MNF Voyage Summary

Voyage #:	IN2022_V03
Voyage title:	**SOTS:** Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania
Mobilisation:	Hobart, 0800hrs Wednesday 27 – Saturday 30 April, 2022
Depart:	Hobart, 1000hrs Wednesday 4 May, 2022
Return:	Hobart, 0800hrs Sunday 15 May, 2022
Demobilisation:	Hobart, Monday 16 May, 2022
Voyage Manager:	Matt Kimber
Chief Scientist:	Elizabeth Shadwick
Affiliation:	CSIRO O&A / AAPP
Co-Chief Scientist	Eric Schulz
Affiliation:	Bureau of Meteorology
Principal Investigators:	Ben Scoulding
Project name:	Ecological and carbon sequestration role of mesopelagic organisms in the Southern Ocean
Affiliation:	CSIRO
Principal Investigators:	Jay Mace, Alain Protat
Project name:	CAPRIX
Affiliation:	Uni of Utah, Bureau of Meteorology
Principal Investigators:	Craig Hanstein
Project name:	ARGO Deployments
Affiliation:	CSIRO
Principal Investigators:	Zanna Chase and Andy Bowie
Project name:	Dust to the ocean: does it really increase productivity?
Affiliation:	University of Tasmania (UTAS)

Voyage Summary

Scientific objectives

Southern Ocean Time Series (SOTS)

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. The IMOS - SOTS moorings are designed to remotely and automatically measure these oceanographic 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 objectives listed below focus on ensuring the long-term dataset is not interrupted (i.e. deploy new moorings, then recover old moorings). The measured parameters include: Sea surface water and air temperature, dissolved oxygen, zooplankton backscatter, CO2 partial pressure and many more.

- The Southern Ocean Flux Station (SOFS) moorings measure meteorological and ocean properties important to air-sea exchanges, ocean stratification, waves, currents, biological productivity and ecosystem structure. Water samples are collected for more detailed nutrient and plankton investigations after recovery.
- Sub-Antarctic Zone sediment trap (SAZ) moorings collect samples to quantify the transfer of carbon and other nutrients to the ocean interior by sinking particles and investigate their ecological controls.

Ancillary work on transit to moorings sites, on station and on return transit, will sample atmospheric and oceanographic conditions using CTD casts, Triaxus towed body, Continuous Plankton Recorder and autonomous profiling Biogeochemical-Argo floats, and potentially casts of a bio-optical sensor package.

Ecological and carbon sequestration role of mesopelagic organisms

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 are 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. This is particularly true 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 the profiling Lagrangian acoustic and optical system (PLAOS) was developed. Lagrangian refers to the motion of the PLAOS in space and time as it profiles the water column from 0 to 1000 m at a descent rate of ~0.5 ms-1. The PLAOS is tethered to the vessel but allowed to free fall until it reaches depth when it is hauled back onboard. The PLAOS is the evolution of an instrument first used in 2006 and has been deployed in its current configuration (with periodic system upgrades) as part of SOTS since 2018. The most recent upgrade includes the addition of downward looking stereo cameras and a pair of upward looking echosounders. This voyage offers the opportunity to test these new systems and to collect visually verified acoustic measurements of micronekton. Further it allows for the testing of a new buoyancy engine to enable the system to do repeat profiles. A Rectangular Midwater Trawl net (RMT16) single wire net will be used to capture micronekton for species identification. The RMT will target discrete micronekton layers identified by the ship-based acoustic systems. 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 AAPP Biogeochemistry and Ecosystems Projects as well as the MESOPP ecosystem program.

Note: Each PLAOS deployment records ~50-60 GB of data. With ~5 targeted deployments (weather permitting), DAP have prepared onboard storage to store data on science drives.

Quantification of dust deposition to the ocean using thorium isotopes in seawater and aerosol sampling

This piggyback project is part of an ARC Discovery Project (CIs Zanna Chase, Andrew Bowie and Peter Strutton) entitled “Dust to the ocean: does it really increase productivity?” The purpose of the larger project and of this piggyback is to quantify dust deposition to the ocean and its chemical and ecological impact by using new geochemical techniques. The SOTS site is unique in the Southern Hemisphere because we can compare a number of different methods to estimate dust deposition and can also look at interannual variability in dust deposition.

In terms of national benefit, mineral dust is an important, yet difficult to quantify source of nutrients to the ocean. This project will deliver more accurate estimates of dust deposition to the ocean around Australia, a region where dust models perform poorly. The expected benefit of the project includes better dust models used to predict future changes in dust deposition to the ocean. Accurate dust predictions are critical for predicting future ocean fish production and carbon uptake.

Cloud Aerosol Precipitation Radiation Interactions eXperiment (CAPRIX)

Currently there are errors in calculations of absorbed solar radiation at the sea surface, linked to uncertainty in predicting global climate sensitivity under CO2 warming and sea surface temperature biases in climate models. It’s hypothesised that microphysical properties of clouds (radiometry and aerosol cloud pre-cursors) in the Southern Ocean and coastal Antarctica are contributing factors. Previous voyages (IN2015_V02, IN2016_V02, IN2018_V01, IN2018_V02) indicate shortwave radiation biases north or south of about 55°S latitude.

What remains nearly unexplored is the seasonal response in cloud and precipitation properties during Autumn when the basin scale productivity declines and the aerosol background changes from sulfate dominant to sea salt dominant. The other major result obtained from past voyages is the potentially important role of ocean productivity (linked to phytoplankton blooms, dimethyl sulphide and resulting atmospheric particles) in the local production of aerosols leading to cloud formation. Increased samples are required during this time and location to draw statistically significant conclusions.

Proposed instruments and critical measurements needed for this project are listed below, requiring coordination and installation during port period (IN2022_P02). All instruments will operate continuously under supervision of MNF SIT engineers and one on-board scientist who has ample experience in manning this instrumentation on Southern Ocean voyages. The engineers and on-board scientist have all been exposed to these instruments in the past and know how to operate them. All instruments have operated on RV Investigator during several voyages since 2016.

ARGO Float Deployments (ARGO)

The Array for Real-Time Geostrophic Oceanography (ARGO) program is a collaboration of scientific institutions around the world, and includes an Australian contribution led by the CSIRO. Given the lifespan of ~3-5 years for each deployed float, the objective on this voyage is to deploy additional floats in strategic areas of the Southern Ocean to maintain geographic coverage of the data array.

