Australia's Marine National Facility

VOYAGE SUMMARY ss2011_v01

IMOS – Southern Ocean Time Series

Voyage period:
16/04/2011 to 22/04/2011

Port of departure:
Hobart, Australia

Port of return:
Hobart, Australia

Responsible laboratory:
Bureau of Meteorology (CAWCR)
GPO Box 1289, Melbourne,
Vic 3001, Australia

Chief Scientist(s)
Eric Schulz, Bureau of Meteorology (CAWCR)

Tom Trull, ACE CRC, University of Tasmania

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Scientific Objectives

The overall scientific objective is to obtain frequent measurements of surface and deep ocean properties that control the transfer of CO_2 from the atmosphere to the upper ocean, and then onwards to the ocean interior in the form of sinking particles. This "biological pump" drives carbon sequestration from the atmosphere, and writes the sedimentary record. The controls on its intensity are complex and involve processes that vary on daily, weekly, seasonal, and interannual timescales. Obtaining observations with the necessary frequency is not possible from ships. For this reason the NCRIS IMOS Southern Ocean Time Series Facility seeks to obtain this information using automated sensor measurements and sample collections.

This voyage will recover the Southern Ocean Flux Station (SOFS-1) mooring to obtain in-air and in-sea measurements to better understand the exchange of heat, moisture, and gases between the ocean and atmosphere. It will also recover the Pulse-7 mooring that has been making measurements of temperature, salinity, mixed layer depth, photosynthetically available radiation, oxygen, total dissolved gases, and phytoplankton fluorescence and backscatter. The Pulse-7 mooring also collects 24 paired water samples, approximately weekly, for later measurement of dissolved nitrate, silicate, inorganic carbon, and total alkalinity.

Voyage Objectives

- Install hydraulic winch tuggers? Test A-frame and winch hydraulics in port?
  Completed successfully.
- Perform test CTD cast in Storm Bay
  Completed successfully.
  Test performed in Storm Bay in 65m water depth.
- Transit to Pulse-7 mooring site
  Completed successfully.
  Arrived 0800 Monday. Surface float to NE of anchor position. Set up SW of anchor location.
  Winds and seas from the West.
- Recover Pulse-7
  Completed successfully.
  Release tripped 0820 Monday (local time).
  Floats came up close astern of ship. Grappled floats by coming alongside and running close down stbd side and coming to a halt. Grappled with hand lines.
  Recovery completed 1610.
- Perform CTD cast to 1000m at Pulse-7 site (with O2, PAR, transmissometer sensors) and sample for salinity, nutrients, alkalinity, DIC.
  Completed successfully Monday evening.
  12 samples collected.
- Near Pulse-7 site, deploy one or two autonomous profilers
  Completed successfully.
  Two autonomous profilers deployed on around midday Tuesday 3NM NE of SOFS-1 anchor site.
- Transit to SOFS-1 bottom mooring site
  Completed successfully. Arrived around midday Tuesday.
- Unspool net drum
  This task was cancelled.
  The weather was suitable for recovering the bottom section of SOFS-1, so the SOFS tether was wound over the top of Pulse tether to save time.
- Recover SOFS-1 bottom mooring
  Completed successfully.
  Conditions were moderate with lumpy confused seas and some big swell.
  Release triggered at 1220, floats sighted at expected location at 1304 in a big tangle. Floats on deck 1426, lower section recovery completed 1730. Break occurred in soft tether at the base of the wire to synthetic transition piece.
- Transit to SOFS-1 top mooring (float) – free drifting
  Completed successfully.
  Transit to the NE commenced 1740, arrived around midnight.
- Obtain ship-based meteorological measurements near SOFS-1 mooring, by holding ship head-to-weather near mooring for up to 24 hours (schedule permitting, and no line floating on surface.)
  Completed successfully.
  12 hours collected on arrival (midnight-midday Wednesday).
- Perform CTD cast to 1000m at SOFS-1 site (with O2, PAR, transmissometer sensors) and sample for salinity, nutrients, alkalinity, DIC. If weather excludes CTD then collect underway water samples.
  Completed successfully Wednesday morning near SOFS-1 buoy.
  12 samples collected.
- Recover SOFS-1 top mooring using workboat to capture float if possible
  Completed successfully.
  Conditions were too rough to launch the work boat (20kt wind, 5-7m swell).
  Recovery method was to run lifting wire through A-frame, around the starboard side and used a sling and hook on a pole to attach to the lifting bale on the mooring. We took a few runs at it about noon, but called a halt to see if conditions would improve as the buoy was moving a lot and colliding with the ship-side and gunnel. A second attempt was made in the late afternoon and the mooring was successfully captured and brought onto the back deck.
  Mooring operations were completed after a break for dinner at around 1900.
  Future SOFS mooring recovery will be easier with the planned introduction of a pop-out recovery line system.
- Near SOFS-1, deploy ANFOG ocean glider from stern A-frame
  All preparation steps were completed successfully despite some communications problems between the glider and control centre. Launch occurred at 2035 after obtaining permission from the ANTFOG glider pilot. The glider was deployed by hand over the stern near the SOFS-1 top site (45 59'S, 141 25.4'E) and observed on the surface prior to the ship leaving the area.

