Glider Deployment Report: AMLR01 (November 20, 2024)

Table of contents

Summary

The Ecosystem Science Division (ESD) at the Southwest Fisheries Science Center (SWFSC) deployed glider **AMLR01** (unit_681) on 2024-11-20 off the coast of **Smith Island in the Southern Ocean** (-62.95°N, -62.34°W) (Figure 1). Sensors deployed on the glider are listed in Table 1.

Figure 1 (A) displays tracklines of glider during deployment, while (B) displays the broad deployment area. The glider remained deployed for 44 days, performed 389 dives, and traveled a total of 1056.26 km while diving to a maximum depth of 919.1 m. The glider was recovered on 2025-01-02, approximately 25 km southwest of Nelson Island.

This deployment had two goals: 1) to estimate the density of Antarctic krill in an area important for krill-dependent predators and the krill fishery; and 2) to compare echosounder data between the older Acoustic Zooplankton Fish Profiler (AZFP, deployed on AMLR01) and the newer Nortek wideband echosounder (concurrently deployed on AMLR08). AMLR08 suffered a pump malfunction and was recovered on 2024-11-24.

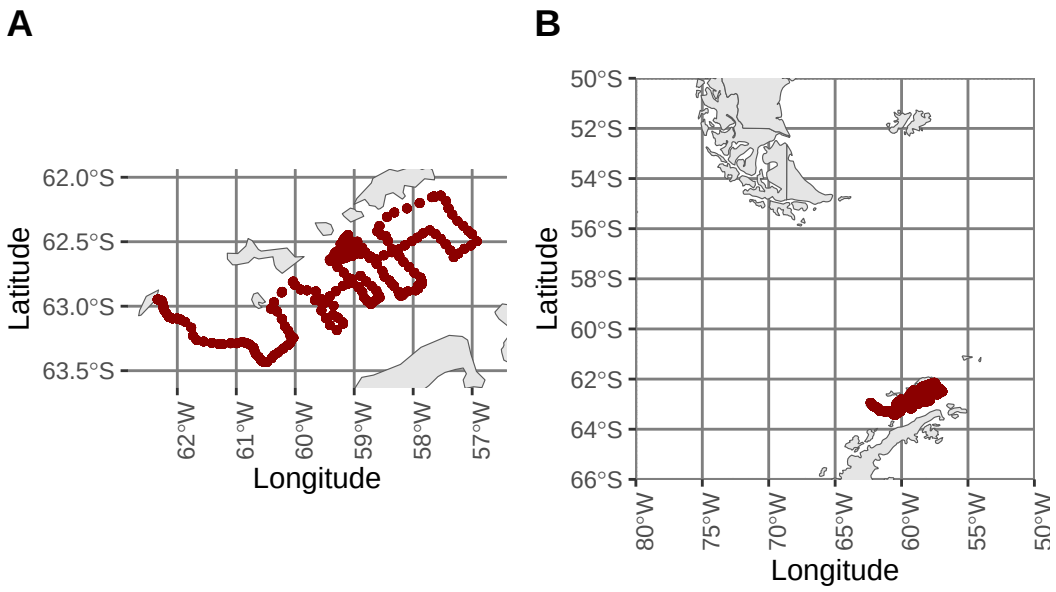


Figure 1: Glider tracklines. A displays close-up tracklines, while B displays the broad deployment area.

Table 1: Science sampling strategies for current glider deployment. Additional settings for the AZFP echosounder, the Williamson and Associates camera, and the Nortek echosounder (if installed) are defined in configuration and initialization files on the glider's science computer, and are also housed on the Google Cloud Platform. All deployment files are available on request.

File Name	Sensor	State to Sample	Depth to Sample	Serial Number
sample01.ma	Sea-Bird Conductivity Temperature Depth (CTD) (SBE-41)	Diving, hovering, climbing	1000 m	9547
sample48.ma	Sea-Bird ECO Puck (backscatter and fluorescence) (FLBBCD-SLC, CDOM)	Diving, hovering, climbing	1000 m	5583
sample54.ma	AANDERAA oxygen optode (4831)	Diving, hovering, climbing	1000 m	0643
sample68.ma	Acoustic Zooplankton Fish Profiler (ASL)	Diving, hovering, climbing	1000 m	59010

Introduction

The Ecosystem Science Division at NOAA Fisheries' Southwest Fisheries Science Center monitors the living marine resources within the Southern Ocean and the California Current in order to satisfy the requirements of several legislative mandates to support conservation and management decision-making. To achieve this goal, we use autonomous underwater buoyancy-driven gliders with integrated sensors for measuring ocean conditions, plankton densities, and marine mammal distributions.

