



# LCOE optimisation offshore wind farms in Denmark using Vortex

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# POINTS FOR DISCUSSION

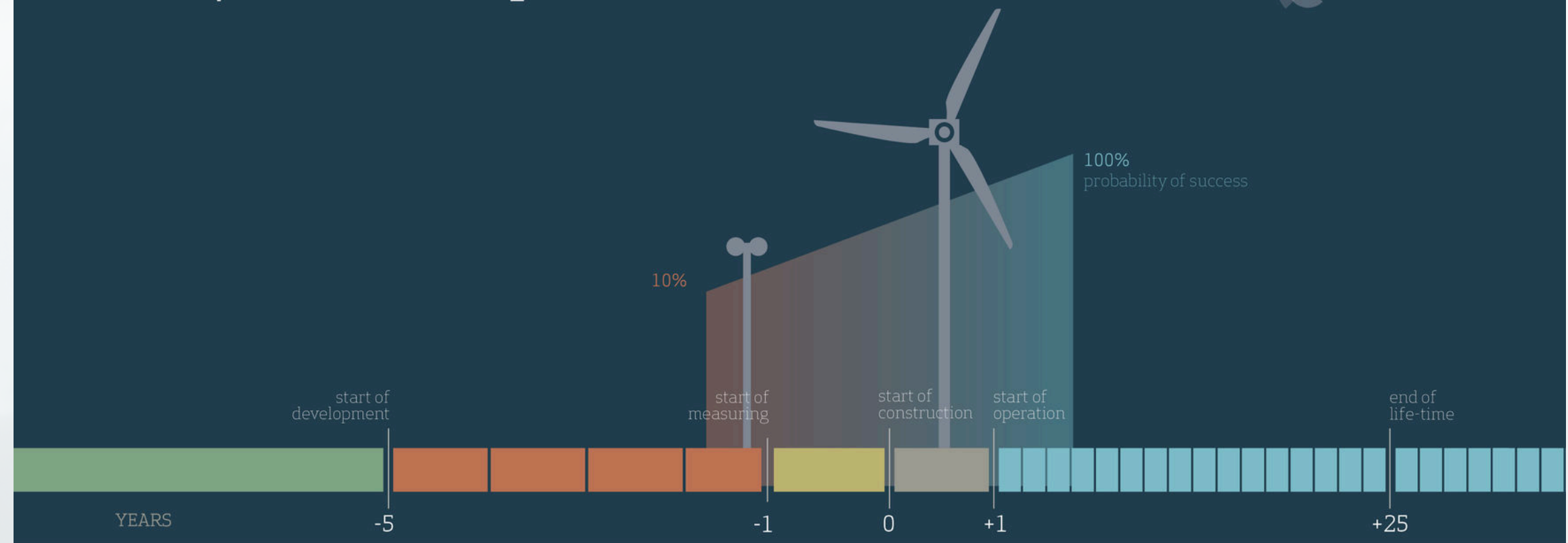
FARM  
SERIES  
LES  
VALIDATION



## **AN INTRODUCTION**

Vortex simulates wind resource data for the wind industry through a prestigious atmospheric model. The modeled data is able to use at any stage of the project lifecycle and can be simulated at any point around the world. Our products are highly accurate and unique thanks to our pioneering on-demand modeling approach.