Voyage objectives

SOTS (not in order of priority)

1. Deploy SOFS-11 meteorology/biogeochemistry mooring
2. Deploy SAZ-24 sediment trap mooring
3. Recover SOFS-10 meteorology/biogeochemistry mooring
4. Recover SAZ-23 sediment trap mooring
5. Do CTDs (2 cast to 4550m, 2 to 600m) at the SOTS site, including collecting samples for nutrients, oxygen, dissolved inorganic carbon, alkalinity, and particulate matter analyses
6. Ship meteorological observations at SOFS buoy for comparisons
7. Tow MacArtney Triaxus on transit to SOTS site
8. Tow CPR on return to Hobart
9. Carry out underway air and water sampling and sensor measurements, including bio-optics and bio-acoustics

Ecological and carbon sequestration role of mesopelagic organisms

1. Repeat PLAOS deployments (5 total, ideal with some day-night comparison).
2. 2-3 Targeted RMT16 net tows at depths down to 1000m (depth determined by echosounder observations).
3. Collect ship-based acoustic data using the ship’s echosounders.

Quantification of dust deposition to the ocean using thorium isotopes in seawater and aerosol sampling.

1. Collect filtered seawater samples (10L) from a depth profile at the SOTS site. Ideally the full water column depth, but if time is limited the upper 1,500m. These samples will be analysed for 230Th and 232Th concentrations at UTAS. We would also retain sample aliquots for possible future analysis of rare earth elements and Nd isotope composition, pending further funding. For this we would need the CTD-rosette (36 bottle ideally), a laminar flow bench and milli-Q

water, all MNF-supplied. We would supply jerry-cans for sampling, storage boxes for the jerry-cans, cartridge filters, and HCl for acidification.

2. Collect rainwater and aerosol samples using the ship's aerosol sampling apparatus. These samples would be analysed for labile and total bioactive trace metals, as well as 232Th, at UTAS. For this we would need the MNF aerosol sampling lab. We would supply filters and storage containers for filters.

   The two sample types provide three independent measures of dust flux.

CAPRIX

Collect a suite of aerosol, cloud, surface radiation, surface eddy momentum, heat and moisture fluxes, and precipitation observations within the seasonally transitioning open ocean waters during early Autumn. This new dataset will be combined with the existing ones collected in 2016 and 2018 to continue to build a comprehensive understanding of the relationship between ocean productivity, aerosol formation, cloud microphysics and then link that understanding to rainfall and snowfall properties and surface radiation. In particular, documenting the seasonal transitions from high Summer to late Autumn will provide a completely unprecedented characterization of Southern Ocean aerosol-cloud-precipitation interactions that are critical to understanding the Earth's climate sensitivity.

Argo

Argo floats will be deployed on an opportunistic basis, when weather and other voyage activities are not impacted.

Results

For each objective, state the degree of success or otherwise. Elaborate on unexpected discoveries. Include a succinct presentation of preliminary data that clearly illustrates a discovery. You may also include any problems encountered which had a significant impact on your ability to achieve the voyage objectives. Please note that any other problems you may have experienced should be detailed in the Chief Scientist's Operational Report.

SOTS

All objectives were achieved except the CPR tow which was not performed due to logistical issues with the net drum. The existing SOFS-10 and SAZ-23 moorings were recovered and replaced by the new SOFS-11 and SAZ-24 moorings which are scheduled to be recovered in May 2023. Three of the four planned CTDs were also completed to support moored sensor interpretations. The ship-SOFS meterological comparisons were performed. The Triaxis was towed along the Hobart-SOTS transit leg.

Deployed Mooring Locations	Latitude	Longitude	Depth
SOFS-11	46.96493° S	141.35117°E	4656.2 m
SAZ-24	46.80848° S	141.83198°E	4665.5m

The SOFS mooring has been deployed at the SOTS site since 2010. Mooring failures, instrument malfunctions and ship availability issues have not allowed a continuous record to be built, but sufficient observations have now been obtained over the last 12 years to permit our first glimpses of inter-annual and seasonal variability. Figure 1 displays the neat heat flux (energy exchanged between the atmosphere and the ocean). The austral summer maximum is quite well defined in December & January at around 135 Wm^{-2} and a standard deviation of 22.5 Wm^{-2} while the winter minimum in June and July is around -98 Wm^{-2} with a larger standard deviation of 37 Wm^{-2}. The spring and autumn heating-cooling sign reversal are quite consistent, occurring in March-April and September.

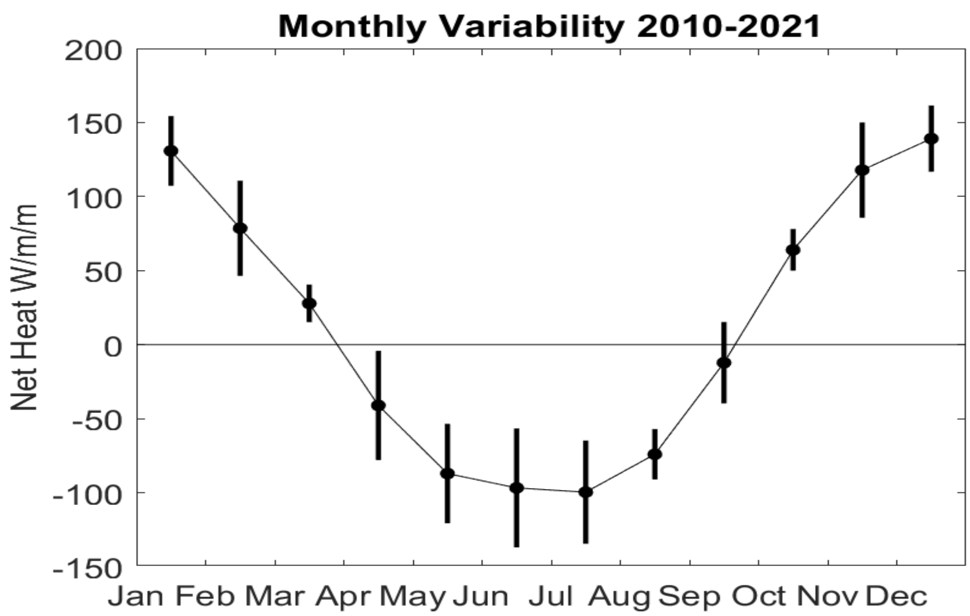


Figure 1. Net heat flux mean (and standard deviation) of monthly average for 2010-2021. Positive value is heat into the ocean.

Ecological and carbon sequestration role of mesopelagic organisms

We achieved 2 deployments with buoyancy engine engaged, from the planned 5. PLAOS operations were restricted to two daytime deployments (see appendix C for an explanation). Hydrodynamic properties of the PLAOS platform were derived from different speeds and buoyancy levels, with a drag coefficient between 0.64-0.83 confirmed for the system. Changes in the hydrodynamic properties as a function of depth were not observed. A method for ballasting correction from an initial tethered descent at different buoyancy levels was completed; this methodology proved successful and will be built into an automated ballasting sequence within the buoyancy engine control program.

No net sampling was done. This was due to AFMA/SPRFMO permitting issues – unable to fish outside Australia's EEZ. A Mammoth Multi-net replaced the RMT (due to staffing issues) but could not be used inside Australia's EEZ due time constraints.

