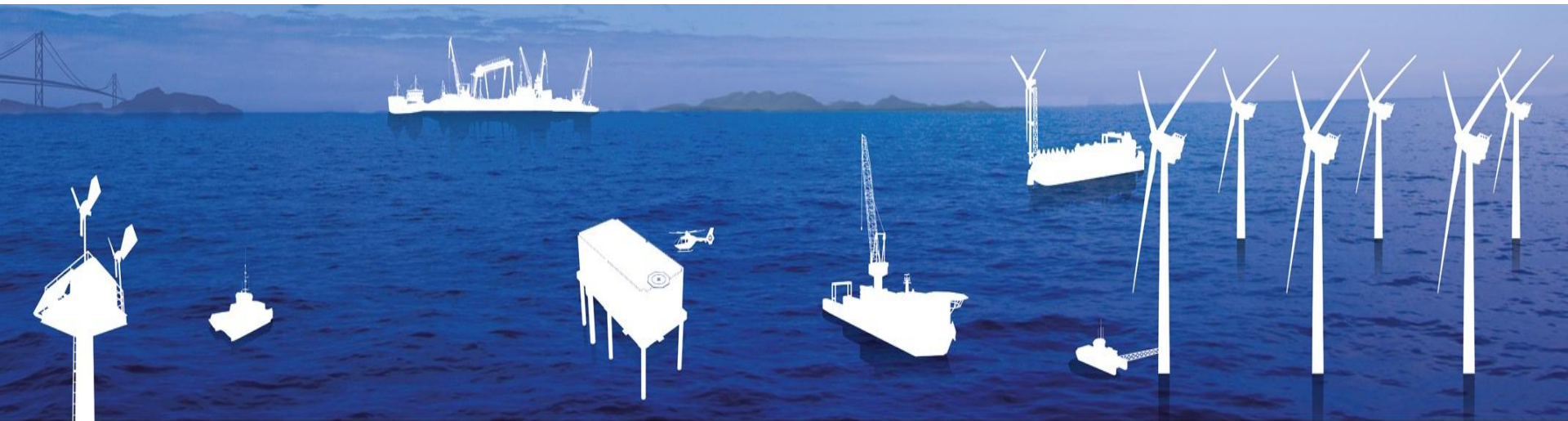




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Babcock FORECAST

Babcock International Group

The Leading Engineering Support Services Company

We take real
responsibility for
delivering outcomes

Managing Assets and Infrastructure

and assure those
outcomes through
process excellence

Delivering Projects and Programmes

by bringing together
leading-edge skills

Integrating Engineering Expertise



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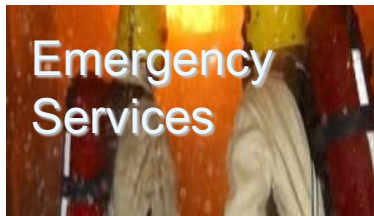
The UK's leading engineering support services company

