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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 #1

Received and published: 22 May 2017

1 Overview:

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

Lucas *et al.* present a comprehensive analysis of a novel inverse methodology for estimating the spatio-temporal location of a trace gas source. Their methodology is evaluated with a controlled release experiment. They are able to estimate the location of the controlled release with impressive spatio-temporal accuracy (their most likely results are within 200 meters of the known location, the release time is within 5 minutes, and the release duration is within 50 minutes). This is particularly impressive given

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the complex topography of the region. This is an excellent manuscript. It is well written, uses state-of-the-art inversion techniques, and the figures are high quality. This manuscript should be published in ACP. The only comments I have are, seemingly, minor.

2 Minor comments:

2.1 Using MSE and CORR?

What is the advantage of using a bulk metric like MSE and CORR, why not use the measured concentrations? It seems that the problem is traditionally framed as the difference between modeled and measured tracer concentrations (the "model-data mismatch"). By moving away from that they instead have to specify a set of metrics to use. It seems to work quite well and I'm somewhat curious as to why.

2.2 FDDA not useful in this case?

It seems counter-intuitive that the FDDA would not be a preferred option in the inversion. This option *should* be incorporating more data and, as such, one would anticipate a better solution. Could the authors comment on this a bit more? For example, could this have to do with the complex terrain (maybe the FDDA doesn't help because it's only impacting some broader-scale flow)? Is using FDDA just adding computational expense that doesn't actually benefit us much at these fine spatial scales?

2.3 Could do an inversion using real release parameters to provide information on WRF-FLEXPART modeling error?

It seems that the authors could also use these same experiments to provide to useful information on the WRF-FLEXPART modeling error and the optimal setup. The authors could do an inversion where they use the known tracer release parameters and just invert for the WRF-FLEXPART setup. Would this give the same setup that was chosen in their current manuscript? Is FDDA still not the optimal setup?

This seems like it should be fairly straight forward to do with their setup and it could be quite useful for the broader community.

3 Specific comments:

Latin hypercube sampling: I'm not familiar with this sampling method, what was the motivation for using this one? Is it particularly well-suited to this problem?

Figure captions: Some of the figure captions could use a little more labeling. For example, Fig. 3 doesn't say what the coloring indicates (presumably it's showing elevation).

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