

Prince Madog cruise 38/04
POL Coastal Observatory cruise 21
8 – 9 September 2004

1. Objectives

1. At 53° 32' N 3° 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 transmissometer / conductivity / temperature logger and a SeaBird MicroCAT were fitted to the frame. A second ADCP (1.2 MHz, 10 minute sampling) and LinkQuest acoustic modem 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.
- c) A single point toroid mooring to telemeter ADCP data with LinkQuest acoustic modem, GPS receiver and Orbcomm transmitter.

To deploy

- d) A sea bed frame for a 600 kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves. A SeaBird SBE 16 plus with pumped conductivity sensor, digiquartz pressure sensor and SeaPoint turbidity sensor and a SeaBird MicroCAT were fitted to the frame
- e) 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.
- f) A sea bed frame for a 1.2 MHz ADCP set to 10 minute sampling and a LinkQuest acoustic modem.
- g) A single point toroid mooring to telemeter ADCP data with LinkQuest acoustic modem, GPS receiver and Orbcomm transmitter.

2. To conduct a CTD / LISST survey of 35 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 near surface and bed water samples for nutrient and suspended sediment determination.

3. To collect 10 vertical net hauls at the mooring site.

4. At the start, to deploy the CTD in 40 m of water to re-spool the CTD wire on its drum.

2.1 Scientific personnel

John Howarth (principal)
John Humphery
John Kenny
Sara O'Donnell

Mike Smithson
Olga Andres (CEFAS)
Stewart Cutchey (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Vladimir Krivtsov (School of Ocean Sciences)

2.2 Ship's officers and crew

Steve Duckworth (Master)
Alan Price (Second Officer)
Neil Holmes (Chief Engineer)
(Second Engineer)
Phil Jones (Bosun)
Tommy Roberts (AB)
(A.B.)
Mick Downey (Cook)

3. Narrative (times in GMT)

The SmartBuoy toroid, anchor chain, sea-bed frame, spare frame ballast weight and instrumentation were loaded onto RV Prince Madog on the afternoon of 7 September 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 8 September in sunshine. Recording of surface sampling and of the ship's ADCP started at 08:11, near Puffin Island, see Figure 1 for the cruise track. Site 25 was reached at 09:50 and a CTD recorded in order to enable correct spooling of the wire on the CTD drum. A stiff south-easterly wind was blowing.

The wind had calmed down by the time the mooring site was reached at 11:49. The ADCP was released at 11:53, was on deck at 11:55 and its ballast weight recovered by 12:02. There was little growth on the frame or transmissometer. The replacement ADCP was deployed at 12:19 and the SmartBuoy between 12:39 and 12:42. The original SmartBuoy was recovered between 12:48 and 12:57 and the telemetry toroid between 13:12 and 13:17. The wave buoy was still in position. During the afternoon, as the CTD circuit was being steamed, the buoy, frame and instruments were cleaned with the ship's jet wash and then disassembled.

CTD 2 was recorded and surface and bed water samples taken for suspended sediment determination. There followed 10 vertical net hauls for zooplankton, between 13:50 and 14:45, the first five with a 1 m diameter hoop and 60 mpi mesh and the second five with a 0.5 m diameter hoop and 200 mpi mesh. The volume of water flowing through the net during the haul was recorded with a flowmeter.

The CTD survey then started at 15:34, going round stations in a different order from usual after site 8 in order to arrive back at the mooring site at between 08.00 and 09.00 the following day to redeploy the telemetry system. The order was 10, 35, 2 – 8, 14 - 17, 28 - 32, 27, 18 - 20, 13 (see Figure 1, showing track and CTD locations) and Table 3. Water samples were obtained from near surface and near bed bottles for nutrient analysis by David Hydes at SOC and for suspended sediment determination. Towards the end of this circuit progress was

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 15:44:00 on 10 August 2004; delayed start 06:00:00 on 11 August 2004. OK.
Stopped at 14:15 on 8 September 2004: 134,264,887 bytes of data downloaded.

No BPR fitted because of doubts about the frame's buoyancy.

25 cm Sea-Tech Transmissometer, ST637, recording in Aanderaa logger (RCM7 11820 / DSU 13101) fitted with temperature (low temperature setting) and conductivity sensors. 10 minute sampling.

Clock set at 15:59:20 on 10 August 2004; started at 16:10 on 10 August 2004.

First air reading at 16:30 on 10/08/2004

Last air reading at 21:40 on 10/08/2004

First blocked path reading at 21:50 on 10/08/2004.

Last blocked path reading at 05:30:00 on 11/08/2004.

CTD calibration, CTD 1 at 11:10 and 11:20 on 11 August 2004.

Switched off at 19:24:20 on 8 September 2004: 25314 words. Clock 4 s fast.

SeaBird MicroCAT temperature, conductivity recorder (2081, ID=02).

10 minute sampling. Reference pressure 25dB.

Clock set at 16:47:00 on 10 August 2004; delayed start at 06:00:00 on 11 August 2004.

