Prince Madog cruise 48/03
17,18 December 2003
POL Coastal Observatory cruise 14
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 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 an Aanderaa temperature and conductivity logger at 10 m below the surface.

To deploy
c) 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.
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 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.
f) 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, and for chlorophyll at selected stations. To obtain water samples for nutrient determination and grab samples of sediment.

3. At 53º 22´ N 3º 55.4´ W, Station 34 – To deploy a new WaveBuoy at Station 34 on the outbound leg and to recover it on the inbound leg.

2.1 Scientific personnel

Phil Knight
Mike Burke
Andrew Lane
Mike Smithson
John Humphrey
Jeff Pugh
Dave Sivyer (CEFAS)
Steve McGlynn (School of Ocean Sciences)
Chris Wood (School of Ocean Sciences)

Ray Wilton (School of Ocean Sciences)

2.2 Ship's officers and crew

Steve Duckworth (Master)
A.D. Price (Chief Officer)
H. Owen (Chief Engineer)
N. Holmes (Second Engineer)
P. Jones (Bosun)
T. Roberts (A.B.)
M. Williams (A.B.)
M. Downey (Cook)

3. Narrative (times in GMT)

The SmartBuoy and Orbcomm torroids, anchor chain, sea-bed frames and instrumentation were loaded onto RV Prince Madog on the afternoon of 16 December 2003. (The torroids were rolled down the walkway.) The ADCP frames were set up on the afterdeck, the Orbcomm Buoy fitted out and the tower and instruments fitted to the SmartBuoy torroid.

RV Prince Madog left Menai Bridge at 07:45 on 17 December. Recording of surface sampling and the ship's ADCP were switched on at 08:45, near Puffin Island, see Fig. 1 for the cruise track. Station 34 was reached at 09.15 and the WaveBuoy deployed by 09:22. Prior to arriving at the mooring site at 11:27 the deck was tidied up to make room for recoveries.

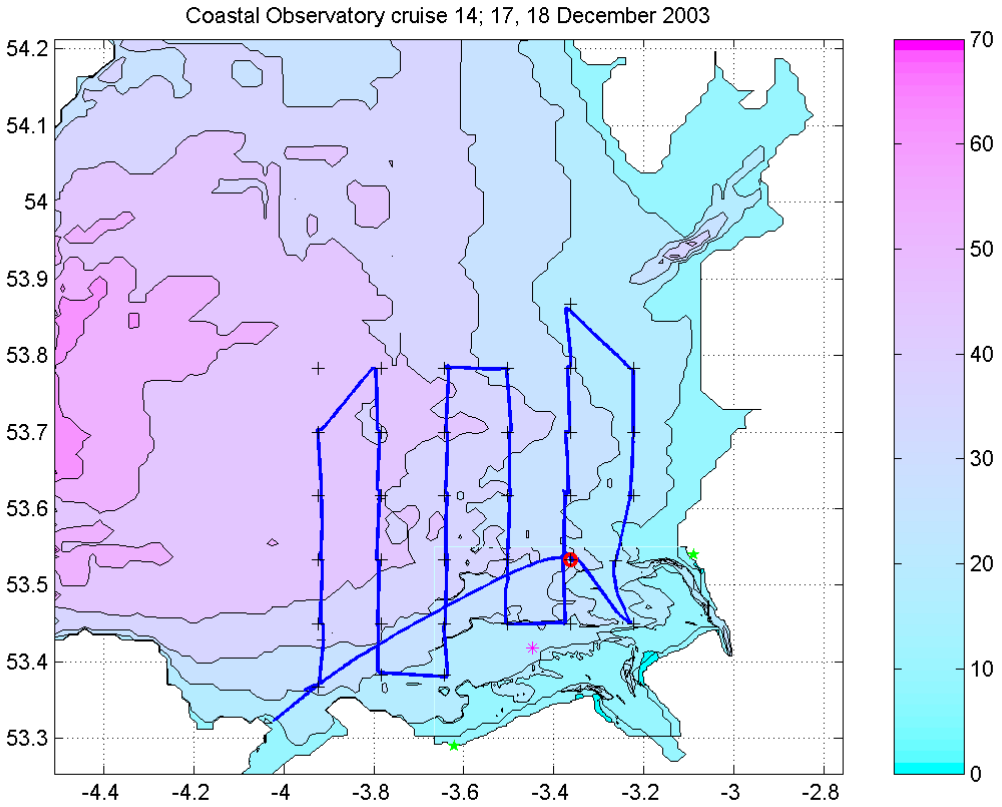
At 11:31 a CTD (Station 1) was carried out for calibration purposes. At 12:08 the ADCP release was fired, the ADCP was on deck at 12:15 and its ballast weight was on the deck by 12:23. The replacement Mean ADCP was deployed at 12:43 and the SmartBuoy between 13:11 and 13:15. The previous SmartBuoy, covered in slime, was recovered between 13:20 and 13:25. The Telemetry buoy was deployed between 13:54 and 13:58 and the Telemetry ADCP at 14:31.

The CTD survey then commenced at 14:43 with another CTD (Station1) (See Figure 1, showing track and CTD locations). Water samples were obtained from all near surface and near bed bottles for nutrient analysis by David Hydes at SOC and mud samples taken at selected sites (see Table 3). The next CTD station was number 10, followed by a new CTD station (Station 35), positioned to the east of Station 1. Stations were then visited in the following order, 2-28, 30-34. CTD at Station 20 was carried out slightly off position due to localised shipping traffic. Station 29 was missed out due to time constraints and the requirement to recover the WaveBuoy in day-light. The WaveBuoy at Station 34 was recovered between 14:12 and 15:00 on the 18 December 2003.

