

Availability of the OBLO infrastructure for wind energy research in Norway

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Christian Michelsen Research



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Norwegian Centre for Offshore Wind Energy

Background

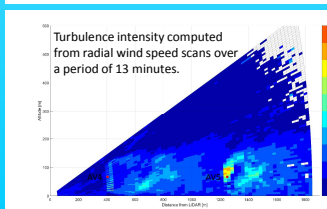
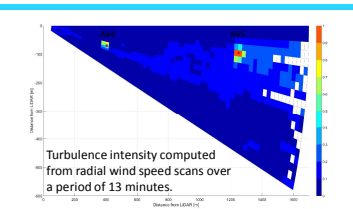
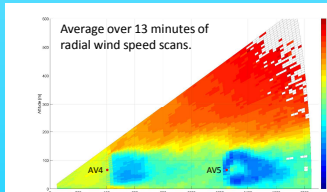
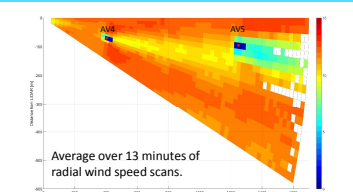
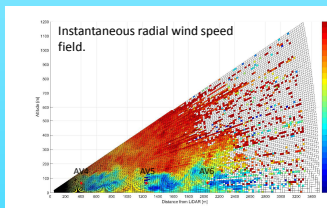
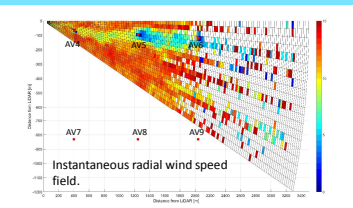
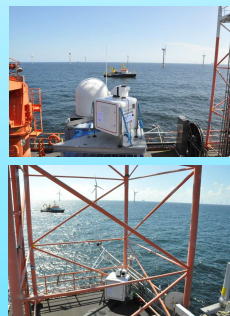
The Offshore Boundary-Layer Observatory (OBLO) infrastructure is part of the Research Council of Norway founded NOWERI (Norwegian Offshore Wind Energy Research) project, which is intended to provide and operate state-of-the-art instrumentation and measurement capabilities for a wide range of atmospheric and oceanographic parameters relevant for offshore wind energy applications. The objective of the OBLO project is to increase the knowledge and understanding of the physical processes relevant for offshore wind energy, such as wind turbine wakes and their interactions with the boundary-layer, atmospheric stability, vertical wind profile relationships and turbulence parameter estimations. The infrastructure is available for public and private research institutions dealing with wind energy in Norway. Between May 2015 – September 2016, instruments of the OBLO infrastructure were deployed at the German wind energy research platform FINO1 during the Norwegian Centre for Offshore Wind Energy (NORCOWE) Offshore Boundary-Layer Experiment (OBLEX-F1). Usage of the OBLO instrumentation allowed NORCOWE scientists to collect a unique data set including both atmospheric and oceanographic measurements. This poster presents some of the OBLO infrastructure and its application at FINO1 during the OBLEX-F1 field campaign.



Meteorological OBLO instrumentation deployed at the German research platform FINO1 in the North Sea.

Radial wind speed measurements

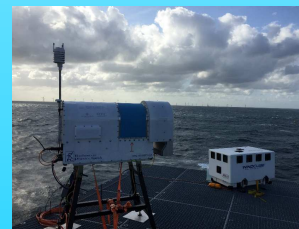
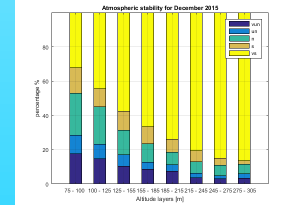
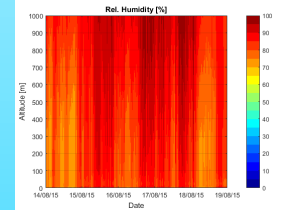
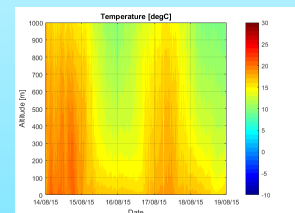
The OBLO portfolio includes two WindCubes100s systems. One additional WindCube100s system is available through Christian Michelsen Research AS. The LiDARs have a scan range of up to 3000 m and a longitudinal resolution of 25 m. The WindCube100s is able to record the radial wind speed over the azimuth range $[0^\circ \ 360^\circ]$ and elevation range $[-10^\circ \ 190^\circ]$. During the OBLEX-F1 campaign, the two LiDAR systems performed both stand alone and combined scans in order to investigate wind turbine wake effects, wake turbulence and wake extensions.



Example of Plan Position Indicator (left column) and Range Height Indicator (right column) scan scenarios directed towards the AV 4 and AV5 wind turbines (denoted by the red dots).

Passive microwave measurements

Two RPG HATPRO-R4 passive microwave radiometers are available through the OBLO project. A passive microwave radiometer measures atmospheric radiation in the K-band and V-band and transforms this information into vertical profiles of temperature and humidity. The accuracy of the temperature measurements with this instrument is comparable to measurements from meteorological masts. Measurements of the absolute humidity are reasonable comparable to mast measurements. Combining the data from the radiometer and the LiDAR systems provides information on the atmospheric stability and boundary-layer height. During the OBLEX-F1 campaign, it was the first time that such an instrument was deployed in the vicinity of an offshore wind farm.

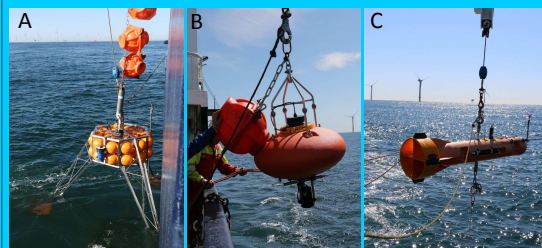


Passive microwave radiometer deployed at FINO1, next to a WindCube V1.

Example of Hovmöller diagrams for temperature (upper panel) and relative humidity (middle panel), and computed atmospheric stability (lower panel).

Oceanographic equipment

The OBLO project also offers access to oceanographic equipment which provides information on the current profile and surface wave field. Such measurements are highly required to quantify the impact of the wave field on the vertical wind profile, and can also contribute to estimate sediment transport around wind turbine foundations. The portfolio for the oceanographic equipment includes one Fugro Oceanor Wavescan buoy, two (sea) bottom frames, two Acoustic Doppler Velocimeters (ADV) and two advanced 5-beam Acoustic Doppler Current Profilers (AD2CP). Additionally, a submersible buoy at which oceanographic instruments can be mounted is available through the University of Bergen.



Oceanographic equipment deployed during OBLEX-F1 to collect data on the wave field and current profile for air-sea interaction studies. A) bottom frame, B) submersible buoy equipped with AD2CP and C) submersible buoy equipped with ADV and shear-probes.

Infrastructure access

As national infrastructure, the OBLO instrumentation is in general available for public and private research institutions dealing with wind energy in Norway. Applications for the use of the instrumentation will be prioritized after the following criteria:

- NORCOWE/NOWITECH partners (fully open projects)
- NORCOWE/NOWITECH partners (closed/partly closed projects)
- Others with data sharing agreements
- Others without data sharing agreements

It is expected that the pricing for the various user groups also will be reflected by this prioritization.

A complete list of available OBLO instrumentation can be found at <http://oblo.uib.no>.

The OBLO project also 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@uib.no, University of Bergen or Martin.Flugge@cmr.no, Christian Michelsen Research AS.