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Total ozone column, aerosol optical depth and precipitable water effects on solar erythemal ultraviolet radiation recorded in Malta.

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ABSTRACT

The Universities of Malta and Valladolid (Spain) developed a measurement campaign, which took place in the Institute for Energy Technology in Marsaxlokk (Southern Malta) between May and October 2012, and it was supported by the Spanish government through the Project titled "Measurement campaign about Solar Radiation, Ozone, and Aerosol in the Mediterranean area" (with reference CGL2010-12140-E). This campaign provided the first ground-based measurements in Malta of erythemal radiation and UV index, which indicate the effectiveness of the sun exposure to produce sunburn on human skin. A wide variety of instruments was involved in the campaign, providing a complete atmospheric characterization. Data of erythemal radiation and UV index (from UVB-1 pyranometer), total shortwave radiaton (global and diffuse components from CM-6B pyranometers), and total ozone column, aerosol optical thickness, and precitable water column (from a Microtops-II sunphotometer) were available in the campaign. Ground-based and satellite instruments were used in the analysis, and several intercomparisons were carried out to validate remote sensing data. OMI, GOME, GOME-2, and MODIS instruments, which provide data of ozone, aerosol load and optical properties, were used to this end. The effects on solar radiation, ultraviolet and total shortwave ranges, of total ozone column, aerosol optical thickness and precipitable water column were obtained using radiation measurements at different fixed solar zenith angles. The empirical results shown a determinant role of the solar position, a negligible effect of ozone on total shortwave radiation, and a stronger attenuation provided by aerosol particles in the erythemal radiation. A variety of aerosol types from different sources (desert dust, biomass burning, continental, and maritime) reach Malta, in this campaign several dust events from the Sahara desert occurred and were analyzed establishing the air mass back-trajectories ending at Malta at several heights calculated by means of the HYSPLIT model. Hence, changes in the UV index due to atmospheric aerosol were characterized.