



ESIG: Meteorology and Energy Systems Workshop.

June 7, 2022
Pascal Storck

VAISALA

Wind Sets the Stage: Solar Steals the Show!
Let's look at those forecasts

Hydro is hard, but wow those forecasts!
Implications for wind/solar

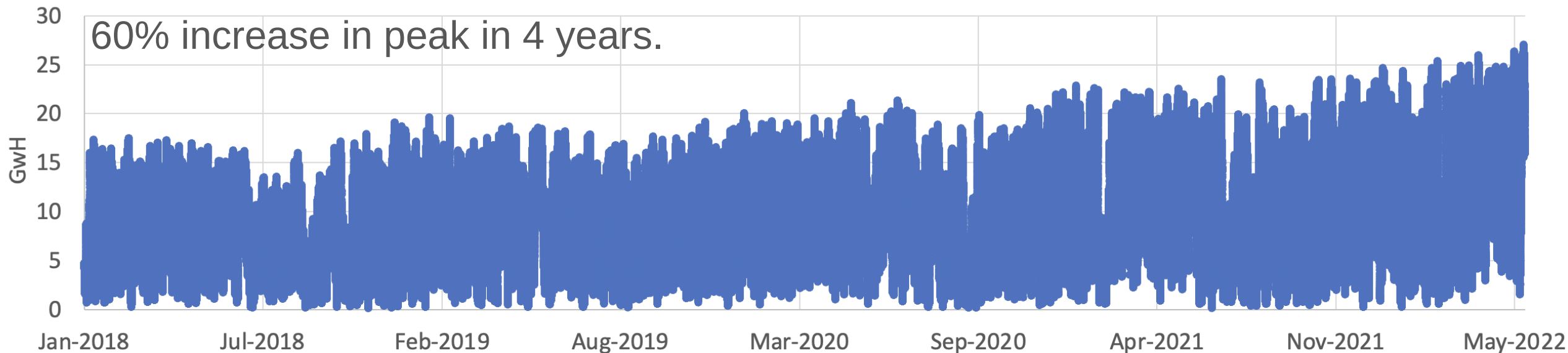
Dynamic Line Rating. TLDR
Needs forecasting too

Integration -> Resource Adequacy
Let's look at those forecasts also

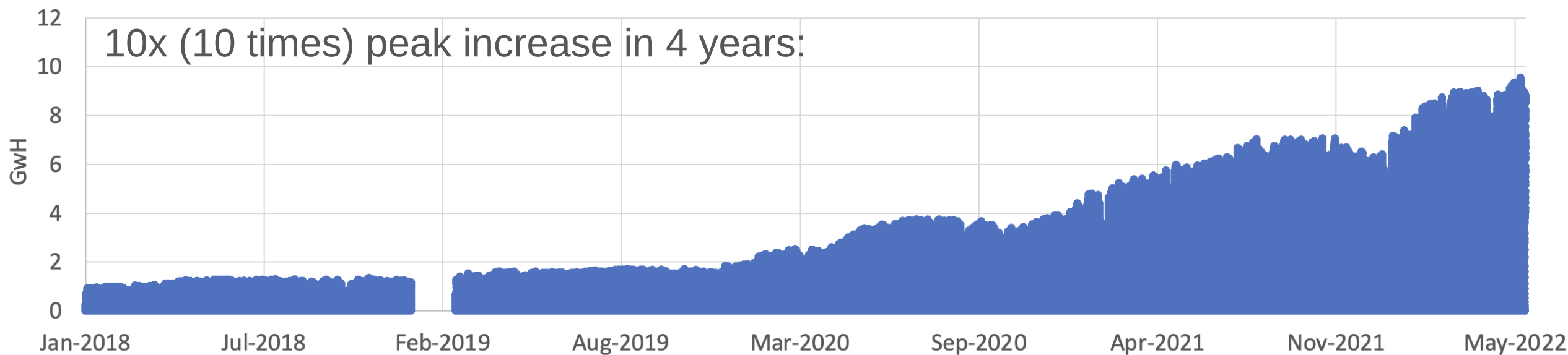
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Wind Sets the Stage. Solar Steals the Show

