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Atmospheric Measurement Techniques Discussions

Interactive comment on "Continuous methane concentration measurements at the Greenland Ice Sheet-atmosphere interface using a low-cost low-power metal oxide sensor system" *by* C. J. Jørgensen et al.

Anonymous Referee #2

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Review of manuscript amt-2019-468

General aspects:

This is a well-written and interesting study showing how low cost metal oxide semiconductor sensors (MOS) for methane (CH4) can be used to follow CH4 mixing ratios over time in Greenland glacier ice caves. Results convincingly indicate that MOS sensors can perform very well and this is promising for easier and less costly monitoring under such conditions (very stable temperature and relative humidity). These tests are

important and I congratulate the authors for their careful and interesting work.

The authors are asked to consider the specific comments below in the revision of the manuscript.

Specific comments (numbers refer to line numbers):

15. Please define CRDS in abstract. Some readers may not be familiar with cavity ring-down spectrometry.

19-20: What was MBE selected instead of MAE or RMSE? With MBE, positive and negative bias cancel out which is not desirable. Please consider using RMSE or MAE instead.

97-98. Is it really correct that the conductivity increase with gas concentration as indicated here? Does not the output voltage increase with CH4 mixing ratio due to increasing resistance at higher CH4 levels, which would mean reduced conductivity?

120. Eq.1: What is R0 in Figure 3? Is it equivalent to Rs? If so, please consider using consistent notation in both text, figures and tables.

139-148: Please here explain why the smoothing was needed. An explanation is given later in the text, but it would be good for understanding to provide the explanation here.

155-160 and elsewhere. At less stable conditions than in the ice cave studied here, it would be challenging to have zero gas and sample gas with the same water concentrations. Hence, correction to humidity seems needed. Please see doi.org/10.5194/bg-2019-499 for detailed analyses of ways to correct for humidity and temperature to derive more generally applicable calibration curves.

163-165- Unclear how the rather poor fit in Figure 6 between MOS and CRDS could be translated into the very close fit in Figure 7. Please clarify this in the manuscript.

163-174. Could the deviation between the lab and the field be due to any other factors?

239-240. This statement gives the impression that the MOS are accurate to 10 ppb level. Is this really correct? This is orders of magnitude better than others have found. The mean bias error is risky to use because negative and positive errors cancel out. Please consider using RMSE as indicator of MOS performance.

243-254. Would not field calibration also be an option as done here and suggested in doi.org/10.5194/bg-2019-499? Given the low temperature - what was the absolute humidity which is what influence sensors more than RH?

305-307. Some of this is addressed in doi.org/10.5194/bg-2019-499 which could be worth citing.

323-324. Please see previous comments regarding MBE vs RMSE.

484-485. Please clarify what FIgure 6 shows in relation to Figures 7 and 8. The offset between the sensor and CRDS data are much greater in Figure 6 than in Figure 7 and 8. Figure 6 looks more like what could be expected from theses sensors, while the fit versus the CDRS in Figure 7 and 8 is extremely close (looks fantastic and almost too good to be true, and it is hard to undestand how the calbration equatinos provided could correct all the offset in Figure). Hence, clarifying the differences between Figure 6 vs 7 and 8 seem very important for fully understanding the study and proper sensor use.

490-496. Legend of Figure 7 has many abbreviations. Please consider to define or spell them out to make it easier to understand the figure independently from the main text? Also it would be of great interest to readers to add humidity to the figure.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-468, 2019.