Prince Madog cruise 34/05
POL Coastal Observatory cruise 30
15 – 16 September 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.

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. Attached with cellulose and chitin bait bags.

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.

b) A CEFAS SmartBuoy in a single point mooring with a Sea-Bird MicroCAT temperature, conductivity logger at 5m 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. Attached with cellulose and chitin bait bags.

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

4. To collect water samples for Ferry-Box calibrations from the underway sampling system.

The plan was to complete mooring operations at site A on Thursday afternoon followed by CTD measurements during the night. On Friday the plan was to complete mooring operations at site B followed by completion of the CTD grid.

2.1 Scientific personnel

Phil Knight (Principal)
Chris Balfour
Ray Edun
Jeff Pugh
Neil Needham (CEFAS)
Dave Sivyer (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Vladimir Krivtsov (School of Ocean Sciences)
Mike Cox (Liverpool University, Biological Sciences)

2.2 Ship's officers and crew

Steve Duckworth (Master)
Dean Atkinson (Chief Officer)
Adrian Simonds (New Master)
Neil Holmes (Chief Engineer)
Les Black (Second Engineer)
Phil Jones (Bosun)
Bob Cumming (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 14 September 2005. The SmartBuoy toroid was rolled down the walkway. Loading was completed by 11:30 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 07:00 on 15 September; see Figure 1 for the cruise track. Recording of surface sampling and the ship's ADCP were started at 08:10, near Puffin Island. Mooring site A was reached at 11:00 and the first CTD profile recorded. The Wave ADCP was located and released at 11:26, recovered and its ballast weight was on deck by 11:42 (The ADV sensor was damaged on recovery). Conditions were fair with moderate winds and rain. The Wave ADCP was deployed at 12:03 (Rope pellets were snagged on the rear of ship on deployment). The SmartBuoy was deployed between 12:28 and 12:33 and the original buoy recovered between 12:40 and 12:46.

The deck was tidied and ten vertical net hauls for zooplankton (five with 0.5 m diameter and five with 1.0 m diameter net holders) were undertaken, starting at 13:19 finishing at 14:20, when the second CTD was recorded. The CTD grid then commenced, visiting sites 10, 35, 2 - 9, 11 – 22. At site B (Site 21), in marginal conditions (winds NE/ Force 5), the wave ADCP was located and released at 09:04, the frame was on the deck at 09:14 and the ballast weight at 09:29. This was not without event. The Bosun injured himself with the grapple hook, which hit him the face. Furthermore the rope from the spooler jammed in the case leading to

the case being smashed up to make it pass through the ship A-frame pully. The replacement wave ADCP was deployed at 09:57. The recovery and deployment of the SmartBuoy were cancelled due to worsening conditions.

The CTD survey then continued, visiting 25, 32, 33, 34, 23, 24 and 26. A CTD was attempted at site 31, however this had to be abandoned due to waves coming over the side of the ship. The remaining CTDs were not carried out due to these conditions.

The ship headed back to Menai Bridge at 16:30. The ship's ADCP and surface monitoring system switched off at 17:37 near to Puffin Island and Prince Madog docked at Menai Bridge at 19:30. Most of the cruise objectives were met , however the SmartBuoy was not recovered or re-deployed at site B due to marginal conditions. Winds were Force 5/6 from the N/NE creating steep waves. Four CTD's stations were also not carried due to the poor conditions. Staying around at anchor was ruled out due to running out of crew on duty time and the latest forecast indicating continued strong winds.

