



Dry-mounted radar systems reduce the need for mooring systems and offshore maintenance interventions, further limiting the industry's environmental footprint. In this way, WaveFusion® supports both the economic efficiency and the sustainability targets of offshore wind developers

Why is local real-time sea state data the key to smarter offshore wind operations?

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What if offshore crews did not have to wait for the weather to change before putting their plans into action? The offshore wind sector is never still. As projects spread further from land, into deeper and more remote waters, operators must constantly balance safety, costs and uptime.

At the heart of every decision offshore is the meteocean condition. With the right data at the right time, operators can reliably make the best enhanced decisions accordingly. Data about the sea state, weather and environmental conditions dictate whether operations can proceed safely or need to be postponed. For decades, the industry has relied on wave buoys and legacy radar systems to gather this data, but limitations in reliability and accuracy have often hindered progress.

Today, that's changing. The latest radar-based wave measurement systems deliver live data on sea state, water level and weather directly to the cloud. No more sole reliance on scattered buoys or incomplete forecasts. Instead, onshore control teams and offshore crews can share the same detailed, real-time view of local conditions, accessible on any device.

The impact goes beyond safety. With accurate, location-specific ocean insight, operators can plan proactively by maximizing available weather windows and dispatching vessels only when conditions are right,

scheduling maintenance before small issues escalate and recovering valuable hours otherwise lost to weather delays. Over time, that means lower costs, smoother operations and minimized downtime.

Why real-time, local sea condition data when I can have a weather forecast?

Every offshore wind project faces the same challenge. The sea never stands still; weather conditions shift rapidly, wave heights can vary significantly across a site and small windows of opportunity can determine whether vessels can safely reach turbines for installation or maintenance.

Traditional methods, such as wave buoys, provide useful insights, but they are far from perfect. Buoys require mooring systems, costly regular maintenance and offshore interventions. They are also fully exposed to the harsh sea conditions, making them vulnerable to damage. Most crucially, buoys only deliver data for a single point, often failing to capture the full complexity of conditions across a site.

For operators tasked with running wind farms that stretch across hundreds of square kilometers, a single point of reference is not enough. Decisions made based on incomplete or outdated data can lead to unnecessary downtime, higher costs and increased emissions, while also risking the safety of offshore crews.

End-to-end ocean visibility

Now, imagine a world where operators no longer need to choose between localized accuracy and broader context.

This is where systems like Miros' WaveFusion® make the difference. Dry-mounted directly onto a turbine, the system observes the sea state at multiple distances simultaneously, merging data in real-time through advanced processing algorithms.

When installed on multiple turbines across a site, the wave radars provide granular visibility into local variations in wave height, direction and period. The result is a clear, accurate, and actionable picture of ocean conditions right where they matter most, at the turbine itself. This enables operators to optimize vessel scheduling and reduce downtime, while reducing the risk of weather-related delays.

WaveFusion combines two complementary measurement approaches. A downward-looking wave sensor providing precise water level and wave data directly beneath the structure and a directional wave radar monitoring up to 12 footprints up to 200 meters away, capturing the broader sea state without interference from the turbine.

By merging these datasets with advanced algorithms, WaveFusion offers a clear and consistent view of local ocean conditions.

The system addresses the shadowing effect caused by large offshore structures, giving operators a more complete understanding of the surrounding sea state.

Why multiple sensors across a site increase ROI

At the risk of stating the obvious, offshore wind farms are vast. Conditions can vary significantly from one end of a site to the other, influenced by water depth, seabed topography and local weather systems.

Installing wave sensors strategically across multiple turbines provides a more detailed understanding of sea states across an entire wind farm. Operators can tailor decision-making to specific areas of the wind farm, ensuring vessels are dispatched only when and where conditions allow, as well as updating operation plans according to real-time sea state across site to optimize operability. This localized accuracy reduces downtime, improves turbine availability and ultimately increases the return on investment for the project.

Accessing the right data at the right time

As the offshore wind sector continues to scale up, the role of data will only become more critical and valuable. State-of-the-art monitoring technology is a step toward a fundamentally new way of operating offshore wind farms, one where real-time, local and reliable data underpins every decision.

In a sector defined by innovation and rapid growth, accurate live data provides the reliable insights needed to refine operations, enhance planning adaptability, reduce risks and drive efficiencies. For offshore wind developers, it is not just about the sensor but rather having

the confidence that comes from having the right data at the right time.

