



Wind Modelled Data for Offshore Projects

Vortex Solutions and Experiences

Webinar

November 2021

Jordi Ferrer

Managing Director

POINTS OF DISCUSSION

1. VORTEX Experience
2. WRF Model
3. VORTEX Solutions for Offshore Projects:
 - A. Standard Solutions
 - B. Customised Solutions

POINTS OF DISCUSSION

1. VORTEX Experience

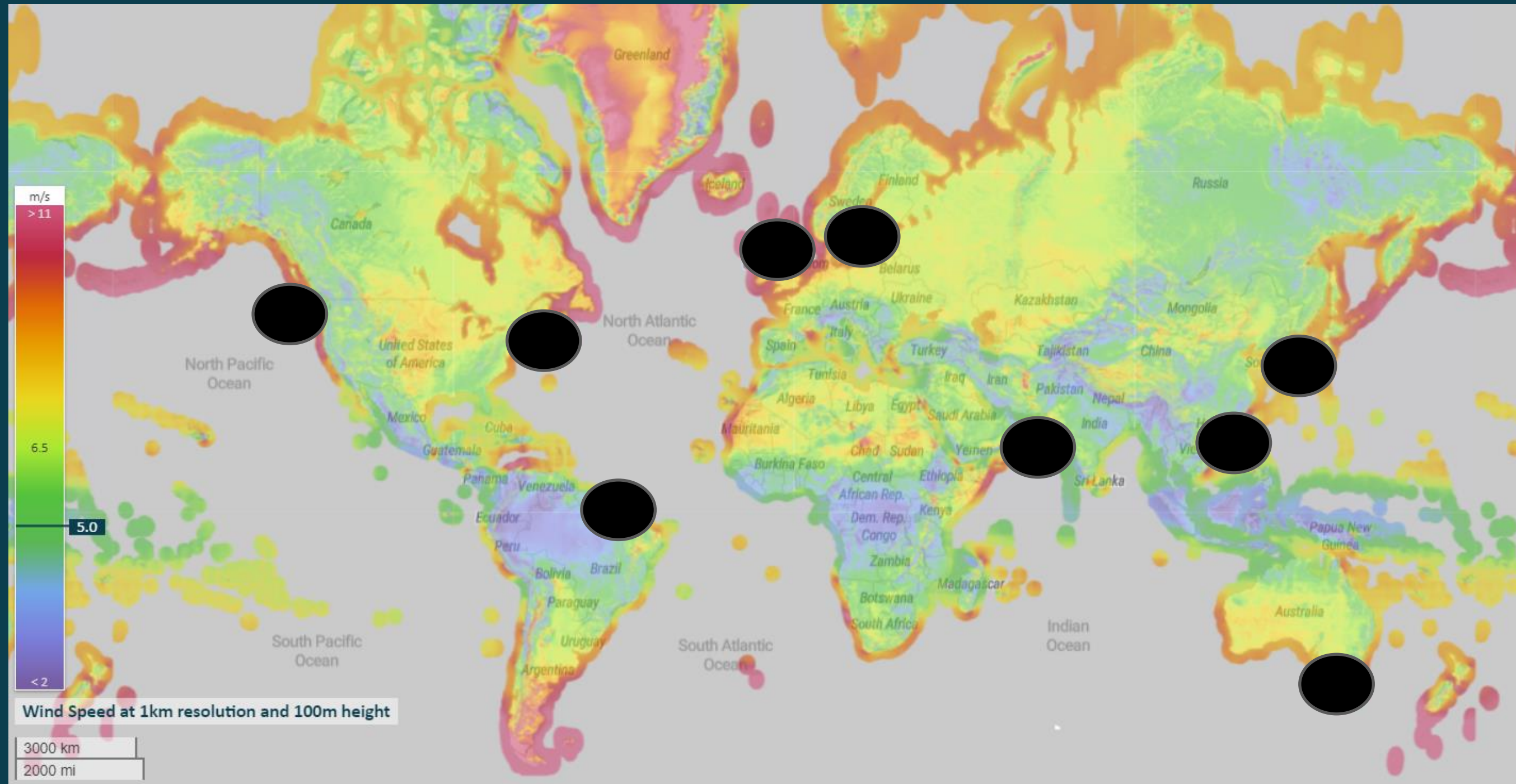
2. WRF Model

3. VORTEX Solutions for Offshore Projects:

A. Standard Solutions

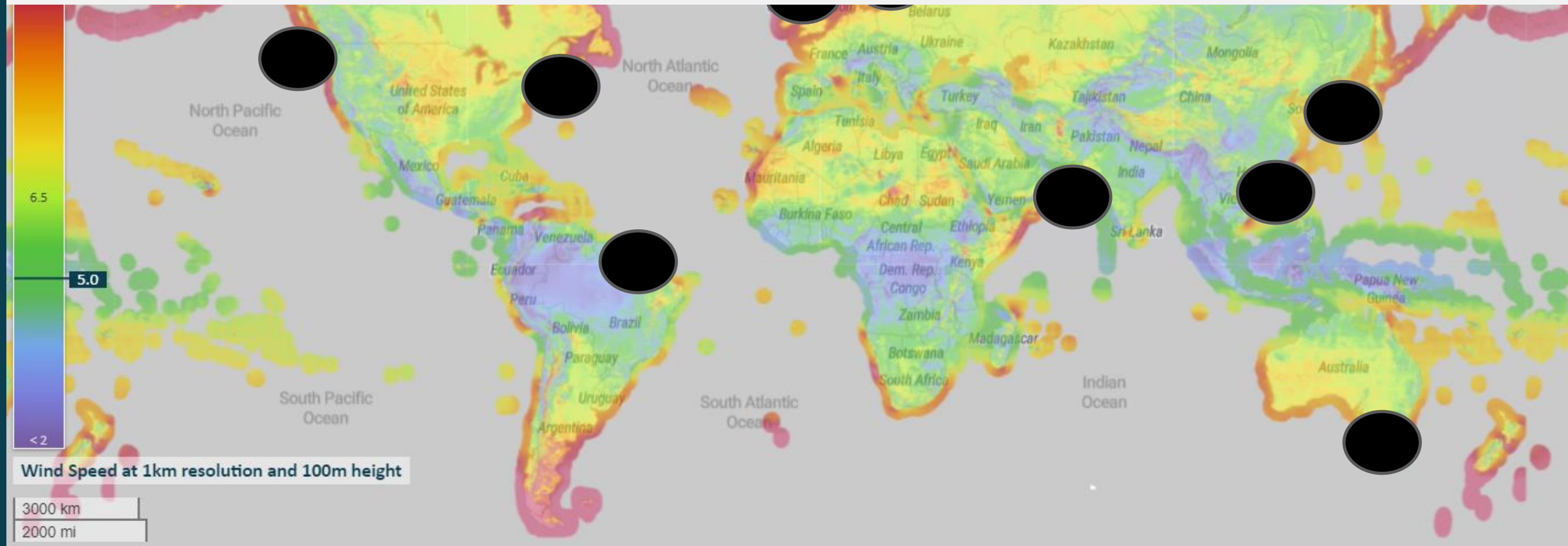
B. Customised Solutions

Experience



Experience

Less measurements



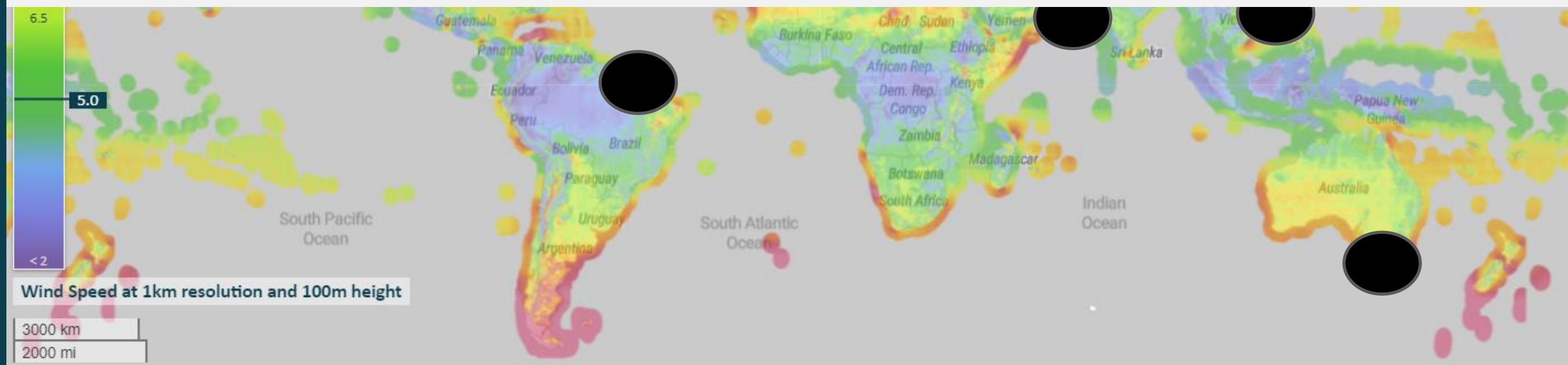
Experience



Less measurements



Different environment



Experience



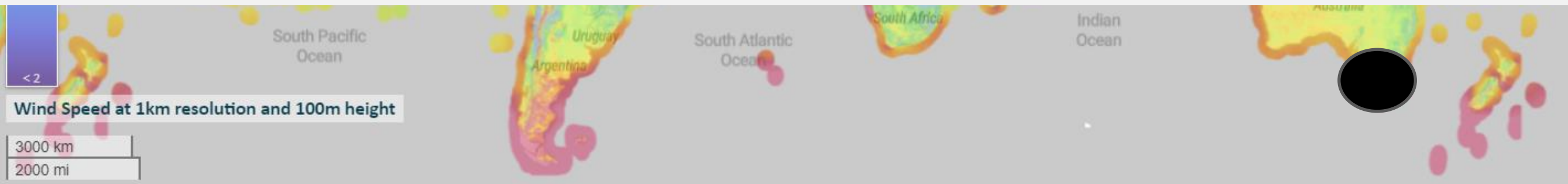
Less measurements



Different environment



Waves



POINTS OF DISCUSSION

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WRF Model

DOWNSCALING

MACROSCALE:



