

RV Investigator Voyage Plan

Voyage #:	IN2018_V07		
Voyage title:	SOTS: Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania;		
Mobilisation:	Hobart, Monday, 6 August 2018 0800		
Depart:	Hobart, Monday, 6 August 2018, 1600		
Return:	Hobart, Saturday, 11 August 2018, 0800		
Demobilisation:	Hobart, Saturday, 11 August 2018		
Voyage Manager:	Max McGuire	Contact details:	max.mcguire@csiro.au
Chief Scientist:	Eric Schulz		
Affiliation:	Bureau of Meteorology	Contact details:	eric.schulz@bom.gov.au

Scientific objectives

Trull: Southern Ocean Time Series

The Southern Ocean has a predominant role in the movement of heat and carbon dioxide into the ocean interior moderating Earth's average surface climate. SOTS uses a set of two automated moorings to measure these processes under extreme conditions, where they are most intense and have been least studied. The atmosphere-ocean exchanges occur on many timescales, from daily insolation cycles to ocean basin decadal oscillations and thus high frequency observations sustained over many years are required. The current context of anthropogenic forcing of rapid climate change adds urgency to the work.

The objective is to deploy a new SOTS mooring (SOFS-7.5). This SOTS mooring delivers to specific aspects of the atmosphere-ocean exchanges:

- The Southern Ocean Flux Station (SOFS) mooring measures meteorological and ocean properties important to air-sea exchanges, ocean stratification, waves, and currents. Additional sensors quantify CO₂ partial pressure, net community production from oxygen and total dissolved gases and nitrate depletion, biomass from bio-optics and bio-acoustics. Water samples are collected for nutrient and plankton measurements after recovery.

Ancillary work will obtain supporting information on atmospheric and oceanographic conditions using CTD casts and underway measurements.

Voyage objectives

1. Deploy SOFS-7.5 meteorology/biogeochemistry mooring & triangulate
2. Do a CTD (1 cast to 2250m) at the SOFS-7.5 site, including collecting samples for nutrients, oxygen, dissolved inorganic carbon, alkalinity, and POC & pigments
3. Carry out underway air sensor measurement comparison between ship and SOFS-7.5 mooring

The priority is deploying SOFS-7.5 mooring (objective 1).

Operational Risk Management

The mooring deployment and recovery operations are high risk, management includes:

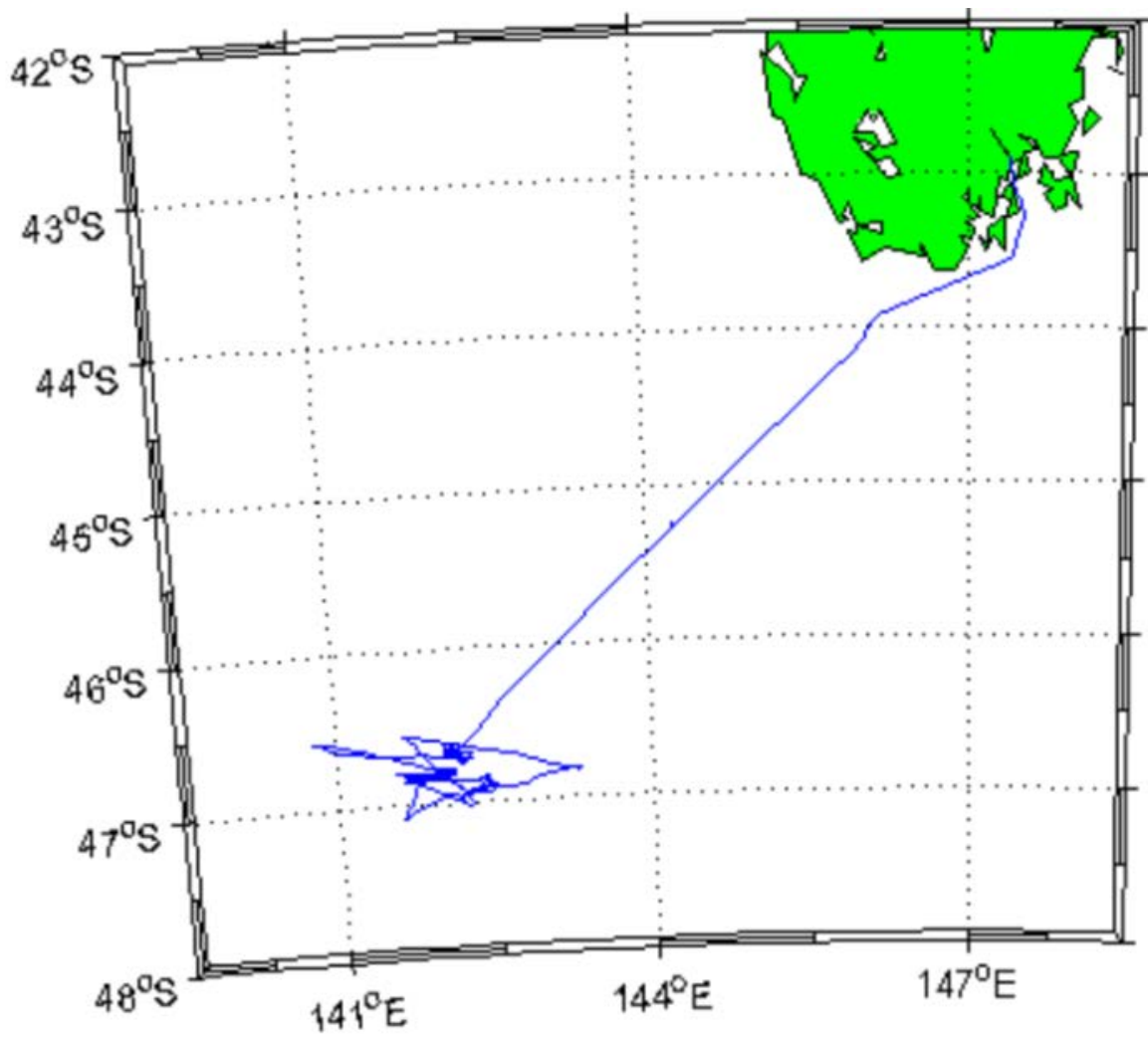
- Detailed procedures reviewed with the crew and science team before and during the voyage
- Job hazard analysis and toolbox meetings
- Restriction of trawl deck working areas to essential participants
- A designated safety observer