Temperatures varied between 7.1ºC (inshore) and 10.4ºC (offshore) and salinities between 31.5 and 34.1.

Surface sampling was switched off at 14:50, near Puffin Island. RV Prince Madog was alongside at Menai Bridge at 16:20. All of the mooring objectives were accomplished and all the CTD sites were visited except for Station 29.

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 2391; battery case 0068.
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 13:55:10 on 27 October 2003, delayed start 06:00:00 on 28 October; checked.
Stopped 17 December 2003, at 22:52, clock is 1 minute 38 seconds fast.

Aanderaa pressure recorder BPR 444, DSU 8123: 10 minute sampling, Clock set at 14:27:00 on 27 October 2003, started 14:30 on 27 October, 2003; first reading at 14:30:45.
Last reading at 00:10:50 (approx) on 18 December 2003, switched off at 00:12:10. Clock is 1 minute slow.

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 15:42:30 on 27 October, started at 15:50:00 on 27 October 2003.

First air reading at 16:00 & last air reading at 20:30 on 27 October 2003.
First blocked path reading 20:40 on 27 October & last blocked path reading at 08:10 on 28 October 2003. CTD calibration, CTD 1 11:30 and 11:40.
Switched off at 18 December 2003, at 00:48, clock is 24 seconds slow.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2506 – ID=03). Clock set at 08:39:30 on 28/10/2003. Delayed start 11:20:00 on 28/10/2003, 10 second sampling, for calibration on CTD 1. Restarted on 10 minute sampling, delayed start 12:30:00 on 28/10/2003, sample num = 227.
Stopped at 01:59:20 on 18 December 2003. Clock is 16 seconds fast.

The frame, D2, was fitted with two Benthos releases, 8A (s/n 44059) – Pyro OTD94, 7A (s/n 44041) – Pyro OTD92, and a spooler with 200 m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring. Aanderaa current meter RCM7 9959 / DSU 8118 without fin at 10 m below the surface to log temperature and conductivity: 10 minute samples.
Clock set at 14:44:45 on 27 October 2003, started at 14:50:00 on 27 October 2003.
Switched off at 21:42 on 17 December 2003. Clock is 1 minute 52 seconds slow.

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 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovery Time	Date
SmartBuoy	53º 32.017′	3º 21.771′	24.0	13:20	17/12/03
ADCP	53º 32.019′	3º 21.616′	23.0	12:08	17/12/03

4.2 The set up of the deployed 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.

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.

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.

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.

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.

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.

e) WaveBuoy
Deployed on trial at CTD station 34 on the way out to the main mooring site.

Table 2. Deployed mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployment Time	Date
SmartBuoy	53º 32.027′	3º 21.857′	23.0	13:12	17/12/03
Mean ADCP	53º 32.012′	3º 21.667′	23.0	12:43	17/12/03

Telemetry ADCP	53º 31.987′	3º 21.733′	25.0	14:31 17/12/03
Telemetry Buoy	53º 31.953′	3º 21.732′	22.0	13:58 17/12/03
Waverider	53º 22.275′	3º 55.509′	22.0	Deployed 09:22 17/12/03 Recovered 14:12 18/12/03

5. CTD

The Sea-Bird 911 CTD recorded light levels (CEFAS light sensor), temperature, conductivity, transmittance and fluorescence at 24 Hz (No oxygen sensor). 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. Sediment grabs were also taken at some of the CTD sites with the Shipek grab. A new CTD station (station 35) was started, nearer to the Mersey entrance than the main mooring site.

Table 3. Nominal CTD positions.

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Chlorophyll & nutrients	Suspended Sediments / nutrients	Grab samples
1	53º 32′	3º 21.8′	yes	yes	yes	yes
2	53º 37′	3º 13.4′	yes		yes	yes
3	53º 42′	3º 13.4′	yes		yes	yes
4	53º 47′	3º 13.4′	yes		yes	yes
5	53º 52′	3º 21.8′	yes	yes	yes	yes
6	53º 47′	3º 21.8′	yes	yes	yes	yes
7	53º 42′	3º 21.8′	yes	yes	yes	yes
8	53º 37′	3º 21.8′	yes	yes	yes	yes
9	53º 32′	3º 21.8′	yes	yes	yes	yes
10	53º 27′	3º 13.4′	yes		yes	yes
11	53º 27′	3º 21.8′	yes	yes	yes	yes
12	53º 27′	3º 30.2′	yes		yes	yes
13	53º 32′	3º 30.2′	yes		yes	
14	53º 37′	3º 30.2′	yes		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	yes

22	53º 23′	3º 38.6′	yes	yes	yes
23	53º 23′	3º 47.0′	yes	yes	yes
24	53º 27′	3º 47.0′	yes	yes	yes
25	53º 32′	3º 47.0′	yes	yes	
26	53º 37′	3º 47.0′	yes	yes	
27	53º 42′	3º 47.0′	yes	yes	
28	53º 47′	3º 47.0′	yes	yes	
29	53º 47′	3º 55.4′	no		
30	53º 42	3º 55.4′	yes	yes	yes
31	53º 37′	3º 55.4′	yes	yes	
32	53º 32′	3º 55.4′	yes	yes	
33	53º 27′	3º 55.4′	yes	yes	yes
34	53º 22′	3º 55.4′	yes	yes	yes
35	53º 31.9′	3º 15.9′	yes	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 09:05 on 17 December near Puffin Island, until 14:50 on 18 December, 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 09:05 on 17 December and 14:50 on 18 December.

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