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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurements of tropospheric NO_2 with an airborne multi-axis DOAS instrument" *by* P. Wang et al.

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General comments Though large NO2 columns have been reported with the GOME and later the SCIAMACHY space borne instruments in coincidence with NOx natural and anthropogenic sources (cities, plants, biomass burning, ship tracks etc..) and thus suspected to lie in the planetary boundary layer, an objective method for the determination of the altitude distribution of the concentration of the species still need to be developed. Moreover, the impact of clouds, particularly in partially cloudy scenes, as well as the intriguing frequent presence of large NO2 amounts over cloudy areas where the PBL could not be seen, still needs to be accessed. It is the merit of this paper to provide: i) a clear and convincing spectral method for NO2 profile retrieval at

least at broad resolution (PBL versus free troposphere); and ii) a demonstration of the mechanism of amplification of the NO2 slant column over cloudy areas by the multiple scattering of sunlight within the upper layer of the cloud providing an explanation of apparent observed NO2 increase over cloudy scenes without adding a high NO2 concentration above the cloud of mysterious origin. These results are of extreme importance for the interpretation of the observation of NO2 and potentially other species, e.g. SO2, BrO,.by UV visible spectrometry from orbit. When implemented in the SCIAMICHY retrieval algorithm, they should result in significant improvement in the understanding of sources and sinks of the species, after the removal of clouds and albedo artefacts. Since the organisation, writing and figures of the paper are excellent, the paper is readily acceptable as it is.

Specific comments Given the above, I have very few, just few suggestions for the discussion of the impact of clouds at the end of section 3: Fig 3 indicates that the NO2 enhancement over cloudy area is not permanent, meaning that the NO2 concentration in the upper part of the cloud varies horizontally. Moreover, it shows a tendency for NO2 enhancement at the edge of the clouds (though not at all edges and not always). Any suggestion for that? Some indication on the meteorology: location of high pressure, presence of front, and type of clouds, indicative of vertical stability, and wind field at surface level or 700 hPa, indicative of horizontal advection, could help understanding if transport could contribute. What about a photochemical contribution because of sunlight extinction within the cloud? or heterogeneous chemistry / dissolution / wash-out ?

Technical comments/ None. Excellent.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 7541, 2004.