



UAV gestütztes  
Laserscanning -  
Optimierte  
Datenerfassung durch  
Kombination  
verschiedener Laser-,  
INS- und bildgebender  
Sensoren



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*RIEGL Laser Measurement Systems*

# RIEGL – Innovation in 3D



## RICOPTER UAS

### Fully integrated turnkey solution

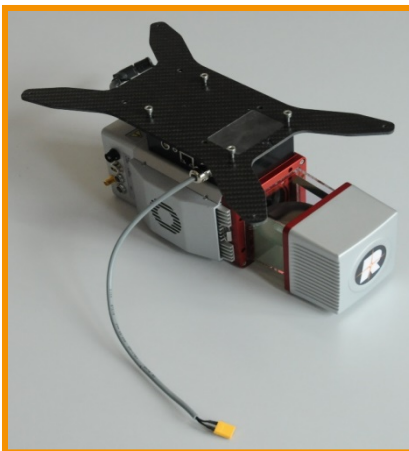
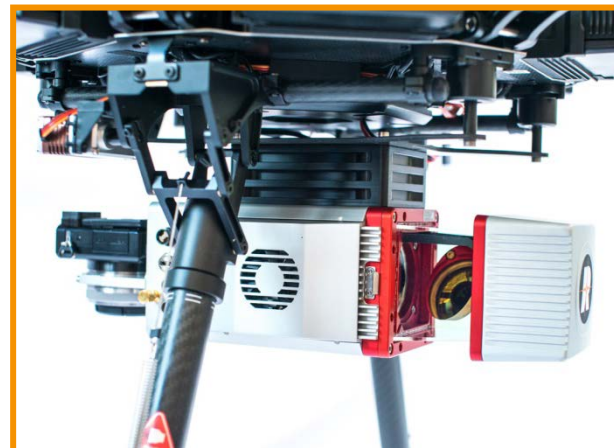
- MTOM: < 25kg
- up to 6.5kg sensor payload
- foldable arms, X8
- up to 30 minutes endurance with full payload
- fully **redundant** system (main & backup flight control)

**NEW**

- *RIEGL* own development – partly based on open-source
- live video & telemetry downstream to ground station display
- customizable frequencies (433, 868, 915 MHz)  
MAVLINK-based command and control link
- powerful telemetry functions (remote control, on-screen-display, etc.)
- optimized for operation of *RIEGL* VUX-SYS with RGB cameras



## Integration Kit 600





## Integration Kit 600

GNSS antenna + mount

shock absorbers

mounting plate

APX-15 UAV or APX-20 UAV IMU/GNSS

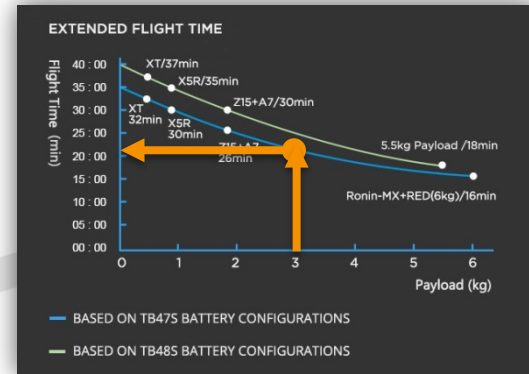
Optional oblique dual camera mount (narrow) with 2 cameras eg. Sony Alpha 6000 cameras

camera options

connection box (incl. connection board „light“)

RIEGL miniVUX-1UAV or RIEGL miniVUX-1DL

Optional nadir camera mount with 1 camera e.g. Sony Alpha 6000 camera



# Unmanned Laser Scanning



Laser scanning utilizing high-end unmanned airborne platforms provides the possibility to acquire data in dangerous and / or hard-to-reach areas, while offering an excellent cost-to-benefit-ratio for numerous applications, e.g. precision farming, forestry and mining.

