

The work by Monteiro et al. presents data collected from the Permian Basin tower network, focused on CH<sub>4</sub>, but also for CO<sub>2</sub>, H<sub>2</sub>S, and CH<sub>4</sub> isotopes, based on *in situ* operations of high-precision CRDS instrumentation. The Permian Basin is most certainly a region of high interest in terms of understanding and quantifying CH<sub>4</sub> emissions from natural gas production, and the data presented here is a significant contribution to quantifying emissions in this region. I find that the manuscript in its current form is mostly clear and well-written in describing the technical aspects of the dataset, and only have relatively minor, technical corrections to suggest prior to publication.

One important issue I would point out is that the data filed ("monteiro-et-al-permian-basin-in-situ-tower-greenhouse-gas-data-2021.zip) do not seem to be accessible when I've tried downloading it from the link provided by the authors (the message I see is "Server Error", "401 - Unauthorized: Access is denied due to invalid credentials. You do not have permission to view this directory or page using the credentials that you supplied"). I trust that this error will be corrected by the authors.

Line 31. "2" in CO<sub>2</sub> should be subscripted.

Line 40. Another important "relatively diffuse, large-area, low-intensity" source of CH<sub>4</sub> worth mentioning may be leaks in residential/commercial natural gas consumption post metering (i.e. In pipes inside homes and buildings). See Wennberg et al. 2012 (10.1021/es301138y).

Figure 1. Could a zoomed-out map of the region be provided to orient the basin to the general region (e.g. A map large enough to show more of Texas)? Also, I was wondering about known well locations, which are shown later plot 7, perhaps add a line in the caption to suggest that well locations are shown in later plots?

Line 148. Note that, as far as I can tell, the sampling sequence for the two inlet heights (and lab observations, in the case of H<sub>2</sub>S?) have not been specified anywhere in the text. This information should be added somewhere, perhaps in section 3.1 (which might require a slight adjustment in the section title)?

Line 150. Can the authors clarify why different lengths of the Nafion dryers were used? I'm assuming this was to account for the different flow rates of the Picarro instruments?

Line 153. The regulator part# specified here (51-14 A-590) currently does not seem to adequately identify the regulator, as nothing under this part# comes up in my search. My guess is that the regulator referred to here is the Model 14 ([https://industry.airliquide.us/sites/activity\\_us/files/2015/10/08/nickel\\_plated\\_pressure\\_regulators\\_14.pdf](https://industry.airliquide.us/sites/activity_us/files/2015/10/08/nickel_plated_pressure_regulators_14.pdf)), or perhaps the Model 14A, a low-flow version of the Model 14 ([https://industry.airliquide.us/sites/activity\\_us/files/2015/10/09/low\\_flow\\_regulator\\_14a.pdf](https://industry.airliquide.us/sites/activity_us/files/2015/10/09/low_flow_regulator_14a.pdf)). Somewhat confusingly, Airgas (now another subsidiary of Air Liquide) apparently uses the part# Y12114C590-AL for the Model 14, although I've not seen this part# listed directly on an Airgas catalog/website. If my guess is correct, my suggestion is that you refer to them as Model 14 (or 14A?) regulators, and use the Air Liquide part# for them, where a web search turns up something useful.

Line 156. Just to clarify, the H<sub>2</sub>O correction referred to are those reported by the Picarro instrument, based on the factory default H<sub>2</sub>O correction factors, as opposed to those based on instrument-specific H<sub>2</sub>O correction factors and/or some H<sub>2</sub>O correction applied in post-processing, correct? The wording here seems a little vague, and could be clarified.

Line 163. Regarding the field calibration tanks, can the authors specify the size of the tanks, and their expected lifetime in the field? Also, how were the field tanks calibrated?

Figure 2. I will note that the sampling for multiple inlet heights are not shown in this figure. I've found that similar figures in Richardson et al. 2017 do show how the multiple inlets are configured, and suggest revising Figure 2 in a similar way.

Line 174. The residence times listed here seem long, especially for the G2132-i where the data interpretation may be significantly affected by a 45-70min delay. If there was a good reason for not having an additional air pump to reduce the residence times in the air lines, a common practice when long intake lines are used, then I feel the authors should state this reason. Otherwise, I think the authors should at least state that the delay due to the long residence time should be considered if performing time-matched analysis with other measurements and/or models.

Figures 5, 6: Please add subscripts to CO<sub>2</sub>, CH<sub>4</sub>, and H<sub>2</sub>S.

Line 300. Background determination is certainly a very subjective and difficult issue, and I do feel that a lengthy scientific discussion into the merits of the method presented by the authors is probably beyond the scope of this work, which focuses on presenting the data themselves.

However, since the authors discuss this baseline here, I do hope that the baseline values calculated with this method are made available in the dataset (again, my access was limited so I couldn't check this directly).

Figure 5 vs Figures 7,8. I'm having a somewhat difficult time reconciling the diurnal variability presented for CH<sub>4</sub> in Figure 5 vs the CH<sub>4</sub> pollution magnitudes shown in Figures 7 and 8. Just comparing figures 5(a) and 5(b), I would have thought that the enhancement magnitudes would be larger in summer since the background values (mostly from FORT?) are significantly lower in the summer months. Am I to assume that the large afternoon enhancements seen during the wintertime in Figure 8 are more sporadic in nature and not widespread/frequent enough to be a factor in Figure 5, or is there processing in Figure 5 to remove large outliers that the authors have not explained? Or perhaps, there's large standard deviations in the hourly means in Figure 5 that are not apparent when only looking at the mean? Perhaps some sentences that put the enhancements shown in Figure 8 in context with the overall observed trends would be helpful.

Line 354. Subscript missing in H<sub>2</sub>S.