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The cloudiness effect on UV radiation

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Ultraviolet total solar irradiation, 290-385 nm, at ground level in Valladolid, Spain (lat. 41º 40'N, long. 4º50'W and 840 m a.m.s.l.), has been recorded from February 2001 to June 2008 with an Eppley TUVR radiometer.

The aim of this study is to examine the effects of clouds on the ultraviolet total irradiation (UV). To this end, two parameters have been calculated to quantify the effect of clouds on this radiation: clearness index or hemispherical transmittance and cloud modification factor (CMF). The global hemispherical transmittance is defined as the ratio between the global measured irradiation and the global extraterrestrial irradiation. The global cloud modification factor is defined as the ratio between the global measured irradiation and the estimated in a clear sky model. By analogy, these parameters are defined for ultraviolet range.

The dependence of UV and global hemispherical transmittances on cloudiness (in octas) have been analyzed. It can be seen that, for high solar elevation angles, the global hemispherical transmittance falls 60% from cloudless to overcast skies, whereas UV hemispherical transmittance decreases only 50%. Linear and potential fits have been found like the best relationships between these transmittances.

Moreover, the dependence of UV/G ratio and the clearness index on the cloudiness (in octas) have been studied. Both variables show different behaviours, while the UV/G ratio increases with cloud cover, the clearness index decreases. For example, for high solar elevation, the clearness index falls 50% from cloudless to overcast skies, while the UV/G ratio rises almost 1%.

The relationships between global and UV cloud modification factor have been found. The best ones obtained have been with the exponential or potential functions. It can be shown that these relationships move away from the linearity. Therefore, the clouds do not transmit the UV irradiation and the global solar irradiation in the same way. UV-CMF and global-CMF values higher than the unit have been obtained; this could be explained by the reflection of solar radiation at the edges of cumulus clouds or very thin cirrus clouds that act as a UV greenhouse. The UV-CMF falls around 50% of the value under cloudless skies when conditions of overcast skies are achieved.