



Introducing WEFEX: Forecasting Extreme Weather Risks Across Europe

Kristian L. Nielsen

World Energy and Meteorology Council (WEMC)



INFO@WEMCOUNCIL.ORG



WWW.WEMCOUNCIL.ORG



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OVERVIEW

What I will present

-
- 1 **WEMC and ICS** A short introduction to the organisations behind WEFEX.
 - 2 **Why the tool exists** The motivation for making extreme-event forecasts easier to interpret and use.
 - 3 **Data and method** What data we use, how thresholds are defined, and how ensemble probabilities are produced.
 - 4 **Tool functionality** The WEFEX interface, spatial aggregation, probability maps, and skill layers.
 - 5 **Historical examples** May extreme cold/heat.
 - 6 **Future development** More models, new metrics, global coverage, and S2S forecasts.
-

BEHIND THE CREATION OF WEFEX

WEMC and Inside Climate Service

WEFEX sits at the intersection of energy-sector weather risk expertise and operational climate-service delivery.



World Energy & Meteorology Council

ENERGY-WEATHER SCIENCE BRIDGE

- Established in 2015 and based at the University of East Anglia, Norwich, UK.
- Links the energy sector with weather, climate, and environmental science communities worldwide.
- Promotes sustainable energy systems and convenes the International Conference Energy & Meteorology (ICEM2027).



Inside Climate Service

CLIMATE RISK INTELLIGENCE

- Founded in 2021 to help organisations assess and manage climate risks.
- Combines historical data, seasonal prediction, projections, advanced modelling, and AI/ML.
- Delivers tailored climate data products, tools, and consultancy for resilient decisions.

WHY THIS TOOL EXISTS

Extreme-weather decisions need probability and context

Temperature, precipitation, wind and wind-gust extremes affect operations, infrastructure, insurance, energy, agriculture and emergency planning.

1 High-impact hazards cut across sectors

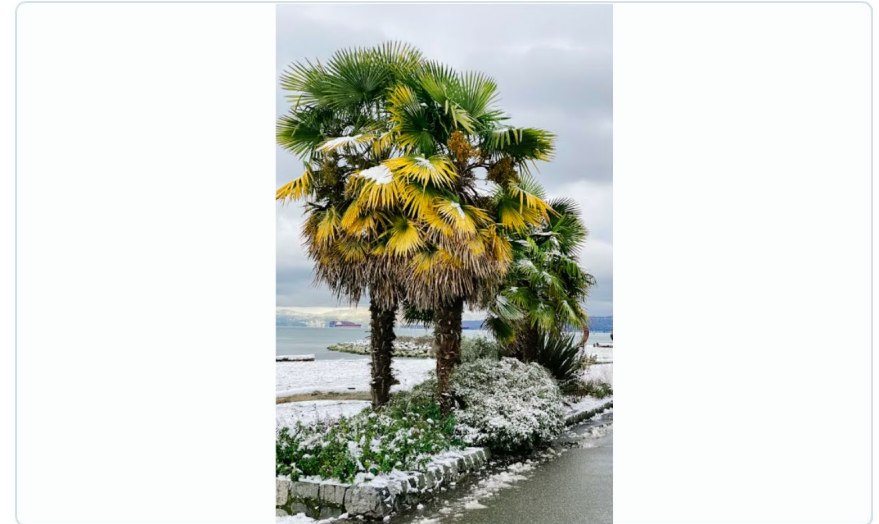
Extreme events can disrupt assets, markets, supply chains and public safety over very different time scales.

2 Users need likelihood, not only one forecast

A deterministic forecast gives one possible outcome; risk decisions require probability and uncertainty.

3 The key signal is relative to normal

WEFEX focuses the difficult question: where, when, and how unusual is the forecast signal?



Is this really unusual cold?

WHAT WEFEX DOES

Transforms forecast data into extreme-risk views

WEFEX makes forecast information comparable to historical climate thresholds, so users can explore both likelihood and unusualness.

FORECAST

Probabilistic extremes

Displays probabilistic forecasts of temperature, precipitation, wind and wind-gust extremes.

CLIMATE

ERA5 thresholds

Compares forecasts with ERA5-based climatological thresholds and percentile context.

HORIZON

Weather to seasonal

Supports weather forecasts, seasonal forecasts, and combined weather plus seasonal views.

EXPLORE

Interactive diagnostics

Lets users explore maps, time series, distributions, and ensemble behaviour.

A compact workflow for decision context

Forecasts

weather, seasonal, combined

+

ERA5

historical climatology

=

Risk views

probability and percentile context

Maps

where the signal is strongest

Time series

when the risk emerges

Distributions

how unusual the forecast is

Ensembles

how robust the signal appears

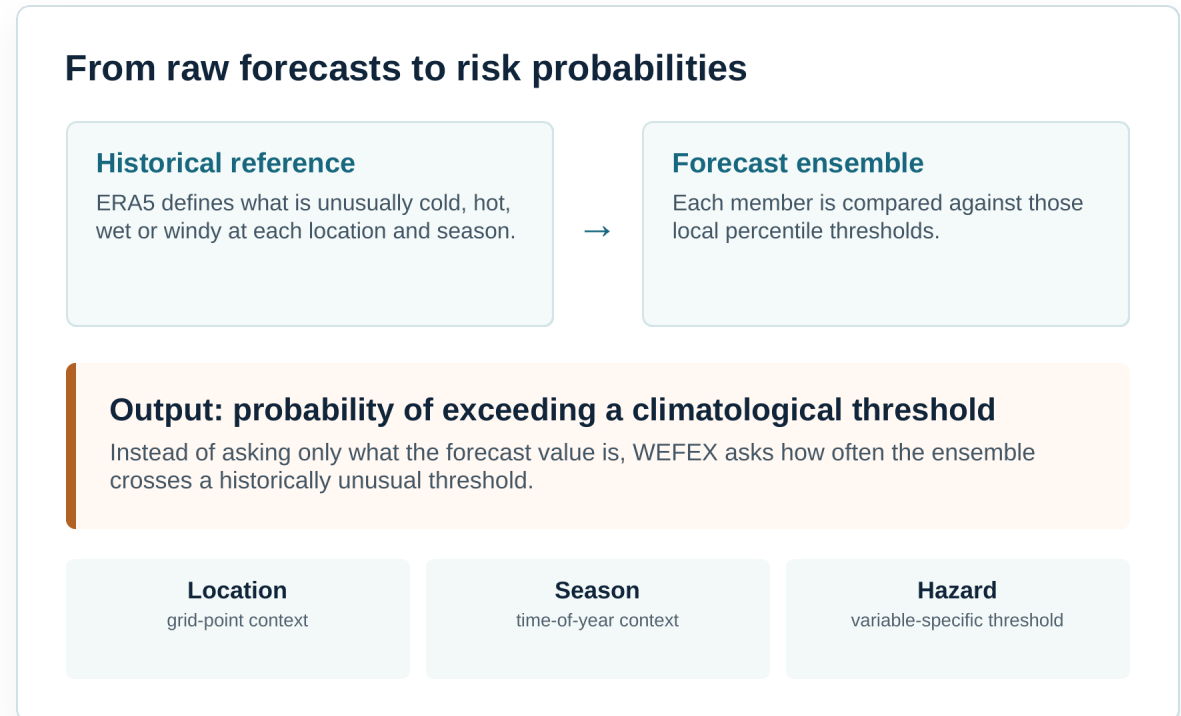
The purpose is not only to show a forecast, but to show whether that forecast is exceptional relative to recent climate.

DATA SOURCES AND FORECAST SYSTEMS

Forecast ensembles plus a historical climate reference

Forecast probabilities are expressed relative to ERA5 percentile thresholds, giving each event a climatological context.

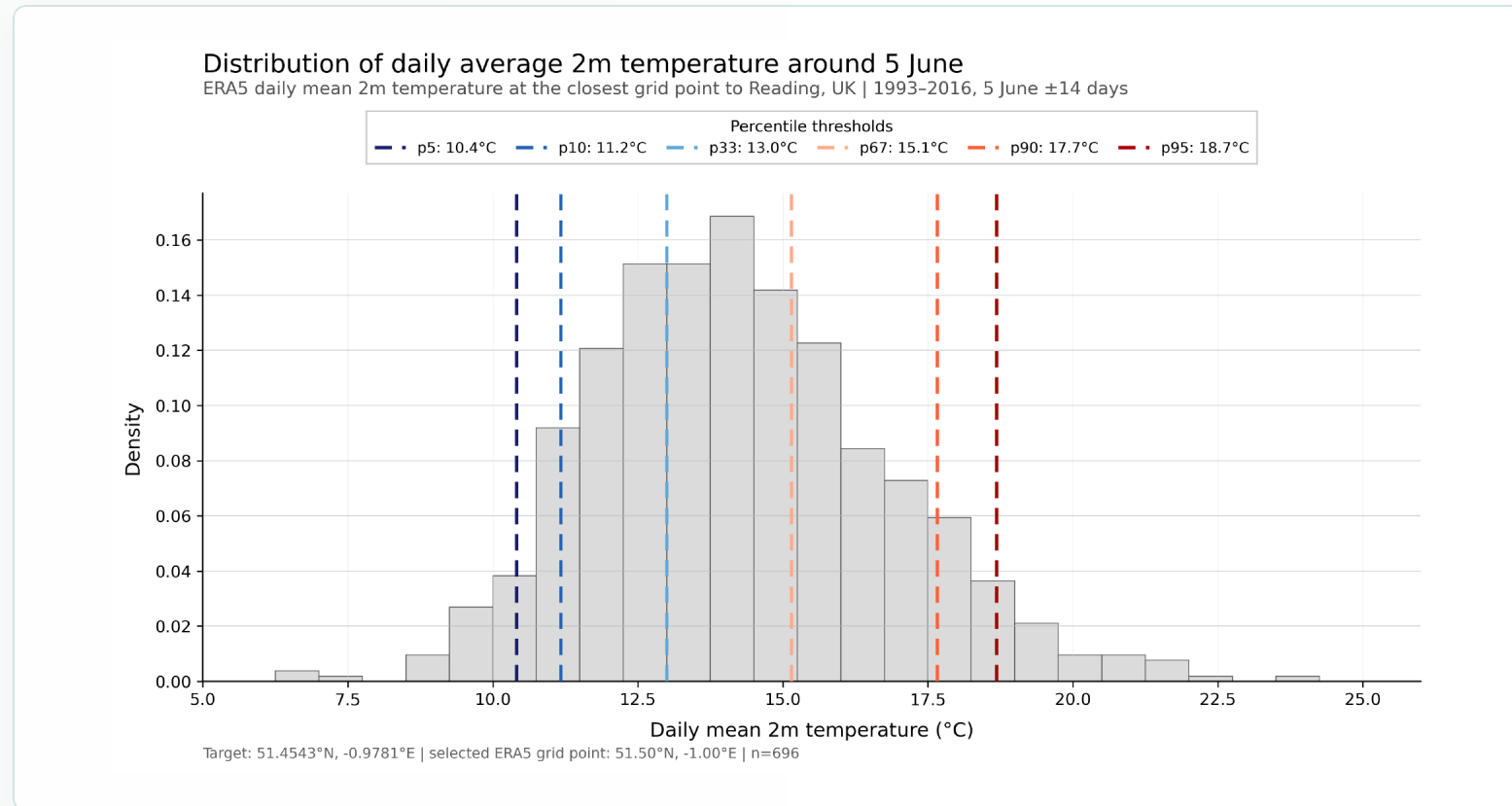
- R ERA5 reanalysis**
Historical and climatological reference used to define percentile thresholds for extreme conditions.
- S ECMWF S5.1**
Seasonal forecast system used for monthly-to-seasonal outlooks of weather-related risk.
- W AIFS and IFS ensembles**
Shorter-range weather forecast information from AI-based and physics-based ensemble systems.



EVENT DEFINITION

What is an "extreme" in WEFEX?

WEFEX defines events with percentiles, so a forecast is interpreted against local climatological conditions rather than a single fixed value.



