**Prince Madog cruise 06/04**
**24,25 February 2004**
**POL Coastal Observatory cruise 15**
**REPORT**

## 1. Objectives

1. At 53º 32´ N 3º 21.8´ W, half a mile west of the Mersey Bar Light Vessel –

To recover
a) A CEFAS wave buoy (replace batteries).
b) A sea bed frame for a 600 kHz ADCP to measure the mean current profile, pressures and directional waves. A pressure recorder, a transmissometer / conductivity / temperature logger and a SeaBird MicroCAT were fitted to the frame.
c) A CEFAS SmartBuoy in a single point mooring with an Aanderaa temperature and conductivity logger at 10 m below the surface.
d) A surface torroid (Telemetry buoy) with an acoustic modem and an Orbcomm satellite communication system.
e) A sea bed frame for a 600 kHz ADCP (Telemetry ADCP) to measure mean current profile and pressures. An acoustic modem was also fitted and linked to the ADCP.

To deploy

f) Deploy a Rapid Lander (on test – recovery planned 2 March)
g) A sea bed frame for a 600 kHz ADCP (Mean ADCP) to measure the mean current profile, pressures and directional waves. A pressure recorder, a transmissometer / conductivity / temperature logger and a SeaBird MicroCAT were also fitted to the frame.
h) A CEFAS SmartBuoy in a single point mooring with a SeaBird MicroCAT temperature, conductivity logger at 5m below the surface and an Aanderaa temperature and conductivity logger at 10 m below the surface.
i) A CEFAS wave buoy
j) A sea bed frame for a 600 kHz ADCP (Telemetry ADCP) to measure mean current profile and pressures. An acoustic modem was also fitted and linked to the ADCP.
k) A surface torroid (Telemetry buoy) with an acoustic modem and an Orbcomm satellite communication system.

2. To conduct a CTD / LISST survey of 34 stations every 5 miles covering the eastern Irish Sea between the North Wales coast and Blackpool and the Lancashire coast and the Great Orme, to determine the effects of the rivers Dee, Mersey and Ribble on Liverpool Bay. To obtain calibration samples for salinity, transmittance, suspended sediment and for chlorophyll at selected stations. To obtain water samples for nutrient determination.

## 2.1 Scientific personnel

Phil Knight
Mike Burke
Mike Smithson
Jeff Pugh
Dave Pearce (CEFAS)

Claire Davis (School of Ocean Sciences)
Rob Ferris (School of Ocean Sciences)
Anne Hammerstein (School of Ocean Sciences)

**2.2 Ship's officers and crew**

Alan Price (Master)
Ian Bosworth (Chief Officer)
A. Williams (Chief Engineer)
N. Holmes (Second Engineer)
T. Roberts (Bosun)
D.D. Williams (A.B.)
D. Lloyd-Jones (A.B.)
E. Pritchard (Cook)

**3. Narrative** (times in GMT)

The SmartBuoy torroid, anchor chain, sea-bed frames and instrumentation were loaded onto RV Prince Madog on the afternoon of 23 February 2004. (The torroid was rolled down the walkway.) The ADCP frame was set up on the afterdeck, the Rapid Lander assembled and the tower and instruments fitted to the SmartBuoy torroid.

RV Prince Madog left Menai Bridge at 08:35 on 24 January. Recording of surface sampling and the ship's ADCP were switched on at 09:26, near Puffin Island, see Fig. 1 for the cruise track. The mooring for the Rapid Lander was put together and general deck tidying.

Arrived at the main site at 11:54. At 12:07 a CTD (Station 1, CTD1) was carried out for calibration purposes. At 12:37 the Rapid Lander was deployed (its anchor released at 12:40). At 12:37 an attempt was made to recover the wave buoy, however this was abandoned due to the sea state (large waves generated by a NNW wind, force 5 together with the strong tidal flow).

