Reply to the Editor's Comments

The paper "Optimization of an Urban-like Monitoring Network for Retrieving an Unknown Point Source Emission" by Hamza Kouichi et al. has been re-assessed in light of the accepted Ngae et. al (2019) manuscript and the previous published articles Kumar et al. (2015a, 2015b, 2016). The current case was discussed with other topical editors and also with executive editors in addition to referee opinions.

The paper presents a further analysis of the renormalisation technique to the MUST dataset using the CFD model fluidyn-PANACHE (already published). The main result consist in reducing the network size form 40 to 13 and 10 sensors.

The points yet to be addressed belong to four categories:

1 - Technical: pertinence of using the same measurements for optimisation and validation and other minor points
2 - Originality of the results, analysis and conclusions.
3 - Applicability in practice of the results, analysis and conclusions
4 - Code description and availability

Reply: *We would like to thank the editors for carefully reading our manuscript and for giving constructive comments in light of our precedent papers and in addition to the referees' opinions. Indeed, this work is a continuation of our previous studies and through which we have tried to provide answers to the questions raised by the editor and reviewers. We have revised the text to include these remarks and made the manuscript more focused on the problem of reducing the size of an existing monitoring network. We have also changed the title of the paper which clearly explains the problem of reducing the size of an existing network. Each of these points is addressed in responses to your following comments.*

One reviewer has a point that has been partially answered by the authors, namely that the optimisation evaluation is done using the MUST set of measurements and this makes it more likely that the resulting sensor configuration performs well reconstructing the source (that "the same measurements shouldn't be used for the optimisation and for the reconstructions"). A robust reply to this criticism is the core result of the QJRMS manuscript, that can therefore not be used as a reply in the context of the current review.

Reply: *First of all we wish to clarify that the core results recently published in the QJRMS are not exactly the reply to the criticism of this paper. As also mentioned in the responses to comments of the previous reviewer and already cited in this gmdd paper, this work including the results in the QJRMS paper were parts of the PhD thesis of the first author of this paper Hamza Kouichi (available online on:* https://www.biblio.univ-evry.fr/theses/2017/2017SACLE020.pdf*). So the framework of the research problem published in the QJRMS paper was already independently developed and the results were available even before submitting any of these manuscripts. As the subject is very complex and* *there are very few papers addressing the problem in a comprehensive manner, now we wish to clarify why we dealt with these two research problems separately.*

In order to develop a robust methodology for the complex problem of optimal sensor placements, the first idea was to utilize the information available from the concentration measurements from a larger network to reduce its size. Similar information has been previously utilized by some researchers while dealing with the optimization problem over flat terrains by developing different approaches. For this purpose, in this first study, we developed and implemented this new methodology for the optimal sensor placement in an urban-like environment by combining the optimization techniques, inverse tracers transport modelling, and Computational Fluid Dynamics. Results from this study were encouraging as we have been able to reduce the number of sensors by 1/3rd and 1/4th of the original network with almost the same level of source detection ability as the original larger number of samplers. And this was an important step to the solution of a complex problem of the optimal sensor designing, especially in the urban-like environment. The real-world applications of this independent research problem are discussed in response to one of your next comment.

In order to apply the above-defined research problem for more general practical application, it was noted that in this study we utilized the concentration measurements in the optimization process to determine the optimal configurations of the networks. However, a priori information about the concentration measurements may not be available in some practical applications for the deployment of the sensors in an optimal way. In order to relax this limitation of dependency on prior concentration measurements in some practical applications, in the QJRMS paper we tried to develop another methodology for determining an optimal sensors network using only the available meteorological conditions. The research problem in the QJRMS paper was designed for different application point of view and is independent of the methodology presented in this study.

