

Wind speed at light speed

 **ZXLidars**

Products & Applications



We are **ZX Lidars**

Accurate, Accepted, Affordable Lidars

Measure the wind higher, further and faster than traditional anemometry. Operate in all climates, reduce wind measurement uncertainty and increase project and design value.

Manage your wind resource risk and optimise your assets by employing the original and single most validated wind industry Lidar available.

ZX Lidars are powerful tools in any wind measurement toolbox: in wind farm Development, Site Construction and through to Site and Project Operations.

Our product family - ZX 300, ZX 300M and ZX TM - allows for accurate, accepted and affordable wind measurements onshore, offshore, and from existing structures such as wind turbines.

Our Team Values

Emotional intelligence. We deliver product, market and technical intelligence with passion and emotion. We believe in what we do, making a positive contribution to the environment with scientific research and development at the core.

Sincerity. We want our customers to love what we do as much as we do. We do our best to make sure that we understand our customers and that our customers understand us. And that's across everything we do. We will only get better the more that we listen to our customers, to the market and to our peers.

Enthusiasm. We love science, technology and market development - and making it all mean something for the benefit of our customers, of our team, and of everyone.

Ian Locker

Ian Locker
Managing Director &
Founder of ZX Lidars

Why Lidar

Safer

According to an independent study by Renewable Energy Systems (RES), substituting masts with Remote Sensing Devices, such as Lidars, leads to fewer accidents and near misses. Additionally Working at Height is limited.

There is now a documented lower chance of an accident or safety incident comparing the use of Remote Sensing Devices to met mast campaigns.

Faster

No planning application for tall structures is required and mobilisation of Lidars can be achieved in just a matter of hours.

Nacelle-based Lidars can be installed and removed rapidly for operational wind measurements.

Cheaper

Increasing turbine hub heights and rotor diameters demand representative wind measurements. Lidars are more cost effective for higher hub heights relative to met masts.

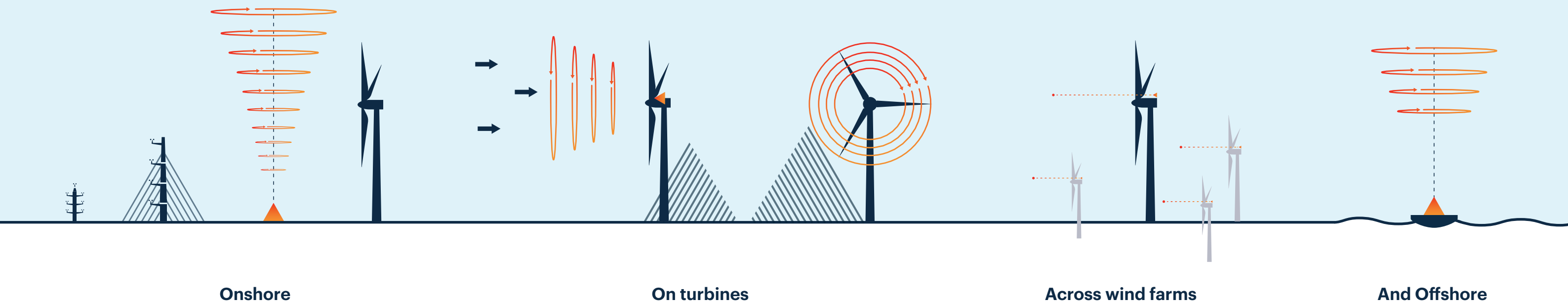
Through-life costs of Lidar are lower with minimal servicing, validation or calibration required.

In operation, coverage across the whole wind farm can be achieved with nacelle-based Lidars.

Better

Lidar measurements can be taken across the whole turbine rotor reducing project uncertainty and validating turbine performance. Lidars are mobile and measurements can be taken across large sites.

Layouts can be optimised, operations can be tailored.



Doppler Lidar

We ♥ Continuous Wave

Doppler Lidar is a proven means of measuring the line of sight wind speed of aerosols found naturally (dust, water, pollution) traveling in the wind. The Doppler shift (the change in frequency) of our emitted laser wave relative to the reflected, or 'backscattered', light from the aerosols is compared and precisely measured.

Up to 50 line of sight measurements are made every second. This ensures high quality, high availability wind information, unique to Continuous Wave Lidar.

Measurements every 20 milliseconds freeze out motion encountered when our Lidar is mounted in turbines or on floating buoys.

Taking so many measurements, in a conical scan pattern, increases the chance of returning a valid wind signal when working in challenging environmental conditions or when part of the scan is blocked by a fixed object.

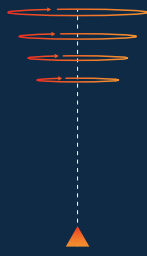
We capture rapidly changing wind flows experienced close to ground level, around structures and even in wind turbine induction zones.

Our true Class 1 eye-safe laser beam is focused at every desired measurement height / range ensuring that availability of this extensive data set is further maximised with constant sensitivity at all heights.



Wind Data Outputs

- Wind speed and wind direction
- Temperature, pressure and humidity
- Vertical wind shear
- Wind veer
- Turbulence Intensity (TI)



ZX 300

Onshore wind measurements from vertical profiling Lidar

Accepted by DNV GL as a Stage 3 Bankable Lidar in simple terrain and by Deutsche WindGuard in complex terrain. Full IEC Classification, the single largest body of evidence of met mast / Lidar validations at the UK Remote Sensing Test Site and gold-standard 'highest height' validations at 213m and 244m.

ZX 300 at a glance:

- Remotely measure the wind from 10 to 300 metres above ground.
- Reduce your measurement uncertainty by measuring higher than a met mast and by mobilising measurements across a whole site.
- Better manage health & safety requirements on site with no need to work at height.
- Be flexible within your planning applications by using a low visual impact, low height device.
- Start your measurement campaign tomorrow with little or no site preparation or planning permits required.
- ZX 300 is fully IEC Classified to IEC 61400-12-1: 2017.



The original wind industry Lidar, with the highest number of IEC compliant met mast validations

A sophisticated, rugged system, highly reliable, designed and built to perform in real world deployments and extreme environments.

Absolute accuracy demonstrated through wind tunnel testing.

DNV GL Stage 3 approved finance-grade data in benign terrain.

Deutsche WindGuard approved CFD conversions for finance-grade data in complex terrain.

Low cost of ownership with no requirement for annual servicing or calibration within a 3 year period.

ZX 300, the well-received mid-life upgrade of our established ZephIR 300 wind Lidar.

New features include:

- Modernised internal components. These benefits are realised through increased in-field performance and long-term serviceability. ZX 300 is provided as standard with an extensive 36 month return-to-base warranty – the longest of any Lidar.
- Refreshed User Interface. Additional contrast modes and streamlined menu systems promote easier navigation when deploying and configuring ZX 300.
- Performance Verification through our rigorous and audited Factory Acceptance Test as standard.
- Real-time Quality Controlled 1-second data. This new best-in-class resolution of wind data enables emerging Lidar applications within the wind, meteorological and associated industries such as crane lifts and helicopter operations. No other Lidar provides a full 360° wind field calculation derived from just one second of data.

In addition, ZX 300 features optimised processing for improved wind data quality control. Extensive field demonstrations have been performed on ZX 300 at the UK Remote Sensing Test Site. The analysis of these deployments spanning several years over all seasons and weather conditions delivers results showing excellent performance and a step forward in the existing accuracy that is considered Stage 3, suitable for standalone wind energy assessments, by DNV GL. ZX 300 is fully IEC Classified to IEC 61400-12-1: 2017.

Take confidence from our extensive 5 year ZX Care Warranty

ZX300 Specification

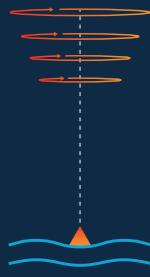
Measurements

Range	10 - 300 metres (Lidar measurement) 0 - 10 metres (onboard met weather station)
Probe length	± 0.07 metres @ 10 metres ± 7.70 metres @ 100 metres
Heights measured	10 User configurable 1 Additional met weather station measurement
Sampling rate	50Hz (up to 50 measurement points every second)
Averaging rate	True 1-second averaging 10 Minute averaging
Accuracy wind speed	0.1 m/s*
Direction variation	< 0.5°
Speed Range	< 1 m/s to 80 m/s

Product

Service interval	36 months from new
Size	900 x 900 x 1001mm
Weight	55kg
IP Rating	IP 67
Power consumption	55W
Power input	12V
Temperature range	-40 + 50°C
Warranty	Up to 5 years
Maintenance	No annual maintenance or calibration in this period

* as measured against calibrated moving target



ZX300M

Offshore wind measurements from vertical profiling Lidar

Newly updated in 2021. Available on all major commercial floating buoys and designed for any offshore platform. Unmatched track-record in the harshest of offshore floating environments. All with the longest service and warranty period, as standard, of any Lidar. Full IEC Classification, the single largest body of evidence of met mast / Lidar validations at the UK Remote Sensing Test Site and gold-standard 'highest height' validations at 213m and 244m.

ZX 300M at a glance:

- 10 to 300 metre wind measurements from deck.
- Specifically designed for the offshore environment with enhanced marinisation.
- Extensive 3 year service period ensuring the lowest cost of ownership of any offshore Lidar available.
- Installed and proven for use on all market-ready floating Lidar platforms.
- Validated across multiple pre-commercial floating deployments and as mast replacements on fixed platforms.
- Collaborative agreements with leading Floating Lidar Device manufacturers for effective Turbulence measurements.



The industry standard Lidar offshore for affordable remote wind speed measurements

Significantly reduce the cost of your measurement campaign.

Reduce your measurement uncertainty by measuring higher than a met mast.

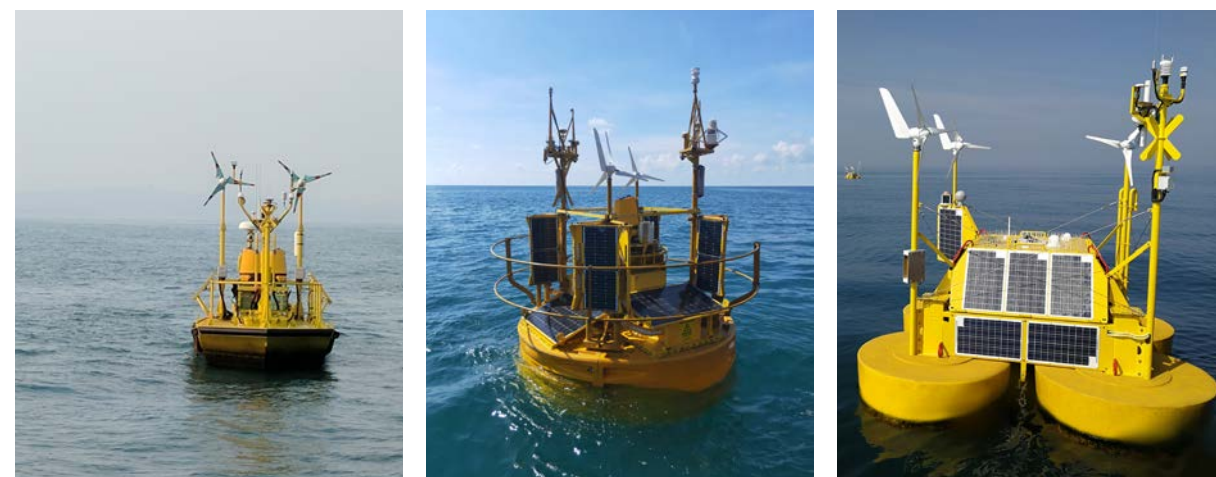
Reduce your measurement uncertainty further by mobilising measurements across a whole site by utilising floating Lidar.

Better manage health & safety requirements on site with no need to work at height.