The mooring protocols are in the ship's Safety Management System (SMS)

Overall activity plan including details for first 24 hours of voyage

6	Aug	<p>Mobilise:</p> <ol style="list-style-type: none"> 1. Load CSIRO winch and spool the wire, preferably prior to mobilisation day 2. Load other mooring gear (SOFS-7.5 large float, anchors) and CPR to main trawl deck. 3. Spool moorings to winches if not done prior. Do on transit if insufficient time. 4. Depart by 1600 and perform anchor moving practice in the river while on transit to Storm Bay and then SOFS-7.5 site
7	Aug	<p>Transit towards SOFS-7.5 site doing underway sensor observations</p> <p>Hold Mooring Procedures Familiarization Meeting with Science Party, Master, Mates and Crew</p>
8	Aug	<p>0000-0600: Transit towards SOFS-7.5 site doing underway sensor observations</p> <p>0600: Arrive SOFS-7.5 site and position 9 miles down-weather from SOFS-target location at first light (sunrise at 0646 (2046 UTC)).</p> <p>0600-2000: Deploy SOFS-7.5 mooring</p> <p>2000-2200: Triangulate SOFS-7.5 anchor, collect ship sensor observations close to SOFS-7.5 (time permitting)</p> <p>2200-2400: CTD cast to 2250m with sampling for salinity, nutrients, oxygen, DIC, Alkalinity, POC, Pigments</p> <p>2400: Deploy CPR (weather permitting) and commence Transit to Hobart</p>
9	Aug	Weather day
10	Aug	0000-2400: Transit to Hobart towing CPR
11	Aug	0800: Arrive Hobart & demobilise