We partially agree with the reviewer and editor that the optimisation evaluation is done using the MUST set of measurements and this makes it more likely that the resulting sensor configuration performs well reconstructing the source (that "the same measurements shouldn't be used for the optimisation and for the reconstructions"). However, this doesn't limit the application of the proposed methodology for some important practical applications like the accurate emissions estimation. In fact, this is a limitation of the MUST data for this application as for a complete process of the designing and the evaluation one requires a sufficiently long set of measurements so that the whole data can be divided into two parts: (i) first part for the designing an optimal sensor network and (ii) the second part for the evaluation of the designed optimal network. However, the durations of the releases in the MUST field experiment were not sufficiently large to divide the whole data from a test release separately into two parts for designing the optimal sensor network and then its evaluation. However, in further evaluation of the resulting optimal sensor configuration, a different set of the concentration measurements can be constructed by adding some noise to the measurements. For a continuous release in steady atmospheric conditions, the average value of the steady concentration in a test release is not expected to deviate drastically from the mean values in each segment of the complete data. So this new set of the concentration *measurements with added noise can partially fulfil the purpose of the evaluation of a designed optimal network. As shown in Table 2, the errors in the estimated source parameters are small even with the new sets of concentration measurements constructed by adding 10% Gaussian noise. We have also evaluated the obtained optimal networks with the other two sets of the concentration measurement, which are generated by adding 15% and 20% random noise to the original concentration observations. The source parameters are still estimated with reasonably good accuracy for these two scenarios. This whole exercise shows that even if we have utilized a different set of the measurements for the evaluation of the optimal networks, the optimal networks have almost the same level of the source detection ability in an urban-like environment.*

Some additional reviews considered that the distinct novelty of the manuscript under consideration in not put forward clearly enough with respect to the manuscripts Ngae et. al (2019) and Kumar et al. (2015a, 2015b, 2016). On the other hand, the scope can be adjusted in underlying that the current work addresses only part of the problem. In this case the text has to be adapted accordingly. The current presentation (and the title) suggests a very general treatment of the problem. This is contrasts with the fact that part of the results seem to be published in Ngae et. al (2019) and Kumar et al. (2015a, 2015b, 2016). In general it has to be highlighted so it becomes immediately clear to an average reader what is new in this manuscript with respect to the other two.

Reply: *It should be noted that the earlier studies mentioned by the editor were conducted for different research problems only for (i) to study the forward dispersion in an urban-like environment using a CFD model by utilizing the MUST diffusion experiment (Kumar et al., 2015a) and (ii) describing methodologies to utilize the renormalization inversion technique with combination of CFD method for localizing and quantifying an unknown ground level or elevated continuous point sources in an urban-like environment (Kumar et al., 2015b, Kumar et al., 2016). However, as editor has also pointed out, that the aim of this study is to demonstrate how the renormalization inversion technique can be applied to optimally placing a smaller number of concentration samplers for quantifying a continuous point source in an urban-like environment with almost the same level of source detection ability as the original larger number of samplers. For this purpose, in this study, we proposed a methodology for designing the optimal monitoring network in an urban-like environment, which is based on the combination of optimization techniques, inverse tracers transport modelling, and Computational Fluid Dynamics. This attests to a new development of a methodology to optimally design the sensors monitoring network in an urban-like environment. The novelty of the manuscript under consideration with respect to the manuscripts Ngae et. al (2019) is already explained in the response to your previous comment. As suggested, we have modified the text accordingly in the revised version of the manuscript in order to adjust the scope and we highlighted that the current work addresses only part of the problem. Title of the paper is now changed.*

Otherwise, it may be put forward how in the view of the authors the results and conclusions can be applied in practice.

