Western Channel Observatory

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PML’s observational platform:

- **Western Channel Observatory (WCO)** is an oceanographic time-series and marine biodiversity reference site in the Western English Channel.

- **WCO**: “measures several key parameters important to the functioning of the marine ecosystem. Station L4 has some of the longest time-series in the world for zooplankton and phytoplankton”

- **WCO**:
  - E1 1903 – Present
  - L4 1988 – Present
  - Over 100 years sustained observations
  - 200+ refereed publications
  - Numerous PhD thesis
Components of the WCO in-situ sampling programme.

- **Plymouth Marine Laboratory** – Met station and control centre.
- **Rame Head Coast Guard station** – Met Station, AIS receiver and Radio communications.
- **L4 (Coastal environment; 12km south of Plymouth)** Weekly vessel sampling and autonomous scientific data buoy.
- **E1 (Open shelf environment; 35km south of Plymouth)** fortnightly vessel sampling and autonomous scientific data buoy.
- **Four stations for Benthic time series.**
- **New Atmospheric Observatory at the Penlee Point.**
Moorings
PML has operated two data buoys at stations L4 and E1 since 2009. Data from our moorings at L4 and E1 is available in real-time when operational.

Nutrients
Nitrate, nitrite, phosphate, silicate and ammonium nutrient data have been collected since 2000 at station L4. A longer (since 1934), now depth resolved, time-series has been collected at station E1. These data are often available on the day of collection.

CTD
The depth resolved temperature and salinity time-series at E1, started in 1903, is one of the longest in the world. CTD data is available often on the day of collection from stations L4 and E1. Data also included in these profiles are oxygen, fluorescence and PAR.

Optics
Electronic and laboratory based bio-optical measurements have been taken by PML at stations L4 and E1 over the past decade in support of satellite algorithm development work. Measurements include CDOM, Inherent Optical Properties and radiometry.

Sunphotometer data
Atmospheric aerosol data have been derived from sunphotometric data at PML since 2001. This replaced the Rame Head AERONET measurements made in the late 1990s.

Zooplankton
Zooplankton data have been collected by PML since 1988 at station L4. These include zooplankton species and Calanus egg production data.

CHN
CHN analysis has been carried out at L4 since 1992, with the analysis being carried out using a Thermoquest FlashEA 1112 elemental analyzer since 2000.

Phytoplankton
Phytoplankton data have been collected by PML since 1992 at station L4. These data are taxonomically identified by microscopy and since 2007 by flow cytometry.

Pigments
Pigment data have been collected at L4 and E1 since 1998 and analysed using HPLC. These data are complemented by chlorophyll-a measurements analysed using a Turner fluorometer since 1992.

Meteorological data
Standard meteorological parameters have been collected every 5 minutes from the roof of PML since 2003, and a live feed is available. Data is also available from Rame Head.

RV Quest Underway System
The R.V. Plymouth Quest is fitted with an underway suite of sensors, which continuously sample from the vessels non-toxic underway water supply. These data can be downloaded and visualised in Google Earth.

Modelling data
As part of ongoing operational model developments within the NCOF partnership, PML is validating model output against in situ CTD profiles at stations L4 and E1.
WCO: Scientific advancement

2010

- 11 articles
- Pelagic and plankton focus
- Descriptive time-series

2015

- 18 articles
- Pelagic and Benthic
- Emphasis on synthesis
- Physics to fish
• Line of sight wireless communication with PML
• Range of air mass types and pollution levels
• Influence of oceans on land and vice versa
• Measurements:
  – Meteorology
  – Ozone
  – Sulfur dioxide (SO₂)
  – Carbon dioxide (CO₂)
  – Methane (CH₄)
  – Fluxes (CO₂, CH₄, Heat, Momentum)
  – Aerosol composition
Plymouth Quest

- Length = 21.5m, beam = 6.4m and displacement of 205 tonnes.
- Three cabins providing 6 berths.
- Category 2 workboat (60 miles from safe haven).
- 2 x 5 tonne trawl winches.
- Various sweep line winches.
- 5 tonne crane.
- 10 tonne seawater tank.
- Various scientific systems.

