Prince Madog cruise 30/05
POL Coastal Observatory cruise 29
17 – 18 August 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 a SeaPoint turbidity sensor were fitted to the frame. The frame is fitted with a SonTek ADV.
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 Aanderaa RDCP600 to measure current profile, referenced from the sea-bed, surface and enhanced surface and one estimated surface values.

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 a SeaPoint turbidity sensor were fitted to the frame. The frame is fitted with an SonTek ADV.
e) A CEFAS SmartBuoy in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 5m below the surface.

2. At 53º 27′ N 3º 38.6′ W (site 21, second site, B)
To recover
f) 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.

g) 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
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 and a SeaPoint turbidity sensor were fitted to the frame

i) A CEFAS SmartBuoy in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 5m below the surface.

3. At 53º 23.5′ N 3º 14.3′ W (off Hilbre Island) to deploy
j) A directional wave buoy.

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. Collect 10 vertical net hauls at mooring site A.

6. To collect water sample for Stan van den Berg from underway sampling system from north-east corner of the CTD grid.

The plan was to complete mooring operations at site A on Wednesday afternoon followed by CTD measurements during the night. On Thursday the wave buoy would be deployed about 08:00 (near to high water), followed by mooring operations at site B and the completion of the CTD grid.

2.1 Scientific personnel

John Howarth (Principal)
Chris Balfour
Mike Burke
Ray Edun
Mike Smithson
Naomi Greenwood (CEFAS)
Olga Andres (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Vladimir Krivtsov (School of Ocean Sciences)
Conrad Chapman (Liverpool University)

2.2 Ship's officers and crew

Marcus Elliott (Master)
Andy Wallis (Chief Officer)
Arfon Williams (Chief Engineer)
Kevin Wild (Second Engineer)
Tommy Roberts (A.B.)
Dave Williams (A.B.)
Dave Leigh(A.B.)
Mick Downey (Cook)

3. Narrative (times in GMT)

The SmartBuoy toroid, anchor chain clumps, two sea-bed frames, wave buoy and instrumentation were loaded onto RV Prince Madog on the morning of 16 August 2005. The SmartBuoy toroid was rolled down the walkway. Loading was completed by 10:30 because of restrictions using the tractor down the walkway below mid-tide. 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 08:00 on 17 August; see Figure 1 for the cruise track. The start had been delayed by an hour for a courier to bring from Lowestoft a cable connecting the logger to the Orbcomm transmitter on the SmartBuoy, which had not been packed. Recording of surface sampling and the ship's ADCP were started at 08:51 and 08:52, near Puffin Island. Mooring site A was reached at 11:44 and the first CTD profile recorded. The Wave ADCP was located and released at 11:55, recovered and its ballast weight was on deck by 12:13. The 0 – 125 FTU cable was removed from the turbidity sensor on the ADCP frame and fitted to the replacement frame, which was deployed at 12:36. Conditions were good with light winds, calm seas and sunshine. The SmartBuoy was deployed between 12:52 and 12:54 and the original buoy recovered between 13:00 and 13:07. Finally the Aanderaa ADCP was released at 13:19 and on deck by 13:26. Unfortunately the spooler line went under the ship, caught fast on the rudder and parted.