Reply: *This study presents a practical method for managing realistic situations. This study shows that it is possible to reconstruct a source of atmospheric emissions with a limited number of concentration measurements and presents a methodology for selecting the 'best' sensors positions based on an optimality criterion. The applications of the proposed method for the optimization of a sensor network with limited numbers can be very useful and demanding in many real-world problems. For example, in oil and gas industries, estimation of the emissions of the greenhouse gases (GHG) like methane (CH4) is a challenging problem. In order to utilize an inversion method to estimate the CH4 emissions, accurate measurements of the methane at a network of the high precision sensors, downwind of a possible source, is a prerequisite. However, in order to obtain these accurate CH4 measurements, the cost of high precision methane sensors like Cavity Ring Down Spectroscopy/Spectrometer (CRDS) or similar other sensors is currently so high that we cannot deploy these sensors in a large number. However, alternatively, we can obtain the initial measurements by deploying a sufficiently large number of low-cost sensors (which may not be as high precision as CRDS or others) on a large monitoring network. Using these less accurate CH4 measurements and the proposed optimization methodology in this study, we can quickly design an optimal network, which provides the 'best' sensors positions with the reduced number of sensors. Then, high precision sensors can be deployed on this obtained optimal network to measure the accurate CH4 measurements. These concentration measurements can be utilized in an inversion method to estimate the accurate CH4 emissions. A similar and very useful application of the method proposed here can be applied for the estimation of the methane emissions from landfills. We have revised the text and given more explanation regarding the usefulness of the methodology and its practical applicability.*

Remember that the article cannot be published if the authors do not make their code available. There appears to not even be a code availability section. This is not only referring to the CFD code, which is not the core of the article and has been published before. The authors have to make the pieces of code used in the core results, including the renormalisation and the optimisation. If possible, the scripts used for preparing the figures presenting the main results have to be provided as well. The executive editors clearly state: "The paper must be rejected if the authors refuse to comply with requests to make the code accessible within the requirements of GMD."

Reply: *We should mention here that a large part of the code was already made available at the time of revision as a compressed folder in the supporting information. We have further improved the readability of the code by introducing detailed comments. The updated full version of the code is now made available along with the manuscript. The MATLAB version of the code is executable for coupling between the optimization algorithm (SA) (the renormalization algorithm) and the CFD retroplumes calculated for a sample test trial 14 of the MUST field experiment.*

I suggest the authors to revise the manuscript in a way that makes the criticisms irrelevant. This includes reworking the introduction (and also the discussion) narrowing the scope in order to describe more accurately what the paper delivers and how it is related to the previously published works. I suggest to explain and discuss more explicitly the results and conclusions of the works previously published by the group (i.e. Ngae et. al (2019) and Kumar et al. (2015a, 2015b, 2016).) and precise the relationship of the results and conclusions presented in the current manuscript.

Reply: *As suggested, we have revised the text accordingly. Most of these papers are already being referred in the previous version and now we have also described our recent paper Ngae et. al (2019) and how it is related to the current study.*

The main outstanding point is however the code availability. The paper cannot be published without it. A possible way forward in the context of GMD is to put the accent in the description of the code (and reproducibility) as it seems that none of the previously published works the code is sufficiently documented.

Reply: *The code is now available with detailed comments for more comprehension.*

minor/specific points:

p 1 l1 "sensors measuring the polluting substances" > sensors measuring polluting substances

Reply: *Corrected*

l2 "environment with a view to estimate an unknown" > environment in order to estimate an unknown

Reply: *Corrected*

l3 " The methodology was presented by coupling the" > The methodology is presented by coupling the optimal network was analyzed by > optimal network is analyzed by
Reply: *Corrected*

l10 "In 80% trials, emission rates with the 10 and 13 sensors networks were estimated within a factor of two which are also comparable to 75% from the original network." this phrase is not clear enough for the abstract, please clarify.

Reply: *The phrase is modified in the revised version for more clarification.*

l11 The last phrase: "This study presents an application of the renormalization data-assimilation theory for determining the optimal monitoring networks to estimate a continuous point source emission in an urban-like environment." is background/introduction information, and should be combined with the first-second phrase.

Reply: *Modified accordingly.*

l17 "by the concern authority." The concerned authorities?

