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Atmospheric Measurement Techniques Discussions

Interactive comment on "A new laser–based and ultra–portable gas sensor for indoor and outdoor formaldehyde (HCHO) monitoring" *by* Joshua D. Shutter et al.

Anonymous Referee #3

Received and published: 28 January 2019

General Comments:

Shutter et al. report a miniaturized instrument for monitoring grade data for formaldehyde, HCHO, based on a mid infrared laser / Herriot cell combination. They demonstrate performance sufficient for slow time response (15-60 min) HCHO in some outdoor and (likely) many indoor environments. They compare this instrument to state of the art, research grade LIF instruments with might higher precision, showing agreement to within 10% in the slope and $\pm$0.5 ppbv absolute difference for most conditions. They further demonstrate the utility of the instrument through a series of measurements at different locations on the Harvard campus in "personal monitoring mode".

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Discussion paper

The only significant comment is that this paper lacks a definitive statement of the instrument accuracy. Inter-comparison data are given, but there is no single statement of the accuracy of the instrument or the factors that determine it. Somewhere in the paper, perhaps after the comparison section and before the personal monitoring demonstrations, there should be paragraph that summarizes the estimates of accuracy and how it was determined. This information should also appear in the abstract.

Overall this is a short but solid paper. It will be of substantial interest to the readership of AMT. I recommend publication after attention to the comment above and the following minor comments.

Minor Comments:

Abstact, Line 15: “Good” agreement is not a well defined term. Abstract would be more useful if this were a number, e.g., agreement to with xx%.

Abstract, Line 17-19: Instrument precision (or LOD) is given, but accuracy is not stated. What is it?

Page1, Line 34: Not clear what is meant by “upwards of 15 and 40 ppbv”. At least for outdoor measurement, and I suspect for indoor measurement, these appear to by high levels that would be on the upper end of a distribution, though the phrasing does not make this very clear or quantitative. Is there a better number that represents and average, especially for the indoor environment?

Page 2, Line 6: Table 1 omits the cavity enhanced spectroscopy method of Washenfelder, AMT 9(1): p. 41-52 (2016) which reports a sensitivity and accuracy within the range of the other instruments.

Page 2, lines 8-9: It would be useful to the reader to translate the number to a set of actual T and RH conditions – e.g., what RH would 1500 ppmv correspond to at representative temperatures of say 25, 15 and 0 C?

Page 2, Line 33: What is the sample material for the Aeris cell? Does that material

show any effects toward adsorption / desorption or reaction with H2CO?

Page 3, line 10-11: Is the inlet system in figure 3 external to the package in Fig 1? This seems likely, and should be noted.

Page 3, line 12-13: The zero switch time is 15 s on / off, and the acquisition rate is 1 Hz. How much time is required to achieve stable operation after a switch? Some of the data must not be valid, limiting the actual time of measurement or duty cycle.

Page 3, line 14: Is there a quantitative measure of the scrubbing efficiency of the DNPH cartridge for H2CO? Even a limit (e.g., > xx.x%) would be useful to quote here if specified by the manufacturer or measured.

Page 3, line 29: Out of curiosity, is H2CO ever observed offgassing from new Teflon tubing, filters or their packaging?

Page 4, line 24: very minor comment, but "nearly 16$\pm$9%" does not make sense, in that the number and its uncertainty is given precisely, so the word "nearly" should be omitted.

Page 5, line 20: Are the differences between fit methods a statement of the instrument accuracy? Can this be the number quoted in the abstract?

Page 6, line 13: Is there any evidence for passivation of the Aeris sensor inlet or internal surfaces, or can the entire response time be attributed to the H2CO delivery system. See question above regarding Aeris sample cell material.

Page 6, line 21: Another very minor comment, but suggest remove "good" since the numbers given above speak quantitatively about the instrument accuracy.

Page 6, page 34-39: Do the authors know of any reason why the different fit methods should differ by 14%? This difference is larger than given above. Identifying the cause may help to address it. Is this number the one that should be used for instrument accuracy?

Page 7, line 24-26: While the statement is clearly correct, it is also somewhat of a throwaway. The sensor is not close to achieving the time resolution or precision for this application, but the “in its current state” implies this to be a future goal. Suggest omitting. At authors discretion.

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