US1k Model and the Seasonal Outlook for Utility Operations & Power Trading

Chris Hyde

Scottsdale, AZ | May 7th, 2025

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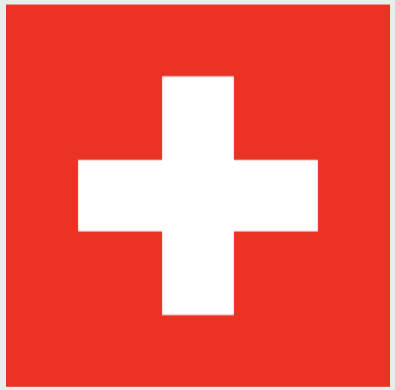

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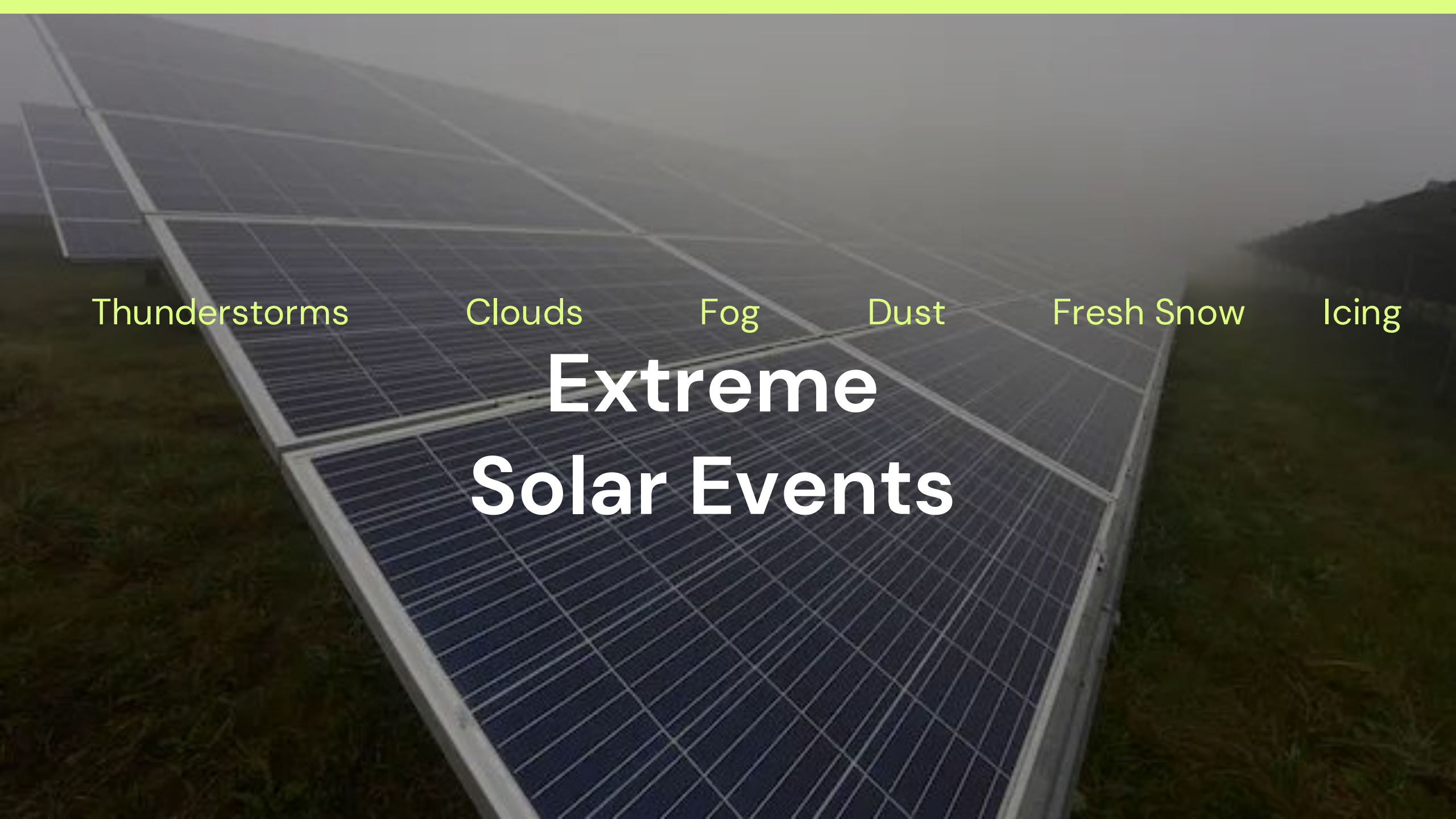
Agenda

1. US1k Model Background and Case Studies
2. Look Back at Winter
3. Cooling Season Forecast
4. Tropical Outlook
5. Energy Survey

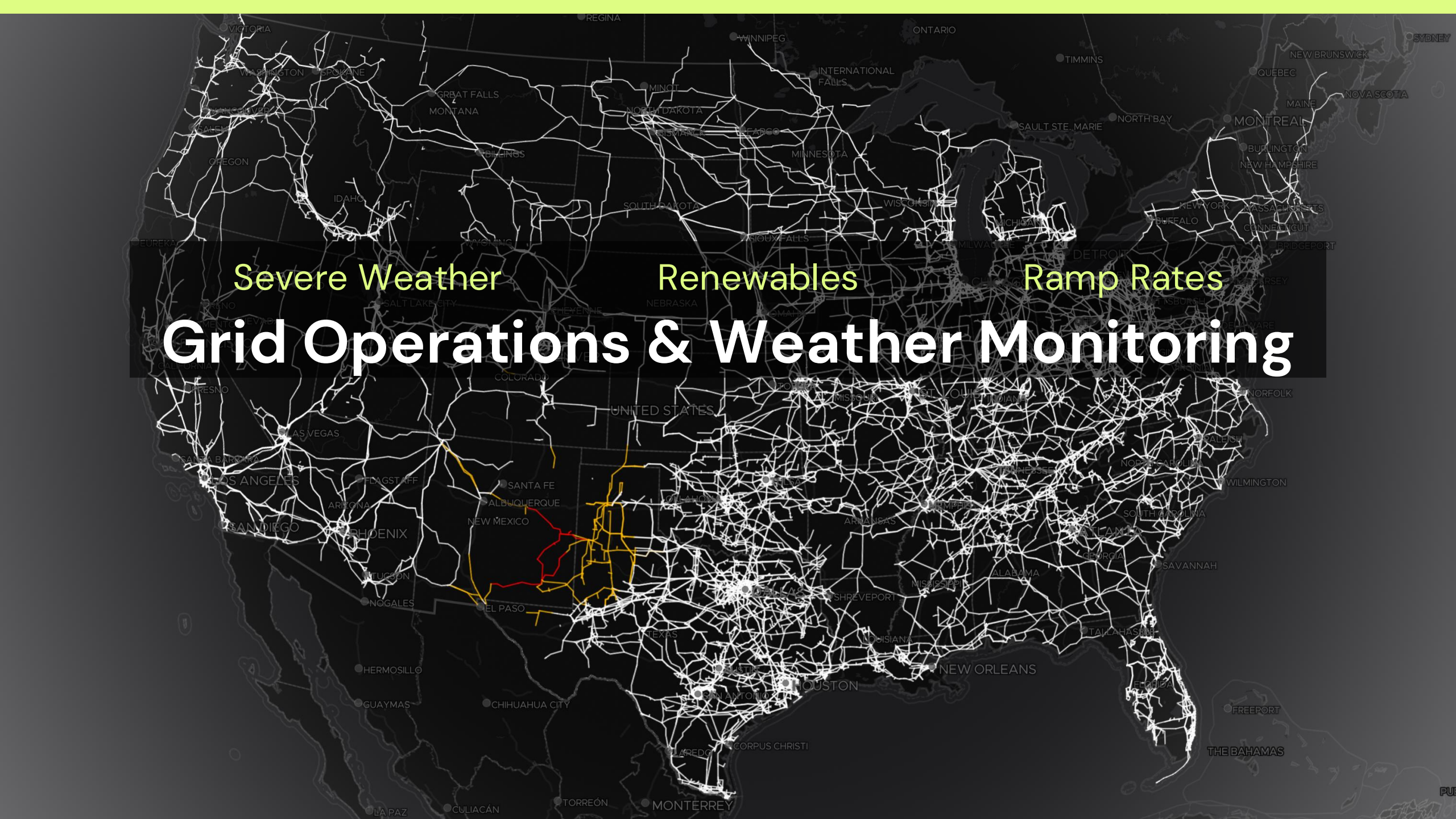
Freezing Rain Wet Snow Icing Downbursts Line Galloping

Severe Weather

Curtailments
Wake Effects
Ramps
Thunderstorms
Wind
Gusts
Icing
Extreme
Wind Events

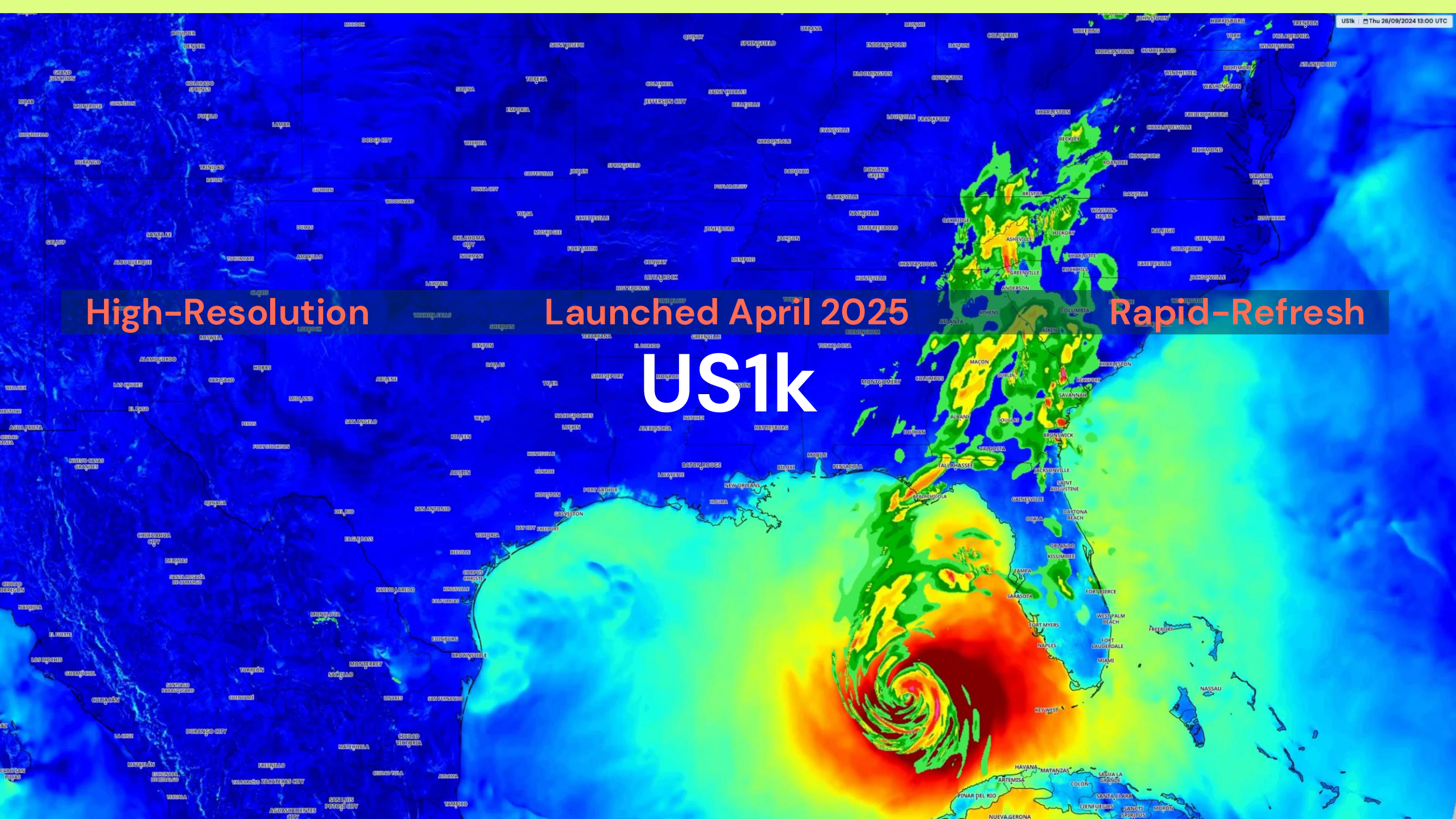

Thunderstorms
Clouds
Fog
Dust
Fresh Snow
Icing
Extreme
Solar Events

Growing Renewables
Price Spikes
Negative Prices
Increasing Market Volatility


Severe Weather
Renewables
Ramp Rates
Grid Operations & Weather Monitoring

Lower Resolution
Less Updates
Traditional
Weather Models

Real-time
High-Resolution
Rapid-Refresh
High Performance Computing

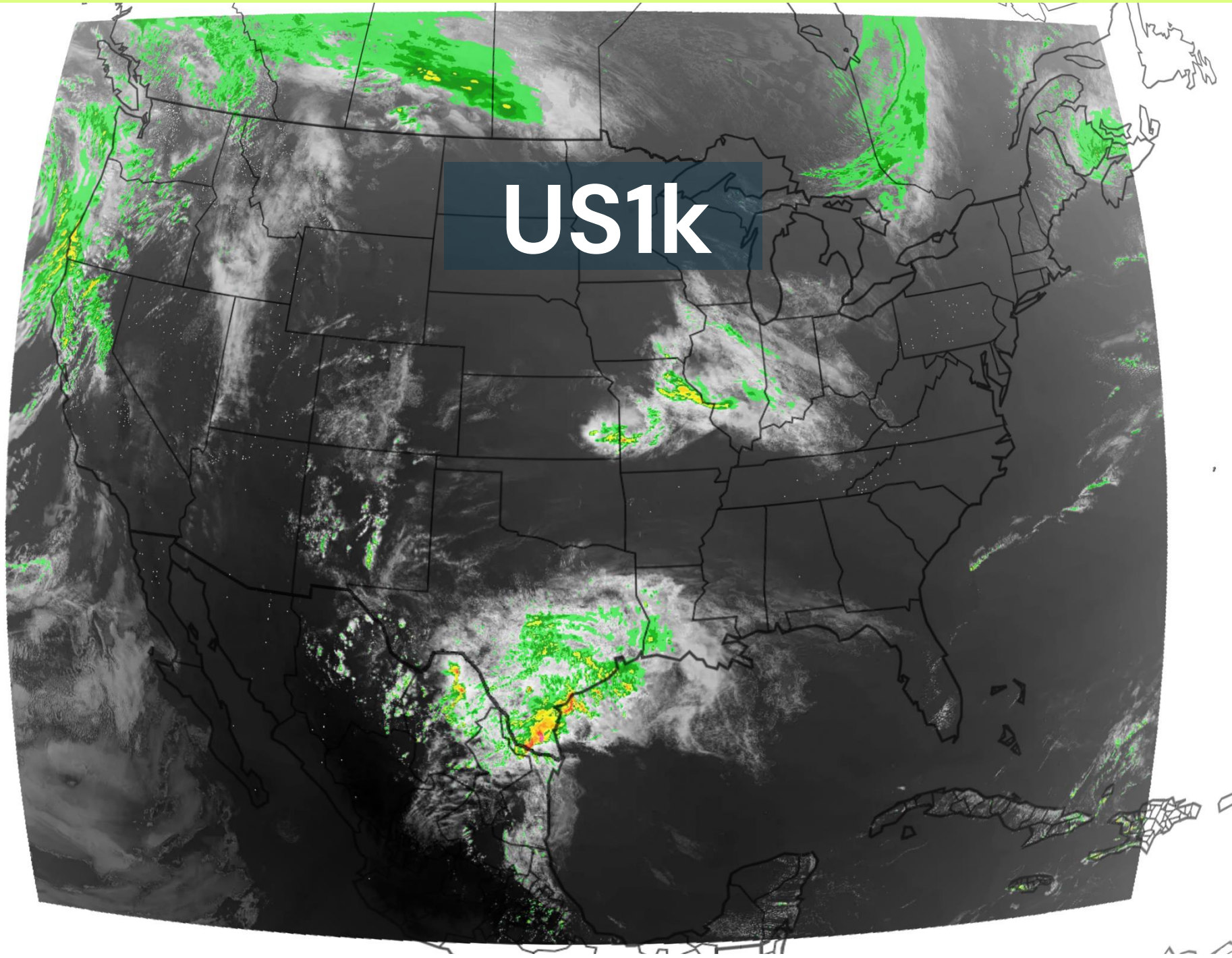

US1k | Thu 26/09/2024 13:00 UTC
High-Resolution
Launched April 2025
Rapid-Refresh
US1k

