



Introduction to the S2S4E project

Albert Soret Miravet (BSC)



Climate forecasting for energy. 4 December 2020, online



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This project has received funding from the Horizon 2020 programme under grant agreement n°776787.

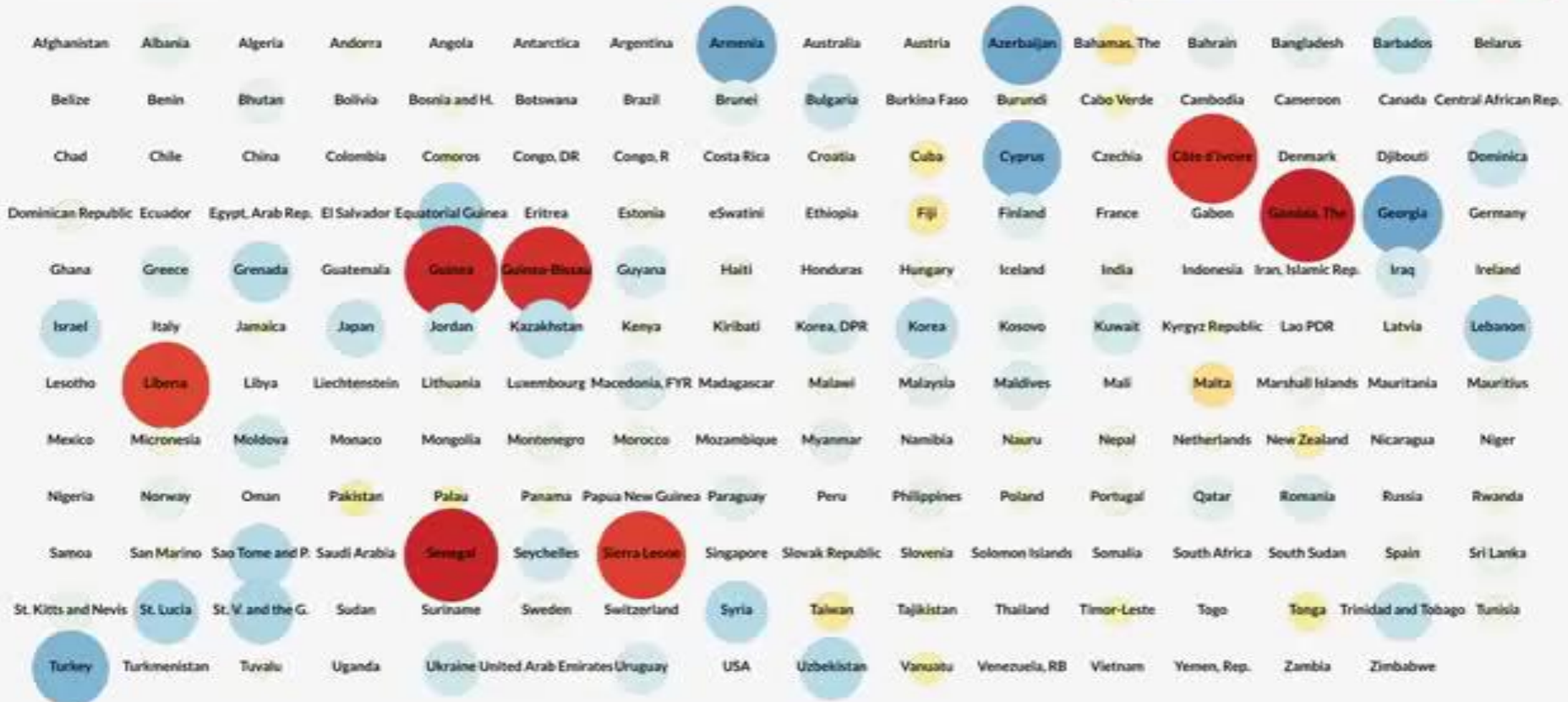
Weather forecast is a familiar concept ...



... and climate change too, but what about climate variability?

Temperature Anomalies by Country
Years 1880 - 2017

1880



Data Source:
NASA GISS, GISTEMP Land-Ocean Temperature Index (LOTI), ERSSTv5, 1200km smoothing
<https://data.giss.nasa.gov/gistemp/>
Average of monthly temperature anomalies, GISTEMP base period 1951 - 1980.

Video license: CC-BY-4.0
Antti Lipponen (@anttilip)

Link: <https://youtu.be/PhbdyNnUliM>

Context and motivation

- ▶ Energy sector routinely uses weather forecast, especially between day-ahead and one week. Beyond this time horizon, climatological data are used.



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Europe freeze 'East' arrives

© 28 February 2018



'Beast from the East' sends British energy prices skyward

Like 15M

By Susanna Twidale

LONDON (Reuters) - A col
wholesale energy prices to a
to secure supplies.



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Thursday, Aug 30th 2018 1PM 25°C 4PM 26°C 5-Day Forecast

Science & Tech

Britain's turbines are producing 40% less energy as wind 'disappears' for six weeks across the UK causing record low electricity production

- Britain got 15 per cent of its power from wind last year — twice as much as coal
- Since the start of June, wind farms have been producing almost no electricity
- The 'wind drought' has seen July 2018 be 40% less productive than July 2017
- In the still weather, solar energy has increased by 10% to help cover the drop-off



Applications

Weather forecast	Climate predictions			Climate projections or multidecadal
1-15 days	Sub-seasonal 10 d-1 month	Seasonal 1-6 months	Decadal 1-10 years	20-100 years

Applications for wind/solar/hydro generation

Time

Post-construction decisions

Energy producers:

commit energy sales for next day
Grid operators: Market prices and grid balance

Energy traders: Anticipate energy prices

Plant operators: planning for cleaning and maintenance

Post-construction decisions

Energy producers: Resource management strategies

Energy traders: Resource effects on markets

Plant operators: Planning for maintenance works, especially offshore wind O&M

Plant investors: anticipate cash flow, optimize return on investments

Pre-construction decisions

Power plant developers: Site selection. Future risks assessment.

