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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 #2

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The manuscript "A measurement-based verification framework for UK greenhouse gas emissions: an overview of the Greenhouse gAs Uk and Global Emissions (GAUGE) project" by P. Palmer et al. presents the motivation, design and execution of a research project aimed at quantifying the UK budget of the major greenhouse gases (CO_2, CH_4 and N_2O) over the period 2013-2015. The paper describes on the one hand the measurement strategy, consisting of various types of observations, adapted for the project in order to achieve its goal of a sectorial GhG quantification. On the other hand it outlines the project's modelling strategy that should make use of the measurements to

estimate the magnitude, distribution and uncertainty of the UK GhG emissions.

Overall the manuscript is concise and well written. provides a nice overview of the GAUGE project and serves very well as an introductory paper to the special issue. However, this is exactly the main criticism: the paper does not mention at all that it belongs to the special issue nor that it actually stands as an introductory article for this special issue. Taken as a stand alone paper it is in fact rather weak on the science; it mentions different measurement strategies and different modelling approaches but it hardly provides any analysis of results but refers to dedicated papers for these results. This would be fine if the paper would be set in context to the special issue.

The paper would also benefit from a more in depth discussion in the concluding remarks especially with regard to providing advice to the community for planning and setting up future GhG monitoring and quantification systems, for instance, which measurements were helpful, which did not provide extra information, which modelling strategy seemed to be more successful and why etc.

Detailed comments: L 110: Lower posterior fluxes than prior fluxes doesn't mean that they are necessarily better or more correct. Is there a way to qualify this?

Section 2.2 North Sea Ferry: I am not sure about the nomenclature here, but I would not consider a ferry with a fixed route as a mobile platform. A mobile platform is a platform that can be moved to different places depending on external circumstances, which is not the case with a fixed ferry route.

L 304: 'flux inversion models' is often wrongly used as a term to refer to inverse modelling system solving for fluxes. These systems are inverting atmospheric concentrations and yielding fluxes as a result of the inversion. So better to use just 'inversion models' or 'inverse modelling system'.

L 495: Which sectors are described?

Ll 499/500: Do you also take into account model uncertainty, and how do you quantify

the model uncertainty?

L 571: Where do the boundary conditions come from?

Ll 531ff: I think you need to comment in the paper on the error you make when using anthropogenic CO_2 emissions from 2009 for the years beyond 2009. The same is true for the CH_4 emissions beyond 2010. How can climatological ocean fluxes cover a certain period?

Ll 562ff: You need to comment on the fairly large model spread and how this effects the quantification of the emissions in the inversion. It would also be helpful to provide the spread in relative units to better understand the differences in the spread between the three gases.

L 577: Do you mean Jan instead of July here?

Ll 589ff: You don't mention MOZART here, is there a specific reason for this?

Ll 598/599: I don't understand how these biases reflect errors in the prior emissions if you use the same prior for both models.

Ll 605/605: How do the different methods impact on the resulting posterior fluxes (in addition to the different forward models)?

Ll 618/619: Can you quantify this or provide a reference for this statement.

Ll 651ff: It would be nice if you could give an example of estimated fluxes here as well and not only refer to other papers in the special issue.

Ll 698ff: Is the coverage also too sparse for estimating CH_4 fluxes? I would imagine that it is not only a matter of higher spatial resolution but also depends on the revisit time to 'see' more cloud free scenes.

Fig 2: It seems to be not very useful to display one-minute mean values over 4 years, the individual values are not visible at all. Maybe aggregate the measurements to lower

temporal resolution or show a much shorter time period.

Fig 9 top panel: Where does the 'outlier' with a value of ∼23 ppm in the Jul observations at approximately 40 degrees come from?

Fig 11: The different lines in the time series plot for GOSAT are hardly visible.

Tab 8: This table doesn't convey much information and could be removed.

Tab 9: 'E' and 'L' stand for Eulerian and Lagrangian model type, please explain in the table caption.

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