O3-02 NEW RETRIEVAL APPROACH TO TROPOSPHERIC NO$_2$ BY SYNERGISTIC INVERSION OF SATELLITE NADIR DOAS SOUNDINGS AND GROUND-BASED FTIR MEASUREMENTS

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Ground-based FTIR is a highly accurate measure for the pure stratospheric column of NO$_2$, and can thus be used synergistically with satellite NADIR DOAS soundings to complement the reference sector method for global tropospheric NO$_2$ retrievals.

Columnar NO$_2$ from FTIR measurements at the Zugspitze (47.42 °N, 10.98 °E, 2964 m asl.) were used synergistically with SCIAMACHY satellite data (Univ. Bremen algorithm UB1.5). A new concept to match FTIR data to the time of satellite overpass makes use of the NO$_2$ daytime increasing rate retrieved from the FTIR data set itself [+1.02(6)E+14 cm^{-2}/h]. SCIAMACHY data within a 200-km selection radius around Zugspitze were considered, and a pollution-clearing scheme was developed to select only pixels corresponding to clean background (free) tropospheric conditions. Analysis of the averaging kernels gives proof that a high-mountain-site FTIR is a highly accurate measure for the stratospheric column, while SCIAMACHY shows significant tropospheric sensitivity. Based on this, we set up a combined FTIR-SCIAMACHY retrieval for NO$_2$ which delivers two independent pieces of information for troposphere and stratosphere, respectively (Fig. 1a). It yields an annual cycle of the background (free) tropospheric column between 0.75-1.54E+15 cm^{-2}, and an intermediate phase between that known for boundary layer and stratosphere, respectively (Fig. 1b).

References
Sussmann, R., et al., Atmos. Chem. Phys., 5, 2657–2677, 2005
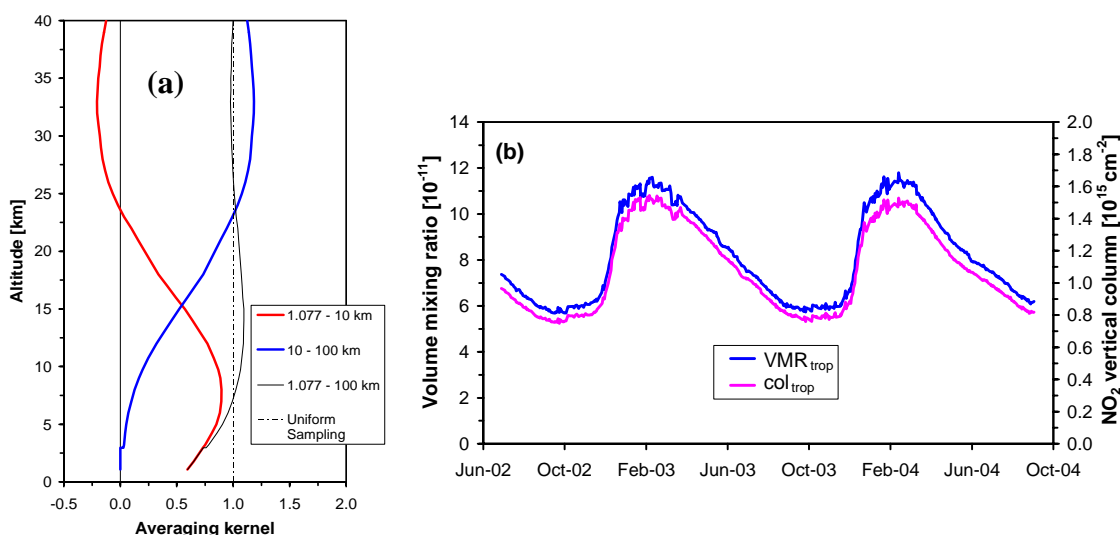
Fig. 1: (a) Averaging kernels for the combined FTIR/SCIAMACHY retrieval. Red: Trop. column (1.077 – 10 km) kernel. Blue: Strat. kernel (10 - 100 km). Black: total col. kernel. (b) Time series of the background trop. col. (1.077 km – 10 km, magenta), and trop. VMR $_{trop}$ (blue).