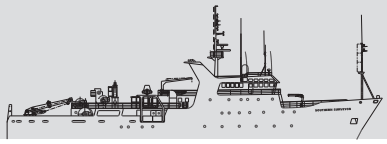

MARINE
NATIONAL FACILITY

2012 program

RV Southern Surveyor

CSIRO

voyagesummaryss2011_v03

ss2011_v03

Voyage: Southern Ocean Time Series Moorings

Itinerary

Depart Hobart
Monday 1 August 2011

Arrive Hobart
Sunday 7 August 2011

Project

Australian Bluewater Observing System Southern Ocean Time Series

Coordinating body

Australian Integrated Marine Observing System

Responsible Laboratory

Antarctic Climate and Ecosystems Cooperative Research Centre
(ACE CRC)

Principal Investigators

Dr. Tom Trull (Chief Scientist)
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ACE CRC – UTAS – CMAR – CAWCR
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Bureau of Meteorology – CAWCR
Phone: 03 9669 4618 **Email**: E.Schulz@bom.gov.au

Objectives And Brief Narrative Of Voyage

The overall scientific objective of the Integrated Marine Observing System Southern Ocean Time Series facility is to obtain frequent measurements of surface and deep ocean properties that control the transfer heat, moisture, energy and CO_2 from the atmosphere to the upper ocean to improve understanding of climate and carbon processes. The facility also obtains measurements of the onward transfer of carbon to the ocean interior in the form of sinking particles. This "biological pump" drives carbon sequestration from the atmosphere, and writes the sedimentary record, and thus offers a means to evaluate models of climate and carbon cycling over longer timescales than instrumental records. The controls on the biological pump intensity are complex and involve processes that vary on daily, weekly, seasonal, and inter-annual 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.

Objectives specific to this voyage included:

1. deploy the Pulse-8 mooring to make measurements of temperature, salinity, mixed layer depth, photosynthetically available radiation, oxygen, total dissolved gases, phytoplankton fluorescence and backscatter, and dissolved nitrate. The Pulse-8 mooring will also collect 24 paired water samples, approximately weekly, for later measurement of dissolved nitrate, silicate, inorganic carbon, and total alkalinity, and for phytoplankton identification.
2. deploy the SAZ47-14 deep ocean sediment trap mooring that collects samples to quantify the transfer of particulate carbon and other materials to the ocean interior
3. recover the SAZ47-13 deep ocean sediment trap mooring deployed in September 2010
4. carry out underway and CTD based measurements of water column stratification and nutrient content for comparison to the moored instruments.
5. deploy an ocean glider to obtain spatially distributed measurements of temperature, salinity, oxygen, phytoplankton fluorescence and particle backscatter in the vicinity of the moorings.

A second (leg) SOTS voyage, currently scheduled for Nov. 2011 will:

1. deploy profiling floats
2. deploy the SOFS air sea flux station mooring

Voyage Objectives and Results *(in italics)*

1. In Port:

- test A-frames and winch hydraulics
- spool on SAZ47-14 mooring
- spool on Pulse-8 mooring, and set up trawl deck for mooring work
- have crew trained in moving package across deck using A frame and net drum winch, 200 mm above deck
- Load SAZ mooring service van.
- Load 2 anchors, cage pallets and Mooring gear

All operations completed, except crew training which was determined to be unnecessary based on crew existing expertise.

2. On first day in Storm Bay or off shelf at a convenient site and time:

- do test CTD cast and lower SAZ47-14 acoustic releases for in-water test,

This test was precluded by in Storm Bay by crew scheduling, and off-shore by rough weather. The acoustic releases were deployed without the in-water test.

3. Deploy Pulse-8 at this site, triangulate

Deployment and triangulation fully successful.

4. Deploy SAZ47-14 mooring, triangulate final position

Deployment and triangulation fully successful.

5. Recover SAZ47-13 mooring

Recovery fully successful.

6. Do two CTD casts to 1000m (with O_2, PAR, transmissometer sensors) and sample for salinity, nutrients, alkalinity, DIC. (one near Pulse-8, one near SAZ-14).

Completed.

7. Deploy one or two ARGO floats

These deployments have been held for the second leg of this SOTS voyage to be carried out in November 2011.

