Prince Madog cruise 14/08
POL Coastal Observatory cruise 53
13th-16th May 2008

1. Objectives

1. To recover and deploy a CEFAS waverider buoy at the Mersey bar (53°32.05'N, 3°21.20'W).

2. 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) Undertake a 25 hour CTD survey. CTD profiles to be made every half hour with water samples collected at the near surface and near bed every hour for suspended particulate matter (SPM) concentrations and nutrient analysis.

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

3. 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.
- 1200 kHz telemetry ADCP was fitted to the frame.
- 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.

c) A telemetry toroid.

To deploy

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 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, 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.

4. 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.

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

6. 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 -20$_o$C.

7. Collect bathymetric data along the cruise track using a BGS supplied multibeam swath echosounder.

2.1 Scientific personnel

Matthew Palmer (Principal Scientist)
Chris Balfour
John Kenny
Emlyn Jones
Jeff Polton
Dave Pearce (CEFAS)
Naomi Greewood (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Claire Mahaffey (Liverpool University)
Carol Cotterill (BGS)

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.)
Hefin Griffiths (A.B.)
Mick Callaghan (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 12th May 2008, around high water between 1500 and 1600. 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.

Prince Madog left Menai Bridge at 0700 on 13th May 2008. Weather was fine with a moderate force 3 NE wind. The ship's surface monitoring and ADCP were switched on at 0749 at around Puffin Island. The multibeam echosounder was turned on at 0703. The underway pCO_2 system had suffered damage during the previous cruise, having received a damaged air inlet pipe. Following discussion between the PSO and Nick Mountford-Hardman at PML we were advised to run the pCO2 system for water measurement only. The pCO2 was indicating it was not dry and was not turned on until 1012.

The CEFAS Waverider buoy was recovered at 1116 at 53°32.069'N, 3°21.261'W. Due to excessive knotting in the recovery line possibly due to heavy mussel growth the mooring anchor was not recoverable and was cut away at 1130 53°32.058'N, 3°21.344'W. A replacement Waverider buoy was deployed at 53°32.058'N, 3°21.188'W at 1156 in 20.6m of water.

We arrived at the main mooring site, 53°32.101'N, 3°21.614'W at 1205.

- A single CTD cast was made for the purposes of calibration of the moored instrumentation to be recovered at for water samples for CEFAS.
- The acoustic release on the ADCP frame was triggered at 1223 and the frame fully recovered by 1241. The replacement ADCP frame was deployed at 1324, position 53°32.077'N, 3°21.534'W in 21.4m of water.
- The replacement CEFAS SmartBuoy was deployed at 53°32.055'N, 3°21.416'W at 1340 in 21.5m water depth. The SmartBuoy to be recovered was on board by1356.
- A single CTD cast was made for the purposes of calibration of the moored instrumentation to be recovered and for water samples for CEFAS.
- Vertical zooplankton net hauls were undertaken between 1445 and 1527.

The 25 Hour CTD survey at site A commenced at 1602 with the ship at anchor. During the survey CTD casts were made every half hour with water samples collected every hour for:

- Nutrient (Nitrate, nitrite, phosphate and silicate) concentrations of near bed and near surface water were analysed on board by Claire Mahaffey (University of Liverpool, DEOS) using the Bran & Luebbe & Quaatro nutrient analyser.
- Water samples from near bed and near surface were filtered on board. Samples were frozen for calculation of SPM concentrations at a later date.
- CEFAS personnel collected samples for nutrient (TOXN and silicate), salinity and SPM analysis for each hour and 3 Oxygen samples for calibration of CEFAS and POL optodes.

The following water samples were collected on the CTD rosette: bottles used: 2 – SPM bottom, 3 – salinity; 4 -nutrients bottom, 5 – Oxygen bottom (CEFAS); 8 - SPM top; 9 – nutrients surface, 10 & 11 – surface (Cefas). The 25 hour station finished at 1706 and was followed by a sediment grab sample (Andy Plater, UoL) and surface water samples stored for lab analysis (Elena Stoica, UoL).

