Prince Madog cruise 11/05
POL Coastal Observatory cruise 25
5 – 7 April 2005

1. Objectives

1. At 53º 32´ N 3º 21.8´ W, half a mile west of the Mersey Bar Light Vessel (site A)
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.
d) A single point toroid mooring to telemeter ADCP data with LinkQuest acoustic modem, GPS receiver and Orbcomm transmitter (this buoy was off station, last reported near Mersey marker buoy Q1).

To deploy
e) 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 two SeaPoint turbidity sensors were fitted to the frame.
f) 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.

2. At 53º27´ N 3º 38.6´ W (site 21, second site, B)
To deploy
g) 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.
h) A marking toroid in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 3m below the surface.

3. At 53º 27´ N 3º 30.2´ W (site 12)
To recover
i) 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. This was deployed as part of the Dee experiment.

4. To conduct a CTD / LISST survey of 34 sites 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.

5. To collect 10 vertical net hauls at mooring site A.

6. To conduct a 25 hour station at 53º 32´ N 3º 21.8´ W with CTDs profiles recorded every half hour and surface and bed water samples taken every hour.

The plan was to deploy the second site, recover the ADCP at site 12, do the mooring work at site A, followed by the 25 hour station and the CTD grid.

2.1 Scientific personnel

John Howarth (Principal)
Mike Burke
Mike Smithson
John Kenny
Stewart Cutchey (CEFAS)
Olga Andres (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Vladimir Krivtsov (School of Ocean Sciences)

2.2 Ship's officers and crew

Andrew Wallace (Master)
Crispin Partridge (Chief Officer)
Arfon Williams (Chief Engineer)
(Second Engineer)
Tommy Roberts (A.B.)
David Williams (A.B.)
Paul Blundell (A.B.)
Eifion Pritchard (Cook)

3. Narrative (times in GMT)

The SmartBuoy toroid, anchor chain clumps, two sea-bed frames and instrumentation were loaded onto RV Prince Madog on the afternoon of 4 April 2005. The SmartBuoy toroid was rolled down the walkway whilst the marker buoy for the site B, since it was already made up and had been stored in the pavilion and since the tide was out, was lowered onto the mud by the pavilion crane. When the buoy floated as the tide came in it was towed by hand out to the pontoon and tied up so that it could be craned onto the Prince Madog the next morning prior to sailing. 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 07:05 on the 5 April 2005, see Figure 1 for cruise track. Recording of surface sampling and the ship's ADCP were started at 08:06, near Puffin Island. The marker buoy at site B was deployed between 09:44 and 09:47 and the ADCP at 09:51. A CTD profile was recorded. Site 12 was reached at 10:47 and a CTD recorded. Unsuccessful attempts to contact the ADCP were made between 11:05 and 11:20. These were ended and a course set for mooring site A, with the intention of performing a more extensive acoustic search during the CTD grid.

Mooring site A was reached at 12:10 and a CTD profile recorded. Winds were 12 – 16 m s^{-1} from south of west. The telemetry ADCP was released at 12:19, sighted on the surface at 12:22, on deck at 12:42 and its ballast weight on deck at 12:49. The waves ADCP was released at 13:17, sighted on the surface at 13:21, on deck at 13:35 and its ballast weight on deck 13:49. The blanking plug from the recovered Sea Bird SBE16*plus* was removed from this frame and fitted to the frame about to be deployed. There was superficial corrosion on the burn wire releases. The replacement waves ADCP was deployed at 14:07. It was too rough for SmartBuoy operations so a course was set for Mersey buoy Q1 to see if the wandering telemetry toroid could be located, which it was, a cable south of Q1, at 53º 30.82´ N 3º 16.62´ W. The buoy was recovered between 14:41 and 15:20, it taking several attempts to grapple. The reason the buoy was drifting was now apparent – the end of the mooring chain was free, the boss hook attaching the anchor clump was missing. The chain itself was polished showing that it had been dragging on the sea bed and acting as a limited anchor, which was presumably why the buoy had not drifted far.

