RV *Investigator* Voyage Plan

Voyage #:	**IN2018_V02**		
Voyage title:	SOTS: Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania; Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site		
Mobilisation:	Hobart, Thursday-Friday, 1-2 March 2018		
Depart:	Hobart, Saturday, 3 March 08:00 for equipment tests in Storm Bay and then transit to SOTS site		
Return:	Hobart, Tuesday, 20 March 2018, 0800		
Demobilisation:	Hobart, Tuesday, 20 March 2018		
Voyage Manager:	Lisa Woodward	Contact details:	Lisa.Woodward@csiro.au
Chief Scientist:	Thomas W. Trull		
Affiliation:	CSIRO	Contact details:	Tom.Trull@csiro.au
Principal Investigators:	Philip Boyd		
Project name:	Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site		
Affiliation:	UTAS	Contact details:	Philip.Boyd@utas.edu.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 primary objective is to first deploy a new set of SOTS moorings (SOFS-7 and SAZ-20) and then recover the existing SOTS moorings (SOFS-6 and SAZ-19). Each of the SOTS moorings delivers to specific aspects of the atmosphere-ocean exchanges:

- the SAZ sediment trap mooring collects samples to quantify the transfer of carbon and other nutrients to the ocean interior by sinking particles, and investigate their ecological controls.
- 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 CO_2 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, underway measurements, Triaxus towed body, Continuous Plankton Recorder and autonomous profiling Biogeochemical-Argo floats, and potentially casts of a bio-optical sensor package.

Boyd: Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site

The subantarctic water mass forms a circumpolar ring which comprises half of the open waters of the Southern Ocean. Complex environmental forcing controls its productivity, ecology and biogeochemistry both in the present day and in the geological past. An improved mechanistic understanding of these controls on the marine biota is needed, and will provide the context to better interpret observations being obtained at unparalleled resolution by the SOTS moorings. Our study will forge strong links with SOTS by determining how environmental forcing manifests itself in biological and biogeochemical signatures across a range of scales. A better understanding of this relationship will aid the development of a state-of-the-art coupled iron and carbon biogeochemical model which will be validated using future multi-property time-series observations.

Our main aim is to enhance our understanding of the interlinked biogeochemical cycles of iron and carbon in the Southern Ocean to better understand how intra-seasonal, seasonal and interannual variability in iron supply and recycling influences the productivity and export of carbon into the ocean's interior in the subantarctic circumpolar ring. Additional aims include:

- Elucidation of the relative roles of iron supply versus biological and photochemical recycling in driving subantarctic primary productivity and export fluxes.
- Resolution of the interplay of multiple environmental controls – irradiance, mixed layer depth, trace element supply (zinc, copper etc), silicate supply, iron availability – across a range of temporal and spatial scales – to better predict changes in rates of primary productivity.

- Enhancement of knowledge on the interplay of mesoscale and submesoscale physics and biogeochemistry in the vicinity of the SOTS site to better understand the degree of coupling and integration of surface ocean processes with those in the subsurface ocean (such as the sensors and particle traps on the SOTS mooring).

Voyage objectives

SOTS

1. Deploy SOFS-7 meteorology/biogeochemistry mooring
2. Deploy SAZ-20 sediment trap mooring
3. Recover SAZ-19 sediment trap mooring
4. Recover SOFS-6 meteorology/biogeochemistry mooring (lower portion only)
5. Do CTDs (2 casts to 2250m) at the SOTS site, including collecting samples for nutrients, oxygen, dissolved inorganic carbon, alkalinity, and particulate matter analyses
6. Carry out underway air and water sampling and sensor measurements, including bio-optics and bio-acoustics
7. Deploy 2-3 Biogeochemical-Argo autonomous profiling floats at the SOTS site, potentially augmented by casts of a bio-optical sensor package.
8. Tow MacArtney Triaxus on return to Hobart
9. Tow CPR on transit to SOTS site

