

VAISALA

Managing the invisible risk

Two approaches for modern wind mitigation in ports



Making the invisible risk visible

Around the globe, severe wind events are increasing in frequency and severity because of climate change. Seaports are often hit hardest by severe weather, and wind is already the most dangerous climate factor in port operations. A recent UN port industry survey showed that wind-related damages account for 46% of all the weather-related costs to ports.

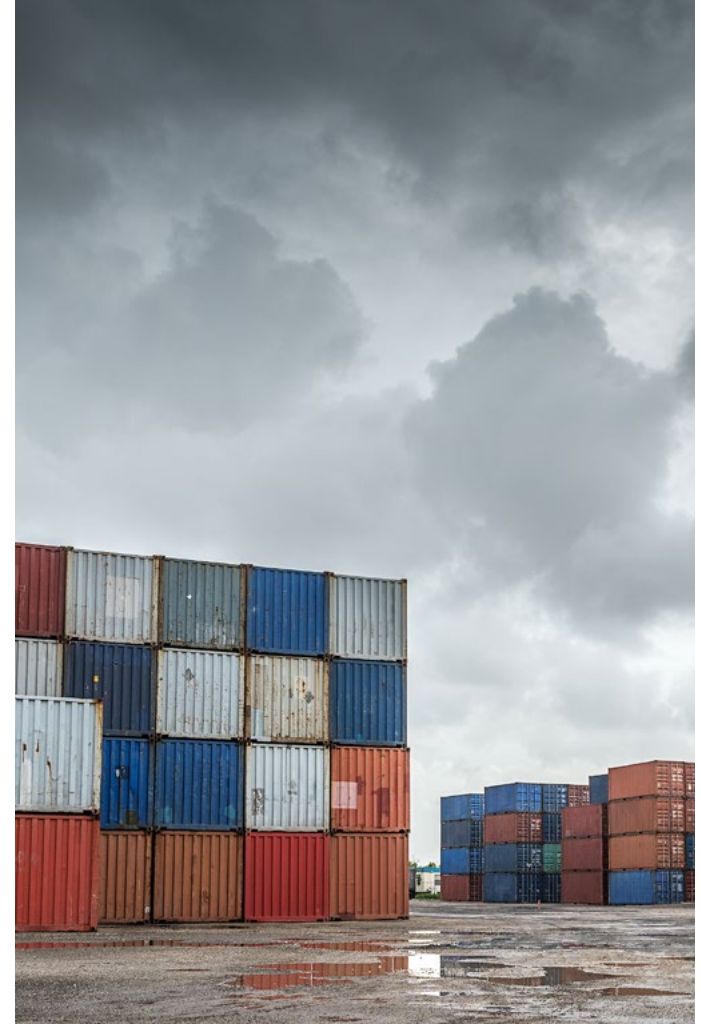
Because of this, mitigating the effects of the wind is one of the most cost-efficient and future-aware actions ports can take. Happily, the technology for reducing wind-related risks for port and terminal employees, operations, and assets is available now.

These sensing and forecasting technologies complement existing digitization efforts at ports, which are intended to improve just-in-time (JIT) port operations. Wind mitigation solutions are logical parts of a port's broader digital transformation process because they are easy to integrate and provide real-time situational awareness for many stakeholders.

