Using high-density LiDAR data for building models

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Comparing Cameras and LiDAR?

Sensor	Aircraft speed (km/h)	Density (points/m²)	Swath (m)	Coverage rate (km²/h)	Comment
DMCIIe	250	25	3100	775	20cm GSD
DMCIIe	250	44	2300	575	15cm GSD
DMCIII	425	25	5100	2168	20cm GSD
DMCIII	425	44	3800	1615	15cm GSD
SPL100	425	8	2500	1063	
SPL100	425	15	2000	850	
SPL100	425	30	1000	425	15 points/m² with 50% side overlap

Comparing LiDAR and Cameras is here done on points/m², please note difference in aircraft speed.

LiDAR can be flown day and night, needing only a line of sight between sensor and terrain. Camera is normally restricted to a sun angle of > 30 degrees

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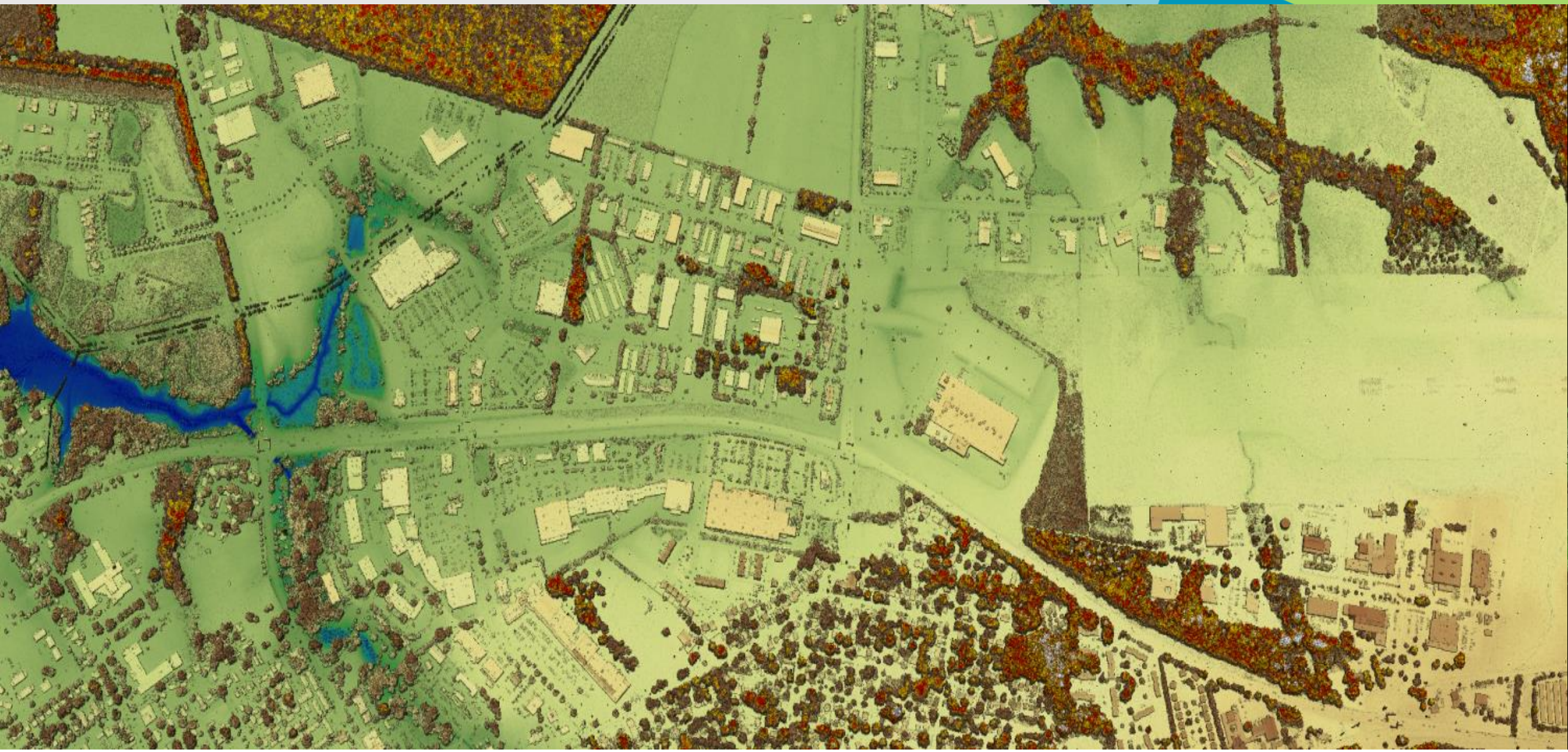

Look at what we can get with just LiDAR! It's ready for Mapping

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HxMap evolving…

RCD30

RCD30 Oblique

DMC IIe & III

City Mapper

SPL100

Terrain Mapper

Leica Mission Pro

Novatel Inertial Explorer

- ✓ RawQC
- ✓ Data Ingest
- ✓ APM/ AT
- ✓ DSM Generation
- ✓ Image Output
- ✓ Rectification
- ✓ LiDAR Output
- ✓ Building models & Textures

Leica HxMap

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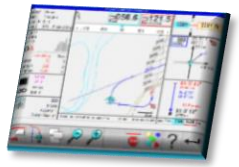
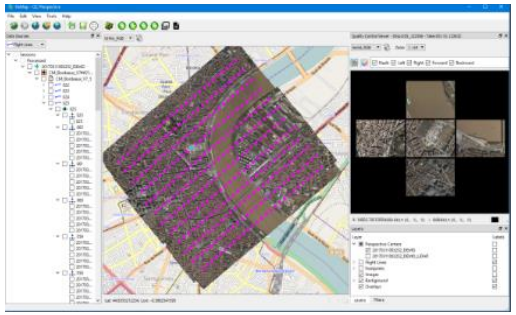
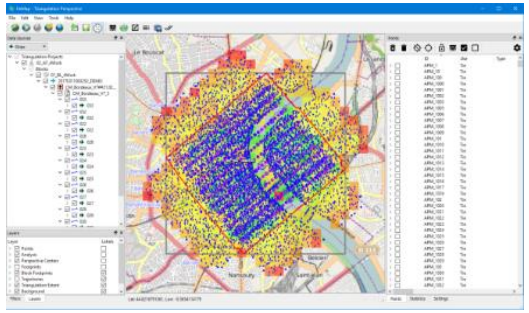
Concept of HxMap