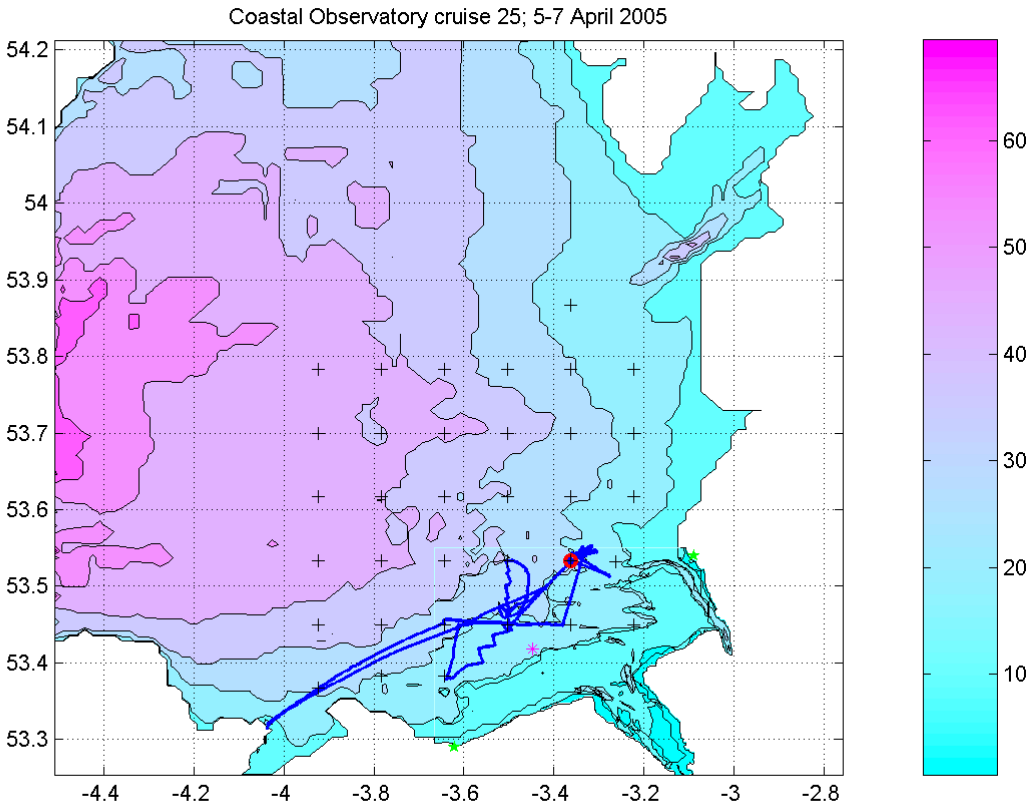

Figure 1. Cruise track.

We returned to the mooring site and commenced the 25 hour station at 16:00, with CTD profiles and water samples on the hour and CTD profiles alone on the half hour. By 02:00 on 6 April conditions had deteriorated, with winds up to 23 m s^{-1}, and CTD operations were stopped. The situation was reviewed at 10:00 with winds 12 – 15 m s^{-1} from the south west and a trial CTD recorded. Although successful the sea state was too rough, the wire kept on snatching, for safe CTD operations to continue. We steamed closer inshore, to site 11, in the hope the sea might be calmer, but it was still too rough to work. An acoustic search for the

missing ADCP near site 12 was then started, steaming westward stopping every 1 mile to listen, through site 12 towards site 21. We then steamed to site 22, stopping to listen on the way. It was still to rough for CTD operation. Finally we returned to site 12 and continued the acoustic search northward to site 13, finishing the acoustic search at 18:15.

The situation was reviewed at 07:00 on 7 April. Since it was still too rough for CTD operation, and hence also for mooring work, and since there was no forecast improvement the cruise was ended and a course set for Menai Bridge.

Because of the continuous bad weather (2 days were effectively lost) the cruise had not been particularly successful – the majority of the mooring work was completed but the SmartBuoy turn around was not accomplished and the ADCP at site 12 could not be located despite an extensive search. Only 9.5 hours of the 25 hour CTD station was completed and only 3 sites, out of 34 on the CTD grid, visited. No zooplankton net hauls were made. The most important omission was the deployment of the SmartBuoy since this deployment should capture the spring bloom. The cruise immediate following has kindly agreed to deploy it (weather permitting) since this was scheduled to visit Liverpool Bay.

