



Feel the wind.

High Performance Computing and sensor networks at Vestas Wind Systems A/S

Anders Rhod Gregersen

agreg@vestas.com

Senior specialist, Vestas Wind Systems A/S

Introduction

Increasing business case certainty

Pre-installation

Post-installation

Challenges

Enabling HPC



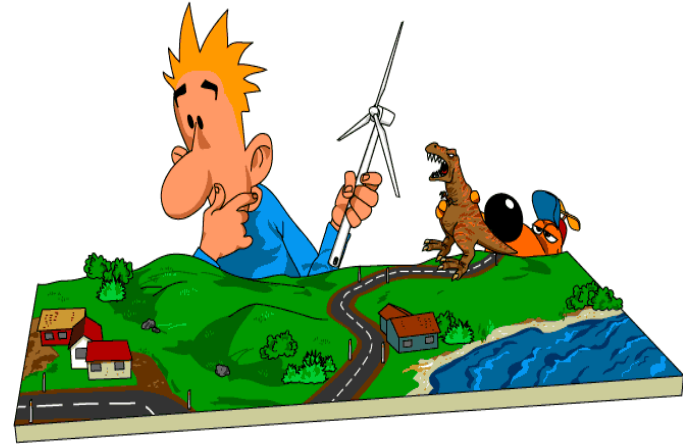
Finding a good site

Traditional process:

Point measurements (met mast)

Point estimate of wind resource

Point estimate of turbulence



Drawbacks:

Costly

Time consuming

Point measurement of flow

No weather context

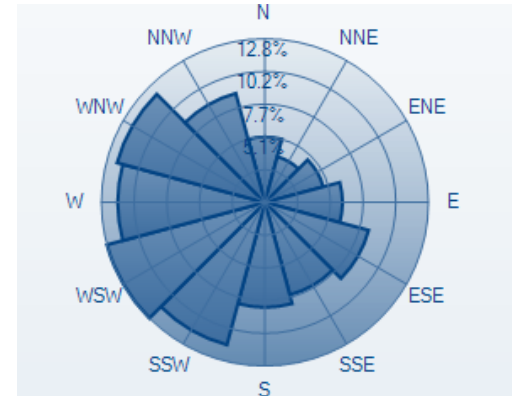


Finding a good site (II)

HPC aided process:

Better understanding of flow over terrain:

- Turbulence
- Wind shear
- In flow angles...



Better understanding of the wind resource

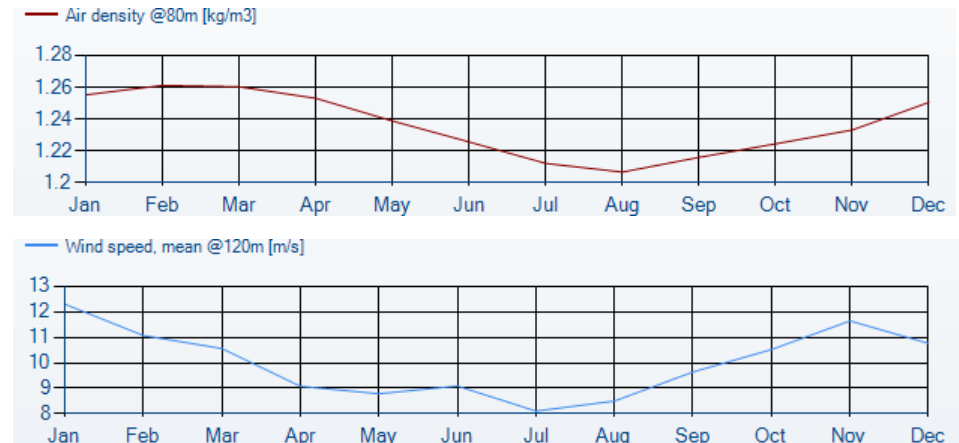
Better insight into extreme events (lightning, icing...)