FTSE 100

- ❖ Market cap. £4.4bn
- ❖ £3.25bn revenue in 2013
- ❖ **£12bn order book**

Managing customer assets worth **c. £42bn**

27,000 skilled employees worldwide



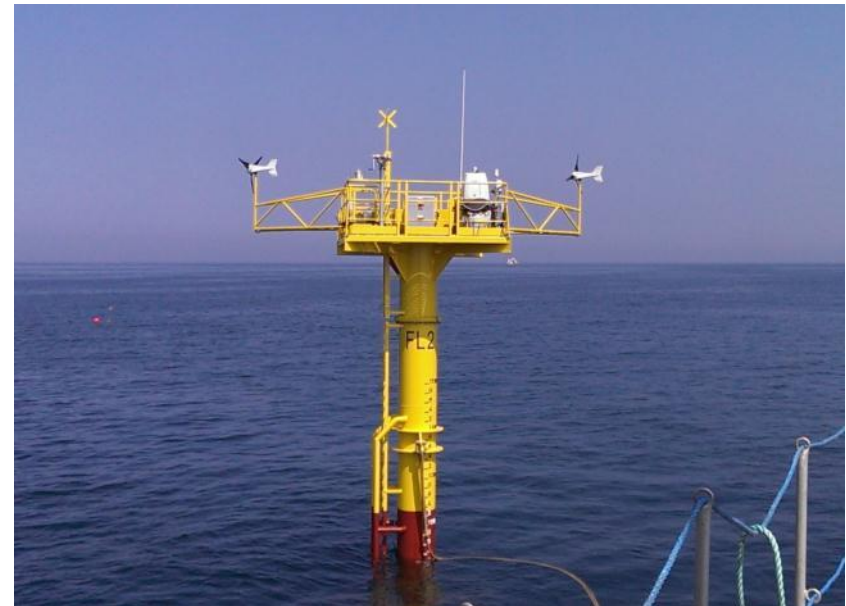
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FORECAST Overview

Key Features

- Inherently stable platform
- Industry leading ZephIR 300 LiDAR unit
- No mechanical compensation or data post processing required – reduced uncertainty
- Safe and easy access for maintenance etc
- Easily repositioned
- Elevated platform – improves survivability and marine safety
- N-2 redundant mooring system



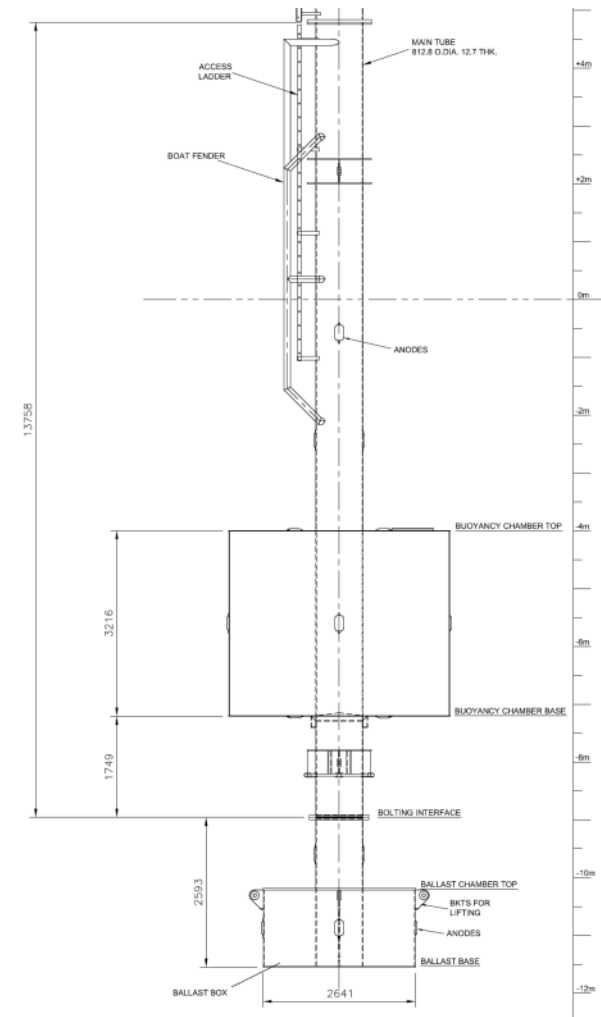
Buoy Design

Low Motion Buoy

- Inherently stable, shallow draft spar buoy
- Low pitch, roll and heave
- Modular design