Depending on the specific deployment objective, Slocum gliders are equipped with a suite of sensors. We obtain acoustic estimates of zooplankton density (primarily Antarctic krill in the Southern Ocean) using one of two different echosounders: an Acoustic Zooplankton Fish Profiler with discrete frequencies at 67.5 and 125 kHz (AZFP, ASL, Inc) and a mini-Signature 100 wideband echosounder with continuous frequencies between 70 and 120 kHz (Nortek). We also collect ancillary oceanographic data (temperature, salinity, dissolved oxygen, chlorophyll, colored dissolved organic matter, backscatter, and photosynthetically active radiation) to characterize the marine environment. Additional sensors may include passive acoustic monitors for marine mammal detection ("Wispr", Embedded Ocean Systems; digital acoustic monitoring "DMON", Woods Hole Oceanographic Institution), "glidercams" for verifying acoustic targets (Williamson and Associates, Inc.) and shadowgraph cameras for obtaining imagery of the plankton community (Williamson and Associates, Inc.). Imagery is used to train artificial intelligence (AI) models to automate plankton identification.

Pre-deployment preparation and testing

Prior to deployment, the ESD has a standard protocol for preparing and testing gliders to minimize or eliminate issues that may occur due to human error during deployment:

Slocum gliders

1. Gliders are properly ballasted (i.e., weighted) so that the density of the glider matches the density of the water in which it will be deployed. Weight and flotation configurations are documented
2. The junctions between glider sections are thoroughly cleaned, old o-rings are discarded, new o-rings are inspected for damage that may compromise their ability to form a watertight seal, new o-rings are properly lubricated, and the glider is sealed together. All cable connections are photographed to document the "final seal" and ensure the glider was reassembled properly
3. A "Functional Checkout" is performed to ensure and document that all glider systems and science sensors are functioning properly. During the Functional Checkout, we verify the battery type installed in the glider (lithium primary or lithium rechargeable) and that the appropriate battery duration (total coulomb amp hours) is active in the glider's autoexec.mi file

4. Two test missions are performed in the SWFSC test tank (20 m x 10 m x 10 m) to ensure the glider is performing as expected
5. Once per year, glider compasses are calibrated (the compass was not calibrated prior to this deployment)
6. Biofouling prevention measures are applied as necessary
7. Glider flight and science sampling files are prepared according to mission objectives. These objectives are identified by the Principal Investigators for each deployment. Files are uploaded to the Teledyne Webb Research Slocum Fleet Mission Control (SFMC) web interface and sent to the glider just prior to deployment over the Iridium connection
8. When gliders are shipped to their deployment location, ESD glider technicians perform a second Functional Checkout to ensure the gliders function properly after transit

Deployment-specific testing

Because AMLR01 had not been deployed since 2021 and AMLR08 had not been deployed since it was repaired after a catastrophic electrical failure in 2022, both gliders were deployed in San Diego for one day in July to ensure they performed as expected. Both gliders performed well, and because their sensor configurations did not include any combinations of sensors that had led to electrical problems in the past, no further deployment-specific testing (beyond our standard pre-deployment preparations and tests) was done.

Deployment

"AMLR01" was deployed on 2024-11-20, off the coast of Smith Island in the Southern Ocean (-62.95°N, -62.34°W) from the DAP vessel M/V *Betanzos*. This glider was deployed with the sensor configuration listed above, and with lithium primary batteries (coulomb amp hour total = 800). We began this deployment using the autoballast feature to maximize oil pump efficiency while maintaining the appropriate dive angle of 23 degrees for the AZFP echosounder. Autoballast converged successfully for the majority of the deployment.

This glider performed well for the entire 44-day mission. The glider used 298.32 amp hours over 44 days, or 37.29% of its battery capacity.