Acoustic data was recorded continuously by the RV Investigator's 6 hull-mounted echosounders (18, 38, 70, 120, 200 and 333 kHz). This data will be reviewed onshore and will contribute to IMOS BASOOP.

Environmental DNA (eDNA) was sampled at various depth strata (4000m – 25m) to identify mesopelagic biota. 22 eDNA samples were collected from 3 CTD casts. 2L water samples were run through a peristaltic pump onto 0.2um Sterivax filters and frozen at -80^{o}C for further processing on land. Samples collected during the voyage will also contribute to a SOTS eDNA timeseries.

Quantification of dust deposition to the ocean using thorium isotopes in seawater and aerosol sampling

The trace metal team at UTAS collected samples that helped support ongoing studies to quantify dust deposition to the Southern Ocean. These studies aim to estimate trace elements and isotopes (TEI's) in aerosol, surface water and deep ocean inventories. In addition to the above sample collection, we also completed ancillary objectives for CSIRO, UTAS and NIWA which included the collection of samples for particulate organic carbon (POC), chlorophyll pigments, phytoplankton taxonomy, and lipid biomarkers and soluble ions in aerosols.

We achieved the main objective of the project which was to collect large volumes (~10 L) of filtered seawater using the ships CTD. These will be analysed at UTAS for ^{230}Th and ^{232}Th isotopes to quantify the dust flux to this region. Thirty-three large volume samples were collected on three CTD deployments, with the deepest cast lowered to 4690 m depth. In addition to this, we also collected thirty-five small volume (250 mL) samples to analyse for rare-earth elements and U isotopes; and six 5 L samples for Taryn Noble to analyse for Pb isotopes. 'Ship exposure' blanks were collected for the Th (four) and Pb (two) isotope samples during the sampling.

The group also collected a full transect of aerosol samples from Storm Bay to the SOTS site using the ships onboard aerosol sampling system. Sample collection continued while on-station at SOTS, and we continued sample collection of aerosols until the 14 of May. Trace Metals were collected using ultra-clean techniques for analysis at UTAS, and lipid biomarkers and soluble ions were collected using the FAS system for analysis at NIWA. Overall, the trace metal team collected samples for 4 research groups, across 3 different organisations. Samples collected from this voyage will help researchers better understand biogeochemical processes in the Southern Ocean.

CAPRIX

To achieve the objectives of CAPRIX, we have deployed the stabilized platform container with the BoM cloud radar and lidar, as well as the NASA micro rain radar (MRR-PRO) and University of Utah's Microwave Radiometer (MWR). To characterize the basic state of the atmosphere, we have also successfully launched about 40 radiosondes. The campaign was a success, with all instruments operating 100% of the time.

The albedo of the Southern Ocean atmosphere controls the amount of sunlight that reaches the surface and is, therefore, critical to many aspects of the region’s climate. Satellite data collected over the Southern Ocean suggest that cloud properties go through substantial seasonal oscillations that appear coupled to the production of biogenic aerosol during Summer. The isolation of the Southern Ocean from anthropogenic and continental sources of aerosol result in very low aerosol numbers during the cold seasons. While cloud properties derived from satellite data suggest that droplet number concentrations in low level clouds also decrease during the cold seasons, few measurements have been collected at the surface to validate these inferences. The timing of the SOTS 2022 voyage in early to mid-May enabled measurements of clouds, aerosols, and precipitation later in the season than has been possible heretofore. Measurements collected by the CAPRIX piggyback project were successful in sampling a wide range of airmasses that varied from very pristine in the early part of the voyage to near continental in their properties later in the voyage. During the first 3-4 days of the voyage, cloud condensation nuclei were very low <10 cm-3 and low-level clouds that occurred during that period tended to drizzle continuously suggesting very low droplet number concentrations and large droplets in broad agreement with satellite data. These measurements were some of the first every collected by ground-based remote sensors in such pristine Southern Ocean air. By the later days of the voyage air mass trajectories were from the continent, CCN was in excess of 100 cm-3, and the clouds measured by the remote sensors suggested high concentrations of small droplets. Data analysis efforts to derive cloud microphysical properties will now be pursued to confirm these initial observations.

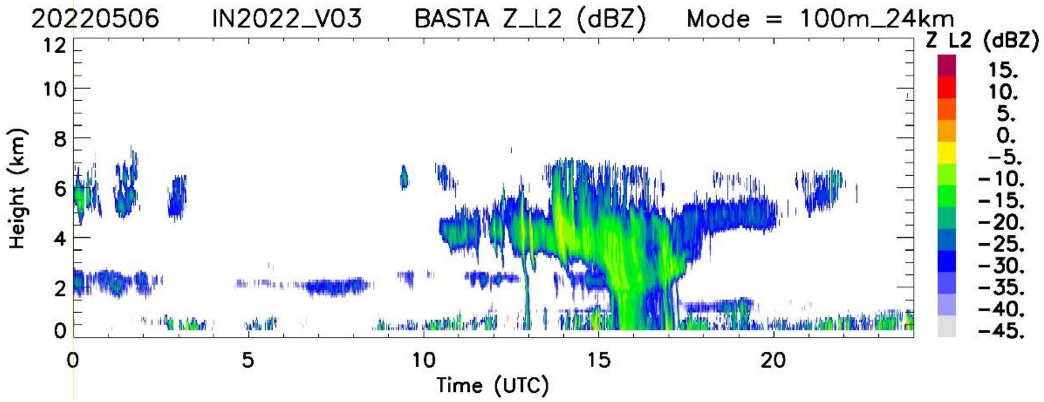


Figure 2. Drizzling shallow clouds and a precipitating system measured by the BASTA W-Band radar on 6 May 2022 in a pristine late season Southern Ocean air mass.

Argo

An Argo float (F1074) was successfully deployed using the new remote drop system and the Starboard K-75 crane; personnel on shore confirmed that the float was activated as anticipated.

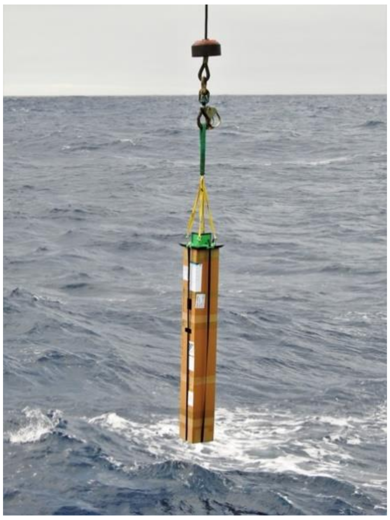


Photo: Svenja Halfter

Voyage narrative

RV *Investigator* departed Hobart on the morning of Wednesday 4th May 2022 1000, delayed for 24 hours due to maintenance to the ship's propulsion system. We proceeded down the Derwent River and undertook a practice mooring anchor lift and also a test dip of the PLAOS over the stern of the ship. By 1600 all tests were completed and we proceeded to Storm Bay and "down south". We performed a CTD to 1000m depth at 2000 and released a weather balloon around 50nm off the coast. We continued on into the Southern Ocean and then launched another balloon in the morning as we commenced towing the MacArtney Triaxus on our transit to the SOTS mooring site. The balloons schedule is 3-hourly launches between 7am and 10pm throughout the voyage.