The deck was tidied and ten vertical net hauls for zooplankton (five with 1 m diameter and five with 0.5 m diameter net holders) were undertaken, finishing at 15:00, when the second CTD was recorded. The CTD grid then commenced, visiting sites 35, 2 - 8, 14 - 17, 28 - 31, 26, 27, 18 – 20, 13, 9, 10, aiming (and succeeding) in arriving at site 10 at 07:17 on 18 August 2005 so that the wave buoy could be deployed to the north of Hilbre Island on the rising tide, approaching high water. This was duly accomplished at 08:07 followed by CTDs at sites 11, 12 and 21 (site B). Here the ADCP was located and released at 10:35, the frame was on the deck at 10:40 and the ballast weight at 10:49. The 0 – 125 FTU cable was removed from the turbidity sensor on the ADCP frame and fitted to the replacement frame, which was deployed at 11:39. The new SmartBuoy was deployed between 11:51 and 11:53 and finally the old SmartBuoy was recovered between 12:07 and 12:11. A second CTD was recorded at the site followed by the remaining CTDs (21- 25 and 32 -34).
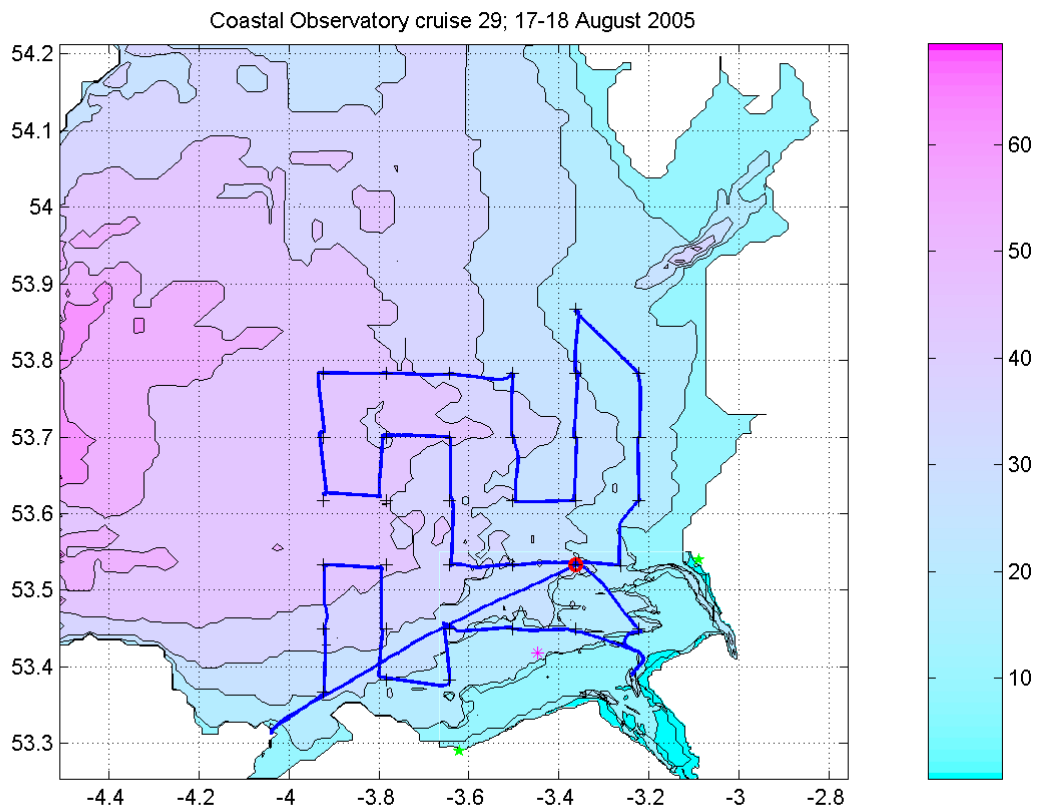

Figure 1. Cruise track.

The CTD survey was completed at 17:00, the ship's ADCP and surface monitoring system switched off at 17:37 at Puffin Island and Prince Madog docked at Menai Bridge at 18:50. The cruise had been successful given two days of fine weather and all the objectives were met.

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 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 1 Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 14:46:30 on 12 July 2005; delayed start 07:00:00 on 13 July 2005.
Stopped at 22:14:00 on 17 August 2005; clock 1 min 15 s fast.
Record length 168,768,607 bytes.

Sea-Bird 16*plus* S/N 4738 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor: S/N 10490 taped to roll bar; set up for 0 - 125 FTU range.
Sample interval 600 s.
Clock set at 15:00:00 on 12 July 2005; delayed start at 11:00:00 on 13 July 2005.
Stopped at 09:30 on 18 August 2005. Clock 3 s fast at 13:43:49 on 18 August 2005.

SonTek ADV (Acoustic Doppler Velocimeter)
ADV Sensor head A638
ADV Logger G365
Started 11:00:00 13 July 2005. Sample rate 16Hz; burst interval 3600s; 19200 samples in each burst, lasting 1200s.
Clock 8 s fast at 14:03:36 on 18 August 2005.

The frame D4 was fitted with two Benthos releases 72858 – Rx 14.5 kHz, Tx 11.0 kHz, enable B, release G and 72863 – Rx 13.5 kHz, Tx 11.0 kHz, enable B, release G 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 2991 at 5 m below the surface. 10 minute samples.
Clock set at 15:16:00 on 12 July 2005. Delayed start 11:00:00 on 13 July 2005.
Stopped at 10:50 on 18 August 2005; clock 4s fast at 13:39:26 on 18 August 2005.

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.
Started at 15:50:00 on 12 July 2005. Clock set at 15:40:00 on 12 July 2005.
Switched off at 12:53:35 on 18 August 2005; clock 2 s slow. Record length 32094 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.

c) Aanderaa RDCP 600 kHz ADCP, Serial No. 0005
Started at 13:00 on 13 July 2005.
Setup was carried out for Column 1, 2, 3, 5 Aanderaa profiles. Setup to do 250 pings in 10 minute intervals.

Column1: Cell size 2m, Overlap 50%, Number of cells 30, cells are instrument referred.
Column2: Cell size 2m, Overlap 50%, Number of cells 20, cells are surface referred.
Column3: Cell size 2m, Overlap 80%, Number of cells 20, cells are surface referred.
Column5: Surface cell.