Percentiles define unusual conditions

- High-value extremes can use thresholds such as p90 or p95.
- For temperature, lower percentiles capture cold extremes and upper percentiles capture warm extremes.
- For precipitation, wind, and wind gusts, upper percentiles are usually the most relevant.
- Event duration can be selected as a 1-day, 3-day, or 5-day mean.

Variable
temperature, rain, wind

Percentile
p10, p90, p95...

Duration
1, 3, or 5 days

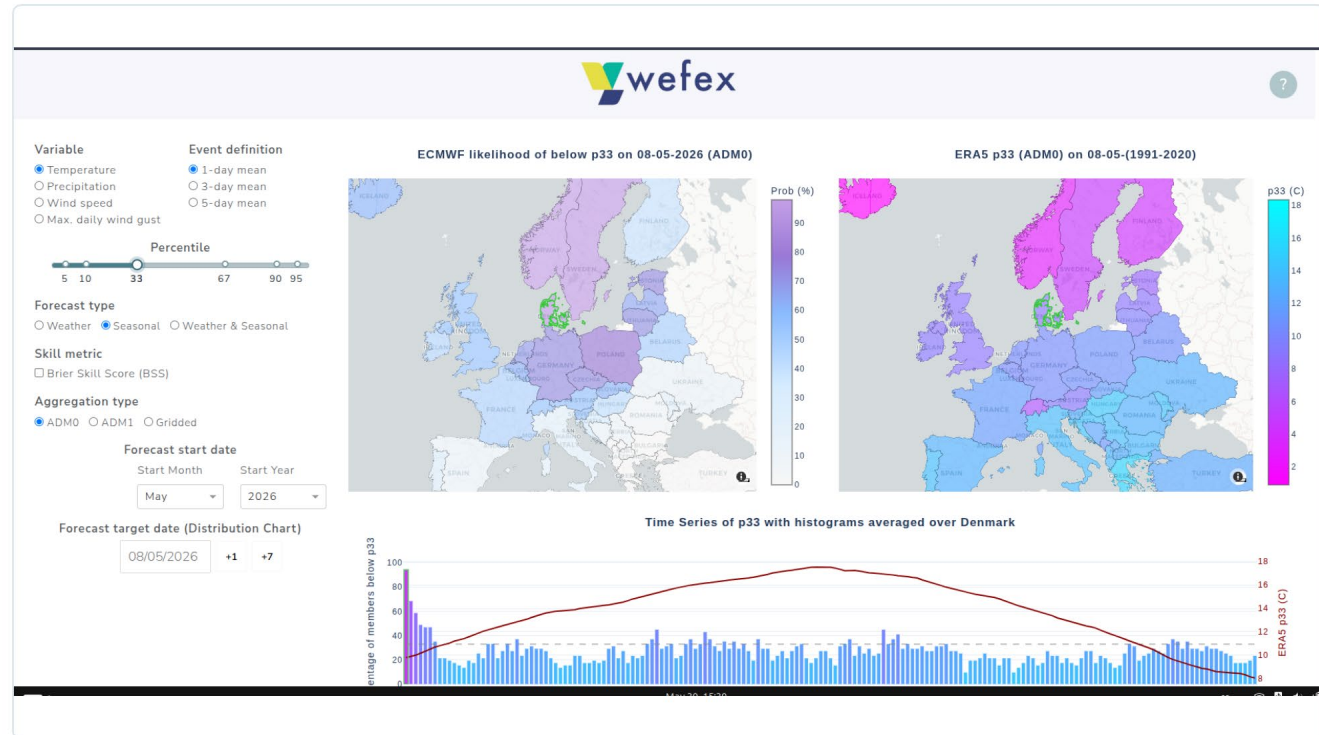
THE USER INTERFACE

One interface for setup, maps, and diagnostics

The interface is organised so users can define an event, inspect the probability field, and drill into local ensemble behaviour.

What the user controls

- Left panel: variable, percentile, event definition, forecast type, model, aggregation, and dates.
- Main view: probability map and reference or ERA5 map.
- Lower panels: time series, probability distribution, and ensemble forecast display.



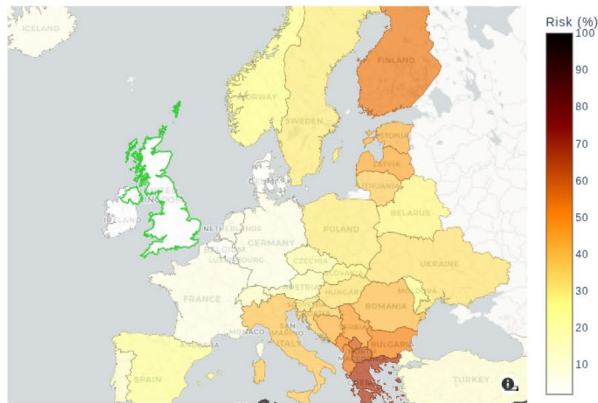
SPATIAL AGGREGATION

Match the forecast signal to the decision scale

Spatial aggregation matters for industrial users because risk decisions are rarely made at only one grid point.

ADM0

AIFS likelihood of above p90 on 07-06-2026 (ADM0)

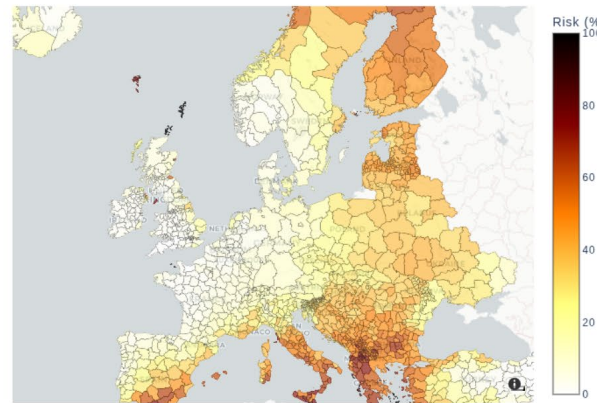


Country-level view

Useful for national planning, market-scale questions, and first-pass operational screening.

ADM1

AIFS likelihood of above p90 on 07-06-2026 (ADM1)



Regional aggregation

Supports subnational decisions where grid detail is too noisy but national averages are too broad.

GRIDDED

AIFS likelihood of above p90 on 07-06-2026



Detailed spatial signal

Best for localised hazards, assets, and identifying gradients in the forecast probability field.

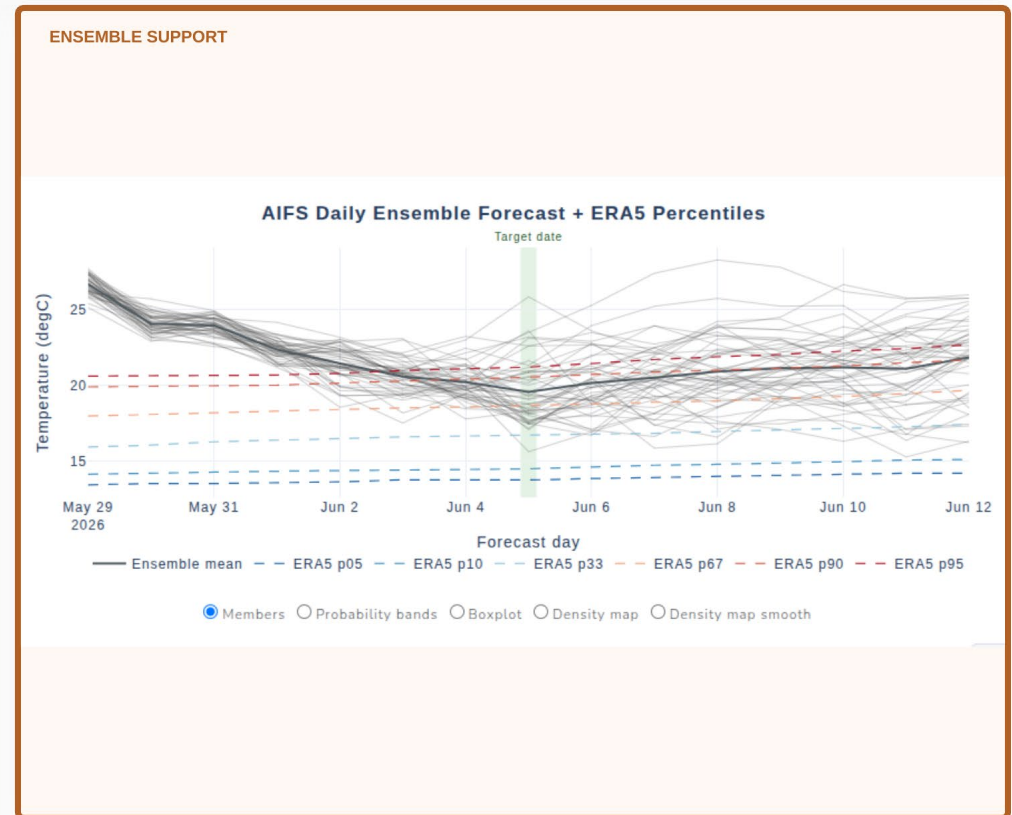
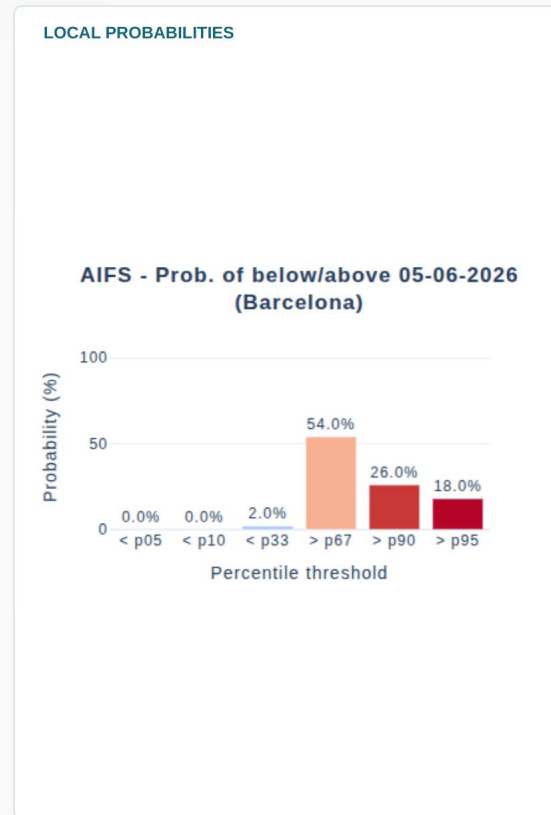
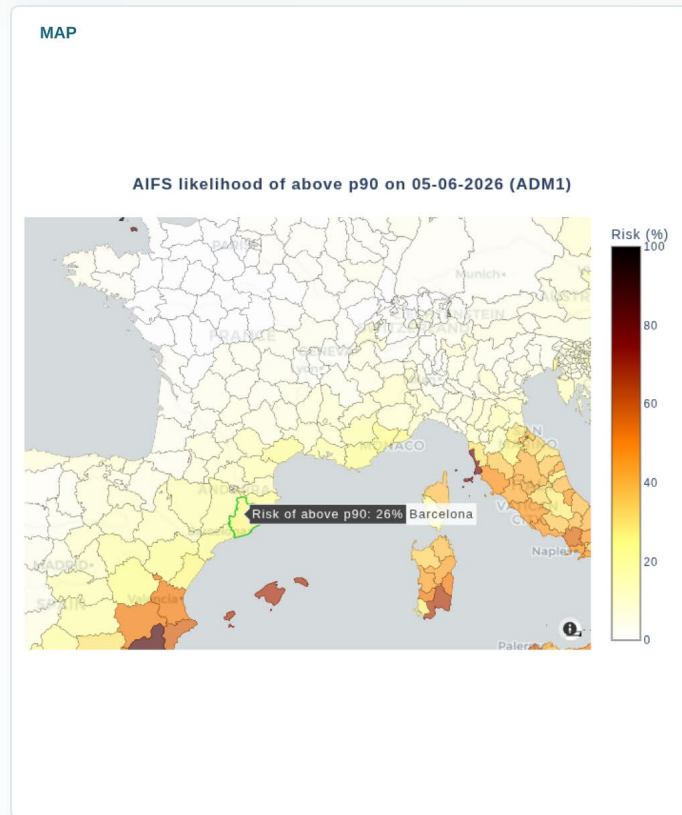
READING THE PROBABILITY MAP

Probability means ensemble support for the selected event

The map is a spatial summary of how many ensemble members cross the selected percentile threshold for the selected date and event definition.

