Prince Madog cruise 09/07
POL Coastal Observatory cruise 44
15-17 May 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. The frame is fitted with a SonTek ADV.
b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring with Sea-Bird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.
c) A CEFAS directional wave buoy.

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 5 and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.
f) A CEFAS directional wave buoy

2. At 53º 27´ N 3º 38.6´ W (site 21, second site, B)
To recover
g) A sea bed frame for a 600 kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves. A Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and a SeaPoint turbidity sensor were fitted to the frame. A 1.2 MHz telemetry ADCP was fitted to the frame.
h) 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
i) 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.
j) 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.

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. A ISUS UV nitrate sensor will be trialled, attached to the CTD frame.

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

5. To conduct a 25 hour CTD station at anchor at 53º 32´ N 3º 21.8´ W with CTD profiles every half hour and water samples every hour.

2.1 Scientific personnel

John Howarth (Principal)
Chris Balfour
Mike Burke
Richard Cooke
Louise Ryan (BODC)
Dave Pearce (CEFAS)
Jo Foden (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Conrad Chapman (Liverpool University)

2.2 Ship's officers and crew

Eric Lloyd (Master)
Andy Wallis (Chief Officer)
Arfon Williams (Chief Engineer)
Brian Clarke (Second Engineer)
Tommy Roberts (A.B.)
Dave Williams (A.B.)
Mick (A.B.)
(Cook)

3. Narrative (times in GMT)

The SmartBuoy toroid, anchor chain clumps, two sea-bed frames and instrumentation were loaded onto RV Prince Madog on the afternoon of 14 May 2007, just after high water. The ADCP frames were set up on the afterdeck and the tower and instruments fitted to the SmartBuoy toroid. Since a replacement CEFAS wave buoy was not delivered because of a communications breakdown by the transporting company, the existing buoy at the Mersey Bar site will be turned round.

Prince Madog left Menai Bridge at 06:50 on 15 May 2007. The flow through pump and the ship's ADCP were switched on at 07:53, by Puffin Island (the surface monitoring system had been logging all night). The pCO_2 system could not be switched on because the password was not recognised. The Mersey Bar mooring site was reached at 10:38, a CTD recorded and the ADCP frame and ballast weight recovered between 11:07 and 11:20. The replacement ADCP frame was deployed at 11:34. The new SmartBuoy was deployed 11:49 to 11:52 and

the old one recovered between 12:02 and 12:09. The zooplankton net hauls were finished by 13:17; since the water was turbid with plankton only the large size net hauls were possible. Recovery of the wave buoy started at 13:39 and the buoy was grappled and on board by 13:46. An attempt was made to pull in the rubber cord by hand but failed, so the mooring was buoyed off. However the ship ran over the buoy and the mooring became tangled with the propeller. Eventually this was cleared (the flow through pump was interrupted between 14:12 and 14:29).

The ship anchored at 14:45 and the 25 hour station started at 15:00 – CTDs every half hour, with water samples every hour. The 25 hour station finished at 16:00 the next day (16 May). Two CTD s were missed because of strong currents (at 02:30 and 14:30 on 16 May). The anchor was recovered and the refurbished wave buoy deployed at 16:22. The CTD grid commenced visiting sites 10, 35, 2 to 21. The ADCP frame was recovered between 07:16 and 07:27 on 17 May 2007 and its replacement deployed at 07:47. An approach was made to the SmartBuoy but conditions were too rough – a combination of swell and strong tidal currents caused seawater to pour over the deck when the gates were open as the ship backed toward the buoy. The survey grid continued with 22, 23 and 24. Returning to site 21 at high water slack, conditions were much improved and the SmartBuoy was recovered at 10:53. The toroid buoy was low in the water. When it was cleaned cracks were observed in its skin – it will need emptying of water and repairing before it can be used again. The trace metal sensor was removed from the buoy with the intention of changing the batteries, downloading the data and re-deploying it on the outgoing SmartBuoy. However no data had been recorded. A few checks were unable to pinpoint the cause, so the SmartBuoy was redeployed at 12:44 without the trace metal monitor. A CTD was recorded at this site and the grid resumed at station 25. The grid was completed at station 34 at 19:35. Surface monitoring and the ship's ADCP were switched off at Puffin Island at 20:14 and Prince madog was alongside at 21:00.

