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State-of-the-*Art Geo*detic equipment

# Novelties of the *RIEGL* equipment

2016

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# *RIEGL* laser measurement systems

TLS

ALS/ULS

MLS

ILS

# Contents

- The VUX-1 Series
- VUX-1 & RiCOPTER vs. LMS-Q780 & DA42
- System integration or use the VUX-SYS?
- The VUX-SYS inside the RICOPTER and the VP-1 heli-pod
- Flexibility in controlling the VUX-SYS
- RiPRECISION for ULS

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- New TLS: VZ-2000 & VZ-400i
- *RIEGL* Multiple Time Around (MTA) capabilities
- New *RIEGL*‘s vision on scanning workflow

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# The VUX

## NEW RIEGL VUX®-1HA High Acc

- compact, rugged and very lightweight design
- easily mountable to whatsoever type of moving
- field of view 355°
- Laser Pulse Repetition Rate PRR > 1 MHz
- high accuracy 5 mm

| Eye Safety Class | Laser Class |
|---|---|
| Max. Range @ Target Reflectivity 80% | 400 m |
| Max. Range @ Target Reflectivity 10% | 150 m |
| Minimum Range | 1.2 m |
| Accuracy | **5 mm** |
| Precision | **3 mm** |
| Max. Effective Measurement Rate | **1,000,000** |
| Max. Scan Speed | 250 scans/s |
| Field of View (FOV) | **355°** |

### Typical Applications

- indoor and outdoor laser mapping
- tunnel profile measurements
- railway applications like clearance analysis, etc.

## NEW RIEGL VUX®-1HA High Accuracy

- compact, rugged and very lightweight design
- easily mountable to whatsoever type of moving platform
- field of view 355°
- Laser Pulse Repetition Rate PRR > 1 MHz
- high accuracy 5 mm

| Eye Safety Class | Laser Class 1 |
|---|---|
| Max. Range @ Target Reflectivity 80% | 400 m |
| Max. Range @ Target Reflectivity 10% | 150 m |
| Minimum Range | 1.2 m |
| Accuracy | **5 mm** |
| Precision | **3 mm** |
| Max. Effective Measurement Rate | **1,000,000 meas./sec** |
| Max. Scan Speed | 250 scans/sec |
| Field of View (FOV) | **355°** |

### Typical Applications

- indoor and outdoor laser mapping
- tunnel profile measurements
- railway applications like clearance analysis, etc.

## IEGL VUX®-1LR Long Range

ugged and very lightweight design
d for airborne surveying from helicopters
/ 330°
ted system solution *RIEGL* VP-1 Helipod
r user-friendly mounting to helicopters

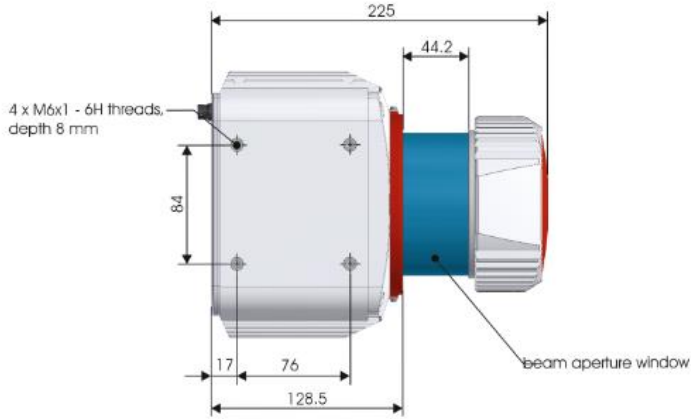
| ass | Laser Class 1 |
|---|---|
| @ Target Reflectivity 60% | **1,350 m** |
| @ Target Reflectivity 20% | **820 m** |
| nge | 5 m |
| cision | 15 mm / 10 mm |
| e Measurement Rate | **750,000 meas./sec** |
| peed | 200 scans/sec |
| (FOV) | 330° |
| ng Flight Altitude AGL | **530 m / 1,740 ft** |

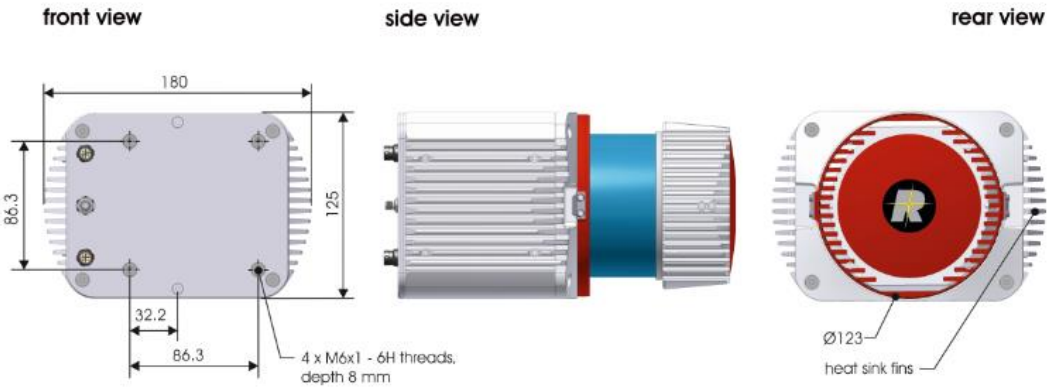
### plications

pping
rail track and pipeline inspection
f urban environments
and cultural heritage domumentation

# The VUX-1 series

- compact package: 227 x 180 x 125 mm
- lightweight: only 3.6 kg

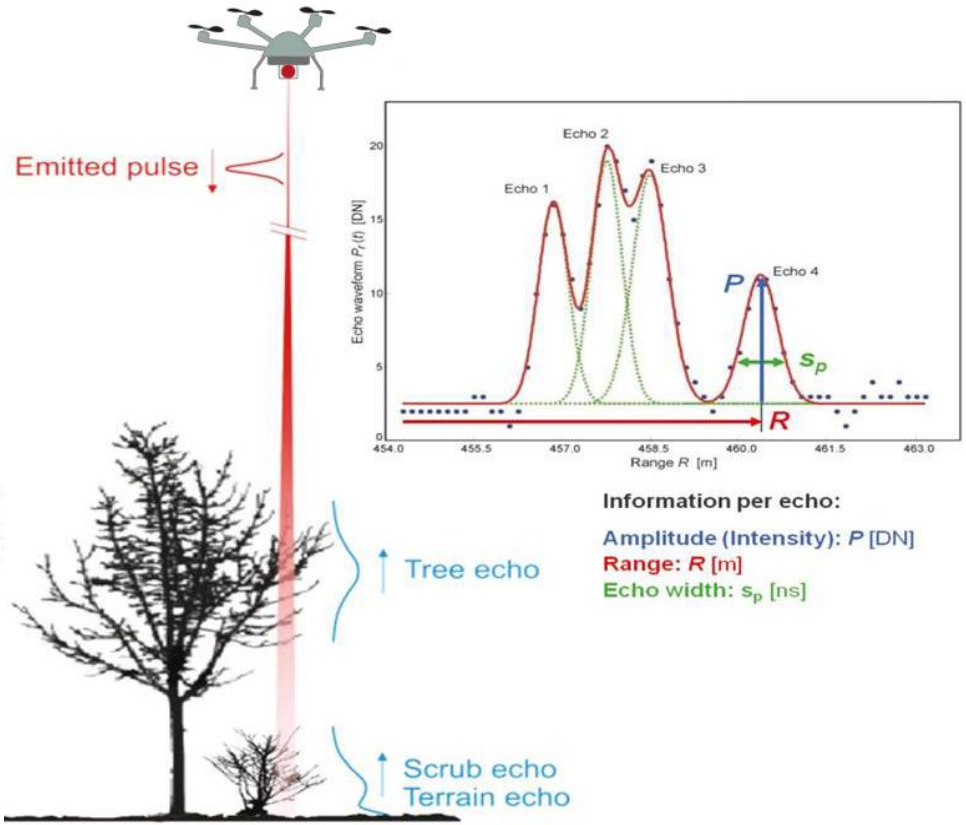


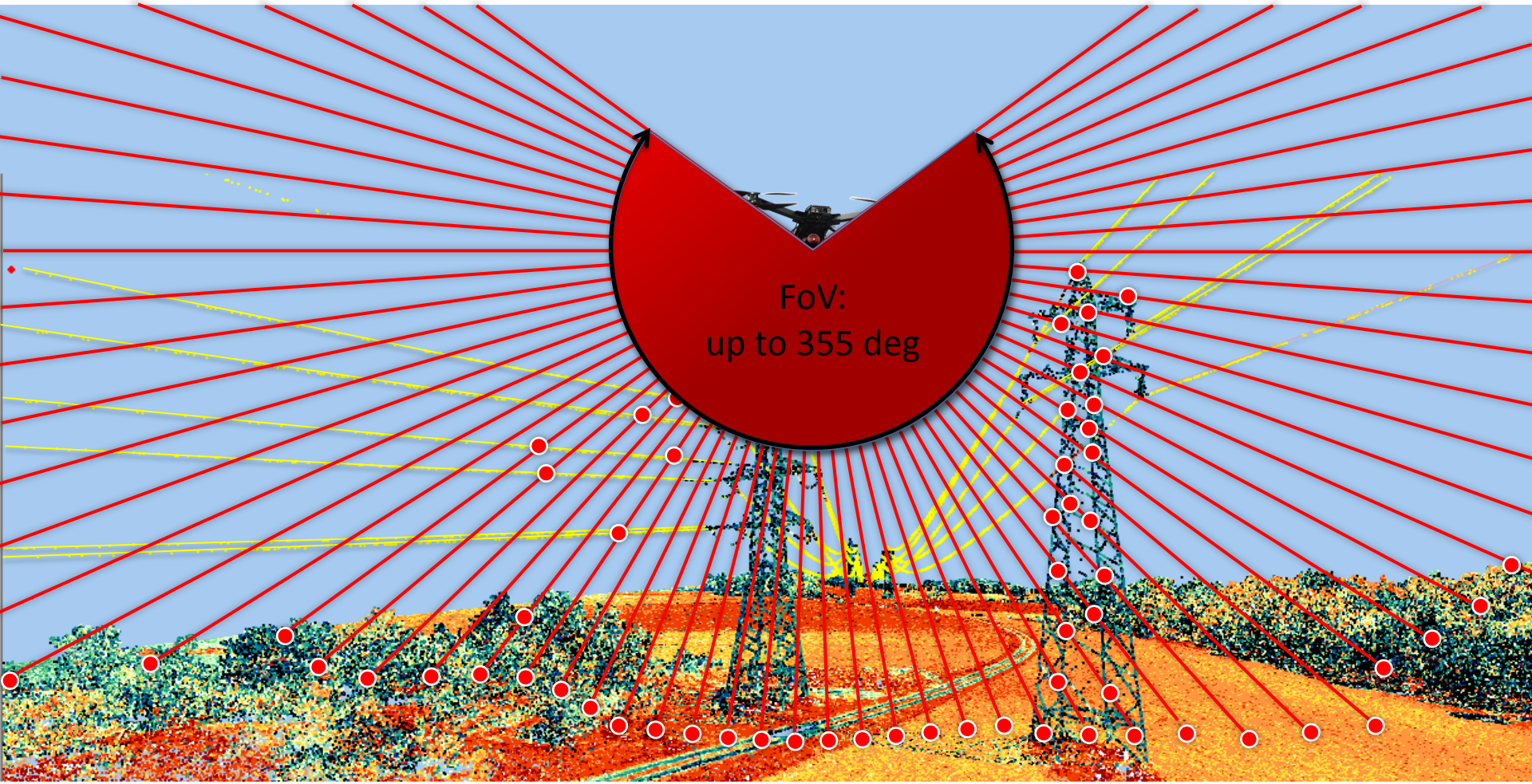
# The VUX-1 series

Online Waveform Processing technique enables:

