Wind and wave directional transit time model for offshore wind O&M

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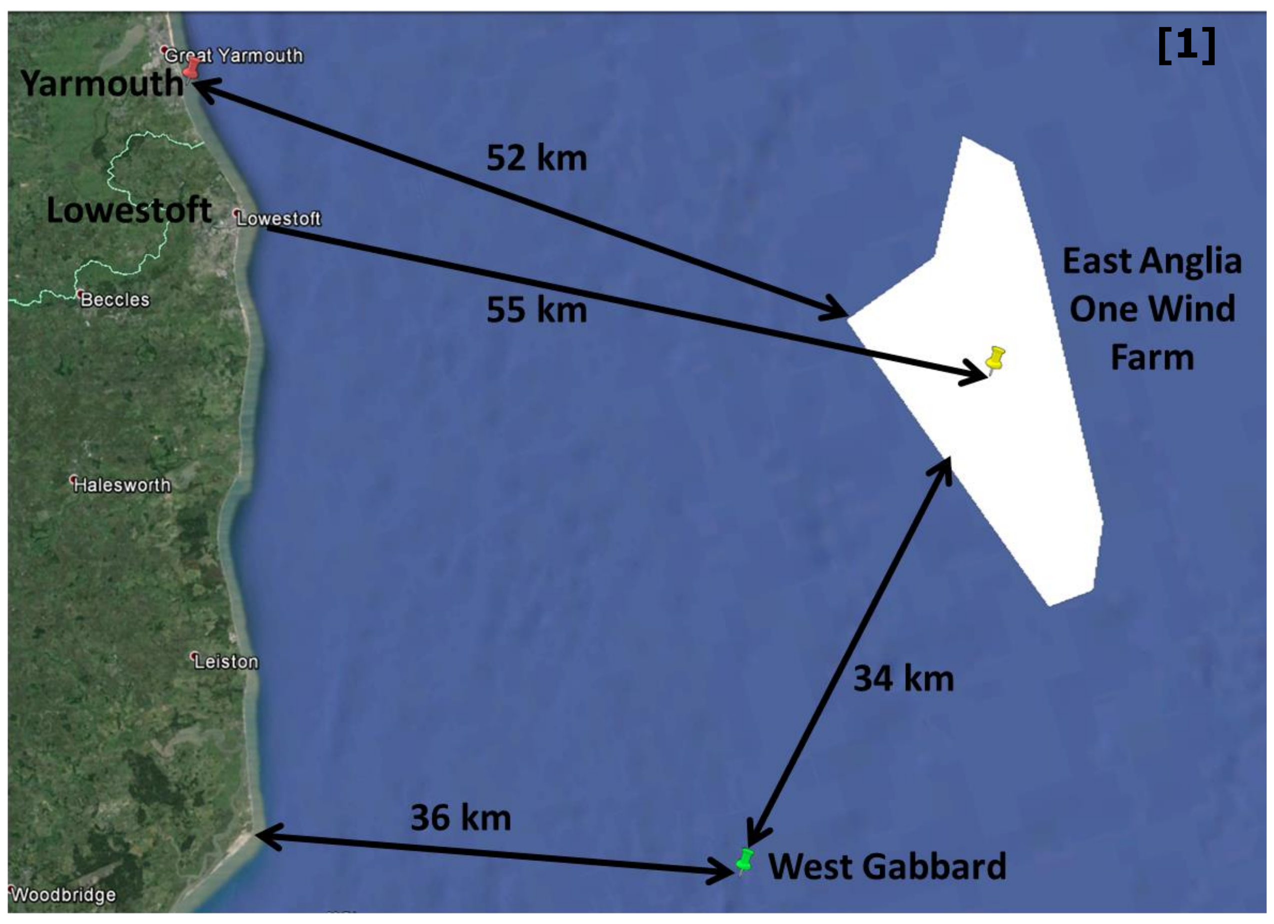
Abstract

Uncertainty in operation and maintenance costs of offshore renewable installations can be incurred through failure to properly account for marine conditions. One such area, vessel utilisation scheduling, requires accurate forecasts of wind and wave conditions to minimise charter costs as well as plant downtime. Additionally, fuel usage and auxiliary costs will increase with longer transfer times. Exploiting auxiliary offshore measurement data and its relation to accessibility constraints could reduce idle charter periods by allowing operatives to better anticipate prevailing site conditions.

