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Atmospheric Measurement Techniques Discussions

Interactive comment on "MIPAS IMK/IAA Carbon Tetrachloride (CCl_4) Retrieval" *by* E. Eckert et al.

Anonymous Referee #2

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This manuscript provides details about a new approach specifically developed to retrieve vertical profile distributions of carbon tetrachloride on the global scale from MIPAS level-1b limb emission spectra, recorded on-board ENVISAT over the 2002-2012 time period, first at full resolution (FR), then at reduced resolution (RR).

As for previous studies, a broad micro-window centered on ∼789 cm-1 is selected, but the authors underscore the influence of PAN on the retrieval, note that while they account for line-mixing effects on the strong CO2 Q-branch at 791.5 cm-1, the fitting of this feature is not entirely satisfactory and that it is preferable to omit the corresponding "spectral slice".

This approach is used to retrieve CCl4 from a subset of the available MIPAS observations, and profiles are retrieved for 09/2003 (FR), 07/2008, 01/2010, 03 and 04/2011 (RR), but it is not clear why these periods have been selected.

The satellite product is carefully characterized in terms of information content and a complete uncertainty analysis is provided, indicating that reliable measurements are available in the 8-25 km altitude range on the global scale, with a vertical resolution which is dependent on (and decreasing with) altitude.

Finally, the new CCl4 cross-section parameters of Harrison et al. (JQSRT, 186, 2017) are tested, and some intercomparisons with collocated (or historical) measurements are presented.

Overall, this is a good manuscript, well-structured and clear, although some figures are desperately small in the present version. It is a useful contribution for a species subject of attention (e.g., SPARC, 2016). The paper is appropriate for AMT and I would recommend publication after implementation of a few changes.

Major comments

- The last sentence of the abstract should be removed, it states "The decline in CCl4 abundance during the MIPAS Envisat measurement period (July 2002 to April 2012) is clearly reflected in the retrieved distributions". I agree that information on (and a proper quotation of) the CCl4 trend would have been a very valuable addition to this study, BUT only a subset of the observations is presented, the periods shown do not cover the 10-year time interval (09/2003 – 04/2011 instead of 07/2002 – 04/2012) and the reader has no element to gauge the CCl4 rate of change and to judge about the validity of this assertion

- Figure 2 shows that the PAN product jointly retrieved with CCl4 is superior to the standard PAN data available thus far from the MIPAS team, it would be equally important to have an idea of the impact of retrieving versus neglecting PAN on the quality of the CCl4 product! In particular, is there a systematic impact on the CCl4 mixing ratios, allowing to close the well-known gap between in situ and remote-sensing data (see e.g. Chipperfield et al., ACP, 16, 2016)? This information would be very valuable for the community and I suggest adding two panels to Fig.2 dedicated to CCl4 with/without

PAN

Specific comments

- Section 4.2: it is somewhat strange that the FR measurements provide a lower DOF (3.5) than the RR observations (4.0). What could be the reason for this? This deserves a comment.

- Figure 7 is really small and the y-axis unnecessarily goes up to 80 km, I suggest limiting the altitude range to something like 0-50 km to improve readability

- Section 5.1.1: ATMOS results are used for a qualitative comparison, but still, why did you use profiles retrieved in the mid-1980s by Zander et al, when the CCl4 spectroscopy was of poor quality? (see Brown et al., Appl. Opt., 35, 1996). Results reported later on by Zander et al. (e.g. GRL, 23, 1996) are very likely more appropriate for a sensible comparison. An alternative would be to use the ATMOS version 3 results available from http://remus.jpl.nasa.gov/atmos/atmosversion3/atmosversion3.html and fully described in Irion et al. (Appl. Opt., 41, 2002)

- Section 5.2.1: the agreement between ACE and MIPAS is best below 15 km (lines 265-266 on page 13), but this is also mostly where the number of coincidences is the smallest (second left frame of Fig. 9). Could this inconsistent sampling have an impact on the statistics?

Minor comments and typos

- The title is not very informative; it could be edited to inform about the fact that first intercomparisons are included in this work

-Page 2, line 22: “in 1987, when it was restricted”: this is incorrect, CCl4 was not among the first species controlled under the Montreal Protocol, it was added to the list in the 1990 London Amendment

- Page 2, line 28: these top-down emissions were evaluated instead of “reported”

- Page 2, line 29, I think a comma is needed after “unreported”

- Page 2, lien 35, here, I suggest replacing “considerably” by “now”

- Page 2, line 37: I would remove the reference to MIPAS here (“besides those of MIPAS. . .”, it is appropriate to introduce the new measurements later on, after the review of previous works

- Page 3, line 65, “as reduced” instead of “is reduced”

- Page 3, line 85: the information about the actual spectral range fitted to retrieve CCl4 is not consistent across the manuscript (see table 1, end of section 3.2...), this should be fixed

- Caption of Fig.2: I guess that the “Black: measured spectrum, hardly discernible because overplotted by modelled spectra” warning has nothing to do here. . .

- Page 7, line 152: I would edit to “of CCl4 for different time periods. All of the. . .”

- Section 5.1.1.: ATMOS also participated to three other shuttle missions, in 1992, 1993 and 1994.

- Section 5.2.: please reword to something like “Since all collocated measurements were retrieved using the spectroscopic data of Nemtchinov and Varanasi (2003) introduced in HITRAN 2000, MIPAS Envisat retrievals based on the same spectroscopic dataset were also used for consistency and in order not to mask possible other discrepancies.”

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