Three main sections

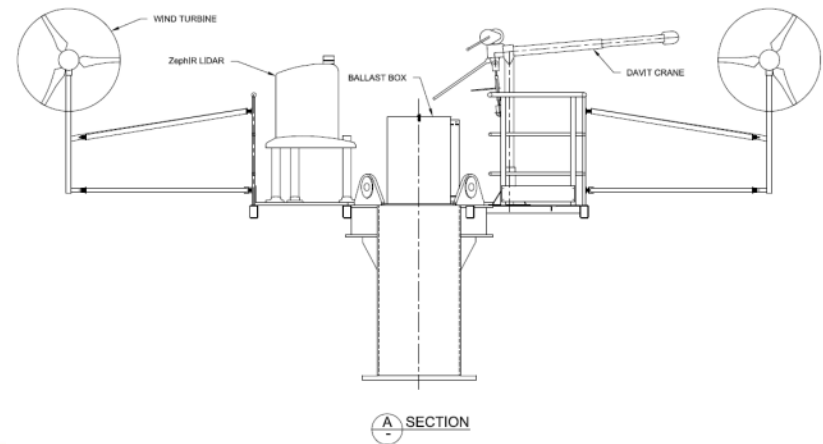
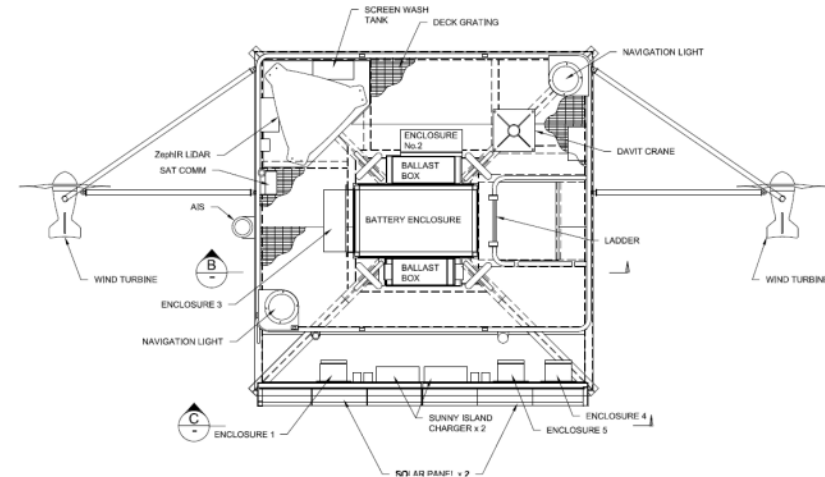
- Main Tube – 812mm OD Pipe
- Buoyancy Tank – 3800mm Ø tank with internal stiffeners
- Ballast Tank – 2600mm Ø tank filled with high density concrete



Platform Design

Platform

- 3.2m x 3.2m platform housing all systems
- Wind turbines mounted on outriggers
- GRP gratings provide walkway
- Main lifting points for whole buoy
- Access from ladder below
- Handrails all around



Systems On Board - Measurement

- ZephIR 300 LiDAR measuring:
 - Wind speed and direction at a number of heights
 - Turbulence intensity at each height
 - Temperature, pressure, humidity and rain
- 10m Met Station
 - Separate met station sited approximately 10m above MSL
 - Sonic Anemometer measuring wind speed, direction and Monin Obukhov length if required
 - Temperature, pressure and relative humidity sensors
- DGPS Compass
 - Accurately records bearing of buoy
 - Also reports pitch, roll and GPS coordinates



Systems On Board - Power

- 2 x Micro Wind Turbines
 - Pitch controlled blades for performance and survivability
 - Independently controlled and regulated for redundancy
- 2 x Solar PV Panels
 - South facing reliable monocrystalline panels
 - Independently controlled and regulated
- 2 x Battery Banks
 - >7 days of reserve power
 - Providing redundancy and maintenance during system operation
 - Additional emergency battery for nav aids only, ~14 days
- Methanol Fuel Cell Option
 - Optional fuel cell providing up to 20 days additional redundancy
 - Ideal for far shore deployments to allow additional repair time



Systems On Board – Data Capture

- Centralised Data Logger
 - Collects all data and provides “plug and play” option for other sensors
- Redundant Communications Link
 - GSM and Satcom link with auto switching
- Data Access
 - Daily emails or uploads with remote access as required
 - Wireless connection to ZephIR possible within ~50m
- System Status Monitoring
 - ZephIR status: wiper, voltage, temperature, fans on, heater on etc
 - Power Status: generator power (each source), battery voltage (each bank)
 - Alarms: gate opened, drift radius exceeded

