

**RV Prince Madog 02/10 Cruise report
POL Coastal Observatory cruise #66
26th – 28th January 2010.**

1. Cruise objectives

1. **At site A 53° 32'N, 3° 21.8'W (CTD station 1)**

To recover:

- a) A sea bed frame containing a 600kHz RDI ADCP (waves ADCP), Sea-Bird SBE 16+, digiquartz pressure sensor, SeaPoint turbidity sensor with wiper, and a Sea-Bird 16*plus* with an Aanderra oxygen optode.
- b) CEFAS SmartBuoy 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:

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

2. **At site B 53° 27'N, 3° 38.6'W (CTD station 21)**

To recover

- a) A sea bed frame containing a 600 kHz RDI ADCP, a Sea-Bird SBE 16+, digiquartz pressure sensor and a SeaPoint turbidity sensor fitted with a wiper.
- b) A CEFAS SmartBuoy in a single point mooring inc. AIS (automatic Identification System). 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 relocate site B to a new permanent position: 53° 32.3' N, 3° 38.4' W (revised station 20).**

To deploy

- a) A sea bed frame for a 600 kHz RDI ADCP measuring mean current profile, pressures and directional waves. A Sea-Bird SBE 16+ (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 inc. a new water sampler for trials. Attached to the mooring wire are Sea-Bird MicroCat temperature, conductivity loggers at 5m and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.

4. **CTD and LISST survey**

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 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 study by David Hydes (NOCS).

5. Sediment samples

- a) Collect sediment samples at each CTD site with a Day grab for Andy Plater (University of Liverpool).
- b) Collect sediment samples (to be sieved) for a benthic survey at sites 1 and 32 for Lucy Abram (University of Liverpool).

6. 25 hour CTD survey at PHiXT coastal station (53° 30.6' N, 3° 23'W, 19m).

- a) The final PHiXT survey (see May, July and August cruise reports). Two tidal cycle survey of hourly CTD casts collecting discrete water samples at a variety of depths for analysis of nutrients, primary production and chlorophyll concentration.
- b) Collect 10 vertical zooplankton hauls for CEFAS during the 25hr station.

2. Cruise personnel

<u>Science crew</u>	<u>Ship's officers and crew</u>
Matthew Palmer (Principal)	Capt. Steve Duckworth
Emlyn Jones	Les Black (Chief)
Terry Doyle	David Shaw
Emmer Litt (PML)	Phil Jones
Anouska Bailey (UoLiverpool)	Meikle Mackay
Lucy Abram (UoLiverpool)	Spencer Payne
Anne Hammerstein (UoBangor)	Colin Hughes
Jennie Keable (CEFAS)	
Manuel Nicolaus (CEFAS)	

3. Cruise Narrative

The ship was loaded by 2000 25th January 2010 at Vittoria Wharf, Birkenhead, Liverpool UK. The ship left Liverpool the following morning at 0630. The ship's underway and pCO₂ instrumentation was turned on at 0725 as the ship passed the Mersey radar tower. The ship's ADCP was activated at 0738. The weather was fine, with light winds forecast for 24 hours. Due to the predicted high westerly winds (force 5-6) on Wednesday 27th, it was decided to complete all mooring operations on the 26th.

All mooring operations were completed at site A by 1009 26/1/10. A single CTD cast was made prior to instrument recovery and following deployment. All moorings were deployed at the new site B by 1304 26/1/10 and a post deployment CTD cast made. All moorings were recovered at the old site B by 1438 26/1/10 following a pre-recovery CTD cast.

Due to the predicted worsening weather during Wednesday a contingency CTD survey was undertaken to provide the best spatial cover by mid-morning. The CTD survey commenced at site 3 at 1800 and continued along three east-west transects. The end of the third transect (station 32) was completed 0823. Sediment grabs were attempted at stn 32 but aborted due to poor weather but 3 vertical zooplankton trawls were successfully completed. Wind had increased force 6 west veering NW, predicted to continue until midday 28th. Station 33 CTD was aborted due to increasing seas. CTD profiles were successfully collected at coastal stations 34 and 23 however following this sea state was to rough to continue. Nutrient samples were collected at stations 22, 21, 12, 11 and 10. CEFAS collected 10 net hauls at site A. The ship headed for Birkenhead at 1640. Underway, pCO₂ and ships

ADCP were turned off at 1819 27th January at the Mersey radio tower. The ship entered Vittoria lock at 1900.