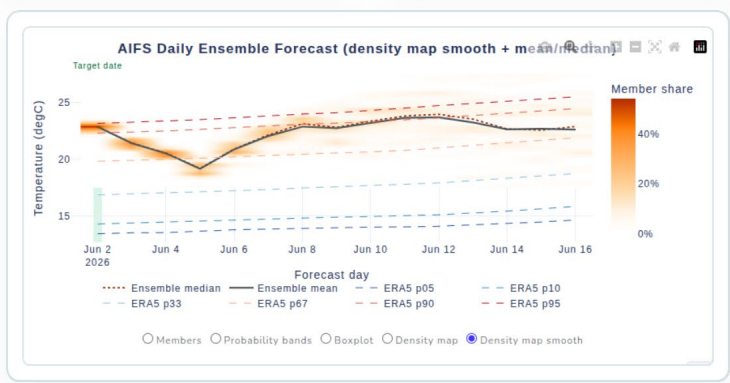
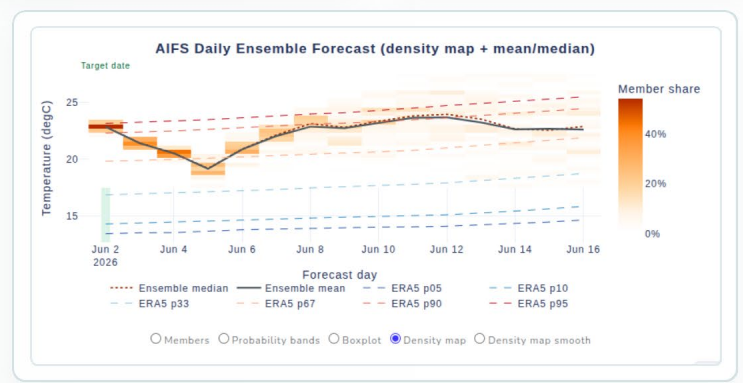
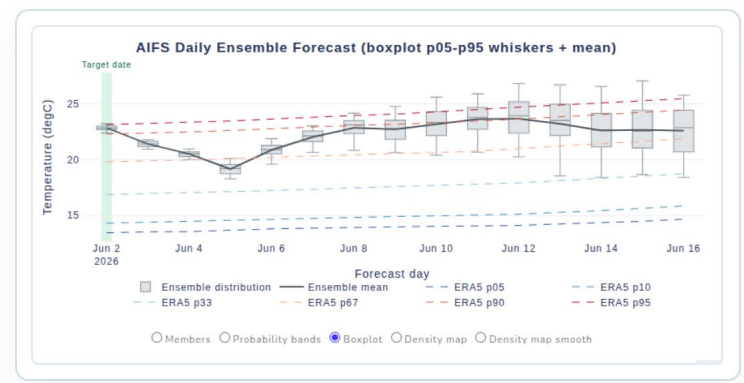
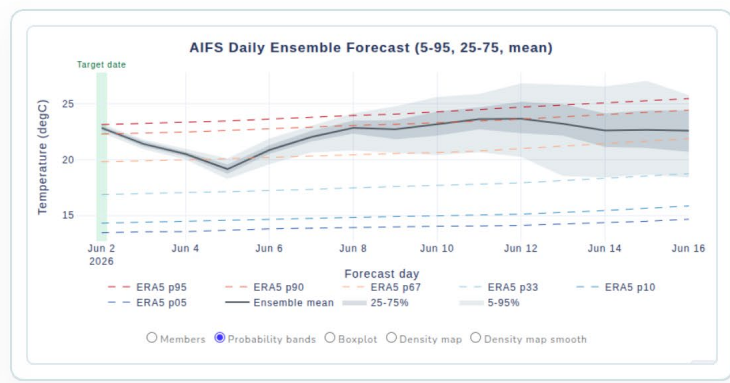
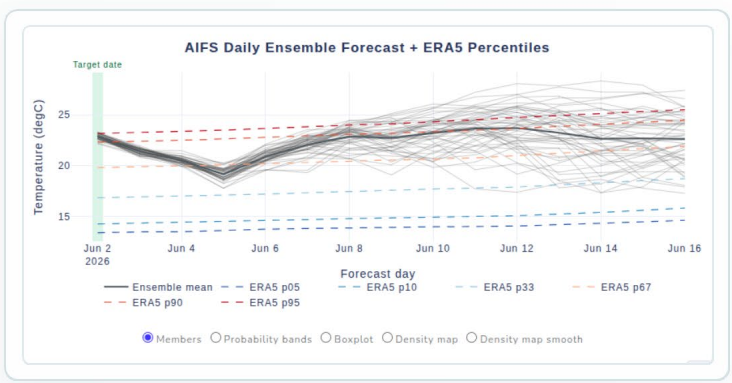
Define the event, check every ensemble member, and map the fraction of members supporting it; selecting a location opens the local ensemble diagnostics.

Probability = members exceeding threshold / all ensemble members



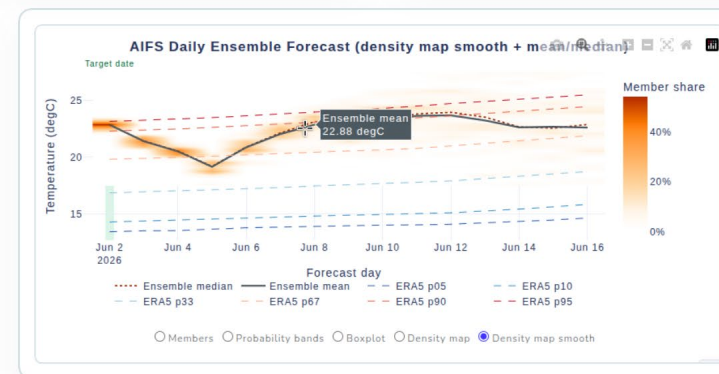
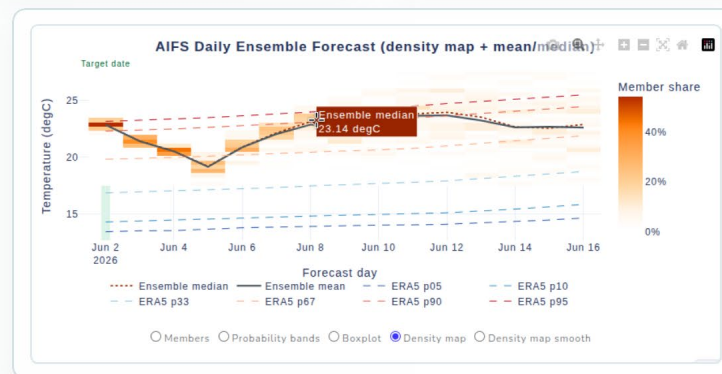
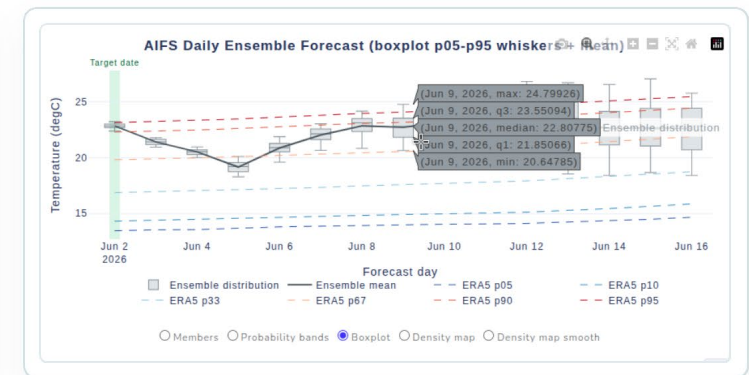
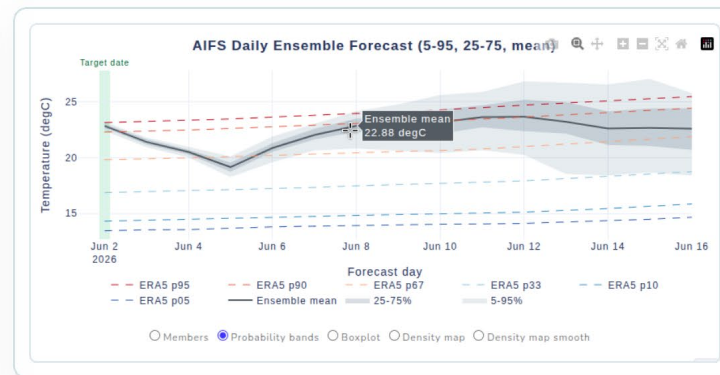
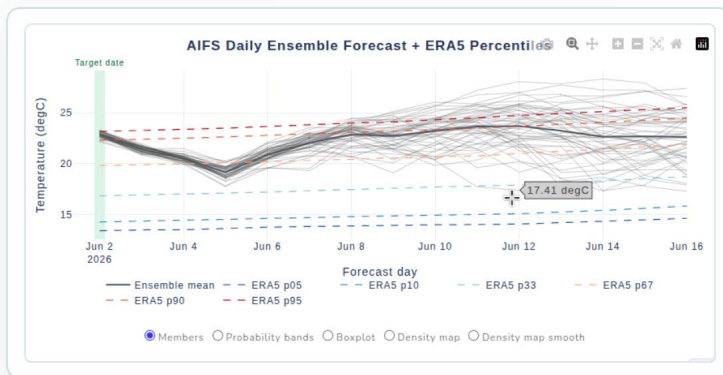
Style options for local ensemble diagnostics

WEFEX provides several views of the same local ensemble information, letting users switch between compact summaries and more detailed distribution views.



The same style options with a selected-date marker

The marker view anchors the ensemble diagnostics to the selected target date, making it easier to connect the lower-panel plots with the map and event definition.





FORECAST SKILL

Brier Skill Score: forecast value relative to climatology

WEFEX uses Brier Skill Score to ask whether probabilistic seasonal forecasts improve on a simple climatological reference.

What is scored?

The Brier Score measures the mean squared error of probabilistic forecasts for a binary event: did the selected threshold occur or not?

$$BS = (1 / N) \sum (p_i - o_i)^2$$
$$BSS = 1 - BS_{\text{forecast}} / BS_{\text{climatology}}$$

Here p_i is the forecast probability and o_i is the observed outcome, equal to 1 if the event occurred and 0 otherwise.

Reference forecast: climatology

The reference forecast is simply the historical event frequency from the climatological reference. BSS therefore asks whether the model improves on using climatology alone.

Why use BSS here?

- It is designed for probabilistic yes/no event forecasts.
- It rewards calibrated probabilities and penalises confident wrong forecasts.
- It provides a direct comparison with climatology, which is the minimum useful baseline for seasonal prediction.
- A positive BSS means the forecast has historically added value over climatology.

