

# **LARGE AREA UAV LiDAR MAPPING: Trinity F90+ with Qube 240 Payload**

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**Business Development**  
**Drones & Geomatics**

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<https://drones.measur.ca>



# Our Learning Checklist

What we'll cover in this presentation

**01** Trinity F90+ Overview

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**02** Qube 240/ LiDAR Overview

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**03** Qbase 3D Mission Planning

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**04** Processing workflow  
- Applanix POSPac  
- YellowScan CloudStation

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**05** Case Studies

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**06** In The Box/Pricing

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# About Measur

Calgary

Burnaby

Toronto

Montreal

DRONES  
GEOMATICS  
MATERIALS TESTING



## SERVICE

We offer fast turnaround on all repairs with parts in stock and emergency repairs are accepted anytime. We repair brands from all manufacturers.



## SUPPORT

Professional, Reliable and Efficient Technical Support is the foundation of our business. Our technical support is always free.



## DEMOS

Want to see the product before purchasing? Measur offers comprehensive field demos for all of our products.



# About Quantum Systems

- Founded in 2015 Germany
- eVTOL Fixed-Wing Drones
- 80+ employees
- Self-developed flight planning software
- Self-developed autopilot software





# Quantum Systems Trinity F90+ and Its benefits

# Vertical Take-off and Land

Take-off in confined or difficult to reach spaces (forest service roads, mines, etc.)

- No belly landings
- No tipping on take-off or land
- Take-off from transport case or ground
- Hand catch possible





# Flight Time

- 90+ minutes of flight-time
- 60 minutes of flight-time with Qube 240 LiDAR payload

## Area In One Flight

- Qube 240 LiDAR: 200 Ha + @ 100m AGL (50 Side overlap)
- RX1RII (42 MP): 170 Ha + @ 120m AGL (75/75 overlap – 1.55 cm/px GSD)
- Sony UMC (20 MP): 230 Ha+ @ 120m AGL (75/75 overlap – 3.19 cm/px GSD)

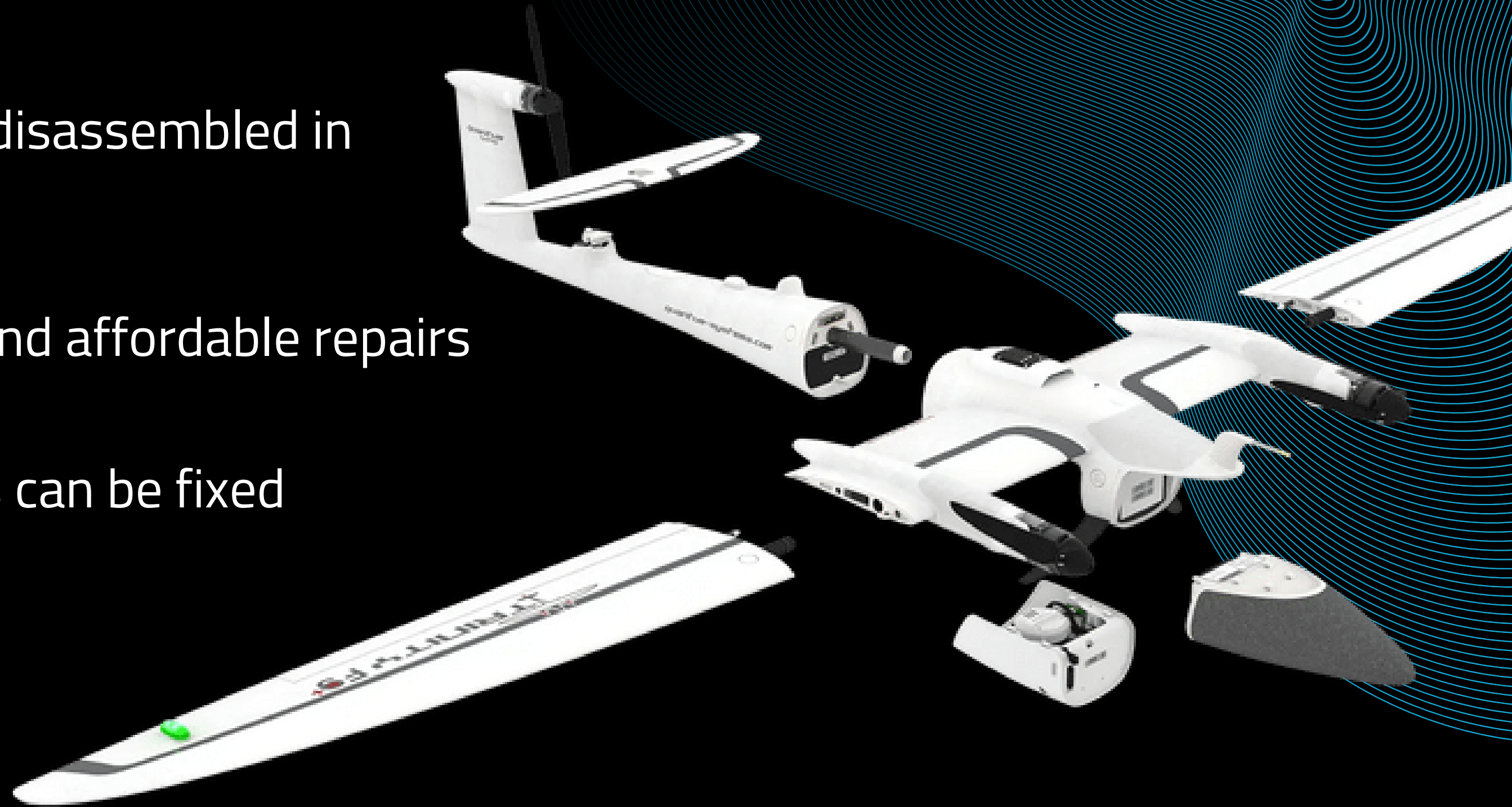


## Weather

- 9 m/s on take-off
  - 12 m/s during cruise mode
  - -12 to 40 C operating temperature
- (Cold weather testing in progress)

# Modular

- 01** Easily assembled/disassembled in under a minute
- 02** Modular for easy and affordable repairs
- 03** Replacement parts can be fixed in the field





# Best In-class Sensor Capabilities



## RGB

- Sony RX1RII (42 MP)
- Sony UMC (20 MP)

## Multispectral

- Micasense RedEdge-MX
- Micasense Altum
- Micasense RedEdge Dual
- RedEdge-MX + Sony UMC
- Micasense RedEdge-P (coming soon)
- Micasense Altum-PT (coming soon)

## Thermal

- FLIR Tau 2 + Sony UMC

## LiDAR

- Qube 240

# iBase GNSS Base Station




- Included with every Trinity F90+ at no extra cost
- Can be used to PPK process every Trinity F90+ payload (including Qube 240)
- L1/L2/L5
- GPS/GLONASS/GALILEO
- 10H on a single charge



\*For best accuracy place iBase over known pin or NRCAN PPP raw base data (Canada)

Qube 240 and all Trinity F90+ Payloads can be PPK'd through third-party base stations (Stonex, Trimble, Leica, Topcon, etc.)



	 <p>Quantum Systems Trinity F90+</p>	 <p>Competitor #1</p>	 <p>Competitor #2</p>
Take-off & Landing	<p>VTOL take-off in tight spaces</p>	<p>VTOL take-off in tight spaces</p>	<p>Large area needed for take-off and landing</p>
Flight-Time	<p>90+ minutes</p> <p>60 minutes with Qube240 LiDAR</p>	<p>60 minutes</p>	<p>90 minutes</p> <p>(Endurance battery with S.O.D.A camera)</p>
Payloads	<p>Sony RX1RII 42 MP</p> <p>Sony UMC 20 MP</p> <p>Micasense RedEdge-MX</p> <p>Micasese Altum</p> <p>Micasense Dual</p> <p>Dual Rededge-MX + UMC</p> <p>Qube 240 LiDAR</p> <p>Flir Tau 2 +UMC (Coming Soon)</p> <p>Micasense Altum (Coming Soon)</p>	<p>Sony RX1RII 42 MP</p> <p>Sony a6100</p> <p>Micasese RedEdge-MX</p> <p>Micasense Altum</p> <p>Micasense Dual</p>	<p>S.O.D.A</p> <p>S.O.D.A 3D</p> <p>Duet T</p> <p>Aeria X</p> <p>Duet M</p> <p>Sequoi+</p> <p>RedEdge-MX</p>
Modular Design	<p>Yes</p>	<p>No</p>	<p>Yes</p>
Remote Control	<p>Included. Assited RC control at all times for maximum safety</p>	<p>No. Virtual joysticks on tablet</p>	<p>Optional</p>
PPK	<p>Yes, standard with all packages</p>	<p>Yes, optional add-on</p>	<p>Yes, optional add-on</p>
ADS-B	<p>Yes, ADS-B IN included. ADS-B OUT optional add-on</p>	<p>No</p>	<p>Optional USB ping</p>
Base Station	<p>iBase GNSS reference station included.</p> <p>Third-Party GNSS compatible.</p>	<p>Third-party GNSS compatible</p>	<p>Third-party GNSS compatible</p>





# YellowScan LiDAR Partnership

**YellowScan**



**YellowScan Mapper+**



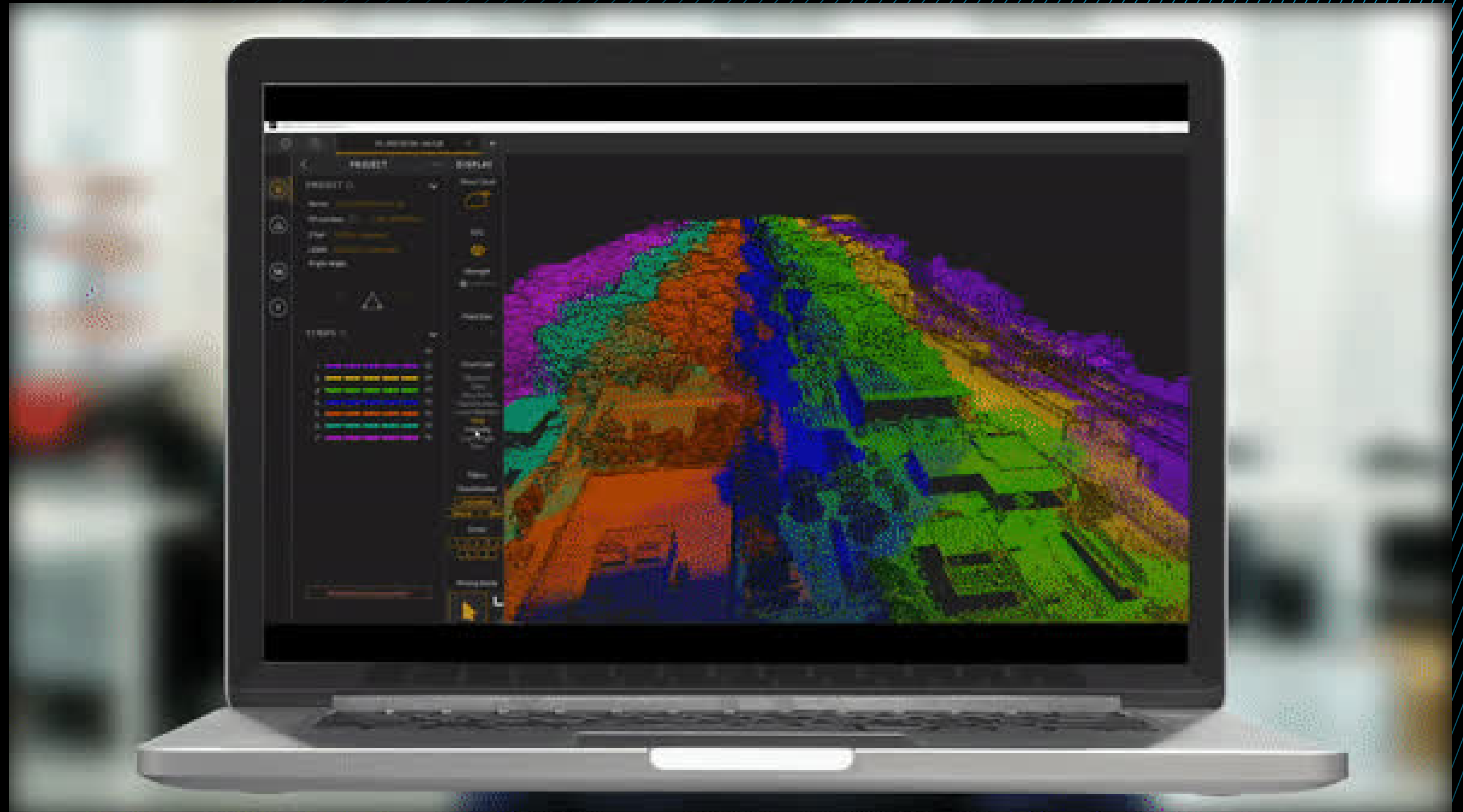
**Qube 240**

The Qube 240 was created in partnership with YellowScan. It is an OEM'd version of the Mapper+ to reduce weight and revise ventilation for use in the Trinity F90+.

# Why LiDAR?

LiDAR is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.

