Atmospheric
Measurement
Techniques
Discussions

Interactive comment on "UK greenhouse gas measurements at two new tall towers for aiding emissions verification" *by* Ann R. Stavert et al.

Anonymous Referee #2

Received and published: 7 August 2018

Journal: AMT

Title: UK greenhouse gas measurements at two new tall towers for aiding emissions verification

Author(s): Ann R. Stavert et al.

MS No.: amt-2018-140

MS Type: Research article

Special Issue: Greenhouse gAs Uk and Global Emissions (GAUGE) project (ACP/AMT inter-journal SI)

1. Does the paper address relevant scientific questions within the scope of AMT? Yes.

(see also 13. below)

2. Does the paper present novel concepts, ideas, tools, or data? Yes, valuable laboratory and field experiments/data.

3. Are substantial conclusions reached? Yes, but not for all parts of the paper (see also 13. below).

4. Are the scientific methods and assumptions valid and clearly outlined? Yes for methods – but the description of the work must be restructured and edited in order to improve clarity for the readers.

5. Are the results sufficient to support the interpretations and conclusions? Yes (for water / drying part).

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes – but I did not see anywhere the information from where the data is available.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes.

8. Does the title clearly reflect the contents of the paper? No (see 13. below)

9. Does the abstract provide a concise and complete summary? Yes

10. Is the overall presentation well-structured and clear? No – text too long, parts should be omitted.

11. Is the language fluent and precise? Not always.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Paper is too long and consists of several parts (description of

new measurement systems, emissions verification, errors related to drying of sample stream) of which the latter part is addressed in most detail and is in my opinion also the most interesting/relevant (and best fitting to the scope of AMT). In some parts, the discussion is difficult to follow. The authors should focus on the part related to water correction and keep the other parts to a minimum (just keep enough to support the drying part) or omit them.

14. Are the number and quality of references appropriate? Yes.

15. Is the amount and quality of supplementary material appropriate? Most parts that will be omitted, can find their place in Supplement.

General comments

The paper reports on the installations of GHG measurement systems at two new tall tower sites, describes their setups and their contribution to uncertainty reduction for UK CH4 emission estimates. In addition, the paper describes extensive tests and evaluates the impact of two different sample air drying strategies applied for CRDS instruments in the lab and installed at these two sites. From these subjects, I consider the latter the most relevant and best described in the paper. The text's length, the writing style and the text structure make it often difficult to follow the work and reasoning of the authors. This regarding, substantial improvements are necessary (i.e. shorten and restructure the text). Also, two of the three instruments measure carbon monoxide (CO) – why was this opportunity not used to evaluate the effects of drying / water corrections on the measurements of CO as well? The experiments and findings related to air drying strategies represent an important contribution to this field of research and should thus be accepted for publication after major corrections and only if the comments within this review are adequately and fully addressed.

Specific comments and technical corrections

Note on Technical corrections: in some cases, I have marked a word or formatting only

once, but make sure to apply the corrections throughout the text where relevant.

Page 1, Line 15 (1/15): "...were located...": I would rather go for "are located"

1/20: "by between" -> "by up to 20 %"

1/29: "..default factory.." it is well established that the default factory water correction is not to be used for the purposes described – this fact should be stated more clearly here.

2/17: write out the names of the gas molecules at first use.

3/3: need "While,"?

3/10: delete "recognised"

3/16: A dramatic reduction in the cost of these instruments could be debated. I suggest you keep only the next sentence, starting in line 17.

4/4: Please explain why dry zero air was chosen for the counter flow purge gas (instead of using the reflux method with sample air from the instrument's outlet). This is relevant because it is on one side true that the drying with dry (zero) air is more effective, but on the other side trace gas species gradients can influence the transition dynamics of these trace species across the Nafion membrane and thus the composition of the dried sample air as well. If I am not much mistaken, Nafion must be written as Nafion$^{®}$.

5/18: correct to: "m a.g.l."

