

***Interactive comment on “2010–2015 North American methane emissions, sectoral contributions, and trends: a high-resolution inversion of GOSAT satellite observations of atmospheric methane” by Joannes D. Maasakkers et al.***

**Anonymous Referee #1**

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**GENERAL**

This is an excellent, well-crafted and important paper. The findings have significant implications for our understanding of US, Canadian and Mexican methane emissions. They also draw attention to knowledge gaps – for example in quantification of methane fluxes from wetlands. The methodology is detailed and convincingly performed: assuming there are no unexpected errors of computation the results should be sound

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and uncertainties appropriate, given the limitations of the data. The work should be published after minor revisions.

**SPECIFIC**

P2 Line 5 – Very dated flavour to this - maybe add some more up to date work later than Kirschke et al. 2013 - for example Saunois et al papers, and also perhaps recent measurements of global growth. P2 L20 – P3 L7. These paragraphs have a sense of being written a long time ago and only given a quick brush-over update with the addition of brief cursory mentions of the work by Lan et al. 2019 and Bruhwiler et al. 2017. For a non-North American readers (this is a European journal), it would help to give more discussion in these paragraphs to these two recent and important studies. P3 L33 – P4 L1. How much does the cloud cover problem affect GOSAT sensing of wetland emissions? In the equatorial tropics the cloud cover is essentially 100% all through the rainy seasons so it's hard to argue that the cloud-free periods are representative: indeed, they may be warmer. In North America however, with weather system passages, it could be argued that cloud-free episodes are disproportionately in cool clear weather when moisture (and methane) advection is least. Thus GOSAT may disproportionately observe low flux periods. P4 L11 Table 1 – please can this table also estimate the Soil Sink, which is passed over in this Table and not well discussed in the paper as a whole (see also P9 L15). P4 L15-18 – For the priors, the Canadian data are from a business consultancy ICF, and are not from a governmental or peer reviewed source. Thus the use of this data set needs to be defended. Why is this ICF inventory preferred to the Canadian governmental data – does this choice of prior imply that something is assumed to be wrong with the Canadian UNFCCC submission? P4 L5 – Is Fung et al. 1991 the most recent information about termites? P5 L1 – the authors will be aware of the recent publications challenging these estimates of seepage and implying they are much too high. It would be useful to comment on why the higher values are chosen, as they are fairly hard to defend given the ice core evidence. P5 L18 – for those of us not familiar with this correction, maybe add a little justification of

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the term – does this reflect the Brewer-Dobson circulation? How much impact on North America is there from 1. the polar vortex downwelling of low methane air, and 2. major convective systems upwelling in the Gulf of Mexico region? P6 Table1 Open fires – ‘natural’ – though most are human lit. I’m surprised Canada is only 60% of the CONUS: it has some pretty big fires! Seeps number seems too big. Gas distribution in Mexico 0 and production in Mexico 01.? The ICF and IMP data sources are rather old – I wonder if they ‘look back’ a longish way. Are these priors valid for 2010-15? (NOTE – these comments were written before seeing Fig. 4) P10 L8-9 q10 and CH4:CO2 discussion is interesting and might be worth extending a little as it’s important. P11 L108 are significant and the Figure is important and very useful. P12 L8 – 30% lower. Has there also been a reduction in deliberate venting and inefficient flaring? P13 Table 2 is very valuable. P14 L11 – Aha!- at last a brief further comment on Lan et al. It would help to mention Lan et al rather more in this paper. From the European perspective both the Lan and Bruhwiler studies seem to be important and well worth more discussion. P14 L16-17. This is very depressing that landfill emissions are not decreasing. That surely implies a regulatory failure of some magnitude? P14 L18-31 Likewise this paragraph seems to imply that there has been little improvement in practice and technology over the period of study and that all emission changes are due to production shifts (for example to the Marcellus). Is this really so? Have leak and vent reduction efforts and technological improvements really had so little impact? P14 last paragraph and onto p15 – Canada is trying hard to reduce methane emissions – is the emission decrease really only due to production shifts and not to the regulatory and technical changes? Has government action really had no impact? P15 L34 – Separating Urban emissions from wetlands is a global problem as so many cities are in deltas. This is probably beyond what is possible from satellites and needs in situ and aircraft field data - both isotopic sampling and vehicle based mapping.

CONCLUSION. This is an important paper, well written and with significant findings. It should be published after minor revisions

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