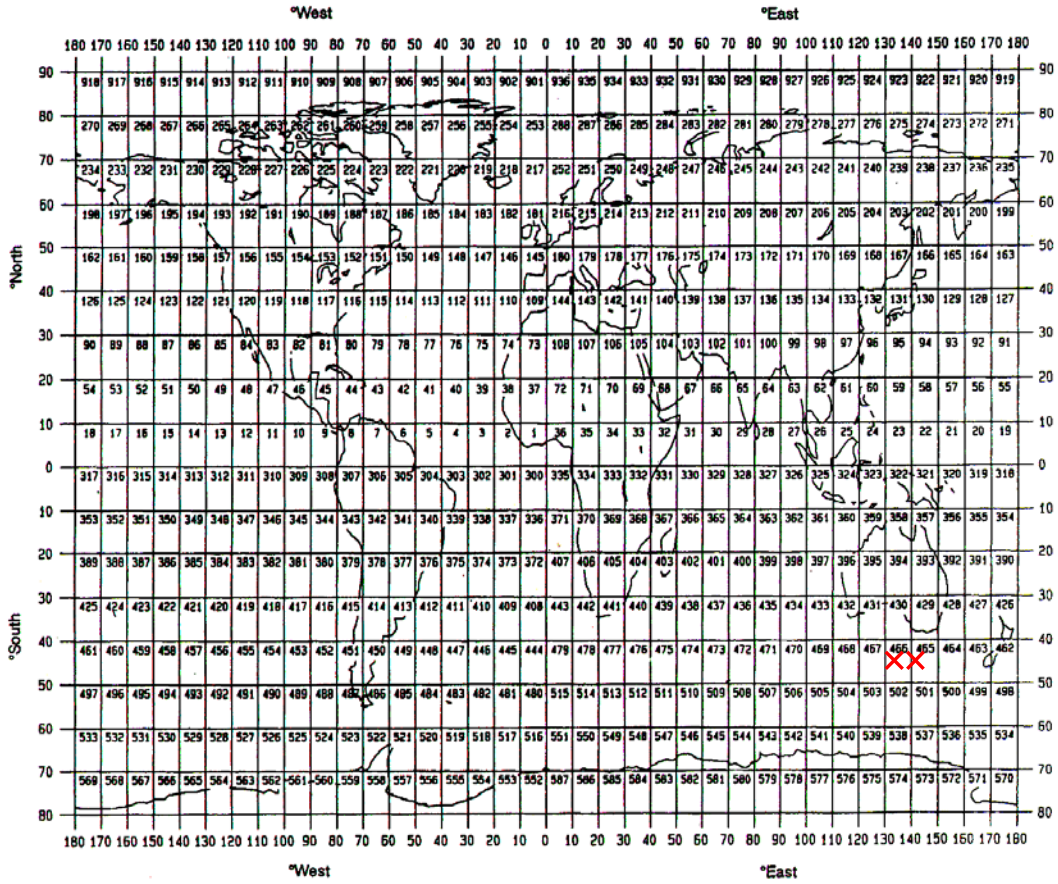
Voyage Narrative

We departed on schedule on Saturday afternoon 1600. The transit to the test CTD cast in Storm Bay and the Pulse-7 site occurred in good conditions and we arrived 0800 Monday morning. The acoustic release was triggered in short order with floats sited at 0845 and mooring recovery completed by 1610 under deteriorating conditions. A CTD was completed at 1815 and then we slowly transited the 17 miles West to the SOFS-1 anchor site overnight under windy conditions, arriving 0800 Tuesday. The morning was spent tidying up the back deck and deploying two Apex autonomous profiling floats. At 2120 the SOFs-1 acoustic release was triggered with the floats spotted 1304 in a big tangle. The floats and bottom section (~4,000m rope) was recovered by 1730. The SOFS-1mooring had broken at the base of the wire to synthetic transition piece where the mooring changes from a stiff structure to the flexible nylon rope. We then transited to the SOFs-1 top (drifting top), 50 Nm NW. We arrived around midnight and commenced ship-buoy meteorology inter-comparisons until mid-day Wednesday while tidying up the back deck and unspooling SOFS-1 nylon rope. In moderate conditions (20 kts, 5-7m swell) we attempted SOFS-1 buoy recovery. The first attempts were aborted and recommenced later after taking a CTD although the conditions had not improved. The buoy was captured late afternoon and all stowed away by 1700. We then commenced our return to Hobart and deployed the ANFOG sea-glider at 2035.

Summary

The voyage was a success with all objectives achieved. The underway systems and CTD worked. Pulse-7 was recovered without any problems. SOFS-1 buoy recovery presented some significant challenges in attaching a lifting line to the buoy. The current system relies on calm conditions which cannot be expected in the Southern Ocean. The next deployment will include a new radio controlled pop-out recovery line which should greatly facilitate buoy recovery via the use of grappling hooks rather than having to get close enough to use a pole. Other modifications will be considered as well.

A red “x” indicates where data was collected.



MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

ITEM No.	PI	APPROXIMATE POSITION						DATA TYPE	DESCRIPTION
		LATITUDE			LONGITUDE				
		deg	min	N/S	deg	min	E/W		
1	B	46	56.1 15	S	142	15.0 66	E	H90	Pulse-7 anchored biogeochemistry mooring with small surface float. Recovered 18 April 2011 for redeployment in July 2011.
2	B	46	43.3	S	141	57.2	E	D06	ARGO Float – free drifting, profiling to 1000m Deployed 19 April 2011.
3	A	45	59.9	S	141	25.4	E	M02, M06, M90,H17, D01, H72	SOFS-1 anchored meteorological mooring with large surface tower buoy. Surface buoy broke loose and free drifting. Has a light that flashes every 6 seconds Deployed 17 March 2010. Recovered 20 April 2011.
4	B	46	43.3	S	141	57.2	E	D06	ARGO Float – free drifting, profiling to 1000m Deployed 19 April 2011.
5	B	46	56.0	S	141	32.3	E	D06	Seaglider – engaged in piloted mission diving to 1000m depth and expected to return to Hobart over approximately next 2 months. Deployed 20 April 2011.