1 km Resolution

Hourly Updates

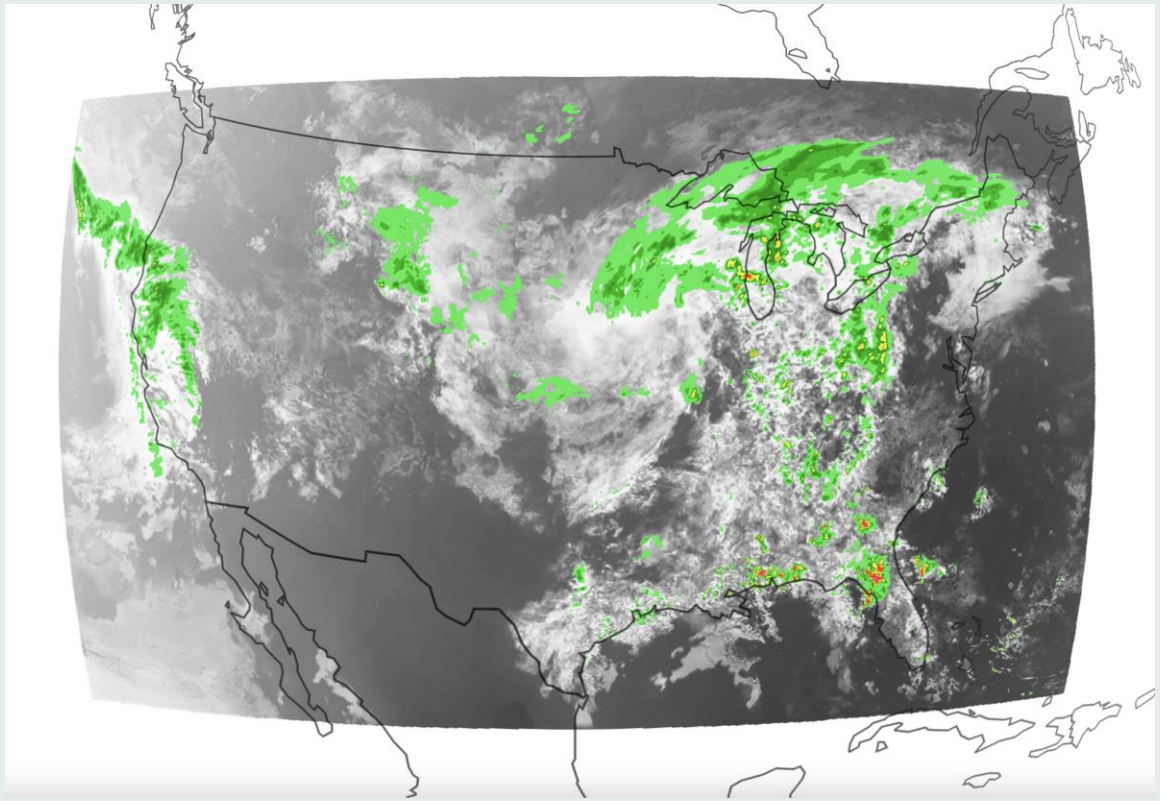
+48 h Lead time

15 min Resolution



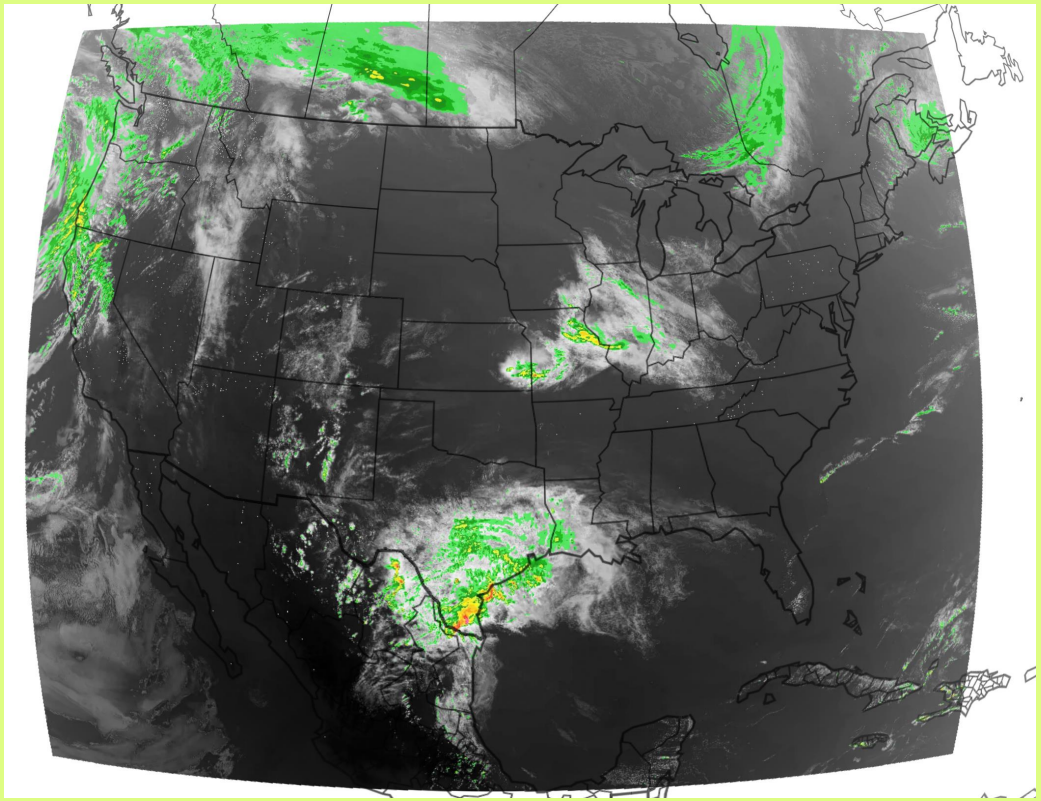
Spatial resolution

HRRR: 3 km



Vertical levels: 50

US1k: 1 km



Vertical levels: 80

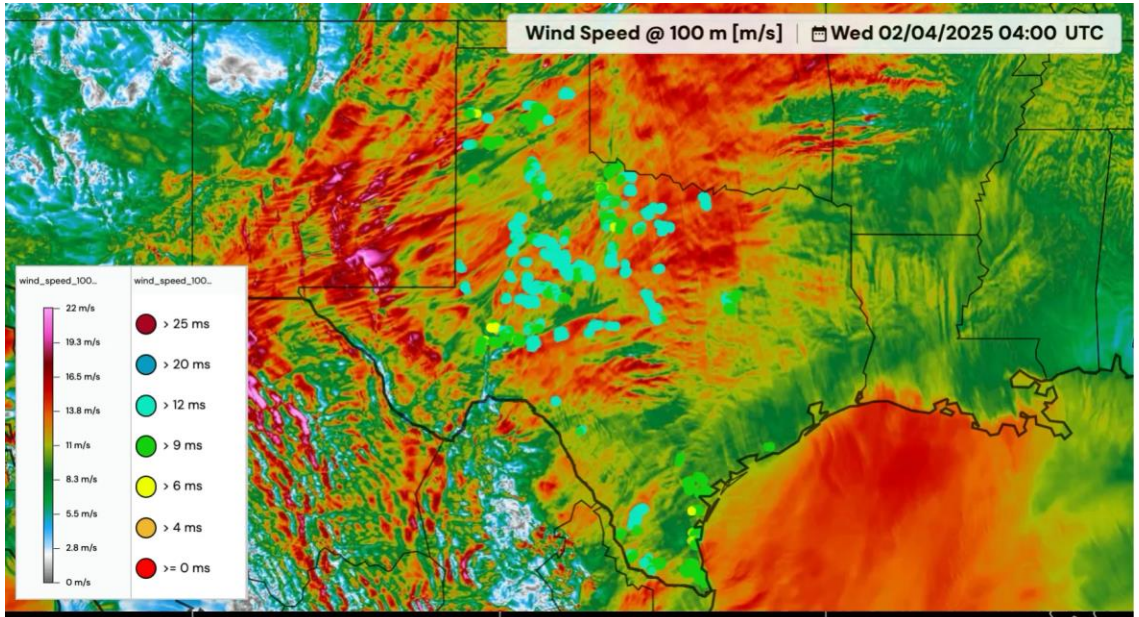
Temporal resolution

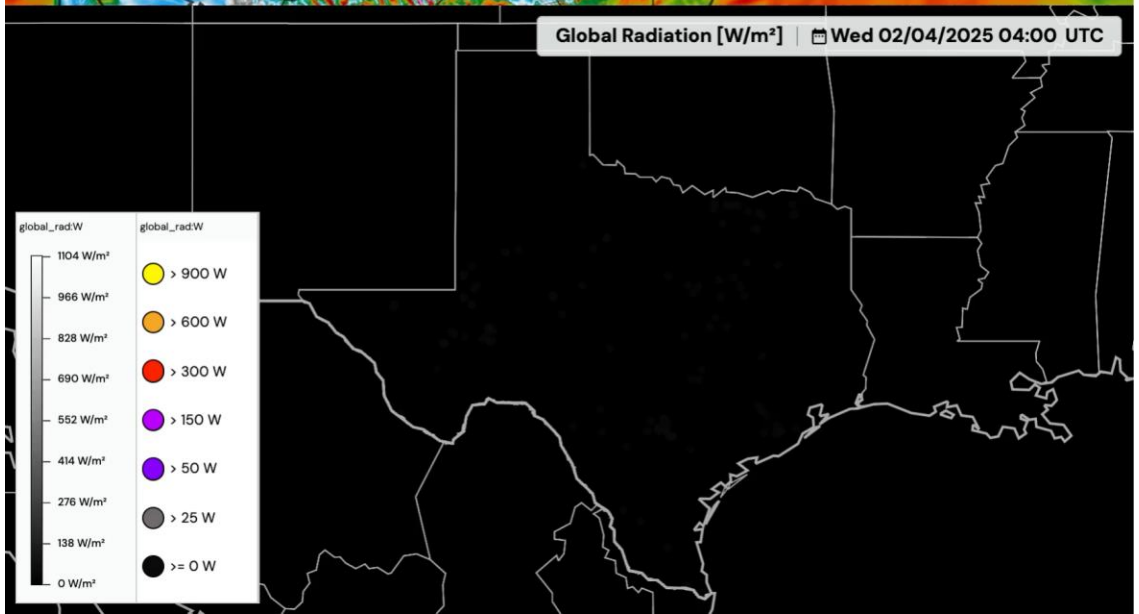
HRRR	US1k
Lead time	
48 h (00/06/12/18 UTC)	48 h (00/06/12/18 UTC)
18 h (01/02/ … /22/23 UTC)	27 h (01/02/ … /22/23 UTC)
Native temporal resolution	
15 min (first 24 hours or a set of parameters)	15 min (all parameters & lead times)
1 h (remaining lead times and parameters)	
Availability	
2:00 h (48 h runs) / 1:25 – 1:45 h (18 h runs)	2:10 h (48 h runs) / 1:47 h (27 h runs) 1:39 h (all runs: first 24 h)

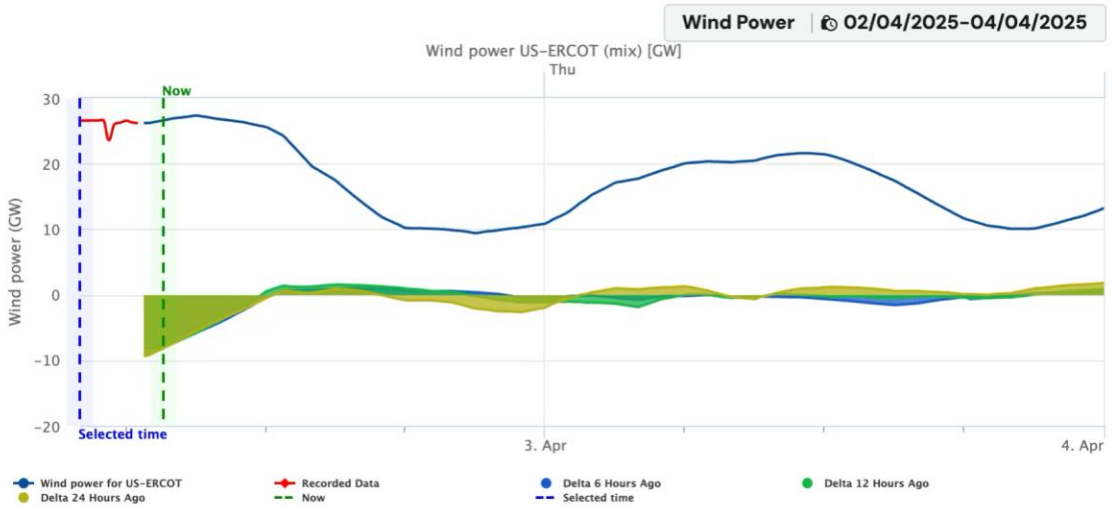
Hourly model updates with 15 min resolution

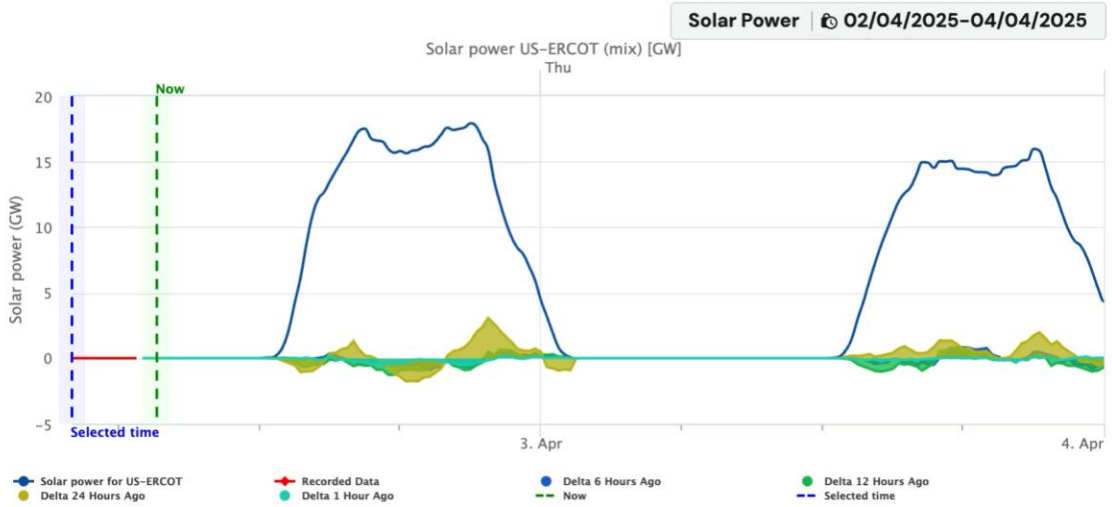
First 24 hours of lead time with a latency of 1.6 hours

High-Resolution Power Forecast for ERCOT Region









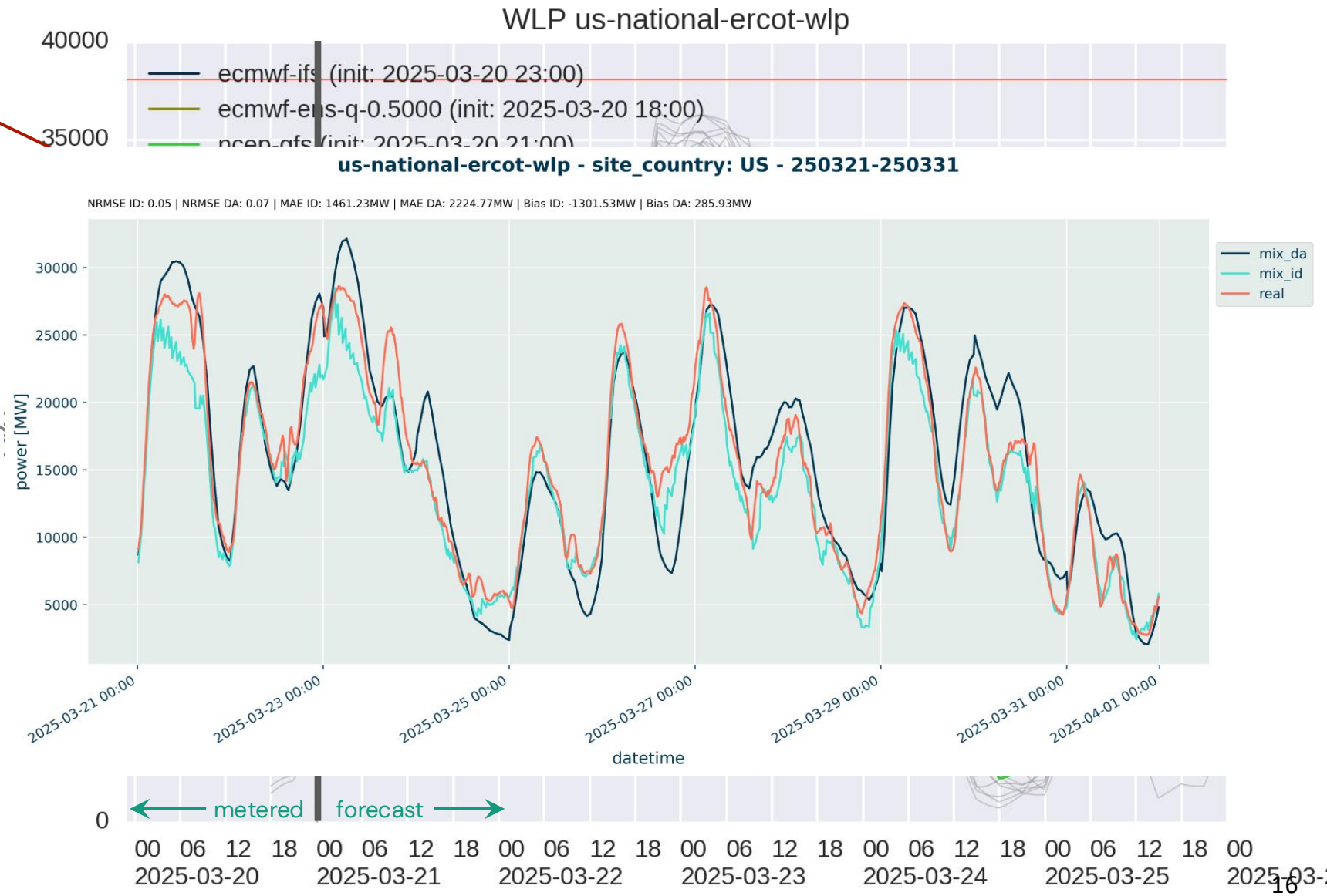
High-Resolution Power Forecast for ERCOT Region

