Using **AI downscaling** and **physical models** to **anticipate & mitigate wind drought** months

Seasonal wind forecasts: how to anticipate and mitigate wind drought impacts

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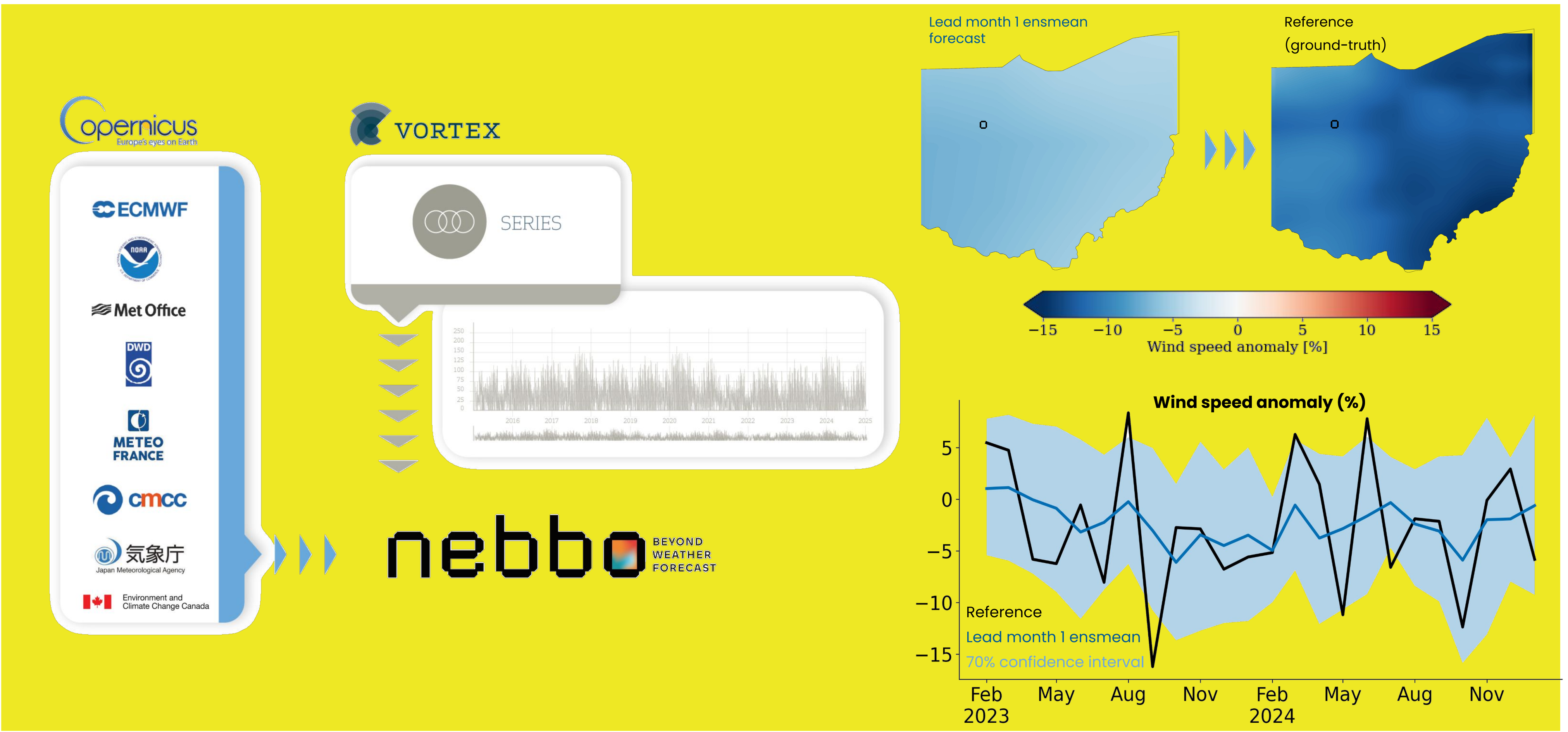

Fig. 1: Nebbo methodology represented at the left side. At the top right, the Hog Creek wind farm is displayed in an Ohio map (top) for both forecast & historical layers during the peak of its wind drought period (Oct 24). At the bottom right, the time series for the Nebbo multi-model forecast (ensemble mean) with lead month 1 and 70% coverage is shown for Feb 23 - Jan 25.

Introduction

Nebbo leverages **AI-enhanced seasonal forecasts** to **reliably** foresee **anomalous** episodes. In this poster, the **Hog Creek** park (40.79º, -83.730º; Dola, Ohio) is featured as a **use-case**. During **May - Nov 2024**, the site suffered from a **wind drought** which was **successfully foreseen months** in **advance**.

Methods

Our technology consists of 3 main steps:

- Forecast calibration through **statistical downscaling** using:
  - 3km mesoscale ERA5-simulated 30yrs time series as ground truth (Vortex SERIES)
  - 8 different state-of-the-art physical models from renowned weather centres (C3S hub)
- **Multi-model** definition
- **Predictive interval** construction
  - Used to avoid reliability issues and obtain statistically valid results from the forecasted probability distribution

Results

Based on our methodology, we conclude that:

- Forecast bias is corrected but variance is still slightly large compared to reference (Fig. 4).
- The multi-model approach is generally more robust than individual models.
- Predictive intervals are effective:
  - They cover the ground truth approximately 70% of the time, as expected (Fig. 2).
  - They remain informative with reasonable width (Fig. 2).
  - They offer a better alternative to an imperfect forecast distribution.

