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Atmospheric Measurement Techniques Discussions
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# *Interactive comment on* "Quantifying methane point sources from fine-scale (GHGSat) satellite observations of atmospheric methane plumes" *by* Daniel J. Varon et al.

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"Quantifying methane point sources from fine-scale (GHGSat) satellite observations of atmospheric methane plumes" by Varon et al. compares four different approaches for methane point source quantification using simulated data. The two most promising methods (Integrated Mass Enhancement and Cross Sectional Flux) for this application are described in more detail along with characterization of their uncertainties. This short manuscript provides some very useful results that are timely and widely applicable to the current state of science in this field. While the launch of GHGSat-D clearly motivated this work, with no actual GHGSat data used in the study and multiple potential missions on the horizon in the same range of capabilities, to make this work most widely applicable to the scientific community, it would be advisable to keep the paper's title more general (removing 'GHGSat'). This would be consistent with the authors' statement on page 2 "Our work is motivated by the need to interpret GHGSat observations but is more generally applicable to any fine-scale plume observations from space".

Overall, my view is that the findings of the study are scientifically sound and generally justified by the simulations. The study also demonstrates some of the important differences in $CH_4$ and $CO_2$ point source quantification that we not so apparent even just a few years ago, but are becoming clearer with the heightened scientific attention to this field. I would recommend acceptance of the manuscript for publication in AMT with the suggested modification to the title and provided that a number of specific points outlined below could be addressed.

Specific Comments and Technical Corrections

Page 1, Line 25: With such a small number of nadir methane column observing satellites, which use a diversity of technologies that result in a range of observing characteristics, the word "conventional" does not really apply. "Most existing and upcoming methane observing satellites . . ." would be a better introductory phrase.

P1, L26: Since Jacob et al. (2016) reviews methane observations from space, the authors could easily have provided a more accurate description of SWIR mission pixel resolutions here than "1-10 km". From the list in Jacob et al. (2016) the proposed CarbonSat has the smallest pixel size at 2x2 $km^2$ (although this was the "goal" with a "threshold" of 2x3 $km^2$) while SCIAMACHY had the largest at 30x60$km^2$. Regardless of exact numbers, these pixels sizes are orders of magnitude larger than those of GHGSat, but Jacob et al. (2016, Table 2) showed that the proposed missions CarbonSat and GEO-FTS have point source detection thresholds (0.80 and 0.61 tons/hour, respectively) that are much closer to GHGSat (0.25 t/h) that SCIAMACHY (68 t/h) or

GOSAT (7.1 t/h) due to a greater emphasis on measurement precision. An additional sentence somewhere to clarify the differences in precision would enhance understanding for the reader. Furthermore, it might be useful to make one more distinction, the difference between imaging missions (GHGSat, TROPOMI, SCIAMACHY, GeoCarb . . .) and non-imaging missions (GOSAT, MERLIN). Imaging data have clear advantages for point source work, yet the word 'image' never appears in the manuscript, aside from the references.

P2, L1: Can the authors confirm whether 10x10 $km^2$ is indeed correct, since multiple other documents (for example Germain et al., 2017, McKeever et al., 2017 etc.) say 12x12 $km^2$.

P3, L6: Worden et al. (2013) is missing from the reference list.

P4, L3: Subsection 2.2 should be "Source pixel method".

P7, L5-16 and Figure 2. This is a very useful and important result that helps to differentiate between the different challenges in quantifying $CH_4$ and $CO_2$ sources, and the necessary observations and techniques for source estimations.

P8, L27: Additional clarification on the methods of median filtering and Gaussian filtering would be helpful here.

P9, L1-4: The square root of the area seems like a better measure of 'size' than perimeter.

P10, L15-16: The assumption here is that a snapshot of the emissions is representative of the mean annual emission rate, i.e. the intra-annual variability is insignificant or the observation is near the mean of a predictable intra-annual variability, but it is possible that neither of these may be the case depending on the nature of the methane source.

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