Atmos. Chem. Phys. Discuss., 5, S5013–S5016, 2005
www.atmos-chem-phys.org/acpd/5/S5013/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

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.

Anonymous Referee #3

Received and published: 12 January 2006

This paper presents a data set of O3 and NO2 vertical profiles derived from balloon-borne solar occultation measurements performed using FTIR and UV-visible DOAS instruments jointly operated on the same gondola. The study focuses first on an assessment of the agreement between the two balloon techniques in terms of their respective error sources; second the available measurements are used to validate satellite measurements of O3 and NO2 profiles inferred from Envisat/SCIAMACHY skylight limb observations, under a limited number of geophysical conditions (3 flights for high-

latitude spring and one flight for mid-latitude fall conditions).

The validation work relies on a sophisticated and innovative approach where air-mass trajectory calculations and photochemical modeling are used to minimise the impact of time and spatial mismatches between satellite and correlative observations. The added value of this approach is demonstrated by a remarkable improvement of the agreement between satellite and balloon profiles, especially in the case of the photochemically active NO2 molecule. Clearly the Butz et al. study contains valuable material suitable for publication in ACP. Overall the manuscript is well written and adequately structured and therefore I recommend its publication after attention to the general and specifics comments described below.

General comments

1. This paper involves comparisons between a number of different data sets (LPMA FTIR, DOAS UV-Vis, as well as SCIAMACHY data retrieved by 3 different institutes). For validation purposes, a key issue is to assess the accuracy of the correlative balloon measurements, as identified by the authors. The study presents a good analysis of the comparisons, however a proper estimation of the errors on each technique (independent from the intercomparison) is somewhat lacking. Typical uncertainty estimates should be provided for each technique prior to the comparison. This is especially important since the two techniques apparently have rather different error budgets. Since from the comparison one can only conclude on the agreement within combined error bars, it is essential to provide independent estimates of these error bars. In the present manuscript, these can only be roughly estimated by inspection of Fig. 4. Even there, error bars on raw (unsmoothed) DOAS results are not given.

2. Along the same line, I think that the discussion of satellite validation results could be improved by adding more explicit comments on whether the observed differences fall or not within the combined uncertainties of transported and photochem-

ACPD

5, S5013–S5016, 2005

ically corrected balloon data and satellite measurements. Looking at the results, my impression is that satellite retrievals (at least those from Bremen and the 3 profiles from Heidelberg) are satisfying above 20 km, but not below. However it is difficult to realize whether the discrepancies at lower altitudes can be considered as due to errors in satellite retrievals or to problems related to the validation process itself (photochemical correction, horizontal smoothing of actual spatial inhomogeneities, etc.). Maybe it is not possible to conclude on this issue based on available data, but then this should be made clear and suggestions should be provided on how to improve on this in future studies.

3. Given the complexity of the comparison methodology, I think that a graphical illustration of the technique would be useful. This requires an additional figure which could be inserted e.g. before Fig. 1, or before Fig. 4.

Specific comments

P10750, L9: replace ". . . , exploiting that O3 and NO2 absorb electromagnetic . . . " by "exploiting the fact that O3 and NO2 absorb electromagnetic . . . "

P10760, L26: it is unclear how the temperature dependence is treated here. Are there 6 cross-sections included in the least-squares process to account for NO2 and O3 absorption?

P10761 and before: it is unclear from the description of the satellite algorithm whether cloud effects are only considered by one group, or if this aspect of the retrieval has been simply omitted by others in their general description. Please check for consistency here.

P10767, L19: The temperature dependence of the NO2 cross-section is quasi linear in the 440 nm wavelength region, hence extrapolation (linear?) should not be a major source of uncertainty here. Anyway this could even be checked using the Bogumil et al. data for which measurements are available down to 203 K.

ACPD

5, S5013–S5016, 2005

P10771, L22: replace “artificial” by “arbitrary”

P10772, L1: In fact none approach is optimal in this case. I guess the choice of applying a stacked calculation at the location of the balloon flight was made essentially for simplicity reason.

P10772, L26: add “in the absence of available DOAS measurements” at the end of the sentence.

P10775, L4: I would move the sentence in L13-14 of this section right after the sentence ending by “... Fig. 8”, in the following way: “Although a detailed comparison of the different retrieval exercises is beyond the scope of the present study, we note that the internal agreement of the satellite data . . . ”

P10789, Fig.2 caption: replace “The 1032 data points are grouped . . . ” by “The 1032 data points corresponding to the 6 flights of Table 1 are grouped ...”

P10792-10794: Figures 5 and 6 are quite complex and hardly readable as printed here. Fonts are too small (and distorted) and the different curves are difficult to distinguish. Please resize and reorganize the various plots to improve readability.

P10796, Figures 7 and 8. Since balloon data are reference data here, I think it would be more logical to plot relative differences w.r.t. balloon data, i.e. [O3_SCIA / O3_balloon] – 1. Please take this just as a suggestion, in case the plot can be easily redrawn.

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