

Interactive comment on “Operational total and tropospheric NO₂ column retrieval for GOME-2” by P. Valks et al.

Anonymous Referee #1

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The manuscript is very well written and matches the scope of AMT. I recommend publication after some necessary revisions as listed below.

P1619: Add references for tropospheric NO_x chemistry.

P1619 L26: "daily basis": clarify that ERS-2 does not provide daily coverage!

P1621 L27f: make clear that this is the default.

P1624 L7: So far, the model is fully linear. It could be noted that it becomes nonlinear by shift/squeeze, which is described later.

P1625 2nd paragraph and P1626 1st paragraph both deal with shift. I recommend to have both of them consecutively.

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P1625 3rd paragraph: add a reference for the determination of the Ring reference spectrum.

P1625 L27: "to correct": add "partly"

P1629 2nd paragraph: please comment on possible alternatives - do you plan to use the Kleipool LER in future?

P1630 L10: This depends on the actual profiles of NO₂, aerosols and clouds as well as on the aerosol properties as SSA!

P1631 L5: The first step is the calculation of total VCD via Eq. 2 with a stratospheric AMF.

Section 5.1: For any stratospheric correction procedure, the stratosphere might be overestimated, which causes negative tropospheric columns. This has to be mentioned, and plots and maps should not hide negative values, if they occur! For instance on 22 Feb 2008 (Fig. 1), the estimated stratospheric column is higher than the observed total column over western Europe, thus also at OHP! Negative tropospheric columns for single pixels and in the monthly mean provide additional information on the uncertainty of the stratospheric correction, see Beirle et al., 2010, AMT.

P1632 L14: This is much lower than the value given in Martin et al., 2002, please comment on that.

P1634 5.3: Global cover is lost for GOME, but particularly Europe is still covered. Thus I recommend to compare GOME and GOME2 for the same month over Europe.

P1639 L22: Please show the Mozart fields for the day shown in Fig. 1 (22 Feb 2008) (instead or additionally) to see whether the model would be able to avoid/reduce the stratospheric overestimation over Europe.

P1640 L7-15: The given uncertainty is quite small, but I expect that it has a strong seasonal and regional dependency. Especially in winter close to the polar vortex, it will be

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much higher, which has an impact of several regions of general interest for NO₂ analysis, i.e. Europe and the US eastcoast. Thus, please also mention regional/seasonal maximal uncertainties.

In addition, it is obvious that the uncertainty of the stratospheric column is higher over polluted regions that have been masked out and interpolated. Thus, I recommend to calculate the uncertainty of the stratospheric column for the polluted regions alone, as this is relevant for the tropospheric product for most studies.

P1644 L5: Please specify how far the MAXDOAS measurements help to address the validity of cloud properties and AMF calculations.

P1645 L23: Also the high stratospheric dynamics causes higher std of slant columns in winter.

P1646 L13: "remain sensitive": In case of NO₂ above the cloud, sensitivity is even increased!

Table 2: CTP error of 3%: This is a highly non-Gaussian error! For low CTP, i.e. high shielding clouds, the 40 hPa will have virtually no effect on Mt, but for high CTP, a small change of CTP can have a very strong impact on Mt, if the cloud is within the NO₂ layer. Please also comment on errors due to the simplification of a reflecting cloud and neglecting multiple scattering.

Fig. 1: Please add a panel showing the resulting tropospheric column (also the negative values!).

Fig. 3: GOME for 2007 for Europe?

Fig. 4: Please modify the colorscale such that it is possible to recognize negative columns.

Fig. 8: Please substitute or add 22 Feb 2008

Figs. 10, 12, 14, 15: Linear regression is not appropriate for these scatterplots, as
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both x and y have uncertainties and the resulting slopes should not depend on the arbitrary choice of the variable used as x. So please use orthogonal regression; see <http://www.atmos-chem-phys.net/8/5477/2008/acp-8-5477-2008.html>

Fig. 13: Please modify the range of the y-axis such that negative VCDs are also visible.

Fig. 14: Add a similar scatterplot for the daily VCDs, as in Fig 13a.

Please include a kind of outlook paragraph describing possible future improvements. In this context, also discuss the differences to the retrieval presented by Richter et al., AMTD, 2011, and explain how far the advances described there might be applied to the operational product as well.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1617, 2011.