Investors: Evaluate return on investments

Policy-makers: Asses changes to energy mix
River-basin managers: understand changes to better manage the river flow



Applications for demand

Daily operation decisions

Grid operators:

Anticipate hot/cold days.
 Schedule power plants to reinforce supply.

Energy traders: Anticipate energy prices.

Mid-term planning

Grid operators:

Anticipate hotter/colder seasons
 Schedule power plants to reinforce supply.

Energy traders:

Anticipate energy prices.

Long-term planning

Grid operators:

Anticipate addition of more capacity. Adaptation of transmission lines

Policy-makers:

Plan addition of more capacity.
 Understand changes to energy mix



S2S4E project

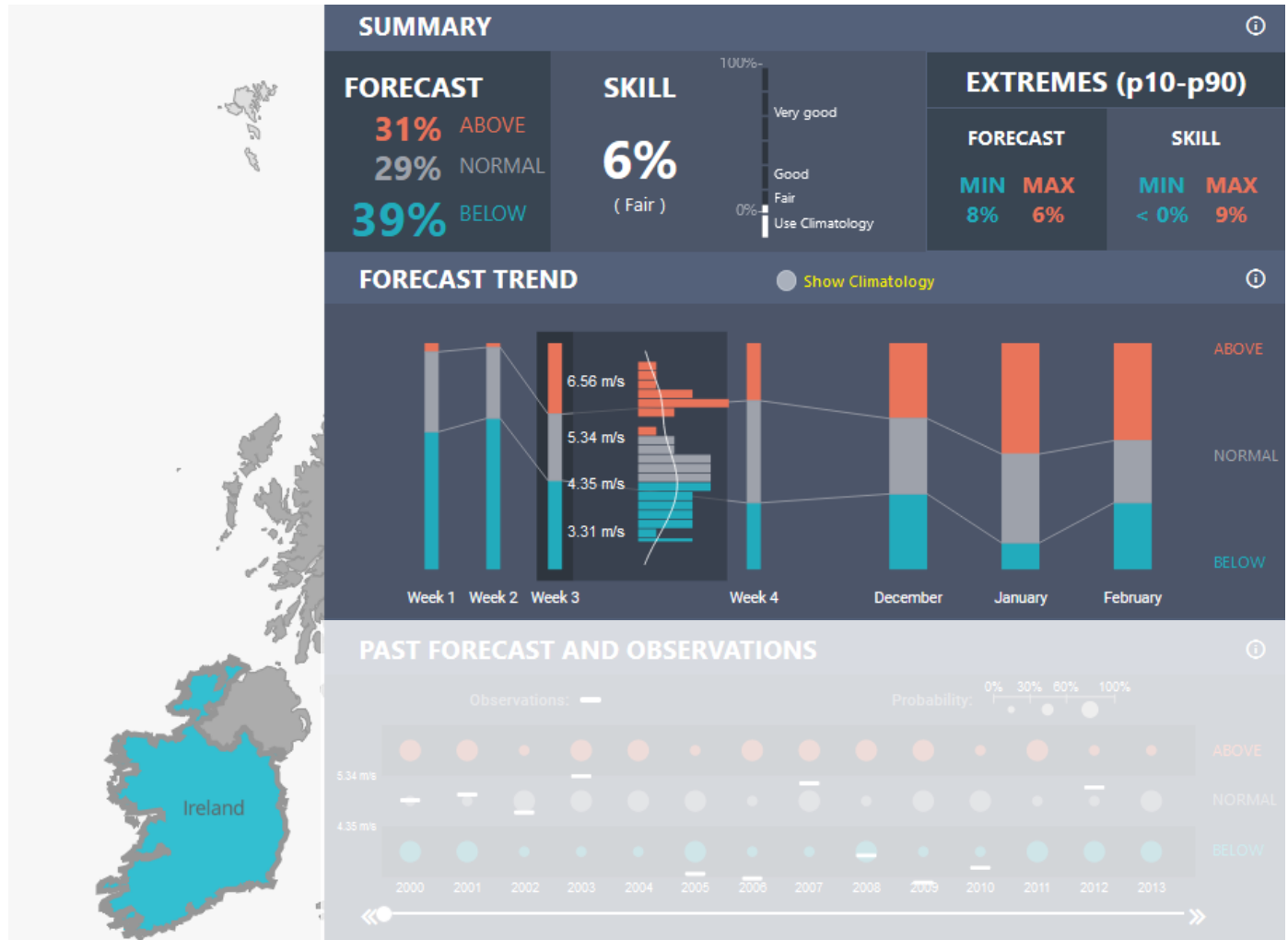
S2S4E challenges

Predictability

▶ How can we predict climate for the coming season if we cannot predict the weather next week? Slow components (sea surface temperature, soil moisture, etc.) force the atmosphere.



Skill



Forecast available in the S2S4E DST for 14-20 Dec 2020, issued three weeks before, for wind

