised to improve readability and clarity. A description of the Figure C1 colors has been added to the caption.

7. For Table 2, please briefly clarify how “Trend” was calculated and how its statistical significance was assessed.

   The trend is estimated using a simple linear regression. We clarified this in the text.

8. Footnote 3 in Sect. 2.4.3 appears to contain an arithmetic inconsistency: 0.428/(1−0.428) is approximately 0.748 rather than 0.728. Please verify the conversion factor and clarify whether this is only a typographical error or whether it affects the lime-emission estimates and the released dataset.

   Thank you for pointing this out. The value is indeed 0.748 and we have fixed the numerical value in the text. The analysis had used the correct value and is not affected.