RV Prince Madog 21/10 cruise report
NOC Coastal Observatory cruise 70
7 – 8 July 2010

1. Cruise objectives

1.1 At site A, 53° 32′ N, 3° 21.8′ W (CTD station 1)

To recover:

a) A sea bed frame containing a 600 kHz RDI ADCP (waves ADCP), SeaBird SBE 16*plus*, digiquartz pressure sensor, SeaPoint turbidity sensor with wiper; a SeaBird SBE 16*plus* with an Aanderra oxygen Optode and a FSI conductivity, temperature logger.
b) CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m and 15 m below the surface. Also attached was a Contros pCO_2 instrument.

To deploy:

a) A sea bed frame containing a 600 kHz RDI ADCP (measuring mean current profile, pressures and directional waves), SeaBird SBE 16*plus* (with pumped conductivity sensor), digiquartz pressure sensor, a SeaPoint turbidity sensor with wiper and SeaBird SBE 16*plus* (with an Aanderra oxygen Optode).
b) CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m and 15 m below the surface. Plus a new WetLabs ACS unit and frame at 5m.

To collect ten vertical zooplankton hauls for CEFAS.

1.2 At 'new' site B, 53° 32.3′ N, 3° 38.4′ W (CTD station 20)

To recover:

a) A sea bed frame containing a 600 kHz RDI ADCP, a SeaBird SBE 16*plus*, digiquartz pressure sensor and a SeaPoint turbidity sensor fitted with a wiper.
b) A CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m and 15 m below the surface.

To deploy:

a) A sea bed frame for a 600 kHz RDI ADCP measuring mean current profile, pressures and directional waves; a SeaBird SBE 16*plus* (with pumped conductivity sensor), digiquartz pressure sensor and a SeaPoint turbidity sensor (fitted with a wiper).
b) A CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m, 15 m and 20 m below the surface.

1.3 CTD and LISST survey

To conduct a CTD survey including LISST measurements at 34 sites every five nautical miles covering the eastern Irish Sea to determine the effects of the rivers Dee, Mersey and Ribble on Liverpool Bay. The survey covers the area from the coast of North Wales to a line extending westwards from Blackpool, and from the Lancashire coast to a line extending northwards from Great Ormes Head.

To obtain calibration samples for salinity, transmittance and suspended sediment at selected stations. To obtain near surface and bed water samples for nutrient (nitrate, phosphate, silicate) and suspended sediment determination. To obtain surface samples for a Defra pH/Alkalinity study by David Hydes (NOC, at Southampton). NOC Liverpool has supplied filtering equipment and filters for determining concentrations of suspended sediment and chlorophyll-*a*. CDOM samples will be obtained at some sites.

1.4 Other activities

Sea bed sediment samples

Collect sediment samples at each CTD site with a Day grab for Andy Plater (University of Liverpool) and Ken Pye (Royal Holloway College). Ken Pye's samples were taken at sites which were missed on the previous cruise.

pCO_2

A pCO_2 instrument was installed prior to the survey.

Trace metal analysis

Collect samples for trace metal analysis, for insitu analysis and lab analysis.

2. Cruise participants

Scientific personnel

Phil Knight (Principal, NOC)
Chris Balfour (NOC)
Terry Doyle (NOC)
Ray Edun (NOC)
Andy Lane (NOC)
Anne Forbes-Brook (Bangor University)
Elke Neubacher (CEFAS)
Dave Sivyer (CEFAS)
Pascal Salaun (University of Liverpool)
Kris Gibbon-Walsh (University of Liverpool)

Ship's officers and crew

Steve Duckworth (Master)
David Shaw (Chief Officer)
Les Black (Chief Engineer)
Meikle MacKay (2nd Engineer)
David Leigh (AB)
Gary Barnes (AB)
Phil Jones (AB)
Colin Hughes (Cook)

3. Cruise narrative (all times in GMT)

Loading RV Prince Madog at Vittoria Wharf, Birkenhead took place during the evening of Tuesday 6 July 2010. In parallel a pCO_2 system was fitted to run alongside the underway sampling.

Prince Madog left Vittoria Wharf at 05:00 GMT on 7 July 2010, however another ship in the lock delayed the exit into the river until 06:10. The ship's ADCP and Enviro systems were switched on at 06:28 and pCO_2 at 06:56. The first CTD was recorded on arrival at site A at 07:49 close to high water. The ADCP was recovered, by 08:09. The burn wire cables were removed from the frame, refurbished and fitted to the new frame, which was deployed at 09:02. (Subsequently the Benthos acoustic releases were removed from the frame and fitted to the Site B frame.)

The Smart Buoy was deployed at 09:40 and the old buoy recovered between 09:54 and 10:01. A Cefas Contros pCO_2 sensor was taken off the SmartBuoy and left running in a tank of water fed from the underway system. The standard pCO_2 sensor was running in parallel. A second CTD at site A was a carried out at 10:13, with a full suite of water samples. The vertical net hauls commenced at 10:33 and finished at 11:30.

The CTD survey was started beginning at site 22 to gain shelter from increasing SW winds. This was followed by sites 23, 34, 33, 24, 21, 12, 11, 10, 35, 9, 13, 20, 25, 32, 31, 26, 19, 14, 8 and 2. Site B was reached at 06:05 on 8 July 2010 and another CTD carried out. The ADCP was recovered, by 06:37. As with the first ADCP frame, the burn wire cables were removed, refurbished and fitted to the new frame, which was deployed at 07:36. The SmartBuoy was deployed at 07:59 and the old buoy recovered between 08:08 and 08:15. A post recovery CTD was then carried out.

The CTD survey resumed. Sites 30, 27, 18, 15, 7, 3, 4, 6, 16 and 17 were visited. The CTD survey finished at 16:50 and the RV Prince Madog headed back for a 21:00 lock. The pCO_2 system was switched off at 19:18, and flow though systems and ship's ADCP at 20:04. Two additional CTD's were carried out within the Mersey shipping channel for trace metal analysis (No LISST, only bottle 8). RV Prince Madog docked in Birkenhead at 21:10. All heavy equipment was unloaded onto the dock by 21:40. RV Prince Madog left Vittoria dock and headed for Menai Bridge at 06:00 on 9 July 2010.

The cruise was successful. All the mooring work was accomplished at sites A and B. CTD profiles and water samples were recorded at 31 sites (out of a possible 34 – sites 28, 29 and 5 were not visited). Two extra CTD's were carried out for trace metal analysis in the river channel. 6790 litres of oil were used during this survey.

*** Track will be added if it becomes available before cruise report release. ***

Figure 1: Cruise track

4. Moorings

4.1 Recovered instrumentation

Site A: Bedframe

Waves ADCP 600 kHz RDI S/N 2390 firmware v50.36
Mode 1: 100 pings every 10 minutes 35 × 1 m bins (2.65–36.65 m above the bed)
Beam coordinates – speeds, correlation, echo intensity, % good
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 08:07:30 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010
Stopped logging 06:52:00 on 9 July 2010.
File sizes RDI000=808 bytes; RDI001 = 142212070
Clock drift = + 1 minute and 4 seconds over the deployment.

SeaBird SBE 16plus S/N 4736 (RS232)
Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10320) taped to roll bar setup for 0–125 FTU range and fitted with wiper.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay.
Clock set at 08:36:30 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010
Stopped logging at 09:43:10 on 9 July 2010.
File size = 4343 samples
Clock drift = + 6 seconds over the deployment.

Aanderaa Optode (S/N 674) on SeaBird SBE 16plus S/N 4490 (RS232)
Mounted horizontally with a not pumped conductivity sensor. Sample interval 600 s.
Clock set at 08:59:30 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010
Stopped logging at 09:52:00 on 9 July 2010.
File size = 4343 samples
Clock drift = +6 seconds over the deployment.

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases: S/N 70536 (Rx=10.5 kHz, Tx=12.0 kHz, RC=D) and S/N 71922 (Rx=11.5 kHz, Tx=12.0 kHz, RC=A)

Site A: SmartBuoy mooring

SeaBird MicroCat temperature and conductivity recorder S/N 4966
Mounted at 5 m below the surface.
Clock set at 09:30:00 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010.
Stopped logging at 10:40:00 on 9 July 2010
File size 4348 samples
Clock drift = + 6 seconds over the deployment

SeaBird MicroCat temperature and conductivity recorder S/N 4998
Mounted at 10 m below the surface.
Clock set at 09:41:30 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010
Stopped logging at 10:33:40 on 9 July 2010
File size = 4348 samples
Clock drift = + 4 seconds over the deployment

Mini-logger (StarOddi) S/N 2841
Mounted at 7.5 m below the surface. Set to record at 600s intervals.
Delayed start at 06:00:00 on 09/06/2010.

Stopped logging at 11:08:45 on 9 July 2010
File size = 4352 samples
Clock drift = -15 seconds over the deployment

Mini-logger (StarOddi) S/N 2842
Mounted at 15 m below the surface. Set to record at 600s intervals.
Delayed start at 06:00:00 on 09/06/2010.
Stopped logging at 11:19:40 on 9 July 2010
File size = 4352 samples
Clock drift = 0 seconds over the deployment

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter at 1 m below surface, light sensors at 1 m and 2 m below the surface, a fluorometer (SeaPoint), oxygen sensor (Aanderaa Optode), an in-situ NAS2E nutrient analyzer and a water sampler which obtains samples every fourth day for laboratory analysis (ToxN and silicate) and every eighth day (phytoplankton species, composition and abundance). The conductivity, temperature, optical back scatter and light data are transmitted back to CEFAS via Orbcomm satellite.

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

Site B: Bedframe

Waves ADCP 600 kHz RDI S/N 5806 firmware v50.36
Mode 1: 100 pings every 10 minutes.
45 × 1 m bins (2.65–46.65 m above the bed, WN45).
Beam coordinates – speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 08:20:00 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010.
Stopped logging at 06:58:30 on 9 July 2010
File size = 143077070 bytes.
Clock drift = + 54 seconds over the deployment.

SeaBird SBE 16plus S/N 4738 (RS485)
Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10538) taped to roll bar; setup for 0–125 FTU range and fitted with wiper.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay
Clock reset at 08:46:00 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010
Stopped logging at 09:32:40 on 9 July 2010.
File size = 4342 samples
Clock drift = +7 seconds over the deployment

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:
S/N 72381 (Rx=11.0 kHz, Tx=12.0 kHz, RC=B)
S/N 69676 (Rx=11.5 kHz, Tx=12.0 kHz, RC=C)

Site B: SmartBuoy mooring

SeaBird MicroCat temperature and conductivity recorder S/N 5434
Mounted at 5 m below the surface
Clock set at 09:35:00 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010.
Stopped logging at 09:59:40 on 9 July 2010
File size = 4344 samples
Clock drift = +5 seconds over the deployment

SeaBird MicroCat temperature and conductivity recorder S/N 5792
Mounted at 10 m below the surface
Clock set at 09:47:00 on 08/06/2010: delayed start at 06:00:00 on 09/06/2010.
Stopped logging at 10:04:10 on 9 July 2010
File size = 4345 samples
Clock drift = +36 seconds over the deployment

Mini-logger (StarOddi) S/N 2843 mounted at 7.5 m below the surface
Set to record at 600 s intervals
Delayed start at 06:00:00 on 09/06/2010
Stopped logging at 11:47:15 on 9 July 2010
File size = 4356 samples
Clock drift = 0 seconds over the deployment

Mini-logger (StarOddi) S/N 2844 mounted at 15 m below the surface
Set to record at 600 s intervals
Delayed start at 06:00:00 on 09/06/2010
Noted as **LOST**

Mini-logger (StarOddi) S/N 2849 mounted at 20 m below the surface
Set to record at 600 s intervals
Delayed start at 06:00:00 on 09/06/2010
Stopped logging at 11:51:45 on 9 July 2010
File size = 4356 samples
Clock drift = +2 seconds over the deployment

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter and a fluorometer at 1 m below surface. 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 one clump of scrap chain.

Table 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Recovered Time	Date
ADCP frame (Site A)	53º 31.987′	3º 21.517′	25.4	08:09	07/07/10
SmartBuoy (Site A)	53º 32.057′	3º 21.822′	24.9	09:54	07/07/10
ADCP frame (Site B)	53º 32.348′	3º 38.457′	36.2	06:30	08/07/10
SmartBuoy (Site B)	53º 32.431′	3º 38.326′	35.0	08:08	08/07/10

4.2 Deployed instrumentation configuration

Site A: Bedframe

Waves ADCP 600 kHz RDI S/N 12239: Memory 1.5GB
Mode 1: 100 pings every 10 minutes 35 × 1 m bins (2.65–36.65 m above the bed)
Beam coordinates – speeds, correlation, echo intensity, % good
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 10:00:00 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010

SeaBird SBE 16plus S/N 4596
Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10471) taped to roll bar setup for 0–125 FTU range and fitted with wiper.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay.
Clock set at 10:22:00 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010

SeaBird SBE 16plus S/N 4741 (RS232) with Aanderaa Optode (S/N 675)
Sample interval 600 s.
Clock set at 10:41:00 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010

FSI CTD S/N 2195
Clock set at 10:54:15 on 6/7/2010. Delayed start at 06:00:00 on 7/7/2010
Interval time = 10 seconds; Record time 40 seconds;
Sample rate = 4Hz; Average sample 40 seconds.

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:
S/N 70358 (Rx=11.0 kHz, Tx=12.0 kHz, RC=A)
S/N 72382 (Rx=10.0 kHz, Tx=12.0 kHz, RC=A)

Site A: SmartBuoy mooring

SeaBird MicroCat temperature and conductivity recorder S/N 5435
(**last digit in S/N not clear from written engineer notes**)
Mounted at 5 m below the surface.
Times not noted for the above serial number.

AC-S S/N 059 at 5m below surface – attached WetLabs fluorometer S/N 1514

SeaBird MicroCat temperature and conductivity recorder S/N 5790
Mounted at 10 m below the surface.
Clock set at 12:03:30 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010

Mini-logger (StarOddi) S/N 2836
Mounted at 7.5 m below the surface. Set to record at 600s intervals.
Delayed start at 06:00:00 on 07/07/2010.

Mini-logger (StarOddi) S/N 2838
Mounted at 15 m below the surface. Set to record at 600s intervals.

Delayed start at 06:00:00 on 07/07/2010.

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter at 1 m below surface, light sensors at 1 m and 2 m below the surface, a fluorometer (SeaPoint), oxygen sensor (Aanderaa Optode), an in-situ NAS2E nutrient analyzer and a water sampler which obtains samples every fourth day for laboratory analysis (ToxN and silicate) and every eighth day (phytoplankton species, composition and abundance). The conductivity, temperature, optical back scatter and light data are transmitted back to CEFAS via Orbcomm satellite.

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: Bedframe

Waves ADCP 600 kHz RDI S/N 5807: Memory 1GB.
Mode 1: 100 pings every 10 minutes.
45 × 1 m bins (2.65–46.65 m above the bed, WN45).
Beam coordinates – speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 10:07:00 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010.

SeaBird SBE 16plus S/N 4737 (RS485)
Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10537) taped to roll bar; setup for 0–125 FTU range and fitted with wiper.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay
Clock reset at 10:31:00 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:
S/N 70356 (Rx=10.5 kHz, Tx=12.0 kHz, RC=D)
S/N 71922 (Rx=11.5 kHz, Tx=12.0 kHz, RC=A)

Site B: SmartBuoy mooring

SeaBird MicroCat temperature and conductivity recorder S/N 2506
Mounted at 5 m below the surface
Clock set at 11:56:30 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010.

SeaBird MicroCat temperature and conductivity recorder S/N 5791
Mounted at 10 m below the surface
Clock set at 12:08:00 on 06/07/2010: delayed start at 06:00:00 on 07/07/2010.

Mini-logger (StarOddi) S/N 2840 mounted at 7.5 m below the surface
Set to record at 600 s intervals
Delayed start at 06:00:00 on 07/07/2010

Mini-logger (StarOddi) S/N 2848 mounted at 15 m below the surface
Set to record at 600 s intervals
Delayed start at 06:00:00 on 07/07/2010

Mini-logger (StarOddi) S/N 2851 mounted at 20 m below the surface
Set to record at 600 s intervals
Delayed start at 06:00:00 on 07/07/2010

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter and a fluorometer at 1 m below surface. 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)	53º 31.980´	3º 21.548´	24.3	09:02	07/07/10
SmartBuoy (Site A)	53º 32.112.´	3º 21.688´	23.5	09:40	07/07/10
ADCP frame (Site B)	53º 32.374´	3º 38.445´	39.0	07:36	08/07/10
SmartBuoy (Site B)	53º 32.271´	3º 38.205´	38.1	08:00	08/07/10

5. CTD

The SeaBird 911 CTD recorded downwelling PAR light levels, temperature, conductivity, oxygen concentration, transmittance and fluorescence at 24 Hz. The frame was fitted with an altimeter. The CTD temperature data was checked against a SeaBird SBE35 precision thermometer. Water samples were taken from a near-bed (3 m above bed) bottle for calibration of the CTD salinity data by Anne Forbes-Brook (Bangor University). Water samples were taken from the near surface (1 m) and near bed (3 m above bed) bottles and filtered to determine suspended sediment load and chlorophyll-a concentrations, nutrient concentration, ammonia oxidation/nitrification rate assessment, surface alkalinity (Defra) and for CEFAS calibration. A LISST-100X particle sizer with internal logging is normally attached to the CTD frame. Copies of the SeaBird binary files were taken off for processing and calibration at BODC / NOC. A Satlantic SUNA nitrate analyzer was fitted to the CTD underneath the frame and its data logged by the SeaBird data logging system. This replaced the LISST 25 because there were no spare channels.

The bottle positions on the rosette were

Near bed:
- Bottle 3 – SPM;
- Bottle 4 – nutrients,
- Bottle 5 – Cefas

Near surface:
- Bottle 8 – Trace metals (at approx 7m from surface);
- Bottle 9 – SPM;
- Bottle 10 – nutrients and pH;

Bottle 11,12 – Cefas.

Table 3. Nominal CTD positions, stations visited and samples taken

Station	Latitude (N)	Longitude (W)	Trace Metals	Sediments & Chl-a	Nutrients top+bot	Grab no.	CEFAS calibration	pH
1(A)&9	53° 32.0′	3° 21.8′	yes	yes	yes		yes	yes
2	53° 37.0′	3° 13.4′		yes	yes	21		yes
3	53° 42.0′	3° 13.4′	yes	yes	yes	27		yes
4	53° 47.0′	3° 13.4′		yes	yes	28		yes
5	53° 52.0′	3° 21.8′	not	visited				
6	53° 47.0′	3° 21.8′		yes	yes	29		yes
7	53° 42.0′	3° 21.8′	yes	yes	yes	26	yes	yes
8	53° 37.0′	3° 21.8′		yes	yes	20		yes
10	53° 27.0′	3° 13.4′	yes	yes	yes	9	yes	yes
11	53° 27.0′	3° 21.8′	yes	yes	yes	8		yes
12	53° 27.0′	3° 30.2′	yes	yes	yes	7	yes	yes
13	53° 32.0′	3° 30.2′		yes	yes	12		yes
14	53° 37.0′	3° 30.2′		yes	yes	19		yes
15	53° 42.0′	3° 30.2′	yes	yes	yes	25		yes
16	53° 47.0′	3° 30.2′	yes	yes	yes			yes
17	53° 47.0′	3° 38.6′	yes	yes	yes		yes	yes
18	53° 42.0′	3° 38.6′	yes	yes	yes	24		yes
19	53° 37.0′	3° 38.6′	yes	yes	yes	18		Yes
20(B)*	53° 32.3′	3° 38.4′	yes	yes	yes	13	yes	yes
21*	53° 27.0′	3° 38.6′	yes	yes	yes	6		Yes
22	53° 23.7′	3° 38.6′	yes	yes	yes	1	yes	Yes
23	53° 23.0′	3° 47.0′		yes	yes	2		Yes
24	53° 27.0′	3° 47.0′	yes	yes	yes	5		Yes
25	53° 32.0′	3° 47.0′		yes	yes	14		yes
26	53° 37.0′	3° 47.0′	yes	yes	yes	17		Yes
27	53° 42.0′	3° 47.0′	yes	yes	yes	23		yes
28	53° 47.0′	3° 47.0′	not	visited				
29	53° 47.0′	3° 55.4′	not	visited				
30	53° 42.0′	3° 55.4′	yes	yes	yes	22	yes	yes
31	53° 37.0′	3° 55.4′	yes	yes	yes	16		Yes
32	53° 32.0′	3° 55.4′	yes	yes	yes	15		yes
33	53° 27.0′	3° 55.4′	yes	yes	yes	4		Yes
34	53° 22.0′	3° 55.4′	yes	yes	yes	3	yes	Yes
35	53° 32.0′	3° 15.9′	yes	yes	yes	10		yes
Copper1[x]	53° 30.7′	3° 06.6′	yes					
Copper2[x]	53° 26.0′	3° 01.4′	yes					

*Before cruise 66 (26/01/2010), Stn 21 was referred to as Site B and Stn 20 was at 53° 32.0′ N 3° 38.6′ W

[X] Only bottle 8 was used, The LISST was not switched on

6. Surface sampling

The intake of the surface sampling system is located about 3 m below the water line of RV Prince Madog. The parameters recorded every minute by the WS Oceans system are: date, transmittance, hull temperature (°C), barometric pressure (mbar), fluorescence, oxygen concentration, turbidity, salinity and conductivity sensor water temperature (°C). A met package measures and records barometric pressure (mbar), solar radiation (W m^{-2}), PAR (photosynthetically active radiation, µmol m^{-2} s^{-1}), air temperature (°C), relative humidity, relative wind speed (m s^{-1}), relative wind direction (°) with zero indicating wind on the bow, minimum air temperature (°C), maximum air temperature (°C) and wind gust (m s^{-1}).

The ship was fitted with a 300 kHz ADCP set to record current velocity 25 × 2 m bins (bin nearest the surface at 5.1 m depth), every 30 s with 29 pings per ensemble.

The pCO_2 instrument was refitted.

Underway data and ship's ADCP data were recorded every minute between 06:28 on 07/07/2010 and 20:04 on 8/07/2010, as Prince Madog passed the Seaforth radar tower.

Acknowledgements

The assistance of the master, officers and crew of the RV Prince Madog and all scientists is appreciated in ensuring the success of this cruise.