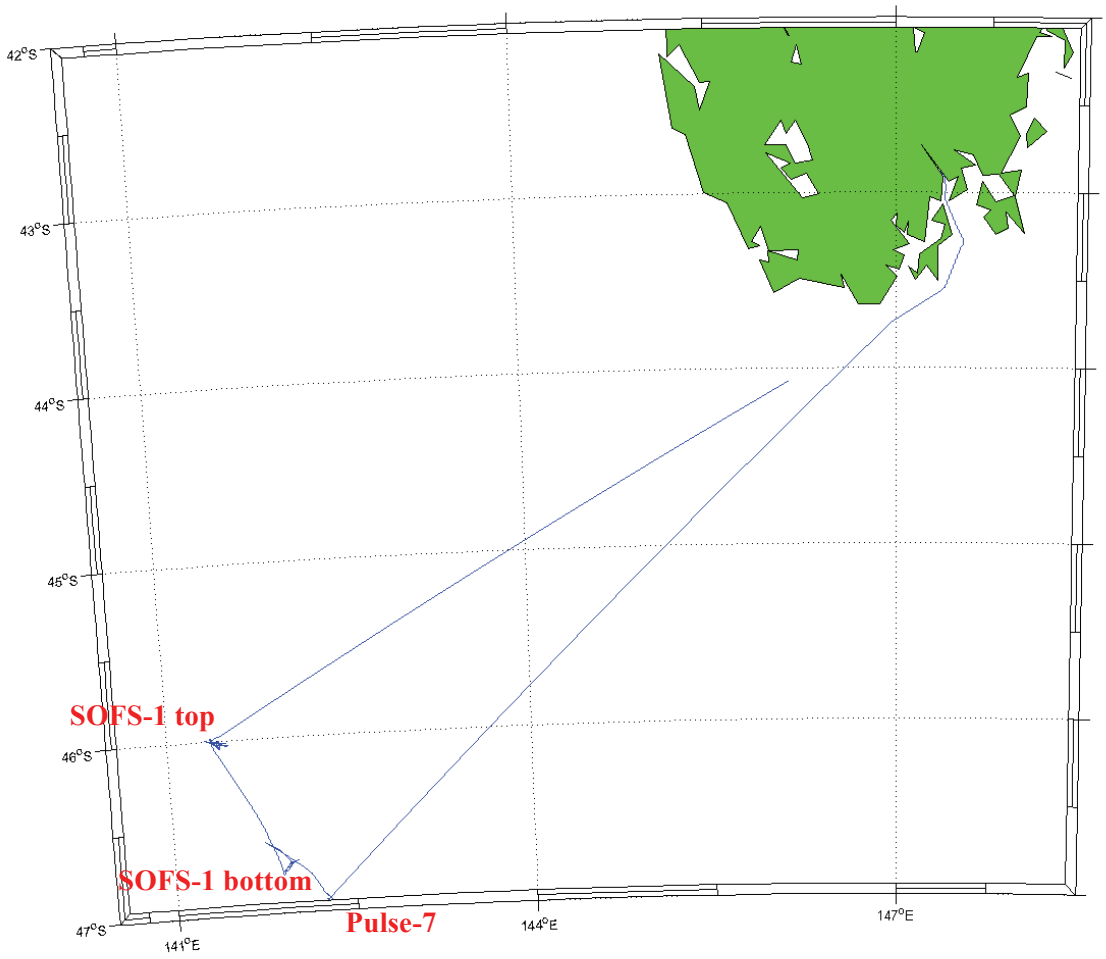
SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

ITEM No.	PI	NO	UNITS	DATA TYPE	DESCRIPTION
1	B	3	stations	H10	1 test CTD cast to 10m (no samples), and 2 CTD casts to 1000m (with Niskin bottle samples). Sensors mounted for temperature, salinity, photosynthetically available radiation, phytoplankton fluorescence, transmission, O2. Samples taken at 12 depths for onshore analysis of salinity, nutrients, dissolved inorganic carbon, alkalinity, and particulate organic carbon, for comparison with Pulse-7 mooring results.
2	A&B	740	miles	H71	Continuous monitoring of underway seawater supply for temperature, salinity, transmission, oxygen, argon for study of surface ocean productivity and physical heat and mass flux.
3	B	4	launches	H13	Expendable Bathythermographs (XBTs) for sound speed and equipment testing.
4	A	740	miles	M02	Continuous monitoring of incoming short and long-wave radiation for heat fluxes.
5	A	740	miles	M06	Continuous monitoring of routine met. observations (wind, air temp., humidity and pressure) for heat, mass & momentum fluxes.
6	A	740	miles	M90	Continuous monitoring of precipitation for mass fluxes.

