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Voyage: Sustained Monitoring of the East Australian Current: mass, heat and freshwater transports

Voyage period

Start: 20/08/2013 End: 03/09/2013 Port of departure: Brisbane, Australia Port of return: Brisbane, Australia

Responsible laboratory

CSIRO Marine and Atmospheric Research Castray Esplanade, Hobart, Tasmania, Australia

Chief Scientist

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Scientific Objectives

The East Australian Current (EAC) is a complex and highly energetic western boundary system in the south-western Pacific off eastern Australia. It provides both the western boundary of the South Pacific gyre and the linking element between the Pacific and Indian Ocean gyres. This voyage will retrieve an array of full-depth current meter and property (CTD) moorings from the continental slope to the abyssal waters off Brisbane (26° S). At this location the EAC, north of the high eddy variability, the approaching its maximum strength and its flow is relatively uniform and coherent. The aim of this observing system is to capture the mean and time-varying flow of the EAC. The array is a component of IMOS, and will provide an intensive reference set of measurements of the EAC flow over sustained period for monitoring EAC transport, improved understanding of relationship of EAC and the South Pacific gyre and impact of the coastal marine ecosystem and the validation and interpretation of the current system in numerous climate and ocean models. The mooring array is located on the existing long-term XBT transects, satellite altimetry and glider tracks. The EAC deep mooring array is complemented by a Queensland- IMOS operated inshore mooring array on the continental shelf region which has already been recovered.

Voyage Objectives

The main aim of the voyage will be to retrieve an array of (5) full-depth current meter/CTD moorings extending from the continental slope to the abyssal waters off Brisbane. The following specific objectives will be performed:

- 1. Complete ADCP sections from inshore to offshore
- 2. Complete CTDs (plus LADCP) along section steaming from inshore to the offshore mooring
- 3. Complete CTD/rosette station at each location with LADCP.
- 4. Retrieve each of the moorings at deployed locations.
- 5. Complete a final ADCP section along the mooring line

Results

All objectives of the voyage were completed successfully. The central aim was to recover 5 deepwater moorings which captured the flow of the EAC adjacent to Brisbane and which were deployed in April 2012. A combination of a very professional, well organized mooring team, a highly supportive ships master and crew, a good stable platform and excellent weather ensured that all tasks were completed with a minimum of fuss.

Each of the 5 mooring recoveries turned out to be quite straightforward. This was due to a combination of the well prepared, highly competent mooring team and the ideal weather conditions. The 5 moorings were recovered virtually intact apart from the upper beacon on moorings 3 and 4 and a Seabird CTD on mooring 3. The presence of longline fishing gear and hooks on both moorings strongly suggested that these missing instruments were removed by persons unknown presumably while attempting to disentangle fishing line from the moorings. We were very pleased to note that nearly all of the instruments have collected data with no sign of battery failures, and with a limited number of the Starmon temperature sensors showing signs of erroneous data.

As the data processing from the moorings will not be completed for some months no results are yet available from these deployments. However, a range of supplementary measurements were made during the voyage including CTDs, LADCP profiles, shipboard ADCP and standard underway observations. These data provide a comprehensive picture of the state of the EAC system east of Brisbane. Figure 1 shows the surface current field, SST of the Coral Sea region as determined from satellite observations. A strong EAC is seen to be pushing southwards advecting warm surface water all along the eastern Australian coast south of 24°S. The voyage track off Brisbane cuts across this southward flow and into a region of northward return flow east of 155°E.



Figure 1: The surface geostrophic velocity (arrows) derived from satellite altimetry (sea level anomaly) plus a mean dynamic height field (CARS). The filled contours show the satellite SST and the white contours indicate the sea surface topography (m). All results apply to 25-August 2013 which is the mid-point of the voyage.

Before, during and following the mooring recoveries we completed 8 separate ADCP transects of the array section over a period of 8 days (Figure 2). We observe the main EAC southward core positioned west of 154.8° E with strongest surface currents at 154° E of up to 1.5ms⁻¹. A northward return flow east of 155° E, appears to grow in strength over the week of the transects. There are indications of a northward undercurrent below 400-m on the slope. These results confirmed that our 5 moorings were located suitably to sample changes in the structure of the EAC from inshore to offshore. We have also clearly captured the full offshore extent of the current. However, we will use the results from this set of data to fine-tune the locations of the moorings. In particular, there may be some slight rearrangement of the inshore (coastal) moorings. Figure 2 also shows the very dynamic nature of the EAC at this location. All of the EAC features show distinct changes within the week of observation. We await the processing of the mooring data to provide a detailed description of these temporal changes in the current.



Figure 2: The left panels show the meridional component of velocity from the shipboard ADCP for the 8 separate transects. The right panels show the meridional velocity anomaly for the same transects. The mean velocity obtained from the 8 transects have been removed to create the anomalies.