Boyd: Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site

1. Underway oceanographic sampling of mesoscale and sub-mesoscale physics and biogeochemistry in the vicinity of the SOTS mooring (sampling underway seawater, TM clean tow-fish)
2. Repeat temporal vertical physics, chemistry, bio-optics and biological profiles near the SOTS mooring (using ISP, TMR, TM clean tow fish, CTD)
3. Process studies of key questions including the supply of recycled versus new iron (using zooplankton nets, ISP, TMR, TM clean tow fish, CTD, MNF rad van and deckboard incubators)
4. Ocean and atmospheric sampling to develop a stable isotopic budget for iron (using atmospheric chemistry lab, and zooplankton net tows, ISP, TMR, TM clean tow fish)
5. Deployment and recovery of the free-drifting RESPIRE sinking particle traps (with traps for trace elements, in-situ oxygen respiration, and particle forms as isolated into polyacrylamide gels).
6. Targeted experimental manipulations, such as fluctuating light incubations to better understand data obtained from 1. and 2. (using walk-in CT room, other lab temp-controlled incubators and the MNF deckboard incubation platform). Particles collected using Niskin bottles, nets and the underway seawater supply will provide material for aggregation and sinking experiment using the SNOWMAN (Simulator of Non-finite, Open Wheeled Marine Aggregation and siNking) and traditional roller tank + table. These experiments target a better understanding of the dynamics of carbon export in the SOTS area related to surface planktonic communities.

Kloser Acoustic zooplankton and fish Piggy-Back Project:

1. With vessel stationary, deploy PLAOS acoustic-optical profiling device to 1000m depth, 2 times per night for up to 5 nights. Each cast takes ~1.5 hours. Protocols have been developed for the PLAOS operations on previous trials and operational voyages. The deployments need to commence at night at least 1 hour after sunset and finish at least 1 hours before sunrise. Deploy the PLAOS during the day for 1 -2 casts to characterise the vertical flux of organisms to assist with zooplankton grazing experiments.
2. Operate the ships underway bio-acoustic sensors during the voyage to characterise the epipelagic and mesopelagic scattering (IMOS bioacoustics). Trials of broadband acoustics from the vessels transducers and CTD casts to 1000 m will also be done on an opportunistic basis. Test the reduction in noise on the acoustic systems from previous voyage recommendations.
3. Capture key zooplankton/micronekton organisms using a single wire ISAAC Kid (or RMT25) trawl towed obliquely to 600 m depth and a 1 m surface net for species identification, isotope and acoustic reflectance studies. Three to five night time tows and two day time tows are envisaged (~3 hrs per operation).

The overall priority is the SOTS moorings (SOTS objectives 1-4), because these cannot be downscaled and have the highest dependence on weather. The next priority is to complete Boyd objectives, then remaining SOTS objectives, then Kloser piggy-back objectives, with the intent to reduce the number of each of these operations (CTDs, TMRs, drifting traps, PLAOS, nets, etc.) so that some results are achieved for all.

Operational Risk Management

SOTS:

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)

Boyd Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site:

Over-the-side operations using TMR, ISP, CTD, zooplankton nets and the TM clean tow fish have been used successfully and without incident on several previous voyages – hence they have not been labelled as high risk on those voyages and so normal MNF procedures will be used.

The deployment and recovery of the RESPIRE 300 m long surface tethered free drifting mooring has also been conducted successfully on to Investigator voyages. It is considered a medium/high risk operation and so risk management includes all of the checks and balances applied above to the SOTS moorings (the deployment and recovery will conducted by the SOTS mooring team).

Kloser Piggy-Back:

The PLAOS and ISAAC Kid trawl have been used on several previous voyages – they have not been flagged as high risk on those voyages so normal MNF procedures will be used.