Power MIX: model blend

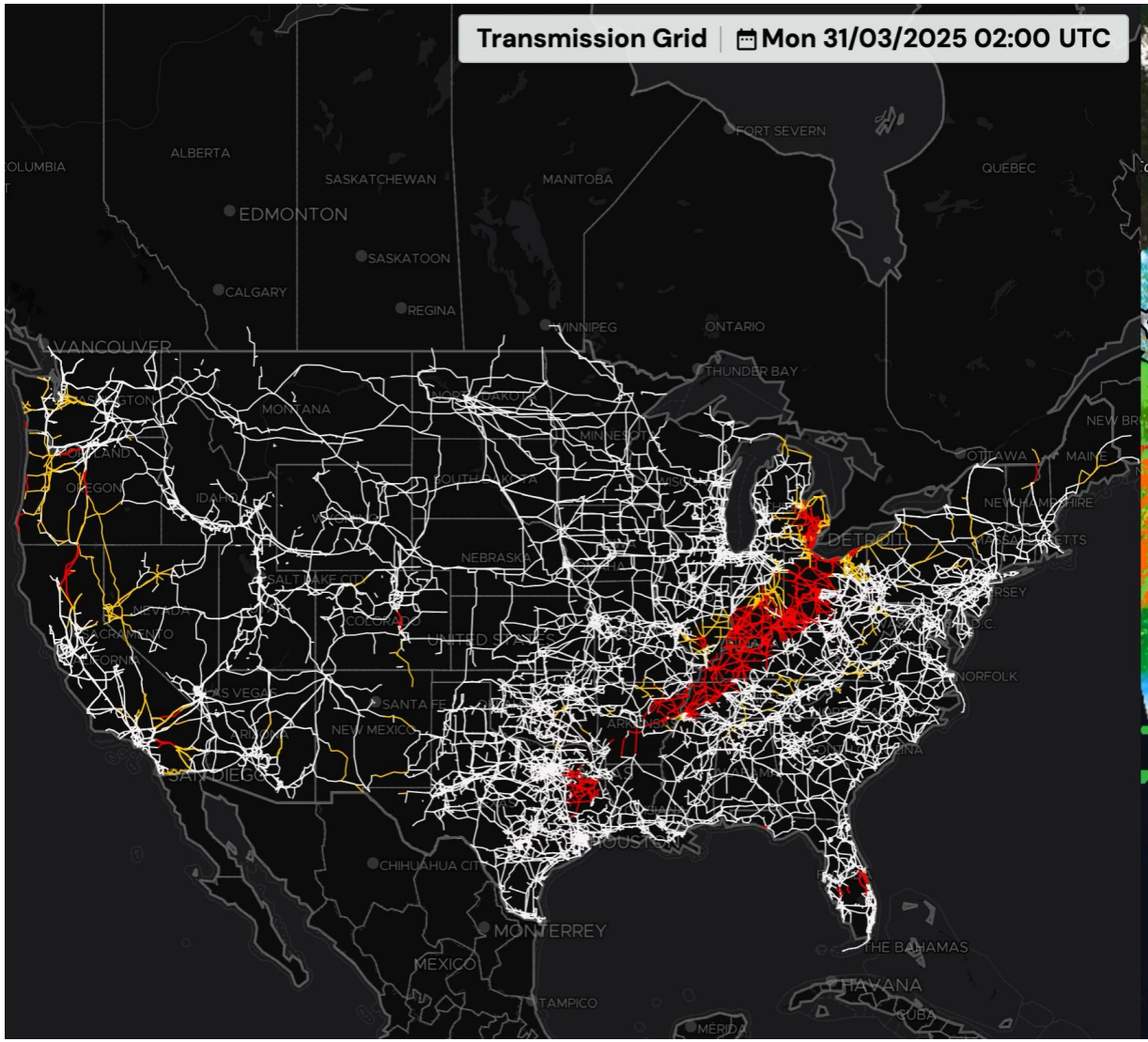
updated every 15 minutes

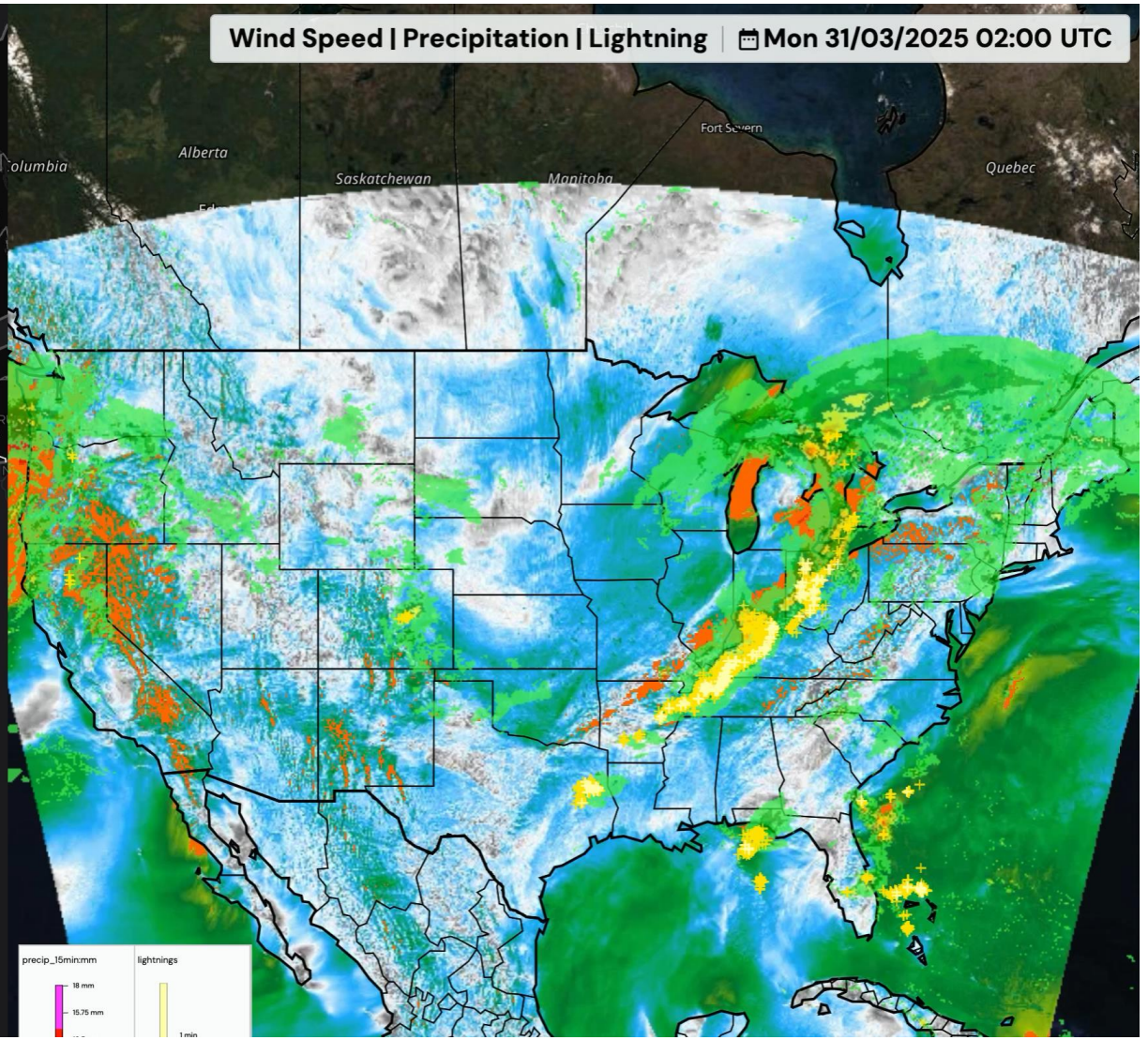
ECMWF Ensembles

lead time: 15 days

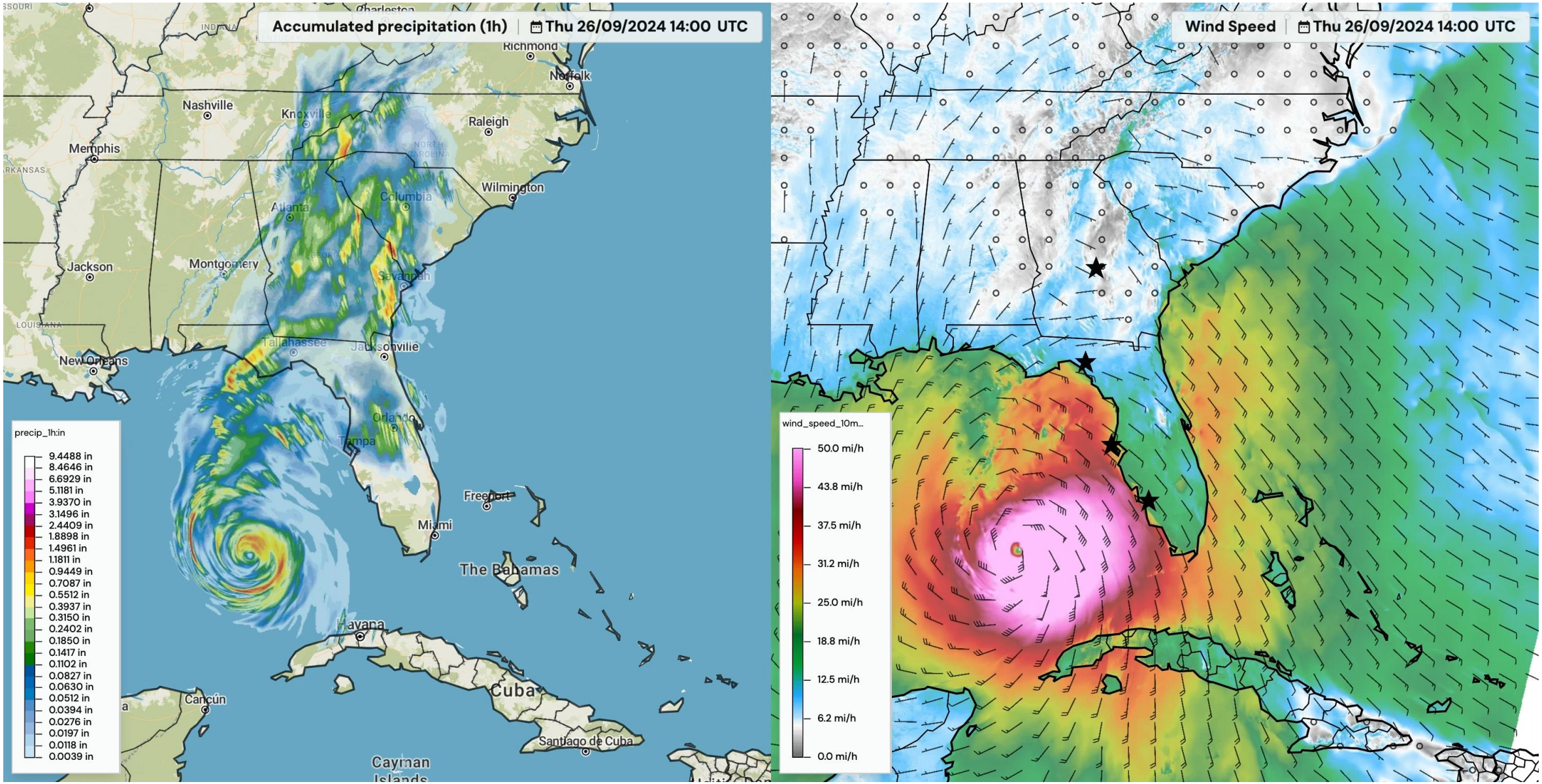


Grid Operations: Security & Stability

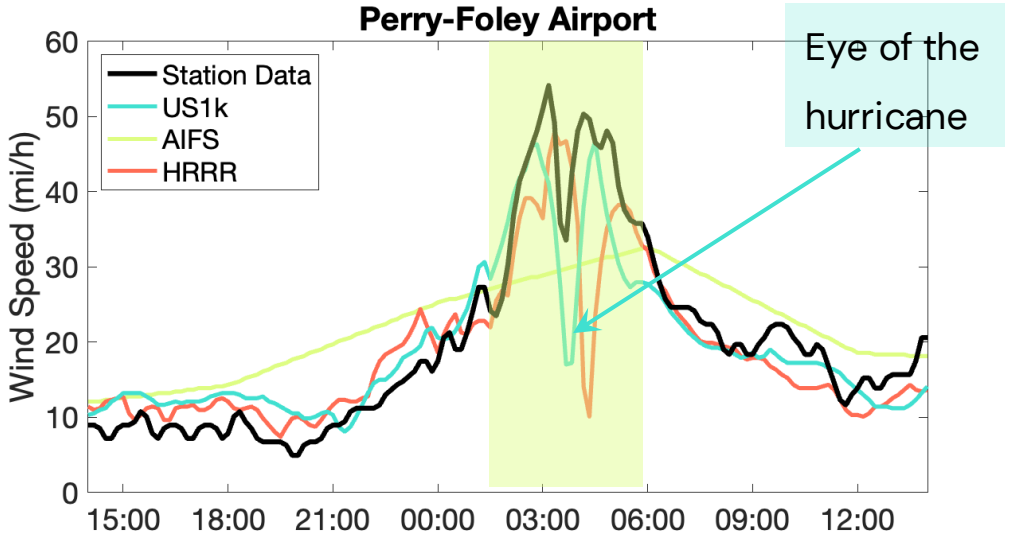


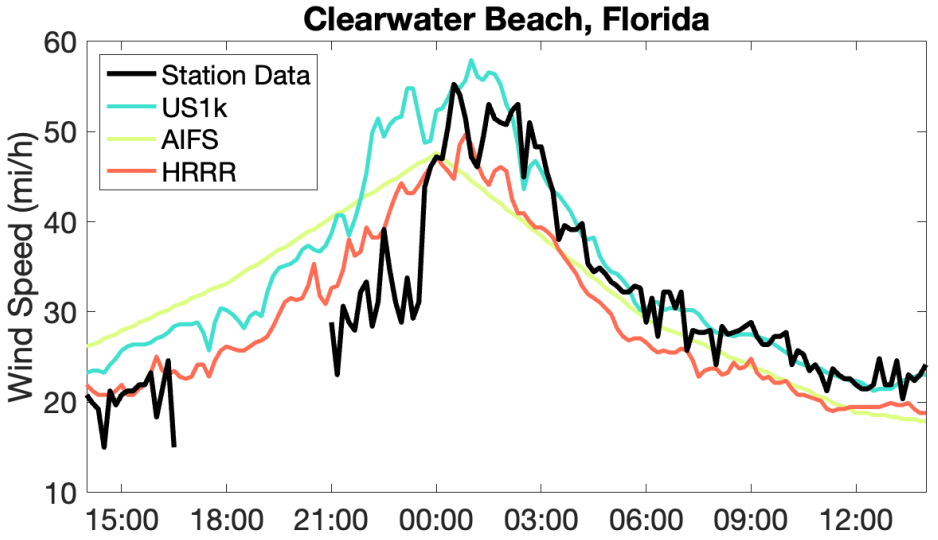


Forecasting Hurricane Helene with US1k

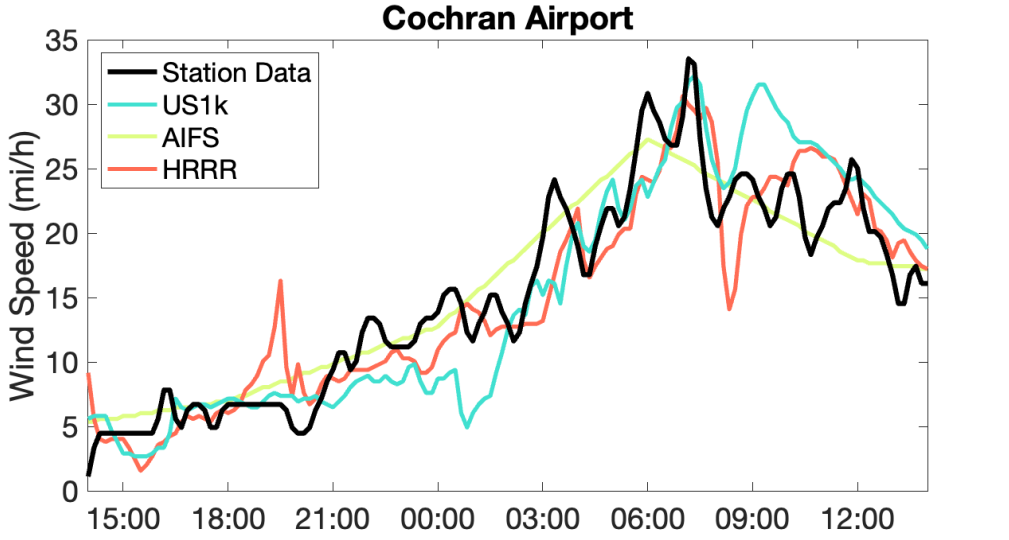


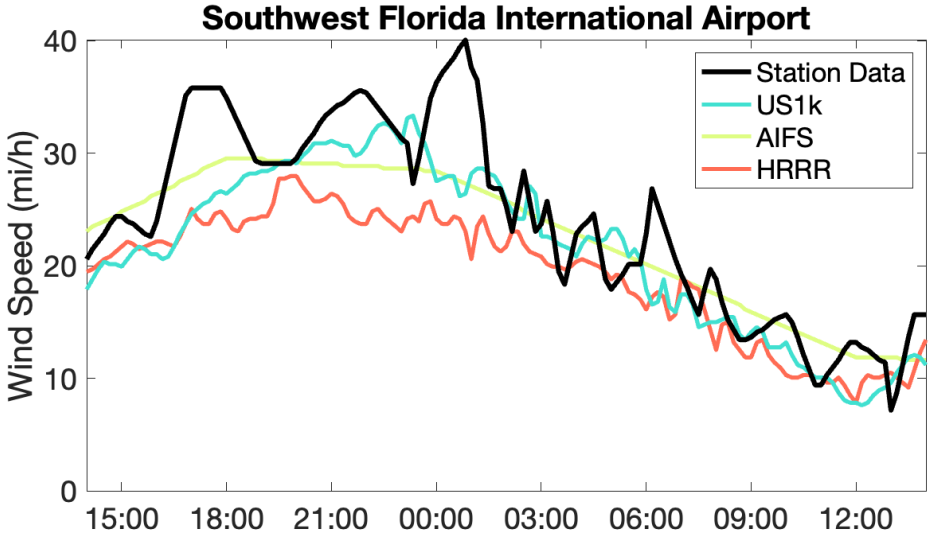
Forecasting Hurricane Helene with US1k





US1k RMSE: 5.3 (mph)
AIFS RMSE: 6 (mph)
HRRR RMSE: 5.6 (mph)



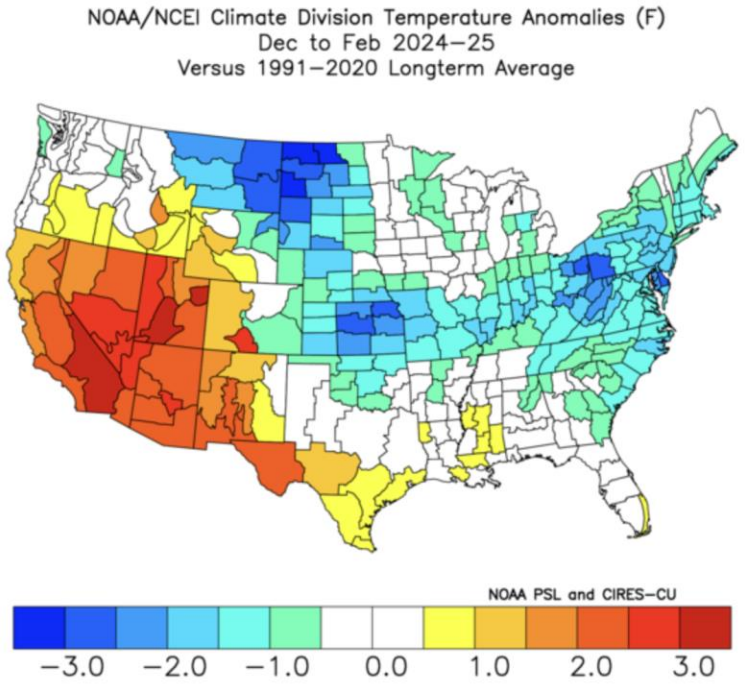


US1k forecasted wind speeds (10 m) during Hurricane Helene more accurately than HRRR and AIFS at these station locations.