## LiDAR Sensors for Unmanned Aircraft

### RIEGL VUX-1UAV

- 3.5 kg / 7.7 lbs
- up to 500,000 meas./sec
- accuracy 10 mm
- operating flight altitude more than 1,000 ft



### RIEGL miniVUX-1UAV

- 1.55 kg / 3.4 lbs
- up to 100,000 meas./sec
- accuracy 15 mm



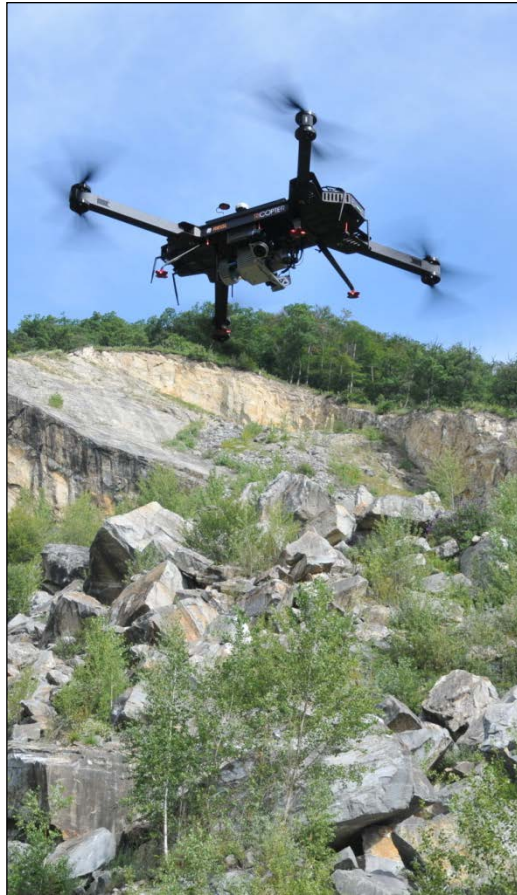
**NEW**

### RIEGL miniVUX-1DL

- „downward-looking“, optimized for corridor mapping
- up to 100,000 meas./sec
- accuracy 15 mm



World Premiere at  
**Intergeo 2017**



## What is the *RIEGL VUX-SYS*?



**RIEGL VUX-SYS**  
RICOPTER with  
*RIEGL VUX-SYS*



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



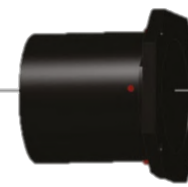
**RIEGL VUX-SYS**  
VMQ-1HA or UAV with  
*RIEGL VUX-SYS*

### **RIEGL VUX-SYS**

control unit  
GPS receiver



camera



inertial  
meas. unit

### **RIEGL VUX-1**



## RIEGL miniVUX-1 series

- **RIEGL miniVUX-1DL**
  - 232 x 99 x 121 mm
  - **2.4 kg**
  - FoV:  $\pm 23^\circ = 46^\circ$



- **RIEGL miniVUX-1UAV**
  - 242 x 99 x 85 mm
  - **1.6 kg**
  - FoV:  $360^\circ$

## range measurement performance

### Technical Data RIEGL miniVUX®-SYS

#### Scanner Performance

RIEGL UAV LiDAR Sensors  
(for details refer to the corresponding data sheet)

Typ. Operating Flight Altitude AGL <sup>1)</sup>  
 Maximum Range <sup>4)</sup>  
 Minimum Range  
 Accuracy / Precision  
 Laser Pulse Repetition Rate  
 Max. Effective Measurement Rate  
 Field of View  
 Max. Scan Speed  
 Max. Number of Targets per Pulse <sup>6)</sup>

#### RIEGL miniVUX-1UAV

80 m (260 ft) <sup>2)</sup>  
 250 m  
 3 m  
 15 mm / 10 mm  
 up to 100 kHz  
 up to 100,000 meas./sec.  
 up to 360° <sup>5)</sup>  
 100 scans/sec  
 5