Enables:

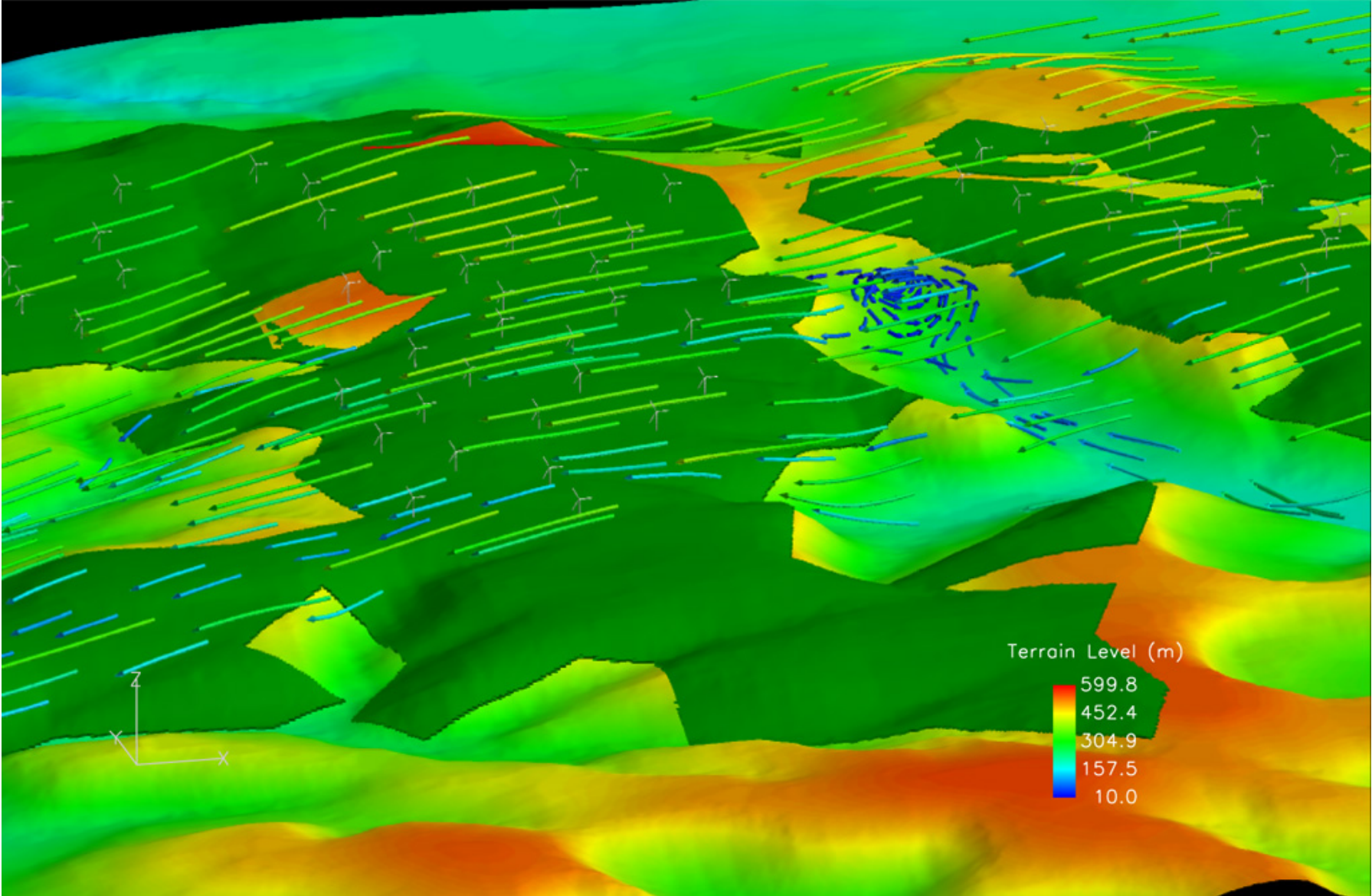
Virtual siting

Business case certainty

Cost of energy map



Flow over terrain



Map layers

