Terrain Modeling and Mapping for Telecom Network Installation Using Scanning Technology

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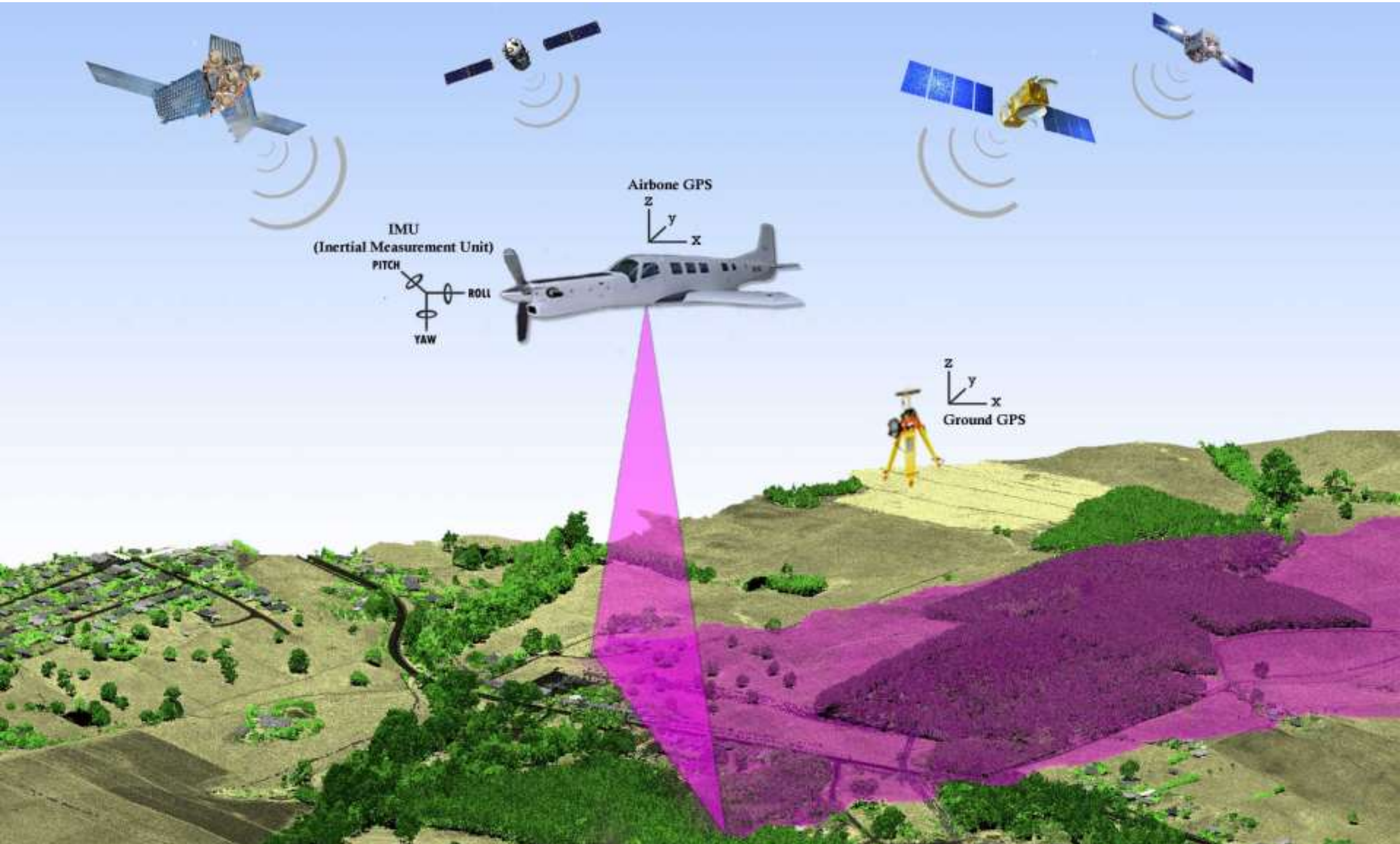
Summarising LiDAR
(Airborne Laser Scanning)

LiDAR is a reliable survey technique, capable of:

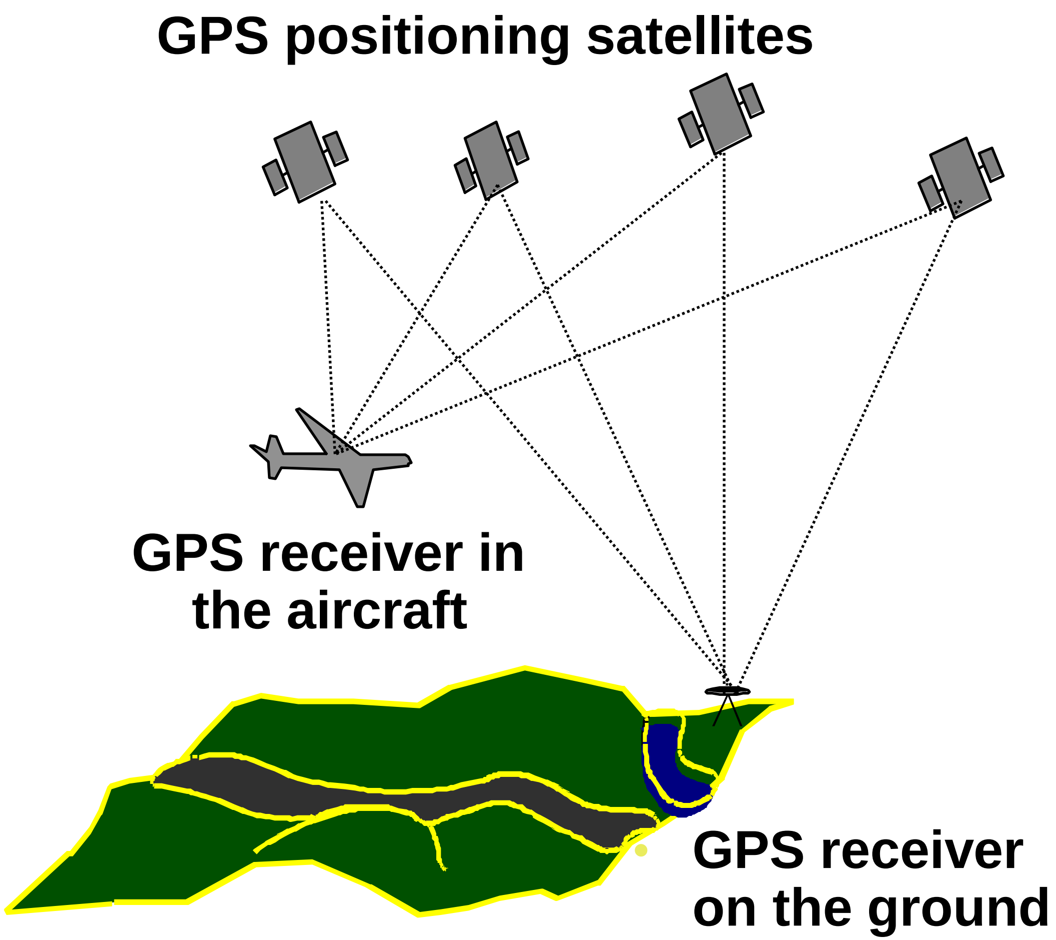
- acquiring over 500 million data points per hour
- measures ground & above ground features
- defines terrain under vegetation
- typical data accuracy of 0.15m rms
- typical point spacing of less than 1m
- typically defines 5000ha per hour
- is proven, reliable and eye-safe.

LiDAR (Airborne Laser Scanning)



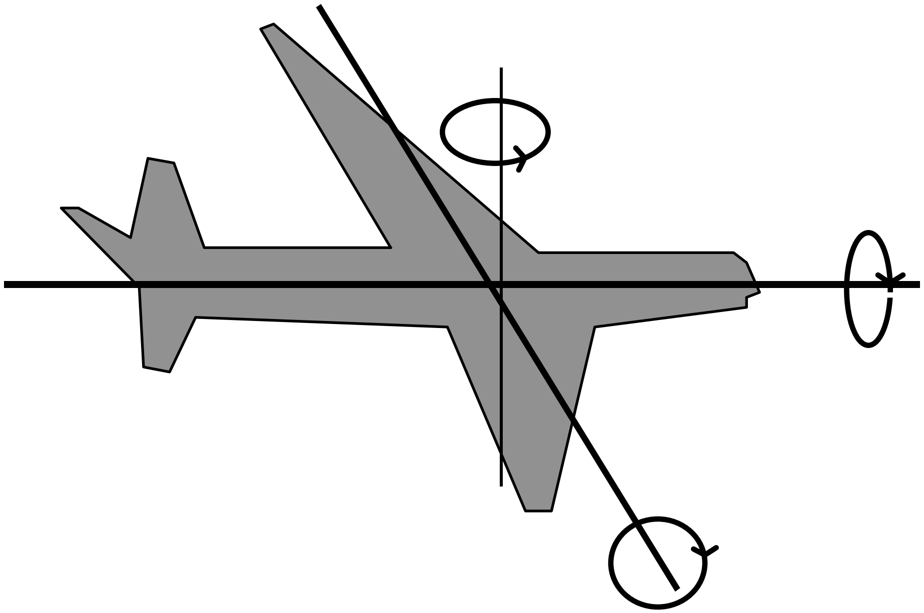
The Concept of LiDAR

Advanced satellite positioning technology determines the location of the aircraft with respect to the terrain.



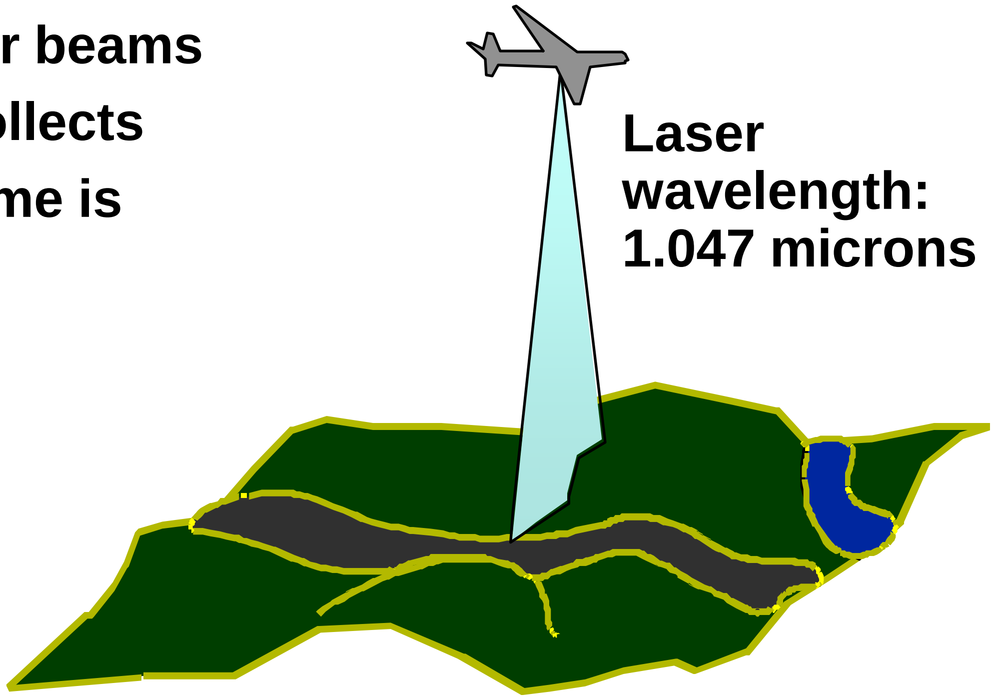
The Concept of LiDAR

The attitude of the aircraft is determined by an accurate Inertial Measurement Unit (IMU).



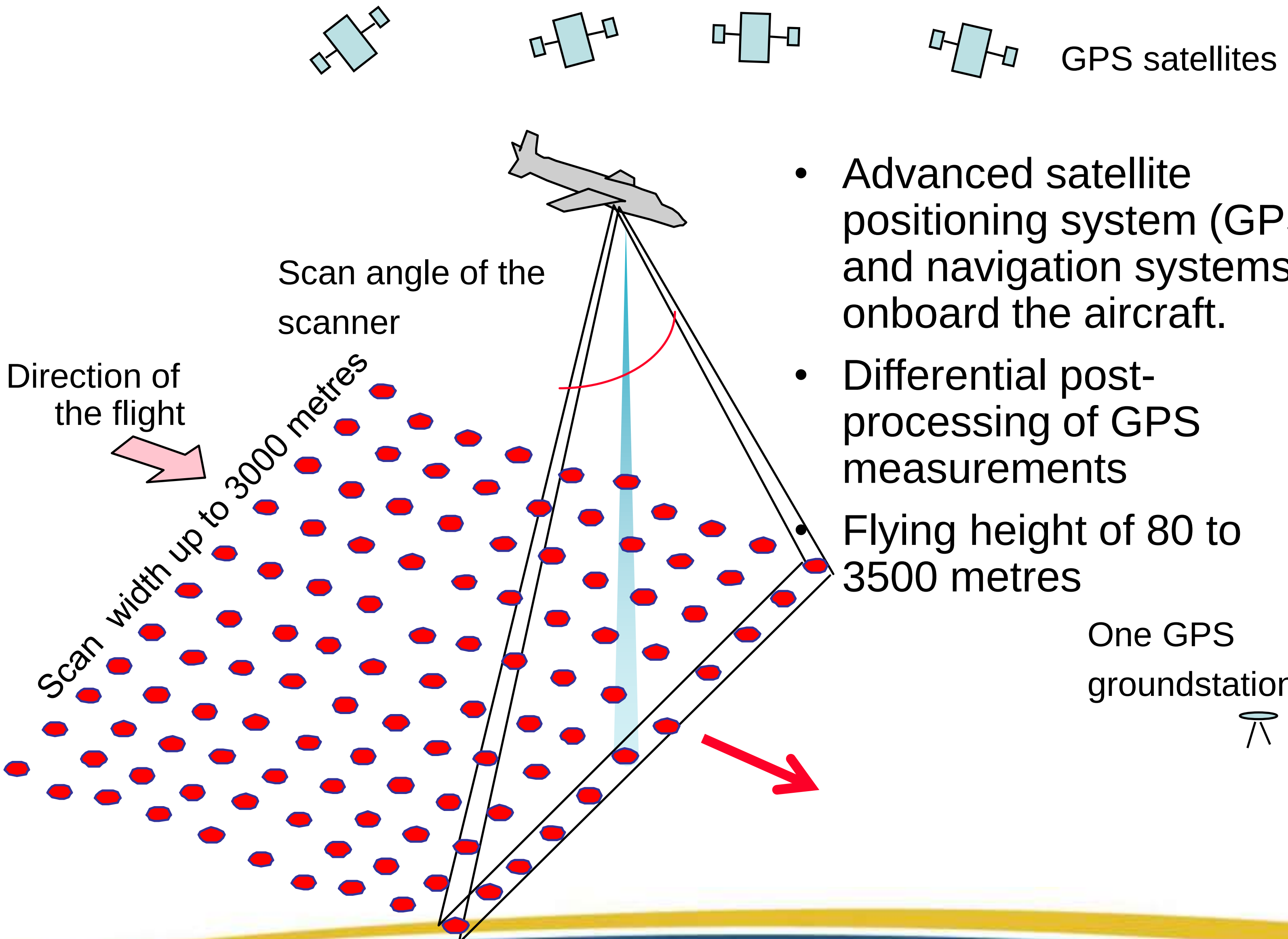
The Concept of LiDAR

The laser scanner emits laser beams with a high frequency and collects the reflections. The transit time is accurately measured.



