Prince Madog cruise 22/04
POL Coastal Observatory cruise 18
8 - 11 June 2004

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 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.
b) 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.

To deploy
c) A sea bed frame for a 600 kHz ADCP (waves 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.
d) 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.
e) A wave rider buoy

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 and suspended sediment

3. Recover a sea bed frame from 53º 23´ N 4º 41.925´ W (off Holyhead) for ADCP, ADV and LISST deployed during CASIX cruise May 2004.

2.1 Scientific personnel
Mike Burke
Jason Holt (principal)
Mike Smithson
John Kenny
Ray Wilton
Dave Pearce (CEFAS)
Dave Sivyer (CEFAS)

2.2 Ship's officers and crew

3. Narrative (times in GMT)

The SmartBuoy toroid, wave rider buoy, anchor chain, sea-bed frame and instrumentation were loaded onto RV Prince Madog on 8 June May 2004. (The toroid was rolled down the

walkway.) The ADCP frame was set up on the afterdeck and the tower and instruments fitted to the SmartBuoy toroid.

RV Prince Madog left Menai Bridge at 07:00 on 9 June 2004 in drizzle and weak winds. Recording of surface sampling and of the ship's ADCP started at 08:04, past Puffin Island, see Figure. 1 for the cruise track.

On arrival at the mooring site at 10:30 the transmissometer CTD calibration (number 1) was carried out at 10:40. SPM took over 1 hour to filter.

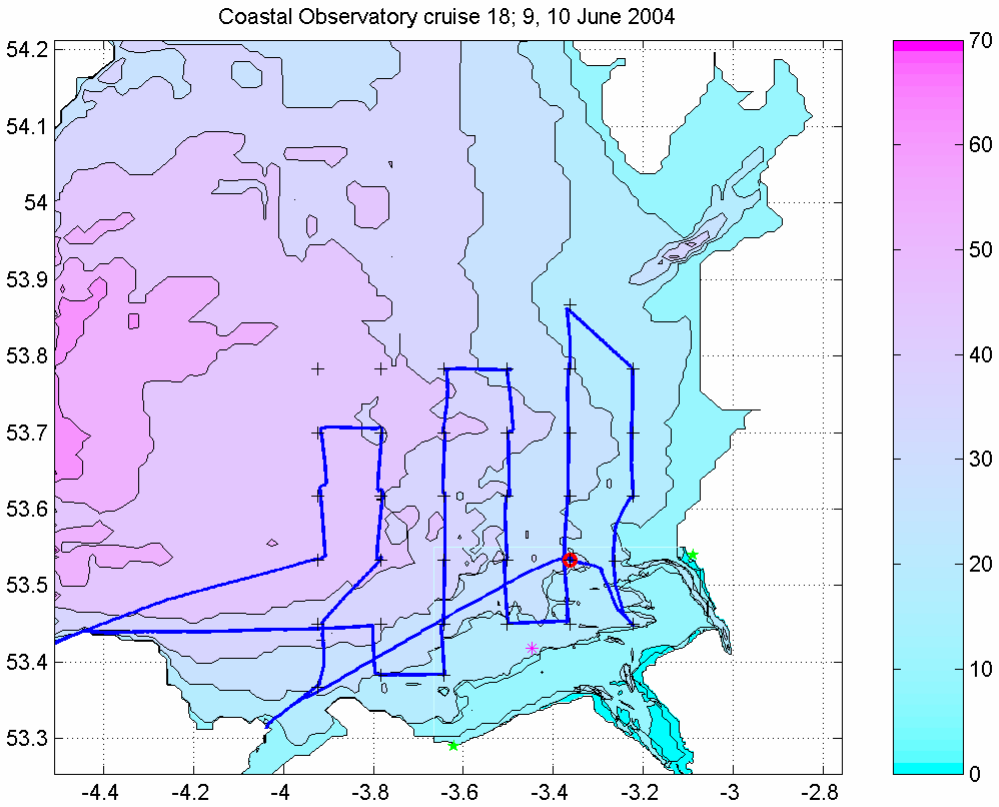
The wave rider buoy was deployed at 11:00 and a search made for the bottom half of the previous mooring; this was unsuccessful.

