Cruise Report

JR 281

RRS James Clark Ross

14 March – 26 April 2013

PART I: Cruise Management

1.1 Scientific Personnel

These came from University of East Anglia (UEA), Southampton University and National Oceanography Centre (NOCS), Woods Hole Oceanographic Institution (WHOI), and the British Antarctic Survey (BAS), as follows:

PSO	Jean-Baptise Sallée	BAS
Physical Oceanography	Andrew Meijers	BAS
	Brian King	NOCS
	Jan Zika	NOCS
	Pierre Labreuche	LEGI
	Xinfeng Liang	MIT
VMP	Daffyd Evans	NOCS
	Alex Forryan	NOCS
	Sean Whelan	WHOI
Mooring	Paul Anker	BAS
	Phil Mele	LDEO
Tracer measurements	Marie-José Messias	UEA
	Siobhan Moran	UEA
	Stephen Woodward	UEA
	Brian Guest	WHOI
	Andrew Watson	UEA
	Benjamin Mills	UEA
Swath/Data management	Gwen Buys	BAS
NMF technical support	John Wynar	NOCS
	James Burris	NOCS
BAS technical support	Richard Cable (ITE)	BAS
	Julian Klepacki (AME)	BAS

1.2 Ships Personnel

Graham P Chapman	Master
Timothy S Page	Chief Officer
Simon D Evans	2nd Officer
Peter J Rosewall	3rd Officer
John Summers	Deck Officer
Charles A Waddicor	ETO (Coms)
David J Cutting	Chief Engineer
Glynn Collard	2nd Engineer
James C Ditchfield	3rd Engineer
Steven J Eadie	4th Engineer
Simon A Wright	Deck Engineer
Nicholas J Dunbar	ETO (Eng)
James S Gibson	Purser
Frances E Colgan	Doctor
George M Stewart	Bosun
Derek G Jenkins	Bosun's Mate
Clifford Mullaney	SG1
Colin J Leggett	SG1
John P O'duffy	SG1
John J Mcgowan	SG1
Phillip J Inglis	SG1
Mark A Robinshaw	MG1
Ian B Herbert	MG1
Keith A Walker	Cook
Barry D Hoult	2nd Cook
Kenneth Weston	Senior Steward
James Newall	Steward
Derek W Lee	Steward
Thomas R Patterson	Steward
George W Brown	Cadet
Paul A Cuthill	Cadet

1.3 Cruise Objectives

The cruise JR281 consisted of four separate Southern Ocean units of work: JR273A - JR272B - JR252B – JR278. Specifically, it involved conducting a set of mooring recoveries/redeployments and three repeat hydrographic sections: one along the ridge crest of the North Scotia Ridge; one from South Georgia, down to the Weddell Sea (a subset of the WOCE section A23), and one across Drake Passage (WOCE section SR1b). Combined, this consisted of more than 100 CTD stations, plus running underway surface ocean/met sensors.

The intention was to determine the interannual variability in water masses and fluxes across the region, where sits the major topographic obstacles in the path of the Antarctic Circumpolar Current. These lines have each been conducted previously, so changes in water mass composition since that time will be interpreted in the context of known climate variability.

The work along the crest of the North Scotia Ridge also includes measurements of the DIMES tracer and microstructure turbulence funded by the extension to the DIMES programme. Therefore, merging the four cruises allow us to make measurements of the DIMES tracer along other lines at almost no extra cost.

In addition JR81 involved mooring work in Orkney Passage as a contribution to long term monitoring of the passage. Orkney Passage is a crucial route for northward export of bottom water. The work done on JR281 concentrates on work done by BAS through the Long-Term Monitoring and Survey project (2005-present) in collaboration with LDEO, whose work in this region started with the DOVETAIL and CORC-ARCHES projects (PI: A. Gordon); the LDEO contribution toward the monitoring is presently funded through the NOAA Ocean Climate Observation Program (PI: B. Huber)

1.4 Dimes Objectives

JR281 contributed partly to the DIMES project, "Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean", which is a joint UK and US project, funded by the National Science Foundation in the US and NERC in the UK. The objective of DIMES is "to test and, if necessary, redefine the present paradigm of Southern Ocean mixing by obtaining the first systematic measurements of mixing processes in two contrasting regimes (the SE Pacific and the SW Atlantic) of the Antarctic Circumpolar Current (ACC)". The methods used are (1) the release of an inert chemical tracer, CF_3SF_5 (tri-fluoromethyl sulphur pentafluoride) in the SE Pacific sector west of Drake Passage and following its dispersion horizontally and laterally as it transits the SE Pacific, Drake passage and the Scotia Sea, (2) The use of fine structure and microstructure measurements from LADCP, CTD and free-falling microstructure probes, (3) the deployment of a substantial array of moorings in the east of Drake Passage to observe the relationship between eddy activity, internal wave activity and vertical and horizontal mixing (4) the release of numerous floats both neutral density type RAFOS floats and surface drifters and (5) interpretation of model data.

The original plan for the DIMES field program is shown in fig 1.4.1, showing the geographic location of the program and the time line of the project. JR281 took tracer and microstructure measurements for the DIMES project.

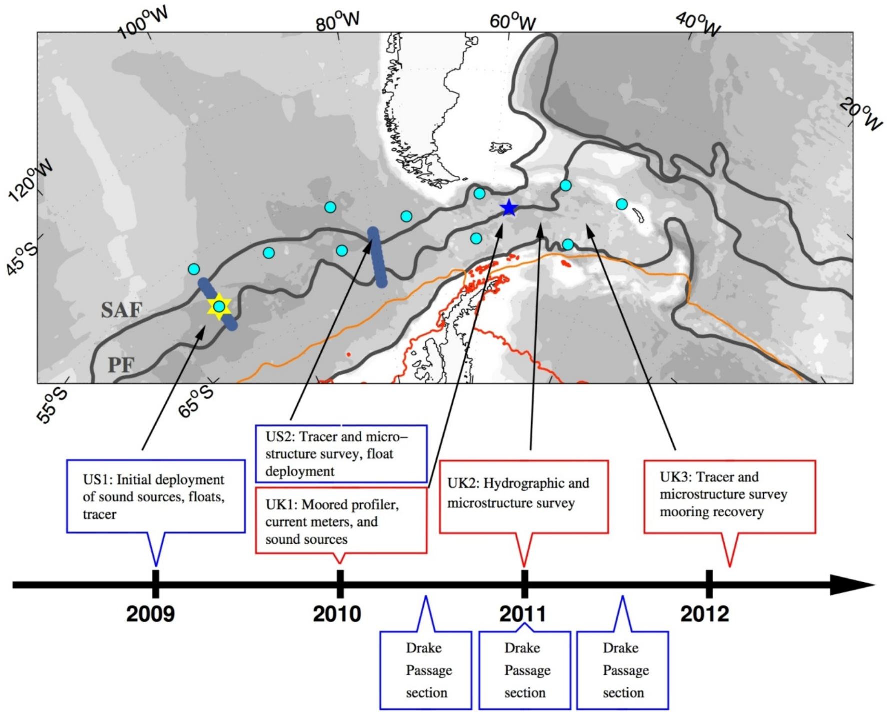

Figure 1.4.1: Original plan for the DIMES program, showing approximate location of cruises and time line. JR281 is partly funded by the extension to the DIMES programme.

1.5. Cruise Track

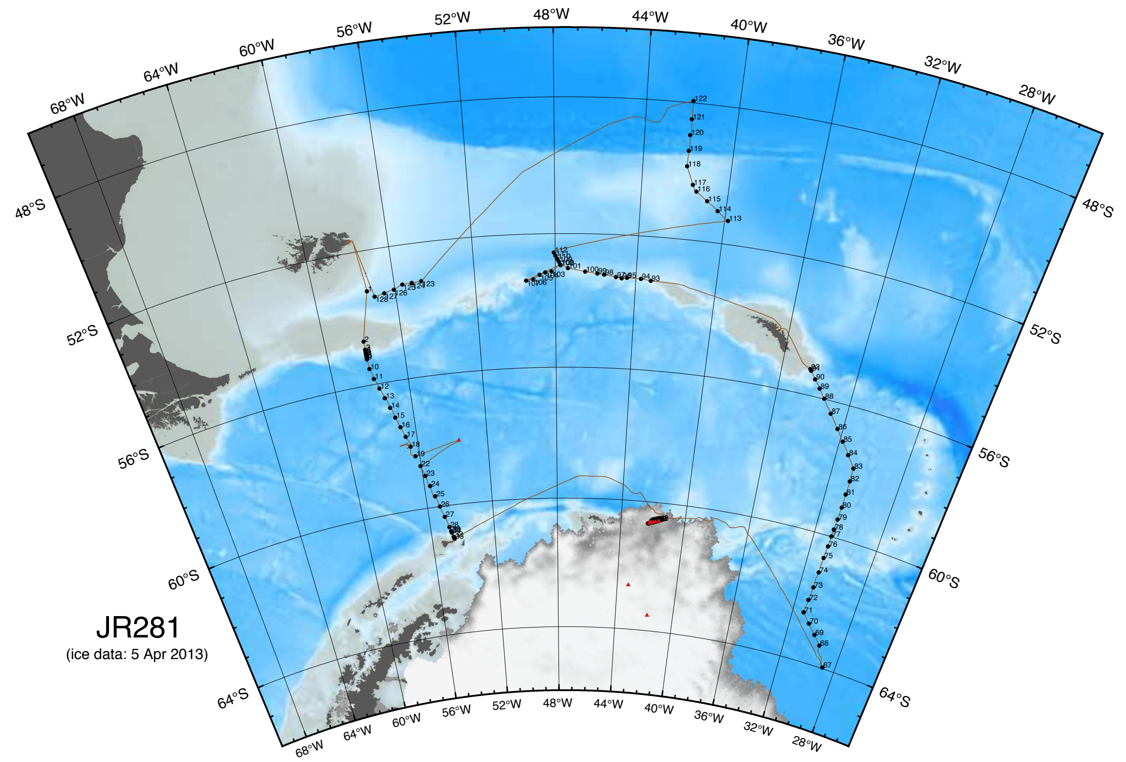

Figure 1.5.1: JR 281 Cruise track

1.6 Cruise Itinerary

(i) SR1 section: 18 March – 27 March

Station #	Section #	lat (de	lat (minutes)	lon (de	lon (minute)	2	time @ station	depth (Sm 3	mooring	CTD	VMP	ARGO
1 (*)	CTD_Test	53	12.289'S	57	23.116'W		18-Mar-2013 19:26:00	1698 m	-	CTD1	-	-
2 (*)	SR1a	54	40.025'S	58	0.042'W		19-Mar-2013 07:06:00	160 m	-	CTD2	US-test	-
3 (*)	SR1a	54	55.150'S	57	59.758'W		19-Mar-2013 10:34:00	723 m	-	CTD3	US-test	-
4 (*)	SR1a	54	58.676'S	57	59.868'W		19-Mar-2013 13:01:00	1024 m	-	CTD4	US-test	-
5 (*)	SR1a	55	0.547'S	57	59.234'W		19-Mar-2013 14:41:00	1469 m	-	CTD5	VMP1 (UK-2	-
6 (*)	SR1a	55	4.175'S	58	0.037'W		19-Mar-2013 17:50:00	2051 m	-	CTD6	US-test	-
7 (*)	SR1a	55	7.381'S	57	57.700'W		19-Mar-2013 20:36:00	2736 m	-	CTD7	VMP2 (UK)	-
8 (*)	SR1a	55	10.359'S	57	57.506'W		20-Mar-2013 01:24:00	3065 m	-	CTD8	VMP3 (UK)	ARGO1
9 (*)	SR1a	55	13.154'S	57	59.684'W		20-Mar-2013 06:21:00	3707 m	-	CTD9	VMP4 (US-5	-
10 (*)	SR1a	55	30.924'S	57	56.426'W		20-Mar-2013 12:18:00	4247 m	-	CTD10	-	ARGO2
11 (*)	SR1a	55	49.510'S	57	49.056'W		20-Mar-2013 17:37:00	4943 m	-	CTD11	VMP5 (UK)	-
12 (*)	SR1a	56	8.508'S	57	37.185'W		21-Mar-2013 04:21:00	3440 m	-	CTD12	VMP6 (UK)	ARGO3
13 (*)	SR1a	56	27.812'S	57	23.789'W		21-Mar-2013 11:18:00	3788 m	-	CTD13	VMP7 (US-2	-
14 (*)	SR1a	56	46.566'S	57	12.010'W		21-Mar-2013 17:54:00	2450 m	-	CTD14	VMP8 (UK)	ARGO4
15 (*)	SR1a	57	5.989'S	57	2.308'W		22-Mar-2013 00:36:00	3980 m	-	CTD15	-	-
16 (*)	SR1a	57	24.696'S	56	50.744'W		22-Mar-2013 06:09:00	3326 m	-	CTD16	-	-
17 (*)	SR1a	57	43.622'S	56	38.822'W		22-Mar-2013 11:27:00	3462 m	-	CTD17	-	ARGO5
STORM (*)		57	53.088'S	56	32.979'W		22-Mar-2013 14:37:00					
18 (*)	SR1a	58	3.008'S	56	26.704'W		23-Mar-2013 13:54:00	4130 m	-	CTD18	-	-
19 (*)	SR1a	58	21.951'S	56	14.907'W		23-Mar-2013 20:22:00	3830 m	-	CTD19	-	ARGO6
20 (*)	SoSo	58	3.128'S	53	37.956'W		24-Mar-2013 08:27:00	4034 m	SoSo - R	-	-	-
21 (*)	SR1b	58	30.799'S	55	22.186'W		24-Mar-2013 15:55:00	4091 m	-	-	VMP9 (US-5	-
22 (*)	SR1b	58	41.104'S	56	3.082'W		24-Mar-2013 19:53:00	3770 m	-	CTD20	VMP10 (UK)	-
23 (*)	SR1b	59	0.100'S	55	51.207'W		25-Mar-2013 03:48:00	3803 m	-	CTD21	-	-
24 (*)	SR1b	59	20.040'S	55	39.182'W		25-Mar-2013 09:24:00	3723 m	-	CTD22	-	-
25 (*)	SR1b	59	40.370'S	55	26.107'W		25-Mar-2013 15:06:00	3788 m	-	CTD23	VMP11 (UK)	ARGO7
26 (*)	SR1b	60	0.348'S	55	14.535'W		25-Mar-2013 22:31:00	3713 m	-	CTD24	VMP12 (UK)	-
27 (*)	SR1b	60	19.630'S	55	1.234'W		26-Mar-2013 05:15:00	3400 m	-	CTD25	VMP13 (US-	-
28 (*)	SR1b	60	40.363'S	54	49.080'W		26-Mar-2013 13:24:00	3083 m	-	CTD26	VMP14 (UK)	-
29 (*)	SR1b	60	47.989'S	54	44.784'W		26-Mar-2013 18:27:00	2595 m	-	CTD27	VMP15 (US)	-
30 (*)	SR1b	60	50.073'S	54	43.338'W		26-Mar-2013 23:03:00	1712 m	-	CTD28	-	-
31 (*)	SR1b	60	51.004'S	54	42.825'W		27-Mar-2013 01:24:00	987 m	-	CTD29	-	-
32 (*)	SR1b	60	58.826'S	54	37.750'W		27-Mar-2013 03:47:00	590 m	-	CTD30	-	-
33 (*)	SR1b	61	2.724'S	54	35.350'W		27-Mar-2013 05:30:00	351 m	-	CTD31	-	-

(ii) Orkney Passage section: 29 March – 02 April

34 (*)	Orkney	60	37.104'S	41	57.165'W	29-Mar-2013 08:40:00	3699 m	OP5 - R	-	-	-
35 (*)	Orkney	60	36.936'S	41	57.367'W	29-Mar-2013 11:50:00	3691 m	-	Aborted	-	-
36 (*)	Orkney	60	37.091'S	41	58.288'W	29-Mar-2013 12:48:00	3753 m	-	CTD32	-	-
37 (*)	Orkney	60	36.727'S	41	57.917'W	29-Mar-2013 15:40:00	3695 m	OP5 - D	-	-	-
38 (*)	Orkney	60	35.853'S	41	52.639'W	29-Mar-2013 22:19:00	3372 m	-	CTD33	-	-
39 (*)	Orkney	60	34.759'S	41	45.674'W	30-Mar-2013 01:49:00	3068 m	-	CTD34	-	-
40 (*)	Orkney	60	34.242'S	41	41.870'W	30-Mar-2013 04:41:00	2837 m	-	CTD35	-	-
41 (*)	Orkney	60	33.677'S	41	37.765'W	30-Mar-2013 07:10:00	2618 m	OP6 - R	-	-	-
42 (*)	Orkney	60	33.274'S	41	37.919'W	30-Mar-2013 09:07:00	2628 m	-	Aborted	-	-
43 (*)	Orkney	60	33.275'S	41	37.919'W	30-Mar-2013 09:39:00	2628 m	-	Aborted	-	-
44 (*)	Orkney	60	33.275'S	41	37.920'W	30-Mar-2013 10:05:00	2628 m	-	Aborted	-	-
45 (*)	Orkney	60	32.913'S	41	37.660'W	30-Mar-2013 11:40:00	2620 m	-	CTD36	-	-
46 (*)	Orkney	60	33.437'S	41	37.931'W	30-Mar-2013 13:48:00	2628 m	OP6 - D	-	-	-
47 (*)	Orkney	60	37.076'S	42	0.631'W	30-Mar-2013 19:30:00	3850 m	-	CTD37	-	-
48 (*)	Orkney	60	37.413'S	42	3.006'W	30-Mar-2013 22:36:00	3907 m	-	CTD38	-	-
49 (*)	Orkney	60	37.705'S	42	6.749'W	31-Mar-2013 02:12:00	3792 m	-	CTD39	-	-
50 (*)	Orkney	60	39.267'S	42	13.375'W	31-Mar-2013 06:54:00	2899 m	OP3 - R	-	-	-
51 (*)	Orkney	60	38.006'S	42	10.035'W	31-Mar-2013 10:06:00	3530 m	OP2 - R	-	-	-
52 (*)	Orkney	60	38.086'S	42	10.307'W	31-Mar-2013 13:50:00	3491 m	-	CTD40	-	-
53 (*)	Orkney	60	40.009'S	42	15.502'W	31-Mar-2013 17:42:00	2477 m	-	CTD41	-	-
54 (*)	Orkney	60	38.990'S	42	12.806'W	31-Mar-2013 19:45:00	3035 m	-	CTD42	-	-
55 (*)	Orkney	60	38.616'S	42	11.495'W	31-Mar-2013 22:47:00	3262 m	-	CTD43	-	-
56 (*)	Orkney	60	38.121'S	42	8.595'W	01-Apr-2013 01:42:00	3617 m	-	CTD44	-	-
57 (*)	Orkney	60	39.310'S	42	13.564'W	01-Apr-2013 05:17:00	2865 m	OP3 - D	-	-	-
58 (*)	Orkney	60	37.777'S	42	4.528'W	01-Apr-2013 08:38:00	3872 m	OP1 - R	-	-	-
59 (*)	Orkney	60	38.888'S	42	12.411'W	01-Apr-2013 13:06:00	3102 m	OP2 - D	-	-	-
60 (*)	Orkney	60	40.017'S	42	18.397'W	01-Apr-2013 23:08:00	2095 m	-	CTD45	-	-
61 (*)	Orkney	60	37.729'S	42	5.060'W	02-Apr-2013 02:06:00	3862 m	-	CTD46	-	-
62 (*)	Orkney	60	37.324'S	42	5.491'W	02-Apr-2013 09:17:00	3872 m	OP1 - D	-	-	-

(iii) A23 section: 06 March – 11 April

67 (*)	A23	63 57.849'S	28 52.667'W	06-Apr-2013 00:30:00	4787 m	-	CTD49	-	-
68 (*)	A23	63 20.794'S	29 34.017'W	06-Apr-2013 08:04:00	4690 m	-	CTD50	-	-
69 (*)	A23	63 4.345'S	30 6.842'W	06-Apr-2013 13:48:00	4882 m	-	CTD51	-	-
70 (*)	A23	62 46.967'S	30 41.629'W	06-Apr-2013 19:44:00	4833 m	-	CTD52	-	-
71 (*)	A23	62 29.465'S	31 15.580'W	07-Apr-2013 01:54:00	4800 m	-	CTD53	-	-
72 (*)	A23	62 4.530'S	31 10.988'W	07-Apr-2013 08:30:00	4699 m	-	CTD54	-	-
73 (*)	A23	61 39.707'S	31 6.650'W	07-Apr-2013 14:12:00	2489 m	-	CTD55	-	-
74 (*)	A23	61 10.257'S	31 2.767'W	07-Apr-2013 19:55:00	3223 m	-	CTD56	-	-
75 (*)	A23	60 41.472'S	31 0.446'W	08-Apr-2013 01:42:00	1377 m	-	CTD57	-	-
76 (*)	A23	60 18.918'S	30 57.511'W	08-Apr-2013 05:46:00	2634 m	-	CTD58	-	-
77 (*)	A23	59 59.701'S	30 55.698'W	08-Apr-2013 10:00:00	2896 m	-	CTD59	-	-
78 (*)	A23	59 46.036'S	30 54.172'W	08-Apr-2013 13:42:00	3363 m	-	CTD60	-	-
79 (*)	A23	59 26.161'S	30 51.576'W	08-Apr-2013 18:34:00	2929 m	-	CTD61	-	-
80 (*)	A23	59 3.110'S	30 49.552'W	08-Apr-2013 23:40:00	2639 m	-	CTD62	-	-
81 (*)	A23	58 38.099'S	30 49.409'W	09-Apr-2013 05:00:00	3401 m	-	CTD63	-	-
82 (*)	A23	58 12.795'S	30 49.128'W	09-Apr-2013 10:26:00	3550 m	-	CTD64	UK-test	-
83 (*)	A23	57 48.186'S	30 49.875'W	09-Apr-2013 16:17:00	3059 m	-	CTD65	VMP16 (US)	-
84 (*)	A23	57 27.599'S	31 18.735'W	09-Apr-2013 23:38:00	3619 m	-	CTD66	VMP17 (UK)	-
85 (*)	A23	57 6.081'S	31 50.053'W	10-Apr-2013 06:57:00	3473 m	-	CTD67	VMP18 (UK)	-
86 (*)	A23	56 46.518'S	32 18.171'W	10-Apr-2013 13:54:00	3211 m	-	CTD68	-	-
87 (*)	A23	56 22.468'S	32 51.860'W	10-Apr-2013 19:30:00	3090 m	-	CTD69	VMP19 (US)	-
88 (*)	A23	55 59.223'S	33 25.513'W	11-Apr-2013 02:17:00	3207 m	-	CTD70	VMP20 (UK)	-
89 (*)	A23	55 43.047'S	33 45.748'W	11-Apr-2013 07:39:00	3458 m	-	CTD71	VMP21 (UK)	-
90 (*)	A23	55 29.045'S	34 7.649'W	11-Apr-2013 13:24:00	2302 m	-	CTD72	VMP22 (US)	-
91 (*)	A23	55 15.592'S	34 26.614'W	11-Apr-2013 18:17:00	1261 m	-	CTD73	-	-
92 (*)	A23	55 13.003'S	34 30.399'W	11-Apr-2013 20:20:00	260 m	-	CTD74	-	-

Break in South Georgia: 12 April

(iv) North Scotia Ridge section: 14 April – 18 April

93 (*)	NSR	53 18.788'S	43 15.608'W	14-Apr-2013 09:15:00	977 m	-	CTD75	-	-
94 (*)	NSR	53 16.293'S	43 45.082'W	14-Apr-2013 12:24:00	1717 m	-	CTD76	-	-
95 (*)	NSR	53 15.992'S	44 26.728'W	14-Apr-2013 16:21:00	1098 m	-	CTD77	-	-
96 (*)	NSR	53 17.309'S	44 42.608'W	14-Apr-2013 18:41:00	1369 m	-	CTD78	-	-
97 (*)	NSR	53 15.404'S	44 59.797'W	14-Apr-2013 21:30:00	1951 m	-	CTD79	VMP23 (UK)	-
98 (*)	NSR	53 11.939'S	45 35.661'W	15-Apr-2013 10:51:00	1955 m	-	CTD80	VMP24 (UK)	-
99 (*)	NSR	53 10.531'S	45 55.159'W	15-Apr-2013 14:46:00	1789 m	-	CTD81	VMP25 (US)	-
100 (*)	NSR	53 7.523'S	46 31.481'W	15-Apr-2013 18:53:00	1378 m	-	CTD82	VMP26 (UK)	-
101 (*)	NSR	53 0.864'S	47 23.119'W	15-Apr-2013 23:50:00	1975 m	-	CTD83	VMP27 (US)	-
102 (*)	NSR	52 55.036'S	47 45.139'W	16-Apr-2013 04:23:00	2968 m	-	CTD84	VMP28 (UK)	-
103 (*)	NSR	53 6.996'S	48 11.158'W	16-Apr-2013 10:00:00	2209 m	-	CTD85	29/30(UK&L	-
104 (*)	NSR	53 9.078'S	48 30.142'W	16-Apr-2013 16:54:00	2893 m	-	CTD86	VMP31 (UK)	-
105 (*)	NSR	53 12.828'S	48 46.092'W	16-Apr-2013 21:30:00	2794 m	-	CTD87	VMP32 (US)	-
106 (*)	NSR	53 20.632'S	49 4.815'W	17-Apr-2013 02:18:00	2751 m	-	CTD88	VMP33 (UK)	-
107 (*)	NSR	53 22.554'S	49 26.087'W	17-Apr-2013 07:43:00	2131 m	-	CTD89	VMP34 (UK)	-
108 (*)	NSR	52 54.083'S	47 45.226'W	17-Apr-2013 16:19:00	2968 m	-	CTD90	VMP35 (UK)	-
109 (*)	NSR	52 48.359'S	47 49.549'W	17-Apr-2013 20:46:00	3019 m	-	CTD91	VMP36 (UK)	-
110 (*)	NSR	52 43.779'S	47 54.546'W	18-Apr-2013 00:48:00	3634 m	-	CTD92	VMP37 (US)	-
111 (*)	NSR	52 38.016'S	47 58.861'W	18-Apr-2013 05:06:00	3719 m	-	CTD93	VMP38 (UK)	-
112 (*)	NSR	52 32.273'S	48 2.688'W	18-Apr-2013 10:11:00	3786 m	-	CTD94	VMP39 (UK)	-

(v) Argentinian basin section: 19 April – 22 April

113 (*)	AB	51 19.081'S	39 51.016'W	19-Apr-2013 19:17:00	3817 m	-	CTD95	VMP40 (UK)	-
114 (*)	AB	51 3.244'S	40 22.855'W	20-Apr-2013 02:42:00	3745 m	-	CTD96	VMP41 (UK)	-
115 (*)	AB	50 48.570'S	40 55.428'W	20-Apr-2013 09:45:00	2335 m	-	CTD97	-	-
116 (*)	AB	50 33.579'S	41 27.775'W	20-Apr-2013 14:42:00	1803 m	-	CTD98	-	-
117 (*)	AB	50 22.407'S	41 39.437'W	20-Apr-2013 18:04:00	1517 m	-	CTD99	-	-
118 (*)	AB	49 51.014'S	41 59.919'W	20-Apr-2013 23:25:00	1775 m	-	CTD100	-	-
119 (*)	AB	49 23.718'S	41 58.527'W	21-Apr-2013 05:11:00	5362 m	-	CTD101	VMP42 (UK)	-
120 (*)	AB	48 56.510'S	41 57.951'W	21-Apr-2013 13:23:00	5244 m	-	CTD102	VMP43 (US)	-
121 (*)	AB	48 29.109'S	41 59.315'W	21-Apr-2013 20:20:00	5591 m	-	CTD103	VMP44 (UK)	-
122 (*)	AB	47 56.557'S	41 59.855'W	22-Apr-2013 06:16:00	6110 m	-	CTD104	-	-

(vi) Falkland Through section: 25 April – 26 April

123 (*)	AB	53 8.755'S	54 38.080'W	25-Apr-2013 11:01:00	2910 m	-	CTD105	VMP45 (UK)	-
124 (*)	AB	53 9.378'S	55 7.048'W	25-Apr-2013 16:30:00	2667 m	-	CTD106	VMP46 (UK)	-
125 (*)	AB	53 9.974'S	55 35.802'W	25-Apr-2013 21:24:00	2253 m	-	CTD107	VMP47 (US)	-
126 (*)	AB	53 16.505'S	56 2.260'W	26-Apr-2013 02:02:00	2297 m	-	CTD108	VMP48 (UK)	-
127 (*)	AB	53 20.650'S	56 32.521'W	26-Apr-2013 06:36:00	2398 m	-	CTD109	VMP49 (UK)	-
128 (*)	AB	53 22.619'S	56 47.996'W	26-Apr-2013 11:06:00	2448 m	-	CTD110	-	-

1.7 Cruise Narrative

14/03/2013:
The advanced party for JR281 arrived at 4 pm. The Falkland referendum took place last weekend and attracted a number of international observer and journalists. 98.8% of Falkland residents declare to want that Falkland stay a British Island, and Argentina argue that since Britain "invaded" Malvinas, votes from British invaders has no value to their eyes. As a consequence of the referendum and the international media attraction, all accommodations in Stanley are booked out. The ship is therefore at his maximal capacity with previous cruise party and the advanced party for JR281 sharing James Clark Ross accommodation. James Clark Ross is docked at the floating dock of FIPASS.
15/03/2013:
Cargo is being organised with the help of Simon and Simon, the chief officer and the deck engineer. Cargo has been spotted in the shed. Tracer container is now placed on the aft deck and has been lash down this morning. The tracer team start to setup their gear. By the end of the day, all cargo was on the ship, and UK-VMP was mounted. However, the power charger of the VMP blew up for no clear reasons. After contacting the manufacturer (Rockland) it turns out that it might be due to the internal battery being disconnected. VMP will be dismounted and remounted tomorrow.
16/03/2013:
The remainder of the scientific party arrived at 4 pm today and were warmly welcomed with a very nice sun shinning in Falkland sky. The only person missing is now Richard Cable who will arrive on the day of departure. Mobilisation continued with mooring winch being lashed down on the aft deck next to the tracer container. Gas bottle were placed next to the winch. Tracer team continue to work on their machine. UK-VMP is now mounted, and seems to work. We put it in charge.
17/03/2013:
We are leaving tomorrow. Most gear is now ready. Sean were performing test on the US-VMP, which were all successful. Both VMP are now up and running. O-rings of the Niskins were replaced. Instruments and Niskins are ready on the Rosette. Final tests were performed on the tracer machine. We are ready to leave and some people got rewarded by going for a walk near Gipsy Cove. Most of us enjoyed a last nice meal on meal at the Malvinas tonight. The only dark point is that two participants seem to have bug stomach. We hope that they will recover quickly and that the bug will not spread on the ship.
18/03/2013:
Ship sailed at 9 this morning. Richard Cable boarded the ship this morning one hour before leaving, after being dropped by the vessel Faros, which docked at FIPASS. Dolphin escorted us for a short while around Port William. We conducted a CTD test on the northern edge of the Falkland through at a bottom depth of 1700 m. Conversely to last year DIMES cruise, the tracer isopycnal was not found in these 1700 m of water, but still, relatively high concentrations of tracer were found at bottom. The ship is not moving too much which gives everyone a good chance to get use to the ship motion. Although some people are a bit drowsy, no one seems to suffer too much from the motion.
19/03/2013:
A very busy first day of work. We arrived at the first station of the Drake Passage section at 10 am, and worked almost non-stop for the entire day due to the very short steaming time between stations (9-20 minutes). We conducted six full depth CTD profiles, four UK-VMP tests (surface tethered buoyancy tests and one untethered 500 m cast), and seven US-VMP

tests (surface tethered buoyancy tests). This day has been a bit hectic with each team not entirely spun up and a lot of work. Everyone is a bit exhausted.

20/03/2013:

Another busy day, with five CTD and two VMP. Tracer analysis team are just coping with a lot of closely spaced station, meaning many samples and not much time to analyse them. In addition, Marie-Jose found an internal leak in the tracer analysis machine, which caused very noisy tracer profiles on the first 8 stations. The leak has now been found and successfully repaired. We deployed two APEX floats on station 8 and 10. While we were able to proceed with two VMP profiles at night, since sunrise a thick fog forced us to cancel the other planned VMP. The fog cleared off around 7 pm while the CTD was in the water. In order to not miss an additional VMP cast and to not loose too much time, it is been decided to deploy the VMP while CTD was still in the water, the strong eastward currents suggesting that it would quickly clear away from the ship in the opposite direction as the CTD. That is exactly what it did and we successfully recovered it. The extra hours on station (waiting for VMP while CTD was finished) allowed slowing the pace for the tracer analysis team.

21/03/2013:

Very nice sunny day with light wind and small waves. The calm before the storm… 40 knots winds and 10 m waves are forecasted for tomorrow. The nice conditions allowed us to successfully perform three additional CTD casts and two full depth VMP profiles. The US-VMP needed one more test to double check descent rate. In order to try avoiding as much as possible a gap in the dataset, it is been decide to deploy to 2000 m (with a bottom depth around 3800 m), and the VMP has been deployed while CTD was at the bottom to minimize the time between CTD on deck and VMP at surface. The 11^{th} US-VMP test was a success and we now should be able to use it for full depth profiles. With the station spacing being finally of 20 nm, tracer team has more time to analyse and is slowly catching up. We also had the chance today to see penguins playing near the ships. In summary, today was very satisfying, which was good for everyone moral after the busy start.

22/03/2013:

Wind started to pick up early in the night and gradually increased. At 5 pm, winds were blowing at 30 knots with gust in the high 30's and waves around 5-7 m. We were able to do three CTD casts without VMP. The forecasts indicating a slowly degrading weather, we were reluctant to take the risk to put the VMP in without knowing what would be the situation four hours later, when VMP surfaces. At station 18, around 5pm it has been decided to stop working until, at least, the next morning. Fortunately, the strong ship motion only affected a few of us. Most people are handling it ok so far. Trying to think positive, this pause in our work, gives the tracer team the possibility to catch up, and in general, to relax a bit. We however hope this will not last too long.

23/03/2013:

We were able to get back to work around midday today after the strong winds finally decide to ease down. Waves are still too big to get the VMP in the water though. After a couple of CTD we started our journey toward the DIMES sound source mooring. It is planned to arrive in the morning at first light and start mooring recovery.

24/03/2013:

We successfully recovered the sound source mooring this morning. The operation was done very efficiently. Mooring popped up in 15 minutes after release and the sound source could be recovered and turned off. We then steamed back on our CTD/VMP section and had the time for a CTD and VMP cast after a short stop to test VMP buoyancy. The sea was very calm and the sun shining, which was a very appreciable, change after these last days of heavy weather.

25/03/2013:

Today we managed to get 4 additional CTD casts. The weather was alright, however the fog became a bit of a concern, making VMP operation risky. We finally decided to put the VMP in the water anyway at a risk of loosing time searching for it in the fog. Everything went fine at the end and we could get some interesting microstructure measurement.

26/03/2013:

The fog does not want to go away making us (me) a bit nervous at each VMP cast. We however managed to find the VMP very quickly after it surfaced so far. An additional 4 CTD and 3 VMP. Probably one of the most efficient day since the start of the cruise.

27/03/2013:

We finished the SR1 section this morning after three very closely spaced CTD casts on the shelf. The sun rose when we were right next to Elephant Island. Impressive to see this islands from that close and think of all the history behinds it. We are now on our way to the Orkney Passage for some day of mooring work.

28/03/2013:

Still steaming. Everyone appreciates the break and the view of iceberg. We are looking at latest sea-ice maps and hope the ice condition will allow working in good conditions. We are going in Orkney Passage first and then, depending on ice conditions, hope to go a bit more south to recover and redeploy LDEO mooring.

29/03/2013:

We arrived this morning and discovered with much disappointment the heavy ice conditions. After passing OP6, where we estimated from radar that there were too many ice floes, we went to OP4. The conditions were marginal, and after many discussions, I preferred to stay on the safe side for the first mooring and go to the next site, at OP5. We timed the release of OP5 with the speed of the ice floes and go it just wrong, the two moorings end ending up on each side of one floe. Captain managed however to recover it safely. Redeployment was also an issue because of floes density but a solution has been found and the mooring could be redeployed today.

30/03/2013:

We did CTD work overnight but could not put the VMP in the water because of ice. OP6 was recovered and redeployed. After many discussions with Simon (deck eng) and George (bosun), a solution was found to deploy the mooring "weight first": usual way is to deploy top first and tow the floating mooring during the deployment, but this is impossible in such ice condition. The alternative way is to deploy anchor first, but that put a lot of pressure on the winch and cable and therefore the cable as to be put on the winch with pressure or the cable coat can be damaged, putting the mooring at risks. Unfortunately we do not have means to put pressure on the cable when putting on the winch. There were therefore an issue here. For the small mooring (~500 m) of yesterday, we found a solution by deploying top first, but instead of letting the mooring drift away, we attached it on the stern of the ship with weak link. It worked ok, but this is not a possible option for long moorings (~1-2 km). The solution taken was to put only one layer of cable at a time on the mooring, i.e. put one layer of cable; deploy anchor first; attach the cable on deck; put another layer of cable on the winch; continue deployment; attach cable on deck; etc. This makes the deployment much longer than normal, but allow deploying the mooring with the current winch setup and with heavy ice conditions.

31/03/2013:

We recovered OP3 and OP2. We decided to recover two mooring in order to have time to download and recharge instrument overnight without loosing too much time. We continued working on CTD section and made good progress. Much work has also been devoted to the April fools blog joke (we sighted a Polar Bear drifting on an ice floe)!

01/04/2013:

A long day for the mooring team with the deployment of OP3 and OP2, and the recovery of OP1. The wind is forecast to peak up tomorrow around lunchtime, so we tried to fit as much as we could today. If the timing of the forecast is right, we hope to be able to re-deploy OP1 in the morning before the highest wind hit us.

02/04/2013:

We redeployed OP1, just on time before the wind became too strong. We are very satisfied with this Orkney Passage work. Despite the poor conditions, we managed to fit the recovery and redeployment of the 6 moorings and 17 CTD, completing one of the highest density sections of the passage. Satellite ice maps were showing 100% ice coverage in the area of the LDEO mooring. It has consequently been decided to leave them in the water for one more year, hoping that we can recover them next year (both instrument and release have enough battery for at least one more year).

03/04/2013 – 05/04/2013:

Almost three days of steaming along the edge of sea-ice. Everyone enjoyed this break with many iceberg sighting, and the good weather conditions and forecast kept everyone moral up, ready to attack the second half of the cruise.

06/04/2013 – 08/04/2013:

We made very good progress on the A23 section. 13 CTD stations in 3 days. The weather has been very good which is very pleasant for working efficiently, but maybe more importantly, allows everyone to have good rest and feel good, which helps to keep a good atmosphere on the ship.

09/04/2013:

It is decided; we will stop in South Georgia. I've been planning that since a long time, and I am very pleased to being able to confirm the rumour to everyone. We will be able to dock on the 12th morning and stay either 12 or 24 hours depending on when we need to be back in the Falkland (still in discussion with BAS office in Cambridge). With the current progress we should arrive near South Georgia on the 11th evening. I therefore chose to add VMP profiles to each station to reduce the pace (and hopefully get interesting information on mixing in the bottom water layer on their exit way from the scotia sea to the Atlantic basin).

10/04/2013 – 11/04/2013:

We continued great progress on the section and finished it tonight with a total 25 CTD and 7 VMP. More than expected! Everyone is exited and get ready for a well-deserved stop in South Georgia.

12/04/2013:

Awesome clear sky and warm day in South Georgia. The base commander of KEP organised a BBQ for us in the evening.

13/04/2013:

We left South Georgia under an amazing morning sun. We are now steaming for 26h hours before the first station of the north scotia ridge. Perfect time to share and look at the picture from yesterday.

14/04/2013:

First day of work after South Georgia break. The waves are back again. That's been a long time we have not seen them. We arrived at the first station of the Shag rock passage in the morning around nine, and had time for four CTD casts. Unfortunately the waves prevent us of doing VMP. We're hoping that they will ease down during the night at suggested from the forecast.

15/04/2013:

After a long night waiting for the waves to ease enough to be able to put the VMP in the water, we managed four CTD+VMP casts. The tracer machine had a few issue that hopefully could be resolved overnight. Tracer team is then very busy trying to keep up as much as they can.

16/04/2013:

We have been trying to reduce the pace to give the tracer team to keep up. Consequently we did a double VMP cast, which should be interesting to test the consistency of the two instruments. I also slightly re-designed the plan to make sure to not have more than 4 tracer stations per 24h. We are still doing good on time, and tracer measurements shows that the tracer concentration are still very low, so we are discussing the possibility of changing the track of the end of the cruise to go a bit and make a small section across the ACC further downstream.

17/04/2013:

After many discussions, we decided to go at the exit gateway of the Argentinian basin, where we should have time for an extra section across the polar and subantarctic front. Although one could have thought that the news of extra stations would not been so well received after almost 5 weeks at sea, there has been actually much excitement in going further "searching" for the tracer. Bets on tracer concentration that we will find over there are open!

18/04/2013 – 19/04/2013:

Steaming toward the "extra" Argentinian basin section

20/04/2013:

We started the section with CTD and VMP. Unfortunately the waves and wind picked up a bit and forced us to cancel VMP on the Plateau. We should however have a window of relatively good weather for the next one or two days, which should allow us getting VMP as we pass the Falkland escarpment.

21/04/2013:

We arrived in the Argentinian basin overnight. The floor dropped to more than 5km north of the Falkland escarpment. We are now back in the Polar Front and Subantarctic Front and the tracer peak concentration is still very low. Today we have been able do some very deep VMP and CTD. Waves and wind are supposed to pick up again overnight.

22/04/2013:

After a very marginal VMP cast overnight, we finished the section with a CTD this morning. The last CTD was cancelled to large waves building up. It has been preferred to sail away rather than going a the next site, three hours away, where the waves would have been very likely to be too large for a last CTD. Depending on the speed that the ship will be able to make in the storm, we might have time for extra section across the Subantarctic front, off the Falkland Island.

23/04/2013 – 24/04/2013:

Probably the most tiring days of the trip. We have been hit by a big storm, and ship tried to make its way across it. It has been hard to sleep for most of us and a few were a bit sick. Hopefully the weather is improving. A few more stations across the SAF before going back in Stanley.

25/04/2013:

The weather has finally settled. We are making good progress on the last section of the cruise. The last few stormy day, after 5 week at sea have been a bit tiring, but we can now feel the end approaching. We plan to finish stations tomorrow by dinnertime, and have a "end of cruise dinner" in the evening.

26/04/2013:

We finished the 110th and last CTD in early afternoon today. I think this cruise has been a great success, with more work achieved than originally planed, with whale, sea-ice, iceberg and even a stop in South Georgia, and more importantly (but not unrelated) a very good atmosphere on the ship. Merci everyone!

PART II: Underway Data

2.1 Navigation

Brian King

As part of the routine daily processing four navigation streams were extracted from SCS into mexec directories, as summarised in the following table:

mexec directory	mexec short name	mexec directory abbreviation	mexec file root
nav/ash	ashtech	M_ASH	ash
nav/gyros	gyro_s	M_GYS	gys
nav/seapos	seatex_gll	M_POS	pos
nav/seahead	seatex_hdt	M_SEAHEAD	seatexhead
chf	emlog_vhw	M_CHF	chf

One stream (gyro) was given intermediate processing before appending into the accumulated cruise file.
Synchro gyro & Ashtech ADU heading: The Ashtech ADU did not provide any good heading data throughout the cruise. The usual intermediate processing of ashtech data was therefore not performed. Ashtech position data was used to fill in a short gap in the seatex positions when the seatex went offline. The gap in seatex heading was filled with synchro gyro. Standard processing on previous cruises includes scripts *mgyr_01*, *mash_01* and *mash_02* to clean up any duplicated times in the gyro stream, and then an ashtech minus gyro comparison, which cleans up the ashtech data before producing a smoothed ashtech minus gyro time series. This is crucial for shipboard ADCP on *Discovery* , but not used on the *James Cook* or *JCR*.
Data from the furuno GPS were logged in SCS but not converted to mstar. This conversion could easily be done ashore if required.
Master files such as pos_jr281_01.nc contain the full and final cruise archives for nav streams.
Script
m_jr281_daily_processing
called *mday_00* to read in all streams, inserted the required scripts for streams that required intervention, and then *mday_02* to append into an accumulating cruise file. As usual the scripts
mday_00_get_all.m
and
mday_02_run_all.m
were edited to select streams available and required on the cruise.
A script *mday_plots_all.m* was run to generate some summary daily plots to enable quick-look assessment of data quality or data gaps. This calls *mday_plots.m* for various data streams, including fully processed true wind if available. It is intended to run on all ships, skipping datastreams that are not available.
The Chernikeef emlog was read in as part of daily processing, but no further use was made of it, or analysis undertaken. Occasional visual inspection suggested it was reasonably well calbrated, but no requirement for a carefully calibrated emlog stream was identified.
Bestnav: *mbest_all* runs a series of scripts to produce the master bestnav file, bst_jr281_01. This uses seatex_gll for position, and merges on seatex heading so that there is a complete file containing position, heading, course and speed made good, and distance run. The data are reduced to a 30-second time base and heading is properly vector averaged. This is the

'definitive' cruise navigation file. The file is found in the nav/seapos directory. In order to avoid the problem of housekeeping variables like distrun across daily files, the bestnav processing is rerun from the start of the cruise each time it is required. There is therefore only ever one bst_jr281_01 file.

2.2 Oceanlogger And Anemometer

Brian King

This report covers surface surface meteorology and other oceanlogger measurements, except pumped seawater covered in Section 2.5.
There are two relevant met SCS streams: oceanlogger and anemometer

mexec directory	mexec short name	mexec directory abbreviation	mexec file root	variables
met/surfmet	surfmet	M_MET	met	wind_dir wind_speed
ocl/	oceanlogger	M_OCL	ocl	airtemp1 humidity1 par1 tir1 airtemp2 humidity2 par2 tir2 baro1 baro2
ocl	oceanlogger	M_OCL	ocl	tstemp conductivity salinity sound_velocity chlorophyll sampletemp flowrate sstemp trans

Note that apart from salinity in the thermosalinograph, all other data have no further calibration applied. For example, no record was made of meteorology sensor numbers, calibrations applied en route to SCS, date of last sensor cal, etc.
Meteorology
Wind variables: Ship speed, position and heading from the bst file (Section 2.1) are merged onto the wind data in the surfmet. The absolute wind speed is calculated and vector averaged in one multi-step script *mtruew_01*. As with bst processing, this is rerun for the entire cruise each time the data are updated. The output files from this processing are
met_jr281_true.nc
met_jr281_trueav.nc
The latter file is reduced to 1-minute averages, with correct vector averaging when required. In order to avoid ambiguity, variable units are explicit in whether wind directions are 'towards' or 'from' the direction in question. The result is a bit cumbersome, but should be unambiguous if the units are read carefully.
Wind over the stern: The standard test of whether the relative wind processing has been done correctly would be to observe no change in the calculated absolute wind when the ship changes direction or speed. This can be misleading, since the anemometer sited on the foremast under-reads speed by a significant margin when the wind is over the stern.

Therefore if either the ‘before’ or ‘after’ wind direction is over the stern, there can be a significant change in the apparent true wind speed during such manoeuvres.
Frozen anemometer: In periods of very cold weather, the anemometer gave absent, or sometimes wildly erroneous, data. This was assumed to be due to freezing of the sonic head. Some crude editing of these periods was performed, but the cleaning was not comprehensive. In summary, the wind data are fully processed, but cannot be regarded as perfectly ‘clean’.

Air temperature, humidity, irradiance and surface pressure

Downwelling PAR and TIR data are found in the ocl stream, which also contains barometer pressure. These streams were ingested and strored, but no further processing was undertaken. The temperature-1 sensor failed early in the cruise, and could not be replaced at sea. That data stream, together with humidity-1 is therefore bad.

Underway surface thermosalinograph

This is described in Section 2.5

2.3 EA600 bathymetry

Brian King

Two sources for bathymetry were processed. EA600 was processed in mexec from SCS files. EM122 swath was processed in delayed mode by Gwen Buys.

EM122

A finished cleaned centre beam depth time series was provided from the post-processing, and read in to mstar. Files were
jr281_centrebeam.dat (ASCII listing)
em122_jr281_post.nc generated using *mem120_from_postprocessed.m*
The EM122 centre beam data in SCS was also routinely read in during the cruise as part of daily processing, and cleaned using scripts *mem120_01.m mem120_02.m*. These data were merged with ea600 and used for QC, as described below.

EA600

The EA600 was operated throughout the cruise, except when pinging was switched off for VMP tracking and mooring communications. Data quality was sometimes poor or non-existent when sea state was unfavourable. Screen dumps of the analogue display are not available, so cleaning of dubious data in post-processing is by a mixture of guesswork and 'plausibility'.
Data were read into mexec directory 'sim'. The scripts were overhauled and tidied from previous cruises, and the following scripts were used. The intention is to make them suitable on all ships, with ship-dependent switches for things like variable names.
msim_01:
read raw data for the day (sim_jr281_d080_raw.nc);
pick data in depth range 5 to 10000, to discard zeros;
take median depth in 300 second bins, to discard noise
example output file: sim_jr281_d080_smooth.nc
make duplicate file in sim_jr281_d080_edited.nc
msim_02:
merge on swath centre beam data for the day of available, to be used in cleaning
msim_plot:
enter *mplxyed* for manual removal of bad data. Note: the intention is that the files are set up so this file is used to edit bad data in the ea600 file. The equivalent file in the em122 sequence should be used to edit bad data in the em122 stream.
msim_plot displays an extra window with the full ea600 data, to guide the use of *mplxyed*. A 'quick and dirty edit' was made to the code that plots this window, to add satellite bathymetry, and em120 centre beam depths. Positions for the SS bathymetery were loaded on the fly from 'seapos, culled to approximately 5 minute intervals, and depths retrieved using script *pos_to_ssdep*. Em122 data were loaded on the fly from the SCS em122 file, and displayed with depths less than 50m discarded. This script would benefit from an overhaul to make its approach more consistent with other mexec scripts. The 'spare' window is useful for Matlab zooming, as well as for comparing all available estimates of seabed depth.
EA600 data quality: when the ea600 is noisy, it is often very difficult to infer just from the digitised records whether the instrument was finding the bottom or simply returning random noise close to the last known good depth. Accordingly the *mplxyed* editing was done in a fairly harsh manner, preferring to discard data which seemed noisy and for which there was no good evidence that the data were correct. The dataset therefore has many gaps.

EA600 data were acquired from 76/1821 to 117/1218. Approximately 80% of the 5-minute bins during that period have valid depths retained.
After cleaning in *mplxyed*, daily files were appended into a single file

sim_jr281_01.nc

navigation was added

sim_jr281_01_nav.nc

and Carter area correction applied using *mcalc*

sim_jr281_01_nav_cordep.nc

This last file is therefore the master EA600 file, with corrected bottom depths in 5 minute bins.

EM120 centre beam

Em120 centre beam depths were logged in SCS and downloaded in daily files to mexec directory 'em122. Section 2.4 has a description of EM122 operation and data processing.
Two scripts were written to load and edit EM122 data, based on the scripts for EA600:
mem120_01:
read raw data (em122_jr281_d080_raw.nc)
mdatpik for snd > 20
mavmed, median in 300 second bins (em122_jr281_d080_smooth.nc)
copy file to 'edited' (em122_jr281_d080_edited.nc) ready for manual editing
mem120_02:
merge on ea600 for display in mplxyed for QC.
mem120_plot:
If all the relevant files exist, display the Matlab window with EM120, EA600 and SS bathymetry, then enter *mplxyed* on the edited file. This step can be repeated as often as required. The Matlab plot window displays the data as found in the most recently updated 'edited' file.
The branch was not much used in this cruise. A cleaned version of em122 data was provided from the main swath processing at the end of the cruise.

Merging of EM122 and EA600

Since each data stream has some good measurements where the other absent, the best available estimate of cruise bathymetry requires the two streams to be merged. This task was not undertaken at sea.

2.4 Multibeam Bathymetry

Gwen Buys

2.4.1. Overview

Multibeam bathymetry support was provided throughout JR281 to aid deployment of the VMP equipment. Data was collected for the majority of the cruise whilst the ship was underway with the exception of some periods of bad weather, equipment malfunction and when transiting previously swathed shelf areas.

At the beginning of the cruise we encountered multiple errors with the EM122 system. These were rectified by restoring the SIS software to a previous version. Once restored the EM122 multibeam equipment performed well throughout the cruise with the exception of some minor issues which are given in detail below. The following section gives an overview of the operational settings and issues encountered on this cruise and some recommendations for future cruises. General operational documentation for the EM122 can be found on the JCR wiki (http://wiki.jcr.nerc-bas.ac.uk/JCR_EM122_Multibeam_Bathymetry)

2.4.1. Survey Information

EM122 survey details are given in the table below and illustrated in figure 2.4.1. There were many breaks in the multibeam acquisition between the timeframes listed due to the ship being stationary (scientific deployment, hove to etc). Files consist of a maximum of one hour of data.

Survey name	**Timeframes (UTC)**	**Description**	**Order**	**No of files**
jr281_a	18/03/2013 14:57 18/03/2013 23:26	Transit from south of the Falkland Islands to the north end of the SR1 line.	1	5
jr281_b	19/03/2013 01:31 27/03/2013 11:05	Coverage of the SR1 line including the transit to and from the SoSo mooring.	2	83 (no file 38)
jr281_c	27/03/2013 11:07 31/03/2013 10:47	Transit from the south end of the SR1 line to the Orkney Passage mooring area.	3	53
jr281_d	04/04/2013 02:10 06/04/2013 11:00	Transit from the Orkney Passage mooring area to the start of the A23 line.	4	54
jr281_e	06/04/2013 14:24 11/04/2013 23:22	Coverage of the A23 line.	5	75
jr281_f	12/04/2013 00:19 12/04/2013 07:16	Small transit across the south east of the South Georgia shelf.	6	7
jr281_g	14/04/2013 07:40 19/04/2013 22:13	Coverage of the eastern NSR stations and the transit to the south of the AB line.	7	89
jr281_h	20/04/2013 02:49 22/04/2013 10:35	Coverage of the AB line.	8	39
jr281_i	24/04/2013 17:30 26/04/2013 20:57	The second half of the transit from the AB line to the western NSR line and	9	42

		coverage of the western NSR stations.		

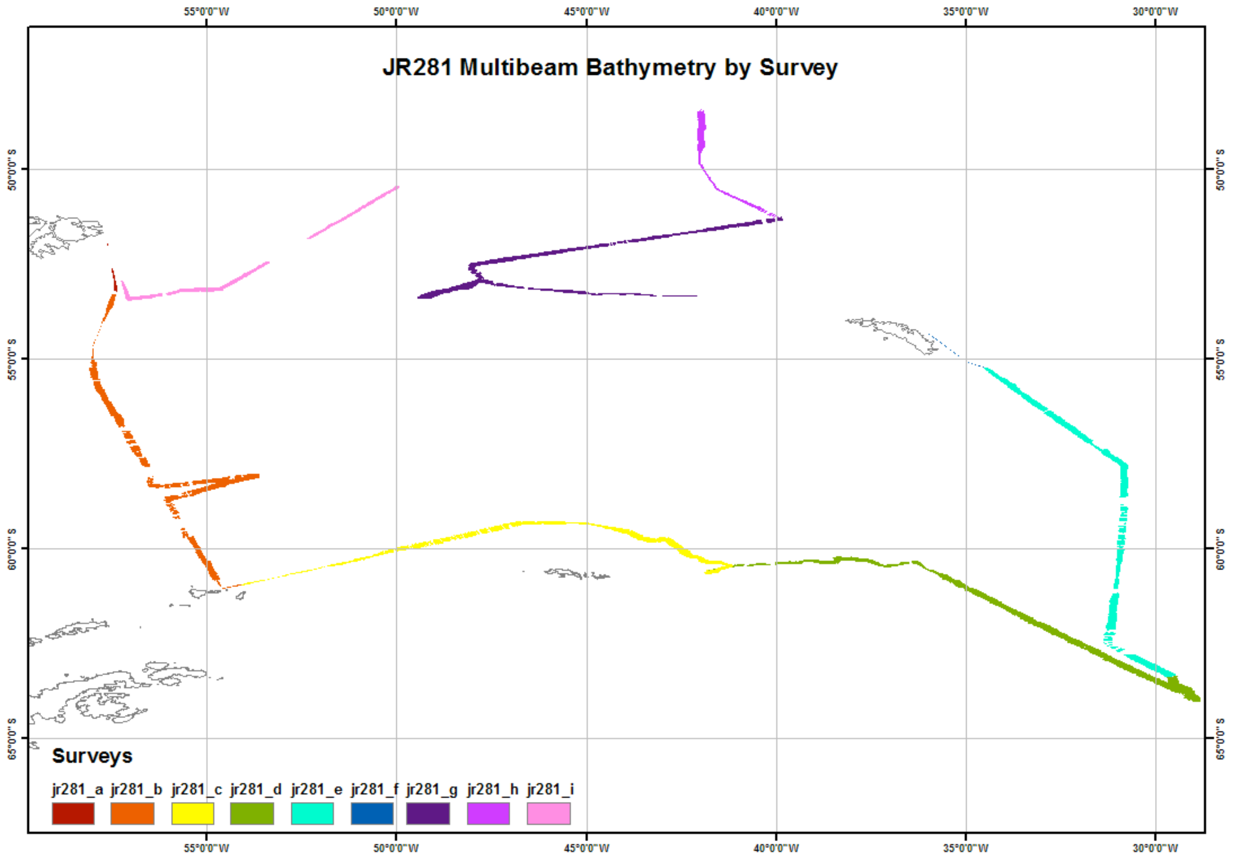

Figure 2.4.1: JR281 multibeam data collection shown by survey.

2.4.3. Operational Settings

The EM122 system is run through the Windows based SIS software provided by Kongsberg. Throughout the cruise the EM122 was run in external trigger mode with the ping rate calculated by the Simrad Synchronisation Unit (SSU). SIS creates 'on the fly' grids of the data as it is collected and these are displayed in the geographical window. The creation of these grids requires that a grid size is defined for each new survey which cannot be changed once selected. During this cruise the number of cells in the processing grid was always set to 128*128 and the grid cell size to 30 m. Angular coverage mode was set to manual and beam spacing to high density equidistant for the duration of the cruise. The max beam angle was varied from 45° to 60° depending on the sea state, water depth and bathymetry with the max width kept constant at 20,000 m to port and starboard. Pitch stabilisation was set on, yaw stabilisation off, auto tilt off, along direction to 0° and heading filter to medium. Spike filter strength was set to medium, range gate to normal, phase ramp to normal and penetration filter strength to off. Slope and sector tracking were both switched on and the angle from nadir was set to 6°. Salinity was used as the absorption coefficient source with the default value of 35ppm. Throughout the cruise the mammal protection power level was set to max with a startup ramp time of 0 mins. The real time data cleaning was set to auto 0 which provided a satisfactory level of automatic flagging of anomalous data points, i.e. many of the bad points were flagged and no automatically flagged points were required to be restored. When cleaning the data using MBSystem (see Data Processing section below) the automatically flagged points are marked as 'sonar' edits and are shown in green. For the large majority of the cruise the dual pulse mode was set to dynamic (i.e. on), however when in water depths of approximately < 500m it was set to off.

2.4.4. BIST Tests

The Built In Self Tests (BIST) were carried out twice during the cruise. First on departure from Stanley on the 18th of March and again on the 13th of April after departure from KEP. On both occasions all tests were passed with the exception of test 7 the TX channels test which fails due to some failed channels in the transceiver unit, a known issue which is detailed in the JRtri006 trials cruise report. The results of the tests were saved as text files in D:/sisdata/common/bist with filenames JR281_date.

2.4.5. Import of Sound Velocity Profiles

Sound velocity profiles were acquired exclusively from the CTD's deployed for the JR281 oceanographic work. The SVP was updated approximately once or twice a day with files read from U:/asvp/by-leg/20130317 into the SIS SVP Editor, extended and thinned and then automatically saved to D:/sisdata/common/svp_abscoeff/20130317. The file was then applied by opening a Runtime Parameters window in SIS and navigating to the Sound Speed tab.

2.4.6. Helmsman Program

The SIS software has an additional program called Helm which is used for the helmsman display. The need for this function on JR281 was not great, however the program was run at all times to allow the bridge to see the coverage of data collection. The program is run from the main EM122 machine and can be displayed in the additional monitor (positioned above the main monitor) whose image is transferred to a repeater monitor on the bridge. Unfortunately the helmsman display monitor was broken so during this cruise the Topas monitor was used to display the Helm program, with this monitor set to repeat on the bridge. In general the program worked ok and served its purpose.

2.4.7. Use of Background Grids

It is possible to add background images in GeoTiff format to both the SIS and Helm programs. This functionality was often used during the cruise. A series of GeoTiffs had been created at the beginning of the season from an up to date ArcGIS grid of the BAS multibeam data holdings. These images were stored on G:/Multibeam Background Data for the JCR 12-13 Season/Background GeoTiffs for SIS and uploaded to SIS from there using the Import/Export tool.

2.4.8. Interaction with the EA600 Echosounder

The EM122 and EA600 were both run through the Simrad Synchronisation Unit (SSU) with the EA600 in passive mode. As encountered on JR259 last season, when the EM122 dual ping mode was set to 'Dynamic' the EA600 received two distinct returns and often picked the 'second' ping as the true depth. This was generally deeper than the true depth under the hull. The problem was overcome as before by the officers on the bridge setting a realistic depth range for the EA600 to listen in.

2.4.9. Data Processing

Raw data were automatically written to the data drive (D:/sisdata/raw/'survey name') on the EM122 acquisition machine and then a cron job running every 10 minutes copied the data to the path:
/data/cruise/jcr/current/em122/raw/*'survey name'*

where current is a symbolic link to the leg id 20130317 (the date the cruise started - YYYYMMDD)

Data were processed with MB System v5.3.2012 installed on the Linux virtual server JRLC (full server name is jrlc.jcr.nerc-bas.ac.uk) following the same general procedures detailed in the JR93, JR134, JR168 and JR259 cruise reports. MB can be setup by typing,

    setup mb
    setup gmt

GMT (version 4.5.9) is needed for several of the MB System subroutines and is worth setting up at the same time. Type, 'man mbsystem' for an overview of MB.

2.4.10. Copying the data and producing auxiliary files

The perl script *mbcopy_em122* was used to copy raw EM122 data into MB system format and produce auxiliary files. To run the script type,

    setup gsd
    mbcopy_em122

from a Unix/Linux command line. You will be asked several questions regarding the raw data location, the desired location of the copied data and whether you want all the lines copied (type 'n' if you are actively acquiring data and the script will not copy the last hour file as it will not be complete). This information will be stored in a defaults file in your home directory and will not need to be re-typed until you change survey names. Note that the script will check for lines already copied and will ignore these. You can however, force the script to start at a predetermined line number if you do not want the earlier line numbers copied. The script automatically creates a text file of all the raw data copied (named raw_datalist) and creates auxiliary files which help MB speed up functions such as gridding.

2.4.11. Cleaning the data

All of the data cleaning was done manually using the mbedit graphical interface. This allows the user to manually flag data in either a ping-by-ping view or as a waterfall view where n number of pings can be viewed together. Detailed editing was done using the ping-by-ping view for each hour file followed by a quick look using the waterfall view to check for any erroneous depth values missed.
Cleaning the data creates two additional files, a .esf file which holds the flagging information and a .par file which contains a whole variety of edits including cleaning and navigation fixes. Navigation data was not a problem during JR259 so did not need fixing.

2.4.12. Processing the data

The command *mbprocess* takes information from the .par file and processes the .mb59 data to produce a final output file. If the input file is called "data.mb59", the processed file becomes "datap.mb59". *mbprocess* also creates additional auxillary files (.inf, .fnv, .fbt). The command takes the form of:

    mbprocess –Iraw_datalist –F-1

A text file containing the names of all the processed data can then be created (proc_datalist on this cruise, i.e. type, 'ls *p. mb59 > proc_datalist'). If at some point the user decides to go back and re-clean the data or edit the navigation for a single file, mbprocess can be run with the same command and it will process only the newly edited files.

To recap the processes and the files they create are:

Input	Process	Output
data.raw	mbkongsbergpreprocess	*data*.mb59 *data*.mb59.ata *data*.mb59.ath *data*.mb59.ats *data*.mb59.sta
data. mb59	mbdatalist	*data*.mb59.inf *data*.mb59.fbt *data*.mb59.fnv
Note : The above two processes are combined in the script mbcopy_em122		
data.mb59	mbclean/mbedit	*data*. mb59.esf *data*. mb59.par
data. mb59	mbprocess	*data* p.mb59 *data* p.mb59.inf *data* p.mb59.fbt *data* p.mb59.fnv

2.4.13. Gridding the data

The command *mbgrid* with its associated options produces a user-defined grid for viewing the cleaned swath results. Data were output directly to ArcGIS ascii grids as ArcGIS was the primary software tool used to view the grids. One of the limitations of ArcGIS grids is the need for matching x and y grid resolution values. Hence, with a non projected grid it was necessary to use identical values in degrees (usually 0.002) that are unequal in real world distance, particularly at high latitudes. The command and some of the more common options used are:

mbgrid -Iproc_datalist (can be ../ etc if in another directory)
-O'grid filename' (naming scheme – 'surveyname_resolution' e.g. jr281_a_002. A suffix is automatically added)
-R-29/-26/-57/-55 (bounding co-ords, min long/max long/min lat/max lat. **Note that MB will default to the maximum extent of the input files. This is very useful for survey overviews. No –R flag is needed in this case**)
-E0.002/0.002/degrees! (grid resolution; 0.002 degrees in this case. ! forces the resolution by changing the extent slightly if necessary.)
-G4 (Specifies an ArcGIS ascii grid output)
-A2 (produces a grid with bathymetry as negative values)
-F1 (type of filter used; 1=gaussian weighting, 2=median weighting)
-C3 (spline interpolation into data free areas, ~300m in this case (grid resolution x 3)
-M (produces two further grids; one giving the number of beams within each grid cell and the other giving the standard deviation of those beams in each grid cell)
-J (Projection defaults to geographic but see man mbgrid for 1000's of projected systems on offer. –E would then be set to n/n/metres!

Ascii xyz files were also produced from the cleaned data (with the exception of survey jr281_e – see below) using the command *mblist* and the following options

mblist –Iproc_datalist –F-1 –D3 > survey_name.mbxyz

-D3 is the output format (simple X, Y, Topography [-Z]) and the output text file can be called anything you like. The file suffix 'mbxyz' was used to avoid confusion with Neptune 'xyz' files produced on older cruises.

The mbxyz files can be used as an input to the GMT nearneighbor command or any other gridding software that accepts ascii xyz files.

Generated ascii grid files were converted into ArcGIS binary grids using the ArcGIS tool 'Ascii to raster'. They could then be viewed and manipulated using ArcGIS v10.1 and this proved a very useful tool for finding data spikes that needed further cleaning. This was done by both visual inspection of the bathymetric grid and identifying anomalies within the standard deviation grid. In general all survey files that caused standard deviations above 150m within a 0.002 degree grid cell were inspected again and cleaned if necessary. This provided a very robust way to identify spikes and false multiples that had not been seen at the cleaning stage. It was considered that standard deviations lower than 150m could be real in areas of high variability or more likely random noise in the outer beams that would average out in the grid itself.

2.4.14. File Structure

A common file structure was created to hold all the mb data located under /data/cruise/jcr/20120207/work/mb/*'survey_name'*

Each survey_name (e.g. jr281_a) directory contains processing, grd and mbxyz subdirectories. The processing directory holds all the copied mb59 files, the edits and the processed mb59 files. The grd directory holds any GMT grids or ArcGIS ascii grids while the mbxyz directory holds the xyz text output.

2.4.15. Software Crashes / Errors

SIS

On first starting up SIS an error message appeared stating "Unable to connect to GridEngine.". After consulting the manual the HDDS process was restarted in an attempt to fix the GridEngine error but it was not successful. After contacting Craig Wallace from Kongsberg a re-install of the database was tried to fix the problem but unfortunately this was unsuccessful as well.

As the SIS software had been updated to version 3.9.2 in December 2012 and the issue has appeared since then it was decided that the best course of action to bring the EM122 back into working order for this cruise was to roll back the SIS software to the previous version. This was achieved by using a backup image saved on disk. The roll back was carried out by Richard Cable.

After the roll back of the software the EM122 functioned as expected and the gridding option was available.

The SIS software crashed once during the cruise when trying to import a third background image file while three grid surveys were loaded. The crash occurred whilst transiting a previously swathed area when data logging was not required and hence did not impact on data collection. Similar crashes were encountered during JR259 last season and can be minimised by removing unnecessary background grids and surveys using the Import/Export tool and Remove Selected.

SSU

On the morning of the 4th of April 2013 the SSU froze and stopped sending a trigger to the EM122. This was not noticed immediately and hence resulted in the loss of about 45mins of data. The SSU machine was rebooted and the correct settings entered in and the system worked for a few minutes before freezing again. After a second reboot the system behaved as expected and no further issues were encountered with it for the remainder of the cruise.

Seapath
During the night shift of the 24th – 25th of April 2013 the Seapath system failed and hence no motion data was sent to SIS. The problem took a few hours to be resolved and during this time the EM122 continued to collect bathymetry data but SIS did not produce any grids. When processing it was clear that without the motion compensation the data was useless and hence all pings were flagged for the duration of the Seapath downtime. Unfortunately when the data was gridded it became evident that in data files where Seapath was down for part of the file the whole data file was 'corrupted' and hence further processing was required to remove all pings from such files. The result was a data gap of just over 4 hours. As this occurred on transit over a previously swathed area and did not coincide with any science stations there were no significant implications for the cruise.

MBSystem
When the data from survey jr281_e (the A23 line) was gridded with mbgrid there were significant standard deviations in many areas of the grid. The affected data files were identified and checked again with mbedit. The issue was found to be out of range (approx 455°) heading values assigned to certain pings within the file. The issue only occurred when the ship was sailing due north and the heading was jumping between 0 and 360°. After re-checking the grids created in SIS it was concluded that the issue was with MBSystem and that the raw data was not affected. The navigation for the affected files was checked with mbnavedit but the out of range heading values were not visible there. As it was not very feasible to contact the MBSystem developers and send data samples from the ship the issue was left to be resolved when back in the office in Cambridge. As a result the final grid and mbxyz file for survey jr281_e do not yet exist and will have to be created once the issue is resolved. An example of the issue as seen when gridding the data and when assessing it in mbedit can be seen below in Figure 2.4.3.

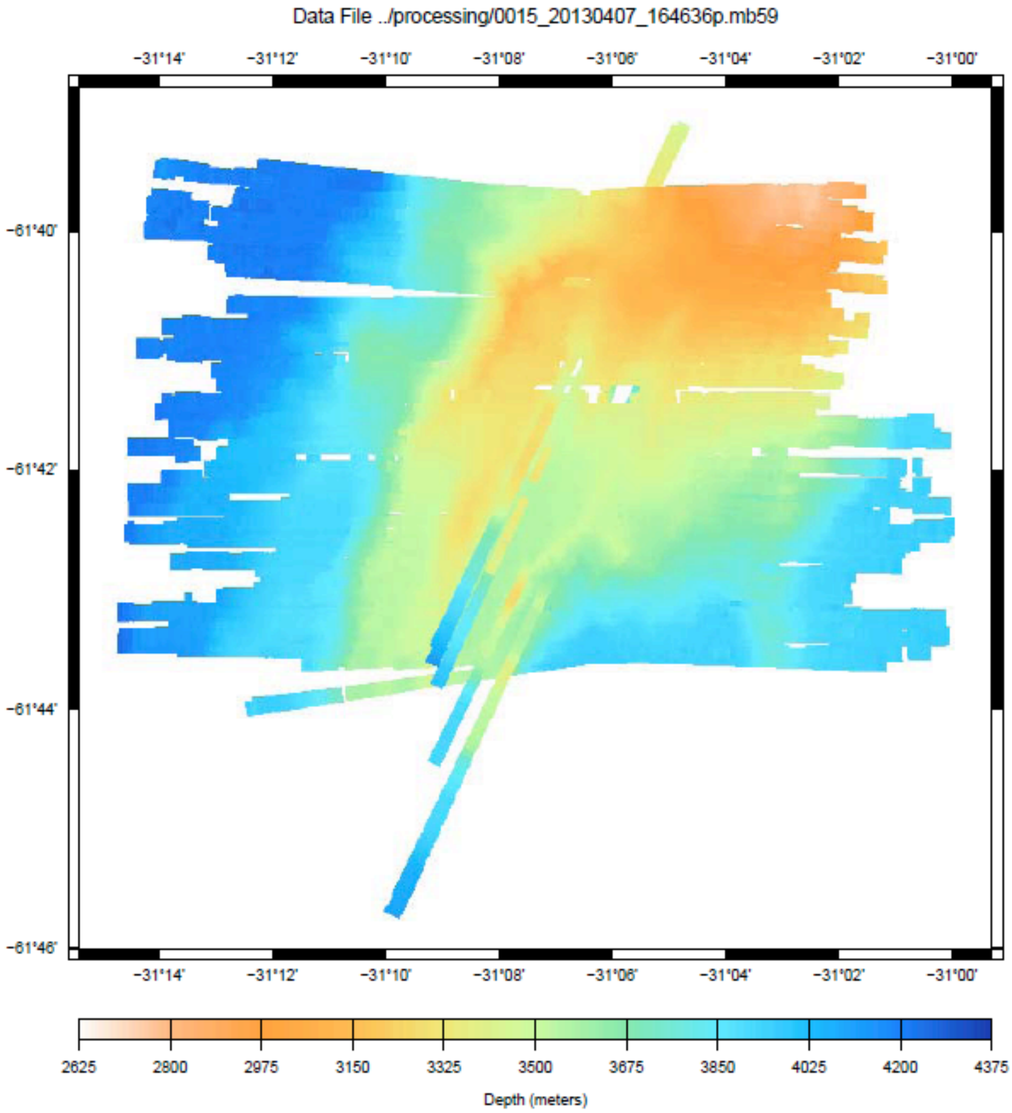

Figure 2.4.2: Grid showing an example of erroneous heading of approx 455° assigned to some pings in data file 0015 of survey jr281_e.

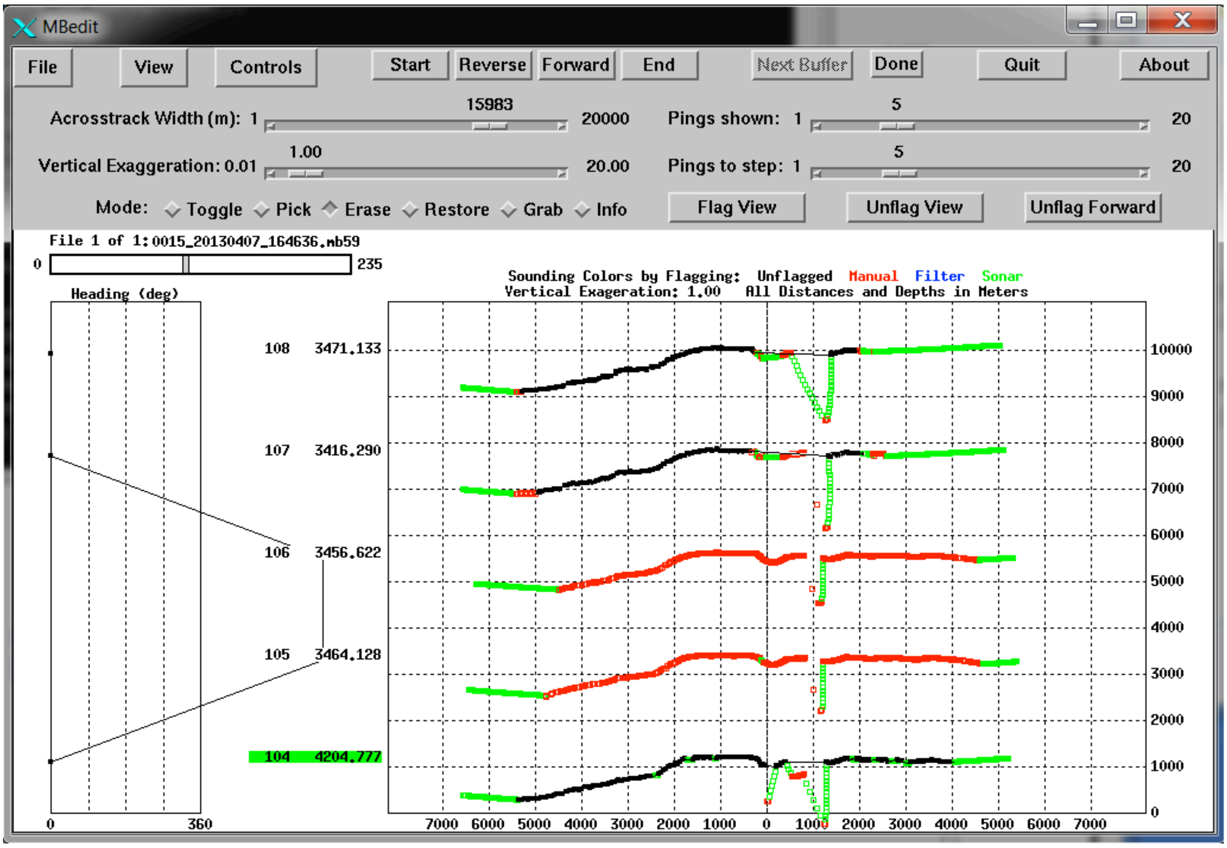

Figure 2.4.3: Screenshot from mbedit showing an example of erroneous heading of approx 455° assigned to some pings in data file 0015 of survey jr281_e.

2.5 Surface Pumped Seawater And Thermosalinigraph

Brian King

The list of variables is as follows

mexec directory	mexec short name	mexec directory abbreviation	mexec file root	variables
ocl	oceanlogger	M_OCL	ocl	tstemp conductivity salinity sound_velocity chlorophyll sampletemp flowrate sstemp trans

Note the alternative temperatures: sstemp for seawater intake, tstemp for fluorometer, sampletemp is the SBE housing temperature. Due to misunderstanding early in the cruise, scripts were set up as if tstemp was the required sea surface temperature. However this was not a serious problem because all temperatures were carried throughout. At the end of the cruise, scripts were edited to use sstemp as the main sea surface temperature, and sstemp was edited to nan wherever tstemp had previously been edited to nan.

Offset in sstemp

The variable sstemp clearly has an offset, at least at low temperatures. When the sea approached freezing temperatures, sstemp crossed below -1.8°C, reaching a minimum of -2.0C, well below the freezing point for sweater. Enquiries confirm that arrangements are in hand for installing a superior sensor for this data stream. The offset was confirmed by comparison with CTD temperatures just before the CTD left the water on recovery, but no systematic sstemp calibration was worked out.

Underway surface thermosalinograph

As noted above, the calibrated TSG record is in the ‘ocl directory.

First note that no calibration or data cleaning has been applied to the fluorometer or transmissometer data, except that it has sometimes been set to absent where the salinity is absent.

Data were set to absent at any time that the pumps were known to be off, either close to port or where the flowrate indicated there was little or fluctuating supply.

Data were read in as part of the daily processing.

Relatively simple cleaning and calibration has been applied to the appended dataset, following the path worked out on jc069.

The full processing sequence was thus

1) mtsg_medav_clean_cal.m

calls *mtsg_cleanup.m*
input: ocl_tsg_jr281_01
output: ocl_tsg_jr281_01_medav_clean

creates 1-minute median bin average of data, then removes known bad data in *mtsg_cleanup*. *mtsg_cleanup* has times of pumps off hardwired in for each cruise. In addition it loads times of bad data from file ocl/bad_time_lims.mat. This file is added to by script *mtsg_findbad*. Between the times identified as bad, all variables are set to nan. This is because this procedure was originally conceived as a means of discarding data when the pumps were off, not merely when salinity had a problem.

2) mtsg_findbad.m

allows graphical identification of bad data. Using an interface similar to *mdcs_03g.* See *help mtsg_findbad*. Note the use of 'n' to store the start and end of bad data and move on to the next segment of bad data is **CRITICAL**. This script should be run at least once, if only to initialise the bad_time_lims file.

3) After *mtsg_findbad*, you can loop through steps (1) and (2) as often as required, until a sufficiently clean salinity file is obtained. Limits of bad times are accumulated by successive uses of *mtsg_findbad*, so it is a good idea to back up the bad_time_lims.mat file.

5) *mtsg_bottle_compare_jr281.m*

input: ocl_jr281_01_medav_clean or
ocl_jr281_01_medav_clean_cal

output: ocl_jr281_01_botcompare.nc

merges the clean 1-minute data onto bottle samples. The script is set up to make it easy to switch between uncalibrated (variable salin) or calibrated (variable salin_cal) data (Set the case switch at the start of the .m file). Individual bottle residuals are plotted, as well as a smoothed time series of the residuals, which can then be used as a slowly-varying adjustment to the TSG salinity.

6) *mtsg_apply_salcal*.m

calls *mtsg_salcal.m*

input: ocl_jc069_01_medav_clean

and ocl_jc069_01_botcompare.nc

output: ocl_jc069_01_medav_clean_cal

smooths the differences in botcompare, interpolates and adds them to the uncalibrated salinity data. Step 5 can be repeated after this step, to check that the residuals are now acceptable.

The residuals have mean 0.0002 and iqr 0.0025.

2.6. Vessel-Mounted Acoustic Doppler Current Profiler

J.B. Sallée

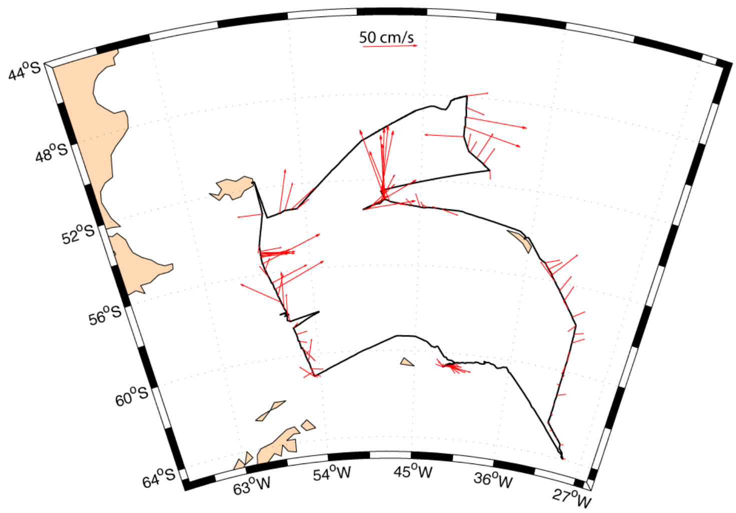

Figure 2.6.1: VMADCP velocity averaged at each JR281 stations

2.6.1 Introduction

A 75 kHz RD Instruments Ocean Surveyor (OS75) ADCP was used during this cruise. This has also been used on JR139 (in Dec 2005, Chief Scientist Stansfield), JR161 (Oct-Dec 2006, Shreeve), JR165 (Feb 2007, Shoosmith), JR193 (Dec 2007, Quartly), JR177 (Jan 2008, Tarling), JR218 (Oct 2008, Woodward) and JR200 (Mar 2009, Korb), JR195 (Yelland), JR276 (Watson). The OS75 is capable of profiling to deeper levels in the water column than the previous 150 kHz ADCP and can also be configured to run in either narrowband or broadband modes.

2.6.2 Instrumentation

The OS75 unit is sited in the transducer well in the hull of the *JCR*. This is flooded with a mixture of 90% de-ionised water and 10% monopropylene glycol. With the previous 150 kHz unit, the use of a mixture of water/antifreeze in the transducer chest required a post-processing correction to derived ADCP velocities. However, the new OS75 unit uses a phased array transducer that produces all four beams from a single aperture at specific angles. A consequence of the way the beams are formed is that horizontal velocities derived using this instrument are independent of the speed of sound (vertical velocities, on the other hand, are not), hence this correction is no longer required.

The OS75 transducer on the *JCR* is aligned at approximately 60 degrees relative to the centre line. This differs from the recommended 45 degrees. Shortly after sailing for JR139, the hull depth was measured by Robert Patterson (Chief Officer), and found to be 6.47m. Combined with a value for the distance of the transducer behind the seachest window of 100-200mm and a window thickness of 50mm, this implies a transducer depth of 6.3m. This is the value assumed for JR200, but note that the ship was very heavily laden during cruise JR139, and for other cruises it may be shallower.

During the trials cruise (JR139), it was noted that the OS75 causes interference with most of the other acoustic instruments on *JCR,* including the EM120 swath bathymetry system. To circumvent this, the ADCP pinging can be synchronised with the other acoustic instruments using the SSU. This issue was investigated in detail on JR218. On JR281 the Swath was used during the CTD transect but the ADCP was run unsynchronised. In shallow water the ADCP was set in bottom track mode with varying depths (and therefore ping rates).

The heading feed to the OS75 is the heading from the Seapath GPS unit. This differs from the previous ADCP setup on *JCR,* which took a heading feed from the ship's gyrocompass and required correction to GPS heading (from Ashtech) in post-processing.

2.6.3 Configuration

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The OS75 ran in two modes during JR281: narrowband with bottom-tracking on and narrowband with bottom-tracking off. While bottom tracking the maximum water depth was set to 800m (50 bins, each 16 metres). Water-tracking was always fifty 16 metre bins. SSU was not used. Narrowband profiling was enabled with an 8 metre blanking distance. The 'set modes' configuration files, as described in JR195 report, were used during the cruise.

Reducing the maximum water depth to less than twice the actual water depth (as measured by the EA600) has two significant advantages (see JR218 report for full details). Firstly it speeds up the ping rate as the instrument spends less time waiting for echoes. The second advantage is that the instrument stops listening before it can hear double-bottom echoes (sounds that goes transducer-bottom-surface-bottom-transducer). This leads to cleaner plots of the water column velocities.
Salinity at the transducer was set to zero, and Beam 3 misalignment was set to 60.08 degrees (see above discussion).

Data logging was stopped and restarted once every 2 days to keep files to a manageable size for processing.

The two configuration files used during the cruise (with and without bottom track) can be found at the end of this section.

2.6.4 Outputs

The ADCP writes files to a network drive that is samba-mounted from the Unix system. The raw data (.ENR and .N1R) are also written to the local PC hard drive. For use in the matlab scripts the raw data saved to the PC would have to be run through the VMDas software again to create the .ENX files. When the Unix system is accessed (via samba) from a separate networked PC, this enables post-processing of the data without the need to move files.
Output files are of the form JR281_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present filesize exceeds 10 Mbyte.
ZZZ are the filename extensions, and are of the form:-
.N1R (NMEA telegram + ADCP timestamp; ASCII)
.ENR (Beam co-ordinate single-ping data; binary). These two are the raw data, saved to both disks
.VMO (VmDas configuration; ASCII)
.NMS (Navigation and attitude; binary)
.ENS (Beam co-ordinate single-ping data + NMEA data; binary)

.LOG (Log of ADCP communication and VmDas error; ASCII)
.ENX (Earth co-ordinate single-ping data; binary). This is read by matlab processing
.STA (Earth co-ordinate short-term averaged data; binary)
.LTA (Earth co-ordinate long-term averaged data; binary).

.N1R and .ENR files are saved to the secondary file path and can be reprocessed by the software to create the above files.

2.6.5 CODAS/Hawaii processing.

Note that this software sometimes outputs a decimal day, calculated from time in seconds since the start of the year. Decimal day is 0.5 for noon on the 1st January: this contrasts with a jday of 1.5 for noon on the 1st January.
Each 2-day file was processed separately and each produced a separate water- or bottom-tracking calibration (Table 2.6.1), which can be compared to those found previously (Table 2.6.2). The files are approximately 48 hours long. Angle calibration proposed by CODAS was so small that we decided to apply a zero calibration for angle. The median amplitude calibration proposed by CODAS ranged from 1.0085 to 1.0145, and we decided to apply a 1% correction of 1.001.

File NNN	BT/WT	Amplitude			Phase		
		Median	Mean	s.d.	Median	Mean	s.d
001	BT	1.0085	1.0080	0.0011	-0.0521	-0.0341	0.0570
002	BT	1.0099	1.0103	0.0017	-0.0079	-0.0048	0.0849
003	BT	1.0092	1.0095	0.0038	-0.0126	-0.0286	0.0888
018	BT	1.0143	1.0144	0.0012	-0.0183	-0.0122	0.0899
019	BT	1.0145	1.0178	0.0084	0.0548	0.1268	0.3070
031	BT	1.0100	1.0095	0.0025	-0.0621	-0.0428	0.1176

Table 2.6.1 Calibrations derived from the CODAS processing. ***BT indicates bottom tracking mode***.

cruise	date	bot/water	mean amplitude	mean angle	notes
JR281	April 2013	Bottom	1.001	0	CODAS processing
JR276	April 2011	bottom	1.0116	-1.0564	CODAS processing
JR195	Nov 2009	Water	1.0155	-0.2060	CODAS processing
JR195	Nov 2009	bottom	1.0381	+0.6080	CODAS processing
JR200	Mar-Apr 2009	water	1.0150	-0.0876	
JR177	Jan 2008	water	1.0124	-0.0559	
JR165	Mar-Apr 2007		1.0127	-0.0078	
JR158	Feb 2007	water	1.0161	+0.1245	

JR161	Oct-Dec 2006	bottom	1.0127	-0.0481	

Table 2.6.2. Mean calibration results for JR281 and previous cruises.

Below is a summary of the processing steps. [UH HTML documentation in /local/users/pstar/cruise/sw/uh_adcp/programs/adcp_doc/index.html].

1) Created once at start of cruise
~/data/vmadcp/jr281_os75
~/data/vmadcp/jr281_os75/rawdata

2) **cd ~pstar/jr281/data/vmadcp/jr281_os75**
cshell script in /local/users/pstar/cruise/data/exec
vmadcp_linkscript_jr281

- synchronised files from /mnt/data/cruise/jcr/current/adcp into /local/users/pstar/jr281/data/vmadcp/jrCCC_os75/rawdata
- create directory 'rawdataNNN' if necessary
- create file links in 'rawdataNNN' pointing to rawdata file in 'rawdata' directory

NB: file names like OS75_JR281NNN_000000.ENX
NNN increments each time the ADCP logging is re-started. **Data logging was stopped and started once every two days.** The 000000 increments each time a new file is started, when the previous one reaches 10 Mb.
All raw files are automatically transferred to /mnt/data/cruise/jcr/current/adcp (i.e. on jrlb)

3) **adcptree.py jrCCCNNNnbenx --datatype enx**
Note nb for narrowband ping, and that the -- datatype has two dash characters

4) **cd jrCCCNNNnbenx** copy in a **q_py.cnt** file. Generally, you only need to edit the dbname and datadir for each **NNN**. An example q_py.cnt file is
q_py.cnt is
comments follow hash marks; this is a comment line
--yearbase **2013**
--dbname **jr281001nnx**
--datadir
/local/users/pstar/cruise/data/vmadcp/**jr281_os75/rawdata001**
#--datafile_glob "*.LTA"
--datafile_glob *.ENX
--instname os75
--instclass os
--datatype enx
--auto
--rotate_angle 0.0
--pingtype nb
--ducer_depth 5
#--verbose
end of q_py.cnt
end of q_py.cnt

At the start of the cruise check **yearbase**, **dbname, os75** or **os150** and datatype **enx (glob ENX)**. Dbname should be of form jrCCCNNNPTT where P is n for narrowband, b for broadband. The instrument should be operated in narrow unless there is a good reason to choose broad. TT is “nx” for ENX; “ns” for ENS; “nr” for ENR; “lt” for LTA; “st” for STA. Standard processing is to process ENX. As far as I can tell, dbname must not exceed 11 chars. So if we use 9 for jr281NNNn, there are only two left to identify ENX, ENS, LTA, STA

6) still in directory ~data/vmadcp/jr281_os75/jr281001nbenx
quick_adcp.py --cntfile q_py.cnt *("killed matlab engine" is the normal message received)*
This takes a minute or two per 24 hours of ENX data. Note –cntfile has two dash characters

7) To see the BT (bottom track) or WT (water track) calibration, look at the ascii output of jr281001nbenx/cal/*/*out (note that a calibration is not always achieved, for example if the ship has made no manoeuvres while the ADCP is in water tracking mode, so there may be no *out file). Note also that additional calibration information maybe saved after flags applied after gautoedit process.

8) To access data in Matlab
matlab &
>> **m_setup**
>> **codaspaths**

Manually clean up data by applying flags to suspected bad data cycles**.**
>> **cd data/vmadcp/jr281_os75/jr281001nbenx/edit**
>> **gautoedit**
Clean up data. Select day and step (typically 0.1 or 0.2 days) to view, then "show now". "show now" may have to be done twice to get the surface velocity plot. "show next" to step through the file. "Del bad times" sets "bad" flags for a section of time, or for a whole profile. "rzap" allows single bins to be flagged.

9) Applying edits identified in gautoedit
The gautoedit process in Matlab sets flags, but doesn’t change the data. To apply the flags and recalculate a calibration,
quick_adcp.py –-cntfile q_pyedit.cnt *(note two dashes before cntfile)*
where q_pyedit.cnt contains
q_pyedit.cnt is
comments follow hash marks; this is a comment line
--yearbase 2013
--steps2rerun apply_edit:navsteps:calib:matfiles
--instname os75
--auto
end of q_pyrot.cnt

10) To get data into MSTAR:
>> **cd /local/users/pstar/cruise/data/vmadcp/jr281_os75/jr281NNNnbenx**
>> **mcod_01**
produces output file
os75_jr281NNNnnx.nc

which has a collection of vars of dimensions Nx1 1xM NxM
>> **mcod_02**
will calculate water speed and ship speed and get all the vars onto an NxM grid.
This step makes data available for comparison with LADCP data.

11) Append individual 48-hour files using
>>mcod_mapend

12) **cd /local/users/pstar/cruise/data/vmadcp/jr281_os75/jr281NNNnbenx**
In directory apply the final cal **ONLY ONCE** (adjustments are cumulative, so if this step is done twice, the cal is applied twice) when you have done the edits and applied the time-varying heading adjustment. After inspecting the cal out files, and deciding what the amplitude and phase of the calibration should be:
quick_adcp.py –-cntfile q_pyrot.cnt *(note two dashes before cntfile), where q_pyrot.cnt contains:*
q_pyrot.cnt is
comments follow hash marks; this is a comment line
--yearbase 2013
--rotate_angle 0
--rotate_amp 1.01
--steps2rerun rotate:navsteps:calib
--auto
end of q_pyrot.cnt

Final calibration values used were those given by the JR281 Bottom Track data.

13) In each directory re-create Matlab files:
>>cd /local/users/pstar/cruise/data/vmadcp/jr281_os75/jr281NNNnbenx
>>mcod_01
>>mcod_02

Then remove and recreate the appended matlab file:
>>cd /local/users/pstar/cruise/data/vmadcp/jr281_os75
>>!/bin/rm os75_jr281nnx_01.nc
>>mcod_mapend

2.6.6 Configuration files used in JR281

JR 800m BottomTrack 8mBins NotThruSSU.txt
;--\
; ADCP Command File for use with VmDas software.
;
; ADCP type: 75 Khz Ocean Surveyor
; Setup name: default
; Setup type: High resolution, short range profile(broadband) 500 m
;
; NOTE: Any line beginning with a semicolon in the first
;   column is treated as a comment and is ignored by
;   the VmDas software.
;

; NOTE: This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 13January2006 (for JR141: routing through the SSU)
;--/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE: VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for broadband single-ping profile mode (WP), one hundred (WN) 8 meter bins (WS),
; 8 meter blanking distance (WF), 390 cm/s ambiguity vel (WV)

; Switch off Narrowband NP0
NP1
nn100
ns800
nf0800

; Switch on Broadband WP1

WP000
WN100
WS800
WF0800

WV390

; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1000 meters (BX)
BP01
BX10000

; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000050

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000100

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor

EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.3m on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; Set Trigger In/Out [ADCP run through SSU]
CX0,0

; save this setup to non-volatile memory in the ADCP
CK

JR 800m WaterTrack 8mBins NotThruSSU.txt

```
;----------------------------------------------------------------------------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    High resolution, short range profile(broadband)  500 m
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 13January2006 (for JR141: routing through the SSU)
;----------------------------------------------------------------------------/
; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for broadband single-ping profile mode (WP), one hundred (WN) 8 meter bins (WS),
; 8 meter blanking distance (WF), 390 cm/s ambiguity vel (WV)

; Switch off Narrowband NP0
NP1
nn100
```

```
ns800
nf0800

; Switch on Broadband  WP1

WP000
WN100
WS800
WF0800

WV390

; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1000 meters (BX)
BP01
BX10000

; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000050

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000100

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.3m on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; Set Trigger In/Out [ADCP run through SSU]
CX0,0

; save this setup to non-volatile memory in the ADCP
CK
```

PART III: Discrete samples

3.1 Salinity

3.1.1 Introduction

Discrete salinity samples were taken throughout the cruise for two purposes: the calibration of CTD salinity profiles (see section 4.1) and the calibration of underway TSG data (see section 2.5). These were then analysed using a salinometer on board. The following section outlines the aims of the sampling, the method of sampling and the method of sample processing.

3.1.2 Aim

The aim of the discrete salinity samples was to provide accurate information for the calibration of salinity data provided by CTD casts and underway TSG. This allowed for the processing of said data while the cruise was in progress so that the results could inform day-to-day planning.

3.1.3 Sampling methods

All samples were taken using 200 ml glass sample bottles with plastic lids, supplied by OSIL1, in cases of 24 bottles. Each bottle was labelled with a unique number, and in a uniquely numbered case. Log sheets were used to note the case number and bottle number of each sample taken. Bottles were filled in order to leave minimal air for evaporation to occur whilst leaving enough air to allow for adequate mixing of the sample before sampling, in order to counteract any stratification that may have developed. The bottle necks and lids were dried thoroughly before plastic caps, also supplied by OSIL, were placed inside the bottle necks immediately after sampling in order to seal the air within the bottles to counteract evaporation. Obviously the small amount of air sealed in the bottle will have caused a slight salty bias in all samples.

We started with 82 bottles of standard seawater. Given the number of CTDs planned, we chose to sample 10 bottles from each CTD, which made for 2 CTDs per crate. However, as the cruise went on and more CTDs were planned, we noticed we would encounter a shortage of standards before the end. Since the CTD and conductivity meter sensors were well behaved, after station 55 we reduced the number of salinities to 8 samples per CTD, which gave us 3 CTDs per crate and increased the ratio of CTDs to standards used.

3.1.4 CTD sampling

See section 4.1 for a detailed description of CTD deployment. The CTD instrument contains a rosette of 24 niskins, closed at various depths during deployment in order to capture samples of water at those depths. For early CTD cast, the niskins to sample for salinity were decided in order to provide the best coverage of the salinity profile measured by the conductivity probe on the CTD. In practice, this normally meant sampling from the deepest niskins, the shallowest niskins, and some in the middle. After noticing how stable the CTD and salinometer sensors were, the niskins to sample for salinity were chosen in order to sample deep areas of low salinity gradient, as well as the surface extreme. In practice, this meant sampling mainly from the deepest niskins, and a few from the mid and shallow depths. When sampling, the sample bottles were first rinsed twice using the water from the niskin to be sampled, and the water used poured back over the tap. This was to minimise contamination of the sample from anything on the inside surface of the bottle. The bottle was then filled as described above, capped and replaced in the relevant case.

3.1.5 TSG sampling

See section 2.5 for a detailed description of underway TSG measurements. Underway instruments aboard the ship constantly measured the salinity of the sea water passing through the ship from the immediate surroundings. In order to calibrate these measurements, samples of this water were taken roughly every 4 hours as part of the watchkeepers' duties. The tap supplying the underway water was open constantly and the flow rate was monitored and logged every 4 hours as part of the underway data logging procedure. The sample bottle was filled and emptied twice to ensure minimum contamination, before being filled as described above, capped and placed in the relevant case.

3.1.6 Sample Processing

Examples will be given for the processing of samples from CTDs 98,99 and 100, as well as TSG 1.

== Conductivity measurements ==

Once a case of sample bottles was full, it was transferred to the temperature-controlled laboratory, where it remained a minimum of 24 hours before being sampled. This was to ensure that all samples were at the same temperature on sampling for consistency of measurements. The temperature of the room was monitored and logged every 4 hours as part of the underway data logging procedure.
Since the bath within the salinometer was set at 24°C, to ensure accurate measurements
the room temperature had to be roughly between 21°C and 23°C.

Salinity measurements were taken using a Guildline2 AutoSal Salinometer, model 8400B, s/n 65763, provided by OSIL.

The salinometric analysis was carried out as per the manufacturer's recommendations. The sample bottle to be measured was agitated to remove any stratification. Before any measurements were taken, the measurement cell was filled using the peristaltic pump and flushed three times with the relevant sample in order to avoid any contamination from previous samples. The analyst ensured that no bubbles were present in the cell before measuring the sample. The cell was flushed, filled and then measured a further two times in order to have a total of three measurements for each sample.

The software "Autosal_2009" was used to aquire the conductivity of the sample. For each measure, the mean conductivity over 10 seconds was aquired. The mean of 3 measures was then calculated for each sample. If the 3 measures differed from the mean by a standard deviation of more than 0.00005, the measure was deemed unconsistent, and the analyst had to choose which measure to take again, reflush and fill the cell and take another measure, until the measures differed by less than 0.00005.

At the beginning and end of each measurement session, and between crates, one standard was run using a bottle of IAPSO Standard Seawater, either batch P153, P154 or 155, with conductivity ratios of K15 = 0.99979, K15=0.99990 and K15 = 0.99981 respectively.

One .xls data file was created for each crate on which files and samples were all given unique names:
For the crate concerning stations 99 to 100 and samples 1 to 24, processed on date 16 April 2013 for example:
- File: JR281 CTD_98 16 Apr 2013.xls
- Bottle: CTD098_1 to CTD098_24, plus CTD098_9052 for the batch.

For all stations the CTD number has three digits, but the bottles only the necessary numbers. For instance, station 1 sample 1 would have a bottle number: CTD001_1
Standard numbers were all incremented each time one was made, starting from 9001.
For example, the first batch, run with the samples from station 1 would be CTD001_9001 The next one, run with the samples from station 3 would be CTD003_9002. This was repeated for each sample in the relevant crate, as well as for the standard bottles, treated as samples.

Here is an example of the output from the software :

SALINITY DATA FILE			
Cruise Number:	JR281		
Crate:	ctd_98		
Operator:	PL		
Date:	16-Apr-13		
Time:	23:36:00		
Salinometer S/N:	65763		
ZERO Reading	0.00001		
Reference Value:	6021	Bath Temperature:	24°C

Bottle number	Date	Time	Sample 1	Sample 2	Sample 3	Average	offset	Salinity
ctd098_1	16/04/13	23:53:16	1.985582	1.985646	1.985655	1.985628	-0.000004	34.7173
ctd098_2	16/04/13	23:56:54	1.985776	1.985759	1.985758	1.985764	-0.000004	34.7199
ctd098_3	17/04/13	00:00:10	1.985251	1.985238	1.985223	1.985237	-0.000004	34.7096
ctd098_4	17/04/13	00:03:20	1.983328	1.98335	1.98334	1.983339	-0.000004	34.6723
ctd098_5	17/04/13	00:06:46	1.981154	1.981151	1.981146	1.98115	-0.000004	34.6293
ctd098_6	17/04/13	00:10:00	1.972493	1.97251	1.972488	1.972497	-0.000004	34.4593
ctd098_7	17/04/13	00:13:19	1.954805	1.954779	1.954774	1.954786	-0.000004	34.1119
ctd098_8	17/04/13	00:16:50	1.941272	1.94127	1.94129	1.941277	-0.00000	33.8473

							4	
ctd098_9	17/04/13	00:20:13	1.985695	1.985691	1.985647	1.985678	-0.000004	34.7182
ctd098_10	17/04/13	00:23:33	1.985205	01/01/51	1.985171	1.985159	-0.000004	34.708
ctd098_11	17/04/13	00:28:12	1.984018	1.98401	1.984048	1.984025	-0.000004	34.6858
ctd098_12	17/04/13	00:31:41	1.983503	1.983505	1.983494	1.983501	-0.000004	34.6755
ctd098_13	17/04/13	00:35:11	1.98309	1.983068	1.983099	1.983086	-0.000004	34.6673
ctd098_14	17/04/13	00:38:42	1.982428	1.982387	1.982422	1.982412	-0.000004	34.6541
ctd098_15	17/04/13	00:52:23	1.981663	1.981696	1.981706	1.981688	-0.000004	34.6398
ctd098_16	17/04/13	00:56:27	1.941125	1.941135	1.94113	1.94113	-0.000004	33.8444
ctd098_17	17/04/13	01:00:31	1.985582	1.985611	1.98562	1.985604	-0.000004	34.7168
ctd098_18	17/04/13	01:05:13	1.984803	1.984806	1.984814	1.984808	-0.000004	34.7011
ctd098_19	17/04/13	01:09:32	1.984243	1.984307	1.984273	1.984274	-0.000004	34.6907
ctd098_20	17/04/13	01:13:42	1.983454	1.983429	1.983488	1.983457	-0.000004	34.6746
ctd098_21	17/04/13	01:17:30	1.982984	1.982958	1.98299	1.982977	-0.000004	34.6652
ctd098_22	17/04/13	01:22:06	1.981893	1.981893	1.981911	1.981899	-0.000004	34.644
ctd098_23	17/04/13	01:25:41	1.980626	1.980625	1.980647	1.980633	-0.000004	34.6191
ctd098_24	17/04/13	01:30:28	1.939716	1.939749	1.939775	1.939747	-0.000004	33.8173
ctd098_9052	17/04/13	01:35:21	1.99963	1.999642	1.999645	1.999639	-0.000004	34.9928

== File editing ==

The machine was standardized sometime before it got on board
Our choice was to not standardize the machine, but to run standards as any other samples, so as to manually decide what offset to give during the post-processing, enabling us to

observe any long term drift in the measurements.

Once the measures were taken, the .xls files were put onto the network smb://jrlb/legwork/sal/.
They were then downloaded from a work station (macmini2,1):

rsync -av smb://jrlb/legwork/sal/* ~/sal/.

Each crate file was then duplicated into as many files as there were different CTDs together in the crate.
The files were renamed, for CTD XXX, or TSG YYY:
sal_jr281_XXX.xls
tsg_jr281_XXX.xls

For instance, file JR281 ctd98 16 Apr 2013.xls contained samples from CTD 98 to 100, leading to the presence of four files on the drive :
JR281 ctd98 16 Apr 2013.xls
sal_jr281_098.xls
sal_jr281_099.xls
sal_jr281_100.xls

The files comes with a header comporting diverse information, about the analyst or cruise for instance, followed by one line for each sample run.

First, in the file for one CTD, we removed the data for other CTDs that did not match the file title.

Bottle number	Date	Time	Sample 1	Sample 2	Sample 3	Average	offset	Salinity
ctd098_9	17/04/13	00:20:13	1.985695	1.985691	1.985647	1.985678	-0.000004	34.7182
ctd098_10	17/04/13	00:23:33	1.985205	01/01/51	1.985171	1.985159	-0.000004	34.708
ctd098_11	17/04/13	00:28:12	1.984018	1.98401	1.984048	1.984025	-0.000004	34.6858
ctd098_12	17/04/13	00:31:41	1.983503	1.983505	1.983494	1.983501	-0.000004	34.6755
ctd098_13	17/04/13	00:35:11	1.98309	1.983068	1.983099	1.983086	-0.000004	34.6673
ctd098_14	17/04/13	00:38:42	1.982428	1.982387	1.982422	1.982412	-0.000004	34.6541
ctd098_15	17/04/13	00:52:23	1.981663	1.981696	1.981706	1.981688	-0.000004	34.6398
ctd098_16	17/04/13	00:56:27	1.941125	1.941135	1.94113	1.94113	-0.000004	33.8444

We then changed the sample name to that corresponding to the particular CTD cast in question. For example:

Bottle number	Date	Time	Sample 1	Sample 2	Sample 3	Average	offset	Salinity
ctd099_9	17/04/13	00:20:13	1.985695	1.985691	1.985647	1.985678	-0.000004	34.7182

ctd099_10	17/04/13	00:23:33	1.985205	01/01/51	1.985171	1.985159	-0.000004	34.708
ctd099_11	17/04/13	00:28:12	1.984018	1.98401	1.984048	1.984025	-0.000004	34.6858
ctd099_12	17/04/13	00:31:41	1.983503	1.983505	1.983494	1.983501	-0.000004	34.6755
ctd099_13	17/04/13	00:35:11	1.98309	1.983068	1.983099	1.983086	-0.000004	34.6673
ctd099_14	17/04/13	00:38:42	1.982428	1.982387	1.982422	1.982412	-0.000004	34.6541
ctd099_15	17/04/13	00:52:23	1.981663	1.981696	1.981706	1.981688	-0.000004	34.6398
ctd099_16	17/04/13	00:56:27	1.941125	1.941135	1.94113	1.94113	-0.000004	33.8444

Then we added an extra column that will give the niskin number corresponding to the sample.
The terminology is: XXXYY, where XXX is the CTS number, YY the niskin bottle number.

Bottle number	Date	Time	Sample 1	Sample 2	Sample 3	Average	offset	Salinity	sampnum
ctd099_9	17/04/13	00:20:13	1.985695	1.985691	1.985647	1.985678	-0.000004	34.7182	9901
ctd099_10	17/04/13	00:23:33	1.985205	01/01/51	1.985171	1.985159	-0.000004	34.708	9903
ctd099_11	17/04/13	00:28:12	1.984018	1.98401	1.984048	1.984025	-0.000004	34.6858	9905
ctd099_12	17/04/13	00:31:41	1.983503	1.983505	1.983494	1.983501	-0.000004	34.6755	9907
ctd099_13	17/04/13	00:35:11	1.98309	1.983068	1.983099	1.983086	-0.000004	34.6673	9909
ctd099_14	17/04/13	00:38:42	1.982428	1.982387	1.982422	1.982412	-0.000004	34.6541	9911
ctd099_15	17/04/13	00:52:23	1.981663	1.981696	1.981706	1.981688	-0.000004	34.6398	9913
ctd099_16	17/04/13	00:56:27	1.941125	1.941135	1.94113	1.94113	-0.000004	33.8444	9924

For TSGs, the terminology is DDDHHMMSS, where DDD is the Julian day, HH,MM and SS the hours, minutes and seconds at the time of the sample.

Bottle number	Date	Time	Sample 1	Sample 2	Sample 3	Average	offset	Salinity	time
tsg001_1	25/03/1	01:44:1	1.9498	1.9498	1.9498	1.9498	-	34.016	780811

	3	2	9	98	92	93	0.0000 04		00

For standards, the terminology is 99ZZZZ where ZZZZ is the number previously assigned to the batch. For instance, the 8th batch of the cruise, taken while running the crate for TSG1, had name TSG001_9008, were renamed 999008.

Bottle number	Date	Time	Sample 1	Sample 2	Sample 3	Averag e	offset	Salinity	time
tsg001_9 008	25/03/1 3	01:40:5 8	1.9998 55	1.9998 58	1.9998 56	1.9998 56	- 0.0000 04	34.997 1,0	999008

One all this is done, we saved one version of the file as .xls, one as .csv.
The .csv file is used by the matlab scripts.

We then uploaded the processed files from working drive to legwork:
rsync -av ~/sal/* smb://jrlb/legwork/sal/.
Finally, we downloaded the files to nosea2 for future use:
From nosea2:
rsync -av smb://jrlb/legwork/sal/* ~/sal/.

== From conductivity to salinity ==

All recorded measurements were converted into salinity using the Unesco algorithm for practical salinity (Unesco, 1980).

The accuracy of the results gained is improved by the time averaging and the three separate measurements for each sample. The standardised check at the beginning and end of the crates gave an idea of how consistent the salinometer precision had been, which should be taken into account in error analysis. The temperature of the water bath in the Salinometer was kept at 24 degrees Celsius throughout the cruise. The temperature of the lab remained fairly constant throughout the cruise, although slight diurnal variations and the effect of the analyst being in the lab during the sampling process could not be avoided. This is not expected to affect the results as the water bath in the salinometer ensures consistency of sampling.

In this cruise, we used an offset in salinity of -3 from station 1 to 66, of -2 from station 67 to the end.

3.1.7 Extra Batches

During the cruise we came upon boxes containing old batches: p141, best used before 12th June 2002, and p151, best used before 20th May, 2012.

3.1.8 Software issues

During the measurement of the crate for CTD 045, for an unknown reason, the software broke down. Afterwards global information were asked for before each sample, instead of each crate, which would have considerably slowed down the processing rate.
After copying the Autosal directory for safekeeping, we used the windows "add and remove programs" utility from the ressource center.
Once removed, however, the software still had an icon on the Desktop.
This icon runned the software as it had originaly, without any bug, given that the .ini files were correctly reset to their previous values.

3.1.9 Recommandations

There was a high potential on this cruise to run out of sea water standards. We had enough in the end mostly through luck that batches were left behind from previous cruises. Be sure to specifically allocate standards for individual cruises, with sufficient spares for breakage/loss or to allow for unplanned extra CTDs. Additionally, be sure to know who is in charge of bringing a computer and the relevant software. It would probably be wise to also ensure a spare salinometer is available on the cruise.

3.1.10 References

1. OSIL
Culkin House
C7/C8 Endeavour Business Park
Penner Road, Havant
Hampshire PO9 1QN
2. Guildline Instruments Ltd.
P.O. Box 99, 21 Gilroy St.
Smith Falls, Ontario,
K7A 4S9
3. National Instruments Corporation Ltd.
Measurement House, Newbury Business Park
London Road
Newbury, Berkshire RG14 2PS

3.2 Measurements And Distributions Of The Tracer SF5CF3

Marie-José Messias[1], Benjamin Mills[1], Andrew Watson[1], Steve Woodward[1], Siobhan Moran[1], and Brian Guest[2]
1. School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK.
2. Woods Hole Oceanographic Institution, Woods Hole, MA. 02543, USA.

3.2.1 Sample collection and analysis technique

The released tracer, trifluoromethyl sulphur pentafluoride (SF_5CF_3) and two transient tracers (sulphur hexafluoride (SF_6) and dichlorodifluoromethane (CFC-12)) were measured on board by a purge-and-trap gas chromatographic method. The instrumentation was built and developed at the University of East Anglia based on the Lamont Doherty Earth Observatory design [Smethie, personnel communication]. A total of 2500 seawater samples including ~10% of duplicates were measured.

Sample collection

Water samples were collected from 10 litre bottles as soon as the CTD sampling rosette was on board. The Niskin nitrile 'O' rings were first washed in isopropanol and baked in a vacuum oven for 24 hours to remove susceptible contamination before installation in Niskin bottles. Water samples were collected in 2 liter ground-glass stoppered bottles that were filled from the bottom using Tygon tubing and overflowed 1 time to expel all water exposed to the air. A single sample will use a minimum of 4.5 l from the Niskin. Immediately after sampling, the glass bottles were immersed in a cool box containing cold deep seawater and kept at a temperature below 7°C until analysis to prevent degassing.

Analysis technique

Sample analysis was performed when possible within 24 hours of the sampling. Samples were introduced to the system by applying nitrogen (N_2) pressure to the top of the sample bottles, forcing the water to flow through and fill a 1165 cm^3 calibrated volume. The measured volumes of seawater were then transferred to a purge and trap system, entering the sparge tower under vacuum. The water was sparged with a N_2 flow at 270ml/min for 3 minutes and trapped at -110°C on a Unibeads 3S trap (two inches of 1/8inch tubing) immersed in the headspace of liquid nitrogen. The purge and trap system was interfaced to an Agilent 6890N gas chromatograph with electron capture detector (MicroECD at 330°C). The traps were heated to 110° C and contents injected into the gas chromatographs. The SF_6, SF_5CF_3 and CFC-12 separation was achieved using a 1m Porasil B packed pre-column and a 1.5m carbograph AC main column. A six inch molecular sieve post column was used to remove N_2O. The three columns were kept in the oven at 75°C. The carrier gas, N_2, was cleaned by a series of purifying traps. The running time per sample was ~10 minutes.

Calibration

The SF_5CF_3, SF_6, CFC-12 concentrations in air and water were calculated using external gaseous standards. We use two working standards supplied respectively by NOAA (Brad Hall, March 2010) and BOC (2009). The NOAA standard is clean air enriched in SF_5CF_3 inside a 29L Aculife-treated aluminium cylinders calibrated for SF_6 and CFC-12 by NOAA (Table 3.2.1.1). The NOAA 2010 standard was intercalibrated against the WHOI 5B standard for SF_5CF_3 during the JC054 cruise in January 2010 and then during JC69 in February 2012 with our instrument. The BOC standard is nitrogen enriched in SF_6 inside a 10L steel cylinder. The BOC standard was intercalibrated against the NOAA 2010 standard for SF_6 during JR281.

	Mixing ratio ppt	Std Dev	calibration
SF_6	14.0	0.05	Scale NOAA 2006
CFC-12	513.9	1.3	Scale NOAA 2001
SF_5CF_3	63.9	0.1	Intercalibration with Ledwell 5B tank 7/01/2011 – UK 2
SF_5CF_3	64.3	0.2	Intercalibration with Ledwell 5B tank 7/02/2012 – UK 3
SF_5CF_3	76.6	0.2	Gravimetric value revised by NOAA 1/08/2013 (previous value given in 2010 was 97.4), cylinder not analysed

Table 3.2.1.1: Concentrations of the working standard NOAA tank # ALL-072115

SF_5CF_3, SF_6 and CFC-12 concentrations in air and seawater samples were determined by fitting their chromatographic peak area to multipoint calibration curves, made by injecting known volumes of gas from the working standard to the analytical system (Fig. 3.2.1.1). The routine calibration curves were made by injection of nine different volumes (0.1, 0.25, 0.3, 0.5, 1, 2, 3, 5, 8 ml) of the working standards when time permitted. Larger calibration curves (up to 143 ml) were also made to cover the high CFC-12 concentration of a 1165ml sample of surface seawater (Table 3.2.1.2). The changes in the sensitivity of the system were tracked by injections of a fixed volume of standard gas in between stations (Fig. 3.2.1.2) and used to adjust the calibration curves respectively. For each sample, the ECD sensitivity to flow and temperature changes was corrected by normalising to the baseline levels.

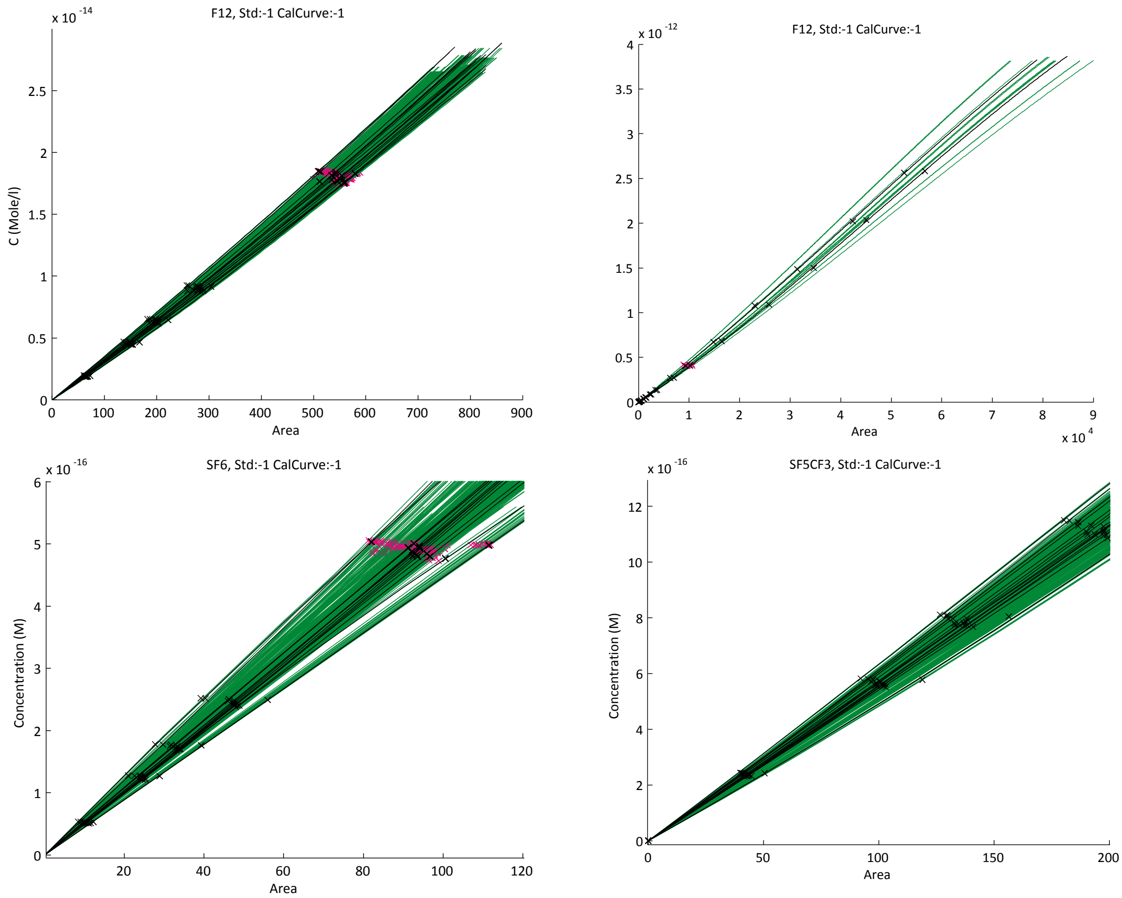

Figure 3.2.1.1: Calibration curves for CFC-12 for a) small range, b) high range values, c) SF_5CF_3 and d) SF_6 small range values. The measured calibrated curves are in black with the injection points marked by a cross and the extrapolated calibrated curves from the 1 ml standard value are in green.

	Target water	Surface water	1ml NOAAA	3ml NOAA	5ml NOAA	8ml NOAA	15X8ML NOAA	19X8ML NOAA
SF_6	240	600	90	281	470	744	11073	12369
SF_5CF_3	30	7	360	1129	1862	2853	39165	4954
CFC-12	10000	56000	540	1565	2528	3761	46076	58075

Table 3.2.1.2: Range of chromatogram peak areas for a 1165 ml seawater sample compared to different volumes of standard NOAA 2010.

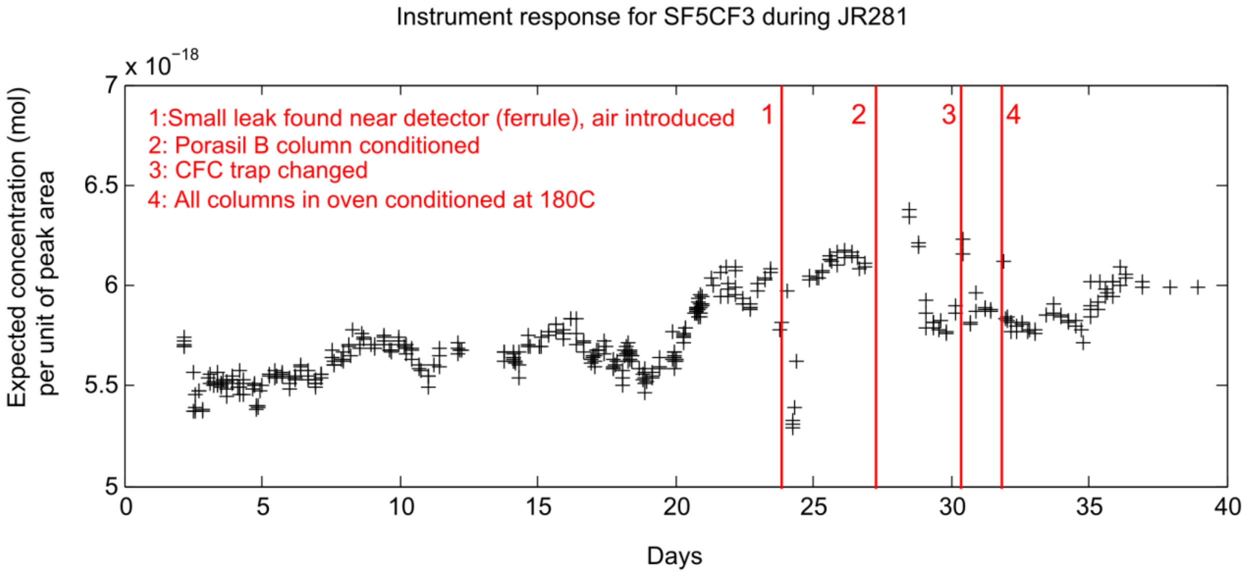

Figure 3.2.1.2: Instrument response for the analysis of 1 ml of NOOA 2010. Abrupt changes correspond to instrument interventions (numbered 1 to 4 in figure).

Detection limit and precision

An large volume of water (1165 ml) was sparged in order to increase the detection limit of the tracer in water. The detection for SF_5CF_3 was limited by the chromatogram integration of the peak for an area of 2 corresponding to 15E-18 M (mol/L). The SF_5CF_3 reproducibility of the samples was estimated from the analysis of 147 duplicate samples (two consecutive samples drawn from same Niskin bottle), giving a precision (1 standard deviation) for dissolved SF_5CF_3 measurements of ~ 3% or $5x10^{-18}$M, whichever is greater. The SF_6 and CFC-12 reproducibility for low concentrations was best estimated at the test station (#72) where all Niskin bottles were fired at the same depth (1150 dbars) and only one sample was drawn per Niskin. This is because SF_6 and CFC-12 concentrations are high in the atmosphere and the second sample taken from the Niskin is prone to air contamination when there is less than 5 liters of water left in the Niskin bottle for the duplicate. The results from the test station for 21 samples gave a mean of $3.10x10^{-17}$ M with a standard deviation of $2.2x10^{-18}$ for SF_6 and a mean of $1.19x10^{-13}$ M with a standard deviation of $4.01x10^{-15}$ for CFC-12.

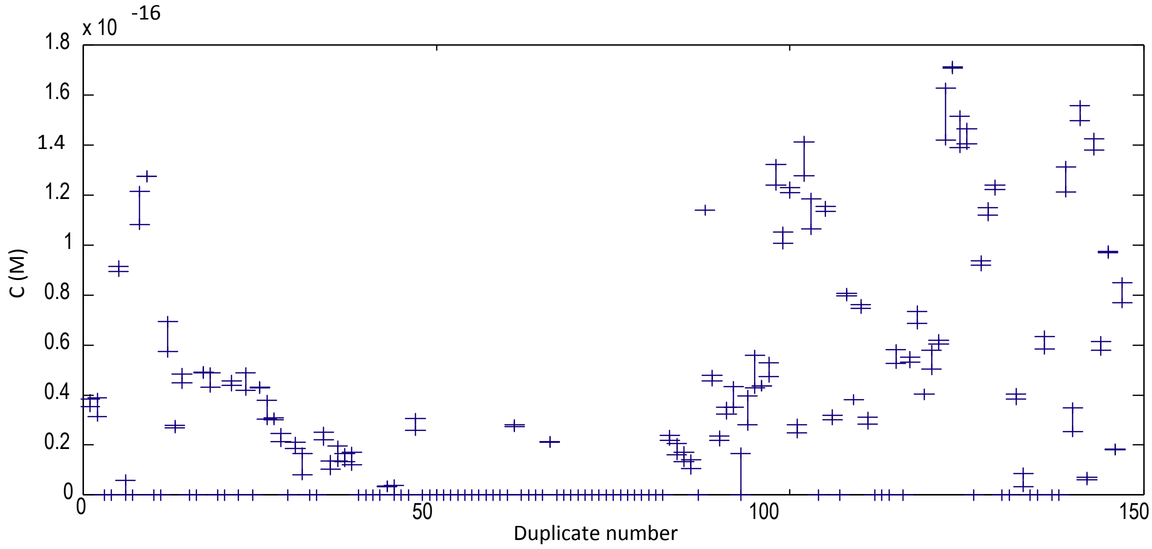

Figure 3.2.1.3: SF_5CF_3 concentrations for each duplicate drawn from same Niskin bottles along the cruise.

Blank and sparge efficiency corrections

Blank or 'contamination' are normally estimated from the analysis of tracer free water and subtracted from the measured concentrations. The blank for SF_5CF_3 was zero. The blanks for SF_6 and CFC-12 were respectively 0.017 $x10^{-15}$ M and 1.5 x10-^{15}M, both estimated from samples drawn from niskin bottle where seawater was beforehand sparged for 8 hours to removed the gases trace

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Sparging efficiency was determined by successive resparge of a single sample until no further compound could be detected.

Tracer	**SF_6**	**SF_5CF_3**	**CFC-12**
Sparge efficiency %	94.7	96.7	87.99

Table 3.2.1.3: Sparge efficiencies during JR281.

Atmospheric and surface concentrations for SF_5CF_3

SF_5CF_3 in the atmosphere is very low at the sub part per trillion (ppt) level by volume, however it is detectable in cold surface waters (Fig. 3.2.2.1). Our air measurements made near station 36 (60.62°S 41.97°W) on the 29/03/2013 are ~0.18 +/- 10 percent ppt. This value is between predicted current levels of SF_5CF_3 of approximately 0.17 (Sturge, personnel communication) and 0.26 +/- 10 percent error ppt (considering an increasing of ~six percent per year based on analyses conducted on Antarctic, Sturges *et al.* 2000, Stay, 2007). Assuming 100% saturation, 0.18ppt in the atmosphere will correspond to a concentration of 45 attomolar in surface fresh water at 5°C (using Busenberg and Plummer, 2008, solubility relationship for pure water).

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3.2.2 Preliminary results

The sampling depths of the Niskin bottles were optimised to bracket the tracer density spread range along the SR1 section, the top part of the A23 section, the North Scotia Ridge (NSR) section and in the Argentine Basin. Where no tracer was found (i.e. the Orkney Passage and the southern part of A23 section), the sampling depths of the Niskin bottles were more regular along the water column with an emphasis for the bottom and deep waters.

SF_5CF_3 distributions

The tracer (73 kg) was released in February 2009 (cruise US1), on the 27.9 kg m^{-3} neutral density surface (in UCDW ~1500 m depth) in the Pacific upstream of the Drake Passage at 58°S, 107°W between the SAF and the PF. Subsequent cruises (see box in Figure 3.2.2.2) monitored its vertical and horizontal dispersion downstream of the release (note only a fraction of the released amount could be surveyed each time). This cruise, 4.25 years after the release, is the 4th cruise performed by the UK team using the analysis system described above.

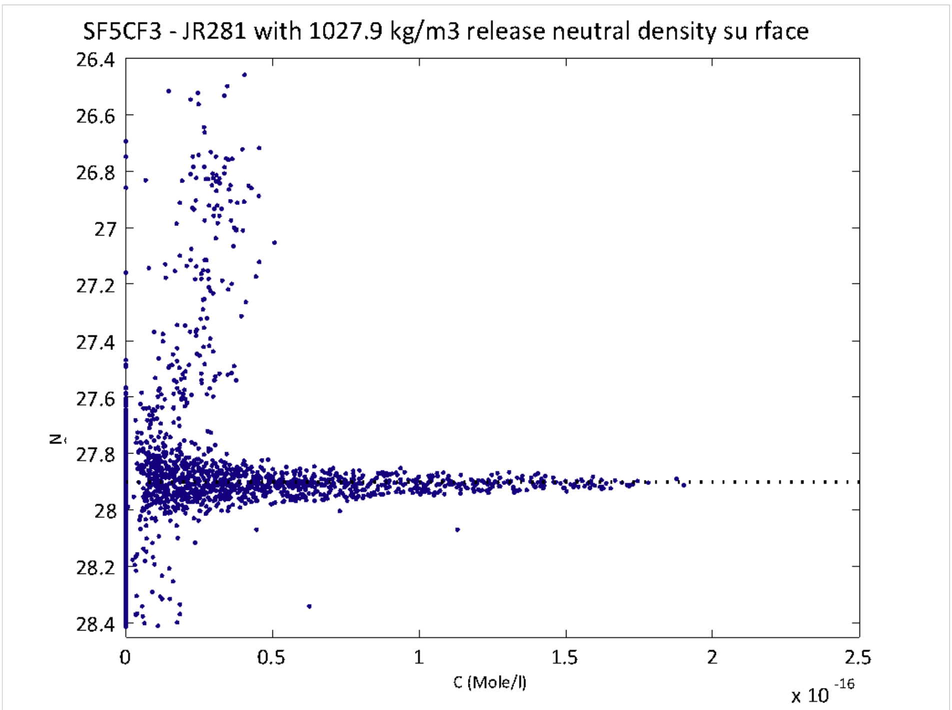


Figure 3.2.2.1: All SF_5CF_3 data points measured during the JR281 cruise including outliers.

Figure 3.2.2.1 shows all the measurements of SF_5CF_3 (all individual profiles are shown in the appendix). The tracer appeared roughly centred on the target density with a near Gaussian peak shape at almost all stations. The peak maximum concentrations during JR281 were around 5 time higher than the surface values. The comparison of the column-integrated concentrations with previous cruises at repeated transects (Fig. 3.2.2.2) show a dramatic decrease between last year cruise JC069 (DIMES UK3) and JR281 at both the SR1 and NSR transects. This suggests that the bulk of the tracer has now passed through the North Scotia Ridge.

The dispersion of the tracer for the JR281 survey is illustrated Fig. 3.2.2.3. The mean column integral including all stations (where tracer was found) was 27.4 picomol/m^2. Considering that 387.6 moles (molar mass of SF_5CF_3 is 196.0635 g/mol) were released, a rough calculation of the patch extension within the ACC would suggest between 115 to 284 degrees longitude (115 is the length of a ribbon with a concentration of 50 picomol.m^{-2} within 10 degrees latitude, 284 is the length of a ribbon with a concentration of 30 picomol.m^{-2} within 7 degrees latitude). The largest column integrals (70-80 picomol/m^2) were found north of the North Scotia Ridge at the Falkland Trough (FT, 55°W, 53°S) and at the Falkland Plateau (FP, 42°W, 50°S) sections before getting into the Argentine abyssal plain where the tracer peak shape and concentrations showed interleaving and mixing with warmer and saltier North Atlantic Deep Water. The peak at the last station of the northern section did not have a Gaussian shape (STN 122 in appendix).

Cruise	Time (years)
US1	0 (Tracer release)
US2	1
UK2	1.9
UK2.5	2.2
US3	2.5
UK3	3.1
UK4	4.25

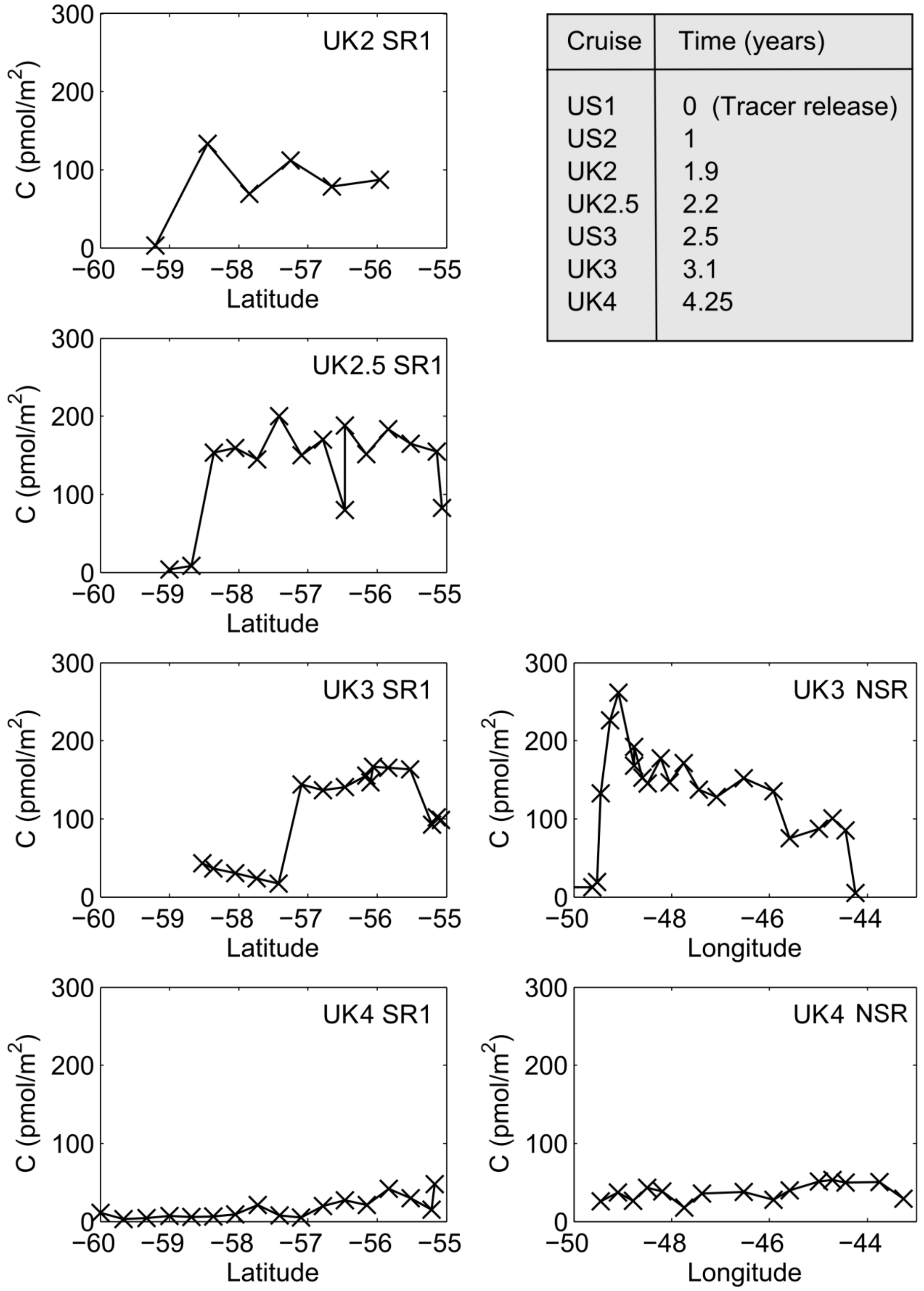


Figure 3.2.2.2: Transect comparison of tracer column-integrated concentrations observed over time during DIMES at the SR1 and NSR transects.

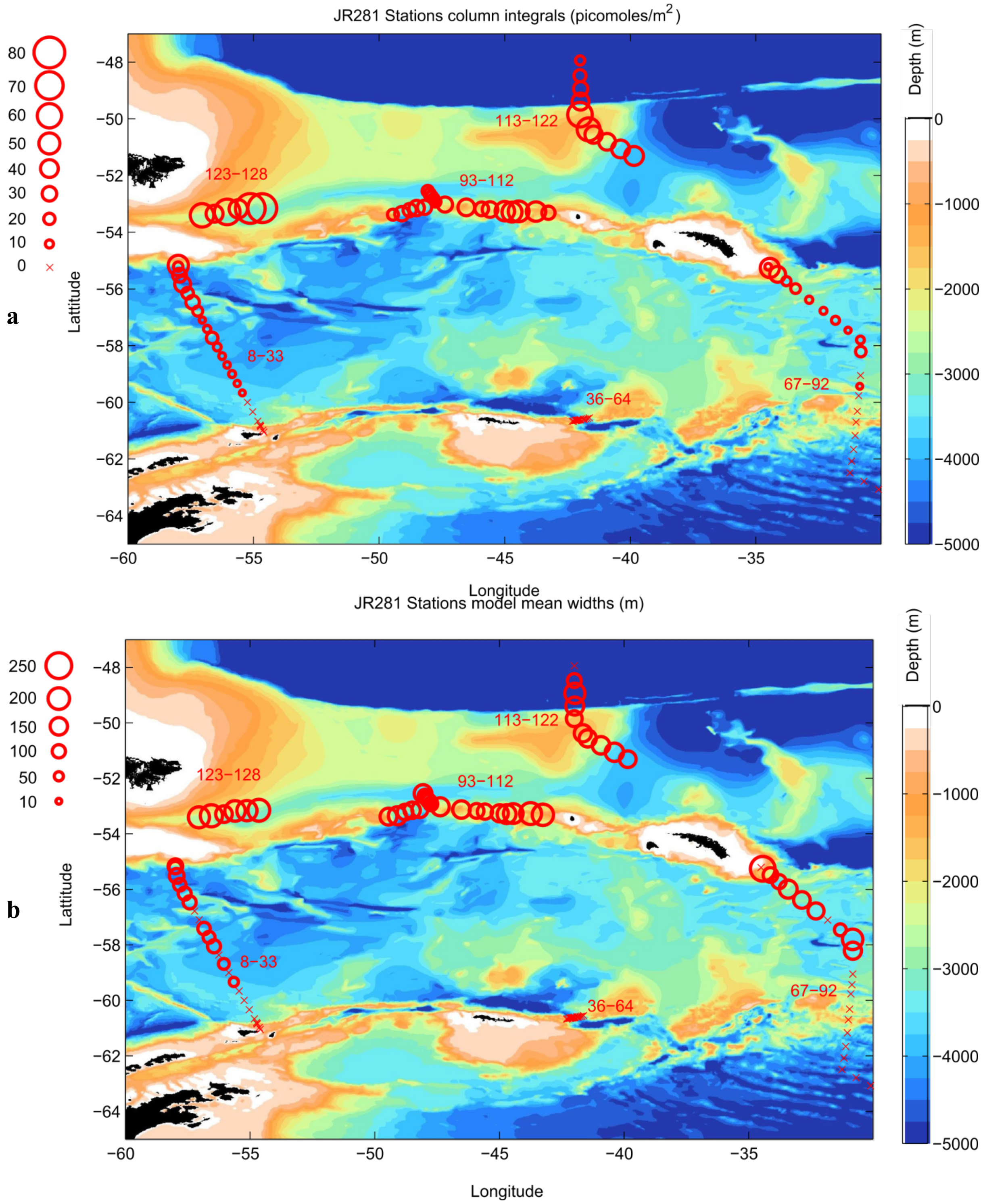


Figure 3.2.2.3: Maps of the column-integrated concentrations a) and widths b) of the tracer profiles at each station. Circle diameter is proportional to the tracer concentration (10^{-12} mol m^{-2}) or width (m), crosses show stations without released tracer and numbers denote stations. GEBCO 2mn topography is shown in colour. The spread of the tracer as it follows the AAC flow is expected to be mainly zonal upstream of Drake passage then, converging at Drake passage and finally veering north before going east again.

The concentration and vertical spread of the tracer found during JR281 is compared to the previous cruises in Fig. 3.2.2.4 and 3.2.2.5 based on mean profiles of the different surveyed regions. Although the tracer concentration found during JR281 were low, the precision of the measurements and the Gaussian shape of the profiles allow estimates of the vertical spread of the tracer and mixing rates.

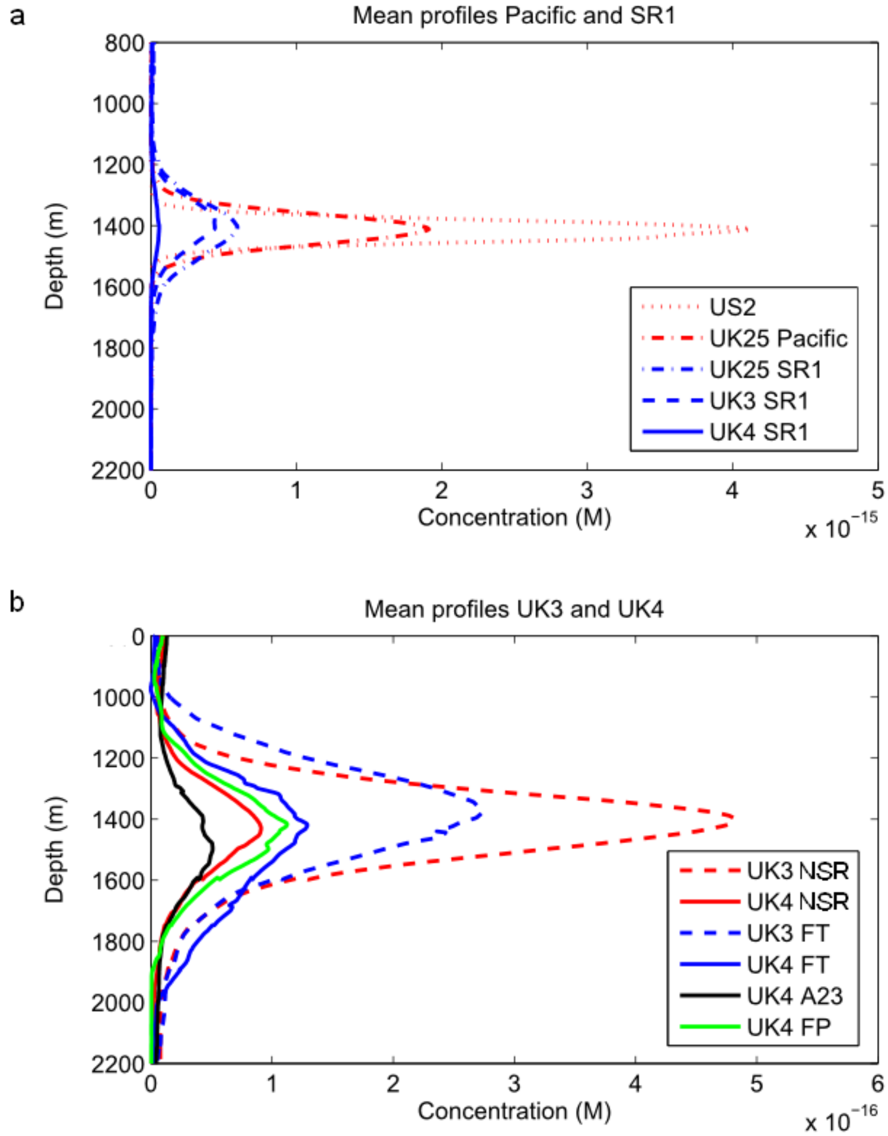


Figure 3.2.2.4: Regions comparison of mean tracer profiles observed overtime during DIMES. Profile were interpolated against density and then converted to depth using the JR276 mean-density-vs-depth profile to convert between both variables. Mean profiles include all profiles of each transect and do not differentiate between the different frontal regions of the ACC.

The JR281 vertical mixing rates in the different regions (Figure 3.2.2.5) are fairly consistent with the results of previous cruises, in particular at the SR1 repeat. Surveys of the NRS and in the Argentine Basin were not performed at the same positions during JR281 (year 4.25) and JC069 (year 3.1), however both cruises show the same tendency with higher mixing rates downstream of the North Scotia Ridge.

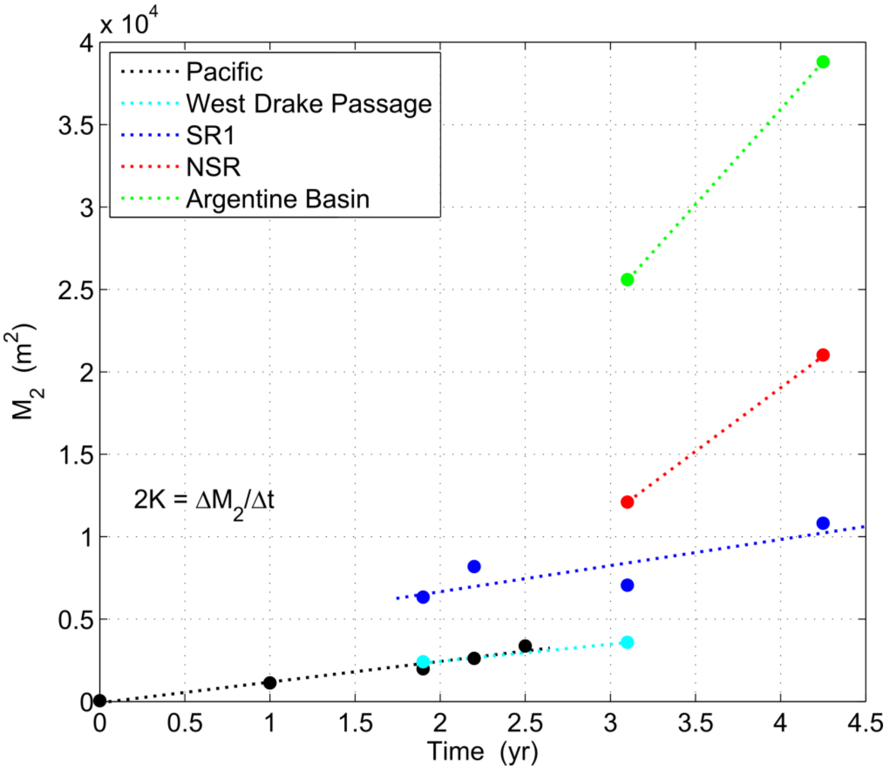


Figure 3.2.2.5: Vertical dispersion of the tracer over time in different regions, displayed as the second moment (M_2) versus time.

SF_6 and CFC-12 distributions

Stations 36 to 92 were sampled and analysed for CFC-12 and SF_6 as no tracer from the release was found at these locations. Initial, uncalibrated results are presented in Figure 3.2.2.6. The distributions of both transient tracers are consistent with each other and with previous studies, showing a surface maximum, low concentrations within Circumpolar Deep Waters and a relatively high signal in the bottom waters.

Acknowledgements

We would like to thank the captain and all of the ship-side staff, BAS technicians and the scientific party on cruise JR281. Special thanks to Simon Wright for his invaluable help and providing us with liquid nitrogen. Finally thanks to everybody who helped with the water sampling for the tracer analysis.

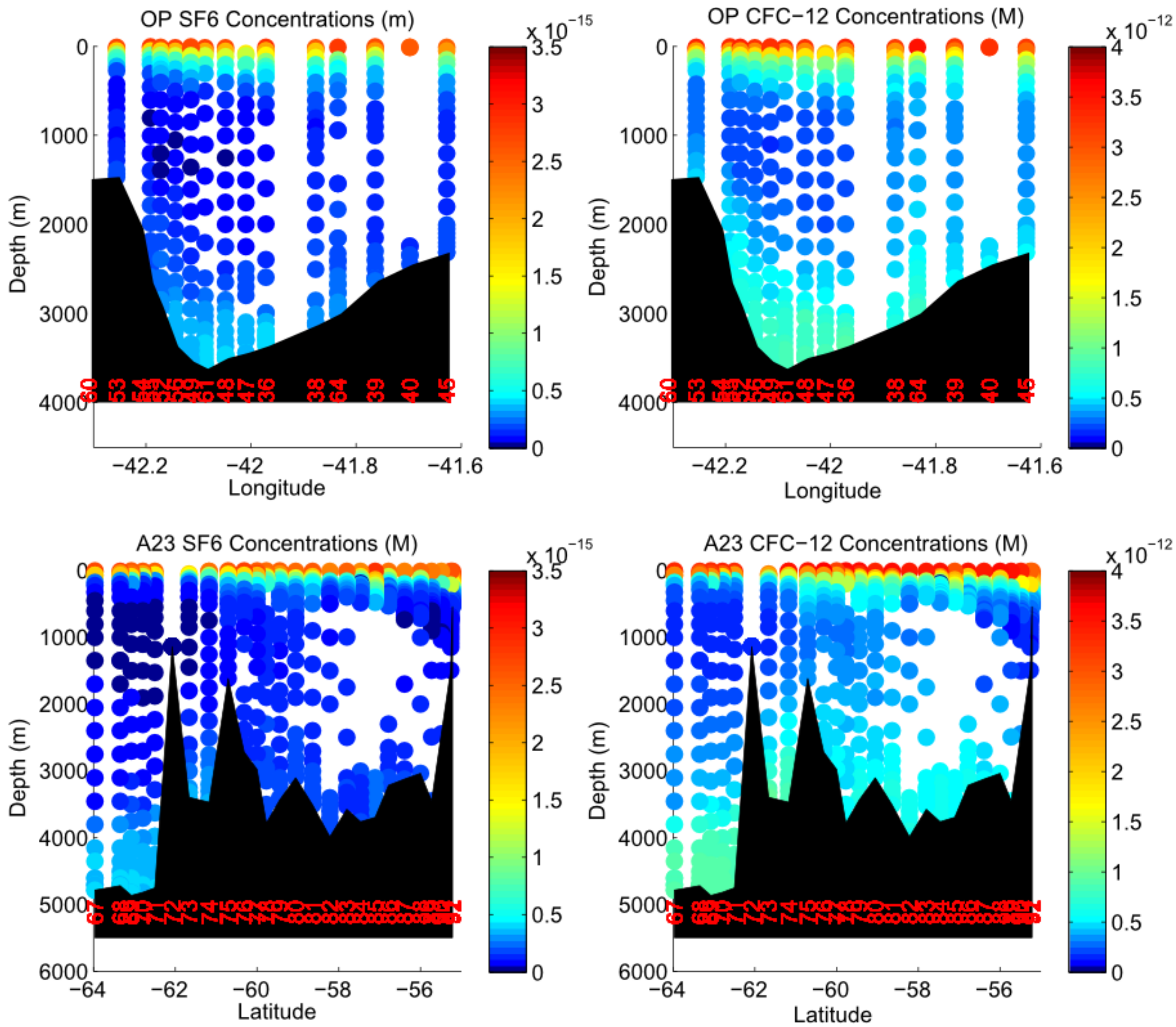


Figure 3.2.2.6: SF_6 and CFC-12 vertical distributions along the Orkney Passage and A23 transects.

References

Busenberg, E., and L. N. Plummer. Dating groundwater with trifluoromethyl sulfurpentafluoride (SF5CF3), sulphur hexafluoride (SF6), CF3Cl (CFC-13), and CF2Cl2 (CFC-12),2008; Water Resour. Res., 44, W02431, doi:10.1029/ 2007WR006150..

Sturges WT, Wallington TJ, Hurley MD, *et al*. A potent greenhouse gas identified in the atmosphere: SF_5CF_3. Science 2000; 289:611-613.

Tsai WT. The prediction of environmental fate for trifluoromethyl sulfur pentafluoride (SF_5CF_3), A potent greenhouse gas. J Haz Mat 2007; 149: 747-751.

3.2.3 Appendix – All SF_5CF_3 profiles

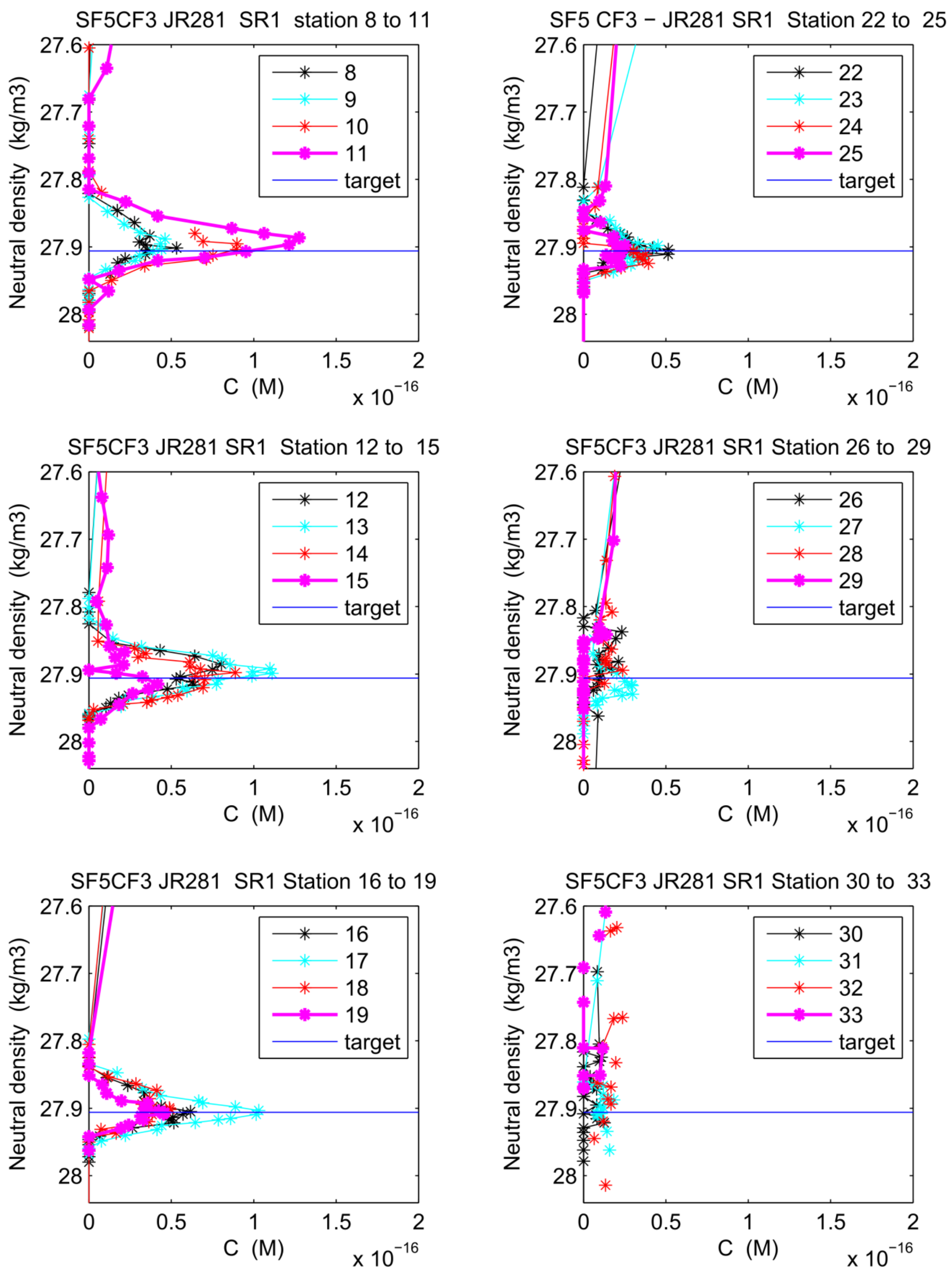


Figure 3.2.3.1: Tracer data for stations with tracer from the release plotted as a function of neutral density with bottle position and interpolating lines.

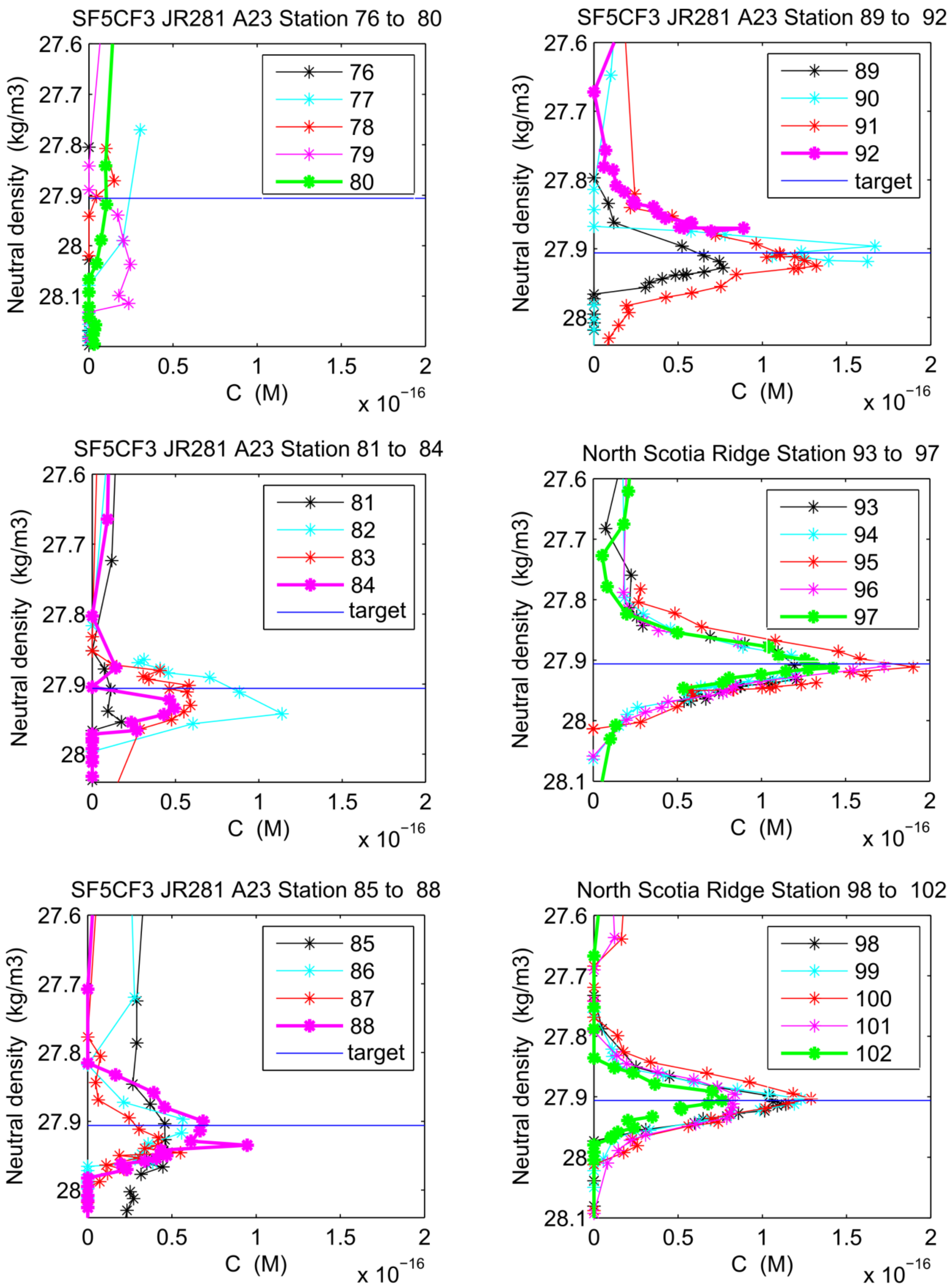


Figure 3.2.3.1 (continued)

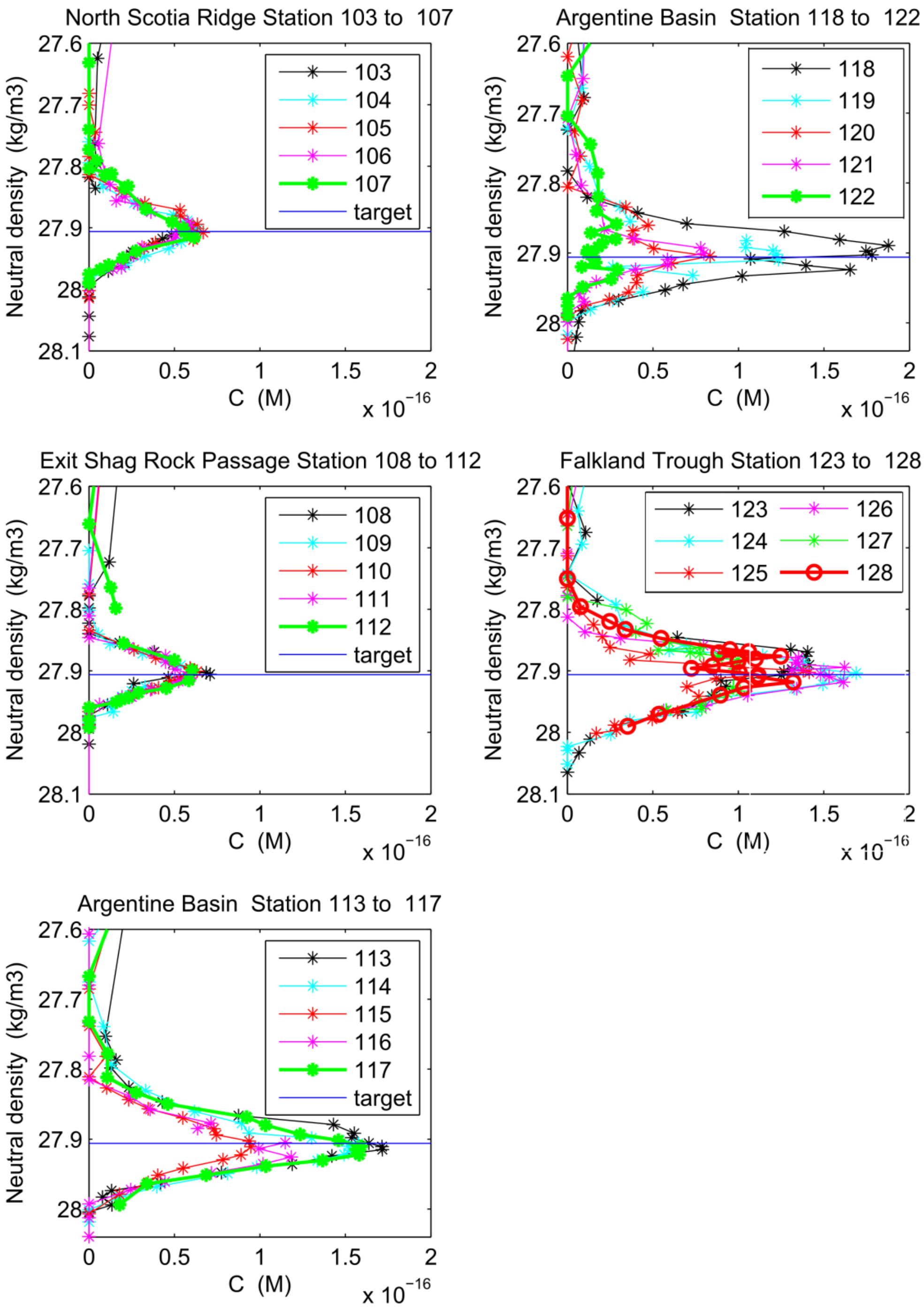


Figure 3.2.3.1 (continued)

PART IV: Deployed Equipment

4.1. CTD

Report not delivered. After more than a year of reminders without positive answer, it was (unfortunately) decided to not include this section in the present report. The data analysis and calibration was performed by Brian King (NOC). Please contact him directly in case of any question: bak2w07@soton.ac.uk

4.2. Lowered Acoustic Doppler Current Profiler (LADCP)

Xinfeng Liang

The LADCP system used during Cruise JR281 consists of two ADCPs, an external battery, inter-connection cables, two communication/charging cables, a battery charger and a MacBook. LADCP profiles were collected at all CTD stations in order to derive full-depth profiles of ocean velocity, as well as profiles of finescale vertical shear of horizontal velocities. The data are expected to provide background information for studying small-scale process and can be used to evaluate the existing finescale parameterization methods for diapycnal mixing. Preliminary processing was performed immediately following data download using the LDEO LADCP processing software. Both raw and processed data can be found in the final LADCP data set. LADCP operations during JR281 were partially supported by a grand from the US National Science Foundation (OCE-1030309, PI: Andreas Thurnherr).

4.2.1. LADCP System

Two Teledyne/RDI Workhorse 300kHz ADCPs were mounted on the CTD rosette, with one pointing downward (downlooker) and the other pointing upward (uplooker). The LADCPs were powered with a standard battery/charger system.

Data acquisition was carried out using the LDEO "acquire" software, version 1.5. The software was installed on a MacBook running MacOSX 10.5. The computer was configured to synchronize the clock automatically. Communications between the acquisition computer and the ADCPs took place across two parallel RS-232 connections, via a KeySpan 4-port USB-to-serial adapter. Data backup was done automatically onto an external USB disk. The setting file for the "acquire" software can be found in the Appendix section.

All stations were carried out with the instrument configurations supplied with the LDEO data acquisitions software – 25×8m bins, beam coordinates, zero blanking distance, narrow bandwidth, 4.0 ambiguity velocity, 1.3s/1.5s staggered ping rate. This is one of the configurations that were used during the DIMES UK2 & UK3 cruises (JC054 & JC 069). The associated command files can be found in the Appendix section.

4.2.2. Processing Methods

There are currently at least three publicly available software packages that can be used to process LADCP data: 1) One package based on *shear method* and written by Eric Firing at University of Hawaii; 2) one package based on *inverse method* and maintained by Andreas Thurnherr at LDEO; 3) one also based on *inverse method* and maintained by Gerd Krahman at IfM/Geomar in Kiel. All JR281 LADCP data were processed with the LDEO LADCP processing software, which can be obtained from: http://www.ldeo.columbia.edu/~ant/LADCP. The LADCP processing during this cruise was briefed as follows. For detailed information on the software, refer to "How to Process LADCP Data with the LDEO Software" (A. M. Thurnherr, 2010), which can also be downloaded from the link above.

4.2.2.1. General Settings

All the processing was carried out on a MacBook, which was also used to communicate with the ADCPs as well as to acquire LADCP data. On the MacBook, necessary software including MATLAB, LDEO LADCP Processing Software (Version IX) and a program called "magdec" were installed. Here the program "magdec" was used to calculate the magnetic declination, which is the difference between magnetic and true bearings. Also, a set of perl programs written by Dr. Andreas Thurnherr were also installed. These perl programs can be used to examine many features of the raw LADCP data and can also be downloaded from http://www.ldeo.columbia.edu/~ant/LADCP

To obtain high-quality full-depth velocity profiles, three auxiliary data are usually needed: 1) the bottom-tracking data, which can provide constrain for the velocity near the seabed; 2) the GPS data, which can provide constrain for the depth-integrated velocity; and 3) shipboard-ADCP (SADCP) data, which can be used to constrain the velocities near the sea surface. In addition to these, another useful auxiliary data are the CTD time-series, which can be used to improve the accuracy of the depth estimation from LADCP data. Since the bottom-track data were included in the raw LADCP data, before processing LADCP data, only CTD time-series, GPS and SADCP data were firstly prepared.

CTD time-series with a temporal resolution of 1s was provided by Dr. Brian King immediately after it was processed, which was usually available just one day after the deployment. For the preliminary processing, the salinity of the CTD data was not calibrated. The data therefore need to be re-processed when all the CTD calibrations are finished. But effects of the calibration are usually not dramatic. The GPS time series with the same temporal resolution of the CTD time-series was collected and merged with the CTD data for each cast, so only one file including both the CTD and GPS time-series was provided for each station during this cruise.

During each CTD/LADCP deployment, SADCP data were collected with a 75kHz system. Different from the CTD data, each SADCP file provided no temporal information but only profiles of zonal and meridional velocities as well as their standard deviations.

Although the ADCP used as downlooker during the cruise has the RDI LADCP mode (WM15) installed and it reports bottom-tracking data calculated from water-tracking pings, from the experience during cruise JC054 we chose to use the post-processed bottom tracking data to constrain the velocity measurements. For all stations (total number: 111), bottom-tracking data were successfully obtained.

4.2.2.2. Processing

The casts were processed directly with the LDEO LADCP processing software. Before processing, a cruise-specific directory named "data" was created and the subdirectories were structured as follows:

- LADCP Data Files: raw
- Processed LADCP Files:
    - On_cruise/processed : processed with both uplooker and downlooker

  - DL/processed : processed only with the downlooker
  - UL/processed : processed only with the uplooker
- Checkpointing Files: checkpoints
- CTD Time-series Files: CTD/1Hz
- SADCP Files: SADCP

In order for processing to work correctly, a MATLAB file named "set_cast_params.m", which contained many cruise-specific parameters, was also generated under the "data" directory. A sample of the "set_cast_params.m" can be found in the Appendix section. For detailed information on meanings of different parameters in the file, refer to "default.m", a file included in the LDEO LADCP processing software package. After creating the directories and "set_cast_params.m", the LADCP data were processed by typing process_cast(nnn) under the data directory in the MATLAB command window, where nnn stands for the station number.

4.2.3. Problems

During the whole cruise, the downlooker (BAS unit: sn: 14443) worked perfectly well, but the uplooker failed a few times. After the first test cast, it was found that the uplooker (BAS unit: sn 15060) had a broken beam. It was then replaced with another BAS unit (sn: 14897). This unit (sn: 14897) worked well from station 2 to station 86. Then it started to show a weak 2nd beam. It was replaced with a NOC unit (sn: 13400) on station 90. However, the NOC unit did not last long. It started to show a weak 3rd beam on station 115, and then got worse on station 116 and 117 (a broken 3rd beam on station 116 and broken 2nd and 3rd beams on station 117). We then replaced it with a LDEO unit (sn: 12736) on station 118. It should be noted that during the cruise, we also tried to use another LDEO unit (sn: 3441). However, its firmware is old, a special command file is needed, so we just used another unit.

On station 60, a gap of 10 minutes between two consecutively numbered ensembles was found in both ADCP files. That is because the master did not ping at all for 10 minutes sometime during the upcast. That could be due to a bad connection with the battery, so we checked and reconnected the instruments and battery after that cast. Station 60 is the only station that has this problem and the LDEO LADCP processing software processed the data without problems.

During the cruise, some tests on the effects of the wake of the rosette were done. On stations 19-25, only the uplooker was rotated about 22 degrees clockwise. Then, on stations 26-33, the uplooker was rotated back to the original position. From station 34, as suggested by Dr. Andreas Thurnherr, the uplooker was rotated about 22 degrees clockwise again, and the downlooker was also rotated about 45 degrees.

The acquire software was easy to use and worked very well during the whole cruise. One problem we encountered was on several stations (e.g. station 008) when downloading the LADCP data, warning messages like "Retry 0: Timeout 105" appeared several times. Most times after retrying several times, the data were downloaded successfully. Also, error messages "can't get prompt" appeared many times. We had to disconnect the cable and reconnected the MacBook and the instrument, and then the problems were solved.

4.2.4. Preliminary Results

Preliminary results from sections SR1 and Orkney Passage are presented as follows. Here, the results are mainly presented in three different ways: 1) velocity vectors near the sea-floor, which show the spatial pattern and the effects of the topography; 2) vertical sections of velocities, which reveal the spatial pattern in the x-z or y-z planes; and 3) profiles of zonal and meridional velocities, which show the baroclinic structures as well as the finescale structures much more clearly than the other ways.

4.2.4.1. SR1 Section

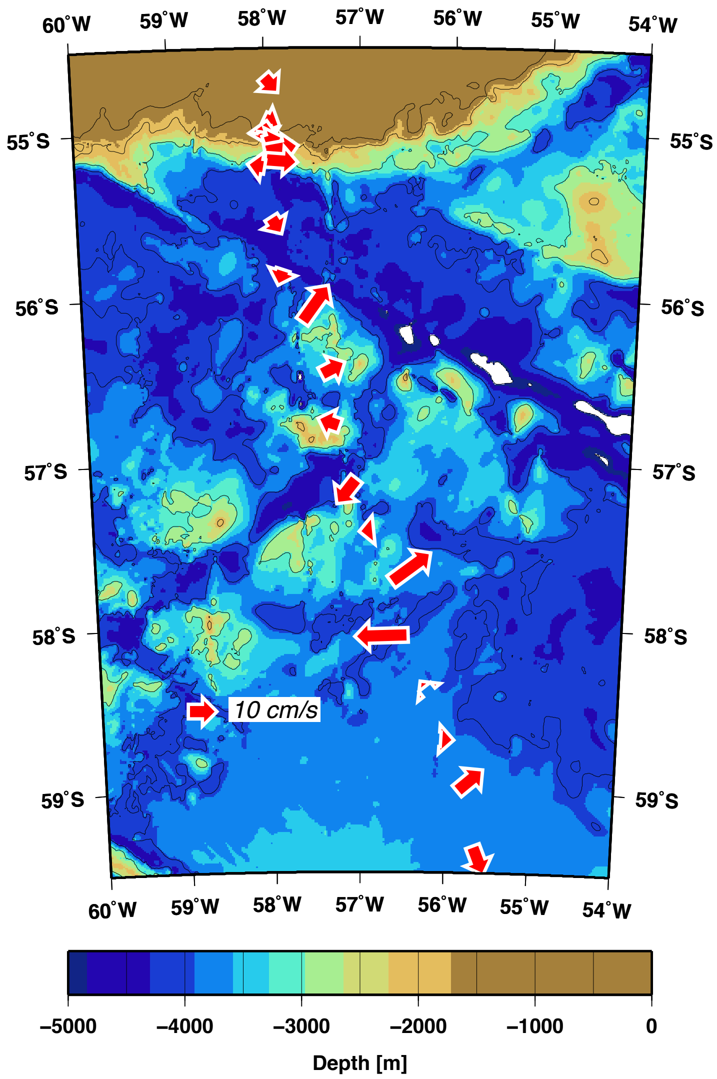


Figure 4.2.1. Bathymetry and locations of stations along the section SR1. Arrows show the ocean velocities near the sea-floor.

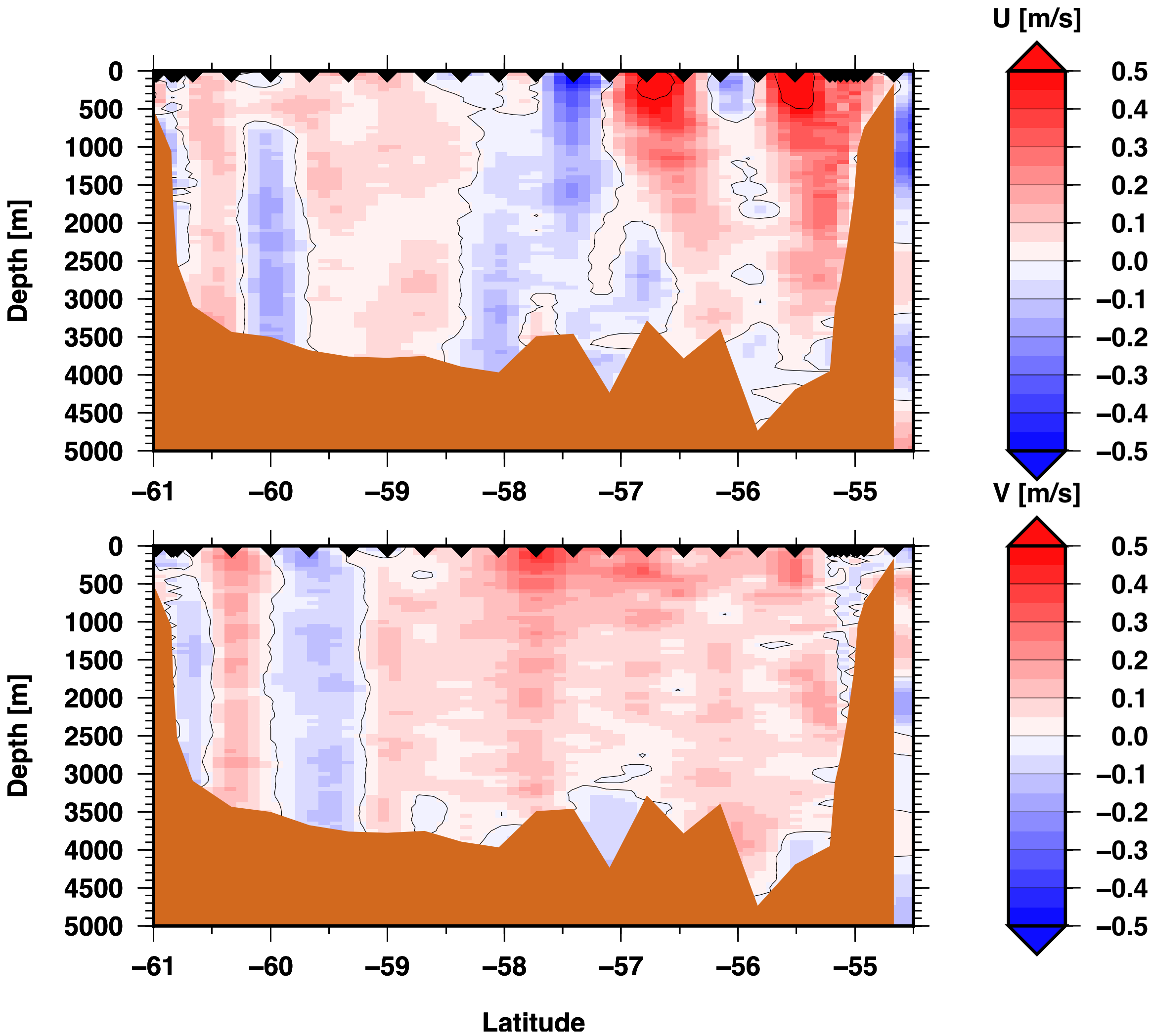


Figure 4.2.2. Zonal (upper) and meridional (lower) velocities on stations along the section SR1. The barotropic structures are clearly revealed.

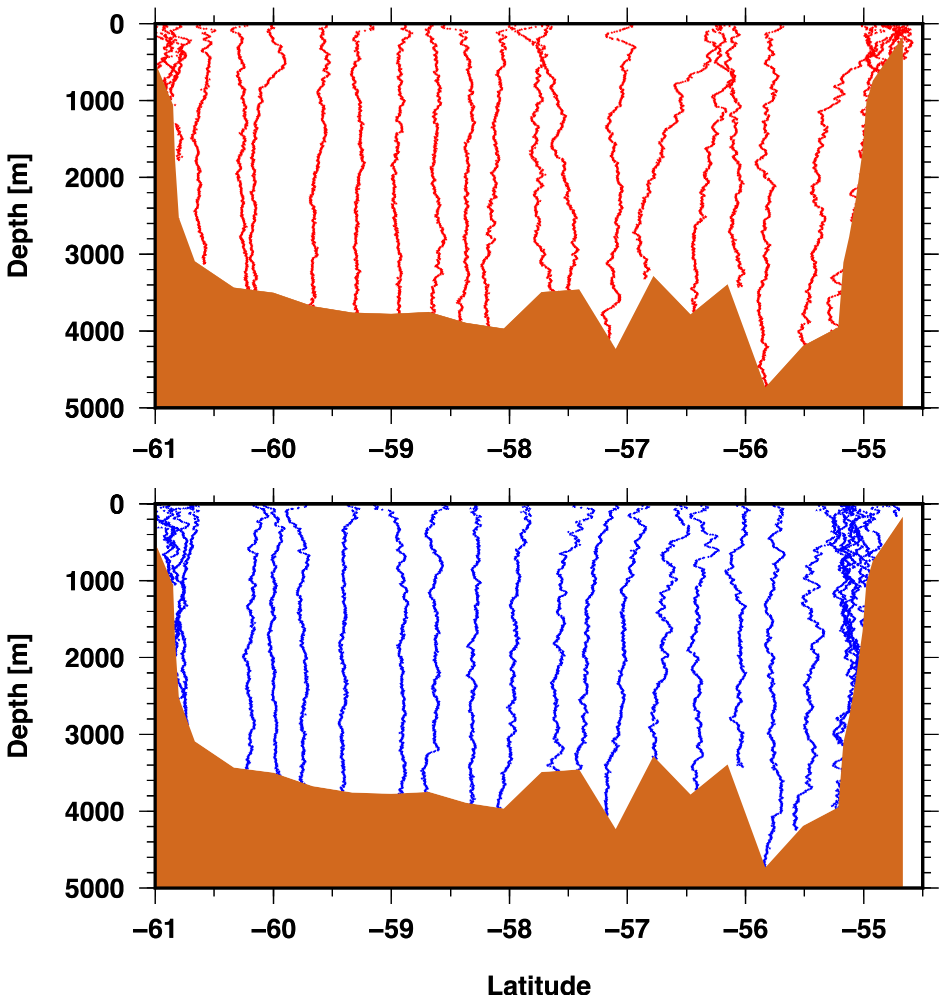


Figure 4.2.3. Profiles of zonal (upper) and meridional (lower) velocities on stations along the section SR1. This figures reveals many finescale structures above the depth of 2000 m, particular on stations between 57.5S and 55.5S. It could be related to the strong currents in that region. This feature is similar to the observation revealed in DIMES UK 3 and deserves some further investigation.

4.2.4.1. Orkney Passage

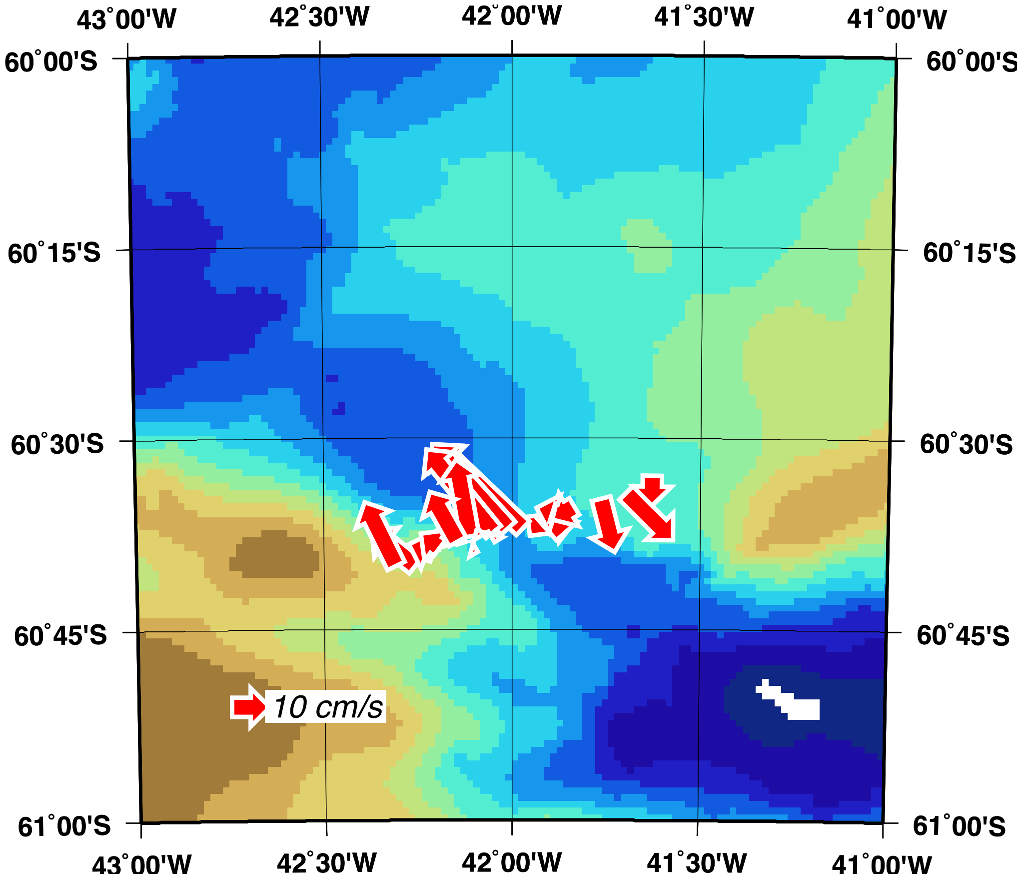


Figure 4.2.4. Bathymetry and locations of stations in the Orkney Passage. Arrows show the ocean velocities near the sea-floor. The strongest flow appears at the deepest point in the passage.

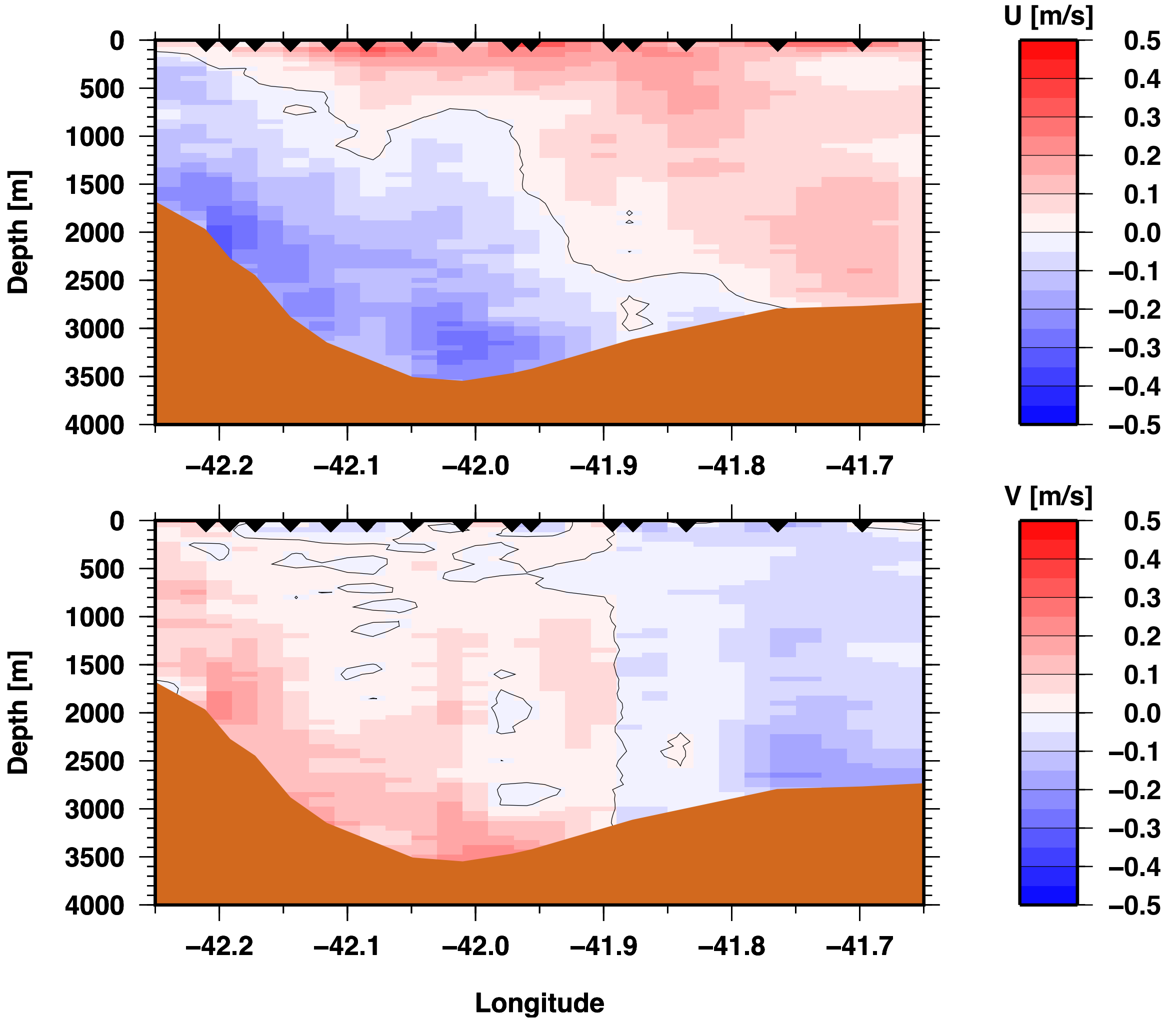


Figure 4.2.5. Sections of zonal (upper) and meridional (lower) velocities in the Orkney Passage. The currents on the two sides of the passage flow in the opposite directions.

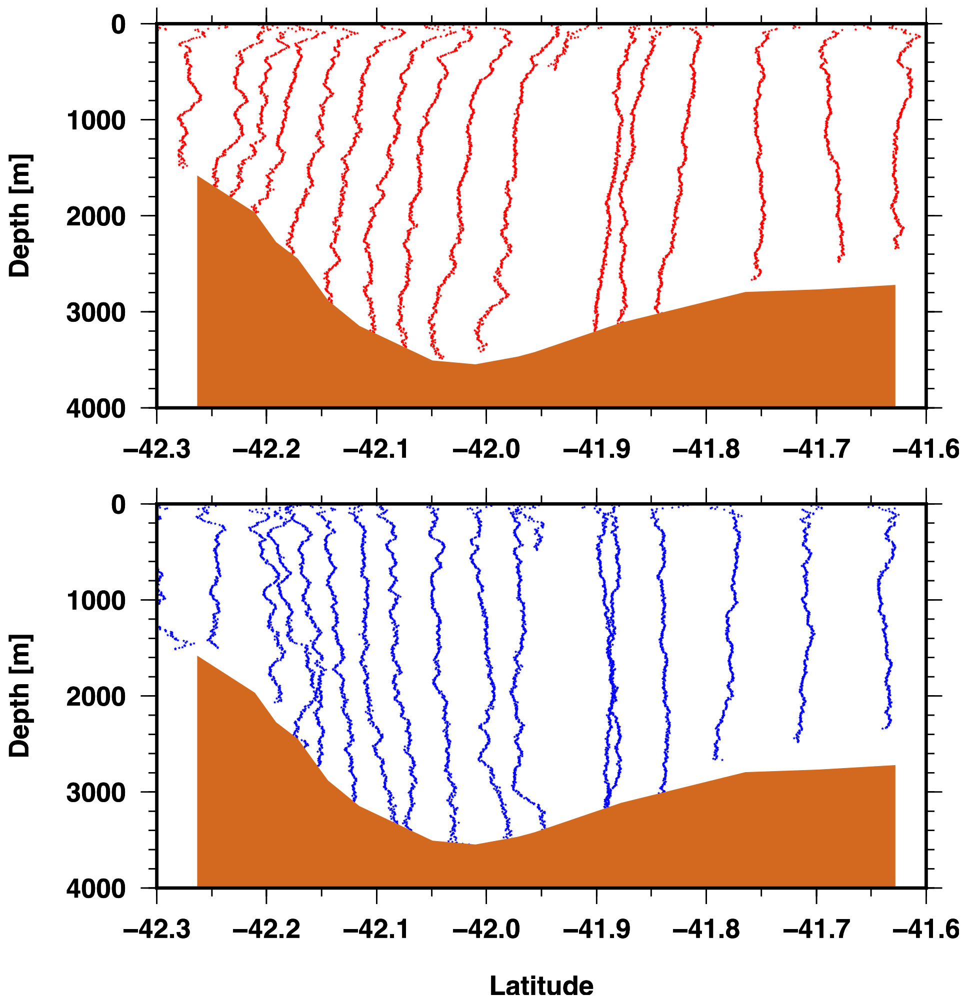


Figure 4.2.6. Profiles of zonal (upper) and meridional (lower) velocities in the Orkney Passage. The LADCP profiles on the west side of the passage show more finescale structures.

4.2.5. Appendixes

4.2.5.1. CRUISE_SETUP.expect

```
#======================================================================
#               C R U I S E _ S E T U P . E X P E C T
#               (c) 2004 A.M. Thurnherr
#               uE-Info: 68 60 NIL 0 0 72 2 2 8 NIL ofnI
#======================================================================

#--------
# HISTORY
#--------

# Mar 10, 2004: - created during NBP0402
# Apr  4, 2004: - final version NBP0402
# Jun 15, 2004: - adapted to BB150/Workhorse setup
# Jun 16, 2004: - ditto
# Jun 19, 2004: - BUG: could not handle multiple BB150 data files
# Jan 19, 2006: - updated documentation
```

```
#                         - allowed for empty-string time_server
# Nov  4, 2006: - changed backup dir structure
# Aug 25, 2010: - rename* funs modified to allow them to be used to ensure
#                           that downladed file names have correct case
#                         - renamed from DEFAULTS.expect to CRUISE_SETUP.expect
# Aug 26, 2010: - added ymodem_receive_cmd
#                         - changed default string quotes to {} to prevent Tcl variable
#                           and command substitutions
# Oct 18, 2010: - changed comment for ymodem_receive_cmd to account for the
#                           fact that bbabble now uses the -u option by default
# Mar 19, 2013: - Modified for JR281 by Xinfeng Liang.

#-----------
# TWEAKABLES
#-----------

# At the beginning of each cast, the clock of the acquisition computer should
# synchronized with the master clock used for timestamping the GPS information.
# The best way to accomplish this is to run a NTP daemon (e.g. ntpd) polling
# an NTP server on the ship.
# If running ntpd is inconvenient or not possible, the follwing variable can
# be set to the name of the NTP server, in which case the time is sync'ed
# at the beginning of each cast with the function set_computer_time (defined
# below).
# If there is no NTP server available, the variable should be set to the
# empty string and the clock must be sync'ed manually.

set time_server       {};

# bbabble needs to know the tty device name(s) of the serial connection(s)
# to the ADCP head(s). If only one head is connected, tty1 is ignored.
# If two heads are connected, the device names are exchangeable, i.e.
# either instrument can be connected to either port.

set tty0 {/dev/cu.USA49W1d1P1.1};
set tty1 {/dev/cu.USA49W1d1P2.2};

# In case of 2 ADCP heads, babble needs to know which is the master and
# which is the slave. This is accomplished by setting the following variables
# to the corresponding instrument serial numbers (PS0 output). By convention,
# the downlooker is the master. If only a single head is connected, both
# variables are ignored.

set slave_sn 12736;     ### LDEO unit: stn 118-
#set slave_sn 13400;    ### NOC unit; stn 90-117
#set slave_sn 14897;             ### BAS unit; stn 002-089
#set slave_sn  15060;            ### BAS unit; stn 001, Broken third beam
#set slave_sn 3441;     ### LDEO unit, stn 018- NOT WOKRING DUE TO THE FIRMWARE VERSION
set master_sn 14443;             ### BAS unit; stn 001-

# Before deployment, every ADCP head has to be programmed by sending it
# a corresponding command file, defined by the following variables. If only
# a single head is connected, the slave_* variable is ignored.

set master_cmd_file {MASTER.cmd};
set slave_cmd_file  {SLAVE.cmd};

# For convenience, it is best to use the station number to name the ADCP data
# files, and to indicate whether the data file comes from the master or
# slave. The following variables variables define the printf(3) format
# that is used to create the files names from the station number. If only
# a single head is connected, the slave_* variable is ignored.

set slave_deployment_name_fmt          {%03dUL};
set master_deployment_name_fmt         {%03dDL};

# Older RDI instruments (e.g. the BB150) do not allow the data-file name
```

```
# to be defined in the instrument, in which case the files have to be
# renamed after downloading. The following variables define the shell
# globbing patterns for the master and slave. For example, the UH BB150
# used during CLIVAR P02 generated files with extension .612; the coresponding
# globbing pattern is {*.612}. If only a single head is connected, the
# slave_* variable is ignored.
# NB: For dual-headed LADCP systems it is important that the globs do not
#     match both master and slave data files. {*.000} therefore will not
#     work for dual-head Workhorse systems.

set master_download_glob     {};
set slave_download_glob      {};

# For consistency it is nicest if low station numbers contain leading
# zeroes. The following variable defines the corresponding printf(3) format.

set stn_format {%03d};

# The following directory is used to store command files, instrument
# configurations and ADCP data. Separate subdirectories (named according to
# stn_format) are used for each cast.

set raw_dir {../data/raw};

# After downloading, the data directory is backed up to the following
# directory. Make sure that it resides on a different disk than raw_dir.
# Empty string disables backup for testing purposes.
# NOTE: RELATIVE PATHNAMES MUST START FROM CAST DIR (NOT ACQUISITION DIR)

set backup_dir {/Volumes/BARRACUDA/DIMES_UK4/raw};

# By default, bbabble will look for standard UN*X ymodem receive
# programs (rb and lrb) and call the first one it finds with the
# -u option. If neither of the standard programs exist, if neither is in the
# current $PATH, or if non-standard options have to be passed the following
# variable can be set to a non-empty string, such as {/sw/bin/rb -u}

set ymodem_receive_cmd {}

# bbabble can be made to abort downloading after a preset amount of time,
# defined by the following variable.

set download_timeout 999999;

#----------------------------------------------------------------------
# Semi-Standard Functions
#----------------------------------------------------------------------

# The program for polling an NTP server is different on different
# UN*X systems. Either rdate or ntpdate should be available. Note
# that sudo will propt for the login password of the user running
# the LADCP acquisition, unless it is explicitly set to allow execution
# of the command without a password.

proc set_computer_time {} {                         # set computer clock
        global time_server;
        if {[string length $time_server] == 0} {return}
        exec sudo rdate -s $time_server;
#       exec sudo ntpdate -s $time_server;
}

#----------------------------------------------------------------------

# After the LADCP data files have been downloaded they should be
# checked. A simple yet effective check consists in estimating the
# bottom depth (zmax) and end depth (zend) by time-integrating the
# vertical-velocity measurements. There are two different publicly
```

```
# available programs to accomplish this: scanbb from the UH LADCP
# software suite, and mkProfile from the perl-utilities available
# from the LDEO LADCP repository.

proc check_data {file} {                                    # check data file
        exec sh -c "mkProfile -Q $file 2> `basename $file .000`.profinfo";
        exec sh -c "cat `basename $file .000`.profinfo > /dev/tty";
#       exec sh -c "scanbb $file";
#       exec sh -c "sed -n '/^zmax/,/^zend/s/ at.*/m/p' `basename $file .000`.scn > /dev/tty";
}

#----------------------------------------------------------------------
# The following two routines backup the master and slave files from the
# raw directory.

proc backup_master_data {stn} {
        global stn_format master_deployment_name_fmt master_cmd_file backup_dir;
        if {[string length $backup_dir] == 0} {return}

        if {![file isdirectory $backup_dir]} {
                error "$backup_dir does not exist relative to [pwd]";
        }

        set stnstr [format $stn_format $stn];
        set cast_dir [format %s/%s $backup_dir $stnstr];
        if {![file isdirectory $cast_dir]} {exec mkdir $cast_dir};
        exec sh -c "cp [format $master_deployment_name_fmt $stn]* $cast_dir";
        exec sh -c "cp $master_cmd_file* $cast_dir";
        exec sh -c "cp *log $cast_dir";
}

proc backup_slave_data {stn} {                              # copy data to network
        global stn_format slave_deployment_name_fmt slave_cmd_file backup_dir;
        if {[string length $backup_dir] == 0} {return}

        if {![file isdirectory $backup_dir]} {
                error "$backup_dir does not exist relative to [pwd]";
        }

        set stnstr [format $stn_format $stn];
        set cast_dir [format %s/%s $backup_dir $stnstr];
        if {![file isdirectory $cast_dir]} {exec mkdir $cast_dir};
        exec sh -c "cp [format $slave_deployment_name_fmt $stn]* $cast_dir";
        exec sh -c "cp $slave_cmd_file* $cast_dir";
        exec sh -c "cp *log $cast_dir";
}

#----------------------------------------------------------------------

# See comments on master_download_glob and slave_download_glob above.

proc rename_master_download_file {target} {                 # rename after download
        global master_download_glob;

        if {[string length $master_download_glob] == 0} {return}
        set files [glob -nocomplain $master_download_glob];
        set nfiles [llength $files];
        if {$nfiles == 0} {
                if {![file exists $target]} {
                        error {can't find downloaded master file};
                }
                return;
    }
    if {$nfiles > 1} {
            send_user {WARNING: Multiple files downloaded from master --- rename, backup, check manually!};
        }
        if {![string equal [lindex $files end] $target]} {
```

```
			exec mv [lindex $files end] $target;
		}
}

proc rename_slave_download_file {target} {			# rename after download
		global slave_download_glob;

		if {[string length $slave_download_glob] == 0} {return}
		set files [glob -nocomplain $slave_download_glob];
		set nfiles [llength $files];
		if {$nfiles == 0} {
			if {![file exists $target]} {
				error {can't find downloaded slave file};
			}
			return;
	}
	if {$nfiles > 1} {
			send_user {WARNING: Multiple files downloaded from slave --- rename, backup, check manually!};
		}
		if {![string equal [lindex $files end] $target]} {
			exec mv [lindex $files end] $target;
		}
}
```

4.2.5.2 MASTER.cmd

```
;======================================================================
;		M A S T E R . C M D
;		doc: Tue Jun 15 11:46:07 2004
;		dlm: Sun Dec 26 17:16:02 2010
;		(c) 2004 A.M. Thurnherr
;		uE-Info: 24 51 NIL 0 0 72 2 2 8 NIL ofnI
;======================================================================

; This is the default master/downlooker command file

; NOTES:
;   - this version requires firmware 16.30 or higher
;   - should contain only commands that change factory defaults
;   - assumes that WM15 is installed (L commands are used)
;   - collect data in beam coordinates
;   - staggered single-ping ensembles every 1.5s/2.0s
;   - narrow bandwidth
;   - 25 8m cells --- reduce after determining the regional instrument

; CRUISE LOG:
;	001	use default settings
;	004	increased ambiguity velocity from 2.5m/s to 3.0m/s
;	011	increased ambiguity velocity from 3.0m/s to 3.5m/s
;		increased pinging rate from 1.5/2.0s to 1.3s/1.5s
;	020	increased ambiguity velocity to 4.0m/s
;		increased ping rate to 1.0s/1.3s
;	023	decreased ping rate to 1.2s/1.4s
;	033	decreased ping rate to 1.3/1.5s

WM15			; water mode 15 (LADCP)

TC2			; ensembles per burst
LP1			; pings per ensemble
TB 00:00:02.80		; time per burst
TE 00:00:01.30		; time per ensemble
TP 00:00.00		; time between pings

LN25			; number of depth cells
LS0800			; bin size [cm]
LF0			; blank after transmit [cm]
```

```
LW1                     ; narrow bandwidth LADCP mode
LV400                   ; ambiguity velocity [cm/s]

SM1                     ; master
SA011                   ; send pulse before each ensemble
SB0                     ; disable hardware-break detection on Channel B (ICN118)
SW5500                  ; wait .5500 s after sending sync pulse
SI0                     ; # of ensembles to wait before sending sync pulse

EZ0011101               ; Sensor source:
                        ;       - manual speed of sound (EC)
                        ;       - manual depth of transducer (ED = 0 [dm])
                        ;       - measured heading (EH)
                        ;       - measured pitch (EP)
                        ;       - measured roll (ER)
                        ;       - manual salinity (ES = 35 [psu])
                        ;       - measured temperature (ET)

EX00100                 ; coordinate transformation:
                        ;       - radial beam coordinates (2 bits)
                        ;       - use pitch/roll (not used for beam coords?)
                        ;       - no 3-beam solutions
                        ;       - no bin mapping

CF11101                 ; Flow control:
                        ;       - automatic ensemble cycling (next ens when ready)
                        ;       - automatic ping cycling (ping when ready)
                        ;       - binary data output
                        ;       - disable serial output
                        ;       - enable data recorder

CK                      ; keep params as user defaults (across power failures)
CS                      ; start pinging
```

4.2.5.3. SLAVE.cmd

```
;======================================================================
;       S L A V E . C M D
;       doc: Tue Jun 15 11:46:07 2004
;       dlm: Fri Jan  7 23:25:28 2011
;       (c) 2004 A.M. Thurnherr
;       uE-Info: 22 1 NIL 0 0 72 2 2 8 NIL ofnI
;======================================================================

; This is the default slave/uplooker command file

; NOTES:
;   - this version requires firmware 16.30 or higher
;   - contains only commands that change factory defaults
;   - assumes that WM15 (LADCP) mode is installed
;   - collect data in beam coordinates
;   - single-ping ensembles; timing determined by [MASTER.cmd]
;   - narrow bandwidth
;   - 25x 8m cells

; HISTORY:
;   Jan  7, 2011: - created for Firmware 16.30 or higher from old version
;                 - increased pinging rate

WM15                    ; water mode 15 (LADCP)

LP1                     ; pings per ensemble
```

```
TP 00:00.00                 ; time between pings
TE 00:00:00.00              ; time per ensemble

LN25                        ; number of depth cells
LS0800                      ; bin size [cm]
LF0                         ; blank after transmit [cm]

WB1                         ; narrow bandwidth mode 1 (not sure if required)
LW1                         ; narrow bandwidth LADCP mode
LV400                       ; ambiguity velocity [cm/s]

SM2                         ; slave
SA011                       ; wait for pulse before ensemble
SB0                         ; disable hardware-break detection on Channel B (ICN118)

EZ0011101                   ; Sensor source:
                            ;       - manual speed of sound (EC)
                            ;       - manual depth of transducer (ED = 0 [dm])
                            ;       - measured heading (EH)
                            ;       - measured pitch (EP)
                            ;       - measured roll (ER)
                            ;       - manual salinity (ES = 35 [psu])
                            ;       - measured temperature (ET)

EX00100                     ; coordinate transformation:
                            ;       - radial beam coordinates (2 bits)
                            ;       - use pitch/roll (not used for beam coords?)
                            ;       - no 3-beam solutions
                            ;       - no bin mapping

CF11101                     ; Flow control:
                            ;       - automatic ensemble cycling (next ens when ready)
                            ;       - automatic ping cycling (ping when ready)
                            ;       - binary data output
                            ;       - disable serial output
                            ;       - enable data recorder

CK                          ; keep params as user defaults (across power failures)
CS                          ; start pinging
```

4.2.5.4. set_cast_params.m

```
%======================================================================
%           S E T _ C A S T _ P A R A M S . M
%           doc: Mon Oct 30 23:25:48 2006
%           dlm: Fri Aug 19 13:50:14 2011
%           (c) 2006 ladder@
%           uE-Info: 9 22 NIL 0 0 72 0 2 4 NIL ofnI
%======================================================================

processing_version = 1;

if processing_version == 1                      % on cruise
        subdir = 'on_cruise';
elseif processing_version == 2                  % 5m res, UL only
        subdir = 'UL';
elseif processing_version == 3                  % 5m rez, DL only
        subdir = 'DL';
elseif processing_version == 4                  % 5m rez, UL, GPS constraint only
        subdir = 'UL_GPS';
elseif processing_version == 5                  % 5m rez, DL, GPS constraint only
        subdir = 'DL_GPS';
end
```

```
close all; figure(100);
more off;

f.ladcpdo = sprintf('raw/%03d/%03dDL000.000',stn,stn);
f.ladcpup = sprintf('raw/%03d/%03dUL000.000',stn,stn);

if processing_version == 3 || processing_version == 5          % downlooker only
        f.ladcpup = ' ';
elseif processing_version == 2 || processing_version == 4 % uplooker only
        f.ladcpdo = f.ladcpup;
        f.ladcpup = ' ';
end

f.res = sprintf('%s/processed/%03d',subdir,stn);
f.checkpoints = sprintf('checkpoints/%03d',stn);
f.sadcp     = sprintf('SADCP/os75_jr281_ctd_%03d.mat',stn);

% alternate SADCP files consisting of 20 minutes of data at the
% beginning and 20 minutes at the end, except for the first few
% stations where SADCP operation was inconsistent during casts
% when the NOC VMP was in the water. I found no reason to use
% these
%f.sadcp = sprintf('SADCP/%03d.sadcp',stn);

% if stn==7                                        % insufficient SADCP data
%       f.sadcp = ' ';
% end

f.ctd = sprintf('CTD/1Hz/ctd_jr281_%03d_1hz_txt',stn);
if exist(f.ctd,'file')
        f.ctd_header_lines      = 0;            % file layout
        f.ctd_fields_per_line           = 6;
        f.ctd_pressure_field= 2;
        f.ctd_temperature_field = 3;
        f.ctd_salinity_field  = 4;
        f.ctd_time_field                = 1;
        f.ctd_time_base                 = 0;            % elapsed

        f.nav = f.ctd;
        f.nav_header_lines              = f.ctd_header_lines;
        f.nav_fields_per_line           = f.ctd_fields_per_line;
        f.nav_time_field                = f.ctd_time_field;
        f.nav_lat_field                 = 5;
        f.nav_lon_field                 = 6;
        f.nav_time_base         = f.ctd_time_base;
else
        f.ctd = ' ';
%       p.drot = 6.3;                                   %%% nominal
end

%=====================================================================

p.cruise_id             = 'JR281';
p.whoami= 'X. Liang';
p.name                  = sprintf('%s cast #%d (processing version %d)',p.cruise_id,p.ladcp_station,processing_version);

p.saveplot                      = [1:14];
p.saveplot_png          = [];
p.orig = 0; % save original data or not

p.ladcp_station = stn;

p.btrk_ts = 30;                 % with 10 default, false bottom detected on stn 002
                                        % with 20, false bottom detected on stns 22 & 23

if processing_version ~= 1
```

```
        p.avdz = 5;                 % for compatibility with UH & new shearmethod output
        ps.dz = 5;
end

% The following stations had marginal RDI BT data (few seabed points,
% fishy-looking BT profiles in some cases):
%       8, 11, 13, 29, 37, 38, 40, 41, 42, 44
% For consistency, all stations were reprocessed using post-processed
% BT data.

p.btrk_mode = 2;

if processing_version == 4 || processing_version == 5                    % disable BT & SADCP
        ps.botfac = 0;
        ps.sadcpfac = 0;
end

p.edit_mask_dn_bins = [1];
p.edit_mask_up_bins = [1];

p.checkpoints = [1];

%======================================================================
% Diagnostic paramters
%======================================================================
% ps.sadcpfac = 0;
% p.ignore_beam = [4 2];    % for DL/UL profiles
% p.ignore_beam = [4 nan];  % for DL only
% p.ignore_beam = [2 nan];  % for UL only
```

4.3 UK VMP-5500 Operations and Measurements

4.3.1 Overview

The Vertical Microstructure Profiler (VMP-5500, VMP for short thereafter) is a much loved scientific instrument manufactured by Rockland Scientific International that measures profiles of temperature, conductivity and velocity microstructure (i.e. on the length scales of the dissipation of turbulent flows, typically a few millimetres to tens of centimetres) throughout the water column. The NOCS VMP was used during the JR281 / UK DIMES 4 which represents the fourth instalment of the DIMES microstructure programme (the first three sets of measurements having been conducted in the UK/US DIMES 2 January – March 2010, UK DIMES 2.5 December – January 2010/11, and UK DIMES 3 January - March 2011). The central goal of the DIMES microstructure programme is to obtain measurements of turbulent kinetic energy dissipation and mixing across a range of topographic and flow regimes in the Southeast Pacific and Southwest Atlantic sectors of the Antarctic Circumpolar Current.

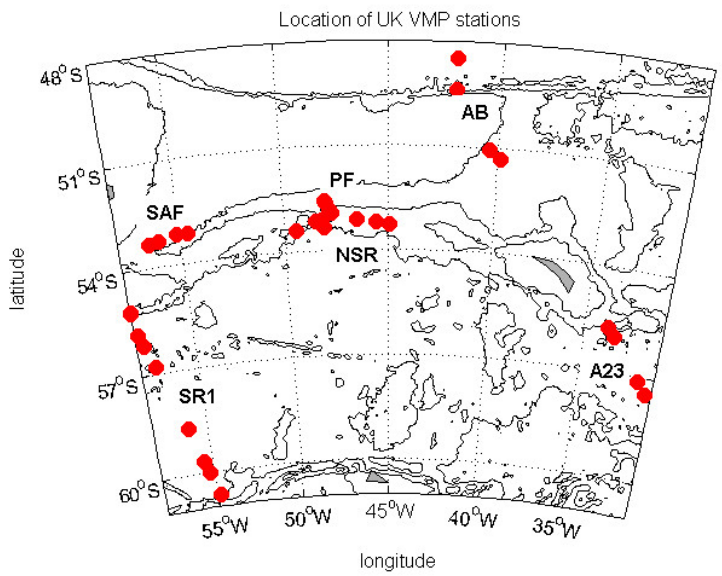


Figure 4.3.1: The location of casts made with the UK VMP during cruise JR281. Contours of bathymetry are shown at 1000 m intervals. The location of the sections Drake Passage (SR1), North Scotia Ridge (NSR) A23, Polar Front (PF) Argentine Basin (AB) and Sub-Antarctic Front (SAF) referred to in the text are indicated.

It was planned to deploy the VMP on the first (Drake Passage: SR1) and last (North Scotia Ridge : NSR) sections of the cruise as well as overnight during the mooring operations in the Orkney Passage. Weather conditions severely restricted deployments during the SR1 section (9 UK deployments made from a planned 20) and the presence of ice in the Orkney Passage meant no deployments were made while mooring operations were scheduled. However, the majority of the planned deployments were made during the final NSR section. In addition to the planned VMP deployments, four deployments were made at the Northern end of the A23 section, four deployments were made along the Polar Front (PF), four VMP deployments were made on the Northern section of the cruise in the Argentine Basin (AB) and four deployments were made across the Sub-Antarctic front (SAF). In total the UK VMP was deployed for 33 full depth casts (see table 1 and figure 1).

Stn. (CTD no.)	Ac. Dpth. (m)	Max. Press. (db)	Rel. Press. (db)	Deployment				Recovery				Notes
				Lat. (°N)	Lon.(°E)	Date	Time (GMT)	Lat. (°N)	Lon. (°E)	Date	Time (GMT)	
5	1667		182	-55.0064	-57.9953	19/03/13	19:21	-55.0064	-57.9953	19/03/13	20:00	Untethered test dip to 250 m
7	2800	2845	2726	-55.1248	-57.9938	19/03/13	23:50	-55.1242	-57.9267	20/03/13	03:37	Full depth profile to within 100 db of seabed.
8	3125	3177	3089	-55.1705	-57.9932	20/03/13	04:35	-55.1726	-57.9261	20/03/13	08:40	Full depth profile to within 70 db of seabed.
11	4770	4868	4780	-55.8328	-57.8205	20/03/13	23:02	-55.8175	-57.8165	21/03/13	05:00	Updated setup.cfg file. Start delayed due to fog - deployed while CTD was underway. Full depth to within 70 db of seabed
12	3400	3459	3410	-56.1496	-57.6230	21/03/13	07:40	-56.1348	-57.6159	21/03/13	11:45	Full depth profile to within 30 db of seabed.
14	3250	3305	3036	-56.7848	-57.2282	21/03/13	21:10			22/03/13	01:10	Full depth.
22	3750	3819	3751	-58.6845	-56.0540	25/03/13	00:12	-58.6833	-56.0413	25/03/13	04:52	Full depth to within 50db of seabed. Replaced conductivity probe with C102 Station originally numbered 20 in setup.cfg file.
25	3670	3737	3668	-59.6712	-55.4641	25/03/13	18:28	-59.6696	-55.4420	25/03/13	22:55	Full depth to within 50 db of seabed.
26	3510	3573	3504	-59.9997	-55.2382	26/03/13	01:47	-60.0080	-55.2513	26/03/13	06:01	Full depth to within 50 db of seabed.
28	3100	3153	3034	-60.6668	-54.8248	26/03/13	16:48	-60.6747	-54.7774	26/03/13	20:25	Full depth to 100 db from seabed. Conductivity probe broken – replaced with C99.
84	3700	3767	3450	-57.4582	-31.3278	10/03/13	03:02	-57.4613	-31.3008	10/03/13	07:05	Full depth to within 300 db (shallowing topography in direction of current). First full depth with USBL beacon attached.
85	3697	3255	3210	-57.1065	-31.8300	10/04/13	10:23	-57.1024	-31.8308	10/04/13	14:11	Full depth, planned for 3200 m as station was over a valley - VMP did not drift as far as expected.
88	3058	2845	2777	-55.9913	-33.4172	11/04/13	05:36	-55.9828	-33.4337	11/04/13	08:33	Full depth with new weight arrangements (1 big + 1 std). Set to 2800 m depth (water depth 3100 m) as swath indicates a large bump roughly to tje east of direction of travel

												shallowest depth 2750 m - likely to end up in 2900 m depth. Cast aborted at surface - recovered , shutdown, and reset weights. Restarted and deployed ok. Dive completed ok - pressure release in logfile. Datafile corrupt - looks like VMP did not shut down when short plug was removed.
89	3741	3254	3210	-55.7255	-33.7837	11/04/13	10:54	-55.7084	-33.7438	11/04/13	14:21	Again steeply shallowing bathymetry in likely direction of travel. Planned for 3200 m as this was shallowest depth.
97	1863	1888	1843	-53.2586	-44.9914	15/04/13	09:30	-53.2546	-44.9998	15/04/13	11:30	Delayed due to rough weather. Full depth to within 30 db
98	1825	1850	1804	-53.2012	-45.5875	15/04/13	14:14	-53.1961	-45.6108	15/04/13	16:25	Full depth to within 30 db
100	1400	1417	1202	-53.1253	-46.5255	15/04/13	22:21	-53.1260	-46.5250	15/04/13	23:40	Full depth
102	2950	2997	2931	-52.9388	-47.7389	16/04/13	07:34	-52.9007	-47.7635	16/04/13	10:47	Full depth to 50 db
103	2505	2543	2496	-53.1227	-48.1902	16/04/13	13:33	-53.1039	-48.1946	16/04/13	16:10	Full depth
104	2793	2837	2746	-53.1493	-48.5027	16/04/13	20:18	-53.1530	-48.4998	16/04/13	23:12	Full depth. Short plug replaced possible water ingress into connector.
106	2970	3018	2921	53.3481	48.1011	17/04/13	05:44	53.3440	48.0852	17/04/13	09:10	Full depth
107	1930	1957	1890	-53.3806	-49.4560	17/04/13	11:03	-53.3740	-49.4302	17/04/13	13:10	Full depth : cleaned up VMP storage archived all data files up to station 84 onto Toshiba.
108	2989	3037	2946	-52.9278	-47.7485	17/04/13	19:42	-52.8784	-47.7579	17/04/13	23:10	Full depth
109	2946	2993	2946	-52.8304	-47.8253	18/04/13	00:00	-52.7744	-47.8297	18/04/13	03:05	Full depth : aborted 30 mins early due to fizz-link breaking : fsck run on filesystem post dive.
111	3715	3781	3734	-52.6499	-47.9827	18/04/13	08:20	-52.6237	-47.9682	18/04/13	12:28	Full depth to 30 db
112	3745	3812	3766	-52.5584	-48.0629	18/04/13	13:33	-52.5177	-48.0280	18/04/13	17:35	Full depth to 30 db
113	3790	3857	3792	-51.3095	-39.8460	19/04/13	22:38	-51.3267	-39.8528	20/04/13	02:35	Full depth to 50 db.
114	3730	3796	3719	-51.0588	-40.3854	20/04/13	05:55	-51.0484	-40.3783	20/04/13	09:55	Full depth to 60 db from seabed. replaced micro-conductivuty sensor with SN 098 before deployment.
119	5400	5516	5443	-49.3933	-41.9978	21/04/13	08:42	-49.3978	-41.9541	21/04/13	13:39	Set to 5350 m (~ 20 m deeper than CTD went). Datafile on instrument named jr281_114_005.p New micro conductivity sensor before cast.

121	5600	5722	5546	-48.4775	-42.0000	21/04/13	23:40	-48.4921	-41.9816	22/04/13	05:04	To the max 5500 m. Micro conductivity sensor broken on recovery.
123	2900	2974	2880	-53.1487	-54.6468	25/04/13	14:21	-53.1438	-54.6232	25/04/13	17:30	Full depth to 50db
124	2645	2685	2569	-53.1622	-55.1265	25/04/13	19:46	-53.1510	-55.1075	25/04/13	22:27	Full depth to 50 db
126	2360	2394	2328	-53.2872	-56.0438	26/04/13	05:12	-53.2959	-56.0292	26/04/13	08:00	Full depth to 50 db
127	2390	2425	2348	-53.3475	-56.5484	26/04/13	09:45	-53.3409	-56.5361	26/04/13	12:17	Last one! Full depth to 50 db

Table 4.3.1: VMP 6000 deployments during cruise JR281.

Preliminary results are shown in figures 4.3.3 to 4.3.8 in section 4.3.6.

4.3.2 Operating Issues

Prior to being dispatched for the cruise the VMP had just been returned from Rockland Scientific, while last minute changes to the travel arrangements resulted is a drastically shortened mobilization. Consequently, it was not until after departure from port that it was found that the VMP's operating system had been upgraded. The upgrade to the operating system required a new configuration file to be written from scratch and also resulted in the instrument now producing data files which could not be read by the existing processing scripts, using the original ODAS matlab library.

A new version of the ODAS matlab library (v 3.1) was obtained from Rockland Scientific and the processing scripts were re-written. A new format configuration file was also constructed using the latest version of the instrument calibrations available on board (dating from 2008). It is not known, at this point, if the VMP microstructure boards were re-calibrated at the time the operating system was upgraded. The new format configuration file used for this cruise is included below in section 4.3 Appendix 2.

The Ixsea Model MT861S-R-P1 LBL Acoustic Transponder proved to be unreliable and only worked intermittently. Since it was not possible to determine whether the transponder would operate prior to a dive for the majority of the stations on the SR1 section it was not possible to track the instrument during a dive. Fortunately this did not result in significant time lost locating the instrument on the surface, in part, due to the DF radar fitted to the *RSS James Clark Ross* (JCR) which is far superior to the hand help DF locator supplied with the VMP.

Due to the unreliability of the Ixsea accoustic transponder it was decided to attempt to fit one of the JCR Ultra Short Base Line (USBL) beacons. The USBL beacon was successfully fitted (figure 2) and proved to be extremely reliable and of great benefit. Recovery times for casts with the USBL beacon fitted were consistently of order 30 minutes or less as the ship was able to be positioned accurately within 200 m of where the VMP was due to surface. Fitting of the USBL beacon also had the additional benefit that the VMP could be deployed in foggy/poor visibility conditions where previously no deployment would have been attempted. Had the USBL beacon been fitted for the start of the cruise a further three casts would have been possible on the SR1 section.

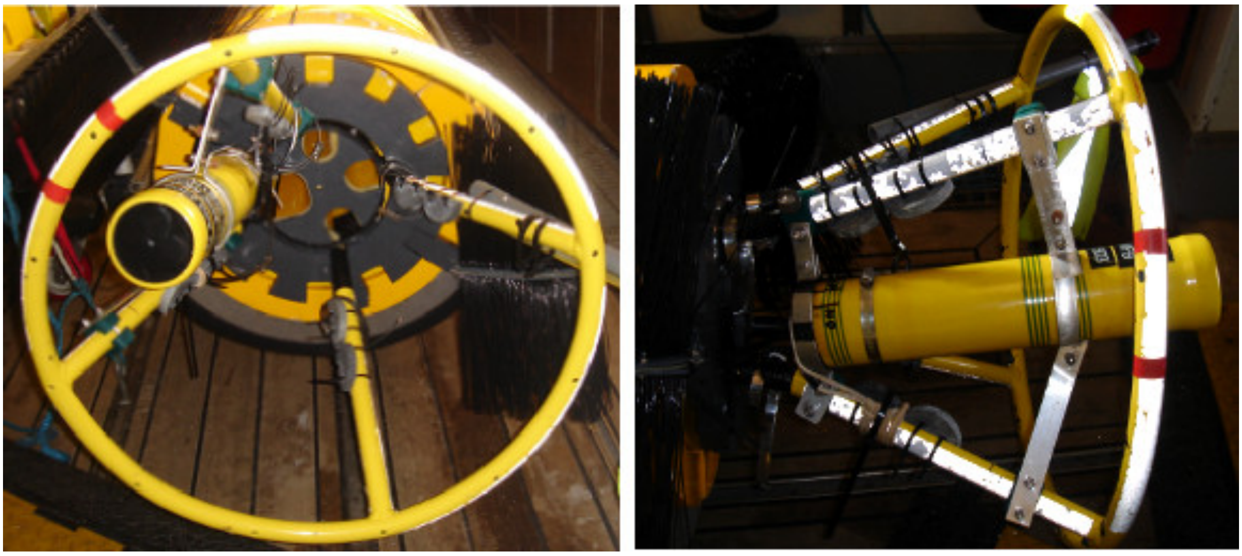


Figure 4.3.2: Views of the VMP with the JCR USBL beacon fitted. Note the additional lead weight also fitted to the recovery handle.

Some problems were encountered in ballasting the VMP for use with the USBL beacon. The VMP was deployed on JR281 without the EM current meter attached. Since the VMP is ballasted for deployment with the EM current meter (weight ~ 3 – 4 kg) this has the consequence that the VMP is over-buoyant and, with the standard drop weights supplied, can only achieve a maximum fall rate of ~ 0.43 dbar s^{-1}. While this fall rate is adequate under normal conditions further reductions in weight of more than one or two kilos can result in the fall rate dropping below 0.2 dbar s^{-1} and the VMP jettisoning it's weights prematurely. Unfortunately the USBL beacon is significantly lighter in water than the Ixsea transponder requiring additional weight to be added to the VMP to achieve a sink rate of greater than 0.2 dbar s^{-1}. Initially additional lead weights (~ 2.3 kg) were attached to the VMP recovery handle. However, it was finally decided to use additional drop weight. Large drop weights ~ 2.5 kg heavier than the standard were fabricated on the ship by welding an additional half drop weight to a standard drop weight. The VMP was then deployed with one standard weight and one large weight. The use of the large drop weight resulted in a maximum fall rate of ~ 0.45 dbar s^{-1} for the instrument.

4.3.3 Dive Planning

Dive planning for the VMP requires the operator to guess the likely depth of the seabed at the deepest point of the VMP's dive. Knowledge of the current speed, current direction, and accurate bathymenty maps can improve the quality of this guesswork especially in regions with strong current flows and variable bathymetry. To a first order, during this cruise, it was found that the distance and direction the VMP is likely to drift can be estimated from the vessel mounted acoustic doppler current profiler (VMADCP). Once the likely distance and direction of the VMP's drift has been determined, accurate bathymetry maps of the area, from the shipboard EA1200 swath bathymetry system can then be used to determine a safe maximum depth for the cast which is close, but not too close, to the seabed. This depth can be either greater or shallower by up to several hundreds of meters than the water depth under the ship when the VMP is deployed. A sample log-sheet for a dive and a dive checklist are included in section 4.3 Appendix 3.

4.3.4 Deployment and Recovery

Thanks to the efforts of the NMF Technicians and the JCR Deck Crew, deployment and recovery of the VMP went smoothly, even during poor weather conditions. All deployments were made using the ship's rear starboard Effer crane, with the instrument hoisted by a sling around the tail bale. It was released in the water using a 'sea catch'. The VMP was recovered using hooked poles fitted with releasing recovery lines and craned aboard by its bale using the starboard midships winch and gantry. Apart from the reduced vessel motion at midships, this location also kept the profiler away from thruster wash and prevented it going out of sight under the stern flare. The NOCS VMP was stored in the ship's wet lab. Further technical details of deployment and recovery are given on the attached BAS Guidance Note (section 4.3 Appendix 4).

4.3.5 Processing Instructions

All processing scripts used on this cruise were re-written due to changes in the VMP data file (see section 4.3.2). However the processing steps and the calculations preformed remain the same as described in previous cruise reports. A summary of the processing steps is given below :

Function	Description
vmp_read_odas	Reads in the VMP datafile and produces two matlab files, one containing the raw un-calibrated VMP data, the other containing the extracted downcast data with all calibrations supplied in the setup.cfg file applied ('_cdc.mat').
vmp_firstlook	Produces a series of diagnostic plots for the raw un-calibrated VMP data.
vmp_process_seabird	Processes the VMP seabird data and applies various corrections. Output is saved as a separate matlab file ('_CTD.mat').
vmp_process_micro	Processes the VMP microstructure shear, temperature and conductivity. Microstructure temperature and conductivity are calibrated by regressing against the processed VMP seabird temperature and conductivity. Output is saved as a separate matlab file ('_Micro.mat').

4.3.6 Preliminary Results

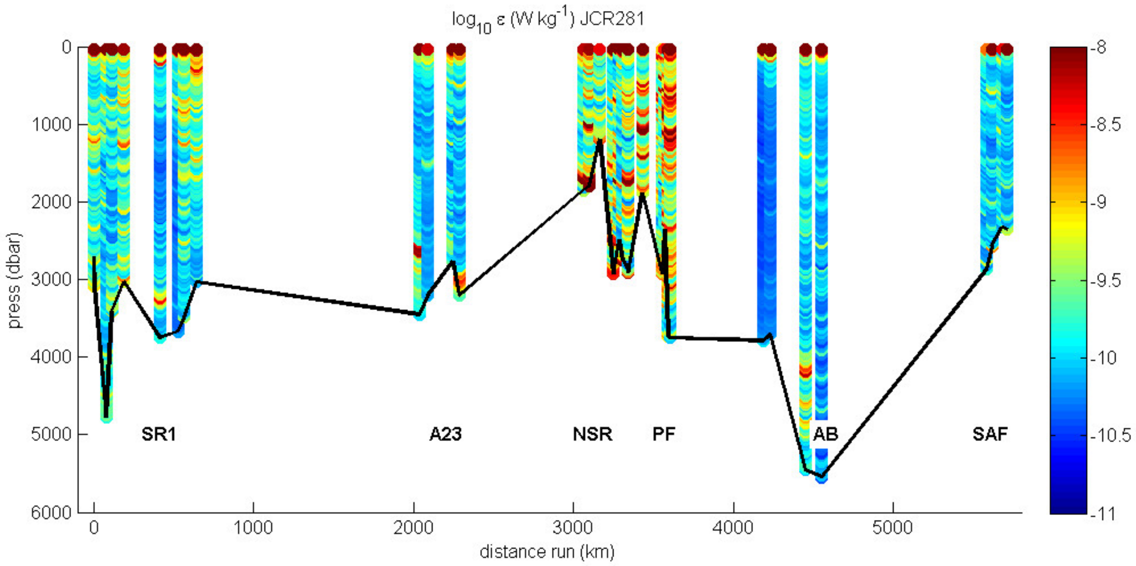


Figure 4.3.3. Log_{10} turbulent kinetic energy dissipation (ε W kg^{-1}) for all UK VMP stations on cruise JR281. The locations of named sections are shown in figure 4.3.1. The maximum depth of each cast is shown as a solid black line.

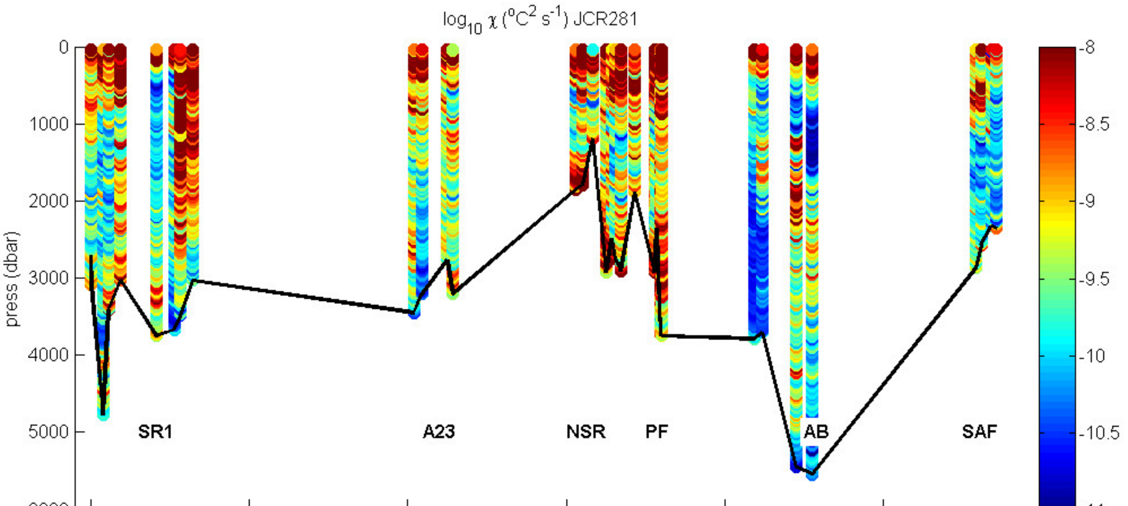


Figure 4.3.4 Log_{10} thermal dissipation (χ $^{o}C^{2}s^{-1}$) for all UK VMP stations of cruise JR281. The locations of named sections are shown in figure 4.3.1. The maximum depth of each cast is shown as a solid black line.

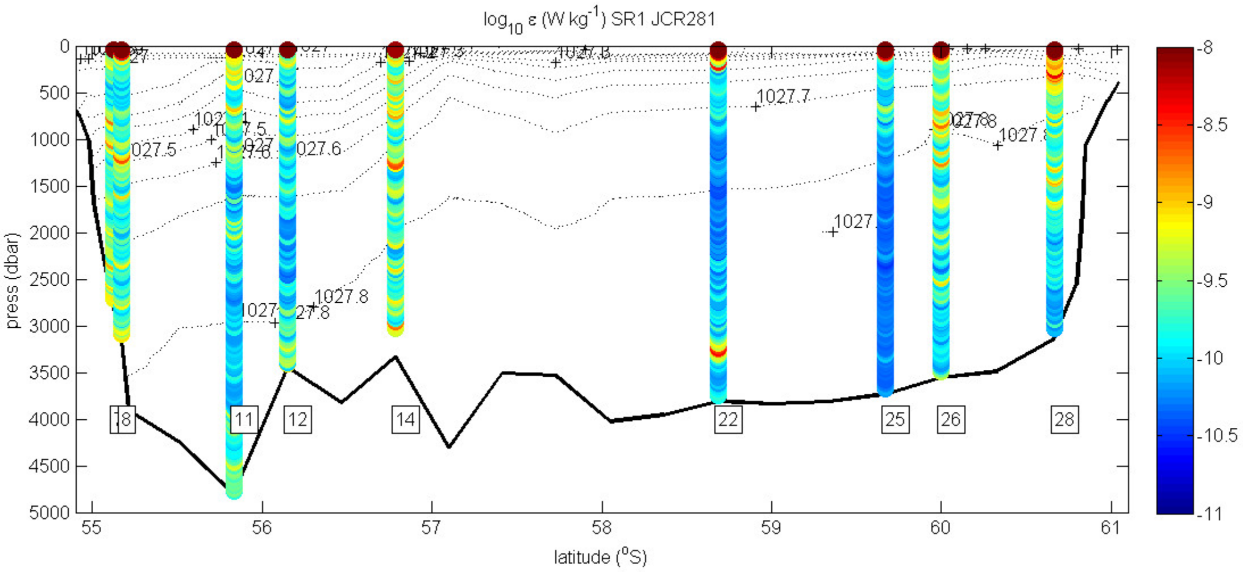


Figure 4.3.5. Log_{10} turbulent kinetic energy dissipation (ε W kg^{-1}) for the SR1 section of cruise JR281. The station numbers are indicated.

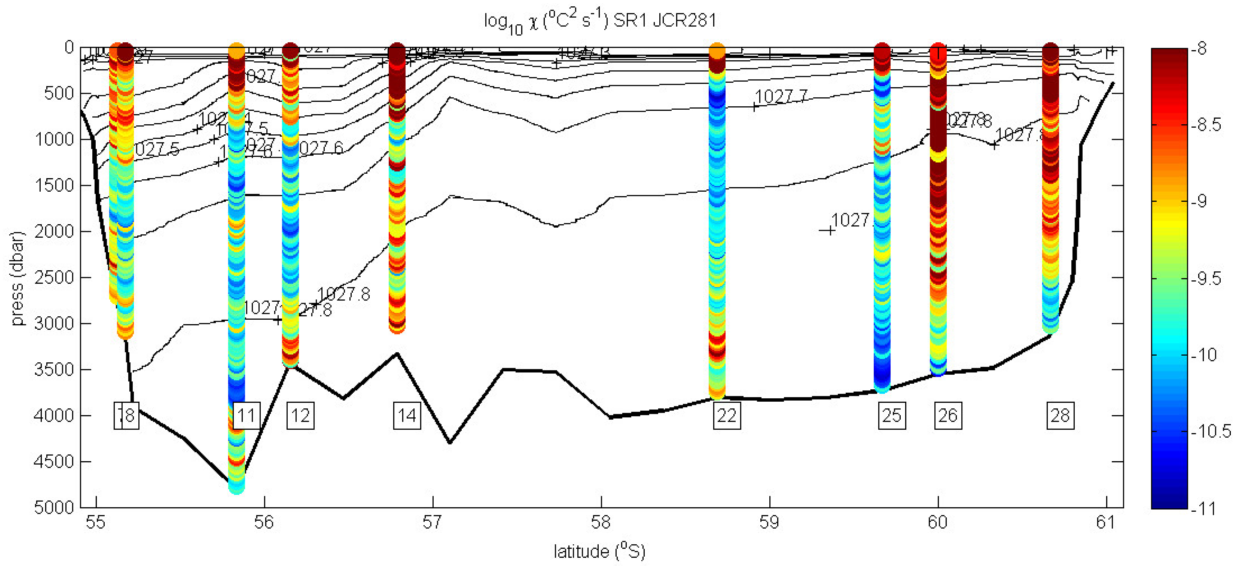


Figure 4.3.6: Log_{10} thermal dissipation (χ $^{o}C^{2}s^{-1}$) for the SR1 section of cruise JR281.The station numbers are indicated.

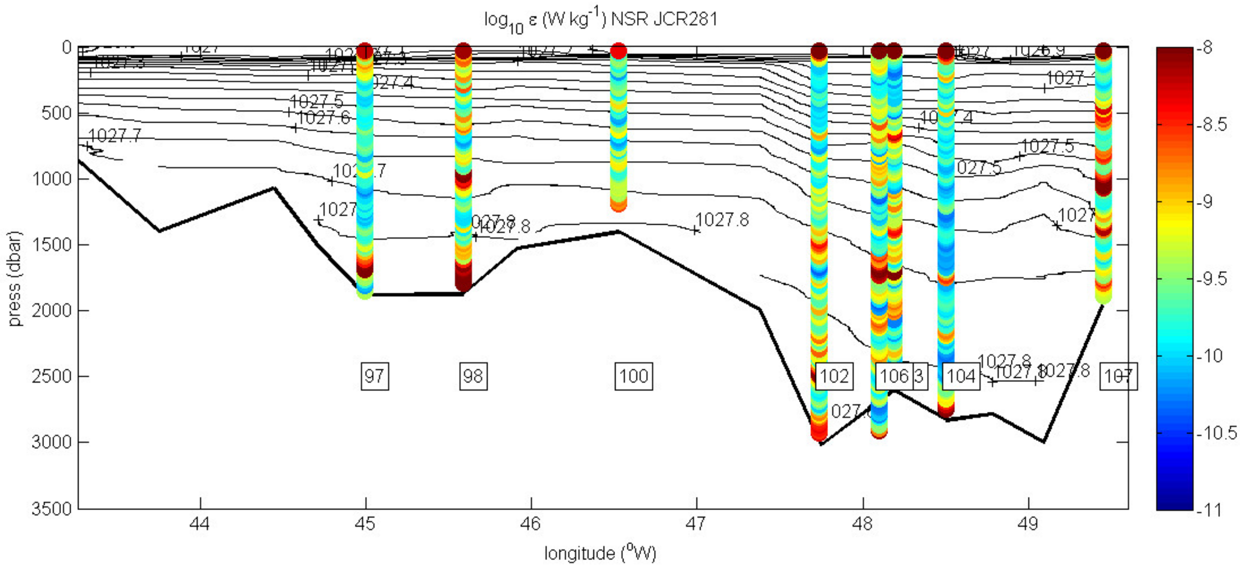


Figure 4.3.7: Log_{10} turbulent kinetic energy dissipation (ε W kg^{-1}) for the NSR section of cruise JR281. The station numbers are indicated.

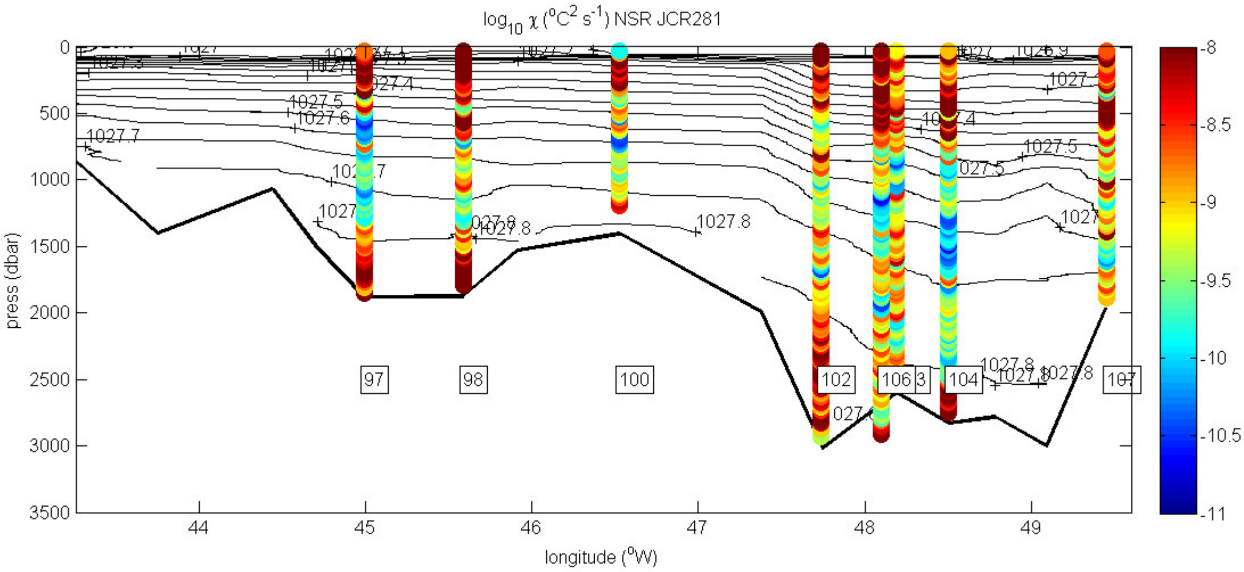


Figure 4.3.8: Log_{10} thermal dissipation (χ $^{o}C^{2}s^{-1}$) for the NSR section of cruise JR281.The station numbers are indicated.

4.3.7 Appendix 1: VMP-5500 Instrument Configuration

Base Instrument: VMP-5500 SN 016

Microstructure Sensors	**Finestructure Sensors**	**Other**	**Recovery Aids**
2 shear probes 2 microtemperature fp07 thermistors	Seabird 3c conductivity cell Seabird 4f	IC sensors 3-axis accelerometer Pressure sensor	A yellow flag. Seimac Ltd Novatech Model ST-400A Strobe

1 microconductivity	temperature cell	Magnetometer	Seimac Ltd Novatech Model RF-700A1 RDF Beacon Seimac Ltd Novatech Model AS-900A Argos Beacon Ixsea Model MT861S-R-P1 LBL Acoustic Transponder with Pressure Sensor.

Table 4.3.2: Configuration of the UK VMP used on cruise JR281.

Stations	Microstructure					SeaBird	
	Shear 1	Shear 2	Temp 1	Temp 2	Conductivity	Temp.	Conductivity
5 - 22	M400	M542	T357	T356	C103	4634	3240
23 - 28					C102		
29 - 114					C99		
114 - 118					C98		
119 - 121					C26		
123 - on							

Table 4.3.3: Sensor serial numbers used for each deployment during cruise JR281.

Shear 1			Shear 2			Temp 1	Temp 2	Cond. 1
Serial	Sensitivity	Gain	Serial	Sensitivity	Gain	Gain	Gain	Gain
M400	0.0676	1.045	M542	0.1087	1.02	0.99	0.995	1.0
						Note : Standard parameters are used in the configuration file for microstructure temperature and conductivity. Calibration is done by regression to SeaBird values.		

Table 4.3.4: Calibration coefficients for shear sensors used during JR281. Gain values used for each of the differentiated microstructure channels is also given.

4.3.8 Appendix 2: VMP Configuration File (setup.cfg).

```
; Setup,cfg for JCR281 Initial setup March 18th 2013
; Coefficients from calibration documents :
;  astp board calibrations 13-08-2010
;  Uc board calibrations 16-08-10
;  Magnotometer 14-9-2010
;  SBE 4634 25-07-2012
;  SBE 3240 21-7-2012
;  Shear probes M400 18-9-2012
;              M542 19-9-2012
;
disk=/root/data
prefix=jr281_020_
recsize=1
profile=vertical
no-fast=8
no-slow=2
man_com_rate=3
max_time = 11100
max_pressure = 3751
rate = 512
```

```
; These setting result in all microstructure sensors being sampled at 152 Hz
; while MicroT, Pressure, SBE, Battery Voltage is samples at 512/8 = 64 Hz
; NB dMicroT is still sampled at 512 Hz
[matrix]
num_rows=8
row01=255  0  1 2 3 5 7 8 9 12
row02=  4  6  1 2 3 5 7 8 9 12
row03= 10 11  1 2 3 5 7 8 9 12
row04= 16 17  1 2 3 5 7 8 9 12
row05= 18 19  1 2 3 5 7 8 9 12
row06= 32 33  1 2 3 5 7 8 9 12
row07= 34 0   1 2 3 5 7 8 9 12
row08= 0  37  1 2 3 5 7 8 9 12

; Sensor coefficients
[gnd1]
id=0
type=gnd
name=Gnd
coef0=0

[pitch]
id=1
name=Ax
type=accel
coef0=1955
coef1=17154

[roll]
id=2
name=Ay
type=accel
coef0=-338
coef1=13000

[az]
id=3
name=Az
type=accel
coef0=343
coef1=12855

; ??? Update to Serial 357
[therm1]
id=4
type=therm
name=T1
adc_fs=5.0
adc_bits=16
a=-17
b=0.99878
G=6
E_B=0.68208
beta=3143.55
T_0=289.301

; ??? Update to Serial 357
[dtherm1]
id=5
type=therm
name=T1_dT1
diff_gain=0.99
adc_fs=5.0
```

```
adc_bits=16
a=-17
b=0.99878
G=6
E_B=0.68208
beta=3143.55
T_0=289.301

; ??? Update to Serial T356
[therm2]
id=6
type=therm
name=T2
adc_fs=5.0
adc_bits=16
a=-17
b=0.99878
G=6
E_B=0.68208
beta=3143.55
T_0=289.301

; ??? Update to Serial T356
[dtherm2]
id=7
type=therm
name=T2_dT2
diff_gain=0.995
adc_fs=5.0
adc_bits=16
a=-17
b=0.99878
G=6
E_B=0.68208
beta=3143.55
T_0=289.301

; Serial M400
[shear1]
id=8
type=shear
name=sh1
diff_gain=1.045
sens=0.0676
adc_fs=5.0
adc_bits=16

; Serial M542
[shear2]
id=9
type=shear
name=sh2
diff_gain=1.02
sens=0.1087
adc_fs=5.0
adc_bits=16

[pres]
id=10
name=P
type=poly
units=[dbar]
coef0=-11.1
coef1=0.29503
```

```
coef2=-2.19e-7
coef3=0
adc_fs=5
adc_bits=16

[dpres]
id=11
name=P_dP
type=poly
units=[dbar]
diff_gain=20.5
coef0=-11.7
coef1=0.29535
coef2=-2.687e-7
coef3=0
adc_fs=5
adc_bits=16

; ??? Update to Serial C103
[ucond1]
id=12
type=ucond
name=C1_dC1
diff_gain=1
a=1.194
b=197
K=1.03e-3
adc_fs=5.0
adc_bits=16

; Serial 4634
[sbt1]
id_even=16
id_odd=17
name=SBT1
type=sbt
coef0=4.34849050e-3
coef1=6.39072060e-4
coef2=2.10927420e-5
coef3=1.75525691e-6
coef4=1000
coef5=24e6
coef6=128

; Serial 3240
[sbc1]
id_even=18
id_odd=19
name=SBC1
type=sbc
coef0=-1.04387165e1
coef1=0
coef2=1.44191506e0
coef3=-1.02559708e-3
coef4=1.56519303e-4
coef5=24e6
coef6=128

[mz]
id=32
type=magn
name=Mz
coef0=64
coef1=68.88
```

[my]
id=33
type=magn
name=My
coef0=41.5
coef1=72.57

[mx]
id=34
type=magn
name=Mx
coef0=236
coef1=70.43

[genvoltage0]
id=37
type=voltage
name=V_Bat
adc_bits=16
adc_fs=5.0
G=0.1
units=[V]

4.3.9 Appendix 3: NOCS VMP-5500 logsheet and Dive checklist

VMP – 5500 Dive LOG

Cruise: JR276	Station Number:	Year and Day of Year:

Sensor Information

Fine. Var.	Channel	Used		Micro. Var.	Channel	Used		Probe
GND1	0			Ax	1			
T1	4			Ay	2			
T2	6			Az	3			
P	10			T1_dT1	5			
SBT1E	16			T2_dT2	7			
SBT1O	17			Sh1	8			
SBC1E	18			Sh2	9			
SBC1O	19			P_dP	11			
Mz	32			C_dC	12			
My	33							
Mx	34							
EMvel1	35							
EMvel2	36							
Vbat	37							

Sensor Notes:
Deployment
Name:

Time instrument turned on:		Deployment position:	
Acoustic depth (m):		Bottom press. P_{bot} (db):	
On-deck press. P_{deck} (db):		Assumed overshoot P_{over} (db):	
Safety allowance P_{safe} (db, ≥ 50db recommended):		Specified max. press. (db, must not exceed $P_{bot} + P_{deck} - P_{over} - P_{safe}$):	
Estimated dive time (s, at a dive rate of ~0.55 s^{-1}):		Specified max. time (s):	
Available memory (/root/data):		Enough (at ca. 50Mb /1000	

		m)?:	
Memory cleared?:		If not, most recent data file in memory:	
Main battery voltage (V, should be ≥ 12.8V)		Dive start time i.e. LED flashing (GMT):	
Ship position when VMP released:		Time when VMP released (GMT):	
		Expected surface time (GMT):	

Comments:

Recovery
Name:

Station Number:		DOY / time VMP spotted:	
Range / bearing at which VMP spotted:		Ship position when VMP spotted:	
Date / time VMP on deck:		Recovery position:	
Acoustic depth (m) / corrected bottom pressure:			
Post-dive main battery voltage (V):		Time charging started (GMT):	
Estimated charging end time (GMT):		Time charging ended (GMT):	
Voltage after charging:			
Name of data file:		Size of data file:	
Method of dive end:		Max. pressure of dive:	

Comments:

4.3.10. Appendix 4: VMP Deployment/Recovery Checklist

Deployment

Laptop - ~30 minutes prior to launch:

1. New Log Sheet
2. Plug in VMP and connect the Ethernet cable. Turn the instrument on and start weight battery charge (20-30 minute charge)
3. Connect to the instrument, in terminal window:
   a. **telnet 196.168.2.2**
   b. login: **root** / password: **rglr0x**
4. Check file space on instrument, type "**df**". In "*root/data*" there should be **~100,000 KB per 1000m**
5. Check channels, get deck pressure, in terminal window:
   a. **odas4ir –f setup.txt –c all –s 1024**, check values look sensible. Run **./calcheck.sh** record to file.
   b. **odas4ir –f setup.txt**, record on "On-deck press P_{deck} in log sheet
6. Calculate max pressure and time for deployment, in Matlab:
   a. **calculate_max_press_and_time**
   b. Record "*Bottom press* P_{bot}", "*Assumed overshoot* P_{over}", "*Safety allowance* P_{safe}", "Specified *max. press.*", "*Estimated dive time*" and "*Specified max. time*"
7. Enter information into "*setup.txt*", in terminal window:
   a. **edit setup.txt**
   b. Update "*station number*", "*max_time*" and "*max_pressure*"
   c. Press "esc" to save and exit, select "*Leave Editor*" and then "*Save Changes*"
8. Test "*setup.txt*" file, in terminal window:
   a. **odas4ir –f setup.txt**, check for errors, exit with "*ctrl-c*"
9. Turn off instrument and disconnect from power suppy, in terminal window:
   a. **shutdown now**
   b. Disconnect white plastic on-off switch, turn off power supply
   c. Check voltage at power supply end, should be >12.8V

On Deck:

1. Turn on and test the recovery aids
2. Remove tube from SBE conductivity sensor
3. Disconnect E/CRG cable from the instrument and install the dummy plugs at both ends, wait 36 seconds
4. Install the weights
5. Turn the instrument ON by connecting the shorting plug, check LED is flashing and record "*Diving start time*"
6. Deploy, record time and position and estimated surface time

Recovery

On Deck - ~10 minutes prior to expected surface time:

1. Send lookouts to bridge
2. When spotted: record date, time, ship position, range and bearing
3. Recover: record date, time and ship's postion in the log sheet
4. Turn off recovery aids
5. Replace the tube on the SBE conductivity cell and fill with Millipore water
6. Rinse with fresh water
7. Turn instrument off, remove shorting plug and connect the E/CRG cable to the instrument
8. Check the magnesium safety pin

Laptop

1. Check and record the recovery voltage at the power supply
2. Plug the instrument in and start charging
3. Connect the Ethernet cable to the laptop, turn the instrument on by connecting plastic plug
4. FTP date and log file from the instrument to the laptop, in terminal window:
   a. "cd" to root data directory and create a new directory for the cast, "cd" to this new directory
   b. FTP to instrument:
      i. **ftp root@192.168.2.2** / password: **rglr0x**
      ii. **prompt**
      iii. **mget jr281_station#***
      iv. **get setup.txt**
      v. **quit**
5. Turn off the instrument by disconnecting the white plastic on-off switch on the E/CRG cable. Leave to charge for the next dive, note on the log sheet when charging started and estimated completion time. Assign someone to turn it off.
6. In Matlab perform quicklook of the data
7. Record remaining recovery details: name and size of data files and method of dive end (from station *.txt file)
8. Archive data ASAP

4.3.11. Appendix 5 BAS Deployment Sheet

Ship: R.R.S. James Clark Ross		
Sheet Number: 056	Issue Status: A	Issue Date: 25/04/11
Item: VMP (Vertical Microstructure Profiler)	Type: 5500	
Owner: NMF		
Brief Description: Freefalling Profiler		
Deployment Location: Starboard After Effer		
Weight: 200 Kg (In Air)	**Approx Dimensions:** 3m Long, Up to 0.6m diameter.	

Winch: N/A	Wire: N/A
Max. Cable Veer Rate: N/A	Max. Cable Haul Rate: N/A
Vessel Deployment Speed: On Station	**Vessel Recovery Speed:** Move vessel as required
Persons required on deck	Duty
Person in charge with radio NMF Technician Two Science Staff. Two Seamen	Oversee / assist with deployment & comms to bridge. To co-ordinate/control operations and assist in deployment/recovery Final checks and to assist in deployment/recovery. To assist in deployment/recovery

Safety / Protective Clothing and Gear required:

- Hard Hats: Safety Footwear: Work Gloves: Warm. Foul weather gear as required.

Operation Control Room Support equipment :

- Echo Sounder to monitor bottom depth (SWATH/EA600)
- Hydrophone unit if using ship's transducer rather than dunker hydrophone.

Notes :

- There is a slight delay after coming on station as depth is checked and profiler mission is finalized before moving it out onto deck.
- Ensure everyone is clear which parts of the profiler that can be touched during deployment and recovery to prevent damage to sensors.

Refer to Risk Assessment Number: MRA/GEN/11/JR

Pre Deployment Checks:

- All persons involved understand what is required.
- Working area safe and adequately lit.
- Communication between Deck / Bridge established.
- On station - Permission from the bridge to proceed.

Deployment Technique: 1. Before starting extend Effer to maximum extent to reduce time in deploying profiler and secure "sea catch" to hook to prevent its loss. 2. Attach profiler to "sea catch" via strop and fit safety pin. Attach additional steadying line to maintain orientation of profiler during deployment. 3. Confirm with bridge permission to launch and that DF beacon is working. 4. Lift profiler on crane and then remove weight safety strap. 5. Slew profiler over the side to the launch position. 6. Remove the "sea catch" safety pin. 7. Lower the profiler and clear the steadying line. 8. When ready release the profiler. 9. Monitor VMP during the deployment via the hydrophone and keep bridge updated on progress.
Recovery Technique: 1. Monitor the VMP during its ascent and keep the bridge updated on its expected surface time and ranges. 2. Move the vessel and range to locate vessel close to expected surfacing position. 3. Once sighted manoeuvre vessel to bring profiler to starboard side under the Midships gantry. 4. Meanwhile prepare two poles fitted with releasing recovery lines and move the Midships gantry over the side with auxiliary winch wire run to deck. 5. Hook recovery line to profile using long pole. 6. Shackle recovery line to auxiliary winch wire and recover using winch and gantry. 7. Lower profiler into trolley. 8. Secure the deck and inform the bridge.

4.3.12. UK VMP Recommendations

The operation of the UK VMP is highly dependent on the weather. Typically, due to the constraints of having to manually handle the instrument on deck and crane it over the side, deployment is not possible in winds greater than 30 knts or seas of 4 m or greater. Even in suitable weather conditions damage to the instrument can occur on recovery. During cruise JR281 the UK VMP had three microconductivity probes broken on recovery and the US VMP suffered a broken weight release mechanism.

Provision of a track launch system, similar to that used for the WHOI HRP profiler would greatly facilitate VMP launch and recovery and reduce the risk of injury to personnel and damage to the instrument. By minimising the on-deck handling of the VMP the use of such a track launch system would also potentially make deployment in worse weather conditions possible and increase the number of stations where the VMP could be deployed.

The instrument is also extremely difficult to spot at the surface in poor visibility during daylight hours (at night the VMP strobe significantly improves visibility) which can also

result in stations being missed due to poor visibility. On previous cruises, using the standard configuration of the recovery aids, recovery has occasionally taken several hours due the difficulty in locating the instrument and typically takes of the order of an hour.
From the experiences of deploying the VMP on cruise JR281 it is strongly suggested that the VMP be fitted with a full ocean depth USBL beacon in place of the Ixsea acoustic transponder. The use of a USBL beacon in place of the Ixsea acoustic transponder on cruise JR281 has dramatically improved the speed of recovery. Recovery times for casts, when the USBL beacon was fitted, were routinely of order 30 minutes – even in thick to moderate fog during daylight hours. Had the USBL beacon been fitted at the start of the cruise a further three casts on the SR1 line, which were cancelled due to poor surface visibility, could have been successfully made.
The VMP is ballasted for use with an EM current meter but is often deployed, as on cruise JR281, without the current meter attached. This results in the fall rate for the instrument, using standard sized drop weights, being reduced from ~ 0.6 dbar s^{-1} to 0.43 dbar s^{-1}. While this does not affect the VMP data quality the reduced fall rate can add between 30 – 40 minutes to the duration of a dive.
It is also suggested that the VMP be ballasted for use without the EM current meter by either using different configuration buoyancy or by the provision of larger drop weights.

4.4 Moorings

Paul Anker and P. Abrahamsen

The moorings work component of JR281 aimed to recover, service and re-deploy six instrumentation moorings within the Orkney Passage and two moorings located on the slope in the Northwestern Weddell Sea. The former group are primarily equipped and maintained by British Antarctic Survey (BAS) whilst the latter fall within the responsibility of Lamont-Doherty Earth Observatory (LDEO) with some equipment shared across the deployments.

All six of the Orkney Passage (OP) moorings were successfully recovered and re-deployed in the six days ship time allocated. Observations from the SSMIS satellite indicated very heavy sea ice conditions (>98% cover) over the region of the LDEO moorings within the work period and the decision was made to not attempt recovery. Instrumentation on these moorings should retain battery power to operate for another year when recovery will hopefully be possible.

The assigned work period from 29/03/13 to 03/04/13 was heavily impacted by the presence of one and two year sea ice in the Orkney Passage area as shown in the following plots from SSMIS data. Ice cover under 8% is not plotted but all mooring operations were affected by the presence of sea ice throughout.

Details of individual moorings and their instrumentation are tabulated at the end of this section along with diagrams of the mooring array.

Mooring	Recovery	Deployment	Latitude	Longitude	Depth
OP1	01/04/13 11:48	02/04/13 17:06	60° 37.609' S	042° 05.348' W	3625 m
OP2	31/04/13 14:30	01/04/13 21:30	60° 38.189' S	042° 10.717' W	3023 m
OP3	31/04/13 10:15	01/04/13 10:30	60° 39.315' S	042° 13.775' W	1752 m
OP4	03/04/13 11:19	03/04/13 20:25	60° 35.388' S	041° 49.763' W	2949 m
OP5	29/04/13 12:45	29/03/13 21:00	60° 36.559' S	041° 58.693' W	3403 m
OP6	30/03/13 10:32	30/03/13 18:37	60° 33.775' S	041° 37.964' W	2309 m

Figure 1: Sea ice cover on first day of work period. Observed cover was significantly higher than 8%.

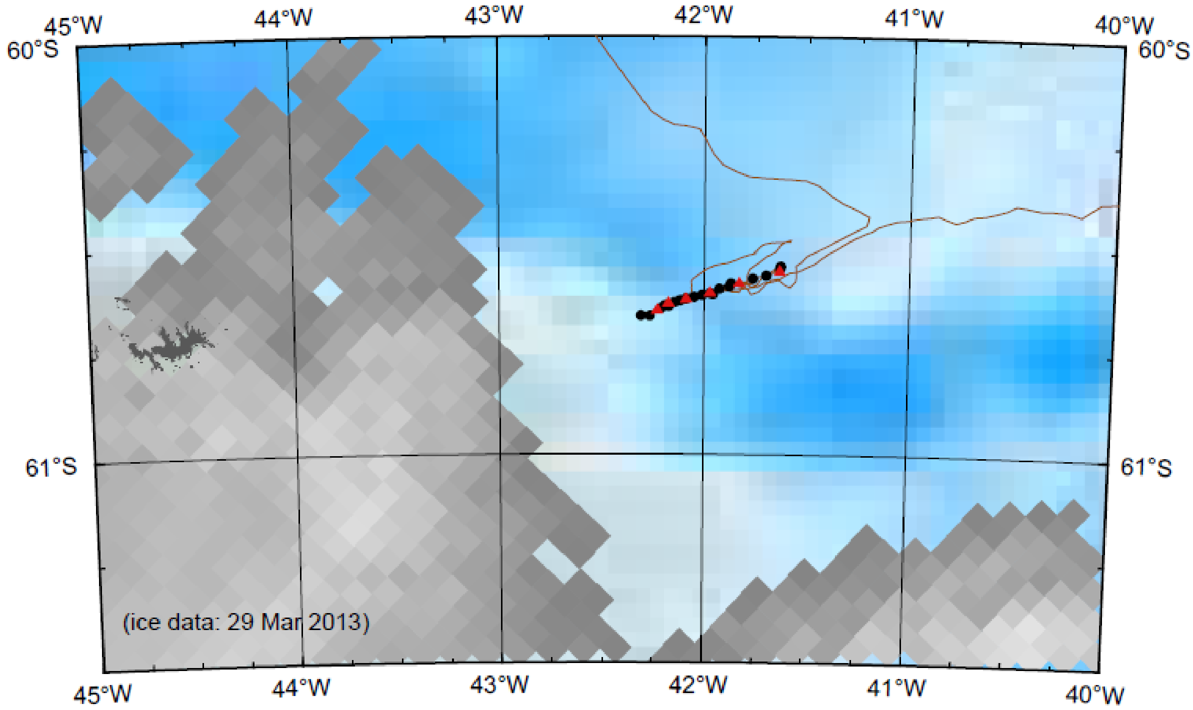
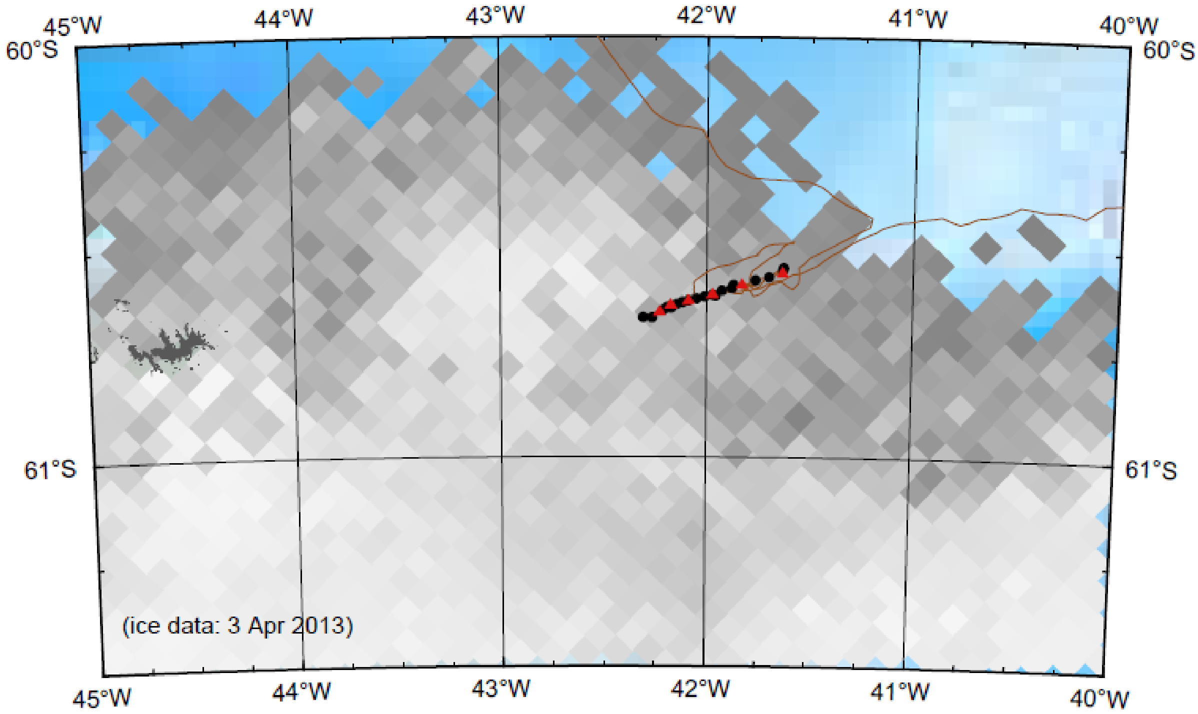


Figure 2: Sea ice cover on last day of work period



Recovery of Sound Source Mooring

Opportunistic recovery of a sound source mooring for Florida State University was carried out on 24/03/13.

Ship arrived at location 1000 m N of mooring site at 11:20. Initial interrogations to establish range returned erratic distances but within the range expected. Release command issued at 11:48 and floatation buoys spotted at 11:57.

Mooring was recovered release floatation first with the sound source subsequently recovered. The size and weight of the sound source proved a little tricky to recover to deck but sea conditions were conducive to a safe recovery. The sound source was rested upon its strong back on the deck before lowering onto a pallet. The 100 m of wire separating the sound source from the main buoyancy group proved useful in keeping them separate and allowing straight forward recovery. The main group of floatation became tangled on ascent leading to the recovery of approximately 17 spheres in a single group, along with the top beacon buoy. The fact that this became tangled in the main mass meant that it surfaced upside down with the radio beacon generally un-readable from the bridge HFDF.

Orkney Passage Mooring Recoveries

First mooring site visited was OP6 on 29/03/13 but with significant sea ice coverage it was deemed too risky for a release. A similar situation was encountered at the OP4 site. Continuing to OP5, conditions were conducive to recovery but were hampered somewhat by floatation interaction with bergs approx 10 m diameter. Interactions with sea ice occurred on a number of recoveries most notably OP2 where floatation was dragged under floes, resulting in a significantly longer recovery period and damage to three hard hats requiring replacement.

Mooring acoustic release commands were timed with the aim of the expected point of surfacing to be ice free. Consideration of sub-surface drift of the mooring string (utilising onboard ADCP data) and the surface drift of the covering ice enabled most recoveries to limit the complications of ice.

All moorings were ‘captured’ to the starboard side of the ship with the side gantry used to haul the beacon buoy and top floatation group onto deck where a line to the mooring winch was attached and run to the stern. From here floatation could be hauled onto deck and removed from the wire.

All instrument data was downloaded as soon as possible with data validity being checked by plotting with GMT.

The recovery of OP2 presented a significant tangle (potentially exacerbated by ice interaction) which required cutting of the wire once all instrumentation and floatation were onboard. Rapid recovery of the remaining wire lead to a knot engaging in the A-frame block and parting the wire at this point.

Orkney Passage Mooring Deployments

All deployments were carried out anchor first arrangement to avoid interaction with the sea ice present and to allow the ship to protect the mooring from incoming floes. The new BAS scientific mooring winch was used for all deployments with the wire running direct from the storage drum through a deck block bolted to the deck at a position 7 m aft of the winch, and through a block suspended from the rear gantry (A-frame). Control of the gantry allowed positioning of the wire to ease clamp-on instrument attachment.

Anchor first deployments were not anticipated for this period of mooring work and so the capstan drive component of the new BAS scientific winch was not loaded. It was envisioned that if anchor first deployments were required the existing mooring winches on the JCR would suffice. Unfortunately the use of the new winch required the removal of 2700 m of Kevlar rope stored on the drum which was loaded on to both JCR mooring winches for temporary storage, precluding their use in this work period.

The new scientific winch presented problems for anchor first deployments. Without the accompanying traction/capstan drive it would prove difficult to load wire on to the storage drum under tension, a process which would seat the wire tighter together on the drum. Without this tension, the additional weight of the anchor on the line could cause the wire to dig in to layers beneath, potentially causing damage to the wire sheath when pulled out during deployment. The use of a 10 mm diameter Kevlar ‘leader’ on the drum compounded this problem, being a softer material more prone to mechanical damage and of dissimilar diameter making neat laying of the smaller diameter wire difficult.

Deployment of OP5 avoided loading the mooring winch by fully constructing the mooring on deck and stringing the two lengths of wire below the ships aft. This technique worked well for this short mooring but a different technique was developed for subsequent deployments, the procedure of which was tested for suitability immediately before the recovery of OP3.

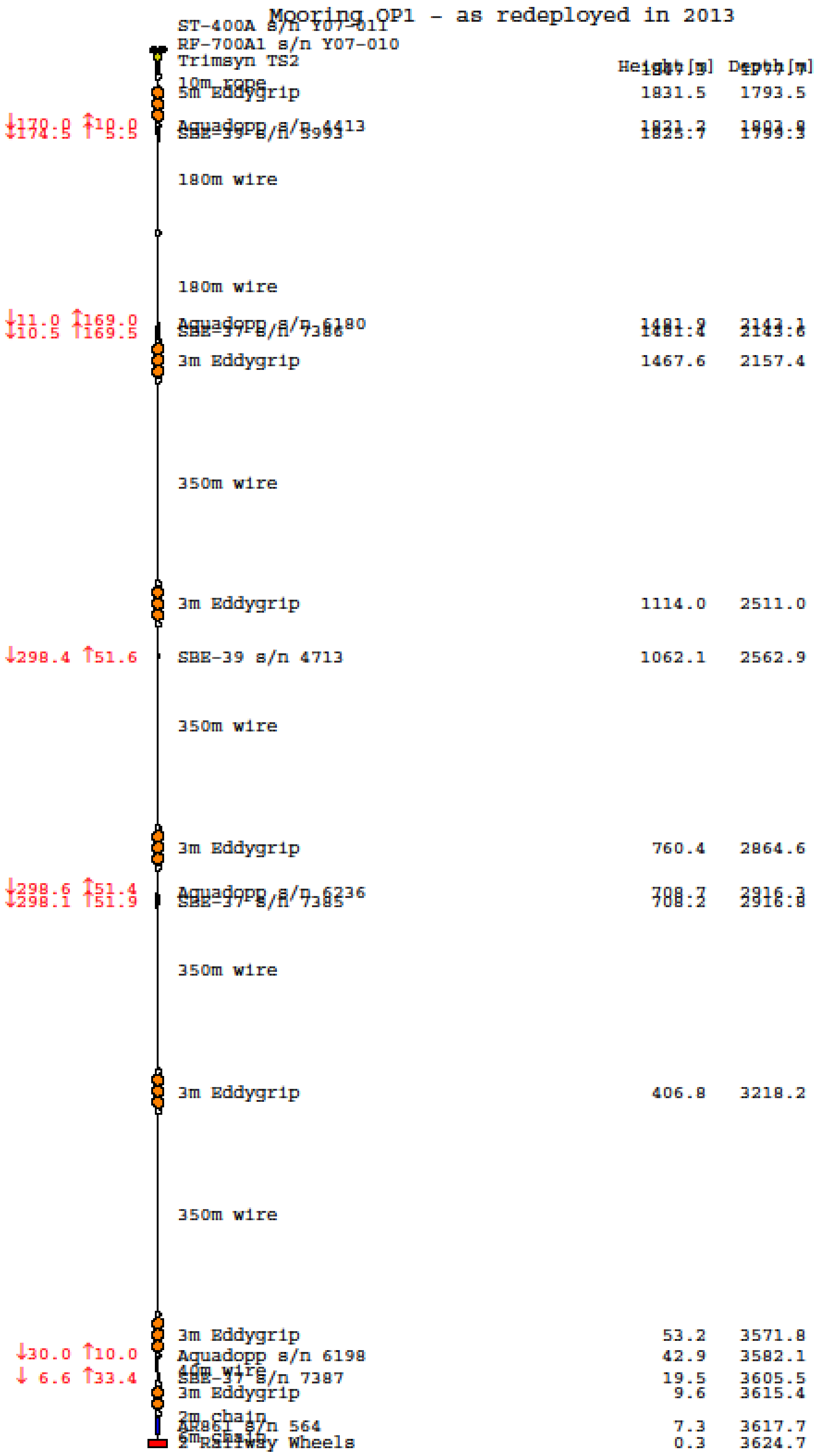
The Kevlar leader was removed and replaced with a 12mm steel wire leader and a length of spare 8.5 mm mooring wire which was wound on top providing a more substantial and even surface upon which to load. When an additional length of wire (or the addition of in line floatation or instrumentation) were to be added to a mooring during deployment the currently deployed length and anchor weight were secured to the deck by means of a rope and cleat and a separate chain connection. An additional ring and shackle was added to the bottom connection of most floatation groups to ease securing the chain during this process. Each additional wire length was wound on to the drum in individual lengths before being attached to the mooring and deployed, with the process repeated at each new wire. This prevented many layers of wire building up on the drum thus reducing the chance of wire digging in on itself, at the expense of extended deployment times.

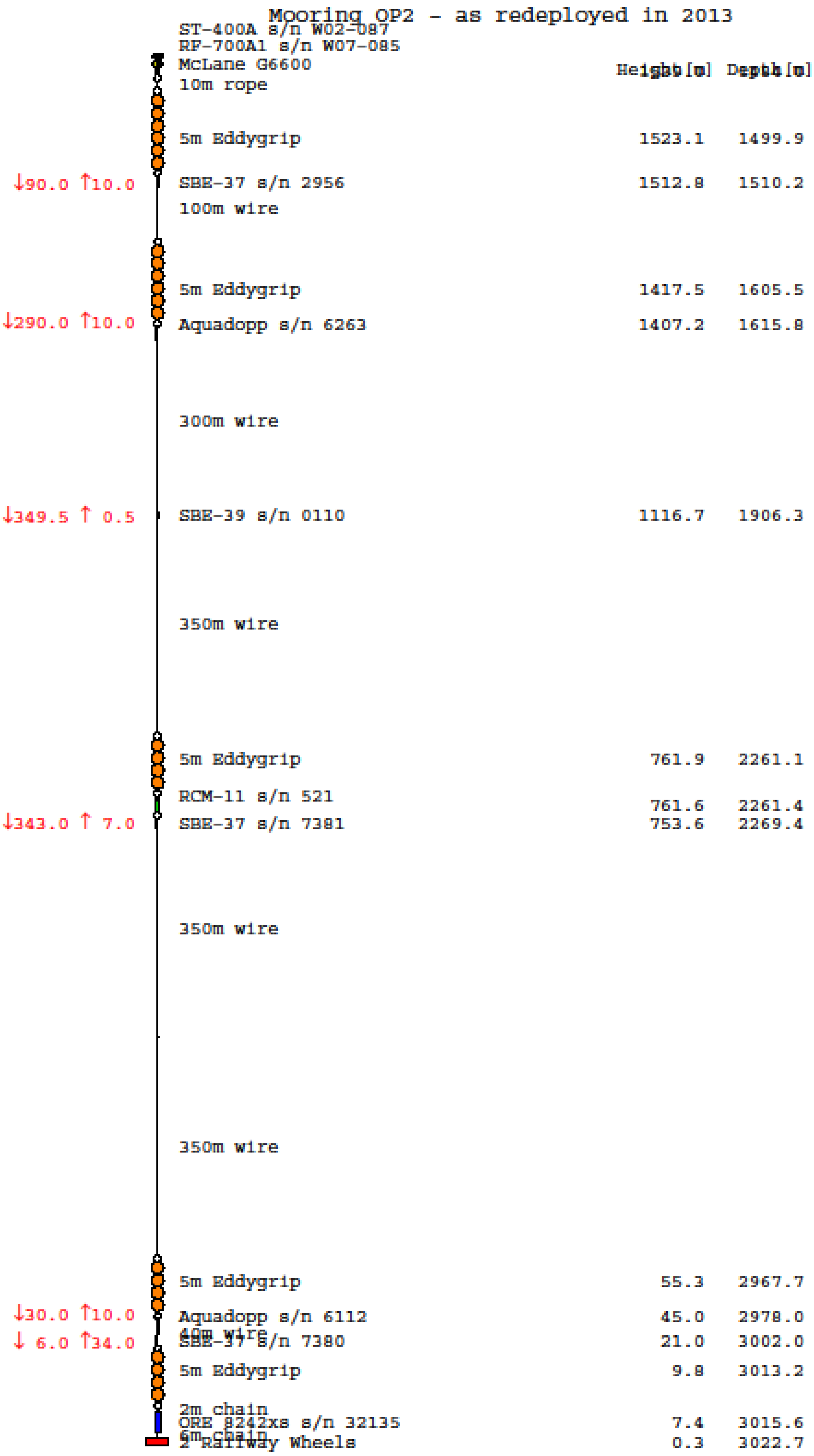
The future use of the traction/capstan component of the winch would minimise load on the storage drum and allow tension to be placed on the wire when loading before deployment. Both of which actions will limit damage to the wire.
This being said, no damage to the wire was observed during deployments although the wire did have a tendency to ‘skip’ across the drum when being unloaded under high tension, briefly dynamically loading the mooring string. Initial drum loading under tension would limit this behaviour.
The winch, whilst not designed to carry out such deployments without its capstan component, performed adequately at handling the loads but did require application of additional grease to a number of ports throughout early deployments.

OP1 was re-deployed in the exact same configuration as recovered but on deploying the penultimate floatation group at 15:12z significant slack was noticed on the mooring wire. Deployment was continued with the final group of six buoys of which two remained on the surface after removing all anchor support from the ship at 15:40. The mooring was recovered and a decision was made to remove three buoys from the top group and remove the penultimate group of three completely. An additional length of chain (approx 5 kg) was added to the beacon buoy as it was noticed to be sitting askew to the surface. The possibility of recovering the entire mooring and adding an additional railway wheel weight was dismissed as requiring too much time in what was a deteriorating weather window. The new arrangement was released from the ship at 17:06 and sunk at a reasonable rate of 46 m/min. The beacon buoy sat well in the water with the additional weight. The reason for the mooring not sinking is most likely the reduced weight of the railway wheels used. A sample of the railway wheels used gave an average weight of 325 kg each. Accounting for weight in water it appears that they were not sufficient to sink the mooring. The Mooring Design and Dynamics (MDD) Matlab script which was originally used to design each mooring uses a value of 915kg for the weight of two railway wheels. Future deployments should account for variations in railway wheel sizes and weights and the diagrams produced by the MDD scripts must be used with caution ie. specifying weight required, not simply number of wheels required.

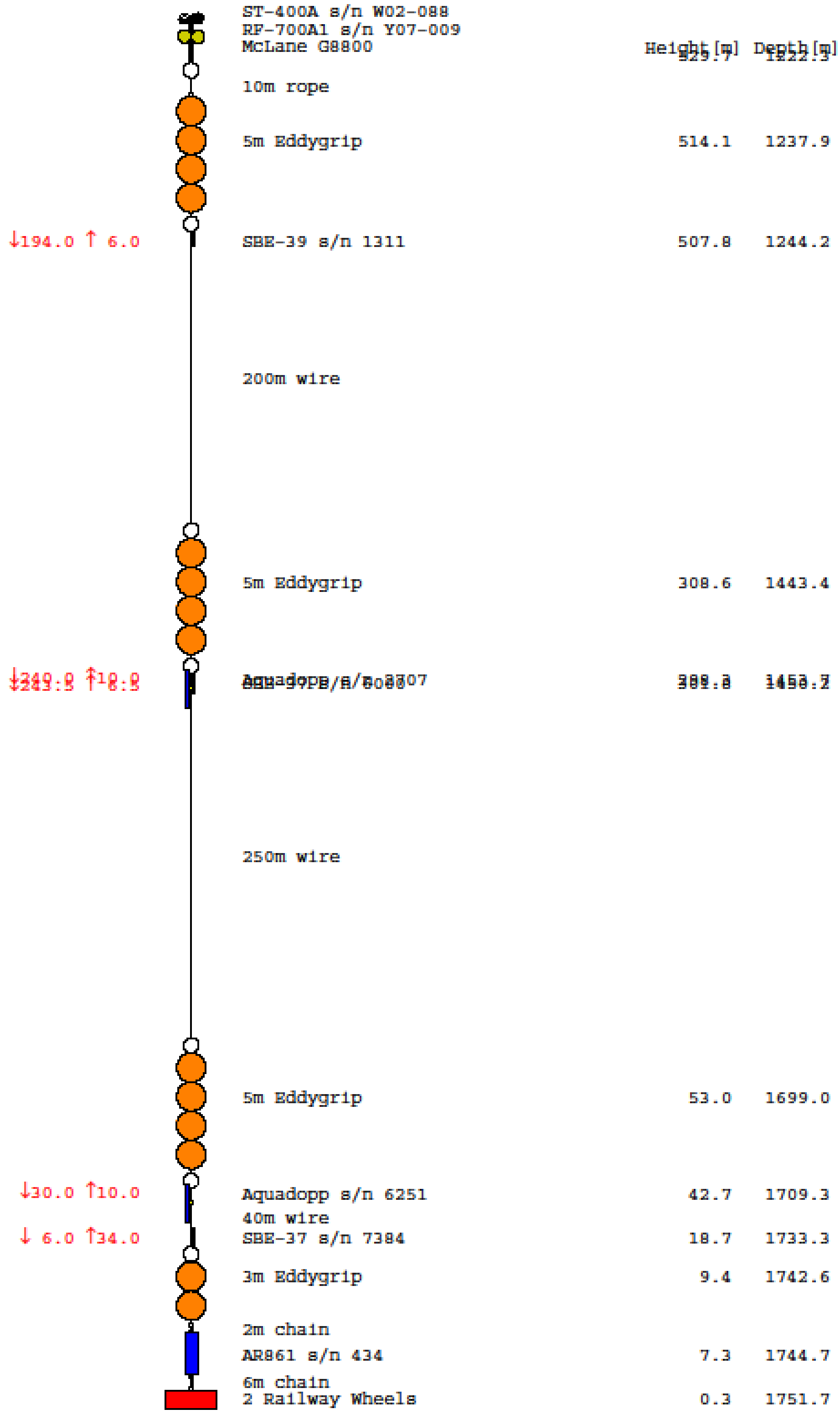
Before all deployments correct operation of VHDF beacons was confirmed by the bridge.

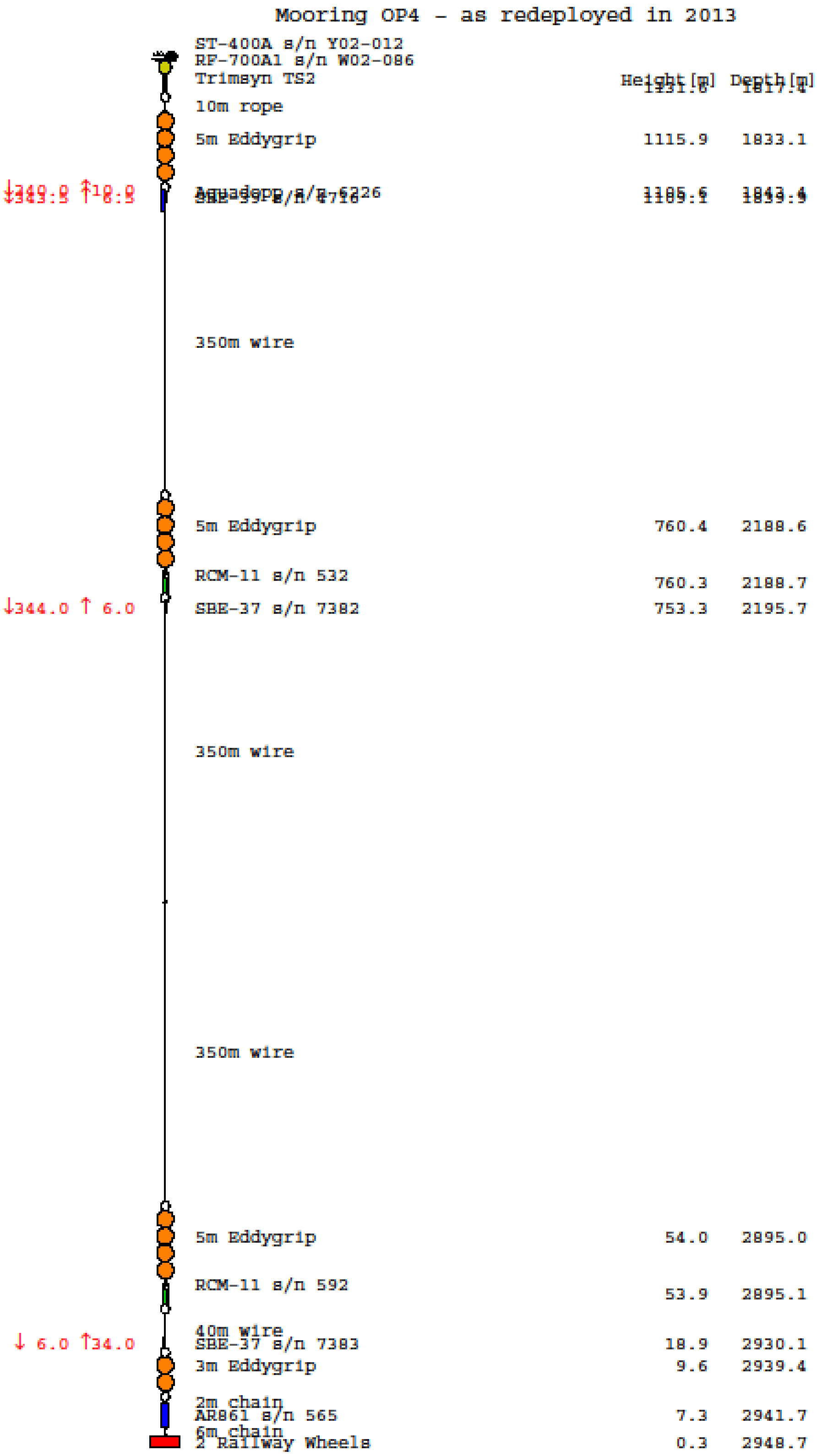
Once each mooring was released its descent was monitored using the acoustic release ranging function. Ice conditions caused problems with deploying the hydrophone from the ship deck, both potentially causing damage by impact, and by pulling the hydrophone off vertical, deteriorating communications. The hull mounted acoustic transducer was employed for the last two mooring recoveries and deployments and proved very efficient.


Mooring OP1 - as redeployed in 2013
ST-400A s/n Y07-011
RF-700A1 s/n Y07-010
Trimsyn TS2
Height [m]
Depth [m]
10m rope
5m Eddygrip
1831.5
1793.5
Aquadopp s/n 4413
SBE-39 s/n 5993
180m wire
180m wire
Aquadopp s/n 6180
SBE-37 s/n 7386
3m Eddygrip
1467.6
2157.4
350m wire
3m Eddygrip
1114.0
2511.0
↓298.4 ↑51.6
SBE-39 s/n 4713
1062.1
2562.9
350m wire
3m Eddygrip
760.4
2864.6
↓298.6 ↑51.4
↓298.1 ↑51.9
Aquadopp s/n 6236
SBE-37 s/n 7385
350m wire
3m Eddygrip
406.8
3218.2
350m wire
3m Eddygrip
53.2
3571.8
↓30.0 ↑10.0
Aquadopp s/n 6198
42.9
3582.1
↓ 6.6 ↑33.4
40m wire
SBE-37 s/n 7387
19.5
3605.5
3m Eddygrip
9.6
3615.4
2m chain
AR861 s/n 564
7.3
3617.7
6m chain
2 Railway Wheels
0.3
3624.7

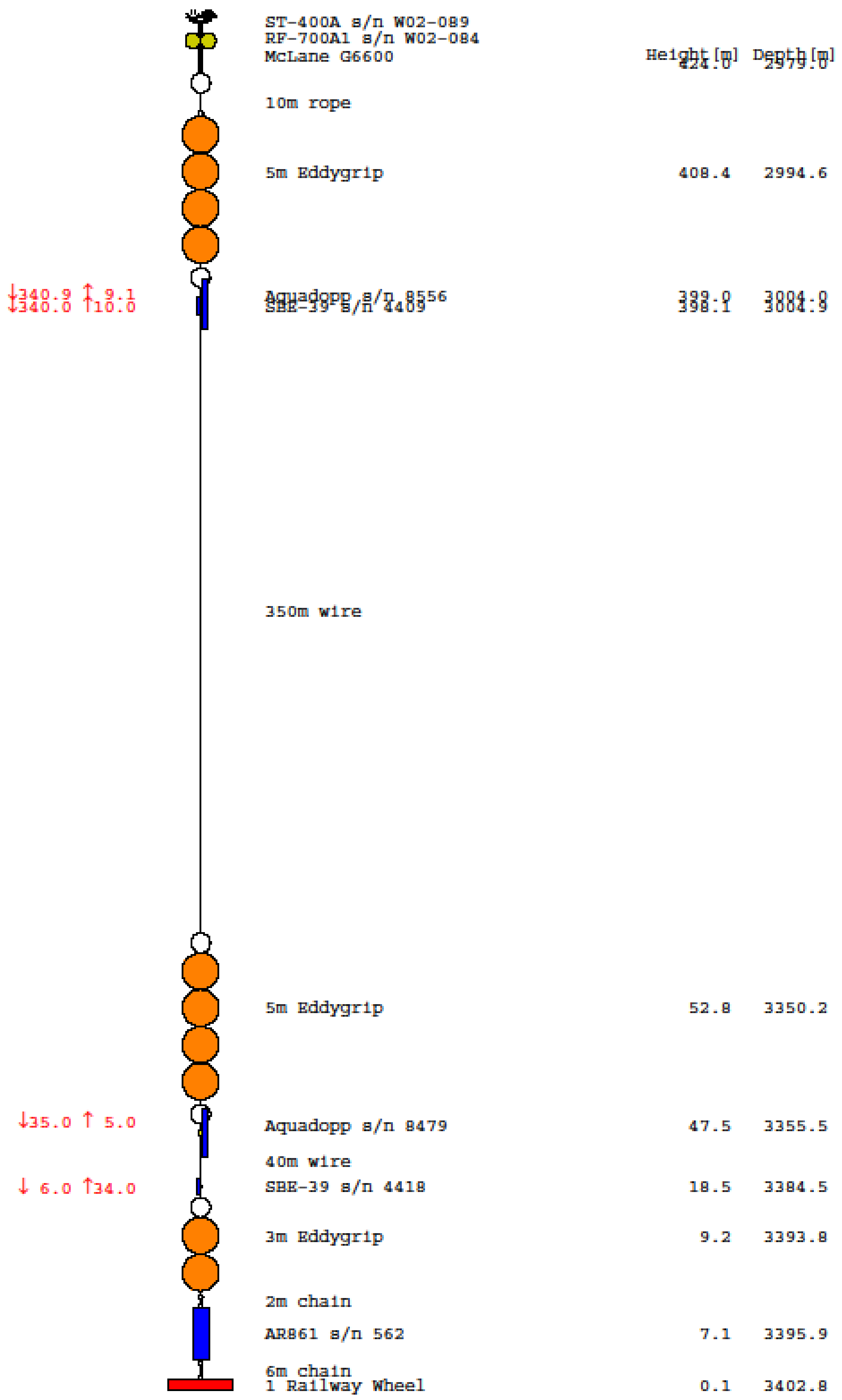

Mooring OP2 - as redeployed in 2013
ST-400A s/n W02-087
RF-700A1 s/n W07-085
McLane G6600
10m rope
Height [m]
Depth [m]
5m Eddygrip 1523.1 1499.9
↓90.0 ↑10.0
SBE-37 s/n 2956 1512.8 1510.2
100m wire
5m Eddygrip 1417.5 1605.5
↓290.0 ↑10.0
Aquadopp s/n 6263 1407.2 1615.8
300m wire
↓349.5 ↑ 0.5
SBE-39 s/n 0110 1116.7 1906.3
350m wire
5m Eddygrip 761.9 2261.1
RCM-11 s/n 521 761.6 2261.4
↓343.0 ↑ 7.0
SBE-37 s/n 7381 753.6 2269.4
350m wire
350m wire
5m Eddygrip 55.3 2967.7
↓30.0 ↑10.0
Aquadopp s/n 6112 45.0 2978.0
40m wire
↓ 6.0 ↑34.0
SBE-37 s/n 7380 21.0 3002.0
5m Eddygrip 9.8 3013.2
2m chain
ORE 8242xs s/n 32135 7.4 3015.6
6m chain
2 Railway Wheels 0.3 3022.7

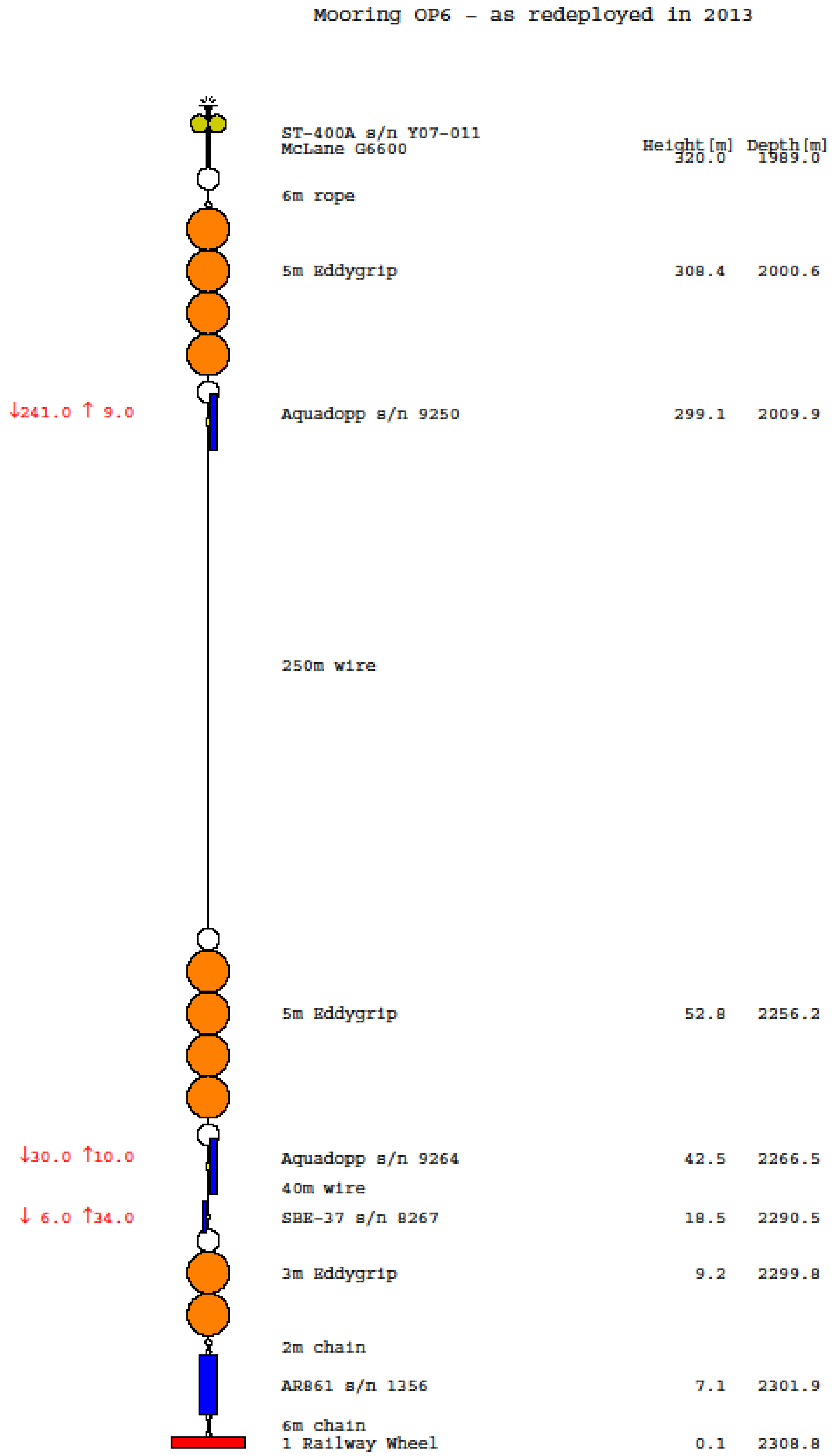
Mooring OP3 – as redeployed in 2013




Mooring OP4 – as redeployed in 2013
ST-400A s/n Y02-012
RF-700A1 s/n W02-086
Trimsyn TS2
10m rope
5m Eddygrip 1115.9 1833.1
350m wire
5m Eddygrip 760.4 2188.6
RCM-11 s/n 532 760.3 2188.7
↓344.0 ↑ 6.0
SBE-37 s/n 7382 753.3 2195.7
350m wire
350m wire
5m Eddygrip 54.0 2895.0
RCM-11 s/n 592 53.9 2895.1
↓ 6.0 ↑34.0
SBE-37 s/n 7383 18.9 2930.1
3m Eddygrip 9.6 2939.4
AR861 s/n 565 7.3 2941.7
2 Railway Wheels 0.3 2948.7

Mooring OP5 – as redeployed in 2013




Mooring OP6 – as redeployed in 2013
Height [m] Depth [m]
ST-400A s/n Y07-011
McLane G6600 320.0 1989.0
6m rope
5m Eddygrip 308.4 2000.6
↓241.0 ↑ 9.0
Aquadopp s/n 9250 299.1 2009.9
250m wire
5m Eddygrip 52.8 2256.2
↓30.0 ↑10.0
Aquadopp s/n 9264 42.5 2266.5
40m wire
↓ 6.0 ↑34.0
SBE-37 s/n 8267 18.5 2290.5
3m Eddygrip 9.2 2299.8
2m chain
AR861 s/n 1356 7.1 2301.9
6m chain
1 Railway Wheel 0.1 2308.8

Recoveries

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)

OP1

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Out of Water @ (GMT)	Clock Offset (instr-GMT, mm:ss)	Comments
Novatech RF-700A1 (Y07-010)	1846	1812	VHF beacon	-		-	Channel C (160.725MHz)
Novatech ST-400A (Y07-011)	1846	1814	Xenon flasher	-		-	
Aquadopp DW (5993)	1821	1838	U,V,W,TE,PR, TILT	15	12:57	-00:46	A6L 3879
SBE-39 (4413)	1825	1838	TE	15	12:57		
Aquadopp DW (6180)	1482	2182	V U,V,W,TE,PR, TILT	15	13:17	+00:27	A6L 3867
SBE-37 (7386)	1481	2182	TE,PR,CO	15	13:17		
SBE-39 (4713)	1062	2602	TE	15	13:44		
Aquadopp DW (6236)	709	2956	U,V,W,TE,PR, TILT	15	14:00		Time comparison dialogue did not operate on termination of logging.

(7387)							cond. cell. Washed through thoroughly
AR861 Release (564)	7	3657	-	-	14:33	-	

OP2

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Out of Water @ (GMT)	Clock Offset (instr-GMT, mm:ss)	Comments
Novatech RF-700A1 (W07-085)	1539	1555	VHF beacon	-		-	Channel C (160.725MHz)
Novatech ST-400A (W02-087)	1539	1555	Xenon flasher	-		-	
SBE-37 (2956)	1512	1577	TE,PR,CO	15	15:22		
Aquadopp DW (6263)	1407	1683	U,V,W,TE,PR, TILT	15	15:39		Time comparison dialogue did not operate on termination of logging.
SBE-39 (0110)	1117	1974	TE,PR	15	15:47		Desiccant bag ripped. Powder on battery casing
RCM-11 (521)	762	2332	U,V,W,TE,CO,TIL T, SNR	60	11:58		Recovered DSU:14744
SBE-37 (7381)	754	2342	TE,PR,CO	15	11:55		No data found on recovery. Bench test demonstrated normal logging. Instrument redeployed
Aquadopp DW (6112)	45	3045	U,V,W,TE,PR, TILT	15			Time comparison dialogue did not operate on termination of logging.
SBE-37 (7380)	21	3073	TE,PR,CO	15			
ORE 8242 Release (32134)	7	3087	-	-		-	Failed. Possible leak thru port. Not redeployed. Returned to LDEO for refurb
Ore 8242 Release (32135)	7	3087	-	-		-	Operated successfully on first attempt

OP3

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Out of Water @ (GMT)	Clock Offset (instr-GMT, mm:ss)	Comments
Novatech RF-700A1 (Y07-009)	530	1237	VHF beacon	-		-	Channel C (160.725MHz)
Novatech ST-400A (W02-088)	530	1237	Xenon flasher	-		-	
SBE-39 (1311)	508	1258	TE,PR	15	11:38		
Aquadopp DW (6000)	298	1464	U,V,W,TE,PR, TILT	15	11:40	-01:30	A6L 3880
SBE-37 (2707)	302	1464	TE,PR,CO	15	11:40		LDEO instrument, 3-pin connector, replaced old style battery pack with new Li red top pack
Aquadopp DW (6251)	43	1719	U,V,W,TE,PR, TILT	15	11:56	+00:06	A6L 3873
SBE-37 (7384)	19	1747	TE,PR,CO	15	12:08		
AR861 Release (434)	7	1758	-	-	21:21	-	

OP4

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Out of Water @ (GMT)	Clock Offset (instr-GMT, mm:ss)	Comments
Novatech RF-700A1 (W02-086)	1131	1831	VHF beacon	-		-	Channel C (160.725MHz)
Novatech ST-400A (Y02-012)	1131	1831	Xenon flasher	-		-	
Aquadopp DW (6226)	1110	1852	U,V,W,TE,PR, TILT	15		-02:25	A6L 3869
SBE-39 (4716)	1109	1853	TE	15			

RCM-11 (532)	760	2202	U,V,W,TE,CO, TILT, SNR	60		DSU errors, unable to establish offset	Recovered DSU: 15384
SBE-37 (7383)	753	2209	TE,PR,CO	15			
RCM-11 (592)	54	2908	U,V,W,TE,CO, TILT, SNR	60		DSU errors, unable to establish offset	Recovered DSU: 15238 Some bio-fouling seen inside conductivity cell (Pic 9947)
SBE-37 (7382)	19	2943	TE,PR,CO	15			Drift seen in data. No visible obstructions in cond. cell. Washed through thoroughly
AR861 Release (565)	7	2954	-	-		-	

OP5

Instrument (s/n)	**Height (m)**	**Nominal Depth (m)**	**Parameters Measured**	**Sample Interval (min)**	**Out of Water @ (GMT)**	**Clock Offset (instr-GMT, mm:ss)**	**Comments**
Novatech RF-700A1 (W02-084)	425	2971	VHF beacon	-		-	
Novatech ST-400A (W02-089)	425	2971	Xenon flasher	-		-	
RCM-8 (12677)	410	2986	SPD,DIR, TEarctic,PR	60	14:01		Returned to LDEO Recovered DSU: 15239
SBE-39 (4409)	403	2993	TE	15	14:38	+02:00	
RCM-8 (12669)	53	3343	SPD,DIR, TEarctic,PR	60	14:32		Returned to LDEO Recovered DSU: 15236
SBE-39 (4418)	19	3377	TE	15	14:38		
AR861 Release (562)	8	2954	-	-	14:38	-	

OP6

Instrument (s/n)	**Height (m)**	**Nominal Depth (m)**	**Parameters Measured**	**Sample Interval (min)**	**Out of Water @ (GMT)**	**Clock Offset (instr-GMT, mm:ss)**	**Comments**

Novatech ST-400A (Y07-011)	323	2010	Xenon flasher	-		-	
Aquadopp DW (9250)	299	2010	U,V,W,TE,PR, Tilt	15	11:20		Time comparison dialogue did not operate on termination of logging Logging stopped @ 14:10:46z 30/03/13
Aquadopp DW (9264)	43	2266	U,V,W,TE,PR, Tilt	15	11:26		Time comparison dialogue did not operate on termination of logging Logging stopped @ 12:03:30z 30/03/13
SBE-37 (8267)	19	2290	TE,PR,CO	15	11:34	+00:14	
AR861 Release (1356)	7	2302	-	-	11:39	-	

Deployments

OP1

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Start Time, GMT (dd/mm/yy hh:mm:ss)	In Water @ (GMT)	Comments
Novatech RF-700A1 (Y07-010)	1846	1701	VHF beacon	-	-		Channel C (160.725MHz)
Novatech ST-400A (Y07-011)	1846	1701	Xenon flasher	-	-		
Aquadopp DW (5993)	1821	1726	U,V,W,TE,PR, TILT	15	02/04/13 11:30:00	15:28	A6L 3879
SBE-39 (4413)	1825	1721	TE	15	02/04/13 11:30:00	15:28	
Aquadopp DW (6180)	1482	2065	V U,V,W,TE,PR, TILT	15	02/04/13 11:00:00	15:05	A6L 3867
SBE-37 (7386)	1481	2066	TE,PR,CO	15		15:05	
SBE-39	1062	2485	TE	15	02/04/13	14:09	

(4713)					11:00:00		
Aquadopp DW (6236)	709	2838	U,V,W,TE,PR, TILT	15	02/04/13 11:00:00	13:38	A6L 3907
SBE-37 (7387)	708	2839	TE,PR,CO	15		13:38	Position on mooring swapped with SBE-37 (7385) to qualify drift
Aquadopp DW (6198)	43	3504	U,V,W,TE,PR, TILT	15	02/04/13 11:00:00	12:27	A6L 3872
SBE-37 (7385)	19	3528	TE,PR,CO	15		12:22	Position on mooring swapped with SBE-37 (7387) to qualify drift
AR861 Release (564)	7	3540	-	-	-	12:18	

OP2

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Start Time, GMT (dd/mm/yy hh:mm:ss)	In Water @ (GMT)	Comments
Novatech RF-700A1 (W07-085)	1539	1609	VHF beacon	-	-		Channel C (160.725MHz)
Novatech ST-400A (W02-087)	1539	1609	Xenon flasher	-	-		Pressure switch repaired. Working on deck. Not seen working in water
SBE-37 (2956)	1512	1635	TE,PR,CO	15		21:06	
Aquadopp DW (6263)	1407	1741	U,V,W,TE,PR, TILT	15	01/04/13 18:30:00	20:43	A6L 3870
SBE-39 (4897)	1117	2031	TE,PR	15	01/04/13 17:00:00	20:27	Newer instrument replaces old SBE-39 (0110)
RCM-11 (521)	762	2386	U,V,W,TE,CO,TILT, SNR	60	01/04/13 17:00:00	19:56	Only single bushing between shackle and frame on top and bottom Deployed DSU: 14742
SBE-37 (7381)	754	2394	TE,PR,CO	15	01/04/13 16:30:00	19:36	No data found on recovery. Bench test demonstrated normal logging. Instrument redeployed
Aquadopp DW	45	3103	U,V,W,TE	15	01/04/13	18:44	A6L 3871

(6112)			,PR, TILT		18:00:00		
SBE-37 (7380)	21	3127	TE,PR,CO	15	01/04/13 16:30:00	18:37	
Ore 8242 Release (32135)	7	3141	-	-	-	1833	Redeployed in single release arrangement

OP3

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Start Time, GMT (dd/mm/yy hh:mm:ss)	In Water @ (GMT)	Comments
Novatech RF-700A1 (Y07-009)	530	1162	VHF beacon	-	-		Channel C (160.725MHz)
Novatech ST-400A (W02-088)	530	1162	Xenon flasher	-	-		
SBE-39 (1311)	508	1184	TE,PR	15	01/04/13 09:00:00	10:21	
Aquadopp DW (6000)	298	1394	U,V,W,TE,PR, TILT	15	01/04/13 11:00:00	09:55	A6L 3880
SBE-37 (2707)	302	1394	TE,PR,CO	15	01/04/13 09:00:00	09:55	LDEO instrument, 3-pin connector, replaced old style battery pack with new Li red top pack
Aquadopp DW (6251)	43	1649	U,V,W,TE,PR, TILT	15	01/04/13 11:00:00	09:32	A6L 3873
SBE-37 (7384)	19	1673	TE,PR,CO	15	01/04/13 11:00:00	09:25	
AR861 Release (434)	7	1684	-	-	-	09:20	

OP4

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Start Time, GMT (dd/mm/yy hh:mm:ss)	In Water @ (GMT)	Comments
Novatech RF-700A1	1132	1811	VHF beacon	-	-		Channel C (160.725MHz)

(W02-086)							
Novatech ST-400A (Y02-012)	1132	1811	Xenon flasher	-	-		
Aquadopp DW (6226)	1106	1837	U,V,W,TE,PR, TILT	15	03/04/13 17:00:00	20:12	A6L 3869
SBE-39 (4716)	1109	1834	TE	15	03/04/13 17:00:00	20:12	
RCM-11 (532)	760	2183	U,V,W,TE,CO, TILT, SNR	60	03/04/13 18:00:00	19:50	Deployed DSU: 15239 DSU count on power up: 00013
SBE-37 (7382)	753	2190	TE,PR,CO	15	03/04/13 17:00:00	19:35	Position on mooring swapped with SBE-37 (7383) to qualify drift
RCM-11 (592)	54	2889	U,V,W,TE,CO, TILT, SNR	60	03/04/13 18:00:00	18:51	Deployed DSU:15236 DSU count on power up: 00013
SBE-37 (7383)	19	2924	TE,PR,CO	15	03/04/13 17:30:00	18:37	Position on mooring swapped with SBE-37 (7382) to qualify drift
AR861 Release (565)	7	2935	-	-	-	18:34	

OP5

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample Interval (min)	Start Time, GMT (dd/mm/yy hh:mm:ss)	In Water @ (GMT)	Comments
Novatech RF-700A1 (W02-084)	424	2959	VHF beacon	-	-		
Novatech ST-400A (W02-089)	424	2959	Xenon flasher	-	-		
Aquadopp (8556)	403	2980	U,V,W,TE,PR, TILT	15	03/29/13 19:00:00	20:10	Replacement for RCM-8 (12677) LDEO instrument 50Wh Alkaline batteries
SBE-39 (4409)	401	2982	TE	15	03/29/13 18:30:00	20:10	
Aquadopp (8479)	48	3335	U,V,W,TE,PR, TILT	15	03/29/13 19:00:00	20:46	Replacement for RCM-8 (12669) LDEO instrument

							50Wh Alkaline batteries
SBE-39 (4418)	19	3364	TE	15	03/29/13 18:30:00	20:46	
AR861 Release (562)	7	3376	-	-	-		

OP6

Instrument (s/n)	Height (m)	Nominal Depth (m)	Parameters Measured	Sample interval (min)	Start Time, GMT (dd/mm/yy hh:mm:ss)	In Water @ (GMT)	Comments
Novatech ST-400A (Y07-011)	322	1982	Xenon flasher	-	-	18:30	
Aquadopp DW (9250)	299	2005	U,V,W,TE,PR, Tilt	15	30/03/13 16:30:00	18:20	A6L 4753/P23954 Replaced both O-rings
Aquadopp DW (9264)	43	2261	U,V,W,TE,PR, Tilt	15	30/03/13 16:30:00	18:10	A6L 4754/P23954 Replaced both O-rings
SBE-37 (8267)	19	2285	TE,PR,CO	15		17:48	Replaced thin O-ring (30857)
AR861 Release (1356)	7	2297	-	-	-	17:33	

4.5. APEX Floats

Andrew Meijers and Brian King

4.5.1 Introduction

One of the physics team responsibilities on JR281 was the preparation and launch of APEX type Argo floats. APEX stands for Autonomous Profiling Explorer, and these floats are equipped with an array of sensors that measure salinity/conductivity, temperature, and pressure, whilst tracking the position of the float via the contingent of ARGOS satellites orbiting the Earth. The data collected by the floats is automatically transmitted to these satellites when the float surfaces. The floats manoeuvre vertically through the water column by means of pumping fluid into and out of an external bladder. This particular type of float is designed to be neutrally buoyant at a depth of 1000m (parking pressure). The float then descends to a depth of 2000m and then rises back up to the surface. This process is repeated as long as battery life remains, resulting in a continuous cycle of high quality ocean temperature and salinity profiles from 2000m depth to the surface. The profiling cycle length is programmable, and these particular floats have a cycle period of 10 days.

4.5.2 Objectives

During this cruise, eight APEX floats were to be launched at different locations along the SR1b (approximately 54-56°W) transect across Drake Passage. The principal aim of this venture was to increase the population of Argo floats in the South Atlantic, in order to augment the quantity and quality of ocean profile data in this location. The launch positions were chosen to approximately evenly cover the section. All eight floats were equipped with sea ice avoidance algorithms to detect the presence of sea ice during their ascent and abort the profile if needed, and could therefore be deployed in the vicinity of the sea ice edge.

4.5.3 Float Identification

Each float had its own unique serial number on the hull. All the information for each of the floats, including pre-deployment tests and also when the float was actually launched was recorded in a log. The main information has been compiled in the following table.

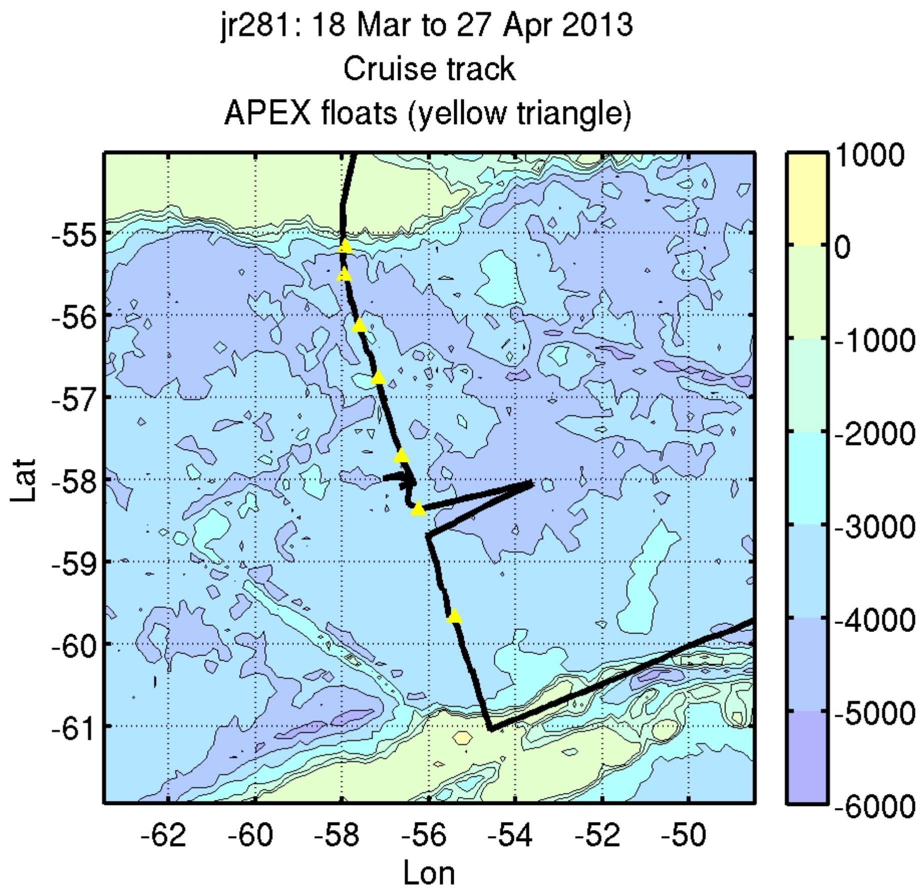
Table 4.5.1: Key APEX float information

Float ID	Pre-deployment test time (year day/UTC)	Deployment time (year day/UTC)	Deployment latitude	Deployment longitude	Associated CTD station number
5589	078/1615	79/0850	-55.174	-57.925	8
5590	079/1432	79/1615	-55.516	-57.952	10
5595	080/0150	Not deployed	Not deployed	Not deployed	Not deployed
5602	080/0203	80/1153	-56.134	-57.616	12
5603	080/2240	81/0120	-56.772	-57.173	14
5604	081/1640	81/1735	-57.720	-56.653	17

6242	082/0030	83/0235	-58.367	-56.250	19
6243	082/0040	84/2315	-59.674	-55.426	23

4.5.4 Launch Positions

The figure below shows the positions where the APEX floats were deployed along the SR1b section with cruise track and bathymetry also shown.



4.5.5 Pre-deployment checks

Prior to their deployment the floats were brought from their storage location on the aft deck into the ship rough lab and tests were run on each float to ensure that it was functioning as expected. These checks were performed using a laptop computer with a COM1 port to which the cables could be connected. Care was taken to ensure that the clamps were touching only the terminals protruding from the float and not the hull of the float itself, to ensure a good connection. Problems were initially encountered communicating with the floats as the usb to serial converter could not be made to work. This problem was solved by procuring an older laptop with a serial port from the MNF. The program used for communication with the floats was Hyper-Terminal.

Log sheets and instructions for the pre-deployment checks were created by Brian King, based on the provided APEX manuals and check sheets. All communications and commands sent to the floats were recorded using the 'record' option in Hyper-Terminal and the resulting logs saved. For each pre-deployment check the testing check sheet was followed carefully and deviations from the expected results recorded, and if possible, corrected.

The list of values for the float mission parameters e.g. park pressure, Argos repetition period, up-time, down-time, etc. were first displayed in the terminal, and the preset values were checked for reasonableness. The preset values on all floats were found to be the same and matched those provided in the APEX instruction manuals.

The float internal time offset from GMT was then checked and corrected using the ship radiocode clock. These offsets were typically in the range of 10-30s. To test if the float was able to transmit data, a transmit command was then sent to the float which would generate a beep from the provided cat's meow receiver in confirmation.

The high pressure pumps then were tested by monitoring the original positions of the pistons (should be 100 counts for shipping), and then the pump was extended and retracted by 4 counts. The battery voltage was checked, and was supposed to be higher than 15.2V. No voltage higher than 15.1V was recorded but the lowest value (14.8V) was deemed acceptable. The float internal vacuum was checked for a value of between 78-88 counts.

The pneumatic system test was then run in two stages. Firstly the pumps were run for 6 seconds and the vacuum counts were observed after each run. The pumping continued until the internal vacuum had reached 120 counts, and once this value was reached the time was recorded. The second stage took place five minutes later and consisted of checking that the vacuum counts had held at a relatively constant level (no more than 1-2 counts of vacuum drop). Checking the pumps were running at this stage required pressing an ear to the pressure casing due to the high noise environment of the ship rough lab.

Following the five minute wait the CTD check was carried out where the current values of temperature, salinity and pressure were displayed to check that they were sensible. All that was left after this was to run an internal self test. The floats were then set to hibernate and the text capture could be stopped and the recorded log file saved.

4.5.6 Pre-deployment Issues

Several issues arose during the pre-deployment tests that are worth noting. These issues are listed below:

- Floats 5589 and 5595 accidentally had pressure activated missions started during the testing procedure. These were reset using the 'K' kill mission command. Float 5589 then completed testing normally.
- Float 5595 failed testing due to having an internal vacuum of 102 counts, well outside the acceptable range. Several attempts were made to change this by opening the air valve and running the pump, or by changing the piston position. It was also tested by increasing the internal vacuum to 120 counts and then opening the pressure valve. As for the other floats the vacuum reduced, but only to its initial value of 102 counts. Further attempts to correct the internal vacuum were deemed too involved and risky to attempt at sea and so this float was not deployed, and instead returned to the UK with the ship.
- Floats 5596 and 6243 had internal piston positions of 99. These were corrected to 100 during testing.

4.5.7 Deployment

Several hours before deployment the float mission was activated by rubbing the provided magnet across the reset panel of the APEX float and removing the CTD sensor covers. This started the float transmitting with six audible beeps of the cat's meow receiver. The float then activated its pump and inflated its air bladder, this was confirmed again by pressing an ear to the pressure casing. This inflation typically took less than 20 minutes. After the initial 6 transmissions the float transmitted test transmissions approximately every 45 seconds. This predeployment phase lasted 6 hours, during which time the float was deployed in each case.

The procedure of deployment would occur immediately after a CTD/VMP station was completed and the ship had begun steaming slowly to produce and effective speed through the water of around 0.5-1 knot. Usually about three to four people were present for a launch; one or two scientific staff to deploy the instrument and one or two of the deck crew to assist and communicate the progress of the deployment with the bridge. The float was prepared on deck by threading a rope through the plastic damper plate with one end of the rope attached securely to the ship with a bowline. Two people from the physics watch would lift the float over the starboard quarter, keeping it upright. One person would then steady the rope outboard of the gunwale to prevent the float from hitting the side of the ship while the other would take the weight on the rope and start lowering it slowly into the water. When the float was in the water, it was allowed to stream out behind the ship and the untied end of the rope was released to run through the damper plate and let the float go. When the rope was recovered an announcement would be made to the bridge to say all lines were clear. The time and coordinates of the float deployment were recorded.

4.5.8 Deployment issues

- During deployment of Float 5590 the untied line end became tangled and knotted on deck and could not be let go to run through the damper plate. The tied end was cut loose and the rope retrieved. No rope was left attached to the instrument. Care was taken to more carefully coil the untied rope end in subsequent deployments.

- The loose end of the rope somehow became knotted during the deployment of Float 6243 and would not run through the damper plate while the float trailed behind the ship. The float was hauled back in, the knot undone and then redeployed. The second deployment was hurried and the float was not lowered as slowly as it should have been. The float hit the water roughly, probably from a height of a metre. However, it was observed to float in the correct orientation afterwards and appeared unharmed.

Part V: Cruise Services

5.1. Technicians Report

Name of AME engineer: Julian Klepacki

Instrument	Used?	Comments
XBT (aft UIC) (PC, I/F box, handgun)		
Scintillation counter (prep lab)		
AutoSal (labs on upper deck) S/N 63360		
AutoSal (labs on upper deck) S/N 65763	Y	
AutoSal (labs on upper deck) S/N 68533		
Portasal S/N 68164		
Magnetometer STCM1 (aft UIC)	Y	Calibration performed 26/04/2013. File JR281STCMcal260413.txt
AME workshop PC	Y	Problem reading AME back-up sticks due to incompatible format between windows 7 (exfat) and XP (ntfs/fat). Upgrade workshop PC to windows 7 Would be good.

GPS, MRU, Gyro

GPS Furuno GP32 (bridge – port side)	Y	
DGPS Ashtec ADU5 (bridge – port side)	Y	
DGPS, MRU Seatex Seapath (UIC – swath suite)	Y	Seatex hung 25/04/2013. Temperature o.k; 43 degrees. Restarted and o.k.
DGPS Ashtec Glonass GG24 (bridge – starboard side)	Y	Needed Resetting a number of times early on in cruise.
Gyro synchro to RS232 Navitron NT925HDI	Y	

(UIC – aft)		
TSS HRP (UIC repeater)	Y	

ACOUSTIC

Instrument	Used?	Comments
ADCP (aft UIC)	Y	VmDAS crashed 17/04/2013 viewing 'Options' Restarted Fine.
Waterfall Hydrophone (aft UIC)	Y	Hull Transducer used for moorings release with Ixsea TT801 deck unit, worked very well.
EM122 (for'd UIC)	Y	Had to revert back to previous version, as recently upgraded (J.Robst) and problems encountered (IT activity)
TOPAS (for'd UIC)		
EPC plotter (used with TOPAS)		
EK60 (mid UIC)		
HP deskjet 1 (used with EK)		
HP deskjet 2 (used with EK)		
SSU (for'd UIC)	Y	Seems to have hung-up a couple of times during this trip. A simple restart solved it. Some confusion on the group settings for EA/EM. Instructions added to AME Wiki.
SVP S/N3298 (cage when unused)		
SVP S/N3314 (cage when unused)		
10kHz IOS pinger		
Sonardyne USBL (aft UIC)	Y	Used WSM transponder to track NOCs VPM. Performed without trouble. Cleared NavPC of old LOG files due to HD being full and hanging system.

OCEANLOGGER

Instrument	Used?	Comments
Main logging PC hardware and software	Y	
Barometer (back of logger rack) #V145002 (7/03)	Y	
Barometer	Y	

#V145003 (7/03)		
TH1, Air humidity & temp (for'd mast) #60599556	Y	TH1 dropping out and ceased functioning completely. Started dropping out once we were in fog. Moisture ingress into connector presumed. Will rectify in Immingham after forehead works complete.
TH2, Air humidity & temp (for'd mast) #60599558	Y	
Thermosalinograph SBE45 (prep lab) #4524698-0016		
Thermosalinograph SBE45 # 4538936-0130	Y	Replaced 18/03/2013 as reported to be drifting by M. Yelland (NOC).
Thermosalinograph SBE45 #4524698-0018	Y	Fitted 18/03/2013. Cal runs out Aug 2013.
Uncontaminated seawater temp SBE38 #		
SBE45 + SBE38 Interface #		
Fluorometer (prep lab)	Y	
Transmissometer C-STAR CST-396DR	Y	
TIR sensor (pyranometer) (for'd mast) #112993 TIR1	Y	
TIR sensor #112992 TIR2	Y	

OCEANLOGGER – cont.

PAR sensor (for'd mast) #110127 PAR1	Y	
PAR sensor #110126 PAR2	Y	
Flow meter + Transmitter (prep room) #11950	Y	Appears to have suffered leaks. Considerable salt/deposit build-up around meter body? Investigate at refit.
Uncontaminated	Y	

seawater temp (transducer space)		

CTD (all kept in cage/ sci hold when not in use)

Instrument	**Used?**	**Comments**
CTD PC	Y	
Deck unit 1 SBE11plus S/N 11P15759-0458		
Deck unit 2 SBE11plus S/N 11P20391-0502	Y	
Underwater unit SBE9plus #09P15759-0480 Press #67241		
Underwater unit SBE9plus #09P20391-0541 Press #75429		
Underwater unit SBE9plus #09P30856-0707 Press #89973	Y	
Underwater unit SBE9plus #09P35716-0771 Press #93686		
Carousel & pylon SBE32 #3215759-0173		
Carousel & pylon SBE32 #0248		
Carousel & Pylon 24 Bottle #0636	Y	
CTD swivel linkage	Y	
CTD swivel S/N196115	Y	On Stainless frame. Replaced 13/04/13. Fails Insulation tests. See notes.
CTD swivel S/N196111	Y	Fitted to Stainless frame 13/04/13.

CTD contd – C & T & pumps – please state which primary and secondary

Temp sensor SBE3plus #03P2191		
Temp sensor SBE3plus #03P4874		
Temp sensor SBE3plus #03P5623	Y	Primary

Temp sensor SBE3plus #03P5645	Y	Secondary, Replaced 24/04/2013. ~1m°C T1±T2 diff.
Temp sensor SBE3plus #03P2366		
Temp sensor SBE3plus #03P2307	Y	Fitted 24/04/2013. Closer meas. to Pri-temp <1m°C diff.
Temp sensor SBE3plus #03P2705		
Temp sensor SBE3plus #03P2709		
Temp sensor SBE3plus #03P4235		
Temp sensor SBE3plus #03P4302		
Cond sensor SBE4C #044126	Y	Primary, iced-up late morning of 30/03/13. defrosted and used for remaining of day. changed evening 30/03/13, as drift increasing. See notes.
Cond sensor SBE4C #044087	Y	Secondary. Replaced 22/03/2013, 0.01 drift from primary. Refitted 02/04/13.
Cond sensor SBE4C #043248	Y	Secondary, Fitted 22/03/2013. Replaced 01/04/2013 Drift.
Cond sensor SBE4C #041912		
Cond sensor SBE4C #042248		
Cond sensor SBE4C #042222		
Cond sensor SBE4C #041913	Y	Primary, Fitted 30/03/13
Cond sensor SBE4C #042255		
Cond sensor SBE4C #042289		
Cond sensor SBE4C #042813	Y	Secondary. Fitted 01/04/13. Replaced 02/04/13. Drift, then no output on bench test.
Cond sensor SBE4C #042875		
Pump SBE5T # 51807	Y	Sec. Fitted 30/03/13
Pump SBE5T # 54458	Y	Pri. Fitted 30/03/12
Pump SBE5T # 54709	Y	Primary. Appeared to develop fault. see notes Impeller circlip missing.
Pump SBE5T	Y	Secondary, changed as matter of course.

# 54488		
Pump SBE5T # 52371		
Pump SBE5T # 52395		
Pump SBE5T # 52400		
Pump SBE5T # 53415		

CTD contd

Instrument	**Used?**	**Comments**
Fluorometer Aquatracka MkIII #0088-3598C		
Fluorometer Aquatracka MkIII # 12_8513_03	Y	
Fluorometer Aquatracka MkIII #088249		
Standards Thermometer SBE35 #3515759-0056	Y	
Standards Thermometer SBE35 #3515759-0005		
Standards Thermometer SBE35 # 3527735-0024		
Standards Thermometer SBE35 # 3535231-0047		
Altimeter PA200 #2130.26993		
Altimeter PA200 #7742.163162		
Altimeter PA200 #244738		
Altimeter PA200 #244739	Y	Installed as of beginning of cruise. Failed 29/03/13. Outputs ~0.7 volts on the bench, shows const. 10m on Seasave.
Altimeter PA200 #244740	Y	Fitted 29/03/13 to replace #244739. Working fine.
Altimeter PA200 #2130.27001		

Transmissometer C-Star #CST-1279DR		
Transmissometer C-Star #CST-527DR	Y	
Transmissometer C-Star CST 846DR		
Oxygen sensor SBE43 #0242		
Oxygen sensor SBE43 #0245		
Oxygen sensor SBE43 #0620		
Oxygen sensor SBE43 #2290	Y	
Oxygen sensor SBE43 #0676		
PAR sensor #7235		
PAR sensor #70441	Y	
PAR sensor #7252		
PAR sensor #7274		
PAR sensor #7275		
LADCP #14443	Y	Master. 118 casts, no problems with beams.
LADCP #15060	Y	Installed 16/03/13 as slave, shows beam 3 problems. Removed 18/03/13. See notes.
LADCP #14897	Y	Fitted 18/03/13 Slave/Upfacing. Removed 22/03/13 due to spectra density difference between master and slave? Fitted WHOI LADCP #3441. #14897 refitted due to WHOI #3441 firmware too old to accept scripts. Removed on 11/04/13 as beam2 shows weakness. Fitted NOC unit #13400. NOC unit failed 19/20/04/2013. Beams 2 & 3. Fitted WHOI/Lamont unit .
LADCP Battery Pack	Y	
AME Laptop (BBTalk)	Y	Old Dell lent out for serial port work with Argo-floats.

CTD contd

Notes on any other part of CTD e.g. faulty cables,		Lanyards tight (but still usable) with larger rosette and offset pylon due to NOC frame being used.

wire drum slip ring, bottles, swivel, frame, tubing etc.		Replaced bottle #17 and #21 due to leaks. All O-rings replaced on bottles for vacuum-oven-dried/cleaned, but used ones.

AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	Used?	Comments
EA600 (bridge and UIC remote)	Y	
Anemometer	Y	
Gyro	Y	
DopplerLog	Y	
EMLog	Y	
CLAM winch monitoring system	Y	

At the end of the cruise, please ensure that:

- the XBT is left in a suitable state (store in cage if not to be used for a while – do not leave on deck or in UIC as it will get kicked around). Remove all deck cables at end of cruise prior to refit.
- the salinity sample bottles have been washed out and left with deionised water in – please check this otherwise the bottles will build up crud and have to be replaced.
- the CTD is left in a suitable state (washed (including all peripherals), triton + deionised water washed through TC duct, empty syringes put on T duct inlets to keep dust out and stored appropriately). Be careful about freezing before next use – this will damage the C sensors (run through with used standard seawater to reduce the chance of freezing before the next use). Remove all the connector locking sleeves and wash with fresh water. Blank off all unconnected connectors. See the CTD wisdom file for more information. If the CTD is not going to be used for a few weeks, at the end of your cruise please clean all connectors and attach dummy plugs or fit the connectors back after cleaning if they are not corroded.
- the CTD winch slip rings are cleaned if the CTD has been used – this prevents failure through accumulated dirt.
- the SVP is left in a suitable state (washed and stowed). Do not leave this on deck without a cover for any length of time as it rusts. Stow inside at end of cruise.
- all manuals have been returned to the designated drawers and cupboards.
- you clean all the fans listed below every cruise or every month, whichever is the longer.

<u>Please clean the intake fans on the following machines:</u>

Instrument	Cleaned?
Oceanlogger	N
EM120, TOPAS, NEPTUNE UPSs	N
Seatex Seapath	N
Topas tweendeck	N
EM120 Tween deck	N

Additional notes and recommendations for change / future work

AUTOSAL
Recommend setting up Autosal with dedicated PC to run interface-logging software. Either OSIL ACI2002, software or the NMFS Labview based vi. I have obtained a copy of the NMFS 'vi'. Believe it will improve Autosal stations having this setup as an option.

CTD
The SBE4C conductivity sensors #044126 and #044087 both introduced an 0.01 offset into the salinity measurement. This was discovered by comparing Autosal, CTD and post processing measurements. At first it was considered cal coefficients were entered incorrectly. Serial numbers and coefficients all confirmed O.K, so secondary SBE4C was swopped over for unit #043248. Salinities now for this secondary unit correlate for all measurements obtained; CTD, Salinity, post processing etc. Primary SBE4C #044126 replaced due to icing and then showing drift. Secondary SBE4C #043248 replaced with #042813 due to showing drift.

Conductivity cells availability was being depleted, so some tests/cleaning were done to gauge which units to put back into service. SBE4C #044126,043248,044087 were bench tested with sea-standard water of known measured conductivity (42.688mS/cm at 24^{o}C). Then cleaned by soaking with 1% triton-milliQ solution, flushed and then re-tested with same water. Pre-flush average difference between cells was 0.0847 S/m. Post-flush average difference was 0.0047 S/m. C-cell #044087 (0.01 offset) put back into service as secondary.

SBE4C History
Secondary #044087 Removed 22/03/13. Refitted 02/04/13.
Secondary #042813 Fitted 01/04/13. Replaced 02/04/13. Drift, then no OP on bench.
Secondary #043248 Fitted 22/03/13. Replaced 01/04/13. Drift
Primary #041913 fitted 30/03/13. Remained good.
Primary #044126 fitted as of start. Replaced 30/03/13. Iced + Drift.
Secondary #044087 fitted as of start. Replaced 22/03/13. Drift.

CTD Swivel
Occasional spikes/noisy data we experienced with the alarm sounding in one instance. Insulation testing (megohm) the seacable returned exceptionally low values of resistance; 200kΩ at 1kV. First off the slip rings were checked. These were found to have deposits of carbon dust from the brushes. This was blown off and the contacts cleaned as matter of course.

Seacable resistance now acceptable;
250V: fluctuates at 700-1000MΩ, then settles at >1GΩ.
500V: fluctuates at 1-2GΩ, then settles at >2GΩ.
1kV: fluctuates at 2-3GΩ, then settles at >4GΩ.

I tested through the rest of the system; with SBE9 isolated i tested resistance with swivel #196115 connected. This returned low values:
250V: 100-200MΩ
500V: ~50MΩ
1kV: ~30MΩ

I was expecting readings to be out of range. I measured the other swivel #196111 for comparison. Swivel documentation states >500MΩ at 1kV for insulation test pass. This returned as expected, >1GΩ, >2GΩ and >4GΩ for 250V, 500V and 1kV respectively. Swivel #196111 replaced #196115.

Patch cable for between swivel and sbe9 was also tested and returned good results >1, >2 and >4GΩ for respective voltage values.

<u>CTD Bottles</u>
On a couple of occasions CTD bottle(s) have dislodged themselves from the top-mount and are only held in place by the lower-mount-pin. I have never seen this happen before, maybe it is due to the NOC frame in some capacity. As a chord is used to 'lace' through the inner brackets of the bottles and secure by tying to frame. So it is something experienced previously. BAS CTD frame to my knowledge has never implemented this additional security, but could be something to start doing. Recommend a complete overhaul of bottles; labels, re-lanyard, seals etc of bottles once we get our own frame back.

<u>LADCP</u>
LADCPs continue to give problematic service. Unit #15060 was added as slave/up-facing and after the first test station (JR281_001) was shown to have a weak beam 3. Figure 1 shows the echo amplitudes for individual beams obtained from the raw data captured at first test station. The yellow trace is beam 3 and can be seen to be significantly lower than the other beams that compare with each other.

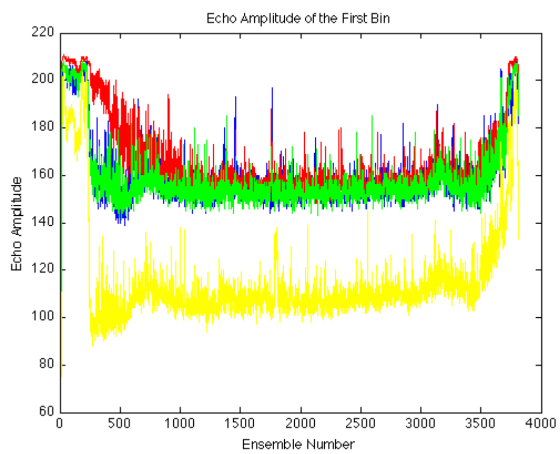


Figure 1. LADCP #15060 Beam Echo Amplitudes

As a comparison I ran the raw data of the test station cast through WinADCP. Figure 1 plot was obtained by academic third-party written software. Figure 2 shows the results from WinADCP. Beam 3 problem is easily seen looking at the beam intensity and correlation profiles. They should ideally all fall on-top of each other, like Figure 3 illustrates.

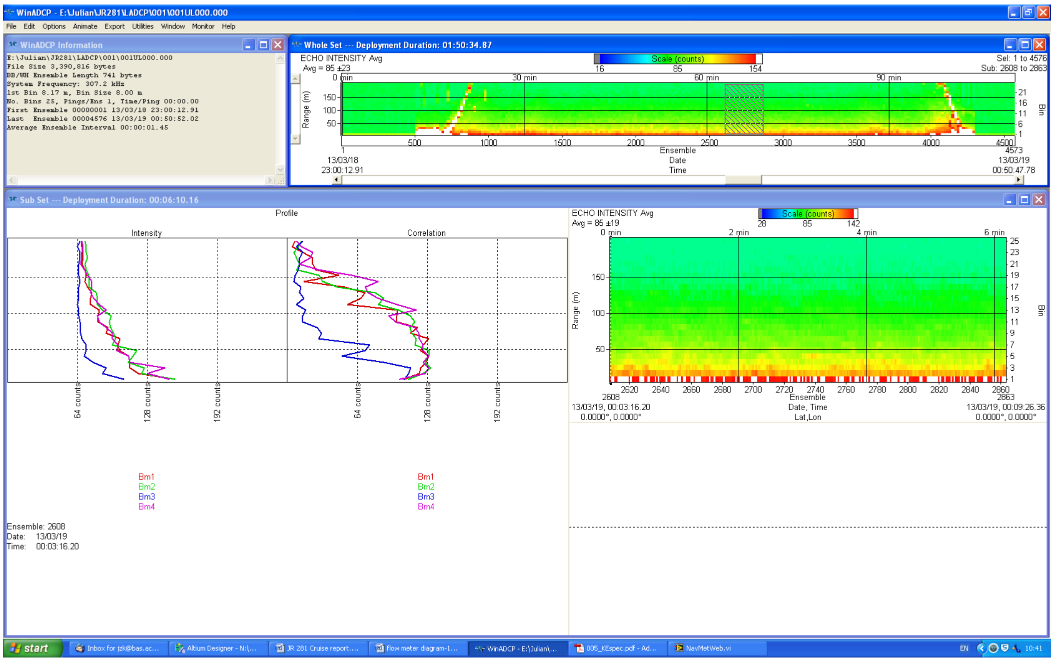


Figure 2. #15060 WinADCP results for test station (JR281_001) data

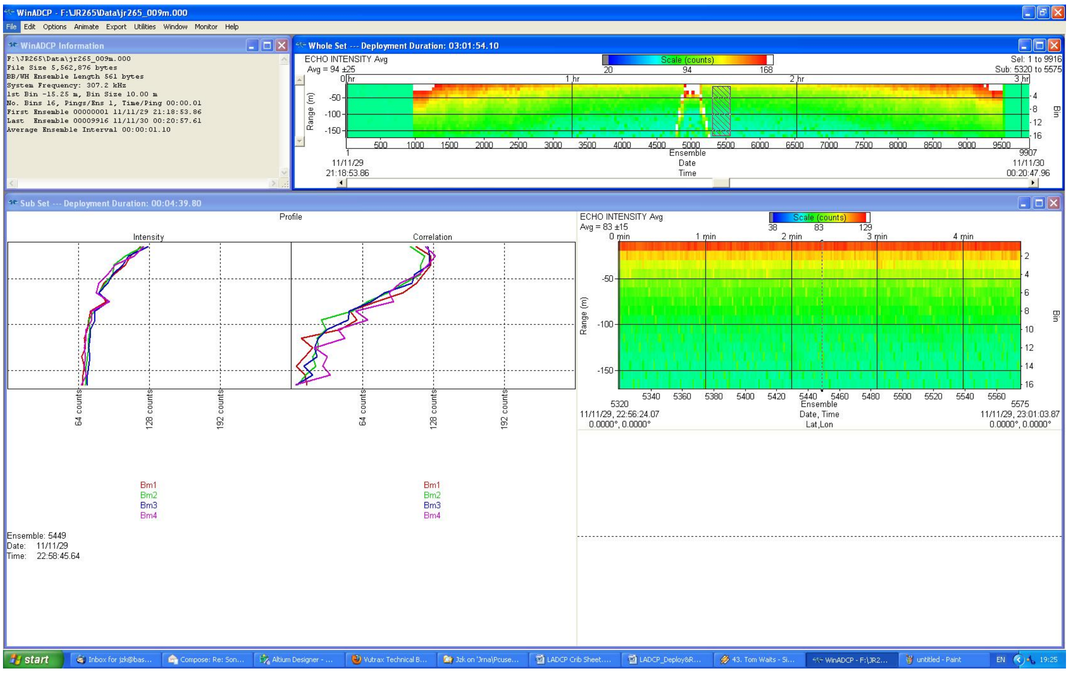


Figure 3. Example Correct operation of LADCP; Intensity and Correlation profiles in-line.

Unit #15060 was removed with unit #14897 fitted. Unit #14897 operated for approximately 17 casts, a portion (~10) of them deep 3k5-4k2m without identified problems. It was then considered that there 'might' be an issue with the unit #14897. This was pointed out after data obtained was processed independently and remotely by operator's supervisor. The 'potential' problem was that the received spectra between the two units; #14443 (DownLook) and #14897 (UpLook) did not look satisfactory, Figure 4 shows results. These were expected to be closer together, inline etc. Unit #14897 is considered 90+% likely to be O.K, but further investigation should be carried for AME's own conclusions. Consulting Teledyne on these matters are necessary to identify if this is in fact a problem or as expected. Unit #14897 has been removed and replaced by a WHOI unit, but then swopped back to #14897 as the WHOI unit firmware was too old to accept third-party script commands.

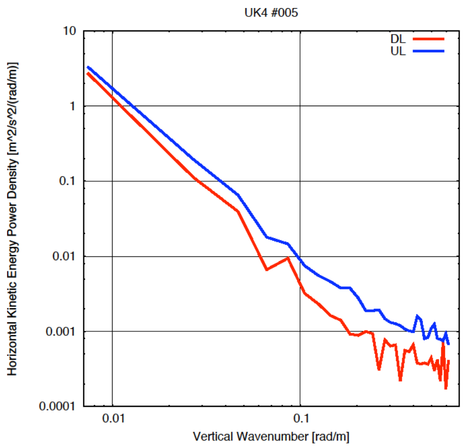


Figure 4. #14443 (DL) & #14897 (UL) spectra comparison.

LADCPs rotated slightly ~22^0 (UL) and ~45^0 (DL). This evidently made a difference. Hypothesis is units experience interference from CTD seacable or 'wake' from carousel. Figures 5 and 6 show cast results pre and post LADCP shift and difference rotating units made. Need more understanding on this, somewhat unclear from user.

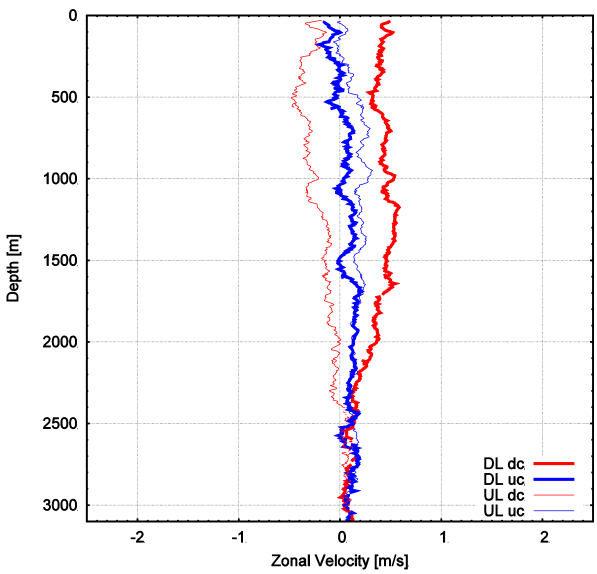


Figure 5. LADCP cast with CTD 'wake'

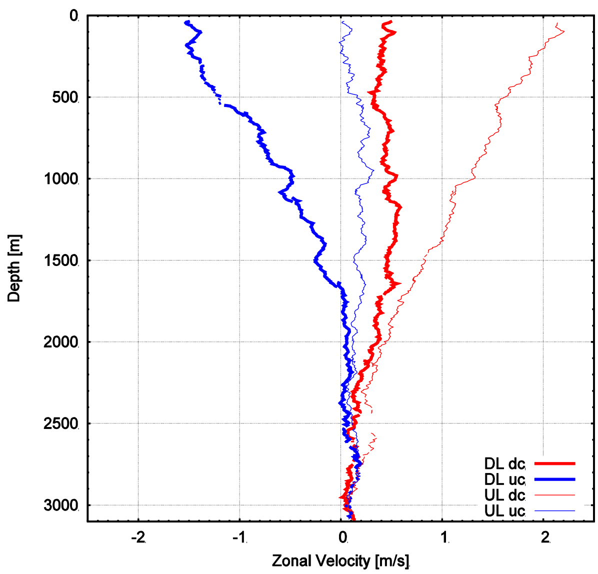


Figure 6. LADCP cast without CTD 'wake'

On the 11/04/2013 unit #14897 was removed as beam 2 shows weak intensity. Figure 7 shows weak beam 2 data as obtained from WinADCP. NOC unit #13400 was fitted. NOC unit #13400 failed beam 2 and 3 20/04/2013.

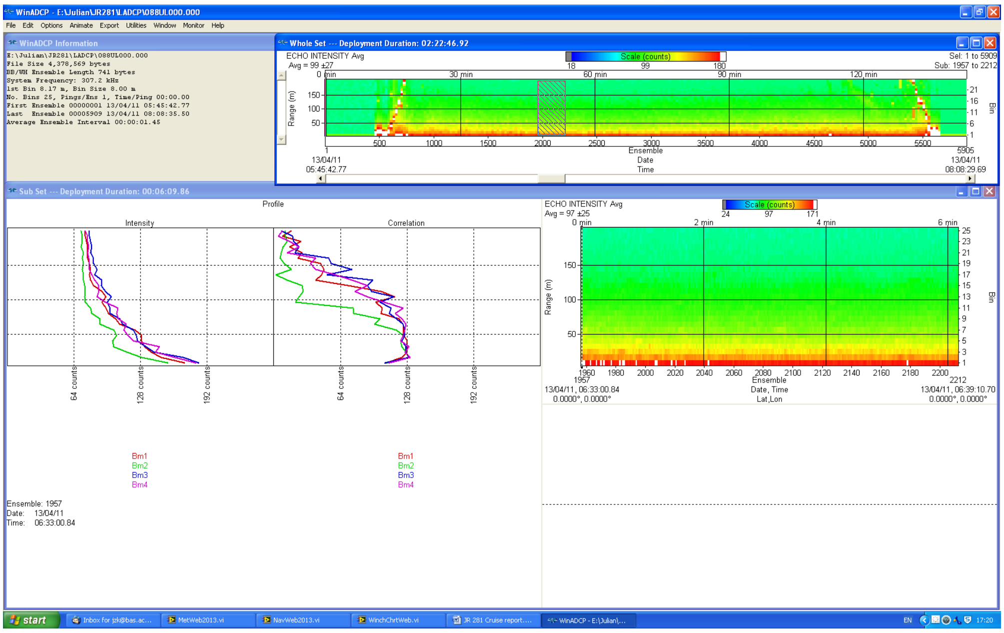


Figure 7. #14897 weak beam 2. JR281 cast 088.

<u>LADCP History</u>
#14443 Fitted as master (DF).
#15060 Fitted as slave (UF) 16/03/2013. Removed 18/03/2013, weak beam 3 (Fig. 1&2)
#14897 Fitted as slave 18/03/2013, Removed 22/03/2013, density mismatch (Fig. 4).
#3441(WHOI) Fitted as slave 22/03/2013, Removed 22/03/2013. Firmware too old.
#14897 Fitted as slave 22/03/2013, Removed 11/04/2013, weak beam 2 (Fig. 7).
#13400(NOC) Fitted as slave 11/04/2013. Removed 20/04/2013
Lamont/MIT unit fitted and used for remainder of cruise.

Apparently TRDI have created a 100% uncompressible potting solving the historical problem of beams failing. So far 2013 (3 months) has seen 110 LADCP units in use with new compound, and no reported fails.

<u>TH1</u>
Ocean Logger Temp and humidity 1 sensor continues to drop out once it has been in damp conditions (fog). I suspect that the instrument connection has become susceptible to water ingress. The complete Met/Solar instruments are being removed in Los Palmas for ship-works. During this time they will be investigate and problems rectified.

<u>SBE5T</u>
CTD station 42 pumps failed to run. This was due to ice in the Primary conductivity cell #044126 being iced-up. Ice was removed and CTD re-cast. On re-cast the alarm sounded. Data-Word ‘B’ displayed 0001, one operator stated he saw the word go from 0010 to 0000 before changing to 0001. Data-word LSB is pump status; 0=off, 1=on. Second bit is bottom-

contact, 0=closed, 1=open. Error experienced implied ‘bottom-contact’. Third-bit is water-sampler-pylon interface ‘confirm’ signal, 1=confirm. MSB is modem-carrier-detect signal, 0=carrier, 1=no carrier

Seacable tested (megohm) and tested o.k. All connectors for pumps, CTs and Bottom-contact were checked, re-greased etc. Bottom-contact dummy plug was in good condition and internally dry.

CTD recast, this time instantly as pumps came on data-word ‘B’ went from 0010 to 0001 and alarm sounded.

Pumps disconnected from SBE9 and C cells loaded with seawater. Deck unit powered up after short delay pump signal came on data-word 0010 to 0011, no alarms. Re-connect to pumps and repeat tests, same results; normal operation. Fault could not be repeated on deck. Pump investigations showed primary pump impeller ‘seized’ with ice. Pumps changed for elimination. Deck tests showed both pumps operational, correct data-word, no alarms.

Cables were considered to be OK, but cable tests/replacements next option after pumps eliminated.

CTD recast and this time performed without problems.

Seabird support conclude moisture ingress into bottom-contact, even if it ‘looks’ dry. Not sure what was happening, but I think the bottom-contact error was misleading, somehow caused by something else. Problem did not reoccur.

5.2. IT Report

R. Cable

Netware system
Netware presented no problems during the cruise

Unix Systems
All UNIX systems on board presented no problems during the cruise.

Linux Systems
Linux Systems, including AMS3, jrla, jrlb presented no problems during the cruise.
AMS syncing on schedule but from time to time individual users would wait several hours at a time as the system presumably struggled with large quantities of mail, and or large attachments.

SCS
Continuous acq started 17th March 2013
All back end processes, scs to levc, raw2compress, and web displays presented no problems.
Jred to change legs for next cruise.
Acq stopped 27th April 20123

Em120
The upgrade to 3.9.2 had caused the grid engine to fail.
So restored server back to version 3.8.2 with image of old server, grid engine then working ok.

ADCP
Rebooted on the 17th April 2013, restarted and selected control file
JR 800m WaterTrack 8mBins NotThruSSU to gain pings back from hardware.

SSU
No pings were being received; SSU had hung so restarted 4th April 2013.

Seatex
Hung 25th May, no data received. Power cycled both units and data flow was restored.

Net Gear switch
Switch auto negotiation failed, switch swapped out and network now ok.

5.3. Data management

Gwen Buys

Event Logs

The event log webapp system (http://eventlog.jcr.nerc-bas.ac.uk/eventlog/analyst/view_logs) was used extensively throughout the cruise. At the beginning of the cruise individual event logs were created for the following instruments: EM122, CTD, VMP, ADCP and ARGO. Additionally a General Info log was created to record any information which did not obviously fit into the individual logs.

Throughout the cruise the majority of the logs were regularly updated to detail events such as time in and out of water, start and end of data logging and any other incidents relating to the equipment.

At the end of the cruise each log was exported to a csv format file and saved to the legwork directory.

Deployment Log

As initially trialed during JR259-275-255B last season an Excel based deployment log was created for JR281 to keep a record of all physical events / deployments from the ship. The log recorded the location, start time, end time (only if applicable) and depth of each deployment. The information was added to the log manually using a combination of reference to the online event logs for individual instruments and reference to the bridge science log. The deployment log was designed from a similar log used by the British Oceanographic Data Centre (BODC) and each instrument was referenced with a gear code taken from a list devised by BODC (the gear code for the VMP equipment was not know and will need to be updated once back in the office).

Although this was a trial and the addition of data to the log was time consuming it is hoped that keeping records in this way will aid the transfer of metadata to BODC. If this trial is deemed useful by BODC then the aim is to create a database version which can be automatically updated from the individual instrument logsheets.

The deployment log exists as a separate document entitled: deployment_list_jr281.xls