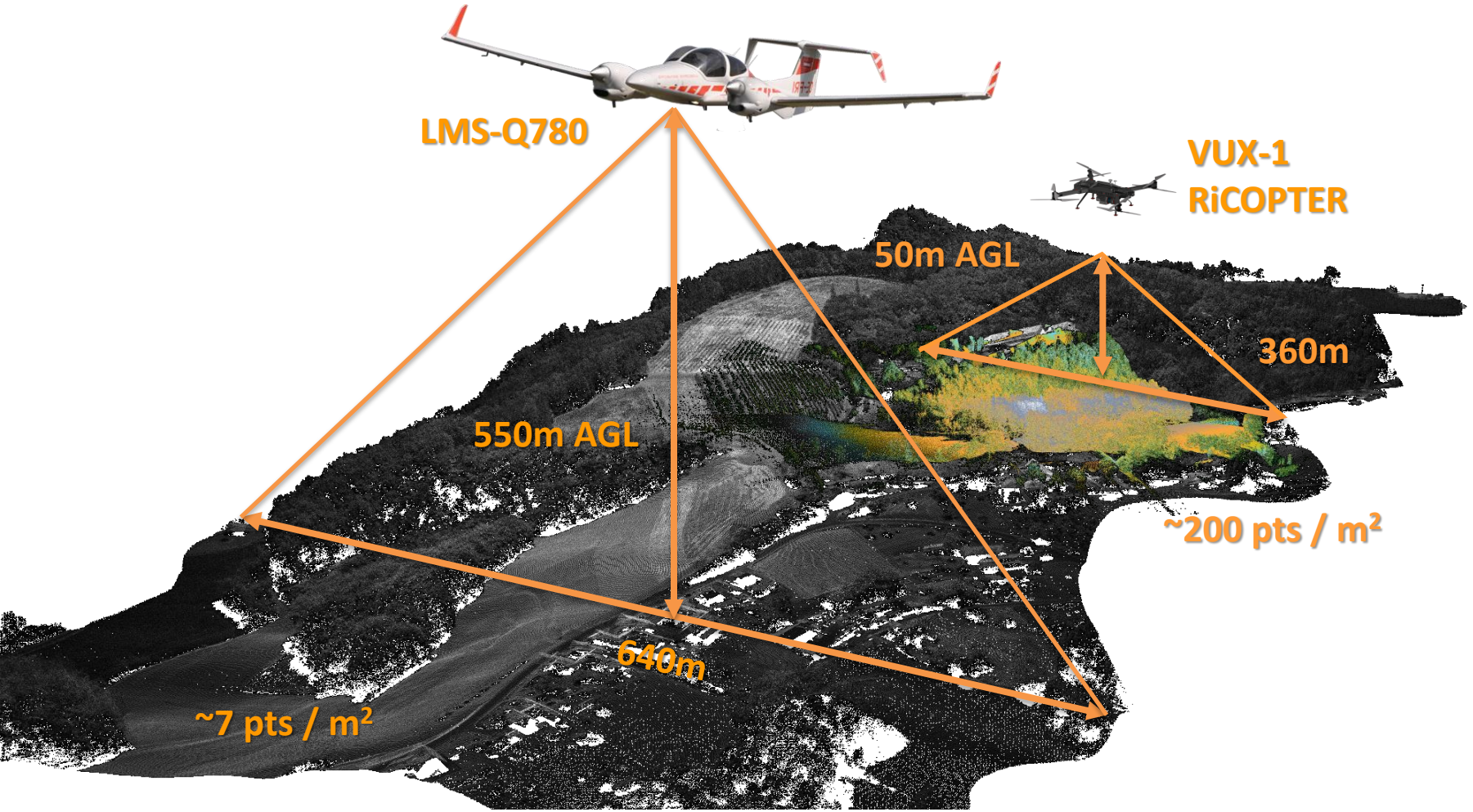
- multiple target capability
- high measurement accuracy
- calibrated reflectance



