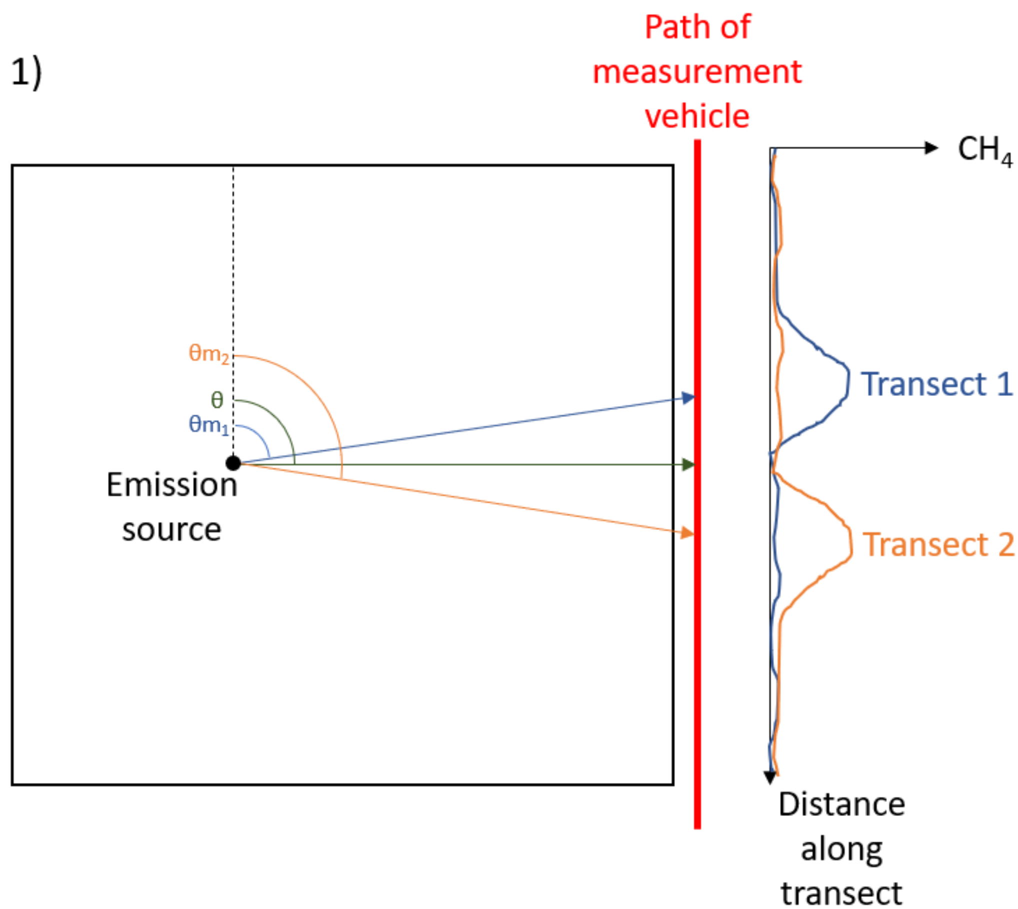
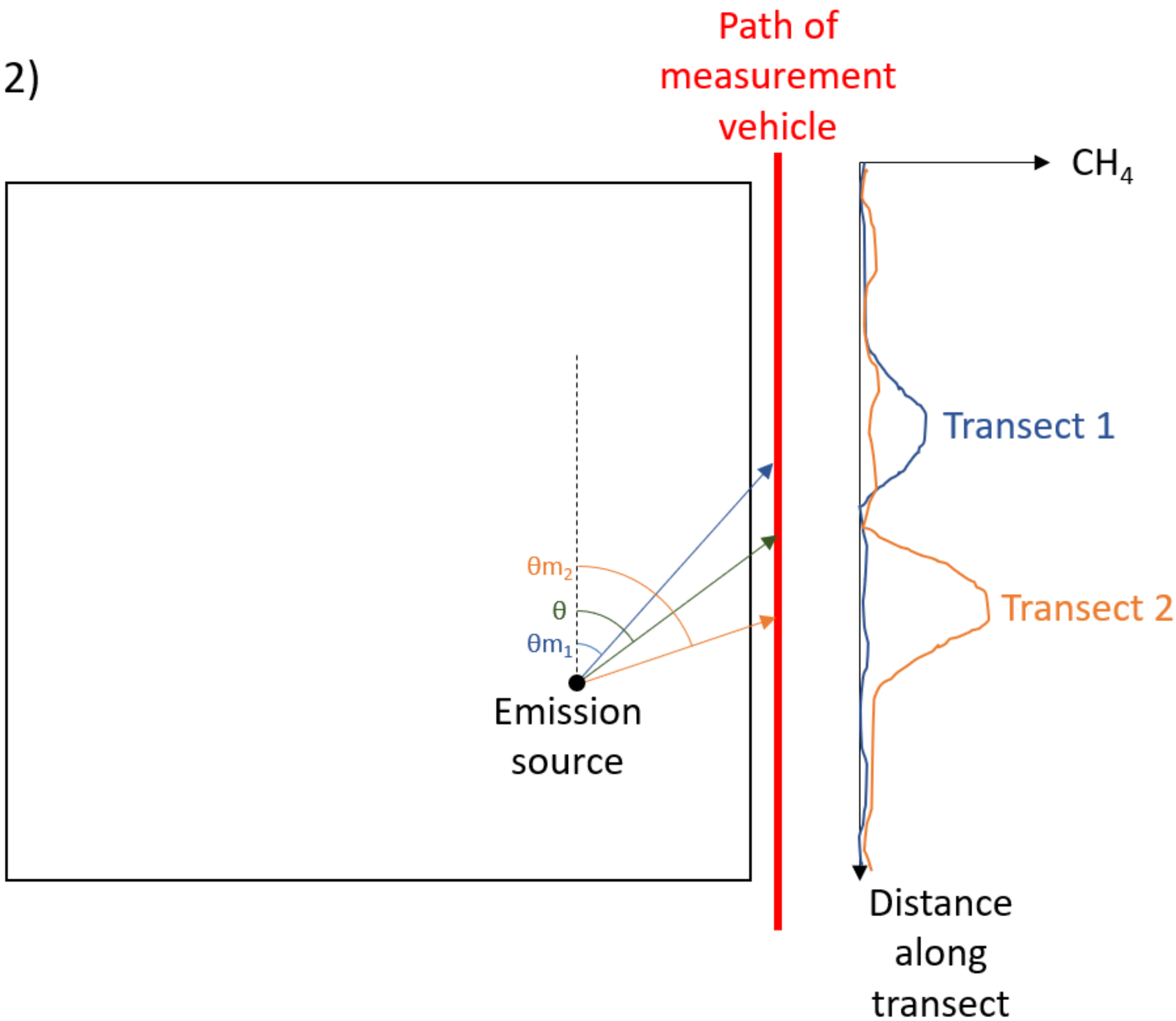
Thanks to the authors for further explaining their approach. I can now see that with multiple transects this method can in theory constrain the location as well as the strength of the emission. I had missed the important point that the X and Y axis in Eq. 1 are defined according to θ_m rather than θ. Consequently, while J_w will always be minimised by moving the source further away, in cases where the plume amplitude differs significantly between transects J_p could have lower values for release locations closer to the transect. So I agree with the conclusions of the authors: in theory there could be enough information to constrain the location and emission rate using this approach, but in practice it has not worked in this case. I think that conclusion is a useful one, so I suggest that this paper should be published in AMT, but I have some additional comments that I think it would be good to address.

