Seasonal wind speed predictions

Technical content: medium

SPECS Fact sheet #7

October 2016

Seasonal wind predictions provide information on how likely it is that the coming season will be less, equally or more windy than normal. In order to be useful for the wind energy sector, seasonal wind predictions need to be tailored to the user requirements.

How do we tailor seasonal wind speed predictions?

Seasonal wind speed predictions

We use 10-metre wind speed forecasts from a seasonal prediction system called System 4, from the European Centre for Medium Range Weather Forecasts (ECMWF, Molteni et al. 2011). The operational System 4 forecasts are produced at the beginning of each month with 51 ensemble members. An ensemble corresponds to a group of model simulations characterizing climate predictions that are conducted using slightly different initial conditions that are plausible given the past and current set of wind speed observations or measurements.

Prediction bias correction

Given the sparsity of global wind observations, the ERA-Interim global reanalysis is used as the best available estimate of wind for validation purposes. The reanalysis combines information from discontinuous past meteorological observations with global forecast models to obtain a continuous grid of wind data with no information gaps (Dee et al. 2011). As with every variable predicted in a coupled model forecast system, the prediction of wind speed is affected by biases. Seasonal predictions require bias correction in order to statistically resemble the observational reference and to minimize forecast errors (Doblas-Reyes et al. 2005). To correct the bias of the prediction, we apply the methods simple bias correction, calibration using cross-validation and quantile mapping.

Prediction quality assessment

The quality of predictions is assessed by comparing predicted values with the "observations" provided by the reanalysis. A skill score (see Factsheet #5) is calculated to evaluate if the model provides better information than just assuming that the average wind conditions of the last years (approach based in the climatology) reflect the wind conditions for the future.

Climate services for the wind energy sector

At the end, the percentage of probability that wind speed in the next season will be lower, equal and higher than normal is calculated, and the most probable category of wind speed is indicated according to the obtained results (Figure 1, at the back). Seasonal predictions are probabilistic in nature, meaning that they give the probability of occurrence of certain outcomes rather than a single 'yes-no' deterministic prediction. This information is crucial in order to know how useful wind seasonal predictions are to support decision-making in the wind energy sector (Weisheimer & Palmer 2014). See Factsheet #4 on predictions' reliability.

Applications

- Mid-term operations & maintenance planning
- Energy trading & electricity prices
- Estimation of more accurate budgets
- Meet the balance between demand & supply

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

This project is funded by the Seventh Framework Programme (FP7) of the European Commission GA 308378

specs@bsc.es

Seasonal wind speed predictions

Technical content: medium

SPECS Fact sheet #7

October 2016

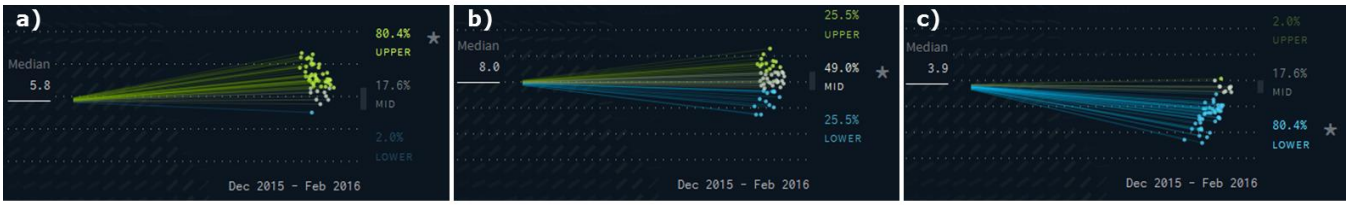

Figure 1: Examples of tercile categories corresponding to different cases of most likely wind speed categories: a) prediction with expected wind speeds above normal, b) prediction with expected normal wind speeds, and c) prediction with expected wind speeds below normal. Probabilities are computed as the percentage of ensemble members under the lower tercile (below normal wind speed), the ensemble of members between the lower and upper terciles (normal wind speed) and the percentage of members above the upper tercile (above normal wind speed). The most likely wind speed category is indicated by a * symbol. Source: Project Ukko, http://project-ukko.net/

Climate predictions vs climatology

Decision makers normally use a retrospective climatology to have an estimation of the expected wind. A common assumption is that future conditions will be similar to past conditions, but this assumption entails two inherent shortcomings:

- Past conditions can be highly variable, which can make them of limited use when guessing the future.

- The climatology can not predict events which have never happened before, i.e. extreme events, which are particularly harmful and whose prediction is of special interest for stakeholders. In addition, a climatological approach does not take into account changes in atmospheric dynamics, such as those caused by climate change. This may render past conditions useless for predicting future events.

Global predictions of wind speed

Using the methodology described here, global predictions of wind speed tailored to the energy sector can be obtained (Figure 2).

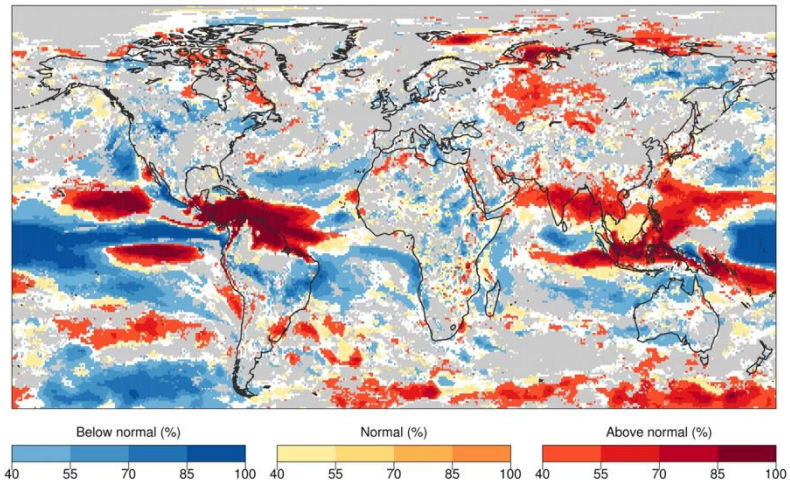

Figure 2: Wind speed prediction. Coloured areas show the most likely wind speed category (below normal, normal , and above normal) and its percentage probability to occur. These categories show where the model improve upon the current approach using the climatology. Normal represents the average of the past. White areas show where the probability is <40% and approximately equal for the three categories. Grey areas show where the model does not improve upon the current approach, which assumes that the future will look like the past. Source: Torralba et al. (under review)

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

This project is funded by the Seventh Framework Programme (FP7) of the European Commission GA 308378

specs@bsc.es