VORTEX

Would you like … ?

- More **accurate** 6-month wind-speed-anomaly **predictions**

albert.bosch@vortexfdc.com

Winterwind
INTERNATIONAL WIND ENERGY CONFERENCE

Would you like … ?

- More **accurate** 6-month wind-speed-anomaly **predictions**
- Annual energy production budget **updates**

albert.bosch@vortexfdc.com

Would you like … ?

- More **accurate** 6-month wind-speed-anomaly **predictions**
- Annual energy production budget **updates**
- Energy **storage** scheduling
- Long-term energy **trading**

albert.bosch@vortexfdc.com

6-Month seasonal forecasting of monthly wind speed anomalies

Albert Bosch, Gerard Castro, Jordi Ferrer
VORTEX (www.vortexfdc.com)

6-Month seasonal forecasting of monthly wind speed anomalies

Using monthly climatology averages is not effective for anomalous cases because, monthly wind speed anomaly changes every month.

albert.bosch@vortexfdc.com

Objectives

- To **develop** a new methodology for seasonal forecasting.
- To **improve** on **climatology** for 6-month wind speed anomaly predictions.

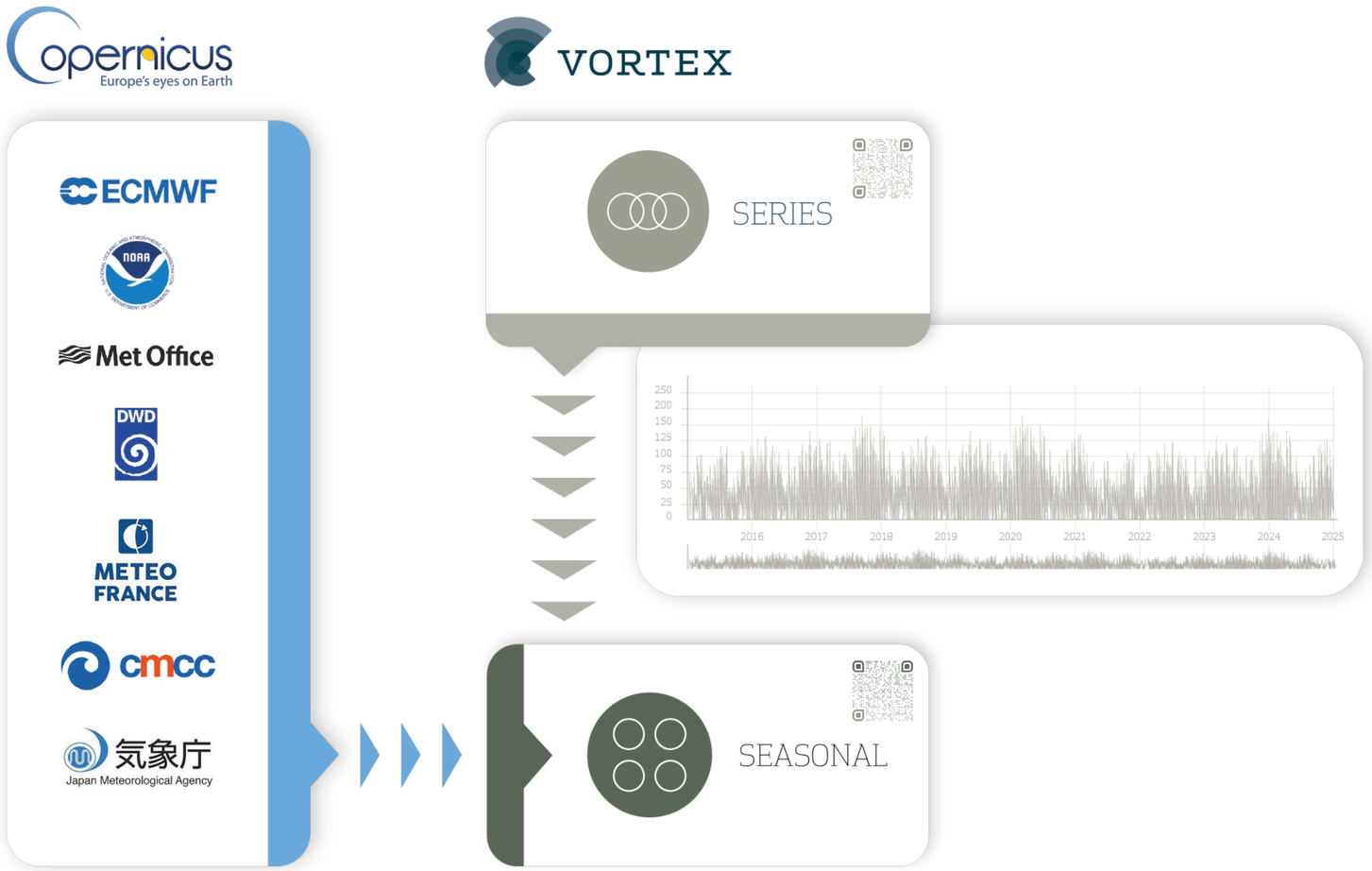
Objectives

- To **develop** a new methodology for seasonal forecasting.
- To **improve** on **climatology** for 6-month wind speed anomaly predictions.
- To **increase** forecast **skill** using multiple seasonal models.
- To **use** machine learning to obtain the best site-specific performance.

Objectives

- To **develop** a new methodology for seasonal forecasting.
- To **improve** on **climatology** for 6-month wind speed anomaly predictions.
- To **increase** forecast **skill** using multiple seasonal models.
- To **use** machine learning to obtain the best site-specific performance.
- To **validate** the new methodology in 50 sites around global wind industry regions and in 19 European locations.

Methods



1. A **Vortex SERIES** is launched to obtain the monthly wind speed averages as climatic reference.
2. **Anomalies** are calculated for each month over a reference period for different **seasonal models** from **Copernicus**.