Be flexible within your planning applications by using a low visual impact, low height device.

ZX 300M was newly updated in 2021 and features include:

- Our Continuous Wave laser measures the Line of Sight wind speed every 20 milliseconds to 'freeze' any motion encountered.
- Multi-layered, highly insulated, plastic moulded Lidar housing, with additives to provide high UV stability and improved marine growth resistance.
- Highest grade of marine connectors available for all peripheral items, 2000+hrs salt spray tested.
- Custom stainless steel frame to allow for ease of handling and efficient securing to any platform surface.
- Marine met station with improved yaw determination, for floating offshore platforms.
- Stainless steel window wiper system with silicone wiper blade.
- All External components tested to IEC60068-2-11.



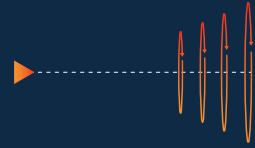
ZX300M Specification

Measurements

Range	10 - 300 metres (Lidar measurement) 0 - 10 metres (onboard met weather station)
Probe length	± 0.07 metres @ 10 metres ± 7.70 metres @ 100 metres
Heights measured	10 User configurable 1 Additional met weather station measurement
Sampling rate	50Hz (up to 50 measurement points every second)
Averaging rate	True 1-second averaging 10 Minute averaging
Accuracy wind speed	0.1 m/s*
Direction variation	< 0.5°
Range	< 1 m/s to 80 m/s

Product

Service interval	36 months from new
Size	805 x 845 x 966mm
Weight	53.4kg
IP Rating	IP 68
Power consumption	55W
Power input	12V
Temperature range	-40 + 50°C
Warranty	3 years
Maintenance	No annual maintenance or calibration in this period



Turbine-mounted wind measurements from horizontal profiling Lidar

Power Performance Measurements from the only Lidar that measures the full shear and veer wind profile of a wind turbine. Accurately and automatically detect complex flow conditions such as wakes. Operate in all environmental conditions with market-leading Lidar sensitivity. Compensate for turbine movement automatically for accurate measurements above ground level, e.g. hub height.

ZX TM at a glance:

- Remotely measure the wind ahead of wind turbines from 10m to 550m.
- Operational Power Performance measurements & Power Curve Condition Monitoring.
- Remove cup anemometer or Nacelle Transfer Function uncertainty or calibration issues.
- Standard industry-accepted methodologies and measurements for: Power Curves, Nacelle Transfer Function calibration including Yaw Alignment, and Wake Detection.
- Application and campaign-focused User Interface ensuring ease of data handling.
- Extensive 3 year service period ensuring the lowest cost of through-life ownership.
- Suitable for installation on all major turbine platforms.
- Approved by Siemens Gamesa Renewable Energy and other leading OEMs for Power Performance Testing.



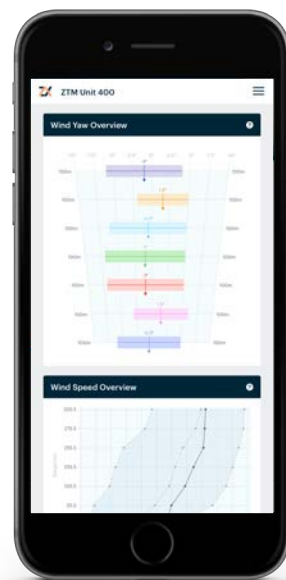
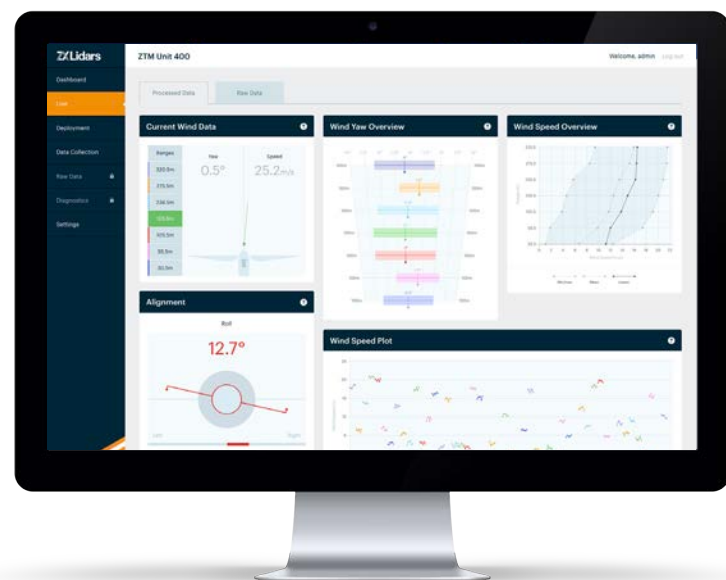
Optimise wind turbines, wind farms and wind projects

Improve the Levelised Cost of Energy of a wind farm by:

- Producing more energy for the same cost.
- Reducing operating costs for the same production.
- Increasing project value with more certain wind measurements.

ZX TM features include:

- Lidar Control Unit (LCU) mounted in the nacelle, and a Lidar Optical Head (LOH) mounted on the Turbine Integration Kit (TIK) which is mounted on to the nacelle roof.
- 17 Horizontal measurement ranges and up to 15 Vertical Slices at each range – the most comprehensive measurement capability of any Lidar, delivering Rotor Equivalent Wind Speed and Slices for IEC Power Curves.
- High Lidar directional positional accuracy on turbine essential for any set point changes relative to rotor alignment using unique patented auto-alignment technique in addition to roll / inclination sensors on board.
- Extensive 3 year service life as standard.
- High availability with all laser energy focused at each measurement range, with low susceptibility to turbine blades due to short measurement integration time (50Hz).
- “Application mode” software helping you to define Key Performance Indicators, campaign duration and to include turbine parameters, in addition to the initial installation and easy configuration of the Lidar.



ZX TM Specification

Measurements

Configurations	3" Lidar optical head, 15 or 30 degree half-angle scan 17 horizontal ranges with configurable dwell times 15 vertical slices at each range across the rotor disk
Wind characteristics	Wind speed, shear, veer, wind yaw misalignment, turbulence, rotor equivalent wind speed (REWS), windflow complexity
Scan & Data sample rate	Full rotor scan for REWS measurement 50Hz / 20ms measurements
Speed range	0.5 - 45 m/s (wind loading survivability up to 70 m/s)
Accuracy	Wind speed, 0.1 m/s Wind direction, 0.5°
Measurement range	10m - 550m

Product

Weight	Lidar Optical Head (LOH): 20 kg Lidar Control Unit (LCU): 29 kg Turbine Integration Kit (TIK): 35kg
Size	LOH: 356 x 285 x 823 mm LCU: 209 x 513 x 630 mm Cable length: 10 m (or 15m option)
IP Rating	LOH: IP 66 LCU: IP 65 Marine atmosphere compliant (IEC 60068-2-52) Operating humidity 0 to 100% RH
Ambient temperature range	LOH: -30 to 50°C LCU: -40 to 60°C
Warranty / Maintenance	3 year warranty as standard No factory maintenance or calibration required during 3 year service period
AC Power	Nominal: 96 W Hot / cold conditions: Up to 275 W Maximum rating: 400 W
Compliance	Class 1 Eye Safe Infrared Laser, IEC60825-1
Mounting	Wind turbine nacelle, platform or ground mounted

Access

User Interface	Web-based interface via laptop, mobile or tablet
Data Interfaces	Ethernet via M12 to RJ45 (adaptor cable) WLAN 802.11 a, b, g, n, d Cellular POE Modem (Optional)
Comms protocols	Web based GUI for configuration, measurements and status monitoring Modbus (TCP) Web API Local Data Broadcast (UDP) File transfer protocol (FTP) Push and Pull
Data storage	24 months
Timestamp	GPS (with optional local time offset) or NTP

Compliance

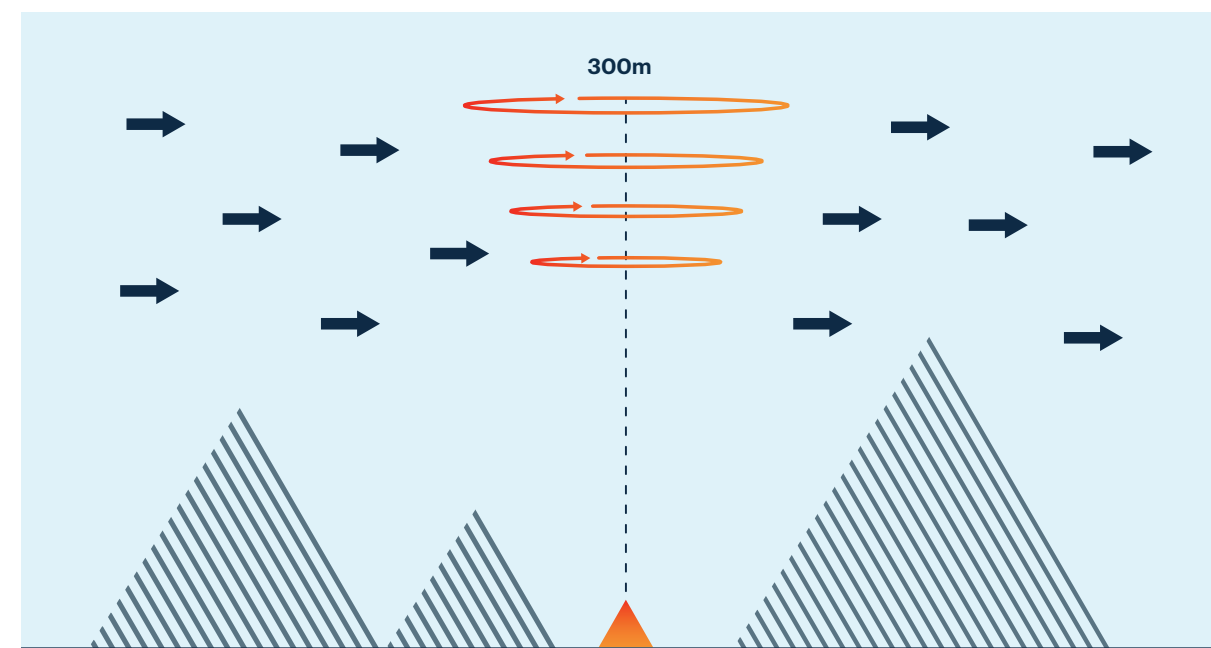
CE	2014/35/EU, 2014/30/EU, 2011/65/EU, 2014/53/EU
EMC	IEC 61000-6-2 (Immunity) IEC 61000-6-4 (Emissions)
Laser safety	BS EN 80625-1:2014 Class 1

Onshore wind resource assessment

Determine the wind resource and flow characteristics across a project site so that wind turbine siting, specification and suitability studies can be performed. Accurate annual and lifetime energy yield predictions can also be made.



Stand alone wind measurements



 Lidar  Wind  Lidar beam

Entirely replace the need for a met mast within an Energy Yield Analysis wind / measurement campaign.

