

Interactive comment on “FLEXINVERT: an atmospheric Bayesian inversion framework for determining surface fluxes of trace species using an optimized grid” by R. L. Thompson and A. Stohl

Anonymous Referee #2

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General Comment

I think that the work and method described are good. It could be a very useful tool for people to use in understanding emissions. The key point is that many assumptions are required to be made and the user needs to understand what they are before this tool is used.

Specific Comments

p.3756 l.4: This is only true if the original LPDM run is on a fine enough resolution and large enough domain to meet all needs and also not if applied to gases with different loss processes - unless all particle info retained.

C1181

p.3757 Eq2: I do not like the notation H_{bg}. It has different units to H_{nest} and H_{out}.

p.3758 Eq3: time/density has units time x volume / mass not time/volume as stated. What am I missing? Please clarify.

p.3759 l.7: I assume that n_i trajectories terminate in the grid cell? Please re-word to make clearer.

p.3759 l.22: Only works if site 'sees' background air 25% of the time. This part ignores the influence of latitude / altitude that is actually known. The next part also assumes that the prior is correct and the site not too polluted. It was unclear to me how the time-series from lower quartile obs - (prior x SRR) was combined with just the time-series of (prior x SRR)? Are these steps sequential or exclusive?

p.3761 l.2: Helpful to add a comment that =0 as each fine grid can only be in one coarse grid.

p.3762 l.2: Change 'row' to 'rows'.

p.3762 l.11: I assume that a measurement can have contributions from several latitudinal bands rather than just one as stated here, it is contradicted in the next paragraph, please clarify and re-word.

P.3761-2, Eq 5 and 9: I would suggest the use of the word 'and' rather than commas

p.3763 l.8: Please either use 'modelled' or 'modeled' throughout or whatever the journal requires, both are used at the moment.

p.3763 l.8: It does not need to stay within the bounds does it? Are they not expressed as standard deviation uncertainties and therefore have tails? What bounds are being described here?

p.3763 l.21: Out of interest, why if M»N is it easier to invert MxM matrix? I am obviously missing something but it struck me as odd.

C1182

p.3763 l.24: 'The' rather than 'This'

p.3764 l.20: What happens if the uncertainty of the prior flux is provided? Is this method still imposed?

p.3766 l.8: I suspect that the errors in the meteorology e.g. Boundary Layer etc, will be much larger than stochastic uncertainty. So uncertainty will be under-estimated. Obviously not much can be done but a sentence describing this would be helpful.

p.3766 l.20: Is the 'minimum error' user defined, please state.

p.3767 Sect 2.8: Not sure this is a good idea to retain within the paper. I would suggest just removing this section, it seems rather unfinished work.

p.3768 Sect 2.9: 'error-free observations' - this needs more discussion. What does it mean for the results? What assumptions are being made? Are the uncertainties being affected?

p.3769 l.5: Why is the reaction with OH a good reason to choose CH₄? Was it because it has a linear loss process?

p.3769 l.12: Suggest replacing 'and largely wetlands and' with 'principally wetlands'

p.3769 l.25: Suggest replacing 'quite' with 'very'

p.3768 Sect 3.1.1: No mention of release height for mountain stations, agl or asl and a sentence to describe the issue here.

p.3769: It would appear that LMP and CIB have the same impact as in-situ sites, were the different number of observations per site not used in calculating Fig 2a? I suggest this is important.

p.3770 l.28: Add except high altitude sites to be consistent with p.3774 l.3.

p.3770 l.28: Boundary layer averages?

p.3770 l.20: 'closest available' - I assume you mean 3-hr map that encompasses the C1183

observation?

p.3770 l.22: It would appear that the in-situ obs are given greater uncertainty as they also have a representation error (variability error maybe better term). In fact the opposite is true, the flask data is only one point so nothing is known about the variability. This therefore should be higher than the in-situ data.

p.3771 l.17: Therefore some observations are used twice - please state this and comment on the possible effect.

p.3771 l.25: It was interesting to note that uncertainty in background was though more certain than measurement error - I would think the opposite?

p.3772 l.25: Highlights that considerable care is required. Is this an issue with the prior or poor modelling of MHD? Prior has a dominate effect and the uncertainty in the prior is not propagated.

p.3773 l.11: Suggest removing 'slightly'

p.3774 l.25: Link this to discussion on other mountain sites used in the inversion JFJ and CMN etc as mentioned earlier.

p.3775 l.15: Relevant observations e.g. Cabauw used in Bergamaschi work which would have a dominate effect in Benelux.

I could not find some of the references that are listed in the actual paper, probably missed some e.g. Etiope, Houweling, Lambert and Sanderson.

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