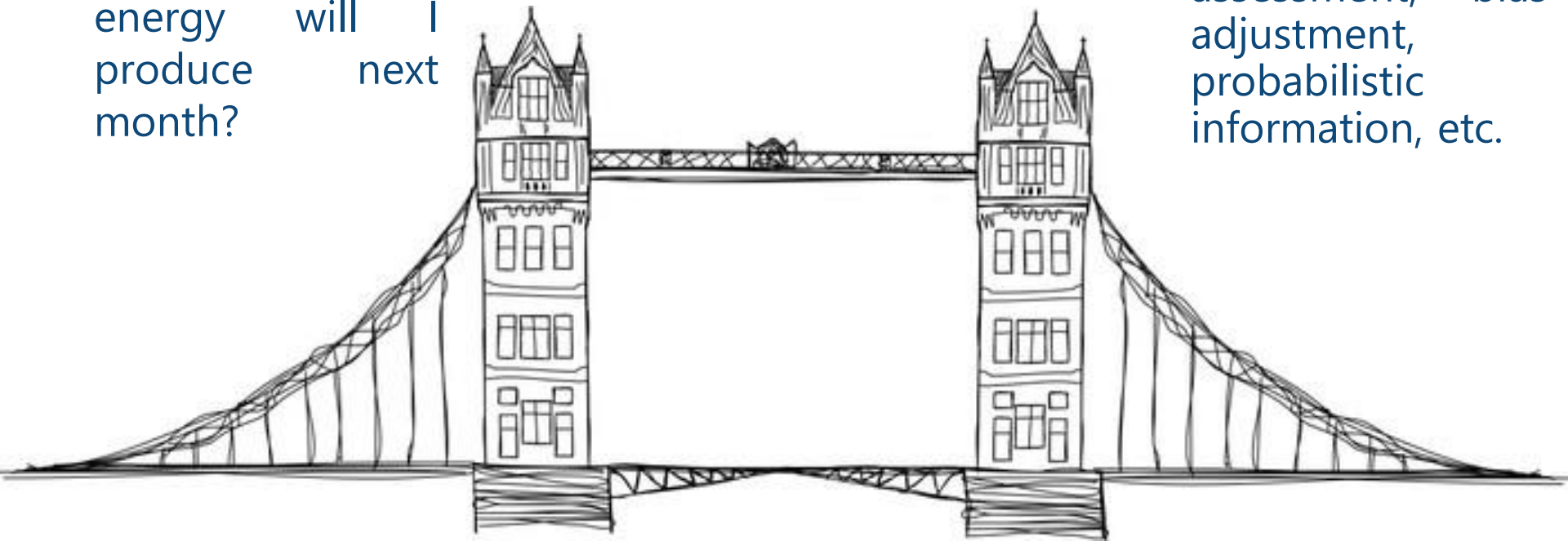
“A prediction has no value without an estimate of forecasting skill based on past performance”

Main achievements

Interdisciplinary team working together

► User: How much energy will I produce next month?

► Scientist: Skill assessment, bias adjustment, probabilistic information, etc.



Project results

- ▶ Publications
- ▶ Project deliverables
- ▶ Cases studies
- ▶ Forecast outlooks
- ▶ Temperature extremes outlooks
- ▶ Webinars

WIND DROUGHT IN USA
First quarter 2015

BASIC FACTS

- Stakeholders: DIPP
- Area: USA
- Season: Winter
- Year: 2015
- Forecast range: seasonal

WHAT

Average wind speed fell well below normal, causing wind farms to experience financial problems due to the lack of energy production.

WHERE

Wind speed reductions were most severe over the US, and were most pronounced in the central and southern parts of the country.

WHEN

The central part of the wind drought occurred during the first quarter of 2015. The low wind speed was most pronounced during the first two quarters.

WHY

High North Pacific Mode (NPM) index, which is associated with a strong low pressure system over the North Pacific, led to a strong high pressure system over the central and southern parts of the US.



natureenergy

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Better seasonal forecasts for the renewable energy industry

Anton Orlov, Jana Sillmann & Ilaria Vigo

Nature Energy 5, 108–110(2020) | Cite this article

694 Accesses | 3 Citations | 12 Altmetric | Metrics

- 1 An Author Correction to this article was published on 25 February 2020
- 1 This article has been updated

Anomalous seasons such as extremely cold winters or low-wind summers can seriously disrupt renewable energy productivity and reliability. Better seasonal forecasts providing more accurate information tailored to stakeholder needs can help the renewable energy industry prepare for such extremes.

Why energy?

- ▶ Main contributor to GHG emissions
- ▶ Advanced users, in many cases with experience in meteorology, crucial for a climate services project
- ▶ Replicability

“A failure to adapt to a changing technological environment (...)higher temperatures over the last two summers in the United Kingdom meant that people on lower incomes opted to stay at home.”

Why another “tool”?

- ▶ Operational service: key to get user involvement and foster climate services.
- ▶ Way to learn not only for users, but also for scientists.

Forbes

How Thomas Cook Flew Into The Perfect Storm



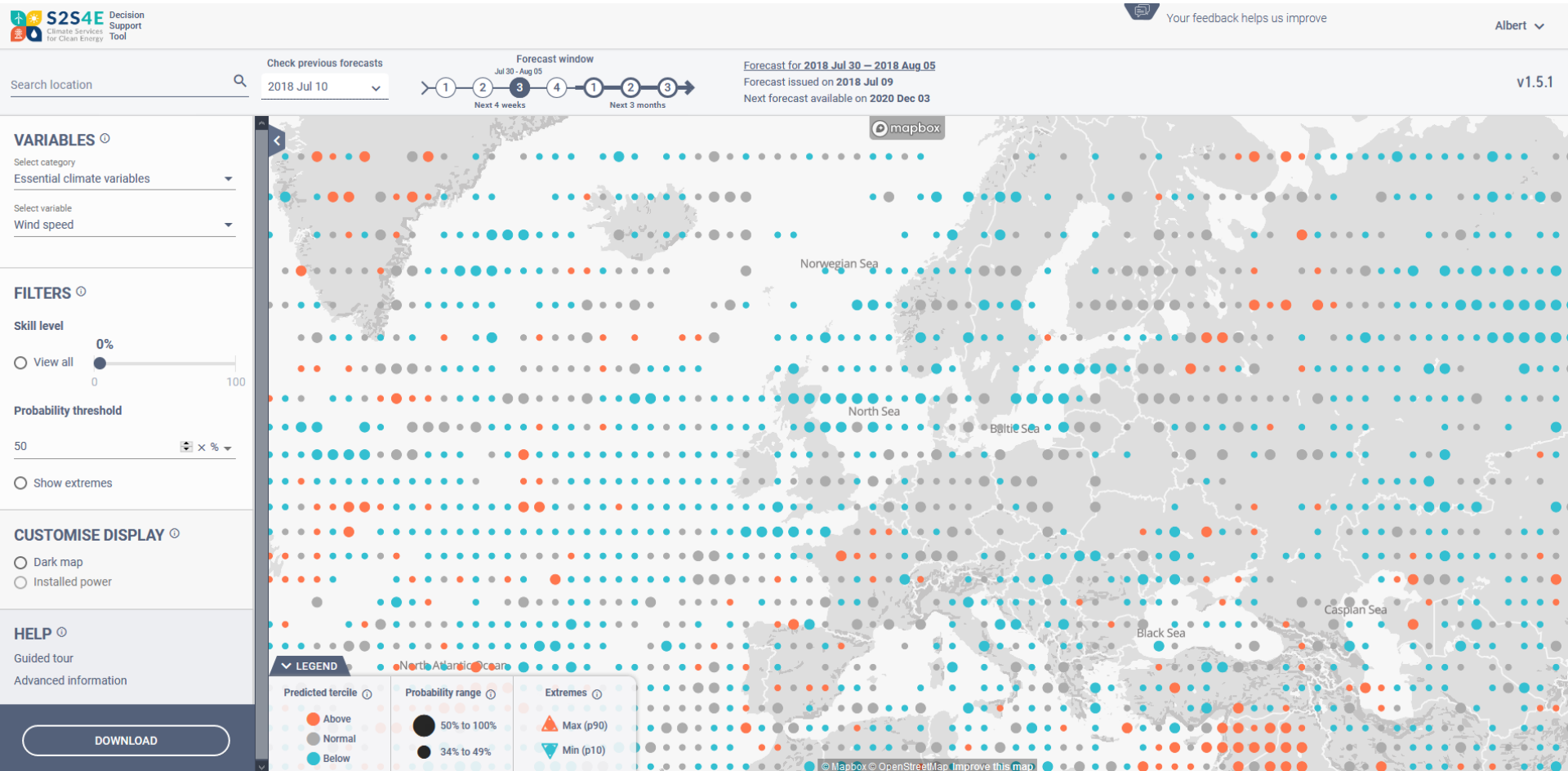
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LONDON, ENGLAND - SEPTEMBER 23: A street sweeper walks past a Thomas Cook shopfront on September 23, 2019 in London, United Kingdom. The collapse of the 178-year-old travel firm triggered a massive repatriation effort, as the British Civil Aviation GETTY IMAGES

