Prince Madog cruise 16/06
POL Coastal Observatory cruise 35
9-11 May 2006

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 (with cellulose bags) in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 5m and 10m below the surface.
c) A nutrient analyser in a sea bed frame measuring nitrate and phosphate four times a semi-diurnal tidal cycle.

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 a SonTek ADV.
e) A CEFAS SmartBuoy in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 5m and 10m below the surface.

To deploy and recover
f) To deploy and recover an experimental spooler system.

g) To carry out an in-situ 25 hour CTD survey every half hour, with water samples every hour. To obtain near surface and bed water samples for nutrient and suspended sediment determination.

2. At 53º 27´ N 3º 38.6´ W (site 21, second site, B)
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. A 1.2 MHz telemetry ADCP was fitted to the frame.
b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring.

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 are fitted to the frame. A 1.2 MHz telemetry ADCP is fitted to the frame.
d) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring.

e) Take water sample for Mike Cox (Liverpool University).

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.

2.1 Scientific personnel

Phil Knight (Principal)
Mike Smithson
Ray Edun
Andrew Willmott
Chris Balfour
Dave Pearce (CEFAS)
Dave Sivyer (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Martin Preston (Liverpool University)

2.2 Ship's officers and crew

Steve Duckworth (Master)
Sohail Amir Ali (Chief Officer)
Alan Thompson (Chief Engineer)
Les Black (Second Engineer)
Phil Jones (Bosun)
Dave Leigh (A.B.)
Robert Cumming (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 morning of 8 May 2006, just after high water. There was a delay in loading, because the tractor was not available until 10:30 when it arrived back from being repaired. This delay was compounded, because there was still gear on board from the last cruise which had to be taken off first, and a dive boat was being loaded at the same time. The SmartBuoy toroid was rolled down the walkway. Loading was completed around 13:00. The ADCP and nutrient frames were set up on the afterdeck and the tower and instruments fitted to the SmartBuoy toroid. There was also a problem with the A-frame which was investigated by engineers during the afternoon.

RV Prince Madog left Menai Bridge at 07:16 on 9 April; see Figure 1 for the cruise track. Underway sampling was started at 08:22 and the ship's ADCP was started at 08:24, near Puffin Island. Mooring site B (CTD station 21) was reached at 10:07 and the telemetry buoy

recovered between 10:07 and 10:12. On route to the Mersey Bar site a Willow Warbler landed on the ship for a rest, while a porpoise was seen near to the ship's bow wave.

The Mersey Bar site was reached at 11:30 and a CTD carried out. The SmartBuoy was deployed between 11:52 and 11:56. The Wave ADCP was recovered between 12:04 and 12:17. The ADV was then refurbished and the deck tidied between 12:25 and 13:21. During the same time period ten vertical net hauls for zooplankton, five with a 1 m diameter ring and five with a 0.5 m diameter ring were carried out. The Wave ADCP was deployed with the refurbished ADV at 14:22. On approach to recover the SmartBuoy a seal was seen resting on the side of the buoy. The SmartBuoy was recovered between 14:30 and 14:35. This was followed by recovery of the nutrient analyser frame between 14:54 and 15:13.

After anchoring, the 25 hour CTD station was commenced at 16:00, with a CTD each hour (water samples taken) and half past each hour (no water samples taken). At 17:21 the new spooler system was tested (deployed and recovered) and the whole process filmed. No POL sediment filtering was carried out during the 25 hour station due to limited available filters. During this period Cefas filtered water samples for suspended sediments.