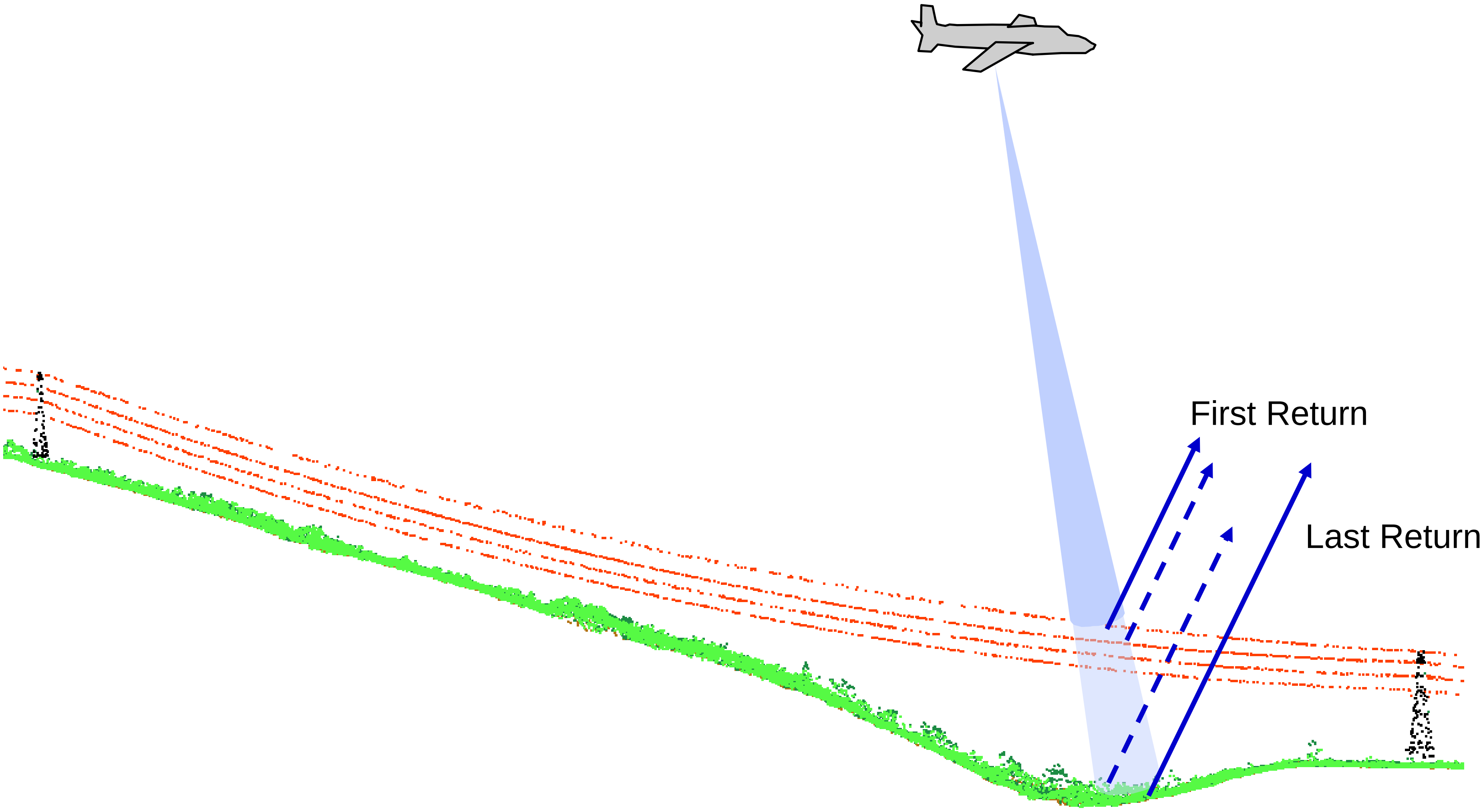
Laser wavelength: 1.047 microns

The Concept of LiDAR



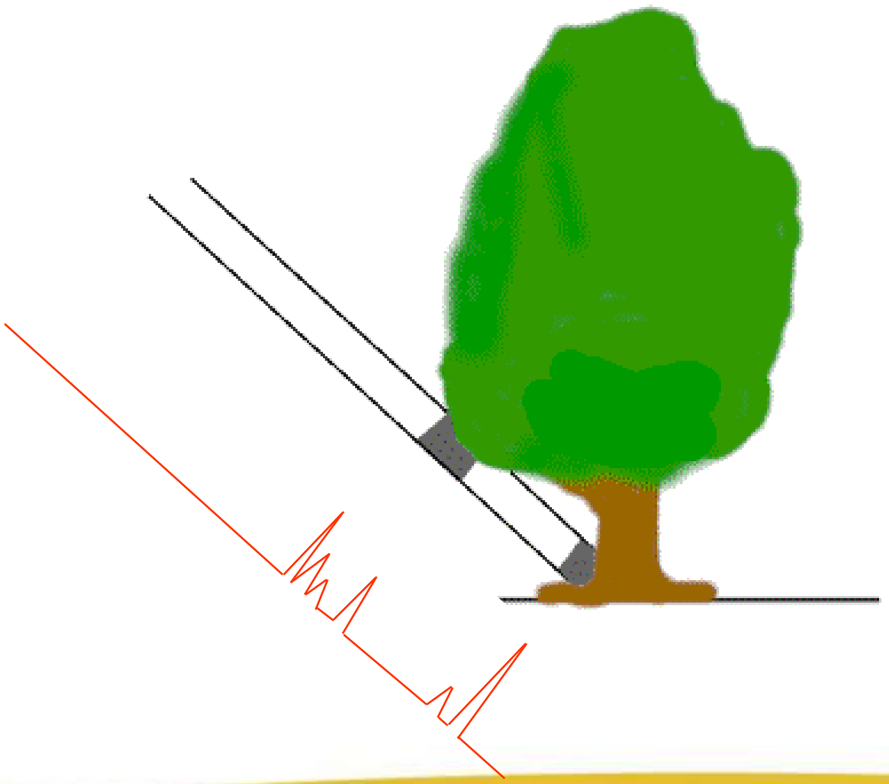
- Advanced satellite positioning system (GPS) and navigation systems onboard the aircraft.
- Differential post-processing of GPS measurements
- Flying height of 80 to 3500 metres

Multiple Returns per Emitted Laser



Intensity of Return

records the intensity of the return signal from the first and last laser return



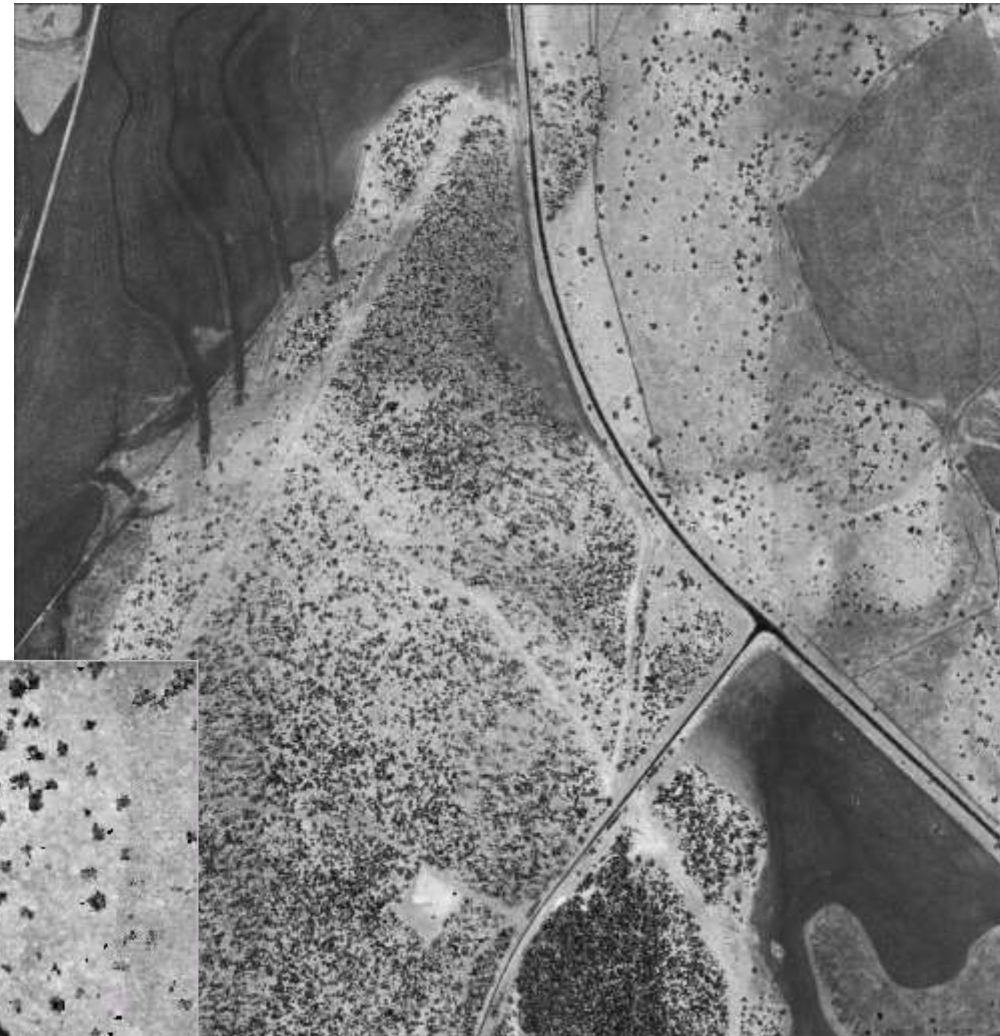

David
Clark

Route Planning

- In a single pass of the aircraft, measure terrain shape, features and vegetation canopy to fast and accurately.

Intensity of Return

Geo-referenced intensity images for site analysis and access



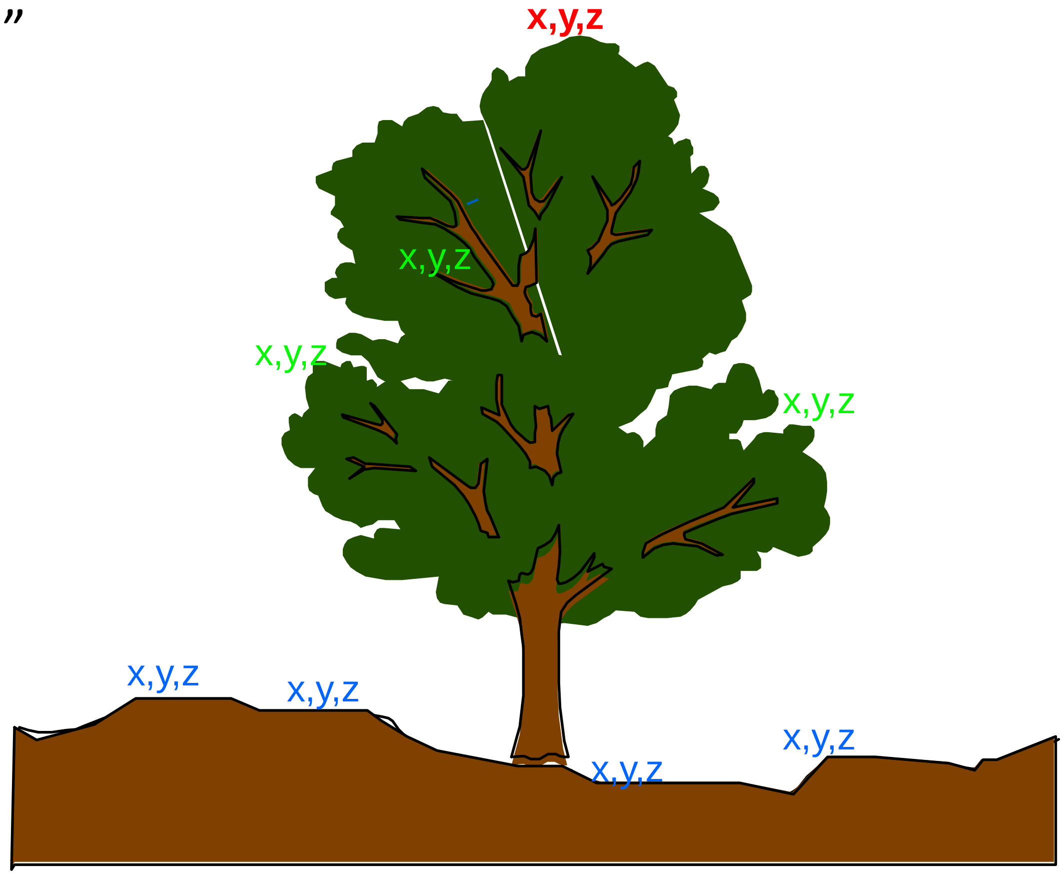
The LiDAR is an "Active sensor" so these images are available at night

Data Classification

Automatic processing applies morphological filters to classify the data into "ground" and "non-ground" points.

Further classification can define "canopy" points.