After a calm transit south we arrived at the SOFS-10 site around 0500 Friday 6th May and stood off approximately 4 miles until day-break when we moved up near to the buoy to collect comparison meteorological observations. At 1030 a CTD cast to 600m for mooring instrument calibrations was performed and completed by 1200. The PLAUS was deployed for a second test at 1330 and completed by 1600. A CTD for UTas to 4500m depth was then performed. Around midnight we transited 40 miles to the SOFS-11 deployment site and set up 18.5 miles NE of the target.

On Saturday 7th May we commenced deployment of SOFS-11 at 0500 under light conditions and completed the anchor drop at around 2015. We then triangulated the anchor position before moving 3NM away to perform a CTD to 1250m depth after midnight. In the early morning the PLAUS was deployed and then a deep CTD for UTas performed at 1000. On Sunday the PLAUS was deployed a number of times throughout the day while spooling for the next mooring operation was also performed.

On Monday the 9th SAZ-24 mooring was deployed. Work commenced at first light (0600) to ensure completion before the weather deteriorated mid-afternoon. The SAZ mooring was deployed by 1430 and then the anchor position triangulated. The evening and night were spent filling in some missing bathymetry data as conditions deteriorated.

We transited 50 miles back to the SOFS-10 site during the morning and commenced collecting comparison observations throughout the afternoon. During the evening the conditions deteriorated and the ship steered a comfortable course overnight to the northwest.

We returned to the SOTS site by around midday on Wednesday the 11th March and a UTas CTD was performed at 2000 once conditions had abated.

On Thursday morning we commenced recovery of the SAZ-23 mooring, setting up 1 mile from the anchor and triggering the releases at 0730. The floats were spotted around 0747 and the top section of the float grappled and secured onboard by 0850. The mooring recovery was completed by 1330 and the afternoon was spent spooling wire off the net drum as we transited back to SOFS-10. On arrival at the site a deep CTD to 4000m was performed before commencing overnight ship-buoy comparisons at 0140.

On Friday the 13 May 2022 we commenced recovering SOFS-10 after breakfast at around 0800. The top=end mooring recovery operation went smoothly and was completed by 1610. We then undertook a final shallow CTD to 200m to post calibrate SOFS-10 instruments. We commenced transit or Hobart at 1830 and arrived in the port at 0800 on Sunday 15 May 2022.

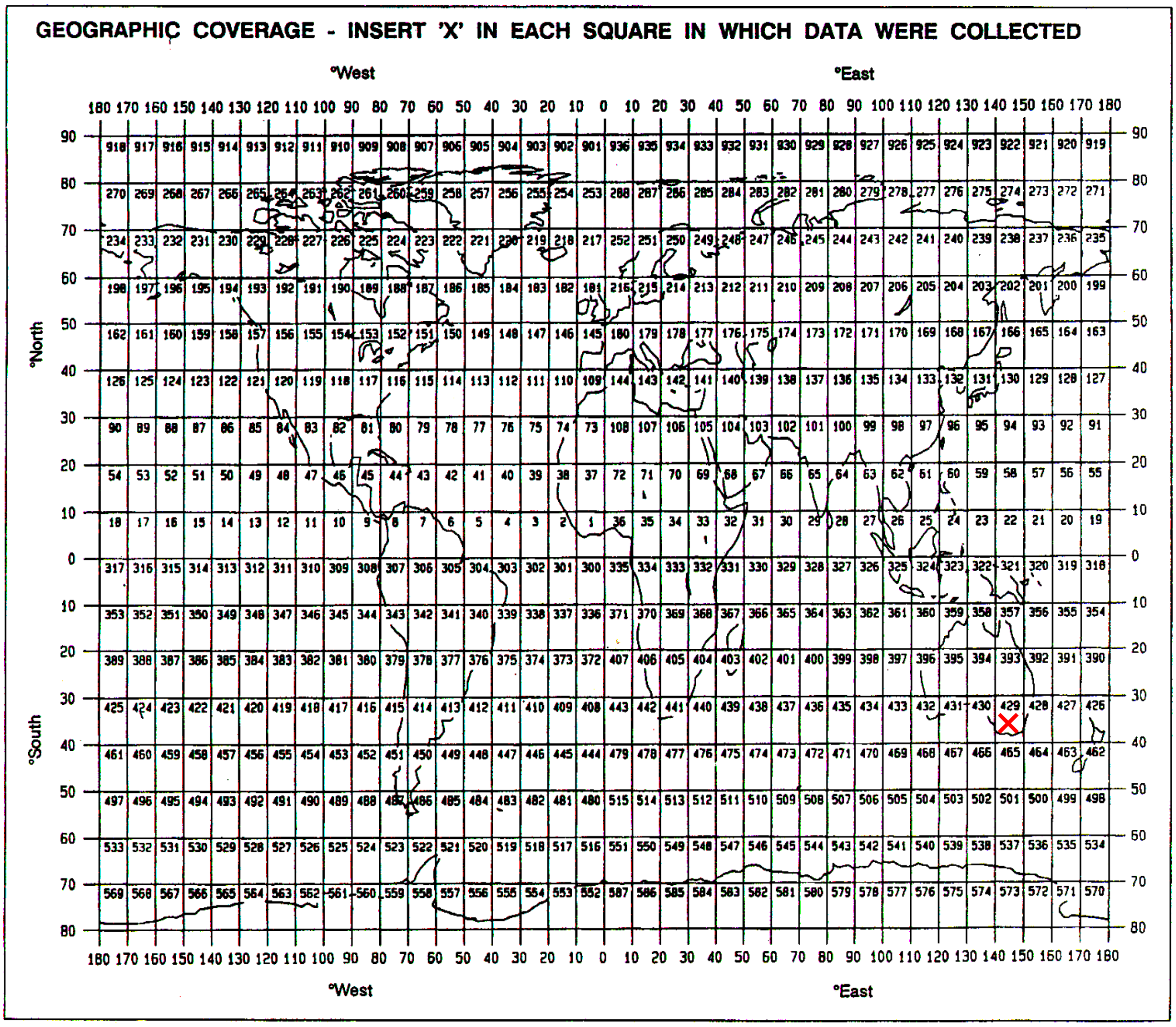
Outreach, education and communications activities

There were 2 PhD students, and 2 MSc students on board the voyage. All students were given the opportunity to assist with the hydrochemistry sampling from the CTD, and radiosonde balloon launches in addition to their individual project tasks. Elisabeth Shadwick will be interviewed by ABC news radio on the 15th May 2022 to talk about the voyage, the moorings and the science.