#### RIEGL miniVUX-1DL

80 m (260 ft) <sup>3)</sup>  
 200 m  
 3 m  
 15 mm / 10 mm  
 up to 100 kHz  
 up to 100,000 meas./sec.  
 up to 46° field of view, +23° off nadir  
 100 scans/sec  
 5

1) Rounded values

2) Reflectance  $\rho \geq 20\%$ , flat terrain assumed, scan angle  $\pm 45^\circ$  FOV, additional roll angle  $\pm 5^\circ$

3) Reflectance  $\rho \geq 20\%$ , flat terrain assumed, scan angle  $\pm 23^\circ$  FOV, additional roll angle  $\pm 5^\circ$

#### IMU & GNSS <sup>7)</sup>

IMU Accuracy  
 Roll, Pitch  
 Heading  
 IMU Sampling Rate  
 Position Accuracy (typ.)  
 horizontal  
 vertical

#### Applanix APX-15 UAV <sup>8)</sup>

0.025°  
 0.08°  
 200 Hz  
 < 0.05 m  
 < 0.1 m

#### Applanix APX-20 UAV <sup>8)</sup>

0.015°  
 0.035°  
 200 Hz  
 < 0.05 m  
 < 0.1 m

4) Maximum range is specified for natural targets  $\rho \geq 60\%$ .

5) Selectable. Consider limitations when integrated in kinematic systems.

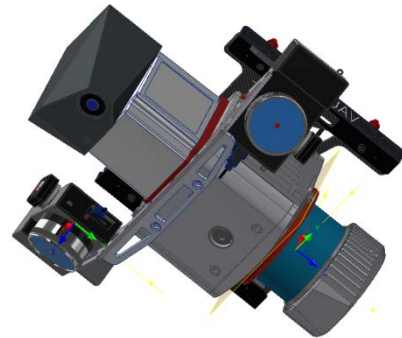
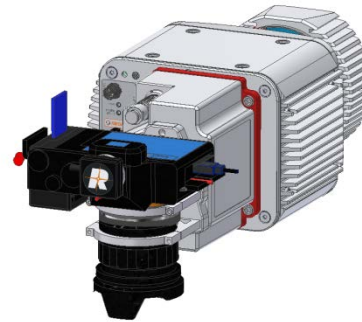
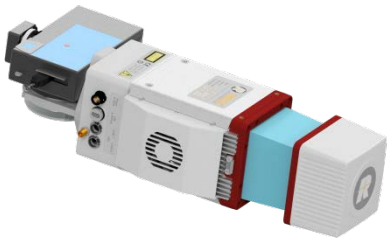
6) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

## NEW INS/GNSS system – Applanix APX20

- NEW INS/GNSS system – Applanix **APX-20 UAV**
- smaller, lighter more compact design (~ 1kg less weight)
- miniVUX-SYS: integrated in interface box
- VUX-SYS: housing with adapted back panel

