# Reviewer Remarks on Manuscript ID: egusphere-2025-6126

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## General Comments

This manuscript presents MethaneSAT observations of six oil and gas producing basins around the world and calculates methane intensities for each basin. Spatial emission maps for each basin (produced independently only from MethaneSAT observations) are disaggregated into estimates of sectoral emissions using combinations of bottom-up emission inventories as priors. Estimates of per-basin average emission rates and methane intensities generally agree with other top-down studies performed for the same regions. This manuscript is of good quality, but I would recommend that the authors investigate the minor points listed in "Specific Comments".

## Specific Comments

1. [Page 5, lines 151–154] In your discussion of the sensitivity study methods, the comparison between mean and median emission rates per common global grid cell may be unstable. In Region A, there are at most nine independently calculated emission rate estimates per grid cell, whereas in Region B there are at most three, with other regions falling somewhere in between. With sample sizes this small, estimates of either the mean or the median at the grid-cell level are inherently unstable, and the addition of a single new observation could dramatically alter the mean or median value of the grid cell emission rate. I would appreciate either further clarification of what this comparison is intended to demonstrate, or an exploration of an alternative approach. For example, you could perform a bootstrap analysis in which the common global grid-cell value is repeatedly sampled from the available emission estimates within each grid cell, and then show where the basin-wide mean- and median-based calculations fall within the basin-wide bootstrapped distribution (i.e., similar to the bootstrapping algorithms presented in Appendix B).

   In addition, the text states that emission rates are being averaged per grid cell, a description that is also used in the caption of Figure S1. However, the label in the bottom-left panel of Figure S1 indicates that MethaneSAT observations are being averaged, rather than MethaneSAT regridded emissions. This discrepancy should be clarified. Furthermore, the figure does not specify what the error bars in Figure S1 represent.

2. [Page 6, lines 181-185] Here you describe the databases used as prior inputs for your regions and for non–oil and gas as well as oil and gas sources. While Figures S7 and S8 examine how varying the choice of prior database influences the sectoral attribution of emissions derived from MethaneSAT, a clearer explanation of how the specific combination of prior databases used for the final results was selected would be helpful. In particular, it would be useful to clarify how and why COMBO 26 in Figure S7 and COMBO 15 in Figure S8 were chosen as the final configurations.

3. [Page 7, lines 217-218] You state that an assumed methane composition of 80% in natural gas was used for all intensity metric calculations. Did you perform a sensitivity analysis to assess how varying this assumed methane concentration affects the resulting intensity estimates? In addition, are there datasets or studies that could be used to sample basin-specific methane concentrations in natural gas? For example, Burdeau et al. [2025] provide basin-level produced gas composition estimates for two of the U.S. basins included in your study, albeit for a slightly earlier timeframe.

4. [Page 17, lines 491-496] You note that MethaneSAT underestimates methane emissions relative to EDGAR for the Amu Darya and Zagros Foldbelt basins, shown in Figure 6. Could you elaborate on potential reasons for this discrepancy? At present, no discussion is provided. In addition, on line 496 you reference Figure 7 when discussing this underestimation relative to EDGAR; however, there are only six figures, and this appears to be a reference to Figure 6.

# Technical corrections

1. For Figure 1, I found the tick label fontsize and inset text fontsize to be a bit small and blurry. Please ensure the final figures are clear.

2. I believe Figure 4 is missing a legend to indicate which part of the bars represent oil and gas vs. non-oil and gas emissions. If following the convention from Figure 3, I believe the white portions of the bars should be the non-oil and gas emissions, but this is not indicated in Figure 4.

3. Page 2, line 52, I think a citation to Veefkind et. al. 2012 for when you introduce TROPOMI would be nice here for completeness.

4. On line 64, page 2, you need to remove the period after "(i.e., $220 \times 440$ km$^2$)".

5. Page 3, line 79, I believe there is a placeholder "refer to Zhan et. al. 2020" that made it into the final preprint. I believe there should just be a citation to Zhang (not Zhan) et. al. 2020 here.

6. Page 3, line 85, you've got another placeholder for citing Shen et. al. 2022, ACP still in here.

7. Another placeholder citation on Page 3, Line 88.

8. For Figures S3 and S4, the current captions refer to"Sentinel-5P" as the source of SRON-TROPOMI super-emitter detections. For clarity, these should identify that the TROPOMI instrument on the Sentinel-5P satellite provides the methane observations from which plume detections are derived. Moreover, please include formal references and citations for all datasets used in all panels of these figures.

9. There are grammatical and typographical errors in the manuscript that need to be addressed before the article is published, but did not hinder the review process.

**Overall Recommendation:** accept subject to minor revisions.

# References

P. M. Burdeau, E. D. Sherwin, S. C. Biraud, E. S. F. Berman, and A. R. Brandt. High-resolution national mapping of natural gas composition substantially updates methane leakage impacts. *Nature Communications*, 16(1):11297, Nov. 2025. ISSN 2041-1723. doi: 10.1038/s41467-025-66465-6. URL https://doi.org/10.1038/s41467-025-66465-6.