INTO THE REAL WORLD:

ASSESSING THE VALUE

OF

WIND ASSIST TECHNOLOGY

B. Howett, T. Cui, M. Kim, O. Turan, AH. Day, A. Incecik

The Department of Naval Architecture, Ocean and Marine Engineering,
University of Strathclyde, 100 Montrose Street, Glasgow G4 0LZ, UK

benjamin.hobin@strath.ac.uk

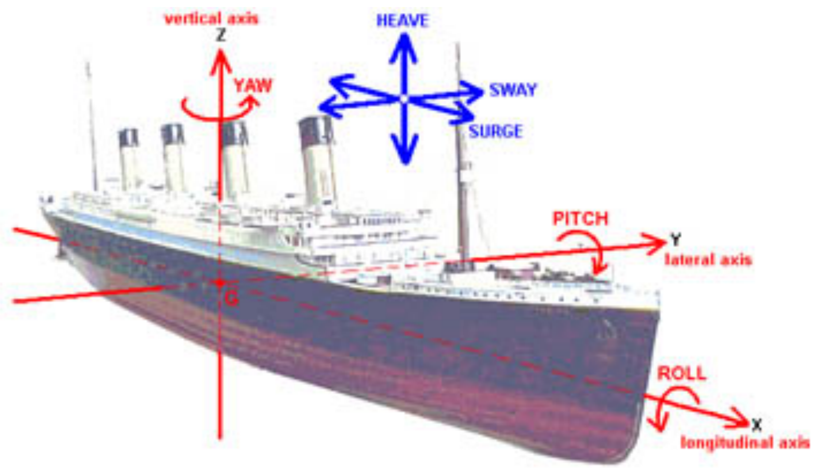
Introduction: **WASPP**

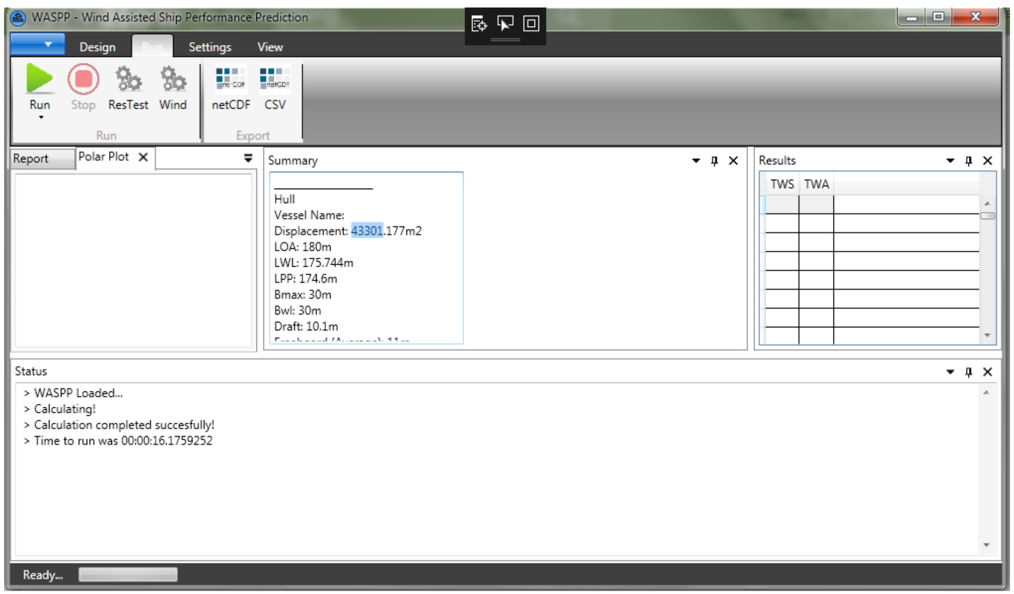
Calculates all Aerodynamic and Hydrodynamic forces

