Dear Mr/Mrs,

We thank the referee for the constructive comments and helpful suggestions to improve this manuscript. We respond to each of the review comments. The original comments made by the reviewer are numbered and typeset in italic font, whereas our response is printed in normal format.

1. *The authors state that since AIRS CH4 has already been validated and cite Xiong et al. (2015). It would be helpful to the reader if they briefly summarized the validation results, in order to provide context for the AIRS TANSO-FTS comparisons.*

Some description was added in the context "Validation to AIRS V6 CH_4 data were recently made using ~1000 aircraft profiles (Xiong et al., 2015), and the results show the mean biases of AIRS CH_4 at layers 343-441 hPa and 441-575 hPa are -0.76% and -0.05% and the RMS errors are 1.56% and 1.16%, respectively. Some correlation of the retrieval error with Degree of Freedoms (DOFs) was also found, and the errors in the spring and in the high northern latitudes are larger than in other seasons or regions.

2. *A reference and a brief definition of the AIRS cloud clearing would be helpful.*

A new definition and reference (Aumann et al., 2003) has been added for AIRS cloud clearing.

3. *Orbit information on GOSAT should be included, as it was for AIRS.*

We added more detailed description on GOSAT and instruments in the context.

4. *A companion difference plot to Figure 2 would be helpful.*

We have added the plot of difference in Figure.2.

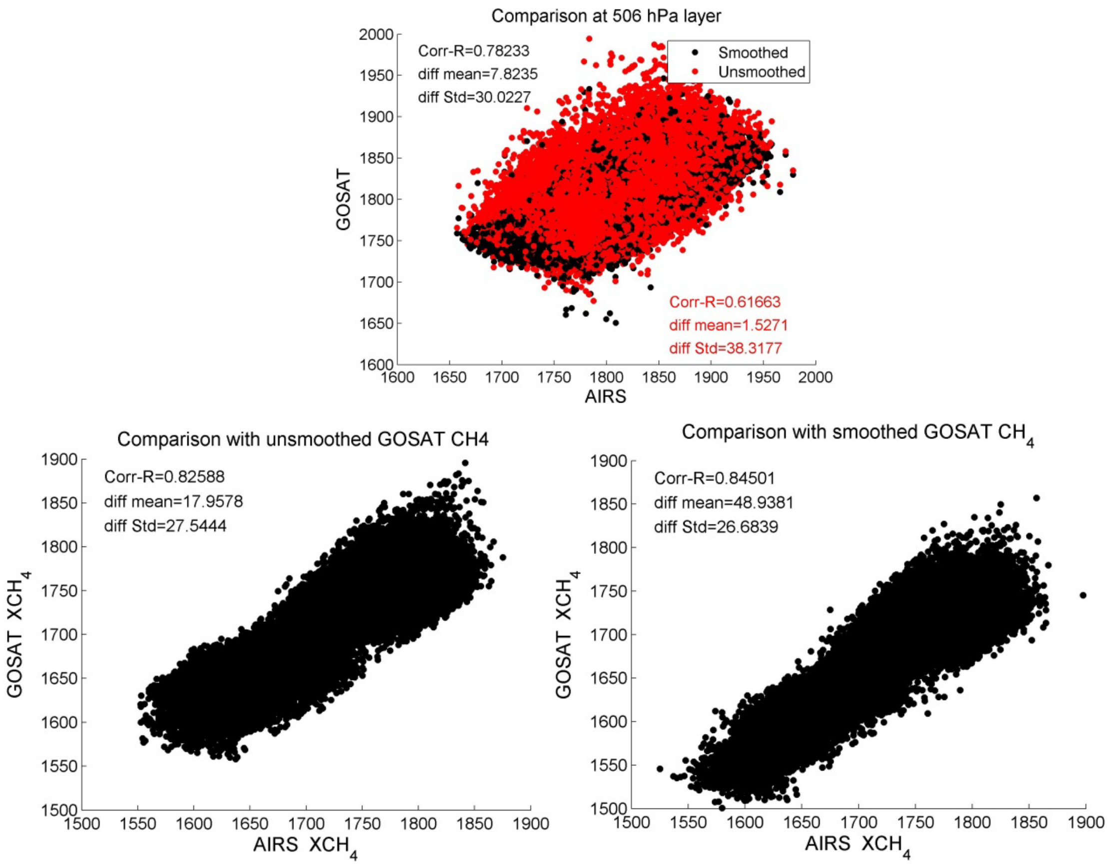
5. *Provide equation 14 from Rodger and Connor, and explain why the RMS and chi_square results indicate good consistency*

Equation 14 from Rodgers and Connor is added in the text.