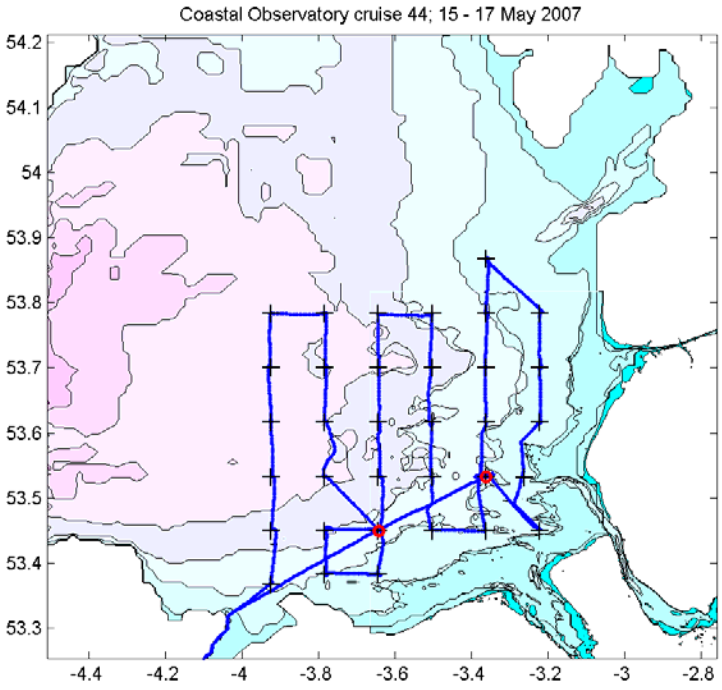

Figure 1. Cruise track.

All the major cruise objectives were accomplished – the moorings were serviced, the water sampling grid and 25 hour station completed. There were a very few equipment failures / data missing – there was no pCO_2 (password) or met -wind speed, direction, air temperature, relative humidity, solar radiation (program being re-written); the surface salinity was consistently (independent of salinity) too high by 2.31 – 2.35; the ISUS uv nitrate sensor was not deployed (lack of effort and preparation time). The ADV returned very little data (about a day); the sea bed conductivities at site A were too low (pump?) and the trace metal monitor recorded no data.

As hoped the plankton were blooming, especially in the vicinity of site. The water column was generally well mixed, except near site A and the whole region was relatively fresh.

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 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 1 Gbyte PCMCIA memory; hourly wave recording enabled.
Clock reset at 13:29:35 on 15 April; delayed start 06:00:00 on 16 April 2007.
Break issued at 23:40 on 15 May 2007. Clock drift +29s.

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 40 s, range 400; pump 0.5s, 1 s delay.
Clock set at 12:05:50 on 15 April 2007; delayed start at 12:00:00 on 16 April 2007.
Stopped at 22:24 on 15 May 2007. Clock drift GMT+5s. 4239 lines of data recorded.
Conductivity too low throughout. Pump??

SonTek ADV (Acoustic Doppler Velocimeter); Logger G321; head A840.
ADV transmitter 1.61m above bed (deck); measured on recovery. Receiver with red tape pointing along scaffolding towards frame (in direction of ADCP beam 2).
Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s.
Delayed start at 12:00 on 16 April 2007.
Could not establish communication with logger. 31 files on memory card. Maybe 33 hours of good data in first file.

The frame D4 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 200m of rope for recovery of the ballast weight.

b) SmartBuoy Mooring.
Sea-Bird MicroCat temperature and conductivity recorder Serial number 2991 (RS485) at 5 m below the surface. Sample interval 600s.

