

In this work, Griffith et al. have deployed an open path near-IR FTS instrument to measure CO₂, CH₄, O₂, H₂O, and HDO over a 3 km round-trip path over the city of Heidelberg. These measurements were performed nearly continuously over the course of 4 months, and were compared against a WMO-calibrated in-situ point sensor instrument (also an FTS, though mid-IR) located at one end of the path. The authors are able to use an impressive 60% of the data that was collected over these four months. However, the authors find significant discrepancies between the measured O₂ concentrations and the known dry air mole fraction of O₂, as well as large differences between the CO₂ and CH₄ measured by the open-path FTS instrument and the point sensor FTS instrument. I have some comments that should be addressed prior to publication in AMT.

Major comments:

The authors collect multiple CO₂ bands in the spectrum shown in Figure 3, specifically a stronger band at 2.01 microns, a medium band at 2.06 microns, and a weaker band at 1.6 microns. The authors fit the first two bands, but not the one at 1.6 microns (~6250 cm⁻¹). Have they considered doing this and comparing the CO₂ retrieved between the two spectral regions?

The authors do not discuss the residuals observed in Figure 4. There are some fits at e.g. 7805 cm⁻¹ in the O₂ fit that look like imperfect Voigt fits, but the majority of residuals do not have this appearance. Do the authors have any ideas what causes these large residuals? Do the residuals change as a function of time of day, and could partially result from stray light?

The authors use O₂ simply as a “system check”. Could they use it to filter out spectra that have been influenced significantly by stray light (which then results in the large spikes observed in the O₂ time series in Figure 7)? Do the authors have an explanation for the additional 1.6% O₂ bias beyond what is observed by TCCON? If the extra 1.6% discrepancy is due to e.g. unidentified instrumental systematics, could the authors use the O₂ to correct the CO₂ and CH₄ data for the same issues and possibly get better agreement between the open path and point source measurements? The ability to retrieve O₂ is one of this instrument’s strengths compared to the frequency comb instrument and I think that the authors could capitalize on this strength more than they currently do.

Do the biases for CO₂ and CH₄ change if the authors use the same wind cutoff for “well mixed” conditions for both gases? They currently consider CO₂ to be well-mixed at wind speeds >6 m/s and CH₄ to be well-mixed at wind speeds >2 m/s.

I do not agree with the author’s assessment that the additional difference between the in-situ and corrected open path CO₂ is the result of local emissions. Based on where the City Center is marked in Figure 3, emissions from the city center would affect primarily the open path measurements with S or SE winds as mentioned and would thus bias the open path instrument high relative to the point sensor, not low. Additionally, if there were very local traffic sources from Berliner Strasse, that should be evident as narrow, sharp spikes in the point sensor data (or at the very minimum, the two are likely to agree during most of the night when traffic is presumably minimal and there is no stray light) and that does not seem to be observed in the data

in Figure 9. Both time series have similar shapes, but with an offset between the corrected open path data and the in situ data that does seem to drift with time.

Do the authors have any idea what is causing the large discrepancy between the open path and in situ CH₄ data? Is the power station a natural gas station that would be expected to leak CH₄? Are there other local sources of CH₄ that are not geographically evenly distributed and might come from the WSW?

Minor comments:

Page 4, lines 13-14: the 3000 spectra that were thrown out due to poor visibility and other weather-related phenomena is approximately 11% of the of the total number of spectra. Why were the other ~30% rejected?

Page 4, line 25: When was the point sensor last calibrated against the WMO-GAW standards? How often does this instrument need to be calibrated? Could drift or lineshape change in this instrument cause some of the offset between the open-path and point sensor instruments?

Page 7, line 12: How are the CO₂ and CH₄ corrected to dry air mole fraction?

Page 9, lines 1-2: It is not clear whether the 2.5% and 0.7% biases observed for CO₂ and CH₄ include the correction or not. Is the total CO₂ bias 5%?

Figure 2: Please label the launch/receive and retroreflector ends of the path, as well as the location of the point sensor and Berliner Strasse. Please add a North indicator or compass rose. Is there a dominant wind direction that can be added to the plot as well?

Figure 7: A zoom in on one of the spikes would be nice so the reader can see that they are indeed sharp and centered at ~6 pm local time.

Figure 11: A zoom in on a time period similar to Figure 9 would be nice.

Figure 12: y axis in a and x-axis in histogram should be changed to ppb.