This was the U.S. AMLR Program's first glider deployment with no mission interruptions (i.e., aborts). While the glider experienced strong eastward currents along the southern coast of King George Island, pilots were able to direct the glider into deeper water and keep it on track. The glider was recovered on schedule on 2025-01-02, approximately 25 km southwest of Nelson Island, by the M/Y *Hanse Explorer* and U.S. AMLR Program staff.

The only noteworthy "issue" of this deployment occurred when a military glider with a different name experienced an abort and connected to Teledyne Webb's Slocum Fleet Mission Control as AMLR01, briefly leading us to believe that our glider had aborted its mission. We were able to quickly determine that our AMLR01 had not aborted its mission.

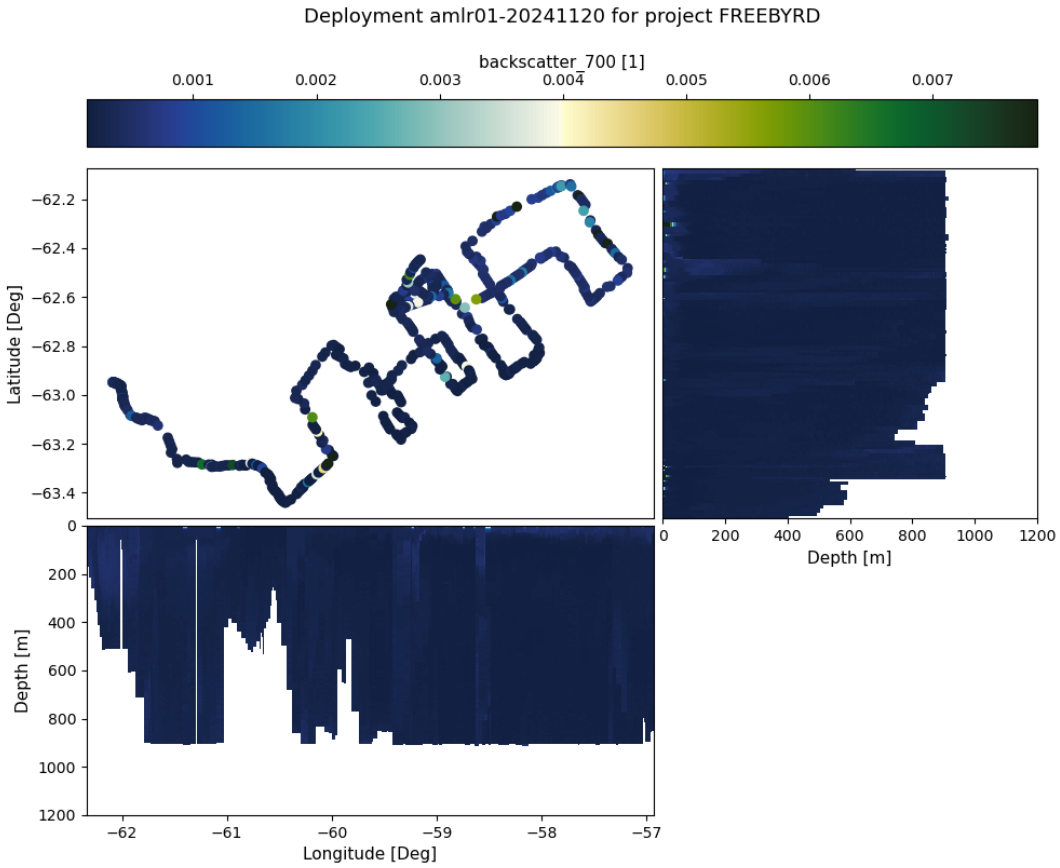
AMLR01 remains in Antarctica at Cape Shirreff until camp closes in March, at which point it will be transported to Punta Arenas, Chile, and eventually back to the U.S.

