



Met Office

E-Surfmar moored buoy technical description

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JCOMM Technical Workshop on Wave Measurements from Buoys, 2-3 October, New York, USA



E-Surfmar moored buoy systems



- K-series buoys (Met Office, Irish Marine Institute and Meteo-France)
- Oceanor buoys (Puertos del Estado and Iceland Met Office)
- Other wave measurement networks within the E-Surfmar region

Specifications

- 3 m diameter hull
- 6 m overall height
- 4 m sensor exposure height above sea level
- 1.5 m diameter sensor ring
- Duplicate sensors attached with quick release clamps



Data Acquisition System

- Duplicate electronics
- Duplicate satellite communications systems
- Systems cross linked for maximum resilience
- All instruments bar the wave sensor(s) are also duplicated





Moored buoy mid-life communications upgrade



- Replace Meteosat DCP communications on one side of the buoys with an Iridium system
 - already proven on Turbot Bank (since Nov 2005) and K2 (since Apr 2007)
 - this year implemented on K7, K5, Sule Skerry and (last week) Brittany and Gascogne
 - hybrid (Iridium/DCP) system is a short-term/temporary solution as our analogue DCPs are obsolete
 - plan to investigate other potential communications systems (e.g. Inmarsat BGAN, Meteosat Digital DCP etc)

Buoy Data Acquisition Electronics

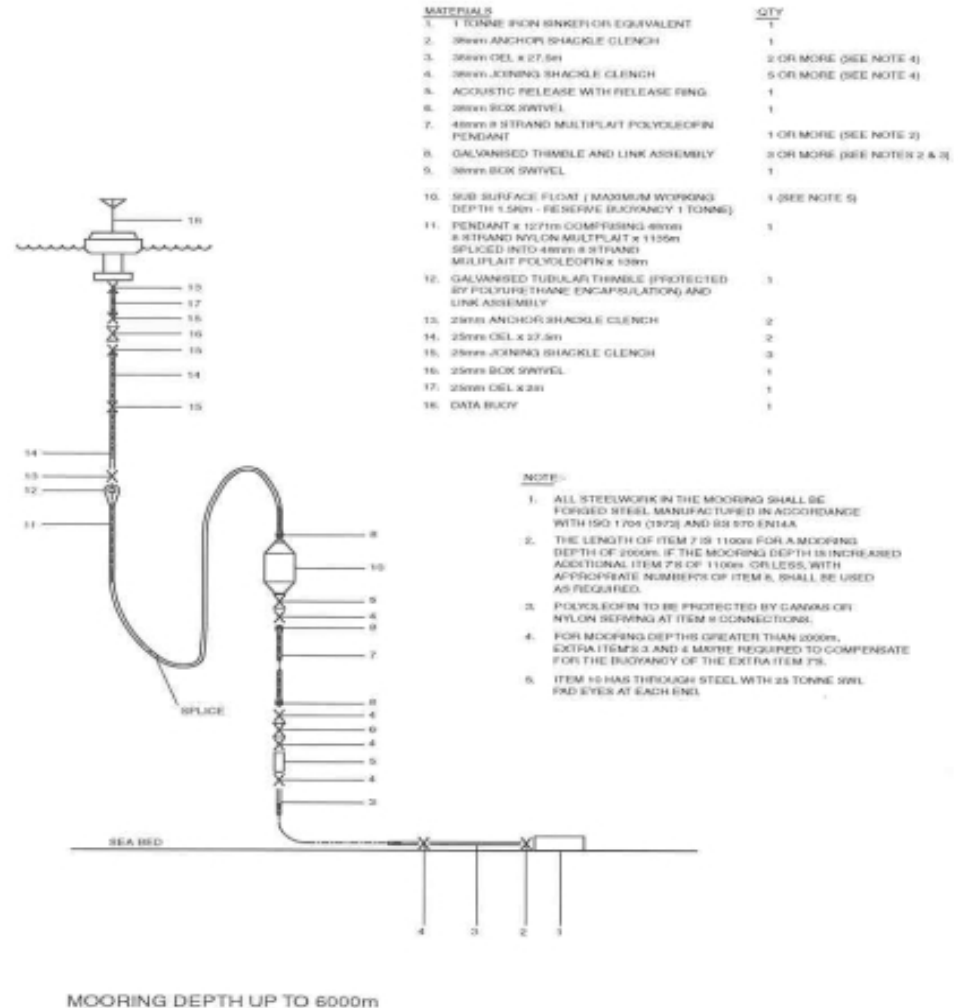
Meteosat enabled



Iridium Enabled



- In water depths of 30 to 100 metres all chain mooring is used with a subsurface float where appropriate
- Moorings used in deeper water are an inverse catenary type with a 1 tonne reserve buoyancy sub-surface float and an acoustic release





