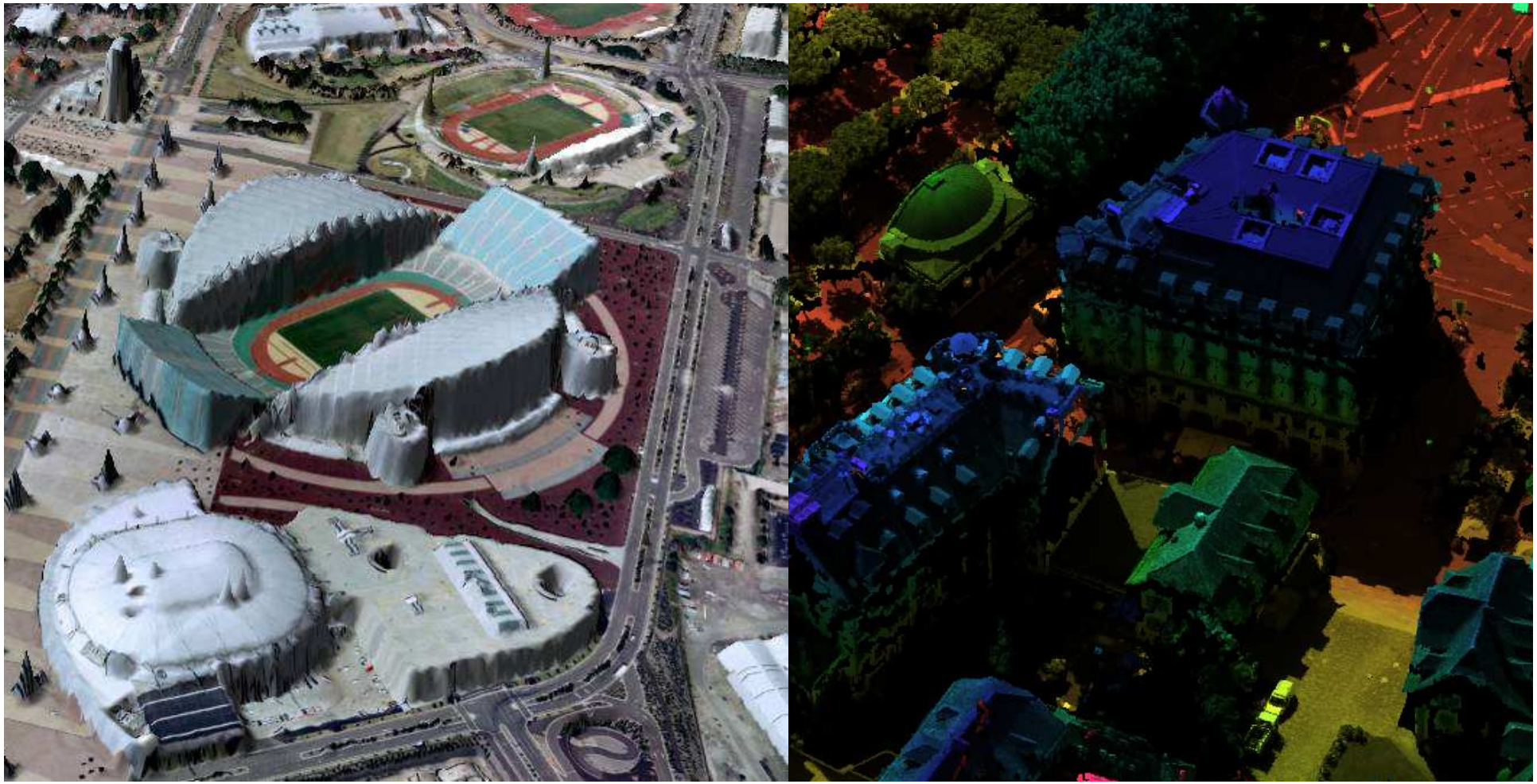

Info Cloud – Complimentary or competing technology to LiDAR?

IGF – Hyderabad – 22nd – 24th January 2013

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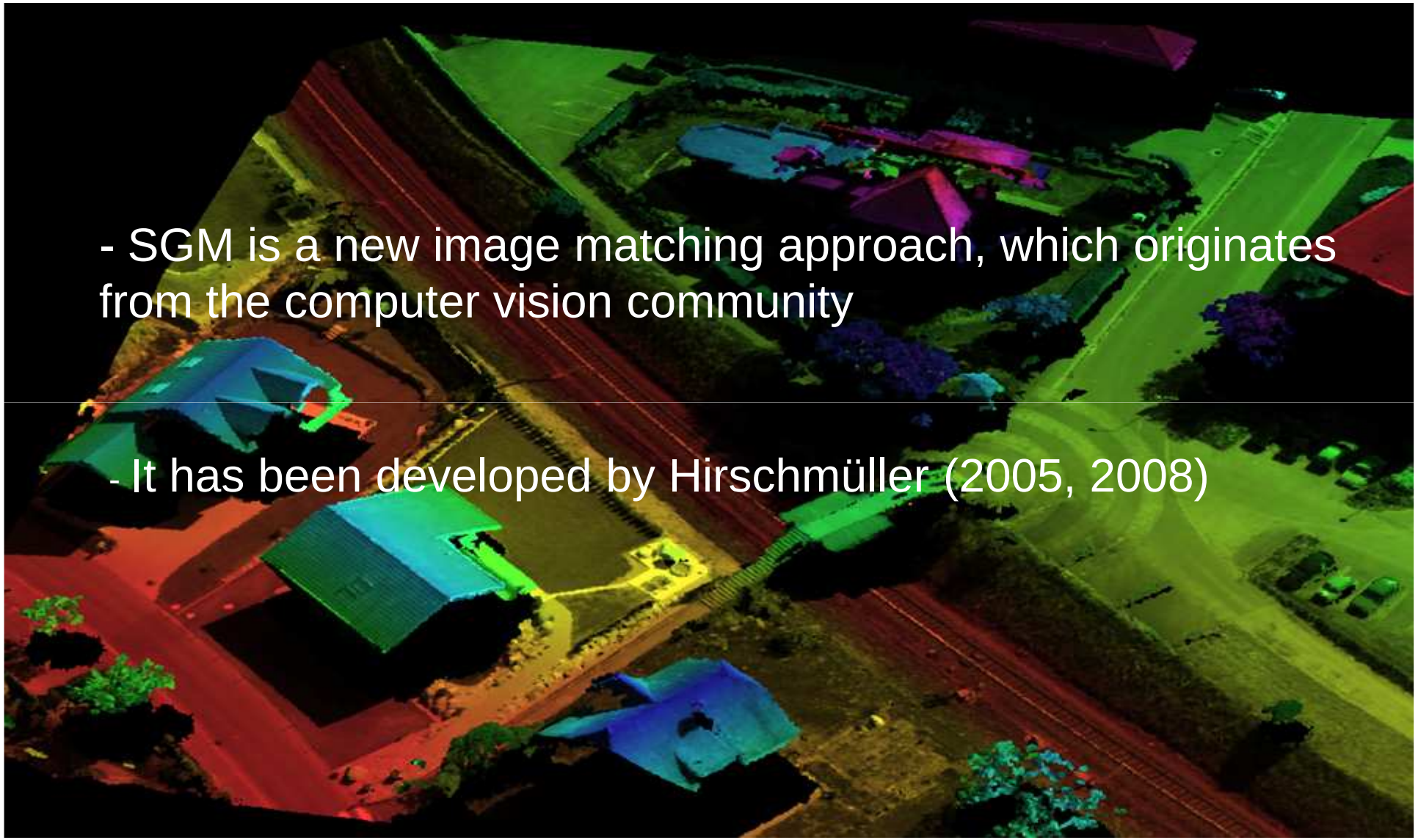
DSM Extraction applying Semi-Global Matching techniques



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Comparison: Image Matching vs. LIDAR

	LiDAR	ADS / Frame
Sensor	**active**	**passive**
Geometry	**top and ground**	**top**
Radiometry	**Intensity**	**PAN & NRGB, NDVI**

	LiDAR	DSM from ADS / Frame Data
Typical High Resolution	**30 cm**	**5 cm**
Points / Square Meter	**10**	**300 (75% matches)**

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Comparison: Image Matching vs. LIDAR

	LiDAR	DSM from ADS / Frame Data
Horizontal Accuracy	**10-15 cm (altitude-dependent)**	**0.5 x GSD 2.5 cm @ 5 cm GSD**
Vertical Accuracy	**~5 cm**	**1.5 x GSD 7.5 cm @ 5 cm GSD**

	LiDAR	DSM from ADS / Frame Data
3D Point Computation (points/s)	**~1,000,000**	**10,000-20,000**
System	**2 x AMD Opteron 2220, 2.8 GHz**	**Intel Core i7, 2.8 GHz**

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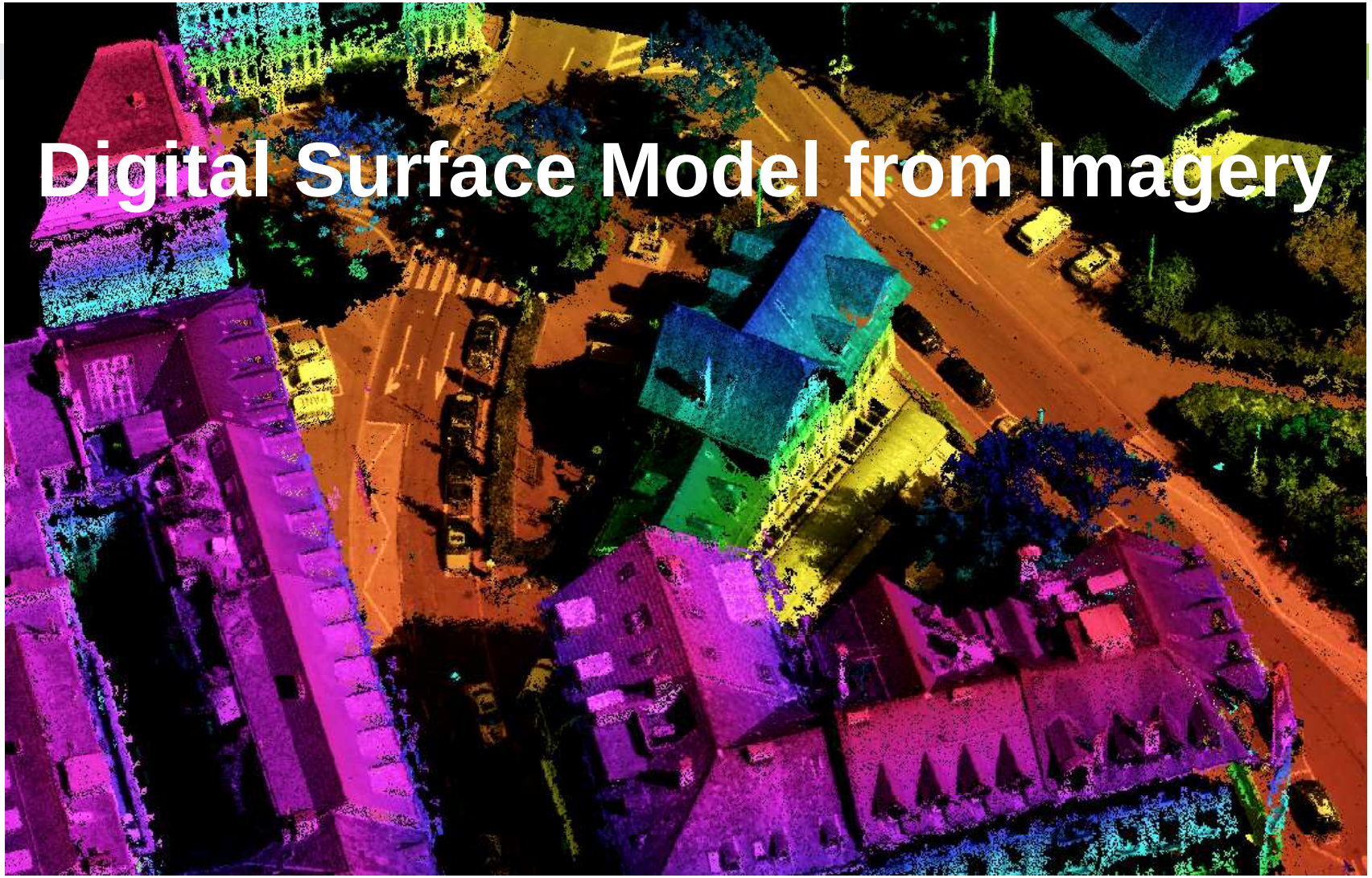
Digital Surface Model from Imagery



