

MARINE
NATIONAL FACILITY

2013

RV Southern Surveyor
program



voyagesummaryss2013_v06

SS2013_v06

Voyage: Integrated Marine Observing System (IMOS) Facility
3. Southern Ocean Time Series (SOTS) moorings for climate
and carbon cycle studies southwest of Tasmania (47°S, 140°E)

Voyage period

Start: 6/10/2013

End: 17/10/2013

Port of departure: Hobart, Australia

Port of return: Hobart, Australia

Responsible laboratory

ACE CRC

PB 80, Hobart, Tas 7001, Australia

Chief Scientist

Dr Eric Schulz

Bureau of Meteorology

Executive Summary

This voyage was carried out as part of an ongoing effort to service the IMOS Southern Ocean Time Series Facility. The Facility will be operating with a reduced number of moorings at the site for the next 18 months. Three moorings were recovered (SOFS-4 air-sea flux mooring, SAZ-15 sediment trap mooring, and Pulse-10 biogeochemistry mooring). One mooring (SAZ-16) that was deployed on the last voyage in May 2013 (ss2013_v03) was left in the water for later recovery – either in around June 2014, or April 2015. Additional ancillary work included CTD casts and underway water samples.

Scientific Objectives

The overall scientific objective is to obtain frequent measurements of surface and deep ocean properties that control the transfer of CO₂ 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 inter-annual timescales. Obtaining observations with the necessary frequency is not possible from ships. For this reason the IMOS Southern Ocean Time Series Facility seeks to obtain this information using automated sensor measurements and sample collections.

Voyage Objectives

This voyage was an early recovery mission, made necessary when the planned April 2014 service voyage became unavailable. The moorings recovered were:

- **SOFS-4 mooring**
To make meteorological and upper ocean measurements of physical and chemical properties important to air-sea exchange of heat, water, momentum, and dissolved gases (oxygen and CO₂).
- **Pulse-10 mooring**
To make upper ocean measurements of properties that control carbon uptake and export to the ocean interior, including temperature, salinity, mixed layer depth, light, oxygen, total dissolved gases, phytoplankton fluorescence, particle backscatter, and dissolved nitrate, and collect 24 paired water samples later study of nutrients and phytoplankton identification.
- **SAZ-15 mooring**
To collect sediment trap samples in the deep sea (below 1000m) to quantify the transfer of particulate carbon and other materials to the ocean interior.

SAZ-16 mooring was left in the ocean to complete its program, for recovery in 2014 or 2015.

Ancillary measurements carried out included underway and CTD sensor and sample collections. No ancillary zooplankton net drops or CPR tows were performed as this equipment was not provided prior to departure.

Voyage Narrative

Friday 4 October 2013

Mobilisation day. Loading of equipment

Monday 7 October

Departed at 0800 in pleasant conditions. While in sheltered waters we practiced SOFS buoy recovery operation with winches and A-frame on the aft deck. A test CTD was performed to 90m. We commenced transit to SOTS site at around 1500.

Tuesday 8 October

We continued to transit in moderate conditions with 30kt Westerlies. Recovery procedure meetings for each mooring were held throughout the day. We arrived at the site around 2100 and stationed the ship off the SOFS-4 mooring to collect meteorological comparison observations over night.

Wednesday 9 October

0600 dawn at the SAZ-15 site revealed good conditions with winds around 20kts and seas 2-3m. After 0630 JHA/Toolbox and aft deck toolbox meetings, the ship took up position 0.5Nm NW of the anchor site and the releases triggered at 0800. Floats were spotted on the surface shortly after and grappling commenced around 0900. The mooring recovery was completed by 1730, debrief by 1830, craning and unspooling completed by 2200.

Thursday 10 October

Weather was inclement (30-40kts) and expected to deteriorate further. 0615 communicated with Pulse-10 acoustic release (to confirm it would respond when triggered later) and morning spent unspooling remainder of SAZ-15 wire. Overnight conditions deteriorated further with wind gusting to 60kts.

Friday 11 October

Rough conditions. Ship on most comfortable heading for the day with a slow upwind course. Brief 2-hour lull in winds at 1800, but soon back up to full strength again.

Saturday 12 October

Conditions still unsuitable for mooring operations with 40kt westerlies. Communicated with SAZ-16 acoustic release and received response that system is working as planned.