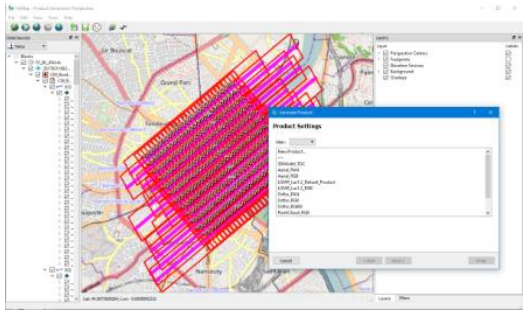
Leica Mission Pro



Leica FlightPro







LiDAR data

GNSS/IMU data

Waypoint Inertial Explorer

Initial QC

Ingest
Raw data processing
Georeferencing

QC & Review

1:1 Quality check of captured data
Setup image radiometry

LiDAR Calibration

Aerial Triangulation
Run APM
Ground Control Measurement
Bundle Block Adjustment

Product generation
Aerial Images
Ortho Images
InfoCloud (DSM)
LiDAR Point Cloud
Building Models & Textures

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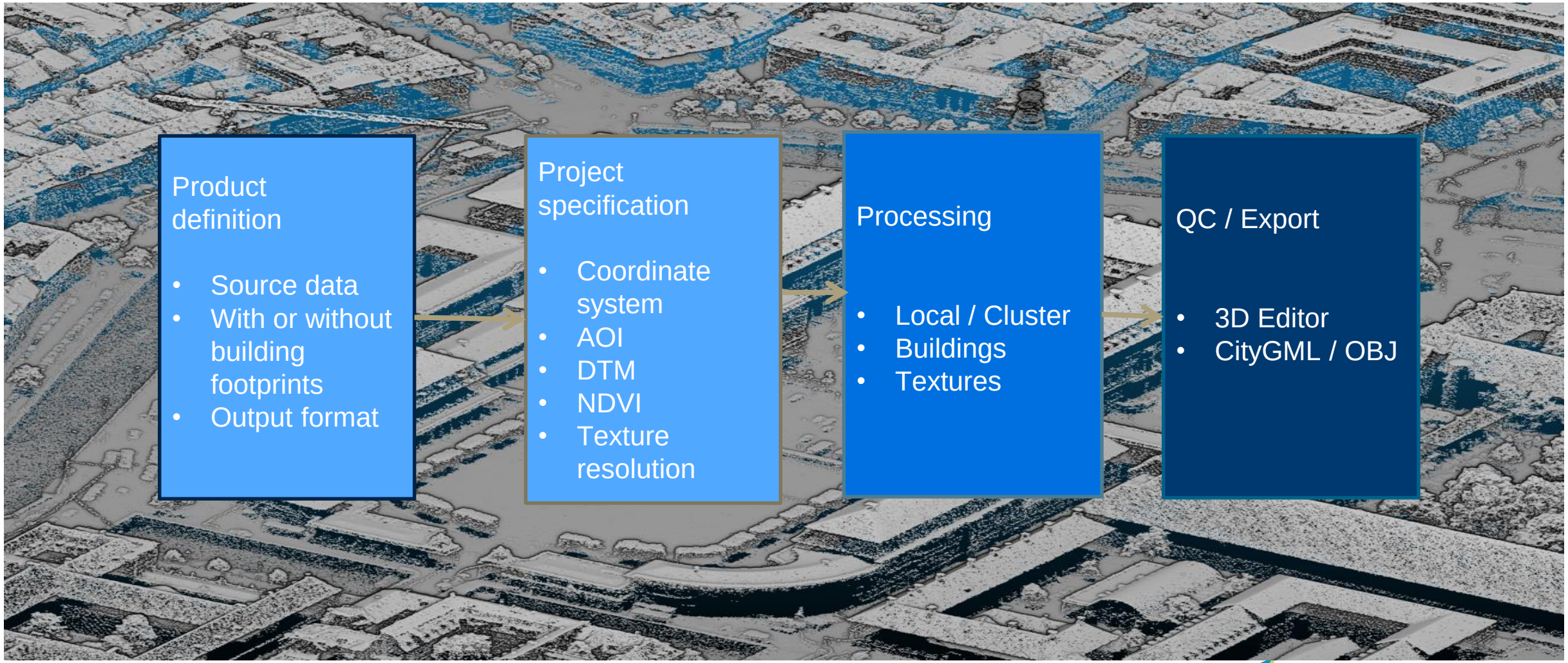
HxMap – 3D modelling workflow with HxMap BuildingFinder



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What BuildingFinder can do!

- HxMap Building Finder is focusing on delivery of LOD 2 for large scale areas
- The software can automatically find buildings contours, but existing building polygons can be added
- With HxMap 3DEditor datasets can be edited and then textured by TextureMapper
- Segmentation can be done down to 30*30 cell size
- For superstructure on rooftops a cell size of 5*5 m are normally used but down to 1 m are possible

