Prince Madog cruise 37/08
POL Coastal Observatory cruise 58
10 – 12 December 2008

1. Objectives

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

To recover
a) A sea bed frame containing a 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 with a SeaPoint turbidity sensor, Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor with a Aanderra oxygen optode and a SonTek ADV.

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) an identical bedframe to that which was recovered. Plus a FSI CTD logger for comparisons with the Sea-Bird SBE 16plus.
d) an identical CEFAS smartbuoy to that which was recovered. Plus an AC-S logger.

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

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

To recover
a) 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.

b) 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 1200 kHz telemetry ADCP was fitted to the frame.

To deploy
d) 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.

e) 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.

3. At Site C 53º 32.3´ N 3º 27´ W

This deployment was a 'one off' deployment as part of the CObs/Bangor University 'fate of freshwater project'.

To recover
a) A sea bed frame with a 600 kHz RDI ADCP to measure the mean current profile and pressures. A Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor.
b) A single point mooring with 6ft toroid surface marker buoy with a Sea-Bird MicroCat temperature and conductivity logger at 5m.

4. At 53º 23.6´ N 3º 14.2´ W (Hilbre Channel)

To deploy
a) A wavebuoy.

5. 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. To obtain surface samples for a Defra pH study by David Hydes (NOCS).

6. Collect sediment samples at each of the CTD sites.

7. Collect near surface water samples for Elena Stoica at stations 1, 21 & the most offshore station. Some of these samples are to be 'fixed' using provided formaldehyde solutions and frozen at -20ºC and others left in the fridge.

8. To collect and analyse water samples along a line EW to station 1 (carried out by Anouska Bailey and Davis from LU.

2.1 Scientific personnel

Phil Knight (Principal Scientist)
Andy Lane
Terry Doyle
John Kenny
Mike Burke
Clare Davis (LU)
Anouska Bailey (LU)
Helen Lees (CEFAS)
Neil Needham (CEFAS)
Anne Hammerstein (School of Ocean Sciences)

2.2 Ship's officers and crew

Eric Lloyd (Master)
Nick Davies (Chief Officer)
Arfon Williams (Chief Engineer)
Andrew Westmore (2nd Engineer)
Tom Roberts (A.B.)
Mick Callaghan (A.B)
David Robinson (A.B.)
Eifion Pritchard (Cook)

3. Narrative (times in GMT)

The anchor chain clumps, two sea-bed frames with instrumentation and a nearly complete SmartBuoy were loaded onto RV Prince Madog at 18:00 on 9 December 2008 at Vittoria Dock, Birkenhead.

RV Prince Madog left Birkenhead at 07:00 on 10 December 2008. The ship's surface monitoring, pCO_2 system and ADCP were switched on between 07:58 & 08:01 at the entrance to the river Mersey.

Conditions were too rough at Site A for deployment/recovery work and RV Prince Madog headed for the relative shelter of the Hilbre Channel to deploy the wave buoy. The wave buoy was successfully deployed between 10:12 and 10:14 on 10 December 2008.

CTD's were then carried at stations 11, 10, & 1 (site A). At site A the ADCP release was fired at 14:41 and surfaced at 14:58 on 10 December 2008. The replacement ADCP was then deployed at 16:10. CTD's were then carried out at stations 1, 2, 7, 8, 14, 19, 18, 17, 28, 29 (Surface water samples were taken for Elena Stoica), 30, 27, 26, 31, 32, 25, 20, 13 & 1. The replacement SmartBuoy was deployed at 08:48 on 11 December 2008 and the old buoy recovered between 08:58 and 09:17. Another CTD was carried out at station 1. Surface water samples were taken for Elena Stoica.

Site C (temporary site) was reached at 10:00 on 11 December 2008. There was no sign of the surface buoy. The ADCP release was fired at 10:07 and surfaced at 10:10. A yellow buoy was spotted near to the Hamilton Gas platform. RV Prince Madog headed for the buoy. After moving closer this turned out to be one of the gas production buoys, however a smaller buoy was spotted along the same line of sight. This turned out to be the lost surface buoy from Site C. The steel work was damaged and paint marks suggested that it had been hit by a ship and dragged. The whole mooring was still intact including the anchor. It was recovered between 10:43 and 10:47.

