We thank Joseph Pitt for his useful discussion on the principle of our inversion approach and on the use of plume widths as a further constraint on the release locations. These will lead to clarifications and to the extension of our discussions.

This study presents a new approach to determine the location and rate of point source emissions, and tests the method using a series of controlled releases. Mobile measurements of mole fraction are made on board a car, which performs repeated transects through the plume downwind of the release. A Gaussian plume model (driven by local meteorological measurements) is used to simulate mole fractions at the measurement locations for an ensemble of release locations and emission rates. The offset between modelled and measured locations of the plume centre is calculated, in addition to the difference between the integrated plume enhancement (a.k.a. plume amplitude) for the modelled and measured datasets. Estimates for both release location and emission rate are derived by minimising a cost function that seeks to reduce these two measures of model-measurement mismatch.

The study is well-motivated and the details of the experiment are clearly described.

We thank J. Pitt for this general and positive assessment of our study.

Unfortunately, if I've understood it correctly, I think there is a fundamental problem with the method developed here. As far as I can tell, there is insufficient information content in the plume amplitude and plume-centre location to constrain both the location and rate of emissions.

We feel that this general comment confuses two different things

- 1) the idea that there could be a lack of information to constrain both the location and rate of the emissions in the theoretical frame of the proposed method
- 2) the lack of information to constrain both the location and rate of the emissions in practice, when applying the method to the specific experiments with the specific configurations presented in this study

We do not agree with (1) which is the basis of this general comment, but our analysis and discussions support (2).

Actually, this general comment

- nearly follows some of the point of the discussion we led in the second paragraph of section 5.3 (lines 469-475)
- misses the follow-up of this discussion in the third and sixth paragraph of section 6
- extrapolates what is actually a diagnostic from the first set of experiments into the assumption that it could be a fundamental problem of the method which could have been anticipated (an assumption we disagree with)

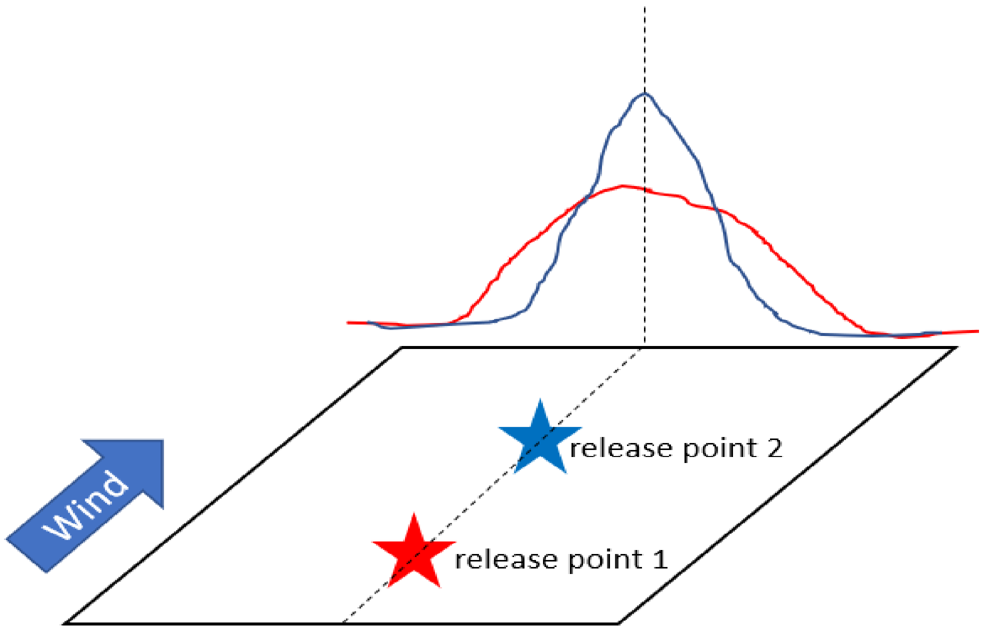
However, we realize that by having applied our method to a release for which we had one plume transect only without any warning, we have raised a source of confusion regarding its concept. In our revised manuscript, we will extend our discussions on the topic (in particular at the beginning of section 5.3 and in section 6) to clarify it. We will also explain why the case with one plume transect only is analyzed and used for the general statistics of uncertainties in the release estimates, even though our method relies on the use of multiple plume transects to derive the location of the sources.

