Geophysical Research Abstracts,
Vol. 11, EGU2009-10160-2, 2009
EGU General Assembly 2009

An improved tropospheric NO2 retrieval for OMI satellite observations

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Nitrogen oxides are key precursors of both ozone and secondary aerosols, and they are harmful to humans and ecosystems. The Ozone Monitoring Instrument (OMI) is a recent UV/visible spectrometer on NASA's Aura satellite with a comparatively small pixel size and daily global coverage which makes it particularly suitable for air quality monitoring. Information on vertical tropospheric columns (VTCs) of tropospheric trace gases is derived from the spectroscopic data by means of a retrieval algorithm. However, the retrieval depends on a number of so-called "a priori" assumptions which introduce considerable uncertainties in the derived quantity. Current operational retrievals are based on global a priori data sets at coarse spatial and temporal resolution, which are much coarser than the resolution of individual OMI pixels. Furthermore, there are simplified physical descriptions such as Lambertian surface assumed for albedo data set. Therefore the improvement of the a priori assumptions used for the computation is a main concern to obtain accurate values of $NO_2$of high spatial resolution.

In order to obtain more accurate vertical tropospheric columns of nitrogen dioxide (NO_2) than currently available, we are developing new data sets of critical retrieval parameters at high temporal and spatial resolution for Europe, such as a high resolution surface pressure map, illumination and viewing geometry dependent surface reflectance, and a-priori vertical NO_2 profiles from a regional model. As a first step, we analyzed the sensitivity of retrieved NO_2 to the surface pressure, and addressed the issue in a quantitative way by reprocessing selected periods with accurate pixel-average surface pressures deduced from a high resolution topography data set. The differences between original and enhanced retrieval were analyzed for different seasons separately, and validated with in situ NO_2 VTCs calculated from ground-based measurements over the Swiss plateau and selected background stations in the Po Valley in Italy. The results demonstrate the importance of an accurate (i.e. high resolution) treatment of this parameter, in particular in the vicinity of complex topography such the Alps. As a second step, a new illumination and viewing geometry dependent surface reflectance data set is currently being developed for the OMI observations based on high temporal and spatial resolution multiangular reflectance observations from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS). As a first analysis, a comparison of this new surface reflectance data set with the coarse albedo data set of the operational product will be shown and a preliminary sensitivity analysis of the impact on the retrieved NO_2 accuracy will be presented.