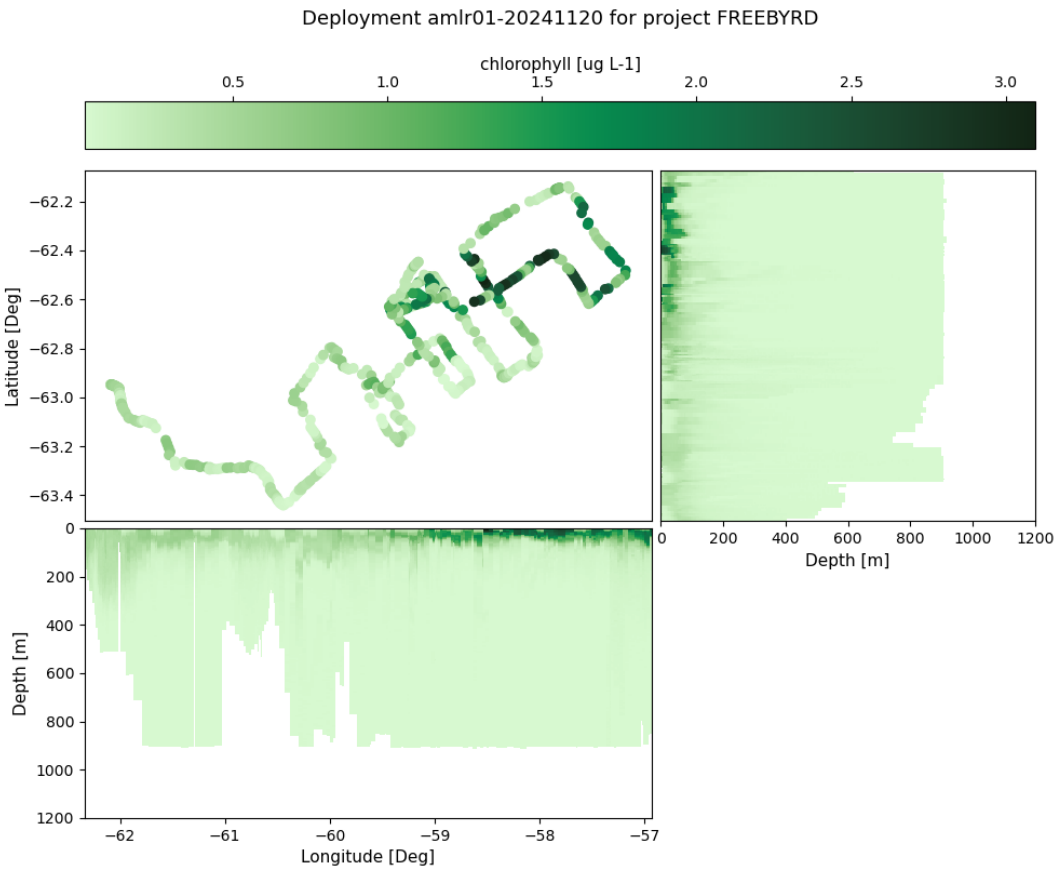
Post-deployment actions

We received AMLR01 back in La Jolla, CA, on 2025-06-12. The glider was inspected, cleaned, and all data were downloaded and archived on NOAA's Google Cloud Platform. Data will be quality checked and analyzed at a later date.

Figures

Plots below are generated from raw data which has not yet been quality-checked.