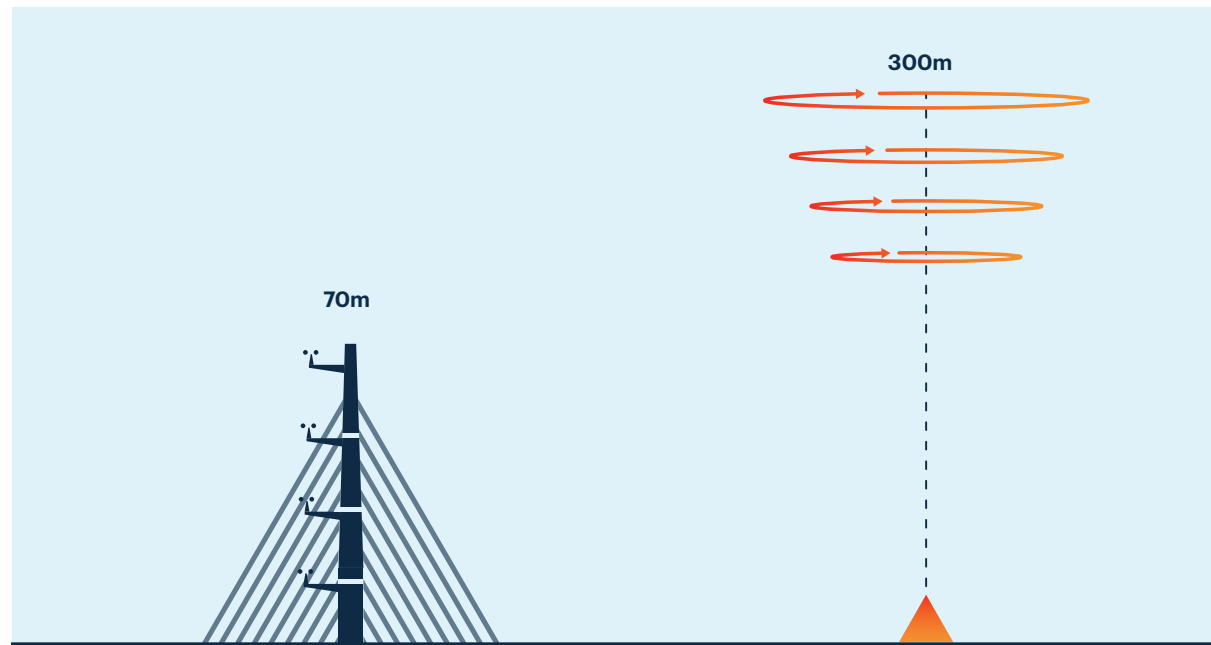
Remove uncertainties associated with met masts including flow distortion, cup calibration and seasonal issues.

Remove certain planning permits required for tall mast structures.

Remove Working at Height considerations by actively working towards industry best practice.

Classification of ZX 300 confirms extremely low uncertainty wind measurement comparable to, or in some cases better than, Class 1 mechanical cup anemometers.

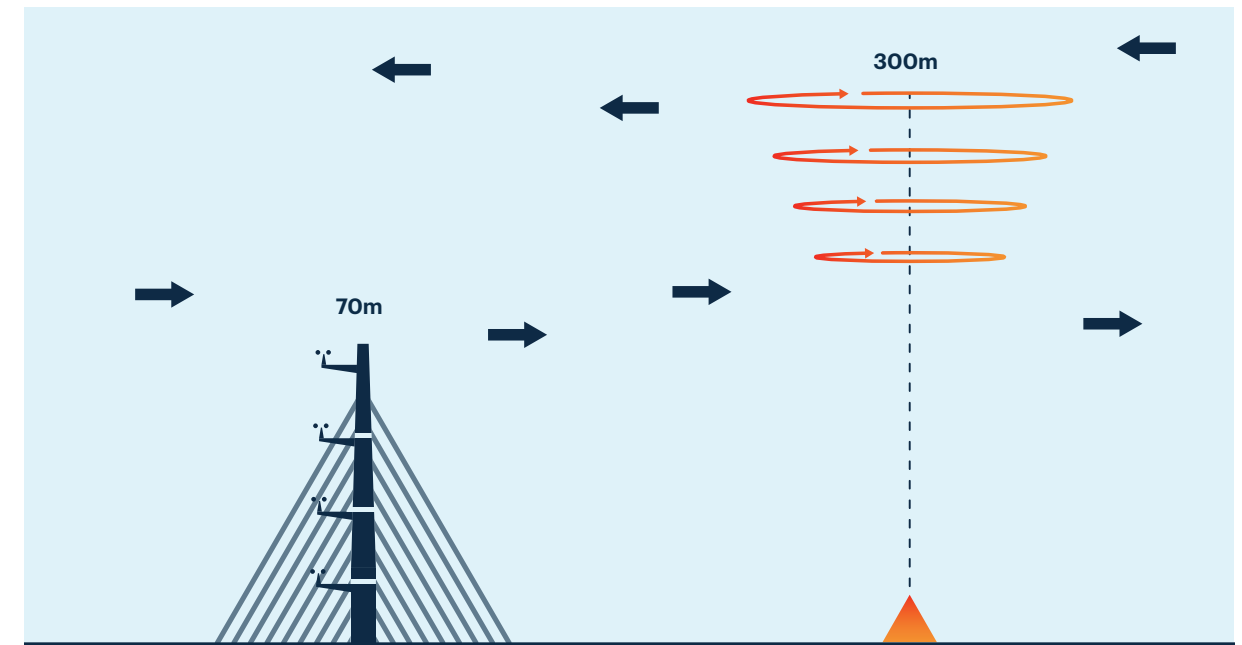
Verify your met mast



- Verify neglected or old met masts with industry reference Lidar, ZX 300.
- Identify flow distortion at the anemometer caused by the mast itself.
- Confirm any deterioration in anemometry calibration that can occur over time.
- Discover misalignment of anemometry with respect to the mast.
- Detect anemometry failings during freezing temperatures or other extreme wind events.
- Validate wind shear model used for wind speeds above met mast while on site.

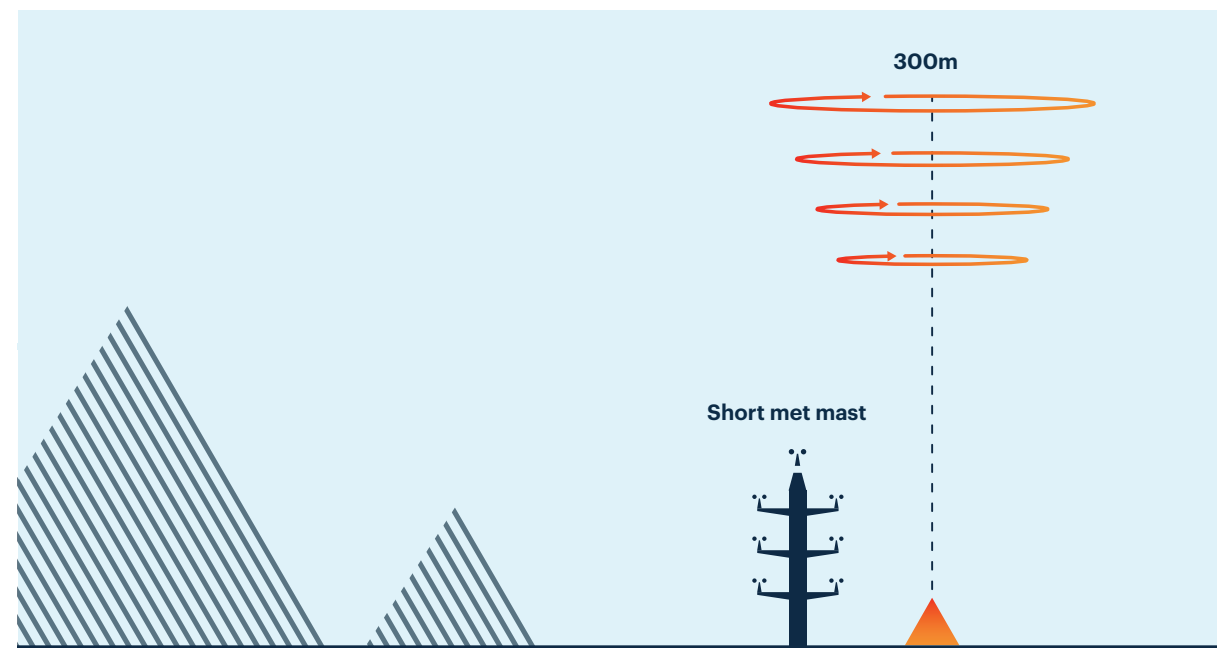
ZX 300 can be deployed for less than 4 weeks to verify your met mast measuring wind speeds and characteristics from as low as 10 metres to as high as 200+ metres – ensuring correlations may be performed on even the shortest masts.

Complement and go beyond your met mast measurements



- Reduce shear uncertainty by measuring to turbine hub height, top tip and beyond.
- Reduce horizontal uncertainty by moving around the wind farm site.
- Improve the accuracy of flow modelling by measuring at multiple nodes in the wind farm.
- Operate seamlessly throughout the winter when icing may be a challenge for cup anemometers.

Combine fixed short met masts with roaming Lidar



▲ Lidar → Wind — Lidar beam

Enable a short met mast methodology easily and cost effectively, progressing multiple sites across your wind portfolio.

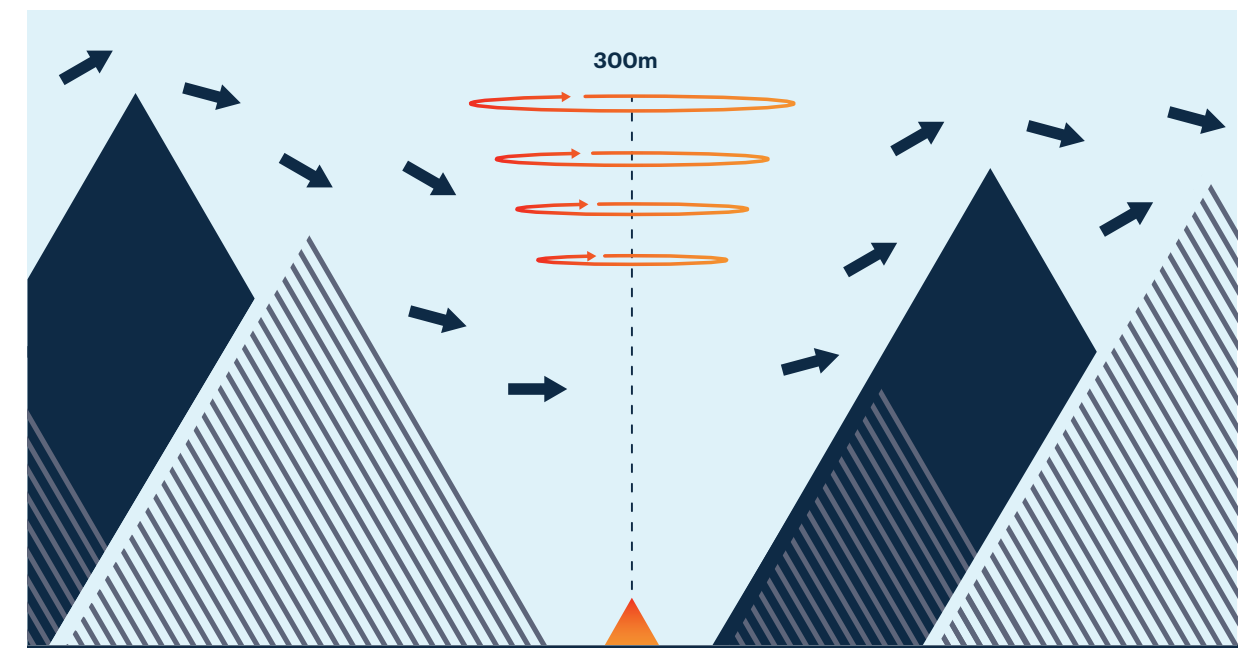
Reduce shear uncertainty by measuring to turbine hub height, top tip and beyond.

Reduce horizontal uncertainty by moving around the wind farm site.

Improve the accuracy of flow modelling by measuring at multiple nodes in the wind farm.

Progressing multiple sites with a roaming ZX 300 and a fixed short mast has been used to support the financing of portfolios of wind farms and is a methodology accepted by leading consultants, financiers and their engineers.

Working in complex flow



▲ Lidar → Wind — Lidar beam

Entirely replace the need for a met mast within an Energy Yield Analysis campaign in complex flow conditions.