Systems On Board – Nav Aids

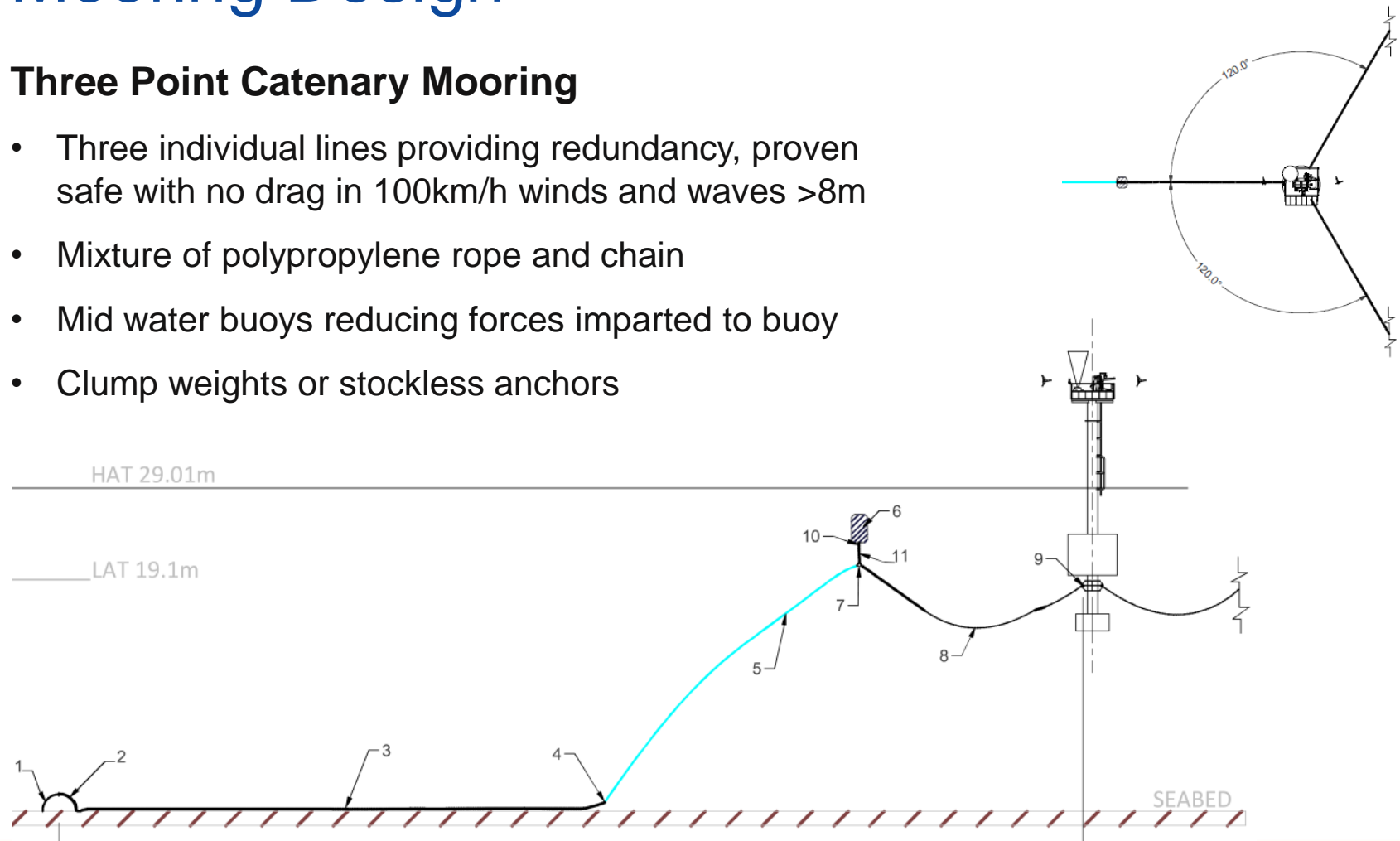
- Navigation Lanterns
 - 2 synchronised LED navigational lanterns providing redundancy and excellent all round visibility
 - Normally yellow with 2nm visibility, other colours possible
 - Auto switch on at dusk
- AIS AtoN
 - Automatic Identification System Aid to Navigation
 - Reports exact position to marine traffic every 3 minutes
 - Provides additional method of tracking position



