Atmos. Chem. Phys. Discuss., 8, S12179–S12185, 2009
www.atmos-chem-phys-discuss.net/8/S12179/2009/

Atmospheric Chemistry and Physics Discussions

ACPD

8, S12179–S12185, 2009

Interactive Comment

Interactive comment on "Identifying convective transport of carbon monoxide by comparing remotely sensed observations from TES with cloud modeling simulations" *by* J. J. Halland et al.

J. J. Halland et al.

Received and published: 8 May 2009

Final Author Comments

REFEREE 1

General Comments (largest concern):

The difference between observed profiles 7 and 10 in Fig. 19 is partly due to the difference in the a priori profiles. However, a much greater issue is that the squall line is not totally uniform along its length, and the location of the TES axis is not at a constant distance from the squall line (the axis intersects the squall line). The revised discussion of the figure mentions these issues and provides our best attempt to quantify the role of the a priori. The Logan et al. (2008) reference also is cited, as the reviewer suggests.

Specific Comments:

Page 19202, Line 14, This was an oversight on our part. The results section of the revised manuscript describes the sensitivity tests on which this conclusion is based.

Page 19205, Line 26; We agree and have removed the statement about completely different technology

Page 19210, Line 24; We have added material to Section 2.6 to answer the reviewer’s questions.

Page 19211, Sect. 2.6; We have made the two suggested wording changes, and added material to make this section more informative.

Page 19214, Line 17; Equations 2) and 3) were used to calculate the values in Table 2. Notice that values for specific levels are input. The time period of calculation is now stated in the text, and the caption for Table 2 has been modified to make this clear.

Page 19217, Line 15; We are referring to the difference between the temperature and dew point profiles used in making the actual TES retrievals vs. the single profile that we used in the simulated retrievals. We have re-phrased this sentence to clear up the confusion

Technical Corrections

Page 19213, Line 28; We have changed the wording as the reviewer suggested.

Page 19214, Line 4; Equation 2 now is written in mathematical symbols. Dickerson (2005) is listed in the references. It is a website.

Page 19233, Fig. 5; We have changed the title to Updraft Speed&. This is a better term than vertical velocity when referring to thunderstorms

Page 19234, Fig. 6, Min; has been removed. Fig. 6 was mentioned on line 24 of page

ACPD

8, S12179–S12185, 2009

Interactive Comment

19211. However, we now provide additional discussion since it is an important figure.

Page 19235, Fig. 7 and others; We agree that these figures need improvement. We have reduced margins, deleted reference vectors, increased font sizes and made other changes so they can be seen more easily.

Page 19240, Fig. 12 and others; We have increased font sizes and added - to the first label.

Page 19242, Fig. 14 and Fig. 19; We agree that there is duplication among the a) and b) panels of each figure. We have deleted one panel from each figure.

REFEREE 2

General Comment

Since the general comments are a condensed version of the specific comments that follow. We answer them in the sections below.

Specific Comments

Abstract Page 2, line 22; We have deleted 'or other parameters' in the abstract and conclusions.

Introduction Page 2, Line 26; We have added the oxidation of methane and NMHCs.

Page 3, 1st para; This is good information to add. We have done so.

Page 3, Line 24; We have defined 'ABL' atmospheric boundary layer.

Page 5, Line 26; We have removed the statement about different technology being used. We have clarified that global coverage requires ˜ 10 days due to nadir only measurements. We have added material at the very beginning of Section 2 to briefly describe the squall line case and explain why it was chosen. More detailed information is given later in Section 2.

Section 2 Page 6, Line 23; We now provide a physical explanation for DOFS.

ACPD

8, S12179–S12185, 2009

Page 7; The reviewer's comment has been inserted in the revision.

Page 7, Line 25; We now briefly introduce the squall line at the end of the Introduction(see previous comment). Figure 13 has been moved into Section 2. It should be emphasized that we perform 2-D modeling perpendicular to the length of the squall line. Thus, 'model domain' means the x-z 'cross section' used in the cloud model. The location of the 2-D axis cannot be specified since the squall line is assumed to be uniform along its length. We have mostly eliminated the term 'model domain' in the revision, and where it is used emphasize that it refers to two dimensions only

Page 9, Line 15; The emissions reference is added.

Page 10, 2nd para; This is where Fig. 13 will be moved.