Stopped at 19:14:30 on 8 September 2004; sample number 4112. Clock is 7 s fast.

Telemetry ADCP 1200 kHz RDI 0572.

Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.003 m s^{-1}).

30 x 1 m bins (2.15 – 31.15 m above the bed).

Earth co-ordinates - speeds, correlation, echo intensity, % good.

Sound velocity calculated from temperature, depth and salinity of 32.

1 GByte memory.

Clock reset at 15:36:30 on 10 August 2004, delayed start 06:50:00 on 11 August.

Stopped at 14:16 on 8 September 2004: 3,057,119 bytes of data downloaded.

The ADCP recorded 10 minutes averages internally and sent a sub-set of east & north component data (PD12 format) every hour (on the hour) via a LinkQuest modem S/N UWM9f 07337 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 before deployment. The system failed to work, since recovery showed the wrong ADCP had been connected to the modem.

The frame D6 was fitted with two Benthos releases 44056 - 13.5 kHz 5A, pyro OTD103 and 40266 - 11.0 kHz 3A, pyro OTD105, and a spooler with 200m of rope for recovery of the ballast weight. Release 11.0 kHz A OTD 105 fired first time.

b) SmartBuoy Mooring.

SeaBird MicroCAT temperature, conductivity recorder (2010 – ID=01) at 5 m below the surface. 10 minute samples. Reference pressure set at 25 dB.

Clock set at 16:40:00 on 10 August 2004. Delayed start 06:00:00 on 11 August 2004.

Stopped at 20:07:12 on 8 September 2004.; sample number 4117.

Aanderaa current meter RCM7 9631 / DSU 8117 without fin at 10 m below the surface to log temperature (low temperature setting) and conductivity: 10 minute samples.
 Clock set at 16:09:00 on 10 August 2004; started at 16:20:00 on 10 August 2004.
 Switched off at 19:47:10 on 8 September 2004; 25326 words. Clock is 2 s fast.

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) Telemetry buoy

A LinkQuest acoustic modem S/N UWM9f 07336 and battery pack, a GPS receiver and an Orbcomm satellite system and battery pack were fixed to a toroid. The Orbcomm system was setup to send e-mails once an hour, containing data from the ADCP (Format PD12) received by the acoustic modem link.

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.

	<u>Latitude</u> (N)	<u>Longitude</u> (W)	<u>Water</u> <u>Depth</u> (m)	<u>Deployment</u> <u>Time</u> <u>Date</u>
ADCP frame	53° 32.004'	3° 21.877'	22	11:49 08/09/04
SmartBuoy	53° 32.186'	3° 22.162'	22	12:48 08/09/04
Telemetry toroid	53° 32.103'	3° 21.825'	22.5	13:12 08/09/04

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

d) Waves ADCP 600 kHz RDI 2391.

Battery cases 0250 and 3070 combined fitted with used batteries since supplier failed to deliver 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 14:03:30 on 7 September; delayed start 06:00:00 on 8 September 2004. OK.

SeaBird 16 plus S/N 4597 on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor S/N 10223 taped to roll bar. The calibration CTD cast will be performed after recovery.

Sample interval 600 s; diquartz integration time 40 s.

Clock set at 16:08:30 on 7 September; delayed start at 12:00:00 on 8 September 2004.

SeaBird MicroCAT RS485 temperature, conductivity recorder S/N 2991 on spider.

10 minute sampling. Reference pressure 25dB.

Clock set at 14:53:00 on 7 September 2004; delayed start at 12:00:00 on 8 September 2004.

The frame was fitted with two Benthos releases 44068 - 11.5 kHz 4A, pyro OTD101 and 69676 - 11.5 kHz enable F, release D with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

e) SmartBuoy Mooring.

SeaBird MicroCAT temperature, conductivity and pressure recorder (25060 – ID=03) at 5 m below the surface. 10 minute samples.

Clock set at 14:37:00 on 7 September 2004. Delayed start 12:00:00 on 8 September 2004.

Aanderaa current meter RCM7 9959 / DSU 8123 without fin at 10 m below the surface to log temperature (low temperature setting) and conductivity: 10 minute samples.

Clock set at 15:08:00 on 7 September 2004; started at 15:20:00 on 7 September 2004.

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.

f) Telemetry ADCP 1200 kHz RDI 0572.

Battery case 0254 fitted with part used batteries. Moved to opposite corener from ADCP.

Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.003 m s⁻¹).

30 x 1 m bins (2.15 – 31.15 m above the bed).

Earth co-ordinates - speeds, correlation, echo intensity, % good.

Sound velocity calculated from temperature, depth and salinity of 32.

1 GByte memory.

Clock reset at 14:46:00 on 8 September, delayed start 15:50:00 on 8 September 2004. OK.

The ADCP recorded 10 minutes averages internally and sent a sub-set of east & north component data (PD12 format) every hour (on the hour) via a LinkQuest modem S/N UWM9f 07337 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 before deployment. LinkQuest battery pack not changed.