Resolves force vectors and moments around ship axis

Balances forces so accelerations are zero

4 DOF solution – Surge, Sway, Roll, Yaw





WASPP

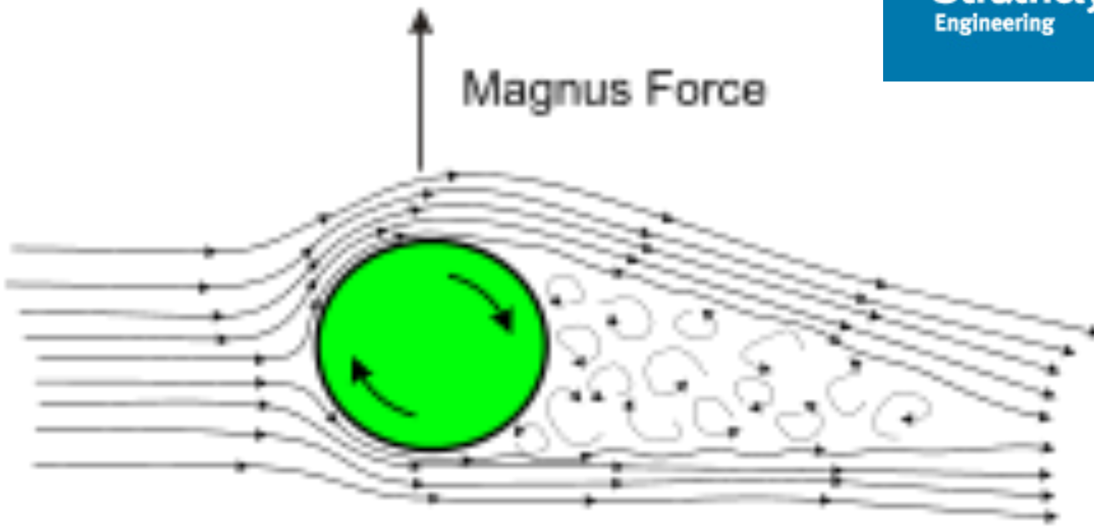
Wind Assisted Ship Performance Prediction

Introduction: Example Vessel

125m Bulk Carrier

??

??



Flettner Rotors

Technology dates back to the 1920s

Recent resurgence around 2010

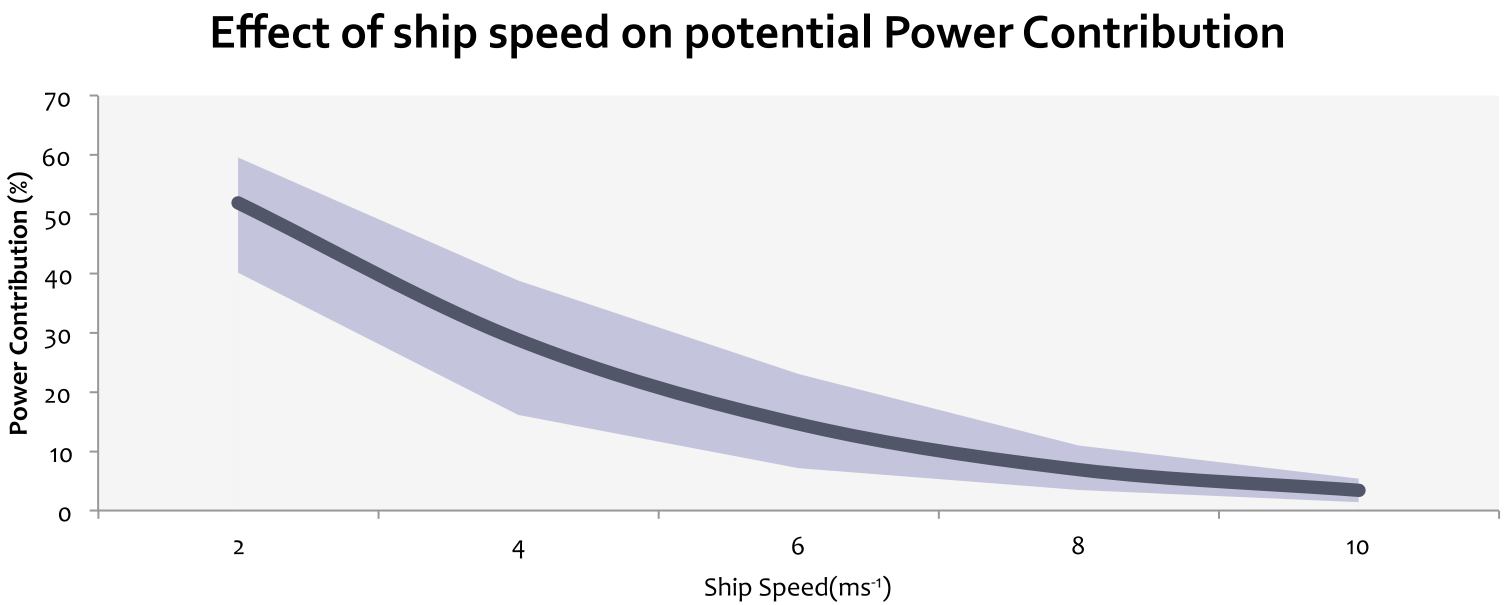
Powered rotating cylindrical columns

Generates lift through the 'Magnus' effect

Design Factors: **Speed**

We know ship speed adversely affects wind assist performance

...But by how much?



