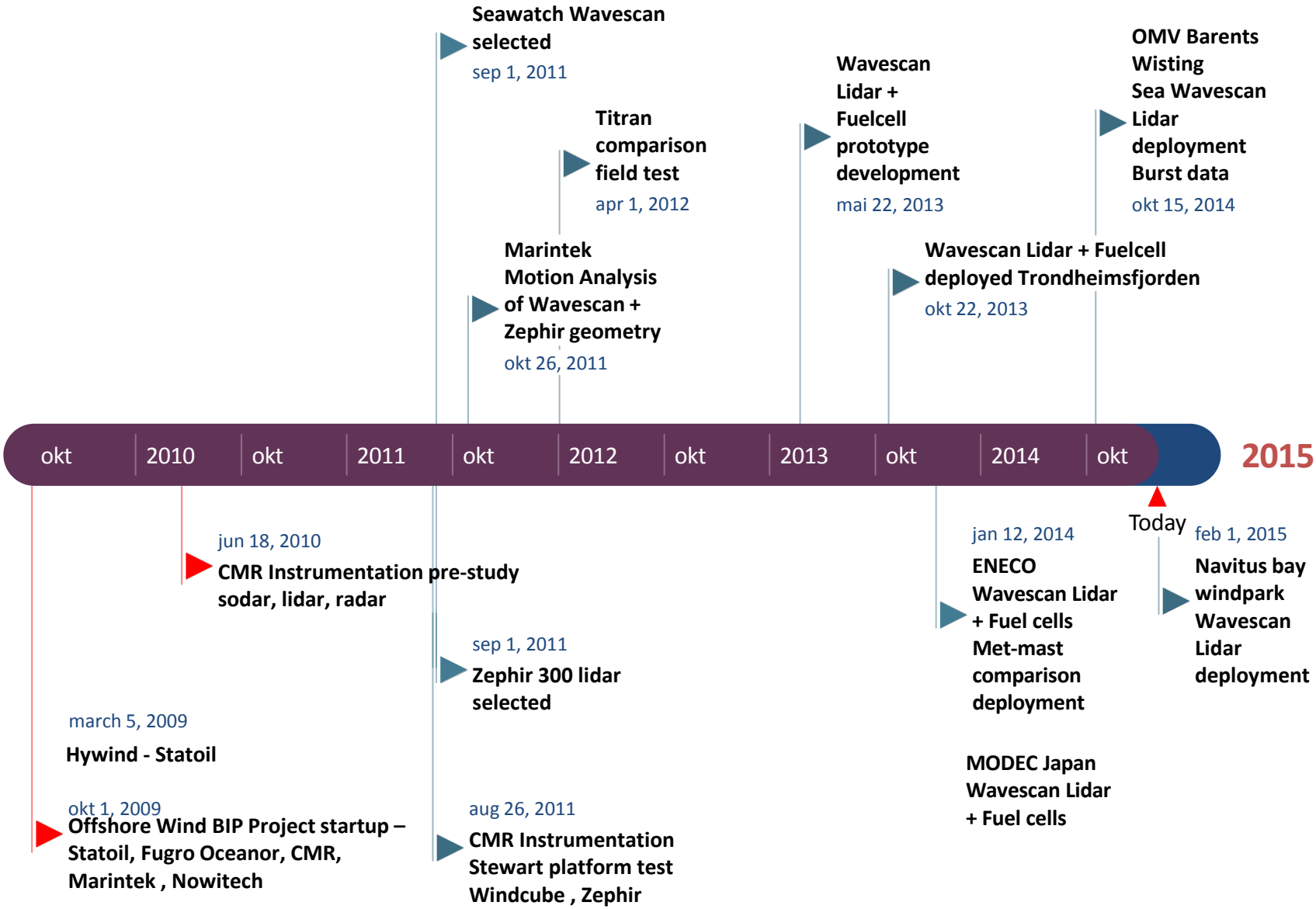
Fugro OCEANOR SEAWATCH Wind LiDAR BUOY

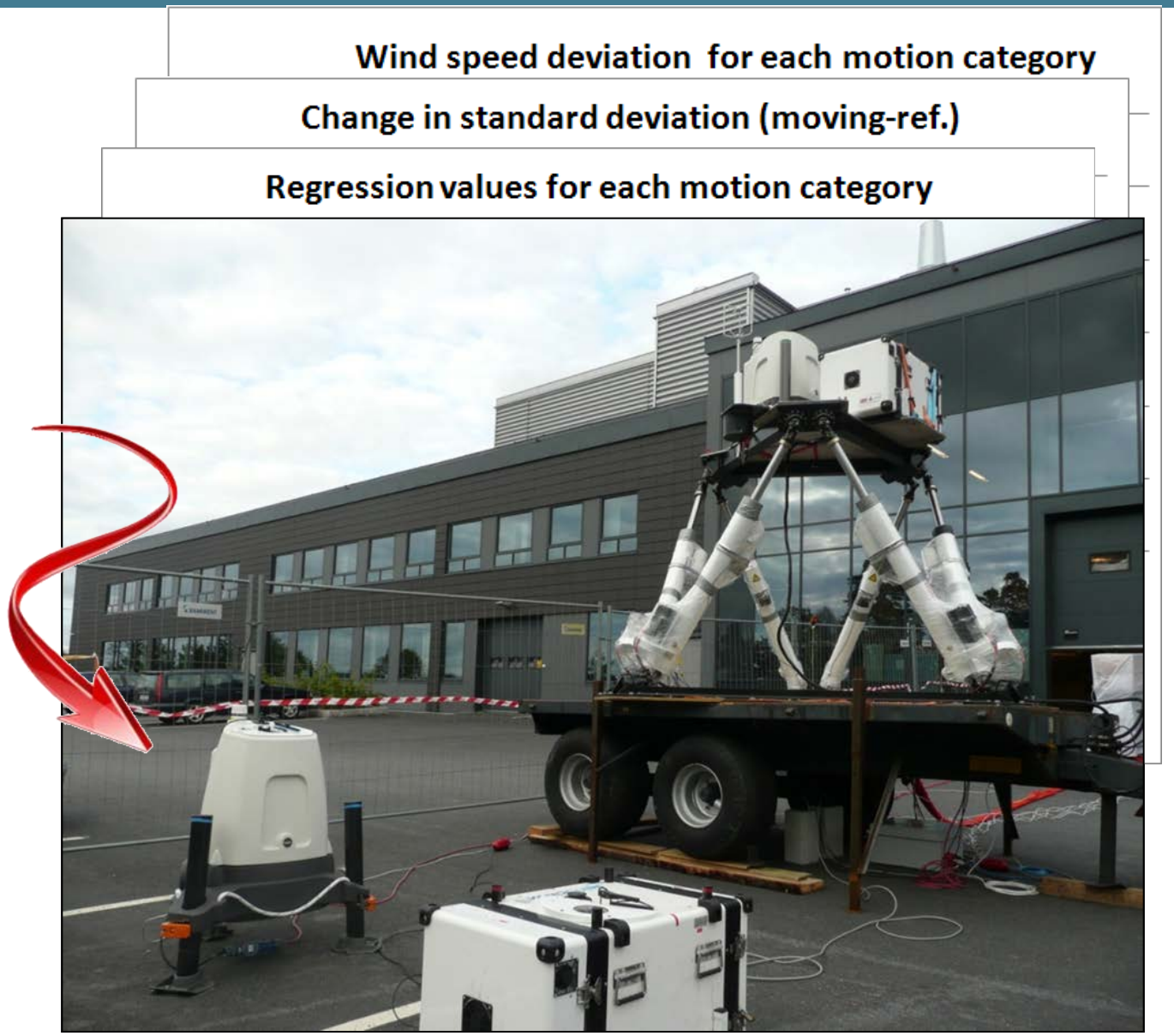
A compact, proven measurement buoy that includes waves, current profile and wind profile