See our detailed answers below.

It seems like the plume-centre location can be used to constrain the location of the release to a line along the average wind vector,

Not when considering two or more plume transects which is the fundamental basis of the method.

while the plume amplitude can either constrain the emission rate for a given release location on this line, or the release location for a given emission rate. Take the following example where the wind is perpendicular to the transects:



In this case any release location along the dotted line will result in the same modelled plume-centre location. But a source at release point 2 with a low emission rate will produce the same plume amplitude as a source at release point 1 with a high emission rate. These would produce the same value of J for this transect.

These considerations regarding the lack of constraint on the release location when having one plume transect only are misleading. A major cause for such considerations was our analysis of a release with one plume transect only without raising any warning. However, the principle of our method relies on multiple plume transects.

The additional explanation will be added to the description of the method in section 3.2.
And an explanation regarding the analysis of release #12 will now be given in section 4.2.

In all but one case presented in this study there are multiple transects of the plume.

Yes, it is the critical point.

This adds extra information to the case above. But I don't think it is being used to constrain the location in a useful way. Because the emission rate Qe does not impact JW, J is minimised by setting the location of the release to minimise JW, then setting the release rate to minimise Jp given this location.

The minimization is not iterative, it minimizes both components simultaneously.

If the plume centre-location is different for two transects then JW is minimised by moving the source location further away from the transects.

In principle, such a tendency should be balanced by the need to fit the individual areas of the plume transects. However, our results (and our discussion) showed that, in practice, Jw is much larger than Jp, which explains that, yes, the source location is pushed away.

Figure 3 is the perfect example of this in action. JW alone sets the source location, but the x-value of this source location is purely an artefact of the way the cost function has been constructed.

See our explanation above.

In section 5.3 it is stated that Jp does not "push far enough for finding a source location".

The idea of using J^{log} (section 5.3) was driven by the need to overcome this problem, adding constraint on the fit to the amplitude of each plume transect. We will now extend the discussion at the beginning of section 5.3.

But in most cases it has no impact on the estimated source location at all, I suspect for the reasons outlined above.

We do not see any explanation above in the reviewer's comment regarding why Jp would not push far enough to find the source location. Our explanation is the relative weight between Jp and Jw, not the principle of the estimation method. Several investigations discussed in section 6 could help overcome this issue. We will extend these discussions in the revised manuscript.

This is apparent from tables 3 and 5 – the locations are usually the same regardless of whether J or Jlog is used as the cost function, because in both cases JW is the same.

We thought that using J^{log} would solve for the problem by putting more weight on the fit to "small" plume cross-sections. However, J^{log}_p kept on being much smaller than Jw. This led to our discussions on that topic in section 6.

In cases where there is a difference I guess that it probably arises from some combination of the geometry of the ATEX zone boundary and the discretisation of release locations and emission rates.

The discretization of the release locations and rates is kept the same when using J or J^{log}, so we do not really understand this assumption. On the opposite, our assumption that using J^{log} puts more weight on the fit to small plume transect properly explains why the location errors are different when using it instead of J.

Note that this result demonstrates that Jp or J^{log}_{p} does have some weight on the estimation of the release location.

It's entirely possible that I've misunderstood what's going on here – if so then I'm sure the authors can put me straight! But until I have faith in the overall approach, I can't recommend that this paper is published. If the authors can convince me that the method is sound then I'm happy to provide more detailed feedback on specific points. Otherwise I think the best option might be to reject this paper in its current form and consider what additional information could be used to better constrain the problem.

We hope that our answers clarify this whole discussion.

One obvious candidate would be to use the plume width in some capacity, but I think that to do so would require a more complex model,

Yes, it would.

as one would need to simulate the likely width of the instantaneous plume (rather than the time-averaged plume represented in the Gaussian plume model). Perhaps that is a bad idea…

It is a good idea and definitely something to tests with a more complex model. We will add a small discussion on that point in section 6.

but either way I think some additional constraint is required in order to render this approach useful in determining source location as well as emission rate.

Other options to solve for this issue when applying the method to our specific study case will be better stressed in section 6.