# Wind farm development



MAPS



MAST



LES



SERIES



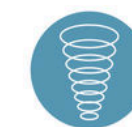
LES



FARM



BLOCKS



EXTREMES



BLOCKS



LES

CLIMATE SCALE



SEASONAL



SIROCCO

PROSPECTING

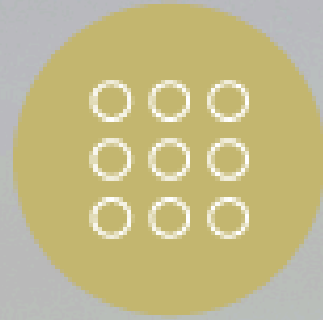
PRE-FEASIBILITY

DESIGN

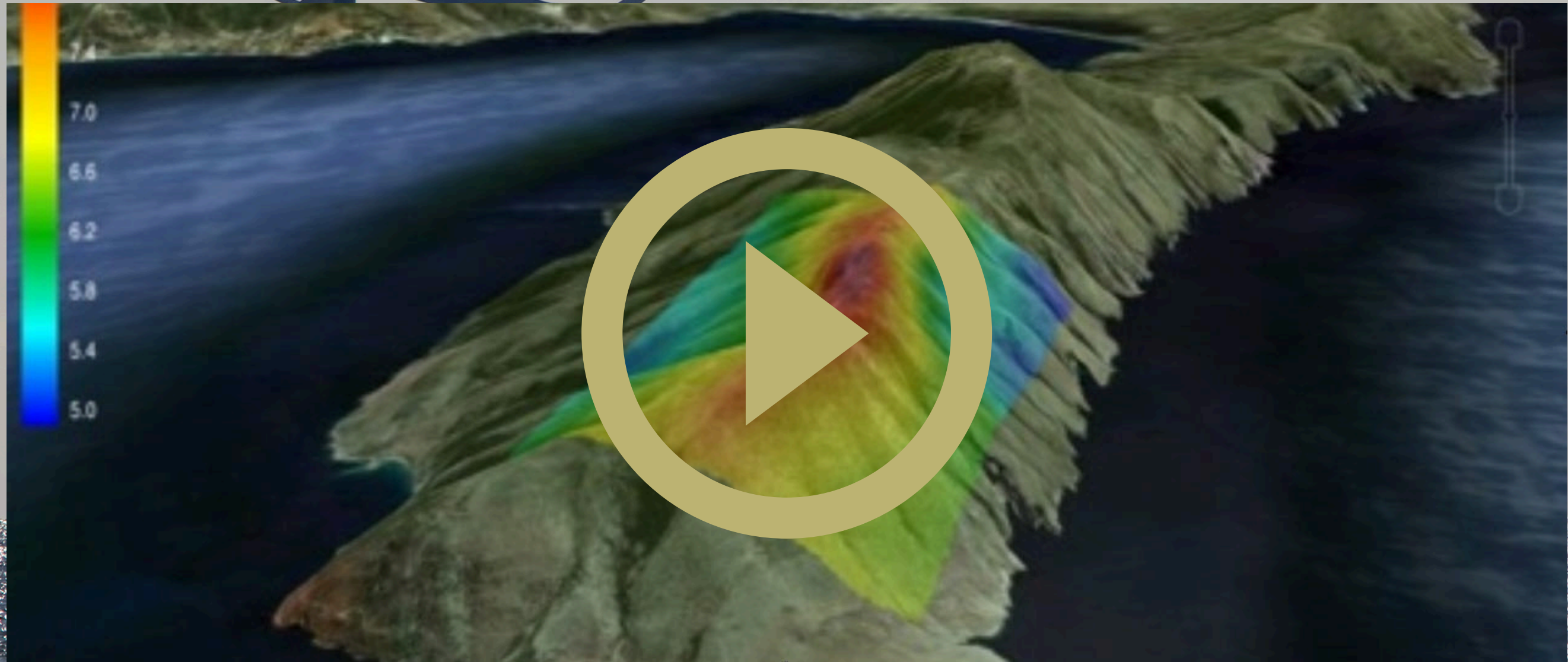
OPERATION

POINTS FOR DISCUSSION

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FARM





## WRG FILE

All heights included from 50m to 300m  
16 sectors wind direction rose



## 100 M RESOLUTION

Characteristic turbulence intensity  
distribution in speed bins.



