Cruise Report
FV Argos Georgia
Voyage SS24
30 January – 1 March 2024

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Background

Weddell Sea Deep Water (WSDW) is a key precursor to Antarctic Bottom Water (Orsi et al., 1999), which covers much of the abyssal World Ocean (Johnson, 2008), forming the lower limb of the meridional overturning circulation (Lumpkin & Speer, 2007). The British Antarctic Survey (BAS) has monitored exports of WSDW since 2006, deploying moorings in collaboration with Lamont-Doherty Earth Observatory, Columbia University, in Orkney Passage and the northwest Weddell Sea. Orkney Passage, east of the South Orkney Islands, is the largest export route for WSDW across South Scotia Ridge into the Scotia Sea (Naveira Garabato et al., 2002). However, little is known about the deeper export route through South Sandwich Trench (SST), farther to the east.

BAS hoped to obtain hydrographic and bathymetric data from SST for several years, with the aim of ascertaining if there is a shallow sill that may be suitable for long-term monitoring of the WSDW exports through this route; this was included as an extra task if weather and time permitted on several cruises during the ORCHESTRA programme (Meijers et al., 2023). On 11-13 Mar 2019, on RRS *James Clark Ross* cruise JR18005 ("ANDREX-2"), multibeam data were collected, confirming that a saddle point with a depth just below 6000 m depth was present in the trench. A section of six CTD casts was obtained along this ridge (Meijers, 2019).

In parallel, unbeknownst to us, in Feb 2019 the Five Deeps Expedition obtained multibeam data in SST, confirming that the deepest point in the Southern Ocean (delineated by 60°S) is in southern part of SST, at 60° 28.77'S 025° 32.52'W, 7434 m depth, while the northern part of SST contains the deepest point in the South Atlantic Ocean, Meteor Deep, now confirmed to be 8266 m deep (Bongionvanni et al., 2021). Multibeam data from this expedition are publicly available through the British Geological Survey (Caladan Oceanic LLC, 2021) and meet IHO survey quality standards.

OCEAN:ICE (Ocean-Cryosphere Exchanges in ANtarctica: Impacts on Climate and the Earth System) is a Horizon Europe project, funded by the European Commission and by UKRI (under the Horizon Europe guarantee scheme for UK participants). The project started on 1 Nov 2022 and will run for 4 years until 31 Oct 2026. The overall aims are to assess the impacts of key Antarctic Ice Sheet and Southern Ocean processes on Planet Earth, via their influence on sea level rise, deep water formation, ocean circulation and climate. More details can be found on the project website, https://ocean-ice.eu/.

As part of Workpackage 5 of the project, investigating Antarctic deep water formation and export routes, we proposed to deploy two moorings in SST. The original plan was to deploy and recover these moorings in collaboration with project partners in South Africa, from RV *S. A. Agulhas II*. Unfortunately, these plans fell through in autumn 2023, and a search for other research vessels going to the deployment area in 2023-24 proved fruitless. However, we identified that longline fishing vessel *Argos Georgia*, operated by Argos Froyanes Limited, was undertaking research and commercial fishing near the South Sandwich Islands in CCAMLR sub-area 48.4, north of 60°S. In collaboration with AFL we managed to secure a berth on the vessel, obtain the required permits from the Foreign Commonwealth and Development Office (Antarctic Permit no. 20/2023-2024) and the Government of South Georgia and the South Sandwich Islands (Regulated Activity Permit no. 2024/006), and ship the mooring equipment from Cambridge to Stanley just in time for the vessel's departure. The vessel's identifier for this fishing campaign, around the South Sandwich Islands, is SS24. This report summarises the mooring deployments on this voyage. As this deployment forms milestone MS9 of OCEAN:ICE, a report has been submitted to the European Commission and is available to download from Zenodo (Abrahamsen, 2024). A cruise summary report ("ROSCOP form") for the voyage, listing the deployments, has also been submitted to the British Oceanographic Data Centre.

Ship time has been secured to recover the moorings on RRS *Sir David Attenborough* in February/March 2025, in conjunction with turnaround of the Orkney Passage moorings as part of the second Antarctic cruise of the BIOPOLE (biogeochemical processes and ecosystem function in changing polar systems and their global impacts) programme.

Acknowledgements

We would like to the captain and crew of FV *Argos Georgia* for their support of this project and flexibility in finding ways to deploy oceanographic moorings from a fishing vessel. We are grateful to the directors of Argos Froyanes Limited for allowing us to deploy the moorings on their vessel. This deployment would not be possible without the tremendous assistance of Andrew Newman from AFL, who has been key in organising this collaboration, helping prepare the permit applications, and obtaining the support of the directors. Logistical support from the BAS office in Stanley (Michelle Vincent and Donna Ford) was invaluable in getting the cruise mobilised and de-mobilised, along with the support of the BAS Supply Chain Logistics and Operations teams in Cambridge. The collaboration with AFL was initially suggested by Mark Belchier from the Government of South Georgia and the South Sandwich Islands. The BAS Environment Office, the Government of South Georgia and the South Sandwich Islands, and the Polar Regions Unit at the Foreign, Commonwealth and Development Office all assisted in evaluating and approving our permits at very short notice. And, finally, we would like to thank the directors of BAS, operations programme manager Chris Aldridge, and head of risk and assurance Steve Marshall for their thorough evaluation and ultimate support of this collaboration.

The mooring deployment forms part of OCEAN:ICE (Ocean-Cryosphere Exchanges in ANtarctica: Impacts on Climate and the Earth System), which is co-funded by the European Union, Horizon Europe Funding Programme for research and innovation under grant agreement no. 101060452 and by UK Research and Innovation. Prior research leading to this deployment, including purchase of some of the mooring instrumentation and equipment, received funding from the Natural Environment Research Council through National Capability funding to the British Antarctic Survey and via grants NE/K012843/1 and NE/K013181/1 (DynOPO), NE/N018095/1 (ORCHESTRA), and NE/V013254/1 (ENCORE); from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 821001 (SO-CHIC); and from NOAA's Climate Program Office's Ocean and Monitoring Division (Fund Ref 100007298).