Why another “tool”?

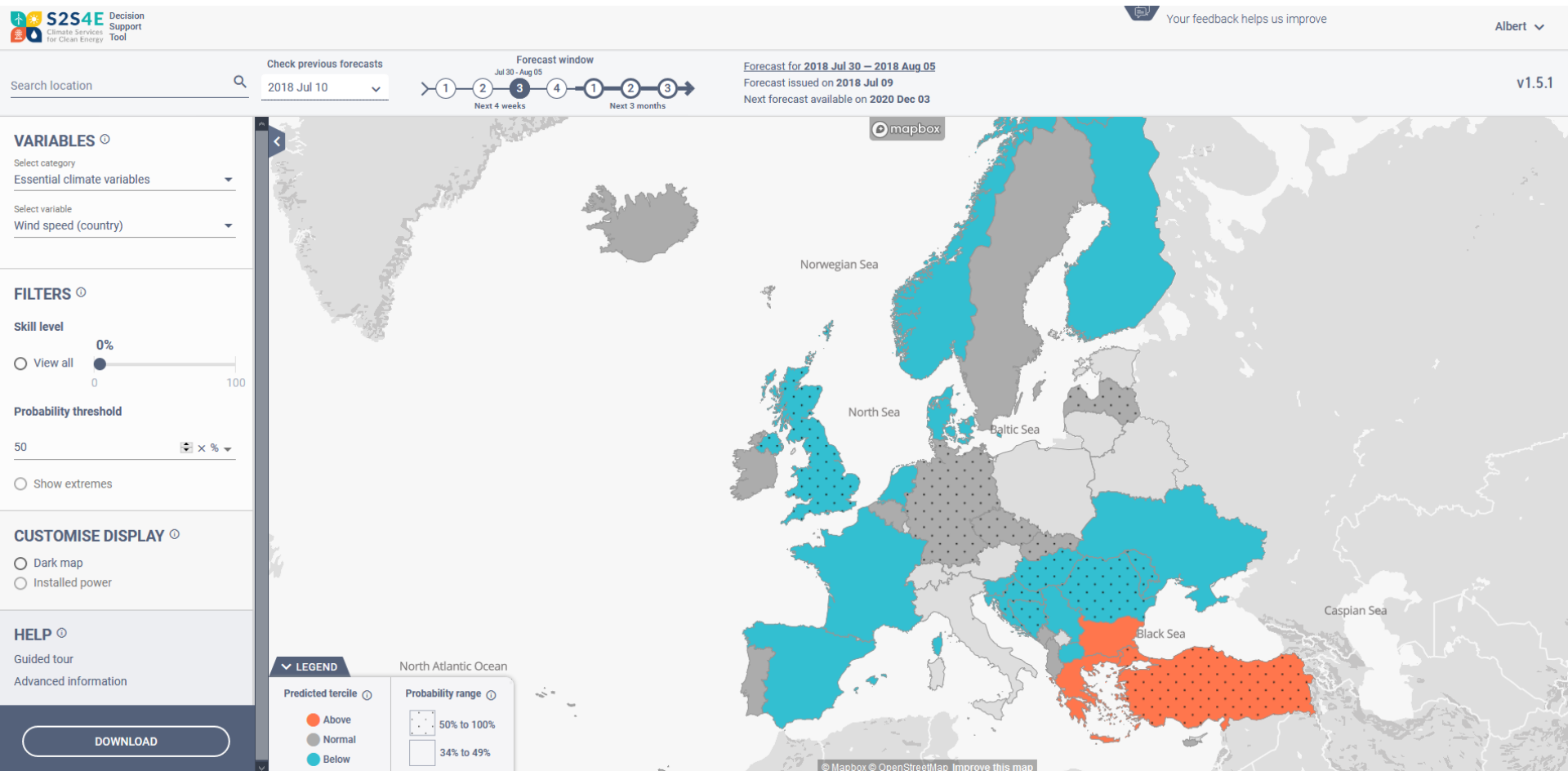
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Forecast available in the S2S4E DST for 30 July - 5 August 2018, issued three weeks before, for wind

Why another “tool”?

