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Validation of TROPOMI HCHO VCDs over Southern Germany using ground based MAX-DOAS measurements

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The TROPOspheric Monitoring Instrument (TROPOMI) is a passive nadir-viewing satellite borne imaging spectrometer on board the Sentinel-5 Precursor (S5P) satellite which was launched on 13^{th} October 2017. Compared to previous satellite instruments such as SCIAMACHY, GOME-2 and OMI, TROPOMI provides much higher spatial resolution with a ground pixel size of 25km^2 (3.5km $\times$ 7km) at nadir. TROPOMI provides global observation of cloud, aerosol and multiple atmospheric trace gases and greenhouse gases. The tropospheric vertical column densities (VCDs) of the TROPOMI formaldehyde (HCHO) level 2 product is retrieved using relative vertical profile shape from the operation forecast chemistry transport model TM5 with 1×1 degree resolution. Compared to the satellite instrument resolution, the model resolution might be too coarse for observations over urban areas and other complex terrains. In this research, we present a validation study of the TROPOMI operational product of HCHO using ground based Multi Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measurements. Tropospheric vertical column densities of HCHO derived from TROPOMI spectra are compared to ground based MAX-DOAS measurements over Southern Germany at Munich and Zugspitze. Tropospheric HCHO VCDs are retrieved from MAX-DOAS measurements using the optimal estimation method with radiative transfer model library for radiative transfer (libRadtran) as forward model. These MAX-DOAS stations cover both urban (Munich) and rural (Zugspitze) over complex terrain. The influence of aerosol and HCHO vertical profiles are estimated by using MAX-DOAS derived aerosol and HCHO profiles for the TROPOMI VCDs retrieval.