Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-1151-RC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "High-resolution inversion of methane emissions in the Southeast US using SEAC^{4}RS aircraft observations of atmospheric methane: anthropogenic and wetland sources" *by* Jian-Xiong Sheng et al.

Anonymous Referee #1

Received and published: 19 January 2018

Summary/General comments: Sheng et al. present a high resolution inversion of SEAC4RS aircraft methane data to find optimal methane emissions in that region in that time frame. They find the new, gridded EPA inventory is consistent with their observations, while WETCHIMP methane emissions are found to be too high. This paper is well placed in ACP. Overall the paper is well written, clear, and adds to our understanding of methane emissions in the US. I have only a couple of concerns – once these are addressed I would encourage publication.

Major comments: I have two larger concerns: The definition of region: The region

studied is defined as the Southeast US and is illustrated in Figure 1. My problem is that the SEAC4RS data does not constrain emissions for this whole region. In fact, less than half the domain has a significant sensitivity (AK sensitivity) and thus is informed by the analysis. Important regions that have large fluxes in the prior inventories (fossil in TX, wetland in FL, GA, SC) are not constrained by the work but are included in the regional flux estimates. This should be corrected. At a minimum, the area defined should be compressed to not include large expanses with minimal surface sensitivity in the west. Even better, would be to use the AK sensitivity to filter only the domain where there is significant surface constraint. This could be illustrated in Figure 1, and that mask could be applied to the domain for flux estimation. This would be straightforward for the authors to do and would make the results more robust.

Transport error/60 ppb: I'm a little unclear on how 60 ppb was settled on as the observation-model error. Transport error could be significant, and I would like to see more discussion/explanation of how that is accounted for. If the 60 ppb is derived from the observationsâĂŤI wonder if it is more representative of atmospheric variability?

Minor comments: Page 1 Line 3: The % will be lower once accounting for the above comment.

Page 1 Line 11: It's not clear you can state your work is in contrast with national scale work. Not only is the work on different scales, it is for different years, and, more importantly, different times of year. This study is focused on only Aug-Sept, whereas other studies have used 1+ year of data. This needs to be made clearer throughout that the results are for Aug.-Sept. only.

Page 2 Line 9: Should indicate here at least once if Tg C or Tg CH4.

Page 2 Lines 15-20: This is not strictly accurate. Miller et al., 2013 did not rely on EDGAR, as a geostatistical approach was used. I would suggest changes phrasing here to correct this. (A side commentâĂŤthe Miller work did have little data in the Southeast so it was essentially unconstrained).

Page 4 Lines 5-6: I have some concerns about the way the flask data has been aggregated onto a grid here. It would be very helpful to see some continuous variables for the flights and where the flasks were sampled. This would enable the reader to assess if averaging the discrete flask samples is representative of 0.25 degree boxes, or if the samples are representative of smaller atmospheric features (such as plumes).

Page 4 Line 17: I'd like more on the 60 ppb.

Page 6 Lines 10-20. Care is needed here as mentioned before not all these studies relied to this level on EDGAR. Also, many of those studies were rather unsensitive to the SE, so they likely do not see the wetland emissions, as opposed to falsely attributing those emissions to anthropogenic sources. At the least, we cannot make the conclusion in lines 18-19.

Page 6 lines 29-31: these fractions will come down when accounting for region of sensitivity.

Page 6 line 7: Should specify this finding of regional consistency is for Aug.-Sept. only.

Figure 1: Zoom and add contours as described in major comment.

Figure 2: I struggle with the map figure as it is hard to interpret the methane concentration on a map like this where we don't know if it is when the mixing layer is deep or shallow or what the background value is on the given day. For example, are regions with blue and red adjacent indicative of high spatial variability or from different sampling?

Figure 5: Update when updating domain definition.

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