

**GE**  
**SMART**  
**ASIA 2018**



**Locate**  
#Locate18



WHEN

**9 – 11 APRIL 2018**

WHERE

**ADELAIDE, AUSTRALIA**

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**RIEGL**<sup>®</sup>



**GPS LANDS**  
(M) SDN BHD

**GE**<sup>™</sup>  
**SMART**  
**ASIA 2015**

**RIEGL VUX-SYS on RiCOPTER,  
a fully integrated UAV-based  
Airborne Laser Scanning System**



**C S LIM**

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## Content

- Why ULS (**U**n**m**anned **L**aser **S**canning)  
Advantages of this new technique
- *RIEGL* VUX-1 series LIDAR engine
- *RIEGL* VUX-SYS, a fully integrated system
- *RIEGL* RiCOPTER, a powerful UAV carrying platform
- Example data from different applications

# ULS entering the surveying market



# Different scales of LIDAR applications



## UAV hype – why with LIDAR?

- LIDAR advantages
  - long range and high accuracy
  - penetration of vegetation
  - excellently suited for surveying of feature-poor areas
  - independent of ambient light
- UAV advantages for LIDAR
  - quick deployment
  - flexibility of vantage point
- ULS is reducing entry-level barrier for using advanced LIDAR technology

## VUX-1 series

- survey-grade LIDAR instrument
- lightweight: only 3.6 kg
- compact package:  
227 x 180 x 125 mm<sup>3</sup>



### VUX-1 Series:

- VUX-1UAV
- VUX-1HA **High Accuracy**
- VUX-1LR **Long Range**

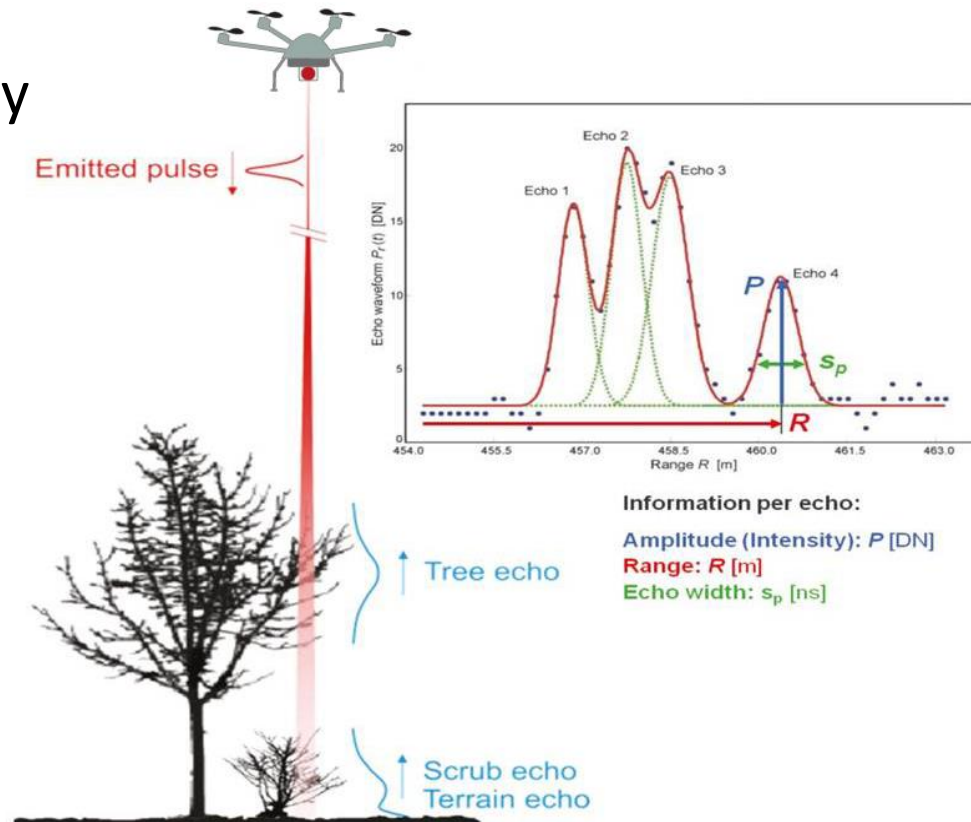
World Premiere at  
**RIEGL LIDAR 2015**

# VUX-1 series



online waveform processing technique enables

- multiple target capability
- high measurement accuracy
- calibrated reflectance





# VUX-1 series

## 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

## NEW RIEGL VUX®-1HA High Acc

- compact, rugged and very lightweight design
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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	<b>5 mm</b>
Precision	<b>3 mm</b>
Max. Effective Measurement Rate	<b>1,000,000</b>
Max. Scan Speed	250 scans/s
Field of View (FOV)	<b>355°</b>

**Typical Applications**

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

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	<b>5 mm</b>
Precision	<b>3 mm</b>
Max. Effective Measurement Rate	<b>1,000,000 meas./sec</b>
Max. Scan Speed	250 scans/sec
Field of View (FOV)	<b>355°</b>

**Typical Applications**

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

## RIEGL VUX®-1LR Long Range

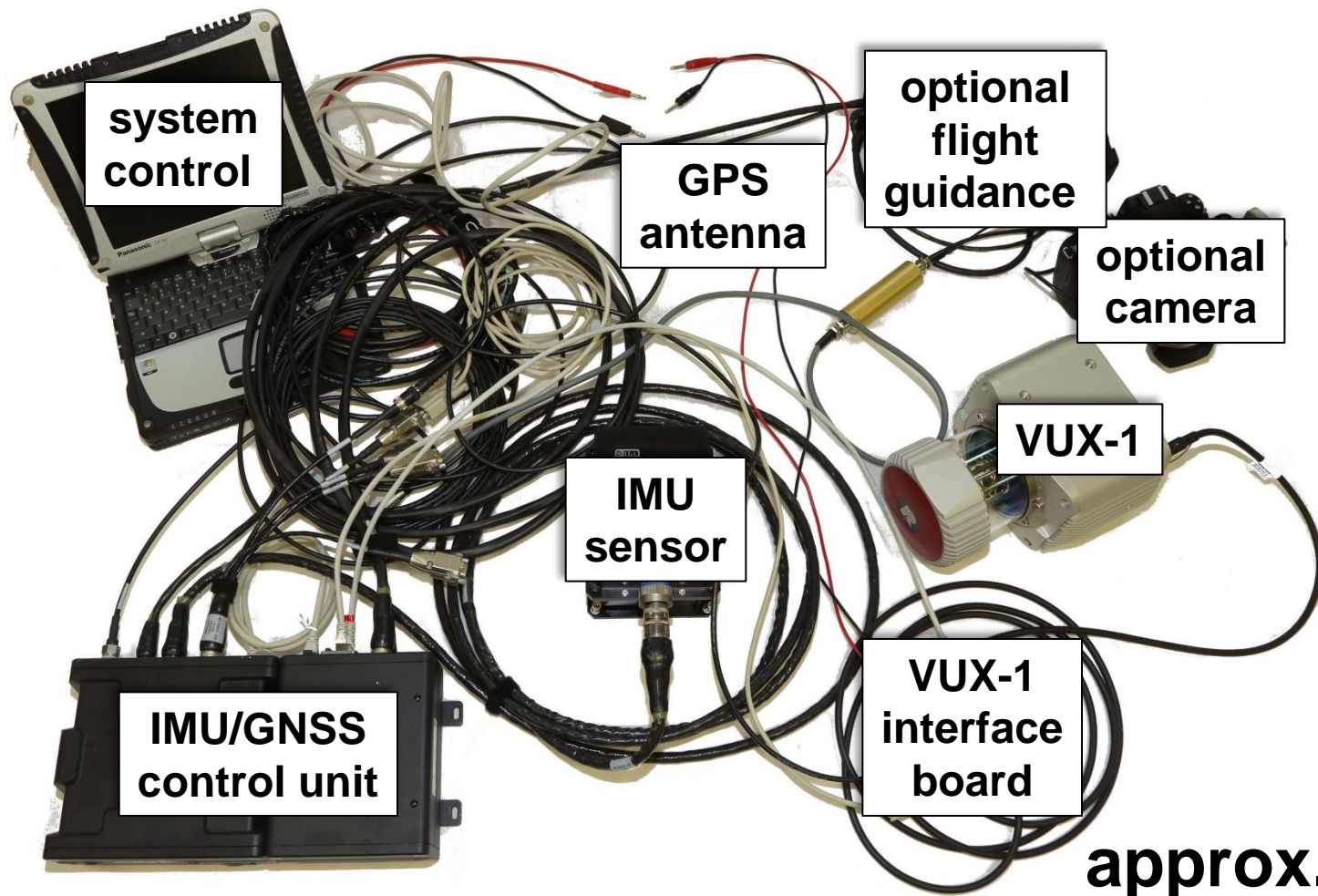
compact, rugged and very lightweight design  
 ideal for airborne surveying from helicopters  
 or 330°  
 integrated system solution RIEGL VP-1 Helipod  
 for user-friendly mounting to helicopters

