



Are we still running offshore wind on 'good enough' data?

Words: Lars Ivar Leivestad, Commercial Manager Offshore Wind, Miros

Bigger turbines, tighter margins and harsher conditions, yet many offshore wind decisions still rest on outdated data. The result: a growing disconnect between what's predicted and what's actually happening at sea.

Offshore wind has scaled fast. Turbines are larger, projects are moving further offshore and vessel operations are pushed harder than ever. At the same time, margins are tightening and the tolerance for delays or incidents is shrinking.

Yet one critical element has not kept pace.

Too many operational decisions are still based on 'good enough' sea state data. Hindcast models, sparse buoy measurements and assumptions carried forward from early site surveys continue to define when we lift, when we transfer crew and when we stop operations.

These inputs were never designed to support real-time decision making. They were designed for planning. Treating them as operational truth creates a gap between assumed and actual conditions at the site. That gap is where risk builds, time is lost and safety margins are eroded.

This is not a technology problem.

The capability to measure the sea surface in real-time, at the point of operation, already exists. What remains is a shift in mindset. Offshore wind is not a static system defined at the design stage. It is a live operational environment, changing hour by hour.

Quality data in. Quality operations out. The industry understands this principle. The question is whether it is ready to apply it consistently.

Decisions are made based on different versions of reality

Across offshore wind projects, a consistent issue persists. Different stakeholders often operate with different datasets. Developers rely on one set of assumptions. Vessel

operators depend on each other. OEMs and insurers bring their own models.

This fragmentation creates misalignment and unnecessary risk. Decisions are made based on different versions of reality.

A single, trusted source of sea state data changes this dynamic. Installing reliable wave measurement early and maintaining it throughout the lifecycle creates a shared reference point for all parties. The same data informs installation planning, operational decisions, structural assessment and long-term strategy.

This alignment improves communication and supports more transparent risk management. It also strengthens predictive models and AI systems, because no model can outperform the quality of the data it is built on.

With that foundation in place, the value of continuous measurement becomes clear across every phase of a wind farm's lifecycle.

Why are we still estimating what we can measure in real-time?

Metocean data has always been part of offshore wind development, but its role has largely been front-loaded. Data is collected during site assessment, models are built and design envelopes are defined. Once installation begins, operations often rely on forecasts and historical assumptions rather than continuous measurement at the actual work location.

This approach no longer holds. Installation campaigns are more complex, weather windows are tighter and vessel utilization is critical. Decisions need to be based on what is happening at the site, not what was predicted.

The challenge becomes more pronounced in floating wind. Wave conditions are not only operational constraints but direct drivers of platform motion, mooring loads and fatigue.

Real-time data removes excuses.

Industry standards have already pointed in this direction. DNV-ST-N001¹ highlights the need for site-specific metocean data to reduce uncertainty and ensure safe and efficient marine operations, while IEC 61400-3-1² highlights the importance of validating models using representative, site-specific environmental data, including measurements where available. Despite this, continuous, location-specific measurement is still not widely implemented.

Measure early, measure continuously. Use live data from day one.

A more robust approach is to install reliable local wave measurement early in the project lifecycle and maintain it throughout the life of the asset. This shifts sea state data from a one-time input into an operational backbone.

Radar-based, dry-mounted wave sensors provide direct measurement of sea surface conditions in real-time. Installed on turbines, substations, or vessels, they deliver continuous, location-specific data on wave height, period, and direction, along with derived insights such as wave spectra and vessel response in all weather conditions.

The value is cumulative. Data collected during construction becomes the reference for commissioning. Commissioning data becomes the baseline for operations. Over time, the dataset evolves into a long-term record supporting structural assessment and strategic decisions.

Real-time data where risk is highest

During construction, uncertainty translates directly into cost and risk. Weather windows are often defined conservatively, based on forecasts and historical data, leading to delays. At the same time, limited visibility into actual conditions can expose operations to higher loads than anticipated.

Real-time sea surface measurement allows operators to validate forecasts against measured conditions and adjust plans accordingly. Short-term wave prediction



Installed on turbines, substations, or vessels, Miros real-time wave sensors deliver continuous, location-specific data on wave height, period, and direction, with insights like wave spectra and vessel response in all weather conditions

provides a forward-looking view of conditions over the next operational window, critical for heavy lifts.

