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Improved intraday power forecasts of unmeasured wind plants with weather predictions and nearby online power measurements

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Wind energy is a major weather dependent power source but for forecasting, real-time power measurements are not available for most wind plants. This poses problems for intraday forecasts, because numerical weather prediction (NWP) is relatively inaccurate at short time horizons; intraday forecasts based on measured power are more accurate than those based solely on NWP.

This is especially true for electrical grid node forecasts, which predict wind power production for small spatial regions in which there may be very few power measurements. A grid node forecast can be produced by summing the forecasts of all plants within the node. When power measurements are available, the plant forecasts are produced by accurate autoregressive statistical models, trained specifically for each so-called "reference plant," and based on both real-time power measurements and NWP parameters; when there is no measured power, plant power forecast can be produced by applying a generic empirical power curve to forecasted NWP wind speed. While less accurate, the pure NWP forecasts do reflect the spatial behavior modeled by the NWP, so a grid node sum that includes them may be more accurate than one that is produced by only spatially interpolating the reference plant forecasts.

In this work, we test this idea. Three approaches are compared. The first approach spatially interpolates the reference plant forecasts to predict the unmeasured plant power. The reference plant forecasts are trained on real-time measurements and the latest available weather forecast at the location of the plant. Unfortunately, the result of the interpolation is unreliable when distances to the unmeasured plants are large. For this reason, a second method is investigated, which is based on the NWP wind speed forecast at the unmeasured location and the generic power curve. The third approach combines the best of the power curve and the interpolation approaches. Depending upon distance, the reference plant forecasts and the power curve forecasts are weighted and summed.

For this study, historic power measurements and weather predictions, collected between 2013 and mid-2015, are used for 82 German reference plants. The main result is that the combination of both reference and NWP-only forecasts significantly improves single plant forecast quality, and therefore, the grid node forecast is also improved.