Figure 1. Illustration of Vortex SEASONAL [1] prediction methodology

Methods

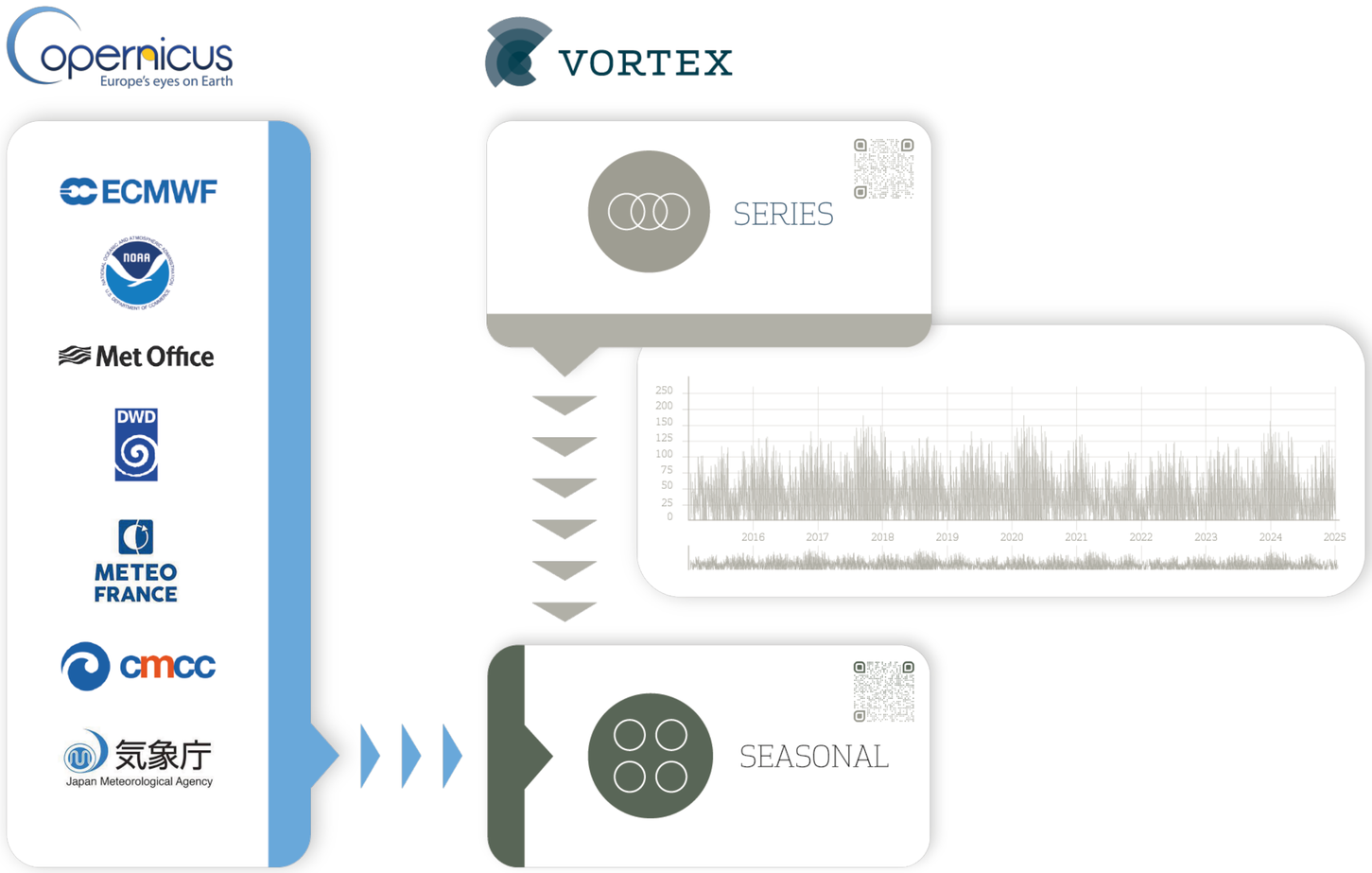


Figure 1. Illustration of Vortex SEASONAL [1] prediction methodology

1. A **Vortex SERIES** was launched to obtain the monthly wind speed averages as climatic reference.
2. **Anomalies** were calculated for each month over a reference period for different **seasonal models** from **Copernicus**.
3. The models were **compared** for each site and lead month, and then **ranked** based on the reference anomalies.
4. To further enhance the forecast skill, **machine learning** techniques were employed, and the improvement over climatology and trending are maximised to **select the best performing seasonal model**.

