



FOWIND (Facilitating Offshore Wind in India) is a European Union funded project, led by Global Wind Energy Council (GWEC), which promotes offshore wind power to facilitate India's transition towards a low carbon energy future.

MeteoPole is a France-based consulting firm – with Indian office in Hyderabad - providing services at each stage of wind farm project development. It focuses on reducing financial risks through a range of advanced technologies : from LiDAR measurements to cloud-based wind simulations (ZephyrCloud). **CSTEP** on behalf of FOWIND project consortium, has appointed MeteoPole as the official LiDAR supplier.

The WindCube v2 Offshore : the Best-in-Class Solution for Offshore Wind Resource Assessment.

As part of FOWIND project, a measurement campaign is expected to be performed in Gujarat to assess the offshore potential. The WindCube LiDAR has been chosen as the most suitable solution in terms of device performance and cost-effectiveness. Indeed, being ultra-portable, it enables simple installation on any stable platform and it shows very good accuracy and data availability.

The 5th of May 2016: Demonstration at NIWE Office in Chennai

On the 5th of May 2016, MeteoPole performed a demonstration of the device utilization at the National Institute of Wind Energy (NIWE) office in Chennai. NIWE is FOWIND's Knowledge Partner. It included a presentation of the WindCube working principle, the installation steps and the safety recommendations. The device was also installed and configured to show the first results. The LiDAR has been handed over to NIWE for further FOWIND activities.



Installation and configuration of the WindCube



Demonstration and observation of the first results

WINDCUBE KEY FEATURES

Measurements	Measurement Heights	12 configurable height of measurements from 40m to 200m
	Speed and Direction Accuracy	Speed: ± 0.1 m/s. Direction: $\pm 2^\circ$
Data	Sampling frequency	1 Hz.
	Output Data	1s/10 min horizontal, vertical wind speed and direction at each height, min & max wind speed, standard deviation, Carrier to Noise Ratio, Data availability, GPS coordinates.
Transportation	Weight and Size	45kg, L-W-H: 543x552x540 mm
Software	Features	Remote or local configuration and control, real-time display, diagnostic

MAIN APPLICATIONS

- ✓ Site prospecting and assessment
- ✓ Optimization of P75 & P90 values (reduce uncertainties – horizontal and vertical uncertainties)
- ✓ Site suitability assessment
- ✓ Power Curve Measurement



The 18th of May 2016: Validation of the WindCube Performance

Context: As a first step before the offshore deployment, it has been decided that NIWE will lead the validation process to check the WindCube performance and accuracy. This is the first WindCube LiDAR validation conducted in India. This is a key step but also a good opportunity to showcase the LiDAR performance on a well-known site in India.

The Validation Period: The WindCube observed data will be compared to the measurements of a 120-meter met mast located in NIWE's test site at Kayathar in Tuticorin District, Tamil Nadu. On the 18th of May 2016, the WindCube LiDAR commissioning was performed on-site. This validation phase will validate the WindCube accuracy through the comparison of 10-minute average wind speed and direction as well as the performance of the WindCube in terms of data availability. This first campaign also provides the opportunity to try out the WindCube set up (Power supply, remote access and control) before offshore deployment.

