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Interactive Comment

Interactive comment on "An approach to retrieve information on the carbonyl fluoride (COF_2) vertical distributions above Jungfraujoch by FTIR multi-spectrum multi-window fitting" *by* P. Duchatelet et al.

P. Duchatelet et al.

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We thank the reviewer for her/his comments. In the following, **her/his comments or questions [RC]** are followed by our responses [AC].

[RC] A little more detail of the "multi-spectra" approach might be useful, as the reader would not be sure if they are co-adds of the spectra that assume a common airmass or, as I suspect, a fitting that allows each spectrum to have a unique airmass.

[AC] The reviewer is right, the second option is correct. The following sentence has been added to the text, p.3172 l.20 : "During this multi-spectrum multi-window fitting procedure, individual airmass files are also computed for each spectrum."

[RC] I would like to see a little more detail in the discussion of errors. For example, what specifically are the parameters included in the model parameter errors?

[AC] As requested by the reviewer, the following description has been added to the text p.3176 l.16: "The forward model parameter error includes errors induced by retrieval parameters (like, e.g., the wavenumber shift, the background slope, the background curvature, etc) which can improve fitting quality when they are adjusted during the retrieval procedure. In our case, only the wavenumber shift and the background slope are adjusted during the retrieval procedure, for each microwindow of both spectral regions (InSb and MCT). An independent wavenumber shift for each microwindow is also applied. When a microwindow contains solar absorption lines, the error induces by the solar line shift is also included in the forward model parameter error."

The magnitude of the model parameter error is very often poor (compared to other error sources like e.g. smoothing and measurement errors) and is thus generally neglected. Regardless, we have decided to include this error in Table 3, in order to make it as complete as possible. It is also worth to notice that the model parameter error do not include error sources due to instrumental line shape, SZA and temperature profiles. That is the reason why we have evaluated these contributions separately, following a perturbation method, as mentioned in Section 3.

[RC] What estimate of atmospheric variability was used in the estimation of smoothing error?

[AC] As specified at the end of Section 2, the Sa matrix used for our retrievals and consequently, for the evaluation of the smoothing error, has been derived from ACE-FTS satellite data. The variability profile used (corresponding to diagonal elements of the Sa matrix) is plotted on top left part of Figure 1. The VMR-correlation matrix plotted on bottom panel of Figure 1 has been used to add extra-diagonal elements to Sa. For

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clarity, a sentence reminding the way of construction of the Sa matrix used for the estimation of the smoothing error, has been added p.3176 l.16: "The Sa matrix used for the estimation of smoothing error is the variability matrix deduced from ACE-FTS satellite data (see end of Sect. 2)."

[RC] For the multispectral fit, is there allowance that the SZA of each spectrum may have independent errors?

[AC] The SZA error values that appear in Table 3 were obtained under the assumption that, during the multi-spectrum fit, all SZA are simultaneously affected by an error of $\pm 0.2^\circ$. For example (this example will be hereunder named by "testcase"), for a multi-spectrum fit with 3 spectra, we have assumed an error of $\pm 0.2^\circ$ for the 3 SZA simultaneously and then, quantify the impact on COF2 partial and total columns. To try to answer to your question, we have also proceeded to the following test: in the testcase, instead of modify the 3 SZA simultaneously, we have modified the SZA of only one of the three spectra involved in the multi-spectrum fit; there are six different ways to proceed to this, pending: (i) which spectrum has seen its SZA value modified, (ii) if the error value assumed is equal to $+0.2^\circ$ or -0.2°. All of these six combinations have been tested. In all cases, SZA error values obtained are always smaller than those derived from the testcase. The same conclusions can be drawn when: (i) two of the three spectra of the testcase see their SZA values simultaneously modified, (ii) a larger number of spectra is involved in the retrieval procedure. To summarize, SZA error values reported in Table 3 can be considered as maxima, as they have been obtained when considering the most disadvantageous situation (all fitted spectra are affected by a SZA error of $\pm 0.2^\circ$). It is also important to say that the $\pm 0.2^\circ$ value chosen as an a priori SZA uncertainty can also be considered as a maximum value, as it has been estimated by considering several observation conditions, including the most disadvantageous situations (e.g., when the sun is low on the skyline that is when SZA varies quite quickly).

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 3167, 2009.

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