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Interactive comment on "Inter-comparison of stratospheric O_3 and NO_2 abundances retrieved from balloon borne direct sun observations and Envisat/SCIAMACHY limb measurements" *by* A. Butz et al.

F. Stroh (Referee)

f.stroh@fz-juelich.de

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The paper presents an in-depth validation of O_3 and NO_2 profiles derived from satellite-based UV-VIS limb observations by balloon-borne occultation measurements in the UV-VIS and MIR spectral regions. First the balloon-borne measurements are inter-compared and characterized in terms of their measurement errors. Intercomparisons with profiles derived from SCIAMACHY limb measurements employing different retrieval procedures are presented for various geolocations and seasons. In order to

minimize the spatial mismatch of the balloon and satellite measurements an air mass trajectory model is applied to identify best matches. In order to correct for the diurnal variation of the NO_2 abundances a photochemical model is employed.

The next section will present some general views on the employed validation strategy while the second section lists some more specific comments on the paper by Butz et al. Some suggestions for improvements are presented.

1. General Comments

In the introduction the need for high precision measurements is high-lighted in order to constrain photochemical models. The analysis of the validation data can hardly establish the internal consistency of the O_3 LPMA and DOAS measurements to below the required level of around 10% in the 20 to 30km altitude regime, which is disappointing. For the NO_2 measurements error limits are about 20% even, which renders the data almost not useful for the purpose of model validation. However, the data presented are still useful in order to identify problems and inconsistencies of the current state within the SCIAMACHY satellite retrievals.

For the future more efforts must be made in order to isolate the causes of the rather large systematic differences between DOAS and LPMA measurements especially for O_3 in order to arrive at more reliable validation data sets. Unfortunately, the in-situ O_3 data which are supposed to be accurate to around the 5% level can not clearly identify as to which of the two instruments is more accurate. Regarding the obvious drawbacks in the LPMA data the priority should be given to a better characterisation of the DOAS measurements. The availability of accurate tracer data (e.g. N_2O) might enable some new insights into the instrumental or retrieval problems by studying trace gas correlations (e.g. O_3 vs. N_2O) instead of constituent profile data.

ACPD

5, S4680–S4683, 2005

2. Specific Comments

p.10750, l.8ff: Historically the Dobson technique should be mentioned when talking about UV/VIS remote sensing measurements in general.

p.10752, l.25: The Weidner et al. study, cited here, concludes an "overall good agreement" while some of the figures clearly show differences between Mini-DOAS limb measurements and occultation measurements which lie outside the error bars indicated for both techniques, especially for O_3. Therefore the statement "very good agreements" used here seems not justified.

p.10764, l.1: Which criteria have been used to select the aerosol loadings employed for the different validation scenarios and what is the sensitivity of the modelled NO_2? In general a table detailing the modelling input parameters for the different runs would be useful.

Section 3 Internal LPMA/DOAS comparison First O_3 and NO_2 SCDs are intercompared and then the intercomparison of NO_2 profiles has a dedicated section. I miss a similar section on the intercomparison of O_3 profiles which exhibit a more significant systematic bias that should urgently be characterized.

p.10767, l.23ff: It seems rather arbitrary to exclude LPMA NO_2 data points on the basis of their level of agreement with the DOAS measurements if afterwards they are used in order to intercompare these two sets of data. The resulting difference of 6.6% ($\pm 14\%$) is referenced afterwards (e.g. in the discussion section) without mentioning the constraint used in the derivation. Here an independent selection criterium should be established (signal-to-noise ratio, ...), especially since the exclusion of the "noisier" data seems to almost double the systematic difference between the DOAS and LPMA measurement. This may also give a hint to the origin of this systematic difference. This issue should be explored since also for

ACPD

5, S4680–S4683, 2005

O_3 there is a marked systematic positive bias of the DOAS with respect to the LPMA measurement.

3. Conclusions

Overall the detailed study validates the novel technique of SCIAMACHY limb observations which enable to retrieve vertically well resolved global trace gas profiles from UV/VIS satellite measurements. This technique may deliver new insights into various atmospheric processes, such as winter-time polar ozone loss, and therefore its validation is an important prerequisite for the further development of this technique. Therefore the paper by Butz et al. represents an important study that is suited to ACP. The study also provides valuable insights into the reliability of the underlying balloon-borne LPMA/DOAS validation measurements. I think the paper should be published with minor revisions, which are requested within the above section "Specific comments".

The author wishes to apologize for the extremely late submission of this review. Due to the participation in an extended field campaign the review could only be completed at the very end of the discussion period.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 10747, 2005.