WRF



MESOSCALE:



WRF

MICROSCALE:

Raw reanalysis data
ERA5, MERRA2, CFSR



MAPS



SERIES



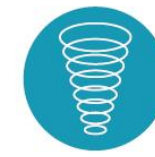
FARM



LES



BLOCKS



EXTREMES

WRF Model

DOWNSCALING

MACROSCALE:



WRF



MESOSCALE:



WRF

MICROSCALE:

Raw reanalysis data
ERA5, MERRA2, CFSR



MAPS



SERIES



FARM



LES



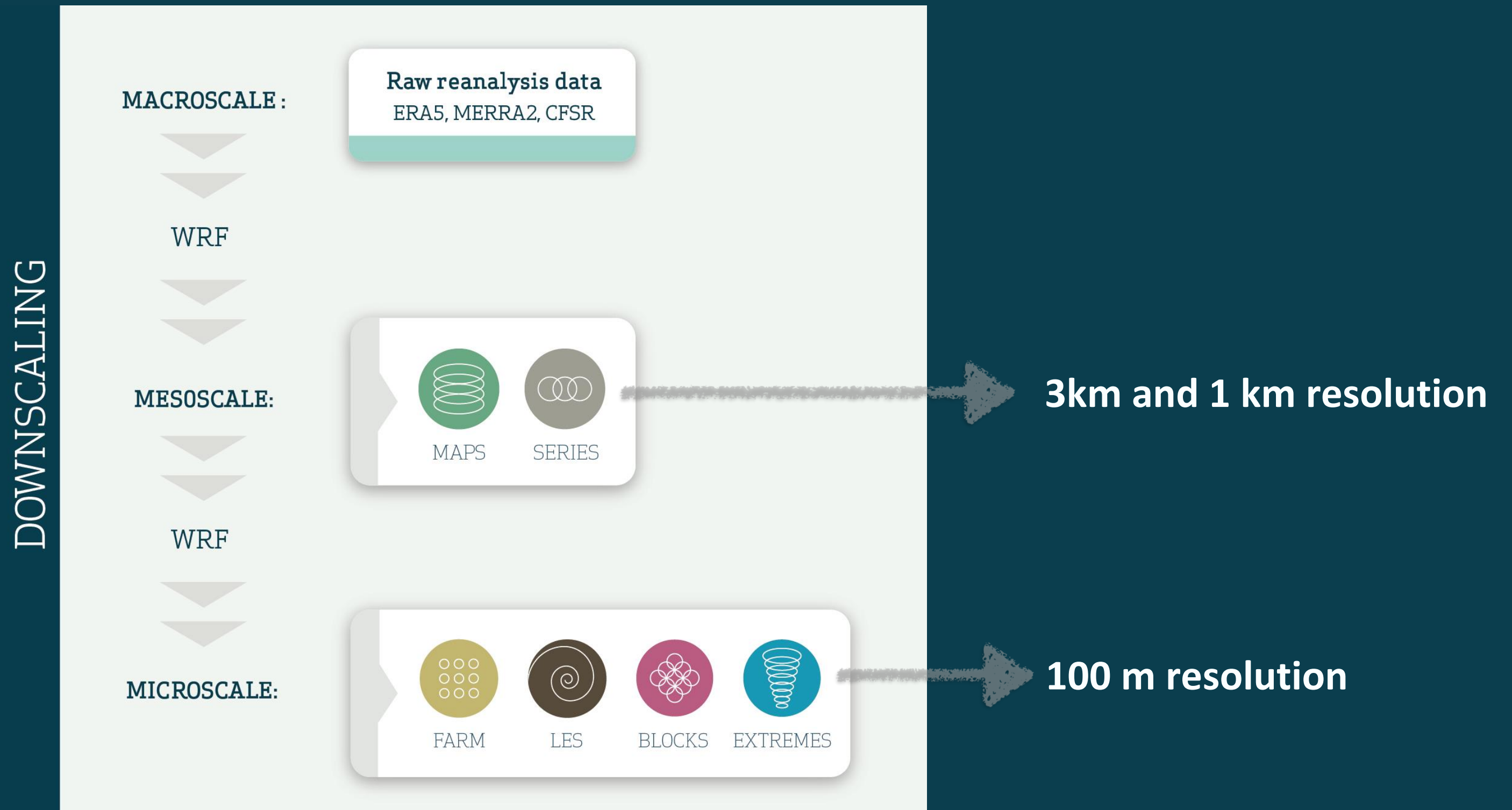
BLOCKS



EXTREMES

3km and 1 km resolution

WRF Model



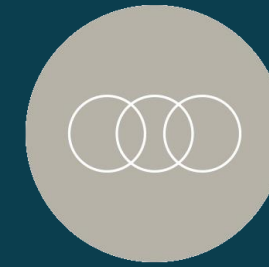
POINTS OF DISCUSSION

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Vortex Standard Solutions for Offshore Wind Projects

Vortex SERIES

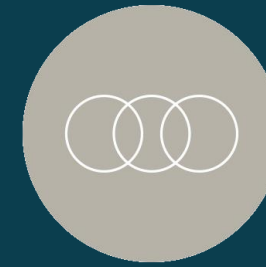
Standard Solution



- Long-term time series

Vortex SERIES

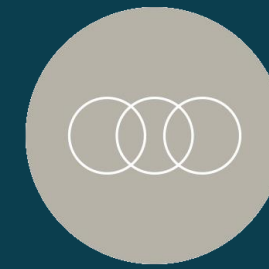
Standard Solution



- Long-term time series
- 10 / 20 / 30 / 38 years available

Vortex SERIES

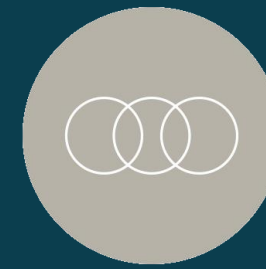
Standard Solution



- Long-term time series
- 10 / 20 / 30 / 38 years available
- Hourly time-stamp

Vortex SERIES

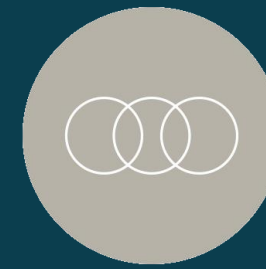
Standard Solution



- Long-term time series
- 10 / 20 / 30 / 38 years available
- Hourly time-stamp
- Simulated at 3 km horizontal resolution

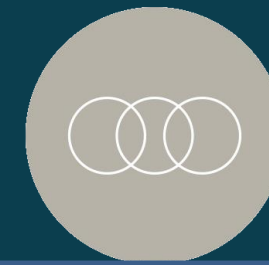
Vortex SERIES

Standard Solution



- Long-term time series
- 10 / 20 / 30 / 38 years available
- Hourly time-stamp
- Simulated at 3 km horizontal resolution
- Three reanalysis sources available: ERA5, CFSR, MERRA2

Vortex SERIES



Prepared for Vortex
Offshore Wind Model Validation



MetOceanWorks

Offshore Wind Model Validation

ERA5 and Vortex Downscaling

04 August 2021

MetOceanWorks Reference:

