Prince Madog cruise 21/05
POL Coastal Observatory cruise 27
15 – 17 June 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.

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 and a SeaPoint turbidity sensor were fitted to the frame.
d) 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 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 SeaPoint turbidity sensor 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.

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. The frame is fitted with an ADV.
h) 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.

3. At 53º 27´ N 3º 30.2´ W (site 12)
To recover by dragging 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 and was located on the previous cruise.

4. At 53º 23.033´ N 3º 14.292´ W (off Hilbre Island)
To recover a directional wave buoy deployed as part of the Dee experiment.

5. 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.

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

The plan was to complete mooring operations at site A on Wednesday afternoon followed by CTD measurements during the night. On Thursday mooring operations at site B would start at 07:00, followed by dragging for the ADCP at site 12, recovery of the Dee wave buoy at 15:00 and completion of the CTD grid.

2.1 Scientific personnel

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2.2 Ship's officers and crew

Steve Duckworth (Master)
Andrew Wallis (Chief Officer)
Neil Holmes(Chief Engineer)
Les Black (Second Engineer)
Tommy Roberts (A.B.)
Bob Munn (A.B.)
Peter Zwart (A.B.)
Terry Gordon (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 14 June 2005. The SmartBuoy toroid was rolled down the walkway. Because of new Health and Safety requirements loading was delayed until 12:00 (the tractor cannot go down the walkway until the water level is at least 4 m) and took longer than usual, finishing at 15:30. 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 08:30 on 15 June, delayed for an hour and a half waiting for a part to arrive by courier so that a replacement wire could be installed on the

ship's crane. See Figure 1 for the cruise track. Recording of surface sampling and the ship's ADCP were started at 09:30, near Puffin Island. Mooring site A was reached at 12:05 and the first CTD profile recorded. The ADCP was released at 12:30, was on deck at 12:40 and its ballast frame by 12:48. Conditions were good, the sea state was slight, with winds weakening from the south. The replacement ADCP frame was deployed at 13:09. The SmartBuoy was deployed between 13:40 and 13:43 and the original buoy recovered between13:47 and 14:06. The recovery was enlivened by the appearance of a long wooden spar caught in the long link chain close to the anchor clump. The spar was not recovered and sank as soon as it was released. There was no growth on the buoy or ADCP frame. The deck was tidied and the second CTD recorded at 14:55 followed by ten vertical net hauls for zooplankton, finishing at 16:05. The CTD grid commenced for the night, visiting sites 35, 2-8, 14 – 17, 28 - 30, 27, 18 – 20, 13, 21.

The ADCP at site B (21) was located and released at 07:23 on 16 June; the ADCP frame was on the deck at 07:36 and the recovery completed at 07:48. The frame was clean; the sea bed appears to be composed primarily of sand. The replacement ADCP was deployed at 08:05. The SmartBuoy was deployed between 08:26 and 08:36, about 300 m south of the ADCP. The old SmartBuoy was recovered between 08:37 and 08:46 – there was only a small amount of growth on the buoy. A CTD was recorded and a course made for the last known position of the ADCP at site 12 which was reached at 09:50. Contact was immediately made with the ADCP and its position determined. Several passes dragging a loop of wire behind the ship, were made, with a couple of false contacts, before the ADCP stray line was finally snagged and lassoed. The ADCP frame and ballast weight, still in a unit, were on the deck by 12:28 – the mechanics of the release mechanism appear to have failed, becoming jammed with sediment or growth. The best position (53º 26.460´ N 3º 30.153´ W) indicated the frame had not moved since deployment on 31 January 2005. The frame and instrumentation were covered in barnacles.

