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An improved retrieval of tropospheric NO_2 columns from the Ozone Monitoring Instrument

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Global mapping of atmospheric NO_2 concentrations provides important information on NO_x emissions, on the formation of secondary pollutants, as well as on the transport and chemistry of tropospheric nitrogen oxides. Since the mid-nineties, satellite remote sensing using spectral fitting techniques has been used to derive tropospheric NO_2 concentrations on global, regional, and near-urban scales. Measurements from GOME, SCIAMACHY, OMI, and GOME-2 have mapped the NO_x pollution in ever finer spatial detail, and allowed the detection of significant trends in NO_2 concentrations. In spite of these and many other successful applications of NO_2 satellite measurements, a number of scientific questions about the accuracy of such retrievals remain.
In this presentation we address these scientific issues by focusing on the Dutch OMI NO_2 (DOMINO) retrieval algorithm. Recent studies using DOMINO retrievals version 1.02 showed modest to good agreement with independent observations, but v1.02 appears to be biased high by 0%-40%. Most studies point to the air mass factors (AMFs) as the source of the most significant retrieval errors. We improve DOMINO AMFs by better radiative transfer modelling, more accurate descriptions of surface albedo and surface pressure, and using more realistic a priori vertical distributions of NO_2. A simple method (vicarious calibration) is applied to evaluate and correct for the stripes apparent in the OMI NO_2 retrievals. We also investigate the effect of aerosols in cloud-free scenes on the OMI O_2-O_2 retrievals that are used to correct for scattering by clouds in the DOMINO NO_2 retrieval. Concurrent measurements of aerosol optical thickness from MODIS Aqua and OMI cloud parameters demonstrate that the OMI O_2-O_2 cloud algorithm detects cloud fractions up to 0.15 in cloud-free situations with high AOT. These enhanced cloud fractions are generally above the polluted NO_2 layer, leading to a net screening effect, and aerosol correction factors < 1 over the eastern United States in summertime. Our new, improved retrievals (v2.0) are 10%-20% smaller than v1.02 retrievals. We will conclude by showing a detailed comparison of v1.02 and v2.0 retrievals to independent validation data around the world.