Satellite Wave Data for a Surrogate Wave Model for Offshore Wind Farm Operations

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1. CONTEXT

Marine operations represent up to 1/3 of total project costs for offshore wind farms. With more turbines and greater distances from shore, costs associated with longer transit times and more weather downtime will grow, especially as projects move into deeper waters with the emergence of floating offshore turbines.

Additionally, competition for the few purpose-built vessels for offshore wind operations is set to become fiercer as more countries enter the market, driving up vessel charter costs.

Wave forecasts are used to optimise operation planning, make cost-effective use of vessels, and identify weather windows. More accurate and detailed forecasting can reduce costs in an industry gearing up for massive global growth.

2. OVERVIEW

This project uses a machine learning approach to create a surrogate wave model. It is trained on a numerical wave model, to learn the relationship between wave conditions at satellite measurement locations, and wave conditions over an area.

The surrogate wave model can then run with real-time satellite data inputs to provide a spatial data set for waves, without the high computational power needed to run the numerical wave model itself.

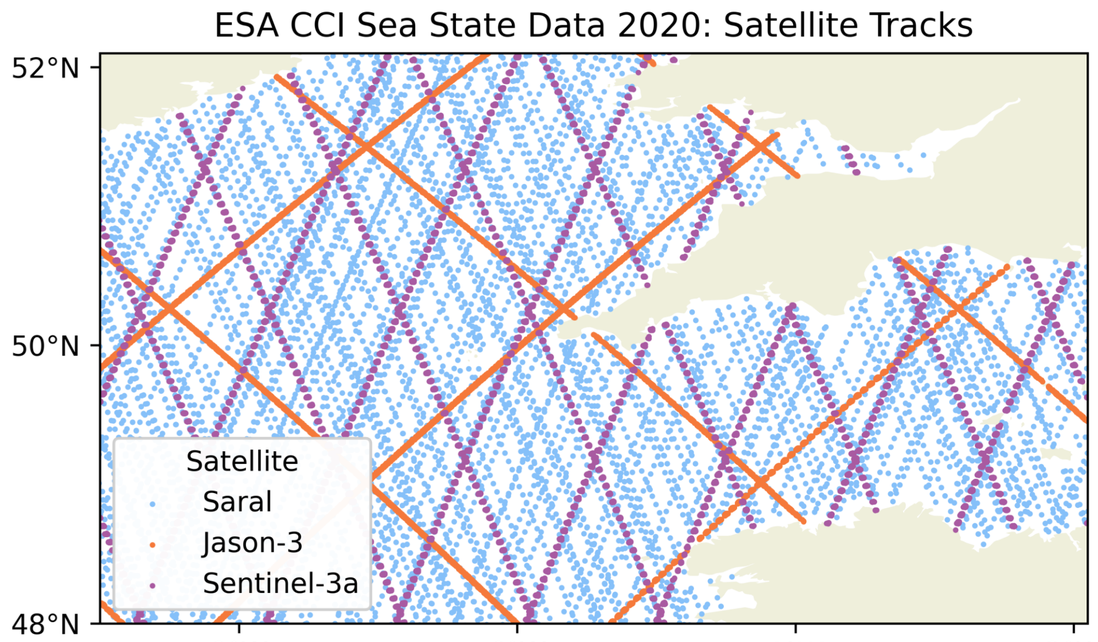
The result is a wave model that runs more frequently, on any computer and can update incredibly quickly. Integrating measurements gives high accuracy, opening a new approach to forecasts for marine operations.

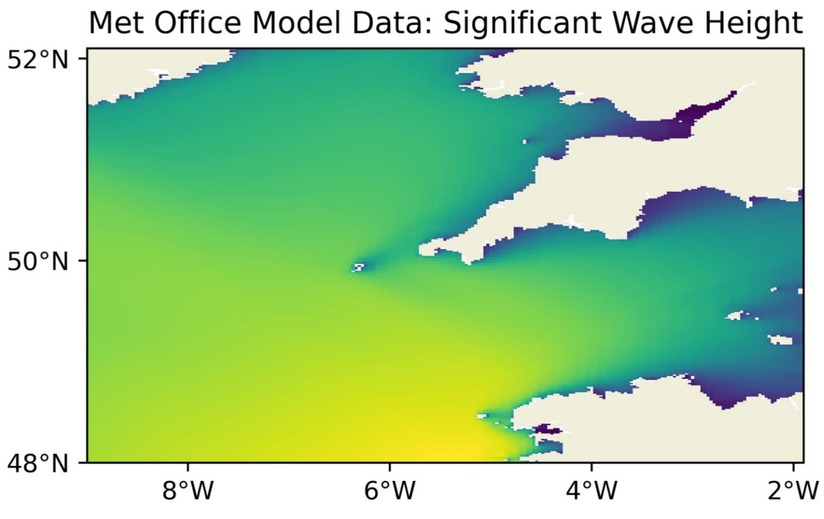
3. SATELLITE DATA

Oceanographic satellite data provides consistent global coverage of the sea surface, acting as a useful complement to point location wave buoy data to enhance the surrogate wave model.

Several Earth Observation satellite missions host radar altimeters that measure significant wave height along a narrow beam and provide measurements approximately every 7 km along the track.

Tracks are repeated in accordance with the revisit cycle of the satellite. The graph to the right shows satellite tracks for Jason-3 (repeated every 10 days), Sentinel-3a (repeated every 27 days), and SARAL (orbiting on the ‘SARAL Drifting Phase’) , to demonstrate spatial coverage of the data in the Celtic Sea.





4. WAVE MODELS

Wave forecasts are typically produced from numerical wave models that represent the physics of ocean wave energy transfer.

Previous work created a surrogate model trained on wave data from buoys and the UK Met Office numerical model that outputs a forecast. This project will assess the suitability of using satellite-derived wave data with the surrogate model framework.

Comments and suggestions are very welcome!
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