Sunday 13 October

Conditions eased somewhat overnight. Toolbox meeting held on bridge at 0800, but conditions still not settled enough for mooring operations. Squalls, snow, hail and very cold southerly blowing (air temperature around 3 Deg C).

Monday 14 October

0600 Conditions moderate with 20kt winds. Toolbox held. Pulse-10 release triggered 0700 and float sighted 0750. Floats on board 0820 and mooring recovery completed 1400. Craning and unspooling completed 2130. CTD some miles to the east of Pulse site performed at 1700. Profiled to 1250m, samples 1000m-surface, 10 depths with doubles: DO, DIC, Salts, Nutrients, large volumes near surface for plankton and at 1000m for reference.

Tuesday 15 October

0600 Conditions good with 25kt winds and moderate seas from the west. Overcast with fog, light rain and snow flakes. Toolbox held. The SOFS-4 release was triggered at 0700 and floats spotted 0815. The floats were successfully grappled on the first go and on board by 0850. The buoy was recovered by 1330 and mooring operations completed by 1420. A CTD some miles to the north east of the SOFS site was performed at 1600. Profiled to 1250m, samples 1000m-surface, 10 depths with doubles: DO, DIC, Salts, Nutrients and large volume near surface for plankton. Transit to Hobart commenced 1630.

Three points relating to this recovery were:

- A 4-pack and 8-pack of glass ball flotation had imploded (12 out of 40), but still sufficient flotation to lift releases to the surface. The strategy of creating smaller (4 ball) packs and increasing spacing between packs appears to have been successful with the spread of damage isolated to individual packs. The two packs destroyed were not adjacent.
- The auto-recovery line launcher has been under development for some time and deployed on the last three SOFS moorings. This recovery saw the first successful activation and deployment of the recovery line. The light messenger line was grappled with little trouble. The heavier recovery line was easily extracted by tugging on the messenger line. The recovery line is 18m long (messenger ~26m, 2Ton breaking load). The messenger line was pulled in by hand and cleated on the bulwark. There was some difficulty and lengthy delays in securing the recovery line to the ship's lifting line
- A SOFS float landing & securing structure, consisting of two parallel landing rails running fore and aft and designed to provide a simple cradle in which to land the buoy was trialled. The equipment worked well, allowing for immediate securing of the buoy and longer-term strapping down to be achieved simply and quickly.

Wednesday 16 October

Continued transit to Hobart under rough conditions with strong 40kt (gusting 70kt) westerlies and 7-8m seas on the beam. Heavy rolling. Galley closed – spag boll for breakfast, lunch & tea.

Thursday 17 October

Arrived in Hobart for pilot at 0800. Alongside dock at 0900 and demobilisation commenced.

Nearby mooring that will not be recovered until 2014 or 2015

SAZ-16 Deployed 4 May 2013			
Anchor Target Site	46° 47.400'S	141° 49.500'E	4530 m
Anchor Drop Site:	46° 47.7516' S	141° 48.8316'E	4496 m
Anchor Triangulated Site:	46° 47.603'S	141° 49.392'E	4531 m
Distance from Drop to Triangulated site: 0.41 nmiles			
Distance from Drop to Target site: 0.58 nmiles			
Subsurface mooring – no surface expression			

CTD Deployments

CTD deployments 02 and 03 were carried out to 1250m depth. Niskin bottle samples were collected at 10 depths (1000, 800, 600, 400, 200, 150, 120, 70, 30, 5m; paired Niskins with both sampled each depth) for dissolved oxygen, DIC, alkalinity, salinity and nutrients. Mounted sensors measured temperature, conductivity, dissolved oxygen, photo synthetically available radiation, phytoplankton fluorescence, and beam transmission.

Water was collected at 1000 and 800m from deployment 02 and 03 for the CMAR Calibration facility.

Water was collected at 5m from deployment 02 and 03 for Phil Boyd for phytoplankton work.

Summary

The voyage was successful in achieving all scientific goals. Mooring operational procedures had been revised prior to the voyage to provide a more structured approach to the recoveries. The use of smaller recovery teams, supported by fresh teams for follow-on work (craning and spooling) worked well with improved on-deck control and coordination.

