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Geoscientific Model Development Discussions
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Interactive comment on "Development of CarbonTracker Europe-CH_4 – Part 2: global methane emission estimates and their evaluation for 2000–2012" *by* Aki Tsuruta et al.

Anonymous Referee #1

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This paper presents the results of a study assimilating ground-based in-situ methane concentrations into the CarbonTracker Europe-CH4 model using an Ensemble Kalman filter. The authors compare the posterior model with independent observations, and discuss the differences between the prior and posterior fluxes.

In general I find the paper well-presented and worthy of publication after the following comments are addressed.

General comments

A lot of figures are relegated to the supplemental information, while I would prefer to see them in the main paper. I appreciate this can be a matter of preference, but I have

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Discussion paper

made the case for their promotion in my comments below.

In most of the figures/tables showing either the model run with posterior emissions, only the posterior values are plotted. I would like to see the priors on the figures as well, in order to assess the improvement made by assimilating the data.

Specific comments

Pg. 5, first paragraph: I found it a bit confusing throughout the paper that the modified Transcom regions and the regions to be optimized were both referred to solely as "regions".

Pg. 5, line 12-13: There is a discrepancy here with respect to the companion paper Tsuruta et al., 2016: that paper has a different number of regions optimized.

Pg. 5, line 16: What was the variance for the ice region?

Pg. 6, line 30: I believe that many of these observations are not available for the whole 2000-2012 time period and you might consider giving the date range in Table 2. Does the assimilation system show any effects of observations turning "off" and "on"?

Pg. 7, line 3: In the companion paper (Tsuruta et al., 2016) the minimum mdm is 7.5 ppb. Is this a difference in the approach between the two papers? I'd also suggest you include which category of observation has this value.

Pg. 9, second paragraph and Figure 3: I really cannot make most of these observations out on Figure 3 because of the large range of values used. In fact, I had to stare at the posterior differences for quite a long time before I was sure the three sub-figures were different. I suggest plotting the posterior panels with a different colour scale so the differences can be made out.

Pg. 9, third paragraph: A2007 and B2007 are used here (and throughout the paper), but I don't believe they are formally defined.

Pg. 10, third paragraph: I think you've missed a chance to draw some conclusions

about the model due to the fact that the agreement with TCCON tends to be better before the averaging kernels are applied. As noted in the paper, applying the kernels does make the comparison more valid, as the effects of the prior used in the TCCON analysis and the instruments' vertical sensitivity are taken into account. The fact that this makes the agreement worse could indicate that there's some compensating effect in the total column, which I think you can see by looking at the comparisons with IMECC in Figure 5.

Pg. 10, line 15-16: Why not show the prior?

Pg. 10, line 24-25: I'm not sure I understand what you're getting at here: why would missing spring observations in one year affect the trend over the study period?

Pg. 10, line 32: Can you not be sure that the data was not used by the inversion?

Pg. 11, line 1: I know observations are few and far between in Australia, but Cape Grim is in a much different environment than Wollongong! Wollongong is a hard site to model in general – see for example Fraser et al., 2011.

Pg. 11, line 6: I think this is a typo? Darwin is closer to the Equator than Wollongong.

Pg. 11, last paragraph: The text occasionally refers to Figure 8 when it should be Figure S3 and vice versa.

Pg. 12, line 31: Differences are also surely due to the different time periods studied.

Pg. 14, line 8: Fig. Sx? I think this figure was dropped from the submitted manuscript.

Pg. 15, line 28: Should this be a reference to Fig. 11?

Pg. 16, line 22: Should this be Fig. S4?

Pg. 19, line 15: Is there something missing after i.e.? I don't understand the reference to i here.

Pg. 22, line 7: I don't understand what is meant here by the extra degree of freedom.

Pg. 23, line 10: Here is an example of where I found the term “region” to be confusing, as I thought at first you were referring to the optimized regions here, where in most of your inversions only one of anthropogenic or biogenic emissions were optimized.

Figure 1: Please add a reference here to Table 6 for the names of the regions.

Figure 2: I find the colour scheme a little difficult – very hard to make out the green regions in amongst the lighter blue! You could also consider blocking out the modified Transcom regions with black lines.

Figure 3 (again): For the comparisons with the prior I assume it’s all *surface* observations that are used? (As opposed to TCCON etc. . .) Can you also plot the prior difference using only the assimilated observations? It would make it more straight-forward to assess the performance of the inversion.

Figure 4: Do the observations appear on the top panel? Can you also plot the differences between the observations and the prior and posterior (for XCH4 only)? You could consider adding a vertical line at 2007 in both panels.

Figure 5: I would use Figure S1 here since it shows the prior concentrations too. It would also be useful to give the prior RMSEs.

Figure 7: I would use Figure S2 here since you discuss many of the sites in that figure in the main paper. (And you don’t discuss Park Falls, but it appears here.) I’d also like to see the prior concentrations included.

Figure 8: Again, I’d suggest using Figure S3 here and showing all the regions in the main paper. And I’d include the priors on these figures too.

Figure 12: This figure is impossible for me to decipher. I’d replace this with the bottom panels from Figure S4. (Or even move S4 to the main paper and remove Asian temperate from Figure 11.)

Figure 13: Since you have the space, you could include Australia in the bottom right.

Tables 5 and 6: Please include the prior RMSEs as well.

Typographical comments

Throughout the manuscript, “North” and “South” should be capitalized when referring to the continents (e.g. “North America”) but not when referring to regions (e.g. “south Africa”).

Pg. 1, line 31: . . . and (b) the parametrization. . .” (remove “on”).

Pg. 2, line 31: . . .changes **in** emission sources. . .

Pg. 7, line 4: . . .20 times **mdm** because...

Pg. 9, line 4: . . .emissions and **if it** is actually. . .

Pg. 9, line 23: . . .change much **in** B2007. . .

Pg. 9, line 2: . . .Fig. 4 **are** calculated. . .

Pg. 19, line 19: . . .optimized in M1 **and** M3. . .

Pg. 19, line 32: . . .around the **coast** were not. . .

Pg. 22, line 12: . . .variation or **lack** of . . .

Pg. 22., line 31: . . .CTE-CH4 **differ** by the . . .

References

Tsuruta, A. et al.: Development of CarbonTracker Europe-CH4 –Part 1: system set-up and sensitivity analysis, 2016. (submitted to Geosci. Model Dev. Discuss.)

Fraser, A. et al.: The Australian methane budget: Interpreting surface and train-borne measurements using a chemistry transport model, J. Geophys. Res., 116, D20306, doi:10.1029/2011JD015964, 2011.

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