A CTD at this site (12) was attempted but abandoned because the wire was snatching since the wind had increased to 12 m s^{-1}, from the south-west. However, conditions were adequate for CTD work at stations 11 and 10. The ship then entered the Hilbre Swash and approached the wave recorder off Hilbre Island. Conditions were not good with wind speeds of 17 m s^{-1} from the southwest. Prince Madog anchored and on the second attempt the wave buoy was grappled and recovered by 16:27. A course was set for station 12 and with the winds easying to 12 m s^{-1} the rest of the CTD grid was completed by 01:30 on 17 June, in sometimes marginal conditions. Prince Madog docked at 06:05.

The cruise had been successful, with all objectives met including recovery of the recalcitrant ADCP, despite windy weather on Thursday afternoon / night.

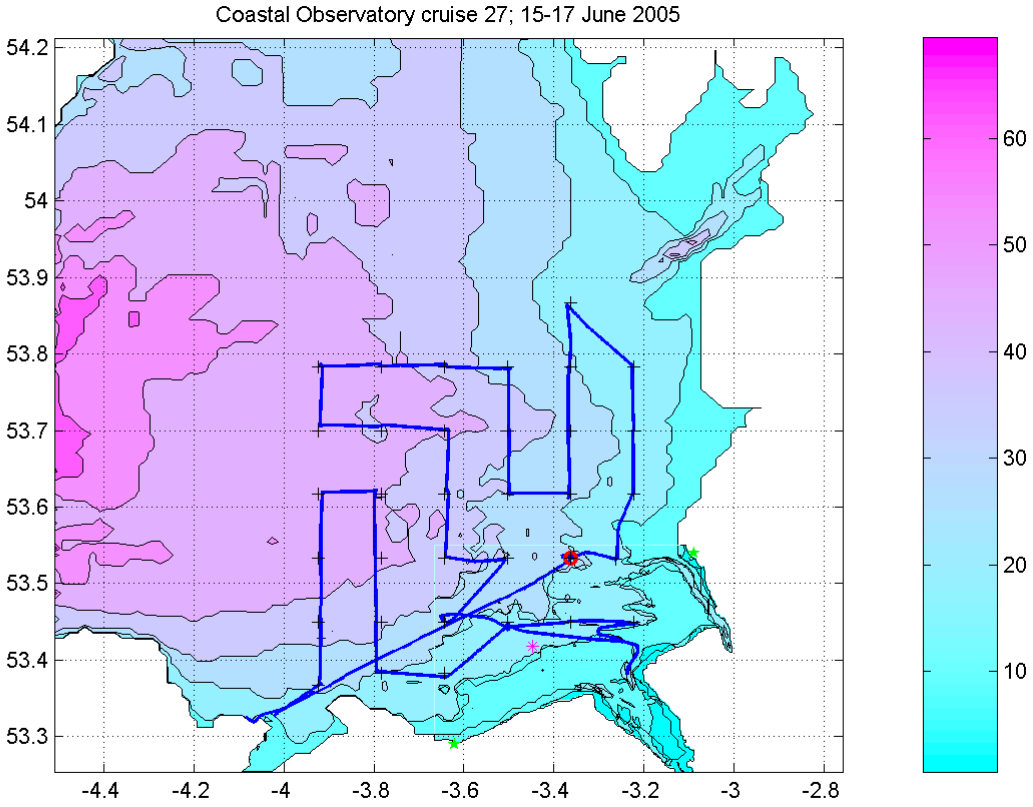

Figure 1. Cruise track.

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 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 1 Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 14:31:15 on 10 May 2005; delayed start 07:00:00 on 11 May 2005. Started on time.
The instrument was stopped on 15 June 2005 and the data downloaded; file size 163,496 kB.

Sea-Bird 16*plus* S/N 4738, id=#03 on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor: S/N 10490 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 14:32:00 on 10 May 2005; delayed start at 11:00:00 on 11 May 2005.
The instrument was stopped at 21:21:30 on 15 June, 2005; sample no 5091.
Calibration on CTD 13 station 16; on bottom 23:48 on 15 June to 00.00 on 16 June.
Clock correct; sample interval 120 s; delayed start at 23:45:00 on 15 June
Stopped at 00:21:00 on 16 June; sample nos 5091 to 5109.

