Atmospheric
Measurement
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Discussions

# *Interactive comment on* "Design of an ozone and nitrogen dioxide sensor unit and its long-term operation within a sensor network in the city of Zurich" *by* Michael Mueller et al.

**Anonymous Referee #2**

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General Comments This study presents long-term measurements with low-cost ozone and NO2 sensors, and reports on their accuracy, sensitivity as well as providing a method for their calibration and data control for long-term measurements. I found it an interesting and well thought out study, with some interesting findings related to their sensor performance when deployed for ambient monitoring. There are not many studies reporting on the long-term deployment of low cost sensors and so their finding would be of broad interest as low cost sensors is a hot topic. While the paper was mostly well written, I did find some sections a bit hard to read, and I think that this could be improved by being more explicit at the end of sections on what the actual findings/conclusions were. For example, by the end of Section 5.2, it wasn't clear to

me whether the sensors were in agreement? Or Section 4.2, which was the better model to use? I think by adding a sentence or two at the end would help the reader follow the progression of findings through the paper. I would add though that I did find the overall findings and conclusion well summarized in the final section. While there are not many, there have been some reported studies on ambient measurements using 'low-cost' sensors, and I would have liked to see some discussion comparing results to the literature. For example, Lewis et al., (2016) found seemingly contradictory results, as they found the ozone sensor performed better than the NO2 sensor for ambient measurements and I would interested to on the authors thoughts on why.

Overall, I would recommend this manuscript for publication after consideration to the following comments.

Specific comments

Abstract, line 9: Perhaps you could indicate the accuracy of the diffusion tubes?

Abstract: It would be worth also mentioning how the ozone sensors performed, a part from their accuracy?

Section 2.2.1: It was not clear to me where the sites used where located? I suggest amending Table 1 to include how far the AQM/reference sites were from the sensor units, this is important information when understanding the calibrations and corrections applied later.

Section 3.1: Why were only 2 ozone sensors used and not three like for NO2? How can you be sure which is ozone sensor was correct?

Section 3.3, line 11? What does $\Delta t_0$ represent and how exactly did you measure it in the field?

Section 3.3, line 18-19: I think you should expand this discussion, is just RH and NO2 that the sensor is responding to?

Section 4.1: I found the description of the different data sets a bit confusing. Was the 10% of the data selected from the whole time series for the calibration(whole year)? The reported concentrations for NO2 and O3, were these for the 10% of the selected data for the calibration? I suggest that this paragraph is re-worded to clarify what data sets were used for calibration of each model.

Section 4.2, line 26: Which variables were used in the model?

Page 9, line 20: Please re-word, I wasn't sure what became evident of the ozone sensors.

Section 5.1, line 6: Should you remove the negative values? Wont this give a positive bias to your averaging?

Section 5.3: In Fig 7, there appears to be a seasonal trend, with greater discrepancy between the sensors and the diffusion tubes during the summer compared to winter? Perhaps the authors could consider why this may have occurred?

Section 5.5: Why did the ozone sensors have such poor agreement at the end when the NO2 sensors did not have this issue? You mentioned earlier the issue of them being clogged by airborne particles, was this a contributing factor? How come the agreement was poor when the ozone sensors were still reasonably correlated with the reference instrument? In addition, it is also not clear here how the measurements at AQM differ to the reference instruments?

Figure 2: I found this figure hard to understand; it wasn't clear to me how it depicts 3 tests, perhaps because the y-axis has many parameters. I suggest simplifying by only including the most relevant data, or splitting into multiple plots.

Figure 3: What do the two columns of numbers on the left of the plots represent? I would also indicate what RMSE represents in the caption.

Technical Comments: Page 6 line 21: Should it read 'may both experience interference with temperature and humidity'?

Page 7 line 8: should it read: 'calibration of the sensors for all the SUs'

Page 8, line 14: Obviously is mis spelt.

Page 9, line 18: Progressively rather than progressionally?

Page 10, line 18-19: Please indicate the figure number, I'm guessing 6?

Page 11: line 26-7: please indicate the figure numbers.

References

Lewis, A.C., Lee, J.D., Edwards, P.M., Shaw, M.D., Evans, M.J., Moller, S.J., Smith, K.R., Buckley, J.W., Ellis, M., Gillot, S.R., White, A., 2016. Evaluating the performance of low cost chemical sensors for air pollution research. Faraday Discussions 189, 85-103.