ULS
Unmanned Laser Scanning

RiCOPTER with
high performance LiDAR Sensors

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Content

- Why ULS (**U**nmanned **L**aser **S**canning)

  Advantages of this new technique
- *RIEGL* ULS LIDAR engines
- *RIEGL* VUX-SYS, a fully integrated system
- *RIEGL* RiCOPTER, a powerful UAV carrying platform
- Example data from different applications

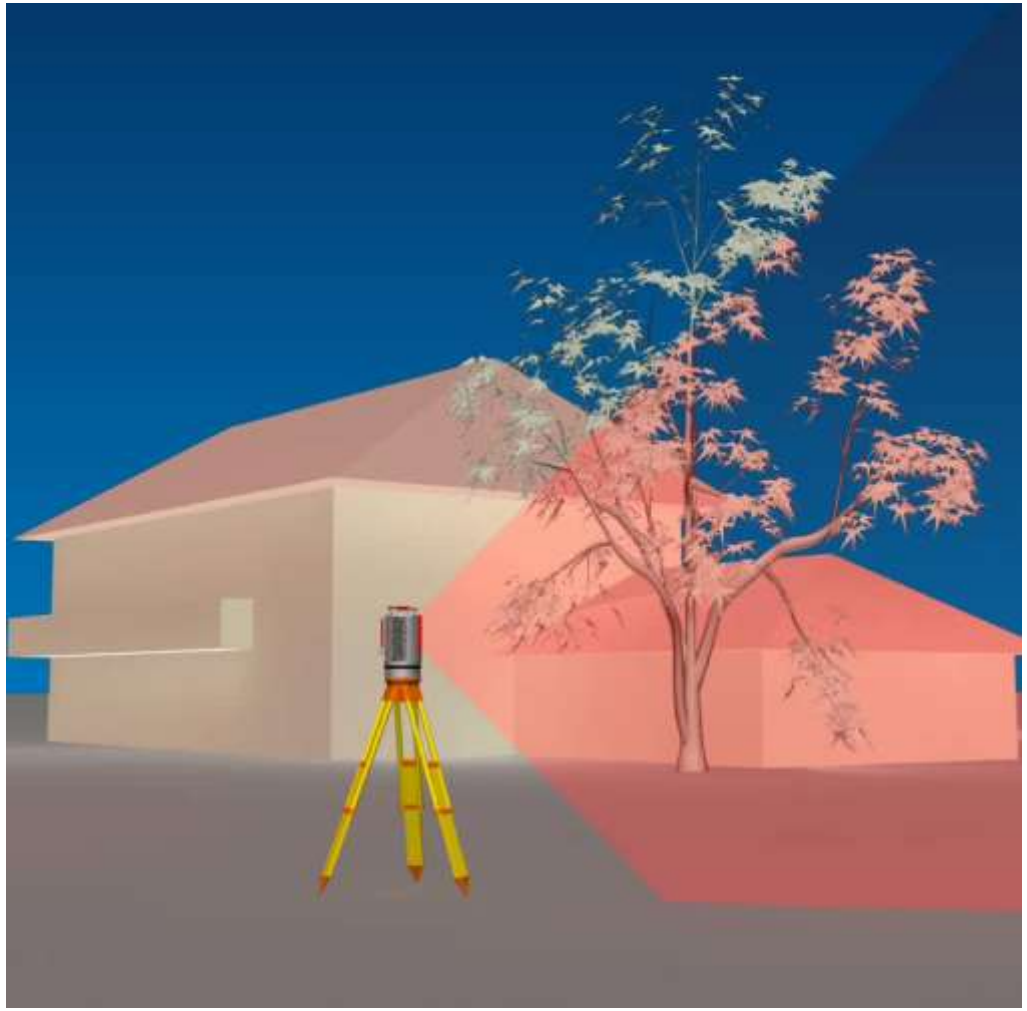
LiDAR Platforms

STATIC

MOBILE

AIRBORNE

UAV



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

RIEGL ULS Sensors

Technical Data *RIEGL* BDF-1

Laser Product Classification	Class 2M Laser Product according to IEC 60825-1:2014
Range Measurement Performance	
Measuring Principle	time of flight measurement, echo signal digitization, online waveform processing, concurrent full waveform output for all measurements
Minimum Range	1 m
Maximum Range	50 m
Accuracy [1] [3]	10 mm
Precision [2] [3]	5 mm
Laser Pulse Repetition Rate	4 kHz
Achievable Secchi Depth vs. Measurement Rate[4]	1.0 @ 4,000 meas./sec (single pulse) 1.2 @ 400 meas./sec (10 pulses averaged) 1.5 @ 40 meas./sec. (100 pulses averaged)
Echo Signal Intensity	for each echo signal, high-resolution 16 bit intensity information is provided
Laser Wavelength	532 nm (green)
Laser Beam Footprint	approx. 70 mm @ 1 m approx. 20 mm @ 20 m

1) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
2) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
3) One sigma @ 15 m range under *RIEGL* test conditions.
4) Flight altitude 15 m above water surface.