Mooring Design

Three Point Catenary Mooring

- Three individual lines providing redundancy, proven safe with no drag in 100km/h winds and waves >8m
- Mixture of polypropylene rope and chain
- Mid water buoys reducing forces imparted to buoy
- Clump weights or stockless anchors



Fabrication & Installation

Fabrication

- Modular build allowing simultaneous fit out
- 12-14 week build time for new build
- All major commissioning done on shore

Installation

- Towed to position using small tug / workcat
- Moorings deployed in advance
- Systems checked and commissioned
- Installation time 1-2 days (weather dependent)



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Operation and Maintenance

Maintenance

- Design maintenance intervals of 6 months
- Routine maintenance includes:
 - Screen wash top up
 - Structural condition inspection
 - Systems condition inspection
 - Equipment wash down

Access

- Stable platform provides safe working environment
- Accessed via fendered ladder
- Small vessel used for transport
- Access weather limit of c1.5m significant wave height



Carbon Trust OWA Validation – Gwynt Y Mor

- Validation on Gwynt Y Mor under the Carbon Trust OWA programme
- Key Criteria measured against fixed met mast
 - Wind Speed Accuracy
 - Wind Direction Accuracy
 - System and Data Availability
- Frazer Nash Consultants conduct data validation, verified by GL Garrad Hassan

OWA Partners:



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Gwynt Y Mor Trial – Accuracy Results

