Prince Madog cruise 23/07
POL Coastal Observatory cruise 48
3 – 4 October 2007

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 a SeaPoint turbidity sensor was fitted to the frame. The frame was fitted with a SonTek ADV.
b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring with SeaBird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 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 Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor, SeaPoint turbidity sensor were fitted to the frame.
d) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring with Sea-Bird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.

2. At 53º 27´ N 3º 38.6´ W (site 21, second site, B)
To recover
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 a SeaPoint turbidity sensor were fitted to the frame. A 1200 kHz telemetry ADCP was fitted to the frame.
f) A CEFAS SmartBuoy (with cellulose bags and trace metal sensor) in a single point mooring with Sea-Bird MicroCat temperature, conductivity loggers at 5m and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.
g) A telemetry toroid.

To deploy
h) 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, a SeaPoint turbidity and an Aanderaa conductivity sensor sensor were fitted to the frame. A 1200 kHz telemetry ADCP was fitted to the frame.
i) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring with Sea-Bird MicroCat temperature, conductivity loggers at 5m and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.
j) A telemetry toroid.

3. 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.

4. Collect 10 vertical net hauls at mooring site A.

5. Collect benthos samples at the two mooring sites.

6. Collect sediment samples at each of the CTD sites

2.1 Scientific personnel

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John Kenny
Mike Smithson
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Dave Sivyer (CEFAS)
Neil Needham (CEFAS)
Ray Wilton (School of Ocean Sciences)
Claire Mahaffey(Liverpool University)
Heidi Tillin (Liverpool University)

2.2 Ship's officers and crew

Steve Duckworth (Master)
David Shaw (Chief Officer)
Alan Thompson (Chief Engineer)
Meikle McKay (Second Engineer)
Phil Jones (Bosun)
Dave Leigh (A.B.)
Hefin Griffiths (A.B.)
Robert Weston (Cook)

3. Narrative (times in GMT)

The SmartBuoy toroid, anchor chain clumps, two sea-bed frames (and stacker) and instrumentation were loaded onto RV Prince Madog on the afternoon of 2 October 2007, just after high water. The ADCP frames were set up on the afterdeck and the tower and instruments fitted to the SmartBuoy toroid.

Prince Madog left Menai Bridge at 07:20 on 3 October 2007 – the slight delay was caused by the absence of a milk delivery. The ship's underway pCO_2, surface monitoring and ADCP were switched on by Puffin Island. However the pCO_2 system came up with an alarm, traced to water in the system which was eventually sorted out by the time the Mersey Bar site was reached. A new (acoustic) anemometer had been fitted prior to the cruise. The relative humidity sensor was not working and initially the sea surface salinity values appeared to be low.

The telemetry toroid at Site B was recovered, between 09:55 and 10:01, so that the telemetry system could be thoroughly checked since telemetry of ADCP data had failed. The toroid added to clutter on the deck but did not unduly hinder mooring deployments, partly because the ADCP frame stacker enabled one frame to be put out of the way.

The Mersey Bar mooring site was reached at 11:15 and a CTD recorded (bottles used: 3 – salinity; 4 -SPM bottom; 9 - SPM top; 10,11 – surface, Cefas). The ADCP release was fired at 11:25, the frame quickly surfaced and was grappled. The pellet line was wrapped round the body of the ADV head, which does not appear to have been damaged. The ADCP and its ballast weight were on deck by 11:47. The clamp for the ADV head was swapped onto the new frame which was then deployed at 12:22. The replacement SmartBuoy was deployed at 12:42 and the old buoy recovered between 12:53 and 12:58. A second CTD was recorded at 13:12, followed by the zooplankton vertical net hauls, 13:35 – 14:15 and a series of grab samples with a day grab, which finished at 14:39, primarily for benthos sampling.

The CTD and grab survey then proceeded with sites 35, 2 – 16. The weather was by now not very pleasant so CTDs but no grab samples were obtained at sites 17, 18 and no measurements at site 19. A CTD only was obtained at site 20. At site 21, the second mooring site, it was clearly too rough for mooring work but had improved sufficiently to obtain grab samples, for the benthos survey, and a CTD. CTDs and grabs were obtained at sites 22, 23 and 24 by which time the sea had calmed down sufficiently for mooring operations. So the ADCP at site 21 was recovered between 11:31 and 11:56. (The first release appeared not to have worked, the burn wire may just have taken a long time to break, but the frame appeared quickly after the second release was fired.) The telemetry toroid was then deployed at 12:23, followed by the Smart Bouy, 12:42 – 12:50. The old buoy was recovered between 12:55 and 13:04 – the sensor head of the trace metal sensor was missing. The acoustic modem was transferred from the recovered ADCP frame to the replacement frame, which was then deployed at 13:21.

