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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A Bayesian inversion estimate of N₂O emissions for western and central Europe and the assessment of aggregation errors" *by* R. L. Thompson et al.

Anonymous Referee #3

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In this paper a thorough test is performed of a Bayesian inversion system based on the Lagrangian STILT model. All tests are performed at inversion of N2O fluxes using semi-continuous observations at one single station, the Ochsenkopf mountain observatory in the east of Germany. In the test realistic prior fluxes and synthetic data are used to examine the influence of different error sources and assumptions on error correlation structures in time and space in the Bayesian inversion framework. Finally the inversion system is tested with real observations for 2007, with rather promising results.

The article is in general well written, though lacking clarity in some parts, and to my opinion deserves publication in ACP after a few medium size modifications and quite

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some smaller ones. I will try not repeat the smaller modifications already mentioned by the other two reviewers that have scrutinized the paper also in the mean time.

It is quite unfortunate that the authors choose to limit the paper to the use of only one observing site. At least in the synthetic inversion the use of more potential sites could give interesting results on the improvements in error reductions possible for more extended networks, as these are now becoming available, at least in Europe. The paper that came out just after this paper from Corraza et al (2010) in this issue of ACPD is an example of a study where continuous observations of N2O from more stations are used. This paper should refer to this otherwise also fine paper.

I would like to see the inversion tests identifiers (A..D) come back in the text for easy reference.

A few of the synthetic experiments in this paper lead to conclusions that do not go beyond the general conclusions on limitations of Bayesian inversion systems and the influence of choices in error correlation structures, I would like to see more specific conclusions towards this specific case for inversion of N2O fluxes using one (!) receptor point and what this tells us for the direction to go to improve the inversion system and the observation (network).

26076-6: Please add the expected and target precision and accuracy of current measurements (and references)

26079-19: The choice of column height as 0.5*H is arbitrary and not motivated carefully, though this could have a large influence on the model results in less well mixed conditions. I assume a sensitivity analysis has been carried out in the past for STILT and/or similar models to which you can refer

26082-18: One could argue that the horizontal and spatial resolution needed depend on the actual variability of the fluxes. Here the choices are made based purely on pragmatic grounds, it is needed to discuss the optimal choice of the resolution. If these

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resolutions are not feasible in the current setup one could think of e.g. using a smaller domain.

26092-11: What was the reason for not using the continuous observations also available for Bialystok (Popa et al, 2010)?

26094-6: In W-Europe the influence of human activities like manure spreading and fertilizer application leads to huge peaks in emissions that are likely to dominate the atmospheric signal in the periods mentioned, especially connected to rain fall events. This would lead to a recommendation of using prior fluxes where these facors are taken into account to derive a more realistic prior flux field variation in time.

Minor comments/corrections:

Abstract

26074-7:The influence on the retrieval of. . .

-9: if→when

-10: delete: then, ensues→occurs

-21: is worrisome→can be reason for concern

26075-1: is slowing→ will slow down

-13: perturbed→enhanced

-25: the study by Corrazza (2010) should be inserted here now

26076-14: there can only ever be a→ there is only a

-14: sites→sites,

-27: 1→one

-27: it → it is

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26077-6: ensues→occurs/follows

-7: may best be utilized→may be utilized best

-9: but with→applied to

-13: the mountain→a mountain

-20: The→This

26079-8: chosen for→chosen to cover

-13: footprint→emission sensitivity under the instantaneous footprint (F(xi,yj,tm))

-14: footprint→ F

26080-5: I would mention here that background concentrations come from interpolated observed fields that will be explained later in the text.

-15: I would propose to rephrase to something like: We considered at the time of the setup of this experiment that...

-22: delete the word: very

26082-20: It is -> It can be

26086-2: has -> have

-23 30 days seems too long for temporal correlation length scale of boundary errors, and are propably be due to the 14 day averages used here

26087-1: were -> was

-17 allthough close to 1, the chi-square value is lower then one, even for this reference synthetic inversion, please indicate the possible reasons for the deviation and why we cannot reach a perfect inversion here

26088-5: has -> have

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26089-4: Rephrase to: The value of chi-square in the case when T=30 days and D=200 km is noteworthy, as it increases...

-8: which -> that

-19: for -> when

26090-16: 0.1 -> 0.1 ppb

26091-3: is that which.. -> is one that uses observations with the highest resolution.

-13 is alone not ... -> is by itself not always sufficient

26094-19: rephrase: that not accounting for temporal aggregation of fluxes...

Table 3 caption: explain how the parameters have been calculated

Table 4 caption: add units

Figure 6: Differences between obs, prior and posterioir are not clear from these plots, please add scatter plots

Figure 7: for clarity please plot country borders on bluish plots in more contrasting color (e.g. white)

References

Corazza, M., Bergamaschi, P., Vermeulen, A. T., Aalto, T., Haszpra, L., Meinhardt, F., O'Doherty, S., Thompson, R., Moncrieff, J., Popa, E., Steinbacher, M., Jordan, A., Dlugokencky, E., Brühl, C., Krol, M., and Dentener, F.: Inverse modelling of European N2O emissions: assimilating observations from different networks, Atmos. Chem. Phys. Discuss., 10, 26319-26359, doi:10.5194/acpd-10-26319-2010, 2010

Popa, M. E., Gloor, M., Manning, A. C., Jordan, A., Schultz, U., Haensel, F., Seifert, T., and Heimann, M.: Measurements of greenhouse gases and related tracers at Bialystok tall tower station in Poland, Atmos. Meas. Tech., 3, 407-427, doi:10.5194/amt-3-407-2010, 2010

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