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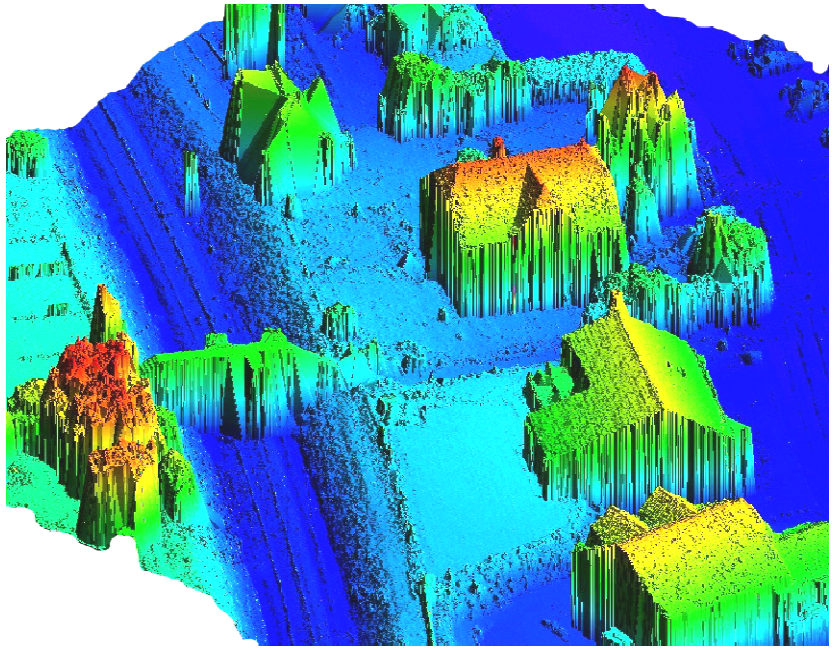
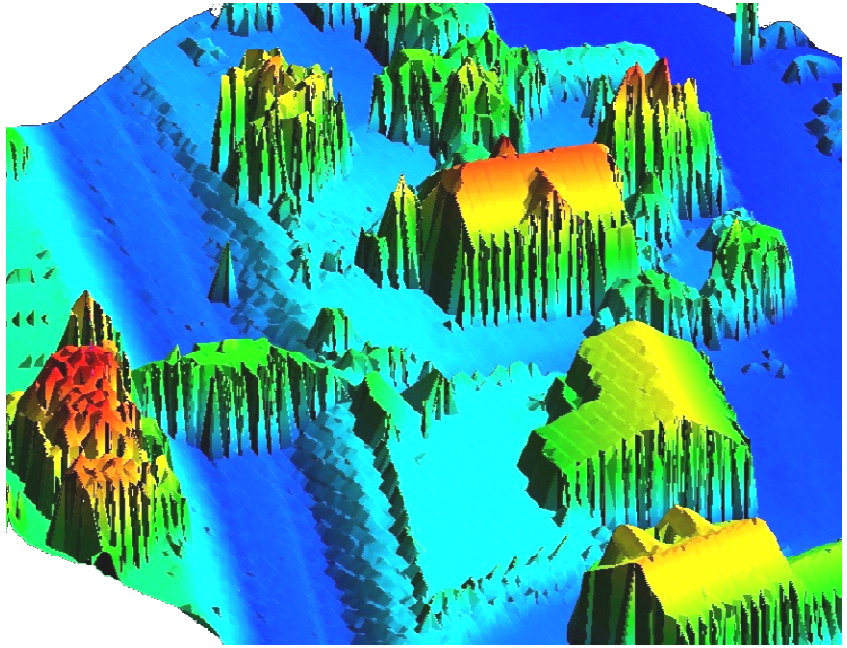
Resolution: ImageCloud - LiDAR

Romanshorn - Visual Comparison

DSM: 350 points/m^2



LiDAR: 8 points/m^2



- Much more detail in DSM results due to higher resolution

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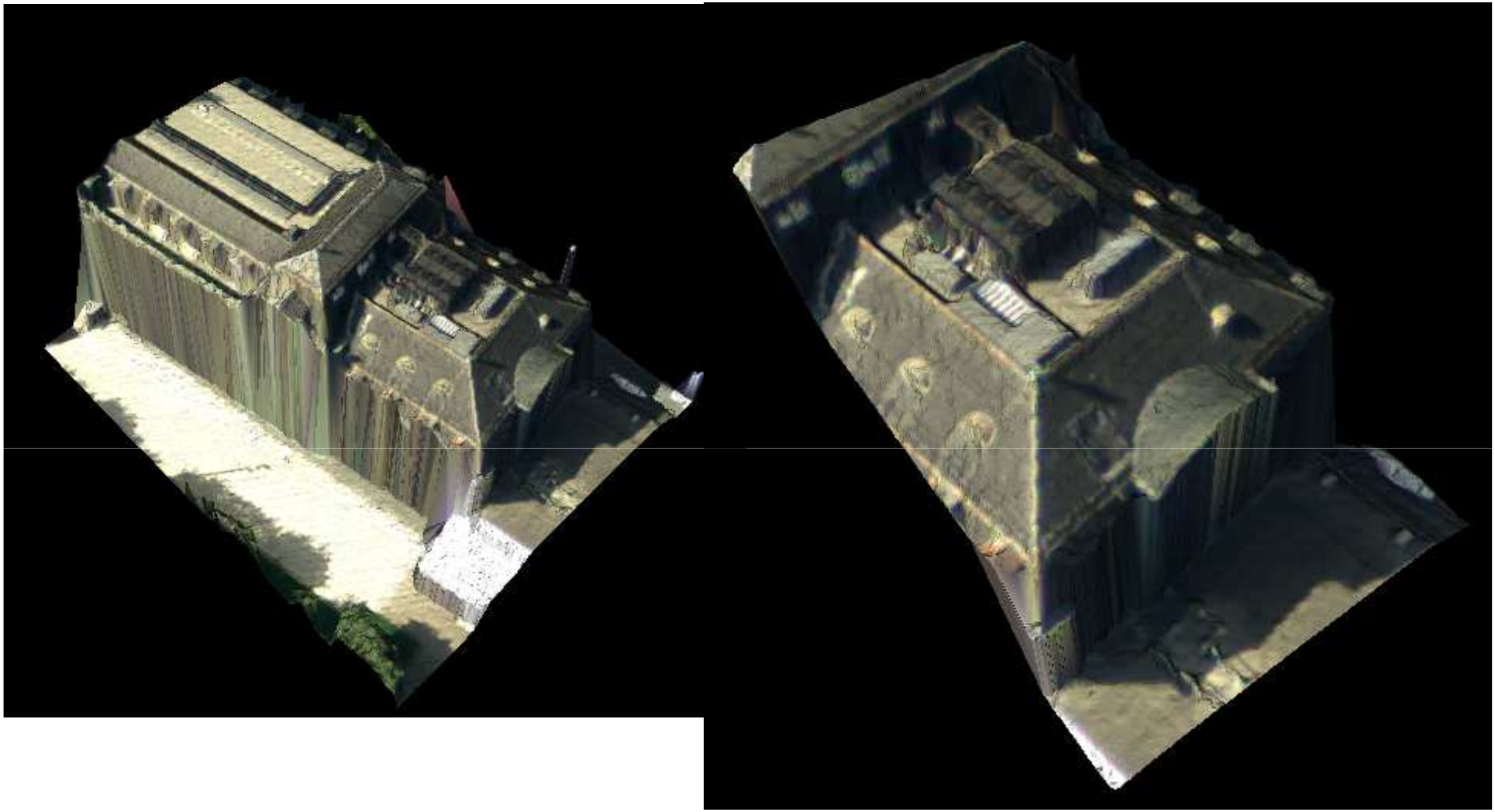
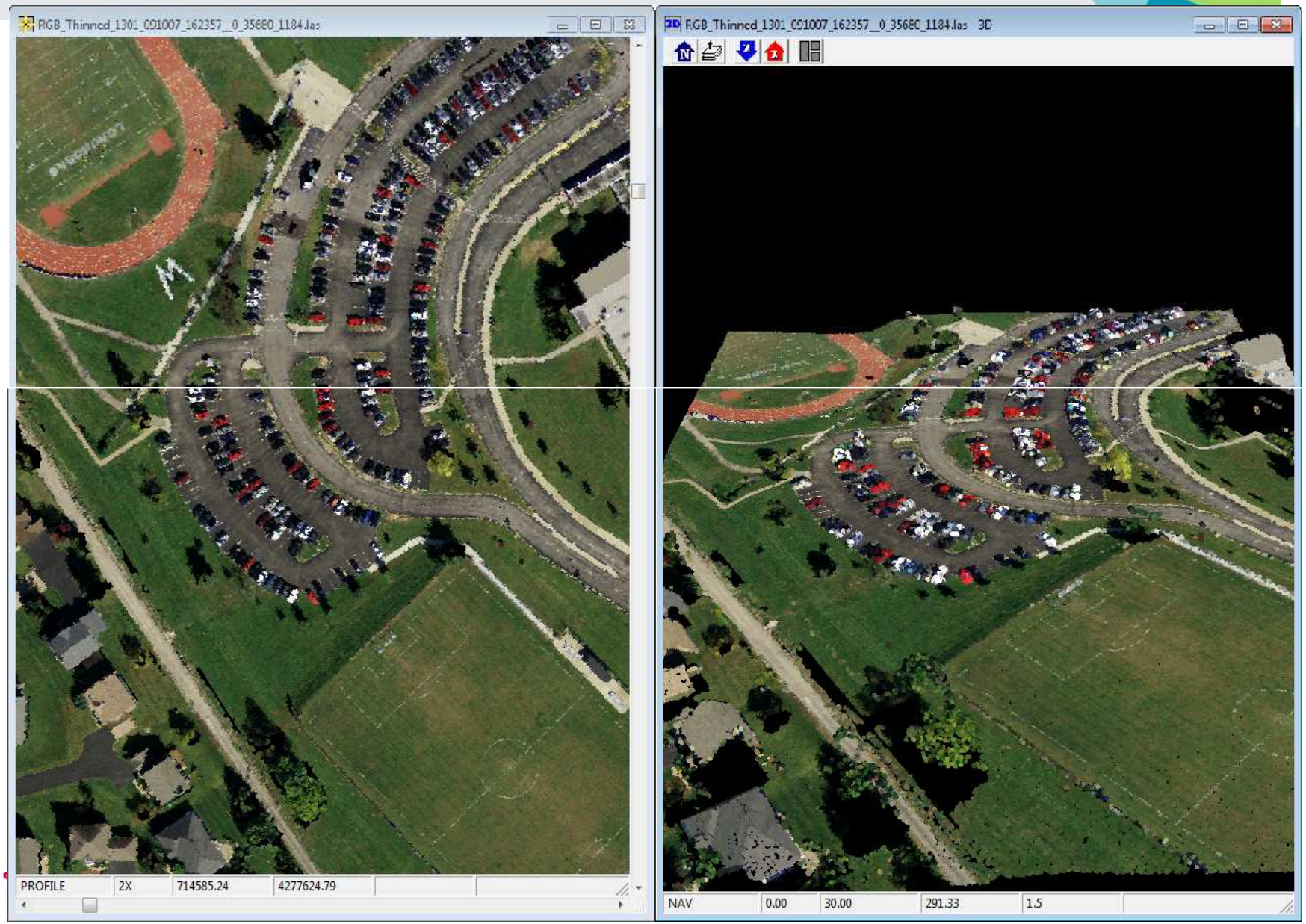
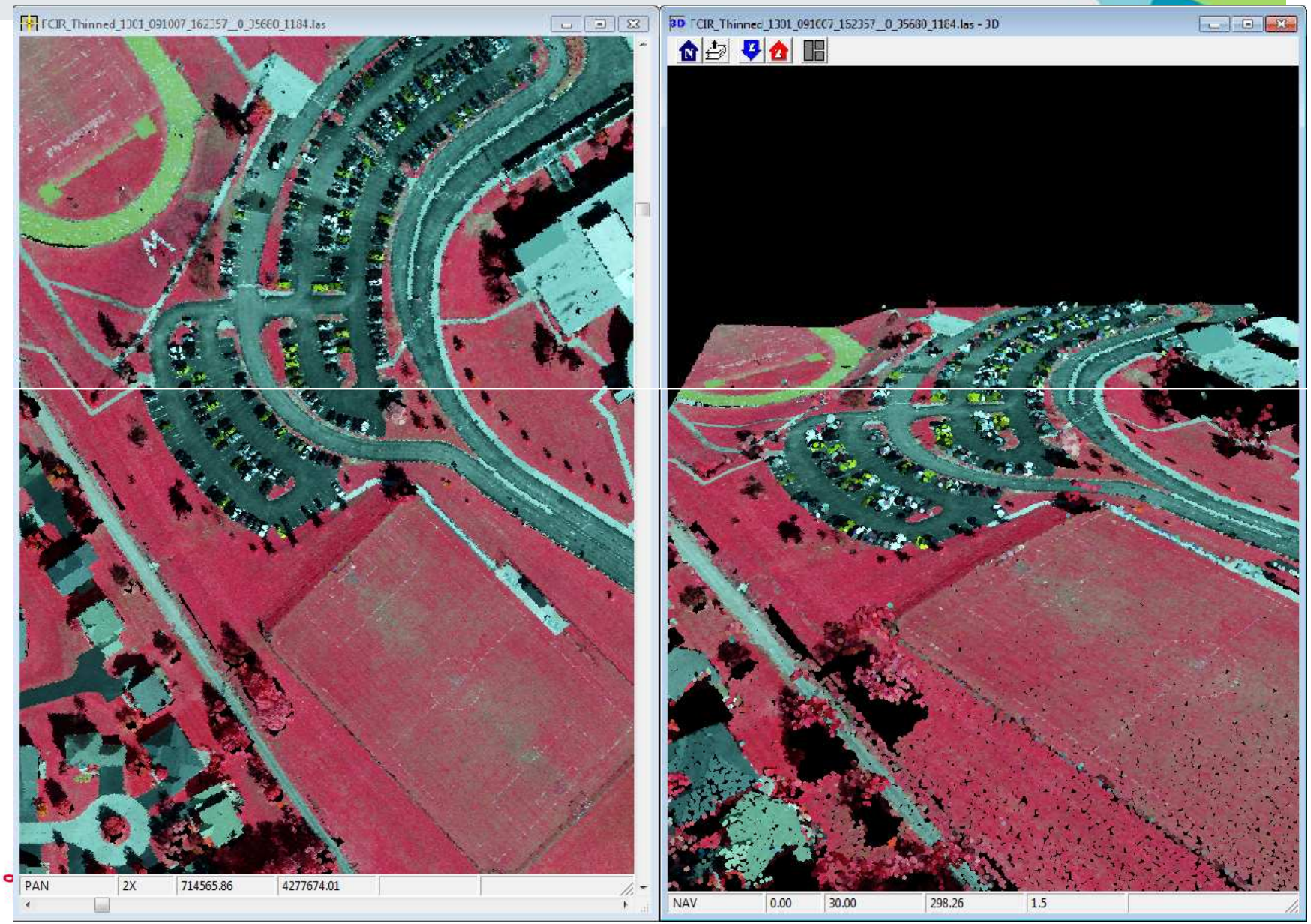
DSM – Accurate Building Reconstruction



