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Assessment of the stratospheric NO_2 column using long-term ground-based UV-visible and satellite nadir observations

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Zenith-sky UV-visible instruments have been used to monitor stratospheric NO_2 columns from pole to pole for more than 2 decades, as part of the Network for the Detection of Atmospheric Composition Change (NDACC). Long-term monitoring and fit-for-purpose data quality are essential commitments of the network. Recently, recommendations were made for a better harmonization of the retrieval of NO_2 stratospheric vertical columns (Van Roozendael and Hendrick 2012, http://ndacc-uvvis-wg.aeronomie.be/tools/NDACC_UVVIS-WG_NO_2settings_v4.pdf). Those include, in addition to the use of harmonized SCD settings, a common approach to the air-mass factor (AMF) calculation, based on pre-calculated look-up tables of climatological AMFs resolved in latitude, time, wavelength, surface albedo, solar zenith angle and station altitude.

The impact of the NDACC recommendations on the quality of the zenith-sky UV-visible stratospheric NO_2 columns is first illustrated based on 10 SAOZ (Système d'Analyse par Observations Zénithales) instruments deployed from the Arctic to the Antarctic. The long-term time-series of SAOZ and other ground-based NDACC zenith-sky measurements are then used in synergy with data from an ensemble of satellite UV-vis nadir sensors (GOME-2, SCIAMACHY and OMI), for characterising the stratospheric NO_2 columns on the global scale. Appropriate photochemical state matching is applied whenever necessary to combine/compare the different data sets. Results are interpreted in terms of ground-based network data homogeneity, and accuracy, consistency and long-term stability of space-borne stratospheric NO_2 columns. The consistency with previously published studies including stratospheric NO_2 column measurements from limb sensors such as MIPAS and SCIAMACHY is also discussed. These quality-assessed ground-based and satellite data sets offer new perspectives for the analysis of the variability and trends of stratospheric NO_2 at the global scale.