Discussion

Our **methodology** successfully provides **reliable forecasts** across different **lead months**, particularly the first ones. The **multi-model** approach and **predictive intervals** enhance accuracy, ensuring **statistically valid** and **informative** results. Thus, **stakeholders** could **use** this **technology** to **anticipate** and **mitigate** the **impact** of **wind drought** periods, such as the observed in Hog Creek during May-Nov 2024.

Extra tables & figures

Forecast metrics
for **1**, **2** and **3** months ahead

	L1	L2	L3
MAE (m/s)	0.33	0.35	0.37
Interval width (m/s)	1.08	1.27	1.24
Coverage (%)	75	79	75
Anomaly sign hit rate (%)	79	79	71

Fig. 2: Re-forecast metrics for Nebbo multi-model & Feb 2023 - Jan 2025 period. The ensemble mean of lead months 1 (L1), 2 (L2) & 3 (L3) is compared with Vortex SERIES ground-truth.

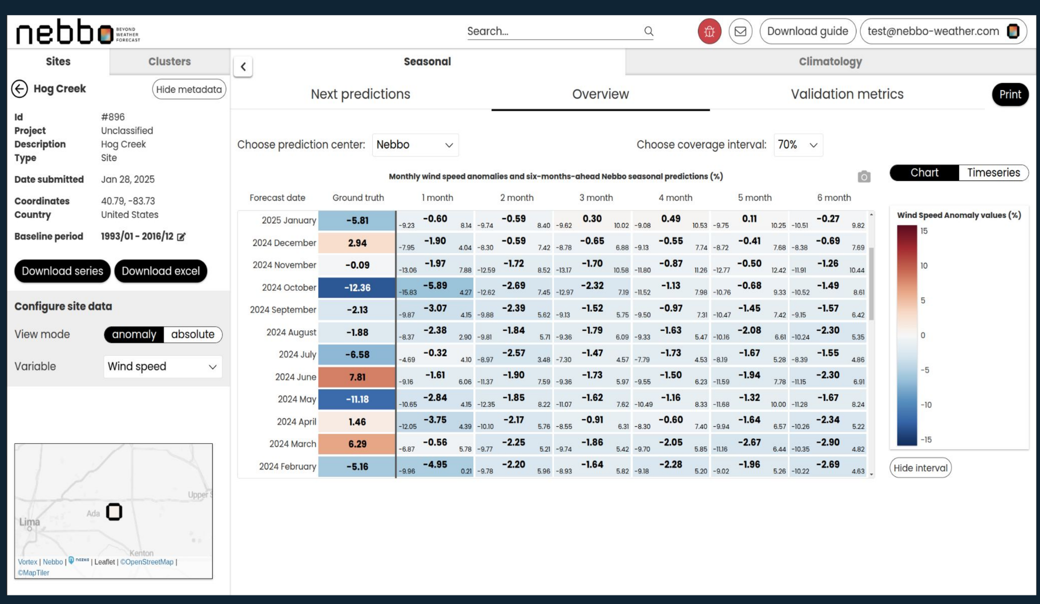

Fig. 3: Overview tab of the Nebbo interface. It showcases the different predictions (with intervals) for different forecast months and lead months.

Forecast distributions
for **1**, **2** and **3** months ahead

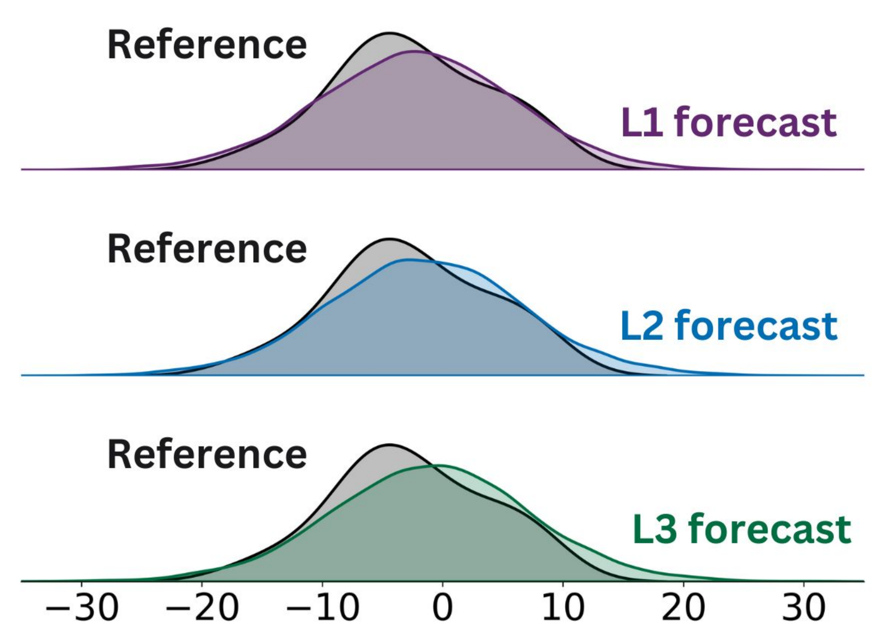

Fig. 4: Re-forecast distributions for Nebbo multi-model & Feb 2023 - Jan 2025 period. The ensemble forecast distributions of lead months 1 (L1), 2 (L2) & 3 (L3) is compared with Vortex SERIES ground-truth (Reference).

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nebbo BEYOND WEATHER FORECAST

Vortex **Multiverse**