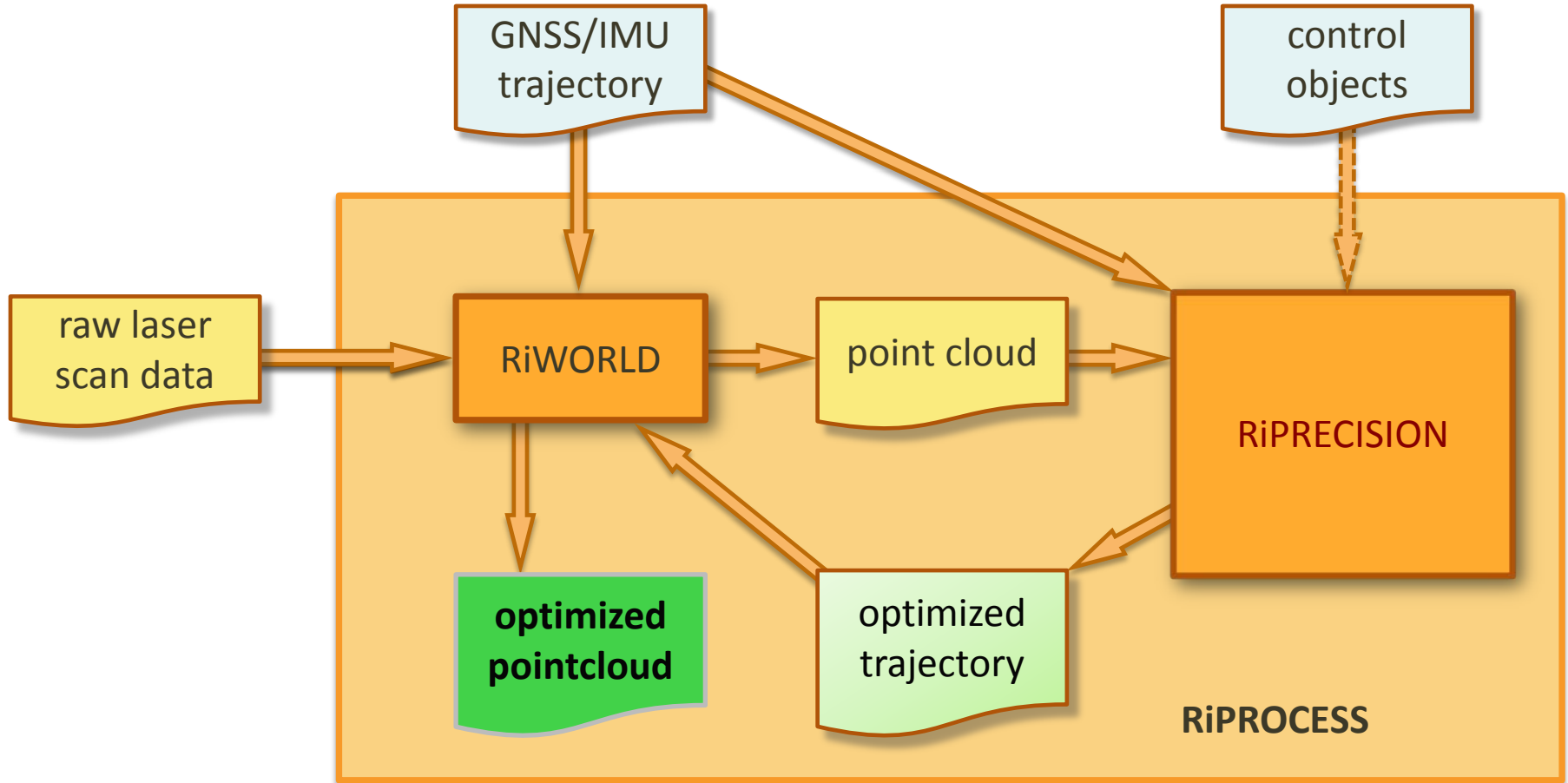


## camera solutions

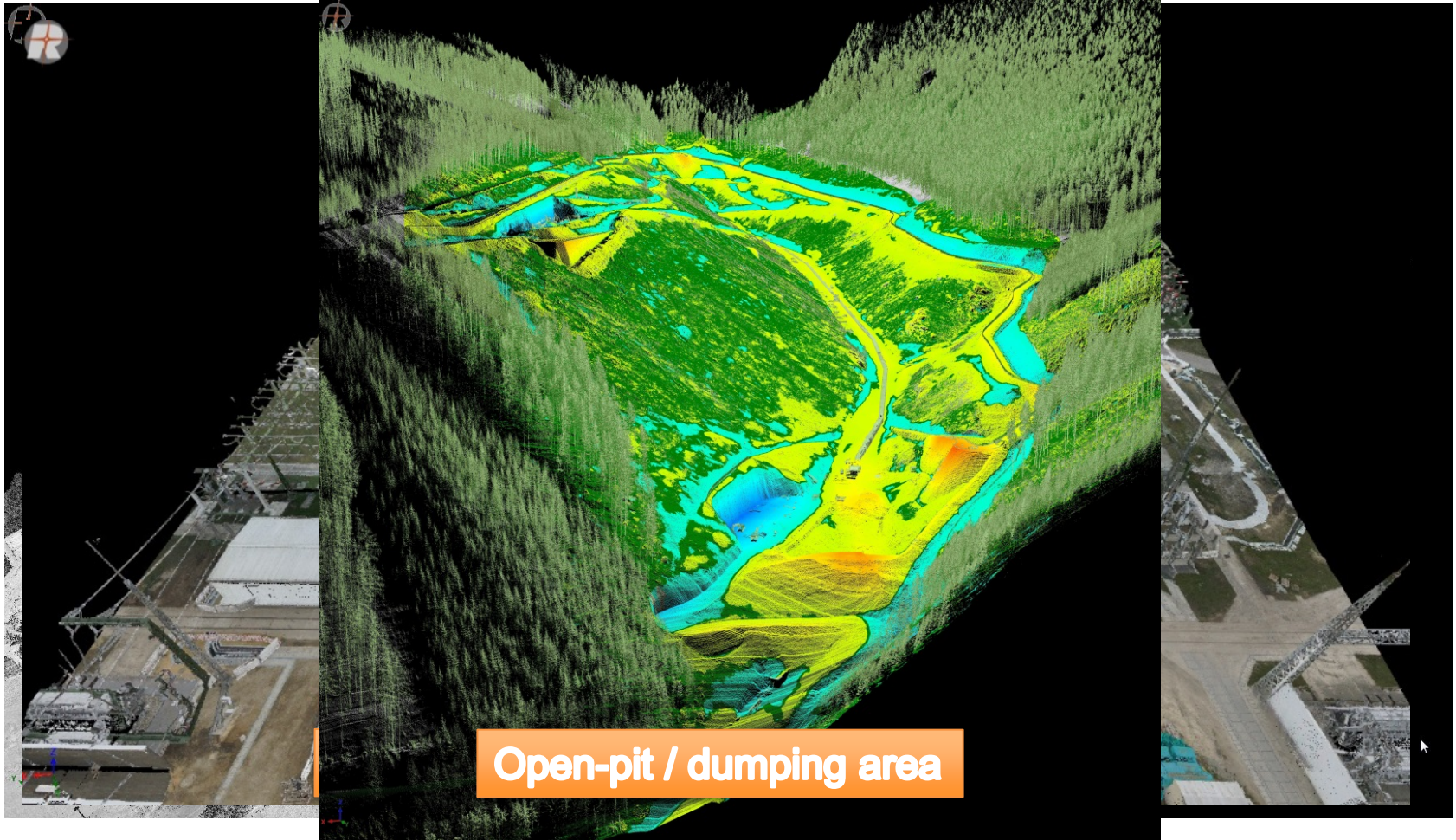


- nadir and oblique camera solution for all scanners
  - Sony Alpha 6000 or Sony Alpha 7R
- Thermal / hyperspectral imagery integration
  - Flir Tau2 / Vue Pro or Workswell WIRIS 640

