

Interactive comment on “Weak-constraint inverse modeling using HYSPLIT Lagrangian dispersion model and Cross Appalachian Tracer Experiment (CAPTEX) observations – Effect of including model uncertainties on source term estimation” by Tianfeng Chai et al.

Anonymous Referee #1

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The manuscript addresses an inverse modelling study using CAPTEX data in which the effect of including model uncertainties is analyzed in the frame of source term estimation. The manuscript is well written, however, the potential contribution of the study is not clear. The study is focused on highlighting two major points: (i) advantage in using differences of logarithm of concentrations in source estimation and (ii) improvement in source estimation using a hypothetical form of observation and model uncertainty. This is not new and already established in the literature of parametric estimation prob-

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lems and in the solution of inverse problems. Based on result and discussion, the study seems another application of source term estimation with sensitivity to their hypothetical model uncertainty formulation but there is no development in view of model, methodology or estimation. Following are my comments:

Major comments:

1. A major question is regarding the hypothetical form of the error formulation?. It is not clarified why this particular form is chosen?. Also, what is the evidence or guarantee that the same formulation with observed coefficients would work in other or similar source term estimation problems?.
2. The Authors did not explain well if their inverse problem is over-determined or under-determined. By noting their discretized grid and number of measurements, it seems an over-determined problem, If so, why do you need a smoothing constraint?.
3. Authors did not explain why the using concentration difference and logarithmic concentration difference results so differently for the estimation of release rate. How could be the difference is so drastic between table 2 and table 3.
4. It is not clear how cost function normalization can avoid spurious solutions in logarithm concentration difference?. Does this spuriousness appear while using only concentration differences?.
5. What is the utility of introducing the third part of the equation 1 if coefficient c_{sm} is always put to zero?.
6. The coefficients a_0 , f_0 or a_h , f_h are chosen arbitrary, there is no justification why a particular set has been chosen?.
7. In Figure 2, the scale of observations and model concentration is not clear? Is it correct? What are the range of observed and modelled concentrations?.
8. Adding the model uncertainties to ϵ_m are simply an increase of magnitude in the previously chosen quadratic function based on observed concentration. Did you try by increasing only the values of f_0 or a_0 to analyze the same kind of effect?.
9. Page 9, line 30, Another aspectas the metric variable. What does it mean that range of release estimates are not as large as those using concentration variable?.
10. What about uncertainties in the source parameters due to varying nature of model or observation uncertainties. Is it possible to compute it with given procedure?.

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