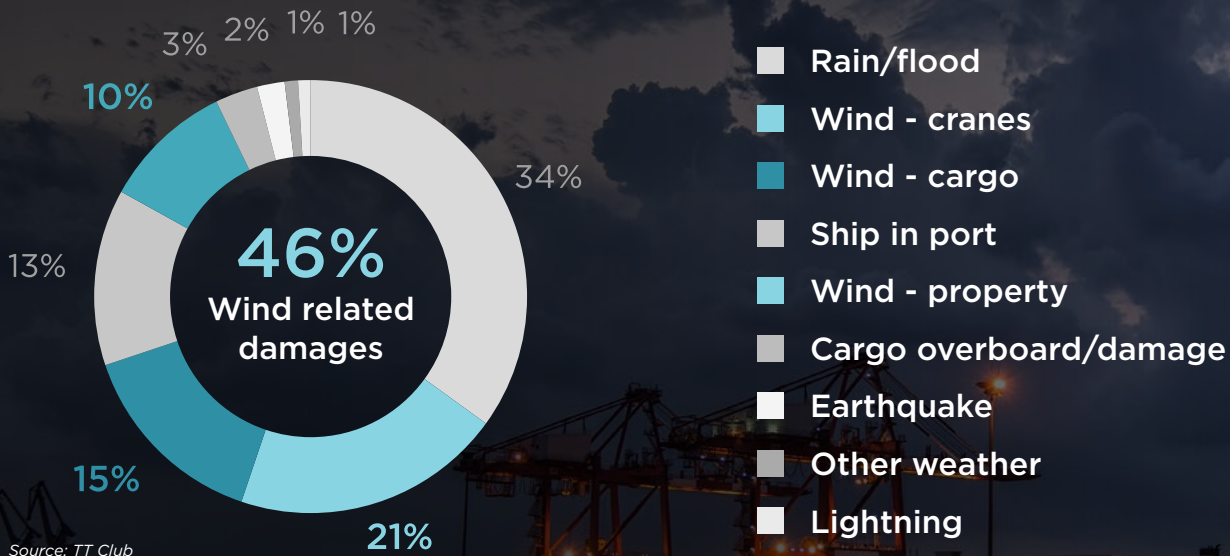
This guide addresses two key approaches to managing the invisible risk of severe wind in port environments:

- 1 Using accurate, broad-coverage, real-time wind data for better decisions**
- 2 Improving on leading forecast models by integrating hyperlocal wind observations and historical data**

Each of these approaches is supported by real-world studies and examples, all of which make the value of these exciting technologies clearer and more compelling.



Ports and terminal weather issue cost percentages



Wind mitigation solutions are logical parts of a port's broader digital transformation process because they are easy to integrate and provide real-time situational awareness for many stakeholders.

1

Using accurate, broad-coverage, real-time wind data for better decisions

Today's ports are large and complex, often reaching tens of kilometers in area. They also feature widely varying structures, topographies, vessel types, and layouts, all of which interact with the wind in complex ways. Local wind behaviors can vary significantly within a single port area.

As a result, existing wind monitoring solutions are often insufficient. Many ports can benefit from local wind observation and nowcasting tools, which dramatically improve situational awareness, improve safety and operational continuity, and enable much more confident, data-driven decisions.

The increasing need for localized wind insights



Port facilities induce high turbulent winds



Modern ports handle bigger ships and corresponding facilities (cranes, buildings, etc.)



Extreme weather conditions are increasing due to climate change



Recent incidents suggest that limits for safe conditions are being exceeded sooner than in the past



The port of Hong Kong

Lidar has arrived

Wind Lidar is already crucial for many applications across the wind energy, aviation, meteorology, and maritime industries. Today, with climate change providing new risks and operational challenges, ports can quickly and cost-effectively deploy wind lidar to make a real difference to their operations.

WindCube at a glance

WindCube is the most trusted, frequently deployed wind lidar technology available in the world with more than 1500 units deployed. Two WindCube solutions are especially valuable in port applications because they provide real-time visibility into developing wind situations:



WindCube is the industry standard in vertical profiling lidars, providing accurate, local wind measurement up to 300m heights. It has gained global recognition for its successes in the wind energy, aviation, and meteorology fields, and today it is a valuable tool for the maritime sector.



WindCube Scan provides 3D, spatial wind data at ranges up to 10km. One WindCube Scan unit can provide a detailed, accurate picture of the wind behavior across a large area, making it an invaluable asset for understanding how wind affects a complex area like a port, fields, and today it is a valuable tool for the maritime sector.

