Response to the Reviewer #1

The idea of the paper is to achieve the best result with as less as possible information. This idea is very innovative and I support any new effort. The application is the atmospheric dispersion in urban areas. The goal is to find the source when we know the flow field and the real concentration measurements.

I have one major comment/question.

When authors try to validate this approach they compare results of source inversion (distance to true source etc) with 'optimal network' of 10 sensors with the results obtained by the full network (40 sensors). Why don't they directly compare results of 'optimal' network of 10 sensors with the results of other networks of 10 sensors? Of course, there are too many of such networks. But by application of the combination same procedure as we did in Kovalets et al (2011) and Efthimiou et al (2017) they at least could prove that their 'optimal network' yields the results within say best 5 or 10% of the results that could be achieved with 10 sensors.

Reply: *We would like to thank Dr. Efthimiou for the positive feedback and we appreciate his comments/questions. We have carefully considered his comments and worked to include them in a revised version of the manuscript according to the proposed suggestions.*

Dr. Efthimiou's above comment can be complied into two following comments and please find below the responses to these as follows:

Comment 1: Why don't we directly compare results of the 'optimal' network of 10 sensors with the results of other networks of 10 sensors?

Reply: *The comparison with networks of the same size (10 sensors for example) is performed implicitly during the optimization process. The Simulated Annealing used in this study compares at each iteration two networks (of the same size) and retains the 'best one'. The networks are generated randomly like in Kovalets et al (2011) and Efthimiou et al (2017). Since the search space is quite large, the number of the compared networks is equivalent to the number of iterations. The comparison is based on a cost function named Normalized Errors Js and inspired from the renormalized data assimilation method. This cost function quantifies the quadratic distance between the observed and the simulated measurements according to the normalized Gram matrix* H_w*. The 'optimal network' produce the 'best' description of the observations (i.e. corresponds to the minimal quadratic distance) and permits a posteriori to reconstruct its origin. In figures 1, 2 & 3 is presented the evolution of the cost functions (trials 5, 11 & 19) during the optimization process. For these trials, ~* 3×10^4 *networks of 10 sensors are compared. The challenge in our study is to design the networks without using a priori the parameters of the real source and without considering an acceptance level of networks quality (the solution is 'good' if it satisfies three fixed criteria of values* $rH \leq 15$ *m,* $rV \leq 2.5$ *m,* $\delta q \leq 4$ *) as performed in Kovalets et al (2011) and Efthimiou et al (2017). These points are more clearly discussed in the revised text.*

Comment 2: Why we compare results of source inversion (distance to the true source, etc.) with ’optimal network’ of 10 sensors with the results obtained by the full network (40 sensors)?

Reply: *The results obtained by the optimal networks of 10 and 13 sensors are compared as a posteriori with the original network of 40 sensors used in MUST experiment and evaluated for source reconstruction by using the renormalization technique (Kumar et al, 2015b). As in practice, the number of measurements is limited, this comparison allowed concluding that in urban areas, the reduction of networks size is possible and does not degrade significantly its efficiency in source estimation. For more details, the choice of the size of the network (10 and 13) is fixed after observing that an acceptable estimation of the source in majorities of the trials was enabled by using minimum 8 sensors. Also by using more than 13 sensors optimal networks, the errors in source parameters estimation are stable and does not improve significantly (Kouichi, 2017). For this reason, the optimized networks were constructed and evaluated for sizes 10 and 13 (1/4th and ∼ 1/3rd of the original network of 40 sensors) with the original large network. These points are more clearly discussed in the revised text.*

References

1) I.V. Kovalets, S. Andronopoulos, A.G. Venetsanos, J.G. Bartzis, Identification of strength and location of stationary point source of atmospheric pollutant in urban conditions using computational fluid dynamics model, Math Comput Simulat, 82 (2011) 244-257.

2) G.C. Efthimiou, I.V. Kovalets, A. Venetsanos, S. Andronopoulos, C.D. Argyropoulos, K. Kakosimos, An optimized inverse modelling method for determining the location and strength of a point source releasing airborne material in urban environment, Atmos. Environ., 170 (2017) 118-129

3) Kouichi, H. (2017), Sensors networks optimization for the characterization of atmospheric releases source, Theses, Université Paris Saclay, France.

4) Kumar, P., Feiz, A.-A., Singh, S. K., Ngae, P., and Turbelin, G.: Reconstruction of an atmospheric tracer source in an urban-like environment, 15 Journal of Geophysical Research: Atmospheres, 120, 12 589–12 604, https://doi.org/10.1002/2015JD024110, http://dx.doi.org/10.1002/ 2015JD024110, 2015b.