Moored buoy mid-life wind system upgrade



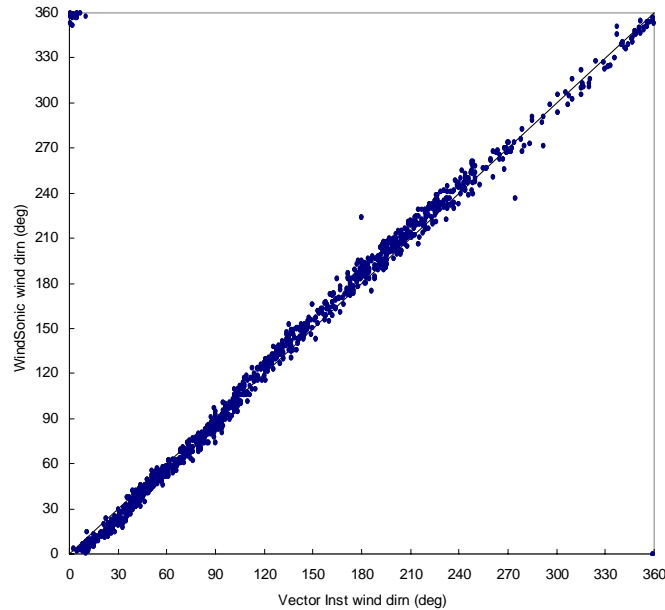
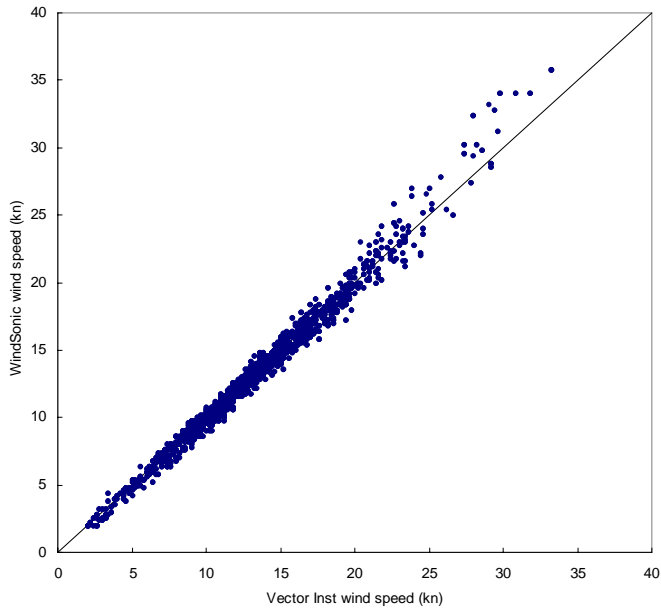
- Replace cup and vane anemometer with new wind system based on Gill WindSonic and TrueNorth revolution electronic compass (using an interface board to replicate the analogue output from the Vector instruments sensors)
 - increased lifetime (present wind system often fails after 6-9 months)
 - installing new wind system on one side of the buoys (to provide a period of comparison)
- New wind system deployed on K7 (April 2008), K5 (July 2008) and Brittany and Gascogne (last week)
 - preliminary results look encouraging but need to see how systems survive the winter months
- Wind information is complementary to wave data