From data to actionable intelligence, anywhere and anytime

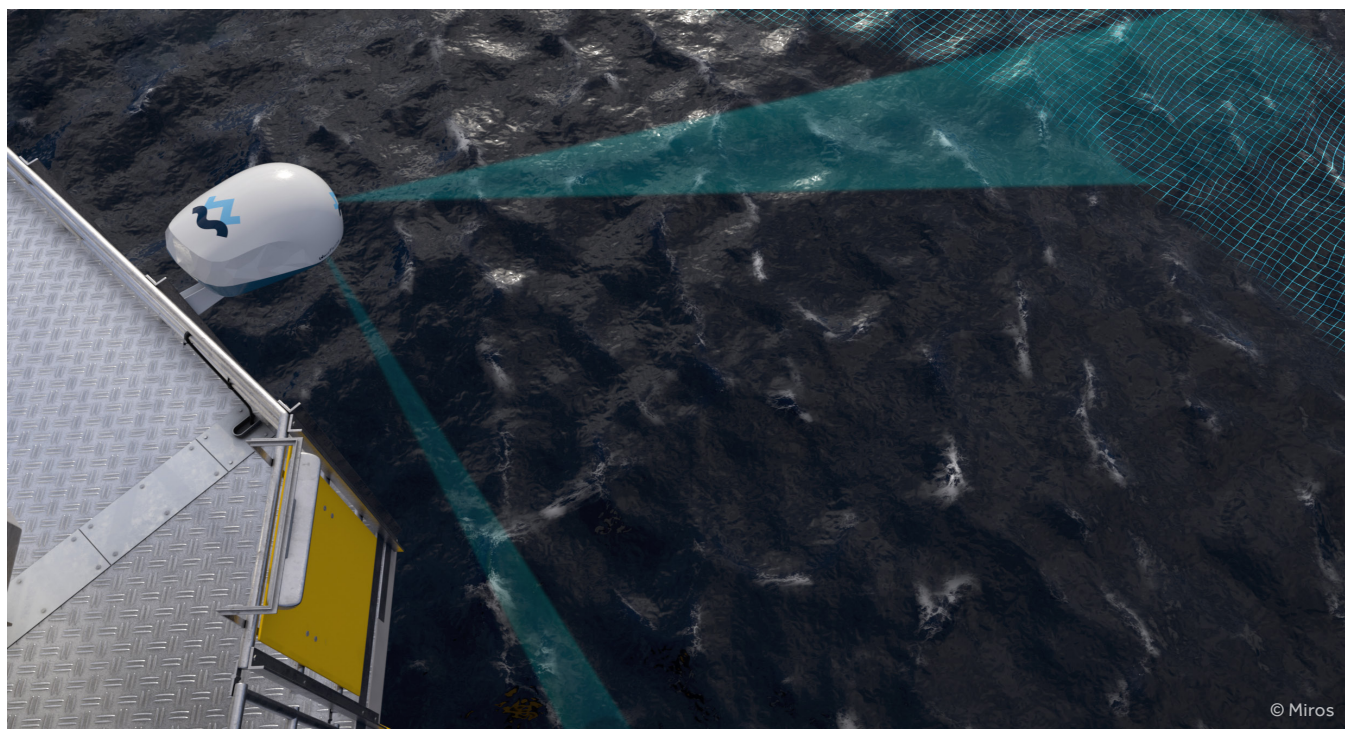
But collecting data is only half the story. The real value lies in transforming it into actionable intelligence. With WaveFusion technology, real-time ocean measurements are streamed directly to secure cloud platforms, where they become instantly accessible to all teams. Miros Cloud platforms utilize Microsoft Azure Cloud, the same system used by NASA to monitor their space station sensors in real-time.

This shared situational awareness enables faster, safer and more collaborative decision-making. Operators can optimize vessel dispatch by targeting weather windows more precisely, reduce emissions by avoiding unnecessary voyages and plan maintenance with confidence by combining live and historical data to anticipate structural stresses.

Miros' Data Explorer dashboards bring this intelligence to life, offering an intuitive platform to view, analyze and share insights. Both real-time and historical data are centralized in one place, making trend analysis, forecasting and performance optimization seamless. By removing the complexity of dealing with multiple sources and formats, Data Explorer ensures that decision makers, from control centers to vessel operators, always work from the same accurate picture of ocean conditions.

Future-proofing operations with the Sea-State-as-a-Service model

Unchanged hardware alone can't meet the evolving demands of offshore wind operations through a wind farm's lifespan. That's why Miros offers wave radars through



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a Sea-State-as-a-Service subscription. Instead of purchasing equipment, operators gain secure, continuous access to real-time ocean data. Miros handles installation, maintenance and upgrades, ensuring the system stays up-to-date and operational with minimal downtime.

Similar to self-driving cars getting new algorithms to gain additional features and capabilities, the Sea-State-as-a-Service model provides customers with future feature upgrade capabilities according to current customer feedback and evolving customer operation vision.

The subscription model keeps pace with technological advances while removing the risk and complexity of managing hardware. Operators can focus on having consistent, reliable data to inform decisions, rather than on the equipment itself. Sea-State-as-a-Service provides exactly that: ongoing access to accurate and actionable ocean information.

