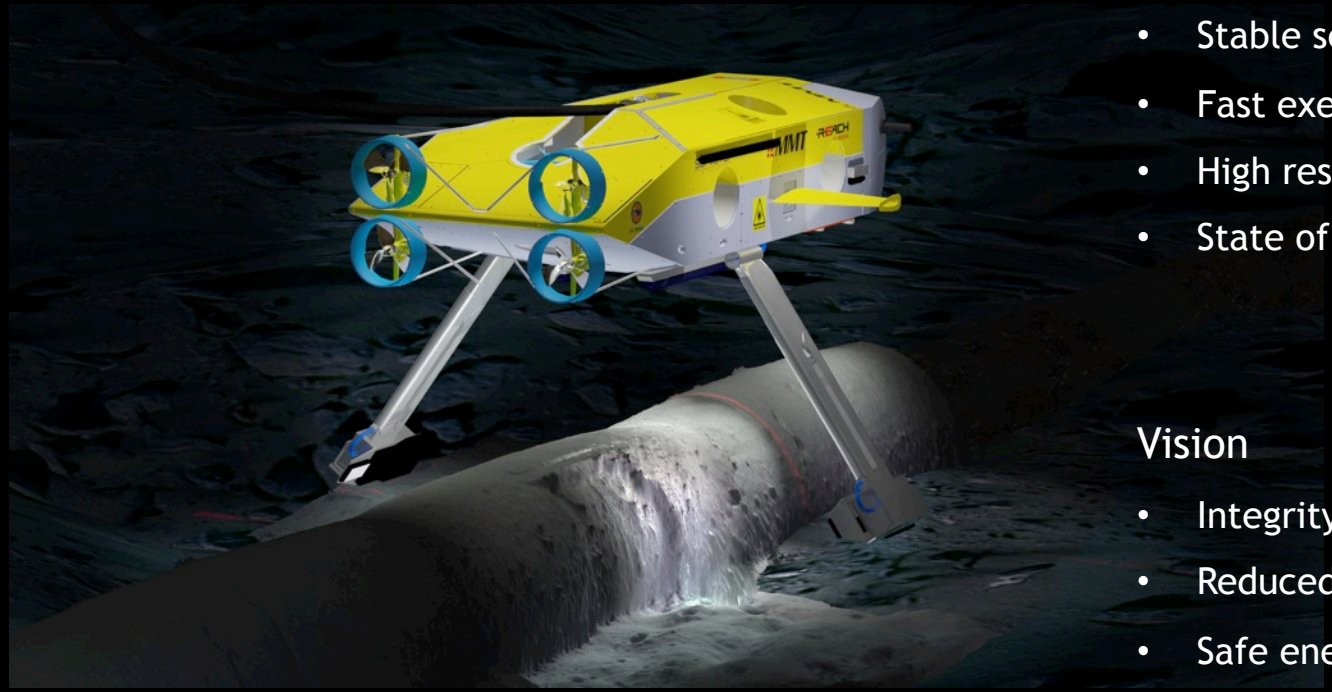
SURVEYOR INTERCEPTOR PRECISION AT SPEED


EACH
SUBSEA
WLL 15T

SURVEYOR INTERCEPTOR (SROV)



A specialized Survey – Inspection ROV

Concept

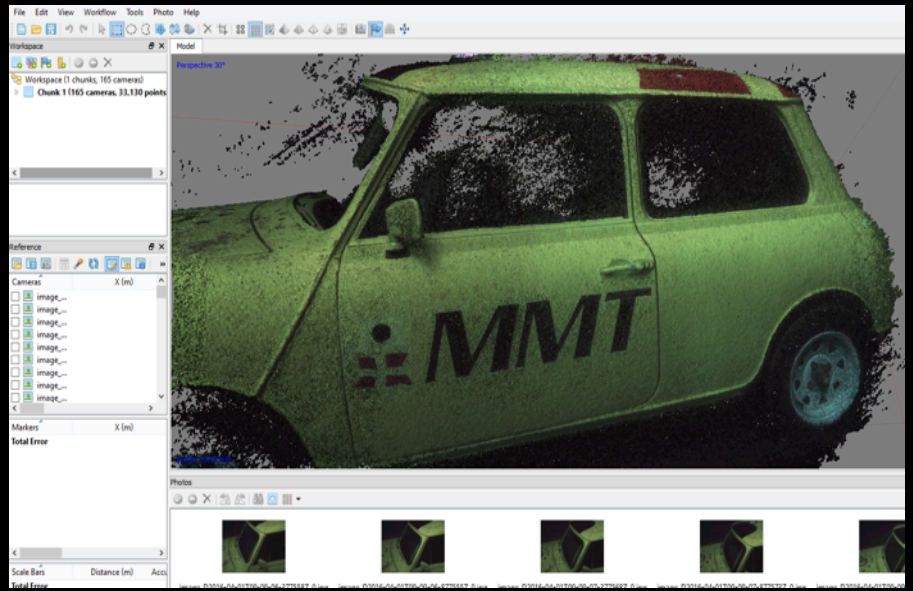
- Stable sensor carrier
- Fast execution
- High resolution
- State of the art equipment

Vision

- Integrity management at lower cost
- Reduced risk
- Safe energy transport
- Pro active integrity management