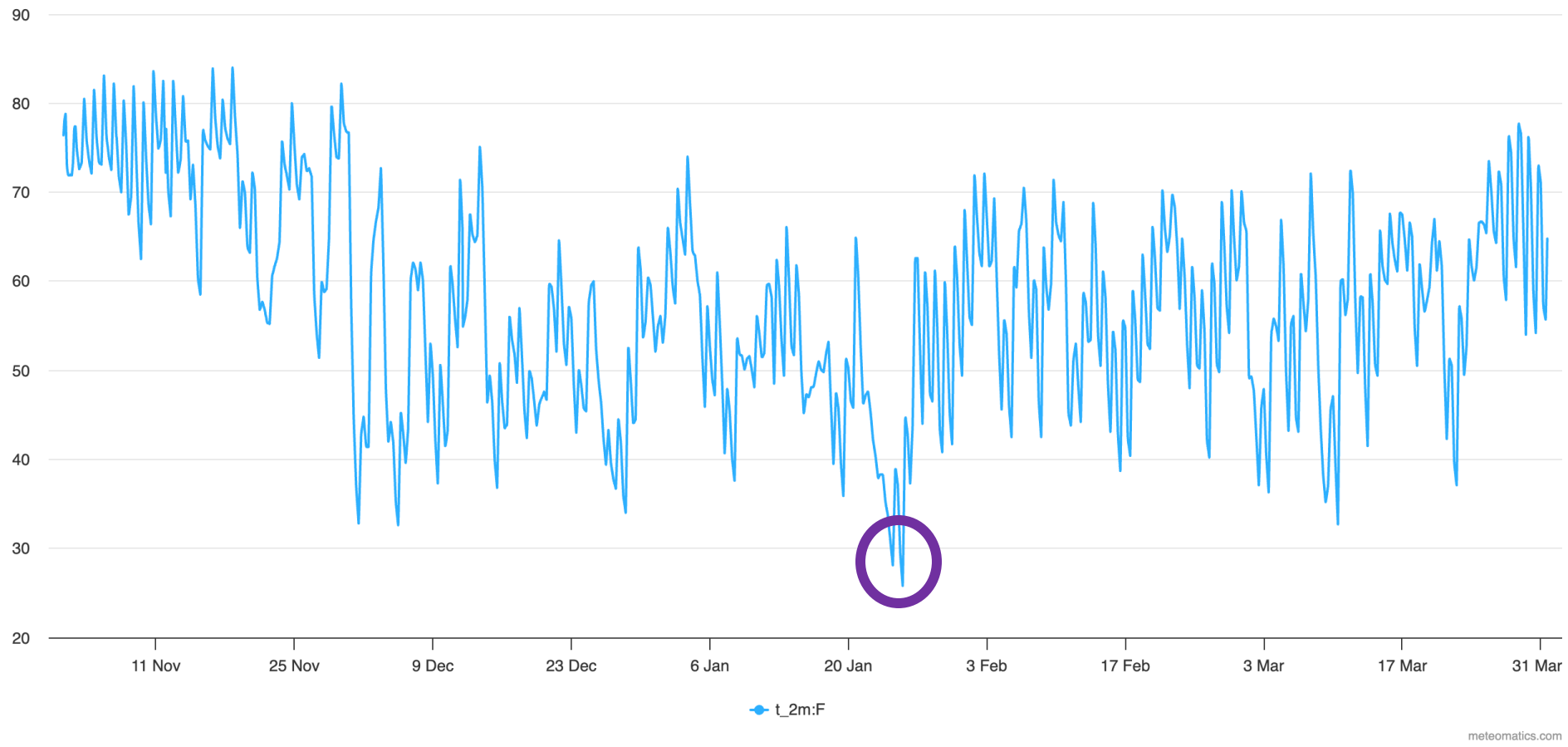
Heating Season 2024-25

Heating Season Summary

1. October forecasts were warm South and East
2. Weak La Nina arrived later than forecast
3. Volatility captured, including mid-January cold