Long Range

eight design
g from helicopters

GL VP-1 Helipod
g to helicopters

	Laser Class 1
%	1,350 m
%	820 m
	5 m
	15 mm / 10 mm
	750,000 meas./sec
	200 scans/sec
	330°
	530 m / 1,740 ft

Max. Effective Mea
Max. Scan Speed
Field of View (FOV)

Field of View (FOV)
Max. Operating Flight

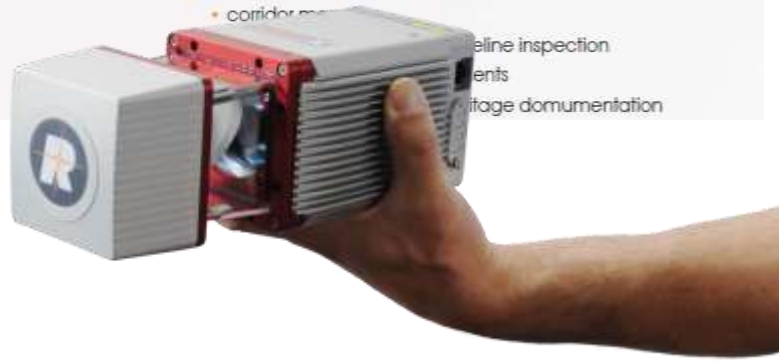
Class 1 Laser Product accord

Typical Applications

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

- topography in open-cast mining
- terrain and canyon mapping
- corridor mapping

- corridor m
- eline inspection
- ents
- itage domumentation

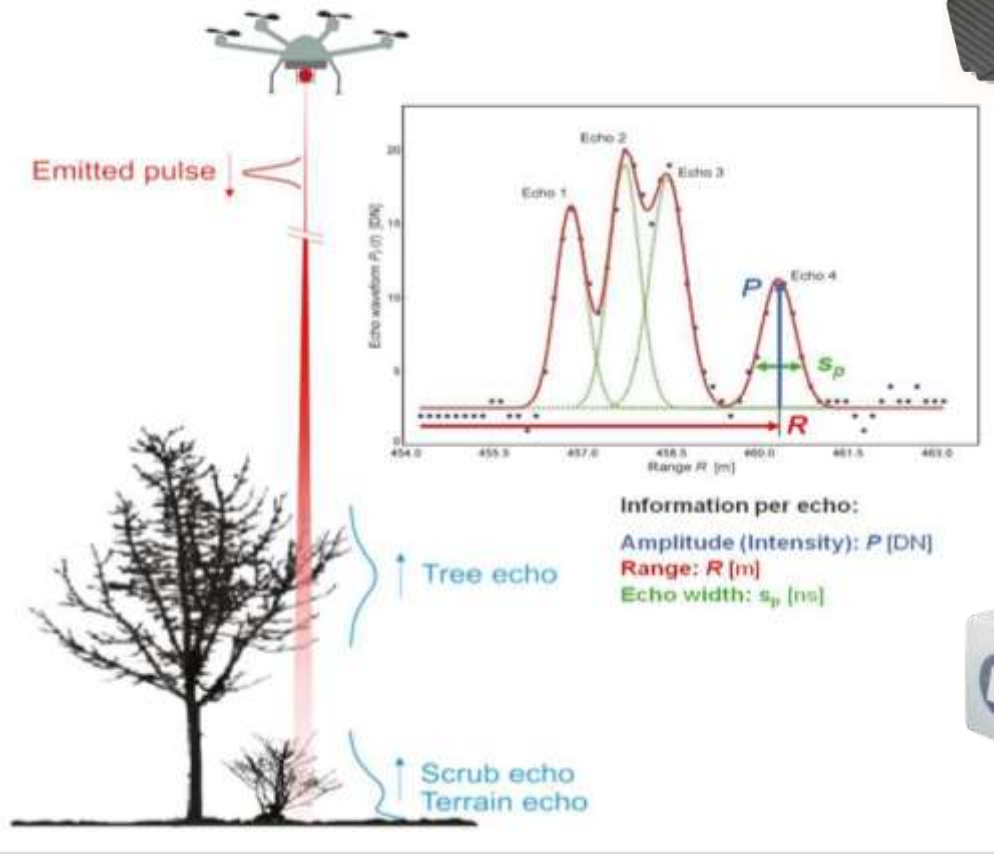


RIEGL

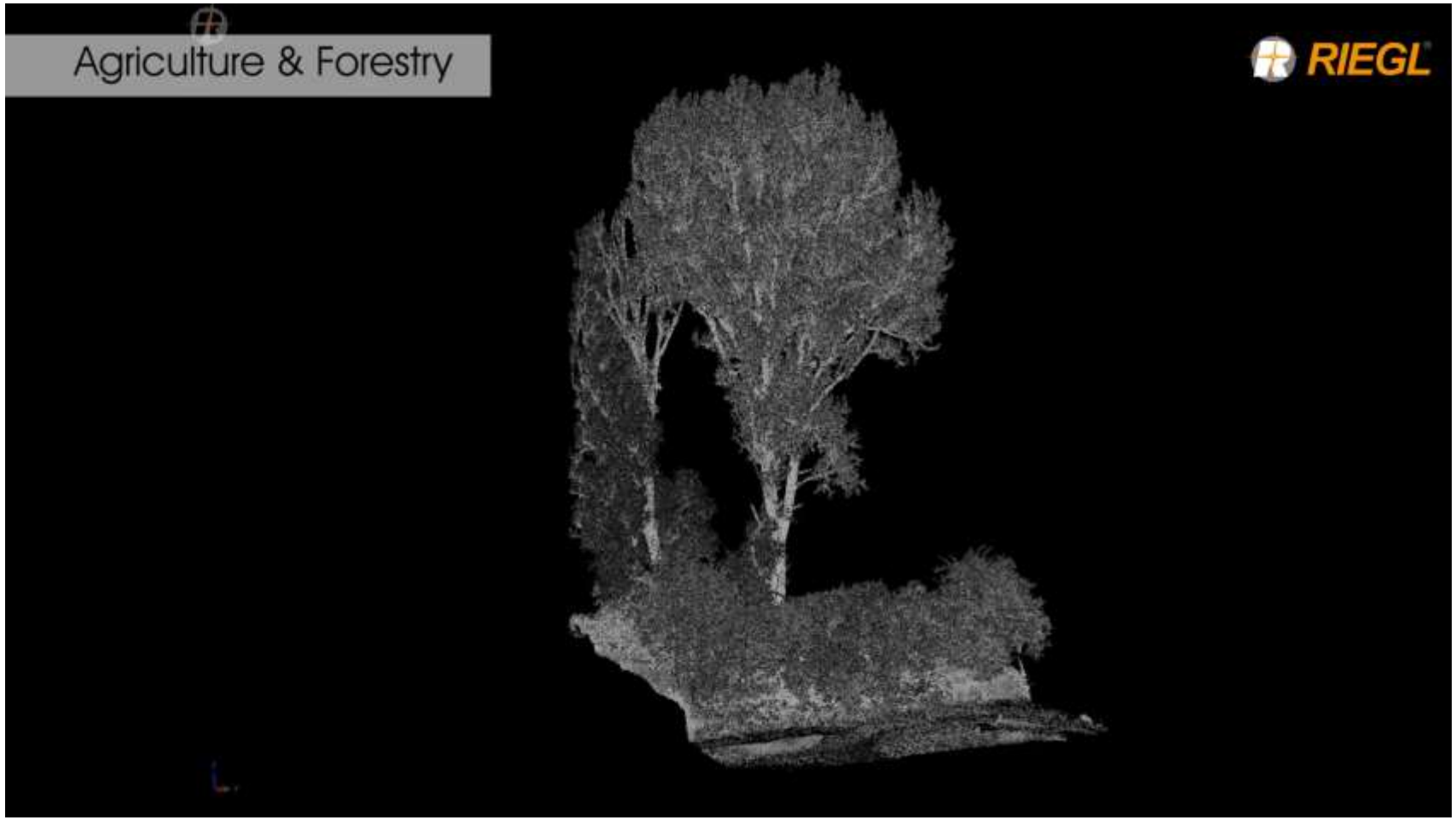
