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Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessing a low-cost methane sensor quantification system for use in complex rural and urban environments" *by* Ashley Collier-Oxandale et al.

Anonymous Referee #1

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This work presents a detailed analysis of the performance of one type of low cost metal-oxide sensor for methane detection. The study involved the deployment of multiple sensors both in the Colorado Front Range (for a period of ∼1 month) and in urban Los Angeles (for ∼2 months). These experiments were well designed within the constraints of larger studies, providing multiple opportunities for infield comparison of the sensors with established methane measurement technologies. The analysis presented provides a thorough comparison of several calibration strategies and possible explanations for the observed discrepancies. The authors show that the sensors are capable of providing useful information on spatial variability, whilst not overstating their capabilities. Overall I feel the paper is well written and a valuable contribution to the growing

body of work assessing the potential of low cost sensor technologies. I therefore recommend publication after the following minor comments have been addressed.

Minor comments:

1) It would be beneficial to the readers if the authors could provide more detail on how well the sensors agreed when they were co-located. Previous work (e.g. Jiao et al. 2016; Smith et al. 2017) has shown that variability between sensors can be significant. As Figs. 16 and 18 attribute observed differences between spatially distributed sensor signals to variations in methane concentrations at the different locations, an idea of the observed variability between co-located calibrated sensors would be useful. This could potentially be added as an extra panel to one or both of these figures?

2) As acknowledged by the authors, the analytical method used by the sensors in this study is sensitive to hydrocarbons other than just methane. As oil and gas operations co-emit a variety of hydrocarbons along with methane it is possible that the sensor response attributed to methane could instead be due to other hydrocarbons. Although the authors say that this will be covered in a future publication, I feel the issue does require some further discussion in this manuscript.

The authors state that the calibration parameters derived for the two study locations are significantly different, a problem well documented in the literature, but it would be useful to know which of the parameters in the equation show the most difference between the locations. Figure 6 shows that temperature and humidity observed in Los Angeles are within the range seen in Colorado, so one would expect the parameters associated with sensor response to these variables to be similar? It is likely that the hydrocarbons co-emitted with methane in Los Angeles and Colorado are different (geological basins often show characteristic hydrocarbon fingerprints). This would be visible as a difference in the parameters associated with the sensor sensitivity to methane if the sensor was responding more to the co-emitted hydrocarbons than the methane. The authors should comment further on this source of uncertainty.

3) I am not convinced by usefulness of the methane baseline filtering approach shown in Fig. 5 (A.P.). Removing data points that are below a known background methane would surely introduce a negative bias into the sensor data and unlike the other filters does not seem to be a test of the calibration model, but just a method of improving the agreement statistics. These signals below background levels could be indicative of other sensor dependencies not captured by the calibration model, (e.g. changing hydrocarbon mix (see comment 2) and thus contain useful information. I would suggest omitting this filter or providing more justification of why it is a valid approach.

Typographical errors:

Pg 15 line 12 “it is important explore” should read “it is important to explore” Pg 19 line 4 “temperate” should read temperature

References

Jiao W., et al.: Community Air Sensor Network (CAIRSENSE) project: evaluation of low-cost sensor performance in a suburban environment in the southeastern United States. Atmos. Meas. Tech., 9, 5281–5292, 2016.

Smith K. R., et al.: Clustering approaches to improve the performance of low cost air pollution sensors. Faraday Discuss., 200,621, 2017.

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