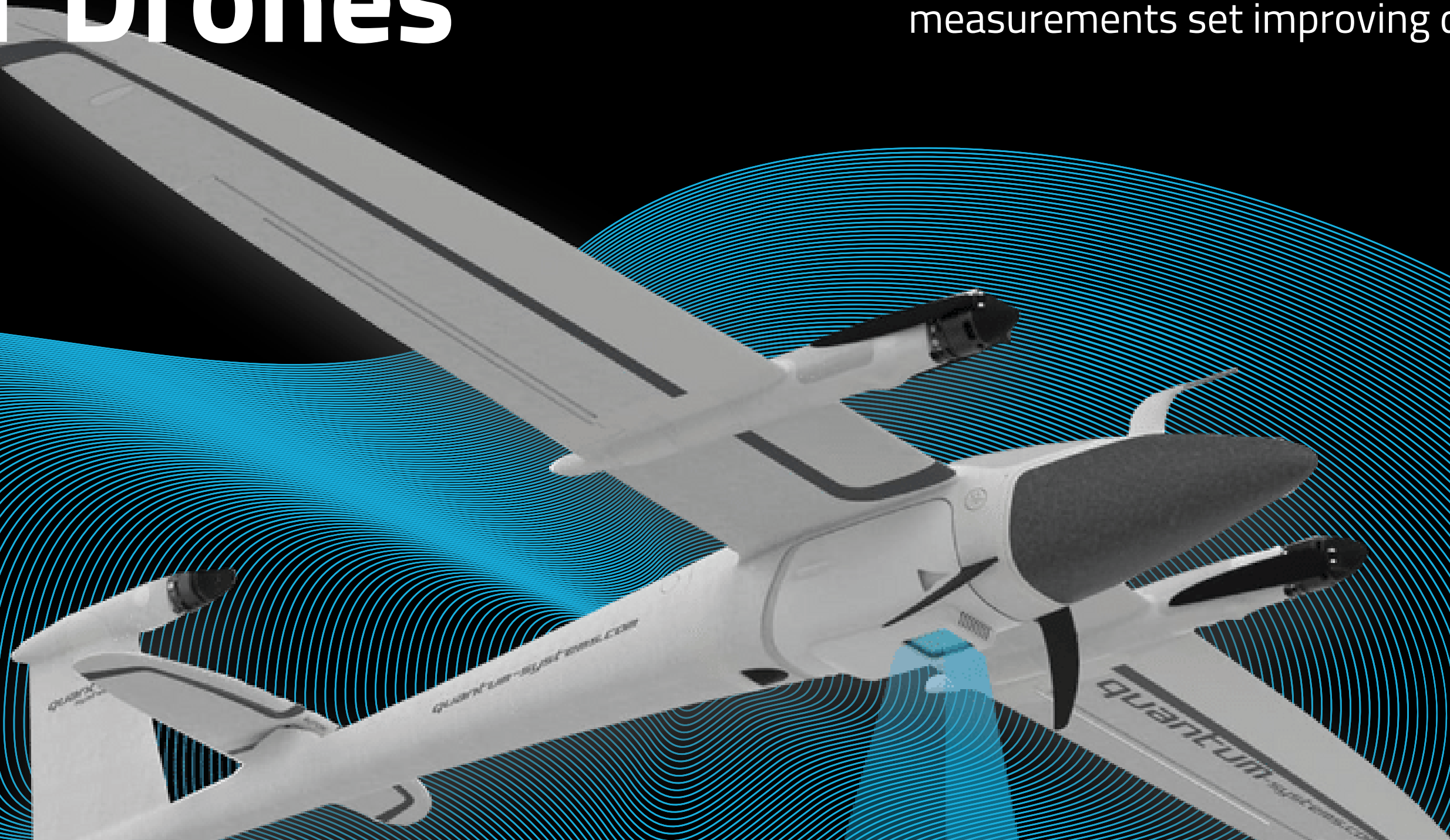
- High vertical accuracy in areas with dense vegetation
- Accurate terrain models in areas with vegetation
- Beneficial on sites with low visibility or poor lighting conditions
- Capture details small in diameter (power lines, etc.)
- Faster processing time
- Map non-linear areas due to larger FOV





# Fixed-Wing Drones vs. Multi- Rotor Drones

- More area coverage
- Straighter flight lines
- Smooth turns (no stops) keep IMU initialized and minimize risk of IMU drift
- Non-gimbal mount keeps lever arm measurements set improving data quality





# LiDAR Specs

- Livox Avia Sensor
- 70.4° Horizontal Field of View
- 240,000 pts/s
- 3 Echoes
- Applanix APX-15 UAV GNSS-Inertial solution



## Typical Mapping Accuracy

± 2 CM Precision

± 3 CM Accuracy

1) Precision (reproducibility or repeatability), accounts for the variation in successive measurements taken on the same target. Here precision value is obtained by averaging the precision from 3 flight levels @60, 90 and 120 m AGL. At each flight level, the precision is considered as the mean value of absolute elevation differences between 2 flight lines recorded in opposite directions over a nadir-located 40m<sup>2</sup> hard surface area.

(2) Accuracy is the degree of conformity of a measured position to its actual (true) value. Here accuracy value is obtained by averaging the accuracy from 3 flight levels @ 60, 90 and 120mAGL. At each flight level, the accuracy is considered as the RMSE value of the elevation differences between targets and the point cloud extracted from 2 flight lines recorded in opposite directions. Validation targets are located within a 40m wide corridor centered along the flight line axis.

# Why Integrate LIVOX AVIA?

## Fixed-State LiDAR

Because the AVIA is not a rotating puck, you can get a high point density while flying at higher speeds due to the fixed-state sensor with narrow FOV.

## Applanix APX-15 INS Integrated

- IMU Precision: 0.025 degree (roll, pitch)

## Recommendations

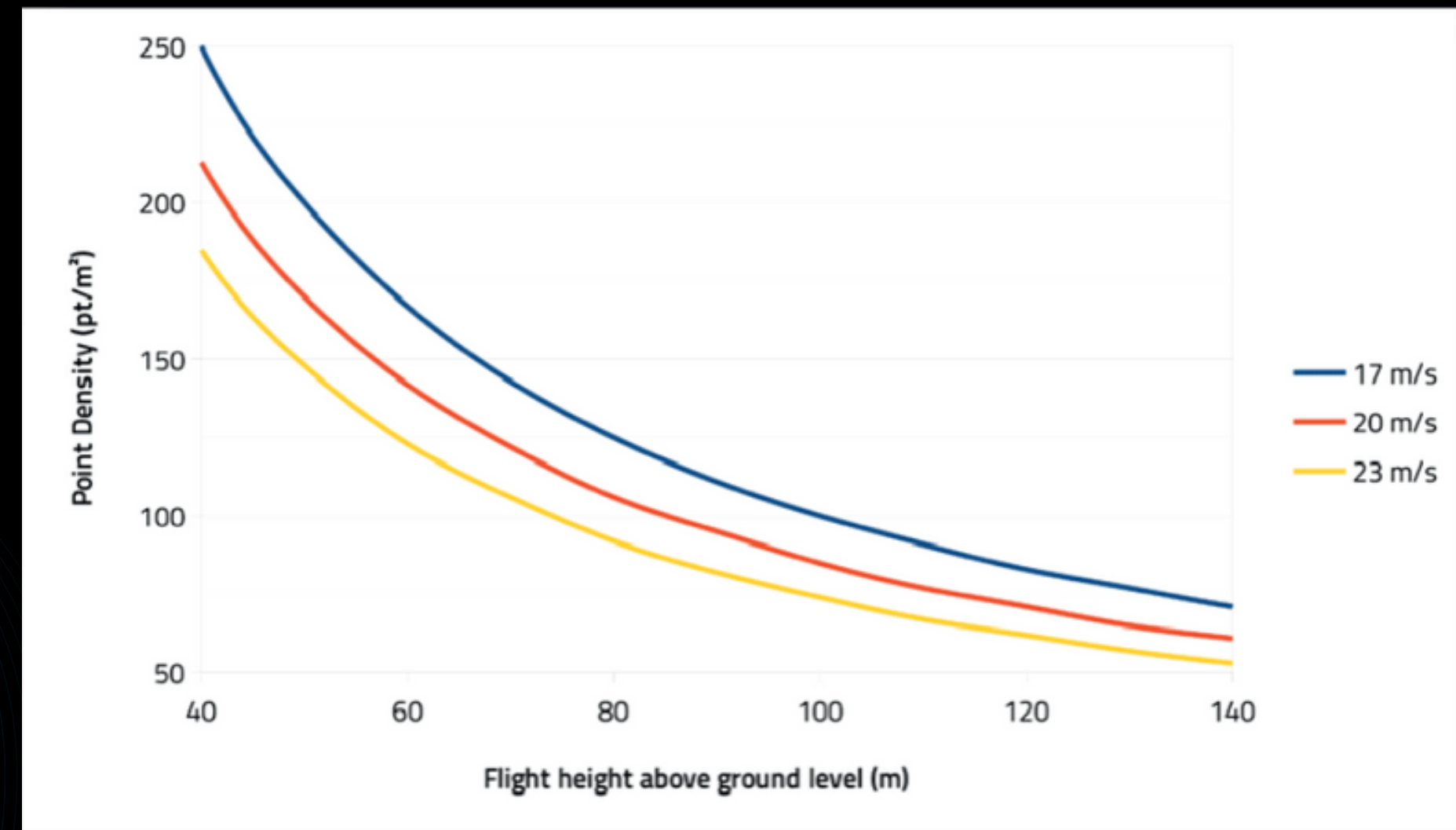
- 50% overlap
- 100m AGL



*Please note that the Qube 240 is only compatible with the Trinity F90+*

# Point Density By Ground Speed and Altitude

- FOV of [Qube 240](#) is  $70.4^{\circ}$
- Swath is approximately 1.4 times flying height
- Be careful of headwind or tailwind
- Vegetation, slope, reflectivity all affect this





# One-Button Operation

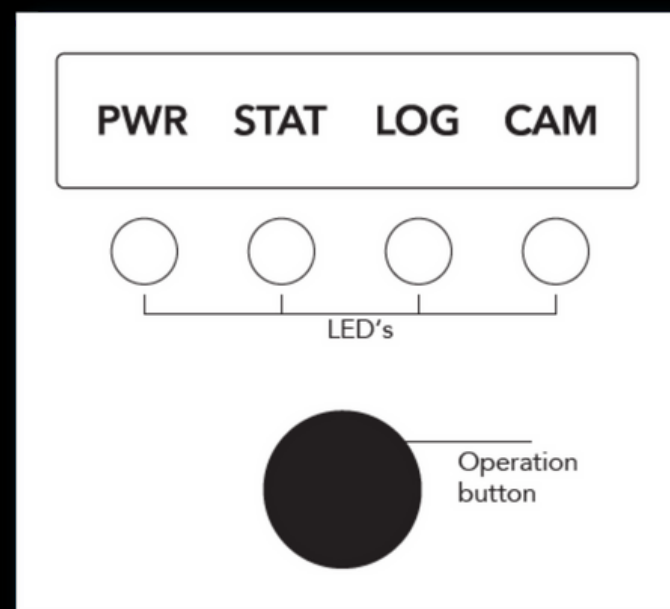
**PWR:** Power indicator

**STAT:** **Still Green** when IMU is synchronized and enough satellites are visible

**LOG:** Flashes when acquisition started  
(**Green** if space >30 GB)

**CAM:** Not relevant to Qube 240

**Operation Button:** quick press to start/stop recording.



# Workflow

## Flight Plan

- Qbase 3D Flight Planning Software (FREE)
- Custom DEM import
- 3D View
- KML import
- Advanced terrain following features

## Data Capture

- One-button operation on Qube 240
- VTOL Trinity F90+ for difficult areas
- 60 minutes of flight-time
- All data stored on USB drive

## Process Data

- Applanix POSPac for Georeferencing
- PPK from GNSS base station, PPRTX, and more
- CloudStation for strip adjustment, classification, and more
- Drag & drop
- User friendly & intuitive

## Output

- Through YellowScan CloudStation
- Output LAS/LAZ
- Terrain Model Export (DTM, DSM, DHM, Hillshade)
- Any Coordinate System (NAD83 CSRS – HTv2, etc.)



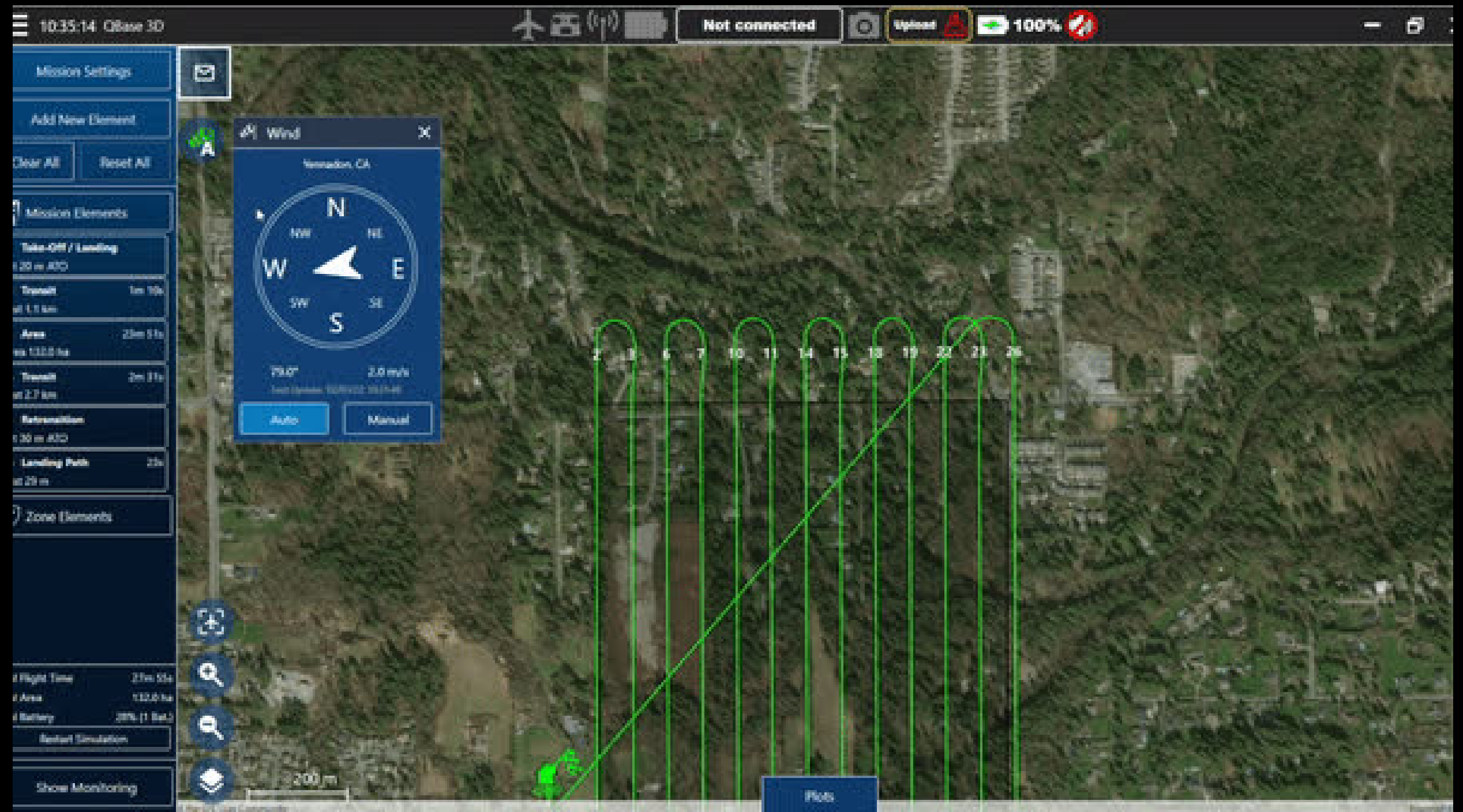
# QBase 3D

mission planning software



# Features

- Windows 10
- No cost
- Unlimited licenses
- Flight planning, flight monitoring, geotagging (except Qube 240)
- Area or corridor mission planning
- 3D view
- Plan "paths" for custom flight missions



# Elevation

- Download elevation data for terrain following
- Custom elevation data import supported