For jack-up vessels, accurate wave data improves assessment of leg loads and stability. For cable lay operations, it supports better control of tension and execution. Combining measured data with wave and vessel motion prediction enables better use of weather windows while maintaining safety margins.

This is about removing uncertainty from critical decisions, not about pushing limits.

Do your assumptions hold in real-time conditions?

Commissioning is where design assumptions are tested against real-time conditions. Locally measured sea state data provides the basis for this validation.

Comparing actual wave conditions with

modeled inputs helps identify discrepancies early. This allows operators to refine operational thresholds based on evidence.

Motion-based workability limits can be adjusted using measured data, leading to fewer aborted operations. Structural health monitoring systems also benefit from a clear baseline linking environmental conditions to structural response.

Without this link, it becomes difficult to distinguish between normal behavior and early signs of degradation.

Why operations and maintenance depend on live data for uptime

In the operational phase, access drives performance. Crew transfers and maintenance depend on sea state conditions, yet decisions are often based on forecasts that do not capture local variability.

Real-time wave data provides a direct view of conditions at the turbine location. Combined with vessel motion prediction, it allows operators to assess whether gangway transfers can be carried out safely. Short-term wave prediction enables better timing of operations.

This leads to fewer aborted transfers, improved planning and reduced downtime. Continuous data also supports fatigue tracking and lifetime modeling based on actual loads.

IEA Wind Task 26³ identifies improved use of operational data and digital tools as an important lever for reducing offshore wind costs.

In floating wind, real-time wave data becomes structural data

For floating wind, wave data becomes a core input to structural performance. Wave conditions directly influence platform motion, mooring tension and cable behavior, all driving fatigue and long-term integrity.

Without continuous measurement, there is limited ability to validate design assumptions or track structural response. Real-time data enables ongoing assessment and improves understanding of fatigue accumulation.

In this context, wave measurement is part of the structural monitoring framework.

Life extension and repowering: what does your real-time load history actually show?

As offshore wind farms mature, operators must decide whether to extend asset life or repower. These decisions depend on understanding the actual load history.

Without measured data, assessments rely on conservative assumptions. Continuous wave measurement provides a long-term record of



Predict short-term wave and vessel motion beyond limits before they hit, powered by real-time measured data and AI that adapts to any sea state



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Real-time wave data provide a direct view of conditions at the turbine location, while vessel motion prediction shows crews when transfers are safe to make

environmental loading, supporting data-driven reassessment of fatigue and remaining life.

ISO 19901-9⁴ requires that structural integrity and life extension decisions are supported by measured data and monitoring to reduce uncertainty, but when offshore wind turbines are assessed on assumed rather than real-time loads, operators are effectively making safety and lifetime decisions without knowing their true fatigue exposure.

Controlling risk at the end. End of life still depends on real-time conditions.

Decommissioning brings similar challenges to installation. Heavy lifts and activities depend on stable conditions.

Real-time wave data support better planning of weather windows and reduce uncertainty. It also provides context on structural conditions when combined with historical data.

At this stage, reliable data is essential.

If your input data quality is flawed, what exactly are you optimizing?

The industry is investing heavily in digitalization, automation and predictive analytics. These tools promise better planning and efficiency, but they depend on input data.

If that data is inconsistent or based on outdated assumptions, the output will reflect those limitations. This is not an algorithm issue. It is a data quality issue.

Before optimizing operations, the industry must ensure it is measuring the right reality, at the right place, at the right time.

The shift is straightforward. Measure early. Measure at the location of operation. Continue measuring throughout the lifecycle. Align stakeholders around a shared dataset.

The impact is significant. Safer operations, better use of weather windows, reduced uncertainty and more informed decisions.

The tools are available. The value is clear. What remains is a choice. Move beyond 'good enough,' or continue operating with a gap between assumption and reality.

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References

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³ <https://iea-wind.org/task26/>

⁴ <https://www.iso.org/standard/67936.html>



About the author

Lars Ivar Leivestad has a comprehensive operational, technical and commercial background within the energy sector.

He brings a unique blend of technical expertise and strategic management skills to his role, making significant contributions to bringing real-time ocean insights to the forefront of the offshore wind sector.