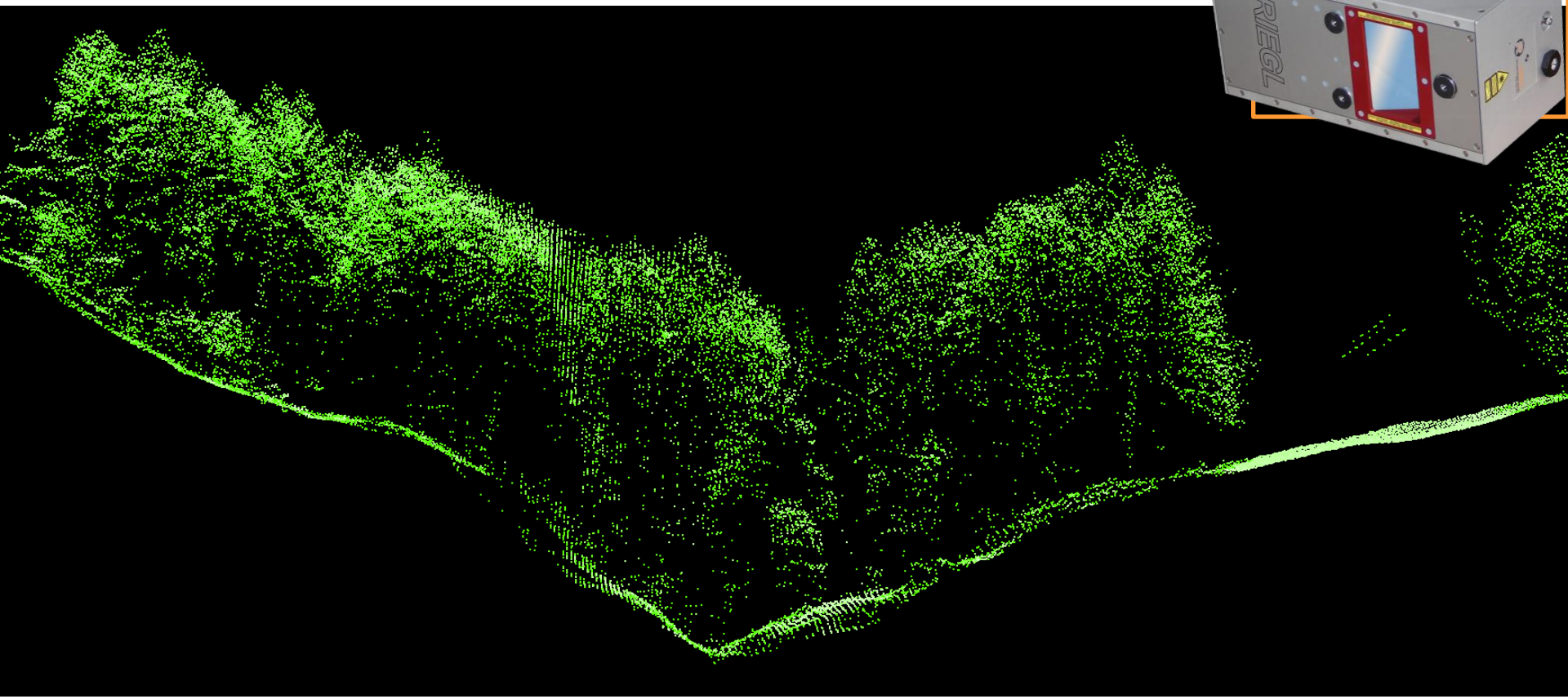
# Measurement principle of the VUX-1



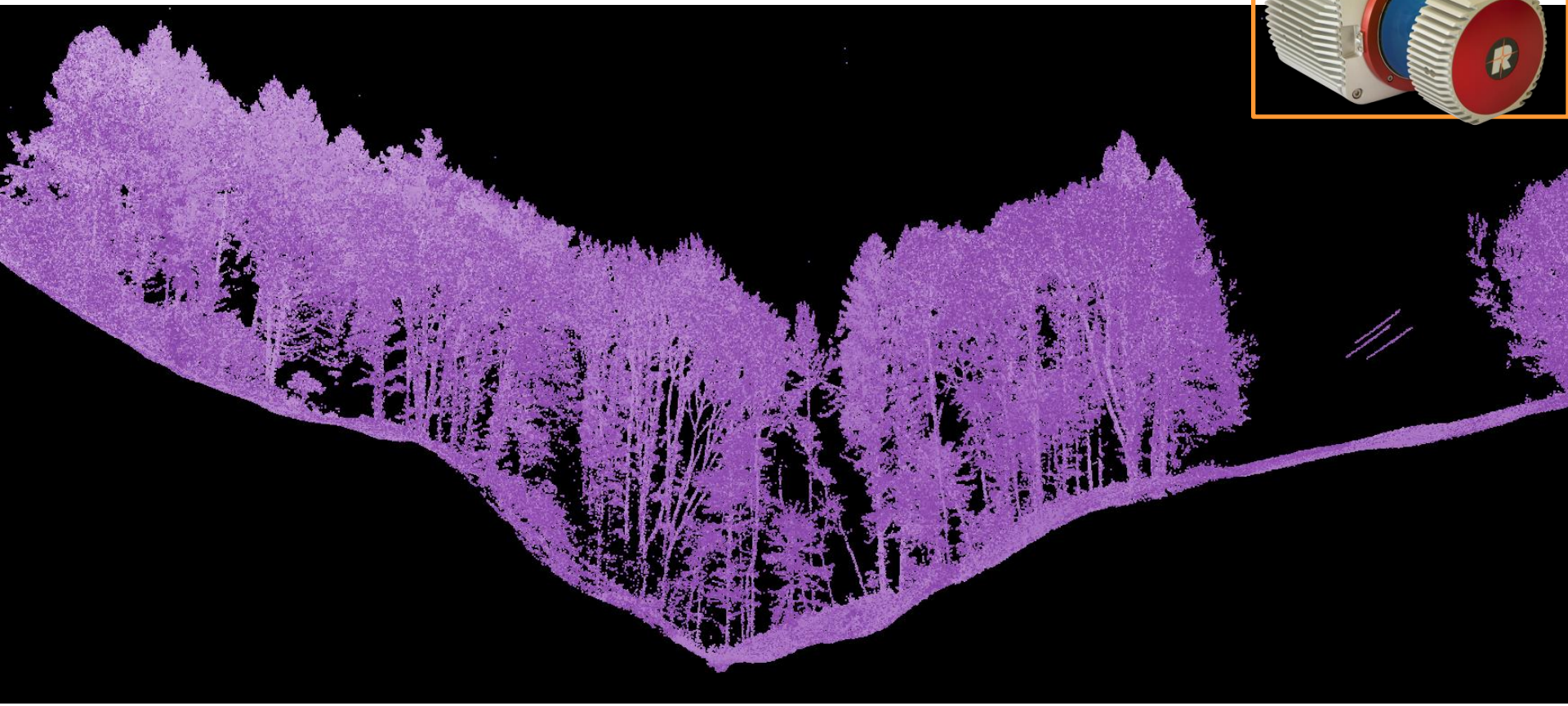
# Sample data VUX-1 and LMS-Q780



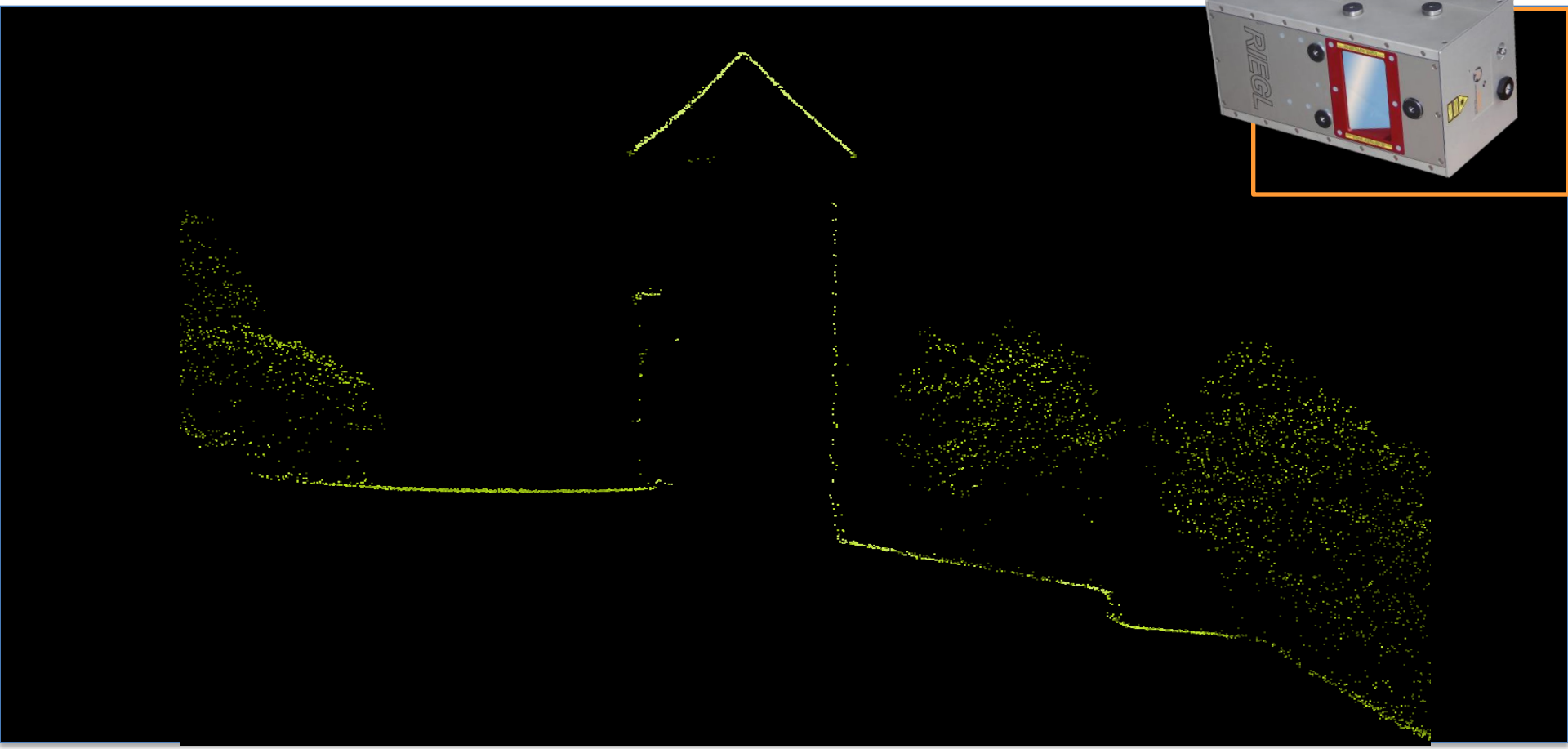
# LMS-Q780, approx. 10 pts/m²



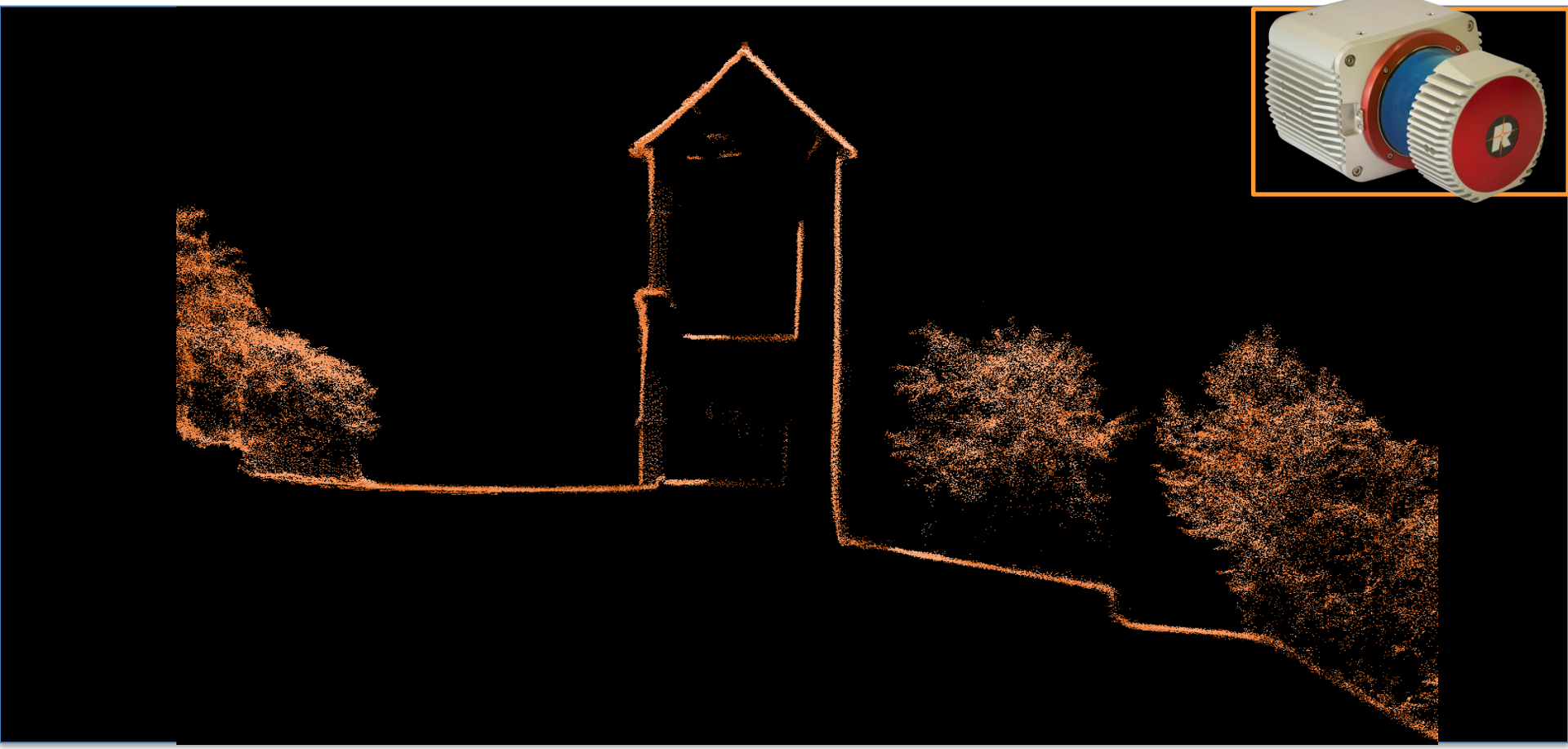
# VUX-1, >> 100 pts/m²



# Q780, approx. 10 pts/m²



# VUX-1, >> 100 pts/m²



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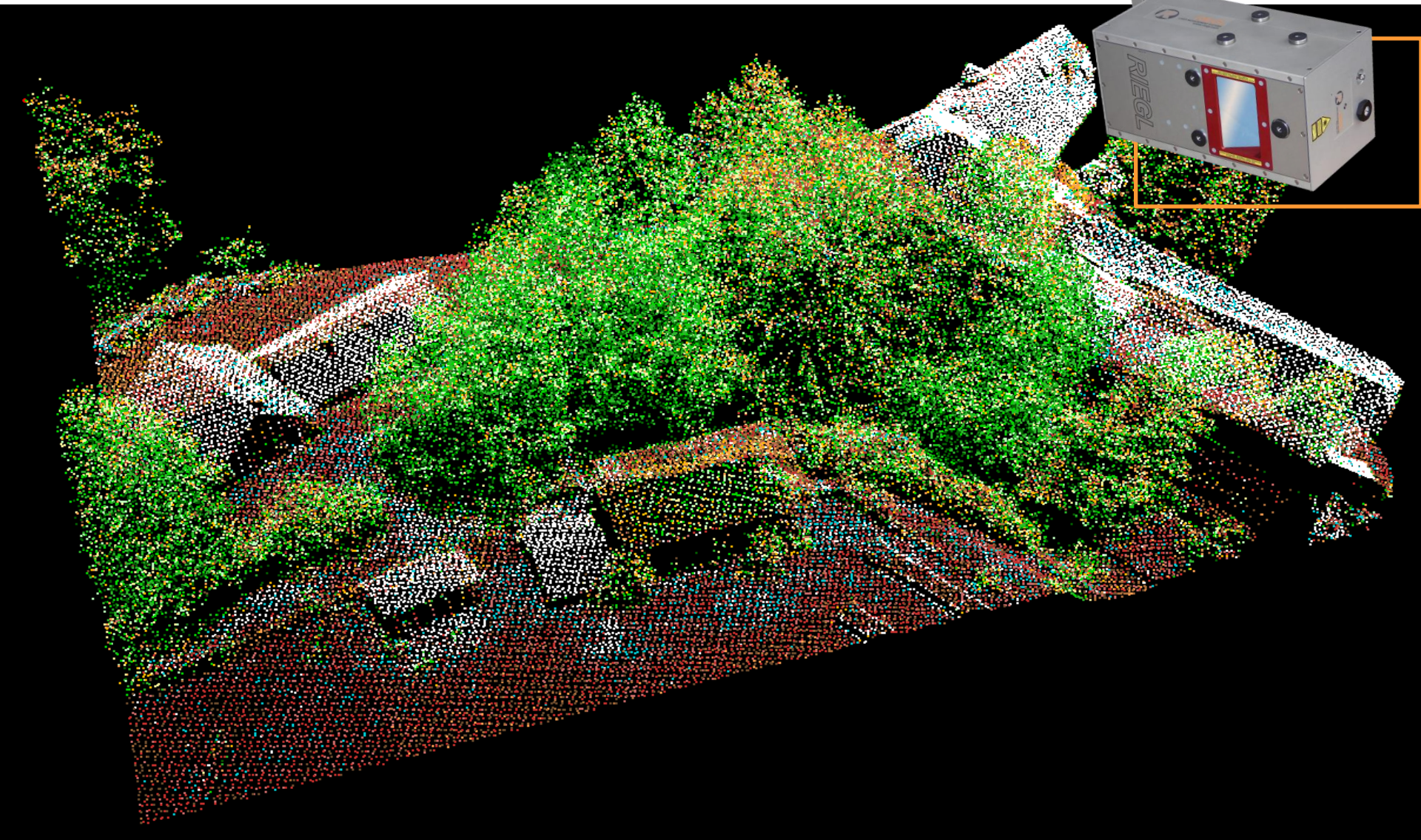
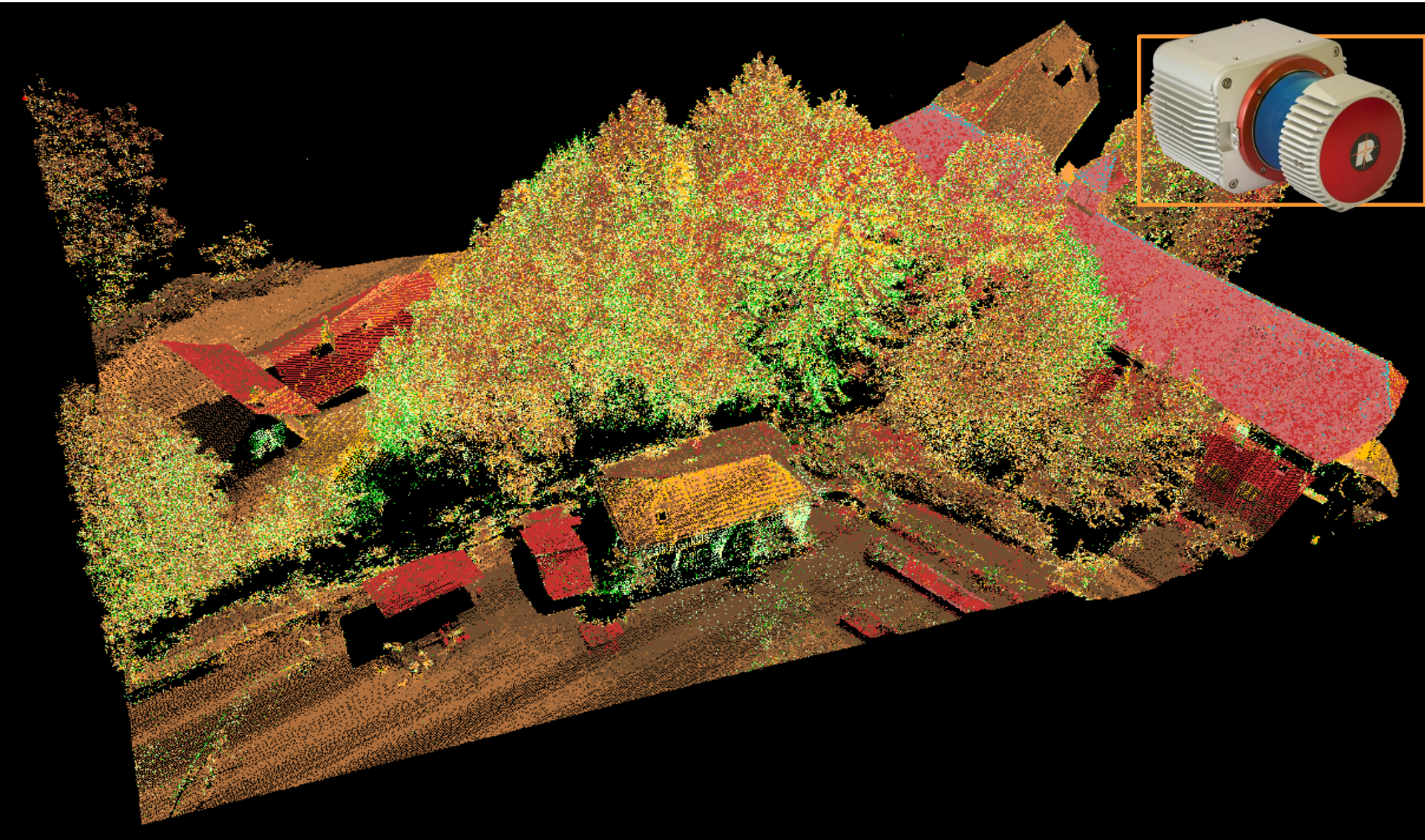
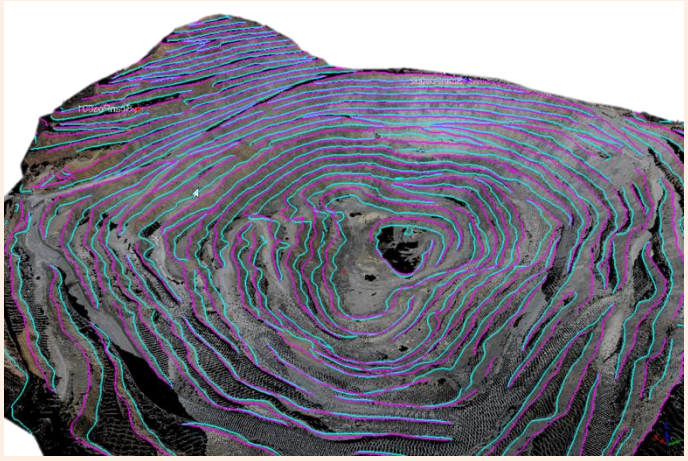
# ALS – data



