

Interactive comment on “SCIAMACHY tropospheric NO₂ over the Alpine region and importance of pixel surface pressure for the column retrieval” by D. Schaub et al.

Anonymous Referee #2

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The paper by Schaub et al. reports on observations of tropospheric nitrogen dioxide (NO₂) above Switzerland and the Alpine region retrieved from measurements of the Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY). For this study NO₂ data from the TEMIS project (www.temis.nl) have been utilised. The NO₂ observations have been compared to a Swiss NO_x emission inventory and a reasonable correlation was found. In addition, seasonal NO_x lifetimes have been estimated using measurements during anticyclonic clear sky conditions. From a comparison between GOME and SCIAMACHY NO₂ the authors find indication for a possible impact of the (inaccurate) surface pressure used within the retrieval on the tropospheric NO₂ column. Sensitivity studies on this effect show an error in the range

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Interactive Discussion

Discussion Paper

of 10 to 40% for NO₂ columns over the Swiss Plateau.

Even though the authors show some interesting results I have serious concerns on the methods used within the paper. Therefore I'm not able to recommend it for publication in ACP in its current stage.

General comments:

The possible impact of the topography (surface pressure) on the air mass factor calculation is a well-known fact in the DOAS community. Almost all state-of-the-art retrieval algorithms for tropospheric satellite data take into account the surface height and the surface pressure for the calculation of the air mass factor. This study is the first which quantifies the effect of the spatial resolution for this retrieval parameter on the calculated trace gas column under “real” conditions. However, there are several inconsistencies in the presentation of the work which makes it very difficult to see the leitmotif of the paper.

- There is no point in using the comparison between GOME and SCIAMACHY data to introduce the impact of the surface pressure (see comment above). In this context: what is the reason for the incredible low number of GOME measurements for all seasons (less than 200 measurements for the whole seasonal cycle from seven years!)?
- Why there is a need to estimate NO_x lifetimes on a number of pages in a paper with the title “... and importance of pixel surface pressure for the column retrieval”?
- For the sensitivity study only two (of in total sixteen) satellite pixels measured in winter season have been investigated (see Table 2). But the starting point was the disagreement between GOME and SCIAMACHY exactly for this season. Why there is no disagreement between GOME and SCIAMACHY e.g. in autumn?

- In agreement with reviewer #1: what about the impact of the albedo assumptions on the NO₂ retrieval presented here? To my knowledge TEMIS uses 1°×1.25° albedo databases (Koelemejer et al.) on a monthly basis. Land-snow transitions which one can expect for almost the whole year in the Alpine region might lead to similar or even larger smearing effects/errors than the surface height.
- What is the impact of the FRESCO retrieval error (roughly 0.05 and much more for surfaces like snow and ice) on the results presented here? In this context: The sense escapes me for values of 0.027 or 0.008 in cloud fraction in Table 2.
- Isn't it the easiest way to use high resolution topography databases like GTOPO30 already included in the TEMIS retrieval and surface pressures according to the barometric formula to calculate the air mass factor? Possible variations as a result of actual meteorological conditions seem to be negligible.

Minor corrections/comments:

- Introduction: resolution of space-borne NO₂: SCIAMACHY 60×30 km² and 30×30 km² depending on season and latitude, see your own Figure 2, OMI, see reviewer #1, the spatial resolution is much poorer to the edge of the swath.
- Data 2.1: The DOAS retrieval is explained somewhat mistakable. What is fitted is a polynomial, several reference spectra for the trace gases and a calculated Ring spectrum to the logarithm of the ratio of earthshine radiance and solar irradiance (see e.g. http://www.temis.nl/docs/AD_NO2.pdf). Please use another reference to introduce the DOAS, e.g. Platt, 1994.

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