Atmos. Chem. Phys. Discuss., 8, S12075–S12079, 2009
www.atmos-chem-phys-discuss.net/8/S12075/2009/

Atmospheric Chemistry and Physics Discussions

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.

Anonymous Referee #2

Received and published: 16 April 2009

General comments

This paper describes the vertical transport of carbon monoxide (CO) by mesoscale convective systems using simulations of a squall line by a 2-D model. It also investigates the capabilities of the TES/AURA instrument to detect such large CO uplifts to the upper troposphere using simulated TES retrievals. The actual TES retrievals in the vicinity of a squall line which occurred during the INTEX-B experiment are finally discussed.

Since the lack of vertical sensitivity is the main drawback of nadir space-borne instruments like TES, this work on the ability of TES to detect large vertical transport is very

interesting for both remote sensing and atmospheric chemistry applications. It clearly states the potential and limitations of such retrievals. Therefore, I recommend publication in ACP. However, I also think the paper would greatly benefit from several minor revisions, in particular in the introduction of the method and in the discussion of the TES retrievals.

The synthetic TES retrievals along the model domain, i.e. along the squall line, clearly show the potential benefit of such observations for the quantification of vertical transport. However, the actual retrievals are not convincing. This is here mainly attributed to the lack of vertical information. However, the TES footprint is not directly along the squall line (Fig. 18). It would be useful to have synthetic TES retrievals along the TES footprint in order to evaluate the impact of the collocation in addition to the impact of the TES averaging kernels. Then, what would an instrument with the TES characteristics but improved horizontal coverage see?

Regarding the method, it is not clear why the authors focused on this specific event in March 2006, especially since the TES actual retrievals in the vicinity of the squall line only show one interesting profile. Also, the link to the INTEX-B experiment is not clear since they are not using any in situ observation from the campaign. The motivation for choosing this event should be given in the introduction.

Specific, detailed comments are listed below.

Specific comments

Abstract.

p.2, l.22: “or other parameters”: never mentioned in the text. Mention it also in the conclusion.

Introduction.

p.2, l.26: CO is also produced by the oxidation of methane and NMHC.

ACPD

8, S12075–S12079, 2009

p.3, 1st paragraph: transport to the upper troposphere has important implications for climate but also for the intercontinental transport of pollution, i.e. for air quality. The longer lifetime but also faster transport (?) means a larger scale impact.

p.3, l.24: 'ABL' not defined.

p.5: l.26: the statement that TES utilizes a completely different technology than previous CO remote sensors is not true. MOPITT also measures in the IR in a nadir viewing geometry, and another precursor, the Japanese IMG instrument used the same kind of spectrometer (cf. Clerbaux et al., 1998; Barret et al., 2005).

The statement that a global survey is performed in $\sim$ one day is also misleading since a global survey does not mean global coverage, which is only achieved after $\sim$ 10 days (?) since only nadir measurements are undertaken. Please specify the revisit time or the number of days for global coverage.

As mentioned in the general comments, I think it would be helpful to have an introduction of the time period chosen for the simulation, why it is interesting and representative. Also, why is it useful to mention that it occurred during the INTEX-B period? Will in situ measurements be used?

Section 2.

p.6, l. 23: explain what a DOFS means physically.

p.7: remote sensing is not ideal and the nadir geometry implies that the information is integrated in the vertical (more vertical resolution in limb viewing but it is also remote sensing).

p.7, l. 25: this is the first time that the time period studied and the INTEX-B campaign are mentioned. It should be introduced before.

This case study could also be introduced in more detail in a specific subsection at the end of section 2 (maybe together with the 2.5 or 2.6 section), with the Fig. 13 clearly

ACPD

8, S12075–S12079, 2009

showing the location of the event. It would also be useful to have superimposed on this figure the model domain.

p. 9, l. 15: give reference for the CO emissions.

p. 10, paragraph 2: again, the reader is a little bit lost. It would be useful to have a map like Fig. 13 to locate the model domain and the squall line that will be studied.

Could you use INTEX B observations for the thermodynamic environment? How do you know that the situation was similar?

p. 11, section 2.6: this section is only clear once the reader has gone through all the results. It would again be much clearer if the squall line / case study was clearly introduced. Maybe Fig. 18 could be moved here.

"Profile 17" does not mean anything at this point.

Section 3.

Section 3.1: Are there INTEX-B observations that could be used for validation?

p. 13, l. 21: background CO values are far from zero!

p. 14, equ. 3: rewrite in a more scientific language.

p. 15, l. 8: remove 'metric' before tons (not useful).

p. 16, sect. 3.3, paragr. 2: again, it would be helpful if the description of the squall line appears earlier in the paper.

Also, the 'model domain' is mentioned at several occasions. Specified clearly what it is.

p. 18, 2^{nd} paragraph: I am not sure to understand the argument. If there is a cloud, then there is no sensitivity within and below the cloud (and also above?). So that in the real world, no information in these regions are useful.

ACPD

8, S12075–S12079, 2009

Would cloud clearing procedures help retrieve these informations?

Section 3.4:

Fig. 13: the missing data do not seem to correspond to clouds in the figure. . . ?

Here, the TES retrieval along the TES footprint is qualitatively compared to the synthetic TES retrievals along the squall line. But it is not exactly the same location. It would be helpful to know if synthetic retrievals along the TES footprint would have the same shape (I guess not). Then what is the most limiting factor: horizontal coverage or vertical sensitivity??

Conclusions:

Cloud contamination issues for should be mentioned in the conclusions.

It would also be useful to know if a better coverage would allow more significant results (in particular with the availability of similar products with much better horizontal coverage like AIRS or IASI).

Figures:

Fig. 14 (a): no variations are observed so maybe this plot is not useful and the profile is enough.

Fig. 15 : Two profiles would maybe be easier to read. This figure could then be merged (as part a) with the AK diagonal in Fig. 14 (b).

Fig. 15b. could then be added to Fig. 16 as reference.

Fig. 18: give origin of the radar reflectivity plotted (observations? Model?)

Fig. 19: clarify the legend.

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