Vortex_C00001_R03_Wind_Model_Validation

Commercial in Confidence

Andrew Watson MSc CSci CMarSci MIMarEST

Senior Metocean Consultant & Director

andrew.watson@metoceanworks.com

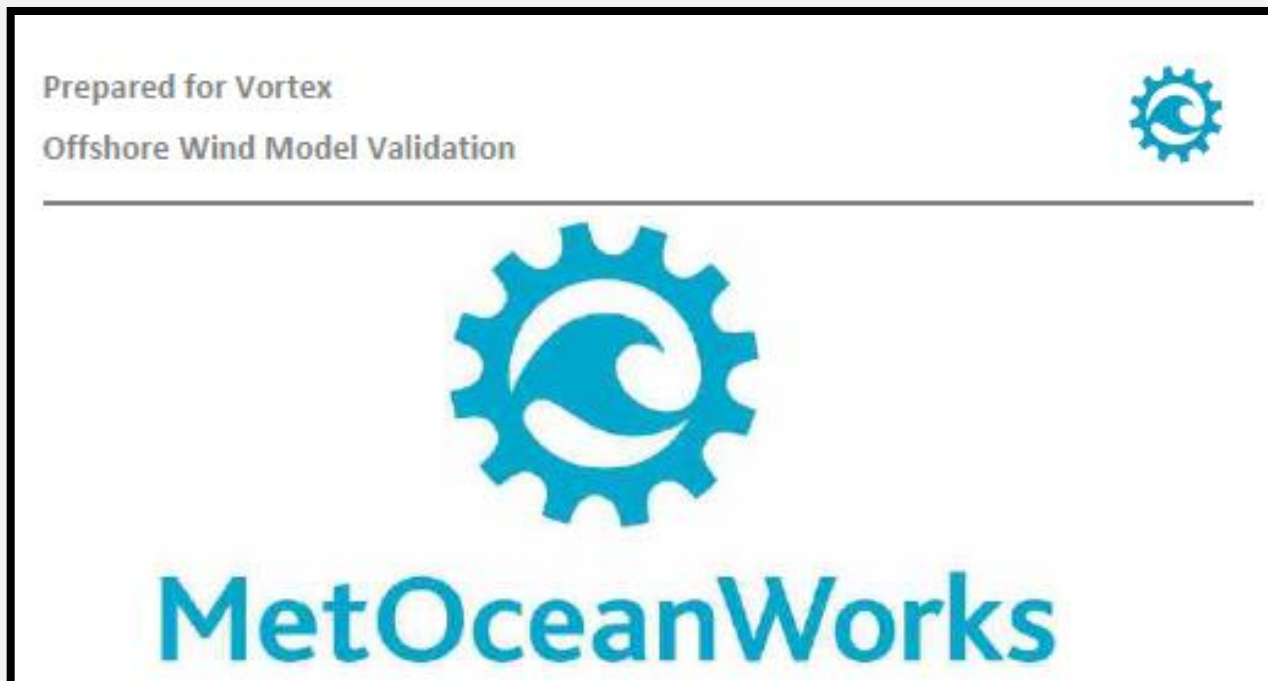
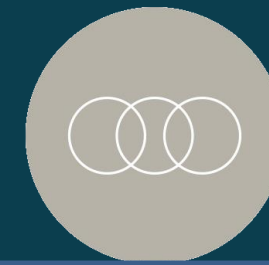
Contact +44 (0)7763 896635

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External validation 13 offshore sites

Vortex SERIES



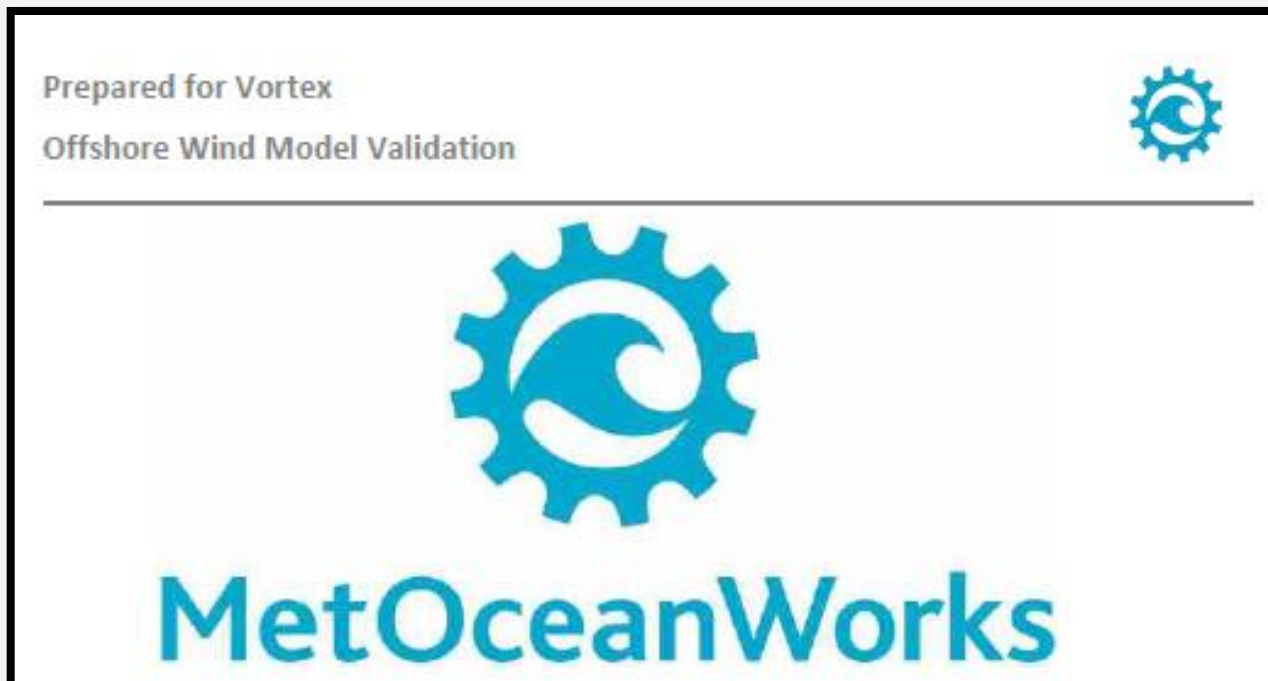
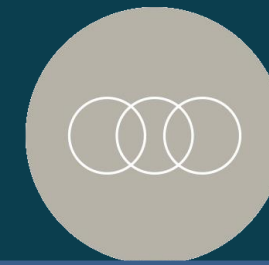
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External validation 13 offshore sites

High hub heights: VORTEX ERA5 bias and RMS is closer to zero than ERA5 raw in most sites.



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External validation 13 offshore sites

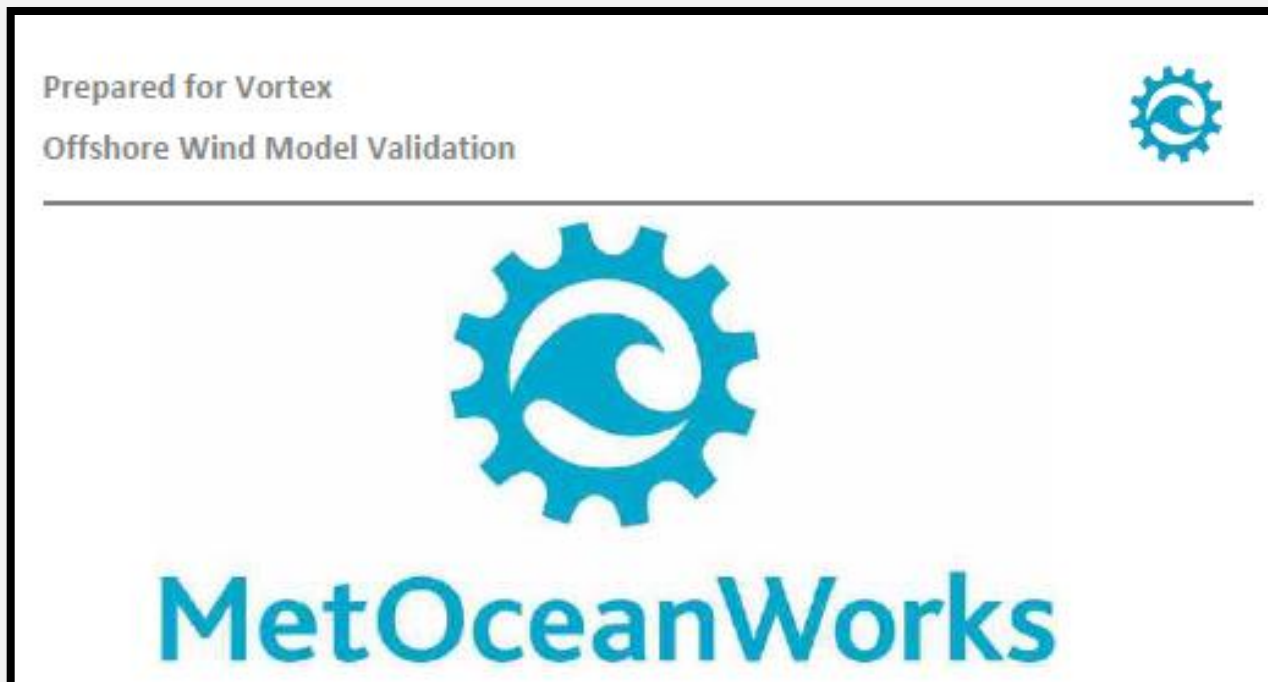
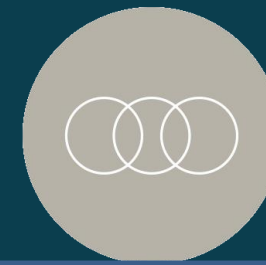
High hub heights: VORTEX ERA5 bias and RMS is closer to zero than ERA5 raw in most sites.

04 August 2021

Low hub heights: VORTEX ERA5 data shows even better results than ERA5 raw.

