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DISCUSSION

Comments on: Space-time wind speed forecasting for improved power system dispatch

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This paper contains a number of interesting ideas and we are grateful for the opportunity to comment on it. It is particularly pleasing to see that the authors have included a comparison of the forecasting methods under a realistic power system economic dispatch model. As the authors discuss, the loss function associated with the economic dispatch model is asymmetric, in that over-forecasting the realized wind power production requires deployment of additional reserve capacity, while the consequences of under-forecasting are minimal for the overall power system.

The rotating regime-switching space-time diurnal (RRSTD) model and the autoregressive reference model are both inherently probabilistic in nature and can return full predictive distributions. Given the asymmetry of the loss function, it is likely that the optimal point forecast derived from a predictive distribution diverges from the center of the distribution (Gneiting, 2011). The authors partially account for this by employing the over-forecasting errors only in the reserve requirement component of the economic dispatch model. Furthermore, an inflation factor of 1.2 is used as a reliability margin. While this solution appears to work well in practice, we wonder if an additional economic gain could be achieved by fully utilizing the probabilistic properties of the RRSTD model in conjunction with the statistical properties of the loss function under the economic dispatch model.

The RRSTD method predicts the wind speed at the turbine location, which is then subsequently transformed to wind power using the power curve provided by the turbine manufacturer. In a recent paper, Messner et al. (2013) apply wind speed

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forecasts from a numerical weather prediction model to predict wind power production at lead times from 12 to 48 h. For their setting, Messner and co-authors show that the wind power predictions can be significantly improved using an inverse power curve transformation—modeling the relationship between wind speed forecasts and transformed power—rather than a power curve transformation.

Predictions at longer lead times often require different methods than the short-term predictions considered in the current paper. However, it appears that the general principles of the method proposed by Messner et al. (2013) could also hold in the current setting. In the power curve transformation, the transformation of error is highly heteroskedastic due to the shape of the power curve and it seems that the current framework does not fully account for this.

A related debate is whether wind power forecasting should optimally be performed in two steps, with a first step resulting in wind speed forecasts which are subsequently transformed deterministically to power, or in a single step where the same, or similar, input variables are used as covariates in a wind power prediction model. There has been no conclusive evidence that we are aware of, pointing to the superiority of one approach versus the other. Therefore, we are of the opinion that more comparative studies examining both modeling frameworks are needed. A realistic power system economic dispatch model as applied here provides an excellent tool for such comparisons. As the authors note, the two step approach has the advantage that its first step can also be applied in locations where wind turbines have yet to be installed. However, the evaluation of the potential of wind power production at a given location might require predictions of distributional wind speed information rather than detailed forecasts for a given lead time.

Finally, we have a few more specific comments regarding the model inference and the data analysis performed in this study. The RRSTD model is quite complex and consists of several different components. For this reason, the parameters of the various components are estimated independently using distinct optimization criteria. Would it be feasible to unify the estimating framework somewhat?

Table 5 in the paper shows the economic performance of the competing methods for a few somewhat arbitrarily chosen dates in the test set. Here, it would have been interesting to also include the original RSTD method. While these results indicate that the RRSTD method has the potential to provide significant economic gain as compared to the persistence forecast, it seems that the overall improvement is not quite as substantial as 2.9 %, the gain observed on August 15. We also wonder why the winter season has been removed from the data set.

With prolific growth in global wind power production, wind power prediction presents an important and topical research field where statistical approaches play a fundamental role. This paper nicely brings together the two aspects of forecasting and forecast verification, and is likely to stimulate further research.

References

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