At 13:01 the Mean ADCP release was fired. Since it did not appear at the surface the second pyro was fired and it came to the surface at 13:45. The Mean ADCP was on deck at 13:56 and its ballast weight by 14:05. The replacement Mean ADCP was deployed at 14:37 and the SmartBuoy between 15:12 and 15:15.

The previous SmartBuoy, covered in slime, was recovered between 15:32 and 15:45. It was particularly difficult to recover due to the sea state and its overall size and shape.

The Telemetry buoy was recovered between 16:00 and 16:11 and the Telemetry ADCP at 16:30. The Telemetry ADCP ballast weights were lost when a rope snapped connecting them to the ADCP frame.

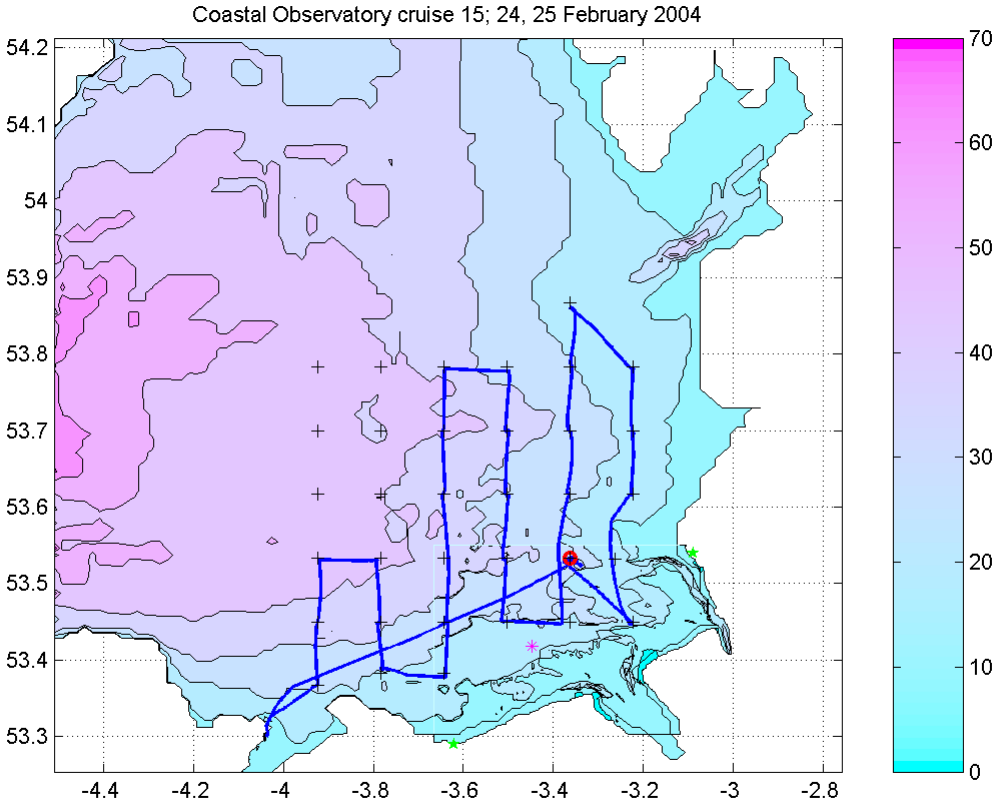
The CTD survey then commenced at 17:09 with another CTD (Station1, CTD 2) (See Figure 1, showing track and CTD locations). Water samples were obtained from near surface and near bed bottles for nutrient analysis by David Hydes at SOC (see Table 3). The next CTD station was number 10, followed by Station 35. Stations were then visited in the following

order, 2-9, 11-25, 32-34. Other stations were missed due to time constraints and rapidly deteriorating weather conditions (Winds from the North, force 7).

Temperatures varied between 5.5ºC (inshore) and 7.4ºC (offshore) and salinities between 30.0 and 33.8.

Surface sampling was switched off at 16:25, near Puffin Island. RV Prince Madog was alongside at Menai Bridge at 17:30. Most of the mooring objectives were accomplished and most of the CTD sites were visited. NNW winds ranged from force 5-7 (force 3 at the southern end of the survey) during the cruise with large waves.

