Ms. Ref. No.: acp-2016-963

Title: Estimating the size of a methane emission point-source at different scales: from local to landscape

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Dear Editor,

We would like to thank the referee #2 for their comments. Please find our detailed responses below.

Yours sincerely,

Stuart Riddick (corresponding author)

and co-authors: Sarah Connors, Andrew Robinson, Alistair Manning, Pippa Jones, David Lowry, Euan Nisbet, Robert Skelton, Grant Allen, Joseph Pitt and Neil Harris

Reviewer #2

My main problem in this paper is the conclusion that the landscape inverse modeling approach can be used to identify point sources. The inversion method lacks details and the discussion is somewhat superficial. I think OSSEs would be required to determine the ability of observations at the landscape scale to constrain emission hotspots.	We have refocused the paper and made the point that distinct emission sources can be observed within an emission landscape. We suggest that landscape inversion models can be used to identify emission hot-spots within an emission landscape.	Page 1 L25 the following has been removed: "is in good agreement with more labour-intensive near-source approaches and" Page 1 L26 the following has been removed: "to provide high-quality emission estimates" Page 12 L31 the following was removed: "agreement between the mid-distance estimates and the" and "that provide data for regional inversion models" Page 13 L19 the following was added: "output from" Page 12 L32 the following was removed: "the network and even to quantify their emissions hotspots"

		Page 13 L20 the following was added "an emission landscape"
P6, L9-10: "The standard deviation of the lateral (σy, m) and vertical (σz, m) mixing ratio distribution are calculated from the stability class of the air (Pasquill, 1974)." So what are the values for the standard deviation used in this paper?	The values used can be found in the Supplementary Material Section 1.	
P7, L19: "This allows for any potential bias due to highly uncertain observations to be accounted for." I don't see how the bias would be accounted for.	High methane concentration values seen at Haddenham are usually short lived and appear as peaks lasting only a few hours (max). They usually occur at nighttime and, as the isotopic analysis shows, probably come from a landfill, which is an intermittent of methane. These are therefore more uncertain. The values would have a relatively high cost score at these times. So, by including the hourly SD into the uncertainty calculation this helps to de-weight the	

	large concentrations, which have higher uncertainty, from increasing the overall cost score.	
P9, L14-15: "A statistical filtering technique separated methane mixing ratios at each site into. . ." What is this statistical filtering?	See comment above.	
P9, L16: Why "18th percentile"? Why not 10th or 25th?	This percentile is used as a result of sensitivity analysis showing that the resulting InTEM inversion results produced the lowest cost scores and therefore means the emissions produced are closer to the measured observations than any other percentiles tested. I tested from the 5^{th} to the 45^{th}. Sensitivity analysis shows this baseline produces emission results with consistently stable emissions with the lowest cost score of all baselines tested.	
P9, L21: "For a more detailed description of the	A new paragraph is included to make the link to the	Text added at P9 L12:

measurement sites and the InTEM setup please refer to Connors et al. (in prep).” I think more details about the InTEM setup should be given. For example, what prior constraints or regularization do you use? This is crucial for an inversion.	InTEM setup described in Connors et al. (in prep.), Sarah Connors’ thesis and the new information in the supplementary material clearer. This inversion does not use a prior, like the other studies referenced here. Priors are not essential but they are more commonly used than not. It uses a cost function similar to a least-squares approach. Bayesian cost-functions use priors and the analysis could (and probably should) be repeated with a Bayesian CF to comparison and a better assessment of errors.	“The results presented here are taken from a study developing a method to estimate regional CH4 emissions in East Anglia (Connors et al., in prep.). More details on the measurements sites, the inversion set-up used for InTEM, the diagnostics used and the emission uncertainties can be found there and in Connors (2015). The main points for the purposes of this paper are summarised below and in the Supplementary Material.”
P12, L4: “. . .using near-source measurements are 453 kg hr-1 in June/July 2015. . .” I thought the near-source measurements cover only two days? This looks like two-month data.	Corrected as suggested	Added at p12 L16: “30th June and 1st July 2015”
P12, L15-20: Table 4 shows the lowest emissions month is	This was typo and should be 1110 kg/hr and has been	

in April (111 kg/hr). I am not very convinced that seasonality is due to temperature. Does stability class in the Gaussian plume approach play a role?	corrected. The response of CH_4 emission from landfill to temperature is well documented and a result of methanotrophic bacteria becoming more active during the summer months.	
P12, L33-34: I am not convinced by this conclusion. See my general comments.		Added at P12 L19: "We suggest that the agreement in emissions estimates between the near-source and middle-distance methods indicate that a Gaussian plume approach can be used to estimate emissions up to 7 km from a relatively large source. However, this may be an upper estimate of the distance that this approach is effective as the fetch between the source and detector was relatively flat and a more aerodynamically complex landscape may reduce the model's efficacy." At P12 L25: "Our results suggest that larger emission hot-spots can be detected within the

		emission landscape generated by an inversion model. However, we would suggest that future sensitivity studies should be conducted to estimate the size of emission hot-spots within a landscape where the source is farther from a measurement site used as input to the inversion model.”