# VUX-1 sample data



# Sample data: open-pit mine survey



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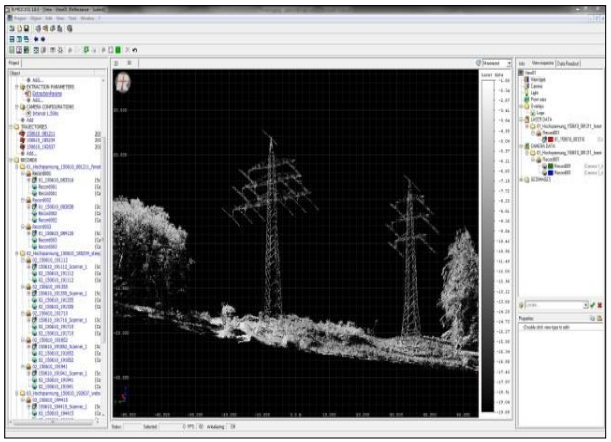
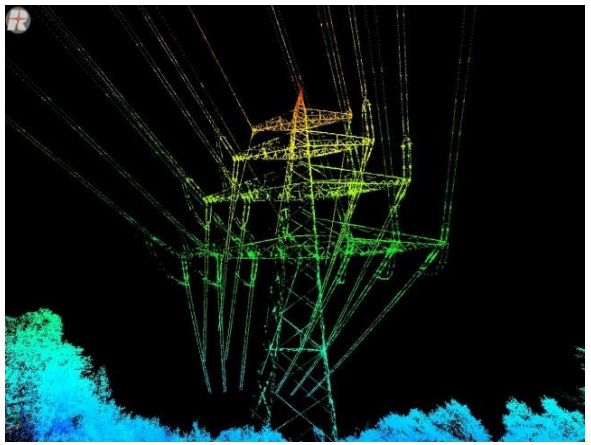
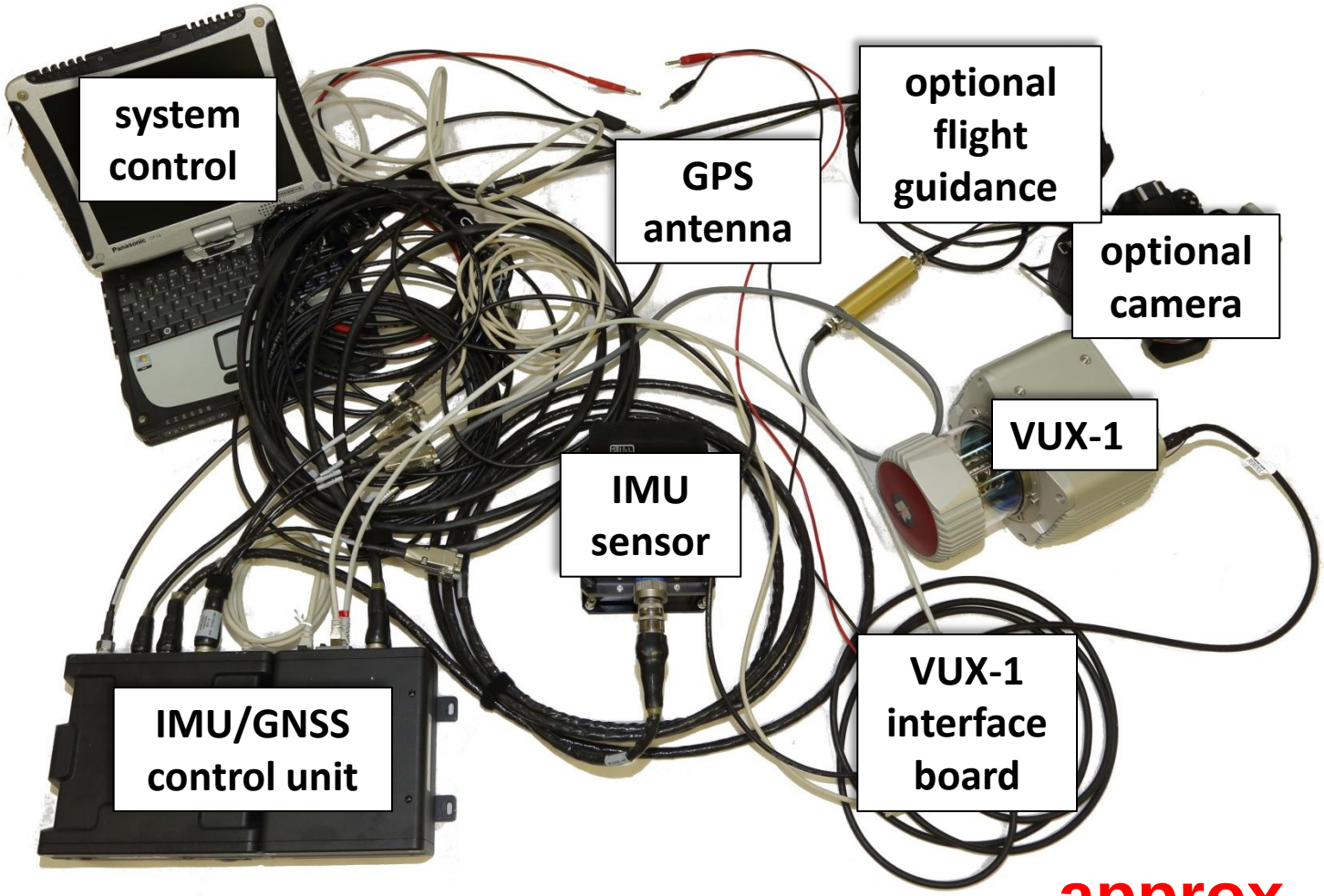
# Samples data: power line survey





