The Offshore Boundary Layer Observatory (OBLO)

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Background

During the last decade, the number of installed offshore wind turbines has increased significantly. In the coming years, 30% of all new wind turbine installations are expected to be offshore. The European Wind Energy Association (EWEA) forecast 40 GW of installed offshore wind capacity by the end of 2020. Despite the huge increase of offshore installations, the environmental and meteorological conditions in which these turbines operate are not always well understood. Model studies such as Sullivan et al. (2008) and Nilsson et al. (2012) have shown that the interaction between ocean and the atmosphere lead to increased turbulence in the lower 200 m of the Marine Atmospheric Boundary Layer (MABL), thus increasing loads and fatigue on turbines rotor blades. To increase the understanding of the physical processes within the MABL and their interactions with offshore wind turbines, the Norwegian research centres NORCOWE and NOWITECH collaborate on the RCN founded NOWERI (Norwegian Offshore Wind Energy Research Infrastructure) project. One of the major aims of NOWERI is the realization of an Offshore Boundary Layer Observatory (OBLO), which is intended to provide and operate state-of-the-art instrumentation and measurement capabilities for a wide range of atmospheric and oceanographic parameters relevant for offshore wind energy application. This poster presents newly purchased instrumentation that will become available for both public and private research institutions dealing within wind energy.

Wind profile

1 x LiDAR WindCube V1

Scanning range:40 – 200 m
Range resolution: 20 m, 10 altitudes
Data accumulation time: 1 s
Power supply: 230 V AC or 27 V DC
Weight: 60 Kg

2 x 3D scanning LiDAR - WindCube 100S

Scanning range: 3500 m
Range resolution: 100 m, 240 user programmable range gates

Azimuth range: 0 to 360 deg
Elevation range: -10 to 190 deg
Data accumulation time 0.5 - 10 s
Power supply: 110 - 240 V AC or 24 V DC
Weight: 232 kg

One additional WindCube 100S is available through NORCOWE.

1 x LiDAR ZephIR Z300

Scanning range: 100 - 300 m
Range resolution: 10 heights
Data accumulation time: 1 s
Power supply: 100 - 250 V AC or 12 V DC
Weight: 63 kg

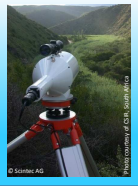
1 x SODAR with WindRass extension (Scintec – MFAS)

SODAR:
Scanning range:30 – 1000 m
Range resolution: 10 m, 100 range gates
Data accumulation time: 1 to 60 min

WindRass (wind and temperature)
Scanning range:40 – 800 m
Range resolution: 10 m
Data accumulation time: 1 to 60 min

Power supply: 100 - 240 V AC or 12 - 14 V DC
Weight: > 190 Kg

Turbulent fluxes



1 x Scintec Scintillometer BLS900

Provides information on turbulent heat and momentum fluxes and cross winds over a given path length.

Path length: 500 – 6000 m.
Data accumulation time: 1 to 60 min
Power supply: 12 V DC
Weight: 23 Kg

Temperature & Humidity

2 x Passive Microwave Radiometer

Provides both horizontal and vertical profiles of temperature and humidity and thus information on atmospheric stability.

Scanning range: 1000 m
Range resolution: 50 m for temperature,
100 m for humidity

Elevation range: 0 – 90 deg
Azimuth range 0 – 360 deg. (optional)
Data accumulation time: > 1 s, user defined
Power supply: 110 - 240 V AC or 24 V DC
Weight: 60 kg

Oceanographic measurements

1 x Fugro Oceanor Wavescan buoy

Recorded atmospheric parameters at 3.5 masl :
Wind speed, air temperature, humidity, precipitation and solar radiation.
Can be equipped with the NORCOWE Direct Covariance Flux system for investigation of the turbulent air-sea momentum and heat exchange fluxes.

Recorded oceanographic parameters:
Directional wave measurements, current velocity and direction, water temperature, salinity, current profile and CTD profile

Operation time > 1 month
Power supply: lead acid and Lithium batteries, solar panels

2 x Bottom Lander

A bottom mounted tripod frame which can be equipped with several sensors for measurement of sea currents, surface waves and upper layer momentum exchange and turbulence intensity.

Dimensions: 3.5 m diameter, 2.6 m height
Frame weight: 200 Kg
Anchor weights: 3 x 100 Kg

Planned: 1 x (submerged) elliptic buoy

A submerged underwater flotation element which can be equipped with an upward looking current profiler (AD2CP) for sampling of momentum exchange and turbulence intensity in the upper ocean layers.

Dimensions: 1 m diameter, 0.5 m height
Mooring weight: 200 Kg
Anchor weight: 400 Kg

Infrastructure access

The presented instrumentation is available for public and private research institutions dealing with wind energy. The OBLO project offers services for planning and execution of field deployments and post-analysis of the gathered data through the University of Bergen and Christian Michelsen Research AS.

For more information and access to the infrastructure, please contact Joachim.Reuder@gfi.uib.no, University of Bergen or Martin.Flugge@cmr.no , Christian Michelsen Research AS.

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References:

Sullivan et al, 2008: Large-eddy simulations and observations of atmospheric marine boundary layers above nonequilibrium surface waves. J. Atmos. Sci., 65(4), 1225-1245

Nilsson et al, 2012: Convective boundary-layer structure in the presence of wind-following swell. Q. J. ROY. METEOR. SOC., 138(667), 1476-1489