8. Deploy ANFOG ocean glider

Completed.

9. Sample underway clean seawater supply

Completed

10. Piggy-back Project

Rex Keen from CSIRO Land & Water Earth Observation Group carried out test deployments of the DALEC spectro-radiometer throughout the voyage. The Dalec is an autonomous sea-going hyperspectral radiometer designed to continuously measure above water ocean reflectance during ship transit.

Following commissioning the instrument will remain onboard the Southern Surveyor and compliment the underway data currently collected.

During the course of the voyage the communications and data logging systems of the DALEC were tested with both local and network storage functioning reliably. The UDP transfer of data functioned well with sample packets successfully captured using network monitoring software. The UDP function will allow future integration into underway systems and data capture via Techsas.

The physical mounting and deployment system was tested and functioned well across a range of conditions during the voyage. Sea testing of the instrument uncovered issues with the instruments automatic azimuth tracking system and motor drive; these were not experienced during testing in port. Thorough troubleshooting was carried out with the results referred to the manufacturer to enable a firmware update to be developed. The voyage has provided an ideal opportunity to test the DALEC instrument, the instrument is still in its development stage however with a fix for the tracking issues the DALEC will form a reliable source of underway radiometric measurements.

Voyage Narrative (times in this section are local = GMT+10)

Monday 01 Aug
departure was on time at 16:00, with rough weather making for uncomfortable conditions once off the shelf and slowing transit to 8-9 knots. Underway seawater samples were collected for nutrient analyses as we transited south of Maatsuyker island across the shelf break, to examine possible contributions from the Zeehan current bringing warm waters southward, at the request of CSIRO scientist Karen Wild-Allen.

Tuesday 02 Aug
was spent in transit in unpleasantly lumpy seas.

Wednesday 03 Aug
we arrived at the new Pulse-8 deployment site at ~11:00 Weds., and agreed to proceed with the deployment in marginal conditions – winds 25-30 knots and 3-5m confused seas. Deployment was completed by 22:00. Opposing seas, wind, and current made the deployment difficult, and delays related to a mis-assembled component of the mooring (danlino-bungie array), and to difficulties snagging gear on the two anchors placed in the trawl deck chute led to us overshooting the targeted drop site by about 1 nautical mile. Associated draft recommendations to make deck work simpler and quicker are outlined at the end of this report.

Thursday 04 Aug
morning we began the SAZ47-14 deployment in light winds (5-15 knots) and calm seas (2-3m) The deployment was carried out on a heading of ~300 starting 6 miles from the target and the anchor was deployed very close to the target. The deployment was completed about 18:30 and we then did a first CTD, for which sensors functioned correctly, but only 1 bottle fired.

Friday 05 Aug
after overnight transit to the SAZ47-13 site, we released the SAZ47-13 mooring at ~08:30. Recovery was very smooth – with the ship moving in beautifully to bring the pick-up line onto the port quarter where it was retrieved with the first shot of the air-cannon grapple. All equipment was successfully recovered without damage before 14:00 and all SAZ sediment traps exhibited complete and excellent sample recovery. We then did a CTD to 1250m with all 12 bottle successful, transited back to the Pulse-8 deployment site and triangulated the anchor drop point, and did a second CTD to 1250. We departed for Hobart about 21:00, and collected underway nutrient, dissolved inorganic carbon and alkalinity samples until 01:00.

Saturday 06 Aug
morning we briefly set the ship to weather and deployed the ANFOG ocean glider using the A-frame, and then continued our transit to Hobart.

