

Review of: Measurement report: Temporal variability of vertical profiles of CO₂ and CH₄ over urban environment

The manuscript presents a detailed description of a dataset consisting of vertical profiles of CO₂ and CH₄ concentrations, along with meteorological variables collected over an 11-month period in Krakow, Poland. Throughout the manuscript, the authors describe the methodology and campaign strategies, as well as the dataset characteristics, highlighting its value for model validation and plume detection.

The authors clearly link variations in the vertical concentrations of both greenhouse gases to the evolution of the urban atmospheric boundary layer, as well as to the influence of local terrain and emission plumes. The results provide an overview of daily and monthly averages during the study period, diurnal cycles, and a synthesis of observations at specific altitudes. The manuscript also includes case studies that demonstrate the potential of vertical profiles for emission plume detection.

This study is particularly relevant for advancing both measurement techniques and data assimilation in atmospheric modeling (e.g., Bayesian inversions), especially by improving the understanding of nighttime CO₂ and CH₄ concentrations.

I appreciate the authors' efforts in addressing the issues raised during the previous review rounds, including the addition of more detailed figures and captions, as well as improvements to the introduction and data interpretation.

In its current version, I consider the manuscript suitable for publication after technical revisions and a thorough English grammar check.

Specific comments:

Lines 53–54: The sentence (*...not including lack of representation of the full atmosphere (surface based),...*) is confusing in its current form .

Line 60: Incorrect citation format for Enting et al. (1995),...

Line 91-92: Incomplete sentence

Lines 98-100, 105-107: Remove word 'either'.

Line 119: *'their system has higher of spatial smoothing'*: please, rephrase.

Line 132-133: *'villages which surround it forming a metropolitan areas with a total population reaches almost 1.4 million.'*: please, rephrase.

Line 146: Clarify what is meant by "semi-natural" fauna and flora.

Line 151: Correct to “released from”

Line 178: Correct to “If passengers were”

Table1: Please verify the sunrise times for 01–02.06.2021 and 13–14.07.2021. Based on external sources, the reported times appear to be incorrect (<https://www.timeanddate.com/sun/poland/krakow?month=6&year=2021>)

Line 181-183: It would be useful to indicate how frequently these conditions occurred during the campaigns.

Line 198: Correct to “passenger.”

Table 2 and Table 3: Replace “parameter” with “variable.”

Line 277: Indicate which supplement the reader should refer to.

Figure 3: Consider removing the word “concentration” from the y-axis label for consistency with subsequent figures.

Line 339-340: Consider mentioning the natural seasonal variability of CH₄ due to hydroxyl radicals (OH).

Figure 7 and Figure 9: missing y-axis labels

Figure 8: Consider rearranging the panels to match the sequence used in Figure 6.

Figure 9 and Figure 10: Please clarify why the 180–200 m average in Figure 9A does not show higher values than 80–100 m, as seems to be the case in Figure 10B (suggesting a plume that is not visible in Figure 9A).

Table S3: The symbol “÷” should likely be replaced with “–”.