We would like to thank the reviewer for the comments and suggestions to our manuscript. In the following, we answer to the reviewer's comments and indicate the changes in the manuscript that were implemented according to the recommendations. The comments are in black. Our answers are in blue.

Referee #3:

Lian et al., Development and deployment of a mid-cost CO_2 sensor monitoring network to support atmospheric inverse modeling for quantification of urban CO_2 emissions in Paris, is a well-written and thorough piece of science that will be a useful resource for others working in this burgeoning field. I have only two substantive comments that the authors might consider addressing briefly within the text.

Response:

We thank the referee for the positive comments on our manuscript.

Firstly, on page 5, line 17, the authors write: "measuring dry air from two target cylinders with known CO_2 mole fractions. … for a duration of 10 minutes, utilizing only the last three minutes of data", when discussing the calibration. Later in that paragraph, they say, "The target gas is injected … for a duration of 3 minutes and only the last-minute data are used" to deal with sensor drift. It would be helpful if the authors commented on the sufficiency of the three minutes of target gas measurement. Is the measurement stable after two minutes? Did the authors run the target gas for longer periods and determine this was optimal for eliminating sensor drift while minimizing gas consumption?

Response:

We have added the following paragraph in the supplement (Text S1 and Figure S4) to explain the settings for these two flushing times:

"To mitigate delays in sensor responses and ensure stability, thorough CO_2 flushing of the sensor cell is necessary. During the CO_2 correction coefficient IC_1 determination process, we sequentially sampled CO_2 mole fraction for a duration of 10 minutes, with 7 minutes dedicated to flushing and only the last 3 minutes of data used. During the on-site daily target gas injection for the $CO_{2_{offset}}$ calculation, we sampled CO_2 mole fraction for a duration of 3 minutes, with 2 minutes of flushing and only the last minute of data used.

The differences in flushing times are due to two reasons. First, the CO_2 correction coefficient IC_1 is determined through a multipoint CO_2 regression using the seven mole fraction values assigned within the 400-600 ppm range. Conversely, the CO_2 concentration in the target tank (which contains dry compressed natural air, pressurized at 200 bars and calibrated in CO_2) is supposed to be close to the ambient air CO_2 concentration on-site during midday. The step between two different CO_2 concentrations in the IC_1 determination process is greater than that during the target tank injection for drift correction, thus requiring a longer flushing time to achieve stabilization. Second, the CRDS and the mid-cost HPP sensor do not measure at the same flow rate, approximately 0.25 LPM for the CRDS and about 1 LPM for the HPP. They also have different precision targets. The CRDS sensor requires an extended period of target gas measurements to achieve a stability of less than 0.05 ppm, which is suitable for applications beyond this specific intercomparison. Therefore, the flushing time in the IC_1 determination process, when the HPP sensor measures in parallel with the CRDS, is expected to be longer.

Before implementing this setting, we carried out several sensitivity tests on the sensor performance with a daily injection of target gas lasting 5 minutes at LSCE laboratory. The following figure shows the evolution of target gas injection duration in relation to the differences in CO_2 concentration between the other 4 minutes and the 3rd minute at one HPP sensor (HPP3) over 26 days. It demonstrates that a 3-minute target gas injection, specifically utilizing the 3rd minute data, proved to be sufficient. The added value of the 4th- and 5th- minute injection is rather limited. Therefore, the choice of a two-minute flush serves as a good compromise between maintaining good sensor performance (ensuring a target accuracy of 1 ppm) and minimizing gas consumption (thereby extending the lifespan of the tank and reducing associated maintenance requirements)."