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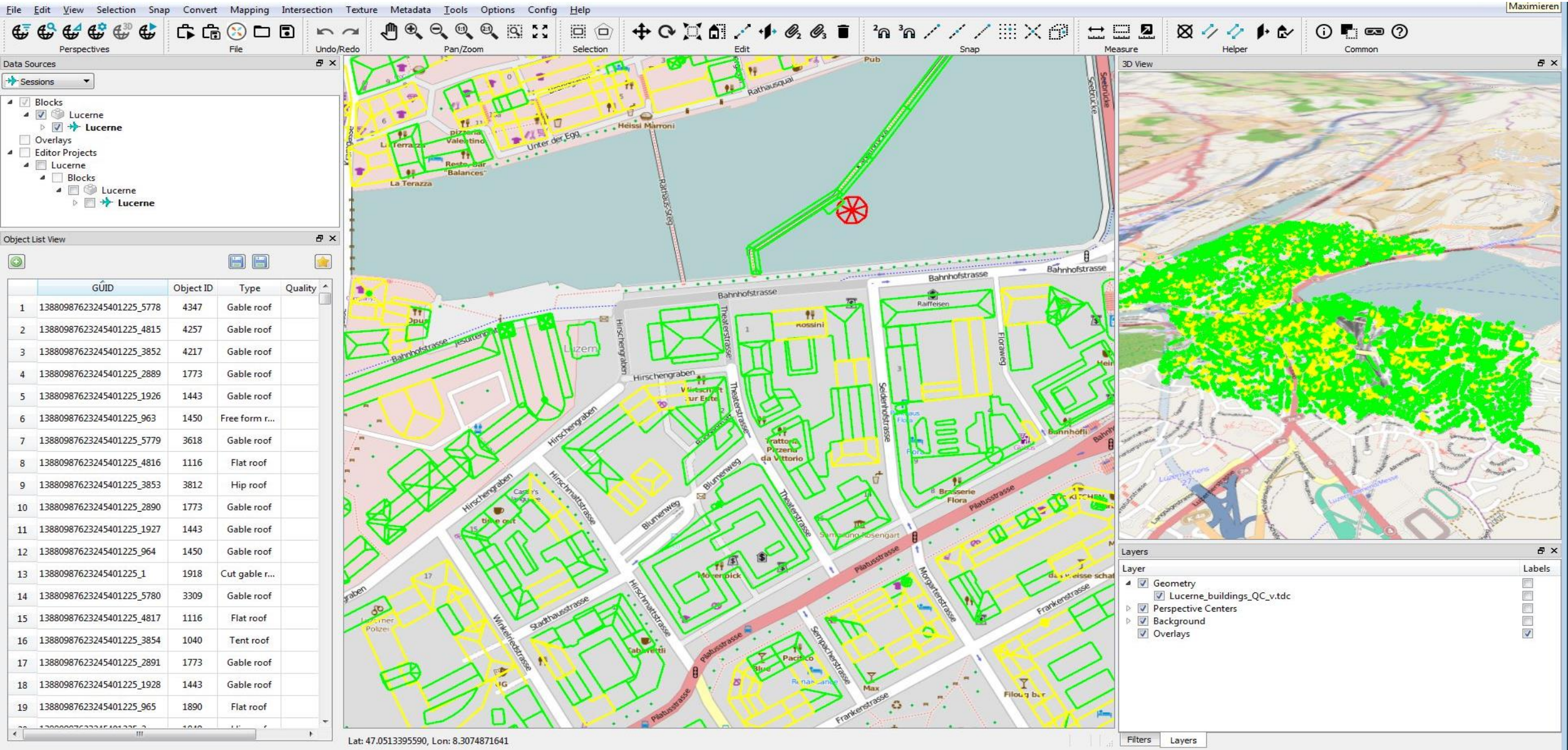
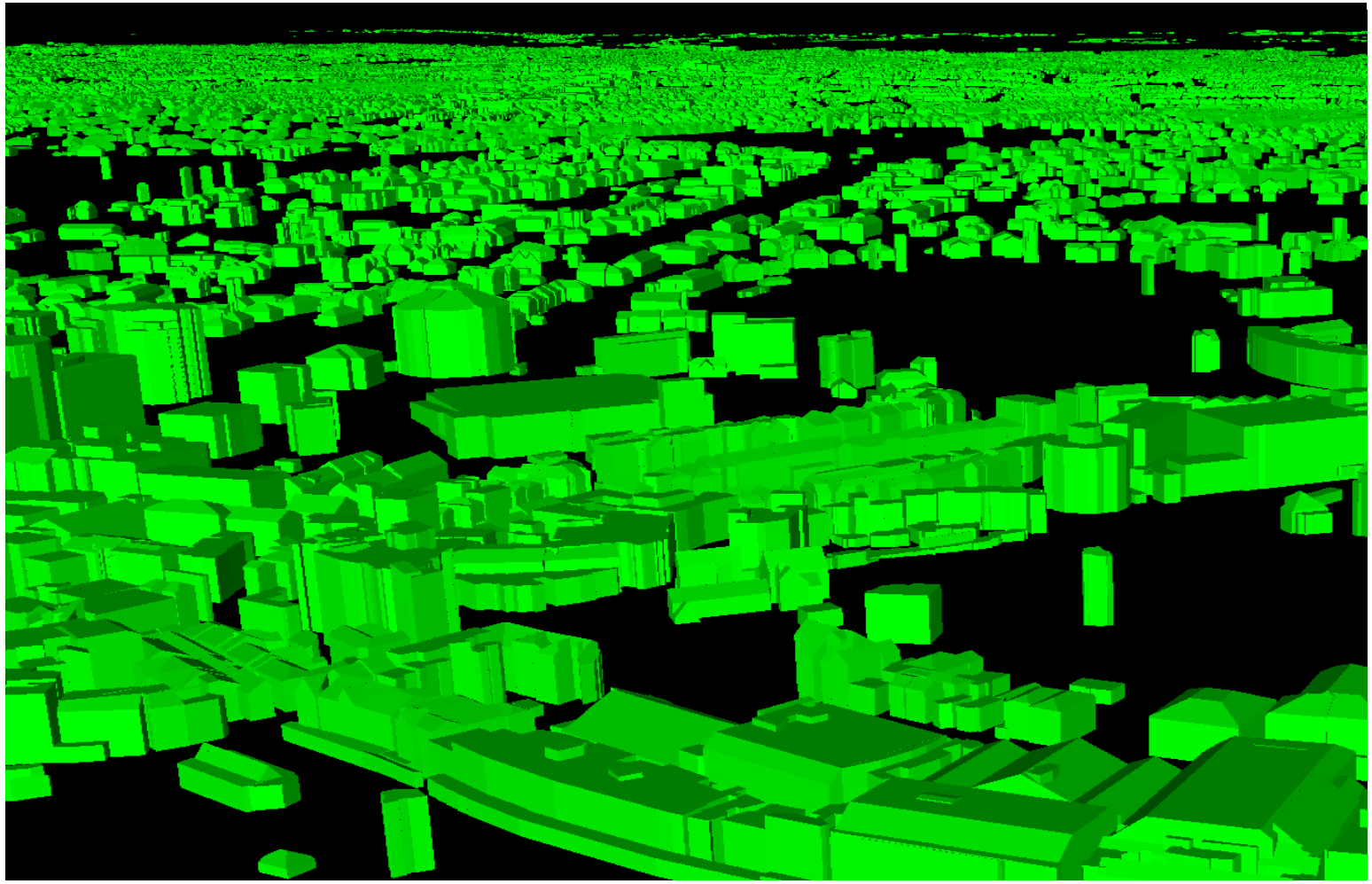
CityModelling & 3DEditor