Comparison of wind data from K5



Surface Marine Programme



WindSonic-Vector Inst

Mean speed difference -0.07 kn
RMS speed difference 0.67 kn

Mean direction difference -0.21 deg
RMS direction difference 6.58 deg

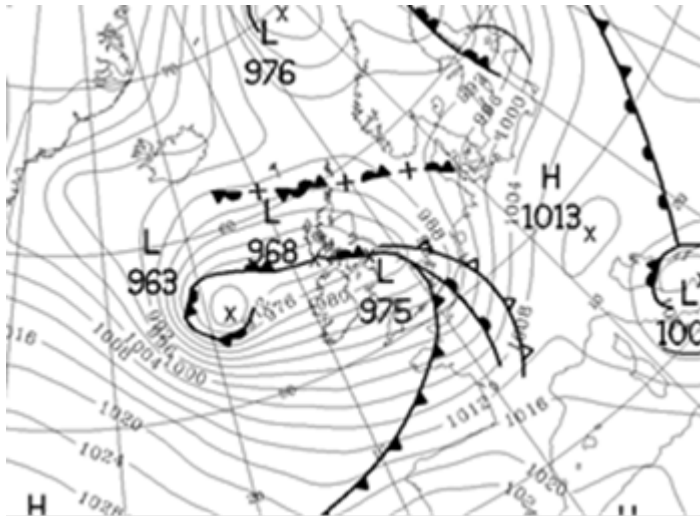
Sample period 19 July to 5 Sept

WindSonic readings are higher at wind speeds above 25 kn

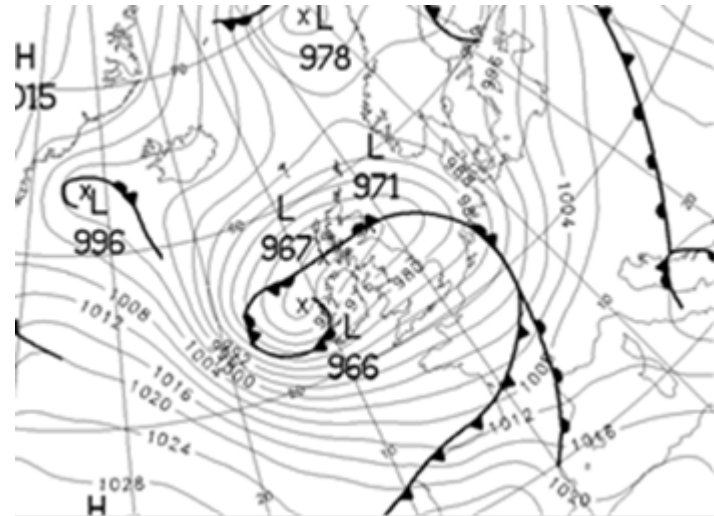
- Presently have a single Datawell MkII heave sensor mounted (in the base of the buoy)
- Heave sensor voltage output is reduced by use of high-stability scaling resistors to allow the full range of conditions to be sampled (by CR10x data logger)
- Heave sensor output sampled every 0.25 s and every 2½ minutes compute the 'significant' wave height and 'average' wave period over the past 17½ minutes
- SWH is 4x the RMS value of the water level above the mean level of the water surface (4x because waves are trochoidal in form)
- Average wave period is determined from the number of upward crossings through the mean level (which is updated every 2½ minutes) over the previous 17½ minutes

K3 – December storm

- Recorded what is believed to be the highest SWH ever recorded from a moored buoy (over 18.2 m on 8 Dec 2007)

