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Estimation of cloud optical depth for low clouds from UV Erythemal irradiance

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This study illustrates a method for estimation of the cloud optical depth from the UV erythemal irradiance (UVER) and cloud cover for low clouds, both obtained experimentally.

Measurements of global UVER were taken every 5 minutes at the Burjassot campus of the University of Valencia (39° 30'N, 0° 25'W, 30 m) using a broadband UVB-1 radiometer by Yankee Environmental Systems, which has a spectral range between 280 and 400 nm and a spectral sensitivity close to the erythemal action spectrum. In order to register the cloud cover for low cloudiness, an automatized sky camera SONA SIELTEC SL is used; it takes pictures of the whole hemisphere every 5 minutes during 24 hours.

The process to obtain the cloud optical depth was the following: at first, a selection of images of the sky with total cloudiness or partially covered with low clouds for 2011 was made, based on the photos made by sky camera. Then, relying on these images and due to application of the special software where according to the grey level image cloud cover was obtained.

Subsequently, the calculation of the UVER irradiance with previous datum for cloudless skies was carried out on the basis of a multiple scattering atmospheric radiative transfer code, the SBDART. This model solves radiative transfer equation numerically using the DISORT algorithm and considering atmosphere to be plane-parallel. There have been several parameters taken into consideration for aerosol classification: monthly average values of aerosol optical depth, single scattering albedo and asymmetry factor, calculated from measurements of the photometer CIMEL CE318 located on the roof with the rest of instruments. Monthly average values of aerosol optical depth were taken into account due to the fact that it is impossible to take measurements for the cloudy days. The used ozone value was the one provided daily by the OMI satellite.

The next step was to estimate the fraction of experimental UVER proceeding from clouds, taking into account two previous parameters, cloud cover for low clouds and UVER for cloudless skies modelled by SBDART.

Finally, the cloud optical depths are to be calculated using a minimization method. The SBDART program is launched constantly, while cloud optical depth is being changed successively until the deviation between the fraction of experimental UVER proceeding from clouds and the UVER modelled by SBDART is less than 3%, providing in such a way final value of cloud optical depth considered as a correct one.

Optical depth values, obtained in this study, range between 0 and 80 and will enable us to establish connections between the radiative properties of clouds and their attenuation in the range of UVER.