

INTO THE REAL WORLD: ASSESSING THE VALUE OF WIND ASSIST TECHNOLOGY

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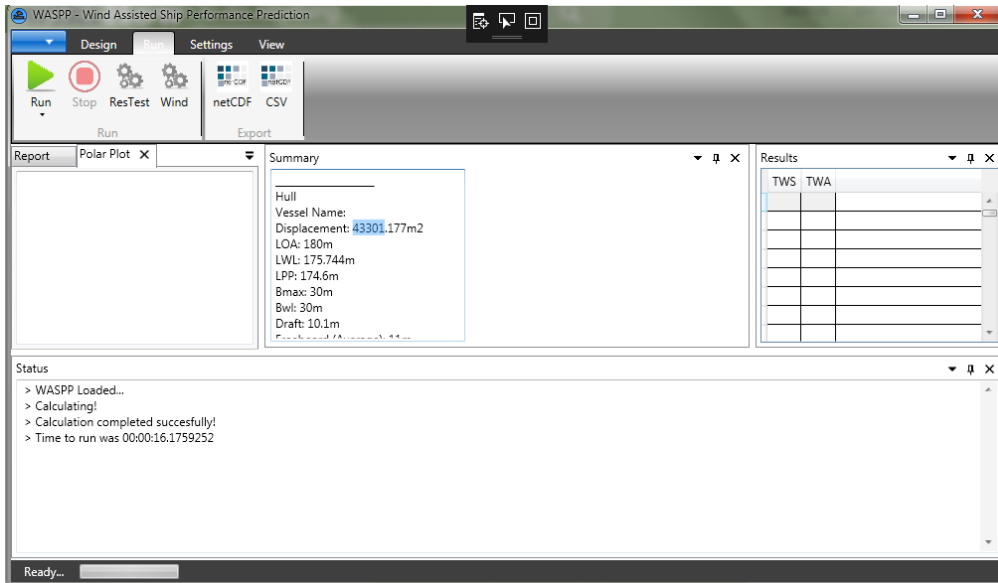
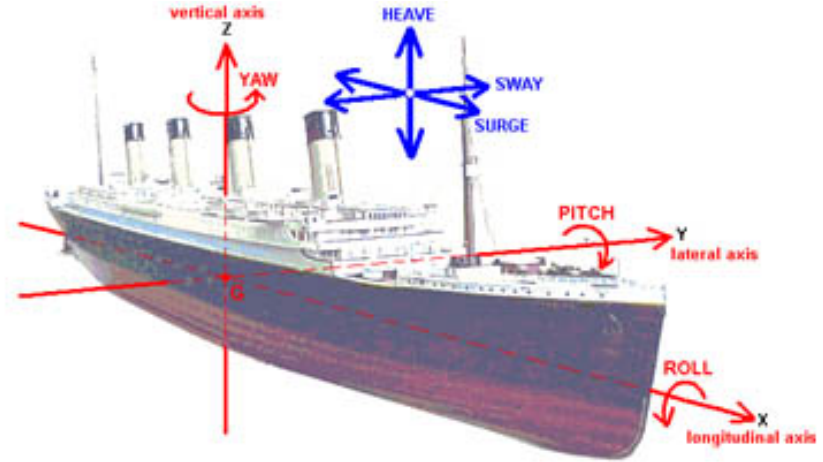
Introduction: WASPP