A CTD was recorded and the grid completed in fine weather by 20:55, omitting site 28, and grabs at sites 30 and 32. The surface monitoring system, ship's ADCP and pCO_2 system were switched off at 21:30, by Puffin Island, and Prince Madog docked at Menai Bridge at 22:30.

All the major cruise objectives were accomplished, although two CTD sites were missed out, despite poor weather during the night of 3 / 4 October. The water column was well mixed, with little signs of phytoplankton productivity.

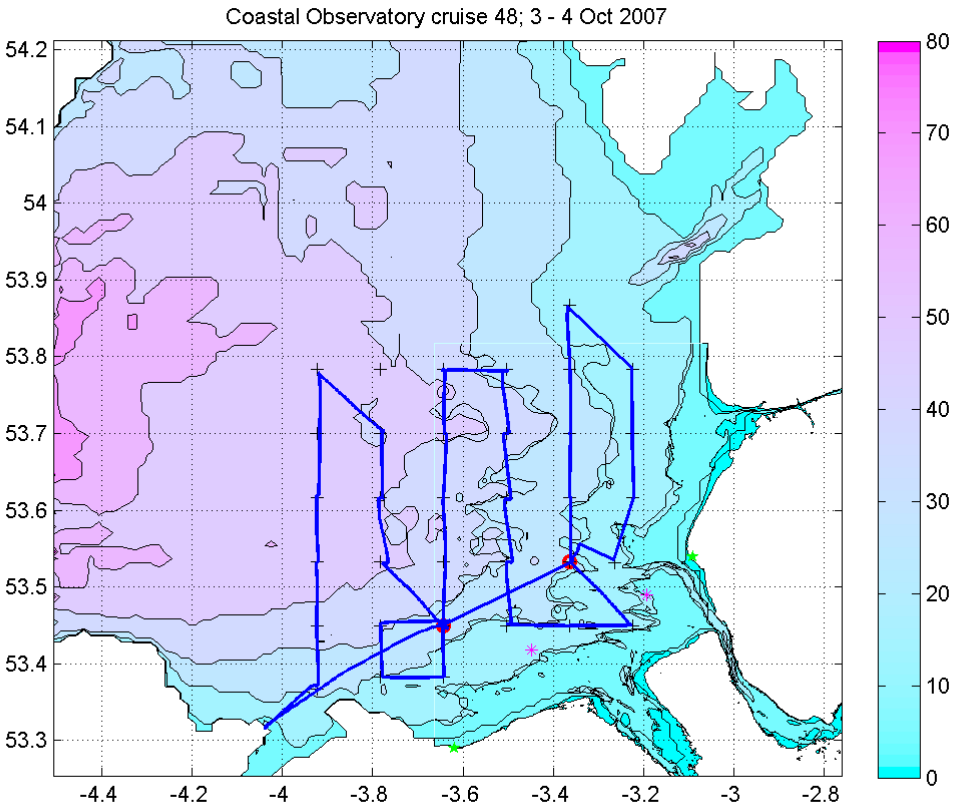

Figure 1. Cruise track.

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

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

Site A

a) Waves ADCP 600 kHz RDI 5807**.**
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.
1Gb PCMCIA memory; hourly wave recording enabled.
Clock reset at 14:27:50 on 28 August; delayed start 08:00:00 on 29 August 2007.

Sea-Bird 16plus S/N 4736 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor 10490 taped to roll bar; set up for 0 - 125 FTU range.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay.
Clock set at 12:38:00 on 28 August 2007; delayed start at 08:00:00 on 29 August 2007.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G250; head B252.
ADV transmitter 1.325m above bed (deck). Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s.
Clock set 14:50:00 on 28 August 2007. Delayed start at 08:00 on 29 August 2007.

The frame was fitted with two Benthos releases 71904 – Rx 10.0 kHz, Tx 12.0 kHz, release C and 72382 – Rx 10.0 kHz, Tx 12.0 kHz, release A 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 Serial number 4998 at 5m below the surface. Sample interval 600s.
Clock set at 13:30:00 on 28 August 2007. Delayed start 08:00:00 on 29 August 2007.
Stopped at 22:46:00 on 3 October 2007; clock 4 s slow; 5129 samples, downloaded ok.