Eye Safety Class	Laser Class 1
Max. Range @ Target Reflectivity 60%	<b>1,350 m</b>
Max. Range @ Target Reflectivity 20%	<b>820 m</b>
Minimum Range	5 m
Precision	15 mm / 10 mm
Max. Measurement Rate	<b>750,000 meas./sec</b>
Max. Scan Speed	200 scans/sec
Field of View (FOV)	330°
Max. Flight Altitude AGL	<b>530 m / 1,740 ft</b>

**Typical Applications**

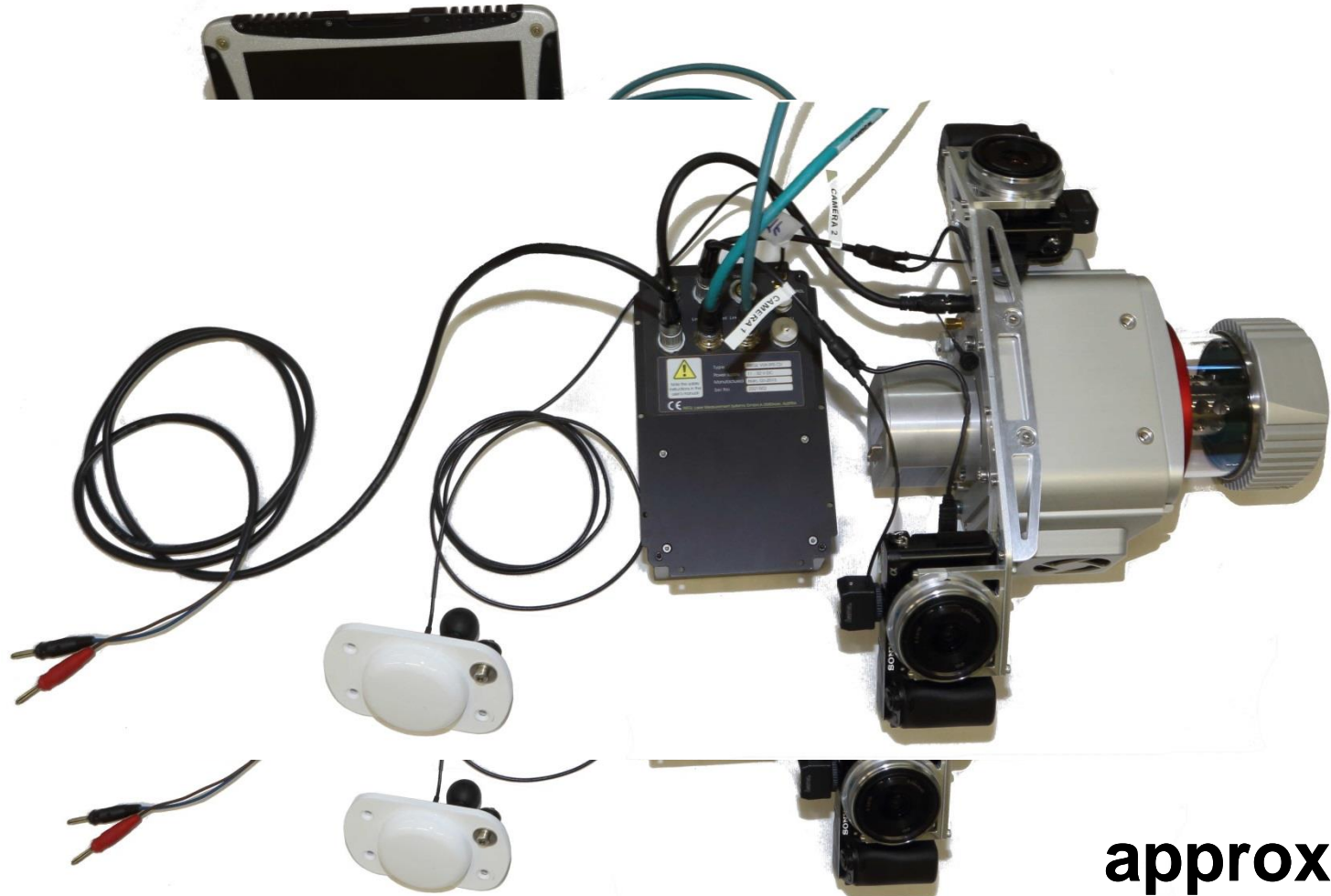
- indoor and outdoor laser mapping
- tunnel profile measurements
- railway applications like clearance analysis, etc.