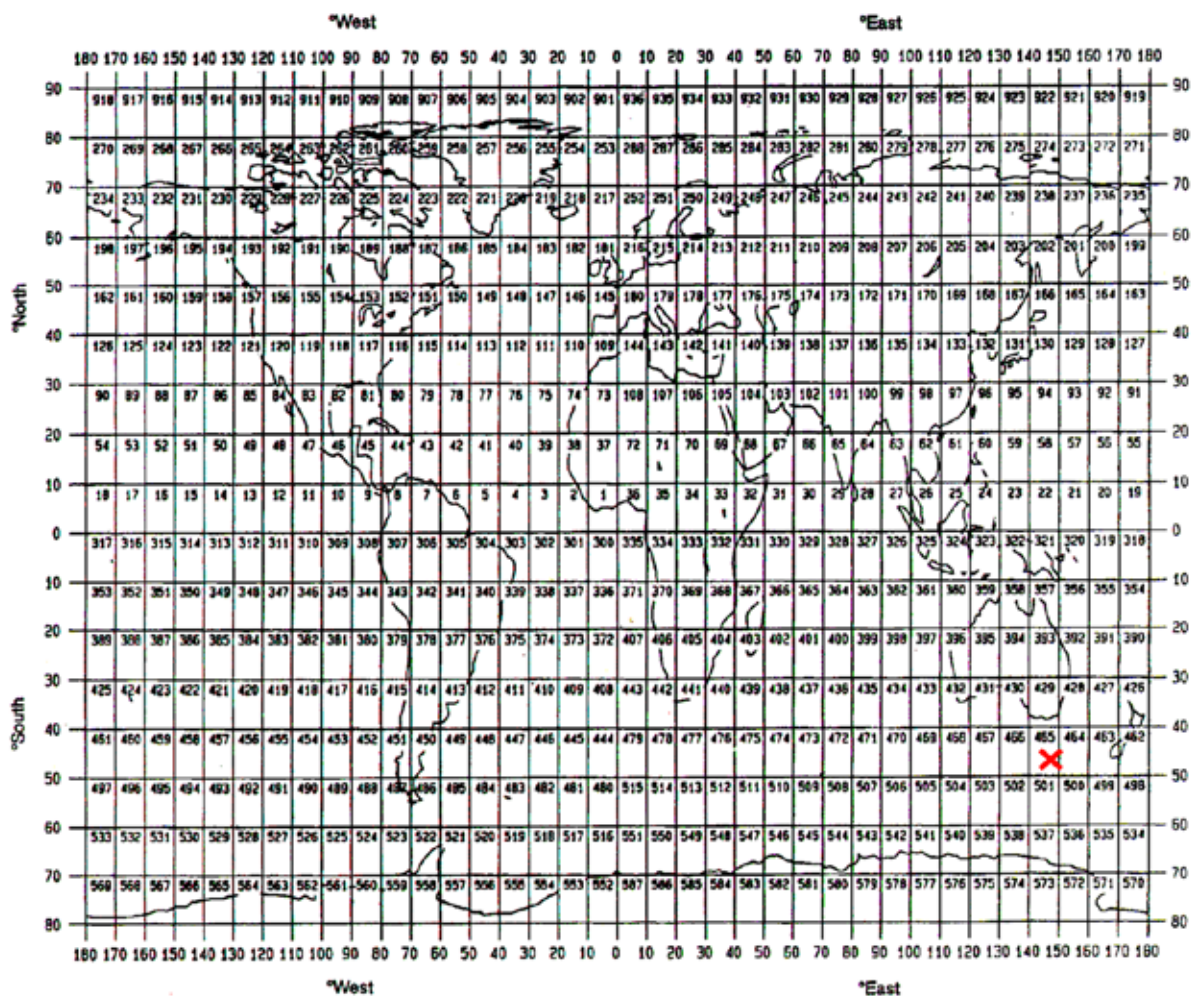
The crew and science party performed superbly despite prolonged rough and tedious seas.

