National Oceanography Centre
Cruise Report for RRS James Cook Cruise JC105

15th June – 24th June 2014

Southampton to Southampton

Shelf Sea Biogeochemistry

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Cruise participants

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Ships Crew

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Bob Lucas (Chief Engineer)
Graham Bullimore (Purser)
Pete Newton (Chief Officer)
Ian MacLeod (2nd Officer)
Nick Norrish (2nd Officer)
Paul Damerell (Senior ETO)
John Hagan (2nd Engineer)
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Frank Davitt (3rd Engineer)
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John MacDonald (CPO SC)
Brian Conteh (ERPO)
John Smyth (ERPO)
Steve Duncan (PO Deck)
John Haughton (Head Chef)
Wally Link (Chef)
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1. Cruise background and objectives

The large continental land masses are surrounded by extensive shallow (ca 100m depth) seas known as the 'shelf seas'. These act as the boundary between the massively perturbed terrestrial environment and the vast open ocean marine system, and have huge socio-economic importance. They are the primary regions of human marine resource exploitation, including both renewable and fossil fuel energy sources, recreation, trade and food production. Although comprising only about 5% of the global ocean surface area, the shelf seas provide 90% of the global fish catches which form an important source of food to much of the global population. They also play an important role in the ecosystem services provided by the oceans as a whole, in particular in storing carbon away from the atmosphere.

Physical and biochemical processes in shelf seas influence the removal of CO_2 from the atmosphere and the subsequent storage of carbon in the deep ocean. Biological growth draws carbon out of the water, which is then replaced by carbon in CO_2 from the atmosphere. In the shelf seas this growth is supported by terrestrial and open ocean sources of nutrients, implying intimate roles for both the terrestrial biosphere and the open ocean environment in regulating shelf sea climate services. The oceans can also be a major source or sink for other greenhouse gases, including nitrous oxide (N_2O), with the shallow shelf seas thought to play a key role. An additional focus is the role of the shelf as a supplier of iron to the open ocean.

The spatial extent of the submerged continental shelves varies greatly. The NW European shelf sea is one of the largest and hence is likely to play a significant role in marine biogeochemical cycling, alongside providing a useful model for other systems However, even in this relatively well studied region, we lack a good understanding of the principal controls on the cycling of carbon and the major nutrient elements, nitrogen, phosphorous, silicon and iron. Consequently it is also difficult to predict how the cycling of these elements and hence the carbon removal they support may be altered by ongoing and potential future global change.

The Shelf Sea Biogeochemistry research programme, co-funded by NERC and Defra, aims to reduce uncertainly in our process understanding of the cycling of nutrients and carbon, and the controls on primary and secondary production in both the UK and European shelf seas and in wider global biogeochemical cycles. A series of long-term moorings and gliders have been deployed in the Celtic Sea in early 2014 and will remain in the water until late summer 2015. They will provide an unprecedented recorded of both physical and biogeochemical measurements across a full seasonal cycle providing the research community with (a) a long term record of the parameters controlling biogeochemical cycling rates and pathways, (b) a background against which to set process studies carried out on subsequent cruises and (b) essential data for model validation and development.

The aim of JC105 is to service the gliders and moorings and to collect baseline samples of nutrients and carbon for a shelf wide sampling campaign. There are 4 well defined practical objectives:

1. Recover and re-deploy a total of 8 moorings in the Celtic Sea (a mixture of landers and moorings) located at 5 separate sites (see Figure 1).
2. Recover 4 gliders
3. Collect biogeochemical samples (inorganic nutrients, oxygen, DIC, total alkalinity, chlorophyll) for the whole shelf sampling campaign.

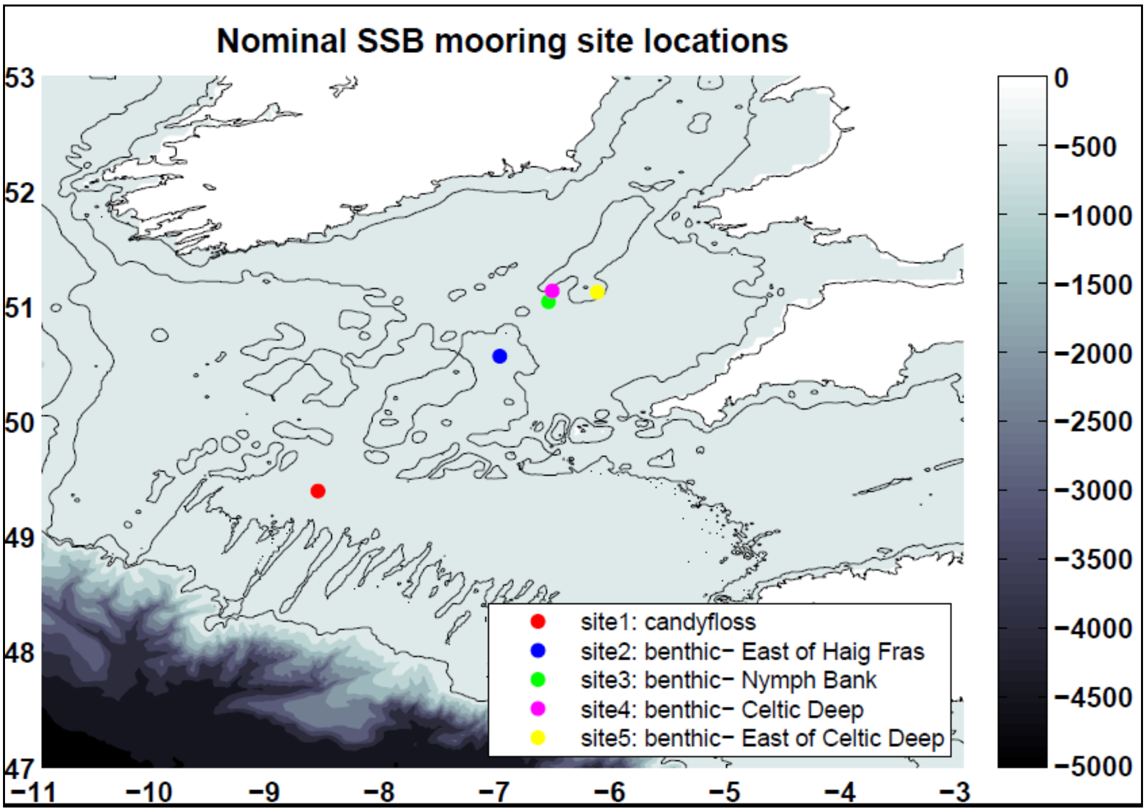


Figure 1: Celtic Sea mooring site locations

2. Cruise Narrative

All times in GMT

Sunday 15th June 2014 (Jday 166)

Met: Fair weather, 10 knots of wind (Force 3), westerly. Sea state: calm

Sailing time 07:30 with a course set for Site 2. Passed Calshot Spit at 08:40 GMT.

Non-toxic water supply turned on while rounding the Needles at approx. 11:00 GMT.

12:15 first DIC/TA, organic and inorganic nutrient samples taken from underway as part of WP1 whole shelf sampling programme.

17:41 Underway PCO_2 system on and working.

Monday 16th June 2014 (Jday 167)

Met: 12 knots of wind, north-easterly, slight sea state

We arrived at Site 2 at 12:00. There was a delay in starting the CTD because of a sensor fault in the parallelogram. The first CTD was underway by 13:26 from which only surface and bottom samples were taken. This was followed by a 50 m dip with the Cefas profiler. Recovery of the Cefas mini-lander started at 14:42 when the 3 surface floats were grappled. The 250 m rope to the 100 kg anchor clump was wound onboard, followed by 300 m of ground wire and then the lander itself. Deployment of the replacement lander started at 16:44, pellet line first. The clump was lowered to the bed and 300 m of wire paid out slowly behind. The lander was lowered to position and released acoustically from a few metres above the bottom. A post deployment CTD, with 6 sample depths was then carried out. Work at Site 2 finished around 19:00 and a course set for the start of an underway ADCP survey near the Celtic Deep Smartbuoy. The waypoints (24 nm apart) were chosen either side of a chlorophyll front that was visible from the weekly CHL satellite image.

Concern over glider Stella and her drift relative to French-UK boundary that is unclear near the shelf edge. Seek clarification from Rolly Rogers as to our permissions to enter French water for an emergency recovery.

Tuesday 17th June 2014 (Jday 168)

Met: 14.8 knots north-easterly wind, bright sunshine

Stella drift appears to be more northerly and therefore not towards the French-UK boundary. Her drift pattern does not appear to be any different than the previous weeks/days.

Completion of two stations was planned for the day. The first CTD with a full suite of samples was taken at 06:00, followed by a shallow dip with the Cefas profiler at Site 3. Recovery of the mini-lander commenced at 08:00 when the 3 surface buffs were successfully grappled. The clump weight was then bought onboard and the lander itself lifted to just above the water. At this point the recovery wire snapped and the lander dropped back into the water. It is likely that the recovery wire (mild steel) became wrapped around one of the stainless steel lander legs (or pulled taught against it) during deployment in March and subsequently corroded and/or frayed during its time in the water. The backup buffs and recovery line were successfully acoustically released and the lander retrieved. The replacement lander was deployed without any problems by 11:00.

After a short 45 minute steam to Site 4 a pre-recovery CTD and shallow Cefas profiler dip were carried out. Recovery of the Smartbuoy (inc. Inline frame and temperature loggers) was completed by 14:30. There was a delay in deploying the replacement Smartbuoy at Site 4 due to miscommunication over temperature loggers needing to be mounted on the wire. The mooring was deployed anchor first and the necessary spacing between thermistors was estimated as the wire came off the drum. Site 4 was completed with a CTD cast. At the end of the cast (17:30) the ship headed west to occupy the same VMADCP transect as the night before (50.9542, -6.8083 to 51.2996, -6.5045). An 08:00 arrival time at Site 5 the following morning was set.

Wednesday 18th June 2014 (Jday 169)

Met: 2-3 knots north-north easterly wind, bright sunshine

Arrived at Site 5 at 08:00 for a pre-recovery CTD. The surface buffs for the lander however were not visible. We spent 1.5 hours attempting to make contact with the transducer, but without success. Search radius from lander position increased from 100m to 400 m. The search was abandoned at 11:00. Endeavour could come back with a camera? There were a lot of vessels around so the lander was probably caught by shipping.

A new lander position was agreed 300 m to the NE of the Guardbuoy and the mooring successfully laid and a post-deployment CTD cast taken.

Course set for Site 1 (Candyfloss) with a CTD station (A1) programmed for 21:00 en-route. Surface and bottom samples were taken as part of the whole shelf sampling programme.

Noticed that after a software reboot the VMADCP OS150 kHz had started logging to /command_files/ and had reset the numbering. Files 001, 002 and 003 therefore needed relabeling 005, 006 and 007.

Thursday 19th June 2014 (Jday 170)

Met: 2-3 knots NE in morning, freshening to 16 knots early evening. Clear and bright. Sea state calm

Arrival at Site 1 (Candyfloss) and completion of a CTD and dip with Cefas profiler. Recovery of temperature chain and ADCP string went smoothly. Recovery of NOC-L lander first attempted at 11:00 by releasing the spooler and 300 m recovery line. By 12:00 the spooler could still not be seen at the surface so the first backup acoustic release was fired. The frame however did not surface. At 12:15 the spooler was sighted lying almost completely below the surface. It was recovered, together with the frame (minus the ballast weight). There was concern over whether the frame was sufficiently buoyant though so deployment of the new frame was delayed. The Smartbuoy and temperature chain were therefore deployed, followed by a post-deployment CTD. The bedframe was rescheduled for deployment on return to Site 1 giving time for extra ballast to be added.

Light, radar reflector and St. Georges cross missing from the Guard Buoy at Site 1.

Friday 20th June 2014

Met: 16 knots wind, 66 degrees, moderate swell

Started the 12 hr CTD glider calibration at 06:00. Shortly after starting however Stella called in for the first time in days and was only 16 nm away from our location. Dave White made communication and got her to stay at the surface and blow her nose cone. We stopped the CTD station and went to pick her up. We returned to the glider recovery position and recommenced the 12 hr CTD cycle at 11:00. Profiles were taken approximately every hour until 23:00. We remained within 0.5 nm of the gliders throughout this calibration exercise. During the day James Burris attempted to locate the remaining gliders using the goneo (Argo beacons), but with minimal success.

Saturday 21st June 2014 – World Ocean Day

Met: Wind 17 knots, 80 degrees, 1 m chop in the morning. Afternoon picked up to 23 knots, 90 degrees with more white capping and some spray.

Raleigh and Eltanin were set to perform shallow water (100 m) dives from 23:00 20/06/2014 onwards in order that they maintained their positions overnight. At 05:00 20/06/2014 they were sent into recovery mode. Recovery of Raleigh and Eltanin. Difficult to find in building sea state.

Formalhaut had not called in for 5 days so no attempt was made to find her – other than using the goneo. Quick attempt to communicate with the Fastnet LT2 lander but no success.

13:00 started CTD transect from deep water (2600m towards Site 1). Completed 2 deep stations off shelf and one on-shelf (A2-A4).

Sunday 22nd June 2014

Met: 16 knots wind, 334 degrees (1-2 m of swell)

Return to Site 1 to deploy the ADCP mooring. Tests were performed on the NOC-L lander that had been fitted with additional buoyancy. The frame on its own was positively buoyant. The frame+lander was just about negatively buoyant but an extra lead weight was added. Final calibration casts performed. Headed half way back towards A4 CTD site for a last CTD to complete the cross-shelf transect. End of science at 16:00.

Monday 23rd June 2014

Transit back to Southampton and packing

Tuesday 24th June 2014

09:00 pilot

3. Sea surface hydrography and meteorology (Surfmet)

Background and objectives

The status of the sea surface and meteorology (surfmet) system was monitored by Mark Maltby (NMFSS). The Surfmet data will be processed by the British Oceanographic Data Centre (BODC).

Instrument description

The sea surface hydrography suite of sensors were plumbed, in-line, to the clean seawater pumped supply line. The Sea-Bird SBE 38 was located close to the seawater intake towards the hull of the ship where it was less likely to suffer from any interior heating effects. The remaining sensors were located in the CTD annex on the main deck, intake pipe (estimated to be ~ 30 m). The depth of the seawater intake was estimated to be approximately 5.5 m. The flow of seawater through the system was initially down-regulated and de-bubbled using an Instrument Laboratory, Vortex de-bubbler before the flow was regulated to approximately 1500 ml/min using a floating ball flow meter prior to the first sensor, the fluorometer. This was followed in-line by the transmissometer and finally the thermosalinograph (TSG) before the water was wasted to the drain. The meteorology platform was located on the ship's foremast at the bow of the ship. The foremast was approximately 17.1 m above typical sea level. Table 1 describes the current suite of sensors. Figure 1 shows the current orientation of the met platform.

Data processing

Output from the Surfmet sensors were initially logged by a designated PC before being registered by the TECHSAS logging system and broadcast to NetCDF and UKORS format in raw_data area of the level-C logging system. Some of the sensor’s firmware, connection modules and PC software manipulated the output prior to this (Figure 2). Once in the Level-C logging system, the data was further manipulated by the in-house NMF process, windcalc using bestnav and relmov producing prowind and stored in the pro_data area of the files system.

1 second, 10 second and 60 second average files were produced.

Table 1: Surfmet sensors fitted on JC105

Manufacturer	Model	Sensor	Serial number	Location (e.g Port)	Height above sea level (m)	Last calibration date	Comments (e.g accuracy)
Skye	SKE510/s	PAR	38884	Starboard	18.48	13/08/2012	
Skye	SKE510/s	PAR	28561	Port	18.48	04/07/2013	
Kipp &Zonen	CM 6B	TIR	994132	Starboard	18.48	10/07/2012	
Kipp &Zonen	CM 6B	TIR	994133	Port	18.48	10/07/2012	
Gill	Windsonic	Aneometer	064537	Starboard	18.77	No Cal	
Vaisala	HMP45	Temp/Hum	B4950010	Starboard	18.60	06/07/2013	
Vaisala	PTB110	Pressure	J0710002	Starboard	17.55	03/03/2014	
Wet Labs	WS3S	Fluorimeter	WS3S-351P	Water sampling Room		20/08/2013	
Wet Labs	CST	Transmissometer	CST-1132PR	Water Sampling Room		19/07/2012	Not used for 1st year cal good till 19/07/2014
Sea-Bird	SBE38	Temperature	3854115-0489	Water Sampling Room		12/01/2014	
Sea-Bird	SBE45	TSG	454881-0229	Water Sampling Room		14/01/2014	

General observations

Underway started on 15/06/2014 @ 10:50:43

Transmissometer readings open 4.6619 closed 0.0589

JAMES COOK MET PLATFORM

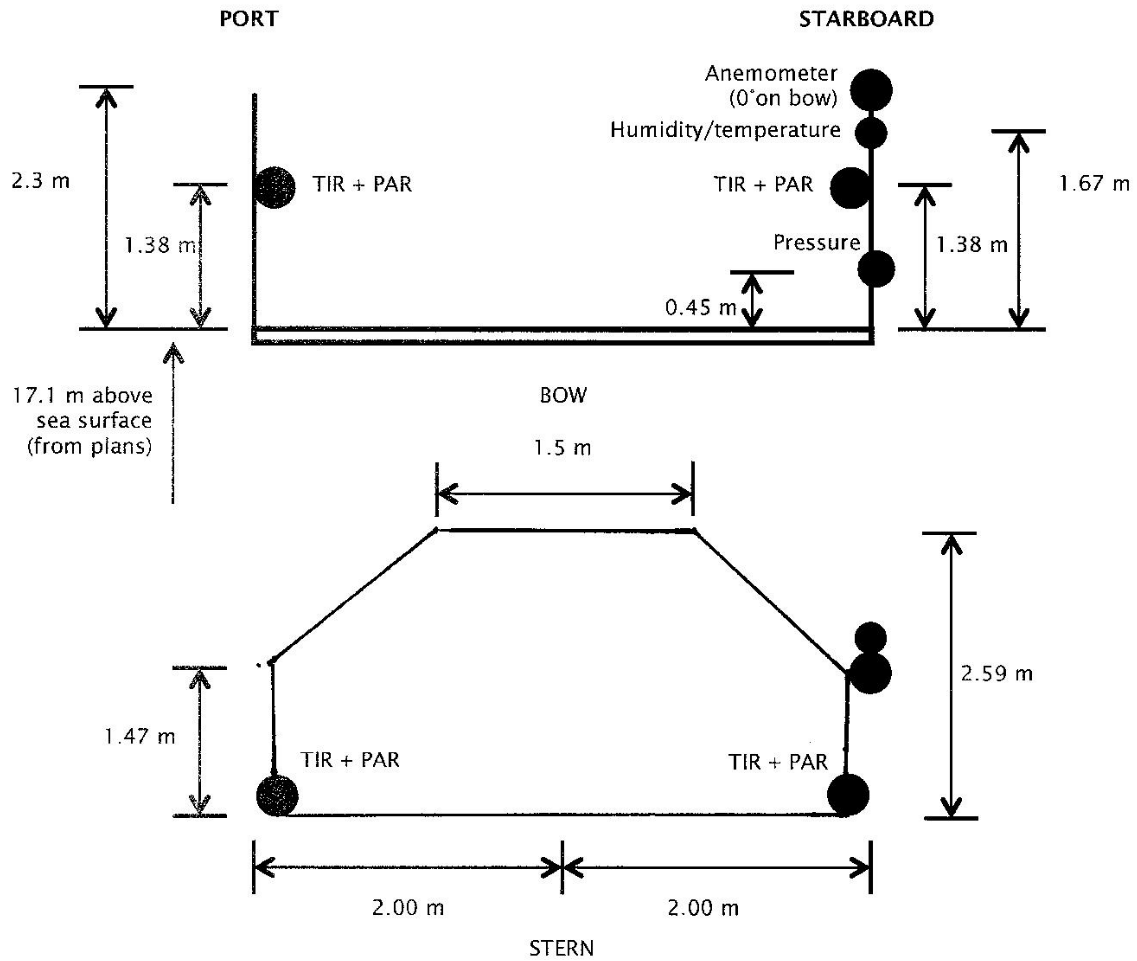


Figure 2: Schematic of met platform layout

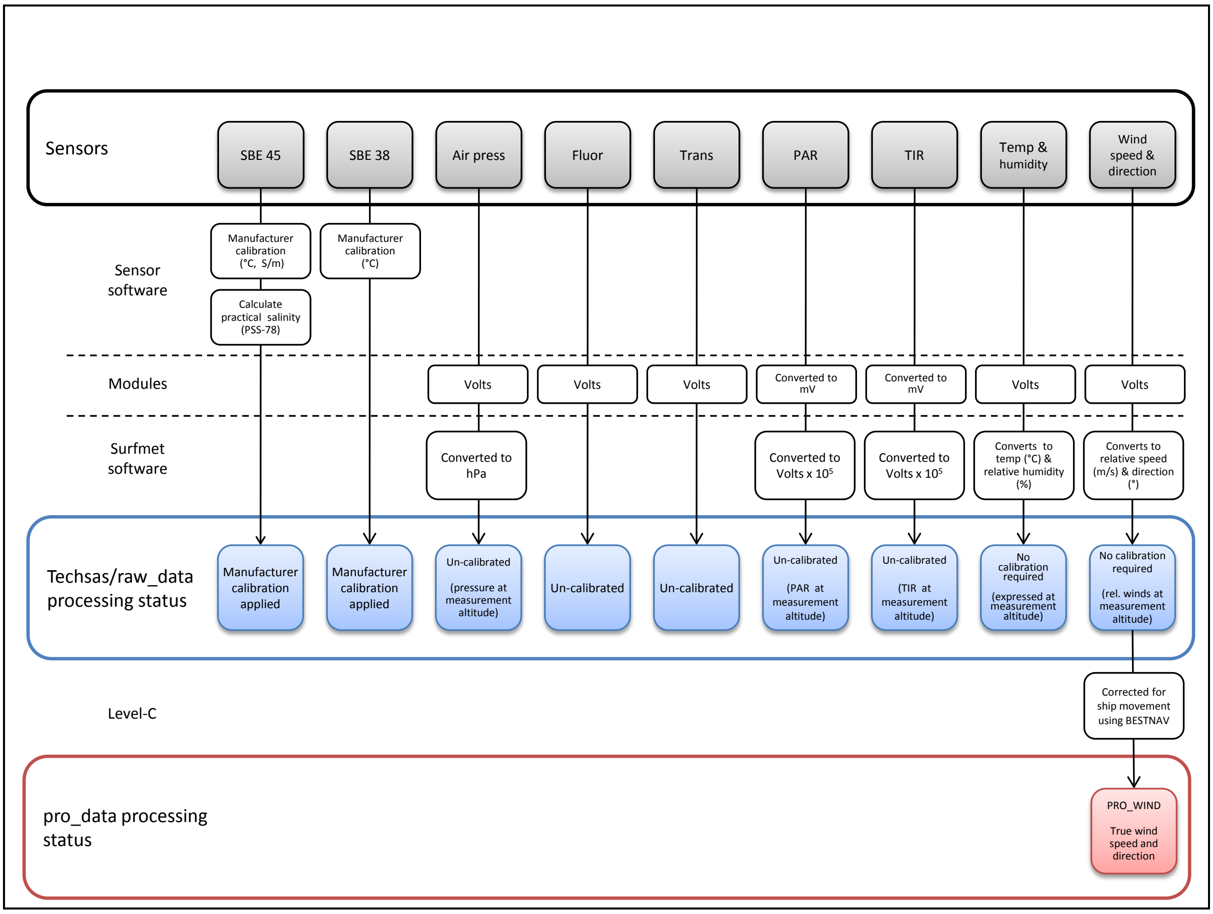


Figure 3: Surfmet data processing. Diagrams shows the processing route from sensor to pro_data in the level-C logging system

4. Underway PCO_2 analysis

Set up and run by Mark Maltby on behalf of Vas Kitidis (PML)

A PML-Dartcom Live pCO_2 instrument was set up in the wet lab. Gas standards (BOC Ltd.; nominal mixing ratios 250, 380, 450 ppmv in synthetic air; calibrated against NOAA primaries) were located in the gas store and an air sampling line was taken from the Decklab to the foremast. The system comprises a showerhead equilibrator vented through a second equilibrator, platinum resistance thermometer, nafion dryer, non-dispersive infrared detector (LiCOR, LI-840) and associated hardware and electronics. The system was linked to the ship's LAN and transmitted data in near-real-time to a server at PML. Ancillary Data water collated and emailed to PML (Vas Kitidis) daily. Underway pCO_2 was measured every 15 minutes, marine air every 45 minutes and standards every hour.

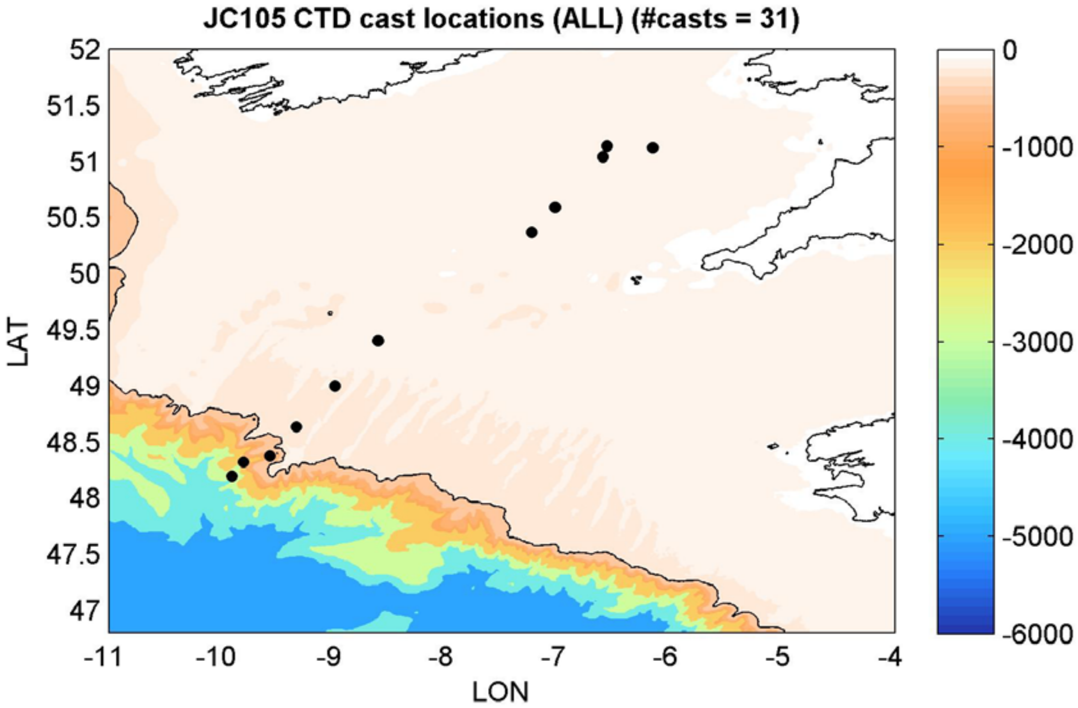
There is a gap in the data from 23:45 21/06/2014 until 08:20 22/06/2014 because the computer froze and was unresponsive. It was rebooted and logging continued.

Data logging started on 15/06/2014 17:41

5. CTD

A total of 31 casts with the stainless steel were completed. See technical reports for sensor serial numbers and channels.

Map of CTD cast locations



Raw data files:

The following raw data files were generated:

JC105_001.bl (a record of bottle firing locations)
JC105_001.hdr (header file)
JC105_001.hex (raw data file)
JC105_001.con (configuration file)

Where _001 is the cast number (not STNNBR)

SBEDataProcessing steps

The following processing routines were run in the SBEDataProcessing software (Seasave Version 7.23.2):

1. **DatCnv:** A conversion routine to read in the raw CTD data file (.hex) containing data in engineering units output by the CTD hardware. Calibrations as appropriate though the instrument configuration file (.CON) are applied.

   Data Setup options were set to the following:

   Process scans to end of file: yes
   Scans to skip: 0
   Output format: ascii
   Convert data from: upcast & downcast

Create file types: both bottle and data
Source of scan range data: bottle log .BL file
Scan range offset: -2.5 seconds
Scan range duration: 5 seconds for
Merge separate header file: No
Apply oxygen hysteresis correction: yes (2 second window)
Apply oxygen Tau correction: yes

Selected output variables:
- Time [seconds]
- Pressure [db]
- Temperature [ITS-90, °C] and Temperature 2 [ITS-90, °C], referring to primary and secondary sensors)
- Conductivity and Conductivity 2 [S/m]
- Salinity and salinity 2 [PSU, PSS-78]
- Oxygen raw, SBE 43 [V]
- Oxygen, SBE 43 [µmol/l]
- Beam attenuation [1/m]
- Fluorescence [µg/l]
- PAR/irradiance, downwelling [W m^2]
- Turbidity [m^{-1} sr^{-1}]
- Altimeter [m]
- Voltage channel 2: Downwelling Irradiance sensor (DWIRR)
- Voltage channel 3: Upwelling Irradiance sensor (UWIRR)
- Voltage channel 4: Altimeter
- Voltage channel 5: Light scattering Wetlabs BBRTD
- Voltage channel 6: Transmissometer
- Voltage channel 7: Fluorometer

2. **Bottle Summary** was run to create a .BTL file containing the average, standard deviation, min and max values at bottle firings. .ROS files were placed in the same directory as the .bl files during this routine to ensure that bottle rosette position was captured in the .btl file.

   Output saved to JC105_001.btl

3. **Wild Edit:** Removal of pressure spikes
   Standard deviations for pass 1: 2
   Standard deviations for pass 2: 20
   Scans per black: 100
   Keep data within this distance of the mean: 0
   Exclude scans marked as bad: yes

4. **Filter:** Run on the pressure channel to smooth out high frequency data
   Low pass filter time B: 0.15 seconds

5. **AlignCTD:** Based on examination of different casts a 3 second advance was chosen for alignment of the oxygen sensor. This alignment is a function of the temperature and the state of the oxygen sensor membrane. The colder (deeper) the water the greater the advance needed. The above alignments were chosen as a compromise between results in deep (cold) and shallow (warmer) waters.

The deck unit was set to advance both the primary and secondary conductivity channels by + 1.75 scans (equivalent to 0.073 seconds at 24 Hz), but further testing of -1, -2, -3, +1 ,+2 and +3 scans (on both sensors) showed that an adjustment of -1 scan (= -0.0417 seconds) resulted in the greatest reduction in noise in the salinity channel.

6. **CellTM:** Removes the effect of thermal inertia on the conductivity cells. Alpha = 0.03 (thermal anomaly amplitude) and 1/beta = 7 (thermal anomaly time constant) for both cells.

   Output of steps 1-6 above saved in JC105_001.cnv (24 Hz resolution)

7. **Derive:** Variables selected are
   Salinity and Salinty 2 [PSU, PSS-78]
   Oxygen SBE43 [µmol/l]
   Oxygen Tau correction: yes (2 second window)

   Output saved to JC105_001_derive.cnv (24 Hz resolution)

8. **BinAverage:** Average into 2Hz (0.5 seconds),
   Exclude bad scans: yes
   Scans to skip over: 0
   Casts to process: Up and down

9. **Strip:** Remove salinity and oxygen channels from the 2 Hz file that were originally created by DatCnv, but then later regenerated by Derive.

   Output saved to JC105_001_derive_2Hz.cnv

Matlab processing steps
The following processing steps were performed in MATLAB:

(1) Create a .mat file of meta data extracted from the cruise Event Log with the following variables:

   CRUISECODE e.g. JC105
   STNNBR (as per BODC data management guidance for the Shelf Sea Biogeochemistry programme)
   DATE and TIME of the cast at the bottom of the profile
   LAT and LON when the CTD was at the bottom of the profile
   DEPTH (nominal water depth in metres from echo sounder)
   CAST (CTD cast number, e.g. 001)

   File created: JC105_metadata.mat

(2) Extract data from 2Hz averaged files (e.g. JC105_001_derive_2Hz.cnv), merge with metadata and save into a matlab structure for each cast. Each file (JC105_001_derive_2Hz.mat) contains the following un-calibrated channels.

```
CTD001 =

            CRUISE: 'JC105'
```

```
            CAST: 1
          STNNBR: 1
            DATE: '16/06/2014'
            TIME: '13:38'
             LAT: 50.5928
             LON: -7.0295
           DEPTH: 106                  [m]
         CTDtime: [3439x1 double]      [seconds]
         CTDpres: [3439x1 double]      [db]
        CTDtemp1: [3439x1 double]      [°C]
        CTDtemp2: [3439x1 double]      [°C]
        CTDcond1: [3439x1 double]      [S/m]
        CTDcond2: [3439x1 double]      [S/m]
      CTDoxy_raw: [3439x1 double]      [V]
          CTDatt: [3439x1 double]      [1/m]
        CTDfluor: [3439x1 double]      [µg/l]
          CTDpar: [3439x1 double]      [Wm^2]
         CTDturb: [3439x1 double]      [m^-1 sr^-1]
          CTDalt: [3439x1 double]      [m]
   CTDpar_dn_raw: [3439x1 double]      [V]
   CTDpar_up_raw: [3439x1 double]      [V]
      CTDalt_raw: [3439x1 double]      [V]
     CTDturb_raw: [3439x1 double]      [V]
      CTDatt_raw: [3439x1 double]      [V]
    CTDfluor_raw: [3439x1 double]      [V]
         CTDsal1: [3439x1 double]      [PSU]
         CTDsal2: [3439x1 double]      [PSU]
    CTDoxy_umoll: [3439x1 double]      [µmol/l]
         CTDflag: [3439x1 double]
```

(3) Extract data from 24Hz files (e.g. JC105_CTD001_derive.cnv), merge with metadata and save into a matlab structure for each cast. Each file (DY008_001_derive.mat) contains the following <u>un-calibrated</u> channels.

```
CTD001 =

         CRUISE: 'JC105'
           CAST: 1
         STNNBR: 1
           DATE: '16/06/2014'
           TIME: '13:38'
            LAT: 50.5928
            LON: -7.0295
          DEPTH: 106                    [m]
        CTDtime: [41263x1 double]       [seconds]
        CTDpres: [41263x1 double]       [db]
       CTDtemp1: [41263x1 double]       [°C]
       CTDtemp2: [41263x1 double]       [°C]
       CTDcond1: [41263x1 double]       [S/m]
       CTDcond2: [41263x1 double]       [S/m]
      CTDsal1_1: [41263x1 double]       [PSU]
      CTDsal2_1: [41263x1 double]       [PSU]
     CTDoxy_raw: [41263x1 double]       [V]
```

```
CTD_oxy_umoll_1: [41263x1 double]    [µmol/l]
         CTDatt: [41263x1 double]    [1/m]
       CTDfluor: [41263x1 double]    [µg/l]
         CTDpar: [41263x1 double]    [Wm2]
        CTDturb: [41263x1 double]    [m-1 sr-1]
         CTDalt: [41263x1 double]    [m]
  CTDpar_dn_raw: [41263x1 double]    [V]
  CTDpar_up_raw: [41263x1 double]    [V]
     CTDalt_raw: [41263x1 double]    [V]
    CTDturb_raw: [41263x1 double]    [V]
     CTDatt_raw: [41263x1 double]    [V]
   CTDfluor_raw: [41263x1 double]    [V]
        CTDsal1: [41263x1 double]    [PSU]
        CTDsal2: [41263x1 double]    [PSU]
   CTDoxy_umoll: [41263x1 double]    [µmol/l]
        CTDflag: [41263x1 double]
```

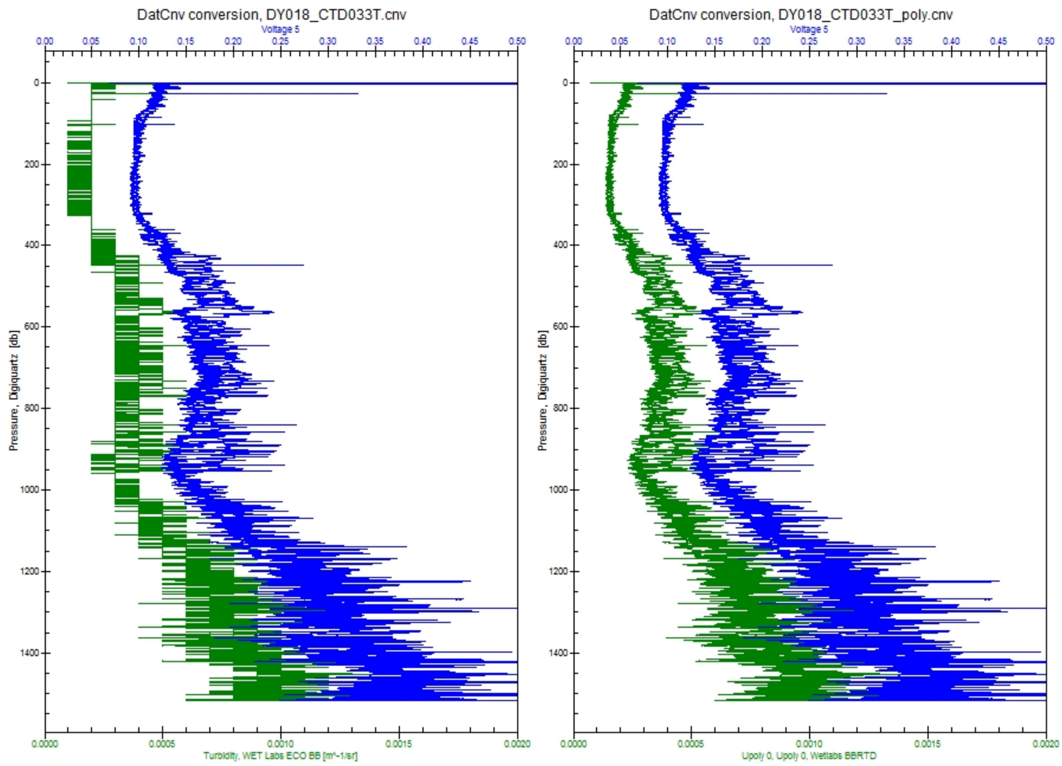
Note that '_1' for the first instances of salinity and oxygen in this file are variables before re-derivation in the SeaBird Processing routines.

The PAR sensor was removed for deep casts CTD027 and CTD028. The PAR channel is therefore zero for these two profiles.

Inspection of the turbidity channel (CTDturb) and comparison to the original raw voltage (CTDturb_raw) revealed a potential bug in the SeaBird DatCnv conversion module. After correspondence with SeaBird, it was confirmed that the converted ECO-BB output was being reported to a fixed precision (see email chain at the end of the report). This is demonstrated below (left) where the raw voltage channel (blue) is compared to the SeaBird DatCnv output (green). Direct conversion using the scale factor (SF) and dark counts (DC) supplied in the manufacturer's calibration appears to rectify this problem (right plot). We therefore replace the original turbidity channel in the .cnv files with a corrected version using:

CTDturb = CTDturb_raw .* SF - (SF x DC);

This appears to reinstate the original resolution.



(4) Manual identification of the surface soak (while waiting for pumps to turn on) and the end of the downcast using the 2Hz files. Times to crop were saved to JC105_ castcrop_times.mat.

```
    CAST: [31x6 char]
  STNNBR: [31x1 double]
CTDstart: [31x1 double] [seconds]
 CTDstop: [31x1 double] [seconds]
```

This was then used to crop both the 2Hz and 24Hz files and output (i.e. just the downcast recordings) saved to JC105_CTD001_derive_2Hz_cropped.mat and JC105_CTD001_derive_cropped.mat respectively.

(5) De-spiking of downcast 24 Hz data. The salinity, conductivity, temperature, oxygen, attenuation, turbidity and fluorescence channels were all de-spiked. The worst spikes were identified using an automated routine (similar to WildEdit) where the data was scanned twice and points falling outside a threshold of *nstd* x standard deviations from the mean within a set window size were removed (turned into NaNs).

Window size (#scans) and number of standard deviations from the mean (nstd) used for each channel.

Channel	*Pass 1 window*	*Pass 1 nstd*	*Pass 2 window*	*Pass 2 nstd*
Temperature, conductivity, fluorescence	100	3	200	3
Salinity, turbidity	200	2	200	3
Oxygen, attenuation	100	2	200	3

Auto-despiking saved to JC105_CTD001_derived_cropped_autospike.mat

Manual de-spiking was then performed to remove larger sections of bad data or any remaining isolated spikes in each channel.

Large ‘spikes’ were often observed in the CT sensors lasting a few seconds, predominantly in the thermocline. This is a persistent problem in shallow water with strong property gradients (e.g. see for example D352, D376); particularly where a large CTD package carrying large volume bottles is used. The spikes coincide with a decrease in the decent rate of the CTD package and are therefore likely associated with inefficient flushing of water around the sensors. It is caused by the pitch and roll of the boat, so is accentuated in rough weather. As the decent rate of the CTD package slows on the downcast ‘old’ water (from above and therefore typically warmer) is pushed back passed the sensors. As the decent rate increases again ‘new’ water is flushed past the sensors. A similar problem can occur if the veer rate on the CTD winch varies (as was the case on CD173).

The largest and most significant warm anomalies identified in the primary and secondary CT sensors were removed. This was at times up to 5 m of the profile. The impact of smaller scale anomalies that were not removed is mostly minimised during the averaging processes, but care should be taken when interpreting smaller scale features, particularly through the thermocline. The casts are more than good enough for looking at large scale trends and anomalies but should probably not be used for Thorpe scale analysis and interpretation of fine scale structures. To achieve this in a shelf sea environment free fall profiling techniques are more suitable.

Although ‘old’ water would also have been flushed back past the auxiliary sensors (turbidity, oxygen, chlorophyll, attenuation) the coincident measurements in these channels were (a) not always anomalous and/or (b) the associated anomaly did not always exactly coincide (or could even be confidently identified, especially for oxygen). As such removal of data from auxiliary channels using scans flagged as bad in the primary/secondary CT channels was not always appropriate or did not improve data quality. The worst individual spikes within these channels however were manually identified and removed (NaN’d).

Output saved to JC105_CTD001_derived_cropped_autospike_manualspike.mat

Additional channels added into this file:

Vectors of 0’s and 1’s indicating data that has been NaN’d (=1). Outputs depend on channels loaded and viewed so each column may have variable meaning and is saved for processing archive purposes only.

```
Pindex: [18900x3 double]
Sindex: [18900x3 double]
Aindex: [18900x4 double]
```

(6) Average 24Hz (cropped and de-spiked data) into 1 db. Linear interpolation used when no data available for averaging.

Files for each cast were created: JC105_001_1db_dn.mat

All the 1 db profiles (except PAR) are then further smoothed with a 10 m running median window. The chlorophyll is smoothed with a 5 m window to better preserve the subsurface chlorophyll maximum.

File output: JC105_001_1db_dn_smth.mat

(7) Application of calibrations to salinity, chlorophyll and oxygen in 1db smoothed downcasts. Calibrated files saved to JC105_001_1db_dn_smth_calib.mat.

Sigma theta (σ_θ) (relative to 0 pressure) is also calculated at this stage using the matlab function sw_pden-1000 from the SEAWATER toolkit.

```
CTD001 =

         CRUISE: 'JC105'
           CAST: 1
         STNNBR: 1
           DATE: '16/06/2014'
           TIME: '13:38'
            LAT: 50.5928
            LON: -7.0295
          DEPTH: 106              [m]
           pres: [102x1 double]  [db]
           time: [102x1 double]  [seconds]
          temp1: [102x1 double]  [°C]
          temp2: [102x1 double]  [°C]
           sal1: [102x1 double]  [PSU] - calibrated
           sal2: [102x1 double]  [PSU] - calibrated
          cond1: [102x1 double]  [S/m] – not calibrated
          cond2: [102x1 double]  [S/m] – not calibrated
      oxy_umoll: [102x1 double]  [µmol/l] – calibrated
          fluor: [102x1 double]  [µg/l] – calibrated
            par: [102x1 double]  [Wm2]
           turb: [102x1 double]  [m-1 sr-1]
            att: [102x1 double] [1/m]
    sigma_theta: [102x1 double]
```

The calibrations were also applied to the 24 Hz data (cropped and de-spiked) and output to .mat files JC105_001_derive_cropped_autospike_manualspike_calib.mat containing the same variables as above.

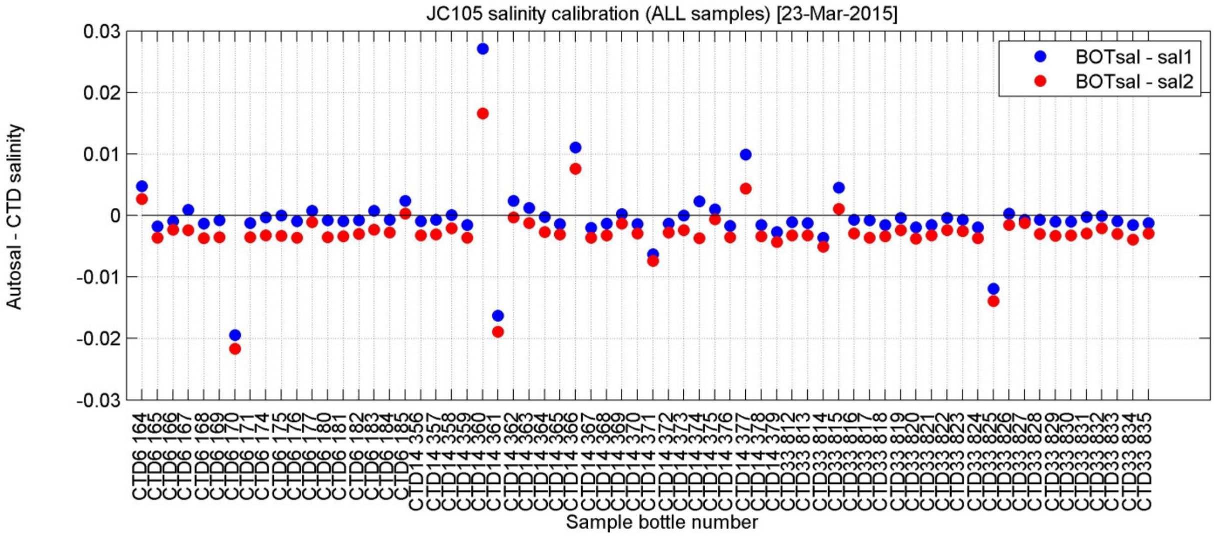
(8) Application of salinity, chlorophyll and oxygen calibrations to bottle firing data. A new file, JC105 _btl_calib.mat, with variables CTDsal1_cal, CTDsal2_cal, CTDoxy_umoll_cal and CTDfluor_cal was created.

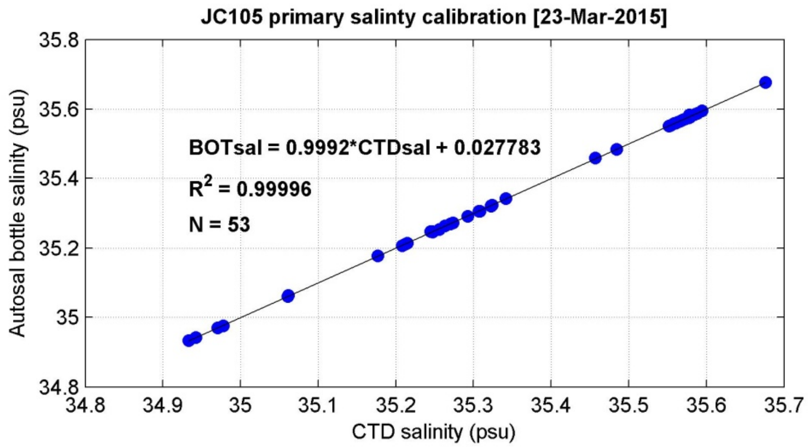
Calibrations

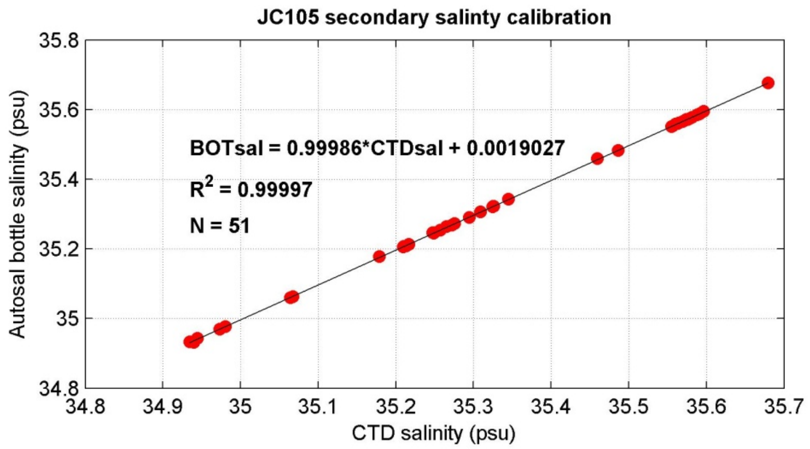
Salinity

4 samples (bottle # 173, 174, 178 and 179) were removed because it was unclear which cast and niskin bottle the sample was taken from.

66 salinity samples were taken and analysed on a Guildline Autosal salinometer. Using all samples the mean and standard deviation of residuals from the primary and secondary sensors were -0.00051667± 0.0054088 and -0.0029061± 0.0046362 respectively. After removal of outliers where the difference between Autosal and CTD values was greater than 1standard deviation and where the standard deviation of the temperature at bottle firing was > 0.01 °C the mean ± standard deviations for the primary and secondary sensors became -0.00051887± 0.001313 and -0.0029157±0.0011321 respectively.

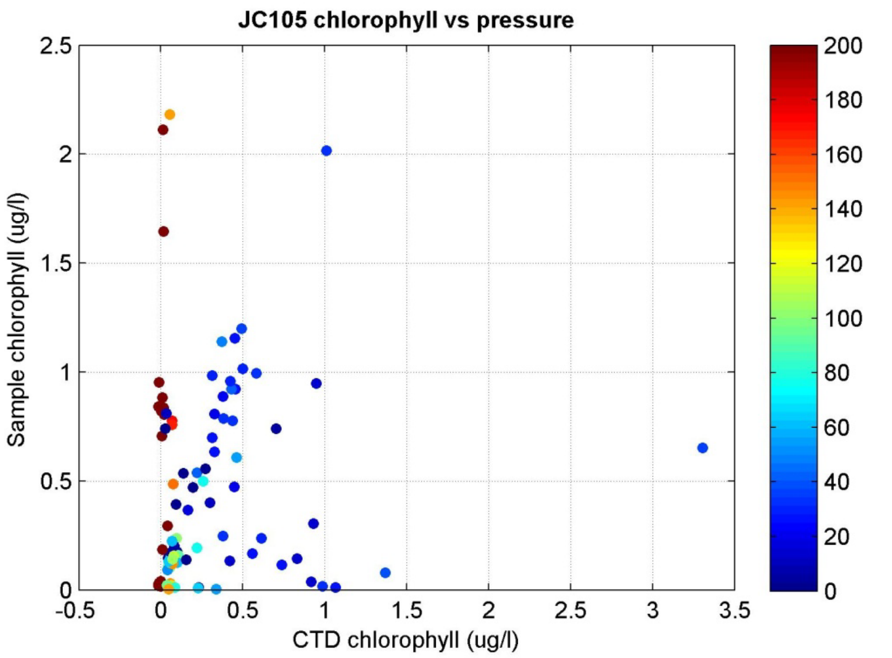




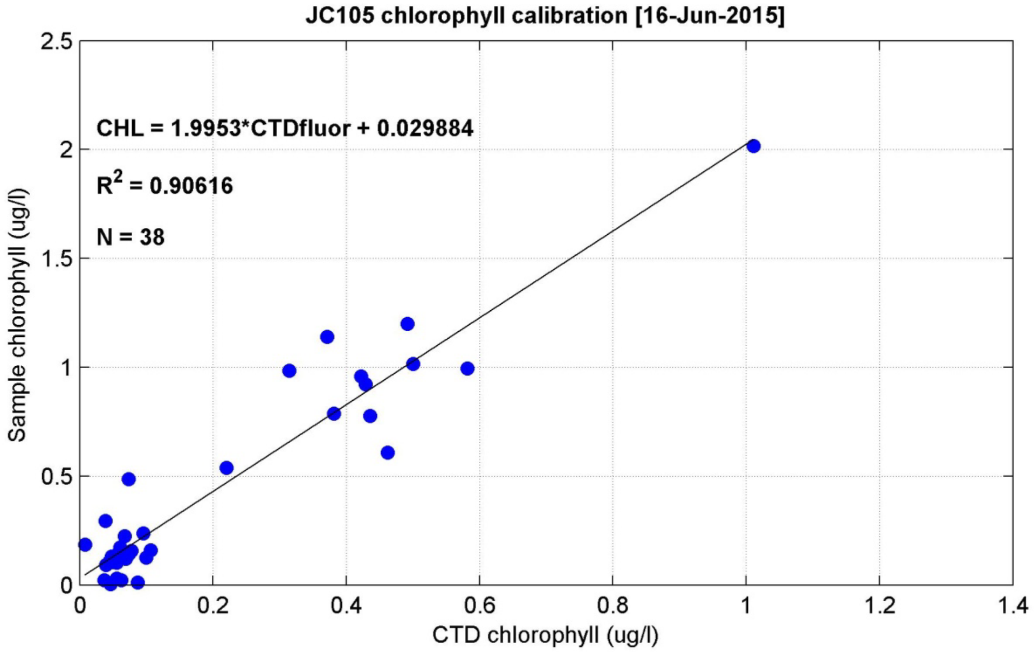


Chlorophyll

In total 94 chlorophyll samples were taken. However, there are a large number of suspect points (e.g. high concentrations at depth, >200m).

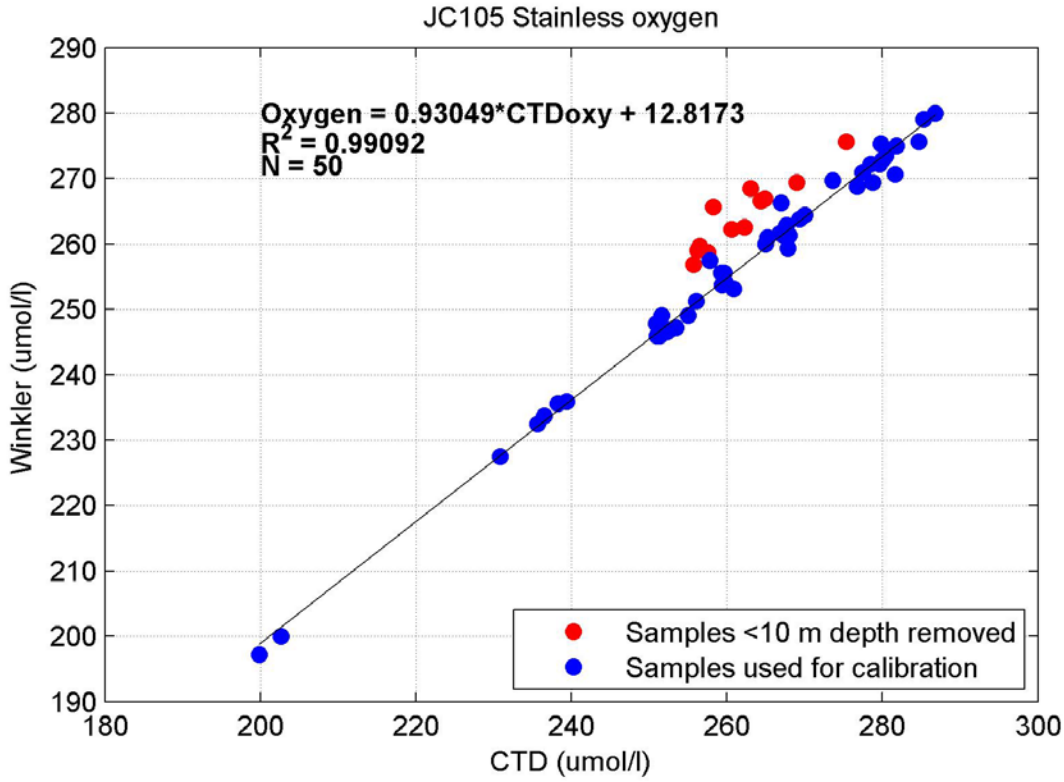


After removal of these points and samples taken during daylight in the surface 30 m, only 38 points remained. The following calibrations were applied to the fluorometer.



Oxygen

A total of 62 samples were taken for oxygen calibration and reported in units of mg/l. A conversion to umol/l was applied using mg/l x 0.69976 x 44.661. A total of 12 samples were removed, all taken within the top 10 m since the oxygen titration reported concentrations less than the CTD optode. The following calibration based on 50 samples was applied.



Emails between Seabird and Dougal Mountifield regarding ECO-BB module conversion

Urgent: Wetlabs BB con file module SBE Data Processing problem
Date: Wed, 19 Nov 2014 08:28:13 +0000
From: Dougal Mountifield
To: SeaBird

Hi,

I am currently at sea on RRS Discovery. We are deploying 2 CTD packages which both have Wetlabs BBrtd instruments installed as a 0-5V analog channel on a SBE 9+ underwater unit. We are using the Wetlabs BB module in the con file. 9+ When acquiring the data in Seasave the data from the instrument looks fine, however after data conversion in SBE data processing, and plotting in Seaplot, the profile from the BB is quantised resulting in very poor resolution. The voltage channel is fine (V5). If the BB module in the con file is replaced with a user poly (as used prior to the introduction of the Wetlabs con file module) the result is fine. Have you seen this problem before? Is it possible that the RS-232 digital version of the Wetlabs BB module is applied in error with a 9+ instead of the 0-5V analog version?

Please see the attached graphs, one with V5 and Wetlabs BB module and one with V5 and user poly. Also attached is the cast specific con file with the BB module selected and the associated instrument calibration sheet from Wetlabs. We don't have sufficient network bandwidth to send the data file. We are using v.7.23.2, but have also tried some older versions with the same result.

Urgent assistance would be appreciated.

Dougal Mountifield
National Marine Facilities - Sea Systems Sensors & Moorings Group National Oceanography Centre, Southampton UK.
Aboard RRS Discovery.

****

From: Stephanie Jaeger [mailto:sjaeger@seabird.com]
Sent: 19 November 2014 21:54
To: dm1@noc.ac.uk
Cc: techsupport@seabird.com; Benson, Jeffrey Ray; Hopkins, Joanne
Subject: RE: Urgent: Wetlabs BB con file module SBE Data Processing problem

Hi Dougal,

Thanks for bringing this to our attention. We haven't noted this issue before, and I will check with the software engineer to clarify the conversion formula that is currently used for the parameter "Turbidity Meter, WET Labs, ECO-BB" in the .xmlcon file. Has the data in the plot that you sent been processed at all beyond the data conversion step?

In the meantime, it sounds like you have found a workaround while on the cruise, using the user polynomial function. It should be a simple conversion step:

Turbidity = ?(?c) = (Output - Dark Output) * Scale Factor

When possible, it will be helpful to have the raw data, if you could send a copy of a HEX file? It could also work if you would like to send a short section of the cast (such as 100 m), as an example.

Let us know if you have any further questions on this.

Regards,

Stephanie

Stephanie Jaeger, M.Sc.
Technical Support
Sea-Bird Electronics

****

From: Stephanie Jaeger [sjaeger@seabird.com]
Sent: 12/10/2014 9:25 AM
To: dougal.mountifield@noc.ac.uk;
dm1@noc.ac.uk
Cc: daves@wetlabs.com; jeh200@noc.ac.uk; jrbn@noc.ac.uk
Subject: RE: Urgent: Wetlabs BB con file module SBE Data Processing problem [ref:_00D7096pT._50070vbxjt:ref]

Hi Dougal,

Thanks for the update. We were able to reproduce the issue that you mentioned. The software engineer found that the converted ECO-BB output is reported to a fixed precision. The user polynomial function reports a fixed number of significant figures, rather than a fixed precision, so it will provide the same resolution as raw data, regardless of the mean data level.

I'm checking in with Wetlabs directly about your question, in order to get further feedback about the best output to use, given the limits on data resolution for the ECO-BB.

Regards,
Stephanie

****

From: Stephanie Jaeger [sjaeger@seabird.com]
Sent: 18/12/2014 19:54
To: dougal.mountifield@noc.ac.uk;
dm1@noc.ac.uk
Cc: daves@wetlabs.com; jeh200@noc.ac.uk; jrbn@noc.ac.uk
Subject: RE: Urgent: Wetlabs BB con file module SBE Data Processing problem [ref:_00D7096pT._50070vbxjt:ref]

Hi Dougal,

I'm following up regarding your question on this processing the ECO-BB data. I did check in with Wetlabs, and they confirmed that the raw resolution (given in voltage on the A/D channel) should match the resolution of the converted engineering output. So, the output should show up as it does with the User Polynomial function, as you mentioned.

Also, we noted that the units of the output variable should be in "scattering" rather than "turbidity." So, the variable will be fixed to be named "OBS Meter, WET Labs, ECO-BB" rather than turbidity.

We have reported this to the software engineer, and he'll work to resolve this in a future version of SBE Data Processing.

Thank you for letting us know about this, and let me know if you have further questions.
Regards,
Stephanie

6. Dissolved Organic Matter

Background and objectives

Dissolved organic matter discrete samples were collected by James Fox, Rosie Houlding and Paul Nelson on behalf of Claire Mahaffey and Clare Davis at the University of Liverpool. Samples were collected from CTD casts as part of WP1 in order to characterise the water column of the study area and to calibrate the sensors on deployed gliders and the CEFAS Smart buoy.

Sampling strategy

Discrete samples for dissolved organic carbon, nitrate and phosphate (DOC, DOP, DON) were collected from 21 CTD casts carried out with the stainless CTD package. Samples were withdrawn from 2 to 6 depths, spanning the entire water column (Table 2). Samples were also collected from the non-toxic, pumped seawater supply (Table 3).

Methods

For dissolved organic matter (DOC, DOP, DON) a clean worksace was prepared using bench guard material before preparation of sample syringes and filters. In order to avoid sample contamination appropriate PPE (safety glasses and Ansell *Dura-Touch* vinyl gloves) was worn during the enitre sampling procedure described below. Filters wre prepared by unscrewing the plastic filter holder and removing the o-ring with tweezers. A 25mm filter circle (Whatman GFF) was then placed onto the plastic holder before the o-ring was replaced and the filter holder reassembled.

Water samples were collected in 5 L high density polyethylene (HDPE) bottles. Samples were withdrawn from CTD niskin bottles and from the non-toxic, pumped seawater supply using silicone tubing after the sample collection bottle had been rinsed 3 times with water. The filtering procedure began with the rinsing of the tubing and syringe using collected water. A small amount of sample water was drawn into the sampling apparatus before being removed, this was repeated three times. The sample storage bottle was then rinsed three times before sample collection. Samples were then immediately labelled and stored at -20^{o}C.

Between sampling washing and cleaning of the samling equipment was carried out using 10% HCL. After each sample the filter was removed and the plastic holder rinsed with HCL into a plastic beaker. The holder was then transferred to another beaker containing MQ water and rinsed, this was repeated three times. The MQ water was then replaced in each beaker before cleaning of the syringe and tubing. A small amount of HCL was drawn into the syringe through the tubing before being discarded into a waste container. MQ water was then drawn into the syringe before being discarded and the procedure repeated for each beaker. The filter holder was then reassembled and stored until next use.

Data quality notes

One glass syringe was broken during sample collection. The end broke off during the first stage of sample collection when the syringe and tubing were being rinsed. The syringe and tubing were replaced. This occured during the final sampling session and has been logged

Table 2: DOM samples withdrawn from the CTD bottle samples

STNNBR	CTD CASTNO	ROSETTE POSITION	Depth
001	1	1	100
001	1	13	2.5
005	2	1	104
005	2	2	62
005	2	3	32
005	2	13	27
005	2	14	17
005	2	15	3.5
007	3	1	97
007	3	2	51
007	3	3	41
007	3	13	31
007	3	14	21
007	3	15	1
012	4	1	96
012	4	13	32
013	5	1	91
013	5	2	61
013	5	3	41
013	5	13	31
013	5	14	26
013	5	15	1.5
017	6	1	91
017	6	3	2.4
018	7	1	98
018	7	2	51
018	7	3	35
018	7	13	26
018	7	14	21
018	7	15	1.2
022	8	1	93
022	8	13	31
023	9	1	109
023	9	13	4
024	10	1	144
024	10	2	62
024	10	3	47
024	10	13	38
024	10	14	25
024	10	15	1.2
031	11	1	141

031	11	13	2.6
032	12	1	501
032	12	2	202
032	12	13	28
032	12	14	4
034	13	1	498
034	13	3	325
034	13	13	75
034	13	15	25
038	17	1	499
038	17	3	326
038	17	5	251
038	17	13	77
038	17	15	27
038	17	18	3
040	19	1	500
040	19	3	302
040	19	5	172
040	19	13	142
040	19	15	28
040	19	18	13
043	22	1	488
043	22	3	327
043	22	5	227
043	22	13	128
043	22	15	53
043	22	18	13
052	27	1	2609
052	27	3	1999
052	27	5	951
052	27	13	502
052	27	15	103
052	27	18	13
053	28	1	2089
053	28	3	1838
053	28	5	1125
053	28	7	999
053	28	9	600
053	28	14	302
053	28	16	78
053	28	21	13
054	29	1	167
054	29	3	93
054	29	5	64

054	29	13	54
054	29	15	29
054	29	18	13
058	30	1	141
058	30	3	61
058	30	5	36
058	30	13	61
058	30	15	11
058	30	18	2
060	31	1	150
060	31	3	31
060	31	13	21
060	31	15	11
060	31	18	2

Table 3: DOM samples withdrawn from the non-toxic, pumped sea water supply

DATE (UTC)	**TIME (UTC)**	**SAMPNUM (e.g. UW1)**	**Uncorrected water column depth (m)**
15/06/14	12:12	UW1	37
16/06/14	11:00	UW2	109
17/06/14	11:22	UW3	101
18/06/14	19:57	UW4	110
19/06/14	12:19	UW5	147
21/06/14	13:05	UW6	2608

7. Dissolved inorganic nutrients

Background and objectives

Dissolved inorganic nutrient discrete samples were collected by James Fox, Rosie Houlding and Paul Nelson on behalf of Malcolm Woodward (PML). Samples were collected from CTD casts as part of WP1 in order to characterise the water column of the study area and to calibrate the sensors on deployed gliders and the CEFAS Smart buoy.

Sampling strategy

Discrete samples were collected from 21 CTD casts carried out with the stainless CTD package. Samples were withdrawn from 2 to 6 depths, spanning the entire water column (Table 4). Samples were also collected from the non-toxic, pumped seawater supply (Table 5).

Methods

A clean working area was prepared and gloves were changed after the collection of water samples from the CTD rosette. A plastic syringe with a sampling tube attached was then used to draw a small amount of water from te sample collection bottle to rinse the syringe and tubing, this was reapeated three times. The syringe was then filled before an Acrodisc filter was attached to the syringe and flushed through with approx. 25ml of sample. The syringe was then refilled and the filter reattached before a small amount of sample was filtered into the sample bottle for rinsing. This was repeated twice more. The sampling bottle was then filled, labelled and stored at -20^{o}C. The sampling equipment (syringe, tubing, collection bottle) was then rinsed using MQ water before the next samping event. A new filter was used for the bottom and top of the water column during CTD casts.

Table 4: Dissolved inorganic nutrient samples withdrawn from CTD samples

STNNBR	CTD CASTNO	ROSETTE POSITION	Depth
001	1	1	100
001	1	13	2.5
005	2	1	104
005	2	2	62
005	2	3	32
005	2	13	27
005	2	14	17
005	2	15	3.5
007	3	1	97
007	3	2	51
007	3	3	41
007	3	13	31
007	3	14	21
007	3	15	1
012	4	1	96
012	4	13	32
013	5	1	91
013	5	2	61
013	5	3	41
013	5	13	31

013	5	14	26
013	5	15	1.5
017	6	1	91
017	6	3	2.4
018	7	1	98
018	7	2	51
018	7	3	35
018	7	13	26
018	7	14	21
018	7	15	1.2
022	8	1	93
022	8	13	31
023	9	1	109
023	9	13	4
024	10	1	144
024	10	2	62
024	10	3	47
024	10	13	38
024	10	14	25
024	10	15	1.2
031	11	1	141
031	11	13	2.6
032	12	1	501
032	12	2	202
032	12	13	28
032	12	14	4
034	13	1	498
034	13	3	325
034	13	13	75
034	13	15	25
038	17	1	499
038	17	3	326
038	17	5	251
038	17	13	77
038	17	15	27
038	17	18	3
040	19	1	500
040	19	3	302
040	19	5	172
040	19	13	142
040	19	15	28
040	19	18	13
043	22	1	488
043	22	3	327

043	22	5	227
043	22	13	128
043	22	15	53
043	22	18	13
052	27	1	2609
052	27	3	1999
052	27	5	951
052	27	13	502
052	27	15	103
052	27	18	13
053	28	1	2089
053	28	3	1838
053	28	5	1125
053	28	7	999
053	28	9	600
053	28	14	302
053	28	16	78
053	28	21	13
054	29	1	167
054	29	3	93
054	29	5	64
054	29	13	54
054	29	15	29
054	29	18	13
058	30	1	141
058	30	3	61
058	30	5	36
058	30	13	61
058	30	15	11
058	30	18	2
060	31	1	150
060	31	3	31
060	31	13	21
060	31	15	11
060	31	18	2

Table 5: Dissolved inorganic nutrient samples withdrawn from the non-toxic, underway supply

DATE (UTC)	TIME (UTC)	SAMPNUM (e.g. UW1)	**Uncorrected water column depth (m)**
15/06/14	12:15	UW1	37
16/06/14	10:57	UW2	109
17/06/14	11:20	UW3	101
18/06/14	20:00	UW4	110
19/06/14	12:17	UW5	147
21/06/14	13:04	UW6	2608

8. Dissolved Inorganic Carbon and Total Alkalinity

Background and objectives

Dissolved inorganic carbon (DIC) and total alkalinity (TA) discrete samples were collected by James Fox, Rosie Houlding and Paul Nelson on behalf of Sue Hartman and Caroline Kimivae at the National Oceanography Centre, Southampton (NOC). Samples were collected from CTD casts as part of WP1 in order to characterise the water column of the study area (post-bloom) and to calibrate the sensors on deployed gliders and the CEFAS Smart buoy. Samples were also collected underway. CTD and underway samples were collected as part of the Shelf Wide monitoring programme.

Sampling strategy

Discrete samples were collected from 21 CTD casts carried out with the stainless steel CTD package. Samples were withdrawn from 2 to 6 depths, spanning the entire water column (Table 6). Samples were also collected from the non-toxic, pumped seawater supply (Table 7). The non-toxic, pumped seawater intake was located approximately 6 m below sea level.

Methods

Samples were collected in 250 ml glass stoppard bottles. Samples were withdrawn from CTD niskin bottles and the non-toxic, pumped seawater supply using silicone tubing. The tubing was inserted into the base of bottle and slowly filled (and over-filled) from the bottom to avoid and remove air bubbles. Samples were immediately poisoned by removing 2.5 ml volume and adding 50 µl saturated mercuric chloride solution. The samples were then stored in the dark at room temperature for analysis back at NOC.

Table 6: Discrete DIC and TA samples withdrawn from CTD samples

STNNBR	CTD CASTNO	ROSETTE POSITION	Depth	Bottle ID
001	1	1	100	854
001	1	13	2.5	855
005	2	1	104	856
005	2	2	62	857
005	2	3	32	858
005	2	13	27	859
005	2	14	17	860
005	2	15	3.5	861
007	3	1	97	862
007	3	2	51	863
007	3	3	41	864
007	3	13	31	865
007	3	14	21	866
007	3	15	1	867
012	4	1	96	868
012	4	13	32	869
013	5	1	91	870
013	5	2	61	871
013	5	3	41	872
013	5	13	31	873

013	5	14	26	810
013	5	15	1.5	811
017	6	1	91	812
017	6	3	2.4	813
018	7	1	98	814
018	7	2	51	815
018	7	3	35	816
018	7	13	26	817
018	7	14	21	818
018	7	15	1.2	819
022	8	1	93	820
022	8	13	31	821
023	9	1	109	822
023	9	13	4	823
024	10	1	144	824
024	10	2	62	825
024	10	3	47	826
024	10	13	38	827
024	10	14	25	828
024	10	15	1.2	829
031	11	1	141	874
031	11	13	2.6	875
032	12	1	501	876
032	12	2	202	877
032	12	13	28	878
032	12	14	4	879
034	13	1	498	880
034	13	3	325	881
034	13	13	75	882
034	13	15	25	883
038	17	1	499	884
038	17	3	326	885
038	17	5	251	886
038	17	13	77	887
038	17	15	27	888
038	17	18	3	889
040	19	1	500	890
040	19	3	302	891
040	19	5	172	892
040	19	13	142	893
040	19	15	28	830
040	19	18	13	831
043	22	1	488	832
043	22	3	327	833

043	22	5	227	834
043	22	13	128	835
043	22	15	53	836
043	22	18	13	837
052	27	1	2609	838
052	27	3	1999	839
052	27	5	951	840
052	27	13	502	841
052	27	15	103	843
052	27	18	13	844
053	28	1	2089	845
053	28	3	1838	846
053	28	5	1125	847
053	28	7	999	848
053	28	9	600	849
053	28	14	302	346
053	28	16	78	191
053	28	21	13	210
054	29	1	167	347
054	29	3	93	348
054	29	5	64	445
054	29	13	54	850
054	29	15	29	851
054	29	19	13	852
058	30	1	141	853
058	30	3	61	900
058	30	5	36	897
058	30	13	61	898
058	30	15	11	899
058	30	18	2	901
060	31	1	150	790
060	31	5	31	791
060	31	13	21	902
060	31	15	11	903
060	31	18	2	904

Table 7: DIC-TA samples from the non-toxic underway supply

DATE (UTC)	TIME (UTC)	Sample ID (SAMPNO)	Uncorrected water column depth (m)
		DIC/TA	
15/06/14	12.10	785	36
16/06/14	10.55	786	109
17/06/14	11.16	787	101
18/06/14	19.57	788	110
19/06/14	12.17	789	147
21/06/14	13.02	780	2611

9. Chlorophyll-a samples

Background and objectives
Chlorophyll-a discrete samples were collected by James Fox, Rosie Houlding and Paul Nelson in order to calibrate the CTD, Cefas Smartbuoys, landers and glider sensors.

Sampling strategy
Discrete samples were collected from 21 CTD casts carried out with the stainless CTD package. Samples were withdrawn from 2 to 6 depths (Table 8).

Methods
500ml CTD water was collected in dark brown plastic bottles from predetermined depths. 200ml was mesured out from eac depth and filtered under gentle pressure through a 25mm diameter Whatman GF/F. Once finished filtering, each filters was removed, folded and placed into a labelled cryovial. Cryovials were placed into a plastic storage box and stoed in a -80°C freezer.
Sent back to Alex Poulton (NOC) for extration.

Table 8: Chl-a samples withdrawn from CTD samples

Station Number	Cast Number	Rosette Position	Depth (m)	Volume filtered (ml)
001	1	1	100	200
001	1	13	2.5	200
005	2	1	104	200
005	2	2	62	200
005	2	3	32	200
005	2	13	27	200
005	2	14	17	200
005	2	15	3.5	200
007	3	1	97	200
007	3	2	51	200
007	3	3	41	200
007	3	13	31	200
007	3	14	21	200
007	3	15	1	200
012	4	1	96	200
012	4	13	32	200
013	5	1	91	200
013	5	2	61	200
013	5	3	41	200
013	5	13	31	200
013	5	14	26	200
013	5	15	1.5	205
017	6	1	91	200
017	6	3	2.4	200
018	7	1	98	200
018	7	2	51	200

018	7	3	35	200
018	7	13	26	200
018	7	14	21	200
018	7	15	1.2	200
022	8	1	93	200
022	8	13	31	200
023	9	1	109	200
023	9	13	4	200
024	10	1	144	200
024	10	2	62	200
024	10	3	47	200
024	10	13	38	200
024	10	14	25	205
024	10	15	1.2	200
031	11	1	141	200
031	11	13	2.6	200
032	12	1	501	200
032	12	2	202	200
032	12	13	28	200
032	12	14	4	200
034	13	1	498	200
034	13	3	325	205
034	13	13	75	210
034	13	15	25	200
038	17	1	499	200
038	17	3	326	200
038	17	5	251	200
038	17	13	77	200
038	17	15	27	200
038	17	18	3	200
040	19	1	500	200
040	19	3	302	200
040	19	5	172	205
040	19	13	142	200
040	19	15	28	200
040	19	18	13	200
043	22	1	488	200
043	22	3	327	200
043	22	5	227	200
043	22	13	128	200
043	22	15	53	200
043	22	18	13	200
052	27	1	2609	200
052	27	3	1999	200

052	27	5	951	205
052	27	13	502	205
052	27	15	103	200
052	27	18	13	200
053	28	16	78	200
053	28	19	33	200
053	28	21	13	200
054	29	1	167	200
054	29	3	93	200
054	29	5	64	200
054	29	13	54	200
054	29	15	29	200
054	29	19	13	200
058	30	1	141	200
058	30	3	61	200
058	30	5	36	200
058	30	13	61	200
058	30	15	11	200
058	30	18	2	200
060	31	1	150	200
060	31	5	31	205
060	31	13	21	200
060	31	15	11	205
060	31	18	2	200

10. Suspended Particulate Matter

Methodology

A known volume of water (~1000ml) was sub-sampled from the stainless CTD bottles from 2-8 different depths. This was filtered through pre-weighed GFF filters to extract suspended particulate matter (SPM).

Table 9: SPM samples withdrawn from CTD samples

Date	STNNBR	Cast Number	Site Name	ROSETTE POSITION	Depth	FILTER ID	Filter weight	Volume filtered (ml)
	001	**1**		1	100	X70	0.12650	930
	001	**1**		2	2.5	X60	0.12674	980
	005	**2**		1	104	X3	0.12704	1000
	005	**2**		2	62	47	0.12710	990
	005	**2**		3	32	X91	0.12681	1000
	005	**2**		13	27	X66	0.12662	1000
	005	**2**		14	17	X78	0.12644	1000
	005	**2**		15	3.5	X55	0.12760	1000
	007	**3**		1	97	X65	0.12672	1000
	007	**3**		2	51	X88	0.12547	1000
	007	**3**		3	41	X14	0.12642	1000
	007	**3**		13	31	X79	0.12743	1000
	007	**3**		14	21	X62	0.12433	1000
	007	**3**		15	1	X87	0.12551	1000
	012	**4**		1	96	X83	0.12673	1000
	012	**4**		13	32	X75	0.12605	1000
	013	**5**		1	91	X19	0.12704	1000
	013	**5**		2	61	X84	0.12523	990
	013	**5**		3	41	X54	0.12618	1000
	013	**5**		13	31	X4	0.12621	1000
	013	**5**		14	26	X42	0.12508	1000
	013	**5**		15	1.5	X21	0.12527	1000
	017	**6**		1	91	X9	0.12954	950
	017	**6**		3	2.4	X24	0.12581	980
	018	**7**		1	98	X59	0.12609	990
	018	**7**		2	51	X64	0.12549	1000
	018	**7**		3	35	X69	0.12602	1000
	018	**7**		13	26	X23	0.12513	1000
	018	**7**		14	21	X74	0.12637	1000
	018	**7**		15	1.2	X89	0.12522	1000
	022	**8**		1	93	X8	0.12579	1000
	022	**8**		13	31	X94	0.12503	1000
	023	**9**		1	109	X61	0.12658	1000
	023	**9**		13	4	X96	0.12438	1000
	024	**10**		1	144	X53	0.12738	1000
	024	**10**		2	62	X71	0.12579	1000
	024	**10**		3	47	X52	0.12652	1000
	024	**10**		13	38	X93	0.12538	1000
	024	**10**		14	25	X12	0.12568	1000
	024	**10**		15	1.2	X17	0.12619	1000
	031	**11**		1	141	X49	0.12549	1000
	031	**11**		13	2.6	X7	0.12724	1000
	032	**12**		1	501	X72	0.12585	990
	032	**12**		2	202	X77	0.12692	1000
	032	**12**		13	28	X51	0.12611	1000
	032	**12**		14	4	X100	0.12678	1000
	034	**13**		1	498	X58	0.12464	1000
	034	**13**		3	325	X63	0.12513	1000
	034	**13**		13	75	X67	0.12583	1000
	034	**13**		15	25	X76	0.12611	1000
	038	**17**		1	499	X6	0.12685	1000
	038	**17**		3	326	X13	0.12565	1000
	038	**17**		5	251	X1	0.12648	1000
	038	**17**		13	71	X22	0.12616	1000
	038	**17**		15	27	X2	0.12545	1000

	038	**17**		18	3	X86	0.12656	1000
	040	**19**		1	500	X23	0.12640	990
	040	**19**		3	302	X46	0.12664	1000
	040	**19**		5	172	X56	0.12665	1000
	040	**19**		13	142	X73	0.12619	1000
	040	**19**		15	28	X45	0.12593	1000
	040	**19**		18	13	X92	0.12474	1000
	043	**22**		1	488	X41	0.12627	1000
	043	**22**		3	327	X44	0.12683	1000
	.043	**22**		5	227	X37	0.12585	990
	043	**22**		13	128	X82	0.12675	1000
	043	**22**		15	53	X16	0.12637	1000
	043	**22**		18	13	X31	0.12577	1000
	052	**27**		1	2609	X27	0.12638	1000
	052	**27**		3	1999	X57	0.12577	1000
	052	**27**		5	951	X20	0.12653	1000
	052	**27**		13	502	X50	0.12580	1000
	052	**27**		15	103	X32	0.12674	1000
	052	**27**		18	13	X36	0.12554	1000
	053	**28**		1	2098	X90	0.12681	990
	053	**28**		3	1838	X97	0.12742	1000
	053	**28**		5	1125	X11	0.12663	1000
	053	**28**		7	999	X15	012595	1000
	053	**28**		9	600	X35	0.12455	1000
	053	**28**		14	202	X40	0.12677	1000
	053	**28**		16	78	X26	0.12415	1000
	053	**28**		19	33	X29	0.12545	1000
	054	**29**		1	167	X34	0.12548	1000
	054	**29**		3	93	X39	0.12717	1000
	054	**29**		5	64	X80	0.12569	1000
	054	**29**		13	54	X85	0.12592	1000
	054	**29**		15	29	X43	0.12547	1000
	054	**29**		18	13	X48	0.12612	1000
	058	**30**		1	141	X5	0.12584	1000
	058	**30**		3	61	X10	0.12675	1000
	058	**30**		5	36	X33	0.12592	1000
	058	**30**		13	31	X38	0.12650	1000
	058	**30**		15	11	X81	0.12649	1000
	058	**30**		18	2	X95	0.12484	1000
	060	**31**		1	150	X28	0.12544	1000
	060	**31**		3	51	X30	0.12520	1000
	060	**31**		5	31	N1404	0.13977	1000
	060	**31**		13	21	N1405	0.13709	1000
	060	**31**		15	11	N1406	0.13627	1000
	060	**31**		18	2	N1407	0.14201	1000

11. Oxygen samples

Oxygen analysis was carried out onboard by Paul Nelson. The method used is a modification of the classical Winkler (1988) titration procedure.

The seawater is collected from Niskin bottles using stoppered glass bottles, the sample is treated with a strong manganese (II) solution (Manganous sulphate) and a concentrated reagent containing sodium iodide and sodium hydroxide (alkaline iodide). The bottle is then carefully stoppered so as to exclude bubbles of air and shaken. Bottles are stored under water until required for analysis.

Stoppered lids are carefully removed and sulphuric acid is added to liberate iodine and the surplus iodide ions combine to generate the I_3^- complex. The I_3^- complex is titrated against thiosulphate solution using a Metrohm Dosimat 665 Autotitrator with a SiS endpoint detector.

Table 10: Dissolved Oxygen samples withdrawn from CTD samples

STN No.	Sample depth (m)	DATE collected	Cast No.	Bottle No.	comments	DO2 mg/L
1	100	16/06/2014	1	1	Site 2 Pre	8.24
1	2.5	16/06/2014	1	13	Site 2 Pre	8.39
5	104	16/06/2014	2	1	Site 2 Pre	8.18
5	62	16/06/2014	2	2	Site 2 Post	8.18
5	32	16/06/2014	2	3	Site 2 Post	7.90
5	27	16/06/2014	2	13	Site 2 Post	8.62
5	17	16/06/2014	2	14	Site 2 Post	8.63
5	3.5	16/06/2014	2	15	Site 2 Post	8.40
7	97	17/06/2014	3	1	Site 3 Pre	7.93
7	21	17/06/2014	3	14	Site 3 Pre	8.73
7	1.0	17/06/2014	3	15	Site 3 Pre	8.59
12	96.	17/06/2014	4	1	Site 3 Post	7.97
12	32	17/06/2014	4	13	Site 3 Post	8.36
13	91	17/06/2014	5	1	Site 4 Pre	7.87
13	61	17/06/2014	5	2	Site 4 Pre	7.87
13	41	17/06/2014	5	3	Site 4 Pre	7.97
13	31	17/06/2014	5	13	Site 4 Pre	8.41
13	26	17/06/2014	5	14	Site 4 Pre	8.66
13	1.5	17/06/2014	5	15	Site 4 Pre	8.53
17	91	17/06/2014	6	1	Site 4 Post	7.91
17	2.4	17/06/2014	6	3	Site 4 Post	8.62
18	98	18/06/2014	7	1	Site 5 Pre	7.87
18	51	18/06/2014	7	2	Site 5 Pre	7.89
18	35	18/06/2014	7	3	Site 5 Pre	8.10
18	26	18/06/2014	7	13	Site 5 Pre	8.36
18	21	18/06/2014	7	14	Site 5 Pre	8.71
18	1.2	18/06/2014	7	15	Site 5 Pre	8.54
22	93	18/06/2014	8	1	Site 5 Post	7.89
22	31	18/06/2014	8	13	Site 5 Post	8.30
23	109	18/06/2014	9	1	CTD A1	8.12

23	4.0	18/06/2014	9	13	CTD A1	8.22
24	144	19/06/2014	10	1	Site 1 Pre	8.37
24	62	19/06/2014	10	2	Site 1 Pre	8.36
24	47	19/06/2014	10	3	Site 1 Pre	8.44
24	38	19/06/2014	10	13	Site 1 Pre	8.71
24	25	19/06/2014	10	14	Site 1 Pre	8.75
24	1.2	19/06/2014	10	15	Site 1 Pre	8.29
31	141	19/06/2014	11	1	Site 1 Post	8.38
31	2.6	19/06/2014	11	13	Site 1 Post	8.28
32	501	20/06/2014	12	1	CTD Glider	7.54
32	202	20/06/2014	12	2	CTD Glider	8.04
32	28	20/06/2014	12	13	CTD Glider	8.81
32	4.0	20/06/2014	12	14	CTD Glider	8.82
34	498	20/06/2014	13	1	CTD 13	7.48
34	75	20/06/2014	13	13	CTD 13	8.32
38	499	20/06/2014	17	1	CTD 17	7.28
38	27	20/06/2014	17	15	CTD 17	8.80
40	500	20/06/2014	19	1	CTD 19	7.44
40	28	20/06/2014	19	15	CTD 19	8.93
43	488	21/06/2014	22	1	CTD 22	7.55
43	53	21/06/2014	22	15	CTD 22	8.67
52	1999	21/06/2014	27	3	CTD 27	8.52
52	951	21/06/2014	27	5	CTD 27	6.40
53	999	22/06/2014	28	7	CTD 28	6.31
53	33	22/06/2014	28	19	CTD 28	8.60
54	167	22/06/2014	29	1	CTD 29	8.50
54	54	22/06/2014	29	13	CTD 29	8.46
58	36	22/06/2014	30	5	CTD 30	8.82
58	11	22/06/2014	30	15	CTD 30	8.35
58	2.0	22/06/2014	30	18	CTD 30	8.31
60	150	22/06/2014	31	1	CTD 31	8.13
60	21	22/06/2014	31	13	CTD 31	8.96

12. Salinity sample analysis

A Guildline 8400B, (S/N 65764) was installed in the Constant Environment Laboratory and used by Jeff Benson to analyse salinity samples.

Table 11: Results of autosal analysis mapped against CTD cast, station number and rosette position

NMFID	STNNBR	ROSPOS	Bottle number	BOTsal
19	40	4	CTD6 164	35.583
19	40	13	CTD6 165	35.5723
19	40	15	CTD6 166	35.5859
19	40	18	CTD6 167	35.5847
22	43	1	CTD6 168	35.5752
22	43	3	CTD6 169	35.5658
22	43	5	CTD6 170	35.5653
22	43	13	CTD6 171	35.5874
28	53	1	CTD6 174	35.0606
27	52	5	CTD6 175	35.6763
27	52	3	CTD6 176	34.9765
27	52	1	CTD6 177	34.943
29	54	1	CTD6 180	35.5512
29	54	13	CTD6 181	35.5527
30	58	1	CTD6 182	35.3221
30	58	18	CTD6 183	35.3427
31	60	1	CTD6 184	35.4835
31	60	13	CTD6 185	35.4595
2	5	1	CTD14 356	35.2691
2	5	2	CTD14 357	35.2726
2	5	15	CTD14 358	35.2468
3	7	1	CTD14 359	35.2095
3	7	13	CTD14 360	34.9341
1	1	2	CTD14 361	35.2464
1	1	13	CTD14 362	35.2474
1	1	1	CTD14 363	35.264
3	7	15	CTD14 364	34.9702
4	12	1	CTD14 365	35.2133
4	12	13	CTD14 366	35.1044
5	13	1	CTD14 367	35.2061
5	13	2	CTD14 368	35.2069
5	13	15	CTD14 369	34.9334
6	17	1	CTD14 370	35.2069
6	17	3	CTD14 371	34.9325
7	18	1	CTD14 372	35.246
7	18	2	CTD14 373	35.2469
7	18	14	CTD14 374	35.0636

7	18	15	CTD14 375	35.1779
8	22	1	CTD14 376	35.254
8	22	14	CTD14 377	35.2317
9	23	1	CTD14 378	35.291
9	23	13	CTD14 379	35.3055
10	24	1	CTD33 812	35.3225
10	24	2	CTD33 813	35.3229
10	24	3	CTD33 814	35.3157
10	24	13	CTD33 815	35.3016
10	24	14	CTD33 816	35.3063
10	24	15	CTD33 817	35.331
11	31	1	CTD33 818	35.321
11	31	13	CTD33 819	35.3226
12	32	1	CTD33 820	35.5745
12	32	2	CTD33 821	35.5778
12	32	13	CTD33 822	35.5605
12	32	14	CTD33 823	35.5618
13	34	1	CTD33 824	35.5765
13	34	2	CTD33 825	35.5664
13	34	13	CTD33 826	35.5946
13	34	15	CTD33 827	35.553
17	38	1	CTD33 828	35.5845
17	38	3	CTD33 829	35.5714
17	38	5	CTD33 830	35.5766
17	38	13	CTD33 831	35.5689
17	38	15	CTD33 832	35.5583
17	38	18	CTD33 833	35.5713
19	40	1	CTD33 834	35.5774
19	40	3	CTD33 835	35.5769

13. FRRF

Fast repetition rate fluorometry (FRRf) data were collected by James Fox using two *FastOcean* fluorometers (Chelsea Technologies Group, CTG) provided by National Marine Facilities (NMF) and one *FastTracka* MK II fluorometers (CTG) provided by the University of Essex. *FastAct* (CTG) units were used with one of each machine (MK II and III) in order to collect light response data. The second *FastOcean* instrument was fitted with a flow through chamber to allow the continuous collection of dark adapted fluorescence measurements. Discrete samples were taken from the various depths and a light response curve was run after dark adaption of the sample (sample container was kept in a water bath set at temperature of collection). Water samples were measured from 21 CTD casts as well as 26 additional “underway stations” (a sample was drawn from the ships continuous non-toxic underway water supply for the collection of pigments and FRRf) independent of the SSB program. Attempts were made during the duration of the cruise to run continuous light response curves using the *FastOcean* and underway water supply. Issues with equipment meant this was only possible for 6 of the 9 days at sea. Dark chamber measurements took place continuously (one measurement per 3-6 seconds) from the 19/06/2014 - 24/06/2014.

Table 12: FRRf sample logs

STN#/Event	Date	Time	Cast	Rosette #	Sample depth	Fluorescence	Lat	Long	Pigments	FRRf	Filter pad colour/Comments
UW2	16/06/2014	11.00	-	-	-						
STN001	16/06/2014	13.00	1	13	100	-	-	-	Y	Y	
STN001	16/06/2014	13.00	1	1	25	-	-	-	Y	Y	
STN005	16/06/2014	17.00	2	1	104	-	-	-	N	N	
STN005	16/16/2014	17.00	2	2	62	-	-	-	Y	Y	
STN005	16/06/2014	17.00	2	3	32	-	-	-	Y	Y	
STN005	16/06/2014	17.00	2	13	27	-	-	-	Y	Y	
STN005	16/06/2014	17.00	2	14	17	-	-	-	Y	Y	
STN005	16/06/2014	17.00	2	15	3.5	-	-	-	N	N	
STN007	17/06/2014	6.30	3	1	97	-	-	-	Y	Y	
STN007	17/06/2014	6.30	3	2	51	-	-	-	Y	Y	
STN007	17/06/2014	6.30	3	3	41	-	-	-	Y	Y	
STN007	17/06/2014	6.30	3	13	31	-	-	-	Y	Y	
STN007	17/06/2014	6.30	3	14	21	-	-	-	Y	Y	
STN007	17/06/2014	6.30	3	15	1	-	-	-	Y	Y	
STN012	17/06/2014		4	1	96	-	-	-	N	Y	
STN012	17/06/2014		4	13	32	-	-	-	N	Y	
STN013	17/06/2014	17.00	5	1	91	-	-	-	Y	Y	
STN013	17/06/2014	17.00	5	2	61	-	-	-	Y	Y	
STN013	17/06/2014	17.00	5	3	41	-	-	-	Y	Y	
STN013	17/06/2014	17.00	5	13	31	-	-	-	Y	Y	
STN013	17/06/2014	17.00	5	14	26	-	-	-	Y	Y	
STN013	17/06/2014	17.00	5	15	1.5	-	-	-	Y	Y	
STN017	17/06/2014		6	1	91	-	-	-	Y	Y	
STN017	17/06/2014		6	3	2.4	-	-	-	Y	Y	
STN018	18/06/2014	8.30	7	1	98	-	-	-	Y	Y	
STN018	18/06/2014	8.30	7	2	51	-	-	-	Y	Y	
STN018	18/06/2014	8.30	7	3	35	-	-	-	Y	Y	
STN018	18/06/2014	8.30	7	13	26	-	-	-	Y	Y	
STN018	18/06/2014	8.30	7	14	21	-	-	-	Y	Y	
STN018	18/06/2014	8.30	7	15	1.2	-	-	-	Y	Y	

UW4	18/06/2014	20.00	-	-	-	-	-	-	Y	N	
STN022	18/06/2014		8	1	93	-	-	-	N	N	
STN022	18/06/2014		8	13	31	-	-	-	Y	Y	
STN023	18/06/2014		9	1	109	-	-	-	Y	N	
STN023	18/06/2014		9	13	4	-	-	-	Y	N	
UW5	19/06/2014	-	-	-	-	-	-	-	Y	Y	
STN024	19/06/2014		10	1	144	-	-	-	N	N	
STN024	19/06/2014		10	2	62	-	-	-	N	Y	
STN024	19/06/2014		10	3	47	-	-	-	Y	Y	good colour
STN024	19/06/2014		10	13	38	-	-	-	Y	Y	good colour
STN024	19/06/2014		10	14	25	-	-	-	Y	Y	good colour
STN024	19/06/2014		10	15	1.2	-	-	-	Y	Y	
STN031	19/06/2014		11	1	141	-	-	-	N	N	
STN031	19/06/2014		11	13	26	-	-	-	Y	Y	
STN032	20/06/2014	6.30	12	1	501	-	-	-	N	N	
STN032	20/06/2014	6.30	12	2	202	-	-	-	N	N	
STN032	20/06/2014	6.30	12	13	28	-	-	-	Y	Y	good colour
STN032	20/06/2014	6.30	12	14	4	-	-	-	Y	Y	good colour
STN034	20/06/2014	12.00	13	1	498	-	-	-	N	N	
STN034	20/06/2014	12.00	13	3	325	-	-	-	Y	N	v. Little colour
STN034	20/06/2014	12.00	13	13	75	-	-	-	Y	Y	v. Little colour
STN034	20/06/2014	12.00	13	15	25	-	-	-	Y	Y	v. Little colour
STN038	20/06/2014	15.40	17	1	499	-	-	-	N	N	
STN038	20/06/2014	15.40	17	3	326	-	-	-	N	N	
STN038	20/06/2014	15.40	17	5	25	-	-	-	N	N	
STN038	20/06/2014	15.40	17	13	71	-	-	-	Y	Y	avg. Colour
STN038	20/06/2014	15.40	17	15	27	-	-	-	Y	Y	good colour
STN038	20/06/2014	15.40	17	18	3	-	-	-	Y	Y	good colour
STN040	20/06/2014	17.40	19	1	500	-	-	-	N	N	
STN040	20/06/2014	17.40	19	3	302	-	-	-	N	N	
STN040	20/06/2014	17.40	19	5	172	-	-	-		N	
STN040	20/06/2014	17.40	19	13	142	-	-	-	Y	N	
STN040	20/06/2014	17.40	19	15	28	-	-	-	Y	Y	good colour
STN040	20/06/2014	17.40	19	18	13	-	-	-	Y	Y	good colour
UWD1	20/06/2014	19.45	-	-			48◦ 22.658N	9◦ 33.921 W	N	Y	
STN043	20/06/2014	20.00	22	1	488	-	-	-	N	N	

STN043	20/06/2014	20.00	22	3	327	-	-	-	N	N	
STN043	20/06/2014	20.00	22	5	227	-	-	-	N	N	
STN043	20/06/2014	20.00	22	13	128	-	-	-	N	N	
STN043	20/06/2014	20.00	22	15	53	-	-	-	Y	Y	avg. Colour
STN043	20/06/2014	20.00	22	18	13	-	-	-	Y	Y	good colour
UWD2	20/06/2014	21.00	-	-	-	-	48◦22.659N	9◦33.921W	N	Y	
UWD3	21/06/2014	8.48	-	-	-	0.241	48◦22.800N	9◦32.177W	Y	Y	
UWD4	21/06/2014	10.15	-	-	-	0.14	48◦19.905N	9◦26.514W	Y	Y	
UWD5	21/06/2014	11.44	-	-	-	0.21	48◦15.910N	9◦40.223W	Y	Y	
UWD6	21/06/2014	12.55	-	-	-	0.156	48◦11.714N	9◦54.409W	Y	Y	
UWD7	21/06/2014	13.45	-	-	-	0.162	48◦11.647N	9◦54.329W	Y	Y	
UWD8	21/06/2014	14.55	-	-	-	0.204	48◦11.649N	9◦54.328W	Y	Y	
STN052	21/06/2014	16.00	27	1	2609	-	-	-	N	N	
STN052	21/06/2014	16.00	27	3	1999	-	-	-	N	N	
STN052	21/06/2014	16.00	27	5	951	-	-	-	N	N	
STN052	21/06/2014	16.00	27	13	502	-	-	-	N	N	
STN052	21/06/2014	16.00	27	15	103	-	-	-	Y	Y	v. Little colour
STN052	21/06/2014	16.00	27	18	13	-	-	-	Y	Y	good colour
UWD9	21/06/2014	16.43	-	-	-	0.21	48◦19.166N	9◦47.927	Y	Y	
UWD10	21/06/2014	18.28	-	-	-	-	-	-	Y	Y	
STN053	21/06/2014		28	1	2154	-	-	-	N	N	
STN053	21/06/2014		28	3	1838	-	-	-	N	N	
STN053	21/06/2014		28	5	1125	-	-	-	N	N	
STN053	21/06/2014		28	7	999	-	-	-	N	N	
STN053	21/06/2014		28	9	600	-	-	-	N	N	
STN053	21/06/2014		28	14	302	-	-	-	N	N	
STN053	21/06/2014		28	16	78	-	-	-	Y	Y	v. Little colour
STN054	22/06/2014		28	19	33	-	-	-	Y	Y	v. Little colour
STN053	21/06/2014		28	21	13	-	-	-	Y	Y	avg. Colour
UWD11	21/06/2014	21.38	-	-	-				Y	Y	
STN054	21/06/2014	22.00	29	1	167	-	-	-	N	N	
STN054	21/06/2014	22.00	29	3	93	-	-	-	N	N	
STN054	21/06/2014	22.00	29	5	64	-	-	-	Y	Y	
STN054	21/06/2014	22.00	29	13	54	-	-	-	Y	Y	
STN054	21/06/2014	22.00	29	15	29	-	-	-	Y	Y	
STN054	21/06/2014	22.00	29	18	13	-	-	-	Y	Y	

UWD12	22/06/2014	8.14	-	-	-	0.087	49◦23.980N	08◦36.058W	Y	Y	
STN058	22/06/2014	11.30	30	1	141	-	-	-	Y	Y	
STN058	22/06/2014	11.30	30	3	61	-	-	-	Y	Y	
STN054	22/06/2014	11.30	30	5	36	-	-	-	Y	Y	v.good colour
STN054	22/06/2014	11.30	30	13	31	-	-	-	Y	Y	v.good colour
STN054	22/06/2014	11.30	30	15	11	-	-	-	Y	Y	good colour
STN054	22/06/2014	11.30	30	18	2	-	-	-	Y	Y	good colour
STN054	22/06/2014	16.00	31	1	150	-	-	-	Y	N	
STN054	22/06/2014	16.00	31	3	51	-	-	-	Y	N	
STN054	22/06/2014	16.00	31	5	33	-	-	-	Y	N	
STN054	22/06/2014	16.00	31	13	21	-	-	-	Y	N	
STN054	22/06/2014	16.00	31	15	11	-	-	-	Y	N	
STN054	22/06/2014	16.00	31	18	2	-	-	-	Y	N	
UWD13	22/06/2014	17.27	-	-	-	0.0992	49◦03.255N	8◦40.145W	Y	Y	
UWD14	22/06/2014	18.33	-	-	-	0.0928	49◦05.802N	8◦25.844W	Y	Y	
UWD15	23/06/2014	9.10	-	-	-	0.0748	49◦43.468N	5◦09.553W	Y	Y	
UWD16	23/06/2014	10.05	-	-	-	0.0717	49◦45.767N	5◦00.320W	Y	Y	
UWD17	23/06/2014	11.10	-	-	-	0.0719	49◦48.660N	4◦49.207W	Y	Y	
UWD18	23/06/2014	13.13	-	-	-	0.0842	49◦53.616N	4◦29.901W	Y	Y	
UWD19	23/06/2014	14.15	-	-	-	0.0745	49◦55.765N	4◦20.090W	Y	Y	
UWD20	23/06/2014	16.26	-	-	-	0.0856	50◦00.969N	3◦58.013W	Y	Y	
UWD21	23/06/2014	18.20	-	-	-	0.0853	50◦05.805N	3◦38.572W	Y	Y	
UWD22	23/06/2014	19.37	-	-	-	0.0851	50◦08.672N	3◦26.160W	Y	Y	
UWD23	23/06/2014	20.37	-	-	-	0.0865	50◦10.733N	3◦17.507W	Y	Y	

(red)	SSB underway
(blue)	Independent underway
(green)	Rosette station

14. VMADCP

OS150 configuration

No. Bins: 96
Bin Size: 4 m
Blanking distance: 4 m
Transducer depth: 6 m
High resolution (Broadband) processing
Bottom track range when on: 500 m
EA = 0°

OS75 configuration

No. Bins: 48
Bin Size: 16 m
Blanking distance: 8 m
Transducer depth: 6 m
Low resolution (long-range) processing
Bottom track range when on: 1200 m
EA initially set to 0° then changed to 9°

Table 13: Log of files created from the OS150

JDAY - DATE	TIME	FILENAME	O/C	COMMENTS
166 15/06/2014	09:36	ADCP150_JC105001	OPENED	Setup file OS150BB_BTon_JC105_up_nosync EA = 0 In Southampton Water
166	13:24		CLOSED	
166	13:25	ADCP150_JC105002	OPENED	
167 16/06/2014	08:13		CLOSED	
167	08:14	ADCP150_JC105003	OPENED	Approaching Site 2
167	18:57		CLOSED	End of work at Site 2
167	18:58	ADCP150_JC105004	OPENED	En route to Site 3 and start of VMADCP transect
168 17/06/2014	05:50		CLOSED	Software appeared to crash/freeze at 21:00 on Jday 167
168	05:55	ADCP150_JC105005	OPENED	Restarted VMDAS before opening at start of work at Site 3. Original file saved to \command_files\ as 001
168	17:40		CLOSED	End of work at Site 4 and starting ADCP transect again
168	17:40	ADCP150_JC105006	OPENED	Starting ADCP transect at Celtic Deep
169 18/06/2014	09:20		CLOSED	Original file saved to \command_files\ as 002
169	11:01	ADCP150_JC105007	OPENED	Site 5. Original file saved to \command_files\ as 003
169	11:04		CLOSED	Realised folder/file logging error
169	11:07	ADCP150_JC105008	OPENED	Site 5. Realised folder/file logging error
169	16:05		CLOSED	
169	16:20	ADCP150_JC105009	OPENED	En-route to Site 1. Logging again to \raw_data\
170 19/06/2014	06:48		CLOSED	
170	06:49	ADCP150_JC105010	OPENED	Start of work at Site 1
170	11:12		CLOSED	Closed to remove acoustic noise while recovering

				bedframe
170	12:30	ADCP150_JC105011	OPENED	Site 1
171 20/06/2014	06:01		CLOSED	Arrival at glider recovery site (shelf edge)
171	06:02	ADCP150_JC105012	OPENED	Start of glider calibration CTDs. Included excursion to get Stella
172 21/06/2014	10:00		CLOSED	Closed to start pinging LT2 lander
172	10:51	ADCP150_JC105013	OPENED	Setup file OS150BB_BToff_JC105_up_nosync. Change of config file while in deep water off the shelf
172	21:01		CLOSED	
172	21:03	ADCP150_JC105014	OPENED	Bottom track back on. Heading source HDT
173 22/06/2014	16:05		CLOSED	End of science after final CTD cast at A5
173	16:06	ADCP150_JC105015	OPENED	Transit home
174 23/06/2014	09:02		CLOSED	

Table 14: Log of files created from the OS75

JDAY - DATE	TIME	FILENAME	O/C	COMMENTS
166 15/06/2014	09:40	ADCP75_JC105001	OPENED	Setup file JC105_75_BTon_up_nosync. EA = 0. IN Southampton water
166	14:03		CLOSED	
166	14:04	ADCP75_JC105002	OPENED	In channel. Software appeared to freeze at 21:24
167 16/06/14	08:15		CLOSED	Software appeared to freeze at 21:24 15/06/2014 but files were still being modified at 08:15 16/06/2014
167	08:18	ADCP75_JC105003	OPENED	Same config. Approaching Site 2.
167	09:49		CLOSED	
167	09:53	ADCP75_JC105004	OPENED	New config. file with EA-9 based on misalignment angle calculation from file 002 of -8.96°. Beam 3 is 9° clockwise from the ships centreline? JC105_75_BTon_up_nosync_EA9
167	18:56		CLOSED	End of work at Site 2.
167	19:05	ADCP75_JC105005	OPENED	En-route to Site 3 and start of overnight ADCp transect
168 17/06/2014	05:51		CLOSED	
168	05:52	ADCP75_JC105006	OPENED	Site 3
168	17:38		CLOSED	End of work at Site 4
168	17:39	ADCP75_JC105007	OPENED	Start of ADCP transect at Celtic Deep
169 18/06/2014	09:20		CLOSED	
169	11:03	ADCP75_JC105008	OPENED	Site 5 and transit to Site 1
170 19/06/2014	06:50		CLOSED	
170	06:50	ADCP75_JC105009	OPENED	Start of work at Site 1
170	11:12		CLOSED	Closed to reduce noise during bedframe recovery
170	12:30	ADCP75_JC105010	OPENED	Site 1
171 20/06/2014	06:03		CLOSED	
171	06:03	ADCP75_JC105011	OPENED	Start of glider calibration CTDs at shelf edge. Included excursion to recover Stella.
172 21/06/2014	10:01		CLOSED	Pinging LT2 lander
172	10:45	ADCP75_JC105012	OPENED	Bottom track off. JC105_75_BToff_up_nosync. En-route to start of cross-shelf CTD transect. EA=0
172	21:04		CLOSED	
172	21:05	ADCP75_JC105013	OPENED	Bottom track back on
173 22/06/2014	16:06		CLOSED	End of science at CTD station A5
173	16:07	ADCP75_JC105014	OPENED	Transit back to Southampton
174 23/06/2014	09:01		CLOSED	

15. Long term moorings

Summary

Table 13 summarises the deployment and recovery times and positions of the long-term moorings. Note that the Cefas Mini-lander at Site 5 could not be located and was therefore not recovered. Also, the Cefas Smartbuoy at Site 1 started drifting away from its position on 11th May 2014 so was recovered by the RRS Discovery on 31st May 2014 whilst on her way back to the UK. More detailed mooring and sensor information can be found in the following sections. Further times and positions relevant to the mooring deployments and recoveries can be found in the cruise Event Logs (see Appendix).

Table 15: Summary of long-term mooring deployment and recovery positions and dates/times

	Mooring	**Date**	**Time**	**Latitude**	**Longitude**	**Depth (m)**
Recoveries		*Recovery start time*				
Site 1 (Candyfloss)	Temperature chain	19/06/2014	09:17	49° 23.97123 N	8° 36.23039 W	149
	ADCP bedframe	19/06/2014	11:10	49° 23.94856 N	8° 36.01027 W	147
	In-line ADCP mooring	19/06/2014	10:30	49° 24.10733 N	8° 36.0656 W	149
Site 2 (East of Haig Fras)	Cefas Mini-lander	16/06/2014	14:42	50° 35.7890 N	7° 1.62899 W	107
Site 3 (Nymph Bank)	Cefas Mini-lander	17/06/2014	09:02	51° 2.7111 N	6° 35.86665 W	104
Site 4 (Celtic Deep)	Cefas Smartbuoy	17/06/2014	13:45	51° 8.26289 N	6° 33.94874 W	97
Site 5 (East of Celtic Deep)	Cefas Mini-lander	NOT RECOVERED				105
Deployments		*Recovery end time (anchor/frame dropped)*				
Site 1 (Candyfloss)	Temperature chain	19/06/2014	17:08	49° 24.01266 N	8° 36.12702 W	
	ADCP bedframe	22/06/2014	10:47	49° 23.97278 N	8° 35.85584 W	
	In-line ADCP mooring	22/06/2014	08:52	49° 24.14275 N	8° 36.00268 W	
	Cefas Smartbuoy	19/06/2014	14:29	49° 24.1280 N	8° 36.19334 W	
Site 2 (East of Haig Fras)	Cefas Mini-lander	16/06/2014	17:32	50° 35.73941 N	7° 1.33929 W	109
Site 3 (Nymph Bank)	Cefas Mini-lander	17/06/2014	10:42	51° 2.61211 N	6° 35.96045 W	103
Site 4 (Celtic Deep)	Cefas Smartbuoy	17/06/2014	16:56	51° 8.25839 N	6° 34.02668 W	97
Site 5 (East of Celtic Deep)	Cefas Mini-lander	18/06/2014	13:52	51° 7.68305 N	6° 9.34062 W	102

Site 1 Recoveries

ADCP Bedframe

It is suspected that spooler when released at ~11:15 required > 1 hour to make the surface, and the surface current of ~0.5m/s resulted in the spooler only just making the surface for a visual identification. This delay resulted in a ballast jettison being requested for 12:00. Subsequent acoustic range finding with a surface/ship's hull transducer indicated that the frame had not moved from its initial position after the ballast jettison release had been activated at 12:00. Shortly after this the spooler was spotted on the surface. It later transpired that when the spooler was released the frame did not have enough buoyancy to clear the ballast and surface. An updated procedure will be devised for operating the NOCL Spoolerbuoy™ that will include a longer time to allow surfacing, the use of more buoyant spooler rope and the use of more positive buoyancy in the upper part of the frame.	
NOCL component	**Details**
RS485 + DQ pressure CTD, SN4596	77cm above seabed – horizontal mounting – clock drift GMT +0s on 19/06/14 – preliminary checks show a full data return.
*Flowquest 150 kHz ADCP, SN11043	Unable to communicate with instrument after recovery – the problem is being investigated with support from the manufacturer, LinkQuest USA.
*600 kHz RDI (turbulence mode) gimbal ADCP, SN5807 2GB mem	After recovery the instrument was shut down at 18:48 on 20/06/14 and a clock drift of GMT +11 seconds was recorded. Preliminary checks show a full data return with data recording worked correctly for 85 days from 26/03/14 to 20/06/14
NOCL Spoolerbuoy™ acoustic release for frame and ballast recovery attempt	SN72382, RX 10.0, TX 12.0, Release A
NOCL ballast jettison acoustic release 1	SN72381, RX 11.0, TX 12.0, Release B
NOCL ballast jettison acoustic release 2	SN72858, RX 14.5, TX 12.0, Release A

* Script file/parameters available upon request

Temperature Chain

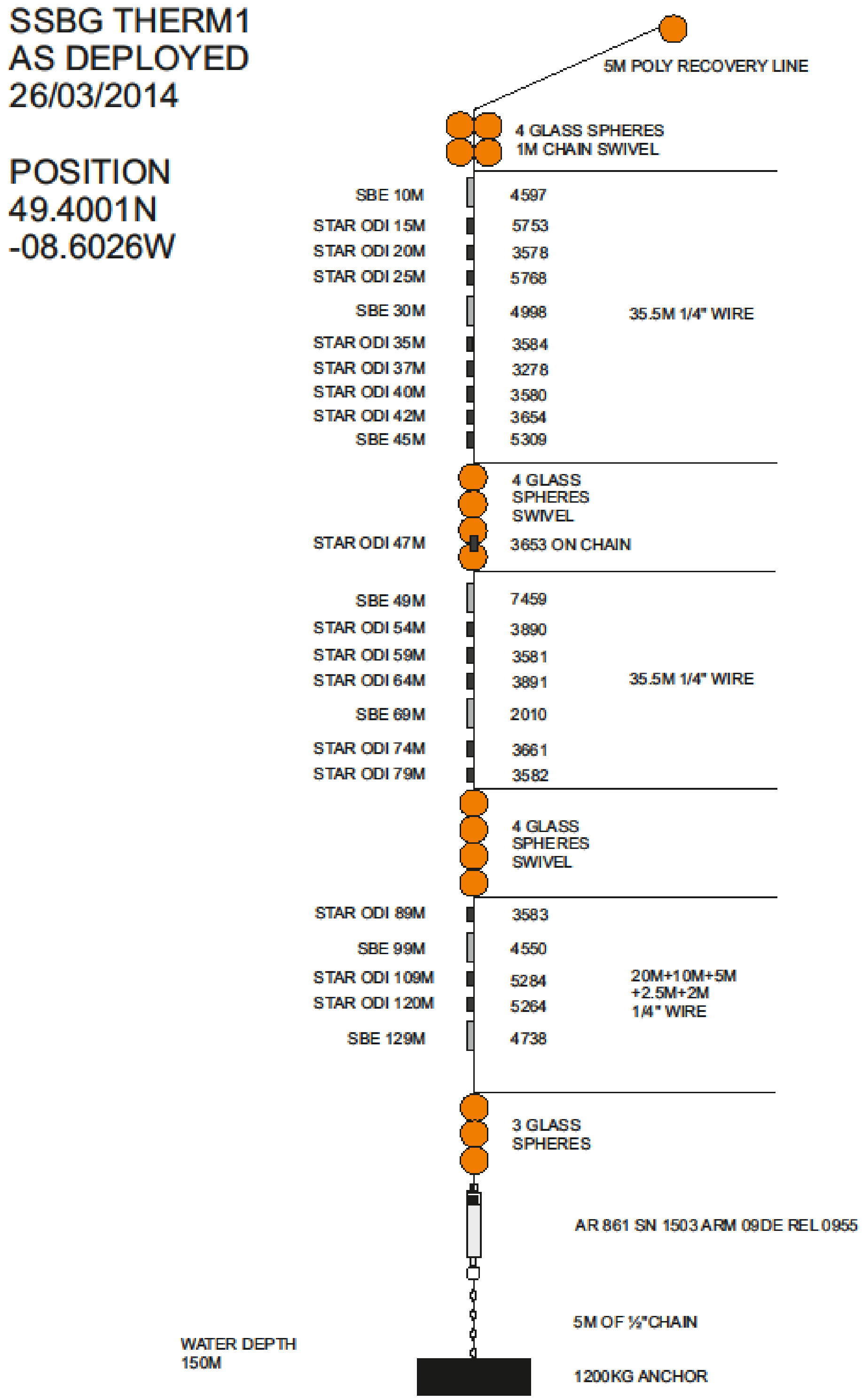


Figure 4: Mooring diagram of Site 1 temperature chain recovered on JC015

Long term T chain1

The Long Term T chain 1 instruments were put into a sink of saltwater on 19/06/14 for measurement comparison before removal and data downloading started on 21/06/14. Initial indications show a full data return from the Long Term T chain 1 instruments deployed during DY008.

Depth	Type	Param	SN	Details
-10	SBE 16+	RS485+ DQ pressure CTD	4597	Clock drift was GMT +41s
-15	Star Oddi DST	CT	5753	Clock drift GMT -2s, 61% batt
-20	Starmon mini	T	3578	Clock drift GMT -12s, 83% batt
-25	Star Oddi DST	CT	5768	Clock drift GMT -5s, 61% batt
-30	SBE 37	RS232 + press (unpump) CTD	4998	Clock drift GMT +17s
-35	Starmon mini	T	3584	Clock drift GMT -10s, 83% batt
-37	Star Oddi DST	TP	3278	Clock drift GMT -7s, 45% batt
-40	Starmon mini	T	3580	Clock drift GMT -20s, 83% batt
-42	Star Oddi DST	TP	3654	Clock drift GMT -17s, 45% batt
-45	SBE 16+	RS232 + DQ pressure CTD	5309	Clock drift GMT +18s
-47	Star Oddi DST	TP	3653	Clock drift GMT -7s, 43% batt
-49	SBE 37	RS485+pressure (pumped) CTD	7459	Clock drift GMT +13s
-54	Starmon mini	T	3890	Clock drift GMT -5s, 88% batt
-59	Starmon mini	T	3581	Clock drift GMT -8s, 83% batt
-64	Starmon mini	T	3891	Clock drift GMT -4s, 88% batt
-69	SBE 37	IM + No pressure CT	2010	Clock drift GMT -28s
-74	Star Oddi DST	TP	3661	Clock drift GMT -3s, 40% batt
-79	Starmon mini	T	3582	Clock drift GMT -8s, 83% batt
-89	Starmon mini	T	3583	Clock drift GMT -2s, 83% batt
-99	SBE 37	RS232 + press (pumped) CTD	4550	Clock drift GMT -2s
-109	Star Oddi DST	TP	5284	Clock drift GMT -6s, 71% batt
-120	Star Oddi DST	TP	5264	Clock drift GMT -6s, 71% batt
-129	SBE 16+	RS485 + DQ pressure CTD	4738	Clock drift GMT +42s

In-line ADCP (turbulence) mooring

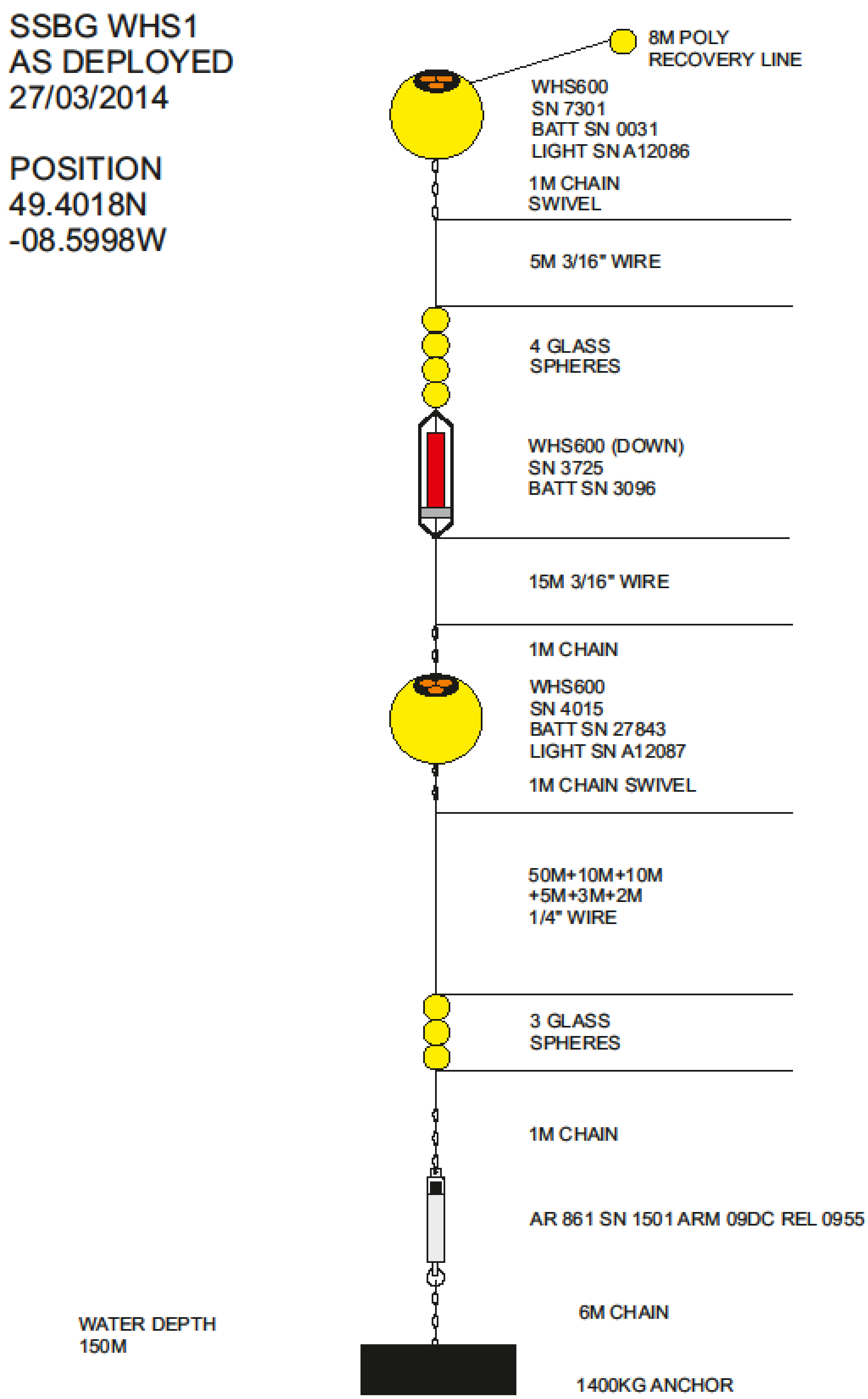


Figure 5: Mooring diagram of Site 1 in-line ADCP (turbulence) mooring recovered on JC105

Cefas Smartbuoy

The Smartbuoy broke free from its mooring position on 11th May 2014 and was subsequently recovered by the RRS Discovery on 31st May. All the surface instrumentation attached to the surface toroid was recovered, but not the temperature loggers or water sampler mounted below.

Cefas Instrumentation on surface buoy was all set to record for 5 min every 30 minutes on the half hour:

ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu +wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper
- Licor 192 PAR sensor in-air
- SBE37
- 50 port water sampler for inorganic nutrients

NOCL component	Details
McLane RAS 500 Water Sampler, SNML12500-01 at ~-100m	Suspect trawling activity caused the loss of the water sampler.
Starmon Mini SN3887 at -2.5m	Instrument lost due to suspected trawling activity.
DST Cent SN3602 at -5m	Instrument lost due to suspected trawling activity.

Site 1 Deployments

ADCP bedframe

Extra buoyancy of ~60KG was added to this frame and an extra ballast weight of ~30kg	
NOCL component	**Details**
RS485 + DQ pressure, pumped CTD, SN4736	Clock reset and logging set for 10:30 on 22/06/14 - 79cm above seabed, 300s logging interval – horizontal mounting
*Flowquest 150 kHz ADCP, SN11625	Memory cleared on 14/06/14, clock reset and delayed start set for 08:00 on 19/06/14 – 85cm from seabed to top of sensor array
*600 kHz RDI (turbulence mode) gimbal ADCP, SN20903 2GB mem, 200m pressure sensor	97cm above seabed – beam 4 points towards the frame spooler - clock reset to 16:10 on 13/06/14 and logging set for 08:00 on 19/06/14
NOCL Spoolerbuoy™ acoustic release for frame and ballast recovery attempt	SN72863, RX 13.5, TX 12.0, Release A
NOCL ballast jettison acoustic release 2	SN70355, RX 10.0, TX 12.0, Release B
NOCL ballast jettison acoustic release 1	SN70358, RX 11.0, TX 12.0, Release A

* Script file/parameters available upon request

Temperature Chain

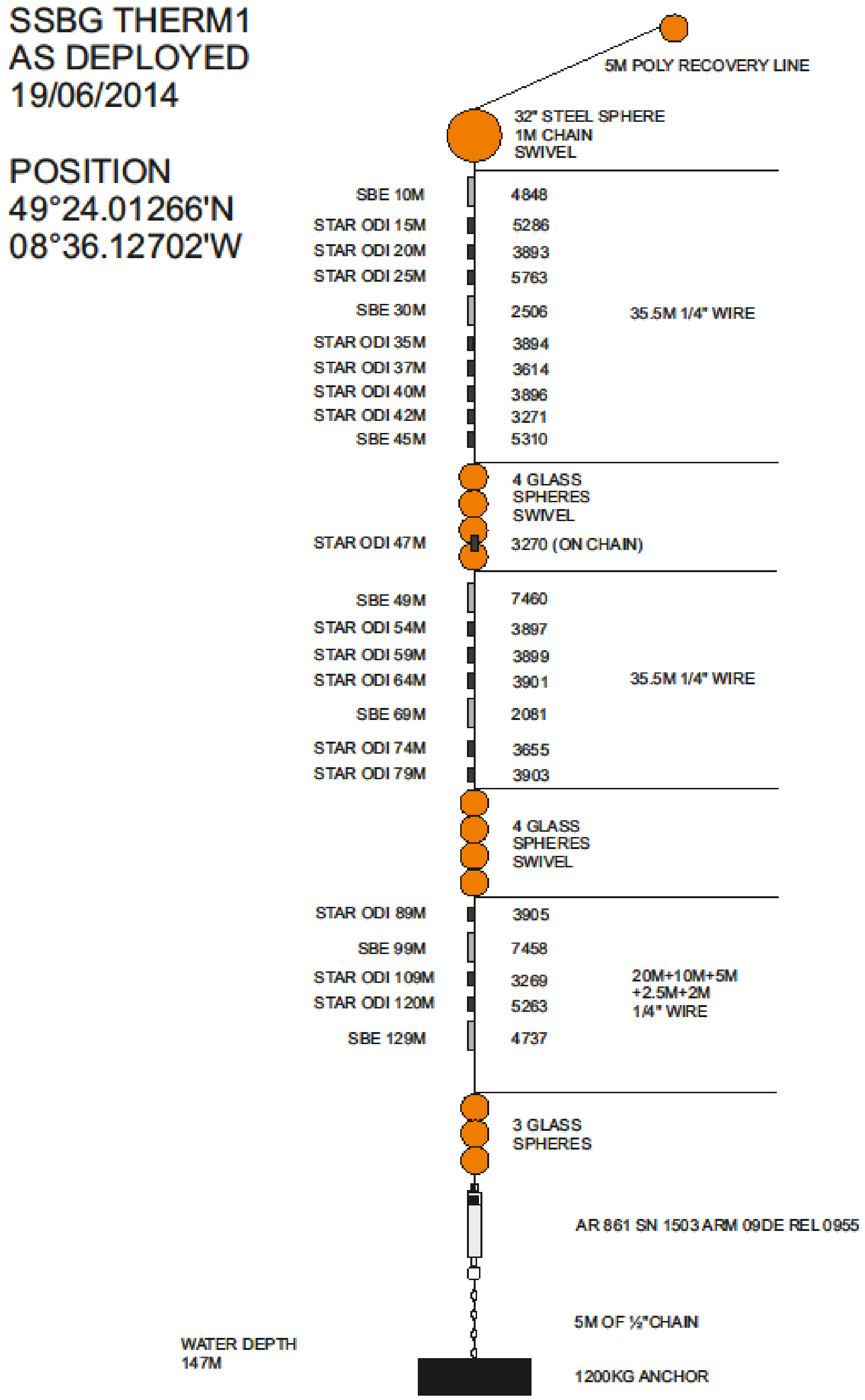


Figure 6: Mooring diagram of Site 1 temperature chain as deployed on JC105

Long term T chain2 (Logging interval 300s)				
Depth	**Type**	**Param**	**SN**	**Details**
-10	SBE 16+	RS232+ DQ pressure pumped CTD	4848	Clock reset and logging set for 16:00 on 19/06/14 – new batts
-15	Star Oddi DST	CT	5286	Clock reset and logging set for 08:00 on 18/06/14 – 74% batt
-20	Starmon mini	T	3893	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-25	Star Oddi DST	CT	5763	Clock reset and logging set for 08:00 on 18/06/14 – 74% batt
-30	SBE 37	RS232 + press (unpump) CTD	2506	Clock reset and logging set for 16:00 on 19/06/14
-35	Starmon mini	T	3894	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-37	Star Oddi DST	T only – changed due to low bat	3614	Clock reset and logging set for 08:00 on 18/06/14 – 49% batt
-40	Starmon mini	T	3896	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-42	Star Oddi DST	TP	3271	Clock reset and logging set for 08:00 on 18/06/14 – 44% batt
-45	SBE 16+	RS232 + DQ pressure Pumped CTD	5310	Clock reset and logging set for 16:00 on 19/06/14 – new batts
-47	Star Oddi DST	TP	3270	Clock reset and logging set for 08:00 on 18/06/14 – 44% batt
-49	SBE 37	RS232+pressure (pumped) V2 CTD	7460	Clock reset and logging set for 16:00 on 19/06/14
-54	Starmon mini	T	3897	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-59	Starmon mini	T	3899	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-64	Starmon mini	T	3901	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-69	SBE 37	IM + No pressure CT	2081	Clock reset and logging set for 16:00 on 19/06/14
-74	Star Oddi DST	TP	3655	Clock reset and logging set for 08:00 on 18/06/14 – 45% batt
-79	Starmon mini	T	3903	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-89	Starmon mini	T	3905	Clock reset and logging set for 08:00 on 18/06/14 – 89% batt
-99	SBE 37	RS232 + press (pumped) V2 CTD	7458	Clock reset and logging set for 16:00 on 19/06/14
-109	Star Oddi DST	TP	3269	Clock reset and logging set for 08:00 on 18/06/14 – 45% batt
-120	Star Oddi DST	TP	5263	Clock reset and logging set for 08:00 on 18/06/14 – 75% batt
-129	SBE 16+	RS485 + DQ pressure pumped CTD	4737	Clock reset and logging set for 16:00 on 19/06/14 – new batts

In-line ADCP (Turbulence) mooring

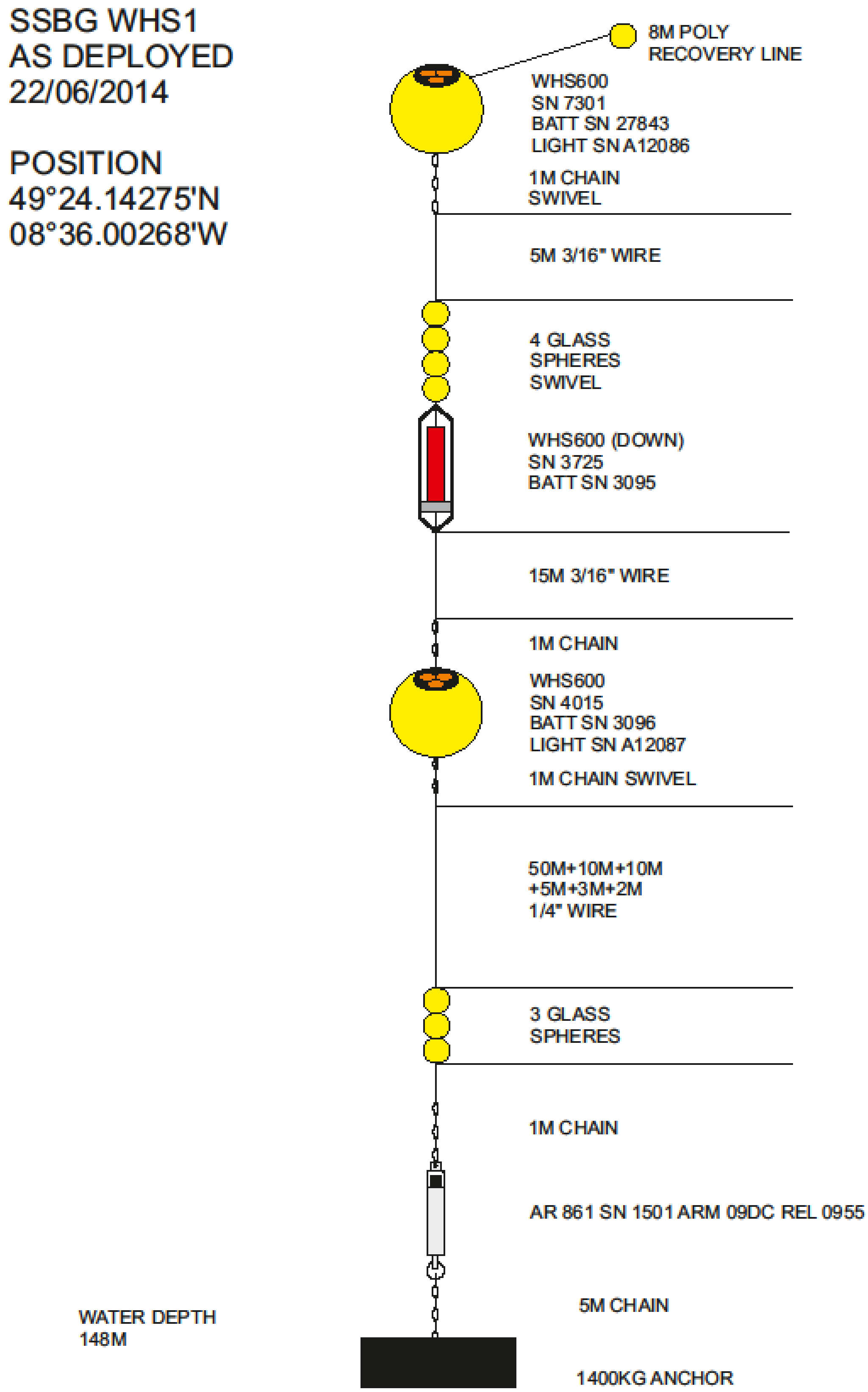


Figure 7: Mooring diagram of Site 1 in-line ADCP (turbulence) mooring as deployed on JC105

Cefas Smartbuoy

Cefas Instrumentation on surface buoy was all set to record for 5 min every 30 minutes on the half hour:

ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu +wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper
- Licor 192 PAR sensor in-air
- SBE37
- 50 port water sampler for inorganic nutrients

NOCL component	Details
Starmon Mini SN3898 at -2.5m	88% of battery life left, clock reset and logging set for 300s interval starting at 18:00 on 18/06/14.
DST Cent SN3599 at -5m	47% of battery life left, clock reset and logging set for 300s interval starting at 18:00 on 18/06/14.

Site 2 Recoveries

Cefas mini-lander with the following mounted:
ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper

NOCL component	Details
*600 kHz RDI ADCP, SN3644	After recovery and interrupting logging at 20:00 on 16/06/1 the clock drift was recorded as GMT +28s. Preliminary indications show that data recording seems to have worked correctly for 85 days from 22/03/14 to 16/06/14. The ADCP seems to have been damaged during recovery and seawater ingress had occurred. It is likely that the frame was dragged across the seabed during recovery which could account for this damage.

* Script file/parameters available upon request

Site 2 Deployments

Cefas mini-lander with the following mounted:
ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper

NOCL component	Details
*600 kHz RDI ADCP, SN12239 Pressure sensor blanked	One internal and two external batteries, all unused at deployment start. The top of the ADCP the backup recovery spooler is between ADCP beams 3 and 1, ADCP is 110cm above seabed. Clock reset and logging set to start at 11:00 on 16/06/14, 2GB of memory installed.

* Script file/parameters available upon request

Site 3 Recoveries

Cefas mini-lander with the following mounted:
ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper

NOCL component	Details
*600 kHz RDI ADCP, SN2390	After recovery and interrupting logging at 09:53 on 17/06/1 the clock drift was recorded as GMT +2:14s. Preliminary indications show that data recording seems to have worked correctly for 85 days from 22/03/14 to 16/06/14.

* Script file/parameters available upon request

Recovery of the mini-lander commenced when the 3 surface buffs were successfully grappled. The clump weight was then bought onboard and the lander itself lifted to just above the water line. At this point the recovery wire snapped and the lander dropped back into the water. It is likely that the recovery wire (mild steel) became wrapped around one of the stainless steel lander legs (or pulled taught against it) during deployment in March and subsequently corroded and/or frayed during its time in the water. The backup buffs and recovery line were successfully acoustically released and the lander retrieved.

Site 3 Deployments

Cefas mini-lander with the following mounted:
ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper

NOCL component	Details
*600 kHz RDI ADCP, SN12241 Pressure sensor blanked	One internal and two external batteries, all unused at deployment start. The top of the ADCP is 112cm off the seabed and beam 1 points to the backup recovery spooler. Clock reset and logging set to start at 21:00 on 16/06/14, 2GB of memory installed.

* Script file/parameters available upon reques

Site 4 Recoveries

Cefas Smartbuoy with the following instrumentation attached sampling for 5 mins every 30 mins on the half hour:

ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper
- Licor 192 PAR sensor in-air
- SBE37
- 50 port water sampler for inorganic nutrients

Please note that the recovered SBE 56 and 59 loggers put into a bucket of seawater at 14:30 on 17/06/14 for cross measurement checks. The loggers were removed from the bucket at ~16:50 on 17/06/14

NOCL component	**Details**
*300 kHz RDI ADCP, SN13759 mounted on inline frame in an upward facing orientation.	On 17/06/14 after recovery the clock drift was GMT +14 seconds. Data recording seems to have worked correctly for 86 days from 22/03/14 to 17/06/14 however the file size generated is only~30MB. This could be as a result of a problem with the ADCP script file.
SBE 39 T+P SN6761	Logging stopped at 18:55 GMT on 18/06/14, clock drift was GMT + 6 seconds. Initial indications show a full data return has been achieved.
SBE 56 T SN3593	Initial indications show a full data return has been achieved and there was no evidence of significant (> several seconds) clock drift with this logger.
SBE 56 T SN3590	Initial indications show a full data return has been achieved and there was no evidence of significant (> several seconds) clock drift with this logger.
SBE 56 T SN3592	Initial indications show a full data return has been achieved and there was no evidence of significant (> several seconds) clock drift with this logger.
SBE 56 T SN3596	Initial indications show a full data return has been achieved and there was no evidence of significant (> several seconds) clock drift with this logger.
SBE 39 T+P SN6762	Logging stopped at 20:11 GMT on 18/06/14, clock drift was GMT + 2 seconds. Initial indications show a full data return has been achieved

* Script file/parameters available upon request

Site 4 Deployments

Cefas Smartbuoy with the following instrumentation attached sampling for 5 mins every 30 mins on the half hour:

ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper
- Licor 192 PAR sensor in-air
- SBE37
- 50 port water sampler for inorganic nutrients

At 14:30 on 17/6/14 the SBE 39 and 56 loggers were added to a bucket of water for measurement cross checks with the previously recovered SBE 56 and 39 loggers, which were removed from the bucket at 16:50.	
NOCL component	**Details**
*300 kHz RDI ADCP, SN14745 mounted on inline frame – upward facing at ~-74m	One internal and two external batteries, all unused at deployment start. Clock reset and logging set to start at 18:00 on 16/06/14, 2.5GB of memory installed.
SBE 39 T+P SN6759	Mounted at -10m with 300s sample interval. Clock reset and logging started at 06:00 on 17/06/14
SBE 56 T SN3591	Mounted at -20m with 300s sample interval. Clock reset and logging started at 06:00 on 17/06/14
SBE 56 T SN3594	Mounted at -30m with 300s sample interval. Clock reset and logging started at 06:00 on 17/06/14
SBE 56 T SN3595	Mounted at -40m with 300s sample interval. Clock reset and logging started at 06:00 on 17/06/14
SBE 56 T SN3597	Mounted at -60m with 300s sample interval. Clock reset and logging started at 06:00 on 17/06/14
SBE 39 T+P SN6760	Mounted at -74m on 300KHz ADCP inline frame with 300s sample interval. Clock reset and logging started at 06:00 on 17/06/14

* Script file/parameters available upon request

Site 5 Recoveries

The Cefas mini-lander at Site 5 was not recovered. Upon arrival at the site the 3 surface buffs were not visible. We spent 1.5 hours attempting to make contact with the transducer by performing a search with a widening radius of 100-400m from the lander position but without success.

Site 5 Deployments

Cefas mini-lander with the following mounted:
ESM2 logger with Aanderaa CT and Druck pressure with the following connected:-

- Seapoint SCF Chl flu + wiper
- Seapoint OBS + wiper
- Aanderaa optode + wiper

NOCL component	**Details**
*600 kHz RDI ADCP, SN5806 Pressure sensor blanked	One internal and two external batteries, all unused at deployment start. The top of the ADCP is 1.11m off the seabed and the backup recovery spooler is between beams 4 and 2. Clock reset and logging set to start at 21:00 on 17/06/14, 2.5GB of memory installed.

* Script file/parameters available upon request

Instead of laying the new lander directly on top of the unrecovered mooring, a new position was agreed 300 m to the NE of the Guardbuoy.

16. Glider recoveries and calibration

3 gliders were recovered on JC105 on behalf of SSBG WP1, SSBG WP3 and the Sensors on Gliders programme.

Table 16: Glider recovery dates, times and positions

Glider	SN	STNNBR	Date-Time	Latitude	Longitude	Sensors	Data set PI
Stella (deep water Slocum)	436	033	20/06/14 09:01	48° 17.8755’ N	9° 57.32269’ W	CTD, optode, Eco-puck, PAR (switched off)	Peter Statham (SSBG)
Raleigh (shallow water Slocum)	399	048	21/06/14 07:36	48° 23.44819’ N	9° 33.34932’ W	CTD, optode, Eco-puck	Matthew Palmer (SSBG)
Eltanin (Seaglider)	SG550	049	21/06/14 09:17	48° 22.14493’ N	9° 31.88782’ W	CTD, optode, Eco-puck, PAR, Oxygen (off)	Sensors on Gliders (SoG)

Problems
Glider Fomalhault (SG525) was not recovered. The last GPS fix it gave was on 14/06/2014 17:30:05, 48° 22.32’N, 9° 33.37’W. It stopped transmitting both via Iridium and Argos so no communication was possible. It was assumed that the glider had been hit by a ship since it had been flying without issue prior to this date. Gonieo (direction finder using Argos) was used throughout the day on 20/06/2014 and for half a day on 21/06/2014 in an attempt to locate it but this was unsuccessful.

Stella aborted her mission due to a leak and entered ‘last-gasp’ mode on 03/06/2014, after which date position fixes via Argos were only received every few days. Luckily a fix was received (at approx. 05:30 20/06/2014) just after we had started the calibration CTDs 16 nm away. David White (MARS) was able to make communication and get the glider to jettison its ballast and pop the nose cone. The CTD s were stopped and we went to recover Stella immediately.

Glider calibration
In order to both calibrate and cross-calibrate the gliders they were all bought together at the same location in 500 m of water (near the head of a canyon). On 10/06/2014 they were all given two waypoint (WP1 48° 22.48’N, 9° 34.0710’W; WP2 48° 22.780’N, 9° 34.710’ W) to fly between and maintain position as best as possible. Scientific instrumentation that had previously been switched off to conserve battery (not knowing when recovery was going to be) were switched back on at this point (apart from oxygen on Eltanin). Only CTDs left on previously.

15 full depth CTDs were carried out over a period of 12 hours at 48° 22.657’ N, 9° 33.918’ W. Table 17 and Table 18 shows the GPS fixes for Raleigh and Eltanin during this period, the only two operational gliders remaining in the area. They remained within 0.5 nm of the ship during this calibration exercise.

Table 17: Positions of Raleigh during calibration CTDs

Date-Time	Latitude	Longitude
20/06/2014 12:38	48.37840	-9.56960
20/06/2014 14:10	48.37790	-9.57352
20/06/2014 15:30	48.3766	-9.57268
20/06/2014 16:52	48.3731	-9.56613
20/06/2014 19:31	48.3785	-9.55895
20/06/2014 20:48	48.37830	-9.55702

Table 18: Positions of Eltanin during calibration CTDs

Date-Time	Latitude	Longitude
20/06/2014 11:07	48.37680	-9.56725
20/06/2014 14:21	48.3793	-9.57252
20/06/2014 18:11	48.3754	-9.57415

17. Acknowledgements

Thanks to all ships officers, crew and NMFSS support in helping to make this cruise a success.