Calculates all Aerodynamic and Hydrodynamic forces

Resolves force vectors and moments around ship axis

Balances forces so accelerations are zero

4 DOF solution – Surge, Sway, Roll, Yaw



WASPP
Wind Assisted Ship
Performance Prediction

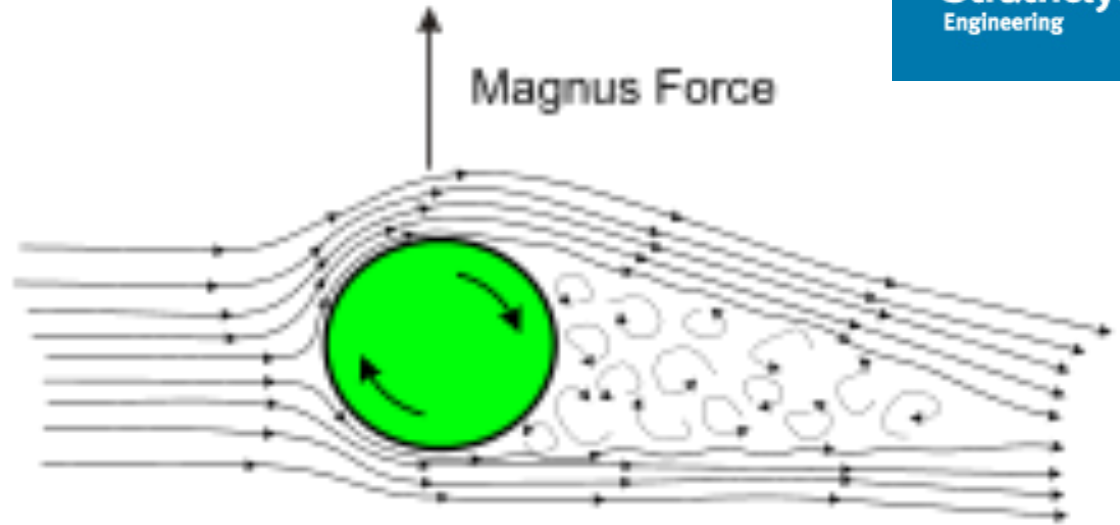
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Introduction: Example Vessel

125m Bulk Carrier

??

??



Flettner Rotors

Technology dates back to the 1920s

Recent resurgence around 2010

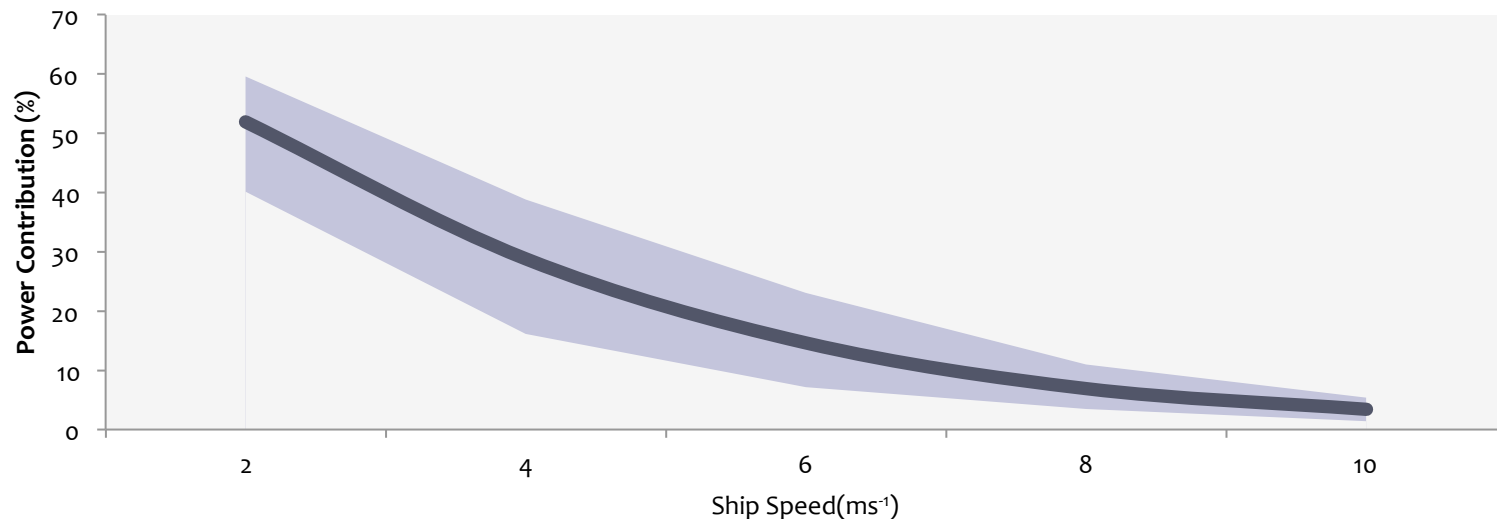
Powered rotating cylindrical columns

Generates lift through the 'Magnus' effect

Design Factors: Speed

We know ship speed adversely affects wind assist performance
...But by how much?