☐ Use Own DEM

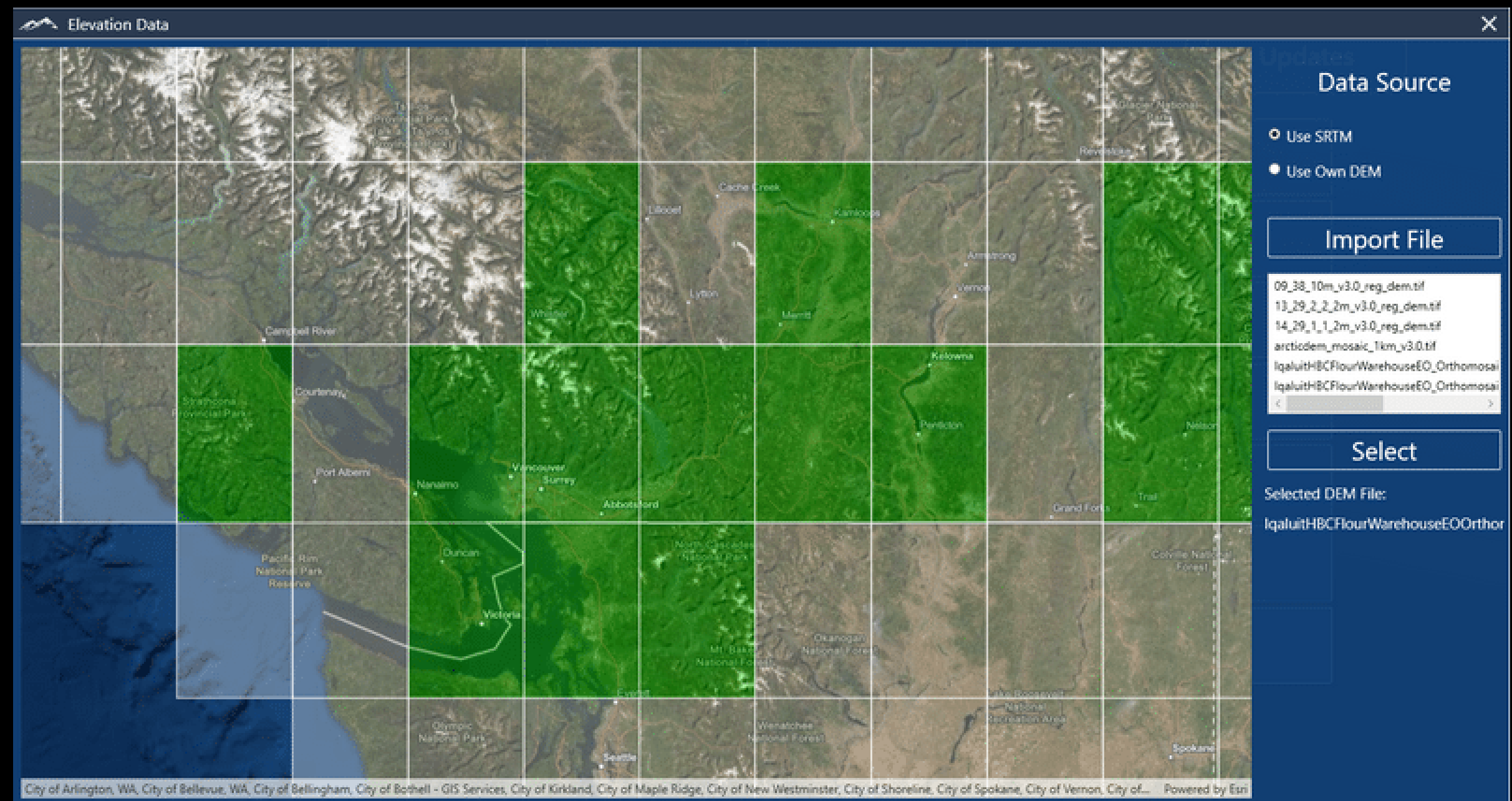
**Import File**

09\_38\_10m\_v3.0\_reg\_dem.tif  
13\_29\_2\_2\_2m\_v3.0\_reg\_dem.tif  
14\_29\_1\_1\_2m\_v3.0\_reg\_dem.tif  
arcticdem\_mosaic\_1km\_v3.0.tif  
IqaluitHBCFlourWarehouseEO\_Orthomosaic.tif  
IqaluitHBCFlourWarehouseEO\_Orthomosaic.tif

**Select**

Selected DEM File:  
IqaluitHBCFlourWarehouseEOOrthor

Import own DEM (TIF  
file, WGS84)



# Elevation

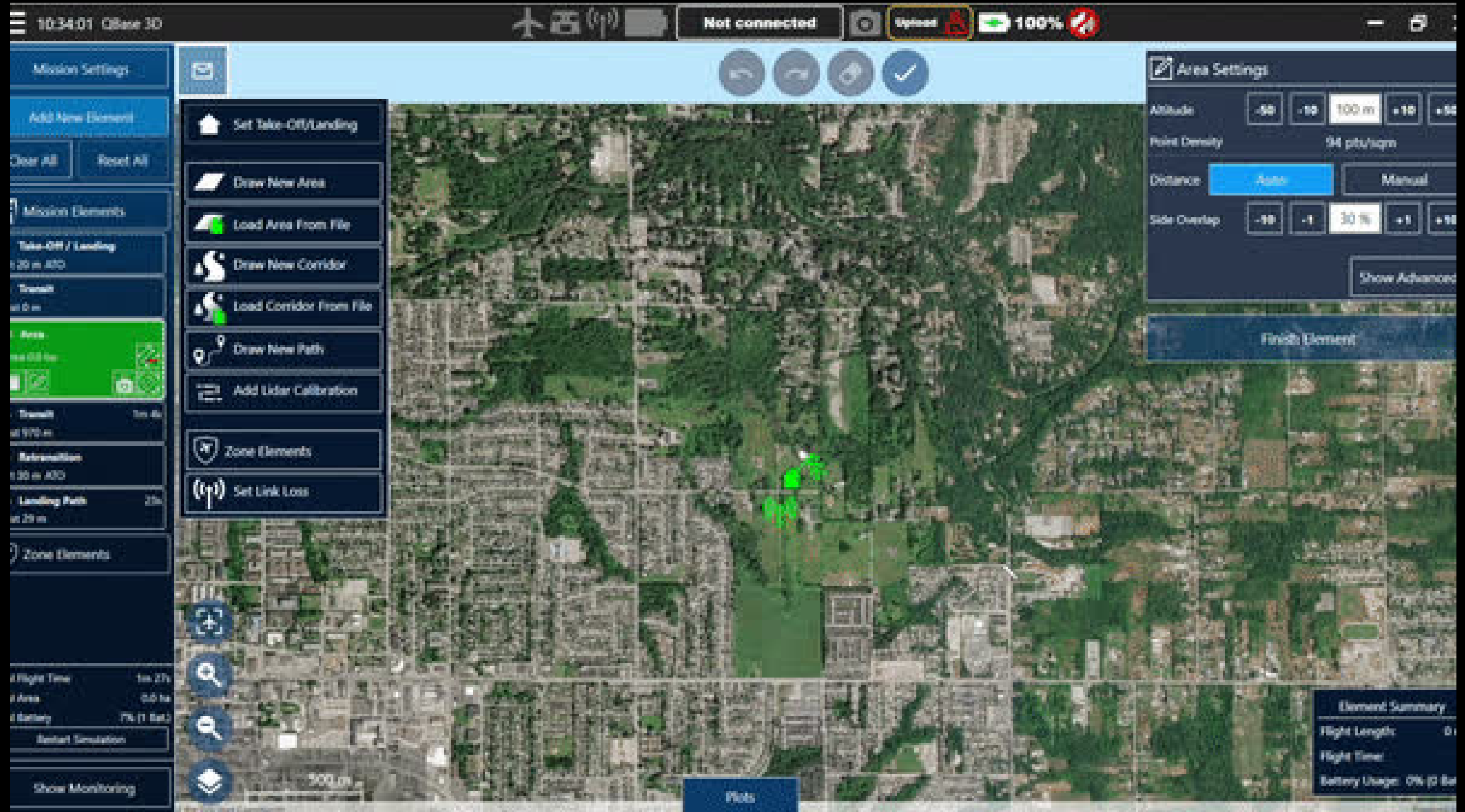
Custom elevation data  
imported for Iqaluit





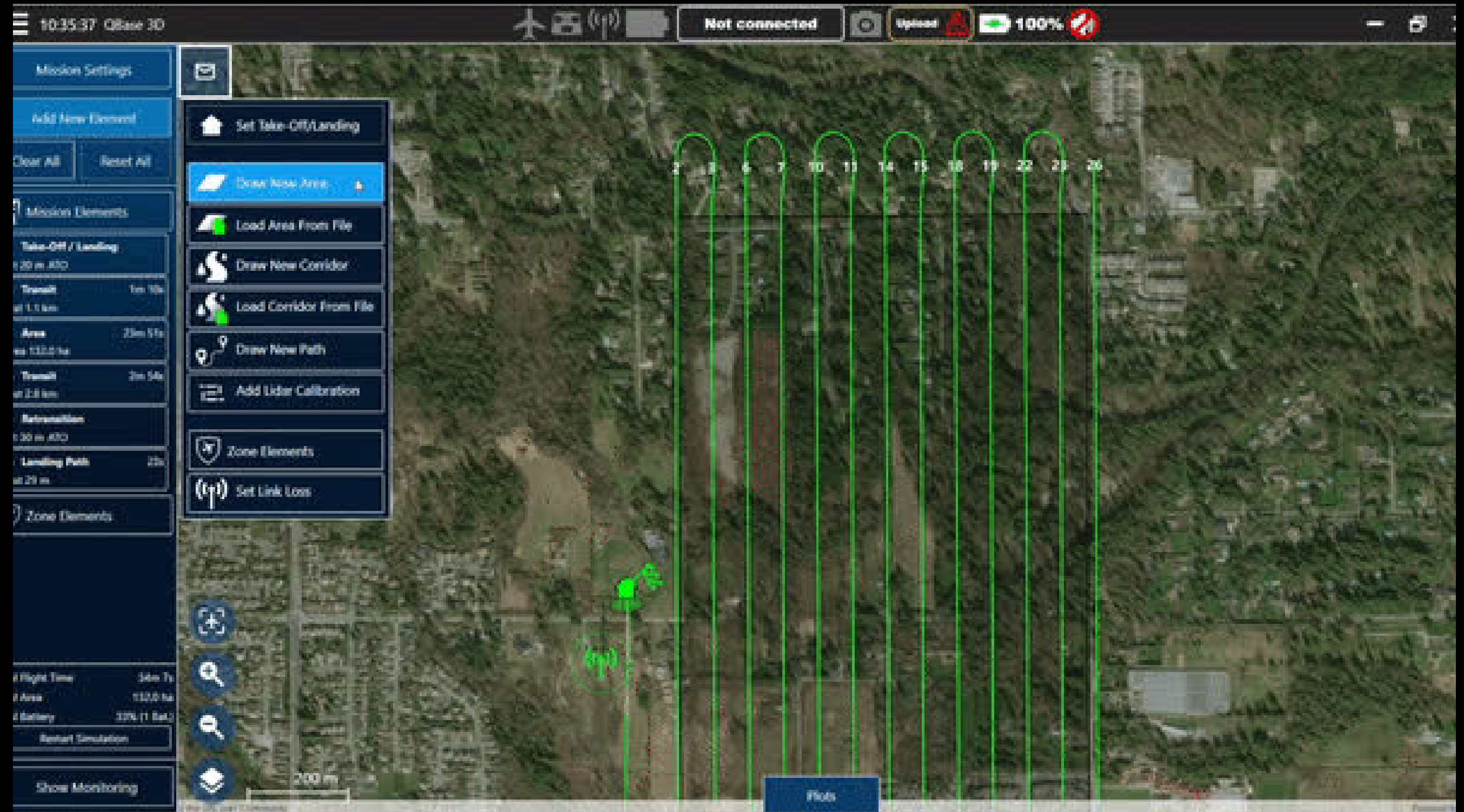
# Area Planning

- .kml or .shp import
- Set entry/exit extensions for optimal line entry
- Terrain following parameters
- "Optimize Leg Sequence" for auto-generated most efficient path



# Calibration Loops

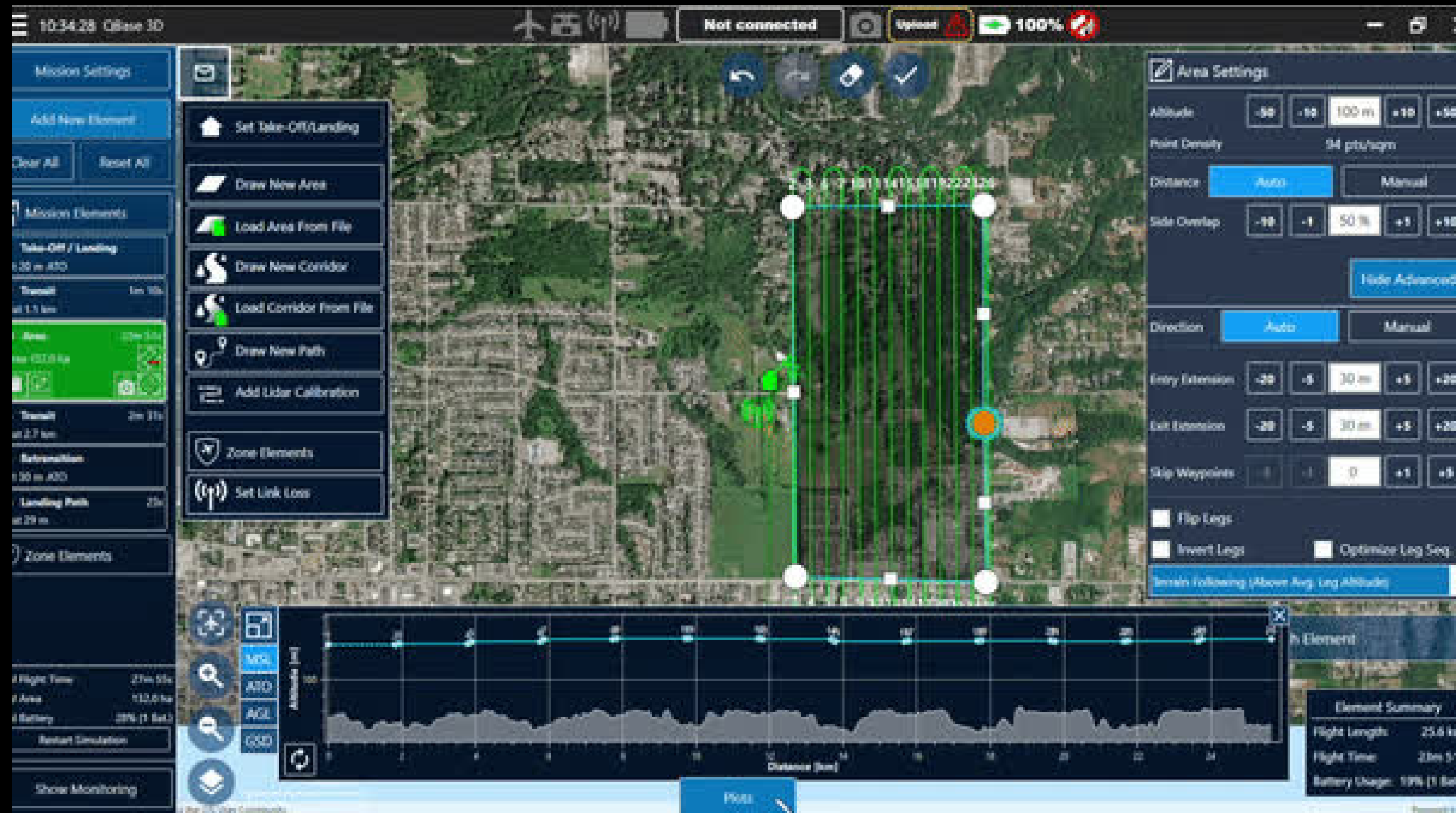
For the IMU to be correctly initialized, it is mandatory for the Trinity F90+ to fly the initialization figure at the beginning AND end of the flight. The main objective is to provide enough acceleration to initiate the IMU.