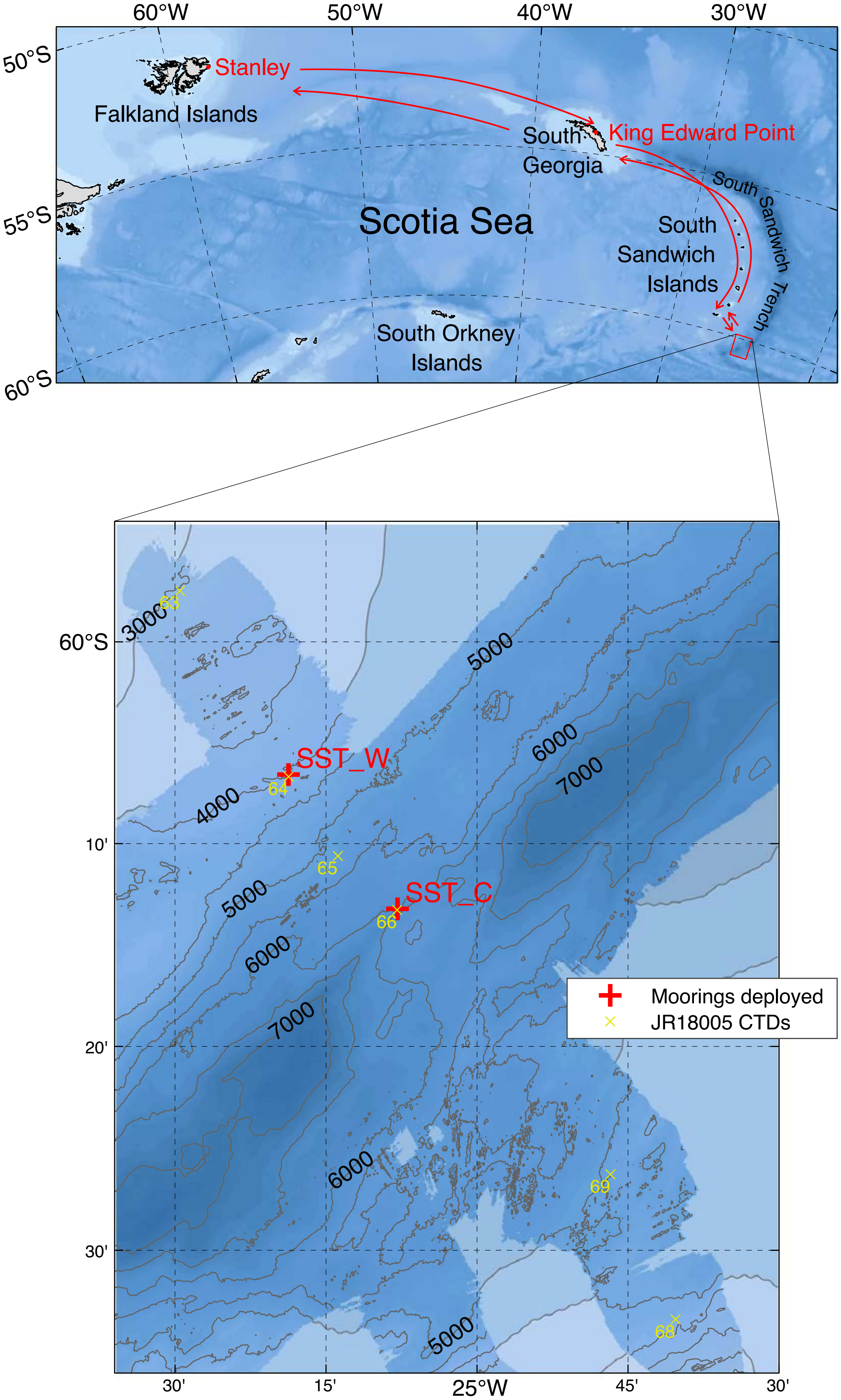

Figure 1: Overview of the vessel route and mooring deployments on the cruise. Locations of the JR18005 CTD casts are also shown on the detail map, which shows BAS and Five Deeps multibeam data superimposed on GEBCO_2023.

Cruise personnel

Science party

Povl Abrahamsen (British Antarctic Survey)

CCAMLR Scheme of International Scientific Observation (SISO) observers

Nuno Figueiredo Carrilho (MRAG Ltd)

Beatriz Rodriguez Delgado (MRAG Ltd)

Officers and crew

Jose Saborido Rey, Captain
Brais Muñiz Outeiral, Chief Mate
Alexander Zaplitny, 2nd Mate
Ramon Garcia Reiriz, Chief Engineer
Antonio Barreiro Torea, 2nd Engineer
Igor Korzhak, Bosun (Line Boss)
Maksim Gaidamakov, 2nd Bosun
Jose Luis Rodriguez Espinoza ("Puma"), Factory Bosun
Nurcholis, 2nd Factory Bosun

Ali Mustain, Cook
Akmad Ripai, Deckhand
Chaerudin, Deckhand
Kapidin, Deckhand
Plat Kazimetov, Deckhand
Ruslan Kriukov, Deckhand
Julio Mendoza Guzman, Deckhand
Harry Thomson, Deckhand
Triono, Deckhand

Cruise narrative

Unless otherwise noted, all times are in vessel local time: UTC-2, South Georgia Time, when underway; UTC-3, Falkland Islands Standard Time, when alongside or at anchor in Stanley.

Thurs 25 Jan: Povl Abrahamsen (EPA) boarded overnight flight from Heathrow Airport to São Paolo, Brazil.

Fri 26 Jan: Arrived at São Paolo, connecting flight to Santiago, Chile. Stayed at Holiday Inn airport hotel overnight, went into city centre for afternoon sightseeing and dinner.

Sat 27 Jan: Early morning flight from Santiago to Punta Arenas, and onward to Mount Pleasant, Falkland Islands. Bus transfer to Malvina House Hotel, Stanley. FV *Argos Georgia* (AG) at anchor in Stanley Harbour.

Sun 28 Jan: Walked around Stanley and did a bit of shopping in morning. Met with Andrew Newman from Argos Froyanes Limited at Malvina House after lunch, to discuss plans for vessel mobilisation and mooring deployments. Walked out to Whalebone Cove in afternoon. Container ship MV *Scout* arrived at FIPASS east berth late evening from Montevideo, Uruguay, carrying cruise cargo and equipment for AG. Unloading began immediately after arrival, continuing overnight and throughout the next day.