# DIY system integration



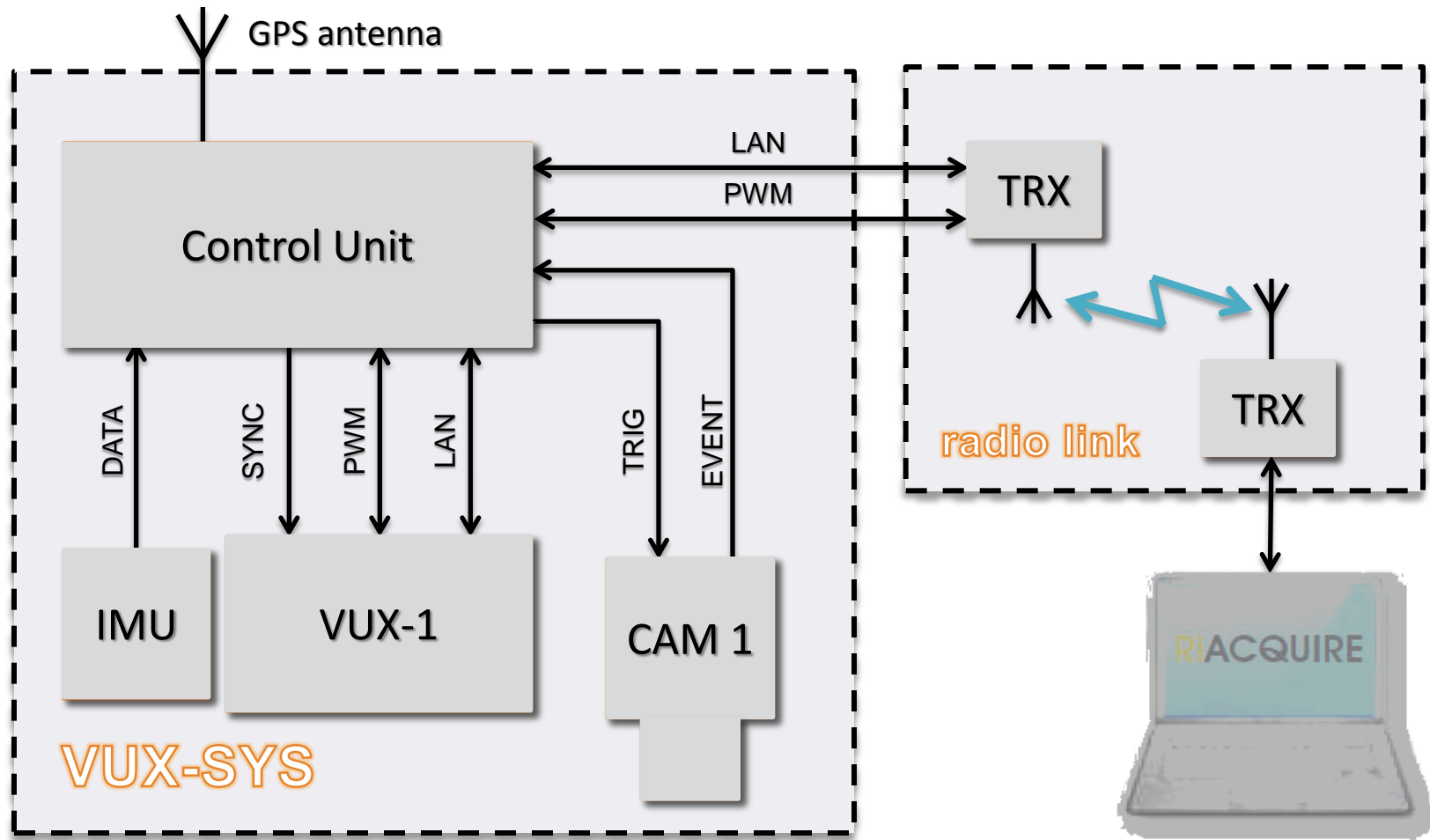
approx. 17 kg

# VUX-SYS integration fbs&Up for ALS



**approx. 605kg**

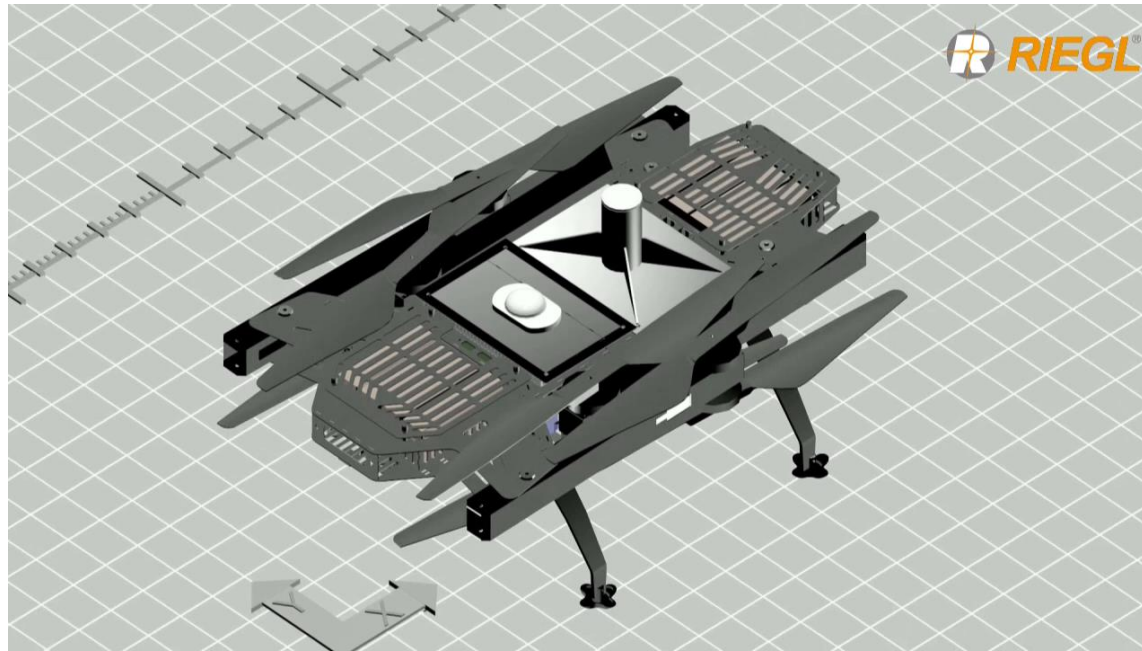
# VUX-SYS remote control capability



The VUX-SYS inside the

RICOPTER



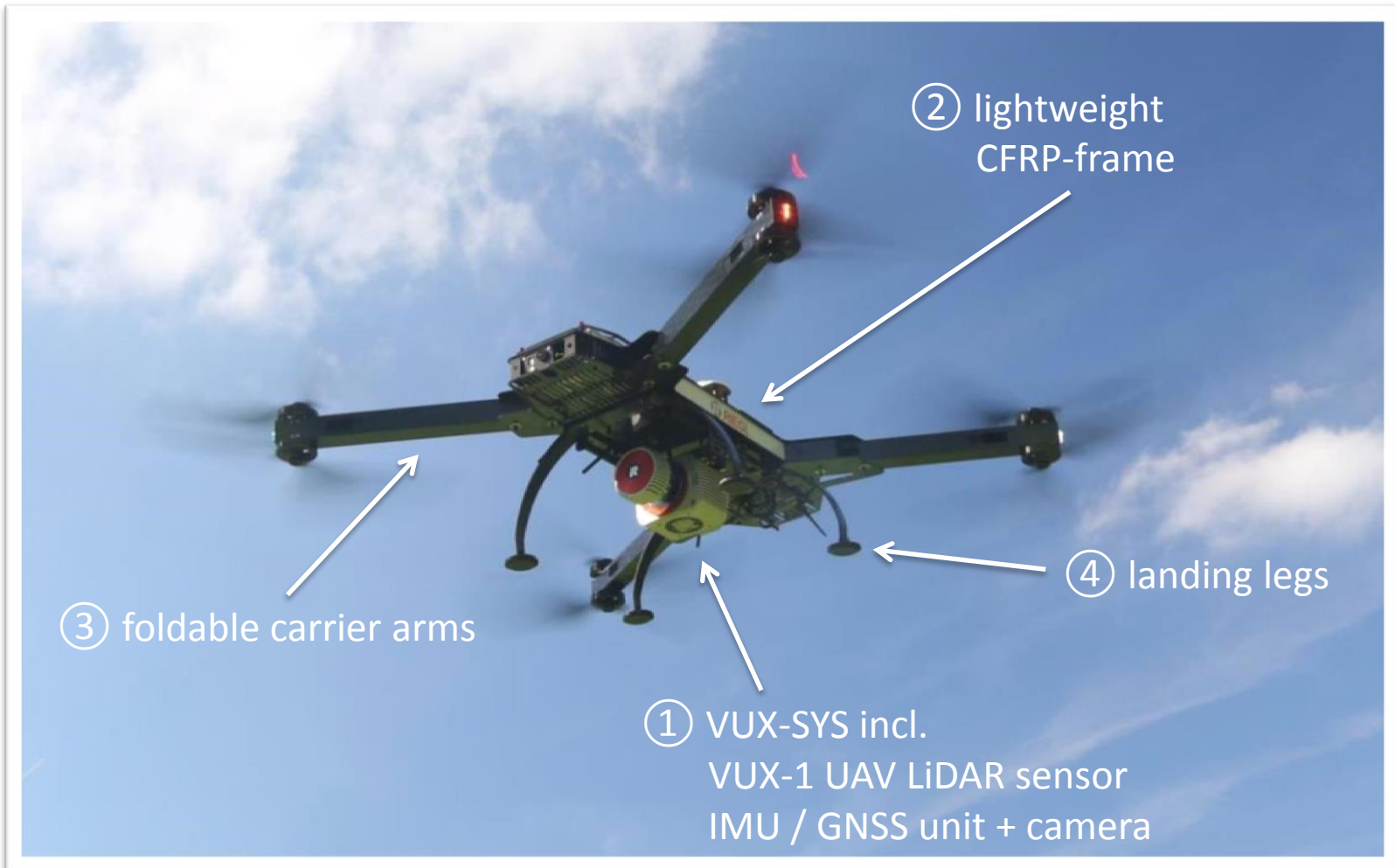


- Fully integrated turnkey solution
  - <25 kg take-off weight
  - 8 kg sensor payload
  - 30 minutes endurance
  - Optimized for operation of VUX-SYS including cameras