Site B (Station 21) was reached at 12:23 and a CTD carried out. The ADCP was recovered between 12:55 and 13:11. The replacement ADCP was then deployed at 13:32. The replacement SmartBuoy was deployed at 13:57. The SmartBuoy at site B was recovered between 14:06 and 14:13. Surface water samples were taken for Elena Stoica. This was followed by CTD's at stations 21, 22, 12, Cefas zooplankton net hauls at Site A and a CTD at station 35.

The surface monitoring, ADCP and pCO$_2$ systems were switched off at 20:13. Prince Madog arrived at Vittoria Dock, Birkenhead at 21:00 on 11 December 2008 and unloaded. All the major moorings objectives were completed. Most of the CTD survey was completed. Weather conditions were good apart from the first 12 hours when a rough sea state persisted.
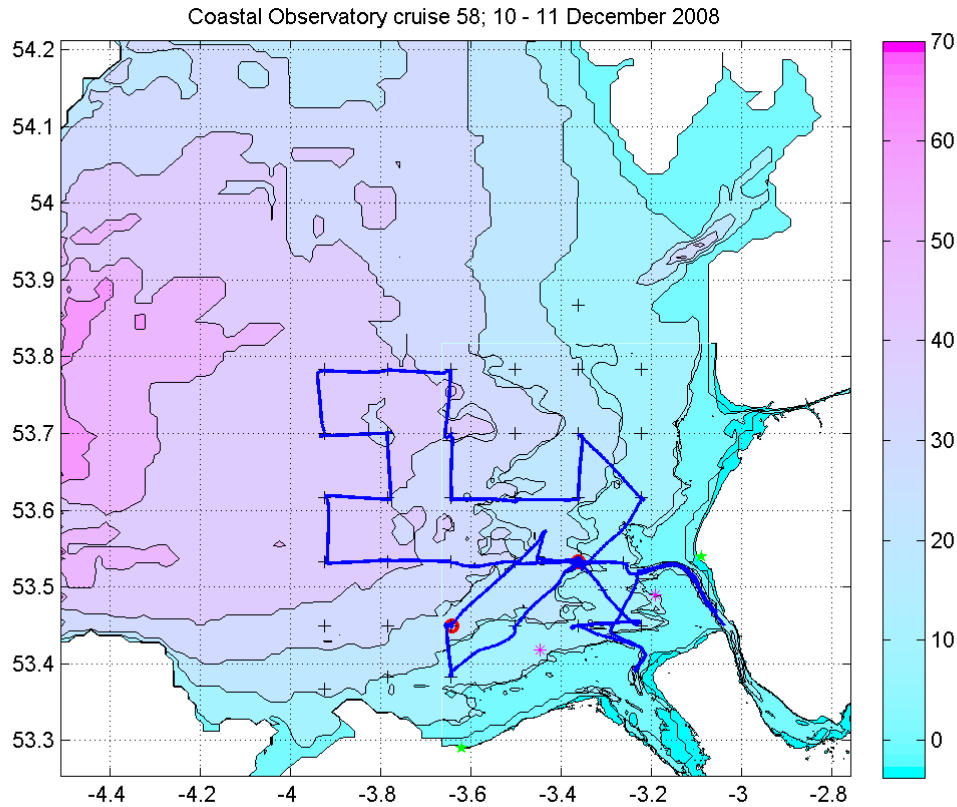

Figure 1. Cruise track.

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 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.
Clock reset at 15:39:00 on 21/10/08.
Logging set to start at 06:00 on 22/10/08.
Stopped logging at 14:29 on 16/12/08.

Sea-Bird 16plus S/N 4736 on base of frame with pumped conductivity sensor underneath. Sample interval 600s. 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 reset at 18:22 on 20/10/08. Logging set to start at 12:00 on 21/10/08. Stopped at 09:50 on 18/12/08.