# VUX-1 system integration

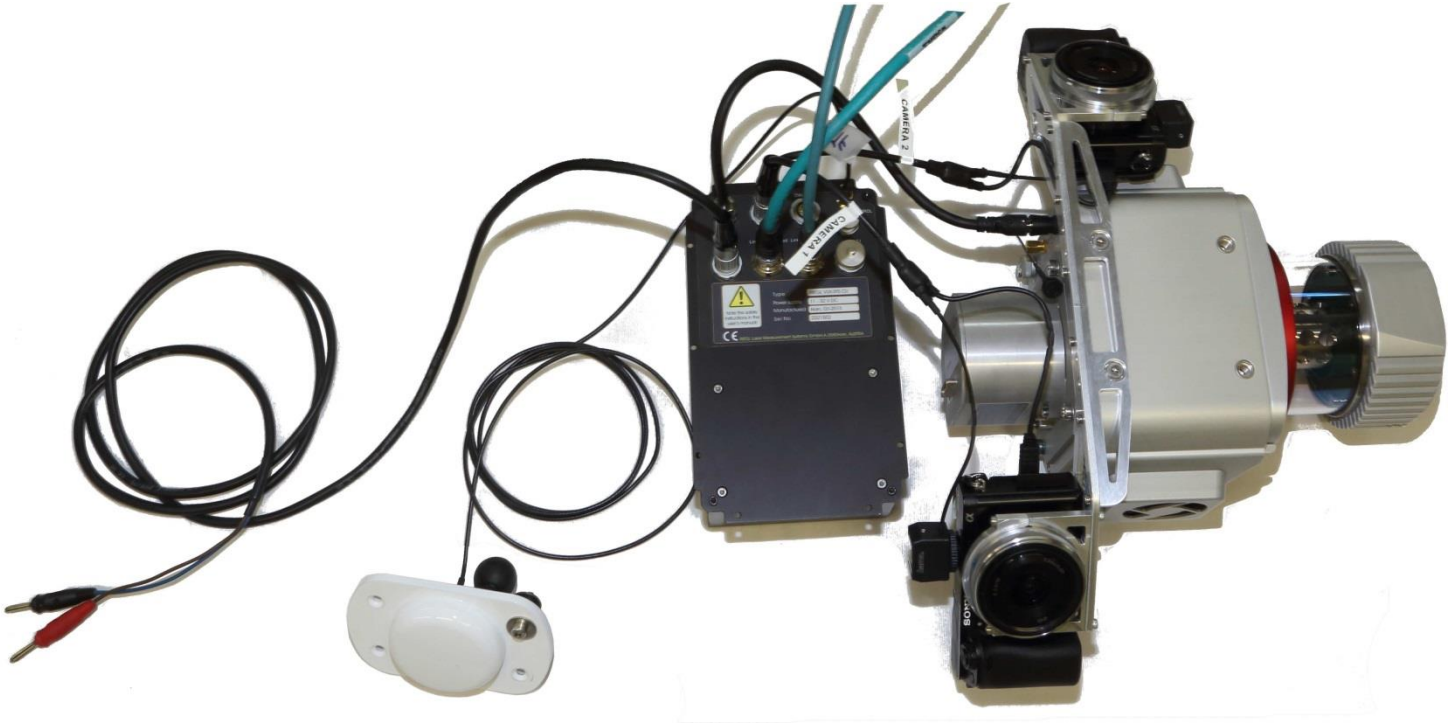



**approx. 17 kg**

# VUX-SYS integration for ALS

**approx. 10 kg**

# VUX-SYS integration for ULS




**approx. 6.5 kg**

# What is the *RIEGL* VUX-SYS?

**RiCOPTER with *RIEGL* VUX-SYS**

**VP-1 with *RIEGL* VUX-SYS**

**RIEGL VUX-SYS**

control unit
GPS receiver

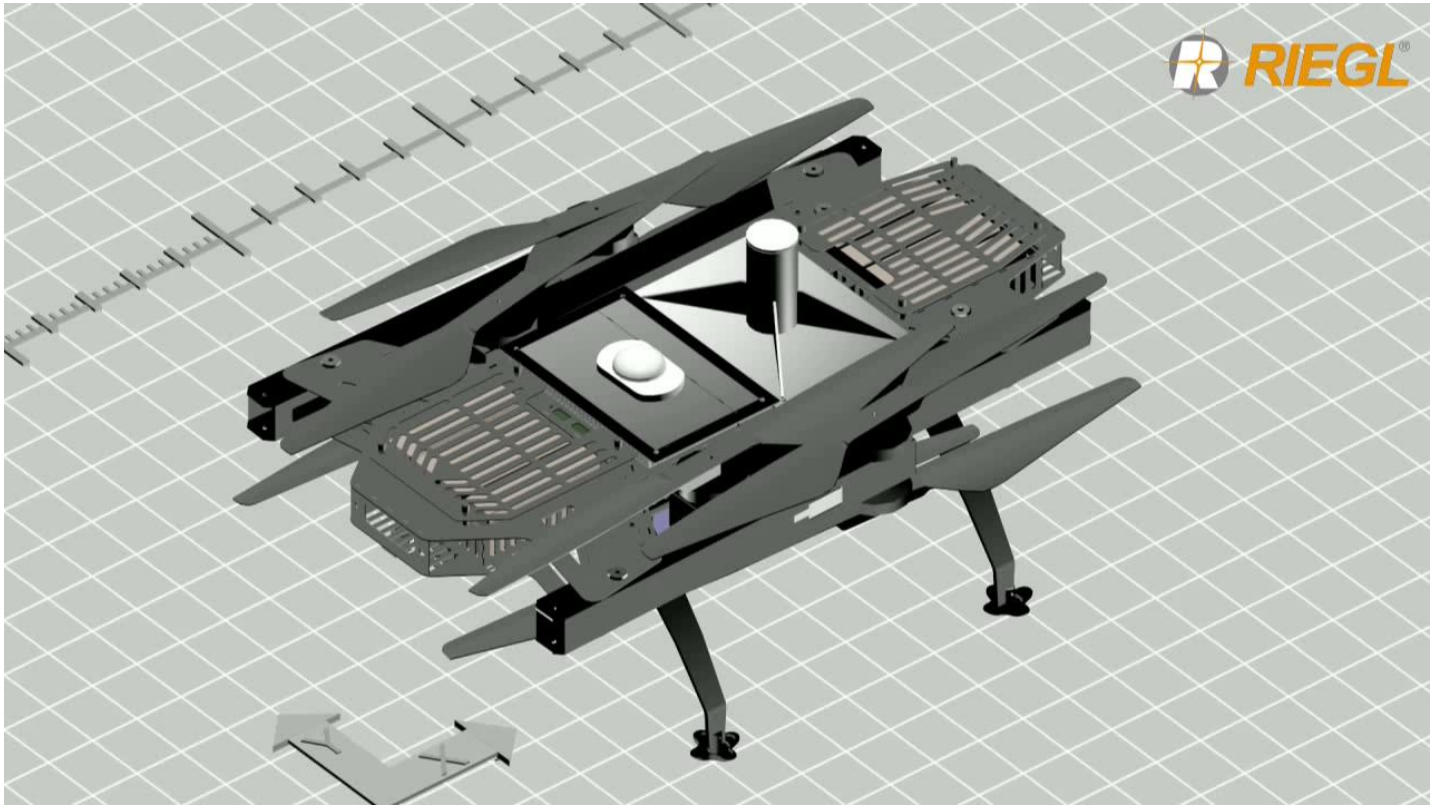
**RIEGL VUX-1**

camera

inertial
meas. unit

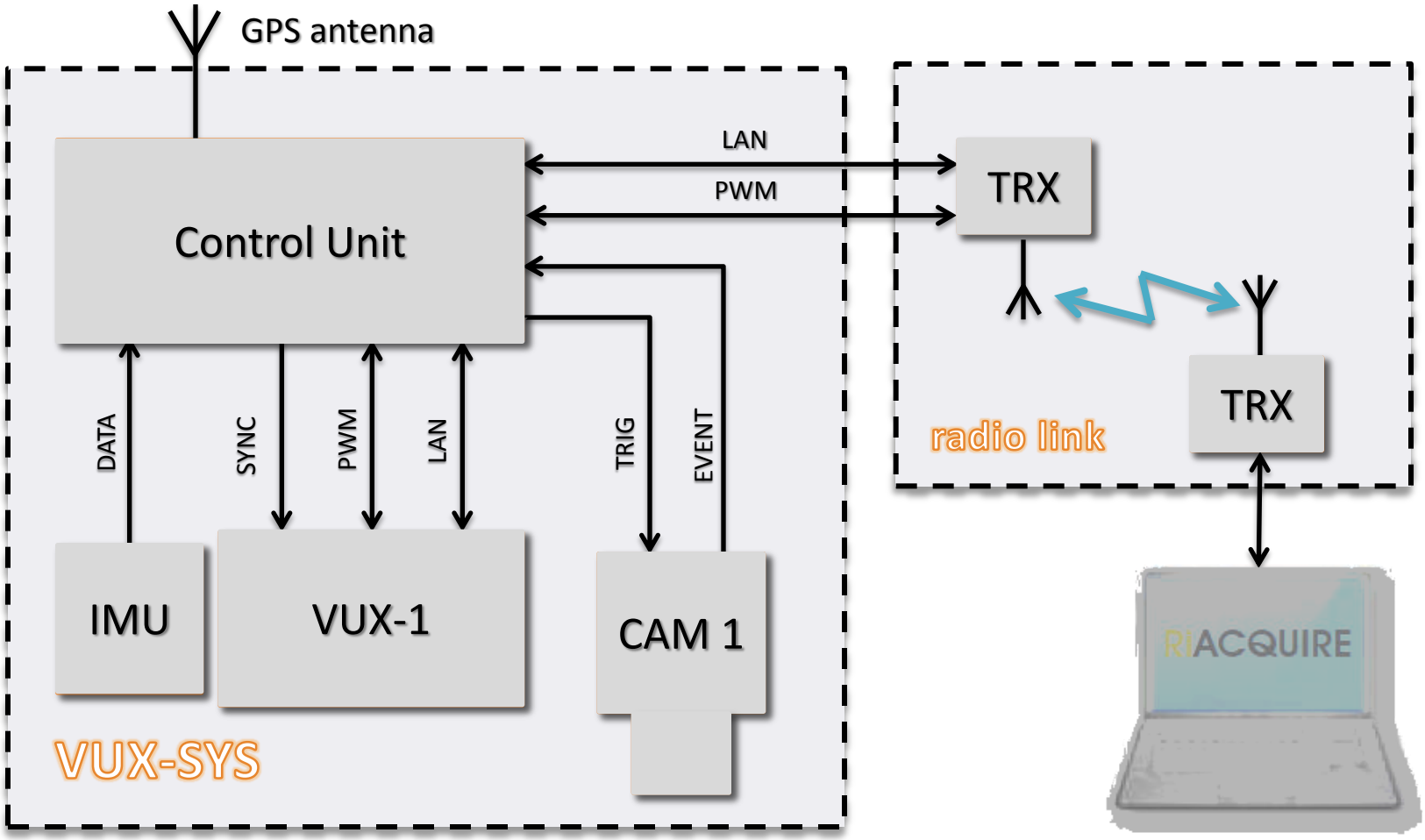
# The VUX-SYS inside the RiCOPTER

# RiCOPTER – fully integrated solution

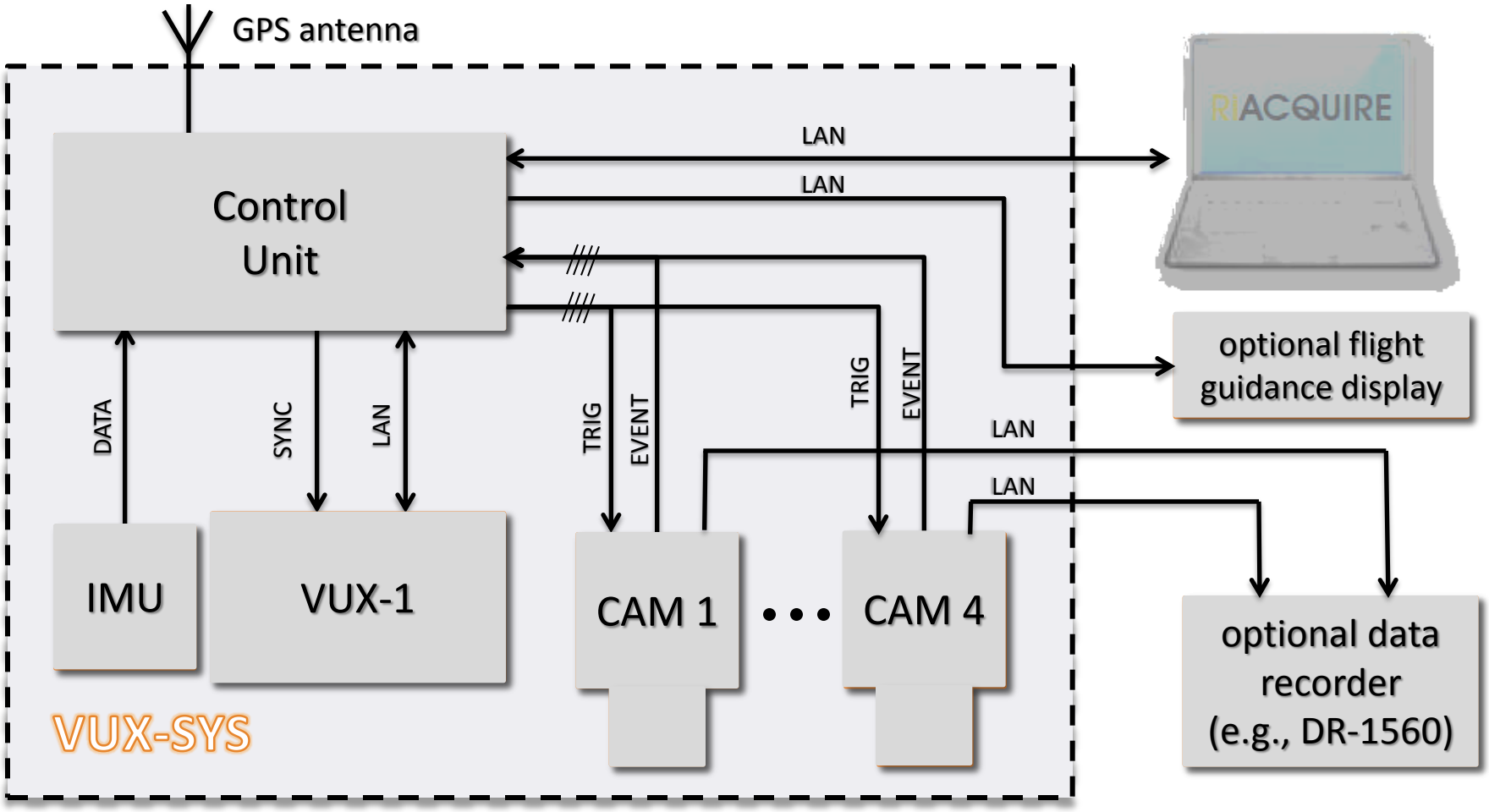



- Fully integrated turnkey solution
  - <25 kg take-off weight
  - 8 kg sensor payload
  - 30 minutes + endurance
  - Optimized for operation of VUX-SYS with camera

