

## ***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 #3**

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This is a very thorough and very timely publication that examines the performance of NO<sub>2</sub> and ozone electrochemical sensors when used as part of an operation air quality network in Zurich. There is very high demand for work of this kind, and the literature contains rather few balanced studies that take a long-term approach to evaluating performance. There is some basic lab testing reported, comparisons of various correction models, and some interesting approaches to data analysis, including comparisons of a sensor network during periods of notionally homogeneous atmospheric composition.

The manuscript is rather dense and technical to read so would benefit from some careful editing to improve readability. There are a few areas where some additional clarifications are needed, but in principle the paper should be published in close to its

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current form.

The sensor units developed by the EMPA team are described in some detail, each containing a number of duplicate and triplicate sensors. The text isn't very clear however about how data from the redundant sensors is used in the paper's subsequent analysis. Is the information from all three NO<sub>2</sub> sensors included in the statistics on for example RMSE (mean, median?), or is one single sensor chosen, with the other two NO<sub>2</sub> sensors truly redundant spares in case of failure? The later part of the paper shows how the identical sensors in each box compare to one another and this is very interesting, but there needs to be better clarification of how each contributes to the datasets that are the main conclusions of the study. Page 10 refers to the mean of sensors in each box, but its not clear if this approach is used through the paper, or just in this part.

The paper includes some lab testing of sensor interferences, and this shows some similar results to other studies. Are the various mixtures of co-pollutants that are tested presented to the sensors in 'real' air (e.g. zero air, or synthetic air) or blended in pure N<sub>2</sub>?

Figure 2 is really far too small to be read clearly for so many different chemicals, so a better way of showing this data is needed.

There is a lot of information in Figure, and the text refers to this figure as showing for example the impacts and temperature RH correction compared between models. It is quite hard for the reader to find this in a many different models, so could the figure or text more directly identify those models that show these differences?

The comparisons between sensors in Figure 6 are interesting (associated text is on page 10). There is reference to drift in RMSE and R<sup>2</sup> over time, but its quite hard to see this in the data. I presume this is inferred because towards the end of the period more sensors have RMSE value above 4 ppb, than at the start? Is there perhaps another way this could be shown graphically since this is an important point.

The comparison of sensors in homogeneous air is an interesting approach. Can the figure and text be made a little clearer about which bits of data in Figure 8 are from Sensor Units, and which are data being reported from standard reference instruments. I have assumed that the sites in normal font, eg SWD, SCH, STA are only showing reference instrument data, for those selected periods, whilst WIN, STV, ETH for example are only showing sensor data?

Figure 11 seemed to be a little surplus to requirements in the paper. It is good that the Sensor Units captured a plausible diurnal trend, but since the two sensor locations and two AQ reference stations are not co-located, there isn't much to infer from comparing the two types of data.

Minor editorial changes

Page 2 'metal oxide'

Page 2 Line 27, '...were operated at these locations until August 2. ...

Page 5. Line 11. Presumably this should read something like: '...leading to the omission of a few measurements where there were small variations in measurement frequency'?

Page 6 Line 4. It is temperature and humidity that interfere with the sensors, not the other way around.

Page 7. Line 7. This isn't clear, but I have assumed this to mean the sensors were operated some way away from the reference site. The explanation of the PAR/REM approach to calibration needs a slightly expanded and better description here. It becomes clearer the more you read on in latter pages.

P8 line 14 – obviously

Figure 6 (and elsewhere). Can the captioning use the same abbreviations as the text, eg DS1, DS3. There is some interchange between dataset 2 - DS 2 etc.

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