Summary

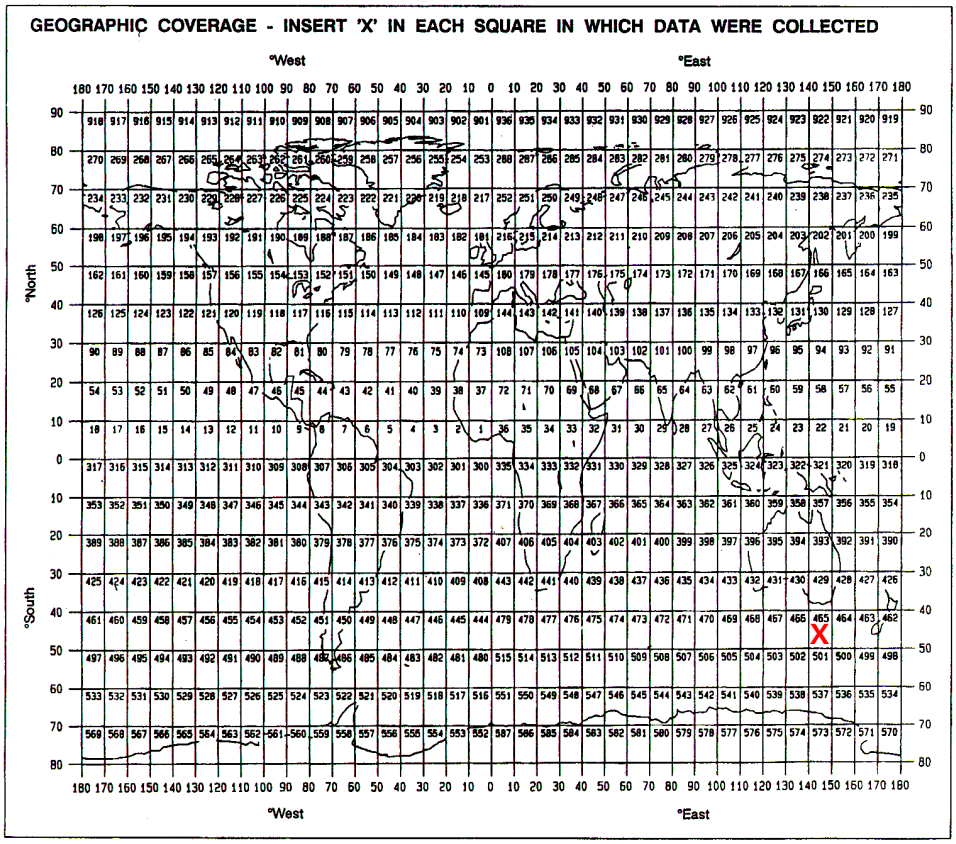
The voyage was very successful in achieving its objectives. The Pulse-8 and SAZ47- 14 moorings and the ANFOG glider were deployed, and the SAZ47-13 mooring recovered as planned. These achievements are a very strong testament to the abilities of the crew, science team, and ship.

Master, crew and science party discussions following the mooring deployments identified a few suggestions for ways to shorten the on-deck deployment times, as follows:

1. consider storing the anchors outside the trawl deck chute
2. consider eliminating or simplifying the mounting of Pulse mooring anchor parachutes
3. consider constructing a deck-stand for the Pulse mooring RAS instrument pack that would allow its bottom bridle to be mounted prior to loading, and from which it could be directly deployed (as done with the Pulse surface buoy)

Marsden Squares

Move a red "x" into squares in which data was collected



Moorings, Bottom Mounted Gear And Drifting Systems

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the voyage. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

Item No	PI see page above	Approximate Position						Data type enter code(s) from list on last page	Description Identify, as appropriate, the nature of the instrumentation the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any identifiers given to the site.
		Latitude			Longitude				
		deg	min	N/S	deg	min	E/W		
1	A	46	47.176	S	141	49.348	E	B73	SAZ47-13 sediment trap mooring recovered SAZ47-14 sediment trap mooring deployed. Both moorings have 3 Mclane Research Labs Parflux-cup-carousel conical funnel sediment traps at approximately 1000, 2000, 3800m depth, and a single current meter at ~1000m depth. SAZ47-14 also has a Prime Focus Indented Rotating Sphere sediment trap at ~1000m.. The top of the mooring is ~800m below the surface. The position shown is the anchor drop position for SAZ47-14.
2	A	46	55.356	S	142	12.532	E	H17 H21 H24 H33 H72 D01	Pulse-8 surface biogeochemical mooring deployed for recovery in July 2012. This mooring is longer than the water depth and the small 1m diameter surface float moves in a circle of ~1.1mile radius. Most Instruments are concentrated in a sub-surface package at ~35m depth: 1. Wetlabs ECO PAR sensor 2. Wetlabs FLNTUS sensor 3. ISUS Nitrate sensor 4. Seabird 16+ CTD 5. SBE43 O2 electrode 6. Aanderaa O2 optode 7. Pro-Oceanus gas tension device 8. Mclane RAS 500 water sampler (48 half-litre samples collected sequentially). In addition there are temperature loggers placed at ~10 m intervals from 45 to 160m depth to define mixed layer depth. The surface float has accelerometers to determine wave motions and a surface PAR sensor. The position shown is the anchor drop position for Pulse-8
3	A	45	44.64		143	57.63		H11 H17 H21	One unpowered (iRobot) ocean glider deployed UTC 5/08/2011 23:16 to be piloted towards Tasmania for recovery before end 2011

