

We are grateful to the referee for thorough evaluation of our manuscript. Our responses to the comments are detailed below. Please note that *the referee's comment* and our responses are in different styles. The page and line numbers shown below correspond to those in the revised manuscript.

We note the following corrections: (1) Figure 4 (b) has been modified with color shades added according to the referee's suggestion. (2) The analyzer's name "MIRA ULTRA" at every place has been changed to "MIRA Ultra" to be consistent with the producer. The labels of Figure 3 have been corrected accordingly.

The manuscript presents a methane source characterization in the Tokyo area using mobile measurements of CH₄ and C₂H₆. Although this technique is not novel, this is the first study of its kind in the Tokyo area. It is very interesting to see a comparison with other major cities, where most CH₄ sources are of fossil origin, while in Tokyo biogenic sources seem to be more important. The manuscript is generally well written, and the instrument characterization is well detailed. However, I find the emission quantification method not sound, due to the issues related to the height of the emission release, the distance from the source and different wind conditions, which affect gas dispersion. I am not sure that, given the different meteorological and sampling conditions during the sampling campaigns, it is possible to quantify areal emissions by using the equation yielded during the control release experiment. I see this procedure as a general assessment of emissions rather than a tool for comparing the estimated fluxes to reported emissions, because the level of uncertainty associated with such estimates is simply too high. In the manuscript all these biases are described, but it is hard to reach a conclusion whether emission inventories underestimate methane sources or not, and I would give way less weight to the emission quantification part.

Therefore, I suggest publication after addressing this issue and the following minor points:

We acknowledge that this comment indeed addresses the issue which has incompletely resolved in this study. It is why we presented detailed descriptions on possible sources of uncertainty in estimating emissions, and therefore we decided to avoid immediate discussion on possible under/overestimation of the inventories, as pointed out by the referee. The uncertainty in upscaling emissions using an empirical conversion from CH₄ concentration enhancement to emission rate is a common problem in similar studies, and we continue to improve the methodologies by combining ongoing series of follow-up measurement studies in Tokyo and Osaka (vehicle and stationary measurements). Nevertheless, in the present manuscript, we consider that it is worth presenting our preliminary estimates as our current best knowledge. In particular, we hope to highlight implication from our emission estimates that urban fossil fuel sources with magnitude comparable to biogenic sources are not taken account, which is qualitatively valid even with the large uncertainty in magnitude of the estimated emissions.

Given this comment, we revisited every relevant place in the manuscript to minimize possible misleading wordings. The following corrections have been made; in Section 5.2, (1) One sentence ("Our estimates are therefore may appear comparable to the reported emissions.") has been left out and the following sentence has been modified to "Although these emission estimates are not considered to conclusive due to large uncertainties, it is noteworthy that..." (P17 L411) (2) The first sentence in the last paragraph of Section 5.2 has been modified to "Lastly, we stress that our emission estimates presented in this study are preliminary and that accurate evaluation of the emission reporting by the local government is currently difficult." (P18 L419)

Line 117: the repeatability of..

Corrected.

Line 128: explain here why you chose the 1 ppm threshold. You explained that later, but I feel that we need more explanation at this stage

The “> 1 ppm” here did not mean any threshold. It was intended to indicate that a possible bias of ~25 ppb (0.025 ppm) at the CH₄ mole fraction level of ~5 ppm was small in comparison to the observed variability with magnitude of >1 ppm, which means that possible corresponding correction would not change analysis results. We have rephrased the sentence as follows.

P5 L133: “As this possible bias (~0.025 ppm) is relatively small in comparison to the observed variability (>1 ppm excess values with respect to the baseline), we apply no corrections for CH₄ measurements during the Tokyo mobile campaign measurements.”

130: why do the C₂H₆ values by MIRA Ultra vary so much?

Although we cannot identify a single cause, it is plausibly to do with reproducibility of quantification of absorption specific to the low concentration C₂H₆ (i.e., <1 ppb at background). Uncertainty at initial determination of the C₂H₆ absorption spectrum when turned on may cause day-by-day biases.

137: “The mole fractions here are uncorrected as..”. This sentence is not clear, please rephrase.

We have corrected the sentence as follows.

P6 L144: “The mole fractions here are reported values by the instrument and applied no corrections.”

Figure 165: change the y axis label. Should this be “difference from the nominal value (ppm)..?”. Please clarify

To keep the axis labels short, we hope to keep them same, but we have added the following sentence in the figure caption.

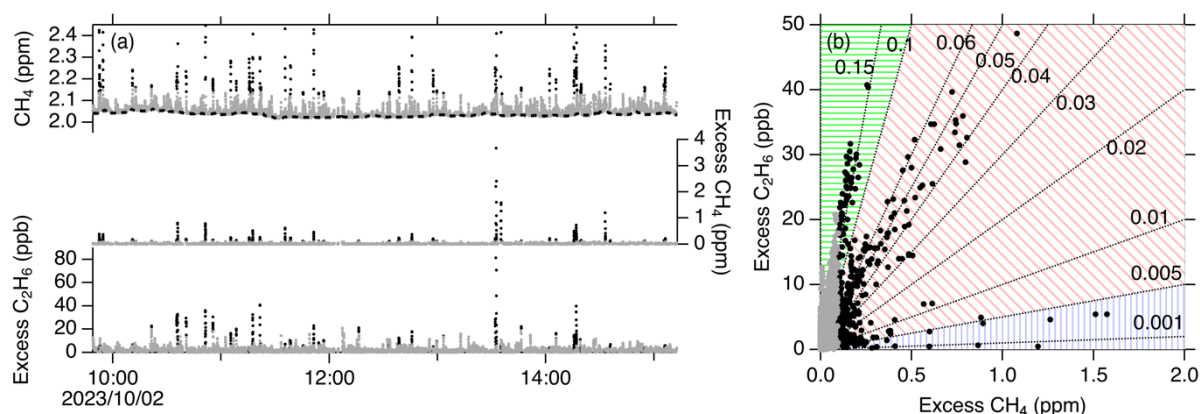
Figure 2 caption: “Note that CH₄ and C₂H₆ mole fractions are plotted as differences from nominal values.”

Line 244-249: I would move these sentences to the result section

Corrected according to the suggestion.

Figure 4 (b): could you change the colors of red lines according to the source category (e.g. fossil, biogenic and combustion)?

We have corrected the figure as attached below so that readers can visually understand the source categories. The figure caption was modified accordingly.



Line 270-272: Move to the result section

Corrected according to the suggestion.

Line 307: I would explain the concept of LP density here

We have inserted the following sentence.

P13 L320: “The LP density is count of LPs per travel distance and indicate average frequency of CH₄ enhancement encounters in a target city (Vogel et al. 2024; Ueyama et al. 2025).”

Table 2: I am not very convinced about reporting these emission estimates, see my previous comment

We appreciate the referee’s criticism. As explained above, we still consider that the emission calculation is worth presenting at least to explain our qualitative conclusion. We have revised our descriptions so that readers do not misunderstand that our calculation is quantitatively conclusive.