Photovoltaic production forecast : the significant role of the meteorological satellites

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Power production from photovoltaic system is an intermittent energy source. Forecasting the production of such energy is then especially helpful for the integration of this electricity into existing power supply structures. Solar energy production is driven by solar irradiance received at ground level. Then, presence and optical thickness of clouds should be predicted at any time scales, from minutes up to several days. These specific characteristics cannot be accurately predicted in a intra-day horizon with traditional numerical weather (NWP) prediction models. However, the use of meteorological geostationary satellites provide significant benefits to this issue. In this work, we present a survey of different satellite-based applications contributing to improve solar irradiance forecasting methods.

Since the late seventies, images from visible channel of those space-born radiometers are used to assess solar radiance at ground level. Methods have been developed and converted images from the European Meteosat, American NOAA-GOES and Japanese GMS satellites into solar irradiance maps. Today, 30-year time series of solar data are now available on an daily or sometimes hourly basis with a spatial resolution from 3 km (HelioClim, SolarGis, NASA-SMSE, . . .). These datasets permitted the building of local atlases by combining, at very fine scale, accurate parameters influencing solar irradiance, such as ground elevation. Moreover, ground measurements permitted to correct the error of satellite-based irradiance assessment at a sub-kilometer scale.
Satellite-derived data are also specifically used for solar irradiance forecast schemes. Methods are based on the identification of cloud structures behavior from consecutive satellites images. A cloud cover map is then extrapolated and solar irradiance is predicted with a better accuracy than NWP models for a forecast time range inferior to 6 hours.

The conclusions of our survey underline the perspectives of solar radiation forecasting improvement allowed by existing and future satellite products.