Summary Of Measurements And Samples Taken

Except for the data already described above under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the voyage, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) XBT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO, UNITS: for each data set, enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

Item No	PI see page above	No see above	Units see above	Data type enter code(s) from list on last page	Description Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e.g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
1	A	1	cast	H10	2 CTD casts to 1250m, sampled at 12 depths for shore-based analyses of nutrients, salinity, DIC, alkalinity
2	A	8	station	H22 H24 H26 H27 H74	Water samples taken from underway surface supply for shore-based analyses of nutrients, salinity, DIC, alkalinity . Locations of these samples are listed below this table..
3	B	700	miles	H71	Continuous monitoring of underway seawater supply for temperature, salinity for study of physical heat and mass flux
4	B	700	miles	M02	Continuous monitoring of incoming short and long-wave radiation for heat fluxes
5	B	700	miles	M06	Continuous monitoring of routine meteorological observations (wind, ait temperature, humidity and pressure) for heat, mass and momentum fluxes
6	B	700	miles	M90	Continuous monitoring of precipitation for mass fluxes
7	B	700	miles	H71	Continuous monitoring of skin sea surface temperature during calm rain-free conditions

Underway Sample List (2xnutrients, DIC, Alk at each site, labeled 1103_site)

SS11103. All samples taken from underway supply at exit from fluorometer by T.Trull

Site	UTC time	UTC date	Lat	Lon	Nutrient	DIC/Alk
1	13:18	01/08/2011	43 46.060	146 59.225	1	none
2	14:16	01/08/2011	43 50.600	146 51.505	2	none
3	15:17	01/08/2011	43 58.713	146 47.540	3	none
4	16:17	01/08/2011	44 05.024	146 41.449	4	none
5	17:17	01/08/2011	44 09.861	146 33.146	5	none
30	12:17	05/08/2011	46 50.709	142 21.40	30	25
31	13:11	05/08/2011	46 45.03	142 29.91	31	26
32	14:06	05/08/2011	46 39.45	142 38.30	32	27
33	15:12	05/08/2011	46 32.74	142 48.36	33	28

CTD	Locations			
5	03:18	05/08/2011	46 52.023	141 37.865
6	09:11	05/08/2011	46 55.569	142 08.970

Curation Report

For each data-set or sample collected identify the arrangements made for its lodgement and or curation. The description should identify the Organisational Unit that will house and curate the data and or sample, the names of national / international repositories. Where a physical sample is to become part of a collection this should be stated and the collection named. Where physical samples are to be returned to a laboratory for further study the laboratory should be named as should the method of preservation and the proposed duration for which the sample is to be retained.

1. Samples of sinking particles collected by the deep moored sediment traps from the SAZ47-13 mooring are curated by the ACE CRC SAZ-Project and retained indefinitely. Samples are collected directly into mercuric chloride poisoned brines in the sediment traps to render them sterile. In the ACE CRC laboratory they are divided into fractions for analysis and archiving..
2. Water samples collected from the ship's underway seawater supply are returned to CSIRO Marine and Atmospheric Research for nutrient, salinity, DIC, and Alkalinity measurements and then discarded following quarantine protocols.