Mon 29 Jan: Went to BAS office to discuss mobilisation plans. BAS container was unloaded from *Scout* in late morning and brought to Argos warehouse for unstuffing. Container fully unstuffed, all cruise cargo set aside, and remaining cargo loaded back into container. Cargo subsequently brought to FIPASS centre berth. Returned to town for lunch and then to Malvina House, where I packed my bags and checked out. AG came alongside FIPASS in afternoon, and I was brought to the ship by BAS office staff, joining the vessel at 16:30 local time (UTC-3). Cargo was loaded onto vessel: mooring weights and six floats to aft end of bridge deck, remaining floats to cargo hold, and all other equipment to rope store next to the line magazine room. Dinner on board.

Tues 30 Jan: Vessel departed FIPASS at 06:00 local (UTC-3) for South Georgia. Vessel changed to South Georgia time (UTC-2) after departure. Vessel familiarisation and safety drills. Started preparing ropes for buoys in afternoon.

Wed 31 Jan: Batteries installed in acoustic releases and current meters; tested on bench.

Thurs 1 Feb: Remaining instruments and beacons had batteries fitted.

Fri 2 Feb: Approaching South Georgia, slow steaming in afternoon and overnight.

Sat 3 Feb: Arrived at Cumberland Bay near King Edward Point, South Georgia, in morning for fisheries inspection. Government officers and BAS marine biologist brought to vessel by launch. Following the inspection, the government officers had to wait for the license to be issued from Cambridge, and the two observers and EPA were taken ashore for a brief walk around the station. After the license was issued, all returned to AG, and the vessel departed Cumberland Bay in early afternoon toward the north end of the South Sandwich Islands (SSI).

Sun 4 Feb: First three longlines deployed north of SSI in evening for research fishing.

Mon 5 Feb – Wed 14 Feb: For each of these days, three research lines were recovered in morning/afternoon, and three more deployed in afternoon/evening, as the vessel gradually moved south along and between the islands of SSI. Remaining mooring equipment was gradually prepared, and the crew flaked the mooring ropes into bait buckets in preparation for deployment. Discussions held with crew about mooring deployments at various times.

Thurs 15 Feb: Last three research lines recovered through day, with particularly many fish on the 30th and final line. Two commercial fishing lines (31 & 32) deployed in afternoon, with slight drama as one line was caught on the bulbous bow and dragged several miles following deployment. Slow steaming overnight toward South Sandwich Trench mooring locations.

Fri 16 Feb: Crossed 60°S shortly after midnight (00:04), arriving at SST_W mooring location at 07:20. Deployment preparations commenced, slightly hampered by the failure of the cargo lift to the hold. Thus, all Eddygrip buoyancy was deployed from deck, rather than from the magazine room. SST_W deployed 11:00-11:52. Then steamed to SST_C, which was deployed 13:49-15:04. Crossed 60°S at 17:15. Started recovering first two commercial lines (31 & 32) in evening and overnight.

Sat 17 Feb – Wed 21 Feb: Commercial fishing for Antarctic toothfish near the southern part of SSI (lines 33-42).

Thurs 22 Feb – Sat 24 Feb: Commercial fishing for Patagonian toothfish near the northern part of SSI (lines 43-45).

Sat 24 Feb: After hauling line 45, started steaming west toward the Falkland Islands at 3 pm.

Sun 25 Feb – Wed 28 Feb: Steaming west toward the Falkland Islands.

Thurs 29 Feb: Vessel entered Port William at 9 am (UTC-2), dropped anchor in Stanley Harbour anchorage SH12 at 9:45. Ship clocks changed to UTC-3 (Falkland Islands Time).

Fri 1 Mar: Pilot on board 06:00. Anchor aweigh shortly afterwards, and vessel moored at FIPASS centre berth 06:40. Cargo unloaded from vessel and packed in cages for northbound shipping or storage for 2024/25 BIOPOLE cruise shortly after breakfast. EPA disembarked vessel at 09:30; cargo paperwork completed at BAS office, followed by lunch and a recreational trip to Cape Pembroke, Yorke Point, and Gypsy Cove. Stayed at Malvina House Hotel overnight.

Sat 2 Mar: Early morning bus from Stanley to Mount Pleasant Complex, then afternoon/evening flight via Punta Arenas to Santiago, Chile. Night in Holiday Inn airport hotel.

Sun 3 Mar: Afternoon flight from Santiago to São Paolo, Brazil, followed by overnight flight to Heathrow Airport, London UK.

Mon 4 Mar: Arrived Heathrow Airport in afternoon, transfer to BAS, Cambridge.

Mooring deployments

Two sub-surface oceanographic moorings were deployed in South Sandwich Trench, one at the saddle point of the ridge across the trough (SST_C), and the other on the western flank at approx. 4000 m depth (SST_W). The moorings were not triangulated after deployment, but the anchor drop positions are shown in Table 1, with the most reliable depth estimate underlined.

Table 1. Mooring deployment (anchor drop) times, positions, and estimated depths, with the most reliable depth source underlined.

Mooring	Deployment time (UTC)	Latitude	Longitude	Bottom depth (est.)
SST_W	16/02/2024 13:52	60° 06.583'S	025° 18.728'W	<u>3958 (BAS multibeam)</u> 3973 (JR18005 CTD 64)
SST_C	16/02/2024 17:04	60° 13.220'S	025° 07.897'W	<u>5964 (Five Deeps MB)</u> 6008 (BAS multibeam) 5932 (JR18005 CTD 66)

Estimated depths are shown from three sources, where available: the Five Deeps multibeam grid, a grid of BAS multibeam holdings (mainly JR18005 in this region), and the depths of the nearest CTD cast from JR18005 (calculated from CTD profiles and altimeter). Within SST, the BAS grid appears consistently deeper than Five Deeps; this may be because of the choice of sound speed profile in JR18005; data used for this grid have not been fully cleaned, so local errors may also exist. Both grids appear slightly deeper than the CTD-derived bottom depths. GEBCO_2023 (GEBCO Compilation Group, 2023), while better than many earlier gridded bathymetry compilations, differs significantly from the multibeam grids. These depths, extracted along straight lines between the casts on the JR18005 CTD section, are shown in Figure 2.

