The main aim of this study is to show the different variability of erythemal ultraviolet (UVER) and total shortwave (SW) radiation. To this end, the influence of solar zenith angle (SZA), Total Ozone Column (TOC), Precipitable Water Column (PWC) and Aerosol Optical Depth (AOD) on radiative fluxes have been shown.

**SOLAR RADIOMETRIC STATION (SRS)**

 Coordinates: 41º49’N, 4º56’W and 848 m a.s.l., Valladolid (Spain).

**TOTAL OZONE COLUMN**

 Figure 2: UVER and SW irradiance under cloudless conditions as a function of TOC for different SZA.

 To remove the dependence on SZA (Fig. 1), 10 different sub-datasets were selected for different fixed SZA with an error of ± 0.1º.

 Figure 2 shows the UVER irradiance variability with TOC (TOMS-OMI and GOME-GOME2 satellite data) for different solar zenith angles, and a linear correlation between 0.3 and 0.8 appears with the worst correlations for SZA > 30º. The decrease trend in percentage is close to the same value for all SZA values, and the average of this trend is -0.31%DU-1. Hence, the ozone effect can be removed by normalization to a standard value, 313 DU (average value in the region), through the next expression:

 \[ \text{UVER}_{313DU} = [1 - 0.31(313-\text{TOC})/100] \text{UVER}_{\text{meas}} \]

 On the other hand, SW irradiance does not show clearly variation with the TOC, being the maximum correlation lower than 0.1. This result is due to the ozone absorption band is in the UV region (a little portion of SW irradiance).

**AEROSOL OPTICAL DEPTH**

 Finally, the effect of aerosols on solar radiation were studied. The \( \text{UVER}_{313DU} \) and the SW (to remove the water vapour effect on SW, PWC was only considered between 1 and 1.4 cm), are represented in Fig. 4 as a function of the hourly aerosol optical depth at 440 nm (AOD440), data provided by the AERONET-RIMA station of Palencia (Spain).

 A negative trend is shown for all SZA. In the UVER irradiance case, the correlation with the linear fits varies between 0.1 and 0.6, and the trend shows an average value of -37% for AOD440 unity. In the SW irradiance case this percentage falls up to -28.4% for AOD440 unity, and the correlations take values from 0.3 to 0.8.

 In conclusion, the effect of aerosols is stronger on the UVER irradiance than the SW one.

**CONCLUSIONS**

- UVER irradiance depends on SZA cosine by a power law while SW one shows a linear trend.
- UVER is affected by ozone which reduces UVER levels around -0.31%DU-1, and by aerosols (-28.4% for AOD440 unity).
- The ozone effect on SW irradiance is negligible, but SW depends on water vapour (~ -3.36%cm-1) and aerosols. The dependency on AOD440 is weaker than in the UVER case.

Financiary supports from the Spanish MICINN (ref. CGL2009-08979/CLI, CGL2008-05939-C03-00/CLI and CGL 2009-09740) and from the B-220 Project of the Junta de Castilla y León are gratefully acknowledged. The authors also thank the OMI International Science Team and the German Aerospace Center (DLR) for the remote sensing ozone data. The authors would like to acknowledge the AERONET-PHOTONS-RIMA team for the managements of these networks.

**ACKNOWLEDGEMENTS**

**UVER_{meas}** is the measured UVER irradiance normalized to 1 AU and under cloudless conditions, and **UVER_{313DU}** is the same irradiance but normalized to 313 DU.

---

**Figure 1:** UVER and SW irradiance under cloudless conditions as a function of SZA cosine.

**Figure 2:** UVER and SW irradiance under cloudless conditions as a function of TOC for different SZA.

**Figure 3:** UVER normalized to 313 DU and SW irradiance under cloudless conditions as a function of PWC for different SZA.

**Figure 4:** UVER irradiance, normalized to 313 DU, and SW irradiance, with PWC between 1 and 1.4 cm, under cloudless conditions as a function of AOD for different SZA.

---

**Figure 1:** UVER and SW irradiance under cloudless conditions as a function of SZA cosine.