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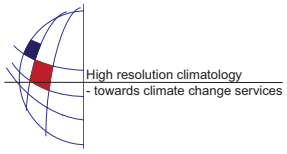

Towards the automatic identification of cloudiness condition by means of solar global irradiance measurements

G. Sanchez, A. Serrano, and M.L. Cancillo
University of Extremadura, Department of Physics, Badajoz, Spain (gsanchezw@alumnos.unex.es / +34 924 289651)

This study focuses on the design of an automatic algorithm for classification of the cloudiness condition based only on global irradiance measurements. Clouds are a major modulating factor for the Earth radiation budget. They attenuate the solar radiation and control the terrestrial radiation participating in the energy balance. Generally, cloudiness is a limiting factor for the solar radiation reaching the ground, highly contributing to the Earth albedo. Additionally it is the main responsible for the high variability shown by the downward irradiance measured at ground level.

Being a major source for the attenuation and high-frequency variability of the solar radiation available for energy purposes in solar power plants, the characterization of the cloudiness condition is of great interest. This importance is even higher in Southern Europe, where very high irradiation values are reached during long periods within the year.

Thus, several indexes have been proposed in the literature for the characterization of the cloudiness condition of the sky. Among these indexes, those exclusively involving global irradiance are of special interest since this variable is the most widely available measurement in most radiometric stations. Taking this into account, this study proposes an automatic algorithm for classifying the cloudiness condition of the sky into three categories: cloud-free, partially cloudy and overcast.

For that aim, solar global irradiance was measured by Kipp&Zonen CMP11 pyranometer installed on the terrace of the Physics building in the Campus of Badajoz (Spain) of the University of Extremadura. Measurements were recorded at one-minute basis for a period of study extending from 23 November 2009 to 31 March 2010.

The algorithm is based on the clearness index kt, which is calculated as the ratio between the solar global downward irradiance measured at ground and the solar downward irradiance at the top of the atmosphere. Since partially cloudy conditions exhibit large variability in the solar global irradiance measured at ground and, therefore, in the kt index, the algorithm is based, along with the value of the kt index, on the local variability. This variability was locally computed as the coefficient of variation of a two-neighbor window around each measurement.

The consideration of both, the value of kt index and its local variability, highly improves previous classifications consisting in applying fixed thresholds to the kt index value. The proposed algorithm is applied to certain selected cases and compared to classifications proposed by other authors.