## Workflow – Post-processing

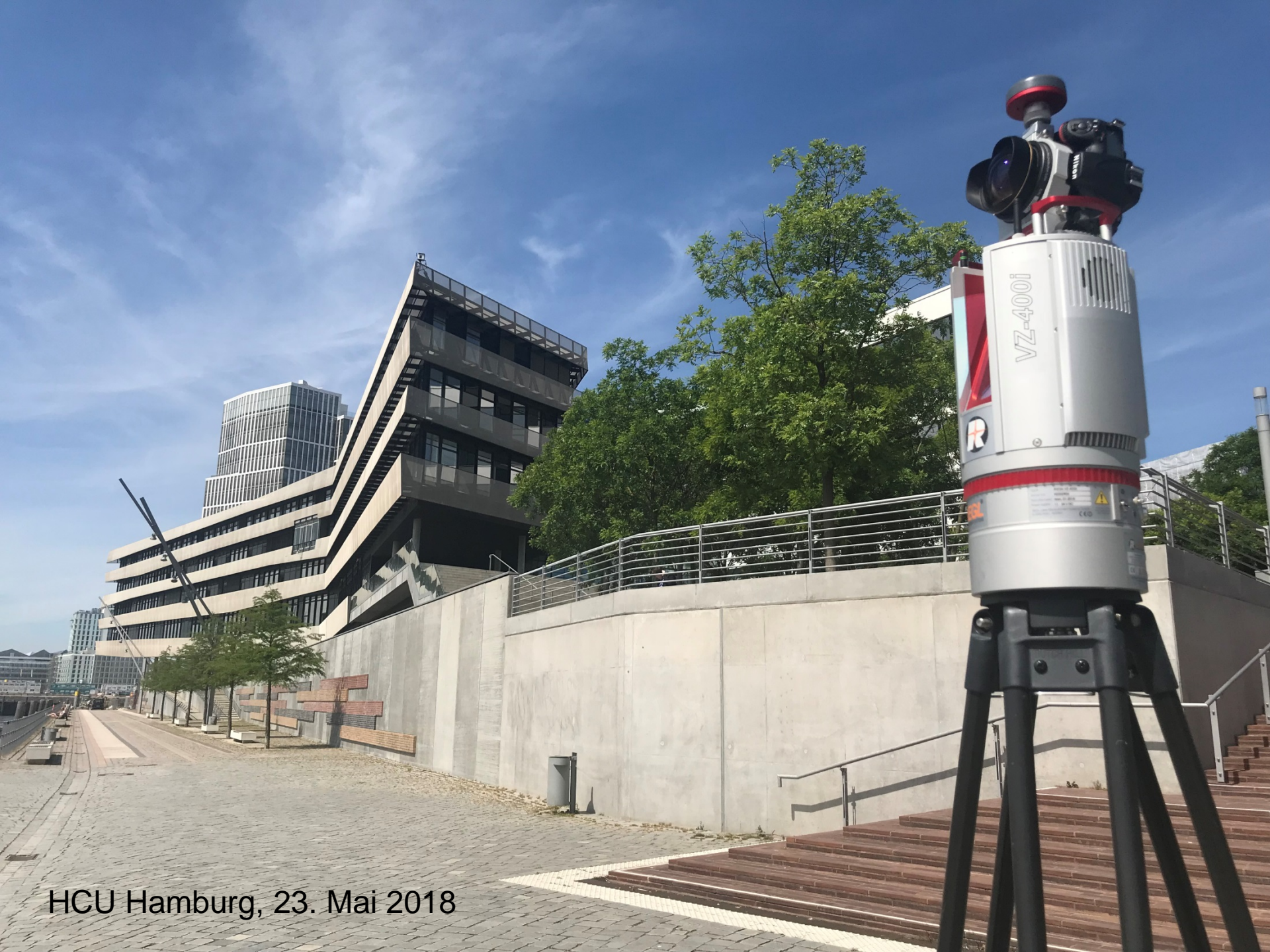


## LiDAR pointclouds – results



# UAV-based Laser Scanning