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

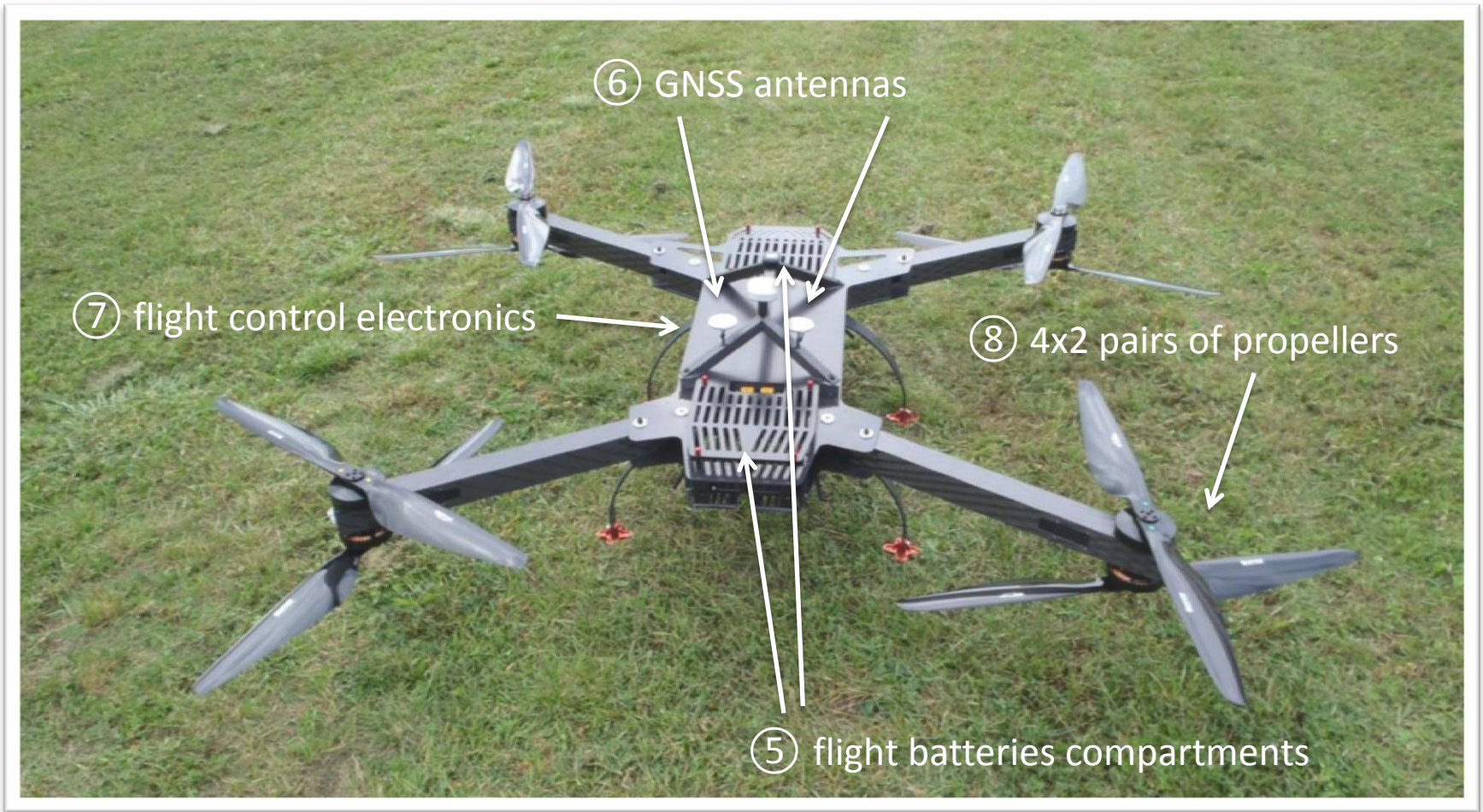


## RICOPTER – System Set-up (1)

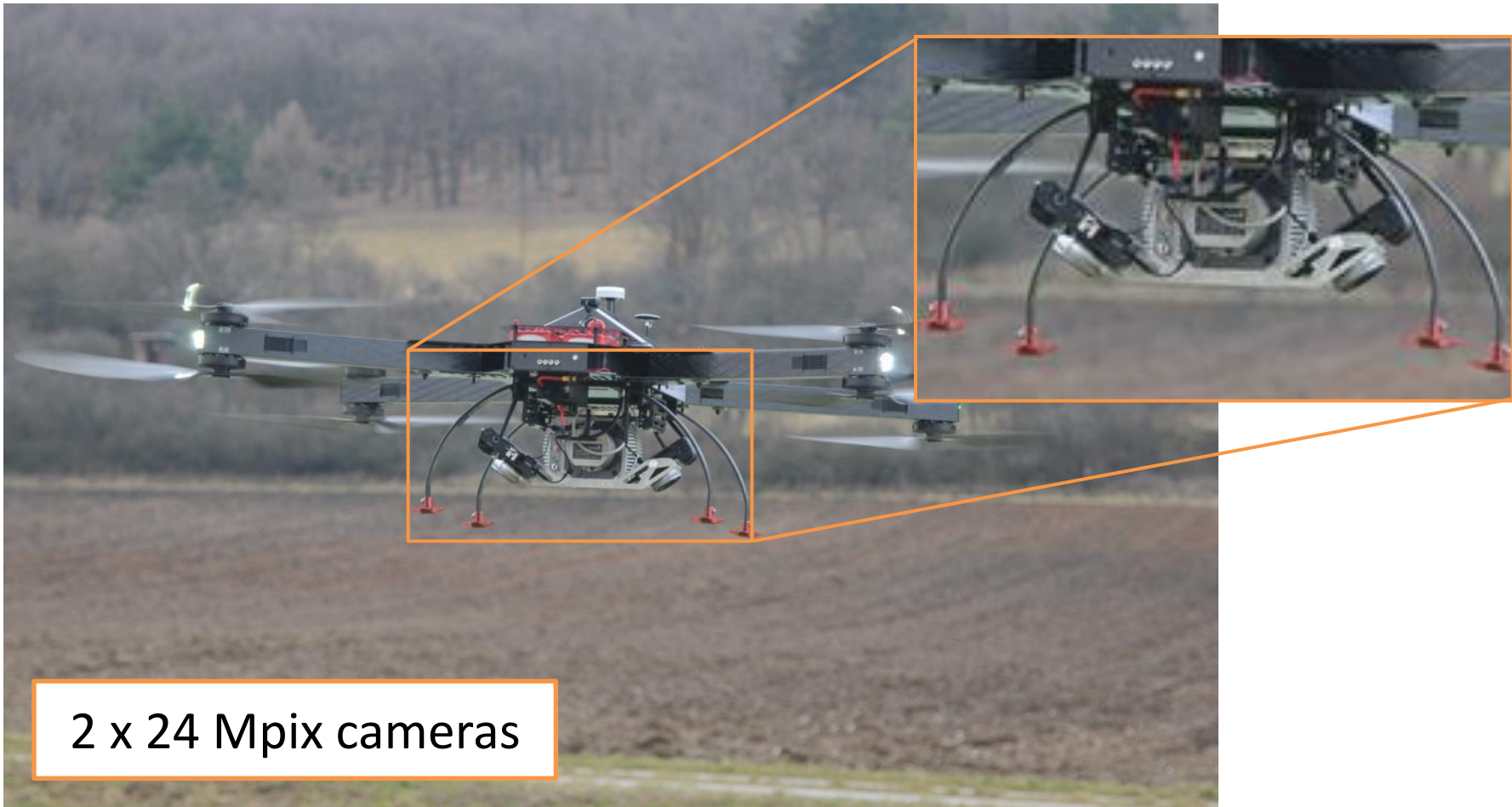




## RICOPTER – System Set-up (2)



## RiCOPTER – camera system



# Ground station



**Weight: 16 kg**

**RIEGL RICOPTER**

- Battery: 15.00 V (35 %)
- GPS: 9
- Telemetry: 100 %
- Control mode: Auto
- Downlink: yes
- Uplink: yes
- State: armed
- Altitude: 15.27 m
- Altitude AMSL: 379.29 m
- Altitude AGL: 15.33 m
- Elevation: 363.96 m
- Vertical speed: 0.04 m/s
- Horizontal speed: 0.33 m/s
- Latitude: 48°41'40.92"N
- Longitude: 15°36'40.79"E

