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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterization of Tropospheric Emission Spectrometer (TES) CO_2 for carbon cycle science" *by* S. S. Kulawik et al.

Anonymous Referee #1

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In this paper the authors perform a thorough analysis of initial carbon dioxide (CO2) retrievals from the Tropospheric Emission Spectrometer (TES). This retrieval is mainly sensitive to mid-tropospheric CO2 amounts, with the authors focusing much of their analysis on the 511 hPa altitude where the sensitivity from the measurement was found on average to be 45%.

The retrieved CO2 values were compared to a variety of other CO2 datasets including surface measurements, in situ aircraft measurements and modelled data.

This paper goes on to give the results of a study aimed at identifying the potential benefit on the uncertainty in CO2 flux estimates from incorporating the TES CO2 data on various spatial resolutions and finds that a reduction in uncertainty of up to 70% is achievable over certain regions.

General Comments

The work presented in this paper offers a thorough examination of the TES CO2 results. Retrievals of CO2 in the thermal-IR prove a significant challenge and the authors recognise this fact and hence go into considerable detail in their comparisons. The TES CO2 was found to largely agree with the other datasets but where differences did occur, reasonable explanations were offered in the text. The majority of issues with this work lie with the clarity of some of the figures (and are addressed in the specific comments below).

When the comparisons are performed (P27425 and Figure 12), it is stated that the agreement is within 2 ppm for all datasets. However, for the Southern Hemisphere this value is of comparable magnitude to the seasonal cycle and in fact for Jul-Dec the TES results appear to be considerably different to the other measurements, enough so that they should be commented upon in more detail.

Specific Comments

P27416 – 1-4: The authors state that the degrees of freedom available for CO2 could be increased if more windows were included to independently determine temperature, h2o, etc and that averaging to reduce measurement error could be performed but it is not clear whether this has been attempted and if not, the reasons for it. A brief comment to clarify this would prove useful.

P27420 – 9: Reference is made to the different versions of TES radiance data (v003 and v004) and that this affects the observed bias in the retrieval but the differences between these data versions is not mentioned apart from that v004 includes a frequency calibration update. A comment/reference regarding any additional differences and the reasons why these affect the bias should be included if possible.

Figure 2 – Due to the large amount of information being conveyed, this figure would benefit from a key/legend in addition to the caption. The large black border outlining

the image could be reduced in thickness.

Figure 3 – Rather than “dRadiance”, the units should be included on the y-axis.

Figure 4 – The colourbar on the right-hand plots partially obscure the y-axis (which I assume is altitude). This should be correct so that the y-axis is visible.

Figure 5 – The caption does not specify which geographical regions or time periods these averaging kernels are for or how many retrievals these have been averaged for. In addition, as thermal contrast is important over land, whether these are daytime or nighttime retrievals becomes important. Additional detail in the caption would be useful and some of these issues may need to be clarified in the text when commenting upon the sensitivity of the retrieval. The fact that the surface AKs actually peak at 500 hpa should also be commented upon.

Figure 9 – It is not clear from the caption what “TES-swap” refers to in the legend.

Figure 15 – The size and layout of this figure requires some improvement with both the colourbar and the map plots themselves too small.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 27401, 2009.