

In this paper, the authors use a high-resolution (~ 25 km) inverse modeling to estimate methane emissions from individual oil and natural gas (O/G) basins in the US and Canada based on 22-month satellite observations from TROPOMI. The authors compared their results with widely-used “bottom-up” emission inventories and other “top-down” emissions. The authors also evaluated the uncertainties from the model and observations. The topic of the paper fits the scope of ACP, and it provides a way to quantify the O/G methane emissions. It is recommended to publish after the authors address the following aspects.

General comments:

1, Do the numbers of samplings in different seasons affect the estimated posterior emissions? The observations in the winter, especially over Canada, are limited because of the snow and high solar zenith angle. Did the authors evaluate the influence of uneven sampling in different seasons?

2, New infrastructures could also contribute to an increase in CH₄ emissions (e.g., in Permian Basin). These new sources, however, are not reported in a priori emission inventories. Besides, scaling a priori emissions to a certain year could not solve this problem, either. How did the authors deal with these “missing” emissions? Whether the model can correctly locate these emissions that are not in the emissions inventory?

3, Line 221 to 258: About the discussion over Canada, the authors argue that the lower emission than other “top-down” inventories is possibly due to a decreasing trend of O/G emissions after 2014 in Canada. It is quite tricky to argue in this way. The estimation in this paper is still 40% higher than that of ECCC-reported emissions (ECCC, 2020) and EDGAR v6. If the authors want to draw this conclusion, the authors should first prove both “top-down” inventories and “bottom-up” inventories catch the same trend but only show differences in absolute values.

4, The section 3 has a lot of repetitive content with the method section. Please combine them and reorganize the structure of the paper.

5, Line 310: I doubt the argument here. First, the number of observations of TROPOMI is limited by the retrieval over water. Many offshore oil/gas sources (e.g., the Middle East) are difficult to be resolved. Second, as shown in Fig S17, many places in the world have no data even with a 22-month recording.

Specific comments:

1, Line 49 and 56: Please check the format of the two references of Lu et al.

2, Line 64: Please give the definition of the blended albedo or refer to the relevant reference.

3, Line 121: The projects of Fig. S5 and S6 seem to be distorted. Please use right projections.

4, Line 122: “gridcells” should be “grid cells”. Please correct all of them in the paper.

5, Line 126-127: How about the new sources? Although the emissions from bottom-up inventory can be scaled to the later years, the locations won't change, which means the new sources are not included.

6, Line 182: Please specify if the authors used XCH₄ with the surface correction. According to Figure 1, the authors also should clarify here that XCH₄ has been corrected by the elevation.

7, Line 196: “x” should be “×”. Please check the paper and correct all of them.

8, Line 215: Any explanations about the decreases?

9, Line 295: A typo of “areal”?