Pitch: 2, Roll: 0, Heading: 77, Course: 313

## Charging station

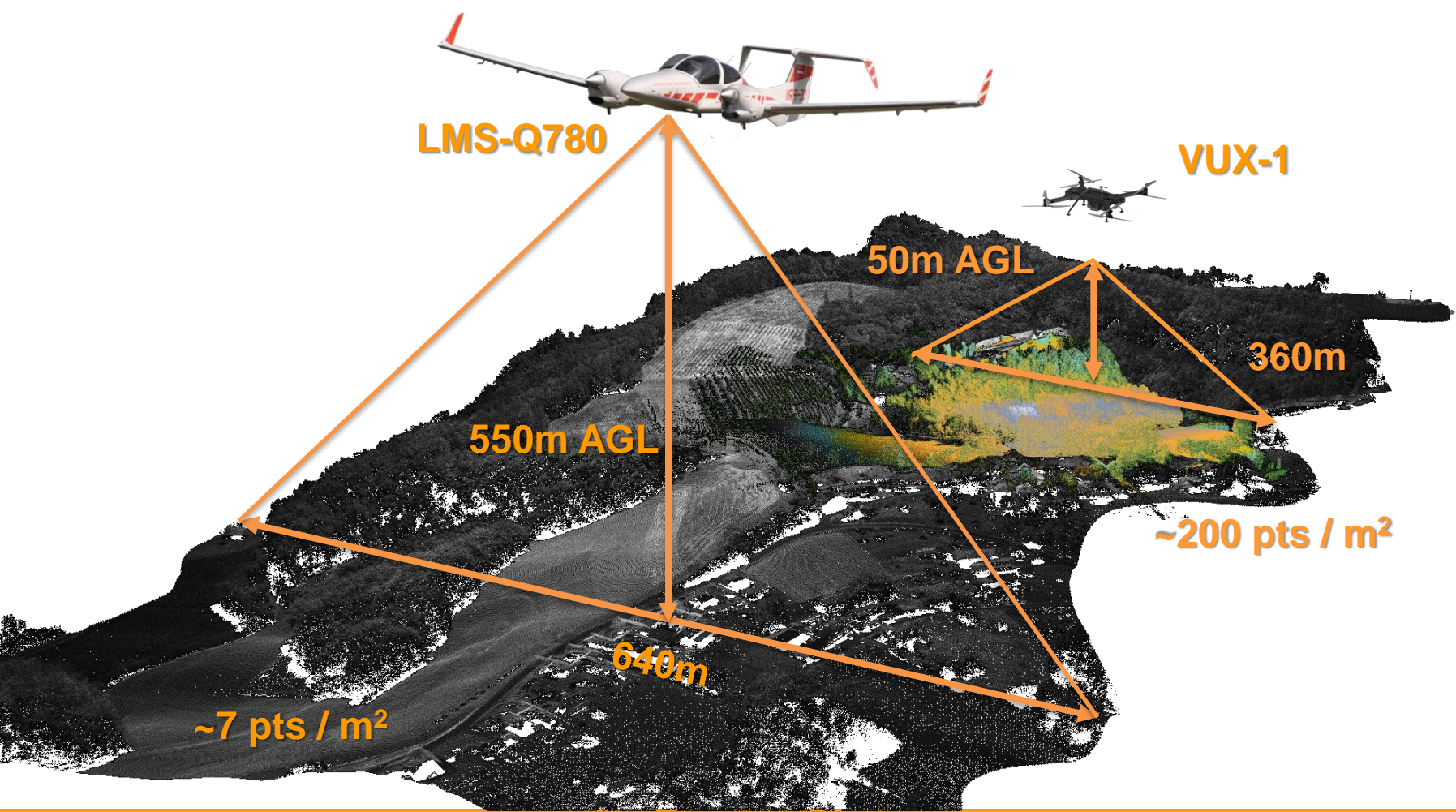
- Professional charging station for RiCOPTER battery set
- 200 – 240 V / max. 2.600 Watt
- 4 loading slots for max. 13A each
- Loading time: approx. 1 hour for 1 set (4 batteries)



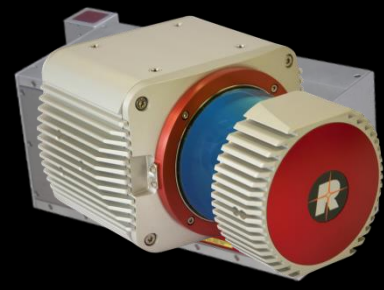
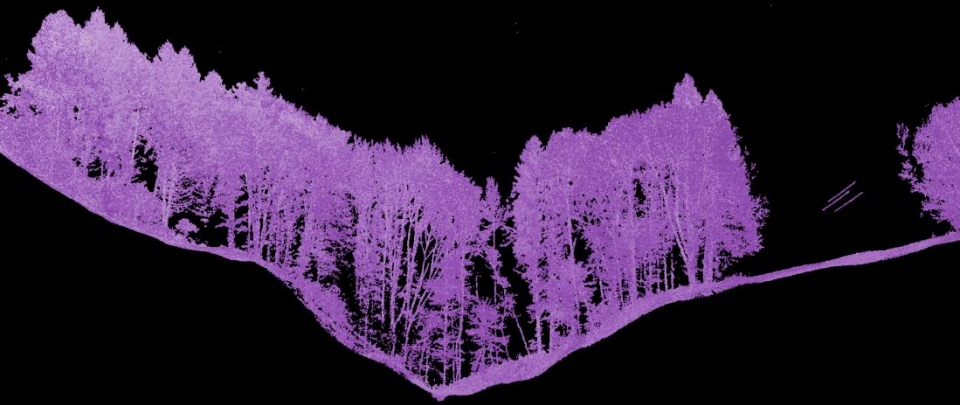
Weight: 26 kg



