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Interactive comment on "The Utah urban carbon dioxide (UUCON) and Uintah Basin greenhouse gas networks: Instrumentation, data and measurement uncertainty" *by* Ryan Bares et al.

Anonymous Referee #2

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This manuscript presents the data from the UUCON and Uintah basin GHG networks. The dataset is a valuable addition to the urban GHG research field, and the manuscript overall is well-written in describing the instrumentation and uncertainty analysis associated with this dataset.

I suggest minor revisions to address a few notable questions, namely:

– I feel that one of the most difficult aspects of an urban GHG monitoring network is the delicate balance between being in close to the emissions in the area but not "too close", as in being influenced by emissions in very close proximity to the measurement site that would be difficult to interpret from a modeling perspective. The authors actually

mention this "contamination" in Ln126, as one of the motivations to implement changes to the instrumentation that would better capture high-frequency variations. So, have the authors looked into whether local "contamination" can be identified in the dataset? I feel a flag that identifies periods of potential local "contamination" could be of great value to the potential user of the data, as such screening may require detailed knowledge of the site environement that only the authors could have. If not for this paper, perhaps another study could be done that delves deeper into this issue?

– I find it surprising that the Uptgt results presented in this study seem quite high compared to those from other networks, and also that Figures 10, 11 suggest signficiant variation and trends in this value. The authors do mention differences in instrumentation compared to other networks and influence from the environement where the instruments are operated in as possible explanations for these results, but I do wonder if a more thorough investigation is warranted to really understand this issue.

– Because the calbration/target tanks are dry and the air measurements are made "wet" (without any drying), it seems like uncertainties in the moisture correction would become a significant source of uncertainty in the air measurements, and this uncertainty would not be captured in Uptgt, Utgt. Do the authors have thoughts on this issue? Should some representation of the moisture correction uncertainty be presented to the users of the data?

– I'm a bit puzzled by the relatively poor performance of the LGR instruments compared to the older Licor instruments. Just out of curiosity, I downloaded the FRU station data (the worst instrument in terms of precision), looked at the numbers for a handful of individual cal runs, and the stdev's I see seem much closer to those of the Licor instruments than to the 1-sigma precisions for the LGR instruments reported in Table 3. I would like to ask that the authors check their calculations and make sure they can stand by the results and discussions presented in this study.

Minor comments below:

Ln23: Remove space in the doi link, e.g. ".org/ 10." -> ".org/10."

Ln37: I'm not sure that stating a flask network is "expensive to operate" is a sound scientific statement, I think most would agree that there are substantial costs to any type of measurement effort, and one might even argue that a flask network is a more affordable way to operate a dense, wide measurement network, if you are willing to sacrifice measurement frequency. I would suggest that the statement be removed.

Ln105: Authors should clarify the "These methods" referenced here.

Ln115: IGRA -> IRGA

Ln123: The change from a non-continuous 5-min collection to the 10-sec data collection requires a bit more explanation. My guess is that the 5L mixing buffer mentioned in Ln139 is essentially what the authors refer to here, with the assumption that the residence (mixing) time in the buffer is about 5 minutes? Perhaps the paragraphs here can be rearranged to make this point more coherent?

Ln159: Do the authors mean "NMP" instead of "UMP"? Can the authors clarify the diaphragm and pump head materials for the pump?

Ln162: Bev-A-Line OD/ID's?

Ln167: What is the material and approx. inner volume of the gas manifold? I assume this was addressed by the 90 sec flushing time, but did the authors worry about dead volumes in the manifold? Ditto for the LGR Multiport Input Unit mentioned in Ln263?

Ln179: How long do the calibration tanks last out in the field? What model regulators used?

Ln182: Perhaps "ID -99" can be removed here, as it is a bit confusing without context, and repeated in Ln 328.

Ln194: Can the authors clarify the "150L" capacity of the aluminum tanks? My guess is that the authors refer to the N150 style tanks, with 29.5L internal volume.

C3

Ln198: How was the ~5000 ppm CO_2 spike tank sourced? Is spiking for CH_4 done separately using an additional tank?

Ln199: Any special air conditions in which the compressors are operated? Any need for dilution to bring the concentrations down in the tanks, and if so how is this done?

Ln 203: Cause of assigment difference on the tanks? Misassignment or tank drift? Has previous data be updated to reflect the assignment change in the lab standards?