PRINCIPAL INVESTIGATORS

A. Eric Schulz, BOM-CAWCR, E.Schulz@bom.gov.au

B. Tom Trull, ACE CRC – UTAS – CMAR-CAWCR, Tom.Trull@utas.edu.au

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



MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS									
Item No.	PI	Approximate position						Data Type	DESCRIPTION
		deg	Latitude min	N/S	deg	Logitude min	E/W		
1	A	46	46.6	S	141	59.6	E	M02, M06, M90, H71, D01, H90, H17, H21	Recovered SOFS-4 (deployed 1 May 2013)
2	B	46	56.3	S	142	17.1	E	H90	Recovered Pulse-10 (deployed 7 May 2013)
3	B	46	50.3	S	141	40.7	E	H90	Recovered SAZ-15 (deployed 18 July 2012)

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN					
Item No.	PI	No.	Units	Data Type	DESCRIPTION
1	B	1	cast	H10	2 CTD casts to 1200m, sampled at 10 depths for analyses of nutrients, salinity, DIC, alkalinity, dissolved oxygen
2	A	700	miles	H71	Continuous monitoring of underway seawater supply for temperature, salinity for study of physical heat and mass flux
3	A	700	miles	M02	Continuous monitoring of incoming short and long-wave radiation for heat fluxes
4	A	700	miles	M06	Continuous monitoring of routine meteorological observations (wind, air temperature, humidity and pressure) for heat, mass and momentum fluxes
5	A	700	miles	M90	Continuous monitoring of precipitation for mass fluxes
6	B	48	samples	H71, H11	Underway Water Samples

Curation Report

Item No.	DESCRIPTION
1	Water samples collected from the CTD and underway system are returned to CSIRO Marine and Atmospheric Research for gas and salinity measurements and then discarded following quarantine protocols.