< 0
worse than climatology

0
no added value

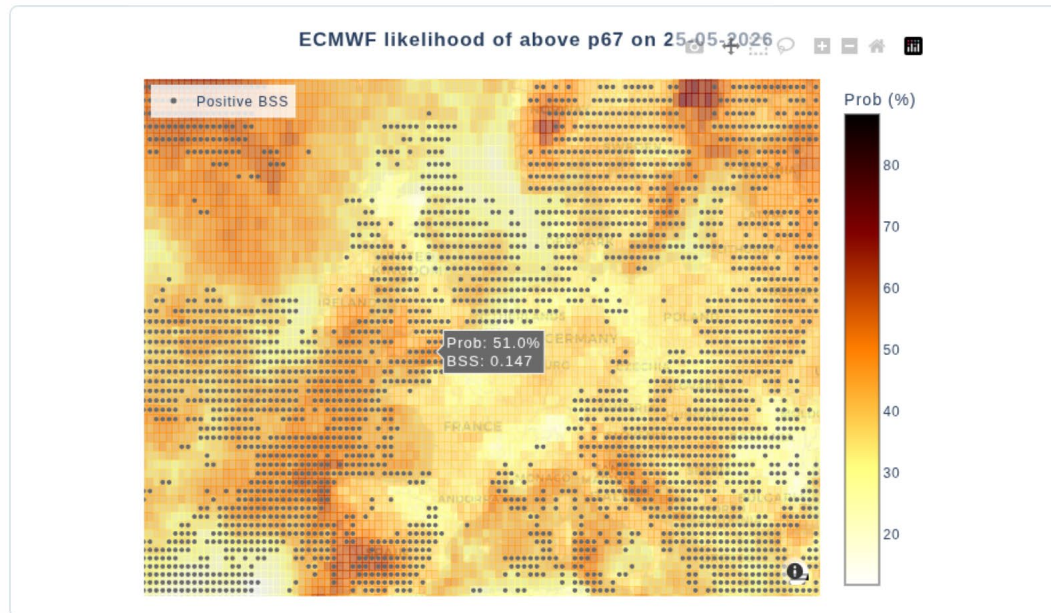
> 0
forecast adds value

FORECAST SKILL IN WEFEX

Skill maps show where forecasts have historically added value

WEFEX displays BSS spatially, so users can compare the probability signal with the historical skill of the seasonal forecast system.

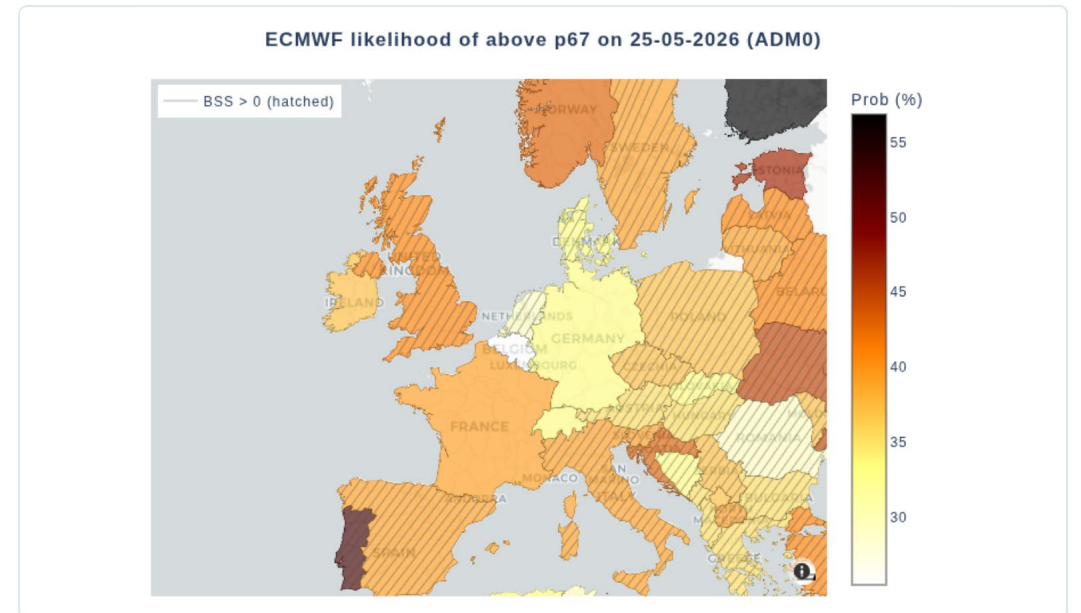
GRIDDED



Local skill structure

Gridded skill keeps the spatial detail, showing where added forecast value varies across the map.

ADMO



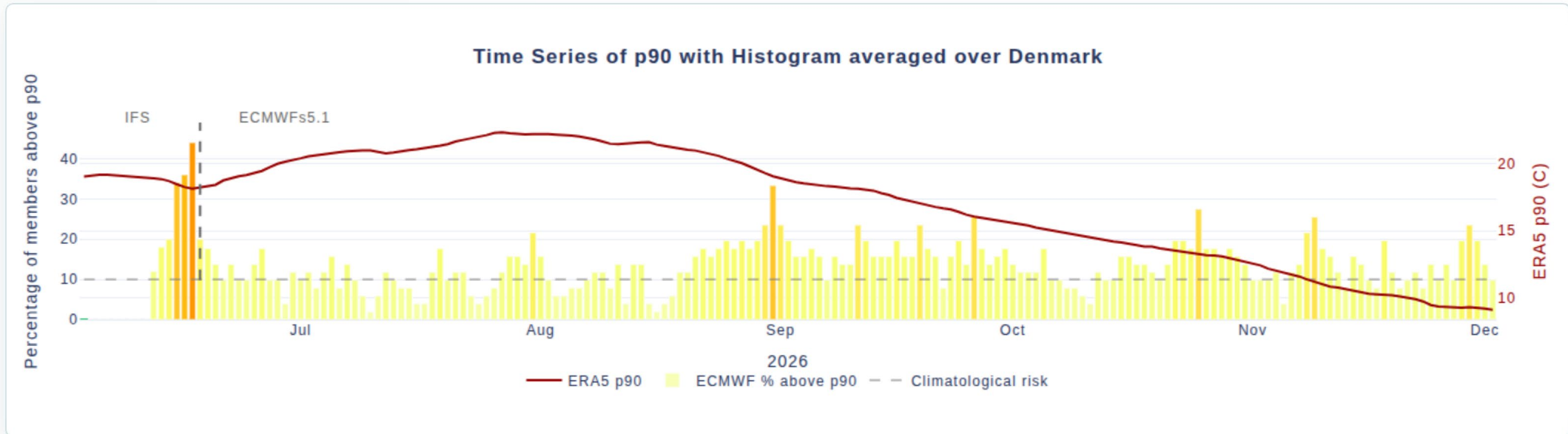
Country-level summary

ADMO aggregation summarises skill at the national scale for broader decision contexts.



Combining weather and seasonal forecasts in one view

WEFEX can show daily risk continuously: the first part uses weather forecasts, while the later period transitions to seasonal forecast information.



NEAR TERM

Daily risks are driven by weather forecasts, where individual days and short lead times are most decision-relevant.

TRANSITION

The view keeps the same daily-risk framing as the source of predictability shifts from weather to seasonal information.

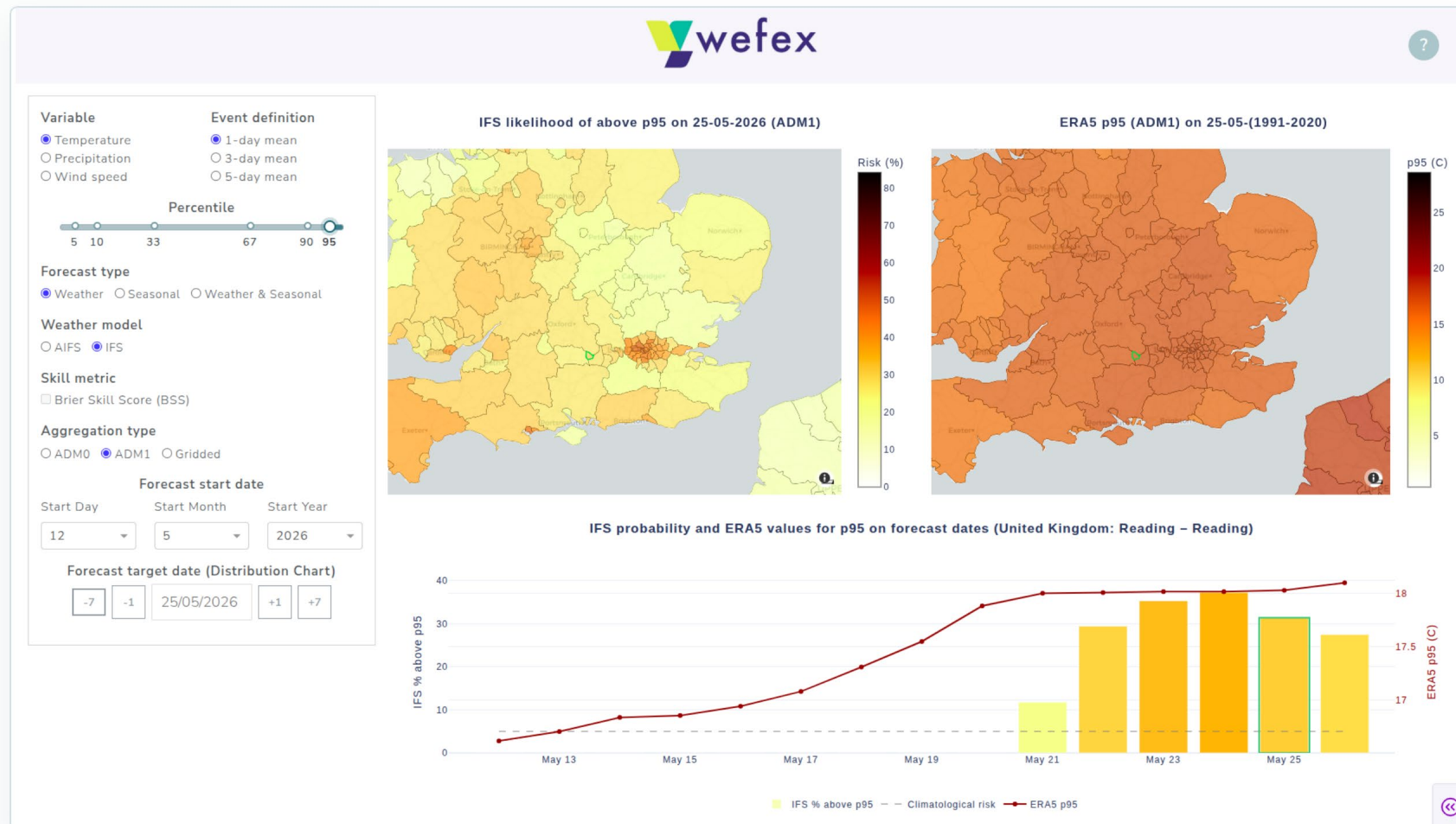
LONGER LEAD

Seasonal forecasts extend the outlook, giving early context for elevated risk beyond the weather-forecast window.