# Terrain Following

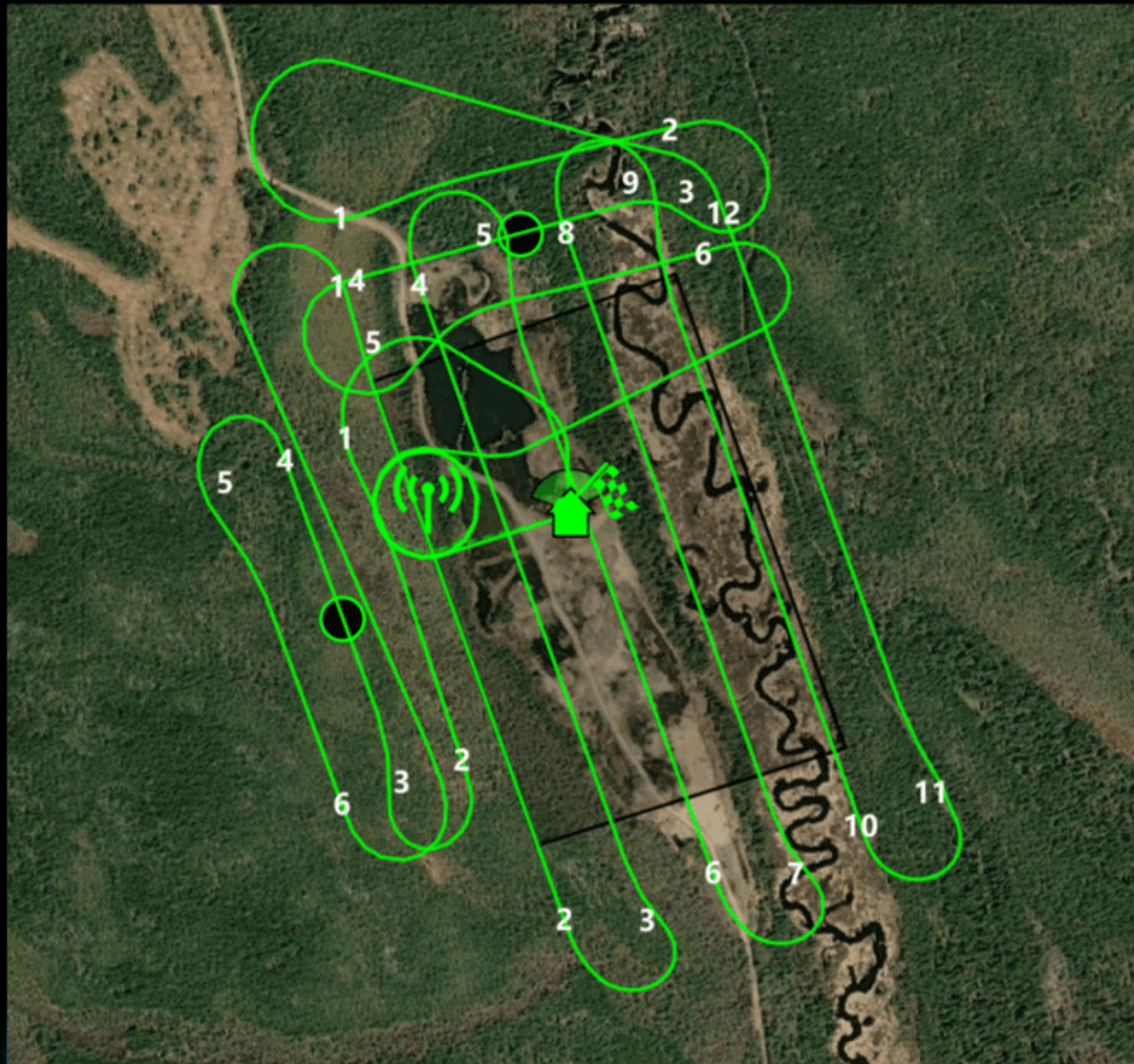
## Different Options:

- Above Max. Area Altitude
- Cross Legs
- Above Avg. Leg Altitude
- Above Max. Leg Altitude
- Advanced Terrain Following

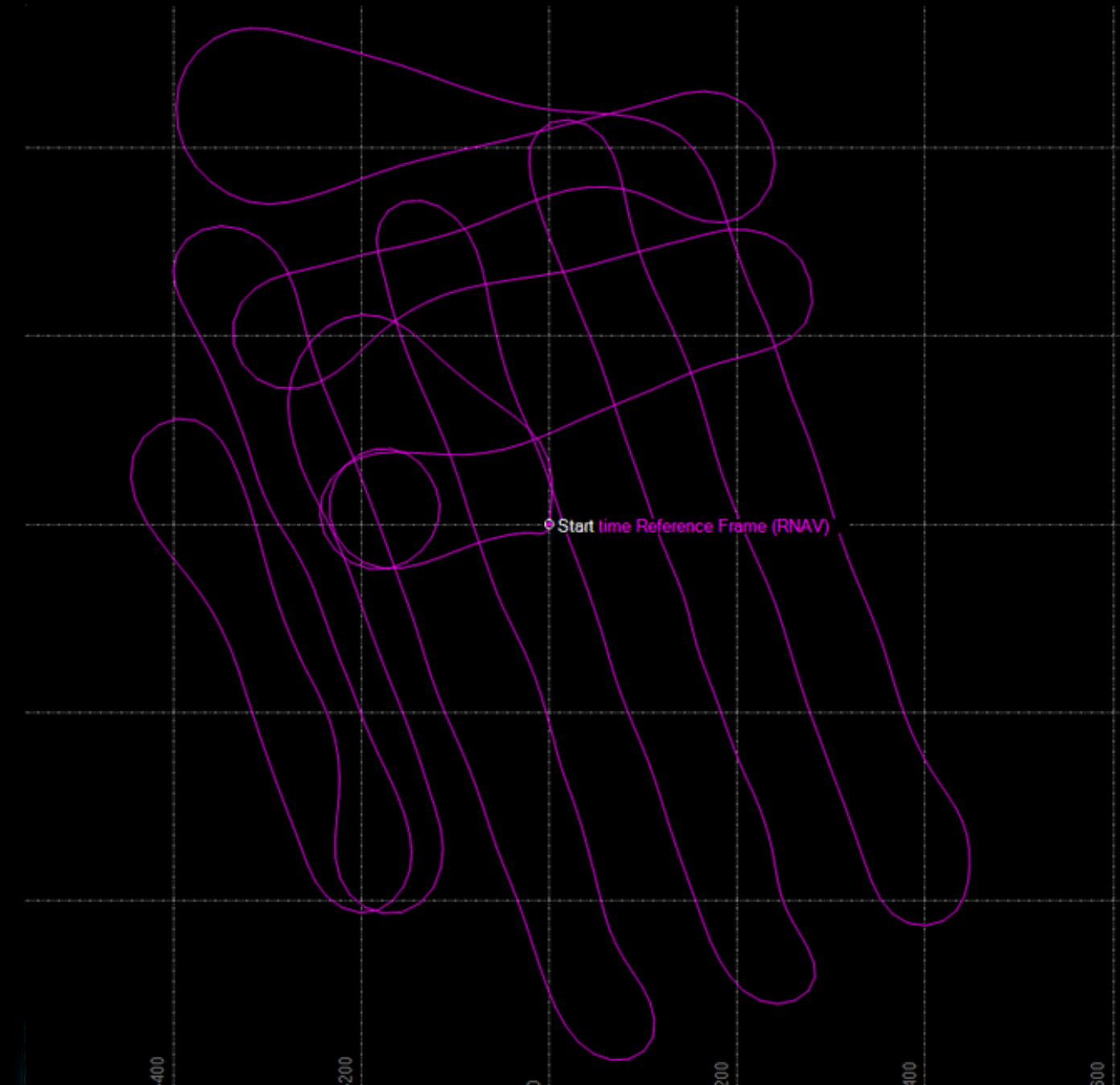




# Qbase Mission Plan Pre-Flight



# Applanix POSPac Recorded Trajectory



quantum  
SPORTS









15:22:51 Office 3D

LANDING

ADP-2

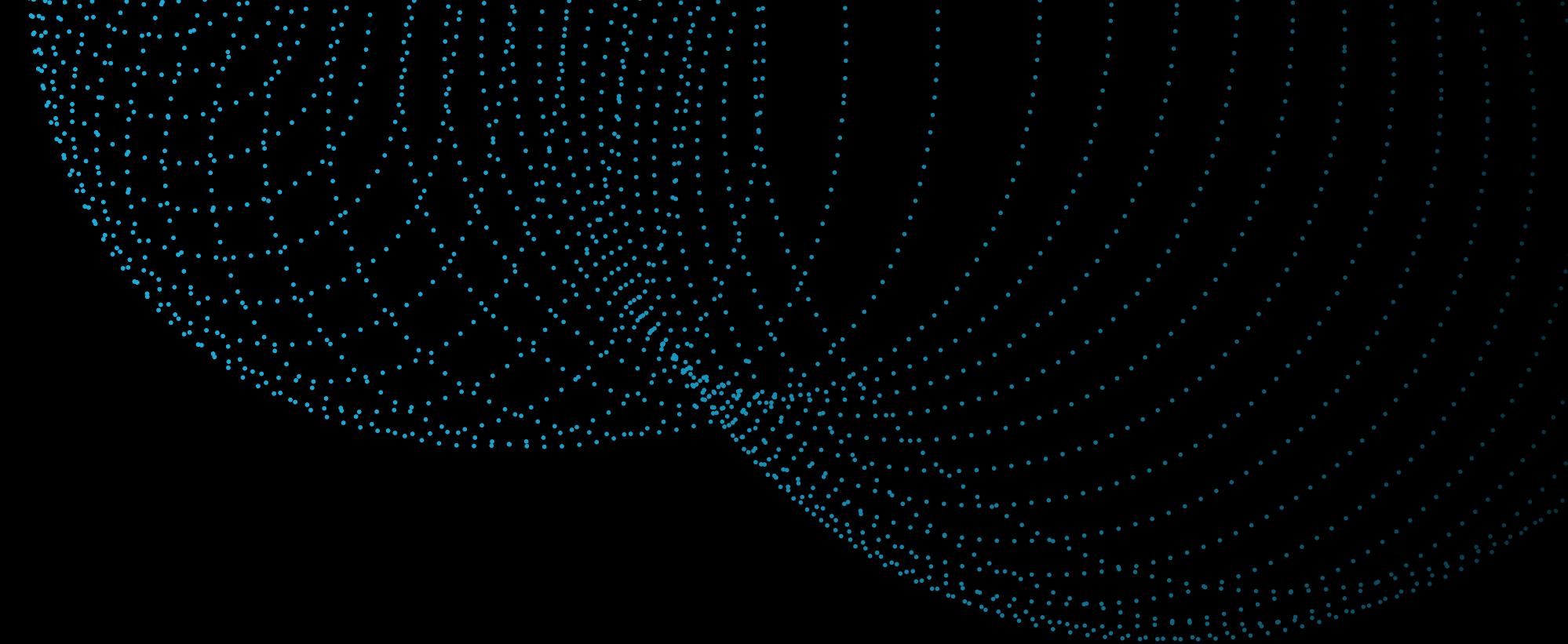
Uploaded




73%

1m 25s

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# Qube 240 Files



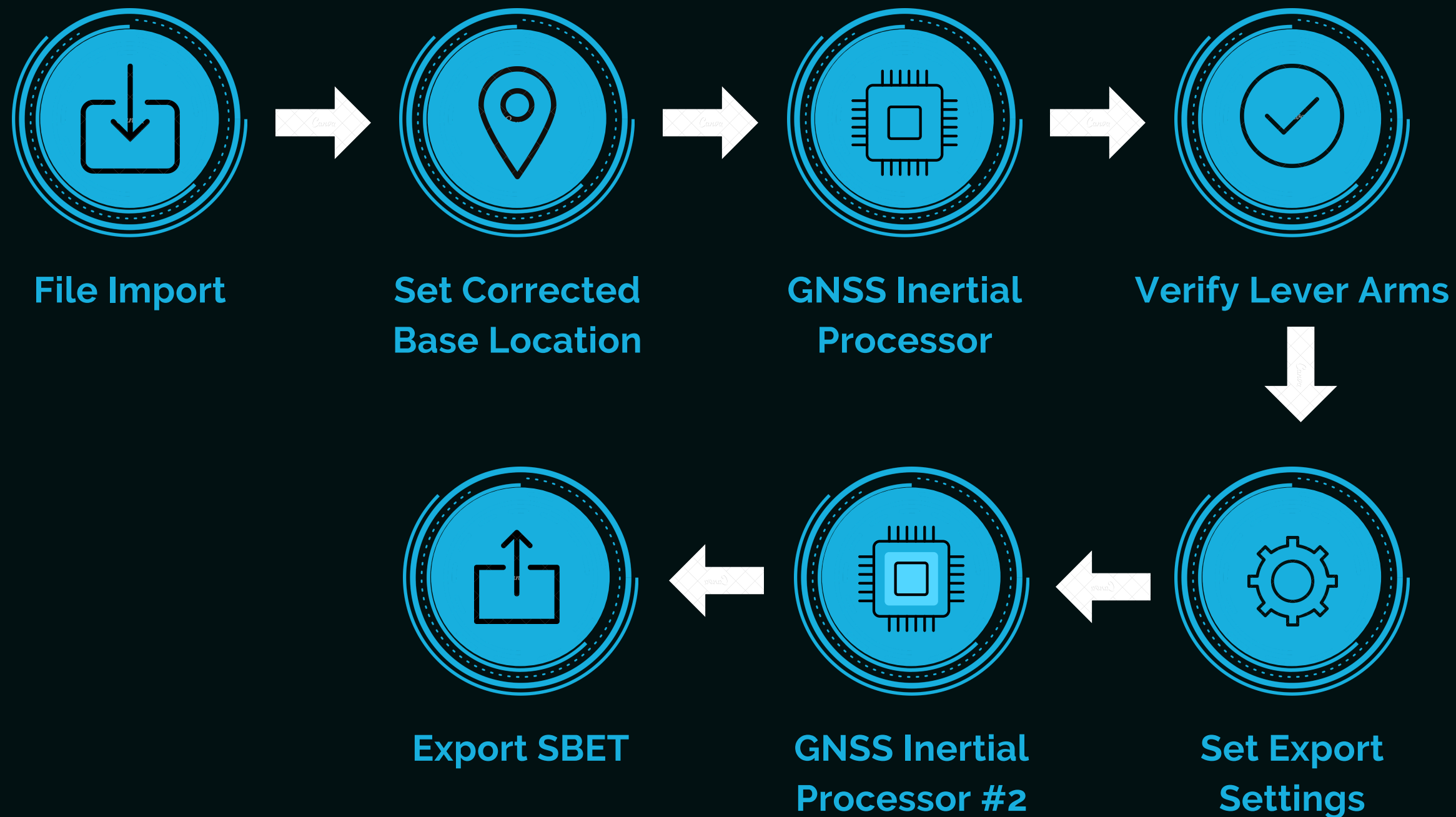
	YS-20211004-171152	2021-10-04 9:30 AM	ys_file	12,056 KB
	YS-20211004-171152.T04	2021-10-04 9:12 AM	T04 File	29,707 KB
	YS-20211004-171152.lvx	2021-10-04 9:29 AM	LVX File	10,739,271 ...