Cost of Energy

Wind Resource

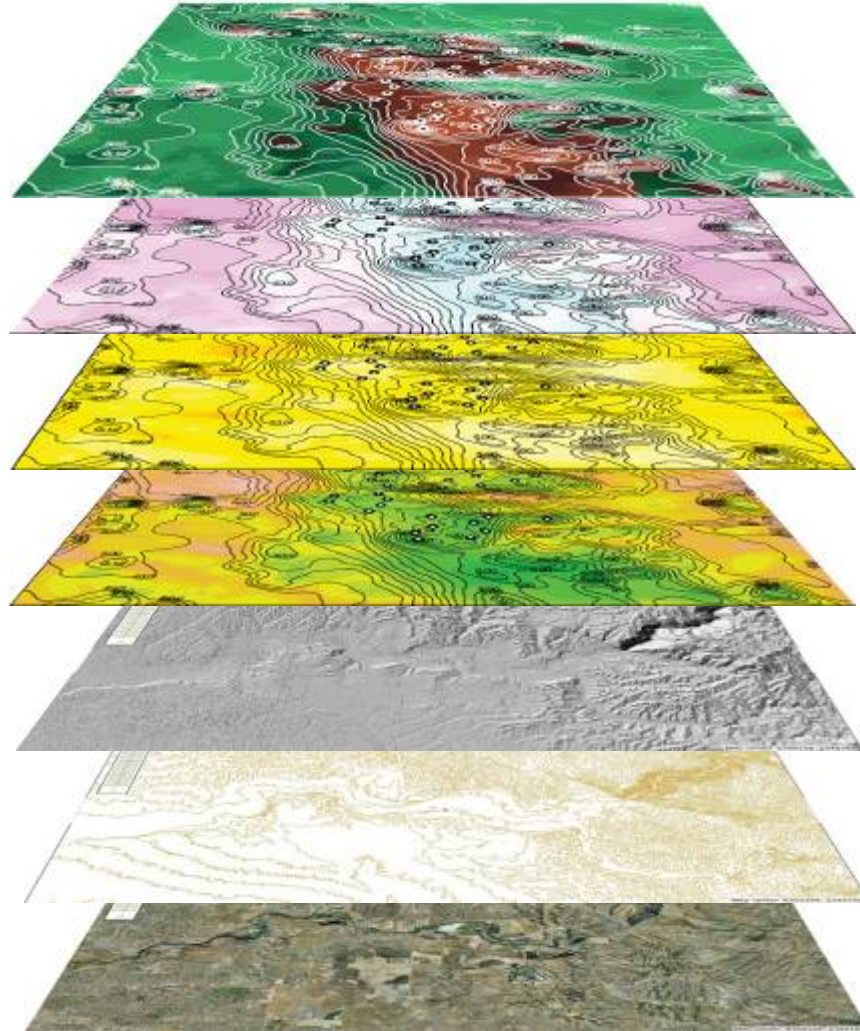
Service Cost

Turbulence

Complexity

Height contours

Site picture