Andrew Watson MSc CSci CMarSci MIMarEST
Senior Metocean Consultant & Director
andrew.watson@metoceanworks.com
Contact +44 (0)7763 896635
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External validation 13 offshore sites

High hub heights: VORTEX ERA5 bias and RMS is closer to zero than ERA5 raw in most sites.

04 August 2021

Low hub heights: VORTEX ERA5 data shows even better results than ERA5 raw.

Andrew Watson MSc CSci CMarSci MIMarEST

Higher wind speeds: VORTEX ERA5 underpredicts by around 2 m/s while ERA5 underpredicts by around 5 m/s.

Vortex LES

Standard Solution



- One-year time series (specific or long-term representative)

Vortex LES

Standard Solution



- One-year time series (specific or long-term representative)
- 10-minute time-stamp

Vortex LES

Standard Solution



- One-year time series (specific or long-term representative)
- 10-minute time-stamp
- Standard deviation and 3 second gust

Vortex LES

Standard Solution



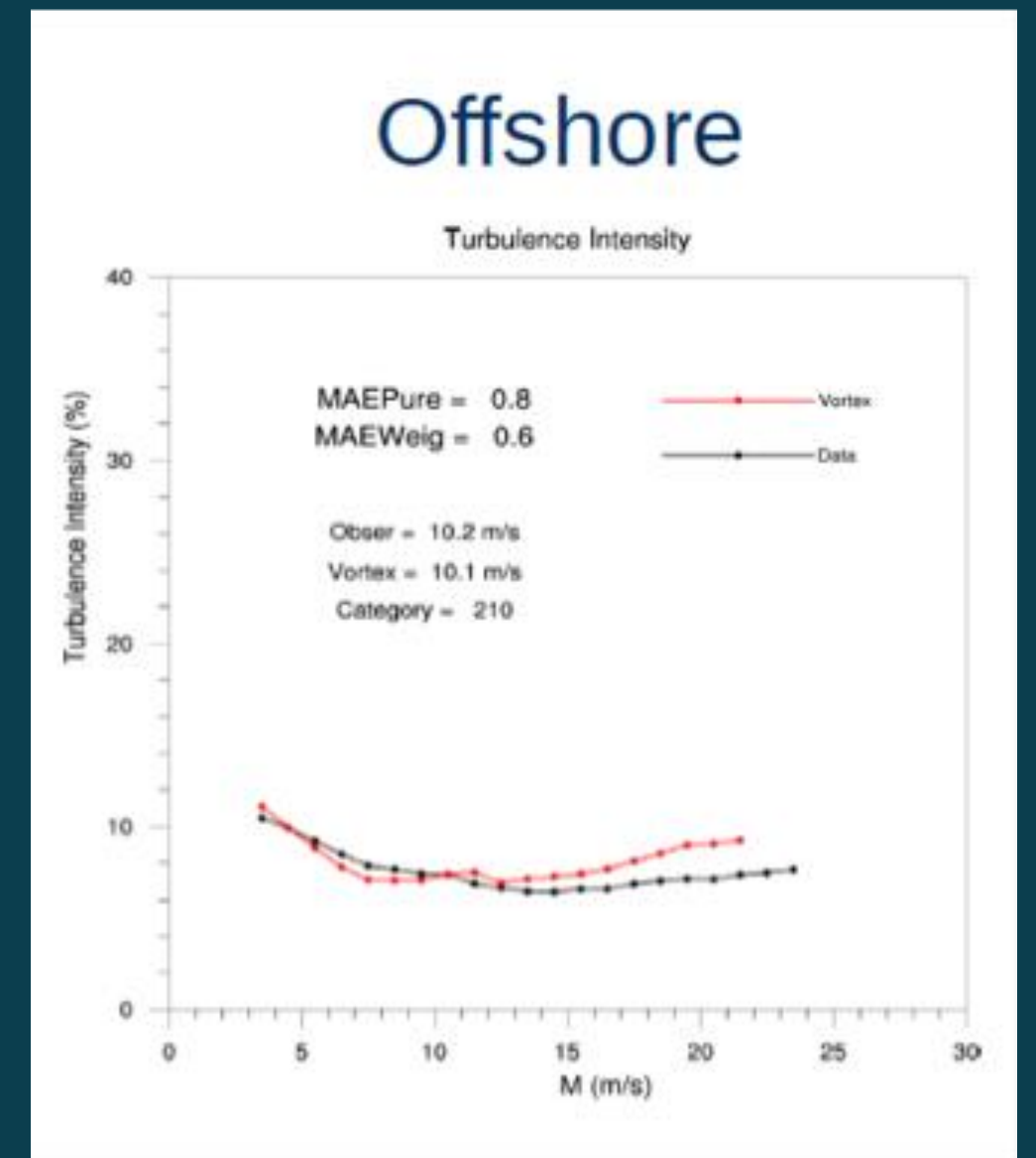
- One-year time series (specific or long-term representative)
- 10-minute time-stamp
- Standard deviation and 3 second gust
- Simulated at 100 m horizontal resolution

Vortex LES

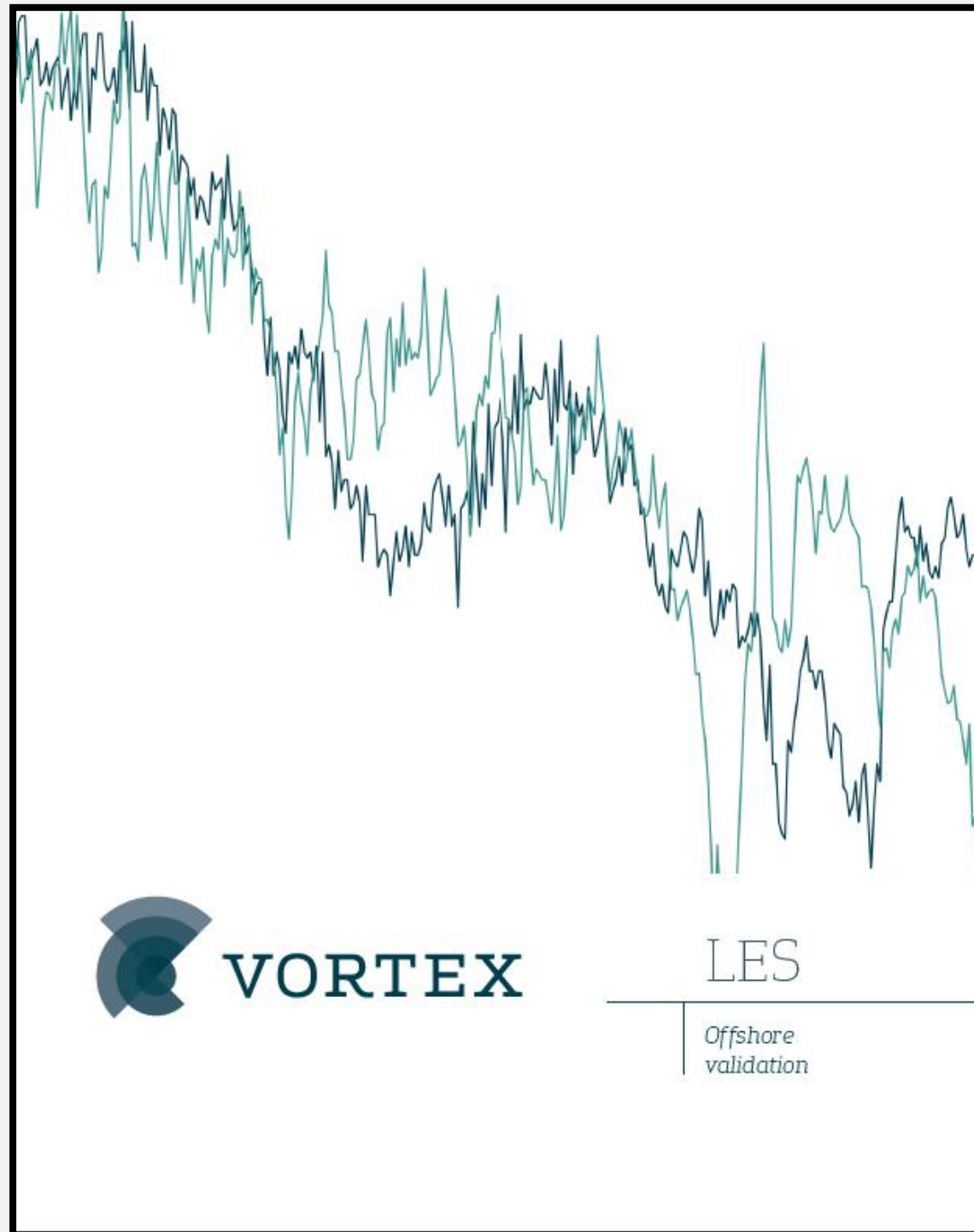
Standard Solution



- One-year time series (specific or long-term representative)
- 10-minute time-stamp
- Standard deviation and 3 second gust
- Simulated at 100 m horizontal resolution



