Solar energy forecasting using Meteosat Second Generation Optimal Cloud Analysis and cloud motion vectors derivation from MSG HRV channel

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Photovoltaic (PV) power production relies on incident shortwave solar radiation that hits solar panels. Giving surface solar irradiance (SSI) forecasting to PV plant managers and electricity grid operators contributes to increase the penetration of PV electricity in the energy mix.
SSI forecasting mainly consists in predicting cloud optical thickness above a given site. Due to the stochastic behaviour of the cloud cover, using images from meteorological geostationary satellite permits to obtain better results than numerical weather prediction models for a forecast time-horizon of up to six hours. In this approach, cloud patterns are detected through the use of images from visible channels of such satellites. Cloud motion vectors are determined from two consecutive images and are used to forecast cloud pattern with an extrapolation of the actual image. Then, a smoothing filter must be applied to the resulting image. Indeed, small scale structures vary randomly and their development cannot be predicted. Finally, filtered images are converted into solar irradiance maps. Smoothing filter cut-off frequency are generally a constant value determined from empirical adjustments between forecast results and punctual measurements of irradiance from ground stations.
In this work, we improve the filter by retrieving a cut-off frequency depending of the forecast time horizon using Optimal Cloud Analysis (OCA) data. We implement the forecast scheme on a 5 months dataset of MSG HRV level 1.5 images over Europe. For a given image, we produced the forecasting at six hourly time horizons coinciding with OCA availability. We compared extrapolate cloud index with OCA cloud optical depth at each hourly forecast. At this time, we determined the cut-off frequency maximizing the spatial correlation between the two different cloud data. Then, from the 5-month dataset, we established a parametrization of the cut-off frequency according to the time forecast horizon. We compared SSI forecast with this new smoothing filter against SSI ground measurements over Europe. Improvements of SSI forecasting accuracy are significant but a 1-year time-series of OCA (available from August 2014) would be more pertinent to conclude.