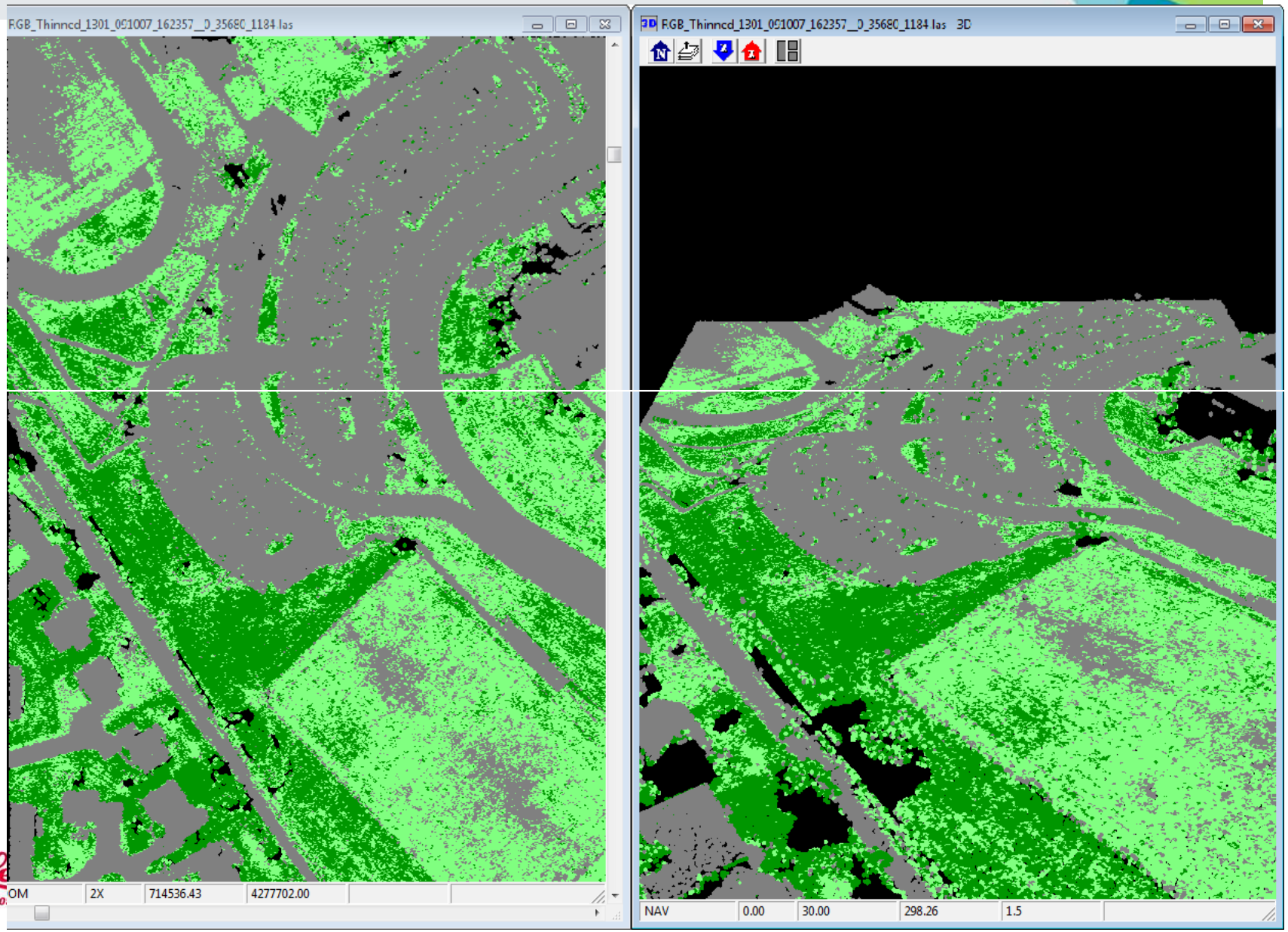
From Point Cloud to Info Cloud (True Color)

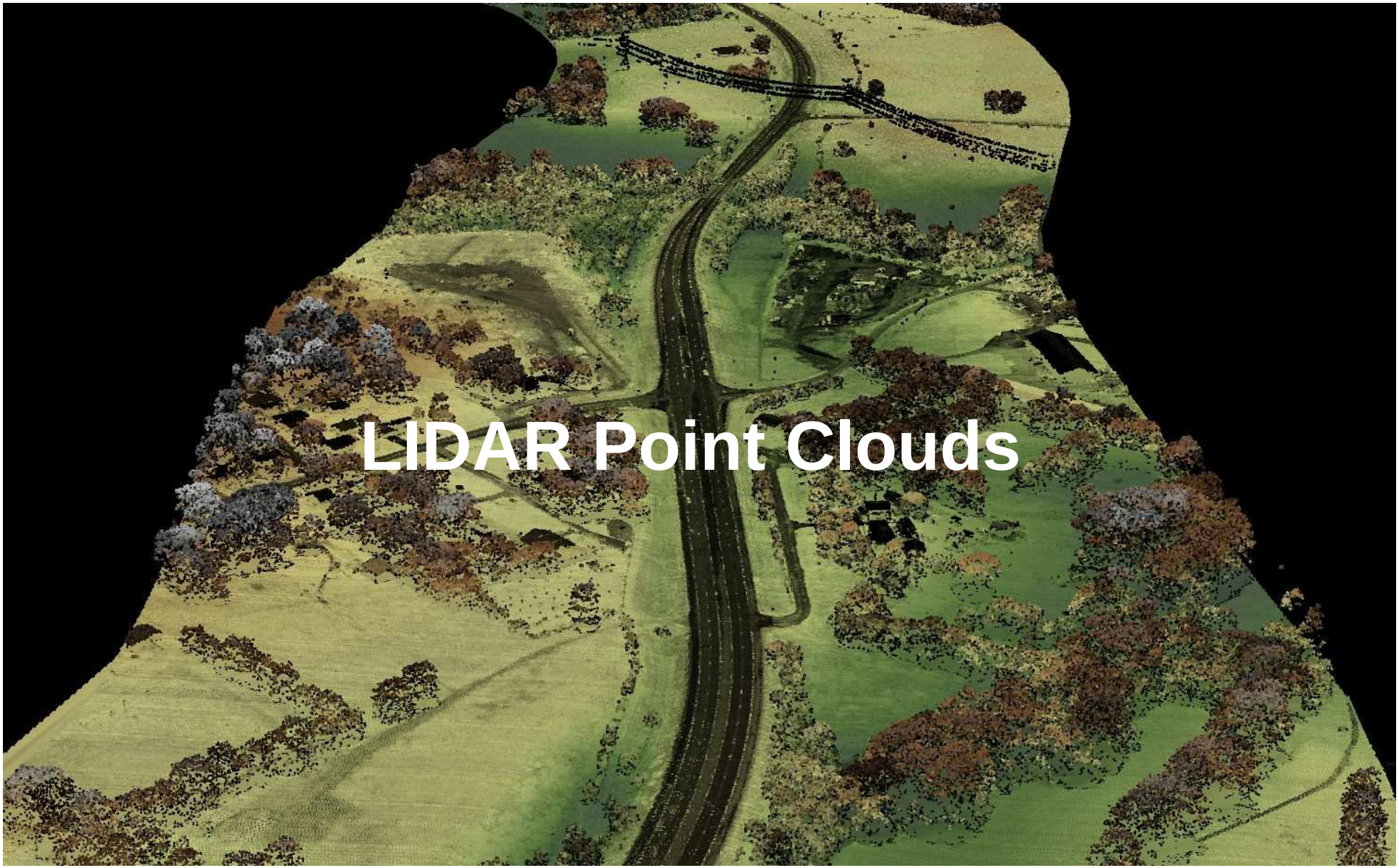


From Point Cloud to Info Cloud (NIR)



From Point Cloud to Info Cloud (NDVI)





