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Linear modelling for PV with multiple irradiation data: Before or after power conversion?

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Weather-dependent energy sources like wind and solar bring an element of weather uncertainty to the operation of power grids that requires information for decision-making at different time horizons. For day-ahead decisions on e.g. scheduling and reserve markets, we rely on numerical weather predictions (NWPs) for meteorological variables. For grid balancing and short-term forecasting from a quarter to many hours, measurements of the current state can be the most reliable predictors. Solar power forecasting uniquely benefits in the short term from the availability of spatially resolved satellite measurements, whose usefulness optical flow techniques and cloud motion vectors (CMV) can extend to larger time horizons.

Several services of course provide NWPs or measurements, and as a practical matter, the best power forecasts rely on the confluence of more than one. When a forecasting system like Fraunhofer IEE's Solar Prediction System (Y.M. Saint Drenan et al., 2016) physically models the PV generation, two possible avenues present themselves: a mix of power forecasts with different meteorological inputs, and a power forecast calculated from a best mix of the irradiation. The first strategy has the advantage of directly targeting the aggregated power. The latter is an indirect approach, with an intermediate target of satellite irradiation measurements that are however better defined than power estimates and are spatially resolved.

We compare these two approaches using linear models within our Solar Prediction System, considering the sensitivity to both geography and forecast horizon. While the day-ahead forecast concerns only NWPs for the irradiation, the short-term mix also involves IEE's cloud-motion forecast detailed in the previous EMS Annual Meeting. The linear model then also helps us to assess the value of the CMV forecast for different time horizons.