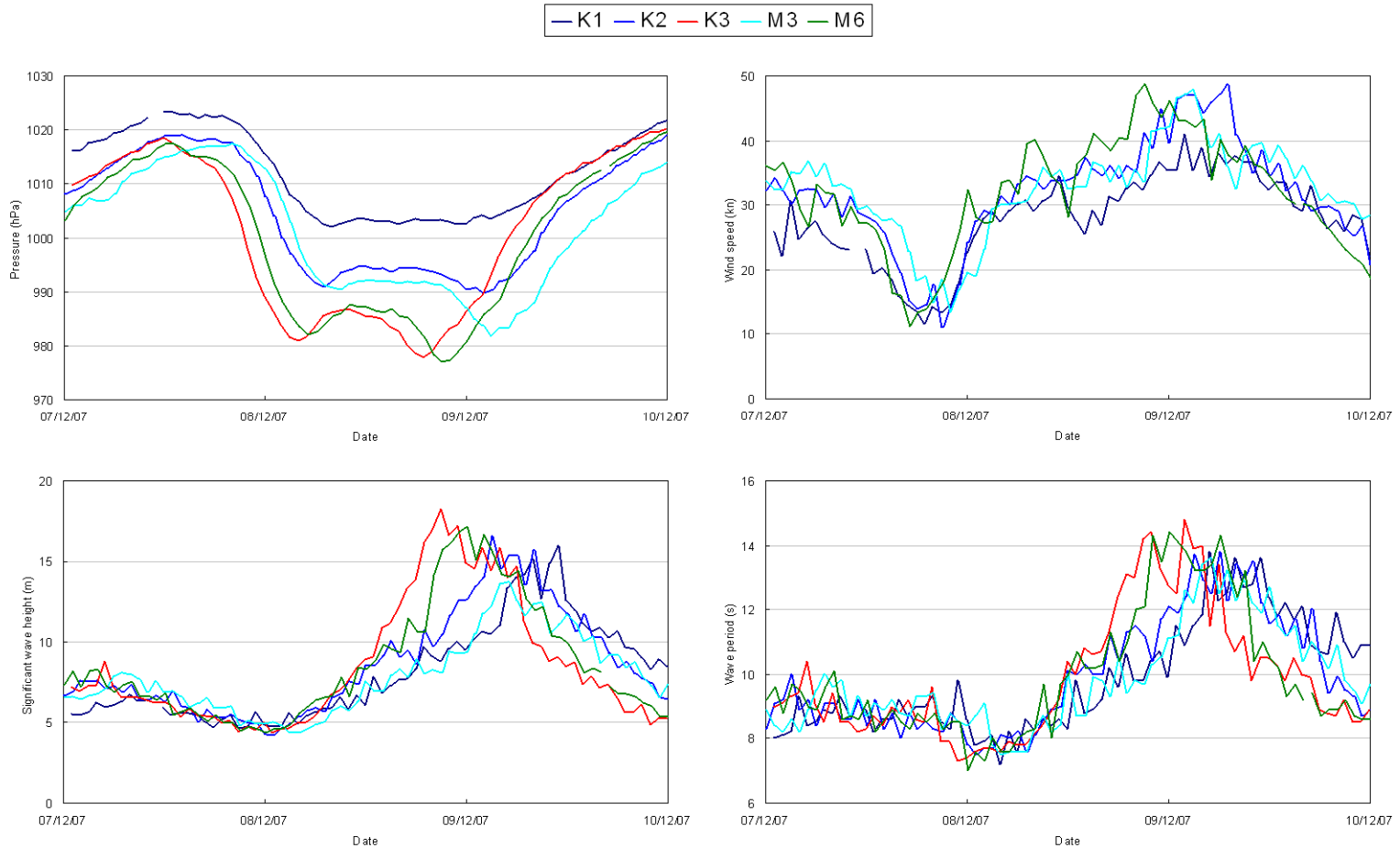


1800 on 8 Dec



0000 on 9 Dec

K3 – December storm



K3 – December storm

- Maximum SWHs were (resolution 2.5 cm)
 - 18.275 m at K3
 - 17.175 m at M6
 - 16.575 m at K2
 - 16.000 m at K1
- Previously the highest we have measured was at 0000 on the 18th January 2005 from K3 with a maximum SWH of 16.6m with a period of 13.5 seconds
