

Response to Reviewer 1:

Minor comments

line 109-112: what are the range of estimates for these numbers? You provided them for the Karion studies, but not these other two.

Added the ranges of each to the paper.

line 184: Perhaps cite the latest EPA greenhouse gas inventory

We cited one from the previous year here because that was where the emission factor came from when this project was active. We cannot cite the most recent report here as the emission factors change from year to year and so the number may be different from the one we used.

line 260-261: do these CH₄ sinks account for other reactive species in the atmosphere? If not, how would background or elevated levels of ethane or other gases affect these CH₄ losses?

This is a fair point. Gases other than CH₄ are emitted from wells and could possibly decrease the reaction rate of OH with CH₄. However, the purpose of this section is just to show that even in above average OH concentrations, the CH₄ sink is negligible. Unless the other gases released from well emissions lead to the production of additional OH, any gas released that will react with OH will only lower the sink's impact further.

Figure 2: if possible, it would be helpful to know where Bradford County was on this map

Updated the figure with the county highlighted in yellow

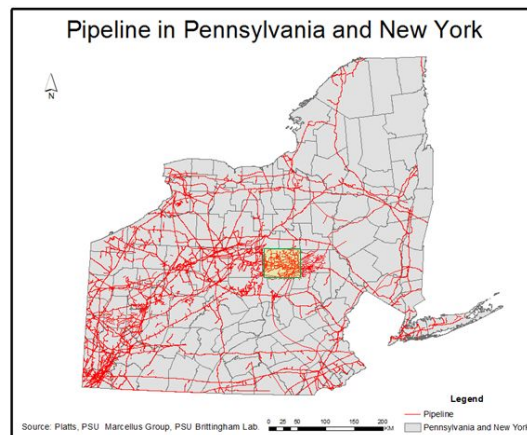
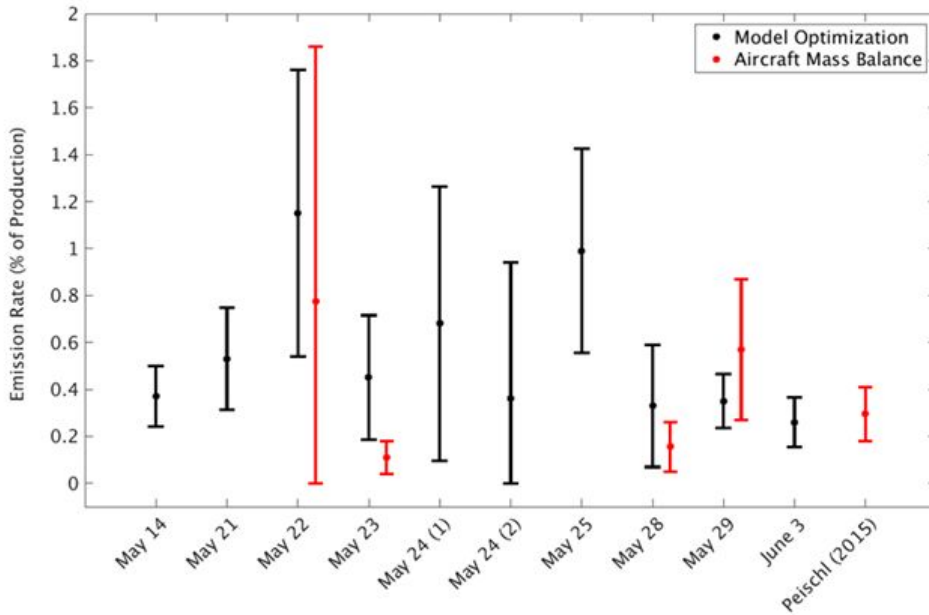


Figure 19: I would add the mean model optimization and aircraft mass balance emission rates to this graph, as well as the Omara and Peischl studies, along with their uncertainties. It seems like one advantage this study has, as mentioned in the introduction, is a narrowing of the uncertainties of these previous studies.

I did not add the mean for each as it made the plot a bit heavy and I want to emphasize the spread for each day. I also did not add Omara's number as it comes from emissions only from well production (no gathering emissions) and all wells from that study were measured in the southwest Marcellus, which has a much different composition compared to the northeast Marcellus. However, I did add the number from the Peischl study to the plot, as his study is a single mass balance flight in the region and so it fits in perfectly with the rest of the graph's content. I am not sure our final findings narrowed the uncertainties as intended so much as it discovered how uncertain the previous estimate may have been.



Technical Comments

The author numbering is not in order.

Fixed

line 48: Methane also has an atmospheric sink from chlorine chemistry.

Clarified the sentence to imply the sink was mostly from OH.

line 58: is "mining" the proper word for natural gas? It may be, I just can't say I've heard that before.

Forget you heard it. It is not a good use of the word. Switched to "drilling and transportation of natural gas".

line 64: add "of" to say "quality and quantity of its emission factors".

Added.

line 107: put "per day" before the abbreviation "MMSCFD", instead of after it.

Switched the order.