Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 8, 1635-1648, 2008
www.atmos-chem-phys.net/8/1635/2008/

NO_2 climatology in the northern subtropical region: diurnal, seasonal and interannual variability

M. Gil[1], M. Yela[1], L. N. Gunn[2], A. Richter[3], I. Alonso[1], M. P. Chipperfield[2], E. Cuevas[4], J. Iglesias[1], M. Navarro[1], O. Puentedura[1], and S. Rodríguez[1]

[1]Area de Investigación e Instrumentación Atmosférica, INTA, Torrejón de Ardoz, Spain
[2]Institute for Atmospheric Science, School of Earth and Environment, University of Leeds, Leeds, UK
[3]Institute of Environmental Physics, University of Bremen, Bremen, Germany
[4]Centro de Investigación Atmosférica de Izaña, INM, Sta. Cruz de Tenerife, Spain

Abstract. Daily NO_2 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_2 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_x 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_2 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_2 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_4 profiles to constrain the model long-lived tracers the agreement is significantly improved. This improvement in modelled column NO_2 is due to better modelled NO_y profiles and points to transport errors in the ECMWF ERA-40 reanalyses.

Final Revised Paper (PDF, 1099 KB) Discussion Paper (ACPD)

Citation: Gil, M., Yela, M., Gunn, L. N., Richter, A., Alonso, I., Chipperfield, M. P., Cuevas, E., Iglesias, J., Navarro, M., Puentedura, O., and Rodríguez, S.: NO_2 climatology in the northern subtropical region: diurnal, seasonal and interannual variability, Atmos. Chem. Phys., 8, 1635-1648, 2008. Bibtex EndNote Reference Manager