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Validation of satellite total ozone and NO2 data with ground-based SAOZ network

D.V. Ionov, F. Goutail, A. Pazmino and J.-P. Pommereau

Service d'Aéronomie, IPSL, CNRS, Paris, France (Dmitry.Ionov@aerov.jussieu.fr / Fax: +33-01-69-20-29-99)

SAOZ (Systeme d'Analyse par Observations Zenithales) is a ground-based UV-Visible zenith-sky spectrometer deployed between 1988 and 1995 at a number of NDACC stations at all latitudes on the globe. The instrument is providing ozone and NO_2 total columns at sunrise and sunset using the Differential Optical Absorption Spectroscopy (DOAS) technique in the visible spectral range. SAOZ observations have been used extensively to validate various atmospheric chemistry satellite instruments such as nadir viewing TOMS, GOME, SCIAMACHY and OMI satellite spectrometers. Here we present the results of comparisons between TOMS (since 1996), GOME (since 1995), SCIAMACHY (since 2002), OMI (since 2004) and ground-based SAOZ at all latitudes – tropics, mid-latitudes and polar regions - in both hemispheres.

According to the results of comparisons of total ozone measurements at 9 SAOZ stations over globe, the average difference with operational satellite data is +0.3$\pm$6.9%, –0.7$\pm$9.4% and –0.5$\pm$6.4% for TOMS (V8), GOME (GDP4) and OMI (OMTO3), respectively (another OMI total ozone product, OMDOAO3, differ from correlative SAOZ ground-based data by +0.0$\pm$7.0%). Earth Probe TOMS total ozone data version 8, corrected recently by NASA, present now better agreement with SAOZ – the average difference from original EP TOMS V8 dataset was –1.0$\pm$7.2%.

To validate satellite total NO_2 data, operational GOME (GDP4) and OMI (OMNO2), along with SCIAMACHY scientific NO_2 product (IUPB v2.1), have been also compared to SAOZ network. All NO_2 columns, observed by satellites and 9 SAOZ ground-based instruments, have been corrected for NO_2 diurnal change and normalized to local noon values using a photochemical box model. Best agreement with SAOZ is found for SCIAMACHY stratospheric NO_2 column – within 0.03±0.49·1015 mol/cm^2. The operational GOME total column (GDP4) is larger than that of SAOZ by 0.26±0.63·1015 mol/cm^2 on average, and the OMI stratospheric column smaller by 0.40±0.49·1015 mol/cm^2. The difference in vertical sensitivity of satellite and ground-based column NO_2 measurements is considered to be one of the key sources of disagreements. Thus, the smoothing errors of both ground- and space-based remote sensing measurements have been evaluated by means of the careful investigation of corresponding averaging kernels.