RV *Investigator* Voyage Plan

VOYAGE #:	IN2023_V07
Version Number:	FINAL
Voyage title:	SWOT-ACC : Smaller Scales Of The Antarctic Circumpolar Current In A Meander South Of Tasmania
Mobilisation:	Hobart, Friday 10 November – Sunday 12 November 2023
Pre-medical clearance period:	Hobart, Monday 13 November – Tuesday 14 November 2023
Depart:	Hobart, Wednesday 15 November 2023 1000
Return:	Hobart, 0800 Wednesday 20 December 2023
Demobilisation:	Hobart, Wednesday 20 December 2023
Chief Scientist:	Benoit Legresy
Affiliation:	CSIRO
Principal Investigators:	Lennart Bach, UTAS Kyla Drushka, APL Annie Foppert, UTAS Rosemary Morrow, LEGOS Maxim Nikurashin, UTAS Beatriz Pena-Molino, CSIRO Helen Phillips, UTAS Kurt Polzin, WHOI Stephen Rintoul, CSIRO Elizabeth Shadwick, CSIRO Andrew Thompson, CALTECH

Scientific objectives

SWOT-ACC aims to significantly improve our capability to observe and understand the impact of small-scale (10-100 km) motions on dynamics of the Antarctic Circumpolar Current (ACC). The novel Surface Water Ocean Topography (SWOT) satellite mission will provide, for the first time, measurements of sea surface height along a broad swath, with spatial resolution at least 10X better than traditional altimeters. While SWOT will provide unprecedented spatial and temporal coverage, in situ subsurface ocean measurements are essential to validate the satellite observations and to determine the relationship between small-scale variability in sea surface height and subsurface ocean circulation and dynamics.

SWOT-ACC will collect multidisciplinary measurements along a swath crossing a standing meander of the ACC. The meander is a hot spot of eddy activity, cross-front exchange, and energetic small-scale motions. The experiment aims to characterise the small-scale variability in the meander; to relate small-scale variability in sea surface height to subsurface ocean structure; to quantify the role of small-scale processes in facilitating transport of heat and carbon between the surface ocean and the interior, and across the ACC; and to investigate the coupling between physical, biogeochemical, and biological processes at small spatial and temporal scales.

By providing essential in situ validation data from a high energy environment, SWOT-ACC will enable application of this revolutionary instrument to other high energy environments, including western boundary currents and the circumpolar ACC. SWOT-ACC will underpin improved climate projections and ocean forecasts by delivering knowledge needed to improve the representation of the influence of small-scale motions on large-scale dynamics. Research users to benefit from the experiment include space agencies, climate modellers and users of climate projections, and users of ocean forecasts (e.g. defence, search & rescue, shipping, and managers of marine resources).

Voyage objectives

The voyage objectives include:

1. Deploy a Tall mooring (including mapping around the a priori site, and a full depth CTD before deployment)
2. Deployment of 3 Gliders
3. Deployment of 3 Standard Argo floats
4. Deployment of 3 EM-APEX Argo floats
5. Deployment of 30 drifters
6. Establishing 2 full depth CTD cross sections of the current in 2 particular trajectories to establish the large-scale dynamic state of the ACC in this area for this particular period
7. 4 full depth CTD casts on future current-and-pressure-equipped inverted echo sounder (CPIES) moorings sites
8. Observe 20 CTD cross sections to 1200m with a close spacing at a relatively quick pace to capture the small-scale features expressing in the top layers of the ocean
9. The total number of CTD should be 130, including 100 to 1200m depth (typically 12 sampling depths) and 30 full depth (typically 24 sampling depths).
10. Triaxus tows (up to 6 days or 144h cumulated over the length of the voyage). Including microstructure sampling.
11. Underway and CTD sampling for micro plankton and CO_2 on top of TS and nutrients.

12. Underway collections of all possible parameters from air-sea fluxes, currents, bio-acoustic, bathymetry. These will be key to interpreting the in situ and satellite data post voyage for the science objectives.

The timing of Triaxus and CTD transects will be guided by the SWOT satellite passages to have the Triaxus tows optimised around the satellite overflight time.

Once the tall mooring deployed and autonomous platforms (gliders, floats, drifters deployed) the voyage will turn in an average5 day loop of CTDs and Triaxus tows. The loop will be observed 5 times. The CTDs will be a mix of 1200m deep and full depth to accommodate the schedule and geographic coverage.

An ARGO float recovery will be pursued on the transit South if weather conditions allow. This ARGO has a large un-telemetered dataset accrued and is very important to the SWOT and other projects. Recovering this float is further important to develop the autonomous systems recovery capability which is a safety to the project given the number of assets we are deploying in the southern work area. The Area of this float is also a good area for CTD test casts where water masses are expected to be well established to test the CTD and test dip the Mooring instruments on the rosette before they're put on the mooring line.

