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Atmospheric Measurement Techniques Discussions

Interactive comment on "Robust statistical calibration and characterization of portable low-cost air quality monitoring sensors to quantify real-time O_3 and NO_2 concentrations in diverse environments" *by* Ravi Sahu et al.

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Response to Anonymous Referee #3

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We thank the referee for the comments and suggestions. Below we offer clarifications in response to the general and specific comments of the referee. The paper has undergone a major revision that will be communicated to the editorial desk shortly.

General Comments

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1. Invalid Timestamps: although around half the timestamps were rejected for our experiments, it was still the case, especially for summer months, that at least one timestamp (frequently several) were found valid every hour. We note that this does not contradict the rejection of 52% timestamps since site D (resp. site M) offered timestamps at 1 minute (resp. 15 minute) intervals. Thus, the timestamps considered valid could still accurately track diurnal changes in AQ parameters (as indicated by Figure 9). A conservative approach was adopted when rejecting timestamps. We recall that a total of 8 parameters are involved in the training process – four voltage values, relative humidity and temperature values from the LCAQ sensor, and two reference values (one each for O3 and NO2) from the reference monitors. Timestamps where even one of these parameters had an invalid value were rejected. Table 1 has been revised to include more illustrative examples of rejected timestamps. In future work, data imputation techniques could be adopted to increase the number of valid timestamps. We have included a discussion on this point in the (revised) supplementary material.

2. Spatially Diverse Data: the prospect of investigating the effect of spatial variation alone (without bringing seasonal variations into account) is interesting and we did consider this in our initial experiments but found that cross-sensor calibration is a challenging task in itself. For example, even the relative humidity and temperature sensors present in LCAQ sensors do not present good agreement across sensors (please also see point 4 in specific comments below). Thus, investigating spatial variation alone would have required us to do some form of "model transfer" of calibration models from one LCAQ sensor to another. Although an encouraging direction for future work, this was not within the scope of this paper.

3. Parametric vs non-parametric for out-of-sample results: we thank the referee for making this suggestion. We have updated Table 5 to include the generalization results

for the parametric linear least squares method LS as well. As noted by the referee, performance drops are noticed in both algorithmic paradigms. However, as compared to the non-parametric method KNN-D(ML), the drop for LS is less in some cases, but comparable or worse in others. Of course, when diverse data is provided to both algorithms, KNN-D(ML) is superior at exploiting the additional diversity in data.

Specific Comments

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1. We thank the referee for taking pains to point out several typographical and typesetting changes. We have incorporated all of them in the revised version of the manuscript.
2. Commodity: the Alphasense electrochemical sensors used in the SATVAM LCAQ setup were not customized or specifically tailored for our study. Hence we use the term "commodity" to describe them. We have clarified this term at its point of first use in the paper.

3. Sensor Count: we thank the referee for pointing this out. It seems we forgot to include a clarificatory remark in the paper. There were indeed 7 sensors deployed in the field of which 4 were swapped across sites. However, one of the sensors (that was swapped) was experiencing severe malfunction. Its Rh and T sensors were non-functional for the entire duration of the Jun deployment. For the Oct deployment, its data had much larger gaps (sometimes spanning several days), which was qualitatively distinct from the other sensors which experienced only intermittent gaps often lasting a few minutes. For this reason, this sensor was excluded from our study. Although for sake of full disclosure we still mentioned in our original submission that 7 sensors were used, we forgot to include this clarificatory remark. We have now included this clarification in the revision.

4. Rh and T values were obtained from DHT22 sensors located in the individual LCAQ sensors. This was done to ensure that the calibration models, once trained, could perform predictions using data available from the LCAQ sensor alone and not rely on

data from a reference monitor.

5. Figure 6: we agree with the referee and have moved this plot to the supplementary material in the revised version as the plot offers marginal utility with respect to the main discussion. We have also clarified all aspects of the plot in the caption itself as kindly pointed out in the review.

6. "Statistically distributed": we thank the referee for pointing out this typographical error. We meant to write "normally distributed". We have corrected this.

7. Number of rows in figure 6: we regret this formatting error. Our initial submission to the journal was in a two column format (in which Figure 6 did have 4 rows). However, we were requested by the editorial desk to convert to a single column format. We did so but forgot to change this piece of text to reflect the change in formatting. We have corrected this.

8. We agree and have moved the small tutorial on interpreting violin plots to the supplementary.

9. Section 6.4: the referee is indeed correct in observing that sections 6.5 through 6.8 were meant to be subsections of section 6.4 We have corrected this.

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