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Satellite-based tropospheric NO_2 retrieval with explicit aerosol corrections and its application on NO_2 trend analysis in China

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Satellite remote sensing of tropospheric nitrogen dioxide (NO_2) is of great significance for studies on air pollution and human health. So far, there lacks of a systematic estimation for the uncertainties of tropospheric NO_2 VCDs on the global scale, and there is no quantitative evaluation of the influence of aerosols in particular. We improve the original Peking University OMI NO_2 (POMINO) tropospheric NO_2 retrieval algorithm to achieve a global retrieval of tropospheric NO_2 VCDs based on the TROPOMI, and provides a systematic evaluation for the influences of aerosol corrections and other AMF auxiliary parameters on NO_2 retrieval on a global scale. Implicit aerosol corrections, which simply treat aerosols as “effective clouds”, lead to a difference of tropospheric NO_2 columns by 20% to 40% over heavily polluted regions. Compared with the TROPOMI operational NO_2 product, POMINO-TROPOMI research product with explicit aerosol corrections presents stronger signals over major polluted regions around the world, and features a reduced bias against ground-based measurements.

Furthermore, we tentatively quantify the impact of aerosols, of which the content has been reduced drastically in the last decade, on the long-term trend analysis of tropospheric NO_2 over East Central China. Based on the POMINO research products with explicit aerosol corrections, we find much stronger decreasing trend of tropospheric NO_2 over high-pollution areas in December 2012 – 2022, which shows better qualitative agreement with independent ground-based surface NO_2 measurements.

These results provide data support and scientific insight for continuously improving the satellite NO_2 retrieval and evaluating the effectiveness of air pollution control policies.