Overcome logistical and practical issues of siting met masts in complex terrain or forestry.

Use CFD conversion to provide a traceable, auditable comparison of ZX 300 data to expected mast data.

Work with industry leaders in CFD such as Deutsche WindGuard, Natural Power, Meteodyn, WindSim, DNV GL and RES for your data conversions.

In areas of complex flow any comparisons between measurement devices will be biased by the non-laminar flow.

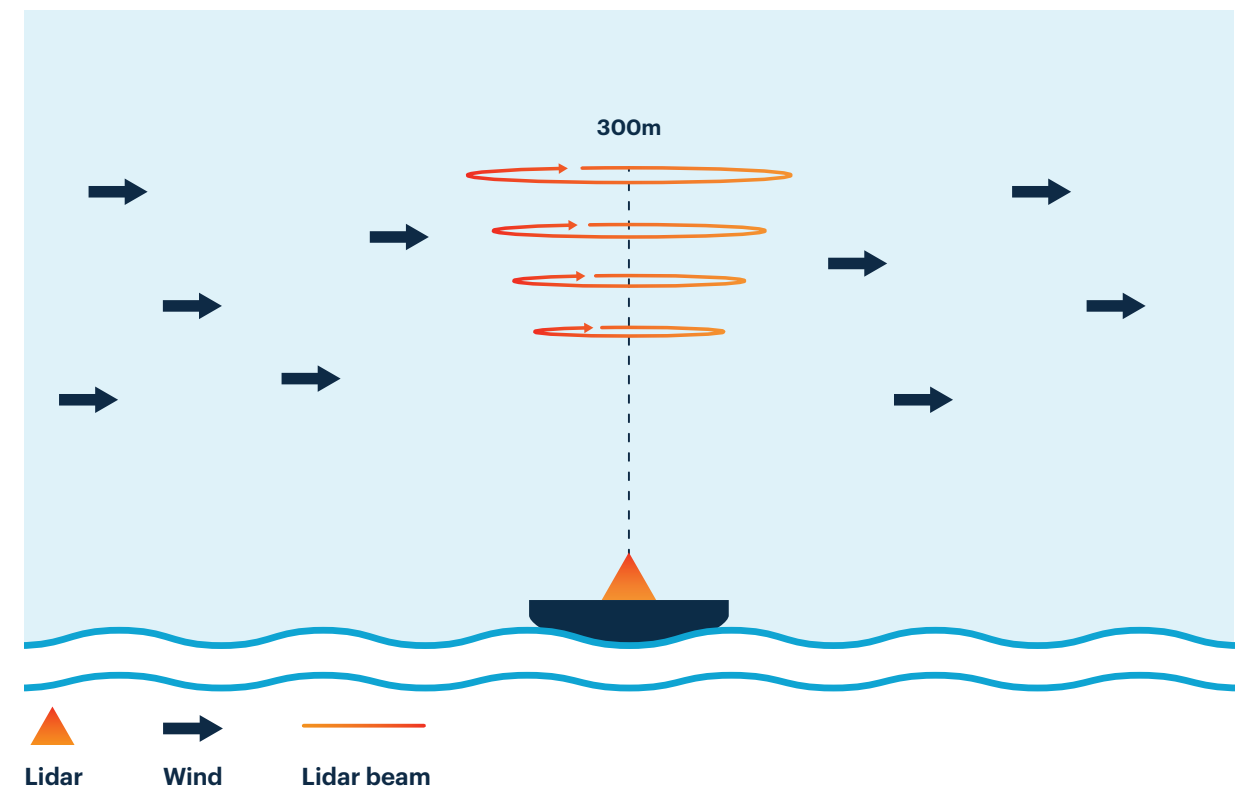
CFD conversion of ZX 300 data is extensively validated, independently accepted and makes the use of stand-alone Lidar in complex flow possible.

Offshore wind resource assessment

Determine the wind resource and flow characteristics across a project site so that wind turbine siting, specification and suitability studies can be performed. Accurate annual and life-time energy yield predictions can also be made.



Stand alone wind measurements



Significantly reduce the costs and risks associated with offshore wind resource assessment by using the industry's choice for floating wind campaigns - ZX 300M.

Deployed on all major buoy types commercially available.

Continuous Wave Lidar technology at the heart of ZX 300M is robust against motion-induced errors.

3 year warranty as standard, keeping your through-life costs to a minimum with no need to service or calibrate during this period - no other Lidar comes close.

Collecting wind data offshore can be prohibitively expensive with tall mast structures.

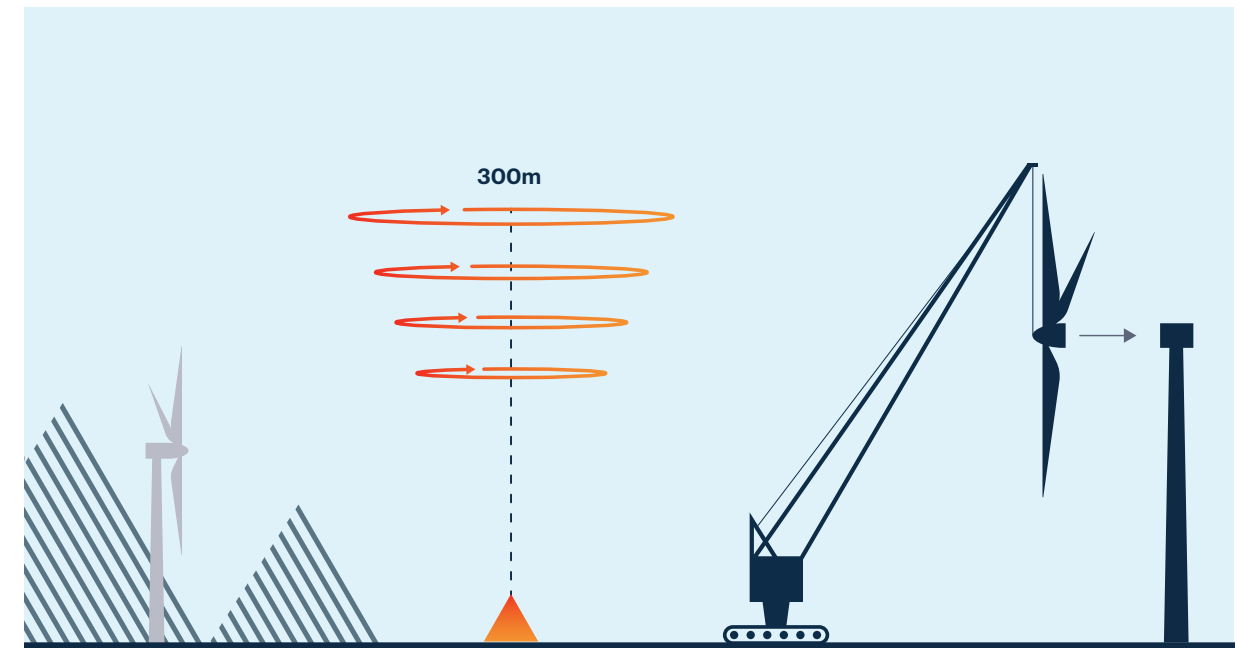
Floating Lidar has been used to collect data for the purpose of financing offshore wind farms.

Wind monitoring

Determine the wind conditions on site to inform accurate decision making during critical construction and operational project stages.



Crane lift monitoring



Lidar improves the accuracy of the forecasting model that may be used for energy trading, access / egress or planned maintenance forecasting used to reduce Waiting on Weather downtime.

Real-time wind information during crane operations giving the greatest level of site wind data available.

Safe and efficient crane lifts are driven through more complete Health & Safety and financial consideration of independent wind information.

Live wind shear profile is directly accessible via a User Interface direct to your local or remote site teams.

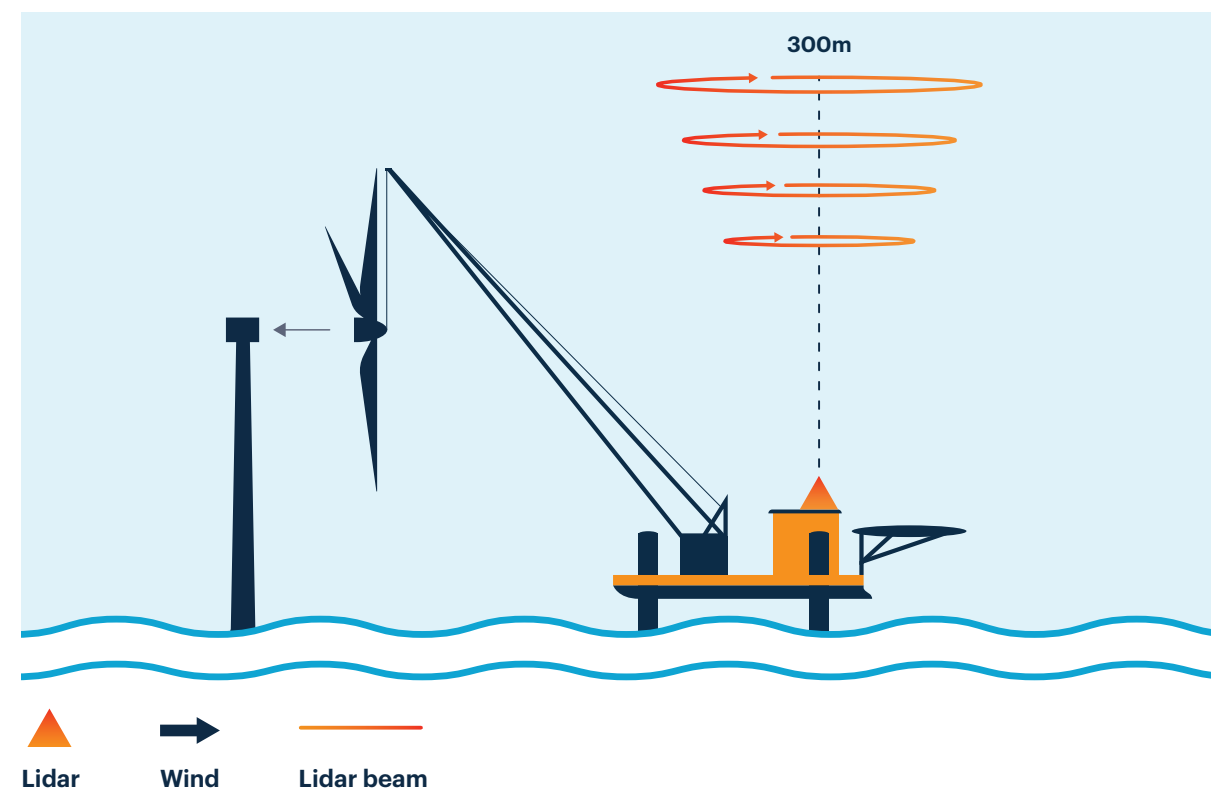
ZX 300 provides wind speed and direction measurements up to crane heights and above.

Offshore wind monitoring

Determine the wind conditions on site to inform accurate decision making during critical construction and operational project stages.



Offshore construction and operations & maintenance wind monitoring



Lidar can improve the accuracy of the forecasting model may be used for energy trading, access / egress or planned maintenance forecasting used to reduce Waiting on Weather downtime.

With 1-second Quality Controlled data, a live feed from a permanently-installed Lidar may be used to inform transport movements, for example helicopter lifts and craning around site.

With an almost real-time, accurate shear profile, any airborne movements around site can be conducted more efficiently and allow operators to work with a higher level of certainty within their internally approved safety windows for these operations.