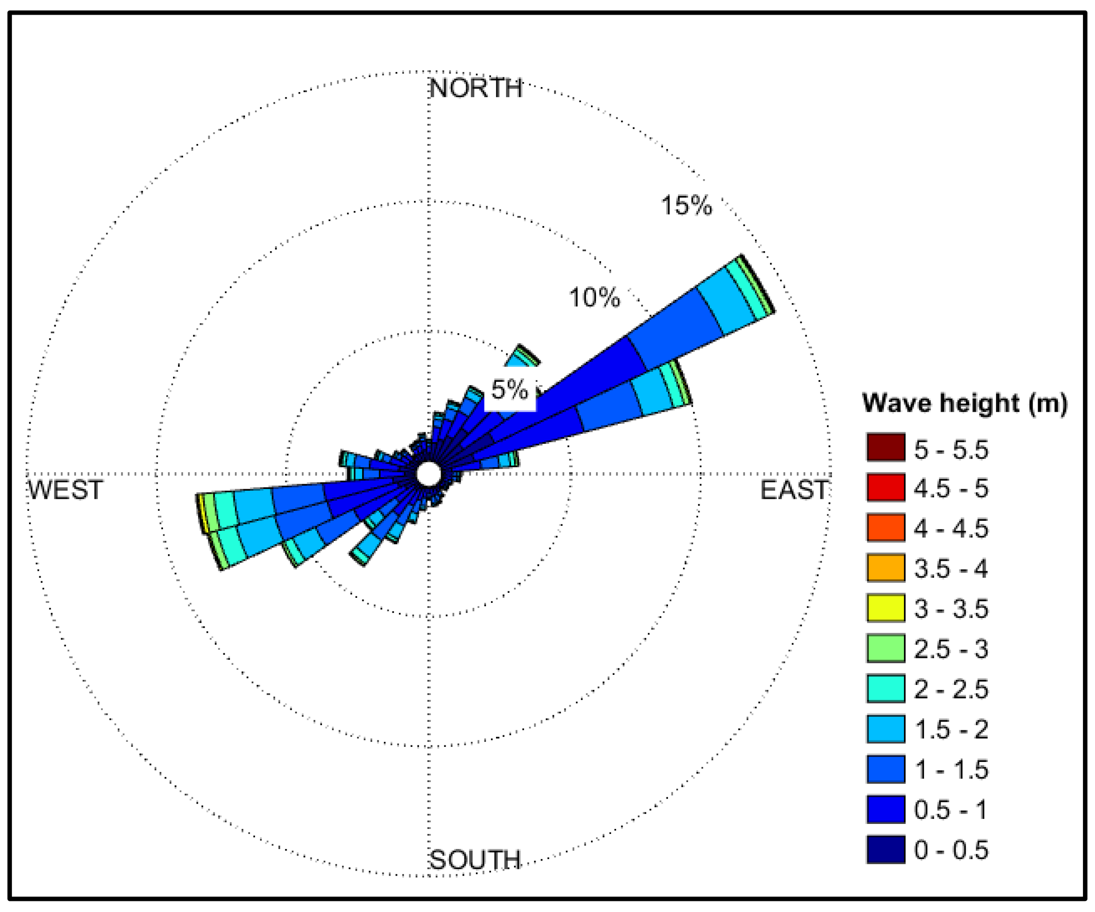
Purpose

A vessel speed loss model will be beneficial to developers and operators as better forecasting of transit times could reduce costs, lost earnings and improve mobilisation of vessels and technicians.