Voyage Narrative

We left Brisbane at 1200 on Tuesday August 20 after loading issues delayed the planned 1000 departure the day before. The weather was very good with bright sunshine and blue skies, and wind below 5 knots. Following the passage down the Brisbane River, the pilotage was completed at 1700 and the ship proceeded to the start of the first section at the North Stradbroke National reference Station (NRS). This initial transect was commenced at 2100. The wind had strengthened to about 20 knots after leaving the river although the conditions remained smooth. Over the inshore portion of the section the sea state increased due to the EAC lying close to the continental slope. This was clearly indicated by the ADCP data.

A CTD toolbox was held at 0630 on Wednesday in preparation for a test CTD cast. This was planned to test the spooling of the CTD winch, and to ensure that all of the Niskins were watertight. Further training in CTD operation for the first timers was carried out at 0830 and the CTD was commenced at 0920. Following the test CTD a further return ADCP transect was completed bringing the ship back to the inshore end of the section at the NRS location. Over these two transects the weather had settled into a very stable pattern with wind generally below 10 knots and only a very slight swell. A full CTD section was then collected as a reference dataset for the mooring array. From Wednesday evening to late on Friday, 12 full-depth CTD casts were completed ranging from 100 to 4700-m depth. The EAC was particularly strong at this time with surface currents greater than 1.5 ms⁻¹ observed. Within the strongest portion of the current it was difficult for the ship to maintain station resulting in both it drifting from the nominal station location and also for the CTD wire angle to increase. Unfortunately this extreme wire increase resulted in some loss of LADCP data at these locations. At each of the CTDs an XBT comparison was carried out. The procedure consisted of launching 3 XBTs just prior to the CTD going into the water with 3 further deployments as it entered the water. In general this was performed without problem, but during very calm conditions, there was a tendency for the XBT wire to drift under the ship. On at least one occasion this resulted in the wire being attached to the CTD line and subsequently wound onto the winch. Fortunately, vigilant winch operators identified any problems before any damage occurred.

In preparation for the commencement of the mooring recovery a toolbox meeting was held at midday on Friday (August 23). The various safety procedures were outlined and the absolute condition that only both essential and fully trained personnel were to be on the back deck during the recovery was emphasized. Following the completion of the final CTD at 1900 the ship proceeded to the location of the inshore mooring. A further CTD was completed at this location (1500-m depth) and the recovery was commenced at 0800. With the weather remaining perfect for the mooring team the day proved to be very productive. Both mooring 1 and 2 were successfully recovered. There was some delay in initially locating mooring 2 after the release was fired. However, after 45 minutes the eagle eye of the chief scientist successfully identified its position.

With the weather continuing to provide near perfect conditions the voyage entered into an efficient and very productive pattern. Overnight, we steamed either inshore or offshore along the section from the recovery position with the ADCP operating, ensuring that at about 0500 the ship was at the location of the next mooring to be recovered. A CTD was then completed and the recovery commenced at a civilized time

in the morning following breakfast. After recovery, and following the removal of any marine growth from the instruments, the download of data was commenced almost immediately. On Sunday (August 25) mooring 3 was recovered. We quickly realized once the mooring had come to the surface that some equipment was missing. Both the top beacon and Seabird CTD that was closely attached were missing. A large amount of long-line fishing gear, including actual fishing line and hooks were tangled through the upper section of the mooring. Since the shackle that connected the beacon and CTD was also missing, we determined that it was most likely that the loss of these items was actually the result of some human intervention rather than due to equipment failure. The recovery team also was faced with the task of handling a large amount of tangles in the Dynnex line that was used on the lower section of the mooring.

We approached the recovery of mooring 4 on Monday August 27 with some trepidation as there was considerable doubt over it being still in position. About a month after the deployment in April 2012, the upper beacon had reported in several times, which indicated that it was breaking the surface, a phenomenon that due to the design, should have been impossible. Then two further reports indicated at least some portion of the mooring was some 250-km to the southeast. The excitement in the team certainly built up as in quick succession, we observed that the mooring release was still active, that it had been triggered successfully, that the mooring had reached the surface and finally that it was virtually intact. Upon inspection of the mooring we ascertained that the upper beacon was again missing (including the shackle) and there was plenty of long-line gear attached to the mooring. We again surmised that whatever agency had been responsible for the missing gear on mooring 3 had also removed the beacon on this mooring. Apart from being very pleased that we had retrieved all the instruments the team was also very satisfied that the design and implementation of the mooring had been vindicated and any losses were due to human intervention beyond our control.

After the excitement of the previous day, the recovery of the final mooring on Tuesday August 28 seemed almost routine. However, we were thankful for the continued stable weather, and recognized that the smooth operation was only due to the skill of the moorings team and crew and also the meticulous preparation carried out prior to the voyage. At this stage of the voyage the main scientific aims had been achieved. All 5 moorings recovered, no serious losses of equipment and a quick assessment of the data collected showed it was of high quality with very few instrument or battery failures. With some voyage time still available we devised a further set of observations to supplement and extend the value of the array data. Three further ADCP sections parallel to the array section were completed. One to the south and two in the north. One of these followed the beginning of the long-term high resolution PX30 XBT section from Brisbane to Fiji. A further set of 10 CTD casts, were completed on this track at the locations which have been occupied on two previous occasions. These observations were completed from Wednesday to Sunday. The ship met the pilot at 0700 and reached the FORGACS jetty on schedule at 0230 on Monday September 3.

