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## NO<sub>2</sub> climatology in the northern subtropical region: diurnal, seasonal and interannual variability

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**Abstract.** Daily NO<sub>2</sub> vertical column density (VCD) has been routinely measured by zenith sky spectroscopy at the subtropical station of Izaña (28° N, 16° W) since 1993 in the framework of the Network for the Detection of Atmospheric Composition Change (NDACC). Based on 14 years of data the first low latitude NO<sub>2</sub> VCD climatology has been established and the main characteristics from short timescales of one day to interannual variability are presented. Instrumental descriptions and different sources of errors are described in detail. The observed diurnal cycle follows that expected by gas-phase NO<sub>x</sub> chemistry, as can be shown by the good agreement with a vertically integrated chemical box model, and is modulated by solar radiation. The seasonal evolution departs from the phase of the hours of daylight, indicating the signature of upper stratospheric temperature changes. From the data record (1993–2006) no significant long-term trends in NO<sub>2</sub> VCD can be inferred. Comparison of the ground-based data sets with nadir-viewing satellite spectrometers shows excellent agreement for SCIAMACHY with differences between both datasets of 1.1%. GOME displays unrealistic features with the largest discrepancies during summer. The ground-based data are compared with long-term output of the SLIMCAT 3-D chemical transport model (CTM). The basic model, forced by ECMWF (ERA-40) analyses, captures the observed NO<sub>2</sub> annual cycle but significantly underestimates the spring/summer maximum (by 12% at sunset and up to 25% at sunrise). In a model run which uses assimilation of satellite CH<sub>4</sub> profiles to constrain the model long-lived tracers the agreement is significantly improved. This improvement in modelled column NO<sub>2</sub> is due to better modelled NO<sub>y</sub> profiles and points to transport errors in the ECMWF ERA-40 reanalyses.

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