EERA Deep Wind 2022:
Weather windows and efficient operational planning for the floating offshore wind industry

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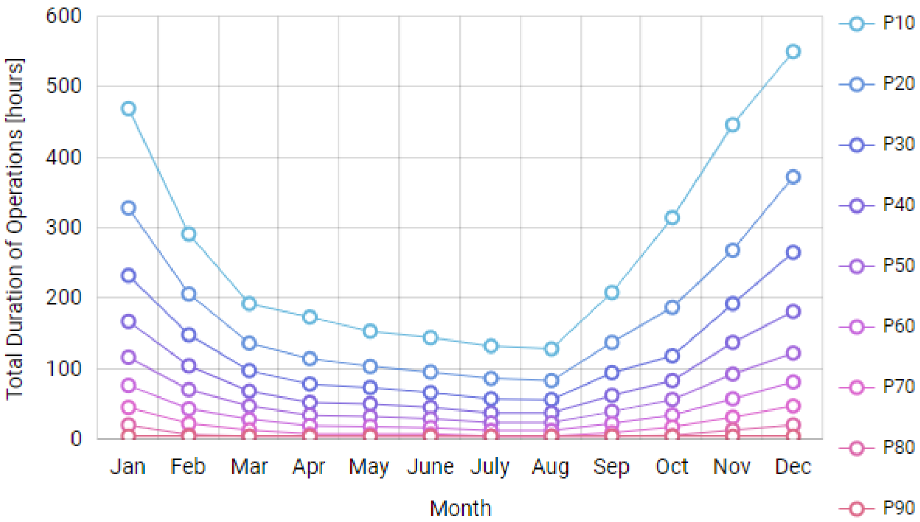
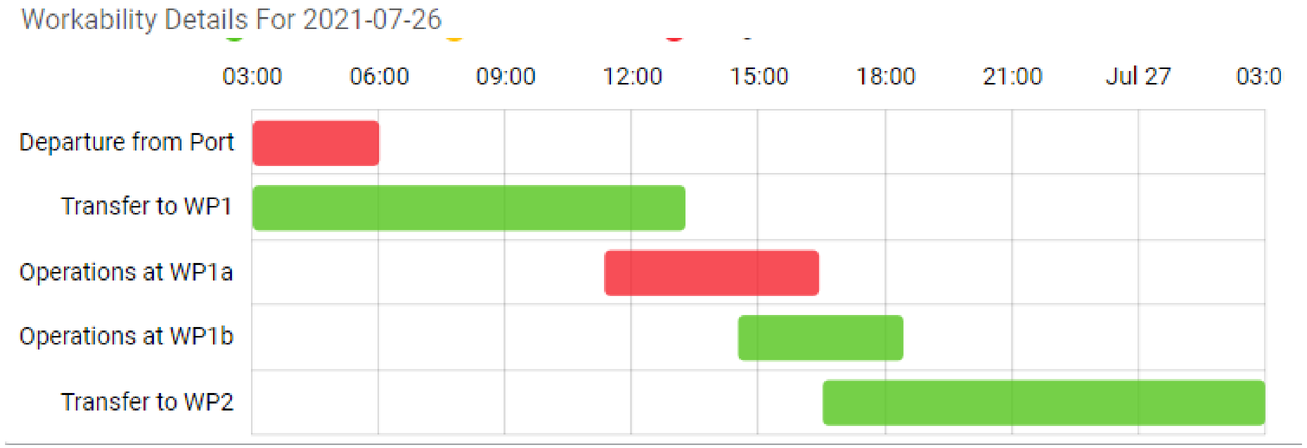
WEATHER-RELATED WORKABILITY AT SEA

Planning is imperative for minimizing safety risks



Seasonal planning at design (**Hindcast**)