# VUX-SYS remote control capability



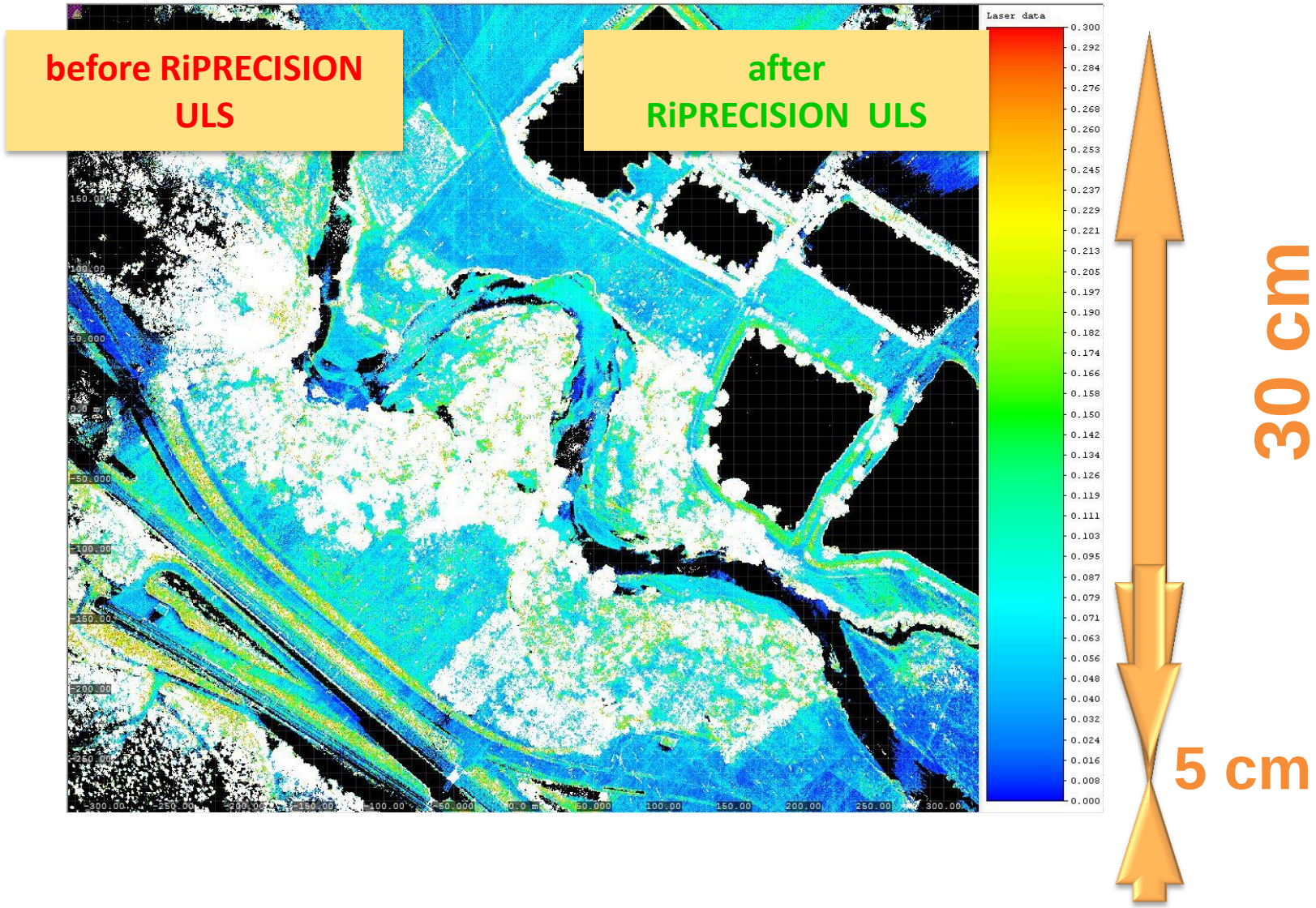
# VUX-SYS conventional ALS setup



# The VUX-SYS with the VP-1 helicopter pod

# The VUX-SYS with the VP-1 helicopter pod

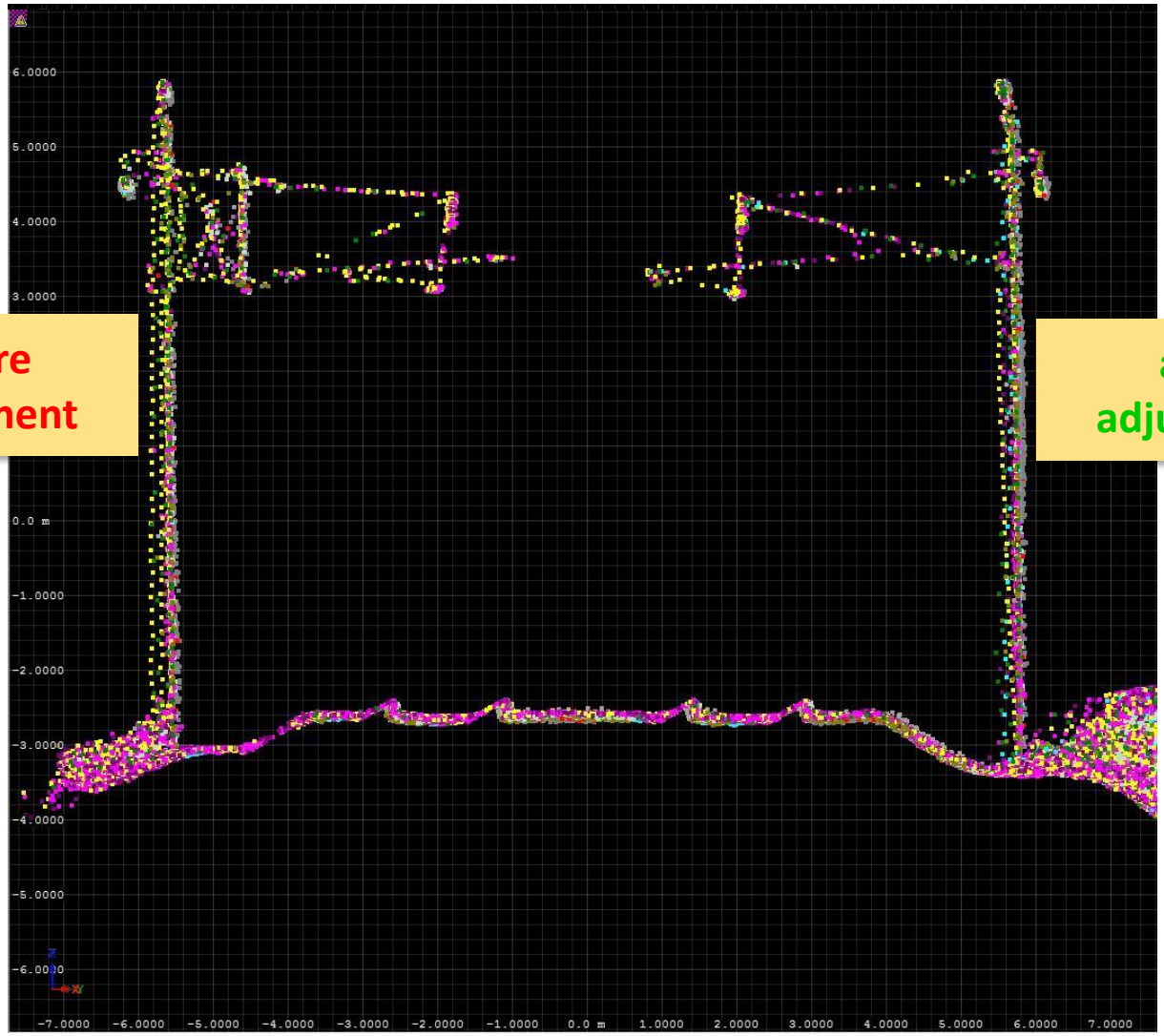
# RiPRECISION ULS – sample data



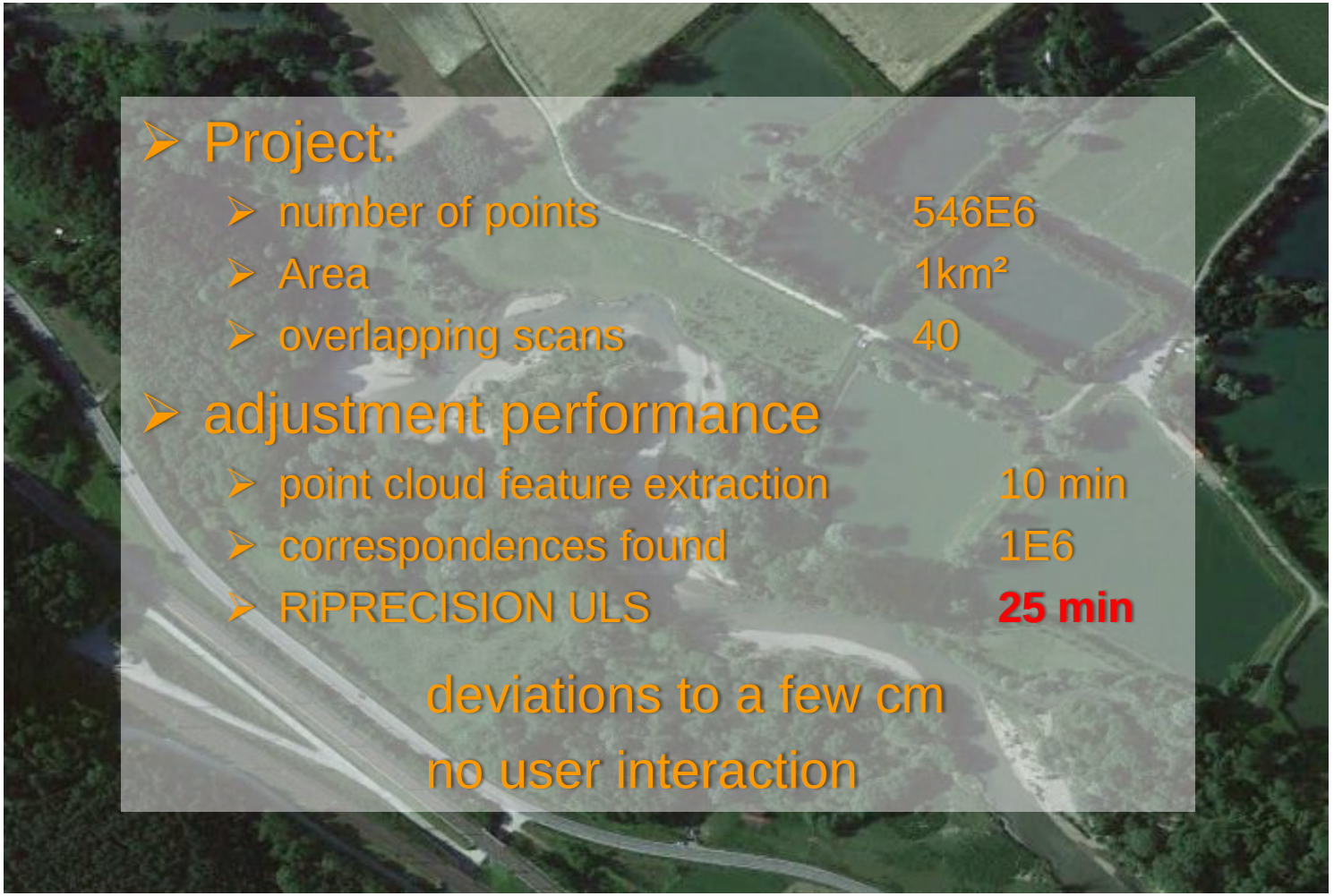
# RiPRECISION ULS – sample data

before adjustment

after adjustment



# Complementary Software - RiPRECISION



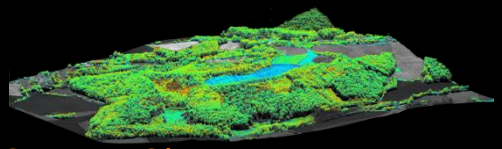
- Project:
  - number of points 546E6
  - Area 1km²
  - overlapping scans 40
- adjustment performance
  - point cloud feature extraction 10 min
  - correspondences found 1E6
  - RiPRECISION ULS **25 min**

