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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sulfur dioxide (SO_2) as observed by MIPAS/Envisat: temporal development and spatial distribution at 15–45 km altitude" *by* M. Höpfner et al.

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We thank referee # 1 for very valuable comments and corrections.

General Comments

a) Given the constant 10 pptv assumed for the a prior, could this have an effect of inflating the retrieval results at 45 km? It would depend on how the authors handle the SO2 profile above 45 km during the retrieval itself, eg a fixed a priori value of 10 pptv at 46 km and above, or a more gradual adjustment which depends on the state vector.

The regularization of our retrieval is performed on basis of a first order Tikhonov constraint as described on page 12395, lines 15–20 of the discussion paper. This introduces only a smoothing of the profile but no bias. We verified this by using very different values for the altitude constant a-priori profile (from 0 to 100 pptv) which lead in all cases to the same resulting profiles of SO2. Further, the altitude grid of our retrieval does not stop at 45 km but reaches up to the top of the simulated atmosphere (100 km). Thus, at and above the altitudes where there is quasi no information any more from the measurements the volume mixing ratios gradually adopt constant values. We will add this information in the new version of the manuscript.

b) For the 'htang' error, I assume this refers to the registration of the MIPAS spectra within the ECMWF T(p) fields so is a linear addition of both (dR/dT)x(dT/dz) and (dR/dp)x(dp/dz) errors (where R is the radiance spectrum).

Yes this understanding is correct. Our forward model KOPRA simulates the radiative transfer in absolute altitude (z) coordinates. So, as atmospheric input parameters we have p(z), T(z) and vmr(z). Thus, the derivative of the MIPAS limb radiance R with respect to altitude z is dR/dz = (dR/dT)x(dT/dz) + (dR/dp)x(dp/dz) + (dR/dvmr)x(dvmr/dz).

c) Section 5.4 (Internal Variability): could some of this be due to an offset between results for the P1 and P2 measurements? It is not clear whether the analysis in Eq (3) and (4) is strictly for adjacent months in time, or just for adjacent months within the dataset which would include spanning the P1-P2 boundary.

Thank's for mentioning this point. Actually the analysis has been performed only for directly adjacent months in time. We will clarify this in the new version.

d) I'm assuming that Fig 7 is missing a legend that explains that the colour codes are reversed for the southern hemisphere. Otherwise 'blue' is always DJF so the comment on p12404, l5 identifying 'blue' with winter would only apply to the northern hemisphere and, more importantly, Fig 7 would show simultaneous distributions in the poles rather than a 6 month phase shift, which would lead to

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many more questions...

Correct: the legend in the figure is only valid for the northern hemisphere and must be changed according to the seasons in the southern hemisphere. This will be corrected in the new article version.

e) Figures generally are a little small in the printed version - try to use the full width of the page.

We will try to optimize this in the new version.

Typographical/grammatical

In the new version we have tackled most of these items according to the suggestions of the referee. Exceptions are:

13) Fig 1: It would have been helpful to have the NESR contribution also shown on these plots.

Actually this is shown as the 'dash-dot-dot-doted' red line indicated by 'noise'.

14) Fig 6: Lat/time variations would probably appear clearer expressed as percentage variations about the mean for each altitude, rather than on an absolute scale.

We have produced such kind of plots for different scales: examples for +-100% and +-400% are attached below. This form of presentation accentuates some variability of SO2 clearer than in Fig. 6. However, other Figures in the paper also concentrate on those items. In order not to overload the paper, we decided to add the proposed plots as additional material for the final version.

15) Fig 12: what is the scale for the black bars?

The scale is given in the legend (plot title).

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 12389, 2013.

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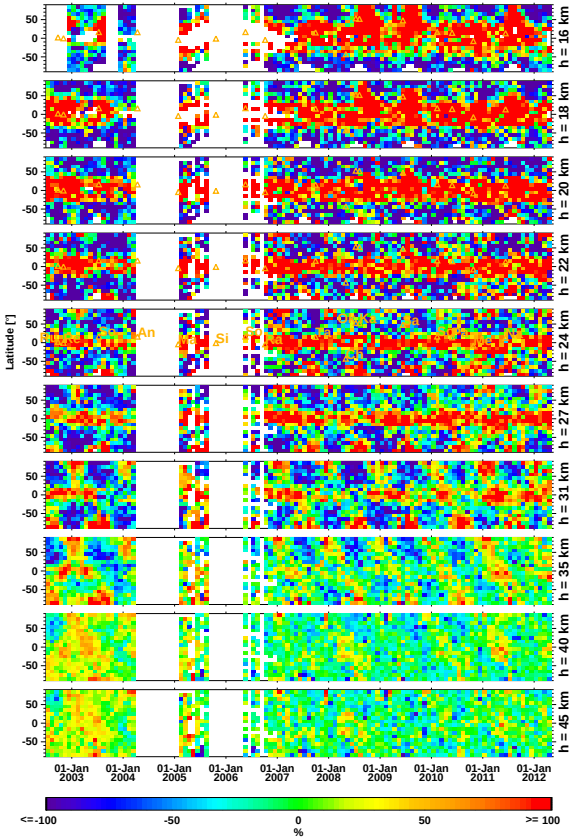

Fig. 1. Same as Fig. 6 of the paper but variation of SO2 relative to the mean for each altitude (scale: -100% - +100%).

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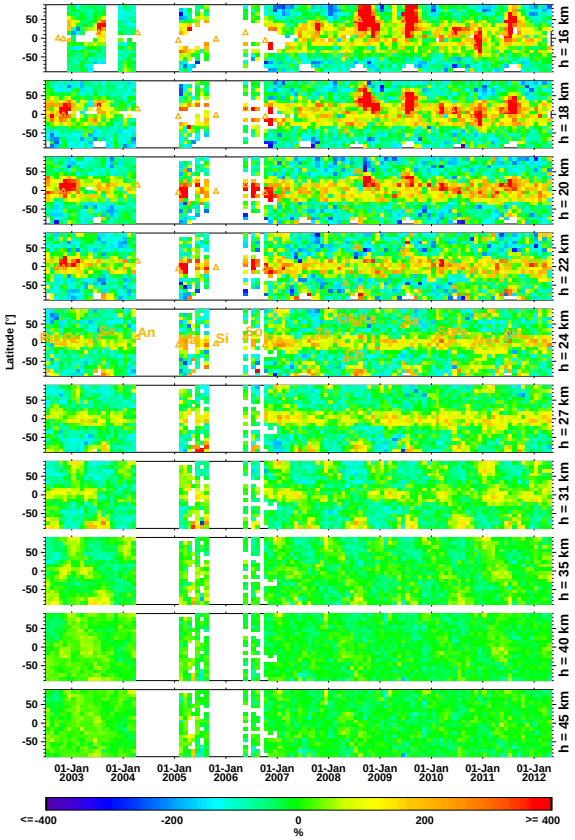

Fig. 2. Same as Fig. 6 of the paper but variation of SO2 relative to the mean for each altitude (scale: -400% - +400%).

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