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Interactive Comment

Interactive comment on "Subtropical trace gas profiles determined by ground-based FTIR spectroscopy at Izaña (28° N, 16° W): Five-year record, error analysis, and comparison with 3-D CTMs" *by* M. Schneider et al.

M. Schneider et al.

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The authors appreciate all the comments made by the referee. Concerning the recommendations about technical corrections they agree with all. Most of them have already been included in the version accepted for ACPD. In the following the specific comments are addressed in detail:

1) The microwindows were chosen for an optimal retrieval of stratospheric O_3. They are well known by the authors. Their inversion is examined in detail in (M. Schneider

et al., JQSRT, 91, 245-274, 2005). Their main differences to the broad microwindow at 1000 cm^{-1} are as follows: At 780 cm^{-1} the Doppler core is 20 % smaller if compared to 1000 cm^{-1}. Hence, from the viewpoint of pressure broadening, this wavenumber region is more sensible to O_3 variations above 30 km. It is nearly independent to temperature. Further it only contains absorptions of the main O_3 isotope. The authors agree with the referee, that the surface bias for stratospheric O_3 (impact of surface O_3 variability on retrieved stratospheric O_3) is larger for the small 780 cm^{-1} microwindows if compared to the broad 1000 cm^{-1} microwindow. This is simply a consequence of the missing tropospheric sensibility in the former. However, the sensitivity analysis presented in Fig. 8 demonstrates that this bias is not reflected in the retrieval. The reason is that it can be neglected if compared to the impact on the retrieval of the large variations in the stratosphere itself.

Currently the application of the 780 cm^{-1} and the 1000 cm^{-1} microwindows simultaneously is investigated. This may improve the tropospheric sensibility, while maintaining the above mentioned advantages of the 780 cm^{-1} microwindows.

2) All retrievals apply two constraints (see page 5265, line 16-20). (a) a positivity constraint (by transformation on logarithmic scale) and (b) a smoothness constraint (by requiring similarity between retrieved and a-priori slope). For O_3 and HF additional constraints where applied, which force the VMR at the surface and at 80 km towards the a-priori data.

3) To avoid misunderstandings the authors would like to remark, that comparing Fig. 2 with Table 2 is not straightforward. In the former not all interlevel correlations are visible. The measurement error covariance matrix $\mathbf{S_y}$ contains all the information about this error:

$$\mathbf{S_y} = \mathbf{G}\epsilon_y\epsilon_y^T\mathbf{G}^T$$

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Here $\mathbf{G}$ is the Gain matrix and ϵ_y the noise in the spectrum. Fig. 2 only depicts the square root of the diagonal elements of $\mathbf{S_y}$. More accurately it can be presented in form of error patterns, which are the eigenvectors of $\mathbf{S_y}$ multiplied with the square root of their eigenvalues. A linear combination of these patterns with normally distributed coefficients ($\mu = 0$, $\sigma = 1$) 'simulates' statistically these errors, including their interlevel correlations. The values given in Table 2 are calculated by integrating these 'simulated' error profiles, and hence account for all interlevel correlations within the considered partial column. To calculate $\mathbf{S_y}$, not only ϵ_y but also the Gain matrix $\mathbf{G}$ is needed. It strongly depends on the constraints applied for the retrieval. The retrieved O_3 profile is forced towards its a-priori value at the surface. This enlarges the smoothing error close to the surface, but on the other hand eliminates widely the measurement error. The authors believe, that the referee applied a Gain matrix, which does not account for the strong constraint at the surface and as a consequence overestimated the measurement error.

The low S/N is explained by the photovoltaic MCT detector which is applied for this wavenumber region. It has lower sensitivity below 850 cm^{-1} if compared to the commonly used photoconductive MCTs. Its advantage is, that it works nearly linear. The nonlinearities typical for photoconductive detectors cause spectral baselines, which may be sources of new errors.

4) The degree of freedom (DOF) additionally depends on the constraints and spectroscopic issues applied for the inversion. Applying small microwindows at 780 cm^{-1} and constraining towards the a-priori surface VMR, eliminates widely the sensibility in the troposphere, which is the main reason for the relative low DOF.

As a mean the measurements are performed at a solar zenith angle of 50 °. This relatively high angle only explains a small part of the low DOF.

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5) In the upper troposphere and in the lower stratosphere (UT/LS) both models overestimate HCl. The reasonable reproduction of the HCl stratospheric column by SLIMCAT is due to the fact that this overestimation in the UT/LS is counterbalanced by an underestimation of HCl in the stratosphere. In KASIMA this feature is more pronounced. This leads together with an overestimation of the HCl column in the initialisation (see Fig. 10, top, HCl column at the end of 2000) and a slight overestimation of the total release of chlorine from the CFC's in the UT/LS (O. Kirner, Diploma Thesis, University of Karlsruhe, Germany, 2004) to the overestimation of the HCl column in KASIMA.

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