Review of Furuta et al. “Design and evaluation of a low-cost sensor node for near-background methane measurement”

This manuscript designed a low-cost methane detector through combining Figaro TGS2600 and TGS2611-E00, temperature and humidity sensing and evaluated its performance range 2-10 ppm for both indoor and outdoor by a high precision methane instrument. The impressiveness of this work is the process of baseline, language expressions and meticulous data processing such as consideration of time drift, resistance conversion, voltage control and so on.

There are three good attempts on the baseline. 1. The time factor is taken into account in the baseline. 2. The author considers TGS2600 as the baseline reference for TGS2611. This is a well attempt based on the assumption that TGS2600 is insensitive to low concentrations of methane. 3. The author divided the data into 10 groups to construct baselines and correlation functions respectively. The 10 groups improved the fitting regression results based on a group of baselines.

However, the time factor and the input of TGS2600 are not significant contribute the estimating of methane. A few conclusions in the manuscript require more robust evidence. Besides, the applicability of similar devices mentioned in this MS in different environments and the drive factor leading to the difference between predicted and measured methane need to be further addressed. Overall, I think this paper is clear and well structured. I recommend it be published after addressing below comments.

Specific comments:

1. Line 14: ‘moderate performance’ could be expressed more quantitatively.

2. Line 19-20: It seems that the lack of high-resolution data and low-cost network have few causations. In addition, could you provide some stronger evidence to support the lack of high-resolution data?

3. Line 75-76: Based on the previous experiments, it is a good idea to exclude the influence of environmental factors through the response difference between the two TGS sensors, thus enabling the monitoring of methane in low concentrations (1-10ppm). However, it is well known that TGS2600 is sensitive to hydrogen, ethanol, iso-butane, carbon monoxide (CO), methane, relative humidity (RH) and temperature, while TGS2611-E00 is only sensitive to methane, hydrogen, ethanol, RH and temperature owing to its additional filter covers. (see FIGARO TGS 2611-E00&2600 product information, the above factors are ranked in order of influence.).

   And therefore, does the effect of hydrogen, ethanol, isobutane, and CO be taken into account in evaluation of the application potential of the TGS2611-E00 in low concentration situation? Especially in the indoor food experiment room. The differences in principle caused by physical between the two sensors and the response characteristics of both two resistance should be presented here.

4. Line 115: In Fig 4B, where is the indoor sample gas inlet of CH_4 reference instrument? It may affect time delay.

5. Line 119: As mentioned above, TGS2600 is also responsible for hydrogen, ethanol, isobutane, and carbon monoxide, and therefore nearby sources of relevant gas emissions or its surrounding environment are needed to be additionally stated.

6. Line 122: Why these data are averaged at 10 mins scale rather other time scale? Is this a universal practice? or is it tested with some experiment then after 10 mins is selected? In addition, what do you means of 10 mins? Average all the data over 10 mins after then record a valid value?

7. Line 132: In the title of Sect 2.2.1, the author reports the situation of increasing background concentration, and how many ppm the concentration is it?

8. Line 134-135: A brief description of laboratory-generated gases with potential effects on resistance is needed.

9. Line 173: 'time parameter'. Is the time parameter taken for the fit calculated from the start time of the per interval? In fact, within a 10-day window, environmental factors do not increase or decrease linearly but time does. Adding the time factor is a good attempt, but what is the contribution or significance of adding this factor?

10. Line 182: Is '2.3 ppm' the optimal selection after lots of tests? Or was it chosen randomly by the author? It would be an important impact factor on fitting result.

11. Line 185: I have seen lots of fitting functions in Appendix B, but can you explain why log is used rather than others? Has any other research used a similar fitting formula before? Or is the log more appropriate after statistics? Some explanation is needed here.

12. Line 212: Authors report that a diurnal cycle during rainy week is caused by soil process, please provide some solid evidence for this diurnal cycle driven by temperature.

13. Line 277: Statistical indicators are recommended to be presented on the figure, and therefore looks more intuitive. In addition, the numbers of data on each sub-figure need to be represented. The first impression is that the numbers of data in ABCD is different from EFGH.

14. Line 281-283: 'Even with the additional sensor term, the accuracy of the regressions varies with time period, as can be seen in the coloring of Fig. 4. For example, the baseline at the beginning of the inside experiment in Fig. 4E has a worse fit than the baseline closer to the end of the experiment.'.

    In Figure 2-A2, from early Apr to the end May, in this period temperature and H_2O fluctuate over a wide range. While before 1 Apr, temperature and H_2O changes obviously smaller, especially temperature. When the author only used only one piecewise to fit the whole study period, and the fitting result will obviously be affected by the number of samples. The former months are about 3 times than the latter months. Thus, it can be expected that the fit will be significantly worse in April and May, i.e. bring greater RMSE. And the data prefer to attribute this result to its representative rather than time.

In addition, in both Figures 4A and 4B, even if the author uses piecewise fitting in 4B, it can be clearly seen that the RMSE of the yellow points in both 4A and 4B is larger than the RMSE of the green points. Compared Fig-2A to Fig-2B, temperature and H_2O in former months (Jan to Apr) also well show larger variation than latter months (after Apr) and therefore imply different possibility with author.

15. Line 293-295: I agree with baseline needs to be regression and is also a good experiment and perspectives. But the drive factor should be clarified.

16. Line 320: How about the averaged change speed of CH_4? Actually, I see lots of black point (high change speed points) on the red line.

17. Line 354-358: From Fig 2, the temperature and H_2O in outside vary great in a day. And from Fig 3 data also Line 368 of MS show that resistance is sensitive to temperature and H_2O. Why not have a try on constructing a fitting baseline by interval of temperature and H_2O? It might get more interested conclusion than a 10 days interval in the outside.

18. Line 361: How about the statistical indicators in per sub-figure? From Fig 7, the effect of piecewise fitting is significantly better than full fitting. The input of TGS2600 can be used to eliminate some predicted extreme outliers, but methane fitting results is not improved significant, especially at low concentrations.

    In Fig 4 data also show that a better resistance fit with the TGS2600 as baseline results with a resistance from 20 to 70. And it also just well confirms that the two TGS have similar changing characteristics potentially caused by temperature and H_2O. Based on the very weak methane fitting improvement performance after the input of TGS2600, the response of TGS2600 under low concentration conditions cannot be ruled out. Therefore, the input of TGS2600 is only more conducive to predicting the resistance of TGS2611, because their resistance changes in principle are relatively similar. Therefore, the experiment almost failed to achieve the purpose of improving methane retrieval by inputting TGS2600 to weaken the influence of other factors.

19. Line 371: Why not make the x and y axes change in the same range? This seems more intuitive.

20. Line 457, ‘we did not find TGS2600 to respond to methane in the studied 2 to 10 ppm range.’. If this MS aimed to conclude this, and it requires more stronger evidence.

21. Line 458-459: ‘We suggestion….’. As comment 20 mentioned above, the response of TGS2600 to methane is not excluded in this MS and is therefore not recommend appear in here.

22. Line 461-463: The indoor and outdoor conclusions obtained by the author are not fair. The temperature and water changes are very small in the indoor experiment, which is a relatively ideal condition compared to the outdoor experiment. This ideal condition can significantly reduce the uncertainty caused by diurnal water and temperature in the baseline fitting (see comment 14). Moreover, correlation analysis also shows that resistance is related to temperature and water intensity. This implies that such networks have high challenging at outdoor application.