ERCOT wind energy GWh

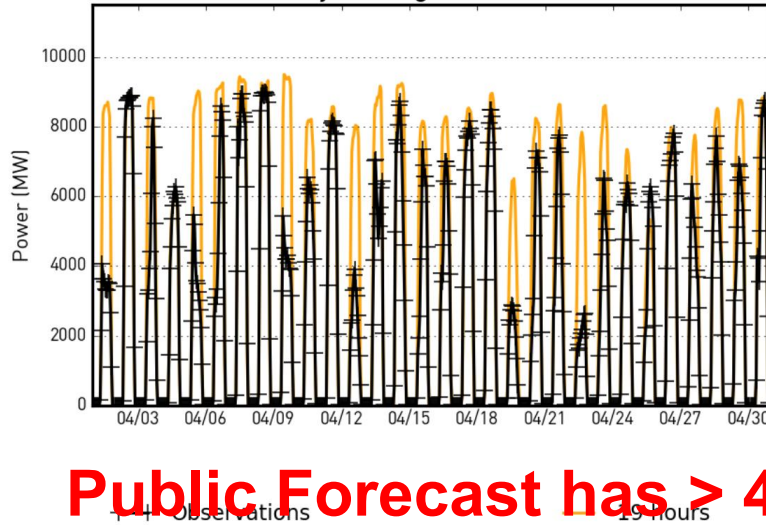


ERCOT solar energy GWh

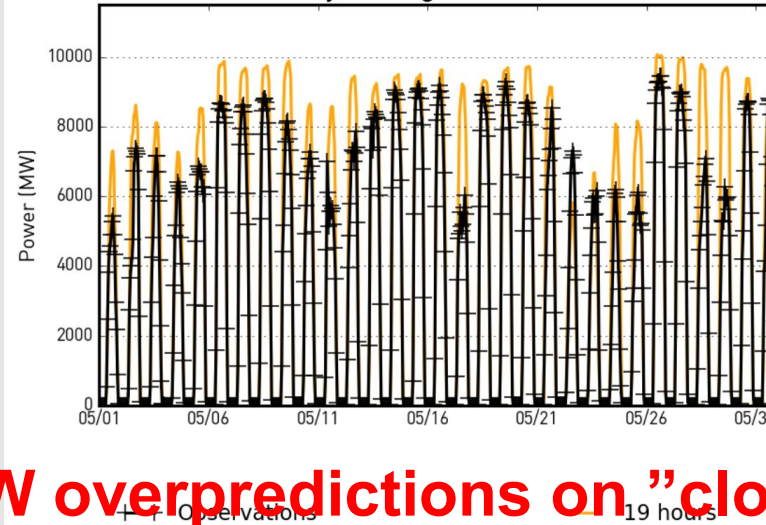


Bias = 700 MW RMSE = 1500 MW

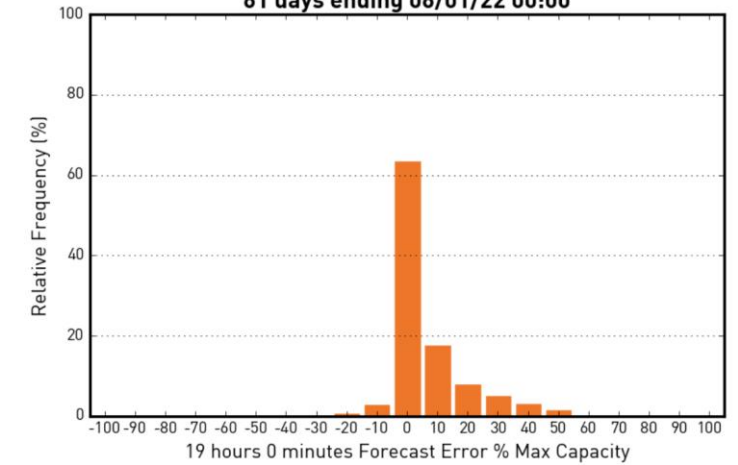
ERCOT Solar Power - Public
30 days ending 05/01/22 00:00



ERCOT Solar Power - Public
31 days ending 06/01/22 00:00



ERCOT Solar Power - Public
61 days ending 06/01/22 00:00



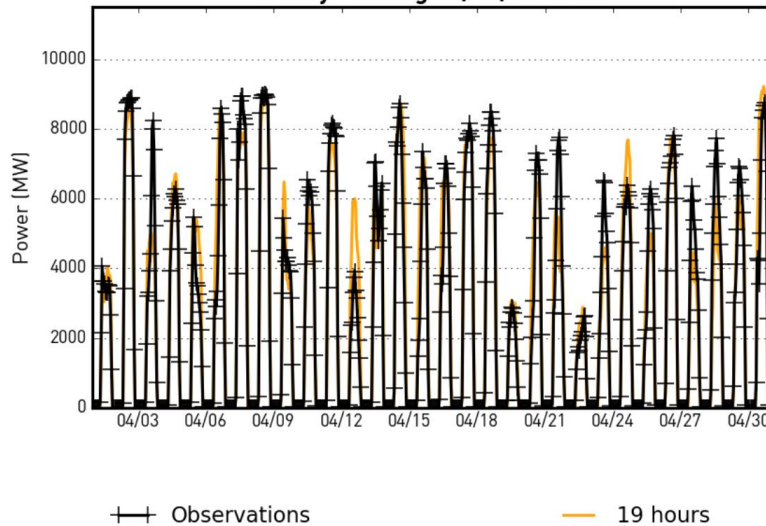
Public Forecast has > 4 GW overpredictions on "cloudy" days!

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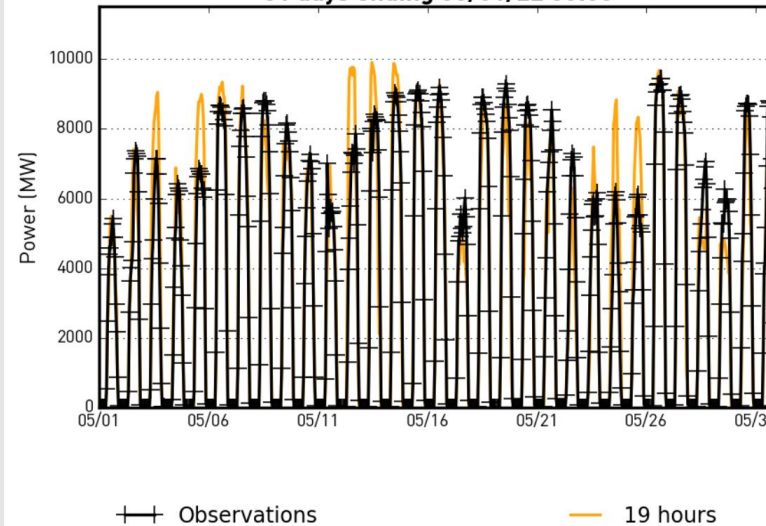
Hourly Time Series Verification: ERCOT Solar