Figure 1. Cruise track




**4. Moorings** (times in GMT)

**4.2 The set up of the recovered instruments was as follows:**

a) Mean ADCP 600 kHz RDI 3644; battery case 3070.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m $s^{-1}$).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Fitted with a pressure sensor and 1 Gbyte memory; hourly wave recording enabled.
Clock set at 14:08:00 on 16 December 2003, delayed start 07:00:00 on 17 December.
Stopped at 14:49 24 February 2004.

Aanderaa pressure recorder BPR 1357, DSU 8125: 10 minute sampling, Clock set at 13:47:30 on 16 December 2003, started 13:50 on 16 December 2003 (no time stamp at beginning); first reading at 13:50:49. Last reading at 14:41:30 on 3 March 2004. Switched off at 14:42 on 3 March 2004. Clock is 1 minute 32 seconds slow.

25 cm Sea-Tech Transmissometer, ST556, recording in Aanderaa logger (RCM7 11820 /DSU 13101) fitted with temperature and conductivity sensors. 10 minute sampling, clock set at 17:55:10 on 16 December, started at 18:00:00 on 16 December 2003.
First air reading at 18:20 & last air reading at 21:30 on 16 December 2003.
First blocked path reading 21:40 on 16 December & last blocked path reading at 06:30 on 17 December 2003. Air readings from 06:40 to 09:40 17 December 2003. CTD calibration, CTD 1 11:40 and 11:50 17 December 2003. Switched off at 12:01:10 on 3 March 2004. Clock is 1 minute 14 seconds slow.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2081 – ID=02). Clock set at 15:12:00 on 26/12/2003. Delayed start 12:00:00 on 17/12/2003. No CTD calibration carried out. Stopped at 13:57 on 3 March 2004. Clock 10 seconds fast.

The frame, D3, was fitted with two Benthos releases, 5A (s/n 44056) – Pyro OTD97, 3A (s/n 40266) – Pyro OTD96, and a spooler with 200m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring. Aanderaa current meter RCM7 9631 / DSU 8117 without fin at 10 m below the surface to log temperature and conductivity: 10 minute samples.
Clock set at 17:37:15 on 16 December 2003, started at 17:40:00 on 16 December 2003.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2010 – ID=01) at 5m below the surface. Clock set at 15:57:10 on 16/12/2003. Delayed start 12:00:00 on 17/12/2003. No pre-deployment calibration. 600 second interval. Sample num = 0. Reference pressure 25m. Stopped at 11:52 on 3 March 2004. Clock 32 seconds fast.

The single point mooring was composed mainly of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

c) Telemetry Mean ADCP 600kHz RDI 2390; battery case 0250
Clock set at 14:34:30 on 16 December 2003, delayed start at 06:50:00 on 17 December 2003. It was setup to record 10 minutes averages recording internally and also to send a sub-set of data (PD12 format) every hour (on the hour) via a LinkQuest modem to the Telemetry buoy. LinkQuest recommend that the acoustic modem should not be used in air at full power. Therefore it was plugged into its battery pack just after the hour and quickly deployed.

The frame, D1, was fitted with two Benthos releases, 4B(s/n 52302) – Pyro OTD95, 4A (s/n 44068) – Pyro OTD93, and a spooler with 200m of rope for recovery of ballast weight.

d) Telemetry buoy
Made up of a standard POL torroid with a LinkQuest acoustic modem and a Orbcomm satellite system. Both devices have separate battery packs. The Acoustic modem was attached to the Orbcomm satellite system. It was setup to send E-mails once every hour, containing data from ADCP RDI 2390 (Format PD12) received by the acoustic modem link.