Voyage track chart

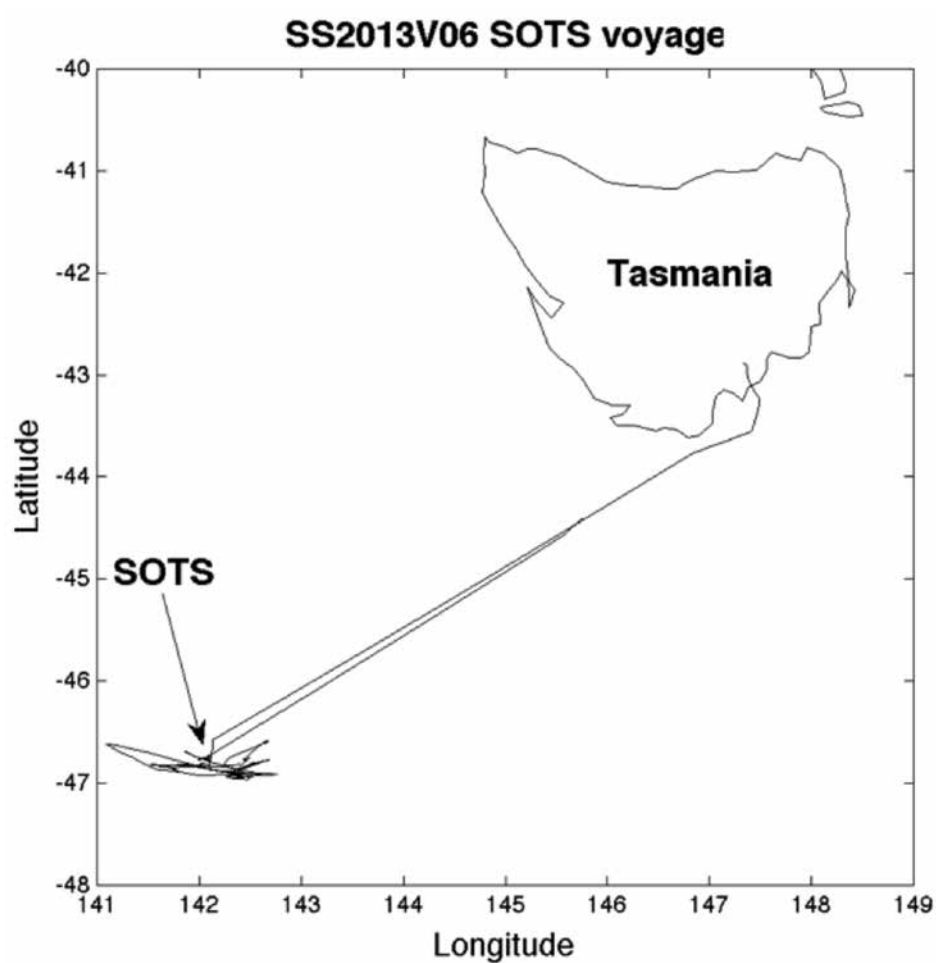


Figure 1: Ship track SS2013_v06

General ocean area(s): Southern Ocean – Indian Sector

Specific areas: Subantarctic Zone southwest of Tasmania

Personnel list

Scientific Participants

Name	Affiliation	Role
1. Eric Schulz	BOM	Chief Scientist, Met OBS, moorings
2. Stephen Bray	ACE CRC	Moorings, sedtraps, CTDs
3. Peter Jansen	IMOS-UTAS	Moorings, Toolbox briefings
4. Mark Lewis	CMAR	Moorings, Technical Supervisor
5. James LaDuke	CMAR	Moorings
6. Don McKenzie	MNF-CMAR	MNF Voyage Manager
7. Tegan Sime	MNF-CMAR	Voyage Manager Understudy
8. Max McGuire	MNF-CMAR	Voyage Manager Understudy
9. Nicole Morgan	MNF-CMAR	MNF Electronics Support
10. Peter Dunne	MNF-CMAR	MNF Electronics Support
11. Pamela Brodie	MNF-CMAR	MNF Computing Support, Deputy Voyage Manager

Marine Crew

Name	Role
John Barr	Master
Mike Tuck	Chief Mate
Tom Watson	2nd Mate
Mike Yorke-Barber	Chief Engineer
Seamus Elder	1st Engineer
Graeme Perkins	2nd Engineer
Cassandra Rowse	Chief Steward
Warren Leary	Chief Cook
Serena Pearson	2nd Cook
Jonathon Lumb	CIR
Ron Johnston	IR
Dave Jephson	IR
Michael Chalk	IR
Nathan Arahanga	IR

Acknowledgements

Thanks to the Master, Crew, MNF staff, and the onboard Science Team the voyage went very smoothly which is testament to the skill and professionalism of all aboard.