Manual checking and editing follows automatic classification



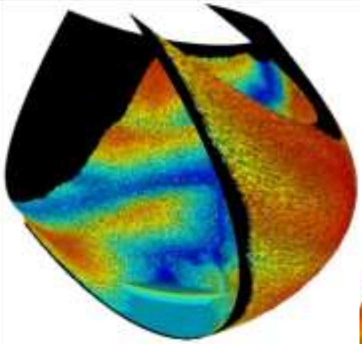
LiDAR Terrain Definition

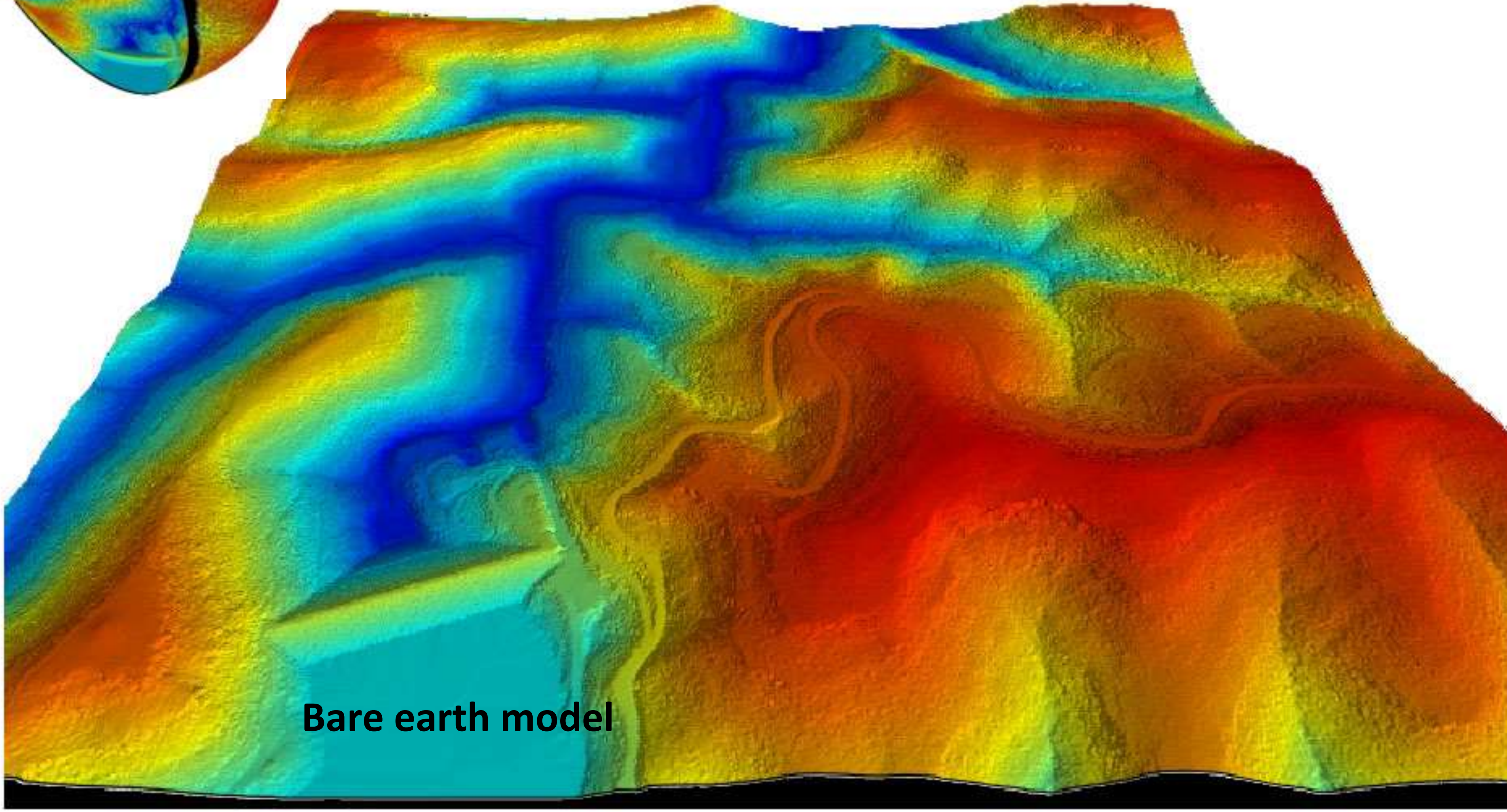
The distribution of data voids and the decrease in vertical accuracy in vegetated areas reflects the fact that the number of laser strikes which reach the ground diminishes under dense vegetation.

The decrease is most significant in areas of low, dense scrub or grasses.