Validation Sites

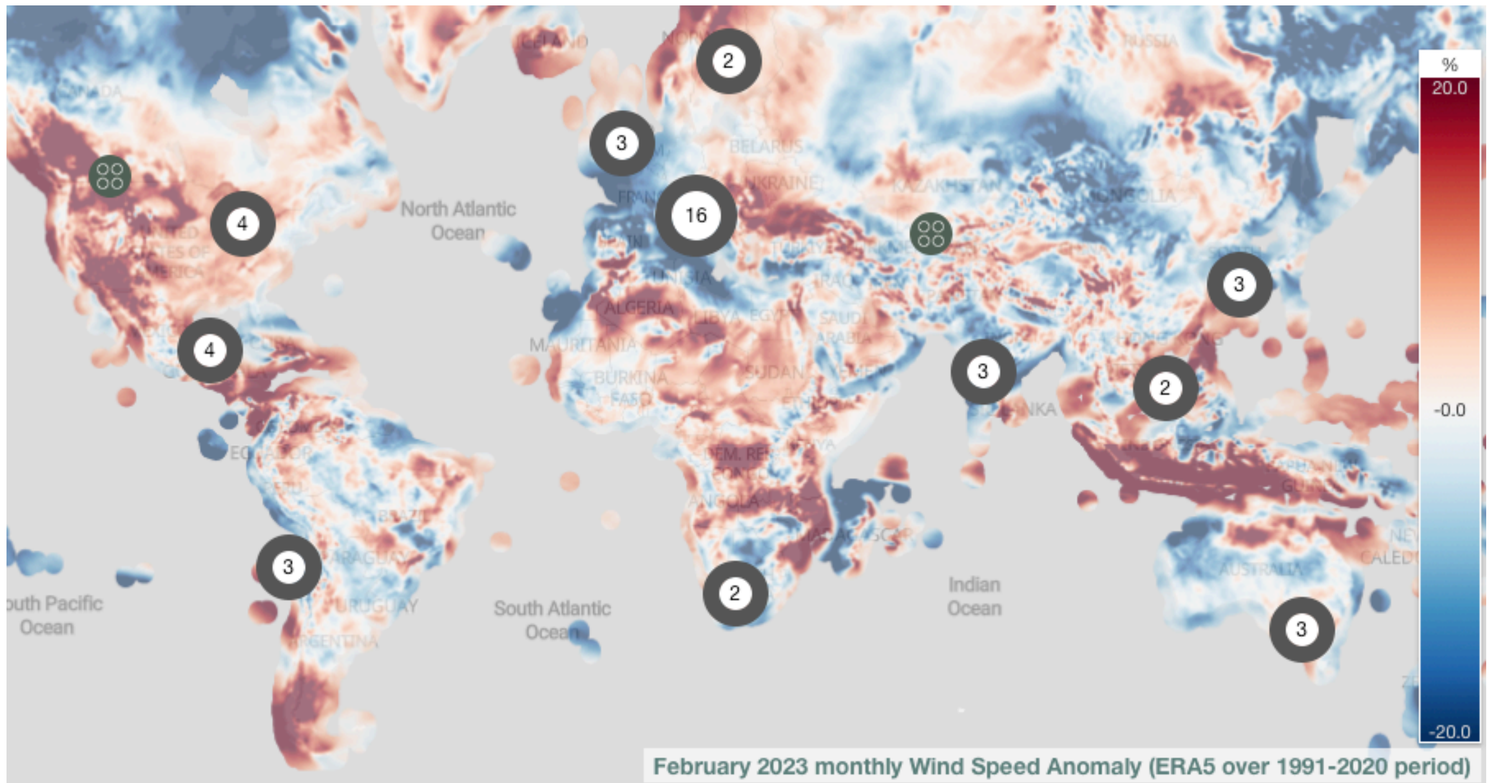


Figure 2. 50 global site locations on wind industry regions.

