Prince Madog cruise 44/03
28, 29 October 2003
POL Coastal Observatory cruise 13
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 two SeaBird MicroCATs 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 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 an Aanderaa temperature and conductivity logger at 10 m below the surface.

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.

2.1 Scientific personnel

John Howarth
Mike Burke
Andrew Lane
Mike Smithson
Dave Sivyer (CEFAS)
Anne Hammerstein (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.)
D. Lloyd-Jones (A.B.)
M. Downey (Cook)

3. Narrative (times in GMT)

The SmartBuoy, anchor chain, sea-bed frame and instrumentation were loaded onto RV Prince Madog on the afternoon of 27 October 2003. (The SmartBuoy 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 08:00 on 28 October, just after low water spring tides. A replacement auto-pilot had been fitted the previous week, see the report of the preceding Coastal Observatory cruise. Recording of surface sampling and the ship's ADCP were switched on at 08:58, near Puffin Island, see Fig. 1 for the cruise track. During the passage to the mooring site sand waves were seen on the echo-sounder with a peak to trough amplitude up to 5 m, the steeper slope facing to the east. The mooring site was reached at 11.15 and the transmissometer / MicroCat calibration CTD carried out between 11.30 and 11.40. The Trinity House vessel Mermaid was in attendance at the Mersey Bar Light Vessel.

At 12:01 the ADCP release was fired, the ADCP was on deck at 12:09 and its ballast weight was on the deck by 12:15. The MicroCats and transmissometer were covered in growth. During this recovery there was mild concern from the bridge because we came close to the waverider mooring. (This had been replaced since the previous cruise, having come adrift the day after end of this cruise (26 September) and been recovered from the sea by Hoylake lifeboat on the next day. It was redeployed on 16 October.) The replacement ADCP was deployed at 13:02 and the SmartBuoy between 13:10 and 13:21. The previous SmartBuoy, covered in slime, was recovered between 13:25 and 13:31. The tail of the old waverider mooring was briefly searched for but nothing seen, perhaps because it was high water spring tides.

The CTD survey then commenced at 13:53 – on this cruise for the first time water samples were obtained from all near surface and near bed bottles for nutrient analysis by David Hydes at SOC. Also on each dip a POL LISST attached to the CTD frame was switched on for testing after its return from the manufacturer for repair. The next CTD station was number 10; thereafter the stations were visited in numerical order. The last CTD profile (station 34) was recorded at 13:51 on 29 October and surface sampling was switched off at 14:26, near Puffin Island. RV Prince Madog was alongside at Menai Bridge at 15:25.

All of the mooring objectives were accomplished and all the CTD sites were visited since the sea state was slight - winds were in the range 6 – 10 m s^{-1} from between west south-west at the start of the cruise and north-west at the end, although atmospheric pressure fell continuously from 1013 to 990 mbar. The area was, with few exceptions, well-mixed in the vertical – at some stations near bed temperatures were slightly warmer than near surface (by less than 0.1ºC) and there was slight stratification at the two north-west stations (29, 30). In general transmittance was less near the bed than the surface. Temperatures varied between 10ºC (inshore) and 13.2ºC (offshore) and salinities between 32.3 and 33.9 – lowest salinities were from off the Wirral along the Welsh coast (winds in the period before the cruise had generally been from the north). Salinities were high, possibly as a consequence of several months of low rainfall.

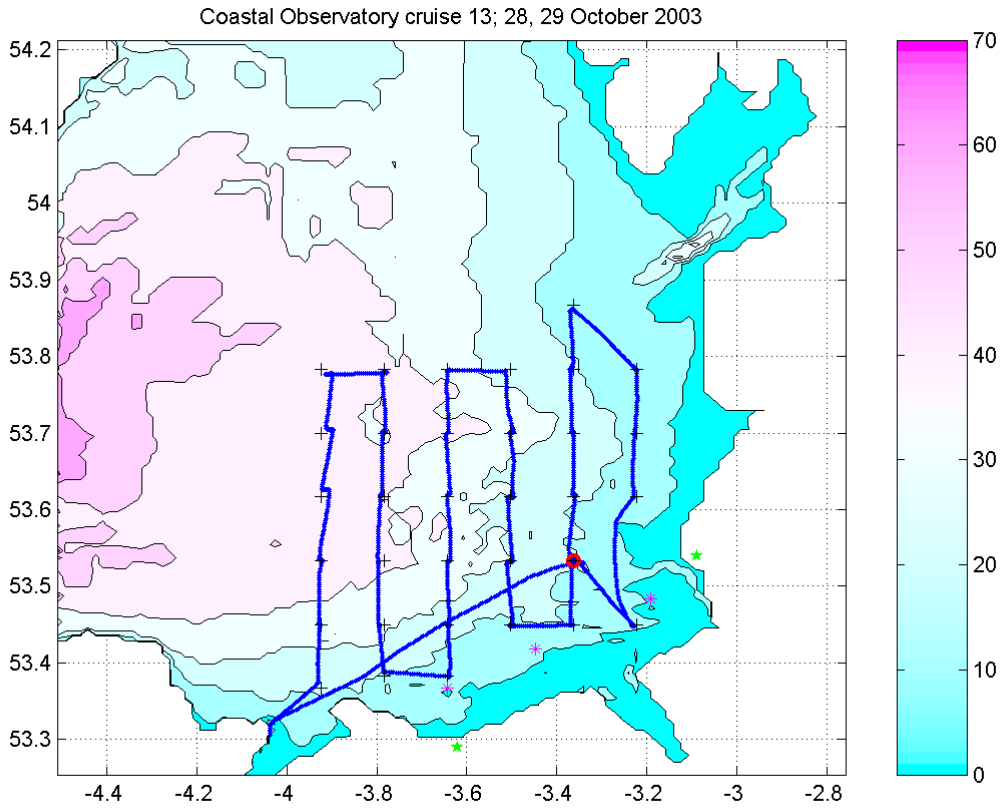

Figure 1. Cruise track.

