Prince Madog cruise 19/08
POL Coastal Observatory cruise 54
25 – 26 June 2008

1. Objectives

1. At Site A 53º 32´ N 3º 21.8´ W, (Observatory CTD station 1 and 9)

To recover

a) A sea bed frame containing:
- 600kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves.
- Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and a SeaPoint turbidity sensor.
- SonTek ADV.
- Anderra oxygen optode.

b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and VEMCO thermistor miniloggers at 7.5 and 15 m below the surface.

To deploy

c) an identical bedframe to that which was recovered.

d) an identical CEFAS smartbuoy to that which was recovered

e) Collect 10 vertical zooplankton net hauls (CEFAS).

2. At Site B 53º 27´ N 3º 38.6´ W (Observatory CTD station 21)

To recover

a) A sea bed frame containing:
- 600 kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves.
- A 1200 kHz ADCP to measure current profile and pressure. This second ADCP would usually provide the data for transmission by telemetry but due to refurbishment of the telemetry buoy for the following month will only provide backup.
- Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and a SeaPoint turbidity sensor.

b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring. Attached to the mooring wire are Sea-Bird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.

To deploy

c) A telemetry toroid.

d) A sea bed frame containing:
- 600 kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves.

• A 1200 kHz ADCP to measure current profile and pressure. This second ADCP provides the data for transmission by telemetry.
• Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor, a SeaPoint turbidity sensor.

e) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring. Attached to the mooring wire are Sea-Bird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 m 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 sediment samples at each of the CTD sites.

5. Collect near surface water samples for Elena Stoica (UoL) at stations 1, 21 & most offshore station. These samples are to be 'fixed' using provided formaldehyde solutions and frozen at -20ºC

6. Collect water samples for Conrad Chapman (UoL).

2.1 Scientific personnel

John Howarth (Principal Scientist)
Terry Doyle
Ray Edun
John Kenny
Emlyn Jones
Neil Needham (CEFAS)
Jenny Keable (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Flo Verspecht (School of Ocean Sciences)
Claire Mahaffey (Liverpool University)
John Grenville (Liverpool University)

2.2 Ship's officers and crew

Eric Lloyd (Master)
Nick Davies (Chief Officer)
Arfon Williams (Chief Engineer)
Andy Westmore (Second Engineer)
Tom Roberts (A.B.)
Mick Callaghan (A.B.)
Hefin Griffiths (A.B.)
Eifion Pritchard (Cook)

3. Narrative (times in GMT)

The anchor chain clumps, two sea-bed frames and instrumentation were loaded onto RV Prince Madog on the afternoon of 24 June between 11:00 and 13:00, approaching high water, and the telemetry toroid was floated round. The ADCP frames were set up on the afterdeck by POL engineers and the tower and instruments fitted to the SmartBuoy toroid by CEFAS personnel. The nutrient analyzer was set up and the POL LISST100 fitted to the CTD frame. A second set of four MicroCats were collected from POL when the originals, recently returned from calibration at Sea Bird, were found to be without batteries.

Prince Madog left Menai Bridge at 06:55 on 25 June 2008. The ship's surface monitoring, pCO_2 system and ADCP were switched on at 07:39 at around Puffin Island. The telemetry toroid was deployed at site 21 in a moderate sea at 09:34 on the way to the Mersey Bar mooring site. On arrival a CTD was recorded but it was now too rough for mooring work or to obtain a grab sample. Since the wind was from the south-southwest CTD and grab sites 10, 11, 12 (no CTD or grab, too rough), 22, 23, 24 were visited. No grab sample was obtained at the latter site despite three drops. Arriving at site 21 a CTD and grab sample were obtained, following by the recovery of the ADCP between 18:20 and 18:54 and the deployment of the replacement ADCP at 19:08. The CTD survey continued throughout the night (20 - 14, 8 – 2 and 35) arriving at the Mersey Bar site at 07:34 on 26 June. Although site 2 was visited it was too rough for a CTD (the wire was snatching when deployment was tried) but a grab sample was obtained. Since it was again too rough for mooring deployments a CTD was recorded, grab sample obtained and the vertical net hauls carried out. We then waited to see whether the weather would improve. It did not; so the site was left at 14:15. Sites 13 and 12 were visited but at both it was too rough for a CTD or a grab. A course was set for site 34 and conditions rapidly improved. At 34 a CTD was recorded and a grab sample obtained.

