

Interactive comment on “Retrieval of tropospheric column densities of NO₂ from combined SCIAMACHY nadir/limb measurements” by S. Beirle et al.

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We thank the reviewer for his/her positive feedback and constructive comments. Below we respond to the specific/technical comments point-by-point.

1. In 2.4.2 the sensitivity of the limb measurements to tropopause variations is estimated with 5% of the stratospheric vertical column. In places where the stratospheric column is equal or higher than the tropospheric column this error should become significant.

Reply: From our analysis of the limb profiles, we found the impact of the choice of the TH (between 12 and 18 km) on LVCDs to be rather small (<5%; see 2.4.2 and C1183

discussion). For the range of LVCDs from 1 to 5e15 molec/cm² (compare Fig. 1 in the supplements), the 5% correspond to absolute errors of 5 to 25e13 molec/cm². For an absolute limb correction scheme, the fixed TH can thus lead to significant errors in the limb estimation, in particular for high latitudes. However, the choice of a fixed TH can not explain the different latitudinal dependencies of limb and nadir VCDs over the reference sector. I.e., up to now, the absolute error in limb and/or nadir VCD is overlaid by other (latitudinal dependent) errors which are not understood at the moment.

For the relative limb correction, however, the 5% error on longitudinal variations (up to 1e15 molec/cm², see Fig. 4) corresponds to LLV errors up to 5e13 molec/cm², which is clearly below typical values of ΔW_{RSM} , i.e. the standard deviation of VCDs in the Reference sector (compare Fig. S2 in the supplements).

The discussion of the impact of the fixed TH on LVCDs and TSCDs is extended accordingly in the manuscript.

2. How large is the spatial sensitivity range of the limb measurements along the satellite track? How strong are the limb measurements affected by strong latitudinal gradients of stratospheric NO₂ (e.g. the step around 25S in October or close to polar vortex edges)? Is it possible to quantify these uncertainties?

Reply: The spatial sensitivity range of the limb measurements of NO₂ along the satellite track is of the order of three- to four hundred km.

The impact of horizontal gradients on the limb retrieval is discussed in Pukite et al., 2008, and, using the “limb-only” orbits in December 2008, in Pukite et al., 2010 (to be submitted). Errors for NO₂ concentrations were found to be 20% on average at the arctic polar vortex (Pukite et al., 2008). Column errors are of the order of 1e14 molec/cm² for strong gradients. These effects are systematic, resulting in an underestimation at the NH polar vortex (looking from low to high levels) and an overestimation at the SH polar vortex (looking from high to low levels). Thus, 3D-effects can not explain our findings of insufficient correction particularly for the SH.

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