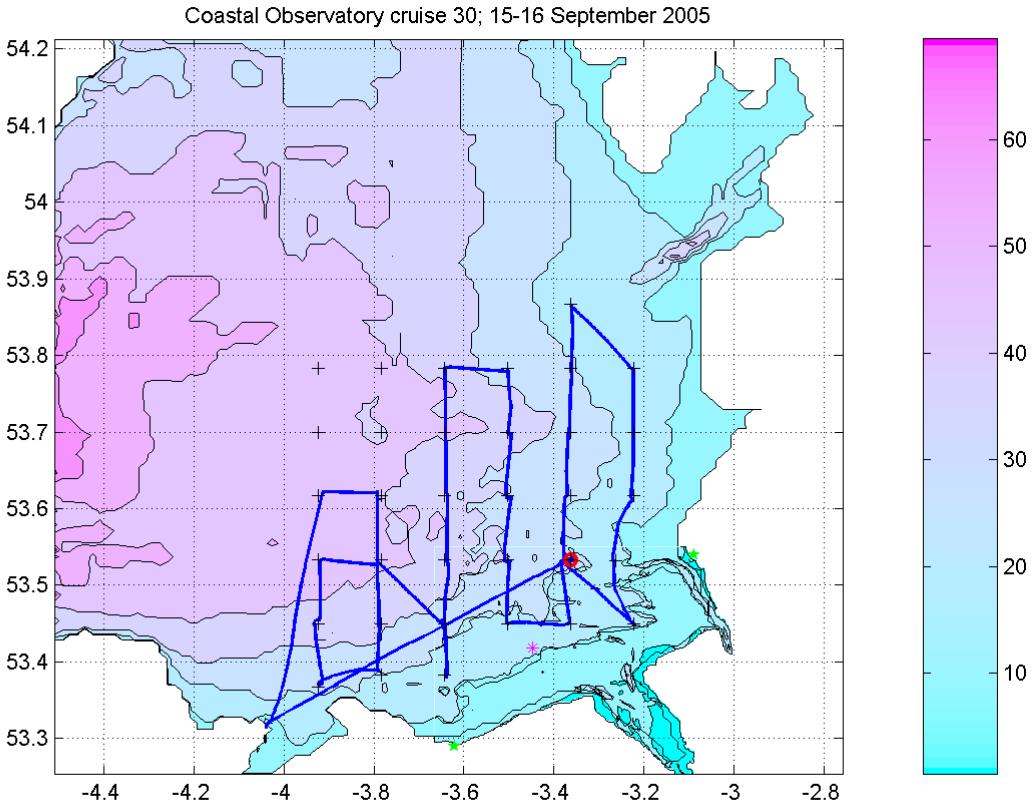

Figure 1. Cruise track.

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 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.
Stopped 22:00 on 15 September 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.
Stopped 11:21 on 15 September 2005.

SonTek ADV (Acoustic Doppler Velocimeter) – Heads at 1.7m from the sea-bed pointing up.
ADV Sensor head A640
ADV Logger G321
Sample rate 16Hz; burst interval 3600; samples in each burst 19200; burst length 1200s.
Clock set 11:44:35 on 16 August 2005. Started 11:00:00 17 August 2005.
Stopped 09:00 on 16 September 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.
Stopped 13:30:00 on 16 September 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.
Stopped at 13:51 on 16 September 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.
Stopped at 12:49 on 16 September 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.
Note: Not recovered on this cruise because of marginal weather conditions.

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 1. Recovery mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovery Time	Date
Waves ADCP (site A)	53º 32.029′	3º 21.619′	23.9	11:33	15/09/05
SmartBuoy (site A)	53º 32.011′	3º 21.717′	22.5	12:41	15/09/05
Waves ADCP (Site B)	53º 27.207′	3º 38.926′	28.5	09:04	16/09/05
Smart Buoy (Site B)	53º 27.108′	3º 38.943′	27.5	**Not recovered**	

4.1 The set up of the deployed instruments was as follows:
Site A
a) Waves ADCP 600 kHz RDI 5806. Battery Case 250.
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 13:57 on 14 July 2005; delayed start 08:00:00 on 15 September 2005.

Sea-Bird 16*plus* S/N 4738 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 13:42:00 on 14 September 2005; delayed start at 11:00:00 on 15 September 2005.

SonTek ADV (Acoustic Doppler Velocimeter) – Heads at 1.7m from the sea-bed pointing up.
ADV Sensor head A638
ADV Logger G365
Clock reset to 13:14:00 on 14 September 2005.
Delayed start 11:00:00 15 September 2005, Sample rate 16Hz, Burst interval 3600s, Samples in each burst is 19200, Burst length is 1200s.

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 12:48:00 on 14 September 2005. Delayed start 11:00:00 on 15 September 2005.

No Aanderaa.

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
a) 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 14:44:00 on 14 September 2005; delayed start 10:00:00 on 16 September 2005.

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;
Clock set at 14:28:00 on 14 September 2005; delayed start at 10:00:00 on 16 September 2005.

