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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Growth rates of stratospheric HCFC-22" *by* D. P. Moore and J. J. Remedios

Anonymous Referee #2

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General Comments

The paper 'Growth rates of stratospheric HCFC-22' by D. P. Moore and J. J. Remedios presents a new HCFC-22 data set for the lower stratosphere region derived from measurements of the Envisat MIPAS satellite experiment. Global data sets of HCFC-22 as presented by the authors are rare, but essential for many scientific applications (e.g. for studies of ozone depletion and global warming). The authors use the standard optimal estimation approach to retrieve HCFC-22 global distributions for selected time periods from the MIPAS radiance measurement. They do not present a validation of their new data set, but characterize the retrieval results by evaluating standard diagnostic quantities. The authors derive bias corrected zonal mean profiles of HCFC-22, estimate the HCFC-22 growth rate from 1994 to 2003 by comparison against ATMOS

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measurements, and finally discuss the HCFC-22 photochemical lifetime. The paper is well written and should be published in ACP after the following specific comments have been addressed.

Specific Comments

page 10516, line 17: CFCs are not only destroyed by photolysis. For some CFCs the chemical decomposition by atomic oxygen is also a loss mechanism, e.g. (Brasseur et al., 'Atmospheric Chemistry and Global Change').

page 10529, line 3 - page 10521, line 7: These paragraphs provide a rather generic description of the standard optimal approach as presented by Rodgers (2000). However, some more concrete information on the actual retrieval problem could be provided. E.g. it would be interesting to know how linear/non-linear the retrieval problem is (e.g. in terms of numbers of iterations required to find a solution). I think it should be explained here or in the following section how the off-diagonal elements of the covariances were set (e.g. zero or auto-regressive model?), i.e. how correlations of errors and a priori are treated in the OPERA scheme.

page 10521, line 7: In order to reproduce the results, it would be necessary to know the exact spectral ranges used for the retrieval of HCFC-22 as well as the total particle extinction. In other paragraphs the microwindow 828.95-829.15/cm is mentioned to provide the information about HCFC-22. Which spectral range is used to provide information about the the total particle extinction or radiometric background?

page 10522, line 11: Please add a reference for the 2% pressure uncertainty.

page 10522, line 12: I was wondering why an uncertainty of 10% was assigned for interfering species instead of using the standard deviations provided by the climatology of Remedios (1999)? The standard deviation of CFC-11 (a major interfering trace gas) is up to 20% in the analyzed altitude range. Hence, it seems more likely that the corresponding retrieval error is underestimated and not overestimated as stated in the

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text?

page 10522, line 22: The authors may also want to point out that the total retrieval error is better than 30% in the best case?

page 10522, line 24 - page 10523, line 7: This paragraph is a bit short and the authors should be more specific. They could point out that the area of the averaging kernels shown in Fig. 3 is close to 100%, indicating that the retrieval results are nearly free of a priori influence. They could also provide some numbers on the vertical resolution of the observations, e.g. by applying the method of Purser and Huang (1993) (or Rodgers, 2000, chap. 3.3).

page 10525, line 9-12: The anomalously high HCFC-22 values in the tropics at 150 mbar require more examination and explanation. As there seems to be no physical reason (dynamics / photochemistry) it may indicate a serious flaw in the retrieval scheme? The high values at 150 mbar will most probably disturb the retrieval at lower altitudes, too (e.g. leading to values to low at 200 mbar). This can be checked for by inspection of the contribution functions. Furthermore, the temperature and pressure uncertainties may be part of the problem as stated by the authors, but do not seem to fully explain the anomaly: Fig. 2 indicates that the retrieval errors due to 2% pressure uncertainty or 1K temperature uncertainty are about 1-2% in the HCFC-22 vmr, but the observed anomaly is about 20%. Did the authors inspect the MIPAS spectra or residual spectra to identify other possible reasons of the anomaly? If the tropical data is not to be trusted at all, it seems better to not discuss them in this paper and remove statements about global values from the text and the corresponding curve in Fig. 4?

page 10526, line 9 and caption of Fig. 3: I think the terms "vertical resolution" (as represented by the peaks of the averaging kernels or the degrees of freedom for signal) and "measurement information" (as represented by the area of the averaging kernels) get mixed up: Concerning the text, how do the authors use the degrees of freedom for signal to filter individual tangent heights as this quantity describes the whole profile?

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Concerning the caption of Fig. 3, the peak values of the averaging kernels do not measure the amount of measurement information (this is approximately measured by their area). The peak values measure the vertical resolution of the observations.

Technical Corrections

None.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 10515, 2007.