Response to Reviewer 3

Please find the original comments of reviewer 3 in black and our replies in green.

General Comments:

The authors report details of a measurement with a DCS system used for sensing greenhouse gases in an urban area. They show that DCS can achieve an order of magnitude better precision for CO2 path-averaged concentration than open-path FTIR at the same location. The application of a turnkey DCS system for precise atmospheric measurements of urban greenhouse gases will be of interest to the EGU community. The article is well-organized, concise, and easy to follow. I recommend the article for publication with only a few minor revisions.

> ***Reply:*** *We thank the reviewer for the positive assessment of our manuscript. Please find our point by point replies below.*

Specific Comments:

1. Line 69: The authors cite Eber et al. 2024 as performing “open-path DCS sensing in the ultra-violet”. However, Eber et al. report a DCS measurement from 514 nm to 520 nm, which is in the visible region of the electromagnetic spectrum. This should be corrected.

> ***Reply:*** *We thank the reviewer for catching this mistake. We corrected it in the manuscript.*

2. Line 135: It would be helpful if the authors would give an example from the literature of real-time averaging at the hardware level.

> ***Reply:*** *We agree with this statement and now reference Roy et al. (2012) as an early example of real-time averaging at the hardware level and Eber et al. (2025) as a more recent example, which is maybe more accessible for outside adoption.*

3. Line 211: The authors note that their system achieves CO2 precision better than all compared studies other than Waxman et al. (2019). However, from figure 8, the actual allan deviation appears to be worse than Malarich et al. (2025) at 1-hour averaging time. As the authors mention, drift in atmospheric composition drives larger allan deviations beyond 400s, which is why they extrapolate a fit for the first seven points. Since Malarich et al. (2025) was performed at Mauna Loa Observatory, far from sources and sinks, whereas this work was performed in an urban environment, it is reasonable to expect Malarich et al. (2025) to show lower allan deviations at longer averaging times, even if the systems perform similarly. This different measurement context should be made explicit for the reader who may not be familiar with the work of Malarich et al. (2025).

> ***Reply:*** *The reviewer is of course correct in their assessment that the data point of Malarich et al. (2025) resembles a lower scatter/higher precision, but that this is a result of the high averaging times, which are only enabled by the low variability. We think that it is still clear from Fig. 8 (now 7) that this is not a result of instrument performance, but we added a statement addressing the fact.*

4. I would like to know whether there is potential for gains in precision with the FTIR system by improving the duty cycle, as is possible with the DCS. Additionally, from looking at figure 5, I am curious about the extent of temporal coverage with the FTIR system and how this compares to the DCS system. Please report the duty cycle of the co-located FTIR instrument and the fractional coverage of 5-minute bins by FTIR.

> ***Reply:*** *The duty cycle of the FTIR instrument can only be estimated from the information the proprietary data format and software provides, but is not explicitly provided natively. An upper bound would be about 95% by dividing the given "scan time" by the total time between two measurements. Calculating it on the basis of the number of points per interferogram and some assumptions about the sampling frequency and decimation yields a lower value of about 70%. Concerning the coverage of 5-minute bins by the FTIR: it is typically very similar to that of the DCS system, since they are both limited by the same visibility constraints. All major differences are down to instrument availability or individual servicing periods of the respective instruments. But for the total time span, the FTIR instrument covers 61% of 5-minute bins, while the DCS covers 76%. But this is mostly dominated by January and February, where the FTIR instrument was not reliably available. In most individual months, the coverage was quite similar. In the past, the FTIR demonstrated coverage of up to 90% under good conditions (Schmitt et al., 2023).*