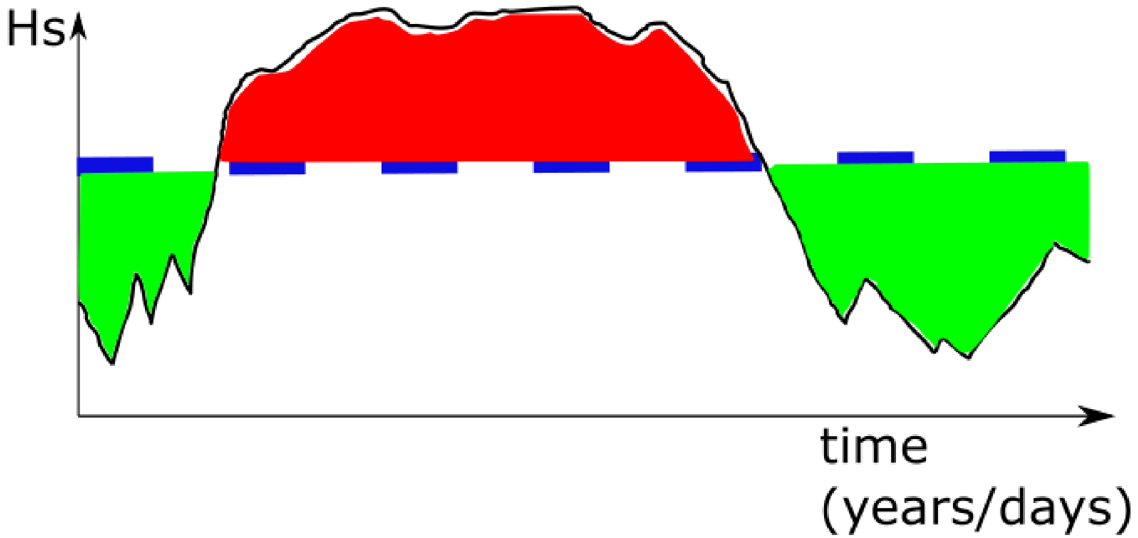
Forecast during operations

WORKABILITY CHALLENGES IN O&M FOR OWFs

Seasickness risk during transfer to OWF

Fall/Injure risk during ladder access

TRADITIONAL APPROACH FOR WORKABILITY ANALYSES



Threshold
(often discretionary and empirical)

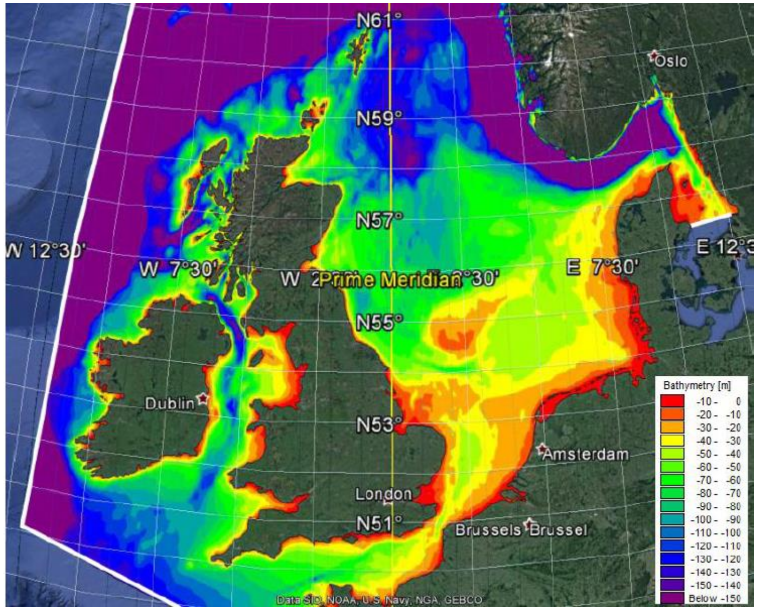
Solid metocean data is key, but not enough!

OUR APPROACH: HIGH-QUALITY METOCEAN DATA

Hydrodynamical and Spectral Wave modelling: datasets for tides, currents, winds, waves