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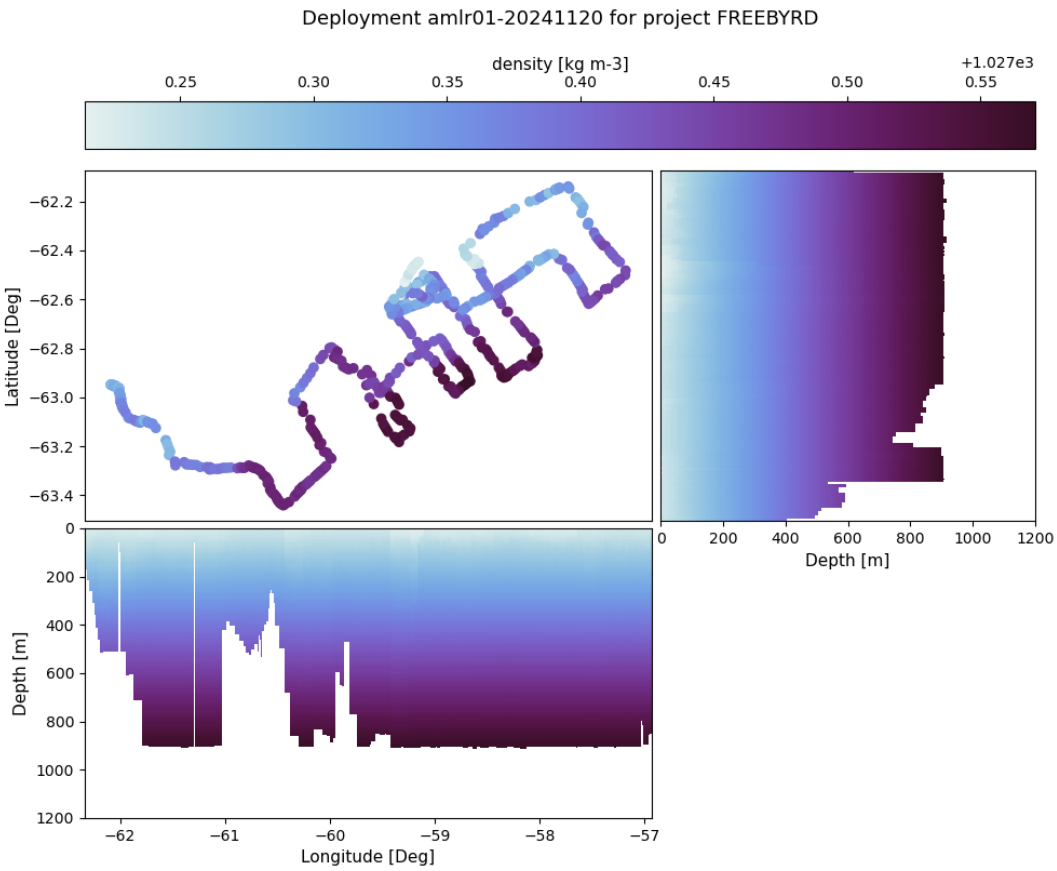
chlorophyll [ug L-1]
0.5
1.0
1.5
2.0
2.5
3.0
Latitude [Deg]
−62.2
−62.4
−62.6
−62.8
−63.0
−63.2
−63.4
Depth [m]
0
200
400
600
800
1000
1200
Longitude [Deg]
−62
−61
−60
−59
−58