Sea-Bird MicroCat temperature and conductivity recorder Serial number 2081 at 10m below the surface. Sample interval 600s. Refererence pressure=25 dbar.
Clock set at 14:01:30 on 28 August 2007. Delayed start 08:00:00 on 29 August 2007.
Stopped at 21:48:00 on 3 October 2007; clock 5 s fast; 5123 samples, downloaded ok.

Mini-logger Serial number 6028E at 7.5 m below the surface set to record at 600s intervals.
Clock set at 16:43:38 28 August 2007. Delayed start at 08:00:00 on 29 August 2007.

Mini-logger Serial number 6022E at 12.5 m below the surface set to record at 600s intervals.
Clock set at 16:42:00 28 August 2007. Delayed start at 08:00:00 on 29 August 2007.

The CEFAS SmartBuoy is fitted with one surface CTD, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (TOXN and silicate; no filtration therefore no phosphate), fluorometer (SeaPoint), oxygen (Aanderaa Optode) and chlorophyll determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm. The frame was fitted with bags for the determination of bacterial degradation.

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.

Site B
e) Waves ADCP 600 kHz RDI 3644.
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 1Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 10:46:00 on 25 July; delayed start 08:00:00 on 26 July 2007.

Telemetry ADCP 1200 kHz RDI 6489**.**
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). Using 512Mb memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 09:40:00 on 25 July; delayed start 15:00:00 on 25 July 2007 (early for testing purposes).
LinkQuest acoustic modem set for transmission of ADCP data every hour.

Sea-Bird 16plus S/N 4596 on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor 10487; set up for 0 - 125 FTU range.
Sample interval 600 s; digiquartz integration time 40s, range 400; run pump 0.5s, 1 s delay.
Clock set at 07:58:00 on 25 July 2007; delayed start at 08:00:00 on 26 July 2007.

The frame was fitted with two Benthos releases 70358 – Rx 11.0 kHz, Tx 12.0 kHz, release A and 70356 – Rx 10.5 kHz, Tx 12.0 kHz, release D both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

f) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure (digiquartz) recorder serial number 5433 at 5 m below the surface. Sample interval 600s.
Clock set at 13:48:00 on 28 August 2007. Delayed start 08:00:00 on 29 August 2007.

Stopped at 13:48:00 on 28 August 2007.
Sea-Bird MicroCat temperature, conductivity and pressure (digiquartz) recorder serial number 5434 at 10m below the surface. Sample interval 600s.
Clock set at 13:42:00 on 28 August 2007. Delayed start 08:00:00 on 29 August 2007.

Mini-logger Serial number 2407 at 7.5 m below the surface set to record at 600s intervals.
Clock set at 03:33:10 on 30 August 2007. Delayed start at 08:00:00 on 30 August 2007.

Mini-logger Serial number 2192E at 11.5 m below the surface set to record at 600s intervals.
Clock set at 03:38:12 on 30 August 2007. Delayed start at 08:00:00 on 30 August 2007.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity and fluorescence sensors). The frame was fitted with bags for the determination of bacterial degradation.

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.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovered Time	Date
Waves ADCP (Site A)	53º 32.104´	3º 21.404´	22.4	11:25	03/10/07
SmartBuoy (Site A)	53º 32.053´	3º 21.697´	24.3	12:53	03/10/07
Waves ADCP (Site B)	53º 27.303´	3º 38.181´	24.1	11:31	04/10/07
Smart Buoy (Site B)	53º 26.932´	3º 38.576´	24.4	12:55	04/10/07
Telemetry toroid (Site B)	53º 27.041´	3º 38.602´	23.0	09:55	03/10/07

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

Site A
c) Waves ADCP 600 kHz RDI 2391**.**
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.
1Gb PCMCIA memory; hourly wave recording enabled.
Clock reset at 13:59:00 on 2 October; delayed start 08:00:00 on 3 October 2007.

Sea-Bird 16plus S/N 4738 on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor 10320 taped to roll bar; set up for 0 - 125 FTU range.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay.
Clock set at 17:24:00 on 2 October 2007; delayed start at 08:00:00 on 3 October 2007.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G412; head B331.
ADV transmitter 1.21m above bed (deck). Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s.
Clock set 14:45:00 on 2 October 2007. Delayed start at 08:00 on 3 October 2007.