Reply: *Corrected.*

p 2 l1 "The problem to optimize a monitoring network is common and consists in reducing the size of a network of sensors at the level of a city, county, or a neighborhood while retaining its properties." This statement contrasts with the following aspects of monitoring networks optimization: First deployment, Updating an existing network, reducing the size of an existing network, increasing the size of an existing network.

Reply: *The text is revised to avoid the contrast and clarification are included.*

Please clarify specifying the actual contribution of this work in the general context.

Reply: *The actual contribution of this work in the general context is clarified in the revised version.*

"This study will be focused with an objective to reconstruct an unknown continuous point source's release in an urban-like environment." This contrasts with the stated narrower focus of reducing an existing network of sensors for source location and intensity estimation. This observation is relevant because the inverse methodology was already introduced in Ngae et. al (2019) and Kumar et al. (2015a, 2015b, 2016). These papers are about inverse modelling on fluidyn-PANACHE fields in the MUST case applying the renormalisation inversion technique. It has to be clear from the beginning what is the new contribution of this work that adds to what has already been published or has been submitted and accepted (namely the network reduction?).

Reply: *The text is revised to avoid the contrast and clarification are included.*

l6 "an optimally monitoring sensors network" something seems missing in this grammatical construction.

Reply: *Corrected.*

l9 "This study presents a methodology for the sensor's locations choice, leading to the best network for the estimation of 10 an unknown point point source in a geometrically complex urban environment." You have to

Reply: *This phrase is revised and modified for more clarification.*

The "the" article in "The SA algorithm was designed for the statistical physics" is spurious > "The SA algorithm was designed in the context of statistical physics?"

Reply: *Corrected.*

p3 l13 "advanced search algorithm*s* like genetic algorithm "

Reply: *Corrected.*

l18 replace "..., etc." with a concrete reference or omit.

Reply: *Omitted.*

p3 l8 " This study deals with a case of reducing the number of sensors in order to obtain an optimal network from an existing network." This sentence is key, because it describes precisely what is done in the study. This information has to be clear much earlier and in the abstract.

Reply: *This information is more highlighted in the revised manuscript and in abstract.*

Sections 2 and 3: provide the working code. This is a fundamental GMD requirement.

Reply: *The code is now available with detailed comments for more comprehension.*

Section 5: You don't have to provide the CFD code if it has been published elsewhere, but if the code described in 2 and 3 requires sample input files, those have to be included, at least for testing purposes.

Reply: *The code is now available and executable for the CFD retroplumes for the trial 14.*

Section 6: Ideally scripts for the results should be provided for reproducibility.

Reply: *The code is now available.*

References

Kumar, P., Feiz, A. A., Ngae, P., Singh, S. K., & Issartel, J. P. (2015a). CFD simulation of short-range plume dispersion from a point release in an urban like environment. Atmospheric Environment, 122, 645–656. http://doi.org/10.1016/j.atmosenv.2015.10.027

Kumar, P., Feiz, A. A., Singh, S. K., Ngae, P., & Turbelin, G. (2015b). Reconstruction of an atmospheric tracer source in an urban-like environment. Journal of Geophysical Research, 120(24), 12,589-12,604. http://doi.org/10.1002/2015JD024110

Kumar, P., Singh, S. K., Feiz, A. A., & Ngae, P. (2016). An urban scale inverse modelling for retrieving unknown elevated emissions with building-resolving simulations. Atmospheric Environment, 140, 135–146. http://doi.org/10.1016/j.atmosenv.2016.05.050

Ngae, P., Kouichi, H., Kumar, P., Feiz, A.-A., & Chpoun, A. (2019). Optimization of an urban monitoring network for emergency response applications: An approach for characterizing the source of hazardous releases. Quarterly Journal of the Royal Meteorological Society. http://doi.org/10.1002/qj.3471

Reply to the Reviewer#3

The paper addresses optimization of a reduced set of receptors among an established arrays of detectors in an urban like monitoring network for retrieving an unknown point source emissions. This task is achieved here by coupling a simulated annealing algorithm, an inversion technique and a CFD model. The study claims to propose an optimal determination of monitoring network, however, this optimality is never achieved. The reallocated network structures are biased towards the source parameters. This is also argued by the previous reviewers which is still not addressed in the revised version. Moreover, there are several instances where results are simply stated without clarification (only some are referred in my comments).