Summary

All objectives of the voyage were completed successfully. The central aim was to recover 5 deepwater moorings which captured the flow of the EAC adjacent to Brisbane. A combination of a very professional, well organized mooring team, a highly supportive ships master and crew, a good stable platform and excellent weather ensured that all tasks were completed with a minimum of fuss.

Project name

Improving the understanding and prediction of ocean currents and the links between large-scale offshore variability and the response of the Australian shelf/slope boundary current system

Coordinating body

Integrated Marine Observing System, Science and Implementation Plan

Project name

SPICE Observation Network

Coordinating body

South Pacific Climate and Circulation Experiment (SPICE)

PRINCIPAL INVESTIGATORS

- A. Ken Ridgway, CSIRO Marine and Atmospheric Research
- B. Bernadette Sloyan, CSIRO Marine and Atmospheric Research



GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED

				MOORI	NGS, E	юттом	MOUN	TED GEAR AI	ND DRIFTING SYSTEMS
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Item No	PI	dea	Latitude min	N/S	dea	Logitude min	F/W	Data Type	DESCRIPTION
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1	А, В	27	18.6	S	153	58	E	D01, D71, H10, H72	Mooring deployed 21/04/2012, includes ADCP, current meters, CTDs, and temperature sensors. See Appendix 2 for detailed instrument configuration
2	А, В	27	18.4	S	153	59.5	E	D01, D71, H72, H10	Mooring deployed 22/04/2012, See appendix 2 for details
3	А, В	27	15.1	S	154	17.4	Е	D01, D71, H72, H10	Mooring deployed 23/04/2012, see appendix 2 for details
4	А, В	27	12.5	S	154	38.8	E	D01, D71, H72, H10	Mooring deployed 25/04/2012, see Appendix 2
5	А, В	27	6.1	S	155	18.0	E	D01, D71, H72, H10	Mooring deployed 26/04/2012, see Appendix 2

			SUMMARY	OF MEASU	JREMENTS AND SAMPLES TAKEN
Item No.	PI	No.	Units	Data Type	DESCRIPTION
6	А, В	10	days	H71	Changes in surface <i>T</i> , <i>S</i>
7	А, В	5	stations	H09	Calibration of CTD sensors
8	А, В	14	stations	H10	Describe EAC water mass structure from T, S, O ₂ .
9	А, В	10	days	D71	Underway shipboard ADCP, resolving EAC flow
10	А, В	14	stations	D71	Lowered ADCP, resolving EAC, calibration of mooring ADCP obs
11	А, В	10	days	M06	Routine measurements
12	А, В	5	stations	H21	Document water mass structure
13	А, В	5	stations	H22	Document water mass structure
14	А, В	5	stations	H24	Document water mass structure
15	А, В	5	stations	H26	Document water mass structure
16	А, В	10	days	G74	High-res bathymetry, mooring deployment
17	А, В	10	days	H74	Underway PCO ₂

Curation Report

ltem No.	DESCRIPTION
1	Data accessed from all intruments. On completion of data processing & QC, data will be archived at CMAR Data Centre and Australian Ocean Data Network (AODN)
2	As above
3	As above
4	As above
5	As above
6	Archived at CMAR Data Centre
7	As above
8	As above
9	As above
10	As above
11	Archived at CMAR Data Centre, AODN
12	Archived at CMAR Data Centre
13	As above
14	As above
15	As above
16	As above
17	Archived at CMAR Data Centre, AODN



General ocean area(s): Coral Sea, Pacific Ocean Specific areas: Continental slope and abyssal plain east of Brisbane, Coral Sea

Voyage track chart

Personnel list

Scientific Participants

Name	Affiliation	Role
Ken Ridgway	CMAR	Chief Scientist
Bernadette Sloyan	CMAR	Co-investigator
Phil Adams	CMAR	Moorings
Dan McLaughlan	CMAR	Moorings
Jamie Derrick	CMAR	Moorings
Rebecca Cowley	CMAR	Moorings
Pamela Brodie	CMAR	MNF Voyage Manager
Peter Dunn	CMAR	MNF Electronics Support
Hugh Barker	CMAR	MNF Computing Support
Sue Reynolds	CMAR	MNF Hydrochem Support
Alicia Navidad	CMAR	MNF Hydrochem Support
Chris Bull	Student/UNSW	Moorings support, CTD
Sjoerd Groeskamp	Student/UTAS	Moorings support, CTD
Andreas Marouchos	CMAR	Moorings engineering

Marine Crew

Name	Role
Mike Watson	Master
John Boyes	1st Mate
Simon Smeaton	2nd Mate
Nick Fleming	Chief Engineer
Mike Yorke-Barber	1st Engineer
Mike Sinclair	2nd Engineer
Graham McDougall	Bosun
Rebecca Lee	Chief Cook
Aaron Buckleton	2nd Cook
Cassandra Rowe	Chief Steward
Rod Langham	IR
Kel Lewis	IR
Doug Hawes	IR
Pete Taylor	IR

Acknowledgements

Funding of the EAC mooring array was provided by the Integrated Marine Observing System (IMOS). This project forms a central component of the IMOS boundary current monitoring array. Additional support was provided by the CSIRO, Wealth from Oceans Flagship. KRR was supported by the Australian Climate Change Science Program (ACCSP). The MNF personnel provided excellent support both before and during the voyage. The meticulous preparation and high level of professionalism of the mooring team led to a very efficient deployment and recovery process. The contributions provided by the science team were both energetic and enthusiastic. The master and crew provided a high level of assistance that contributed greatly to the smooth operation of the voyage. The successful recovery of the array during the voyage was the culmination of nearly 4 years of planning and implementation. It was a most satisfying experience both on a scientific and a personal level.

Ken Ridgway

Chief Scientist Principal Research Scientist CSIRO Marine and Atmospheric Research

APPENDICES

Appendix 1 – Mooring array design

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Notes: 1830110212

Aquadopps are moved to above glass floats to avoid turbulance. Top SBE 37 is moved to EXIOS package. Release and lower assembly's are all standard 62 meter packages. Anchor clumps are mostly interchangable. Anodes are not show, but are installed. EXIOS packages are all standard. Servells are not shown, but may be installed. Antifouling applied to top instrument packages. Farrachutes are not shown, but are installed.



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euk.	FAC 2012	EAC ML
10	drawry arridy	elevation
dramy.	ky / data (Insec1940600220002	cheville 8

depth		instrument	port	tether length	
40	T	ERIOR		7mm TBW x 12m	
			giase fibate 17"	13mm PW8 PC x 3.5m	+
60	T				MZ
60	1	194-2		7mm TBW x 50m	Denth
300	V	ting .			cup III
120	2	WH 300 LR 75	45" systectic ADCP		39
130	4	(2012-1)			40
135		-		7mm T8W x 123m	60
180		map.			100
200	1	58E 37	clamp on		120
			glass floats 17"	13nn PWB PC x 3n	130
250	T	704-2			135
300		NAD			200
				7mm T8W x 152n	200
150	1	164.g			250
400	*	hep.	alors finate 17"	then FMB K + 15e	300
	T		June 1000 L		400
					410
					500
72227			19000		600
500		58E 37	clamp on	7mm T8W x 245m	650
					800
					900
600					1000
					1200
650	*	88 150	45" syntactic ADCP		1200
	2012				1300
800	1	714-0			1400
3000		58E 37	clamp on	7mm TBW x 547m	1500
	T.				1600
1200	*	neg mandete	tension chosesis		1760
1200	8		alors firsts 170	the Park No. 1 Ke	1900
	88		Tune room to	The Local Control of the Local	2000
1300	- 1			7nn T6W x 295n	
100.00		74-9			
2900	T	ednaqo bê	Tension shoesis		
	8		glass floats 17"	13mm PWB IC x 3.5m	
	1			7mm T8W x 245m	
1750	8	1002	gizes floats 17"	13mm PWB PC x 1.9m	
1052	Y	aquadapp	tension chassis	7000 10W X 1000	
1996					
	8			SYNEX 201m	
			glass floats 17"	16mm PWB PC x 5m	
	Y	8242 releases		8000kg rylon x 15m	
	+			9mm TBW x 30m	
				16mm FWB PC x 5m	
	A	makes shown		1000 ke	

EAC 2012 M	22	257	m
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Longitude

Letitude instrument

EXIO5

cheap T

cheap T cheap T WH300

LR75 cheap T cheap T

58E37

cheep T

cheap T cheap T cheap T

58637

88150

cheop T

58E37

cheap T

Aquadopp cheap T

cheep T

Aquadopp cheop T

Aquadopp release

release

50

154.0325	Mate	rials	
27.3			
serial number	Detail	size	quantity
90760	mooring wire	7mm	12
	mooring wire	7mm	58
4016	mooring wire	7mm	123
4021	mooning wine	7mm	152
4022	mooring wire	7mm	245
16431	mooring wire	7mm	647
16374	mooning wine	7mm	295
4023	mooring wire	7mm	246
4024	mooring wire	Zmm	185
9169			1862
4025	mooring wire	9mm	30
4026	COMPOSITION CONTRACTOR		
4027	glass floats	17"	8
4029	glass floats	17"	8
	glass floats	17"	- 4
9170	glass floats	17"	8
	glass floats	17"	8
	glass floats	17"	4
16413	glass floats	17"	6
4030	121140101000		46
9171	tension chassis	6	3
	syntactic	46	1
4031	syntactic	45	1
6496	exios		1
4032	ADCP LR 75		1
	ADCP WH 300		1
4033	ADCP 98 150		1
9470	58E 37		- 4
	aquadepp		2
4034	cheop temp		12
	release		2
	anchor	1500 kg	2

Notes: 1830110212

35674 38675

Aquadopps are moved to above glass floats to avoid turbulance. Top SBE 37 is moved to EXIOS package. Release and lower assembly's are all standard 62 meter packages. Anchor clumps are mostly interchangable. Annodes are not show but are installed. EXIOS packages are all standard. Seivells are not shown but may be installed. Antifouling applied to top instrument packages. Perrachutes are not shown, but are installed. 1

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auth	# EAC 2012	EAC M2
#1481 25	drama arrey	elevation
	dmac1940630220112	checked

40	9	instrument exist 58E 37	part clama on	tether length			EAC 201		9 432	3011
	1			7mm TBW x 12m	+					
60	8	-	gloss floats 17"	13mm FWB PC x 3.5m	M3	Longitude	154.29	Mat	erials	
80		-		7mm TBW x 60m	Depth	Instrument	Serial number	Detail	Size	Quan
100		10.0			202,000		0.2010.0000000		0.2020	93690
	X	WH 300			39	EXTOS	98740	mooring wire	7mm	1
130	X	LR 75	40" syntactic ADCP		40	58E37	9172	mooring wire	7mm	6
130	4				60	cheop T	4035	mooring wire	7mm	12
135					80	cheop T	4036	meeting wire	7mm	15
	1			7mm 10W x 323m	100	cheop T	4037	mooring wine	7mm	24
180	1	the state of the s			120	WH300	16432	meeting wire	7mm	34
200	1	58E 37	clamp on		130	LR75	16375	mooring wire	7mm	19
	*		alore firsts 17"	iles FWB IC + 1.5e	135	cheop T	4038	mooring wine	7.00	29
250	P	mag			180	cheap T	4039	mooring wire	7mm	49
					200	58E37	9173	000000000000		191
100	- 1	m-p			210					
				7mm T8W x 152m	260	cheop T	4042	mooring wire	9mm	з
200		2010			300	cheop T	4044	100000000000000000000000000000000000000		
400	1	http:			360	cheop T	4045	DYNEX	Brinn	49
			alors finate 17*	then FWB IC x 2.5e	400	cheop T	4046	DYNEX	Bren	49
	*		gaar meet to	Manual Control Control Science	410			DYNEX	Snim	99
					500	58E37	9174	DYNEX	Bren	10
					600	cheop T	4047	00.0547.023	-126516	214
500		586.37	clamb on		600		0.000			
	- 1	00E 37	comp on	7mm TBW x 243m	650	88150	16414	DYNEX	Srm	
					800	cheop T	4048	G		
					900	- C. C. C.		aloss floats	17*	
					1000	58E37	9175	aloss floats	17"	
					1000			gloss floats	17*	
600	-	and.			1200	cheop T	4049	alors floats	17*	
660		88 150	45" syntactic ADCP		1200	Aquadeaa	9826	aloss floats	17	
	4 4				1300	cheop T	4050	alors floats	17*	
900		7010			1400			aloss floats	17"	- 0
	1			7mm TBW x 349m	1500	cheop T	4051	aloss floats	170	
000		586 37	along on		1500	Aquadapa	9827	alass floats	17"	- 5
	#		gloss floats 17"	13mm PWB PC x 2.5m	1600			aloss floats	17*	- 8
	8				1750	check T	4062	2		6
200		-		7mm TBW x 294m	1800			tension chass	is.	
		aquadopp	tension chossis		1900			syntactic	46	
300		foreg			2000	Aquadage	9540	syntactic	45	- 5
	-			7mm 1819 x 290m	2200		(1992-1990) (1992-1997)	exios	157	
	4	1010			2500	58E37	9176	ADCP LR 76		- 3
500	I	aquadopp	tension chosele		2500	Aquadopp	9841	ADCP WH 30	0	- 8
			where direct a 170	These Plate May 3 Key	2600			ADCP 89 150		
	æ		Base Lodue 11-	Table Line Line 12 a 2.06	2800			58E 37		- 6
790		Trop.			3000	cheop T	4063	aquedopp		
	1			7mm TBW x 495m	3000	Aquadasp	9842	cheap temp		1
					3200	20.03		release		- 3
. 000	1	aquadopp	fanzion chazala		3600			anchor	1326 kg	- 8
	88		glass floots 17"	13mm PWB PC x 1.9m	4000	58E37	9187			
				Access to the second second	4000	Aquadapa	9844			
200	Y	equadopp	Tansion chousis	own cyrex a wyon	4400	release	36718			
300	8	-0.250	glass floats 27"	13mm PWB PC x 1.9m	4700	release	35723			
		586 37	tension chosels			Notes 18	30110212			
	1			tem dones a ditter						
000	*	Namp .	Containing the Containing of the			Aquadopps	are moved to abo	we gloss floats t	o evoid tu	rbulan
	de la	adragebb	Tension chassis			Top SBE 3	7 is moved to EXI	OS package	1626 7	
			glass floats 17"	Ilan FWB PC x 1.5n		Release and	d lower assembly"	s are all standar	d 62 mete	er pock
	T			The state of the		Anchor clu	mps are mostly in	terchangable.		
	¥ .		S 195 S	6mm dynex x 995m		Annodes or	e not show but a	re installed.		
		wheelab	Tension chouse			EXIOS per	ikages are all star	dard.		
000	æ		glass floots 17"	13mm PWB PC x 3.5m		Swivelis an	e not shown but n	noy be installed.		-
	T T	584 37	fension choosie			Remaching	opplied to top in	strument packag	es.	
	ľ			6mm dynex x 159m		rerrochute	s one not shown	our ane installed		. QI
				Annual and the lot of		Barne	Baann	Barrens	10	C 10/
			almes Beats 770	Mars Bill Br - Se		(Sacal)	o o creatiti	an amb		anki
	₿		True under 51	Jama Provinci X 30		CSIRC	Marine and	d Atmosph	eric Re	sear
	#									the second s
		#141-size				[midt	1.00	- Idea	u-fair	- Jean
	₿	6242 releases		8000kg nylon x 15m		nyaki	* EAC 20)12 ^{desce}	140 EAC	43
		8242 relation		8000kg nylen x 15e 9ee TBW r 10m		nyalis afaar t	Phi EAC 20	012 descr	eter EAC	43 tim
		5242 releases		8000kg nylan x 15m 9mm TBW x 30m		rich daet 35	J ^a EAC 20	012 deser	eleve	43 dice

