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Retrieval of tropospheric column densities of NO_2 from combined SCIAMACHY nadir/limb measurements

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The SCIAMACHY instrument onboard the ESA satellite ENVISAT allows the retrieval of column densities of various trace gases, among them NO_2. As only instrument of its kind, SCIAMACHY measures in an alternating limb/nadir mode. The limb measurements allow a direct determination of stratospheric column densities, which are needed to extract tropospheric from the total column density measurements performed in (quasi simultaneous) nadir geometry.

Here we discuss the potential and limitations of SCIAMACHY limb measurements for estimating stratospheric column densities of NO_2 in comparison to a simple reference sector method, and the consequences for the resulting tropospheric column densities. A direct, absolute limb correction scheme improves spatial patterns of tropospheric NO_2 column densities at high latitudes compared to the simple reference sector method. However, it results in artificial zonal stripes at low latitudes. Thus, also a *relative* limb correction scheme was defined, which turned out to successfully reduce stratospheric artefacts in the resulting tropospheric data product without introducing new ones. This relative limb correction scheme is rather simple, robust, and, in essence, based on measurements alone.

The effect of the different stratospheric estimation schemes on tropospheric column densities is discussed with respect to zonal and temporal dependencies. In addition, error quantities are defined from the nadir/limb measurements which indicate remaining systematic errors as function of latitude and day.

Our new suggested stratospheric estimation scheme, the relative limb correction, improves monthly mean tropospheric slant column densities significantly, e.g. from -1×10^{15} molec/cm^2 (using a simple reference sector method) to ≈ 0 in the Atlantic ocean, and from $+1 \times 10^{15}$ molec/cm^2 to ≈ 0 over Siberia, at 50 N in January.