

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-75

Anonymous Referee #1

Referee comment on "Performance comparison between electrochemical and semiconductor sensors for the monitoring of O₃" by Christophe Claveau et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-75-RC1>, 2022

General comments

The objective of this work is to evaluate the performance of commercial -electrochemical and semiconductor type- low-cost sensors (LCS) to quantify tropospheric ozone under laboratory conditions. The experiments were carried out at different experimental conditions, focused on humidity and temperature effects, to evaluate the LCS output signal dependence on these variables. Given the global and local consequences of air pollution, the subject under study is of prime importance. The evolution of the field of low-cost sensors is essential as they could provide information at finer scales than ever before. However, is in the consideration of this reviewer that the present manuscript needs to be reformulated. An important point that should be extensively reviewed is the structure and clarity of the manuscript, which makes it difficult to follow the content and main points. The writing style needs to be revised as well. The literature review is somewhat scarce and needs to be reconsidered as, in this reviewer's opinion, it is impacting the novelty of the manuscript. This is evident in the results, as much of what the authors find has already been discussed in the scientific literature, neglecting potential impacts.

In relation to the abstract, although it mentions the main objective, including a short summary of results and conclusions will benefit the reader. The description of the problems/issues but also the advantages of these sensor types provided in the introduction need to be refreshed. The references here are somewhat outdated, and this in a field as dynamic as that of LCS seems to be impacting the results and conclusions novelty. I also think that the text in general would benefit if the main points made by the authors are clearly stated. This will also make it easier for the reader to identify and follow some important points that this work could potentially offer. As the current manuscript is focused on evaluating the sensor response (voltage signal) to different lab conditions, correction methods and colocation studies review included in the text dilutes the discussion of topics more relevant to this study. The experimental design is partially described, impacting the transparency and reproducibility of the study. A detailed description would also help to clarify the results and conclusions of the study. Regarding the results and the analysis of the data, it is chaotic, which dilutes important information. There is also a lot of duplicate information that could be summarized or outlined in a more

efficient way.

Specific comments

Having a continuous numeration of lines will be greatly appreciated.

Abstract

Page 1

Line 14: Perhaps "answering questions" fits better the sentence.

Line 15: "In this context, its adaptable and scalable nature will allow the insertion of new consumer measurement components available ("low cost" micro-sensors)". Please rephrase, is not clear what the authors want to convey.

Line 18: Replace "Theses" with "These" and "are tested" by "were tested"

Line 19: Replace "and at ppb level" by "and ppb level", "ambiant" with "ambient"

Introduction

Page 1

Line 31: this paragraph seems to be the continuation of the previous one, which, however, is separated from the first. Also, it is provided with a reference from 2012 -ten years ago- meaning the assertion included in the text represents the technology at that time. Specific studies can be found for each of the named technologies (metal oxide, electrochemical, infrared, photo-ionization sensors) in the last 5-10 years. I strongly suggest diving into more recent literature. Also, what does "target gas" mean in this context?

Line 39: Despite starting this paragraph with "Recently", a similar issue is found as mentioned in the previous comment. Also, would be interesting to know if the mentioned sensors still in the market and if the price corresponds to 2022.

Line 45: Please rephrase/revise the entire paragraph content.

Page 2

Line 19 (2nd page)-Line 6 (3rd page): The first paragraph in these lines describes correction methods, which seem to be a bit outside the scope of the manuscript. Similarly, the next 5 paragraphs are mainly focused on in-field colocation studies, while this is a lab study. I suggest rethinking and rephrasing what of all this is contributing to sustaining your study case and/or helping the reader to understand your work.

Page 3

Line 8: It is said that "We have developed our own sensor". I strongly suggest replacing sensor by system (or node). Also, it would be enriching if you could expand on the differences (here or elsewhere) between an OEM and a system.

Experimental setup

Line 19: replace "prototype sensor" with "prototype system"

Line 20: A detailed description of the exposure chamber will benefit any reader trying to replicate the experiments presented here. This point is a bit vague and needs to be reframed as it is an essential part of the experiments. For example, how the different variables (temperature, RH, flow, pressure, etc) are controlled? How long was the ramp held each time?

Line 44 (3rd page) - Lin 8 (4th page): Please check the intended meaning of these paragraphs and rephrase.

Page 4

Line 10 – Line 21: these paragraphs offer an introductory description of the sensors type, not relevant to the experiment conditions description. These paragraphs could be summarised and moved to the introduction.

Table 1: probably the time range in hours could be more informative. What is the "Number Experimental test"? And "Number values on range"? Is not clear what is trying to be said. For the temperature and humidity columns, what is the number in between parentheses?

Lines 23-29: Please rephrase this paragraph, I couldn't understand what is trying to communicate. Also, could you expand on the reasons behind the different experiments and periods? How many sensors of each type were tested at the same time?

Lines 30-36: Please check the content of the paragraph and rephrase.

Results

Line 4-12: The text states that the differences between the different series are a consequence of changes in the sensor response (drift). Is it possible that part of the differences found are due to the experimental set-up? One way to provide evidence in this regard would be to have duplicate sensors exposed to the same conditions.

Line 26-33: what is the "room temperature"? And the "higher temperature"? Again, having duplicate sensors would help to support the manuscript statements, but it doesn't seem to be the case.

Line 39: "The voltage response increases with humidity", but series #9 seems to be an outlier. What would be the explanation for this? Also, the Figure number should be stated.

Line 49: could you expand based on your findings about the observed hysteresis effect on the sensors?

Lines 1-5: the manuscript states a good agreement exists between series #5 (black line, Figure 10) and series #7 (blue line). Please revise this, as it doesn't seem to be the case.

Line 17: how the series were combined to produce the figure 12?

Line 31: it is not clear how the manufacturer curve shown in fig 14 was obtained.

Line 47: "The mean values of the voltage response between the series are close up to 200 mg/m³ but for values above 200 µg/m³ the quality of the measurements does not allow to obtain a reliable result". Check the meaning of the sentence. Also, why it doesn't allow to obtain a reliable result? Expand.

Line 2: "The figure shows a strong drift between the values obtained during the first month of use and the 3rd and 4th months of use". Is the positive change in the baseline shown in Fig 18, due only to drift? Could there be other effects?

Conclusions

Line 29: "the measurements precision is enough for air quality studies with European regulation" Could you expand on this? Qualitative or quantitative studies? There will be soon a new European Directive (with lower limit values in order to follow the new WHO guidelines). Do you think the electrochemical sensors will be able to cope with them?

Line 32: The text mentions "the linearity properties...", but in all the figures the response was treated as non-linear.

Figures

Regarding the figures (5 to 18), in my opinion, they are too many and important information is diluted. I suggest selecting (and rearranging) the most pertinent figures for the main text and the rest could go to the supplementary. Another relevant comment is that the R-square for non-linear models is statistically incorrect.