

Interactive comment on “Development of CarbonTracker Europe-CH₄ – Part 1: system set-up and sensitivity analyses” by Aki Tsuruta et al.

Anonymous Referee #1

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The manuscript “Development of CarbonTracker Europe-CH₄ – Part 1: system set-up and sensitivity analyses” by A. Tsuruta et al. presents a sensitivity study of the resulting methane fluxes to the underlying assumptions of the atmospheric inversion system. The authors analyse seven different inversion system set ups (by varying EnKF ensemble size, length of assimilation window, prior flux fields, prior error covariance matrix, structure of the control vector and convection scheme in the transport model) with respect to the estimated fluxes and their posterior uncertainties over a period of five months (June to October 2007).

Unfortunately, the manuscript is not well written and would improve from English language editing. There are also inconsistencies and misunderstandings especially in the

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Introduction section; for example page 1, lines 31/32: which models are based on assimilation techniques? It is rather that in atmospheric transport inversions assimilation techniques are often employed to invert the transport. Another example just follows on page 2, line 1: the inversion method does not provide information on the emissions; it is rather the observations that provide information. I suggest the authors (some of the co-authors are native or close-to-native speakers and some are world-leading experts in inverse modelling) carefully go through the manuscript to improve the language and correct these misunderstandings of how transport inversions work.

The main problem of this manuscript, however, is its aim, as the authors state: 'The aim is to introduce the set-up and choices for an inversion system, which will be used in long term studies and presented in an accompanying paper.' Is this really sufficient for a publication in its own or could that have been merged into the accompanying paper that looks at long-term methane emissions and trends. And how much do we really learn from a sensitivity study covering a very short time period (5 months) with no interannual nor seasonal variability for an inversion aiming to analyse long-term emission fields and trends? On top of that the CTE-CH₄ system has essentially already been published elsewhere (see Tsuruta et al., 2015).

Here are a few suggestions to improve the manuscript:

- Why did the authors finally choose S1 and S5 for the long-term experiment in the accompanying paper? Based on the evaluation in this manuscript here there are not any indications to rule out any of the tested configurations. At least the authors do not provide any objective reasons.
- Is there anything the inverse modelling community can learn from the experiments here in general? Maybe the results of some of the experiments can be analysed in more depth such that the findings can be generalised?
- It would be illustrative to run some longer experiments to account for seasonal and interannual variability for some selected set-ups.

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- Although the title suggests that the inversion system focuses on Europe the analysis of the results in the manuscript does not. What is the effect of the zoom over Europe? And although you zoom over Europe you only distinguish between four regions.
- In Fig 4 plotting the relative differences in the uncertainty estimates would be much more illustrative.
- In Fig 5 the fit against the observations when transporting the posterior fluxes is not very impressive in this kind of plot. Maybe time series for some selected stations would illustrate the improvement much better.

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