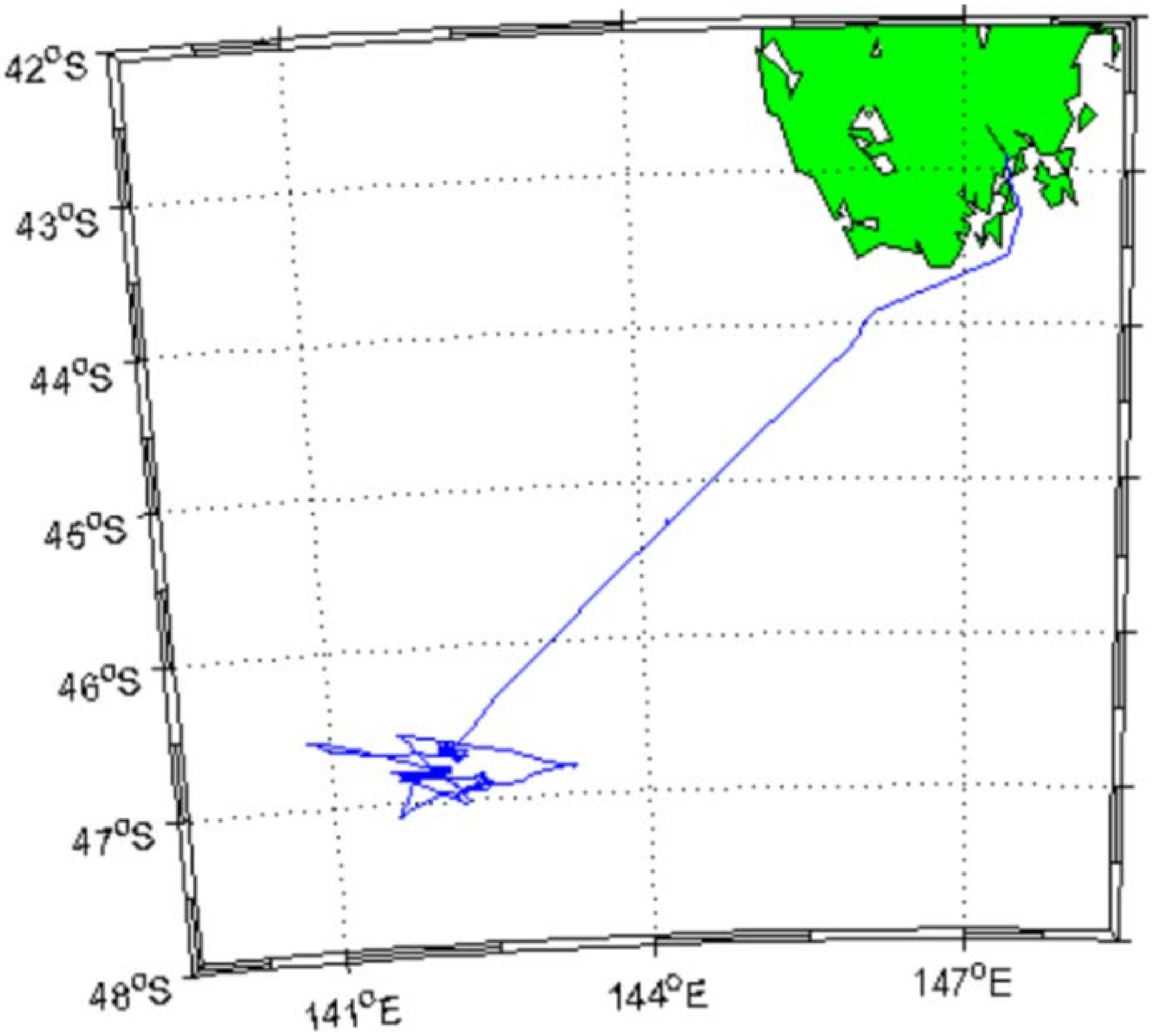
Overall activity plan including details for first 24 hours of voyage