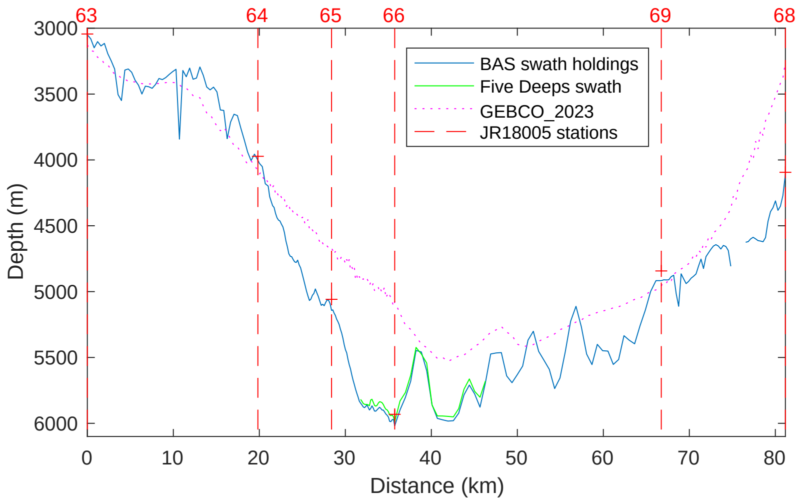

Figure 2. Bottom depths along the JR18005 CTD section.

The placement of mooring instruments relative to the CTD/LADCP casts on JR18005 is shown in Figure 3 and Figure 4. The moorings were designed to cover a distribution of water mass properties and currents within the WSDW layer. The upper boundary of WSDW in SST lies at approx. 1500 m depth. The original intention was to deploy a SBE 37-SM ("Microcat") temperature-conductivity-pressure recorder with each current meter. Unfortunately, because of shipping problems, four Microcats did not arrive in Stanley in time to reach the vessel, and the three available Microcats were distributed with two at the bottom and top of the SST_C, and the third in the middle of SST_W.

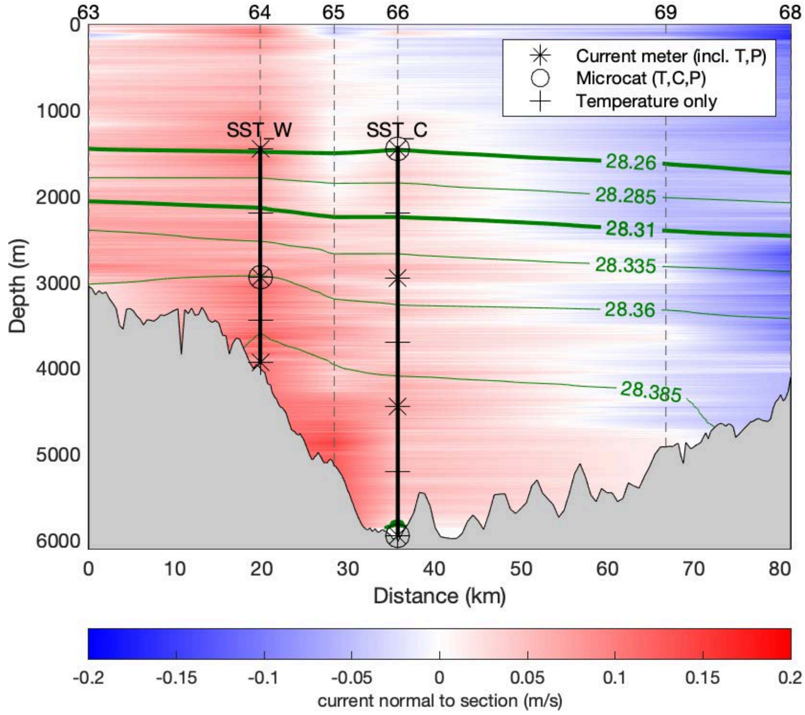

Figure 3. LADCP section showing currents normal to the section, with the location of the moorings and their instruments superimposed. Contours of neutral density γ^n are plotted in green, with the 28.26, 28.31, and 28.40 kg m^{-3} contours, the upper limits of WSBW, lWSDW, and WSDW/uWSDW, plotted in bold.

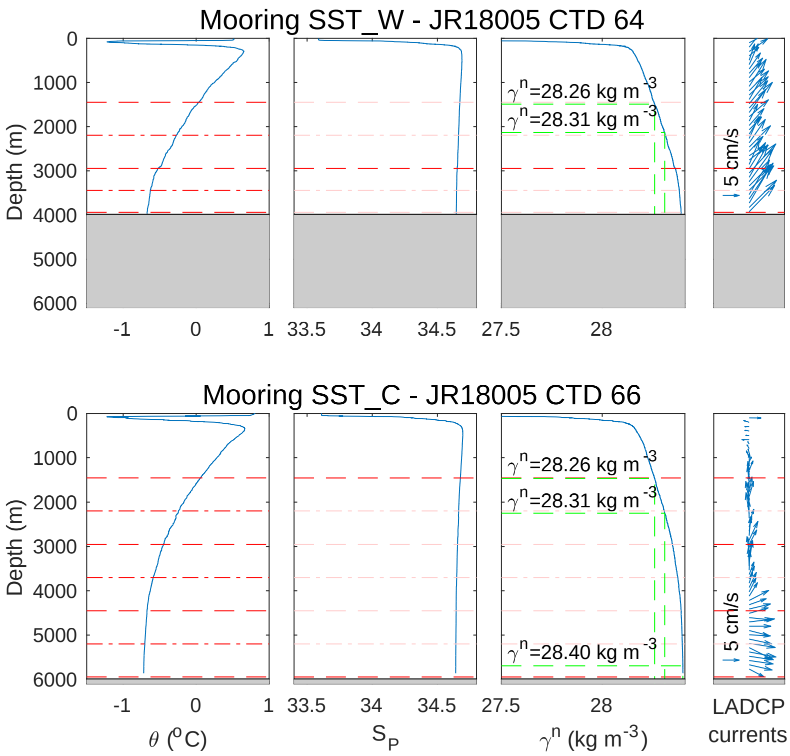

Figure 4. CTD and LADCP profiles from JR18005 at the mooring locations, with depths of instruments superimposed. The panels show potential temperature θ, practical salinity S_P, neutral density γ^n, and LADCP current vectors, respectively.

