

## ***Interactive comment on “Estimating regional fluxes of CO<sub>2</sub> and CH<sub>4</sub> using space-borne observations of XCH<sub>4</sub> : XCO<sub>2</sub>” by A. Fraser et al.***

**Anonymous Referee #1**

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General comments:

This paper describes how ratios of XCH<sub>4</sub>:XCO<sub>2</sub> from GOSAT can be used to constrain CO<sub>2</sub> and CH<sub>4</sub> emissions using an inversion scheme. This is an innovative use of GOSAT data, particularly given that the ratios are less sensitive to errors from interfering aerosol and clouds and provide enhanced coverage. Results are presented for OSSE's; these results are illuminating and highlight the need for use of surface data to better constrain the inversion and make the best possible use of satellite data. The paper is clearly written and is appropriate for publication in ACP. The authors clearly state what the limitations of the satellite data are and the difficulty of the problem at hand. Providing a bit more description would be helpful to the reader. For example:

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Section 2.1: Please include a few more details on the filtering of GOSAT data instead of making the readers hunt for it in other publications. For example, a few key sentences from Parker et al. (2011) on the cloud filtering would be helpful. Also, please point out here that data over oceans are not used. It would be nice to briefly describe validation of data with TCCON, even if the versions or quantities are not exactly the same. This section reports that Fraser et al. (2013) used “the previous version of the data.” Please provide more details on the differences between the versions (do you just mean XCH4 or is it more than that?).

Section 3.1: Please list the resolution of the GEOS-Chem model here rather than later (from Sect. 3.2, we find that it is the same 4 x 5 degree resolution of the GEOS-5 meteorological data). Please give a general reference for GEOS-Chem and GEOS-5.

Section 3.2: More detail is needed here. For the prior error covariances, please state that the values were empirically chosen if this is the case or provide more detail for the estimates of these numbers. For the GOSAT observation error covariance, it is stated “For GOSAT, we use the provided measurement error.” Who provided this error? Is it the radiance error propagated through to retrievals? It is also stated “When we average we sum these errors in quadrature.” Please be more specific, average what and which errors?

p.15875, L12: Please explain why this is “as expected”.

Technical comments:

Figs. 4-6: The captions are very long, repeat information from the figures and the text (and each other). They can be shortened with no loss of information. For example, it is not necessary to repeat in Figs. 4 and 5 that “The model has been sampled at the time and location of the GOSAT observations, and convolved with scene-dependent averaging kernels.” This information is already provided in the text and doesn’t need to be repeated. You could just say “see text for more details”.

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Fig. 4 caption: Please state that the variations are computed about the “annual” mean values as in the text (or just say see text for details).

Fig. 5: The lines are sometimes overlapping for XCH4 and XCO2. I think it would be better to put these on separate panels. There is a lot of white space in the ratio plots that could be reduced. It's not clear how useful the correlation coefficient is when there is not much variability (i.e., low values do not necessarily indicate a poor result). Since the correlations are not discussed in the text, they could be removed.

p.15879, L15-16: Subject-verb plurality does not agree.

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