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Intraday solar energy forecasting using cloud motion observation from satellite combined with WRF irradiance forecast

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Photovoltaic energy integration into the electrical grid is generally planned one day in advance using day-ahead solar energy forecasting. Intraday global horizontal irradiance (GHI) forecasting permits to adjust the load differences remaining between planned supply and actual demand, by anticipating the use of compensation systems (e.g. battery storage), whose costs are thus reduced.

GHI forecasts have been implemented using satellite images. Reuniwatt's method (called Soleksat) uses MSG satellite to assess a cloud motion vector field between two subsequent images. This field is used to extrapolate the cloud cover observed in the current image and to deduce its corresponding GHI. This method assumes that cloud motion from a very short time-lapse is constant for several hours. However, after a time horizon of 4 hours, forecasting error significantly increases; after 6 hours, it is generally admitted that numerical weather prediction (NWP) models give better results than satellite-based methods. Therefore, combining Soleksat's forecasting results issuing from satellite-based methods with NWP should increase forecasting accuracy. Previous studies have been experimented using NWP from national weather offices.

The purpose of our work consists in assessing the performance of the combination between Soleksat and WRF. A 1-year dataset of collocated hourly forecasts was produced and validated over the Baseline Surface Radiation Network stations of Palaiseau and Carpentras (France) from March 2013 to February 2014. A linear regression between Soleksat and WRF outputs was performed to produce a hybrid GHI. Regression coefficients were computed using collocated forecasting results between WRF and Soleksat for a minimal period of 30 days before the computation of the hybrid GHI. This latter presented a reduction of relative RMSE between 2 and 10 % compared to the GHI providing from Soleksat. Results are discussed according to time horizon, period duration used for regression coefficients computation and cloud cover state.