- Paper on the event has been submitted to Weather and accepted for publication



Met Office

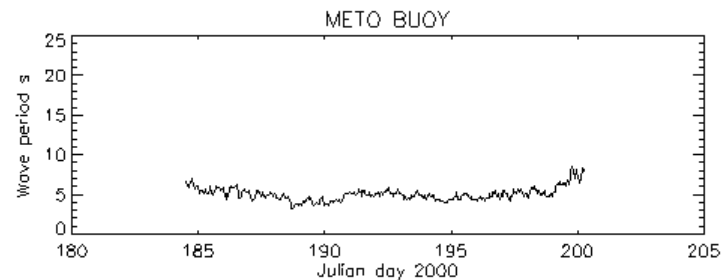
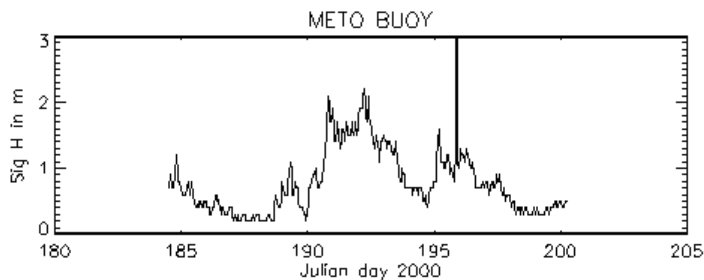
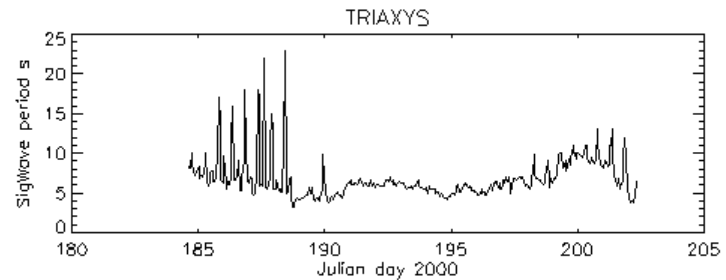
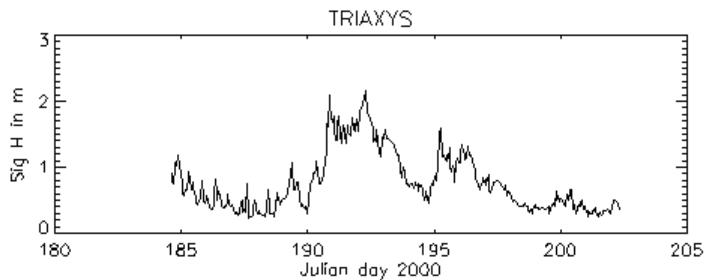
10th March 2008 event



