Application of Quantitative Route Modelling of Navigation Safety Impacts of Offshore Wind Farms

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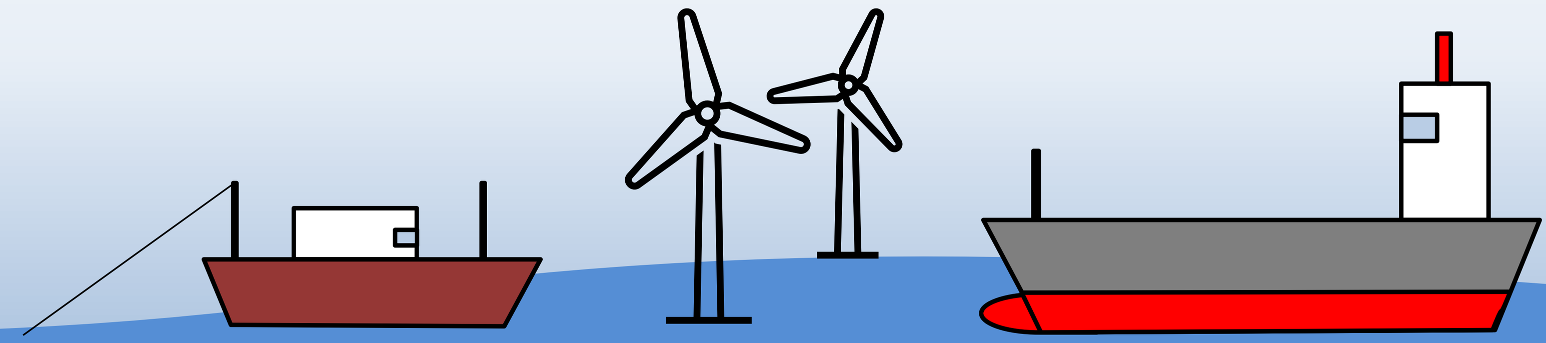


Background

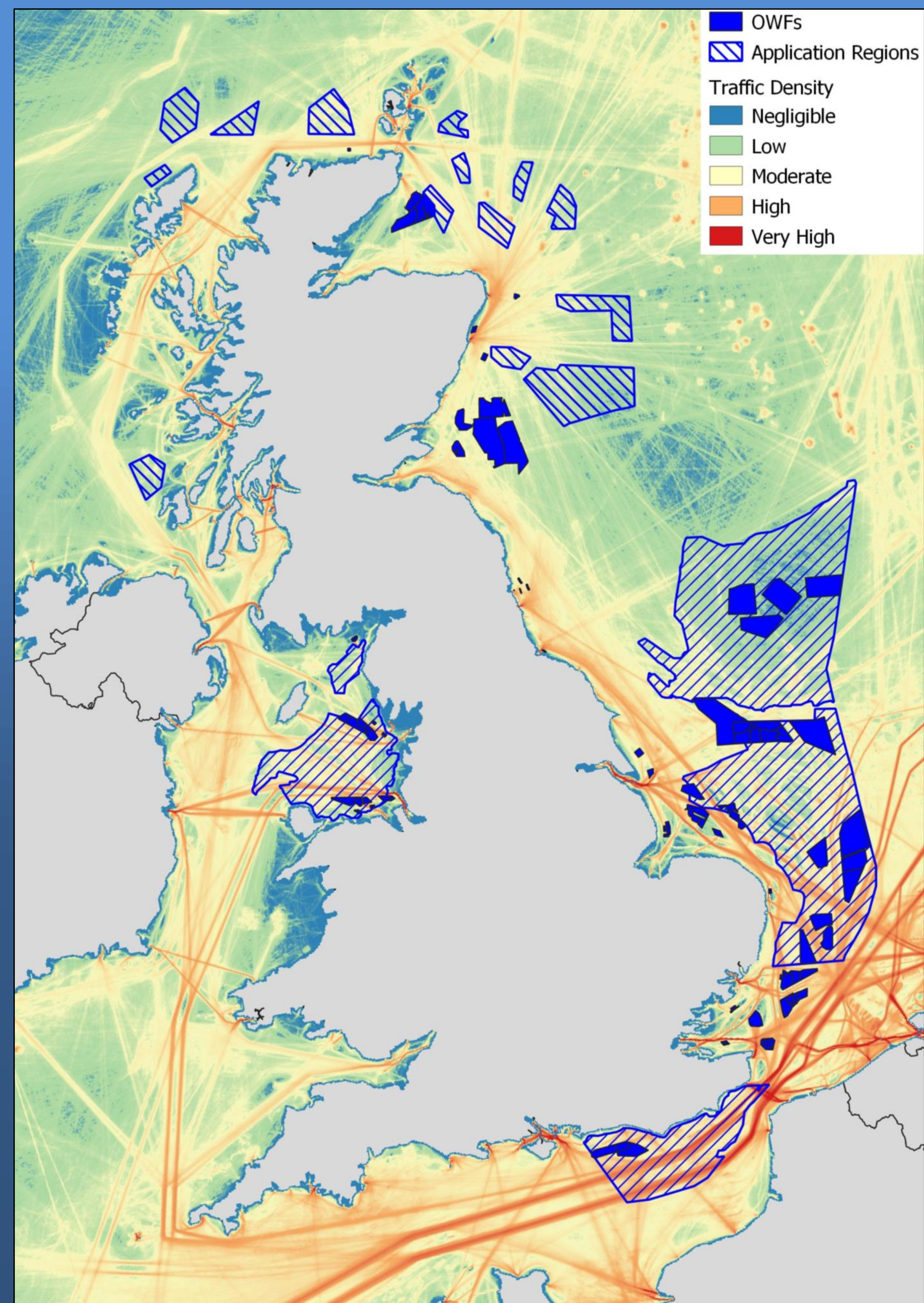
Offshore Wind Farms (OWFs) can pose significant risks to commercial shipping if not properly managed, including:

- Contact/Allision with turbines.
- Increasing the risk of collision by altering existing shipping routes.
- Impact on radar/electronic equipment.
- Increased transit time on shipping routes.

Navigation Risk Assessment (NRAs) are conducted to assess these risks, and where necessary, identify mitigation measures to reduce the impacts to acceptable levels [1]. Consultation, risk assessment and analytical techniques are all utilised to help assess these risks.

However, predicting these impacts is challenging as navigational accidents are rare-events and caused by numerous interacting factors. As a result there may be significant uncertainty in both the risk level and requirement for mitigation. Therefore, there could be value in the development or application of novel quantitative tools to assess navigation risks of OWFs. As yet these tools are generally simplistic or proprietary to specific consultancies.

This project tests the suitability of applying quantitative risk models to navigation safety studies for OWF developments.

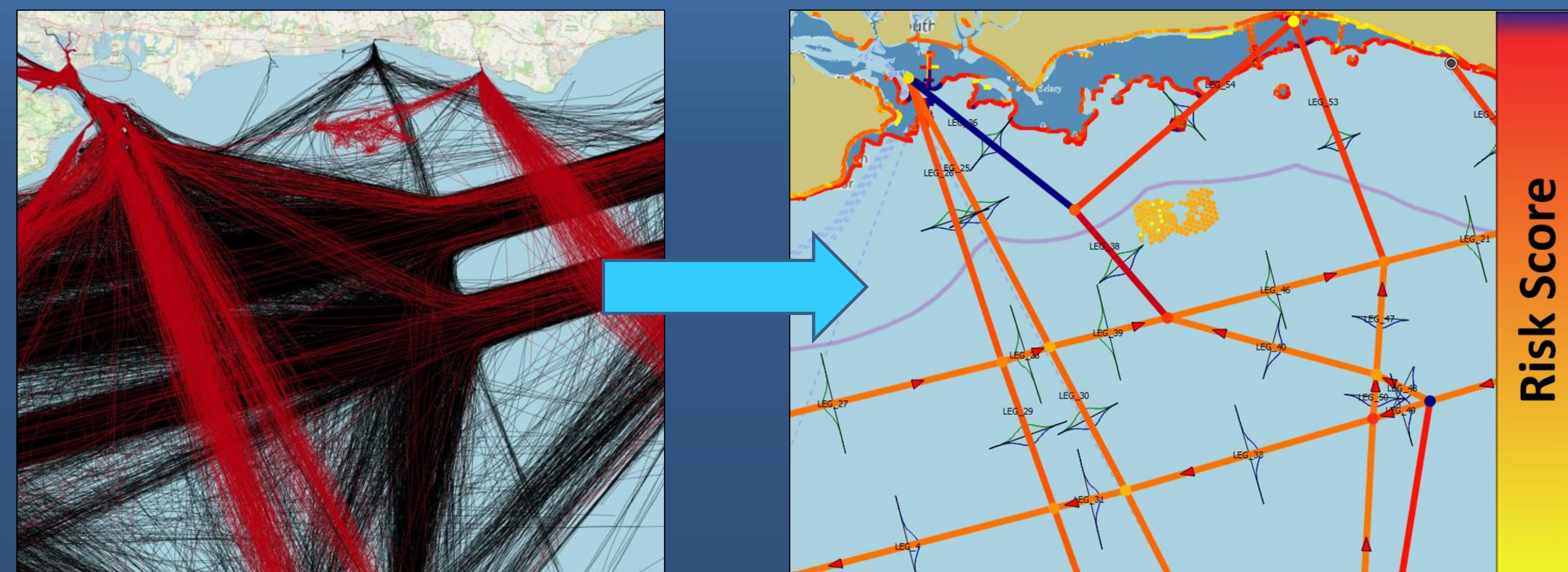


UK Shipping Density and OWFs plus Round 4 and Scotwind bidding areas.

Experiments

Historical vessel traffic data for 2017 [4] was collected and analysed within the Crown Estate's English Channel "South-East" Round 4 bidding region, to simulate how existing and future projects could impact hazard likelihoods. Data was inputted into IWRAP and key shipping routes identified and modelled. IWRAP then calculates probabilities of collision, grounding and allision.

The results demonstrate that the risk of collision is greatest around the entrance to the Solent and Traffic Lanes. The model is able to differentiate which turbines/layouts are most at risk. Furthermore, possible new lease areas will have high powered/drift contact risks and likely have significant increases on collision risk.



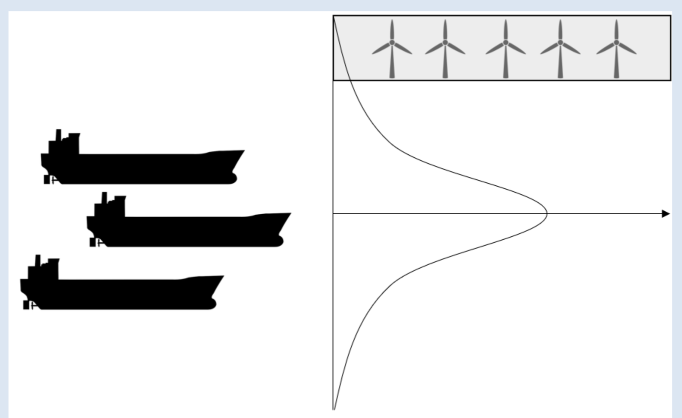