Since it is hard to get the common xc, Sc, the a covariance matrix S_{AIRS} and $S_{GOSAT,}$ we used the Averaging Kernel and first guess of AIRS CH4 to calculate a smoothed version of GOSAT profile based on Eq.(4), where we treated GOSAT profile as the true profile. Then we calculated the difference between AIRS profile and the smoothed version, and the chi-square. And the correlation coefficient R^2 between RMS differences and chi-square is 0.51. So we think they have good consistence

6. *The authors compare the AIRS and TANSO-FTS level mixing ratios and column averaged mixing ratios using the Rodgers and Connor approach, state that the differences are smaller when the smoothing is applied, then decide not to smooth the data in the rest of paper. This seems rather pointless; the fact that the smoothed results are in better agreement is not surprising, as this process removes, or at least reduces, various sources of difference (vertical sampling, different a priori, different constraint). As another reviewer 1 has already stated, it would be much better to show all results using both methods.*

Based on this suggestion, we tried to use AIRS averaging kernels to smooth GOSAT CH4 profiles (2010.Aug~Sep), then compared the CH4 total columns calculated from the smoothed GOSAT profiles with AIRS. We found that, not like the comparison in the most sensitive layer that shows the difference is much smaller and correlation is much better using the AK smoothed profiles, the total column using the smoothing is just slightly better than without smoothing. This is understandable since the amount of CH_4 in the troposphere constitutes most of the total column, but both AIRS and GOSAT FTS have little sensitivity in the troposphere. Here, we can show the comparison of smoothed GOSAT data to AIRS using two months' data. Considering the smooth with AIRS averaging kernels make little difference comparing to the unsmoothed data, we did not add smoothed total columns in section 3.3 and thereafter.



7. *More detail on obtaining the total column for the TANSO-FTS should be provided,as using surface pressure alone is not sufficient.*

We have modified the text. Pressure profile **P** and surface pressure $\mathbf{P_0}$ are used to convert GOSAT-TIR CH_4 profile **X** to total column Tc. First, pressure gradient is calculated as $\Delta P_i = P_{i+1} - P_i$, and *i* denotes layer number; the formular to calculate Tc is :$\text{Tc} = \sum \Delta P_i \cdot X_i \,/(P_0 - P_T)$, where P_T is the top layer pressure. Pressure profile is included in the GOSAT-TIR product.

8. *I. The comments on the source of the uncertainties over the high southern latitudes need to be justified. When does the snow/ice coverage peak? Are the data south of 60S taken mostly over ocean? What do the authors think is the source of the differences between AIRS and TANSO-FTS at these latitudes? Surface emissivity? View angle? Different a priori? Given the low DOFS the latter is probably very important, and the Rodgers and Connors approach would probably show this.*

We revised this sentence. All the above factors can contribute to this difference.

9. Page 10556, line 9: Don't you mean rows instead of columns ? (Rodgers,2000, page 47)

We changed it.

10. *Figure.6: X-axis name? still one day of data?*

Figure.6 used one day data (2010.09.04) to calculate the RMS difference and error chi-square of AIRS and GOSAT-TIR CH_4 data. The X-axis is sample number. According to referee comment 2, we replot Fig.6(a) to a histogram graph.

11. Figure 7: smoothed and unsmoothed data? One day of data?.

Figure.7 used one day data (2010.09.04) and we added it in the caption of the figure.

Technical Corrections:

Texts and figures have been revised following referee's comments.

A copy of the manuscript with tracked change as well as a clear version is submitted.

Best Regards,

Mingmin Zou and all co-authors.