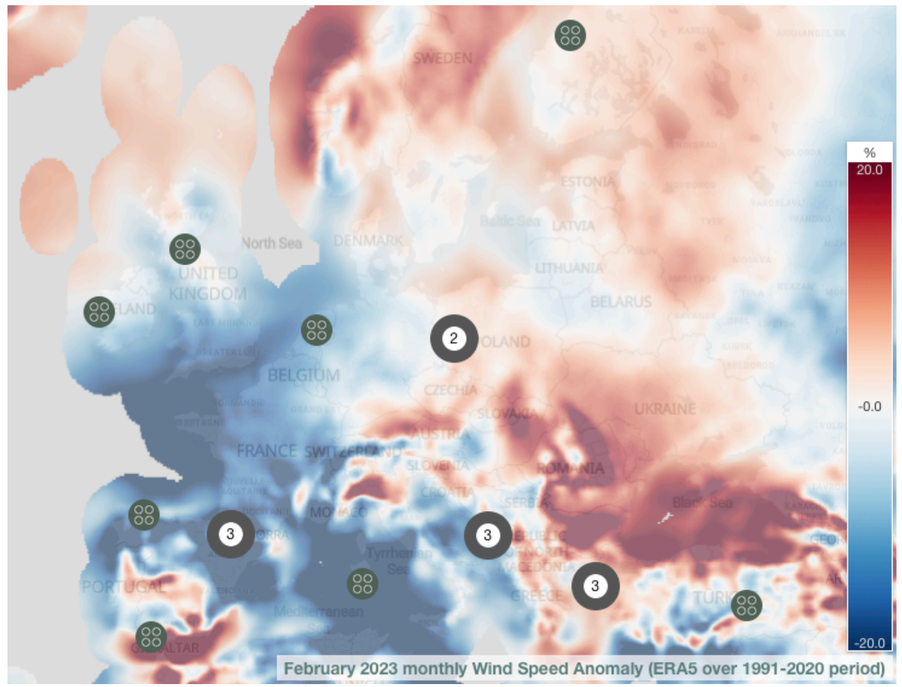


Figure 3. 19 European site locations on wind industry regions.