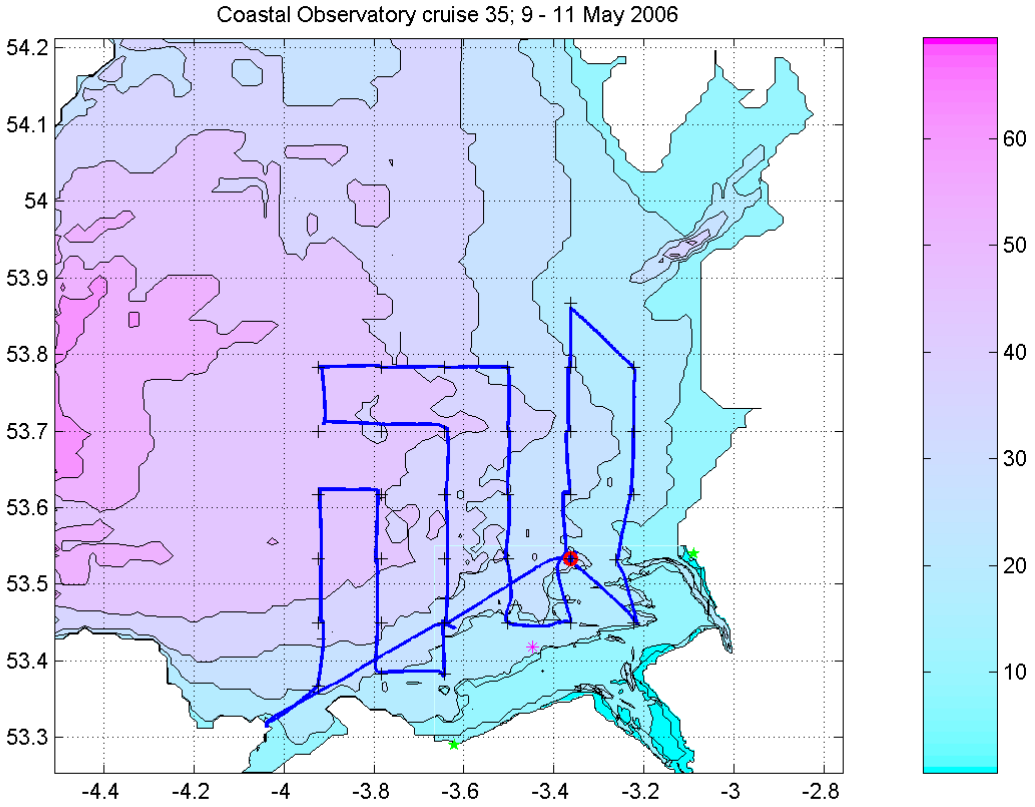

Figure 1. Cruise track.

At 17:56 the CTD survey was started with sites 10,35,2-9,11-17, 28-30, 27, 18-21. At 11:19 on 11 May the ADCP(wave+telemetry) frame was deployed at site B. The replacement SmartBuoy was deployed between 11:33 and 11:37. Followed by the recovery of the old SmartBuoy between 11:41 and 11:50. The light off the recovered SmartBuoy was used for the telemetry buoy. The telemetry buoy was deployed between 12:18 and 12:20

approximately 100m to the north of the ADCP frame. The previous ADCP (wave+telemetry) frame was recovered between 12:29 and 12:45.

The CTD survey was then re-commenced starting at 21, then 22-26, 31-34 finishing on the 11 May at 19:20. Surface monitoring and the ship's ADCP were switched off a 19:39 and she was alongside at Menai Bridge at 21:35. The weather conditions throughout the cruise were good with clear skies and light winds (< force 3). Towards the end of the cruise the sea state was calm. The cruise has been very successful, with all the major objectives met and the 25 hr CTD station and CTD grid completed.

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 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 19:48:00 on 7 March; delayed start 06:00:00 on 8 March 2006.
Stopped at 12:00:10 on 10 March 2006 (Time GMT + 19s).

Sea-Bird 16*plus* S/N 4596 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor: S/N 10487 taped to roll bar; 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 20:37:00 on 7 March 2006; delayed start at 06:00:00 on 8 March 2006.
Stopped at 10:35:00 on 10 May 2006 (Time GMT + 7s).

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger (Base G321, sensor A640)
Sensor height to middle of fork 1.58m. Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Compass orientation changed. Clock reset to 19:52:00 on 7 March 2006. Delayed start at 06:00:00 on 8 March 2006. On recovery the batteries were flat.

The frame was fitted with two Benthos releases 72382 – Rx 10.0 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.

b) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature and conductivity recorder Serial number 2081 at 5m below the surface. Sample interval 600s.
Clock set at 20:15:00 on 7 March 2006. Delayed start 06:00:00 on 8 March 2006.
Stopped at 12:35:30 on 10 May 2006 (Time GMT +7s).

Sea-Bird MicroCAT temperature and conductivity recorder Serial number 2010 at 10m below the surface. Sample interval 600s.

Clock set at 20:20:20 on 7 March 2006. Delayed start 06:00:00 on 8 March 2006.
Stopped at 14:10:00 on 10 May 2006 (Time GMT +26s).

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 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) Ecolab nutrient analyser measuring nitrate and phosphate four times in a semi-diurnal tidal cycle.

The frame D1 was fitted with two Benthos releases 72850 – Rx 11.5 kHz, Tx 12.0 kHz, release C and 67679 – Rx 11.5 kHz, Tx 12.0 kHz, release B both with a burn wire, and a spooler with 200m of rope for recovery of the ballast weight.

