Spatial Imperatives for Solar Potential: Resultant outcomes

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NATIONAL ENERGY CONFERENCE – MALTA

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Scope

Building polygon extraction

- To finalise the DSM/DTM generation, data cleaning and Building Polygon extraction

Building of a GIS-Based model

- The creation of the spatial layers

- overlays of the layers in a workspace linked to the different datasets provided by EWA

- creation of the aligned solar panels

- estimating output

Solar Potential Determination

- determine the technical potential, in terms of energy (capacity and generation), separately of rooftop and facade solar PV in Malta using tools (moved from QGIS and the UMEP tool) to ArcGISPro and in-house python coding

The layers employed…

Building a Spatial Model: the data layers, methods and technologies

- LiDAR pointcloud and updates due to using a 2018 base

- Planning applications 2018 - 2022

- Digital Surface Model – Digital Terrain Model

- Roof extraction

- Roof splitting

- Slope analysis

- Roof area categorisation >1.5m^2

FF0   Change from 10m2 to 1.5m2
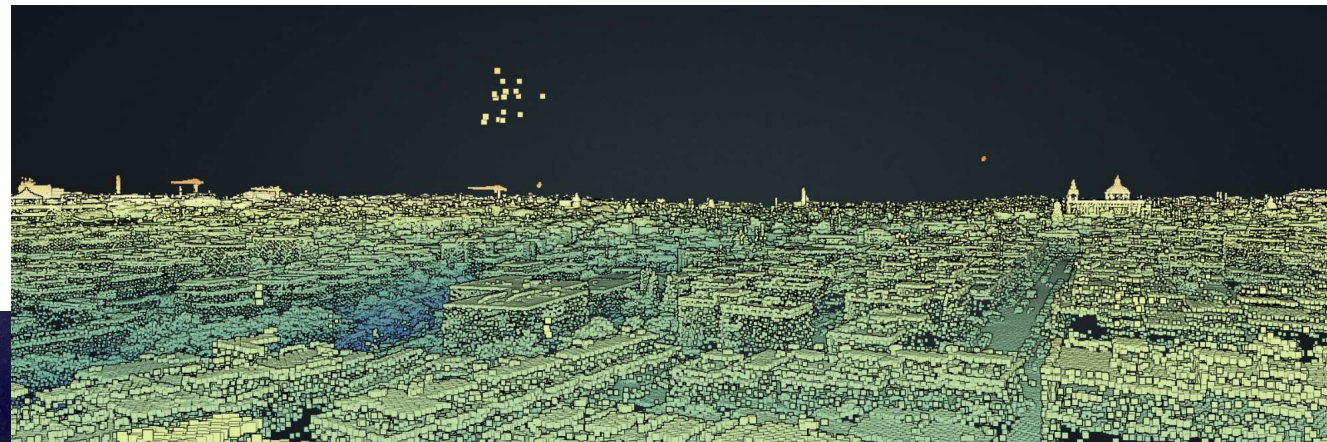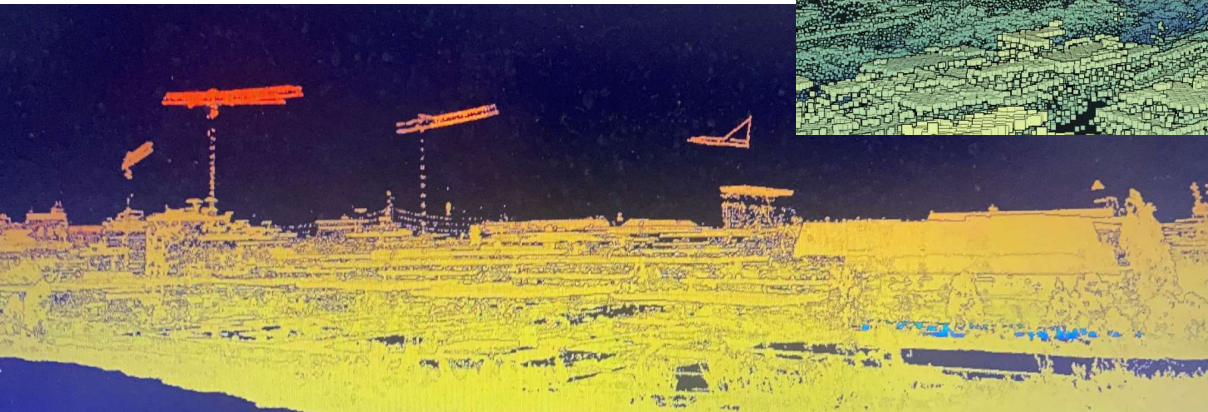Frankie Farrugia, 2023-10-21T11:45:54.792

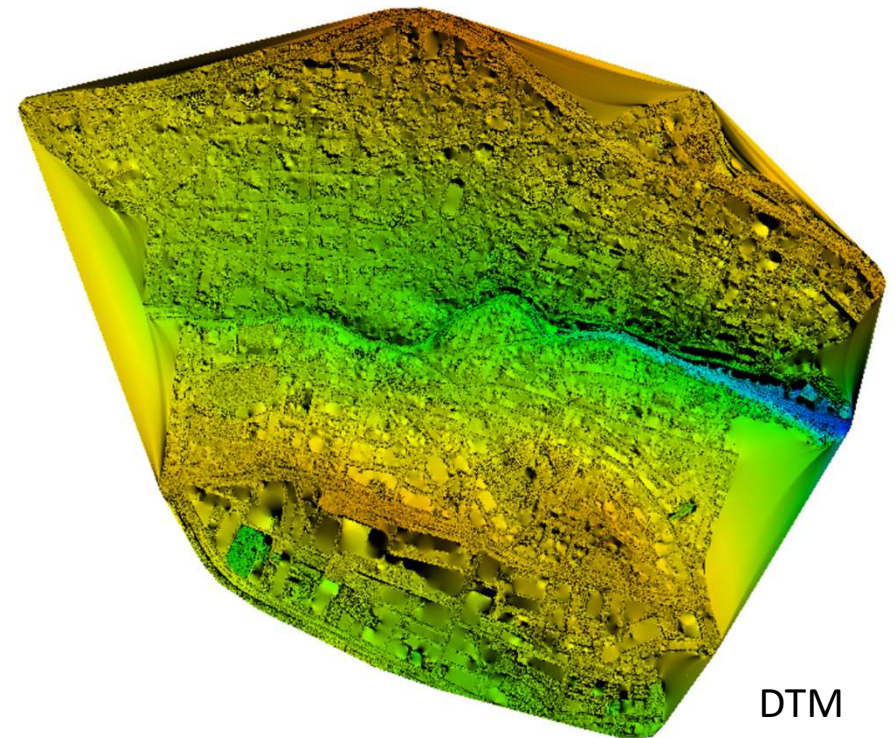# The Simple things in life…

And the more complex ones

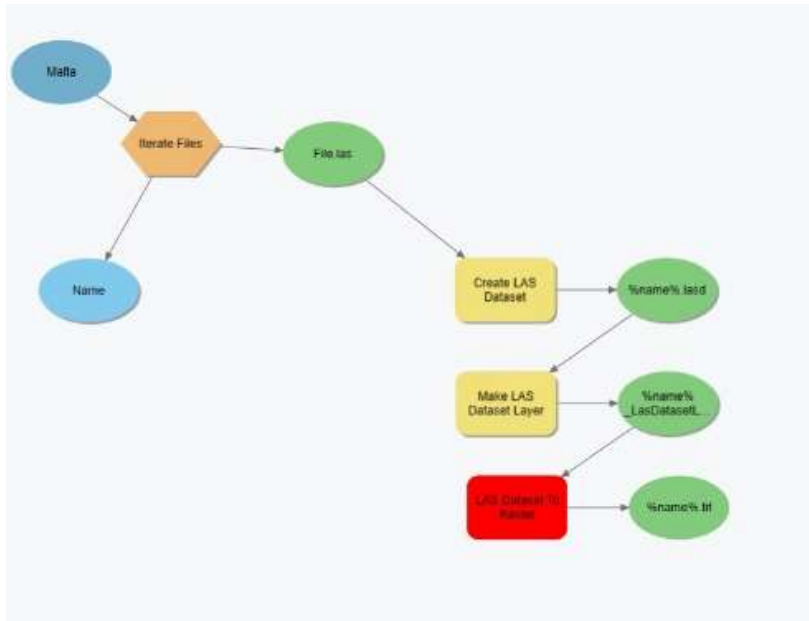# Space from space…

LiDAR and its anomalies

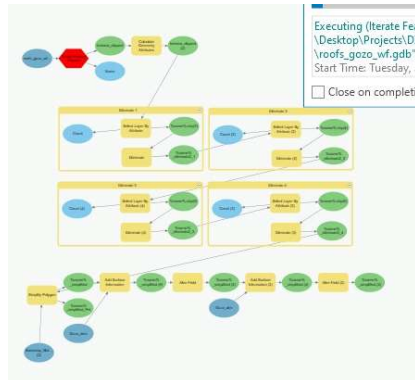# Initial processing…