deviations to a few cm

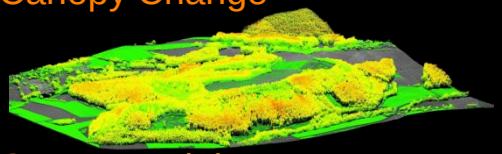
no user interaction

# Environmental Monitoring

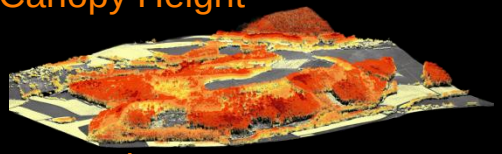
Layers of Information



Canopy Change

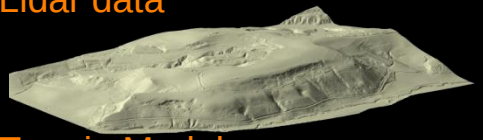


Canopy Height

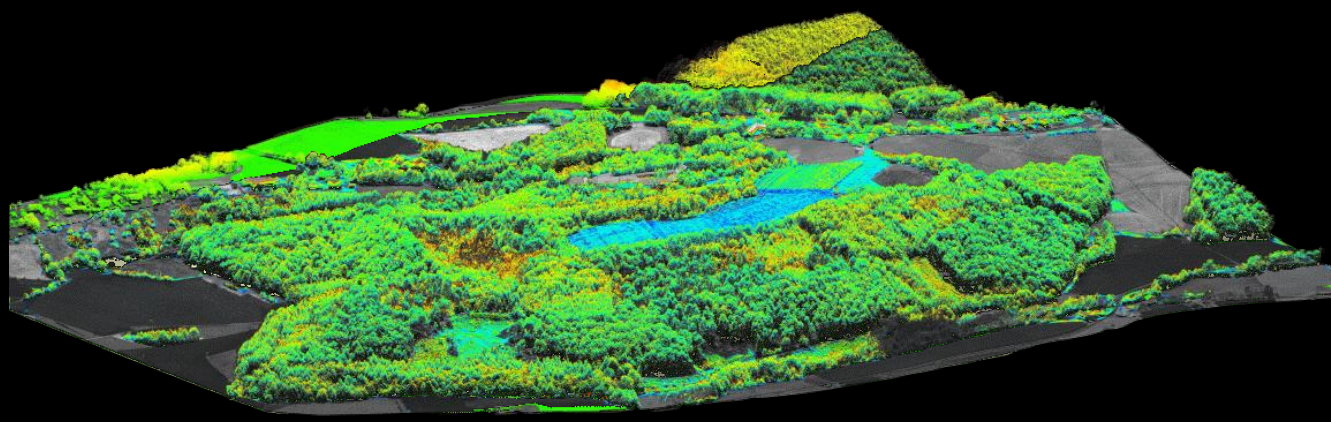


Vegetation

Lidar data



Terrain Model



Canopy Change
Canopy Height
Vegetation
Lidar data
Terrain Model

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# *RIEGL* laser measurement systems

TLS

ALS/ULS

MLS

ILS

# New *RIEGL* Terrestrial Laser Scanners

## *RIEGL* V-line 3D laser scanners

| | Middle | RIEGL VZ-400i NEW | ng | RIEGL VZ-2000 NEW | ry Long range | Ultra Long Range |
|---|---|---|---|---|---|---|
| | RIEGL VZ | | GL V | | RIEGL VZ-4000 | RIEGL VZ-6000 |
| | | | | | | |
| | | IMU MEMS inside | | | | Snow & Ice |
| **Vert FOV:** | | 100 deg | 0 de | 100 deg | 0 deg | 60 deg |
| **PRR:** | | 1.2 MHz | 0 kH | 1 MHz | 300 kHz | 300 kHz |
| **Range:** | | 800 m | 400 | 2050 m | 4000 m / 10 000 m | 6000 m / 12 000 m |
| **Rotation speed:** | | 150°/sec | 0°/s | 150°/sec | 0°/sec | 60°/sec |

# New scanners - new possibilities

600 m VZ-400 300 kHz

**800 m VZ-400i 1.2 MHz**

1400 m VZ-1000 300 kHz

**2050 m VZ-2000 1.0 MHz**

4000 m VZ-4000 300 kHz

6000 m VZ-6000 300 kHz

330m 976kHz

270m 1MHz

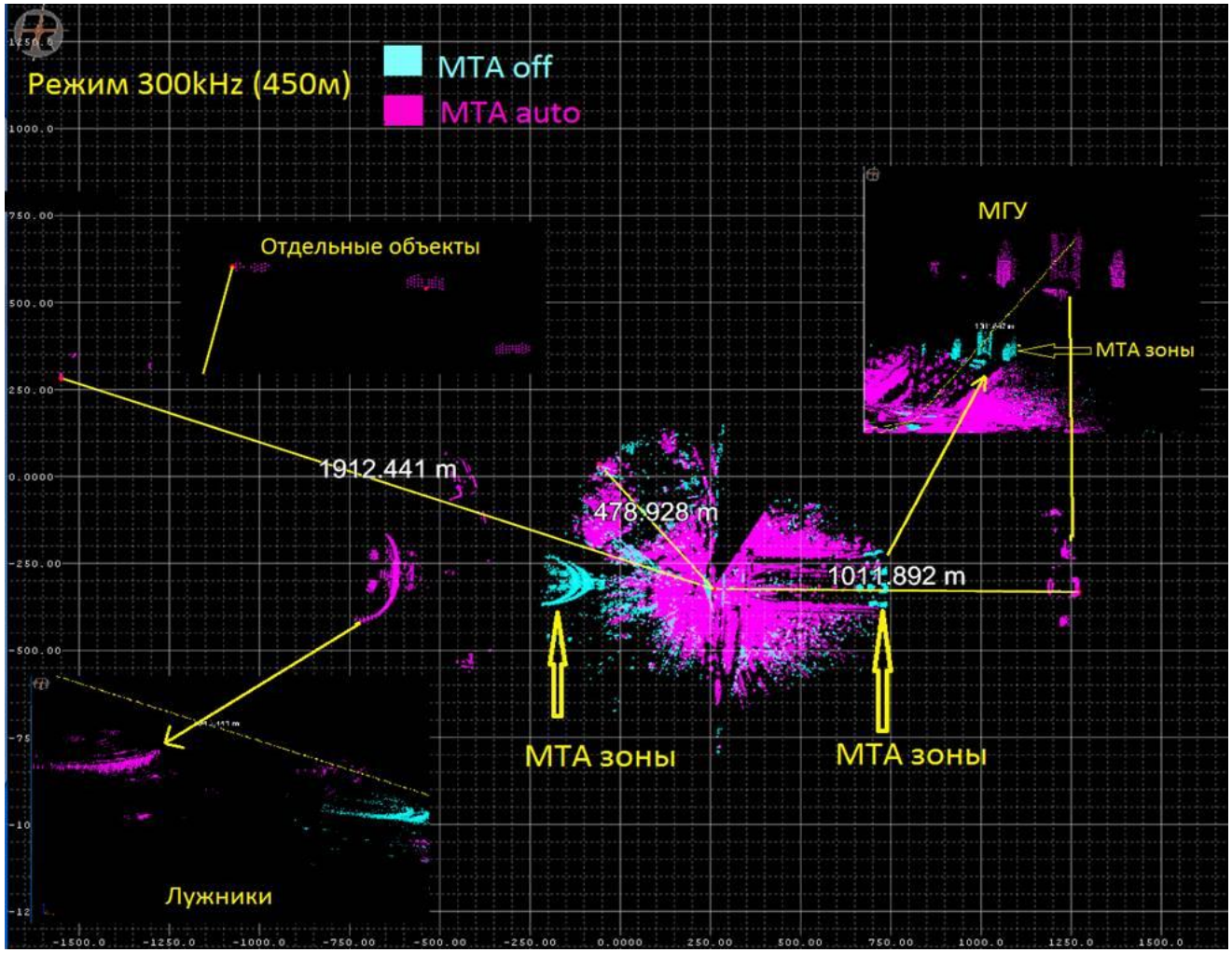
187m 1MHz

2000m 80kHz

3000m 10kHz

# *RIEGL* Multiple Time Around (MTA) zones

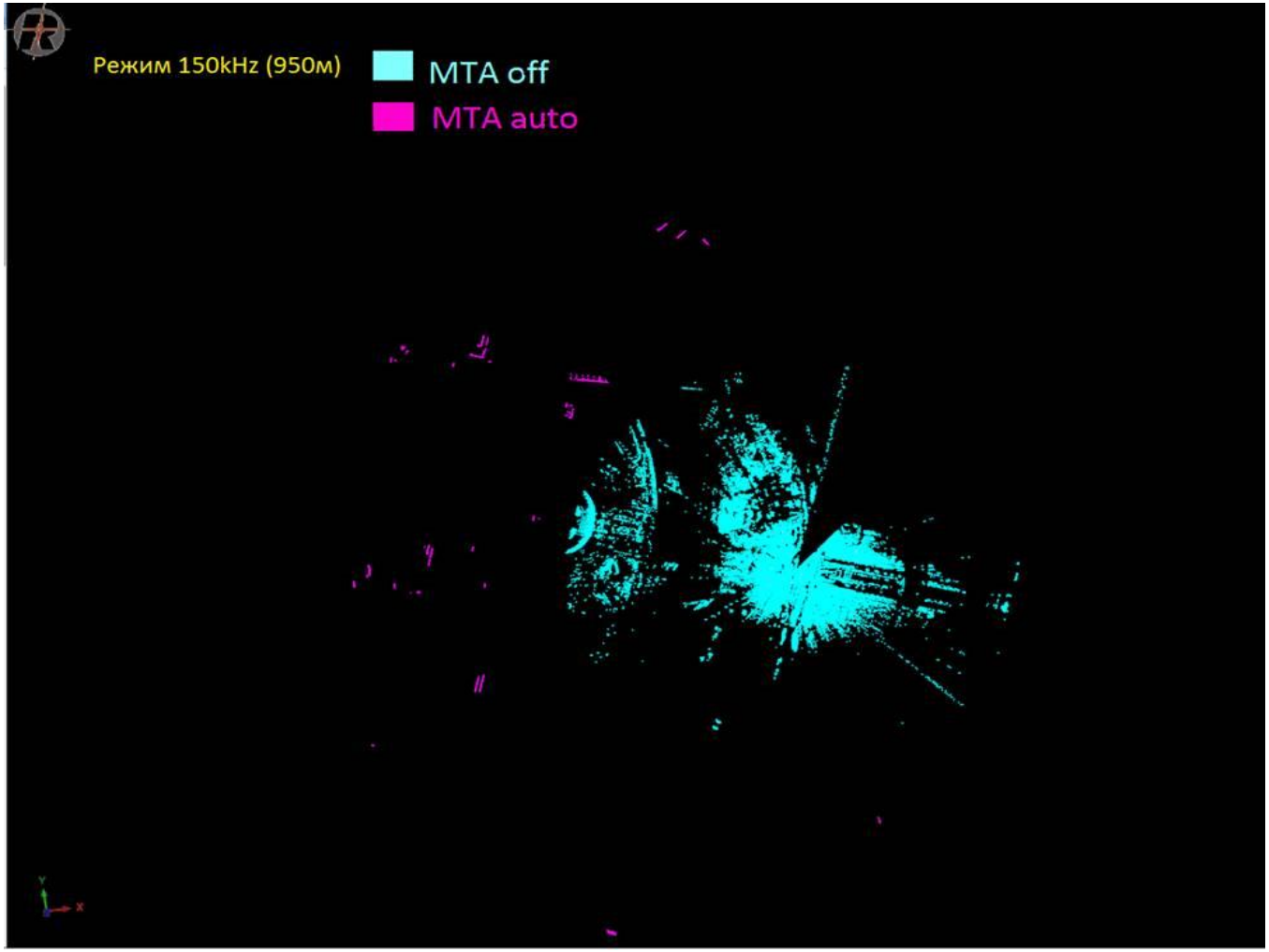
## *RIEGL* VZ-1000 (300 kHz / 450 m)




В этом режиме сканер показал самое лучшее соотношение «прироста» дальности и детализации. Получены отражения от объекта на расстоянии почти 2 км. При этом ближняя зона разрешения неоднозначности (MTA1) ограничена по ТТХ расстоянием в 450 метров.