Generation of SPL surveyed area for Bournemouth city in UK

- 80 km^2 with 106.500 building objects
- LiDAR data with 8-10 p/m^2
- Classification (ground, vegetation, buildings) done by HxMap
- LOD2 as the end product
- Classification is done in about 24 hours on a single computer.
- Building generation about 14 hours on a cluster with 6 nodes



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Example for Copenhagen

- Basic inputs (collected data):
  - Oblique images with 4 cm resolution
  - SPL LiDAR data with 30 p/m^2
  - Area 1 km^2
- Product:
  - Building boundaries in 2D
  - LOD2 building models
  - Building models with texture
- Processing time*:
- 3 h for block model
- 3 h for texturing

- Need for LiDAR points
  - Rural areas + 8 p/m^2
  - Urban + 10 p/m^2
- Note:
  - XY accuracy is limited to the accuracy of the LiDAR data and it's not easy to get better XY MSQ than 25 cm
  - Automatic alignment of buildings is a needed function in the software

*Single node, Xeon E5-2640 CPU, 32 GB RAM

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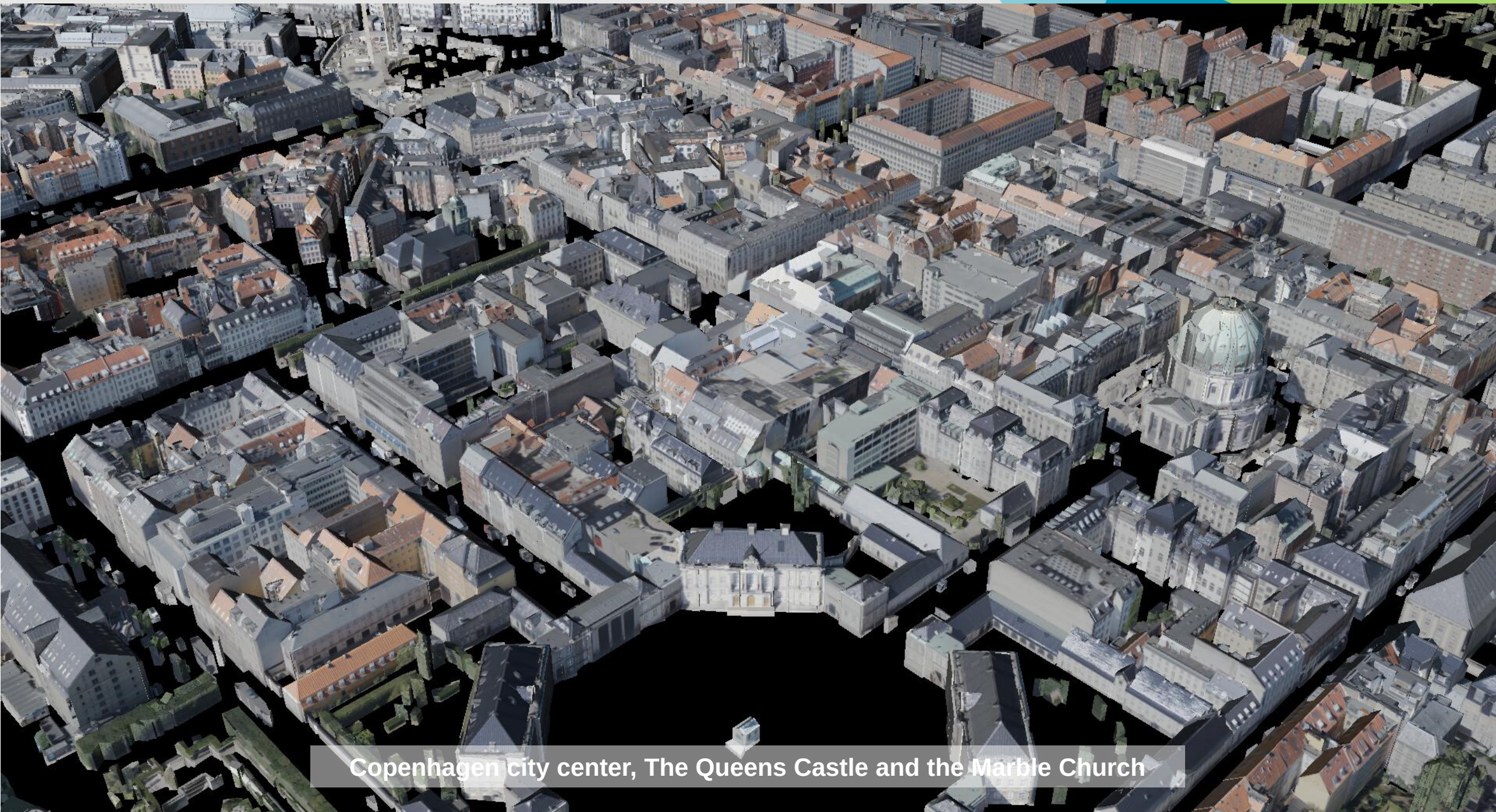

Copenhagen city center, The Queens Castle and the Marble Church

Frankfurt city center generated by BuildingFinder, data source TerrainMapper LiDAR sensor

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Point classification

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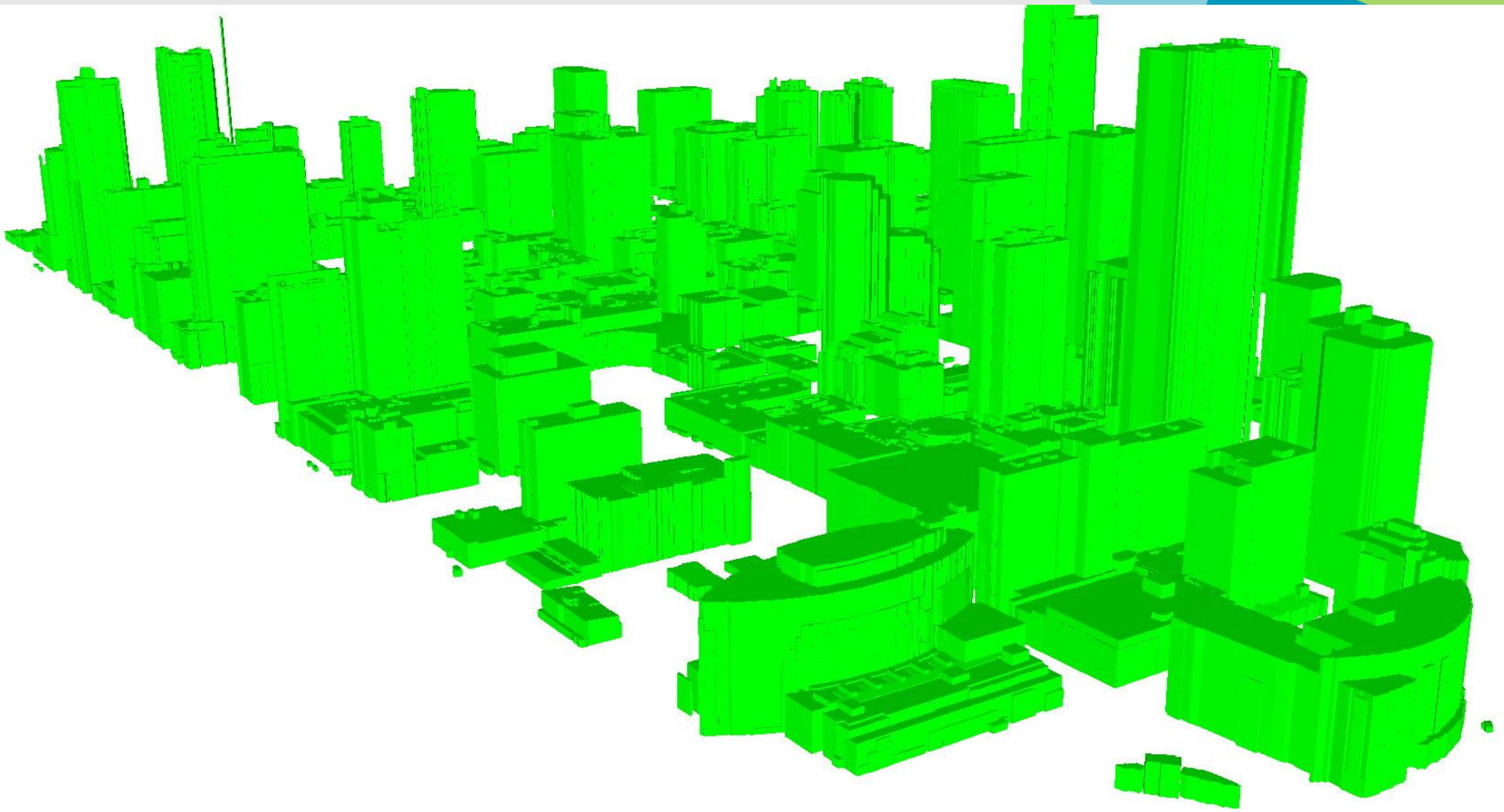

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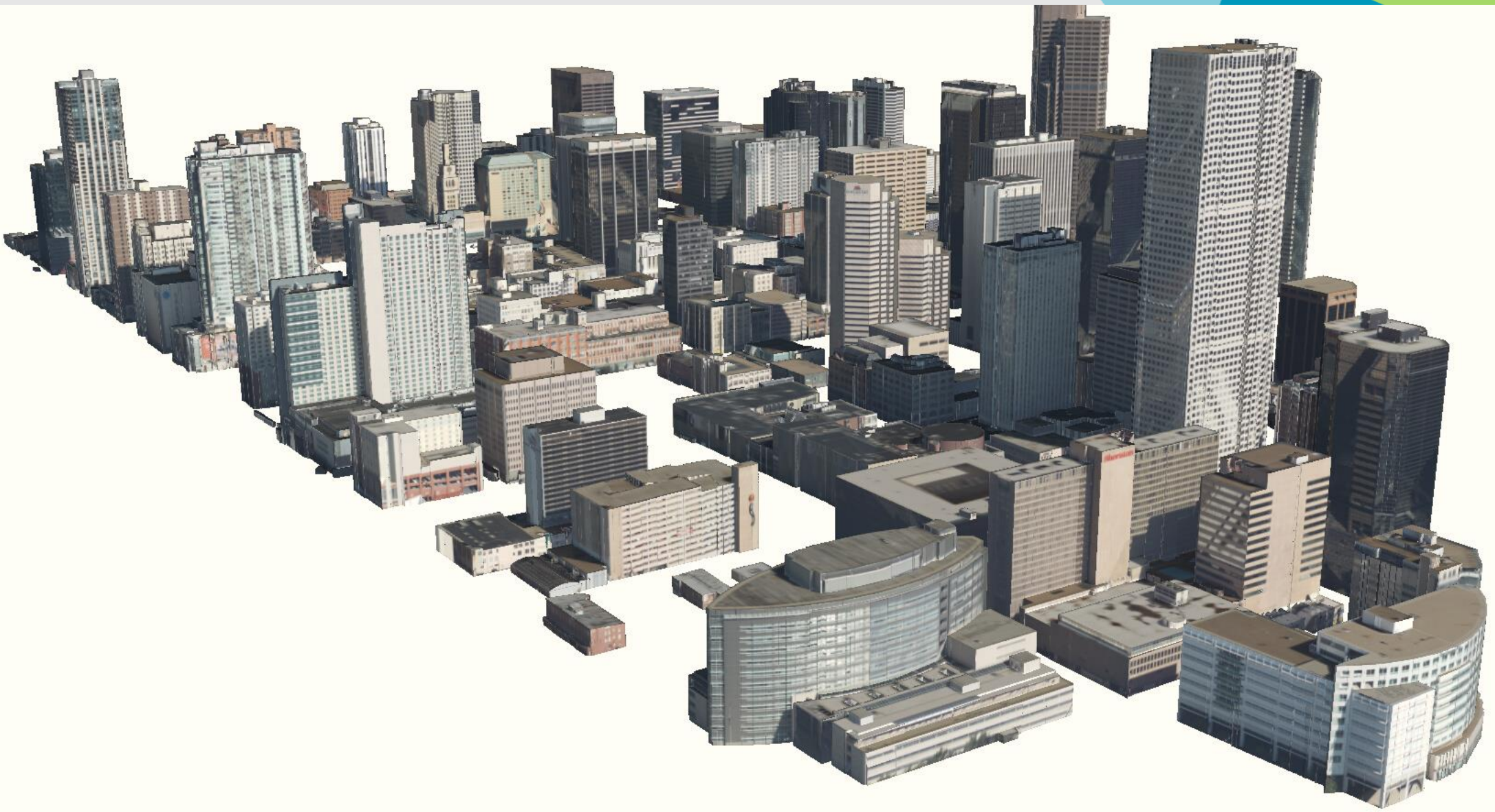

Texturing

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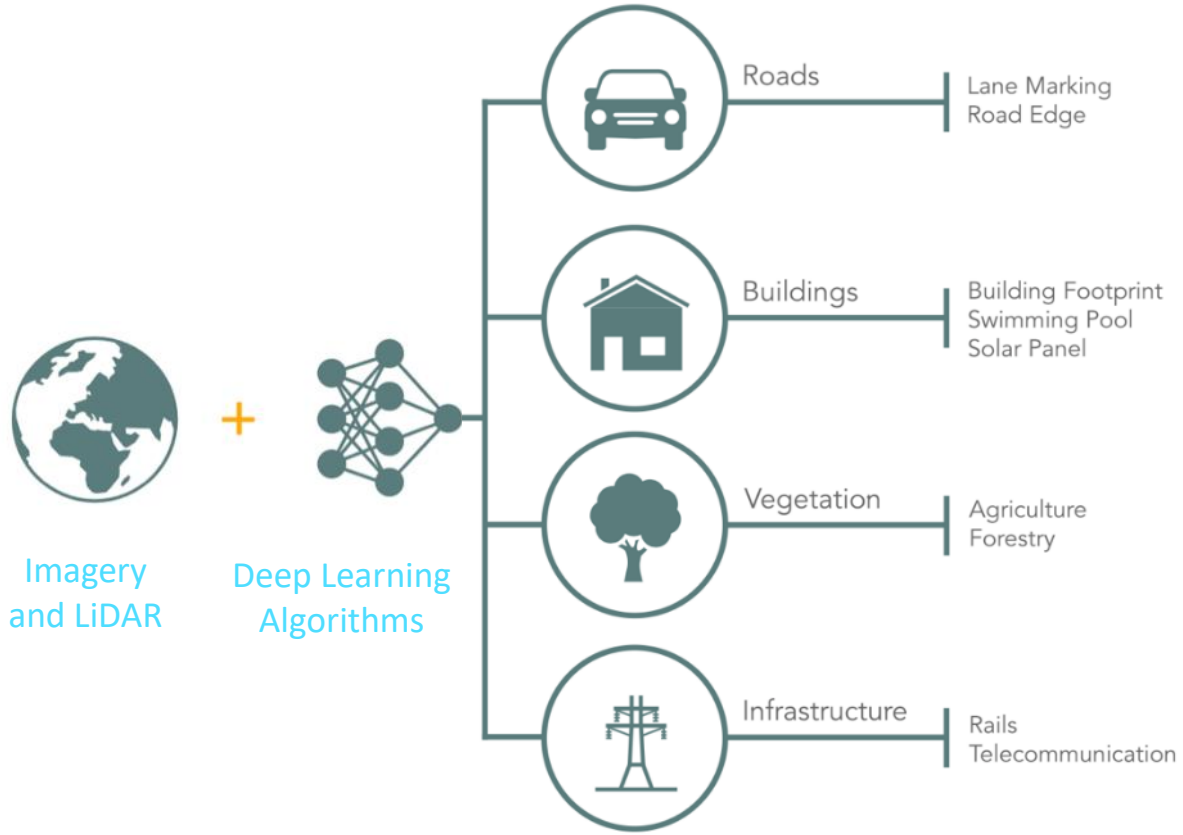
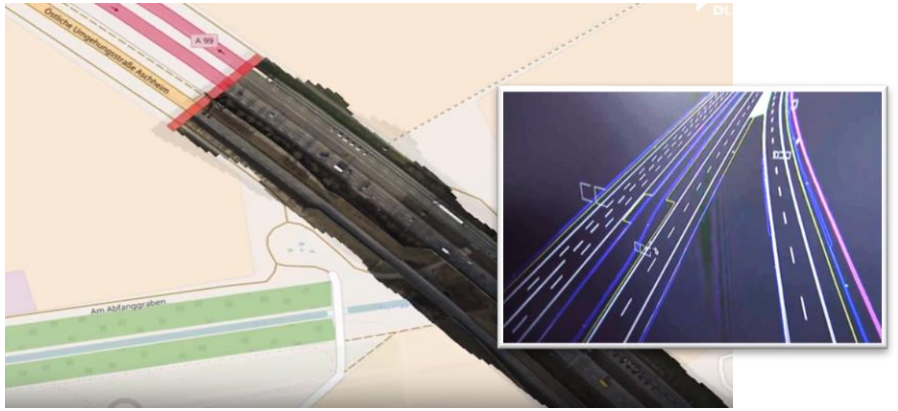
Machine vision AI – location Intelligence can do a lot with LiDAR data. Examples: TerraLoupe

- TerraLoupe has built state-of-the-art deep learning algorithms to analyze large amounts of earth imagery at scale





terraloupe

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Results | LiDAR Dataset | Ground Classification

Raw

Manual classification

Terraloupe classification

Detection test with LiDAR datasets

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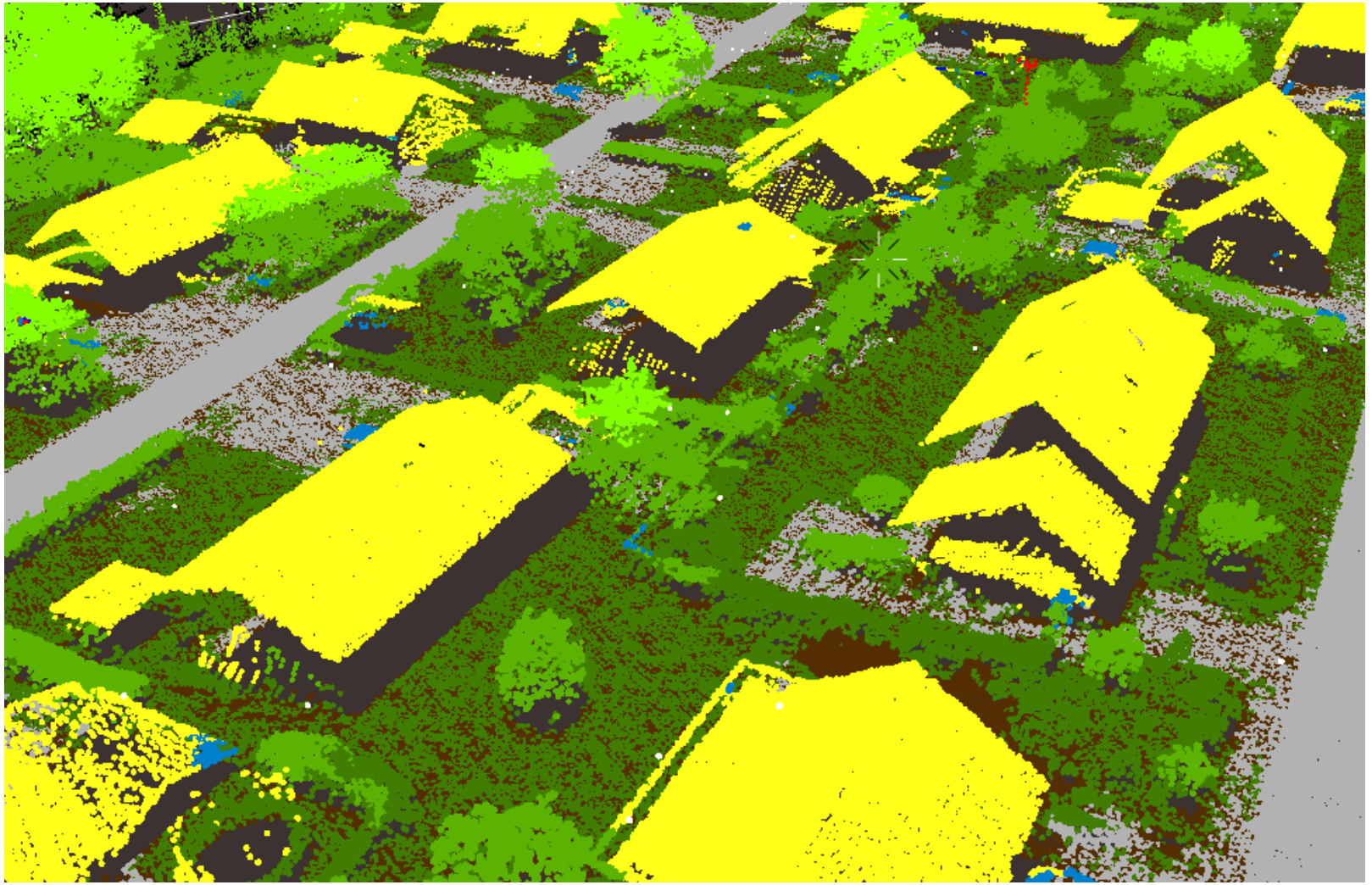
Results | LiDAR Dataset | Roof Classification via AI



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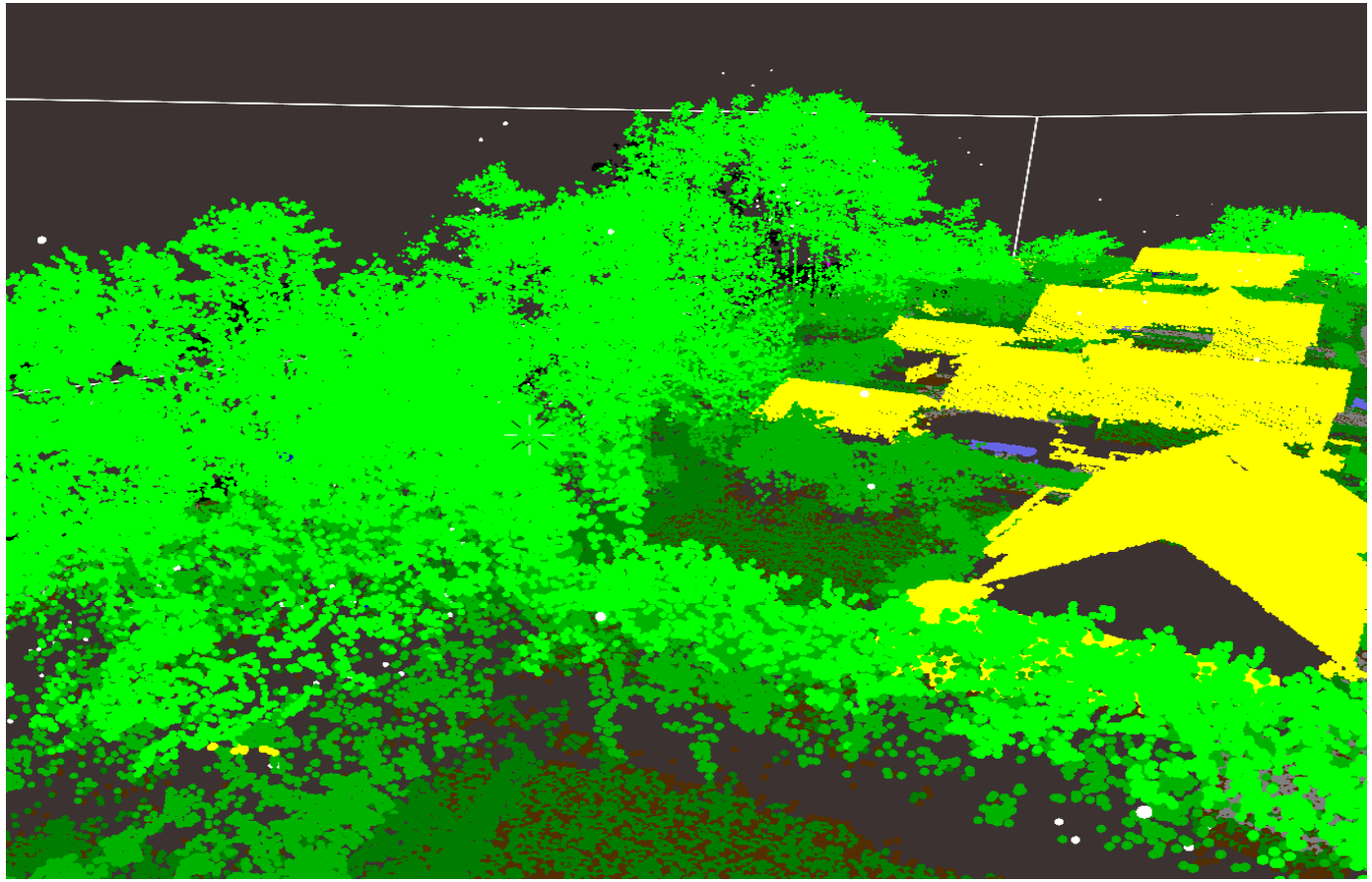
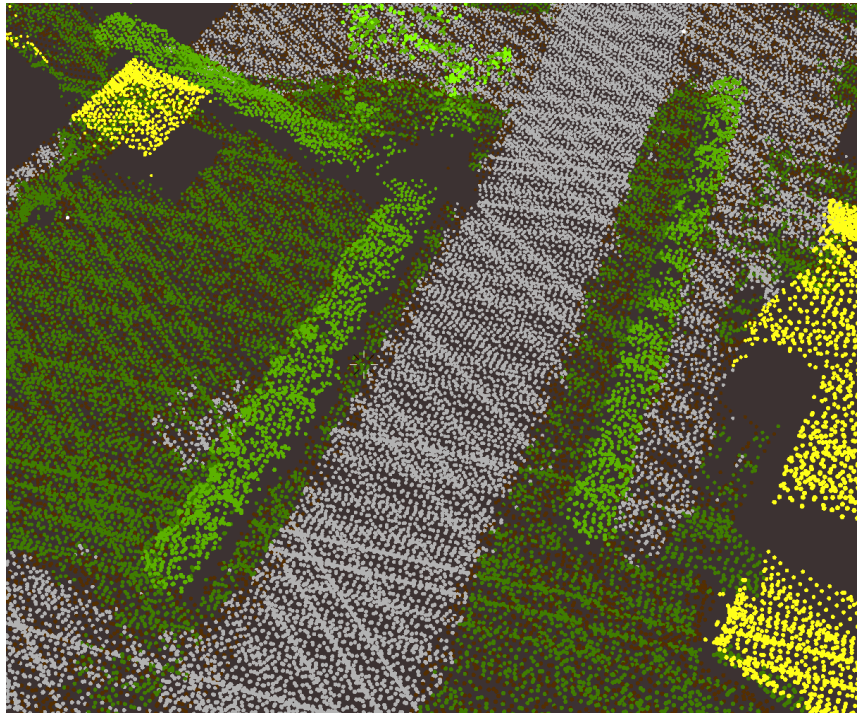
Results | LiDAR Dataset | Vegetation Example



Higher vegetation



Bushes

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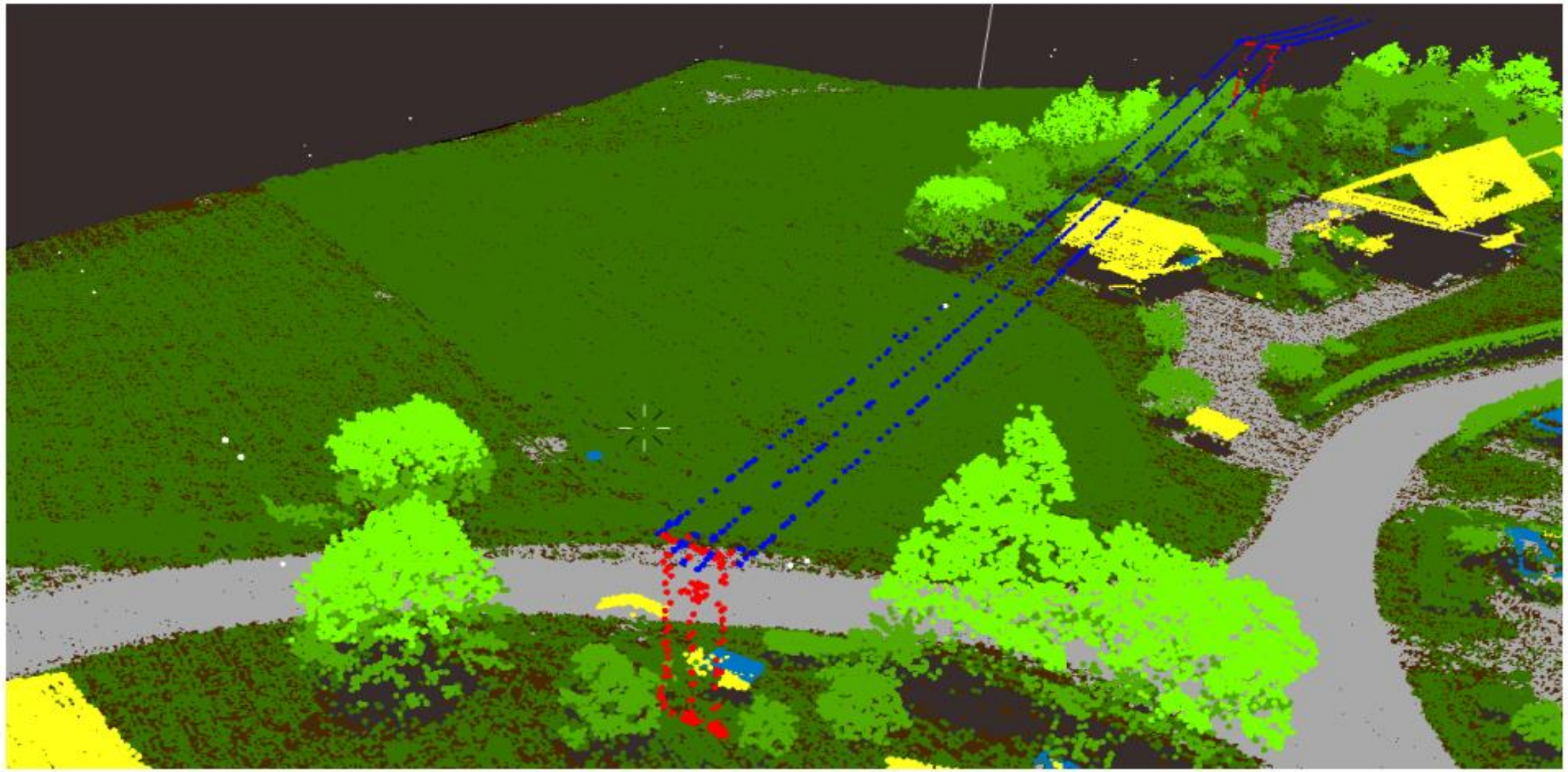
Results | LiDAR Dataset | Poles & Power Lines



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Thank you!
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