Tall Mooring Deployment

The location of the Tall mooring anchoring will be finely determined in situ with some additional bathymetry mapping. But should be 3600m depth in the local zoom (Figure 1)

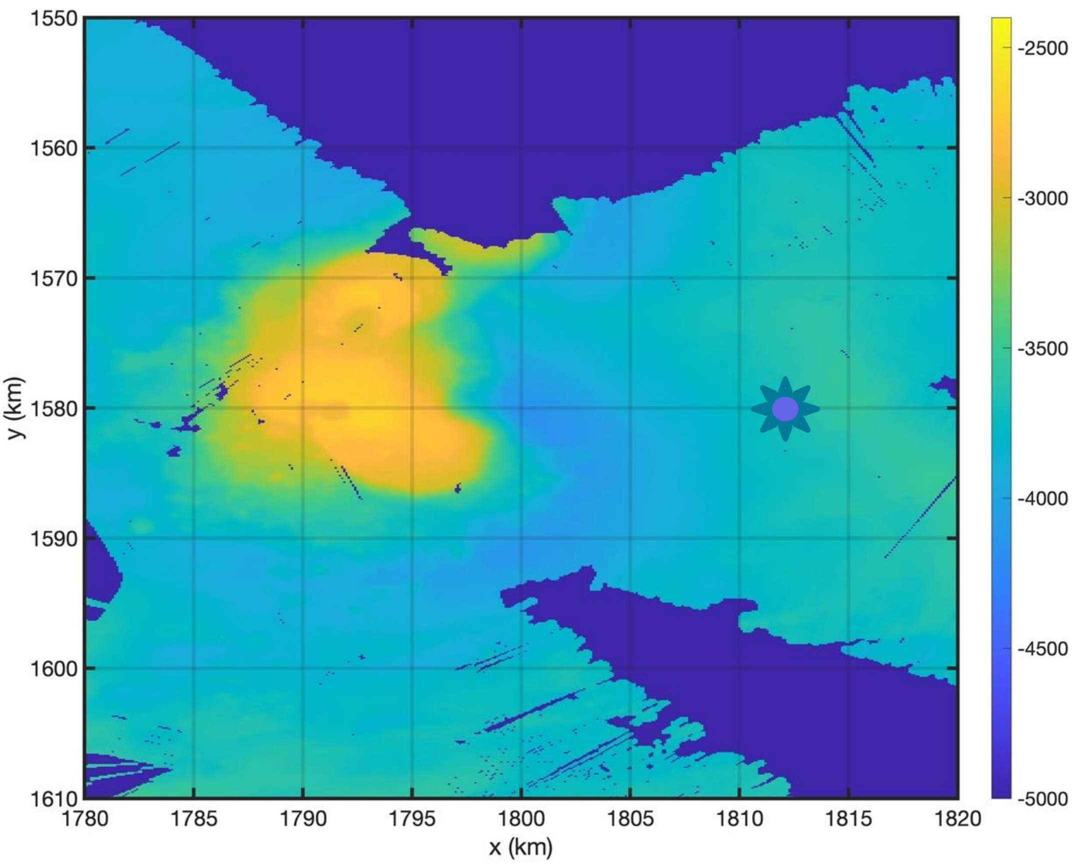

Figure 1 : local bathymetry around the mooring are for the SWOT-ACC experiment the trough of the ACC meander is linked to the seamount in this figure and the aim will be to have the mooring deployed downstream from this seamount, on the polar front at a fixed depth of ~3600m.

Drifter, Glider & ARGO Float Deployments

There is a large number of autonomous instruments which will be deployed West of the primary program area at the front end of voyage once the mooring deployment is completed. The deployments will likely be split into 3 packages and different days. The deployments location and timing rationale follows the imperative to have identified oceanographic features (using Near real time satellite data), have these feature likely to then cross the survey area, the deployment need to happen at times that are not the SWOT satellite overflight period when we need to be profiling in the trapezoidal pattern with triaxus.

Deployment of the 3 BGC Argo floats involve a prior CTD cast to 2500m.

Triaxus & CTD Transects

The trapezoidal shape boxing transects for the CTD and Triaxus sections follow a compromise between positions within a number of SWOT satellite imaging swathes, crossing the polar front quite systematically and in a more probable cross front direction, and surrounding the tall mooring.

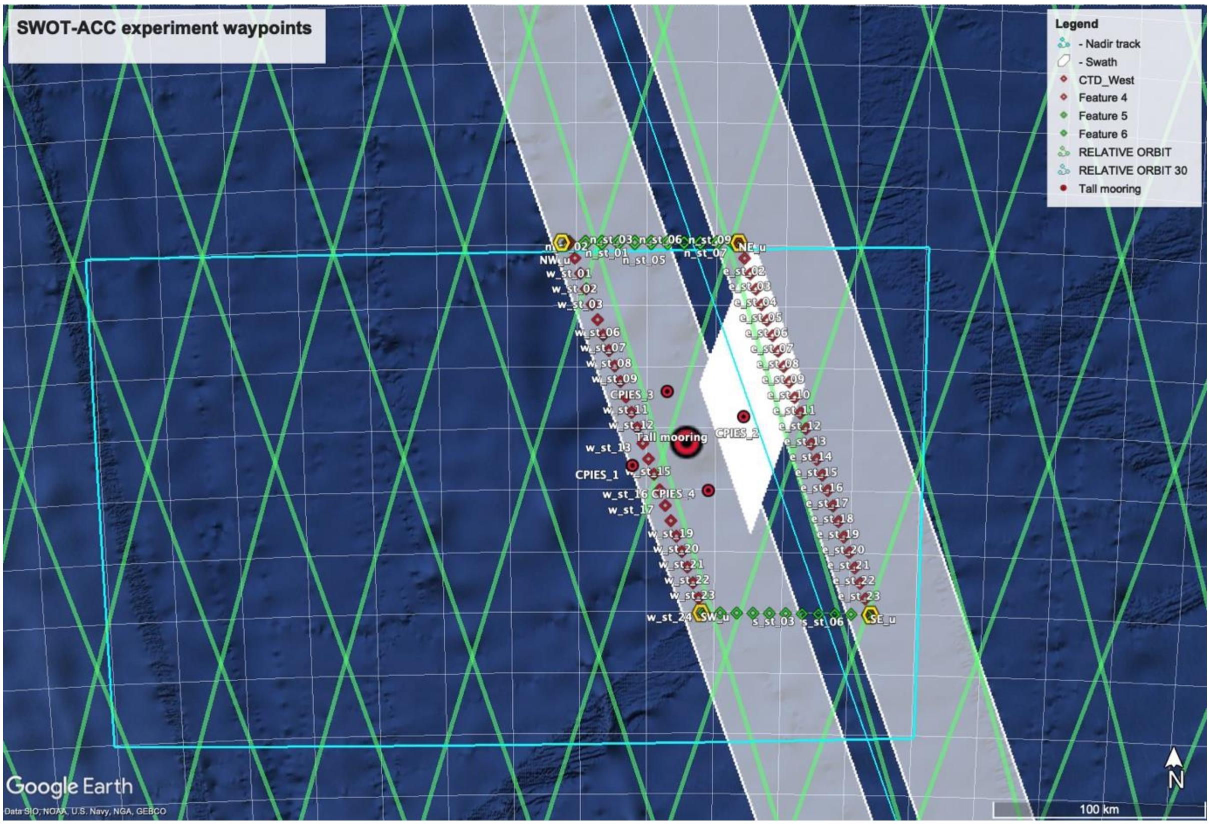

Figure 2 : map of the SWOT-ACC experiment transects of waypoints with the FSP SWOT coverage

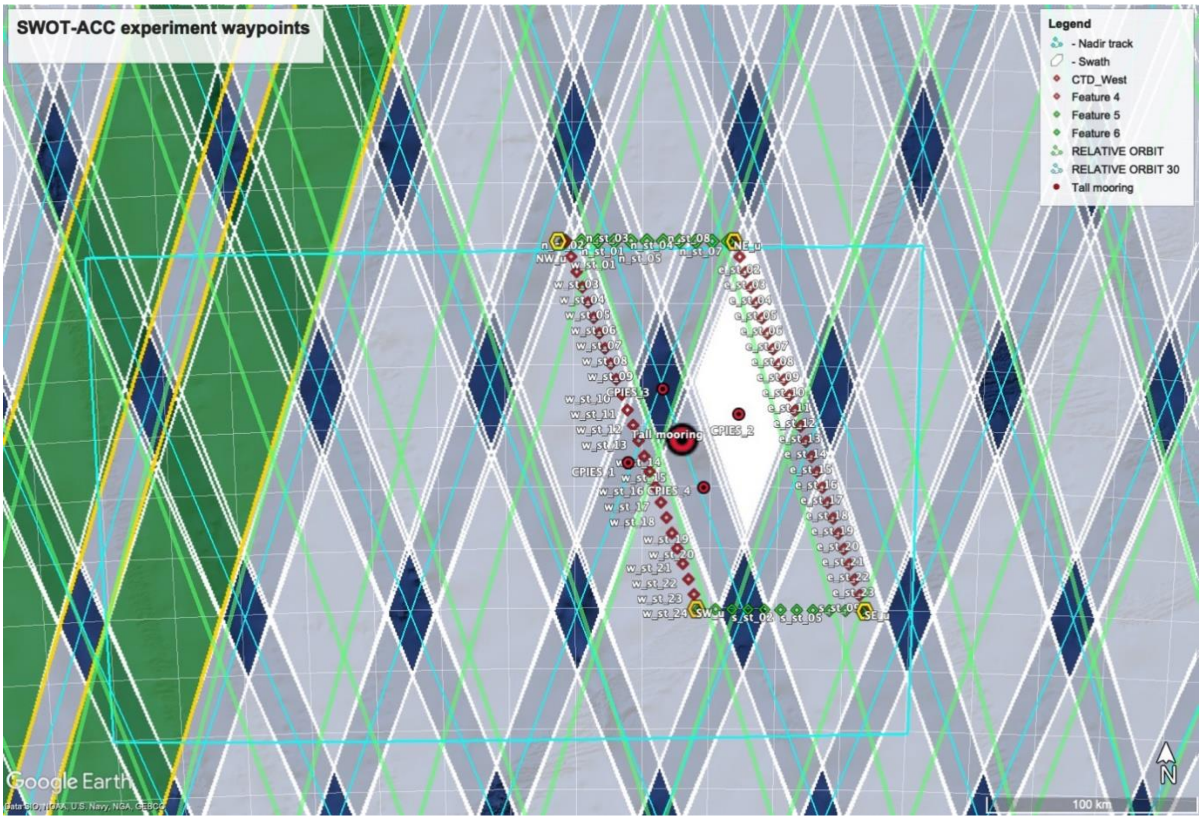

Figure 3: map of the SWOT-ACC experiment transects of waypoints with the Science phase SWOT coverage.

The final sequence of observations of the CTD stations network and Triaxus tows will be adjusted as a function of the satellite passages timing, the state of the ocean from latest available satellite data, weather, and daylight for operations.

Voyage track example

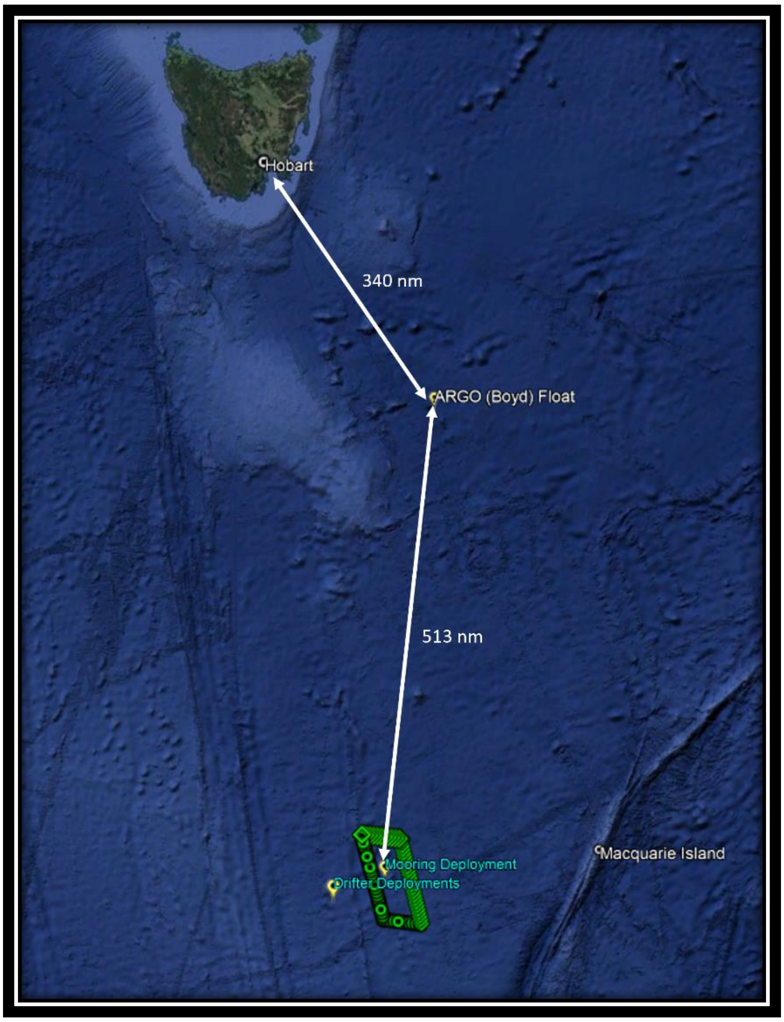

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Figure 4: Program area and location relative to Tasmania

Waypoints and stations

NOTE: Waypoints for glider/drifter/float deployments will be refined once in the program area

Transits computed with 10kts, GSM cal lines 8kts

<table>
<tr><th>SITE</th><th>DDM LATITUDE</th><th>DDM LONGITUDE</th><th>DISTANCE (NM)</th><th>TOTAL DISTANCE (NM)</th><th>STEAMING TIME (HRS)</th></tr>
<tr><td>Hobart</td><td>42° 52.2</td><td>147° 21.0</td><td></td><td></td><td></td></tr>
<tr><td>Storm Bay</td><td>43° 19.8</td><td>147° 21.5</td><td>27.62</td><td>27.62</td><td>2.5</td></tr>
<tr><td>GSM cal line #2 start</td><td>43° 24.47</td><td>147° 27.93</td><td>6.61</td><td>34.23</td><td>0.7</td></tr>
<tr><td>GSM cal line #2 end</td><td>43° 30.63</td><td>147° 26.61</td><td>6.22</td><td>40.45</td><td>0.8</td></tr>
<tr><td>ARGO Float Recovery, MNF Test CTD & Science Test CTD x 2</td><td>47° 15.18</td><td>152° 15.30</td><td>273.5</td><td>354.69</td><td>27.4</td></tr>
<tr><td>Tall Mooring & CTD</td><td>55° 48.00</td><td>152° 18.00</td><td>513.17</td><td>867.86</td><td>51.3</td></tr>
<tr><td>Glider/Float/Drifter Deployments</td><td>56° 18.00</td><td>150° 42.00</td><td>61.48</td><td>929.34</td><td>6.1</td></tr>
<tr><td>SW Corner (w_st_24)</td><td>56° 30.18</td><td>152° 25.26</td><td>58.46</td><td colspan="2" rowspan="4">Estimated 1370nm</td></tr>
<tr><td>SE Corner (e_st_24)</td><td>56° 29.82</td><td>153° 38.94</td><td>40.7</td></tr>
<tr><td>NE Corner (e_st_00)</td><td>55° 00.00</td><td>152° 39.00</td><td>96.01</td></tr>
<tr><td>NW Corner (w_st_00)</td><td>55° 00.00</td><td>151° 26.100</td><td>41.84</td></tr>
<tr><td colspan="6">Note: The trapezoid loop (274nm) of CTD & Triaxus is nominally passed 5 times and may include passage across the program area to line up with SWOT timing. This distance is not included in the cumulative total</td></tr>
<tr><td>GSM cal line #3 end</td><td>43° 28.37</td><td>147° 29.713</td><td>708.83</td><td>1638.17</td><td>71</td></tr>
<tr><td>GSM cal line #3 start</td><td>43° 23.824</td><td>147° 29.656</td><td>4.55</td><td>1642.72</td><td>0.5</td></tr>
<tr><td>Storm Bay</td><td>43° 19.8</td><td>147° 21.5</td><td>7.17</td><td>1649.89</td><td>1</td></tr>
<tr><td>Hobart</td><td>42° 52.2</td><td>147° 21.0</td><td>27.62</td><td>1677.51</td><td>2.5</td></tr>
</table>

Activity plan for first 24-48 hours of voyage & Time Estimates

Date	Activity
13 – 14 November 2023	PCR, ABF Clearance, Board RVI, Sea Going Inductions, Muster Lab Inductions Final mobilisation activities (including spooling Mooring lines) Bunkers @ Selfs Point Pre-voyage medical clearance
15 November 2023	Departure @ 1000, steam to ARGO float recovery site CTD sampling training (each shift)
16 November 2023	ARGO float recovery (daylight), MNF Test cast @1000m, Science test CTDs (2 x 1200-1500m with Mooring instruments attached)
17 November 2023	Depart ARGO float recovery site and steam for Mooring deployment location
18 November 2023	Transit
19 November 2023	Arrive at mooring site, map location and prepare for mooring deployment during day, full CTD
20 – 23 November 2023	CTDs & deployment of first package of autonomous instrumentation (Glider, BGC Argo, EM-APEX, 3 x drifters)
24 November 2023	FIRST SWOT over-flight: 18hr Triaxus tow centered on 22:47. First Triaxus tow will have a buffer to verify performance with additional instrumentation.
25 November 2023	Deploy second package of autonomous instrumentation
26 November – 14 December	CTD / Triaxus on trapezoid loop. Triaxus timed with SWOT over-flight
15 December 2023	FINAL SWOT over-flight, remaining time in program area to be filled with CTD
17 December 2023	Depart program area for return to Hobart (departure to be determined by Master during program)
20 December 2023	Arrival in Hobart 0800 Demobilisation & depart vessel

Permits

This voyage will transit through the following Marine Parks:

- *Huon Marine Park*
- *Tasman Fracture Marine Park*

Underway systems are covered by: Permit variation PA2020-00041-7 - South-east Network

NOTE: All scientific acoustic systems will need to be turned off when traversing these marine parks as they are currently excluded from the MNF blanket permits.

Piggyback projects

Cloud Aerosol Precipitation Radiation Interactions eXperiment 2023 (CAPRIX_2023)

Principal Investigators: Alain Protat (Bureau of Meteorology), Simon Alexander (AAD), Gerald "Jay" Mace (University of Utah), Jessie Creamean (Colorado State University)

Objectives:

Cloud microphysical properties produced from the competition between supercooled liquid and ice particles for water vapour in subfreezing cumulus clouds over the Southern Ocean and off the coast of Antarctica have been directly linked to errors in absorbed solar radiation at the sea surface, which have been further linked to uncertainty in predicting global climate sensitivity under CO_2 warming and sea surface temperature biases in climate models.

Strikingly, the latest climate simulations using improved knowledge gained on the frequency of occurrence of supercooled liquid water from earlier voyages (IN2015_V02, IN2016_V02, IN2018_V01, IN2018_V02, IN2022_V03, IN2023_V03) indicate the existence of two distinct large surface shortwave radiation biases of opposite sign north or south of about 55°S latitude. From the IN2018_V01 observations collected closer to the coast of Antarctica, we have gathered evidence that emissions of aerosol precursors from over Antarctica produce very high concentrations of aerosols and different cloud properties from further north and from when air masses bring pristine air from the open ocean. However, our number of samples remain quite limited to draw statistically significant conclusions. 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 and driving cloud microphysical properties. However, only partial observations were collected during earlier voyages, which did not fully capture the suite of interactions. 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.

Following these conclusions, our proposal here is to collect a suite of aerosol, cloud, surface radiation and precipitation observations during spring (IN2023_V07). This new dataset will be combined with the existing ones collected in the period 2016 - 2022 to continue to build a comprehensive understanding of the relationship between ocean productivity, aerosol formation, cloud microphysics and then link that understanding to rainfall properties and surface radiation. We have not collected data in Austral spring yet, so this dataset would also complement our long-term goal of characterizing the annual cycle of aerosol – cloud – precipitation interactions and how different levels of biological productivity influence such interactions.

Media Activities

The MNF will seek to pursue opportunities that arise during the voyage to promote the science, scientists and ship, via conventional and social media channels, in consultation and/or collaboration with the relevant ship user.

A media plan is in place for this voyage and can be referenced separately to this voyage plan.

Signature

Your name	Benoit LEGRESY
Title	Chief Scientist
Signature	
Date:	23 October 2023

List of additional figures and documents

a. Appendix A: MNF Equipment

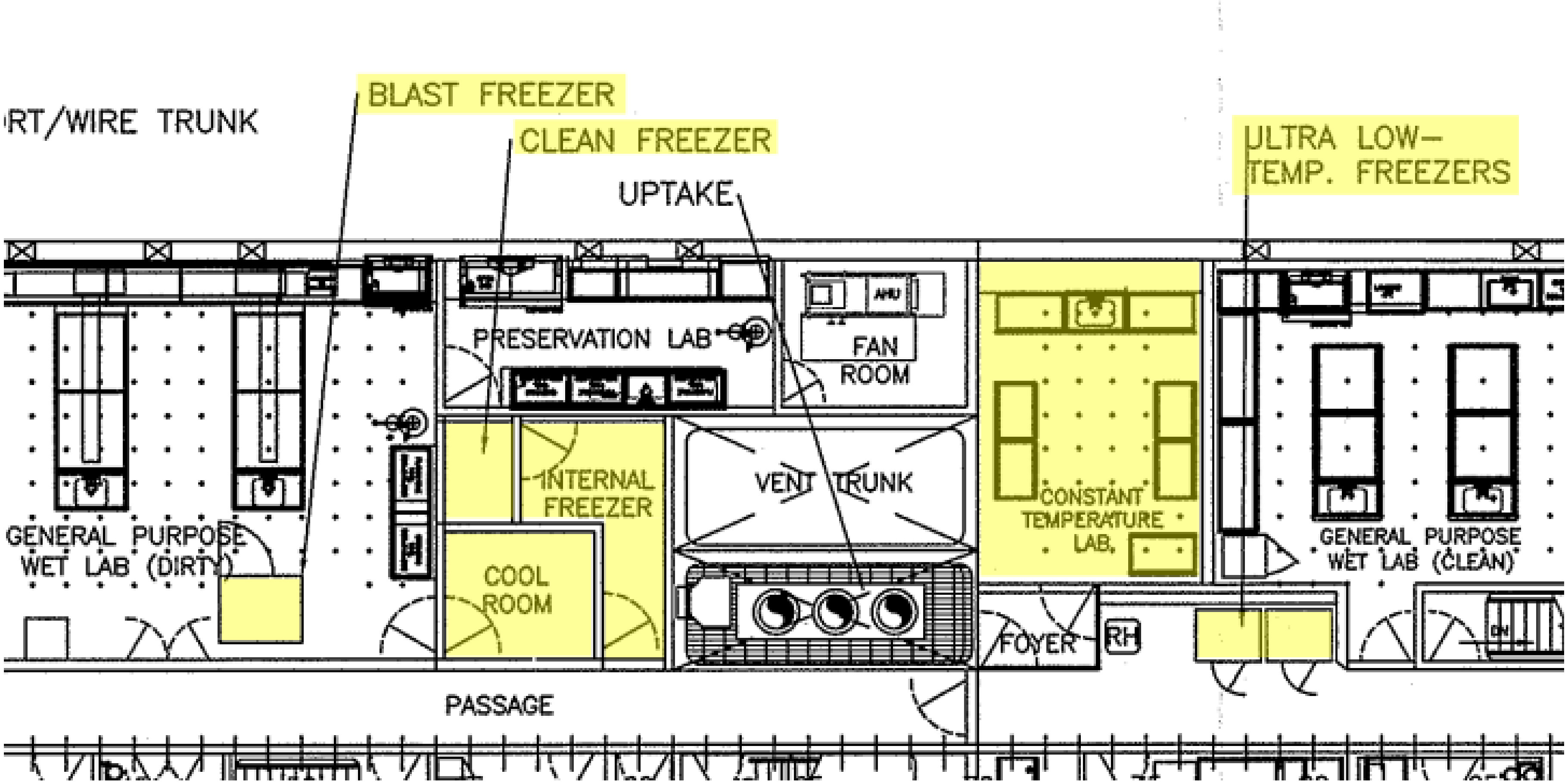
Appendix A

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.

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Aerosol Sampling Lab	X	Protat – piggyback
Air Chemistry Lab	X	Protat - piggyback
Preservation Lab	X	
Constant Temperature Lab (Min temp: ~4°C / Max temp ~35°C)	X	Hydrochem - third salinometer, lab @ 20 °C
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		
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3		

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Clean Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >2.5m^3 Co-located within the Internal freezer and separated by a door		
Blast Freezer (Dirty Wet lab) (Min temp -30°C / Max temp 0°C) Internal volume >1.5m^3 Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.		
Cool Room (Dirty Wet lab) (Min temp 0°C / Max temp 10°C)		
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80°C / Max temp -80°C)	X	Flow cytometry samples Protat – piggyback (INP DNA water samples for CSU)
YODA Freezers (x2) (Clean Dry lab) (Min temp -20°C / Max temp 10°C)		



MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Isotope Laboratory			
Trace Metal Niskin Sampling Container (TM1-blue - 20ft)			

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace Metal Seawater Analysis Laboratory (TM2-white - 20ft)			
Trace Metal Rosette and Niskin Storage Container			
Modular Hazchem Locker			
Stabilised Platform Container	X		Protat – piggyback
Clothing Container			Level 2

STANDARD SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
CTD - Seabird 911 with 36 Bottle Rosette	X		
CTD - Seabird 911 with 24 Bottle Rosette			
Lowered ADCP	X		
Continuous Plankton Recorder (CPR)			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
TRIAXUS – Underway Profiling CTD	X		Dual temperature, conductivity and dissolved oxygen (SBE9plus and dual pumped temperature/conductivity/dissolved oxygen circuits) PAR Chlorophyll-A, CDROM, optical backscatter (Eco-triplet) Plankton counter (Laser Optical Plankton Counter) Transmissometer

SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
			USER SUPPLIED: - SUNA nitrate sensor (Elizabeth Shadwick) - ADV (CSIRO) - Microride 1000 (WHOI K. Polzin) - MAVS (WHOI K. Polzin) TOWING PROFILE: - Undulations surface to 300m
Equipment to measure seawater sound velocity/CTD:			
XBT System			
Valeport Rapid SV			
Valeport Rapid CTD			
Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			
Deep Towed Camera			
Drop Camera			
Sherman Epibenthic Sled			

SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
Brenke Sled			
Hydro-Bios MultiNet (Mammoth) (1m x 1m) *(has replaced the EZ net)*			
Surface Net (1m x 1m)			
Bongo Net			
Beam Trawl			
MIDOC			
Pelagic Trawl System (net, doors)			
Demersal Trawl System (net, doors)			
RMT-8 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			
RMT-16 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			
Stern ramp		INSTALLED	

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Saltwater Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			
Milli-Q System	X		Protat - piggyback
Sonardyne USBL System			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				NOTES/COMMENTS
BRAND / MODEL	TYPE	ESSENTIAL	DESIRABLE	Refer to the “MNF microscopes procedure” for more information
Leica / M80	Dissecting			
Leica / M80	Dissecting			
Leica /MZ6	Dissecting			
Olympus / CH	Compound			
Olympus /CH	Compound			
Leica / MTU282	Camera tube			
Adapters for tube / Nikon	Pentax			
Ring Light *2 / MEB121	LED			
Heavy Duty Electronic Balance (80kg)				
Medium Duty Electronic Balance (15kg/5g resolution)				

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS			
MICROSCOPES:			NOTES/COMMENTS
Light Duty Electronic Balance (3kg/1g resolution)			

Underway systems

ACOUSTIC UNDERWAY SYSTEMS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
75kHz ADCP	X		Currents in top 700m Priority above any interference with MBES
150kHz ADCP	X		Currents in top 400m Priority above any interference with MBES
Multi Beam Echo Sounder EM122 12kHz (100m to full ocean depth)	X		
Multi Beam Echo Sounder EM710 70-100kHz (0-1000m approx.)			
Sub-Bottom Profiler SBP120			
Scientific Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)			
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)			
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter			

ATMOSPHERIC UNDERWAY SENSORS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Nephelometer	X		Protat - piggyback
Multi Angle Absorption Photometer (MAAP)	X		Protat - piggyback
Scanning Mobility Particle Sizer (SMPS)	X		Protat - piggyback
Radon Detector	X		Protat - piggyback
Ozone Detector	X		Protat - piggyback
Condensation Particle Counter (CPC)	X		Protat - piggyback
Picarro Spectrometer (analysis of CO_2/CH_4/H_2O)	X		Protat - piggyback
Aerodyne Spectrometer (analysis of N_2O/CO/H_2O)	X		Protat - piggyback
Cloud Condensation Nuclei (CCN)	X		Protat - piggyback
Polarimetric Weather Radar	X		Protat - piggyback
Filter Aerosol Sampling units (FAS) x 3			

UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Thermosalinograph	X		
Fluorometer	X		
Optode	X		
pCO2	X		
SST Radiometer			

SEAWATER SYSTEMS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories			
Raw seawater available on deck and in laboratories			

EQUIPMENT AND SAMPLING GEAR REQUIRING EXTERNAL SUPPORT (MAY REQUIRE ADDITIONAL SUPPORT FROM APPLICANTS)			
NAME	ESSENTIAL	DESIRABLE	
Seismic Compressors			
Seismic Acquisition System			

NON-MNF OWNED EQUIPMENT WHICH MAY BE ACCESSED			
NAME	ESSENTIAL	DESIRABLE	PLEASE GIVE THIS CAREFUL CONSIDERATION, AS THERE IS NO GUARANTEE THAT THESE RESOURCES WILL BE AVAILABLE UNLESS SPECIFICALLY REQUESTED. LIAISE WITH YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.
D & N Francis winch			
Box Corer			
UTAS In-Situ Pumps (x2)			
EM2040			

CTD Configuration

Note #1: On every departure a test CTD is to be undertaken, ideally 24 hours prior to the first planned CTD cast. This requirement is a single cast to a minimum of 1000m, firing half the bottles at the maximum depth of the cast, followed by firing of the remaining bottles near the chlorophyll maximum (requiring one stop on the retrieval). This test CTD is essential to the MNF Hydrochemistry team and supports the training of samplers, testing of Niskin bottles, collection of a tracking standard for the voyage, and ongoing quality and uncertainty calculations.

Science Test Casts

Two casts to 1500m to test the mooring instruments will be required during the first transit days

	PLEASE SELECT:
Fundamentals:	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	36
Likely total number of casts:	130
Likely maximum depth of deepest cast:	4800
Lowered ADCP required:	YES
Standard CTD Configuration - Instrumentation (maximum 6 auxiliary channels plus 2 x DO) 6000 m 1 x SBE9+ (CTD) 2 x SBE3P Temperature Sensors 2 x SBE4C Conductivity Sensors 2 x SBE5T pumps 2 x SBE43 Dissolved Oxygen Sensors	
1 x Tritech PA200/500 Altimeter	YES
1 x Biospherical QCP2300HP PAR Sensor	YES
1 x Wetlabs C-Star 25cm Transmissometer	YES
1 x Wetlabs ECO FLCDRTD Fluorometer – CDOM (370/460nm)	YES
1 x Wetlabs ECO FLBBRTD Fluorometer – Chlorophyll-a & BackScatter (2 x Channels - 470/695nm)	
Alternative Instruments (Instruments highlighted in grey can be substituted from standard configuration):	
Seapoint Turbidity Meter – Nephelometer	YES
Chelsea Aquatracka III (430/685nm) Fluorometer – Chlorophyll-a	YES
Seabird SUNA – Ultraviolet Nitrate Analyzer (**Serial Connection - 2000 m**)	YES
Standard LADCP Configuration – Instrumentation: 6000 m 1 x Teledyne 300 kHz LADCP (Slave - Up) 1 x Teledyne 150 kHz LADCP (Master - Down) 1 x 48V Deep Sea Battery	YES
Alternative LADCP Configuration - Instrumentation: 6000 m 1 x Teledyne 300 kHz LADCP (Slave - Up) 1 x Teledyne 300 kHz LADCP (Master - Down)	

	PLEASE SELECT:
1 x 48V Deep SeaBattery	
Hydrochemistry Analyses:	
Salinity	YES
Dissolved Oxygen	YES
Nutrients: Nitrate	YES
Nutrients: Phosphate	YES
Nutrients: Silicate	YES
Nutrients: Nitrite	YES
Nutrients: Ammonia	YES

We plan to have 2 students (1 per shift) assisting with processing the Salinity samples and the doing the sampling sheet control during CTD sampling.

Bottle stops picked based on downcast trace