The frame was fitted with two Benthos releases 70355 – Rx 10.0 kHz, Tx 12.0 kHz, release B and 71919 – Rx 10.5 kHz, Tx 12.0 kHz, release C both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

d) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder Serial number 4966 at 5m below the surface. Sample interval 600s.
Clock set at 14:13:00 on 2 October 2007. Delayed start 08:00:00 on 3 October 2007.

Sea-Bird MicroCat temperature and conductivity recorder Serial number 2010 at 10m below the surface. Sample interval 600s. Refererence pressure=25 dbar.
Clock set at 14:25:30 on 2 October 2007. Delayed start 08:00:00 on 3 October 2007.

Mini-logger Serial number 2425 at 7.5 m below the surface set to record at 600s intervals.
Clock set at 15:26:00 on 2 October 2007. Delayed start at 08:00:00 on 3 October 2007.

Mini-logger Serial number 2112 at 15 m below the surface set to record at 600s intervals.
Clock set at 15:32:00 on 2 October 2007. Delayed start at 08:00:00 on 3 October 2007.

The CEFAS SmartBuoy is fitted with one surface CTD, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (TOXN and silicate; no filtration therefore no phosphate), fluorometer (SeaPoint), oxygen (Aanderaa Optode) and chlorophyll determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm. The frame was fitted with bags for the determination of bacterial degradation.

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.

Site B
h) Waves ADCP 600 kHz RDI 5806.
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 1Gbyte PCMCIA memory; hourly wave recording enabled.

Clock reset at 15:08:00 on 2 October; delayed start 08:00:00 on 3 October 2007.

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). Using 512Mb memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 15:17:00 on 2 October; delayed start 08:00:00 on 3 October 2007.
LinkQuest acoustic modem set for transmission of ADCP data every hour.

Sea-Bird 16plus S/N 4597 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor 10471; set up for 0 - 125 FTU range.
Aanderaa type 4120 C&T sensor serial number 187.
Sample interval 600 s; digiquartz integration time 40s, range 400; run pump 0.5s, 1 s delay.
Clock set at 17:13:00 on 2 October 2007; delayed start at 08:00:00 on 3 October 2007.

The frame was fitted with two Benthos releases 71922 – Rx 11.5 kHz, Tx 12.0 kHz, release A and 67879 – Rx 11.5 kHz, Tx 12.0 kHz, release B both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

i) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity recorder serial number 2506 at 10m below the surface. Sample interval 600s.
Clock set at 14:30:00 on 2 October 2007. Delayed start 08:00:00 on 3 October 2007.

Sea-Bird MicroCat temperature, conductivity and pressure recorder serial number 2991 at 5m below the surface. Sample interval 600s.
Clock set at 08:30:00 on 3 October 2007. Delayed start 09:00:00 on 3 October 2007.

Mini-logger Serial number 2427 at 7.5 m below the surface set to record at 600s intervals.
Clock set at 15:28:00 on 2 October 2007. Delayed start at 08:00:00 on 3 October 2007.

Mini-logger Serial number 2108 at 15 m below the surface set to record at 600s intervals.
Clock set at 15:30:00 on 2 October 2007. Delayed start at 08:00:00 on 3 October 2007.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity and fluorescence sensors). The frame was fitted with bags for the determination of bacterial degradation.

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
Waves ADCP (Site A)	53º 32.114´	3º 21.419´	23.2	12:22	03/10/07
SmartBuoy (Site A)	53º 31.998´	3º 21.769´	24.1	12:42	03/10/07
Waves ADCP (Site B)	53º 27.975´	3º 38.410´	24.4	13:21	04/10/07
Smart Buoy (Site B)	53º 26.917´	3º 38.526´	24.2	12:50	04/10/07

Telemetry toroid (Site B)	53º 27.023′	3º 38.421′	24.0	12:23 04/10/07

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. The rosette will take twelve 10 l water bottles although the capacity is reduced by one (for the LISST-25). One/two water bottles were fired near bed and one/two/three near the surface, when needed. The CTD temperature data was checked against a Sea-Bird SBE35 precision thermometer. Water samples were taken from a near bed 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 NOC (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 and 21 were filtered for chlorophyll and suspended sediment determination and some filtrate was preserved with mercuric chloride for nutrient determination by CEFAS, (in addition samples at station 1 were taken for oxygen analysis). A LISST-100C 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. A LISST-25 particle sizer was fitted to the CTD and its data logged on the Sea-Bird data logging system.