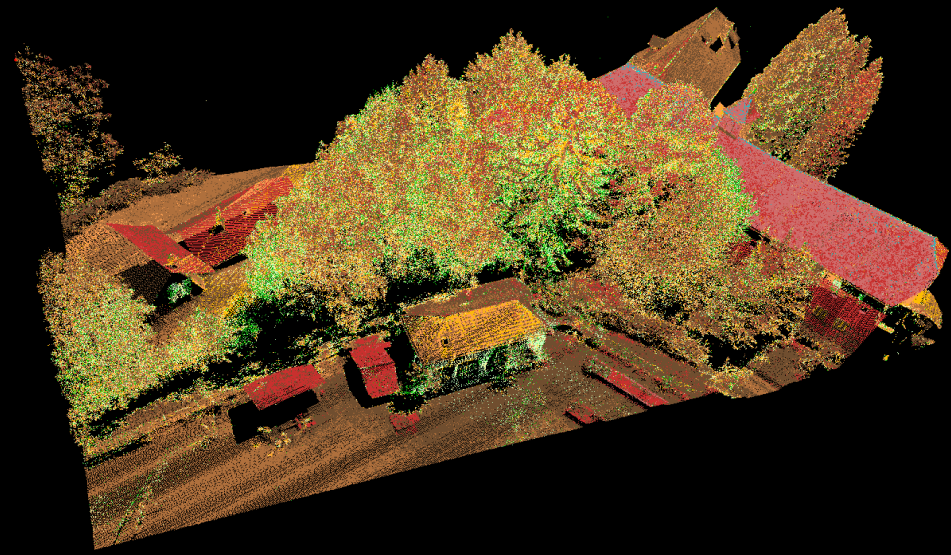
Sample data VUX-1 and LMS-Q780



Sample data VUX-1 and LMS-Q780

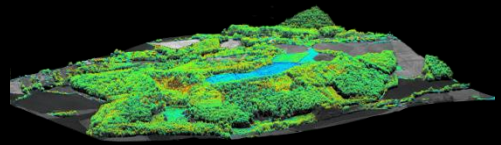


LMS/Q780, approx. 100.000 pts/m<sup>2</sup>

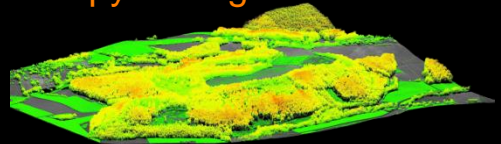


# Applicationental Monitoring

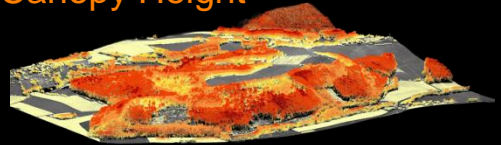
## Layers of Information



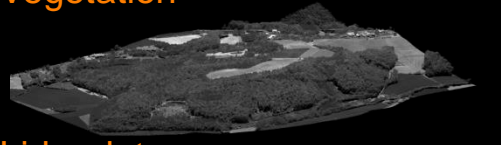
Canopy Change



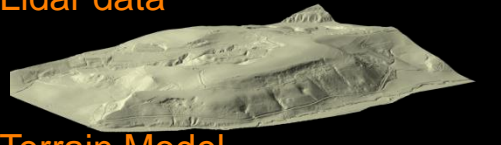
Canopy Height



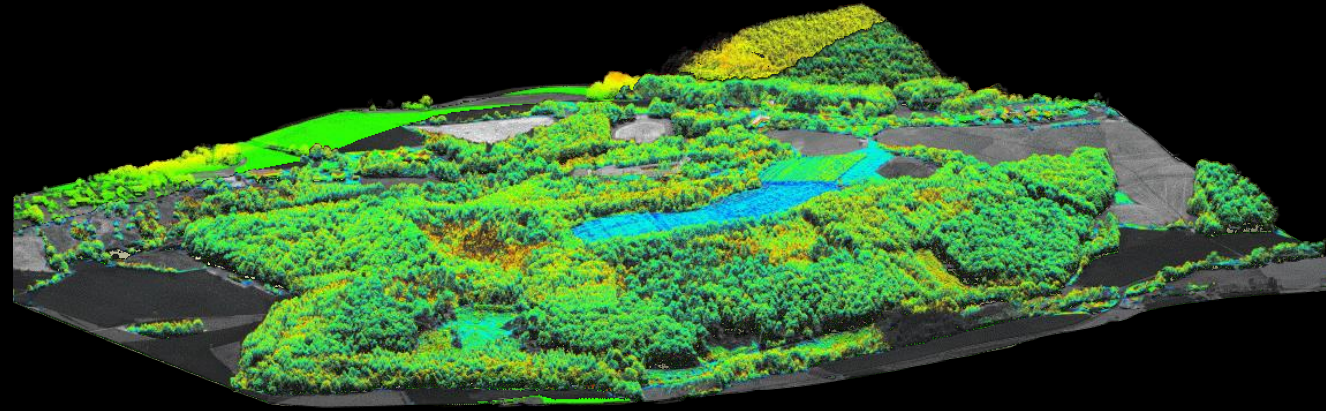
Vegetation



Lidar data