The frame D2 was fitted with two Benthos releases 70355 – Rx 10.0 kHz, Tx 12.0 kHz, enable C, release D and (serial number uncertain) – Rx 11.0 kHz, Tx 10.5 kHz, enable D, release D (uncertain on the previous two codes) both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

Site B
a) Site B. 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 15:46 on 12 July 2005; delayed start 06:00:00 on 14 July 2005.
Stopped at 14:23:03 on 18 August 2005; clock 1 min 5 s fast.
Record length 167,434,471 bytes.

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; set up for 0 - 125 FTU range.
Sample interval 600 s;
Clock set at 14:30:00 on 12 July 2005; delayed start at 11:00:00 on 13 July 2005.
Stopped at 15:52 on 18 August 2005; clock 3 s slow. Record length 5214 samples.

The frame D6 was fitted with two Benthos releases 70354 – Rx 13.0 kHz, Tx 12.0 kHz, enable C, release D and (serial number uncertain) – 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, at 5 m below the surface. 10 minute samples.
Clock set at 15:25:00 on 12 July 2005. Delayed start 11:00:00 on 13 July 2005.
Stopped at 14:49 on 18 August 2005; clock 5 s fast. Record length 5207 samples.

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.
Clock set at 16:45:00 on 12 July 2005. Started at 15:50:00 on 12 July 2005.
Stopped at 15:31:30 on 18 August 2005; clock 36 s fast. Record length 32190 words.

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 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovery Time	Date
Waves ADCP (Site A)	53° 32.022′	3° 21.446′	22.6	11:55	17/08/05
SmartBuoy (Site A)	53° 32.078′	3° 21.943′	21.8	13:00	17/08/05
Aanderaa ADCP (A)	53° 32.049′	3° 22.235′	22.8	13:19	17/08/05
Waves ADCP (Site B)	53° 27.244′	3° 38.916′	29.6	10:35	18/08/05
Smart Buoy (Site B)	53° 27.191′	3° 38.646′	26.9	12:07	18/08/05

4.2 The set up of the deployed instruments was as follows:
Site A
a) 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 1 Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 12:21:30 on 16 August 2005; delayed start 06:00:00 on 17 August 2005.

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; set up for 0 - 125 FTU range.
Sample interval 600 s: Digiquartz integration time 40s.
Clock set at 11:44:00 on 16 August 2005; delayed start at 11:00:00 on 17 August 2005.

SonTek ADV (Acoustic Doppler Velocimeter)
ADV Sensor head A640
ADV Logger G321
Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s.
Clock set 11:44:35 on 16 August 2005. Started 11:00:00 17 August 2005.

The frame D1 was fitted with two Benthos releases 72382 – Rx 10.0 kHz, Tx 11.0 kHz, enable D, release A 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.

b) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature, conductivity and pressure recorder Serial number 2506 at 5 m below the surface. 10 minute samples.
Clock set at 14:56:00 on 16 August 2005. Delayed start 11:00:00 on 17 August 2005.

No Aanderaa.

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) and chlorophyll 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
a) Site B. 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.
Fitted with a pressure sensor and 1Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 14:04:30 on 16 August 2005; delayed start 06:00:00 on 17 August 2005.

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; set up for 0 - 125 FTU range.
Sample interval 600 s; digiquartz integration time 40s
Clock set at *on 16 August 2005*; delayed start at 10:00:00 on 18 August 2005.

The frame D5 was fitted with two Benthos releases 70358 – Rx 11.0 kHz, Tx 12.0 kHz, enable C, release D and 71919 – Rx 10.5 kHz, Tx 11.0 kHz, enable B, release C 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 2081, at 5 m below the surface. 10 minute samples.
Clock set at 16:00:00 on 16 August 2005. Delayed start 10:00:00 on 18 August 2005.

No Aanderaa.

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)	53° 32.020′	3° 21.437′	22.2	12:36	17/08/05
SmartBuoy (site A)	53° 32.018′	3° 21.690′	22.2	12:54	17/08/05
Waves ADCP (Site B)	53° 27.244′	3° 38.893′	28.5	11:39	18/08/05
Smart Buoy (Site B)	53° 27.108′	3° 38.943′	27.5	11:53	18/08/05
Wave buoy (Hilbre)	53° 23.422′	3° 14.253′	18.5	08:07	18/08/05

