Our responses to reviewers are in blue.

REFEREE #1
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General comments: The paper utilizes high-density vertical profiles of CH4 measure- ments from HIPPO aircraft campaigns to validate the TES retrievals (V004 and V005), and assesses the dependence of TES mean biases and residual standard deviations on the size of the spatio-temporal coincidence windows. In addition, the authors re- port that the calculated residual standard deviations are larger than theoretical errors. Based on the validation results, the authors have performed an inversion study using pseudo data to evaluate the utility of the TES V004 data in constraining CH4 sources. This paper, well structured and well written, provides a useful guidance for the application of TES methane retrievals, and should be published after addressing several concerns in the analyses described below.

1)The CH4 concentrations above the Gulfstream V ceiling (8.5 – 14 km) are extrapolated using the TES a priori profile shape, which introduces an error in the observed profile (Equation 3); however, this is ignored in the analysis. Note that this error could be significant as the CH4 concentrations are much lower in the stratosphere than in the troposphere. What is the impact of this error on the retrievals yR, yU, and yL?
In sections 3.2 and 3.3, we now use observations of stratospheric CH4 to infer impact of extrapolation error on the retrievals.

2)The error on each individual retrieval yR, yU, and yL is not given, and only the mean and standard deviation of the diagonals of the TES observation error covariance matrices are given in Fig. 6. By missing this error, one cannot judge whether each individual bias is significant or not, which could be one of the reasons why the residual standard deviations are independent of the size of the spatio-temporal coincidence window.
We have now added 1-sigma theoretical error bars to the individual comparison points in figures 4 and 6. In section 3.2, we now note that "As seen in figure 4, the error for individual retrievals is typically larger than the theoretical error"

3)The residual standard deviations for both TES V004 and V005 validation are significantly larger than the self-reported (or theoretical) errors, and the authors also state that a uniform scaling of the observation error covariance matrix is needed. That is to say the theoretical ones are underestimated. Is there a chance that the residual standard deviations are overestimated, due to inclusion of retrievals with large uncertainties?
By inspecting figures 4 and 6 with theoretical error bars included, one can see that the residual standard deviations are not inflated by retrievals with particularly large uncertainties.

4)In the inverse analysis, the authors conclude that V004 is of limited value for constraining methane emissions, based on TES retrievals with standard deviation of 40 ppb. Can the authors say something about the threshold using the existing model setup, i.e. at what error level the retrievals may be useful in constraining regional methane emissions?
Added information about the observational error covariance matrix to section 4, "We calculate 44.6 ppb RRE from each TES observation used in the V004 validation and use this value to

populate the diagonal of $\mathbf{S}_e$. From the residual difference between HIPPO and GEOS-Chem RTVMR, we estimate model and representation error of 16.3 ppb, confirming that observational error is dominated by instrument error."
Added to the final paragraph of section 4, "Improvement in the OSSE results can be achieved by reducing V004 instrument error to around 16 ppb. However, further improvement will be limited by model and representation errors. "

Detailed Comments
Page 27891 Line 13, change "a priori" to "a priori" or "a-priori", and to other occurrences
We don't understand the request.

Line 15, Bowman et al. (2006) is missing in the References
Line 16, Payne et al. (2009) is missing in the References
References added.

Page 27892 Line 14, change "V005 DOFS are . . ." to "V005 DOFS is"
Done.

Page 27894 Line 2, specify "the nearest profile in space and time", which has a higher priority? Space or time?
We modify the sentence in question to read, "Where a single TES observation is coincident with multiple HIPPO profiles, we match it to the nearest HIPPO profile in time and space, weighting time and space equally within the coincidence window."
Line 3, add a comma after "yL", before "and yU"
Fixed this occurrence and others.
Line 20, remove a redundant period after "1.1%"
Done.
Line 22, Boxe et al. (2010) is missing in the References

Page 27895 Line 10, remove the period in "t.he"
Done.

Page 27903 Fig. 1, add annotations to the x-axis on the right panel as well
Done.

Page 27904 Fig. 2, pressure values in the right panel are not put at the exact places.
Done.