17 VOYAGE SUMMARY - SS2013_v05

				7mm TBW x 12m						
			46" etystoctic							
60	Y	1010			+	10.00	184 48		and other	
80				Zee TBW x 59x	104	Langinude	104.00	Mate	rial	
00	- 1			1000 1000 0 0000		Latitude	27.21			
300	- 1 - I	10.00			Depth	Instrument	Serial number	Detail	Size	Que
175	¥ .	-	territe dessite							
88.50		advancedda	Terative codera		39	EXIOS	99740	mooring wine	7mm	
130	1			7mm TBW x 125m	40			mooring wire	Zmm	
135		Are.			60	chean T	4054	mooring wire	Zeen	1
18.0		2.0			50	cheap T	4055	meaning wine	Zeen	- 14
280	1				100	cheen T	4064	maning wire	Zeen	
200	1	586 37	clamp on		120	Amendana	6881	moning wine	Zeren	
	*		glass floats 17"	13nm PWB PC x 3.5m	120	address of the	1004	mooring wire	Zeen	
250		10.4 m			100	chara T	4007	mooring wire	7000	1
	1				190	cheep 1	4057	mooring wire	Zere	
900	- 1			7mm TBW x 547m	100	crieup i	4000	mooring wire.	Victor,	10
					200	SEE37	9177			19
350		8.4g			200			Contract Capits		
	100				260	cheop T	4069	mooring wire	9mm	
	Y	844			300	cheap T	4060		1	
400	0	LR 75 adcp	45" syntectic		350	cheap T	4061	DYNEX	Bern	4
					400	cheop T	4062	DYNEX	Seren	4
				7mm T&W x 197m	400	LR75	16429	DYNEX	Born	9
					500	58E37	9178	DYNEX	Brim	7
	1				600	cheop T	4063			26
500		586 37	clamp on		600	Aquadapa	9870			
	T				680					
					800	chess T	4066	gloss floats	17*	
					900		0.0000	glass flaste	17"	
		100			1000	58537	9179	alors flast	17"	
400	÷	ang di sa	And the second		1000	Acudana	0973	alars flash	1.70	
400		odregobb	Tension choses a		1200	chasts T	404.7	glass floats	1.70	
			gloss floats 17"	13mm PWB PC x 3.5m	1200	cneep 1	4007	giass rioas	17	
	Y				1210			glass floats	17"	
800	- +	10.00		7mm T8W x 395m	1300	chesp T	4068	glass floats	17"	
					1400			glass floats	17"	
3000	T I	nquedopp	tension chossis		1500	cheap T	4069			
	- 1	446.57	alars as	and the second se	1500	Aquadopp	9882			
	۲.	200 27	compos	7mm 18W x 200m	1600			tension chassi		
1200	31.22	7170			1750	cheap T	4070	syntactic.	46	
	8		glass floats 17"	13mm FWB IC x 3.5m	1800			syntoctic	45	
	æ		102.025N		1900			exios		
1200		5249		The TRUE - DOA	2000	Aquadopp	9889	ADCP LR 76		
1300	- 1	***		7mm 10W x 294m	2200			ADCP WH 300	0	
					2500	58E37	9180	ADCP BB 150		
1500	Ϋ́	equidates	tension chosels		2500	Aquadapa	9890	SRE 37		
	1				2600			oquadepp		
					2800			chean term		
1750	- 1	***		7mm TBW x 495m	3000	chesn T	4071	celeose		
	100				3000	treep 1	0801	resease	122514	
2000	Y	equedopp	tension chosels		3000	wdneerobb	9091	encher	1310 ×g	
	8	0.125.126	aines floots 17"	Dan FWB N x 15n	3200					
	8		Part room to	6nm dynex x 495m	3600	1002010	100000			
				and the second second	4000	58837	9188			
2500	I	osudore	fension choses		4000	Aquadopp	9092			
1000	#	1000000	alors fronts 17"	tion FAB IC - 3 fm	4400	release	35719			
	4		Press results to	sense i new to a state.	4600	release	36721			
		58E 37	tension shoesis	tinn dynex x 493m		Notes: 1	830110212			
1200	*	merer .	120122-020			Aquadoppe	s are moved to ab	ove glass floats t	to avoid t	urbul
3000	4	adrogolik	renews choesie			Top SBE 3	17 is moved to EX	IOS package.		
	B		glass floats 17"	13nm PWB PC x 3.5m		Release or	d lower assembly	's are all standar	d 62 met	er po
	4			ferm dynex x 295e		Anchor cli	umps are mostly in	rterchangable.		
				and officers of below		Annodes	re not show but a	are installed		
4000	T	advogelå	Tension shoesie			EXIOS po	chages are all sto	ndard.		
	8		gioss floats 17"	13mm PWB PC x 3.5m		Swivells a	re not shown but	may be installed.		
	*					Antifoulin	g applied to top in	strument packag	yes.	TH
		586 37	Tension chases	fam denne With		Parrachut	es are not shown.	but are installed	1 /	
				SAM OTHER & TUBE		100.00				
	8			Beer Oyes a 784		Dago	Ocean (Grown	C	SIR
	P		aloss finate 17"	Man PWB PC + Sa				and a state		
	-			And a second second second		COURC	Marine	Atmosphere	nie P	
						CSIRC	marine and	Atmosphe	IC RE	sea
	Y	8242 releases				(each	14	in Ident	the state	-
				6000ia mise x 15e			EAC 20	12	EAC M	1
	+					dise1	dramy		Sec.	0.2
	-			Sam TRid a 30m		45	orrey	1.0.2	elevatio	15
				The second second						And in case of the local division of the loc
	1			10mm PWB PC x 5m		619679	by/dete	the de	4	

