

Interactive
Comment

Interactive comment on “Envisat MIPAS measurements of CFC-11: retrieval, validation, and climatology” by L. Hoffmann et al.

L. Hoffmann et al.

Received and published: 27 May 2008

We thank the anonymous referee for the time and effort spend on reading and correcting the paper. We greatly acknowledge the helpful comments and suggestions. Below please find the reply to each comment (indicated by >>>) and a description of the actions taken.

General comments

The paper reports the assessment of CFC-11 abundances in the stratosphere obtained using MIPAS observations in the first two years of operation. The retrieval of CFC-11 abundances from the measured radiances is obtained using an approximated and fast forward model. Even if yet limited to the two year for which consolidated MIPAS data are available, the analysis provides detailed information on the climatology

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



of this constituent as well as on its time and space variability. This new climatology, that is particularly valuable because of the role that this constituent can have for both ozone recovery and the green house effect, is made available to the scientific community as an electronic supplement to the paper. The paper is clearly written and, apart the few specific issues discussed below, contains exhaustive information about the measurements and the performed analysis. The approximations of the forward model have been validated through comparison with line-by-line calculations and independent retrieval codes. In situ measurements have been used for the validation. Also considering the scientific interest of the results I recommend the paper for publication in ACP with minor modifications.

>>> We thank the referee for these comments.

Specific comments

Pag. 4566, lines 7-22. This discussion of the spectral signatures of CFC-11 is what I expect for a radiometric measurement. It is instead made after the description of the spectroscopic measurement made by MIPAS and before the discussion of the retrieval approach. It is, therefore, difficult to understand the meaning of the quoted interferences. Please consider moving this discussion after Fig.2, as a comment made in the light of the fact that the retrieval uses the approach adopted for radiometric measurements (see next comment).

>>> We agree that the presentation was not clear and rearranged the paragraphs as suggested. We joined the sections 3.1 (CFC-11 spectral signatures) and 3.2 (Forward modelling).

In Sect. 3.2 it is stated that JURASSIC computes the radiative transfer based on the band transmittance approximation. For further details a few references are given. However, it would help the reader if a clarification is made here on whether the mean values calculated by the forward model are those of the spectral elements measured by MIPAS or those of the spectral interval used for the retrieval. The latter seems to be the

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

case, but several points are affected by this uncertainty.

>>> To clarify we added "The mean values calculated by the forward model are those of the spectral windows used for the retrieval." in section 3.1 (new), par. 3.

In Fig. 2 the quantity radiance (844.275 to 850.575 cm⁻¹) could more precisely be qualified as average radiance of band 844.275-850.575 cm⁻¹.

>>> We changed the plot labels accordingly.

Pag. 4573. Discussion about the chi-square-test. I do not agree with this discussion. It is stated that the chi-square-test should provide values around one, however in Fig. 6 values that are much smaller than one are shown without a comment.

>>> To better put the result into a context we rewrote: "However, a peak value near 0.38 indicates that the covariances used are somewhat over-pessimistic. A more detailed analysis shows that both terms of the objective function contribute equally to the observed deviations (distributions peak near 0.17 for the measurements and near 0.15 for the state), i.e. both covariances are affected. Taking into account the more complicated nature of the covariances used in this study we consider the current agreement sufficient."

The normalisation is usually made dividing the chi-square by $m-n$ (the measurements minus the unknowns). For a radiometric retrieval where, most probably, $n=m$ this operation is impossible. Some clarification must be provided in order to understand this unusual chi-square-test.

>>> To clarify, we rewrote in the first paragraph of section 4.1: "The deviations should follow a chi²-distribution with m degrees of freedom. There are $n+m$ measurements, i.e. m radiance data and n a priori data (which are considered as "virtual" measurements), to which n state variables have been fitted." This approach is explained in more detail by Rodgers (2000).

Sect 4.2. I am surprised by the very small differences between the radiometric retrieval

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



Interactive
Comment

and the spectroscopic retrievals. This suggests that the two retrieval approaches not only obtain consistent results, but, most probably, also have the same retrieval error. This is not in agreement with my understanding that the spectral resolution of MIPAS was motivated by the need of reducing the retrieval errors. Could the authors comment on this? Has this something to do with the statement at page 4575, line 10: common retrieval approaches which probably should read common systematic errors?

>>> We added in section 4.2: "Both comparisons with independent retrievals reveal promising results. The comparison with Leicester retrievals confirms that the fast forward model JURASSIC indeed works with sufficient accuracy compared with analyses based on line-by-line forward modelling. In addition, the IMK comparison shows that consistent retrieval results are obtained even if rather different regularisation techniques are applied in the inverse model. The comparisons may indicate that for molecules with broad emission bands like CFC-11 an analysis based on the Envisat MIPAS full spectral resolution radiance measurements will not necessarily improve the retrieval errors. However, the high spectral resolution is essential to study other molecules which can only be detected based on single emission lines."

Technical corrections

pag. 4564, line 14: the the

>>> Corrected.

pag 4566 last sentence. I expect larger signals, and therefore larger S/N at low altitudes.

>>> Since the old sentence was misleading, we rewrote: "Due to the high signal-to-noise ratio at the lowermost altitudes noise becomes a minor source of error and the CFC-11 retrievals are more strongly influenced by other instrument errors or forward model parameter errors."

In Fig.s 3 and 4 the EGA method is not defined.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

>>> We added the definition in sec. 3.1, par. 2.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 4561, 2008.

ACPD

8, S3069–S3073, 2008

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

S3073