Personnel List – Science

Tom Trull	CMAR-UTAS-ACE	IMOS-ABOS Facility Leader - Chief Scientist
Stephen Bray	ACE	SAZ mooring leader
Mark Rosenberg	ACE	deck operations leader
David Cherry	CMAR	deck operations
Peter Jansen	IMOS-UTAS	IMOS-ABOS Project Manager
Eric Schulz	BOM	SOFS mooring leader / Alt Chief scientist
Anoosh Sarraf	MNF-CMAR	Computing support
Rod Palmer	MNF-CMAR	Electronics support
Bruce Barker	MNF-CMAR	Voyage Manager
Tara Martin	MNF-CMAR	Swath mapping
Sascha Frydman	MNF-CMAR	Swath mapping trainee
Rex Keen	CSIRO L&W	Radiometry

Personnel List – Ship

Michael Watson	Master
Mike Tuck	1st Mate
Tom Watson	2nd Mate
Fred Rostron	Chief Engineer
Robert Cave	First Engineer
Graeme Perkins	Second Engineer
John Howard	Bosun
Rod Langham	IR
Gareth Gunn	IR
Jonathon Lumb	IR
Nathan Arahanga	IR
Robert Dittko	Chief Cook
Stuart Mills	Second Cook
Mick O'Connor	Chief Steward

Acknowledgements

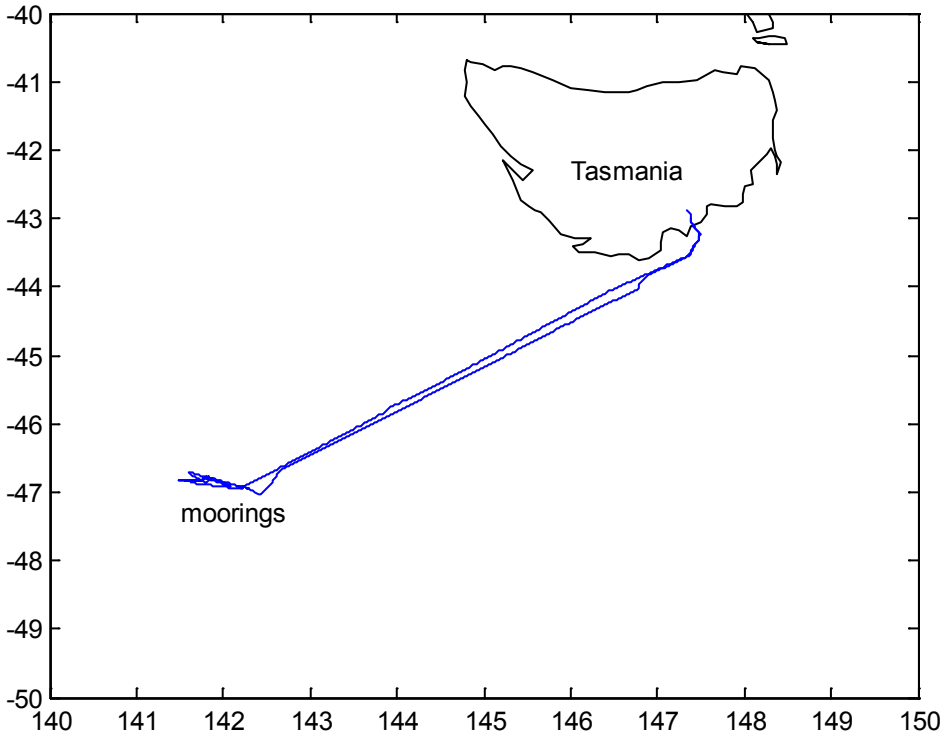
Many thanks to Master, Crew, MNF staff, and the onboard Science Team. Ship handling was superb; deck operations were easy and quick. Computing, electronic, and voyage management support was good. The food was good. The positive attitudes and professionalism of all participants is gratefully acknowledged. Many thanks also to SOTS team landside contributors Danny McLaughlan, Jamie Derrick, Diana Davies, and Phil Adams for robust design, construction, procurement, preparation, and project management. Thanks also to Ben Hollings and ANFOG for glider preparation and support.