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:

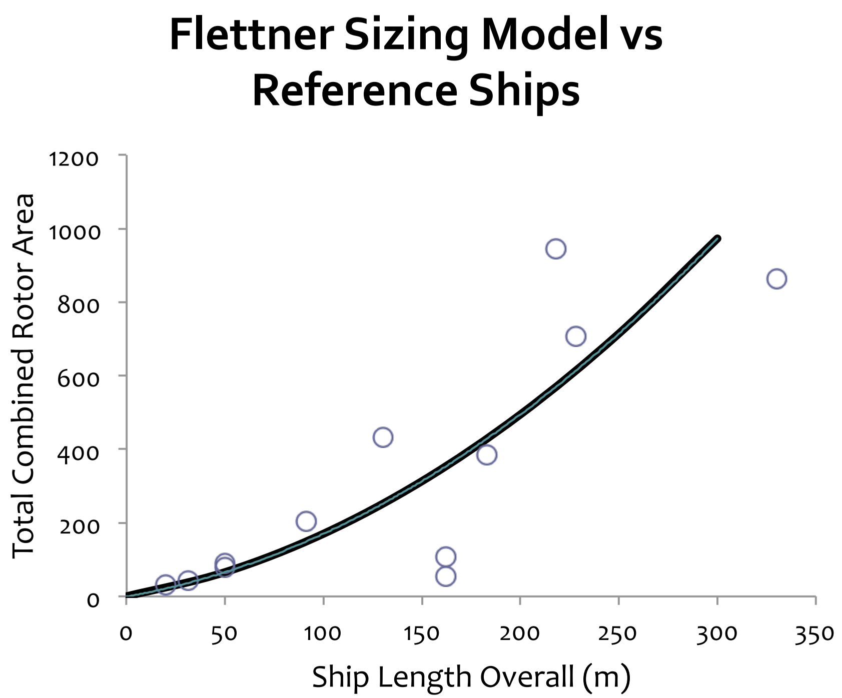
Stability at large heel angles
Sail Area/Displacement
Sail Area/Wetted Surface Area.

Length chosen instead for practical purposes

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

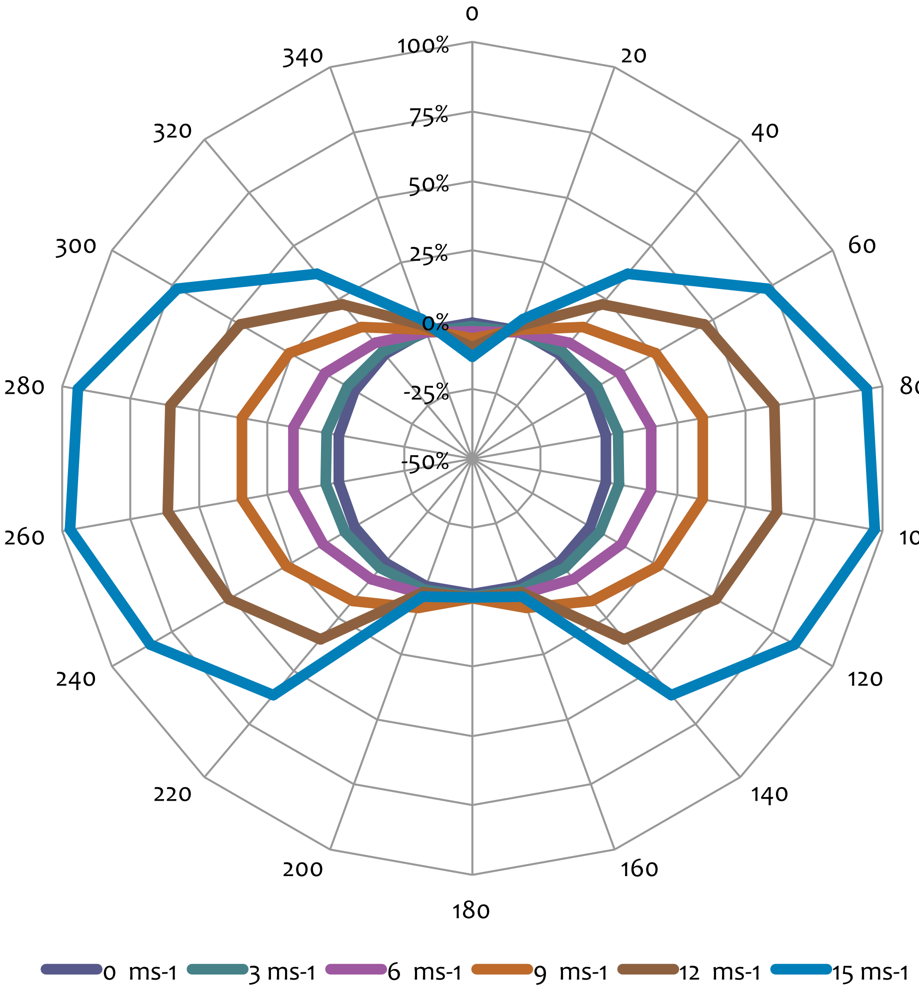
Modified curve based on wind assist assumptions