Summary

The voyage was successful. We continue to maintain an ocean observatory in the inhospitable and remote Southern Ocean to advance our scientific understanding of how the environment is changing. We have maintained this presence since 1996 for the SAZ sediment trap mooring and 2010 for the Southern Ocean Flux Station mooring.

Marsden Squares



Moorings, bottom-mounted gear and drifting systems

This section should be used for reporting all 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 to 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'. Delete section if not applicable.

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	APPROXIMATE POSITION (as degrees, decimal minutes)						DATA TYPE enter code(s) from list in Appendix A	DESCRIPTION
		LATITUDE			LONGITUDE				Identify, as appropriate, the nature of the instrumentation, the parameters measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any site identifiers.
		deg	min	N/S	deg	min	E/W		
1	E. Shadwick & E. Schulz	46	58	S	141	21	E	MO2 M71 M90 H17 D01 D71	Southern Ocean Times Series (SOTS) site: **Deployed** SOFS-11 surface buoy mooring, for recovery in May 2023) See diagram in appendix detailing instruments and depths.
2	E. Shadwick	46.	48. 5	S	141	50	E	H17 B73 D01	Southern Ocean Times Series (SOTS) site: **Deployed** SAZ-24 sub-surface sediment trap mooring, for recovery in May 2023. See diagram in appendix detailing instruments and depths.
3	E. Shadwick & E. Schulz	46	59.9	S	142	17.1	E	MO2 M71 M90 H17 D01 D71	**Recovered** SOFS-10 surface buoy mooring deployed in April 2021. See diagram in appendix detailing instruments and depths.
4	E. Shadwick	46	49.6	S	141	39.1	E	H17 B73	Southern Ocean Times Series (SOTS) site:

<table>
<tr><th rowspan="3">Item Name, Identifier (e.g. serial number)</th><th rowspan="3">Principal Investigator (see Title Page)</th><th colspan="6">APPROXIMATE POSITION (as degrees, decimal minutes)</th><th rowspan="3">DATA TYPE enter code(s) from list in Appendix A</th><th>DESCRIPTION</th></tr>
<tr><th colspan="3">LATITUDE</th><th colspan="3">LONGITUDE</th><th rowspan="2">Identify, as appropriate, the nature of the instrumentation, the parameters measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any site identifiers.</th></tr>
<tr><th>deg</th><th>min</th><th>N/S</th><th>deg</th><th>min</th><th>E/W</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>D01</td><td>Recovered SAZ-23 sub-surface sediment trap mooring deployed in April 2021. See diagram in appendix detailing instruments and depths.</td></tr>
</table>

Summary of data and samples collected

Except for the data already described above under ‘Moorings, bottom-mounted gear and drifting systems’ this section should include a summary of all data (e.g. temperature, salinity) or samples (e.g. cores, net hauls) collected on the voyage.

Separate entries should be made for each distinct and coherent set of data 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 accuracies 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 dataset entry should start on a new line; its description may extend over several lines if necessary.

NO, UNITS: for each dataset, 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 Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	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	Elizabeth Shadwick	46	Discrete samples from CTD casts	H10	Salinity, nutrients (nitrate, phosphate, silicate), and dissolved oxygen measurements performed onboard on water samples taken from 3 CTD-Rosette Niskin bottles
2	Bronte Tilbrook	13	days		Continuous pCO_2 measurements
3	Elizabeth Shadwick	19	Discrete samples from CTD casts	H74, H27	19 samples for each DIC and Alk one 4500m, and 2 600m CTD casts. Samples will be analysed for DIC (coulometry) and Alk (potentiometric titration) at CSIRO in Hobart.
4	Elizabeth Shadwick	63	SAZ sediment trap cups (250ml)	B73	Unfiltered oceanic seawater and particulate matter samples in 250ml cups (n=3*21), collected with three McLane Parflux sediment traps at 1000m, 2000m and 3800m nominal depth for shore-based biogeochemical analysis.
5	Elizabeth Shadwick	5	Filters	B71	6 pairs of 13mm diameter QMA filtersfor shore-based destructive particulate organic carbon (POC) analysis and 25mm GF/F filters for shore-based destructive pigment analysis, taken from CTD Niskin bottles, and 2 POC blank filters.
6	Elizabeth Shadwick	5	Filters	B08	13mm filters (pore size 0.8um) for phytoplankton taxonomy identification (coccolithophores) and enumeration, taken from CTD Niskin bottles.

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	**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.**
7	Elizabeth Shadwick	5	1L bottles	B08	1L plastic bottles, poisoned with 500ul saturated mercuric chloride for phytoplankton taxonomy identification and enumeration, taken from CTD Niskin bottles.
8	Elizabeth Shadwick	48	RAS	H74, H27, B08	48 x 500ml Tedlar sample bags of unfiltered open ocean seawater, poisoned with mercuric chloride for shore-based analysis of nutrients, DIC, Alk and phytoplankton taxonomy identification and enumeration.
9	Elizabeth Shadwick	22	filters	B08	Cartridge filters with particles from 2L seawater taken from CTD-Niskin bottles for eDNA analyses onshore. (stored at -80 C)
10	Zanna Chase	20	filters	H30, H32	20 x GF/F filtered air samples for analysis of aerosols and dust particles onshore (stored at -80C)
11	Zanna Chase	1	400 mL bottles	H30, H32	Untreated rainwater samples for analysis of aerosols and dust particles onshore.
12	Zanna Chase	48	10L bottle	H30, H32	48 x 10L of 0.2 micron filtered seawater from the CTD for 230Th and 232Th analysis onshore.
13	Zanna Chase	35	250 mL bottle	H30, H32	37 x 250mL of 0.2 micron filtered seawater from the CTD for Rare Earth Element (REE) analysis onshore.
14	Zanna Chase	6	filter	H30, H32	6 x 5L of of 0.2 micron filtered seawater from the CTD for Pb analysis onshore

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	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.