CURATION REPORT

ITEM No.	DESCRIPTION
1	Samples analysed at CSIRO Marine and Atmospheric Research (CMAR); Data to be provided to Australian IMOS Ocean Data Portal.
2	CMAR data to be collated with other voyages and provided to Australian IMOS Ocean Data Portal.
3	CMAR data to be collated with other voyages and provided to Australian IMOS Ocean Data Portal.
4, 5, 6	Data is part of underway system and is managed by MNF. Data is also post-processed by Bureau of Meteorology for IMSO and archived in Australian IMOS Ocean Data Portal.

Track chart: Southern Ocean – Indian sector



Personnel list

Scientific Participants

Eric Schulz	BOM	Chief Scientist
Peter Jansen	UTAS	Moorings, glider, floats
Andrew Tabor	CMAR	Moorings – deck lead
Dave Cherry	CMAR	Moorings
Rob Sherrington	CMAR	Moorings
Paul Durack	CMAR	Camera, CTD
Lindsay Pender	CMAR	MNF Voyage Manager
Karl Forcey	CMAR	MNF Electronics Support
Hugh Barker	CMAR	MNF Computing Support
Rod Palmer	CMAR	MNF Electronics Support
Tara Martin	CMAR	MNF Swath Mapping

Marine Crew

Name	Role
Michael Watson	Master
Michael Tuck	Chief Officer
Simon Smeaton	2nd Officer
Tyron Grasso	Deck Cadet
David Middlemiss	Chief Engineer
Jason Searle	1st Engineer
Graeme Perkins	2nd Engineer
Tony Hearne	Chief IR
Nathan Arahanga	Integrated Rating
Kel Lewis	Integrated Rating
Jonathon Lumb	Integrated Rating
Rod Langham	Integrated Rating
Peter Taylor	Trainee IR
Michael Oconnor	Chief Steward
Robert Dittko	Chief Cook
Kurt Miller	Cook

Acknowledgements

Many thanks to Master, Crew, MNF staff and the onboard Science Team. This was a very successful voyage with Tony Hearne (Bosun) and crew playing an active role on the back deck. All activities were achieved with a high level of professionalism and good humour. Thanks also to staff in Hobart and ANFOG for drifter and glider preparation.