The frame D2 was fitted with two Benthos releases 70355 – Rx 10.0 kHz, Tx 12.0 kHz, enable C, release D, which was fired, and one with unknown serial number – 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.

b) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature and conductivity recorder serial number 2010 (id=#01) at 5 m below the surface. 10 minute samples.
Clock set at 16:35:40 on 10 May 2005. Delayed start 11:00:00 on 11 May 2005.
The instrument was stopped at 19:38:45 on 15 June 2005; sample no. 5092.

Aanderaa current meter RCM7 11814 / DSU 8122 without fin at 10 m below the surface to log temperature (low temperature setting) and conductivity: 10 minute samples.
Clock set at 17:06:00 on 10 May 2005. Started at 17:10:00 on 10 May 2005.
Stopped at 18:18:30 on 15 June 2005; clock 14 s slow. Data downloaded - 31368 words.

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.

Site B
e) Site B. Waves ADCP 600 kHz RDI 5803. Battery case 3070.
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 14:57:00 on 10 May 2005; delayed start 07:00:00 on 11 May 2005. Started on time.
The instrument was stopped on 16 June 2005. The file was corrupted and could not be read directly from the memory card. File recovery software worked. File size 167,928 kB.

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.
1 s delay before sampling, pump on for 0.5 s before sampling.
Clock set at 14:12:00 on 10 May 2005; delayed start at 11:00:00 on 11 May 2005.
Stopped at 18:49:30; sample number 5231. Data downloaded.

The frame D6 was fitted with two Benthos releases 70354 – Rx 13.0 kHz, Tx 12.0 kHz, enable C, release D and and one with unknown serial number – Rx 10.5 kHz, Tx 11.0 kHz, enable D, release B 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 and conductivity recorder, Serial number 2991, at 5 m below the surface. 10 minute samples.
Clock set at 08:00:00 on 11 May 2005. Delayed start 11:00:00 on 11 May 2005.
Stopped at 21:35:00 on16 June 2005; clock 10 s fast. Data downloaded.

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 17:10:00 on 10 May 2005.
Stopped at 20:26:20 on 16 June; clock 22 s fast. Data downloaded; 32316 words.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity and chlorophyll fluorescence sensors) and a water sampler which obtains water samples once per day for laboratory nutrient (nitrate, nitrite, phosphate) determination.

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)	Recovery Time	Date
Waves ADCP (site A)	53º 32.051′	3º 21.451′	22.2	12:30	15/06/05
SmartBuoy (site A)	53º 32.120′	3º 21.169′	25.2	13:47	15/06/05
Waves ADCP (Site B)	53º 27.289′	3º 38.756′	27.9	07:23	16/06/05
Smart Buoy (Site B)	53º 27.193′	3º 38.562′	26.2	08:37	16/06/05
Dee ADCP (Site 12)	53º 26.460′	3º 30.153′	15	12:28	16/06/05
Hilbre wavebuoy	53º 23.049′	3º 14.253′	24	16:15	16/06/05

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

Site A
c) Waves ADCP 600 kHz RDI 3644; battery case 3240.
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 PCMCIA memory; hourly wave recording enabled.
Clock reset at 13:40:00 on 14 June 2005; delayed start 07:00:00 on 15 June 2005. Started.

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.
Sample interval 600 s; diqiquartz integration time 40 s; range 400.
1 s delay before sampling, pump on for 0.5 s before sampling.
Clock set at 13:41:00 on 14 June 2005; delayed start at 10:00:00 on 15 June 2005.

The frame D1 was fitted with two Benthos releases 70358 – Rx 11.0 kHz, Tx 12.0 kHz, enable C, release D and 72382 – Rx 10.0 kHz, Tx 11.0 kHz, enable D, release A 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 and conductivity recorder, Serial number 2081 (id=#02), at 5 m below the surface. 10 minute samples.
Clock set at 14:24:20 on 14 June 2005. Delayed start 10:00:00 on 15 June 2005.