Voyage track example



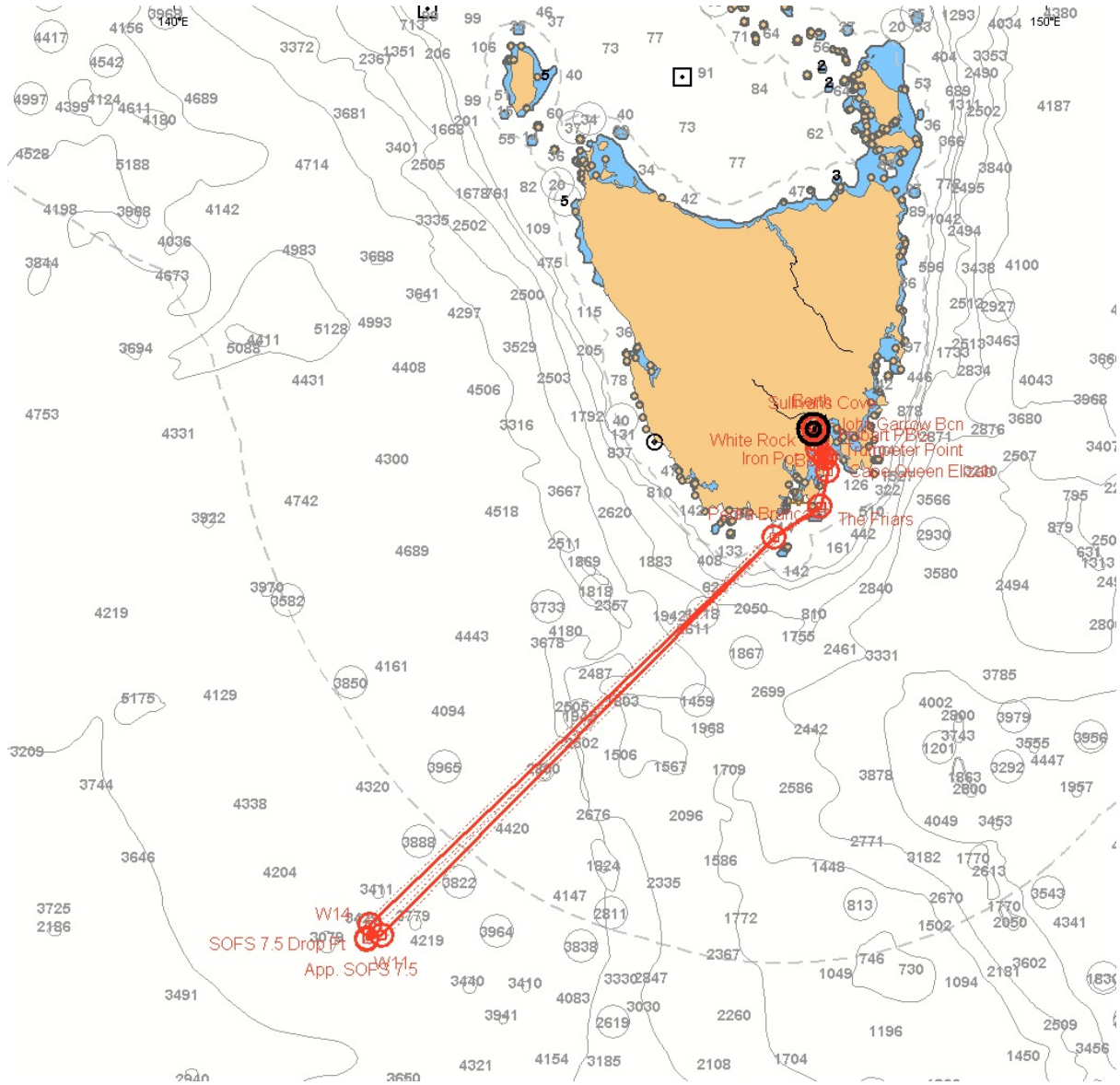
Waypoints and stations

Time estimates are at 9 knots transiting to SOTS, 11 knots return

Waypoint Number	Waypoint Name	Latitude (S)	Longitude (E)	Course	Distance (NM)	Total Distance (NM)
1	Berth	42°53.099	147°20.310	88.2	0.3	0.0
2	Sullivans Cove	42°53.089	147°20.755	135.7	2.2	0.3
3	John Garrow Bcn	42°54.759	147°22.974	179.7	0.8	2.5
4	Hobart PBG	42°55.414	147°22.979	186.6	3.2	3.3
5	White Rock	42°58.592	147°22.475	172	5.1	6.4
6	Iron Pot	43°03.672	147°23.444	142.4	5.5	11.5
7	Trumpeter Point	43°08.000	147°28.000	167.1	6.6	17.0
8	Cape Queen Elizabeth	43°14.400	147°30.000	191.7	17.7	23.5
9	The Friars	43°32.000	147°25.000	237.2	27.9	41.2
10	Pedra Branca	43°47.000	146°53.000	224.7	270.2	69.1
11		46°59.000	142°23.000	253.2	7.1	339.3
12	App. SOFS 7.5	47°01.000	142°13.300	314.9	0.5	346.3
13	SOFS 7.5 Drop Pt	47°00.666	142°12.810	12.7	6.9	346.8
14		46°54.000	142°15.000	46.3	270.9	353.6
15	Pedra Branca	43°47.000	146°53.000	57.2	27.3	624.5
16	The Friars	43°32.000	147°25.000	11.7	18.2	651.8
17	Cape Queen Elizabeth	43°14.400	147°30.000	347.1	6.6	670.1
18	Trumpeter Point	43°08.000	147°28.000	322.4	5.4	676.6
19	Iron Pot	43°03.672	147°23.444	352	5.2	682.1
20	White Rock	42°58.592	147°22.475	6.6	3.2	687.3
21	Hobart PBG	42°55.414	147°22.979	359.7	0.5	690.5
22	John Garrow Bcn	42°54.759	147°22.974	315.7	2.4	691.0
23	Sullivans Cove	42°53.089	147°20.755	268.2	0.4	693.4
24	Berth	42°53.099	147°20.310			693.8