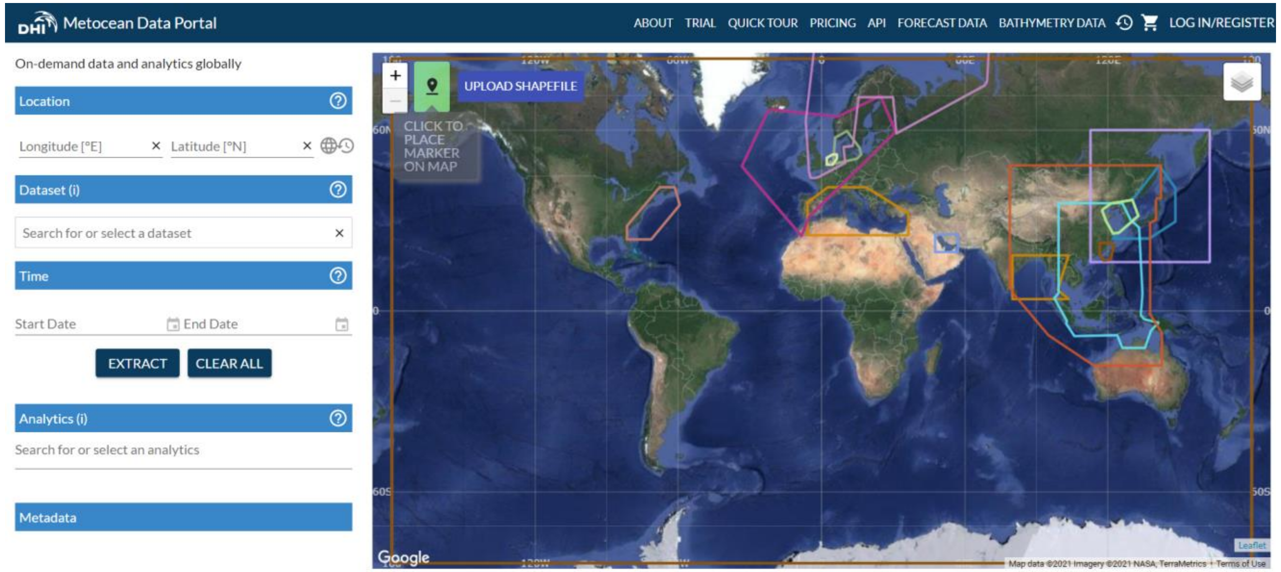
✓ **Forecast**

Hydrodynamical and Spectral Wave modelling



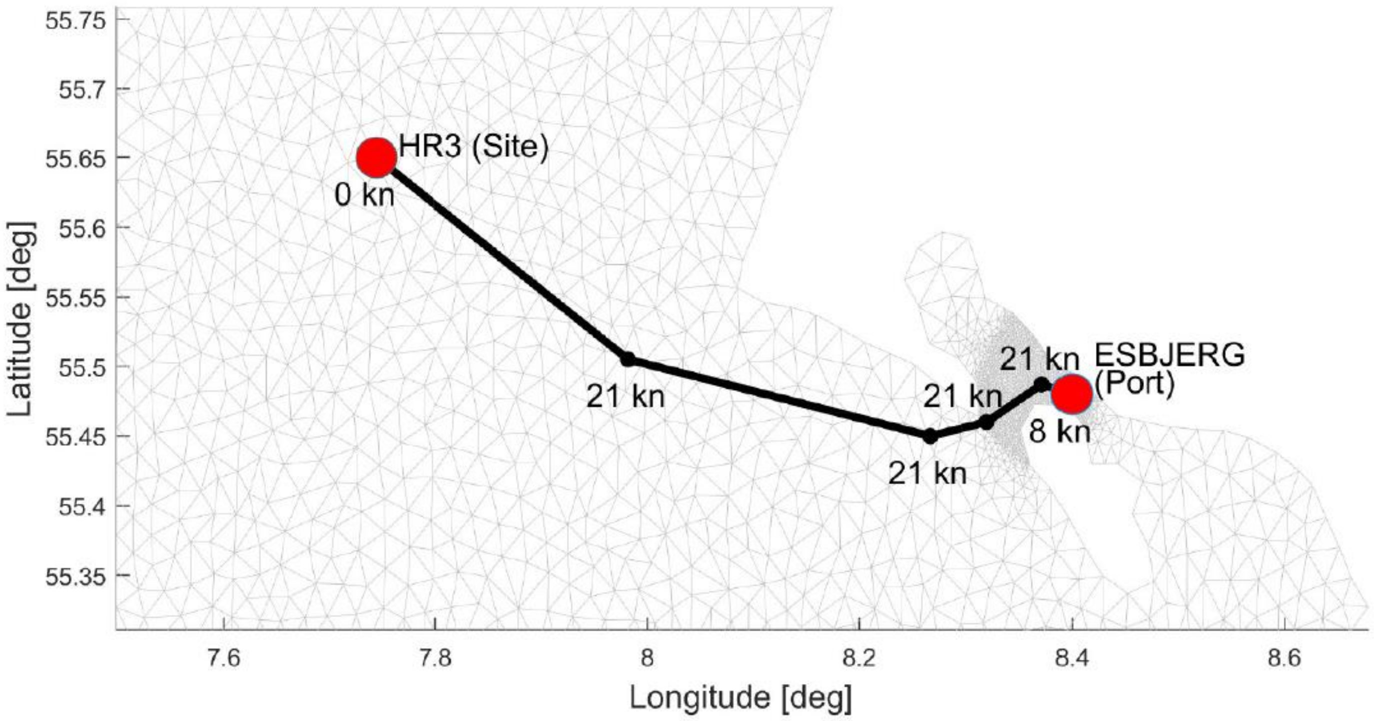
✓ **Hindcast**

Up to 40 years of data



OUR APPROACH: VESSEL NAVIGATION

✅ DHI's Agent Based Modelling engine for quick computations

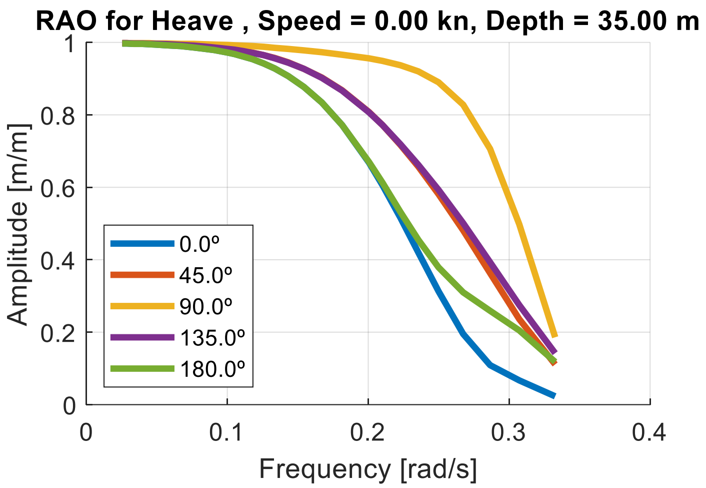


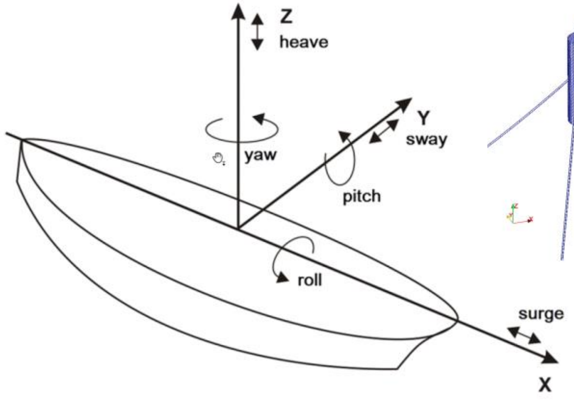
Workability is not ONLY assessed in points (sites), but ALSO along the navigation route.

