Prince Madog cruise 02/07
POL Coastal Observatory cruise 42
14-16 February 2007

1. Objectives

1. At 53º 32´ N 3º 21.8´ W, half a mile west of the Mersey Bar Light Vessel (site A)
To recover
a) A sea bed frame for a 600 kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves. A Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and a SeaPoint turbidity sensor were fitted to the frame.
b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring with Sea-Bird MicroCAT temperature, conductivity loggers at 5m and 10m below the surface.

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

2. At 53º 27´ N 3º 38.6´ W (site 21, second site, B)
To recover
g) A telemetry torroid (equipped with an Orbcomm satellite system and an acoustic modem).
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 are fitted to the frame. A 1.2 MHz telemetry ADCP was fitted to the frame.
i) A CEFAS SmartBuoy (with cellulose bags) and trace metal sensor in a single point mooring with Sea-Bird MicroCAT temperature, conductivity loggers at 5m and 10m below the surface.

To deploy
j) A refurbished telemetry buoy (equipped with an Orbcomm satellite system and an acoustic modem).
k) A sea bed frame for a 600 kHz ADCP (waves and telemetry ADCP combined) 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. Telemetry set up to send subsets of ADCP and Sea-Bird data.
l) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring with Sea-Bird MicroCAT temperature, conductivity loggers at 5m below the surface.

3. To conduct a CTD / LISST survey of 34 sites every 5 miles covering the eastern Irish Sea between the North Wales coast and Blackpool and the Lancashire coast and the Great Orme,

to determine the effects of the rivers Dee, Mersey and Ribble on Liverpool Bay. To obtain calibration samples for salinity, transmittance, suspended sediment and for chlorophyll at selected stations. To obtain near surface and bed water samples for nutrient and suspended sediment determination.

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

5. Carry out Benthos survey at selected sites.

6. Conduct two Beam trawls close to site A and site B (station 21).

2.1 Scientific personnel

Phil Knight (Principal)
Mike Smithson
Emlyn Jones
John Kenny
Martin Poulton
Heidi Tillin (University of Liverpool)
Louise Liberknecht (University of Liverpool)
Stewart Cutchey (CEFAS)
Helen Lees (CEFAS)
Anne Hammerstein (School of Ocean Sciences)

2.2 Ship's officers and crew

Eric Lloyd (Master)
Andrew Wallis (Chief Officer)
Arfon Williams (Chief Engineer)
Stephen Baily (Second Engineer)
Tommy Roberts (Bosun)
David Williams (A.B.)
William Cumming (A.B.)
David Highdale (Cook)

3. Narrative (times in GMT)

The SmartBuoy, anchor chain clumps, three sea-bed frames and instrumentation were loaded onto RV Prince Madog on the morning of 13 February 2007. Loading was completed by 9:30. The ADCP frames and nutrient frame were set up on the afterdeck and the tower and instruments fitted to the SmartBuoy toroid.

Prince Madog set off from Menai Bridge at 08:00 on the 14 February 2007. The pCO2 sensor was switched on at 08:10. Surface sampling and the ship's ADCP were switched on at 08:40 at Puffin Island. Prince Madog reached site A at 11:25 and the first CTD was carried out. The nutrient frame was deployed at 11:40. The ADCP was recovered at 12:24 (weights were lost). The replacement ADCP was deployed at 12.46. The SmartBuoy was deployed at 13:10 (Cellulose bags were not attached due to an oversight) and the previous SmartBuoy recovered, 13:19 – 13:24. This was followed by Zooplankton vertical net hauls.

Due to a forecast for strong winds for the following day it was decided to head down to site B and service the telemetry mooring. Once at site B the ADCP frame was recovered at 15:34 and weights on board by 15:45. The ADCP was deployed at 15:59. The telemetry buoy was recovered at 16:15. It was then refurbished while a Benthic survey was carried out (6 grab samples were taken and sifted). The telemetry buoy was deployed at 18:30. CTD's were then carried out at stations 21, 1, 35, 2-6, 16, 15, 7, 8, 14, 13, 12, 11, 10. The WaveBuoy was then recovered from the Hilbre Channel.

Back at site A, a calibration CTD was carried out followed by the remainder of the Zooplankton vertical net hauls and another Benthic survey. A successful Beam trawl was carried out, however the wooden bar on the trawl was broken on recovery. CTD's were then carried out at sites 21, 22, 23 and 20. The CTD survey was paused due to strong winds (gusts of 50 knots were recorded on the bridge) and wave conditions. Due to these conditions the SmartBuoy was not serviced at site B. Further CTD's were carried out when conditions improved during the evening at sites 24, 25, 19, 18, 17, 28, 27, 26, 31, 32, 33 and 34.

The moorings work was successfully accomplished apart from the SmartBuoy servicing at site B, and with only two CTD sites missed. Surface logging, ship's ADCP and the pCO2 sensor logging were stopped at 08:05, near Puffin Island, and RV Prince Madog berthed at Menai Bridge at 08:15 on 16 February 2007.

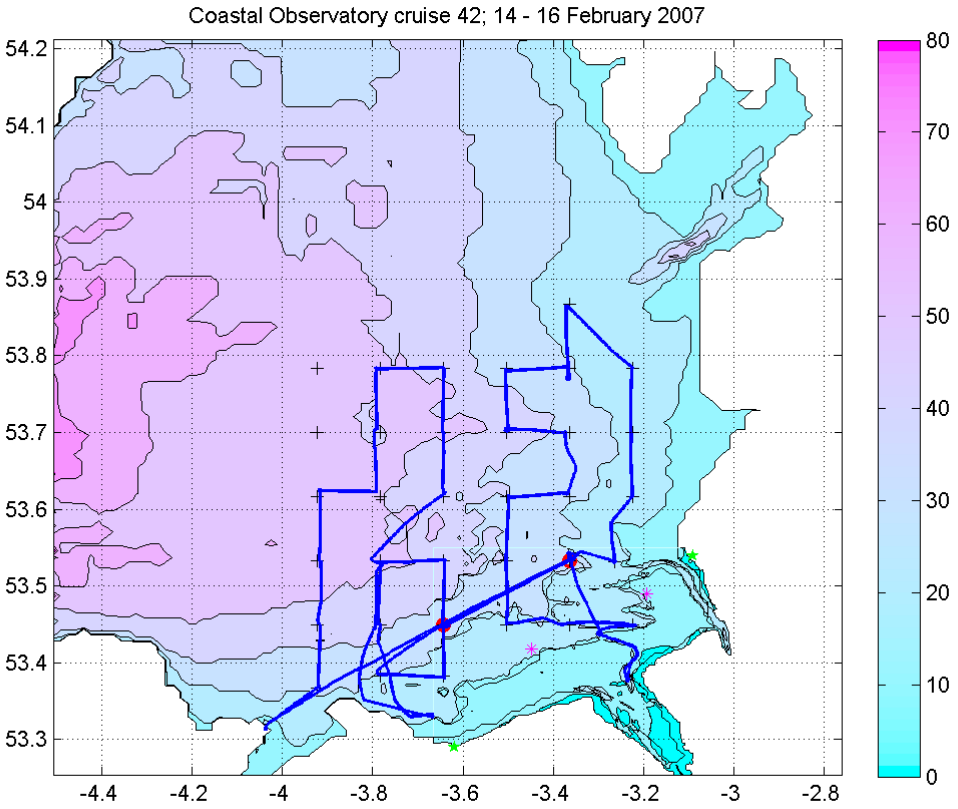

Figure 1. Cruise track.

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 set at 15:25:15 GMT on 12 December 2006; delayed start 08:00:00 on 13 December 2006. Stopped at 10:23:00 on 15 February 2007.

Sea-Bird 16plus 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; pump 0.5s, 1 s delay.
Clock set at 14:11:50 on 12 December 2006; delayed start at 08:00:00 on 13 December 2006.
Stopped at 01:55:15 on 15 February 2007.

SonTek ADV (Acoustic Doppler Velocimeter): ADV Logger G250, sensor B252H. Sensor height to the point of intercept of the three probes was 1.26m. Sample rate 16Hz, burst interval 3600s. Changed compass orientation to up. Time set at 15:55:00 on 12 December 2006; delayed start at 08:00:00 on 13 December 2006. ADV stopped at 09:52:00 on 15 February 2007.

The frame D6 was fitted with two Benthos releases 71922 – Rx 11.5 kHz, Tx 12.0 kHz, release A and 72858 – Rx 14.5 kHz, Tx 12.0 kHz, release A both with a fizz link, and a spooler with 150m 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. Reference pressure = 25dB.
Clock set at 15:36:10 on 12 December 2006. Delayed start 08:00:00 on 13 December 2006.
Stopped at 23:15:30 on 14 February 2007. Clock 30s fast.

Sea-Bird MicroCAT temperature and conductivity recorder Serial number 4998 at 10m below the surface. Sample interval 600s.
Clock set at 15:14:00 on 12 December 2006. Delayed start 08:00:00 on 13 December 2006.
Stopped at 22:29:53 on 14 February 2007. Clock OK.

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

The single point mooring was composed mainly of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

Site B

a) Waves ADCP 600 kHz RDI 5807.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Fitted with a pressure sensor and 1Gbyte PCMCIA memory; hourly wave recording enabled.
Time set at 15:35:30 on 12 December 2006, delayed start at 08:00:00 on 13 December 2006.
Stopped at 22:50:00 on 14 February 2007.

Telemetry ADCP 1200 kHz RDI 3052**.**
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.003 m s^{-1}).
30 x 1 m bins (2.15 – 31.15 m above the bed).
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Time set at 15:44:10 on 12 December 2006.
Delayed start at 08:00:00 on 13 December 2006.
LinkQuest acoustic modem set for transmission of ADCP data every hour.
Stopped at 23:52:30 on 14 February 2007.

Sea-Bird 16plus S/N 4597 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor taped to roll bar S/N 10471; 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 14:25:10 on 12 December 2006; delayed start at 08:00:00 on 13 December 2006.
Stopped at 11:17:30 on 15 February 2007.

The frame D5 was fitted with two Benthos releases 67679 – Rx 11.5 kHz, Tx 12.0 kHz, release B and 72853 – Rx 13.5 kHz, Tx 12.0 kHz, release A both with a fizz link, and a spooler with 100m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring.
The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity and fluorescence sensors). The frame was fitted with cellulose bags for the determination of bacterial degradation and a trace metal sensor (Conrad Chapman, Liverpool University)
Not recovered.

Sea-Bird MicroCAT temperature and conductivity recorder Serial number 2506 at 5m below the surface. Sample interval 600s. Reference pressure = 25dB.
Clock set at 14:52:00 on 12 December 2006. Delayed start 08:00:00 on 13 December 2006.
Not recovered.

Sea-Bird MicroCAT temperature and conductivity recorder Serial number 4966 at 10m below the surface. Sample interval 600s.
Clock set at 15:19:00 on 12 December 2006. Delayed start 08:00:00 on 13 December 2006.
Not recovered.

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. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovered Time	Date
Waves ADCP (Site A)	53º 32.037´	3º 21.472´	22.0	12:24	14/02/07
SmartBuoy (Site A)	53º 32.024´	3º 21.794´	26.7	13:19	14/02/07
Waves ADCP (Site B)	53º 27.007´	3º 38.644´	23.2	15:34	14/02/07
Smart Buoy (Site B)	***53º 27.049´***	***3º 38.446´***	***(Not recovered due to weather)***		
Telemetry Buoy	53º 26.922´	3º 38.648´	26.7	16:15	14/02/07
Wave buoy (Hilbre Channel)	53º 23.400´	3º 14.409´	17.1	08:40	15/02/07

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

Site A

a) 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 1 Gbyte PCMCIA memory; hourly wave recording enabled.
Clock set at 12:00:00 GMT on 13 February 2007; delayed start 08:00:00 on 14 February 2007.

Sea-Bird 16plus 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; pump 0.5s, 1 s delay.
Clock set at 11:41:30 on 13 February 2007; delayed start at 08:00:00 on 14 February 2007.

SonTek ADV (Acoustic Doppler Velocimeter): ADV Logger G458, sensor A823. Sensor height to the point of intercept of the three probes was 1.48m. Sample rate 16Hz, burst interval 3600s. Time set at 12:14:00 on 13 February 2007; delayed start at 08:00:00 on 14 February 2007.

The frame was fitted with two Benthos releases 72850 – Rx 11.5 kHz, Tx 12.0 kHz, release C and 70358 – Rx 11.0 kHz, Tx 12.0 kHz, release A both with a fizz link, and a spooler with 150m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring.
Sea-Bird MicroCAT temperature and conductivity recorder Serial number 2010 at 5m below the surface. Sample interval 600s. Reference pressure = 25dB.
Clock set at 12:00:30 on 13 February 2007. Delayed start 08:00:00 on 14 February 2007.

Sea-Bird MicroCAT temperature and conductivity recorder Serial number 2081 at 10m below the surface. Sample interval 600s.
Clock set at 11:55:25 on 13 February 2007. Delayed start 08:00:00 on 14 February 2007.

The CEFAS SmartBuoy is fitted with one surface CTD, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (TOXN and silicate; no filtration therefore no phosphate), fluorometer (SeaPoint), oxygen (Aanderaa Optode) and chlorophyll determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm. The frame was fitted with cellulose bags for the determination of bacterial degradation (NOT attached due to oversight).

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) Waves ADCP 600 kHz RDI 3644.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Fitted with a pressure sensor and 1Gbyte PCMCIA memory; hourly wave recording enabled.
Time set at 14:57:45 on 13 February 2007, delayed start at 08:00:00 on 14 February 2007.

Sea-Bird 16plus S/N 4848 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor taped to roll bar S/N 10486; 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 11:22:30 on 13 February 2007; delayed start at 08:00:00 on 14 February 2007.

LinkQuest acoustic modem set for transmission of ADCP data every hour. Linked together with Waves ADCP and Sea-Bird 16plus.

The frame was fitted with two Benthos releases 70356 – Rx 10.5 kHz, Tx 12.0 kHz, release D and 71904 – Rx 10.0 kHz, Tx 12.0 kHz, release C both with a fizz link, and a spooler with 100m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring.
Not deployed due to weather conditions.

Table 2. Deployed mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployed Time	Date
Waves ADCP (Site A)	53º 32.046´	3º 21.510´	23.8	12:46	14/02/07
SmartBuoy (Site A)	53º 31.986´	3º 21.759´	22.6	13:10	14/02/07
Nutrient analyser (Site A)	53º 32.039´	3º 21.909´	24.4	11:40	14/02/07
Waves ADCP (Site B)	53º 27.005´	3º 38.536´	23.1	15:59	14/02/07
Smart Buoy (Site B)	***53º 26.931´***	***3º 38.894´***	***(Not deployed due to weather)***		
Telemetry Buoy (Site B)	53º 26.944´	3º 38.618´	26.5	18:30	14/02/07

5. CTD

The Sea-Bird 911 CTD recorded downwelling PAR light levels (CEFAS light sensor), temperature, conductivity, transmittance, oxygen (no calibration samples) and fluorescence at 24 Hz. The frame was fitted with an altimeter, which was not totally reliable, so that measurements were taken to within an estimated 3 m above the bed. The rosette will take twelve 10 l water bottles although the capacity is reduced by one (for the LISST-25). One/two water bottles were fired near bed and one/two/three near the surface, when needed. The CTD temperature data was checked against a Sea-Bird SBE35 precision thermometer. Water samples were taken from a near bed bottle for calibration of the CTD salinity data. Water samples were taken from the near surface and near bed bottles and frozen for nutrient analysis by NOC (nitrate, phosphate, silicate), and also were filtered to determine suspended sediment load and calibrate the CTD transmissometer, by the School of Ocean Sciences. Water samples from the second near surface bottle from stations 1 and 21 were filtered for chlorophyll and suspended sediment determination and some filtrate was preserved with mercuric chloride for nutrient determination by CEFAS, (in addition samples at station 1 were taken for oxygen analysis). A LISST-100C particle sizer with internal logging was also attached to the CTD frame and its data periodically downloaded for analysis by SOS. Copies of the Sea-Bird binary files were taken off for processing and calibration at BODC / POL. A LISST-25 particle sizer was fitted to the CTD and its data logged on the Sea-Bird data logging system.

