Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., author comment AC1
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Reply on RC1

Christophe Claveau et al.

Author comment on "Performance comparison between electrochemical and semiconductors sensors for the monitoring of O3" by Christophe Claveau et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-75-AC1, 2022

We thank again for the interest in our article.

Here are the answers we provide:

Specific comments: numeration of lines has been modified in the revised version of our article

Abstract

Page 1-Line 14: the text has been modified in the revised version of our article

Page 1 -Line 15: We have reworded the paragraph to show that the adaptable nature of our sensor will allow us to test the latest and most
micro sensors and help to answer questions related to pollution exposure.

Page 1 -Line 18: the text has been modified in the revised version of our article

Page 1-Line 19::the text has been modified in the revised version of our article

Introduction

Page 1-line 31-45: The most recent and detailed studies on the performance of MOS (metal oxide sensors)
and electrochemical sensors and concerning ozone are between 2012 and 2018. It seemed important to us
 to present a summary of the studies during these last decades on the subject. All the paragraph
has been rewritten to meet the referee's request. The mentioned caiclips are still on the market at these prices.

Page 2/page 3 (INTRO)

Line 19 (2nd page)-Line 6 (3rd page): the interest of this work is to show in particular that these micro-sensors can be used on the field for precise measurements of the precise measurements of the concentration of the studied gases. This is the reason why
the different studies that have already used these sensors in the field have been

presented. The paragraph has been rewritten in order to keep only the studies that allow to better understand the interest of this work.

Page 3- line 8: the text has been modified in the revised version of our article

Experimental setup

Page 3-line 19: the text has been modified in the revised version of our article

Page 3-line 20: We have detailed the way in which the experiment was carried out as well as the means of control
of the various parameters (temp, humidity...).

Page 3-line 44 - Page 4-line 8: the meaning of the sentences has been checked and the text has been rewritten in the revised version of our article

Page 4- Line 10 – Line 21: the paragraph has been moved to the end of the introduction in the revised version of our article

Table 1: The time range has been specified below the table as well as the number of tests and the number of values for each selected range.
The determined voltage measurement for a given concentration range is the average of all voltage measurements of this range.
The number in parenthesis corresponds to the temperature or humidity differences between the different experiments.
the comments below the table have been added.

Page 4- lines 23-29: The periods group together all the experiments that have been performed in a given period of time.
The number of sensors tested depends on each period and is given in Table 1.The duration of each period has been chosen to realize a sufficient number of experiments to study the performance of each of the micro-sensors. The first two measurement periods were performed to compare the performance of sensors of different technologies. The next two periods of measurements were carried out to study the medium and long term drift of the measurements obtained with electrochemical sensors tested during the first two periods.

Page 4-Lines 30-36: the text has been verified and modified n the revised version of our article

Results

Page 5-line 4-12:The experimental set-up and conditions remained unchanged between series 1 and 2. Similarly, the conditions are unchanged between series 3 and 4. There is therefore no reason why part of the differences observed should be due to the experimental setup. On the other hand, the drift observed between the measurements obtained between series (1-2) on the one hand and (3-4) on the other hand were expected since the temperature and humidity varied.

Page 5-Line 26-33: the temperature is about 301,5K for the series. Measurements with two alphasense sensors in parallel (Alpha 2 and Alpha 3) were made during the third test period. The same results were obtained for the two sensors, i.e. a very weak drift in the short term (over two weeks of measurements). A new figure has been added and presents the results for the Alpha 2 sensor.

Page 5-line 39: Series 9 was made after series 8 where the humidity was higher. There is no reason to think that series 9 gives aberrant results
since they group the measurements on 2 consecutive days and 3 different experiments.

Page 5-line 49: the text has been modified to meet the referree request

Page 6-lines 1-5: The difference between the two series is about 1 to 1,5 %. The text has been modified in the revised version of our article

Page 6-Line 17: the curve is obtained by averaging for each measurement point all the measurements obtained for series 1 and 2 on the one hand (series 1-2 curve) and series 3 and 4 on the other hand (series 3-4 curve).

Page 6-Line 31:The manufacturer gives a technical specification where there is a curve of the voltage response as a function of the concentration. Each point of the curve on the figure is the average of the values obtained on the manufacturer's Technical specification.

Page 6-line 47: Above 200ug/m3 the average values obtained are less reliable than for lower values because the values obtained are more dispersed and the uncertainties on the measurements are more important.

Page 7-line 2: Between the first and third month of the study these sensors were tested with NO2 (measurements not reported in this article).
It is possible that this changed the baseline voltage response when the sensors were used again during the third and fourth month. New tests with new sensors will be necessary to verify this.

Conclusions

Page 7-Line 29:: the European directive (2008/50/EC) defines an alert threshold of 240ug/m3, an information and recommendation threshold of 180ug/m3 on average per hour and an air objective of 120 ug/m3 average concentration over 8 hours. Calibrating every 40ug/m3 up to 320 ug/m3 is equivalent to having 8 levels of measurements every 40ug/m3 which is sufficient to meet the air quality criteria. Even in the case of a loss of sensitivity, with a calibration every 60ug/m3 that would be sufficient to obtain measurements corresponding to these three thresholds (120, 180 and 240 ug/m3). The air quality objective set by the WHO is 100ug/m3 for the maximum daily value over 8 hours and 60 ug/m3 for the average value over 8 hours. during the last 6 months when the concentration is the highest. Even with these new thresholds it will be possible to use these sensors.

Page 7-line 32: All figures have been treated as non-linear because some sensors give results requiring a non-linear fit.
For the alphasense a linear fit is usually sufficient. To illustrate this result I have added a table with a linear and nonlinear
linear and nonlinear treatment of the 4 alphasense sensors.

Figures (5 to 18): the figures have been reorganized and only the most relevant ones have been kept in the revised version of our article.
The others will be put in the supplementar materiels

A new revised manuscript with supplementar materiels will be submitted

Christophe Claveau