Eric Schulz
Chief Scientist

Figure 1: Pulse-7 upper diagram

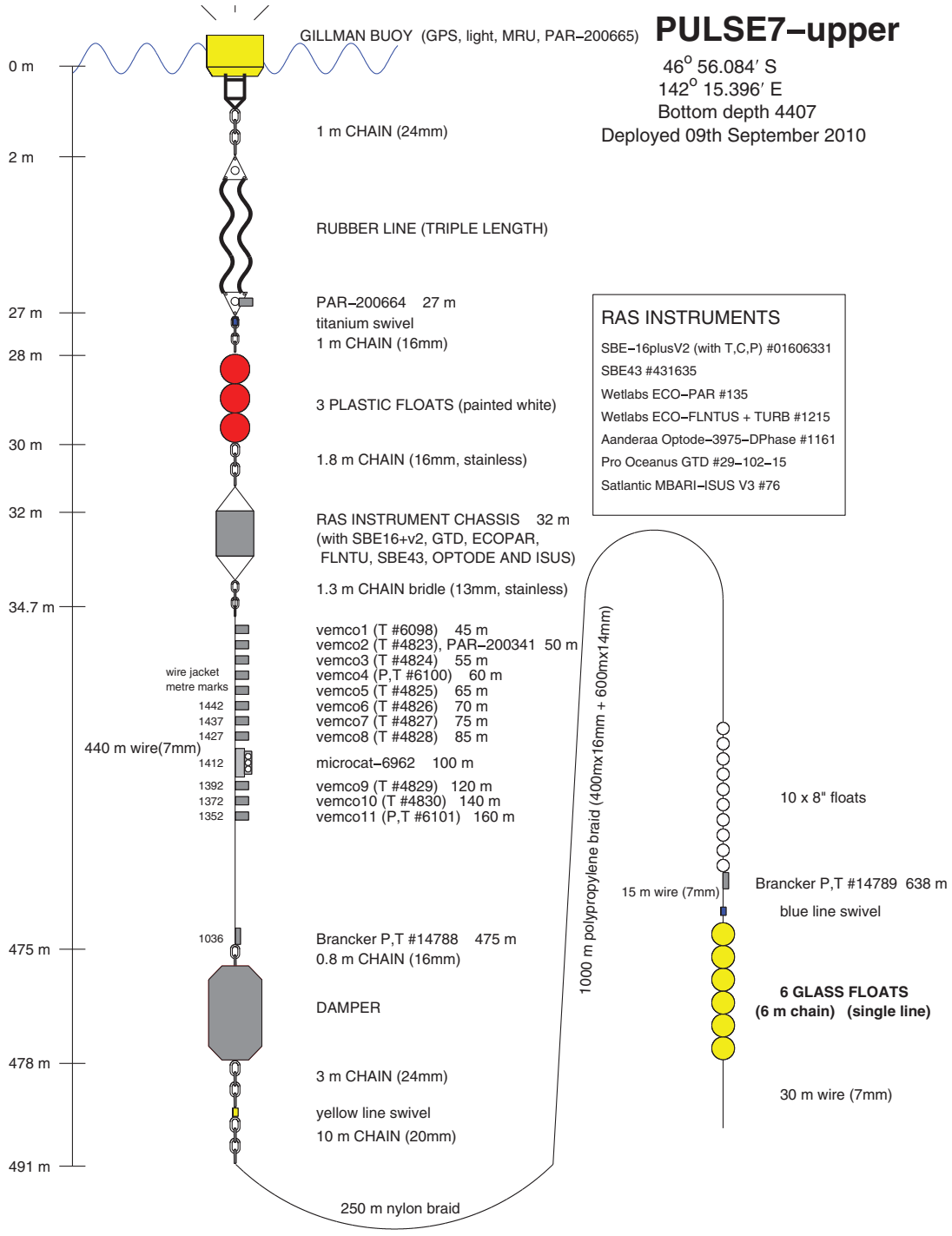


Figure 2: Pulse-7 lower diagram