Effect of ship speed on potential Power Contribution



Less than 12 knots for wind assist benefit?

Rule of Thumb: Ship speed lower than Average wind speed.

Design Factors: Sizing

Traditionally sailing yachts make use of three principle methods for initial sizing of sailplans:

Stability at large heel angles

Sail Area/Displacement

Sail Area/Wetted Surface Area.

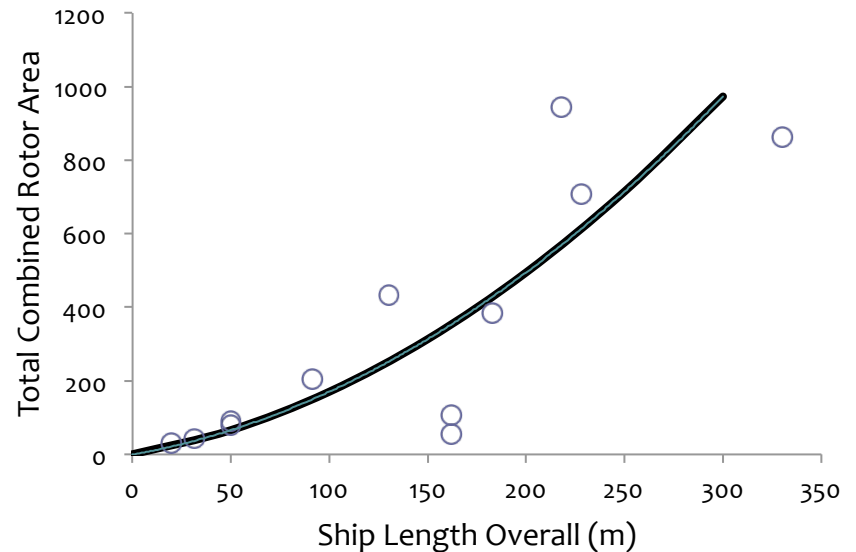
Length chosen instead for practical purposes