In summary;

- all mooring recoveries and deployments were successful.
- CTD profiles, water samples and sediment grab samples in approximately half of the 34 stations were collected.
- The PHIXT 25hr station was not achieved due to poor weather.
- Underway, met, pCO₂ and ships ADCP data was collected over the majority of the grid.

4. Moorings

4.1 Recovered instrumentation:

Site A: Bedframe Recovered 09:07:00 26/1/10.

Waves ADCP 600kHz RDI S/N 2390.

Firmware updated to v50.36.

Mode 1: 100 pings every 10 minutes.

35 x 1m 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 18:24:50 on 01/12/2009.

Delayed start at 06:00:00 on 02/12/2009.

Stopped logging prematurely on 20/1/10.

Clock drift of +77 seconds over deployment.

SeaBird 16*plus* S/N 4736

on base of frame with pumped conductivity sensor

inc. SeaPoint turbidity sensor (S/N 10320) taped to roll bar

0-125 FTU range and fitted with wiper. Sample interval 600s

digiquartz integration time 40s, range 400m

pump 0.5s, 1 s delay.

Clock set at 08:39:00 on 02/12/2009.

Delayed start at 10:00:00 on 02/12/2009

Stopped logging at 13:29:10 29/1/10.

Clock drift +6 seconds over deployment.

Aanderaa optode (S/N 674) mounted on SeaBird 16*plus* S/N 4490

upright on top of frame and (not pumped) conductivity sensor underneath.

Sample interval 600s.

Clock set at 09:00:15 on 02/12/2009.

Delayed start at 10:00:00 on 02/12/2009.

Stopped logging 13:24:10 29/10/10

Clock drift +8 seconds over deployment.

The frame was fitted with

a fizz link,

a spooler with 50m of rope for recovery of the ballast weight

two Benthos releases: S/N 70355 (Rx=10 kHz, Tx=12kHz, RC=B)

S/N 72378 (Rx=10.5kHz, Tx=12kHz, RC=A).

Site A: SmartBuoy Mooring recovered 10:09 26/1/10

SeaBird microcat temperature and conductivity recorder S/N 5434 at 5m below the surface.

Clock set at 18:35:50 on 01/12/2009. Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 14:04:30 29/1/10. Clock drift +6 seconds over deployment.

SeaBird microcat temperature and conductivity recorder S/N 4966 at 10m below the surface.

Clock set at 18:04:00 on 01/12/2009. Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 13:59:30 29/1/10. Clock drift +11 seconds over deployment.

Mini-logger (StarOddi) S/N 2842 at 7.5m below the surface. Set to record at 600s intervals.

Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 14:15:40 29/1/10. Clock drift +8 seconds over deployment.

Mini-logger (StarOddi) S/N 2843 at 15m below the surface. Set to record at 600s intervals.

Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 14:18:50 29/1/10. Clock drift +8 seconds over deployment.

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter at 1m below surface, light sensors at 1 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.

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 recovered 14:07 26/1/10

Waves ADCP 600kHz RDI S/N 5806.

Firmware updated to v50.36.

Mode 1: 100 pings every 10 minutes.

35 x 1m 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 reset at 19:13:40 on 01/12/2009.

Delayed start at 06:00:00 on 02/12/2009

Stopped logging 11:09:30 29/1/10.

Clock drift +12 seconds over deployment.

SeaBird 16*plus* S/N 4738.

Mounted horizontally on base of frame with pumped conductivity sensor

Inc. SeaPoint turbidity sensor (S/N 10538) taped to roll bar, setup for 0-125 FTU range and fitted with wiper.

Sample interval 600s

digiquartz integration time 40s, range 400m

pump 0.5s, 1 s delay.

Clock reset at 08:48:30 on 02/12/2009.

Delayed start at 10:00:00 on 02/12/2009

Stopped logging 13:32:20 29/1/10.

Clock drift +7 seconds over deployment.

The frame was fitted with

a fizz link,

a spooler with 50m of rope for recovery of the ballast weight

two Benthos releases: S/N 72863 (Rx=13.5kHz, Tx=12kHz, RC=A)

S/N 71919 (Rx=10.5kHz, Tx=12kHz, RC=C).

Site B (station 21): SmartBuoy Mooring recovered 14:30 26/1/10

SeaBird microcat temperature and conductivity recorder S/N 5792 at 5m below the surface.

Clock set at 18:58:00 on 01/12/2009.

Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 14:02:00 29/1/10. Clock drift +75 seconds over deployment.

SeaBird microcat temperature and conductivity recorder S/N 4998 at 10m below the surface.

Clock set at 18:53:00 on 01/12/2009. Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 14:07:40 29/1/10. Clock drift +8 seconds over deployment.

Mini-logger (StarOddi) S/N 2852 @7.5 m below the surface. Set to record at 600s intervals.

Delayed start at 06:00:00 on 02/12/2009.

Stopped logging 14:24:30 29/1/10. Clock drift +8 seconds over deployment.

Mini-logger (StarOddi) S/N 2844 @ 15 m below the surface. Set to record at 600s intervals.
 Delayed start at 06:00:00 on 15/09/2009.
 Stopped logging 14:21:50 29/1/10. Clock drift +8 seconds over deployment.

The CEFAS SmartBuoy is fitted with a sensors for conductivity, temperature and optical back scatter and a fluorometer at 1m 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. Attached to the Smartbuoy was a CENTROS pCO₂ sensor for trial.

The surface toroid mooring includes an AIS:
 MMSI number: 992351051.
 Name: POL_Scientific_Buoy_B1

4.2 Deployed instrumentation configuration:

Site A: Bedframe deployed 09:30 26/1/10

Waves ADCP 600kHz RDI S/N 5807.
 Firmware updated to v50.36.
 Mode 1: 100 pings every 10 minutes.
 35 x 1m 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 10:44:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010.

SeaBird 16plus S/N 4736
 Mounted on base of frame with pumped conductivity sensor
 Inc. SeaPoint turbidity sensor (S/N 10471) taped to roll bar setup for 0-125 FTU range and fitted with wiper. Sample interval 600s; digiquartz integration time 40s, range 400; pump 0.5s, 1 s delay.
 Clock set at 11:04:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010

Aanderaa optode (S/N 675) on SeaBird 16plus S/N 4737
 Mounted upright on top of frame and (not pumped) conductivity sensor underneath.
 Sample interval 600s.
 Clock set at 11:30:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010

The frame was fitted with;
 a fizz link,
 a spooler with 50m of rope for recovery of the ballast weight
 two Benthos releases: S/N 72382 (Rx=12kHz, Tx=10kHz, RC=A)
 S/N 72381 (Rx=12kHz, Tx=11kHz, RC=B).

Site A: SmartBuoy Mooring deployed 09:55 26/1/10

SeaBird microcat temperature and conductivity recorder S/N 2081
 Mounted at 5m below the surface.
 Clock set at 11:52:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010.

SeaBird microcat temperature and conductivity recorder S/N 5790
 Mounted at 10m below the surface.
 Clock set at 12:02:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010.

Mini-logger (StarOddi) S/N 2836
 Mounted at 7.5m below the surface.
 Set to record at 600s intervals.
 Delayed start at 06:00:00 on 26/1/2010.

Mini-logger (StarOddi) S/N 2838
 Mounted at 15m below the surface.
 Set to record at 600s intervals.
 Delayed start at 06:00:00 on 26/1/2010.

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter at 1m below surface, light sensors at 1 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.

The Smartbuoy also includes trial experiments;
 Six live cages of mussel samples for toxicology analysis.
 Silicon sheets for trace chemical analysis.
 DGT sampler.
 POCIS.

For further information please contact Naomi Greenwood (naomi.greenwood@cefas.co.uk).

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 (new position): Bedframe deployed 11:35 26/1/10

Waves ADCP 600kHz RDI S/N 5803.
 Firmware updated to v50.36.
 Mode 1: 100 pings every 10 minutes.
 35 x 1m 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 reset at 10:53:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010.

SeaBird 16plus S/N 4737
 Mounted on base of frame with pumped conductivity sensor
 Inc. SeaPoint turbidity sensor (S/N 10537) taped to roll bar; setup for 0-125 FTU range and fitted with wiper.
 Sample interval 600s; digiquartz integration time 40s, range 400; pump 0.5s, 1 s delay.
 Clock reset at 11:17:00 on 25/1/2010.
 Delayed start at 06:00:00 on 26/1/2010

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 70358 (Rx=12kHz, Tx=11kHz, RC=A)
 S/N 69676 (Rx=12kHz, Tx=11.5kHz, RC=C).

Site B: SmartBuoy Mooring deployed 13:04 26/1/10

SeaBird microcat temperature and conductivity recorder S/N 5791 at 5m below the surface.
 Clock set at 18:58:00 on 25/1/2010. Delayed start at 06:00:00 on 26/1/2010.
 SeaBird microcat temperature and conductivity recorder S/N 5793 at 10m below the surface.

Clock set at 12:06:00 on 25/1/2010. Delayed start at 06:00:00 on 26/1/2010.

Mini-logger (StarOddi) S/N 2841 @7.5 m below the surface. Set to record at 600s intervals. Delayed start at 06:00:00 on 26/1/2010.

Mini-logger (StarOddi) S/N 2849 @15 m below the surface. Set to record at 600s intervals. Delayed start at 06:00:00 on 26/1/2010.

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter and a fluorometer at 1m below surface. For the purpose of this deployment the Smartbuoy was equipped with a water sampler for trial by CEFAS.

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.

5. CTD:

The Sea-Bird 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 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 (University of Bangor). 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.

Cast	Station	time	Latitude	Longitude
1	1 pre-mooring	Jan 26 2010 08:50	53deg °31.98'	03deg °21.77'
2	1 post mooring	Jan 26 2010 10:18	53deg °32.06'	03deg °21.96'
3	20 post deployment	Jan 26 2010 13:08	53deg °32.32'	03deg °38.39'
4	21 pre recovery	Jan 26 2010 13:53	53deg °27.08'	03deg °38.53'
5	3	Jan 26 2010 18:03	53deg °41.96'	03deg °13.33'
6	7	Jan 26 2010 18:47	53deg °42.01'	03deg °21.74'
7	15	Jan 26 2010 19:31	53deg °42.09'	03deg °30.12'
8	18	Jan 26 2010 20:15	53deg °41.96'	03deg °38.57'
9	27	Jan 26 2010 20:55	53deg °42.06'	03deg °46.54'
10	30	Jan 26 2010 21:38	53deg °41.86'	03deg °55.01'
11	31	Jan 26 2010 22:20	53deg °37.12'	03deg °55.52'
12	26	Jan 26 2010 23:06	53deg °36.99'	03deg °46.95'
13	19	Jan 26 2010 23:57	53deg °36.84'	03deg °38.75'
14	14	Jan 27 2010 00:57	53deg °36.81'	03deg °30.19'
15	8	Jan 27 2010 01:43	53deg °36.95'	03deg °21.81'
16	2	Jan 27 2010 02:28	53deg °36.96'	03deg °13.35'
17	35	Jan 27 2010 03:19	53deg °32.09'	03deg °15.70'
18	1	Jan 27 2010 04:00	53deg °32.17'	03deg °21.36'
19	13	Jan 27 2010 04:53	53deg °31.93'	03deg °29.94'
20	20	Jan 27 2010 06:05	53deg °32.43'	03deg °38.31'
21	25	Jan 27 2010 07:20	53deg °31.90'	03deg °46.50'

22	32	Jan 27 2010 08:23	53deg °31.85'	03deg °55.16'
23	34	Jan 27 2010 10:28	53deg °22.19'	03deg °55.53'
24	23	Jan 27 2010 11:18	53deg °23.12'	03deg °46.92'

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, Transmittance, Hull Temperature (°C), Barometric Pressure (mbar), Fluorescence, Oxygen concentration, Turbidity, Salinity and Conductivity sensor water temperature (°C). In addition, a pCO₂ sensor is incorporated into the surface sampling system.

A met package measures and records Barometric pressure (mbar), Solar Radiation ($W m^{-2}$), PAR ($\mu\text{mols} / m^2s$), Air Temperature (°C), Relative Humidity, Relative Wind Speed (ms^{-1}), Relative Wind Direction (°) – zero indicates wind on the bow, Minimum Air Temp (°C), Maximum Air Temp (°C) and Wind Gust (ms^{-1}).

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

Underway data, pCO₂ and ship's ADCP data were recorded every minute.

All systems were recording from 07:38 26/1/10 and were stopped by 18:10 27/1/10 at the Crosby radar tower.

7. Acknowledgements

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