Mooring design

Because of questions about the availability of a mooring winch on the *S. A. Agulhas II*, the moorings were designed to be reasonably lightweight, capable of being deployed without the use of a winch. This proved very useful for deployment from AG, which is not set up to deploy mooring lines under tension. The main mooring ropes were 5-mm 12-strand single-braid Dyneema SK78 (Marlow Ropes D12 78), supplied in 1000- or 1500-m lengths, spliced with galvanised 6-mm EN13411 wire rope thimbles on each end, with a red whipping to mark the mid-point of each rope. Buoyancy consisted of Nautilus Vitrovex FS-6700-17 17-inch glass spheres in SR432 super ribbed plastic hardhats, mounted onto 10-mm Nautilus Eddyrope aramid ropes using the Nautilus Eddygrip swivel system. At the top of the moorings, buoys were mounted in groups of five spheres on 5-m ropes; above the releases, three spheres were mounted on 3-m ropes. Federal specification galvanised steel safety bolt shackles (Van Beest Green Pin BN series) were used to connect the mooring components: 7/16" shackles on the Dyneema ropes (and one 3-m Eddyrope, which somehow has smaller thimbles than the other ropes!), 5/8" shackles on the releases and anchor, one 3/4" shackle below the large ring for the tandem releases, and 1/2" shackles elsewhere. The tools required to open the shackles are pairs of 19-mm or 3/4" spanners for the 7/16" shackles, 24-mm spanners for the 1/2" shackles, and 30-mm (bolt) and 28-mm (nut) spanners for the 5/8" shackles – and suitably sturdy pliers and/or heavy-duty side cutters to remove the split pins from the bolts. Mooring elements were separated with galvanised pear-shaped links (Crosby G-341, 1/2" size between Dyneema ropes, 5/8" elsewhere) to allow stoppering during deployment or recovery. Above the uppermost Eddygrip buoyancy, a 15-m length of 12-mm three-strand polypropylene rope leads to a plastic mast mounted on McLane G6600/G8800 three- or four-sphere buoyancy packages, with a single Novatech ST-400A strobe beacon, with the “daylight off” function disabled to aid in location during recovery. A half-metre section of 12-mm long-link chain is used as a counterweight beneath the mast, to ensure that the mast stays upright.

At the bottom of each mooring, two Exail (formerly IxBlue / IxSea) AR861-B2S (“Oceano 2500 S Universal”) acoustic releases were mounted in tandem using Exail Tandem B2S hardware. Two of the releases, 564 and 565, originally built in 2006, were refurbished by the manufacturer last year, including replacement of the transducer; each of these releases was paired with a newer release, with longer since the last factory service. Instead of the manufacturer’s original release ring, a Crosby S-643 1-1/8"x6" weldless ring was used. These have been used successfully in Orkney Passage. The releases were fitted with alkaline batteries, giving an expected life of 4 years. A 1.5-m length of 12-mm long-link grade 30 galvanised chain was used above the tandem kit, a 2-m length used between the release links, and a 6-m length was used to connect the release ring to the mooring weight. On both moorings, 800-kg steel clump weights were used. These were supplied by Saxton Marine and consisted of 38-42mm stud link anchor chain, bundled together with 16mm long-link chain and a safety bolt shackle.

Seven Nortek Aquadopp DW current meters, seven Seabird Scientific SBE 37-SM “Microcat” temperature-conductivity-pressure recorders, three RBR RBRsolo^{3}T|deep temperature loggers, and two SBE 39 temperature loggers were allocated to the project. Four of the Microcats were newly purchased from Seabird Scientific and were shipped directly to Cape Town. Arrangements were made to ship these from Cape Town to Stanley by DHL airfreight, but, unfortunately, because of delays with export documentation for South Africa, the instruments were not delivered in time to reach the vessel, only reaching Santiago on the day of departure. Thus, only three Microcats were available. These Microcats and the two SBE 39s were serviced and calibrated at Seabird Scientific's facility in Germany in Jul/Aug 2023. The RBRsoloTs were manufactured and calibrated in Apr 2021, and were only deployed on a test cast on the CTD rosette on RRS *Discovery* cruise DY158 in Jan 2023. Here, they were found to over-read temperature by 1.5 mK (206993 & 206994) and 2.2 mK (206995) compared with the CTD temperature sensors, calibrated against a SBE 35 deep ocean standards thermometer. This is within specification for the sensors. All instruments were clamped onto the mooring rope, with electrical tape (RBRsolo clamps and Microcat lower cable guides) or 4x0.8 mm Tygon tubing (elsewhere) used for strain relief.

Specifications and sampling settings for all instruments are given in Table 2.

Table 2. Instrument specifications and settings.

	SBE 37-SM	SBE 39	RBRsolo³T	Aquadopp DW
Hardware version	2	-	Deep	Mid-life
Firmware version	3.0h	3.1b	1.063	3.44
Depth rating	7000 m	10,500 m	10,000 m	6000 m
T accuracy	0.002°C	0.002°C	0.002°C	0.1°C
T resolution	0.0001°C	0.0001°C	0.00005°C	0.01°C
T stability/year	0.0024°C	0.0024°C	0.002°C	unknown
P accuracy	0.1% FS	-	-	0.5% FS
P resolution	0.002% FS			0.005% FS
P stability/year	0.05% FS			unknown
C accuracy	0.0003 S/m	-	-	-
C resolution	0.00001 S/m			
C stability/year	0.0036 S/m			
V precision horizontal	-	-	-	0.9 cm/s
V precision vertical				1.4 cm/s
Sample interval	600 s	600 s	60 s	600 s
Averaging interval	-	-	-	60 s
Blanking distance	-	-	-	0.5 m
Compass update rate	-	-	-	2 s
Battery (all lithium)	12 SAFT LS14500 AA	1 Energizer LA-522 9V	1 SAFT LS14500 AA	1 Tadiran TLP-82121/C/NO3A
Battery endurance	>10 years	3 years	>10 years	470 days
Memory endurance	10 years	>10 years	>10 years	3 years / >10 years
Clamp tools	3/8" socket	3/16" Allen key	5 mm Allen key, large flat screwdriver	17mm (6263)/ 13mm (others) socket & spanner
Interface type	4-pin XSG	4-pin XSG	USB-C	8-pin MCBH (round)

Mooring operations

In the weeks leading up to deployment, batteries were installed in all instruments and releases, and the instruments were set up to start at midnight UTC on 15 Feb 2024. Clocks were synchronized to UTC from GPS sources, as internet time synchronisation was not available. The crew flaked the Dyneema mooring ropes into large plastic bait buckets, with half of each rope in each bucket, separated by the red whippings. 750 m of rope fit quite snugly into one bucket (see Figure 10). Floats were installed onto Eddyropes with Eddygrip brackets either in the hold or on deck, and on a calm day a few days before deployment the releases were brought onto the aft of the bridge deck and the tandem kits were assembled, along with the chains. These were lashed in place, as rough weather was expected before deployment.