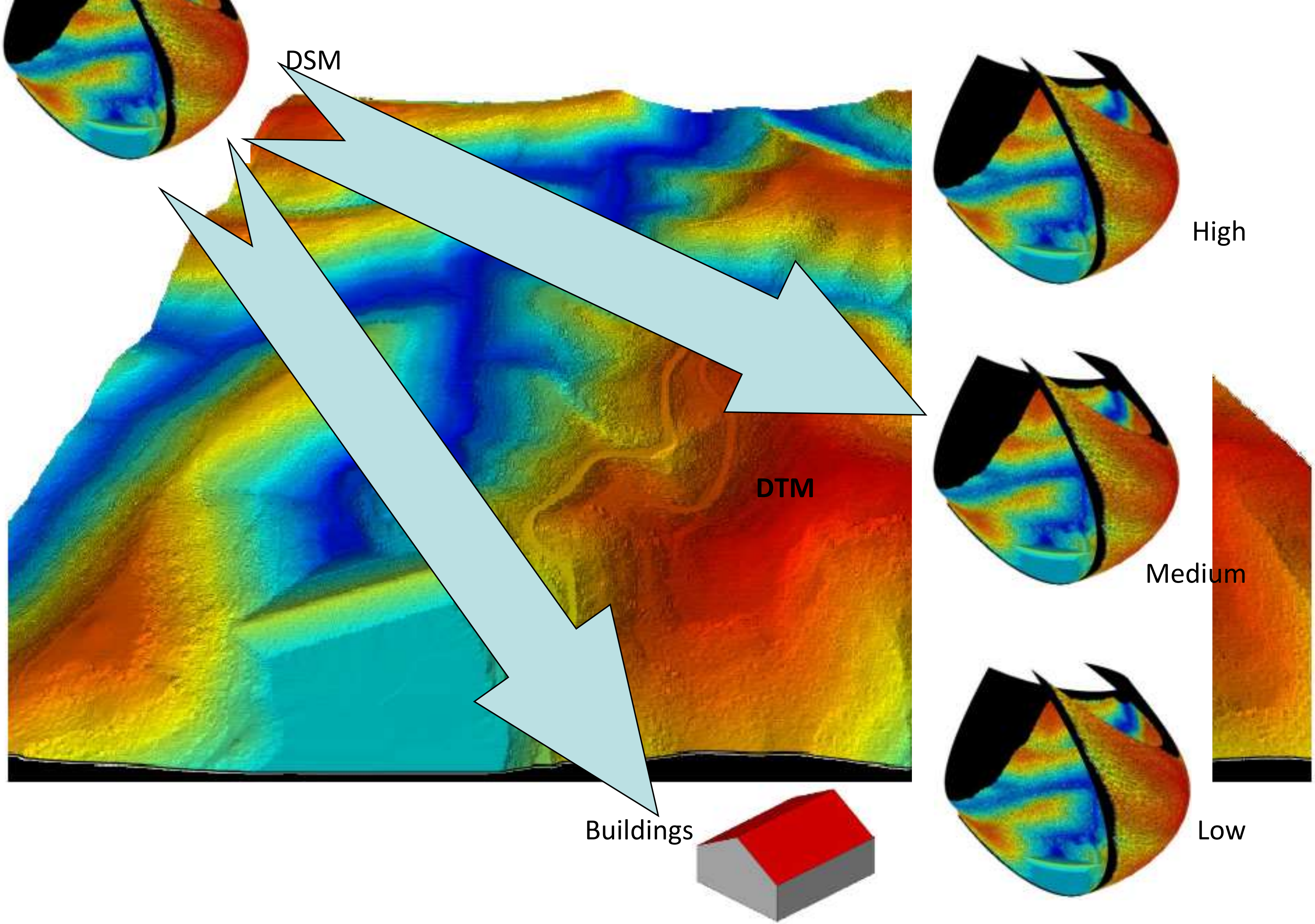
LiDAR Mapping

- LiDAR Defines ground and canopy

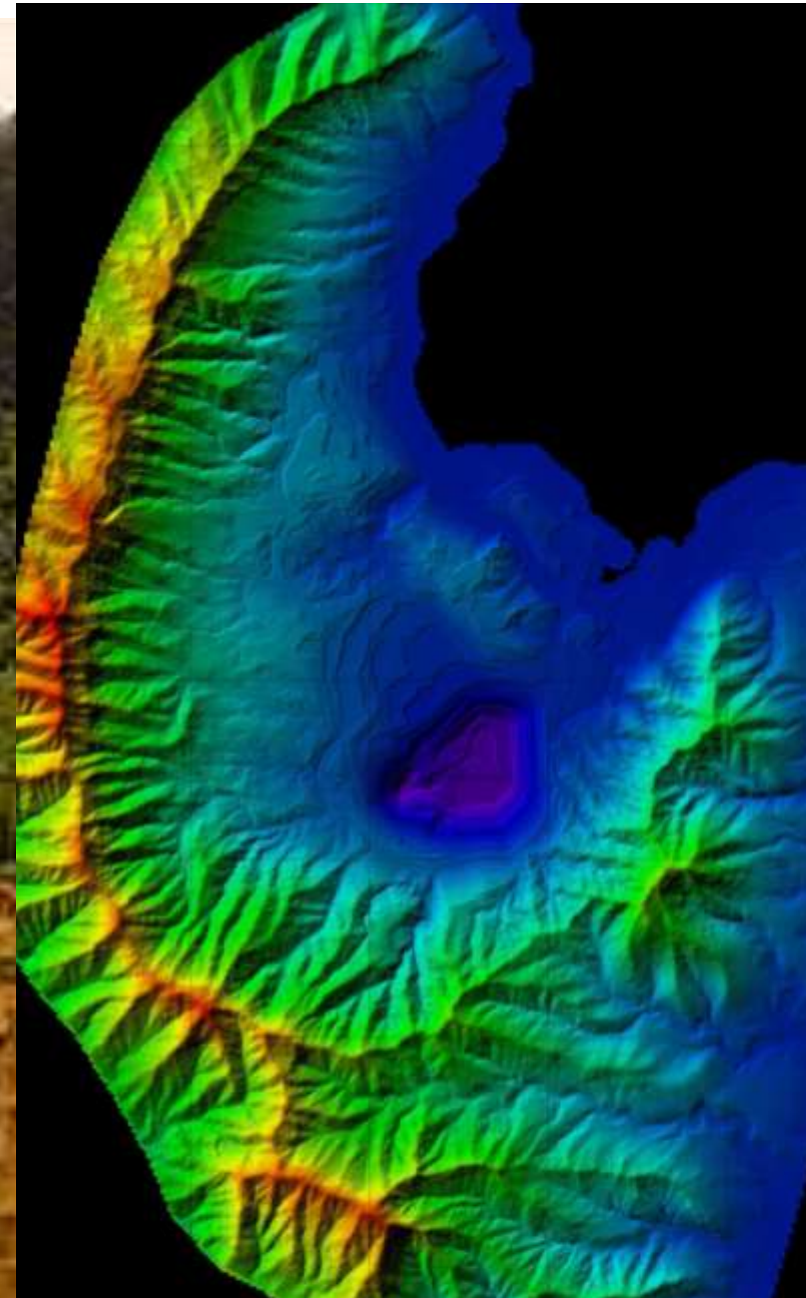

Non-ground points


Bare earth model

Non-Ground into Buildings & Veg Categories

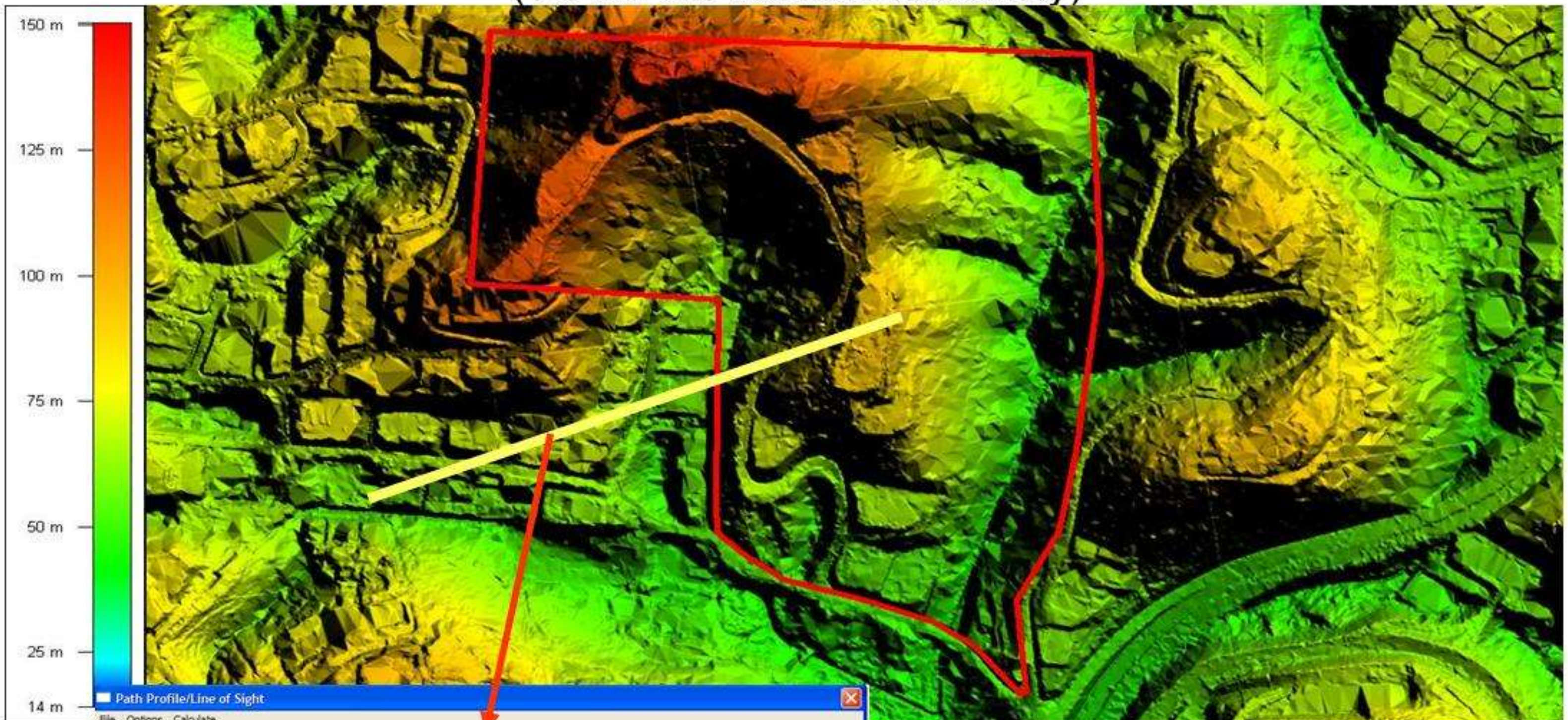


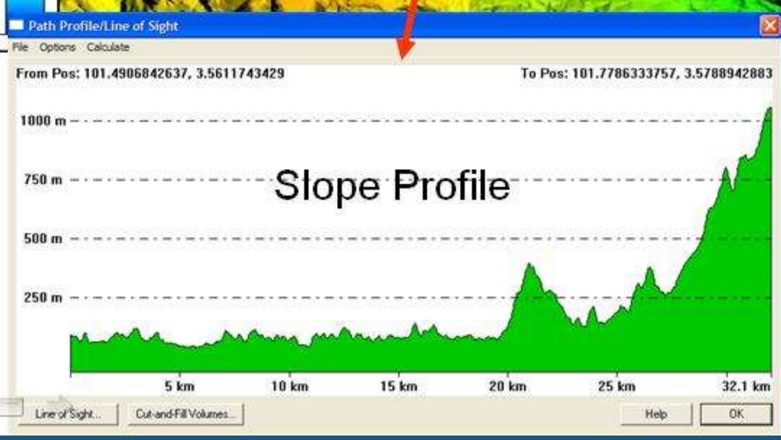
Vegetation Penetration



Bukit Tunku Development Planning

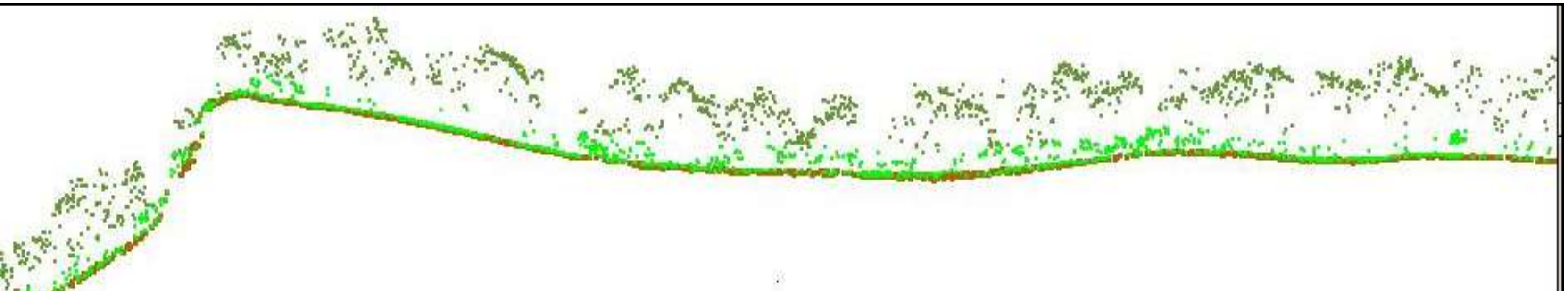
DTM Derived from LiDAR Data
(10-30 cm vertical accuracy)