The spatial survey of CTD casts and sediment grabs commenced at 1820 on the 14th May 2008 at station 10, continuing to 35, 2 to 21. Weather was continuing fine force 3-4 occasionally 5 from the east. We arrived at station 21 (site B), 53°26.910'N, 3°38.794'W at 1351 on the 15th May 2008, weather was fine and had eased to force 3 from the east.

- A single CTD cast was made for the purposes of calibration of the moored instrumentation and for water sample analysis.

• Sediment grab.
• The acoustic release on the ADCP frame was triggered at 1420 and the frame fully recovered by 1427. The replacement ADCP frame was deployed at 1447, position 53°26.990'N, 3°38.321'W in 19.4m of water.
• The replacement CEFAS SmartBuoy was deployed at 53°26.965'N, 3°38.331'W at 1501 in 19.7m water depth. The SmartBuoy to be recovered was on board by 1508.
• The telemetry buoy was recovered at 1527. It was not redeployed but returned to POL for refurbishment.
• A single CTD cast was made for the purposes of calibration of the moored instrumentation to be recovered and for water samples for CEFAS.

The remainder of the spatial survey was completed from stations 22 to 34.

The surface monitoring system, ship's ADCP and pCO_2 system were switched off at 0517 (16/05/08), by Puffin Island, and Prince Madog docked at Menai Bridge at 1720.

We were able to accomplish all of the cruise objectives within the planned schedule except for 2 stations where sediment grabs were not collected for timing reasons.

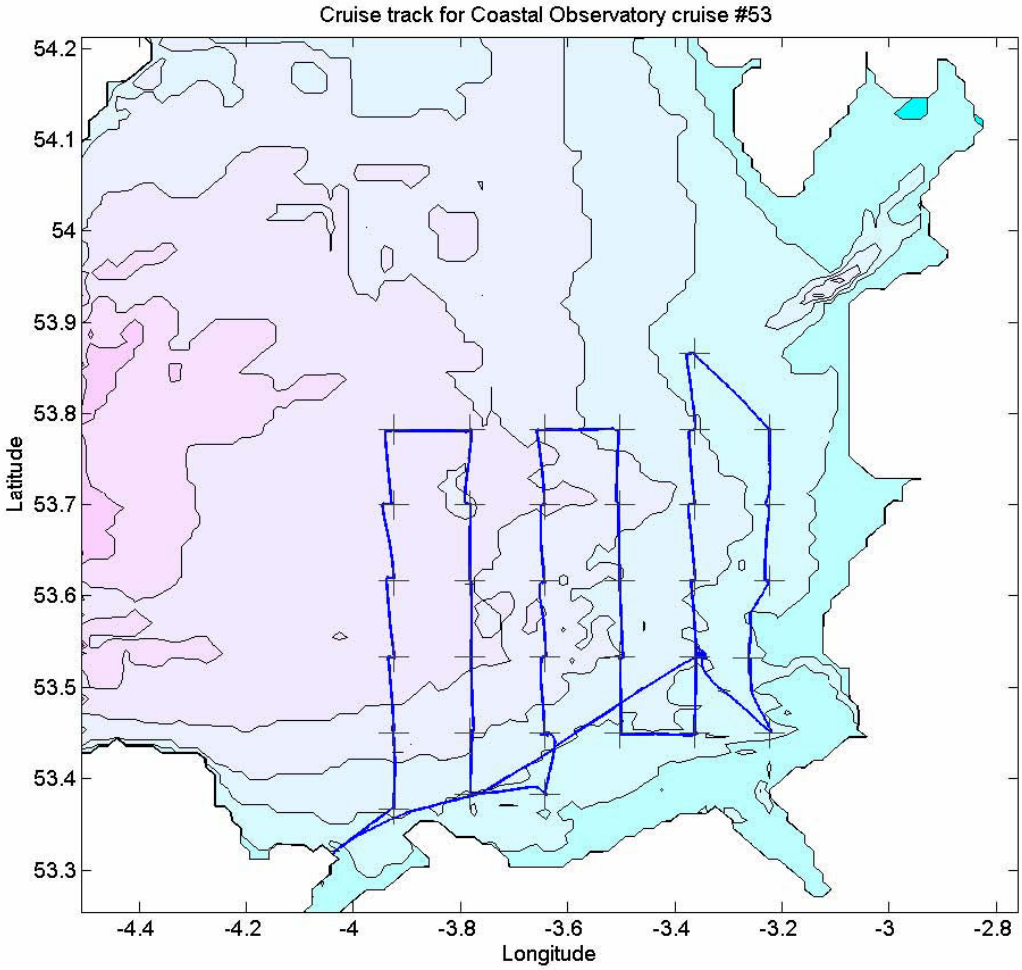

Figure 1. Cruise track.

4. Moorings (times in GMT)

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

Site A

a) 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). 1Gb memory.
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 10:17:30 on 15 April 2008; delayed start 06:00:00 on 16 April 2008.
Clock stopped at 0554 14th May 2008.
Clock drift of ~22s per day identified.

Sea-Bird 16plus S/N 4848 (RS232) on base of frame with pumped conductivity sensor underneath. Sample interval 600s. Attached Aanderaa Optode 674.
SeaPoint turbidity sensor 10489 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 09:30:40 on 15 April 2008; delayed start at 06:00:00 on 16 April 2008.
Stopped at 0559 14th May 2008.
**NB: clock set to BST, should be noted for processing.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G479; head A984.
Distance from center of three prong head on ADV transmitter to deck was 1.23m (i.e. above sea bed).
Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Clock set at 11:37:00 on 15 April 2008; delayed start 06:00:00 on 16 April 2008.
Stopped at 2129 13th May 2008.

The frame was fitted with two Benthos releases s/n 71904 – Rx 10.0 kHz, Tx 12.0 kHz, release C and s/n 70358 – Rx 11.0 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, conductivity and pressure recorder s/n 2010 at 5m below the surface.
Sample interval 600s.
Clock set at 11:04:00 on 15 April 2008. Delayed start 06:00:00 on 16 April 2008.
Stopped on 15th May 2008.

Sea-Bird MicroCat temperature and conductivity recorder s/n 2506 at 10m below the surface.
Sample interval 600s.
Clock set time not noted. Delayed start 06:00 16 April 2008.
Stopped on 15th May 2008.

Mini-logger s/n 6020 at 7.5 m below the surface set to record at 600s intervals. Clock set at 11:57:40 on 15 April 2008. Delayed start at 06:00:00 on 16 April 2008.
Stopped at 1112 15th May 2008.

Mini-logger s/n 0142 at 15 m below the surface set to record at 600s intervals. Clock set at 11:55:11 on 15 April 2008. Delayed start at 06:00:00 16 April 2008.
Stopped at 1117 15th May 2008.

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), 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.

Site B

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). 1 Gb memory.
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 10:08:00 on 15 April 2008; delayed start 06:00:00 on 16 April 2008.
Recovered successfully, clock drift ~22s/d identified.

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 10:21:00 on 15 April 2008; delayed start 15:50:00 on 15 April 2008.
LinkQuest acoustic modem set for transmission of ADCP data every hour.
Recovered successfully.

Sea-Bird 16plus S/N 4596 (RS485) on base of frame with pumped conductivity sensor underneath.Sample interval 600s. SeaPoint turbidity sensor 10538 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 11:50:00 on 15 April 2008; delayed start at 06:00:00 on 16 April 2008.
Recovered successfully.

The frame was fitted with two Benthos releases s/n 70356 – Rx 10.5 kHz, Tx 12.0 kHz, release D and s/n 67679 – 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.
Recovered successfully.

b) SmartBuoy mooring.
Sea-Bird MicroCat temperature, conductivity recorder s/n 2991 at 5 m below the surface. Sample interval 600s.
Clock set at 12:03:00 on 15 April 2008. Delayed start 06:00:00 on 16 April 2008.
Recovered successfully.

Sea-Bird MicroCat temperature, conductivity recorder s/n 4966 at 10 m below the surface. Sample interval 600s.
Clock set at 10:39:00 on 15 April 2008. Delayed start 06:00:00 on 16 April 2008.
Recovered successfully.

Mini-logger s/n 6024 at 7.5 m below the surface set to record at 600s intervals. Clock set at 11:53:10

on 15 April 2008. Delayed start at 06:00:00 on 16 April 2008.
Recovered successfully.

Mini-logger s/n 6028 at 15 m below the surface set to record at 600s intervals. . Clock set at 12:00:00 on 15 April 2008. Delayed start at 06:00:00 on 16 April 2008.
Recovered successfully.

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.

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
Waverider Buoy (Site A)	53º 32.069′	3º 21.261	20.6	1116	13/5/08
ADCP (Site A)	53º 32.153′	3º 21.361	21.0	1241	13/5/08
SmartBuoy (Site A)	53º 32.013′	3º 21.654′	21.6	1356	13/5/08
ADCP (Site B)	53º 26.990′	3º 38.476′	20.1	1427	15/5/08
Smart Buoy (Site B)	53º 26.772′	3º 38.215′	19.5	1514	15/5/08
Telemetry toroid (Site B)	53º 27.077′	3º 38.407′	19.9	1526	15/5/08

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

Site A
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 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.

Sea-Bird 16plus S/N 5310 on base of frame with pumped conductivity sensor underneath.
Sample interval 600s.
Clock set at 17:25 on 12th May 2008; delayed start at 06:00 on 13th May 2008.

SeaPoint turbidity sensor 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 set at 17:25 on 12th May 2008; delayed start at 06:00 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 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) SmartBuoy mooring.
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	1159 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
ADCP (Site B)	53º 26.990′	3º 38.476′	20.1	1447 15/5/08
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 LISST-100C particle sizer with internal logging was 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: CTD and sample information
* Positions stated are nominal station coordinates, SPM = suspended particulate matter, S/B = surface/bottom, UoL = University of Liverpool

CTD	Number	Station	Time	Latitude (N)	Longitude (W)	Water depth (m)	SPM bottle number S/B	Cefas bottle no. S/B UoL	Nutrients bottle no. S/B
	001	1	13/5/8 1209	53º32	3º21.8	21.0	none	10&11/5	None
	002	1	13/5/8 1413	53º32	3º21.8	21.6	8/2	10/no	9/4
	003	1	13/5/8 1602	53º32	3º21.8	22.9	8/2	10/no	9/4
	004	1	13/5/8 1631	53º32	3º21.8	23.4	--	--	--
	005	1	13/5/8 1703	53º32	3º21.8	23.9	8/2	10/no	9/4
	006	1	13/5/8 1731	53º32	3º21.8	24.2	--	--	--
	007	1	13/5/8 1805	53º32	3º21.8	24.2	8/2	10/no	9/4
	008	1	13/5/8 1832	53º32	3º21.8	24.1	--	--	--
	009	1	13/5/8 1902	53º32	3º21.8	24.0	8/2	10&11/no	9/4
	010	1	13/5/8 1930	53º32	3º21.8	23.8	--	--	--
	011	1	13/5/8 2004	53º32	3º21.8	23.2	8/2	10/no	9/4
	012	1	13/5/8 2032	53º32	3º21.8	22.7	--	--	--
	013	1	13/5/8 2102	53º32	3º21.8	22.1	8/2	10/no	9/4
	014	1	13/5/8 2133	53º32	3º21.8	21.7	--	--	--
	015	1	13/5/8	53º32	3º21.8	21.4	8/2	10/no	9/4

			2201						
	016	1	13/5/8 2230	53º32	3º21.8	20.9	--	--	--
	017	1	13/5/8 2259	53º32	3º21.8	20.6	8/2	10/no	9/4
	018	1	13/5/8 2330	53º32	3º21.8	20.2	--	--	--
	019	1	14/5/8 0000	53º32	3º21.8	20.0	8/2	10/no	9/4
	020	1	14/5/8 0029	53º32	3º21.8	20.0	--	--	--
	021	1	14/5/8 0100	53º32	3º21.8	20.0	8/2	10/no	9/4
	022	1	14/5/8 0131	53º32	3º21.8	20.1	--	--	--
	023	1	14/5/8 0200	53º32	3º21.8	20.7	8/2	10/no	9/4
CTD	Number	Station	Time	Latitude (N)	Longitude (W)	Water depth (m)	SPM bottle number S/B	Cefas bottle no. S/B UoL	Nutrients bottle no. S/B
	024	1	14/5/8 0230	53º32	3º21.8	21.0	--	--	--
	025	1	14/5/8 0300	53º32	3º21.8	21.7	8/2	10&11/no	9/4
	026	1	14/5/8 0330	53º32	3º21.8	22.3	--	--	--
	027	1	14/5/8 0400	53º32	3º21.8	22.7	8/2	10/no	9/4
	028	1	14/5/8 0429	53º32	3º21.8	23.4	--	--	--
	029	1	14/5/8 0501	53º32	3º21.8	24.0	8/2	10/no	9/4
	030	1	14/5/8 0547	53º32	3º21.8	24.4	--	--	--
	031	1	14/5/	53º32	3º21.8	24.4	8/2	10/no	9/4

			8 0602						
	032	1	14/5/8 0628	53º32	3º21.8	24.4	--	--	--
	033	1	14/5/8 0704	53º32	3º21.8	24.3	8/2	10/no	9/4
	034	1	14/5/8 0729	53º32	3º21.8	24.2	--	--	--
	035	1	14/5/8 0800	53º32	3º21.8	22.7	8/2	10/no	9/4
	036	1	14/5/8 0830	53º32	3º21.8	23.4	--	--	--
	037	1	14/5/8 0901	53º32	3º21.8	22.8	8/2	10/no	9/4
	038	1	14/5/8 0934	53º32	3º21.8	22.1	--	--	--
	039	1	14/5/8 1001	53º32	3º21.8	21.7	8/2	10/no	9/4
	040	1	14/5/8 1028	53º32	3º21.8	21.2	--	--	--
	041	1	14/5/8 1059	53º32	3º21.8	20.7	8/2	10/no	9/4
	042	1	14/5/8 1130	53º32	3º21.8	20.0	--	--	--
	043	1	14/5/8 1200	53º32	3º21.8	19.8	8/2	10/no	9/4
	044	1	14/5/8 1230	53º32	3º21.8	19.4	--	--	--
	045	1	14/5/8 1300	53º32	3º21.8	19.3	8/2	10/no	9/4
	046	1	14/5/8 1330	53º32	3º21.8	19.2	--	--	--
	047	1	14/5/8 1400	53º32	3º21.8	19.4	8/2	10/no	9/4
	048	1	14/5/8	53º32	3º21.8	19.2	--	--	--

			1430						
	049	1	14/5/8 1500	53º32	3º21.8	20.2	8/2	10/no	9/4
	050	1	14/5/8 1530	53º32	3º21.8	20.9	--	--	--
CTD	Number	Station	Time	Latitude (N)	Longitude (W)	Water depth (m)	SPM bottle number S/B	Cefas bottle no. S/B UoL	Nutrients bottle no. S/B
	051	1	14/5/8 1600	53º32	3º21.8	21.6	8/2	10&11/ no	9/4
	052	1	14/5/8 1630	53º32	3º21.8	22.0	--	--	--
	053	1	14/5/8 1506	53º32	3º21.8	22.9	8/2	10/no	9/4
		End of 25hr station							
	054	10	14/5/8 1820	53º27	3º13.4	18.3	8/2	--	9/4
	055	35	14/5/8 1916	53º32	3º15.9	15.3	8/2	--	9/4
	056	2	14/5/8 2010	53º37	3º13.4	15.9	8/2	--	9/4
	057	3	14/5/8 2103	53º42	3º13.4	19.6	8/2	--	9/4
	058	4	14/5/8 2158	53º47	3º13.4	17.9	8/2	--	9/4
	059	5	14/5/8 2306	53º52	3º21.8	15.9	8/2	--	9/4
	060	6	15/5/8 0004	53º47	3º21.8	19.0	8/2	--	9/4
	061	7	15/5/8 0104	53º42	3º21.8	22.7	8/2	--	9/4
	062	8	15/5/8	53º37	3º21.8	22.1	8/2	--	9/4

			0207						
	063	9	15/5/8 0310	53º32	3º21.8	21.9	8/2	--	9/4
	064	11	15/5/8 0413	53º27	3º21.8	17.9	8/2	--	9/4
	065	12	15/5/8 0521	53º27	3º30.2	19.4	8/2	--	9/4
	066	13	15/5/8 0619	53º32	3º30.2	33.8	8/2	--	9/4
	067	14	15/5/8 0716	53º37	3º30.2	34.7	8/2	--	9/4
	068	15	15/5/8 0812	53º42	3º30.2	40.5	8/2	--	9/4
	069	16	15/5/8 0910	53º47	3º30.2	28.0	8/2	--	9/4
	070	17	15/5/8 1004	53º47	3º38.6	37.4	8/2	--	9/4
	071	18	15/5/8 1157	53º42	3º38.6	39.2	8/2	--	9/4
	072	19	15/5/8 1157	53º37	3º38.6	30.7	8/2	--	9/4
	073	20	15/5/8 1257	53º32	3º38.6	33.0	8/2	--	9/4
	074	21	15/5/8 1351	53º27	3º38.6	22.8	8/2	--	9/4
	075	21	15/5/8 1548	53º27	3º38.6	22.9	--	10/-	--
	076	22	15/5/8 1632	53º23	3º38.6	13.9	8/2	--	9/4
CTD	Number	Station	Time	Latitude (N)	Longitude (W)	Water depth (m)	SPM bottle number S/B	Cefas bottle no. S/B UoL	Nutrients bottle no. S/B
	077	23	15/5/8 1737	53º23	3º47.0	16.0	8/2	--	9/4
	078	24	15/5/	53º27	3º47.0	34.3	8/2	--	9/4

			8 1823						
	079	25	15/5/8 1916	53º32	3º47.0	47.1	8/2	--	9/4
	080	26	15/5/8 2016	53º37	3º47.0	43.4	8/2	--	9/4
	081	27	15/5/8 2115	53º42	3º47.0	43.2	8/2	--	9/4
	082	28	15/5/8 2211	53º47	3º47.0	43.1	8/2	--	9/4
	083	29	15/5/8 2305	53º47	3º55.4	43.8	8/2	--	9/4
	084	30	16/5/8 0007	53º42	3º55.4	42.4	8/2	--	9/4
	085	31	16/5/8 0109	53º37	3º55.4	45.0	8/2	--	9/4
	086	32	16/5/8 0212	53º32	3º55.4	44.1	8/2	--	9/4
	087	33	16/5/8 0318	53º27	3º55.4	36.6	8/2	--	9/4
	088	34	16/5/8 0420	53º22	3º55.4	22.7	8/2	--	9/4

Bed sediment grab sample?
No
No
No
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No
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No
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No
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No
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No
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No
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No
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No
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No
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No
Bed sediment grab sample?
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No
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No
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No
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No
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Bed sediment grab sample?
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Bed sediment grab sample?
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Table 3: CTD and sample information
* Positions stated are nominal station coordinates, SPM = suspended particulate matter, S/B = surface/bottom, UoL = University of Liverpool

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, pCO2 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.

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