Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-741-RC3, 2018

Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #3

Received and published: 26 September 2018

The authors have conducted observation system simulation experiments (OSSEs) to examine the potential of satellites to detect methane emissions from a dense distribution of industrial point sources. They compared the utility of data from TROPOMI, GeoCARB, and a next-generation satellite instrument. They also compared the utility of the satellite data to that from a surface observing network. They found that TROPOMI and GeoCARB can detect high-mode CH4 emitters if the density of the emitters is low. Only the next-generation satellite would have the capability to detect a dense distribution of high-mode CH4 emitters. They suggested that combining TROPOMI or GeoCARB with surface data would help augment the detection capability of these instruments, whereas doing so would offer little additional benefit to the next-generation instrument. This is an interesting study and the manuscript is well written. I especially appreciate

Printer-friendly version

Discussion paper

the investigation of the impact of the L-1 and L-2 regularization. However, I do have a few major concerns. I would recommend publication of the manuscript in ACP after the authors have revised the manuscript to adequately address my concerns.

Major Concerns

1) My first major concern is regarding the treatment of clouds. The authors claim that they "assume clear-sky conditions to simplify the discussion" but this is a serious assumption, which, in my opinion, is unacceptable. The caveat at the end of the conclusions that states "as long as skies are clear" is really problematic. Clouds have a major impact on observational coverage. Would accounting for clouds enhance the disparity between the next-generation satellite and TROPOMI and GeoCARB? Actually, my main concern here is whether accounting for clouds would reduce the POD of the next generation satellite (as envisaged here) to less than 0.8, which would mean that even such an instrument would be unable to detect dense high-emitting sources. It is critical that the authors account for the impact of clouds in their analysis.

2) My other major concern is with the treatment of model transport error. The authors assumed an error of 4 ppb for both the surface and satellite observations. However, that is not a justifiable assumption. The model transport errors at the surface, in the vicinity of point sources, will be very different from that in the CH4 column. Assuming the same transport errors for these two types of measurements does not allow for a fair and meaningful comparison of the satellite and surface measurements.

3) My third concern is with the lack of discussion of the impact of systematic errors in the satellite data. Since the launch GOSAT it has become clear that systematic errors in the greenhouse gas retrievals pose a major challenge for the use of the data. I appreciate that it would be challenging for the authors to reasonably address the issue of biased retrievals in their OSSEs, but they should at least add some discussion in the manuscript about how systematic errors could confound the detection of the CH4 sources.

Technical Comments

1) Page 2, line 8: Satellites do not measure the atmospheric columns of methane. They measure backscattered solar radiation from which the atmospheric columns of methane are retrieved. Please change the wording here.

2) Table 1: The row is not properly aligned for the TROPOMI entry.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-741, 2018.

Printer-friendly version

Discussion paper