Seawatch Wind LiDAR Buoy Timeline

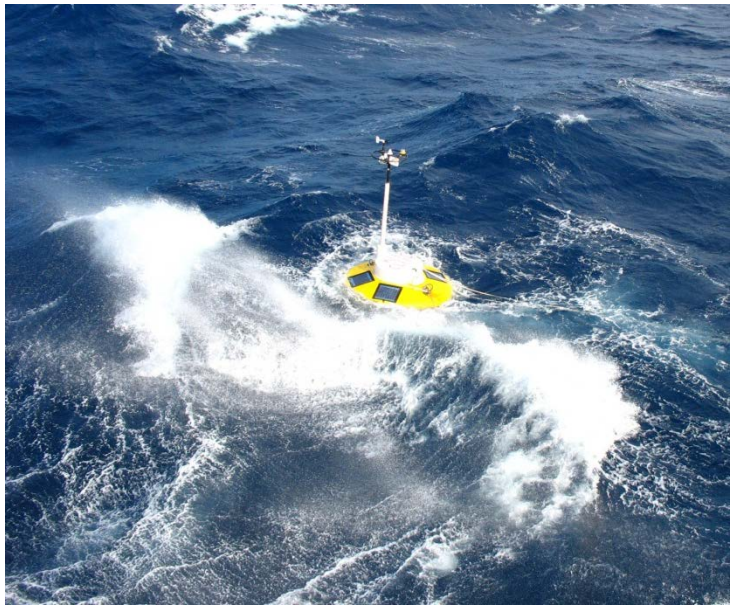


Motion analysis

- 2011 Motion test Stewart platform
  - WindCUBE
  - ZephIR
- 2011 ZephIR 300 selected



Seawatch design



SEAWATCH Wavescan

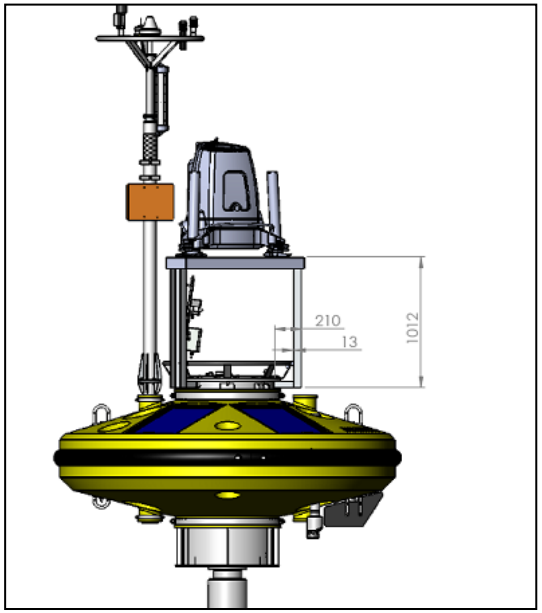
- Successful track record world-wide since 1985
- Uniquely designed to optimise wave direction measurements
- Full on-board processing of all measured data
- Two-way communication link for data transfer and control
- Robust and reliable in temperature extremes and harsh environments

The Seawatch Wind LiDAR Buoy – A single solution possible?

Use a proven oceanographic measurement buoy that has withstood extreme environmental conditions.

Add a proven LiDAR Wind Profiler.

Early design sketch.



