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NATURAL ENVIRONMENT RESEARCH COUNCIL

Report of Survey: Scottish Natural Heritage 2013-3. Loch Alsh, Loch Duich, Long Long, Kyle Rhea

Marine Geoscience Programme

Open Report CR/13/033



BRITISH GEOLOGICAL SURVEY

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Foreword

Marine Scotland (MS) (including Scottish Natural Heritage) and the British Geological Survey (BGS) have entered into a collaborative Memorandum of Understanding (MoU) that forms the basis for collaborative surveys of Scotland's seas in order to further our understanding of Scotland's marine environment, increase the efficiency of use of public resources, enhance the safety of those at sea and contribute to new policy priorities such as marine protected areas, wider conservation measures, marine planning and renewables.

This report details a multibeam survey undertaken in Loch Alsh, Loch Duich, Loch Long and Kyle Rhea by the British Geological Survey (BGS) on behalf of Scottish Natural Heritage (SNH). The BGS survey vessel *White Ribbon* was used to conduct the survey, from 4th March to the 17th of March 2013, which incorporated 14 days of full survey with 2 days for mobilisation/de-mobilisation.

The BGS staff onboard the White Ribbon were hydrographic surveyor Meredith Scanlon and skipper Neil Campbell. Rhys Cooper acted as senior surveyor and project manager.

Acknowledgements

In addition to the BGS staff acknowledged in the Foreword, BGS would like to thank the Harbour Master, Mr Robert Thomson and staff at Kyle of Lochalsh harbour for help and advice during the progress of the survey.

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1 Introduction

1.1 SUMMARY

Vessel:	BGS *White Ribbon*
Duration:	14 days
Dates:	4-17th March 2013
Total area surveyed:	32km^2 (Figure 1)
Depth Range:	2.6m ~ 130m
Staff:	Rhys Cooper, Meredith Scanlon, Neil Campbell

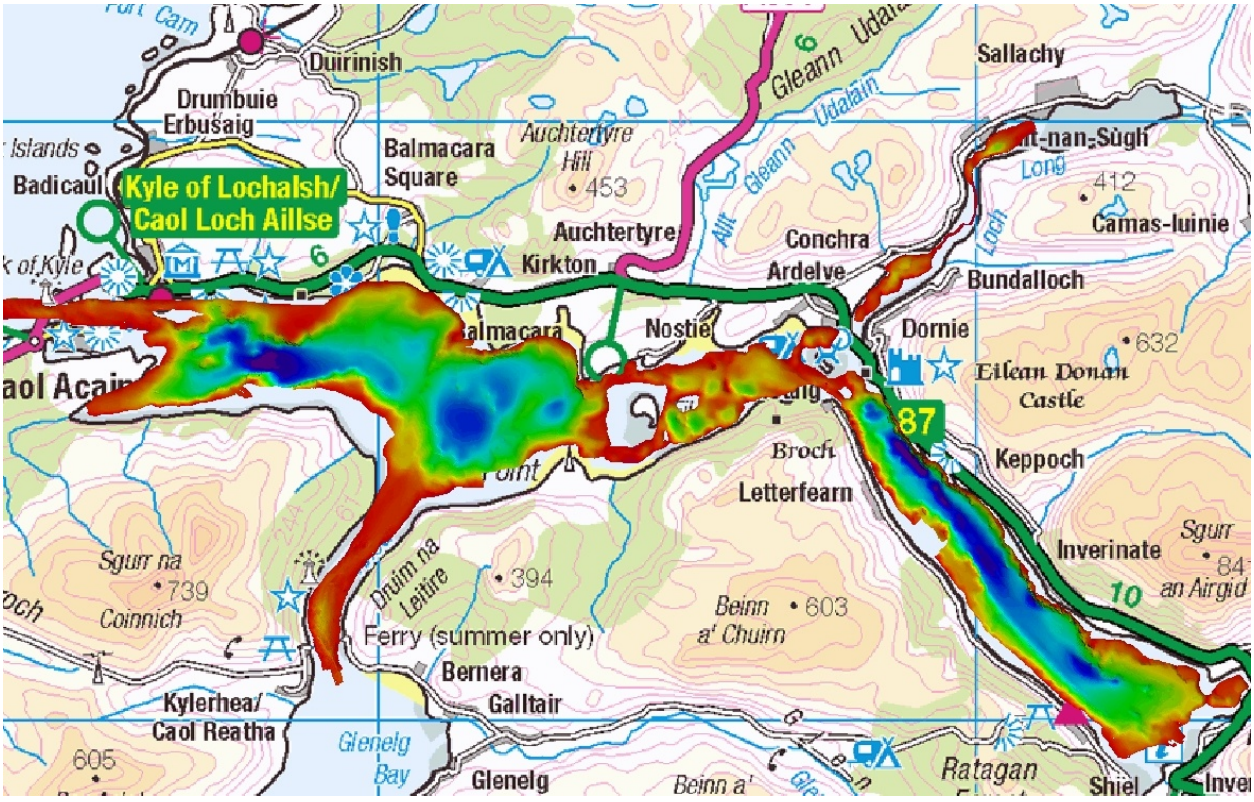


Figure 1 Area of BGS multibeam survey 2013_3

Under the terms and conditions of the MoU between the Scottish Ministers and the Natural Environment Research Council (NERC), Scottish Natural Heritage (SNH) commissioned the British Geological Survey to undertake a programme of multibeam echosounder data acquisition and interpretation within the MPA (Marine Protected Area) proposal area of the Lochs Duich, Long and Alsh and the additional area of the Kyle of Rhea.

The survey commenced on the 4th March 2013 and continued for 14 days until the maximum possible data acquisition was achieved. With limited time and an unfavourable weather forecast it was essential to work as quickly as possible to maximise data coverage. A priority order of survey sites was provided by Scottish Natural Heritage (Figure 2).

1) The area of burrowed mud within Loch Alsh
2) The area of flame-shell and horse-mussel beds within Loch Alsh
3) Loch Long
4) Loch Duich
5) Kyle of Rhea.

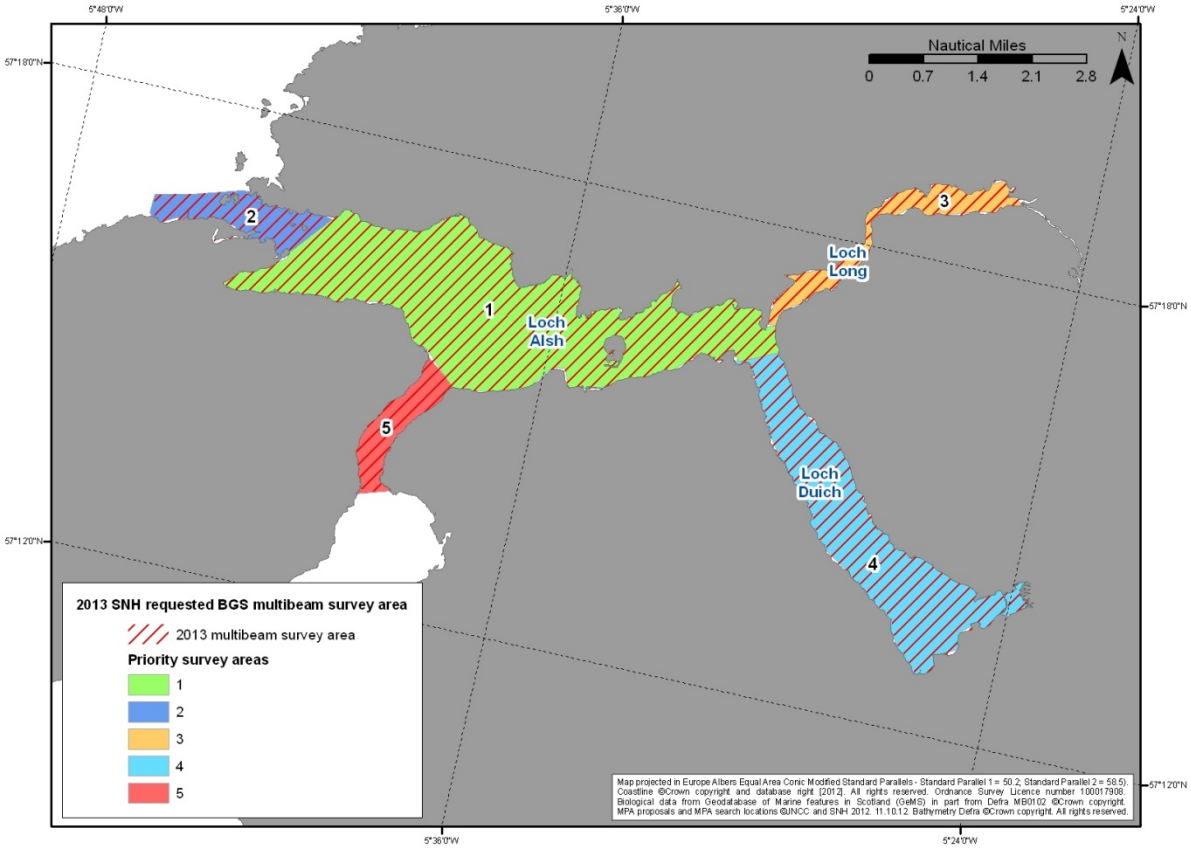


Figure 2 Prioritised areas within Lochs Duich, Long and Alsh.

The dataset was collected in 12 days, with a day either side for mobilisation and de-mobilisation. There was a total of one day of downtime for weather and equipment/software failures. Although some very marginal weather was experienced, the wind was generally easterly in direction and work was able to continue in sheltered areas.

1.2 SURVEY DATA

The *White Ribbon* is equipped with a Kongsberg EM3002D dual head, multibeam echosounder system (MBES). Data were acquired using the Kongsberg SIS operating system, logging raw .ALL files.

These data were processed offline using CARIS HIPS and SIPS 7.1 SP2. Individual field sheets were created for Loch Long, Long Duich, Long Alsh and Kyle Rhea. Backscatter mosaics were created in Fledermaus Geocoder FMGT. All final bathymetric surfaces were produced with a 2m resolution. The backscatter mosaic was generated at 1m resolution. Appendix 5 details the geodetic parameters.

A range of bathymetric products were created in ArcGIS and Fledermaus using the processed output from CARIS and Fledermaus FMGT. Appendix 6 details all finalised digital data deliverables.

The position of the vessel was obtained from a Trimble SPS461 with precision RTK-DGPS corrections provided via the Trimble VRSnow network. Corrections were obtained over the Vodafone (GSM) network via mobile phone and then transmitted to the SPS461 using Bluetooth, which enables the accurate resolution of vessel height relative to the ellipsoid. UKHO's VORF (Vertical Offshore Reference Frame) model was used to define the relationship between the ETRF 89 ellipsoid height and Chart Datum. A tidal correction could then be applied in CARIS.

In the Kyle Rhea survey area, where the mobile-phone network was insufficient, an RTK radio repeater was set-up at a suitable location.

A Valeport TideMaster tide gauge was installed at the Kyle of Lochalsh jetty. This was a back-up for areas where the use of RTK derived ellipsoidal height for tide reduction was not possible due to insufficient mobile-phone coverage. Tide-gauge data were only used in Loch Long. The lack of sufficient mobile-phone coverage in this very narrow and steep-sided loch prevented setting up the radio repeater in a location suitable to reach the most northerly section of the loch.

Sound velocity profiles (SVPs) were collected using a Valeport mini Sound Velocity Probe. The EM3002D has a SV sensor mounted at the heads providing a real-time indication of sound velocity at the transducer face. SVPs were taken at least once a day or whenever the real-time SV sensor at the transducer heads indicated values were out of range. The SVPs were relatively stable throughout the survey area.

Vessel motion/attitude values for pitch, roll and heave were obtained from a Kongsberg Seapath 200. This is an inertial navigation system that can provide accurate real-time attitude, heading, heave, position and velocity data.

1.3 MOBILISATION

Mobilisation commenced on the 4th March 2013 from the British Geological Survey's offices in Edinburgh (Murchison House and Loanhead). The survey vessel *White Ribbon* was transported using an HGV (Figure 3). A Ford Ranger was also used as a back-up vehicle for refuelling.

The *White Ribbon* was launched from Kyle of Lochalsh jetty on the morning of 5th of March and moored at a pontoon in Kyleakin. The jetty at Kyle of Lochalsh was used when weather prevented safe mooring at the Kyleakin tidal pontoon.

The Kongsberg EM3002D dual-head multibeam echosounder is permanently mounted via a moon pool on the *White Ribbon* (Figure 4) and required no additional installation by BGS. The vessel's dimensional survey can be provided on request and is contained within the survey data delivery folder structure.

A full patch test was performed in the survey area on the 5th March (see Appendix 3 for details).

The multibeam processing PC (CARIS HIPS and SIPS 7.1 SP 2) was set-up in the BGS staff accommodation in Kyleakin to allow the continual offline assessment of data quality as the survey progressed.

1.4 SURVEY OPERATIONS

Survey operations were carried out from the 5th until the 16th of March. One skipper (Neil Campbell) and one hydrographic surveyor (Meredith Scanlon) were always onboard the vessel. Rhys Cooper was present for the initial survey set-up, patch test, survey completion phase and de-mobilisation.

High winds prevented vessel operation on the afternoon of 9th March and a Kongsberg SIS acquisition crash/reinstallation prevented work on the afternoon of 14th March.

Line plans were generated using the survey-acquisition software to ensure full data-acquisition coverage and to meet the data quality requirements of the team. The survey plan was flexible to adapt to the time constraints and poor weather conditions. The line plans were designed to minimise the influence of swell and follow the predominant seafloor trend, trying to maintain consistent swath widths whenever possible.

A daily log was compiled by BGS staff (see Appendix 2).



Figure 3: White Ribbon in transit

1.5 DE-MOBILISATION

The *White Ribbon* and survey team arrived back in Edinburgh on the 17th of March.

2 Geophysical Survey Equipment

2.1 EQUIPMENT LIST

Kongsberg EM3002D Dual-Head Multibeam Echosounder

Trimble SPS461

Kongsberg Seapath 200

Valeport TideMaster

Valeport mini Sound Velocity Probe

2.2 KONGSBERG EM3002D MULTIBEAM ECHOSOUNDER

The EM3002D (Figure 4) is a dual-headed system capable of producing up to 508 dynamically focused beams, which produce a swath width of up to 200° operable in water depths of up to 150 m. The system operates in the 300 kHz frequency range, which ensures narrow beams and a small acoustic footprint, and is also robust under conditions with high particle content in the water column.

The EM3002D uses a powerful processing unit and two compact sonar heads. The processing unit applies sophisticated processing algorithms for beam forming, beam stabilisation and bottom detection.

Position and attitude information for the EM3002D is provided from a Trimble SPS461 GPS receiver and Seapath 200 motion reference unit.

Information from the processing unit, Trimble and Seapath are sent to an operator PC running the Kongsberg Seafloor Information System (SIS) acquisition system. The hydrographic surveyor can monitor data quality and adjust settings accordingly within SIS. All data is logged within a Kongsberg .ALL raw file format for subsequent data processing in CARIS (see section 3).





Figure 4: Mounting of EM3002D sonar heads using moon pool in hull of the White Ribbon

2.3 NAVIGATION/VESSEL ATTITUDE

2.3.1 Trimble SPS 461

The position and heading of the vessel was obtained from a Trimble SPS461 with precise RTK-DGPS corrections provided via the Trimble VRSnow network. Corrections were obtained over the Vodafone (GSM) network via mobile phone and then transmitted to the SPS461 via bluetooth (Figure 5). Where no phone network was available a RTK radio repeater was set-up at a suitable location for survey area and mobile-phone signal. This arrangement enabled the accurate resolution of vessel height relative to the ellipsoid. UKHO's VORF model was used to define the relationship between the ETRF 89 ellipsoid height and Chart Datum. A tidal correction could then be applied in CARIS.



Figure 5: Trimble SPS461





Figure 6: RTK radio repeater using Ford Ranger for Kyle Rhea area

2.3.2 SeaPath 200

Vessel motion/attitude and values for pitch, roll and heave were obtained from a Kongsberg Seapath 200 (Figure 7). This is an inertial navigation system that can provide accurate real-time attitude, heading, heave, position and velocity data. High-rate motion data obtained from the system's IMU (Inertial Measurements Unit) and precise position data from two, fixed baseline GPS carrier-phase receivers are integrated in a Kalman Filter within the Seapath Processing Unit.



Figure 7: Seapath 200

2.4 TIDE-GAUGE INSTALLATION

A Valeport TideMaster tide gauge was installed at the Kyle of Lochalsh pier on the 5th March 2013 with the permission of the harbour master (Figure 8). This gauge was an essential back-up to the GPS- derived ellipsoid height.

The quayside at Kyle of Lochalsh was deemed the most suitable location to install the tide gauge as it was relatively secure, stable, and easily accessible. It was not possible to undertake any reconnaissance prior to installation and the time available to set-up and monitor the gauge was limited. The tide readings obtained were reliable, with no visible movement of the pressure sensor. We were informed that the tide-gauge's location did not dry out at low tide; however, its height is approximately 70cm above Chart Datum.

Tide was measured in 10 second bursts and logged every ten minutes to a text file, providing a continuous record during all survey operations. All depths are referenced to Chart Datum.

2.4.1 Tide-gauge level

Tide-gauge height relative to Chart Datum was determined using a Leica GPS500 system (Figure 8), Leica GeoOffice software and the freely available RINEX data from the Ordnance Survey website. The height of the tide gauge relative to Chart Datum was calculated using ETRF ellipsoidal height and VORF (Vertical Offshore Reference Frame) provided by UKHO).

The GPS antenna was positioned on the quayside using a level tripod and tribach. Position was logged for 2 hours. The logged data was then downloaded into Leica GeoOffice to allow the application of RINEX differential corrections from the Ordnance Survey Active GPS network RINEX data server website (http://gps.ordnancesurvey.co.uk/active.asp). The logged data could then be corrected to provide an accurate position and height to approximately 1cm accuracy (Figure 9).

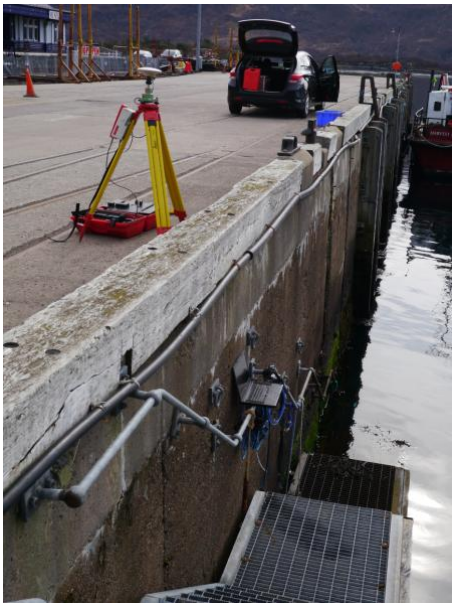




Figure 8: Leica GPS setup at Kyle Lochalsh jetty, Valeport TideMaster tide gauge

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Date/Time	Easting	Northing	Ellipsoid height	Geoid_Sep	Orthogonal height (ODN)	Comments
03/05/2013 09:09	57° 16' 48.04071" N	5° 42' 51.81382" W	59.487	55.2219	4.2651	Logged for 2 hours.

Table 1: GPS logging summary

Ellipsoid height entered in VORF (positive down)	Height of quay relative to CD (from VORF)	Tide gauge below quay	Tide-gauge height relative to Chart Datum
-59.487m	7.016 m above CD	6.255 m	0.761 above CD

Table 2: Determination of tide-gauge height relative to Chart Datum

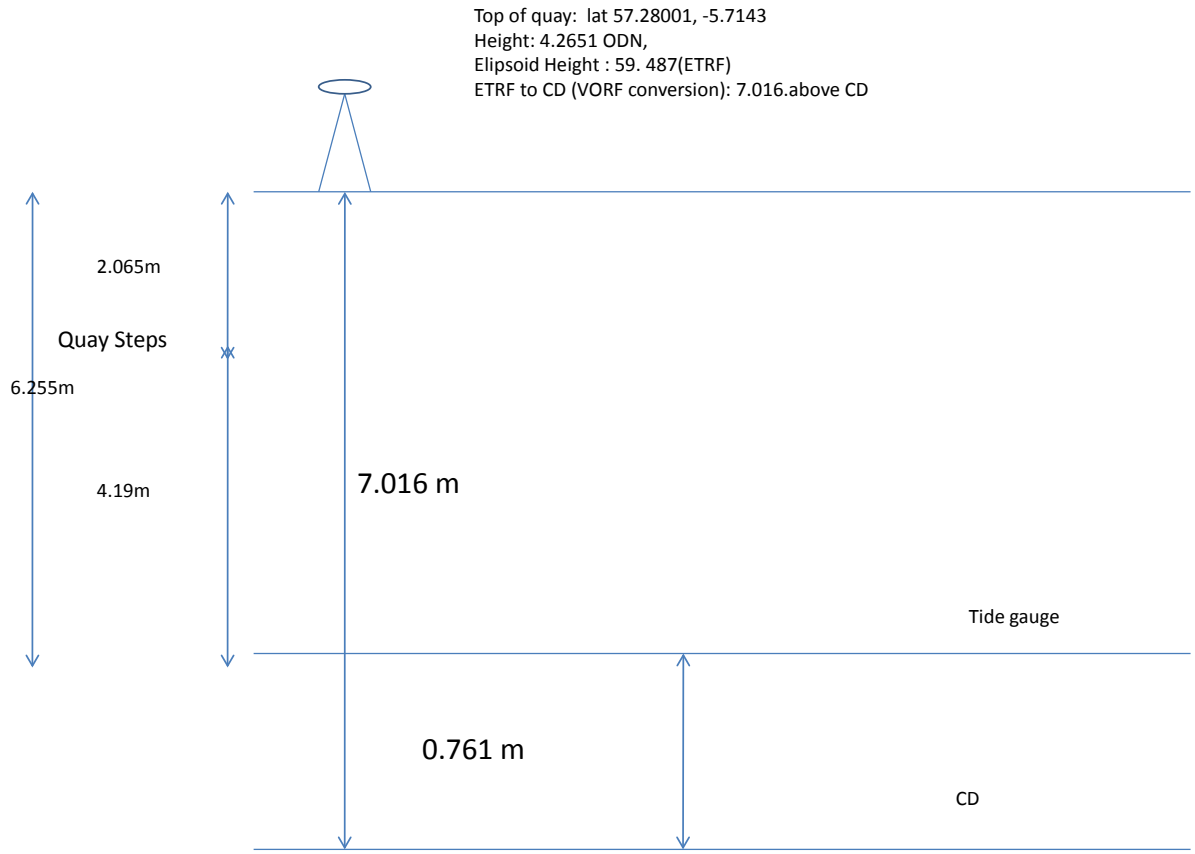


Figure 9: Height level diagram in metres for the Kyle of Lochalsh quay. The antenna height, Chart Datum/Ellipsoid difference and top of quay to tide-gauge measurements were already known. Leica GeoOffice was used to convert ellipsoid heights to ODN heights, and VORF to determine a level below Chart Datum.

3 Data Processing

3.1 MULTIBEAM ECHOSOUNDER

The raw multibeam data were logged as .ALL files within the Kongsberg SIS acquisition software. All vessel offsets were applied in SIS and were therefore not reapplied in CARIS HIPS processing software.

The data were reduced for tide and corrected to Chart Datum using GPS ellipsoid height obtained from real kinematic position (RTK). The UKHO's VORF (Vertical Offshore Reference Frame) was used to correct ETRF89 ellipsoid height to Chart Datum. The GPS height had to be smoothed using a combination of the 'Moving Average function' and the 'Fast-Fourier transformation' low pass filter to ensure vessel movement was not present in the derived GPS tide value and to mask/cover random drop outs of the RTK corrections.

Tide values from the Valeport TideMaster tide gauge were reduced to Chart Datum using VORF and applied in CARIS for data collected in Loch Long. Sound velocity profiles are applied in real-time by the Kongsberg SIS software and are not reapplied in CARIS.

All data processing was conducted in accordance with a standard CARIS Ping to Chart workflow and the 'Standard Operating Procedures for Kongsberg Multibeam Systems' as outlined by the UKHO (Talbot, Read 2011). Individual field sheets were created for Loch Long, Long Duich, Long Alsh and Kyle Rhea.

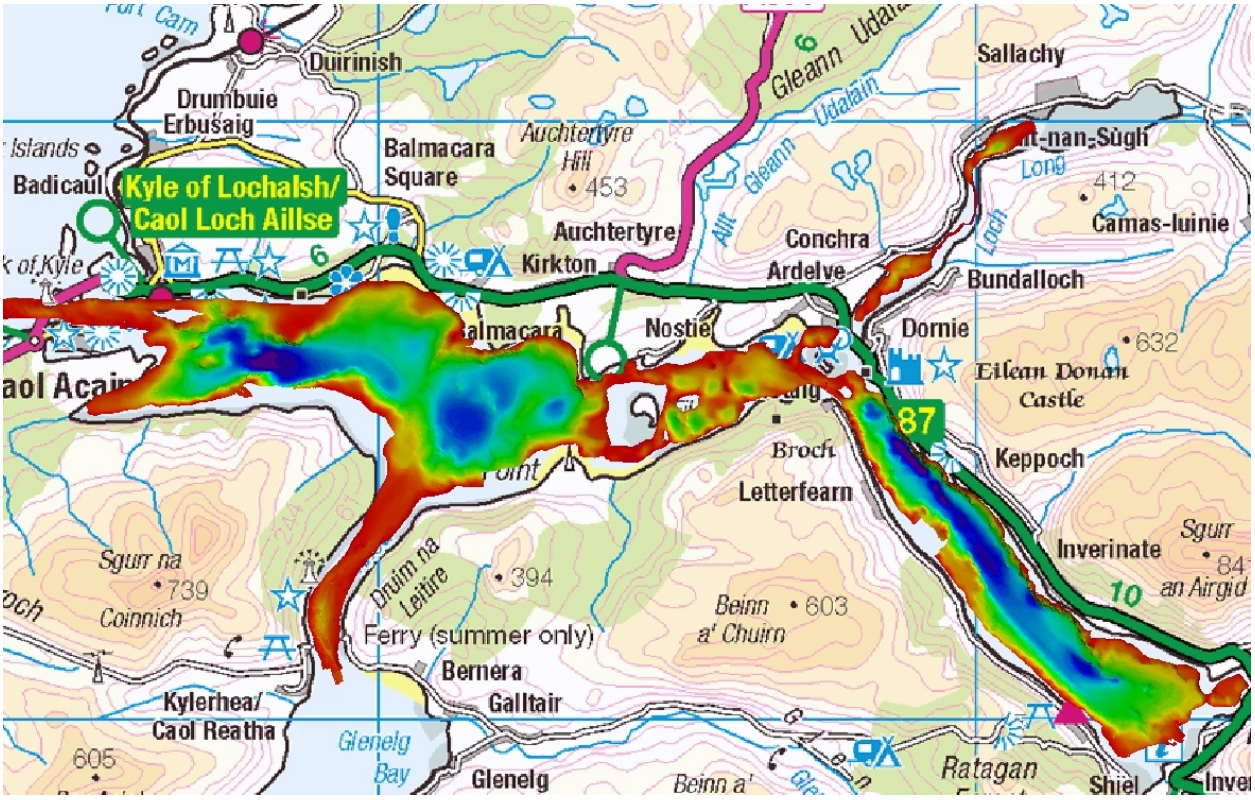
A Total Propagated Uncertainty (TPU) was calculated using vessel offsets and equipment specifications. This enables the initial cleaning of data and creation of a preliminary QC data surface using CUBE (Combined Uncertainty and Bathymetry Estimator). This surface/data was then visually inspected using CARIS subset and swath editors. Any artefacts were manually removed/cleaned prior to the final surface interpolation. Data were initially filtered using the 'CUBE' algorithm within CARIS to an IHO Order 1a depth uncertainty. All associated equipment specifications are stored and applied using the CARIS vessel file. The BGS processing log within the CARIS folder template provides further details.

Backscatter mosaics were created in Fledermaus Geocoder FMGT. All final bathymetric surfaces were produced with a 2m grid size. The backscatter mosaic was generated at 1m resolution.

A range of final bathymetric and backscatter products were created for use in a variety of software formats. The final processed CARIS project is supplied along with a complete set of GSF files.

Appendix 6 details all survey outputs.

Appendix 1 Area of multibeam data acquisition



Appendix 2 Daily Log

04/03/13

Mobilisation from Loanhead and Murchison House.

Rhys Cooper – Enterprise hire car (MH), Meredith Scanlon – BGS Ford Ranger , Neil Campbell – HGV and *White Ribbon* (Loanhead).

Issue at garage refuelling HGV for WR transport. Allstar petrol card not accepted for £700. Needed to break up into seperate £250 transactions.

Leave Edinburgh around 10:00am, arrive Kyleakin 16:30. Not sufficient daylight hours to launch boat or carry out tide gauge installation. Low tide.

05/03/13

Weather: winds E 15-20kts, overcast with showers.

08:00-09:00 – Meet Harbour Master to discuss survey, boat mooring, lorry parking, tide-gauge installation etc

10:00 – Tide-gauge installation opposite Harbour Master office on Kyle of Lochalsh jetty.

11:00 – Boat launch.

12:00 – Equipment checks and full patch test in Loch Alsh at various locations.

13:00 – Commence survey.

06/03/13

Weather: wind E 20-25kts gusting to 30kts, overcast with intermittent rain.

08:30 – Commence survey – Loch Alsh. See separate survey log sheets.

16:00 – Finish survey due to rising wind. Poor forecast for next 2 days. Gales.

07/03/13

Weather : wind E 20-25kts gusting to 30kts, overcast with persistent rain.

08:30 -Commenced survey -Loch Alsh. SV sensor on MBES issue due to loose connection .

16:30 – Finished survey. Rhys Cooper returned to Loanhead.

17:00- Alongside Kyleakin to refuel and then transited to Kyle Harbour (high winds forecasted and lack of space at Kyleakin).

18:00 – Tied up secure at Kyle due to strong winds. Taxi back to Kyleakin.

08/03/2013

Weather: winds 20-25kts increasing to 30-35kts after 1300. Overcast with squally rain.

08:00 –At Kyle, refueled and received a weather update.

08:30 – Passaged to mid Loch Alsh. Wind 20-25kts.

09:00-16:30 – Survey. Data collection marginal into sea. Moonpool acrylic spray guard broken.

17:00 – Alongside Kyle Harbour. Refuelled.

09/03/2013

Weather: wind gusting 30-35kts. Swell short (0.5-1m). Overcast.

08:00- Transited to Kyle.

08:40 –Depart Kyle and passaged to survey grounds.

09:00 – Surveyed Kyle Rhea. Slack tide. No mobile phone signal. Used Satellite-based augmentation systems (SBAS).

11:00 – Sea and swell increased. Roll, pitch and heave all invalid due to short, high swell. Returned to Kyle to solve RTK issue. No RTK corrections. Attempted to contact Trimble to resolve lack of RTK corrections.

12:15- Alongside Kyle Harbour. Identified area to leave RTK station.

10/03/2013

Weather: Wind E/NE 20-25kts gusting to 30kts. Partly cloudy to cloudy with snow squalls passing through area.

08:00 Assessed area for best location to work in for the day. Receiving RTK.

09:15 Depart Kyle and transited to Loch Duich.

10:30 – 16:00 Survey Loch Duich.

16:15 Transit to Kyle via Loch Long (to check depth of water under Dornie Bridge).

17:30 Alongside Kyle. Refueled.

11/03/2013

Weather: wind NNE 8-13kts, Sunny.

07:45 Departed Kyle and transited to north of Kyle Rhea.

08:30 Commenced survey in Loch Alsh and Loch Long. Strong tidal flows of 3kts on ebbing tide.

16:00 Stopped survey and transited to Kyle.

16:30 Alongside Kyleakin. Refuelled.

12/03/2013

Weather: wind neglible, overcast.

07:30 Arrive at boat. Attempt to fix heaters/demisters.

08:30 Depart Kyleakin and transit to eastern end of Loch Alsh. Visibility moderate to poor due to snow flurries and mist. Wind negligible.

09:00 -16:10 Survey operations in eastern Loch Alsh and Loch Duich. Strong spring tidal flows (maximum about 3kts).

16:50 Alongide Kyleakin and refuelled.

13/03/2013

Weather: wind neglible, partly cloudy.

07:45 Depart Kyleakin and transit to eastern Loch Alsh

08:20-16:20 Survey Loch Alsh and Loch Duich.

16:50 Alongside Kyleakin. Refuel.

14/03/2013

Weather: wind NE 2-7kts, radiation fog at first, partly cloudy.

06:45 Depart Loch Long to sail under Dornie bridge at high water with 80% springs (mast and radar dome taken down, clearance of 30cm – by eye). Survey using SBAS due to nature of Loch Long.

11:45 Finish Loch Long. SIS crashes – memory reference error. Speak to Kongsberg. Advised to reinstall SIS. PU Parameters not saved. The reinstallation does not save values.

14:30 R. Cooper arrives from Edinburgh. SIS PU Parameter back-up found on Hard Drive and SIS recovered. Patch test calibration values reapplied.

17:30 Finish Survey. Data processing. Refuel boat.

15/03/2013

Weather: wind NE 8-13kts, partly cloudy.

07:00 R. Cooper departs to set up RTK radio repeater at Balmacarra. *White Ribbon* (WR) departs to undertake survey in Kyle Rhea (no Vodafone mobile-phone network required for RTK corrections). Kyle Rhea needs to be surveyed at slack water.

07:30 *White Ribbon* returns to Kyle of LochAlsh – SIS having trouble with SV at heads, depth values etc

08:00 R Cooper dismantles RTK repeater and joins WR. SV head sensor communications reestablished (>Tools>External Sensor>MicroSV>COM3>9600).

09:00 Survey Loch Alsh.

13:00 RTK repeater set-up at Balmacarra. WR to Kyle Rhea. Slack water required to survey Kyle Rhea due to very strong tidal streams (7-8kts). Slack water at low water used. Very short window (approximately 1 hour) of tidal flow less than 3kts.

17:00 Finish survey. Data processing. Refuel

16/03/2012

Weather: Wind variable 3-8kts, partly cloudy to cloudy.

07:00 RTK repeater set up at Kyle Rhea. Tide gauge checked (laptop missing driver).

08:00 WR to Kyle Rhea for high-water slack tide.

09:00 Data processing, report writing etc

11:00 WR to Loch Duich. RTK repeater taken down, SIM transferred to WR.

17/03/2013

Weather: wind ENE 10-15kts, overcast

08:30 prepare to take WR out of water, de-mobilise and return to Edinburgh.

10:00 WR on lorry using slipway at Kyleakin (shallow slip).

11:15 Depart for Edinburgh with WR to Port Edgar Marina for engine maintenance.

Appendix 3 Patch Test Results

A full boat dimensional survey was carried out by StarNet Survey prior to the operation of the *White Ribbon* as a multibeam-survey vessel. This was achieved using a laser scanner and total station. Full details of this survey can be found in the report produced by StarNet Survey (Hammond and Brown, 2010). These offsets are applied in the installation parameters of the online survey software Kongsberg's SIS.

3.2 PATCH TEST

The patch test was performed on the 5th March 2013 in Loch Alsh. This was not the first patch test on *White Ribbon* and was performed as a part of general QA procedures. It was not expected to find any significant offset errors.

The calibration routine involves identifying the various offset errors between the motion reference unit (MRU), heading and multibeam heads. The patch test identifies the following offset errors:

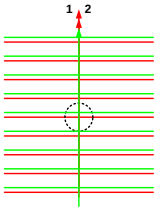
- Latency
- Pitch
- Roll
- Heading

As the EM3002D is a dual-headed system, a set of all four corrections are required for each head. The installation of each head is independent from the other. The calibration procedure must be carried out in the above order to be successful.

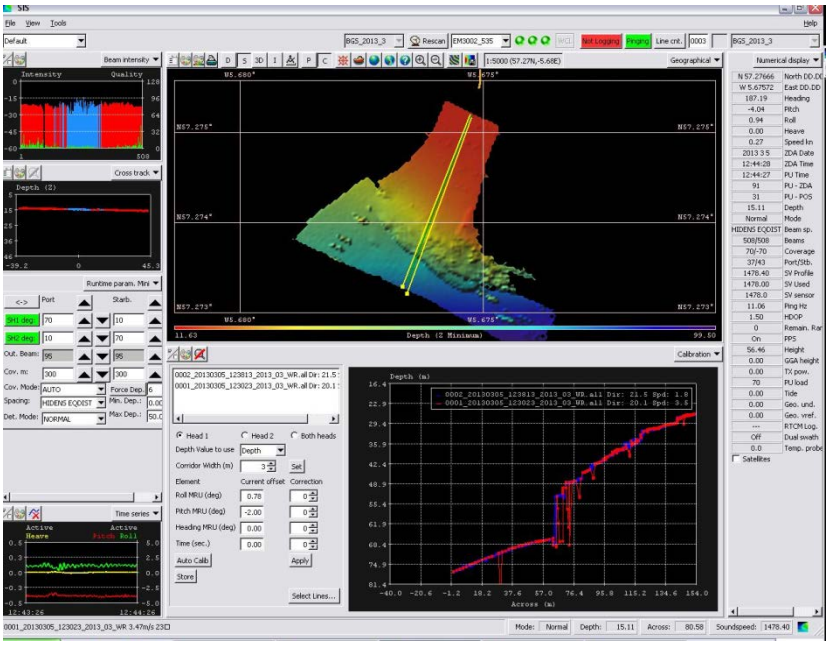
A suitable 'patch' of seafloor is essential for the successful completion of each of the various test routines. They should ideally be performed in the maximum water depth expected during the survey. Each error offset has its own ideal seafloor test area conditions (flat, slope, target). Ideally a large flat area of constant depth and a well defined obstacle/target can be utilised. If this is not possible, seafloor topography such as an obvious outcrop and well defined slope can be used. It is also essential that the sound velocity sensor at the transducer heads is working and that an SVP probe is used prior to commencement over the test area to determine the propagation variation of the water column.

3.2.1 Latency

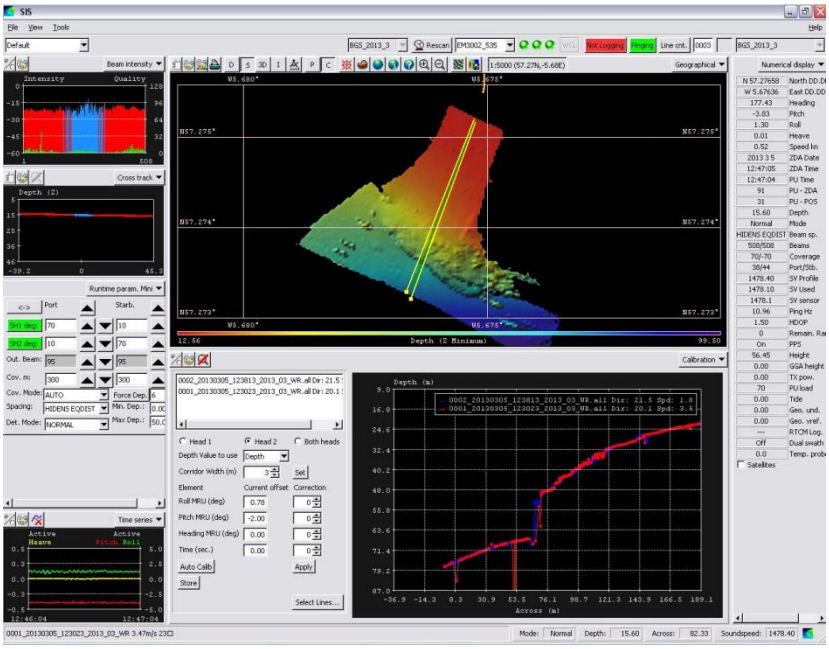
Run 2 lines as indicated below over a distinct object or slope with different speed.



Head 1



Head 2

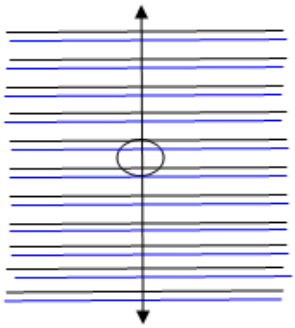


Result

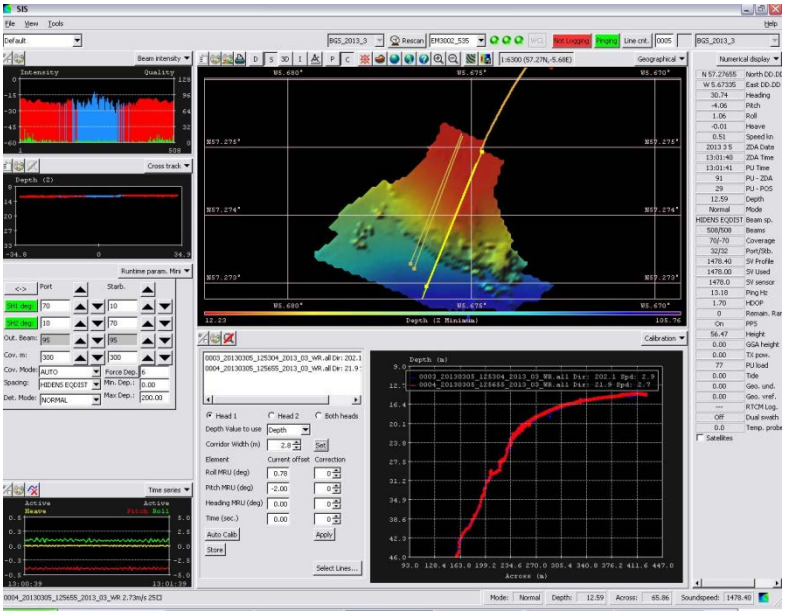
No latency/position delay was identified on the *White Ribbon*

3.2.2 Pitch

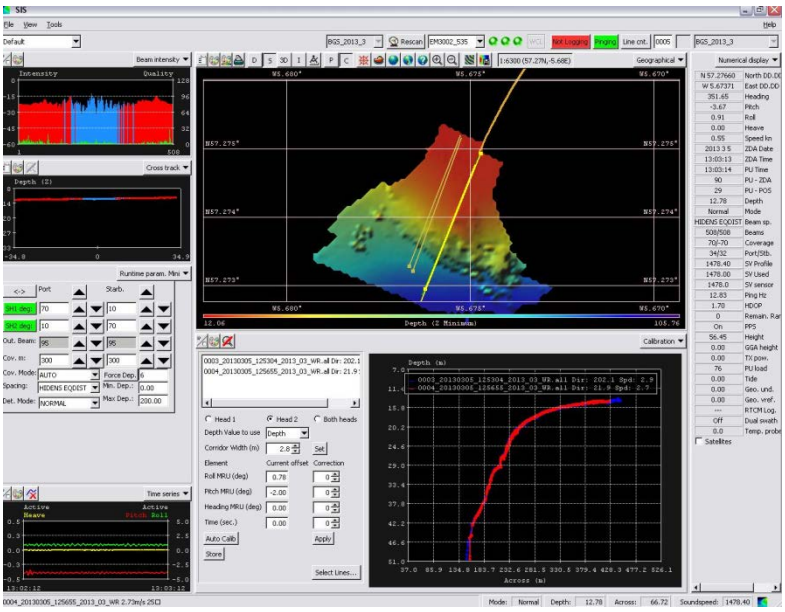
Run 2 lines as indicated below over a distinct object or slope.



Head1



Head 2

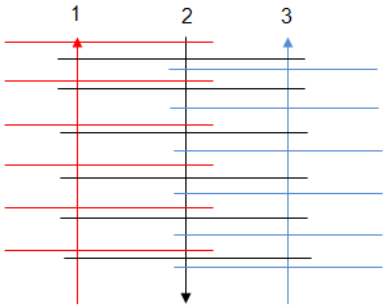


Result

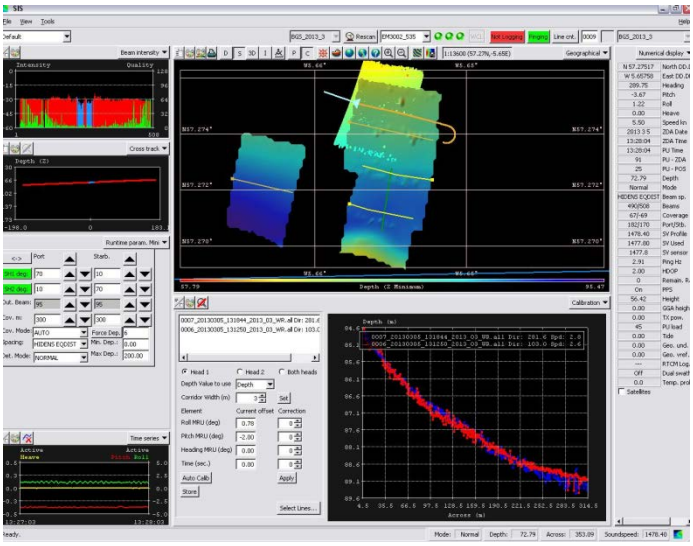
No correction was needed or applied for pitch.

3.2.3 Roll

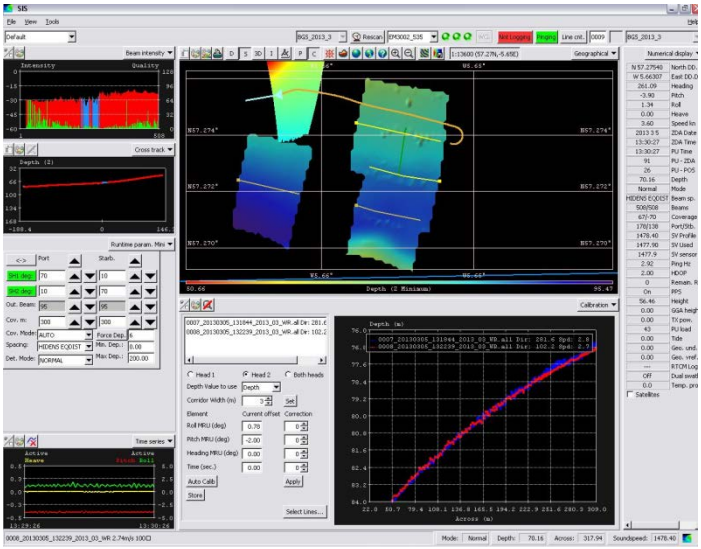
Run 3 lines as indicated below in a flat area. Note: it was very hard to find a large enough flat area to run a proper roll calibration. Previous results from the *White Ribbon* testing in the Firth of Forth in February 2013 are taken as correct. Results from Loch Alsh shown below.



Head 1



Head 2

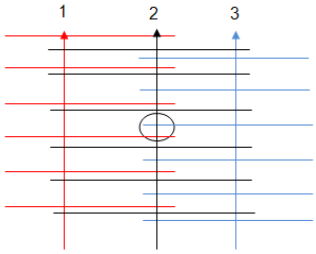


Result

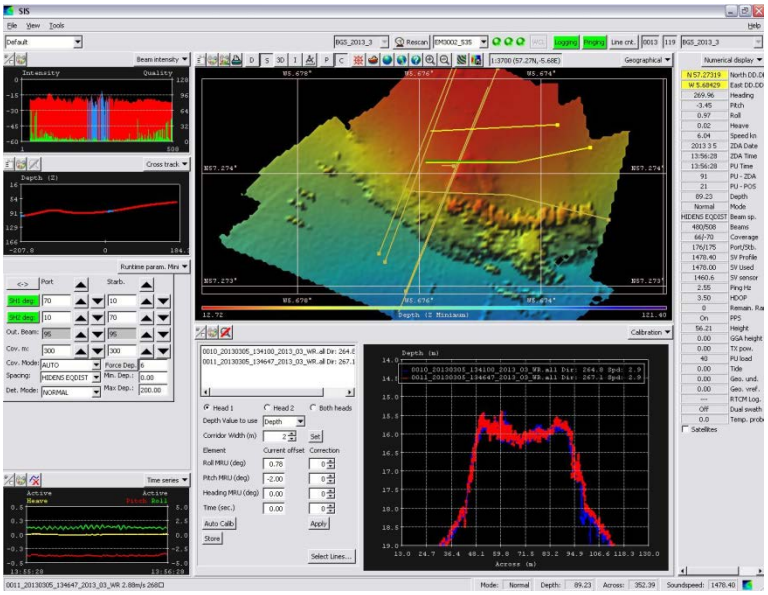
No correction applied

3.2.4 Heading/Yaw

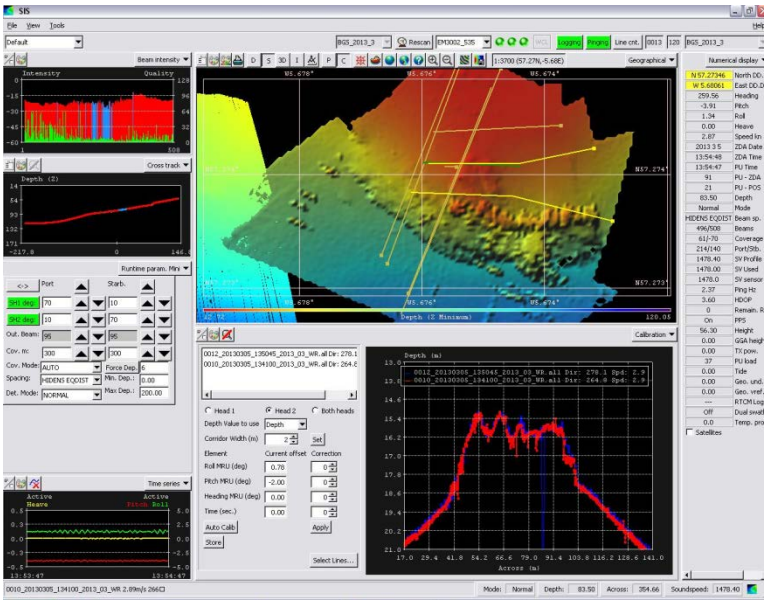
Run 3 lines as indicated below with the 2nd line crossing a distinct object.



Head 1



Head 2



Result

No correction applied

Appendix 4 Personnel

Rhys Cooper – Project Manager, Senior Hydrographic Surveyor

Meredith Scanlon – Hydrographic Surveyor

Neil Campbell – Boat Skipper

Appendix 5 Geodetic Parameters

Survey Classification	IHO Order 1
Horizontal Datum	ETRS 89 (WGS84)
Vertical Datum	Chart Datum
Digital Equipment	Kongsberg EM3002 D, POS MV 320, Fugro StarFix

1 **Geodetic Reference System.**

Horizontal Datum	ETRS 89 (WGS84)
Vertical Datum	Chart Datum (VORF)
Spheroid	GRS80
Semi-major axis	6 378 137.0m
Semi-minor axis	6 356 752.3m
Inverse flattening	298.257222101

2 **Projection System.**

Projection	UTM Grid Zone 29 (N)
Central Meridian (CM)	6˚ W
Latitude of Origin	0˚
False Easting	500 000.00
False Northing	0.0
Scale Factor on CM	0.9996

Appendix 6 Data Delivery Folder Structure

Multibeam

Caris Project - ..\2013_3_SNH\Multibeam\SoftwareFiles\

Raw .ALL files - ..\2013_3_SNH\Multibeam\SoftwareFiles\PreProcess

GSF's - ..\2013_3_SNH\Multibeam\ProcessedData\GSFs

Bathymetry Products

ArcGrids:

..\2013_3_SNH\Multibeam\BathymetryProducts

Tiff images of bathymetry Fledermaus SDs:

..\2013_3_SNH\Multibeam\BathymetryProducts\

Fledermaus SDs:

..\2013_3_SNH\Multibeam\BathymetryProducts\

XYZs:

..\2013_3_SNH\Multibeam\BathymetryProducts\

Backscatter Products

Tiffs:

..\2013_3_SNH\Multibeam\BackscatterProducts\ Sample Station List

References

Most of the references listed below are held in the Library of the British Geological Survey at Keyworth, Nottingham. Copies of the references may be purchased from the Library subject to the current copyright legislation.

TALBOT, A.; READ, R [2011], CARIS HIPS AND SIPS V 7: STANDARD OPERATING PROCEDURES FOR KONGSBERG MARITIME MBES DATA. UNITED KINGDOM HYDROGRAPHIC OFFICE