

General Comments

The manuscript is a measurement report analyzing vertical profiles of CO₂ and CH₄ as well as of various meteorological properties within the first ~300m of the atmosphere over Krakow, Poland. Measurements were obtained across 11 months, giving a nice sampling of conditions over a wide range of seasons and variation in the sources and sinks of CO₂ and CH₄ for this urban location.

Vertical profiles of CO₂ and CH₄ mole fractions and meteorological parameters were used to investigate transitions between the typically more stable nocturnal boundary layer and the convective boundary layer during the day.

Two case studies are presented, with one discussing a potential source for increased CO₂ concentrations in distinct layers above the nocturnal boundary layer observed on some flights. The source is suspected to be a nearby co-generation plant powered by coal combustion. Another case study examines enhancements in CH₄ in certain vertical layers above the nocturnal boundary layer. The source for these peaks in CH₄ is assumed to be different from those of CO₂ as they are not temporally or vertically coincident. The authors state more work is needed to fully understand the sources of these CH₄ peaks above the nocturnal boundary layer.

The dataset is of high temporal and vertical resolution in the lower atmosphere over Krakow, making this a highly useful dataset for multiple applications, including comparison to model simulations, validation of satellite retrievals, and improved understanding of local dynamics in GHGs in urban locations with complex topography and emission sources/sinks as the authors mention.

I see that the paper has undergone significant revisions, and I find it only needing minor revisions. This is a very valuable dataset for the reasons the authors mention throughout, and the figures/discussion provided show the utility of the data for quantifying the evolution of the boundary layer and GHG mole fractions in the lower atmosphere of an urban location across their diurnal cycles.

Specific comments:

Figure 1: I know you mention in the case studies what EC Skawina and EC Krakow are, but it would be great if you could add that to the caption in Fig. 1. I believe 'balloon' is misspelled in your legend.

Line 147: I saw that other reviewers asked about the 'detailed analysis' for determining that altitude calculated from the barometric formula is more precise than that from GPS measurements. It wouldn't hurt to put some result of that analysis in the supplement just to show how you arrived at that conclusion.

Figure 2: Please write in the caption what the grey shading is in panels B. I think I read in another reviewer's comment that these are the daytime and nighttime values, but it would be great to make this very clear in the figure caption.

Line 268: Missing word 'us'?

Line 275: What about with season? Since this discussion is about seasonal and diurnal trends, I think it would sound more complete to comment on both even if just very briefly.

Line 279: Is that true for urban locations? I'm not totally sure, but I wonder how heating at night and transportation patterns for example might compare to diurnal variability from the biosphere. Perhaps provide a citation, thanks.

Line 282: Are you sure that yellow lines are for summer here? I was reading in the Fig 3 legend that JJA is blue?

Line 304: Sunrise should be sunrise

Line 318: What do you mean by 'Over the morning, the enhancement in GHG mole fractions develops a well-mixed layer'? I was seeing that mole fractions of CO₂ and CH₄ below the inversion layer decreased as the morning progressed from sunrise (5:13) to later in the morning (9:22 – lowest concentrations of CO₂ and CH₄ in the boundary layer).

Line 356: I have seen that you wanted to remove the modeling aspect of this paper, but would it be possible to at least show the HYSPLIT trajectory (it can be a very basic run)? Or at least explain why it is not shown in this article (e.g., if a forthcoming paper will evaluate this case study in greater detail).