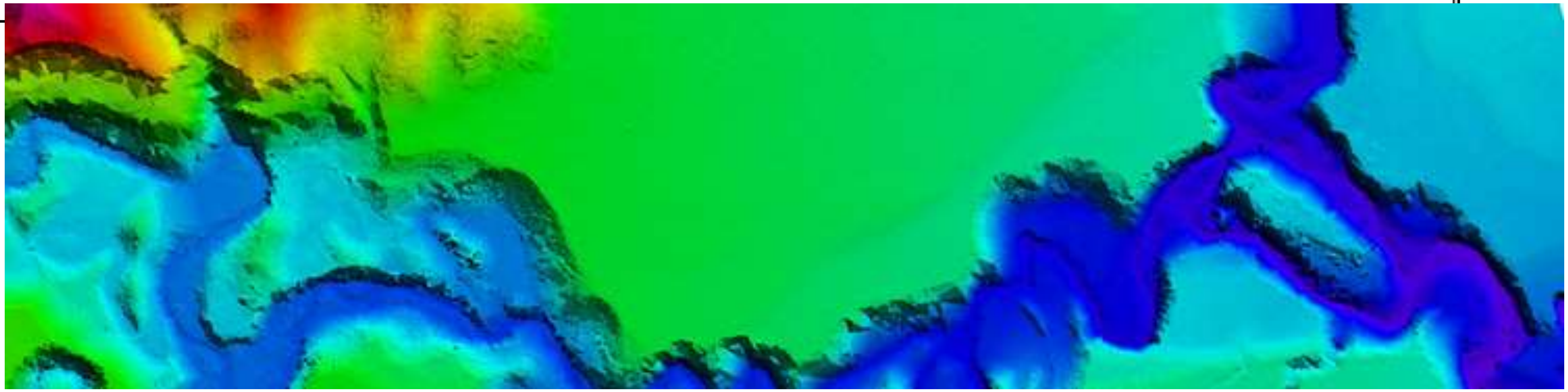


LiDAR Data has been widely used in:
- Road Design
- Flood Modeling
- Town Planning
- River Rehabilitation
- Slope Hazard Mapping
- etc.

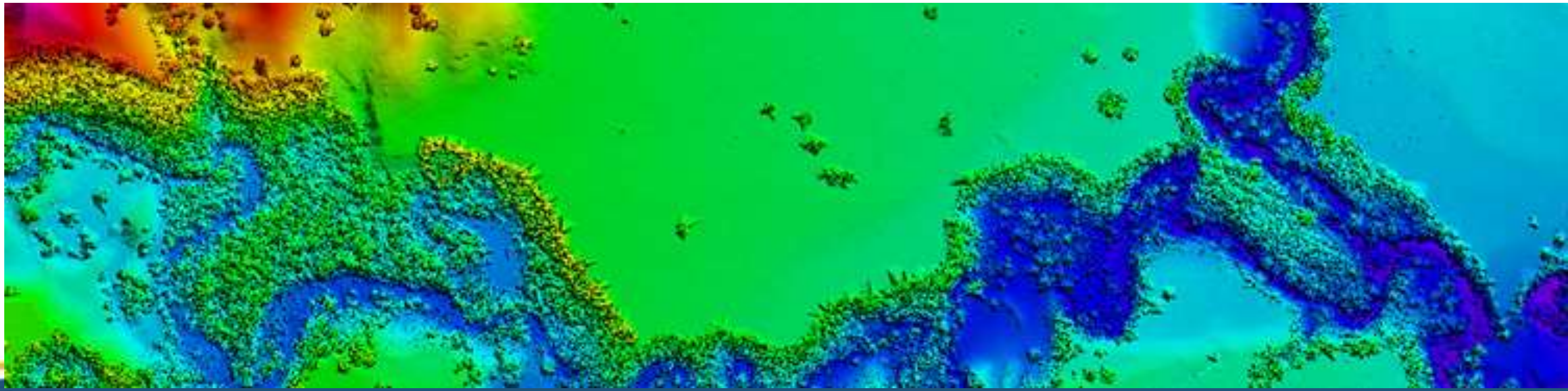
LiDAR Terrain and Surface Models



Point cloud

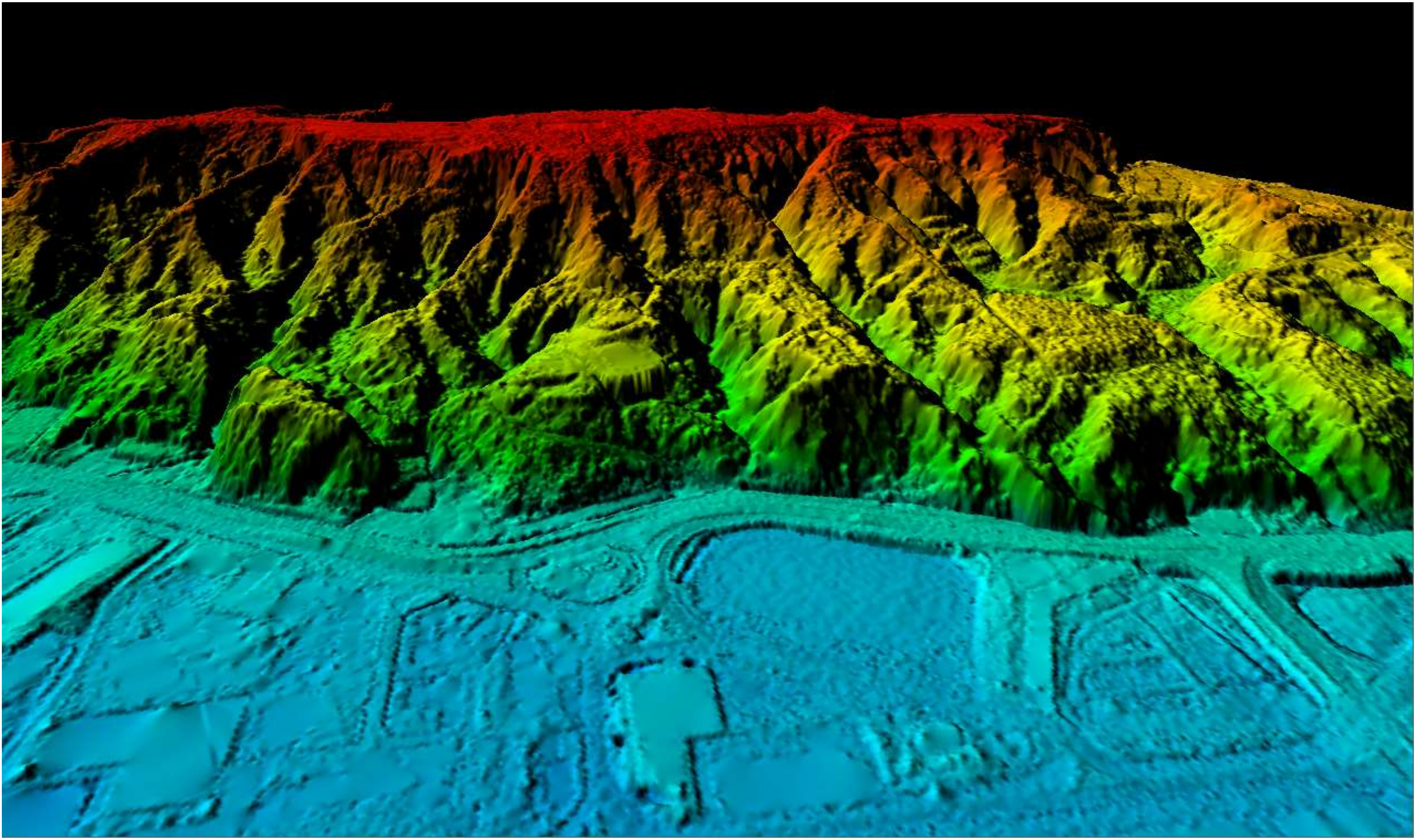


Raster: Digital Terrain Model (DTM), Bare Earth Model

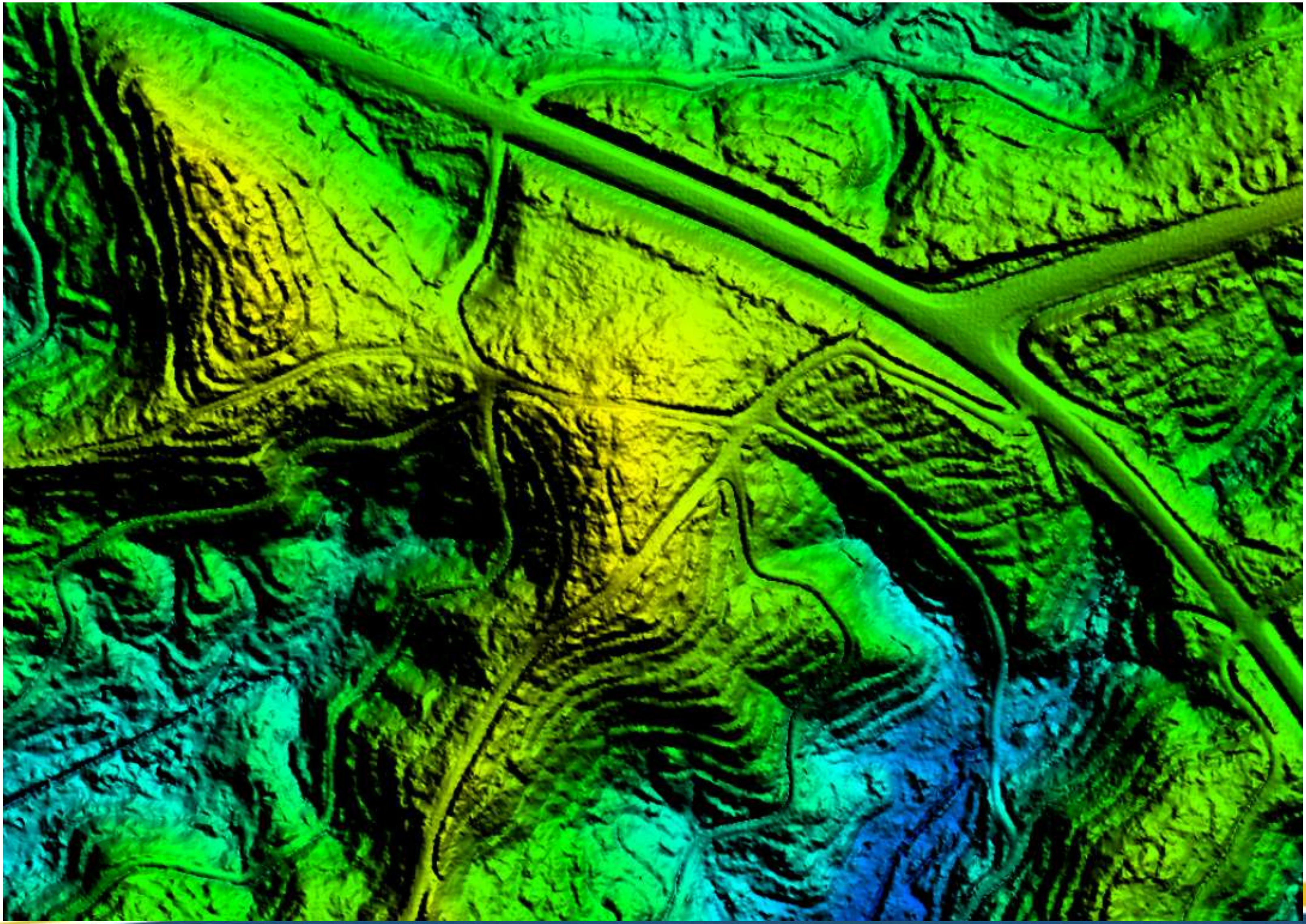


Raster: Digital Surface Model (DSM)

