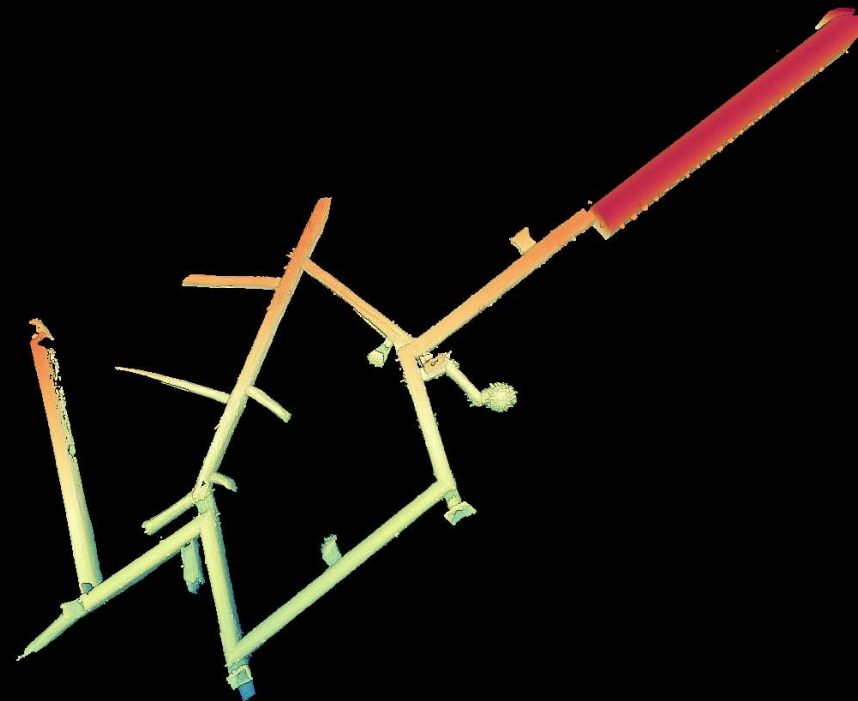


DLA 2021: New technologies in Workshop 7: Use of UAV for your Environmental Data: the Malta experience

28 May 2021



Prof Dr Saviour Formosa

e: saviour.formosa@um.edu.mt

p: <https://www.um.edu.mt/profile/saviourformosa>

Objectives:

- To describe the background for GI and spatial data in use in Malta for spatial planning, environment, heritage, crime
- To depict some outputs and uses
- To describe the approaches taken
- To depict the technologies employed

Need Tools

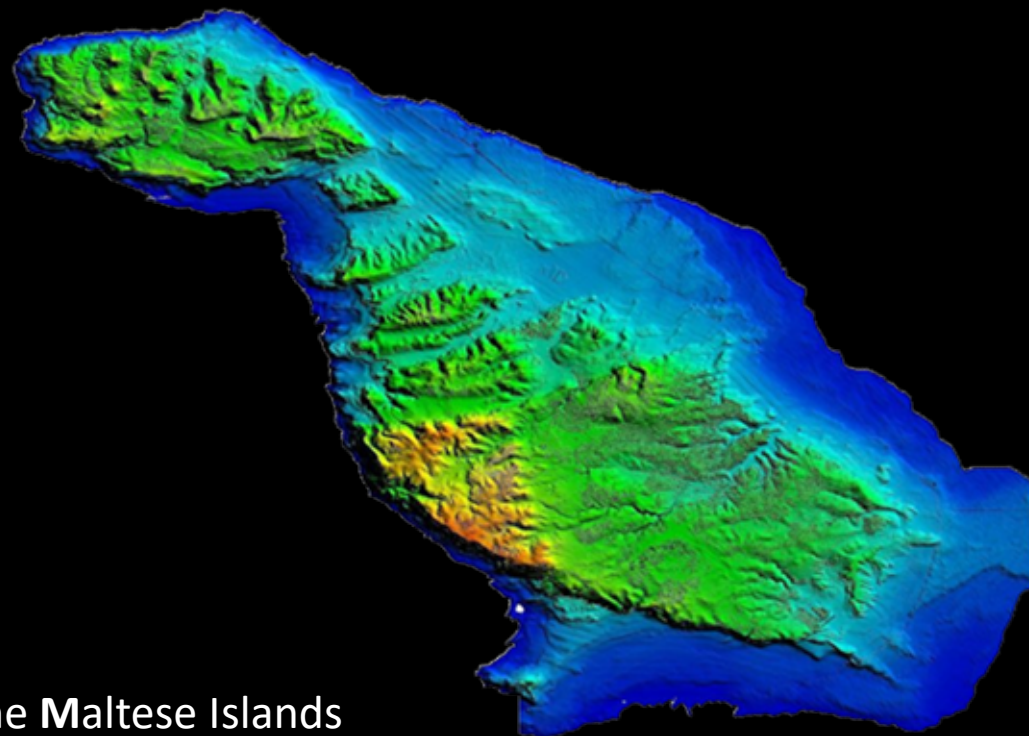
- to help us understand the reality out there
- to aid decision takers to base their deliverables on evidence-based input
- to trigger the recall caches

The power of Visualisation....

If we need to investigate our environment
we need to digitally recreate it in a way that reflects that reality

SIntegraM

Spatial Data Integration for the Maltese Islands



SIntegraM

ERDF.02.030 SIntegraM Project

EUR7m + EUR0.9m + EUR0.2m (UoM)

Start Date – 05/01/2015

End Date – 30/06/20 - 22

Actual concluded date by Planning
Authority 31/12/2019
with an extension to 2022 due to a further
EUR900k input

SIntegraM relevant deliverables:

- Strategy for a National Spatial Data Infrastructure (NSDI)
- National basemap, Imagery and LiDAR
- Core Infrastructure
- Aerial/Terrestrial/Marine technologies
- Immersive technologies
- Reprojection Tool
- Dissemination Tool

Acknowledgements: Malta Planning Authority as Project Leader

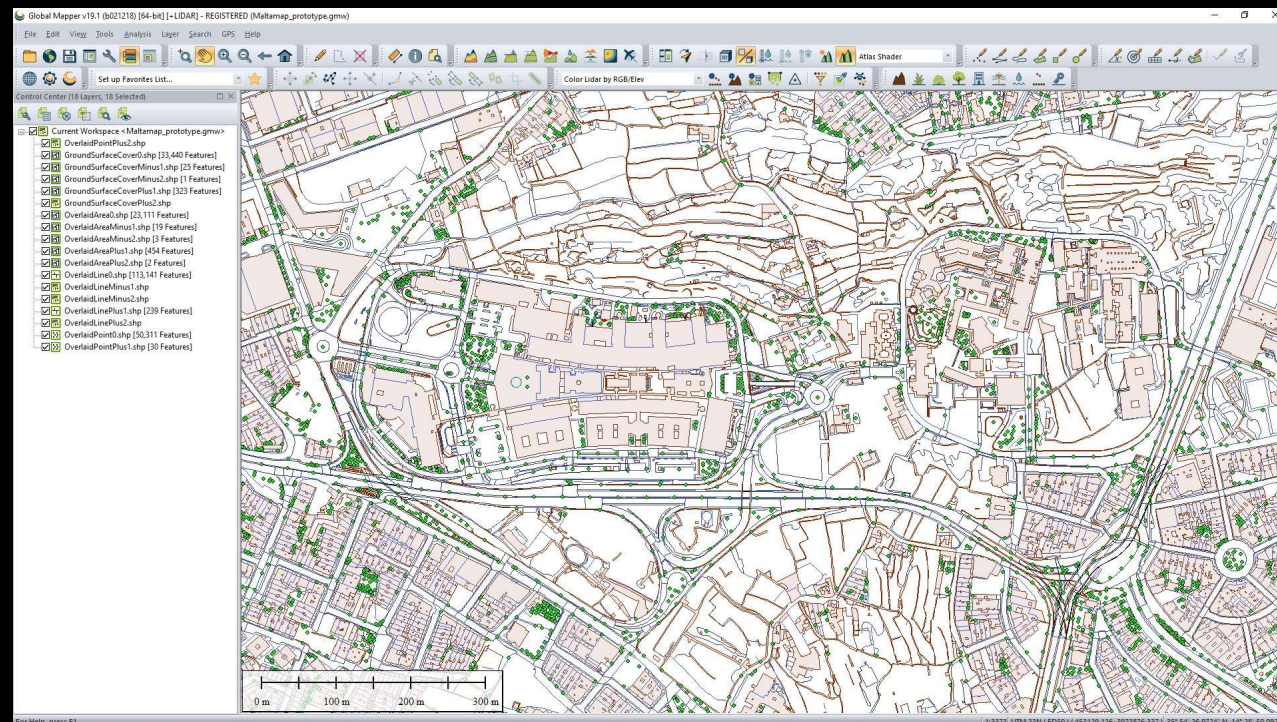
SIntegraM

- identification of information gaps in the data cycle
- identification of data being created
- creation of new basemap (1988 legacy)
- integration of all data in a national system
- creation of data exchange security protocols
- building of infrastructure
- training of experts

- Dissemination:
- 3D pointclouds www.cloudisle.org
- Portal <https://sintegram.gov.mt>
- Geoserver <http://geoserver.pa.org.mt/publicgeoserver>

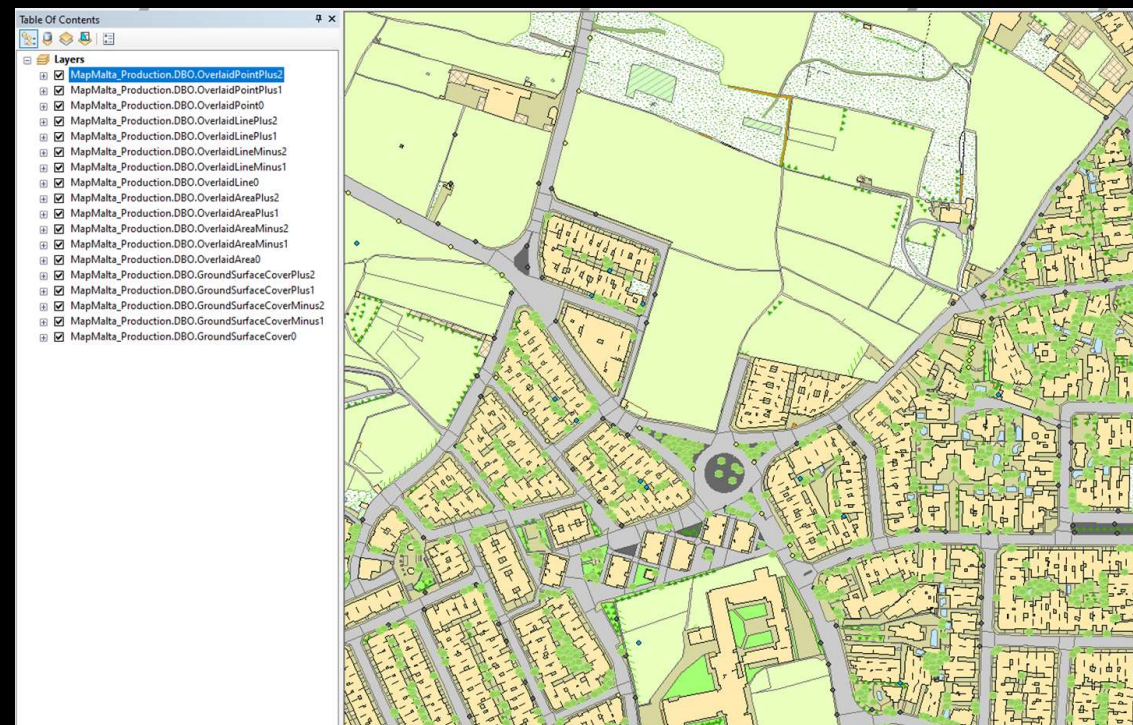
Basemap

An object-oriented geospatial polygonised seamless dataset of non-overlapping polygons that covers the whole of the Maltese Islands.

