

Prince Madog cruise 11/04
POL Coastal Observatory cruise 16
1, 2 April 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 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 (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 sea bed frame for a 1200 kHz ADCP (telemetry ADCP) to measure mean current profile and pressures. An acoustic modem was fitted and linked to the ADCP.

f) A surface toroid (telemetry buoy) with an acoustic modem and an Orbcomm satellite communication system.

2. At 53° 26.900' N 3° 30.304' W to recover a sea bed frame for a 600 kHz ADCP measuring fast sample currents (part of the Dee experiment).

3. 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 and suspended sediment determination.

4) To collect 10 vertical net hauls at the mooring site.

2.1 Scientific personnel

John Howarth

Mike Burke

Emlyn Jones

Jeff Pugh

Mike Smithson

Dave Sivyer (CEFAS)

Olga Andres (CEFAS)

Luke Yates (School of Ocean Sciences)

Anne Hammerstein (School of Ocean Sciences)

2.2 Ship's officers and crew

A. Price (Master)
G. Reay (Second Officer)
A. Williams (Chief Engineer)
N. Holmes (Second Engineer)
T. Roberts (Bosun)
D.D. Williams (A.B.)
P. Blundell (A.B.)
E. Pritchard (Cook)

3. Narrative (times in GMT)

The fully assembled SmartBuoy, telemetry toroid, anchor chain, sea-bed frames and instrumentation were loaded onto RV Prince Madog on the evening of 31 March 2004 in Vittoria Dock, Birkenhead. The ADCP frames were set up on the afterdeck.

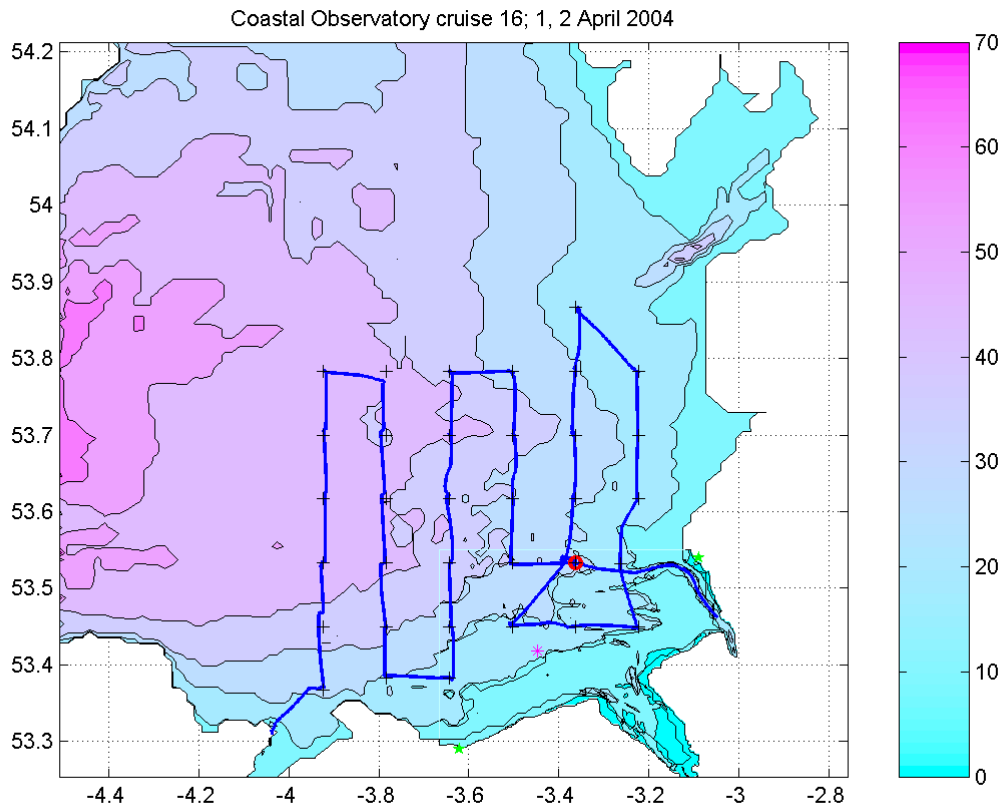
RV Prince Madog left Birkenhead at 05:55 on 1 April. Recording of surface sampling was switched on at 07:22, near the mouth of the Mersey, and the ship's ADCP at 07:44, see Figure. 1 for the cruise track.

On arrival at the mooring site at 08:35 the transmissometer CTD calibration (number 1) was carried out (08:45 – 09:02). The ADCP was released at 09:05 and quickly came to the surface, despite using a fizzlelink release which takes a couple of minutes to function. The frame was on board by 09:18 and its ballast weight by 09:33. The replacement ADCP was deployed at 09:48 and the SmartBuoy between 10:15 and 10:17. The telemetry toroid was deployed at 10:29 followed by the telemetry ADCP at 10:43, a distance of 200 m to the south-south-west. A CTD (number 2) was recorded at 11:36; for this and all subsequent CTDs water samples were obtained and the LISST 100 switched on. The SmartBuoy was recovered between 11:52 and 12:03. There followed 10 vertical net hauls for zooplankton, 12:23 – 13:06, five with a 1 m diameter hoop and 60 mpi mesh and 5 with a 0.5 m diameter hoop and 200 mpi mesh. The speed of hauling of the net was recorded with a flowmeter. During all this mooring work the waverider was visible. Conditions were good, winds about 7 m s^{-1} , from the south-east and the sea calm. One more ADCP, part of the Dee experiment, remained to be recovered, at station 12 close to the North Hoyle Buoy. The site was reached at 13:48, a CTD (3) recorded, and the ADCP recovered between 13:55 and 14:22. It took a few minutes either for the ADCP to surface or for it to be spotted since conditions were hazy. There was no growth on either this or the Coastal Observatory ADCP frame.