Aanderaa current meter RCM8 10526 / DSU 8125 without fin at 10 m below the surface to log temperature (low temperature setting) and conductivity: 10 minute samples.
Started at 15:10:00 on 14 June 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.

Site B
g) Site B. Waves ADCP 600 kHz RDI 2391. Battery case 3235.
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 13:54:00 on 14 June 2005; delayed start 07:00:00 on 15 June 2005. Started.

Sea-Bird 16*plus* S/N 4737 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor: S/N 10489 taped to roll bar.
Sample interval 600 s; diqiquartz integration time 40 s; range 400.
1 s delay before sampling, pump on for 0.5 s before sampling.
Clock set at 13:55:20 on 14 June 2005; delayed start at 10:00:00 on 15 June 2005.

The frame D5 was fitted with two Benthos releases 71919 – Rx 10.5 kHz, Tx 11.0 kHz, enable B, release C and 71922 – Rx 11.5 kHz, Tx 11.0 kHz, enable D, release A both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

h) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature, conductivity and pressure recorder Serial number 2506 (id=#03) at 5 m below the surface. 10 minute samples.
Clock set at 14:19:00 on 14 June 2005. Delayed start 10:00:00 on 15 June 2005.

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.
Started at 15:10:00 on 14 June 2005.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity and fluorescence sensors) and a water sampler which obtains water samples once per day for laboratory nutrient (nitrate, nitrite, phosphate) determination.

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	Date
Waves ADCP (site A)	53º 32.018′	3º 21.430′	22.5	13:09	15/06/05
SmartBuoy (site A)	53º 32.050′	3º 21.637′	23.5	13:43	15/06/05
(Wavebuoy (approx)	53º 31.9′	3º 21.2′)			
Waves ADCP (Site B)	53º 27.215′	3º 38.827′	27.6	08:05	16/06/05
Smart Buoy (Site B)	53º 27.072′	3º 38.887′	26.2	08:28	16/06/05

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	no	yes
2	53º 37′	3º 13.4′	yes		yes
3	53º 42′	3º 13.4′	yes		yes
4	53º 47′	3º 13.4′	yes		yes
5	53º 52′	3º 21.8′	yes	yes	yes
6	53º 47′	3º 21.8′	yes	yes	yes
7	53º 42′	3º 21.8′	yes	yes	yes
8	53º 37′	3º 21.8′	yes	yes	yes
9	53º 32′	3º 21.8′	no	no	no
10	53º 27′	3º 13.4′	yes		yes
11	53º 27′	3º 21.8′	yes	yes	yes
12	53º 27′	3º 30.2′	yes		yes
13	53º 32′	3º 30.2′	yes		yes
14	53º 37′	3º 30.2′	yes		yes
15	53º 42′	3º 30.2′	yes		yes
16	53º 47′	3º 30.2′	yes		yes
17	53º 47′	3º 38.6′	yes		yes
18	53º 42′	3º 38.6′	yes		yes
19	53º 37′	3º 38.6′	yes		yes
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′	yes		yes
26	53º 37′	3º 47.0′	yes		yes
27	53º 42′	3º 47.0′	yes		yes
28	53º 47′	3º 47.0′	yes		yes
29	53º 47′	3º 55.4′	yes		yes
30	53º 42	3º 55.4′	yes		yes
31	53º 37′	3º 55.4′	yes		yes
32	53º 32′	3º 55.4′	yes		yes
33	53º 27′	3º 55.4′	yes		yes
34	53º 22′	3º 55.4′	yes		yes
35	53º 32′	3º 15.9′	yes		yes

