Prince Madog cruise 02/05
POL Coastal Observatory cruise 24
31 January-1 February 2005

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 (waves ADCP) to measure the mean current profile, pressures and directional waves. A Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and SeaPoint turbidity sensor were fitted to the frame.
b) A CEFAS SmartBuoy in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 5m below the surface and an Aanderaa temperature and conductivity logger at 10 m below the surface.
c) A sea bed frame for a 1.2 MHz ADCP (telemetry ADCP) set to 10 minute sampling and a LinkQuest acoustic modem.

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 Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and SeaPoint turbidity sensor was fitted to the frame.
e) A CEFAS SmartBuoy in a single point mooring with a Sea-Bird 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 600 kHz ADCP (telemetry ADCP) set to 10 minute sampling and a LinkQuest acoustic modem.
g) To re-deploy a single point toroid mooring to telemeter ADCP data with LinkQuest acoustic modem, GPS receiver and Orbcomm transmitter.

2. At 53º 26´ N 3º 30.2´ W
To deploy
a) A sea bed frame for a 600 kHz ADCP (Dee ADCP) to measure the mean current profile, pressures and directional waves. A Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and SeaPoint turbidity sensor.

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.

2.1 Scientific personnel

Phil Knight (Principal)

Alex Souza
Mike Burke
Mike Smithson
John Kenny
Dave Sivyer (CEFAS)
Jo Foden (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Vladimir Krivtsov (School of Ocean Sciences)

2.2 Ship's officers and crew

Steve Duckworth (Master)
Nick Davies (Chief Officer)
Neil Holmes (Chief Engineer)
L. Black (Second Engineer)
Phil Jones (Bosun)
Tommy Roberts (A.B.)
L. B. Smith (A.B.)
Mike Downey (Cook)

3. Narrative (times in GMT)

The SmartBuoy toroid, anchor chain clumps, three sea-bed frames, spare frame ballast weight and instrumentation were loaded onto RV Prince Madog on the afternoon of 30 January 2005. The toroid was rolled down the walkway. The ADCP frames and instruments were set up on the afterdeck and the tower and instruments fitted to the SmartBuoy toroid.

RV Prince Madog left Menai Bridge at 09:25 on the 31 January 2005. Recording of surface sampling was not possible due to a faulty computer. The ship's ADCP was started at 10:10, near Puffin Island.

On route to deploy an ADCP for the Dee experiment four CTD's were carried out at sites (stations) 34, 23, 22 and 12. The plan was to deploy the ADCP at site 12, however the charts indicated that site 12 was a designated as a dredging area, so the deployment was made just outside this area.

The mooring site was reached at 13:15. Sea conditions were rough, large waves and strong winds (force 6/7) from the North West. The telemetry toroid was recovered at 14:35, however it was damaged during the recovery after a line snapped. The waves ADCP was released at 15:22. A CTD was started a site 1, however the conditions were too rough to continue without possible damage to the CTD system. It was decided to head for shelter at 15:30. The ship anchored overnight off Llandudno. The ship ADCP was switched off at 18:41.

The ship ADCP was started again at 06:15 on 1 February. RV Prince Madog then proceeded to main mooring site at 06:15, carrying out CTD's at sites 24, 21,20,13 and 1 on route. The deck was cleared and secured for more deployment and recovery work. At 10:38 the Smart Buoy was deployed. At 10:56 the Smart Buoy was recovered. At 11:22 the wave ADCP was recovered.

Tide against wind (force5/6 NW) made for difficult working conditions and it was decided to leave the telemetry ADCP in situ until slack water. In the meantime the following CTD's were carried out at sites 8 and 2. The Telemetry ADCP was recovered at 14:40 on the 1 February 2005.

Cruise objectives were severely affected by adverse weather conditions. Winds ranged between force 5 and force 7 for the whole cruise period, with particular problems associated with waves from the North West. This posed many difficulties during service of the moorings and for CTD dips. The Telemetry system was not re-deployed since the GPS aerial on the Orbcomm satellite was broken during the recovery. Overall, the rest of the moorings were recovered and deployed successfully, however only a 11 CTD's were carried out. RV Prince Madog docked at Vittoria Dock, Birkenhead, at 17:28 to pick up equipment for the Dee Experiment.

4. Moorings (times in GMT)

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

a) Waves ADCP 600 kHz RDI 2391.
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 15:17:00 on 14 December; delayed start 07:00:00 on 15 December 2004. OK.
Last ensemble in wave.0000 is at 20:50:00 on 14/01/05 (short).

Sea-Bird 16*plus* S/N 4597 on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor S/N 10471 taped to roll bar. The calibration CTD cast will be performed after recovery.
Sample interval 600 s; diqiquartz integration time 40 s
1 s delay before sampling, pump on for 0.5 s before sampling.
Clock set at 07:27:00 on 15 December; delayed start at 12:00:00 on 15 December 2004.
Stopped at 12:12:00 on 16/02/05. Sample no. 9074. Clock is 4s fast.

The frame D1 was fitted with two Benthos releases 72378 – 10.5 kHz Receive, 11.0 kHz Transmit,enable B, release B and 71919 – 10.5 kHz Receive, 11.0 kHz enable B, release C, and a spooler with 200m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature, conductivity and pressure recorder (2506 – ID=03) at 5 m below the surface. 10 minute samples.
Clock set at 07:41:00 on 15 December 2004. Delayed start 12:00:00 on 15 December 2004.
Stopped at 09:42:00 on 17/02/05. Clock is 20s fast. Sample no. 9203.