Reply: *Please find below a point by point response to the reviewer's comments. We are grateful for the reviewer's comments and suggestions and appreciate the efforts he/she has made to improve the quality of the manuscript.*

1. Technically, the fundamental limitation of this study lies in the fact that they did not treat the two problems "design of reduced network" and "point source estimation" independently whereas the two problems are mutually exclusive. Same cost function is minimized for both the problems which gives a biased estimate of source parameters.

Reply: *We agree with the reviewer's remarks that in a network optimization problem, finding an optimal rearrangement of a set of receptors and then, point source estimation are two independent sets of problems. In fact, we also followed the same procedure. The choice of the optimal sensors network was not determined based on source estimation. The network optimization problem was independently presented and performed before any evaluation by estimating the point source parameters using the measurements from the sensors in the obtained optimal network. It is very clearly explained in the flow diagram of the methodology in Figure 2 and shows that a point source was estimated only when we obtained the optimal monitoring network. In this work, the first step is to find the best configuration of a limited set of sensors using the meteorological data, the positions of the existing sensors on the instrumented area, a CFD technique and the concentration observations. The second step is to evaluate a posteriori the performance of the optimal networks in comparison with the original network used in the MUST field experiment.*

Also, in order to support the utility of the proposed optimization methodology in current framework, here we also provide an example of an important practical application. In the oil and gas industries, estimation of the emissions of the greenhouse gases (GHG) like methane (CH_4) is a challenging problem. In order to utilize an inversion method to estimate the CH_4 emissions, accurate measurements of the methane at a network of the high precision sensors, downwind of a possible source, is a prerequisite. However, in order to obtain these accurate CH_4 measurements, the cost of high precision methane sensors like Cavity Ring Down Spectroscopy/Spectrometer (CRDS) or others are currently so high that we cannot deploy these sensors in a large number. However, alternatively, we can obtain the initial measurements by deploying a sufficiently large number of low-cost sensors (which may not be as high precision as CRDS or others) on a large monitoring network. Using these less accurate CH_4 measurements and the proposed optimization methodology in this study, we can quickly design an optimal network which provides the 'best' *sensors positions with the reduced number of sensors. Then, high precision sensors can be deployed on this obtained optimal network to measure the accurate CH4 measurements. These concentration measurements can be utilized in an inversion method to estimate accurate CH4 emissions. A similar and very useful application of the method proposed here can be applied for the estimation of the methane emissions from landfills.*

Here the low-cost sensors can rapidly be deployed specifically for collecting the information (i.e., measurements) to be used for a specific need (neutralize the source, refurbishment an installation on industrial site, etc.). In this case, the meteorological conditions (as wind speed and direction, etc.) can be known in real time from the available observations or from numerical weather forecasting models and can be assumed as stationary. The optimization, in this case, can be performed in real time if the interesting area is not complex and the calculation can be conducted quickly in a very short time (using Gaussian model and an optimization algorithm for example) using the measurements from low-cost sensors. If the domain is complex (i.e., contains several obstacles), CFD model should be used to include the effect of the obstacles. However, for an area of interest in a complex urban or industrial environment, an archive database of the CFD calculations can be established for a wide range of meteorological and turbulence conditions and can be utilized in the optimization process.

2. In the paper, the minimization of cost function (section 3.1) and renormalization process (section 2.2 and 2.3) refers to the same estimate for a point source estimation. So, there is no point in presenting these two as different methods and different optimization. This has already been mentioned in several papers, for example. Sharan et al. (2009), Sharan et al. (2012) or Issratel et al. (2012). The authors have already cited these papers.

