Offshore wind project installations: advanced approach for weather risk assessments

Fraunhofer IWES

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Abstract

The approach developed at the Fraunhofer Institute for Wind Energy Systems (IWES) is the Advanced Weather Time Series Scheduling (AdWATSS) method, based on [1]. For statistical significance, this method combines hindcast weather time series of many years (for example, ERA5 reanalysis weather data [2]) with the weather restrictions associated with offshore activities. The method is incorporated into the software tool COAST [3], where a project plan schedule is simulated by placing activities according to their operational limits, constraints and relationships, and minimum-required time for each operation. The weather risk assessment is compared with the weather window statistics method. These sequence-based simulations capture the long-term variability and extreme events in weather conditions.

Critical path analysis

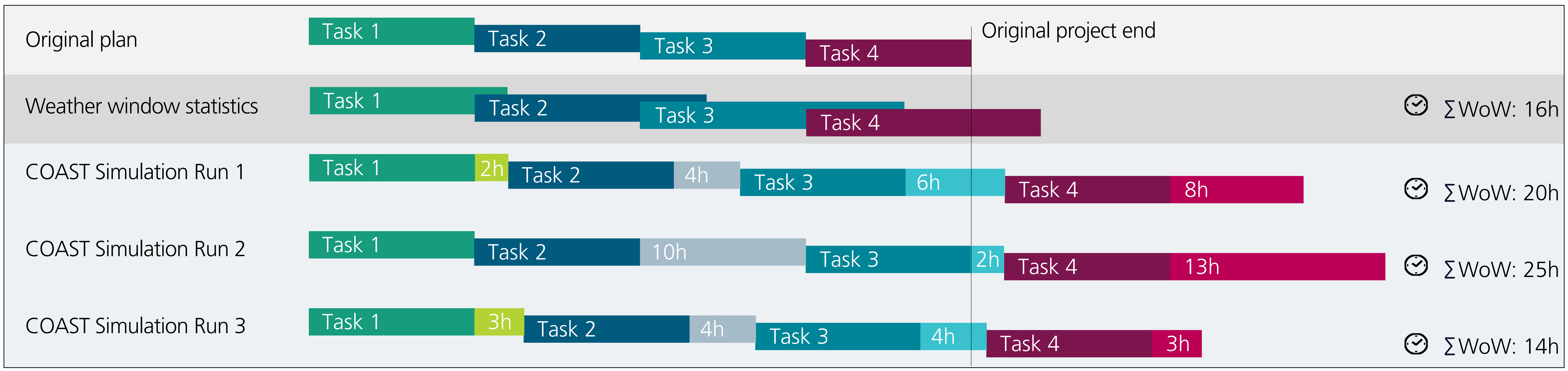

Figure 1. Weather risk assessment carried out with Weather Window Statistics and COAST simulation representation, WoW = Waiting on Weather

Features

Three main features are considered for the weather risk assessment: the analysis of the critical path (Fig. 1), which is defined as the string of dependent activities which, if delayed, have an influence on the entire project end, the use of route-based weather data (Fig. 2), and the ability to place separable tasks according to their minimum completion time with multiple operational constraints (Fig. 3). The three features are combined into a weather risk simulation and compared with the Weather Window Statistics method (Fig. 4).