Sea-Bird 16plus S/N 4490 on base of frame to provide power and logging for optode. Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay. Aanderaa optode S/N 674. Clock reset at 18:25 on 20/10//08. Logging set to start at 12:00 on 21/10/08. Stopped at 13:50 on 18/12/08. Note: Aanderaa optode swapped over immediately after recovery without switching the logger off.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G527; head A983.
Distance from center of three prong head on ADV transmitter to deck was 1.31m (i.e. above sea bed). Red prong aligned to ADCP beam 3. Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Time reset to 15:45 on 21/10/08, logging set to start at 06:00:00 on 22/10/08. Stopped logging on the 3/12/08 (Ran out of memory).

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 70356 (Rx 10.5 kHz, Tx 12.0 kHz, release D) and s/n 71909 (Rx 10.0 kHz, Tx 12.0 kHz, release C).

b) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder s/n 5793 at 5m below the surface. Sample interval 600s.
Clock reset to 17:48:00 on 9 September 2008. Stopped at 15:00 on 18/12/08.

Sea-Bird MicroCat temperature and conductivity recorder s/n 5792 at 10m below the surface. Sample interval 600s.
Clock reset to 17:36 on 9 September 2008. Stopped at 15:50 on 18/12/08.

Mini-logger (Star ODi) s/n 2842 at 7.5 m below the surface set to record at 600s intervals. Set to start sampling at 08:00 on 10 September 2008. Stopped at 16:20 on 18/12/08.

Mini-logger (Star ODi) s/n 2843 at 15 m below the surface set to record at 600s intervals. Set to start sampling at 08:00 on 10 September 2008. Stopped at 16:20 on 18/12/08.

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 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 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.
Clock reset to 16:24:00 on 9 September 2008.
Set to start at 09:00:00 logging on 9 September 2008
Stopped at 14:00 on 16/12/08.

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 16:29:00 on 9 September 2008; delayed start 17:00:00 on 9 September 2008.
Stopped at 14:10 16/12/08.

Sea-Bird 16plus S/N 5310 on base of frame with pumped conductivity sensor underneath. Sample interval 600s. SeaPoint turbidity sensor (S/N 10320) 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 reset at 15:25 on 9 September 2008. Stopped at 01:40 24/12/08.

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 10.0 kHz, Tx 12.0 kHz, release A).

b) SmartBuoy Mooring.

Sea-Bird MicroCat temperature, conductivity recorder s/n 5791 (RS 232) at 5 m below the surface. Sample interval 600s. Clock reset to 17:59 on 9 September 2008. Logging set to start 08:00:00 on 10 September 2008. Stopped at 13:00 on 18/12/08.

Sea-Bird MicroCat temperature, conductivity recorder s/n 5433 (RS 232) at 10 m below the surface. Sample interval 600s. Clock reset to 18:07 on 9 September 2008. Logging set to start 08:00:00 on 10 September 2008. Stopped at12:00 on 18/12/08.

Mini-logger (Star ODi) s/n 2847 at 7.5 m below the surface set to record at 600s intervals.
Set to start sampling at 08:00 on 10 September 2008. Stopped at 15:50 at 18/12/08.

Mini-logger (Star ODi) s/n 2849 at 15 m below the surface set to record at 600s intervals.
Set to start sampling at 08:00 on 10 September 2008. Stopped at 15:30 at 18/12/08.

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.

Site C
a) 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.
Clock reset at 15:51:00 on 21/10/08.

Logging set to start at 06:00 on 22/10/08. Stpped at 15:00 on 16/12/08.

Sea-Bird 16plus S/N 4738 on base of frame with pumped conductivity sensor underneath. Sample interval 600s. Clock reset at 18:15 on 20/10/08. Logging set to start at 12:00 on 21/10/08. Stopped at 12:00 on 18/12/08

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 67670 (Rx 12.0 kHz, Tx 11.5 kHz, release B) and s/n 70358 (Rx 11.0 kHz, Tx 12.0 kHz, release A).

b) Surface buoy mooring
Mooring slightly damaged due to collision and dragging (Steel work bent, red paint on yellow toroid). Sea-Bird MicroCat temperature, conductivity recorder s/n 4966 at 3 m below the surface. Sample interval 600s. Stopped at 14:30 on 18/12/08.