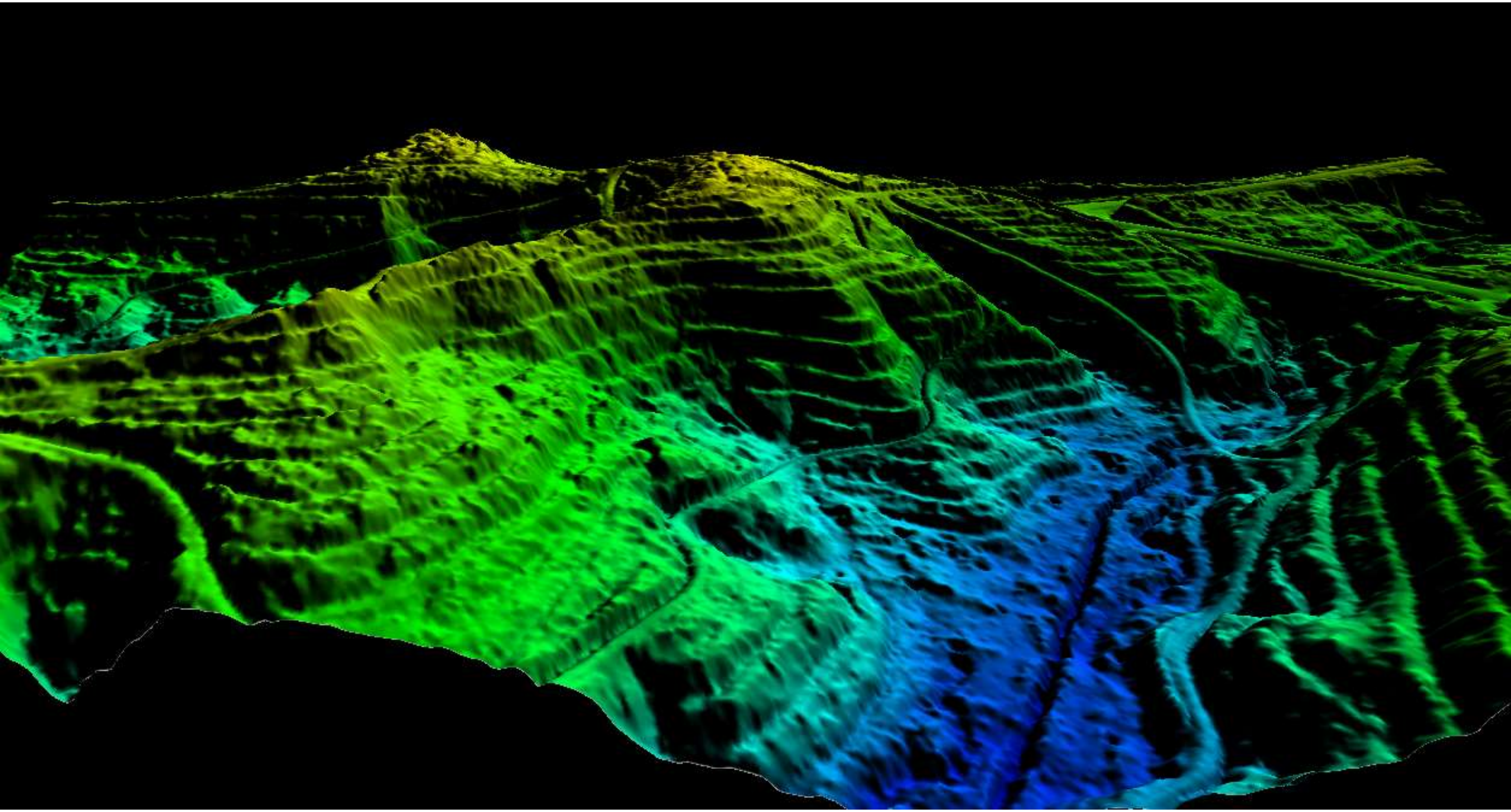
LiDAR Terrain Model



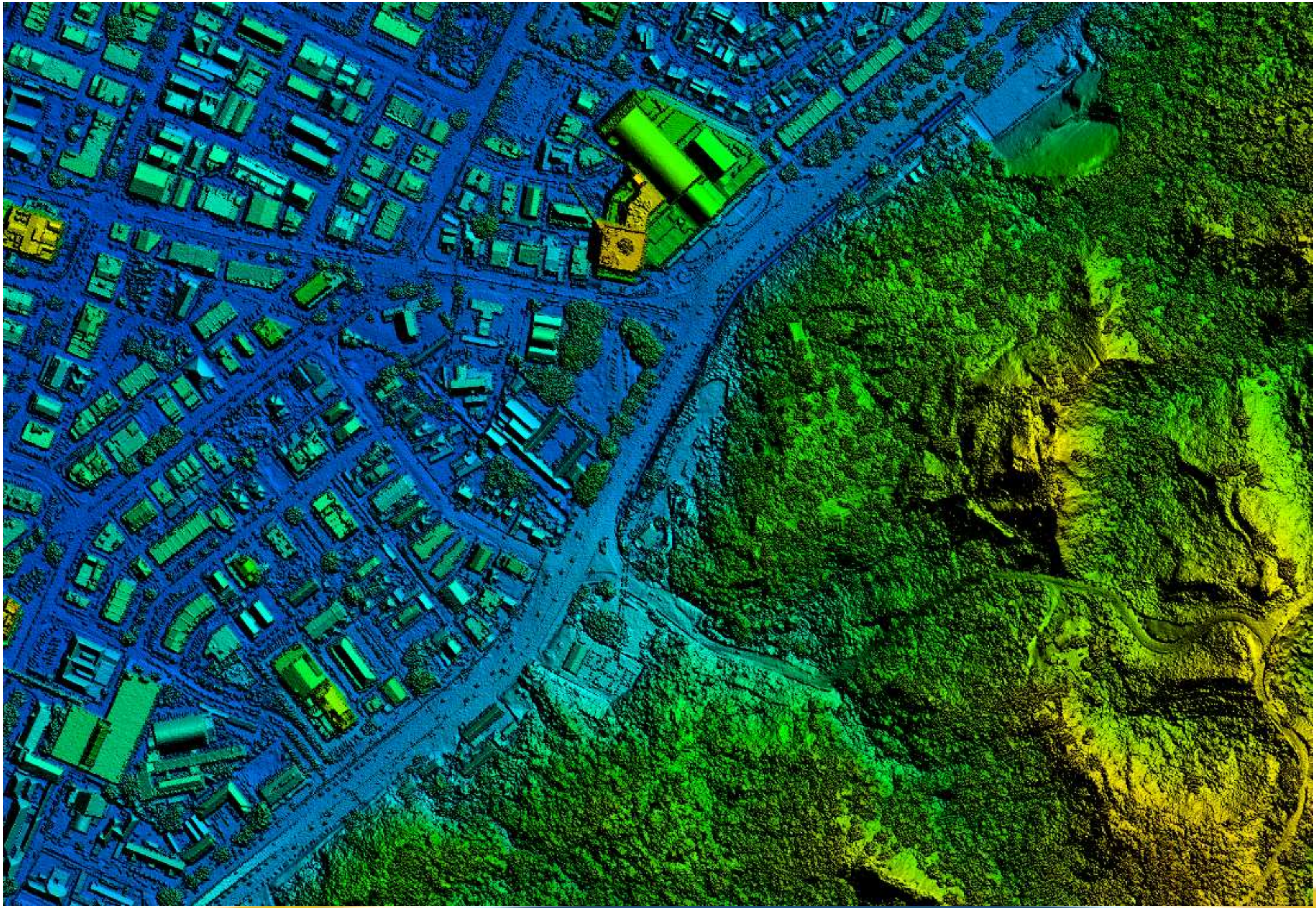
Digital Terrain Model



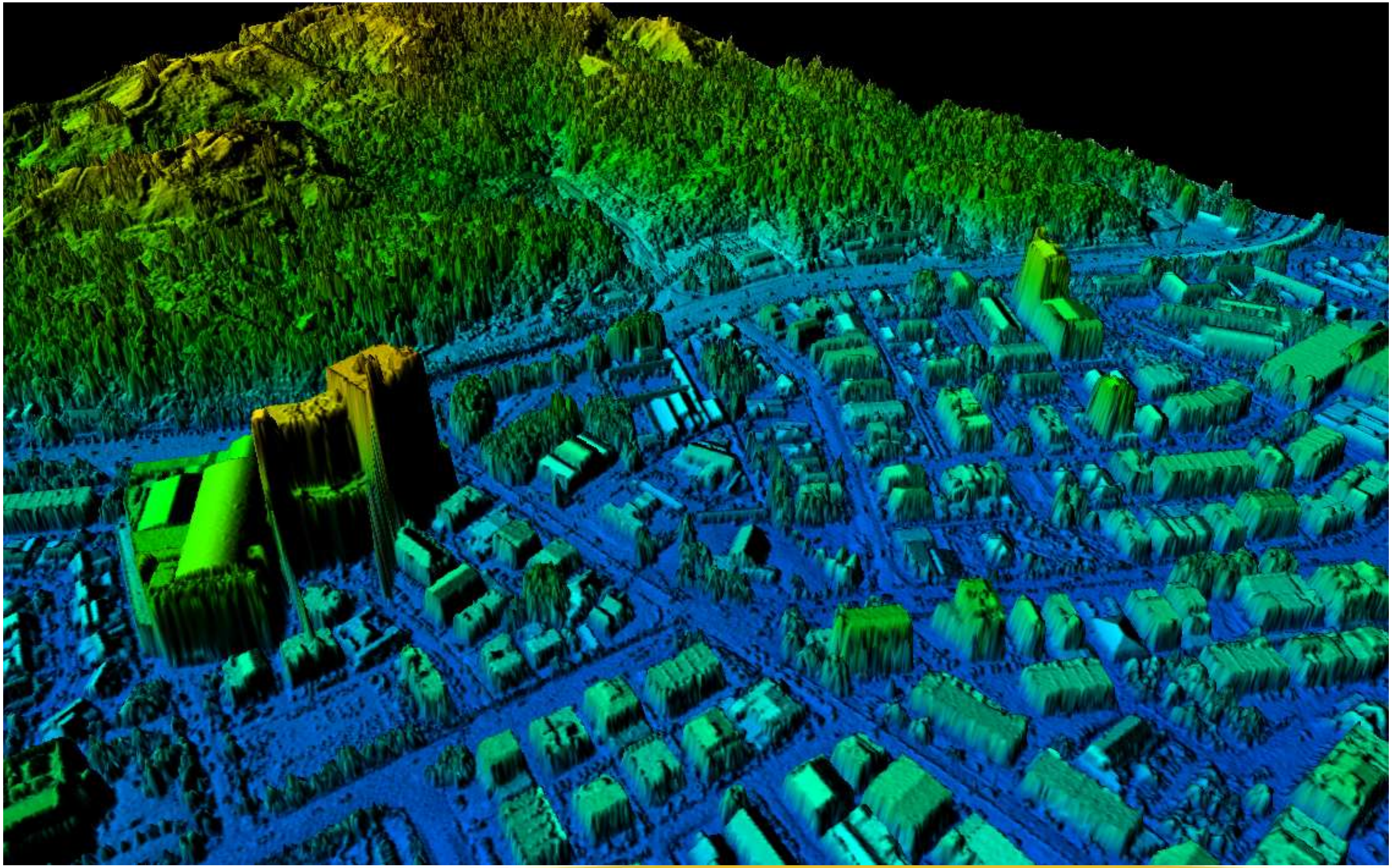
Digital Terrain Model



Digital Surface Model



Digital Surface Model

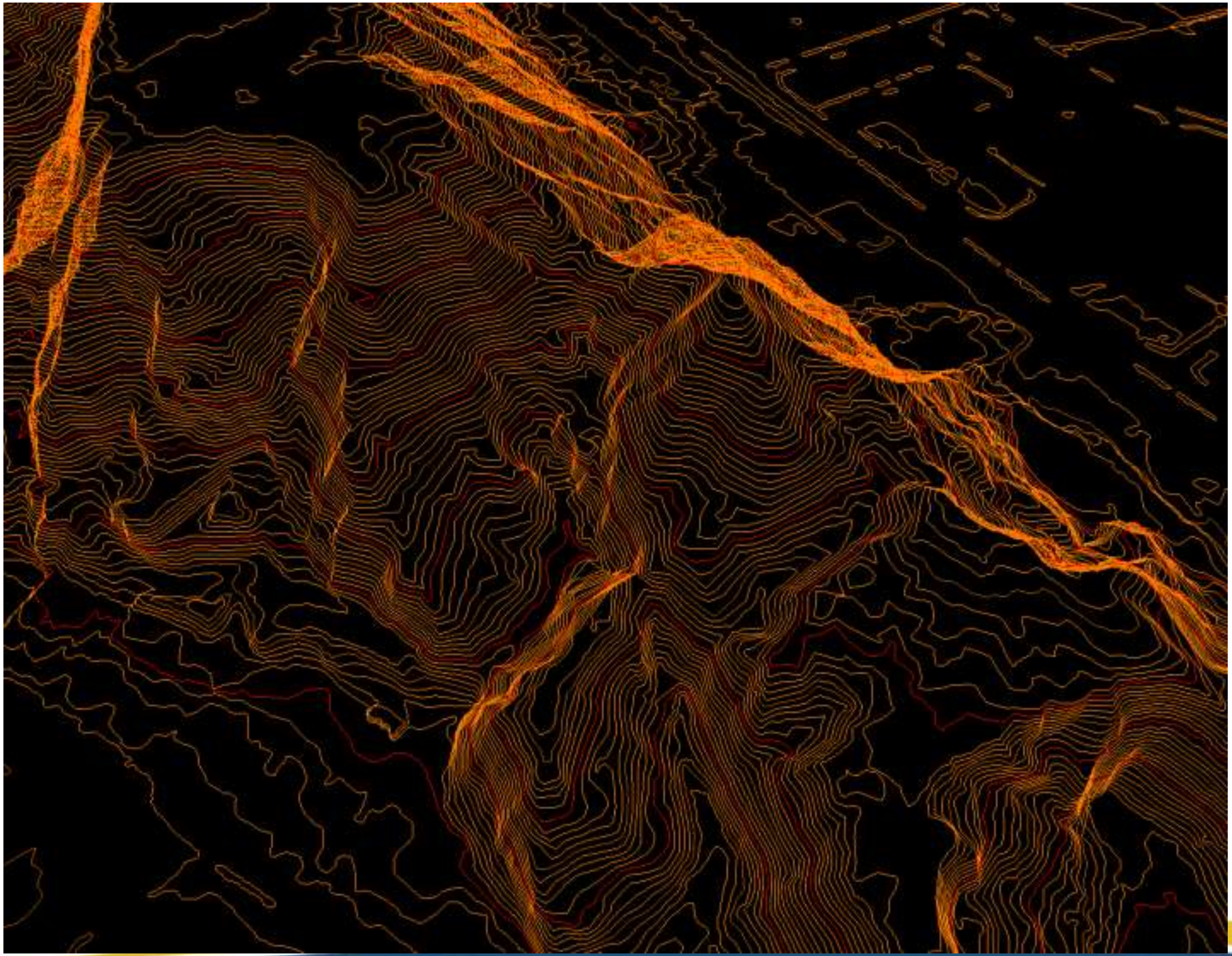


1 meter Colour Intensity Imagery

1 meter Colour Intensity Imagery

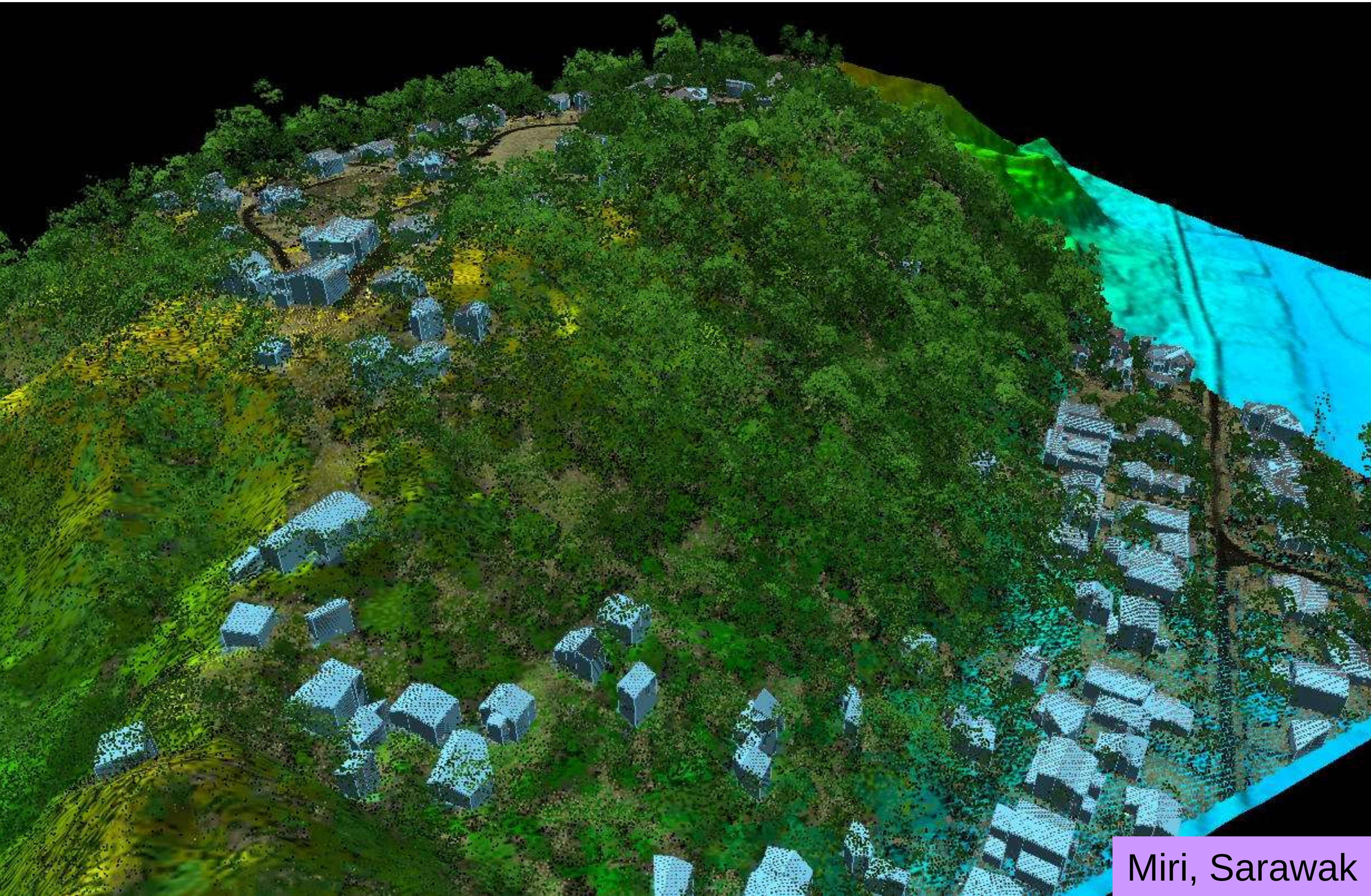
Upgraded Into Colour Intensity Image

1 meter Contour