Processing to DSM-DTM

DTM
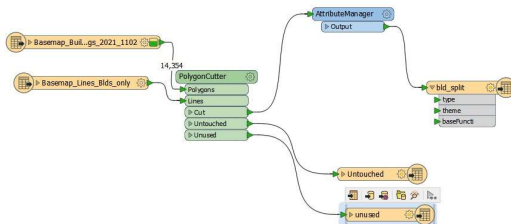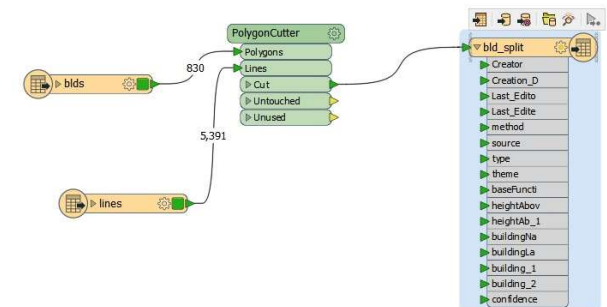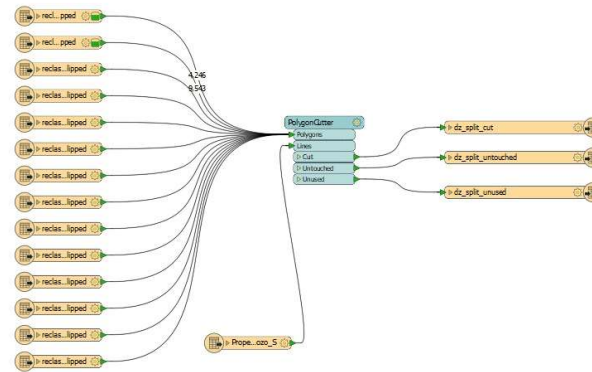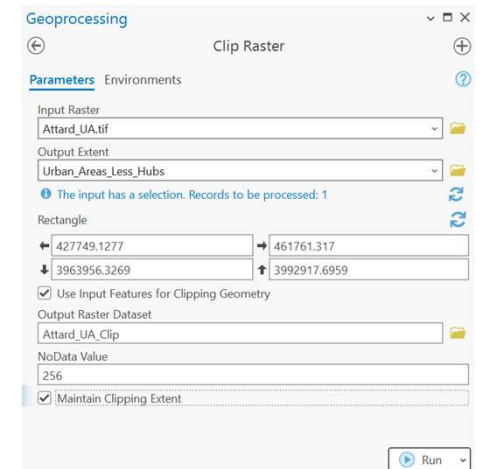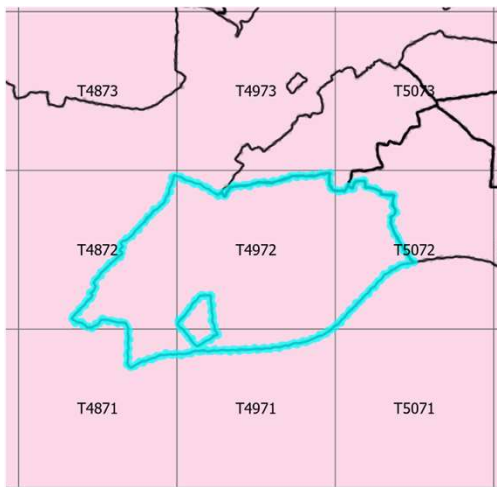
Stepped approach...

Processing to Extract Roofs

Processing: Splitting and Cutting to DSM-DTM
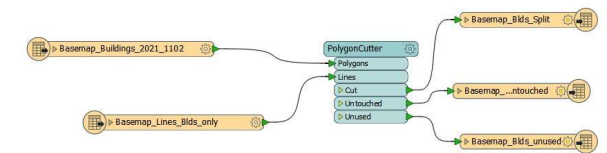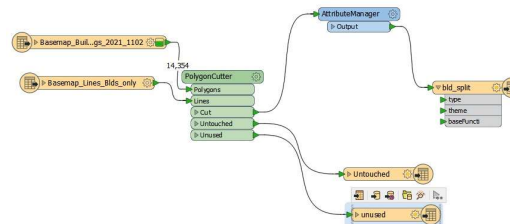
Methodology…

Deep Learning – Identify Solar Panels using AI

Variable identification...

To Identify suitable rooftops

To find appropriate rooftops for installing solar panels, two factors were taken into consideration:

- Roof Slope: The rooftops that have a **slope of 70 degrees or less** were considered.
        Rooftops were identified as flat (slope degree of 0 to 10) in addition to higher slopes (10 to 70 degrees).

- Solar Radiation: Suitable rooftops should receive a **minimum of 900 kWh/m²** of solar radiation. This criterion can be evaluated using a solar radiation raster layer.

- By analysing these two criteria and overlaying the respective raster layers, the rooftops that meet the requirements for solar panel installation were identified.

Methodology...

Deep Learning – Identify Solar Panels using AI

- Creation of a Mosaic

- Clipping of the raster against the urban area boundary

- Extraction of the building parcels

- Deep Learning

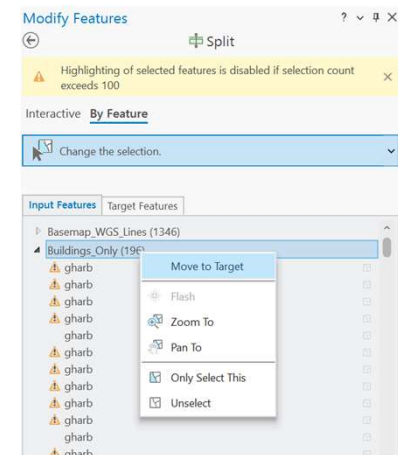- Dissolving the detected features
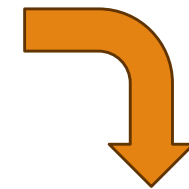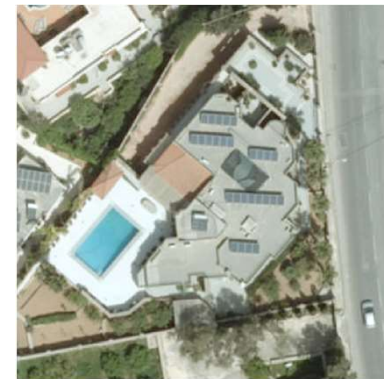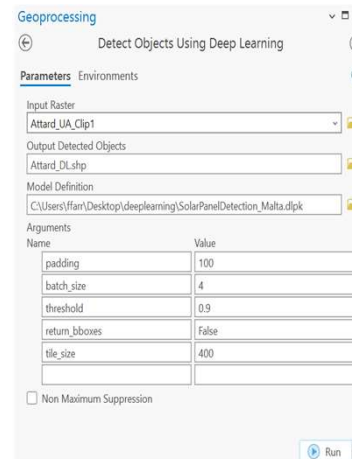
Methodology...

Splitting of basemap blocks to create individual parcels and Assign UUID

- Splitting a polygon dataset by a line dataset

- Assigning a UUID

     Run Python script (imported a tool in ArcGIS Pro toolbox)

