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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying methane and nitrous oxide emissions from the UK using a dense monitoring network" *by* A. L. Ganesan et al.

Anonymous Referee #2

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Ganesan et al. present emission estimates for methane and nitrous oxide for the UK using a new, dense monitoring network of 4 or 3 stations respectively with continuous data at high time resolution. The data quality combined with model developments means that emission estimates are less uncertain than previously, and seasonality in N_2O emissions can be resolved. The paper is very well-written and presents interesting developments and guidance for the design of future networks, and certainly deserves publication in ACP. However, the discussion is somewhat weak in parts and should be extended for a more thorough consideration of the results. Comments and suggestions are presented below in the order in which they appear in the discussion paper.

Comments

- Abstract, P858 L1-8: These three sentences do not really belong in an abstract, but rather in the introduction.
- P858 L21: It would improve the readability to start a new paragraph here, between the discussion of emissions and the discussion of uncertainty.
- P859 L21: I find the wording of this sentence odd; perhaps 'N_2O has the highest emission uncertainty of all the gases in the inventory' or similar.
- P859 L24: Table 1 does show where the emission estimates for CH_4 come from in terms of citations but it does not show that anthropogenic sources dominate, as indicated here in the text. It would be useful to add to Tables 1 and 2, or as a new table, the total emission estimates for all these categories (natural and anthropogenic) for CH_4 and N_2O.
- P861 L21-P862 L15: The information here is quite hard to follow and would be easier to comprehend as a table, with columns (for example): CH_4 instrument, CH_4 measurement period, N_2O instrument and measurement period, sampling heights available and used, and altitude of each site.
- P862 L16-26: Why was two-hour averaging chosen? Did data analysis or a previous publication suggest no significant changes within this time, or is it rather a compromise for the amount of data that can feasibly be handled?
- P862 L24: The abbreviation SD is used several times in the paper and not defined. Although it is relatively common it should still be defined here at the first instance.
- P863 L5: Why were particles tracked for 30 days? Surely most particles would exit the UK domain and even the extended Europe domain long before 30 days.

- P869 Section 5: Should be titled 'Results and Discussion' as no separate discussion section is included. In addition it would improve readability if Section 5 were broken up into a few subsections, according to the different topics ie. total emissions, sectoral comparison, uncertainty...
- P869 L24: How much larger were the uncertainties? It would be interesting to know quantitatively how much difference the extra site makes to the total emission estimates.
- P871 L4-22: The discussion here is a little hypothetical and somewhat meaningless. It is clear that the prior disagrees regarding seasonality, as it is annually resolved, so no information can be found from the seasonal differences to the prior. It is also well-known from countless studies that fertilisation leads to N_2O emissions, and that factors such as fertiliser and climate affect agricultural N_2O emissions. It would be interesting to know if fertiliser is in fact applied earlier (ie. Spring) in eastern England than in central England (summer) in agreement with the posterior modelled seasonality in the emission distribution; or whether climate such as rainfall patterns may be able to explain the different seasonality between these regions in the posterior. This may provide new information on whether the seasonality seems dominated by fertiliser or climate for the modelled years in the UK.
- P871 L24: It is difficult to see if this is true from the referenced figures, as the uncertainties in the figures are relative to the median emissions. In fact it looks like emission uncertainty is lowest across Ireland and south-east England, and quite high around Mace Head and Tacolneston, but perhaps this is due to the magnitude of emissions as well. It may be useful to include a fourth panel to each figure showing the absolute uncertainty in the posterior emissions, or the uncertainty reduction relative to the prior uncertainty.
- P872 L24: Insert a line break and start a new paragraph before switching the

discussion from CH_4 to N_2O.

- P872 L24-27: The ratio between uncertainty at RGL and at TAC is $\sim$0.78 for CH_4, while for N_2O it is $\sim$0.80 (as far as I can tell from the figure). It is therefore not really true that the uncertainties are similar for N_2O and different for CH_4 at the two sites. I would say the uncertainty is higher at TAC for both gases. This may even suggest that it is model error rather than unresolved emission processes - opposite to what the authors propose at L26-27.
- P874 L16: The inclusion of isotope measurements was not discussed in this paper at all. It would of course be interesting to have a discussion of how much isotope measurements may improve results in the current set-up, although it may be beyond the scope of this paper. Otherwise, a paper showing that isotope measurements can improve modelling results should be cited (eg. Rigby et al. 2014?).
- Conclusions: Other changes mentioned throughout the results should be reflected in updated conclusions.
- Figure 1: I would find it useful to see the total emission distributions for CH_4 and N_2O, as well as the major sectoral emissions.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 857, 2015.