The ADCP was released at 11:55, was on deck at 12:05 and its ballast weight recovered by 12:15. The replacement ADCP was deployed at 12:30.

The SMART buoy was deployed at 12:56 and the original smart buoy recovered and its instrumentation removed.

The mooring work was completed by 15:00 in good weather but mild rolling.

Figure 1. Cruise track



The CTD survey started at 15:05 at station 10, then 35, and going around 2 - 24 going round (see Figure 1, showing track and CTD locations and Table 1). Water samples were obtained

from near surface and near bed bottles for nutrient analysis by David Hydes at SOC, but due to lack of personnel and slow filtering, SPM measurements where only made occasionally.

Broke off CTD survey at station 24 to recover Holyhead ADCP at 06:30 on 10 June 2004. Arrived at mooring site at 9:45 in freshening winds. Raised ADCP at 9:55, after firing pyro; the burn wire did not appear to have worked. ACDP on deck at 10:00 in good order except the ADV had rotated on its arm. The ballast was recovered at 10:05.

Steamed to rejoin the CTD survey at station 32, then proceed around track in reverse order: 32, 31,30,27,26,25,33,34. Stations 28 and 29 where omitted due to the prospect of bad weather.

Returned to Menai Bridge, docking at 19:30. Unloaded on 11 June 2004.

4. Moorings (times in GMT)

4.1 The set up of the recovered instruments was as follows:

a) Mean ADCP 600 kHz RDI 3644; battery case 0250, fitted with new batteries.
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 reset at 14:55:00 on 10 May 2004, delayed start 06:00:00 on 11 May.
The ADCP was stopped at 00:10 on 10 June 2004.
The record length is 141,017,088 bytes.

Aanderaa pressure recorder BPR 444, DSU 3994: 10 minute sampling.
Clock set at 14:21:00 on 10 May, started 14:30:00 on 10 May 2004, first reading at 14:30:47.
Stopped at 09:04:38 on 10 June 2004; clock 5 s fast. 22352 words.

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 16:27:30 on 10 May, started at 16:30:00 on 10 May 2004.
First air reading at 16:50 on 10 May & last air reading at 22:00 on 10 May 2004.
Blocked path reading between 22:10 on 10 May 2004 and 05:50 on 11 May 2004.
CTD calibration, CTD 1 on 11 May 2004.
Stopped at 11:23:25 on 10 June 2004; clock is 10 s slow. 26796 words.

SeaBird MicroCAT temperature, conductivity recorder (37SM32218-2991 – ID=01).
10 minute sampling. Reference pressure 25dB.
Clock set at 14:47:00 on 10/05/2004. Delayed start 12:00:00 on 11/05/2004.
Stopped at 23:03 on 9 June 2004; clock 9 s fast. Samplenum = 4243.
Clock reset at 23:52:45 on 9 June 2004; sample interval 10 s; delayed start 00:30 on 10 June 2004.
Calibration CTD 17, Station 15 – on bottom 00:42 to 00:45.
Stopped 01:04:13 on 10 June. Samplenum =4449.

The frame, D4, was fitted with two Benthos releases, 11.5kHz A (s/n 44068) – Pyro OTD104 and 14.5kHz B (s/n 44041) – Pyro OTD105, and a spooler with 200m of rope for recovery of the ballast weight. Release 44068 (pyro OTD104) fired.

b) SmartBuoy Mooring.
SeaBird MicroCAT temperature, conductivity, pressure recorder (37IM29828-2506 – ID=03) at 5 m below the surface. 10 minute samples.
Clock set at 15:36:30 on 10/05/2004. Delayed start 12:00:00 on 10/05/2004.
Stopped at 23:09 on 9 June 2004; clock 9 s fast. Samplenum = 4243.
Clock reset at 23:50:00 on 9 June; sample interval 10 s; delayed start 00:30 on 10 June.
Calibration CTD 17, Station 15 –on bottom 00:42 to 00:45.
Stopped 01:01:35 on 10 June. Samplenum 4433.