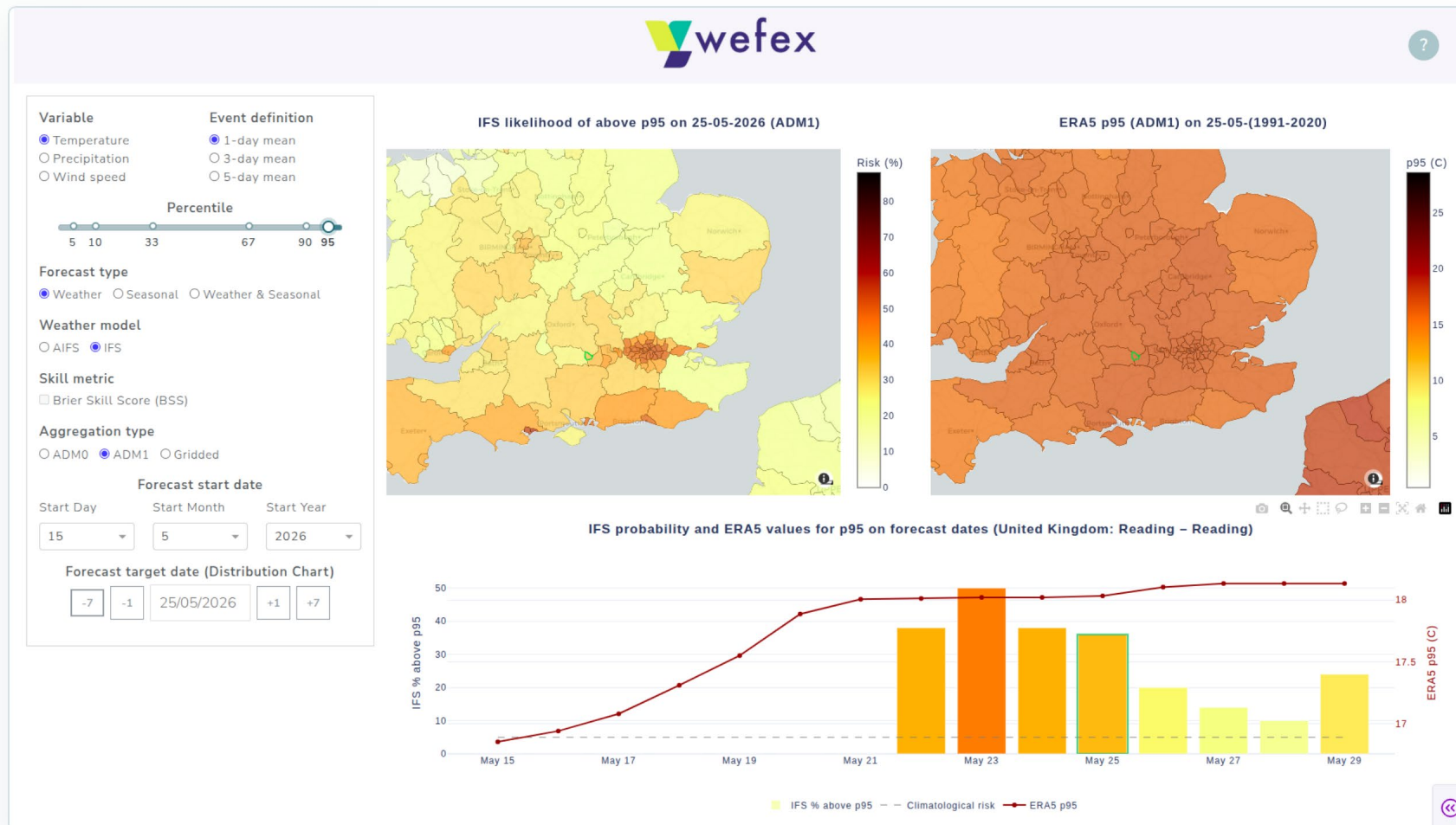
FORECAST START DATE: SHOWN IN SCREENSHOT | 1 OF 4

Forecast of the extreme heatwave in Reading in late May



FORECAST START DATE: SHOWN IN SCREENSHOT | 2 OF 4

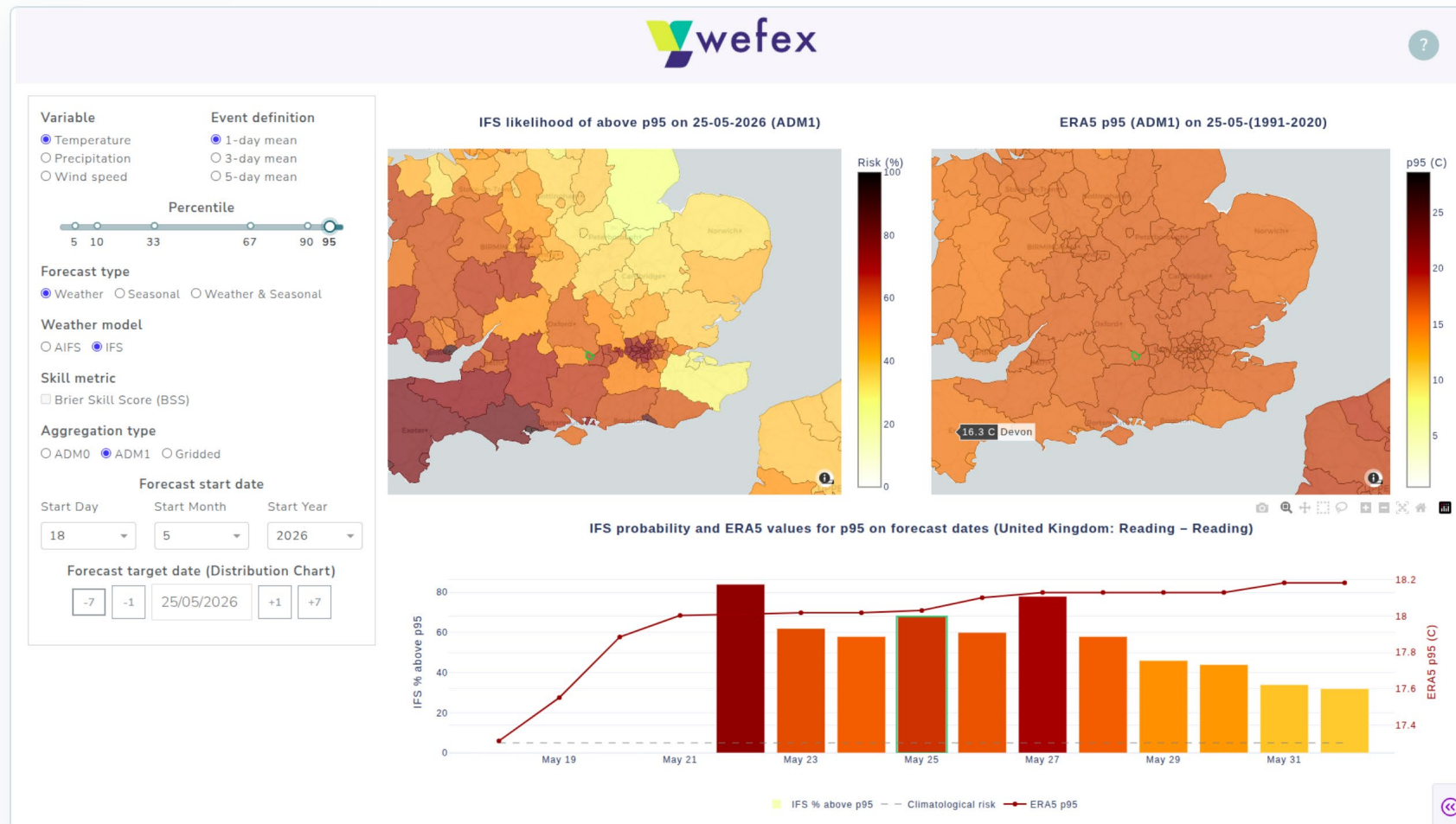
Forecast of the extreme heatwave in Reading in late May





FORECAST START DATE: SHOWN IN SCREENSHOT | 3 OF 4

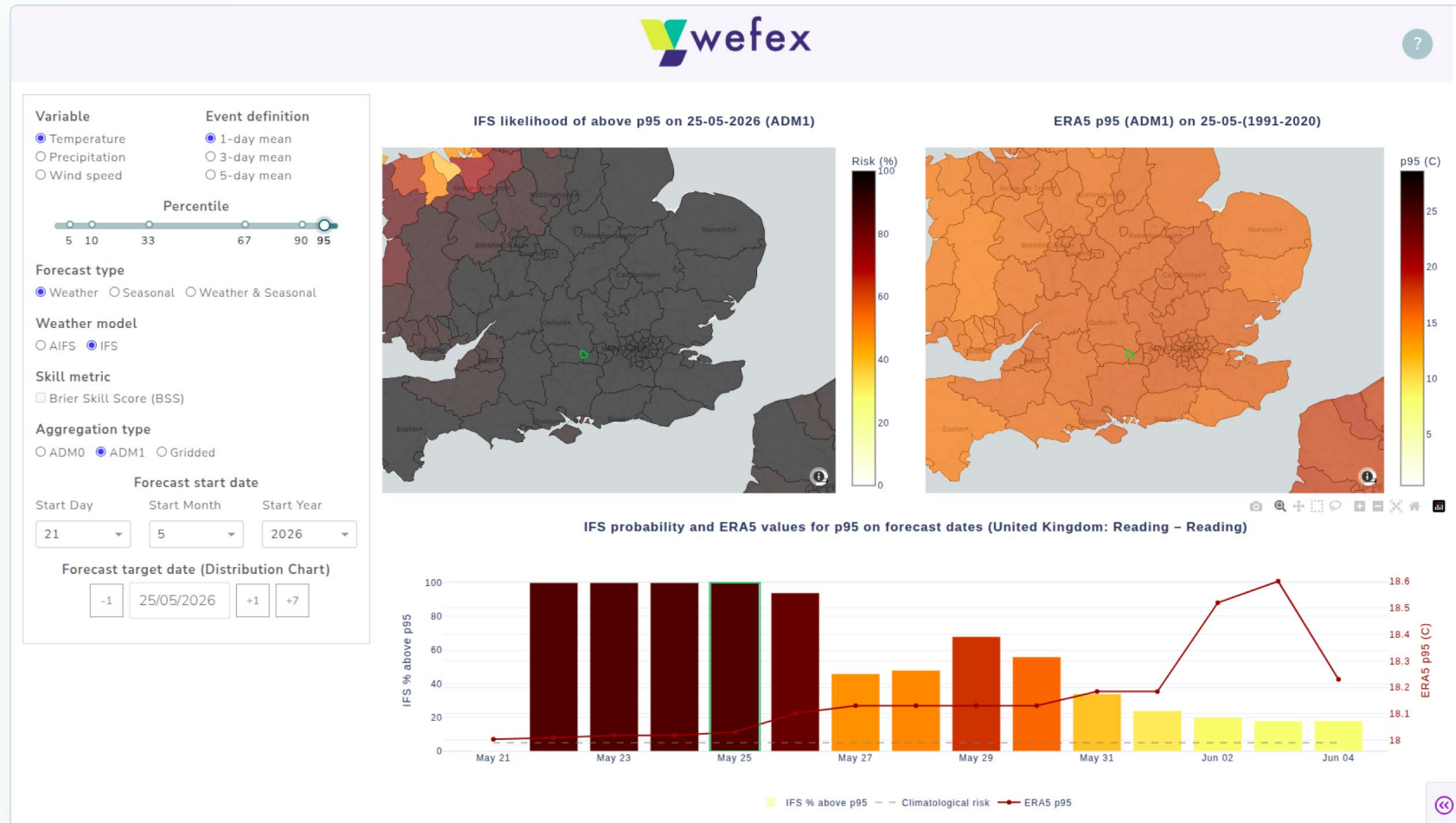
Forecast of the extreme heatwave in Reading in late May