Table 3. Nominal CTD positions. (Ss – Suspended sediments, Nu – Nutrients, Tr – Trace metal samples)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chlorophyll & Nu & Ss	POL Nu	POL Ss
1	53º 32´	3º 21.8´	yes	yes	yes	yes
2	53º 37´	3º 13.4´	yes		yes	yes
3	53º 42´	3º 13.4´	yes		yes	yes
4	53º 47´	3º 13.4´	yes		yes	yes
5	53º 52´	3º 21.8´	yes	yes	yes	yes
6	53º 47´	3º 21.8´	yes	yes	yes	yes
7	53º 42´	3º 21.8´	yes	yes	yes	yes
8	53º 37´	3º 21.8´	yes	yes	yes	yes
9	53º 32´	3º 21.8´	yes	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	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 38.6´	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	no	yes	yes
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´	no			
30	53º 42	3º 55.4´	no			
31	53º 37´	3º 55.4´	yes		yes	yes
32	53º 32´	3º 55.4´	yes		yes	yes
33	53º 27´	3º 55.4´	yes		yes	yes
34	53º 22´	3º 55.4´	yes		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	T / B
2	21	1/ 2	53º 27´	3º 38.6´	27	7.1 / 7.1	33.2 / 33.2
3	1	3/ 4	53º 32´	3º 21.8´	27	6.9 / 7.0	32.4 / 32.7
4	35	5/ 6	53º 31.9´	3º 15.9´	16	6.7 / 6.7	32.0 / 32.1
5	2	7/ 8	53º 37´	3º 13.4´	16	6.5 / 6.5	31.8 / 31.8
6	3	9/10	53º 42´	3º 13.4´	21	6.5 / 6.6	32.1 / 32.1
7	4	11/12	53º 47´	3º 13.4´	19	6.2 / 6.2	31.8 / 31.8
8	5	13/14	53º 52´	3º 21.8´	17	6.7 / 6.7	32.2 / 32.2
9	6	15/16	53º 47´	3º 21.8´	21	6.7 / 6.8	32.3 / 32.4
10	16	17/ 18	53º 47´	3º 30.2´	26	7.0 / 7.0	32.7 / 32.7
11	15	19/ 20	53º 42´	3º 30.2´	37	7.1 / 7.2	32.9 / 33.0
12	7	21/ 22	53º 42´	3º 21.8´	24	6.8 / 6.8	32.3 / 32.4
13	8	23/ 24	53º 37´	3º 21.8´	25	6.8 / 6.9	32.3 / 32.4
14	14	25/ 26	53º 37´	3º 30.2´	26	7.0 / 7.1	32.6 / 32.9
15	13	27/ 28	53º 32´	3º 30.2´	30	7.1 / 7.1	32.9 / 32.9
16	12	29/ 30	53º 27´	3º 30.2´	18	6.9 / 7.0	32.6 / 32.6
17	11	31/ 32	53º 27´	3º 21.8´	18	6.8 / 6.8	32.2 / 32.2
18	10	33/ 34	53º 27´	3º 13.4´	18	6.4 / 6.5	31.3 / 31.4
19	1	35/ 36	53º 32´	3º 21.8´	27	7.1 / 7.1	32.8 / 32.8
20	21	37/ 38	53º 27´	3º 38.6´	25	7.1 / 7.1	32.9 / 32.9
21	22	39/ 40	53º 23´	3º 38.6´	11	6.7 / 6.7	32.4 / 32.4
22	23	41/ 42	53º 23´	3º 47.0´	18	6.6 / 6.7	32.8 / 32.9
23	20	43/ 44	53º 32´	3º 38.6´	34	7.3 / 7.3	33.3 / 33.3
24	24	45/ 46	53º 27´	3º 47.0´	35	7.5 / 7.5	33.5 / 33.5
25	25	47/ 48	53º 32´	3º 47.0´	46	7.5 / 7.4	33.4 / 33.4
26	19	49/ 50	53º 37´	3º 38.6´	33	7.3 / 7.3	33.1 / 33.1

27	18	51/ 52	53º 42´	3º 38.6´	40	7.3 / 7.4	33.0 / 33.1
28	17	53/ 54	53º 47´	3º 38.6´	35	7.1 / 7.2	32.7 / 32.7
29	28	55/ 56	53º 47´	3º 47.0´	40	7.4 / 7.4	33.1 / 33.1
30	27	57/ 58	53º 42´	3º 47.0´	40	7.3 / 7.4	33.0 / 33.1
31	26	59/ 60	53º 37´	3º 47.0´	39	7.4 / 7.4	33.2/ 33.2
32	31	61/ 62	53º 37´	3º 55.4´	45	7.5 / 7.5	33.2 / 33.2
33	32	63/ 64	53º 32´	3º 55.4´	45	7.5 / 7.5	33.3 / 33.4
34	33	65/66	53º 27´	3º 55.4´	38	7.5 / 7.5	33.5 / 33.5
35	34	67/68	53º 22´	3º 55.4´	25	6.6 / 6.6	33.1 / 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. In addition a pCo2 sensor was incorporated into the surface sampling system.

Underway data were recorded every minute from 08:40 on 14 February 2007 until 08:05 on 16 February 2007. The Relative Humidity data, all values about -24.7, are wrong. Copies of the data were taken off the ship as an Excel file, along with a copy of the ship's navigation data.

Data from the pCO2 system were recorded from 08:10 on 14 February 2007 until 08:05 on 16 February 2007.

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 08:40 on 14 February 2007 until 08:05 on 16 February 2007.

Acknowledgements
The assistance of the master, officers, and crew contributed greatly to the success and safety of the cruise.