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 15:15:30 on 10 May 2004, started at 15:20:00 on 10 May 2004.
Stopped at 10:41:34 on 10 June 2004; clock 30 s slow. 26184 words.

The CEFAS SmartBuoy is fitted with 2 surface CTDS, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (nitrate, nitrite, phosphate) determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm.

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) Holyhead ADCP
ADCP 600 kHz RDI 2391; battery case 3070, fitted with new batteries.
Mode 1: 1 ping per second, 20 minute burst per hour, recording every ping.
45 x 1 m bins, first bin at 1.99 m.
Beam co-ordinates - speeds, echo intensity.
Sound velocity calculated from temperature, depth and salinity of 32.
Fitted with a pressure sensor and 1 Gbyte memory.
Clock set at 16:25:00 on 30 April 2004, delayed start 06:00:00 on 02 May 2004.
Stopped at 19:57 on 10 June 2004.
The record length is 775,200,768 bytes.

The frame was fitted with two Benthos releases, 11.5kHz D (s/n 69676) – burn wire and 11.5kHz B (s/n 52301) – pyro, and a spooler with 200m of rope for recovery of the ballast weight. Both releases fired.

Table 1. Recovered mooring positions and times.

Latitude (N)	Longitude (W)	Water Depth (m)	Recovery Time	Recovery Date

Waves ADCP	53º 31.955′	3º 21.561′	22	12:07	9/06/04
SmartBuoy	53º 31.899′	3º 21.547′	24	13:10	9/06/04

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

d) Mean ADCP 600 kHz RDI 3036; battery case 2390.
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 13:47:00 on 8 June 2004; delayed start 06:00:00 on 9 June – started on time.

Aanderaa pressure recorder BPR 1357, DSU 8125: 10 minute sampling.
Clock set at 14:26:00 on 8 June; started 14:30:00 on 8 June, first reading at 14:30:49, no time stamp.

25 cm Sea-Tech Transmissometer, ST637, recording in Aanderaa logger (RCM7 11820 / DSU 13101) fitted with temperature and conductivity sensors. 10 minute sampling.
Clock set at 16:12:00 on 8 June 2004; started at 16:20:00 on 8 June.
Air readings between 16:40 and on 8 June 2004 and 00:30 on 9 June 2004.
Blocked path readings between 00:40 and 08:50 on 9 June 2004.
CTD calibration, CTD 1 at 10:40 on 9 June 2004.

SeaBird MicroCAT temperature, conductivity recorder (37 IM29828 –2081, ID=02).
10 minute sampling. Reference pressure 25dB.
Clock set at 14:55:20 on 8 June 2004; delayed start at 12:00:00 on 9 June 2004.

The frame, D5, was fitted with two Benthos releases 40266 – 11.0 kHz A, pyro OTD103 and 44056 - 13.5 kHz A, pyro OTD104, and a spooler with 200m of rope for recovery of the ballast weight.

e) SmartBuoy Mooring.
SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2010 – ID=01) at 5 m below the surface. 10 minute samples. Reference pressure 25dB.
Clock set at 15:10:00 on 8 June 2004. Delayed start 12:00:00 on 19 June.

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 15:17:20 on 8 June 2004; started at 15:20:00 on 8 June.

The CEFAS SmartBuoy is fitted with 2 surface CTDS, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (nitrate, nitrite, phosphate) determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm.