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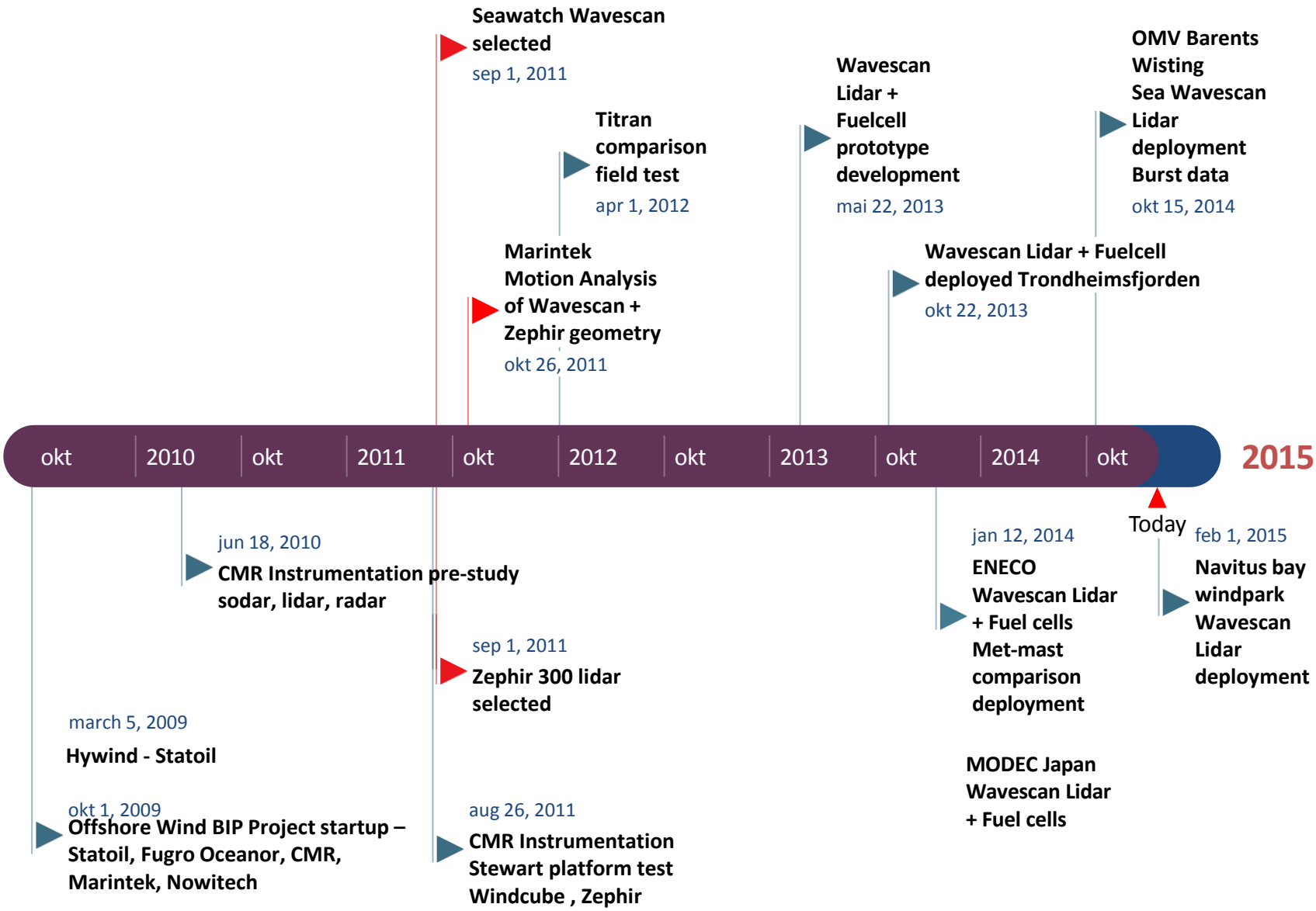
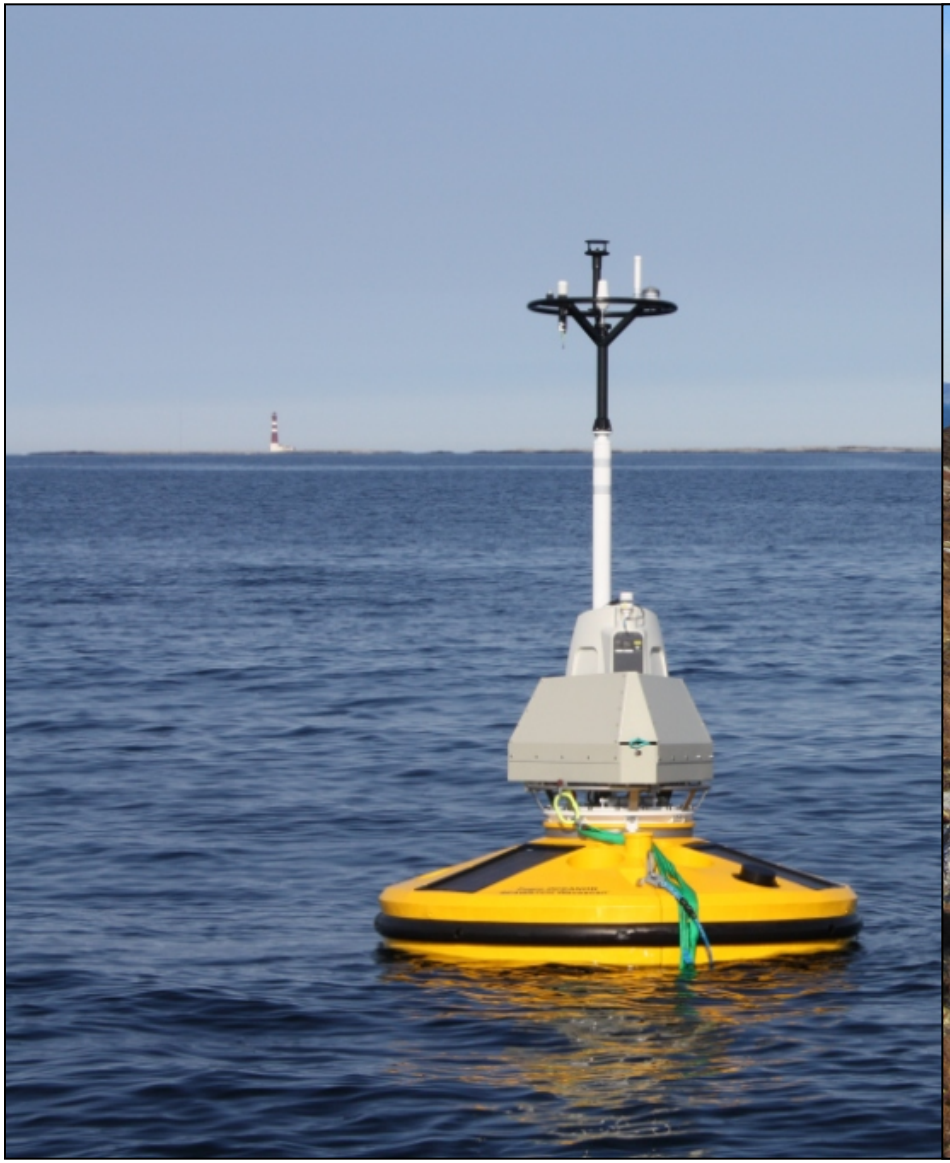


Titran comparison field test 2012



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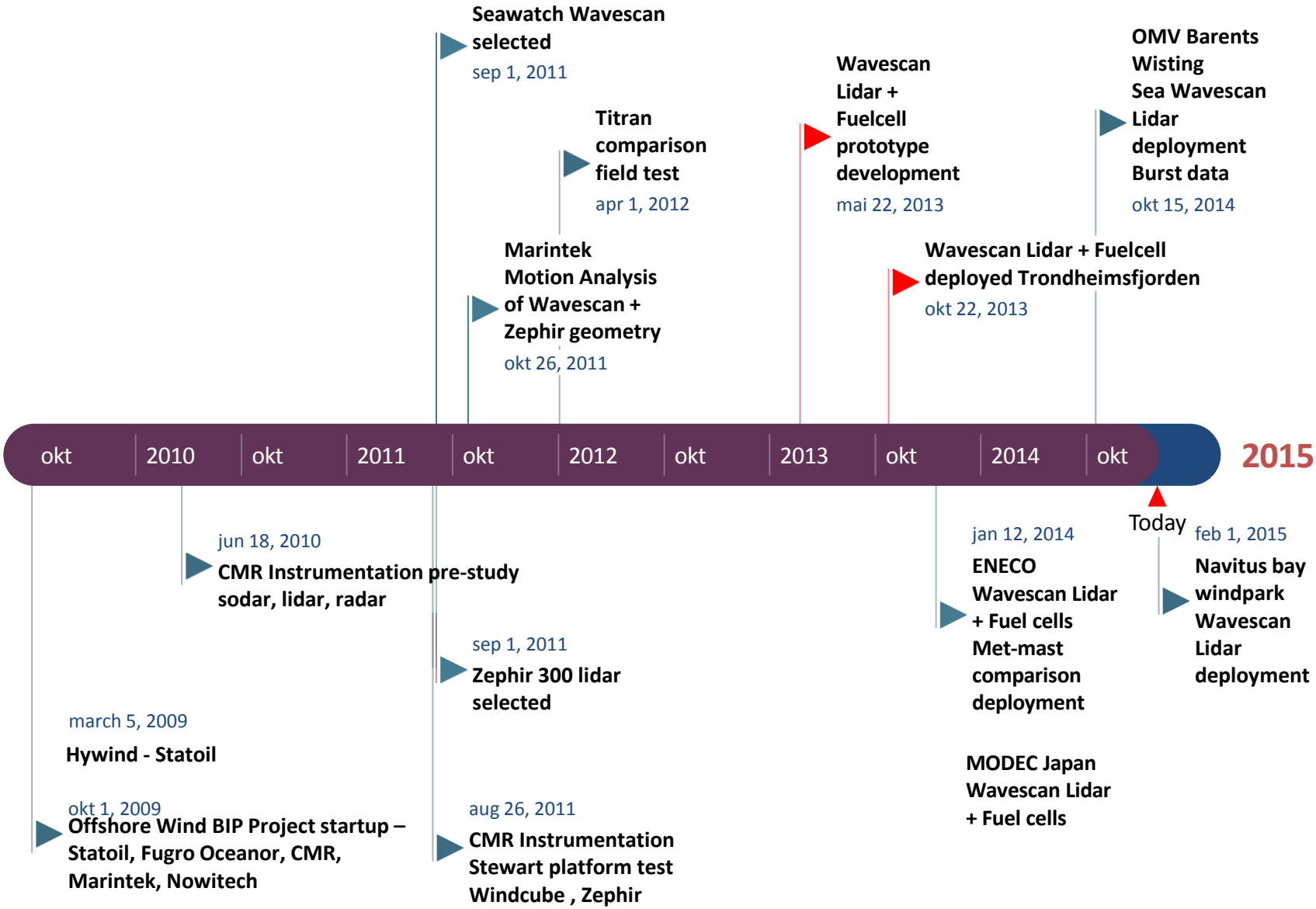