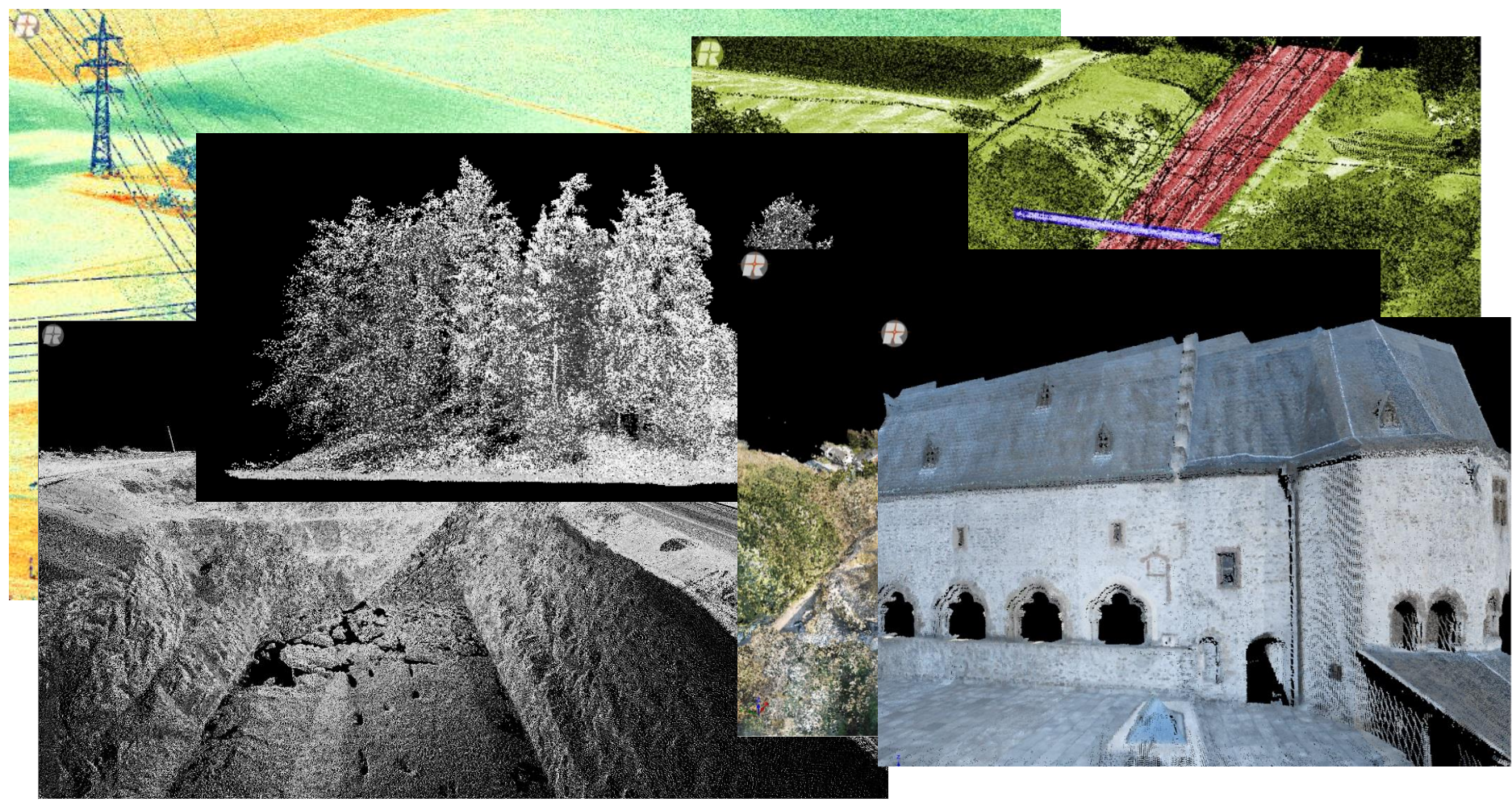


Terrain Model



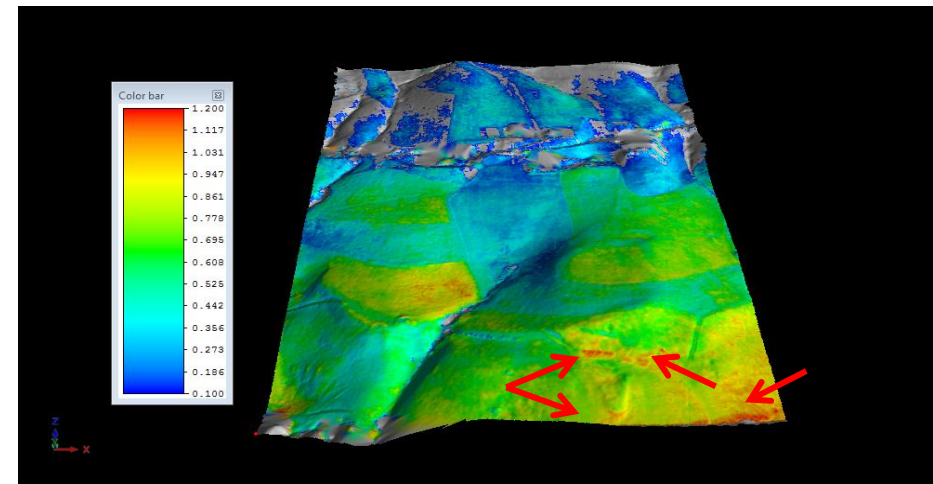
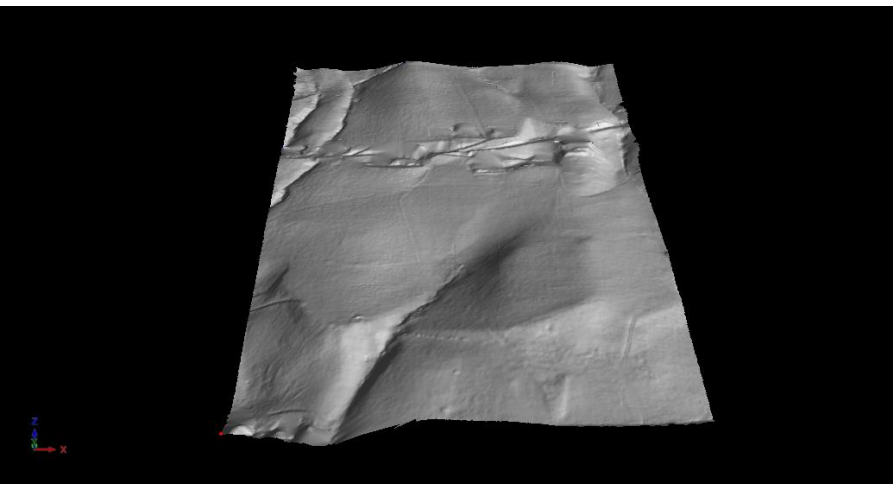
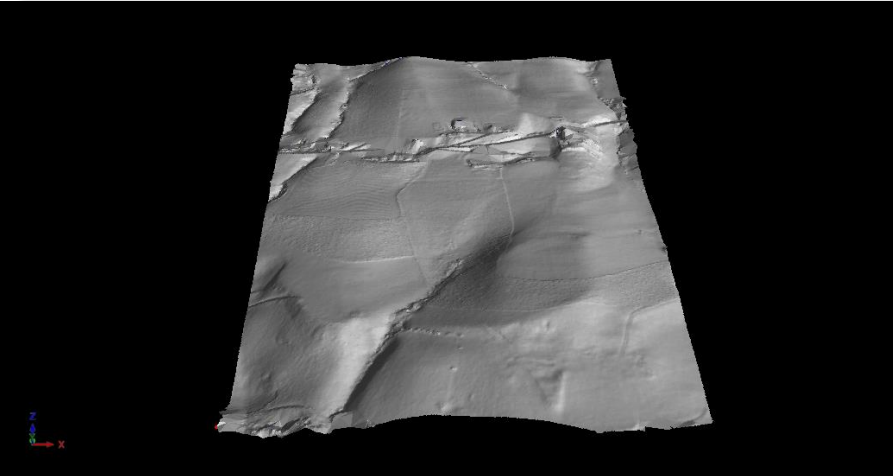
Vegetation Height

# ULS applications

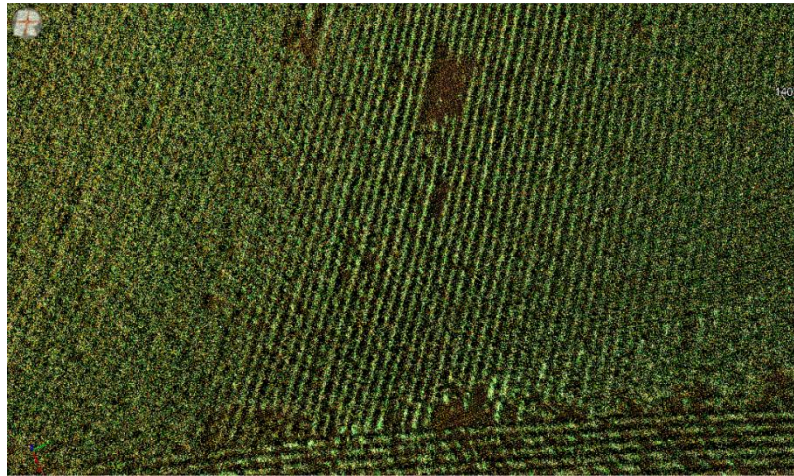
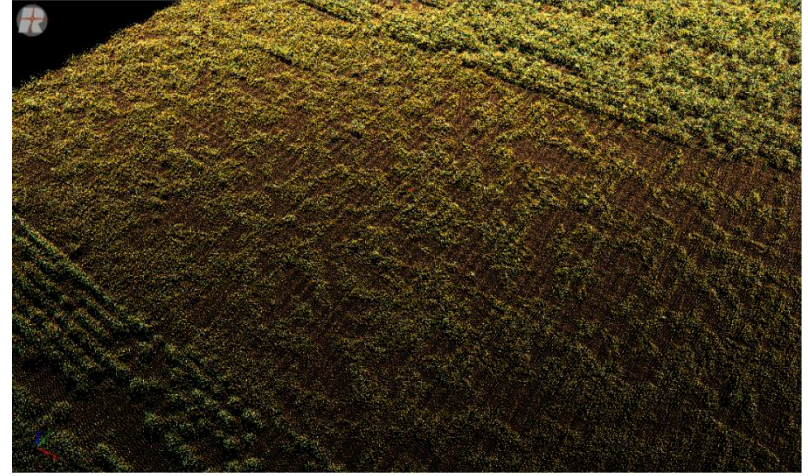
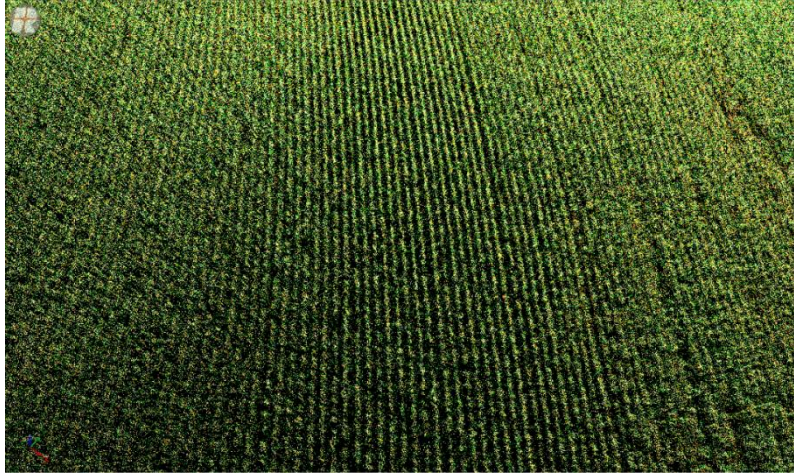




# Landslide survey and mapping



# Precision Farming



# Precision Farming



**RISCAN PRO v1.8.1 - [Object view: DTM\_0.25m (1252 x 747)]**

Project Edit View Tool Registration Window Help ?