Aanderaa current meter RCM7 9959 without fin at 10 m below the surface to log temperature (low temperature setting) and conductivity: 10 minute samples.
Started at 08:06:32 on 15 December 2004.
Stopped at 10:54:00 on 11/02/05. DSU 8123. 50568 words. Clock is 3 mins 16s slow.

The CEFAS SmartBuoy is fitted with two 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 ADCP 600 kHz RDI 3644.
Battery case 0254 fitted with part used batteries.
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 15:42:30 on 14 December, delayed start 06:50:00 on 15 December 2004. OK.
Stopped at 13:40 (approx) on 08 February 2005.

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 was fitted with two Benthos releases 69679 - 11.5 kHz Receive, 12 kHz, enable C, release D and 70358 11.0 kHz Receive, 12.0 kHz Transmit, enable C, release D both with fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

d) 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.

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. 3m chain added beneath buoy to aid recovery.

Table 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovery Time	Recovery Date
Telemetry toroid	53º 31.939′	3º 22.390′	26.0	14:35	31/01/05
Waves ADCP	53º 31.918′	3º 22.036′	25.5	11:22	01/02/05
SmartBuoy	53º 31.820′	3º 22.154′	24.8	10:56	01/02/05
Telemetry ADCP	53º 31.910′	3º 22.655′	24.7	14:40	01/02/05

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

a) Waves ADCP 600 kHz RDI 5803.
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 512 Mbyte memory; hourly wave recording enabled.
Clock reset at 10:30 on 31 January 2005; delayed start 11:50:00 on 31 January 2005.

Sea-Bird 16*plus* S/N 4736 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor S/N 10320 taped to roll bar.
Sample interval 600 s; diqiquartz integration time 40 s (Paros unit=40)
1 s delay before sampling, pump on for 0.5 s before sampling.
Clock set at 10:30 on 31 January 2005; delayed start at 12:00:00 on 31 January 2005.

The frame D2 was fitted with two Benthos releases 70354 - 13.0 kHz enable C, release D and 70355 – 10.0 kHz enable C, release D both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature, conductivity and pressure recorder (2010 – ID=01) at 5 m below the surface. 10 minute samples. Reference pressure 25 db.
Clock set at 15:43:00 on 30 January 2005. Delayed start 09:00:00 on 01 February 2005.

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.
Started at 15:30:00 on 30 January 2005.

The CEFAS SmartBuoy is fitted with two 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) Dee ADCP 600 kHz RDI 2390.
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 10:30 on 31 January 2005; delayed start 12:00:00 on 31 January 2005.

Sea-Bird 16*plus* S/N 4596 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor S/N 10487 taped to roll bar.
Sample interval 600 s; diqiquartz integration time 40 s (Paros unit=40)
1 s delay before sampling, pump on for 0.5 s before sampling.
Clock set at 10:30 on 31 January 2005; delayed start at 12:00:00 on 31 January 2005.

The frame was fitted with two Benthos releases 72863 - 13.5 kHz Receive, 11.0 kHz Transmit, enable B, release G and 72858 - 14.5 kHz Receive, 11.0 kHz Transmit, enable B, release G both with fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

Table 2. Deployed mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployed Time	Date
Wave ADCP	53º 31.994′	3º 22.179′	27.2	15:22	31/01/05
SmartBuoy	53º 32.059′	3º 21.805′	25.0	10:44	01/02/05
Dee ADCP	53º 26.464′	3º 30.168′	19.8	13:15	31/01/05

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.

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Chlorophyll & nutrients	Suspended Sediments / nutrients	Grab & water sample
1	53º 32′	3º 21.8′	yes	yes	yes	
2	53º 37′	3º 13.4′	yes		yes	
3	53º 42′	3º 13.4′				
4	53º 47′	3º 13.4′				
5	53º 52′	3º 21.8′				
6	53º 47′	3º 21.8′				
7	53º 42′	3º 21.8′				
8	53º 37′	3º 21.8′	yes	yes	yes	

9	53º 32′	3º 21.8′			
10	53º 27′	3º 13.4′			
11	53º 27′	3º 21.8′			
12	53º 27′	3º 30.2′	yes		yes
13	53º 32′	3º 30.2′	yes		yes
14	53º 37′	3º 30.2′			
15	53º 42′	3º 30.2′			
16	53º 47′	3º 30.2′			
17	53º 47′	3º 38.6′			
18	53º 42′	3º 38.6′			
19	53º 37′	3º 38.6′			
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′			
26	53º 37′	3º 47.0′			
27	53º 42′	3º 47.0′			
28	53º 47′	3º 47.0′			
29	53º 47′	3º 55.4′			
30	53º 42	3º 55.4′			
31	53º 37′	3º 55.4′			
32	53º 32′	3º 55.4′			
33	53º 27′	3º 55.4′			
34	53º 22′	3º 55.4′	yes	yes	yes
35	53º 32′	3º 15.9′			

6. Surface sampling

The computer responsible for recording the surface sampling was faulty and no data were recovered.

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 10:10 on 31 January 2005 and 18:41 on 31 January, and started again at 06:15 on 1 February 2005, no stop time recorded.

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