FORECAST START DATE: SHOWN IN SCREENSHOT | 4 OF 4

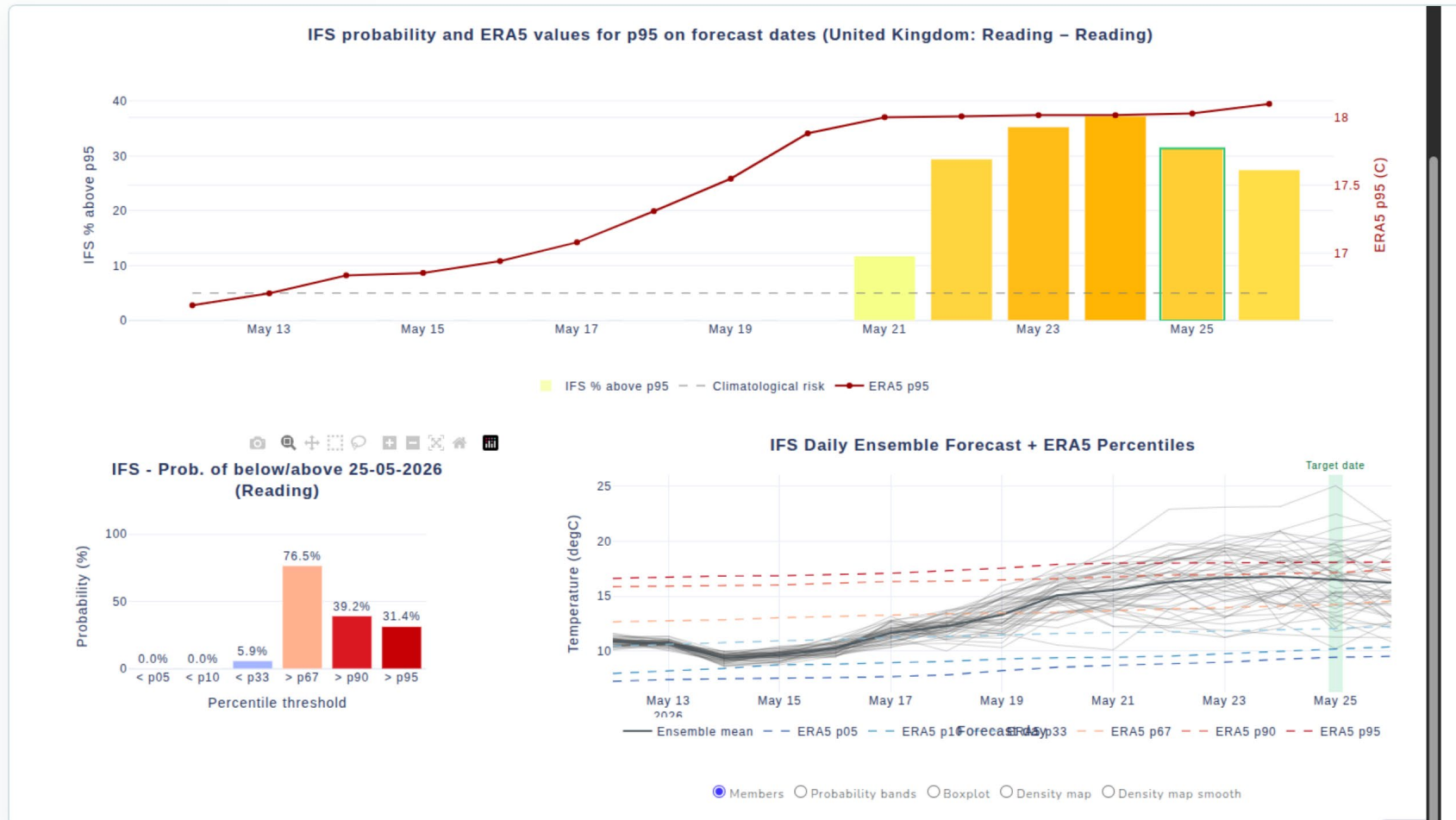
Forecast of the extreme heatwave in Reading in late May





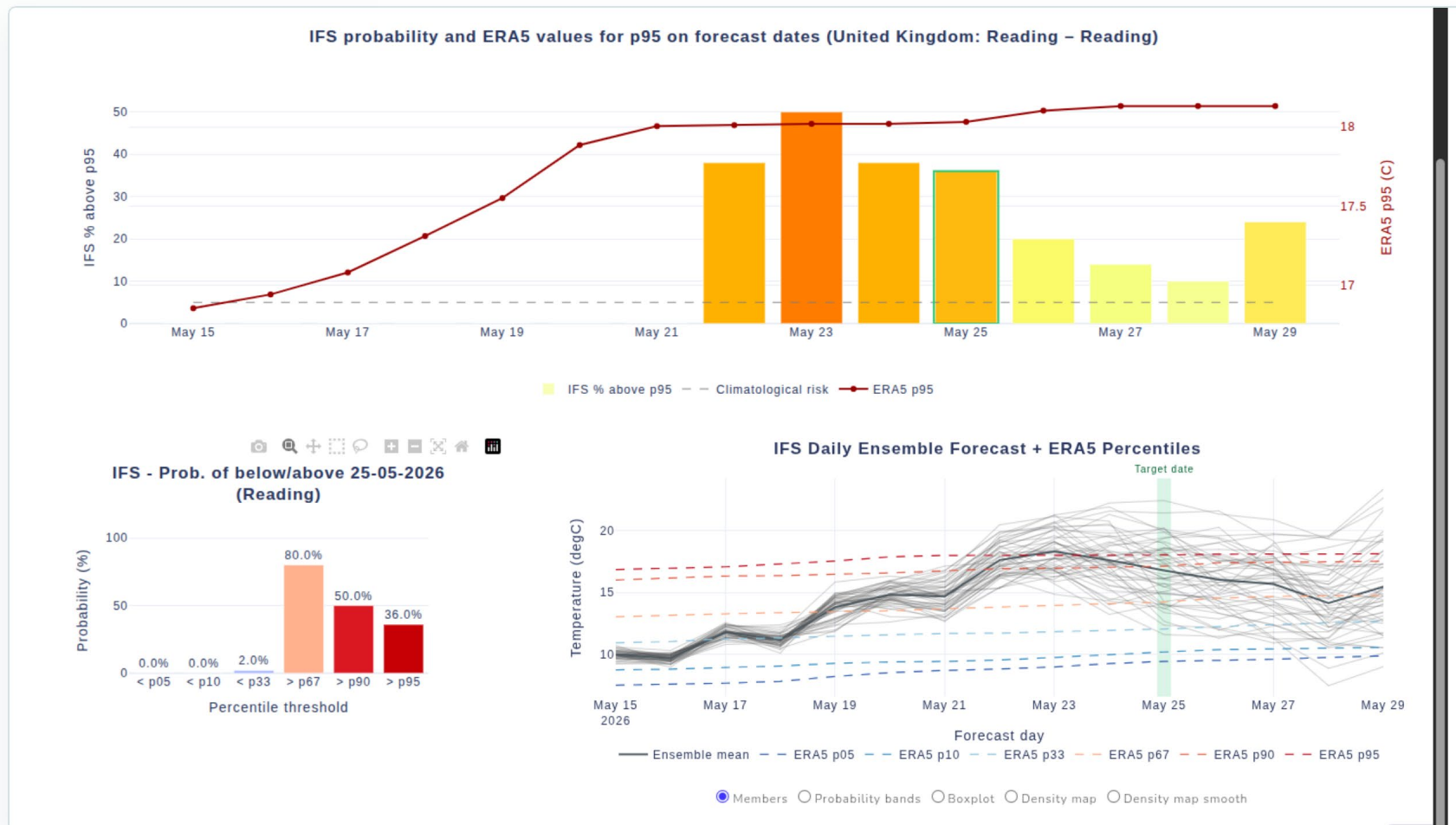
FORECAST START DATE: SHOWN IN SCREENSHOT | 1 OF 4 | ADDITIONAL FIGURES

Forecast of the extreme heatwave in Reading in late May (additional figures)



FORECAST START DATE: SHOWN IN SCREENSHOT | 2 OF 4 | ADDITIONAL FIGURES

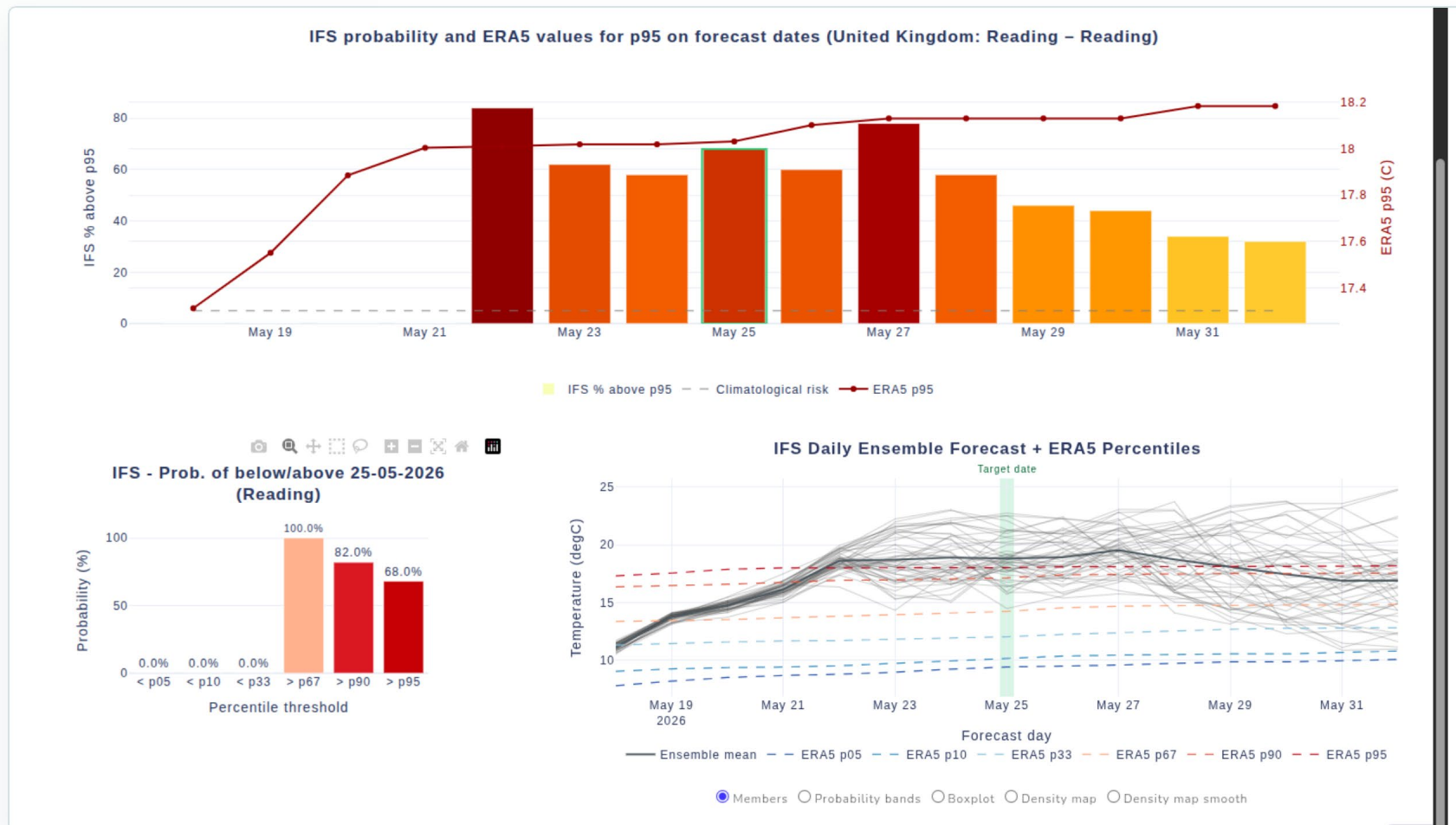
Forecast of the extreme heatwave in Reading in late May (additional figures)





FORECAST START DATE: SHOWN IN SCREENSHOT | 3 OF 4 | ADDITIONAL FIGURES

Forecast of the extreme heatwave in Reading in late May (additional figures)



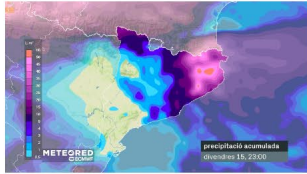
Cold spell across western Europe, 11-15 May 2026

A late-spring cold spell brought unusually low temperatures and renewed public attention to cold-risk impacts across western Europe.

El Meteocat activa l'avis groc per pluja intensa a Barcelona i Girona aquest divendres

Un canvi de temps que, a banda de la pluja, també podria venir acompanyat d'una refrescada, d'entre 4 i 6 °C menys

15 de maig del 2026
3 minuts de lectura



El més vist

Tots els carrers tallats i afectacions al transport per la visita del papa a Barcelona | MAPA

Live View | 0 minuts de lectura

Le Parisien

Météo

Des températures proches de 0 °C en Île-de-France mardi matin, un risque de gelée dans le Nord-Est

En fin de nuit et en tout début de matinée de mardi, le sol pourrait blanchir à cause du gel. L'après-midi, il fera une quinzaine de degrés.

