

RESILIENCE - Climate predictions for the wind energy sector

Authors: M.Terrado, D.Bojovic, I.Christel, Ll.Lledó, V.Torralba, N.González-Reviriego, A.Soret, F.Cucchiatti, L.Calvo, F.Doblas-Reyes

Topics: climate services for energy, seasonal climate predictions, visualization tool, global

Website: www.bsc.es/projects/earthscience/resilience

What is RESILIENCE?

RESILIENCE is a Barcelona Supercomputing Center pre-operational prototype that provides information on the future variation of the wind resource. It presents a novel interactive way to spot patterns in seasonal wind prediction data.

The prototype is the result of an interdisciplinary approach to develop climate services for the energy sector. It builds on the work performed under different projects: SPECS -the improvement climate prediction systems; NEWA -the skill assessment of climate predictions at different time scales; and CLIM4ENERGY, EUPORIAS and RESILIENCE -user engagement & co-production for the development of a prototype tailored to the energy sector. Project Ukko, a visualization tool developed in EUPORIAS, is taken as a departure point.

RESILIENCE puts special emphasis on the challenge of effectively communicating probabilistic predictions to decision-makers. With this aim, a novel visual device that helps informing the development of a coherent visual language for the project has been developed.

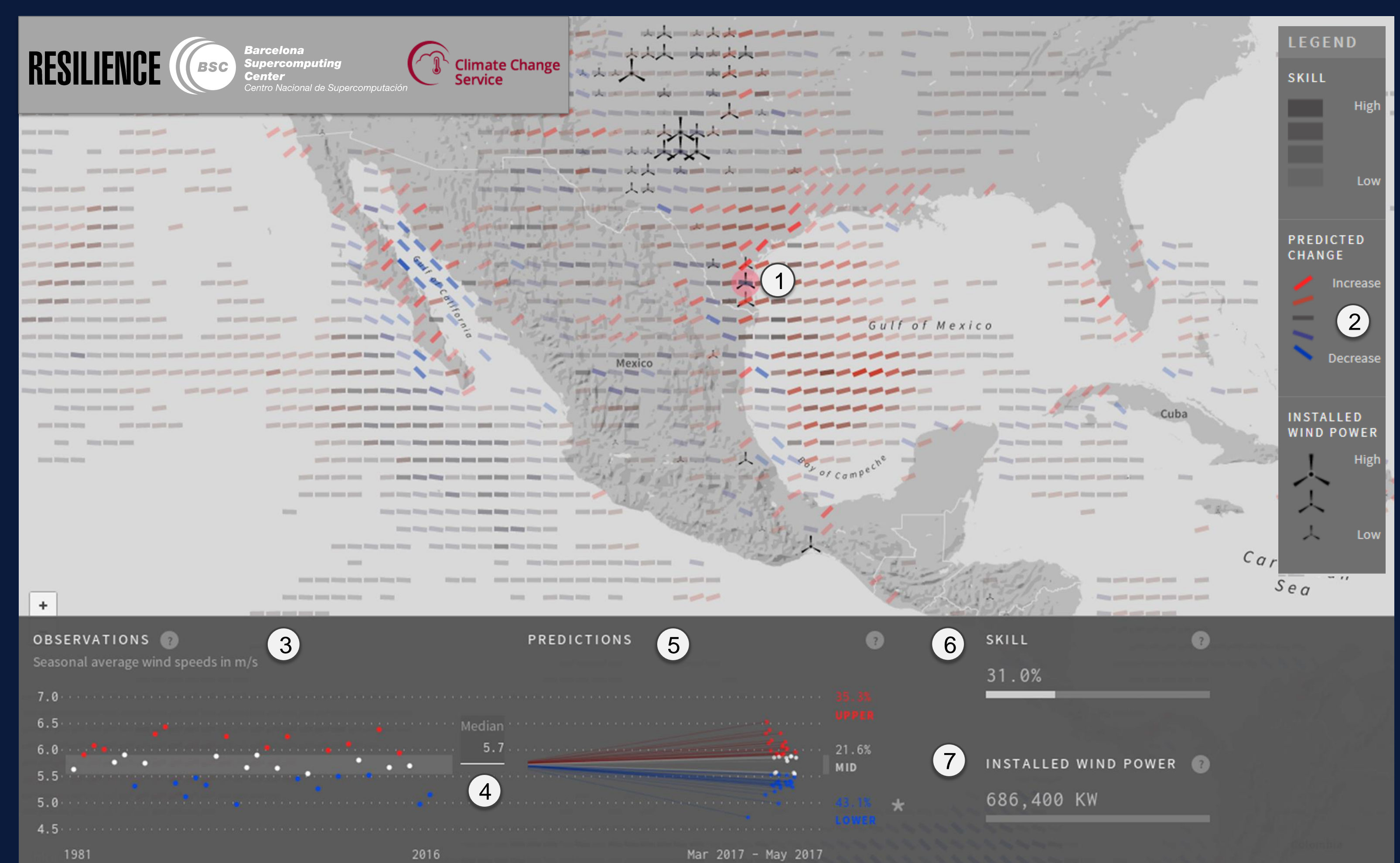
Co-production

RESILIENCE is the result of a co-production process involving the research community at BSC and various users from the renewable energy sector (EDPR, EnBW, VORTEX, etc.). This allows getting users' feedback, which can be integrated in the development of a tailored climate service.

Interested users: energy producers, traders and wind farm operators and investors.

RESILIENCE visualization tool

- Selected geographical area
- Predicted change in wind speed. High probability of reduced wind speed compared to climatology in the predicted season is displayed by blue lines pointing bottom right. High probability of increased wind speeds compared to climatology in the predicted season is displayed by red lines pointing top right
- Seasonal average wind speed in the selected geographical area over the last 30 years based on ERA-Interim. Observations are split into three categories of equal size (terciles). The third of years with the highest wind speed (upper tercile) is marked in red and the third of years with the lowest wind speed (lower tercile) is marked in blue