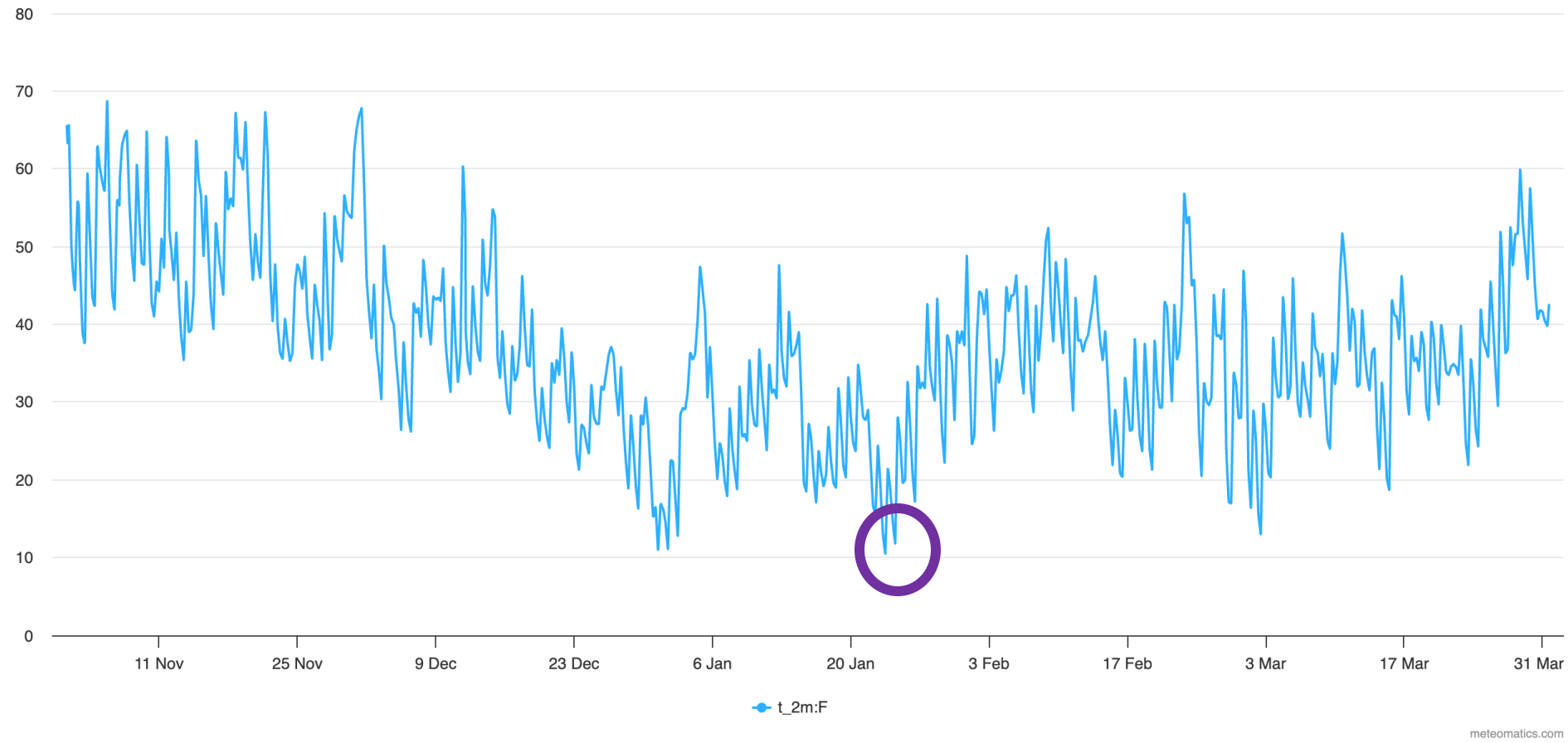


Risk to Temperatures – Houston



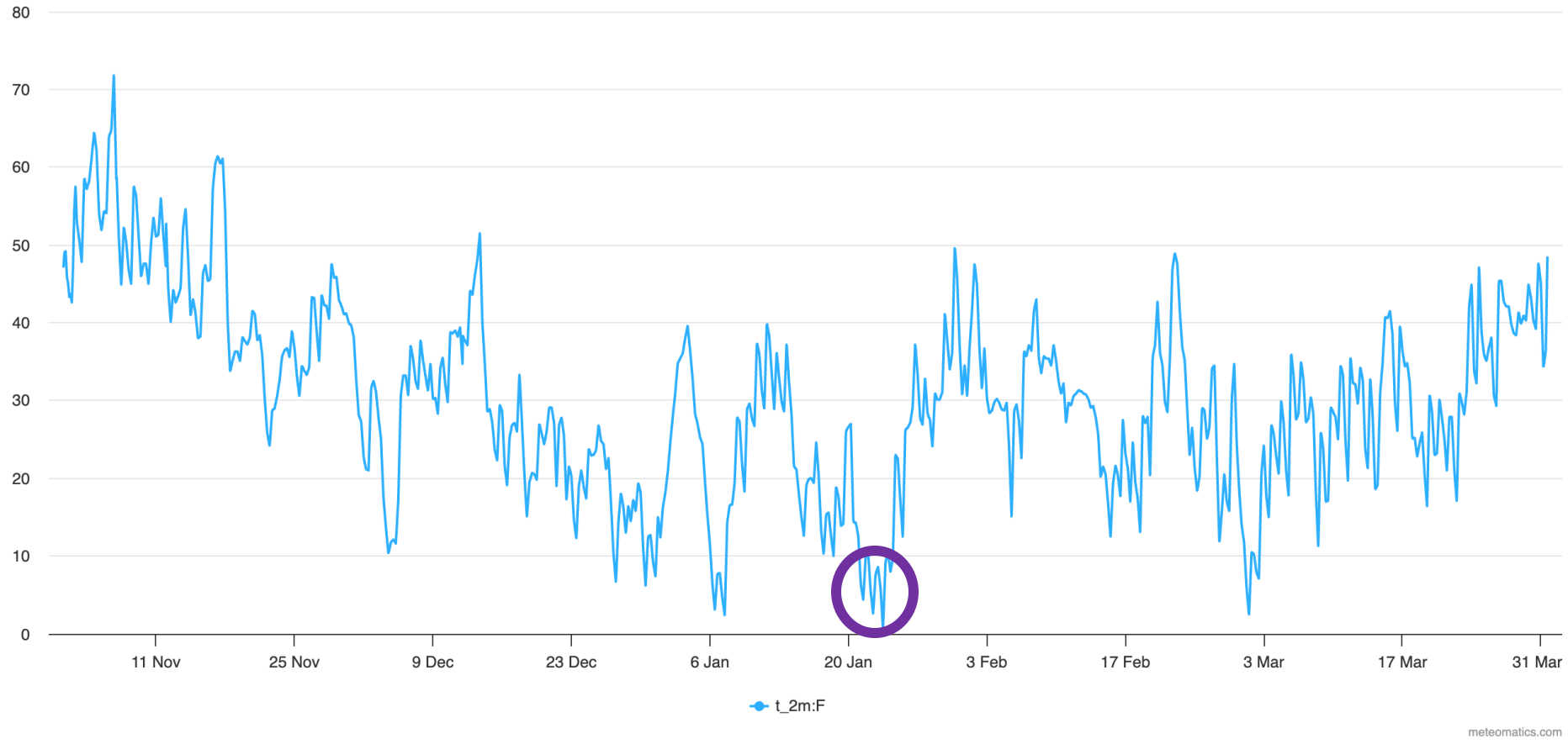
➡ Forecast updated: 28 October

Risk to Temperatures – New York



➡ Forecast updated: 28 October

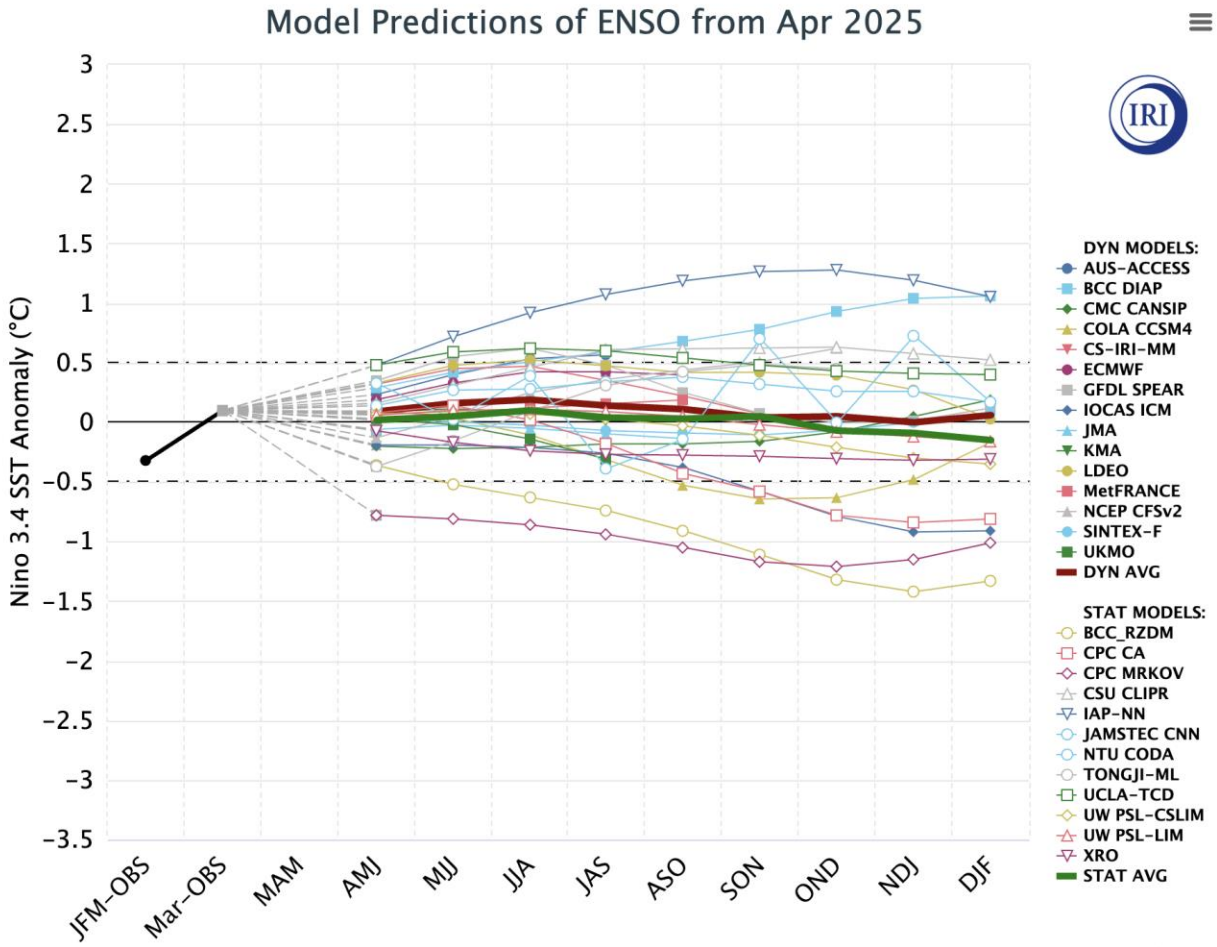
Risk to Temperatures – Chicago



➡ Forecast updated: 28 October

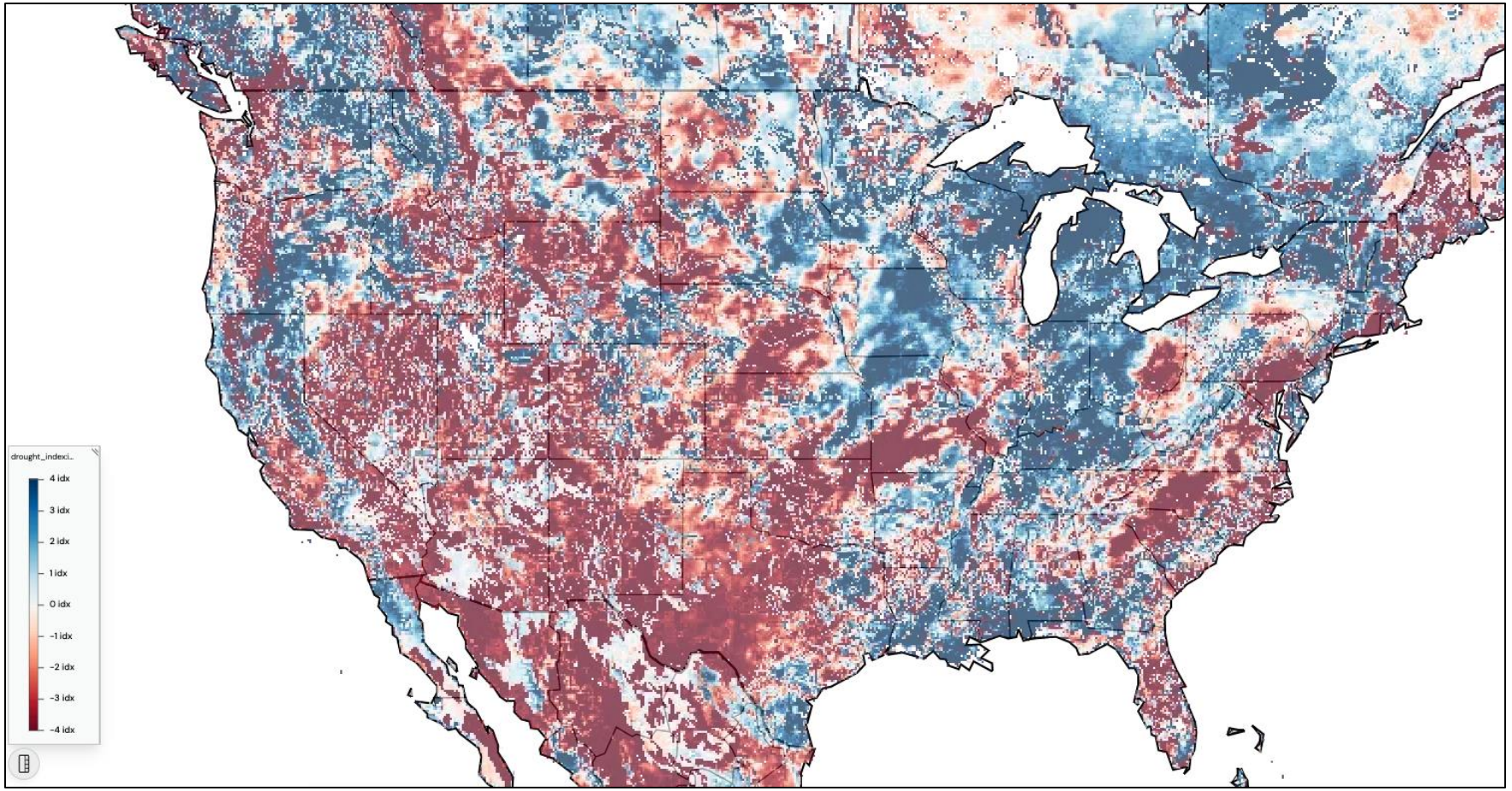
Cooling Season Forecast

Status of Central Pacific



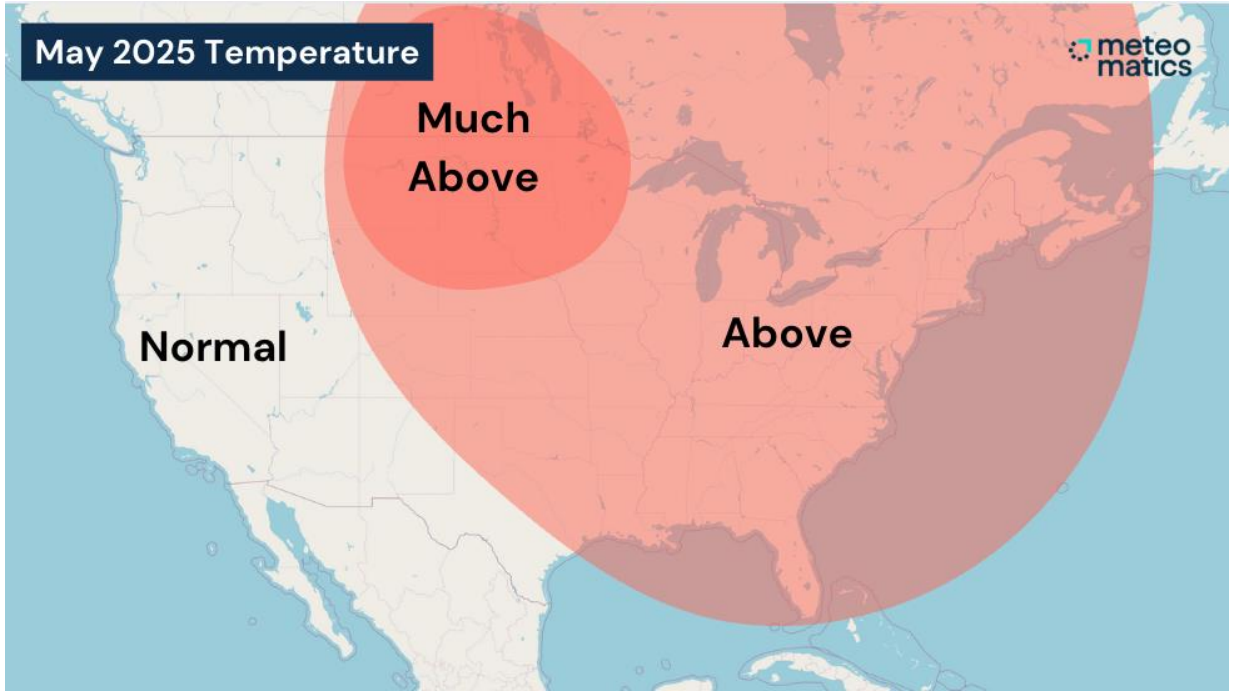
➡ Summary: ENSO Neutral

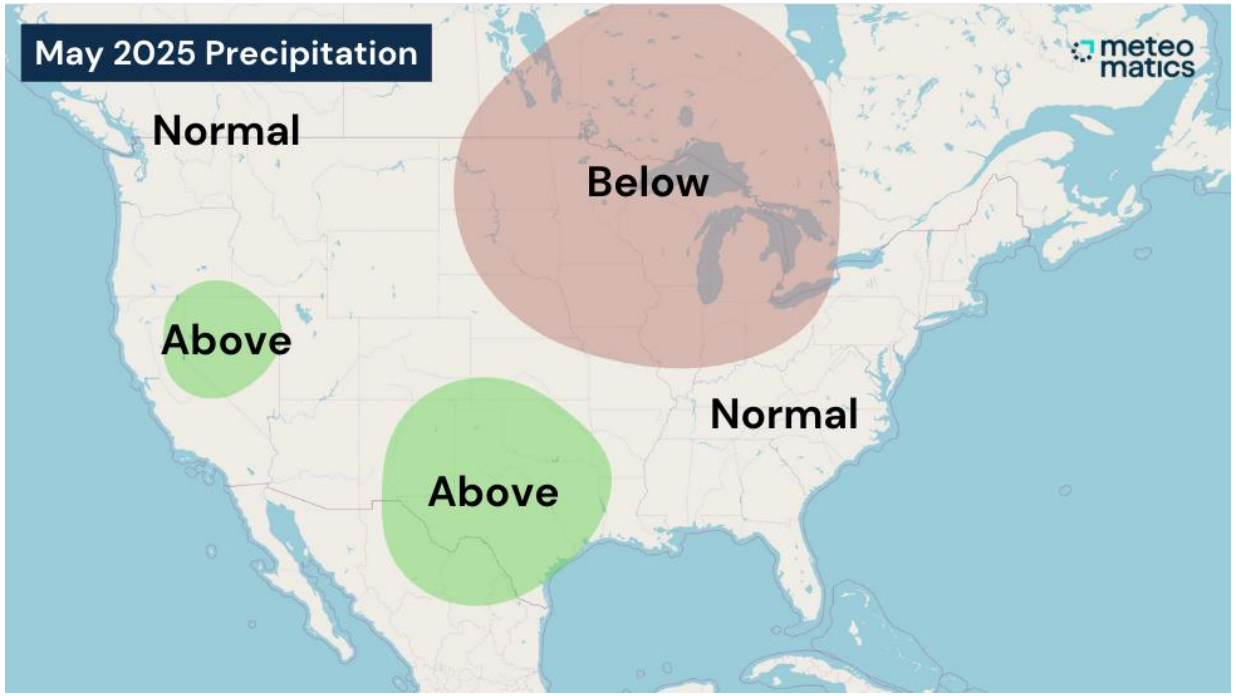
Drought Update



- Summary: SPP, ERCOT and eastern PJM will be monitored

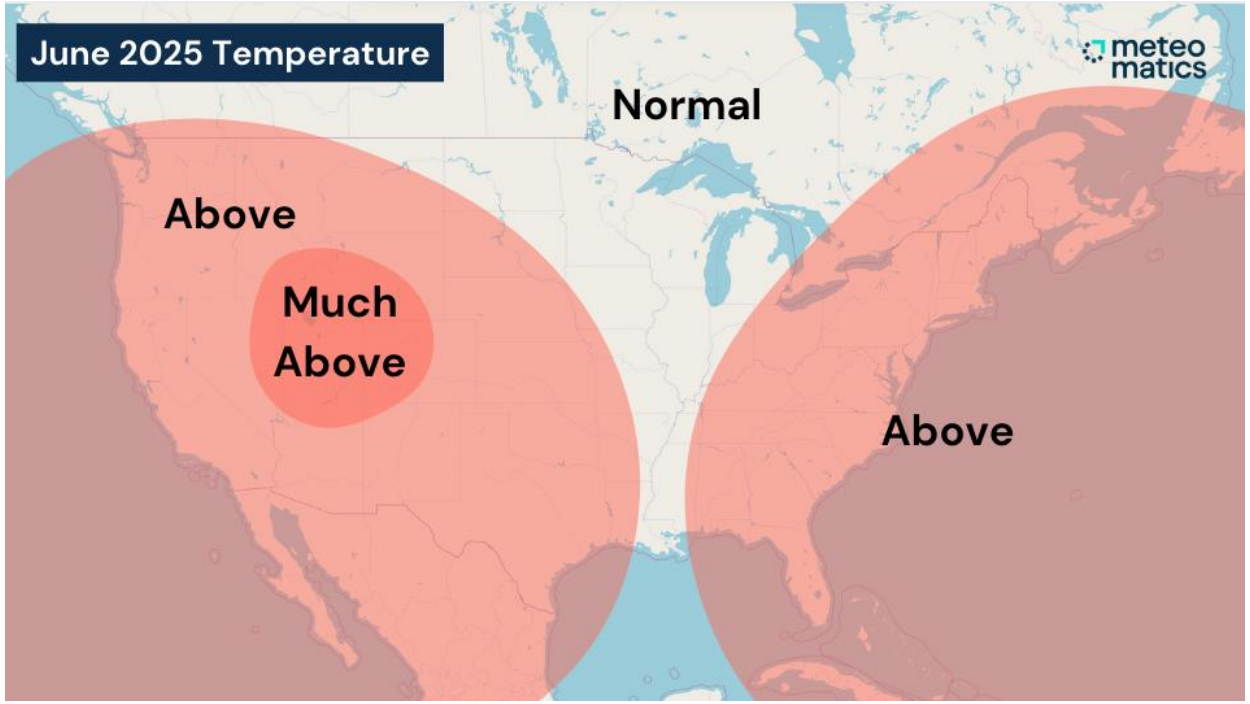
May 2025

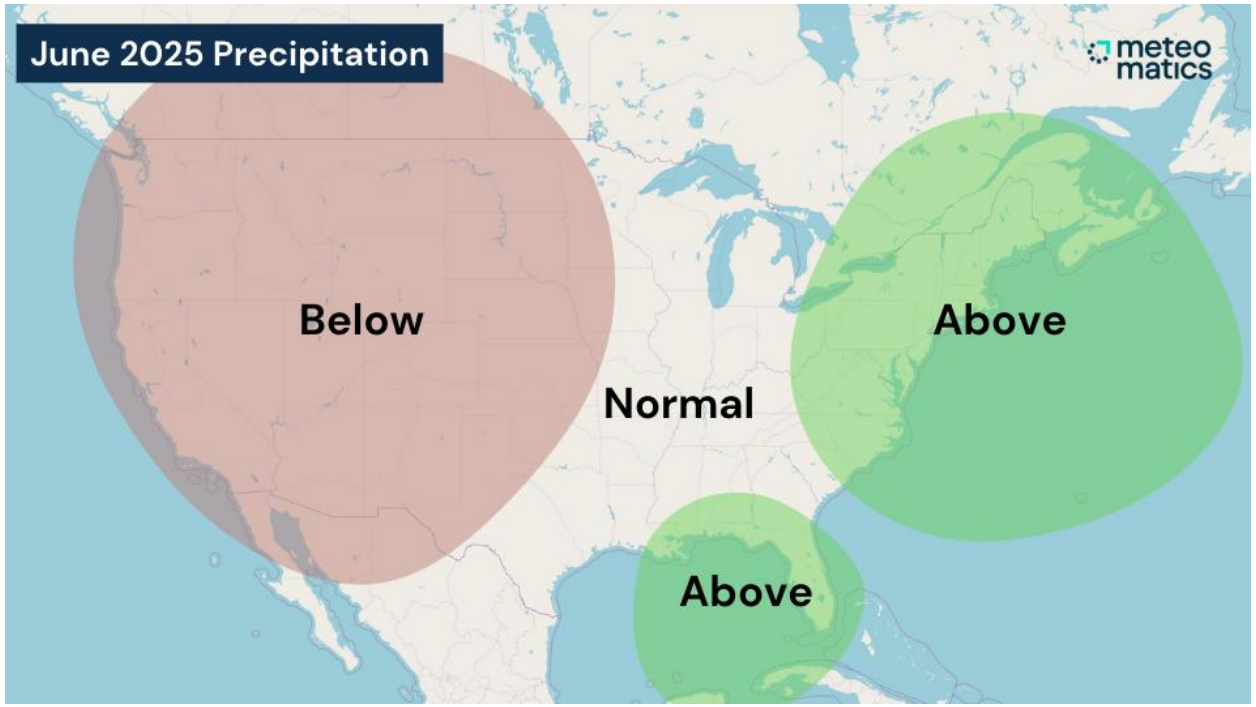




- Risk: Drier in Midwest
- Risk: Warmer in western PJM and MISO
- Summary: Slow, gradual run-off season in PacNW

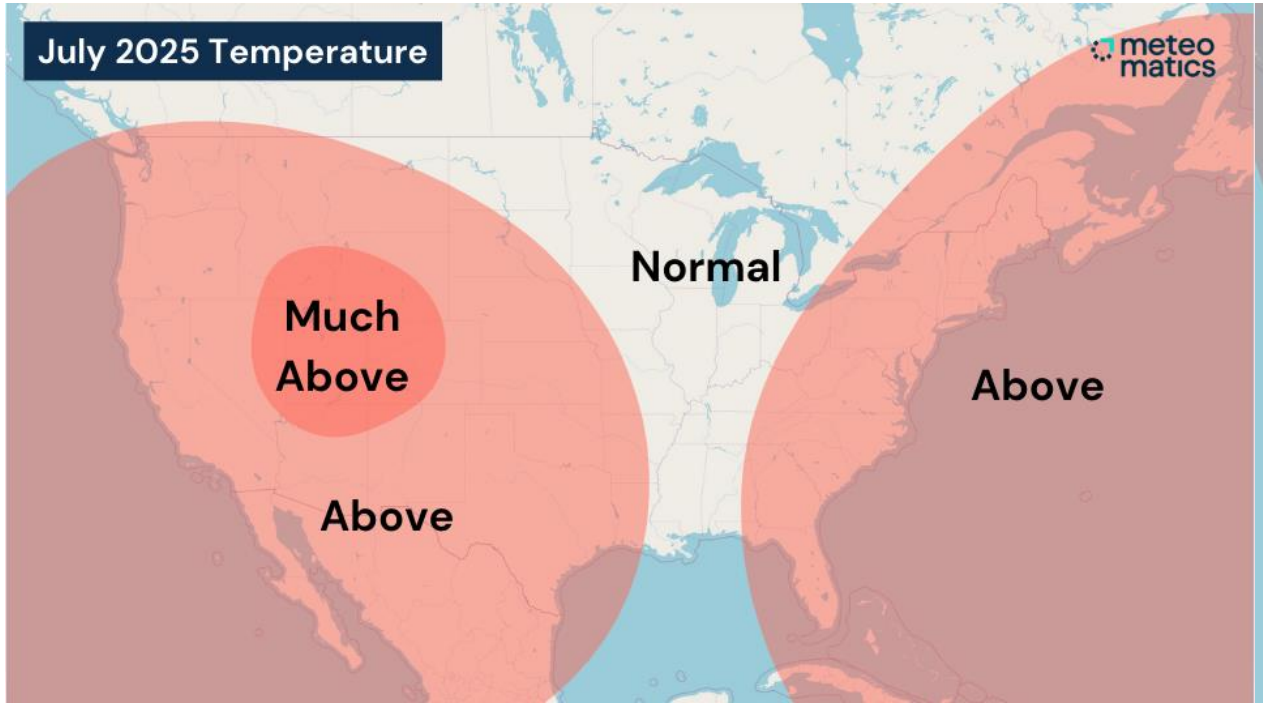
June 2025

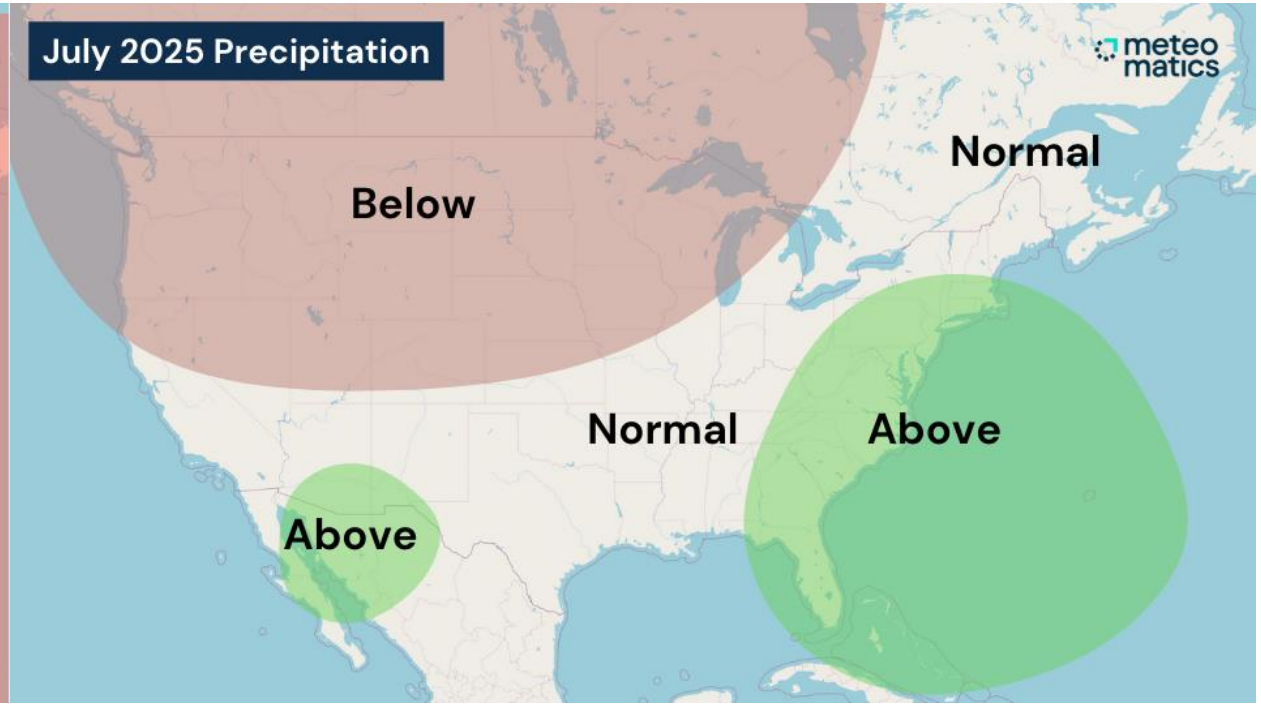




- Risk: Warmer in ERCOT
- Risk: Wetter in Southwest with faster monsoon onset
- Summary: Humidity/rain in eastern PJM could impact load

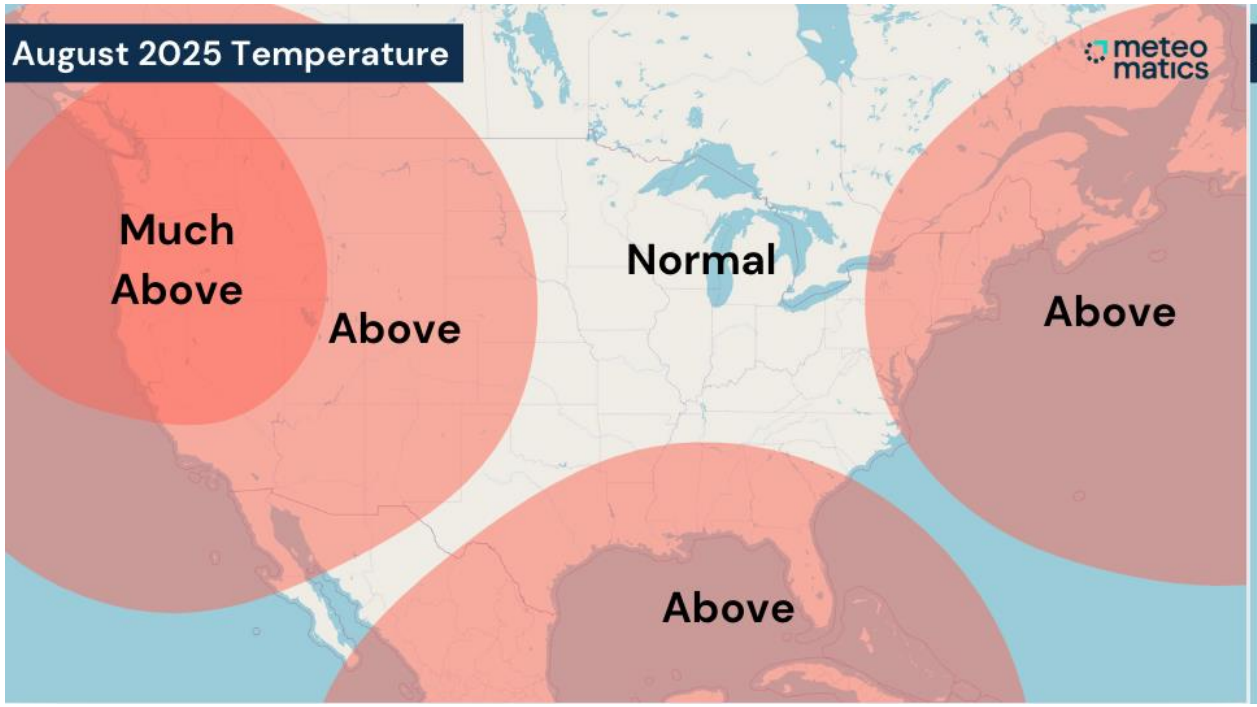
July 2025

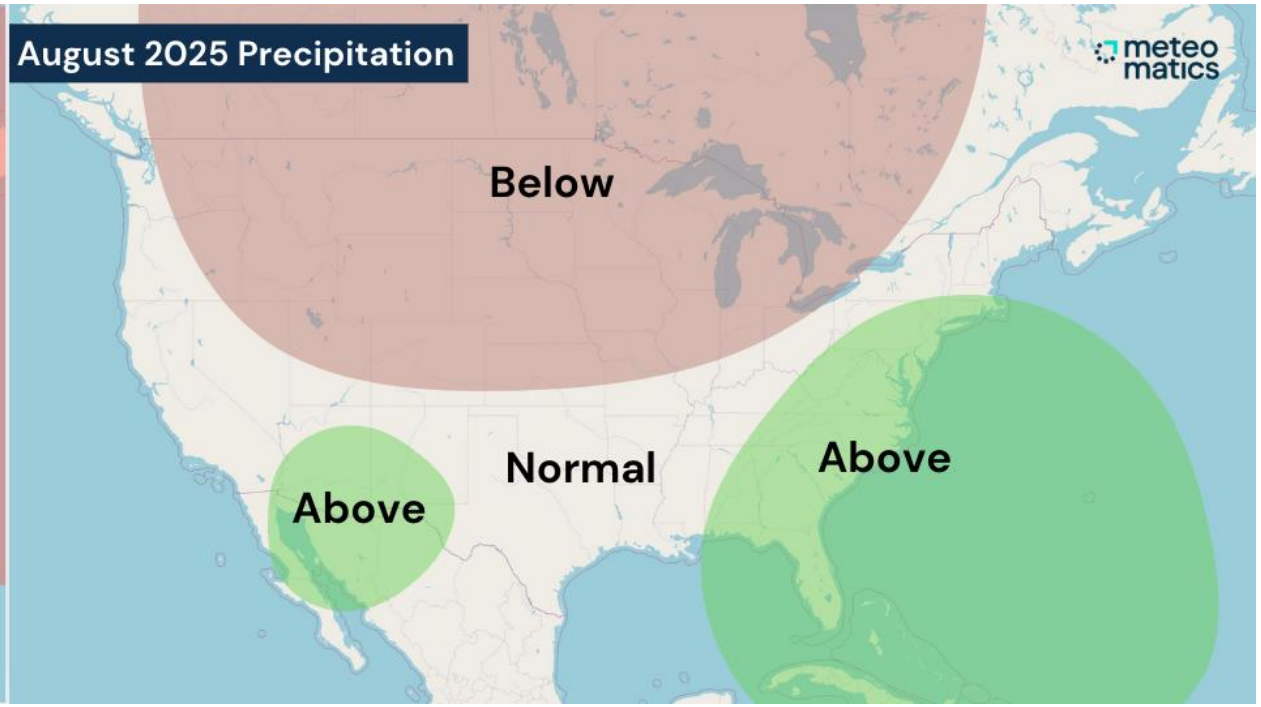




- Risk: Warmer in ERCOT and western PJM
- Risk: Drier in ERCOT
- Summary: Humidity/rain in eastern PJM could impact load