All WindCube solutions are:

- Simple and fast to deploy
- Non-disruptive to local geography and existing infrastructure
- Reliable under nearly any conditions, over long service lives
- Built on mature and repeatedly validated technology
- Able to be repurposed or moved for multiple campaigns
- Augmented by modern, web-based software for fleet management and analysis



Locks of IJmuiden, Holland



WindCube scanning lidar measuring wind loads on ports

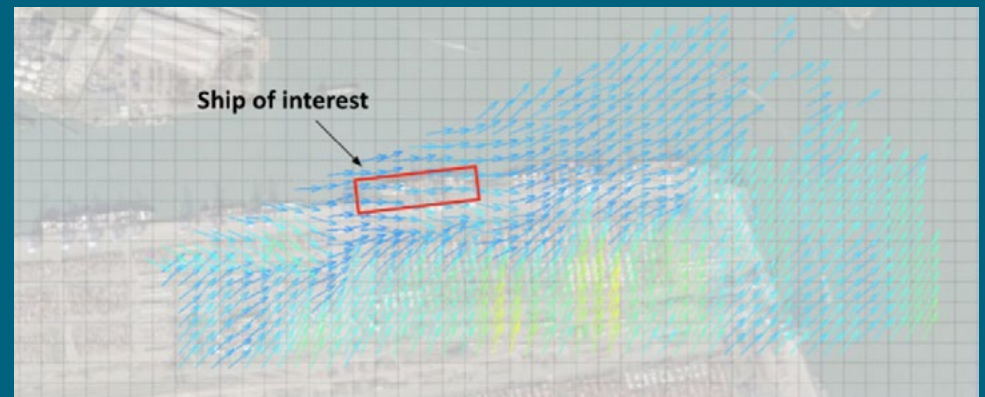
Key application:
WINDLASS JIP by MARIN



WINDLASS JIP is an ongoing, joint industry project lead by the MARIN maritime research institute in the Netherlands and which aim is to study wind loads on ports for large-windage vessels during approach, berthing, and mooring. Based on the joint use of measurements and modelling, the project decided to use WindCube Scan lidar for collecting valuable wind data at several ports. Ships and port structures are getting bigger, and wind events are becoming more severe — so ports need a new operational tool to improve efficiency and workability.

There are already tools available for engineering and research purposes, but WINDLASS plans to develop one specifically for port operators, terminal operators, pilots, linesmen, and other stakeholders.

The main benefit of wind lidars is to provide more information and value surrounding the space and time of wind at ports to stakeholders like pilots and port operators.



Wind data collected by a WindCube Scan from a port deployment in Rotterdam

2

Improving forecast models with hyperlocal wind observations and historical data

Several sophisticated forecasting models are already used by ports to help predict and mitigate severe wind events. These include:

ECMWF

High-resolution global atmospheric model processing data from around 90 satellite instruments, receiving around 800 million observations daily

HRRR

An NOAA real-time, cloud-resolving, convection-allowing atmospheric model run at 3km grid spacing over the continental USA

Despite these models' usefulness, forecasting wind variability on timescales from minutes to days is difficult, and substantial operational gains are possible with increased precision and nowcasting.

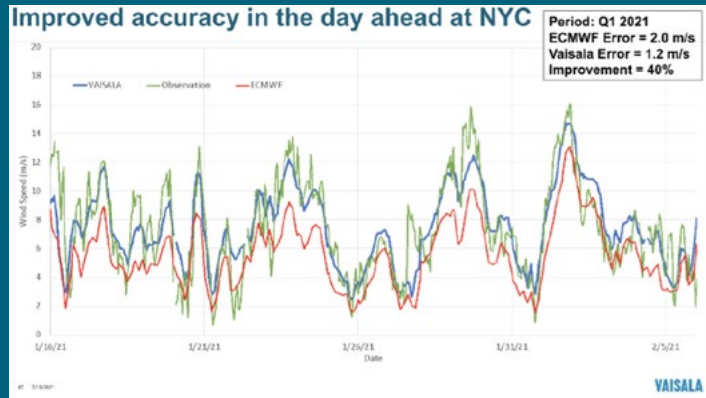
This is why Vaisala developed its Wind Forecasting System. The system:

- Uses multiple NWP models rather than just the single best
- Adds higher resolution (mesoscale) modeling to account for local impact of complex topography near a target site
- Reads from an extensive archive to combine weather model forecast history with on-site (target) data
- Ingests and quality controls local observations (both on-site and nearby) to improve accuracy
- Employs multiple machine learning algorithms to calibrate weather forecasts with high performance tailored to a specific site



This results in accuracy improvements of up to 40%.

For example, the following results came from a 2021 deployment in a port of New York:



This powerful new nowcasting tool promises to lower risk, increase operational continuity, and make effective use of all the useful data available to ports.

Adapt to a gusty future, confidently.

Wind Lidar and modern wind forecasting methods have arrived in port operations, and Vaisala is ready to talk about your unique port environment and needs.

Why Vaisala?

Vaisala produces exceptional products grounded in science and innovation. We have led the way in observation technologies for 80+ years, and our solutions provide insight every day for partners around the globe, in all corners of the ocean, and even on Mars.

We also have the most robust, global support and service network anywhere, ensuring that you'll have an ideal end-to-end partner for the life of your systems.

Learn more and contact us at vaisala.com/maritime.



The weather affects maritime operations more than any other factor. We'll help you master it.

Weather and environmental insights are the greatest catalysts for successful maritime operations— onshore and offshore.

From sensors to systems and digital services, Vaisala provides actionable insights that empower stakeholders to confidently meet new challenges and harness new opportunities.

Our globally trusted maritime weather solutions enable remarkable efficiency gains, digital transformation, the protection of people and investments while supporting clean and responsible operations.

Why Vaisala?

We are scientists and explorers driven by passion, relentless curiosity, and the desire to create a better world. Our 85+ years of innovation and global impact are reflected in our guiding principles for maritime:



Master the weather, master the sea

Vaisala enables stakeholders to harness incredible new possibilities while facing increased severe weather risks driven by climate change. We do this by providing the most advanced weather and environmental insights available anywhere. Guided by our weather measurement expertise, we're advancing maritime operations and empowering today's leaders to master the sea like never before.



Currents of innovation

Maritime is evolving, and the currents of innovation are taking us to a more sustainable and weather-aware industry. Vaisala is the world's most trusted partner for helping maritime leaders navigate this evolution. Fueled by our proven scientific leadership and innovative spirit, we have led the way in providing unparalleled weather and environmental solutions across a multitude of industries for generations. We give maritime stakeholders the most comprehensive weather intelligence available so they can innovate across their entire ecosystem to protect of people, resources, and infrastructures.



Oceans of insight

The maritime industry is a complex ecosystem, with valuable information to be found everywhere. In the atmosphere. In the water. In the movements and topographies of the sea. In complex offshore and onshore hubs of commerce. Vaisala's integrated, end-to-end weather solutions are uniquely capable of transforming oceans of information into concrete, practical insights to enable better decision making. These insights turn uncertainty into confidence, risk into readiness, and potential into power. Our preeminent weather technologies give maritime stakeholders a new competitive advantage: the ability to derive previously unattainable insights from everything around them.



Champions for sustainability

Vaisala partners with maritime stakeholders to support a proactive, informed approach to navigating sustainability initiatives. Our unsurpassed onshore and offshore weather intelligence helps the maritime industry achieve cleaner and more responsible operations, stay ahead of regulatory pressures, and confidently manage risks related to extreme weather. This partnership also strengthens the health of Earth's oceanic ecosystems and the communities of which we are all part.

A large industrial port at night, featuring several tall cranes and a large white ship docked. The scene is illuminated by warm lights, creating a dramatic atmosphere. A large teal diagonal shape is overlaid on the left side of the image.

vaisala.com/maritime

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