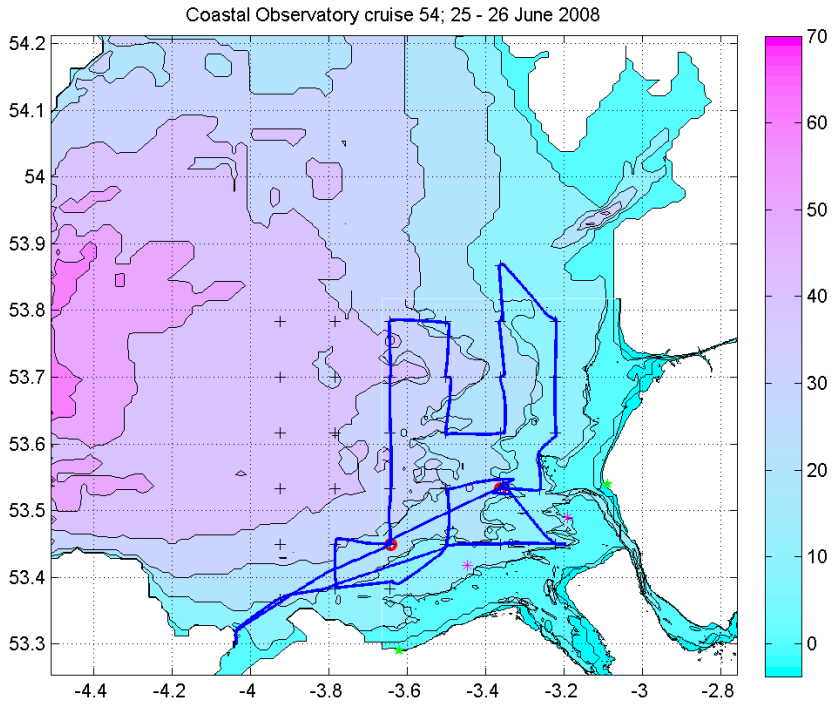

Figure 1. Cruise track.

The surface systems were switched off passing Puffin Island between 18:07 and 18:14 and Prince Madog was along side at 18:57.

The cruise was disappointing because of the weather – only three out of a planned nine mooring operations were carried out, none at the Mersey Bar site. The, short, telemetry record from the frame deployed at Site B indicates it is probably upside down. CTDs were recorded at 22 of the 34 sites

4. Moorings (times in GMT)

4.1 The set up of the recovered instruments was as follows:

Site A

No moorings were recovered because of bad weather.

Site B

a) Waves ADCP 600 kHz RDI 5803**.**
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 16:39 on 12th May 2008; delayed start 06:00 on 13th May 2008**.**
Stopped at 18:06:03 on 26 June 2008; file size 205,880 kB.

Telemetry ADCP 1200 kHz RDI 0572**.**
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 Gb memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 16:48:20 on 12 May 2008; delayed start 05:50:00 on 13 May 2008.
Stopped at 16:12:00 on 26 June 2008; file size 4,712 kB.

Sea-Bird 16plus S/N 5310 on base of frame with pumped conductivity sensor underneath.
SeaPoint turbidity sensor 10320 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 17:25 on 12th May 2008; delayed start at 06:00 on 13th May 2008.
Stopped at 18:10 on 26 June 2008; 6412 samples downloaded.

The frame was fitted with a fizz link, a spooler with 50m of rope for recovery of the ballast weight and two Benthos releases s/n 71922 (Rx 11.5 kHz, Tx 12.0 kHz, release A) and s/n 72382 (Rx 14.5 kHz, Tx 12.0 kHz, release A).

b) The Smart buoy mooring was not recovered because of bad weather.

