

# ***Interactive comment on “A measurement-based verification framework for UK greenhouse gas emissions: an overview of the Greenhouse gAs Uk and Global Emissions (GAUGE) project” by Paul I. Palmer et al.***

## **Anonymous Referee #1**

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### Overall comments:

This overview paper of the GAUGE project generally serves its purpose. We find that a lot of focus is put on describing the measurements and the global models, and as can be found below, I think some connection between the two might be nice to tie the two together, otherwise the paper is a bit disjointed. There is very little reference to how the models will use the measurements (and which measurements), which I think is needed to put some context onto both.

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Also, there are a lot of references to material in prep, not ideal but understandable given the overview nature of this manuscript.

Specifically:

L 89 No comma after “Although”

L183 - Should be mole fractions of Co<sub>2</sub> have a peak diurnal cycle of 10 ppm - these are not flux units.

L202 - please double check the flask information here - I am not sure, but I thought that MHD is part of the surface flask network which does not use PFP's (Hermes) but rather the Sherpa. But perhaps this is not the case for the C14 samples?

<http://www.hpd-online.com/air-samplers.php>

L205-210 - what about TAC, were those samples collected & measured the same way as MHD? If not, uncertainties in the differences might be larger?

L246-250 and Figure 3: This is a very nice looking figure, but it seems that one must account for inter-annual variability (in the global methane concentrations as well as local fluxes) when comparing two sites with different sampling time frames. Sites that sampled only in 2013-2014 (WAO) are compared directly presumably with averages from other sites over different time periods (GLA, 2014-2016?). Some sort of normalization must occur here, or restricting the comparisons to averages over a common time period - also it seems that some sites might have sampled more in different seasons than others (i.e. can you really compare an average diurnal cycle if one site sampled 3 summers and two winters vs. 2 summers and 3 winters)?

L290 - Figure 5 does not have (a), (b) indicated, but they are referred to here. I would recommend a little more discussion of how ship emissions were avoided or perhaps removed later in filtering. It seems unlikely that no ship exhaust was ever measured given the inlet is not at the bow?

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L341/Table 7 discussion: Do these numbers tell you anything about uncertainty in each measurement? As the authors state, clearly some vertical differences are to be expected but it seems that perhaps the time periods could be filtered based on conditions (higher winds, higher PBLs, etc) that one would expect there to be little vertical gradient so that an uncertainty could be determined from this comparison. Otherwise it seems that there was not much point to the comparison. (or at least perhaps it would give us an upper limit on the uncertainty or bias?).

L345 Wording awkward at the end - what is more sensitive to local fluxes?

L350. Perhaps details of the SenseAir NDIR sensor will be in another publication (although I don't see a citation here), but at least a model number would allow us to look up the specific sensor used here, as SenseAir makes several? Or is this something custom made for the ChemSonde? Certainly this method looks very promising. Is data only collected on the ascent? If both, then is there relatively good agreement between ascending and descending data from the same sensor? Are the sensors/payloads recovered or considered expendable?

L407: What kind of co2 sensor is on the UAV? (commercial or custom sensor)? Later CH4 is mentioned also from UAV.

L503: There are other good reasons to run more than one model than just to mitigate criticism! (Gives an idea of transport model uncertainty and spread of possible results, for one (as noted in L519)). This should probably be rephrased.

L515- Regarding the NAME model, this unlike the others is a dispersion model - this could be pointed out and identify what the underlying transport model is used with it.

L635 - the NAME model and inverse method is not given as much space as the global models here, so some questions remain - what is the domain of this inversion, presumably regional rather than global? Was the forward model evaluated as it was for the global models?

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For all the models it would be nice to see comparisons (of the forward runs perhaps) with the observations that are in the beginning of the text, assuming these observations are used in the inversions. Three figures are dedicated to evaluating the basic transport of the global models with comparisons to observations that are not part of GAUGE. It would be nice to link the two sections of this manuscript: the observations and the models in some fashion here, because it reads a bit disjointed.

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