Site B

f) 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 13:31:00 on 4 April; delayed start 06:00:00 on 5 April 2006.
Battery unplugged during afternoon of 11 May 2006.

Sea-Bird 16*plus* S/N 4736 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; digiquartz integration time 40s, range=400; run pump 0.5s, 1 s delay.
Clock set at 07:39:30 on 5 April 2006; delayed start at 11:00:00 on 5 April 2006.
Stopped at 16:33:00 on 11 May 2006. (Time GMT + 4s)

Telemetry ADCP 1.2 MHz RDI 3052.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.003 m s^{-1}).
35 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 and 1 Gbyte PCMCIA memory.
Clock reset at 13:09:30 on 4 April 2006; delayed start 11:50:00 on 5 April 2006.
Battery unplugged during afternoon of 11 May 2006.

The frame D5 was fitted with two Benthos releases 72381 – Rx 11.0 kHz, Tx 12.0 kHz, release B and 71904 – Rx 10.0 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.

g) SmartBuoy Mooring.

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.

No other instrumentation was fitted to the mooring.

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
Nutrient frame (Site A)	53º 32.277′	3º 21.288′	19.8	14:54	09/05/06
Waves ADCP (Site A)*	53º 31.968′	3º 21.595′	23.4	12:04	09/05/06
SmartBuoy (Site A)*	53º 32.156′	3º 21.843′	21.1	14:30	09/05/06
Waves ADCP (Site B)	53º 26.872′	3º 38.355′	25.8	12:29	11/05/06
Smart Buoy (Site B)	53º 26.745′	3º 37.706′	26.0	11:41	11/05/06
Telemetry toroid	53º 26.898′	3º 38.226′		10:07	09/05/06

Notes:
* Moorings deployed on Prince Madog Cruise 09/06 (although one sheet of the ship log says 10/06 with a question mark next to it)
Waves ADCP (Site A) - Deployed at 06:18 on 8 March 2006
SmartBuoy (Site A) - Deployed at 06:35 on 8 March 2006.

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

Site A

a) Waves ADCP 600 kHz RDI 2390**;** battery pack 3036
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 14:46:00 on 8 May; delayed start 08:00:00 on 9 May 2006; started ok.

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 40 s, range 400; pump 0.5s, 1 s delay.
Clock set at 13:43:30 on 8 May 2006; delayed start at 12:00:00 on 9 May 2006.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger (Base G321, sensor A640)
Sensor height to middle of fork 1.59m. Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. The ADV reported that it was unable to initialise the compass. Compass orientation changed (Red mark on prong pointing towards the end and away from the frame; same direction as beam 3 of the ADCP). Clock reset to 13:32:30 on 9 May 2006. Delayed start at 14:00:00 on 9 May 2006.

The frame D4 was fitted with two Benthos releases 72858 – Rx 14.5 kHz, Tx 12.0 kHz, release A and 72863 – Rx 13.5 kHz, Tx 12.0 kHz, release X 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 2991 at 5m below the surface. Sample interval 600s.
Clock set at 14:18:30 on 8 May 2006. Delayed start 12:00:00 on 9 May 2006.

Sea-Bird MicroCAT temperature and conductivity recorder Serial number 2506 at 10m below the surface. Sample interval 600s.
Clock set at 14:06:30 on 8 May 2006. Delayed start 12:00:00 on 9 May 2006.

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 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
f) Site B. 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.
Fitted with a pressure sensor and 1Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 15:38:30 on 8 May; delayed start 08:00:00 on 9 May 2006.

Sea-Bird 16*plus* S/N 4597 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor: SN 10471 taped to roll bar; 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 14:38:30 on 8 May 2006; delayed start at 12:00:00 on 11 May 2006.

Telemetry ADCP 1.2 MHz RDI 0572.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.003 m s^{-1}).
35 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 and 512Mb PCMCIA memory.
Clock reset at 15:23:00 on 8 May 2006; delayed start 15:50:00 on 11 May 2006.

The frame D3 was fitted with two Benthos releases 70358 – Rx 11.0 kHz, Tx 12.0 kHz, release A and 71922 – Rx 11.5 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.

g) SmartBuoy Mooring.

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.

No other instrumentation was fitted to the mooring.

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 31.971´	3º 21.612´	21.2	14:22	09/05/06
SmartBuoy (Site A)	53º 32.068´	3º 21.631´	23.5	11:56	09/05/06
Waves ADCP (Site B)	53º 26.911´	3º 38.428´	26.8	11:19	11/05/06
Smart Buoy (Site B)	53º 26.626´	3º 37.419´	25.7	11:37	11/05/06
Telemetry toroid	53º 26.987´	3º 38.462´	25.5	12:18	11/05/06

4.3 Water for Mike Cox (Liverpool University)
Water collected from surface intake at position 53º 26.924´N 3º 38.543´W during CTD 78 (Station 21) , 12:53 11 May 2006.