Several discussions about how to deploy the moorings were had with the captain, 2nd mate, bosun, chief engineer, and deck crew of the vessel. The original plan was to deploy all top buoyancy, followed by the main mooring line, through the buoy shooting hatch in the starboard side of the line magazine room. Because of the limited deck space in this area, we discussed staging the main mooring lines on the conveyor belt that runs from the hauling area to the magazine room along the starboard side of the vessel. Because of the height of the coaming on the buoy hatch (about 1 m above the deck), we considered building a ramp or table to stage the Vitrovex floats, allowing them to be pushed off the stern, though eventually we concluded that the crew could lift them over the coaming individually. The mooring anchor would be lifted over the port quarter and secured to the bitts using strong sacrificial rope. The acoustic releases and lower buoyancy would be made fast to the railing on the transom, and then connected to the lower end of the main mooring line through the hatch. This would allow the upper part of the mooring to be deployed first. At the end of the line deployment, the releases would be freed from the railing, and finally the sacrificial line to the anchor would be cut.

However, on the morning of the deployment, the wire on the aft cargo elevator failed, making movement of the Vitrovex floats from the hold to the magazine room impossible. Instead, the floats were craned from the hold onto the bridge deck through the hatch above the elevator shaft, and placed onto the forecastle deck. The anchor and releases for the first mooring were also craned down to the forecastle deck and shackled together (see Figure 11). The Dyneema mooring ropes were then prepared at the buoy hatch in the line magazine room. Taking up only four buckets for SST_W, they fit easily in the area near the buoy hatch, along with the beacon mast (see Figure 12), so the conveyor belt was not used. The ropes were shackled together, instruments were clamped onto the rope, and the buckets were laid out in a semi-circle around the hatch, with the crew standing on the outside. Instruments were numbered in sequence of deployment with red marker pen. The bottom of the Dyneema rope was brought up to the forecastle deck via the buoy hatch, the end was shackled to the link above the lower Vitrovex floats, and the lowest current meter was attached. The ship was positioned 4 km upwind of the SST_W target position. After much discussion, the anchor was lifted overboard and secured with a large amount of polypropylene rope, along with the releases. At this stage, the upper buoyancy was connected to the mooring line, and lowered down by crane to the hatch, where the rope to the beacon mast was attached (see Figure 12). Deployment of the upper floats then started, and the mooring line streamed out without incident, with the instruments lifted up to the coaming and thrown overboard when required. After the last instrument had been deployed, with one bucket of rope remaining, I returned to the forecastle deck from the magazine room, to find that several of the lines to the release and anchor had been cut and were still attached to the links above and below the releases, forming a clear entanglement risk to the operation of the tandem kit, and potential marine pollution. The anchor was subsequently lifted to the level of the forecastle deck with the crane, allowing these ropes to be removed, before the anchor finally was released from the crane. The final drop position was very close to the target position.

For SST_C, the need to release the lower part of the mooring without any extra ropes attached was re-emphasized, and an alternative plan was formed, with all lines set to slip cleanly from the crane and bitts when required. Lines were set up in the magazine room, and instruments attached; with six buckets and a larger beacon mast, there was somewhat less space (this was improved once the mast had been deployed; see Figure 13). The upper Vitrovex floats were lowered down by crane and placed in the water before the final deployment of the anchor; the rope was subsequently stoppered off while the anchor and releases were deployed and attached to the bottom of the rope. Deployment of the top of the mooring was resumed (leaving a short length of stopper line attached to the Dyneema rope), and again the line and instruments were deployed without incident. Contrary to the initial plan, the releases were lowered down before the end of the last bucket was reached; this caused the releases to swing down and wrap themselves around the chain above the anchor, but luckily they were not entangled and cleared once the rope came under tension and pulled the releases astern. At this point, the anchor was still attached both to the bitts and to the crane. When the Dyneema rope finally reached the end, the rope on the crane was slackened and cut, and the crane lifted. However, the section of rope that fell tangled around the anchor chain. Subsequently, the crane was lifted again, raising the anchor by the single rope remaining. When this eventually slipped, the anchor fell, and the dynamic load on the rope attached to the bitts caused the rope to break where it was attached to the anchor. Thus, the anchor was deployed slightly prematurely and in a less than controlled manner. However, the vessel had reached very close to the target deployment position, nobody was injured when the rope parted, and no rope remained on the anchor – so all ended well.

Although both deployments were somewhat less smooth than desired, they still resulted in the successful deployment of both moorings near the target positions, and with no apparent damage to the mooring equipment. When the mooring anchor and releases for SST_W were lifted into the water from the forecastle deck, they struck and damaged a floodlight on the aft railing. In addition, the anchors and releases caused minor damage to the paintwork of the ship near the port quarter. The most problematic part of both deployments was the deployment of the anchors and releases. I had originally proposed to bring a Seacatch TR7 quick release, as is commonly used on research vessels when deploying moorings, to the vessel, but was told that this was not necessary. I still maintain that this would be a safer, more controlled, and less wasteful way to lift and release loads from the crane than using ropes – though the final release of the anchor is best done by sacrificial rope around the bitts, to avoid applying sudden changes in load to the crane. If this type of deployment is to be repeated on similar vessels, further thought should be given to handling and deployment of the anchors: the deployment of the upper part of the mooring was actually very smooth, and not entirely dissimilar to how the ends of the longlines are deployed from the vessel.