Verified against known vessels



Introduction: Example Vessel

125m Bulk Carrier
12 Knots Design Speed
3x 78m^2 Rotors
(21m Height above Deck)



Introduction : **The Problem**

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

...given optimal conditions

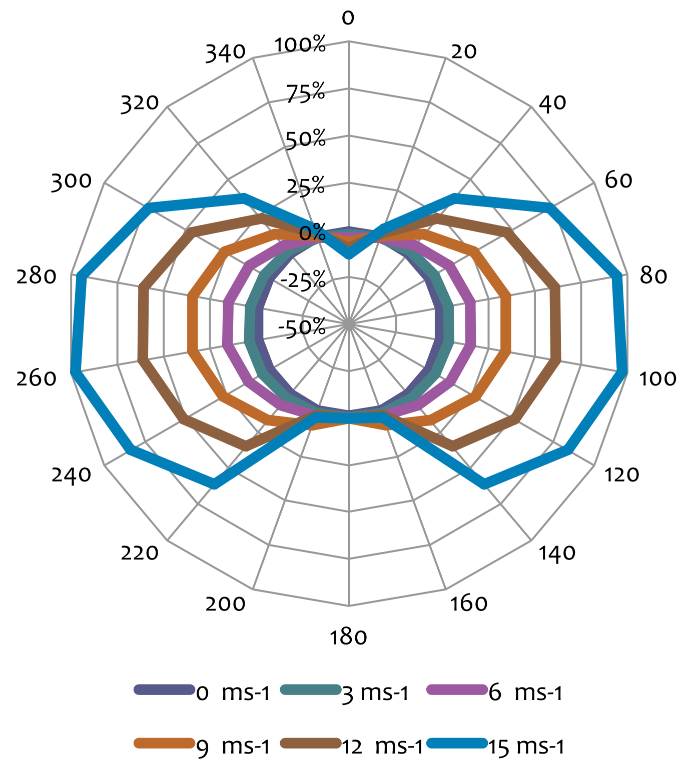
- How often are these optimal conditions?
- What are the tradeoffs outside these conditions?

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

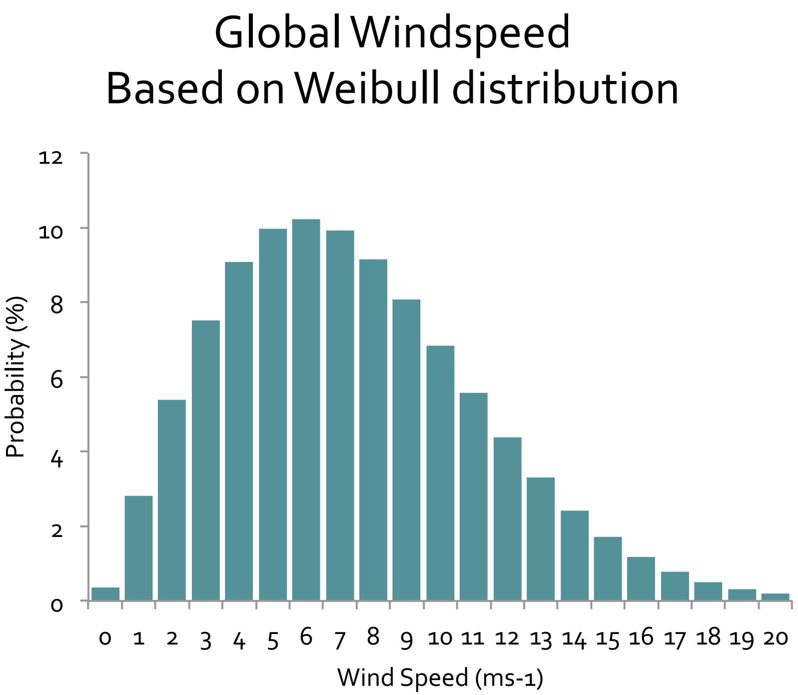
Global wind speed average for ice free seas (Kent 2012) : 7.4ms^{-1}