Results

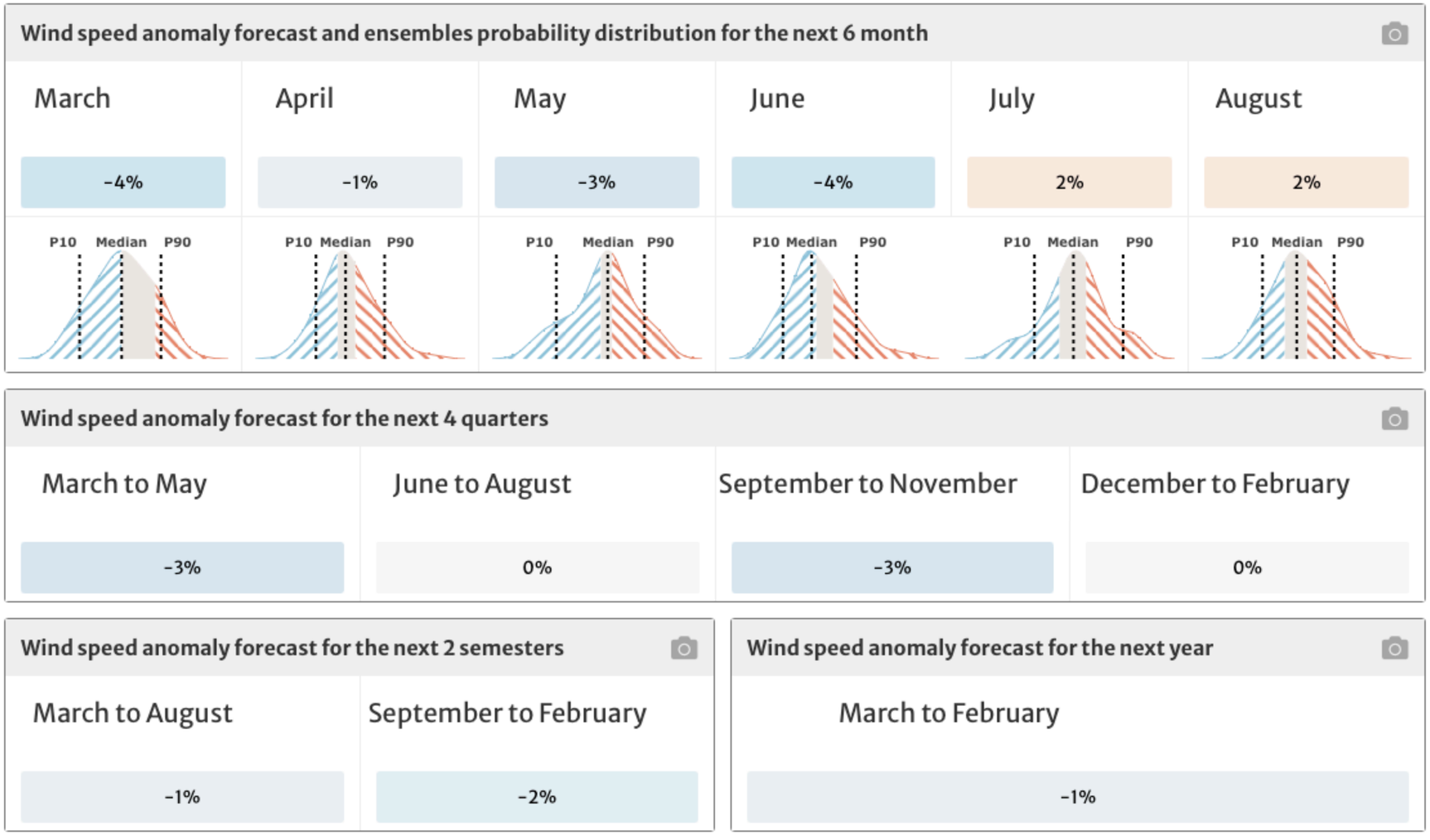


Figure 4. SAMPLE of Vortex SEASONAL monthly prediction.

Results

	Anomaly	1 month	2 month	3 month	4 month	5 month	6 month
2023 March		5.0	4.0	2.0	1.0	3.0	5.0
2023 February	12.22	2.0	6.0	4.0	4.0	2.0	1.0
2023 January	3.25	-0.0	2.0	4.0	4.0	3.0	3.0
2022 December	5.03	2.0	-1.0	1.0	0.0	1.0	2.0
2022 November	5.24	1.0	-1.0	0.0	0.0	1.0	0.0
2022 October	-12.15	-10.0	-1.0	-1.0	-1.0	0.0	-1.0
2022 September	-3.04	-6.0	-3.0	-1.0	-0.0	-2.0	-1.0
2022 August	-15.08	-7.0	-2.0	0.0	0.0	2.0	-1.0
2022 July	-3.11	-6.0	-1.0	-2.0	-3.0	2.0	4.0
2022 June	2.91	2.0	8.0	7.0	4.0	8.0	5.0
2022 May	11.32	6.0	5.0	5.0	4.0	5.0	7.0
2022 April	10.12	6.0	5.0	4.0	1.0	3.0	4.0

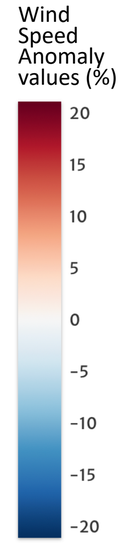


Figure 5. SAMPLE of Monthly wind speed anomalies and six-months ahead Vortex SEASONAL predictions (%)