1 -2	Mar	Mobilise: 1. SOTS: Load CSIRO winch and mooring containers (Sedtrap and Half-Height) and other mooring gear (SOFS-7 large float, anchors) to main trawl deck. Spool moorings to winches. 2. BOYD: Load trace element lab vans (old white van, new blue van, TMR deck box, spare TMR) 3. KLOSER load PLAOS to shelter shed and nets to trawl deck 4. SOTS/BOYD/KLOSER Load lab equipment and begin internal labs setup 5. SOTS: Load Triaxus
3	Mar	0800: Depart In Adventure or Storm Bay, test all of following: CTD, PLAOS, Triaxus, mooring anchor dual lift ~1400: Begin transit to SOTS
4	Mar	Transit to SOTS towing CPR, doing underway sensor observations Hold Mooring Procedures Familiarization Meeting with Science Party, Master, Mates and Crew
5	Mar	0000 Arrive SOTS site - near SOFS-7 target deployment site 0000-0400 SOTS: CTD cast to 2250m 0400-0600 Boyd: TMR cast to 1500m 0600-1000 Boyd: ISP cast to 1500m 1000-1200 Boyd: TM-clean fish (upper 50 m) 1200-1500 SOTS: Deploy RESPIRE drifting traps for Boyd 1500-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 2000-2400 Kloser: PLAOS & ISAAC KID deployments
6	Mar	0000-0400 Kloser: PLAOS & ISAAC KID deployments 0400-0600 transit to SOFS-7 deployment start (9 miles down-weather from target location) 0600-2000 SOTS: deploy SOFS-7 mooring 2000-2400 SOTS: triangulate SOFS-7 anchor, collect ship sensor observations close to SOFS-7
7	Mar	0000-0400 SOTS: collect ship sensor observations close to SOFS-7 0400-0600 Boyd: TMR cast to 1500m 0600-1000 Boyd: ISP cast to 1500m 0800-1800 SOTS: spool on SAZ-20 mooring –deck ops only 1000-1200 Boyd: TM-clean fish (upper 50 m) 1200-1600 Boyd: ISP cast to 1500m 1600-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 2000-2400 Kloser: PLAOS & ISAAC KID deployments
8	Mar	0000-0400 Kloser: PLAOS & ISAAC KID deployments 0400-0600 SOTS: transit to SAZ-20 deployment start (8 miles down-weather target location)

		0600-1500 SOTS: deploy SAZ-20 mooring 1500-1800 SOTS: recover RESPIRE drifting traps, if remaining daylight allows, otherwise at first light on 9 Mar 1800-2400 SOTS: triangulate SAZ-20 anchor location, Kloser PLAOS casts
9	Mar	0000-0400 SOTS: CTD cast to 2250m 0400-0600 Boyd: TMR cast to 1500m 0600-1000 SOTS: recover RESPIRE drifting traps 0600-1000 Boyd: ISP cast to 1500m, if RESPIRE drifting traps recovered on 8 Mar 1000-1300 Boyd: TM-clean fish (upper 50 m) 1400-1600 SOTS: Deploy RESPIRE trap for Boyd Trace Elements 1600-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 1800-2400 Boyd: ISP cast to 1500m,
10	Mar	0000-0500 transit to SAZ-19 recovery site (1 mile down-weather from anchor location) 0600-1800 SOTS: recover SAZ-19 mooring 1800-2400 Kloser: PLAOS & ISAAC KID deployments
11	Mar	0000-0400 SOTS: CTD cast to 2250m / or time is available for Kloser PLAOS casts) 0400-0600 Boyd: TMR cast to 1500m 0600-1000 Boyd: ISP cast to 1500m 1000-1200 Boyd: TM-clean fish (upper 50 m) 1200-1500 Boyd: ISP to 1500 m 1500-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 0600-1800 SOTS: spool on SAZ-20 mooring –deck ops only 1800-2400 SOTS: transit to SOFS-6 site for ship sensor observations near SOFS-6
12	Mar	0000-0400 SOTS: CTD cast to 2250m 0600-1800 SOTS: recovery of SOFS-6 (lower half) 1800-2400 SOTS: transit back to SOFS-7 site (possibly towing Triaxus, depending on remote sensing)
13	Mar	0000-0400 SOTS: continue Triaxus tow or ship sensor observations near SOFS-7 0400-0600 Boyd: TMR cast to 1500m 0600-1000 Boyd: ISP cast to 1500m 1000-1200 Boyd: TM-clean fish (upper 50 m) 1200-1500 SOTS: Recover RESPIRE trap for Boyd 1500-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 2000-2400 Kloser: PLAOS & ISAAC KID deployments
14	Mar	0000-0400 Kloser: PLAOS & ISAAC KID deployments 0400-0600 Boyd: TMR cast to 1500m 0600-1000 Boyd: ISP cast to 1500m