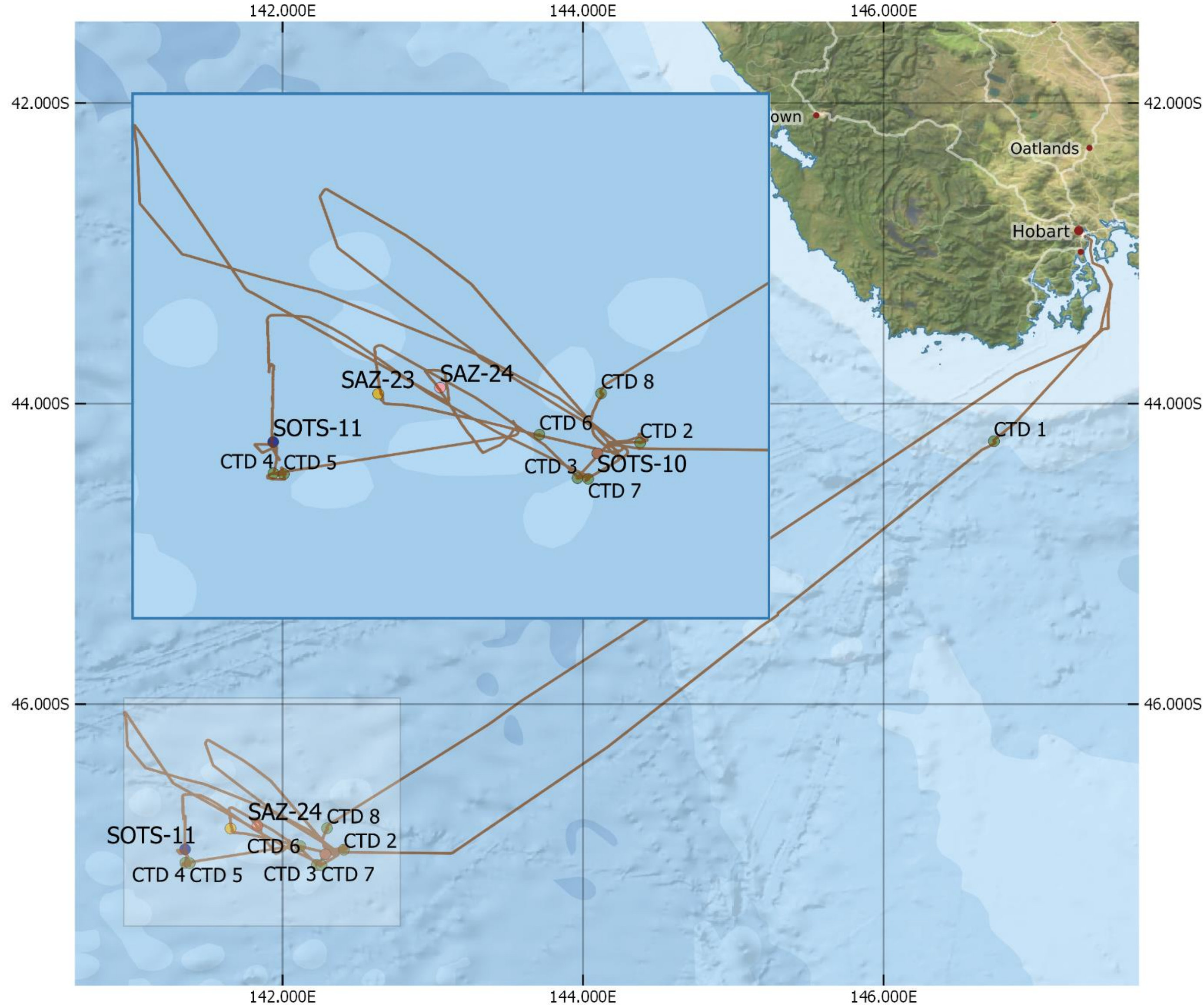
Curation Report

Delete section if not applicable. Describe the storage location for all data/samples collected during the voyage, with each data/sample type included on a separate row. Details should include where the data/samples are being archived/curated, who is responsible for their curation, how the data/samples will be made accessible and to whom, and any further analyses that are underway/will commence.

Item #	Description	Storage	Access	Custodian
	SOTS Project: Water and particle samples collected from the CTD, underway seawater supply, and the SOFS-8 RAS water sampler.	returned to CSIRO Marine and Atmospheric Research for chemical analyses and then discarded following quarantine protocols.	AODN	Elizabeth Shadwick, Cathryn Wynn-Edwards
	SOTS Project: Moored sediment trap samples recovered from the SAZ-21 mooring.	Processed at the University of Tasmania IMAS/AAPP laboratories. 7/10 of each sample is consumed by analyses for particulate organic carbon, particulate inorganic carbon, and biogenic silica. These results are provided for public use via the IMOS Ocean Data Portal. 2/10 of each sample is archived and can be made available for biogeochemical/biological studies by various groups via agreement with SOTS Chief Scientist Elizabeth Shadwick. 1/10 is archived at the IMAS/AAPP laboratories.	AODN	Elizabeth Shadwick, Cathryn Wynn Edwards

Track Chart

Clearly show the area of operation and the *actual* voyage track. The figure should feature a map showing the entire voyage track, and adjacent coastline showing major towns or cities so that readers can see at a glance where *Investigator* was relative to well-known features. You are required to annotate the track chart to illustrate the route followed and the points where data and/or samples were collected. The figure can be shown here (if small) or as an A4 attachment.



Acknowledgements

Please insert acknowledgements to organisations, teams or individuals that have supported your project(s).

Signature

Your name:	Elizabeth Shadwick
Title:	Chief Scientist
Signature:	
Date:	15 May 2022

Appendices

Appendix A - CSR/ROSCOP Parameter Codes

Appendix B – Photograph(s)

