

Griffith et al present an open-path Fourier transform spectrometer operating in the near infrared with the ability to measure CO₂, CH₄, O₂, H₂O and HDO. Such a system has the potential to be useful for small-scale, continuous greenhouse gas observations. The measurements were performed nearly continuously for 4 months over a 3-km-round-trip path, which is large enough to compare with high-resolution atmospheric models, and reached sensitivities of 1-2 ppm for CO₂ and 40 ppb for CH₄ with 5-minute measurement times. The authors attempt to quantify the bias and potential systematic errors by comparing to a WMO-calibrated point sensor located at one end of the open path. Overall, the manuscript provides a useful characterization of the system; however, there are some modifications and additional details that I think should be addressed prior to publication.

Major Comments:

First, for the precision of the measurements, could the authors please provide an Allan deviation from a well-mixed time period? I find this much easier to understand than just listing the precision in words. Also, why was one-quarter of the peak-to-peak used to estimate the precision instead of taking the standard deviation? Finally, the I found the terminology for variability, precision, uncertainty, and repeatability to be a bit confusing because multiple terms were used interchangeably throughout the manuscript (for example, uncertainty, precision, and repeatability). For clarity, could the authors use a consistent set of terms? I suggest perhaps variability for a time series of data and precision for the final derived result (i.e., remove uncertainty and repeatability).

Could the authors provide some more details about the spectral analysis, specifically: How were the wet measurements converted to dry mole fraction? What polynomial order was used in each spectral region? Was any other filtering or rejection done (e.g., were spectra rejected for anything other than poor signal) or were other corrections applied (e.g., “ghosting” corrections)? Was the ILS measured at multiple times to check for any drift in the ILS?

The authors note an additional 1.6% O₂ bias beyond what is observed in TCCON? Since the authors are using the TCCON spectral database, it does not seem that this added bias would be due to line parameters. Do the authors have a suspected source for this added bias? Is the bias constant in time?

Have the authors tried fitting CO₂ in the 1.6 μm band to compare to the 2 μm region?

For CH₄, do the authors have an explanation for what causes the positive tail in the distribution for >6 m/s wind speeds? This would imply that the open-path measurement reads higher than the point sensor, which seems odd at high wind speeds.

There is significant structure in the residuals shown in Figure 4 that is not discussed in Section 2.3. Note 7 of Table 2 briefly discusses some fringing in the residuals, which should be covered in Section 2.3. There also seems to be other structure in the residuals such as low-frequency baseline wobble and maybe also structure at the lines. Have the authors looked at the residuals

in more detail? How stable are the residuals? What causes the additional structures (they look to be larger than the residuals seen by TCCON)?

Finally, have the authors performed any laboratory measurements, e.g., using a multipass cell, with the system to characterize the bias in that configuration? This would be a useful check to see how the open path compares to a controlled system.

Minor comments:

In the introduction, there is no mention of OP-TDLAS or LIDAR systems (e.g., DIAL or IPDA). It would be worthwhile to mention these other technologies and how they compare.

Page 7, line 15: I was under the impression that the WMO scale is not directly SI traceable. Could the authors please clarify where the SI traceability comes from?

Page 10, line 4: CH₄ needs subscript

Page 10, line 30: Typo in the units (cm⁻²)

Section 4.3: Have you tried over a longer path?

Table 1: The values given for the CO₂ spectral range do not agree between the wavenumber and micron columns (i.e., 4800 cm⁻¹ = 2.08 μm).

Table 2: in the δO₂ column, linestrengths row, what is the “()” for?

Fig 7: Perhaps zoom in vertically so that the majority of the time series can be seen more clearly. In addition, have the authors analyzed this data series for a diurnal cycle?