Surface Marine Programme

- During the severe weather on 10th March the K2 moored buoy recorded a maximum SWH of over 17.6 m with a minimum pressure of 961 hPa and 52 kn winds (75 kn gust) several hours earlier
 - this is the second highest measurement we have recorded
- K1 recorded a maximum SWH of 15.8 m and M6 of 14.8 m

- Triaxys spectral wave sensor tested on a K-series moored buoy in 2001 (St Brides's Bay) and compared well to the Datawell MkII heave sensor



Spectral wave trial

- Also compared with a nearby waverider buoy
- Overall there was good agreement between the Triaxys and waverider, but there were significant differences in the measured wave directions during times when $H_s < 1.5$ m
- Also wave period data was unreliable for low waves when $H_s < 1.5$ m
- The unit we trialled was shipped with an old firmware version and our Triaxys systems have since been updated and should better cope with such conditions



Spectral wave data from K5



- Triaxys spectral wave sensor deployed at K5 during July 2008, Datawell heave sensor retained to provide some comparison data
- Spectral wave sensor activated 4 times/day (20 minute samples at 2340, 0540, 1140 and 1740) and data transmitted via Iridium (short-burst)
- Data transmitted in NMEA format
 - Wave statistics
 - Non directional data (energy in 123 frequency bands 0.03 - 0.645 Hz)
 - Mean directional data (energy, mean direction, spread in 56 frequency bands 0.075 – 0.355 Hz)

Spectral wave data

- Data in NMEA format are currently being archived and are available to the wave modelling group for validation
- No analysis or verification of the data has yet been made
- Met Office data handling system being modified to convert spectral data from NMEA into BUFR for storage in operational database and onward dissemination via GTS



Plans for expansion of spectral wave capability



- Extend capability to selected buoys across the network
 - K7 (operated for FOIB/Wavenet)
 - Gascogne (Meteo-France requirement)
 - K1 or K2 to provide information for the south-west approaches
 - Moored buoy planned for PAP to complement the OceanSites reference mooring operated by the National Oceanography Centre Southampton (NOCS) in 2009 – requirement for spectral wave?
- Met Office will assist Meteo-France in putting spectral capability on Lion
- Marine Institute will provide spectral capability on M6



Met Office moored buoy development programme



- Have recently relocated our marine engineering team to the National Oceanography Centre, Southampton (NOCS) to work alongside their deep ocean moorings team
- Sharing of common facilities, exchange of technology capabilities and developments
- Alongside the move to NOCS we have a programme of work to develop a 'next generation' buoy capability
- Aim is to develop a more flexible capability (can configure to meet specific user requirements) that can be used on a range of different hulls (1.5 m, 2 m, 3 m) for use in different situations (coastal, offshore, deep ocean)
- With NOCS to extend capability to include oceanographic measurements

- Have ordered several 3 m hulls from Planet Ocean (XJF Plastics) equipped with a dual Axys Watchman system with Iridium
 - hulls tested and used by Trinity House for coastal deployments, but with Met Office design modifications for more severe (offshore/deep ocean) conditions
 - lighter and easier to handle than our present steel Balmoral hulls
 - systems being prepared for over-winter testing at sea