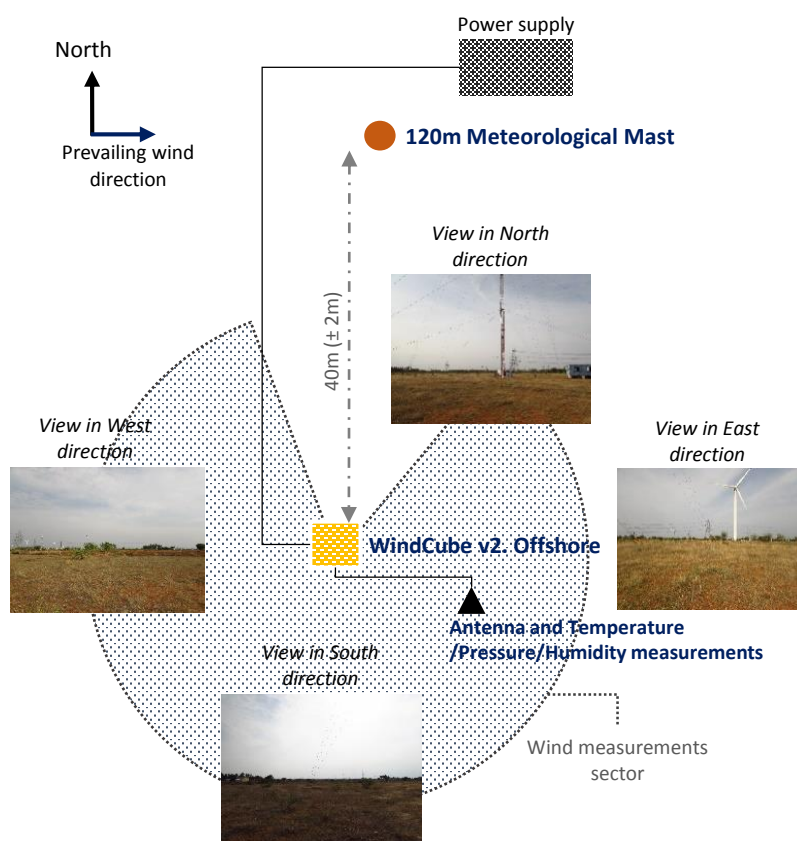


NIWE's Kayathar site (WTTTS/WTRS)



Commissioning of the WindCube

INSTALLATION SET UP



VALIDATION KEY FACTS

Terrain Conditions	Flat terrain, low vegetation.
Wind Features	Wind mostly coming from West direction in May-June (no met mast shadow effect).
WindCube Set Up	Measurement height : 40m, 60m, 90m, 100m, 120m, 140m, 160m, 180m, 200m.
Output	10-minute average wind speed and direction, 10-min average temperature, pressure and relative humidity, data availability.
Installation Duration	2-3 hours.
Validation Duration	1 month – 20/05/2016 to 21/06/2016.

VALIDATION PROCESS

Installation: The WindCube was positioned 40m away from the met mast, south of the met mast. The prevailing wind direction on this site is West so the met mast has no influence on wind characteristics measured at LiDAR location.

Data Processing: All wind speeds below 4m/s and above 20m/s are removed from the dataset. The dataset is considered to be complete once 600 data points will be collected, including 200 points for wind speeds between 4 and 8 m/s at 120m, and 200 points for wind speeds between 8 and 20 m/s at 40m. The 10-minute average wind speed and direction of the WindCube and the Met Mast at 60m, 90m and 120m will be compared.



End of June 2016: Expected Results from the Validation Period

Data Analysis: Based on recommendations from DNV GL (FOWIND Technical Lead), the National Institute of Wind Energy and previous studies performed by MeteoPole, the acceptance criteria were chosen as reference to evaluate the WindCube performance and accuracy. The 10-minute average wind speed and direction will be compared using a linear regression model $y=ax+b$, y being the WindCube data, x the Met Mast data, a the slope and b the offset. Other key values will be evaluated:

- The *Average Wind Speed Deviation* which is the average difference between the WindCube 10-min wind speeds and the Met Mast wind speeds at each height.
- The *Wind Speed Standard Deviation of Deviation* which quantifies the dispersion of the previous error.
- The *Data Availability* which represents the ratio between the number of measurements done and the maximum number of possible measurements.

Acceptance Criteria:

Wind Speed – Linear Regression	Slope a	Should be equal to 1 ± 0.02
	Offset b	Should be equal to 0 ± 0.2 m/s
	R ²	Should be greater than 0.97
Wind direction – Linear Regression	Slope a	Should be equal to 1 ± 0.02
	Offset b	Should be equal to $0 \pm 5^\circ$
	R ²	Should be greater than 0.97

Average Wind Speed Standard Deviation	Should not exceed ± 0.2 m/s
Wind Speed Standard Deviation of Deviation	Should not exceed ± 0.15 m/s
Data Availability	Should reach 100% during 80% of the validation period.

Next Step: the Offshore Deployment

The WindCube will be transported for final installation at the identified offshore site by FOWIND. All data generated under this study is the property of the FOWIND Consortium.

CONTACT FOR FURTHER INFORMATION

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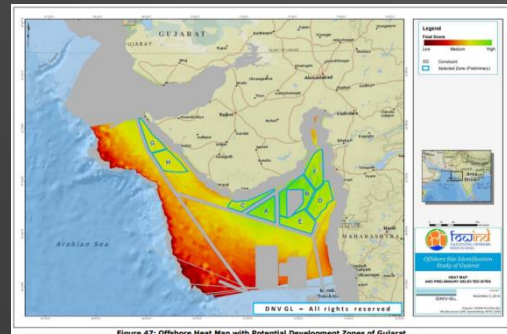


Figure 47: Offshore Heat Map with Potential Development Zones of Gujarat

Offshore deployment zone in Gujarat :
Source: FOWIND Pre-feasibility Reports



View of the 120m Met Mast