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. The rosette will take twelve 10 l water bottles although the capacity is reduced by one (for the LISST-25) and by two to accommodate a bottle with reversing thermometers. 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	Trace metals
1	53º 32′	3º 21.8′	yes	yes	yes	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	yes
9	53º 32′	3º 21.8′	yes	yes	yes	
10	53º 27′	3º 13.4′	yes		yes	yes
11	53º 27′	3º 21.8′	yes	yes	yes	yes
12	53º 27′	3º 30.2′	yes		yes	
13	53º 32′	3º 30.2′	yes		yes	yes
14	53º 37′	3º 30.2′	yes		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	yes
20	53º 32′	3º 38.6′	yes		yes	yes
21	53º 27′	3º 38.6′	yes	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	yes
28	53º 47′	3º 47.0′	yes		yes	yes
29	53º 47′	3º 55.4′	yes		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	yes
34	53º 22′	3º 55.4′	yes		yes	
35	53º 32′	3º 15.9′	yes		yes	yes

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
2	1	1/ 2	53° 32′	3° 21.8′	21	18.2 / 17.8	32.1 / 32.5
3	35	3/ 4	53° 31.9′	3° 15.9′	10	18.8 / 18.4	31.6 / 31.8
4	2	5/ 6	53° 37′	3° 13.4′	11	18.3 / 18.1	32.3 / 32.3
5	3	7/ 8	53° 42′	3° 13.4′	16	18.4 / 17.7	32.7 / 32.9
6	4	9/10	53° 47′	3° 13.4′	16	17.8 / 17.2	33.0 / 33.0
7	5	11/12	53° 52′	3° 21.8′	16	17.9 / 17.2	33.0 / 33.0
8	6	13/14	53° 47′	3° 21.8′	22	17.6 / 17.2	33.0 / 33.0
9	7	15/16	53° 42′	3° 21.8′	27	17.5 / 17.1	32.9 / 32.9
10	8	17/18	53° 37′	3° 21.8′	29	18.1 / 17.3	32.9 / 32.8
11	14	19/20	53° 37′	3° 30.2′	34	17.4 / 17.1	32.9 / 32.9
12	15	21/22	53° 42′	3° 30.2′	40	17.1 / 16.6	32.9 / 33.1
13	16	23/24	53° 47′	3° 30.2′	28	17.1 / 16.9	33.0 / 33.0
14	17	25/26	53° 47′	3° 38.6′	37	17.3 / 16.3	33.2 / 33.3
15	28	27/28	53° 47′	3° 47.0′	42	17.4 / 16.4	33.1 / 33.2
16	29	29/30	53° 47′	3° 55.4′	42	16.7 / 16.0	33.2 / 33.4
17	30	31/32	53° 42	3° 55.4′	41	17.4 / 15.8	33.1 / 33.5
18	31	33/34	53° 37′	3° 55.4′	45	17.3 / 15.8	33.2 / 33.6
19	26	35/36	53° 37′	3° 47.0′	38	17.4 / 16.4	33.0 / 33.2
20	27	37/38	53° 42′	3° 47.0′	38	17.8 / 16.1	33.0 / 33.3
21	18	39/40	53° 42′	3° 38.6′	36	17.8 / 16.4	33.0 / 33.2
22	19	41/42	53° 37′	3° 38.6′	31	17.2 / 16.9	32.9 / 33.0
23	20	43/44	53° 32′	3° 38.6′	33	17 9 / 16.9	32.7 / 33.0
24	13	45/46	53° 32′	3° 30.2′	30	17.4 / 17.3	32.8 / 32.8
25	9	47/48	53° 32′	3° 21.8′	23	17.9 / 17.8	32.5 / 32.6
26	10	49/50	53° 27′	3° 13.4′	18	18.1 / 18.1	31.7 / 31.7
27	11	51/52	53° 27′	3° 21.8′	21	17.7 / 17.7	32.6 / 32.6
28	12	53/54	53° 27′	3° 30.2′	22	17.7 / 17.6	32.7 / 32.7
29	21	55/56	53° 27′	3° 38.6′	29	17.1 / 17.0	33.0 / 33.1
30	21	55/56	53° 27′	3° 38.6′	28	17.6 / 17.1	32.9 / 33.0
31	22	59/60	53° 23′	3° 38.6′	12	18.1 / 18.1	32.4 / 32.4
32	23	61/62	53° 23′	3° 47.0′	19	17.8 / 17.7	32.7 / 32.7
33	24	63/64	53° 27′	3° 47.0′	30	17.6 / 17.0	32.9 / 33.1
34	25	65/66	53° 32′	3° 47.0′	41	16.9 / 16.2	33.1 / 33.4
35	32	67/68	53° 32′	3° 55.4′	44	16.4 / 15.8	33.4 / 33.7
36	33	69/70	53° 27′	3° 55.4′	35	17.3 / 16.3	33.0 / 33.4
38	34	71/72	53° 22′	3° 55.4′	21	17.9 / 17.6	32.6 / 32.7

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^{2}s), 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 08:52 on 17 August until 17:37 on 18 August 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 08:52 on 17 August until 17:37 on 18 August 2005 starting and ending at Puffin Island.