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Short term forecasting of solar irradiance by combining satellite data and numerical weather predictions

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Short term predictions of solar irradiance are the most essential input for photovoltaic (PV) power prediction systems. With the constantly increasing contribution of PV to the electricity mix, reliable predictions of the expected PV power production are getting more and more important as a basis for management and operation strategies. For example in Germany, where PV power can supply up to 30% of the total electricity demand, these services already form an essential part of the grid control and energy trading.

Here, we present a new approach for irradiance forecasting in order to improve the operational PV power prediction system of University of Oldenburg and Meteocontrol GmbH by combing several data sources, including satellite images and different numerical weather prediction (NWP) systems. For forecast horizons up to several days ahead, we have analysed irradiance forecasts of two NWP systems, the global model of the European Centre for Medium-Range Weather Forecasts (ECMWF) and the local area model of the German Weather Service DWD. For intra-day forecast horizons, we have additionally calculated and evaluated irradiance forecasts based on cloud motion vector fields from Meteosat satellite images [1]. Up to several hours ahead the satellite based irradiance forecasts perform significantly better than irradiance forecasts of numerical weather prediction systems, which is demonstrated in an evaluation with 290 irradiance measurement stations in Germany.

The investigation of an optimized combination of the different data sources with post processing methods including measured irradiance data is a second focus of the presentation. As a first approach, we have applied a bias correction in dependence on the cloud situation to the single forecasts and combined the forecasts with weights optimized in dependence on the forecast horizon. The combined approach outperforms forecasts based on one data source only for all forecast horizons. Further improvement is expected by adapting the weights not only to the forecast horizon but also to the weather situation, characterized by different meteorological parameters.

References:
[1] Lorenz, E., Hammer, A., Heinemann, D, 2004. Short term forecasting of solar radiation based on satellite data, EUROSUN2004 (ISES Europe Solar Congress), Freiburg, Germany, 20.06.-23.06.2004