I now see how the relative amplitude of plumes on different transects could in theory provide a constraint on the location of the source. However, if I have understood this correctly, this constraint only exists when the wind direction has a significant component parallel to the transect. To demonstrate what I mean, consider the two diagrams below. In the first the wind is perpendicular to the transect, while in the second there is non-negligible parallel wind component. Both diagrams represent a top-down view of the area, with the path of the measurement vehicle in red and the measured CH_4 enhancements along the transect shown right.



2)



In diagram 2), where there is a significant component of the wind parallel to the transect, the plume is measured closer to the source on transect 2 than on transect 1. Consequently the plume amplitude is larger on transect 2, and the relative amplitude of the plume on transect 2 vs transect 1 can (in theory) help to constrain the emission source location.

However, in diagram 1), where the wind is perpendicular to the transect, the plume amplitudes are the same on transect 1 and transect 2. In this case there is insufficient information to constrain the location of the source, even in theory, because the plume amplitudes could be equally well simulated by various combinations of emission rate and source location. Because J_w will always be minimised by increasing the distance between the source and the measurements, the estimated emission location will be pushed further away from the transects.

So it would seem that to give this method the best chance of working, one would want to conduct sampling in the wind conditions shown in diagram 2) and avoid the perpendicular wind direction shown in diagram 1). If this is the case then I think this is a conclusion worth highlighting for future studies. From table 2 of the manuscript it seems that sampling took place under a variety of wind directions, allowing this hypothesis to be investigated. I have two suggestions for this investigation:

1. Include plots of the form of Figure 3 for all releases in the SI. This will demonstrate whether the relative plume amplitude on different transects does sometimes constrain the source location (using the current definition of J), or whether the estimated source location is pushed to the edge of the box in all cases
2. Test the impact of varying the plume amplitude uncertainty in J_p. Currently a 100% uncertainty in modelled plume amplitude is assumed – as mentioned in the discussion, lower values for this uncertainty could help to constrain the source location. It would be useful to test various choices of this parameter (e.g. 80%, 60%, 40%, 20%, 10%). In cases where there is a component of the wind parallel to the transect, there may be a value below which this constraint kicks in and the location estimate is no longer forced to the furthest distance from the transects. Clearly this would not mean that a lower uncertainty is justified, but it would give us a sense of the model accuracy that would be required for the successful application of this method. This threshold accuracy would presumably be a function of wind direction (relative to the transect). If conducting this analysis for all releases is not feasible, it would at least be good to see these results for a selection of releases covering different wind conditions.

I appreciate that my suggestion 2 has some overlap with the current analysis, where J^{log} is used in place of J. But I think it would be useful for future studies to include an estimate of the required model accuracy, even if it is only strictly applicable to the conditions encountered during these controlled release experiments.

Finally, if in this study the cost function was always minimised by placing the source location at the furthest point from the transect, then I think the comparison of estimated emission rates to other studies should be done using the fixed-location results. As the authors point out, the tendency to overestimate the distance to the source partially counterbalances the tendency of the inversion to underestimate emissions. Presumably if you increased the size of the grid then the location error would be larger and the emission rate error smaller, but this would not mean that the accuracy of the method at estimating the emission rate was inherently improved. I think it is useful to separate the two issues (location and emission rate) in the discussion section; first discuss what improvements would enable the method to estimate the location of the emission with some skill, then discuss the accuracy of the fixed-location emission rate estimates relative to other studies.

In addition to my general suggestions above, I have a couple of specific comments:

- Why was θm set to $\theta \pm 2\sigma_\theta$ when it was outside this range? Surely if the angle between a potential release location and the observed plume is very different to the measured wind direction then that location is unlikely to be the source of the release? Therefore it seems reasonable that J_w will be very large for such a location, and it is not clear to me why it needs to be limited in this way.
- It would be useful to include the results of the fixed-location experiments (using both J and J^{log}), either in tables 3 and 4 or in the SI.