11.4%

Equal probability of encountering all wind angles

Assume global wind speed probability follows a weibull distribution

14.6%

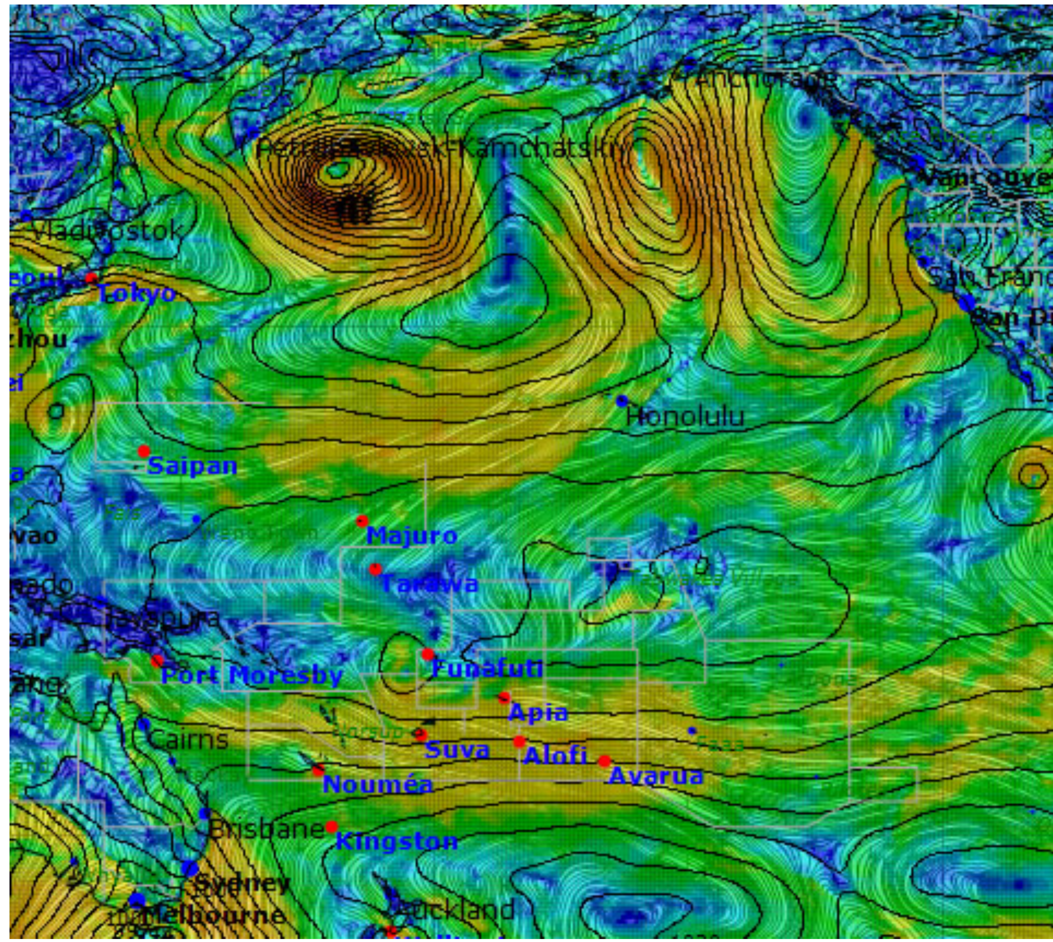


Wind: Voyage Level Modelling

European Centre for Medium range Weather Forecasting (ECMWF)