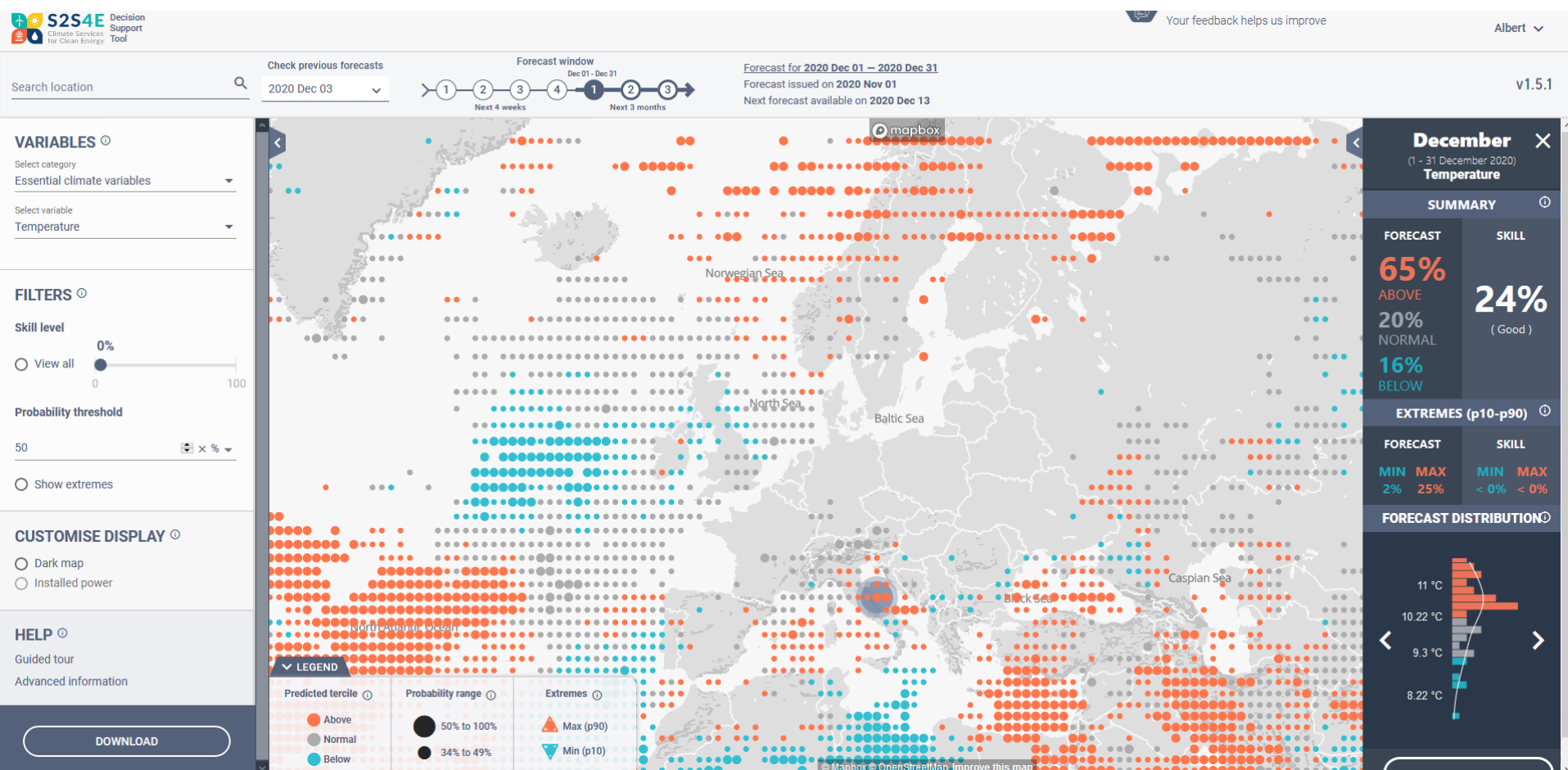
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Forecast available in the S2S4E DST for 30 July - 5 August 2018, issued three weeks before, for wind

Current forecasts

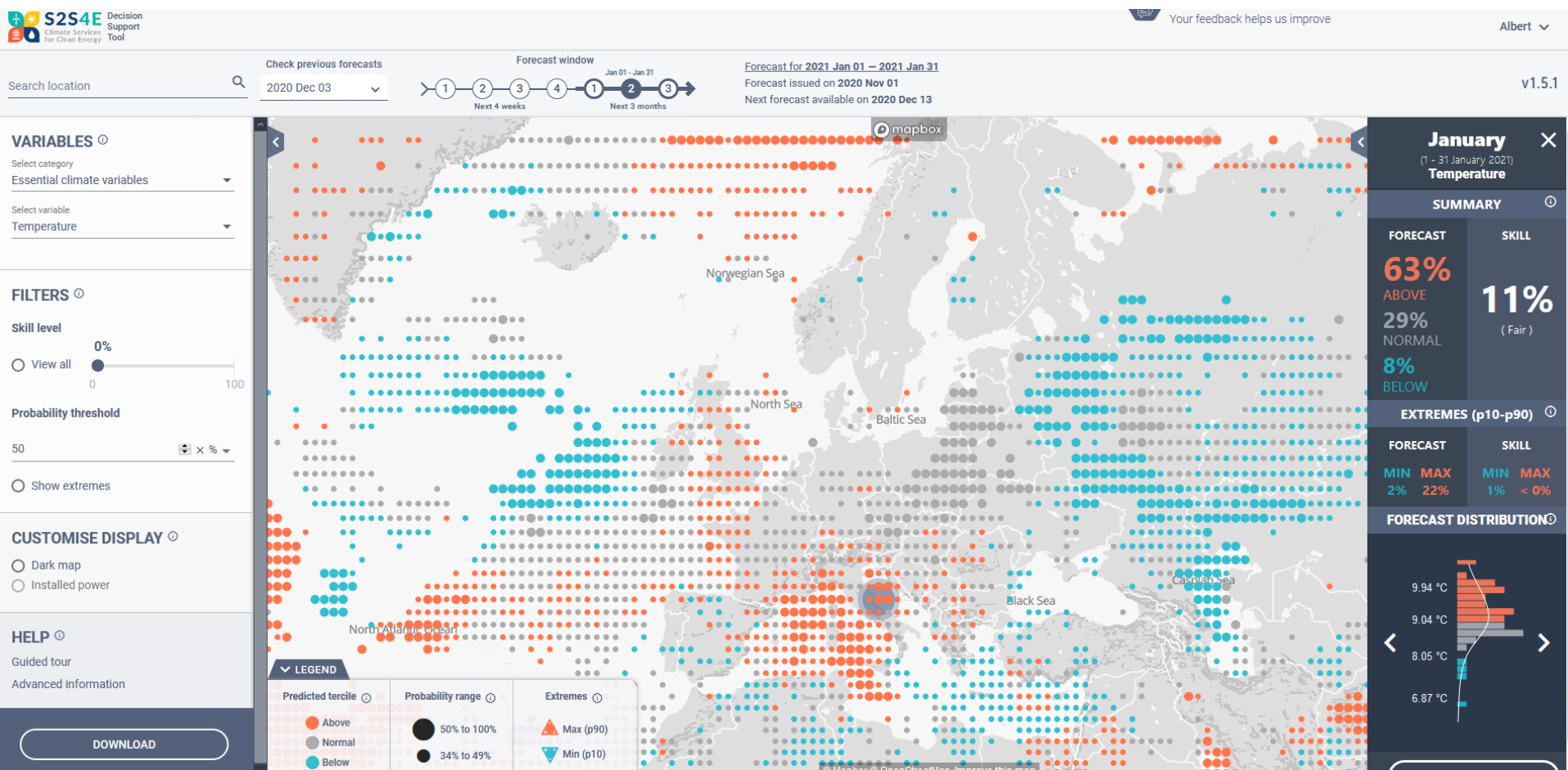
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Forecast available in the S2S4E DST for December 2020, issued in November, for temperature

