Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2018-6-SC5, 2018

Geoscientific Model Development Discussions
Open Access

Interactive comment on "Optimization of an Urban Monitoring Network for Retrieving an Unknown Point Source Emission" *by* Hamza Kouichi et al.

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Received and published: 6 April 2018

The subject of this paper is challenging and very timely; certainly, we would like to know how to monitor the spread of pollutants in the urban milieu as efficiently and accurately as possible. In order to accomplish this task, the Authors derive a method based on the combination of optimization techniques, inverse tracers transport modelling and Computational Fluid Dynamics.

The subject is very difficult and there are very few papers addressing the problem in a comprehensive manner; for this reason it is justified to consider publication of this study.

My main comments are related to the necessity of introducing some clarifications to

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Discussion paper

the presentation.

The Authors attempt to analyze two canonical problems: - Identification of the unknown source - Optimization of the measuring network These two problems are mutually exclusive. Furthermore, they have different cost functionals defined on different vector spaces and, consequently, the set of control parameters is not the same for each case. This important distinction is overlooked in the paper and it is advisable to modify the text by precisely defining the functionals and the control variables.

The problem of optimization of the network is solved using the simulated annealing algorithm. The technique has been introduced to the computational physics over sixty years ago in the classic paper: Metropolis, N.; Rosenbluth, A. W.; Rosenbluth, M.; Teller, A. H.; and Teller, E. "Equation of State Calculations by Fast Computing Machines." J. Chem. Phys. 21, 1087-1092, 1953.

Despite that the original formulation is rooted in the basic principles of physics, the reviewed paper, concerned with the network optimization, is missing the physical interpretation of the Simulated Annealing.

The description of the technique can read as follows:

The algorithm of simulated annealing is initiated by starting from an admissible network. At the subsequent steps, the system moves to another feasible network, according to a prescribed probability, or it remains in the current state. It is crucial to explain how this probability is calculated.

The mobility of the random walk depends on a global parameter T which is interpreted as temperature. The initial values of T are large, allowing free exploration of large extents of the state space (this corresponds to the “melted state” in terms of the kinetic theory of matter).

In the subsequent steps, the temperature is lowered allowing the algorithm to reach a local minimum.

The main characteristic of SA is relatively fast convergence but, unfortunately, it is not possible to prove that the minimum of the cost functional is global. There are several others stochastic minimization methods which can be explored; it is possible that they are potentially more applicable in the context of the monitoring of air pollutants.

My recommendation is to revise the paper. The clarification of the dichotomy between source estimation and network optimization is particularly important. It is also advisable that a description of the simulated annealing algorithm is included.

Please see for example http://katrinaeg.com/simulated-annealing.html

The problem of selection of the initial admissible network and the role of stratification should be discussed. It is well known that the flow around and above complicated structures is characterized by a complex topology. After some analysis of the literature, I'm convinced that the solution of the network optimization depends strongly on the flow Froude number.

The relevant information on the flow in the vicinity of a structure is discussed in the literature, please see for example https://link.springer.com/article/10.1007/s10652-016-9470-3 It would be interesting to present some figures describing both wind and potential temperature fields from the CFD model used in the study.

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