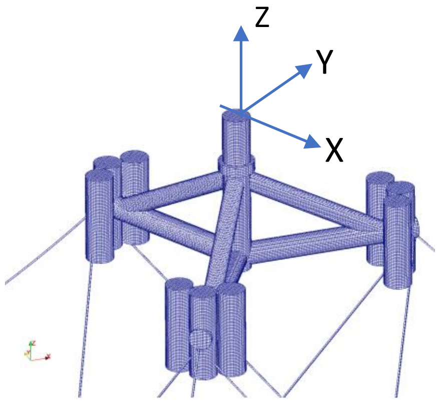
OUR APPROACH: PRACTICAL RISK MEASURES

✓ Standard 6DOF solver

Metocean (Hm0, Tp,...)
Speed
Water depth
Heading







Significant vessel bow heave

$$\Delta_{\text{bow}}^{\text{sig}} = 2 \cdot \sqrt{\int_0^{\infty} [S^{\text{sea}}(\omega_e) \cdot \text{RAO}_{\text{heave,bow}}] d\omega_e + [S^{\text{swell}}(\omega_e) \cdot \text{RAO}_{\text{heave,bow}}] d\omega_e} =$$

$$2 \cdot \sqrt{\int_0^{\infty} [Sm_{\text{heave,bow}}^{\text{sea}}(\omega_e)] d\omega_e + [Sm_{\text{heave,bow}}^{\text{swell}}(\omega_e)] d\omega_e}$$

