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Comparison of clear-sky models performance for a photovoltaic energy production forecasting tool

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Photovoltaic power production relies upon solar radiation received at ground level, that remains difficult to predict. Accurate forecast of surface solar irradiance is essential for grid operators in order to accommodate this intermittent energy in their scheduling, dispatching and regulation of power. Surface solar irradiance forecasting methods can be described as the prediction of the cloud physical property over a specific area. This information is then combined with the value of the irradiance under a clear sky for the same area at the same forecast time. Then, uncertainty of irradiance under clear sky can affect significantly the forecast results accuracy.

Many clear sky models have been designed and are routinely used to compute surface solar irradiance under a sky with no cloud for a diversity of applications. The required inputs for such tools are varying from model to another. The simplest models just take into account the solar elevation, while more detailed ones may include other inputs such as concentration of atmospheric components (aerosols, water vapor, ozone), elevation of the site, ground albedo, in order to represent a realistic atmosphere transmittance. However, availability and quality of some inputs are not always guaranteed at every locations.

The objective of our study is the selection and performance quantification of a clear sky model usable with an innovative solar radiation forecasting tool. We selected the models Bird, Solis, ESRA and McClear. These models demonstrated their accuracy and robustness and their features are suitable for operational processes. We undertook our study over three sites located in Corsica, French Guiana and Reunion Island. We collected available atmospheric parameters (aerosol optical depth and water vapour). We compared simulated global irradiation with ground measurements at clear sky situations. Models accuracy and their sensitivity to input data are discussed. Conclusions underline the input data quality requirements.