Polynomial fit from database:
~100 sailing yachts >50m Loa

Modified curve based on wind assist assumptions

Verified against known vessels

Flettner Sizing Model vs Reference Ships



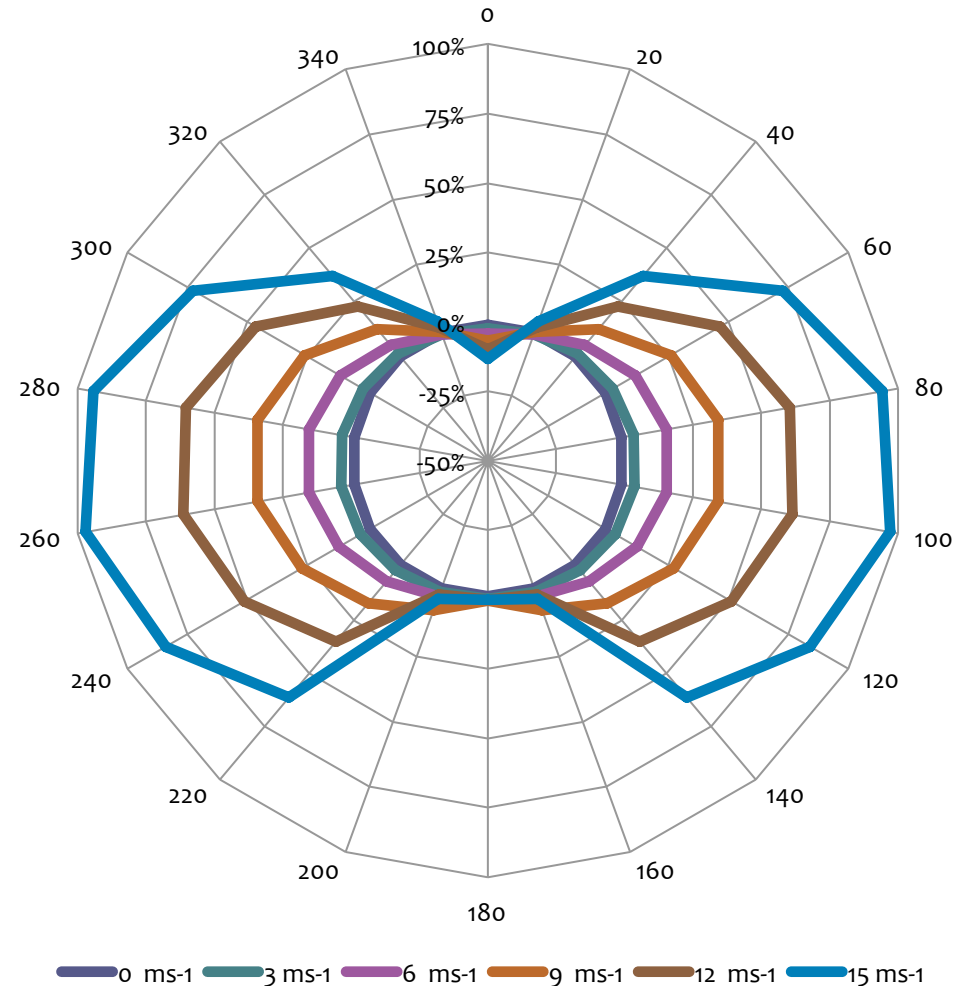
Introduction: Example Vessel

125m Bulk Carrier

12 Knots Design Speed

3x 78m² Rotors

(21m Height above Deck)

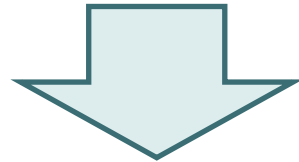


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Introduction : The Problem

Wind assist *can* supply 100% of a ships total
power requirements

...given optimal conditions



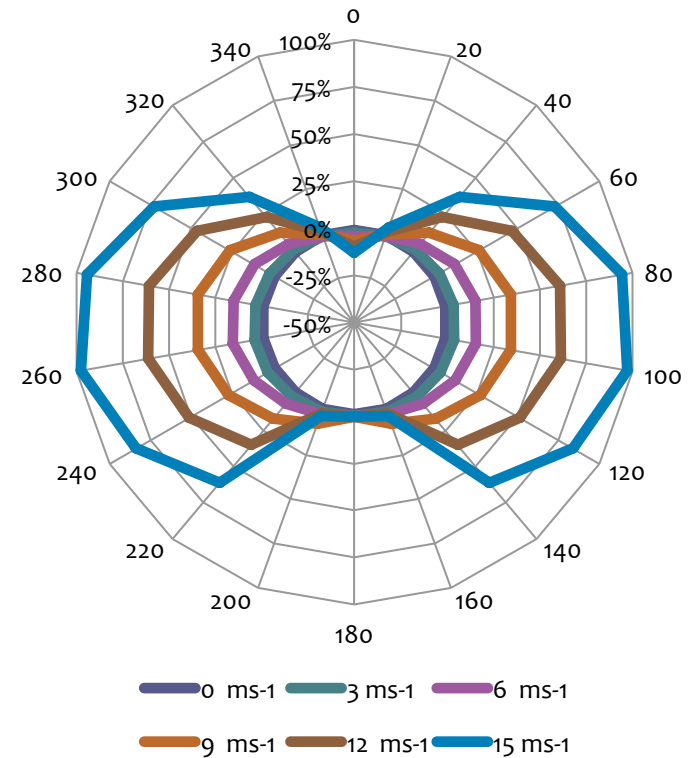
- How often are these optimal conditions?
- What are the tradeoffs outside these conditions?