Eric Schulz

Chief Scientist

16 October 2013

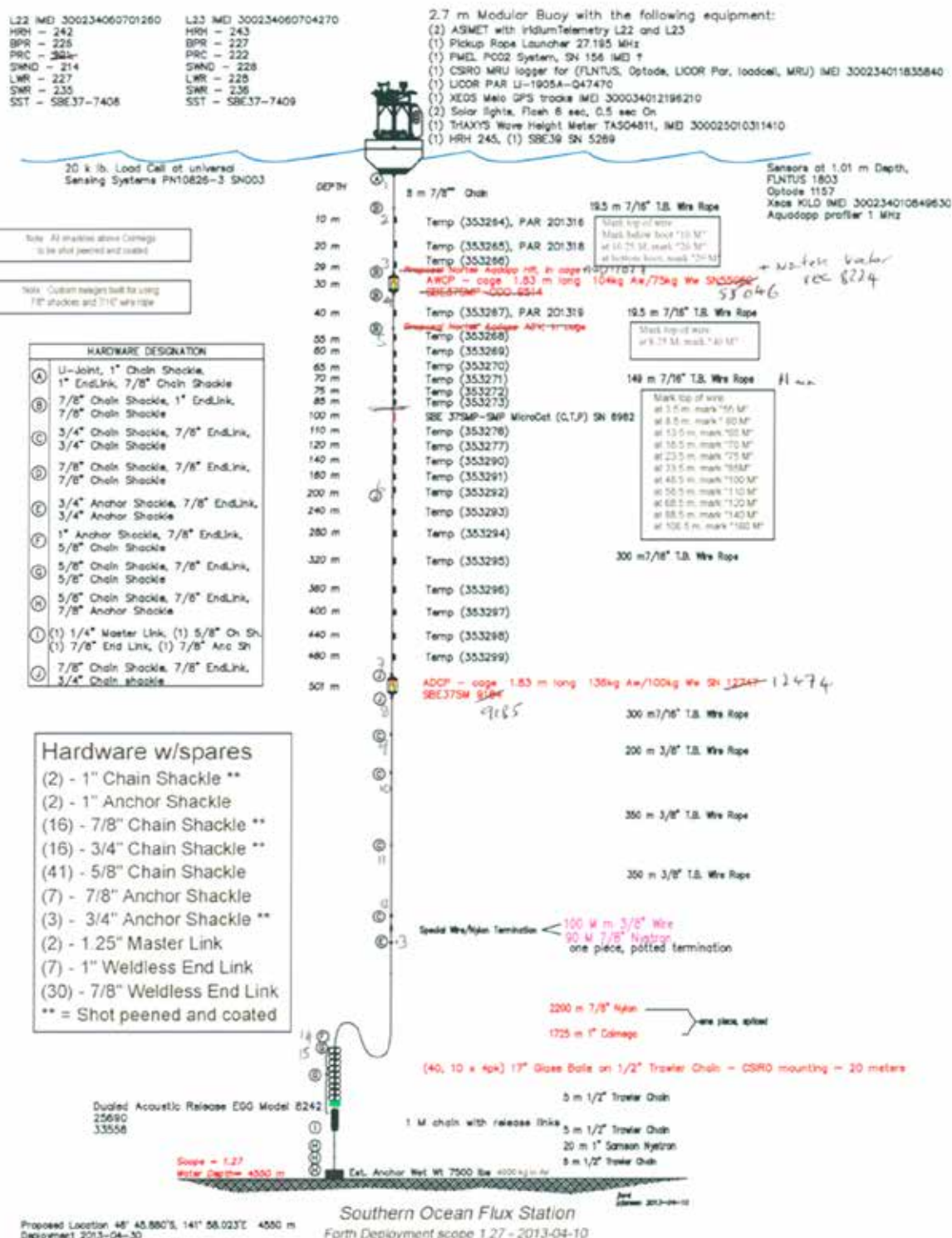


Figure 2: SOFS-4 mooring diagram