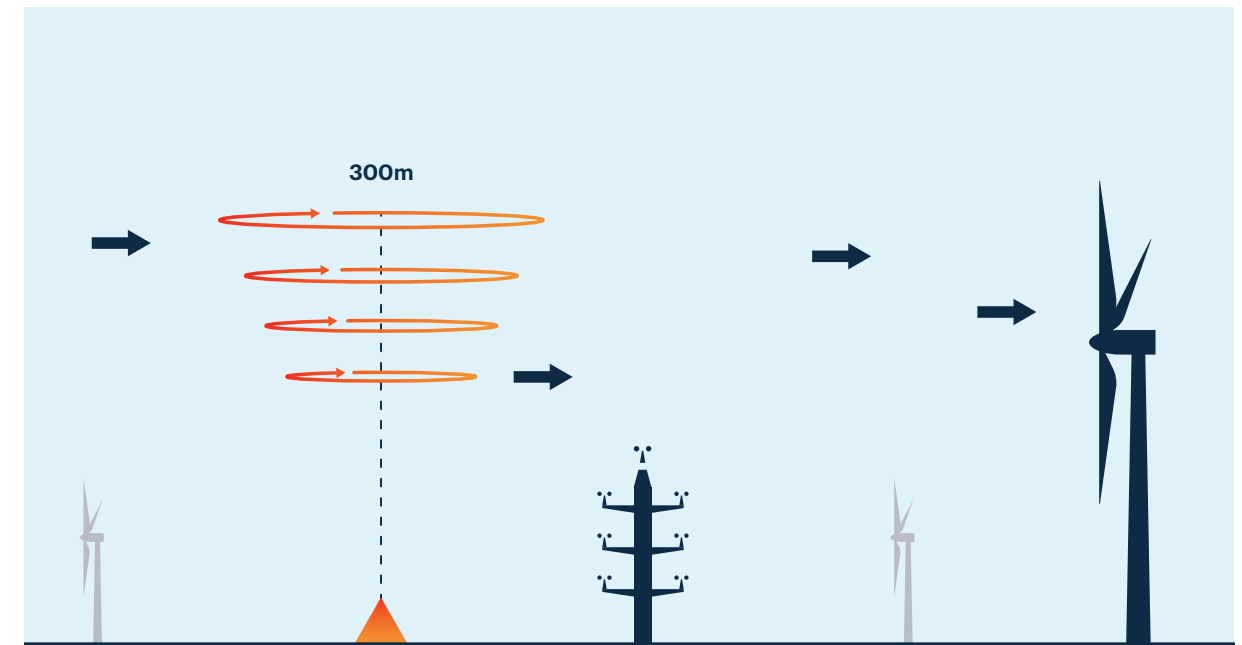
ZX 300M provides wind speed and direction measurements up to crane heights and above.

Wind farm operations

Determine the wind conditions on site to inform accurate decision making during wind farm acceptance, operations and maintenance.



Power Curve Measurements to IEC 61400-12-1: 2017



Independently test a wind turbine's power curve with a more flexible, mobile measurement device.

IEC 61400-12-1: 2017 measurements can be adhered to ensuring turbine manufacturers can accept data gathered.

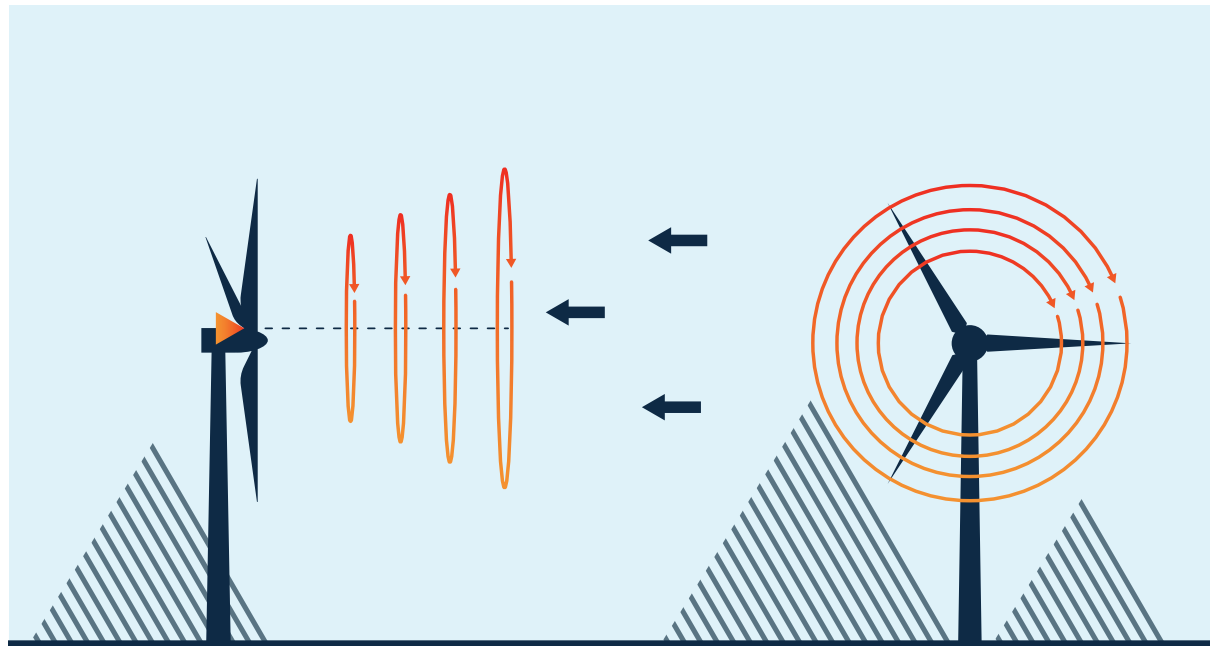
Efficiently measure all turbine power curves previously not possible with traditional anemometry alone.

Include power curve measurements in End of Warranty Inspections ensuring all issues can be rectified within the warranty period.

Power Performance Testing (PPT) compares the actual power curve of a wind turbine to the warranted power curve provided by the wind turbine manufacturer.

ZX 300 provides accurate, accepted wind turbine power curve measurements.

Power Curve Measurements from the turbine, including IEC 61400-50-3



▲ Lidar → Wind — Lidar beam

Understand a turbine's true potential with a nacelle based power curve measurement.

Remove uncertainties with flow distortion around nacelle anemometry by measuring ahead of the turbine in free wind flow.

Benchmark turbine-to-turbine performance to identify any early underperformance from blade erosion, forestry effects or other mechanical issues.

See the full rotor equivalent wind approaching the turbine to identify wakes, ground-effects and yaw misalignment.

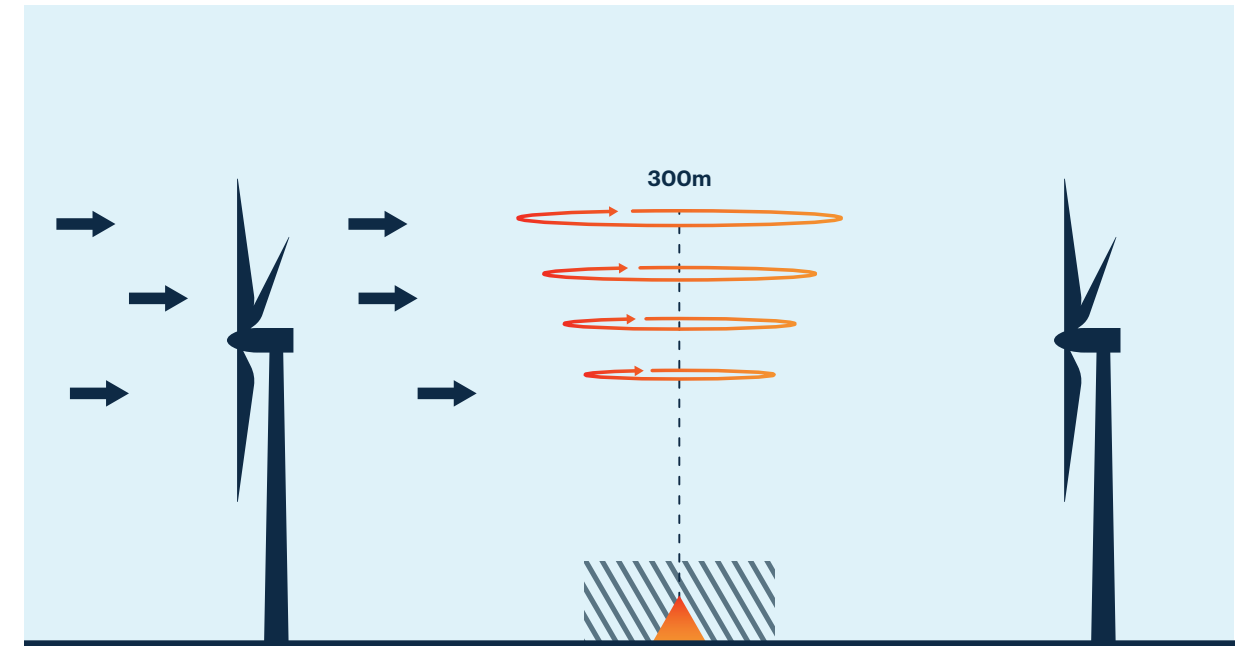
Measurements can be made according to industry-standard procedures that are accepted by turbine manufacturers, when included in Turbine Supply Agreements.

Power Performance Testing (PPT) compares the actual power curve of a wind turbine to the warranted power curve provided by the wind turbine manufacturer.

ZX TM provides full rotor wind measurements and turbine motion-compensated true Hub Height measurement.

ZX TM is approved by Siemens Gamesa Renewable Energy and other leading OEMs for Power Performance Testing.

Permanent Met Lidar



▲ Lidar → Wind — Lidar beam

Entirely replace the need for a Permanent Met Mast with a Permanent Met Lidar.

Remove certain planning permits and changes to planning required for tall mast structure.

Remove the need to work at height actively working towards industry Health & Safety best practice. Remove annual met mast calibration requirements and safety / insurance walkdowns.

Limit ground-work costs and timescales by installing a simple Lidar compound only.

More accurately apply curtailment strategies / wind sector management.

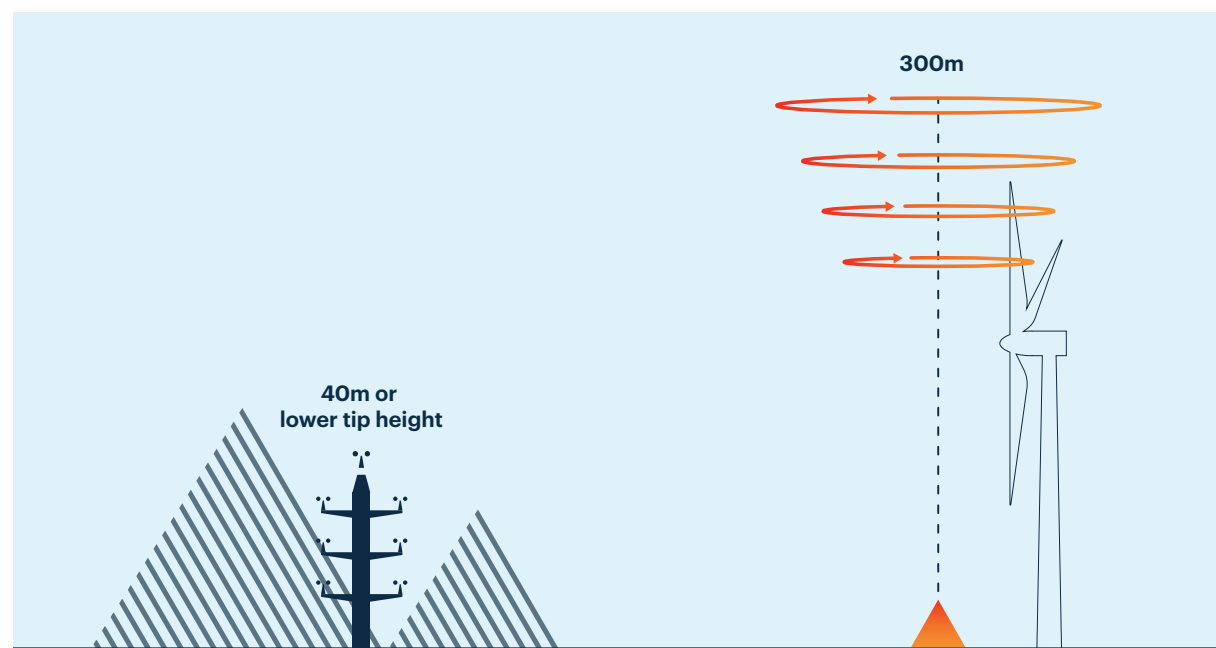
Undertake measurements in the case of either turbine failure / turbine component failure or power loss on site in support of any insurance claims.

