

Interactive comment on “Detecting high-emitting methane sources in oil/gas fields using satellite observations” by Daniel H. Cusworth et al.

Anonymous Referee #2

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The authors investigated the potential of using satellite observed XCH₄ accompanied with surface observations to detect and locate high-mode emitting sites in oil/gas fields. They conducted OSSE on the basis of pseudo-observations from multiple satellites including both recently launched (TROPOMI) and the planned ones (GeoCARB and the next-generation geostationary one with a much finer resolution). An inverse approach was used to relate these satellite observations to the methane sources upwind, and to further assess the capability of different satellite data to detect high emission sites. The main results of this study suggest that the TROPOMI and the planned GeoCARB are unsuccessful at locating high-emitting sources in dense fields of >50 emitters within the 50×50 km² domain. To address this issue, we need the next-generation geostationary satellite data that have a finer spatial-temporal resolution and a higher data precision,

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or complement the current satellite data with a surface observation network. Overall, I think the paper reads well, provides interesting results, and fits the ACP scope. I have some concerns about the method part that should be addressed before this paper accepted for publication. My comments are as follows.

1. I have significant concerns about the effect of meteorological conditions (especially wind speed) on the detection of methane plumes by satellite observations. The high-wind condition promotes the dispersal and dilution of methane in the atmosphere, which makes the methane enhancement relative to background smaller than that under a low-wind condition, and the resulting low concentrations are much difficult to be detected by satellite. Therefore I wonder if the results of this paper are sensitive to the meteorological conditions used. This study was performed based on only a 1-week simulation using the WRF-STILT model, however, it used a very strong statement on the findings in the abstract and conclusion parts. It cannot convince me that the 7 days meteorological fields are representative enough. I suggest that the authors give a detailed discussion on the potential influence of meteorological conditions on their results.
2. It's not clear to me how this study used the WRF-STILT model because the model configurations are not described in details in Sect. 2.2. How many theoretical particles are released from each receptor, and what are the receptor heights? How is the column footprint calculated? Is it integrated from the footprints of different vertical layers? It is important that the method part is self-contained and does not require the reader to go through another source.
3. In the inverse method, the observational error covariance matrix accounts for instrument and model transport errors (line 18, page 6). What about the representation error? How is it considered for the satellite observations that have a different pixel size from the resolution of transport model?



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