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

Atmos. Chem. Phys., 3, 2225-2232, 2003
www.atmos-chem-phys.net/3/2225/2003/

Weekly cycle of NO_2 by GOME measurements: a signature of anthropogenic sources

S. Beirle[1], U. Platt[1], M. Wenig[2], and T. Wagner[1]
[1]Institut für Umweltphysik, Universität Heidelberg, Germany
[2]NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

Abstract. Nitrogen oxides ($NO+NO_2=NO_x$ and reservoir species) are important trace gases in the troposphere with impact on human health, atmospheric chemistry and climate. Besides natural sources (lightning, soil emissions) and biomass burning, fossil fuel combustion is estimated to be responsible for about 50% of the total production of NO_x. Since human activity in industrialized countries largely follows a seven-day cycle, fossil fuel combustion is expected to be reduced during weekends. This "weekend effect" is well known from local, ground based measurements, but has never been analysed on a global scale before.

The Global Ozone Monitoring Experiment (GOME) on board the ESA-satellite ERS-2 allows measurements of NO_2 column densities. By estimating and subtracting the stratospheric column, and considering radiative transfer, vertical column densities (VCD) of tropospheric NO_2 can be determined (e.g. Leue et al., 2001). We demonstrate the statistical analysis of weekly cycles of tropospheric NO_2 VCDs for different regions of the world. In the cycles of the industrialized regions and cities in the US, Europe and Japan a clear Sunday minimum of tropospheric NO_2 VCD can be seen. Sunday NO_2 VCDs are about 25-50% lower than working day levels. Metropolitan areas with other religious and cultural backgrounds (Jerusalem, Mecca) show different weekly patterns corresponding to different days of rest. In China, no weekly pattern can be found.

The presence of a weekly cycle in the measured tropospheric NO_2 VCD may help to identify the different anthropogenic source categories. Furthermore, we estimated the lifetime of tropospheric NO_2 by analysing the mean weekly cycle exemplarily over Germany, obtaining a value of about 6 h in summer and 18-24 h in winter.

Final Revised Paper (PDF, 1287 KB) Discussion Paper (ACPD)

Citation: Beirle, S., Platt, U., Wenig, M., and Wagner, T.: Weekly cycle of NO_2 by GOME measurements: a signature of anthropogenic sources, Atmos. Chem. Phys., 3, 2225-2232, 2003. Bibtex EndNote Reference Manager