

Interactive comment on “Quantification of Methane Sources in the Athabasca Oil Sands Region of Alberta by Aircraft Mass-Balance” by Sabour Baray et al.

Anonymous Referee #1

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Summary/General comments: Baray et al. present aircraft measurements made around the Athabasca Oil Sands region and employ multiple mass balance approaches to quantify methane emissions from the entire region as well as individual facilities/components to the region. They also use multiple trace gases to attribute to specific processes, and compare results with reported inventoried emissions. This paper is well placed in ACP. This paper contributes to our understanding of methane emissions from a unique but potentially high impact source region. Overall this is a well-written paper, a very nice/ sound analysis, and I enthusiastically recommend publishing with only a few minor suggestions.

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Minor comments: Page 4, lines 1-20: this introduction portion is long and dedicated to the recent confusion about global methane and global methane trends. While accurately written, I don't think it is helpful for this paper. Addressing methane emissions from the oil sands is not going to help with these large questions, and motivating the oil sands emissions does not need invoking some the global decadal confusion, but instead could be better motivated focusing on the work in the last 10 years attempting to address methane emissions from the oil and gas production sector, where large discrepancies have been found and this work contributed nicely.

Throughout: Please change the units for methane from ppm to ppb. It is standard to work with methane in ppb, and as the signals observed and discussed make more sense to see in ppb than ppm, this change should be made throughout.

Figure 1: Would help a lot to have spatial scale on these figures. Also would be useful to have some wind arrows indicating what winds look like on each of these flight days.

Figure 3 (and applies to other plumes): I would like to see what the correlation looks like between different gases within each designated plume. Some tracer-tracer plots with the different plumes shown would be helpful to show/establish how robust the correlations are for each of these tracer-tracer relations.

Page 16, Lines 1-18 as well as Table 1: I'm a little worried about the ethane:methane analysis and would like more supporting information. Smith, Kort, Karion et al., 2015 ES&T used continuous ethane:methane measurements over the Barnett Shale and showed that using limited, discrete flask samples could lead to erroneous ethane:methane ratios. It would help if the authors showed on the time series plot illustrating the plume where in the plume(s) the flasks were collected to help illustrate what the flask ethane may be representative of. The limited discrete samples may have been sufficient, or there may be important gaps causing an uncertainty in how much ethane in fact was emitted – at this point I cannot assess this and this should be improved.

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Page 18 Line 6: The vertically varying background can be troublesome/worrisome. It would be helpful to see the profile that is used here and understand how variable the background is.

Page 26, lines 1-2: Should specify the seasonality of fugitive emissions from this unique oil sands source are unknown, not fugitive emissions in general.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-925>, 2017.

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