Ln216: Have the authors thought about calibrating CO_2 on the LGR as well?

Ln217: Subscript missing in "CO2"

Ln225: The authors should note that NOAA is actually working on extending the CO_2 scale to 600 ppm, see presentation from the last GGMT meeting in Switzerland: https://www.wmo.int/pages/prog/arep/gaw/documents/GGMT2017_T04_Hall.pdf

Ln241: Description of the internet stream that provides the network clock is missing. I presume this same internet connection is also used to send the data to the Univ of Utah data server?

LN250: I'm not sure exactly what the authors refer to with "off the shelf". I presume what the authors mean is that the LGR's were largely operated using peripherials from LGR and corrected using LGR's internal algorithms, such that the complete system was "off the shelf". However, I don't think it's fair to characterize the LGR anlyzer itself as more "off the shelf" than the Licor 6262's, I'm sure there are "off the shelf" ways to operate the Licor's as well. I suggest the authors clean up the message here. Also, can you clarify whether the LGR data is calibrated from the internal software, or instead worked up in post processing like the Licor data?

Ln260: Just to make sure, the same protocol of 3 cal gasess that range the actual atmospheric data, prepared in-house?

Ln273: Reword sentence to simply say it wasn't implemented.

Ln274: Can the authors clarify how much of the description in Section 3 apply both to the Li-6262's and the Lgr's, as opposed to only the Li-6262's?

Ln336: Can the authors discuss what checks are implemented in the "automated quality control scripts"?

Ln374: 22 hours, according to Verhulst et al. 2017

Ln395: I don't see blue circles in Figure 8d, but I do see gray circles with a blue line going through them. . .

Ln400: I suggest that the explanation of the yellow shaded region on this line be repeated on the captions for figure 9.

Ln401: "calibrated target tank mole fractions", I initially understood that to mean the concentrations assigned to the target tank from the central lab. Would it be a bit more clear to say "on-site assignment of the target tank"?

Ln402: Can you clarify the "third calibration tank"? Was it the tank with the highest concentration?

Ln402: Not sure why Figure 8d is referenced here?

Ln404: After the "third calibration tank" is re-installed, there is a brief jump in TGT RMSE. Is there an explanation for this? Also, there's a gap in the pTGT calculations at the same time, is there an explanation for this?

Ln407: Are the hourly datafiles with the Up-TGT estimates considered an additional data level, compared to discussions in section 3.4?

Ln429-430: This is an interesting observation. I think one important distinction to make here is that the two analyzers were operated with different peripherals, such that the comparison isn't completely apples-to-apples, per se. I'm also somewhat concerned that the LGR precisions are significantly worse than those suggested in LGR data sheets (100 sec 1-sigma precision for CO_2 0.05 ppm, CH_4 0.3 ppb). While I under-

stand that company data sheets are not to be trusted, I'm surprised that the LGR's show worse precision than the 20 year old Licor's! Have you tried directly replacing the Licor analyzer with the LGR? I understand that the temperature of the lab can have a significant effect on instrument performance, but I would have suspected that most of those effects would concern instrument drift, and that short-term precisions are relatively less affected, so I find the high Up values for the LGR surprising. Can the authors get into a bit more detail on what might be causing these findings?

Ln454: One thing that's clear is that Uptgt is generally higher than Utgt, at least based on eyeballing Figure 10. However, can you be sure that Utgt doesn't underestimate the data uncertainty, due to the fact that the 25hr sampling sequence doesn't fully capture the calibration uncertainties that happen at 3∼6hr intervals?

Please check subscripts for CO_2, CH_4 in the reference list.

Multiple Mitchell et al. 2018 references on list, should clarify in accordance with ESSD style guidelines.

Table 1: Lat/Lon's should specify N, W.

Figure 4: Can the authors clarify the tubing used in the gas connections in the main text?

Figure 7: "Check gas"? Why not "target" tank, just to be consistent?

Figure 9. I'm not sure what 9B is showing here. Also, is there some gray in the background of 9D, and what does that reflect?

Figures 10-11. I'm surprised that there is so much variation in Uptgt, especially for CH_4 where it seems like there are clear jumps (likely at cal tank changes) and long-term drift. Have the authors looked into the cause of these uncertainties? For example I wonder if the spikes in RMSE errors correlate with large spikes in the air concentrations, in which case one may suspect a leak or memory effect in the system?

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