Wind : Distributions

Equal probability of encountering all wind angles

Global wind speed average for ice free seas (Kent 2012) : 7.4ms^{-1}

11.4%



Wind : Distributions

Equal probability of encountering all wind angles

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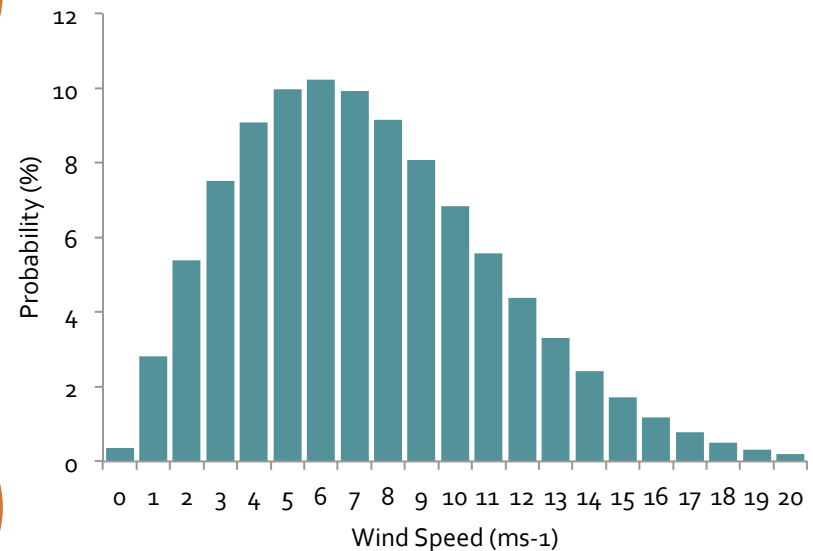
11.4%