The CTD survey then started, going round stations 11, 10, 35, 2 – 9, 13 – 34 (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. The sea had started to warm up in its seasonal cycle, especially near the coast where in places it was 2°C warmer than on the previous cruise, 5 weeks earlier. Hence, temperatures varied little spatially, being between 7 and 8°C . Salinities were in the range 31 to 33.8. Most sites were stratified, but by less than 1°C and 1 psu; only a few sites at the northwestern edge of the grid were well mixed. Surface sampling was switched off at 12:22 on 2 April, near Puffin Island. RV Prince Madog was alongside at Menai Bridge at 13:17.

All the cruise objectives were accomplished since conditions were good – the wind speed was generally less than 10 m s^{-1} , from the south-east and waves were low.

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 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.

Last record at 00:50:00 on 2 April 2004. Record length 178, 683, 287 bytes.

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.

Last reading at 08:41:01 on 29 April 2004; clock correct. Record length 47,717 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 16:22:00 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.

Stopped at 09:11:30 on 29 April 2004; clock 30 s slow. Record length 57,168 words.

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.

Stopped at 16:48:20 on 28 April 2004; clock 23 s fast. 9,245 samples.

The frame, D2, was fitted with two Benthos releases, 14.5 kHz - 7A (s/n 44041) – Pyro OTD94, 11.5 kHz - D (s/n 69676) and a fizzlelink release, and a spooler with 200m of rope for recovery of the ballast weight. There was slight crevice corrosion near the screws in the fizzlelink release.

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.

Stopped at 09:02:00 on 29 April 2004; clock 74 s slow. Record length 52,630 words. The DSU was not updating because the battery was low, but the data look OK for the deployment period.

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 1. Recovered mooring positions and times.

	<u>Latitude</u> (N)	<u>Longitude</u> (W)	<u>Water</u> <u>Depth</u> (m)	<u>Recovery</u> <u>Time</u>	<u>Recovery</u> <u>Date</u>
SmartBuoy	53° 32.088'	3° 21.682'	23	11:52	01/04/04
Waves ADCP	53° 31.929'	3° 21.770'	26	09:05	01/04/04
Dee ADCP	53° 27.039'	3° 30.469'	16	13:55	01/04/04

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

c) Mean ADCP 600 kHz RDI 2390; battery case 3036, 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 09:20:00 on 31 March 2004, delayed start 06:00:00 on 1 April.

Aanderaa pressure recorder BPR 1357, DSU 8125: 10 minute sampling, Clock set at 05:19:00 on 31 March, started 05:40:00 on 31 March 2004, first reading at 05:40:49, 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 05:58:00 on 31 March, started at 06:20:00 on 31 March 2004.
First air reading at 07:20 31 March & last air reading at 05:20 on 1 April 2004.
Blocked path reading between 05:30 and 06:50 on 1 April 2004.
CTD calibration, CTD 1 08:50 and 09:00 (just) 1 April 2004.

SeaBird MicroCAT temperature, conductivity recorder (37IM29828-2081 – ID=02).
10 minute sampling. Reference pressure 25dB.
Clock set at 07:49:00 on 31/04/2004. Delayed start 08:00:00 on 01/04/2004,

The frame, D5, was fitted with two Benthos releases, 8A (s/n 44059) – Pyro OTD101 and 2B (s/n 61170) – Pyro OTD100, and a spooler with 200m of rope for recovery of the ballast weight.

d) 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 07:56:30 on 31/04/2004. Delayed start 08:00:00 on 01/04/2004.

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 05:49:00 on 31 March 2004, started at 05:50:00 on 31 March 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.

e) Telemetry ADCP 1200 kHz RDI 0572; battery case 254.

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.

Clock reset at 20:48:00 on 31 March 2004, delayed start 05:50:00 on 1 April.

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 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 frame, D6, was fitted with two Benthos releases, 3A (s/n 40226) – Pyro OTD102 and 5A (s/n 44056) – Pyro OTD103, and a spooler with 200m of rope for recovery of the ballast weight.

f) Telemetry buoy

A LinkQuest acoustic modem 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. Subsequently it appears that the telemetry system was not working, probably in the acoustic segment since the Orbcomm transmitter responds to e-mailed requests.

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>	
(Waverider	53° 32.171'	3° 21.522'	26	10:42	05/03/04)
Waves ADCP	53° 31.931'	3° 21.828'	26	09:48	01/04/04
SmartBuoy	53° 31.979'	3° 22.110'	26	10:17	01/04/04
Telemetry buoy	53° 32.060'	3° 22.476'	26	10:28	01/04/04
Telemetry ADCP	53° 31.954'	3° 21.559'	27	10:43	01/04/04

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 separate LISST-100 was clamped on the frame and data internally recorded for all CTDs except the first. 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
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
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
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 ($\mu mols / m^2s$), Air Temperature ($^{\circ}C$), Relative Humidity, Relative Wind Speed ($m s^{-1}$), Relative Wind Direction ($^{\circ}$) – zero indicates wind on the bow, Transmissance, 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 (°C). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC.

Data were recorded from 07:22 on 1 April, at the mouth of the Mersey, until 12:21 on 2 April, 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 minute (30 seconds?) with 30 pings / ensemble and data were recorded between 07:40 on 1 April and 12:23 on 2 April.

Acknowledgements

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