Table 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovered Time	Date
ADCP frame (Site A)	53° 32.068´	3° 21.351´	25.4	14:41	10/12/08
SmartBuoy (Site A)	53° 32.088´	3° 21.629´	22.7	08:58	11/12/08
ADCP frame (Site B)	53° 27.014´	3° 38.603´	24.6	12:55	11/12/08
SmartBuoy (Site B)	53° 26.889´	3° 38.639´	26.8	14:06	11/12/08
ADCP frame (Site C)	53° 32.199´	3° 27.074´	31.1	10:07	11/12/08
SmartBuoy (Site C)	53° 32.254´	3° 27.022´	31.1	10:43	11/12/08
Recovered off position at	53° 34.342´	3° 25.949´			

4.2 The set up of the deployed 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). 1 Gb of memory.
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 15:25:30 on 9 December 2008.
Logging set to start at 06:00 on 10 December 2008.

Sea-Bird 16plus S/N 5309 (RS232) on base of frame with pumped conductivity sensor underneath. Sample interval 600s. 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 reset at 16:20 on 9 December 2008. Logging set to start at 06:00 on 10 December 2008.

Sea-Bird 16plus S/N 4741 on top of frame with pumped conductivity sensor underneath.

Sample interval 600s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay. Aanderaa optode S/N 674. Clock reset at 15:50 on 9 December 2008. Logging set to start at 06:00 on 10 December 2008.

FSI NXIC S/N 2195 on top of frame with pumped conductivity sensor underneath. Sample interval 600s. Clock reset at 15:08 on 9 September 2008. Logging set to start at 08:00 on 10 September 2008.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G527; head A943.
Distance from center of three prong head on ADV transmitter to deck was 1.350m (i.e. above sea bed). Red prong aligned to ADCP beam 3. Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Time reset to 15:00:00 on 8 December 2008, logging set to start at 06:00:00 on 10 December 2008. Note: Banged on deployment.

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 72381 (Rx 11.0 kHz, Tx 12.0 kHz, release B).

b) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder s/n 5790 at 5m below the surface. Sample interval 600s.
Clock reset to 16:08:00 on 9 December 2008.
Set to start sampling at 06:00 on 10 December 2008.

Sea-Bird MicroCat temperature and conductivity recorder s/n 2081 at 10m below the surface. Sample interval 600s.
Clock reset to 16:37 on 9 December 2008.
Set to start sampling at 06:00 on 10 December 2008.

Mini-logger (Star ODi) s/n 2838 at 7.5 m below the surface set to record at 600s intervals. Set to start sampling at 06:00 on 10 December 2008.

Mini-logger (Star ODi) s/n 2841 at 15 m below the surface set to record at 600s intervals. Set to start sampling at 06:00 on 10 December 2008.

AC-S s/n 060 at 5m below the surface set to record with 300s intervals and 10s sampling. Clock set at 16:57:00 on 9/12/08. Set to start sampling at 06:00:00 on 10/12/08.

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 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 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). 1 Gb of memory.

Beam co-ordinates - speeds, correlation, echo intensity, % good.

Sound velocity calculated from temperature, depth and salinity of 32.

Clock reset to 15:18:00 on 8 December 2008.

Set to start at 06:00:00 logging on 10 December 2008

Sea-Bird 16plus S/N 4737 (RS485) on base of frame with pumped conductivity sensor underneath. Sample interval 600s. SeaPoint turbidity sensor taped to roll bar; set up for 1 - 125 FTU range. Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay. Clock reset at 15:50 on 9 December 2008. Set to start at 06:00:00 logging on 10 December 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 69676 (Rx 11.5 kHz, Tx 12.0 kHz, release C) and s/n 72858 (Rx 14.5 kHz, Tx 12.0 kHz, release A).

b) SmartBuoy Mooring.

Sea-Bird MicroCat temperature, conductivity recorder s/n 5434 (RS 232) at 5 m below the surface. Sample interval 600s. Clock reset to 16:13 on 9 December 2008. Set to start at 06:00:00 logging on 10 December 2008.