From real-time sea state to proven sustainability gains

Sustainability is at the core of offshore wind's mission. By reducing unnecessary vessel dispatches, real-time sea state measurements directly contribute to that goal by helping to cut fuel consumption and emissions. By improving accuracy in forecasting and planning, it also minimizes the risk of aborted operations, which not only wastes money but also contributes to carbon emissions.

About the authors

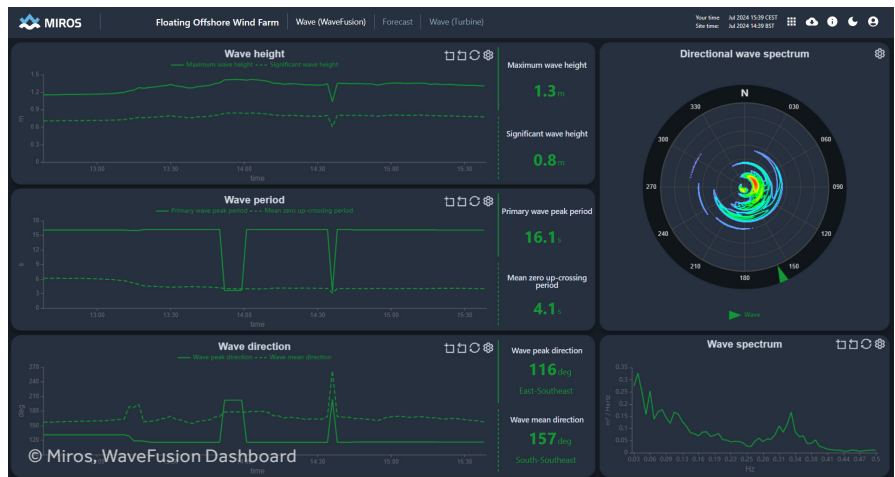


Richard Chen is Customer Success Manager Offshore Wind at Miros.

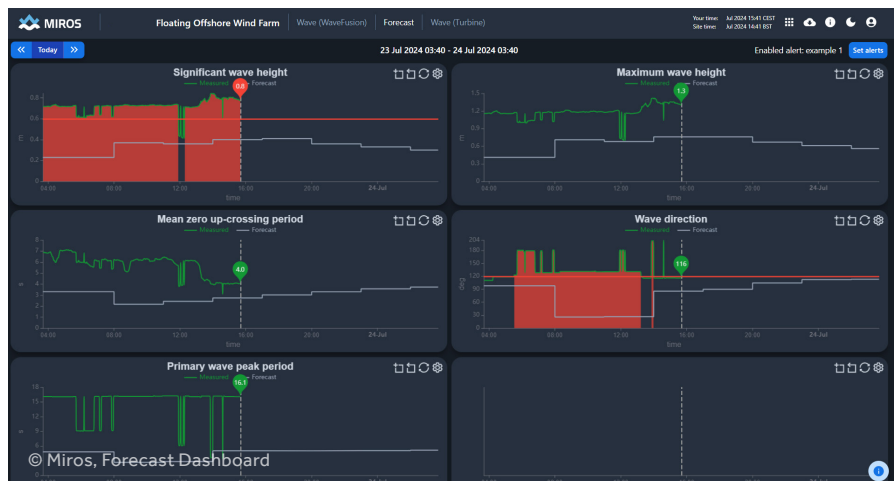
Richard has a career spanning both the wind industry and information technology.

He brings a wealth of experience and expertise and seamlessly merges his knowledge of wind farms and cloud computing to provide invaluable support to customers.

Richard Chen's unwavering commitment to staying at the cutting edge of new technologies and exploring potential integrations underscores his passion for innovation and driving progress in the industry.



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Lars Ivar Leivestad is Commercial Manager Offshore Wind at Miros.

Lars Ivar 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.

Moreover, dry-mounted radar systems reduce the need for mooring systems and offshore maintenance interventions, further limiting the industry's environmental footprint. In this way, WaveFusion supports both the economic efficiency and the sustainability targets of offshore wind developers.

Can the industry afford to operate without real-time clarity?

Offshore wind is entering a new era, one where success is measured not just by how many turbines are spinning, but also by how the uptime and accessibility, as well as how intelligently and efficiently they are managed. The industry's next big leap will not come from simply building bigger farms, but from making sharper, faster and safer decisions powered by real-time insights. With Miros' WaveFusion technology, that leap is already within reach.

The question is no longer whether we can collect data at sea; it is whether we can afford not to use it to its fullest potential. In an industry where every decision carries weight, the clarity of real-time ocean data isn't just an advantage; it is a necessity.

miros-group.com/products/wavefusion/