Mooring diagrams

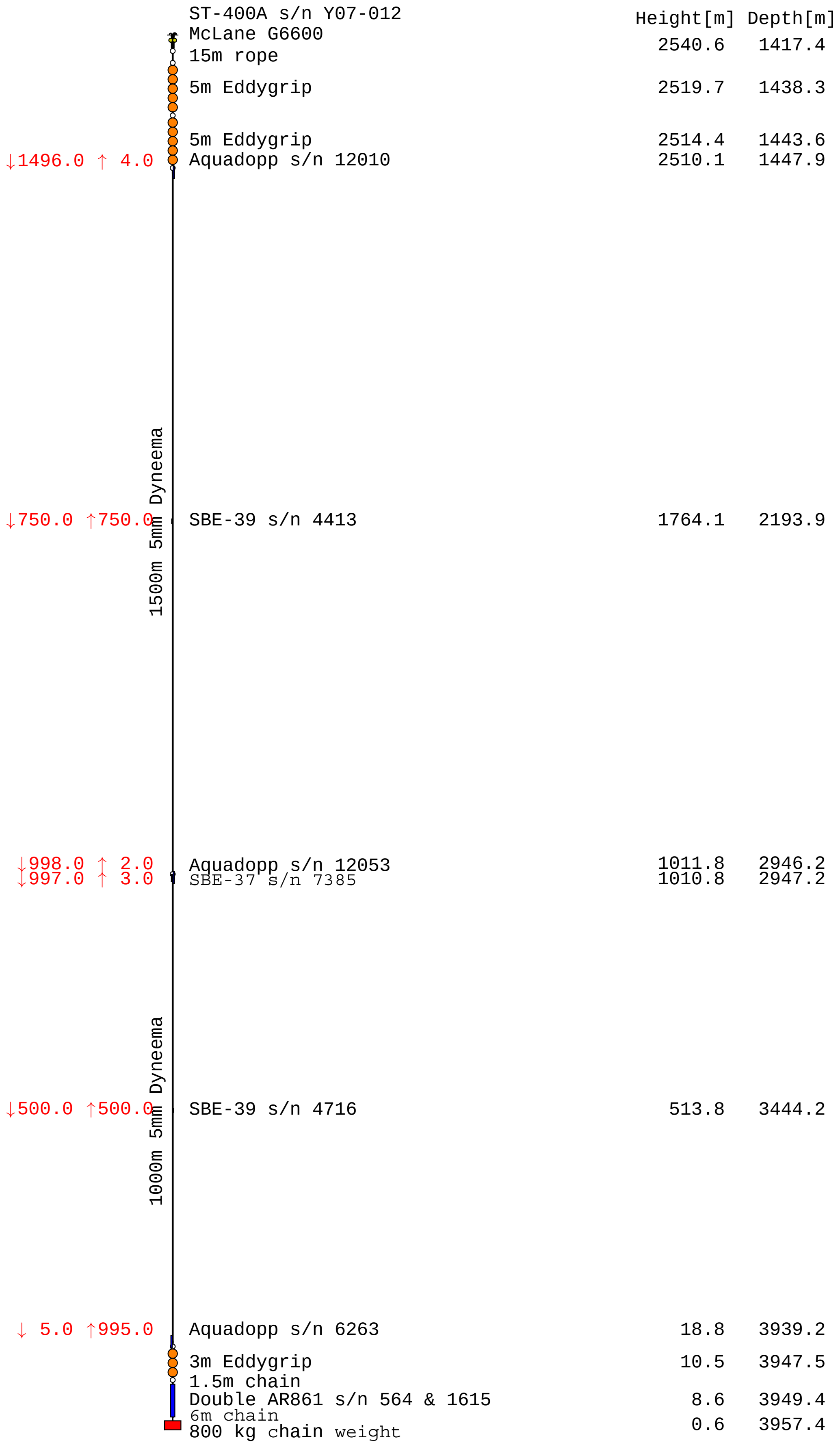

Figure 5. Mooring SST_W as deployed in 2024.