Table 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovered Time	Date
ADCP (Site B)	53º 27.023´	3º 38.557´	25.12	18:45	25/06/08

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

Site A

No equipment was deployed at site A because of bad weather. The setup of the equipment deployed on the previous cruise was:-

a) Waves ADCP 600 kHz RDI S/N 3644, 1Gb memory.
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.
Clock set at 16:39 on 12th May 2008; delayed start 06:00:00 on 13th May 2008.

Sea-Bird 16plus S/N 5309 on base of frame with pumped conductivity sensor underneath.
Sample interval 600s.
Clock set at 17:01:00 on 12th May 2008; delayed start at 06:00:00 on 13th May 2008.

*SeaPoint turbidity sensor 10471 taped to roll bar; set up for **0 - 500 FTU range**.*
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay.
Clock set at 17:01:00 on 12th May 2008; delayed start at 06:00:00 on 13th May 2008.

Anderra optode S/N 675.
Clock set at 17:01:00 on 12th May 2008; delayed start at 06:00:00 on 13th May 2008.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G250; head B252.
Distance from center of three prong head on ADV transmitter to deck was 1.270m (i.e. above sea bed). Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Time reset to 19:04:00 on 12th May 2008, logging set to start at 06:00:00 on 13th May 2008.

The frame was fitted with a fizz link, a spooler with 50m of rope for recovery of the ballast weight and two Benthos releases s/n 70355 (Rx 10.0 kHz, Tx 12.0 kHz, release B) and s/n 72382 (Rx 10 kHz, Tx 12.0 kHz, release A).

b) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder s/n 5790 at 5m below the surface. Sample interval 600s.
Clock set at 15:33:20 on 12th May 2008. Delayed start 06:00:00 on 13th May 2008.

Sea-Bird MicroCat temperature and conductivity recorder s/n 5792 at 10m below the surface. Sample interval 600s.
Clock set at 17:48 on 12th May 2008. Delayed start 06:00 13th May 2008.

Mini-logger s/n 6021E at 7.5 m below the surface set to record at 600s intervals. Clock set at 18:07 on the 12th May 2008. Delayed start at 06:00:00 13th May 2008.

Mini-logger s/n 6023E at 15 m below the surface set to record at 600s intervals. Clock set at 18:03 12th May 2008. Delayed start at 06:00:00 13th May.

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 of material supplied by Mike Cox (University of Liverpool) for the determination of bacterial degradation.

The single point mooring was composed 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 2390, 1GB memory**.**
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.
Clock set at 13:35:20 on 24 June 2008; delayed start 06:00 on 25 June 2008.

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). 1 Gb memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 13:46:10 on 24 June 2008; delayed start 15:50:00 on 24 June 2008.
LinkQuest acoustic modem sn008602 set for transmission of ADCP data every hour.
LinkQuest tx at 16:00:00 on 24 June 2008.

Sea-Bird 16plus S/N 4596 (RS485) on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor 10533 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.
Sample interval 600s.
Clock set at 13:22:50 on 24 June 2008; delayed start at 06:00 on 25 June 2008.

The frame was fitted with a fizz link, a spooler with 50m of rope for recovery of the ballast weight and two Benthos releases s/n 67679 (Rx 11.5 kHz, Tx 12.0 kHz, release B) and s/n 70356 (Rx 10.5 kHz, Tx 12.0 kHz, release D).

b) The SmartBuoy mooring was not deployed because of bad weather. The setup of the equipment deployed on the previous cruise was:-

Sea-Bird MicroCat temperature, conductivity recorder s/n 5793 at 5 m below the surface. Sample interval 600s.
Clock set at 17:52:36 12th May 2008. Delayed start 06:00:00 13th May 2008.

Sea-Bird MicroCat temperature, conductivity recorder s/n 5791 at 10 m below the surface. Sample interval 600s.
Clock set at 17:42:00 12th May 2008. Delayed start 06:00:00 13th May 2008.