The frame D6 was fitted with two Benthos releases 44056 - 13.5 kHz 5A, pyro OTD103 and 70356 10.5 kHz enable C, release D with fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

g) Telemetry buoy

A LinkQuest acoustic modem S/N UWM9f 07336 and battery pack, a GPS receiver and an Orbcomm satellite system and battery pack were fixed to a toroid. The Orbcomm system was setup to send e-mails once an hour, containing data from the ADCP (Format PD12) received by the acoustic modem link. The LinkQuest battery was not changed but the Orbcomm battery was.

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.

	<u>Latitude</u> (N)	<u>Longitude</u> (W)	<u>Water</u> <u>Depth</u> (m)	<u>Deployment</u> <u>Time</u> <u>Date</u>	
(Wave buoy	53° 32.171'	3° 21.522')			
Waves ADCP	53° 31.984'	3° 21.873'	22	12:19	08/09/04
SmartBuoy	53° 32.134'	3° 22.035'	22	12:42	08/09/04
Telemetry toroid	53° 32.111'	3° 22.269'	24.5	09:29	09/09/04
Telemetry ADCP	53° 32.210'	3° 22.333'	24	09:36	09/09/04

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 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 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. A LISST-100 particle sizer with internal logging was also attached to the CTD frame and its data periodically downloaded for analysis by SOS. Copies of the Sea-Bird binary files were taken off for processing and calibration at BODC / POL.

Table 3. Nominal CTD positions.

<u>Site</u>	<u>Latitude</u> (N)	<u>Longitude</u> (W)	<u>Visited on</u> <u>this cruise</u>	<u>Chlorophyll</u> <u>& nutrients</u>	<u>Suspended</u> <u>Sediments/</u> <u>nutrients</u>
1	53° 32'	3° 21.8'	yes	yes	yes (no nutrients)
2	53° 37'	3° 13.4'	yes		yes
3	53° 42'	3° 13.4'	yes		yes
4	53° 47'	3° 13.4'	yes		yes
5	53° 52'	3° 21.8'	yes	yes	yes
6	53° 47'	3° 21.8'	yes	yes	yes
7	53° 42'	3° 21.8'	yes	yes	yes
8	53° 37'	3° 21.8'	yes	yes	yes
9	53° 32'	3° 21.8'	yes	yes	yes

<u>Site</u>	<u>Latitude (N)</u>	<u>Longitude (W)</u>	<u>Visited on this cruise</u>	<u>Chlorophyll & nutrients</u>	<u>Suspended Sediments/ nutrients</u>
10	53° 27'	3° 13.4'	yes		yes
11	53° 27'	3° 21.8'	yes	yes	yes
12	53° 27'	3° 30.2'	yes		yes
13	53° 32'	3° 30.2'	yes		yes
14	53° 37'	3° 30.2'	yes		yes
15	53° 42'	3° 30.2'	yes		yes
16	53° 47'	3° 30.2'	yes		yes
17	53° 47'	3° 38.6'	yes		yes
18	53° 42'	3° 38.6'	yes		yes
19	53° 37'	3° 38.6'	yes		yes
20	53° 32'	3° 38.6'	yes		yes
21	53° 27'	3° 38.6'	yes		yes
22	53° 23'	3° 38.6'	yes		yes
23	53° 23'	3° 47.0'	yes		yes
24	53° 27'	3° 47.0'	yes		yes
25	53° 32'	3° 47.0'	yes		yes (no nutrients)
26	53° 37'	3° 47.0'	yes		yes
27	53° 42'	3° 47.0'	yes		yes
28	53° 47'	3° 47.0'	yes		yes
29	53° 47'	3° 55.4'	yes		yes
30	53° 42'	3° 55.4'	yes		yes
31	53° 37'	3° 55.4'	yes		yes
32	53° 32'	3° 55.4'	yes		yes
33	53° 27'	3° 55.4'	yes		yes
34	53° 22'	3° 55.4'	yes		yes
35	53° 32'	3° 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 ($\mu mol s^{-1} m^{-2}$), Air Temperature ($^{\circ}C$), Relative Humidity, Relative Wind Speed ($m s^{-1}$), Relative Wind Direction ($^{\circ}$) – zero indicates wind on the bow, Transmittance, Hull Temperature ($^{\circ}C$), Barometric Pressure (mbar), Fluorescence, Turbidity, Salinity, Minimum Air Temp ($^{\circ}C$), Maximum Air Temp ($^{\circ}C$), Wind Gust ($m s^{-1}$), GPS Time, Latitude, Longitude, Barometric Pressure Minimum (mbar), Barometric Pressure Maximum (mbar), Conductivity sensor water temperature ($^{\circ}C$). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC.

Data were recorded every minute from 08:12 on 8 September until 15:10 on 9 September starting and ending at 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 29 pings / ensemble. Data were recorded

between 08:11 on 8 September and 15:10 on 9 September. There appeared to no problems with data recording on this cruise.

Acknowledgements

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