Average Power: 2518.1 MW

ERCOT Solar Power - 3TIER Blend
30 days ending 05/01/22 00:00



ERCOT Solar Power - 3TIER Blend
31 days ending 06/01/22 00:00



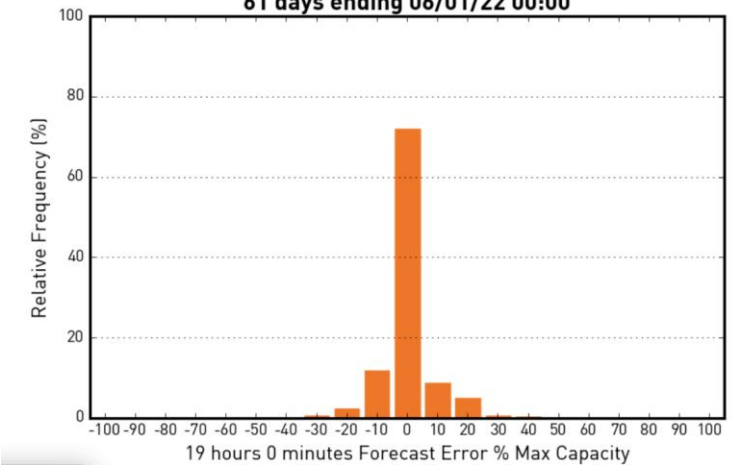
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Wind Error Histogram: ERCOT Solar

MAE: 479.33 MW
RMSE: 873.33 MW
Median: -0.10 MW
Bias (average error): 38.09 MW
(%) between +/- 5.0 %: 71.74 %
Sample size: 1465

Bias = 40 MW RMSE = 900 MW

ERCOT Solar Power - 3TIER Blend
61 days ending 06/01/22 00:00



VAIDALA

Hydro and Next Generation AI

No weather stations required. Keep your tipping buckets at home. What!!!???

Manage water risk. See more clearly into the future with AI-powered forecasts for planning and operations.

CONTACT SALES →

Proven Performance

HydroForecast swept a year long short-term flow forecasting competition hosted by the United States Bureau of Reclamation, CEATI and hydropower utilities and verified by RTI International.

In every competition region, HydroForecast was more accurate further into the future and provided better insight in both drought conditions and 1,000-year storms.

LEARN MORE ABOUT FORECASTS →



New models outperform traditional approaches

Upstream Tech’s theory-guided machine learning model, **HydroForecast**, demonstrated industry best skill across diverse North American hydrologies in a one-year forecast competition

Head-to-head forecast performance

Category	Winner by Region (Sponsor)				
	U.S. West USBR	U.S. Southeast TVA	Alabama Southern Co.	Québec Hydro-Québec	U.S. Mtn. West DOE
All Arounder Leader across all metrics, horizons, seasons and flow ranges					
Flood forecaster Leader in highest flow range					
Quick draw Leader at shortest forecast horizon					
Eagle eye Leader at longest forecast horizon					
Straight shooter Leader with lowest bias					

Legend:  Upstream Tech - HydroForecast  Tennessee Valley Authority  NOAA NWS River Forecast Centers

Also participating:  Sapere Consulting  Hydro Québec  Southern Company  NCAR  OWP OFFICE OF WATER PREDICTION

Winner in 23 of 25 categories in a yearlong competition

Single site skill, spring 2020 - 2021

Nash-Sutcliffe Efficiency (measures skill; 1 = perfect)					
Days ahead		1-3	4-10	6-10	1-10
 HydroForecast		0.96	0.90	0.89	0.92
NOAA River Forecast Center		0.71	0.52	0.45	0.58
National Water Model		0.73	0.43	0.37	0.52
Long-term median		-1.4	-1.4	-1.4	-1.4

More accurate 8 days ahead than the leading US government forecast 2 days ahead

Learn more at <https://hydroforecast.com>

Question: If we don't need a precipitation gauge weather station for streamflow forecasting –why does your forecaster need a wind/solar station at a project to predict energy output?

Are the days of observations numbered, to be replaced with AI and simulation? I think yes.

Dynamic Line Rating: TLDR

**Transmission?
Transmission.
Transmission!**

NEWS RELEASES

FERC Opens Inquiry on Use of Dynamic Line Ratings to Promote Grid Efficiency

February 17, 2022

**Docket No. AD22-5****[Item E-1](#)**

FERC today launched an inquiry to examine whether the use of dynamic line ratings (DLRs), which are based on a wide range of weather and line-specific factors affecting the operation of electric transmission lines, would help ensure just and reasonable wholesale rates by improving the accuracy and transparency of line ratings.

Today's Notice of Inquiry (NOI) builds on Order No. 881, which FERC approved in December of last year. Order No. 881 directs transmission providers to use ambient-adjusted ratings (AARs) as the basis for evaluating near-term transmission service as well as for the determination of the necessity of certain curtailment, interruption or redispatch of near-term transmission service. Transmission line ratings represent the maximum transfer capability of each transmission line. These ratings can change based on weather conditions.

Order No. 881 found that line ratings based on conservative assumptions about worst-case, long-term air temperature and other weather conditions can lead to underutilization of our transmission grid. Therefore, requiring all transmission providers to use AARs will better utilize the grid and help lower costs for consumers.