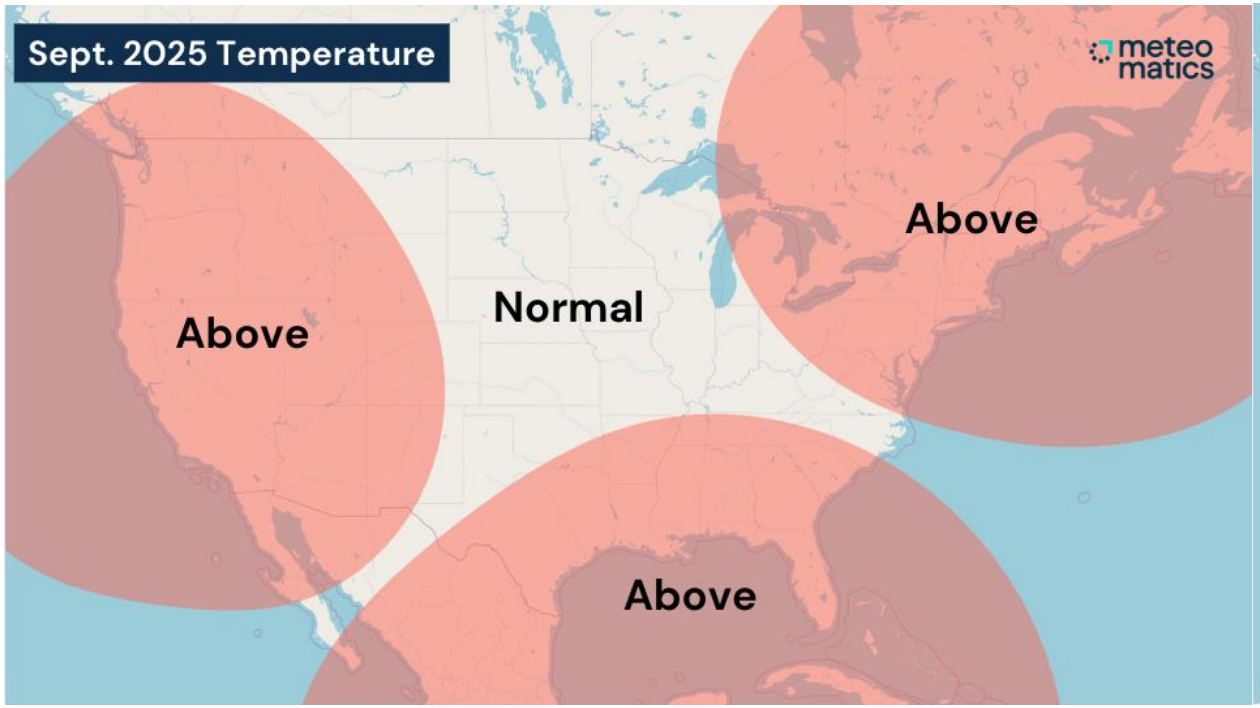
August 2025

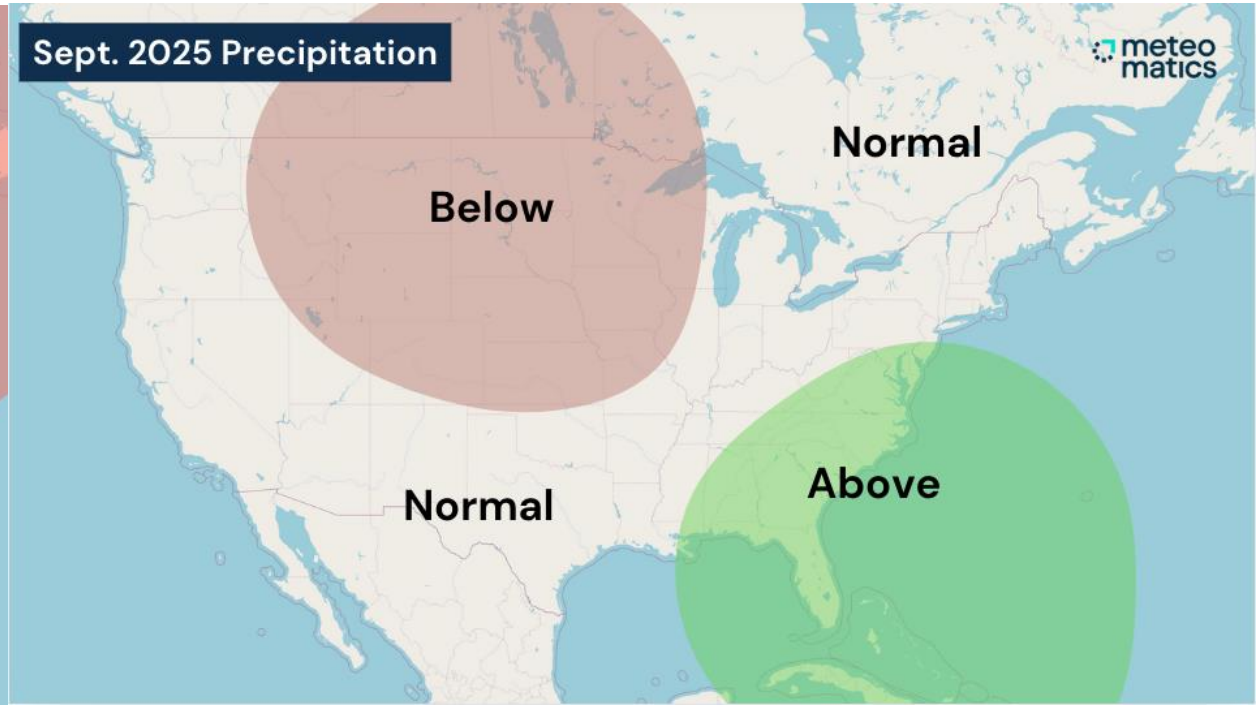




- Risk: Warmer western PJM
- Summary: Humidity/rain in eastern PJM could impact load

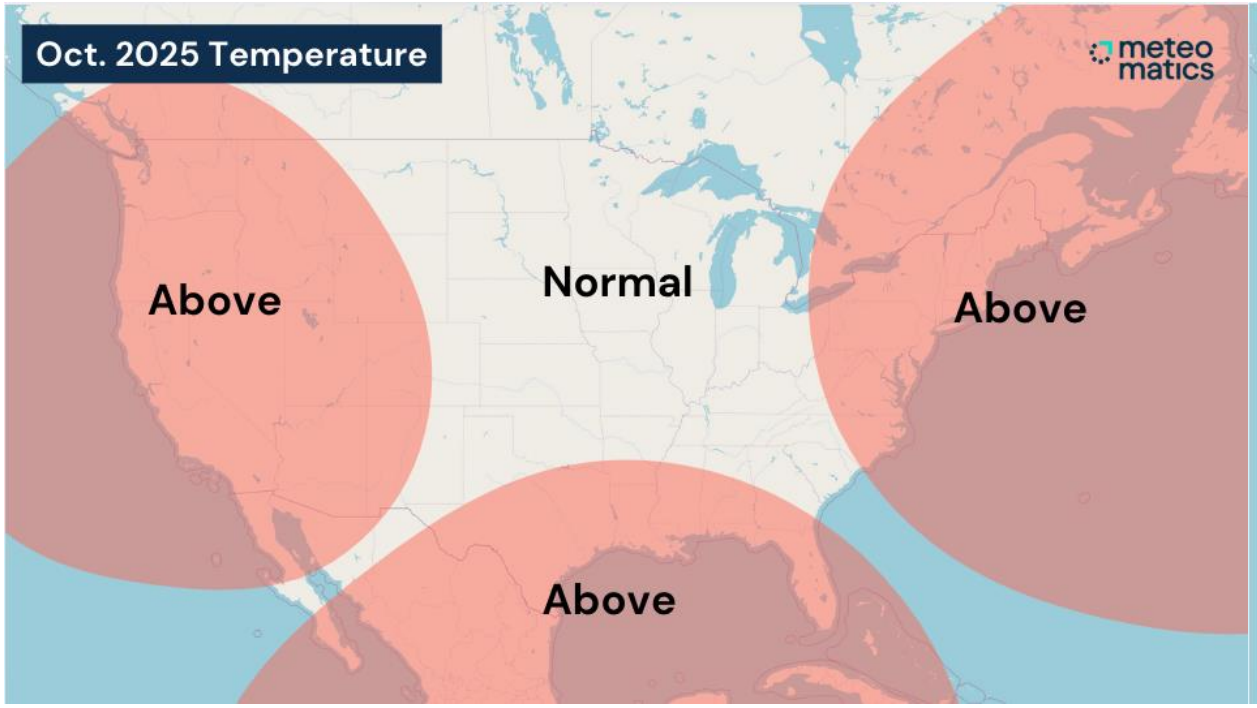
September 2025

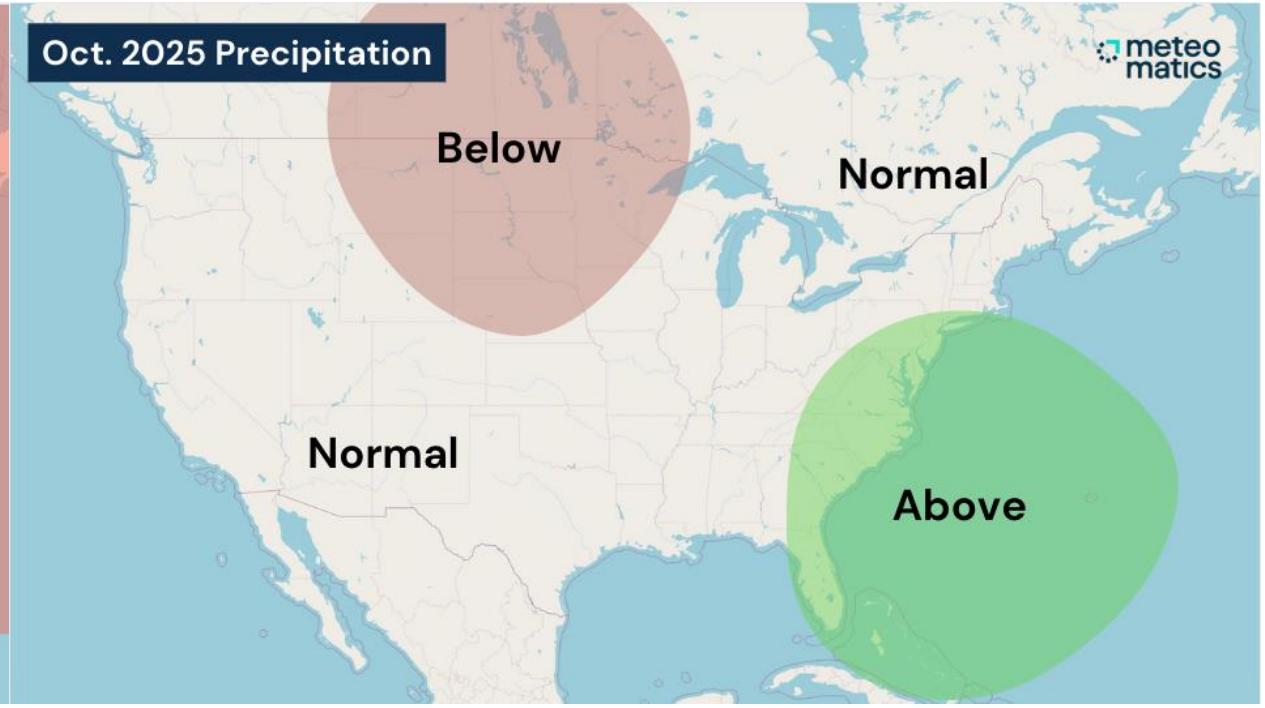




- Risk: Warmer in ISO-NE
- Summary: Southeast and eastern Gulf watching tropics

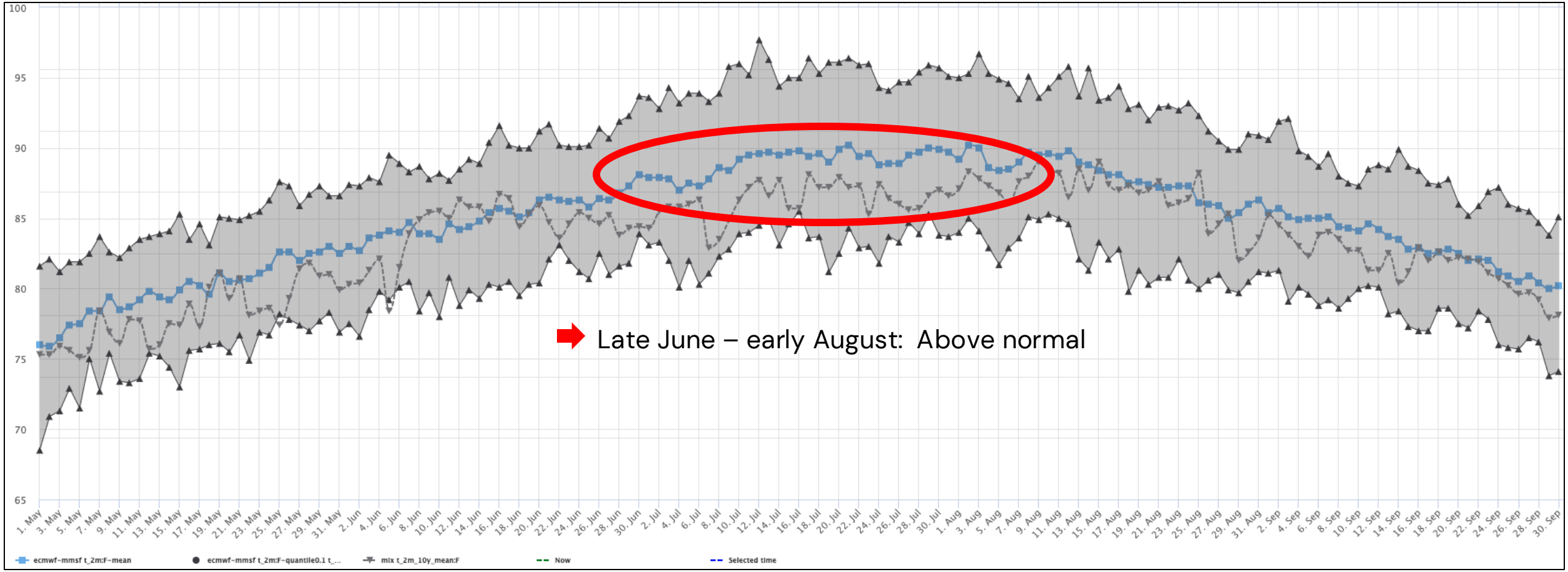
October 2025





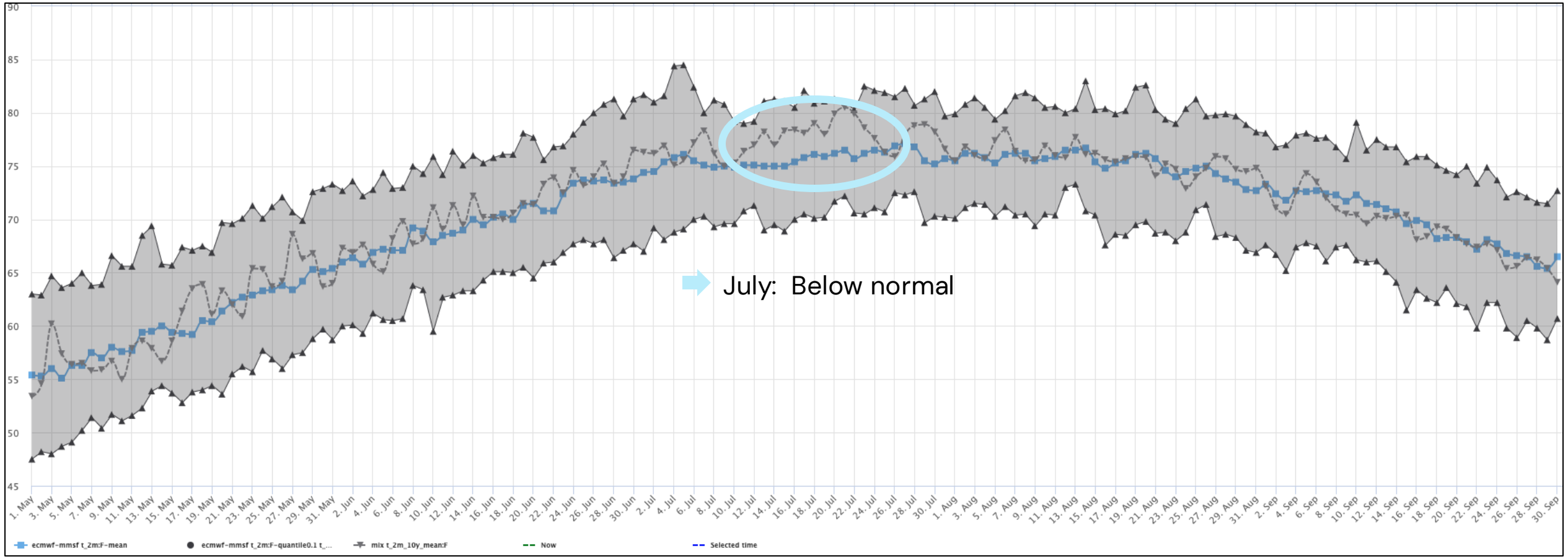
- Risk: Warmer in NYISO and ISO-NE
- Summary: Overall seasonal to warm