Improve the accuracy of the forecasting model may be used for energy trading, access / egress or planned maintenance forecasting (to reduce Waiting on Weather downtime).

With an almost real-time, accurate shear profile, any movements around site can be conducted more efficiently and allow operations, for example craning, to work with a higher level of certainty within their internally approved safety windows for these operations.

ZX 300 provides low 10m measurements through to tip height and above, and can be SCADA / grid integrated providing a new standard in operational wind measurements.

Site Calibration to IEC 61400-12-1: 2017 Annex C



▲ Lidar → Wind — Lidar beam

Perform a site calibration prior to wind farm construction with a short met mast combined with a more flexible, mobile measurement device.

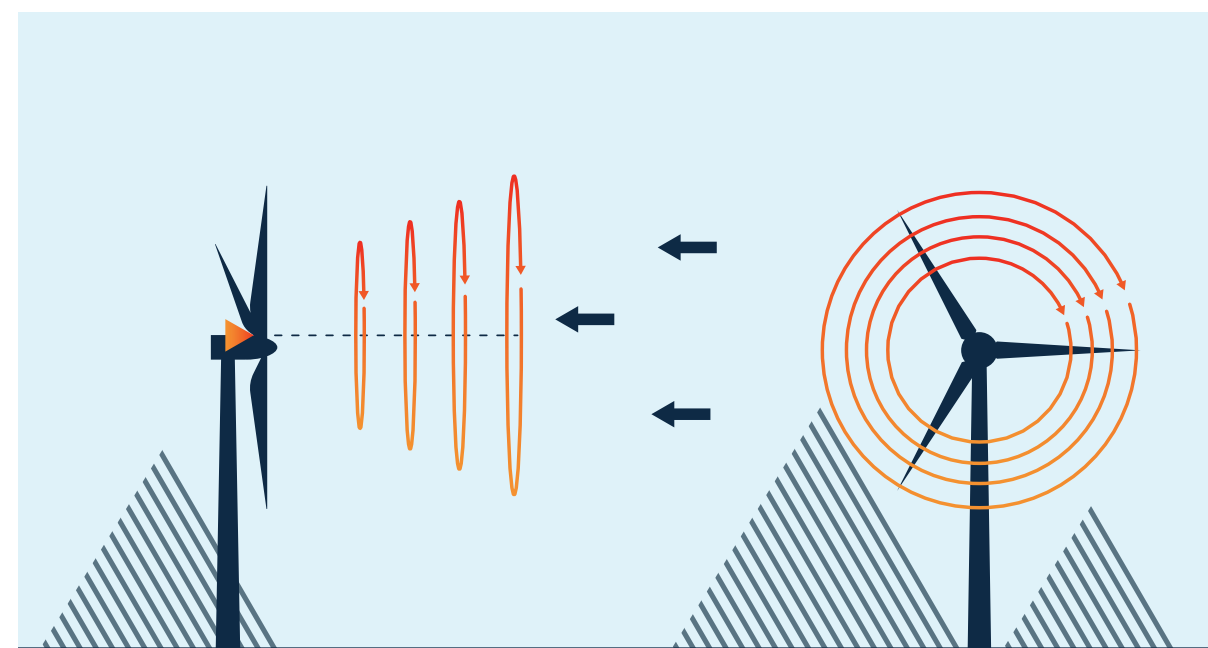
Conduct your site calibration according to IEC 61400-12-1: 2017 Annex C.

Use site calibrations to inform Power Performance Measurements to ensure turbine manufacturers can accept data gathered.

A site calibration is a pre-construction measurement campaign to quantify the wind speed relationship between an upwind location (reference mast / Lidar location) and a to-be-constructed turbine location, using a short met mast and roaming Lidar.

This measurement is required prior to performing a Power Performance Measurement to remove any terrain induced complexity in the flow that might cause a deviation in the free stream flow between mast and turbine location.

Wind resource assesment & site optimisation



▲ Lidar → Wind — Lidar beam

Accurately measure power performance of wind turbines from the nacelle.

Reduce uncertainty in P90, P50 and post-construction energy assessments and provide options for re-financing a wind farm with better-understood rates of return.

Feed machine-learning / condition monitoring performance analysis with more accurate wind data.

Calibrate nacelle instrumentation / transfer functions with free stream wind speed measurements and wind direction vs. yaw alignment.

More accurately apply wind sector management and optimise operational limits such as cut-out wind speeds.

Identify and quantify wake losses and provide options for better wake management throughout the wind farm.

Consider site repowering or technology upgrade paths for existing turbines.

Comply with wind-driven grid scheduling for production forecasting purposes.

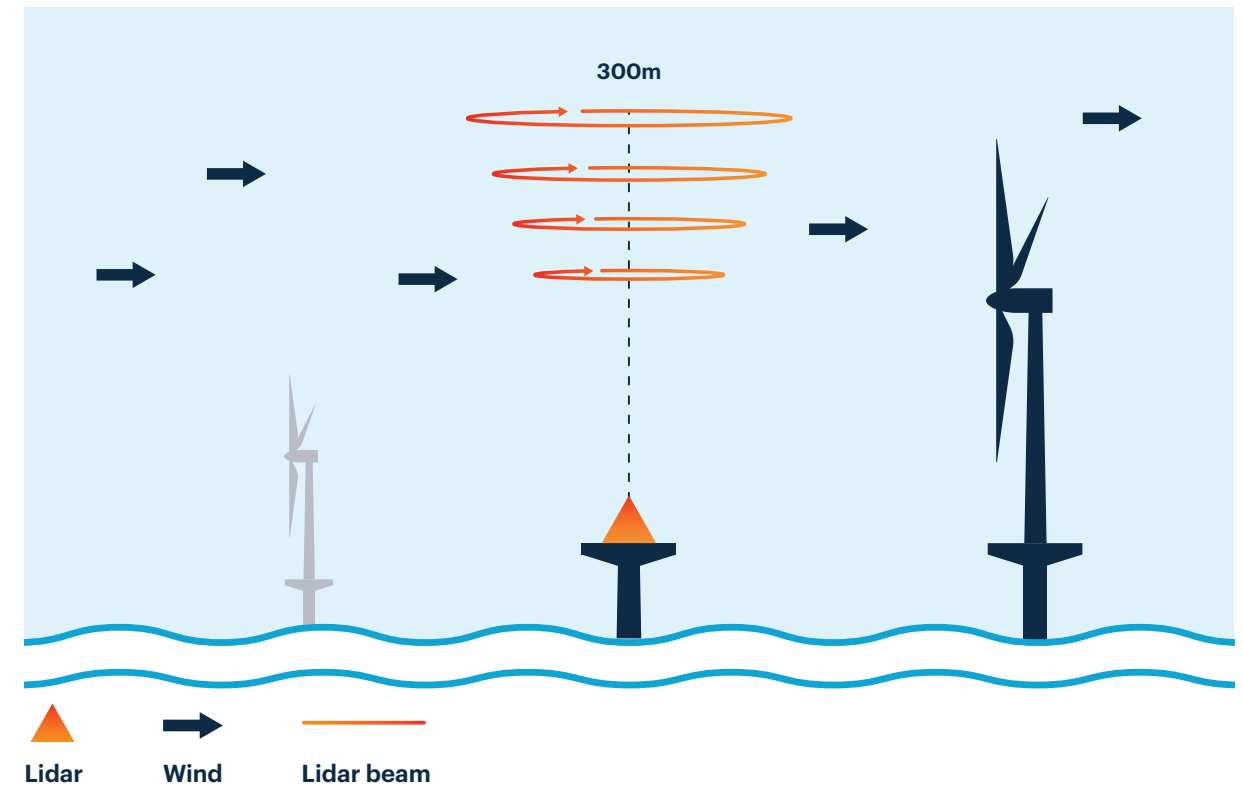
ZX TM has been installed on a Lidar-per-turbine basis to provide site optimisation to wind farm owners. Working in collaboration with site owners, turbine manufacturers and independent wind and economic consultants a Total Wind Farm Optimisation plan can be defined and implemented cost efficiently and with known paybacks.

Offshore wind farm operations

Determine the wind conditions on site to inform accurate decision making during wind farm acceptance, operations and maintenance.



Offshore Permanent Met Lidar



Support an offshore met mast during maintenance or in replacement should the mast need removing.

Remove the need to work at height, actively working towards industry Health & Safety best practice.

Measurements from 10m to 200+m provide correlations to existing anemometry at all heights.

More accurately apply curtailment strategies / wind sector management.

Undertake measurements in the case of either turbine / turbine component or power loss on site in support of any insurance claims.

Improve the accuracy of the forecasting model may be used for energy trading,

access / egress or planned maintenance forecasting used to reduce Waiting on Weather downtime.

With 1-second Quality Controlled data, a live feed from a permanently installed Lidar may be used to inform transport movements, for example helicopter lifts and craning.

With an almost real-time, accurate shear profile, any airborne movements around site can be conducted more efficiently and allow operators to work with a higher level of certainty within their internally approved safety windows for these operations.

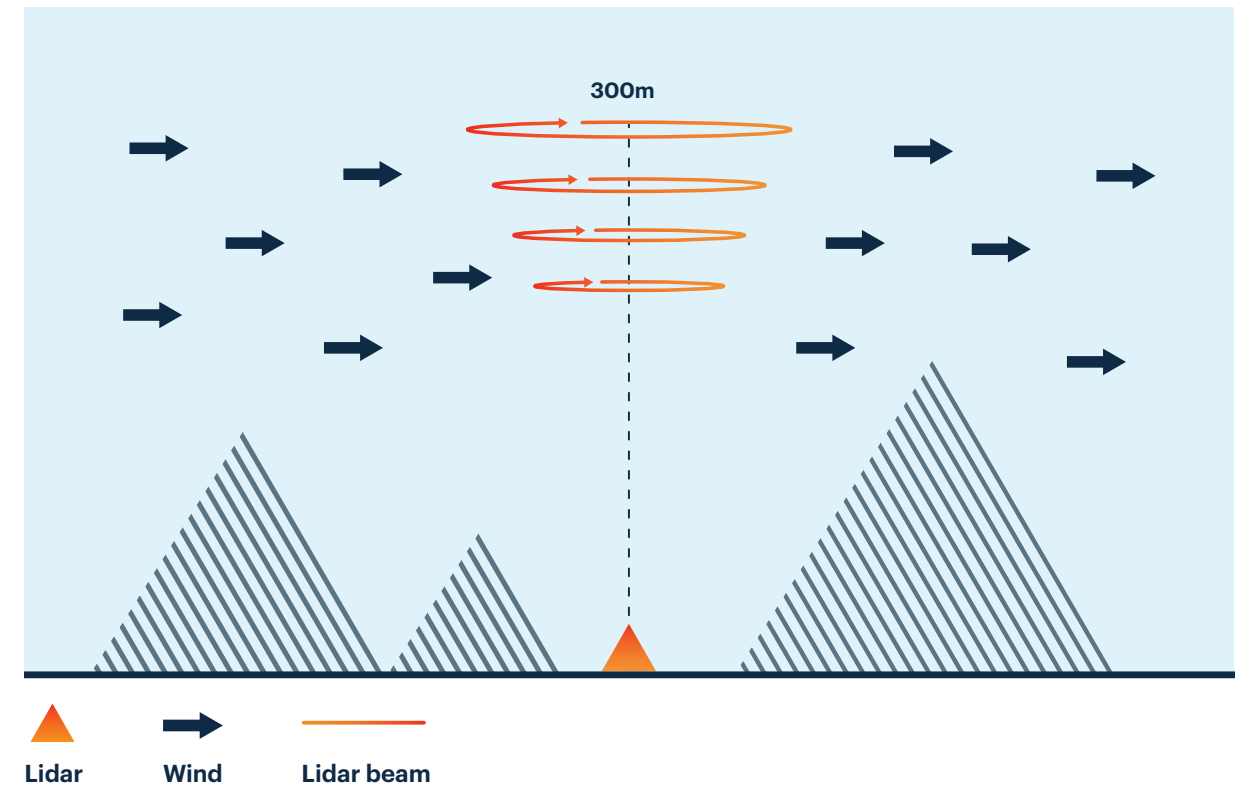
ZX 300M provides low 10m measurements through to tip height and above, and can be SCADA / grid integrated providing a new standard in operational wind measurements.