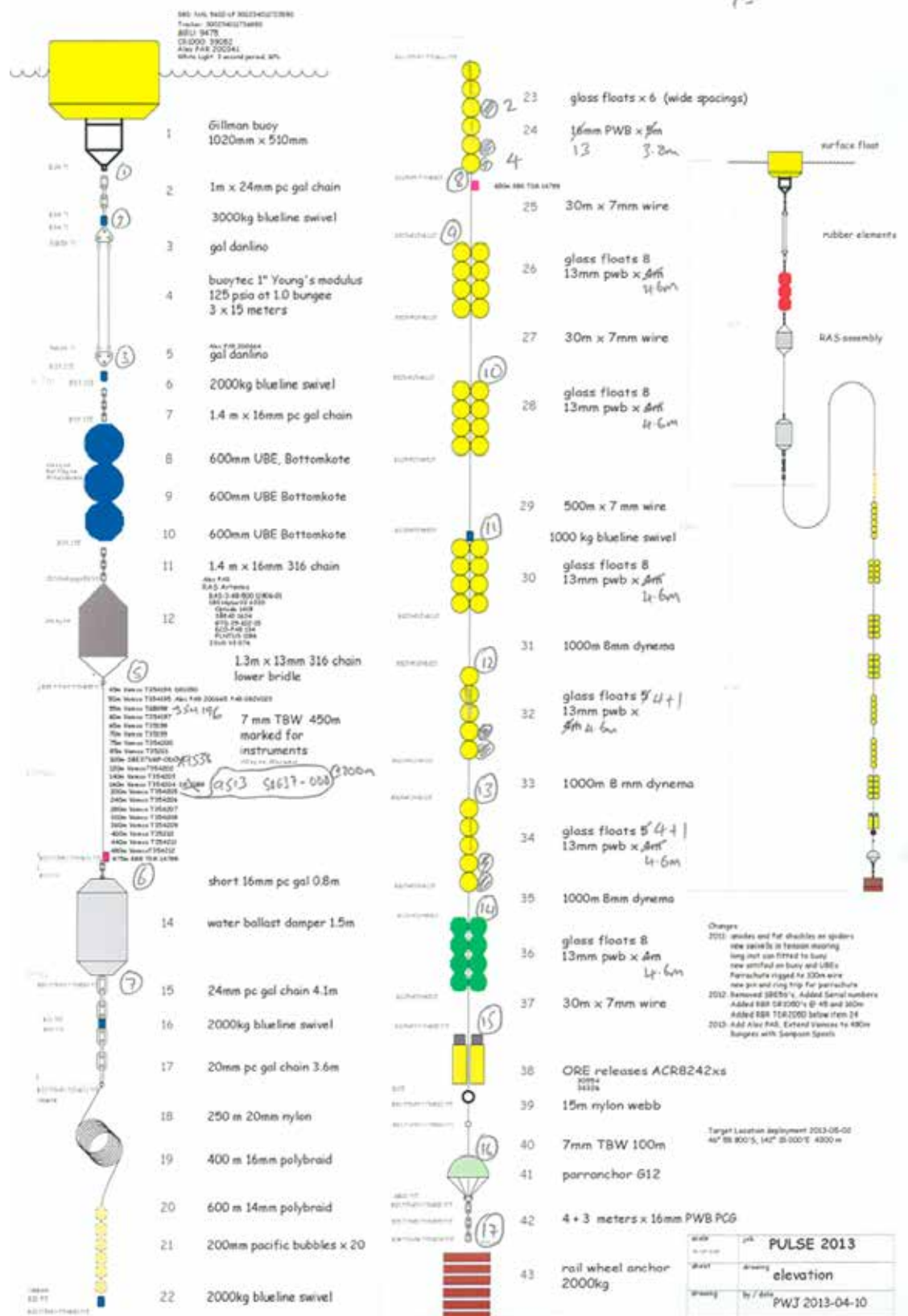


Figure 3: Pulse-10 mooring diagram

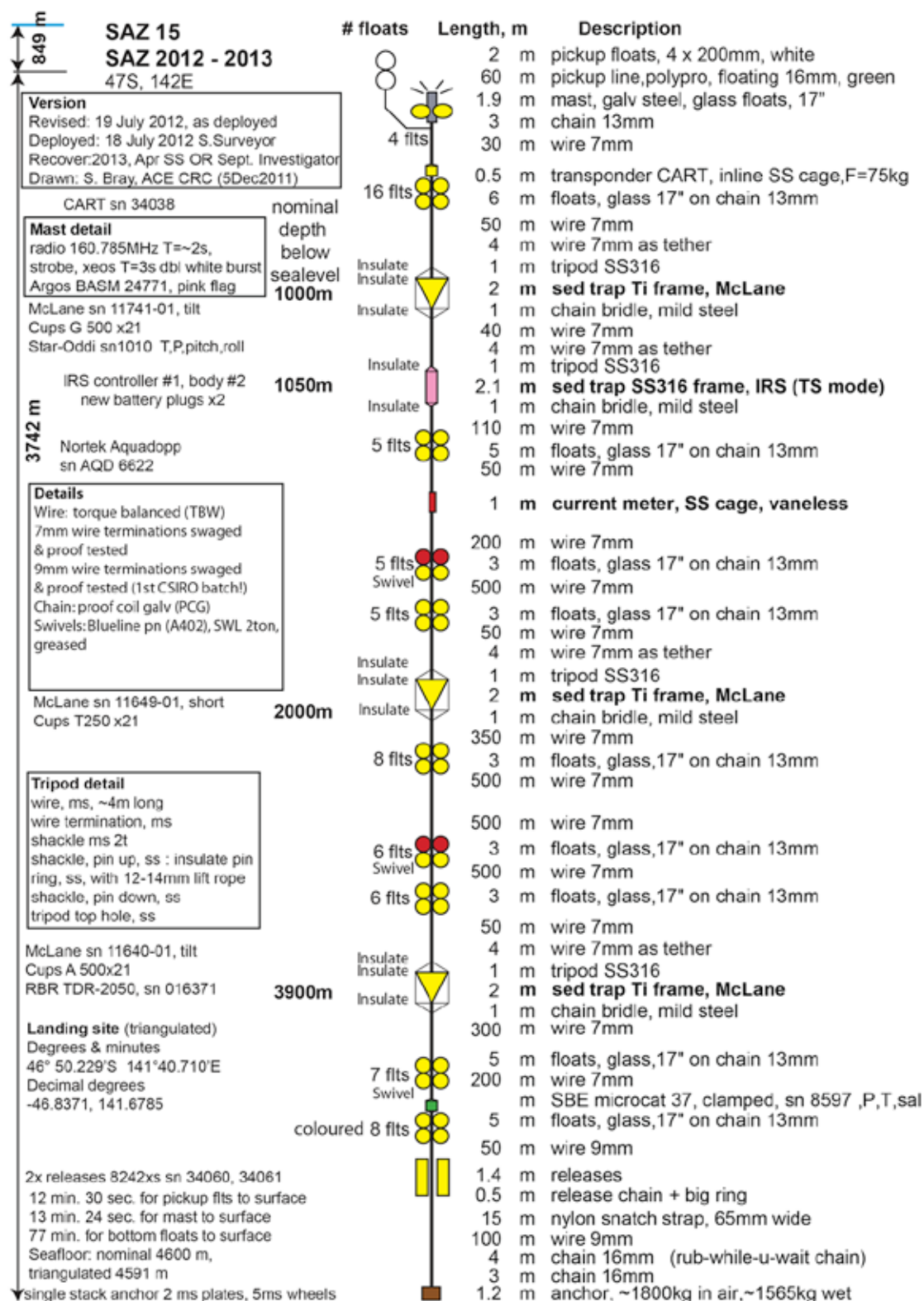


Figure 4: SAZ-15 mooring diagram