VEMCO Mini-logger s/n 6026E at 7.5 m below the surface set to record at 600s intervals. Clock set at 17:59:00 12th May 2008. Delayed start at 06:00:00 13th May 2008.

VEMCO Mini-logger s/n 2425 at 15 m below the surface set to record at 600s intervals. Clock set at 18:01:00 12th May 2008. Delayed start at 06:00:00 13th May 2008.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity sensor and fluorometer). 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.

Table 2. Deployed mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployed Time	Date
(*Waverider Buoy (Site A)*	*53º 32.058´*	*3º 21.188´*	*20.6*	*11:59*	*13/5/08)*
(ADCP frame (Site A)	*53º 32.077´*	*3º 21.534´*	*21.4*	*1324*	*13/5/08)*
(SmartBuoy (Site A)	*53º 32.055´*	*3º 21.416´*	*21.5*	*1340*	*13/5/08)*
Telemetry toroid	53º 27.070´	3º 38.635´	23.0	09:34	25/06/08
ADCP (Site B)	53º 27.118´	3º 38.604´	24.3	19:08	25/06/08
(Smart Buoy (Site B)	*53º 26.965´*	*3º 38.331´*	*19.7*	*1501*	*15/5/08)*

5. CTD

The Sea-Bird 911 CTD recorded downwelling PAR light levels, temperature, conductivity, transmittance and fluorescence at 24 Hz. The frame was fitted with an altimeter, which was in perfect working order. The CTD temperature data was checked against a Sea-Bird SBE35 precision thermometer. Water samples were taken from a near bed (3mab) bottle for calibration of the CTD salinity data by Anne Hammerstein (SOS). Water samples were taken from the near surface (1m) and near bed (3mab) bottles and filtered to determine suspended sediment load concentration, nutrient concentration and for CEFAS calibration. A POL LISST-100C particle sizer with internal logging was attached to the CTD frame. The 'on' light did not appear when the LISST was switched on – it is not known if any data has been recorded. 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)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu & Ss	POL Nu	DEOS Nu	POL Ss	Grab No.
1	53º 32´	3º 21.8´	yes	yes+bottom	yes	yes	yes	21
2	53º 37´	3º 13.4´	yes / no ctd		no	no	no	19
3	53º 42´	3º 13.4´	yes	yes	yes	no	yes	18
4	53º 47´	3º 13.4´	yes		yes	yes	yes	17
5	53º 52´	3º 21.8´	yes	yes	yes	yes	yes	16
6	53º 47´	3º 21.8´	yes		yes	yes	yes	15
7	53º 42´	3º 21.8´	yes	yes	yes	yes	yes	14

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu	& Ss	POL Nu	DEOS Nu	POL Ss	Grab No.
8	53º 37′	3º 21.8′	yes	yes		yes	yes	yes	13
9	53º 32′	3º 21.8′	no						
10	53º 27′	3º 13.4′	yes	yes		yes	yes	yes	1
11	53º 27′	3º 21.8′	yes	yes		yes	yes	yes	2
12	53º 27′	3º 30.2′	yes / no ctd			no	no	no	no
13	53º 32′	3º 30.2′	yes / no ctd			no	no	no	no
14	53º 37′	3º 30.2′	yes			yes	yes	yes	12
15	53º 42′	3º 30.2′	yes			yes	yes	yes	11
16	53º 47′	3º 30.2′	yes			yes	yes	yes	10
17	53º 47′	3º 47.0′	yes			yes	yes	yes	9
18	53º 42′	3º 38.6′	yes			yes	yes	yes	8
19	53º 37′	3º 38.6′	yes	yes		yes	yes	yes	7
20	53º 32′	3º 38.6′	yes			yes	yes	yes	6
21	53º 27′	3º 38.6′	yes	yes		yes	yes	yes	5
22	53º 23′	3º 38.6′	yes			yes	yes	yes	3
23	53º 23′	3º 47.0′	yes			yes	yes	yes	4
24	53º 27′	3º 47.0′	yes			yes	yes	yes	no
25	53º 32′	3º 47.0′	no						
26	53º 37′	3º 47.0′	no						
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′	no						
33	53º 27′	3º 55.4′	no						
34	53º 22′	3º 55.4′	yes	yes		yes	yes	yes	22
35	53º 32′	3º 15.9′	yes			yes	yes	yes	20