Results

Table 1. **GLOBAL** Validation metrics for 6-month ahead prediction (**50** sites)

Bias	Mean Absolute Error	Improvement over climatology (%)	Trending (%)
-0.02	8.56	57.88	60.53

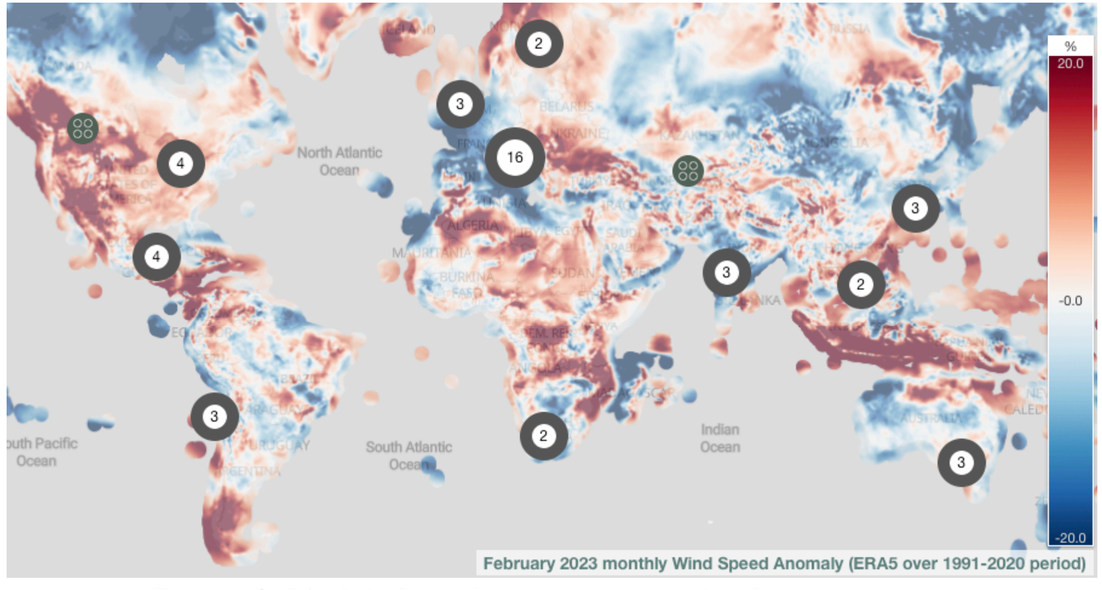


Figure 2. 50 global site locations on wind industry regions.

Results

Table 1. **EUROPEAN** Validation metrics for 6-month ahead prediction (**19** sites)

Month	Bias	Mean Absolute Error	Improvement over climatology (%)	Trending (%)
1	-0.31	3.1	67.5	73.5
2	1.42	3.9	63.7	69.8
3	0.5	4.0	58.9	67.4
4	0.85	3.3	57.1	60.7
5	0.29	3.2	56.1	59.5
6	0.06	3.1	51.4	57.2
MEAN	0.47	3.4	59.1	64.7

