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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Acetylene C₂H₂ retrievals from MIPAS data and regions of enhanced upper tropospheric concentrations in August 2003" *by* R. J. Parker et al.

Anonymous Referee #1

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In this work the authors retrieved the C_2H_2 Volume Mixing Ratio (VMR) from the atmospheric limb radiances acquired by MIPAS in August 2003. The retrieved VMR is then used as a tracer for the transport of biomass/biofuel burning. In addition, the authors confirm that the concentration of C_2H_2 is strongly correlated to CO and the ratio of the two can be used as a robust tracer for the photochemical evolution of the air mass since it last encountered a combustion source. The CO VMR used here is that measured by MOPITT. The VMR of these species is then exploited to investigate atmospheric dynamic features linked e.g. to the Asian monsoon anticyclone and to the

outflow of biomass burning from Africa.

The subject of the paper is interesting, it addresses relevant scientific questions, certainly within the scope of ACP. The scientific methods used are sound and the results are presented clearly, although not always concisely. In my view, beyond the contribution given to the current understanding of atmospheric dynamics, this paper is also important to show the enormous potentiality of the information contained in mid-infrared limb-emission measurements such as those of MIPAS. Therefore I recommend this paper for publication also in ACP, I only have a few general- and some specific- or minor-comments that the authors should attempt to address before final submission to ACP.

1 General comments

1. The discussions reported in the paper could be more concise. I feel that the abstract, the conclusions and especially Sect's 4.3 and 4.4 could be shortened significantly. For example, there should be no need of a Section summary also at the end of each Section...

2. The study of the dynamics presented in the paper would be much stronger if the authors could show that similar results are obtained when data relating to other years (e.g. 2002 and/or 2005) are considered.

3. The paper shows the enormous potentiality of space and time coverage of MIPAS data. For this reason, the choice (of the European Space Agency (ESA), I guess) of not retrieving the C_2H_2 VMR routinely from all MIPAS spectra seems a shame and also a waste of the money invested in the whole mission. Therefore the authors should comment on the feasibility of the routine retrieval of this species and, if feasible, they should issue a strong recommendation (for the ESA) to do so for the whole MIPAS mission dataset.

2 Specific and minor comments

1. P.29736, L.2: The acronym *MIPAS* is used in the abstract without being specified.
2. P.29736, L.6-7: *In our C_2H_2 retrievals ...* This sentence has no meaning in the abstract, what is the meaning of *caution* here ? I suggest to remove this sentence.
3. P.29739, L.11: 0.025 *unapodized spectral resolution*. The units are missing here (cm^{-1}). In addition, how do you define the spectral resolution ? Is it the Full Width Half Maximum of the spectral instrument line shape or just $1/(2 \cdot MPD)$, with $MPD =$ Maximum Path Difference of the interferometer ? Please specify.
4. P.29739, L.16: I heard that ESA or some other scientific institution now started to retrieve routinely also F11, F12, $ClONO_2$ and N_2O_5 from MIPAS spectra. Is there a reference ?
5. P.29739, L.20: *L1B*. Please define the acronym.
6. P.29739, L.22: Replace *0.06 cm^{-1}* with 0.0625 cm^{-1}.
7. P.29740, L.7: Please specify the meaning of *contribution*. Is it the limb-radiance as if in the atmosphere there was only a specific gas ? In this case the plot of Fig.1 is not very illustrative because this spectral region could be (globally) very opaque and the line of C_2H_2 could also be not detectable. I guess what you plotted is instead the "total" limb radiance and the differences between "total" radiance and radiance obtained from an atmosphere where a specific gas has been removed.
8. P.29740, L.8: The acronym for Reference Model should be RM (not RFM).
9. P.29740, L.18,19: From Fig.1 it is not clear to me which is the NO_2 contribution (orange line) in the region under the C_2H_2 line. What did-you assume for NO_2 ?

Day or night distribution ? In order to be conservative I would recommend to use the night distribution.

10. P.29740, L.24: University of Oxford.
11. P.29741, Eq.(1). The following quantities are not defined: iteration index i, $\mathbf{K}$, $\mathbf{D}$, γ, $\mathbf{x_a}$. Please define them. Please clarify also what you have included in the state vector $\mathbf{x}$. Is atmospheric background emission also a fitting parameter ?
12. P.29741, Eq.(2): if the cost function is linear in $\mathbf{x}$ there no need of an iterative procedure to find the minimum. Please correct the expression of χ^2.
13. P.29741, L.15,16: a priori covariance equal to 1000% means standard deviation approximately equal to 33%, which seems quite small compared to the final retrieval error...
14. P.29741, L.16: what is the correlation length ? Please specify or provide a reference.
15. P.29741, L.19,20. Why didn't you use the spectral noise estimates included in the MIPAS L1B files ? These are specific to the individual measured spectra and therefore should be much more accurate than the estimates of Fischer et al. 2008. Later (P.29742, L.9) you state you are using apodisation. Did you account for the correlations introduced by apodisation while building the covariance $\mathbf{S_y}$? If not, can you demonstrate that the effect is negligible ?
16. P.29742, L.1: please explain why you did not consider NO_2 interference during the night. See also previous comment regarding the NO_2 distribution assumed for the calculations reported in Fig.1.
17. P.29742, L.13: χ^2 less than 2. I guess here you refer to some normalization of χ^2. From Eq.(2) I would expect $\chi^2 \approx m$ with m number of elements of the observations vector $\mathbf{y}$, and certainly $m >> 2$!

18. P.29742, L.26: see above comments regarding the possible NO_2 interference.

19. P.29774, L.10,11: the mentioned differences are hardly visible with the color scale of Fig.4a.

20. P.29774, L.18: I would put a "comma" after *further*.

21. P.29752, L.15-17: correlations are not the primary cause of the problem here. The problem arises from the low sensitivity of the measurements to the composition in this height range (stratosphere).

22. P.29752, L.9-17: see the above comment regarding the conciseness of the discussion. Is it really needed a Section summary at the end of each Section ?

23. Figures. Please make sure that units are correctly reported on the axes of all figures and with the same conventions. E.g. units are missing from the vertical axis of Fig.2, they are wrong in the vertical axis of Fig.1. Sometimes units are reported within round brackets, sometimes after a "/". Please use the journal standards.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 29735, 2010.