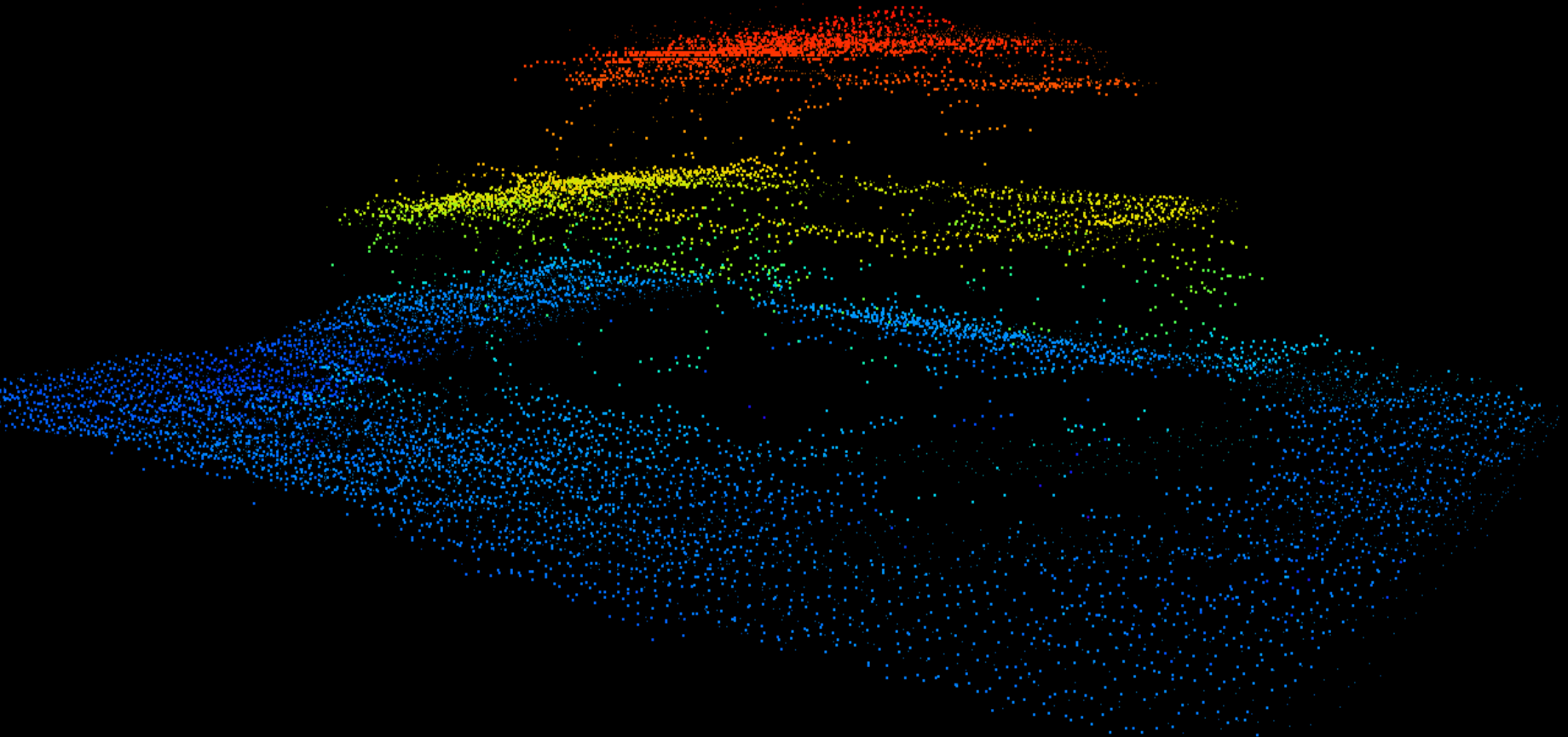
MMT

Structure inspection trials in GBG archipelago

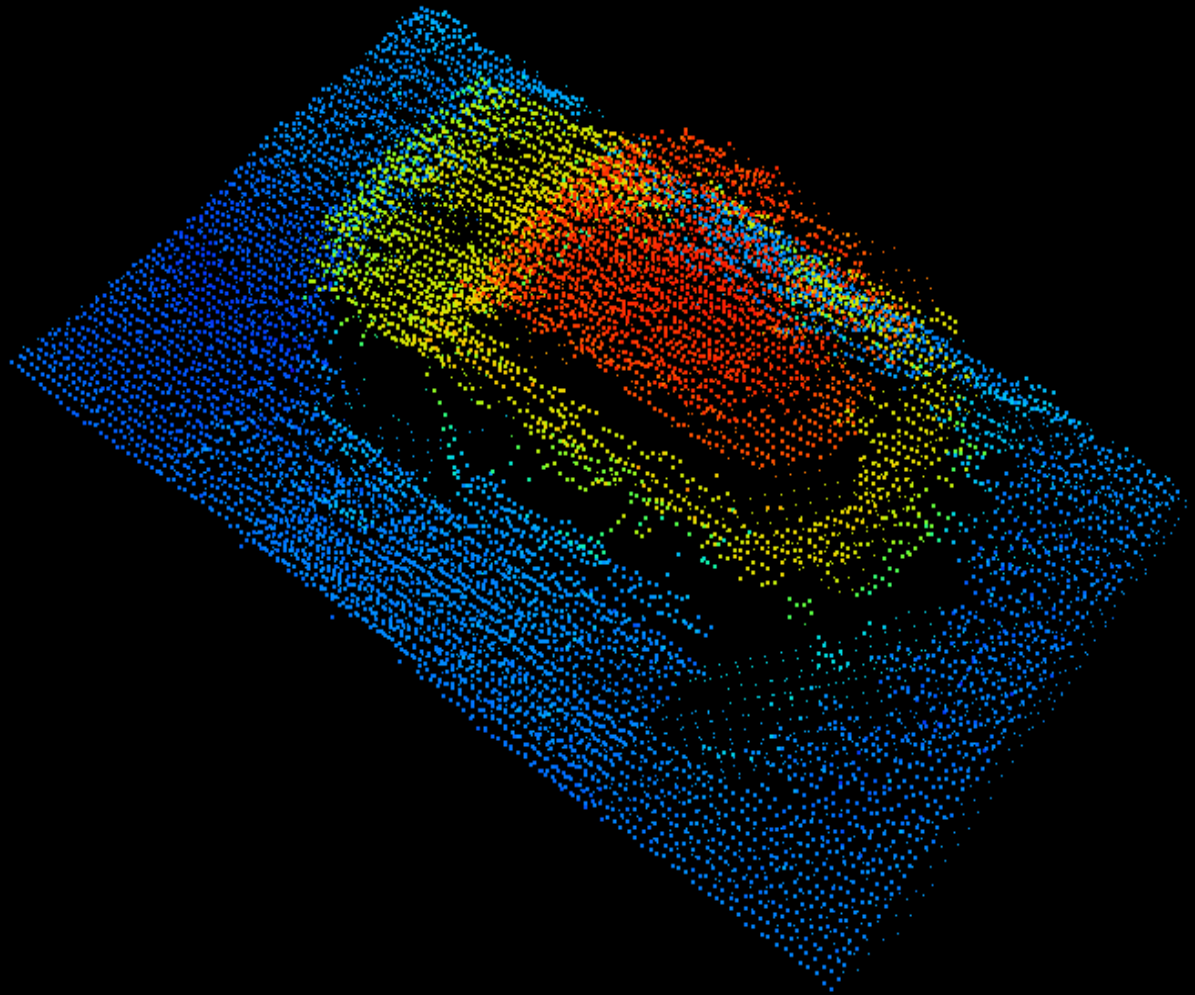


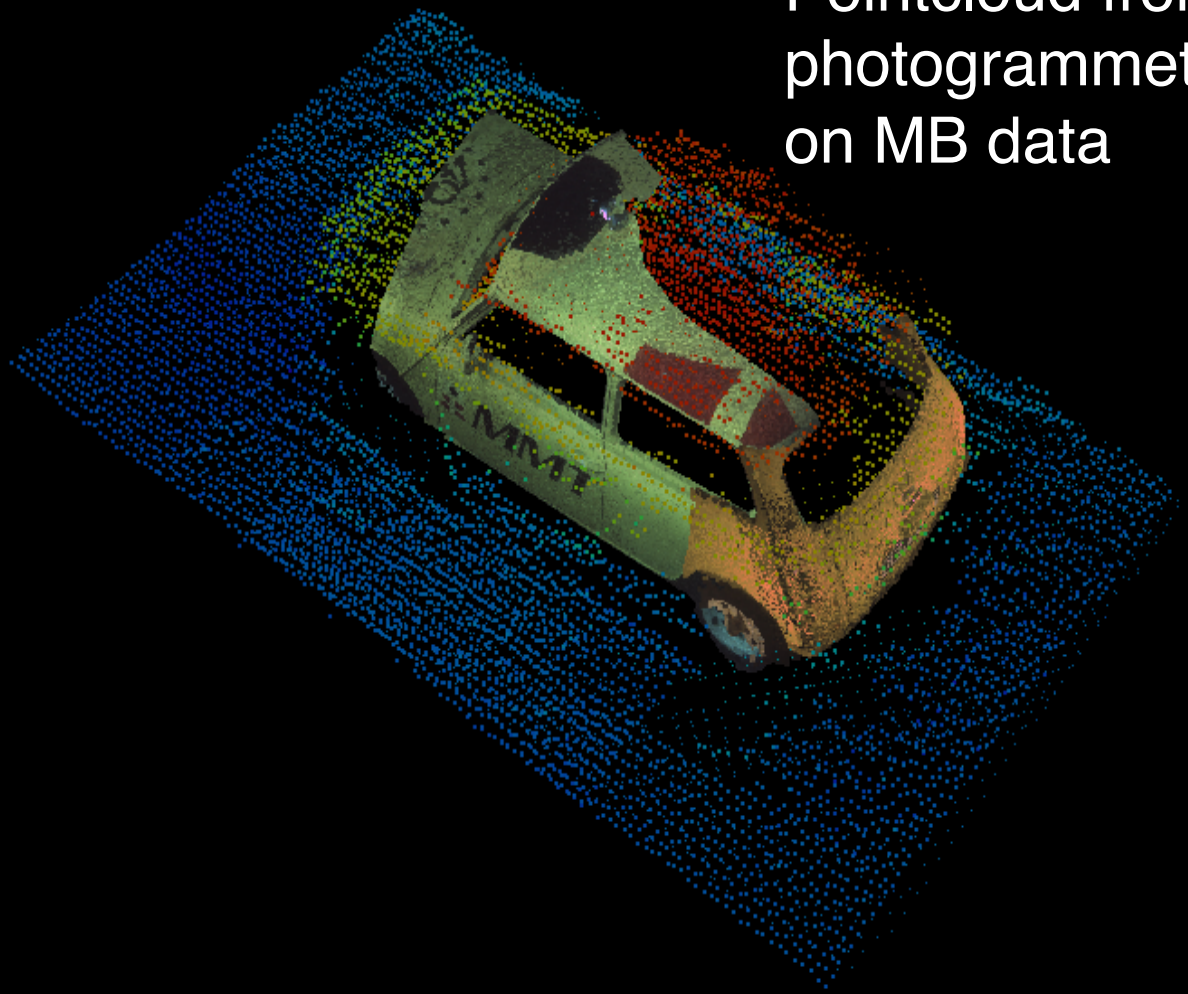
MMT

Multibeam Bathymetry



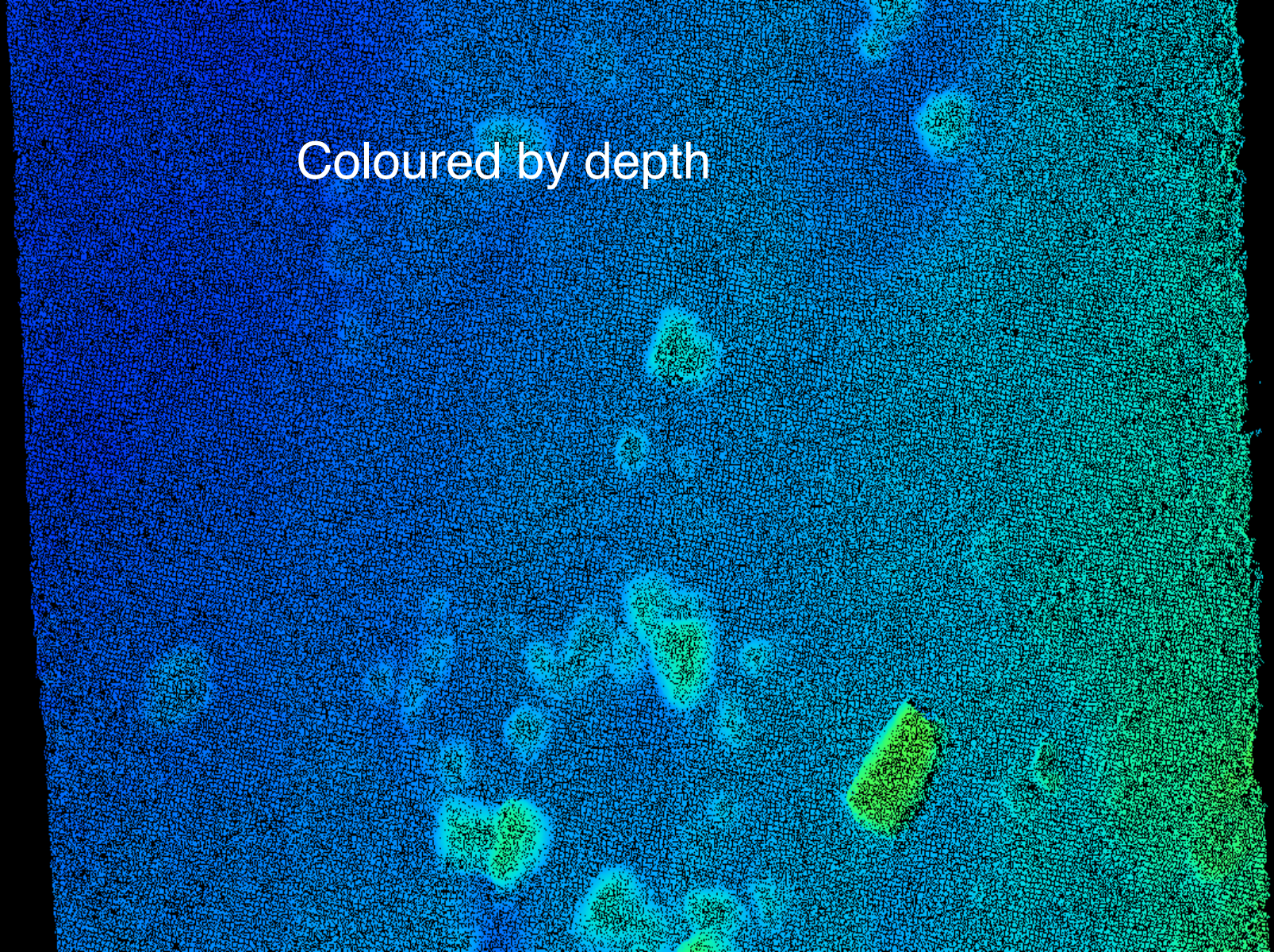
Multibeam 320 kHz 800 beams 0.4°



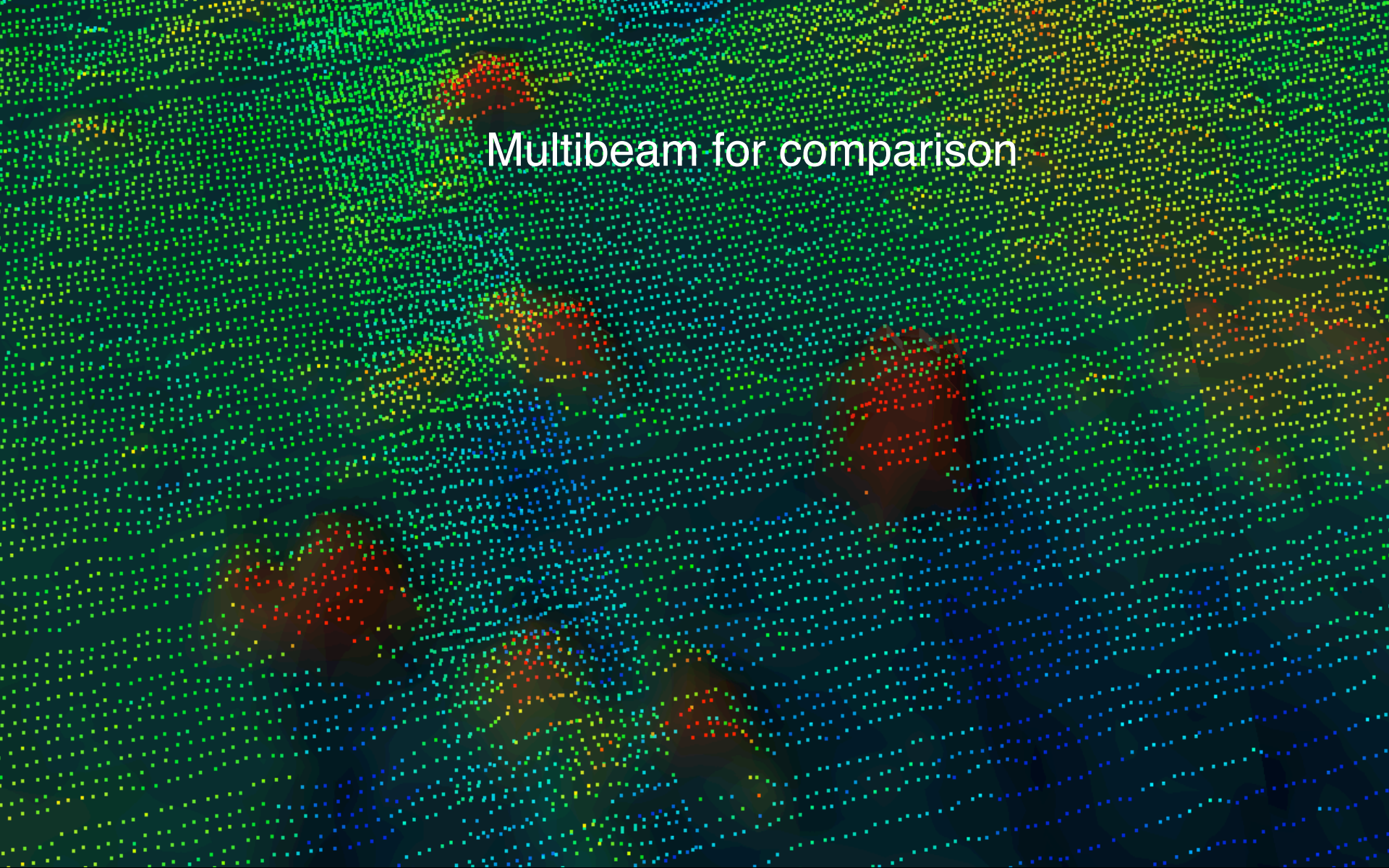


Pointcloud from photogrammetry overlayed on MB data


Ortophoto Baltic 5 m 4 knots


Coloured by depth

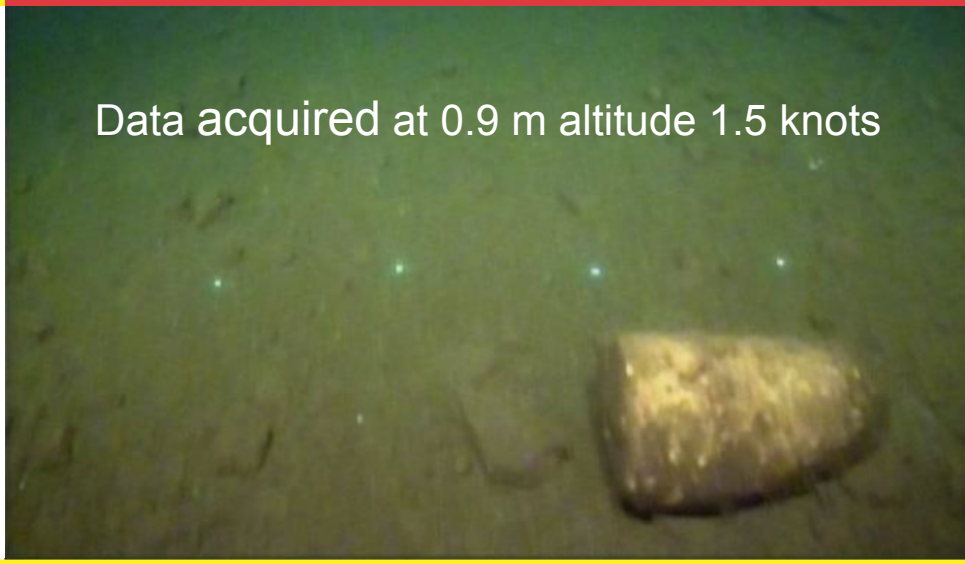

3D <cm resolution


Multibeam for comparison

PHOTOGRAMMETRY DEVELOPMENT

Visual estimation from video inspection

Length	Width	Height
0.5	0.3	0.2

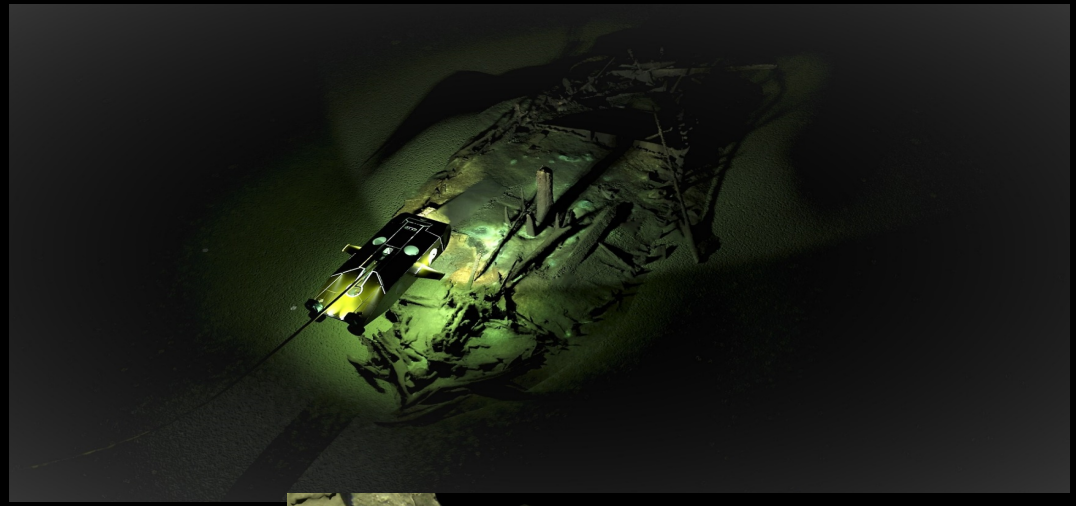


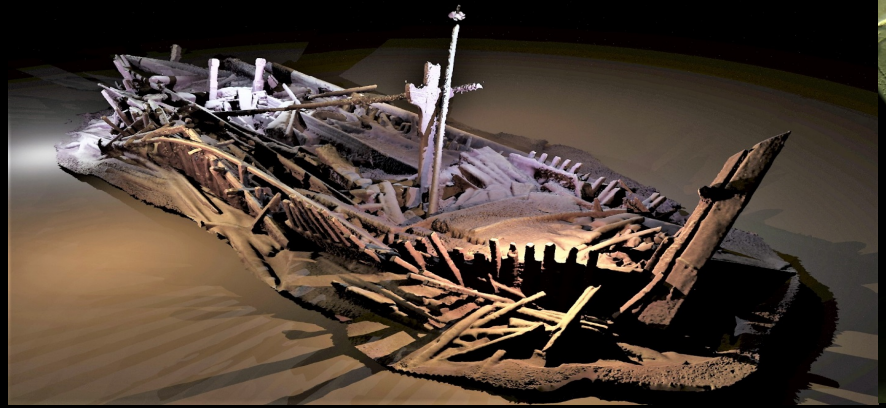
Point cloud measurement from SROV acoustic survey

Length	Width	Height
0.70	0.42	0.34

MMT

Black Sea MAP 2016





FULL SCALE SROV TRIALS

100 km in the Baltic were selected to evaluate the capacity of the Surveyor ROV as an inspection tool.

The work was performed 20:th to 27:th july.

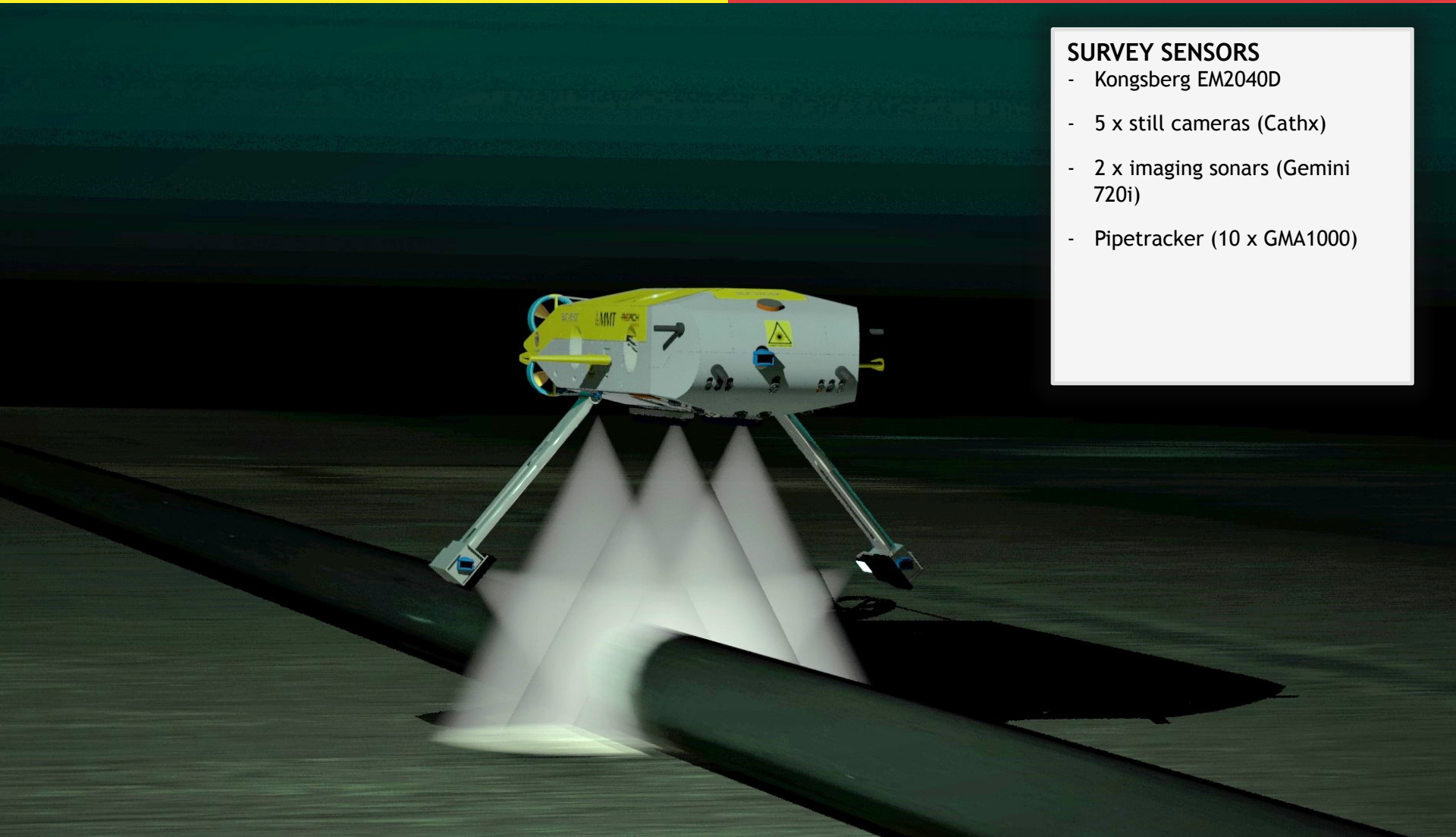
The results were compared to previous inspection of the same blocks.

Both speed of execution, post processing and resolution/ accuracy has been evaluated. This is a summary of the report.

SROV I upgrade

Figure 3 Newly added boom arms with cameras, gradiometers, imaging sonars.

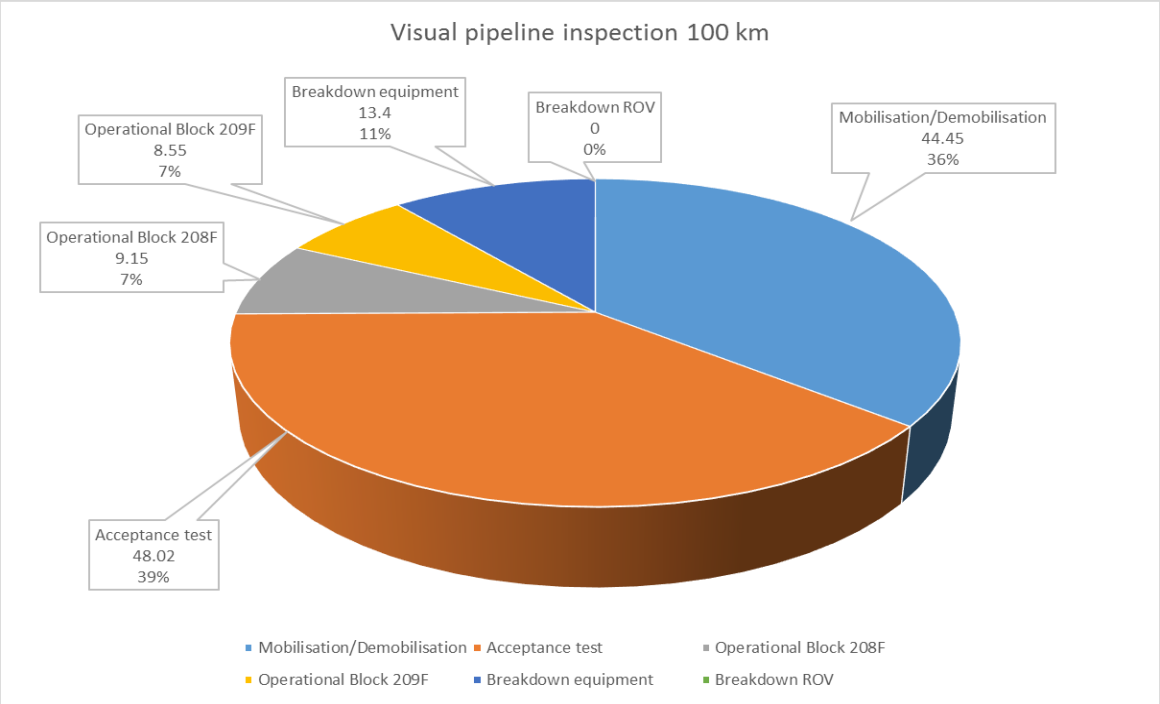
SROV TRIALS



SURVEY SENSORS

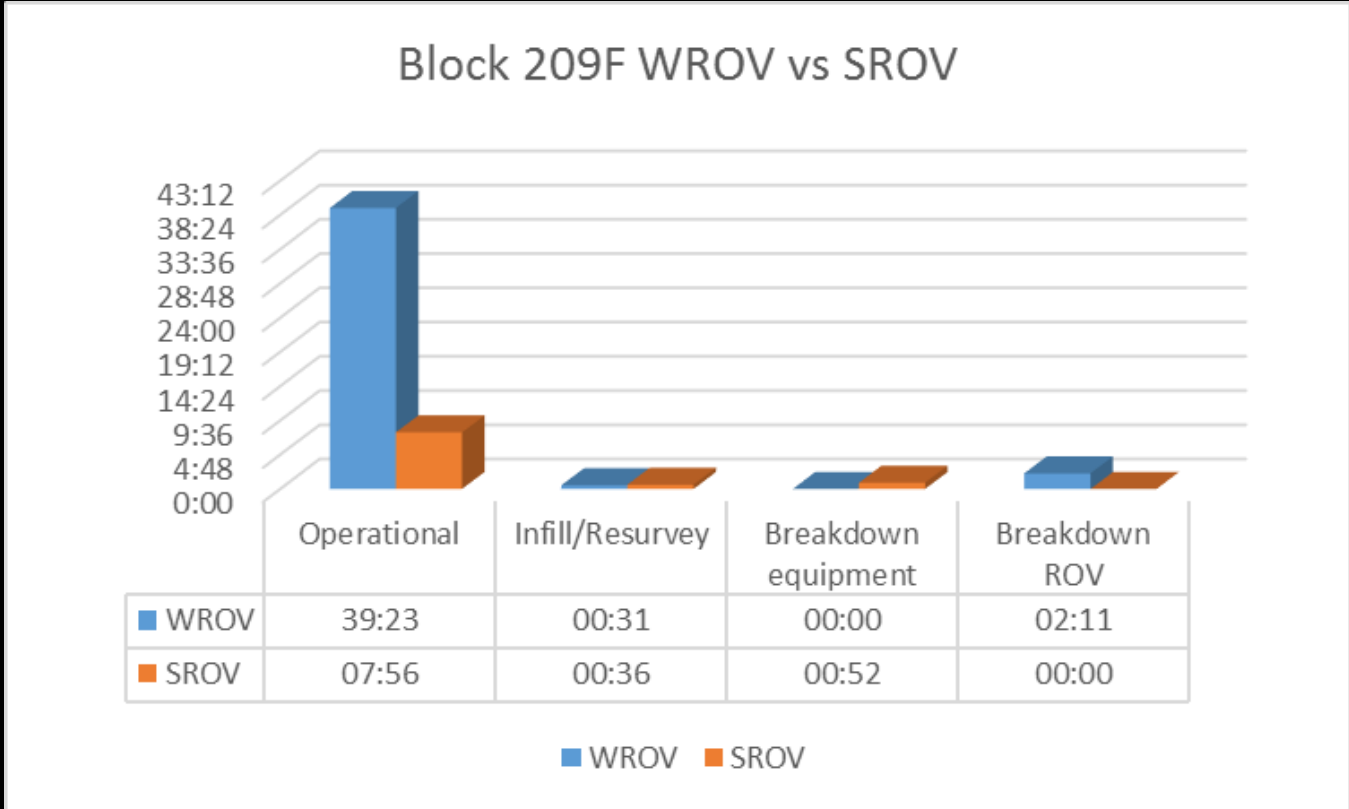
- Kongsberg EM2040D
- 5 x still cameras (Cathx)
- 2 x imaging sonars (Gemini 720i)
- Pipetracker (10 x GMA1000)

VISUAL PIPELINE INSPECTION (100 km)



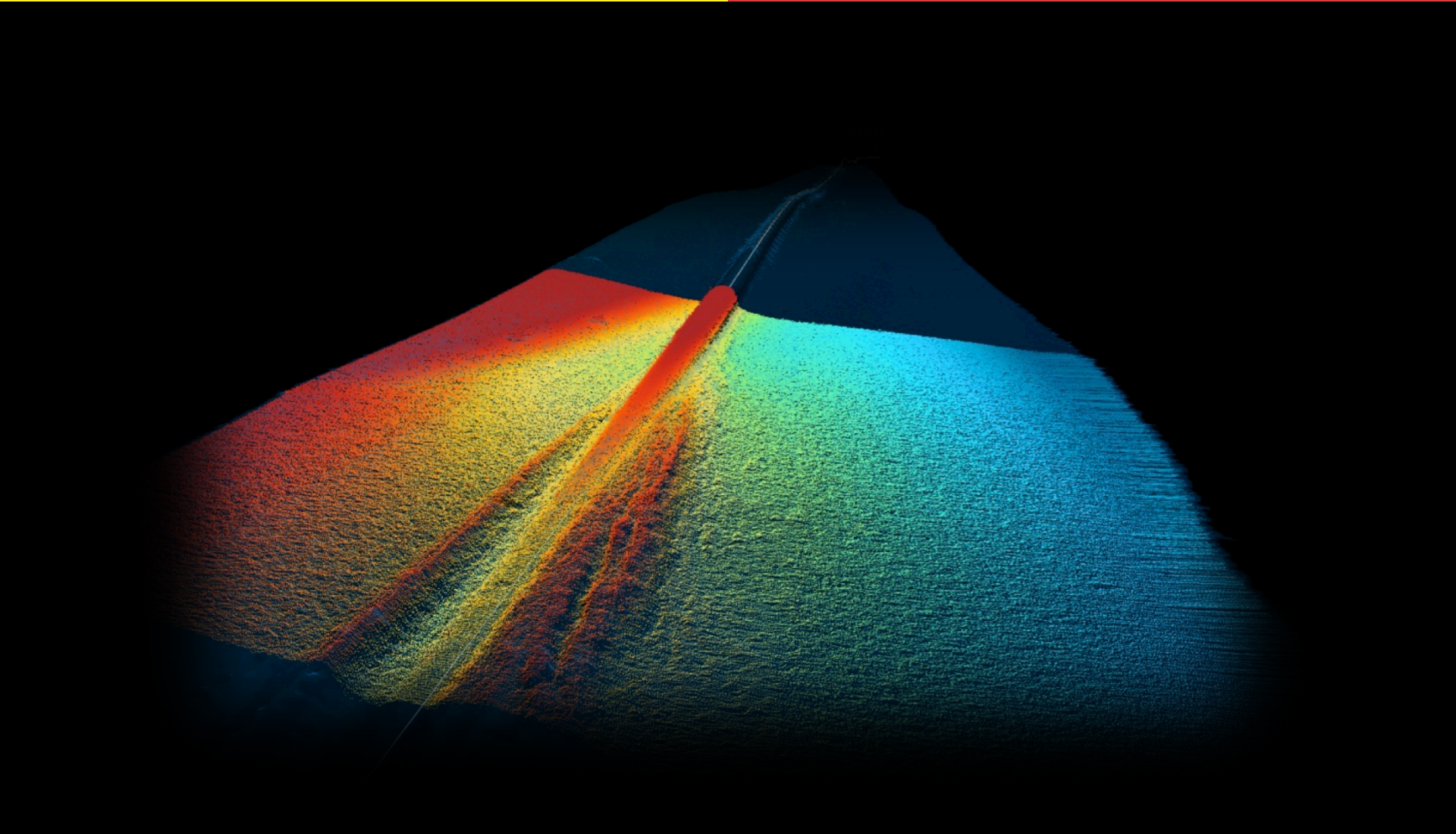
CATEGORY	HOURS	PERCENT %
Mobilisation/Demobilisation	44.45	35.97%
Acceptance test	48.02	38.86%
Operational Block 208F	9.15	7.40%
Operational Block 209F	8.55	6.92%
Breakdown equipment	13.4	10.84%
Breakdown ROV	0	0

VISUAL PIPELINE INSPECTION (B209F)

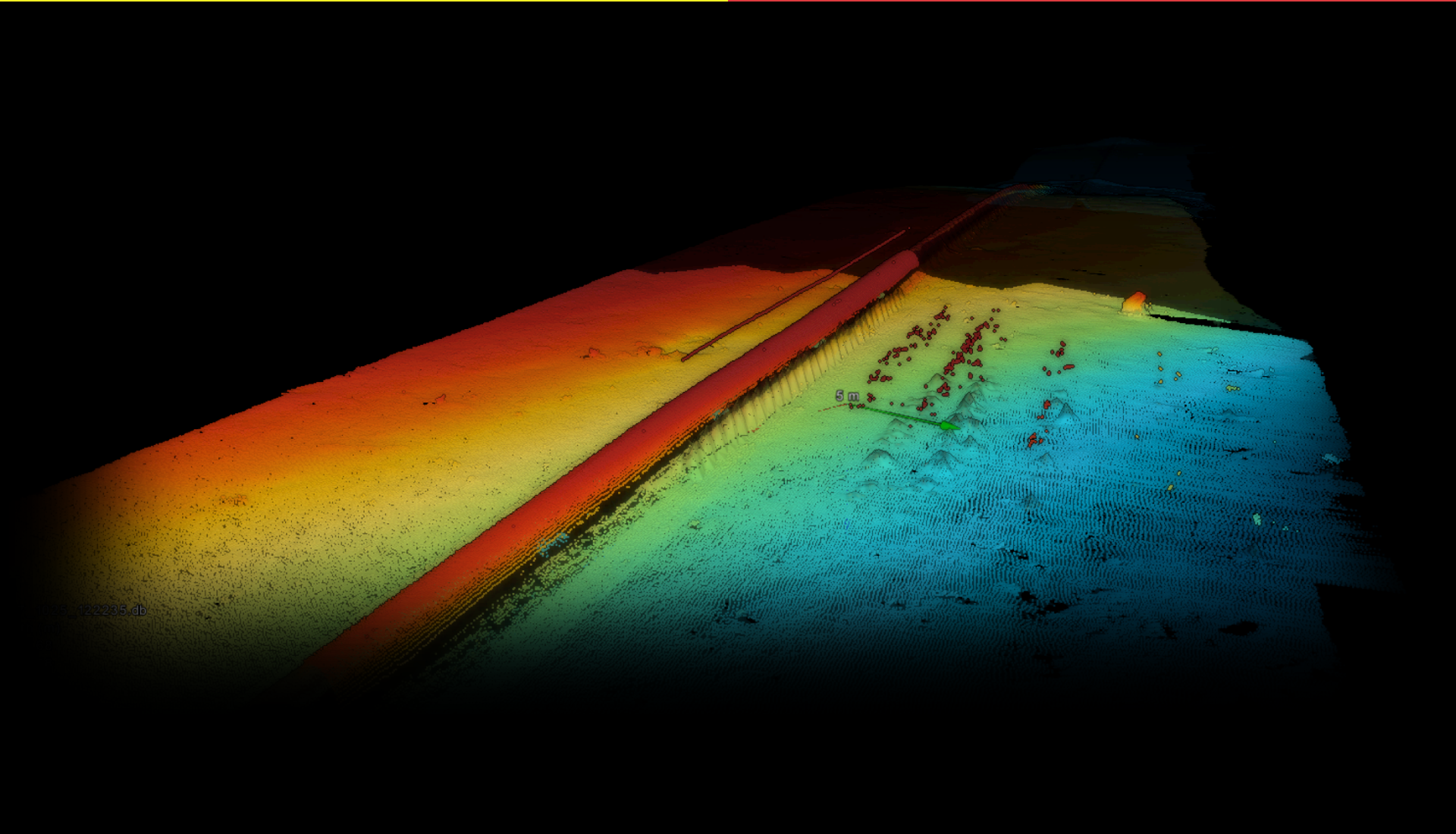


	Operational	Infill/Resurvey	Breakdown equipment	Breakdown ROV
WROV	39:23	00:31	00:00	02:11
SROV	07:56	00:36	00:52	00:00

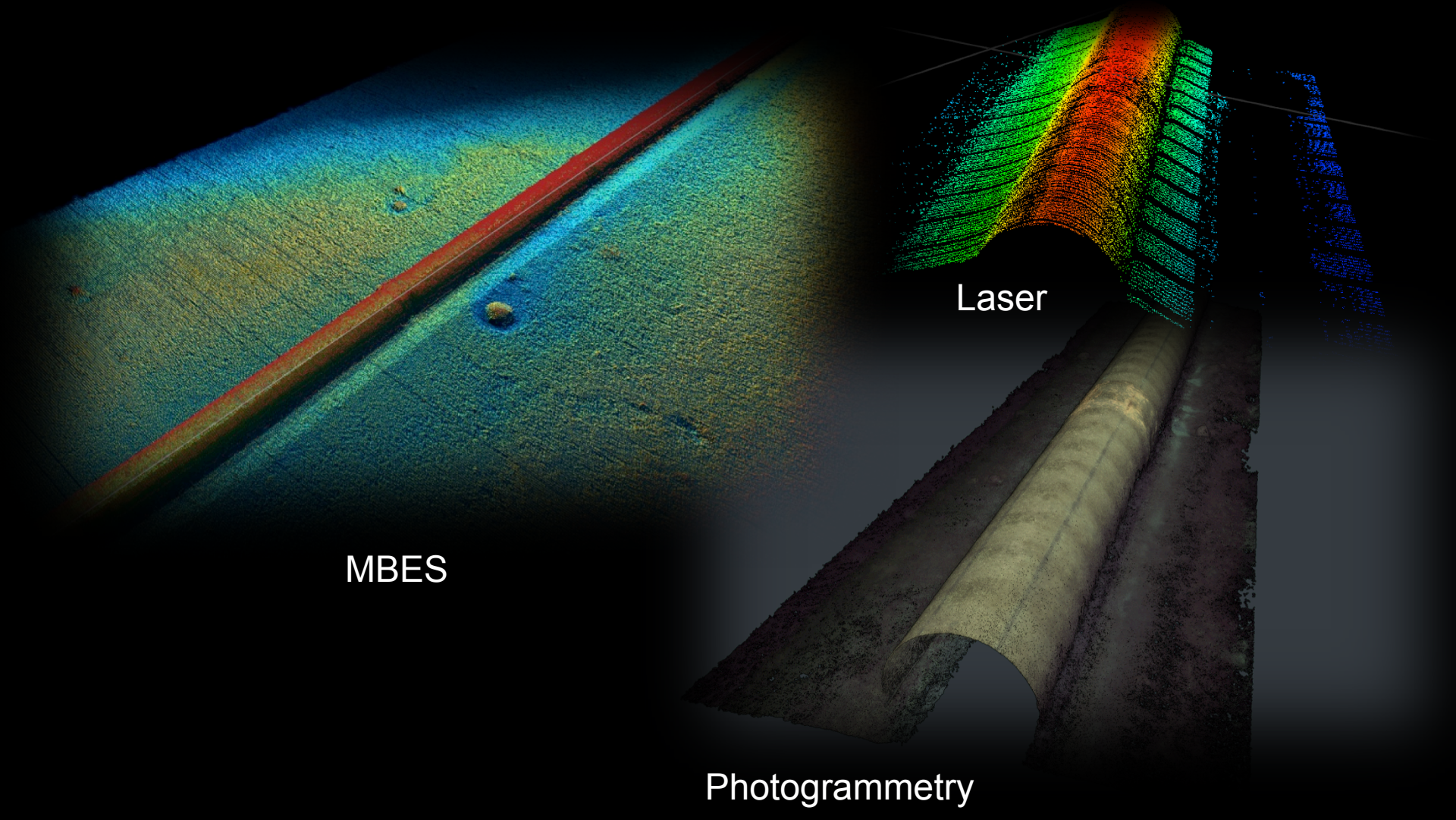
Raw MBES point cloud SROV



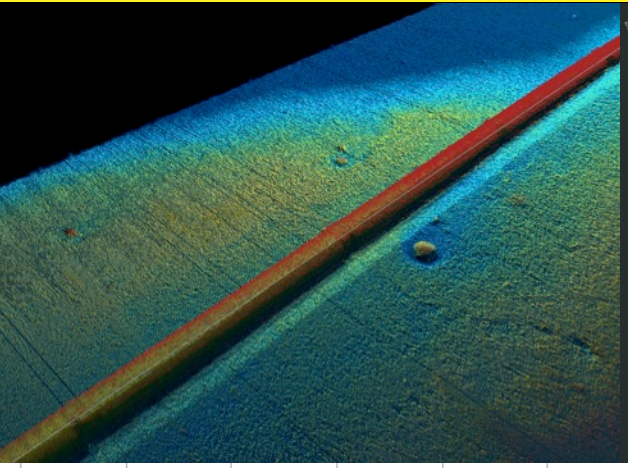
Raw MBES point cloud WROV

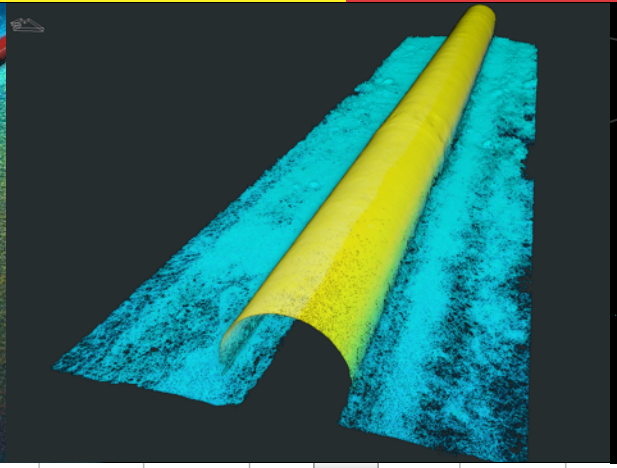


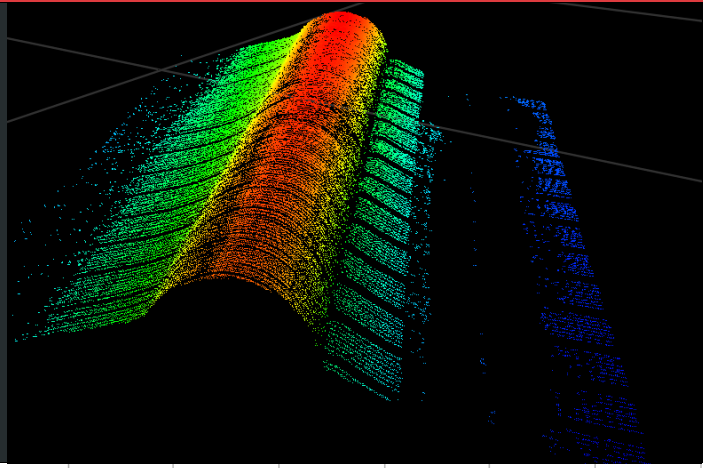
Raw point clouds

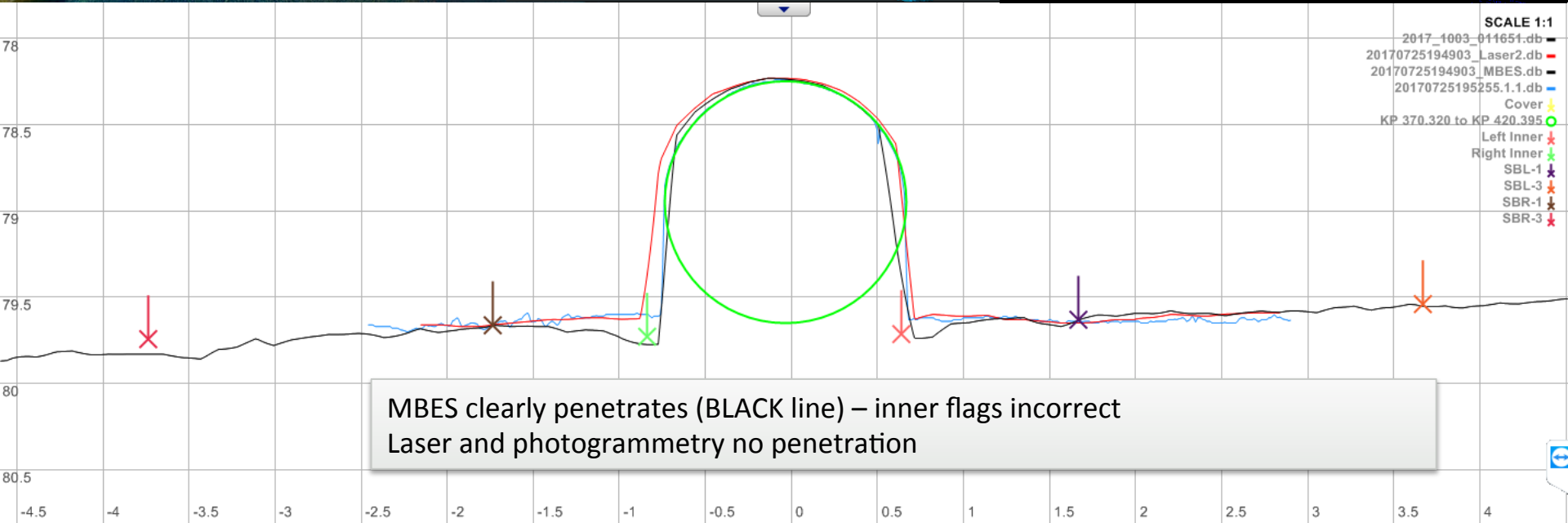


PENETRATION AND INNER FLAGS



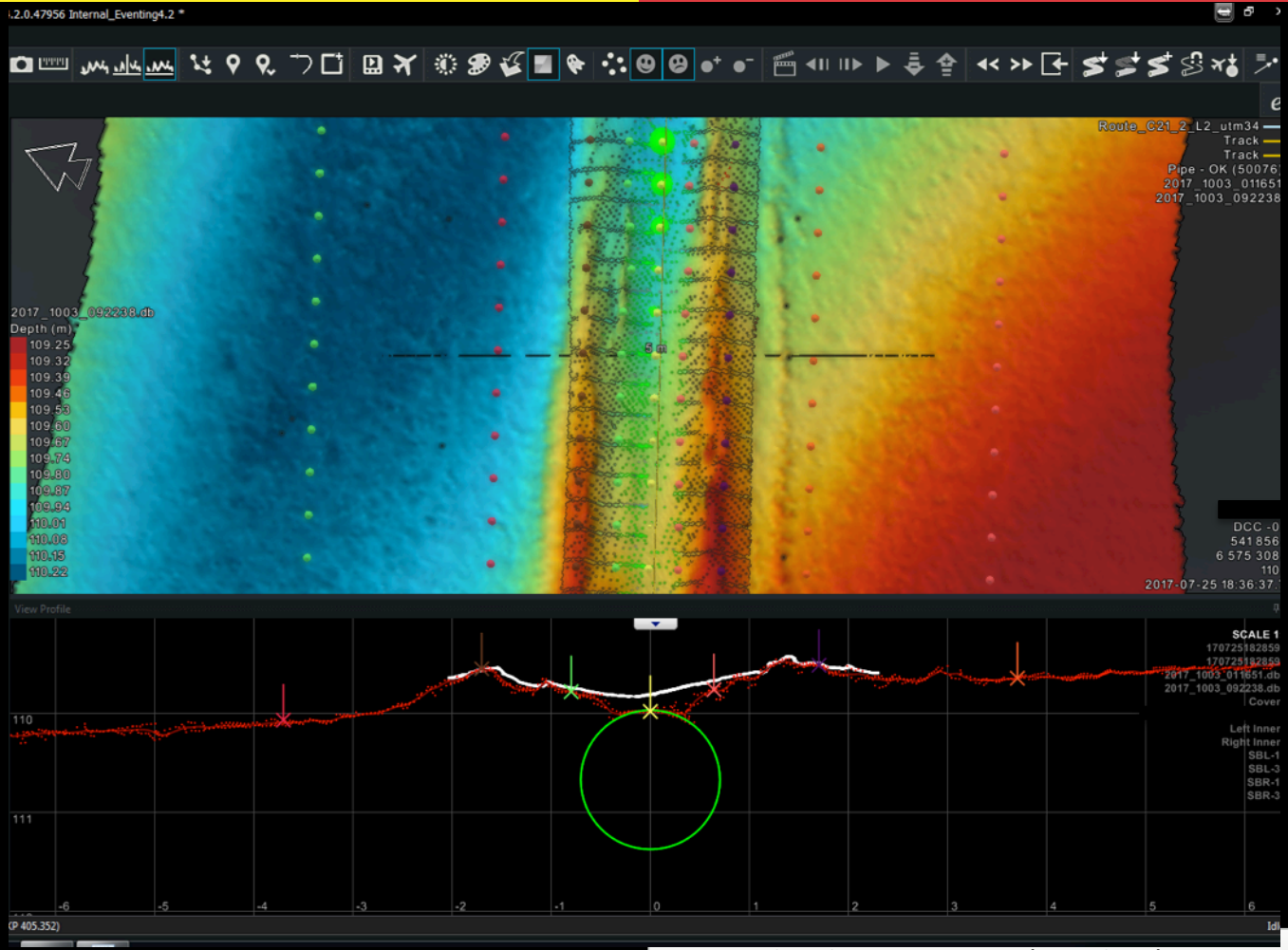






MBES clearly penetrates (BLACK line) – inner flags incorrect
Laser and photogrammetry no penetration

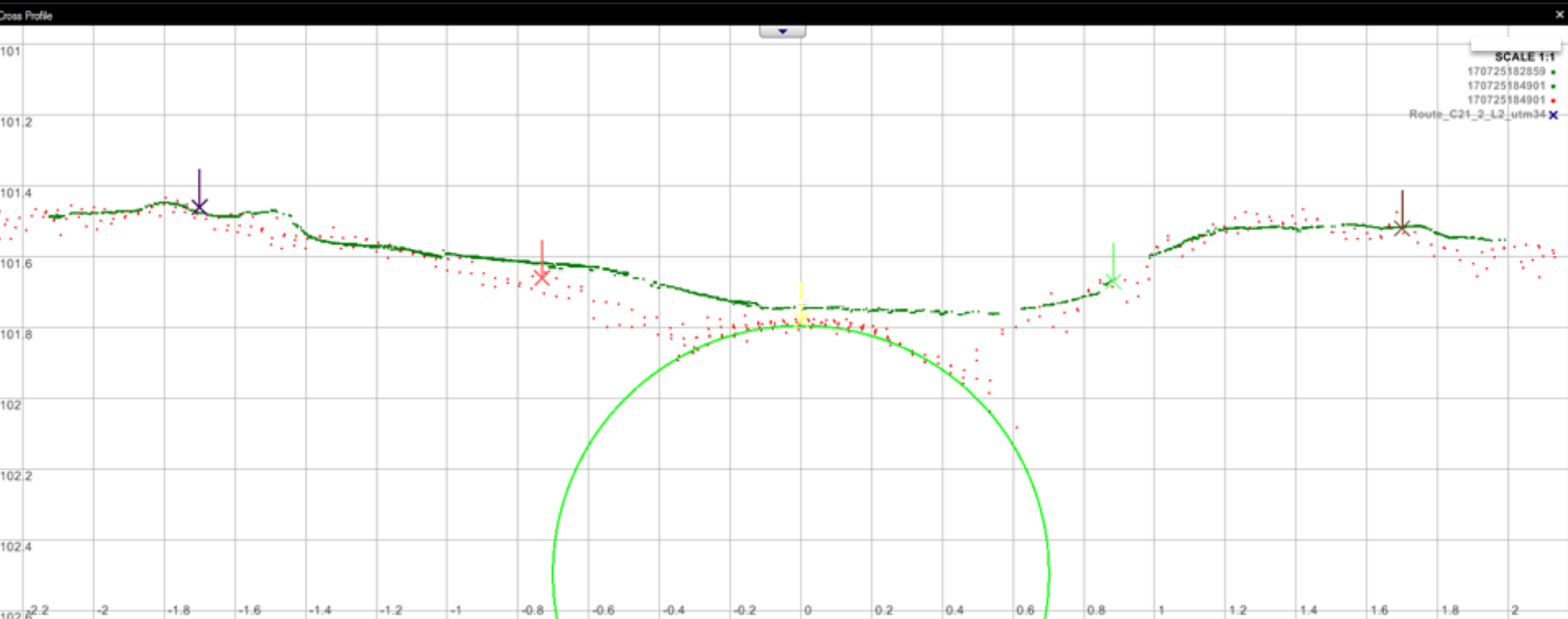
PENETRATION AND INNER FLAGS



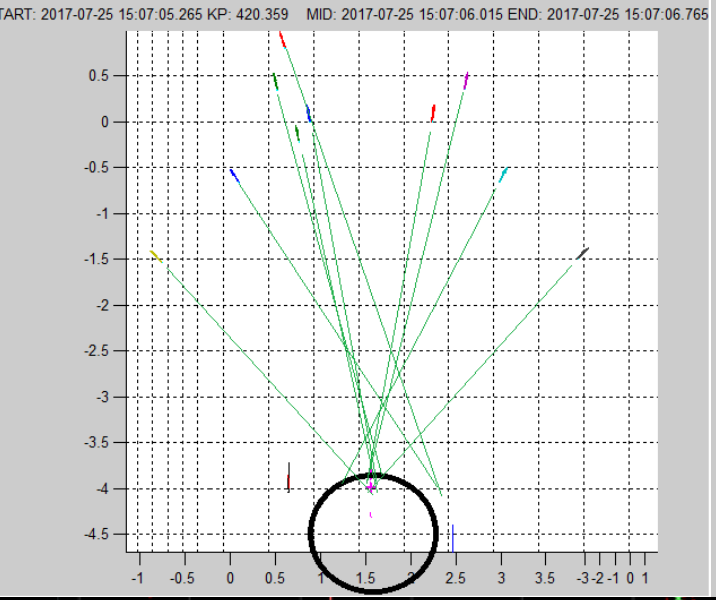
MBES clearly penetrates (RED line) – inner flags incorrect
Laser and photogrammetry no penetration

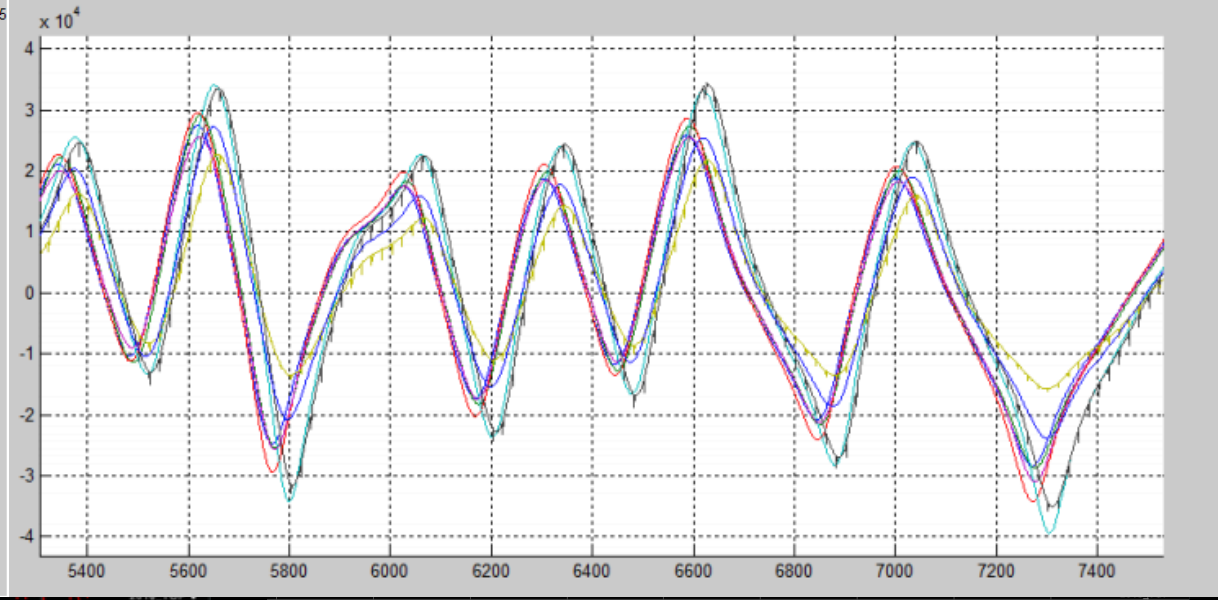
CONCLUSION PENETRATION

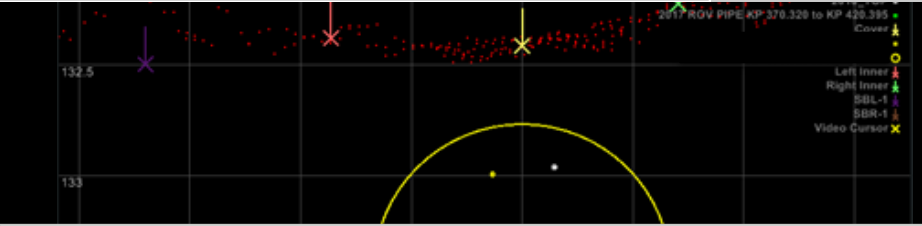
- Laser (and photogrammetry) can be of great value for the Top Of Pipe (TOP) and inner flag quality in areas with penetration issues, however subject to visibility
- MMT plans to conduct a test during Q4 to use two high frequency MBES to cover the TOP ±1.5 m with the purpose to increase the quality of the data and not be dependent on visibility

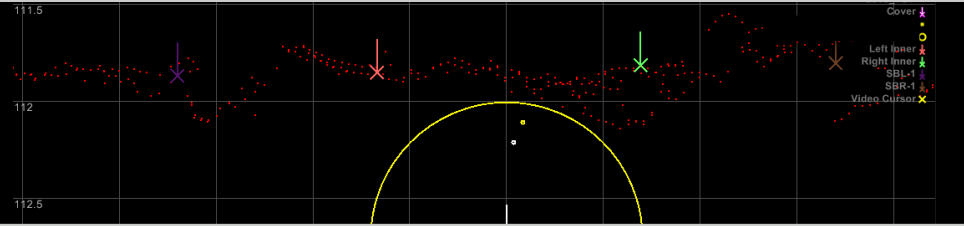


PIPETRACKER / DOB









White dot = TSS 2016 Yellow dot=GMA 1000 Yellow pipe = TSS 2017

A passive pipe tracking system has been developed on 10 GMA-1000 sensors in the SROV and the boom arms.

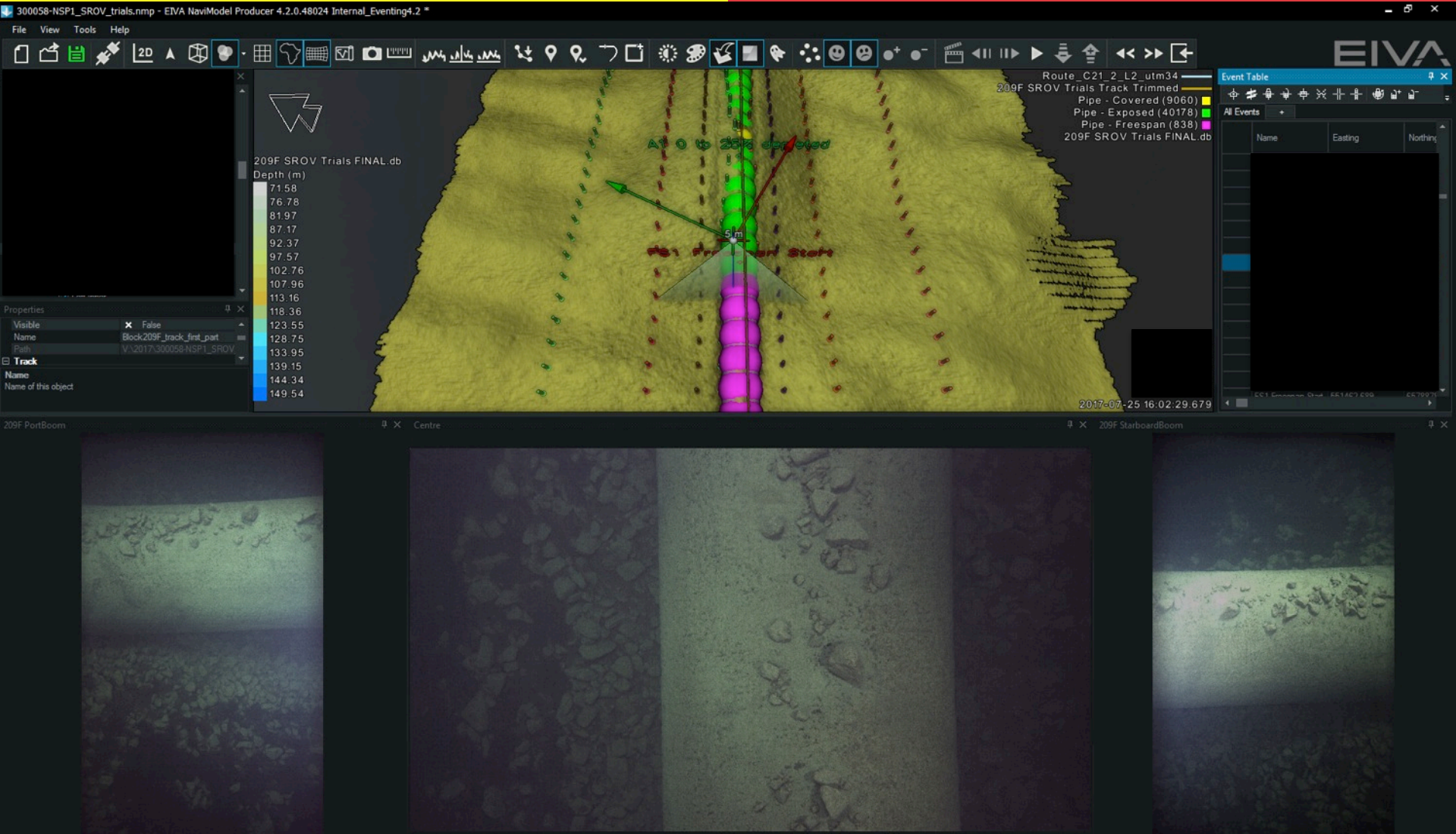
The results show that pipe detection with a <0.2m accuracy is possible. The position of the boom arms is crucial and a system to utilise precise angle sensors is presently being developed.
More test runs are necessary.

REPORTING (B209F)

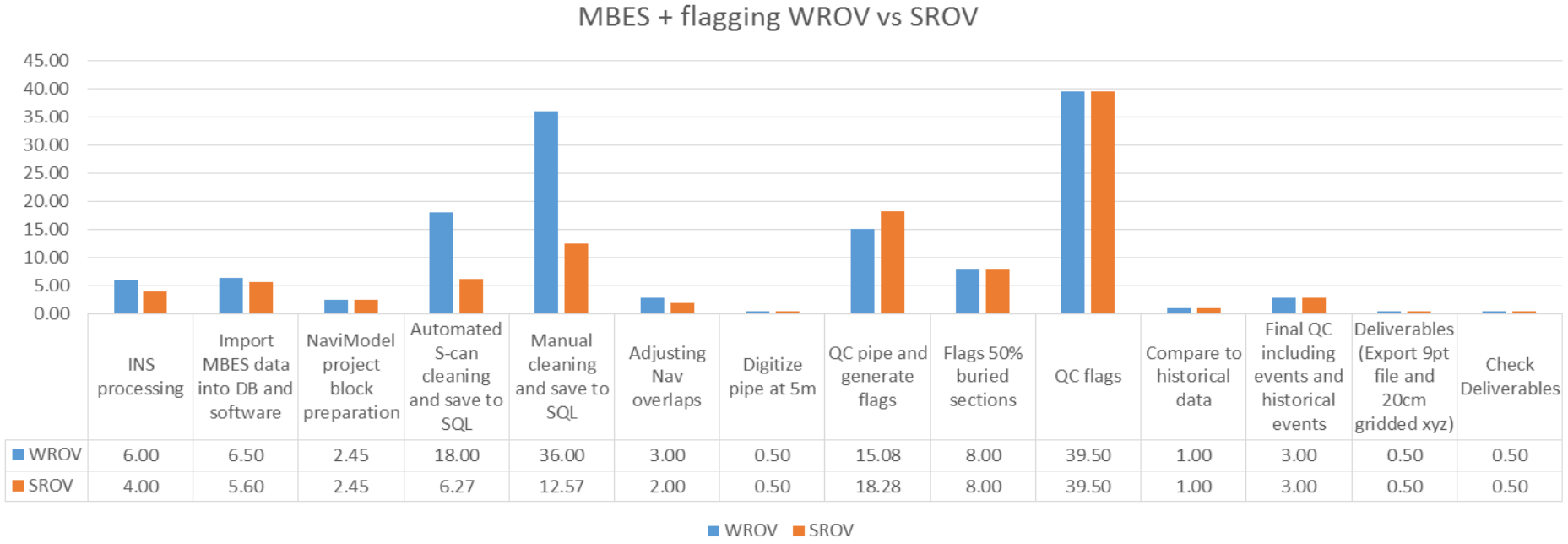
All processing, flagging and eventing were performed in EIVA NaviModel

During the reporting new functions were developed. Functionality and performance will be optimised during Q4 -17 / Q1 -18

REPORTING (B209F)



REPORTING (B209F)



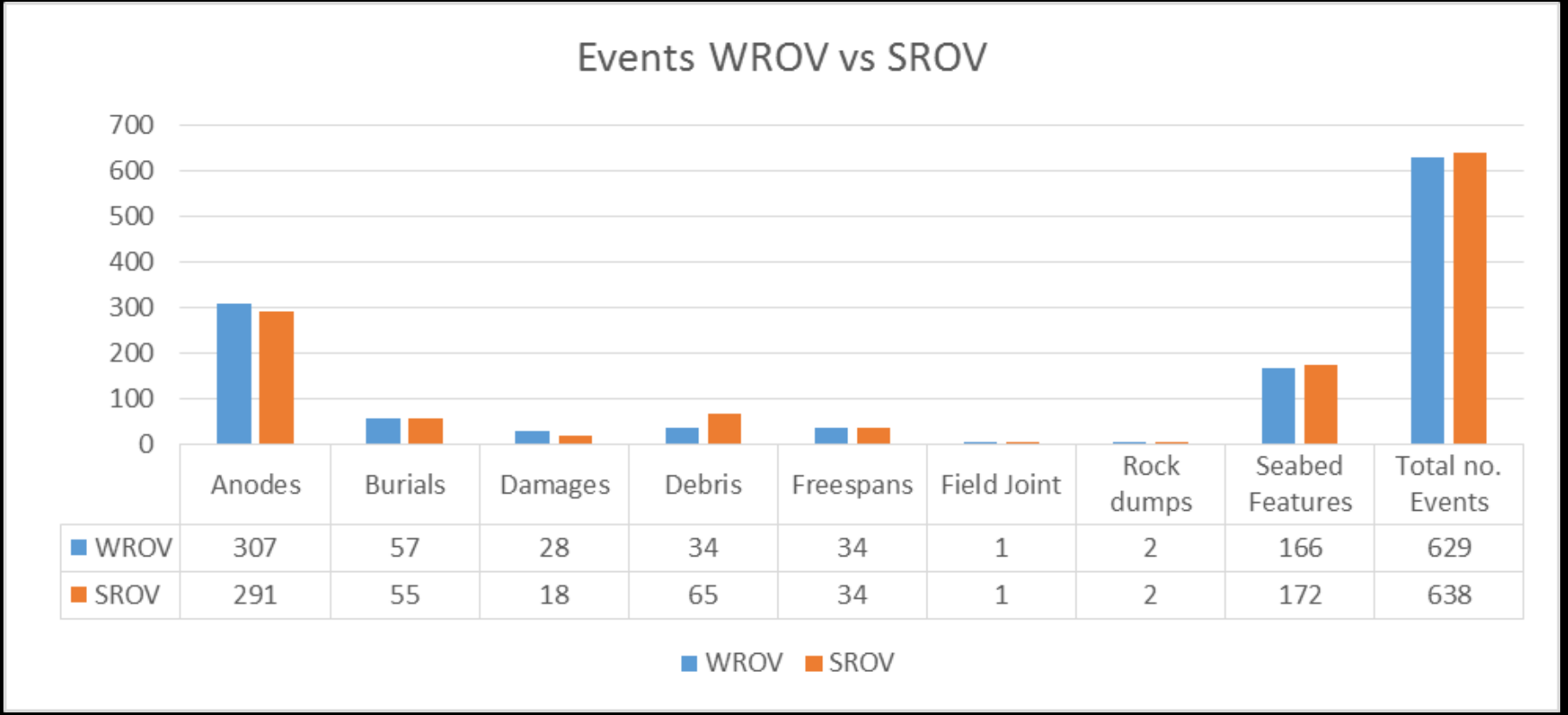
EVENTING / VISUAL REVIEW	WROV	SROV
Preparing data	8	-
Eventing	95	104
Final QC and deliverables	8	5
Total eventing / visual review	**111**	**109**
DELIVERIES AND REVIEW	**WROV**	**SROV**
Compiling deliverables and internal review	36	36
Revision to 03	24	24
Revise to final (including block report)	24	24
Total deliveries and review	**84**	**84**

Total man hours reporting: WROV: 335 hours
Total man hours reporting: SROV: 297 hours

Comments rev02 delivery: 22
Comments rev03 deliver: 10

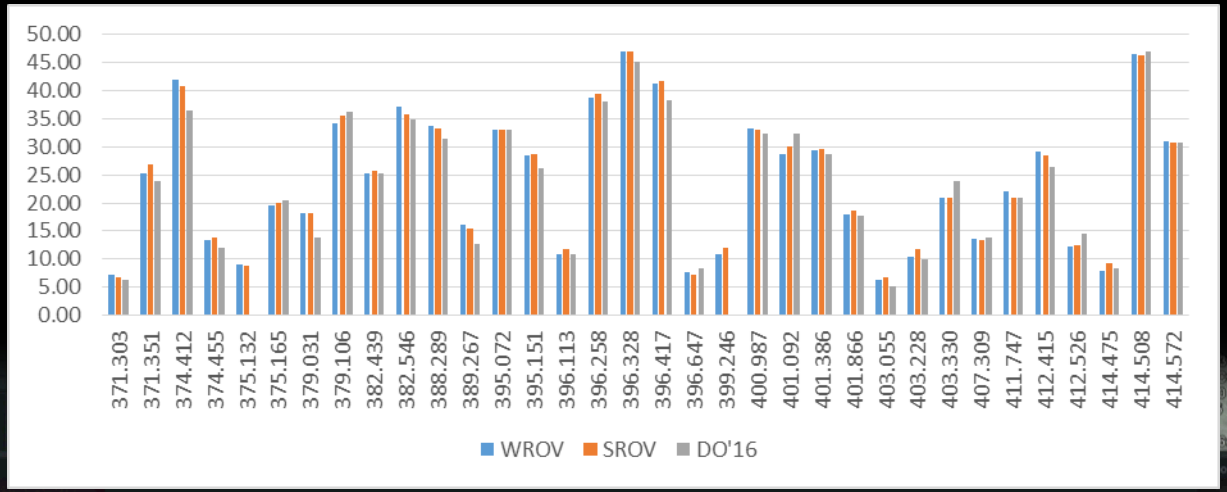
30% comments relates to inconsistency between deliverables

EVENTS (B209F)



	Anodes	Burials	Damages	Debris	Freespans	Field Joint	Rock dumps	Seabed Features	Total no. Events
WROV	307	57	28	34	34	1	2	166	629
SROV	291	55	18	65	34	1	2	172	638

FREESPANS (B209F)

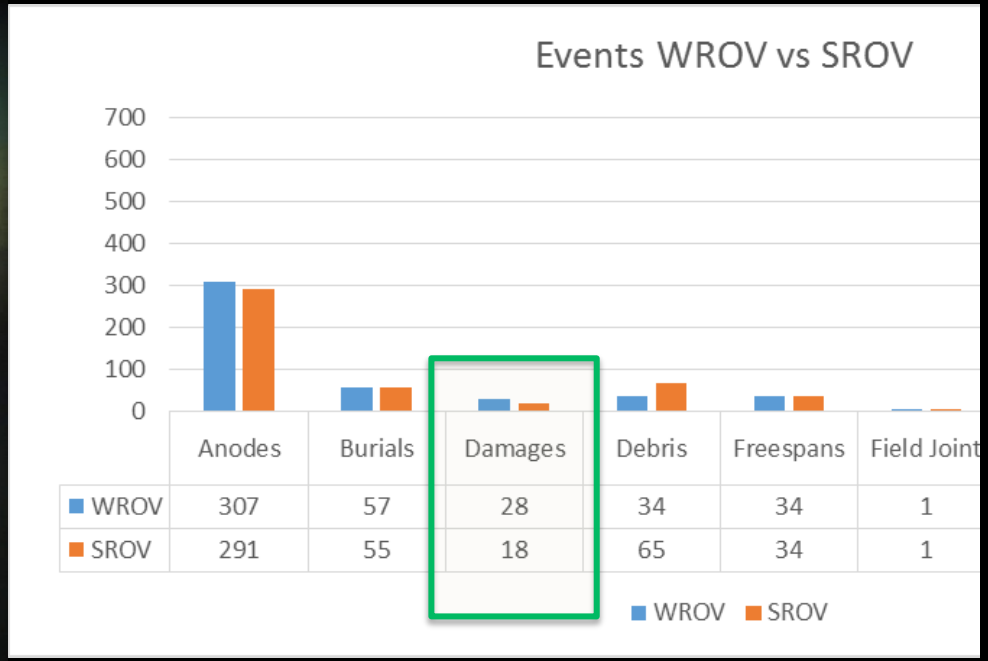


SURVEY	TOTAL NO.	TOTAL LENGTH	STDEV. DIFF LENGTH	TOTAL HEIGHT	STDEV. DIFF HEIGHT
WROV	34	809 m	0.73 m	11.85	0.03 m
SROV	34	815 m	-	12.44	-
Survey 2016	33	772 m	1.76 m	12.6	0.05 m

There is one new freespan reported 2017 compared to 2016. The WROV and the SROV survey correlates well.

The surveys were conducted only 10 days apart, the variances in total length is likely due to the different survey configuration and subjective processing. There is a trend towards longer freespans from 2016-2017.

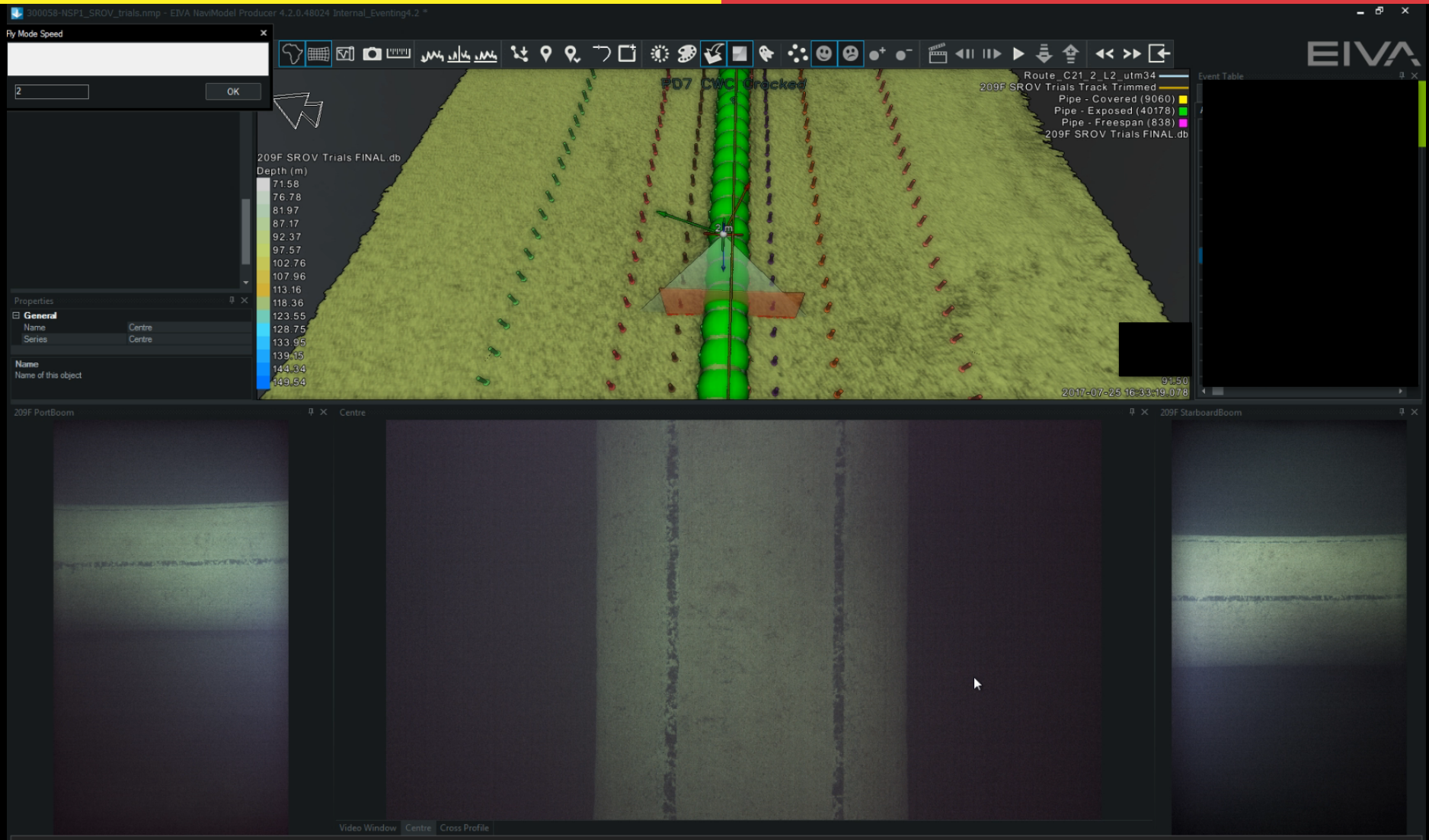
DAMAGES (B209F)



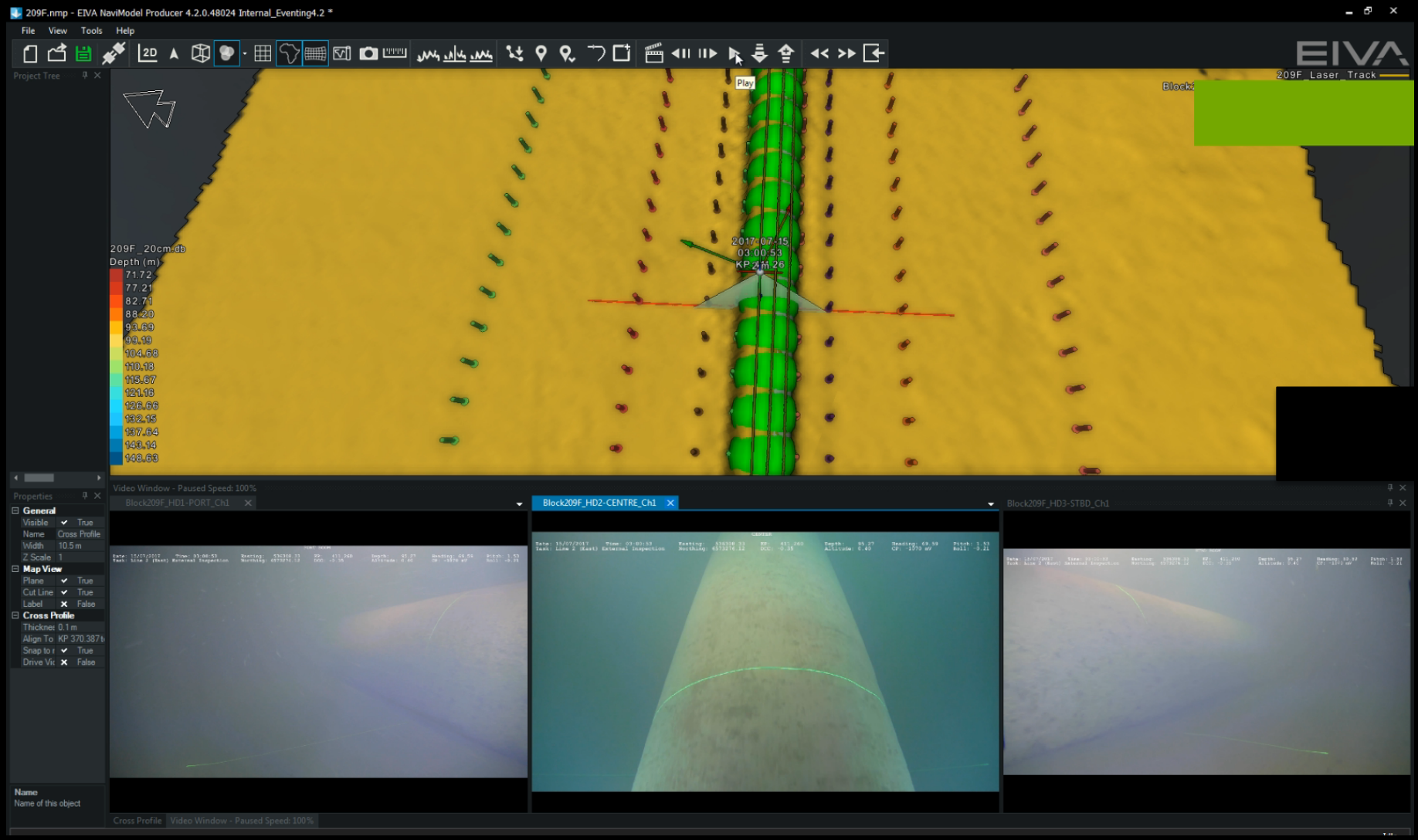
The 2017 SROV survey struggled to identify damages at clock position 4 to 8 – lower survey altitude needed

The 2017 WROV survey reported 16 damages outside clock position 5 to 7 compared to the SROV's 18

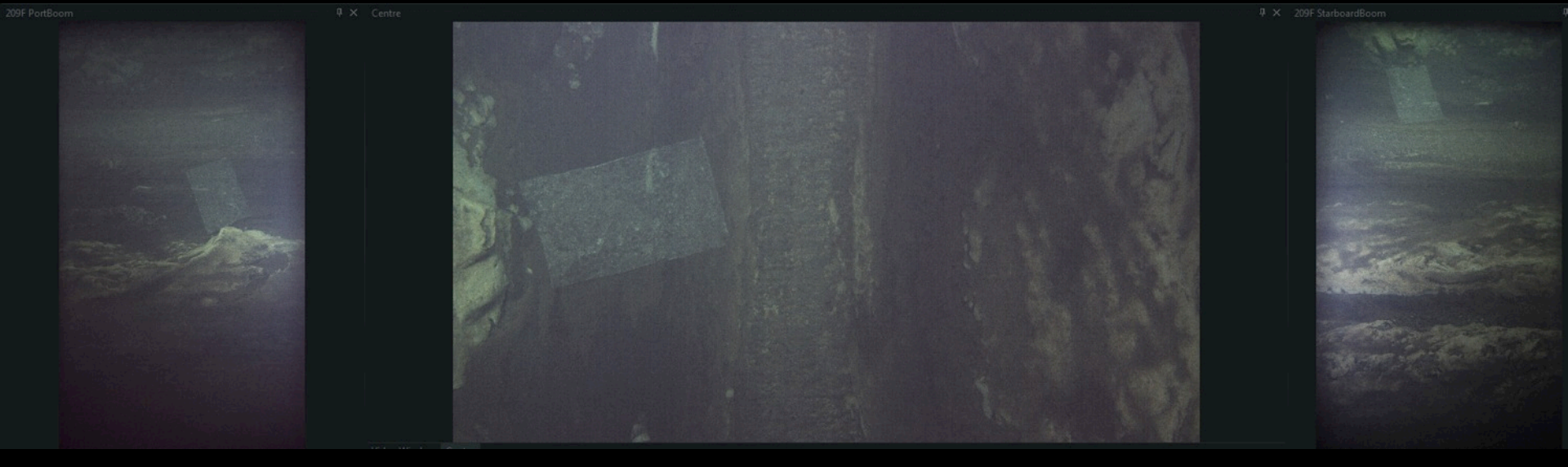
VISUAL DATA EXAMPLES



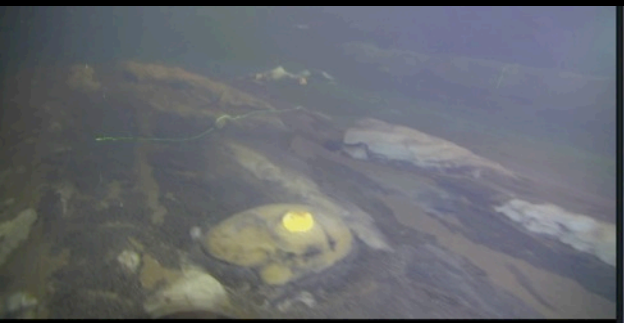
VISUAL DATA EXAMPLES

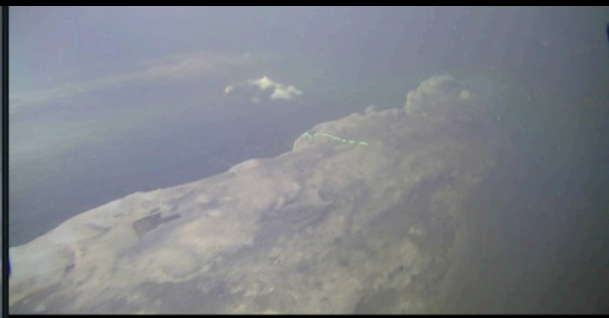


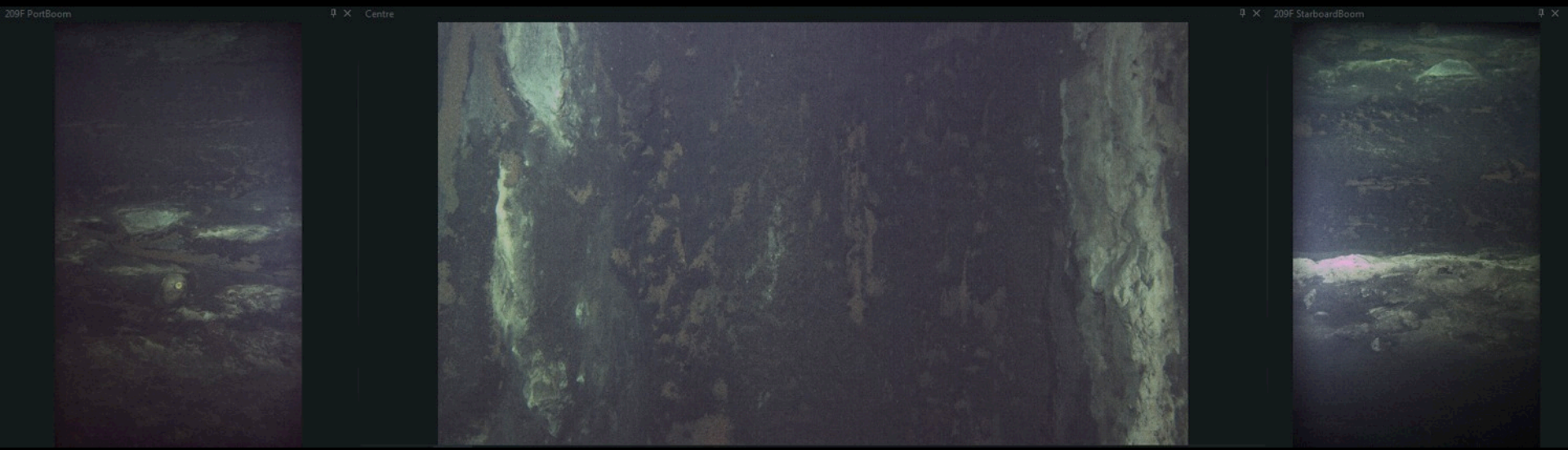
DEBRIS (B209F)



DEBRIS (B209F)







CONCLUSION BOOM STILL CAMERAS

General

- Still imagery resolution is significantly higher than video however more light is needed

