Post-processing of probabilistic storm forecasts for wind farms in the North Sea

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By 2020, a significant increase is expected in Belgian offshore wind energy production. Because the offshore wind farms are situated close to each other, storm events over the North Sea can impact many of these farms in a similar way. An important effect is the wind speed cut out, which occurs when a wind turbine stops producing because of too high wind speeds. To better understand and predict such events, the Royal Meteorological Institute of Belgium (RMI) is involved in the development of dedicated storm forecast tools. The aim is to forecast storm events up to two days ahead, making use of weather models that generate wind speed forecasts at turbine height and localisation. Given the strong push towards the use of probabilistic forecasts in the field of renewable energy generation forecasting, it makes sense to use both deterministic and ensemble weather prediction models. This allows us to better quantify the uncertainty in the forecasts, and helps end users in their decision making process. As is well known, statistical post-processing techniques can further improve such forecasts by correcting some of the inherent errors.

A storm forecast tool has recently been developed at the RMI, and is running operationally since November 2018. It makes use of the deterministic Alaro model (4 km resolution) combined with the ENS ensemble forecasts (∼15 km resolution) of the European Centre for Medium Range Weather Forecasting (ECMWF) to generate wind speed forecasts at turbine height for several farms in the North Sea. These forecasts are generated four times per day, with an hourly timestep (15 minutes for Alaro), up to a lead time of 60 hours. The forecasts are then used to give an estimate of the wind power that will be produced in each wind farm.

We present an overview of our storm forecast tool and the models that are used. We make use of a data set of one year of wind speed measurements at turbine height for a specific wind farm to verify the skill of the ENS wind forecasts. We make use of overall probabilistic skill scores such as the continuous ranked probability score (CRPS), and scores such as the Brier score for specific high threshold events. We then show the improvement that can be attained through post-processing, making use of the so-called "member-by-member" (MBM) approach of Van Schaeybroeck and Vannitsem. This calibration method corrects both the ensemble mean and spread, and has the advantage of preserving rank correlations, so that dependencies across space and time are preserved, which is especially relevant for cut-out events. We discuss the impact of the post-processing method on such events, and some avenues for further research such as post-processing of wind power forecasts.