# *RIEGL* Multiple Time Around (MTA) zones

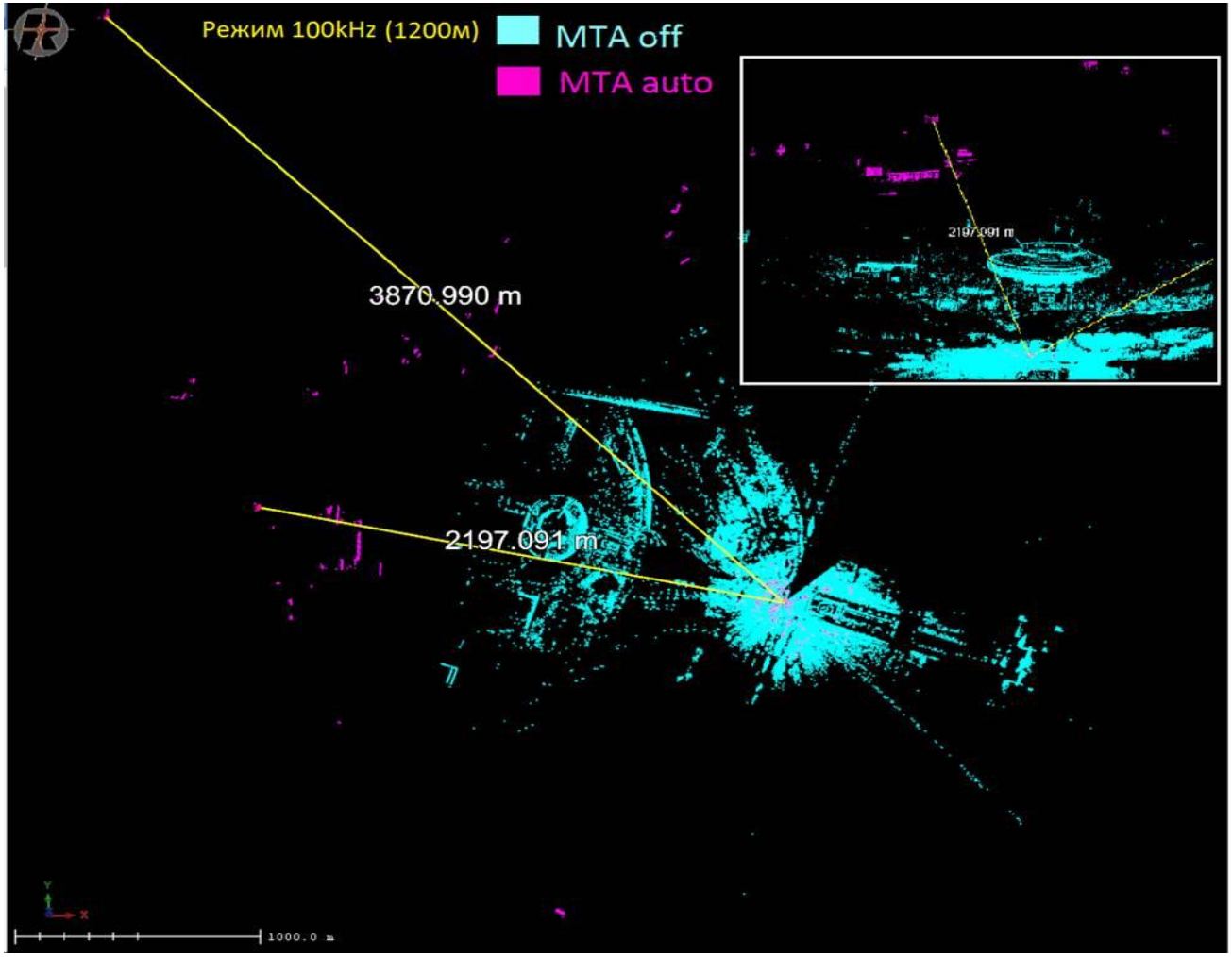
## *RIEGL* VZ-1000 (150 kHz / 950 m)




В режиме 150kHz ближняя зона разрешения неоднозначности (MTA1) ограничена в ТТХ расстоянием 950 метров. После обработки с помощью RiMTA в автоматическом режиме получены отражения от объектов на расстояния до 1900 метров.

# *RIEGL* Multiple Time Around (MTA) zones

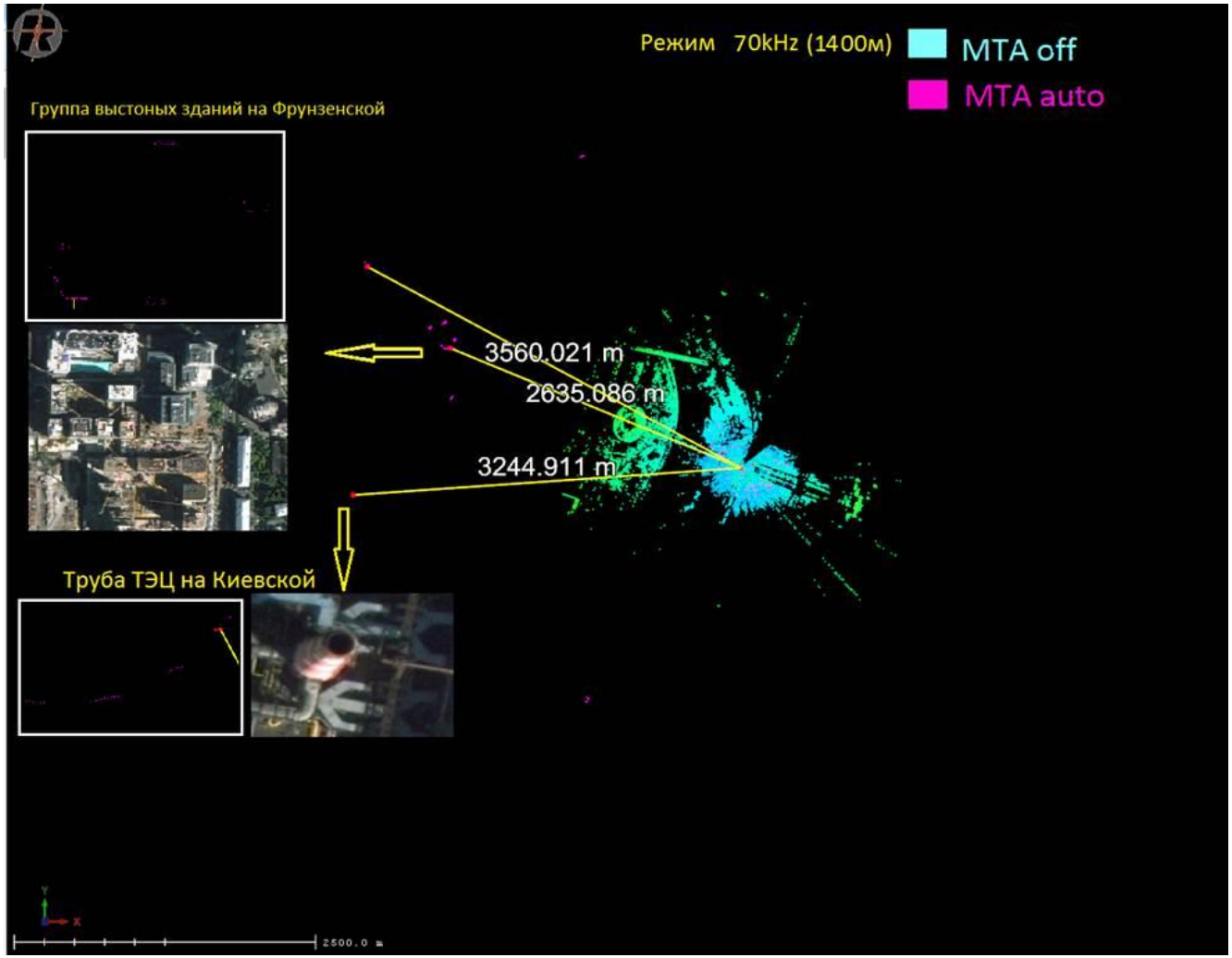
## *RIEGL* VZ-1000 (100 kHz / 1200 m)




В этом режиме сканером были получены отражения от объекта на расстоянии почти 3900 метров (высотное здание БЦ “Gorky Park Tower” Ленинском проспекте) в среднем около 2 км. Максимальная дальность измерений в первой зоне разрешения неоднозначности в этом режиме составляет 1200 метров.

# *RIEGL* Multiple Time Around (MTA) zones

## *RIEGL* VZ-1000 (70 kHz / 1400 m)




Максимальная дальность измерений в первой зоне неоднозначности (MTA1) при частоте 70kHz ограничена дальностью 1400 м. Однако сканером были получены отражения от объектов (зданий) на расстояниях от 2600 до 3500 м.

# New *RIEGL's* vision in scanning

- Stream scandata transfer via WiFi and LTE;
- Storage data in the cloud;
- Pre-process data in the field;
- Final processing by remote person

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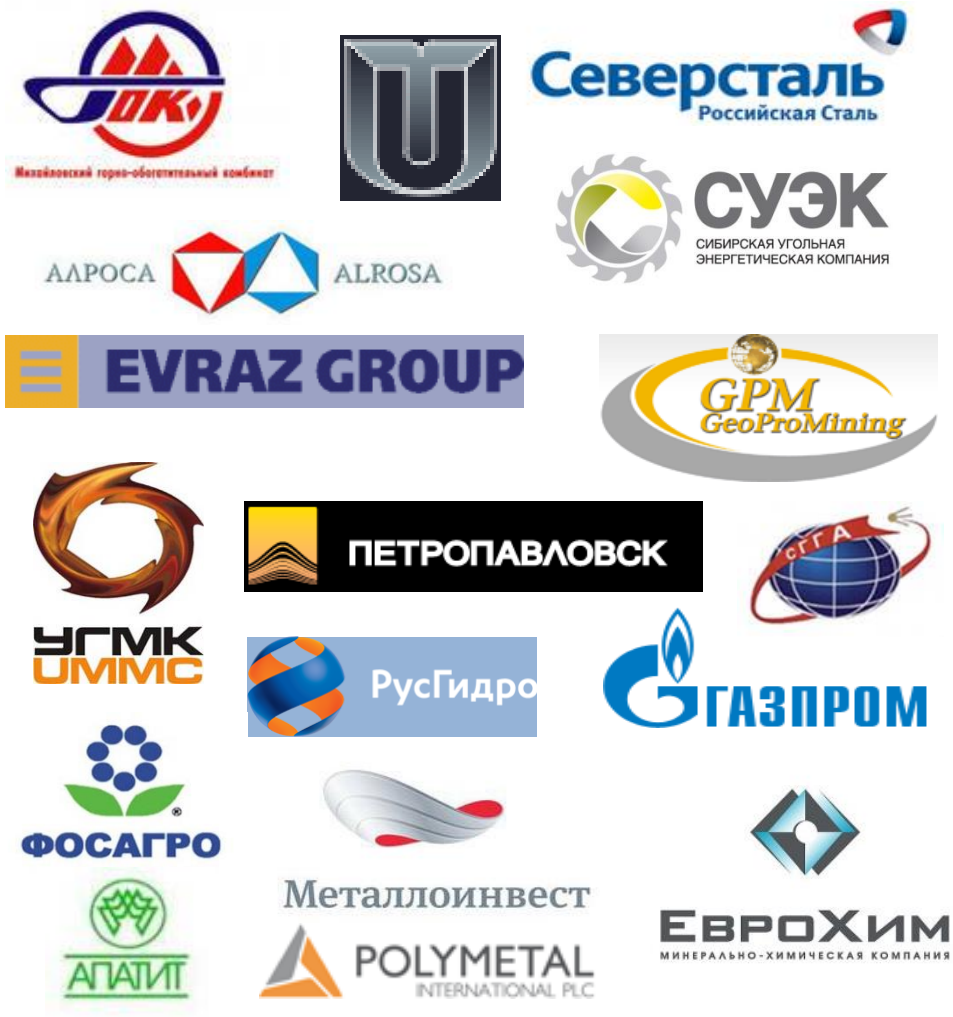
# Different scales of LIDAR applications

ALS
MLS
TLS/ILS
ULS

# End-users of *RIEGL* laser scanners

- In Russia successfully works more than 60 units of *RIEGL* laser scanners of various modifications. Some businesses have several laser scanner RIEGL different models.

- Users of *RIEGL* laser scanners are both private and public companies and organizations as well as institutions of higher education.



# Thank you for attention!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