Target location for mooring deployment

Mooring	Latitude	Longitude	Depth
SOFS-7.5 target	47.0111 °S	142.2135 °E	4550 m



Piggy-back projects

N/A

Investigator equipment (MNF)

Trawl Deck Equipment and Support

- Install CSIRO mooring winch on mid-line forward on deck.
- Stern-ramp cover (“dance-floor”) without overhanging lip on aft surface installed with gap protectors and mounts for user-supplied Bulls Horns fairlead.
- A-frame utility winches.
- Tagging line cleat attachment points fitted.
- deck space for half-height container with mooring gear on starboard aft quarter
- see deck loading plan for further details

O2 Deck Equipment and Support

- Install Investigator net drum winch on Mezzanine with spooler-rail installed aft of it, as the best location as discussed with MNF and ASP for this voyage.

CTD Equipment and Support

- 24- or 36- bottle CTD-rosette with 10 or 12L Niskin bottles and MNF-O₂, MNF-PAR, MNF-Wetlabs CStar 25cm pathlength 700nm red light transmissometer, FLBb/RTD user supplied sensor, and MNF-fluorometer sensors mounted
- Lowered ADCP with all heads working and logging
- CTD voltage inputs calibrated to correctly log sensor inputs
- MNF supplied hydrochemist to carry out oxygen, salinity and nutrient analyses. SOTS requires ~30 analyses of each type.
- WOCE/Go-Ship compliant CTD data processing and output files to be provided, including error estimates for oxygen and nutrient parameters

Underway Equipment and Support

- Multibeam/Multifrequency bio-acoustic system, with MNF supplied electronics, computing, and operational support
- Working and logging underway echosounder with bottom detection and real-time display
- Working and logging underway ADCP, with real-time display
- Working and logging underway thermosalinograph and fluorometer and real-time display
- Working hull mounted 12 kHz transducer for use with acoustic release deck unit

- Working drop keel for bioacoustics, thermosalinograph and ADCP data gathering deployed to >4 m.
- Working and logging meteorological instruments including ISAR SST radiometer (desirable but not essential)

User Equipment

SOTS

For Installation on Trawl Deck (see deck loading plan)

- Bullhorn mooring fairlead to be mounted on ship stern.
- CSIRO mooring winch - requires hydraulic leads to power supply installed in shelter-shed
- 1 x half-height open-top containers to hold mooring equipment
- Full height container for sheltered workspace during mooring operation. Requires monophasic 240V 15 amp power supply.
- SOFS float and recovery cradle
- SOFS-7.5 anchor, approximate weight 3 tonnes
- ~6 cage pallets of mooring equipment
- Handheld and deck mounted pneumatic line throwers (“grappling gun”)
- Video cameras installed on trawl deck
- CPR

For Installation in Shelter Science area

Power Supply for CSIRO Mooring Winch

Pallet of mooring gear

For Installation in Ops room

- acoustic release deck unit to be mounted in the Ops room (and spare unit stored)

For Installation in Underway Lab

- Pigment filtration system in sink and FIRE instrument on bench.
- AC-9 bio-optical instrument on bench

For installation in the General Purpose (Dry Clean) Laboratory,

- particle filtration systems, on forward inboard bench,

- also requires use of laminar flow bench in this lab

Permits


SOTS

- Collection of seawater samples for return to Hobart under ACE CRC Quarantine permit AQIS #IP0001721265.
- Mooring locations and buoy marking details will be provided to AMSA for notice to mariners.
- Operation of underway ship scientific seawater supply through the Tasman Fracture Zone Commonwealth Marine Reserve Permit issued to MNF # CMR-17-000471

