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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "The next generation of low-cost personal air quality sensors for quantitative exposure monitoring" *by* R. Piedrahita et al.

**Anonymous Referee #1**

Received and published: 20 March 2014

General comment: This is an important manuscript detailing the procedures by which users of sensors can utilize in better establishing the performance of their devices and therefore the credibility of data they are collecting. The article is worthy of publication following minor revisions which are documented below:

Abstract: Suggest using the term "collocated" instead of co-location. While both are grammatically similar, the first term is the one most often used in these types of side by side comparisons. I would not suggest you indicate that the collocated comparisons were "better" than the true laboratory calibrations. The laboratory exercise did provide true calibration while the collocated effort provided "normalized" data. Both have their



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merit. I would suggest you indicate that the collocated option provided a potentially less sophisticated but no less valuable approach to establishing sensor performance. Remove the double use of the phrase "M-pods" in lin 24.

page 2427. no comments

page 2428. Be sure to differentiate between FRM and FEM in all of your text. Most regulatory agencies to my knowledge are typically using FEMs for most of their required monitoring. Line 13. Provide a reference indicating the recommendation for daily or weekly calibrations.

page 2429. Provide references associated with the points you discuss in lines 8, 11, 17. page 2430. no comments

page 2431. line 7. I would suggest that you are normalizing response, not calibration. Calibration is an engineering term often referring to a direct challenge and subsequent output of a test device. You are normalizing response of these devices when you discuss the collocated measures. line 13, NAAQS, spell out this acronym.

page 2432. Provide references for the points you are making in lines 18 for the LabView and Labjack devices. Report the version and manufacturer. You indicate in line 21 that you "calibrated the devices for temperature and humidity but offer no insight as to how you did that. What tools and approaches were used. These procedures should be more clearly defined in the text. Provide a reference for line 23 in your discussion about NDIR RH effects. You indicat in line 28 that sensors were warmed up for at least a week to ensure stabilization. Most end users of sensors will not wait that long. Please define what you believe is an adequate warm up time. If it truely takes a week of stabilization, then the system being described is not one of practical use.

page 2433. How did you generate known concentrations of test gas in the laboratory? What purety of gas did you employ? What was the flow of test gas through the chamber and how did you validate that the postulated test atmosphere was correct with respect



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to test gas concentration? Did you employ on-line gas analysis or pull samples for off-line analysis? You do not indicate if you maintained a constant flow rate through the test chamber for all conditions. Was this the case? Greater details need to be provided here concerning how you performed the in-laboratory testing. Provide a reference in support of line 11 with respect to heterogeneousity of the MOx sensors.

page 2434. Define "ambient" in terms of relevant concentrations you believe are applicable. Provide references for line 22 with respect to Taylor approximation. Readers might not be familiar with this data treatment.

page 2435. No comments

page 2436. Line 23 you indicate a "calibration" was performed prior to the deployment. How and where was this done and was protocol was used. Provide a reference concerning the calibration.

page 2437. line 6. How were these calibrated? Was this a laboratory calibration and if so, define it more thoroughly. Lines 10-17. Define the total amount of data censored in either data points, percentage of total or some other metrics. Currently, we have no understanding of how much acceptable data were obtained and used in the statistical treatment.

page 2438. Provide a reference in support of line 24 in the discussion of S/N. Did you actually calculate S/N for the reference monitors or was this a value you pulled from published findings?

page 2439. Drift is a term that often applies to a change in response when the challenge condition has not changed. If that is how you intend for your discussion to be presented, clearly define that for the reader.

page 2440. Lines 10-14. This text is confusing with respect to what was actually performed and there is insufficient text documenting the procedures employed. What does the term "low"mean in line 21. That is a subjective term which should be replaced



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with a value.

page 2440 and follow on pages. I understand the authors wish to include personal monitoring data in this manuscript. However, the article is better presented if all such data are removed. Currently, there is insufficient discussion about subject population, exposure monitoring compliance, survey instruments used and other key aspects of human observational monitoring to include any such reporting in this article. I believe the article is totally sufficient discussing just the laboratory and in-field exercises. I strongly just removal of these data or adding pages of text to support materials and methods and results/discussion. For example, implying that subjects changed their behavior is totally unsubstantiated with the information you provide the reader. Simplify your article by removing this section of the results and discussion.

page 2441. Personal exposure data is not needed in this article. Strongly suggest it be reported elsewhere

page 2442. How did you balance zero grade air? Is that what you are referring to in lines 6-9. I am uncertain of what your intentions are in that text but it calls into question your test apparatus. Better define your intentions here. Lines 12. Suggest you change the word "worse" to "poorer". Line 14. Why are you suggesting power supply issues? Do you have data to support such a hypothesis. Why might it not be intra-variability of the sensors themselves? Others are reporting batch to batch inconsistencies in MOx sensors and maybe this is what you experienced. Lines 22-25. Need to define the % of data removed and parameters used to censor data.

page 2443 Lines 1-18. You provide no supporting data on the personal monitoring performed or the procedures used to ensure adequate data collection rates. Encourage its removal from this article. The term "very good" is not informative and suggest it be replaced with a more definitive qualifier.

page 2444. What are the power issues you refer to here? Might the curious NO2 concentrations you observed be associated with in-home gas appliances? Such observa-



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tions have been previously made by others investigating such events. Lines 18-19. It would be worthwhile for you to define the cost of the in laboratory exercises in contrast to the field normalization events. There should be quite a cost savings here.

Citations; Sufficient except with the needed references defined above.

Table 3. Define S/N as how many folds above baseline (2X, 3X)? That is never reported in the article. Define the "N" term as minutes, seconds? The bold and italic text is confusing. I suggest you use * and ** superscripts to differentiate these lines

Table 2. The values listed in the co-location column are of course not realistic. Should they be included at all? Make a case for their inclusion or simply excise them from the article.

Table 4. Align columns for presentation quality. Maintain significant decimal places in the columns.

Supplemental materials. No comment

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Interactive comment on Atmos. Meas. Tech. Discuss., 7, 2425, 2014.