Cruise Report

RRS James Clark Ross

JR252 & JR254C

19 March - 6 April 2011

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British Antarctic Survey

Cambridge

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Introduction

This cruise report describes the combined JR252 and JR254C cruise on RRS James Clark Ross, departing Port Stanley on March 19th and arriving in Punta Arenas on April 6th. In between, the ship called at Signy Island on March 29th for one day to close the base for the winter.

The main objectives of JR252 were to service the two Lamont-Doherty Earth Observatory (LDEO) moorings in the northern Weddell Sea (M2 and M3), and to redeploy the joint BAS Long-Term Monitoring and Survey (LTMS) and LDEO moorings in Orkney Passage.

JR254C is the part of the Waves, Aerosol and Gas Exchange Study (WAGES), which is aiming to improve our understanding of air-sea fluxes of CO_2 and heat and how they are influenced by breaking waves and other factors. The WAGES team deployed two spar buoys, one free-drifting and one tethered, as well as a tethered balloon with a camera mounted on it.

I would like to thank the officers and crew of RRS James Clark Ross, as well as all members of the science party, for their excellent work on the cruise, significantly easing my job as PSO.

Cruise participants:

Scientific party:

JR252:
Povl Abrahamsen (PSO), BAS
Paul Anker, BAS
Bruce Huber, LDEO

JR254C:
Ian Brooks, U. of Leeds
Sarah Norris, U. of Leeds
Robin Pascal, NOCS
David Tupman, U. of Leeds

Science support:

Johnnie Edmonston, ITS

Paul Woodroffe, AME

Officers and crew:

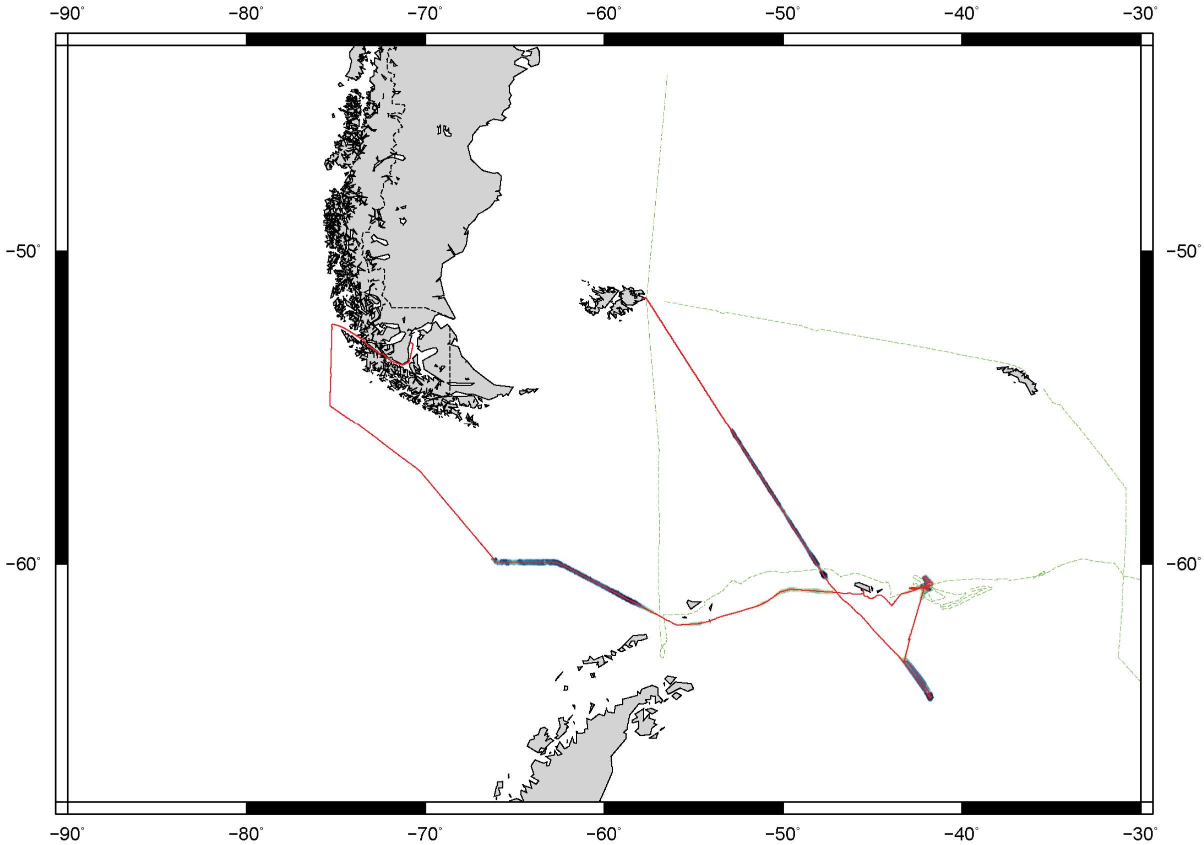
Graham Chapman, Master
Timothy Page, Chief Officer
Simon Evans, 2nd Officer
Peter Rosewall, 3rd Officer
John Summers, Deck Officer
George Brown, Deck Cadet

Frances Colgan, Doctor

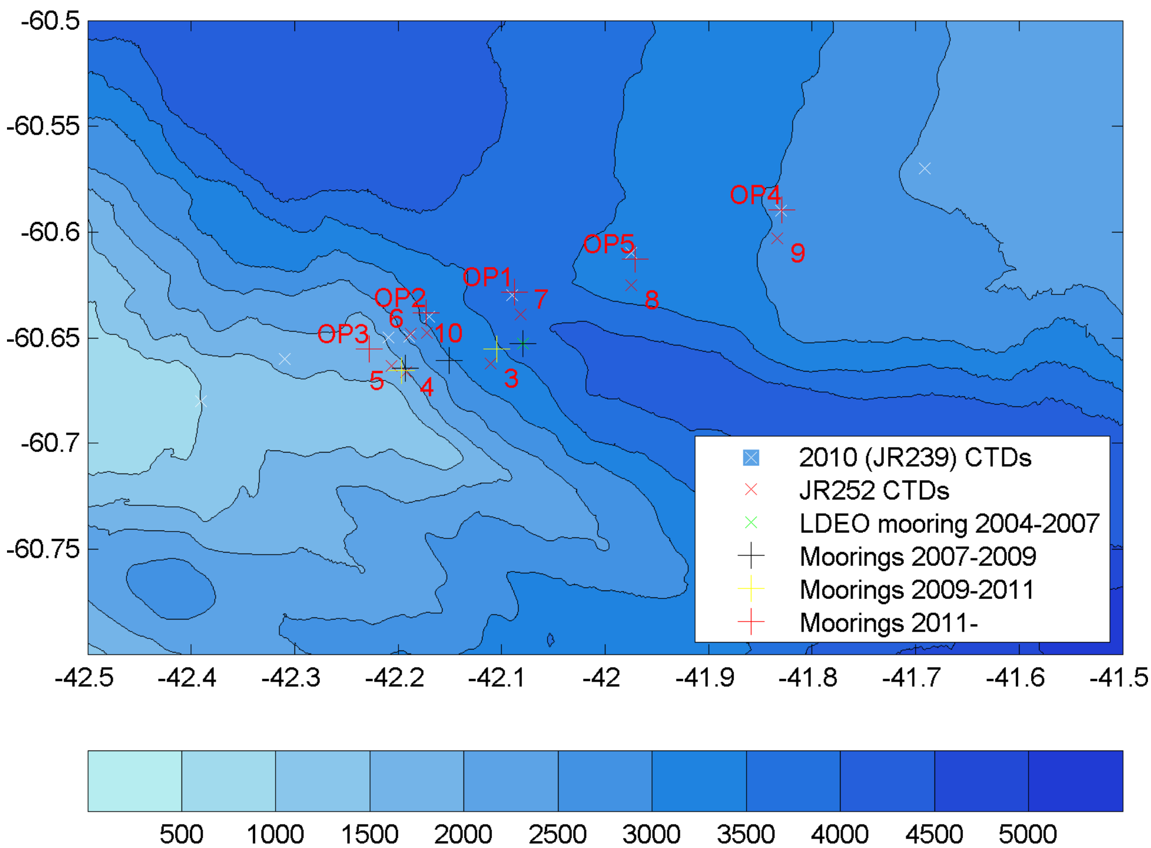
George Stewart, Bosun
Derek Jenkins, Bosun's Mate
Clifford Mullaney, SG1
Colin Leggett, SG1
John O'Duffy, SG1
John McGowan, SG1
Phillip Inglis, SG1

David Cutting, Chief Engineer
Glynn Collard, 2nd Engineer
James Ditchfield, 3rd Engineer
Steven Eadie, 4th Engineer
Simon Wright, Deck Engineer
Nicholas Dunbar, ETO
Charlie Waddicor, ETO (Comms)
Paul Cuthill, ETO Cadet
Mark Robinshaw, MG1
Ian Herbert, MG1

Hamish Gibson, Catering Officer
Keith Walker, Chief Cook
Barry Hoult, 2nd Cook
Kenneth Weston, Senior Steward
Derek Lee, Steward
James Newall, Steward
Thomas Patterson, Steward



JR252/JR254C cruise track (in red); the JR235/6/9 cruise track is shown in green. The start and stop of swath bathymetry recording can also be seen.



Detail of Orkney Passage, showing the locations of deployed moorings and CTD casts.

Cruise narrative

All times are UTC

Saturday, March 19:

- 11:32 – RRS James Clark Ross departed FIPASS

Sunday, March 20:

- 16:16 – Started logging swath bathymetry data

Tuesday, March 22 (Julian day 81):

- 15:30 – Arrived at M2 mooring. Release code sent and acknowledged, but mooring did not rise.
- 17:19 – Drifting wave buoy released (D1)
- 18:24 – Listened for M2 again; mooring replying, but still on bottom
- 18:37 – Tethered wave buoy released (T1)
- 19:59 – Balloon launched (B1)
- 21:05 – Balloon recovered (B1)
- 21:27 – Tethered wave buoy recovered (T1)
- 21:54 – Drifting wave buoy recovered (D1)
- 22:10 – Listened for M2; no reply from mooring
- 22:37 – CTD deployed (cast 1)

Wednesday, March 23 (Julian day 82):

- 00:33 – CTD recovered; hydrophone deployed to listen to M2, but no communications established
- 01:34 – Started steaming toward M3
- 08:40 – Arrived at M3 mooring. Release signal sent; mooring started rising.
- 09:55 – Mooring sighted on surface
- 10:51 – Mooring recovery complete
- 13:15 – Drifting wave buoy released (D2)
- 15:00 – Tethered wave buoy released for towing tests (T2)
- 16:45 – Ship in position for CTD cast 2; CTD deployed
- 19:14 – Tethered wave buoy recovered (T2)
- 19:34 – CTD recovered; steaming toward drifting wave buoy
- 20:08 – Drifting wave buoy recovered (D2); steaming toward M3 deployment position
- 20:38 – Start of M3 mooring deployment
- 21:47 – Mooring released
- 22:39 – Mooring on seabed
- 23:44 – End of ranging; steaming to M2

Thursday, March 24 (Julian day 83):

- 08:30 – Arrived at M2
- 09:03 – Start of M2 mooring deployment
- 09:40 – Mooring released; triangulating for mooring position
- 10:56 – End of ranging; steaming towards OP2
- 14:21 – Stopped for drifting buoy deployment (D3)
- 15:43 – Drifting buoy recovered, as Iridium beacon not working
- 15:50 – Drifting buoy released again

- 17:48 – Tethered buoy deployed (T3)
- 18:16 – Balloon launched (B2)
- 20:25 – Balloon recovered (B2)
- 20:42 – Wave buoy recovered (T3)
- 21:17 – Drifting buoy recovered (D3); steaming to PO2

Friday, March 25 (Julian day 84):

- 07:08 – Arrived at first triangulation point for PIES/OP2. No contact with PIES; good communications to OP2
- 08:33 – Listening for PIES directly above deployment position; no communications with PIES, and no sign of PIES pings
- 08:59 – Proceeding to OP2 release position
- 09:17 – OP2 released; coming to surface
- 09:59 – Mooring sighted; no sign of top floats/beacons
- 10:28 – Mooring hooked in middle; bottom part recovered first ,then top
- 12:16 – OP2 recovery complete
- 12:51 – Start of CTD cast 3 (old OP2)
- 14:57 – End of CTD cast 3 – steaming to OP3 recovery position
- 15:39 – OP3 released, rising
- 15:57 – Mooring sighted
- 16:15 – Mooring grappled
- 16:58 – Mooring recovery complete
- 17:34 – CTD deployed for cast 4 (old OP3)
- 18:52 – CTD recovered
- 19:04 – Balloon deployed (B3)
- 19:49 – Balloon recovered (B3); steaming to OP3 deployment position
- 20:36 – Start of OP3 deployment
- 21:33 – OP3 anchor released; triangulating for mooring position
- 22:43 – Triangulation complete; proceeding to CTD position
- 23:28 – CTD deployed for cast 5 (new OP3)

Saturday, March 26 (Julian day 85):

- 00:47 – CTD recovered; steaming east toward CTD position (halfway between OP2 and OP3)
- 01:20 – Drifting buoy deployed (D4)
- 01:36 – CTD deployed for cast 6
- 03:21 – CTD recovered
- 03:47 – Start of swathing in western part of Orkney Passage
- 10:44 – In position for OP1 deployment
- 11:13 – Start of OP1 deployment
- 13:49 – OP1 anchor released
- 14:33 – OP1 landed on seabed; continuing triangulation
- 15:25 – Triangulation complete; proceeding to CTD position
- 15:53 – Tethered wave buoy deployed (T4)
- 16:05 – CTD deployed for cast 7 (OP1)
- 16:48 – Balloon deployed (B4)

- 17:04 – Balloon recovered (B4)
- 18:08 – Tethered wave buoy recovered (T4)
- 18:27 – CTD recovered
- 19:29 – Tethered wave buoy deployed (T5)
- 21:55 – Tethered wave buoy recovered (T5); heading toward drifting wave buoy
- 22:24 – Drifting wave buoy recovered (D4); heading to OP4 deployment position

Sunday, March 27 (Julian day 86):

- 00:19 – Start of OP4 deployment
- 01:55 – OP4 anchor released; start of triangulation
- 02:29 – OP4 landed on seabed
- 03:13 – End of triangulation; starting swathing on eastern side of Orkney Passage
- 11:00 – On position for OP2 deployment
- 11:35 – Start of OP2 deployment
- 13:29 – OP2 anchor released
- 14:00 – OP2 landed on seabed
- 14:59 – End of triangulation; proceeding to OP5 deployment position
- 16:00 – Start of OP5 deployment
- 16:34 – OP5 anchor released; proceeding to CTD position
- 17:02 – Tethered wave buoy deployed (T6)
- 17:24 – CTD deployed for cast 8 (OP5)
- 19:24 – Tethered wave buoy recovered (T6)
- 19:33 – CTD recovered; triangulation for OP5 continuing
- 20:21 – Triangulation complete; continuing to OP4 CTD
- 21:00 – Tethered wave buoy deployed (T7); problems deploying CTD (wire slipping on traction winch)
- 22:44 – CTD deployed for cast 9 (OP4)

Monday, March 28 (Julian day 87):

- 00:30 – Tethered wave buoy recovered (T7)
- 00:45 – CTD recovered; proceeding to OP2 CTD
- 02:11 – Tethered wave buoy deployed (T8)
- 02:27 – CTD deployed for cast 10 (OP2)
- 04:02 – Tethered wave buoy recovered (T8)
- 04:19 – CTD recovered; steaming west towards Signy
- 15:36 – Tethered wave buoy deployed (T9)
- 17:49 – Balloon deployed (B5)
- 19:04 – Balloon recovered (B5)
- 23:03 – Tethered wave buoy recovered (T9); proceeding to Signy

Tuesday, March 29 (Julian day 88):

- 10:15 – Dropped anchor in Borge Bay, off Signy
- All science team help close Signy Base – afternoon walk to Gourlay Point
- 21:09 – Anchor aweigh, proceeding westward to Punta Arenas

Wednesday, March 30 (Julian day 89):

- Steaming all day

Thursday, March 31 (Julian day 90):

- 17:46 – Tethered wave buoy deployed (T10)
- 20:23 – Tethered wave buoy recovered (T10)

Friday, April 1 (Julian day 91):

- 13:45 – Tethered wave buoy deployed (T11)
- 14:12 – Balloon launched (B6)
- 20:12 – Balloon recovered (B6)
- 20:26 – Tethered wave buoy recovered (T11)

Saturday, April 2 (Julian day 92):

- 12:23 – Tethered wave buoy deployed (T12)
- 12:39 – Balloon launched (B7)
- 12:48 – Stopped recording swath bathymetry, and disabled system until end of cruise
- 14:03 – Balloon recovered (B7)
- 16:42 – Tethered wave buoy recovered (T12); proceeding towards Punta Arenas

Wednesday, April 6:

- 11:54 – Arrived Punta Arenas

JR252

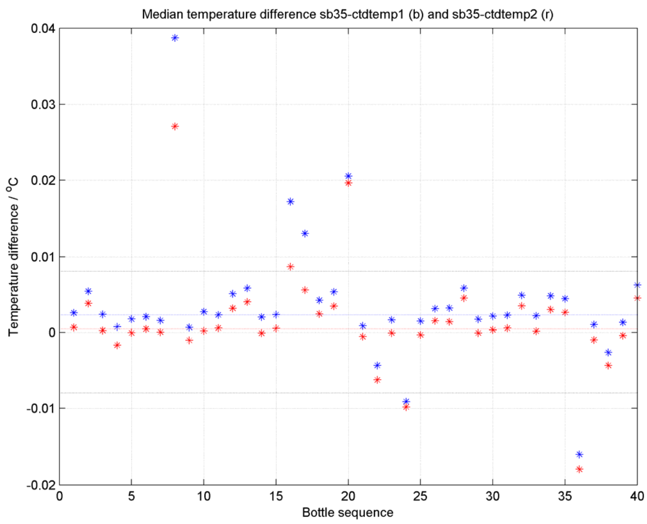
E. Povl Abrahamsen, Bruce A. Huber, and Paul G. D. Anker

CTD casts

The CTD used on JR252 was the BAS Seabird Electronics 911+ system, serial no. 0707. The attached sensors are shown in the table below:

Sensor	Parameter	Serial no.	Cal. date	Offset applied
SBE3plus	Temperature 1	4302	16 Jul 2010	+0.002296
SBE4C	Conductivity 1	2248	25 Jun 2010	+0.001345
SBE9plus/digiquartz	Pressure	89973	13 Jun 2007	Variable (0.05-0.52 dbar)
SBE3plus	Temperature 2	4235	25 Jun 2010	+0.000468
SBE4C	Conductivity 2	2813	20 Jul 2010	+0.000433
Biospherical QCP-2300	PAR irradiance (cosine)	7274	12 Jan 2009	n/a
SBE43	Oxygen	0676	09 Jul 2010	n/a
Tritech PA200	Altimeter	2130-27001	n/a	n/a
Chelsea Aquatracka Mk III	Fluorometer	088-216	27 Aug 2009	n/a
Wetlabs CStar	Transmissometer	CST-396DR	23 Aug 2007	n/a
SBE35	Temperature	0051	01 Jul 2010	n/a

A total of 10 casts were made using the CTD, with four bottles fired on each cast: one near the bottom, one near 2000 m, one at the salinity maximum, and one near the surface. The locations of the CTD casts are shown in the map on page 5.

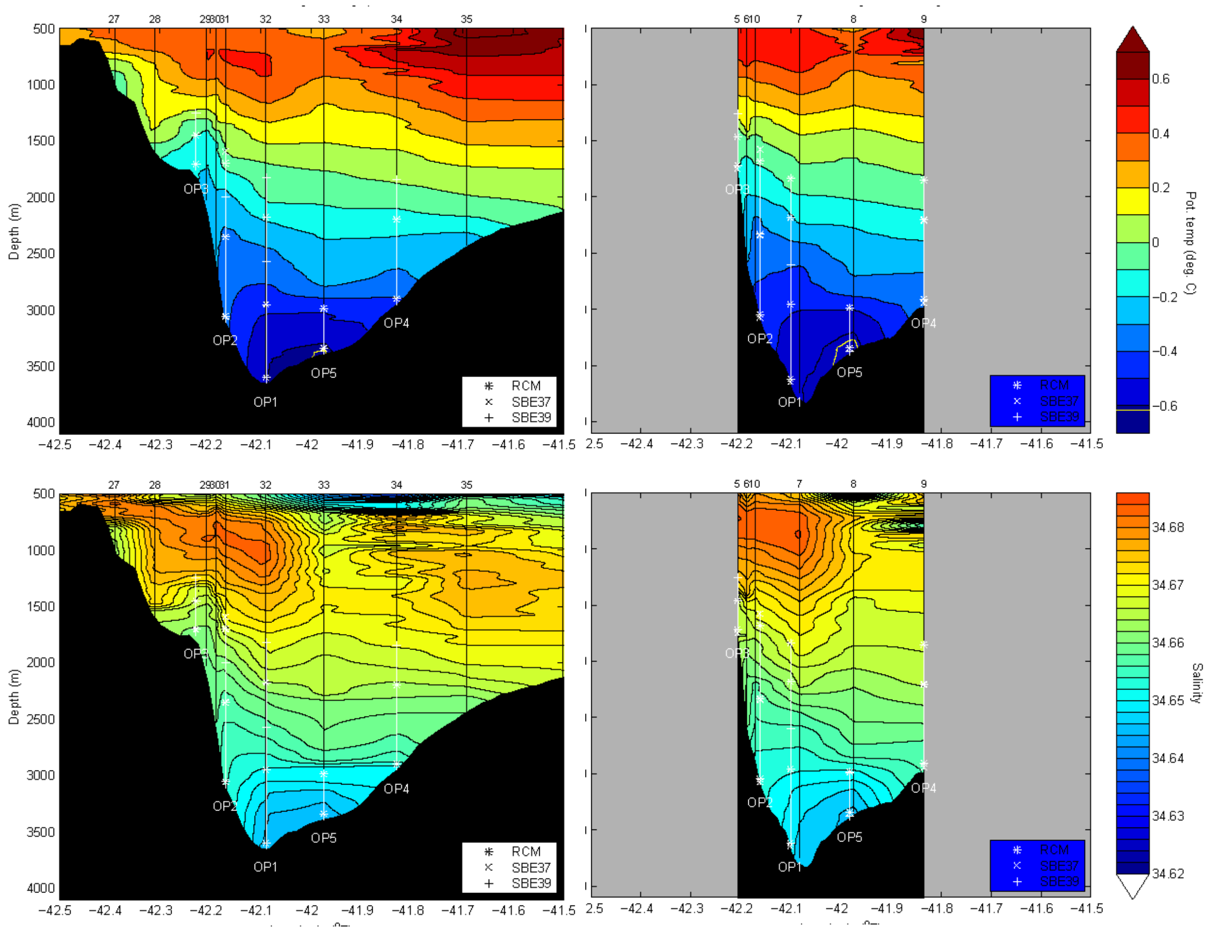


From comparison of the temperature sensors with the data from the SBE35 Deep Ocean Standards Thermometer (which takes a reading, based on averaging eight measurements, every time a bottle is fired), offsets were computed and applied as shown above. While the offset for the secondary sensor is negligible, the offset for the primary sensor is surprisingly high for this instrument. The offsets for the 40 bottles fired are shown in the figure on the right. While there are a few outliers, the overall pattern is quite clear. After discarding points where the range (difference) in raw readings is above 50, or the difference between both sensors and the SBE35 is above 0.005°C, 19 points were used to derive the offsets above, with a standard deviation of 0.0011/0.0012°C for the primary and secondary sensors, respectively.

The conductivity calibrations were based on analyses of salinity samples, using the onboard salinometer, a Guildline Autosal 8400B, s/n 68959. The instrument was standardized using IAPSO standard seawater batch P151. After discarding measurements with standard deviations in CTD conductivity of 0.0005 mS/cm or standard deviations in CTD temperature of 0.001 °C, 31 points were used to derive the offsets, with a resulting standard deviation of 0.0024 mS/cm or 0.0013 PSU for both sensors. These are all within the stated accuracy of the sensor. The section along the main *ALBATROSS*/*ANDREX* section is shown below, along with the 2010 *ANDREX* section.

2010 (JR239 - *ANDREX*)
(showing planned moorings)

2011 (JR252)
(showing actual deployed moorings)



Overall the structure in the two sections looks quite similar; interestingly, the salinity and temperature intrusions found at 500-1500 m depth at the station above the OP4 mooring (JR239 cast 34 and JR252 cast 9) can be seen in both sections. A θ/S diagram is shown on the right, and small instabilities can be seen here.

The two sections also show that the moorings have been deployed quite close to the intended locations, in the planned water masses.

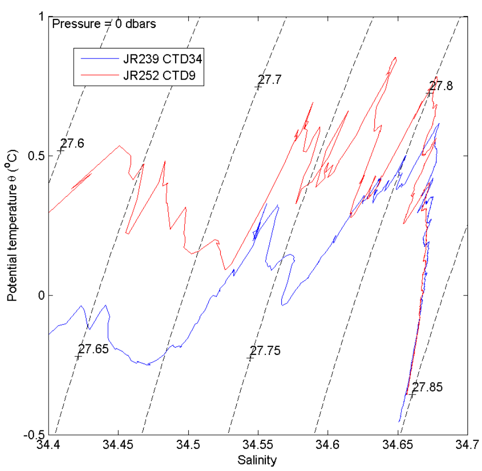


Table of CTD casts. The three times are the start the CTD was launched, the time the rosette reached the bottom, and the end of the cast.

	CTD no.	Station	Date and time	Lat	Lon	EM120 depth
M moorings	1	M2	22/3 22:33 23:31 23/3 00:31	62°S 37.06'	043°W 17.42'	3010
	2	M3	23/3 16:46 18:09 19:32	62°S 31.42'	041°W 46.18'	4548
Old OP section	3	Old OP2	25/3 12:50 13:53 14:54	60°S 39.72'	042°W 06.63'	3315
	4	Old OP3	25/3 17:35 18:11 18:51	60°S 39.95'	042°W 11.52'	1934
New OP section	5	OP3	25/3 23:26 26/3 00:04 00:44	60°S 39.80'	042°W 12.38'	1793
	6		26/3 01:34 02:24 03:19	60°S 38.91'	042°W 11.32'	2613
	7	OP1	26/3 16:05 17:16 18:26	60°S 38.33'	042°W 04.92'	3813
	8	OP5	27/3 17:24 18:27 19:31	60°S 37.51'	041°W 58.49'	3366
	9	OP4	27/3 22:45 23:39 28/3 00:41	60°S 36.17'	041°W 50.03'	2966
	10	OP2	28/3 02:24 03:18 04:16	60°S 38.85'	042°W 10.33'	2877

Note that cast 6 is not at a mooring; this was because of a mistake. The cast was supposed to be at the new OP2 location, but accidentally the coordinates for the JR239 station halfway between OP2 and OP3 was given to the bridge as OP2.

Mooring recoveries and deployments

During JR252 a total of three moorings were recovered and seven were deployed. The recoveries and redeployments are described briefly; diagrams of the moorings are then shown, and details of instrument configurations can be found in the tables at the end of this section.

Mooring	Deployment date	Recovery date	Latitude	Longitude	Depth (m)
M2 (09XX)	28/02/09 03:03	-	*62°S 37.116'*	*043°W 15.006'*	*3092*
M2 (11XX)	24/03/11 09:40	-	62°S 36.925'	043°W 14.618'	3031
M3 (0911)	27/02/09 18:04	23/03/11 08:45	63°S 31.449'	041°W 46.115'	4536
M3 (11XX)	23/03/11 21:47	-	63°S 31.303'	041°W 45.989'	4524
OP2 (0911)	02/03/09 21:36	25/03/11 09:17	60°S 39.326'	042°W 06.635'	3388
OP3 (0911)	02/03/09 18:08	25/03/11 15:39	60°S 39.958'	042°W 11.646'	1952
PIES	23/03/09 21:46	-	*60°S 39.271'*	*042°W 06.518'*	*3459*
OP1 (11XX)	26/03/11 13:49	-	60°S 37.708'	042°W 05.255'	3664
OP2 (11XX)	27/03/11 13:29	-	60°S 38.301'	042°W 10.361'	3094
OP3 (11XX)	25/03/11 21:33	-	60°S 39.309'	042°W 13.696'	1766
OP4 (11XX)	27/03/11 01:55	-	60°S 35.376'	041°W 49.777'	2962
OP5 (11XX)	27/03/11 16:34	-	60°S 36.772'	041°W 58.273'	3396

All of the positions in the table above come from triangulating the releases (except for the two unrecovered moorings, marked in italic typeset). The effective speed of sound at each site was calculated from nearest CTD profile, and the depth computed from the ranges. The computed depths are within 20 m of the swath grid interpolated to the ranged position (13 m for the new Orkney Passage moorings), which, considering the steepness of the topography near the edges of Orkney Passage, is quite good.

Mooring operations

The lack of a stern gantry (A-frame) complicated mooring operations somewhat. While the initial plan for the cruise was to use the side gantry, this was not necessary, and instead all operations were done over the stern. For recoveries, a block was mounted on the starboard Effer crane (2.5T SWL at 10 m reach), with the recovered wire led aft through a block on deck, and then via a stanchion onto the starboard mooring winch. When required, the rope was secured to a large cleat on deck. For deployments, the wire was led directly from the deck block over the stern without using a suspended block. All moorings were deployed anchor last, streaming the mooring out at 1 knot. At the end of the deployment, the release was shackled onto the end of the mooring line; the chain above the anchor was then secured via an expendable rope to a strongpoint on deck, and the anchor lifted overboard using a crane and lowered until the tension was on the sacrificial rope. When the ship was in the estimated drop position (usually overshooting the target position by 20% of the mooring length), the rope was then cut, releasing the anchor.

M2

After arriving at the M2 station on March 22, the release was enabled, and appropriate replies were received. However, after the release command was sent, the range did not decrease, indicating that the mooring had not been released. After waiting on site for several hours while the WAGES team deployed their instruments, we tried to listen to the instrument again, but did not receive any replies. Further attempts were made during the evening, but we did not get any further replies from the release. Although it is possible that the mooring could have come to the surface, it is unlikely that we would not be able to communicate with it at such short range – and it could not have drifted far.

A smaller version of M2 was deployed on the morning of March 24, en route from M3 to Orkney Passage. The instruments and settings are shown in the table below.

M3

M3 was successfully recovered on the morning of March 23. All instruments were recording when recovered, although two pressure sensors had failed during the deployment. M3 was redeployed on the evening of March 23.

Orkney Passage moorings

Recoveries

The first mooring that we attempted to recover in Orkney Passage was an inverted echo sounder (PIES), deployed by University of East Anglia in 2009. We initially tried to triangulate the position of the PIES together with OP2. However, no response was received from the PIES. After finishing the triangulation, we then sat on top of the mooring position and listened for the PIES pings, but did not hear any pings. Finally, we attempted to send the “beacon” command, which should start a series of very loud chirps from the instrument. However, no signs of life were received. We did not attempt to release the PIES, but it is possible that the mooring could have come up if its transmit circuitry was damaged. However, this seems fairly unlikely.

The recovery of OP2 was not quite straight forward. It all started well: after triangulating (and listening for the PIES), the release command was sent and the mooring started to rise. However, one group of floats could not be located on the surface, and once we started the recovery, it was clear that the top floats were missing. The wire from the top was also tangled with some lower wire, so the recovery started from the bottom of the mooring. Once the top finally was recovered, it was clear that all of the top floats (two Benthos 17" spheres and a McLane G6600-3) had imploded. Though we cannot be sure, it seems likely that the older McLane floats imploded, effectively setting off a chain reaction causing the other nearby floats to implode. From the instrument pressure records, it appears that this occurred on 5/5/2009 at, or shortly before, 18:00. The pressure sensor in the uppermost SBE39 had also failed, possibly because of the shock, and a deeper SBE39 also had (unrelated) internal damage, possibly caused by a short circuit or other severe electrical breakdown.

In contrast, the recovery of OP3 went very smoothly, with no unexpected surprises. One pressure sensor on an SBE37 failed, which also causes the conductivity readings to be incorrect.

Deployments

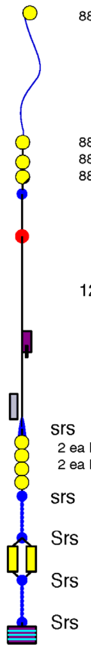
The Orkney Passage deployments were all fairly straight forward, with no unexpected problems.

Three different types of surface buoy were used on the OP moorings. On OP3 a spar attached to two 17" Benthos spheres. These are very heavy, and the bottom of the spar was not weighted enough to lift the beacons properly clear of the water. The recovery of this mooring may be more difficult, and will probably require the use of a crane to bring the spar out of the water because of the weight. On OP1 and OP4 a single Trimsyn TS2-4000 syntactic foam float was used; these floats can be lifted onto deck by hand. On OP2 and OP5 a McLane G6600 (triple 12") float was used on the spar; this was quite a stable configuration, lifting the beacons clear of the water, and is light enough to be lifted onto deck by hand.

In the AR861 releases a new type of release ring was used. Because of concerns that the standard elongated IXSEA stainless steel rings could cause the jaws of the releases to jam in some cases, we used Crosby S-643 7/8"x5-1/2" weldless rings, made from carbon steel. This is clearly not an ideal solution, as the releases are made from stainless steel. However, we estimate that corrosion shouldn’t weaken the rings considerably in the deployment timeframe.

JR252 MOORING M2 2011 DEPLOYMENT

Depth	Element	Serial Number	Distance between elements	Wire marker	Line length/ type
	17" glass	88446			poly rope, 10 m
2780m	17" glass x 3 on 2x2 m 3/8" chain	88445 88448 88317			
2880 m	SBE39 T,P	1232	125 m	**100**	**3/16 wire, 250 m**
3005 m	Microcat T,C,P	2708	25 m	**225**	
3030 m	Aquadopp 6k	9380	2 m		
3036 m	17" glass x 4 on 2x2m 3/8" chain	2 ea Nautilus (SAMS) 2 ea Benthos octagonal (SAMS)	2 m		3/8" chain
3042 m	8242 release(2)	31512 31513	6 m		3/8" chain
3049 m	anchor 350 kg				

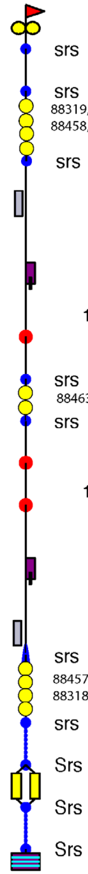


Anchor Drop: Lat S: 62 36.995' S Lon W: 043 14.505' W
Depth: 3049 m (corrrected EM120)
Date/Time (GMT): 24 Mar 2011 0939 Z

Triangulated Position: 62 36.924' S 043 14.618' W

JR252 MOORING M3 2011 DEPLOYMENT

Depth	Element	Serial Number	Distance between elements	Wire marker	Line length/ type
4023 m	McLane Top w/ radio ch 71 156.575 MHz	J05-055	10 m		poly rope, 10 m
4034 m	17" glass x 4 on 2x 2 m 3/8" chain	88319, 88451 88458, 88464	5 m		
4041 m	Aquadopp 6k	2317	45 m	**5**	**3/16 wire, 250 m**
4087 m	Microcat T,C,P	1351	125 m	**50**	
4213 m	SBE39 TP	1247	75 m	**175**	
4288 m	17" glass x 2 on 2 m 3/8" chain	88463, 88447	25 m		
4315 m	SBE39 Trec	0229	125 m	**25**	**3/16 wire, 250 m**
4441 m	SBE39 Trec	0083	95 m	**150**	
4536 m	Microcat T,C,P	4119	3 m	**245**	
4542 m	Aquadopp 6k	1752	2 m	**248**	
4545 m	17" glass x 4 on 2x2m 3/8" chain	88457, 88459 88318, 88444	2 m		3/8" chain
4551 m	8242 release(2)	33152 33147	6 m		3/8" chain
4560 m	anchor 350 kg				



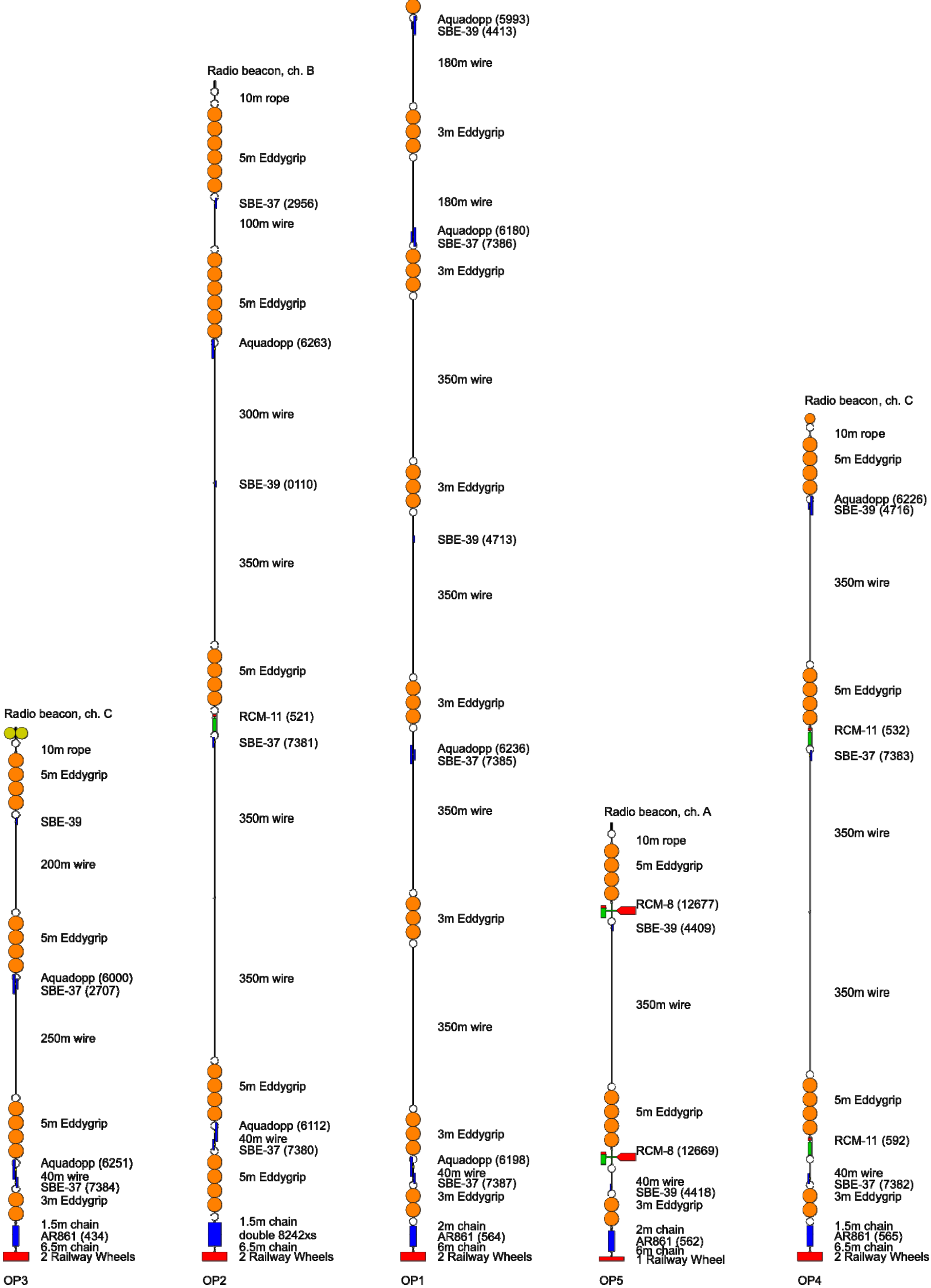
Anchor Drop: Lat S: 63 31.35' S Lon W: 041 46.197' W Depth: 4547 m

Date/Time (GMT): 23 March 2011 2147 Z

Triangulated Position: 63 31.303' S 041 45.998' W

notes: radio duty cycle: 2 s on, 4 off

JR252 - March 2011
Orkney Passage Moorings
As deployed



Mooring instrument configuration details

Parameter abbreviations:

TE: temperature PR: pressure CO: conductivity U: zonal velocity V: meridional velocity W: vertical velocity

SPD: current speed DIR: current direction TILT: tilt SNR: signal strength (RCM11) TEarctic: Arctic temperature (RCM8)

For Nortek Aquadopps, the serial number given is the “instrument ID” (AQD number); the “head ID” (A6L number) and order number are listed under comments.

M2 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
171	2880	SBE39 1232	TE, PR	15	22/03/11 12:00	
44	3005	Microcat 2708	TE, PR, CO	15	22/03/11 12:00	3-pin connector; old-style batteries
19	3030	Aquadopp 9380 (A6L 4697)	U,V, W, TE, PR	30	22/03/11 12:00	round endbell connector, short housing
7	3042	Releases: ORE 8242XS 31512 31513	Enable 422661 422733	Disable 422710 422756	Release 453473 453502	deployed with only one anode – new dual hardware

M3 recovered

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	First record, GMT (DD/MM/YY HH:MM)	Last record, GMT, uncorrected (DD/MM/YY HH:MM)	Number of records	Clock offset (instr-GMT, MM:SS)	Comments
		Radio beacon, Novatech J05-055							Ch. 71, 156.575 MHz; detected by ADF on bridge upon surfacing
	4041	Aquadopp 2317 (2046)	U,V,W,TE,PR, TILT	30	25/02/09 12:00	23/03/11 12:01	36289		clock offset not obtained during data download
	4087	SBE37 1351	TE,PR,CO	30	25/02/09 12:00	23/03/11 13:30	36293	+5:32	
	4213	SBE39 0083	TE	15	25/02/09 12:00	23/03/11 13:15	72583	-1:48	
	4315	SBE39 1826	TE,PR	15	25/02/09 12:00	23/03/11 12:30	72580	+1:38	pressure sensor suspect. Readings of ~ 4060. removed from service for calibration
	4441	SBE39 0229	TE	15	25/02/09 12:00	23/03/11 12:45	72581	-2:05	
	4536	SBE37 4119	TE,PR,CO	30	25/02/09 12:00	23/03/11 14:30	36295	+3:28	
	4542	Aquadopp 1752	U,V,W,TE,PR, TILT	30	25/02/09 12:00	23/03/11 11:30	36288	+3:10	pressure sensor failed shortly after deployment
		Release ORE 8242xs 33147							C cells Primary release - functioned normally
		Release ORE 8242xs 33152							C cells - backup release. Not needed for recovery, not used,

M3 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	comments
519	4041	Aquadopp 2317	U,V,W,PR,TE	30	23/03/11 18:00	square endbell connector
473	4087	Microcat 1351	TE,PR,CO	15	22/03/11 12:00	3-pin connector. Installed new battery holder and AA batteries
347	4213	SBE39 1247	TE, PR	15	22/03/11 12:00	
245	4315	SBE39 0229	TE	15	23/03/11 18:00	
119	4441	SBE39 0083	TE	15	23/03/11 18:00	
24	4536	Microcat 4119	TE, PR, CO	15	23/02/11 18:00	3-pin connector. Installed new battery holder and AA batteries
18	4542	Aquadopp 1752	U,V,W,PR, TE	30	23/03/11 18:00	square endbell connector pressure sensor failed during 09-11 deployment. Instrument redeployed before sensor failure had been detected, so pr data will not be usable.
9	4551	RELEASES: ORE 8242xs 33152 33147	ENABLE 336013 322353	DISABLE 336030 322370	RELEASE 335551 335420	releases deployed with only one anode. New dual hardware used.

OP2 recovered

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	First record, GMT (DD/MM/YY HH:MM)	Last record, GMT, uncorrected (DD/MM/YY HH:MM)	Number of records	Clock offset (instr-GMT, MM:SS)	Comments
1400	2028	SBE39 1310	TE, PR	15	02/03/09 12:00	25/03/11 13:30	72296	+3:21	Pressure sensor failed at 5 May 2009 18:00 possibly due to implosion of top float bundle. Removed from service for repair and recalibration
1125	2303	SBE39 1311	TE, PR	15	02/03/09 12:00	25/03/11 12:45	72294	+3:27	first record in file written at 10:24. Subsequent records written every 15 min beginning at start time of 12:00. see cap file from deployment- instrument started in error, stopped and starttime reset but samplenum not reset to 0 to erase first record. Pressure jumps at 5 May 2009 18:00 from 2518 dbar to 2650 dbar, likely due to implosion of top float bundle.
875	2553	SBE39 1586				?	?	?	No data recovered. Instrument has internal damage. Removed from service.
600	2828	RCM11 590	U,V,TE,CO, TILT,SNR	60	28/02/09 05:00	25/03/11 14:44	18111	-30:48	Incremented to 131339 words at 25/03/11 15:15:23.
300	3128	SBE39 0110	TE	15	02/03/09 12:00	25/03/11 13:45	72297	-2:11	
50	3378	RCM11 521	U,V,TE,CO, TILT,SNR	60	28/02/09 04:59	25/03/11 14:33	18011	-20:15	Incremented to 130782 words at 25/03/11 14:53:30
		Release AR861 562							

OP3 recovered

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	First record, GMT (DD/MM/YY HH:MM)	Last record, GMT, uncorrected (DD/MM/YY HH:MM)	Number of records	Clock offset (instr-GMT, MM:SS)	Comments
500	1452	SBE37 2956	TE,PR,CO	15	02/03/09 12:00	26/03/11 09:00	72374	+4:19	
200	1752	RCM8 12669	SPD, DIR, TE, TEarctic	60	02/03/09 00:00	26/03/11 08:04	18859	+37:15	clock offset derived by observing the record counter increment from 113076 to 113082 at 20:26:04 GMT. For 6 words per record, this corresponds to writing of record number 18847. DSU time at record 18847 is 25 mar 2011 21:04:00.
50	1902	RCM8 12677	SPD, DIR, TEarctic, PR	60	02/03/09 00:00	26/03/11 07:36	18859	+26:00	clock offset derived by observing the record counter increment from 113076 to 113082 at 20:10:00 GMT. For 6 words per record, this corresponds to writing of record number 18847. DSU time at record 18847 is 25 mar 2011 20:36:00.
15	1937	SBE37 2678	TE, PR, CO	15	02/03/09 12:00	25/03/11 19:15	72319	+7:23	has bad pressure sensor, so CO values cannot be trusted. Removed from service for repair and recalibration. Also has a bad bulkhead connector
		Release ORE 8242xs 32134							primary release - operated normally AA battery pack
		Release ORE 8242xs 32135							AA battery pack

OP1 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
1850	1814	Novatech RF-700A1 Y07-010	VHF beacon			Channel C (160.725 MHz)
1850	1814	Novatech ST-400A Y07-011	Xenon flasher			
1826	1838	Aquadopp 5002	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3879, no. 7/9
1826	1838	SBE39 4413	TE	15	24/03/11 00:00	
1482	2182	Aquadopp 6180	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3867, no. 4/9
1482	2182	SBE37 7386	TE, PR, CO	15	24/03/11 00:00	
1062	2602	SBE39 4713	TE	15	24/03/11 00:00	
708	2956	Aquadopp 6236	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3907, no. 9/9
708	2956	SBE37 7385	TE, PR, CO	15	24/03/11 00:00	
45	3619	Aquadopp 6198	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3872, no. 1/9
19	3645	SBE37 7387	TE, PR, CO	15	24/03/11 00:00	
7	3657	Release AR861 564				

OP2 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
1539	1555	Novatech RF-700A1 W07-085	VHF beacon			Channel B (159.480 MHz); pressure switch may be damaged
1539	1555	Novatech ST-400A W02-087	Xenon flasher			Pressure switch may be damaged
1517	1577	SBE37 2956	TE, PR, CO	15	26/03/11 18:00	
1411	1683	Aquadopp 6263	U,V,W,TE,PR, TILT	15	27/03/11 00:00	A6L 3870, no. 2/9
762	2332	RCM11 521	SPD,DIR,TE,CO, TILT,SNR	60	26/03/11 23:00	DSU 14744
752	2342	SBE37 7381	TE, PR, CO	15	24/03/11 00:00	
49	3045	Aquadopp 6112	U,V,W,TE,PR, TILT	15	27/03/11 00:00	A6L 3871, no. 6/9
21	3073	SBE37 7380	TE, PR, CO	15	24/03/11 00:00	
7	3087	Release ORE 8242xs 32134				AA battery pack
7	3087	Release ORE 8242xs 32135				AA battery pack

OP3 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
529	1237	Novatech RF-700A1 Y07-009	VHF beacon			Channel C (160.725 MHz)
529	1237	Novatech ST-400A W02-088	Xenon flasher			
508	1258	SBE39 1311	TE, PR	15	25/03/11 18:00	
302	1464	Aquadopp 6000	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3880, no. 8/9
302	1464	SBE37 2707	TE, PR, CO	15	22/03/11 12:00	
47	1719	Aquadopp 6251	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3873, no. 5/9
19	1747	SBE37 7384	TE, PR, CO	15	24/03/11 00:00	
8	1758	Release AR861 434				

OP4 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
1131	1831	Novatech RF-700A1 W02-086	VHF beacon			Channel C (160.725 MHz)
1131	1831	Novatech ST-400A Y02-012	Xenon flasher			
1110	1852	Aquadopp 6226	U,V,W,TE,PR, TILT	15	24/03/11 00:00	A6L 3869, no. 3/9
1109	1853	SBE39 4716	TE	15	24/03/11 00:00	
760	2202	RCM11 532	SPD,DIR,TE,CO, TILT,SNR	60	24/03/11 17:00	DSU 15384
753	2209	SBE37 7383	TE, PR, CO	15	24/03/11 00:00	
54	2908	RCM11 592	SPD,DIR,TE,CO, TILT,SNR	60	24/03/11 17:00	DSU 15238
19	2943	SBE37 7382	TE, PR, CO	15	24/03/11 00:00	
8	2954	Release AR861 565				

OP5 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
425	2971	Novatech RF-700A1 W02-084	VHF beacon			Channel A (154.585 MHz)
425	2971	Novatech ST-400A W02-089	Xenon flasher			
410	2986	RCM8 12677	SPD, DIR, TEarctic, PR	60	26/03/11 17:00	DSU 15239
403	2993	SBE39 4409	TE	15	24/03/11 00:00	
53	3343	RCM8 12669	SPD, DIR, TE, TEarctic	60	26/03/11 17:00	DSU 15236; rotor bearing may have too much friction
19	3377	SBE39 4418	TE	15	24/03/11 00:00	
8	2954	Release AR861 562				

Swath bathymetry

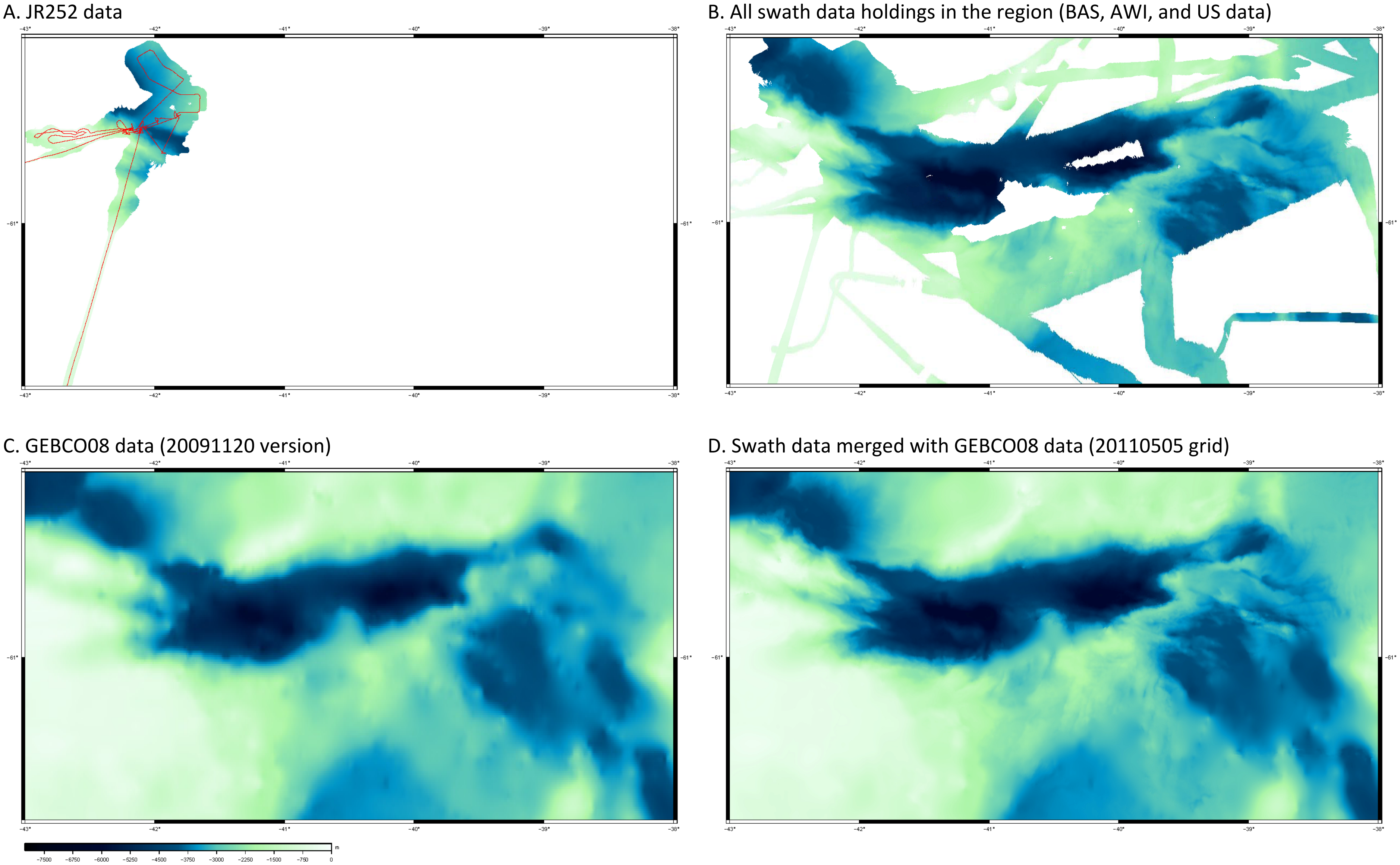
On JR252 the Kongsberg Simrad EM120 multi-beam sonar was run during most of the cruise, when outside EEZs. Logging was stopped when the ship was stationary for science work, and pinging was stopped while using acoustics to communicate with moorings, as the two release systems used (MORS/IXSEA and EG&G/Edgetech/ORE Offshore) both use frequencies near the EM120's 12 kHz.

Data acquisition was performed on a Sun workstation, em120-101, running Simrad's em120 software, version 6.0r3, on Solaris. The default settings, as described in the notes "Using multibeam on an opportunistic basis", by Tara Deen, version dated 10/3/2010, were used – with varying maximum beam angles, depending on the weather conditions. The maximum useful beam angle was around 60 degrees, except in shallow water and very calm conditions.

MB-system 5.12 (Caress and Cheyes, updated Dec. 2009) was used to process the data from the cruise (after the cruise, in Cambridge). First the raw Simrad data were copied onto a laptop running Ubuntu 9.10 Linux, where they were first converted from Simrad format (MB-system ID 56) to MB-system's own Simrad sonar editing format (ID 57). Most of the data were not cleaned, because of time constraints, while all of the data in Orkney Passage have been cleaned, since this is an area of priority.

Overall the EM120 worked well during the cruise, with only one crash of the workstation. The cruise was split into two surveys, jr252_a (from the start of the cruise until arriving at Signy) and jr252_b (from leaving Signy until just before reaching the Chilean EEZ).

The data from Orkney Passage were cleaned and gridded along with data from JR235/6/9 and JR149; these data were then combined with the other data holdings from US, German, and UK sources, and merged with the GEBCO08 bathymetry using the method described in the JR239 cruise report. The data from the Orkney Passage region are shown in the figures on the next page, along with the final swath grid (20110505 version) and the GEBCO08 ½-minute grid (20091120 version). Note that the older 20091120 version of GEBCO08 was used, as this was based on the Smith & Sandwell satellite-derived bathymetry, combined with a database of soundings. The newer 20100927 version uses the AWI Bathymetric Chart of the Weddell Sea in this region, and is markedly worse, making it unusable for these corrections.


A. JR252 data
B. All swath data holdings in the region (BAS, AWI, and US data)
C. GEBCO08 data (20091120 version)
D. Swath data merged with GEBCO08 data (20110505 grid)
−7500 −6750 −6000 −5250 −4500 −3750 −3000 −2250 −1500 −750 0
m

Survey	Note	Lines	Date	Time	XBT/CTD for SVP file name	Station
JR252_a		1 7	20/3 20/3	16:16 23:08	20071228 T5_00017	
		8 30	20/3 21/3	23:08 21:19	20071228 T5_00022	
		31 48	21/3 22/3	21:20 15:19	20071228 T5_00035	 M2
		49 56	23/3 23/3	01:35 08:43	20071228 T5_00035	M2 M3
		57 57	23/3 23/3	23:02 23:16	20071228 T5_00035	Triangulating
		58 58	23/3 23/3	23:22 23:39	20071228 T5_00035	Still triangulating
		59 67	23/3 24/3	23:47 08:22	20071228 T5_00035	End of triangulation M2
		68 71	24/3 24/3	10:57 14:28	JR252 CTD 1	M2 WAGES D3/T3
		72 82	24/3 25/3	20:54 06:55	ES031 CTD 115	WAGES D3/T3
		83 83	25/3 25/3	06:55 07:08	ES031 CTD 115	 Old OP2
	1	1 4	26/3 26/3	01:06 04:27	ES031 CTD 115	New OP3
	2	89 98	26/3 26/3	04:28 14:09	ES031 CTD 115	 OP1
		99 105	26/3 27/3	18:43 00:50	ES031 CTD 115	OP1 OP4
	3	106 116	27/3 27/3	03:14 13:46	ES031 CTD 115	OP4 OP2
		117 118	28/3 28/3	00:51 02:03	ES031 CTD 115	OP2
		119 123	28/3 28/3	04:18 09:07	ES031 CTD 115	 Going to Signy
JR252_b	 4	1 21	29/3 30/3	22:47 19:27	ES031 CTD 115	Leaving Signy
		22 44	30/3 31/3	19:36 17:41	ES031 CTD 115	 WAGES T10
		45 60	31/3 1/4	20:52 12:42	JR84 T5_00008	WAGES T10 WAGES T11
		61 76	1/4 2/4	20:49 12:48	JR84 T5_00008	WAGES T11 WAGES T12

Notes:

1. After tinkering with settings on the EM120 workstation, recording was accidentally started on line 1 instead of line 84. When the mistake was realized, logging was stopped, and the line number was changed to 89.
2. Overnight swath survey west of Orkney Passage
3. Overnight swath survey north-east of Orkney Passage
4. At 19:27 the main map/coverage display on the workstation had stopped updating. When we tried to restart the operator’s interface, the computer froze and had to be rebooted. Logging resumed at 19:36.

JR254C

Robin W. Pascal, Ian M. Brooks, Sarah J. Norris, and David J. Tupman

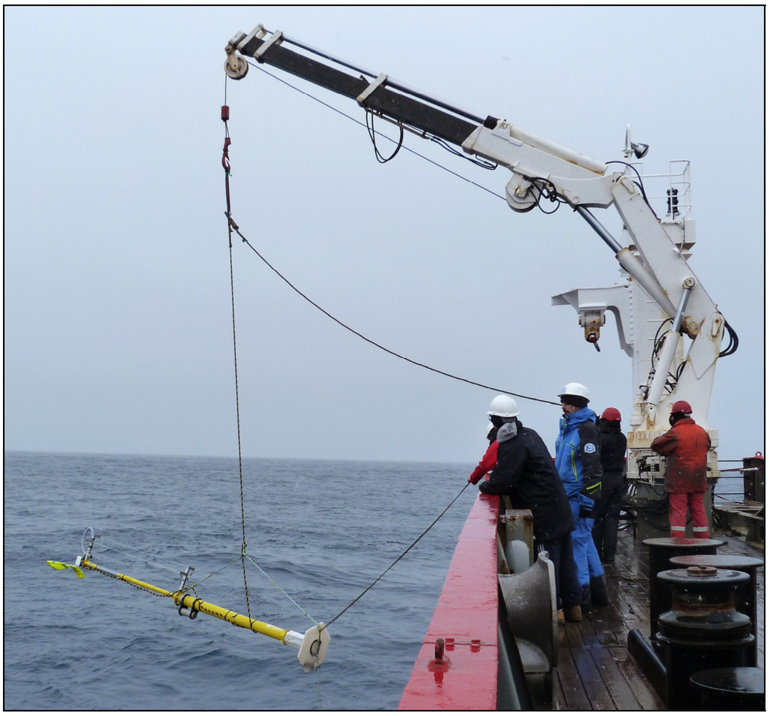
Waves, Aerosol and Gas Exchange Study "WAGES"

"WAGES" is a £1.1M NERC standard grant project which involves a number of staff at NOC and the University of Leeds. The project aims to improve our understanding of the air-sea fluxes of CO2, sea-spray aerosol, sensible heat, latent heat and momentum. To achieve this it is necessary to obtain direct measurements of the fluxes themselves, along with the various physical parameters which drive the fluxes such as: the mean air-sea differences in CO2 concentration (for the CO2 flux), temperature (sensible heat flux) and humidity (latent heat flux); wind speed (all fluxes); sea state and whitecap fraction (for CO2 and aerosol fluxes in particular). To obtain a sufficiently large data set the fluxes and underlying parameters are measured continuously using instrumentation deployed on the *RRS James Clark Ross* from May 2010 to at least September 2012. In addition to the continuous measurements WAGES also includes intensive observation periods (IoPs) during which WAGES staff sail on the JCR in order to deploy a novel spar buoy to obtain wave breaking information and an aerial camera system to obtain whitecap coverage over a wide area. JR252/JR254C provides one such opportunity for WAGES staff utilise 2 days of ship time for WAGES activities.

The WAGES systems installed on the JCR include the autonomous air-sea flux system "AutoFlux" (Yelland et al., 2009), a wave radar system and a bridge top whitecap camera, which have all been in operation since the summer of 2010.

Spar Buoy Deployments.

During JR252 (JR254C) two new 4 m spar buoys, one tethered the other free drifting, were deployed on a number of occasions throughout the cruise (Table 1). These spar buoys are a small version of the 11m buoy deployed during two previous UK-SOLAS cruises on *the RRS Discovery* (Pascal et al., 2010). Although the tethered version of the spar buoy had been deployed on JCR before, the ease of both deployment and recovery, for both buoys, over a range of sea states was very pleasing. This was also the first ever deployment of the free drifting version, the longest deployment being 23 hours. All buoy systems worked well, especially the buoys wave riding characteristics, which dealt well with all conditions seen during deployments. In addition the free drifting buoy showed a reasonable ability for self-orientating the wave wires into wind, ensuring good wire exposure. Polaris Iridium trackers were used to relay the buoys position to the ship via a web interface every 5 minutes. The original unit (NOC1) gave good reliable results until the last deployment when it was shown to have flooded. A second 'new' unit (NOC2) worked reliably on the ship but gave intermittent results on the buoy, and so was limited in use to the tethered buoy. All deployments and recoveries were successfully achieved with the use of the starboard side Effer crane and could be easily integrated into CTD operations. The preferred method of deployment being to deploy the buoy as the ship approached station so that the tether was fully extended before CTD operations began. This ensured that no problems arose from the behaviour of the buoy that could affect ship operations while both the CTD and buoys were deployed.



Above: The drifting spar buoy being deployed.

Deployments table

Jday	Dep. Name	Logger Start	In water	Out Water	Duration (mins)	Hs	Tz	True Wind speed	True Wind Dir.	Lat. (deg N) at dep	Long. (deg E) at dep
81	T1	18:33:56	18:37:10	21:26:45	169	1.86	6.21	5-7	350-10	-62.6240	-43.2418
82	T2	14:56:56	15:02:05	19:13:55	252	2.34	6.98	2-3	120-140	-63.5238	-41.7696
83	T3	17:11:35	17:52:05	20:41:45	171	2.25	5.63	7-10	150-180	-62.0251	-42.9459
85	T4	15:50:30	15:53:57	18:07:09	134	1.77	5.33	10-11	340-360	-60.6389	-42.0822
85	T5	19:25:19	19:30:24	21:54:00	154	1.66	5.36	10-12	330-350	-60.7362	-41.9136
86	T6	16:59:27	17:00:09	19:18:37	138	2.47	6.09	6-9	0-20	-60.6252	-41.9748
86	T7	20:56:57	20:59:38	00:30:11	210	2.58	5.57	8-12	20-50	-60.6029	-41.8340
87	T8	02:08:25	02:13:13	04:00:15	112	2.86	5.77	10-12	20-40	-60.6476	-42.1722
87	T9	15:26:08	15:37:36	23:01:34	447	1.96	4.89	9-12	220-250	-60.9173	-44.8847
90	T10	17:44:27	17:47:52	20:22:00	155	3.46	6.57	15-19	120-140	-61.1076	-58.1424
91	T11	13:42:44	13:46:09	20:24:01	398	3.25	5.21	8-13	170-200	-60.0234	-62.3705
92	T12	12:18:55	12:24:32	16:59:58	275	2.46	6.65	11-15	30-50	-59.8614	-66.1789
81	D1	17:07:59	17:18:45	21:54:24	286	2.28	6.55	5-7	340-360	-62.6236	-43.2423
82	D2	13:10:42	13:12:00	20:08:29	416	2.43	6.48	1-3	100-150	-63.5239	-41.7553
83	D3	14:17:26	14:26:03	21:16:43	430	2.41	5.70	7-10	150-190	-62.0850	-42.9383
85	D4	01:10:06	01:19:01	22:22:27	1269	2.08	4.83	8-14	330-30	-60.6489	-42.1886

Tethered Balloon

A tethered 'Helikite' – a 2 cubic metre balloon, an oblate sphere in shape, with kite wings for additional dynamic lift from the wind – was flown carrying a digital camera to obtain photographs of the sea surface from a high vantage point. The intention is to obtain whitecap fraction from images that cover a large area, or order several hundred m^2, and viewed at a near-normal angle. These estimates will be used to validate those derived from the whitecap imaging camera mounted on the bridge, which runs continuously with an image captured at 1 minute intervals. The bride camera views a smaller area than the balloon borne camera, and requires averaging of several 10s of images in order to obtain a statistically stable estimate of the whitecap fraction. It also views the sea surface at a relatively shallow angle, and might thus suffer biases resulting from sheltering of part of the surface by waves, the shallow viewing angle, and point of view with respect to wave direction.

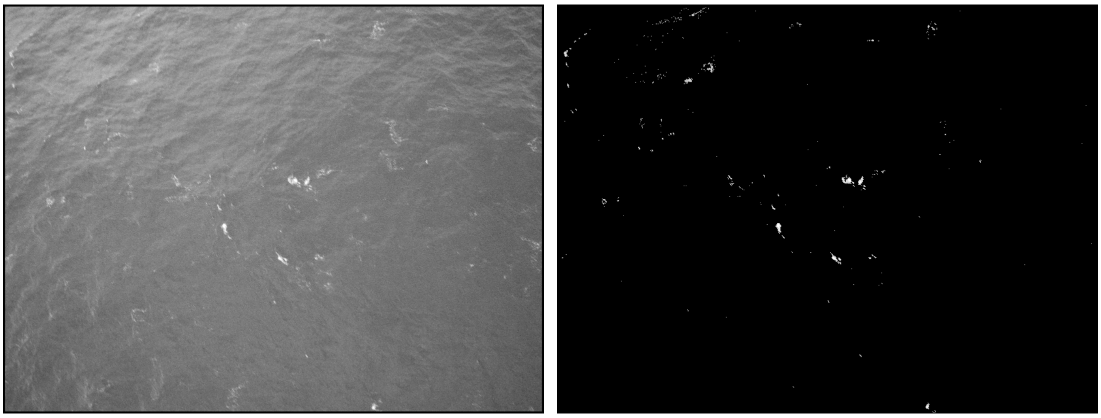
Above: the tethered balloon during launch in strong winds and while flying – the camera can just be seen in its self-levelling cradle at bottom right of this image.

Table 2: Balloon deployments

Deployment	Date	Start time	End time	Comments
1	22/03/2011	19:59	21:05	No significant whitecaps
2	24/03/2011	18:26	20:20	Altimeter added 19:51, camera failed on first ascent. Captured on handful of images on 2nd and 3rd ascents.
3	25/03/2011	19:17	19:47	No whitecaps, but video of ship. Photos of ship wake suitable for testing purposes only.
4	26/03/2011	16:49	17:04	Balloon caught in turbulence – aborted
5	28/03/2011	17:30	19:03	Initially flew OK, then caught in turbulence. Some good imagery

6	01/04/2011	14:17	20:17	5 ascents, 1700 photos in good whitecapping conditions – whitecapping decreasing during afternoon.
7	02/04/2011	12:40	14:04	Another turbulence affected flight but got some usable imagery

The images from both bridge-mounted and balloon-borne cameras are first converted from colour to a simple greyscale image and then processed with an automated threshold determining algorithm (Callaghan and White 2008) to isolate the whitecaps. The fractional area of whitecap can then be determined for each image. An example image is shown below.



Above left: sample image of sea surface obtained from an altitude of approximately 80 m, several areas of whitecap are visible. Above right: the whitecap mask generated by the image processing algorithm, this shows an excellent match with whitecaps identified by eye.

Acknowledgments

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