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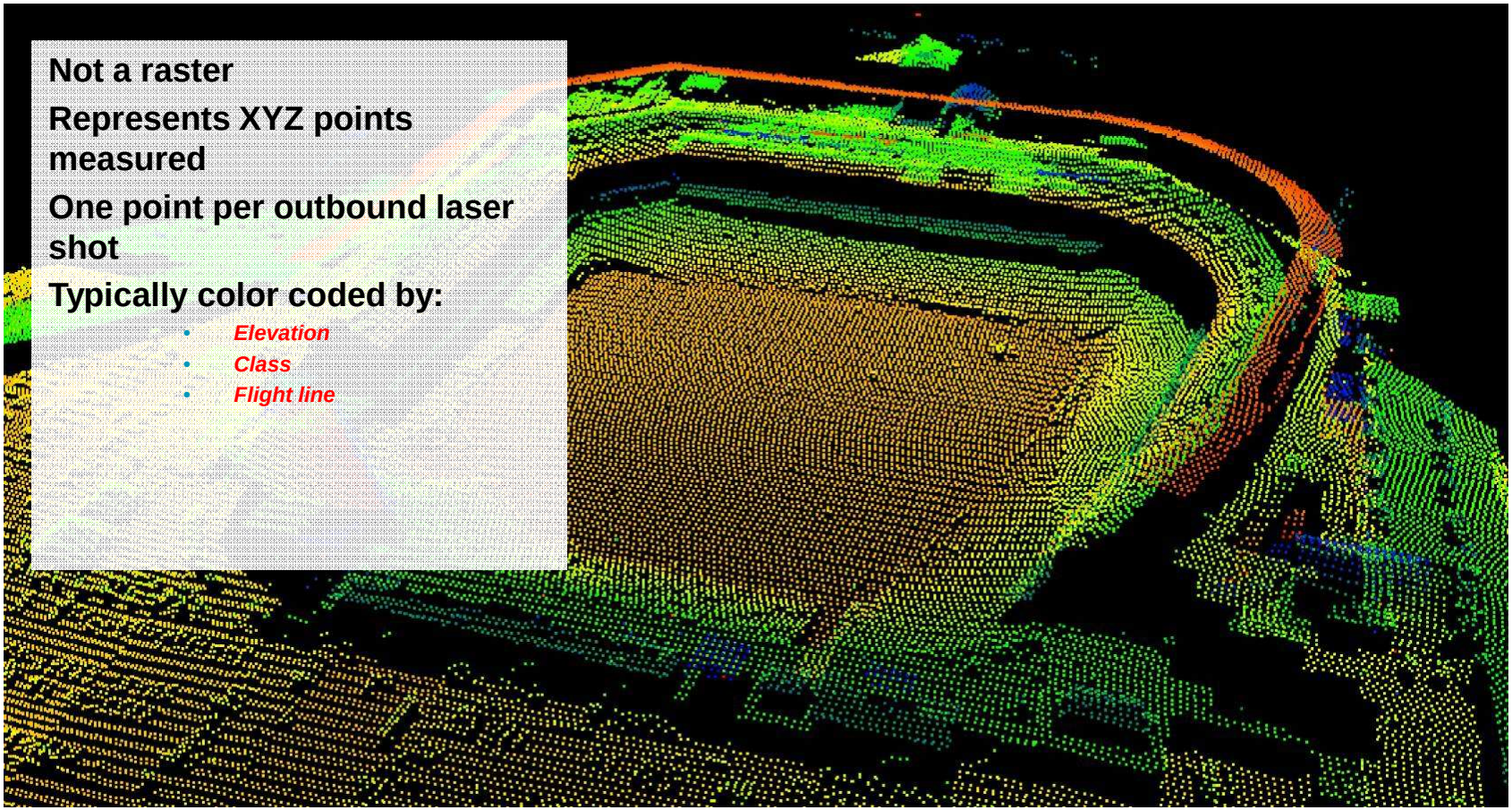
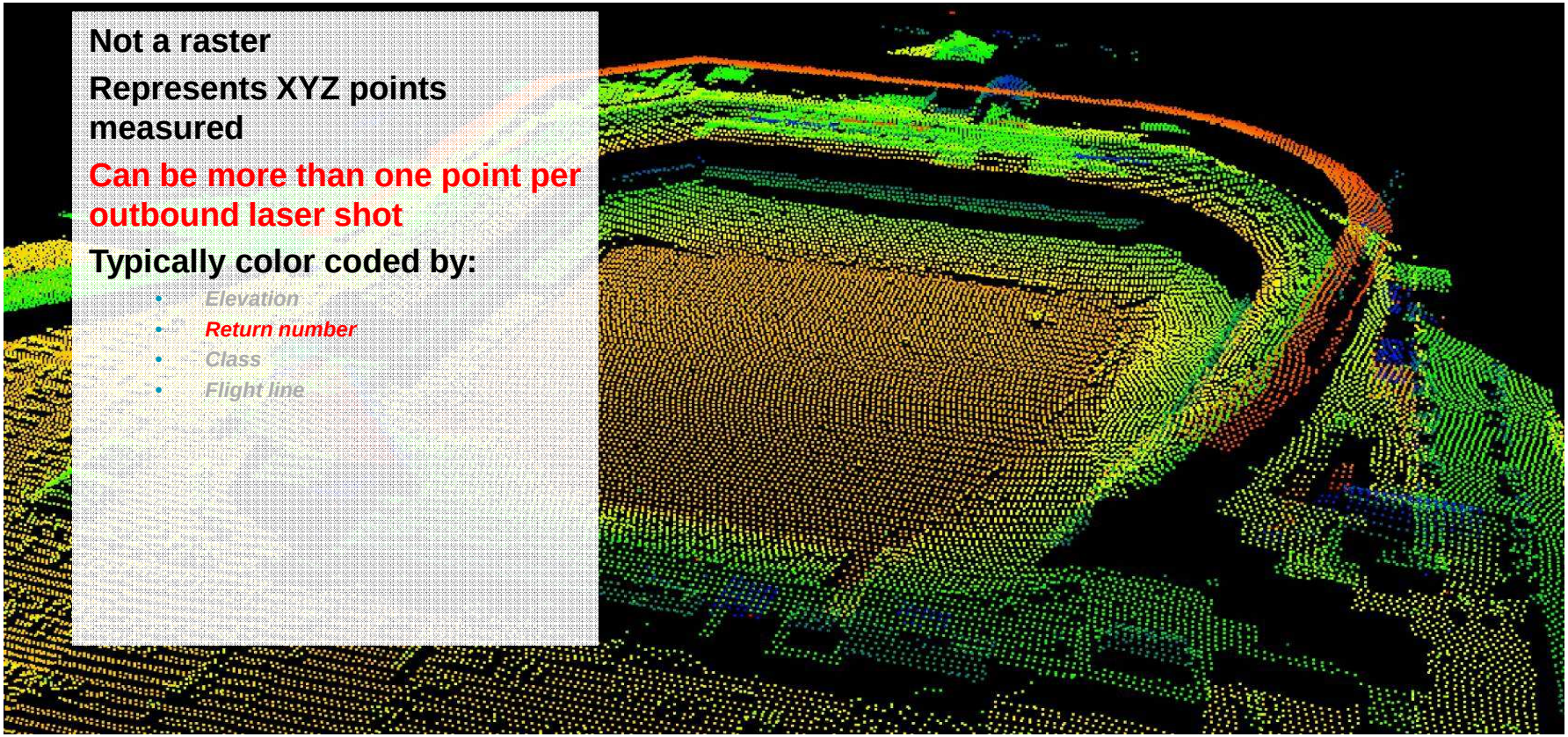
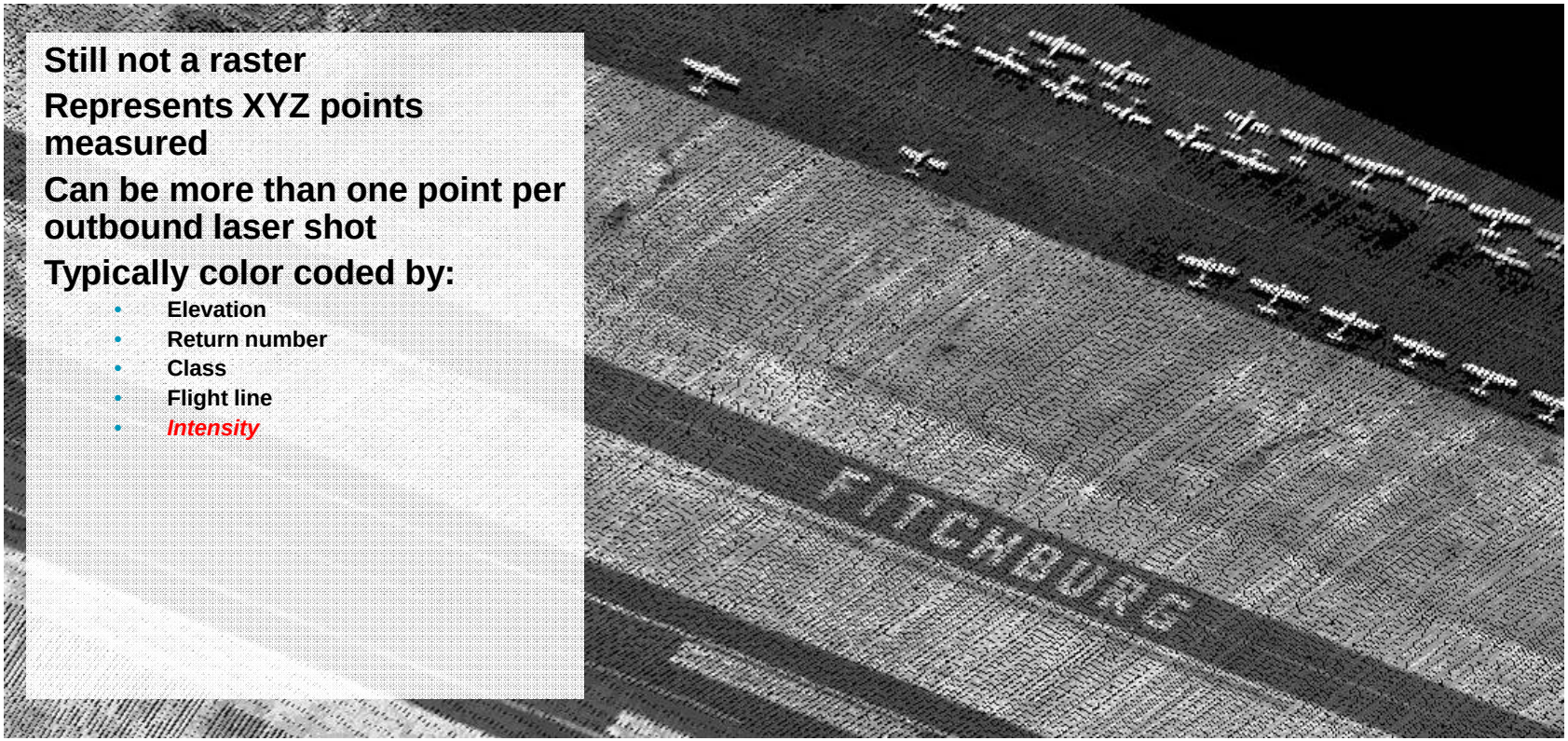
LIDAR: the *original* point cloud (c. 1995 - 1998)



Multi-return point cloud (c. 1998 - 2001)



The discovery of intensity (c. 2001)



Still not a raster

Represents XYZ points measured

Can be more than one point per outbound laser shot

Typically color coded by:

- **Elevation**
- **Return number**
- **Class**
- **Flight line**
- ***Intensity***

Color(IR)izing (c. 2002)

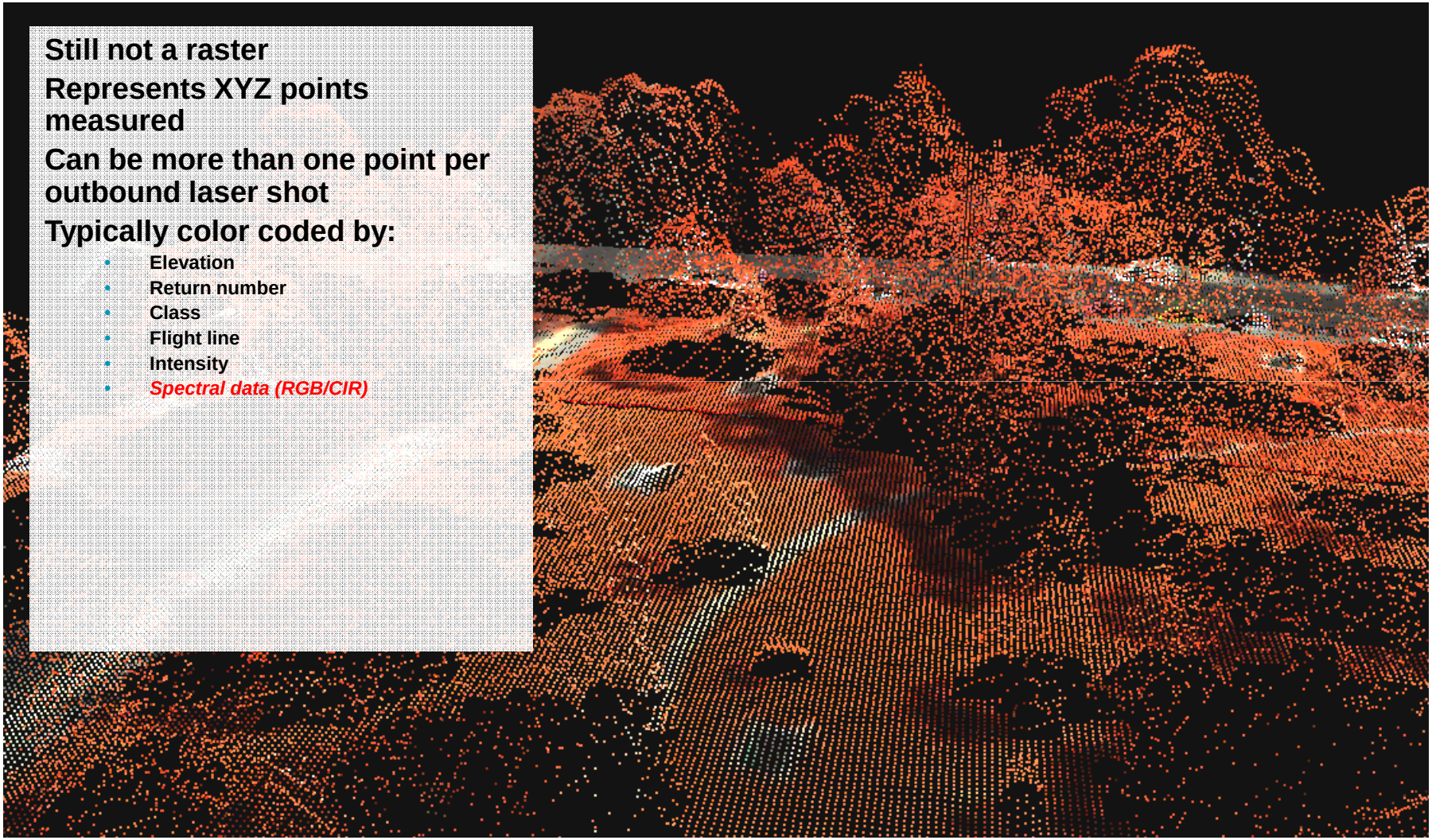
Still not a raster

Represents XYZ points measured

Can be more than one point per outbound laser shot

Typically color coded by:

- **Elevation**
- **Return number**
- **Class**
- **Flight line**
- **Intensity**
- ***Spectral data (RGB/CIR)***



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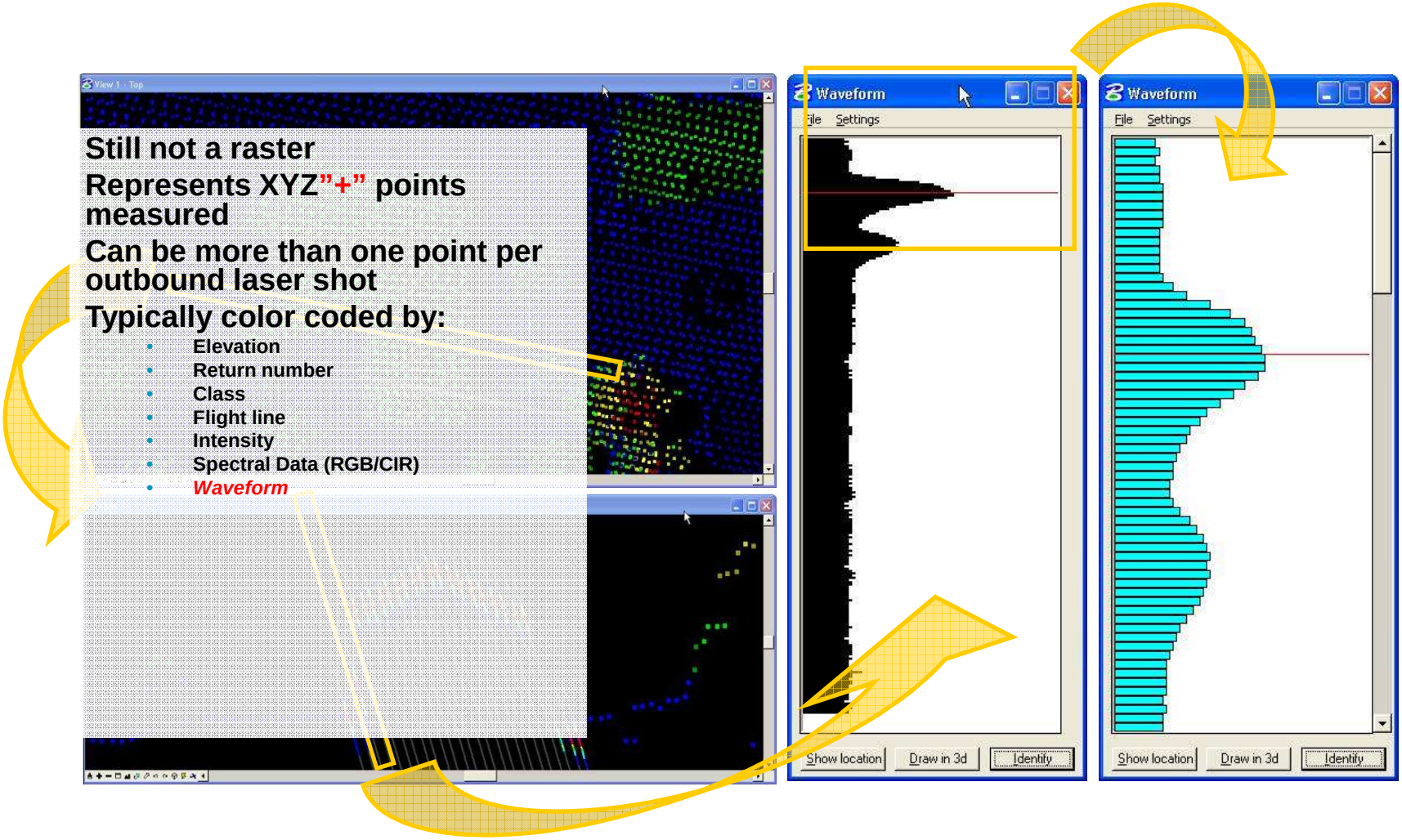
The “new wave”: Full Waveform Digitization (c. 2008)