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. One/two water bottles were fired near bed and one/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 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, 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. (Ss – Suspended sediments, Nu – Nutrients)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu	Cefas Ss	POL Nu	POL Ss
1	53º 32′	3º 21.8′	yes	yes	yes	yes	no
2	53º 37′	3º 13.4′	yes	no	yes	yes	no
3	53º 42′	3º 13.4′	yes	no	yes	yes	no
4	53º 47′	3º 13.4′	yes	no	yes	yes	no
5	53º 52′	3º 21.8′	yes	yes	yes	yes	no
6	53º 47′	3º 21.8′	yes	yes	yes	yes	no
7	53º 42′	3º 21.8′	yes	yes	yes	yes	no
8	53º 37′	3º 21.8′	yes	yes	yes	yes	no
9	53º 32′	3º 21.8′	yes	yes	yes	no	no
10	53º 27′	3º 13.4′	yes	no	yes	yes	no
11	53º 27′	3º 21.8′	yes	yes	yes	yes	no
12	53º 27′	3º 30.2′	yes			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	yes
16	53º 47′	3º 30.2′	yes			yes	yes
17	53º 47′	3º 47.0′	yes			yes	yes
18	53º 42′	3º 38.6′	yes			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	yes	no
22	53º 23′	3º 38.6′	yes			yes	yes
23	53º 23′	3º 47.0′	yes			yes	yes
24	53º 27′	3º 47.0′	yes			yes	yes
25	53º 32′	3º 47.0′	yes			yes	yes
26	53º 37′	3º 47.0′	yes			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	yes
31	53º 37′	3º 55.4′	yes			no	yes
32	53º 32′	3º 55.4′	yes			no	yes
33	53º 27′	3º 55.4′	yes			no	yes
34	53º 22′	3º 55.4′	yes			no	yes
35	53º 32′	3º 15.9′	yes	no	yes	yes	no

Table 4. Surface and bottom parameters from CTD, noted in log book. (includes 25 hour station 1 and survey)

