

## ***Interactive comment on “Satellite observation of atmospheric methane: intercomparison between AIRS and GOSAT TANSO-FTS retrievals” by M. Zou et al.***

**Anonymous Referee #2**

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Overview of review : This paper described the intercomparison results of methane profiles and its total column density between AIRS and GOSAT TANSO-FTS, the methane profiles were retrieved by thermal infrared spectral range of both instruments. The results showed the influence of Averaging Kernel through the comparison, it was found that the AK reduces the difference. The results also showed that the methane mixing ratio at 300-600hPa from AIRS and GOSAT TANSO-FTS was good correlation. The methane total column amounts at the tropics and the southern hemisphere was good agreement within 1%, however, at the mid- and high- latitudes in the northern hemisphere, the methane total column from GOSAT TANSO-FTS is 1-2% lower than that from AIRS due to mainly small degree of freedoms of GOSAT TANSO-FTS. The

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seasonal cycle (its amplitude/phase) was good correlation except at middle-latitude in northern hemisphere. The manuscript was written well, that means, the basic necessary information were existed, and provided the useful information of methane profiles and total column amount through validating two data sets each other. However, the credibility in the part of the used data is weak. In the validation or comparison study, the reliability of one of the data sets should be secured. At the final paragraph of Section 5, the authors mentioned the comparison study with aircraft measurement. The results from Xiong et al. [AMTD, 2015] should be added to the manuscript, which already discussed the validation of AIRS V6 methane data with aircraft data. If there is the paper describing the quality on GOSAT TANSO-FTS TIR, add it to the manuscript. In addition, to make the reader easier understand, this reviewer recommends the following modifications (mainly for figures).

Minor corrections : p.10553, subsection 2.2: Added the influence of cloud contamination in GOSAT TANSO-FTS footprint, if the cloud influence is large. p.10554, l.23: In Figure 1, the GOSAT TANSO-FTS footprint is so thin color, it is difficult to see the distribution. Is Figure1 necessary? Please revisit the other description of data number difference. p.10554, l.16: August 2010 to June 2012 is “almost” two-year period. If possible, added the analysis period to July 2012 or longer. p.10556, l.3: On Figure2, added the average profiles and standard deviation. It is easier to see the difference of profiles between AIRS and GOSAT TANSO-FTS. p.10556, l.12: Why did you choose this location? Were the results at the location the typical characteristic on the global? Please add the explanation. p.10556, l.26: On Figure 5, the latitudinal average of DOF of GOSAT TANSO-FTS is lower than 0.61. Please be clear the value. p.10557, l.20-24: Please modify Figure 6 as follows. It is more helpful to understand that Fig6a is put to X- and Y- axis of Fig6b as PDF distribution. p.10558, l.12: Does ‘direct’ means ‘without AK smoothing’? Please refine the description. p.10559, l.6-9: On Figure11, how much significant the difference between the 5% and 2% STDs is? p.10560, Section5: Added number of Figure that leads the results, for example put Fig.5 at the end of the second paragraph (l.14), Fig.2 at l.16 and Figs 7and 8 at l.21.

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Technical corrections : p.10558, l.23: to June? 2012 p.10558, l.26: attitudes -> latitudes Figure 4: Turn the y-axis upside down. Figure 5: Put the x-axis label, Latitude. Figure 6: Describe the red line explanation Figure 7: The unit (ppbv?) is absent. Please fix the unit in other figures. The data is on 4 September, 2010?

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