Table 1. Recovered mooring positions and times.

| | Latitude (N) | Longitude (W) | Water Depth (m) | Recovery Time | Date |
|---|---|---|---|---|---|
| SmartBuoy | 53º 32.027′ | 3º 21.857′ | 23.0 | 15:32 | 24/02/04 |
| Mean ADCP | 53º 32.012′ | 3º 21.667′ | 23.0 | 13:01 | 24/02/04 |
| Telemetry ADCP | 53º 31.987′ | 3º 21.733′ | 25.0 | 16:30 | 24/02/04 |
| Telemetry Buoy | 53º 31.953′ | 3º 21.732′ | 22.0 | 16:00 | 24/02/04 |

**4.2 The set up of the deployed instruments was as follows:**

a) Mean ADCP 600 kHz RDI 2391; battery case 68.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m $s^{-1}$).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Fitted with a pressure sensor and 512Mb memory; hourly wave recording enabled.
Clock set at 14:05:00 on 23 February 2004, delayed start 07:00:00 on 24 February.

Aanderaa pressure recorder BPR 444, DSU 3994: 10 minute sampling, Clock set at 15:31:00 on 23 February 2004, started 15:40 on 23 February 2004, first reading at 15:40:46.

25 cm Sea-Tech Transmissometer, ST557, recording in Aanderaa logger (RCM7 11814 /DSU 8122) fitted with temperature and conductivity sensors. 10 minute sampling, clock set at 16:22:00 on 23 February, started at 16:30:00 on 23 February 2004.
First air reading at 17:30 & last air reading at 22:10 on 23 February 2004.
First blocked path reading 22:20 on 23 February & last blocked path reading at 06:50 on 24 February 2004. Air readings from 07:00 to 08:30 24 February 2004. CTD calibration, CTD 1 12:10 and 12:20 24 February 2004.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2506 – ID=03). Clock set at 16:00:00 on 23/02/2004. Delayed start 12:00:00 on 24/02/2004.

The frame, D2, was fitted with two Benthos releases, 7A (s/n 44041) – Pyro OTD94, D (s/n 69676), and a spooler with 200m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring. Aanderaa current meter RCM7 9959 / DSU 8123 without fin at 10 m below the surface to log temperature and conductivity: 10 minute samples.
Clock set at 15:46:00 on 23 February 2004, started at 15:50:00 on 23 February 2004.

The single point mooring was composed mainly of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

Table 2. Deployed mooring positions and times.

| Latitude (N) | Longitude (W) | Water Depth (m) | Deployment Time | Date |
|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| SmartBuoy | 53º 32.086′ | 3º 21.595′ | 27.0 | 15:12 | 24/02/04 |
| Mean ADCP | 53º 31.902′ | 3º 21.692′ | 28.0 | 14:37 | 24/02/04 |
| Rapid Lander | 53º 31.788′ | 3º 20.822′ | 28.0 | 12:37 | 24/02/04 |

## 5. CTD

The Sea-Bird 911 CTD recorded light levels (CEFAS light sensor), temperature, conductivity, transmittance, oxygen and fluorescence at 24 Hz. Since the frame was fitted with an altimeter measurements were taken to within 3 m above the bed. Two water bottles were fired near bed and two near the surface, when needed. One of the near bed bottles was fitted with two electronic thermometers to check the CTD temperature data. Water samples were taken from this bottle for calibration of the CTD salinity data. Water samples were taken from the near surface and near bed bottles and frozen for nutrient analysis by SOC, and also were filtered to determine suspended sediment load and calibrate the CTD transmissometer, by the School of Ocean Sciences. Water samples from the second near surface bottle from stations1, 5 – 9 and 11 were filtered for chlorophyll and suspended sediment determination and some filtrate was preserved with mercuric chloride for nutrient determination by CEFAS. A LISST-25 particle sizer was fitted to the CTD and its data logged on the Sea-Bird data logging system. Copies of the Sea-Bird binary files were taken off for processing at BODC / POL.

