Introduction

In this study, an analysis of the predictions based on the high-performance solar radiation REST2 model is presented. REST2 (Reference Evaluation of Solar Transmittance, 2 bands) is a two-band model developed by Gueymard [1] to predict cloudless-sky broadband solar radiation. Model estimations of solar irradiance and illuminance are compared with experimental data. Predictions for different time of the day and different periods along the year are analyzed. In summer time where the illuminance are compared with experimental data. Predictions for different time of the day and different periods along the year are analyzed. In summer time where the illuminance are compared with experimental data.

Characteristics of the radiometric station:
- Sited in the Low Atmospheric Research Center C.I.B.A. (41.82°N, 4.93°W).
- Rural area close to the city of Valladolid, Spain, in the Northwest of the Iberian Peninsula.
- Flat terrain (840m altitude above the sea level) with a type of vegetation dry and low.
- The ground cover is quite homogeneous for a large extension and does not experiment significant changes along the year so that the ground reflectivity doesn’t have a relevant variation in time.

Sensors:
- CM11 Kipp&Zonnen and LICOR Li210-SA have been used to measure global horizontal irradiance and Illuminance respectively on a 10-min basis, placed on a flat platform 1.5 m height.
- Data acquisition system: CR23X Campbell datalogger.

Data:
- Selection of 24 complete clear days distributed along the year 2007.

REST2 Model

Description: REST2 (Reference Evaluation of Solar Transmittance, 2 bands) is a high performance solar radiation model with a two-band scheme, developed by Gueymard who makes a complete description of the method in [1]. The model divides the spectrum in two spectral ranges, band 1 (0.29 to 0.7 μm) and band 2 (0.7 to 4 μm) and simplifies the retrieval of the illuminance whose spectral range corresponds almost perfectly to band 1.

Input data: Precipitable water (w), Angstrom turbidity coefficients (α, β), NO2 content (un), O3 content (uo) and Site pressure (p), Solar zenith angle and the Ground reflectivity.

Performance of the model

Solar Illuminance L is the part of the irradiance sensitive to the human eye and it is obtained from the relationship:

\[ L = K_m \int_{\lambda_1}^{\lambda_2} V(\lambda) I(\lambda) d\lambda \]

where \( I(\lambda) \) is the spectral irradiance, \( V(\lambda) \) is the normalized human eye response and \( K_m \) is the maximum luminous efficacy, 683 lm/W corresponding to 555nm. \( V(\lambda) \) describes the average visual sensitivity of the human eye to light of different wavelengths and its maximum value is 1 at 555nm (CIE).

The ratio of the global horizontal illuminance and the global irradiance is denominated global horizontal luminous efficacy \( K_v \):

\[ K_v = \frac{L}{I} \]

Luminous efficacy may be used to convert radiant energy into luminous energy. As modeled in REST2, irradiance and illuminance are function of the solar position through the solar zenith angle and of the several atmospheric data.

Methodology

In this study, an analysis of the predictions based on the high-performance solar radiation REST2 model is presented. REST2 (Reference Evaluation of Solar Transmittance, 2 bands) is a two-band model developed by Gueymard [1] to predict cloudless-sky broadband solar radiation. Model estimations of solar irradiance and illuminance are compared with experimental data. Predictions for different time of the day and different periods along the year are analyzed. In summer time where the radiation is low. RMSE values about 9% are obtained for both type of magnitudes, radiance and illuminance.

Comparison of REST2 model estimations with experimental data:
- 1411 points
- RMSE=9%, this value decreases when only data with high solar altitudes are considered

Data acquisition system: CR23X Campbell datalogger.

References: