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

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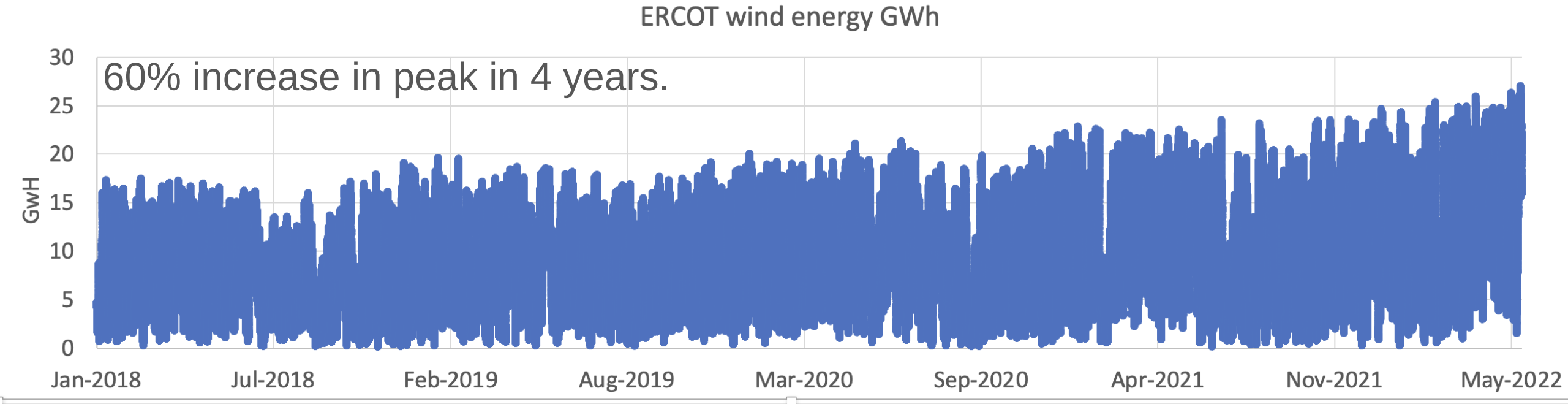
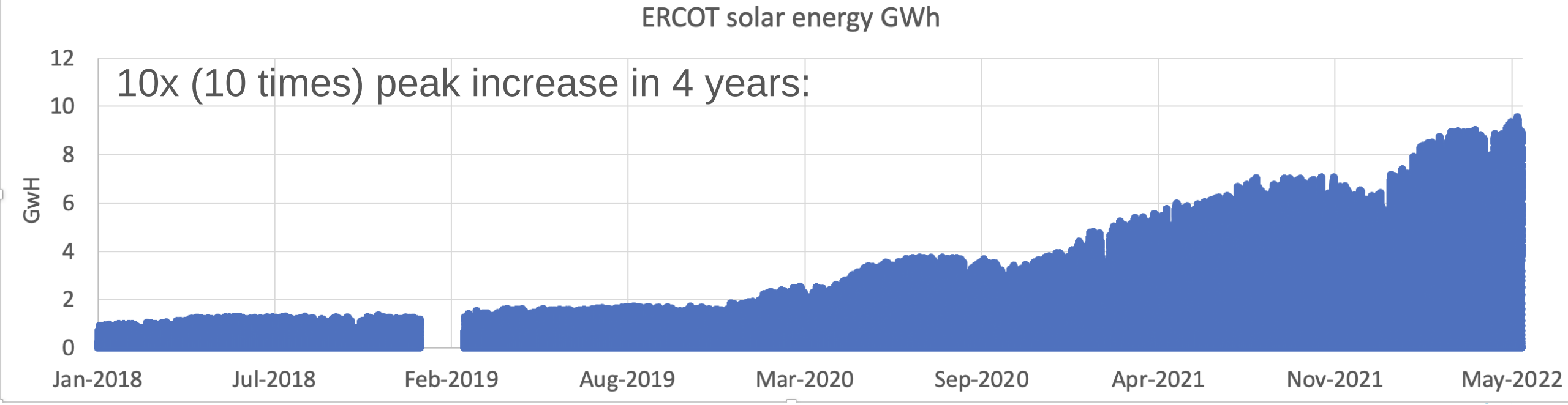
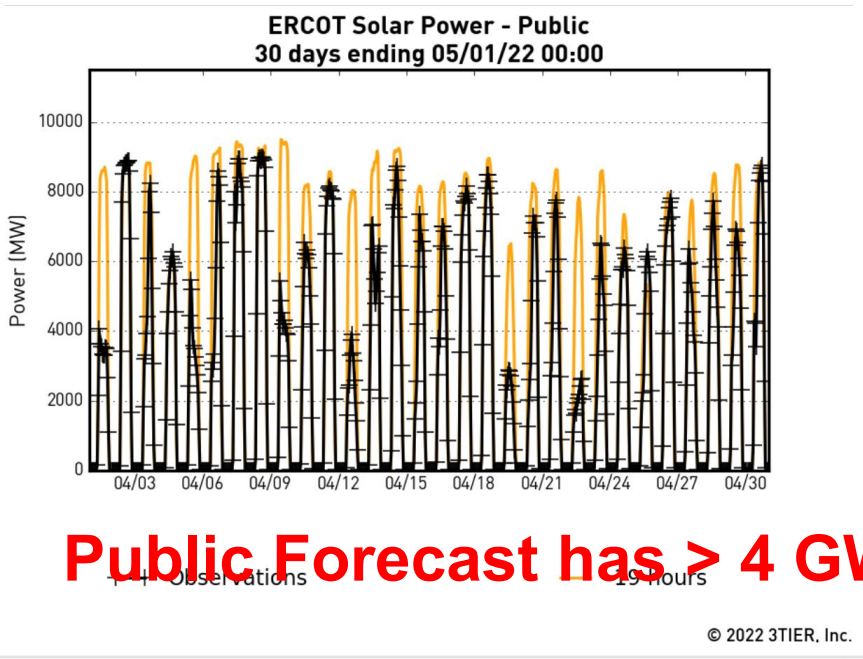
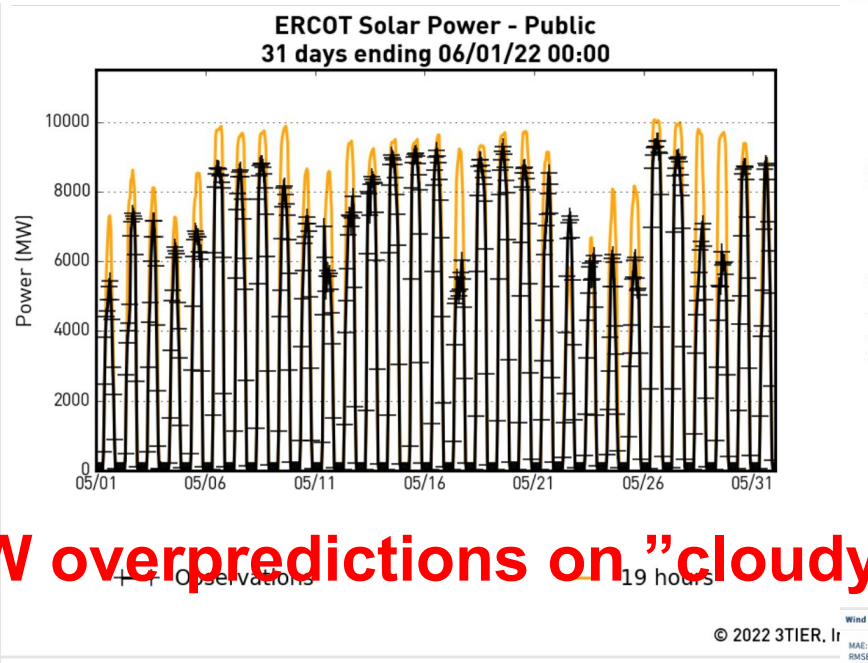
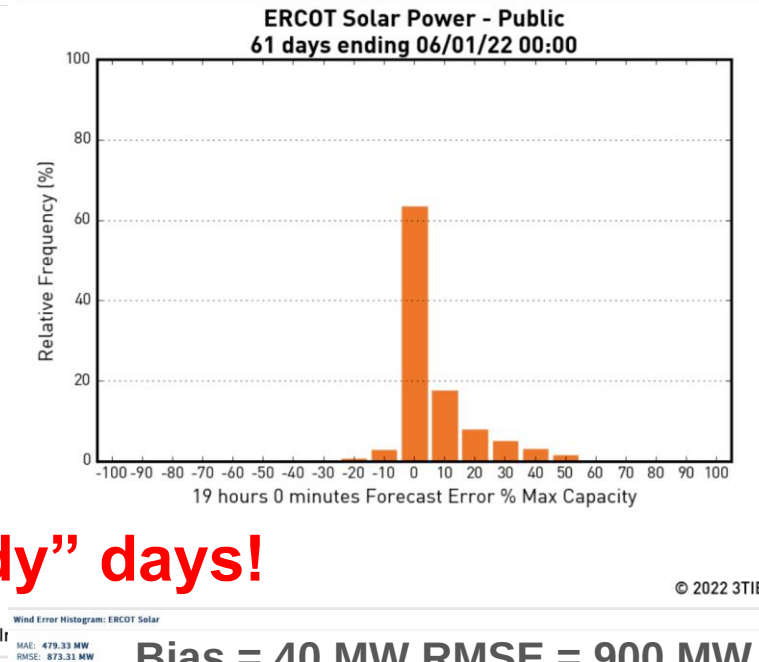

ERCOT wind energy GWh
60% increase in peak in 4 years.
GwH
30
25
20
15
10
5
0
Jan-2018
Jul-2018
Feb-2019
Aug-2019
Mar-2020
Sep-2020
Apr-2021
Nov-2021
May-2022


ERCOT solar energy GWh
10x (10 times) peak increase in 4 years:
GwH
12
10
8
6
4
2
0
Jan-2018
Jul-2018
Feb-2019
Aug-2019
Mar-2020
Sep-2020
Apr-2021
Nov-2021
May-2022

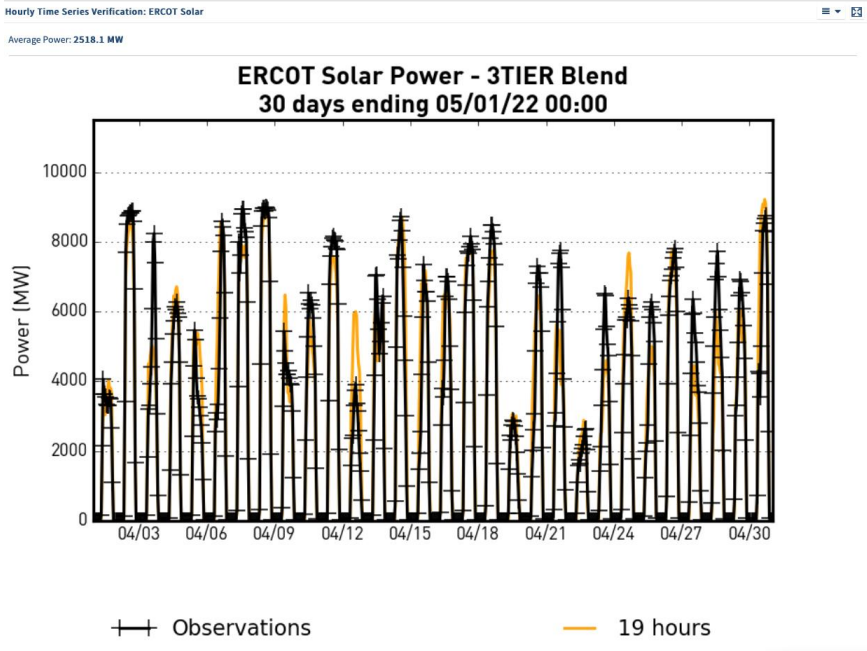


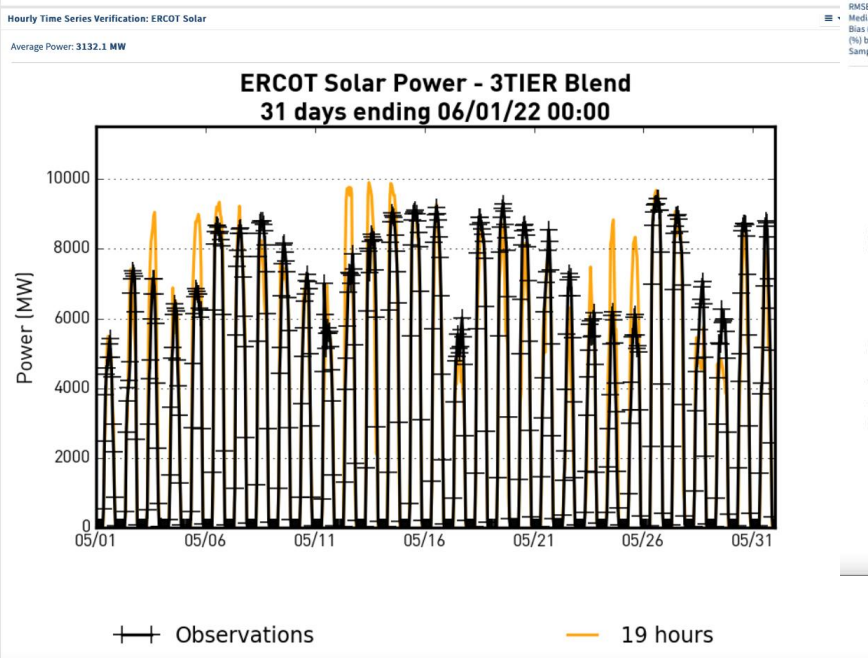


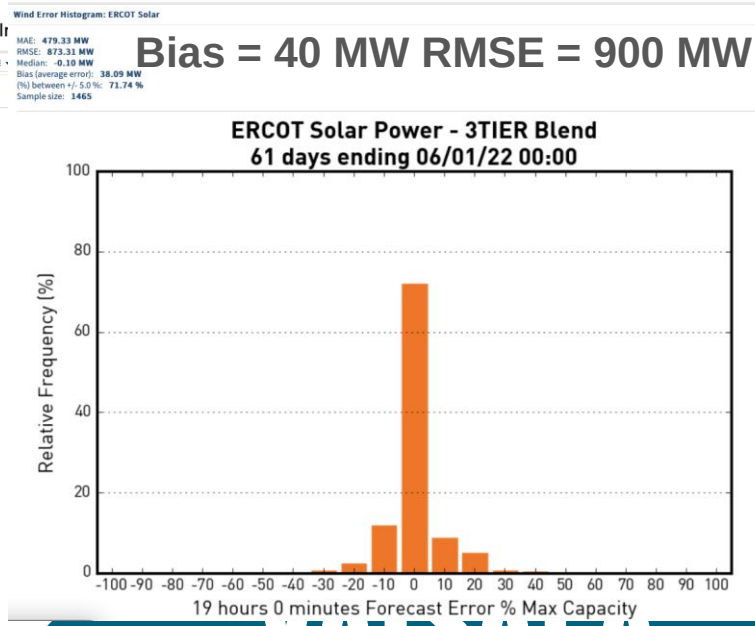


Bias = 700 MW RMSE = 1500 MW

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







Bias = 40 MW RMSE = 900 MW

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Hydro and Next Generation AI

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UPSTREAM TECH

LENS HYDROFORECAST ABOUT BLOG & NEWS LOGIN

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

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 →

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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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Email: mediadl@ferc.gov

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."

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Your Dashboard

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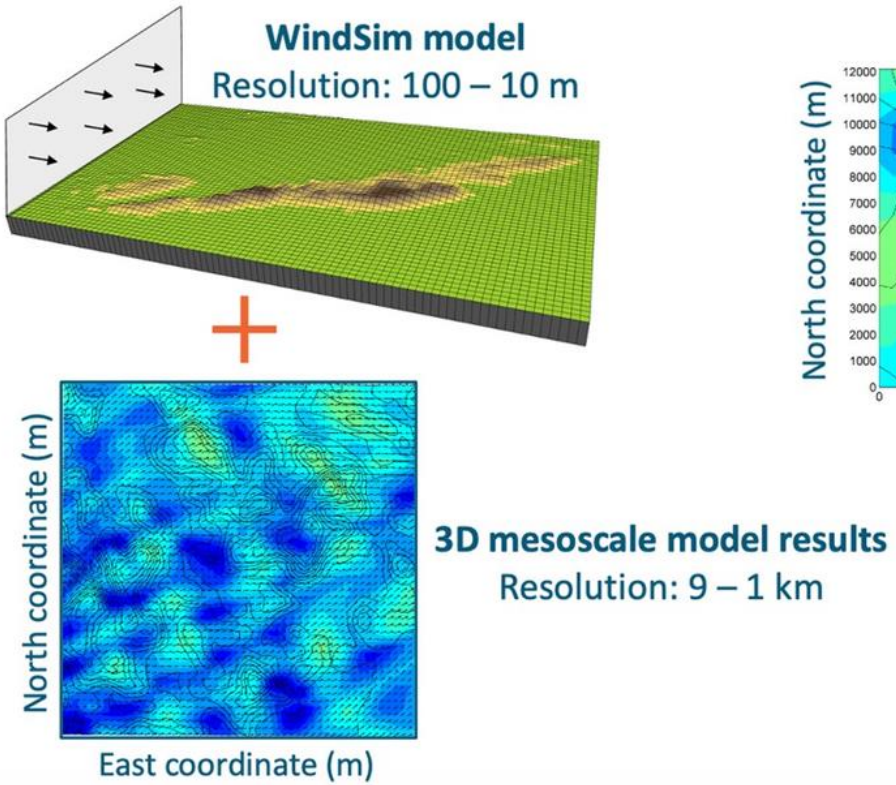
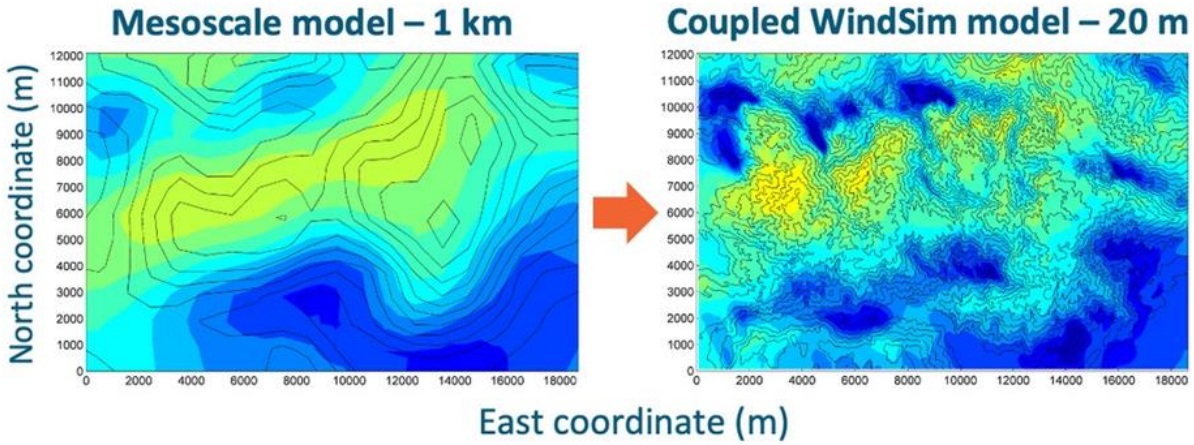
Details of the forecast do matter.
Meso/Microscale Coupling (for now).
Super-resolution AI in the future?
Coming out of the pilot/lab.

Direct physical downscaling





- Enhanced WindSim simulation
- Optional calibration with measurements

Resource Adequacy.
Can it be forecasted months in advance?

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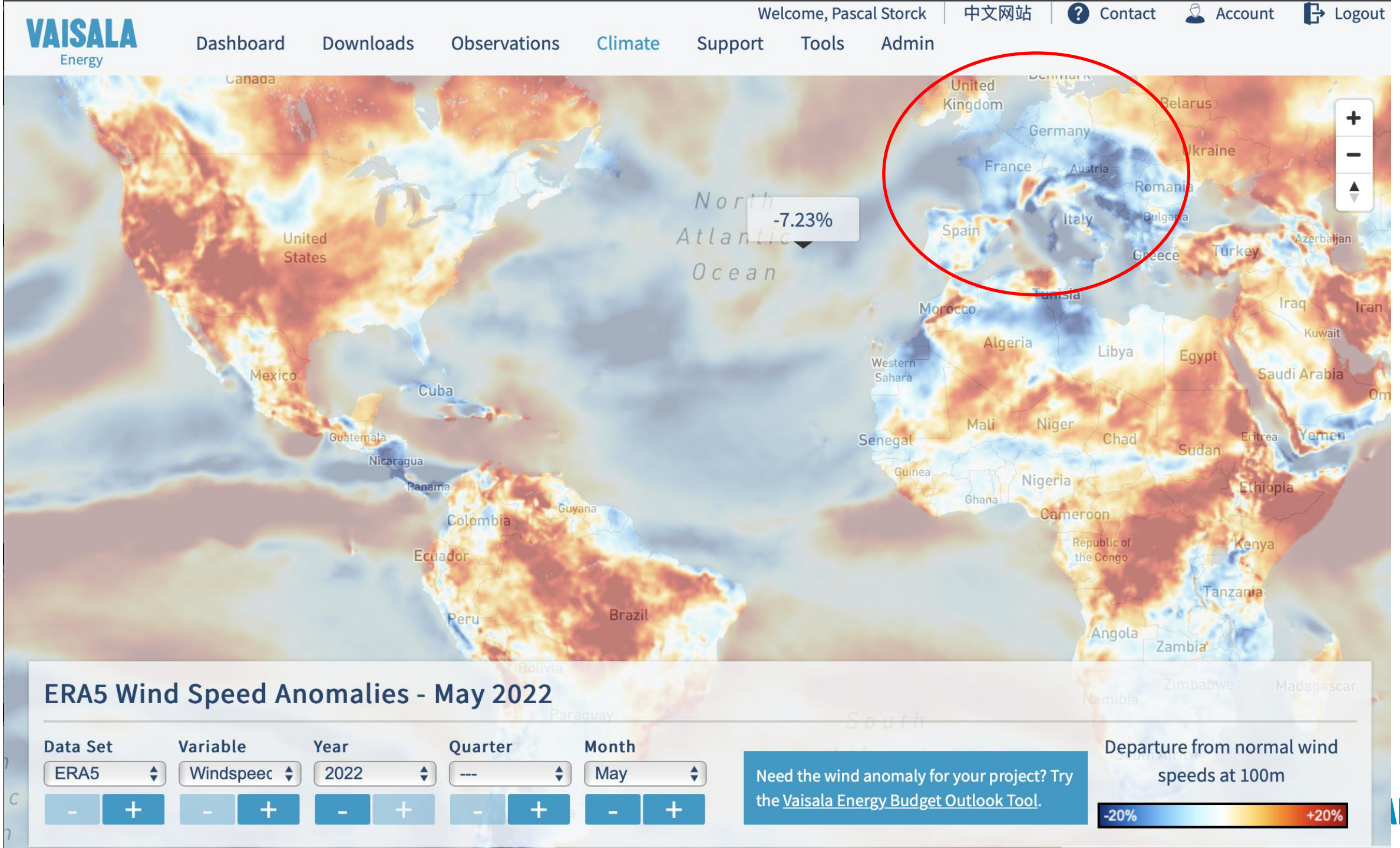
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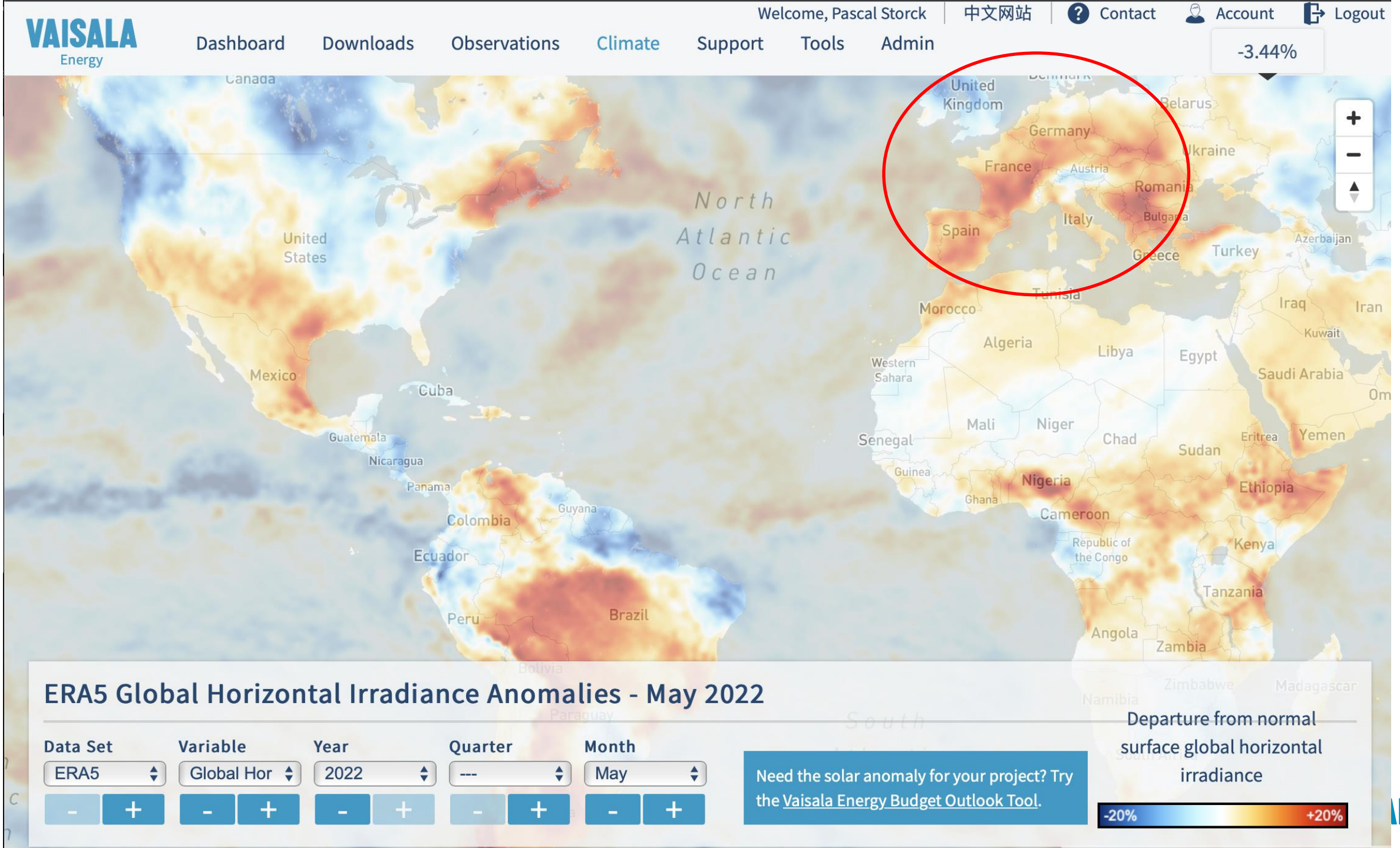
-7.23%
ERA5 Wind Speed Anomalies - May 2022
Data Set
ERA5
Variable
Windspeec
Year
2022
Quarter

Month
May
Need the wind anomaly for your project? Try the Vaisala Energy Budget Outlook Tool.
Departure from normal wind speeds at 100m
-20%
+20%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North Atlantic Ocean
United States
Mexico
Cuba
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Nicaragua
Panama
Colombia
Ecuador
Peru
Brazil
Guyana
Bolivia
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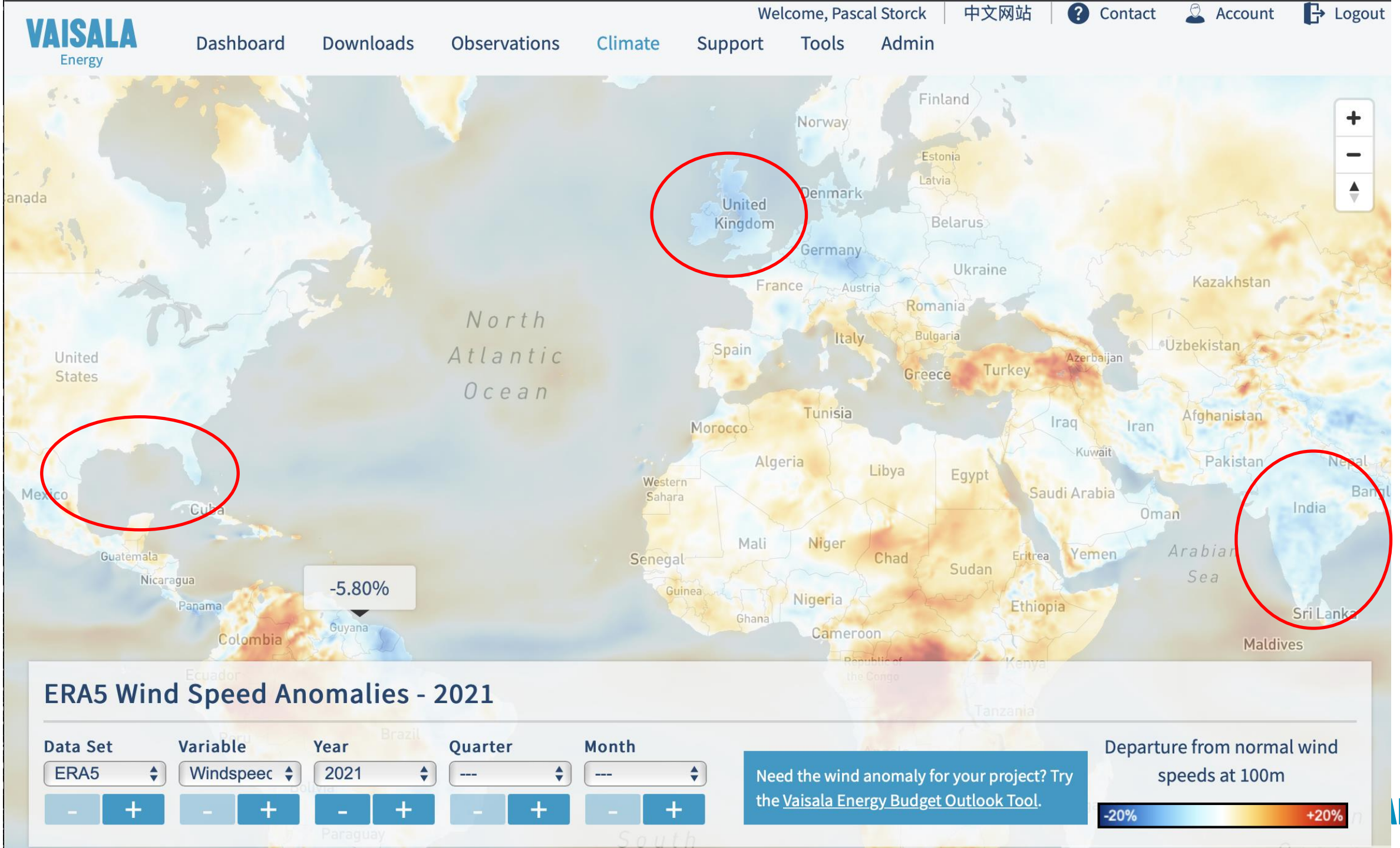
Germany
France
Spain
Italy
Austria
Belarus
Ukraine
Romania
Bulgaria
Greece
Turkey
Azerbaijan
Morocco
Algeria
Tunisia
Libya
Egypt
Western Sahara
Mali
Niger
Chad
Sudan
Eritrea
Yemen
Saudi Arabia
Iraq
Iran
Kuwait
Senegal
Guinea
Ghana
Nigeria
Cameroon
Republic of the Congo
Ethiopia
Kenya
Tanzania
Angola
Zambia
Zimbabwe
Namibia
Madagascar
ERA5 Global Horizontal Irradiance Anomalies - May 2022
Data Set
ERA5
Variable
Global Hor
Year
2022
Quarter

Month
May
Need the solar anomaly for your project? Try the Vaisala Energy Budget Outlook Tool.
Departure from normal surface global horizontal irradiance
-20%
+20%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North Atlantic Ocean
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Morocco
Iraq
Iran
Afghanistan
Kuwait
Pakistan
Algeria
Libya
Egypt
Western Sahara
Saudi Arabia
India
Oman
Mali
Niger
Chad
Sudan
Eritrea
Yemen
Arabian Sea
Senegal
Guinea
Nigeria
Ethiopia
Ghana
Cameroon
Sri Lanka
Maldives
ERA5 Wind Speed Anomalies - 2021
Data Set
ERA5
Variable
Windspeec
Year
2021
Quarter

Month

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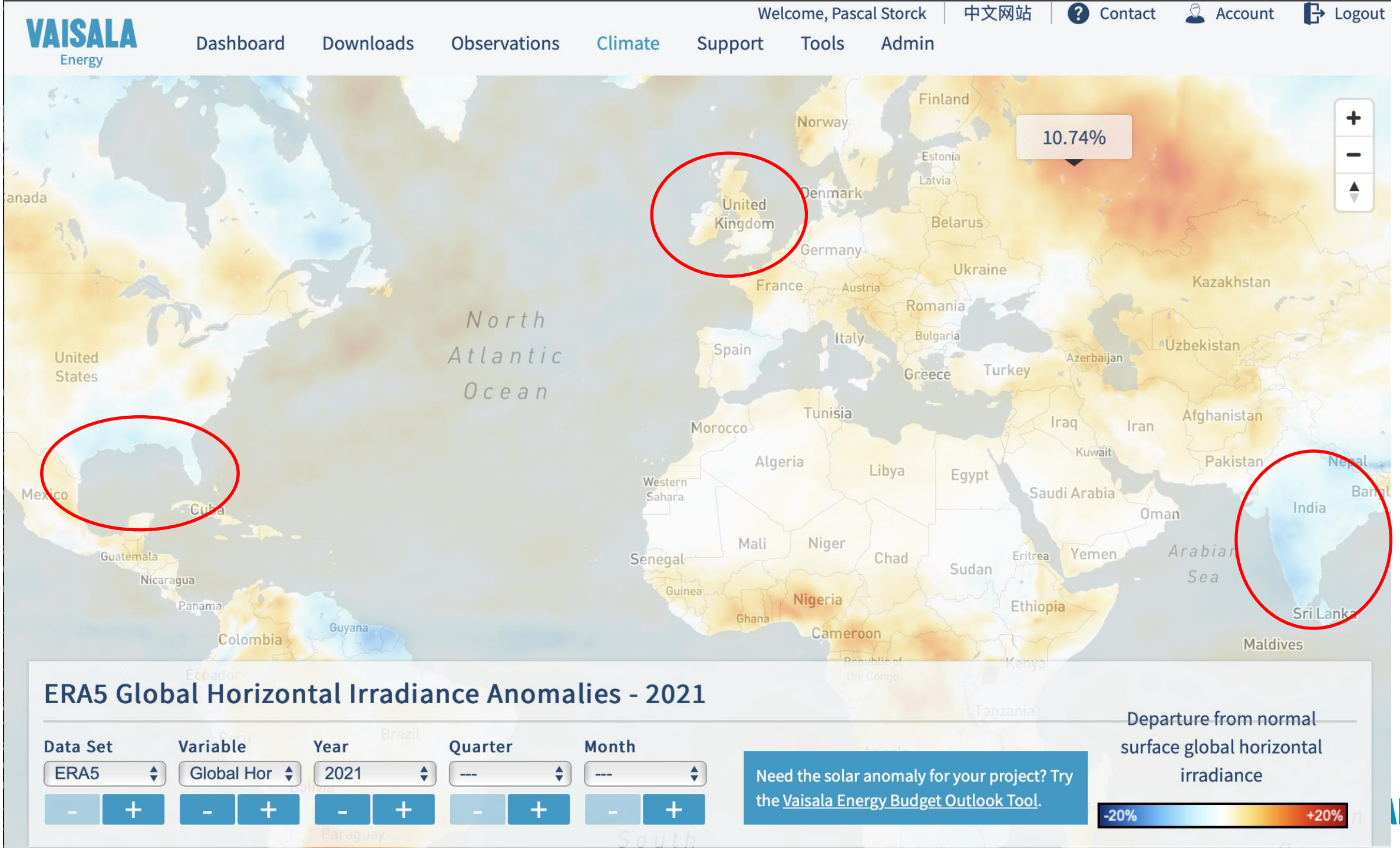
+20%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10.74%
North Atlantic Ocean
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Morocco
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Kuwait
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Western Sahara
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ERA5 Global Horizontal Irradiance Anomalies - 2021
Data Set
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Global Hor
Year
2021
Quarter

Month

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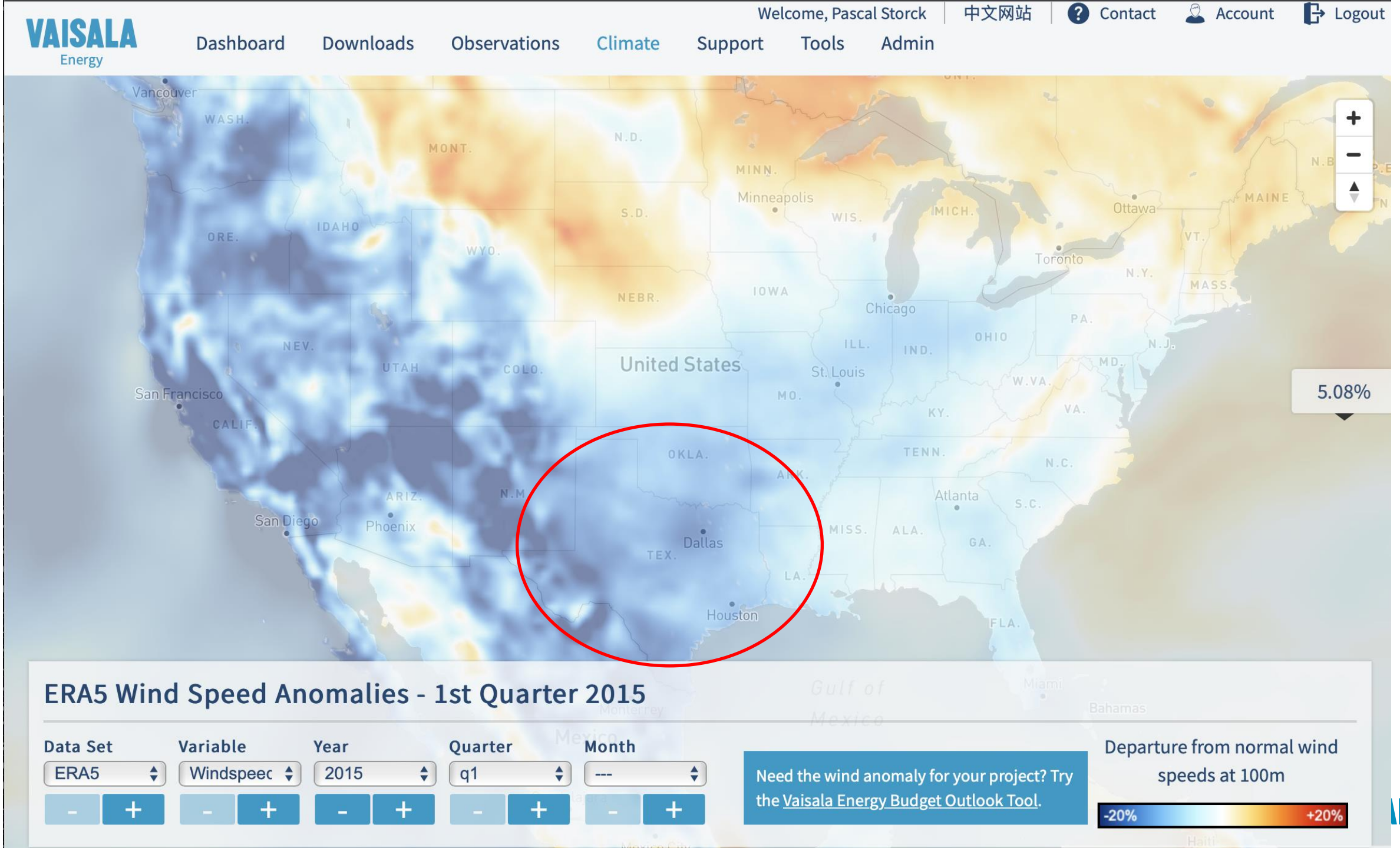
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ARIZ.
N.M.
Atlanta
S.C.
San Diego
Phoenix
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GA.
Dallas
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LA.
Houston
FLA.
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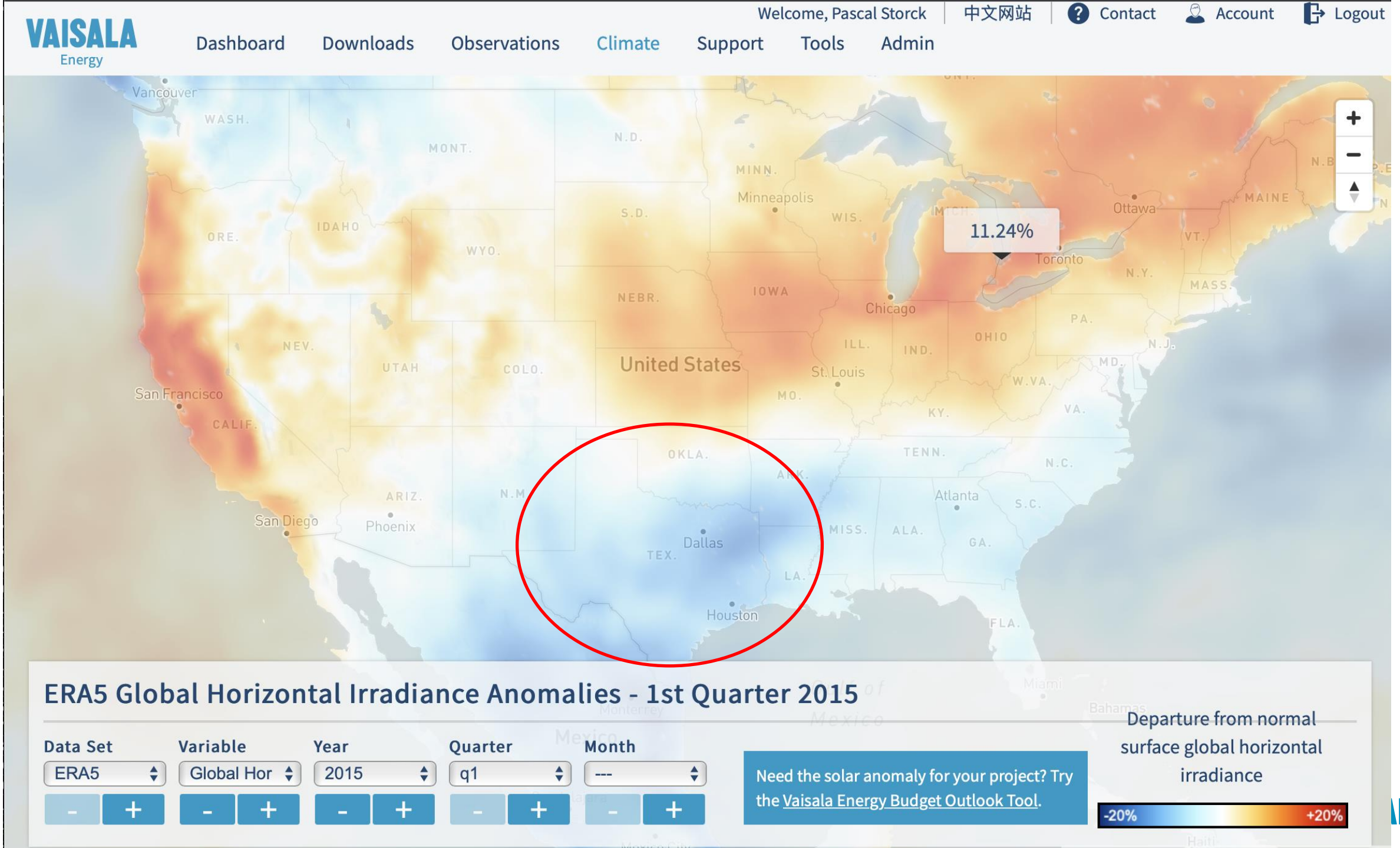
Miami
Bahamas
5.08%
ERA5 Wind Speed Anomalies - 1st Quarter 2015
Data Set
ERA5
Variable
Windspeec
Year
2015
Quarter
q1
Month

Need the wind anomaly for your project? Try the Vaisala Energy Budget Outlook Tool.
Departure from normal wind speeds at 100m
-20%
+20%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Vancouver
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Toronto
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St. Louis
San Francisco
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FLA.
ERA5 Global Horizontal Irradiance Anomalies - 1st Quarter 2015
Data Set
ERA5
Variable
Global Hor
Year
2015
Quarter
q1
Month

Need the solar anomaly for your project? Try the Vaisala Energy Budget Outlook Tool.
Departure from normal surface global horizontal irradiance
-20%
+20%

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

MAE Skill (%) before

Forecast Horizon (months)	All	Q1	Q2	Q3	Q4
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

Forecast Horizon (months)	All	Q1	Q2	Q3	Q4
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.

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

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