Virtual siting

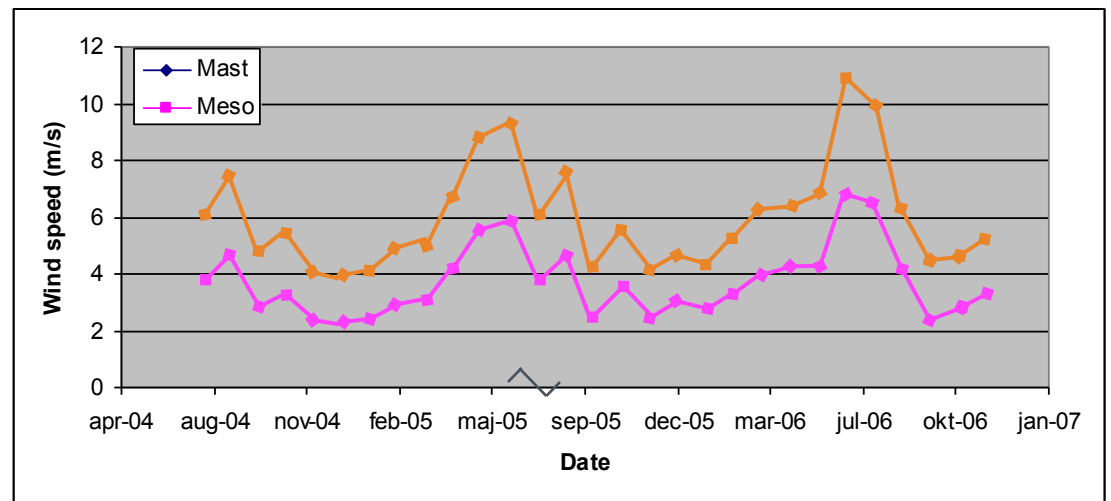
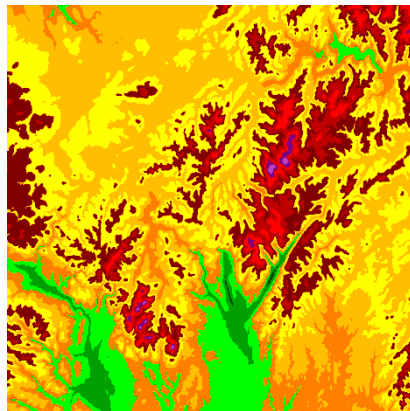
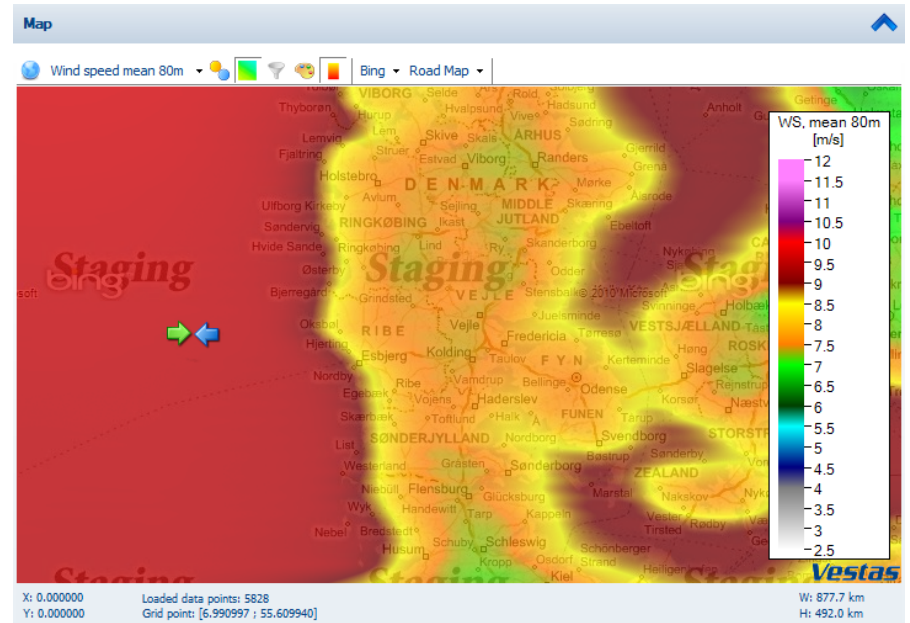
No met mast?