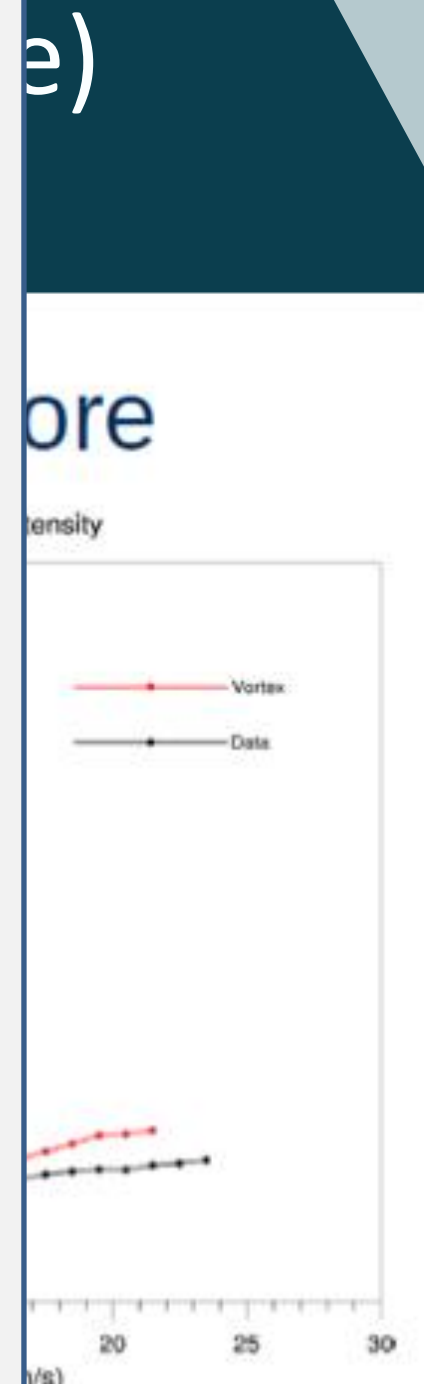
Vortex LES



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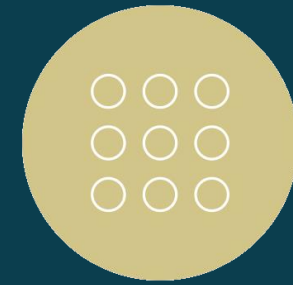
Internal validation 18 offshore sites

Turbulence validation for 5 sites



Vortex FARM

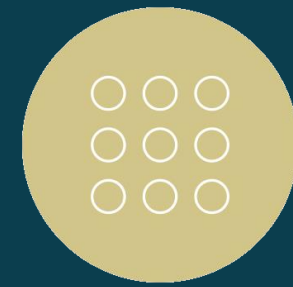
Standard Solution



- High-resolution map

Vortex FARM

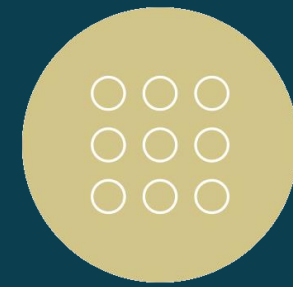
Standard Solution



- High-resolution map
- Simulated at 100 m horizontal resolution

Vortex FARM

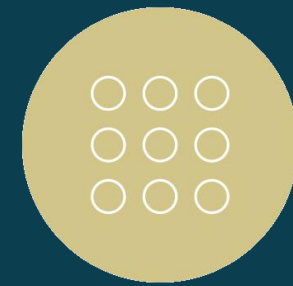
Standard Solution



- High-resolution map
- Simulated at 100 m horizontal resolution
- Areas up to 2,000 km²

Vortex FARM

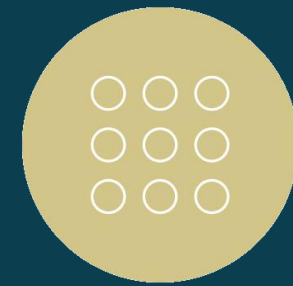
Standard Solution



- High-resolution map
- Simulated at 100 m horizontal resolution
- Areas up to 2,000 km²
- WRG file

Vortex FARM

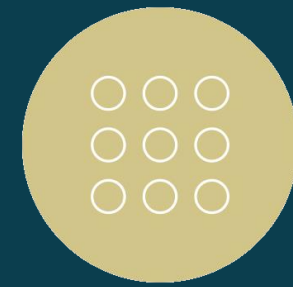
Standard Solution



- High-resolution map
- Simulated at 100 m horizontal resolution
- Areas up to 2,000 km²
- WRG file
- Calibration with measurements (*Remodeling*)

