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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Bayesian inverse modeling of the atmospheric transport and emissions of a controlled tracer release from a nuclear power plant" *by* Donald D. Lucas et al.

Anonymous Referee #2

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This paper evaluates an inversion method using Regression Trees to estimate the strength and location of a tracer release. The method uses measurements from 125 sites around a release site during a field campaign and estimates both the uncertainty in the release parameters and the optimal WRF parameters for the meteorological simulation. The paper is thorough and well described and appropriate for ACP.

Major Comments:

I think it would be of interest to perform a synthetic run using the actual release parameters. In this way, the model could identify the uncertainty due to the simulations alone, which would be of great interest.

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Discussion paper

I would like to see a table for the synthetic test and the actual test, showing the true parameters and the model estimates. I know that this is already shown graphically in Figures 10 and 11, but a table of actual numbers would help.

I am concerned that for some parameters (esp. release height), the inversion range (Table 2) is too narrow. In Figs 10 & 11, some of the histograms continue up to the limit, and hence the results could be due to the input range rather than the inversion itself. I think that an expanded range should have been used – if this is still possible, it would be good to update the paper.

It would be very interesting to see the sensitivity to the model resolution. Maybe a future study could add as a parameter the number of domains used by WRF-FLEXPART. This would show how much is gained by performing a 300m resolution WRF simulation.

Were any sensitivity tests performed with the number of observations? There are few studies that have 125 measurement sites – this dataset could be used to identify how many stations are needed and what their optimal placement is.

Would it be possible to add a pair of scatter plots: one with the optimal parameters and one with an ordinary configuration (given that there is no a priori best guess that is different from the actual source parameters). How well does the model perform overall? How much improvement can be gained by adjusting WRF parameters and how much by adjusting the source parameters? This would be a supplementary angle on the question being addressed in Fig 8.

Minor Comments:

Abstract: I would recommend expanding the description of the WRF results in the abstract since determining the optimal set-up based on measurements is of great interest. In the abstract, I would also recommend providing some context for the accuracy of the estimate – number of stations and average distance. Without that, it is not possible to interpret the significance of the errors in the estimated source parameters.

Fig 1 caption: “used to improve the differences between simulations and observations.” I think this could be rephrased. In fact, the whole caption could be improved.

I’m not sure that I could understand the discussion of the feature scores based on the explanation provided. A few more details would be welcome.

There are examples of boosted regression trees in atmospheric sciences, eg. Sayegh et al., and references therein. I think it would be good to relate the present study to some of those. There are also other studies using FLEXPART for source inversions. I would recommend adding a couple to the introduction and explaining the relationship to the present study.

Sayegh, A., Tate, J. E., & Ropkins, K. (2016). Understanding how roadside concentrations of NOx are influenced by the background levels, traffic density, and meteorological conditions using Boosted Regression Trees. Atmospheric Environment, 127, 163-175.

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