- Median wind speed of ERA-Interim over the past decades
- Wind prediction for the next season. Overall, 51 different ensemble members were generated, resulting in a range of potential outcomes. The percentage of members in each of the terciles gives the probability for the next season to have lower, equal or higher than normal wind speed conditions



- The skill measures how well the prediction system has performed over the last 30 years in the selected region. It informs of the expected performance of the forecasts in the future. A skill of 100% would mean that the prediction system performance is perfect, whereas a skill of 0% means that our model is not better than making a guess based on historical data. Prediction skill is expressed through opacity in the map. Regions with higher skill values are more opaque, and regions with lower skill values are more transparent
- Currently installed wind power in the selected area, which reflects the production capacity in that particular area. Turbine icons of varying size show the overall installed power (generously provided by windpower.net)

Seasonal wind speed predictions

Description

Seasonal wind predictions provide information of how likely will the coming season be less, equal or more windy than normal. RESILIENCE uses 10-m wind speed forecasts from the ECMWF Forecast Prediction System 4¹. The operational System 4 forecasts are produced at the beginning of each month with 51 ensemble members, which use slightly different initial conditions.

Probabilistic predictions

In RESILIENCE, the percentage of probability that wind speed 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. Seasonal wind predictions are probabilistic in nature, meaning that they give the probability of occurrence of certain outcomes rather than a single 'yes-no' prediction².

Future work

RESILIENCE illustrates the added value of seasonal climate predictions for the renewable energy sector. Next steps should focus on predictions at the sub-seasonal scale as well as predictions that are useful to other climate sensitive sectors.

¹ Molteni et al. (2011) The new ECMWF seasonal forecast system (System 4)

² Weisheimer & Palmer (2014) Journal of the Royal Society Interface 11: 20131162