Methodology…

Estimate Solar Power Potential

- Create a solar radiation raster layer

- Convert the units of measurement to KWh

- Identify suitable rooftops

- Create a slope layer

- Reclass the slope to identify flat and steeper roofs

- Convert the raster to polygon

- Assign UUID to suitable roofs

- Add the Min and Max Z value of the building

- Find the minimum Z for each UUID (Python)
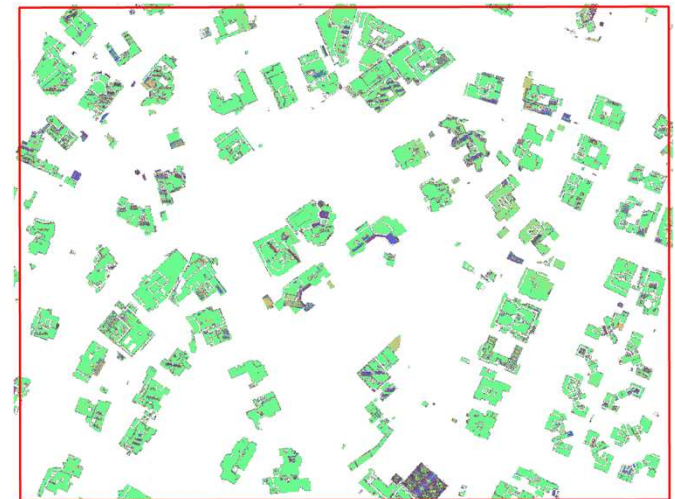
Slope Analysis – Identifying Flat roofs

Methodology...

Estimate Solar Power Potential...

- Identify the Mean Radiance and Roof type for each Rooftop

- Rank Polygons by UUID and Height (Python)

- Extract the Flat roofs only roofs that are rank 1 or 1.1

      into two separate datasets

- Recalculate the area for the new dataset

- *Remove Existing solar panels from suitable roofs*

- Recalculate mean radiance and new solar radiance

- Calculate the "Usable_SR", "Elec_Prod", and "PV_Cap"
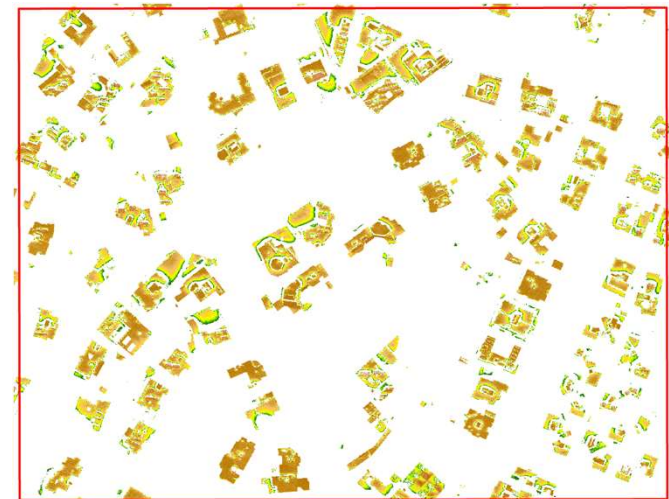
Radiance Analysis – more than 900 KWh

Deliverables

Estimate Solar Power Potential...

Locality_Roofs.shp

Locality_Roofs_Flat.shp

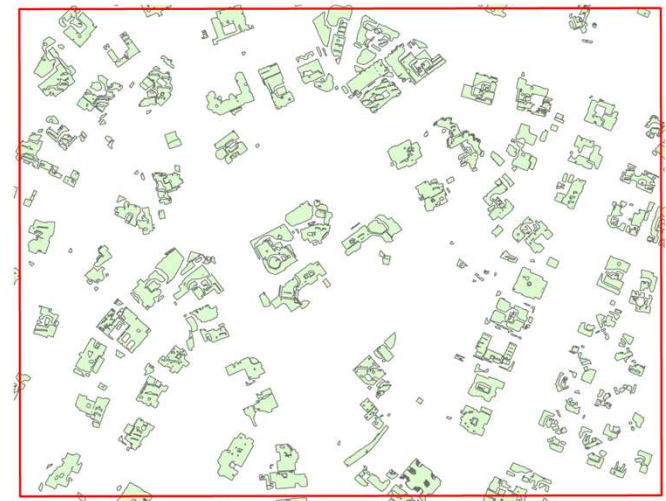Locality_Roofs_Rank1.shp

Locality_Roofs_NoPanels.shp

Locality_Roofs_ NoPanels_Flat.shp

Locality_Roofs_ NoPanels_Rank1.shp

Locality_Footprints_UUID.shp

Locality_ Rad_KWh_70_900_Int.tif

Locality_Slope_Every5.tif

Vectorised Suitable Roofs

Verification and Panel positioning

Aligning panels...

 - Output validation and verification

 - Visual analysis and review

 - Sampling

 - Python coding by EWA to assign rooftop panel positioning

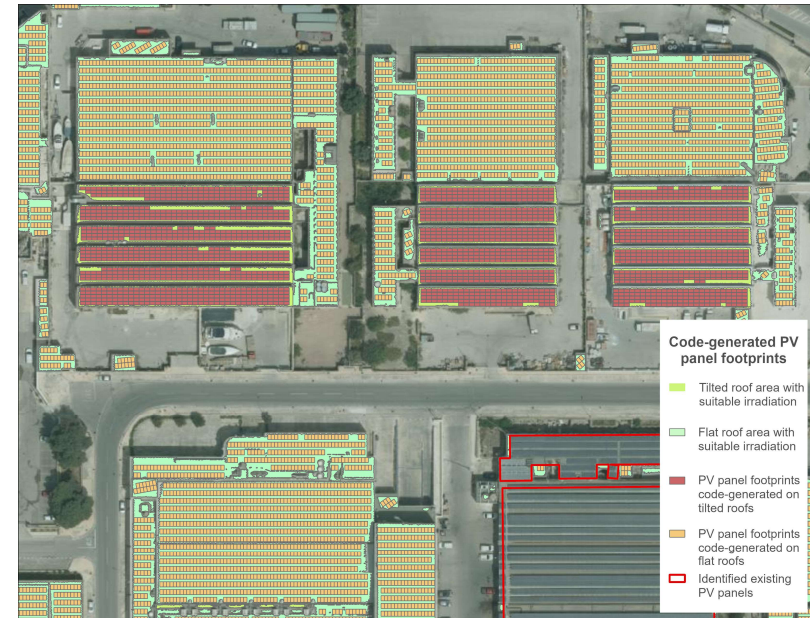# All roofs & highest roofs only

Aligning panels...

- PV panel **footprints** for 20° tilted panels

- No inter-row spacing for installations with two rows on one roof.

- 2 Scenarios:
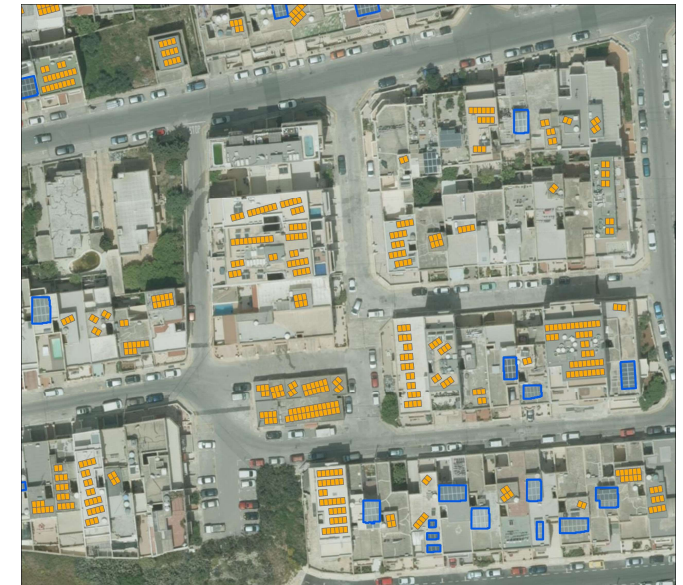
  - All roofs

  - Highest roofs

Industrial Areas

- 2 Scenarios:

- **Flat roofs Scenario**: with inter-row spacing

- **Gable (tilted) roofs Scenario**: without inter-row spacing

Solar Irradiation
kWh/m2/year
1436
900

Code-generated PV panel footprints

Tilted roof area with suitable irradiation

Flat roof area with suitable irradiation

PV panel footprints code-generated on tilted roofs

PV panel footprints code-generated on flat roofs

Identified existing PV panels

Outputs...

- Sample outputs:
Technical potential in
Nadur: 8.2 MWp

- Sample outputs:
Technical potential in St
Julian's: 10.1 MWp

- Results show maximum
possible technical potential
without any restrictions,
assuming 300Wp PV
panels footprints

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