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Evaluation of different models to estimate the global solar radiation on inclined surface

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Global and diffuse solar radiation intensities are, in general, measured on horizontal surfaces, whereas stationary solar conversion systems (both flat plate solar collector and solar photovoltaic) are mounted on inclined surface to maximize the amount of solar radiation incident on the collector surface. Consequently, the solar radiation incident measured on a tilted surface has to be determined by converting solar radiation from horizontal surface to tilted surface of interest. This study evaluates the performance of 14 models transposing 10 minutes, hourly and daily diffuse solar irradiation from horizontal to inclined surface. Solar radiation data from 8 months (April to November 2011) which include diverse atmospheric conditions and solar altitudes, measured on the roof of the radiation tower of the Royal Meteorological Institute of Belgium in Uccle (Longitude 4.35°, Latitude 50.79°) were used for validation purposes. The individual model performance is assessed by an inter-comparison between the calculated and measured solar global radiation on the south-oriented surface tilted at $50.79°$ using statistical methods. The relative performance of the different models under different sky conditions has been studied. Comparison of the statistical errors between the different radiation models in function of the clearness index shows that some models perform better under one type of sky condition. Putting together different models acting under different sky conditions can lead to a diminution of the statistical error between global measured solar radiation and global estimated solar radiation. As models described in this paper have been developed for hourly data inputs, statistical error indexes are minimum for hourly data and increase for 10 minutes and one day frequency data.