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New tropospheric NO_2 retrieval products for OMI and GOME-2, resulting from the European Quality Assurance For Essential Climate Variables (QA4ECV) project

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The FP7 EU-project Quality Assurance for Essential Climate Variables (QA4ECV, www.qa4ecv.eu, EU grant No. 607405) is generating quality assured, harmonized, long-term data records of ECVs or precursors thereof. In our contribution we present an improved retrieval dataset of tropospheric NO_2 columns derived from the OMI and GOME-2A sensor observations over the period 2004-2015. In the near future the dataset will be extended to include GOME and SCIAMACHY observations. Our community algorithm is based on the DOAS method, and is the result of a thorough intercomparison and improvement of all retrieval aspects, including spectral fitting and air mass factor calculation approaches. The QA4ECV NO_2 dataset is a collaborative product from IUP Bremen, BIRA, Max Planck Institute for Chemistry, KNMI and WUR.

We show that improved spectral calibration, and the inclusion of liquid water and intensity-offset correction term in the fitting procedure, leads to 10-30% smaller NO_2 slant columns for OMI as compared to DOMINO-2 or OMI-SP version 2, in better agreement with independent measurements. Moreover the QA4ECV NO_2 slant columns show 15-35% lower uncertainties relative to earlier versions of the spectral fitting algorithm. For the stratospheric correction, the algorithm relies on the assimilation of NO_2 slant columns over remote regions into the Tracer Model 5 (TM5-MP) chemistry transport model. The representation of stratospheric NO_y in the model is improved by nudging ODIN HNO_3:O_3 ratios, leading to more realistic NO_2 stratospheric profiles in the free-running mode, which is relevant at high latitudes near the terminator. The coupling to TM5-MP also allows the calculation of air mass factors from on-line a priori NO_2 vertical profiles simulated at a spatial resolution of $1^\circ \times 1^\circ$, so that hotspot gradients are better resolved in the a priori profile shapes compared to e.g. DOMINO-2. The final QAECV NO_2 product contains overall uncertainty estimates for every pixel, and also information on the contribution of uncertainties of each retrieval sub-step and the input parameters to the overall uncertainty budget. The data format, use of the data, verification of the QA4ECV NO_2 columns and validation with independent MAX-DOAS observations is discussed (QA4ECV Atmospheric Validation Server tool). The product is available at www.qa4ecv.eu.

Comparisons with the DOMINO-2 and TEMIS products will be presented, and indicate that the new QA4ECV tropospheric NO_2 columns are $\pm 10\%$ lower than operational products, and provide more spatial detail on the horizontal distribution of NO_2 in the troposphere.