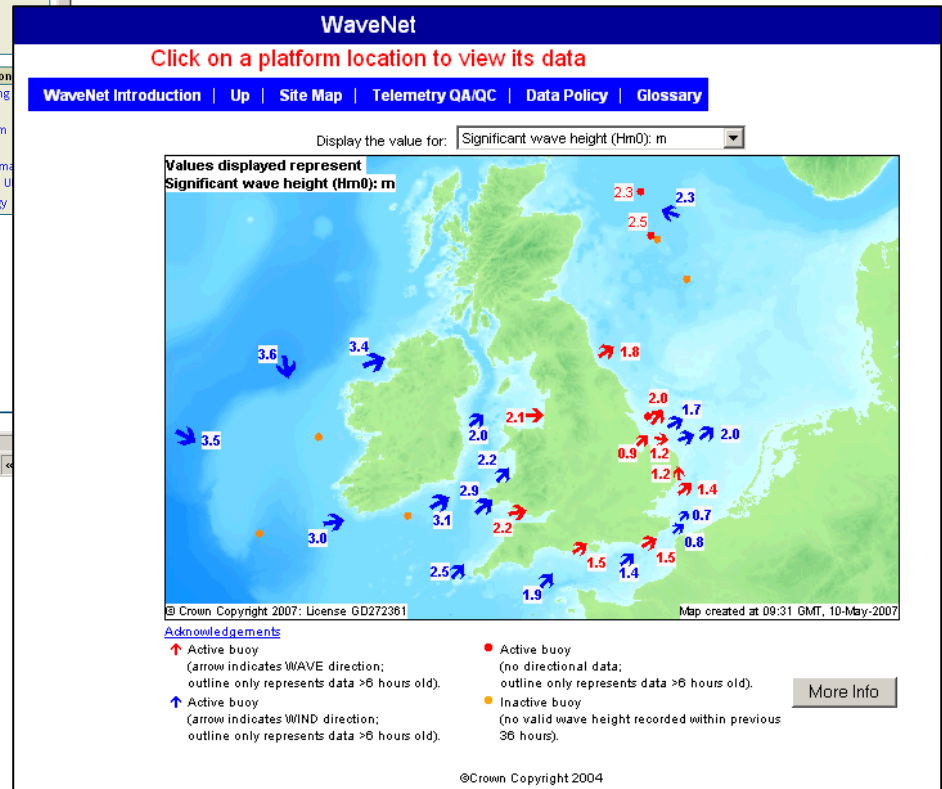
Wavenet



Surface Marine Programme

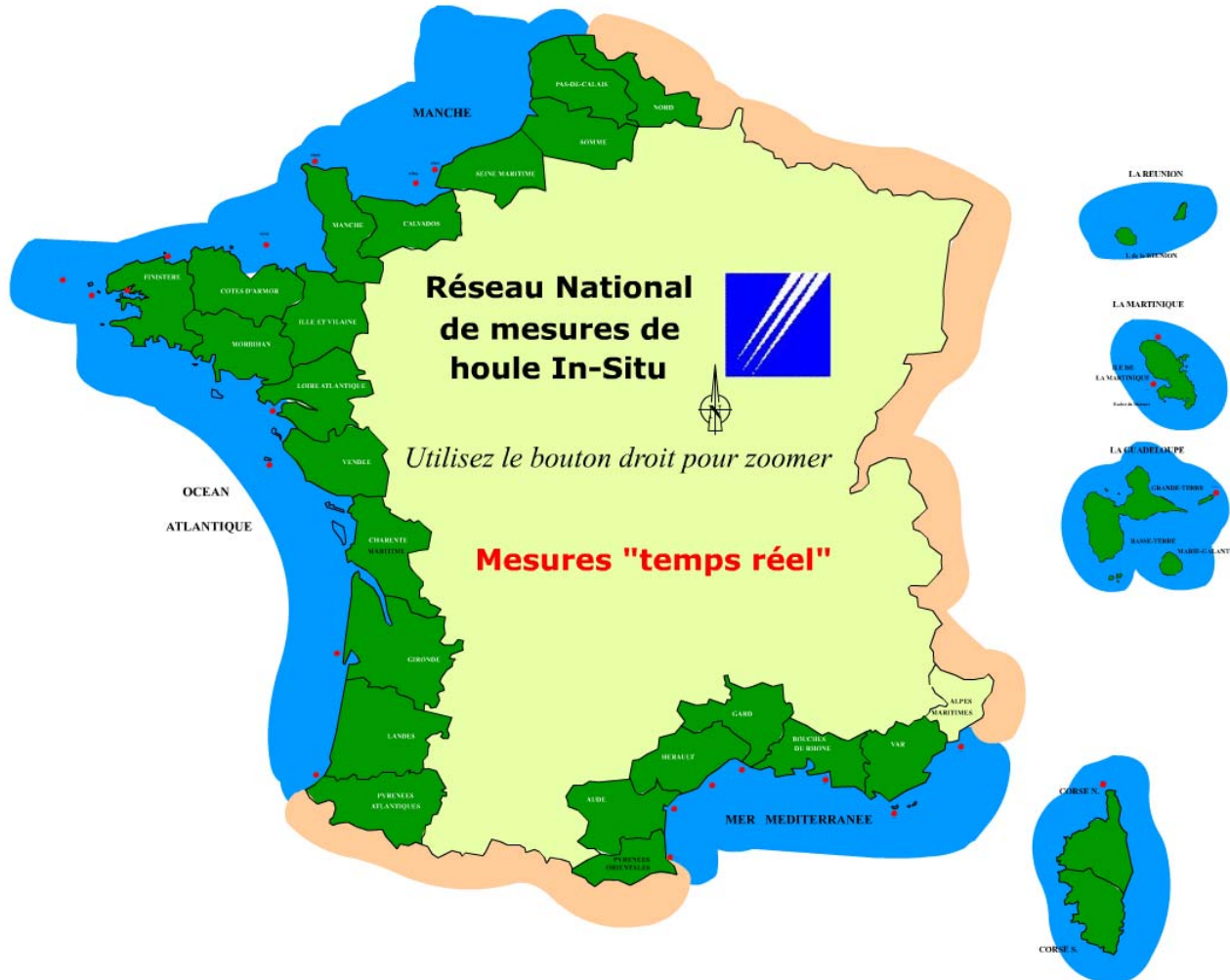
Includes data from

- Met Office buoys + offshore platforms
- CEFAS waverider buoys
- Shell metnet
- Irish buoys/Marathon
- Environment Agency
- and others