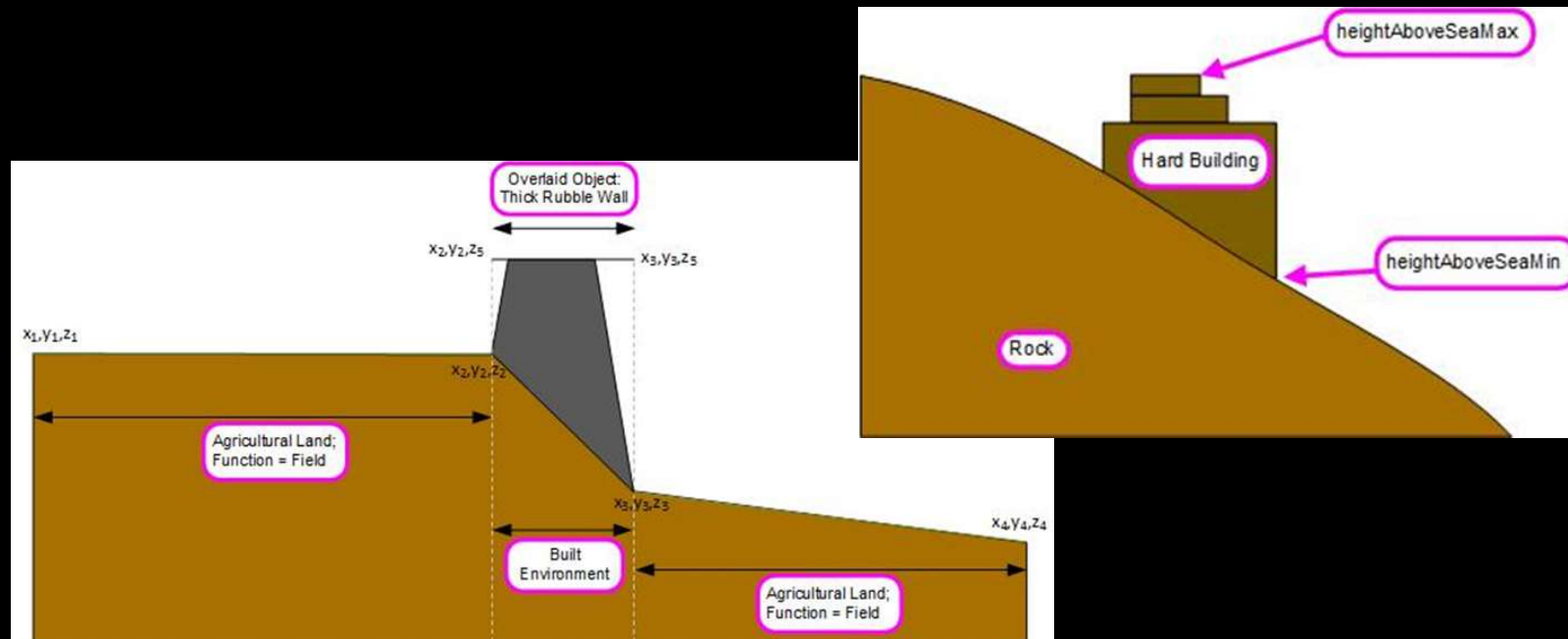


Basemap

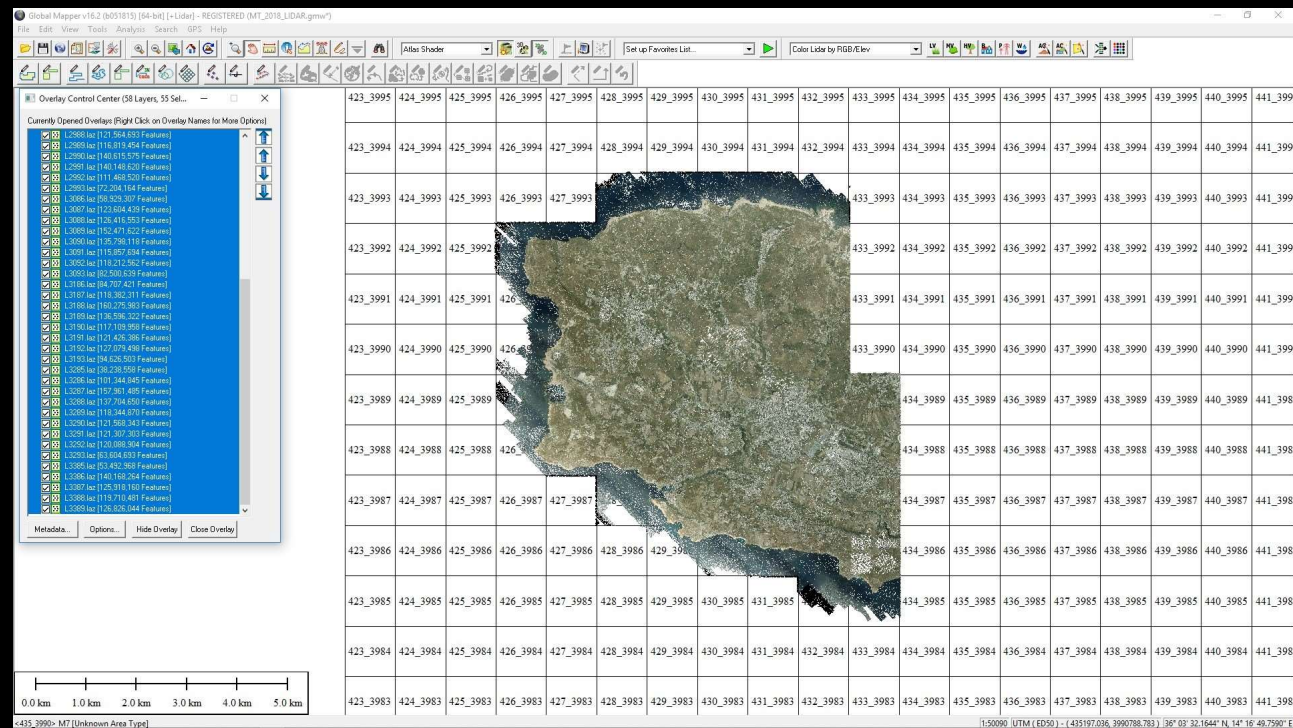
An object-oriented geospatial polygonised seamless dataset of non-overlapping polygons that covers the whole of the Maltese Islands.



Basemap: 3D elements



Orthoimagery

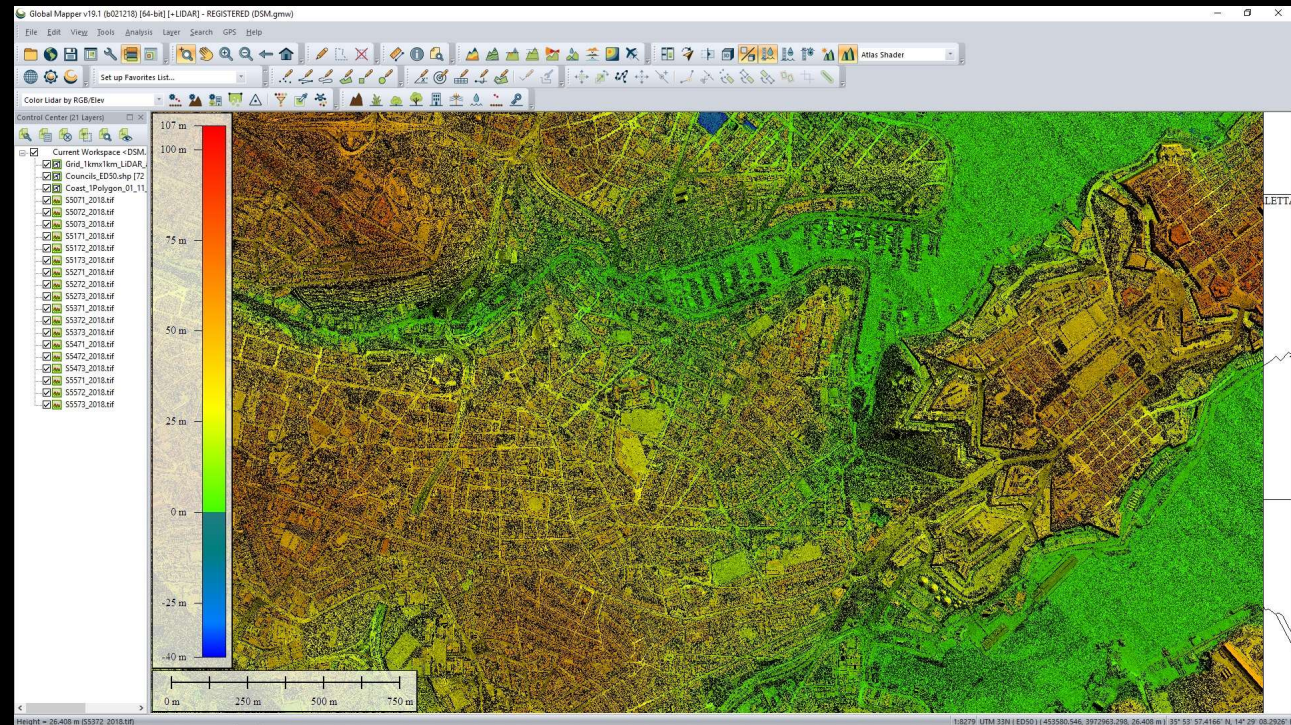


The screenshot displays the Global Mapper v16.2 interface. The main window shows a topographic map of Malta with a grid of coordinates. The grid labels are as follows:

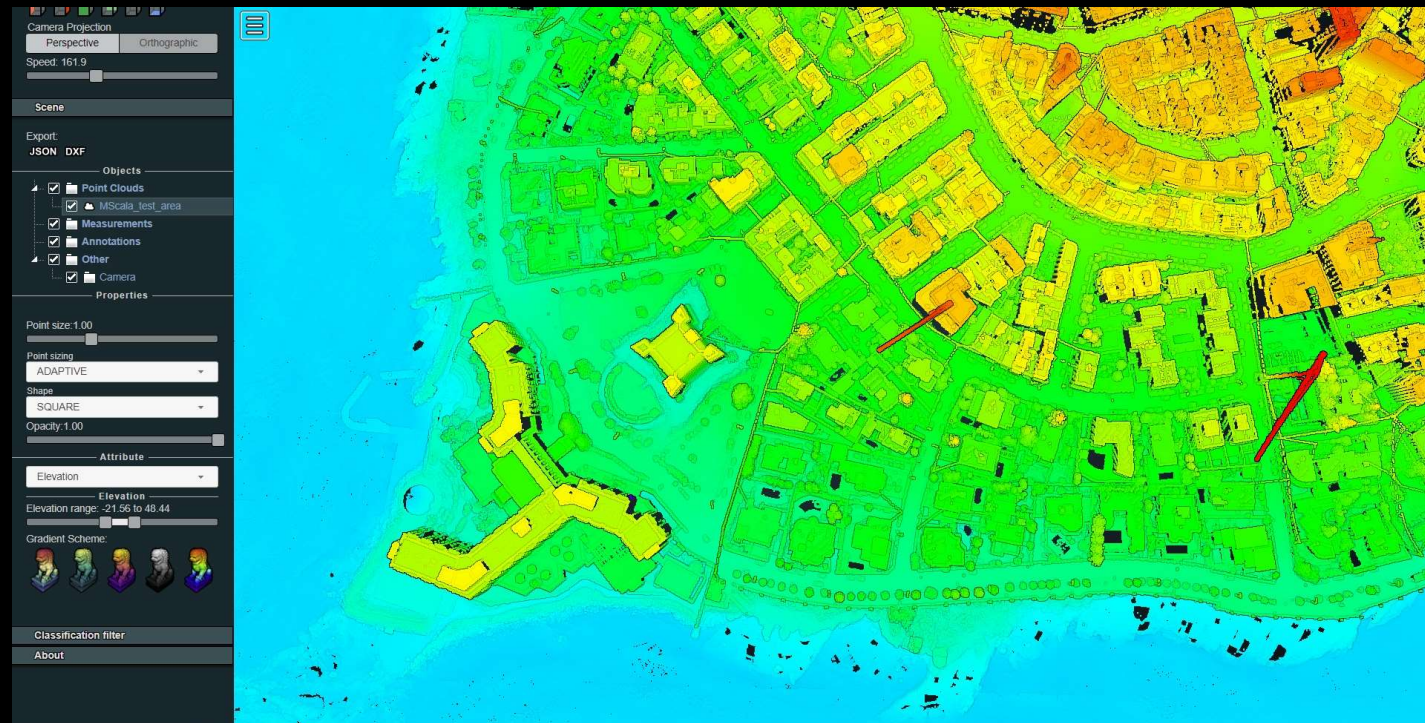
423_3995	424_3995	425_3995	426_3995	427_3995	428_3995	429_3995	430_3995	431_3995	432_3995	433_3995	434_3995	435_3995	436_3995	437_3995	438_3995	439_3995	440_3995	441_3995
423_3994	424_3994	425_3994	426_3994	427_3994	428_3994	429_3994	430_3994	431_3994	432_3994	433_3994	434_3994	435_3994	436_3994	437_3994	438_3994	439_3994	440_3994	441_3994
423_3993	424_3993	425_3993	426_3993	427_3993						433_3993	434_3993	435_3993	436_3993	437_3993	438_3993	439_3993	440_3993	441_3993
423_3992	424_3992	425_3992								433_3992	434_3992	435_3992	436_3992	437_3992	438_3992	439_3992	440_3992	441_3992
423_3991	424_3991	425_3991	426_3991	427_3991						433_3991	434_3991	435_3991	436_3991	437_3991	438_3991	439_3991	440_3991	441_3991
423_3990	424_3990	425_3990	426_3990							433_3990	434_3990	435_3990	436_3990	437_3990	438_3990	439_3990	440_3990	441_3990
423_3989	424_3989	425_3989	426_3989							434_3989	435_3989	436_3989	437_3989	438_3989	439_3989	440_3989	441_3989	
423_3988	424_3988	425_3988	426_3988							434_3988	435_3988	436_3988	437_3988	438_3988	439_3988	440_3988	441_3988	
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423_3983	424_3983	425_3983	426_3983	427_3983	428_3983	429_3983	430_3983	431_3983	432_3983	433_3983	434_3983	435_3983	436_3983	437_3983	438_3983	439_3983	440_3983	441_3983

The overlay control panel on the left lists 55 layers, including various LIDAR and DEM files. A scale bar at the bottom indicates 0.0 km to 5.0 km. The status bar shows coordinates: 435_3990 M7 (Unknown Area Type) and 115090 UTM (ED50) - (435197.036, 3990788.783) 36° 03' 32.1644" N, 14° 16' 46.7590" E.

DSM, DEM



LiDAR



LiDAR



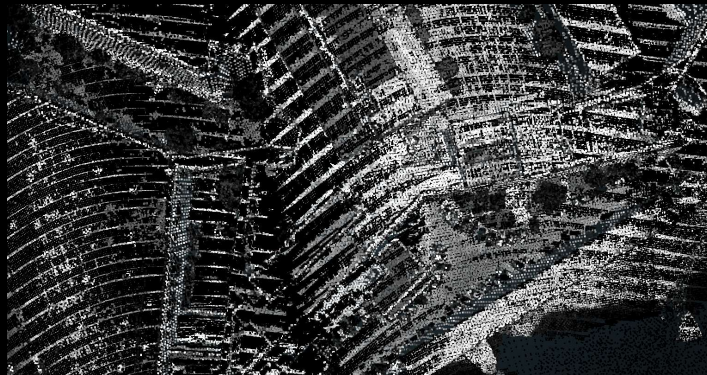
WebGL



LiDAR Runs:

2012	plane based flights
AGL:	3000m
requested:	1pts per msq
acquired:	4pts per msq

2018	plane based flights
AGL:	600m
requested:	40pts per msq
acquired:	180pts per msq



Updating the base map and data: 2018

Going from this...



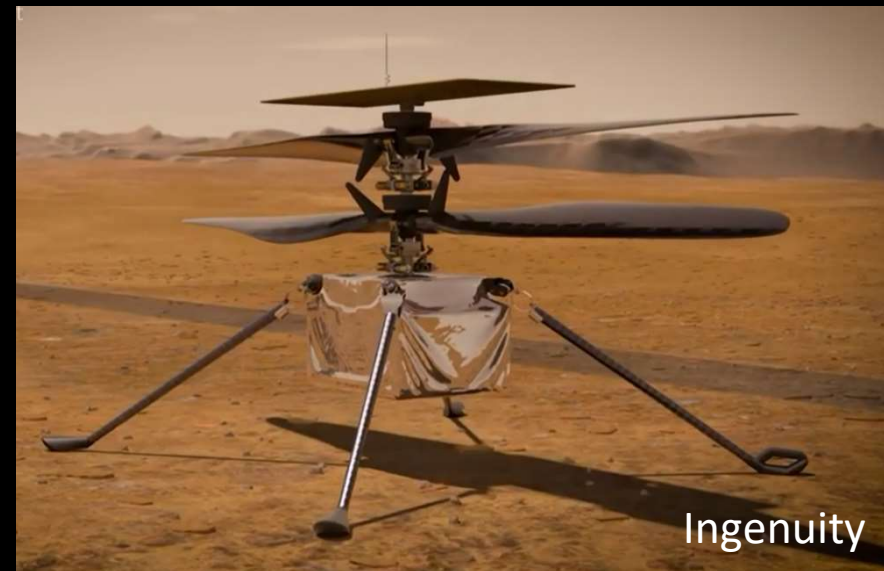
Updating the base map and data: 2020-2022 rolling every 3 years

... to this



Technologies available: Aerial

what I wish for...



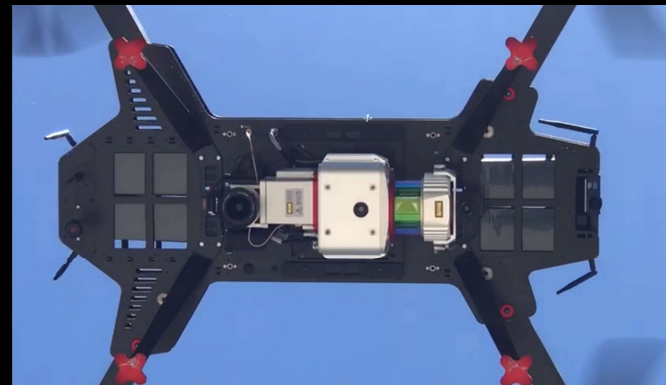
Technologies available: Aerial

what I ended up with...

Tech

Mavic Pro 2
Matrice 210
Matrice 600 Pro
RiCOPTER

RGB, IR, GPR



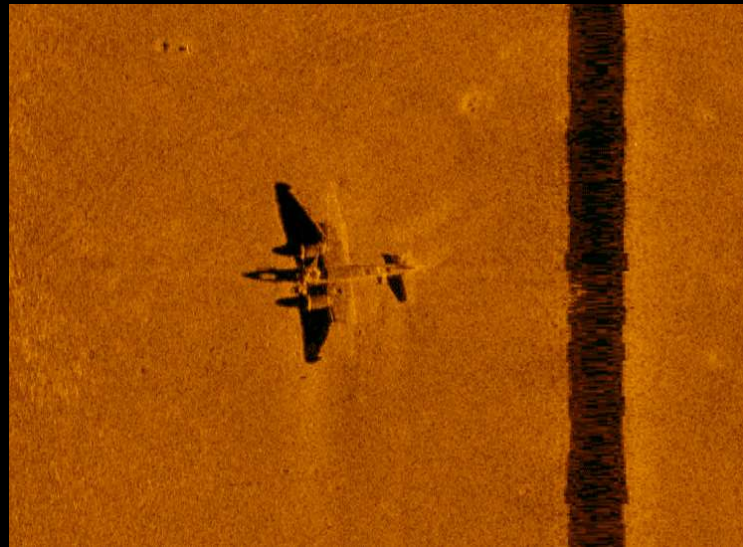
Technologies available: Marine

Tech	Teledyne GAVIA AUV
Depth:	500m
Sensors:	Sidescan sonar Multibeam

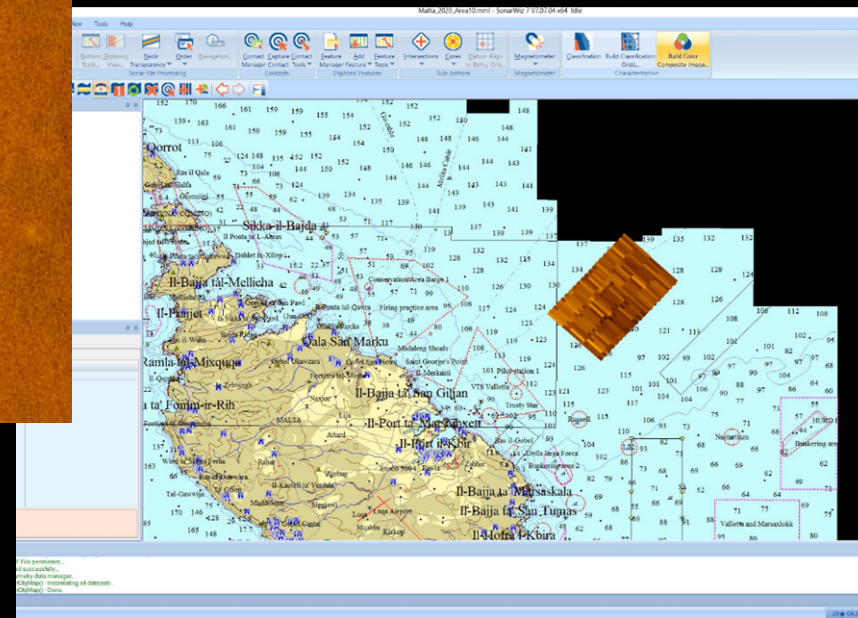


Technologies available: Marine

typical target as detected by AUV during mapping



Ref: Prof Dr Timmy Gambin



Technologies available: Terrestrial Surveying Tech

Tech

GNSS Network

Total Stations

Robotic Total Stations

Field GNSS Rover GS16



Technologies available: Terrestrial Laser Scanner

Tech	TLS LiDAR Scanner
Scan	500,000 points per second 7 images 46 seconds 20million points 300Mb
Floriana Project	531 scans 950Gb
Software	RiScan Pro



Technologies available: Mobile Laser Scanner

This is what we think we are...

Tech	MLS VMX 2HA
Scan	2 LiDAR scanners 6 cameras 500 scans per second
Typical Day	1 Tb capture 4 Tb analytics



Technologies available: Mobile Laser Scanner

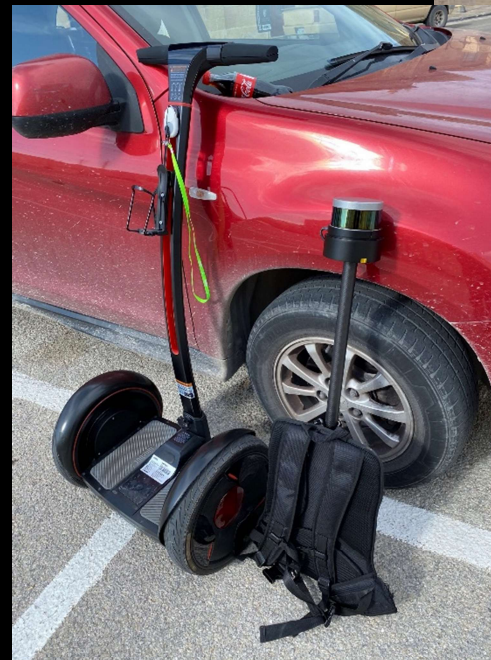
This is what people think we are...



Technologies available: Oh and I forgot again

These are two cool gadgets...

Tech	LiBackpack Ninebot
Scan	LiDAR
Next	GNSS, RGB, LiDAR



With such responsibility... there are consequences



Logistics of update process

1. Identification of the town to be scanned
2. Design of the drone paths
3. Transformation of paths to GIS
4. Mapping of GCPs
5. Marking GCPs in-situ
6. Acquisition of permissions to fly
7. Drone scanning
8. Data transfer (Imagery)
9. Photogrammetric creation of tie-points
10. Anchoring of tie-points to GCPs
11. PointCloud generation (Medium and High density)
12. DEM and orthomosaic generation
13. Basemap update
14. Dissemination: GI and WebGL

Limitations

- Licencing
- Insurance
- Permitting – AGL 60m
- GDPR

- Angry birds
- Court cases

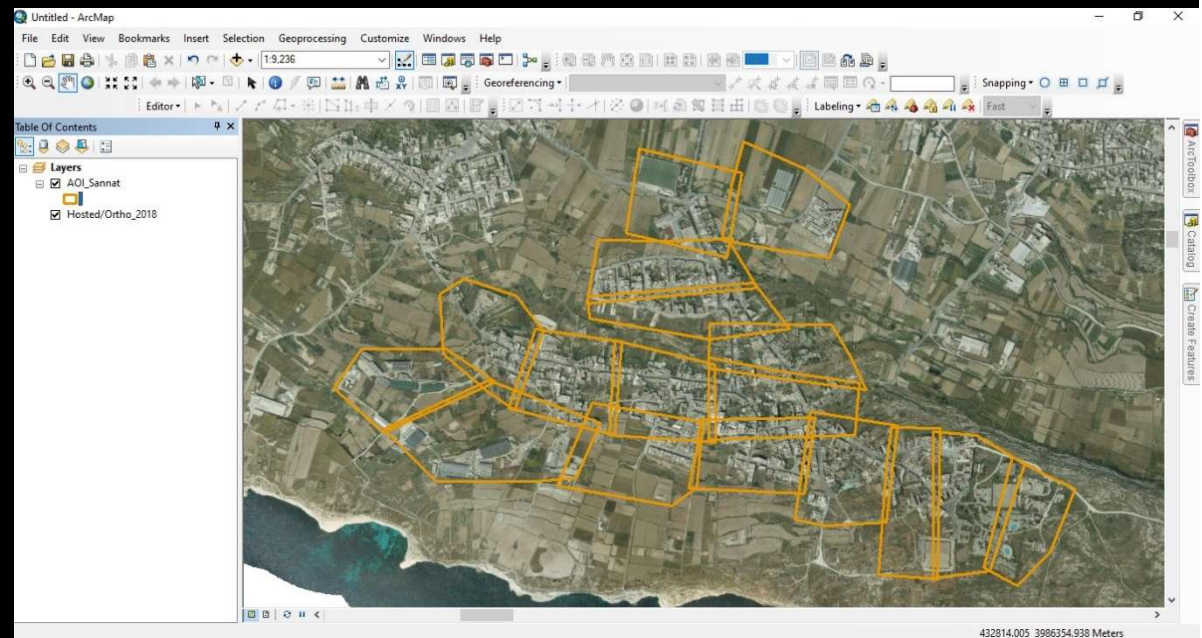
- Weather
- Rogue AUVs
- Electronic interferences
- Pigeons and predators
- Sightseeing planes 500ft
- Military pilots



The Process: The GI component

Various specialists in GI

- MSc, PhD levels
- Techs
- Admin

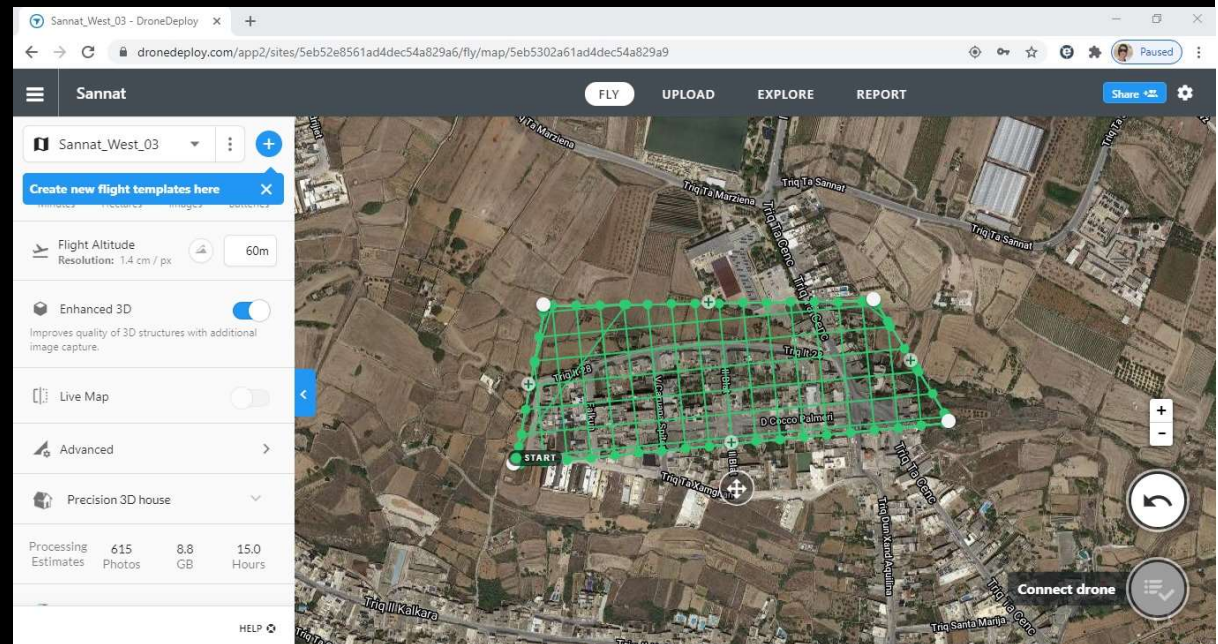


The Process: Identifying the Ground Control Points and painting them...



The Process: The Flight Planning component

- Drone Deploy



Case: Xewkija



RealityCapture

Feature Information

Name: Xewkija AREA

Feature Type: Unknown Area Type

Geometry: 38 vertices, Perimeter: 9.048 km, Area: 2.274 sq km, Bounds: [431993.416, 3988526.189, 432191.584, 3990043.811]

Map Name: User Created Features [Index in Layer: 0]

Right click on an entry for more options (i.e. open URL, etc.)

Attribute	Value
<Last Modified Time>	2021-05-27T13:12:14
PERIMETER	9.048 km
ENCLOSED_AREA	2.274 sq km

Buttons: Edit..., Delete, Vertices..., Fly-Through..., Graphs..., Notation..., Copy to Clipboard

Workspace (1 chunks, 22364 cameras)

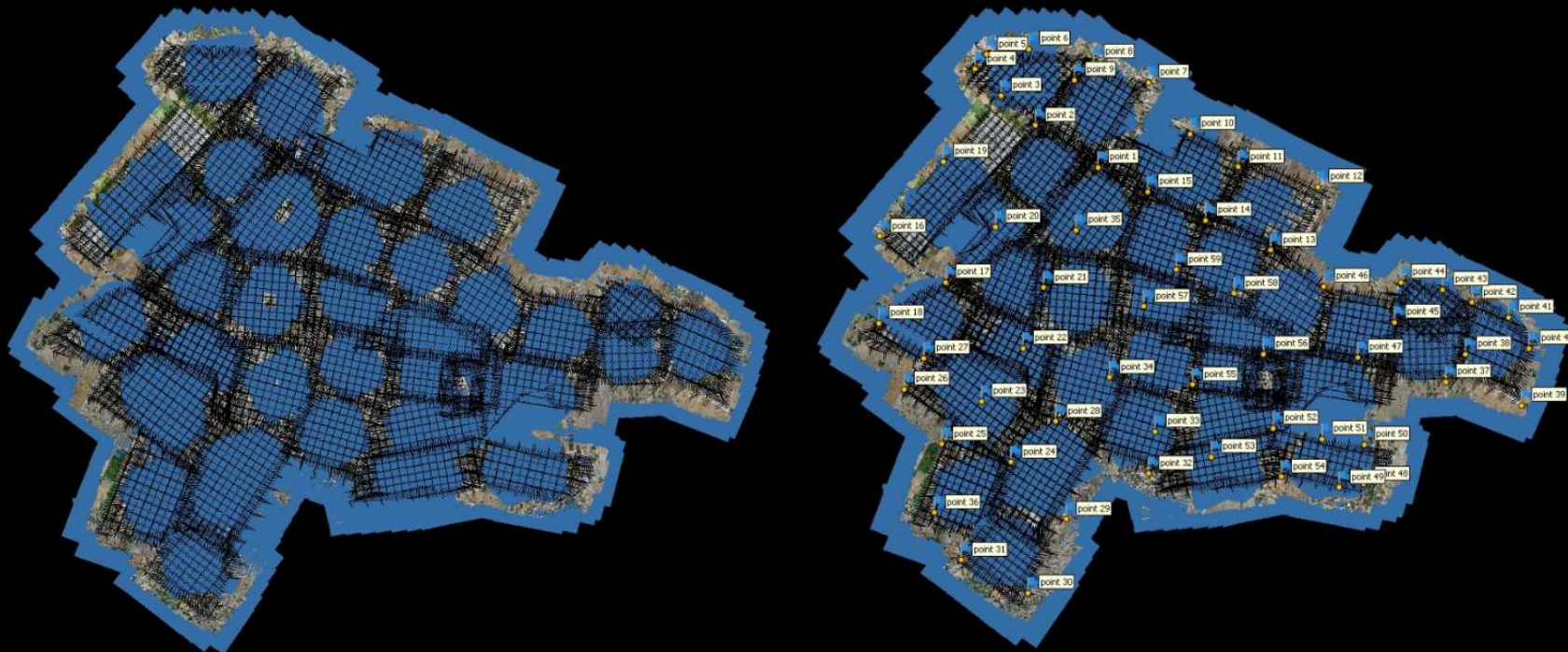
- Chunk 1 (22364 cameras, 59 markers, 17,324,816 points) [R]**
 - Cameras (22361/22364 aligned)
 - Markers (59)
 - Tie Points (17,324,816 points)
 - Depth Maps (22343, Medium quality, Mild filtering)
 - Dense Cloud (1,092,447,543 points, Medium quality)
 - 3D Model (217,306,159 faces)



Case: Xewkija – Flight Paths



Case: Xewkija – Cameras and GCPs (Ground Control Points)



Case: Xewkija – Tie Points and Dense Point Cloud



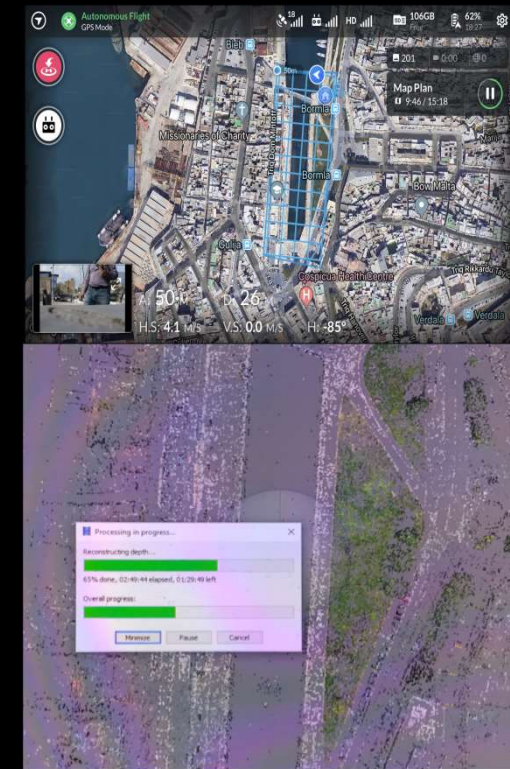
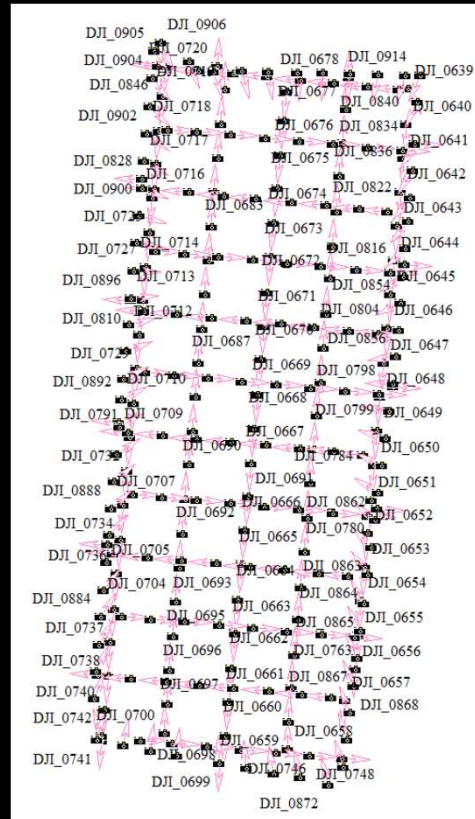
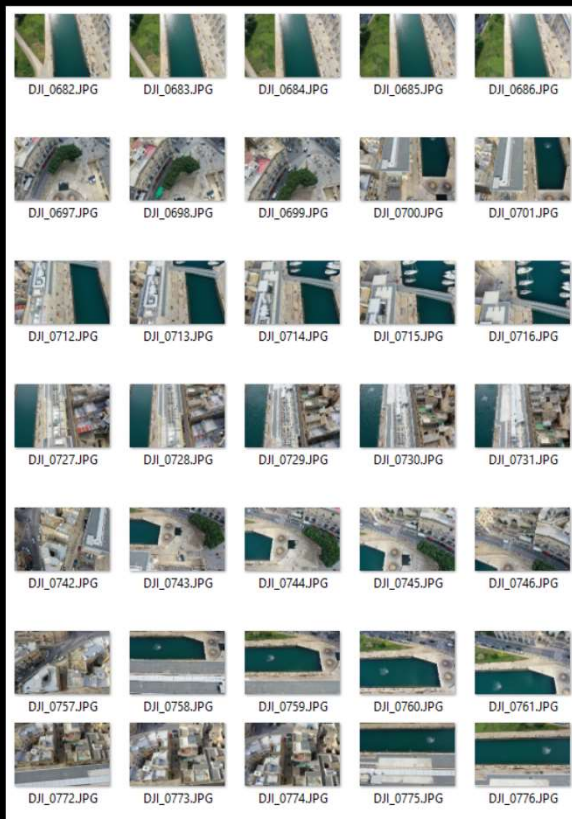
Case: Xewkija – Solid Meshes and Textured Meshes



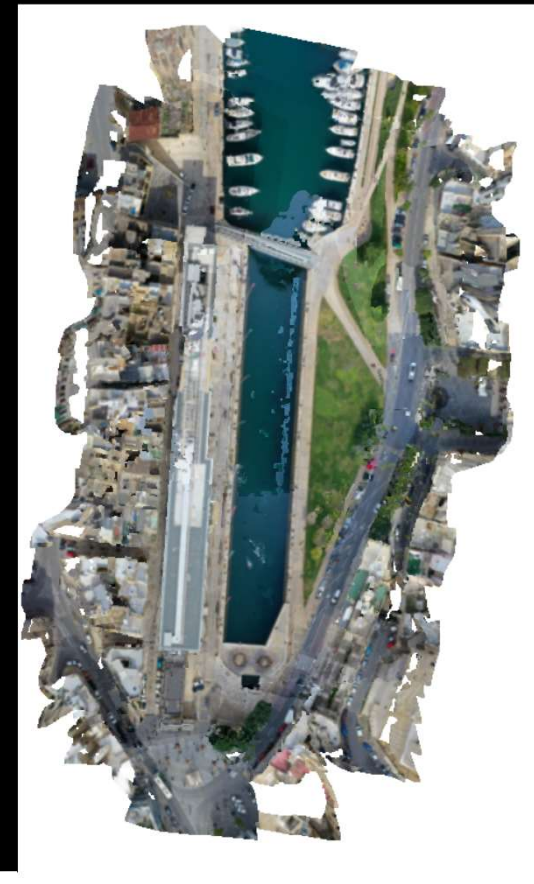
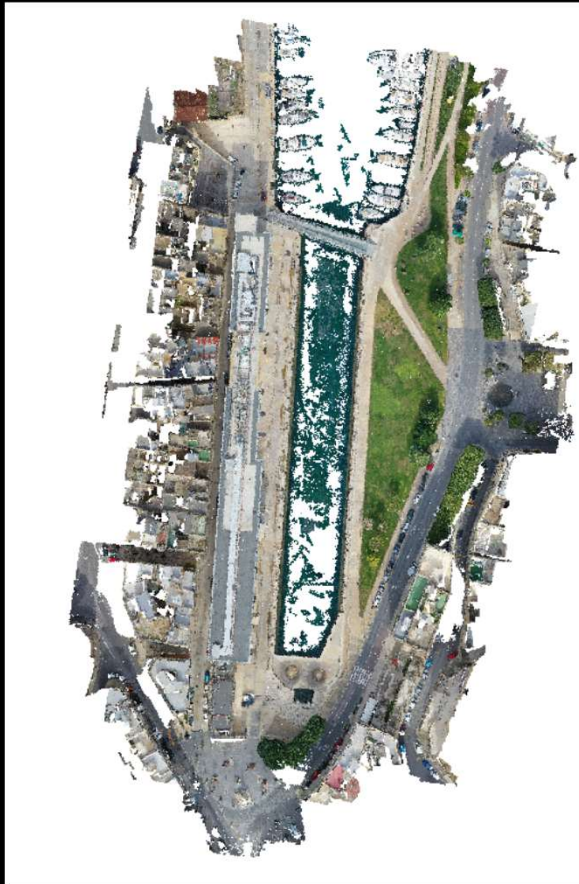
Case: Bormla Dock 1 Rehabilitation – Grand Harbour



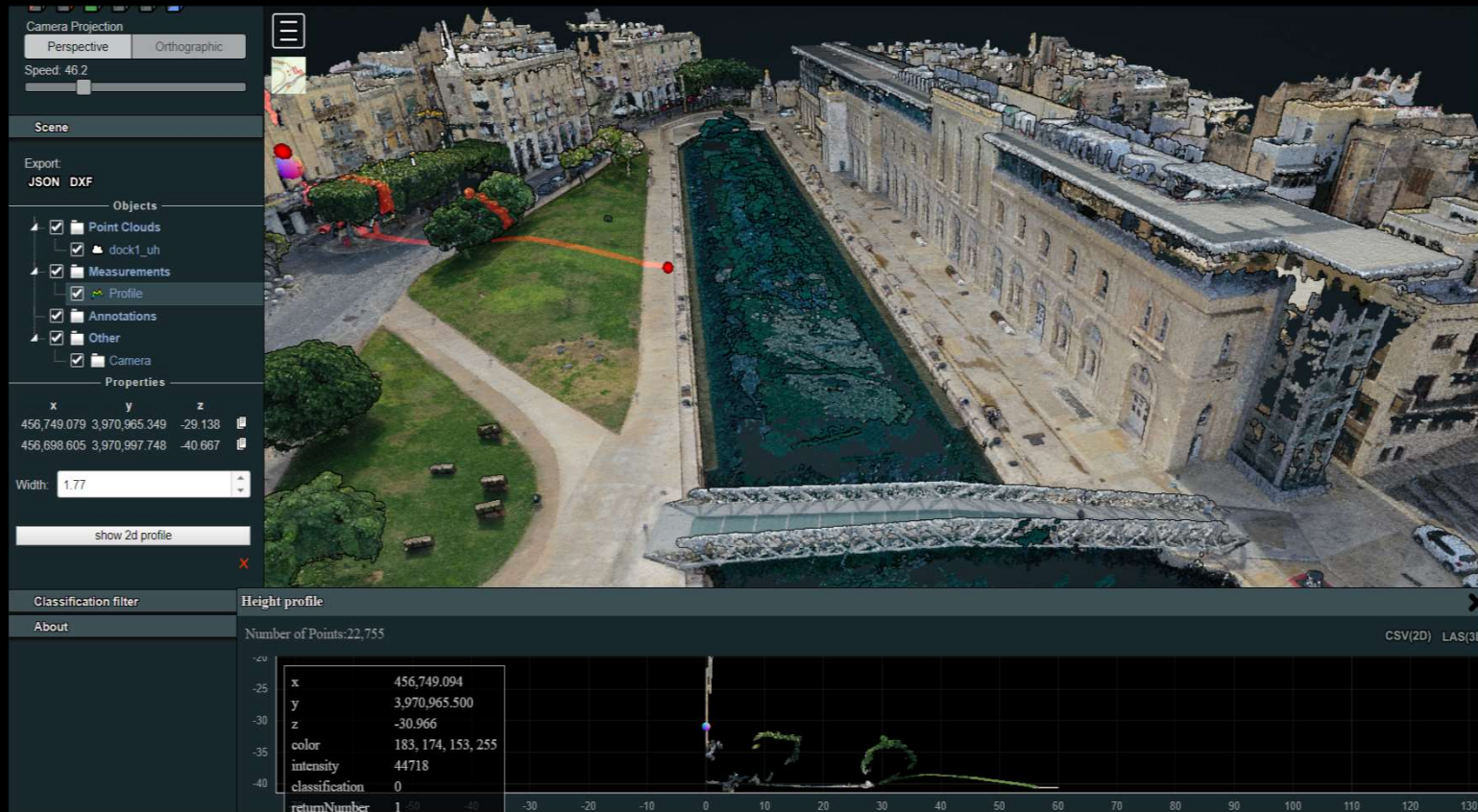
Case: Bormla Dock 1 – Flight, Images, Cameras



Case: Bormla Dock 1 – Pointcloud, DTM, Mesh



Case: Bormla Dock 1 – Rendered Model – www.cloudisle.org



The screenshot displays the CloudIsle software interface. The main view shows a 3D rendered model of Bormla Dock 1, featuring a long canal, a large building, and a park area. The interface includes several panels:

- Camera Projection:** Perspective (selected) and Orthographic. Speed: 46.2.
- Scene:** Export options: JSON, DXF.
- Objects:** A tree view showing selected objects: Point Clouds (dock1_uh), Measurements (Profile), Annotations, Other, and Camera.
- Properties:** A table showing coordinates and a width value.
- Classification filter:** A dropdown menu.
- About:** Information about the point cloud.
- Height profile:** A graph showing the elevation profile of the scene.

The Properties panel shows the following data:

x	y	z
456,749.079	3,970,965.349	-29.138
456,698.605	3,970,997.748	-40.667

The Width is set to 1.77. A button labeled "show 2d profile" is visible.

The Height profile panel shows the following data:

x	y	z	color	intensity	classification	returnNumber
456,749.094	3,970,965.500	-30.966	183, 174, 153, 255	44718	0	1

The Height profile graph shows a vertical axis labeled "z" ranging from -40 to -25 and a horizontal axis ranging from -30 to 130. The graph displays a profile of the scene's elevation.

Other Cases: Ribbon Development on Ridges



Environmental Assessment and Mitigation:

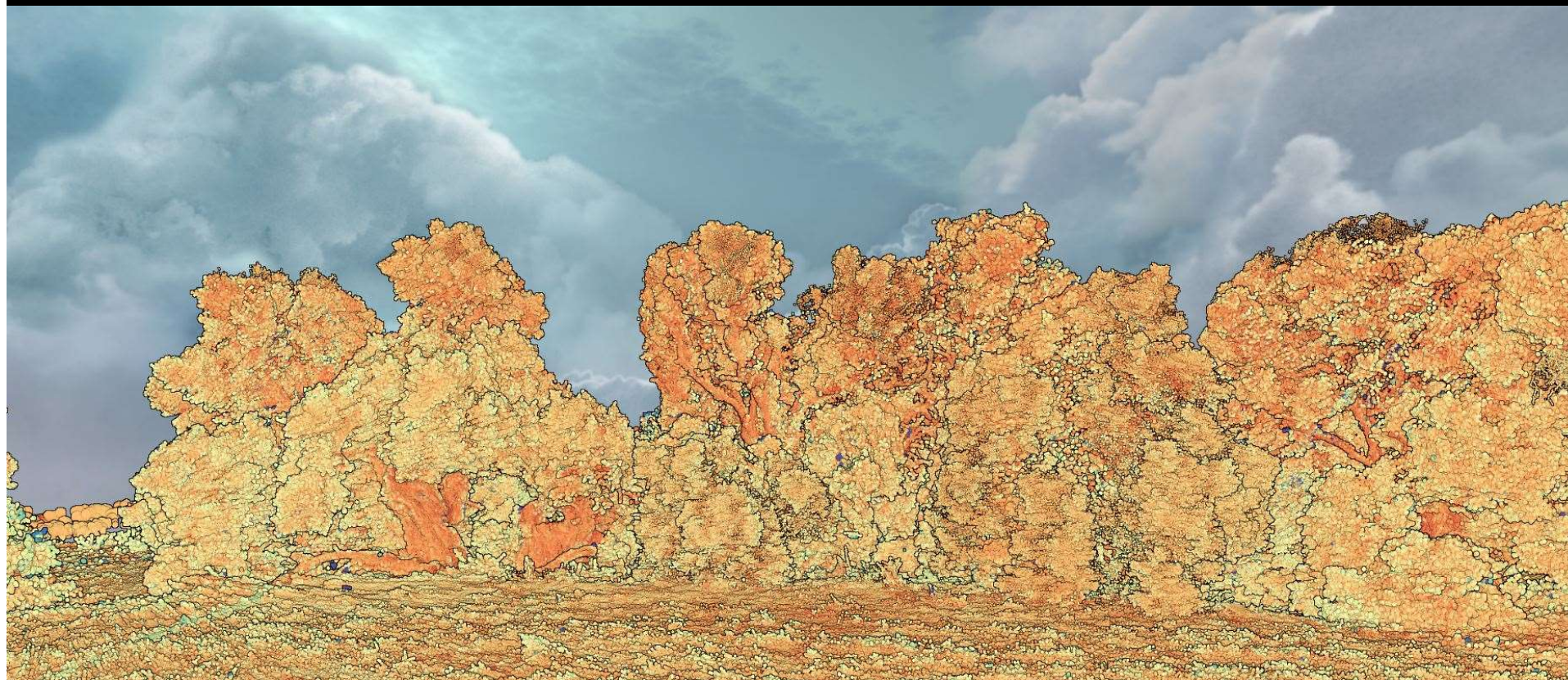
- Resource Extraction and Quarry Rehabilitation



Urban Conservation Area revisiting



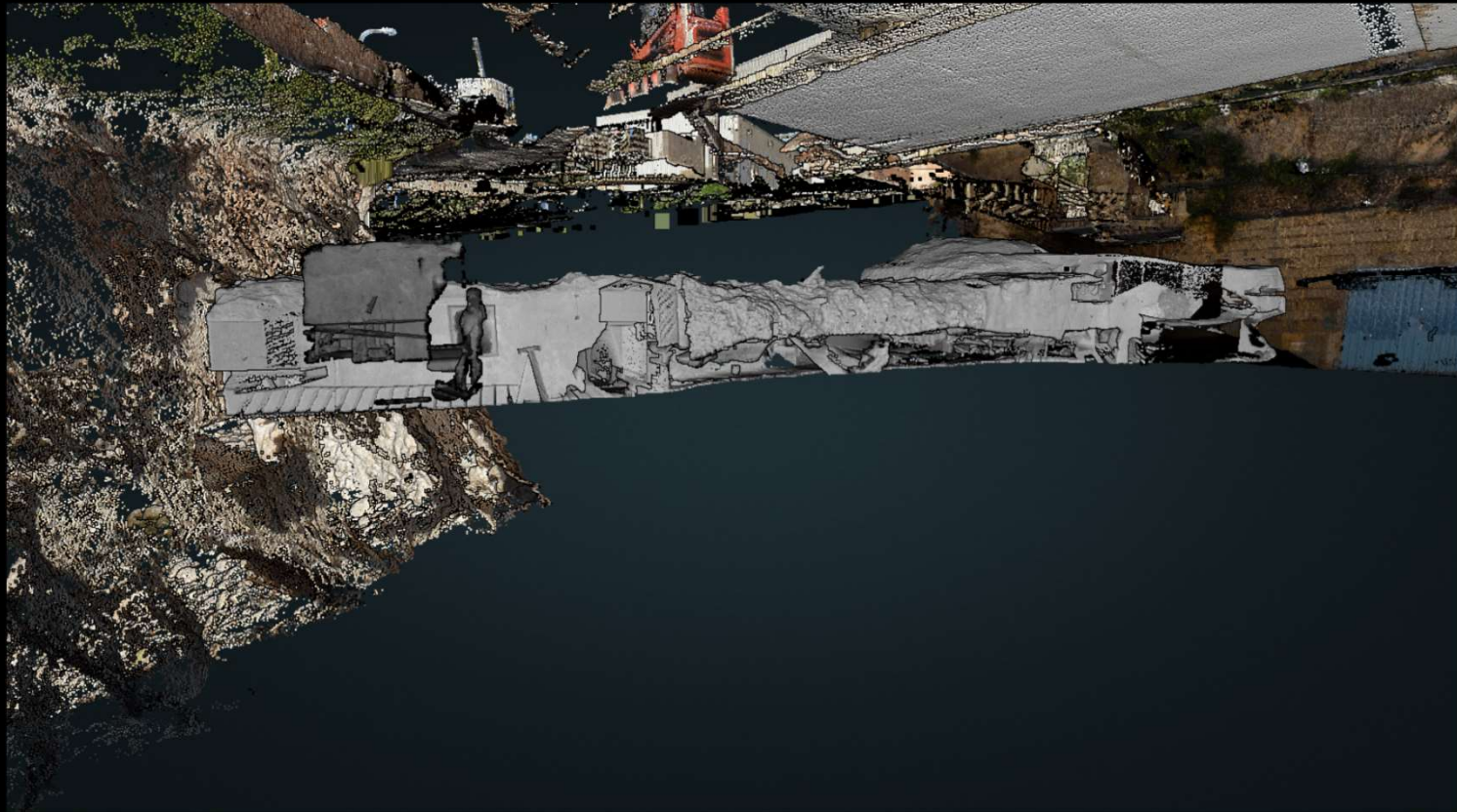
Bidnija - 2000 Year old Olive Grove



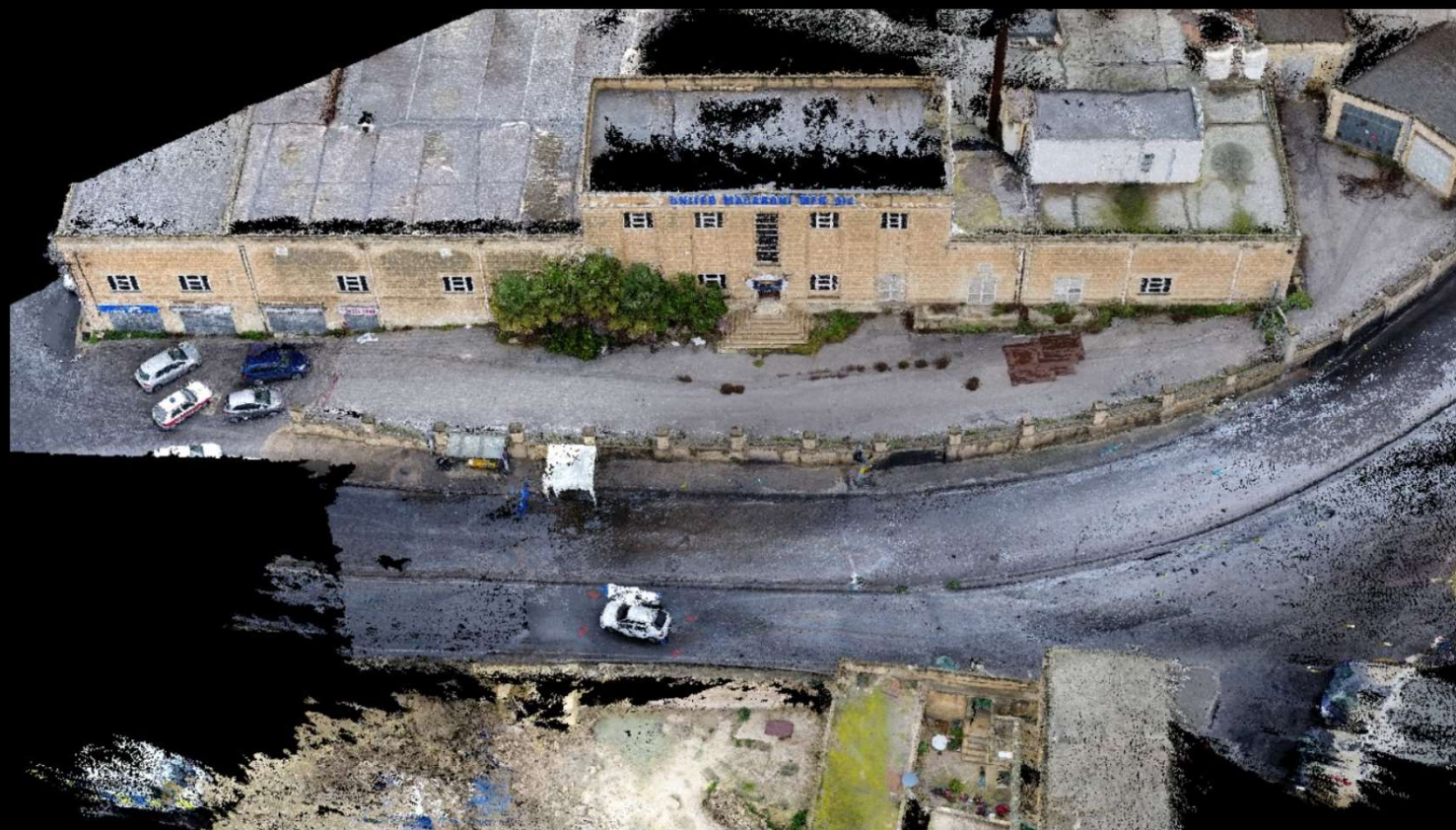
Erosion and Cliff Stapling



Undocumented Tunnel Discovery



Crime Scene: Car bomb



Crime Scene: Car bomb



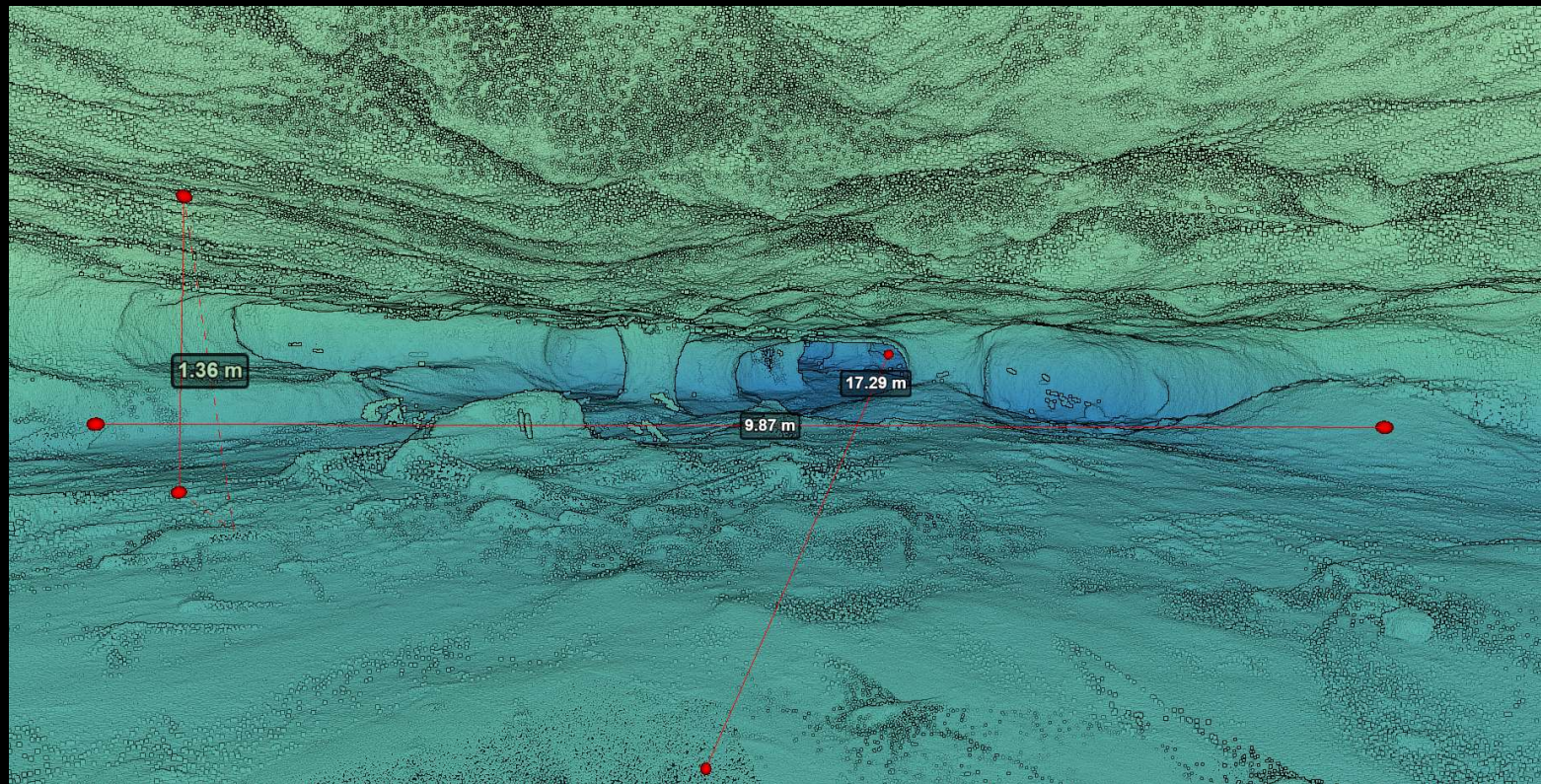
Civil Protection – Fireworks Factory Incident



Case: Deep Underground



Case: Deep Underground



Scanning the Facades – TLS-MLS - a Covid-19 light

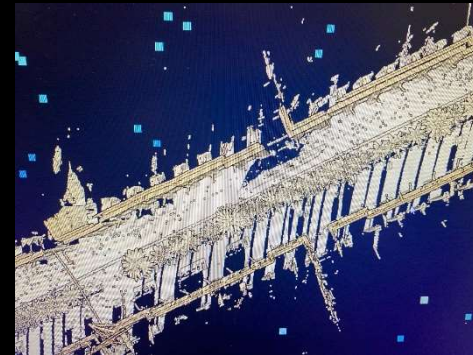
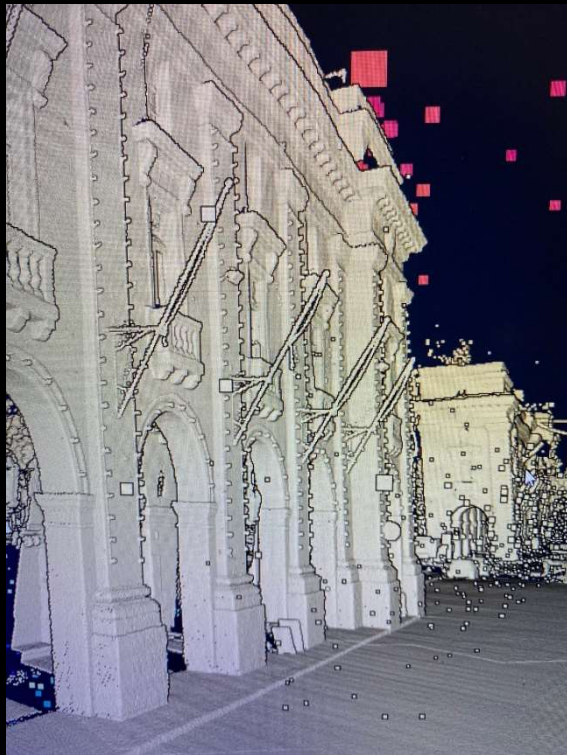
RiSCAN PRO RiPROCESS



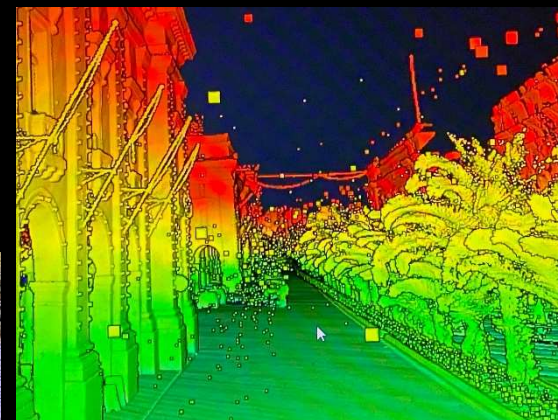
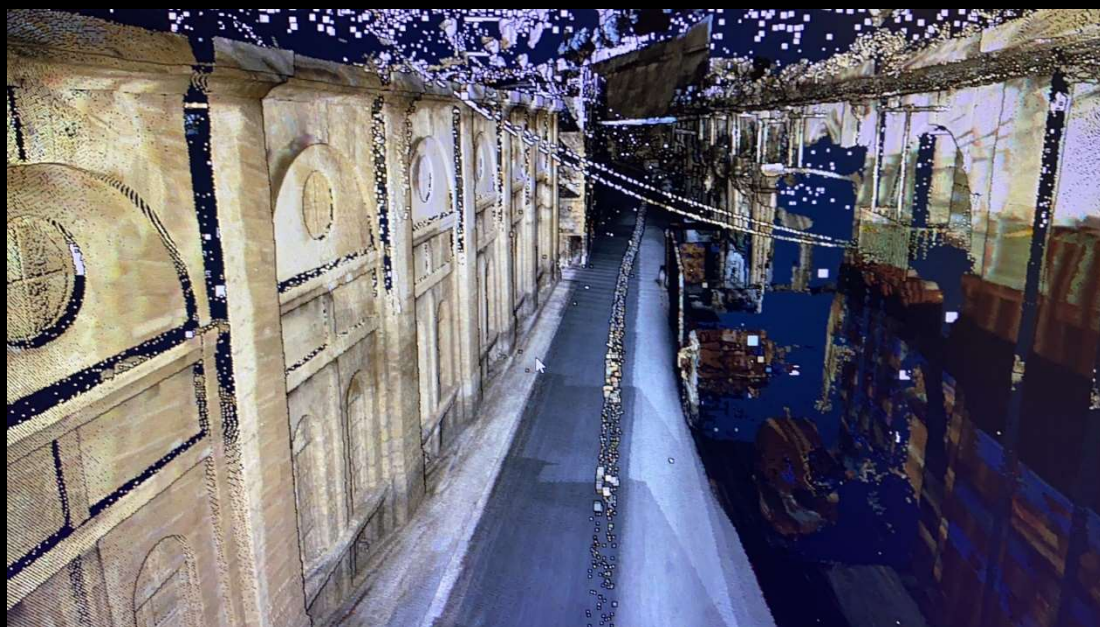
Tech MLS VMX 2HA

