



Satellite-based solar irradiance assessment and forecasting in tropical insular areas

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Abundant solar yield and decreasing costs of PV production units will allow many tropical islands to pursue their economic growth with a clean, affordable and locally produced energy. However, exploiting this PV production is also a challenge for grid safety management. Indeed, tropical weather conditions cause a high variability of the surface solar irradiance (SSI). This leads to sudden drops in power production which are difficult to compensate in non-interconnected territories.

In this context, intraday irradiance forecasting (several hours ahead) is particularly useful to mitigate the production variability by reducing the cost of power storage management. 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 over three measurement sites in Indian Ocean islands: Reunion Island, Cocos (Keeling) Islands and Maldives. In particular, we converted two years of Meteosat-7 visible channel images into cloud index maps. Then, we applied two distinct forecasting methods. A first one computes a cloud motion vector field from a short sequence of consecutive images. The second trains an autoregressive algorithm over a 1-year time series of cloud index maps. An attempt to combine both approaches is also presented. Comparisons between forecasted SSI at to 2 hours and collocated half-hourly pyranometric measurements show a relative RMSE between 40 and 46% for the year 2014.

Error sources related to the tropic insular context (coastal area heterogeneity, sub-pixel scale orographic cloud appearance, convective situation. . .) are discussed at every implementation step for the different methods.