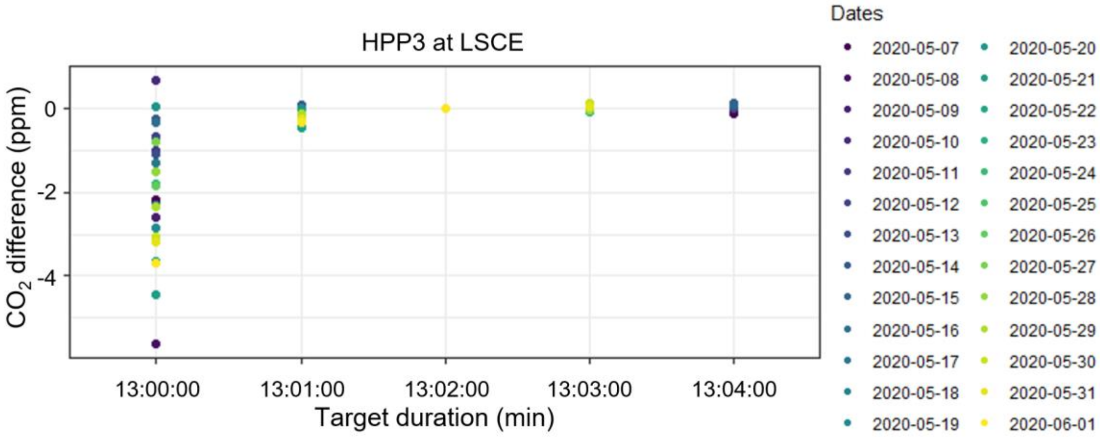

Figure S4. The evolution of target gas injection duration in relation to the differences in CO_2 concentration between the other 4 minutes and the 3rd minute at one HPP sensor (HPP3), with a daily injection of target gas lasting 5 minutes over 26 days at LSCE.

Secondly, the authors have invested a huge effort in developing, testing and deploying the HPP sensors. Much of that effort will be 'banked' e.g. the data handling investment, but there remain significant recalibration efforts when replacing the target tanks every 4-5 months. A short comment on the relative cost saving over the lifetime of the HPP sensors relative to investment in a higher-precision instrument such as a Picarro would be helpful to the audience.

Response:

Thank you for this valuable suggestion. We have added the following sentences in the discussion section:

"The development of mid-cost and medium-precision instruments require a certain amount of funding, manpower and time. After the 2.5-year experience in Paris, the maintenance costs for HPP instruments have been gradually decreased, and their performance has become more stable compared to the initial stages. As of now, the HPP sensor itself is performing well and operating normally. Most of the routine maintenance for the integrated HPP instrument mainly involves cleaning or replacing parts such as the micro-pump and membrane filter. We will continue to monitor the lifespan of this first generation of mid-cost instruments in order to calculate their final expenses and compare them with the high-precision CRDS instrument. In addition, we are also working on several lab developments, such as testing the dual target gas calibration strategy and assessing the impact of adding a thermo-regulated unit, in order to further improve the accuracy of mid-cost instruments. However, it should be noted that these configurations will further increase the cost of the instruments. Finding a balance between accuracy and cost, ensuring that the number of deployed instruments meets the different needs of CO_2 emission monitoring for cities, and comparing these with the operational costs of high-precision CRDS instruments are all crucial considerations."

I make some minor recommendations to improve accessibility of the text.

P2, line 27: use 'the ninth' rather than 'a ninth',

Response: Corrected.

There is some inconsistency in the text about the use of p and P to denote pressure. Please stick to one or the other.

Response: Modified. We have used P consistently in the text, equation, figure and table.

p6, line 34. Change to "For a list of internal flags for some important physical parameters, refer to Table S1".

Response: Changed as suggested

p8. line 33-34. "The p correction substantially reduces the RMSEs of ΔCO_2 to 1.6ppm (HPP4) to 49.7 ppm (HPP7)" is slightly confusing. Suggest revision to: The p correction generally substantially reduces the RMSEs of ΔCO_2. For instance, in HPP4, the p correction reduces the RMSE of ΔCO_2 to 1.6ppm (an improvement of 88% relative to the Raw, H_2O and T corrected RMSE)." While it is commendable that the authors also cite HPP7, the relative improvement in that case was only 1%, significantly lower than the other seven sensors, which causes some confusion for the reader taking in the whole dataset.

Response: Revised as suggested

p22. Figure 6 is very dense. Perhaps panel b) with the modeling data could be omitted and the aspect ratio adjusted for an improved reader experience.

Response: As suggested, panel (b) with the modeling data was omitted, and the aspect ratio of the figure was adjusted. We also bolded the font for an improved reader experience.

p.24 Figure 8 is also very complex and hard to read. Possibly this information could be moved to the supplementary material and a smaller sub-set (possibly only winter and summer and/or every second site by distance from JUS) displayed in Fig 8, to improve readers experience.

Response: Following the suggestion, the original Figure 8 has been split into two separate figures. The revised Figure 8 now displays the winter and summer periods, while the newly added Figure S11 shows the spring and autumn periods.