Atmos. Chem. Phys. Discuss., 13, C5089–C5093, 2013
www.atmos-chem-phys-discuss.net/13/C5089/2013/

Atmospheric Chemistry and Physics Discussions
Open Access

ACPD
13, C5089–C5093, 2013

Interactive Comment

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.

M. Höpfner et al.

michael.hoepfner@kit.edu

Received and published: 24 July 2013

Minor comments:

Section 5.2: I agree that the differences in the comparison with ACE-FTS are not overly large as to hint a problem with one of the instruments. However, they are large enough to make me want to see a graphical representation, ideally one that also shows how these differences compare to the variability in the data.

In response to this comment we have revised section 5.2: instead of referencing the SO2 distribution shown in Fig. 8 of the paper by Doeringer et al. (2012) we now compare directly with the original ACE-FTS dataset (version 3.0) of SO2. This comparison of the ACE-FTS observations with those of MIPAS is shown in Fig. 1 below. For the presentation of the ACE-FTS dataset we have (1) calculated the mean (instead of the median as in Doeringer et al. (2012)), (2) selected the same latitude bands and (3) performed a linear interpolation to the MIPAS altitude grid. The latitude rage 30°N–40°N cannot be used for comparison since there are only two ACE-FTS profiles available, which stem from July, 1st and which apparently have not been recorded in volcanically perturbed air-masses. Between 40°N and 70°N both datasets show the enhanced volcanic SO_2 plume with similarly decreasing extension in altitude towards north. Regarding the absolute values, the results from the MIPAS retrievals of SO_2 appear to be generally lower than those of ACE-FTS. In the altitude range 15–19 km the mean difference between the two instruments is 156 pptv±68 pptv (54%±19%). These differences might be due to the locally and temporally sparse coverage of ACE-FTS compared to MIPAS (see the lower panel of Fig. 9 in Doeringer et al. (2012) and number of limb-scans used to calculate mean profiles as indicated by orange numbers in Fig. 1 below). It can also not be excluded that the differences are caused by measurement errors of either instrument. E.g. our error estimation for MIPAS retrievals in Fig. 3 of the paper indicates relative errors of larger than 100% in the lowest stratosphere caused by the error term due to analysis from mean spectra. Dedicated simulations of this source of error for volcanically enhanced conditions showed MIPAS results that were 100–150 pptv lower than the real profile at 15–17 km altitude. A more detailed analysis of the differences between the two instruments will be possible when MIPAS retrievals of SO_2 from single limb-scans under volcanically enhanced conditions are available.

We will include this analysis in the new version of the manuscript.

We acknowledge Chris Boone and the ACE-FTS-team for provision of the data and for helpful discussions.

Section 5.3: could a higher loading of SO2 in the NH midlatitude troposphere

around 1980 compared to today have an impact on the lower stratospheric in-situ SO2 measurements made at the time?

We agree that this might have led to higher SO2 measurements in the lowest stratosphere at that time. Unfortunately, the time series of in-situ datasets covering this altitude region is rather sparse which makes a valid trend analysis difficult. For such a task it would be necessary to homogenize the available data, assign a proper error estimation and try to sort the measurements according to the origin of the air-masses. We are not aware of any published work of that kind.

Section 6.1: I think that the mid-strat-maximum could be illustrated even better than in Figure 7 by color maps showing a zonal mean (probably four altitude-latitude panels, one for each season).

Agreed: such a Figure (Fig. 2 below) will be added in the new version.

For recent volcanically perturbed periods, could you also compare to Aura-MLS? They have, for example, presented some SO2 vertical profiles in the context of the Nabro eruption (cf. comments to the Bourassa et al. reference in SCIENCE).

Although MLS detects large amounts (often a few hundred ppbv) of SO2 following a volcanic eruption, the MLS SO2 data have persistent systematic errors of about 2-4 ppbv. Therefore it is not possible to form useful monthly zonal means of the MLS data in order to compare with the MIPAS monthly zonal mean data (H.C. Pumphrey, personal communication).

Technical corrections:

We agree with all suggested technical corrections. These will be implemented accordingly in the new version of the manuscript.

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

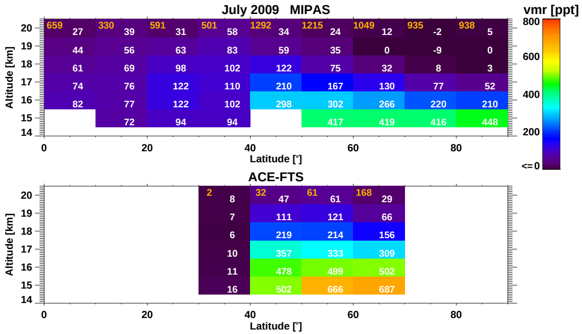

Fig. 1. Latitude-height cross-section of MIPAS (top) and ACE-FTS (bottom) zonal mean SO2 volume mixing ratios in July 2009. Numbers in white show the exact vmr values of each bin in units of ppt.

ACPD
13, C5089–C5093, 2013

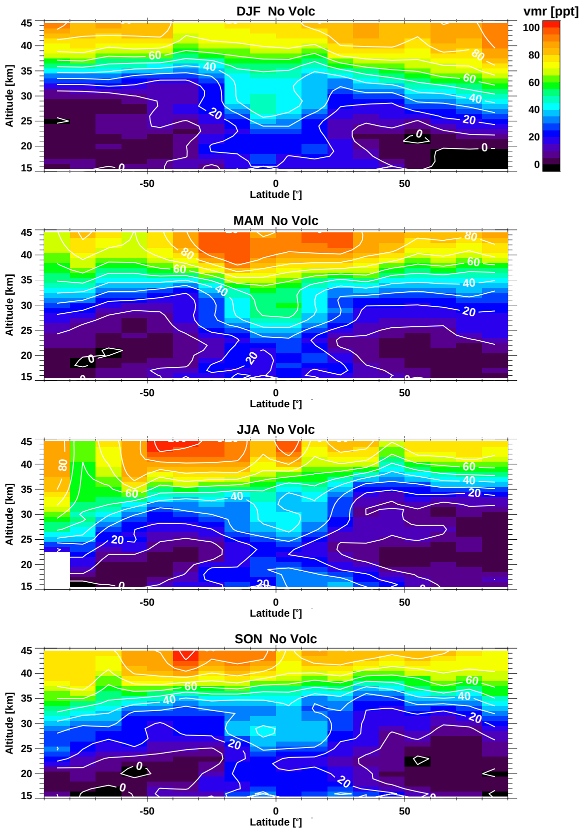

Fig. 2. Mean background seasonal distributions of SO2 from MIPAS.

ACPD
13, C5089–C5093, 2013

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper