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MRV *Scotia*

Survey 1322S

REPORT

29 September – 11 October 2022

Loading: Aberdeen, 26 September 2022
Unloading: Aberdeen, 11 October 2022

In setting the survey programme and specific objectives, etc. the Scientist-in-Charge needs to be aware of the restrictions on working hours and the need to build in adequate rest days and rest breaks as set out in Marine Scotland's Working Time Policy (Notice 34/03). In addition, the Scientist-in-Charge must formally review the risk assessments for the survey with staff on-board before work is commenced.

In the interest of efficient data management it is now mandatory to return the survey report, to I Gibb and the Survey Summary Report (old ROSCOP form) to M Geldart, within four weeks of a survey ending. In the case of the Survey Summary Report a nil return is required, if appropriate

Personnel

R O'Hara Murray (SIC until 5th Oct)
H Smith (SIC 5th – end)
A Gallego
B Rabe
M Bargus
M Kinghorn
R Parpucis

M Geldart did not participate

Out-turn days per project: 13 days ST05B

Gear

Sea-Bird CTDs (SBE 9, SBE25+), water filtering equipment, plankton nets, mooring equipment and dyneema rope, chemistry sampling equipment, weeHoloCam.

Objectives

1. Test the SBE911 and CTD carousel (main CTD crane) and take water samples in the Buchan deep on route to the Faroe-Shetland Channel (Priority 1). *The test position was changed to the Goldeneye oil field as it was on route to JONSIS. The CTD winch did not operate correctly, so the test was eventually abandoned.*

2. Perform hydrographic sampling along the long term monitoring Faroe-Shetland Channel Nolso – Flugga (NOL) section – priority stations will most likely be visited only (Priority 1). *Not attempted due to weather and time constraints and equipment failure.*

3. Perform hydrographic sampling along the long term monitoring Faroe-Shetland

Channel Fair Isle – Munken (FIM) section (Priority 1). *Achieved using SBE25+ and two Niskin bottles. Last station FIM11A abandoned due to weather.*

4. Pick-up Bill Ruck and ROVs from Ullapool and conduct ROV search and recovery for ADCP moorings in Little Minch and Linne Crowlin (Priority 1). *Partially achieved. The Linne Crowlin mooring was recovered using ROV. Currents were too strong at the Little Minch site for ROV.*

5. Recover and re-deploy steel frame ADCP mooring in the summer isles (Priority 1). Partially achieved. *The mooring frame was recovered but the acoustic release and AWAC were lost – the mooring was most likely trawled. The mooring was not re-deployed.*

6. Carry out CTD transect in Loch Ewe and collect water and zooplankton samples between the mouth of the loch and the metocean buoy position (Priority 1). *Achieved using SBE25+ and two Niskin bottles.*

7. Deploy the weeHoloCam at all Loch Ewe CTD transect stations. *Achieved.*

8. If time allows, carry out a grid of CTD stations in Loch Ewe (Priority 2). *Achieved.*

9. Take salinity, chlorophyll, and dissolved oxygen samples along all standard lines, heavily reduced sampling strategy. *Achieved using two water bottles on all stations we visited.*

10. Conduct CTD sections on the west coast, from the coastline up to the edge of the continental shelf (Priority 2, "Shelf" sections, prioritise shelf sections 2 and 4). *Not attempted due to weather and time constraints.*

11. Perform hydrographic sampling along the JONSIS long term monitoring section in the northern North Sea (Priority 1). *Achieved using SBE25+ and two Niskin bottles.*

12. Run the thermosalinograph throughout the survey. *Achieved.*

13. Run the VMADCP on all the standard sections. *Achieved.*

14. Take water samples for long term storage on Fair Isle – Munken or Nolso – Flugga section stations. *Not attempted.*

15. If weather/time permits, perform CTD deployments along the AlterECO line (offshore from Aberdeen) (Priority 2). *Partially achieved.*

16. If weather/time permits repeat the JONSIS line at the end of the cruise and extend to 001° 30' east (Priority 3). *Not attempted.*

17. If weather/time permits perform fine scale VMADCP/CTD survey work on the JONSIS line (around 59° 17' N, 001° 15' W) (Priority 3). *Not attempted.*

18. If weather/time permits, perform VMADCP/CTD survey work in the Moray Firth and/or Aberdeen Bay (Priority 3). *Not attempted.*

19. Install new FLNTU in the water sampling lab. *Achieved.*

20. Submit CTD data to Met Office at regular (6-8 hr) intervals and for early morning model runs (3 am deadline). *Achieved.*

Narrative

29 Sep:
Scotia sailed at 08:00 and, with a poor forecast, made way to the Golden Eye station with a view of then attempting the JONSIS CTD section before heading to the west coast. The CTD test failed, as the CTD winch was extremely fast/jerky on the way up. Getting the CTD back on board was not easy. The ships engineers were not able to identify the problem and worked through the night dismantling the winches hydraulic system. This disabled all ships hydraulics. With the poor forecast and lost time, Scotia headed to North Sound of Orkney to Shelter whilst the engineers worked on the winch.

30 Sep:
Scotia arrived North Sound of Orkney around 06:00 and occupied the following position enabling us to gather VM-ADCP data: 59° 18.7' N, 002° 44.6' W. The wind picked up during the day and then eventually started to drop. Scotia then made way to the ADCP mooring positon in the Summer Isles.
The CTD wire was removed from the carousel in anticipation of a test of the winch, with weight on the end of the wire, the the following morning.

1 Oct:
Scotia arrived in the Summer Isles around 07:00 and we attempted to recover the steel frame housing the AWAC current profiling device. The Edgetech acoustic release (AR) and pop-up buoy surfaced and Scotia approached the buoy a number of times. The buoy repeatedly went under the hull before it could be grappled, and could have snagged on something on the hull. Eventually it was close enough to grapple and was brought aboard. The recovery dyneema was then passed to the aft and taken through a block on the cod end crane to the upper net drums. The frame was then recovered easily, but unfortunately the AWAC and half the gimbal were missing. The terminals from the external battery pack were not corroded at all and we hypothesised that the AWAC had remained attached to the batteries until the frame was recovered, and then fell loose during recovery. The frame showed clear signs of being trawled. Unfortunately the AR was also lost. It was attached to the pop-up buoy when it first surfaced but must have fell out when it went under the boat. This could be preventable in the future by attaching it to the buoy more securely. We recommend adding a small line and bub to the top of the AR and pinching the line in with the pickup line when closing the buoy. The bub would prevent the AR from sliding through the buoy if it comes loose during recovery and may help with the recovery of the buoy too.

The main CTD winch was tested with a weight attached and run in and out a number of times. The theory was that nylon threads within the winches hydraulic system had expanded and ultimately need to be planed down. The engineers were hopeful that by running it in and out a number of times the friction would gradually lessen making the winch operational. This worked, but unfortunately a defect/damage to the wire was discovered just above the nodger/clamp holding the CTD carousel and we decided that a re-termination was needed.

We then sailed to Loch Ewe and started the inner CTD grid using the SBE25+ CTD, hydro 2 wire, and the plankton crane. Around 20:00 we moved to the Loch Ewe transect and did this overnight, using two Niskin bottled attached to hydro 2 wire for top and bottom water samples. The Bongo Nets and weeHoloCam were also deployed on hydro 2 at each station.

2 Oct:
The Loch Ewe transect and grid were completed, and we started a new CTD line taking Scotia into Loch Broom. Scotia arrived in Ullapool at 20:00 to pick up Bill Ruck with ROV equipment and Helen Smith. Departing around 21:30, Scotia made way to the west of Sky

ADCP mooring Location (MIN2110).

3 Oct:
We expected slack water to be around 07:00 – 08:00. The ROV was lowered over the side from the hanger with the tether/umbilical trough a block on the plankton crane. Ideally a larger block would have been used, to reduce the turning angle on the umbilical. The crew and scientists handled the umbilical with care to ensure there were no tight turns. The ROV also had an approx. 6 mm dyneema line attached to the pickup hook held on an arm.

The ROV had a sonar attached, allowing Bill to scan around the seabed for objects. The visibility was poor as it was both dark and every time the ROV moved close to the seabed fine silt/mud was entrained. Many rocks and creel pots were identified, but the AL-200 mooring frame was not located. It became hard for the ROV to manoeuvre in the currents and we also had no idea where exactly the ROV was relative to Scotia (due to currents taking the tether away from the ship etc.)

With the wind forecast to increase, Scotia then made way to the Inner Sound (Linne Crowlin) mooring location (CRO2110). Slack water was predicted to be around 16:00-17:00 and we attempted a few ROV deployments whilst the current remained small. We eventually located the AL-200 with the help of the ROV sonar, but were unable to attach the pickup hook/carabineer. We had most success by moving the ship to the expected location of the AL-200 and then deploying the ROV. As the tide was small, we did not try to estimate the impact of the tide on the tether etc.

4 Oct:
We re-started the ROV recovery work around 04:30-05:00. This time we turned the hook around so that the gate was facing upwards slightly. This way the ROV would have to move forward and up to hook on to the lifting point. The ROV initially had some issues (powered down whilst in water), but after checking the thruster connections, cleaning and applying some silicone grease it worked ok. We located the ADPC frame using sonar (with the same large signature on the sonar as the previous night) and got the hook attached.
Scotia then made way to the remaining mooring location in the Little Minch. We attempted recovery around 13:30 and again around 23:00, but were unable to find the AL-200 moorings. During these attempts, we had some difficulty with the ROV communications and had to recover and re-deploy a few times. We eventually switched to using the backup ROV, which worked OK.

5 Oct:
We had a final recovery attempt around 04:30 with the second ROV. Ultimately, we were defeated by the unusual tides, which were hard to predict exactly. When the tide was slack at the surface it appeared to be running further down the water column. This meant that the ROV tether and dyneema experienced a lot of drag and was often at an angle to the ship. We could not therefor say with any confidence where the ROV was with respect to the ship.
Scotia made way around 06:30 to Rum to attempt recovery of the SAMS Tiree databuoy mooring which had gone adrift the day before. Scotia arrived around 10:30 and the mooring was successfully recovered using the gamma frame at the aft of the ship. A length of wire needed to be slung around the buoy to pull the mooring line aboard first. This way the buoy could be detached from the mooring, allowing it to be more easily maneuverer on board. The crew found it challenging to pick up the buoy as it appeared to be strongly made fast to something on the seabed. At some point during the recovery it came loose allowing the databuoy, mooring chain and subsurface SBE microcat to be recovered.
Scotia then made way to Loch Broom as we needed to drop off Bill Ruck the following morning in Ullapool.
By this time the chief engineer had re-terminated the CTD wire and we used the SBE911 carousel on the Loch Broom CTD line. The 911 appeared to be working well.

6 Oct:
Scotia arrived in Ullapool shortly after 08:00 to drop Bill Ruck off and offload his ROV equipment. Scotia was away by 10:00 and headed for the east end of the JONSIS section, a steam of over 20 hours, this gave the crew and scientists a chance to rest before the next period of work.

7 Oct:
JONSIS section began at 05:30 using the 911+ but part way up the first cast, the comms failed. Connections were checked on the CTD, cables were changed on the rosette and the deck box was swapped out for an old one. The next station was sampled using the SBE25+ on the hydro wire because the AFM did not communicate with the SBE25+ and the rosette. Cables were changed and a different AFM was tried, but no communication through the software SeatermV2AF was forthcoming. We tried one more station with the 911+ set up but again, communications failed on the up cast. Having tried all the avenues for fixing the issue we could think of, we had to use the SBE25+ with two Niskin bottles for the rest of 1322S. JONSIS took 18 hours instead of the standard 12 hours, due to troubleshooting and CTD deployment. Finished JONSIS just before midnight and headed for FIM. Due to the weather forecast for the Faeroe-Shetland Channel, and the time left for 1322S we decided to only attempt one line, FIM being the priority line.

8 Oct:
Arrived at FIM-01 in the early hours ~05:00 and started the line. The worsening weather and method of CTD deployment using hydro 2 and attaching Niskin bottles to the wire made progress slower than usual. However, we made steady progress and kept going along the line. The strong wind and tides meant that the angle of the hydro wire was often quite steep, which made attaching the Niskin bottles awkward.

9 Oct:
Last station on FIM was abandoned before breakfast due to the earlier arrival of bad weather and we turned around to head for home and to do some AlterECO stations if time allowed. Most of the day was spent steaming south-east, 30 hour steam to AlterECO.

10 Oct:
Containers were tidied and cages in the hangar deck were packed where possible in the afternoon once motion had stabilised. Scotia arrived at the Stonehaven end of AlterECO at 15:15 and we managed to sample three stations before the captain called for an end of scientific work and we headed for the Fairway buoy.

11 Oct:
Unloading and tidying of containers, some confusion over cages and unloading priorities.

Scientific Procedures

Whilst the initial difficulties with the CTD winch were overcome, and the CTD wire was then re-terminated by the chief engineer, we ultimately abandoned the use of the CTD crane and winch. We resorted to using our backup hydrographic sampling equipment on hydro 2 wire and the plankton crane. It was clear that troubleshooting was limited without the help of M Geldart (MG) who has good knowledge of the workings of the CTDs and connectors. Unfortunately we could not contact MG because he was signed off sick for the entirety of the cruise. This highlights the need for succession planning and detailed knowledge exchange for future hydro cruises.
The two moorings and the data buoy were recovered at the aft using a block on the cod end crane and the main (upper) net drums. Plankton net samples and weeHoloCam deployments were carried out using the plankton crane and hydro 2 wire.

Normal contacts were maintained with the laboratory.

Submitted:

Rory O'Hara Murray & Helen Smith

Date: 18/10/2022

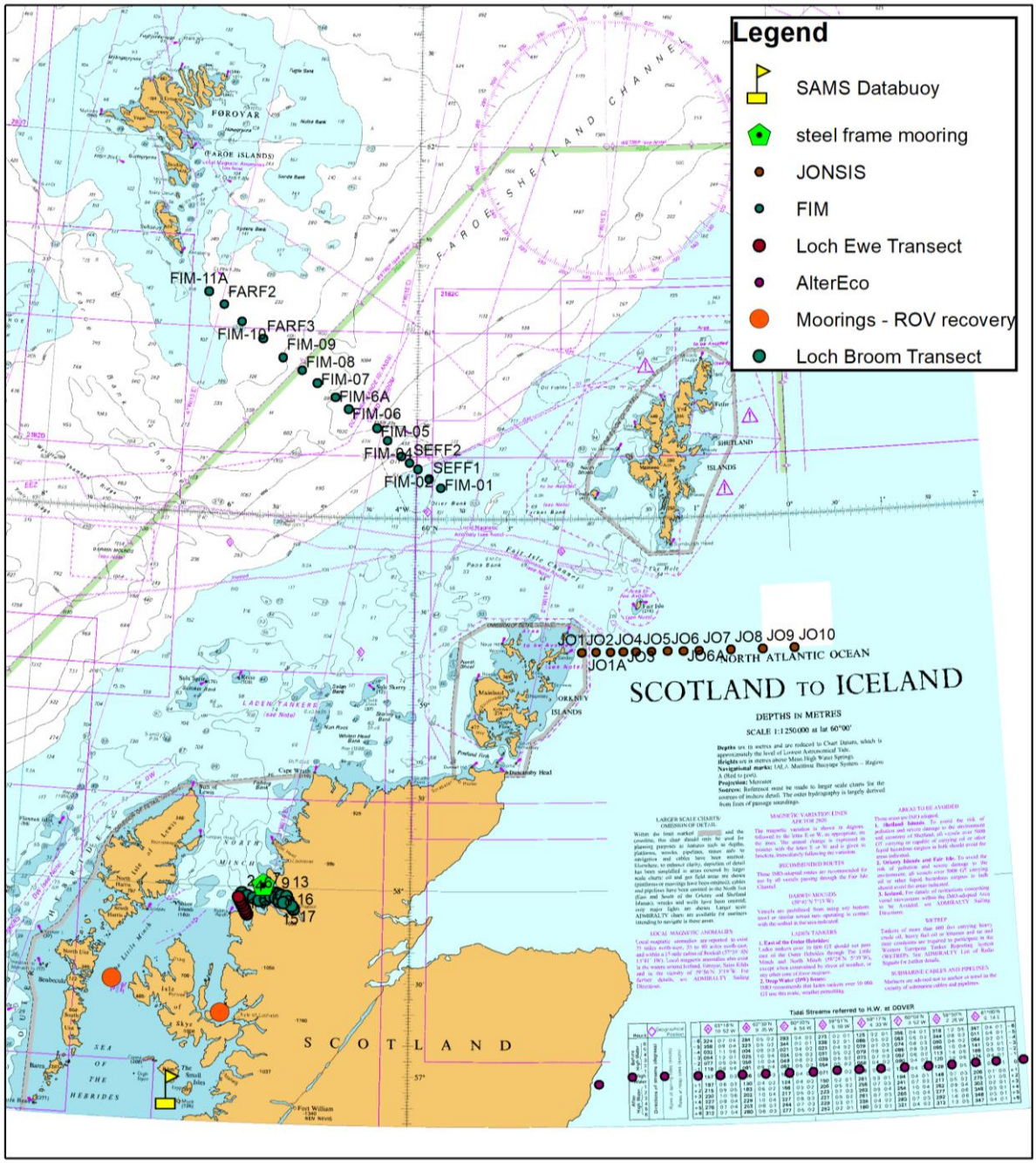


Chart showing key activities on 1322S

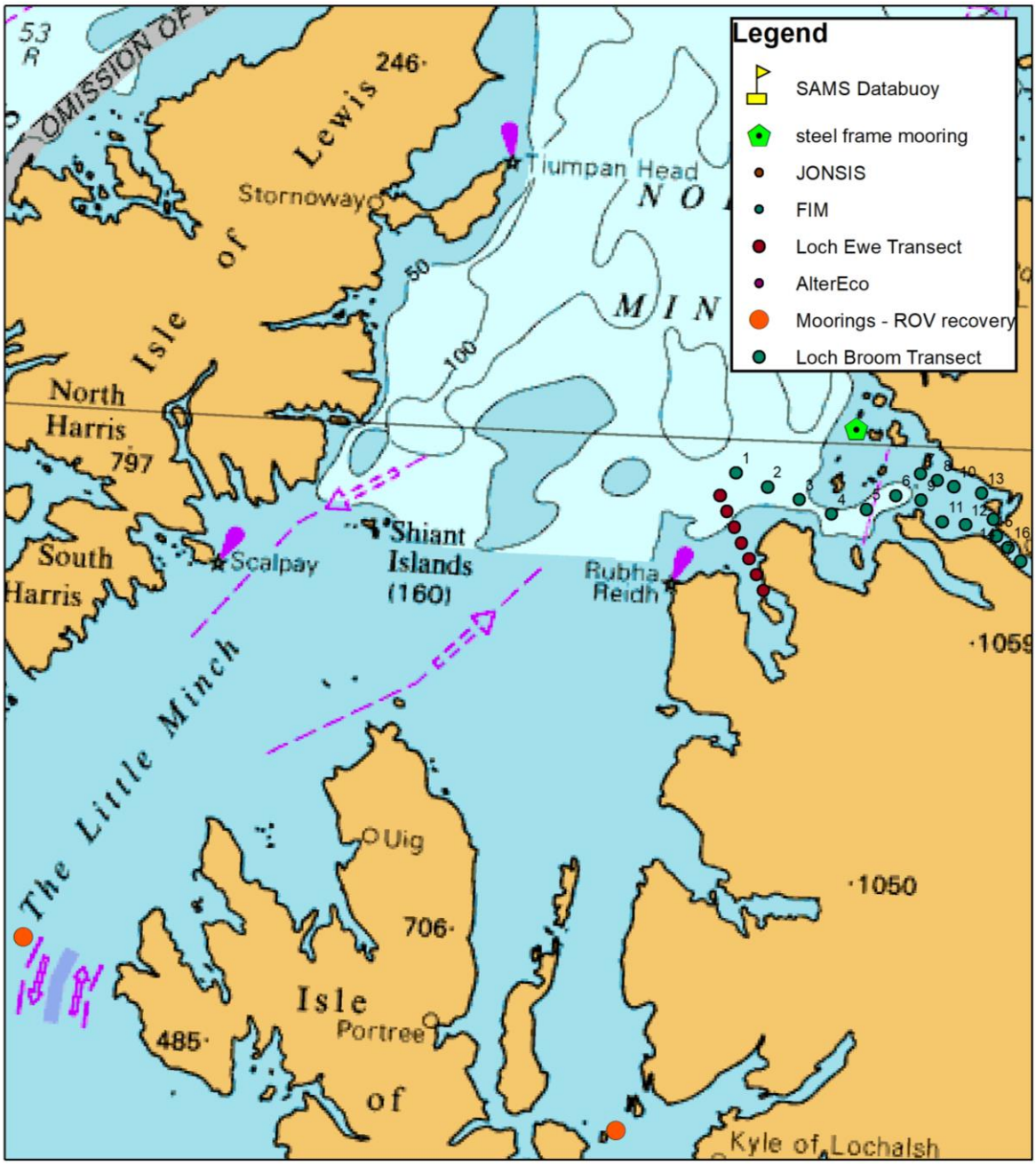


Chart showing the west coast activities, including the Loch Ewe and Loch Broom CTD transects

JONSIS

#	Name	Latitude	Longitude	Depth	Spacing
01	JO 1	59° 17.00' N	02° 14.00' W	75 m	
02	JO 1A	59° 17.00' N	02° 5.00' W	90 m	4.59 nm
03	JO 2	59° 17.00' N	01° 56.00' W	100 m	4.59 nm
04	JO 3	59° 17.00' N	01° 48.00' W	80 m	4.08 nm
05	JO 4	59° 17.00' N	01° 40.00' W	90 m	4.08 nm
06	JO 5	59° 17.00' N	01° 30.00' W	95 m	5.10 nm
07	JO 6	59° 17.00' N	01° 20.00' W	110 m	5.10 nm
08	JO 6A	59° 17.00' N	01° 10.00' W	120 m	5.10 nm
09	JO 7	59° 17.00' N	01° 0.00' W	125 m	5.10 nm
10	JO 8	59° 17.00' N	00° 40.00' W	120 m	10.20 nm
11	JO 9	59° 17.00' N	00° 20.00' W	140 m	10.20 nm
12	JO10	59° 17.00' N	00° 0.00' W	135 m	10.20 nm
			Totals	1180 m	68.36 nm

Fair Isle - Munken (FIM)

#	Name	Latitude	Longitude	Depth	Spacing
01	FIM-01	60° 10.00' N	03° 44.00' W	150 m	
02	SEFF1	60° 13.00' N	03° 51.50' W	170 m	4.74 nm
03	FIM-02	60° 16.00' N	03° 59.00' W	200 m	4.84 nm
04	SEFF2	60° 18.00' N	04° 04.50' W	330 m	3.36 nm
** 05*	*FIM-03*	*60° 20.00' N*	*04° 10.00' W*	*390 m*	*3.03 nm*
06	FIM-04	60° 25.00' N	04° 19.00' W	655 m	6.88 nm
07	FIM-05	60° 29.00' N	04° 26.00' W	995 m	5.45 nm
08	FIM-06	60° 35.00' N	04° 45.00' W	1090 m	11.15 nm
09	FIM-6a	60° 38.00' N	04° 54.00' W	1030 m	5.33 nm
10	FIM-07	60° 43.00' N	05° 06.00' W	915 m	7.70 nm
11	FIM-08	60° 47.00' N	05° 16.00' W	830 m	6.34 nm
12	FIM-09	60° 51.00' N	05° 29.00' W	600 m	7.36 nm
13	FARF3	60° 56.70' N	05° 42.80' W	333 m	8.90 nm
14	FIM-10	61° 02.00' N	05° 57.00' W	280 m	8.68 nm
15	FARF2	61° 07.20' N	06° 09.40' W	250 m	7.95 nm
16	FIM-11A	61° 11.30' N	06° 20.00' W	242 m	7.0 nm
			Totals	8,558 m	108.18 nm

AlterEco

#	Name	Latitude	Longitude	Depth [m]	Spacing
01	AlterEco1	57° 00.00' N	02° 04.00' E	92	
02	AlterEco2	57° 00.00' N	01° 48.00' E	94	8.72 nm
03	AlterEco3	57° 00.00' N	01° 36.00' E	99	6.54 nm
04	AlterEco4	57° 00.00' N	01° 22.00' E	104	7.63 nm
05	AlterEco5	57° 00.00' N	01° 08.00' E	85	7.63 nm
06	AlterEco6	57° 00.00' N	00° 54.00' E	102	7.61 nm
07	AlterEco7	57° 00.00' N	00° 40.00' E	92	7.61 nm
08	AlterEco8	57° 00.00' N	00° 27.00' E	89	7.09 nm
09	AlterEco9	57° 00.00' N	00° 14.00' E	84	7.09 nm
10	AlterEco10	57° 00.00' N	00° 00.00' E	83	7.61 nm
11	AlterEco11	57° 00.00' N	00° 14.00' W	79	7.61 nm
12	AlterEco12	57° 00.00' N	00° 28.00' W	82	7.63 nm
13	AlterEco13	57° 00.00' N	00° 42.00' W	68	7.63 nm
14	AlterEco14	57° 00.00' N	00° 55.00' W	75	7.07 nm
15	AlterEco15	57° 00.00' N	01° 08.00' W	67	7.07 nm
16	AlterEco16	57° 00.00' N	01° 28.00' W	68	10.91 nm
17	AlterEco17	57° 00.00' N	01° 47.00' W	98	10.56 nm
18	*AlterEco18*	*56° 57.80' N*	*02° 06.80' W*	*47*	*10.78 nm*
			Totals	1508 m	136.83 nm

Loch Ewe Transect

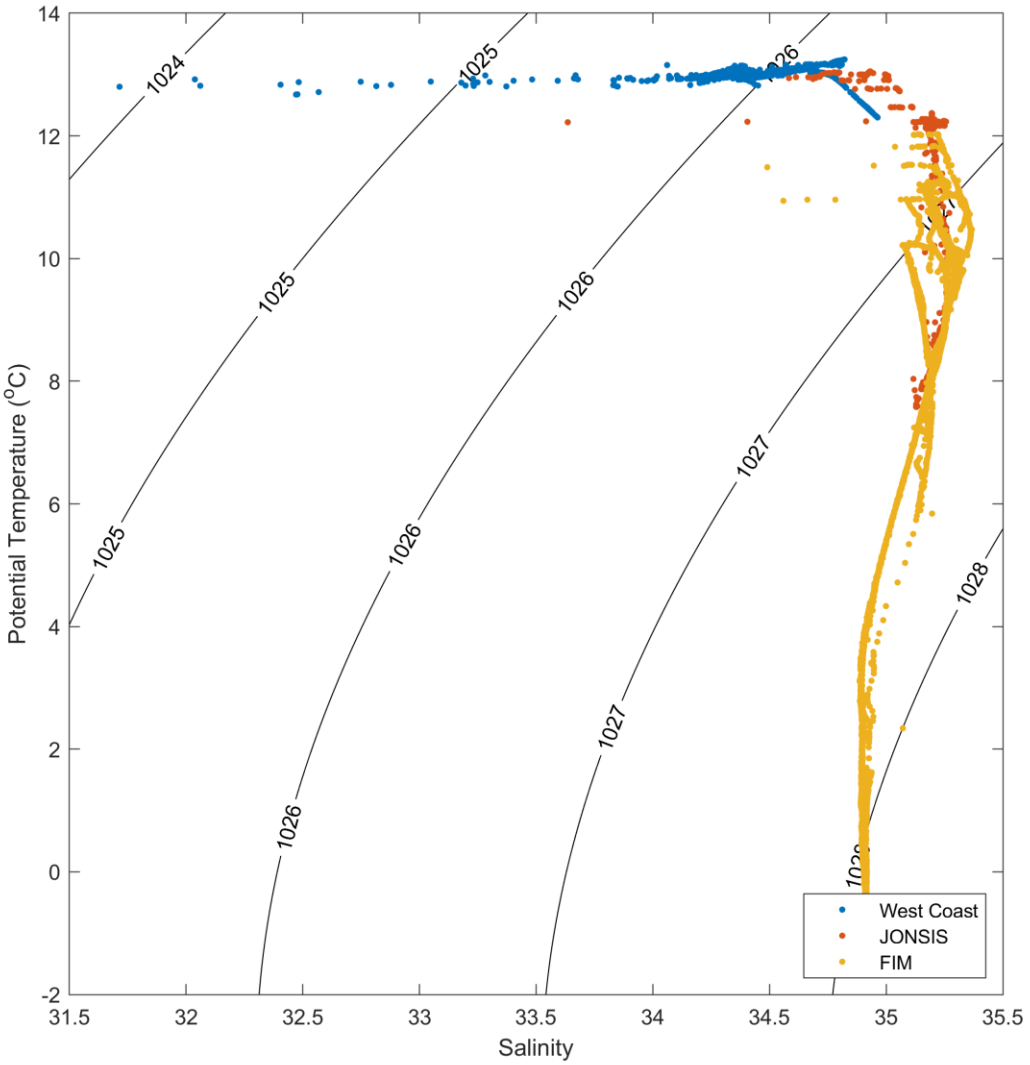
stn	lat		lon			Depth	distance
0	57	50.982	5	39.010	W	46	
1	57	52.104	5	39.674	W	32	1
2	57	53.061	5	40.245	W	37	1
3	57	53.977	5	41.118	W	55	1
4	57	54.893	5	41.992	W	62	1
5	57	55.810	5	42.865	W	82	1
6	57	56.726	5	43.739	W	104	1
7	57	57.642	5	44.612	W	95	1
8	57	58.559	5	45.486	W	123	1
						640	**8**

Loch Ewe CTD grid

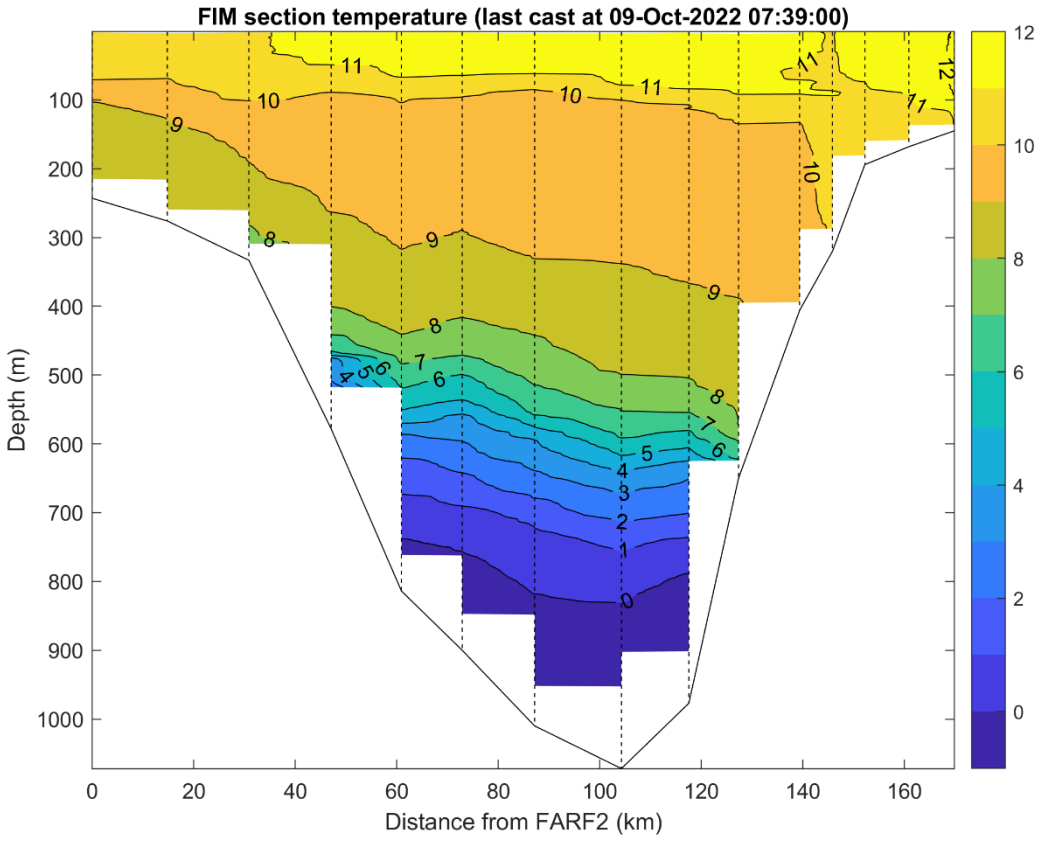
#	Name	Latitude			Longitude			Depth
1	LE grid-01	57	50.68	N	05	36.77	W	18 m
2	LE grid-02	57	51.00	N	05	37.48	W	26 m
3	LE grid-03	57	50.87	N	05	38.79	W	42 m
4	LE grid-04	57	51.05	N	05	39.65	W	45 m
5	LE grid-05	57	50.71	N	05	39.81	W	37 m
6	LE grid-06	57	50.43	N	05	39.26	W	47 m
7	LE grid-07	57	49.76	N	05	38.79	W	45 m
8	LE grid-08	57	49.13	N	05	38.64	W	54 m
9	LE grid-09	57	48.56	N	05	38.43	W	31 m
10	LE grid-10	57	47.78	N	05	38.35	W	45 m
11	LE grid-11	57	47.38	N	05	38.82	W	29m
12	LE grid-12	57	47.75	N	05	37.63	W	42 m
13	LE grid-13	57	47.98	N	05	36.89	W	50 m
14	LE grid-14	57	48.14	N	05	36.26	W	45 m
15	LE grid-15	57	48.6	N	05	36.32	W	42 m
16	LE grid-16	57	48.53	N	05	37.33	W	63 m
17	LE grid-17	57	49.09	N	05	37.97	W	35 m
18	LE grid-18	57	49.07	N	05	35.50	W	

Loch Broom CTD Transect

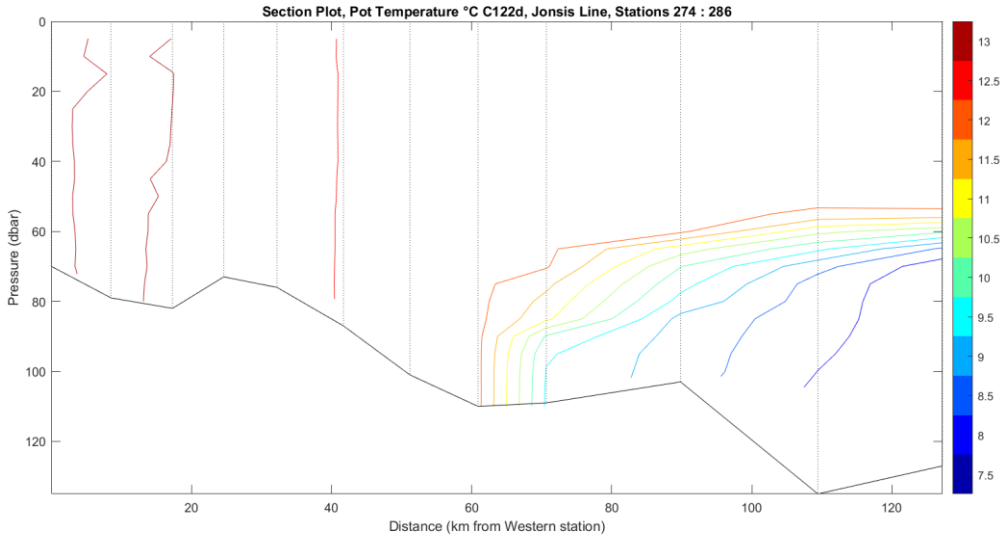
#	Name	Longitude			Latitude		
1	LB01	005	42.055	W	57	58.075	N
2	LB02	005	38.521	W	57	57.325	N
3	LB03	005	34.951	W	57	56.640	N
4	LB04	005	`	W	57	55.869	N
5	LB05	005	27.525	W	57	56.227	N
6	LB06	005	24.292	W	57	57.084	N
7	LB07	005	21.680	W	57	58.406	N
8	LB08	005	19.785	W	57	58.058	N
9	LB09	005	21.519	W	57	56.877	N
10	LB10	005	17.948	W	57	57.735	N
11	LB11	005	19.102	W	57	55.644	N
12	LB12	005	16.549	W	57	55.522	N
13	LB13	005	14.864	W	57	57.407	N
14	LB14	005	13.479	W	57	55.908	N
15	LB15	005	13.110	W	57	54.920	N
16	LB16	005	11.770	W	57	54.279	N
17	LB17	005	10.328	W	57	53.483	N



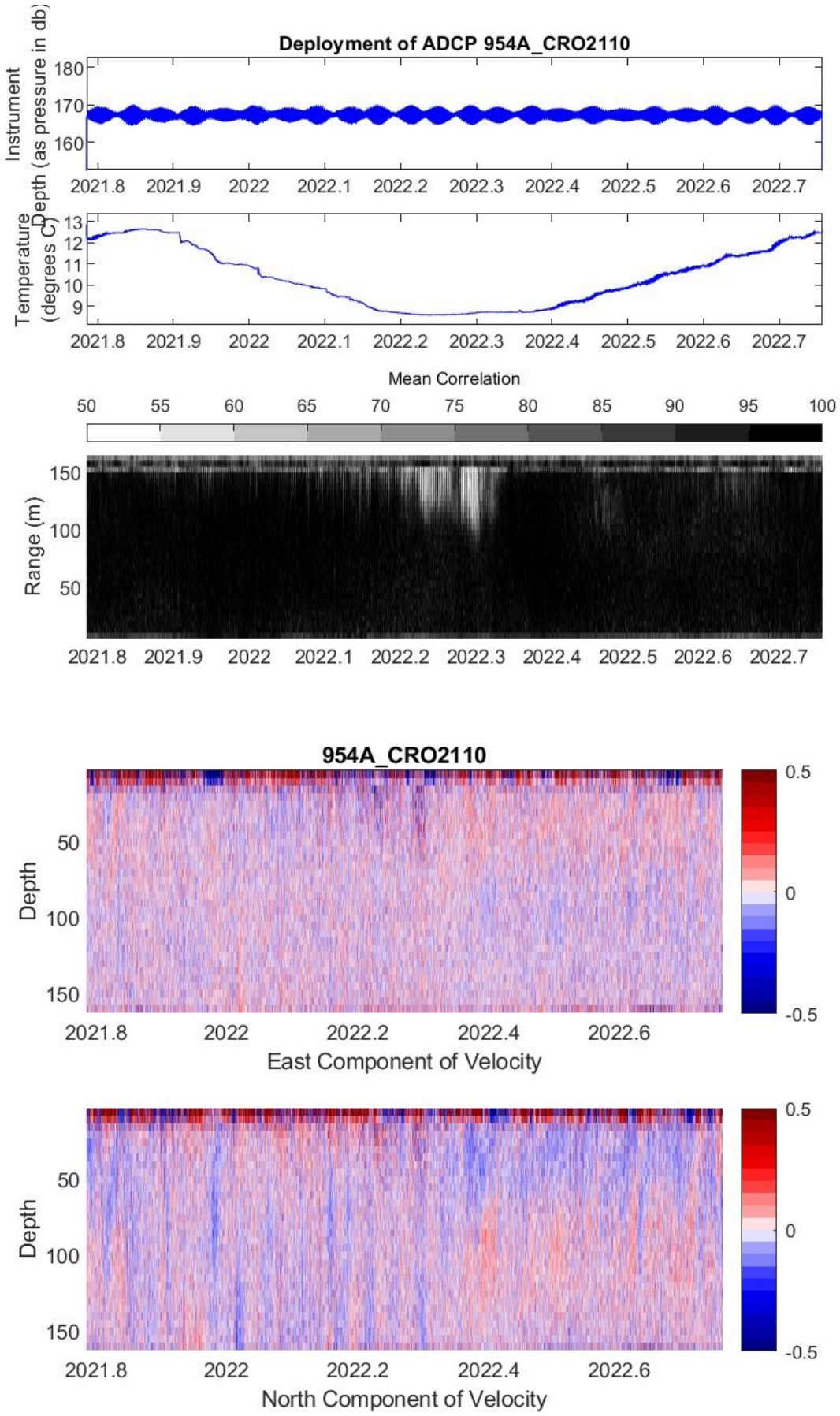
TS diagram for most of the CTD data from 1322S cruise. Some of the west coast and the AlterEco data are not included.



FIM temperature Section



JONSIS potential temperature section



CRO2110 Signature 250 rough data plots