

## Review of Yang et al.

This manuscript offers a robust comparative analysis of six CO<sub>2</sub> emission inventories for China, integrating both local and global datasets. A key strength is its detailed assessment of spatial and temporal uncertainties, an often overlooked but policy-relevant aspect. The study contributes meaningfully by highlighting inventory discrepancies and emphasizing the importance of uncertainty assessments in emission reporting. However, I have the following specific comments that require clarification and revision before the manuscript can be considered for publication.

### General comments

The manuscript is clearly written and well structured, with a logical flow that facilitates understanding of the main objectives and findings.

However, it is not entirely clear whether the emission inventories selected for analysis are the only relevant options available, or what criteria guided their selection. Since the manuscript references other inventories that were ultimately not included in the comparison, it would strengthen the study to provide a clearer rationale for the choices made.

The relevance of the topic is evident, especially in light of China's pivotal role in global emissions and its commitments under the Paris Agreement. Still, the manuscript would benefit from a more explicit explanation of why comparing the latest versions of these inventories is particularly important. A clearer articulation of what distinguishes this study from previous work (beyond simply the version updates) would improve accessibility, especially for readers less familiar with the topic.

The discussion of differences between inventories and their associated uncertainties is engaging and informative. However, a clear take-home message is lacking, particularly regarding which inventories may be considered more reliable or fit for specific purposes. While it is understandable that definitive recommendations may be difficult, the current conclusions are limited, with the mainly strong guidance being to avoid the provincial CEADs inventory. Offering more concrete insights or practical recommendations, especially in the context of supporting policymaking, would significantly strengthen the manuscript.

### Specific Comments

Line 35: To highlight China's role in global emissions, please include the percentage of China's anthropogenic emissions relative to global totals.

Line 44: The CAMS inventory should be included in this overview for completeness.

Line 48: Are there specific reasons for not including CHRED in the analysis? Please clarify.

Line 80: Consider introducing the CAMS inventory definition earlier in this section alongside the others, for consistency.

Line 80: MEIC is initially described (line 47) as a China-specific inventory, but here it is treated as a global inventory. This inconsistency may confuse readers, particularly since

line 116 clarifies that the global version of MEIC is used. Please harmonize these descriptions.

Line 122: The mention of the number of species covered by CAMS is not relevant here, as the analysis focuses on a single species. Also, this level of detail is not provided for the other inventories.

Line 198: Do you have any hypotheses as to why GEMS diverges from the trends observed in other inventories, especially in the residential and commercial sectors?

Table 1: Time Resolution (GEMS column): Please change "Annually" to "Annual" to align with the other entries.

Table 1: Data Source row: Since the "last accessed" date is the same for all inventories, consider moving this note to a table footnote (e.g., marked with an asterisk) to streamline the table.

Figure 3: The growth in electricity and heat production in CAMS appears to stabilize, unlike in other inventories where growth continues. Given CAMS is based on EDGAR, a similar trend would be expected. Could this discrepancy be linked to the use of CAMS-Tempo profiles?

Line 212: It is unclear why MEIC is used as a benchmark for comparison. Please add a brief explanation of this choice.

Figure 5c: What accounts for the squared patches in this figure? A brief explanation in the caption or main text would help readers interpret the results.

Figures 4 & 5: In Figure 4, MEIC shows notable emissions over western China (green shading), while ODIAC does not. This difference should manifest as strong negative values (blue) in Figure 5, yet much of this area appears blank, which I assume represents NaN values. Did you apply any filtering? Please clarify.

Line 241: For clarity, please consider rephrasing this sentence, here is a suggestion:

"Across the spatial domain, EDGAR generally reports lower emissions than MEIC, with negative differences prevailing throughout the region."

Line 287: Could the discrepancy in Shanxi be attributed to a specific sector? A sectoral analysis, as presented in the previous section, would be valuable here.

Line 290: Could you comment on the provincial comparison of the two CEADs estimates beyond Shanxi? Do any provinces show consistent agreement between the two datasets, and are these primarily low-emission regions? A colored map showing the differences between the two CEADs estimates by province could be a useful addition