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Case Study

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Ports in a storm: Safer and stronger

How a multinational wind analysis project is leveraging lidar to help ports prepare for sudden winds

Seaports are vulnerable by nature. Operations and safety can be put at risk by extreme weather, often made worse by their locations in urban areas. A promising, multinational wind and weather analysis project is now underway to help ports be better prepared for storms — especially sudden winds.

Università di Genova

Wind is the world's most destructive natural phenomenon, and port environments are continually exposed to the elements where their structures are put to the test. Cranes and smaller vessels are often prone to damage and collapse, and some buildings may not stand up to extreme winds, creating serious safety and operational hazards.

In Europe, a 50-year old model exists for forecasting the effects of cyclones on ports, but there is no model for thunderstorms. This knowledge gap is partly because storms along the coasts in this region are rare and brief, making them difficult to analyze. Construction in ports has been affected by this lack of insight, and has led to cases of either over-engineered or inadequately built structures.

The challenge: Wind impacts port safety and construction

The Department of Civil, Chemical and Environmental Engineering (DICCA) at the University of Genoa includes a highly respected wind engineering group who regularly studies wind phenomena. To address the challenge of wind in ports, the Department began a project to understand wind fields and optimize wind forecasting.

Their study was expanded to include thunderstorms and became Project Thunderr: an ongoing collaboration that leverages wind lidar to expand storm research and improve port construction and structure design. Joined by organizations in Germany, the Netherlands and Canada, Project Thunderr aims to help ports all around the world—and the cities they serve—to become better prepared for whatever nature throws their way.

The client:

Department of Civil, Chemical and Environmental Engineering, University of Genoa

Vaisala provided:

WindCube Scan

The solution: Major wind analysis project uncovers the details

As DICCA began the project, they selected the WindCube® Scan to complement the extensive wind monitoring network. The WindCube Scan is well-known as the industry standard for accurate and reliable wind measurements, and provides 3D scanning at ranges up to 10km from the shore.

Positioned in the Port of Genoa, the Department is using the WindCube Scan to search for downburst outflows, gust fronts, and waterspouts produced by thunderstorms approaching from the sea.

The wind monitoring network spans several ports across Italy and France and includes the WindCube Scan plus more than 30 ultrasonic anemometers, 3 lidar vertical wind profilers, and PTH sensors. This advanced network detects the position, diameter, structure, direction and translational speed of downbursts. Semi-automated software separates wind events and collects a wide range of information types to classify the weather scenarios in which thunderstorms occur.

The benefits: The future looks brighter for all ports

What began as a small-scale wind study has become an international collaboration, with results expected to benefit ports worldwide. The five-year Project Thunderr will be complete in 2022, and project leaders are on track to study 25 thunderstorms during this time.

Thanks to its rugged design and easy setup, the Department was able to quickly deploy the WindCube Scan where it is needed most. Fast and thorough 3D scans plus automatic 3D cloud and aerosol detection provide data instrumental for understanding downbursts and other wind conditions, while autonomous operation gives more time to focus on wind analysis.

As an integral part of the wind monitoring network, WindCube Scan is an important technology for proving how lidar can be used for updating decades-old forecast models—and creating new ones—for use in port construction and operations.

The project is providing extensive, promising data that could enable everything from wind tunnel testing of new building designs to new classifications for the types and severity of storm-related structural damage.

"Lidar equipment helps us to capture fine detail from the inside of a storm, so we can gauge its geometric structure, distribution and evolution as the storm progresses... Data from the research will help us to design and build safer and more cost-efficient dock structures."

Massimiliano Burlando
Associate Professor at the University of Genoa

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