Wind Speed

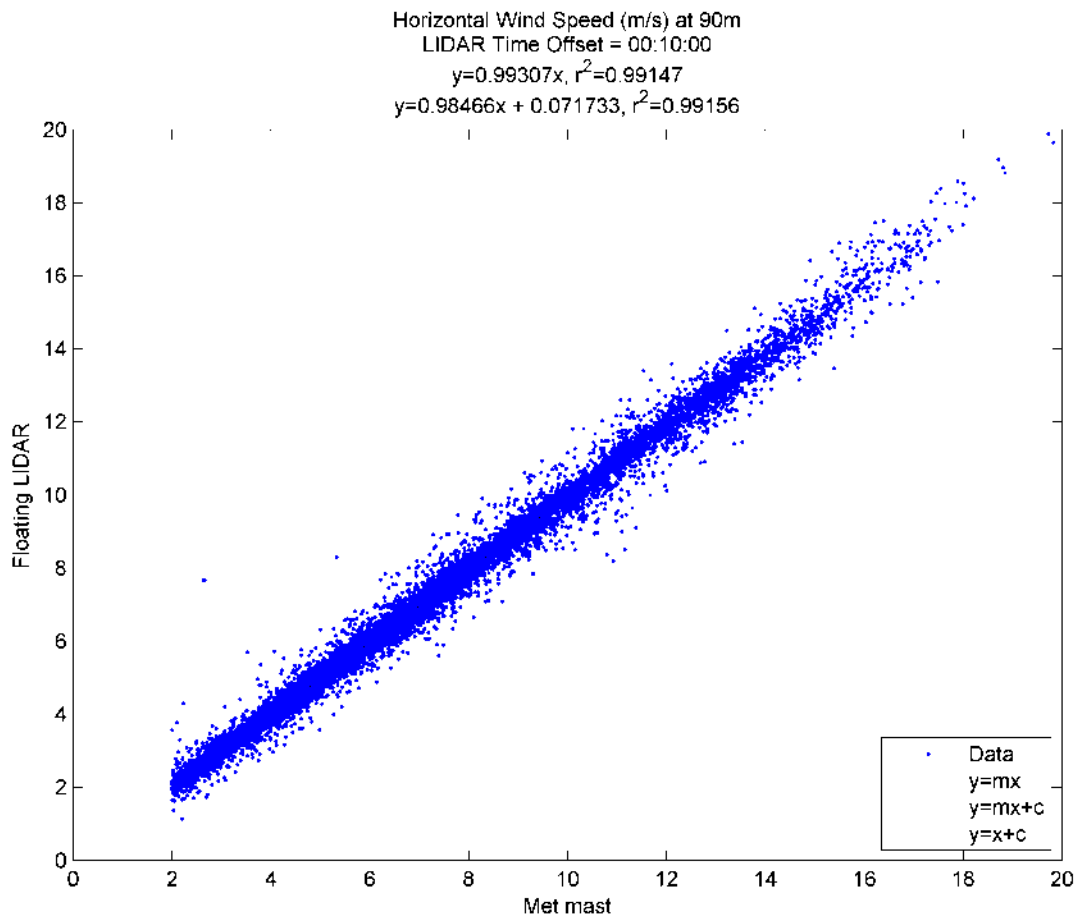
- Excellent correlation

Wind Direction

- Good correlation
- Robust commissioning procedure to eliminate offsets

Data Availability

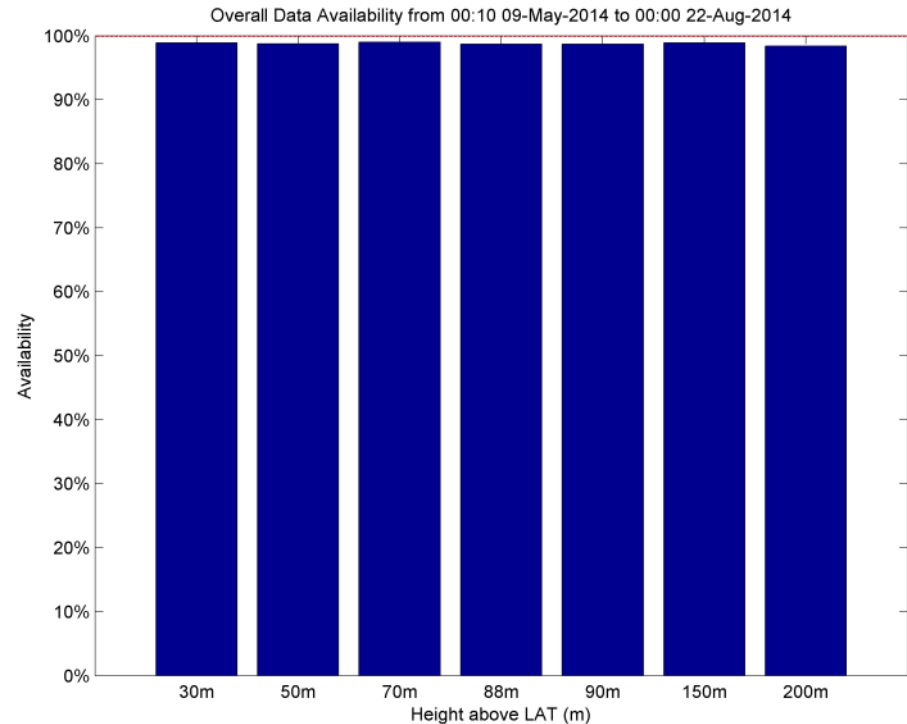
- 99.86% system availability
- >98.5% data availability



Gwynt Y Mor Trial – Availability Results

Excellent availability

- Data availability indicates percentage of data available after removing 9999 and 9998 values
- System availability indicates number of returned time stamped data entries compared to max possible
- Carbon Trust OWA roadmap acceptance criteria states a requirement for 95% system availability and 85% data availability



Summary of data availability (blue bars) and system availability (red dotted line)