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
Waverider	53º 32.040′	3º 21.36′	20	11:10	09/06/04
Waves ADCP	53º 31.997′	3º 21.65′	22	12:35	09/06/04
SmartBuoy	53º 32.025′	3º 21.74′	24	12:57	09/06/04

5. CTD

The Sea-Bird 911 CTD recorded downwelling PAR light levels (CEFAS light sensor), temperature, conductivity, transmittance, oxygen (no calibration samples) and fluorescence at 24 Hz. The frame was fitted with an altimeter, which was not totally reliable, so that measurements were taken to within an estimated 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. (At the CEFAS stations, see below, this bottle was fired near the surface). Water samples were taken from the near surface and near bed bottles and frozen for nutrient analysis by SOC (nitrate, phosphate, silicate), and also a few were filtered to determine suspended sediment load and calibrate the CTD transmissometer, by the School of Ocean Sciences. Filtering for SPM was carried at cast 1, 11, 12, 13 (near surface only), and 27.

Water samples from the second near surface bottle from stations 1, 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 and calibration at BODC / POL.

One CTD was recorded during mooring operations (CTD1). No water samples were obtained during the first which was primarily to calibrate the transmissometer about to be deployed on the ADCP frame. CTDs 2 – 35 were recorded round the grid, see Table 1.

One CTD (cast 027) was made during at the Holyhead mooring recovery at 53º23 4º41.95 in 37.5m with SPM samples.

Zooplankton Nets where used at Station 1: 5 dips with 1m and 5 dips with 0.5m

Table 3. Nominal CTD positions.

Site	CTD	Latitude (N)	Longitude (W)	Visited on this cruise	Chlorophyll & nutrients	nutrients
1	2	53º 32′	3º 21.8′	yes	yes	yes
2	5	53º 37′	3º 13.4′	yes		yes
3	6	53º 42′	3º 13.4′	yes		yes
4	7	53º 47′	3º 13.4′	yes		yes
5	8	53º 52′	3º 21.8′	yes	yes	yes
6	9	53º 47′	3º 21.8′	yes	yes	yes
7	10	53º 42′	3º 21.8′	yes	yes	yes

8	11	53º 37′	3º 21.8′	yes	yes	yes
9	12	53º 32′	3º 21.8′	yes	yes	yes
10	3	53º 27′	3º 13.4′	yes		yes
11	13	53º 27′	3º 21.8′	yes	yes	yes
12	14	53º 27′	3º 30.2′	yes		yes
13	15	53º 32′	3º 30.2′	yes		yes
14	16	53º 37′	3º 30.2′	yes		yes
15	17	53º 42′	3º 30.2′	yes		yes
16	18	53º 47′	3º 30.2′	yes		yes
17	19	53º 47′	3º 38.6′	yes		yes
18	20	53º 42′	3º 38.6′	yes		yes
19	21	53º 37′	3º 38.6′	yes		yes
20	22	53º 32′	3º 38.6′	yes		yes
21	23	53º 27′	3º 38.6′	yes		yes
22	24	53º 23′	3º 38.6′	yes		yes
23	25	53º 23′	3º 47.0′	yes		yes
24	26	53º 27′	3º 47.0′	yes		yes
25	33	53º 32′	3º 47.0′	yes		yes
26	32	53º 37′	3º 47.0′	yes		yes
27	31	53º 42′	3º 47.0′	yes		yes
28		53º 47′	3º 47.0′	no		no
29		53º 47′	3º 55.4′	no		no
30	30	53º 42	3º 55.4′	yes		yes
31	29	53º 37′	3º 55.4′	yes		yes
32	28	53º 32′	3º 55.4′	yes		yes
33	34	53º 27′	3º 55.4′	yes		yes
34	35	53º 22′	3º 55.4′	yes		yes
35	4	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). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC.

Data were recorded every minute from 08:17 on 9 June, near Puffin Island on the way out, until 18:52 on 10 June, near Puffin Island on the way back. 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 29 pings / ensemble. Data were recorded between 08:17 on 9 June and 18:52 on 10 June.

Acknowledgements
The assistance of the Captain, officers, bosun and crew contributed greatly to the success of the cruise.