## 500 - 4000 SQ KM

FARM standard, large and EXTRA



## CALIBRATED

3-D Remodeling: calibrate WRGs with  
measurements

## **WRG FILE**

which characterize the wind field gradients to compute mean AEP



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# SERIES





## **3KM RESOLUTION**

Hourly



## **10, 20, 30 YEARS**

6 months free trial available

Selectable source: NCEP, NASA and ECMWF



## **VARIABLES**

Wind speed and direction, temperature & pressure



## **REMODELING**

Vortex MCP

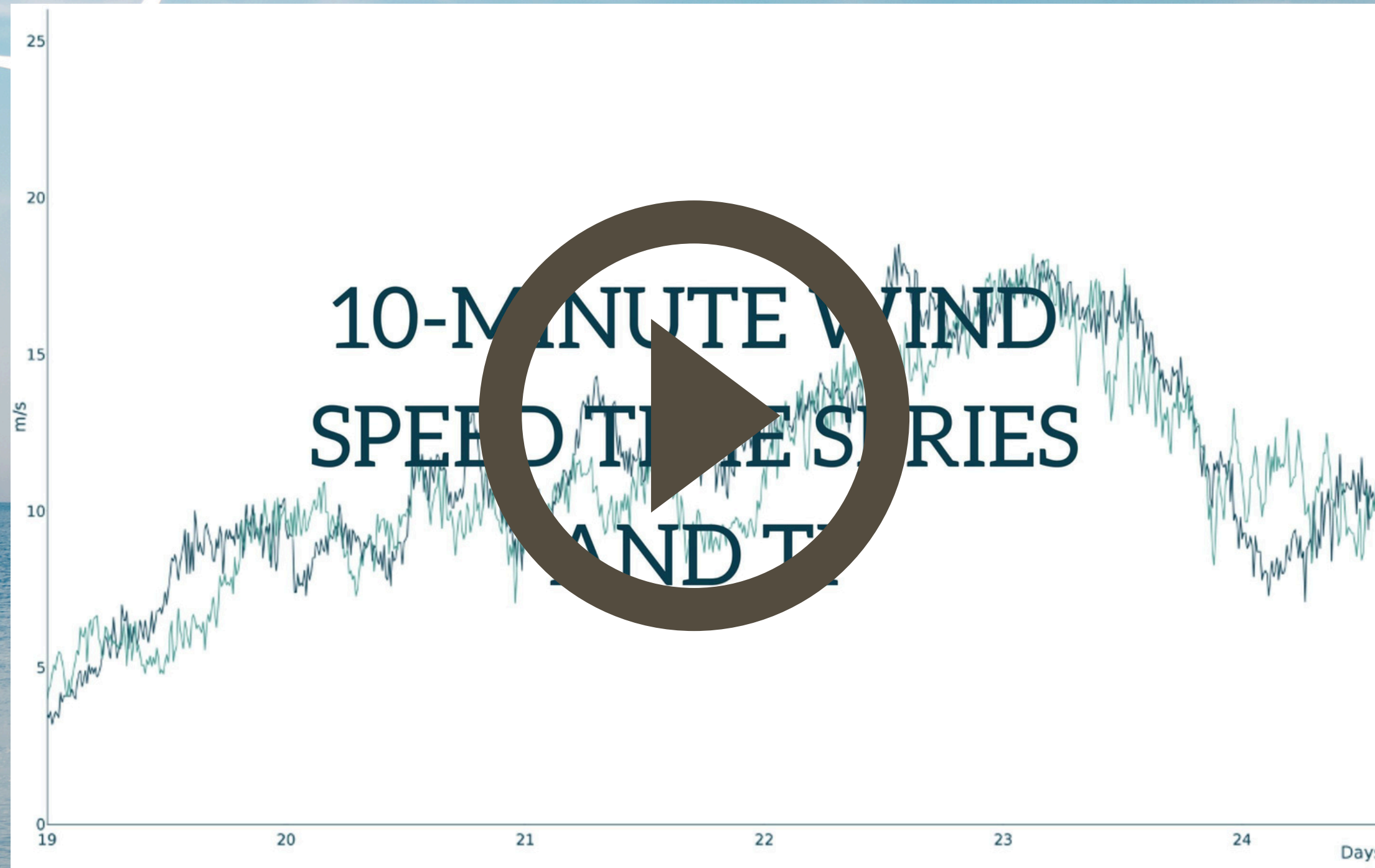
## **SERIES**

contains the annual and seasonal variability that modulate such AEP along years and months

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## **100M RESOLUTION**

Any location worldwide



## **10MIN**

Physically computed 10-min average records.



## **TURBULENCE**

Wind-speed standard deviation for Turbulence Intensity calculation



## **PERIOD SELECTABLE**

1 full year selectable or long-term representative.

## LES

delivers turbulence intensity which is crucial to compute wakes offshore



**POINTS FOR DISCUSSION**

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**VALIDATION**

# LES OFFSHORE VALIDATION

## 18 SETS

Europe, India, China,  
Taiwan and USA

## WIND SPEED

## STANDARD DEVIATION

## TURBULENCE INTENSITY

# RESULTS

	R <sup>2</sup>				RMSE (m/s)				Bias (%)	Abs error (%)	A-error (%)	K-error (%)
	10'	hourly	daily	monthly	10'	hourly	daily	monthly				
Average	0.84	0.87	0.94	0.98	2.05	1.90	1.16	0.46	-1.31	3.06	1.34	8.21
Std Deviation	0.06	0.06	0.03	0.03	0.22	0.42	0.36	0.24	4.13	2.99	3.8	5.93

Table 2: validation results averaged for 18 sites

[vortexfdc.com/resources](https://vortexfdc.com/resources)