•.lvx file – raw LiDAR data produced from Livox Avia.

•.T04 file – GNSS and MEMS inertial data

•.apx file – decimated trajectory file to be used by YellowScan CloudStation

# Applanix POSPac UAV Trajectory Processing





# YellowScan CloudStation

1

Extraction

2

Strip Adjustment

3

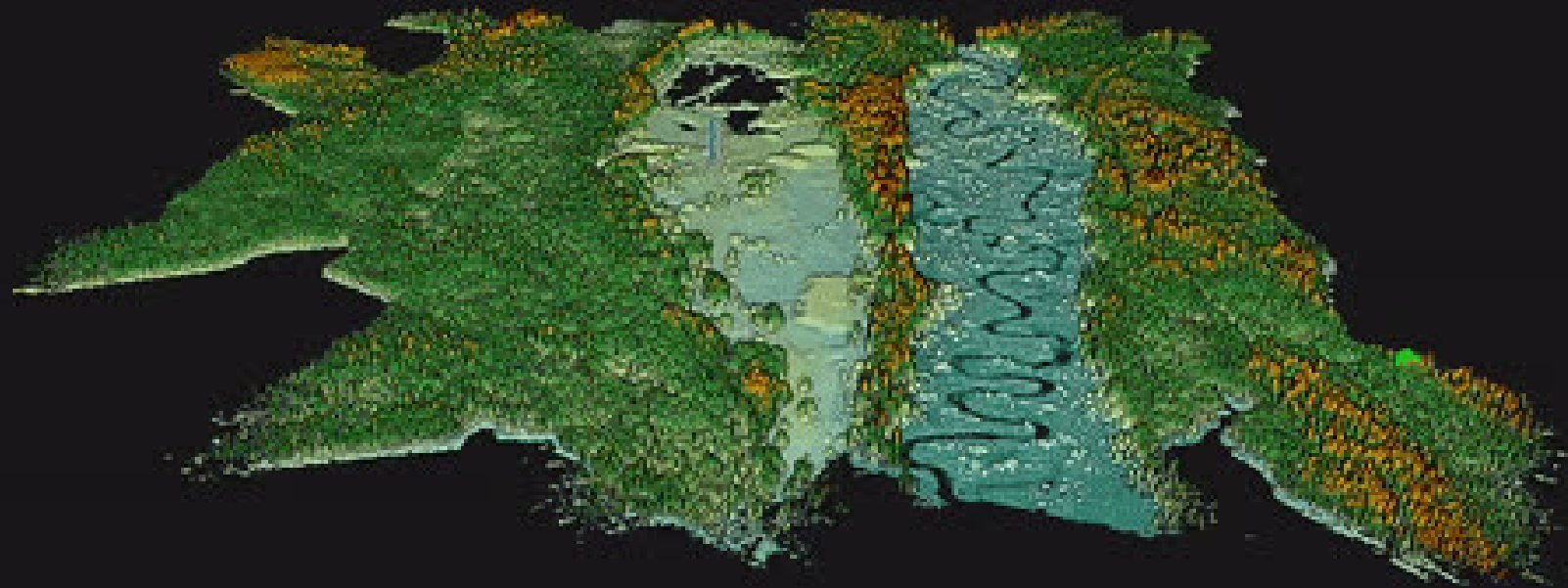
Terrain  
Classification

4

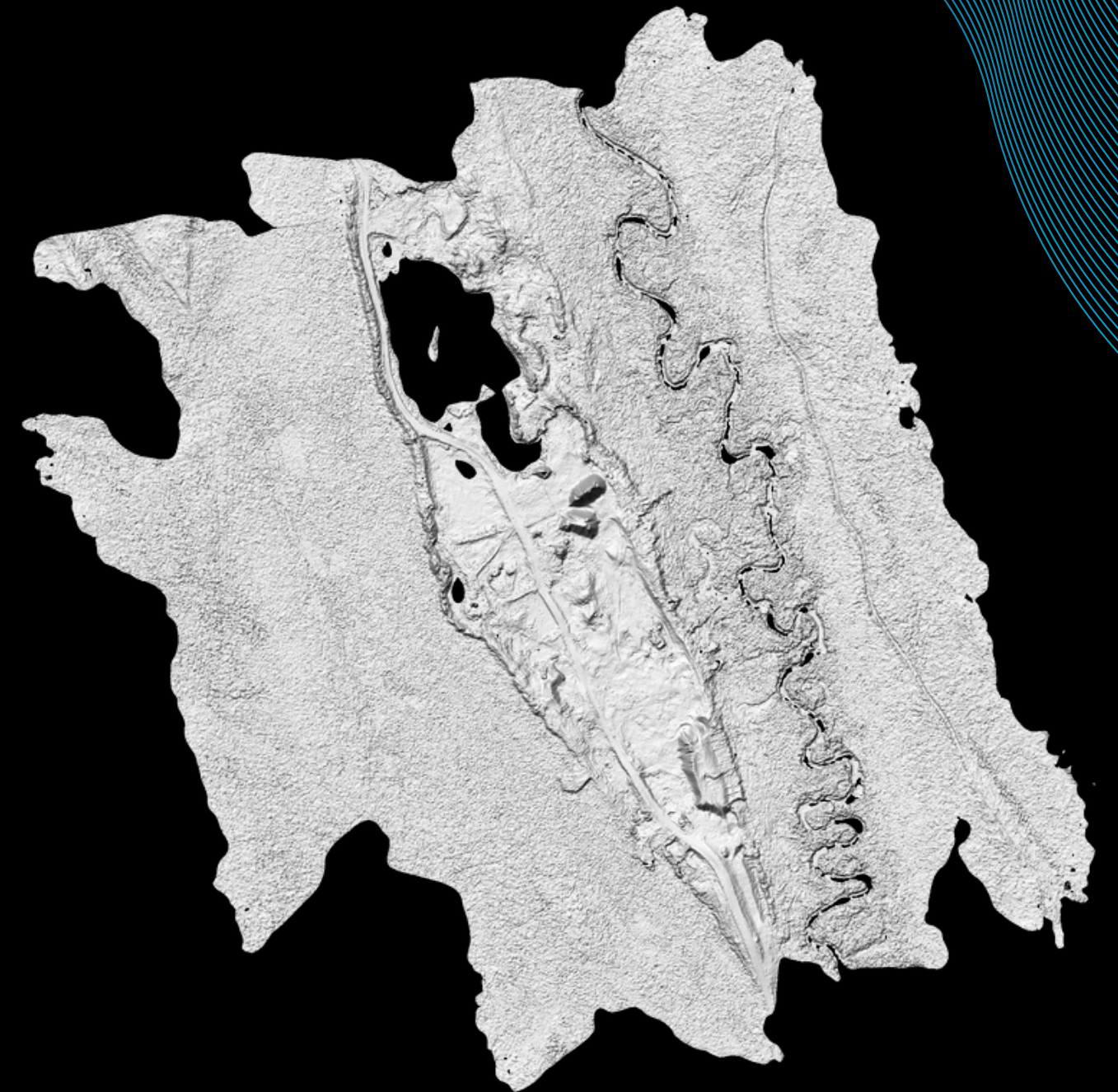
Export

# Data

LAS/LAZ, 1.2/1.4



DSM, DTM, DHM, Hillshade





# Case Study: Saskatchewan Polytechnic

Saskatchewan Polytechnic acquired the Trinity F90+ with the Qube 240 LiDAR payload to detect small changes in elevation and topography at incredibly high-resolutions.

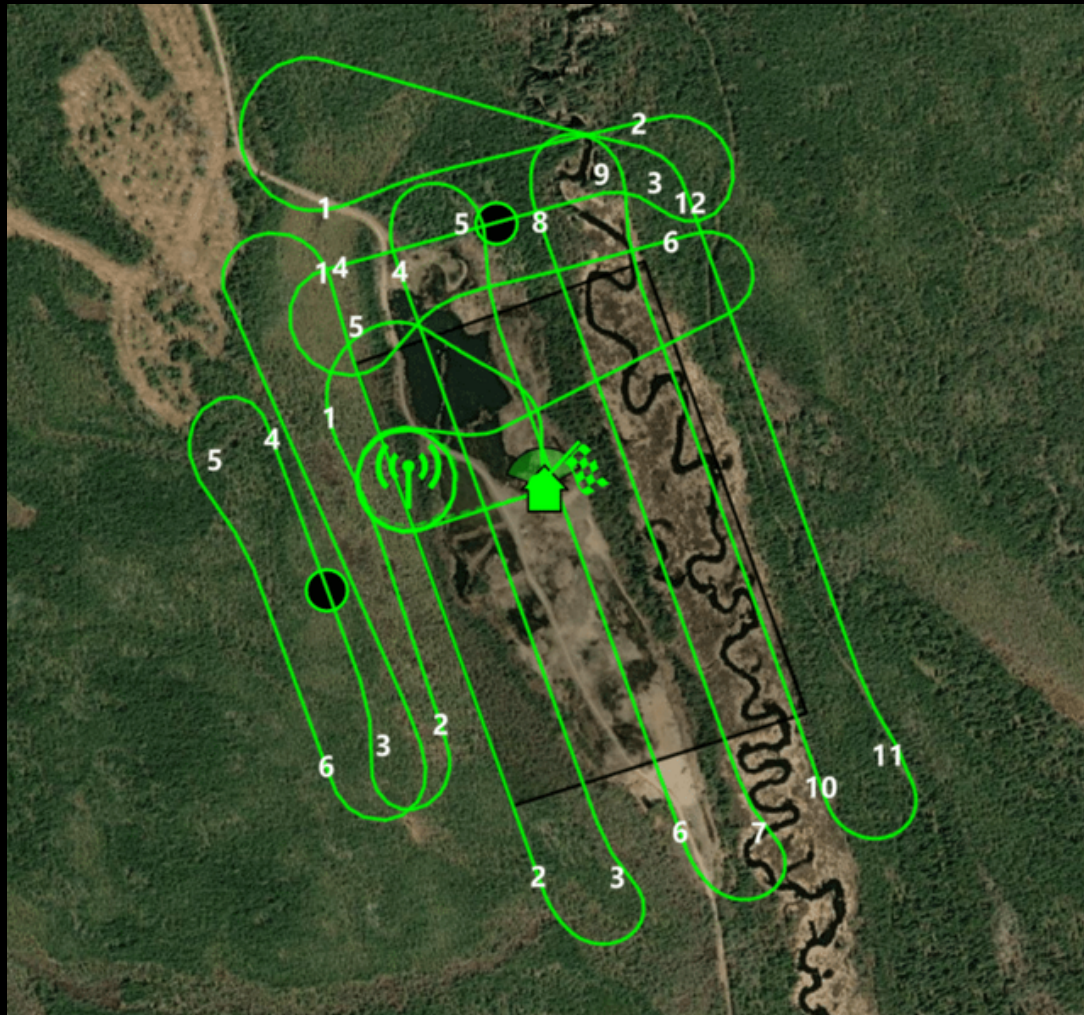
It allows them to better understand how current farming practices can be used to optimize water and fertilizer efficiency across plots. This particular data was used to test the efficacy of LiDAR in the boreal forest by flying plots for a study relating to soil treatments and their effect on Jackpine growth in sandy soils.

Determining the drainage run-off on these sites was an important factor due to the soil type.