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	1-1	1/2	53º 32′	3º 21.8′	22	14.4 / 14.4	32.6 / 32.6
22	1-2	43/44	53º 32′	3º 21.8′	23	14.2 / 14.1	32.8 / 32.9
21	35	41/42	53º 31.9′	3º 15.9′	13	14.7 / 14.7	32.4 / 32.5
20	3	39/40	53º 42′	3º 13.4′	20	15.1 / 15.1	32.4 / 32.4
19	4	37/38	53º 47′	3º 13.4′	20	15.2 / 15.1	32.5 / 32.5
18	5	35/36	53º 52′	3º 21.8′	19	14.5 / 14.5	32.7 / 32.7
17	6	33/34	53º 47′	3º 21.8′	23	14.5 / 14.5	32.7 / 32.7
16	7	31/32	53º 42′	3º 21.8′	27	14.5 / 14.6	32.7 / 32.7
15	8	29/30	53º 37′	3º 21.8′	24	14.4 / 14.4	32.7 / 32.7
2	10	3/4	53º 27′	3º 13.4′	15	15.2 / 15.2	32.3 / 32.3

CTD no	Site	Nuts	Latitude (N)	Longitude (W)	Water depth (m)	Temp (deg)	Salinity
		T/ B				T / B	T / B
3	11	5/6	53º 27′	3º 21.8′	20	14.4 / 14.4	32.7 / 32.7
14	14	27/28	53º 37′	3º 30.2′	30	13.7 / 13.6	32.9 / 33.0
13	15	25/26	53º 42′	3º 30.2′	36	13.7 / 13.4	32.9 / 33.0
12	16	23/24	53º 47′	3º 30.2′	24	14.5 / 14.4	32.7 / 32.8
11	17	21/22	53º 47′	3º 38.6′	33	13.5 / 13.2	33.0 / 33.0
10	18	19/20	53º 42′	3º 38.6′	37	13.3 / 13.2	33.1 / 33.1
9	19	17/18			30	13.5 / 13.4	33.1 / 33.1
8	20	15/16	53º 32′	3º 38.6′	33	13.8 / 13.5	33.1 / 33.2
7	21	13/14	53º 27′	3º 38.6′	27	13.7 / 13.6	33.2 / 33.3
4	22	7/8	53º 23′	3º 38.6′	19	14.0 / 14.0	33.2 / 33.2
5	23	9/10	53º 23′	3º 47.0′	17	14.0 / 14.0	33.2 / 33.2
6	24	11/12	53º 27′	3º 47.0′	34	13.3 / 13.2	33.5 / 33.5
23	34	45/46	53º 22′	3º 55.4′	25	13.2 / 13.3	33.2 / 33.4

Surface water samples were obtained for Elena Stoica at sites 1, 21 and 34.

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, Transmissance, Hull Temperature (ºC), Barometric Pressure (mbar), Fluorescence, Turbidity, Salinity, Conductivity sensor water temperature (ºC). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC. In addition a pCO_2 sensor is incorporated into the surface sampling system.

Met package measures and records Barometric pressure (mbar), 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, Minimum Air Temp (ºC), Maximum Air Temp (ºC), Wind Gust (m s^{-1}).

Underway data, pCO_2 and ships ADCP data were recorded every minute. 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. The systems were switched on at 07:39 on 25 June on passing Puffin Island. The ADCP and underway systems were switched off at 18:07 and the pCO_2 at 18:14 on 26 June on passing Puffin Island.

Acknowledgements
The assistance of the master, officers, and crew is appreciated in ensuring the success of this cruise.