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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Bayesian atmospheric tomography for detection and quantification of methane emissions: Application to data from the 2015 Ginninderra release experiment" *by* Laura Cartwright et al.

Anonymous Referee #1

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Overall, I think this article is well thought-out, well written, and addresses an important problem in source quantification. I have just a handful of suggestions and ideas for the authors.

Broader ideas and suggestions:

- I think it can be difficult to figure out which Copernicus journal is the best fit for an article like this one. I have also seen several articles on inverse methods in Geoscientific Model Development (GMD), another Copernicus journal. I don't

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Discussion paper

think it would be worth switching this article over to GMD at this juncture, but I do think it would be helpful to get guidance from the Copernicus editors on which journal they would recommend for future articles on inverse modeling.

- I would be curious to see how the model results would change if you excluded observations collected when wind speeds are low. Many existing articles simply exlude observations that are collected when wind speeds are low, and the authors point out that this decision and the wind speed cutoff are subjective. I would argue that the choice of weighting function for the low wind speed observations is also somewhat subjective. I would be curious if these low wind speed observations contributes anything to the emissions estimate relative to the traditional approach of exlcluding those observations. I think it could be interesting to run a case with these observations excluded (if and only if it is not a lot of work to do).

- I think it could be useful to include a greater discussion of when and how this statistical model could be applied to other inverse problems. The Ginninderra Controlled Release experiment is a relatively simple and controlled emissions set up, and most real world source quantification problems are likely to be more complicated. For example, there may be multiple leaky natural gas wells in a study area instead of a single point source. I think it could be helpful to lay out for the reader what types of problems you think this model would be well-suited for.

Specific line-by-line suggestions:

- Abstract, line 3: Could you be more specific with the term “misspecifications”? What kind of misspecifications appear at each stage of the inversion processing chain? I think some people in the inverse modeling community may also feel offended by the phrasing of this statement, especially given the very broad scope of this statement. Instead of phrasing the abstract this way, it could be more effective to explain why certain inverse problems are so challenging.

- Abstract, line 6: The word “tomography” is not common in the atmospheric inverse modeling community. I think I know what you mean, but it could be worth clarifying somewhere in the manuscript.
- Abstract, line 9: Perhaps “inverse modeling” would be better than “inversion”?
- Page 2, line 9: Consider moving the clause at the beginning of the sentence to the end of the sentence. I think this change might make the sentence flow better.
- Page 2, line 29-31: This sentence has a relatively complex structure that makes it a bit difficult to read. You might consider simplifying this sentence or splitting it into two sentences for easier readability.
- Page 3, line 4-5: I don’t quite follow the point being made in this sentence. I know that it is important to evaluate atmospheric transport as part of inverse modeling, but I am not sure how that task is naturally part of classical inverse theory.
- Page 5, line 9: What is a Pasquill stability class? I am not positive that your reader will know this term.
- Page 6, line 8: What is a Monin-Obukhov length?
- Figure 2: What message should readers take away from this figure? It could be useful to include a one-sentence takeaway message in the caption.
- Fig. 3: The directional errors are difficult to see in this figure. Consider making the arrow directions larger.
- Pg 11, line 2: Is a half-normal distribution the same as a truncated normal distribution?
- Figure 5: There is a lot going on in this figure. It could be helpful to the reader to state the main takeaway message of this figure somewhere within the caption.

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