Risk to Temperatures – Houston



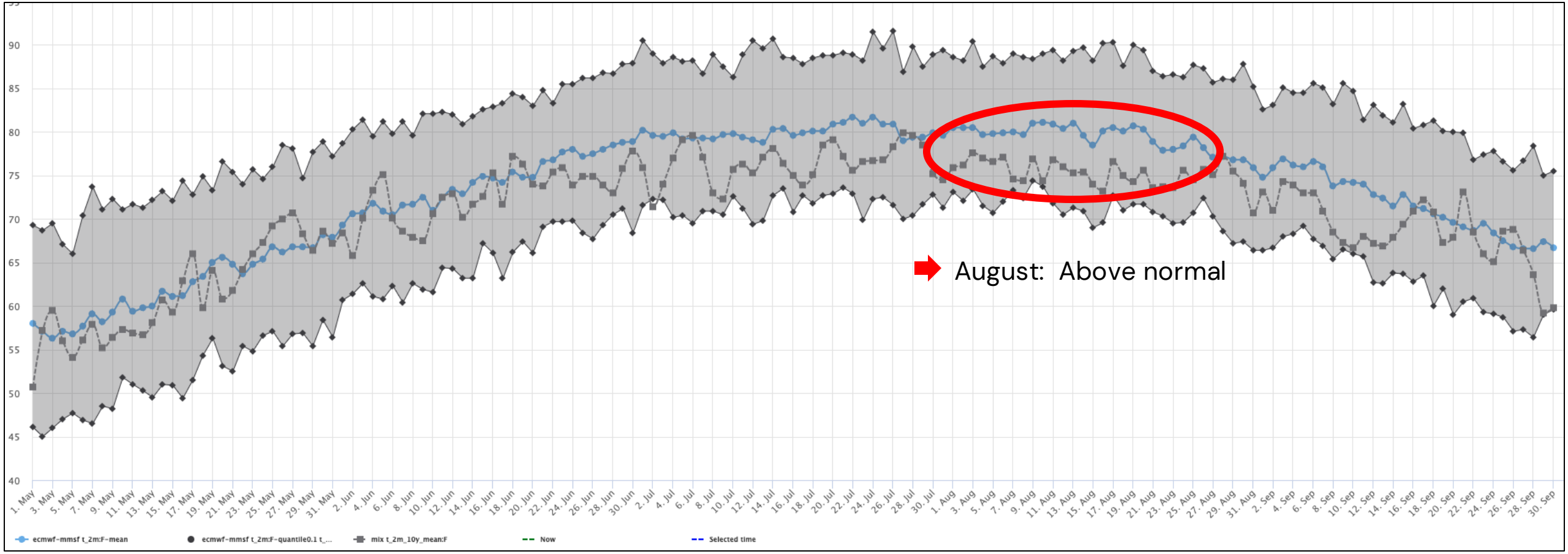
10th–90th quantile 10-year average Ensemble Mean

Risk to Temperatures – New York



10th–90th quantile 10-year average Ensemble Mean

Risk to Temperatures – Chicago



10th–90th quantile 10-year average Ensemble Mean

Tropical Outlook

1. Above normal activity with 17 tropical storms, 10 hurricanes and 4 major hurricanes
2. Sea-surface temperatures above normal in Gulf, which could rapidly intensify storms
3. Bermuda ridge set-up favors tracks toward eastern Gulf and Southeast impacts

Summer/Tropics Summary

1. Rather warm across the West, ERCOT and East Coast
2. Risk to be warmer in western PJM
3. Eastern PJM rain could impact load
4. Tropics active, once again, for eastern Gulf and East Coast

Survey Results

Survey Overview

- **Research Objectives:** Report on the use and impact of weather data on operations to serve senior energy industry professionals

n = 100%

- **Sampling Criteria:**

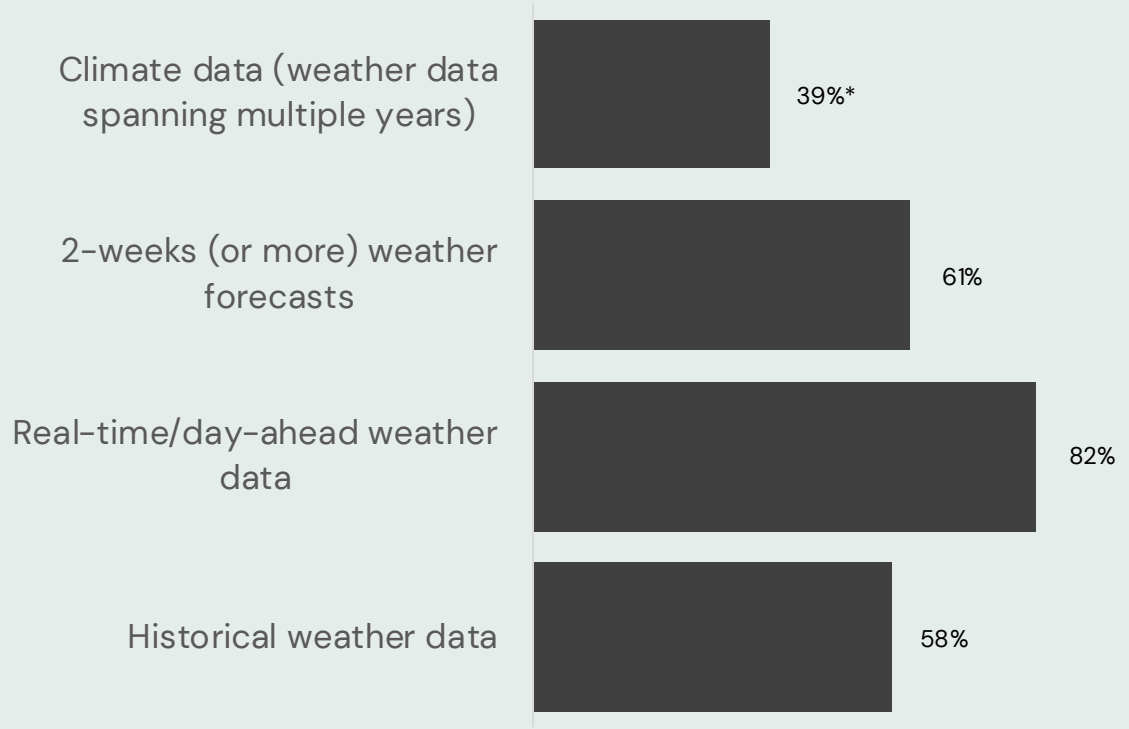
- Senior Position / Decision Maker
- Experienced in Energy Industry
- Works for Large Corporation
- Resides in the US
- Outsources Weather Data
- Employed Full-Time

- **Industries:**

1. Energy Trading — n = 31%
2. Grid Operations — n = 24%
3. Energy Utilities — n = 45%

65% of participants use a mix of in-house and 3rd party tools. Real-time/day-ahead data is used by 82%.

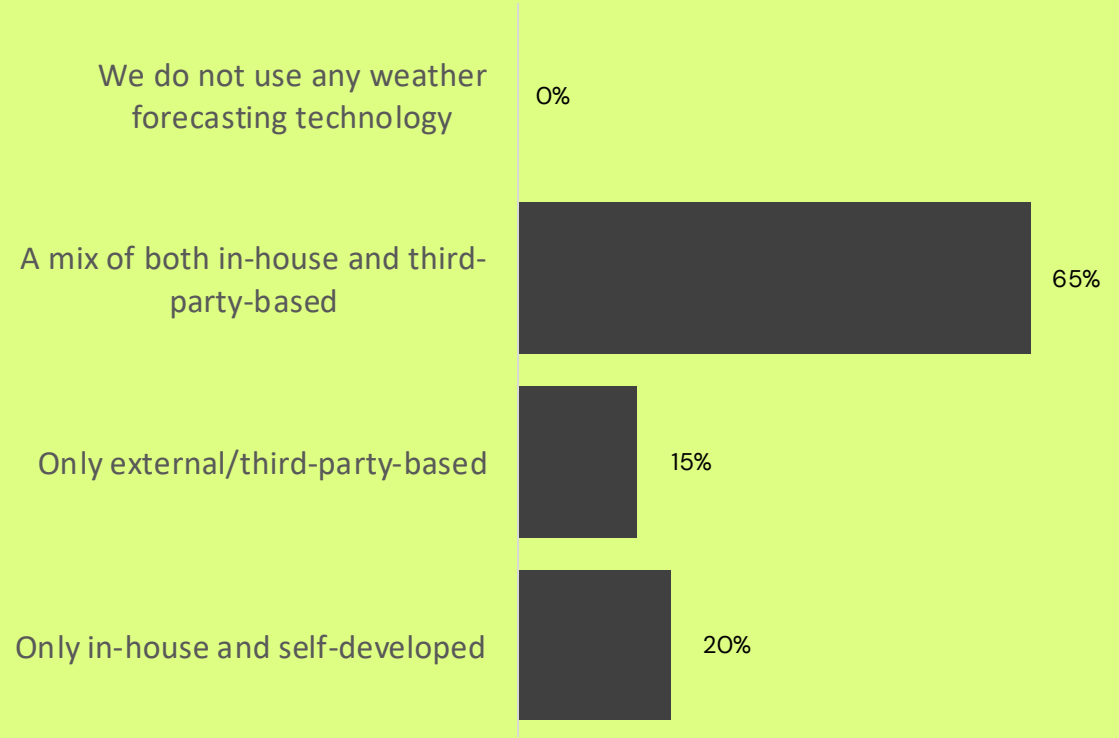
What Type of Weather Data Do You Rely On?



* % of participants who chose this answer

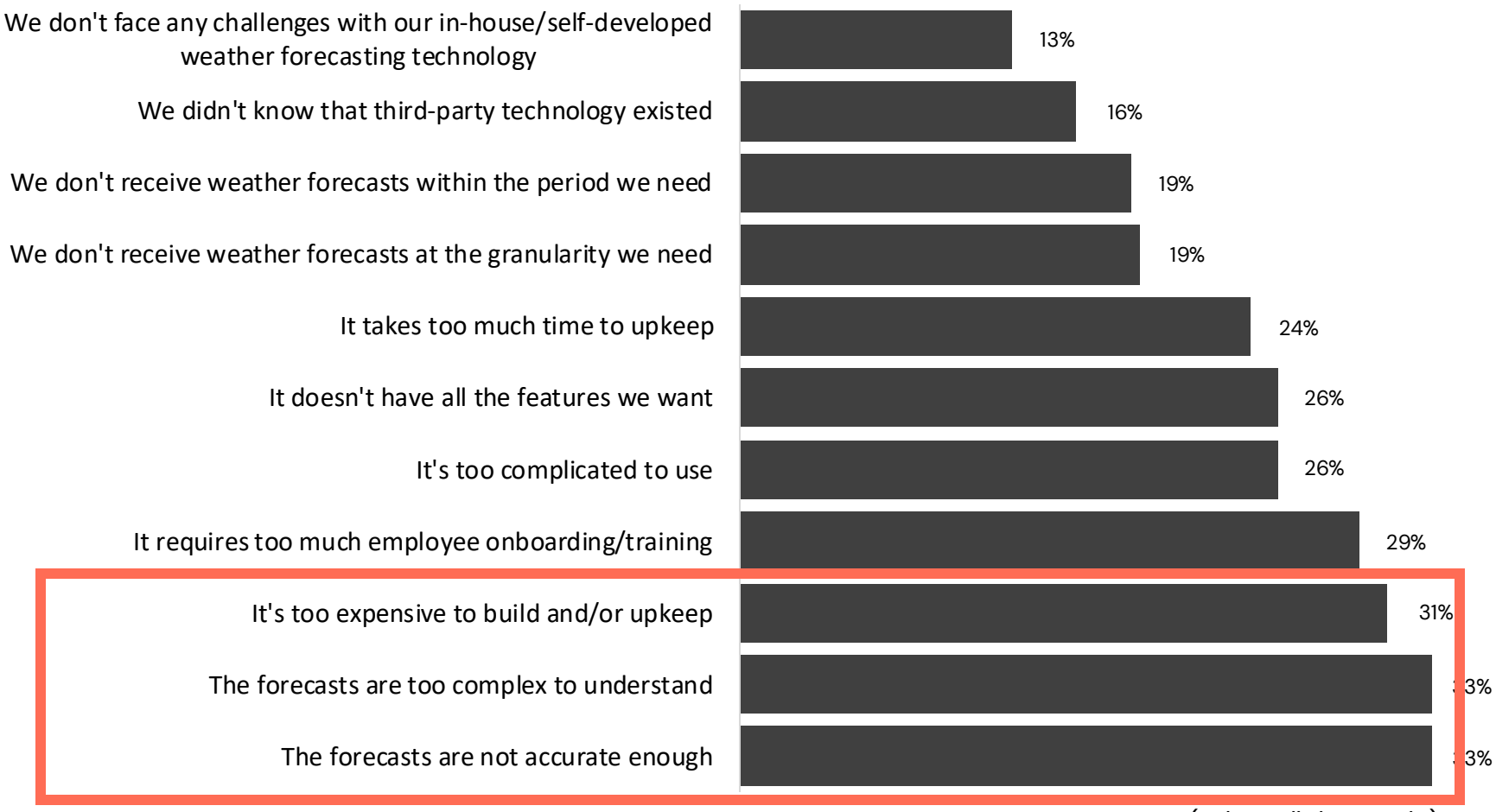
(select all that apply)

What Type of Forecasting Tech Does Your Company Use?



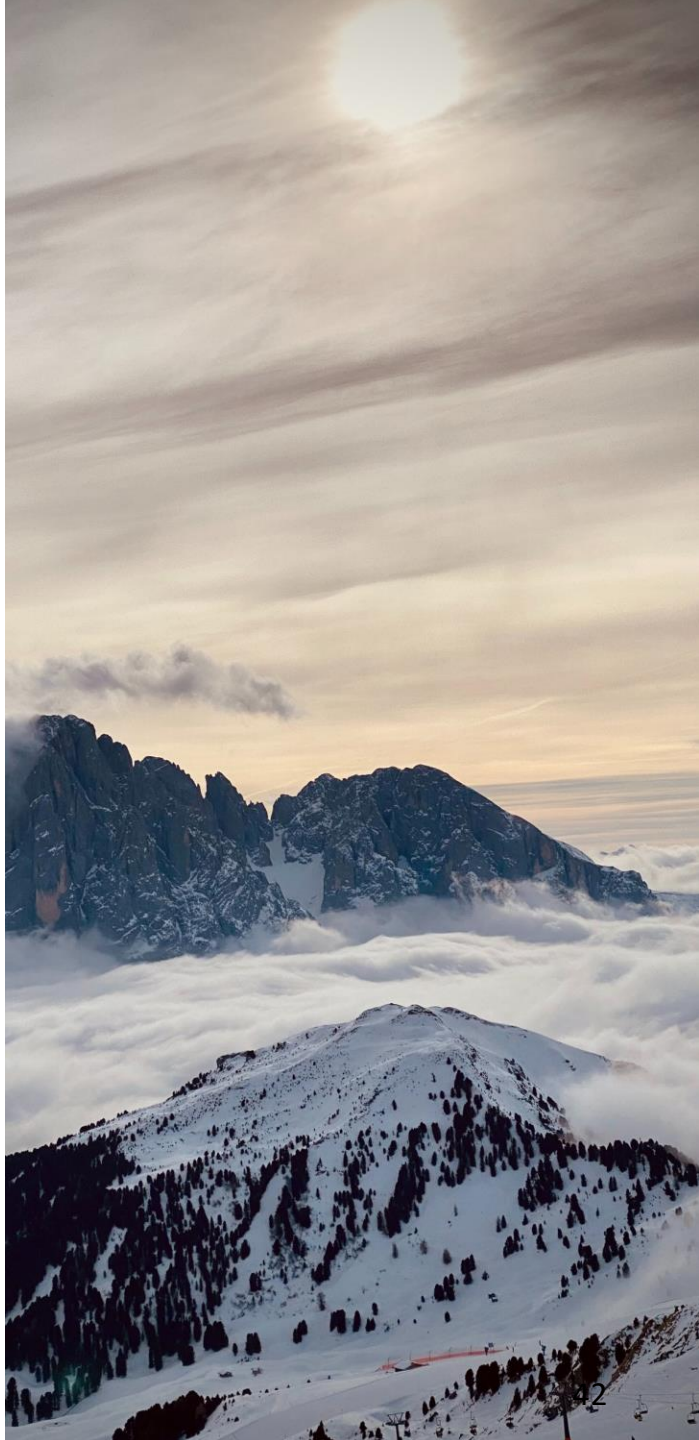
(select one)

What challenges do you currently face, if any, when using in-house/self-developed weather forecasting technology?



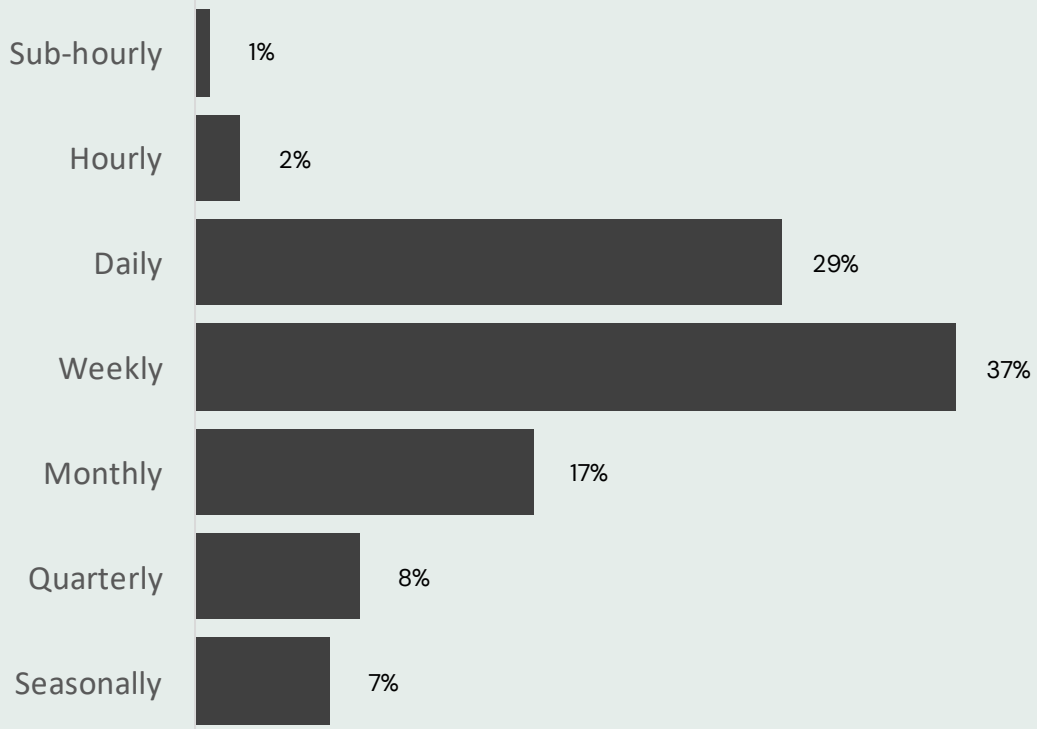
(select all that apply)

Participants need high-accuracy, simple and low-maintenance solutions!