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	1/ 2	53º 32′	3º 21.8′	23	12.3 / 9.4	30.6 / 32.5
4	1-3	3/ 4	53º 32′	3º 21.8′	23	12.5 / 9.5	30.6 / 32.5
6	1-5	5/ 6	53º 32′	3º 21.8′	26	12.1 / 9.6	31.0 / 32.6
8	1-7	7/ 8	53º 32′	3º 21.8′	27	11.8 / 9.6	31.3 / 32.6
10	1-9	9/10	53º 32′	3º 21.8′	28	11.7 / 9.6	31.7 / 32.6
12	1-11	11/12	53º 32′	3º 21.8′	29	11.5 / 9.5	31.7 / 32.7
16	1-15	35/36	53º 32′	3º 21.8′	27	11.5 / 9.6	31.7 / 32.7
18	1-17	13/14	53º 32′	3º 21.8′	26	11.7 / 9.7	31.5 / 32.6
20	1-19	15/16	53º 32′	3º 21.8′	25	11.9 / 9.8	31.0 / 32.6
22	1-21	17/18	53º 32′	3º 21.8′	24	12.2 / 9.7	30.6 / 32.5
24	1-23	19/20	53º 32′	3º 21.8′	24	12.1 / 9.6	30.5 / 32.5
26	1-25	21/22	53º 32′	3º 21.8′	24	12.0 / 9.6	30.5 / 32.5
28	1-27	23/24	53º 32′	3º 21.8′	29	11.9 / 9.6	30.6 / 32.5
30	1-29	25/26	53º 32′	3º 21.8′	26	11.9 / 9.7	30.9 / 32.5
32	1-31	27/28	53º 32′	3º 21.8′	27	11.7 / 9.7	31.0 / 32.6
34	1-33	29/30	53º 32′	3º 21.8′	26	11.6 / 9.6	31.5 / 32.6
36	1-35	31/32	53º 32′	3º 21.8′	29	11.6 / 9.6	31.5 / 32.6
38	1-37	33/34	53º 32′	3º 21.8′	29	11.8 / 9.6	31.5 / 32.7
40	1-39	37/38	53º 32′	3º 21.8′	28	12.6 / 9.6	31.2 / 32.7
42	1-41	39/40	53º 32′	3º 21.8′	26	12.9 / 9.7	31.1 / 32.6
44	1-43	41/42	53º 32′	3º 21.8′	25	13.3 / 9.7	30.7 / 32.6
46	1-45	43/44	53º 32′	3º 21.8′	24	13.4 / 9.7	30.6 / 32.5
48	1-47	45/46	53º 32′	3º 21.8′	23	13.3 / 9.7	30.7 / 32.5
50	1-49	47/48	53º 32′	3º 21.8′	23	12.6 / 9.6	30.7 / 32.4
52	1-51	49/50	53º 32′	3º 21.8′	24	12.9 / 9.6	30.7 / 32.4
53	10	51/52	53º 27′	3º 13.4′	15	12.3 /10.6	31.3 / 31.8
54	35	53/54	53º 31.9′	3º 15.9′	13	12.5 /10.4	30.6 / 31.7
55	2	55/56	53º 37′	3º 13.4′	15	13.0 / 9.9	30.8 / 32.3
56	3	57/58	53º 42′	3º 13.4′	20	12.7 / 9.4	30.8 / 32.5
57	4	59/60	53º 47′	3º 13.4′	20	12.8 /10.7	31.3 / 31.8
58	5	61/62	53º 52′	3º 21.8′	19	12.5 /10.7	31.7 / 32.0
59	6	63/64	53º 47′	3º 21.8′	24	13.2 / 9.4	30.7 / 32.6
60	7	65/66	53º 42′	3º 21.8′	27	12.4 / 9.1	31.1 / 32.9
61	8	67/68	53º 37′	3º 21.8′	28	12.5 / 9.3	30.9 / 32.6
63	11	69/70	53º 27′	3º 21.8′	18	12.2/10.1	31.1 / 32.2
64	12	71/72	53º 27′	3º 30.2′	17	12.5/10.3	30.9 / 32.5
65	13	73/74	53º 32′	3º 30.2′	29	12.0 / 9.5	31.5 / 32.7
66	14	75/76	53º 37′	3º 30.2′	29	12.5 / 9.2	31.1 / 32.7
67	15	77/78	53º 42′	3º 30.2′	35	12.4 / 9.3	31.1 / 33.1
68	16	79/80	53º 47′	3º 30.2′	23	12.7 / 9.3	30.8 / 32.8
69	17	81/82	53º 47′	3º 38.6′	33	11.6 / 9.1	32.5 / 33.3
70	28	83/84	53º 47′	3º 47.0′	42	11.2 / 8.9	32.5 / 33.2

Nominal positions.

CTD no	Site	Nuts	Latitude (N)	Longitude (W)	Water depth (m)	Temp (deg)	Salinity
		T/ B				T / B	T / B
71	29	85/86	53º 47′	3º 55.4′	41	11.3 / 9.2	33.0 / 33.6
72	30	87/88	53º 42	3º 55.4′	44	11.0 / 9.3	32.8 / 33.6
73	27	89/90	53º 42′	3º 47.0′	48	11.0 / 9.0	33.1 / 33.4
74	18	91/92	53º 42′	3º 38.6′	43	11.3 / 9.2	32.5 / 33.5
75	19	93/94	53º 37′	3º 38.6′	37	11.8 / 9.3	33.6 / 33.5
76	20	95/96	53º 32′	3º 38.6′	38	10.2 / 9.4	33.5 / 33.6
78	21	97/98	53º 27′	3º 38.6′	26	10.5/10.0	32.9 / 33.2
79	22	99/100	53º 23′	3º 38.6′	12	11.2/11.1	32.4 / 32.4
80	23	101/102	53º 23′	3º 47.0′	17	11.6 /10.8	32.5 / 32.9
81	24	103/104	53º 27′	3º 47.0′	29	13.1 /10.0	32.9 / 33.3
82	25	105/106	53º 32′	3º 47.0′	41	11.4 / 9.4	33.4 / 33.6
83	26	107/108	53º 37′	3º 47.0′	38	13.3 / 9.3	32.6 / 33.4

Notes: forgot to do nutrients for CTD 14 (Station 1-13), no nutrients taken for site 9, or for first CTD at site 21 (CTD no. 77), or CTD nos 31,32,34 (ran out of bottles),

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.

Underway data were recorded every minute from 08:22 on 9 May until 19:39 on 11 May 2006 starting and ending at Puffin Island. There was a gap between 09:47 and 15:34 on 10 May. 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 08:24 on 9 May until 19:39 on 11 May 2006 starting and ending at Puffin Island (ADCP stopped after 25 hour CTD station and immediately restarted to create two files).

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