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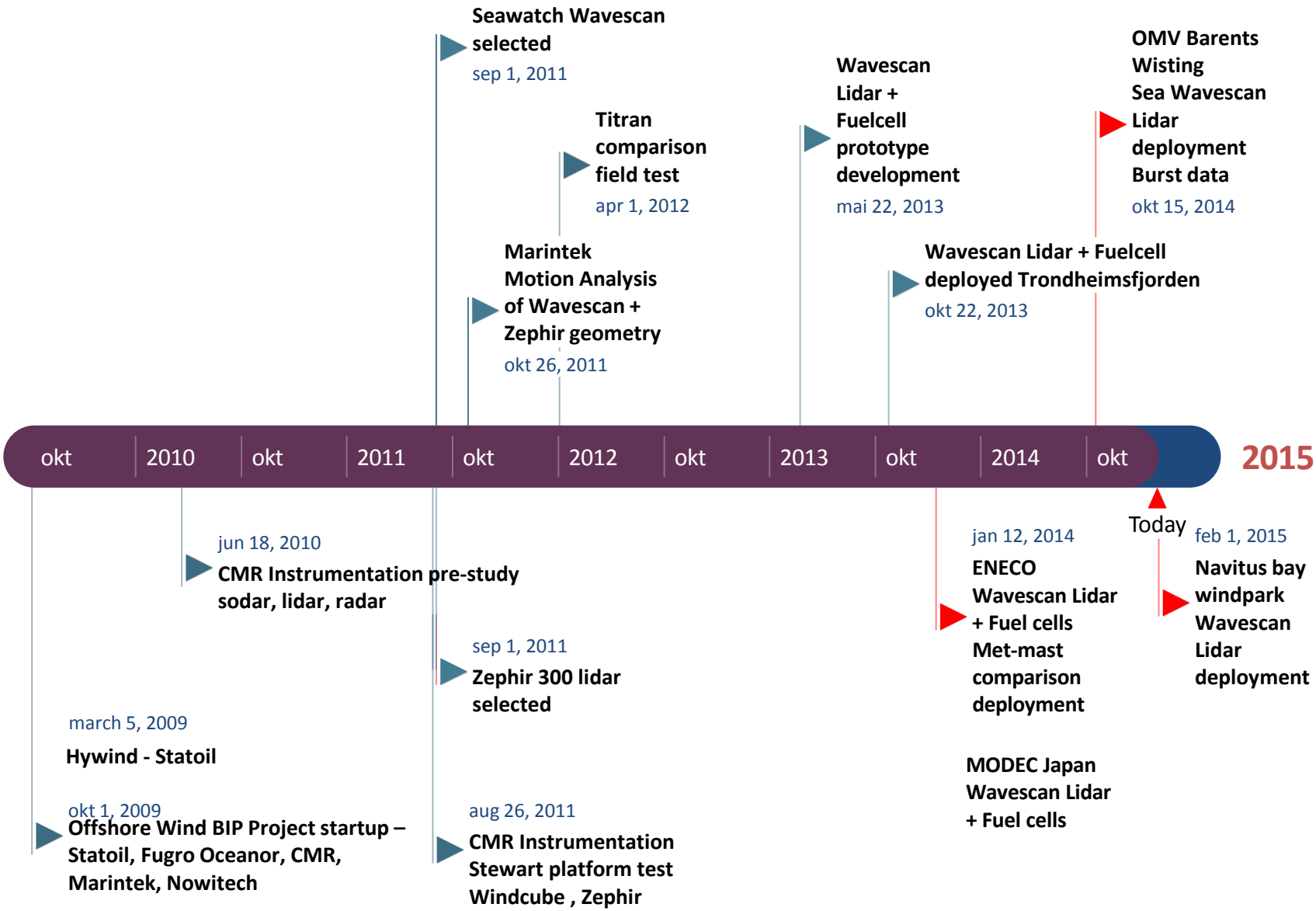
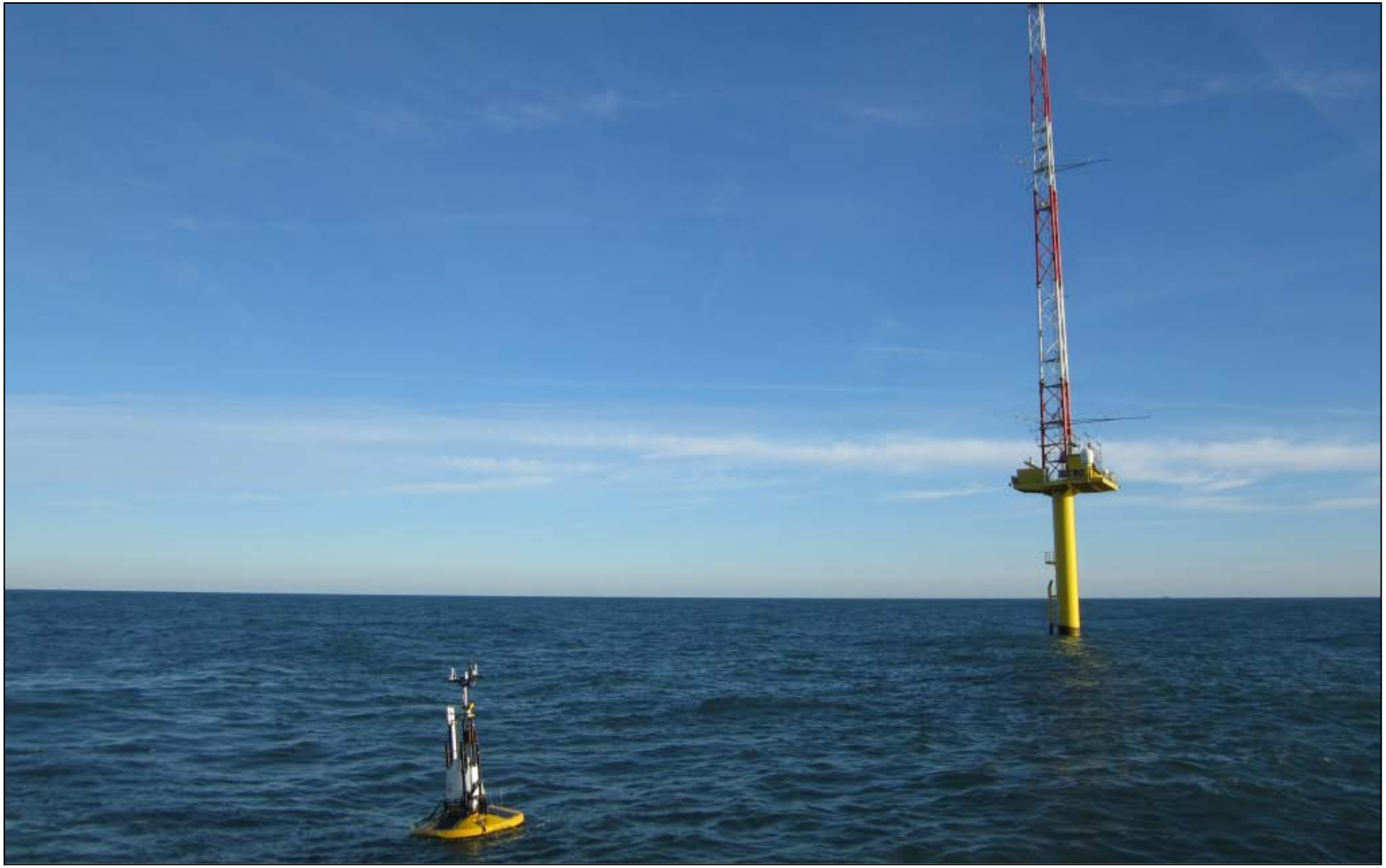