Equal probability of encountering all wind angles

Assume global wind speed probability follows a weibull distribution

14.6%

Global Windspeed
Based on Weibull distribution

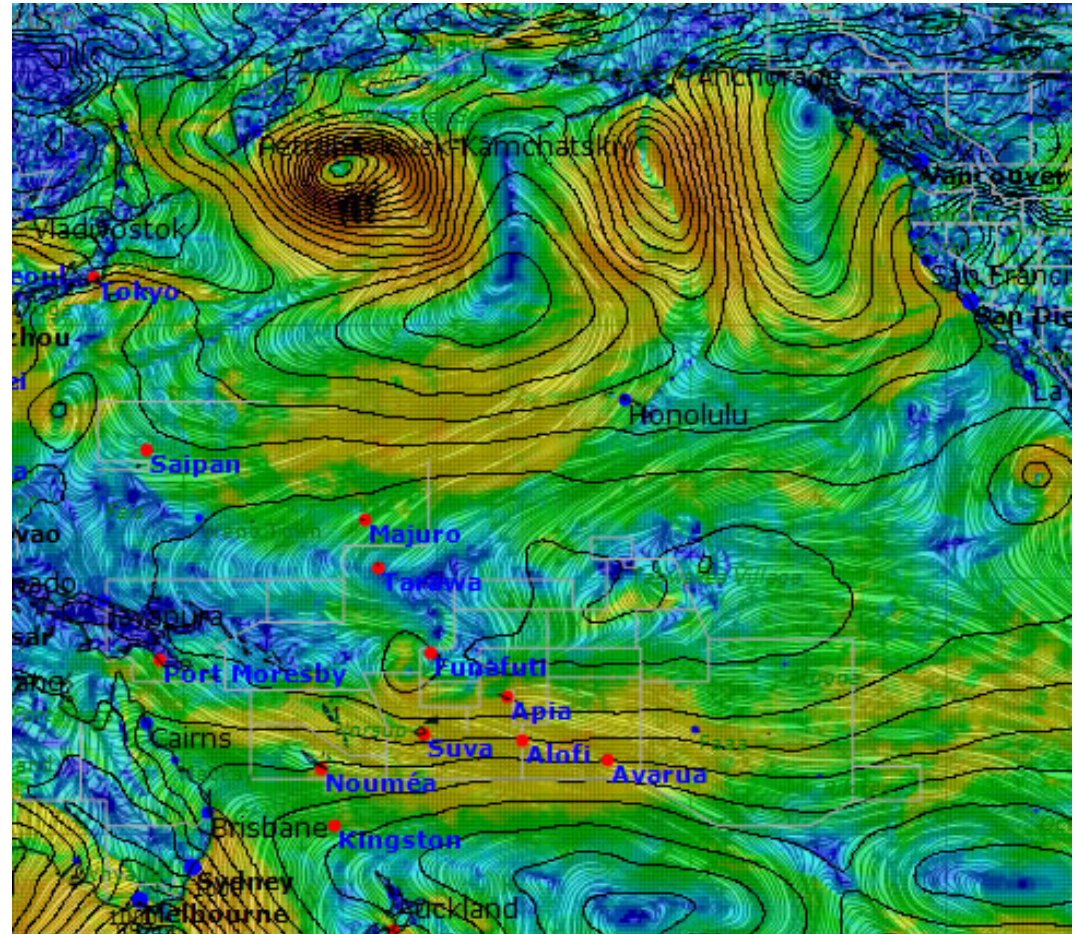


Wind: Voyage Level Modelling

**European Centre for
Medium range Weather
Forecasting (ECMWF)**

ERA-INTERIM is a global
atmospheric reanalysis

37 years of global wind data



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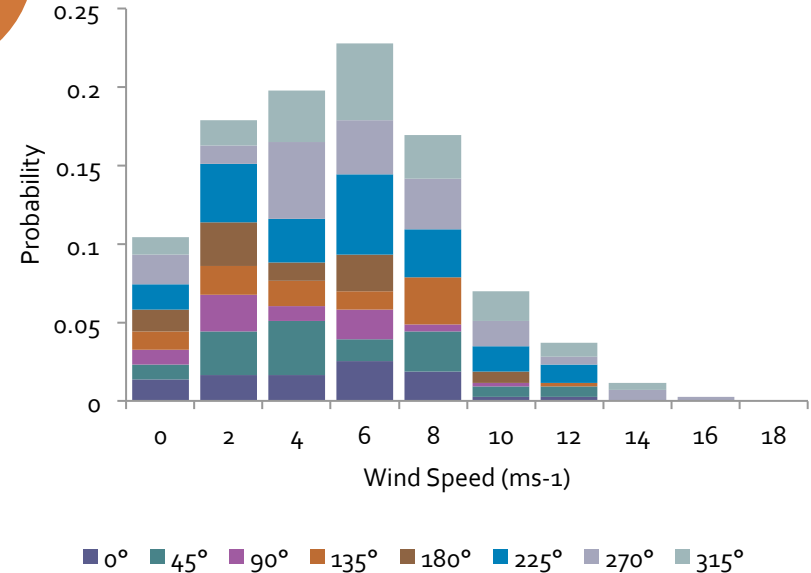
Wind : Voyage Level Modelling