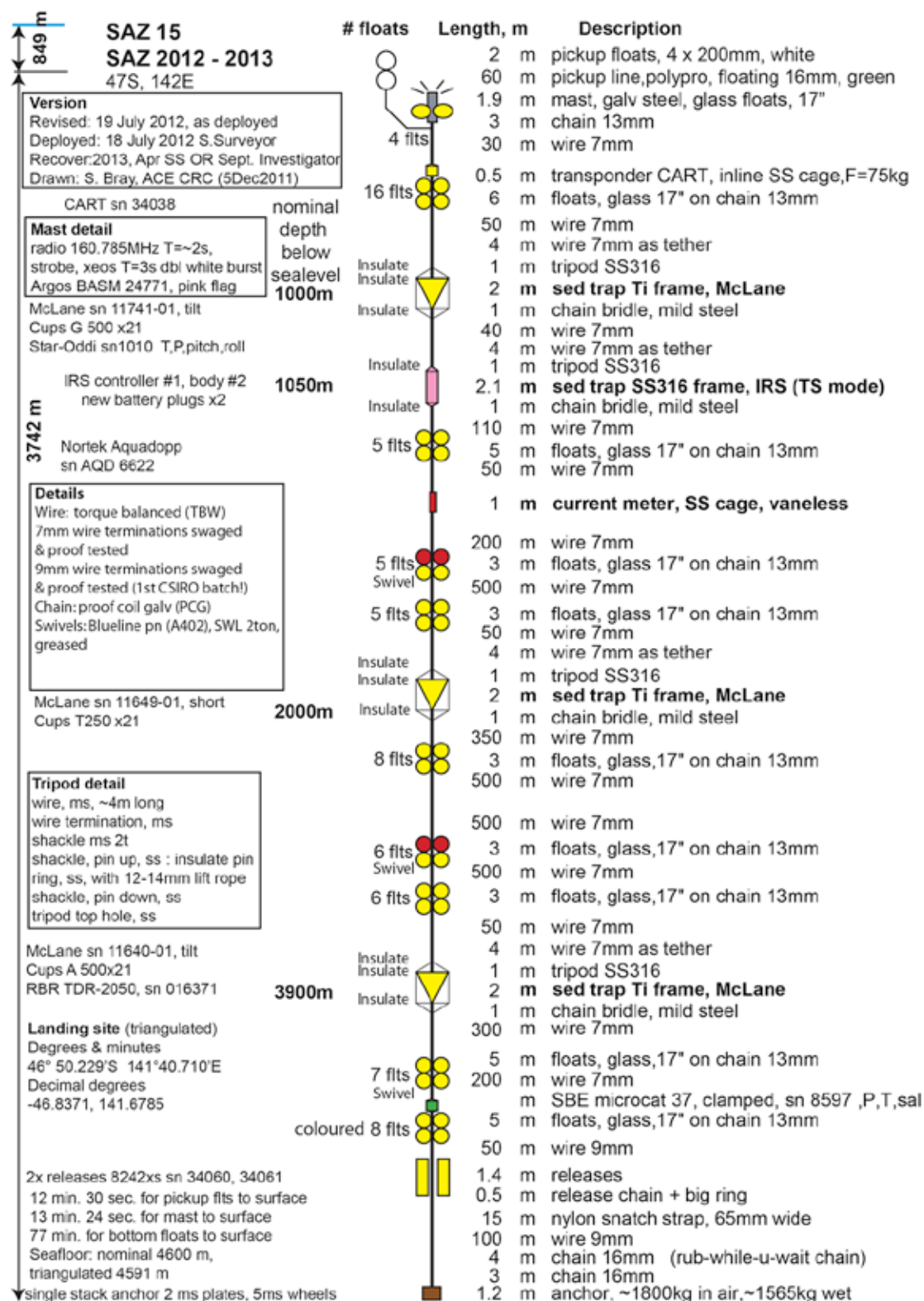


Figure 5: SAZ-16 mooring diagram

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