

Interactive comment on “Estimates of CO₂ fluxes over the City of Cape Town, South Africa, through Bayesian inverse modelling” by Alecia Nickless et al.

Anonymous Referee #2

Received and published: 20 October 2017

The manuscript by Nickless et al. describes a Bayesian inversion study over the city of Cape Town which aims to improve CO₂ flux estimates. Prior estimates for the biosphere fluxes are derived from a land surface model coupled to a regional climate model running at 1km resolution. Prior estimates of fossil fuel emissions are based on a comprehensive inventory analysis. Two monitoring sites were set up recently for this study, whereas the third monitoring site is an established site within the GAW network.

The inversion was able to reduce total flux uncertainties by up to over 90% at a grid cell level. Biosphere fluxes show the largest reduction in uncertainty, mainly due to larger prior uncertainties assigned. The authors conclude that the success of the inversion

C1

largely depends on the quality of the prior estimates for fossil fuel and biosphere fluxes. If they could provide smaller prior uncertainties for the biosphere fluxes then fossil fuel emissions could also be better constrained.

General comments:

Overall I think this work makes an important contribution and should therefore be of interest for readers of ACP. Atmospheric inversions over cities are challenging and I appreciate the amount of work that has gone into this study. However, I think the manuscript can still be improved. The results section for example contains (too) many details including figures and tables. This makes it really difficult for the reader to focus on the main findings. Sentences are sometimes overly long and therefore hard to understand. Figure quality could also be improved.

Specific comments:

Abstract:

- please consider rephrasing the sentence stretching from L6 to L11 on P1.
- information such as “interquartile range” should be removed from the abstract (P1: L15, L16, L17, L18)

Main text:

P5, L9: “CABLE was dynamically coupled to CCAM” I don’t know how many times I read this phrase in the manuscript. Please avoid repetitions.

P6, L19: surface source grid “point” ?

P10, L5-L23: you talk about the generation of sensitivity matrix H, but you also mention sensitivity matrix T, which is confusing

P11, L14-L16: I don’t understand this sentence. Please rephrase using shorter sentences.

C2

P11, L23: "For the network design ..." ? It is confusing that you refer to a network design here.

Figs.3+4: This figures need improvement. Please label the sub-plots. The information is provided in the caption, but it would be much easier to have it in the figure directly. The used colour scheme is probably not that helpful either.

Section 3.1: I found this section far too detailed. Maybe some of the content could be moved to the supplementary material?

Fig6: Please provide a legend for symbols and colours within the figure.

Fig7: Is there a reason why Oct12, Dec12, Jan13 are missing? I am not sure if the diurnal cycle for all months is required in the manuscript?

Table 2: Consider to move this table to supplementary material.

P34, L8-L9: NEE or NEP?

Figs. 9+10: Please provide a legend for symbols and colours within the figure.

Fig.12: Please label the sub-plots (i.e. north, east, south, west)

P42, L1-L3: Please rephrase this sentence.

Figs.13+14: Add labels and improve colour scheme.

Table 3: Is this level of detail really required in the manuscript?

P49: I have difficulties understanding the whole section on this page.

Figs. 15+16: I cant see the value of those figures. I don't think they are even referenced in the text?

Section 3.2.3: Can you please check the units? You refer to fluxes, but units are in ktCO₂.

Fig. 17: Please add a colour legend. Check units.

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Section 3.2.4: Units not consistent. I think, they are all fluxes.

Table 5: move to supplementary material?

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-604>, 2017.

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