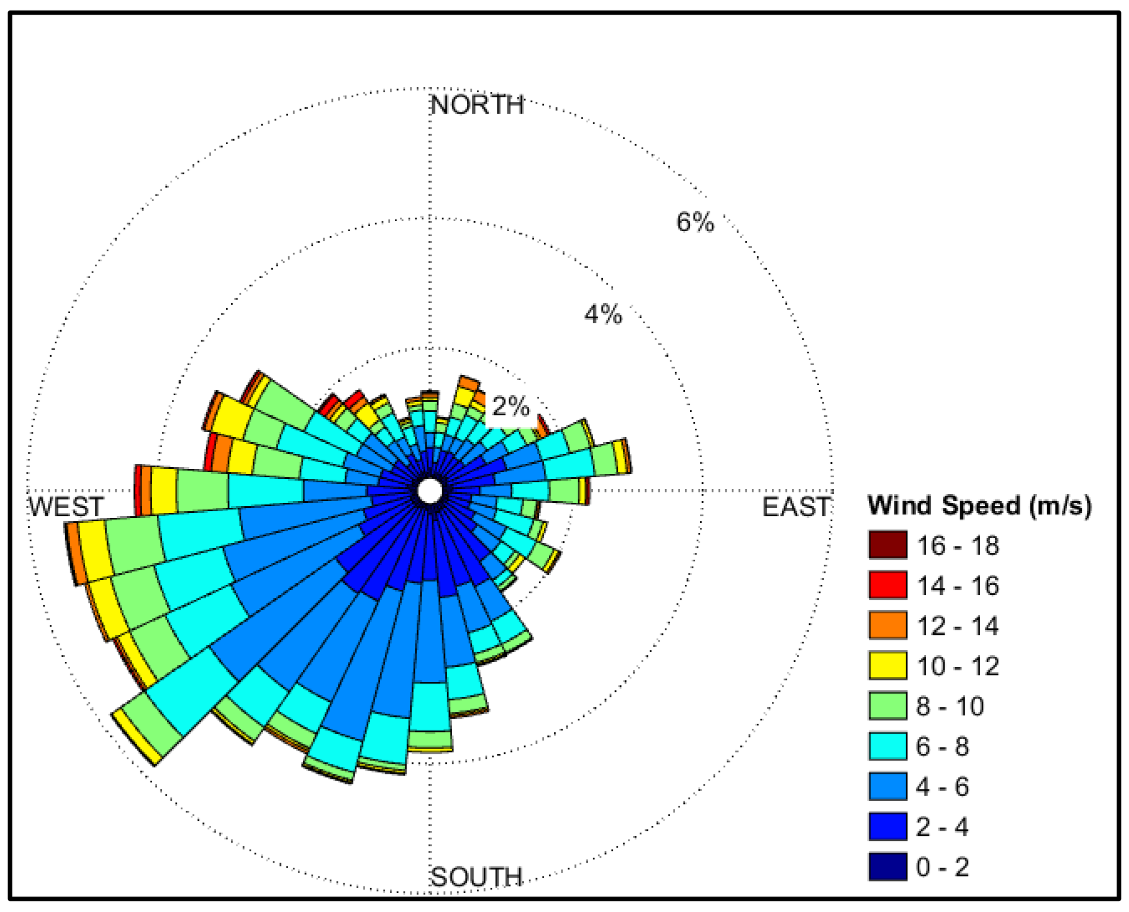
East Anglia One Wind Farm



Wave Rose for West Gabbard

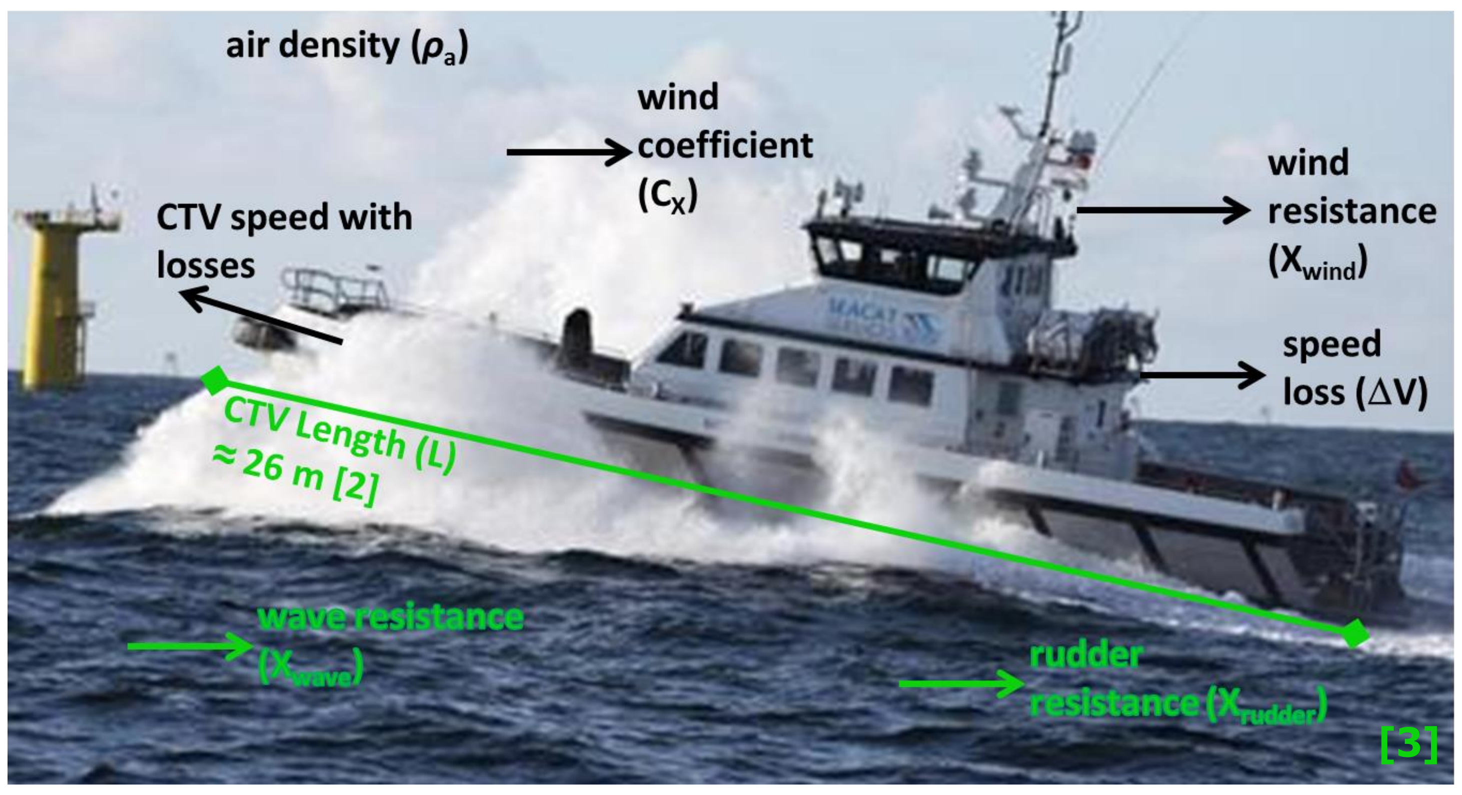


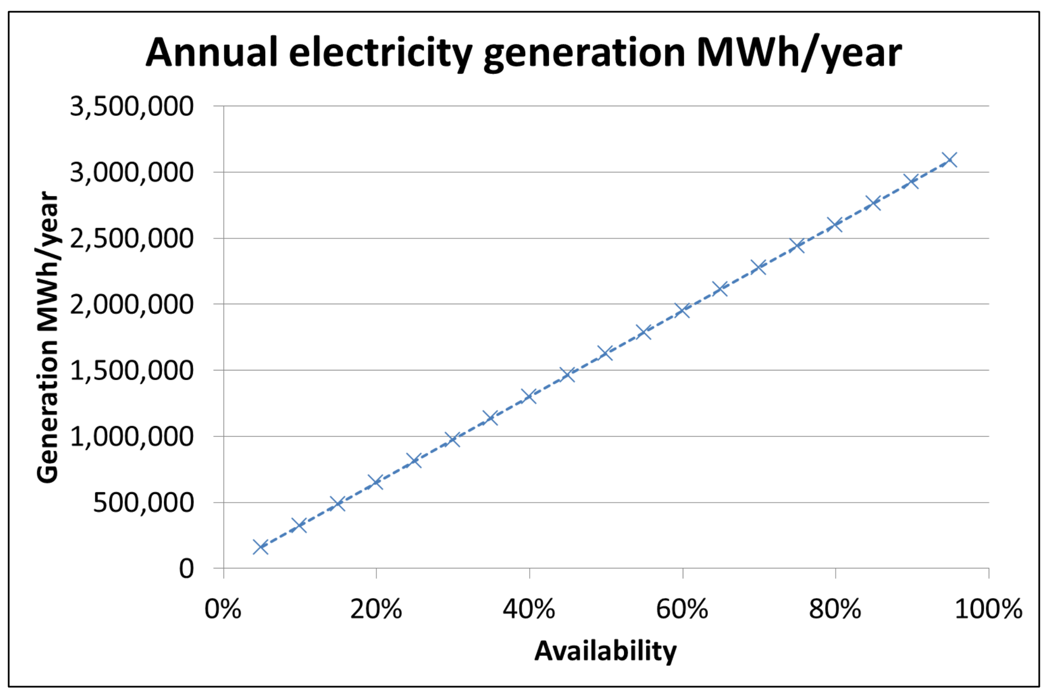
Wind Rose for Yarmouth

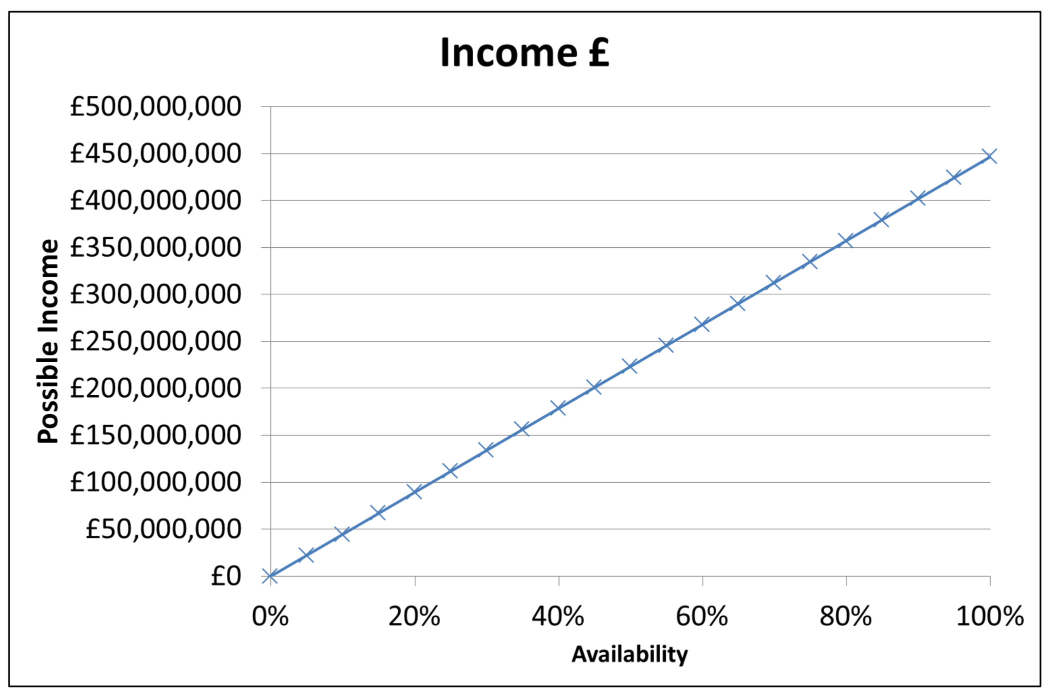


Availability

OEM availability warranties exclude days when maintenance is not possible due to weather conditions. Profitability estimates based on the OEM availability figures could substantially over-predict generation and income. The impact of such overestimations will be magnified by high wind speed and wave heights hampering accessibility with a resulting increase in plant downtime when potential generation is highest.