# Case Study: Saskatchewan Polytechnic



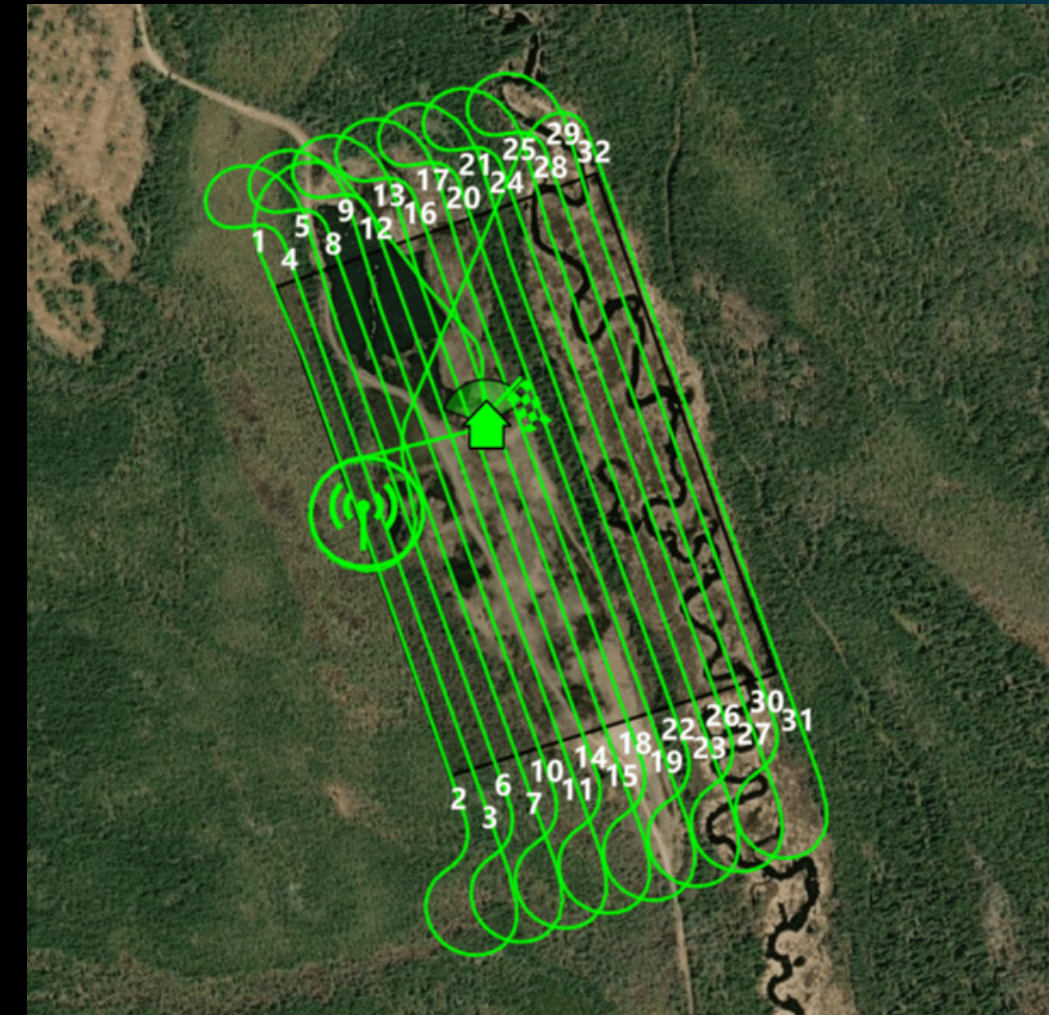
## **LiDAR Flight (Qube 240)**

Flight time: 12 Min 30 Sec

Area Covered: 22 ha

Total Battery: 21%

Overlap: 50%



## **Photogrammetry Flight (Sony RX1RII 42 MP)**

Flight time: 18 min 23 sec

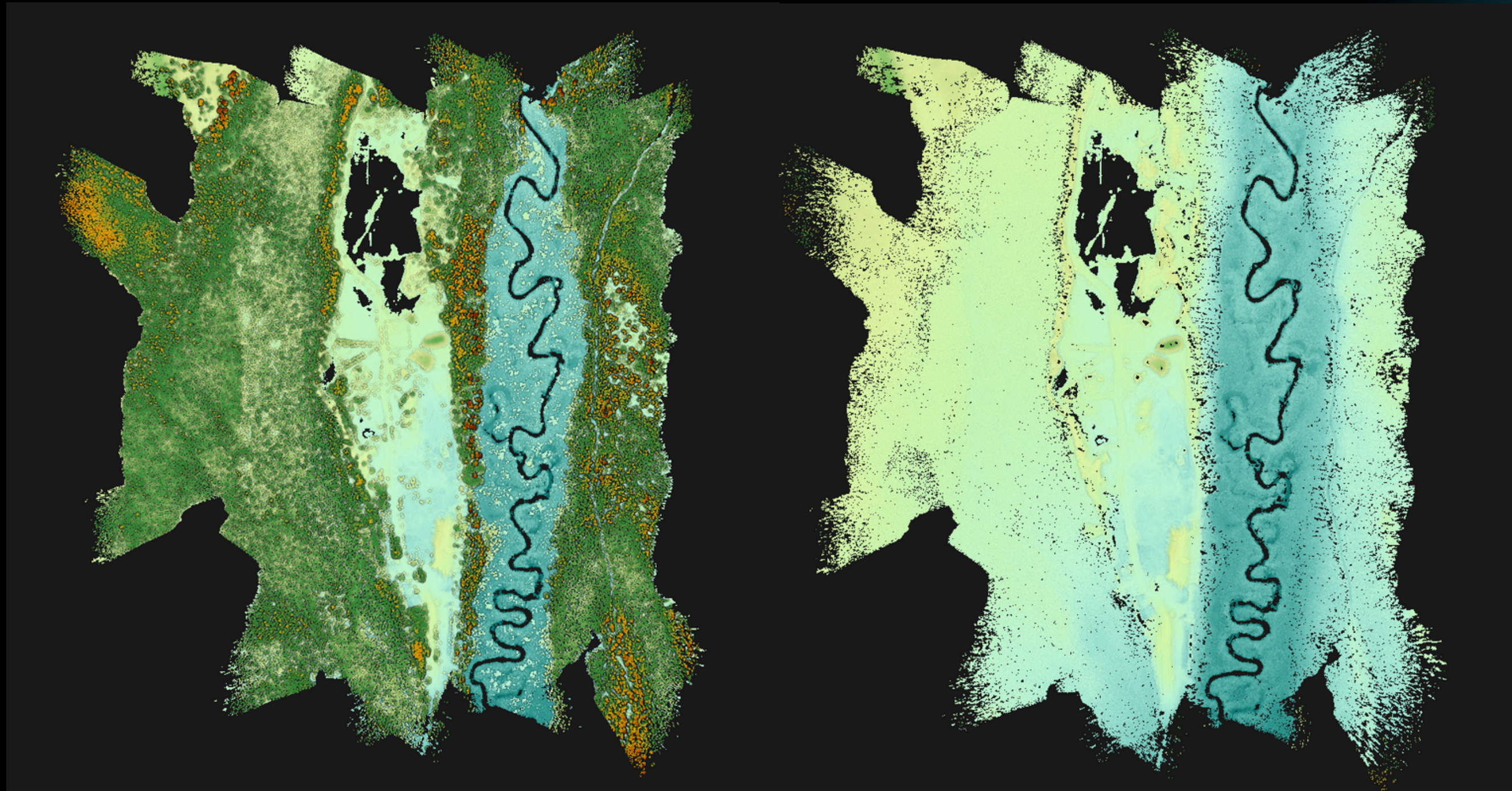
Area Covered: 22 ha

Battery: 21%

Overlap: 75/75



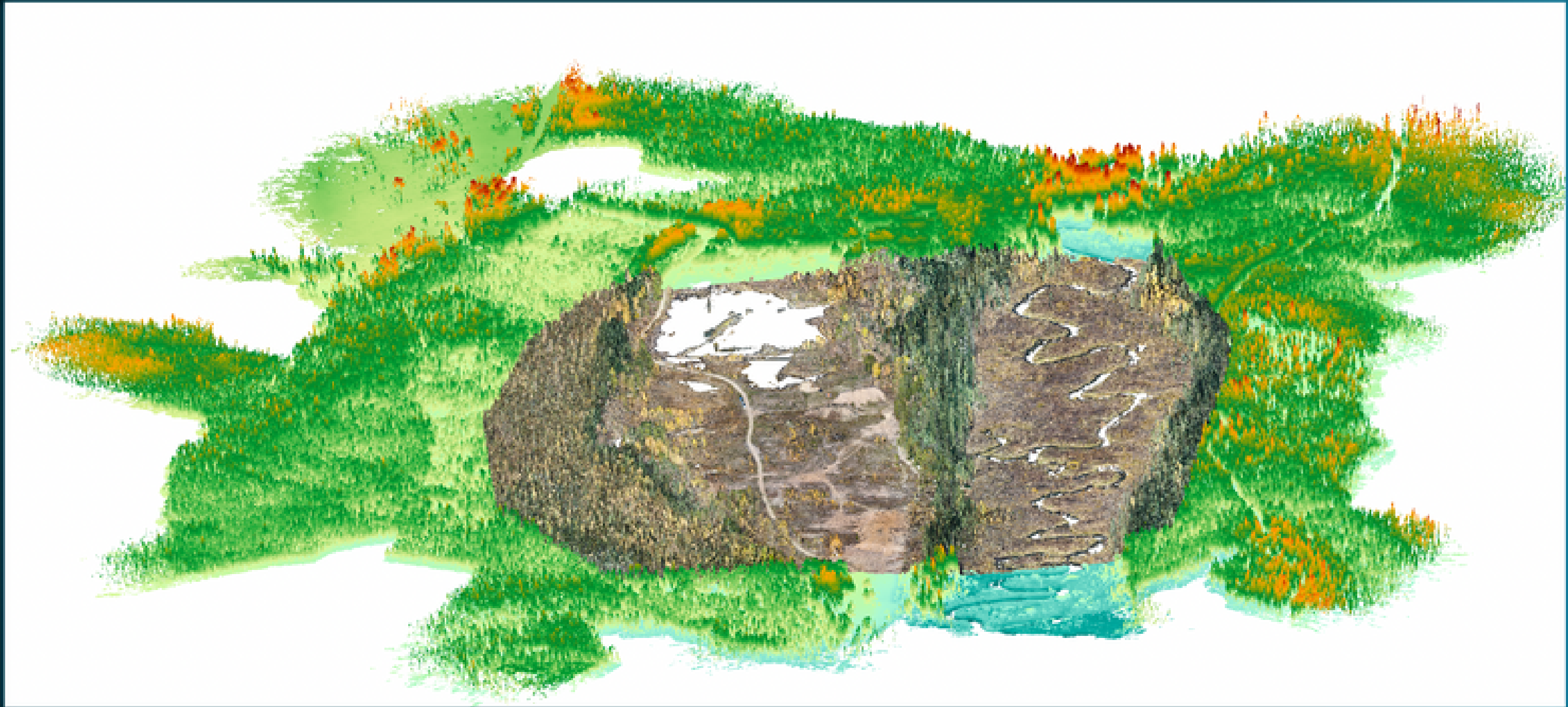
# Case Study: Saskatchewan Polytechnic



Actual Area Covered: ~61 Ha

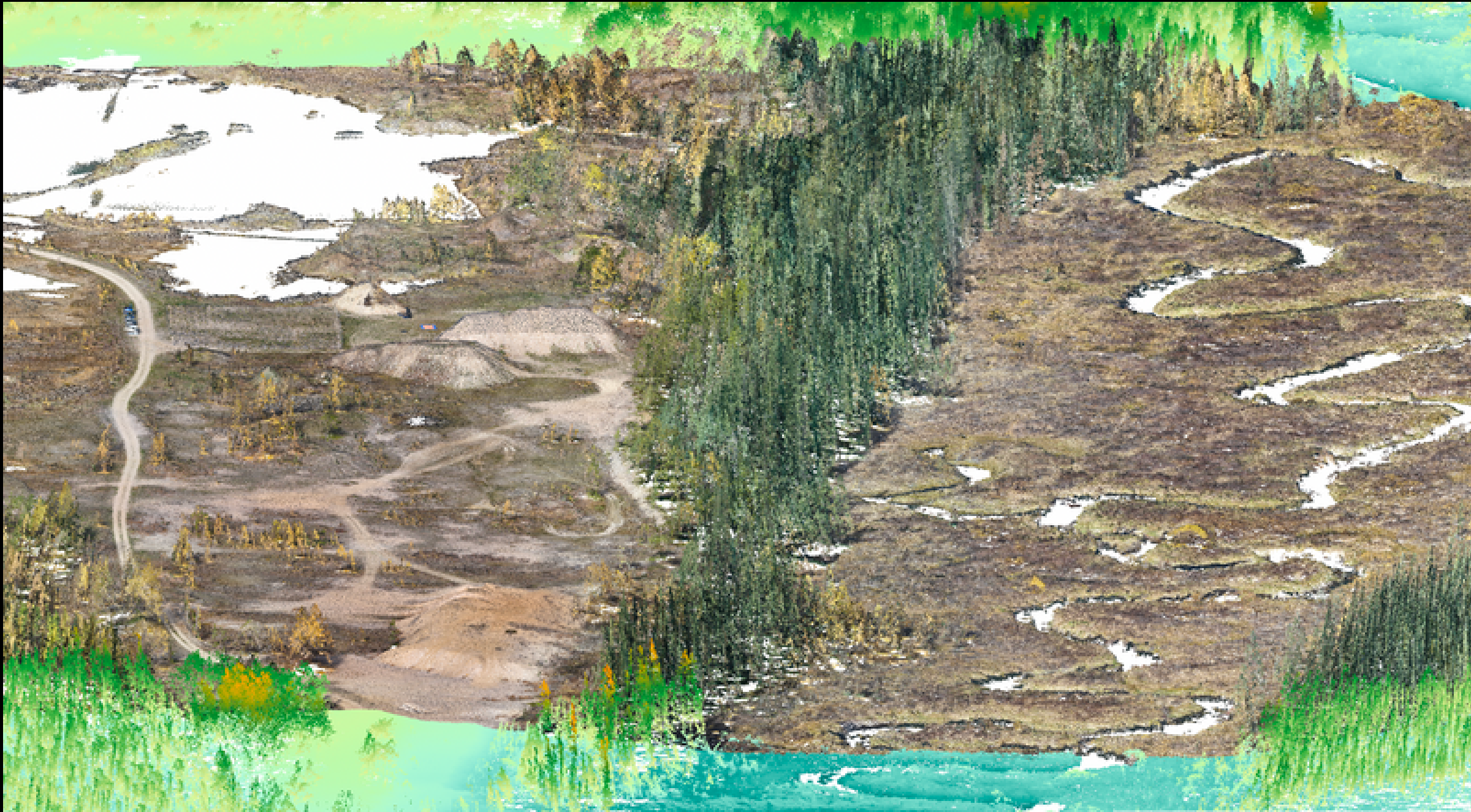


# Case Study: Saskatchewan Polytechnic





# Case Study: Saskatchewan Polytechnic





# Case Study: LiDAR Survey in the High Arctic

Arctic UAV in partnership with the municipality of Naujaat successfully mapped 750 hectares of potential road areas to a nearby lake. Travel to the site was only accessible by helicopter where winds were between 5 m/s and 12 m/s. Conditions were harsh and it took extensive planning and preparation.

"The project saved our customer over \$100,000 over traditional helicopter & external LiDAR systems. The Trinity and Qube 240 is a great addition to our fleet. A great project and success for all involved" - Kirt Ejesiak - CEO





# Case Study: LiDAR Survey in the High Arctic

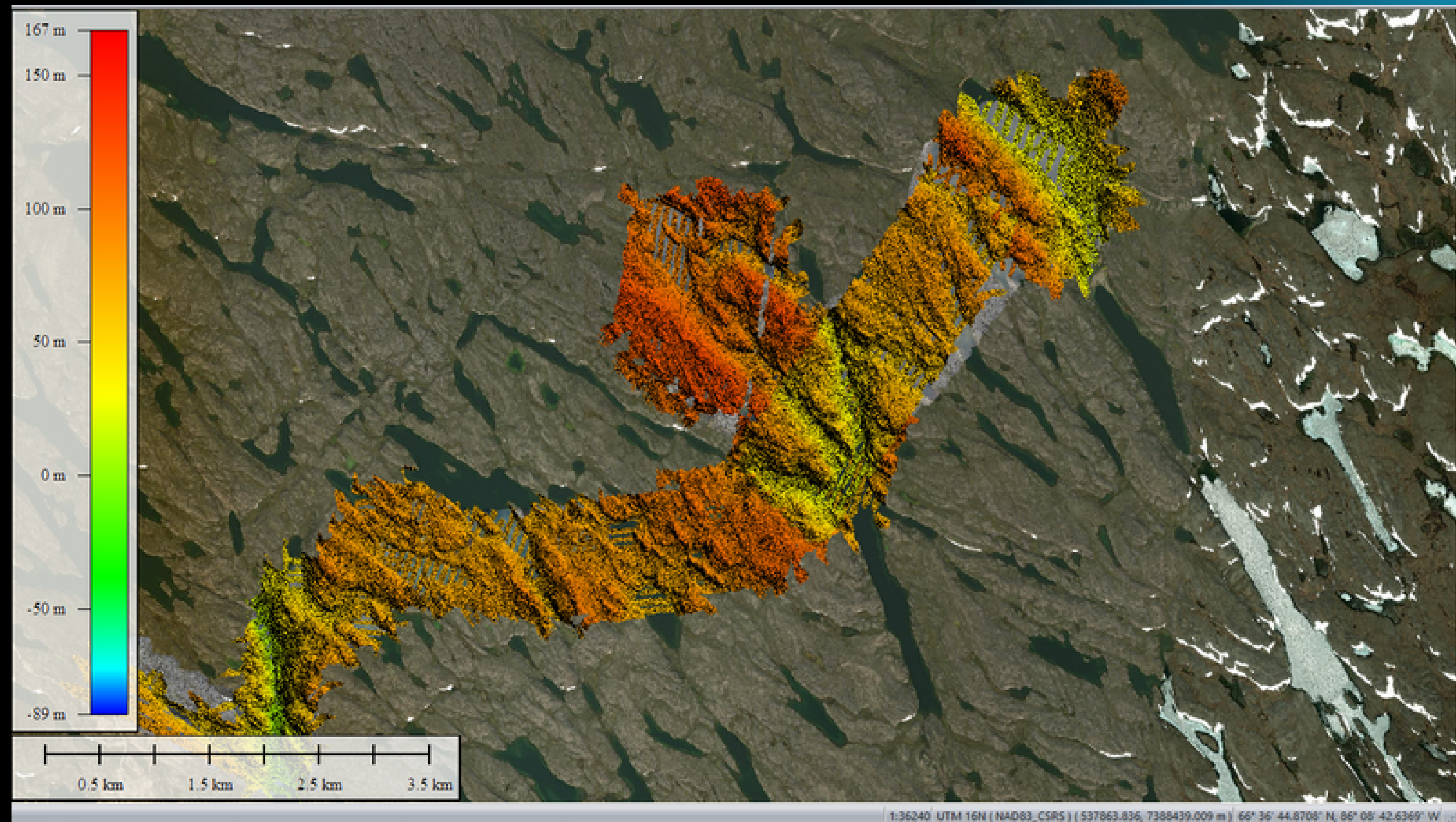
- Remote AOI meant that Arctic UAV had to take a helicopter with UAV equipment slung below to remote area in northern Nunavut
- 5-12 m/s winds
- Area only accessibly by helicopter so mission had to be performed perfectly
- Tough weather conditions affected timing of flights and accessibility to area