−57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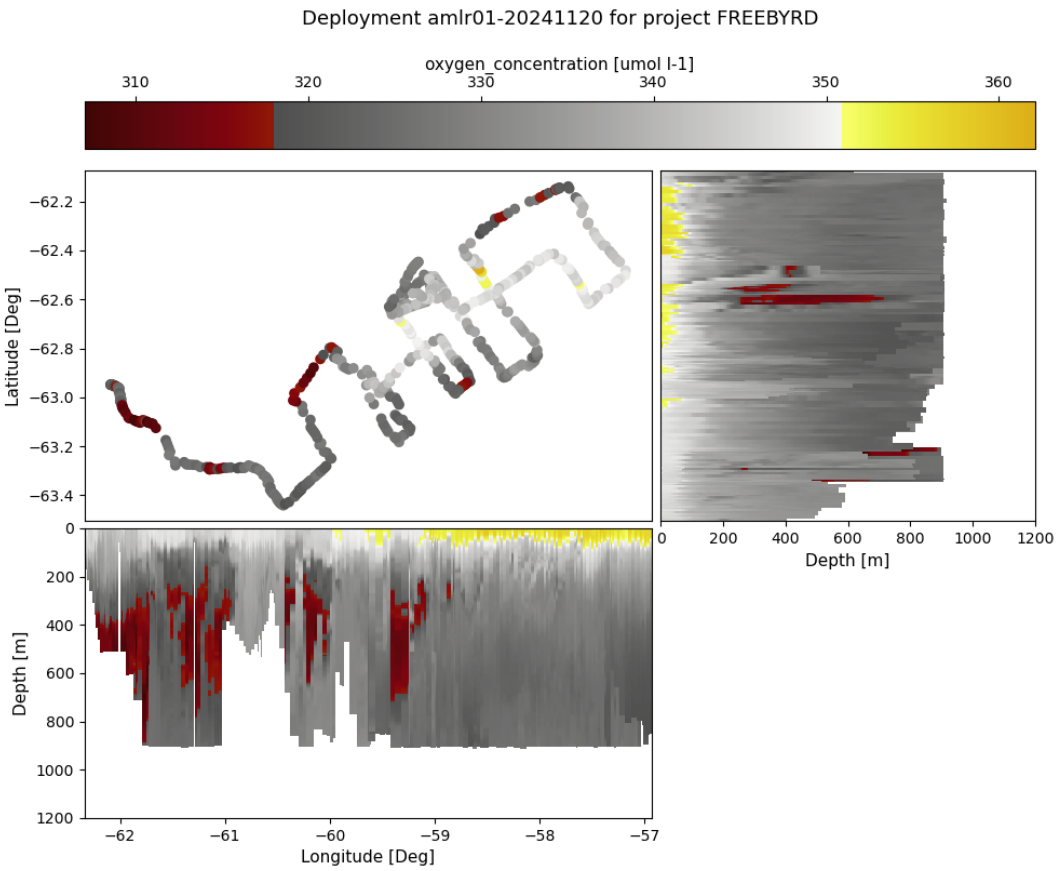
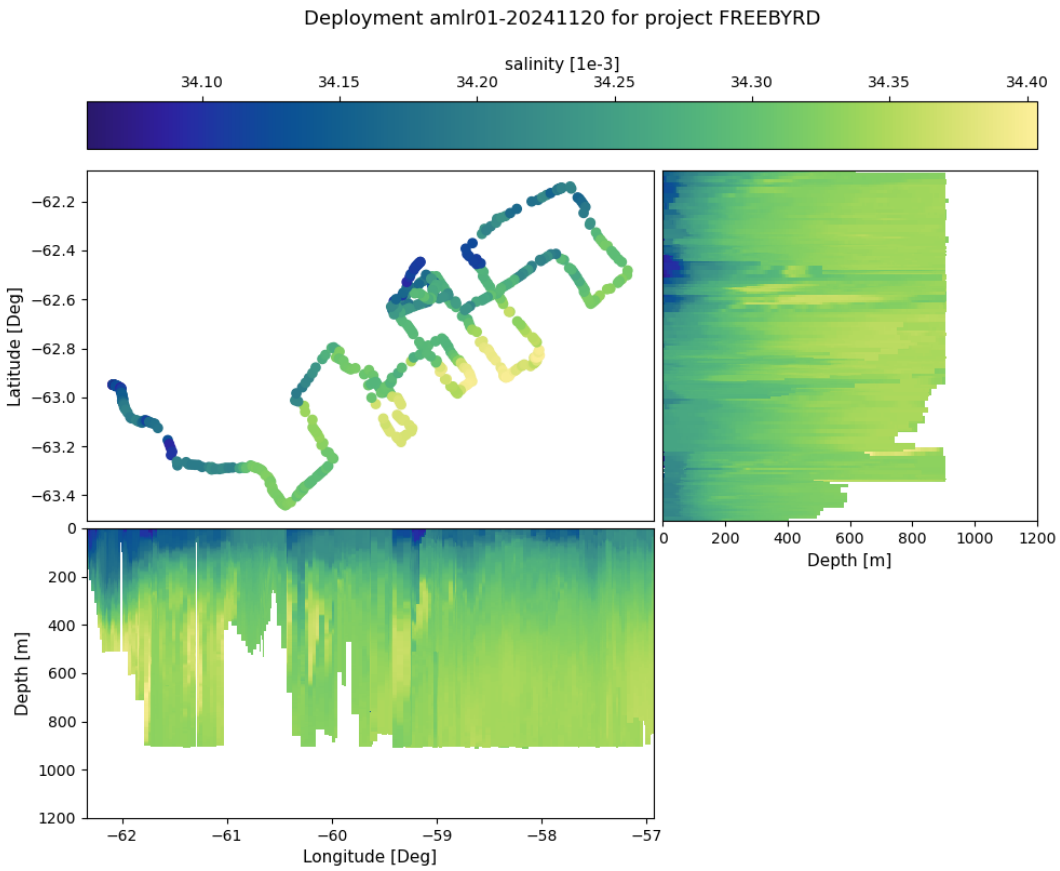
0.30
0.35
0.40
0.45
0.50
0.55
Latitude [Deg]
−62.2
−62.4
−62.6
−62.8
−63.0
−63.2
−63.4
Depth [m]
0
200
400
600
800
1000
1200
Longitude [Deg]
−62
−61
−60
−59
−58
−57