Clock set at 14:04 on 15 April 2007. Delayed start 12:00:00 on 16 April 2007.
Stopped at 13:58 on 15 May 2007; clock GMT+13s. 4188 lines of data recorded.

Sea-Bird MicroCat temperature, conductivity and pressure recorder Serial number 2506 at 10 m below the surface. Sample interval 600s.
Clock set at 14:17:00 on 15 April 2007. Delayed start 12:00:00 on 16 April 2007.
Stopped at 14:45:00 on 15 May 2007; clock GMT+11 s. 4193 lines of data recorded.

Miniloggers set to record at 600s intervals starting at 12:00:00 on 16 April 2007.
Sn 6020E, sn 6021E at 7.5 and 15 m below the surface.
Recovered ok. Data downloaded.

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 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
g) 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 512 Mbyte memory; hourly wave recording enabled.
Clock reset at 11:06:30 on 15 April; delayed start 06:00:00 on 16 April 2007.
Break issued at 13:32:30 on 17 May 2007. Clock drift GMT+48s.

Telemetry ADCP 1200 kHz RDI 3820**.**
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). 512 Mbyte memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 11:32:45 on 15 April; delayed start 06:00:00 on 16 April 2007.
Break issued at 13:27 GMT on 17 May 2007. Clock drift GMT-3s.
LinkQuest acoustic modem 008602 set for transmission of ADCP data every hour.

Sea-Bird 16*plus* S/N 4736 (RS485) on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor: SN 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 10:54:00 15 April 2007; delayed start at 10:00:00 on 16 April 2007.
Stopped at 11:23:45 on 17 May 2007; clock drift GMT + 4 s. 4473 lines of data recorded.

The frame D6 was fitted with two Benthos releases 72863 – Rx 13.5 kHz, Tx 12.0 kHz, release A and 67879 – Rx 11.5 kHz, Tx 12.0 kHz, release B both with a fizz link, and a spooler with 200m of rope for recovery of the ballast weight.

h) SmartBuoy Mooring.
Sea-Bird MicroCat temperature and conductivity recorder Serial number 2010 at 5 m below the surface. Inductive modem. Sample interval 600s.
Clock set at 14:23:25 on 17 April 2007. Delayed start 11:00:00 on 19 April 2007.
Stopped at 12:14:00 on 17 May 2007. Clock drift GMT+9s. 4040 lines of data recorded.

Sea-Bird MicroCat temperature, conductivity and pressure recorder Serial number 4966 (RS232) at 10 m below the surface. Sample interval 600s.
Clock set at 14:34:30 on 17 April 2007. Delayed start 11:00:00 on 19 April 2007.
Stopped at 11:55:00 on 17 May 2007. Clock drift GMT+4s. 4038 lines of data recorded.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity and fluorescence sensors). The frame was fitted with a trace metal monitor and with 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.

Table 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovered Time	Date
Waves ADCP (Site A)	53º 32.066´	3º 21.582´	25.9	11:07	15/05/07
SmartBuoy (Site A)	53º 32.094´	3º 21.659´	24.3	12:02	15/05/07
Wave buoy (Site A)	53º 32.010´	3º 21.321´	21.8	13:46	15/05/07
Waves ADCP (Site B)	53º 27.050´	3º 38.448´	24.7	07:18	17/05/07
Smart Buoy (Site B)	53º 27.057´	3º 38.314´	29.0	10.53	17/05/07

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

Site A
d) Waves ADCP 600 kHz RDI 2390**.**
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 14:08:00 on 14 May; delayed start 07:00:00 on 15 May 2006; started ok.

Sea-Bird 16plus S/N 4596 (RS485) on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor 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 13:49 on 14 May 2007; delayed start at 10:00:00 on 15 May 2007.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G412; head B331.
ADV transmitter 1.225m above bed (deck). Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Compass orientation note: Changed to red mark on receiver pointing parallel to frame in direction of ADCP beam 3.
Clock set. Delayed start at 10:00 on 15 May 2007.

The frame was fitted with two Benthos releases 70338 – Rx 11.0 kHz, Tx 12.0 kHz, release A and 70336 – 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.

e) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder Serial number 4998 at 5m below the surface. Sample interval 600s.
Clock set at 13:02:55 on 14 May 2007. Delayed start 10:00:00 on 15 May 2007.

Sea-Bird MicroCat temperature and conductivity recorder Serial number 2081 at 10m below the surface. Sample interval 600s.
Clock set at 13:11:50 on 14 May 2007. Delayed start 10:00:00 on 15 May 2007.

Miniloggers set to record at 600s intervals starting at 10:00:00 on 15 May 2007.
Sn 6022E (12 bit), sn 6028E (12 bit) at 7.5 and 15 m below the surface.

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 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
i) 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 16:53:00 on 14 May; delayed start 06:00:00 on 17 May 2007.

Telemetry ADCP 1200 kHz RDI 6489**.**
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). 1 Gbyte memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 16:51:00 on 14 May; delayed start 06:00:00 on 17 May 2007.
LinkQuest acoustic modem set for transmission of ADCP data every hour.

Sea-Bird 16plus S/N 4738 (RS485) on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor 10320 taped to roll bar; set up for 0 - 500 FTU range, cable later swapped to 0 – 125 FTU range from recovered Mersey Bar ADCP.
Sample interval 600 s; digiquartz integration time 40s, range 400; run pump 0.5s, 1 s delay.
Clock set at 15:32:20 on 14 May 2007; delayed start at 08:00:00 on 17 May 2007.

The frame was fitted with two Benthos releases 70355 – Rx 10.0 kHz, Tx 12.0 kHz, release B and 71919 – Rx 10.5 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.

j) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder serial number 2506 at 5 m below the surface. Sample interval 600s.
Clock set at 21:41 on 15 May 2007. Delayed start 08:00:00 on 17 May 2007.

Sea-Bird MicroCat temperature and conductivity recorder serial number 2991 at 10m below the surface. Sample interval 600s.
Clock set at 14:30:00 on 15 May 2007. Delayed start 08:00:00 on 17 May 2007.

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 32.049´	3º 21.539´	25.2	11:34	15/05/07
SmartBuoy (Site A)	53º 32.098´	3º 22.046´	25.0	11:52	15/05/07
CEFAS wave buoy (site A)	53º 32.046´	3º 21.199´	20.2	16:22	16/05/07
Waves ADCP (Site B)	53º 27.063´	3º 38.550´	25.3	07:47	17/05/07
Smart Buoy (Site B)	53º 27.059´	3º 38.363´	27.1	12:44	17/05/07
(Telemetry toroid	53º 27.003´	3º 38.571´)			

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.

85 CTD profiles were recorded 36 on the grid and 49 at the anchor station. Two were missed at the anchor station because of fast currents and two empty files (51, 52 - no data lost) whilst the system was rebooted.

Table 3. Nominal CTD positions. (Ss – Suspended sediments, Nu – Nutrients)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu & Ss	POL Nu	POL Ss	Trace metal
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	yes
13	53º 32′	3º 30.2′	yes		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	yes
21	53º 27′	3º 38.6′	yes	yes	yes	yes	
22	53º 23′	3º 38.6′	yes		yes	yes	yes
23	53º 23′	3º 47.0′	yes		yes	yes	yes
24	53º 27′	3º 47.0′	yes		yes	yes	yes
25	53º 32′	3º 47.0′	yes		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	

Table 3. Nominal CTD positions. (Ss – Suspended sediments, Nu – Nutrients)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu & Ss	POL Nu	POL Ss	Trace metal
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		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.

CTD no	Site	Nuts	Nominal positions. Latitude (N)	Longitude (W)	Water depth (m)	Temp (deg)	Salinity
		T/ B				T / B	T / B
1	1		53º 32′	3º 21.8′	27	11.8 / 11.3	32.3 / 32.5
Black marker nutrient sample bottles							
2	1- 1	1/ 2	53º 32′	3º 21.8′	19	13.4 / 12.4	31.3 / 31.8
4	1- 3	3/ 4	53º 32′	3º 21.8′	18	13.2 / 12.3	31.5 / 31.8
6	1- 5	5/ 6	53º 32′	3º 21.8′	19	13.1 / 12.3	31.5 / 31.9
8	1- 7	7/ 8	53º 32′	3º 21.8′	20	12.7 / 12.2	31.7 / 31.9
10	1- 9	9/10	53º 32′	3º 21.8′	22	12.3 / 12.1	31.9 / 32.0
12	1-11	11/12	53º 32′	3º 21.8′	24	12.5 / 11.9	31.9 / 32.1
14	1-13	13/14	53º 32′	3º 21.8′	25	12.0 / 11.9	32.2 / 32.2
16	1-15	15/16	53º 32′	3º 21.8′	27	11.9 / 11.8	32.2 / 32.2
18	1-17	17/18	53º 32′	3º 21.8′	25	11.9 / 11.8	32.2 / 32.2
20	1-19	19/20	53º 32′	3º 21.8′	24	12.1 / 11.7	32.0 / 32.3
22	1-21	21/22	53º 32′	3º 21.8′	21	12.3 / 11.8	31.9 / 32.2
24	1-23	23/24	53º 32′	3º 21.8′	20	12.7 / 11.9	31.5 / 32.1
25	1-24	25/26	53º 32′	3º 21.8′	19	13.0 / 12.5	31.0 / 31.8
27	1-26	27/28	53º 32′	3º 21.8′	19	12.8 / 12.7	31.7 / 31.5
29	1-28	29/30	53º 32′	3º 21.8′	18	12.7 / 12.6	31.4 / 31.6
31	1-30	31/32	53º 32′	3º 21.8′	19	12.7 / 12.6	31.4 / 31.7
33	1-32	33/34	53º 32′	3º 21.8′	22	12.4 / 12.4	31.8 / 31.9
35	1-34	35/36	53º 32′	3º 21.8′	24	12.2 / 12.2	32.0 / 32.0
37	1-36	37/38	53º 32′	3º 21.8′	26	12.0 / 12.0	32.1 / 32.1
39	1-38	39/40	53º 32′	3º 21.8′	26	11.9 / 11.9	32.2 / 32.2
41	1-40	41/42	53º 32′	3º 21.8′	26	12.0 / 11.9	32.2 / 32.2
43	1-42	43/44	53º 32′	3º 21.8′	24	12.1 / 12.0	32.1 / 32.1
45	1-44	45/46	53º 32′	3º 21.8′	23	12.3 / 11.8	31.9 / 32.2
47	1-46	47/48	53º 32′	3º 21.8′	21	12.7 / 11.9	31.6 / 32.1
48	1-47	49/50	53º 32′	3º 21.8′	19	13.0 / 12.3	31.2 / 31.9
50	1-49	51/52	53º 32′	3º 21.8′	18	12.9 / 12.6	31.3 / 31.5
53	10	53/54	53º 27′	3º 13.4′	12	12.9 / 12.8	31.5 / 31.6

Nominal positions.

CTD no	Site	Nuts	Latitude (N)	Longitude (W)	Water depth (m)	Temp (deg)	Salinity
		T/ B				T / B	T / B
54	35	55/56	53º 31.9′	3º 15.9′	12	13.2 / 13.1	30.3 / 30.7
55	2	57/58	53º 37′	3º 13.4′	12	13.1 / 13.1	31.5 / 31.5
56	3	59/60	53º 42′	3º 13.4′	17	13.1 / 13.1	31.7 / 31.8
57	4	61/62	53º 47′	3º 13.4′	18	12.9 / 12.9	32.0 / 32.0
58	5	63/64	53º 52′	3º 21.8′	19	12.8 / 12.8	32.2 / 32.2
59	6	65/66	53º 47′	3º 21.8′	24	12.4 / 12.4	32.2 / 32.2
60	7	67/68	53º 42′	3º 21.8′	29	11.4 / 11.4	32.5 / 32.5
61	8	69/70	53º 37′	3º 21.8′	29	11.6 / 11.6	32.4 / 32.4
62	9	71/72	53º 32′	3º 21.8′	30	11.9 / 11.5	32.2 / 32.5
Red marker nutrient sample bottles							
63	11	1/ 2	53º 27′	3º 21.8′	20	11.9 / 11.8	32.2 / 32.3
64	12	3/ 4	53º 27′	3º 30.2′	20	11.6 / 11.6	32.5 / 32.6
65	13	5/ 6	53º 32′	3º 30.2′	32	11.3 / 11.2	32.6 / 32.8
66	14	7/ 8	53º 37′	3º 30.2′	28	11.4 / 11.4	32.5 / 32.6
67	15	9/10	53º 42′	3º 30.2′	36	11.4 / 11.2	32.5 / 32.7
68	16	11/12	53º 47′	3º 30.2′	23	12.3 / 12.0	32.2 / 32.3
69	17	13/14	53º 47′	3º 38.6′	32	11.4 / 11.1	32.6 / 32.8
70	18	15/16	53º 42′	3º 38.6′	36	11.7 / 11.0	32.5 / 32.9
71	19	17/18	53º 37′	3º 38.6′	30	11.4 / 11.1	32.5 / 33.0
72	20	19/20	53º 32′	3º 38.6′	32	11.3 / 11.1	32.7 / 32.9
73	21- 1	21/22	53º 27′	3º 38.6′	23	11.5 / 11.4	32.6 / 32.7
74	22	23/24	53º 23′	3º 38.6′	15	12.0 / 12.0	32.4 / 32.4
75	23	25/26	53º 23′	3º 47.0′	16	11.7 / 11.6	32.7 / 32.7
76	24	27/28	53º 27′	3º 47.0′	37	11.1 / 11.1	33.2 / 33.2
77	21- 2	29/30	53º 27′	3º 38.6′	27	11.3 / 11.2	32.9 / 33.0
78	25	31/32	53º 32′	3º 47.0′	45	11.0 / 11.0	33.2 / 33.3
79	26	33/34	53º 37′	3º 47.0′	40	10.9 / 10.8	33.5 / 33.6
80	27	35/36	53º 42′	3º 47.0′	37	11.2 / 10.9	33.0 / 33.2
81	28	37/38	53º 47′	3º 47.0′	39	11.1 / 10.9	33.0 / 33.1
82	29	39/40	53º 47′	3º 55.4′	40	11.1 / 10.9	33.3 / 33.3
83	30	41/42	53º 42	3º 55.4′	40	11.3 / 10.8	33.2 / 33.5
84	31	43/44	53º 37′	3º 55.4′	42	11.0 / 10.8	33.6 / 33.6
85	32	45/46	53º 32′	3º 55.4′	43	11.1 / 10.9	33.2 / 33.4
86	33	47/48	53º 27′	3º 55.4′	36	11.3 / 11.1	33.1 / 33.2
87	34	49/50	53º 22′	3º 55.4′	23	12.0 / 11.9	32.6 / 32.6

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 pCO_2 sensor was incorporated into the surface sampling system.

A new high quality temperature sensor has been fitted. The monitoring package software is being written and so there were no wind speed, direction, air temperature, relative humidity or solar radiation data. A new anemometer will be fitted at the end of the cruise. No pCO_2 data were recorded since the system did not recognise the password. The surface salinity was consistently (independent of salinity) too high by 2.31 – 2.35.

Underway data were recorded every minute from 07:53 on 15 May until 20:14 on 17 May 2007, starting and ending at Puffin Island, with a short gap between 14:12 – 14:29 15 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 07:53 on 15 May to 20:14 on 17 May 2007, starting and ending at Puffin Island.

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