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Evaluation of a short-term solar radiation ensemble forecasting system in the Iberian Peninsula

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Accurate short-term, i.e. up to 6 hours ahead, solar radiation forecasts are important for the solar energy integration and solar power plant management. The are several tools to obtain these forecast: statistical techniques, Cloud Motion Vectors (CMV) derived from satellite images or Numerical Weather Prediction (NWP) models. Nevertheless, forecasts accuracy is still far from optimal. This is a challenge for the solar energy integration, especially at high solar power penetrations as expected in the forthcoming years. The relative performance of the different models tends to vary according to, among other, the forecasting horizon, the local topographic features and, notably, the mesoscale weather conditions. This makes the forecasting models flow-dependent. A set of different models can be used as an ensemble forecasting system, the spread of the ensemble indicating the forecasts uncertainty.

In this work we explore the advantages of using a short-term solar radiation ensemble forecasting system for the Iberian Peninsula. Notably, the ensemble is composed by four models: persistence, a CMV-based model, the WRF-Solar model and a hybrid Satellite-NWP model. Up to 6 hours ahead GHI and DNI forecasts are provided by this system, with a latency and time resolution of 15 minutes. Machine learning methods are used to derive an ensemble mean forecasts for the different forecasting horizons and different weather regimes. Spread of the ensemble is used to assess the forecasts uncertainty. We present evaluation results of the system for several locations in the Iberian Peninsula along a period of 2 years. Notably, performance is analyzed on the light of the weather regimes, forecasting horizon and local features of the evaluated locations.

Overall, results showed that the ensemble mean provide improved forecasts. For instance, the nRMSE of the 3 hours-ahead GHI/DNI forecasts of the optimal forecast was reduced by about 20% compared to the best of the four ensemble models. Nevertheless the interaction of the synoptic weather conditions with the local features of the evaluation stations (i.e. topography, location respect to the main flow) showed to play a major role in the performance of the ensemble system.