The Goddard cloud model, as well as other models of its type, usually will not accept the 'raw' radiosonde profile of a squall line environment because the associated vertical variations in temperature, moisture, and wind typically are so great that the model 'blows up'. That is what happened when we attempted to insert the actual squall line environment sounding from INTEX-B. Considerable smoothing of the sounding was required before an acceptable version was obtained. As we smoothed the sounding, we noticed that it became similar to those used previously to simulate squall lines. This determination was based on visual inspection and by calculating various meteorological parameters. Therefore, we simply used the previously published sounding. The sounding we employed was as similar to the one actually occurring during INTEX-B as computationally possible. An abbreviated version of the above is given in the revision.

Page 11, Section 2.6; As mentioned above, we introduce the squall line case earlier in the manuscript. Figure 18 does seem better placed in Section 2.6 than later. That clears up the Profile 17 issue.

Section 3 Section 3.1; There were no DC-8 observations that we could compare with because the aircraft never was appropriately downwind of a region of major convection.

The only other way to produce a verification would be to compare TES results with those from another satellite sensor. Although we considered that approach, it did not seem to worth the effort since each retrieval procedure has its own limitations

Page 13, Line 21; Our goal was to state that the winds (not the CO) were near zero speed. We have re-phrased this sentence to use the word ’calm’.

Page 14, Eq. 3; The equation has been re-stated as suggested.

Page 15, Line 8; Instead of ’metric ton’, we have substituted ’tonne’ (1000 kg). We want to avoid confusion with ’ton’ which in the U.S. refers to 2,000 pounds.

Page 16, Section 3.3, para 2; The squall line now is described earlierat the beginning of Section 2. As noted earlier, we have re-phrased sentences so that ’model domain’ is no longer confusing

Page 18, para 2; The reviewer’s interpretation is correct. We have re-phrased this paragraph to make the argument clearer, using some material from the third paragraph.

Cloud clearing would not be helpful because the cirrus anvil of the squall line has virtually no breaks; it is solid.

Figure 13; We agree that the locations of clouds in Fig. 13 do not exactly agree with the missing data in Fig. 18. As noted in the text, there certainly are TES retrievals whose averaging kernel diagonals suggest considerable cloud contamination. Conversely, there appear to be cases where successful TES retrievals could have been made at slightly different locations along the TES footprint. Explaining these occurrences would require very detailed discussions about the operational implementation of the retrieval algorithm. We believe those detailed descriptions are beyond the scope of the current manuscript.

The reviewer notes here and in the general comments that the TES footprint is not directly along the squall line (Fig. 18). However, the reviewer should note that our simulations are two dimensional, perpendicular to the length of the squall line. The

ACPD

8, S12179–S12185, 2009

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

assumption is that the structure of the squall line, including the resulting vertical transport, are uniform along its length. Although this is never totally true in nature, it is a standard assumption in two dimensional modeling. Even if a squall line could occur with no clouds (physically impossible) such that TES retrievals would not suffer from contamination, there would still be differences in retrievals due to variations along the squall line that are not considered in a 2-D approach. The only solution would be to produce a 3-D simulation of the squall line, and that is far beyond the scope of our research. In summary, we do not believe that simulated soundings are feasible along the TES footprint unless 3-d modeling is used. The revised manuscript contains an abridged version of the above lengthy discussion.

The reviewer asks about horizontal vs. vertical resolution. Certainly, nadir only viewing is a limitation. However, if retrieval locations were selected with a 'person in the loop', more actual TES retrievals probably could have been produced near the edges of the clouds. Nonetheless, we believe that vertical sensitivity is the most limiting factor for TES and most other satellite-based remote sensors.

Conclusions We have added additional conclusions about the effects of cloud contamination

We do not understand the reviewer's comment about 'better coverage'. If you mean more closely spaced TES retrievals, then closer spacing would provide more information since retrievals could be made closer to the edge of the storm’s cirrus anvil.

Figures Fig. 14; The two panels are indeed redundant. We have deleted one of them.

Fig. 15 and Fig. 15b; We believe the reviewer's earlier suggestions about deleting certain panels is the best approach. A merger of Figs. 14 and 15 does not seem appropriate to us.

Fig. 18; This is observed radar reflectivity obtained from the National Weather Service.

We state that in the revised caption.

Fig. 19; At the suggestion of Reviewer 1, we have deleted one of the panels. We also have clarified the legend.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 19201, 2008.