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Analysis of a long-term dataset of global and diffuse horizontal irradiance at northeastern Spain for energy applications

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An accurate knowledge of the global, diffuse and direct beam irradiance at specific geographical locations in high temporal and spatial resolutions is a must requirement for the development of solar energy applications. Most available datasets comprise global irradiance, but it is not the case for diffuse or direct beam components. These two latter are of great importance when converting the data into declined impinging irradiance or specific components like for example daylight or available energy, utilized to assess the feasibility of solar energy systems. The surface irradiance presents a high temporal variability, and analysis of high frequency sampling datasets provides very valuable information for energy applications.

In this contribution, we present an analysis of a long-term dataset of ground measurements of global and diffuse irradiance over a period of 22 years (1986–2007) at northeastern Spain. Ten Irradiance stations of the Catalan Energy Institute (ICAEN) solar network are analyzed to assess the temporal and spatial fluctuations and trends of the ground solar irradiance. The stations provide 5-minutes global and diffuse irradiance over a period of 22 years. In a first step, a quality control testing is applied over our datasets based on QCRad methodology (Long and Shi, 2006; Long and Dutton, 2002). The total amount of valid data from sunrise to sunset is over 6 Million data for global irradiance (87%) and over 4.5 Million data for diffuse irradiance (62%). Then, a comparison and validation of global-to-beam irradiance conversion models is performed to estimate beam irradiance and daily sunshine duration through the clearness index (Kt) and diffuse fraction (Kd). The results allow us to provide a representative solar radiation year which sums up all the climatic information characterizing an annual radiation cycle.

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