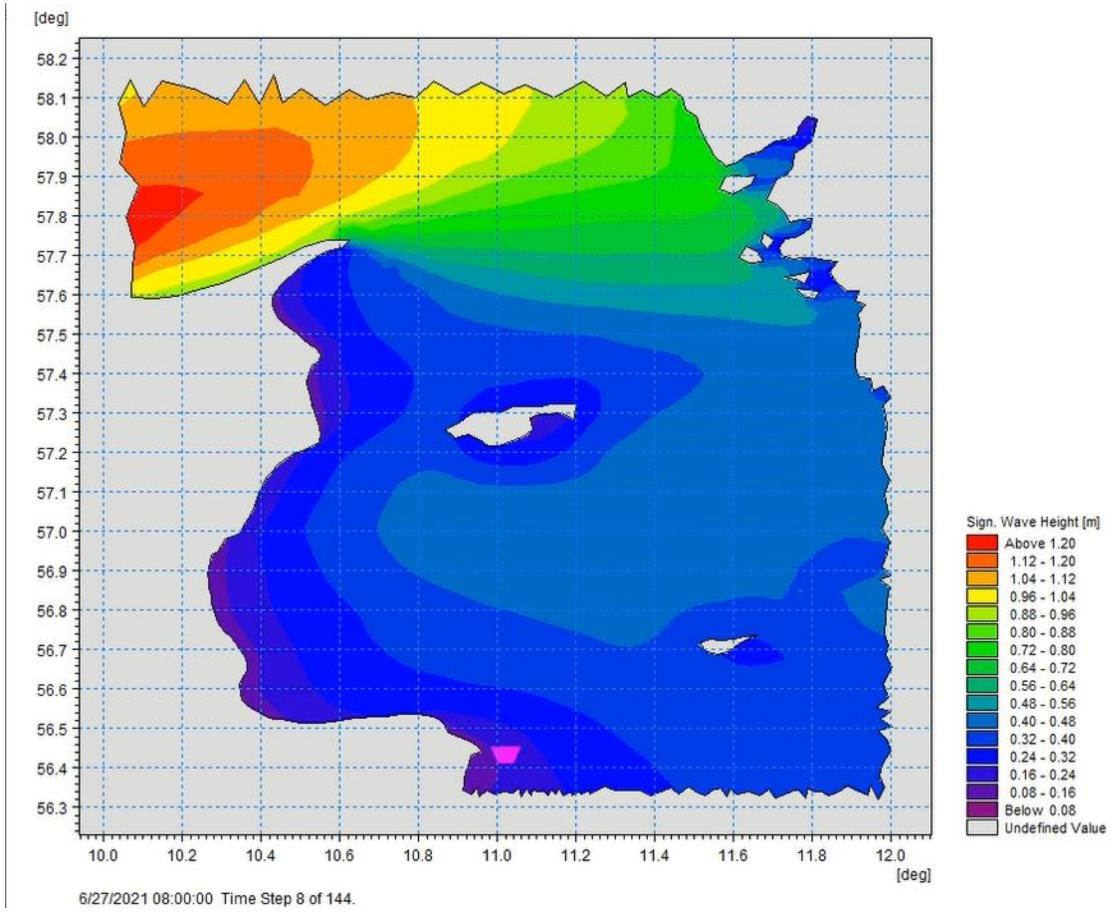
Motion Sickness Index*

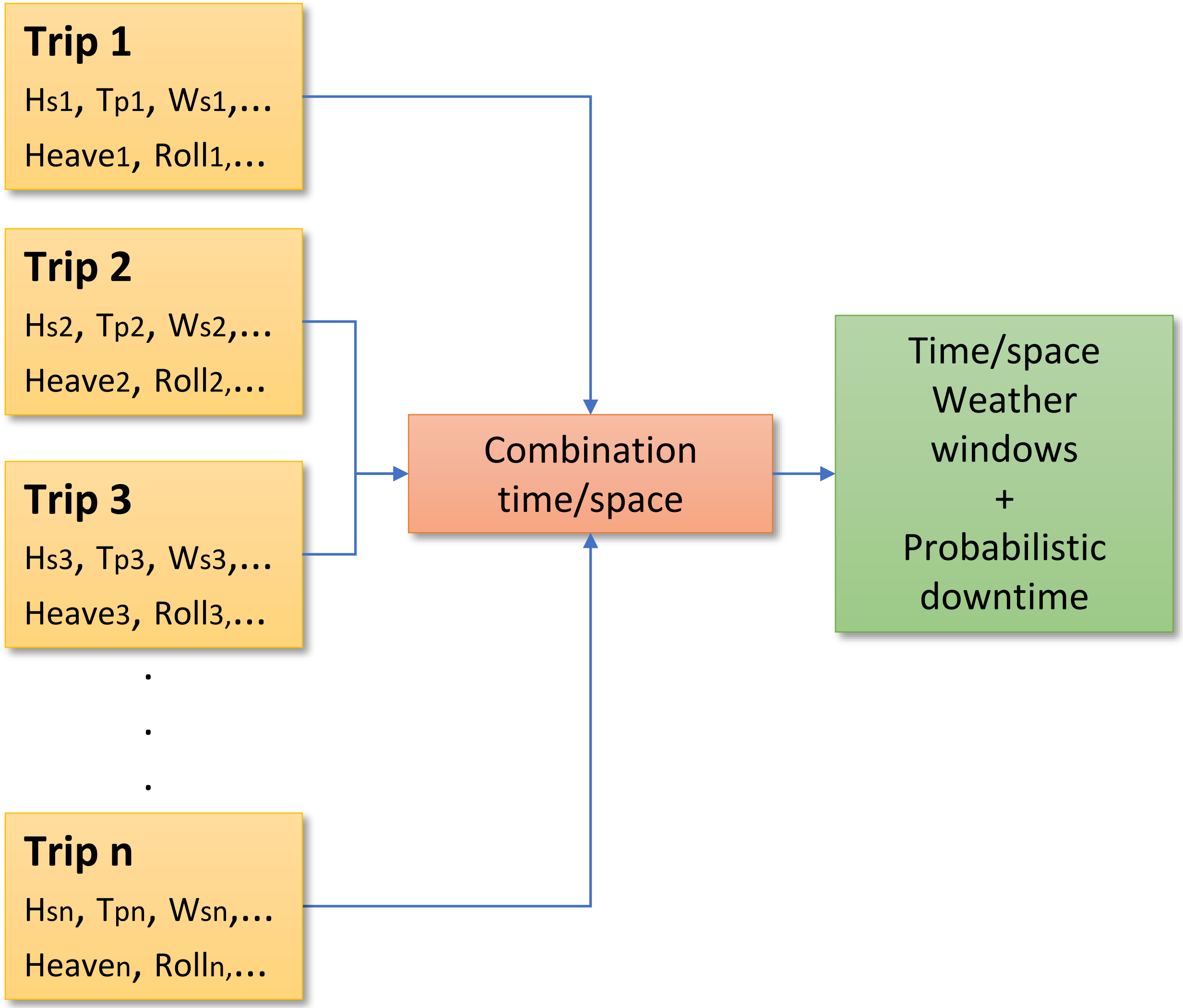
$$\text{MSI} = 100 \left[0.5 + erf\left(\frac{\log_{10}(|\ddot{X}_3|/g) - \mu_{\text{MSI}}}{0.4} \right) \right]$$

*O'Hanlon, J., and McCauley, M. (1974). Motion sickness incidence as a function of vertical sinusoidal motion. Aerosp. Med. 45, 366–369.