		1000-1200 Boyd: TM-clean fish (upper 50 m) 1200-1500 Boyd: ISP to 1500 m 1500-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 2000-0000 Kloser: PLAOS & ISAAC KID deployments
15	Mar	0000-0400 Kloser: PLAOS & ISAAC KID deployments 0400-0600 Boyd: TMR cast to 1500m 0600-1000 Boyd: IISP cast to 1500m 1000-1200 Boyd: TM-clean fish (upper 50 m) 1200-1500 SOTS: Deploy RESPIRE trap for Boyd 1500-1800 Boyd: Zooplankton net tows (upper 100 m) 1800-2000 Boyd: TMR cast to 1500m 2000-0000 Kloser: PLAOS & ISAAC KID deployments
16	Mar	Weather day
17	Mar	Weather day
18	Mar	0600-1800 SOTS: Recover RESPIRE trap for Boyd, Deploy Bio-Argo floats, accompanied by shallow (300m) CTD cast and potentially bio-optical sensor package casts. Depart SOTS site, towing Triaxus
19	Mar	Transit to Hobart towing Triaxus
20	Mar	Arrive Hobart 08:00 Demobilisation

Voyage track example



Waypoints and stations

Time estimates are at 11 knots

	Decimal Latitude	Decimal Longitude	Distance (nm)	Total Distance (nm)	Steaming time (hrs)	Total Steam (hrs)
Hobart	42.87	147.35				
Storm Bay	43.33	147.350	27.62	27.62	2.51	2.51
SOTS	46.80	141.884	311.50	339.12	28.32	30.83
Hobart	42.87	147.35	352.44	748.98	32.04	68.09

Locations of moorings to be recovered

Mooring	Latitude	Longitude	Depth
SOFS-6 anchor triangulation	46.02652 °S	142.12901 °E	4603 m
SAZ-19 anchor triangulation	46.10945 °S	142.30854 °E	4526 m

Target locations for mooring deployments

Mooring	Latitude	Longitude	Depth
SOFS-7 target	47.0111 °S	142.2135 °E	4550 m
SAZ-20 target	46.7937 °S	141.8160 °E	4550 m

Note that 2018 target locations for mooring deployments are ~ 6 hours steam south of the 2017 mooring recovery sites. The voyage will start with the deployments near 47 °S, then the recoveries near 46 °S, then return to near the new moorings for the remainder of the work until return to Hobart.

Piggy-back projects

<u>Rudy Kloser, CSIRO Oceans and Atmosphere</u>

Micronekton biomass and trophic linkages

The small crustaceans, squids, fishes and gelatinous organisms that make up micronekton are a key biological component of the worlds' oceans many making nightly migrations from mesopelagic 200-1000 m depths to the surface epipelagic 0-200m depths. Understanding their diversity, distribution, biomass and energetic needs is key to further understanding the carbon cycle and linking primary production to top predators. Commonly nets, optic and acoustic samplers are used to determine the taxonomy, size, biomass, trophic linkage and energetics of zooplankton and micronekton. Each of these sampling methods have bias and uncertainty that need to be quantified prior to attributing changes within and between regions. In particular for the gelatinous community that covers a wide range of taxonomic and energetic groups that are difficult to sample with nets. To improve vessel mounted acoustic and net sampling methods of macro-zooplankton and micronekton a new profiling multi-frequency acoustic optical system has been developed with the ultimate aim of it being used as a remote sampling tool. On this voyage we will be testing the next phase of a profiling lagrangian acoustic and optical probe (PLAOS) to sample these organisms to depths of 1000 m. These tests will involve detailed sampling of the repeatability of the measurements when varying lighting, using new broadband acoustic sensors and a new buoyancy engine to enable the system to do repeat profiles. An ISACC KID single wire net will be used to capture micronekton for species identification and isotope studies. Development of this methodology and technology will significantly advance our knowledge of micronekton biomass and distribution and provide the necessary structure and function understanding for the development of carbon and ecosystem models of the open ocean linking to the ACE CRC carbon program as well as the MESOPP ecosystem program.