Table 3. Nominal CTD positions.

| Site | Latitude (N) | Longitude (W) | Visited on this cruise | Chlorophyll & nutrients | Suspended Sediments nutrients |
|---|---|---|---|---|---|
| 1 | 53º 32′ | 3º 21.8′ | yes | yes | yes |
| 2 | 53º 37′ | 3º 13.4′ | yes | | yes |
| 3 | 53º 42′ | 3º 13.4′ | yes | | yes |
| 4 | 53º 47′ | 3º 13.4′ | yes | | yes |
| 5 | 53º 52′ | 3º 21.8′ | yes | yes | |
| 6 | 53º 47′ | 3º 21.8′ | yes | yes | |
| 7 | 53º 42′ | 3º 21.8′ | yes | yes | |
| 8 | 53º 37′ | 3º 21.8′ | yes | yes | |
| 9 | 53º 32′ | 3º 21.8′ | yes | yes | |
| 10 | 53º 27′ | 3º 13.4′ | yes | | |
| 11 | 53º 27′ | 3º 21.8′ | yes | yes | |
| 12 | 53º 27′ | 3º 30.2′ | yes | | |
| 13 | 53º 32′ | 3º 30.2′ | yes | | |
| 14 | 53º 37′ | 3º 30.2′ | yes | | |
| 15 | 53º 42′ | 3º 30.2′ | yes | | yes |
| 16 | 53º 47′ | 3º 30.2′ | yes | | yes |
| 17 | 53º 47′ | 3º 38.6′ | yes | | yes |
| 18 | 53º 42′ | 3º 38.6′ | yes | | yes |
| 19 | 53º 37′ | 3º 38.6′ | yes | | yes |
| 20 | 53º 32′ | 3º 38.6′ | yes | | yes |
| 21 | 53º 27′ | 3º 38.6′ | yes | | yes |
| 22 | 53º 23′ | 3º 38.6′ | yes | | yes |
| 23 | 53º 23′ | 3º 47.0′ | yes | | |

| | | | | |
|---|---|---|---|---|
| 24 | 53º 27′ | 3º 47.0′ | yes | |
| 25 | 53º 32′ | 3º 47.0′ | yes | |
| 26 | 53º 37′ | 3º 47.0′ | no | |
| 27 | 53º 42′ | 3º 47.0′ | no | |
| 28 | 53º 47′ | 3º 47.0′ | no | |
| 29 | 53º 47′ | 3º 55.4′ | no | |
| 30 | 53º 42 | 3º 55.4′ | no | |
| 31 | 53º 37′ | 3º 55.4′ | no | |
| 32 | 53º 32′ | 3º 55.4′ | yes | |
| 33 | 53º 27′ | 3º 55.4′ | yes | |
| 34 | 53º 22′ | 3º 55.4′ | yes | yes |
| 35 | 53º 32′ | 3º 15.9′ | yes | yes |

## 6. Surface sampling

The intake for the surface sampling system is located underneath RV Prince Madog, at about 3 m below sea level. The parameters recorded every minute by the WS Oceans system are: Date, Solar Radiation (W $m^{-2}$), PAR (µmols / $m^2s$), Air Temperature (ºC), Relative Humidity, Relative Wind Speed (m $s^{-1}$), Relative Wind Direction (º) – zero indicates wind on the bow, Transmissance, Hull Temperature (ºC), Barometric Pressure (mbar), Fluorescence, Turbidity, Salinity, Minimum Air Temp (ºC), Maximum Air Temp (ºC), Wind Gust (m $s^{-1}$), GPS Time, Latitude, Longitude, Barometric Pressure Minimum (mbar), Barometric Pressure Maximum (mbar), Conductivity sensor water temperature (ºC).

Data were recorded from 09:26 on 24 February near Puffin Island, until 16:25 on 25 February, also near Puffin Island. Copies of the data were taken off the ship as an Excel file, along with a copy of the ship's navigation data.

The ship was fitted with a 300 kHz ADCP set to record 25 x 2m bins, the bin nearest the surface was at 5.1 m depth, every 30 seconds with 28 pings / ensemble and data were recorded between 09:27 on 24 February and 16:25 on 25 February.

**Acknowledgements**
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