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

CTD no	Site	Nuts	Nominal positions. Latitude (N)	Longitude (W)	Water depth (m)	Temp (deg)	Salinity
		T/ B				T / B	T / B
2	1	1/ 2	53º 32′	3º 21.8′	25	13.4 / 13.1	32.4 / 32.4
3	35	3/ 4	53º 31.9′	3º 15.9′	16	13.9 / 13.0	31.9 / 31.9
4	2	5/ 6	53º 37′	3º 13.4′	16	14.1 / 14.0	31.6 / 31.6
5	3	7/ 8	53º 42′	3º 13.4′	20	14.3 / 14.0	31.9 / 31.9
6	4	9/10	53º 47′	3º 13.4′	19	14.4 / 14.2	32.0 / 32.0
7	5	11/12	53º 52′	3º 21.8′	17	13.8 / 13.7	32.0 / 32.2
8	6	13/14	53º 47′	3º 21.8′	21	13.7 / 13.6	32.1 / 32.1
9	7	15/16	53º 42′	3º 21.8′	24	13.5 / 12.8	32.3 / 32.5
10	8	17/18	53º 37′	3º 21.8′	23	13.4 / 13.2	32.2 / 32.3
11	14	19/20	53º 37′	3º 30.2′	28	13.2 / 12.7	32.6 / 32.7
12	15	21/22	53º 42′	3º 30.2′	36	13.4 / 12.1	32.4 / 33.0
13	16	23/24	53º 47′	3º 30.2′	24	13.6 / 12.3	32.3 / 32.9
14	17	25/26	53º 47′	3º 38.6′	35	13.2 / 11.8	32.5 / 33.1
15	28	27/28	53º 47′	3º 47.0′	41	12.2 / 11.7	33.3 / 33.4
16	29	29/30	53º 47′	3º 55.4′	40	11.9 / 11.7	33.5 / 33.6
17	30	31/32	53º 42	3º 55.4′	43	11.9 / 11.8	33.6 / 33.6
18	27	33/34	53º 42′	3º 47.0′	44	12.6 / 11.7	33.2 / 33.4
19	18	35/36	53º 42′	3º 38.6′	41	12.9 / 11.7	32.0 / 33.2
20	19	37/38	53º 37′	3º 38.6′	35	13.1 / 12.1	32.7 / 32.2
21	20	39/40	53º 32′	3º 38.6′	37	12.5 / 12.4	33.1 / 33.2
22	13	41/42	53º 32′	3º 30.2′	33	13.0 / 12.8	32.8 / 32.9
23	21	43/44	53º 27′	3º 38.6′	26	12.6 / 12.6	33.0 / 33.0
25	11	45/46	53º 27′	3º 21.8′	16	13.7 / 13.7	32.2 / 32.2
26	10	47/48	53º 27′	3º 13.4′	15	14.4 / 14.2	31.8 / 31.8
27	12	49/50	53º 27′	3º 30.2′	21	13.4 / 13.3	32.2 / 32.7
28	22	51/52	53º 23′	3º 38.6′	14	13.3 / 13.2	32.8 / 32.8
29	23	53/54	53º 23′	3º 47.0′	18	13.3 / 13.0	33.0 / 33.0
30	24	55/56	53º 27′	3º 47.0′	22	12.6 / 12.6	33.2 / 33.2
31	25	57/58	53º 32′	3º 47.0′	43	12.3 / 12.1	33.3 / 33.6
32	26	59/60	53º 37′	3º 47.0′	41	12.5 / 12.0	33.3 / 33.4
33	31	61/62	53º 37′	3º 55.4′	45	12.4 / 12.0	33.4 / 33.5
34	32	63/64	53º 32′	3º 55.4′	44	12.1 / 11.9	33.5 / 33.6
35	33	65/66	53º 27′	3º 55.4′	37	12.7 / 12.3	33.2 / 33.4
36	34	67/68	53º 22′	3º 55.4′	23	13.7/ 13.2	32.8 / 33.0

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.

Data were recorded every minute from 09:35 on 15 June until 03:05 on 17 June 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 09:30 on 15 June until 03:00 on 17 June 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.