Reply: *We sincerely acknowledge reviewer's concern that the mathematical illustration of the optimization techniques utilized in the present study is already presented in the earlier studies. . However, we are of the view that in order to present the optimization methodology, the presentation of a brief mathematical formulation of the renormalisation technique is necessary.*

The optimality criterion cannot be defined in a consistent manner without presenting the origin and physical significance of the optimization algorithm. If we present directly the adequate cost function (i.e. normalized errors) this cannot be appropriate for readers that don't have any information about the renormalisation method. Further, the detail of point source estimation is presented in the previous version of the manuscript due to the fact that this method has been utilized for the evaluation analyses (i.e. performance in source parameters estimation). However, as suggested by the Reviewer, we have further made an attempt to reduce the size of these sections considerably in the updated manuscript. In the revised manuscript section 3.1 is completely moved to Appendix A.

3. Mathematically, reducing the set of measurements is critical in ill-posed problems since each measurement is a significant entity or information while estimating the characteristics of unknown

space or parameters. In the paper, authors did not analyze how their total measurement information is varying or reducing with their subjective choice of the receptors. The accuracy or closeness of the source parameters can not be the only criterion to believe in a reduced set of network. Note that reducing the measurements will increase the degree of freedom in space and such solutions will be prone to the noise in the model, their variables and measurements. Such issues are never analyzed or taken into account here.

Reply: *We agree with the reviewer's remark about the effects of reducing the set of measurements in an ill-posed problem while estimating the characteristics of unknown parameters. As the reviewer has also pointed it out that reducing the measurements will be prone to the noise, we have performed a posterior analysis of the estimated parameters from the noisy measurements. As shown in Table 2, the errors in the estimated source parameters are small even with the new sets of concentration measurements constructed by adding 10% Gaussian noise to the original measurements. We have also evaluated the obtained optimal networks with two more sets of the concentration measurements, which were generated by adding 15% and 20% random noise to the original concentration observations. The source parameters are still obtained with reasonably good accuracy for these two scenarios. This whole exercise shows that even if we utilize a noisy set of the measurements for the evaluation of the optimal networks, the optimal networks would have almost the same level of the source detection ability in an urban-like environment.*

4. The exact convergence of the simulated annealing algorithm can not be guaranteed. Especially, in case of ill-posed problems, it is highly probable in different simulations to produce several sets of reduced receptors of same size that can have minimum of the cost function. In this case, uniqueness of the selected set of reduced network can be challenged. The paper never discussed such issues which are more common in case of ill-posed problems.

Reply: *Throughout the text, we mentioned this issue that there is no guarantee in the convergence of the SA and we confirmed (based on the adequate bibliographical references) that the obtained network can be the optimal or the near-optimal one. This complex combinatorial optimization approach retained big attention in the literature and the SA is selected following the recommendations from more than one research work of networks optimization in the framework of the atmospheric dispersion context (Abida et al., 2008; Abida and Bocquet, 2009; Jiang et al., 2007; etc.). Nevertheless, before utilizing the probabilistic algorithm SA, we tested its performance in comparison with the Genetic Algorithm GA of evolutionary research technique (Kouichi, 2017). Concerning the statistical study after the achievement of the optimization, we plan to perform this investigation as continuity of this first study. Some of these issues are already discussed in the manuscript and we again discussed in the revised manuscript.*

5. In computation, the computation of weight matrix and gram matrix depends on the number of measurements utilized during the inversion process. Accordingly, these two matrices seems to be changing with each iteration of the simulated annealing algorithm. It seems that the weight matrix is a priori information introduced in the space however, this will be reduced (or at least vary

drastically) with the reductions in the number of measurements. How their variation is affecting the retrieval of source vector or point source location is never explored or discussed here while they are mentioned important in cost function minimization.