ENECO Met-mast comparison deployment



Evaluation of SEAWATCH Wind LiDAR performance

A roadmap towards commercial acceptance of the floating LiDAR technology has been generated and adapted to the SEAWATCH Wind LiDAR buoy specifics by DNV-GL. It defines three stages of technical maturity for the system

- Baseline: As a pre-requisite, the LiDAR measurement unit should have achieved wide-spread acceptance within the offshore wind industry as “proven” in the field of wind resource characterization for non-complex terrain types at least.
- Pre-commercial: Following a successful pilot validation trial, the floating LiDAR technology may be used commercially in limited circumstances – specifically in conditions similar to the ones experienced during the trial. Elevated measurement uncertainty assumptions may be expected for such application, when benchmarked against the deployment of a conventional fixed offshore meteorological mast.
- Commercial: Following successful further trials and early commercial deployments covering a range of site conditions, a sufficient body of evidence is accumulated to relax the elevated uncertainty assumptions.

Evaluation of SEAWATCH Wind LiDAR performance

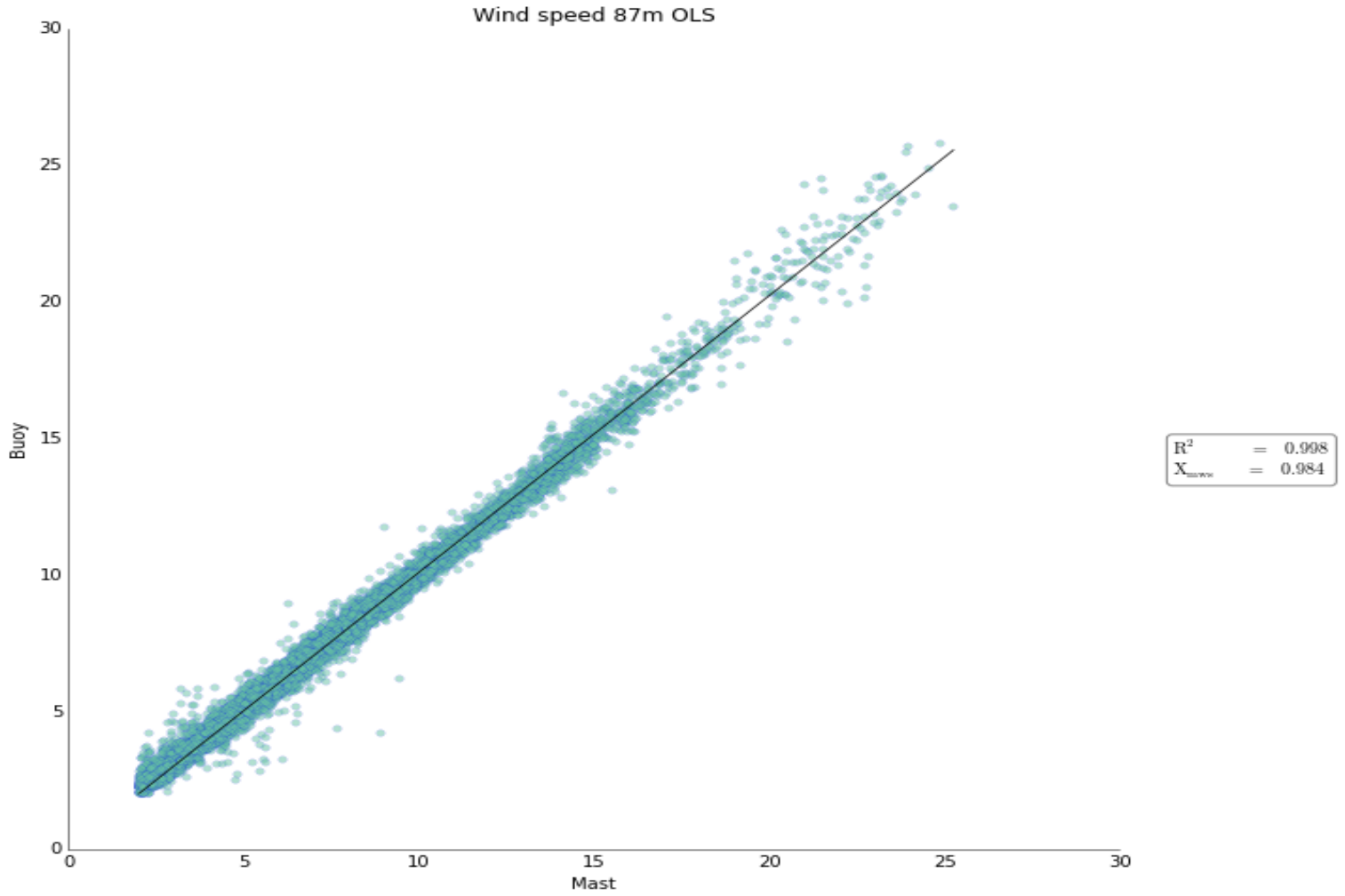
- An evaluation of the buoy floating LIDAR system has been completed by comparing its measurements against data from the IJmuiden met mast over a 6 month period.
- The buoy system has demonstrated its capability to produce accurate wind speed and direction data across the range of sea states and meteorological conditions experienced in this trial (i.e. up to about 5.8 m significant wave height and 9.8 m maximum wave height and 10 min averaged wind speeds up to 26 m/s).
- Has recorded excellent availability throughout the 6 month period and demonstrated structural survivability in the met-ocean conditions present from early spring until mid-autumn.
- DNV GL concludes that the FO SWL Buoy has formally qualified for Stage 2 “pre-commercial” in the context of the Floating LiDAR Commercial Roadmap
- Only in a few instances the wind direction comparisons only meet the prescribed minimum Acceptance Criterion to reach Roadmap Stage 2 (“pre-commercial”). For all other KPIs the best practice Acceptance Criteria are met.