Appendix C – Mooring diagrams

Appendix A – 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

	MARINE BIOLOGY/FISHERIES
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

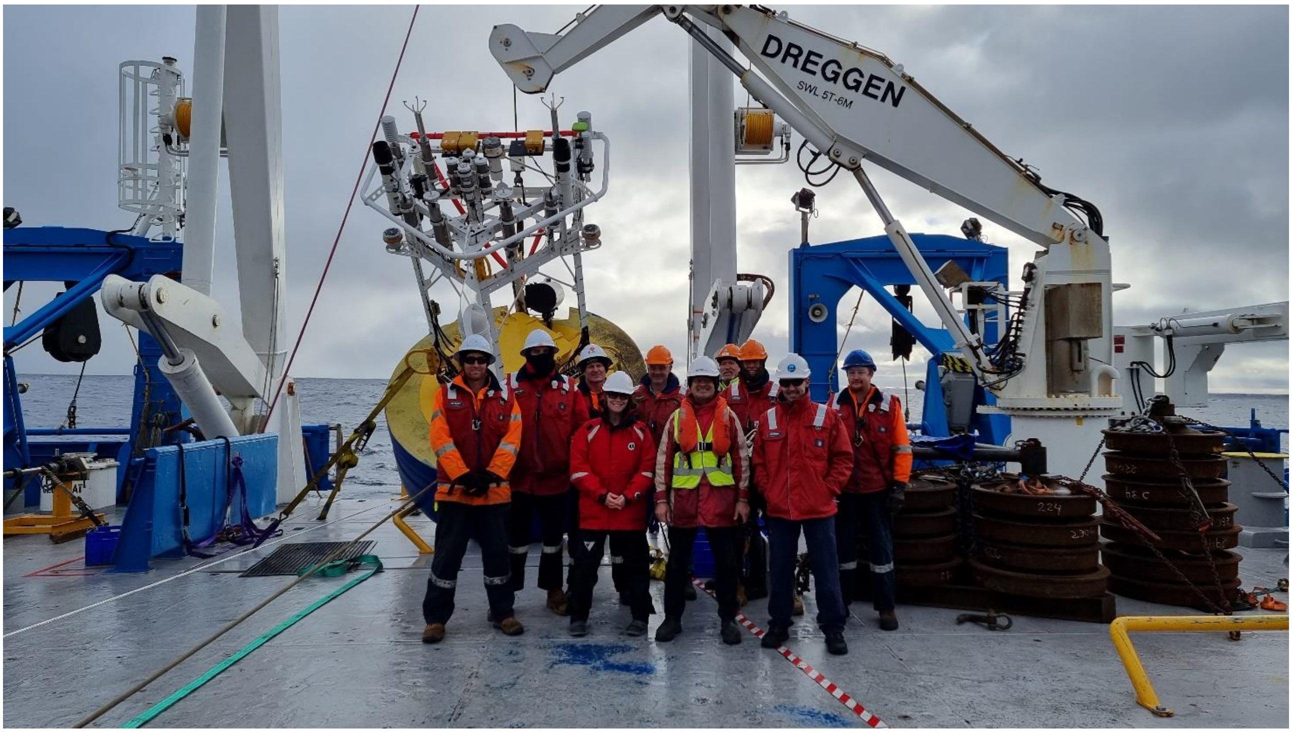
	MARINE GEOLOGY/GEOPHYSICS
G01	Dredge

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

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

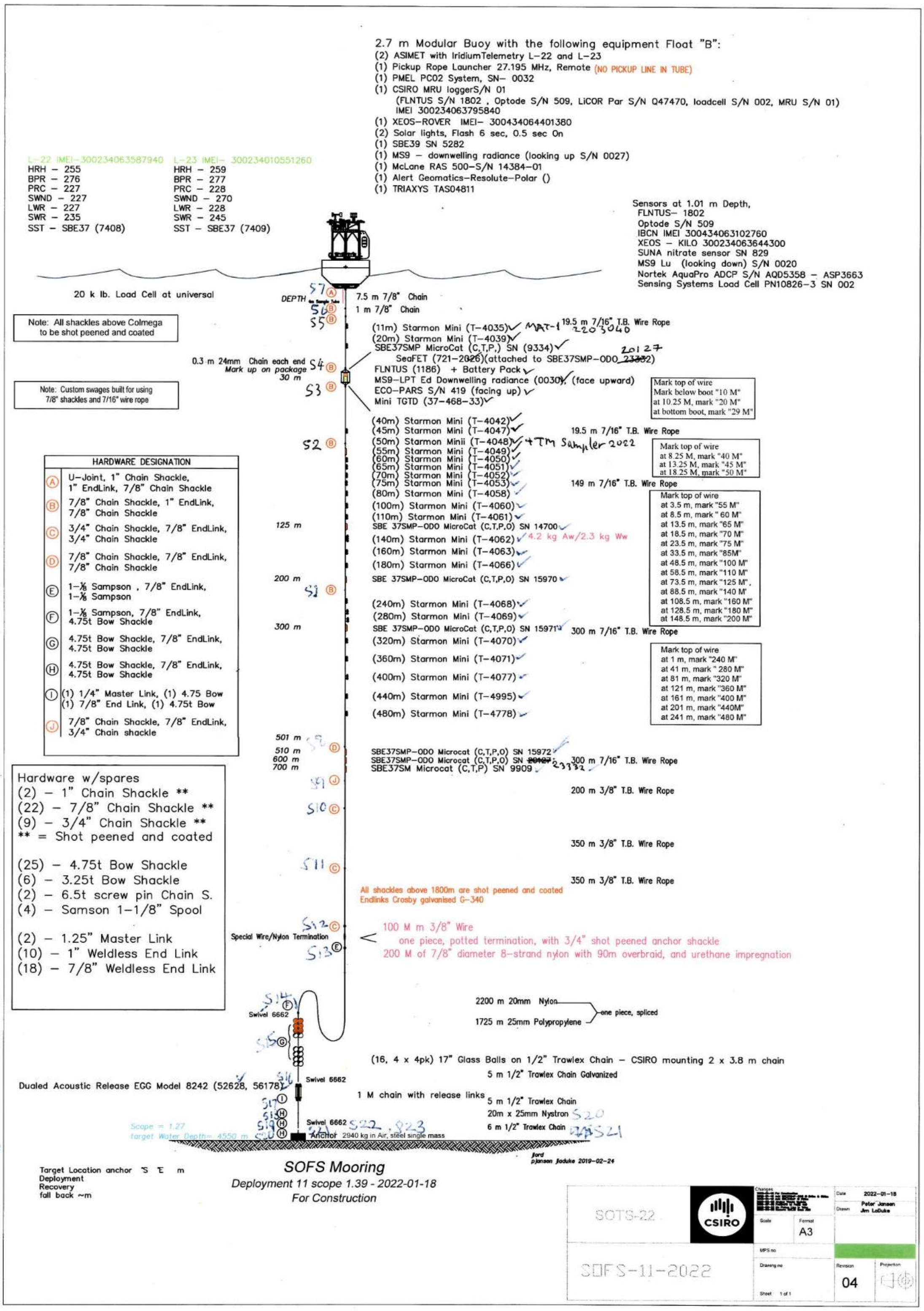
Appendix B – Photographs