The frame D6 was fitted with two Benthos releases (serial no. not known) – Rx 13.0 kHz, Tx 12.0 kHz, enable C, release D and (serial number not known) – 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 15:37:00 on 14 September 2005. Delayed start 10:00:00 on 16 September 2005.
Note: Not deployed on this cruise because of marginal weather conditions.

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 32.027′	3º 21.539′	22.7	12:03	15/09/05
SmartBuoy (Site A)	53º 32.000′	3º 21.957′	22.6	12:33	15/09/05
Waves ADCP (Site B)	53º 27.278′	3º 38.938′	29.8	09:57	16/09/05
Smart Buoy (Site B)				**Not deployed**	

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
1	53º 32′	3º 21.8′	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
9	53º 32′	3º 21.8′	yes	yes	yes
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	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′	no		
28	53º 47′	3º 47.0′	no		
29	53º 47′	3º 55.4′	no		
30	53º 42	3º 55.4′	no		
31	53º 37′	3º 55.4′	no		
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′	23	17.5 / 17.4	32.5 / 32.7
3	10	3/ 4	53º 27′	3º 13.4′	14	17.5 / 17.5	32.2 / 32.2
4	35	5/ 6	53º 31.9′	3º 15.9′	11	17.4 / 17.4	31.8 / 31.9
5	2	7/ 8	53º 37′	3º 13.4′	12	17.4 / 17.4	32.4 / 32.4
6	3	9/10	53º 42′	3º 13.4′	17	17.3 / 17.4	32.6 / 32.7
7	4	11/12	53º 47′	3º 13.4′	18	17.1 / 17.1	32.7 / 32.7
8	5	13/14	53º 52′	3º 21.8′	17	17.0 / 17.0	33.0 / 33.0
9	6	15/16	53º 47′	3º 21.8′	23	17.0 / 17.0	32.9 / 32.9
10	7	17/18	53º 42′	3º 21.8′	27	16.9 / 16.9	33.0 / 33.0
11	8	19/20	53º 37′	3º 21.8′	29	17.1 / 17.1	32.8 / 33.0
12	9	21/22	53º 32′	3º 21.8′	28	17.1 / 17.1	33.1 / 33.2
13	11	23/24	53º 27′	3º 21.8′	21	17.3 / 17.3	32.7 / 32.7
14	12	25/26	53º 27′	3º 30.2′	18	17.2 / 17.2	32.9 / 32.9
15	13	27/28	53º 32′	3º 30.2′	29	17.0 / 17.0	33.1 / 33.1
16	14	29/30	53º 37′	3º 30.2′	24	17.0 / 16.9	32.9 / 33.2
17	15	31/32	53º 42′	3º 30.2′	33	16.8 / 16.8	33.0 / 33.3
18	16	33/34	53º 47′	3º 30.2′	22	17.0 / 17.0	32.9 / 32.9
19	17	35/36	53º 47′	3º 38.6′	32	16.8 / 16.9	33.1 / 33.1
20	18	37/38	53º 42′	3º 38.6′	36	16.7 / 16.7	33.3 / 33.4
21	19	39/40	53º 37′	3º 38.6′	32	16.7 / 16.7	33.3 / 33.3
22	20	41/42	53º 32′	3º 38.6′	34	16.8 / 16.7	33.2 / 33.5
23	21	43/44	53º 27′	3º 38.6′	27	16.9 / 16.9	33.1 / 33.1
24	22	45/46	53º 23′	3º 38.6′	14	17.1 / 17.1	32.9 / 32.9
25	25	47/48	53º 32′	3º 47.0′	30	16.2 / 16.2	33.6 / 33.8
26	32	49/50	53º 32′	3º 55.4′	47	16.1 / 16.0	33.7 / 33.8
27	33	51/52	53º 27′	3º 55.4′	36	16.5 / 16.3	33.5 / 33.7
28	34	53/54	53º 22′	3º 55.4′	22	17.1 / 17.1	32.9 / 32.9
29	23	55/56	53º 23′	3º 47.0′	18	17.1 / 17.1	32.8 / 32.8
30	24	57/58	53º 27′	3º 47.0′	29	16.9 / 16.7	33.2 / 33.3
31	26	59/60	53º 37′	3º 47.0′	37	16.5 / 16.4	33.5 / 33.5

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 08:07 on 15 September until 18:22 on 16 September 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 08:07 on 15 September until 18:22 on 16 September 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.