Vortex FARM

Standard Solution

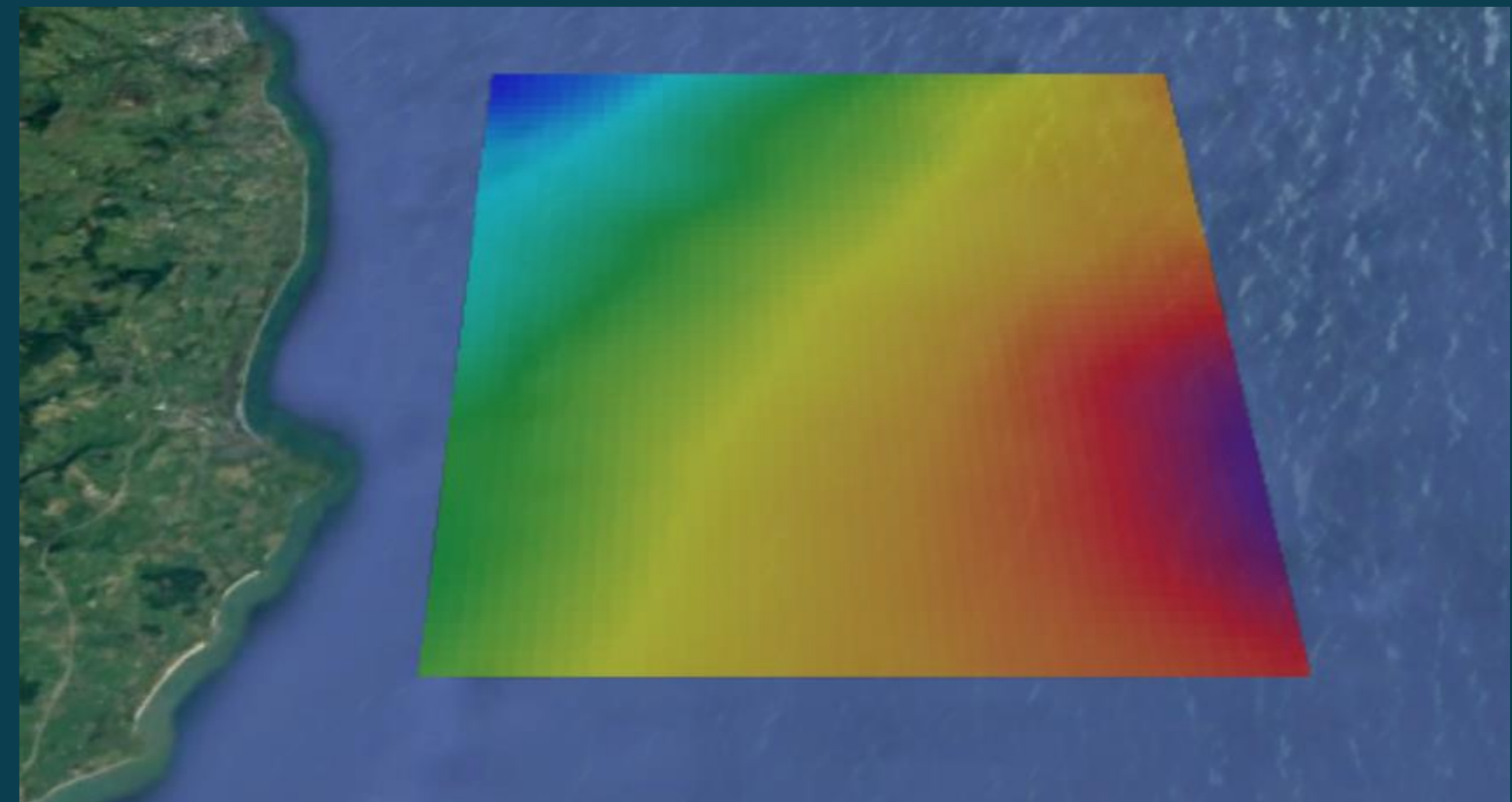


Low bias wind speed

Horizontal wind speed variability well captured

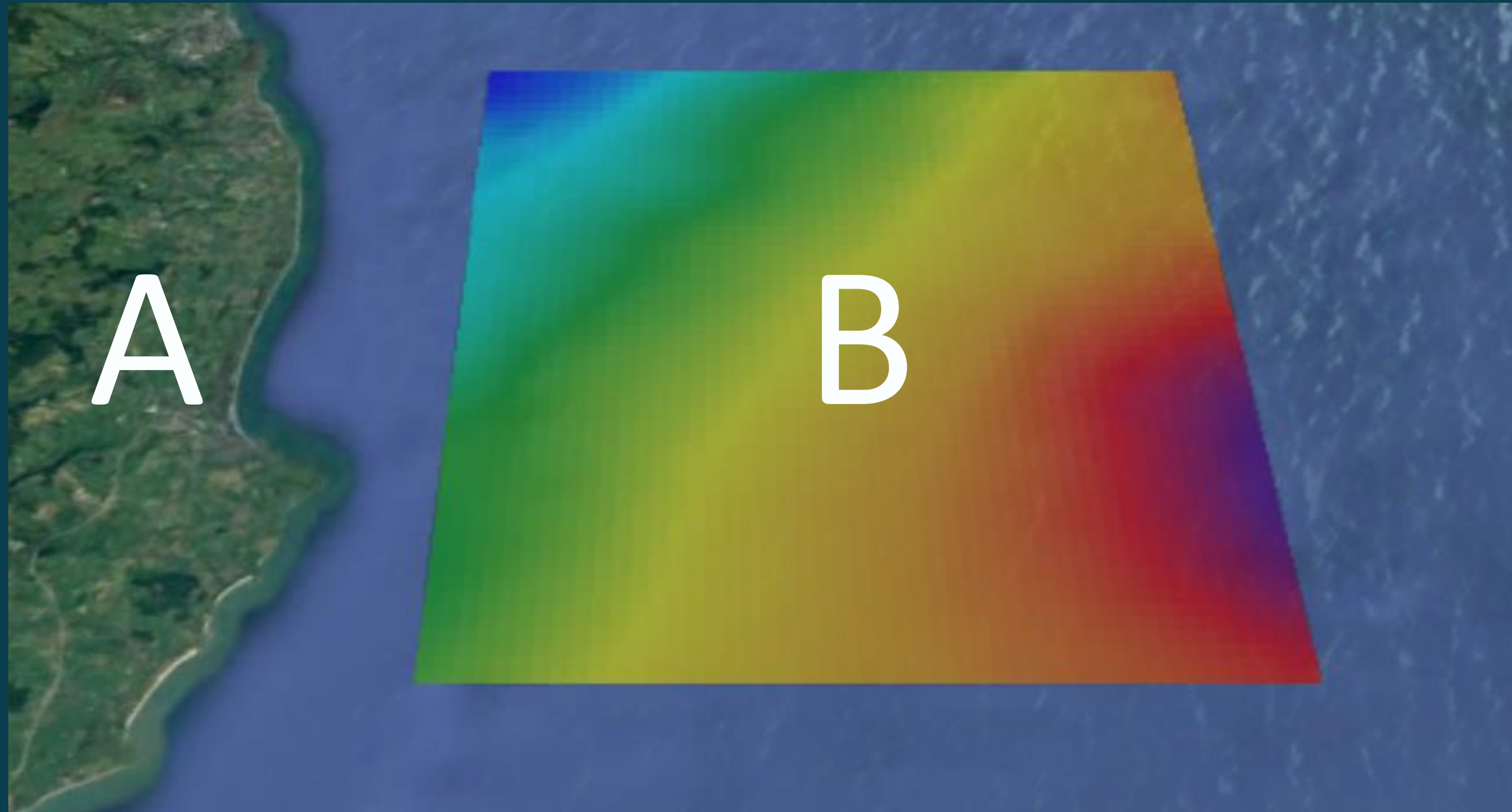
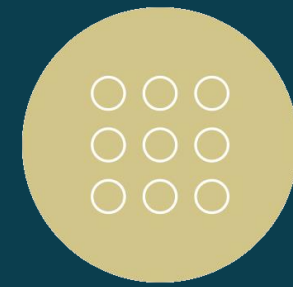
Wind shear profile well captured

Accurate wind direction



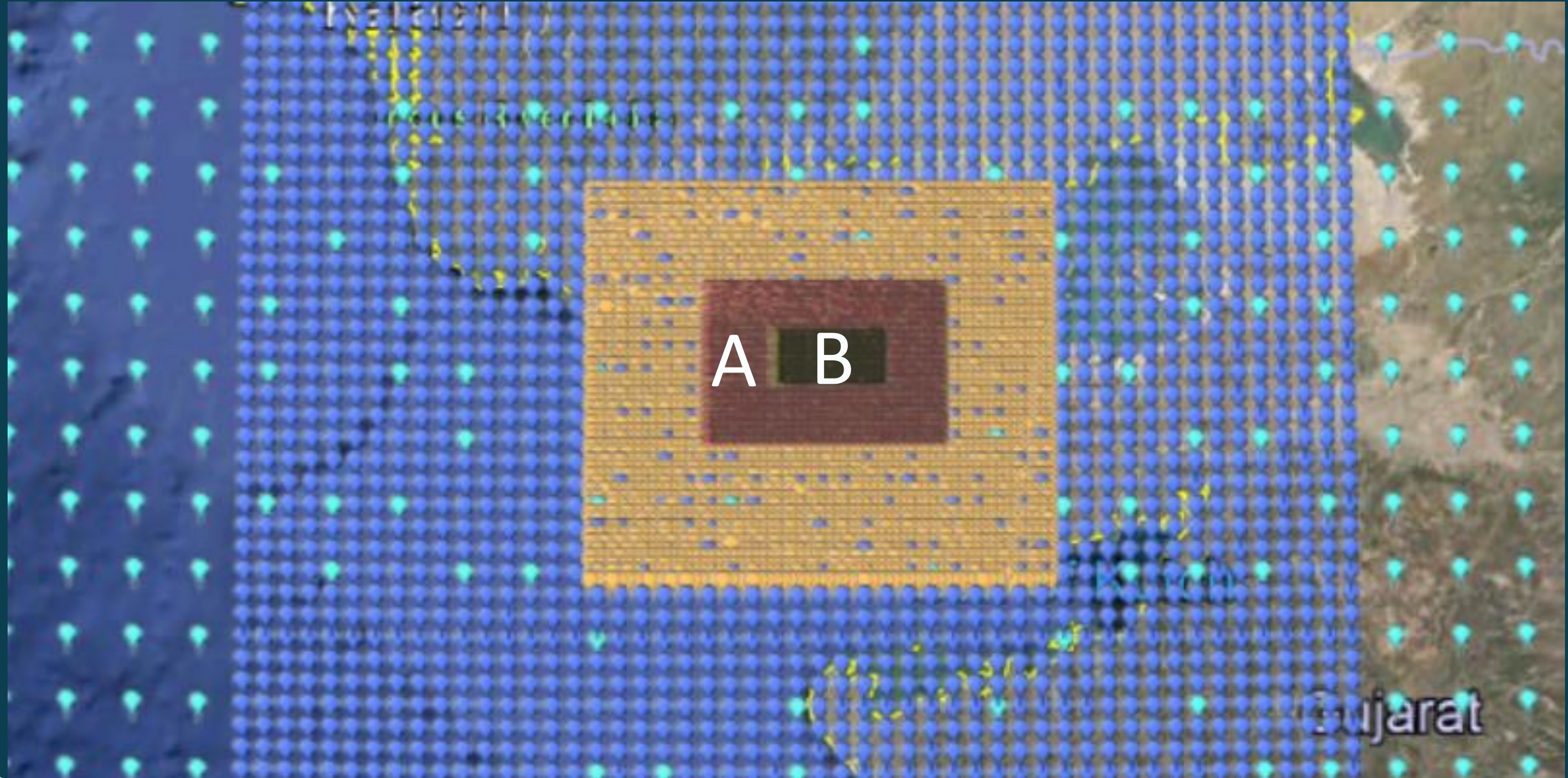
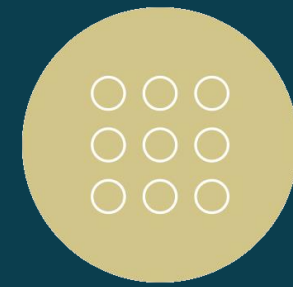
Vortex FARM

Standard Solution



Vortex FARM

Standard Solution



POINTS OF DISCUSSION

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B. Customised Solutions

Vortex Customised Solutions for Offshore Wind Projects

WRF Fitch Wakes Parametrisation

Customised Solution

Grid maps at 1 km
horizontal resolution

WRF Fitch Wakes Parametrisation

Customised Solution

Grid maps at 1 km
horizontal resolution

Time series available &
WRG outputs

WRF Fitch Wakes Parametrisation

Customised Solution

Grid maps at 1 km
horizontal resolution

Time series available &
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Computed for specific
periods