Equal probability of encountering all wind angles

Specific windspeed distribution for UK-NY route: 8.5ms^{-1} average

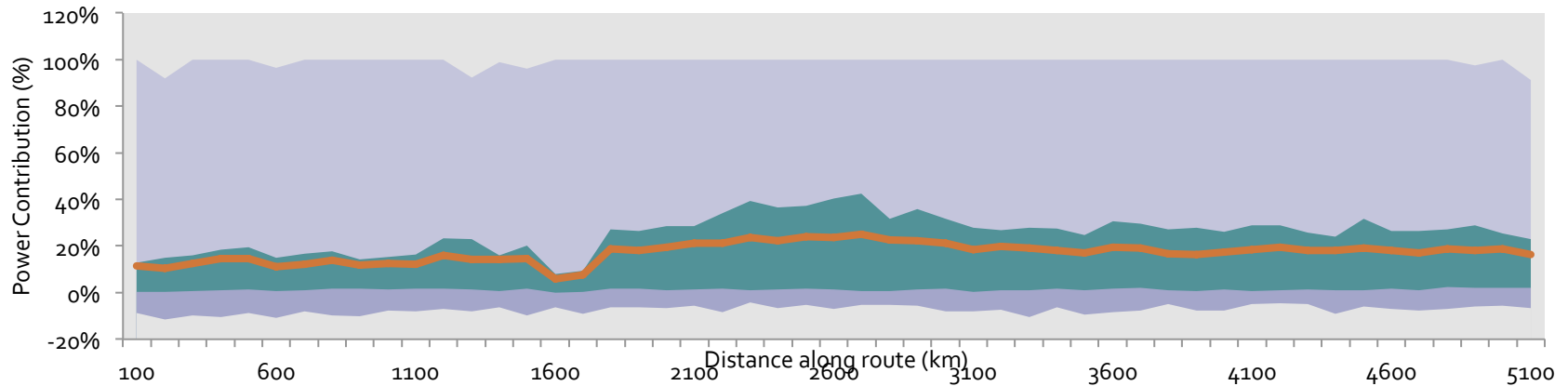
15.5%

UK-NY Windspeed
Based on VLM Data

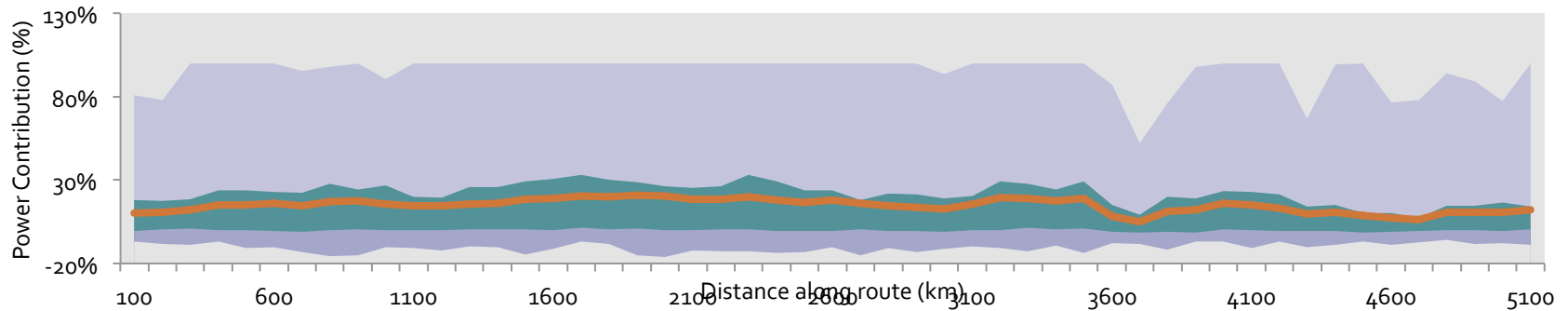


Voyage Level Modelling : Results

Voyage Level Model
New York - UK



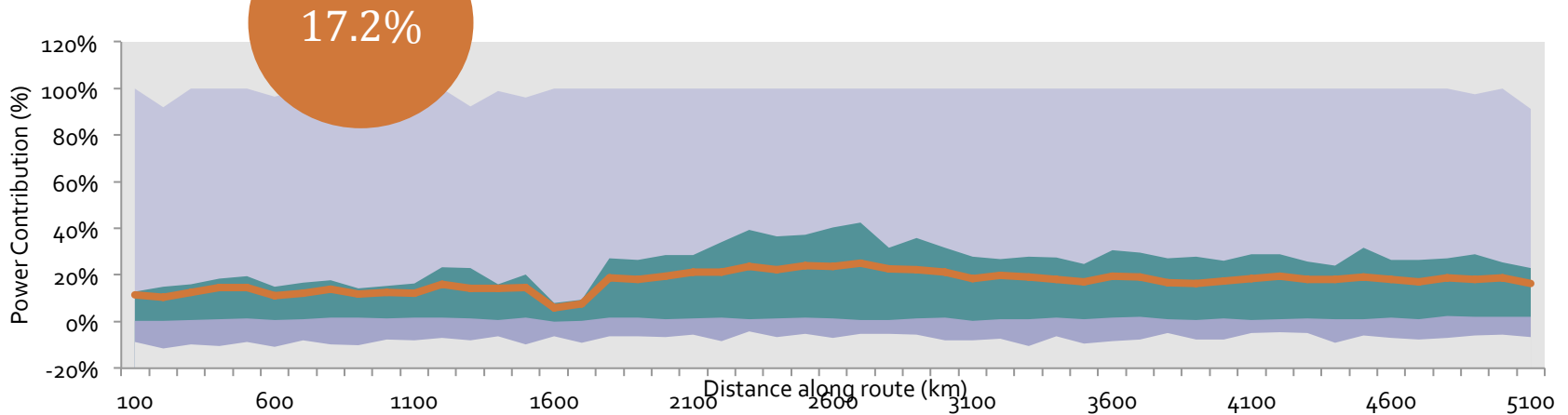
Voyage Level Model
UK - New York



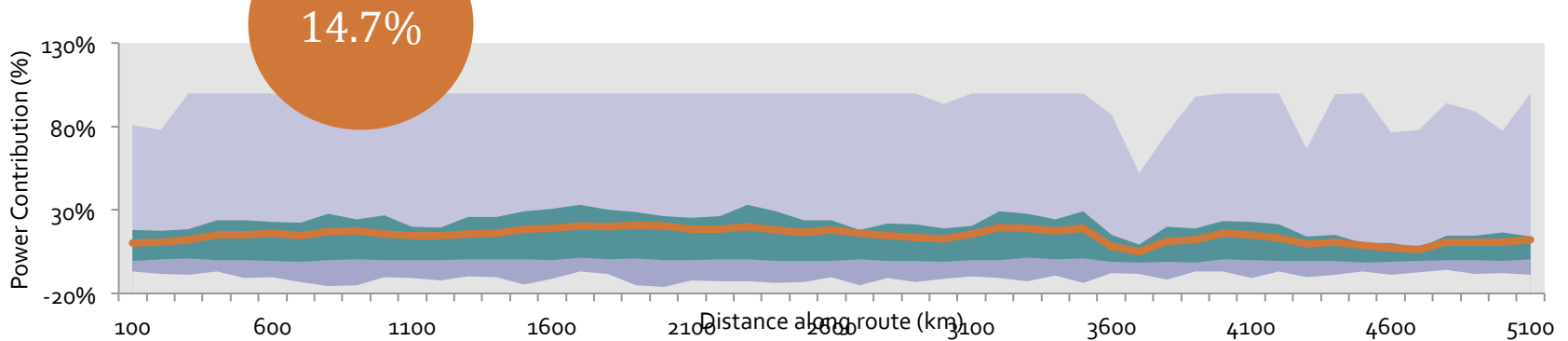
Maximum 25th-75th Percentile Minimum Average

Voyage Level Modelling : Results

Voyage Level Model
New York - UK



Voyage Level Model
UK - New York



Maximum 25th-75th Percentile Minimum Average

Conclusions

Average Windspeed:	11.4%
Windspeed Distribution:	14.6%
Region Specific Distribution:	15.5%
Voyage level Model (UK-NY):	14.7%
Voyage level Model (NY-UK):	17.2%
Voyage level Model (Return):	15.9%

- Wind assist technologies highly sensitive to speed
 - Ships able to operate below true wind speed will see greatest gains
 - Selection of speed is vital when assessing technologies
- Highly sensitive to scaling
 - A standardised reference model is presented
- Wind assist technologies must be considered in context
 - Averaging above the voyage level can lead to confusion and inaccuracy