Software RiProcess

Scanning the Facades – MLS



Scanning the Facades – MLS

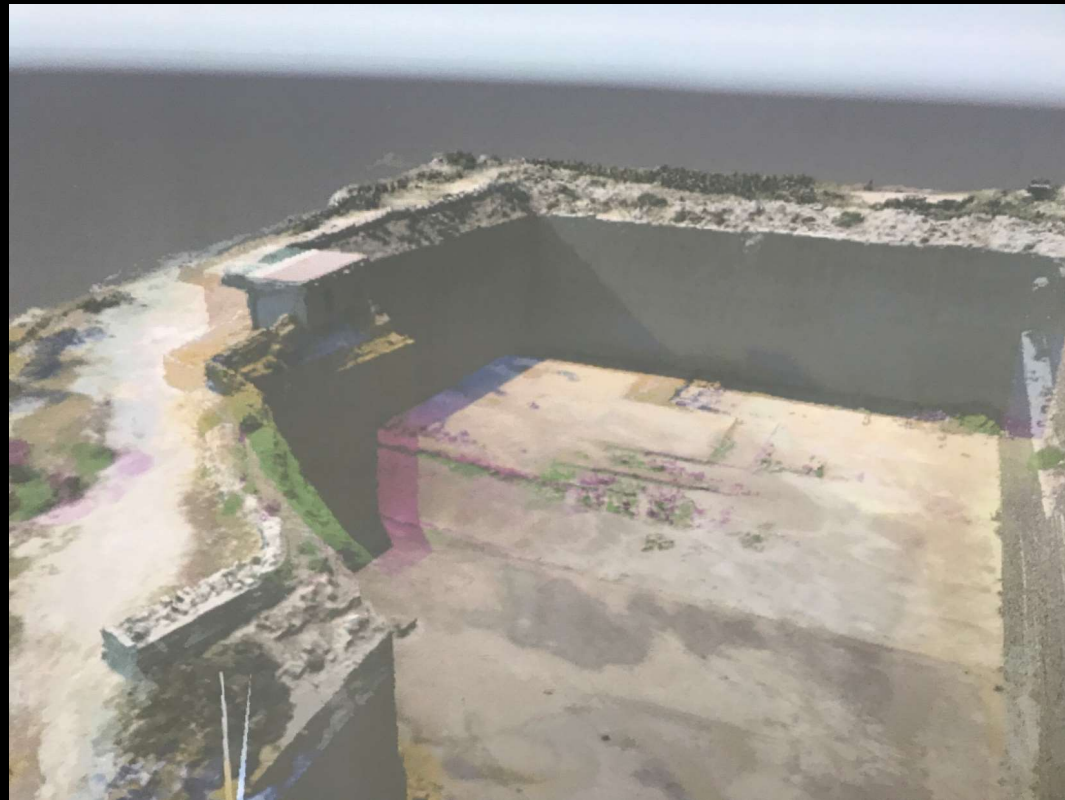


SIntegraM CAVE – Immersion Lab

Tech	CAVE Computer Automated Virtual Environment 4 walls, 2 floors, 1 roof
	Oculus Rift Magic Leap
Software	Unity



Taking the studies to the Policy-Makers and Decision Takers



Taking the studies to the Policy-Makers and Decision Takers

The CAVE
SIntegraM Immersion Lab



Taking the studies to the Policy-Makers and Decision Takers

The CAVE
SIntegraM Immersion Lab



The Wired and Unwired Tech

VR – Oculus Rift

AR/MR – Magic Leap



Taking the studies to the Policy-Makers and Decision Takers



VR – Oculus Rift



Taking the studies to the Gadgets programme

AR/MR – Magic Leap



Decisions affected based on Magic Leap – the Floriana Gardens



Decisions affected based on Magic Leap – the Floriana Gardens

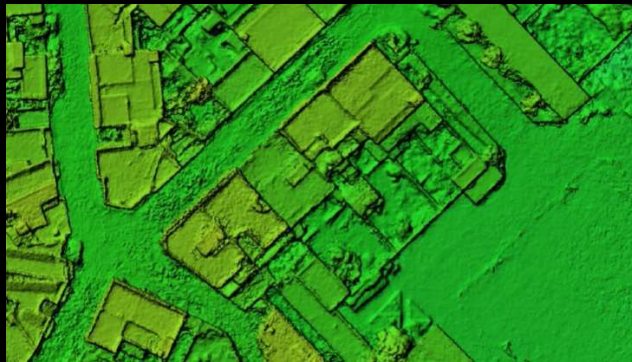


Taking the studies to the Courts



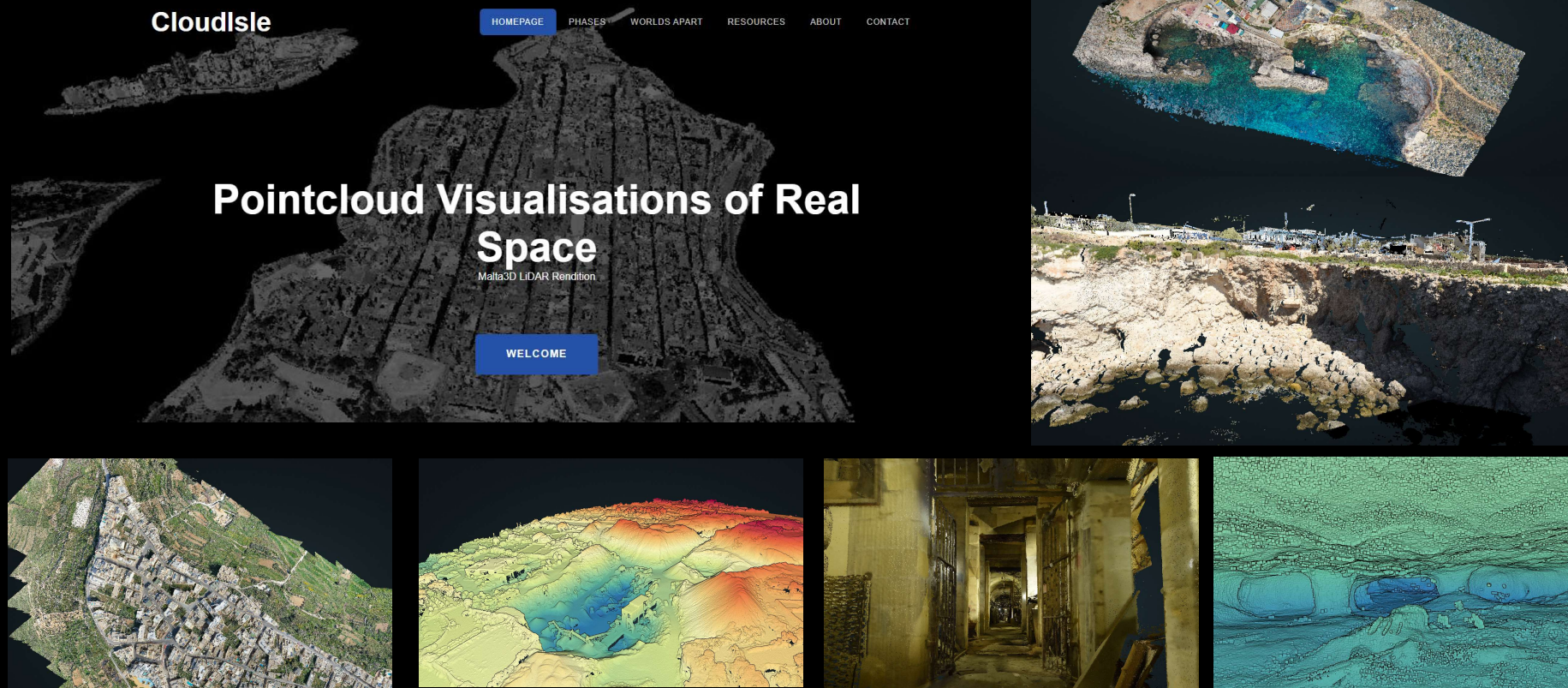
Gadgets

Vimeo videos – copied to Chat



Cloudisle.org

3d pointclouds – links copied to Chat

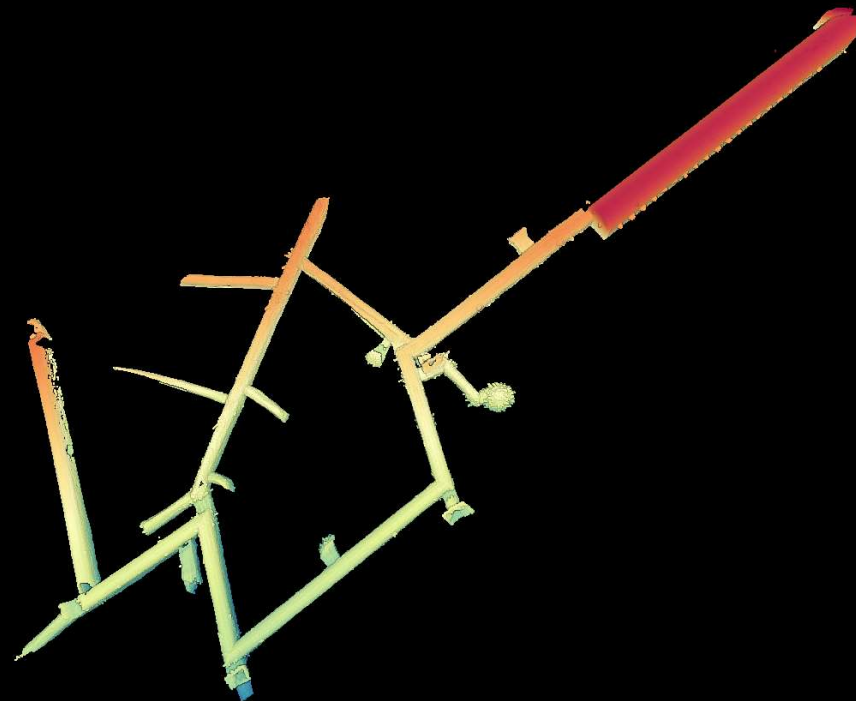


The screenshot displays the Cloudisle website interface. At the top left, the logo "Cloudisle" is visible. A navigation menu at the top includes links for "HOMEPAGE", "PHASES", "WORLDS APART", "RESOURCES", "ABOUT", and "CONTACT". The main heading reads "Pointcloud Visualisations of Real Space" with the subtitle "Malta3D LIDAR Rendition" and a "WELCOME" button below it. The background features a large, detailed pointcloud of a coastal town. To the right, there is a vertical image showing a 3D pointcloud of a coastal area with a blue water area, positioned above a photograph of a cliffside with buildings. Below the main content, there are five smaller images: a pointcloud of a town with green vegetation, a topographic pointcloud with a color gradient from blue to red, a photograph of an interior hallway with arches, and a pointcloud of an interior space with blue and green colors.

DLA 2021: New technologies in Workshop 7: Use of UAV for your Environmental Data: the Malta experience

28 May 2021

Thank You



Prof Dr Saviour Formosa

e: saviour.formosa@um.edu.mt

p: <https://www.um.edu.mt/profile/saviourformosa>