Response to reviewers and editor

This document contains the authors' responses to the public justification of the decision following the final review stage of the manuscript: "Measurement report: Temporal variability of vertical profiles of CO2 and CH4 over urban environment" by Zimnoch et al. The text of the originally submitted article and its public discussion are available at:

https://egusphere.copernicus.org/preprints/2024/egusphere-2024-1167/#discussion

Public justification (visible to the public if the article is accepted and published)

Dear Authors,
One of the referees suggested some minor technical corrections which I would like to ask you address – see below, together with some additional comments by myself. Once these mostly minor/technical issues have been satisfactorily resolved, I will be happy to accept the paper for publication.
Best regards,
Barbara Ervens

We would like to thank both the Editor and the reviewer recognizing the high potential of the dataset described in the manuscript and for your positive assessment of the overall manuscript. Additional remarks are appreciated, as they have allowed us to recognize the remaining inconsistencies.

We have taken all comments from the editor and reviewer into account. Please find our responses to the specific comments below. Following the suggestions from the editor and the reviewer, we also entrusted our manuscript to a professional language editing firm to enhance its linguistic quality.

Editor comments

- Please thoroughly revise the language throughout the manuscript as the manuscript contains numerous mistakes, including grammar, terminology and typographical errors. A non-exhaustive list is provided below, based on a few lines of the manuscript:

Following the major remark concerning language, the text has been professionally proofread by a commercial service provider.

l. 73: 'Vertical' should be lower case – corrected
l. 75: "Direct profile observations of meteorological data can be used to evaluate if the model setup and determine the accuracy of variables critical to pollutant dispersion …" – sentence

seems incomplete – corrected
l. 79: Highly heterogeneous urban landscape drive … should be 'landscapes' – corrected
l. 82: "city applications models" should be 'city application models' – corrected
l. 83: "ability resolve transport" – the word 'to' seems missing – rephrased
l. 96: 'aeroplanes' – use the more common terms airplanes or aircraft – changed as requested
l. 100: 'works' is rather uncommon – better: studies – changed
l. 109: Krakow, city of … - add 'a' (a city of) – changed
l. 110: measurement misspelled – corrected
l. 113: wavelength misspelled – corrected
l. 119: "their system has higher of spatial smoothing" – there seems to be a word missing – rephrased

Additional editor comments
Abstract: The current abstract has more than 400 words which significantly exceeds the limit for abstracts in ACP articles. Please shorten and revise it so it adheres to our author guidelines: https://www.atmospheric-chemistry-and-physics.net/policies/guidelines_for_authors.html

The abstract has been revised and shortened.

l. 14: unmanned aerial vehicle (UAV) – please pay attention to our inclusive language guide (https://www.atmospheric-chemistry-and-physics.net/policies/publication_policy.html) that suggests using 'uncrewed aerial vehicle'. – replaced
l. 131: 'reaching over 800,000' vs 'approximately 1 million inhabitants' (l. 109) – please be more consistent – corrected
l. 277: Please refer to the exact place in the Supplement (table, section, figure?) – refered

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Referee comments

The manuscript presents a detailed description of a dataset consisting of vertical profiles of CO_2 and CH_4 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 CO_2 and CH_4 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 . – rephrased
Line 60: Incorrect citation format for Enting et al. (1995),… – corrected
Line 91-92: Incomplete sentence – corrected
Lines 98-100, 105-107: Remove word 'either'. – removed
Line 119: 'their system has higher of spatial smoothing': please, rephrase. – done
Line 132-133: 'villages which surround it forming a metropolitan areas with a total population reaches almost 1.4 million.': please, rephrase. – done
Line 146: Clarify what is meant by "semi-natural" fauna and flora.

We meant the urban fauna and flora affected either directly or indirectly by anthropogenic activities. The sentence has been altered and now reads:

"Here, we understand the biosphere to consist of flora and fauna, the latter of which includes citizens and domesticated animals"

Line 151: Correct to "released from" – changed
Line 178: Correct to "If passengers were" – changed

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)

Thank you very much for this comment. We recalculated all sunrise and sunset times according to https://gml.noaa.gov/grad/solcalc/sunrise.html. The times provided in Table 1 have been corrected accordingly.

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

We respectfully disagree with the reviewer on this point. All campaigns were conducted under favorable weather conditions, so that these conditions would not occur at all during the individual campaigns.

Statistically, conditions that would preclude flights occur during 140 days of the year on average. Most of them (ca. 90) are due to strong wind or wind gusts, which is expected to induce very intense mixing in the boundary layer (BL) and result in highly uniform vertical profiles at background levels.

Line 198: Correct to "passenger." – corrected
Table 2 and Table 3: Replace "parameter" with "variable." – replaced
Line 277: Indicate which supplement the reader should refer to.

There is only one supplement, but we have added reference to specific figures for clarity.

Figure 3: Consider removing the word "concentration" from the y-axis label for consistency with subsequent figures. – removed

Line 339-340: Consider mentioning the natural seasonal variability of CH_4 due to hydroxyl radicals (OH).

Thank you for this remark. A sentence was added:

"This weak variability may reflect the natural seasonal variability of CH4 primarily controlled by its main sink—the hydroxyl radical (OH)."

Figure 7 and Figure 9: missing y-axis labels – corrected
Figure 8: Consider rearranging the panels to match the sequence used in Figure 6. – rearanged
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). – Thank you for this remark. The text has been modified accordingly
Table S3: The symbol "÷" should likely be replaced with "–". – replaced both in Table S3 and in Table 2 of the main text, for consistency.