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Atmospheric Measurement Techniques Discussions

Interactive comment on "Long-term stability of TES satellite radiance measurements" *by* T. C. Connor et al.

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<Overall comments>

Overall TES calibration is excellent for four years on orbit. The

analytical method is clearly described. It is worth accepting.

On behalf of the authors, thank you very much for the helpful comments and thorough review. We appreciate your hard work and effort. Below, we have addressed each of your comments. In addition, we have modified the text of the paper to reflect your helpful insights, where needed.

<Scientific comments>

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Interactive Discussion

Discussion Paper

(Page 1728, line 3). The comparison is limited to low latitude and window region. When the authors compare mid/high latitude or low temperature target at upper atmosphere (or high temperature if the instrument has non-linearity), how accurate and stable is the TES radiometric calibration?

The reason for not comparing SSTs at higher latitudes is that the buoy density drops off at higher latitudes, whence the accuracy of the buoy SST drops off. We limited our analysis to within $30^0$of the equator to match the analysis that was done for AIRS (which is 15 minutes ahead of TES on the A-train constellation). For colder scenes, in the upper atmosphere, there is a dearth of data against which to validate, and also the environmental conditions can't be specified to the accuracy of something like the RTGSST. There is a connected effort ongoing to compare TES radiances to AIRS radiances across the spectrum, which will assess the performance of the instruments at lower temperatures relative to the AIRS instrument (the reason for comparing to AIRS is that they are both on the A-Train of satellites and have near coincident (fifteen minutes apart) measurements). So, this is an excellent question and we continue to investigate them as part of the ongoing work.

Brief comments on expected accuracy or description of the reason why window region is enough are needed. Especially if TES data used for CO2 and CH4 monitoring, global data including high latitude and cold target at high altitude is important.

Great question, the window regions are the logical first place to look because they are free from other confounding issues, such as atmospheric mischaracterization and the consequent large modeling errors. The expectation is that if no drift is found in the window regions, then there should be no drift in the radiances. The ongoing comparison between TES radiances to AIRS radiances (as mentioned above) will also help establish that the radiances are consistent over time.

(Bias and standard deviation such as in Page 1726 line 4). The source of the bias is thought to be caused from the instrument performance on-orbit. Is my understanding

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correct? If so, what is the major error source? Is it onboard black body? On-orbit, when the authors calibrate with the blackbody and deep space time, ideally there is no change with time in systematic error. What is the possible error source? Is it temperature sensor degradation of the blackbody if it exists?

These are great questions. The answers are found in the TES Validation Report found at: [http://tes.jpl.nasa.gov/uploadedfiles/TES_Validation_Report_v30-1.pdf]

The objective of our study was to find out if the radiances were trending – or alternatively, if the bias was changing.

If the authors briefly explain how the optical bench warming makes optics well aligned, readers can understand easily.

Yes, the Shephard et al. (2008) study also contains a description of the procedure used to warm up the optical bench, which was used to adjust and maintain the alignment of the beam splitter in December 2005. The procedure increases the integrated spectral magnitude thus providing a fourfold increase in the signal-to-noise ratio at higher frequencies, particularly band 1A. We have added this to the manuscript.

<Technical comments>

(1) (Page 1734, line 1). The deviation cycle of 180, 360, and 540 might be caused by the instrument seasonal cycle thermal condition. Is it correct? Brief explanation on cause of the seasonality is helpful.

This is a great question - we received a similar question from Referee 1. It is our assumption that it has to do with the seasonal variability in clouds, which was pointed out in: [Aumann, H. H., S. Broberg, D. Elliott, S. Gaiser, and D. Gregorich (2006), Three years of Atmospheric Infrared Sounder radiometric calibration validation using sea surface temperatures, J. Geophys. Res., 111, D16S90, doi:10.1029/2005JD006822.]. Although there are tight constraints placed on which data we select, there is always the chance that there is some cloud in the scene. There are seasonal signals in the for-

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mation of clouds in the tropics and this is the most likely candidate for the observed pattern in the differences between measured and calculated.

(2)(Page 1743) Unit in Figure 1 is not clear. What do 'counts' mean?

The counts indicate the number of observations falling within the $1/2^0$x$1/2^0$ grid box, which is a colored pixel on the figure.

(3) (Page 1748-9) Fig. 6-7. Jan. 201 $>$ Jan. 2010

Thanks for pointing this out. We will fix this in the manuscript.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1723, 2011.