It is envisaged that the majority of the sampling will be done at night for both the PLAOS and net sampling working around the other projects as needed. We envisage ~10-12 PLAOS deployments and ~5 net deployments during the voyage.

Investigator equipment (MNF)

<u>**SOTS**</u>

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.
- container slot open for SOTS sediment trap van (see user supplied equipment)
- 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-bottle CTD-rosette with 10L Niskin bottles and MNF-O_2, MNF-PAR, MNF-Wetlabs CStar 25cm pathlength, 700nm red light transmissometer, MNF-fluorometer sensors mounted, and an additional SOCCOM supplied FLBBRTD sensor (will be onboard IN2018_v01, but will need transfer from 36 to 24 bottle rosette).
- Lowered ADCP with all heads working and logging
- CTD voltage inputs calibrated to correctly log sensor inputs
- MNF supplied hydrochemists to carry out oxygen, salinity and nutrient analyses. SOTS requires ~70 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

TRIAXUS Equipment and Support

- Triaxus towed body and towed body winch, equipped with:
  - MNF supplied electronics, data display and logging, and piloting support
  - MNF dual CTs with oxygen electrodes
  - MNF-LOPC
  - user-supplied SUNA and FIRe sensors

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

Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site

In addition to the facilities requested by SOTS, this project requires:

1. Both trace metal clean containers (MNF and CSIRO, one for sampling and the other for Flow Injection Analysis) to be mounted one on top of the other on the trawl deck (abutting the aft-most part of the ships superstructure).
2. TMR Deck Box installed on trawl deck (to house the TMR).
3. The MNF Rad van along with the MNF deckboard incubation platform (both in their usual positions).
4. Working MNF TMR and Kevlar on the associated winch, along with all of the operational MNF ISP's.
5. We will bring a Trace Metal clean fish that will be deployed mid-ship off the starboard side. We will require the ships compressor to drive the air pumps and the forward boom is required along to tow the fish.
6. Zooplankton nets will be deployed off the winch on the starboard side at midships. UTAS will supply some nets and others from MNF will be required.
7. MNF supplied hydrochemists to carry out oxygen, salinity and nutrient analyses. Boyd requires ~280 analyses of each type.

<u>Kloser Piggy back</u>

PLAOS

- This will be launched from the side and requires a pot hauler to take the load of the rope on decent and ascent.
- Working positioning system to follow PLAOS with positioning relayed to bridge
- Appropriate side lighting to watch operations

ISACC KID TRAWL and Side Net

- Net provided by user and launched from the rear of the vessel with MNF GP wire. USBL beacon will be used to track position.
- Biological lab and freezer space for specimen sorting and preservation.
- Trawl net monitoring system for depth and wire out monitoring
- Side nets in addition to above while doing ISACC KID Trawl

User Equipment

SOTS

For Installation on Trawl Deck (see deck loading plan)

- Bullhorn mooring fairlead to be mounted on ship stern – this will mean that great care will be needed to avoid it for Triaxus deployments and recoveries.
- CSIRO mooring winch - requires hydraulic leads to power supply installed in shelter-shed
- 1xhalf-height open-top containers to hold mooring equipment
- Full height container for storing and working on sediment traps, – requires monophase 240V 15 amp power supply. This container will also house the in-situ pumps for use during Boyd component.
- SOFS float and recovery cradle
- mooring anchor stacks – 3 to be combined into SOFS-7 anchor, plus single stack for SAZ anchor
- ~6 cage pallets of mooring equipment
- Handheld and deck mounted pneumatic line throwers ("grappling gun")
- Video cameras installed on trawl deck

For Installation in Shelter Shed

Power Supply for CSIRO Mooring Winch

TRIAXUS

Pallet of mooring gear

Potentially bio-optical sensor package

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

- Trull pigment filtration system in sink and FIRe instrument on bench.
- Trull/Schallenberg/Clementson AC-9 bio-optical instrument on bench

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

- Trull particle filtration system, on forward outboard bench,
- also requires use of laminar flow bench in this lab

FlowCAM for rapid particle imaging, particle size spectra.