Vessel Traffic to IWRAP Routes with Derived Risk Scores

Methodology: IWRAP

IWRAP (IALA's Waterway Risk Assessment Program) is a commercial software toolkit developed for calculating collision, grounding and allisions of ships. The underlying logic is that as ship's navigate they encounter hazardous situations, with a conditional probability as a result of engine failure/human error that an accident results. Ship traffic are distilled into "routes", with volumes and distributions, and the geometric interaction or overlap with that route [2,3].

$$N_I = \sum_{Ship\ class\ i=1}^{n\ class} P_{ci} Q_i \int_{ZMin}^{ZMax} f_i(z)dz$$

N_I is the expected number of groundings per year
i is the ship class
P_c is the causation probability
Q is the number of movements
ZMax and ZMin are the transverse coordinates of the obstacle
$f_i(z)$ is the probability density function for the ship traffic
dz is the coordinate and distance perpendicular to the route



Summary

The results of this analysis demonstrate that IWRAP has numerous advantageous features for modelling of OWFs. Most significantly, it enables a standardised method of "What-If" scenario risk modelling to facilitate discussions with stakeholders and provide quantitative inputs for risk assessments, thereby reducing uncertainty. However, several key challenges are highlighted; firstly, the outputs of this method are difficult to validate without appropriate benchmarks. Secondly, the method is static and may not be suitable for non-linear systems such as with significant day-night variations. Thirdly, the methods are sensitive to input variables that are difficult to estimate. Finally, methodological assumptions have been challenged by some authors. As such, further research is needed to address these limitations.

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[4] MMO (2014). Mapping UK shipping density and routes from AIS (MMO 1066).

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