Readout (PRCS) Project manager

- VUX1\_farming
  - CALIBRATIONS
  - COLLECTIONS
  - ANIMATIONS
  - OVERLAYS
  - CONFIGS
  - VALUES
  - VIEWPORTS
    - ViewPort01
    - ViewPort02
  - SCANS
    - ScanPos001
      - SCANPOSIMAGES
      - TIEPOINTSCANS
      - PROFILESCANS
      - UNDISTORTED IMAGES
      - POLYDATA
        - 140523\_Feld123\_truemax\_1m
          - Polydata001
          - Polydata002
          - Polydata003
        - ten01
        - ten02
        - DTM\_0.25m
      - SOP
      - TPL (SOCS)
      - TOL (SOCS)
      - 140523\_Feld4
      - 140523\_Feld123
    - ScanPos002
      - SCANPOSIMAGES
      - TIEPOINTSCANS
      - PROFILESCANS
      - UNDISTORTED IMAGES
      - POLYDATA
      - SOP
      - TPL (SOCS)
      - TOL (SOCS)
      - 140716\_Feld4

Object inspector

Active view: DTM\_0.25m  
Scanner coordinate system: ScanPos001

OBJECTS

- GL\_CAMERA (1)
  - GL\_Camera
- LIGHT\_SOURCES (1)
  - Light source
- POSITIONS (2)
  - ScanPos001
  - ScanPos002
- SCANS (2)
  - 140523\_Feld123 (ScanPos001)
  - 140716\_Feld123 (ScanPos002)
- POLYDATA (1)
  - DTM\_0.25m (ScanPos001)
    - POINTCLOUDS
    - TIEPOINTS
    - TIEOBJECTS
    - POINTS
    - POLYLINES
    - SECTIONS
    - PLANES
    - SPHERES
    - CYLINDERS
    - ORTHOPHOTOS
    - DISTANCES

Properties:

GL\_Camera

- Camera mode: Perspective
- Navigation mode: Free
- Position (X/Y/Z): 44639.923/28535.464/121
- Direction (X/Y/Z): 0.049/0.926/0.374
- Up (X/Y/Z): 0.038/0.373/0.927
- Scene scale: 1
- PRCS scale: 1.000/1.000/1.000
- Focal length: 100
- Near plane: 0.100
- Use auto depth:
- Depth of view: 71743.203

Units: [m] [deg]

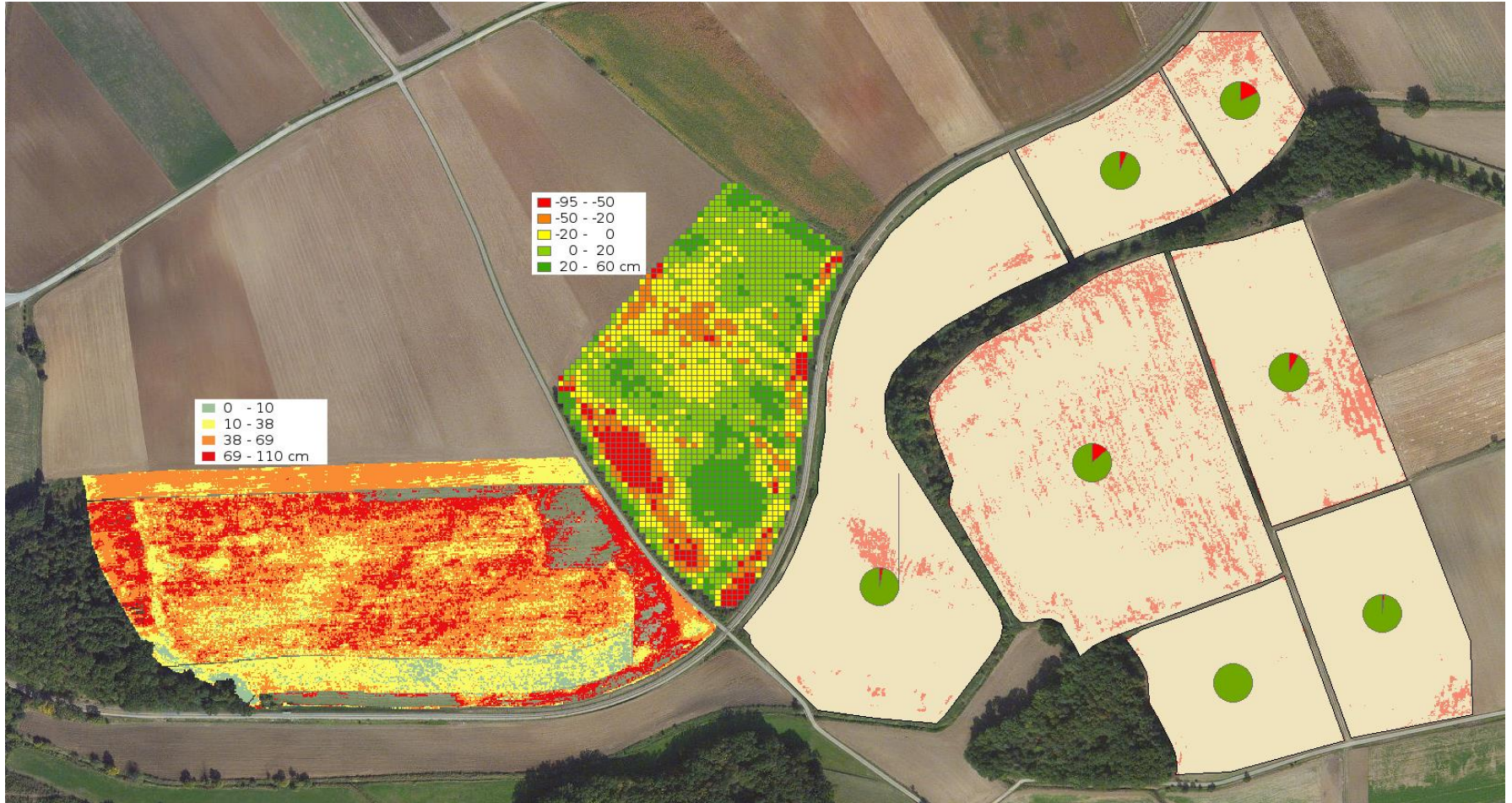
Message list - Thread list - Info

- Project "d:\work\wux\landwirtschaft\VUX1\_farming RiSCAN" saved & verified
- Project "d:\work\wux\landwirtschaft\VUX1\_farming RiSCAN" saved & verified
- Project "d:\work\wux\landwirtschaft\VUX1\_farming RiSCAN" saved & verified
- Project "d:\work\wux\landwirtschaft\VUX1\_farming RiSCAN" saved & verified
- Project "d:\work\wux\landwirtschaft\VUX1\_farming RiSCAN" saved & verified
- Project "d:\work\wux\landwirtschaft\VUX1\_farming RiSCAN" saved & verified

✓ [17094] Filter data	100%	<no info>
✓ [1372] Triangulation finished.	100%	
✓ [1624] Terrain filter	100%	
✓ [1634] Terrain filter	100%	
✓ [1050] Terrain filter	100%	
✓ [3694] Filter data	100%	
✓ [4028] Triangulation finished.	100%	



# Precision Farming



# NEW RIEGL BathyCopter

World's first Small-UAV-Based Surveying System for Hydrographic Applications



## NEW RIEGL BathyCopter

The *RIEGL* BathyCopter is the world's first Small-UAV-based surveying system capable of measuring through the water surface, ideally suited for generating profiles of waterbodies.

The robust and reliable platform design of *RIEGL's* remotely piloted RICOPTER integrates the topobathymetric *RIEGL* LiDAR sensor, an IMU/GNSS unit with antenna, a control unit, and a digital camera.

The BathyCopter marks the first complete Small-UAV LiDAR solution for hydrographic data acquisition!



- RIEGL VUX-SYS in combination with RiCOPTER, a powerful ready to fly UAV-based Airborne Laser Scanning System
- *Usability for many different application*