Reply: *As mentioned before in response to one of the comments from the reviewer, we did not estimate the point source parameters during the optimization process of a monitoring network. The choice of the optimal sensors network was not determined based on source estimation. So it was not necessary to analyze the effect of variation of the weight matrix or Gram matrix on the point source location during the optimization process. To analyze the effect of weight matrix or Gram matrix on the estimation of a point source location is a completely different exercise. This doesn't need an optimization process and can simply be verified by taking the different number of measurements in the source inversion problem. It should be mention here that source estimation was not the main objective of this study and it was conducted only to evaluate the performance ability of the obtained optimal networks.*

6. The study do not bring any significant outcome in terms of methodology, optimality criterion or source localization features. Their discussion is mostly similar to a source estimation study like in Kumar et al. (2015b). In addition, it does not provide any insight related to their sensitivity of source localization with respect to the difficulties faced in the real urban scenarios, model errors / uncertainties, meteorological variability, etc.

Reply: *This point was already responded in detail to one of the comment of Dr. Sarvesh Kumar Singh on the previous version of the manuscript. If we just leave aside the optimization problem, even source reconstruction in a complex urban environment is itself a very complex problem. We think that addressing a far more complex problem than the source estimation in an urban area by combining concepts from an inversion technique, CFD, and optimization algorithm in a comprehensive manner is itself a significant contribution. As responded before, in the present study, the obtained optimal networks were analyzed qualitatively and quantitatively for all the trials of the MUST field experiment. The dispersion of the sensors in the urban-like environment was critically analyzed according to the source position and the meteorological conditions. A fine analysis is performed to highlight the common structures in the optimal networks. Also, a posteriori study is realized in order to evaluate the performance of the optimal networks. For this, the errors in source parameters estimation are compared with the errors obtained from the original network which leads to the important conclusions in networks size reduction in the framework of source reconstruction in an urban environment. As the applicability of the obtained monitoring networks is validated and analyzed by estimating the source parameters from the concentration measurements from the optimal networks, it is obvious to present and analyzed the source reconstruction results and compare these with the one obtained in the previous study. We do not agree with the reviewer's point that this study does not highlight any significant contribution related to optimal networking. In fact, using the proposed methodology, we were accurately able to estimate the source parameters using the measurements only from 1/4th and 1/3rd sensors with approximately similar accuracy compare to the network of the original number of sensors. This is a significant contribution that reduces the number of sensors in a complex urban-like environment* *and without compromising the ability of the network with a minimal number of sensors to estimate an unknown source. As discussed before in response to the reviewer's first comment, from application point of view this method can be very useful and demanding for the accurate methane emissions estimation in oil and gas industries and also from landfills.*

7. Page 15, line 20. The sentence "This tendency makes it possible …." is not clear. The tendency to reallocate the sensors is prior to the knowledge of source location and depends on retro-plumes or mainly flow and dispersion characteristics. So, such tendencies can never be explained in terms of their proximity to the source location. In lines 21-26, the paragraph "The visibility function includes ..." is repetition about the visibility function from previous papers without bringing any new conclusions.

Reply: *This sentences are either modified for more clear presentation or removed in the revised manuscript.*

8. Page 15, line 16, why larger location errors do not necessarily correspond to high intensity errors. This is not obvious. Another example is in line 26, while saying "visibility functions have significant levels." What does it mean?. These are just few examples where results are stated without exploring the reasoning behind them.

Reply: *Here we have just presented a summary of the results from the evaluation exercise. These or similar sentences are modified and clearly explained in the revised manuscript.*

9. Page 16, lines 25-28. I do not see "conditions for near overall optimum" in this paper and how one or more optimal network can satisfy it just by having a common set of few sensors or skeletons.?

Reply: *Modified in the revised version.*

10. Similar to comment #7, Page 16, lines 29- 32. The explanations given here do not signify anything related to the uncertainties of the network structures. The table 2 represents uncertainties for source parameters not for the network structures.

Reply: *The discussion is modified for more clarity.*