Par D.A.S.
Le 11 mai 2026 à 18h00



BBC Sign in Home News Sport Weather iPlayer Sounds

WEATHER
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Temperatures drop to unseasonably low levels as cold snap hits UK

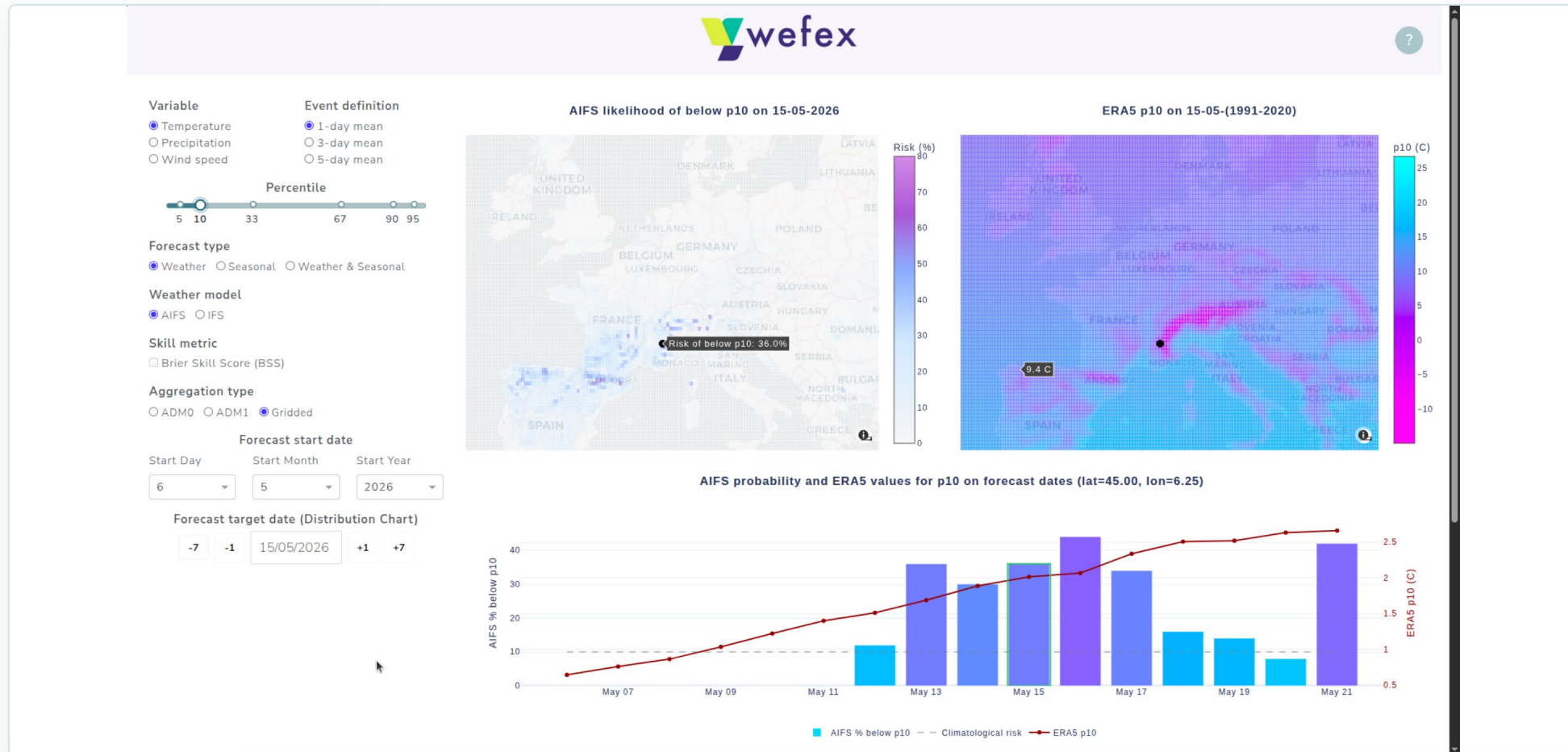


BBC WEATHER WATCHER / JACK MARSH
Frosty start in Witherley, Warwickshire

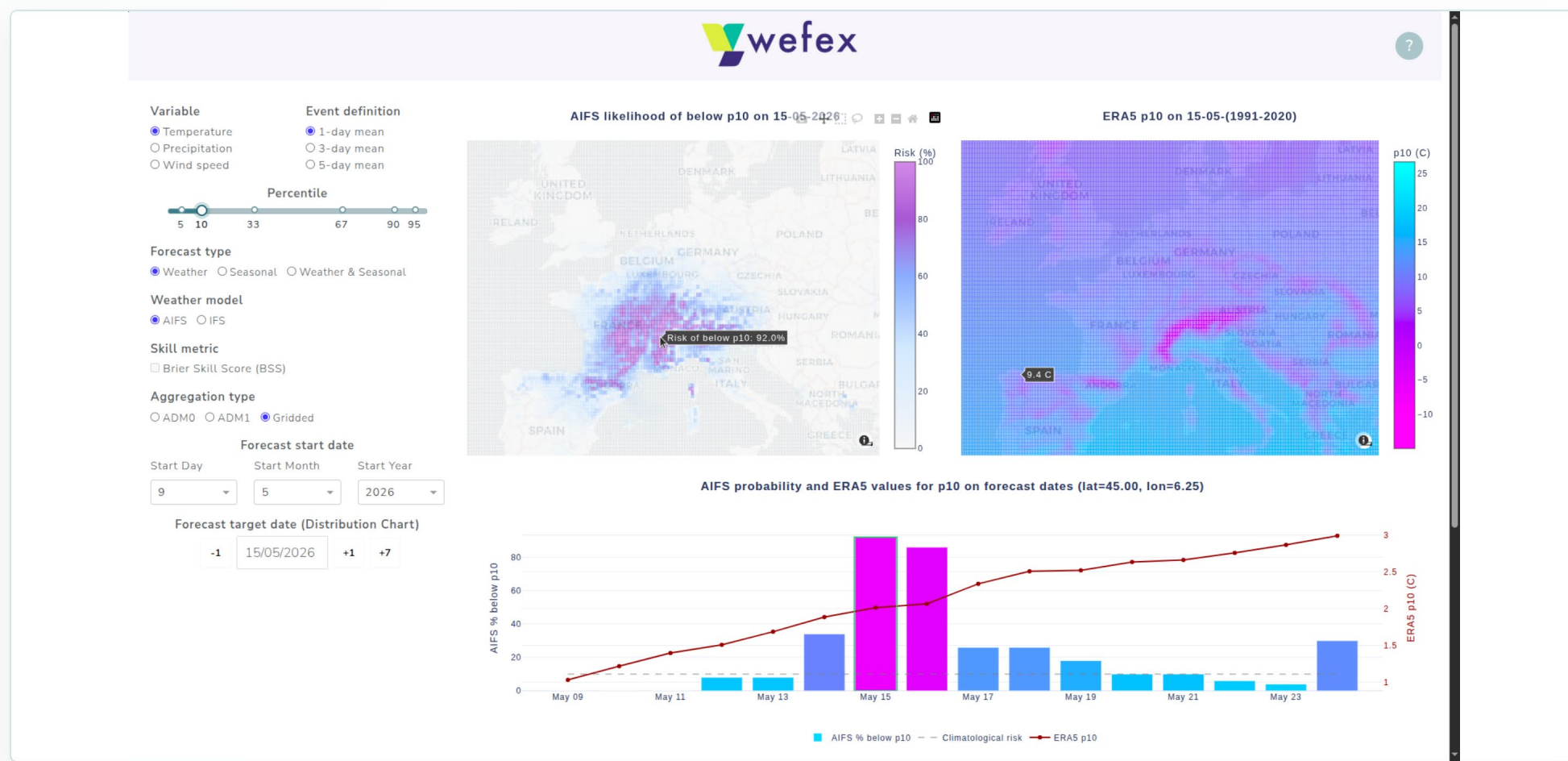
Simon King
Lead Weather Presenter

Sources: Le Parisien, 11 May 2026; Betevé, 15 May 2026; Kronen Zeitung / krone.at, 12 May 2026.; BBC 11 May 2026.