Freespan detection

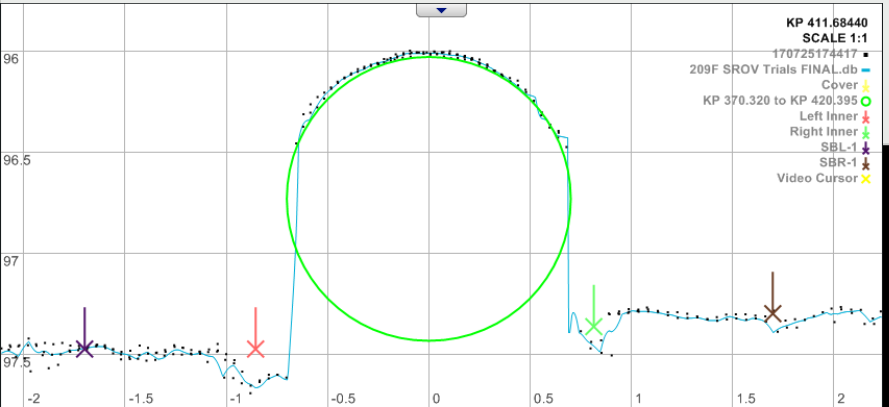
- Freespan detection using acoustic sensors correlates with previous surveys
- Minor freespans are sensitive to degraded MBES data (see example below)

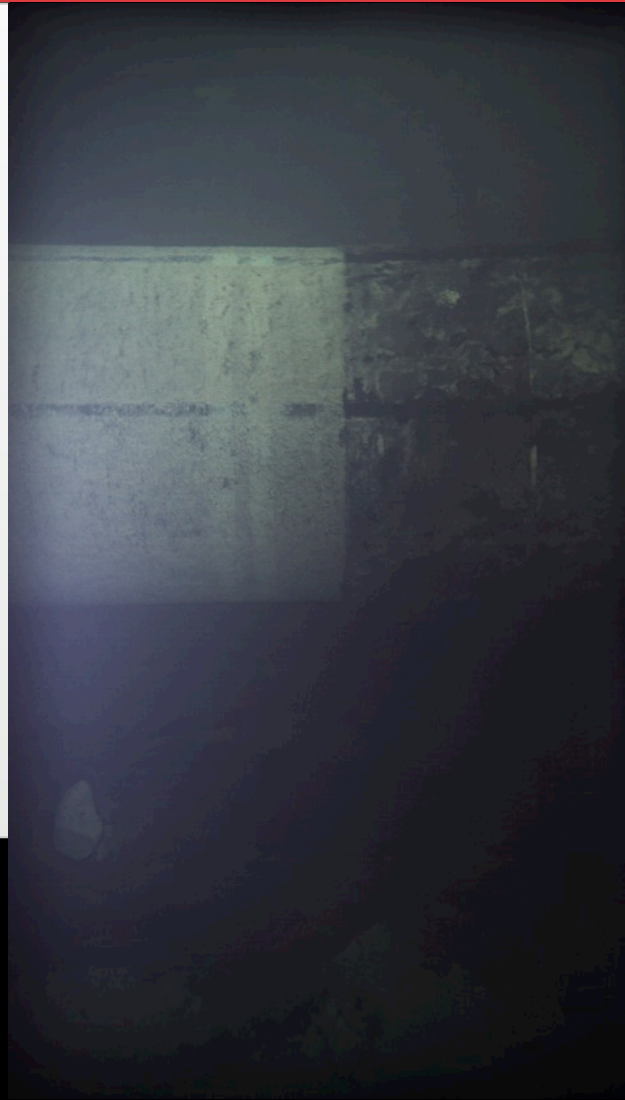
Events Clock position 5 to 7

- Lower events hard to distinguish at dark seafloor

Remedy

- Survey altitude needs to be lower and additional lights to be fitted to the booms for visual confirmation

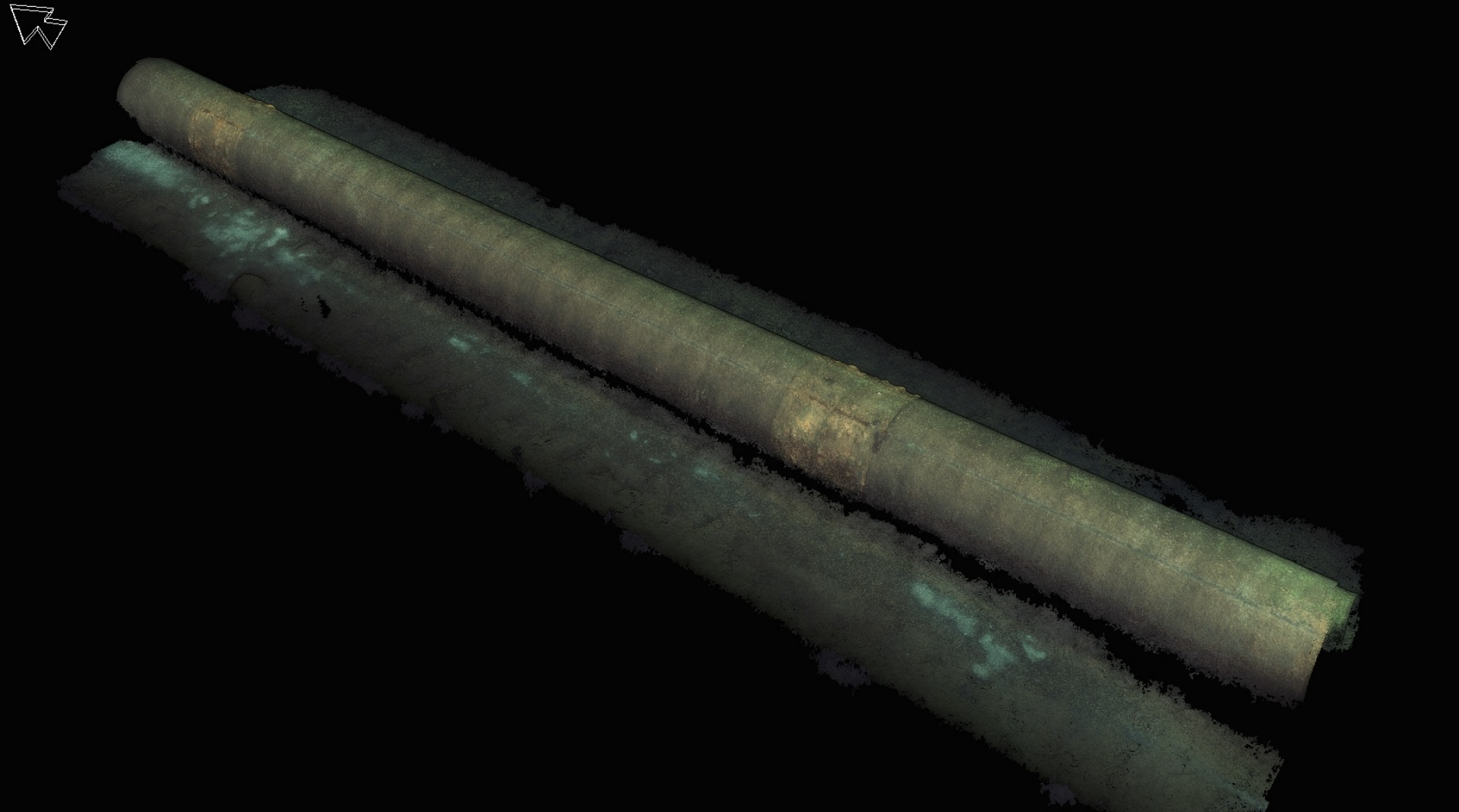




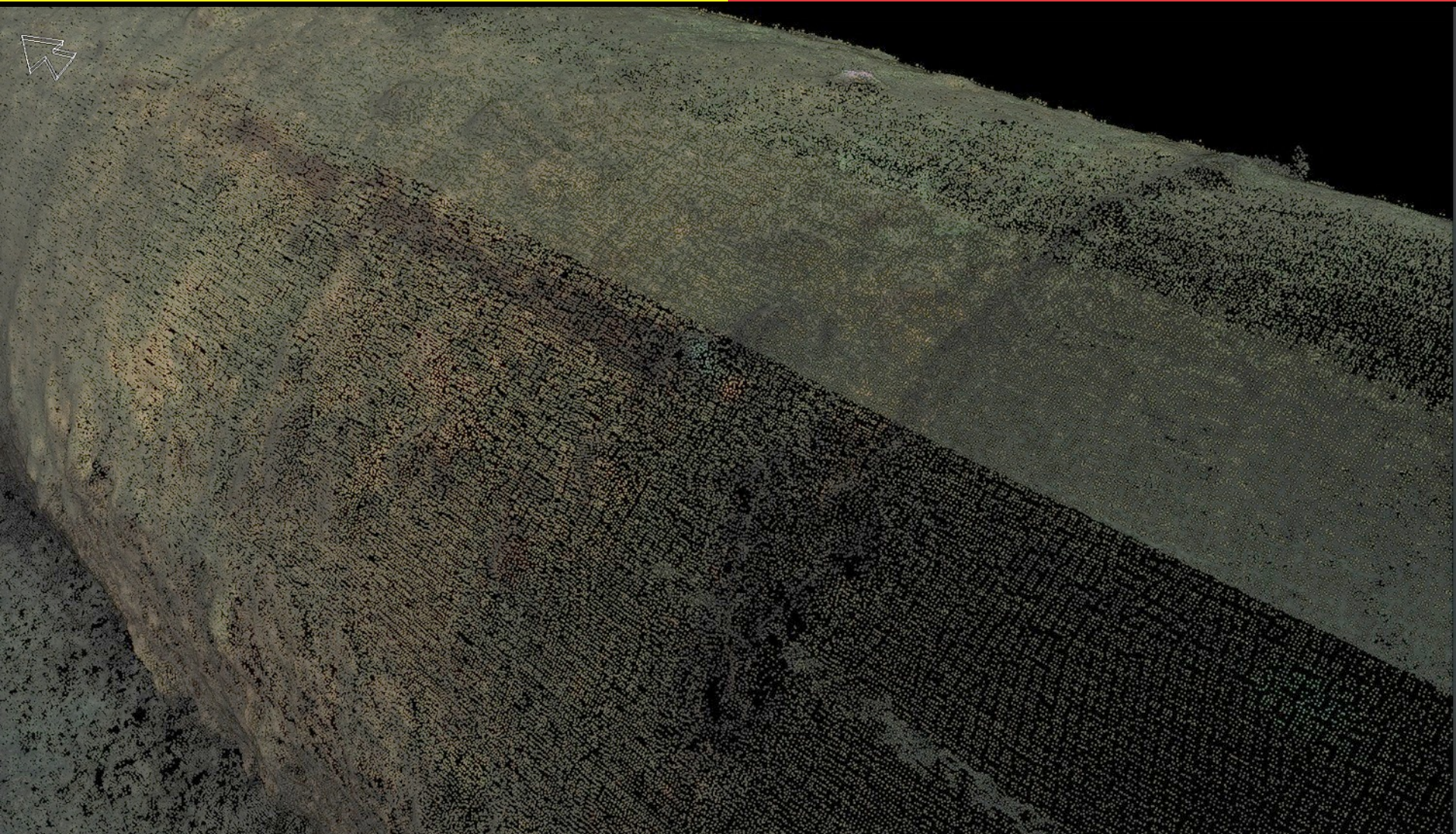
Photomosaic of 20m pipe section

178 images 5 cameras

EXAMPLES



EXAMPLES



CONCLUSIONS

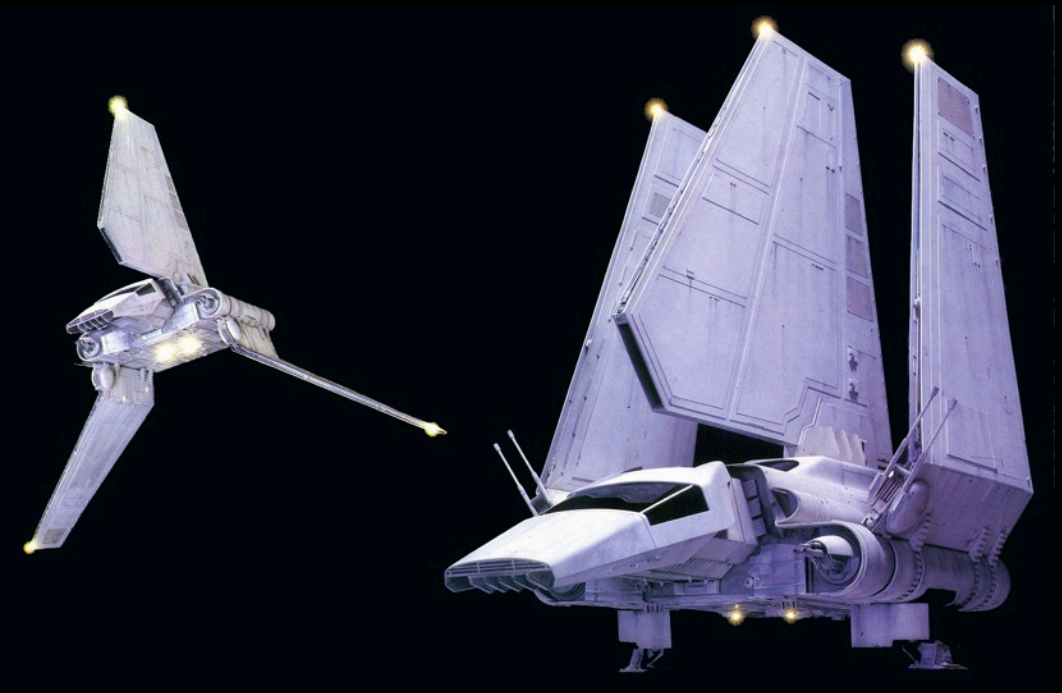
- Traditional Inspection 2017 2400 km — 2223 hours
- 1.07 km/h average inspection speed excluding hi-flies, — 92 days
- Other activities . Target inspection transit CX — 50 days
- Total execution — 142 days

- Possible future inspection — 420 hours

- 5 km/h average — 25 days
- Other activities — 35 days
- Total execution — 60 days

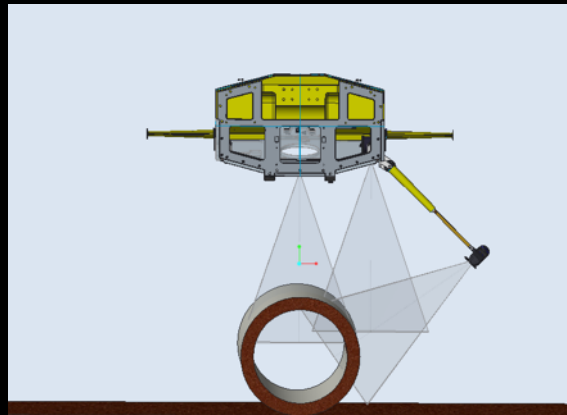
Goal Time Reduction 50%

SROV II



SROV nr 2 is underway

Delivery Q1 2018



THANK YOU!

QUESTIONS ?

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