

Reviewer RC1

The paper demonstrates two applications of using an existing emission inventory comparison method (Thunis et al. 2022) with ensemble concept introduced to illustrate inconsistencies in selected emission inventories. One application is for EU-wide emission inventory comparison and the other application is for local inventory emission inventory comparison. The paper is well-written and well-organized with detailed results and thorough analysis. The results are important and meaningful in terms of shedding lights on 'problematic' inventory with specific pollutant and sector combinations which would require attentions and check-ups from emission inventory developers.

However, the method used in the analysis lacks novelty even with ensemble concept introduced. The method has been described in detail in Thunis et al. 2022 and directly used in this paper with very limited modifications or improvements while the use of ensemble concept relates to input data not the method itself. Therefore, I would not recommend this work to be published on GMD. But I do believe the findings about emission inventory inconsistencies are important and provide insights on next generation emission inventory development. I would suggest the authors to re-organize the paper and submit to other journals which focuses more on applications and findings.

We substantially revised the paper to highlight the construction and application of the ensemble approach. We tried to stress the fact that the ensemble approach is more than just adding a new dataset. One main point is that using the ensemble reduces the number of bilateral comparisons, which relates to the methodology rather than to the dataset. We highlighted the novelty of the approach but also discussed its strengths and weaknesses. We made the following main revisions:

- 1) The application section has now been drastically reduced with several paragraphs removed or moved to supplementary material (SM). We focused in particular on the use of the ensemble approach, both at the local and European scales, and moved some of the bilateral comparisons to the SM. We also removed some of the most technical discussions.
- 2) We turned the discussion section into a discussion dedicated to the added value and limitations of the ensemble approach.
- 3) We introduced sentences throughout the text to clarify the added value of this approach, in relation to the introduction of the ensemble concepts

Comments on ensemble approach:

Though mentioned in discussion section, the limited number of ensemble members (3) might be problematic while typical ensemble approaches used in earth sciences in general requires more ensemble members, for example, WetCHARTS (Bloom et al. 2017b), a global wetland methane emissions dataset generated using bottom-up approach, has 18 ensemble members. Also, the approach of creating ensemble (taking median) with limited number of ensemble members, may result in selecting the same ensemble member for many [p, s] tuples so that the comparison is essentially inventory-to-inventory instead of desired inventory-to-ensemble.

We added the below paragraph to discuss this point in the “added value and limitations of the ensemble” section.

In our work, the number of members of the ensemble is limited to three. This would be an issue if the goal were to obtain more accurate and robust results with the ensemble. In such a case, the more members, the more robust the results of the ensemble. Our goal is however different and consists in creating a benchmark for comparison. Rather than looking at absolute values, we assess differences (between an inventory and the ensemble), for which the accuracy and robustness of the absolute values is of secondary importance.

Minor comments:

- The diamond diagram in the results section may cause confusion for readers, especially to those who is not familiar with Thunis et al. 2022.

We have added explanations in the text to help with the interpretation of this diagram

- Line 345: Is this line a separate figure caption?

No this is the introductory sentence of the paragraph. We removed it

- Figure 1 and following figures: what are the numbers in parentheses next to each legend items?

The numbers within brackets indicate the total number of inconsistencies for a given pollutant/sector. We clarified this in the caption and in the text.