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Comparison of versions 7 and 8 TOMS erythemal UV doses with ground-based measurements at the island of Lampedusa in the period 1998-2003

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The Total Ozone Mapping Spectrometer (TOMS) has the longest time series of globally distributed estimates of UV irradiance at the Earth's surface. The proper interpretation of TOMS estimated irradiances relies on well-calibrated and maintained spectrometers at the Earth's surface. In this study, daily erythemal doses measured by a Brewer spectrophotometer at the island of Lampedusa (35.5° N, 12.6° E), in the Mediterranean, are compared with TOMS observations in the period January 1998 - August 2003. Lampedusa, where the ENEA Station for Climate Observations is operative, is a very good site for ground-based validation of satellite observations, being a small (approximately 20 km^2) island in the Central Mediterranean, far from continental areas. The comparison allows us to recognize how the space-borne observations are influenced by the presence of atmospheric aerosols.

Two TOMS datasets, derived applying different algorithms to retrieve ozone and UV irradiance from the backscattered radiance, are used: Version 7 (V7) and the recently developed Version 8 (V8), which uses new climatologies for ozone and temperature profiles and accounts for the attenuation by tropospheric aerosols through the aerosol index (AI). Previous studies performed with V7 TOMS data have shown that satellite-derived erythemal doses systematically overestimate ground-based measurements, mainly due to uncorrected absorption by aerosols in the troposphere.

The mean bias between the TOMS and Brewer doses for all sky conditions is (9.4±19.8)% for V7 and (7.3±20.0)% for V8, and decreases to (5.6±8.0)% for V7

and (3.4±8.4)% for V8 for the cloud-free cases. The large standard deviations for all sky conditions are due to non-homogeneity in the cloud cover within the sensor filed of view, while those for cloud-free days are caused by the large aerosol variability occurring at Lampedusa.

The biases for cloud-free days have been related to differences in the TOMS AI UV attenuation algorithm and to the aerosol optical depth at 415.6 nm (AOD) measured with a Sun photometer at Lampedusa since 2001. The mean bias between the V7 TOMS and Brewer doses progressively increases with AI and AOD, from ±3% for low AI and AOD, up to 21% for $1.5 \leq AI < 2.5$, and $0.5 \leq AOD < 0.6$. The bias calculated with V8 dataset varies between +6% for $0 \leq AI < 1$ and about –8% for $4 \leq AI < 5$, well within the respective uncertainties of the Brewer and TOMS measurements. TOMS V8 data show a smaller dependency on the aerosol absorption, indicating that the implemented corrections produce more reliable estimated doses.