Chief Scientist

Tom Trull

8 August 2011

Figure 1. Track Map of Voyage



General Ocean Area(s)

Southern Ocean – Indian Sector

Specific Areas

Subantarctic Zone southwest of Tasmania

Figure 2. Pulse-8 Mooring Diagram

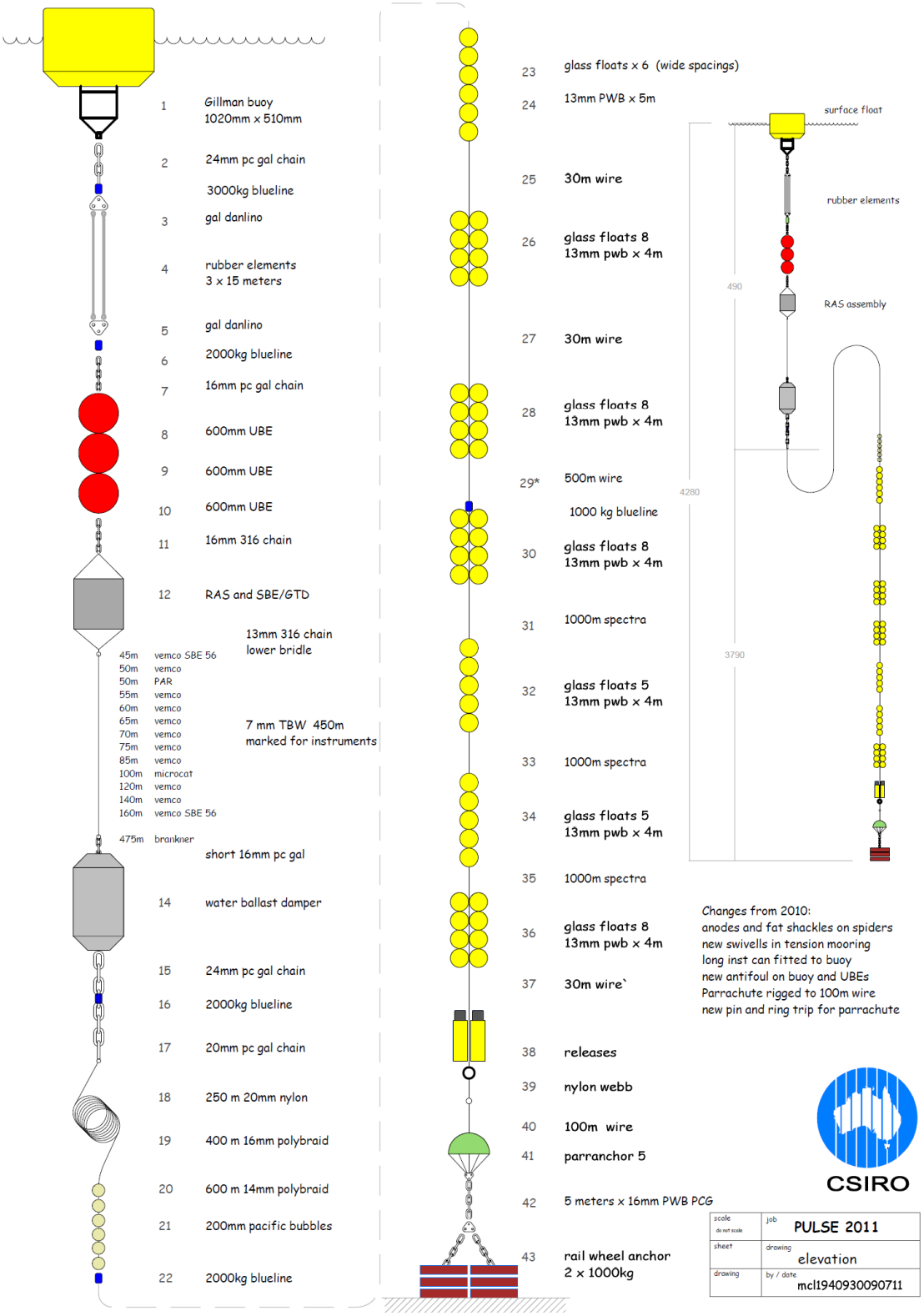


Figure 3. SAZ47-13 Mooring Diagram

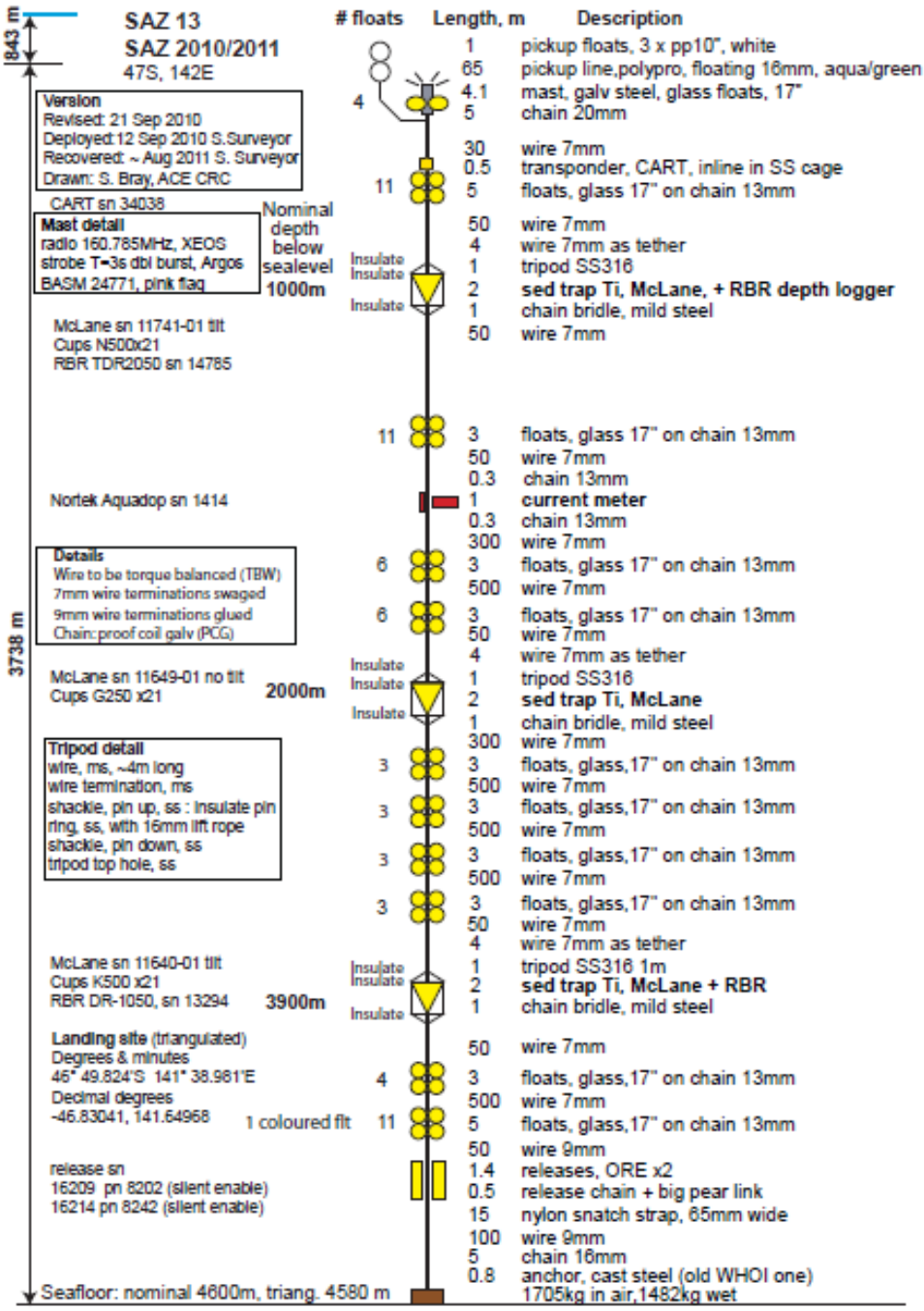


Figure 4. SAZ47-14 Mooring Schematic

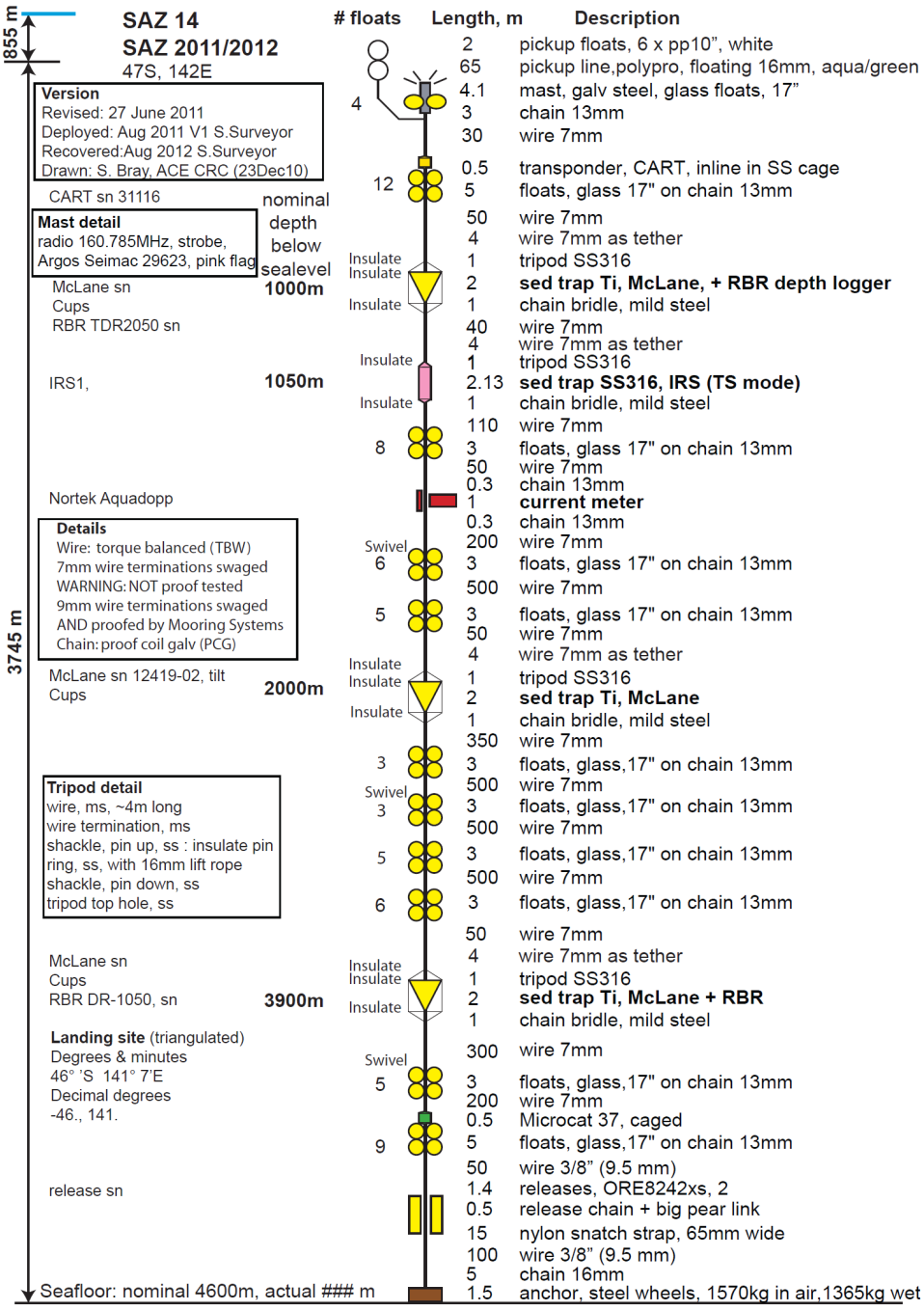


Figure 5. SOTS SS1103 Deployment team.

Left to right: Eric Schulz, Dave Cherry, John Howard, Mark Rosenberg, Pete Jansen, Tom Trull, Stephen Bray. (Not shown: Bruce Barker, Rex Keen, Rod Langham, Nathan Arahanga)

Figure 6. DALEC instrument deployed over the bow of the Southern Surveyor

The physical mounting and deployment system was tested and functioned well across a range of conditions during the trip. Sea testing of the instrument uncovered issues with the instruments automatic azimuth tracking system and motor drive; these were not experienced during testing in port. Thorough troubleshooting was carried out with the results referred to the manufacturer to enable a firmware update to be developed. The voyage has provided an ideal opportunity to test the DALEC instrument, the instrument is still in its development stage however with a fix for the tracking issues the DALEC will form a reliable source of underway radiometric measurements.