Order No. 881 also acknowledged that transmission line ratings could be based on factors beyond forecasted ambient air temperatures and the presence of solar heating. Applying these factors to reflect other weather conditions like wind, cloud cover, solar heating intensity and precipitation, as well as transmission line conditions such as tension or sag, could lead to greater accuracy and enable greater power flows. In addition, the Commission explained that the use of

Contact Information

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Latest News

HEADLINES

[Open Access Podcast: Meet Elin Katz, Director of the Office of Public Participation](#)

May 26, 2022

HEADLINES

[FERC insight | May 2022 Highlights | Volume 5](#)

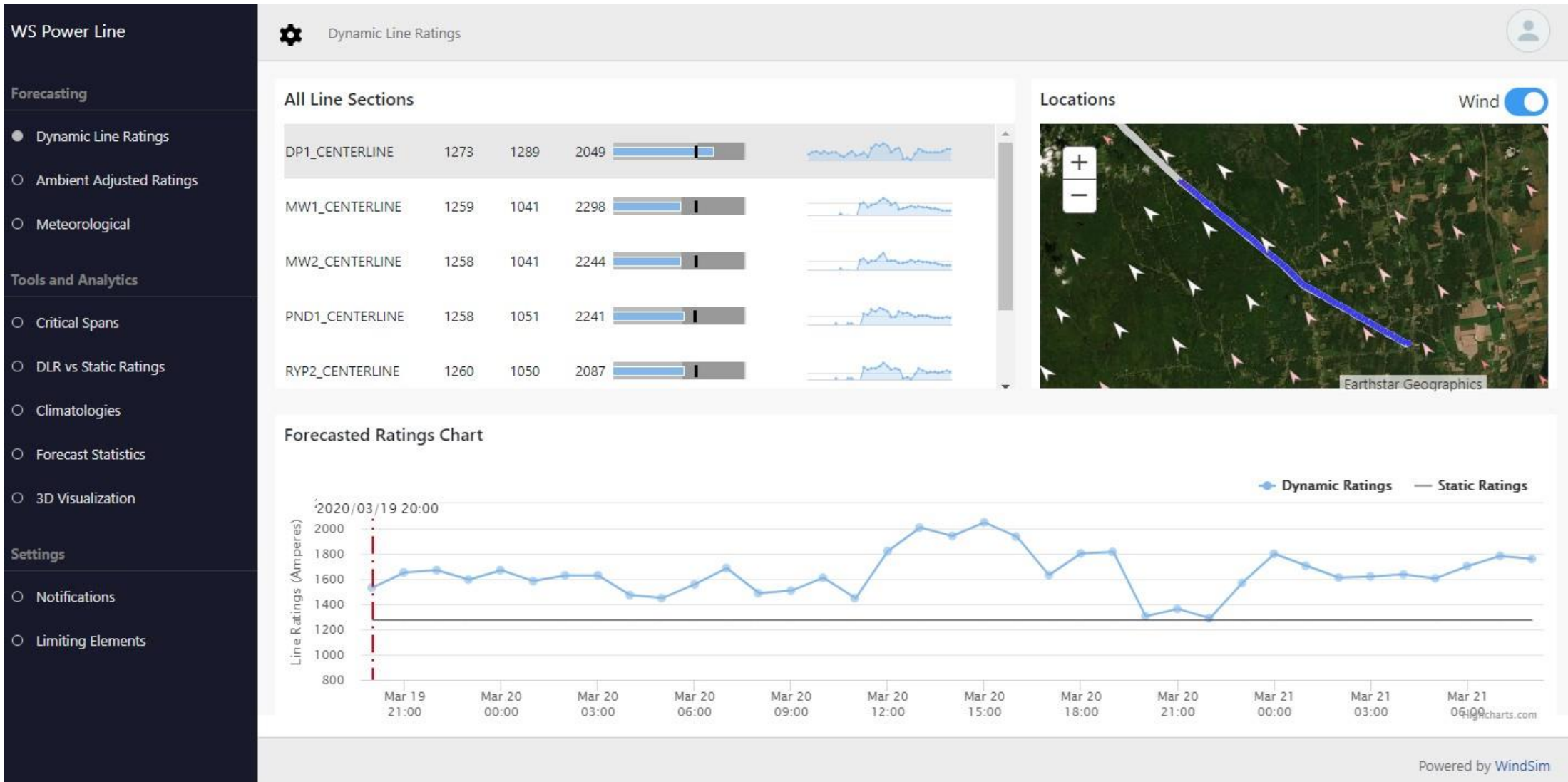
May 26, 2022

HEADLINES

[FERC - NARUC Joint Task Force on Transmission Announces Fourth Meeting](#)

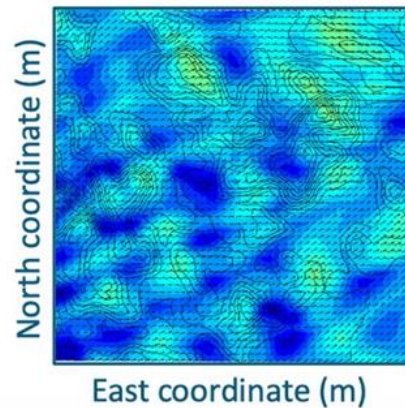
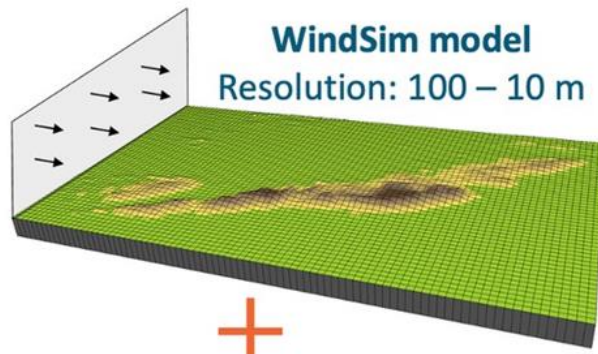
”... Transmission line ratings could be based on . . . forecasted . . . weather conditions . . . like wind, cloud cover, solar heating . . . to enable greater power line flows.”