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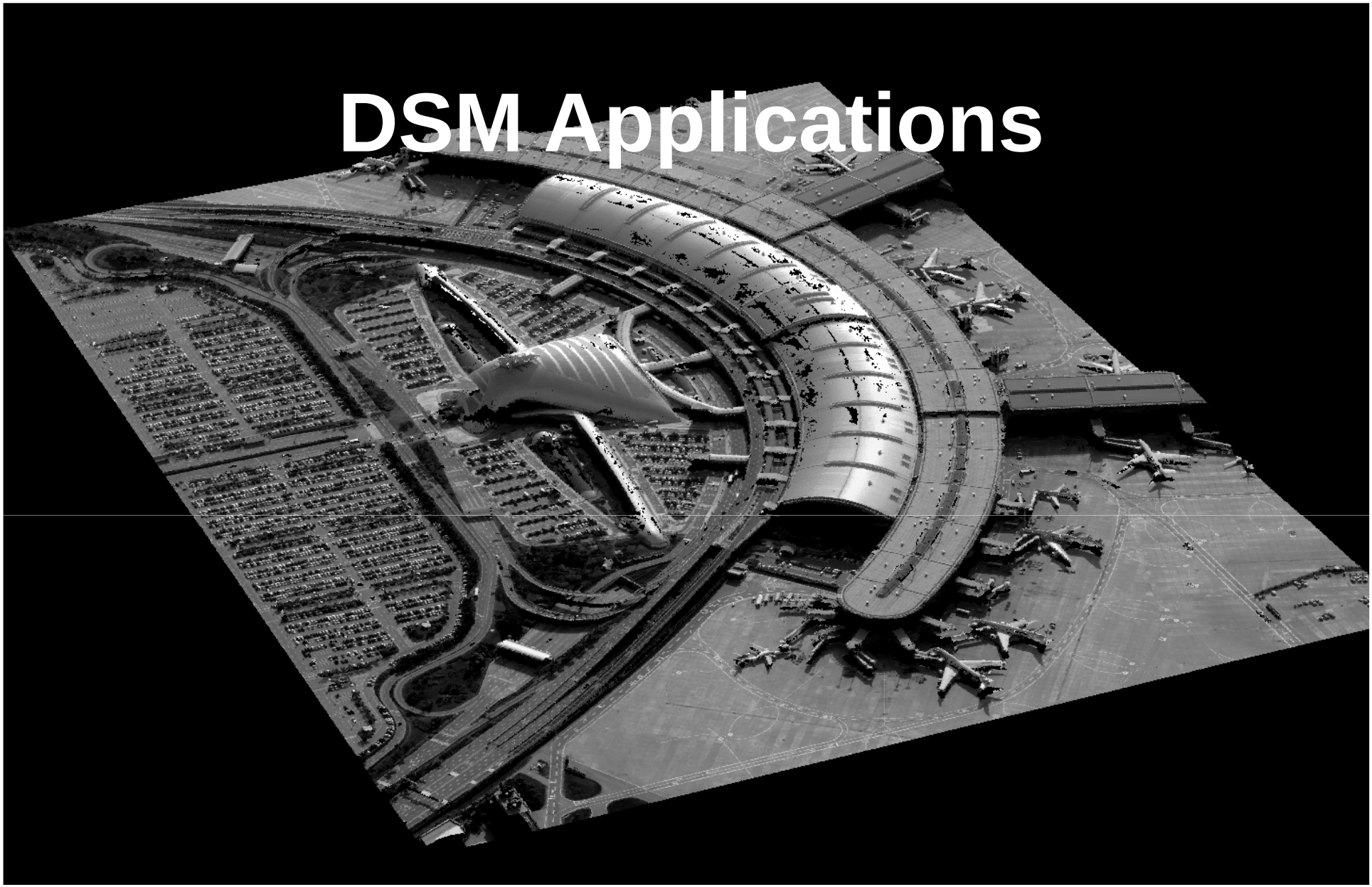
DSM Applications



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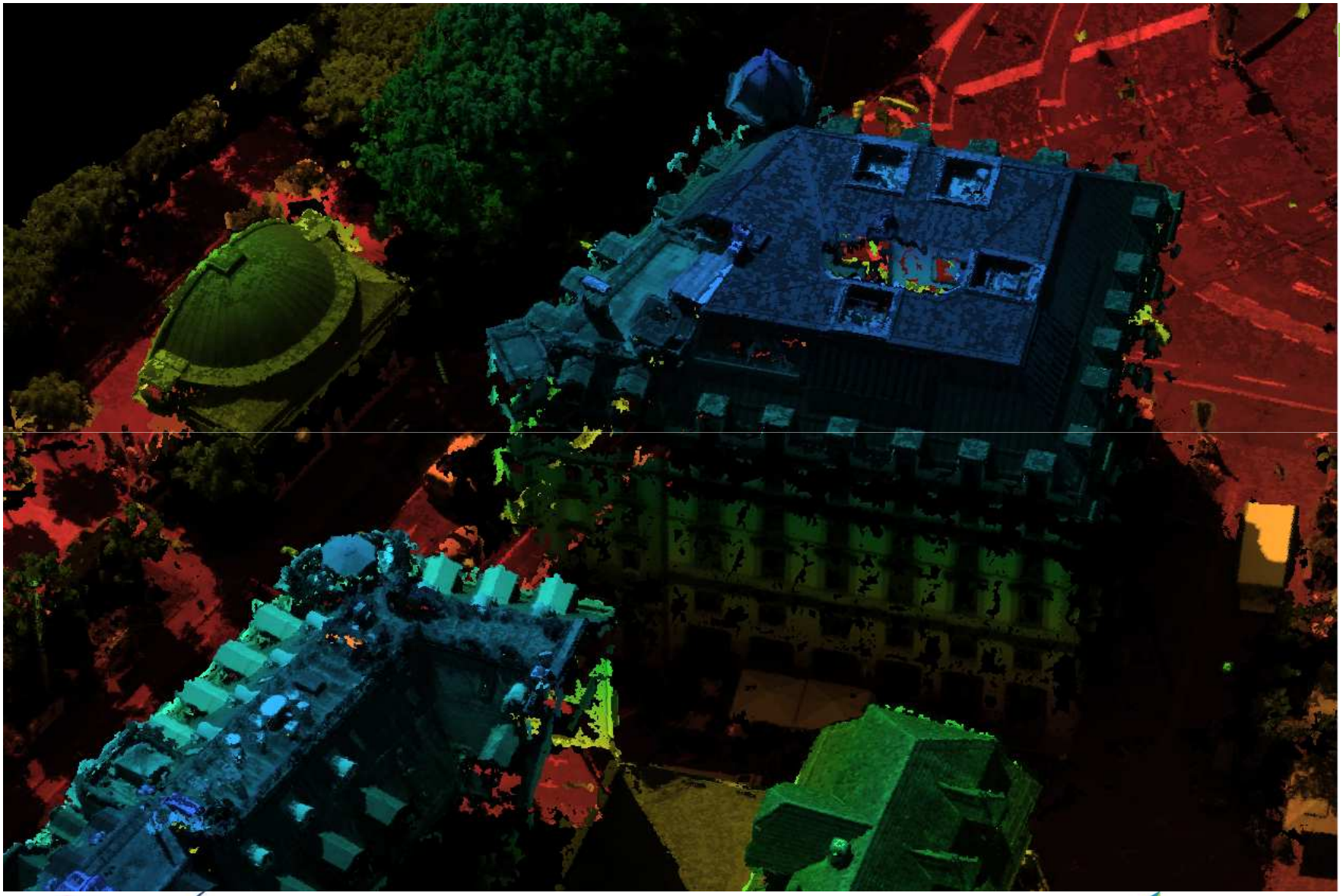
Flood Mapping

3D City Modelling



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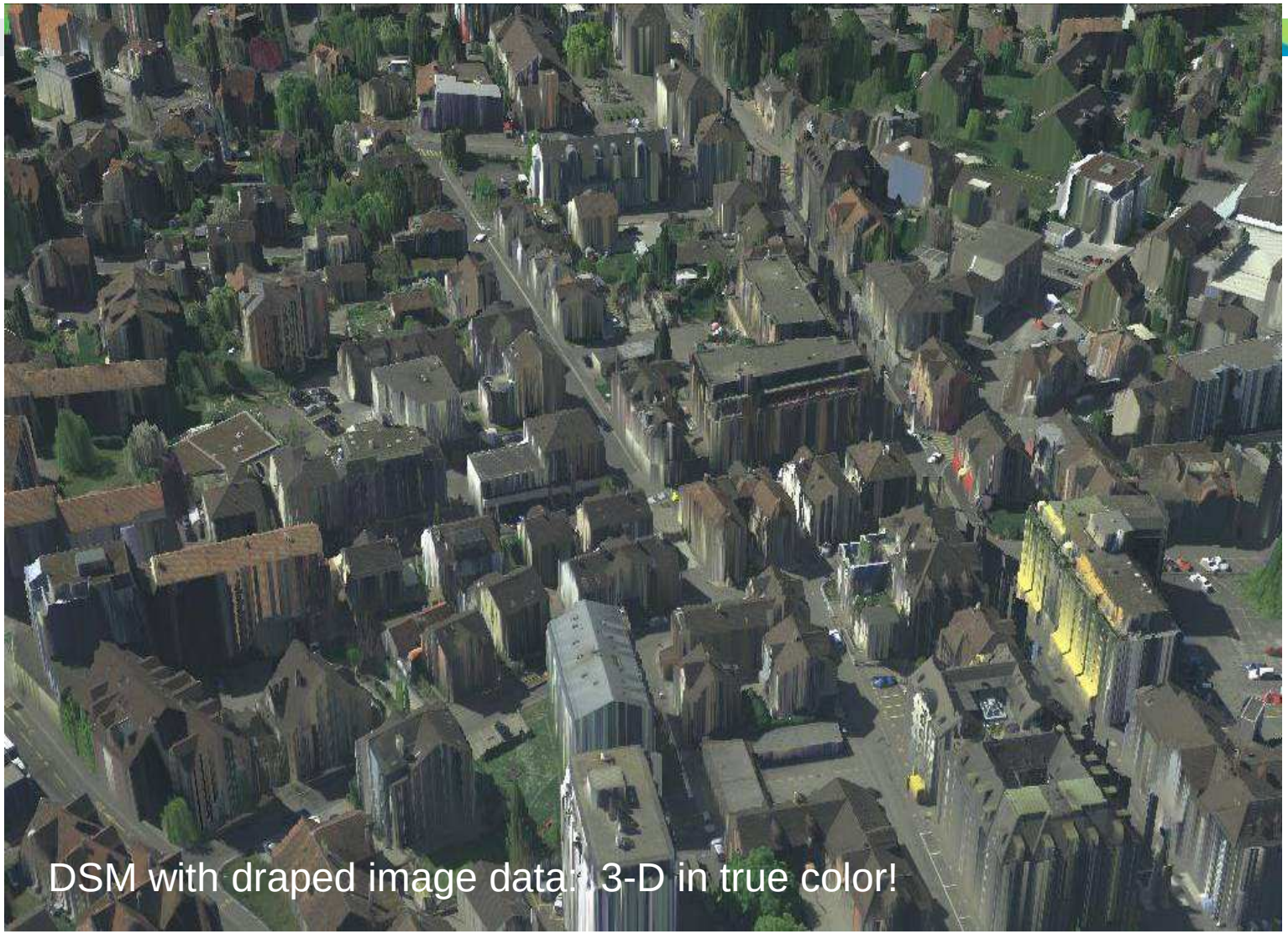
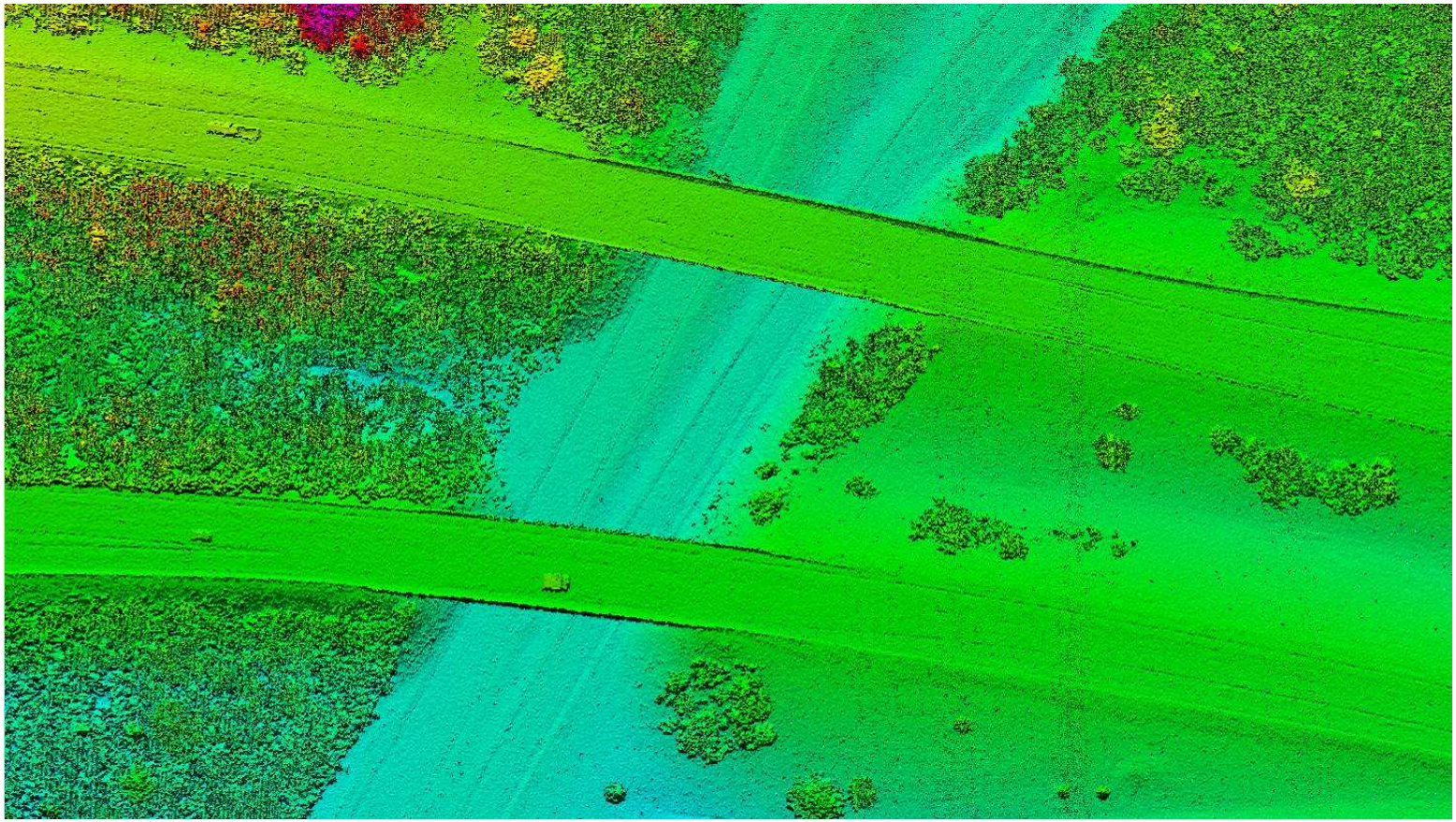
DSMs for Urban modeling – 3D City Models