# Case Study: LiDAR Survey in the High Arctic

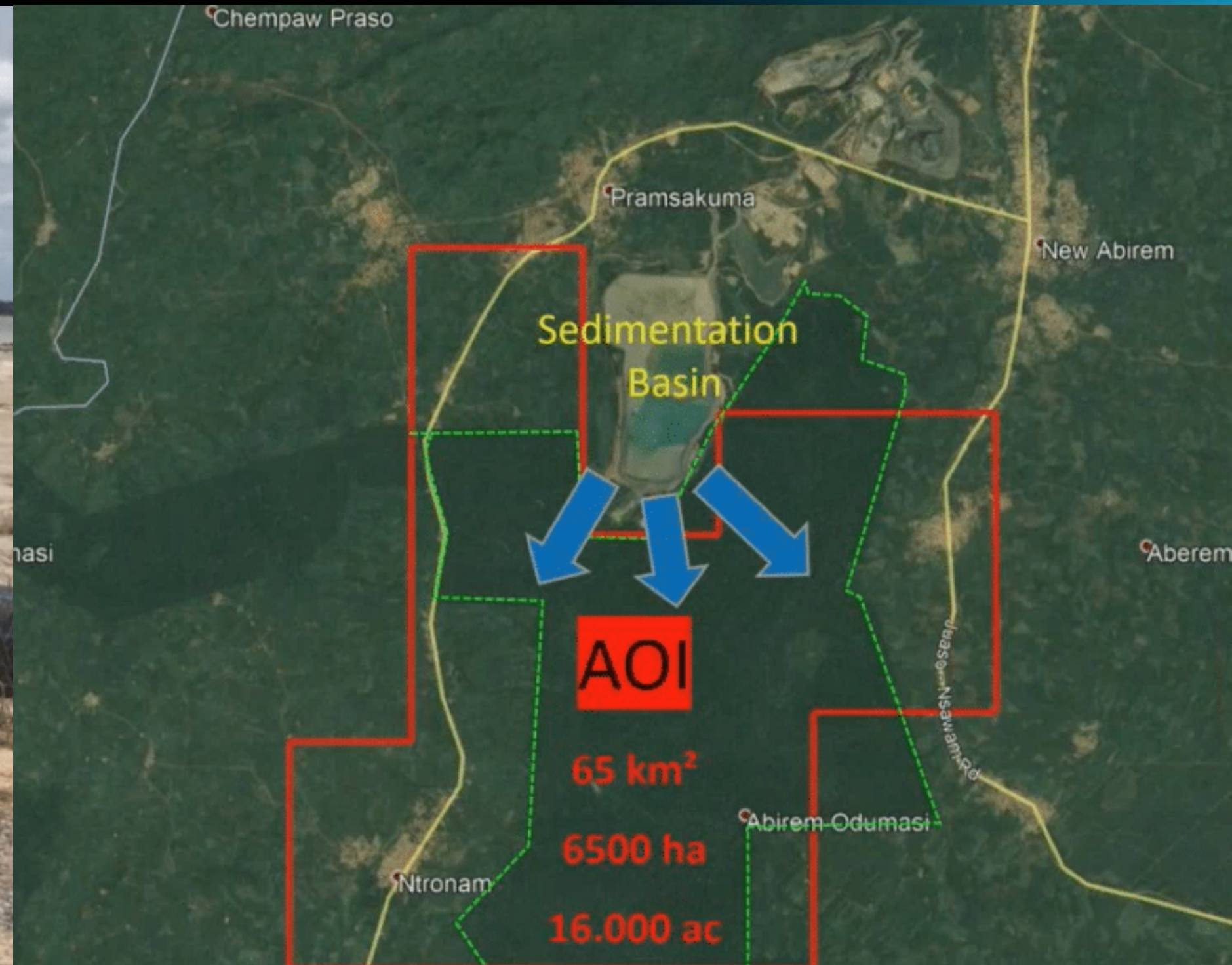
- 500m x 15km area (750 Hectares)
- 21 flights total, ~10 flights with Qube 240 LiDAR
- Separate flights done for photogrammetry
- All done VLOS
- 30-40 minutes per flight
- Travelled by helicopter every 3-4 km
- Project was completed in just over a week





# Case Study: Rocket Mine + Quantum Systems

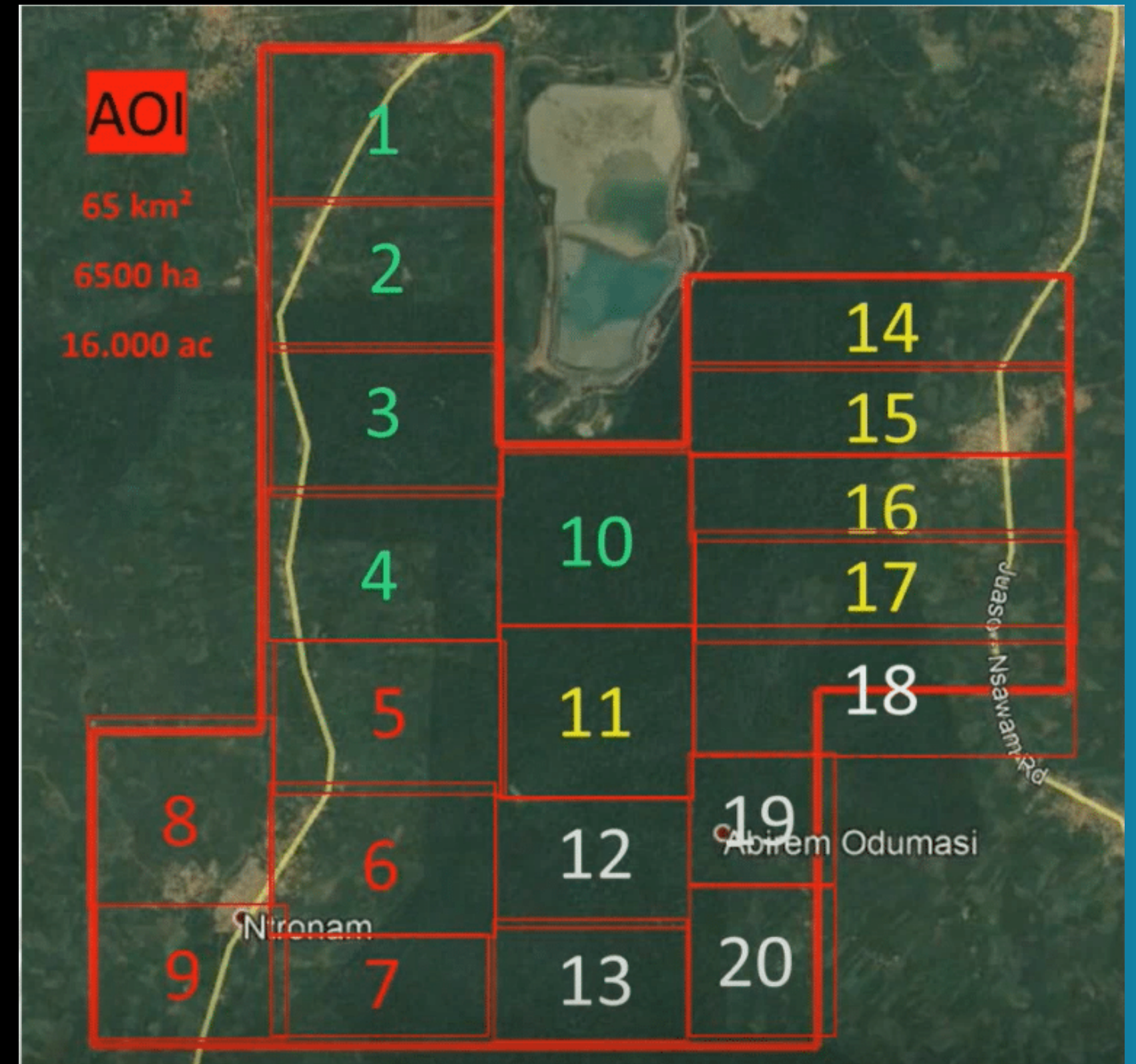
The Newmont Gold Mine tasked Rocket Mine in partnership with Quantum Systems to map their mining lease which was covered in dense canopy. They required an DTM of over 6,500 Ha of Tropical Rainforest to plan protection measures in the event of a dam collapse.





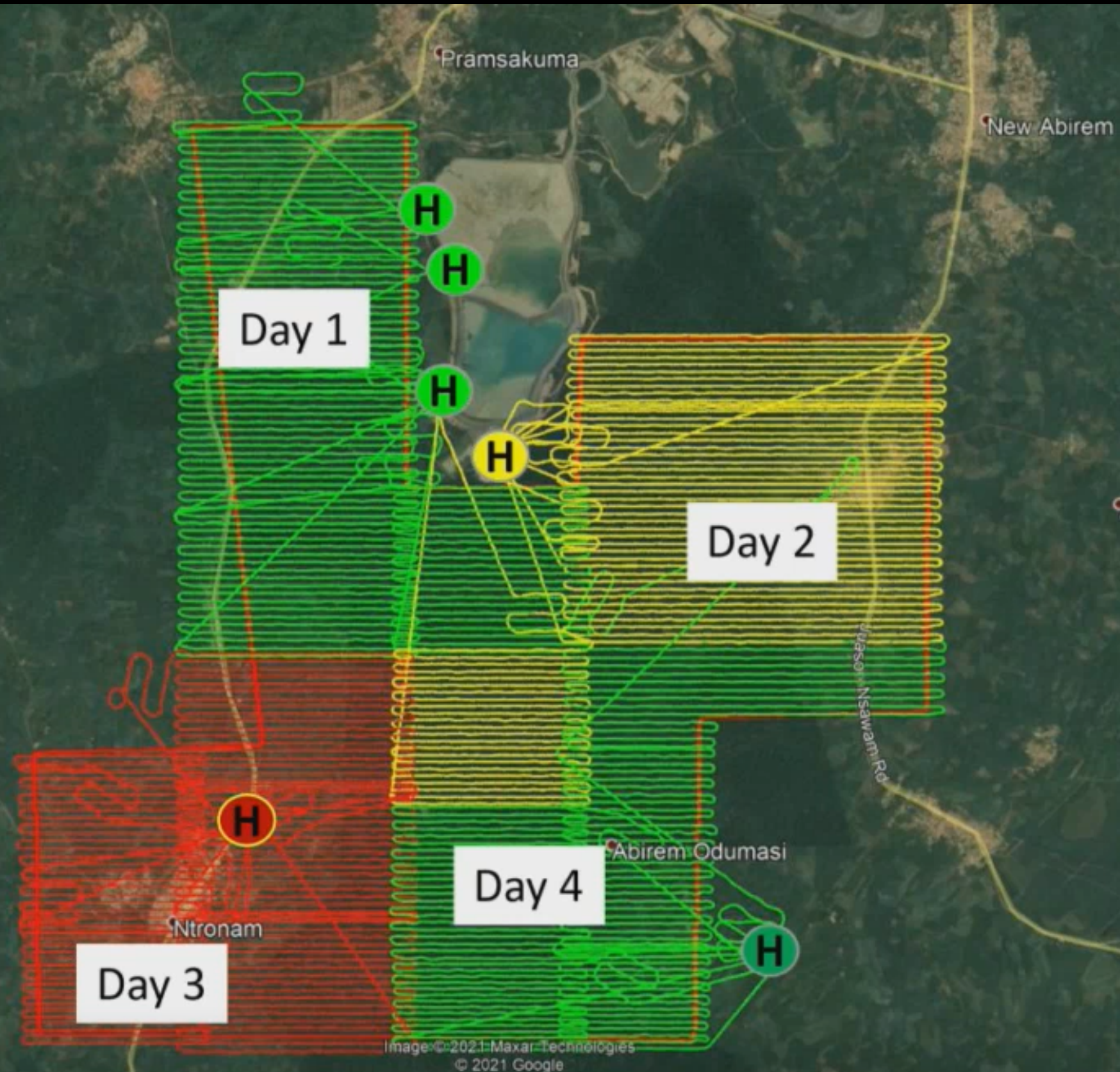
# Mission Plan

- 20 flight at 100-120m AGL (55-60 minute flight-time)
- 6 take-off locations
- 5 flights per day
- Total area: 6,500 Ha





