Response to Referee Comments for Manuscript amt-2020-217

Referee #1:

The manuscript presents low-cost air quality sensor unit for multipollutant, including toxic gases, particulate matter and greenhouse gases (carbon dioxide and methane). The authors report detailed characterisation of two variants of the device: stationary and portable version and present some preliminary results from few field studies. In addition to the characterising the devices, the authors present an online calibration method that rely on the use of traceable gas which is incorporated into the device with auto-calibration functionality built into the operational software of device. This manuscript is well written and presents a new approach physical calibration approach that is more comprehensive than any other work in this field of low-cost air quality sensor. The manuscript also present recommendations on best practices related to design, characterising and deployment of this type of device.

- The authors did not address the issue of safety for the online calibration system which relies on the use of pressurised calibration cylinder (1500 psig). Under normal ambient application, the static variant of the multipollutant device may be exposed to high temperatures especially in the summer. This could pose potential safety concern for the structural integrity of the device.

Response: Thank you for identifying this missing element in the text. It was however something we considered extensively in the design of the device. The cylinder, valves, and associated fittings are selected based on their specifications to withstand the cylinder pressure (reference: Swagelok/TESCOM specifications). For example, the pressurized gas calibration cylinder is constructed with 304L stainless steel with a DOT-3E1800 specification. This specification allows for a maximum working pressure of 1800 psig between -53°C to 37°C, which is higher than our use of 1500 psig. Elevated summertime temperatures are indeed one consideration. The specification calls for a maximum working pressure of 1360 psig at a temperature of 93°C, but based on summertime temperatures in our testing, the monitors do not go over 60°C, and best monitor siting practices suggests shading of the monitor to further mitigate elevated temperatures (as discussed in Section 3.6).

We have added text to the manuscript (lines 251-256) to address this point, and instruct future researchers to pay attention to component specifications and the standard gas concentrations in the cylinder. Furthermore, labels within the device are also used to warn users about the presence of pressurized gas.

- The authors have reported using B431 Alphasense sensor for the OX (P. 3, line 93) but the Table 1 and the text in line 90 page 3 suggest a variant was used. In addition, the authors stated that the static variant uses MiCS-2614 for O3, does this mean the static and portable unit has both OX and O3 measurements? The authors need to clarify this ambiguity.

Response: In the manuscript, the stationary version of the monitor uses the MiCS-2614 sensor to measure O_3 while the portable monitor uses the Alphasense A431 sensor to measure O_3. (via the NO_2 subtraction specified by Alphasense). However, the 3D printed gas manifold was designed to be able to accommodate the Alphasense A431 sensor in the stationary monitor if necessary given the uniform size of the Alphasense A-series sensors. For this study, the Alphasense A431

sensor was solely used in the portable monitor. To reduce any confusion or ambiguity, we have removed the O_x listing on line 93 and added a column to Table 1 to specify which sensors are used in each version.

- I recommend the authors annotate figure 1(b) and figure S3 (a & b) with labels showing main components of the photo presented.

<u>Response:</u> *Thank you for the suggestion. We have added annotations for the main components (e.g. gas inlet, online calibration cylinder) in Figure 1 and Figure S3.*

- P. 10, line 297, the phrase ". . .by the Plantower sensor" sound like the authors are referring to the reference device rather than the MPM device Suggest something like ". . .. . .by the multipollutant device collocated with the reference at the Baltimore Oldtown"

<u>Response:</u> *Thank you for the comment, we have changed the wording to be less ambiguous.*

- P. 17, line 491: there is a red font in the text.

<u>Response:</u> *Fixed, thank you.*

- P. 17, line 494: remove the "of" in the sentence.

<u>Response:</u> *Fixed, thank you.*

- P. 23, line 625 (Figure 3 (a)) add the RH/T corrected to the legend of the time series. Ditto for figures 4(a) and 5(a)

<u>Response:</u> *We have added language to the caption to indicate that "Our Monitor" in the (a) panel time series for Figures 3, 4, and 5 is the corrected, not raw, data.*

- P. 25, figure 8 and 9 captions should include the dates for this deployment.

<u>Response:</u> *We have added the deployment dates in the captions of figure 8 and 9. The NYC deployment occurred on June 23rd, 2018 and the Baltimore deployment occurred on March 2nd, 2019.*

- P. 4, line 85, the phrase ". . . Eqn S2 and Eqn S3" should read ". . . Eqn S3 and Eqn S4"

<u>Response:</u> *Fixed, thank you.*

- P. 9, Figure S9 caption should include the temperature range for the two plots (< 18 and > 18 degree C).
<u>Response:</u> *Fixed, thank you.*