WRF Fitch Wakes Parametrisation

Customised Solution

Grid maps at 1 km
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Time series available &
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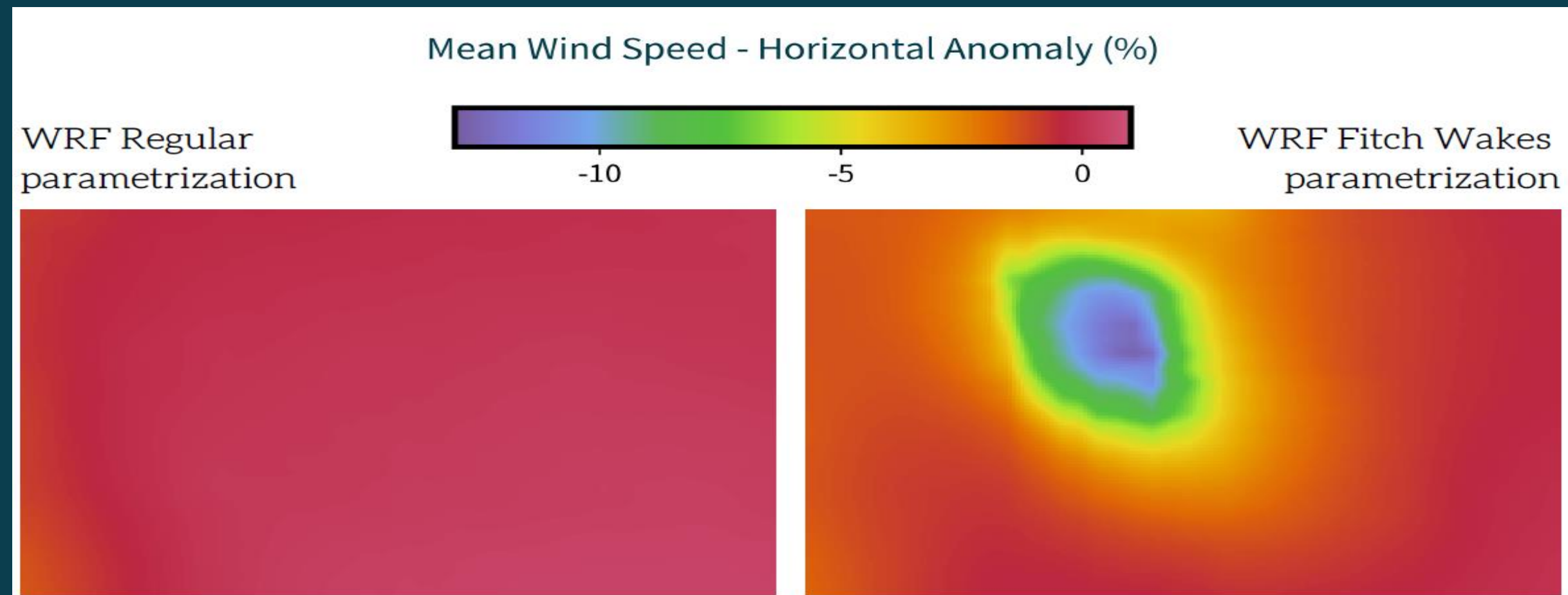
Computed for specific
periods

Fitch WRF input:

- height of the turbine hub
- diameter of the rotor
- standing thrust coefficient
- nominal power of the turbine
- a table of the power production and the thrust coefficient for each wind speed