ERA-INTERIM is a global atmospheric reanalysis

37 years of global wind data

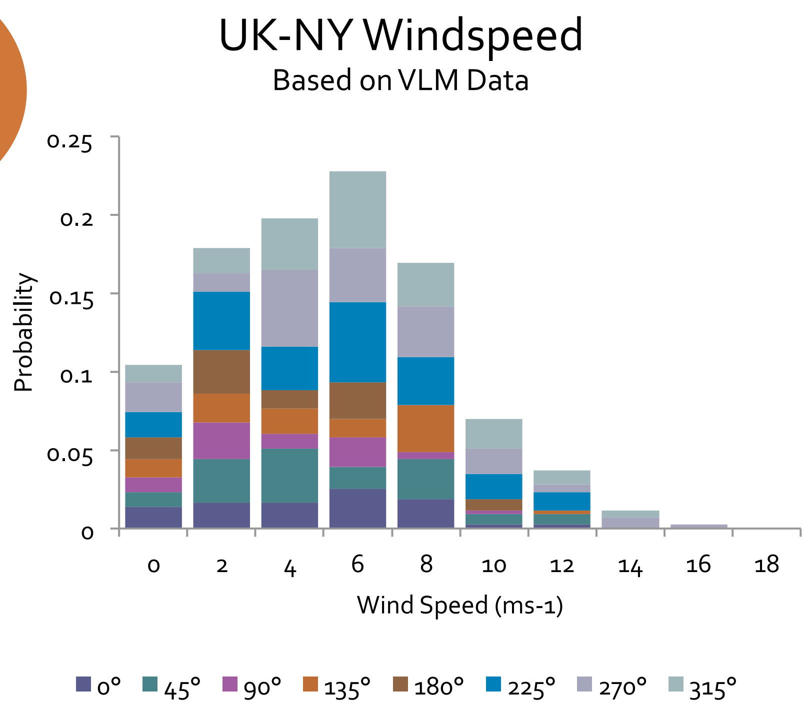


Wind : Voyage Level Modelling

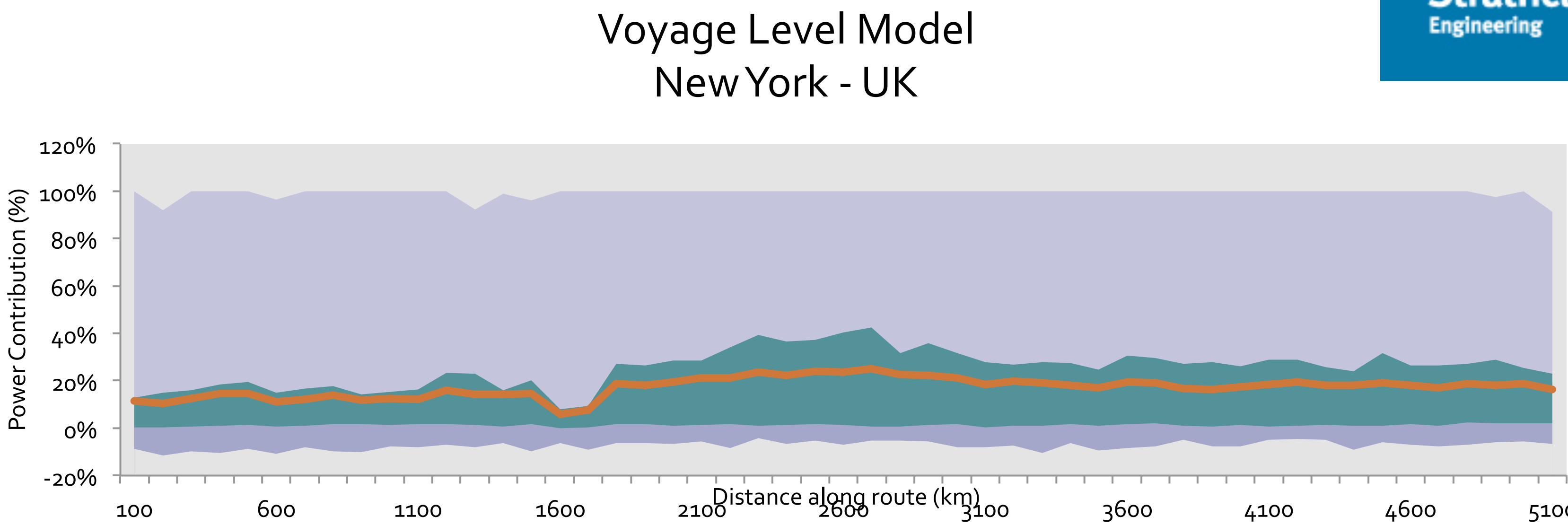
Equal probability of encountering all wind angles

