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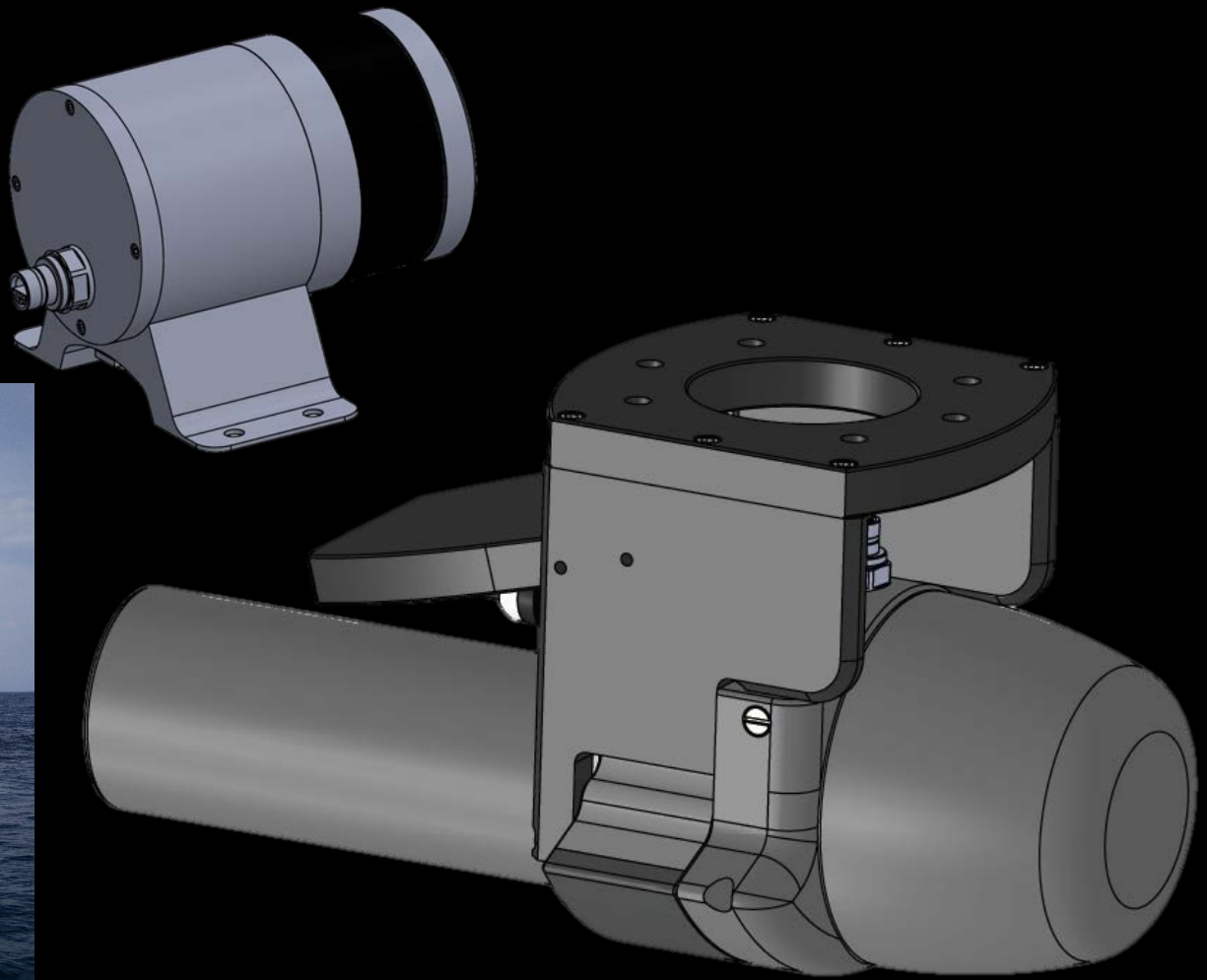
Termini Imerese jetty and Pipeline survey, Sicily Italy
June 23, 2016.
Utilizing Norbit iWBMS 0.9°x 0.95° TX & iLidar



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In June 2016 Ageotec conducted a demonstration of the iWBMS and iLidar to potential clients. The demonstration survey was conducted around the Jetty of Termini Imerese. In addition a small pipeline outside the harbor was also surveyed. The survey was conducted utilizing QPS Qinsy and was processed in Qimera.

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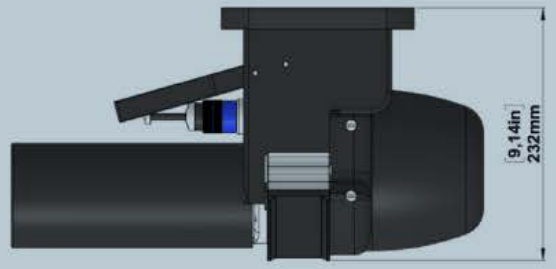
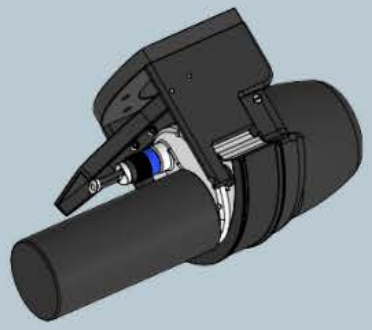
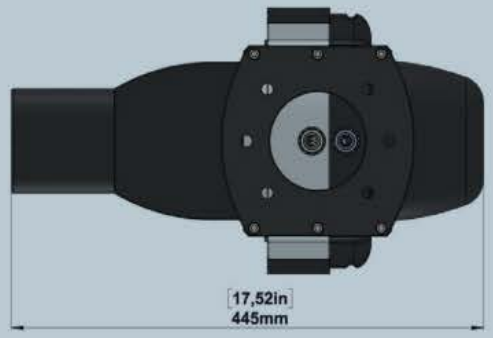
Norbit WBMS 0.9°x 0.95 Tx - Specifications

TECHNICAL SPECIFICATION	
SWATH COVERAGE	7-210° (SHALLOW WATER IHO SPECIAL ORDER >155°)
RANGE RESOLUTION	<10mm (ACOUSTIC)
NUMBER OF BEAMS	256-512 EA & ED
OPERATING FREQUENCY	400kHz w/80kHz BANDWIDTH (FREQ. AGILITY 200-700kHz) (LOW FREQ MODE AND HIGH FREQ ULTRA RESOLUTION MODE)
DEPTH RANGE	0.2-275m (160m TYPICAL)
PING RATE	UP TO 50Hz, ADAPTIVE
RESOLUTION	0.9° ACROSS, 1.9° ALONG @400kHz, OPTION: 0.9° ALONG 0.5° ACROSS, 0.9° ALONG @700kHz
POSITION	HOR: ±(8mm +1ppm X DISTANCE FROM RTK STATION) VER: ±(15mm +1ppm X DISTANCE FROM RTK STATION) *(ASSUMES 1m GNSS SEPARATION)*
HEADING ACCURACY	0.02° (RTK) WITH 2m ANTENNA SEPARATION
PITCH/ROLL ACCURACY	0.01° INDEPENDENT OF ANTENNA SEPARATION
HEAVE ACCURACY	5cm or 5% (2.5cm or 2% TrueHeave)
WEIGHT	APPROX. 9.2kg (AIR) LESS THAN 6kg (WATER)
INTERFACE	ETHERNET
CABLE LENGTH	STD 8m, OPTIONS: 25m, PIGTAIL, CUSTOM UP TO 50m
POWER CONSUMPTION	60W (75W MAX) (10-28VDC, 110-240VAC)
OPERATING TEMP.	-4°C to +40°C (TOPSIDE -20°C to +55°C)
STORAGE TEMP.	-20°C TO +60°C
ENVIRONMENTAL	TOPSIDE: IP67: DUST TIGHT, PROTECTED AGAINST THE EFFECT OF IMMERSION UP TO 1m/WET-END: 100m







Part #12006

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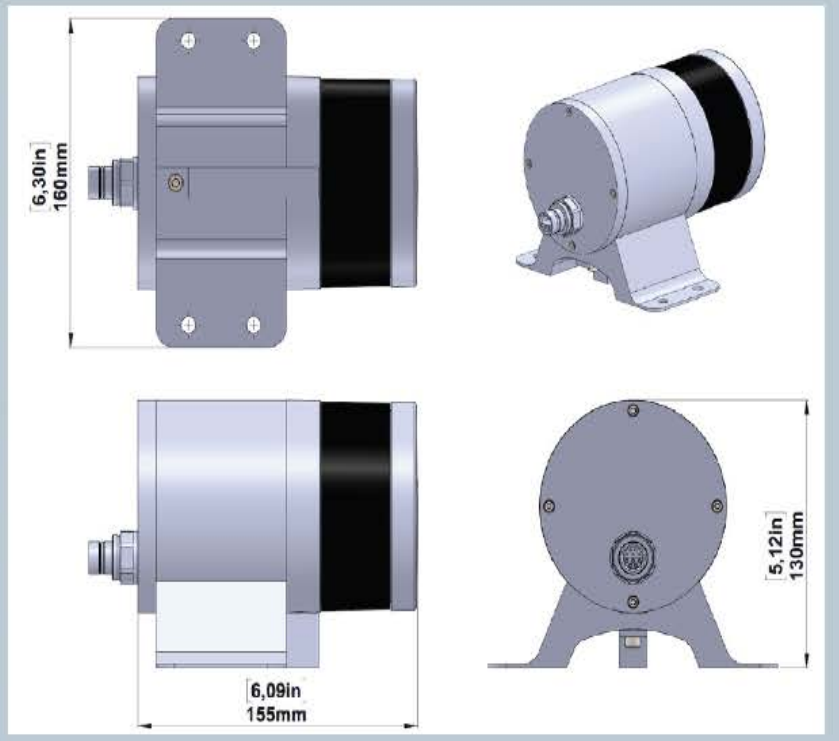
Norbit iLidar- Specifications

TECHNICAL SPECIFICATION

INFRARED LASER MODULE	1-20Hz-TIME OF FLIGHT MEASUREMENTS WITH DUAL RETURNS
FRAME RATE	5-20Hz (10Hz DEFAULT)
WAVE LENGTH PEAK	905nm (TYPICALLY) CLASS 1 EYE SAFE
OUTPUT	UP TO 300.000 POINTS PER SEC
ANGULAR RESOLUTION	2° BETWEEN EVERY OF THE 16 LASER/HORIZONTAL
ANGULAR RESOLUTION	0.1°-0.4° VERTICAL
FIELD OF VIEW	30° VER., 360° HOR
RANGE	100m
DATA I/O	NORBIT PROPIETARY SYNCHRONIZED TIME STAMPED
POWER	8W (TYPICAL)
VOLTAGE	10-29VDC OR 110/220VAC (POWERED DIRECTLY BY THE SIU)
ACCURACY	2cm
DIMENSIONS (DIA. x H x L)	103mm x 130mm x 150mm
WEIGHT	2.4kg



Part #24012

SERVO DRIVEN GEAR SYSTEM IN BOTH AXES WITH MANUAL CLUTCH OVERRIDE SYSTEM 3-AXIS FLUXGATE MAGNETOMETER + 3-AXIS ACCELEROMETER

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Norbit iLidar and 1° TX - Integration

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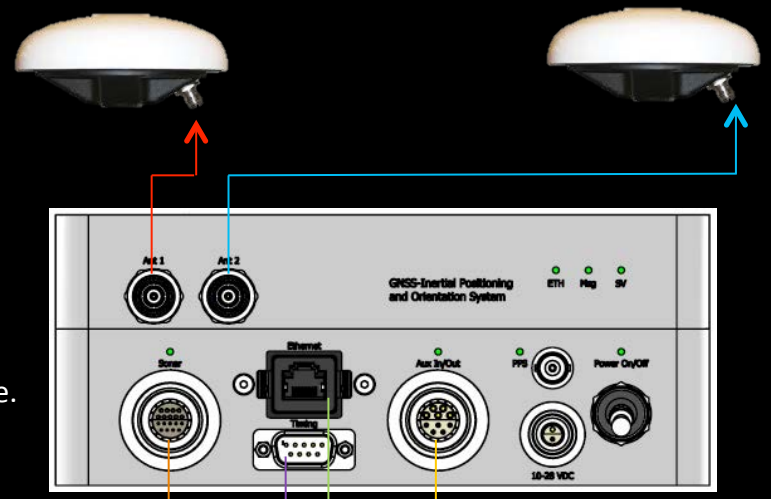
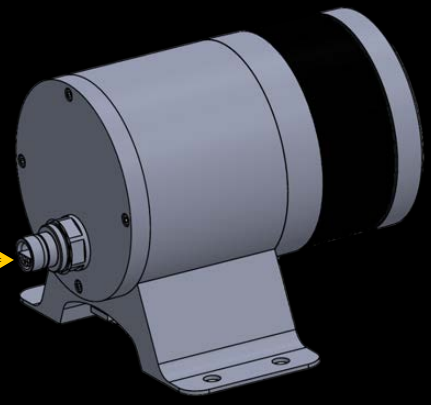


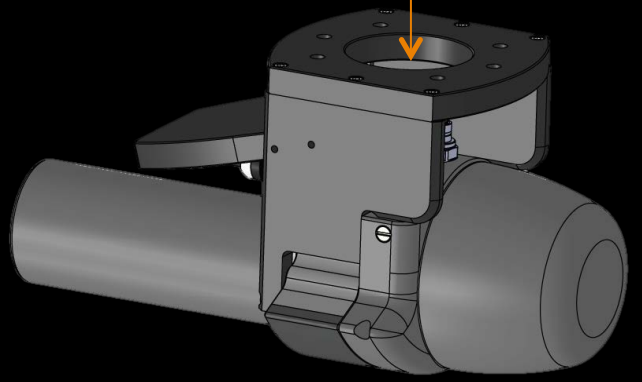
RTK Correction Source.
Into DB9 connector

iLidar Cable



Single IMU/WBMS Cable

Single network Cable



The integrated Norbit systems combines all sensors into a single small topside box. Power can be provided via AC or 12v battery. All systems connect to the survey computer via a single standard network cable.

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The Norbit iWBMS and iLidar were mounted on a T-Bar mount and was a affixed to the starboard side of the vessel. The iLidar was mounted forward of the primary GNSS antenna. Total time for mobilization 2hr.

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Data Acquisition and Processing

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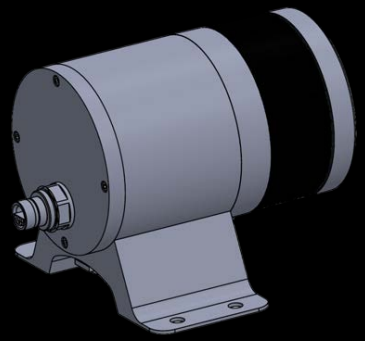

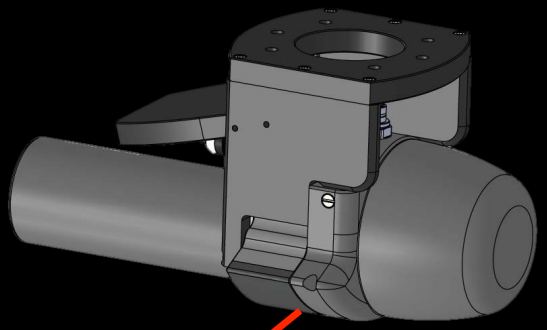

Sonar and Navigation

Sensors

QINSy

Acquisition

Processing

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20cm Pipe line in 13m water depth, collected at 700kHz

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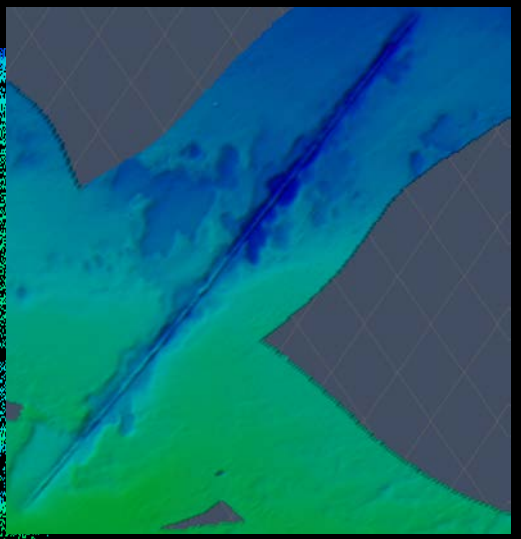

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Profile over the pipeline – 700kHz

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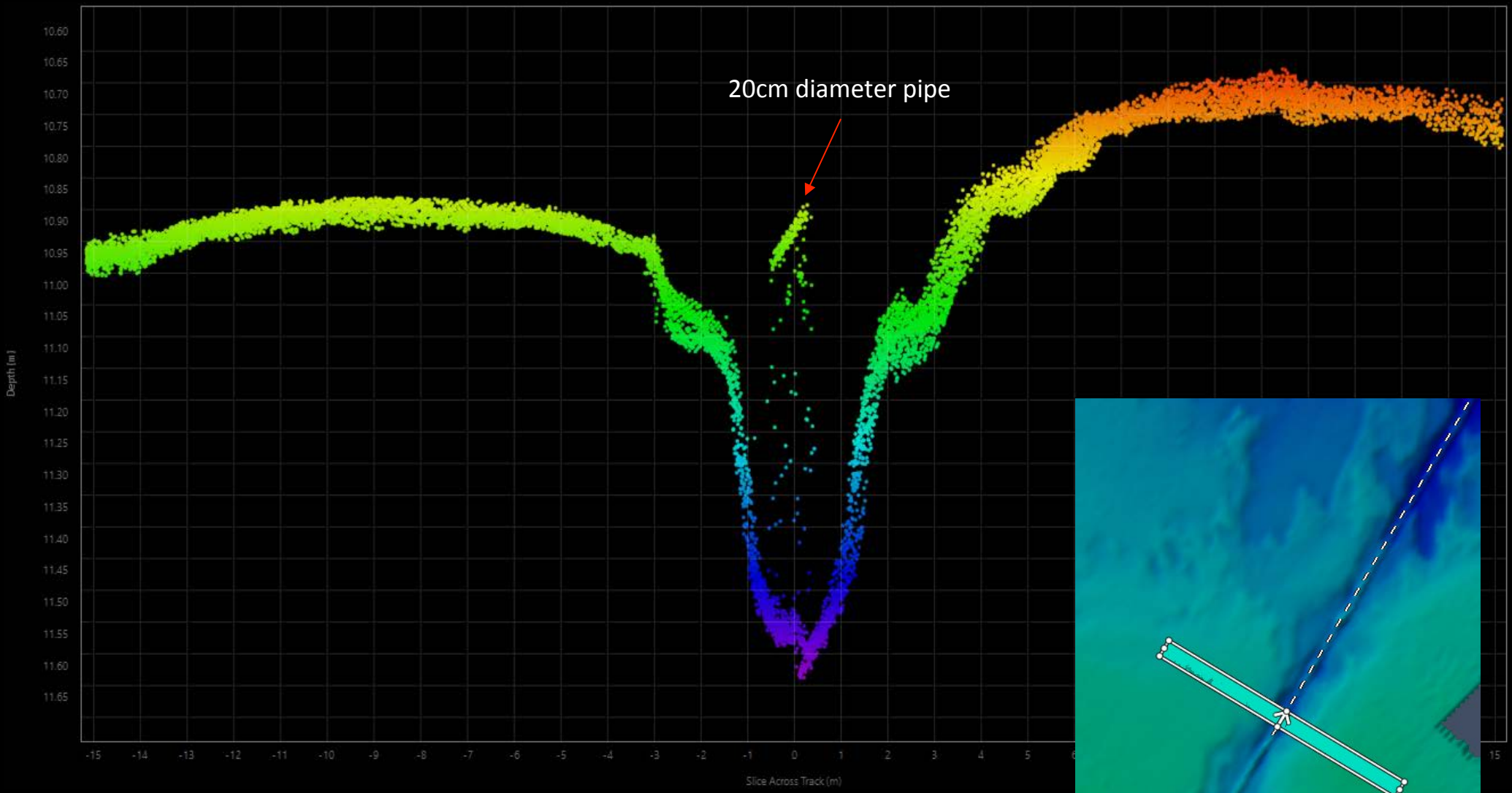

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Jetty is comprised of approximately $2m^3$ concrete blocks on the outside. The inside large boulders comprise the underwater structure.

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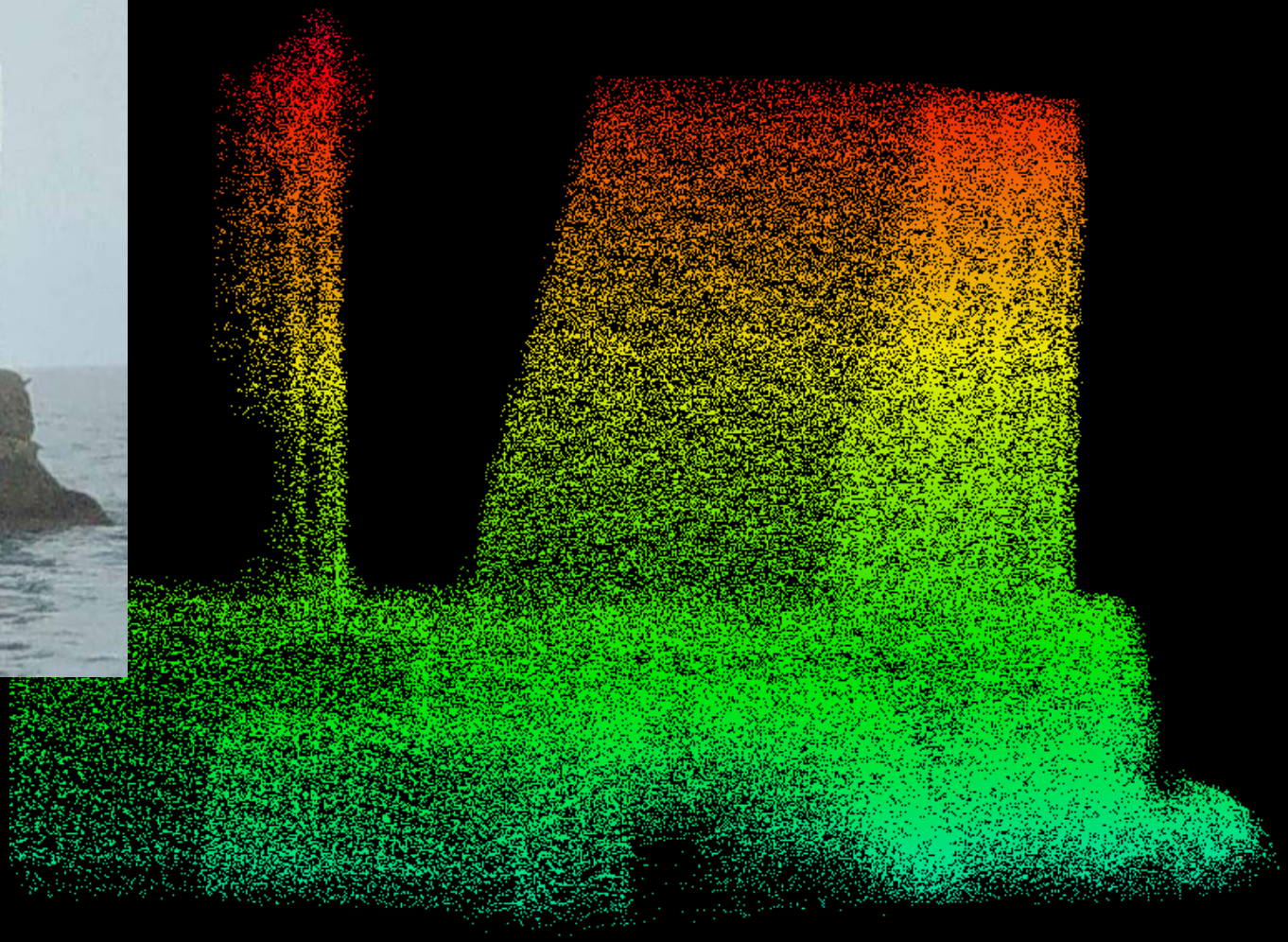
An entrance light on top of a mast sits at the end of the jetty. There is a caged ladder starting approximately half way up the mast. The below images show the mast as it appears in the iLIDAR.



*The wall behind the mast has been edited out

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Single pass of simultaneous multibeam and lidar of a gantry crane on an overhanging dock. The WBMS allows for data to be gathered almost to waters surface. Minimal processing was required on this data.

*Colored By System

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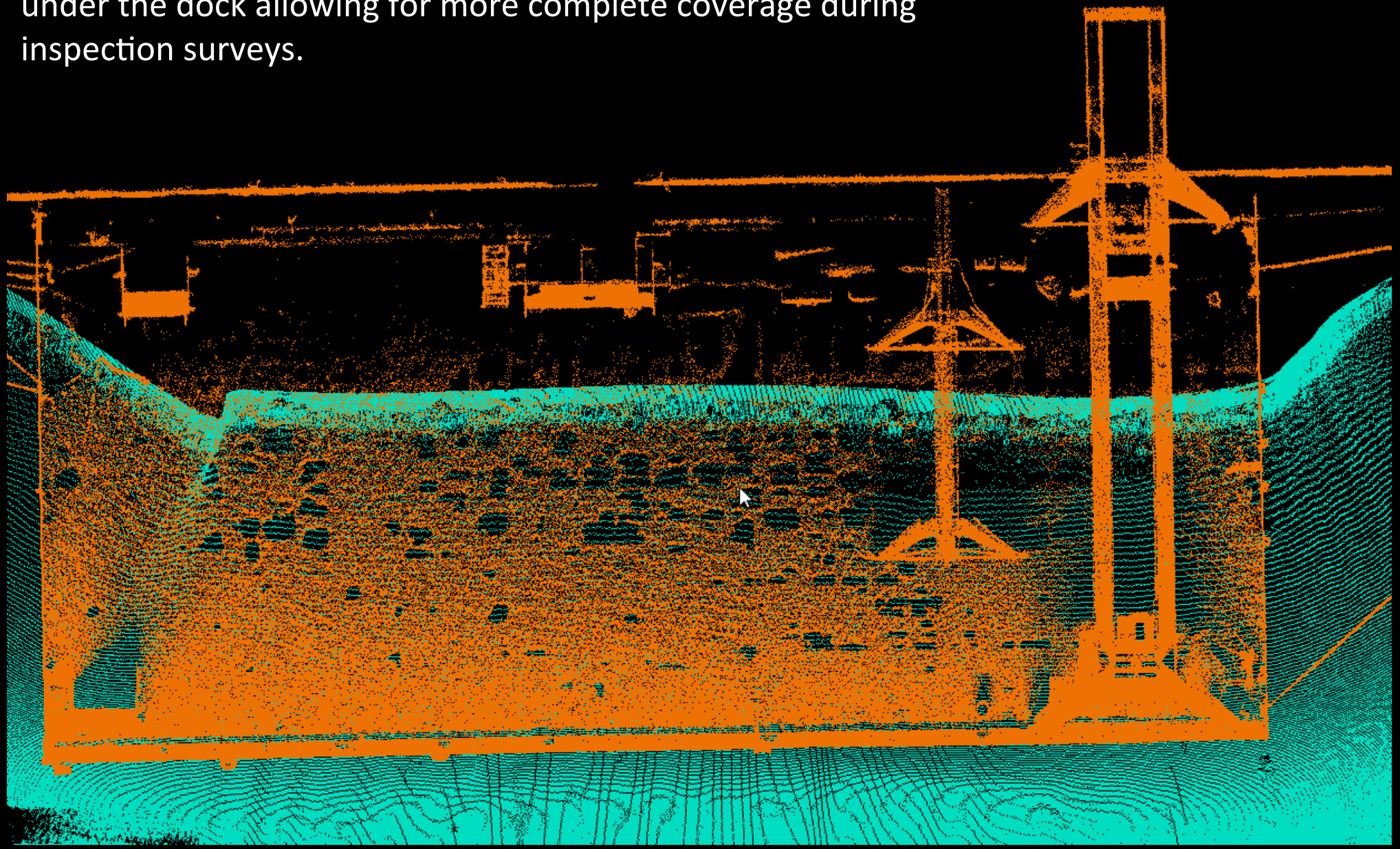
Top down view showing the ability of the WBMS to ensonify under the dock allowing for more complete coverage during inspection surveys.



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The docked tug ARGO. The lidar captured the top of the tug while the WBMS captured the underside.

Kort Nozzle on Argo

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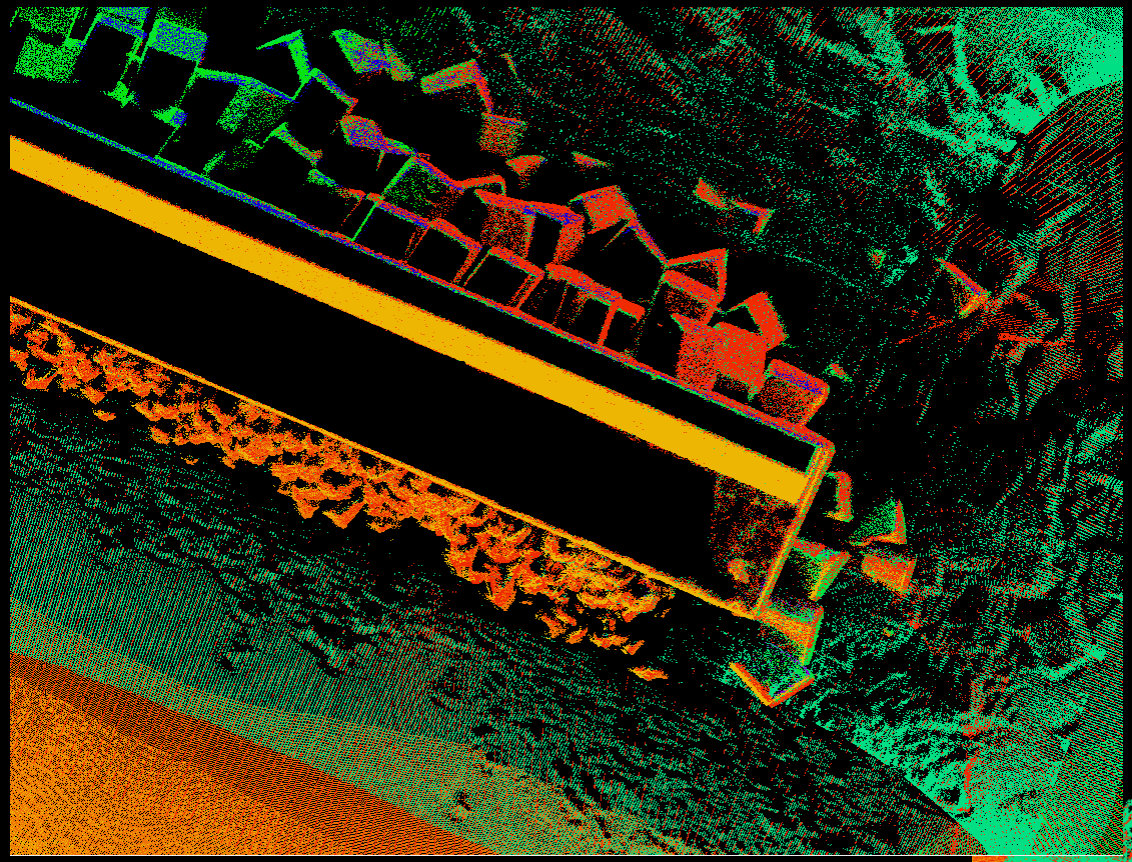

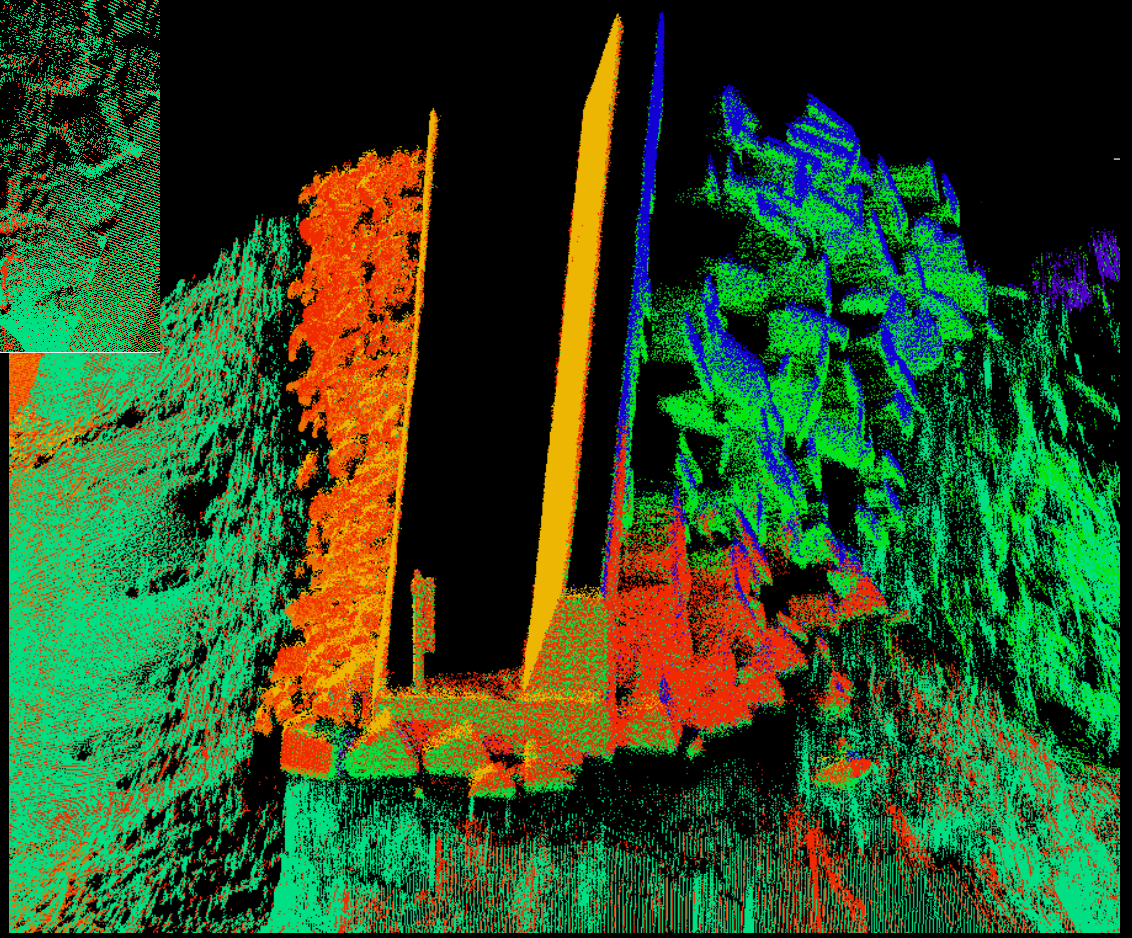

End of the jetty colored by survey line. 400kHz

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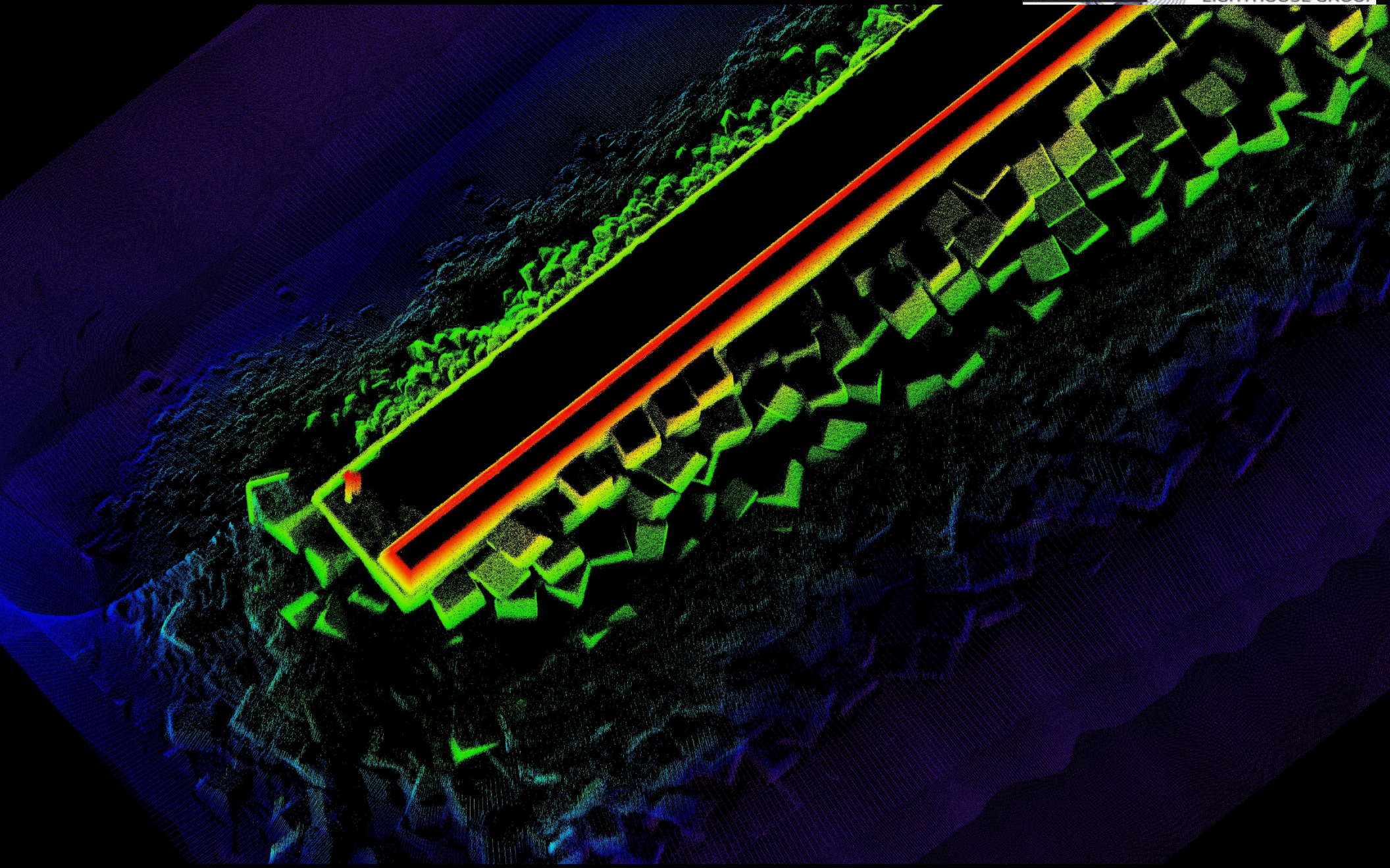

End of the jetty looking down – 400kHz

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Summary

- From arrival at the vessel to time of first survey ping was under 2 hours. This mobilization effort included, building the mount, installing the iWBMS and iLidar, measuring offsets and completing a GAMS calibration.

- The curved receiver array allows for the collection of high quality data up the slope of a bank without the need to remount the head. This reduces the gap between multibeam and lidar and requires a smaller tidal range for complete coverage without sacrificing total swath width as would be required on a traditional flat array mounted at an angle.

- The iLidar greatly increases personnel safety during dyke and jetty surveys. Without vessel mounted lidar survey work would have to be carried out by individuals walking the dyke or jetty. With large irregular objects and slippery surfaces and waves there can be a high risk of personnel injury. This is reduced with the iLidar.

- Traditional survey methods can be slow and laborious. The iLidar offers an increase in productivity reducing the hundreds of points that a survey would have to collect on foot to a few survey lines driven around the target structures.