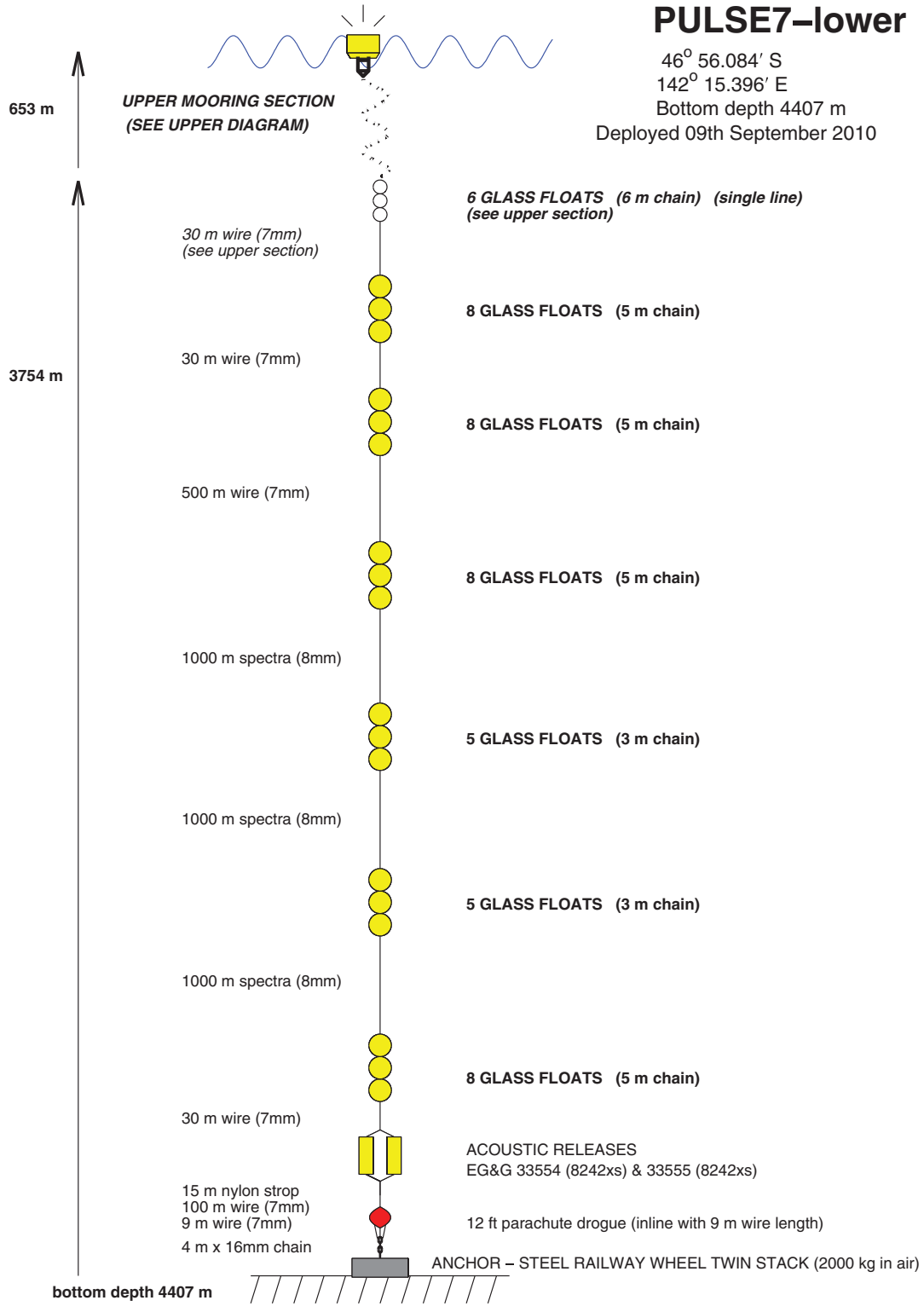
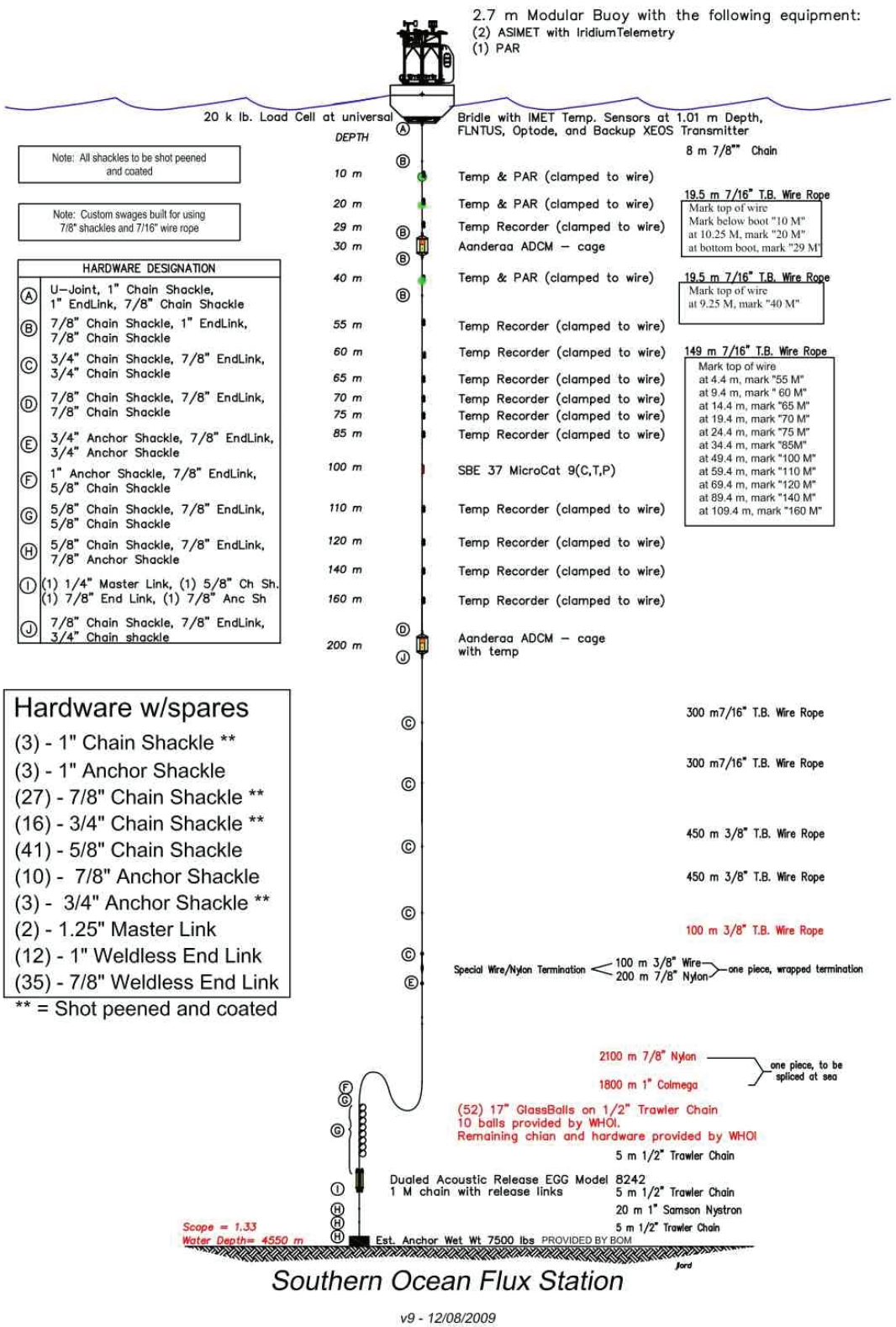


