IRS2012-149
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Daily erythemal radiation validation of satellite retrievals using 14 ground-based stations in both hemispheres

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The Ozone Monitoring Instrument (OMI), on board the NASA EOS Aura spacecraft, provides a global view of the daily erythemal radiation (UVER). The purpose of this study is to validate the remote sensing retrievals of UVER with an inter-comparison with measurements at 14 ground-based stations distributed worldwide between 43ºN and 64ºS in 5 different countries of both hemispheres: Argentine, Australia, Italy, Israel, and Spain.

The six Spanish stations used in this study are located in the cities of A Coruña, León, Madrid, Murcia, Valladolid, and Zaragoza. The Valladolid station is managed by University of Valladolid, while the others belong to the Spanish Meteorological Agency (AEMET). The three stations from Argentina are Buenos Aires, Ushuaia, and Marambio, and these stations are part of the Argentinean National Weather Service. One of the two Italian stations is located on Lampedusa Island (managed by the Italian agency ENEA) and the other is the ENEA-Trisaia Research centre in Southern Italy, where a measurement campaign was carried out in 2010. The Israeli radiation data are recorded at two stations. One located in the Dead Sea basin at Neve Zohar (the lowest terrestrial site on the Earth's surface), and the other on Ben-Gurion University of the Negev campus in Beer Sheva. The Australian station is on the eastern coast of the country at the Toowoomba site.

The ground-based instruments used to record daily UVER measurements are the UVB-1 radiometer of Yankee Environmental Systems Inc. (YES); the UV Biometer model 501, Solar Light Co. (SL), PA, USA; and the Ultraviolet Multifilter Rotating Shadowband Radiometer (UV-MFRSR). All these instruments are well calibrated and regularly maintained.

The total ozone column (TOC) and aerosol absorption optical thickness at 340 nm (AAOT), and aerosol optical thickness at 550 nm (AOT$_{550nm}$) obtained from OMI and Moderate-resolution Imaging Spectroradiometer (MODIS), respectively, are also used.

The obtained results show that OMI data overestimate ground-based UVER measurements except in the high surface albedo stations (e.g., covered by snow), which corroborates the results reported by previous studies. Differences greater than 20% were measured at six stations. In order to reduce the differences, cloudless conditions were selected removing intra-daily changes in cloudiness and the agreement between OMI retrievals and the ground-based measurements improved significantly. However, seven stations still gave an average difference between 10% and 20%. The influences of ozone and aerosols on the observed differences show opposite trends: viz., high ozone column values result in a decrease whereas high turbidity conditions produce an increase in the differences. A correction factor was applied to reduce the differences between both datasets when AAOT data were available, since AAOT is not considered in the OMI algorithm. As a result, after the correction, the difference between satellite and ground-based measurements falls below 20% in more than 90% of the cases. In addition, the height of the station results a key factor to take into account, suggesting that the OMI algorithm does not consider in an appropriate form the low troposphere.