Sea-Bird MicroCat temperature, conductivity recorder s/n 4998 (RS 232) at 10 m below the surface. Sample interval 600s. Clock reset to 16:18 on 9 December 2008. Set to start at 06:00:00 logging on 10 December 2008.

Mini-logger (Star ODi) s/n 2844 at 7.5 m below the surface set to record at 600s intervals. Set to start at 06:00:00 logging on 10 December 2008.

Mini-logger (Star ODi) s/n 2852 at 15 m below the surface set to record at 600s intervals. Set to start at 06:00:00 logging on 10 December 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
ADCP frame (Site A)	53° 32.011´	3° 21.446´	21.6	16:10	10/12/08
SmartBuoy (Site A)	53° 32.216´	3° 21.423´	26.9	08:46	11/12/08
ADCP frame (Site B)	53° 26.994´	3° 38.642´	24.1	13:32	11/12/08
SmartBuoy (Site B)	53° 27.014´	3° 38.777´	24.0	13:57	11/12/08
WaveBuoy (Hilbre Channel)	53° 23.585´	3° 14.224´	10.0	10:12	10/12/08

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. 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, ammonia oxidation/nitrification rate assessment, surface pH (DEFRA) and for CEFAS calibration. A LISST-100X particle sizer with internal logging was attached to the CTD frame. 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	POL Ss	Grab No.	pH
1	53° 32´	3° 21.8´	yes	yes+bottom	yes	yes	3	yes
2	53° 37´	3° 13.4´	yes		yes	yes	4	
3	53° 42´	3° 13.4´						
4	53° 47´	3° 13.4´						
5	53° 52´	3° 21.8´						
6	53° 47´	3° 21.8´						
7	53° 42´	3° 21.8´	yes		yes	yes	5	yes
8	53° 37´	3° 21.8´	yes		yes	yes	6	
9	53° 32´	3° 21.8´						
10	53° 27´	3° 13.4´	yes		yes	yes	2	yes
11	53° 27´	3° 21.8´	yes		yes	yes	1	
12	53° 27´	3° 30.2´	yes		yes	yes	23	yes
13	53° 32´	3° 30.2´	yes		yes	yes	20	yes
14	53° 37´	3° 30.2´	yes		yes	yes	7	
15	53° 42´	3° 30.2´						
16	53° 47´	3° 30.2´						
17	53° 47´	3° 47.0´	yes		yes	yes	10	yes
18	53° 42´	3° 38.6´	yes		yes	yes	9	
19	53° 37´	3° 38.6´	yes		yes	yes	8	yes
20	53° 32´	3° 38.6´	yes		yes	yes	19	yes
21	53° 27´	3° 38.6´	yes	yes	yes	yes	21	yes
22	53° 23´	3° 38.6´	yes		yes	yes	22	yes
23	53° 23´	3° 47.0´						
24	53° 27´	3° 47.0´						
25	53° 32´	3° 47.0´	yes		yes	yes	18	yes
26	53° 37´	3° 47.0´	yes		yes	yes	15	
27	53° 42´	3° 47.0´	yes		yes	yes	14	
28	53° 47´	3° 47.0´	yes		yes	yes	11	

29	53º 47´	3º 55.4´	yes	yes	yes	12	
30	53º 42	3º 55.4´	yes	yes	yes	13	
31	53º 37´	3º 55.4´	yes	yes	yes	16	yes
32	53º 32´	3º 55.4´	yes	yes	yes	17	yes
33	53º 27´	3º 55.4´					
34	53º 22´	3º 55.4´					
35	53º 32´	3º 15.9´	yes	yes	yes		yes

Surface water samples were obtained for Elena Stoica at sites 1 (CTD No.4), 21(CTD No.24) and 29 (CTD No.13).

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$_2$s), 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$_{-1}$).
 ** Wind speed & direction, PAR air temperature, atmospheric pressure and solar irradiation were not working **

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 between 07:58 & 08:01 on 10 December 2008 on passing Puffin Island. The ADCP, underway and pCO_2 systems were switched off at 20:13 on 11 December 2008.

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