Data availability

- Monthly system availability: 1 month average, 99.8 to 99.9%, acceptance criteria >90%
- Overall system availability: Campaign average 99.9%, acceptance criteria >95%

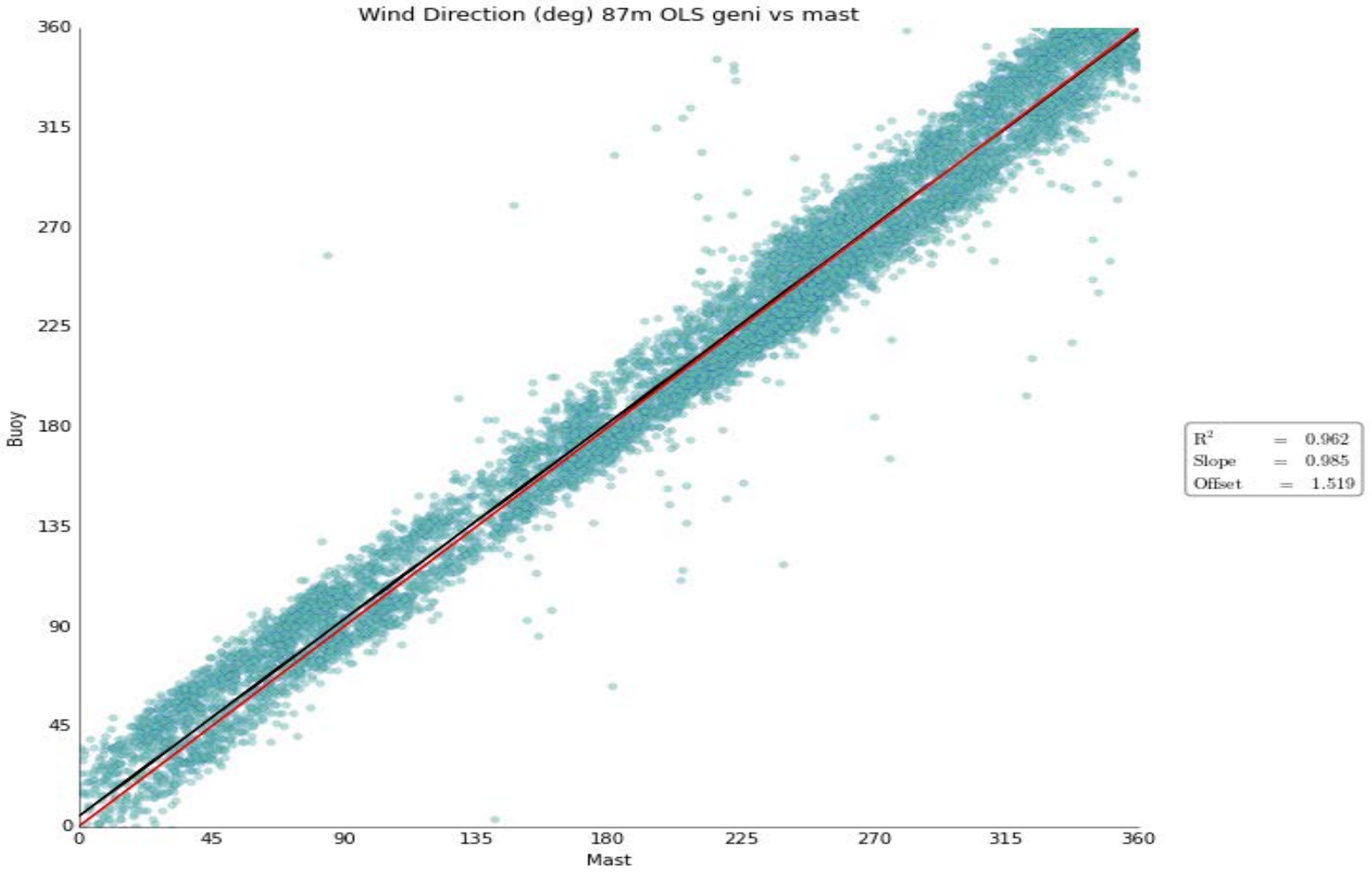
Wind speed

R^2 = 0.99 (Best practice criteria >0.98, minimum 0.97)
Slope = 0.98 (Best practice criteria 0.98-1.02, minimum 0.97-1.03)
Mean offset between 0.11 and 0.15 m/s