Environment and weather monitoring

Determine accurate meteorological data from urban and remote sites in order to assist in the development and testing of the site or any installed equipment.



Lidar Weather Station



ZX 300 wind Lidar weather station provides remote autonomous wind speed and direction measurements for all meteorological applications.

Measure wind speed and wind direction remotely with a proven and accurate light detection and ranging system – a Lidar.

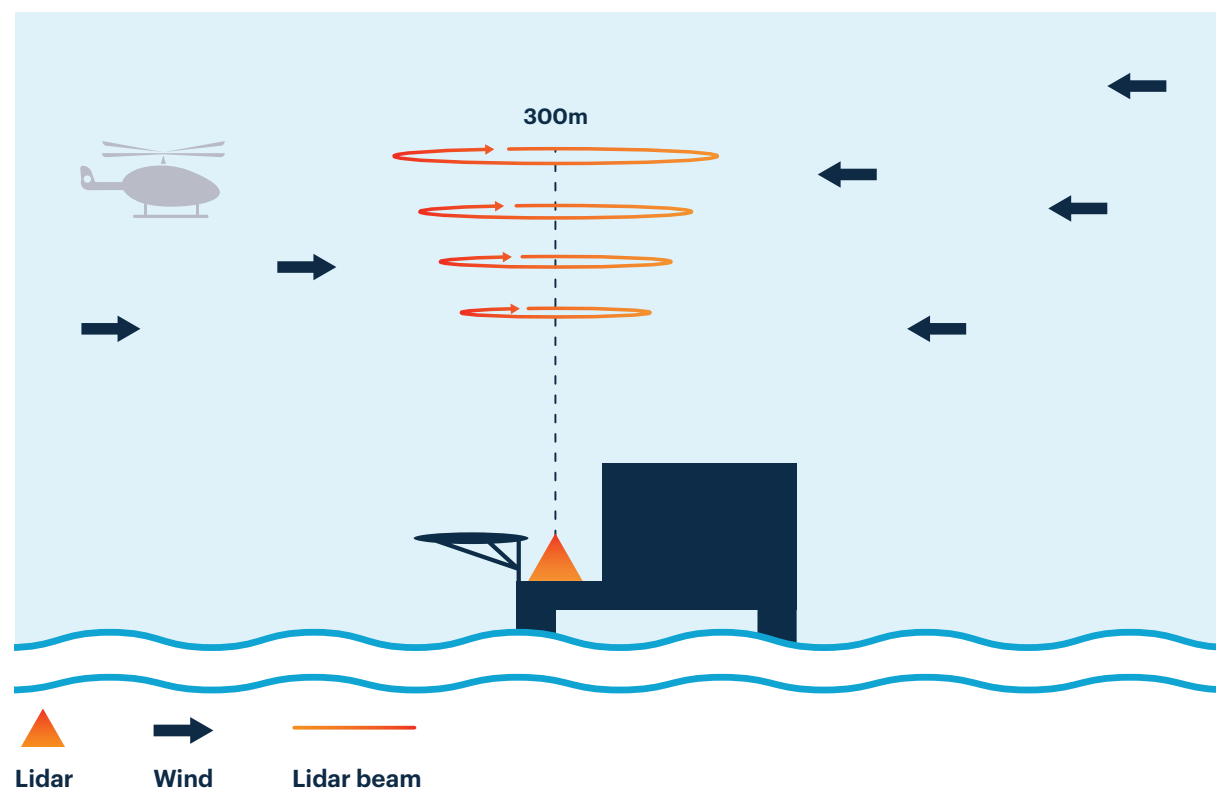
Reduce equipment setup time as ZX 300 can be deployed and measuring wind within just a few minutes.

Calibrated and certified, ZX 300 is traceable to IEC standards for accuracy and repeatability.

Stream real-time wind data from easy to use software installed on your PC.

The ability to quickly and accurately measure the wind allows for a wide range of meteorological applications. ZX 300 has been extensively tested and verified in the strictest of industries – wind energy – where fractions of a percent count.

Offshore platform metocean monitoring



With 1-second QC'd data, a live feed from a permanently installed Lidar may be used to inform transport movements, for example helicopter lifts and craning around site.

With an almost real-time, accurate shear profile any airborne movements around site can be conducted more efficiently. Operators are able to work with a higher level of certainty within their internally approved safety windows for these operations.

Accurate measurement of the vertical profile of wind offshore supports the planning, design, and operations of offshore oil and gas platforms.

Combined with other sensors such as wave radar, a full range of meteorological and oceanographic conditions can be monitored and any effects on platforms quantified.

Extreme events can be monitored and any results fed in to the design of new platforms.

So many uses

So why not try Lidar?

The Use Cases presented here have been tried and tested over the last decade. Lidar users help to inform standards which in turn help to drive change.

New Use Cases are being developed all of the time. Benefits are gained throughout a project lifecycle.

Think about Lidar use from Day 1 of a project. We're confident that value can be gained every day that follows.

ZX Measurement Services

Our background and experience in project development and operation ensures we never lose sight of these key project imperatives. At ZX Measurement Services, we have an underlying and fundamental understanding of the requirements for site measurements and the provision of project data.

Wind Data as a Service

We provide the following extensive field and back office support services:

- Rental of Lidars (all units rented are less than 2 years old at the date of installation).
- Measurement campaign design and optimisation including system security and communications.
- System installation, management, operation and decommissioning including vertical and nacelle-mounted Lidars.
- Power supply design, build, installation, management, rental and sales.
- Training.
- Data management, analysis and reporting.
- Technical customer support.
- Supply and installation of nacelle-mounted Lidars for power performance verification or Power Plant Optimisation (Power Quality Monitoring, yaw error correction and wake mitigation).
- Supply of measurement systems and wind data during project construction including:
 - Wind monitoring during lifting operations.
 - Soil Resistivity Testing.
 - Water Quality Monitoring.

We have a fleet of new Lidars available for long or short term rental campaigns and our rental rates are quite simply the most affordable yet most valuable in the industry.

Our promise to our customers is simple. Excellence in measurements and project data.

Combining ZX Lidars' position as industry leaders in the development and supply of Lidars globally with our experience in the design, application and management of turnkey measurement campaigns offers the unique opportunity for Project Developers, Asset Managers and Owner / Operators to maximise data quality and availability whilst minimising measurement uncertainty and cost.

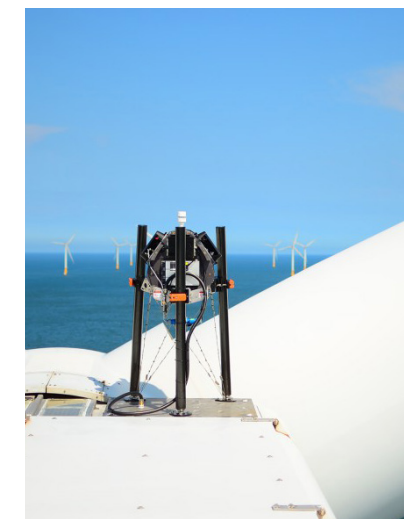
Our customers focus is also our own focus

The availability of high quality data has always been the cornerstone of any energy project. Whether it is wind resource data for the purpose of project development, operational data used in the optimisation of existing power plant or power performance data used in the verification and acceptance testing of existing or newly installed individual turbines, the need for low cost, accurate and reliable measurements has never been more important.

At ZX Measurement Services, our primary focus is the acquisition of the highest quality data with the lowest measurement uncertainty. Our team has over 70 years combined experience in the design, installation and management of measurement systems, ensuring all measurement campaigns are designed and delivered to exactly meet our customers needs whilst optimising new and existing technologies to provide comprehensive data sets.

We only use the best wind monitoring sensors and we supply robust methanol fuel cell based modular remote power supplies, designed and proven to operate in the harshest of environments, all to ensure maximum data availability.

Our focus is always ensuring that projects have the data necessary to succeed.



About us

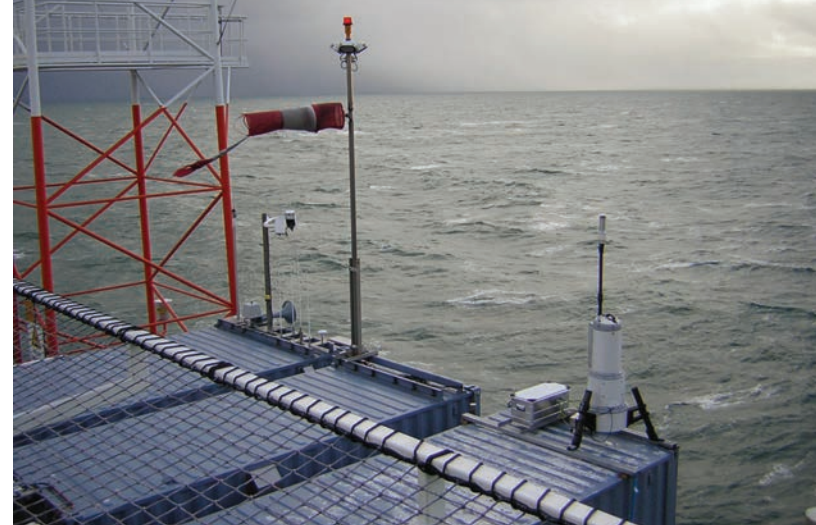
Decades of research into laser applications has been undertaken by many of our team between 1980 and 2000, led by Dr. Michael Harris, our Director of Science. This, combined with the emergence of the commercial telecoms industry resulted in the opportunity for a low-cost Lidar product to remotely sense wind characteristics via measurement of the Doppler shift of light emitted by the Lidar and scattered back from particles in the atmosphere such as dust, moisture and pollen.

Following initial development by the team, Zephir Ltd. was founded in 2007 and our sole shareholder is the UK-based company Fred. Olsen Ltd, founded in 1963 with global outreach. Fred. Olsen-related companies operate across a diverse set of industries, but a backbone of renewable energy industry organisations including consultants, wind farm development, installation vessels and operation & maintenance teams has helped inform and advise our own Lidar organisation.