Current forecasts

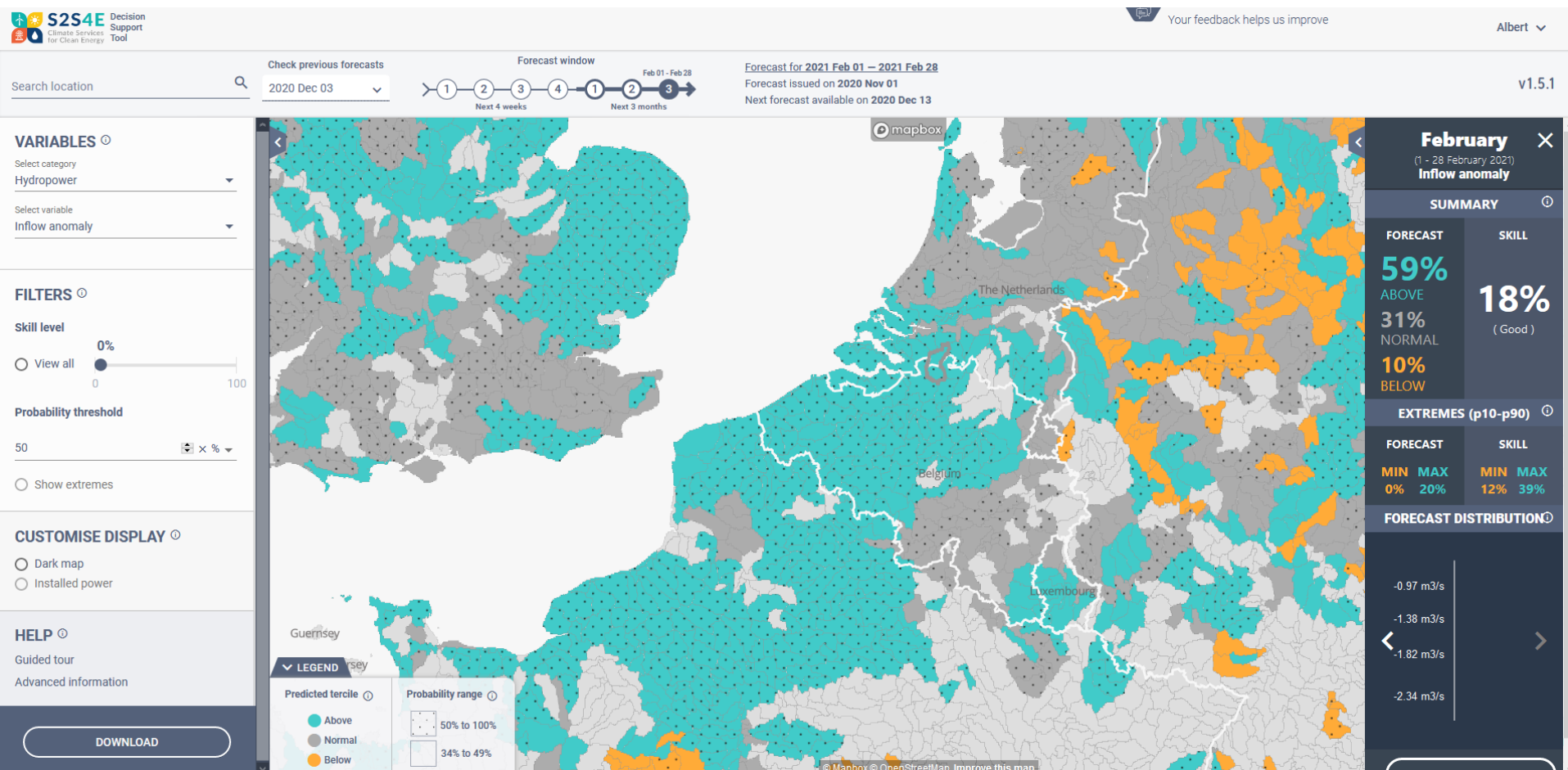
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Forecast available in the S2S4E DST for January 2021, issued in November, for temperature