Your Dashboard

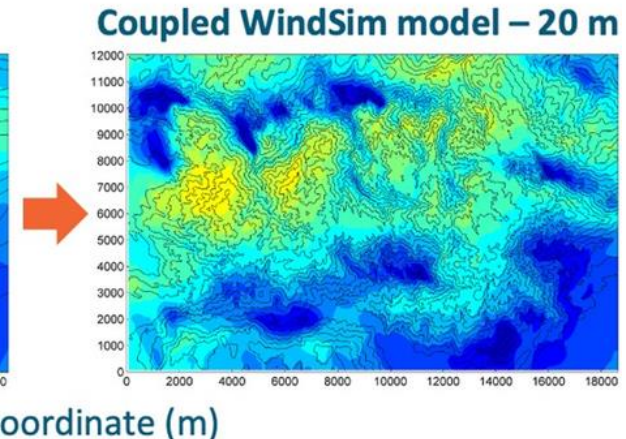
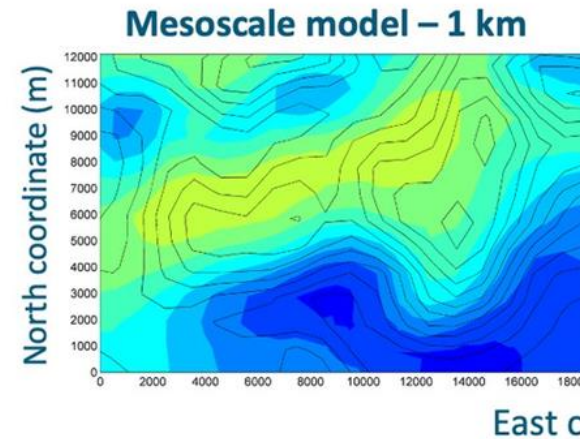


Details of the forecast do matter.
Meso/Microscale Coupling (for now).
Super-resolution AI in the future?
Coming out of the pilot/lab.