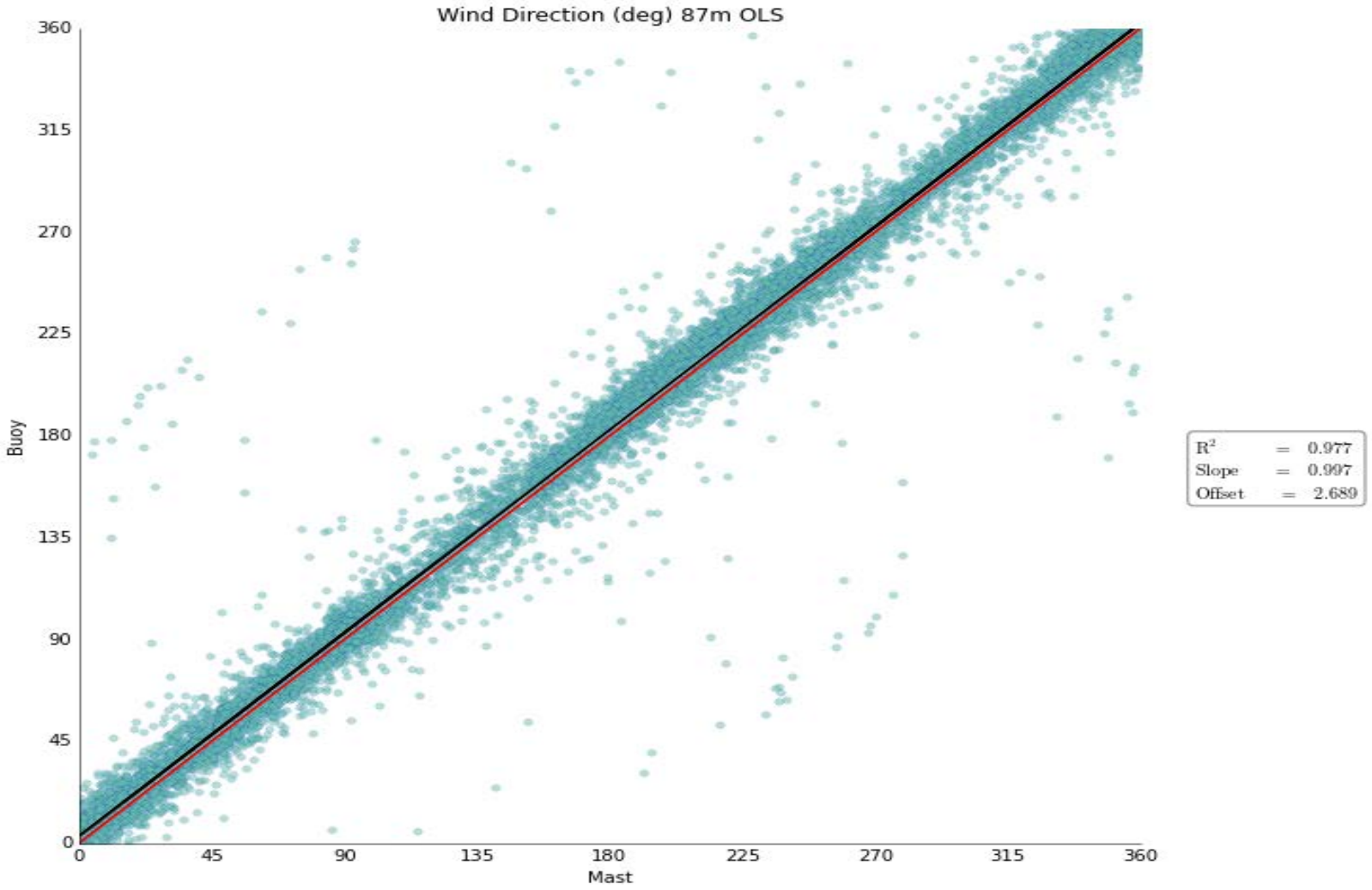
Wind direction

- R^2 between 0.96 and 0.97. (Best practice criteria >0.97, minimum >0.95)
- Slope between 0.97 and 0.99 (Best practice criteria 0.97-1.03, minimum 0.95-1.05)
- Mean offset between 1.5 and 5.8 degrees (Best practice criteria <5 degrees, minimum <10 degrees)



