Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2018-6-RC2, 2018
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Interactive comment on "Optimization of an Urban Monitoring Network for Retrieving an Unknown Point Source Emission" *by* Hamza Kouichi et al.

Anonymous Referee #2

Received and published: 4 April 2018

In this paper, the authors formulate a simulated annealing algorithm with a renormalization inversion algorithm coupled to a CDF flow and dispersion model and apply it to the Mock Urban Setting Test (MUST) tracer field experiment (which simulates an 'urban-like' environment). The aim of the work is to demonstrate how the inversion technique presented can be useful in optimally placing a smaller number of concentration samplers for quantifying a continuous point source with almost the same level of source detection ability as the original larger number of samplers.

The paper is well written, but in my opinion requires a major revision. My comments are as follows:

Main comments:

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Discussion paper

1) The MUST experiments took place under neutral to stable and strongly stable conditions. However, the CFD model used is for neutral conditions and does not include the effects of atmospheric stability over the urban area (the only stability effects included are through the specification of inflow boundary conditions). Atmospheric stability has a profound impact on dispersion and would thus influence the adjoint functions. The authors should discuss the consequences of its neglect on the results and the errors it introduces.

2) I have reservations about the usefulness of the methodology presented in real-world urban environments. The title of the paper states 'urban monitoring network' but there are no real urban configurations used. The MUST experimental domain was only 200 m x 200 m (with buildings represented by a grid of containers) which cannot quite represent an urban area in terms of scale, meteorological variability, or non-uniform terrain or roughness/canopy structure. So in a way the present study does not explore any aspects that are specific to urban environments. The authors should discuss this, particularly how their methodology could be applied and its limitations in real-world urban cases. Following on, the title of the paper should say 'urban-like' or something similar instead of 'urban'.

3) There were a total of 40 concentration samplers. In their optimisation, the authors arbitrarily fixed the number of samplers to 13 and 10 and then determined the optimum positions of these reduced number of samplers from the original 40 samplers. A better question to answer would have been "what is the minimum number of samplers required and what their positions are in order to quantify the source with a given degree of confidence or accuracy?"

The present optimisation is based on fixed meteorological conditions in a trial. In a real situation, the network design would also depend on diurnal and spatial variability in meteorological conditions (e.g. wind direction) which may increase or decrease the optimum number of sites. This, however, is not in the scope of the present study. Perhaps as a future study, the authors may consider using data from full scale field

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measurements such as Salt Lake City Urban 2000 experiment.

4) Dense gas effects are included. How are they taken into account (or inverted) in the backward (i.e. retro plume) dispersion calculation for adjoint functions?

5) What is the uncertainty in the source estimation results in Table 2? Is the approach capable of providing uncertainty estimates (like the Bayesian one)?

6) How does the uncertainty in the results in Table 2 change as the number of samplers is changed? Have you included model and measurement uncertainties in the methodology?

7) Section 2.3: Is there a sensitivity of the source estimation / optimisation to how the weight function is selected? Could there be any other choices of the weight function?

8) Did you specify any a priori bounds on the estimated source position and source emission rate? If yes, what were they?

9) What is the advantage of the present technique compared to, say, the Bayesian approach which also provides probability associated with the solution?

10) Page 3, line 15: 'The Gaussian models are unable to capture. . .' While this may be generally true, a well formulated Gaussian plume model can describe idealised urban dispersion (e.g. Huq and Franzese, BLM, 147, 102-121, 2013).

11) Section 5: Was the CFD model validated using the MUST data for its ability to simulate the measured concentrations?

12) Source position was calculated. Does it include the source height too? Was source height a free parameter or a fixed one?

Other comments

13) Page 2, line 14: What is 'an NP-hard problem'?

14) Page 2, line 35: 'probabilities' should be 'probability'.

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15) Page 3, line 8: ‘required’ should be ‘require’.

16) Page 3, line 10: ‘the continuous’ should be ‘continuous’.

17) Page 3, line 23: ‘was’ should be ‘is’.

18) Is the optimisation methodology presented only valid for a single source?

19) Page 7, line 3: The term temperature should be put in quotes as this is not a real temperature in the present context.

20) Page 9, line 2: ‘stopped’ should be ‘is stopped’.

21) Figures 1 and 3: Why some of the 40 samplers locations do not coincide in these figures?

22) Is the code for simulated annealing algorithm with the renormalization inversion technique available?

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