Personnel List

1.	Max McGuire	MNF	Voyage Manager
2.	Nicole Morgan	MNF	MNF SIT support
3.	Aaron Tyndall	MNF	MNF SIT support
4.	Karl Malakoff	MNF	DAP computing support
5.	Peter Shanks	MNF	DAP computing support
6.	Bernadette Heaney	MNF	GSM support
7.	Craig Davey	MNF	GSM support
8.	Peter Hughes	MNF	Hydrochemist
9.	Eric Schulz	BOM	Chief Scientist
10.	Peter Jansen	ACE-CSIRO	Managing Engineer
11.	Jamie Derrick	CSIRO	SOTS: Mooring Supervisor
12.	Garry Curtis	CSIRO	SOTS: Mooring deck work
13.	Darren Moore	CSIRO	SOTS: Mooring deck work
14.	Diana Davies	ACE	Underway/CTD sampling
15.	Andrew Martini (TBC)	CSIRO	Mooring procedural review/training

Signature

Your name	Eric Schulz
Title	Chief Scientist
Signature	
Date:	21 June 2018

List of additional figures and documents (available separately)

1. Deck Loading Plan
2. SOFS mooring diagram

Scientific equipment and facilities provided by the Marine National Facility

Some equipment items on the list may not be available at the time of sailing. Applicants will be notified directly of any changes.

Indicate what equipment and facilities you require from the Marine National Facility by placing an X in the relevant box.

(i) Standard laboratories and facilities

Name	Essential	Desirable
Aerosol Sampling Lab		
Air Chemistry Lab		
Preservation Lab		
Constant Temperature Lab		
Underway Seawater Analysis Laboratory	X	
GP Wet Lab (dirty)	X	
GP Wet Lab (Clean)		
GP Dry Lab (Clean)	X	
Sheltered Science Area	X	
Observation deck 07 level		
Walk in Freezer		
Clean Freezer		
Blast Freezer		
Ultra-Low Temperature Freezer	X	
Walk in Cool Room		

(ii) Specialised laboratory and facilities

May require additional support

Name	Essential	Desirable
Modular Radiation Laboratory		
Modular Trace Metal Laboratories		
Modular Hazchem Locker		
Deck incubators		
Stabilised Platform Container		

(iii) **Standard laboratory and sampling equipment**

Name	Essential	Desirable
CTD - Seabird 911 with 36 Bottle Rosette		
CTD -Seabed 911 with 24 Bottle Rosette	X	
LADCP	X	
Sonardyne USBL System		
Milli -Q System	X	
Laboratory Incubators		
Heavy Duty Electronic Balance		
Medium Duty Electronic Balance		
Light Duty Electronic Balance		
Surface Net		
Bongo Net		
Smith Mac grab		
Dissecting Microscopes		

(iv) **Specialised laboratory and sampling equipment**

May require additional support

Name	Essential	Desirable
TRIAXUS – Underway Profiling CTD		
Continuous Plankton Recorder (CPR)	X	
Deep tow camera		
Piston Coring System		
Gravity Coring System		
Multi Corer		
XBT System		
Trace Metal Rosette and Bottles, and TMR Deck Box		
Sherman epibenthic sled		
Trace- metal in-situ pumps		
LADCP		
Rock Dredges		
EZ Net		
Rock saw		
Portable pot hauler		
Beam Trawl		
Trawl doors (pelagic or demersal)		
Stern Ramp NEEDS TO BE COVERED WIITH DANCE FLOOR	X	
Trawl monitoring instrumentation (IT1)		
Radiosonde		

(v) **Equipment and sampling gear requiring external support**

May require additional support from applicants

Name	Essential	Desirable
Seismic compressors		
Seismic acquisition system		

(vi) **Underway systems**

Acoustic Underway Systems

Name	Essential	Desirable
75kHz ADCP	X	
150kHz ADCP		
Multi Beam echo sounder EM122 12kHz (100m to full ocean depth)	X	
Multi Beam echo sounder EM710 70-100kHz (0-1000m approx.)	X	
Sub-Bottom Profiler SBP120		
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)	X	
Gravity Meter		
Trace metal clean seawater supply		

(vii) **Atmospheric Underway Sensors**

Name	Essential	Desirable
Nephelometer		
MAAP (multi angle absorption photometer)		
SMPS (scanning mobility particle sizer)		
Radon detector		
Ozone detector		
Manifold instrumentation (intake temperature and humidity)		
Picarro spectrometer (analysis of CO ₂ /CH ₄ /H ₂ O)		
Aerodyne spectrometer (analysis of N ₂ O/CO/H ₂ O)		
O ₂ analyser		
Manifold instrumentation (intake temperature and humidity)		
CCN (Cloud Condensation Nuclei)		
MOUDI (Micro-Orifice Uniform Deposit Impactors)		
Polarimetric Weather Radar		

(viii) **Underway Seawater Instrumentation**

Name	Essential	Desirable
Thermosalinograph	X	
Fluorometer	X	
Optode	X	
PCO ₂	X	