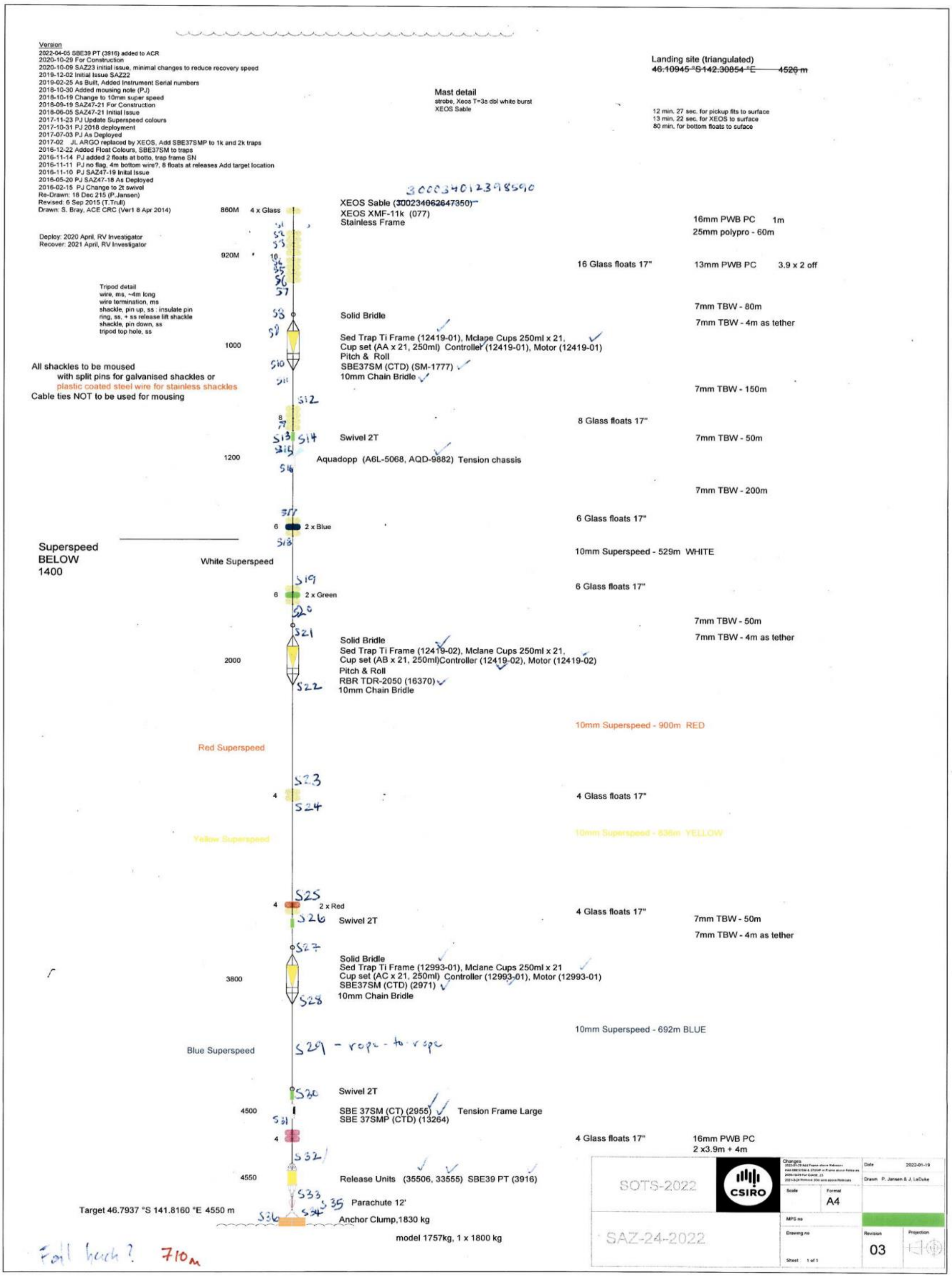
Deployment team for SOFS-11 (left to right). Aaron Scott, Karl Cleary, Russell Towers, Elizabeth Shadwick, Pete Jansen, Eric Schulz, Tim Lane, Tim Fountain, Andrew Martini and Darren Capon. Photo David Flynn (MNF)

Appendix C – Mooring Diagrams

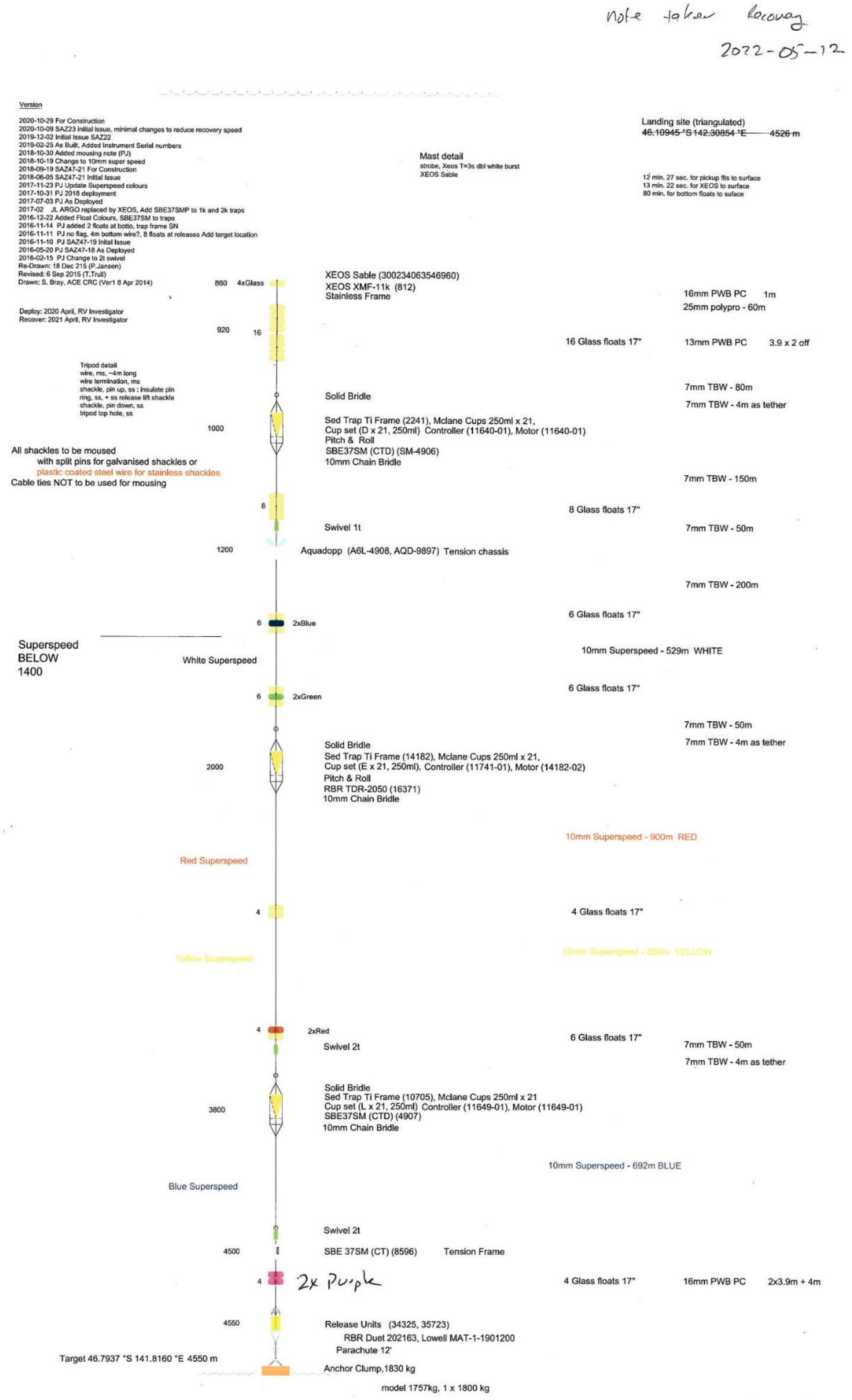
SOFS-11 as deployed



SAZ-24 As deployed



SAZ-23 as recovered



SOFS-10 as recovered