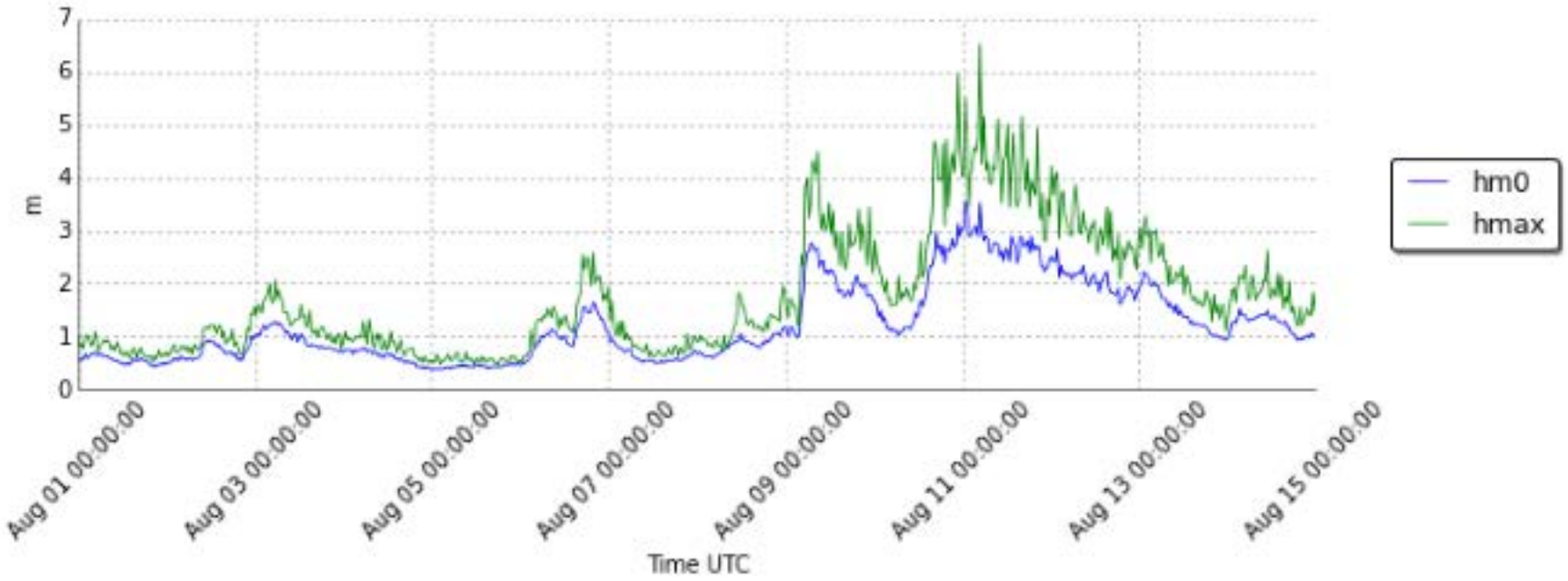
Further improvements

- Wind direction improvements by using better compass measurements

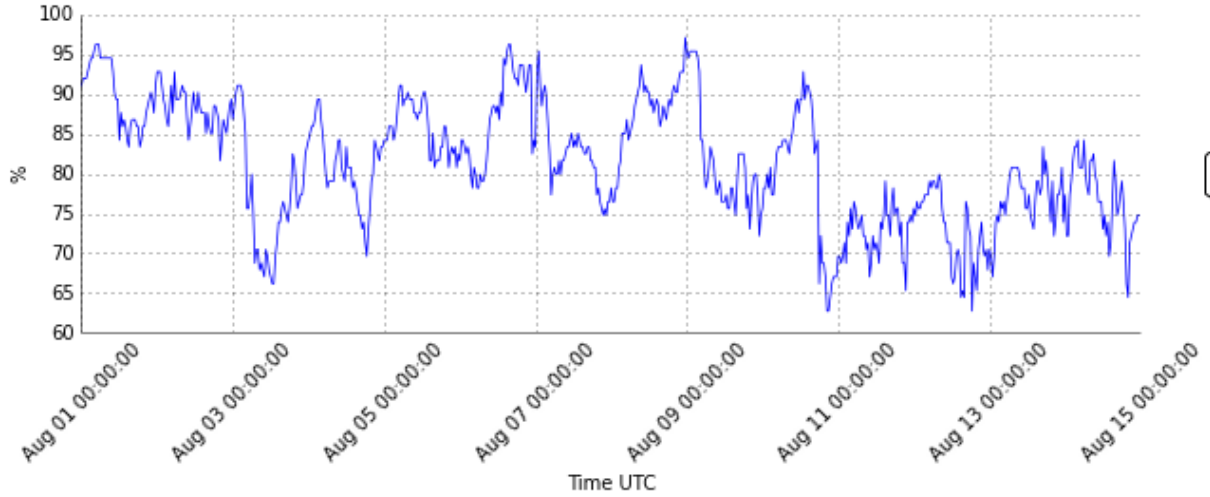


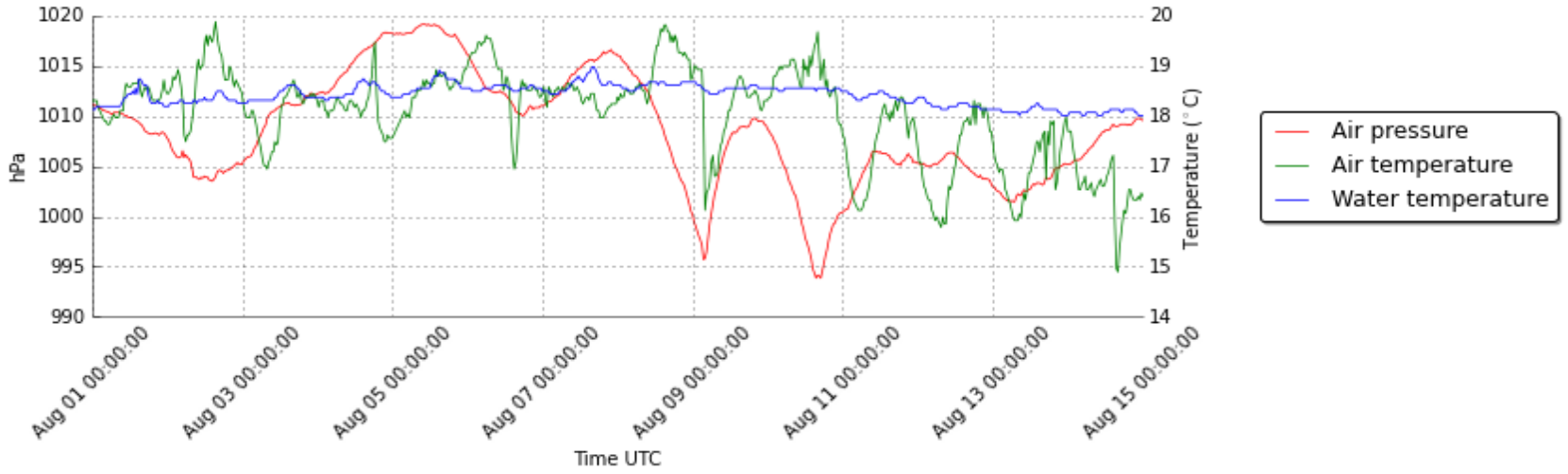
Does the Seawatch still work as a met ocean buoy?

Wave Data – Yes, the systems records robust and reliable wave data



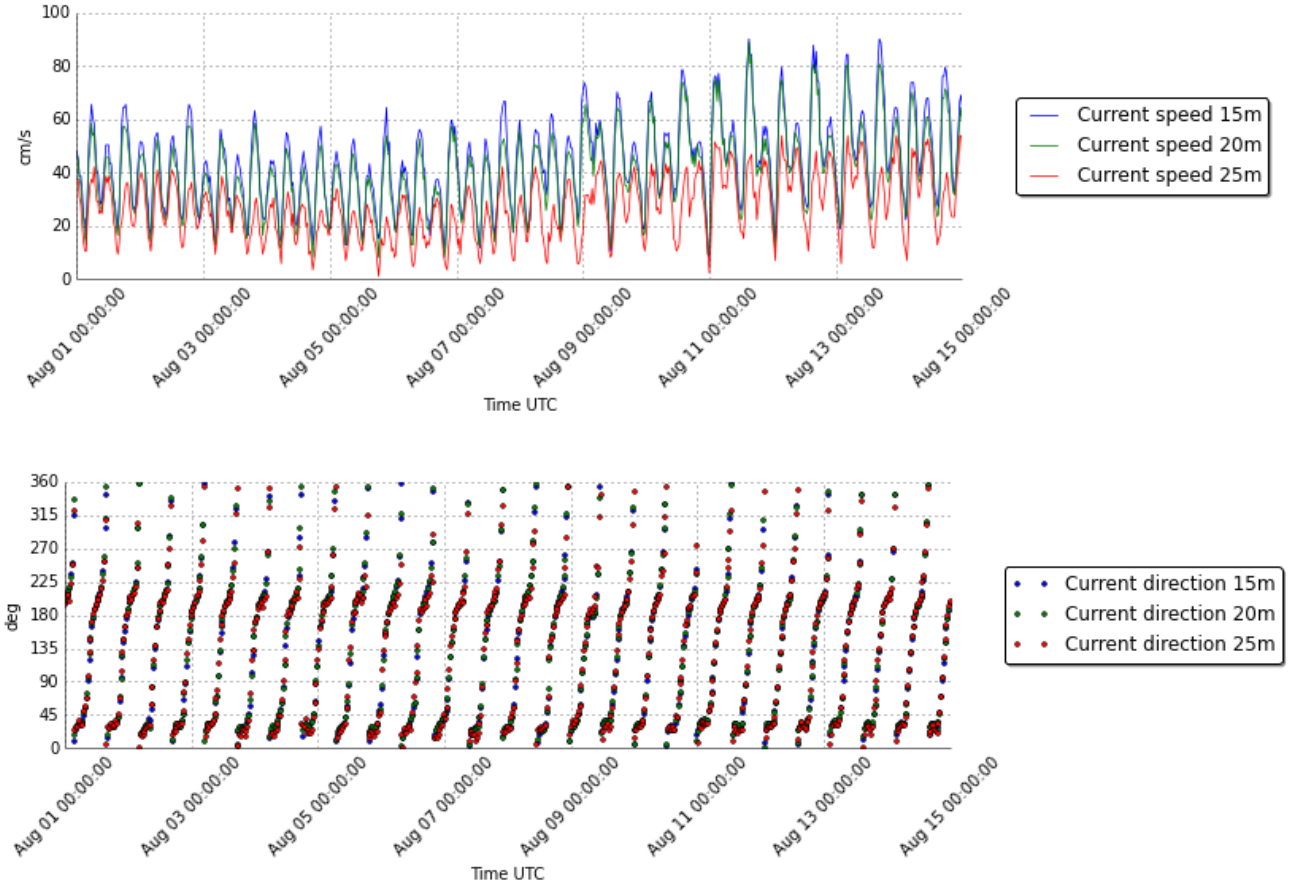
Meteorology – Yes, the systems records robust standard meteorology data





Current data

Current Data – Yes, with the addition of a downward looking current profiler, the system can produce reliable current data



The Seawatch Wind LiDAR Buoy

The result

- A robust proven multi-parameter Meteorological and Oceanographic Measurement Platform
- Wind profiling capability up to 300m
- Current profiling capability down to 1000m
- Directional wave measurements
- Measurement of a wide range of met-ocean parameters
- Flexible energy system
- A fraction of the cost of a traditional met-mast and mobile

Thank you for your time

Fugro OCEANOR
SEAWATCH Wind LiDAR BUOY

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EERA Deepwind 2015