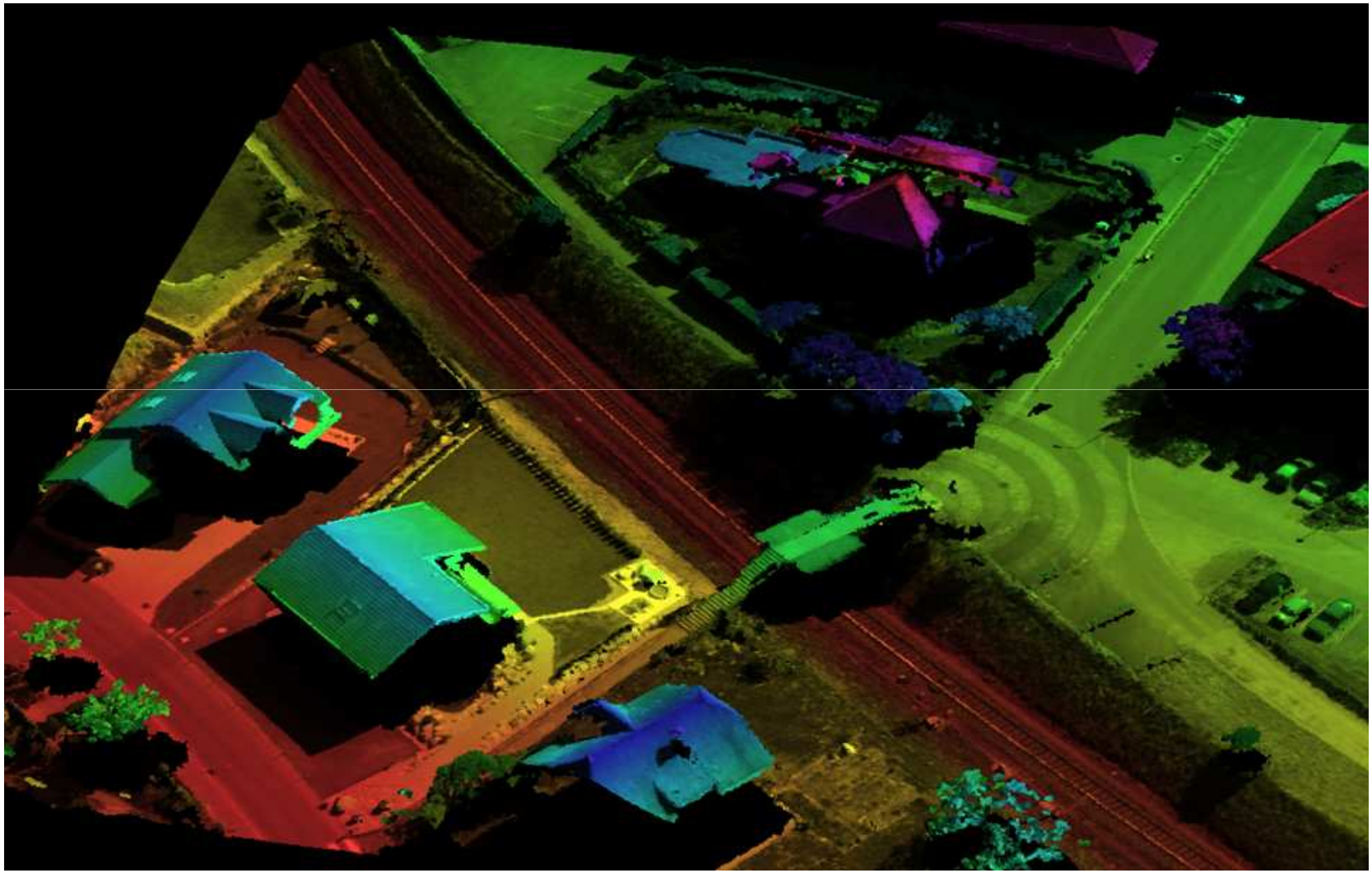
Urban Modeling – Photorealistic rendering for visualization



Corridor mapping - highway corridor mapping



Corridor mapping - rail centerline and gauge inspection



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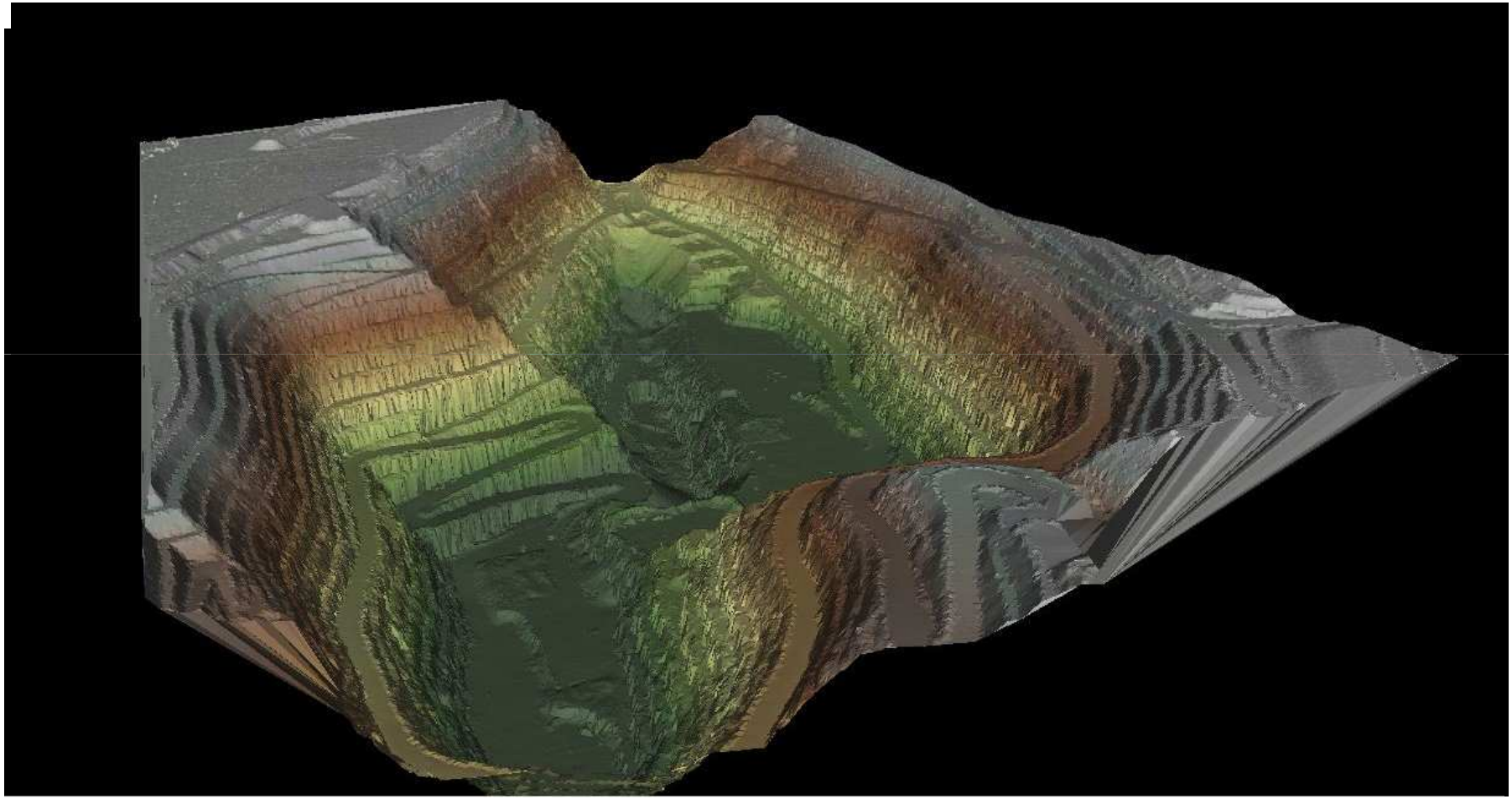
DSM for Mining & Constructions – accurate volume calc.



DSM for Orthophoto generation

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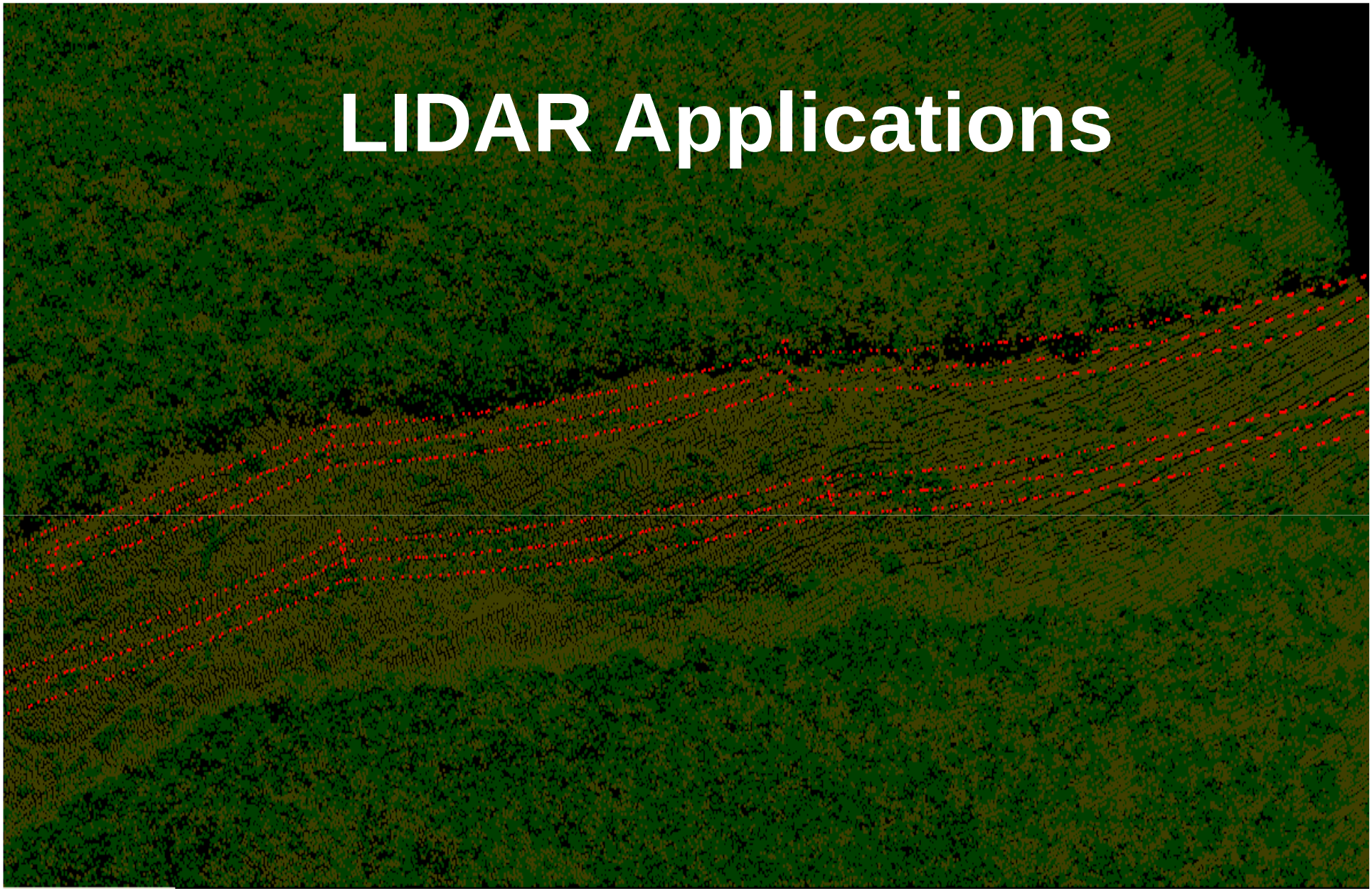
LIDAR Applications



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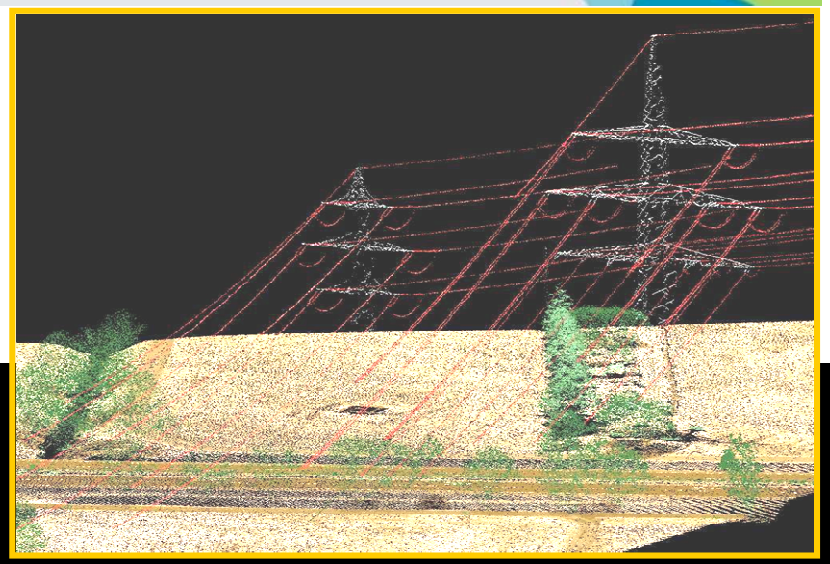
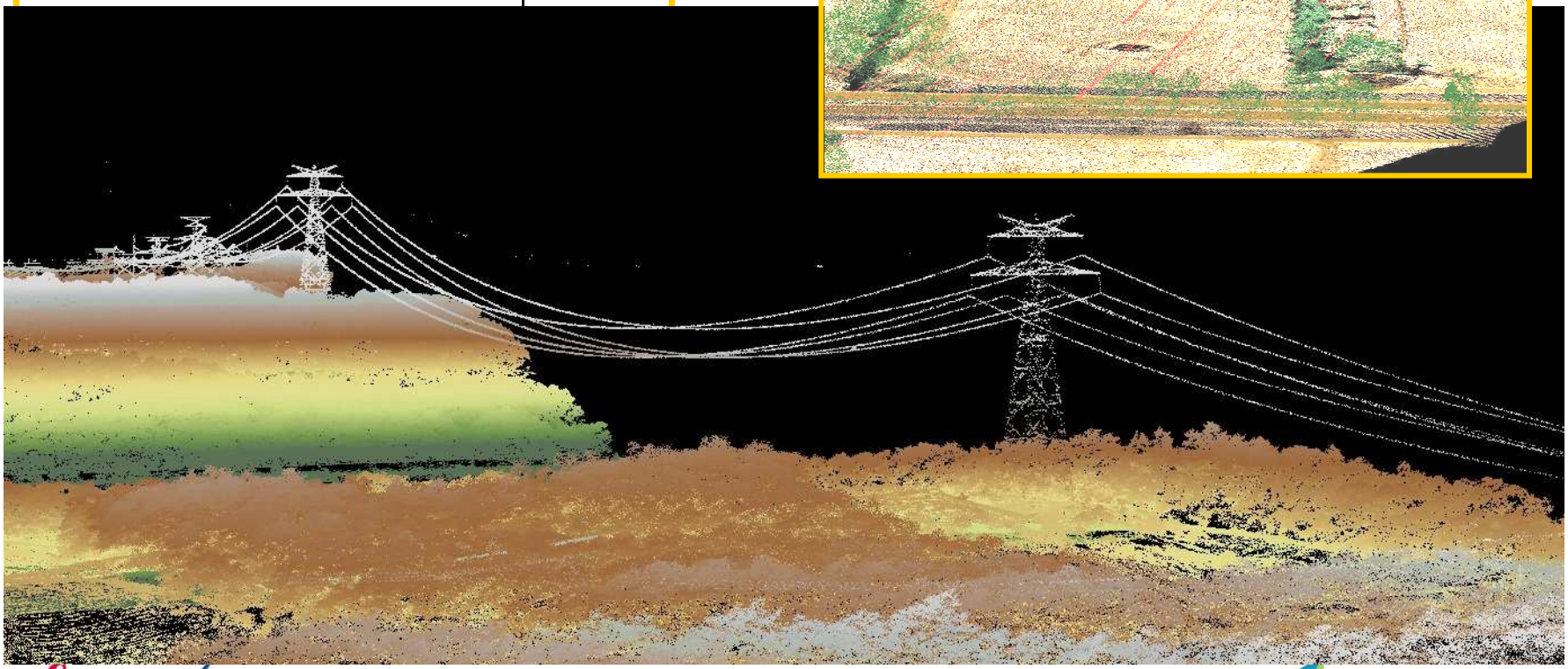
Power Line Mapping with LiDAR

Flying Height (m AGL)	400
Speed (knots)	85
Effective Pulse Rate (kHz)	500
Mode (SPiA / MPiA)	SPiA
FOV (degrees)	25
Effective Scan Rate (Hz)	150.8
Scan Pattern (sine / triangle / raster)	sine
Nadir point density (points/m^2)	39





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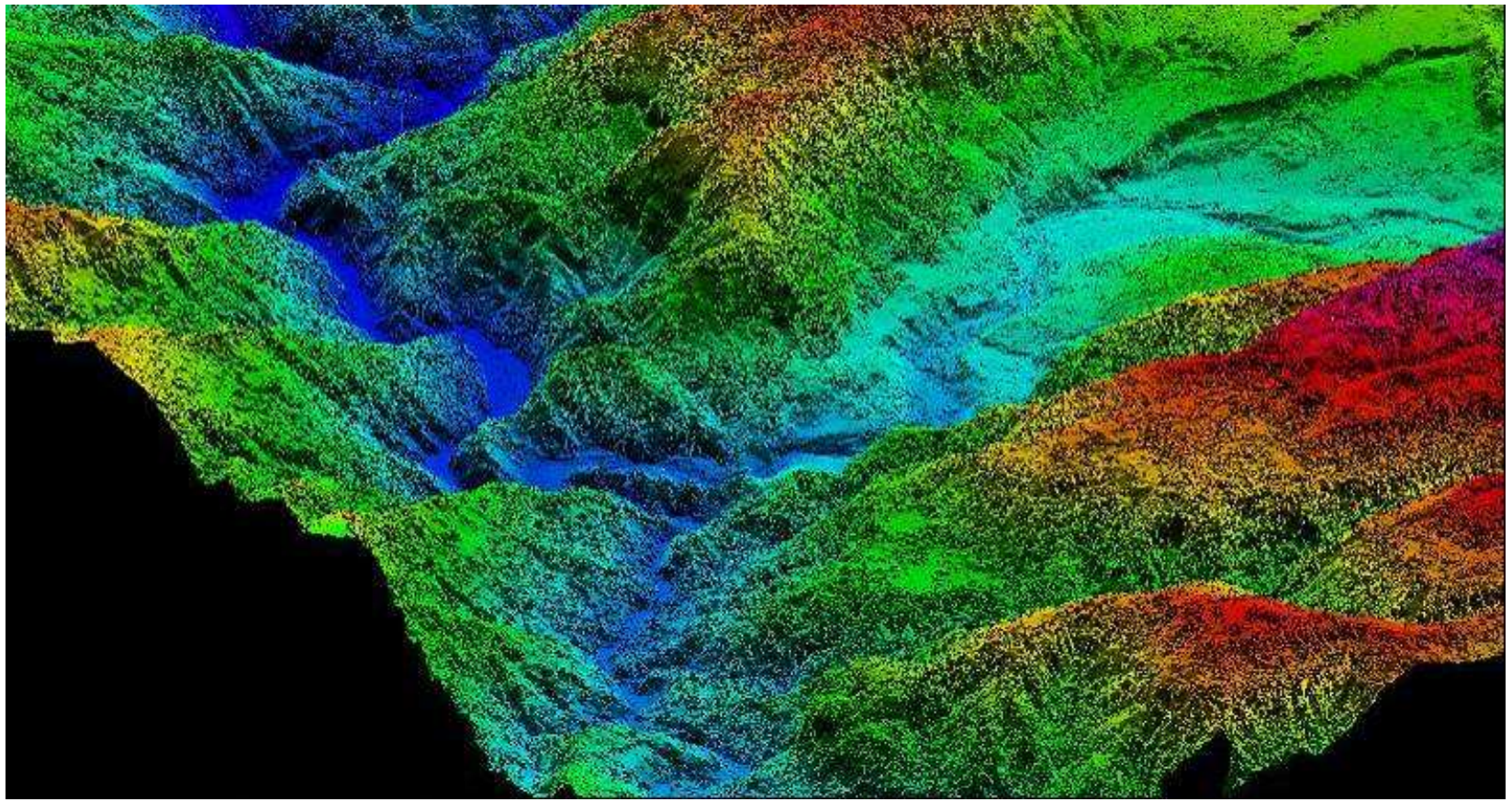
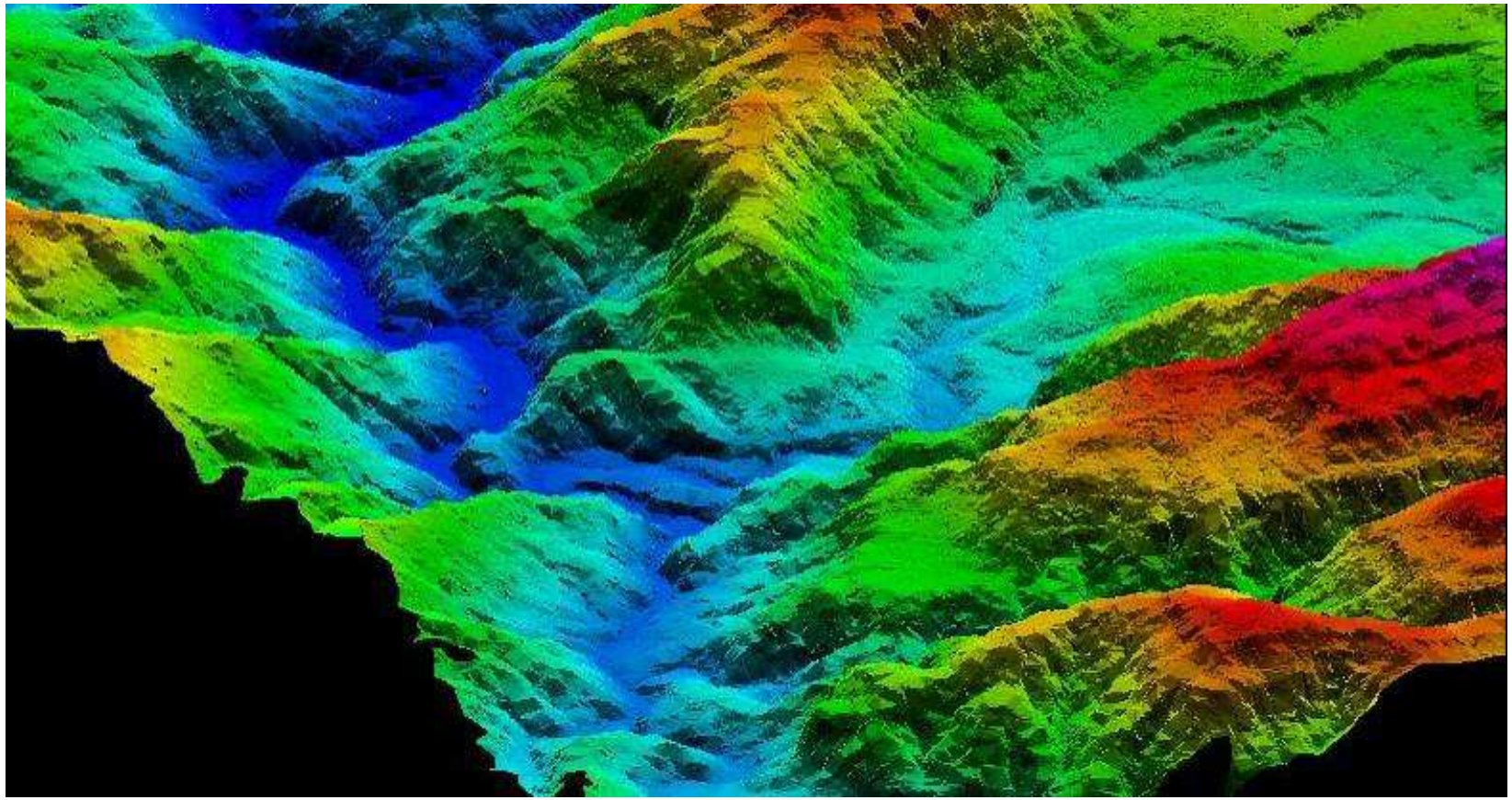
Forestry
Ground profiling during leaf-on conditions

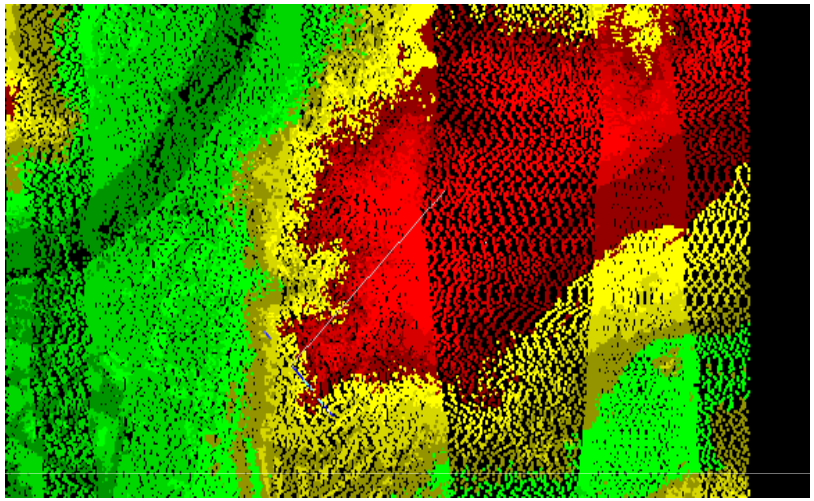


Forestry
Ground profiling during leaf-on conditions



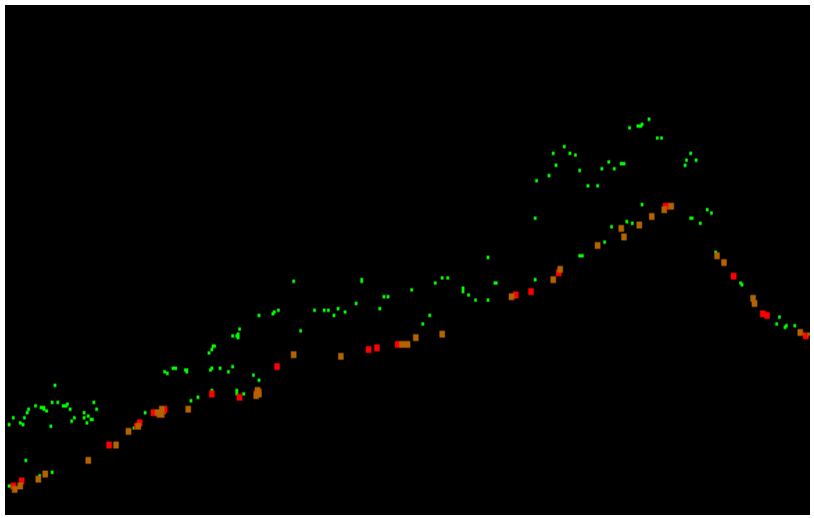
Forestry - tree height and biomass estimation

Top View – Color Coded by elevation

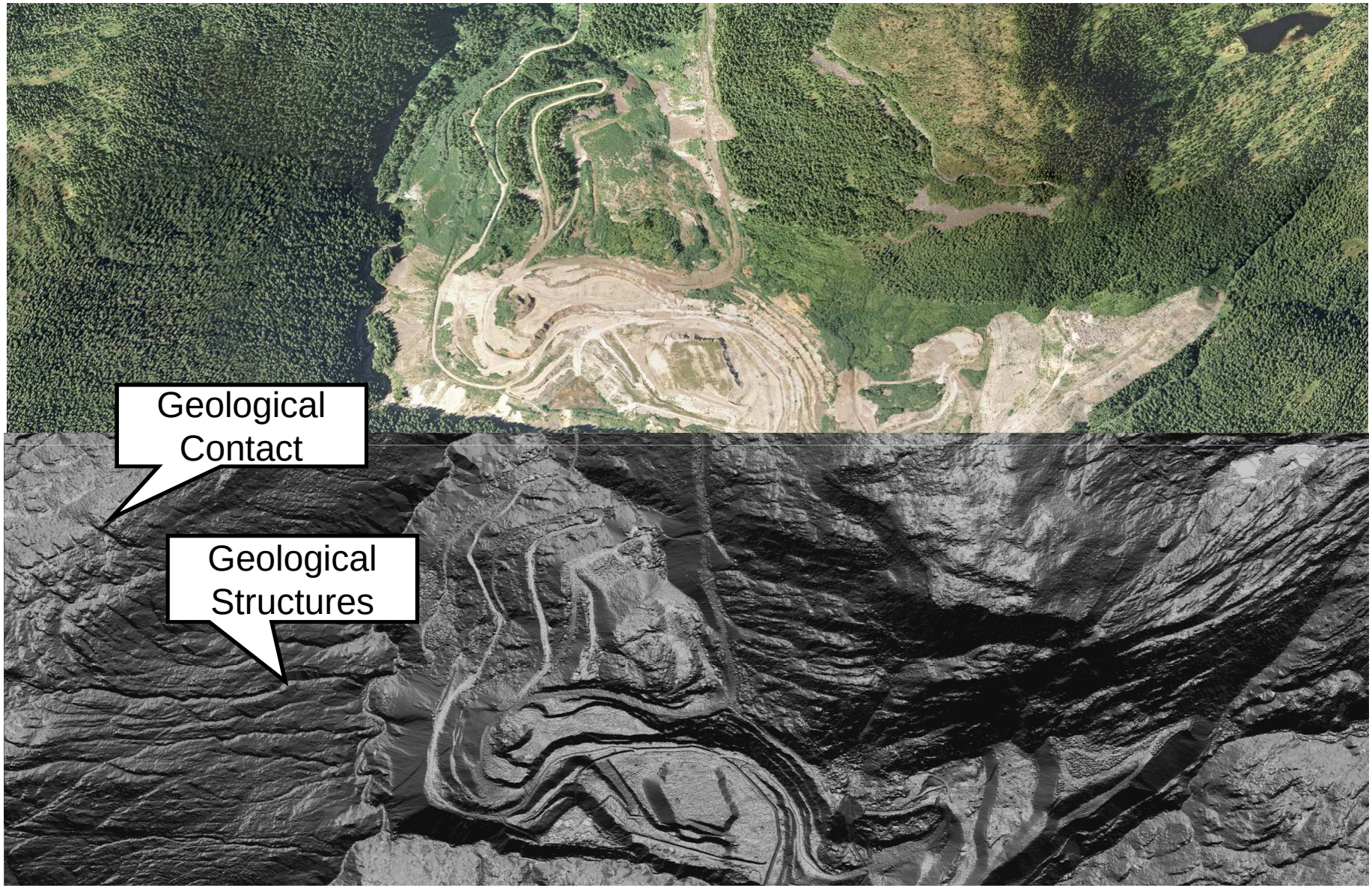


Section view color coded by class

- Brown = Ground
- Green = Vegetation
- Red = Model Key Points



Geological Mapping with LiDAR



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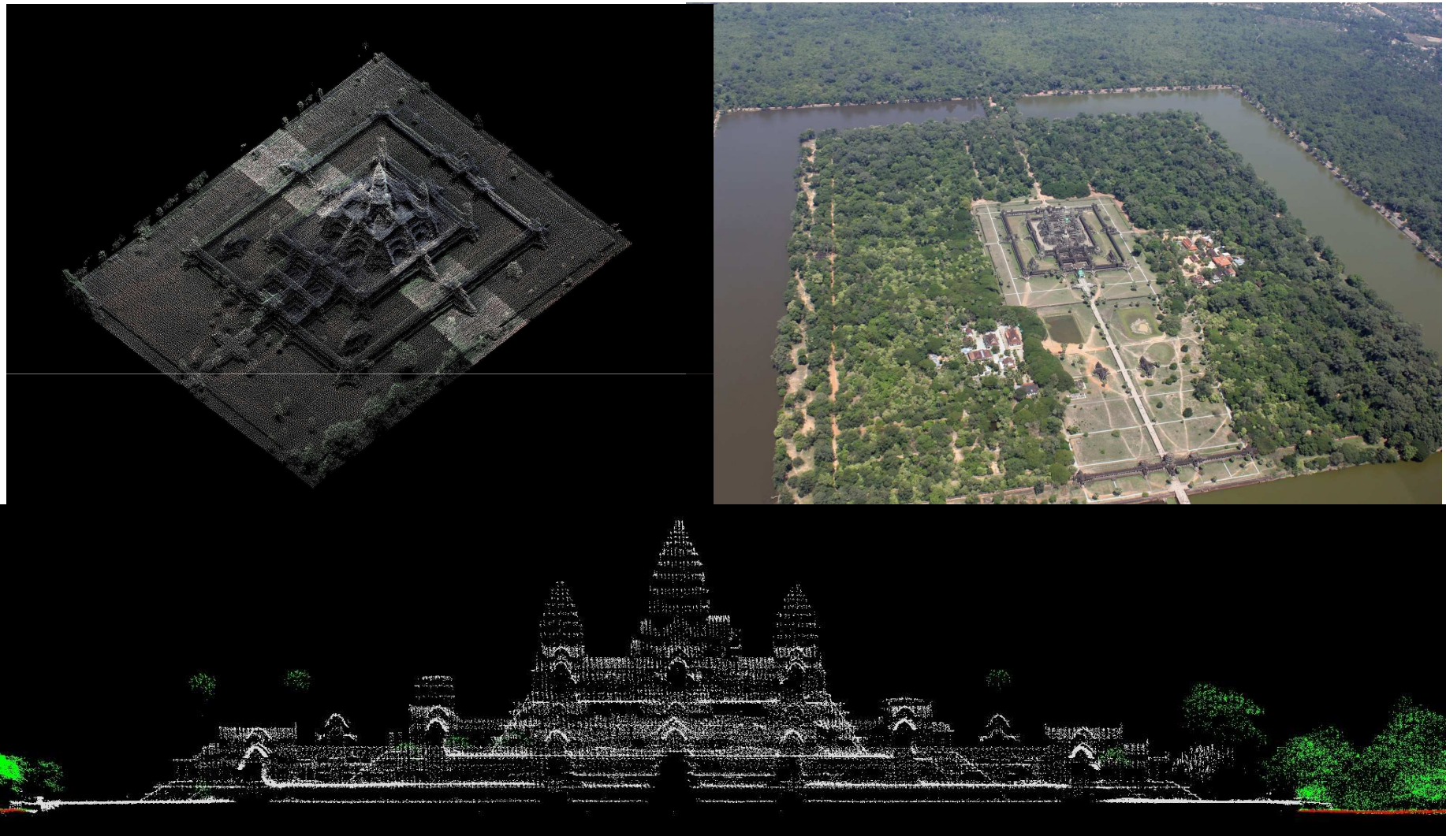
Archeological Mapping with LiDAR



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Conclusions: DSM from imagery vs. LIDAR

Historically limited by

- Algorithm complexity
- Available computing power

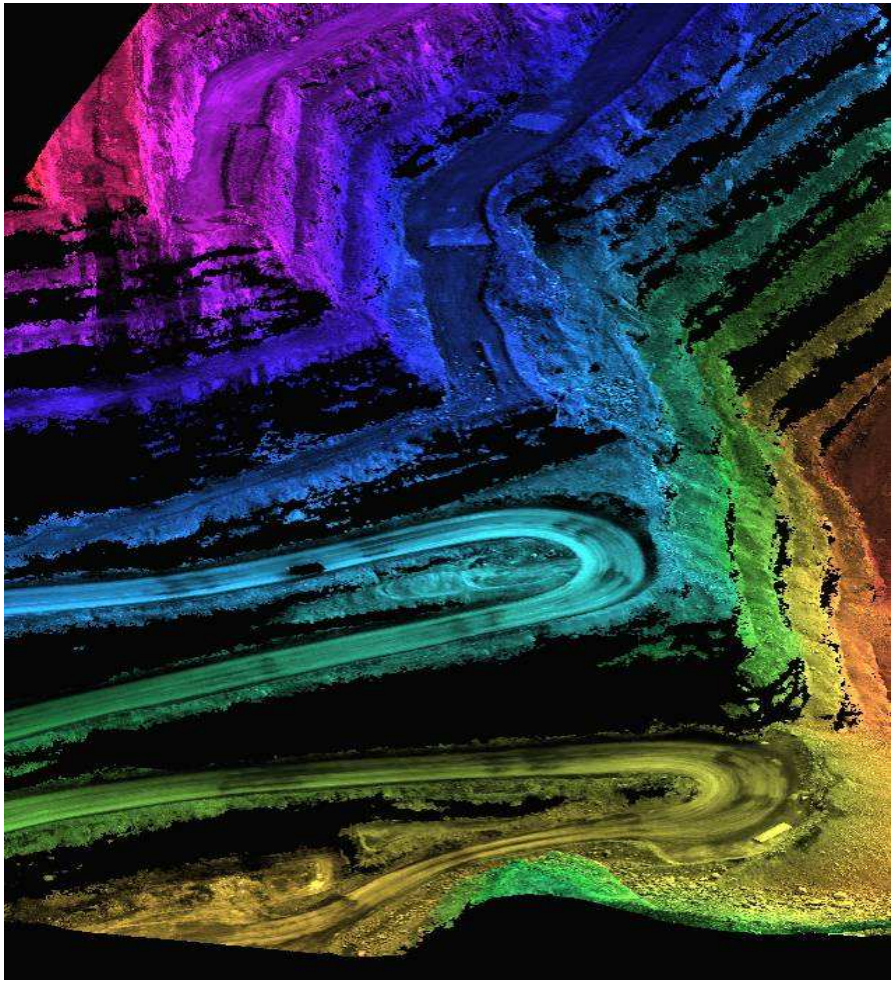
Recent advancements

- Advanced algorithms (e.g., SGM)
- Low-cost computational power

Point acquisition rate (raw data collection in air)

- ALS70-HP example: ***250 kHz laser x 2 outputs = 500 kHz***
- ADS80 example: ***12,000 pixels/line x 1,000 lines/sec x 0.80 match rate = 9.6 MHz!!!***

Implication: careful selection of sensor based on mission requirements !



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Thank you!

Rolf Schaeppi
rolf.schaeppi@hexagongeosystems.com

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