Forecast of the western Europe cold spell, 11-15 May 2026

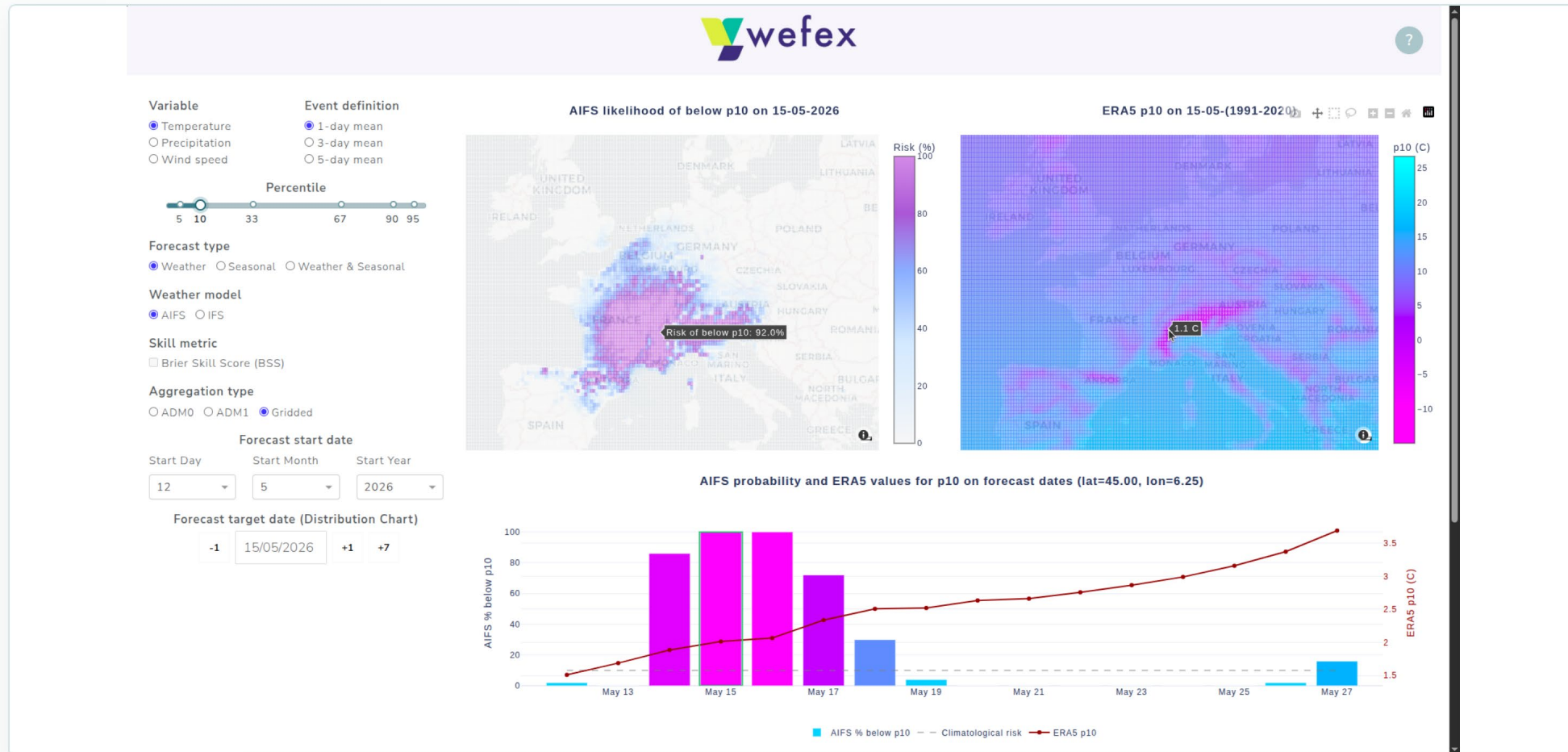


Forecast of the western Europe cold spell, 11-15 May 2026



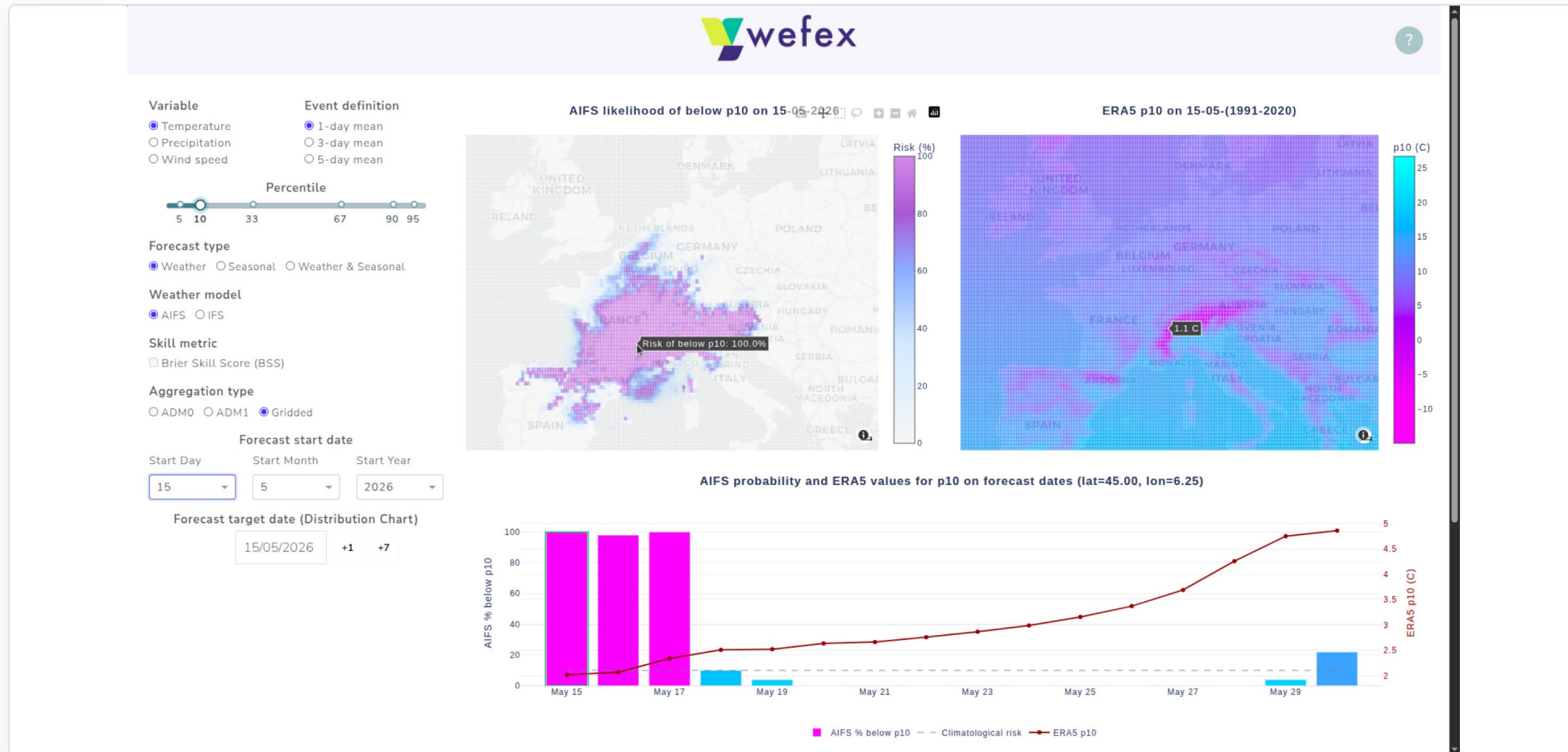


Forecast of the western Europe cold spell, 11-15 May 2026



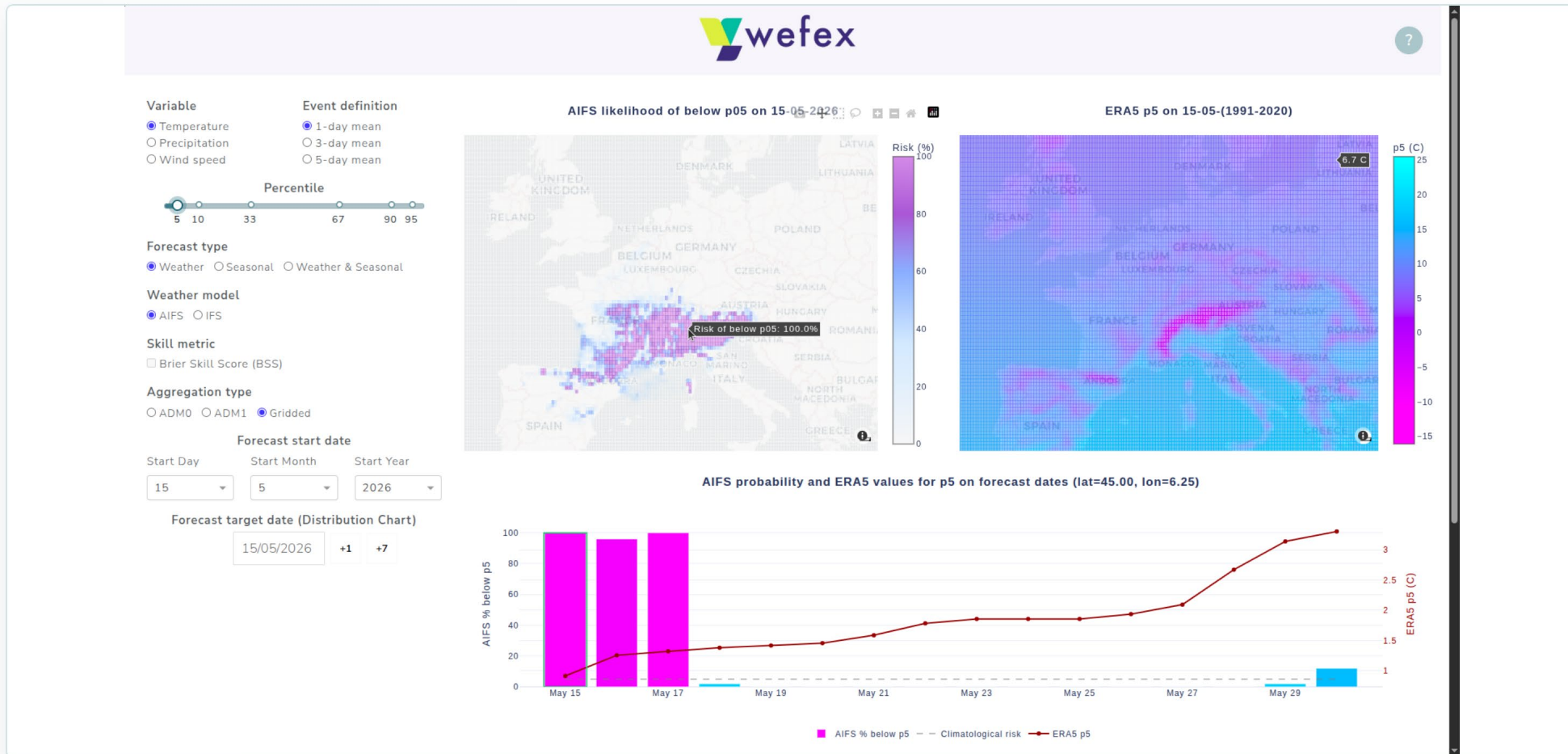


Forecast of the western Europe cold spell, 11-15 May 2026



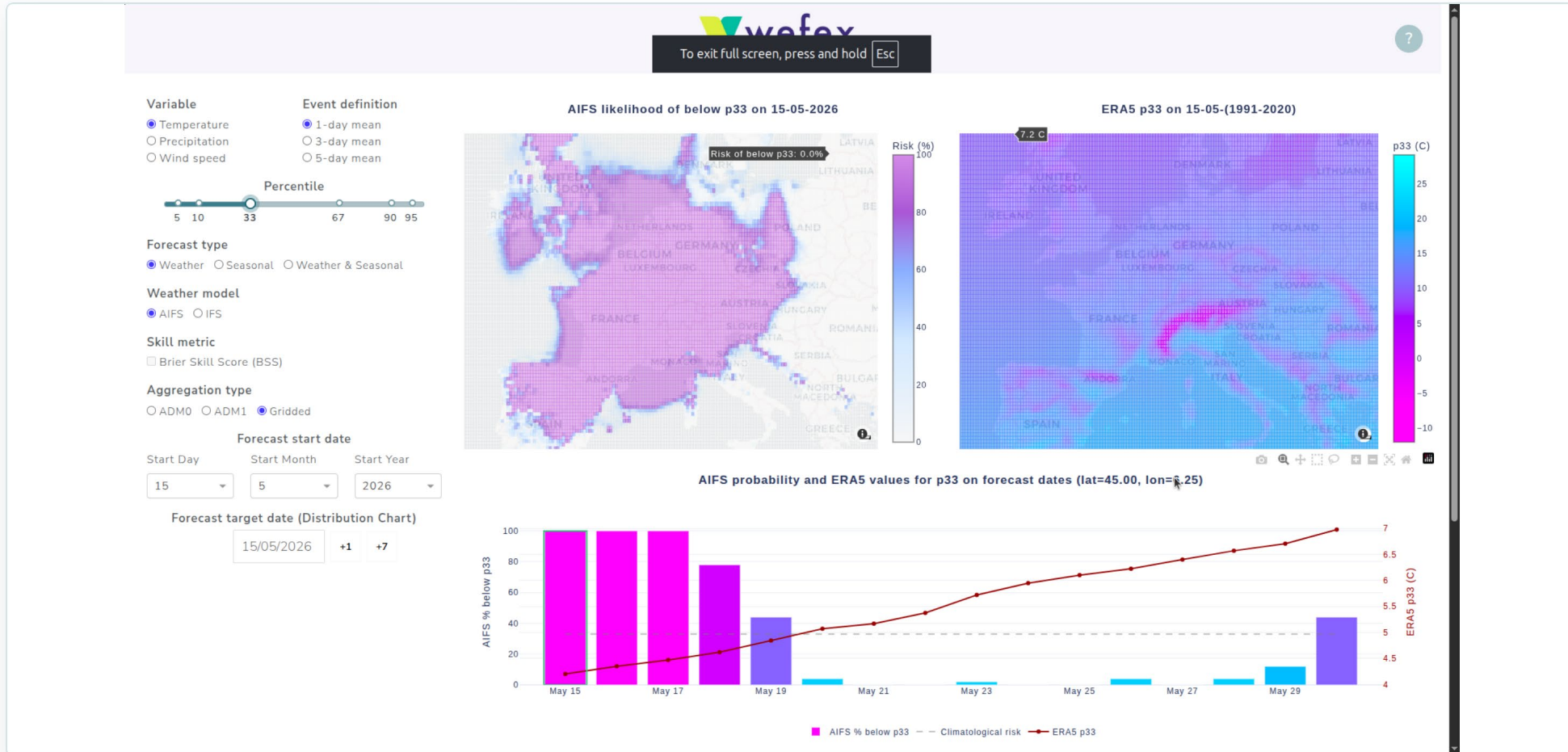


Cold-spell probability view: 5th percentile threshold





Cold-spell probability view: 33rd percentile threshold





WEMC
World Energy &
Meteorology Council

LIVE DEMONSTRATION

WEFEX workflow shown in the interface



POTENTIAL FUTURE ADDITIONS

Where WEFEX could go next

The next development steps can broaden model diversity, time horizons, skill diagnostics, and operational decision support.

FORECAST SYSTEMS

More seasonal models

Add additional seasonal forecast systems to compare signals across models and increase robustness.

SKILL

Daily seasonal skill metric

Develop a new skill metric tailored to seasonal daily forecasts and event-based extremes.

COVERAGE

Global expansion

Move beyond Europe to support global hazard monitoring and international users.

HORIZON

ECMWF S2S

Add sub-seasonal ECMWF forecasts to bridge medium-range weather and seasonal outlooks.

DECISION LAYER

Assets, APIs, compound events

Support user-defined assets and thresholds, export/API workflows, and compound-event screening.

UEF2026 · ECMWF

Thank you

Questions and discussion

Kristian L. Nielsen

World Energy and Meteorology Council (WEMC)

kristian.nielsen@wemcouncil.org



INFO@WEMCOUNCIL.ORG



WWW.WEMCOUNCIL.ORG



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