4D OCEAN

ASV & UAV Surveys

A First Year’s Experience

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- Specialist ASV, UAV and AUV survey services provider
- A new company but full of experience (25 years of multibeam, 14 years of IHO hydrographic survey, 25 years of pipeline inspection)
- Specialist personnel, equipment and software
- ASVs fully equipped for hydrographic and geophysical surveys with full data processing and reporting
- UAVs for topographic, habitat mapping, precision agriculture, asset inspection and archaeology
- AUVs for when resolution matters - subsea assets, archaeology, habitat mapping

Autonomous Survey Equipment

ASV

- SeaRobotics ASV 2.5
- R2Sonic 2020 multibeam echosounder
- Applanix POS MV Wavemaster INS

UAV

- senseFly eBee Plus RTK UAV
- S.O.D.A 20 MP or Parrot Sequoia Multispectral Camera

AUV

- Kongsberg MUNIN AUV
- Kongsberg EM2040 multibeam echosounder
- Kongsberg SAS Sonar

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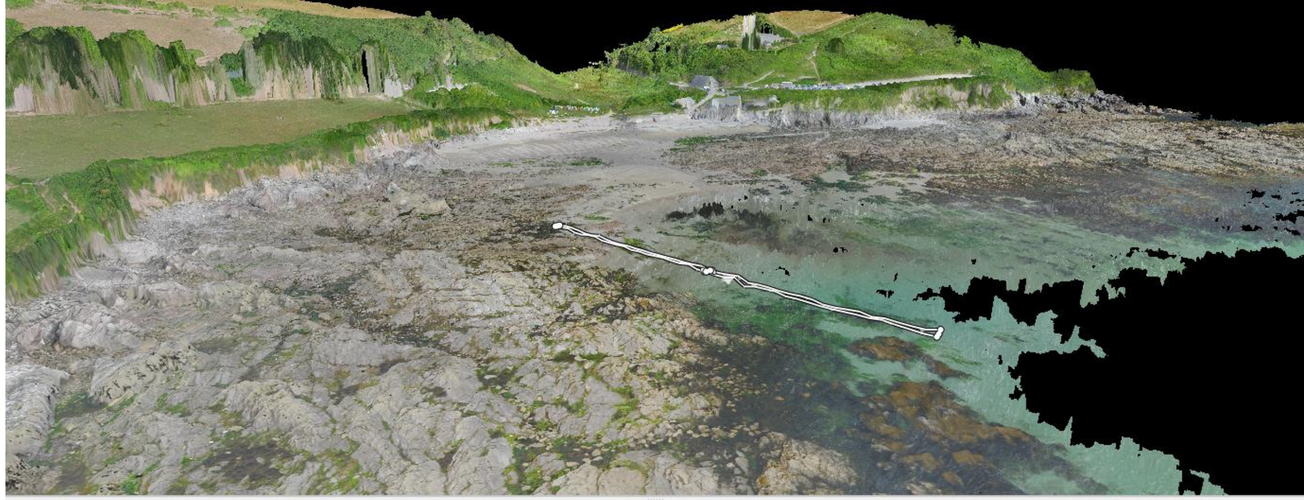
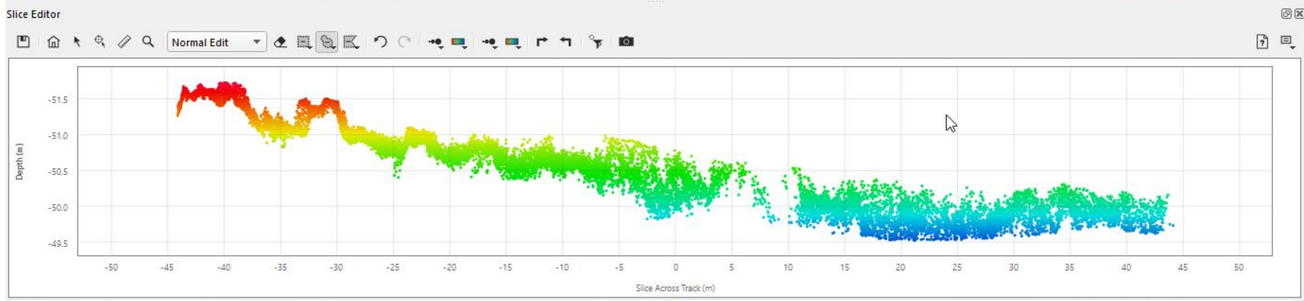
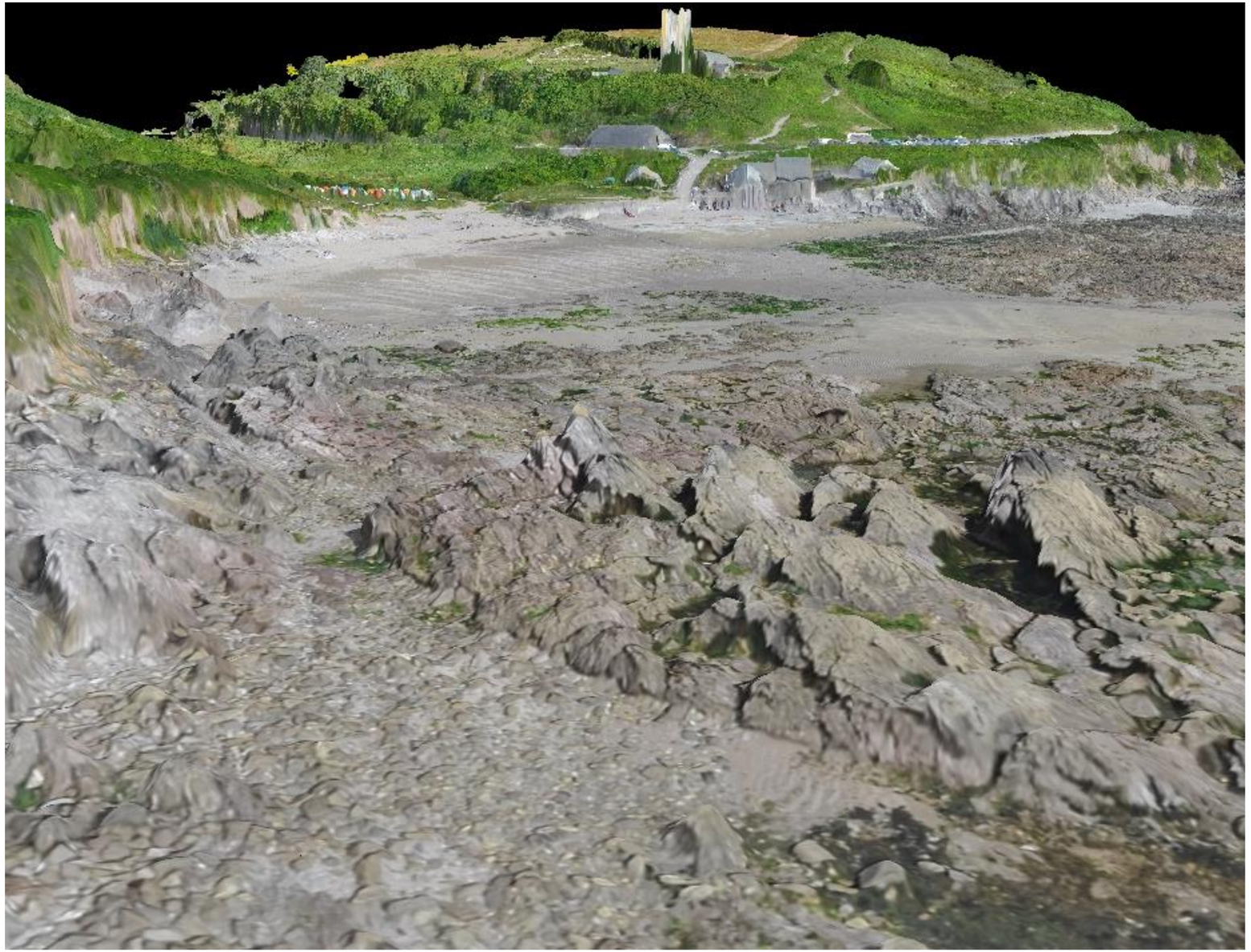
Wembury Bay – 1st Coastal UAV Survey by 4D Ocean

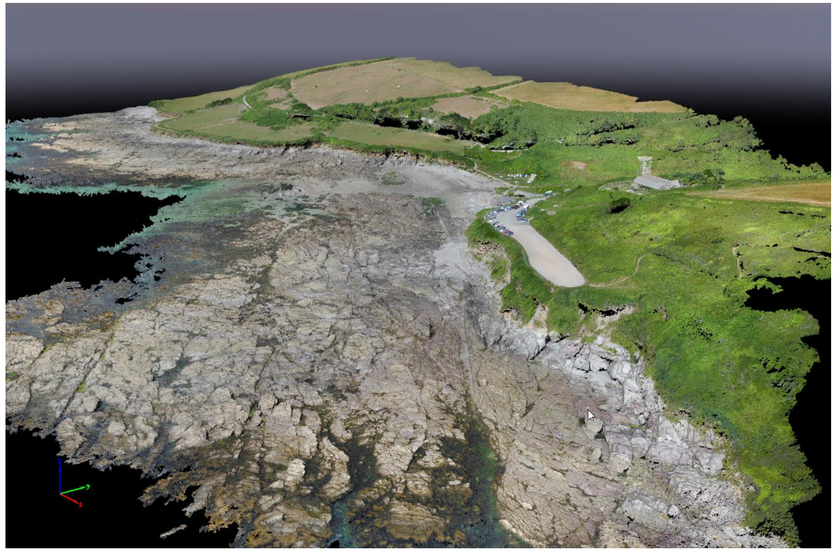
- Surveyed at low water
- No mobile phone reception meant no RTK data so GNSS had to be post processed – turned out to be very easy
- Multi-spectral camera used for one flight to collect data for further analysis to see if it can be used like Satellite Derived Bathymetry
- Two Discoveries were found

1. Bathymetry to 1 or 2 m water depth is possible if the water is clear
2. Surveying is cool when using drones! – My son and friend accompanied me for work experience and that was their finding.









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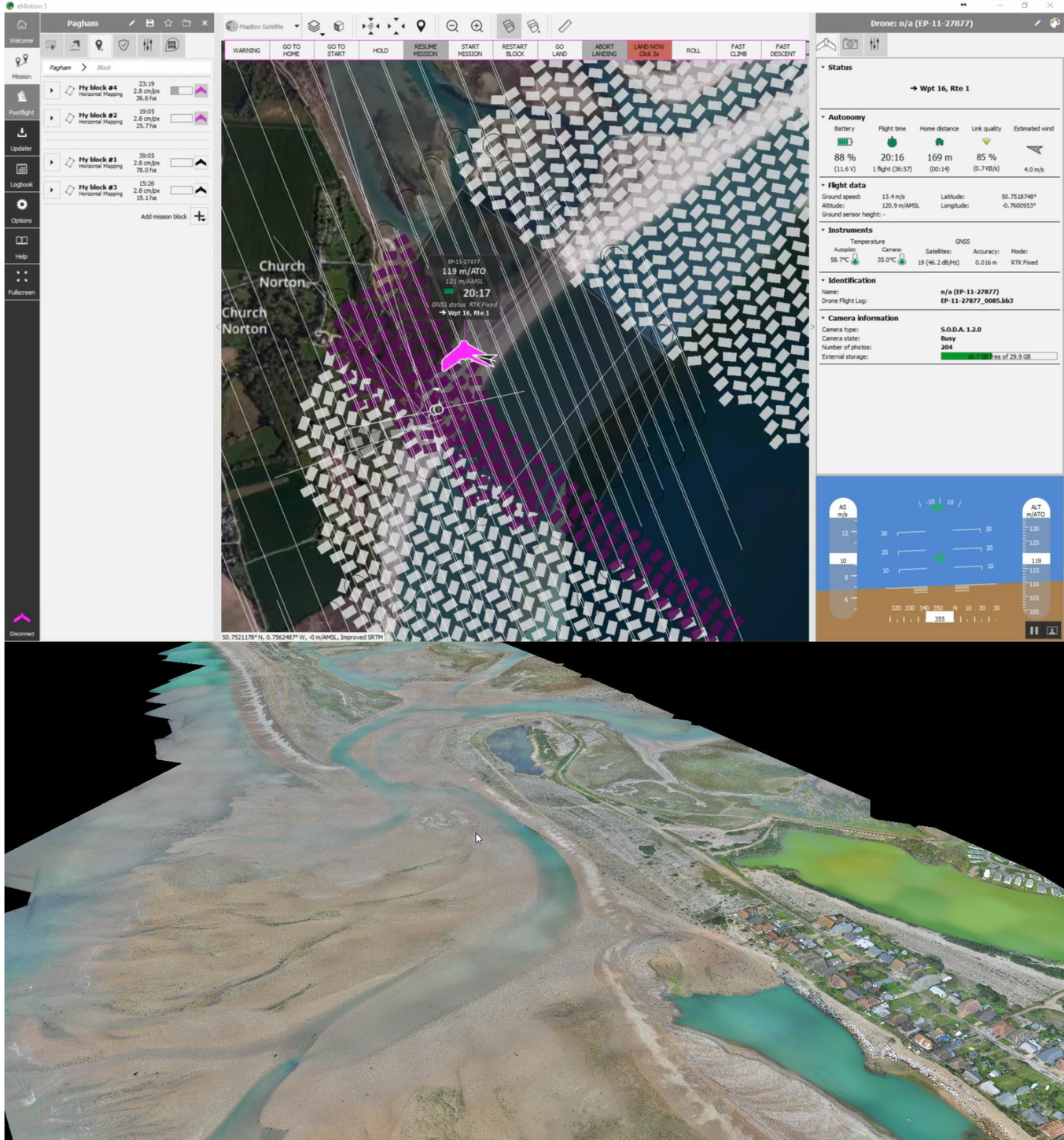
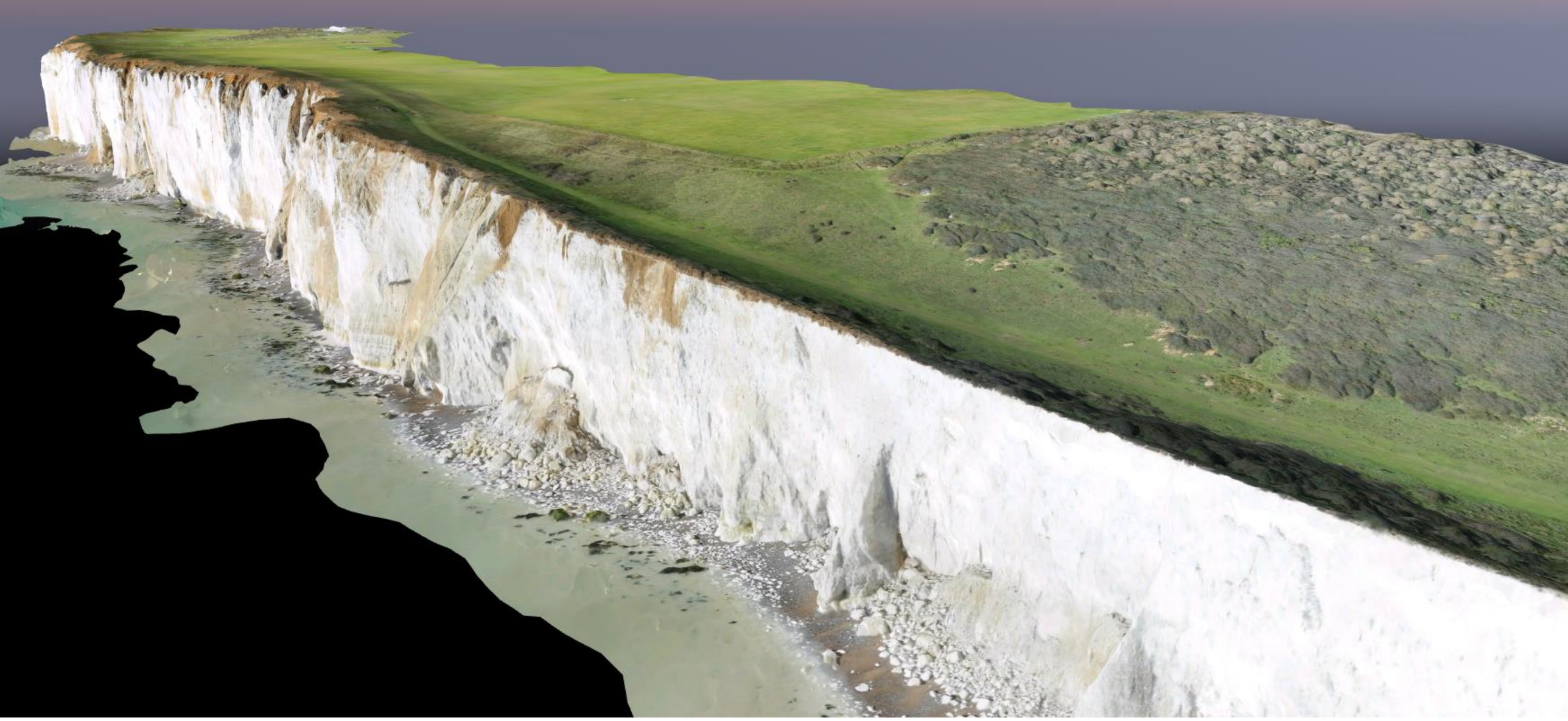
Pagham Spit UAV Survey

- Required rapid turn-around due to river breaching the spit
- Highest resolution data and imagery
- 4 flights to fly the spit.
- 1st flight flown as soon as possible after first light to make the most of low-water in early morning.
- More batteries will be bought to enable non-stop survey operations to maximise survey efficiency at low-water.





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Seaford Head UAV Survey

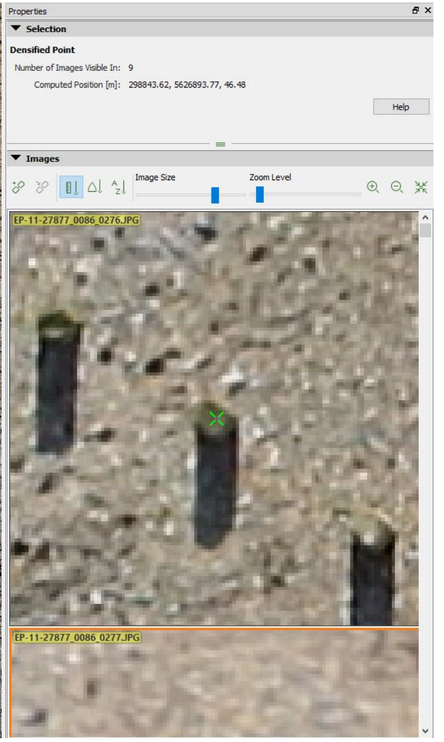
- Tricky area to normally access but actually quite easy to fly
- One day, four flights

Cuckmere Haven UAV Survey

- Ground Control Point information given by EA
- 6 GCPs located in the UAV point cloud

Average Difference		
Easting	Northing	Height
-0.01 m	-0.01 m	0.04

- 1 flight RTK one PPK
- No further position processing



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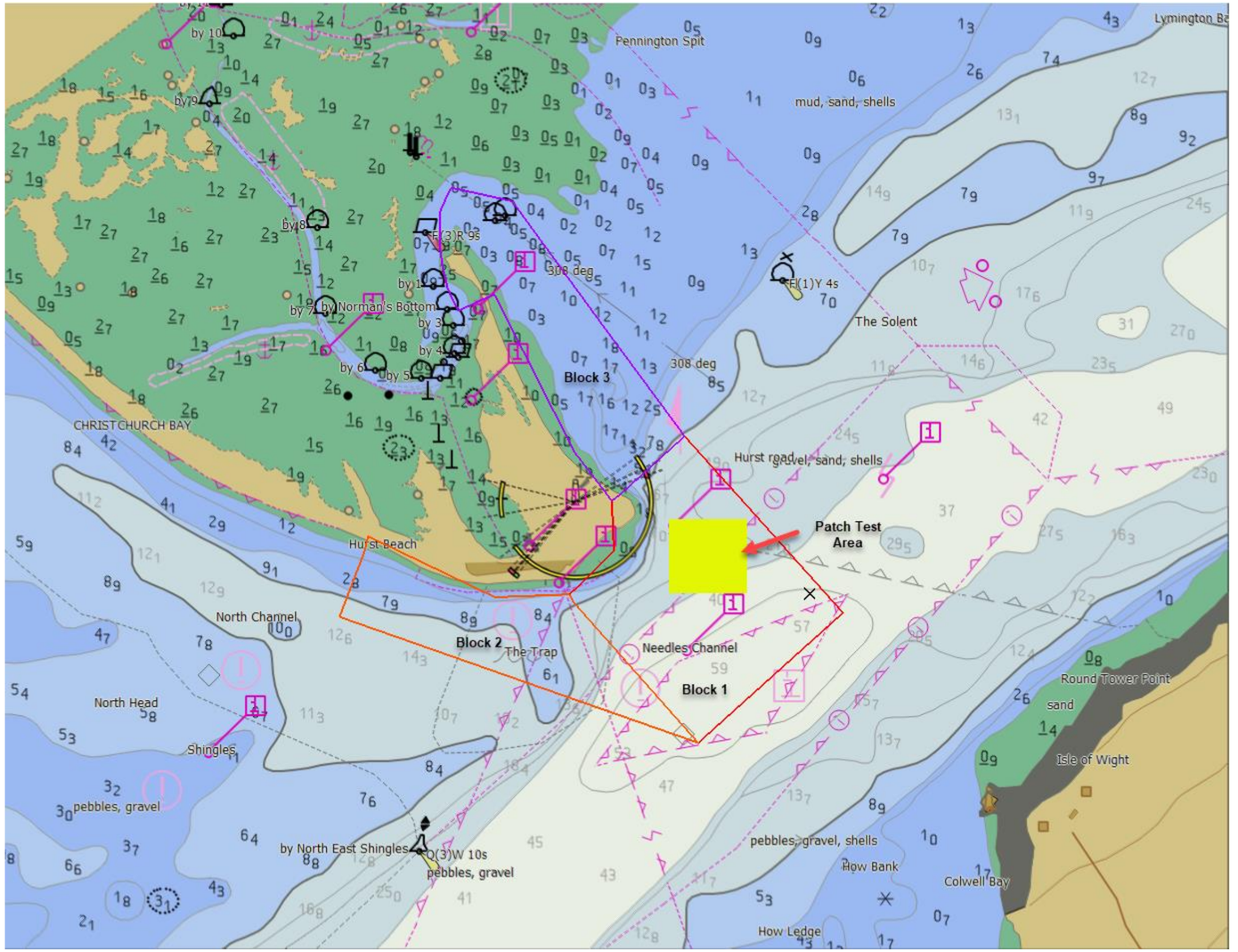
Hurst Spit ASV & UAV Survey

Channel Coastal Observatory

Maritime and Coastguard Agency

United Kingdom Hydrographic Office

- IHO Order 1 Survey for Channel Coastal Observatory and the Maritime & Coastguard Agency with data validated by UKHO
- 3 Blocks: Block 1 in main channel, Block 2 along the spit and Block 3 an area without multibeam coverage.
- Block 1 lies in the western approaches to the Port of Southampton
- Mean High Water Neaps for the ASV & Mean Low Water Neaps for the UAV survey coverage
- Very dynamic current environment.
- Exposed to westerly and south-westerly winds



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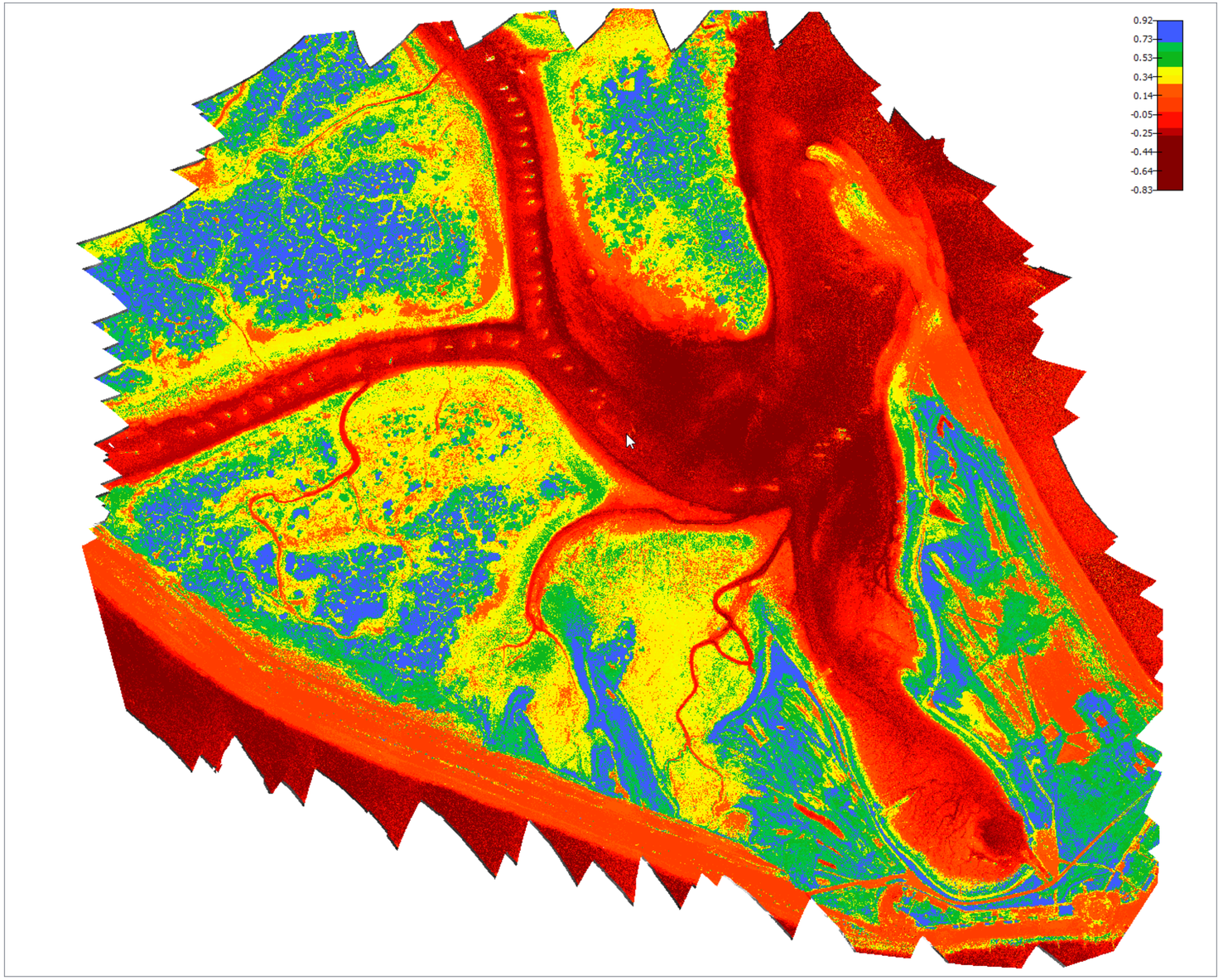
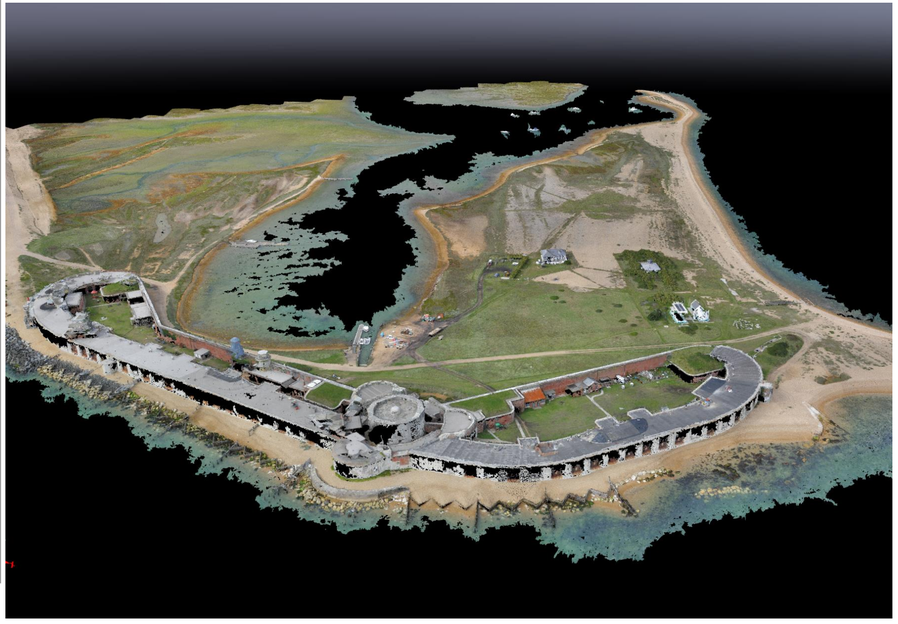
Hurst Spit UAV Survey

- UAV Survey conducted at Low Water Springs and before the ASV survey.
- 3 Flights to cover 80% of Hurst Spit in 3 hours of flying time.
- Multi-spectral camera also flown over salt marsh
- UAV Orthophoto mosaic used for ASV planning to show the coastal edge and any shoals to be avoided.
- Ground Control Points only required to QC UAV data as all photos already geotagged [illegible] RTK





Multi-spectral imagery: Red = water or gravel
everything else is vegetation

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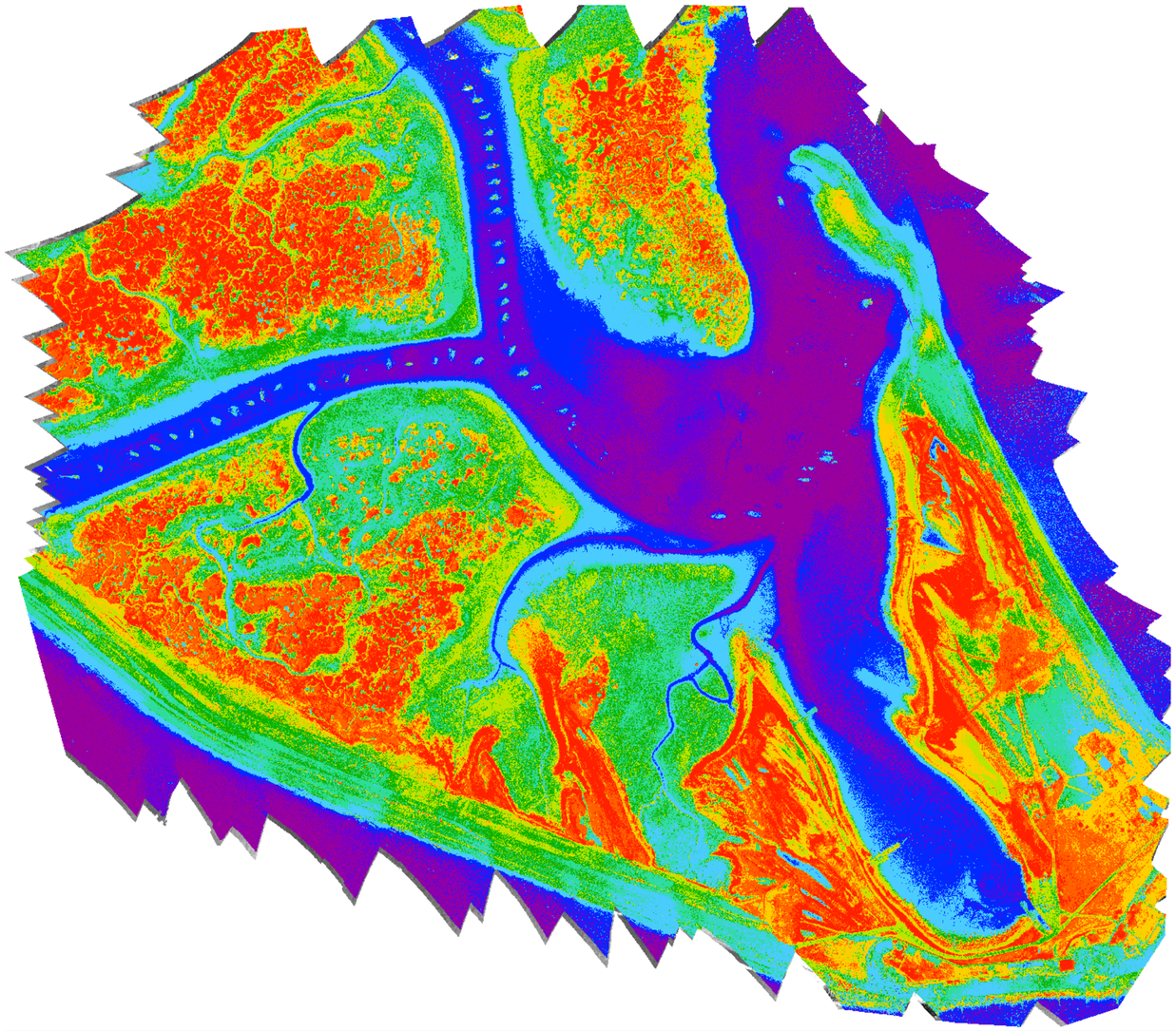
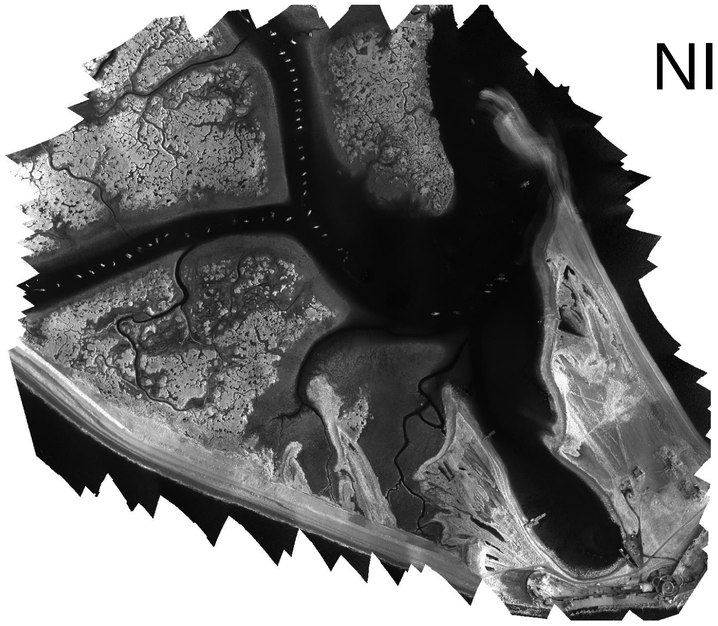
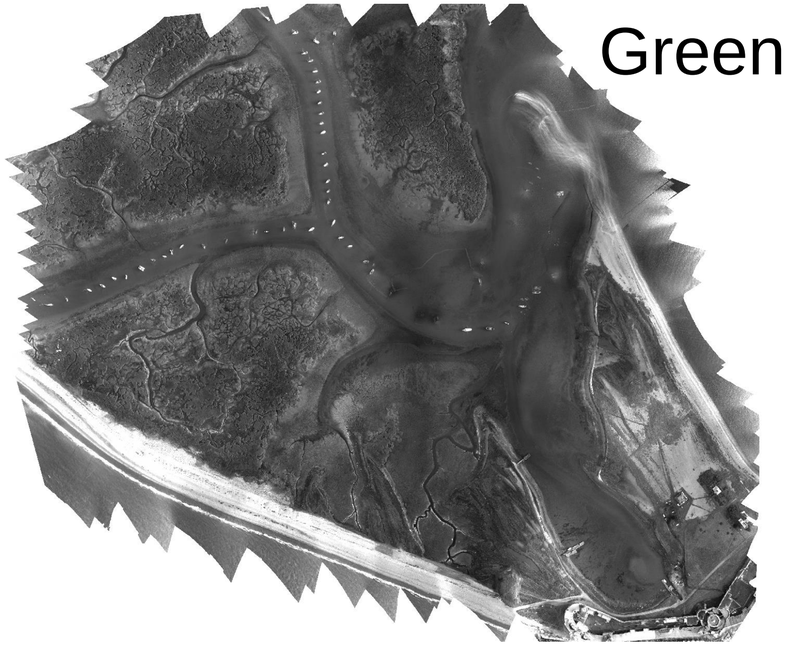






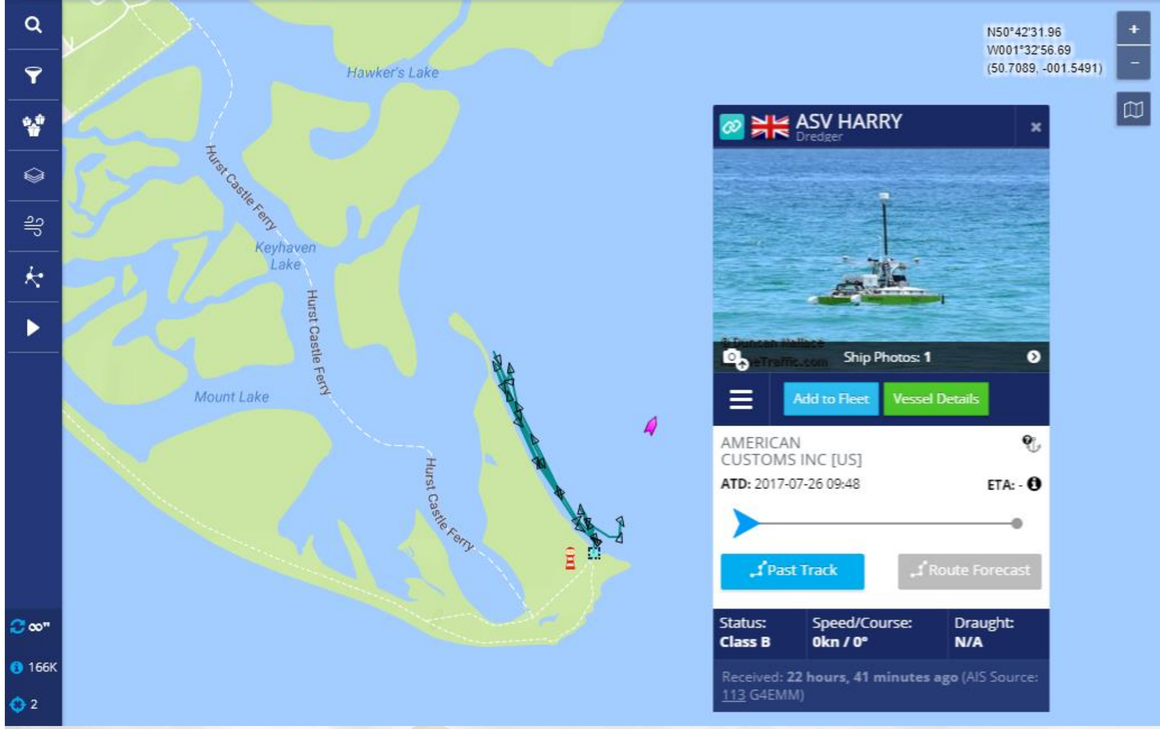
Is this bathy? (NIR-green)/(NIR+green)

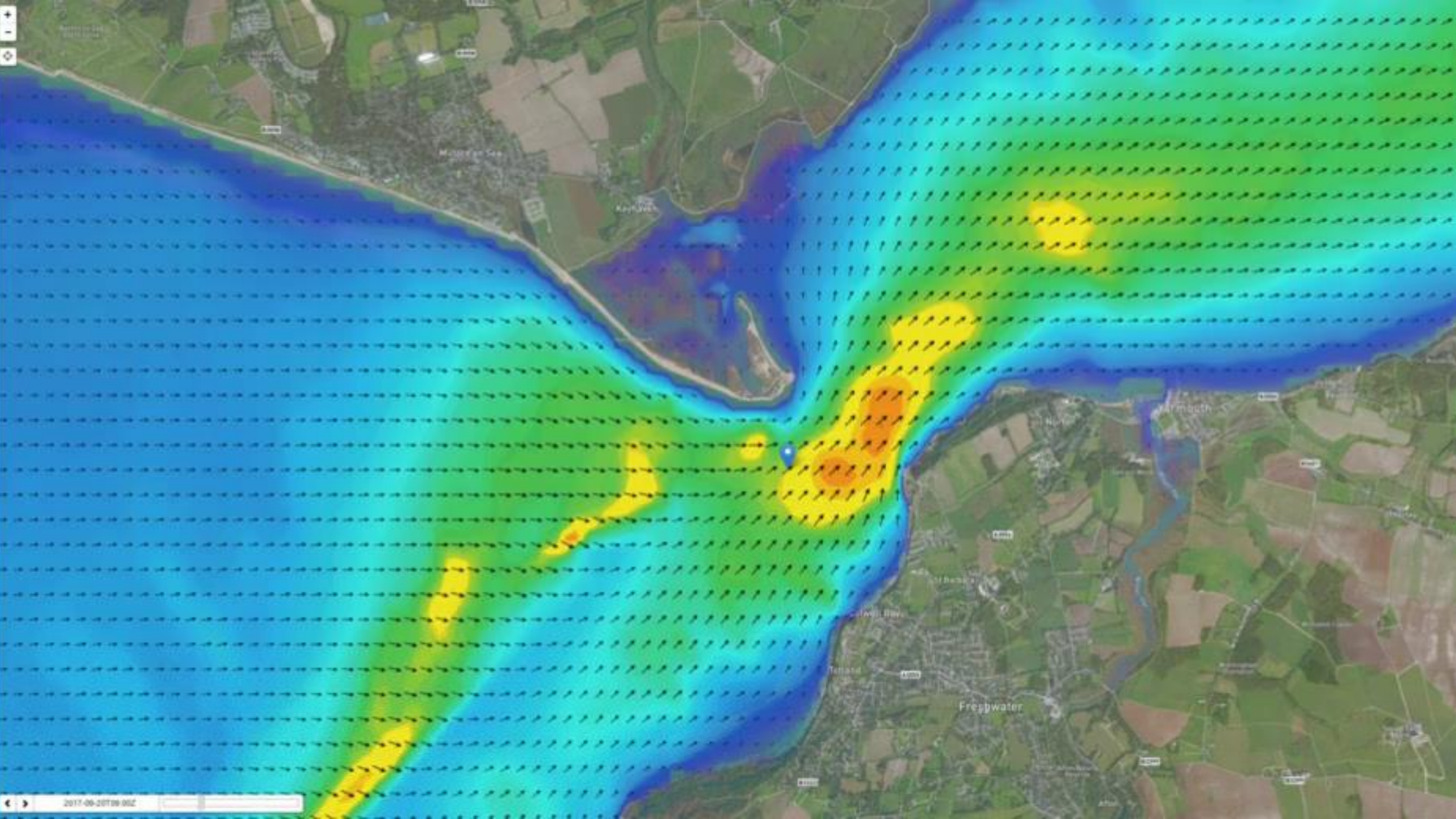
Hurst Spit ASV Survey

- ASV launched at site – no need to transit from a port/marina or use a slip way or require a crane.
- Surveyed at Spring Tides
- Progress could be made at up to 6 knots of current but battery life is limited at that speed.
- Normal Survey at 4 knots
- Very shallow draft of 0.4m

Hurst Spit ASV Survey

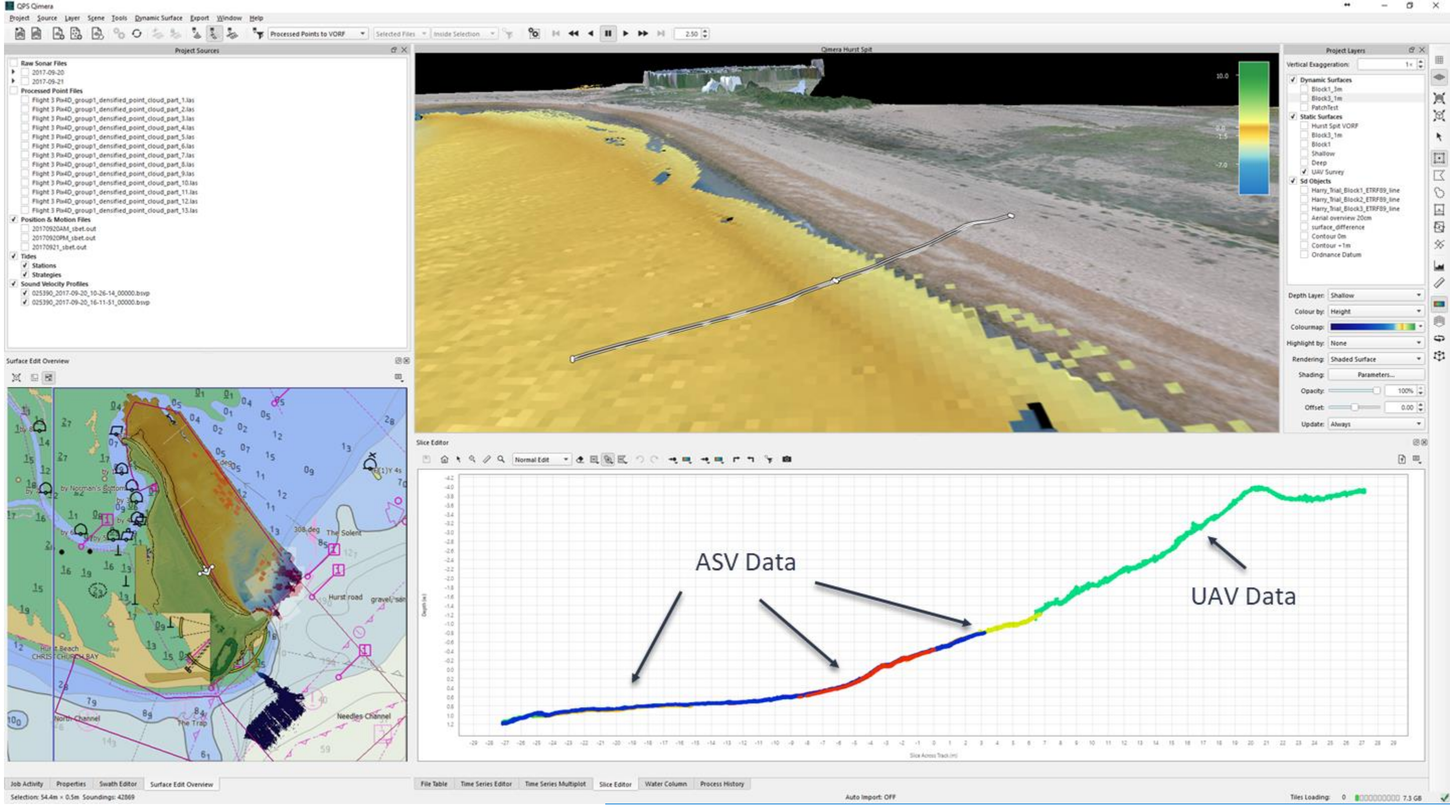
- ASV is guided by the survey software driving the autopilot and automatically giving the control software waypoints.
- Survey lines are pre-planned and automatically run or new survey lines can be generated by the sonar data.
- Hypack’s “Autoline” is at an early stage but showed promise. It required a little helping hand at the beginning and end of the line
- ASV equipped with AIS, lights and a horn to alert others.

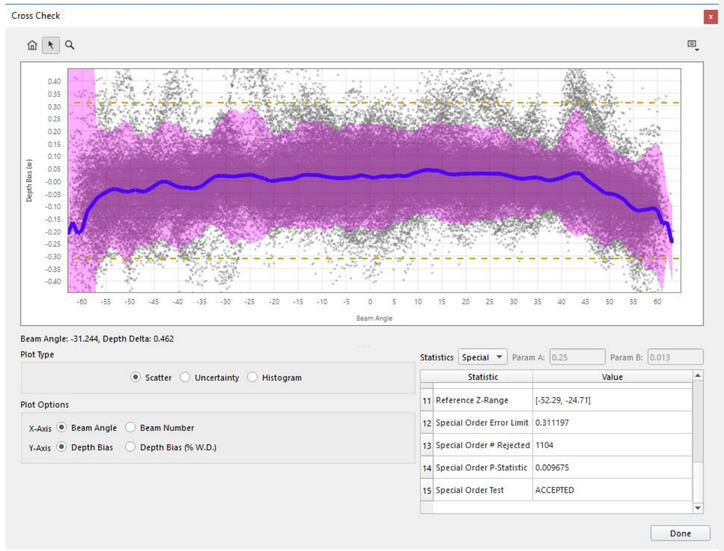


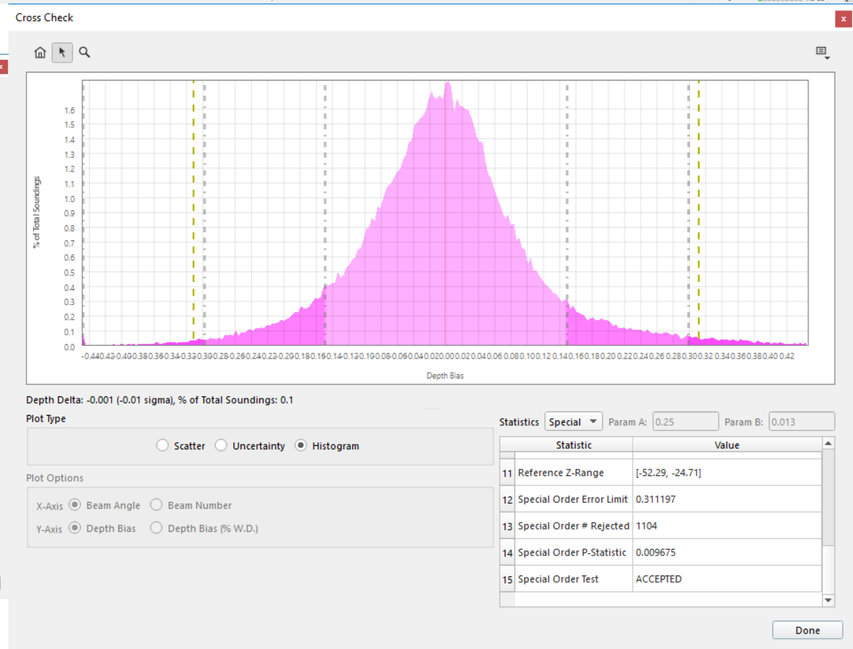

Freshwater
2017-09-20T09:00Z

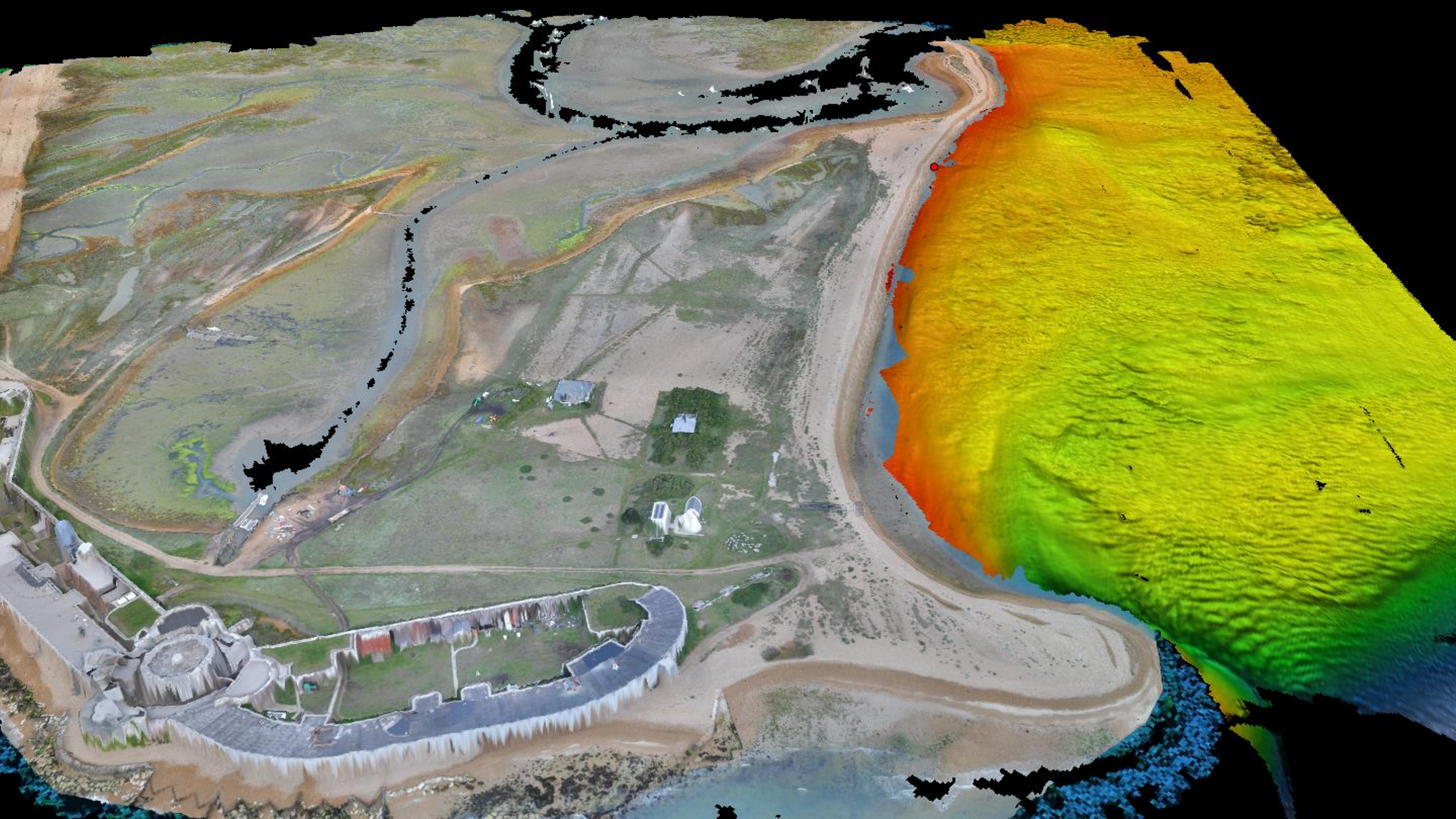
Combined ASV and UAV results

- Pix4D used for initial point cloud creation of UAV data and multi-spectral processing
- QPS Qimera used for all point cloud processing
- Raw sonar data combined with LAS files from the UAV survey to create one seamless model to clean
- The two sets of data matched to within 10 cm
- The ASV survey met IHO Special Order Accuracy



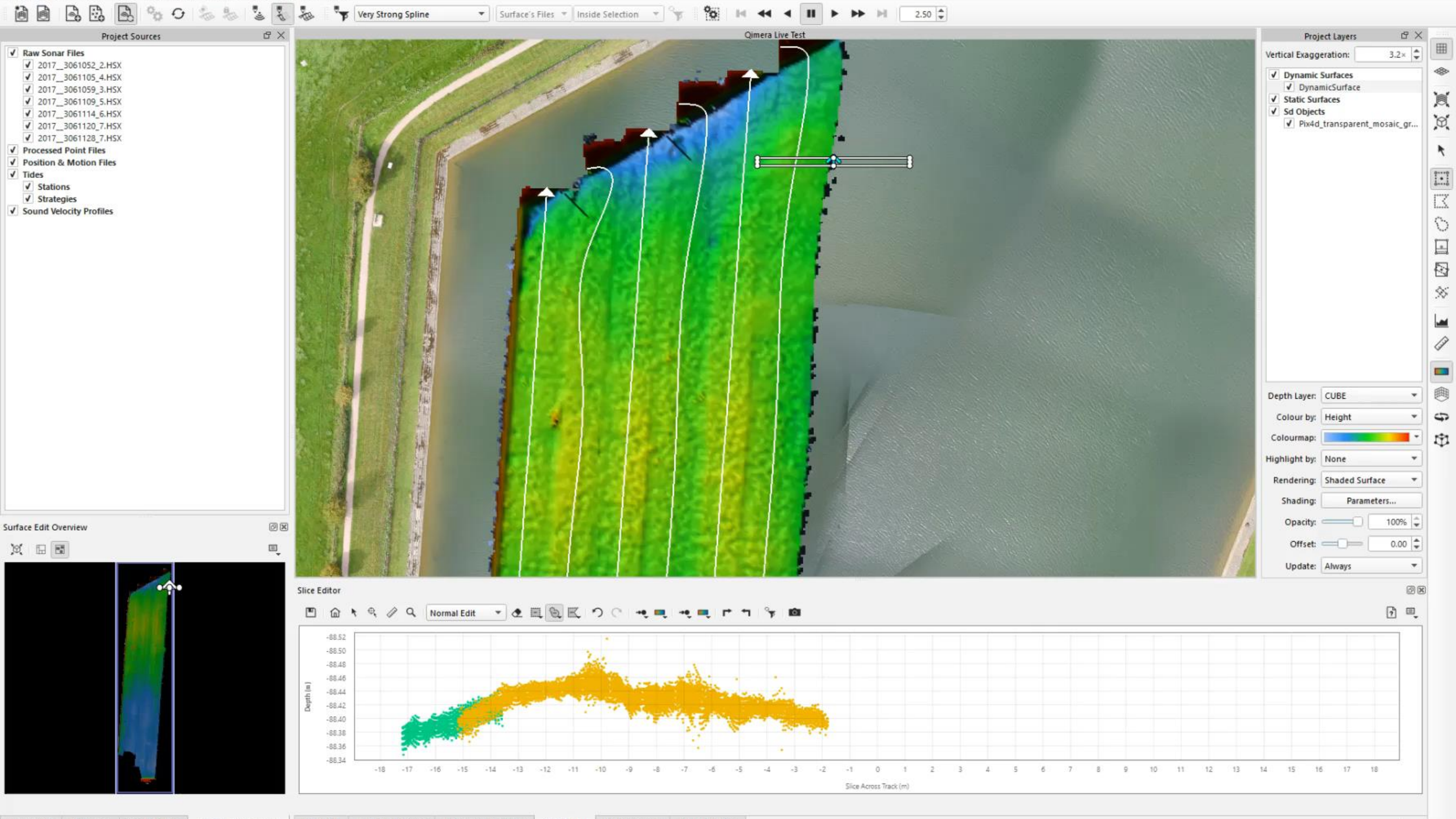


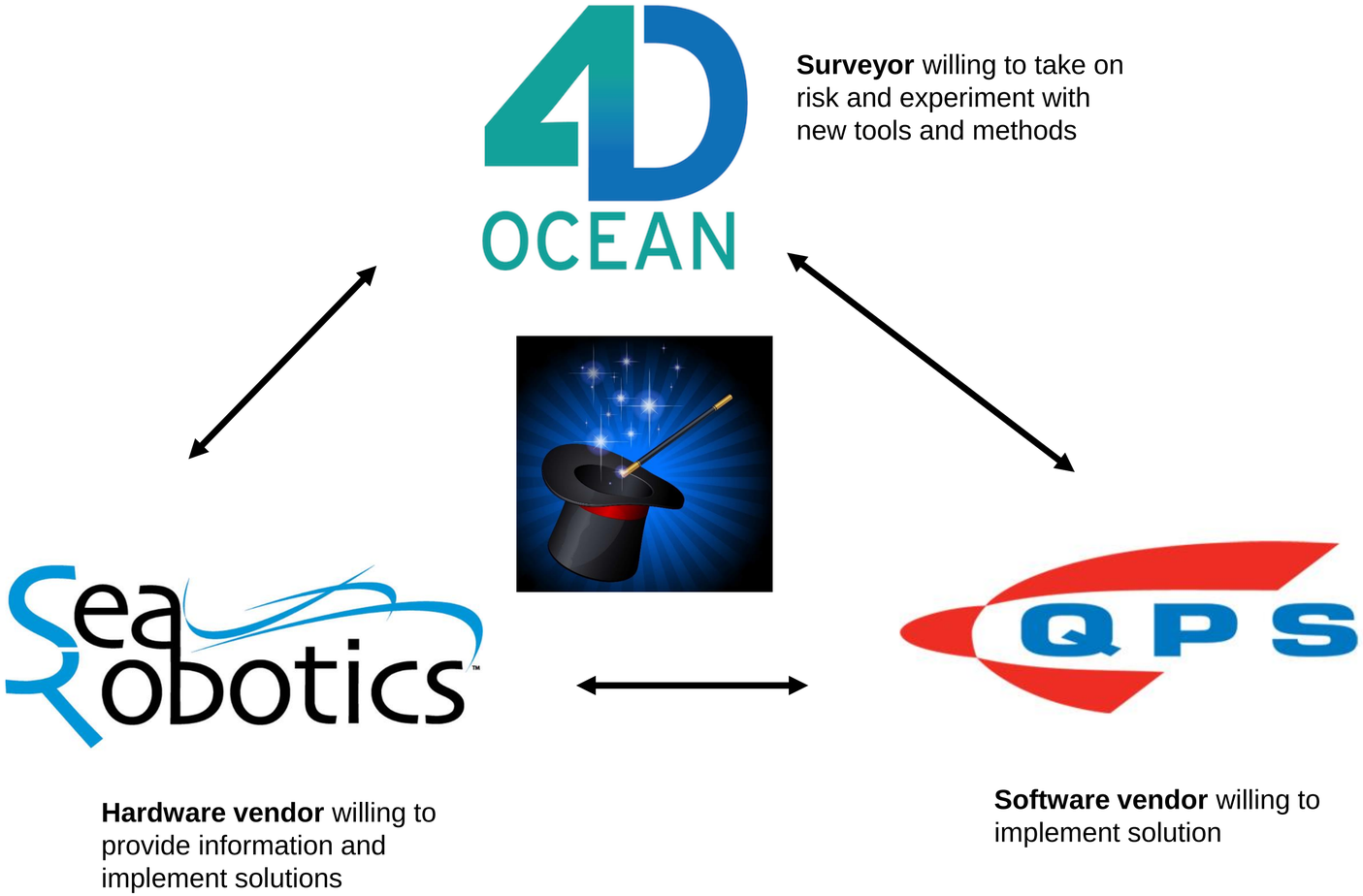




Lessons Learnt

- Tidal currents play a big part in the planning of the survey both in terms of time to survey and endurance of the ASV.
- Autonomous operation is better when the ASV is tracking a line rather than heading towards a start point, especially in high current environments.
- Having a run-in line before the start would ensure line keeping at the beginning would be improved.
- A simple remote control device for launch and recovery would make it easier and would not require shutting down of communication with the ASV.
- AIS is essential as are lights on the ASV as in low light conditions it is quite hard to see the ASV as it is low to the water.
- Screen real-estate is limited so another computer running processing software updated in near real-time will help ensure data quality control


Very Strong Spline
Surface's Files
Inside Selection
2.50
Project Sources
Raw Sonar Files
2017__3061052_2.HSX
2017__3061105_4.HSX
2017__3061059_3.HSX
2017__3061109_5.HSX
2017__3061114_6.HSX
2017__3061120_7.HSX
2017__3061128_7.HSX
Processed Point Files
Position & Motion Files
Tides
Stations
Strategies
Sound Velocity Profiles
Qimera Live Test
Project Layers
Vertical Exaggeration: 3.2×
Dynamic Surfaces
DynamicSurface
Static Surfaces
Sd Objects
Pix4d_transparent_mosaic_gr...
Depth Layer: CUBE
Colour by: Height
Colourmap:
Highlight by: None
Rendering: Shaded Surface
Shading: Parameters...
Opacity: 100%
Offset: 0.00
Update: Always
Surface Edit Overview
Slice Editor
Normal Edit
Depth (m)
-88.52
-88.50
-88.48
-88.46
-88.44
-88.42
-88.40
-88.38
-88.36
-88.34
-18 -17 -16 -15 -14 -13 -12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Slice Across Track (m)

Future Developments – Only happens with Partnerships

- QPS QINSy Autopilot driver includes turn lines and run-in – *completed* - already integrated into SeaRobotics OIS software
- Safe route back to recovery location – keeps line updated in memory and safe path over seabed already surveyed
- Automatic line creation based on sonar coverage that extends/clips to survey area polygon – this will make survey operations totally autonomous
- Include SVP casts in online software control
- Intelligent warnings when data issues occur
- Collision avoidance