Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-963-AC3, 2017

Atmospheric Chemistry and Physics
Discussions
Open Access

Interactive comment on "Estimating the size of a methane emission point-source at different scales: from local to landscape" *by* Stuart N. Riddick et al.

Stuart N. Riddick et al.

sriddick@princeton.edu

Received and published: 12 May 2017

The reviewer has raised an interesting point, but we disagree as to its importance. Before going into detail, we think there are two options: (a) remove the NAME InTEM material and put it in a later paper which describes the method in more detail; and (b) leaving the material in with more explanation and context as to the message we are trying to make with that material. We strongly prefer the latter as there is a real need to start addressing the issue of the consistency of GHG emission estimates across scales which is currently lacking.

The first point we would like to clarify is that the calculation in NAME InTEM does subtract out a baseline before the emissions are estimated. The procedure for baseline estimation is summarised in section 3.2.2 with more information given in Sarah

Connors's thesis (now referenced) as well as in the Connors et al paper (in prep). In the inversion, NAME InTEM only calculates enhancements. The baseline values have been added back in to that figure.

The second point we are trying to make is that we are not trying to hide anything. While the data points are dense in that figure, they are much clearer in the accompanying time series showing the measurements and the calculated values. We have changed the order of those two figures in order to make the point more clearly. The figures could be redrawn, but it would take a few weeks.

Thirdly, we are not sure why this behaviour should be expected for a large-scale inversion model attempting to estimate point source emissions: (a) The different models give different weightings to the large peaks observed in the concentrations. The emissions calculated by WindTrax and the Gaussian Plume model use those peaks as their major source of information. The NAME InTEM approach, on the other hand, tends to give them low statistical weighting because (i) it is hard to model such small-scale signals in the regional inversion and (ii) the events occur most strongly at night when the meteorological description is poorer. (b) There is a large variability in emissions (as shown in several Figures) while NAME InTEM is producing an annual estimate. Further, the emissions are not normally distributed (see new Figure in Supplementary info).

The discrepancies shown in the figure are entirely consistent with these factors as the 'outliers' are nearly all occasions when the measurements are higher than the modelled values. The point of including the analysis in the paper (and it is not a major part) is to examine the consistency between the 3 approaches. We are not trying to exaggerate its importance, but we are trying to highlight its potential for (a) identification of point source emissions, and (b), in time, their quantification. On-going work is underway to improve baseline estimation and error analysis.

Finally, similar anomaly plots cannot be straightforwardly produced for the WindTrax and Gaussian Plume approaches because they solve for the emissions values which match the observations. (In terms of the 3rd point above, they use all the information contained in each peak studied.) We are therefore unclear as to why putting these back into concentrations is meaningful.

Text added to manuscript before P13 L17, i.e. as a new penultimate paragraph:

"Even though the annual emission estimate calculated using the InTEM inversion model is close to that calculated by the Gaussian Plume model, the uncertainty associated with the InTEM inversion estimate is large. Comparison of the measurements with the CH4 time series produced by NAME InTEM (Supplementary Material Section 2 Figures SM2.1 and SM2.2) shows the model to consistently underestimate the larger and sharper observed peaks. This arises as a result of the smaller weighting given to the peaks in the observed atmospheric concentrations in the NAME InTEM analysis (which uses all data) than in the WindTrax and Gaussian plume analyses which focus on these peaks. In particular, high peaks are underweighted because they are small scale features not easily delineated in the regional inversions and the boundary layer is harder to model accurately at night when the highest peaks tend to occur due to their containment within the shallow nocturnal boundary layer. The heteroscedasticity seen in Supplementary Material Section 2 Figure SM2.2 is therefore to be expected as NAME InTEM reproduces the lower values better than the high ones.

The inherent challenges in inversion modelling, such as assuming a constant monthly emission (Supplementary Material Section 2 Figure SM2.3) and the atmospheric variability at night which is poorly resolved by the model, result in the emission estimates calculated in this research having an uncertainty of $\pm$ 91%. This research is presented as an example of inversion modelling: a work in progress and, while the emission estimates are currently uncertain, the location of the emissions are well represented."

Please also note the supplement to this comment:

http://www.atmos-chem-phys-discuss.net/acp-2016-963/acp-2016-963-AC3-supplement.pdf

---

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-963, 2016.