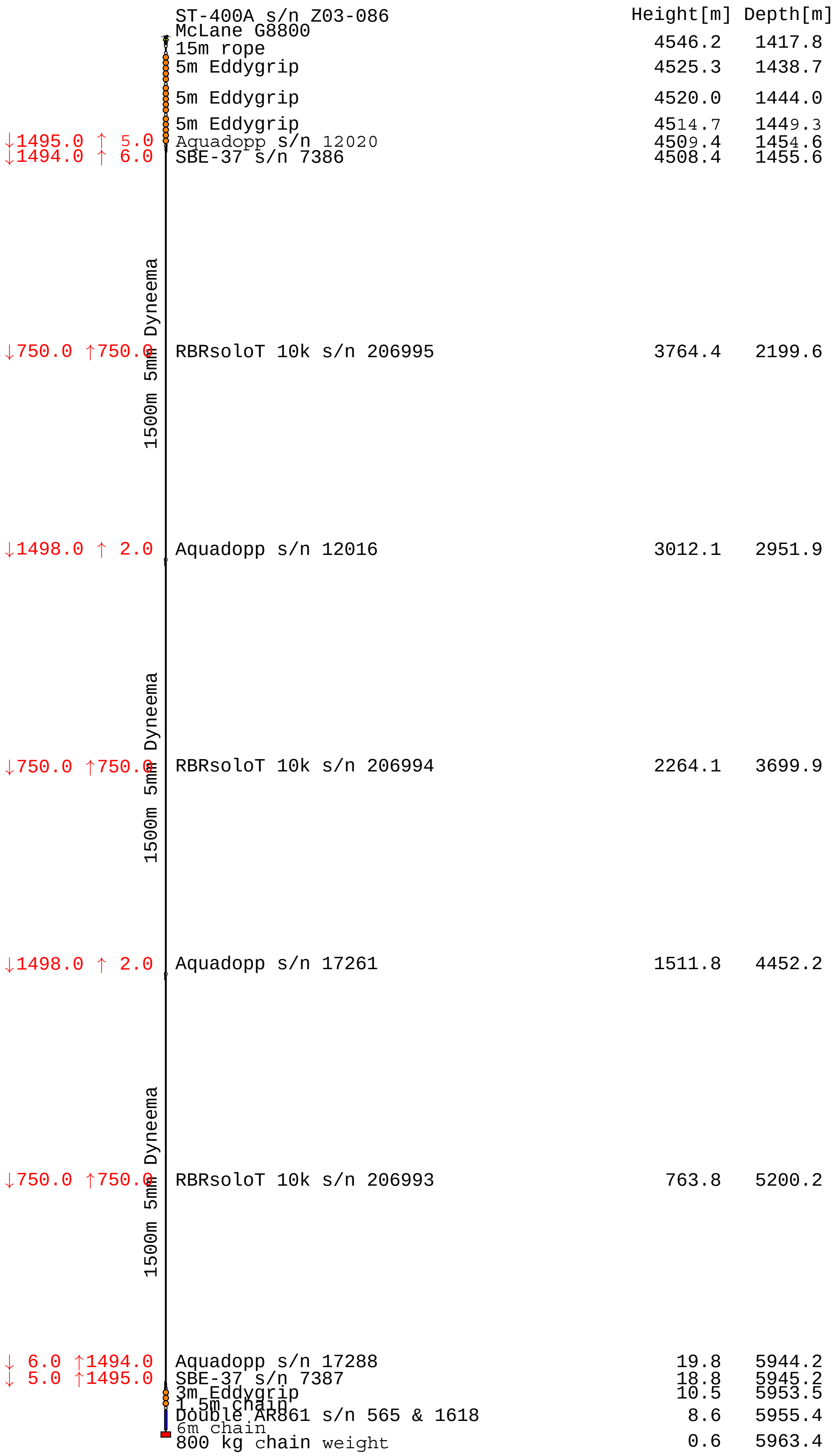

Figure 6. Mooring SST_C as deployed in 2024.

Mooring details

SST_W (2024-2025)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments	
2541	1417	Novatech ST-400A Y07-012 xenon flash beacon (daylight off disabled)				On triangular McLane top float; 15 m PP rope below	
2520	1438	Five orange Vitrovex floats on 5-m Eddygrip rope					
2514	1444	Five orange Vitrovex floats on 5-m Eddygrip rope					
2510	1448	Aquadopp 12010	U, V, W, T, P	10	15/02/2024 00:00:00	M8 (13mm) clamp	On 1500 m 5-mm Dyneema rope
1764	2194	SBE 39 4413	T	10	15/02/2024 00:00:00		
1012	2946	Aquadopp 12053	U, V, W, T, P	10	15/02/2024 00:00:00	M8 (13mm) clamp	On 1000 m 5-mm Dyneema rope
1011	2947	SBE 37-SM 7385	T, C, P	10	15/02/2024 00:00:00		
514	3444	SBE 39 4716	T	10	15/02/2024 00:00:00		
19	3939	Aquadopp 6263	U, V, W, T, P	10	15/02/2024 00:00:00	M10 (17mm) clamp	
11	3947	Three orange Vitrovex floats on 3-m Eddygrip rope					
9	3949	Releases: IxBlue AR861 564 & 1615				1.5 m chain above, 6 m chain below	

SST_C (2024-2025)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments	
4546	1418	Novatech ST-400A Z03-086 xenon flash beacon (daylight off disabled)				On square McLane top float; 15 m PP rope below	
4525	1439	Five orange Vitrovex floats on 5-m Eddygrip rope					
4520	1444	Five orange Vitrovex floats on 5-m Eddygrip rope					
4515	1449	Five orange Vitrovex floats on 5-m Eddygrip rope					
4509	1455	Aquadopp 12020	U, V, W, T, P	10	15/02/2024 00:00:00	M8 (13mm) clamp	On 1500 m 5-mm Dyneema rope
4508	1456	SBE 37-SM 7386	T, C, P	10	15/02/2024 00:00:00		
3764	2200	RBRsoloT 206995	T	1	15/02/2024 00:00:00		
3012	2952	Aquadopp 12016	U, V, W, T, P	10	15/02/2024 00:00:00	M8 (13mm) clamp	On 1500 m 5-mm Dyneema rope
2264	3700	RBRsoloT 206994	T	1	15/02/2024 00:00:00		
1512	4452	Aquadopp 17261	U, V, W, T, P	10	15/02/2024 00:00:00	M8 (13mm) clamp	On 1500 m 5-mm Dyneema rope
764	5200	RBRsoloT 206993	T	1	15/02/2024 00:00:00		
20	5944	Aquadopp 17288	U, V, W, T, P	10	15/02/2024 00:00:00	M8 (13mm) clamp	
19	5945	SBE 37-SM 7387	T, C, P	10	15/02/2024 00:00:00		
11	3947	Three orange Vitrovex floats on 3-m Eddygrip rope					
9	3949	Releases: IxBlue AR861 565 & 1618				1.5 m chain above, 6 m chain below	

Photographs of mooring deployment

Figure 7. Mooring equipment (and three pallets of food) about to be loaded onto FV *Argos Georgia* at FIPASS.

Figure 8. Mooring weights and Eddygrip with three floats on the bridge deck. Bristol Island in background.

Figure 9. Mooring equipment in rope store next to the line magazine room. Workshop used to work on instruments and releases on right.

Figure 10. Mooring ropes flaked into bait buckets in preparation for deployment.

Figure 11. Mooring weight being lifted from bridge deck to port quarter on forecastle deck.

Figure 12. Ends of mooring rope connected to top Eddygrips through the buoy hatch in the line magazine room, ready for deployment.

Figure 13. Deploying the mooring rope and instruments through the buoy hatch through the transom in the line magazine room.

Vessel particulars

FV *Argos Georgia* is a longline fishing vessel, built for polar conditions and operated by Argos Froyanes Limited, a British–Norwegian partnership with operations based in Stanley, Falkland Islands. Main particulars are included below for reference:

Vessel name: Argos Georgia
Home port: Jamestown, St. Helena
Callsign: ZHHJ
IMO number: 9812690
Official number: 708457
Build place: Tersan Shipyard, Turkey
Build year: 2018
Length: 53.85 m
Breadth: 13.0 m
Draught: 5.5 m
Gross tonnage (ITC69): 2004
Classification: DNV GL ✠ 1A Fishing Vessel E0 Ice(1C)

Main engine: Yanmar 6EY26W, 1920 kW
Aux. engine: Caterpillar C32, 994 kW
Fuel capacity: 503 m^3
Water capacity: 46 m^3
Accommodation: 28 persons in 20 cabins; 3 hospital berths
Fishing gear: Mustad Autoline system, 12 mm line, 3 T hauler
Echo sounders: Simrad ES80, 18 & 38 kHz sonars; JRC JLN-652 240-kHz Doppler current meter
Deck equipment: 2 Palfinger PKM250 cranes, 2 T @ 12 m SWL

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