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Solar Radiation Modelling and Forecasting

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Solar energy is one of the most interesting renewable energies on earth. To become an alternative, solar power needs, in addition to good storage systems, tools that allow its easy management, as well as its efficient prediction. Among these tools, solar radiation prediction and characterisation models are fundamental. In this paper, an adaptive solar radiation numerical model for complex terrains is described [1]. This model is an improvement of that presented in [2].

Real sky radiation values are obtained for beam, diffuse and reflected components, using clear sky computed irradiance affected by the clear sky index for the analysed mesh triangle and time step. Terrain discretisation is adapted to orography and albedo to improve reflected irradiance computations. Likewise, the use of surfaces provided by the adaptive discretisation, allows us the option to improve the determination of shadows on the domain [3]. On the other hand, a good solar radiation forecasting system is needed for an optimal management of power systems with a high solar energy penetration. This is the reason to include different prediction options in the model, either using Numerical Weather Prediction (NWP) models [4], or applying forecasting techniques like Bayesian Artificial Neural Networks [5]. The use of satellite images has been introduced to improve the results of those mathematical methods [5]. In addition to these images, measurements and NWP models have been combined [6]. With the computed irradiance values, electrical power generation can be assessed. Photovoltaic and Solar Thermal collectors are easily introduced in our discretised domain, taking into account its position, orientation and inclination and, moreover, considering its capacity for acting like a Sun tracker. Both, photovoltaic and solar thermal models are incorporated to compute the electrical power generation. Forecasted radiation values provide a predicted power generation profile for a period of time in the whole domain. This model is a convenient tool as it computes reliable characteristic or predicted radiation values over a complex terrain and likewise, electrical generation by means of photovoltaic or solar thermal facilities. Examples have been done for Canary Islands.

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