uuu	uu	uuu	uuuu	19.000.000.0000	
depth. 40		instrument exice	part	tether leigth	
				7mm TBW x 12m	
60	$\mathbf{\varphi}$	himi	46" syntactic		+
10				7em TBW x 59m	0
100		3199			
	1	eren an	-		
120	ų	edrogobb	fension chossis		
135		in the second se		7em TBW x 78e	
190		hana			
200	Ĭ	aquedapp	tension chosesis		
	8		glass floats 17"	Line PWB IC x 3.5n	
	Ţ	586 37	clamp on		
300		trap			
400	- 1	head		See Thill - Still-	
				7mm 1014 x 292m	
500					
	4	to ap			
600	T	equadopp	tension chassis		
	8		glass floats 17"	13mm PW0 IC x 3.5m	
800		****		7mm T8W x 394n	
1000	ĭ	and an	And the shares		
1000		advecta	glass floats 17"	Linn PWB AC x 3.5m	
	T	561 27	clamp on		
1200		1144			
				7mm TBW x 497m	
1300		Tomp			
1500		. New			
	8	0.005	glass floats 17"	13mm FW9 IX x 3.5m	
	9				
1750		hing		6mm dynex x 494m	
2000	Ĭ	aquadapp	tension choses		
			gines floats 17"	Line FWB K x 3.5e	
	T				
				bein dynex x /90e	
2600	T	aquodopp	tension chossis	6 - 22252 113	
	۳.		gloss floats 17"	13mm PWB PC x 19m 6mm dunx x 197m	
3000	+	here			
			glose floats 17"	13mm PWB PC x 3.5m	
	T			fmm dynes x 995m	
	*	9 -	6.556.6		
4000	*	strograb	alors floats 17	then FMB IC + 15m	
	T			fore Arres a Stille	
				See dates a little	
			120002010020		
	I		glass floats 17"	16mm PWB PC x 5m	
	Y	8242 releases	0	120220-00120-0020-0	
	+		T	6000kg nylon x 15m	
			4	9em TBW x 30e	
4707	4	anchor clumbs		Idean PWB PC x 5m	
			100	4000 kg	

