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A “smart” method for short-term solar radiation forecasting

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The development of accurate short term (up to 6 hours ahead) solar radiation forecasting techniques is key issue in solar energy. The main challenge that these techniques face is the precise forecasting of the clouds amount and location. Statistical techniques that derive Cloud Motion Vectors (CMV) from satellite images are commonly used for this purpose. Nevertheless, the reliability of solar radiation forecasts based on these techniques reduces considerably with the forecasting horizon. Mainly because CMV methods rely on statistical approaches that does either account for the complex atmospheric dynamic neither cloud thermodynamic. On the other hand, Numerical Weather Prediction (NWP) models provide accurate forecasts of the atmospheric dynamic state and cloudiness in overcast conditions. However, the accuracy of NWP models cloud forecasts is poor in broken sky conditions. In this work we propose and evaluate a “smart” method for short term GHI and DNI forecasting. Firstly, 6 hours ahead GHI and DNI, with a time step of 15 minutes, were obtained based on four models 1) persistence, 2) CMV-based using the Open PIV algorithm, 3) CMV-based using and Optical Flow algorithm and 4) the WRF NWP model. The forecasts were obtained for 4 different locations in southern Spain for a total of 25 days of year 2013. In a second part, the best model among the 4, as a function of the sky conditions and forecasting horizon were identified. The sky condition was evaluated in the satellite image based on stream-lines. Based on these result, a “smart” forecasting model, i.e. the best choice of models for each sky condition and forecasts horizon, was constructed. The performance of the model was tested in a separate set of data, resulting in a reduction of the RMSE value of more than 20% compared to the rest of the models.