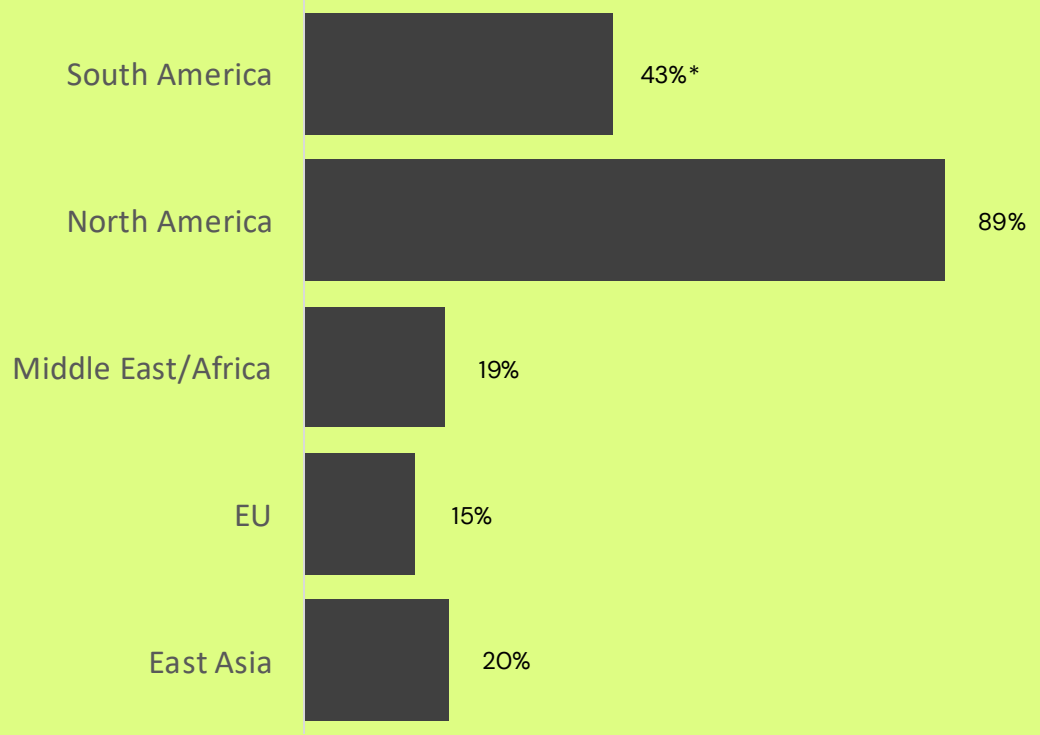
Weather data is needed by 66% of respondents on a daily or weekly basis. The geographical focus is predominantly national.

How frequently does your organization rely on weather data?



(select one)

What are your geographic markets of interest for weather data?

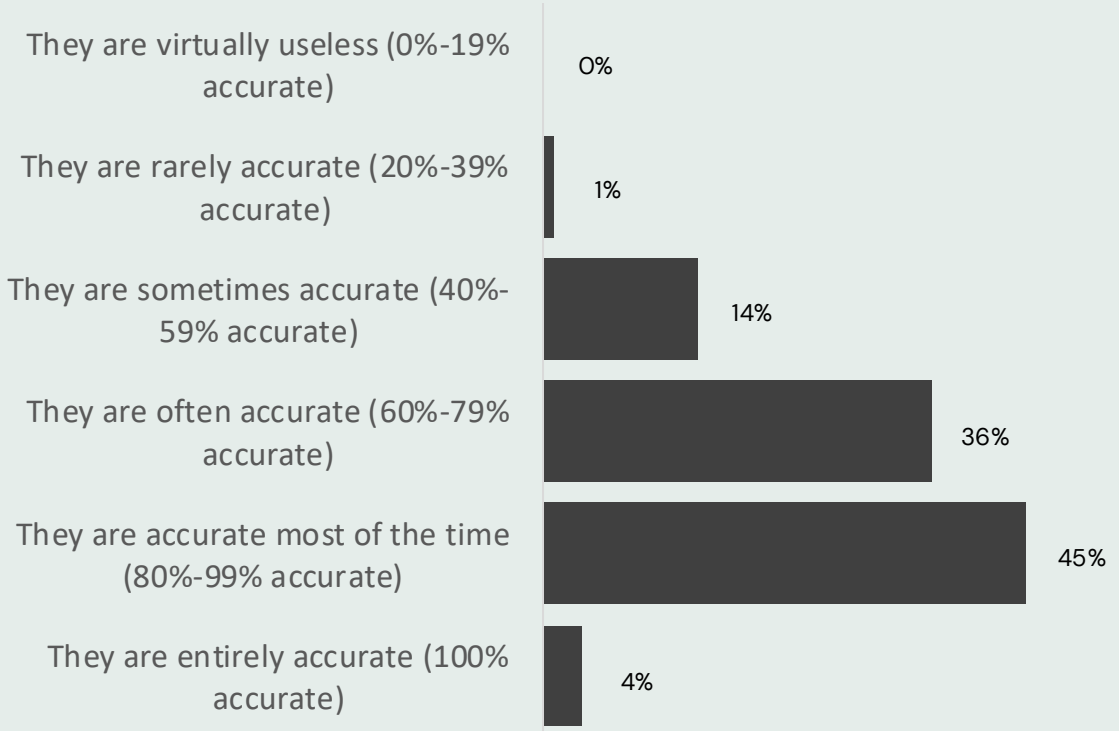


* % of participants who chose this answer

(select all that apply)

While 81% of participants indicate that their forecasts have a high accuracy of 60%–99%, it is still the 2nd biggest challenge after resolution.

How accurate are your company's weather forecasts?



(select one)

What are your top 3 challenges with the current weather data?

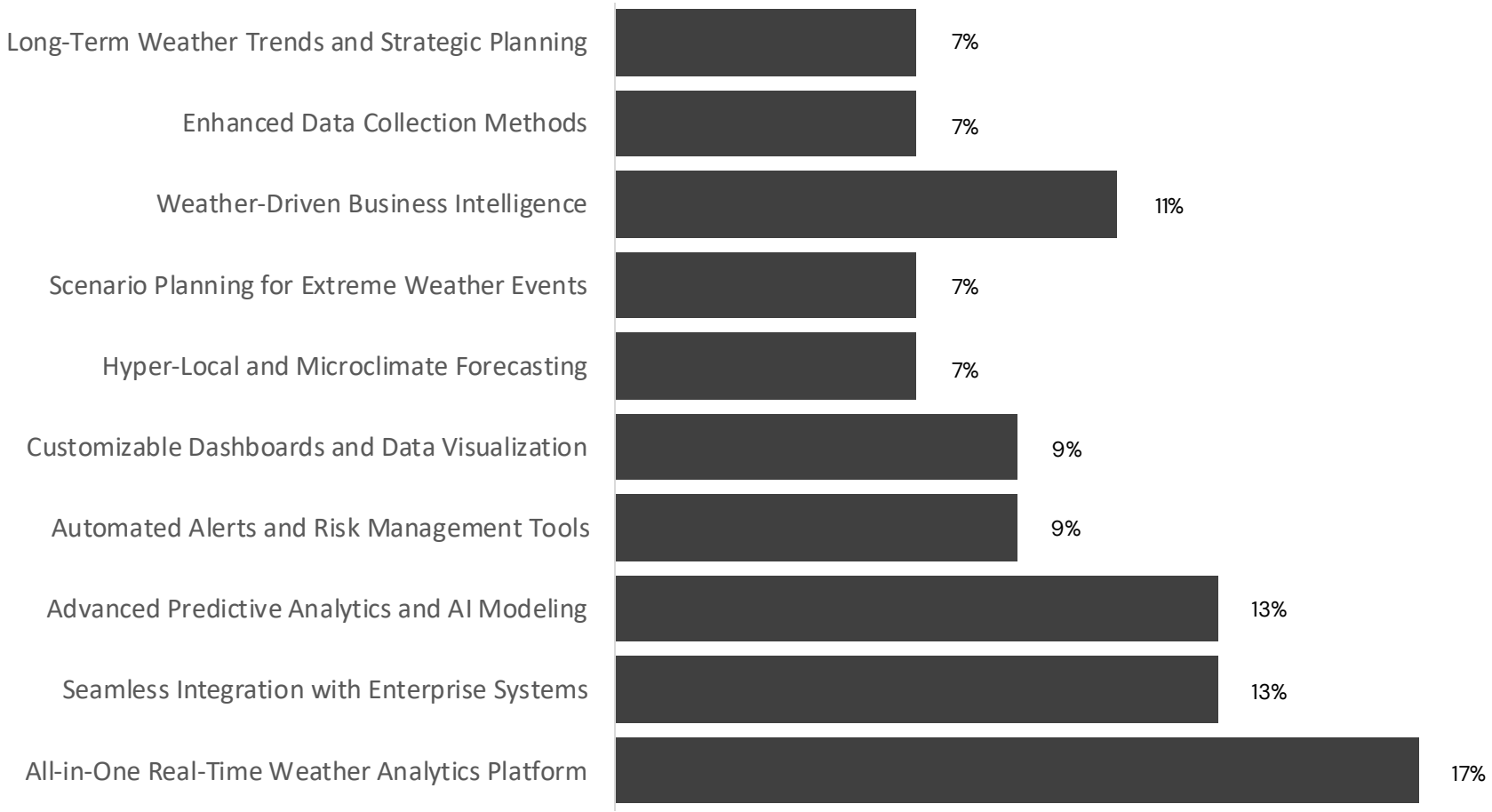
1. The resolution of the weather data is not good/high enough.
2. The accuracy and reliability of the weather data is not sufficient.
3. Inefficient data delivery process (speed, high manual workload, etc.).

...

9. Data is not actionable.

(rank top three)

What would be the most helpful tool or enhancement that would make the weather data that you use more actionable for business decisions?



(open-ended answers; **consolidated with LLM**)

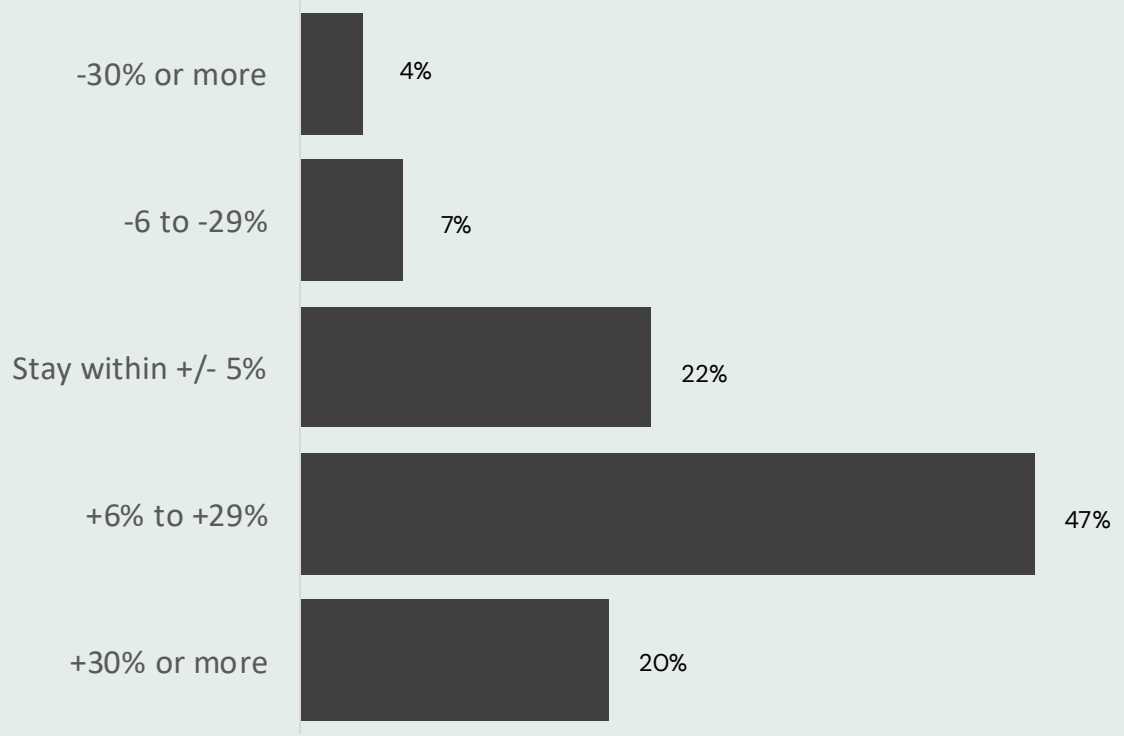
How helpful would each of the following be in making the weather data you use more actionable for business decisions?

	Not at all helpful				Very helpful
	1	2	3	4	5
Artificial Intelligence (AI)/ Machine Learning (ML)	0	1	41	114	116
Visualization and animation of weather data on customizable maps	0	1	48	136	87
Mobile access to weather forecasts, analytical dashboards, and other weather insights	0	0	50	128	94
Dashboards and platforms with intuitive and easy-to-use navigation (also for non-professionals in meteorology)	0	6	47	132	87
Innovative tools around weather data collection (i.e. weather drones)	0	0	49	136	87

AI would provide most value to make data more actionable for decisions!

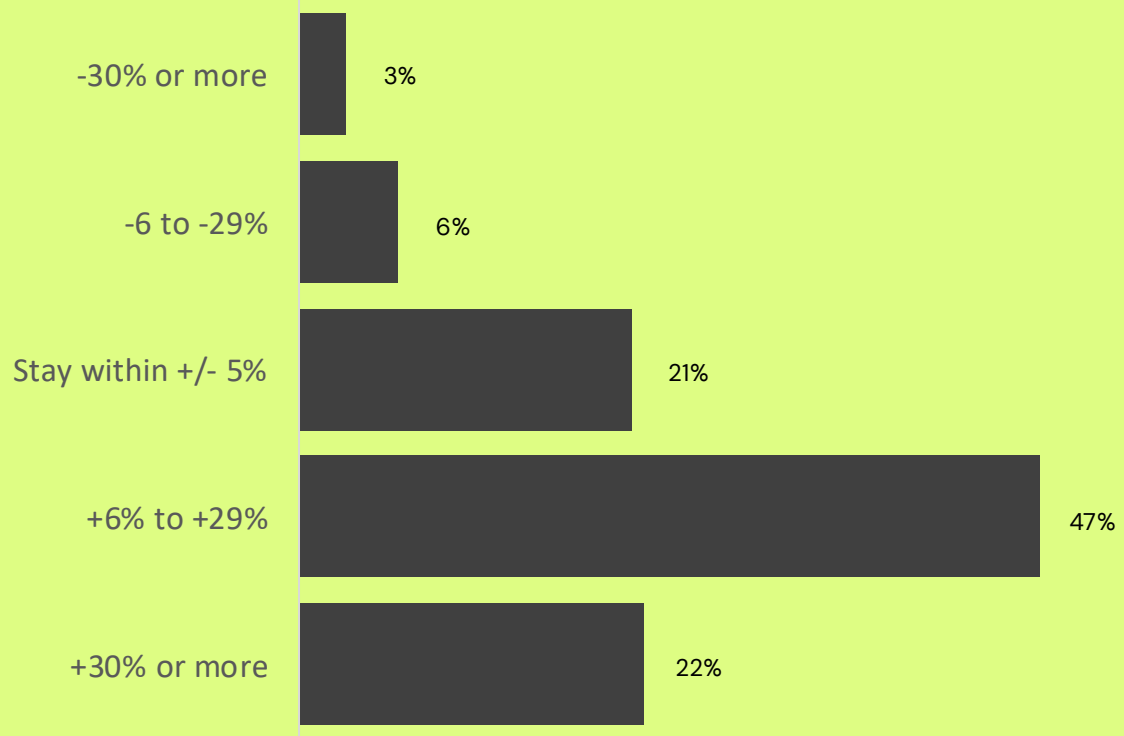
Both weather data and climate data are expected to significantly increase in importance within the next few years.

How do you expect your reliance on weather data to evolve in the next 3-5 years?



(select one)

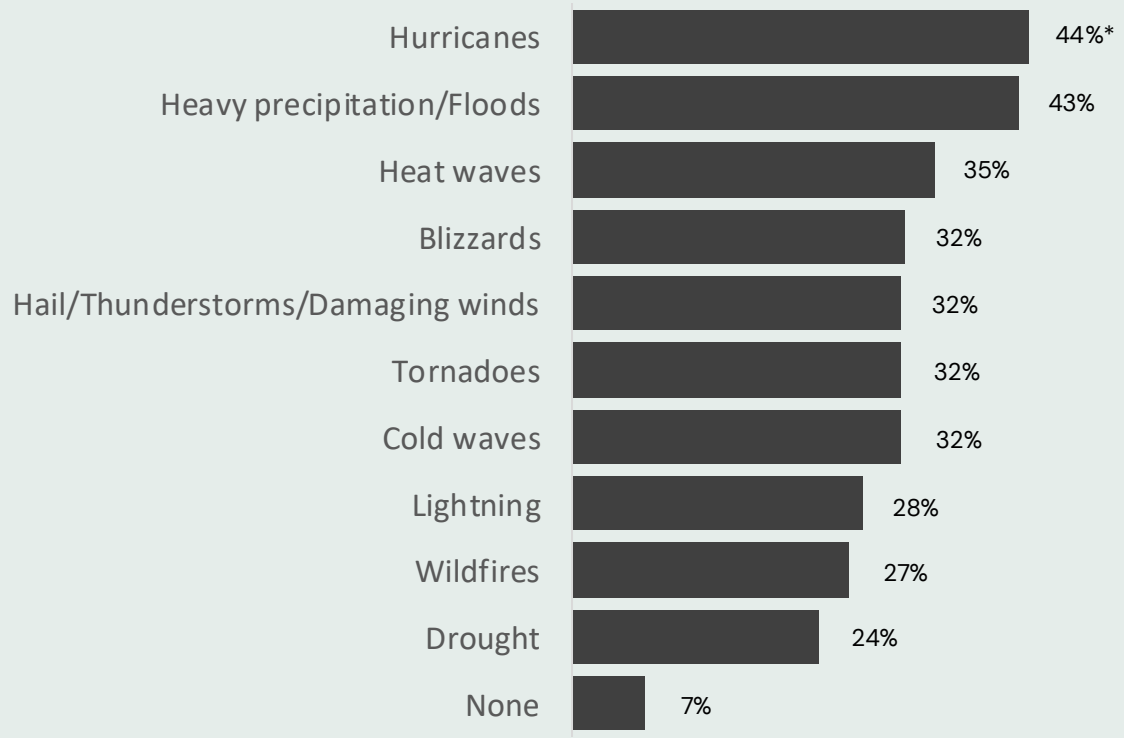
How do you expect your reliance on climate data to evolve in the next 3-5 years?



(select one)

Hurricanes, Floods and Heat Waves have had the highest impact on businesses.

What types of extreme events have impacted your business the most?



* % of participants who chose this answer

(select up to five)

Stairway to Heaven

Data Collection

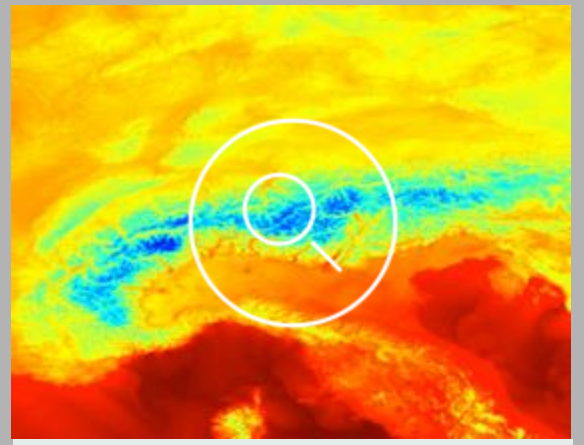
- ✓ ERA5 until 1940
- ✓ Stations
- ✓ Satellites
- ✓ Radar
- ✓ Lightning
- ✓ Ocean data
- ✓ Atmospheric data

Meteodrones

Weather Models

- ✓ Over **30 weather models** from third parties (global, local)
- ✓ **EURO1k** and **US1k**
- ✓ **AI weather models** (AIFS, GraphCast, 4Cast)

EURO1k
US1k



Date Fine-Tuning

- ✓ **Downscaling:** 90 m downscaling technique based on NASA terrain data
- ✓ **Calibration:** further calibration with the latest observations from nearby weather stations.

90 m Downscaling

Data Delivery & Access

- ✓ real time data access through our unique **Weather API**
- ✓ Visualize all Weather Data with our weather map tool **MetX**
- ✓ Calibrated and site-specifc Energy **Power Forecasts**

Weather API
MetX
Power Forecast

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