Applications

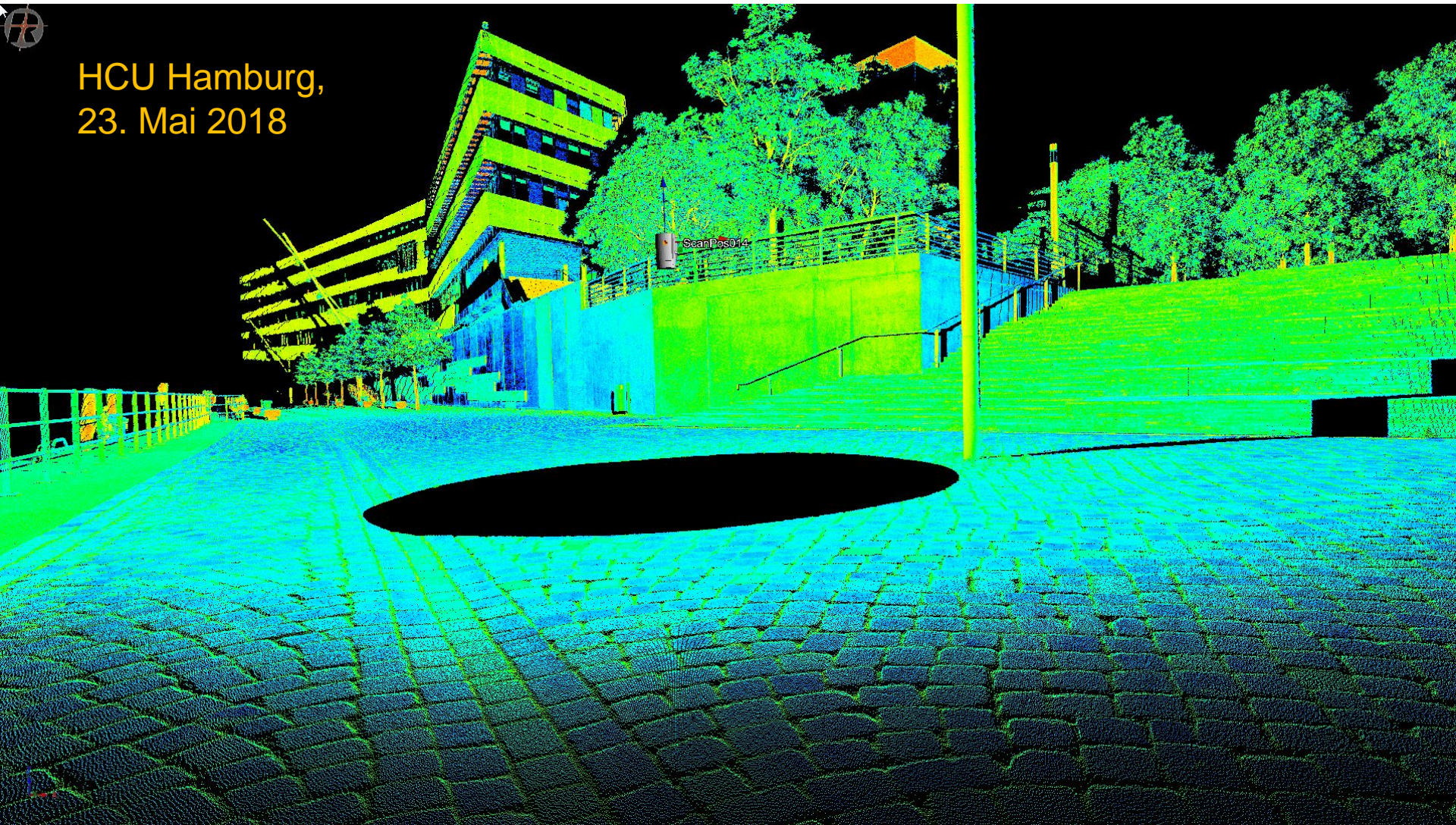
**RiCOPTER with VUX-SYS**



HCU Hamburg, 23. Mai 2018

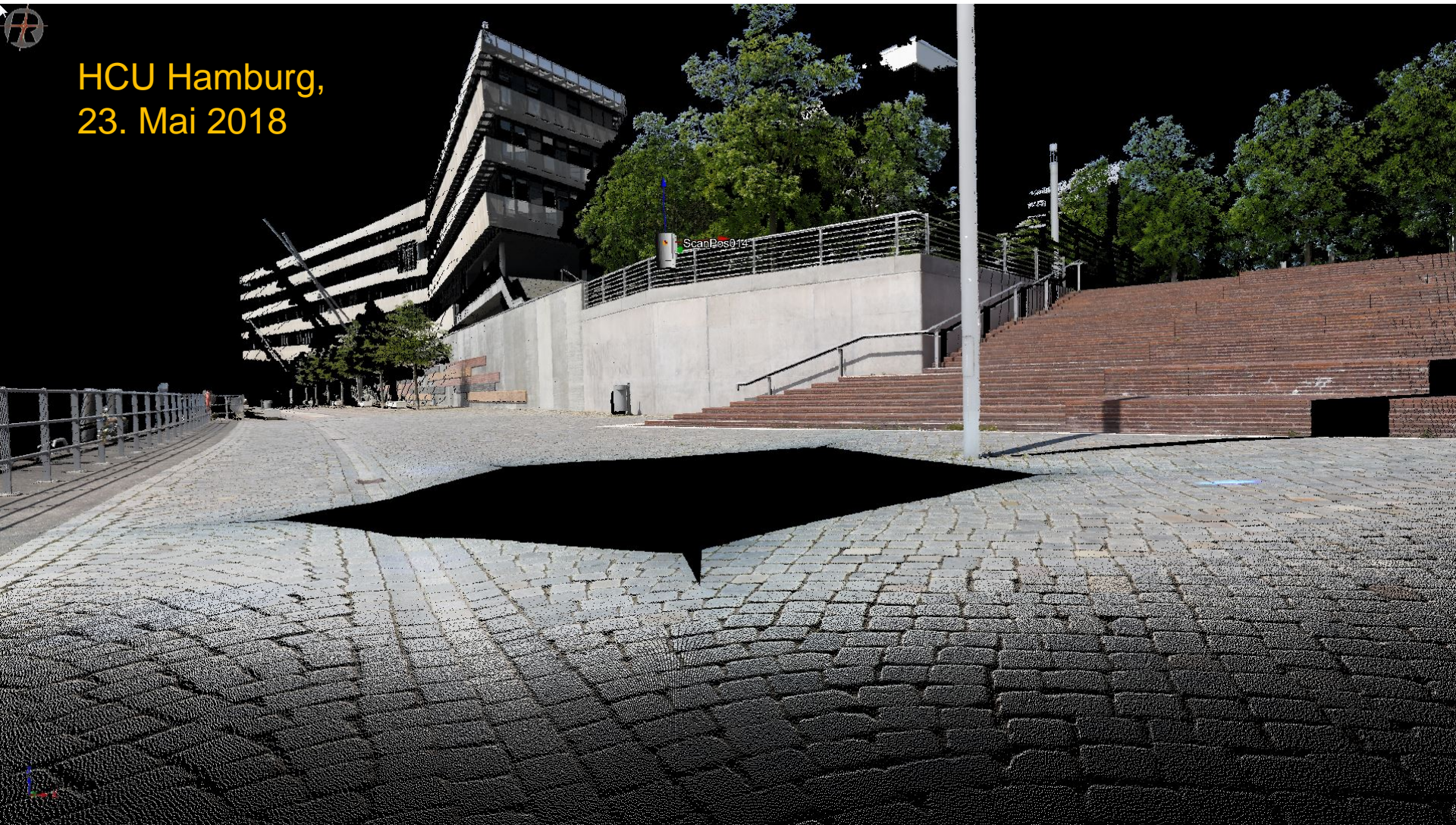


HCU Hamburg,  
23. Mai 2018





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Vielen Dank  
für Ihre Aufmerksamkeit!