An Improved Retrieval of Tropospheric Nitrogen Dioxide from GOME

Randall V. Martin, Kelly Chance, Daniel J. Jacob, Thomas P. Kurosu, Robert J. D. Spurr, Eric Bucsela, James F. Gleason, Paul I. Palmer, Isabelle Bey, Arlene M. Fiore, Qinbin Li, Robert M. Yantosca, and Robert B. A. Koelemeijer

J. Geophys. Res., **107**(D20), 4437, doi:10.1029/2001JD001027, 2002.

Abstract

We present a retrieval of tropospheric nitrogen dioxide (NO_2) columns from the Global Ozone Monitoring Experiment (GOME) satellite instrument that improves in several ways over previous retrievals, especially in the accounting of Rayleigh and cloud scattering. Slant columns, which are directly fitted without low-pass filtering or spectral smoothing, are corrected for an artificial offset likely induced by spectral structure on the diffuser plate of the GOME instrument. The stratospheric column is determined from NO_2 columns over the remote Pacific Ocean to minimize contamination from tropospheric NO_2. The air mass factor (AMF) used to convert slant columns to vertical columns is calculated from the integral of the relative vertical NO_2 distribution from a global 3-D model of tropospheric chemistry driven by assimilated meteorological data (GEOS-CHEM), weighted by altitude-dependent scattering weights computed with a radiative transfer model (LIDORT), using local surface albedos determined from GOME observations at NO_2 wavelengths. The AMF calculation accounts for cloud scattering using cloud fraction, cloud top pressure, and cloud optical thickness from a cloud retrieval algorithm (GOMECAT). Over continental regions with high surface emissions, clouds decrease the AMF by 20-30% relative to clear-sky. GOME is almost twice as sensitive to tropospheric NO_2 columns over ocean than over land. Comparison of the retrieved tropospheric NO_2 columns for July 1996 with GEOS-CHEM values tests both the retrieval and the NOx emissions inventories used in GEOS-CHEM. Retrieved NO_2 columns over the United States, where NO_x emissions are particularly well known, are within 18% of GEOS-CHEM columns and strongly spatially correlated ($r=0.78$, $n=288$, $p<0.005$). Retrieved columns show more NO_2 than GEOS-CHEM columns over the Transvaal region of South Africa, and industrial regions of the northeast United States and Europe. They are lower over Houston, India, eastern Asia, and the biomass burning region of central Africa, possibly because of biases from absorbing aerosols.

The full version of this paper is available as a pdf file [Full Text (pdf)].