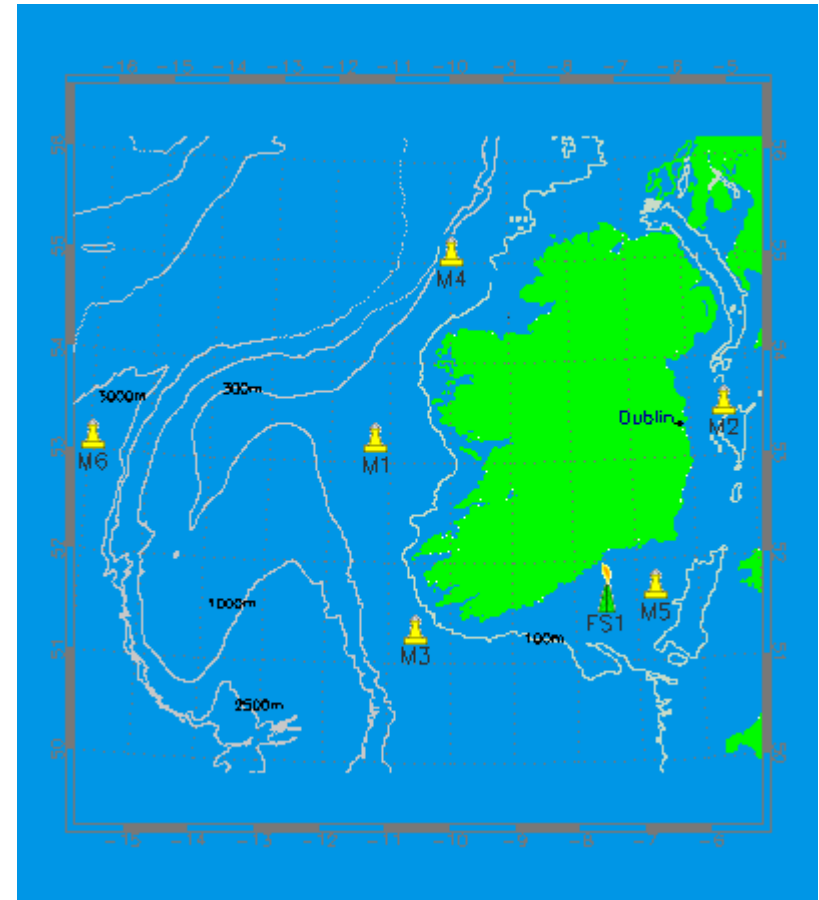


The Defra strategic wave monitoring network for England and Wales
<http://www.cefas.co.uk/wavenet>
 (being extended to Scotland)

CETMEF (French waveriders)



- 6 K-series buoys including the E-SURFMAR buoy at M6





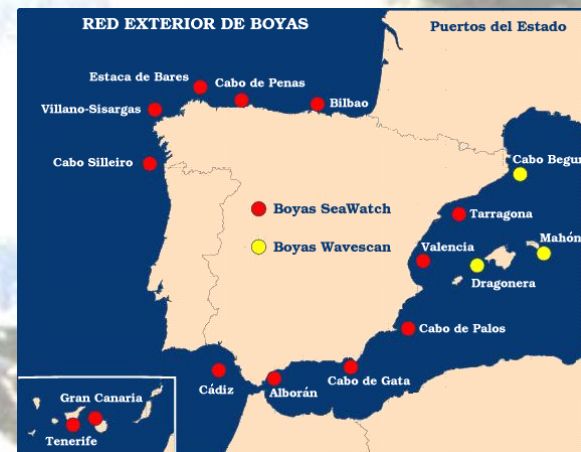
Irish Marine Institute plans



- Plan to upgrade the Irish National Buoy Network over the coming years and have recently issued an open ITT for the supply of offshore Metocean Buoys (closed 23rd Sept 2008)
(<http://www.marine.ie/home/aboutus/tenders/opentenders/TenderMetoceanBuoys.htm>)
- Requirements include
 - spectral wave capability
 - standard met measurements (including sonic anemometry)
 - SB16+ and ADCP for oceanographic measurements
 - systems suitable for extended (24 month) deployment periods

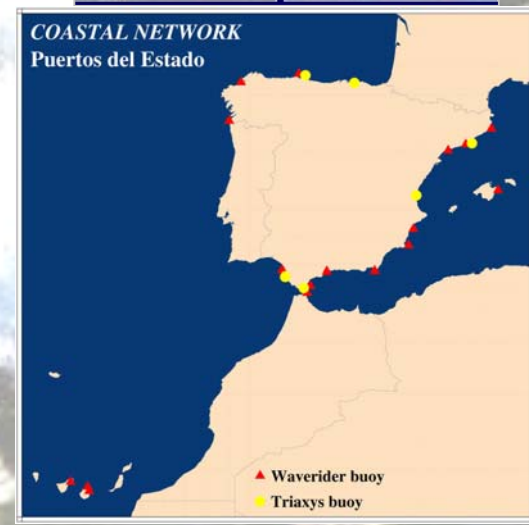
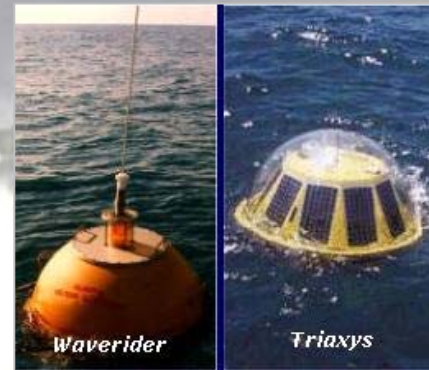
Deep water buoy network

- ◆ 16 measuring sites.
- ◆ Moored in deep waters (200 to 1200 m depth).
- ◆ Directional wave, meteorology, current, salinity and water temperature.
- ◆ Satellite transmission in real time (hourly)
- ◆ ARGOS tracker (watching position and battery level)



Coastal buoy network

- ◆ 23 measuring sites.
- ◆ Moored near the coast.
- ◆ Scalar and directional wave measurements.
- ◆ Radio transmission in real time to a coastal station.
- ◆ ARGOS or INMARSAT tracker (watching position)





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