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Highlight results

- **European forecast errors maps based on COSMO-EU**

- **The effect of spatial smoothing**

Background:

The capacity factor plays an important role during the resource assessment phase for wind farms. The question arises, whether the forecast error might also play a role. Distributed wind farms in Europe according to places with high wind resources and small forecast errors may result in an increased revenue.

While the wind resources are known for Europe, a spatial map of the forecast errors has not been released yet. Therefore, based on the COSMO-EU mesoscale model [1], different forecast skills were analysed and visualized as forecast error maps.

Within this analysis spatial smoothing effects are diagnosed. Fluctuations in wind power and in the resulting forecast errors are smoothed out if several wind farms are pooled together over a large area.

Hence, not only grid point based statistics were calculated, but the different forecast skills were also smoothed over different areas.

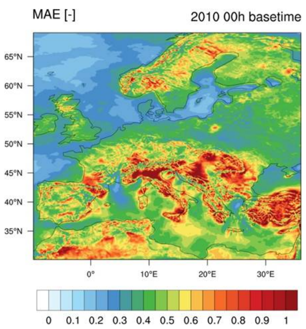

Fig. 1: MAE for 2010 for forecast day 2 normalised with the load factor

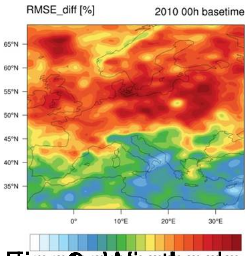

Fig. 2: Wind power forecast error growth in percent from day 1 to day 3 relative to the RMSE at day 2 smoothed for 100 km radius

Grid Based Error Maps:

The COSMO-EU model provides wind speed forecast and analysis data on a 7 by 4.1 km grid. This data is converted to wind power, using a typical power curve of two turbine types. After normalizing the data with the yearly averaged capacity factor, forecast skills (e.g. Mean Absolute Error – MAE, Root Mean Squared Error – RMSE) are calculated.

The forecast error is strongly dependent on the topography as well as on local weather phenomena. Forecast errors are smaller offshore than onshore and smaller in flat terrain than in complex terrain.

Regional forecast skills:

Spatial smoothing results in a smaller variability of wind power and in smaller forecast errors [2]. To analyse the effect of spatial smoothing, an algorithm to average the grid point data was applied. The difference in the RMSE between the third and first forecast day (Fig. 2) shows that there are some onshore regions which have a smaller error growth than other onshore regions. The Baltic Sea and other offshore areas are characterized by large error growth.

Below the results for a smoothing radius of 100 km are presented (Fig. 3). The MAE shows that the forecast errors could be decreased significantly in medium complex terrain compared to the grid point data, e.g. in Great Britain, Central Germany and Central France. As the RMSE focuses on minimum and maximum values as well, it is the better decision tool in terms of resource assessment.

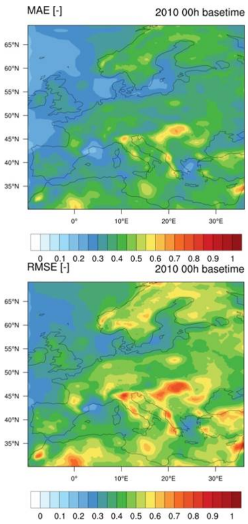

Fig. 3: MAE (left) and RMSE (right) for forecast day 2, smoothed over 100 km and normalised with the load factor, both for 2010

Summary:

Considering forecast errors in the resource assessment phase is a new approach to increase the revenue of sites. Moreover smoothing these forecast errors over regions helps to reduce the variability and the wind power forecast error. However, the usefulness of forecast errors still has to be verified.

Bibliography

[1] http://www.cosmo-model.org/

[2] Focken, U. et al : Short-term prediction of the aggregated power output of wind farms – a statistical analysis of the reduction of the prediction error by spatial smoothing effects. Journal of Wind Engineering and Industrial Aerodynamics, 90:231-246, 2002