Table 3. Nominal CTD positions. (Ss – Suspended sediments, Nu – Nutrients)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu & Ss	POL Nu	POL Ss	Grab
1	53º 32′	3º 21.8′	yes	yes	yes	yes	yes
2	53º 37′	3º 13.4′	yes		yes	yes	yes
3	53º 42′	3º 13.4′	yes		yes	yes	yes
4	53º 47′	3º 13.4′	yes		yes	yes	yes
5	53º 52′	3º 21.8′	yes	yes	yes	yes	yes
6	53º 47′	3º 21.8′	yes	yes	yes	yes	yes
7	53º 42′	3º 21.8′	yes	yes	yes	yes	yes
8	53º 37′	3º 21.8′	yes	yes	yes	yes	yes
9	53º 32′	3º 21.8′	yes	yes	yes	yes	yes
10	53º 27′	3º 13.4′	yes		yes	yes	yes
11	53º 27′	3º 21.8′	yes	yes	yes	yes	yes
12	53º 27′	3º 30.2′	yes		yes	yes	yes
13	53º 32′	3º 30.2′	yes		yes	yes	yes
14	53º 37′	3º 30.2′	yes		yes	yes	yes
15	53º 42′	3º 30.2′	yes		yes	yes	yes
16	53º 47′	3º 30.2′	yes		yes	yes	yes
17	53º 47′	3º 47.0′	yes		yes	yes	no
18	53º 42′	3º 38.6′	yes		yes	yes	no
19	53º 37′	3º 38.6′	no				
20	53º 32′	3º 38.6′	yes		yes	yes	no

21	53º 27′	3º 38.6′	yes	yes	yes	yes	yes
22	53º 23′	3º 38.6′	yes		yes	yes	yes
23	53º 23′	3º 47.0′	yes		yes	yes	yes
24	53º 27′	3º 47.0′	yes		yes	yes	yes
25	53º 32′	3º 47.0′	yes		yes	yes	yes
26	53º 37′	3º 47.0′	yes		yes	yes	yes
27	53º 42′	3º 47.0′	yes		yes	yes	yes
28	53º 47′	3º 47.0′	no				
29	53º 47′	3º 55.4′	yes		yes	yes	yes
30	53º 42	3º 55.4′	yes		yes	yes	no
31	53º 37′	3º 55.4′	yes		yes	yes	yes
32	53º 32′	3º 55.4′	yes		yes	yes	no
33	53º 27′	3º 55.4′	yes		yes	yes	yes
34	53º 22′	3º 55.4′	yes		yes	yes	yes
35	53º 32′	3º 15.9′	yes		yes	yes	yes

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Table 4. Surface and bottom parameters from CTD, noted in log book.

			Nominal positions.				
CTD no	Site	Nuts	Latitude (N)	Longitude (W)	Water depth (m)	Temp (deg)	Salinity
		T/ B				T / B	T / B
1	1-1		53º 32′	3º 21.8′	22	14.5 / 14.5	31.7 / 31.8
2	1-2	1/2	53º 32′	3º 21.8′	24	14.7 / 14.7	32.0 / 32.0
3	35	3/4	53º 31.9′	3º 15.9′	16	14.5 / 14.5	31.7 / 31.7
4	2	5/6	53º 37′	3º 13.4′	16	14.2 / 14.2	31.4 / 31.6
5	3	7/8	53º 42′	3º 13.4′	20	14.3 / 14.2	32.2 / 32.2
6	4	9/10	53º 47′	3º 13.4′	19	14.2 / 14.1	32.4 / 32.4
7	5	11/12	53º 52′	3º 21.8′	17	14.4 / 14.4	32.6 / 32.6
8	6	13/14	53º 47′	3º 21.8′	21	14.7 / 14.7	32.5 / 32.6
9	7	15/16	53º 42′	3º 21.8′	24	14.6 / 14.6	32.4 / 32.4
10	8	17/18	53º 37′	3º 21.8′	25	14.6 / 14.6	32.2 / 32.2
11	9	19/20	53º 32′	3º 21.8′	22	14.5 / 14.7	31.8 / 32.0
12	10	21/22	53º 27′	3º 13.4′	14	14.1 / 14.1	30.8 / 30.8
13	11	23/24	53º 27′	3º 21.8′	15	14.4 / 14.5	31.4 / 31.6
14	12	25/26	53º 27′	3º 30.2′	17	14.7 / 14.8	32.0 / 32.2
15	13	27/28	53º 32′	3º 30.2′	30	14.9 / 15.0	32.5 / 32.6
16	14	29/30	53º 37′	3º 30.2′	30	14.9 / 14.9	32.5 / 32.6
17	15	31/32	53º 42′	3º 30.2′	39	15.0 / 15.0	32.9 / 32.9
18	16	33/34	53º 47′	3º 30.2′	28	14.9 / 14.9	32.9 / 32.9
19	17	35/36	53º 47′	3º 38.6′	38	14.9 / 14.9	33.1 / 33.1
20	18	37/38	53º 42′	3º 38.6′	41	15.0 / 15.0	33.1 / 33.1
21	20	39/40	53º 32′	3º 38.6′	36	15.0 / 15.0	32.8 / 32.8
22	21-1	41/42	53º 27′	3º 38.6′	25	14.8 / 14.9	32.3 / 32.4
23	22	43/44	53º 23′	3º 38.6′	13	14.1 / 14.2	31.6 / 31.6
24	23	45/46	53º 23′	3º 47.0′	12	14.3 / 14.5	31.9 / 32.1
25	24	47/48	53º 27′	3º 47.0′	31	14.9 / 15.0	32.6 / 32.8
26	21-2		53º 27′	3º 38.6′	25	14.9 / 14.8	32.4 / 32.4