Direct physical downscaling



3D mesoscale model results
Resolution: 9 – 1 km

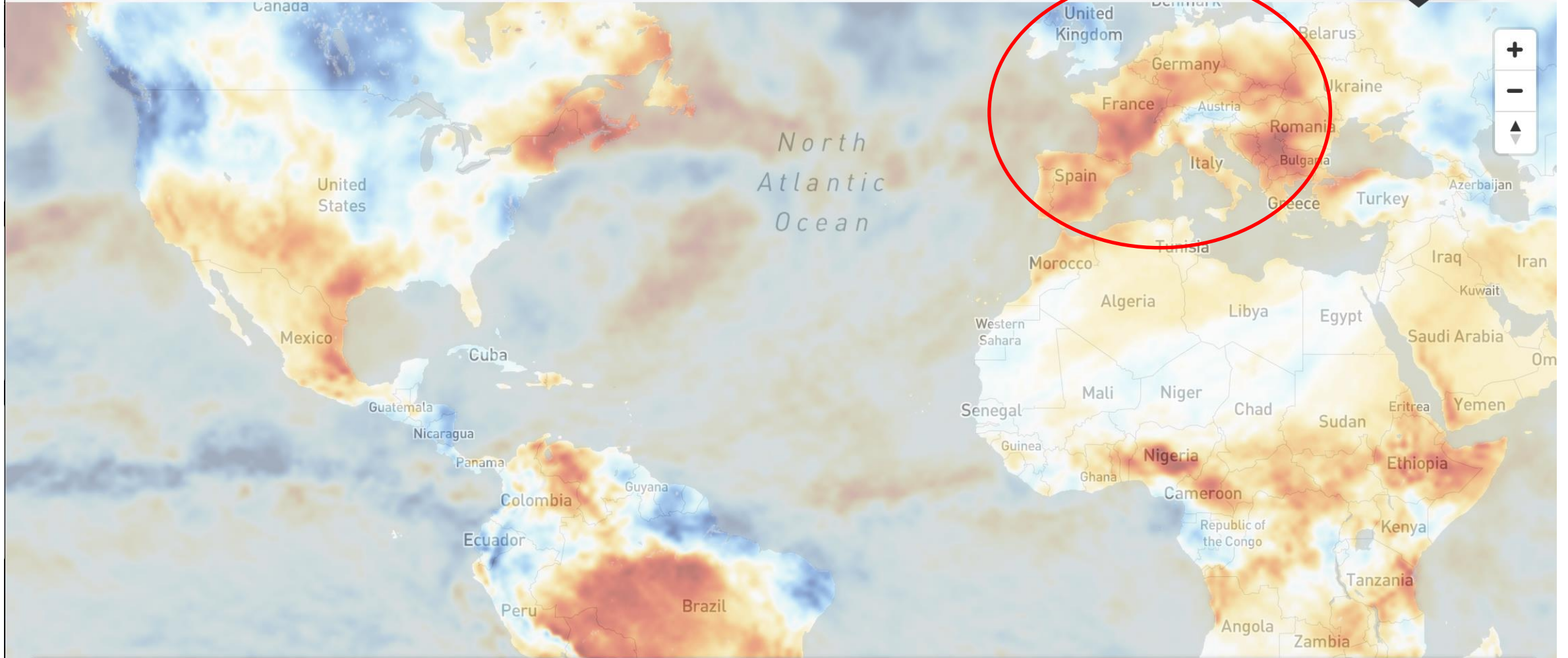


- Enhanced WindSim simulation
- Optional calibration with measurements

**Resource Adequacy.
Can it be forecasted months in
advance?**



-3.44%



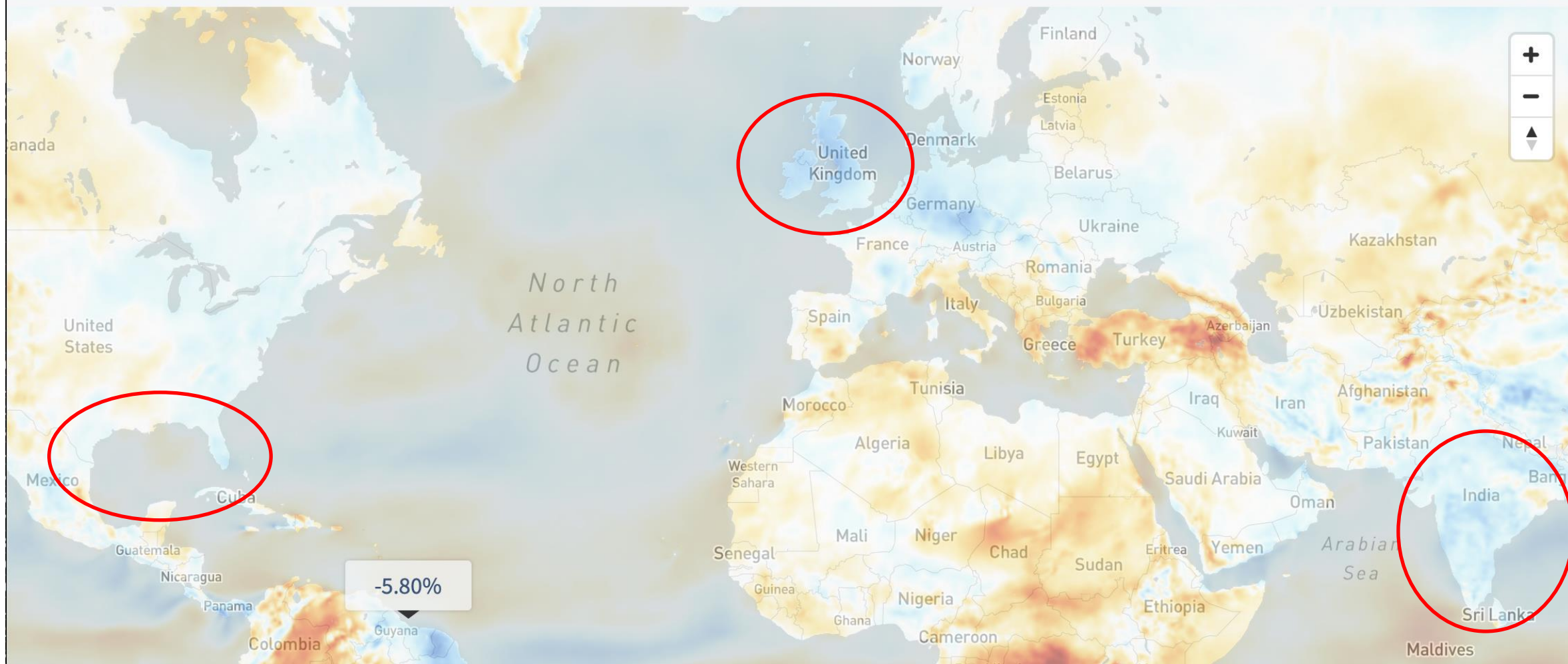
ERA5 Global Horizontal Irradiance Anomalies - May 2022

Data Set	Variable	Year	Quarter	Month
ERA5	Global Hor	2022	---	May
- +	- +	- +	- +	- +

Need the solar anomaly for your project? Try the [Vaisala Energy Budget Outlook Tool](#).

Departure from normal
surface global horizontal
irradiance





ERA5 Wind Speed Anomalies - 2021

Data Set

ERA5

Variable

Windspeed

Year

2021

Quarter

Month

- +

- +

- +

- +

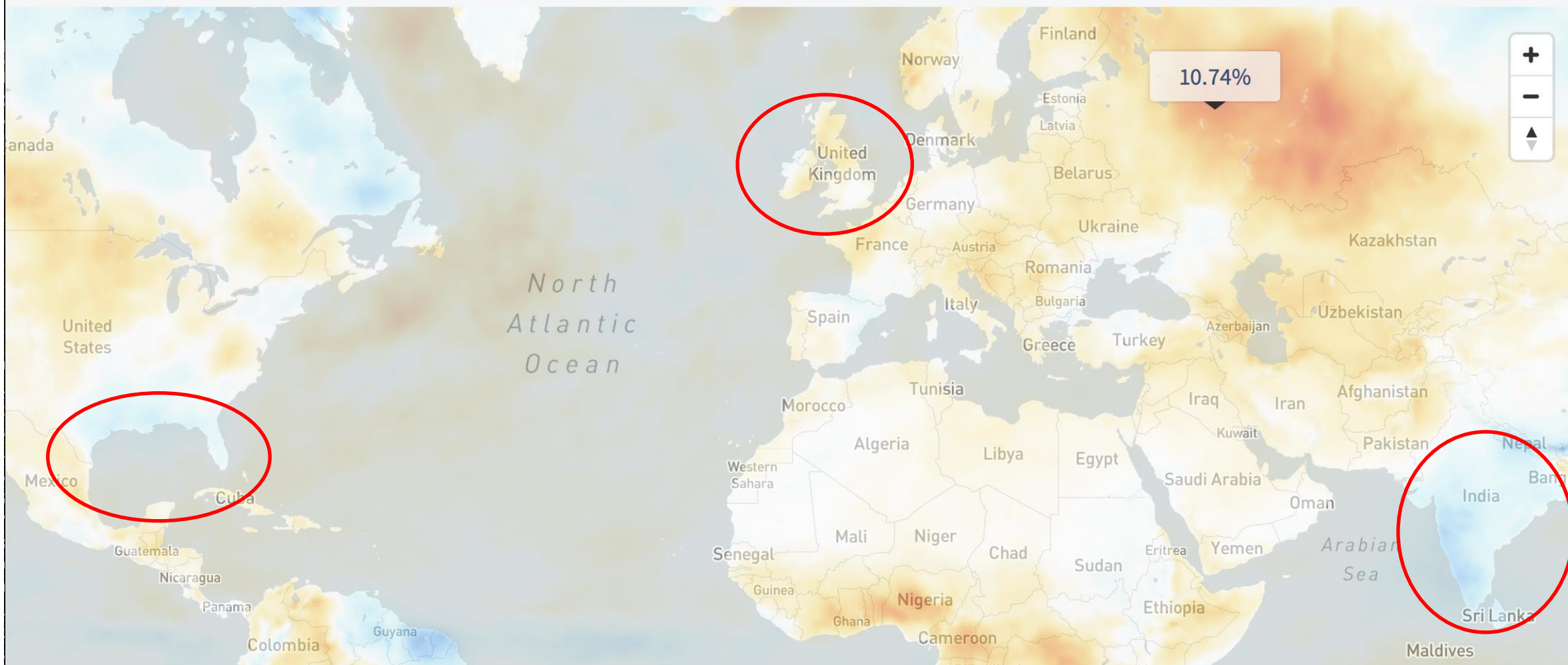
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Need the wind anomaly for your project? Try the [Vaisala Energy Budget Outlook Tool](#).

