PO.104

A semi-operational prototype to forecast wind power from weeks to months ahead

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RESILIENCE - Seasonal wind speed predictions

Predicting the **future variability of energy resources beyond the first two weeks** can allow end users to take calculated, precautionary actions with potential cost savings. Current energy practices use a deterministic approach based on retrospective climatology. Recent advances in global climate models that simulate the physics of the whole climate system, demonstrate that **probabilistic forecasting can improve** upon this methodology at some spatial and temporal scales[1].

RESILIENCE is a semi-operational prototype that aims to provide robust information of the future variability in wind power resources based on probabilistic climate predictions. To reach this objective the RESILIENCE prototype will operate at seasonal time scales providing **seasonal wind speed predictions** for the energy sector.

By presenting this semi-operational prototype, the EU funded project EUPORIAS wants all interested parts in the wind energy sector to visualize how this novel methodology could impact in their decision-making processes and ultimately encourage them to use it.

MINIMISE UNCERTAINTY

The RESILIENCE prototype provides climate prediction reports tailored to the energy sector. It represents the cutting-edge in climate science, to predict how future climate variability will affect renewable power generation.

MANAGE RISK

Climate predictions represent the most robust information currently available, by demonstrating a range of possible scenarios for future power generation, as well as a probability of which will be the most likely outcome.

OPTIMISE STRATEGIES

Significant cost savings can be made with a better anticipation of market changes, thus identifying vulnerabilities and risks in advance. This, in turn, can facilitate calculated and precautionary climate adaptation action.

SCIENCE - Scientific basis

- The seasonal wind speed predictions are based on the **ECMWF Forecast Prediction System-4** data for winter (December-January-February) with start date on 1st of November.
- We use the **51 ensemble members** of the wind speed prediction of S4 on a regular latitude-longitude grid of cell-size 0.75.
- The surface wind speed data from ERA-Interim have been used for validation.
- As with every variable predicted in a coupled model forecast system, the prediction of wind speed is affected by biases. For probabilistic forecasts, this defect consists of their lack of sufficient (probabilistic) reliability[2]. To overcome this, a **calibration** technique[3] for the post-processing of ensemble forecasts has been considered. The method use the “one-year out” cross-validated mode, and provides corrected forecasts with improved statistical properties.
- To evaluate if RESILIENCE is able to provide better information than climatology the simultaneous predicted and observed values are compared over the entire period (1981-2014) with a skill score: the **Ranked Probability Skill Score (RPSS)**. This is the appropriate skill score to validate the cumulative probabilities of the categorical predictions[4].

DESIGN - Visualizing predictions

One of the objectives of the prototype is to develop a user-friendly interface to show seasonal predictions tailored to users expectations and needs.

Project Ukko is the product of the close collaboration between cutting-edge science and big data graphic designers. The aim is to showcase a visualizing tool to provide new perspectives on how to integrate seasonal predictions into sector-relevant formats.

The visualization interface provides global information of the wind speed predictions of the RESILIENCE prototype. In the Map interface three layers of information are presented visually by means of transparency, line width and color/slope

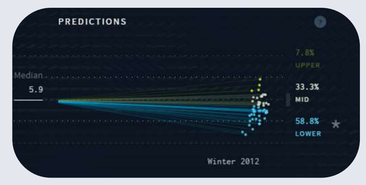
RESILIENCE Interface: Project Ukko

Probabilistic prediction of wind speed for Winter 2012/2013

Terciles categories

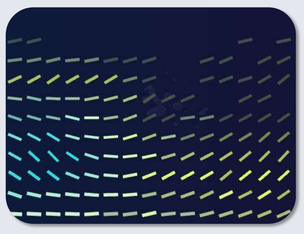
The most likely wind speed category is shown

Example of prediction with expected wind speeds above-normal



Example of prediction with expected wind speeds below-normal

Transparency:
PREDICTION SKILL

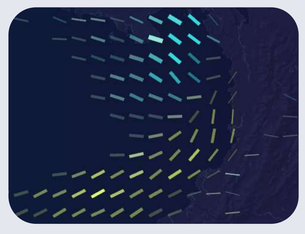


The transparency of the line is an indicator of the prediction skill. Only areas with a positive skill have a visible line, which gets brighter proportionally to a specific measure of skill (the ranked probability skill score)

Line width:
PREDICTED WIND SPEED

The line width is an indicator of the mean wind speed predicted for the coming season. Despite being a deterministic value it is shown for a fast visual detection of areas of interest because of expected high or low wind speeds.

Color and slope:
PREDICTED SEASONAL VARIABILITY



Both color and slope indicate the most probable category and its probability. In spite of providing redundant information, color is intended to highlight coherent areas of change at large scales while the slope illustrates the category at closer scales

References

1. Doblas-Reyes, F. J. et al. (2013). *Wiley Interdisciplinary Reviews: Climate Change*, 4(4), 245-26.
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3. Doblas-Reyes, F.J. et al. (2005) *Tellus A*, 57(3), 234-252
4. Wilks, D. (2011). Academic press.

If you want to participate with your feedback to this prototype in the EUPORIAS project contact us at *info-services-es@bsc.es*

The research leading to these results has received funding from the EU Seventh Framework Programme FP7(2007-2013) under grant agreement nºGA 308291 and the Ministerio de Economía y Competitividad (MINECO) under the project CGL2013-41055-R