Figure 3: SOFS-1 diagram



Appendix 1 – Science Report

Voyage SS01/2011

IMOS-Southern Ocean Time Series

Eric Schulz, Bureau of Meteorology (CAWCR)

Itinerary

Departed Hobart 16:0)

Saturday 16 April 2011

Arrived Hobart 08:00

Friday 22 April 2011

Contribution to Australia's national benefit:

This project lies with the priority of An Environmentally Sustainable Australia: Responding to climate change and variability. The Southern Ocean is important to global and regional climate and carbon cycling, because of its highly energetic interactions with the atmosphere, its deep mixing, and its role in connecting all the basins in the global ocean. The development and deployment of instrumentation to observe air-sea exchanges in these waters is essential to enable informed assessment of possible changes in climate and climate variability, and in uptake of atmospheric CO_2 by the Southern Ocean. The physical and meteorological observations will allow testing of the parameterization of air-sea interactions in climate models. This informs development of climate projections and assessment of their fidelity, and thus their utility in efficient adaptation to changing climate. The carbon, oxygen, and biogeochemical observations will contribute to determining the factors that control, and thus the propensity for change in the ecosystem service the Southern Ocean provides of absorbing significant amounts of anthropogenic CO_2. This informs debate about the urgency of efforts to mitigate emissions.

This voyage achieved significant milestones in the overall effort: i) the first recovery of a full year of air-sea flux observations from SOFS-1, ii) recovery of the second full season of carbon system observations from the Southern Ocean from the Pulse-7 mooring, iii) continuing the effort to map the spatial context of SOTS via the ongoing deployment of gliders and autonomous profiling floats. Data from these systems will be provided via the Integrated Marine Observing System to Australian and international researchers.