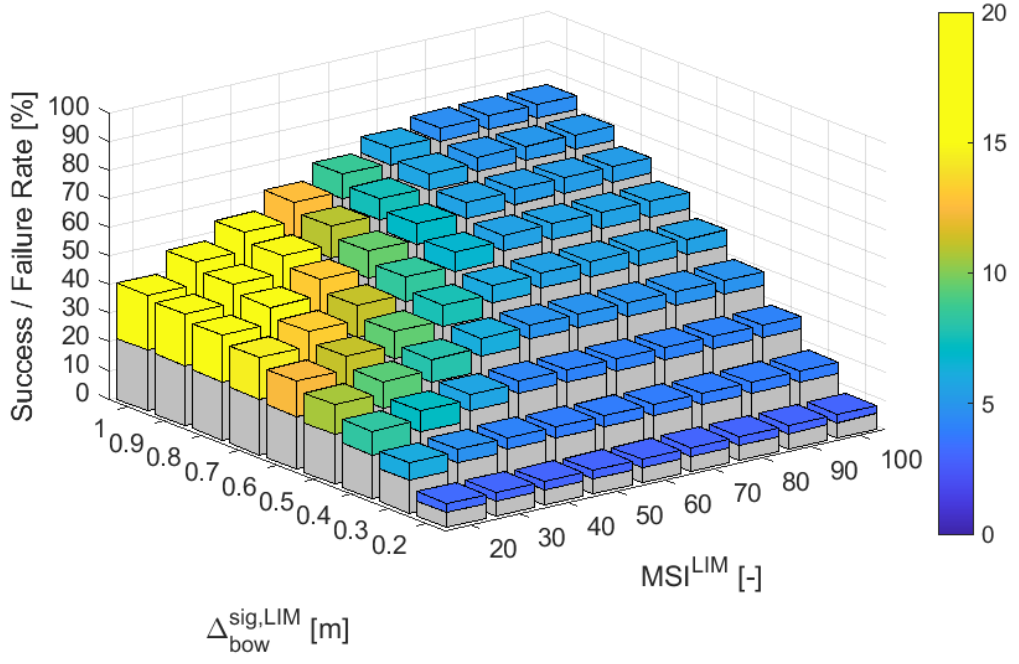
OUR APPROACH: PROBABILISTIC ANALYSES

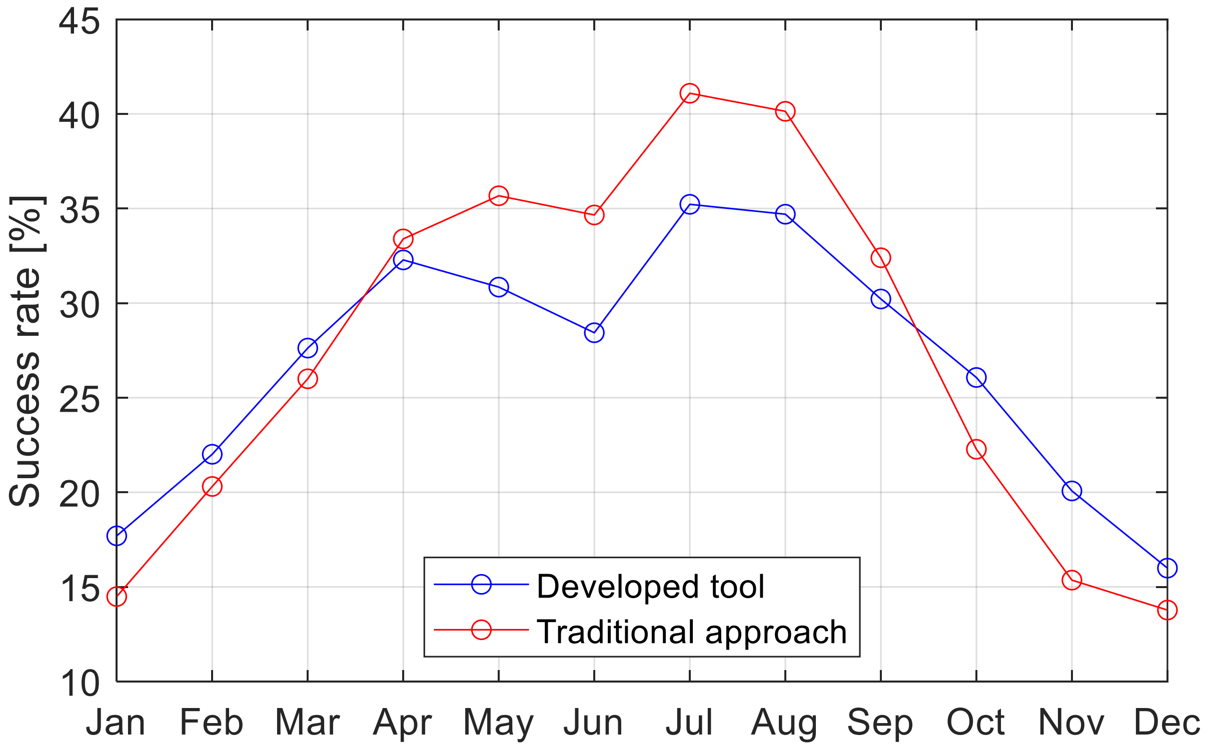
✓ Multiple repetitions of the operation execution





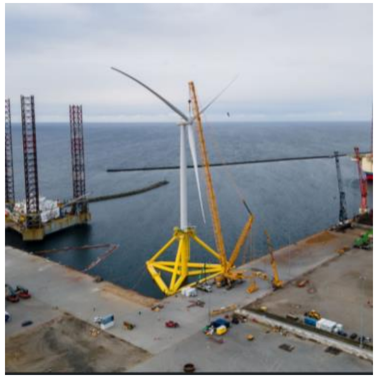
DEVELOPED APPROACH vs TRADITIONAL APPROACH