4. Moorings (times in GMT)

4.1 The set up of the recovered 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.
On recovery unable to communicate on batteries but alright with PSU. Only 65773 bytes. Date reading 5 April 2001 – year wrongly set? therefore no data.

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 and Turner SCUFAfluorimeter.
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.
Stopped at 11:08:06 on 6 April 2005; clock 33 s fast. Sample number 9357.

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.

c) Telemetry ADCP ADCP 600 kHz RDI 5806.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).
30 x 1 m bins (2.65 – 36.65 m above the bed).
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Fitted with a pressure sensor.

Clock reset at 19:24 on 2 March 2005; delayed start at 07:50 on 3 March 2005
Stopped at ~22:54 on 5 April 2005; clock 36 s fast. 3,630,087 bytes.

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 70356 – Rx 10.5 kHz, Tx 12.0 kHz; enable C, release D and xxxx – Rx 11.5 kHz, Tx 12.0 kHz enable F, release D both with a 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	Date
Telemetry toroid	53º 30.816′	3º 16.621′	9.5	14:41	05/04/05
Waves ADCP	53º 32.070′	3º 22.210′	21.8	13:17	05/04/05
Telemetry ADCP	53º 31.821′	3º 21.922′	24.0	12:19	05/04/05

4.2 The set up of the deployed instruments was as follows:
e) Site 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 512 Mbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 14:57 on 4 April 2005; delayed start 06:00:00 on 5 April 2005. Started on time.

Sea-Bird 16*plus* S/N 4737 (ID=#02) on base of frame with pumped conductivity sensor underneath. Two SeaPoint turbidity sensors: S/N 10489 taped to roll bar and S/N 10486 in CTD clamp.
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 17:06:15 on 4 April 2005; delayed start at 12:00:00 on 5 April 2005.

The frame D1 was fitted with two Benthos releases 70358 – Rx 11.0 kHz, Tx 12.0 kHz enable C, release D and 69679 – Rx 11.5 kHz, Tx 12.0 kHz, enable C, release D both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

g) Site B. Waves ADCP 600 kHz RDI 3644. 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 512 Mbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 14:20 on 4 April 2005; delayed start 06:00:00 on 5 April 2005. Started on time.

Sea-Bird 16*plus* S/N 4597 (ID=#02) on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor: S/N 10471 taped to roll bar.
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 17:20 on 4 April 2005; delayed start at 10:00:00 on 5 April 2005.

The frame D5 was fitted with two Benthos releases 71919 – Rx 10.5 kHz, Tx 11.0 kHz enable B, release C and 72378 – Rx 10.5 kHz, Tx 11.0 kHz, enable B, release B both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight

h) Site B marker buoy.
Sea-Bird MicroCAT temperature and conductivity recorder (2081 – ID=#012) at 3 m below the surface. 10 minute samples. Reference pressure 25 db.
Clock set at 17:58:40 on 4 April 2005. Delayed start 10:00:00 on 05 April 2005.

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)	Deployed Time	Deployed Date
Wave ADCP (site B)	53º 27.248´	3º 38.718´	28.6	09:51	05/04/05
Marker buoy (site B)	53º 27.134´	3º 38.612´	27.5	09:47	05/04/05
Wave ADCP (site A)	53º 32.030´	3º 21.565´	20.5	14:07	05/04/05

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
1	53º 32′	3º 21.8′	yes	yes	yes
12	53º 27′	3º 30.2′	yes		yes
21	53º 27′	3º 38.6′	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). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC.

New anti-foulant was fitted to the system – it is changed every two years. Data were recorded every minute from 08:06 on 5 April until 09:40 on 7 April 2005 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 from 08:06 on 5 April until 09:40 on 7 April 2005 starting and ending at Puffin Island.

Acknowledgements
The assistance of the master, officers, and crew contributed greatly to the success and safety of the cruise.