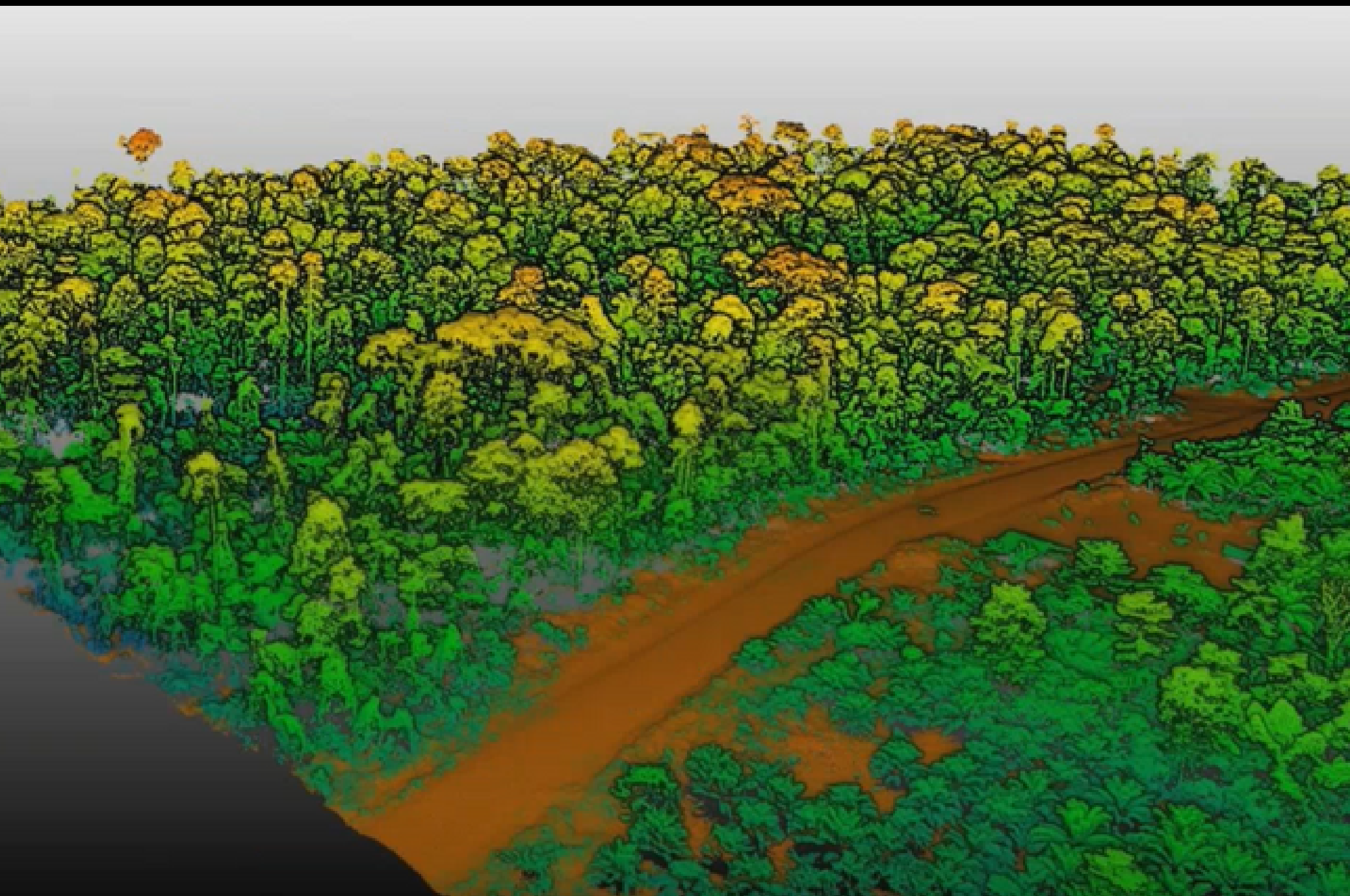
# Mission Flights



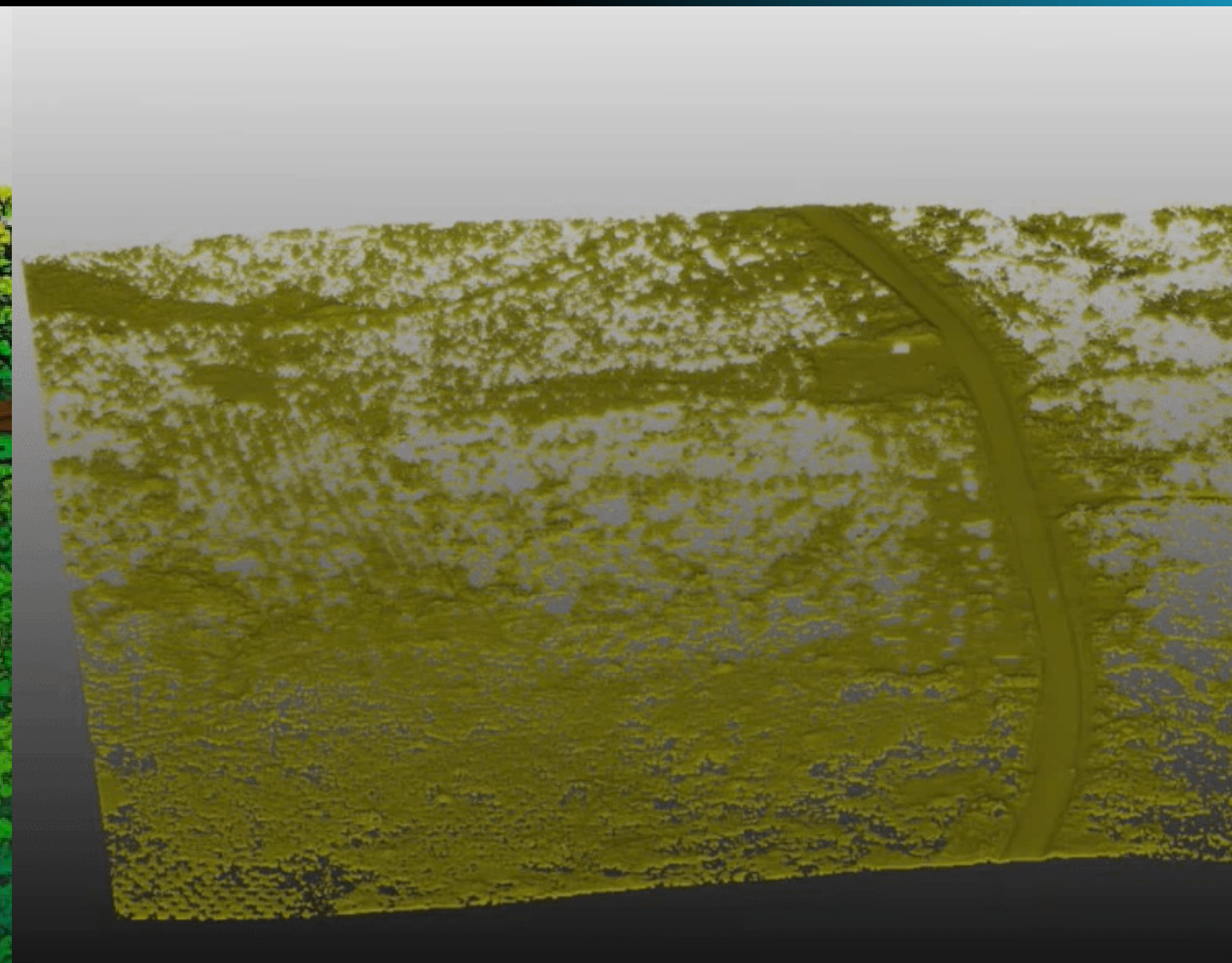


# Data

Point Cloud

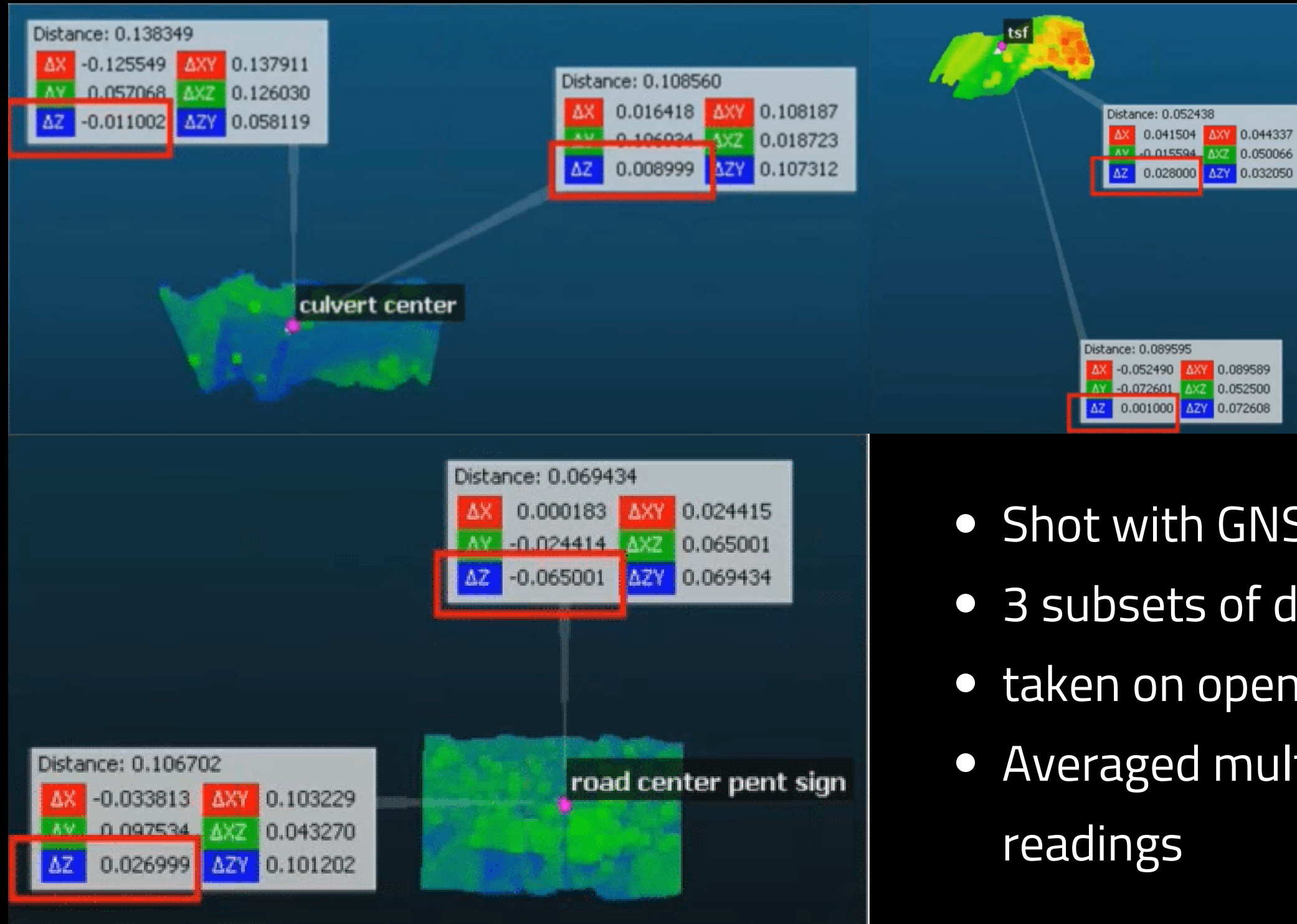


Raw ground points





# Elevation Checks



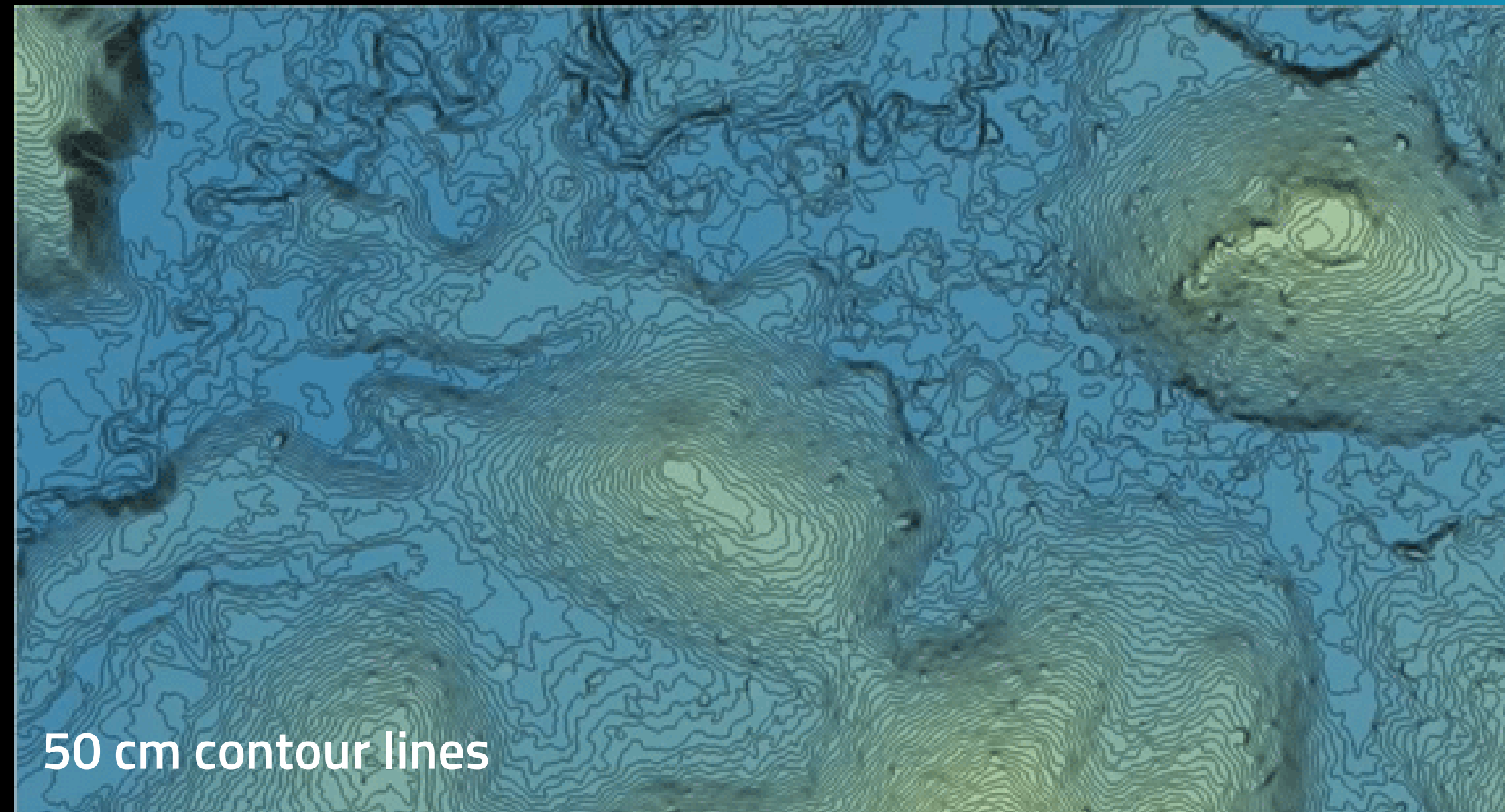
- Shot with GNSS RTK
- 3 subsets of data
- taken on open terrain
- Averaged multiple readings

GCP	Delta z (m)
Point 1	0,028
Point 1	0,001
Point 2	0,026
Point 2	0,065
Point 3	0,011
Point 3	0,008
Mean:	0,023



# Final Results

- 19.3 hours of flight time
- ~6,500 Ha
- 11.1 billion points
- 2.6 billion "ground" points (~40 points per square meter)
- Resampled to 4 points per square meter
- Risk assesment built based on this data



# Trinity F90+ In The Box

- Trinity F90+ UAV
- PPK
- Anti-Collision-Lights
- ADS-B IN
- iBase Base Station
- QBase Ground Control Station
- Remote Controller
- Battery Pack + Charger
- Lightweight Transport Case
- Warranty (1 Year)

**\$26,500**





# Qube 240 in The Box

- Trimble AV14 GNSS Antenna
- 2 x 128 GB USB Flash Drive
- 1 x Ethernet Cable
- 1 x USB for Software Installation
- 1 x Power Cord
- 1 x Microfiber Cloth
- 1 x Pelicase
- 1 x Mounting Dome
- User Manual
- Annual CloudStation Core License
- Annual Strip Adjustment Module License





# Thank you!

Send us a message at [contact@measur.ca](mailto:contact@measur.ca) if you have questions.