	Conditioned	100.3	Mat	ences	
	Latitude	27.1			
hepth	Instrument	Serial number	Detail	Size	Quan
40	EXIOS	97750	mooring wire	7em	12
40			mooring wire	7mm	65
60	cheop T	4072	mooring wire	7mm	78
80			mooning wine	7mm	398
100	cheop T	4073	mooring wire	7mm	394
120	Aquadopp	9893	mooring wire	7mm	49
130			mooring wire	7mm	49
135	cheap T	4074	-7-37-0		1925
180	cheop T	4076			
200	58E37	9181	1.0.02		
200	Aquadapp	9894	mooring wire	9mm	ж
200		1071	NULIER	2.00	
300	cheop (4070	DYNEX	0mm	19
400	share T	40077	OTHER	denem Base	17
400	cheop i	4077	DYNEA	deres.	77
400			DYNEA	Ontro.	1004
600		4078			1000
400	cheop I	4078	den deren		
1000	wdnoorobb	9090	glass rivers	170	- 33
800	share T	4000	grees friedry	1.7	1
000	cheop i	40/9	glass floats	17	- 3
200	10037	0100	glass floats	4700	- 3
0000	Sec3/	9102	glass floats	17	- 8
1000	Adoesopp	9090	glass floats	27	- 13
1200	cheop (4000	glass floats	1701	- 23
1500	chara T	40.01	glass floats	1.90	- 15
400	criedp 1	40.01	Georg contact		1
1500	chaon T	4082			.01
1500	creup r	HUDE	sandas charact		
1600			nemeratic	46	- 23
1780	chain T	4083	partectic	45	
1900	transfer 1	1000	exine		- 83
1900			ATVPID 78		1
000	Amodoto	0807	ADCP WH 30	0	- 2
200	- domarkh	1011	ADCP BB 150		1
1500			SRE 37		- 3
600			oguadapp		- 6
1600			chean term		
1800	Anundann	9996	release		- 6
1000	cheep T	4087	anchor	1325 kg	- 5
1000					
200					
1600					
1000					
1000	Aquadopp	5928			
4400	release	35720			
700	release	35722			
		200.000			

EAC 2012 M5 4707m

Release and lower assembly's are all standard 62 meter packages. Release and lower assembly a are all standard o Anchor clumps are mostly interchangable. Annodes are not show, but are installed. EXIOS packages are all standard. Swivells are not shown, but may be installed. Antifouling applied to top instrument packages. Parrachutes are not shown, but are installed. 1111 CSIRO

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toole	P* EAC 2012	ANTER EAC MS
dian't .	drama array	elevation
drawing .	desc(1940/55220112	dadet

CSR/ROSCOP PARAMETER CODES

METEOROLOGY

- M01 Upper air observations
- M02 Incident radiation
- M05 Occasional standard measurements
- M06 Routine standard measurements
- M71 Atmospheric chemistry
- M90 Other meteorological measurements

PHYSICAL OCEANOGRAPHY

- H71 Surface measurements underway (T,S)
- H13 Bathythermograph
- H09 Water bottle stations
- H10 CTD stations
- H11 Subsurface measurements underway (T,S)
- H72 Thermistor chain
- H16 Transparency (eg transmissometer)
- H17 Optics (eg underwater light levels)
- H73 Geochemical tracers (eg freons)
- D01 Current meters
- D71 Current profiler (eg ADCP)
- D03 Currents measured from ship drift
- D04 GEK
- D05 Surface drifters/drifting buoys
- D06 Neutrally buoyant floats
- D09 Sea level (incl. Bottom pressure & inverted echosounder)
- D72 Instrumented wave measurements
- D90 Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY

- H21 Oxygen
- H74 Carbon dioxide
- H33 Other dissolved gases
- H22 Phosphate
- H23 Total P
- H24 Nitrate
- H25 Nitrite
- H75 Total N
- H76 Ammonia
- H26 Silicate
- H27 Alkalinity
- H28 PH
- H30 Trace elements
- H31 Radioactivity
- H32 Isotopes
- H90 Other chemical oceanographic measurements

MARINE CONTAMINANTS/POLLUTION

- P01 Suspended matter
- P02 Trace metals
- P03 Petroleum residues
- P04 Chlorinated hydrocarbons
- P05 Other dissolved substances
- P12 Bottom deposits
- P13 Contaminants in organisms
- P90 Other contaminant measurements
- B01 Primary productivity
- B02 Phytoplankton pigments (eg chlorophyll, fluorescence)
- B71 Particulate organic matter (inc POC, PON)
- B06 Dissolved organic matter (inc DOC)
- B72 Biochemical measurements (eg lipids, amino acids)
- B73 Sediment traps
- B08 Phytoplankton
- B09 Zooplankton
- B03 Seston
- B10 Neuston
- B11 Nekton
- B13 Eggs & larvae
- B07 Pelagic bacteria/micro-organisms
- B16 Benthic bacteria/micro-organisms
- B17 Phytobenthos
- B18 Zoobenthos
- B25 Birds
- B26 Mammals & reptiles
- B14 Pelagic fish
- B19 Demersal fish
- B20 Molluscs
- B21 Crustaceans
- B28 Acoustic reflection on marine organisms
- B37 Taggings
- B64 Gear research
- B65 Exploratory fishing
- B90 Other biological/fisheries measurements

MARINE GEOLOGY/GEOPHYSICS

- G01 Dredge
- G02 Grab
- G03 Core rock
- G04 Core soft bottom
- G08 Bottom photography
- G71 In-situ seafloor measurement/sampling
- G72 Geophysical measurements made at depth
- G73 Single-beam echosounding
- G74 Multi-beam echosounding
- G24 Long/short range side scan sonar
- G75 Single channel seismic reflection
- G76 Multichannel seismic reflection
- G26 Seismic refraction
- G27 Gravity measurements
- G28 Magnetic measurements
- G90 Other geological/geophysical measurements