Departure from normal wind speeds at 100m

-20% +20%

LA



ERA5 Global Horizontal Irradiance Anomalies - 2021

Data Set

ERA5

Variable

Global Hor

Year

2021

Quarter

Month

- +

- +

- +

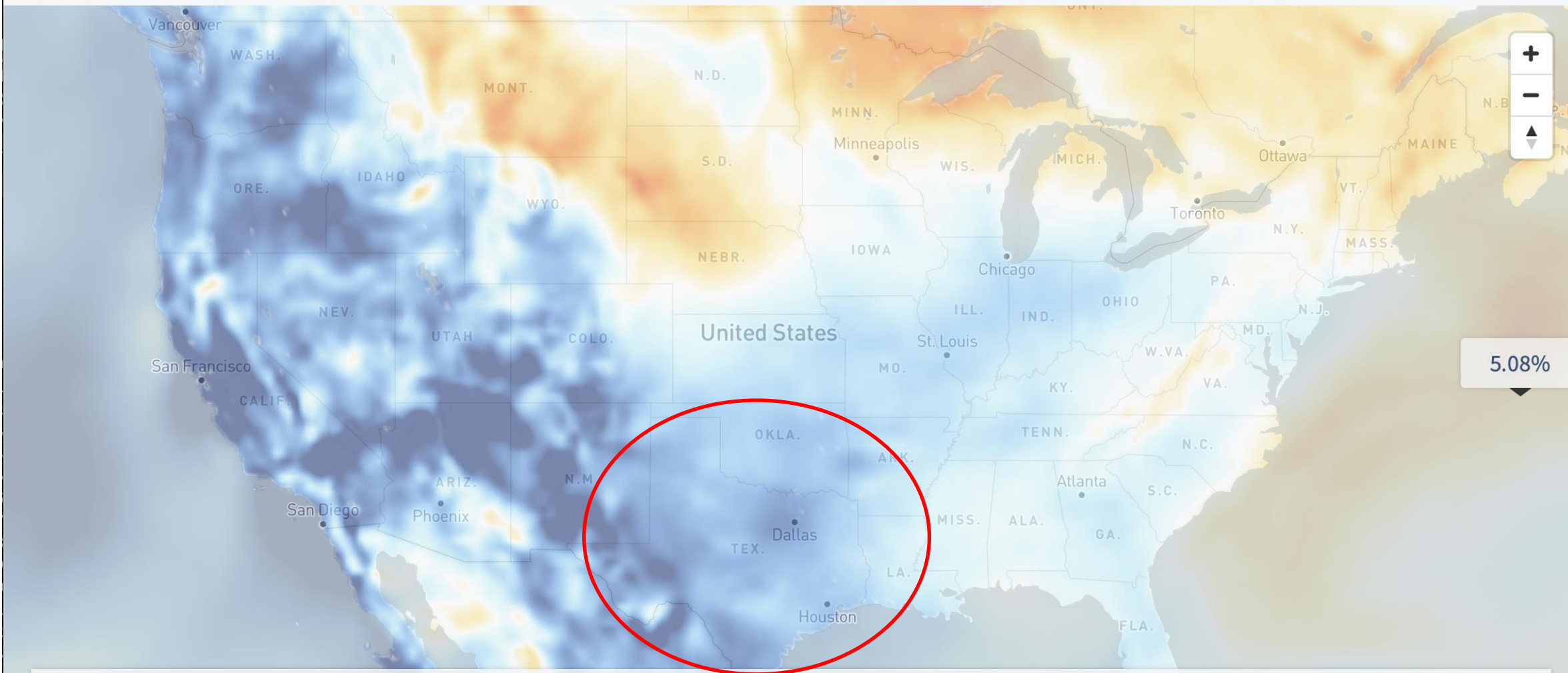
- +

- +

Need the solar anomaly for your project? Try the [Vaisala Energy Budget Outlook Tool](#).

