



Advantages and drawbacks of a statistical clear-sky model: a case study with photovoltaic power production data

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Photovoltaic (PV) 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 most advanced clear sky models require concentration of atmospheric components influencing atmosphere transmittance in the shortwave range, namely the aerosols, water vapor and ozone. Availability and quality of some inputs are not always guaranteed at every locations. Moreover, such deterministic clear sky models are not always accurate at low solar elevation angles. Thus, solar irradiance forecast scheme can be penalized by poor quality data at the first minutes of the day.

In order to avoid radiative transfer modeling difficulties when the sun is close to the horizon, several authors proposed statistical clear sky models. Considering a 1-year time-series of PV power data, a smoothing function using a weighted quantile regression method compute recursively the local maximum. These clear-sky power data are compared with those derived from deterministic clear sky models outputs (McClear and simplified Solis). Results are discussed according to season, solar elevation angles. Statistics clear sky models give better results at very low solar angles. Moreover, local shading effects are taken into accounts.