For installation in the CTD room (on athwartship bench next to sink)

- Trull/Bodrossy cartridge filtration system

For installation on the Triaxus towed body

- SUNA nitrate sensor
- FIRE fluorescence induction and relaxation sensor (maximum depth 200m)
- Kloser Bioacoustic sensor on the Triaxus – subject to discussion and testing
- LOPC

Boyd: Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site

We will bring a Trace Metal clean fish that will be deployed mid-ship off the starboard side. We will require the ships compressor to drive the air pumps and the forward boom is required along to tow the fish.

Zooplankton nets will be deployed off the winch on the starboard side at midships. UTAS will supply some nets and others from NF will be required.

RESPIRE particle interceptors for deployment by the SOTS team will be brought by UTAS and stored in the ships General Purpose Dirty Wet lab.

SNOWMAN particle aggregator and roller table to be installed in CT room.

Spare Trace Element Rosette for storage on Trawl Deck.

Kloser piggyback

- PLAOS system in shelter shed with spares
- PLAOS spares box in General Purpose Dirty Wet lab
- ISAAC Kid midwater trawl stored on the rear deck

- Side net boom ready for deployment of side nets
- Storage of two side nets for the voyage

Permits

SOTS

- Collection of seawater and sediment trap 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.
- Towing of the CPR, Triaxus, and operation of underway ship scientific seawater supply through the Tasman Fracture Zone Commonwealth Marine Reserve Permit issued to MNF # CMR-17-000471

Boyd: Subantarctic Biogeochemistry of Carbon and Iron, Southern Ocean Time Series site

- Quarantine permit for phyto- and zoo-plankton and trace metal samples, UTAS IMAS AQIS #IP0001035393.

Kloser piggyback

- Animal ethics permit for mid-water towing with ISAAC Kid trawl
- AFMA permit for mid-water towing with ISAAC Kid trawl
- Quarantine permit for zooplankton and micronekton samples, #IPXXXX – application filed number to be advised.
- Commonwealth MPA permit for logging acoustic sensors, # CMR-17-000471.

Personnel List

1.	Lisa Woodward	MNF	Voyage Manager
2.	Rod Palmer	MNF	MNF SIT support
3.	Nicole Morgan	MNF	MNF SIT support
4.	Pamela Brodie	MNF	DAP computing support
5.	Karl Malakoff	MNF	DAP computing support
6.	Bernadette Heaney	MNF	GSM support
7.	Cassie Schwanger	MNF	Hydrochemist
8.	Julie Janssen	MNF	Hydrochemist
9.	Tom Trull	CSIRO-ACE	SOTS: Chief Scientist
10.	Eric Schulz	BOM	SOTS: Co-Chief Scientist
11.	Peter Jansen	ACE-CSIRO	SOTS: Managing Engineer
12.	Phil De Boer	CSIRO	SOTS: Mooring Supervisor
13.	Gary Curtis	CSIRO	SOTS: Mooring deck work
14.	Darren Moore	CSIRO	SOTS: Mooring deck work
15.	Diana Davies	ACE	SOTS: sediment traps
16.	Christina Schlallenberg	ACE	SOTS: incubations
17.	Flavia Tarquinio	Edith Cowan Univ.	Boyd: radionuclides
18.	Rudy Kloser	CSIRO	Kloser- PI
19.	Ben Scoulding	CSIRO	Kloser – PLAOS- Nets
20.	Jeff Cordell	CSIRO	Kloser – PLAOS technology
21.	Haris Kunnath	CSIRO	Kloser – PLAOS – post Doc
22.	Caroline Sutton	CSIRO	Kloser – Nets biologist
23.	Adrian Flynn	Fathom Pacific	Kloser – Acoustics/Nets
24.	Philip Boyd	UTAS	Boyd: PI
25.	Emma Cavan	UTAS	Boyd: Microbes
26.	Mathieu Bressac	UTAS	Boyd: RESPIRE traps
27.	Manu Laurenceau-Cornec	UTAS	Boyd: Particles
28.	Svenja Haftner	UTAS student	Boyd: Zooplankton, student
29.	Robert Strzepek	UTAS	Boyd: Phytoplankton
30.	Michael Ellwood	ANU	Boyd: Iron chemsitry
31.	David Janssen	ANU Student	Boyd: Iron chemistry
32.	Robin Grun	ANU Student	Boyd: zinc chemistry
33.	Viena Puigcorbe Lacueva	Edith Cowan Univ.	Boyd: radionuclides
34.	Michael Strzelec	ACE-CRC/UTAS student	Boyd: aerosols, student
35.	Steve Wilhelm	U. Tennessee	Boyd: viruses
36.	Gary Le Cleir	U. Tennessee	Boyd: viruses
37.	Naomi Gilbert	U.Tennessee	Boyd: viruses/omics
38.	Ben Twining	Bigelow (USA)	Boyd: Iron particles
39.	Dan Ohnemus	Bigelow (USA)	Boyd: Iron particles
40.	Kiefer Forsch	Scripps Institute of Ocean.	Boyd: microbes/ligands

