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Interactive comment on "Differences in ozone retrieval in MIPAS channels A and AB: a spectroscopic issue" *by* Norbert Glatthor et al.

Anonymous Referee #2

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General comments

The present manuscript of Glatthor *et al.* provides an in-depth analysis of differences between ozone retrieval results from two separate MIPAS channels A (including ozone absorption lines from the ν_2 and ν_3 fundamentals) and AB (including lines of the ν_1 and ν_3 fundamentals). These differences are sizeable and significant and reach about 8 % at the maximum of the stratospheric ozone peak. After having ruled out model, retrieval and instrumental errors being responsible for this discrepancy, the authors compare retrieval results using different spectroscopic databases. They find that pressure broadening parameters in the various data sets are quite different and lead to the large discrepancy rather than inconsistencies in the line strength data.

The manuscript is well written and structured. The method is valid and figures were selected appropriately. The paper should therefore be published after the necessary corrections have been made.

The manuscript could possibly gain more widespread interest by i) including a comparison of pressure broadening parameters to including the MIPAS data base and ii) by quantifying the impact on total ozone columns. This would allow to better estimate the impact of this particular parameter on the existing bias between UV and IR comparison measurements (see Orphal et al., 2016, and references therein).

Specific comments

There are two possibly important omissions in the paper. As already pointed out above, the MIPAS database/spectroscopy deserves a short presentation so that similarities and differences with respect to the other data bases become clear. It would also be helpful to see a detailed comparison of line-broadening parameters between MIPAS and HITRAN and MIPAS and GEISA (such as in Figs. 8 and 9 for HITRAN and GEISA) to better understand differences in the data bases. This also because MIPAS is finally recommended to be preferred over the other data sets. The other issue is that line intensities (see line strengths of $\nu_2 = 1 \leftarrow 0,\ (J+1, J+1, 1) \leftarrow (J, J, 0)$ transitions in Fig. 13, for example) are compared using reference temperatures at room, but at stratospheric temperatures the lower state energies (and to a lesser extent partition sums) also contribute. The quoted line strength uncertainty might thus be too optimistic. While partition sums cannot lead to an inter-band bias, lower state energies can. For the sake of completeness a discussion of the impact of possible differences in lower state energies or a comparison of low temperature intensities would be required.

The manuscript preparation guidelines request that "works cited in a manuscript should be accepted for publication or published already" and the authors should therefore avoid utilizing personal communications. The communications used are not really required and seem to be problematic. For example, in Section 3 (*Error estimates of ozone lines and band intensities*), a pers. communication (J.–M. Flaud) is given to motivate relative errors of the three fundamentals. Eq. (1) indicates that the relative error is the same for the ν_1, ν_2 and ν_3 bands. However, the comparison of experimental data with intensity calculations from the same author shows that the agreement in the ν_2 cold band is usually worse than in the other two fundamental bands (See section 5.2.2. of Wagner et al., 2002). This information therefore seems to be conflicting. Later it is stated that "These inappropriate halfwidths (M. Birk, pers. comm.) are the reason for the stronger ozone lines in the model spectrum using HITRAN-2008 data in Figure 12. This deficiency is still present in later versions up to HITRAN-2016." A priori, it is not clear which set of half widths should be correct and which not and why these half widths cause problems. Non-continuous behaviour is visible in both data sets (see Fig. 13 right). Wouldn't it be more informative and decisive to show the direct comparison between modelled and experimental spectra ?

The study of Janssen et al. (2016) needs to be mentioned in the paper. It has evident methodological links and has already identified differences in pressure broadening parameters between GEISA (version of 2011) and HITRAN (version of 2012) being the main reason for ozone column retrieval differences in the ν_3 spectral region at 10 µm. It seems that the surprising effect (section 8: *Additional observations*) of systematic biases in the air broadened half width potentially leading to positive and negative feedbacks depending on the optical thickness of the atmosphere is discussed there as well.

Fig. 6 requires correction. On the one hand some technical information on averaging kernel thresholds and orbit numbers are probably not very informative. On the other hand, the difference plot and the absolute values of the GEISA retrievals are not

compatible in the altitude range < 10 km. There is a clear offset ($\mathrm{AB} - \mathrm{B} > 0$) between the two bands on the left panel, but the difference plot on the right shows $\mathrm{AB} = \mathrm{B}$.

Absolute deviations at the per cent level are difficult to perceive on the logarithmic scale. The left plot of Fig. 13 should show the relative deviation between intensities from HIT-08 and PF-3.0.

Technical corrections

- p. 1, l. 8 : Thus spectroscopic . . . → Thus, spectroscopic . . .
- p. 3, l. 27–29 : Phrase is incomplete/wrong
- p. 3, l. 29 : schema → scheme
- p. 4, l. 22 : The acronym IAA appears for the first time. Please explain.
- p. 7, l. 18 : .Since → . Since
- p. 7, l. 22 : basing → based (?)
- p. 8, l. 6 : ar → are
- p. 10, l. 4–5 : To check, if . . . → We performed two additional tests to check if . . .
- p. 11, l. 6 : could be widely excluded → could be excluded
- p. 11, l. 7-9 : Repeated use of also. Delete one instance.
- p. 22, Fig. 7 : The top panels might be omitted. They do not provide information that is not already contained in the bottom panels. The legend would need to be adjusted accordingly.

- p. 23, Fig. 9 caption : Add units to line strength values.
- p. 26, Fig. 13 : Units are missing on vertical axes.

References

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