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TOPAS ozone profile retrieval from TROPOMI L1B version 2 dataset

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The TOPAS (Tikhonov regularized Ozone Profile retrievAl with SCIATRAN) algorithm to retrieve vertical profiles of ozone from space-borne observations in nadir viewing geometry has been developed at the Institute of Environmental Physics (IUP) of the University of Bremen and applied to TROPOMI L1B spectral data version 2. The data set covers the period from June 2018 to October 2019. But it is not available continuously, but for only single weeks of all 3 months. TROPOMI spectral radiance from channel UV1 and UV2 between 270 nm and 331 nm are used for the retrieval. Since the ozone profiles are very sensitive to absolute calibration at short wavelengths, a re-calibration of the measured radiances is required using comparisons with simulated radiances with ozone limb profiles from collocated MLS/Aura used as input. The time-independent re-calibration bases on simulations for cloud-free pixels of four orbits distributed over the time period. Studies with synthetic spectra show that individual profiles in the stratosphere can be retrieved with the accuracy of about 10%. In the troposphere, the retrieval errors are larger depending on the a-priori profile used. The vertical resolution is between 6 and 10 km above 18 km altitude and 15 – 25 km below. There are around 6 degree of freedom between 0 – 60 km. The TOPAS ozone profiles retrieved from TROPOMI were validated using data from ozone sondes and stratospheric ozone lidars. Above 18 km, the comparison with sondes shows excellent agreement within less than ± 5% for all latitudes. The standard deviation of mean differences is about 10%. Below 18 km, the relative mean deviation in the tropics and northern latitudes is still quite good remaining within ± 20%. At southern latitudes larger differences of up to +40% occur between 10 and 15 km. Here the standard deviation is about 50% between 7 and 18 km and about 25% below 7 km. The validation of stratospheric ozone profiles with ground-based lidar measurements also shows very good agreement. The relative mean deviation is below ± 5% in the 18 – 45 km range with a standard deviation of 10%. A pilot application for one day of TROPOMI data with a comparison to MLS and OMPS confirmed the lidar validation results. The relative mean difference

between TROPOMI and MLS or OMPS is largely below ± 5% between 20 – 50 km except for the very high latitudes where differences are getting larger.