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

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

a) Mean ADCP 600 kHz RDI 2390; 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 card; hourly wave recording enabled.
Clock set at 12:44 on 23 September 2003, delayed start 06:00:00 on 24 September, started on time. Stopped at 15:50 on 28 October; clock 67 s fast. 162,901,231 bytes of data were recorded; however the data translation program hung up at 06:00 on 8 October. (Subsequently the data files were sent to RDI but no more data could be recovered.)

Aanderaa pressure recorder BPR 1357, DSU 8117: 10 minute sampling, clock set at 13:04:30 on 23 September 2003; started at 13:20 on 23 September 2003; first reading at 13:20:48.
Stopped at 08:42 on 29 October 2003; clock 29 s fast. 7337 words. Data short. Errors in data after 06:50 on 1 October; last record at 11:30 on 3 October.

25 cm Sea-Tech Transmissometer, ST631, recording in Aanderaa logger (RCM7 11820 /DSU 13101) fitted with temperature and conductivity sensors: 10 minute sampling, Clock set at 22:01:30 on 23 September, started at 22:10:00 on 23 September 2003.
Air readings from 22:30 on 23 September until 05:50 on 24 September.

Blocked path reading from 05:50 until 08:20 on 24 September.
Stopped at 10:10:30 on 29 October; clock 18 s slow. 21840 words?? Download very slow. Some missing words but otherwise ok until 21 October 2003.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2010 – ID01). Clock set at 08:48:15 on 24/9/2003. Delayed start 10:20:00 on 24/9/2003, 10 second sampling. Sample num = 326 restart 10 minute sampling, delayed start 11:30:00 on 24/9/2003.
Stopped at 14:54 on 28 October, sample number 5243. The clock was 9s fast.
The post deployment calibration was carried out on CTD 16, station 15. The clock was set at 00:20:00 on 29 October, 10 second sampling from delayed start 00:40:00 to 01:24:10, sample number 5508.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2081 – ID02). Clock set at 08:43:10 on 24/9/2003. Delayed start 10:20:00 on 24/9/2003, 10 second sampling, calibration dip CTD1 – readings between 10:50 and 11:00. Restarted on 10 minute sampling at sample num 353, 11:30 on 24/9/2003.
Stopped at 13:44 on 28 October, sample number 5263. The clock was 2s fast.
The post deployment calibration was carried out on CTD 16, station 15. The clock was set at 00:23:10 on 29 October, 10 second sampling from delayed start 00:40:00 to 01:25:25, sample number 5536.

The frame, D3, was fitted with two Benthos releases, 4A (s/n 44068) – Pyro OTD91, 4B (s/n 52302) – Pyro OTD93, and a spooler with 200 m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring. Aanderaa current meter RCM7 9631 / DSU 3994 without fin at 10 m below the surface to log temperature and conductivity: 10 minute samples.
Clock set at 13:17:30 on 23 September 2003, started at 13:30:00 on 23 September 2003.
Stopped at 09:22 on 29 October 2003; clock 7s fast. 25091 words; the data look ok until 23:50 on 20 October 2003.

The single point mooring was composed mainly of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a 1 tonne clump of scrap chain.

Table 1. Recovered mooring positions and times, in 2003.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployment Time	Deployment Date	Water Depth (m)	Recovery Time	Recovery Date
SmartBuoy	53º 32.075´	3º 21.716´	25.0	12:12	24/09	27.5	13.25	28/10
ADCP	53º 32.104´	3º 21.630´	25.0	11:42	24/09	26	12:01	28/10

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

c) 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.

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.

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.

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.

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.

d) 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.

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	Deployment Date
SmartBuoy	53º 32.020´	3º 21.791´	27.5	13:21	28/10/03
ADCP	53º 32.004´	3º 21.718´	27.5	13:02	28/10/03
(Waverider	53º 32.14´	3º 21.48´)			

5. CTD

The Sea-Bird 911 CTD recorded temperature, conductivity, transmittance 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	yes
6	53º 47′	3º 21.8′	yes	yes	yes
7	53º 42′	3º 21.8′	yes	yes	yes
8	53º 37′	3º 21.8′	yes	yes	yes
9	53º 32′	3º 21.8′	yes	yes	yes
10	53º 27′	3º 13.4′	yes		yes
11	53º 27′	3º 21.8′	yes	yes	yes
12	53º 27′	3º 30.2′	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
22	53º 23′	3º 38.6′	yes		yes
23	53º 23′	3º 47.0′	yes		yes
24	53º 27′	3º 47.0′	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′	yes		yes
30	53º 42	3º 55.4′	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
34	53º 22′	3º 55.4′	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 08:59 on 28 October near Puffin Island, until 14:25 on 29 October, 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 08:59 on 28 October and 14:25 on 29 October.

Acknowledgements
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