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A transboundary transport episode of nitrogen dioxide as observed from GOME and its impact in the Alpine region

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Abstract. High tropospheric NO_2 amounts are occasionally detected by space-borne spectrometers above cloudy scenes. For monitoring of near-ground air pollution such data are not directly applicable because clouds shield the highly polluted planetary boundary layer (PBL). We present a method based on trajectories which implicitly estimates the additional sub-cloud NO_2 distribution in order to model concentrations at ground stations. The method is applied to a transboundary pollution transport episode which led to high NO_2 vertical tropospheric column densities (VTCs) over middle Europe observed by the Global Ozone Monitoring Experiment (GOME) instrument above clouds on 17 February 2001. The case study shows that pollution originally residing near the ground in central Germany, the Ruhr area and adjacent parts of the Netherlands and Belgium has been advected to higher tropospheric levels by a passing weather front. Combining the above-cloud NO_2 VTCs with trajectory information covering the GOME columns and including their sub-cloud part yields an estimate of the total NO_2 distribution within the tropospheric columns. The highly polluted air masses are then traced by forward trajectories starting from the GOME columns to move further to the Alpine region and their impact there is assessed. Considering ground-based in-situ measurements in the Alpine region, we conclude that for this episode, at least 50% of the NO_2 concentration recorded at the sites can be attributed to transboundary transport during the frontal passage. This study demonstrates the potential of using NO_2 VTCs from GOME detected above clouds when combined with transport modelling.

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