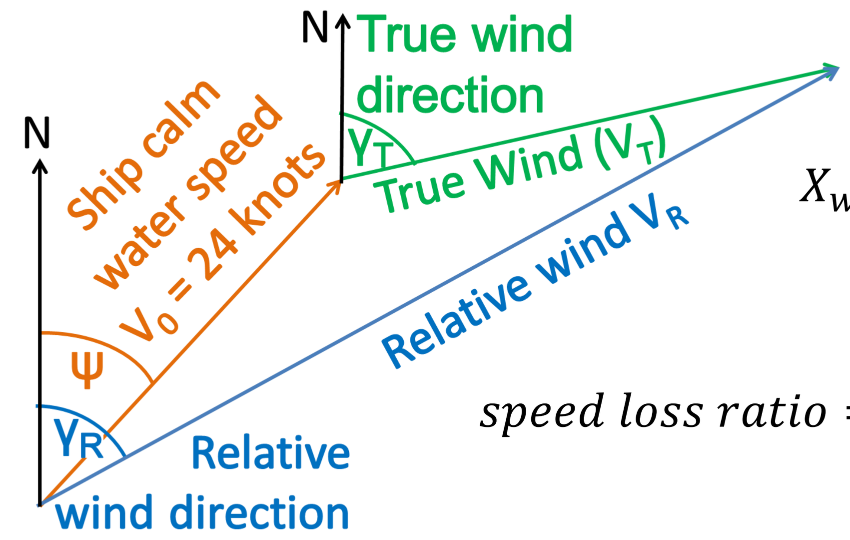




Annual electricity generation is estimated based on the multiplication of availability, capacity factor, hours per year and installed capacity. An installed capacity of 714 MW and strike price of £119/MWh are based on East Anglia One [6]. A capacity factor of 52% is assumed, based on the value for Horns Rev II in 2012 [7].

CTV speed loss model

A model for ship resistance developed by Berlekom [4] and Szelangiewicz [5] is being applied to provide transit time estimates.



$$X_{wind} = \frac{1}{2} C_x(\boldsymbol{\gamma_R})\rho_a L^2 \boldsymbol{V_R}^2$$

$$speed\ loss\ ratio = \sqrt{1 + \frac{total\ resistance}{calm\ resistance}} - 1$$

Conclusions

Existing models omit the effect of direction on operations and fail to account for the complex relations between dependent environmental variables which can impact on operations such as crew transfers, lifting and jacking operations. Advancing towards a demonstration of a strategic maintenance approach of this kind will assist in both reducing direct costs and associated initial project finance. Estimates suggest that a head wind may increase transit times by an order of magnitude while a back wind could reduce transit times. If the vessel power is increased to maintain the intended speed then fuel costs will increase.

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