Total column water vapor retrieval for TROPOMI/S5P observations in the visible blue band

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We present a new total column water vapor (TCWV) retrieval algorithm in the visible blue band for the TROPOspheric Monitoring Instrument (TROPOMI) on board the Sentinel 5 Precursor (S5P) satellite. Retrieving water vapor columns in the blue band has numerous advantages over longer wavelengths. Measurements in the blue band are more sensitive at lower troposphere over oceans due to higher surface albedo at this wavelength band. In addition, no correction for spectral saturation effects is required as water vapor is optically thin in this spectral band. The blue band algorithm uses the differential optical absorption spectroscopic (DOAS) technique to retrieve water vapor slant columns. The measured water vapor slant columns are converted to vertical column using air mass factors (AMFs). The new algorithm has an iterative optimization module to dynamically find the optimal a priori water vapor profile. The dynamic a priori algorithm makes use of the fact that the vertical distribution of water vapor is strongly correlated to the total column. This makes it better suited for climate studies than usual satellite retrievals with static a priori or vertical profile information from chemistry transport model (CTM).

The new algorithm is applied to TROPOMI observations to retrieve TCWV. Due to the long measurement record of GOME-2, the new algorithm is also used to retrieve TCWV from GOME-2. The TCWV data set is validated by comparing to the GOME-2 TCWV operational product retrieved in the red spectral band, MODIS and SSMIS satellite observations. In addition, the new TCWV data set is also compared to ground based sun-photometer and radiosonde measurements. Water vapor columns retrieved in the blue band are in good agreement with the other data sets, indicating that the new algorithm derives precise results. Therefore, it was selected for the S5P Processor Algorithm Laboratory (PAL) project as a future operational product. This algorithm can also be used for the forthcoming Copernicus Sentinel S4 and S5 missions.