Current forecasts

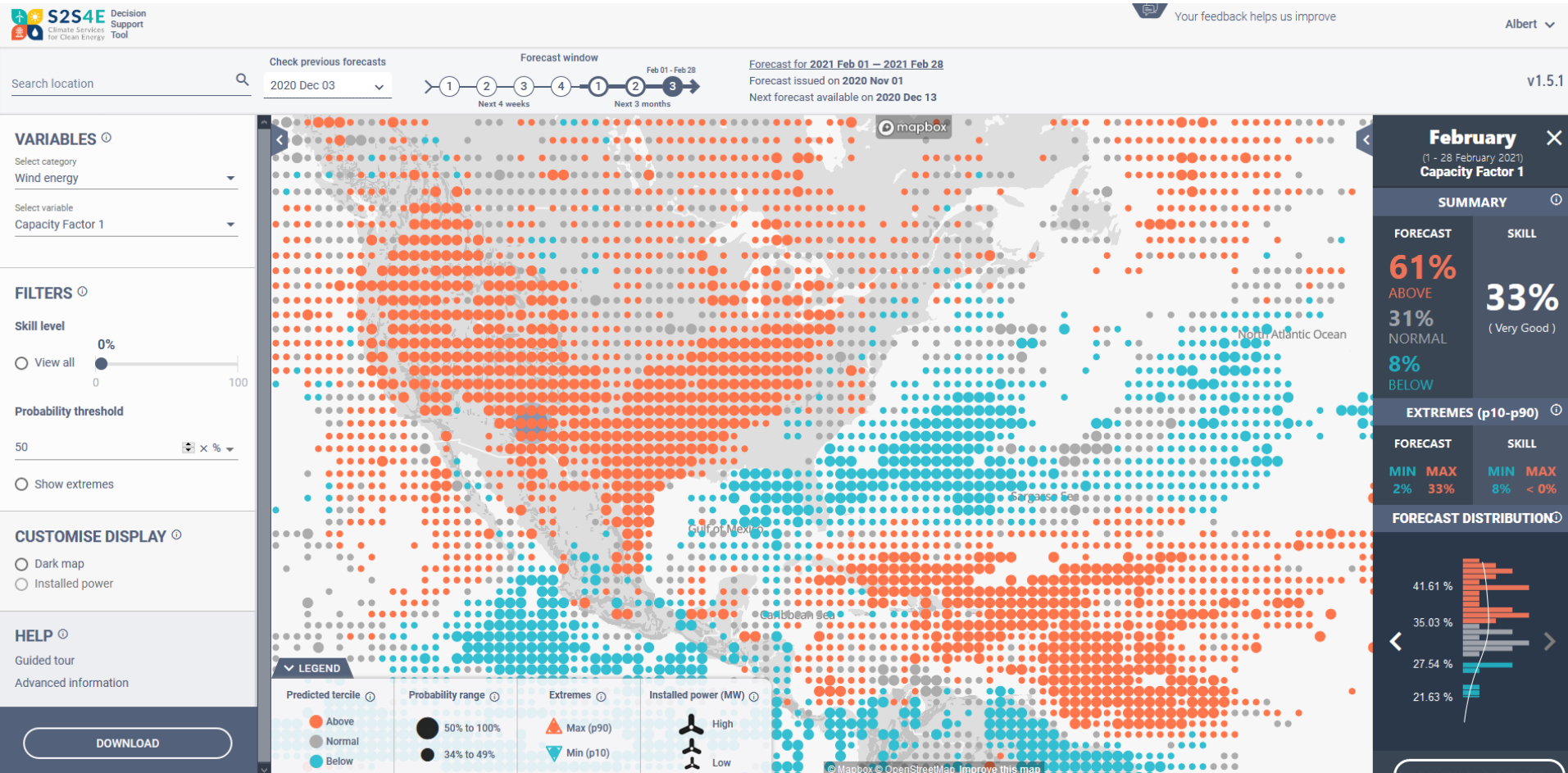
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Forecast available in the S2S4E DST for February 2021, issued in November, for inflow anomaly

Current forecasts

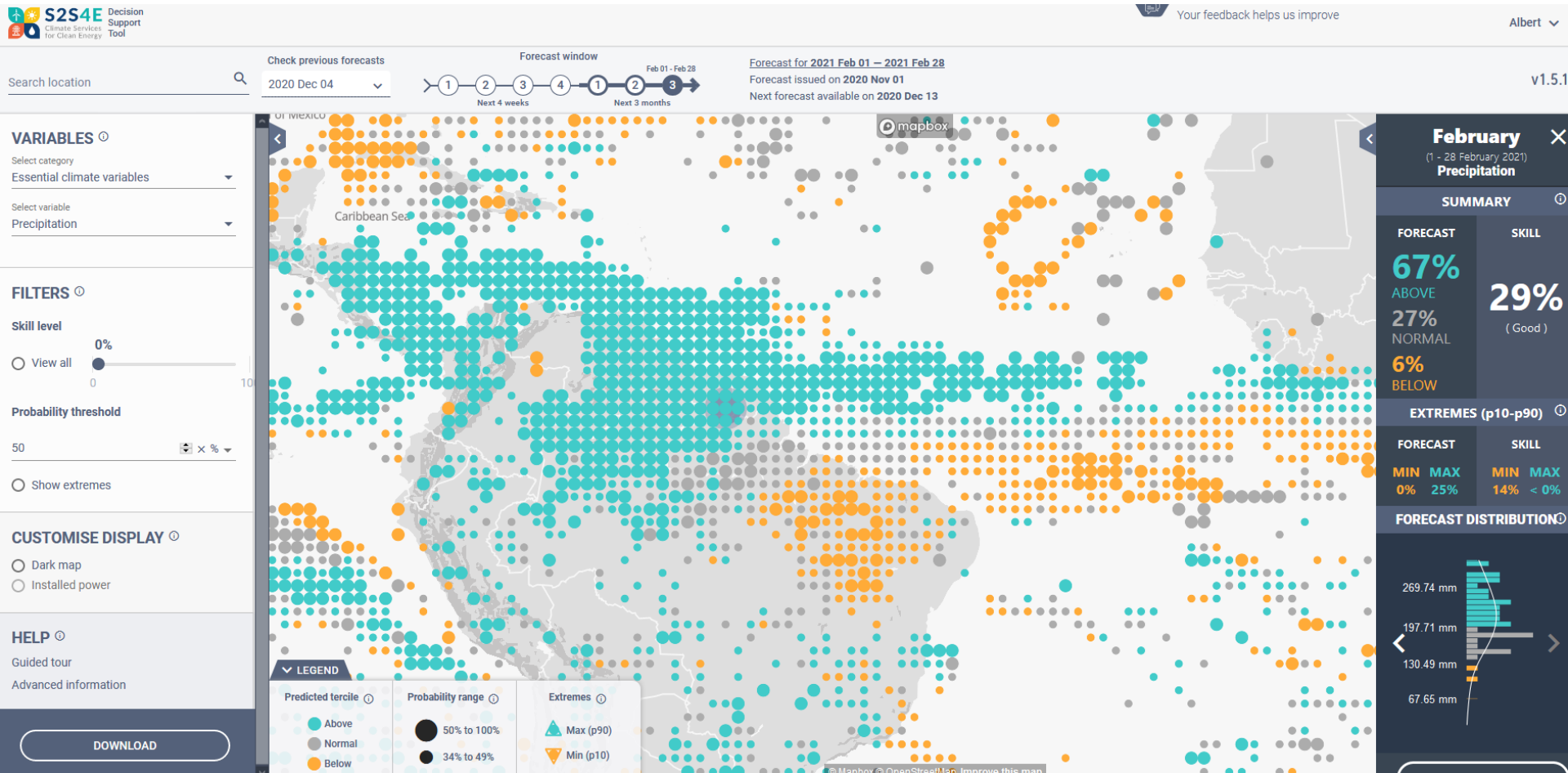
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Forecast available in the S2S4E DST for February 2021, issued in November, for wind capacity factor

