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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Background Heterogeneity and Other Uncertainties in Estimating Urban Methane Flux: Results from the Indianapolis Flux (INFLUX) Experiment" *by* Nikolay V. Balashov et al.

Anonymous Referee #3

Received and published: 22 July 2019

This paper looks at methane emissions from the city of Indianapolis and explores some of the reasons that the many previous studies on the topic have yielded very different emission estimates using different methodologies. This paper is a useful and relevant contribution to the topic of atmospheric inverse methods for urban methane emissions quantification, but I have a couple of complaints.

The narrative of the paper would be improved by more directly addressing the relationship between this paper and the previous investigations of methane from Indianapolis (all of the papers cited in Figure 1). The Introduction does a fine job of giving a general

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review of the previous studies, but the connection to the central problem of different studies/methods yielding different results is weaker in the rest of the sections. For example, how are the methods for background estimation in this paper different than the methods used in the previous studies? In the Conclusions, you recommend a strategy for background estimation for the aircraft mass balance method, but you did not describe how it was done in the previous studies. Also, the Lamb paper identifies a major discrepancy between top-down and bottom-up estimation of the non-biological portion of Indianapolis methane emissions, and the current paper is a follow-on to that paper, but it is not clear whether this paper resolves that question or not, or only partly resolves it.

Specific Comments:

Line 19 – details about the type of analyzers and the measurement heights in the abstract are unnecessary and irrelevant.

Line 103: Please describe briefly how/why the landfill emissions are considered well-known.

Section 2.2 – There are extra details here that are not very relevant to the current paper and have already been described in other papers. This section could be made more concise.

Section 2.4 (Sources) – Although references are given, the source of the numbers in this paragraph is not clear. Are they from direct measurements, an inventory, or something else?

Section 2.4 (Background) – As written, I had to read this section many times to try and understand it and I'm still not sure I fully understand the two methods, so it needs to be re-worked for clarity. Why is a viable method not to take the lowest measurement among all towers at a given hour as a background? How do these two approaches compare to those used in the cited aircraft and tower-based top-down studies?

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Section 2.5 – How far away are your receptors and wind measurement locations since you say that this method requires them to be nearby?

Section 2.6, Line 261 – Which towers were used for which wind directions?

Section 3.1 - The first three sentences could probably be condensed into one concise sentence without losing any meaning. - I am having trouble squaring your description of the domain differences with my understanding of the Lamb paper. By my reading, the Lamb paper describes developing an inventory for the larger domain, but you say that the inventory covered mostly only Marion County. I find it hard to believe that Lamb et al. would perform such a detailed analysis and accidentally compare totally different areas for the inventory and tower inversion. What am I misunderstanding? - With the revised inverse emissions estimate, it is not clear whether you've replicated the methods of the inversion in Lamb et al. over a smaller domain, or whether you've used the boundary layer budget method described in the method section.

Section 3.2 - How much of the data are filtered using the criteria you give? - Line 372: Suggest: "Because Indianapolis is a relatively small emitter of methane, and because there are relatively large sources outside of the city, uncertainties due to background estimation are comparatively large."

Section 3.4 - Isn't the result that the SSLF is the largest and strongest source in the city consistent with your prior understanding, as described in the methods? - Looking at figure 8, I can't tell which enhancements around T10 you think are from SSLF and which are from NG leaks. - How do you square your findings that emissions from NG is not a significant portion of emissions with the findings in Lamb et al. that approximately half the emissions are from NG using ethane as a tracer? Are you saying that you can't see the sources because they are below your detection threshold or that their signals or swamped by that of the SSLF, or are you saying that their existence is entirely not supported by the data? On the one hand, you say there is not much evidence for a diffuse NG source, but on the other hand, even after adjusting the domain, your top-down

estimate is still much higher than the inventories. You should at least acknowledge this contradiction or remaining possible existence of unknown sources. - Line 488: The description of “occasional” on seems incorrect since this apparent signal shows up in Figure 8, which represents a two-year average.

Technical Comments: Line 61: Suggest: “. . . atmospheric methods and inventory assessment have sometimes succeeded. . .” Are there are cases when these two criteria have been met but reconciliation has not been achieved? Line 70: Suggest: “Recent studies of urban CH4 emissions in California indicate. . .” Line 72: The phrasing “large NG infrastructures” is strange and evokes large individual pieces of equipment, which I don’t think is your intent. Line 79: Suggest: “in” → “for” Line 85: Suggest: “. . .comprised of irregular or periodic in situ aircraft measurements, continuous in situ observations. . .” Line 91: Suggest: “well-suited” → “designed” Line 94: Delete: “Recently” Line 103: Suggest: “Uncertainty in total emissions is driven by. . .” Line 132: Suggest: “tubes secured” → “air collected” Line 139: Suggest: “inflow” → “sample air” Line 152: The given link re-directs to some other website. Line 154: Suggest: “The anemometers are located at about 10 m AGL.” Line 200: Suggest: “. . .based on two different sets of criteria. Both approaches identify. . .” Line 316: Suggest: “inventory” → “inventories (Fig. 1)” Line 352: The meaning of the numbers “2 to 150” is unclear. Line 385: Suggest: “at least twice as high” → “approximately twice as large” Line 396: Suggest: “did not change significantly between 2014 and 2016.” Line 519: “Dennis” – Do you mean Brian?

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