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Satellite-based cloud cover detection and tracking for solar irradiance forecasting

Sylvain Cros, Mathieu Turpin, Caroline Lallemand, Hugues Souchard de Lavoreille, and Frederik Kurzrock
Reuniwatt SAS, R&D, Sainte-Clotilde, France (sylvain.cros@reuniwatt.com)

Cloud cover forecast at very short term (up to 6 hours) is useful for solar energy management and also for any applications requiring cloud cover at local scale (airport traffic management, low orbit satellite mission planning, defense application...). In particular, photovoltaic production is strongly dependent cloud cover behavior. It can induce a very high variability of the production which is problematic for a safe and gainful injection into the power grid. This issue is even more critical in non-interconnected territories where network stability is an absolute necessity.

In this context, grid operators of such areas must mitigate the risk of this variability. Intraday irradiance forecasting is useful to plan the energy mix. In particular, the PV power drop probability in the next hours allows a convenient sizing of power reserves. At this time scale, cloud cover evolves with a stochastic behaviour not properly represented in numerical weather prediction (NWP) models. Analysing cloud motion using images from geostationary meteorological satellites is a well-known alternative to forecasting SSI up to 6 hours ahead with a better accuracy than NWP models.

In this study, we present and apply our satellite-based solar irradiance forecasting methods. Firstly, we present the ability to assess solar irradiance over more than 100 sites all over the world. Then, we evaluate our solar irradiance forecast scheme on measurements sites located in the field of view of the satellite Himawari-8 (Ishigakajima, Japan), MSG-11 (Carpentras, France) and MSG-8 (Reunion Island). In particular, we converted 12 months of images from each satellite into cloud index maps. Then, we applied an algorithm computing a cloud motion vector field from a short sequence of consecutive images. Comparisons between forecasted SSI at 2 hour of time horizon and collocated pyranometric measurements show a relative RMSE between 22 and 27%.