6/2: it would be advantageous, if you stated at least once the serial numbers of the Picarro instruments used in your setups.

7/7: Please summarize here briefly the reason for discontinuing the Nafion drying. State the main arguments/problems that are thus avoided or minimized. If the reader jumps to Section 3.3.3 to find out about it s/he will have a hard time finding the explanation. Sentence in 7/12 is similarly ambiguous.

7/26: Note: Picarro analyzers are not calibrated for H2O measurements and often show different positive or negative values close to zero at third place behind the comma. For the sake of completeness of information, it would be informative to know what the zero was for water on all three Picarro instruments.

8/2: please add a short justification/explanation on how the criteria were decided on (particularly the thresholds for 1 min mean standard deviations).

8/11: I am not convinced by the nomenclature for gases; what do you mean with "close-to-ambient standard"? From the continuation of the text, I guess this is a "working tank" that helps you to account/correct for short-term drift? You should then use "standard gas" for what you now call "calibration gas".

8/17: "greatly increases the error" – what does this explicitly mean? How much? Better reformulate, drop "greatly" and, if possible, add facts-based estimates.

8/21: no "target gas" seems to be used – for the appropriate QC, this is required. There is a comment on this in Chapter 4. – but it would be helpful if the authors comment on how the absence of a target gas is influencing the current performance of the system (i.e. what is the impact on the uncertainties, etc.).

9/8: In Table 3, the pre- and post-site calibration values should be given (where applicable).

10/2: The statement "…with the mean absolute precision increasing (i.e. becoming less precise)" seems wrong to me.

10/22: the numbers for pressure and temperature are switched – correct.

12/15: 2.3 Results and discussion; 3.3 has the same name, which is confusing. A paper should have one Results/Discussion section.

13/19: What does "…green space…" refer to?

14/8-19: I can only second the comments by Anonymous Referee #1 on this subject.

14/23: I am reserved about calling a 3.5 years long data set as sufficient for calculating long-term trend curves.

15/2: put spaces between number and unit (e.g., 108 m).

17/25: you can safely drop "extremely low" without losing any information. What were the values for CO?

18:21: this would be an excellent place to state the maximum humidity of air in the cylinders.

19/3: typo in the flow range

19/14: analogously to I.D.; $\frac{1}{4}$" O.D.

19/17: please specify "polymeric plastic tubing" better and explain why it was necessary to include it (particularly as this introduces further possible "active" surfaces that can influence the performance of the system).

19/27: typo "2-5"

20/7: please be more explicit than "were monitored closely and regularly logged."

20/27: a flowmeter rather "monitors' than "ensures"

21/2: it would be helpful for the reader, if you added how this value translates to % H2O

21/7: please specify "stabilise".

21/16: I am not sure what you mean here – if we are talking about H2O < 0.0001 %, we go far below a dew point of 0 deg.C – please explain.

21/19: please clarify the frequency 1.5 Hz/data recording strategy here (as the Picarros record with 0.4 Hz).

22/7: you should number the equations

24/21: use "target gas"

25/14: wrong use of c.f. (cf) – use vs.

27/6: "WMO internal reproducibility"; also, decide what you want to use: internal reproducibility guidelines/requirements/bounds and use throughout the text consistently. Please also explain somewhere (best at first use) why you (correctly) aim for Internal reproducibility and not for the Recommended compatibility.

30/8: can you please explain in a bit more detail how you did this – and how you were able to estimate Nafion-related errors, since, to my knowledge, Reum et al. (2017) did not use one?

31/23: would you be able to discuss the role/importance of the trace gas species gradients between sample and counter flow gas? (see 4/4)

32/3: see 21/16

37: North and scale are missing.

38: all abbreviations used should be explained in the figure's caption

39: I presume "Hour of day" means local time? Better replace with "Hour (LT)". Was summer / winter time used as well?

41: see 14/8-19 comment regarding spikes

Figure S3: equations not legible