Signature

Your name	Thomas W. Trull
Title	Chief Scientist
Signature	
Date:	20 December 2017

List of additional figures and documents

1. Deck Loading Plan
2. SOTS (SOFS and SAZ) mooring diagrams
3. PLAOS photo
4. RESPIRE drifting traps 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	X	
Air Chemistry Lab	X	
Preservation Lab	X	
Constant Temperature Lab	X	
Underway Seawater Analysis Laboratory	X	
GP Wet Lab (dirty)	X	
GP Wet Lab (Clean)	X	
GP Dry Lab (Clean)	X	
Sheltered Science Area	X	
Observation deck 07 level		
Walk in Freezer	X	
Clean Freezer	X	
Blast Freezer	X	
Ultra-Low Temperature Freezer	X	
Walk in Cool Room	X	

(ii) **Specialised laboratory and facilities**

May require additional support

Name	Essential	Desirable
Modular Radiation Laboratory	X	
Modular Trace Metal Laboratories	X	
Modular Hazchem Locker		
Deck incubators	X	
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	X	
Milli -Q System	X	
Laboratory Incubators	X	
Heavy Duty Electronic Balance		
Medium Duty Electronic Balance	X	
Light Duty Electronic Balance	X	
Surface Net	X	
Bongo Net	X	
Smith Mac grab		
Dissecting Microscopes	X	

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

May require additional support

Name	Essential	Desirable
TRIAXUS – Underway Profiling CTD	X	
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	X	
Sherman epibenthic sled		
Trace- metal in-situ pumps	X	
LADCP		
Rock Dredges		
EZ Net		
Rock saw		
Portable pot hauler	X	
Beam Trawl		
Trawl doors (pelagic or demersal)		
Stern Ramp NEEDS TO BE COVERED WIITH DANCE FLOOR	X	
Trawl monitoring instrumentation (ITI)	X	
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)	x	
SMPS (scanning mobility particle sizer)	x	
Radon detector	x	
Ozone detector		X
Manifold instrumentation (intake temperature and humidity)	X	
Picarro spectrometer (analysis of CO_2/CH_4/H_2O)		
Aerodyne spectrometer (analysis of N_2O/CO/H_2O)	X	
O2 analyser		
Manifold instrumentation (intake temperature and humidity)	X	
CCN (Cloud Condensation Nuclei)	x	
MOUDI (Micro-Orifice Uniform Deposit Impactors)	X	
NOx monitor	X	
Polarimetric Weather Radar		

(viii) **Underway Seawater Instrumentation**

Name	Essential	Desirable
Thermosalinograph	X	
Fluorometer	X	
Optode	X	
PCO2	X	