Route-based weather data

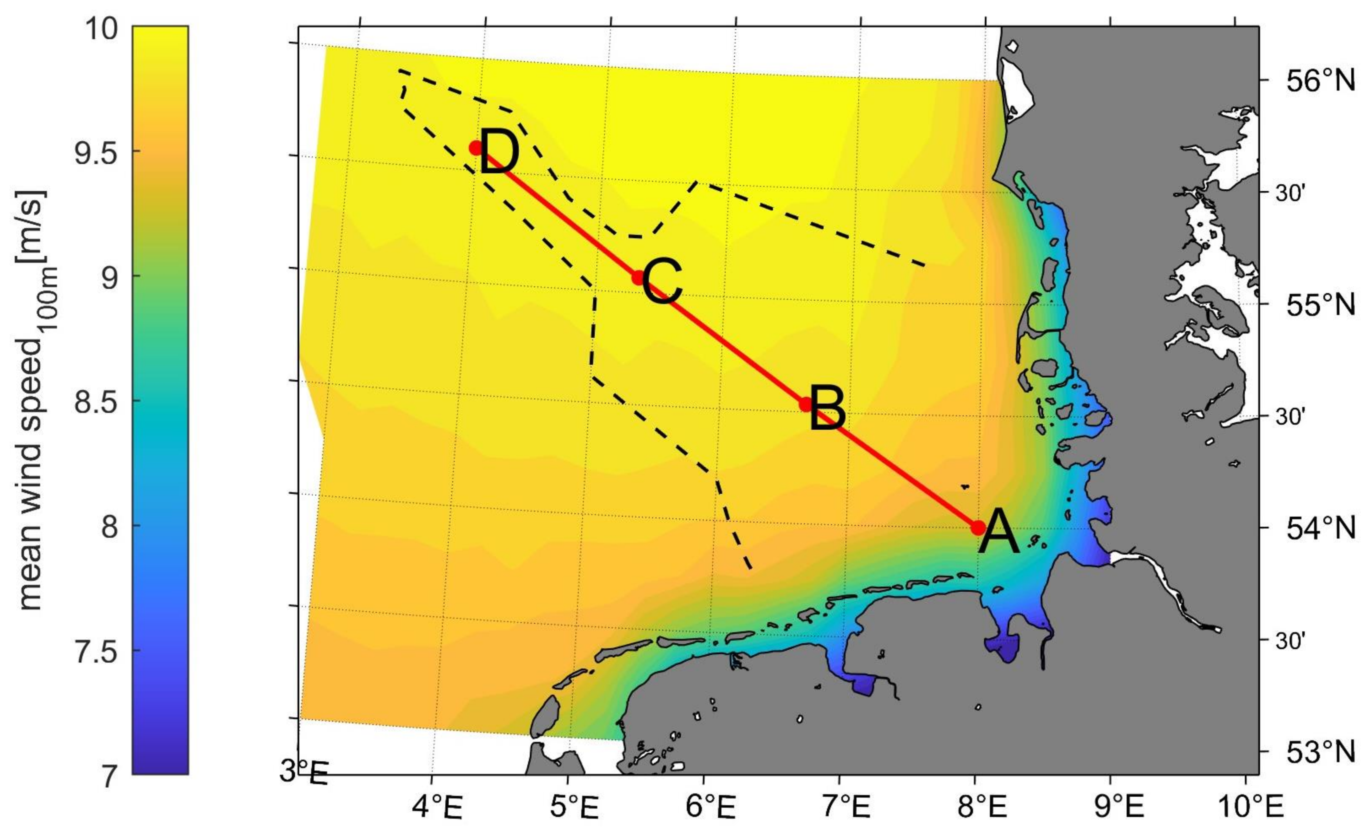

Figure 2. Mean wind speed at 100m in the North Sea

Multi-dimensional operational limits

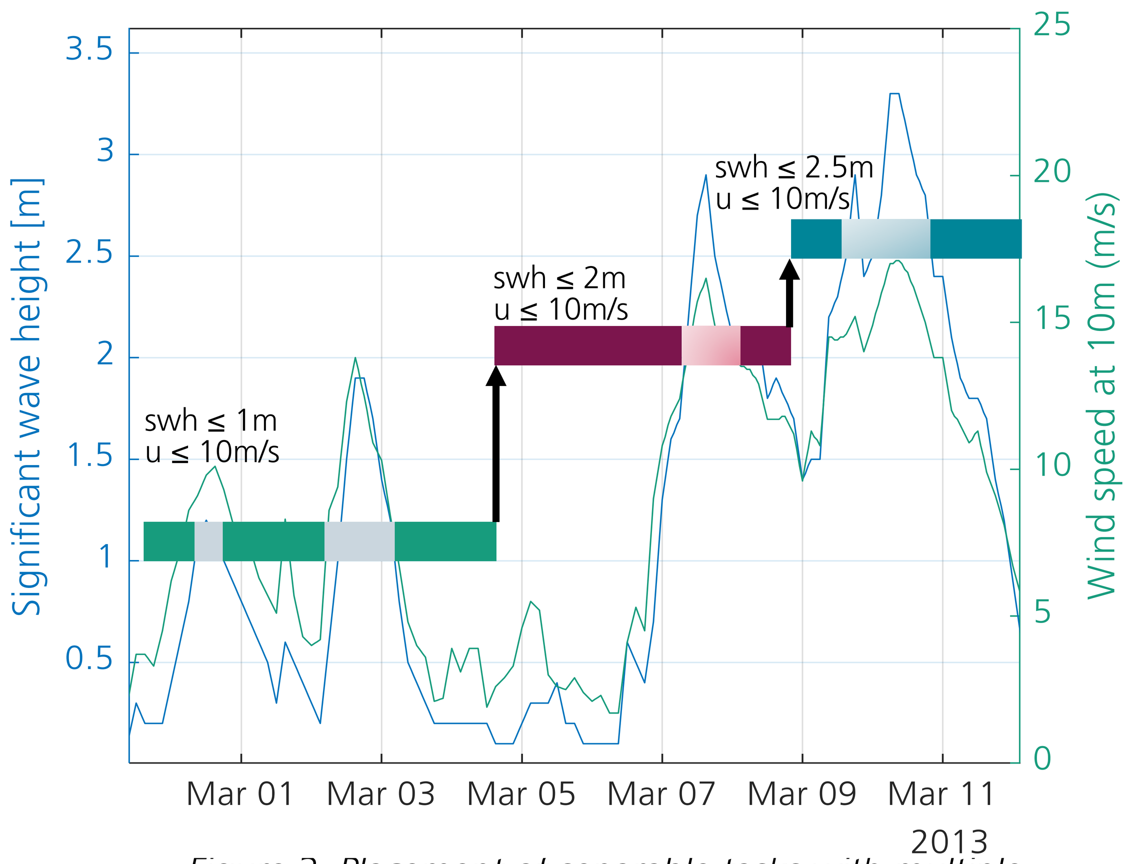

Figure 3. Placement of separable tasks with multiple operational restrictions

Weather risk assessment simulation

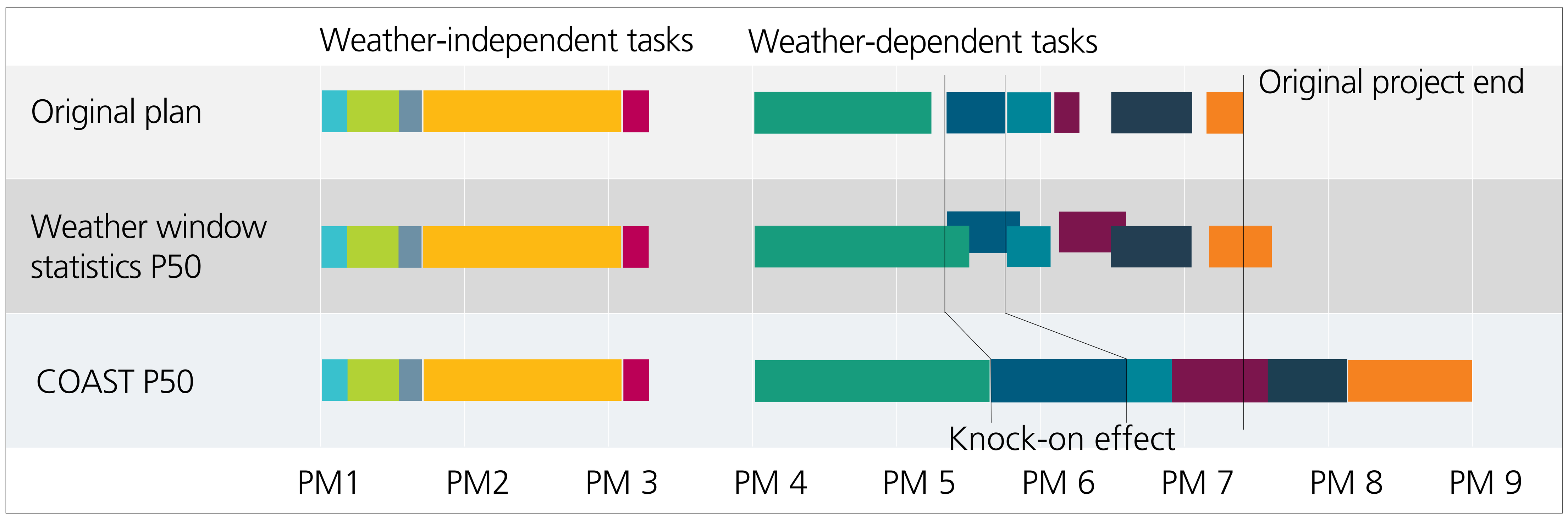

Figure 4. Weather risk assessment from Weather Window Statistics and COAST . The results correspond to a percentile 50 (P50) representation of weather delays, PM = Project Month

Conclusions

- The analysis of the critical path of weather-dependent tasks serves as a basis for the development of more reliable and robust project plan schedules.
- The use of weather data sets for multiple locations and/or route-based weather data allows for a more accurate estimation of the possible project delays.
- The use of multi-dimensional operation parameters helps to estimate the variability of the expected project duration.
- The possibility to model the duration of each task with probabilities is included in the outlook of the project.

References

- [1] J Lübsen and G Wolken-Möhlmann 2020 J. Phys.: Conf. Ser. 1669 012003
- [2] ERA5: Hersbach et al. 201, Copernicus Climate Change Service (C3S)
- [3] COAST 2.0: Final report (2022), Fraunhofer IWES

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