Departure from normal
surface global horizontal
irradiance

-20% +20%



5.08%

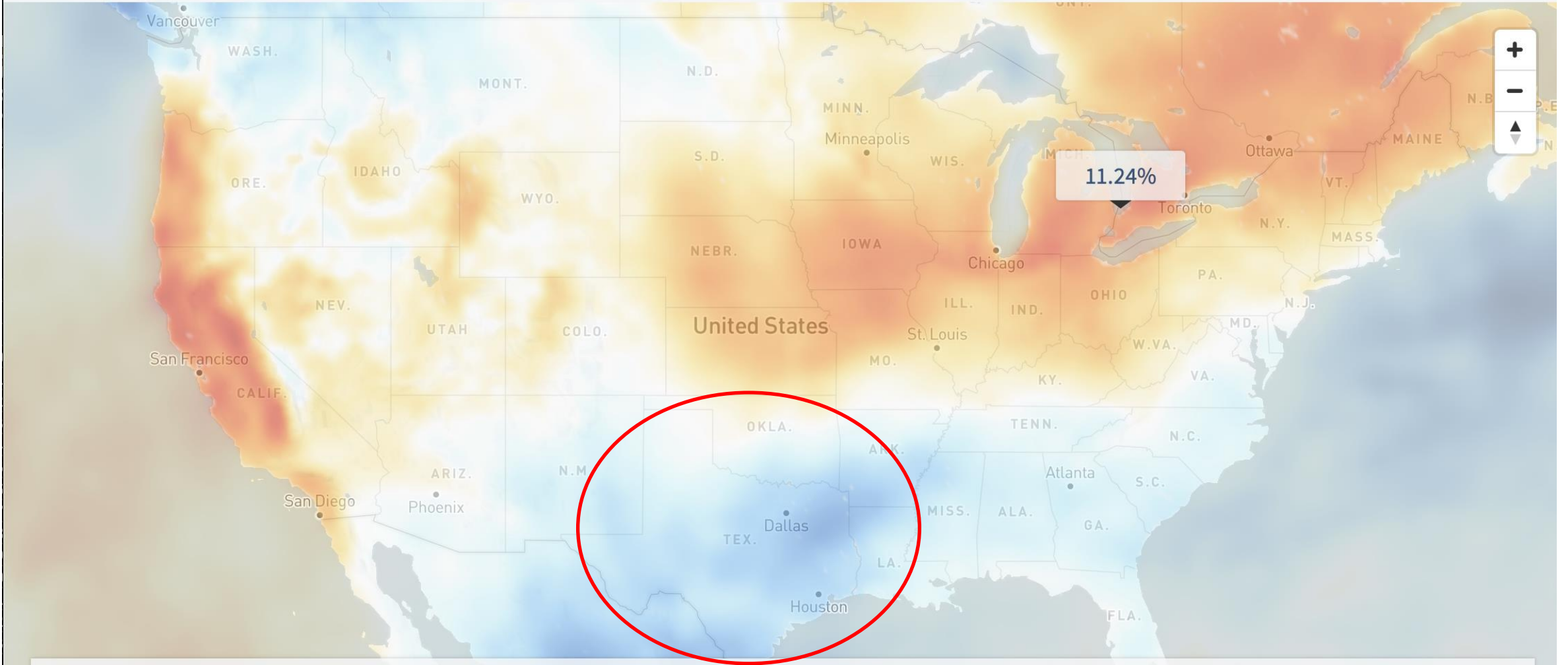
ERA5 Wind Speed Anomalies - 1st Quarter 2015

Data Set	Variable	Year	Quarter	Month
ERA5	Windspeed	2015	q1	---
- +	- +	- +	- +	- +

Need the wind anomaly for your project? Try the [Vaisala Energy Budget Outlook Tool](#).

Departure from normal wind speeds at 100m





ERA5 Global Horizontal Irradiance Anomalies - 1st Quarter 2015

Data Set	Variable	Year	Quarter	Month
ERA5	Global Hor	2015	q1	---
- +	- +	- +	- +	- +

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Departure from normal
surface global horizontal
irradiance

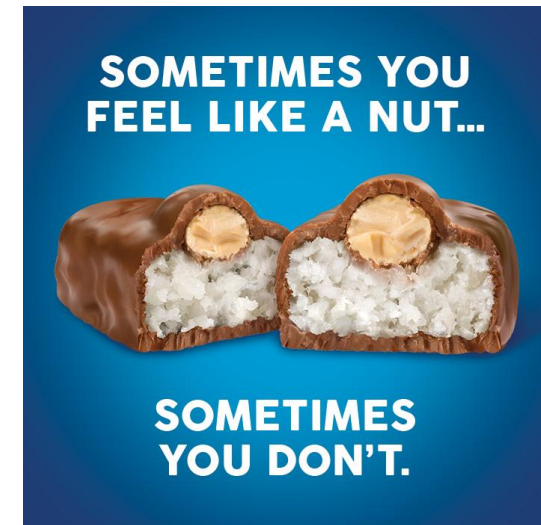


Texas Wind Farm Seasonal Forecast Skill (% improvement over climatology). Merra2 based index versus ERA5 (importance of data mining)

		MAE Skill (%) before				
		All	Q1	Q2	Q3	Q4
Forecast Horizon (months)	1	2	0	0	0	10
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	2	0	0	0	8
	5	5	8	0	0	10
	6	0	0	0	0	0
	7	2	7	0	0	0
	8	2	8	0	0	0
	9	2	10	0	0	0
	10	4	14	0	0	0
	11	4	15	0	0	0
	12	3	12	0	0	0

		MAE Skill (%) with ERA5				
		All	Q1	Q2	Q3	Q4
Forecast Horizon (months)	1	2	11	0	0	0
	2	6	9	0	0	17
	3	5	7	0	0	15
	4	5	9	0	0	14
	5	6	13	0	0	15
	6	6	18	0	0	8
	7	4	21	0	0	0
	8	5	22	0	0	0
	9	4	20	0	0	0
	10	4	17	0	0	0
	11	5	21	0	0	0
	12	3	16	0	0	0

Sometimes you have skill . . .
Sometimes you don't.



These are issues we will be working on for the next decade(s). Thank you.