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Atmospheric Measurement Techniques Discussions

Interactive comment on "Performance of an open-path near infrared measurement system for measurements of CO_2 and CH_4 during extended field trials" *by* Nicholas M. Deutscher et al.

Anonymous Referee #1

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The authors present improvements and further characterization of an open-path NIR FTS system that was initially published (Griffith 2018). The improved system was operated over a 1.55 km path (one-way distance) with significantly improved precision compared to the initial system. The new system was characterized over several months in the field. Overall, the paper is well written and represents enough of an improvement in precision over the initial system that it is appropriate for AMT.

Specific Comments:

- Why was HITRAN 2008 used? How does the bias compare using 2016? What about using independently measured line strengths (e.g., Long et al, GRL, 2020,

doi:10.1029/2019GL086344)?

- What is the magnitude of the short-path correction? From Figure 2 it is apparent that the short-path + temperature effects combined are large, how much of this is attributable to the short-path correction? Related to this, how stable is the short-path spectrum? Did you, e.g., measure at the beginning and end of the campaign?

- Why was O2 not used to correct for pressure variations?

- The running mean of the well-mixed time series also removes potential sensor drift. Can you verify that the observed variability was indeed due to atmospheric variability and not drifting bias? Could you also add the Allan deviation plot?

- I didn't understand the argument for the SNR scaling with path length. If anything, I would think that turbulence should cause additional beam spreading and power loss. Could you explain that more? Do you know the size of the beam at the reflector array? If it is smaller than the array, could this explain it?

- There seem to be step changes in CO and N2O (near 2018-09 and 2018-10, respectively). Do you know what caused those?

- Did you correct the open-path measurements for water content?

- Do you see any difference in bias for the different path lengths?

- What is the expected sensitivity for CO and N2O with different reflectors?

Technical corrections:

- Lidar (DIAL and IPDA) should be added to the list of open path techniques. Probably this should be with TDLAS under a general heading of single-frequency laser techniques. In addition, the CLADS technique should be mentioned under this heading (e.g., Plant et al, Sensors, 2015 doi:10.3390/s150921315)

- The Queisser 2016 ref is DIAL, not DOAS.

- For the LIDAR refs, here is an IPDA system for CO2, CH4, and H2O: Wagner and Plusquellic, Appl Opt, 2016, doi:10.1364/AO.55.006292

- The Waxman 2017 ref should also be include in the frequency comb part of the introduction

- What was the size of the retro array?

- While similar to Griffith 2018, it would be nice to have the full spectrum shown here to provide clarity. It would also be nice to add the short-path spectrum to this figure.

- Could you label the direction towards potential sources on the polar CH4 plot?

- What averaging time was used for the precision numbers?

- Can you also add the O2 time series to Figure 5?

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