27	25	49/50	53º 32′	3º 47.0′	45	15.2 / 15.1	33.0 / 33.1
28	26	51/52	53º 37′	3º 47.0′	42	15.2 / 15.1	33.1 / 33.1
29	27	53/54	53º 42′	3º 47.0′	42	15.1 / 15.0	33.2 / 33.3
30	29	55/56	53º 47′	3º 55.4′	45	15.1 / 15.0	33.4 / 33.7
31	30	57/58	53º 42	3º 55.4′	43	15.1 / 15.0	33.6 / 33.7
32	31	59/60	53º 37′	3º 55.4′	47	15.1 / 15.1	33.4 / 33.4
33	32	61/62	53º 32′	3º 55.4′	47	15.2 / 15.2	33.2 / 33.3
34	33	63/64	53º 27′	3º 55.4′	38	15.1 / 15.1	33.0 / 33.1
35	34	65/66	53º 22′	3º 55.4′	23	14.5 / 14.8	32.2 / 32.5

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Inorganic nutrient concentrations have been determined in the Coastal Observatory time series for the past five years. However, a large fraction of the nutrient pool is in organic form but is not routinely measured. On this cruise, samples were collected for analysis of dissolved organic carbon and dissolved organic nitrogen, as well as total dissolved phosphorus to assess if there are gradients in the organic nutrient pool over the Coastal Observatory grid. In addition, unfiltered seawater was collected to assess the affects of storage on nutrient concentrations over timescales of weeks to months. Overall, 13 stations were sampled in Liverpool Bay. Analysis of samples will be completed in the Department of Earth and Ocean Sciences at the University of Liverpool.

Station number	Samples taken
9	1 x nutrient
	1 x TDP
	3 x DOC/DON
10	1 x nutrient
	1 x TDP
	3 x DOC/DON
11	1 x nutrient
	1 x TDP
12	1 x nutrient
	1 x TDP
13	1 x nutrient
	1 x TDP
14	1 x nutrient
	1 x TDP
15	1 x nutrient
	1 x TDP
21	1 x nutrient
	1 x TDP
	3 x DOC/DON
23	1 x nutrient
	1 x TDP
	3 x DOC/DON
24	1 x nutrient
	1 x TDP
	3 x DOC/DON
26	1 x nutrient
	1 x TDP
27	3 x DOC/DON

29	1 x nutrient 1 x TDP 3 x DOC/DON

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. In addition a pCO_2 sensor was incorporated into the surface sampling system.

A new sonic anemometer was fitted prior to the cruise. No PAR data were recorded and the relative humidity sensor recorded bad data. The transmittance, fluorescence and turbidity were all recorded as voltages.

Underway, including navigation, data were recorded every minute from 08:18 on 3 October until 21:26 on 4 October 2007, starting and ending at Puffin Island. There were three gaps in the data, from 09:52 to 18:17 on 3 October, from 17:32 to 18:07 and from 19:40 to20:14 on 4 October.

pCO_2 data were recorded from about 12:00 on 3 October until 21:26 on 4 October 2007, starting and ending at Puffin Island. The delayed start was caused by an alarm, traced to water in the system.

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 08:18 on 3 October to 21:26 on 04 October 2007, starting and ending at Puffin Island.

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