PML Explorer

- Length = 6.8m, beam = 2.7m and constructed from GRP.
- Twin 90hp Suzuki outboards, independent fuel and batteries.
- Category 3R workboat (20 miles from safe haven).
- 41 knots top speed. No Anti fouling.
- Shallow draught.
- Quick response sampling.
- Buoy maintenance.
• **SeaBird 32 rosette system**

• Live up the wire communications, for depth determination.

• Data collected at stations L4 and E1 are available through the website.
Underway Scientific Sensor Suite

• Sophisticated sampling suite

• Data currently being used for model development and validation.

• Periodic remote sensing optics to better parameterise remote sensing products.

• Google Earth visualisation.
L4 Autonomous Scientific Data Buoy

- Power and control systems designed for expandability.
- Data sampling every hour with data transmissions and website uploads every three hours.
- Thousands of data points giving insights into tidal cycles, seasonal cycles and annual cycles.
- Measuring short duration blooms missed by the regular sampling.
- Maintaining a significantly important time series as well as providing a platform for technological development.
- Met data transmitted to the Met Office for model forecasting.
- New for 2014, a Met Office AMOS system has been deployed on the buoy.
• Met Office collaboration

• Trinity House responsible for mooring deployment.

• AXYS Watchman control system with Iridium communications.

• Met Office responsible for Meteorological data and Tri-Axys directional wave sensor.

• PML responsible for in water sensors and PAR: temperature, salinity, fluorescence, oxygen, turbidity, CDOM and nutrients.

• High frequency, hourly data set transmitted to both institutes.
E1 Buoy – Storm Events Jan - Feb 2014

Av. and Gust wind (knots), Jan – Feb 2014

Max. and Ave. wave heights (m) Jan – Feb 2014

E1 Sampled with Quest
Nitrate measured on the L4 buoy using a Satlantic ISUS compared with in situ water samples analysed in the laboratory by the PML nutrients group.

\[
y = 0.8322x + 3.1033 \\
R^2 = 0.9665
\]

\[
y = 0.3755x + 2.6943 \\
R^2 = 0.6612
\]

\[
y = 0.8804x + 7.4049 \\
R^2 = 0.8163
\]
Corrected L4 buoy Nitrate 2014

Corrected Nitrate measured on the L4 buoy using a Satlantic ISUS compared with in situ water samples analysed in the laboratory by the PML nutrients group.

- Demonstrates the importance of in situ calibration/validation.
- Met parameters compared with Met Office and Rame Head
- Chlorophyll a calibrated against HPLC
- Satlantic SeaFET pH sensor installed March 2014
- In situ calibrations a major strength of the WCO
Future Developments

- L4 buoy to be upgraded with a new scientific buoy encompassing water column profiling capability.
- Hydrosphere UK won the tender process to provide a purpose built MOBILIS system.
- Wireless Ethernet communications.
- Additional power and control capability for future sensors, including third party developmental sensors.
• Provided sea trials for the AutoNaut on the Western Channel Observatory.
• 11 day deployment with comparison study between AutoNaut and L4 buoy, report produced by Gwyn Griffiths of Autonomous Analytics.
• Highlighted a requirement for further comparisons, proposal submitted.
• The WITT is a technology capable of collecting chaotic movement in any direction and turning it into electrical power.

• Motion test sensor was deployed on the L4 buoy in late 2014 to assist modelling of WITT optimisation for maximum power supply.

• Early 2015 L4 buoy to be fitted with prototype device.
• The Western Channel Observatory has multiple platforms to offer for sensor testing.

• The infrastructure is easily accessible.

• Measurements can be verified by robust Lab based analysis and other sensors on the same platform.

• Already working with one major manufacturer to assist with product testing and verification.

• In discussions with two others to determine suitable testing packages.

• McLane Remote Access Samplers (RAS) will be tested on the L4 buoy prior to deployment on the RAPID array.