The art of hind-casting

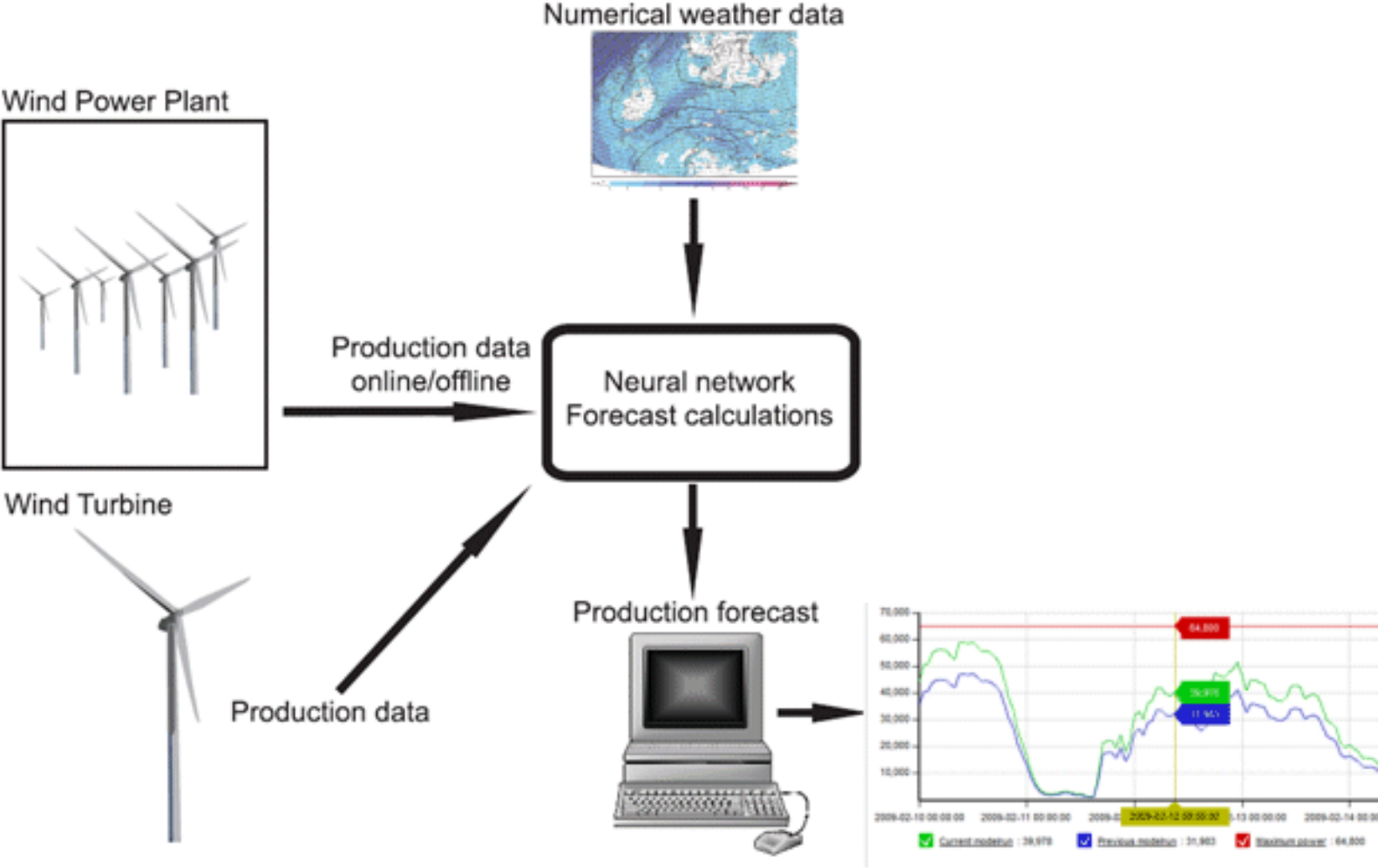
Simulated time series

CFD flow and estimate

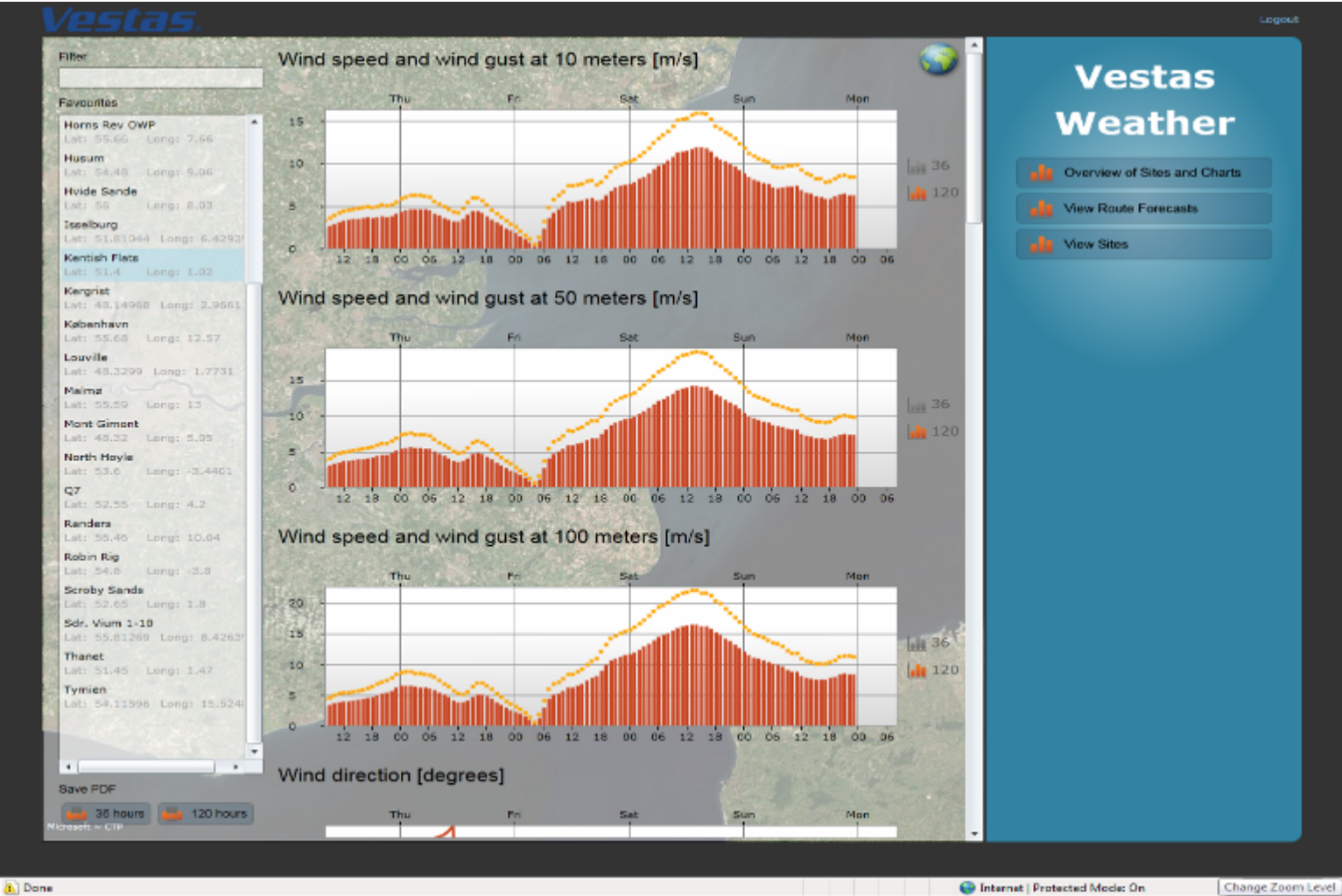
Correcting with measurements



Forecasting power production



Service scheduling





The big data challenge

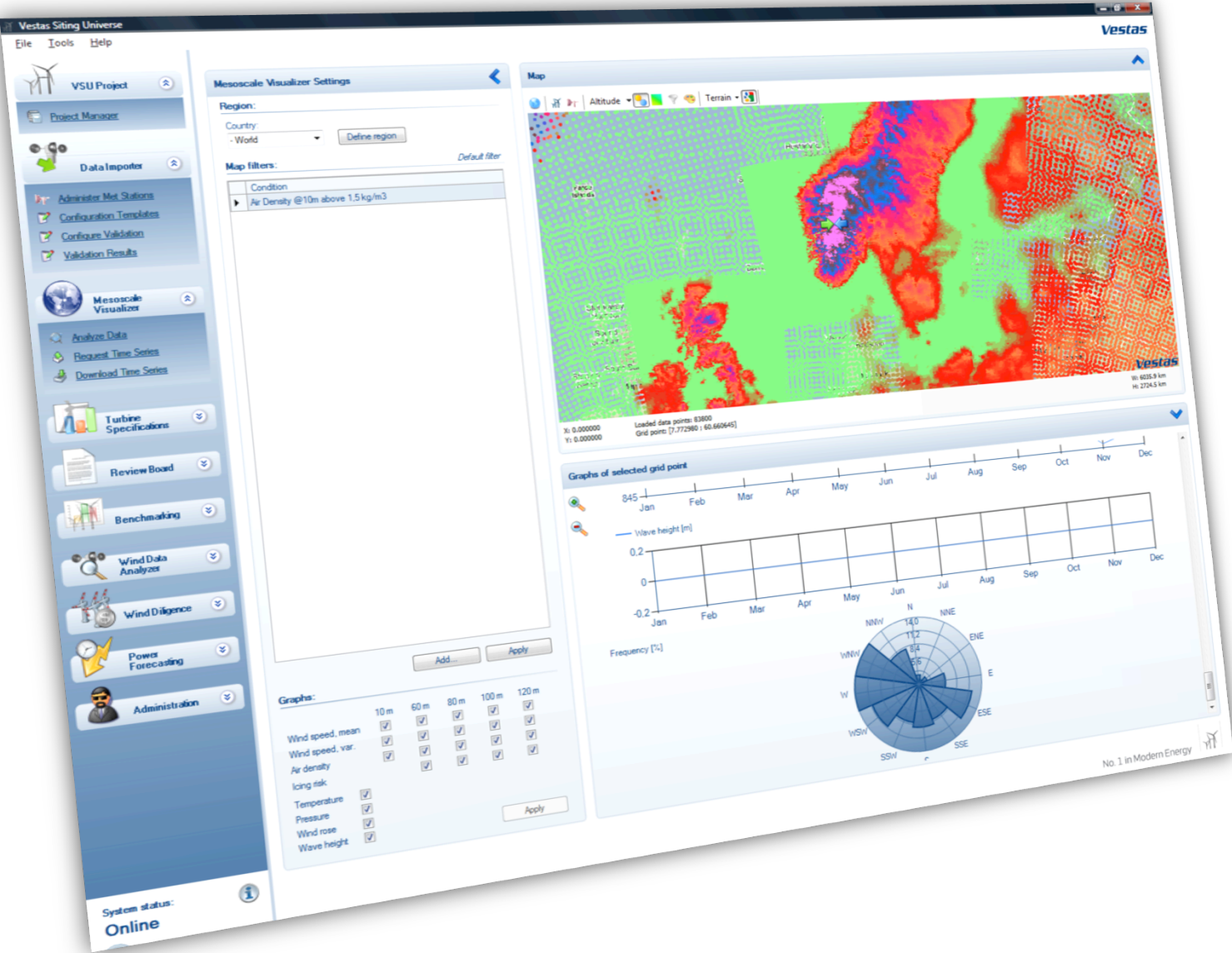
Increased simulation resolution in time and area

Building database technology that scales beyond petabytes

Sensors count rises

Sensor sampling frequency increase

Point and click HPC



Building up HPC capability

Q1/2003

First commercial license for CFD

Q4/2006

First cluster (40 cores)

Q3/2007

CFD model validated.

Q4/2008

Second cluster (15 TFLOPS, TiBs)

Q2/2011

Third cluster (3rd largest industrial HPC, PiBs)



The Vestas logo is displayed in a white, italicized, sans-serif font. It is positioned in the upper left corner of the slide, which features a background of a bright blue sky with wispy white clouds. The logo includes a registered trademark symbol (®) at the end.

Wind. It means the world to us.™

Thank you for your attention

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