Our vision statement from the outset is a A Big Hairy Audacious Goal that we all believe in, from the first employee of Zephir Ltd., Ian Locker - our Managing Director - through to each and every member of the ZX Lidars Family:

A wind Lidar on every commercial wind project and integrated into every large wind turbine

- | | | | |
|-------------|--|-------------|--|
| 2003 | World first turbine mounted wind lidar with Nordex | 2014 | Largest batch of single-type lidar verifications against an IEC mast |
| 2004 | The first and original commercially available Lidar for the wind industry - ZephIR is born | 2015 | The first lidar designed specifically for offshore use, with the longest warranty available - 3 years as standard |
| 2005 | The first wind Lidar deployed offshore on a fixed platform | 2016 | The first wind lidar to support safe lifting on a jack-up vessel, and the first wind lidar SCADA integrated on operational wind farms in replacement of site met masts |
| 2007 | The first wind Lidar to take measurements from a turbine spinner | 2017 | The first wind Lidar to be deployed across a whole wind farm on a Lidar-per-turbine basis |
| 2008 | The first wind Lidar to be signed off against an industry-accepted validation process | 2018 | The first wind Lidar to satisfy all criteria for IEC Classification, and ZX Lidars launched, the new trading platform for Zephir Limited |
| 2009 | The first wind Lidar to be deployed offshore on a floating platform | 2019 | The first wind Lidar to be flown on a Drone |
| 2010 | The first wind Lidar to re-finance and re-power a wind farm | 2020 | The first wind Lidar to achieve an independently accepted MEASNET/TR6 methodology for determining the wind potential and energy yield in complex terrain sites |
| 2011 | The first wind Lidar to be proven in a wind tunnel, and ZephIR 300 is launched | 2021 | The first wind Lidar to be fully integrated in to a retrofit turbine controller for wind farm life extension and power increase. |
| 2012 | The first wind Lidar to be used with very short masts and secure project financing | 2022 | Just you wait... |
| 2012 | The first wind lidar to be used with short met masts for project financing, and DNVGL declare ZephIR 'bankable' - the first Lidar to achieve this status | | |
| 2013 | Winners of the Institute of Physics innovation award for wind Lidar | | |



Our company

The originators and innovators of today's wind lidar industry and community

Our home is in the heart of the UK set at the foot of the Malvern Hills in an Area of Outstanding Natural Beauty. A sympathetically developed site includes our Research & Development, Product Development & Engineering, Commercial and Production teams.

Our company highlights and assets include:

- Europe's largest dedicated wind Lidar facility
- Operating the UK Remote Sensing Test Site
- A 'product-first' business, ZX Lidars
- A 'service-first' business, ZX Measurement Services
- 7500+ system deployments in more than 90 countries globally
- 30 million hours of Lidar operation to date

Acceptance

Calibration

Accurate and stable calibration is a crucial requirement for any wind sensor in the wind industry.

ZX Lidars undergo a rigorous process at the UK Wind Lidar Production Centre to calibrate key aspects of the system. The majority of the tests are automated to ensure consistency and remove subjectivity. Finally, each Lidar is operated in the field against a reference Lidar or met mast to verify correct and accurate operation.

Our core Continuous Wave design ensures this calibration is maintained right through to the Lidar's next service, guaranteeing high quality data throughout the deployment. Nothing drifts, nothing shifts and calibration has been proven to remain correct as proven with pre- and post-performance verifications.

The basic line-of-sight velocity measurement is fundamentally very stable, depending only on the laser wavelength and clock frequency of the digital signal processing; these elements combine to contribute <0.1% uncertainty to the speed calibration.

A calibrated moving target is used to characterise the precise laser scan pattern and orient the Lidar axes, providing full confidence in the position of the Lidar beam in space, essential for the derivation of accurate wind data.

The calibration of measurement height / range is carried out with another calibrated moving target located at a precise long-range distance from the Lidar. A closed-loop positioning system ensures the focus height is maintained during field deployment without the need for re-calibration.

Further tests ensure the correct set-up of peripheral tools such as inclination and motion sensors, and visible alignment laser.

The production of hundreds of Lidars for a period of well over a decade provides confidence in the repeatable nature of calibrations. Each Lidar emerging from the factory displays remarkable consistency with the rest of its batch and with our longstanding reference units, both in factory and in field tests.

In addition, our experience with systems returning from demanding long deployments has demonstrated the robustness of the calibration settings – giving full confidence in the validity of the valuable wind data.

Reliability & Resilience

ZX Lidars are provided with extensive warranty, support and service periods - up to 5 years.

We are able to offer these industry-leading packages due to the core reliability and robustness of our Lidar systems. While we know that the actual cost of Lidar servicing is not high, the cost of recovering Lidars from remote locations and the opportunity cost when they are not in the field providing data are of far more significance.

The benefit? The lowest through-life cost of Lidar ownership.

The key elements of ZX Lidars that ensure this robustness are:

We use a Continuous Wave (CW) laser which means we do not have to use a pulsed wave to achieve its purpose and therefore do not rely on complicated laser charging or timing circuitry and electronics. Avoiding complex designs was a large contributing factor in choosing CW, as it provides high reliability for long periods of autonomous and remote operation.

We use robust, appropriately designed and specified moving mechanical components to provide the industry's longest Lidar service life.

ZX Lidars feature a Class 1, Eye-safe Laser - the laser unit meets Telcordia reliability requirements, designed to satisfy the stringent demands of the telecommunications industry, and delivers the highest possible laser safety – 'true' Class 1.

ZX Lidars scan the laser beam to obtain up to 50 line of sight measurements every second - it's like having 50 steerable Lidar beams: the scanner used to achieve this features a bearing system matched to the specific application of Lidar. Mean Time Before Failure (MTBF) analysis confirms that the expected lifetime far exceeds 10 years of continuous operation. Accelerated Life Tests (ALT) and continued infield operation have proven the theory.

ZX Lidars keep the small window surface area clean by utilising a marine-grade wiper with silicone wiper blade for extended lifetime operation, combined with protection circuitry for situations where the wiper may become frozen to the screen after long periods of dormancy. ALT tests demonstrate the equivalent of 7.5 years wiper operation set against 30% rainfall throughout that period.

ZX Lidars focus the laser beam to ensure the highest and constant sensitivity and therefore availability at all measurement heights and all environmental conditions. The focus is achieved by using a voicecoil system that exceeds the defined lifetime requirements, as confirmed in ALT studies.

ZX Lidars are CE Marked, and we are audited and found to meet the requirements of standard ISO 9001:2015 Quality Management System (UK), and conform to all BS / EU safety and associated regulations.



Classification

Ground-based vertical profiling wind Lidar ZX 300 successfully meets the full conditions for satisfying Classification to IEC 61400-12-1: 2017 Ed. 2 standard.

Before release of the Edition 2 standard in March 2017, we had been preparing our classification campaigns and the results released demonstrate industry-leading compliance, highlighting the highest accuracy of our vertical profiling Lidar with very low uncertainties on measurement data.

The IEC standard involves the Classification of a remote sensing device type by assessing the accuracy of that device in the context of the environmental conditions experienced from two separate test sites. The same unit is deployed at each site over a period of three months or more and an additional unit is also deployed at one of the same test sites.

The results feature campaigns from a DNV GL Remote Sensing Test Site, in addition to the UK Remote Sensing Test Site which is also assessed for IEC compliance by DNV GL.

Test Results

Classification of ZX 300 covers deployments in Autumn, Winter and Spring 2017 through to early 2018 meaning a wide range of environmental conditions have been experienced. The environmental variables considered in the classification included: Air Density; Local Shear Coefficient; Pressure; Rain; Temperature; Temperature Gradient; Turbulence Intensity; Veer Coefficient; Wind Direction.

By way of summary, accuracy classes of 0.3 to 2.8 were calculated for ZX 300. As an example, an accuracy class of 1.5 represents a standard uncertainty of just 0.8%. The accuracy classes and standard uncertainties quoted here are the maximum values that could be applied due to differences in environmental conditions between the verification test and the application of the Lidar. In practice, these differences are likely to be much smaller than the ranges considered during classification.

In addition to this classification work, more than 300 Lidar Performance Verifications have been conducted to date demonstrating repeatability in achieving these very low uncertainties.

ZX 300 is an accepted technology for inclusion in the wide variety of wind campaigns and applications including resource assessment, site calibration and power curve measurements.

Verification

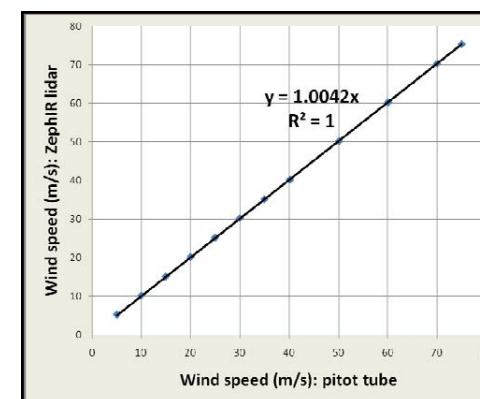
ZX Lidars have been verified in absolute terms at national wind tunnel facilities, at remote sensing test sites, and against tall met masts.

Whilst the ‘volume’ measurement technique of a remote sensing device are different to that of a cup anemometer or pitot tube ‘point’ measurement, ZX Lidars are capable of providing near perfect comparison results.

The benefit? ZX Lidars carry the most extensive body of verification spanning more than 20 years in the wind industry which provides the necessary confidence to consultants, lenders and turbine manufacturers in the use of measured wind data.

As part of a Danish National Advanced Technology Foundation (DNATF) project with the Danish Technical University (formerly Risø) and global manufacturer of wind turbine blades, LM Wind Power, a ZX Lidars device was evaluated in a calibrated wind tunnel.

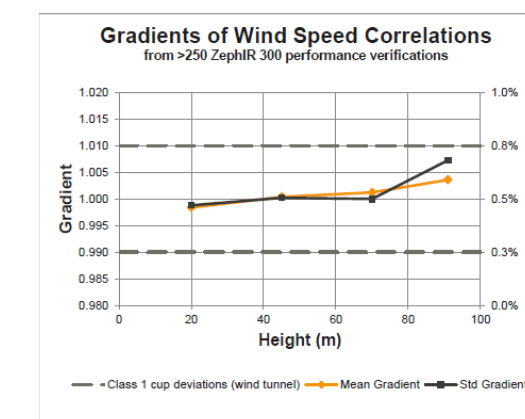
Our Lidar successfully measured wind speeds from 5 m/s to 75 m/s with an averaged difference of just 0.4% for a sustained period of time and across all measured speeds. To the company’s knowledge, these are the first and only reported tests in the world to accurately demonstrate the absolute performance of a Lidar.



More than 500 Performance Verifications have been undertaken of ZX Lidars at the UK Remote Sensing Test Site. The combined results demonstrate repeatable excellence in performance.

Combined results from >250 ZephIR 300 performance verifications					
Height (m)	Gradient		R ²		
	Mean	Std Dev	Mean	Std Dev	R ²
91	1.004	0.007	0.989	0.005	
70	1.001	0.005	0.992	0.004	
45	1.000	0.005	0.992	0.005	
20	0.998	0.005	0.992	0.004	

Further, the difference between ZX Lidars devices has been seen to be extremely minimal showing consistency in performance.



Wind Lidar from green fields



to blue oceans.



**Your Lidar adventure starts today
by speaking to ZX Lidars.**

Email sales@zxlidars.com

Call +44 (0) 1531 651 000

Web ZXLidars.com

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ZX Lidars is a registered trademark of Zephir Ltd.
Our Registered Office is The Greenhouse, Dalry, Castle Douglas, DG7 3XS, UK.
Registered No. SC317594. VAT No. GB243692648

The logo for ZX Lidars, featuring a stylized 'ZX' symbol composed of three parallel diagonal lines in orange and dark blue, followed by the word 'Lidars' in a bold, dark blue sans-serif font.