Deployment amlr01-20241120 for project FREEBYRD
oxygen_concentration [umol l-1]
310
320
330
340
350
360
Latitude [Deg]
−62.2
−62.4
−62.6
−62.8
−63.0
−63.2
−63.4
Depth [m]
0
200
400
600
800
1000
1200
Longitude [Deg]
−62
−61
−60
−59
−58
−57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34.15
34.20
34.25
34.30
34.35
34.40
Latitude [Deg]
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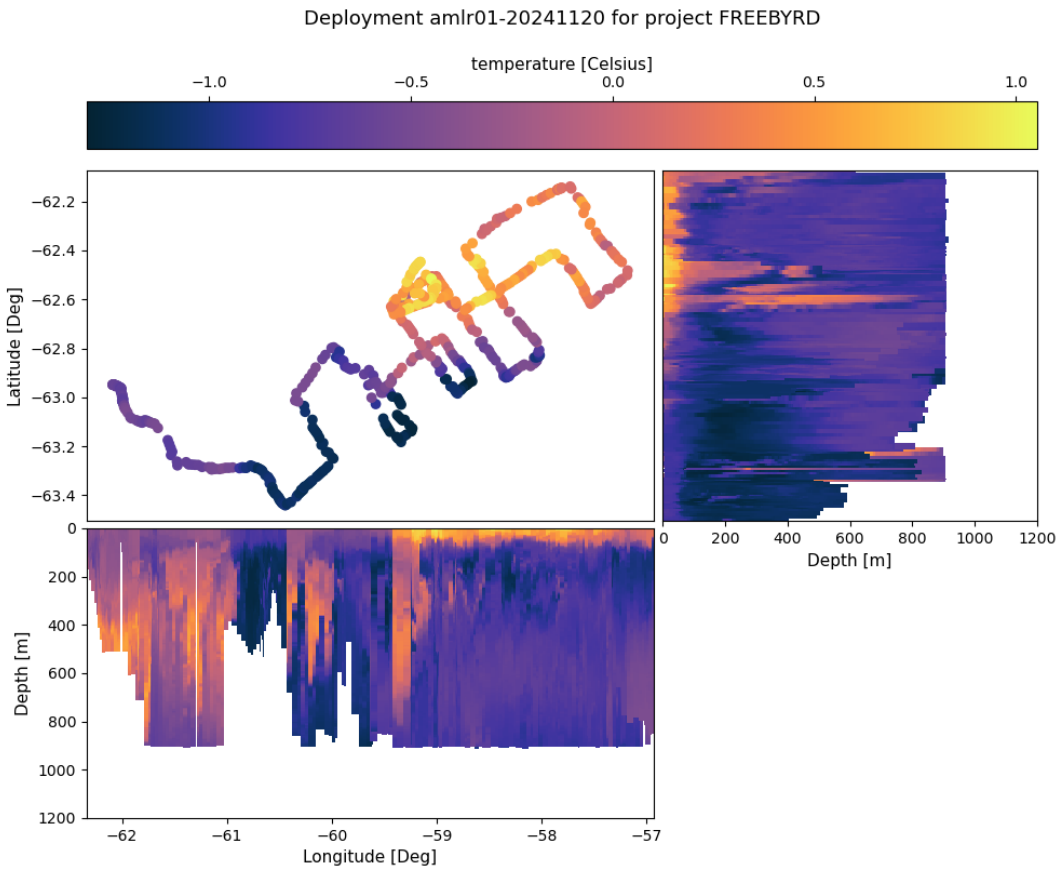
−62.4
−62.6
−62.8
−63.0
−63.2
−63.4
Depth [m]
0
200
400
600
800
1000
1200
Depth [m]
0
200
400
600
800
1000
1200
Longitude [Deg]
−62
−61
−60
−59
−58
−57


Deployment amlr01-20241120 for project FREEBYRD
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−0.5
0.0
0.5
1.0
Latitude [Deg]
−62.2
−62.4
−62.6
−62.8
−63.0
−63.2
−63.4
Depth [m]
0
200
400
600
800
1000
1200
Longitude [Deg]
−62
−61
−60
−59
−58
−57