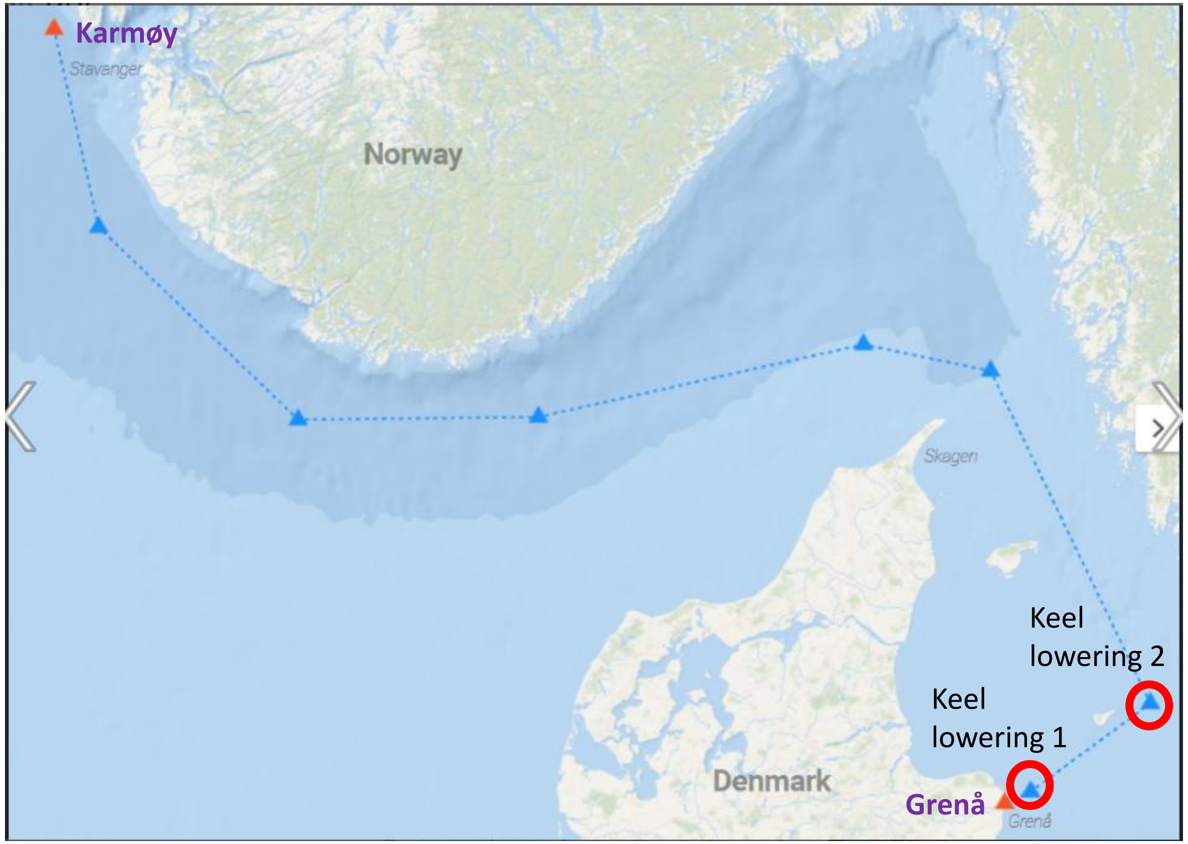




Tomaselli P.D. et al. (2021), *A decision-making tool for planning O&M activities of offshore wind farms using simulated actual decision drivers,* Frontiers in Marine Science, Volume 7