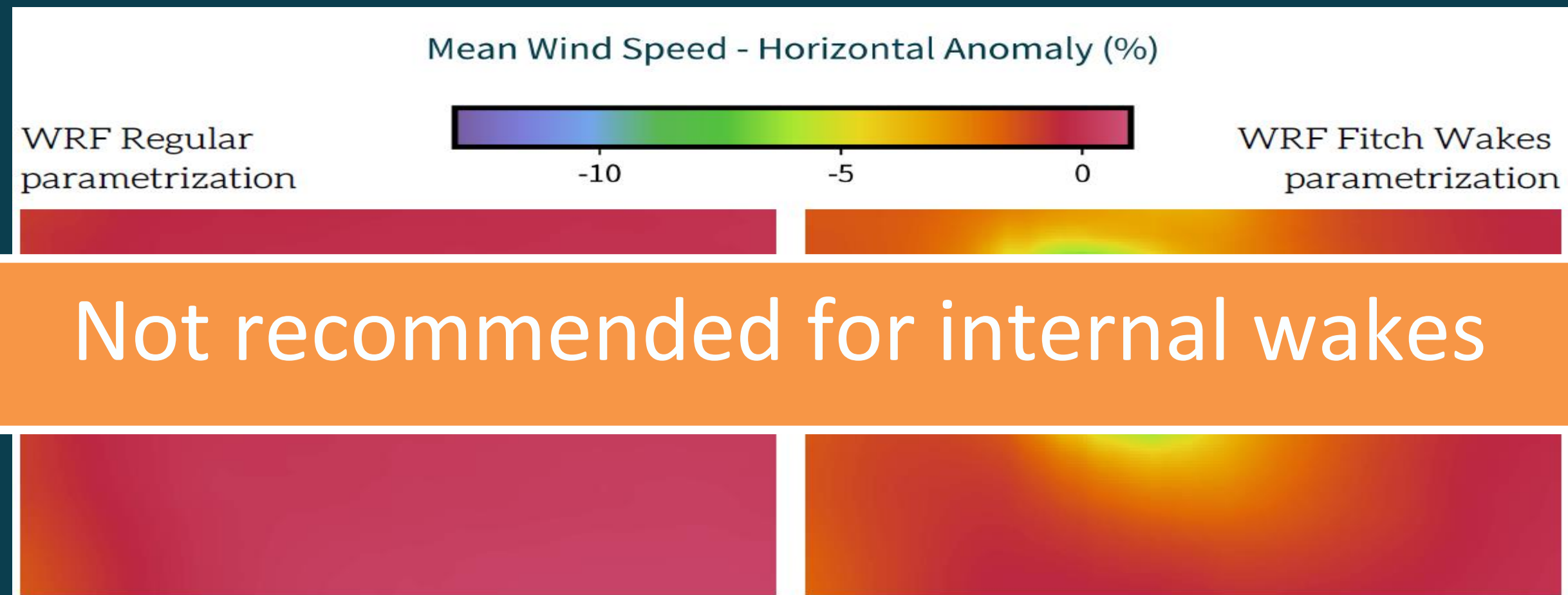
WRF Fitch Wakes Parametrisation

Customised Solution



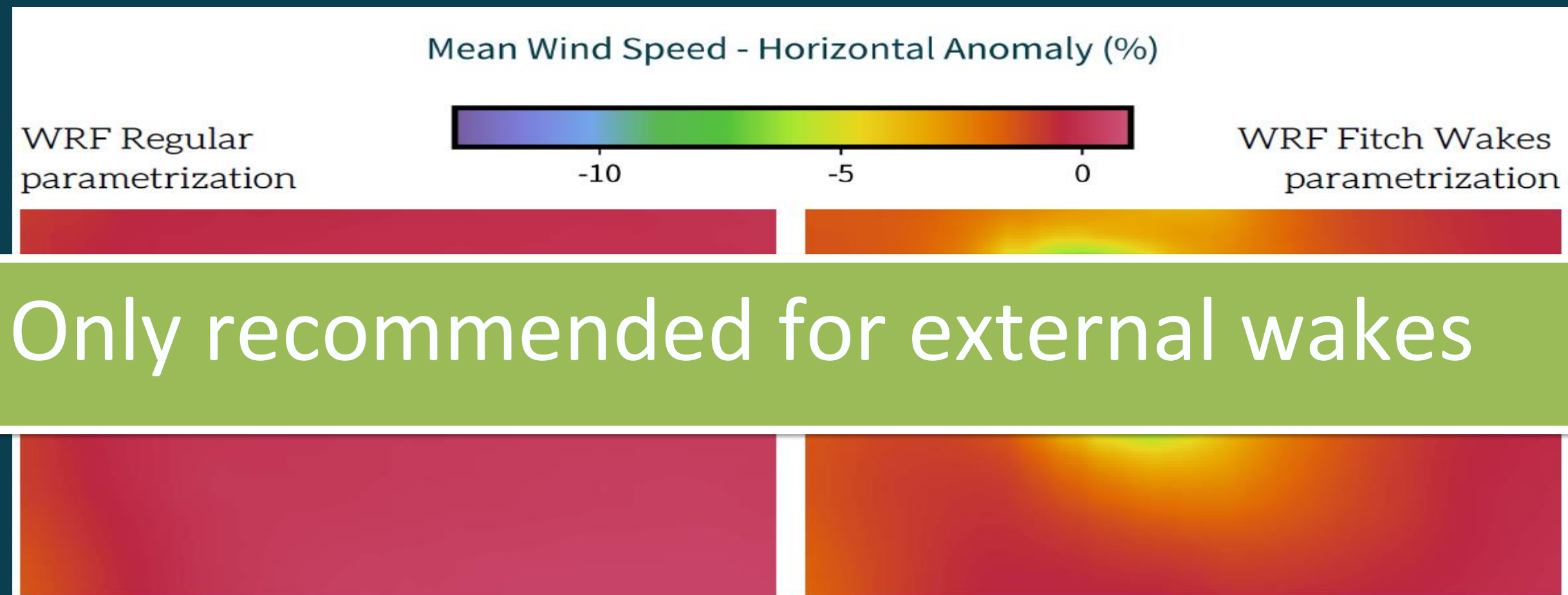
WRF Fitch Wakes Parametrisation

Customised Solution



WRF Fitch Wakes Parametrisation

Customised Solution

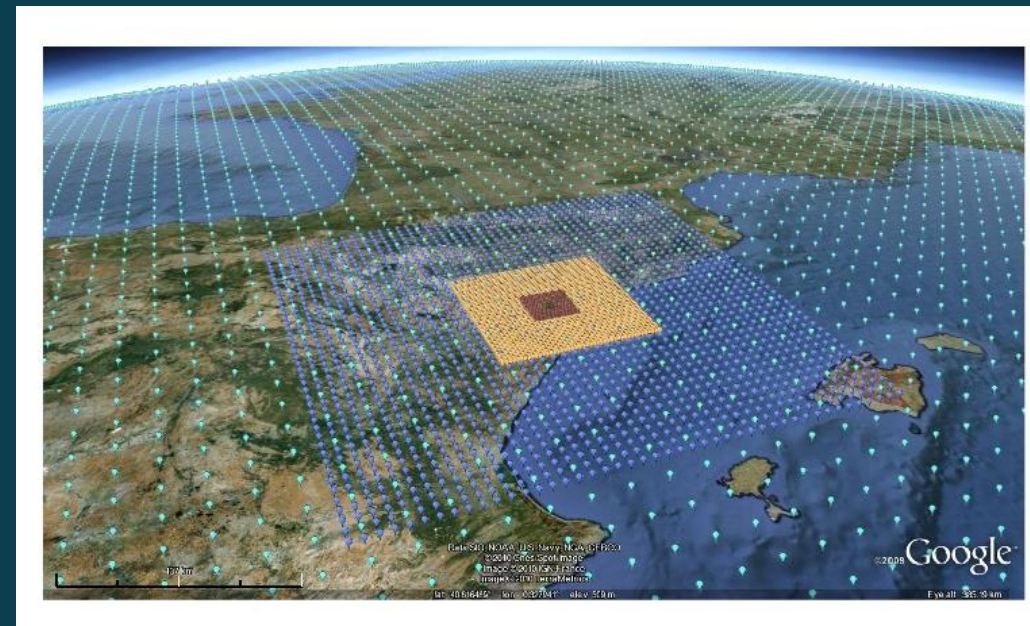


Only recommended for external wakes

Low resolution Grids

Customised Solution

Long term gridded time series

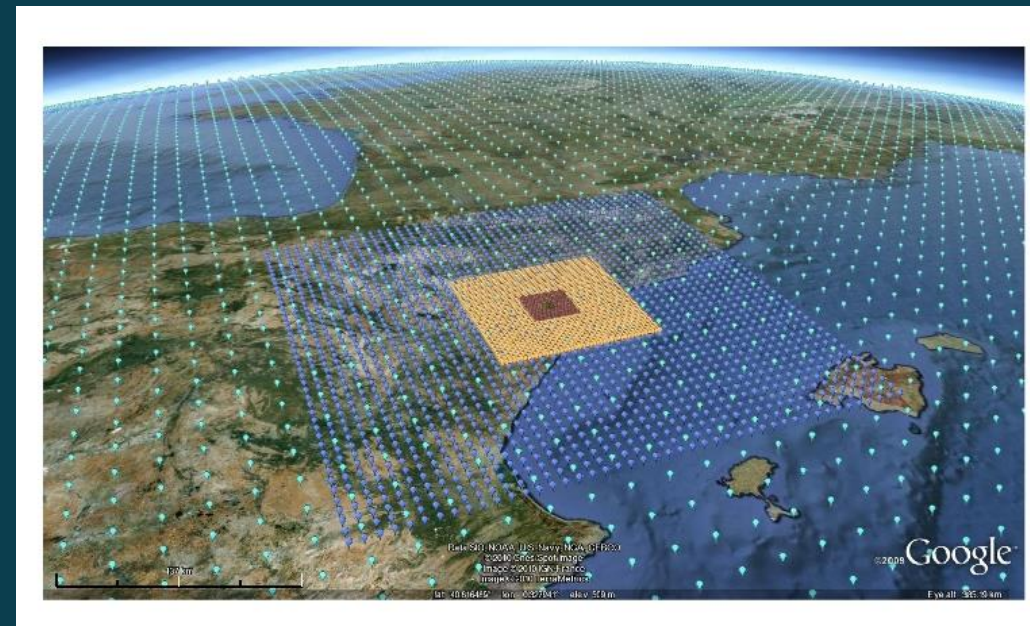


Low resolution Grids

Customised Solution

Long term gridded time series

Regional areas

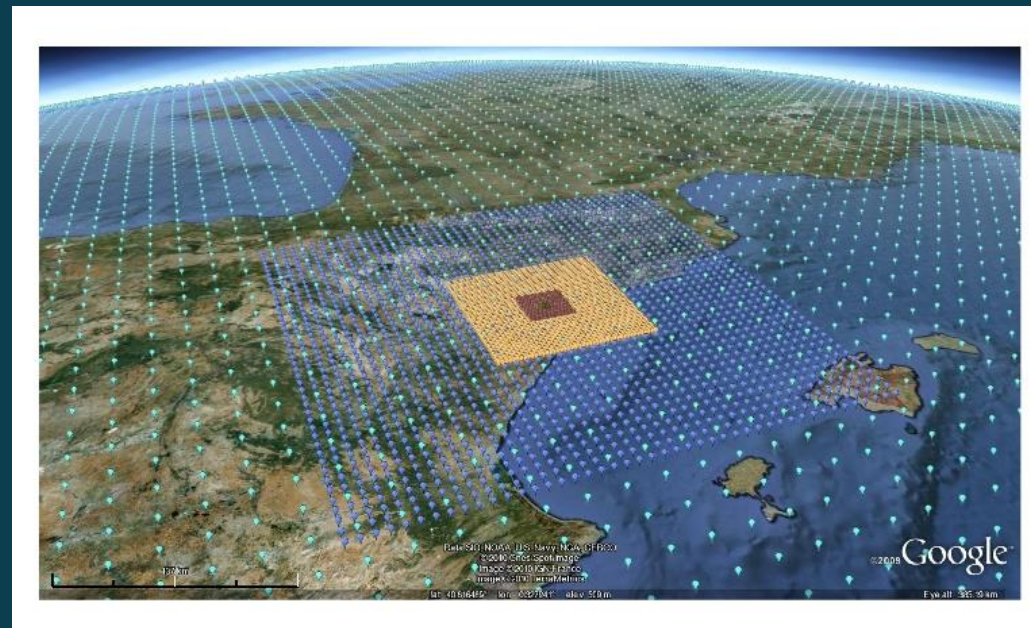


Low resolution Grids

Customised Solution

Long term gridded time series

Regional areas



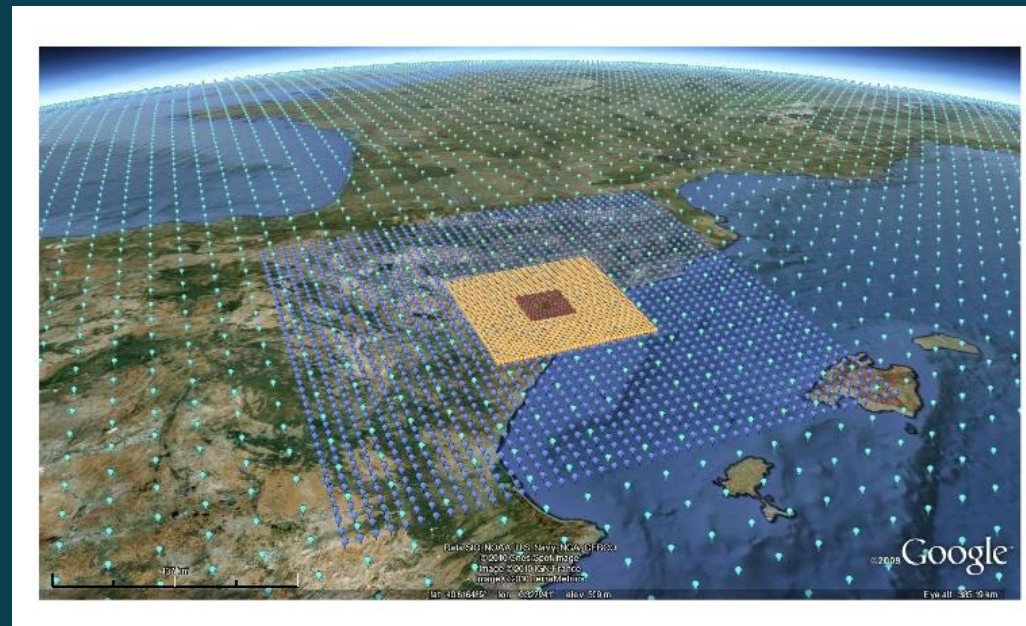
NetCDF files

Low resolution Grids

Customised Solution

Long term gridded time series

Regional areas



NetCDF files

Waves: Gridded time series

Recapitulation

1. We have experience in most of the regions where offshore projects are being developed worldwide.

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2. Our standard solutions: SERIES, LES, FARM.

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4. Extensively validated, internally and by third parties.
5. Find different offshore related documents in our *Knowledge Center*.



Thank you for you attention!



Do you need more information about
Vortex offshore solutions?

Contact us at

jordi.ferrer@vortexfdc.com