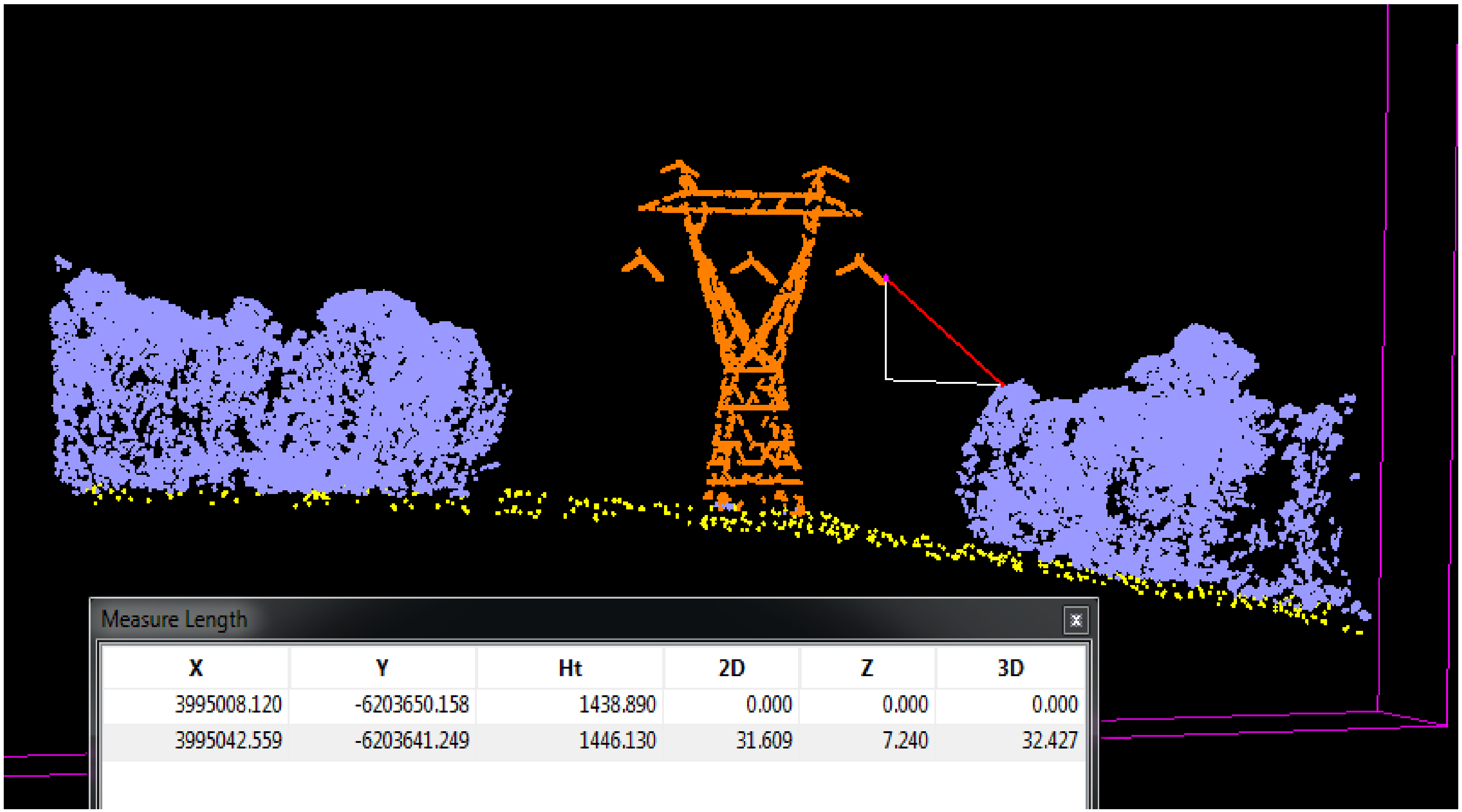
LiDAR Derived Products

LiDAR Derived Products

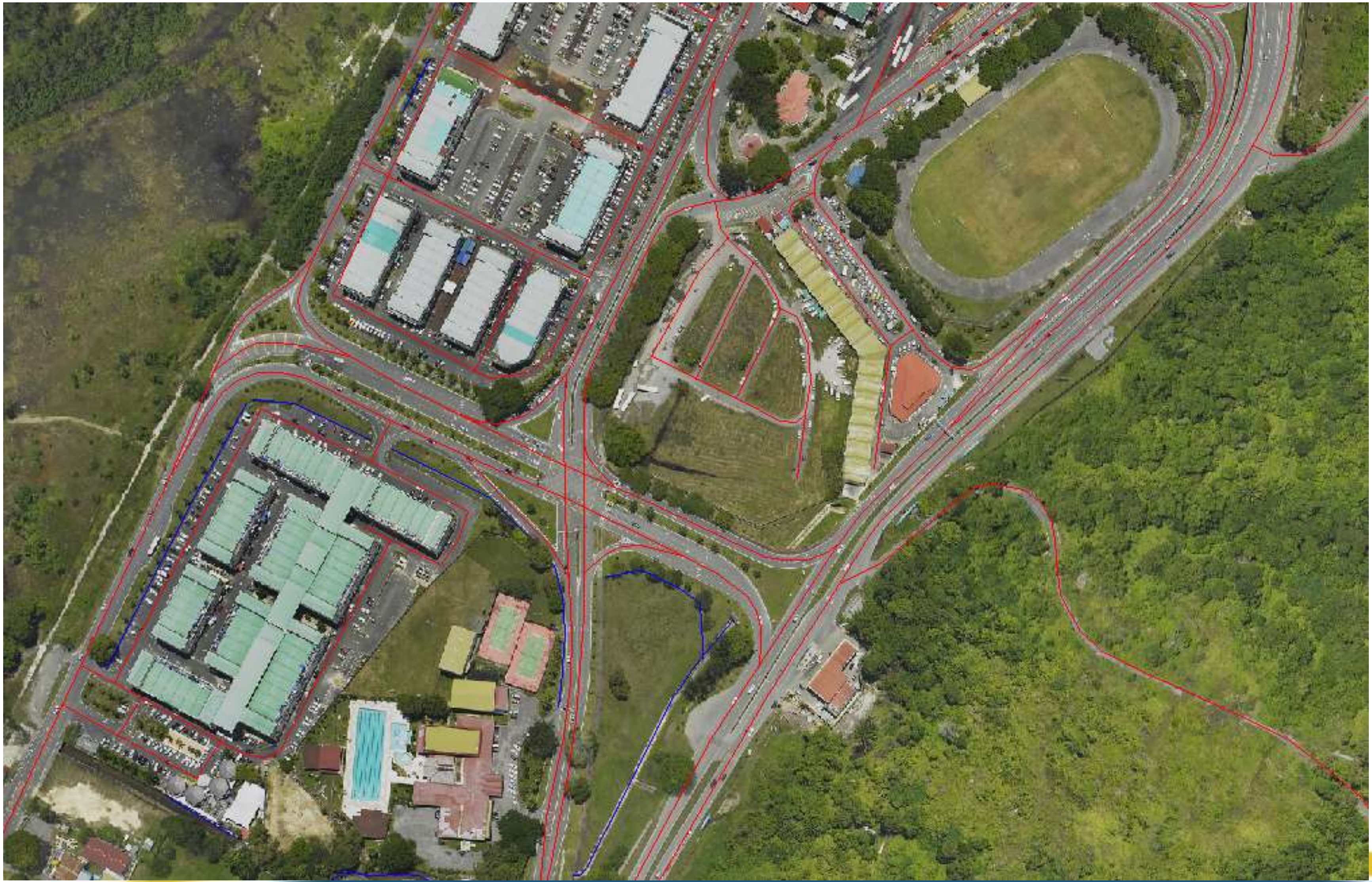


Data Interrogation

- Tools to interrogate the data to visualise and analyse all assets



0.15m GSD Orthophoto

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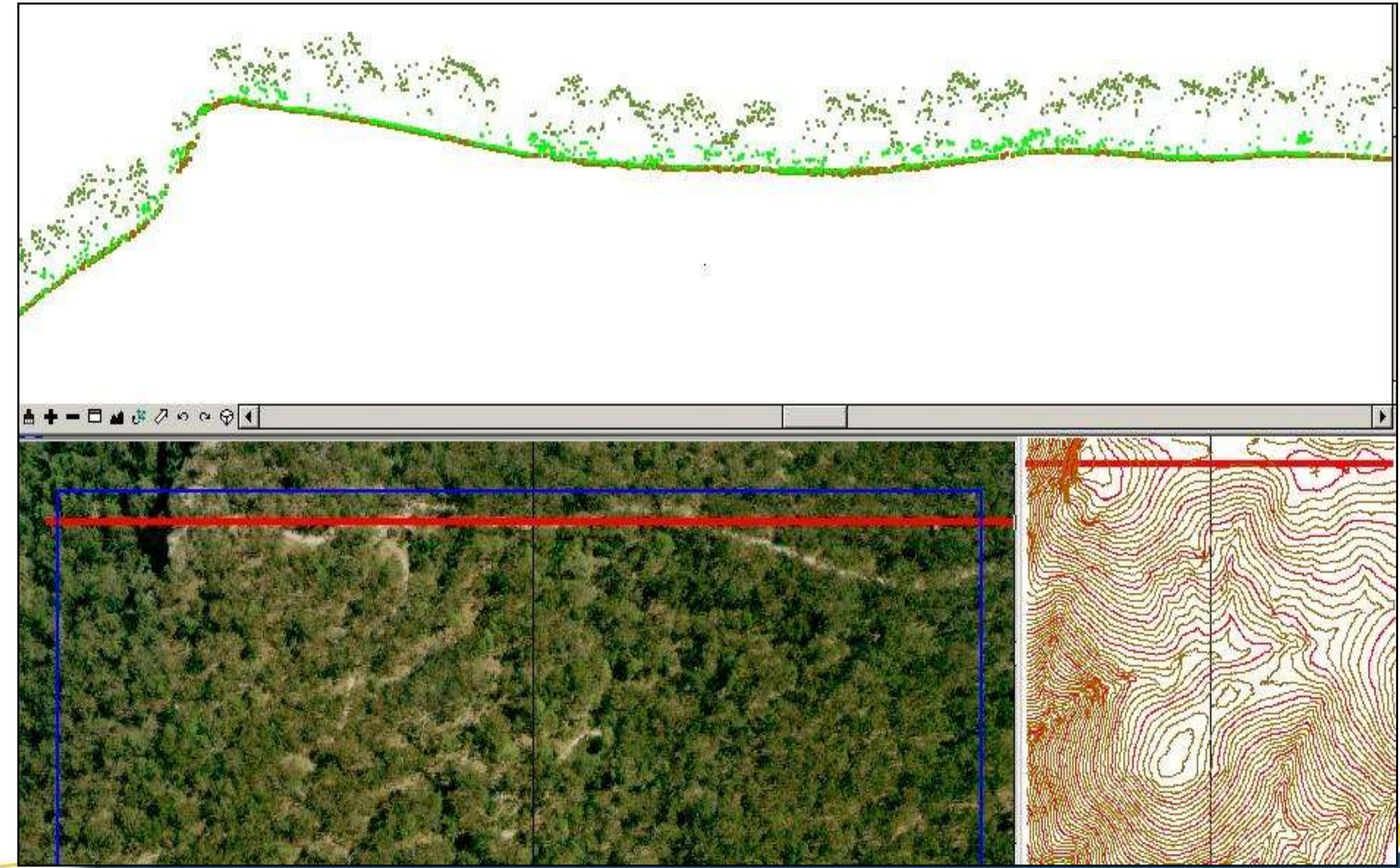
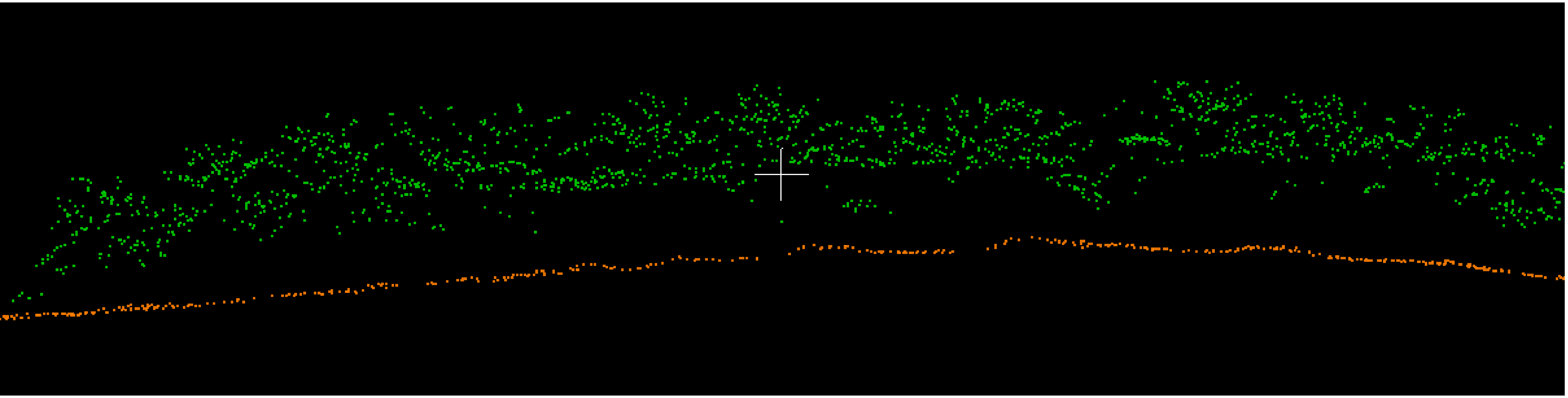
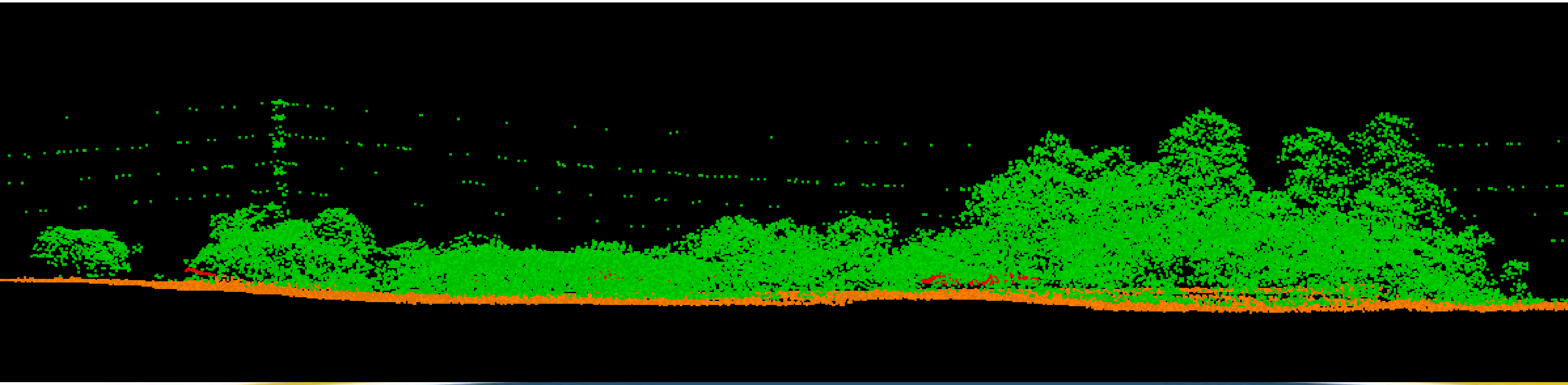
Real LiDAR Data



Vegetation Profile from LiDAR Data

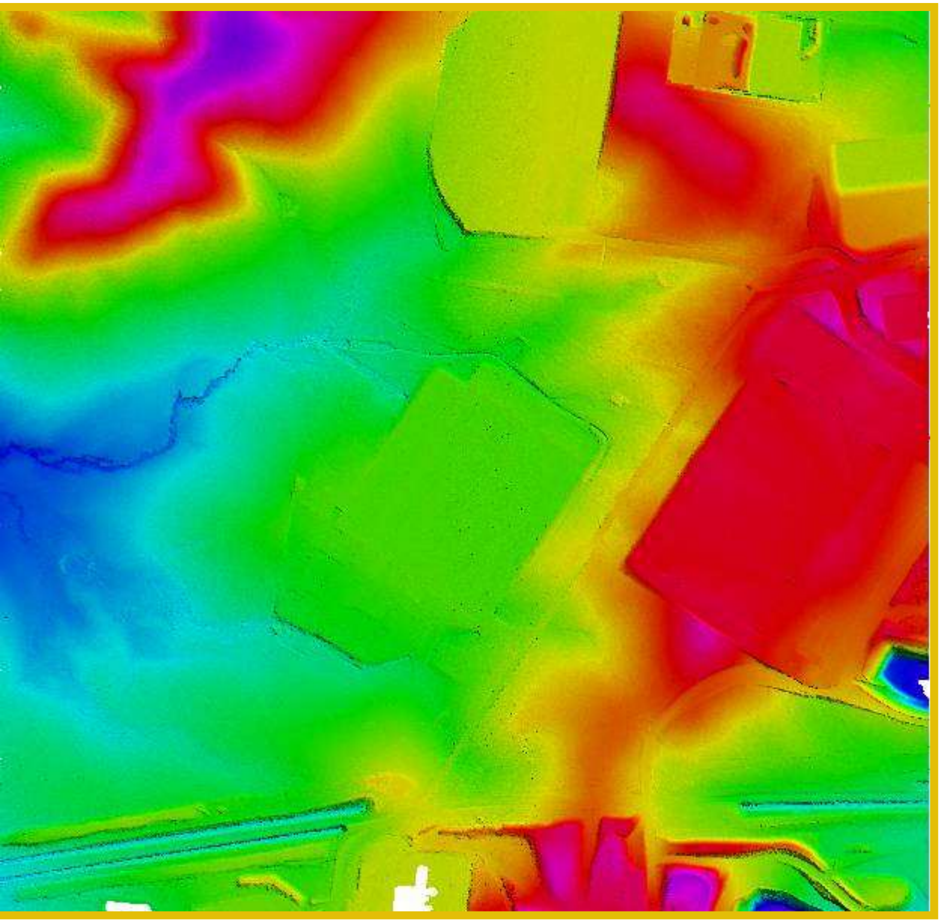


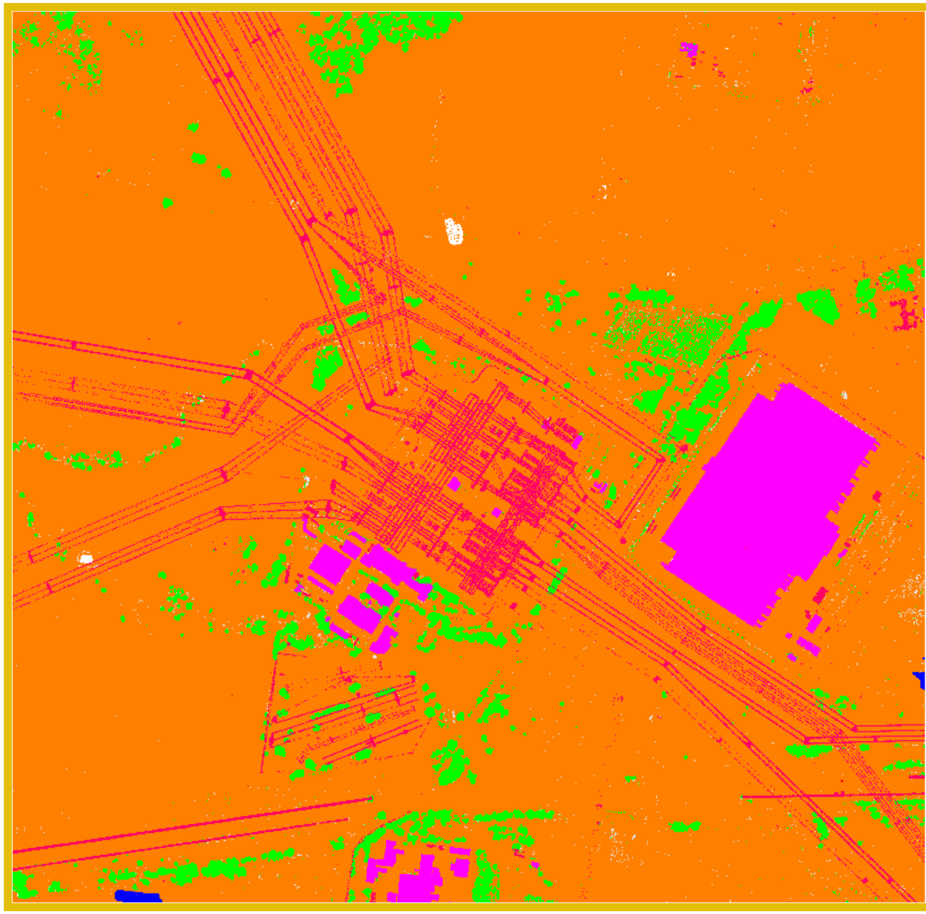
Oil Palm

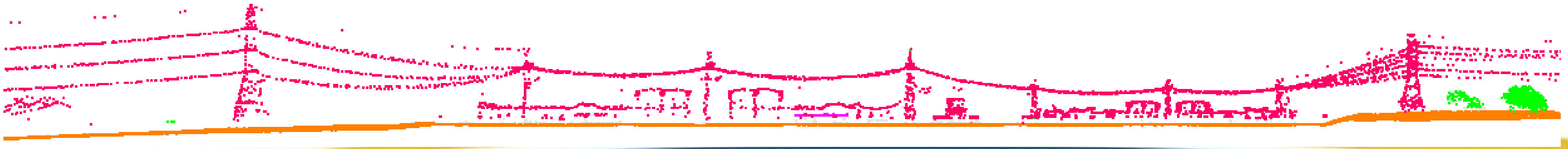


Secondary Forest

LiDAR Terrain, Surface and Point Cloud

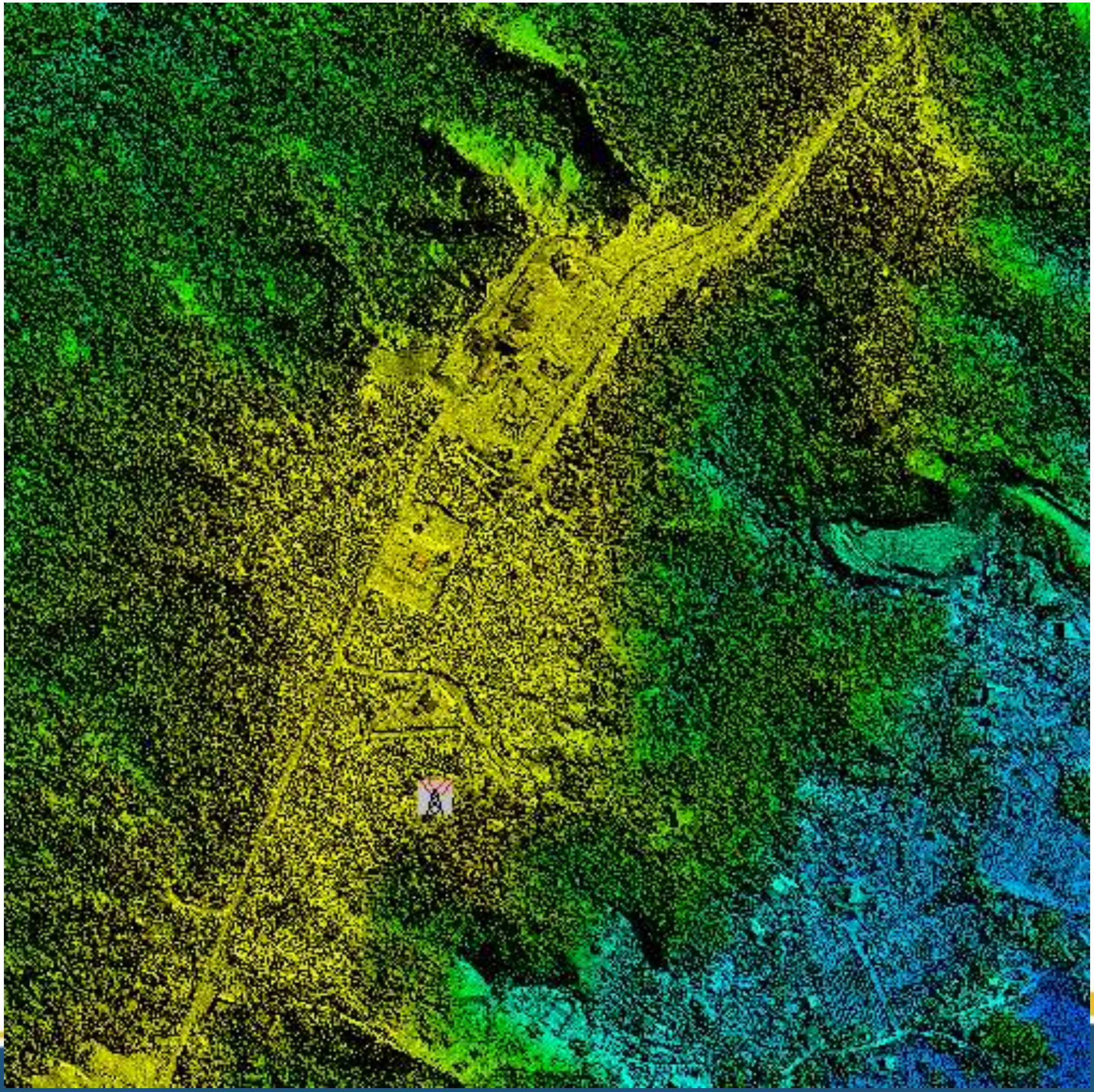




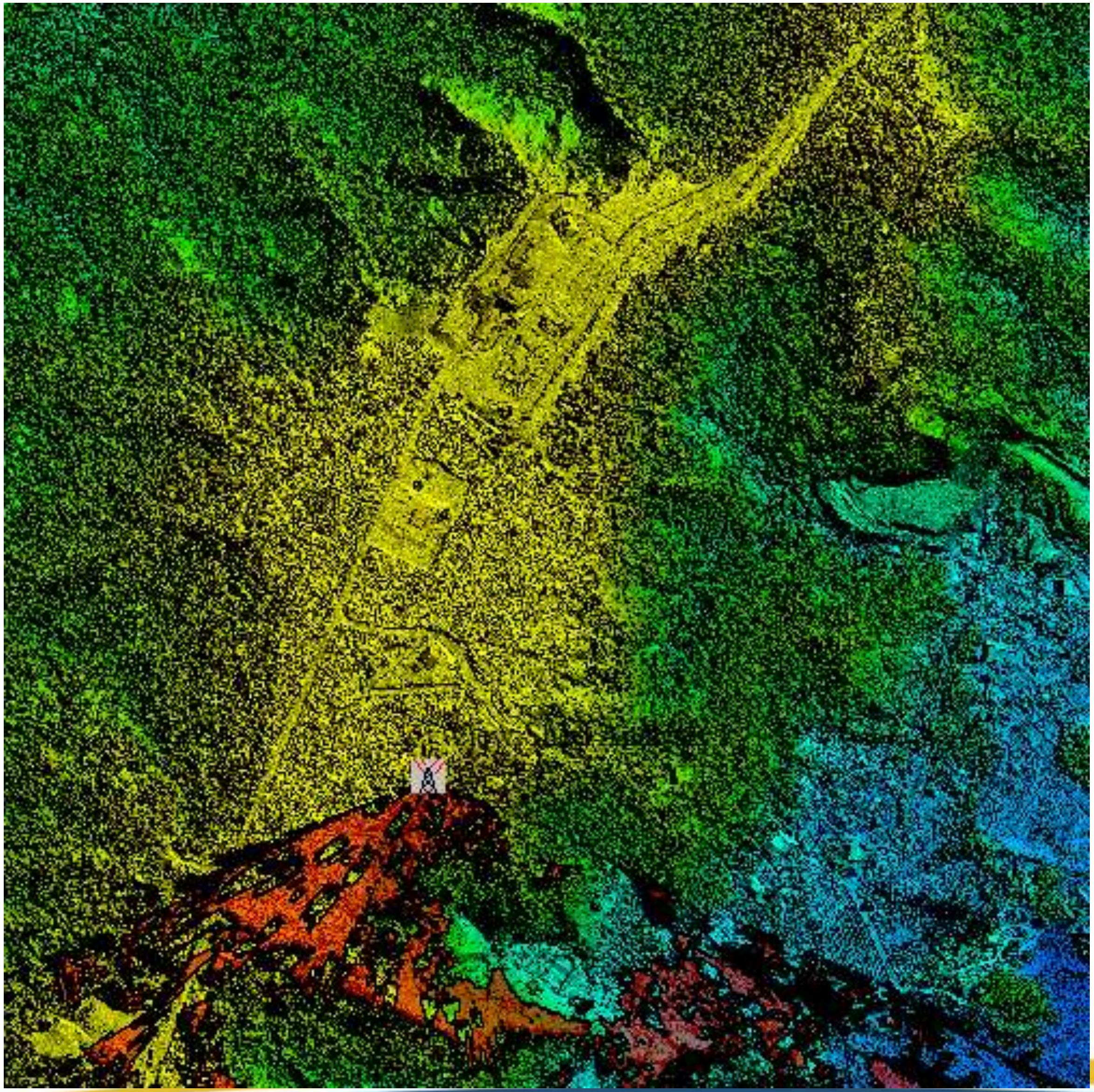


COLOUR INTENSITY MAP 2D VIEW

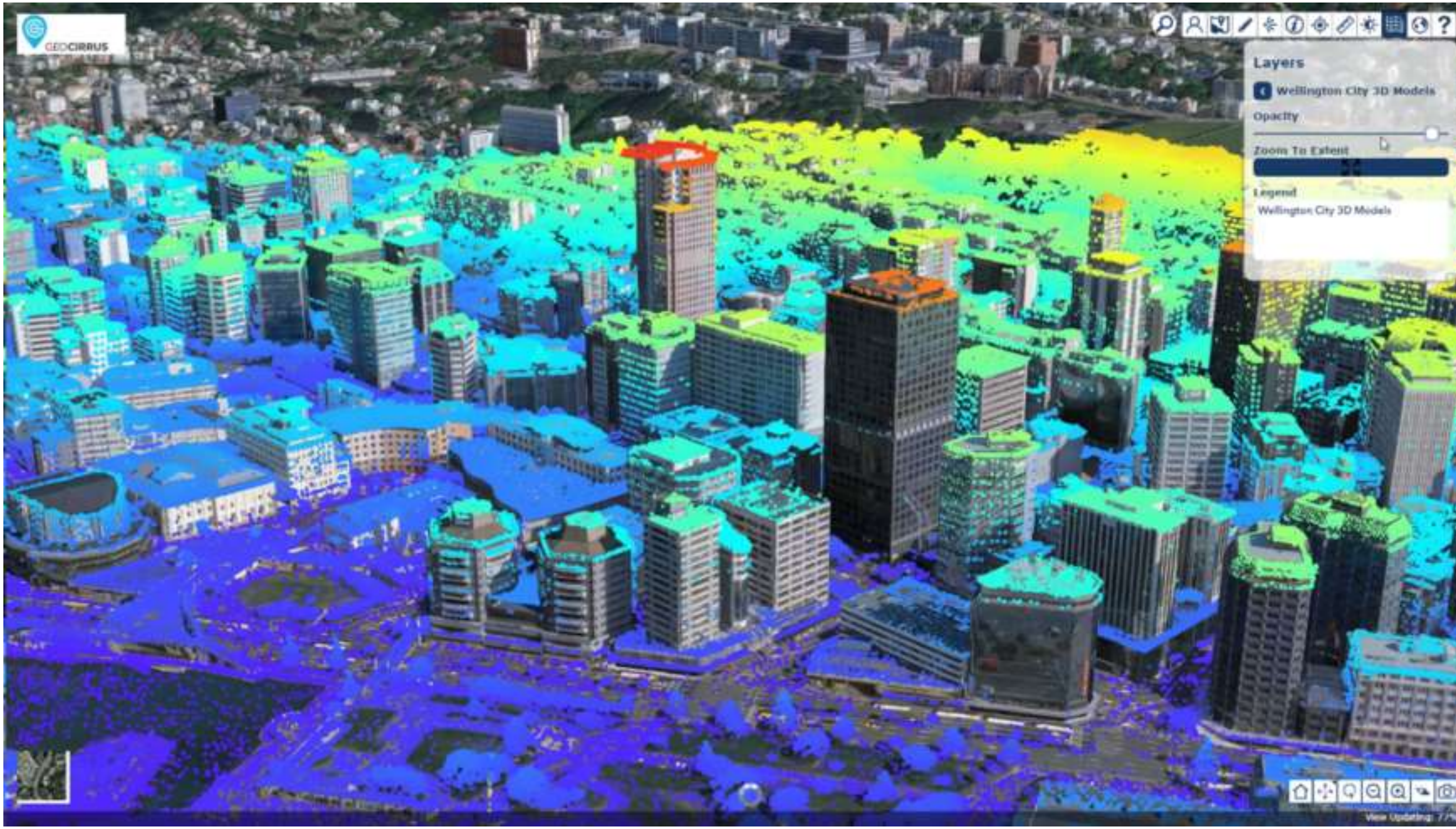
DSM



VIEWSHED ANALYSIS

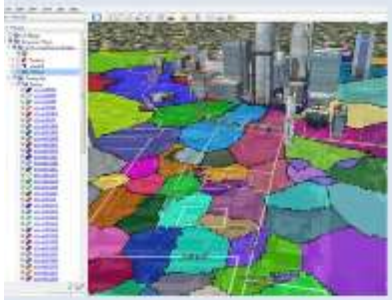


3D City Models from LiDAR Point Cloud



Applications for Telecom Networks

Radio Network Planning



- Planning of optimal tower locations :
  - 3D City Models
  - Survey for new locations
  - Accurate data for Radio Network Planning

Asset Registry

- Maintenance of asset registry for assets spread in multiple locations
- Optimization of capex costs during expansion planning

Operations & Maintenance

- View health, capacity of infrastructure
- Optimal deployment of resources to maintain geographically spread assets
- Total lifecycle cost analysis for each individual asset

Sales Force

- Feasibility studies for new connections
- Customer acquisition with geographically targeted marketing
- Customer service level analysis

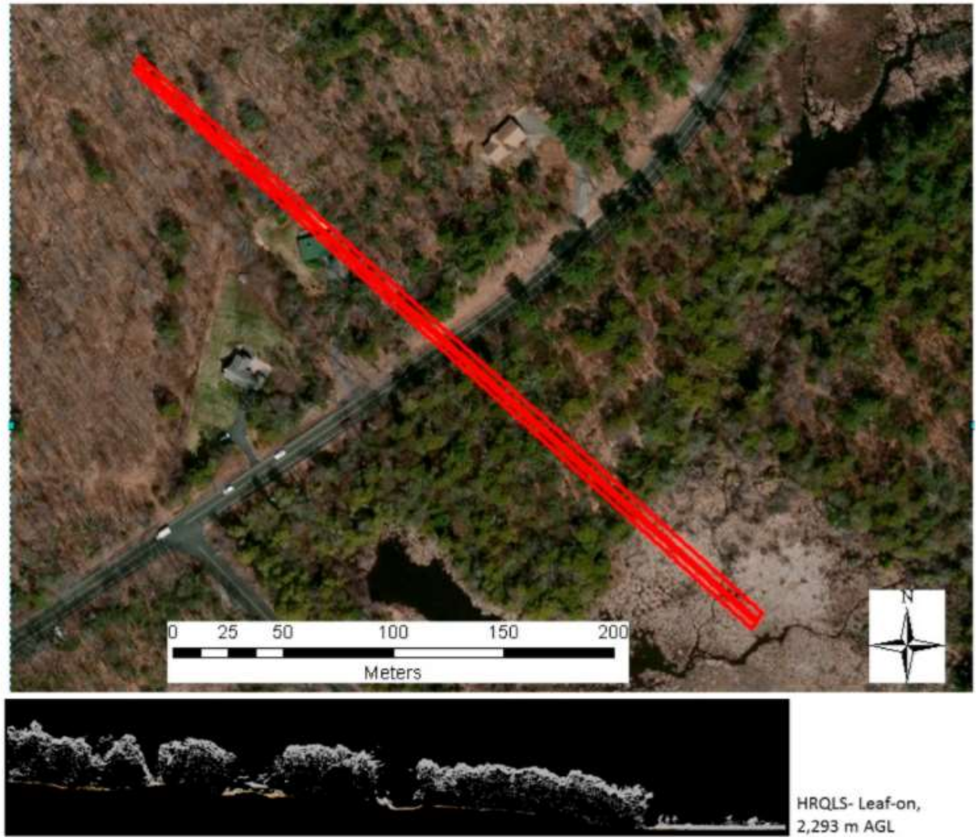
Applications for Telecom Networks

Datasets produced from LiDAR can be used to:

- Determine suitable locations for network towers
- Feasibility analysis of construction
  - Proximity to roads
  - Slope and cut / fill calculations
  - Constructing access tracks to towers
- Mesh network analysis

Applications for Telecom Networks

- Cross sections and Line of Sight Analysis



Applications for Telecom Networks

Wireless Infrastructure Services
- Tower Mapping and Audits
- Structural Mapping
- Site Closeouts
- Asset Management
- 1-A and 2-C Certifications
- Boundary and Topo Surveys
- Pre-Construction Mapping
- As-Built Mapping
- Ground Audits
- Rooftop Audits
- Construction Staking
- Remote Sensing for Survey, Mapping, and Inspection
- 3D Point Clouds
- HD Imagery
- Make Ready and Pole Attachment Services for Small Cell Deployment
- Subsurface Utility Engineering for Fiber Transport Planning

Fiber and Wireline Services
- Route Study and Mapping
- New Build
- Network Extensions
- Network Upgrades
- Joint Use Inventory
- Point-of-Attachment Surveys
- Linear Network Mapping
- Full Topographic Mapping
- As-Built Surveys
- Service Area Maps
- Clearance and Safety Inspections