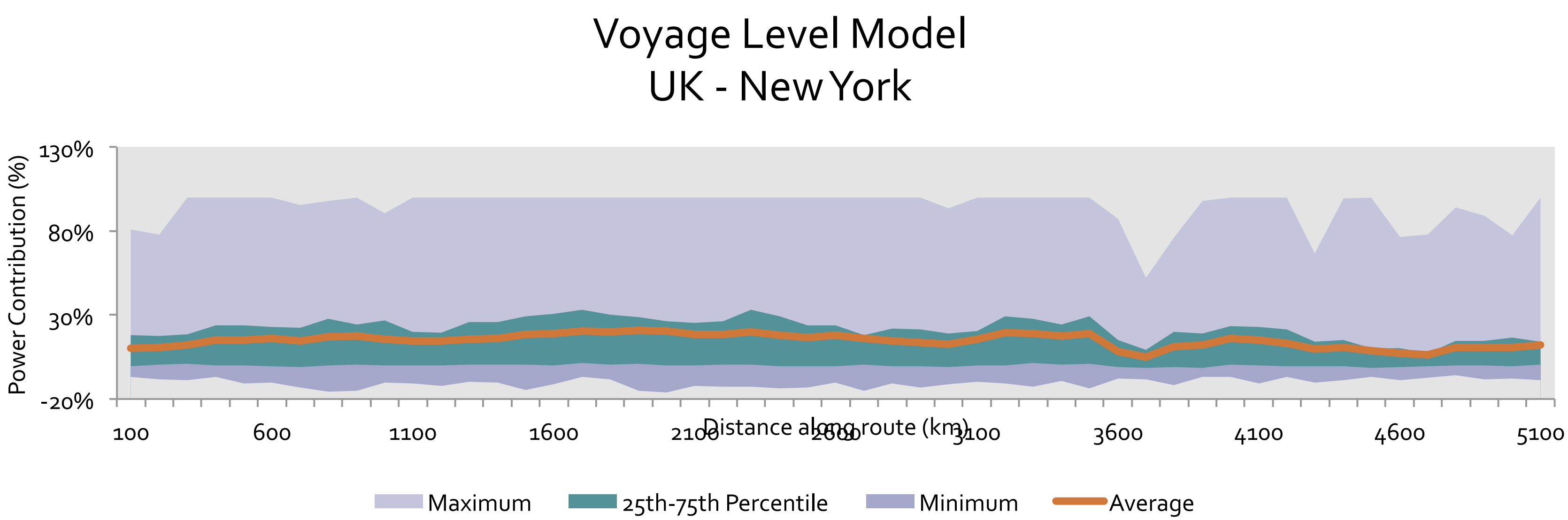
Specific windspeed distribution for UK-NY route: 8.5ms^{-1} average