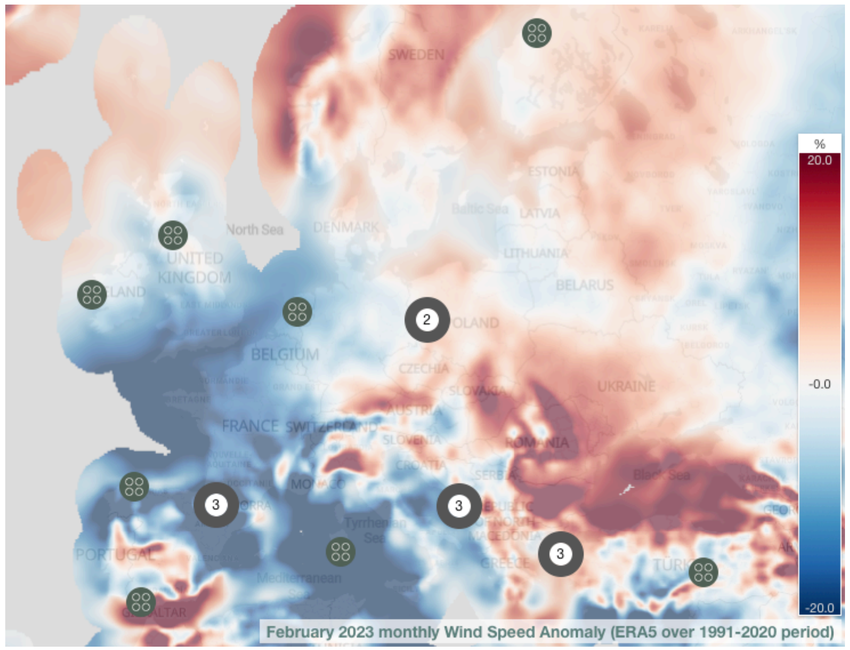


Figure 3. 19 European site locations.

Conclusions

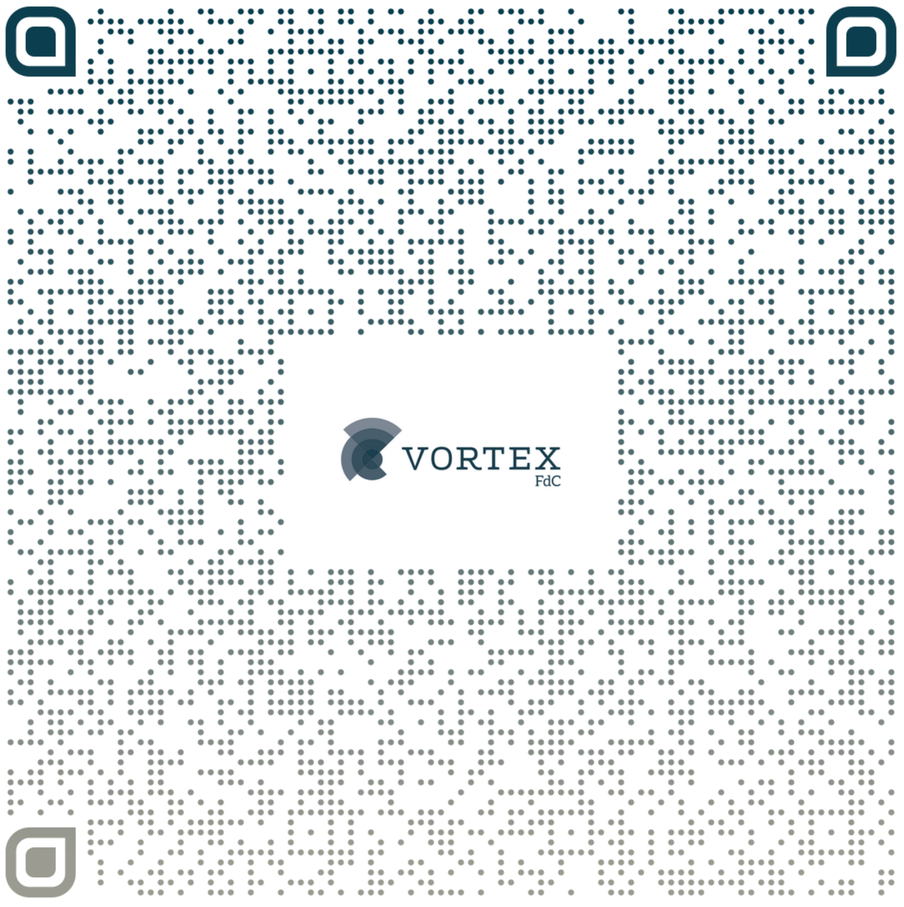
- A new methodology using machine learning techniques was developed without using previous wind-speed measurements to choose the best prediction from different seasonal models.

Conclusions

- A new methodology using machine learning techniques was developed without using previous wind-speed measurements to choose the best prediction from different seasonal models.
- The validation of this methodology demonstrated that it is useful for 6-month forecasting of wind speed anomalies and is able to outperform climatology predictions and skills. This methodology will allow more accurate 6-month wind-speed-anomaly predictions for the wind industry.

Conclusions

- A new methodology using machine learning techniques was developed without using previous wind-speed measurements to choose the best prediction from different seasonal models.
- The validation of this methodology demonstrated that it is useful for 6-month forecasting of wind speed anomalies and is able to outperform climatology predictions and skills. This methodology will allow more accurate 6-month wind-speed-anomaly predictions for the wind industry.



albert.bosch@vortexfdc.com