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Atmospheric Measurement Techniques Discussions

Interactive comment on "Field Calibration of Low-Cost Air Pollution Sensors" *by* Andres Gonzalez et al.

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The paper states that the MAAQSbox also contains sensors for SO2, CO2 and VOC, but only calibration for the five pollutant sensors mentioned above is reported here

âĂć The Air Monitoring Station using as reference does not measure SO2, CO2 and VOC. âĂć Generally, CO2 is not measure in air monitoring station. âĂć The concentration of SO2 is $\sim$ 0 ppb in the other air monitoring stations therefore we are not going to include in the measurements. âĂć The data of VOC is limited in other air monitoring stations. The VOC measurement was also discarded.

In both the Introduction (Line 80) and the Methods (Line 180) it is stated that the aim of this work is to 'evaluate' the performance of the sensors in their MAAQSbox, yet the

design of their study and the data presented only reports a calibration (and not even the full calibration data), not an evaluation. âĂć This is correct, we should not have used the word evaluation but examine low-cost sensor previous short term (2 months) measurements. âĂć Also, we can write more about our results and explain/show other results obtained during calibration.

The co-location dataset comprises a single 6.5-day (154 hour) co-location at one time of year at one site. This dataset is then used to derive a multivariate linear regression calibration for each sensor against its relevant 'reference instrument' value using sensor signals and the internal airstream T and RH values as dependent variables. For calibration of the NO2 and O3 sensors, sensor signals from the other species sensor were also included to allow for potential cross-species interference.

âĂć We only show 156 hours. However, there are other 244 for CO, 170 for NO, and 87 for NO2 and O3 hours of calibration running 5 months later with the same sensors.

However, the authors do not present the actual calibration equation coefficient values and their p values (they only state which variables are included in each sensor calibration equation). âĂć we can add that data

Nor do they present visualisations and/or statistics for the raw comparisons of sensor values against respective reference concentrations. Consequently, in the absence of such information the reader is not able to gauge how well or not each sensor performs prior to the multivariate regression fits, i.e. to gauge how much modification to raw sensor output is being made by the derived multiple regression calibration equation. In other words the reader does not get a sense of how much the sensor signal needs to be corrected for the contribution of other variables to the signal, particularly the extent to which there has to be correction for cross-interference between the NO2 and O3 sensors. Such information would tell the reader how important other variables are. âĂć we can add that data

A more fundamental flaw, however, is that there is no independent evaluation of the

calibration: the same data is used both to derive a calibration equation and then to justify the goodness of the calibration once applied to that data. If one derives a predictor equation from a dataset and then applies the predictor equation to exactly the same dataset then of course the predictions (and their 'evaluation' statistics) are likely to be very good. At the very least, there needs to be sufficient co-location data to (randomly) split into 'training' and 'test' sub-datasets in order to provide some (quasi)independent statistical evaluation of a derived calibration. More usefully still, what potential users of this MAAQSbox need to know is how well does a calibration equation hold in time and at different locations. Is there evidence of any long-term drift in sensor performance/ calibration? âĂć There is evidence of drift in long-term sensor. We can show the two different calibrations conducted by 5 months away. âĂć We can apply the equation if the data presented on this paper to the second calibration and assess the change in raw data and see potential drift.

If the sensors in the MAAQbox is calibrated at one location, does the same calibration hold at another location and/or at another time? If the MAAQbox is calibrated prior to a mobile deployment and is then used as intended on a mobile platform how well does its calibration hold up when the MAAQBox is co-located back at the reference monitoring station? âĂć This was answered above.

All that the data presented in this paper show is that an underlying relationship for sensor performance self-consistently holds within a single 154 hour period. âĂć This was answered above.

Some additional comments: The regression equation written on the panel of Figure 6c does not seem correct. The intercept appears to be much larger than 0.29 ppb, and eyeballing this panel suggests that the plotted regression line is giving much higher values for estimated NO2 than the stated regression line would predict; for example, for a reference value of 15 ppb the regression equation predicts a sensor value of 12.14 ppb but the plotted line shows higher estimated NO2 than this. Also, this panel should include the origin of the scatter plot. âĂć We are going to double check this chart and

the calculation. We will include any change due to new calculations. As soon as we find out the error, we will do a clarification. âĂć In this case the reviewer was correct. The equation should be: y = 0.7873x + 2.8665 âĂć We are going to include the origin of the scatter plot.

The scatter plot in panel 6a should also include the origin of the plot, and why does the regression equation for this panel not have an intercept coefficient? Even if the coefficient is not statistically significant its value should be included to indicate that the regression included an intercept in the fit. âĂć We are going to double check this chart and the calculation. We will include any change due to new calculations. As soon as we find out the error, we will do a clarification. âĂć In this case the reviewer was correct. The equation should be: y = 0.9569x + 0.0159 âĂć We are going to include the intercept

The increased scatter in the calibration scatter plot for NO2 (Figure 6c) is noted but there is no discussion of this. Given that NO2 is a key pollutant in the urban environment, for which quantification by instruments such as MAAQSbox is most keenly sought, there needs to be further comment on what is underlying this poorer performance for NO2 measurement. âĂć We can say more about it and describe/explain the NO2 sensor performance. We can include potential reasons for (poor) the NO2 performance

As indicated above, we are not given the magnitudes or p values of coefficients in the calibration equations: which one of the variables is having the most influence on the NO2 response during this deployment? âĂć As we mentioned, we can include all the p value and coefficient of each variable of each sensor.

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