TetraSpar FOWT TOWOUT APPLICATION





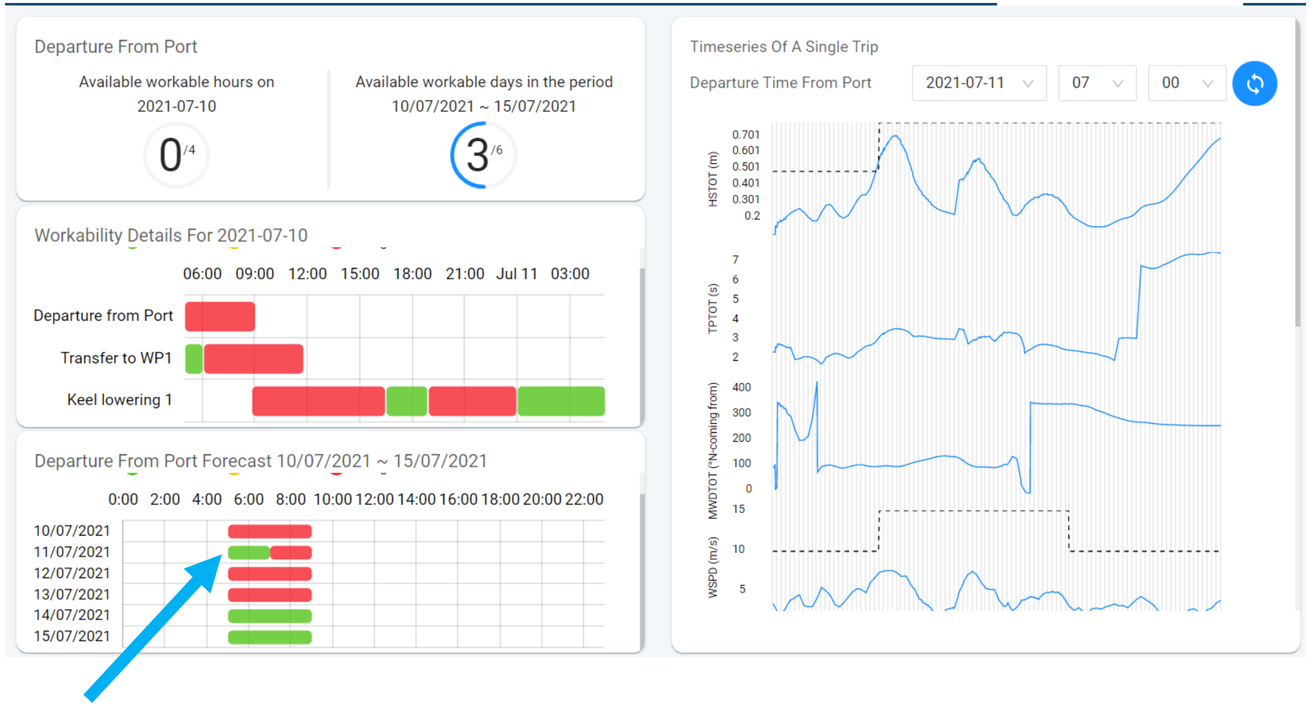
Departure: Grenå (Denmark), July 11

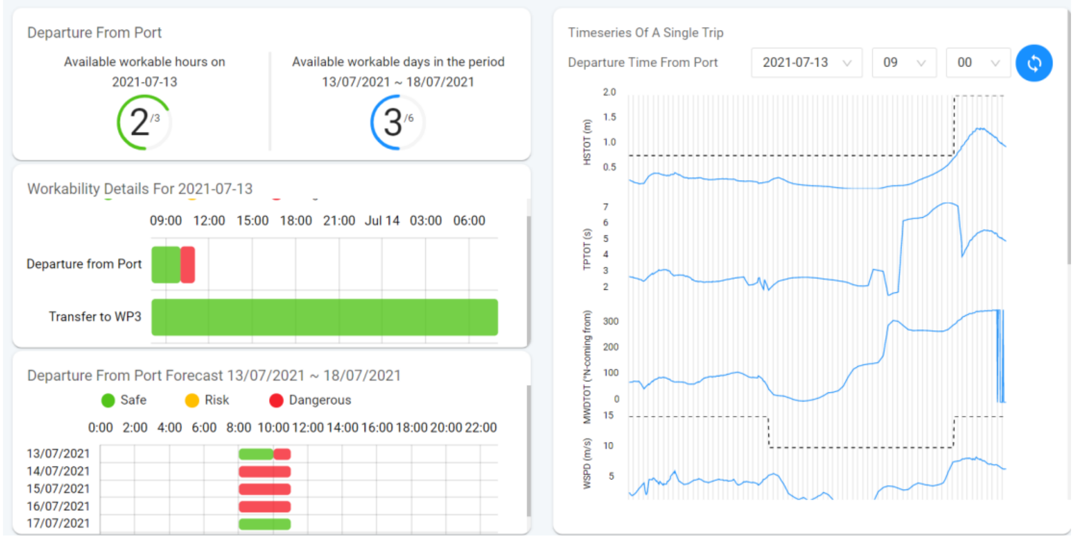
Arrival: Karmøy (Norway), July 23 -including hook-up

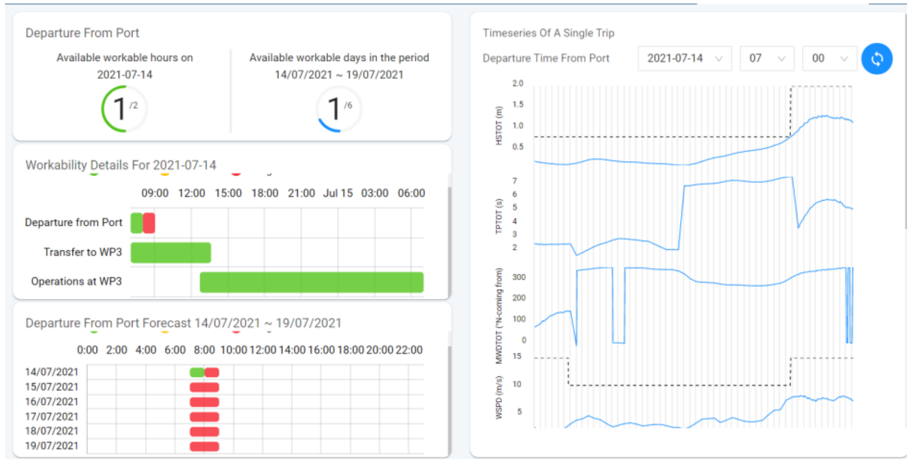
Operational limits: Hs
Wind speed
Towing speed
Current speed
Visibility

Partners: Shell, RWE, TEPCO RP & Stiesdal Offshore Technologies
Image credits: TetraSpar Demonstrator Project

Predictions for Stiesdal's TetraSpar FOWT TOWOUT







CONCLUSIONS & FUTURE WORK

- Floating Offshore Wind industry demands planning tools for towout, installation and O&M activities
- Procedures and weather limitations developed with bottom-fixed foundations and O&G floating structures needs adaptation/update for floating wind
- High-quality metocean data is key, but response of vessel and floater is needed for reliable safety risk minimization
- Contractors can benefit from online tools that agily provide response on workability based on metocean data and floater response
- Expand knowledge on industrial procedures for planning and executing operation on FOWTs
- Parametric modelling of floating wind-related risks for towout, installation and O&M
- Further validation of the approach in other real operational scenarios

Thanks for listening!

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