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## TROPOMI NO<sub>2</sub> retrieval: December 2020 (v1.4) and April 2021 (v2.2) upgrades, and comparisons with OMI and ground-based remote sensing

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The Tropospheric Monitoring Instrument (TROPOMI) on the Sentinel-5 Precursor (S5P) satellite is a unique instrument, combining daily global coverage, very high signal-to-noise, a broad spectral range and very small pixels up to 3.5 x 5.5 km<sup>2</sup>. Retrievals are available for a large number of species, including NO<sub>2</sub>. Due to the very small pixels and daily revisit, TROPOMI provides detailed information on individual sources and source sectors like individual power plants, industrial complexes, cities and suburbs, highways, and even individual ships. The TROPOMI Level-2 NO<sub>2</sub> product is available from 30 April 2018 onwards.

Validation exercises of TROPOMI v1.2 & v1.3 data (2018-2020) with OMI and ground-based remote sensing observations have shown that TROPOMI's tropospheric NO<sub>2</sub> column are low by up to 50% over highly polluted areas compared to independent data. In contrast, the underlying slant columns of TROPOMI agree well with OMI and independent SAOZ observations. Differences between OMI and TROPOMI have been mainly attributed to the different cloud height retrieval, using the O<sub>2</sub>-O<sub>2</sub> versus O<sub>2</sub>-A bands respectively.

In our presentation we discuss recent improvements in the TROPOMI NO<sub>2</sub> retrieval and the impact these have on the tropospheric columns and on the comparisons with OMI and ground-based remote-sensing data.

Version v1.4, which became operational on 2 December 2020, entails a major improvement in the cloud height retrieval, based on a modification of the FRESCO-S cloud retrieval using the O<sub>2</sub>-A band observations. In particular the cloud height over scenes with a small cloud coverage have increased, resulting in larger tropospheric columns in the retrievals over polluted areas.

Version v2.2, to become operational in April/May 2021, includes similar cloud retrieval modifications. Furthermore, it provides a better treatment of saturation issues and transients, is using improved (ir)radiance measurements (level-1b v2 spectra) including degradation corrections,

and includes a new albedo treatment.

The TROPOMI NO<sub>2</sub> retrievals are compared with OMI retrievals (from the QA4ECV product) and to ground-based observations with MAXDOAS and PANDORA instruments.