Current forecasts

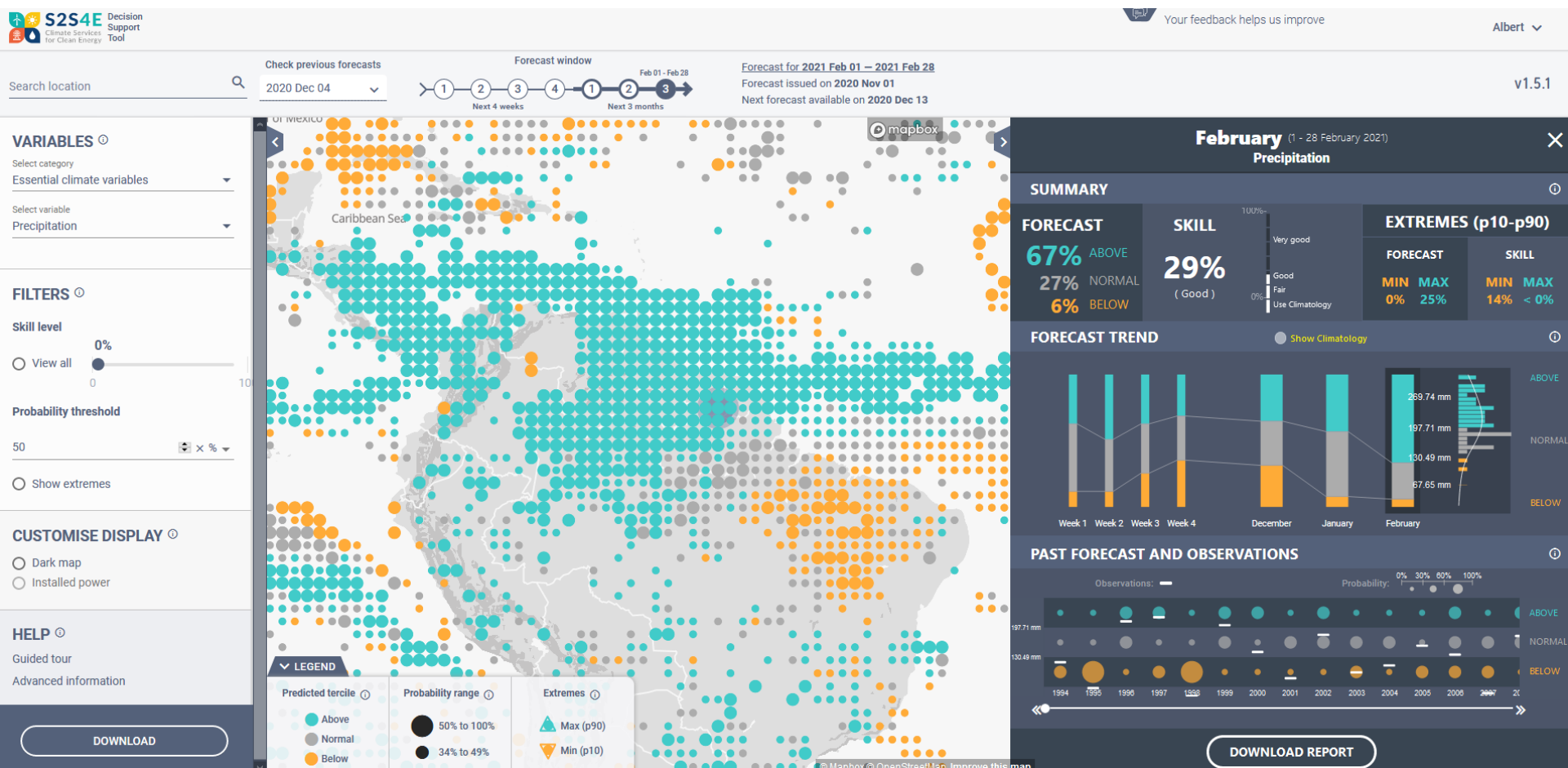
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Forecast available in the S2S4E DST for February 2021, issued in November, for precipitation

Current forecasts

s2s4e.eu/dst



Forecast available in the S2S4E DST for February 2021, issued in November, for precipitation

Thank you

Contact: albert.soret@bsc.es



S2S4E

Climate Services
for Clean Energy



Supplementary material