15.5%



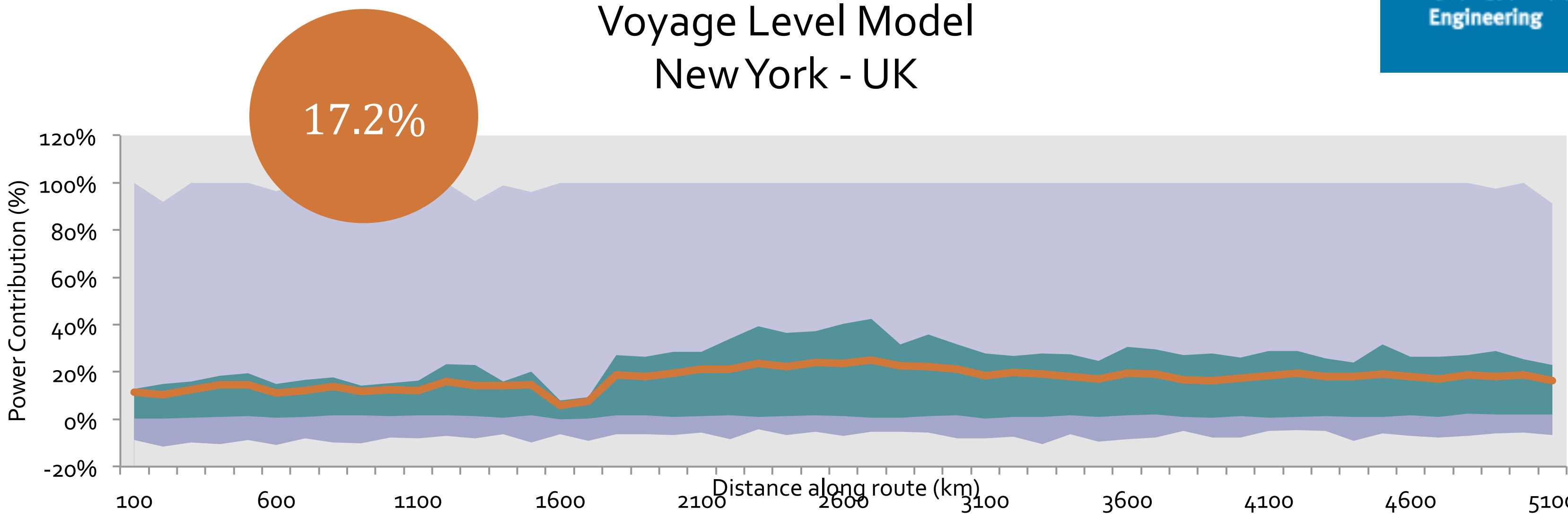
Voyage Level Modelling : **Results**



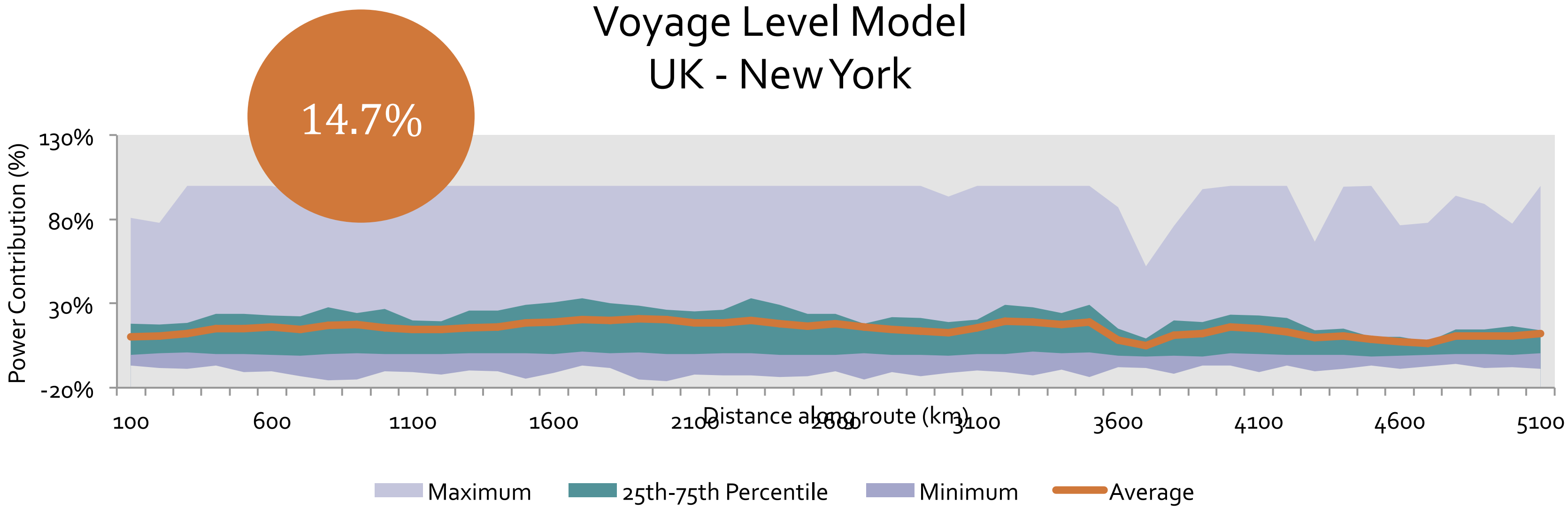


Voyage Level Modelling : **Results**

Voyage Level Model
New York - UK



Voyage Level Model
UK - New York



Conclusions

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