Benefits of Full Waveform Processing

online waveform processing technique enables

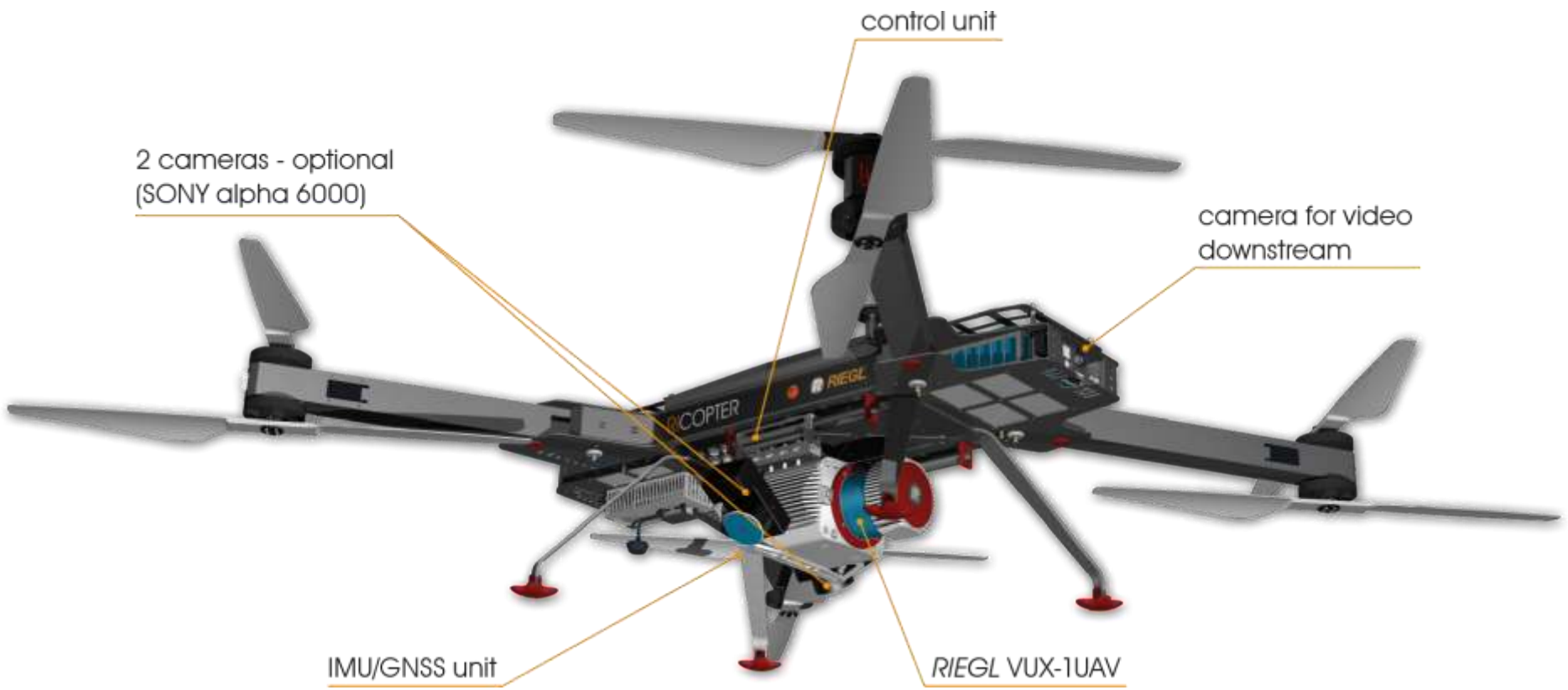
- multiple target capability
- high measurement accuracy
- calibrated reflectance



Benefits of Full Waveform Processing



RIEGL RiCOPTER Setup



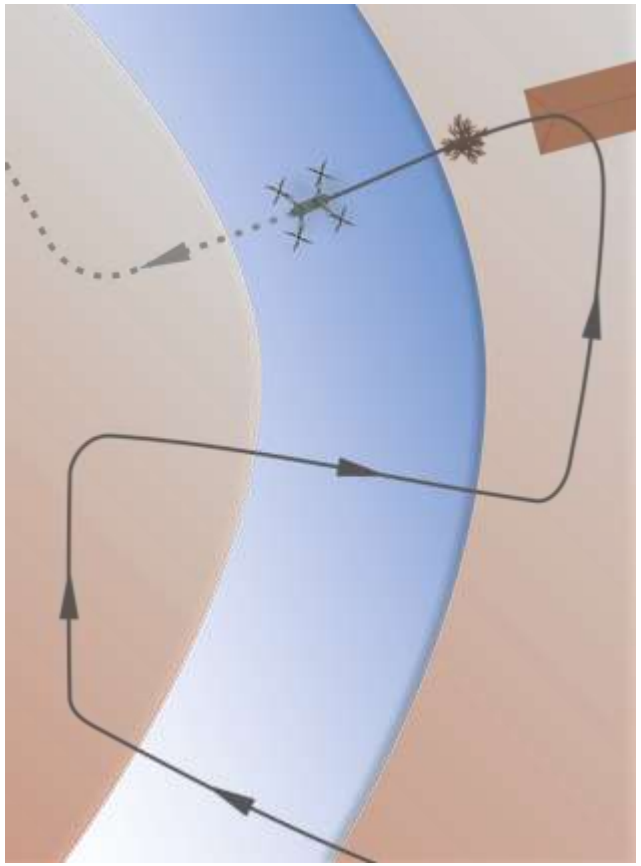
RIEGL RiCOPTER Ground Station Setup

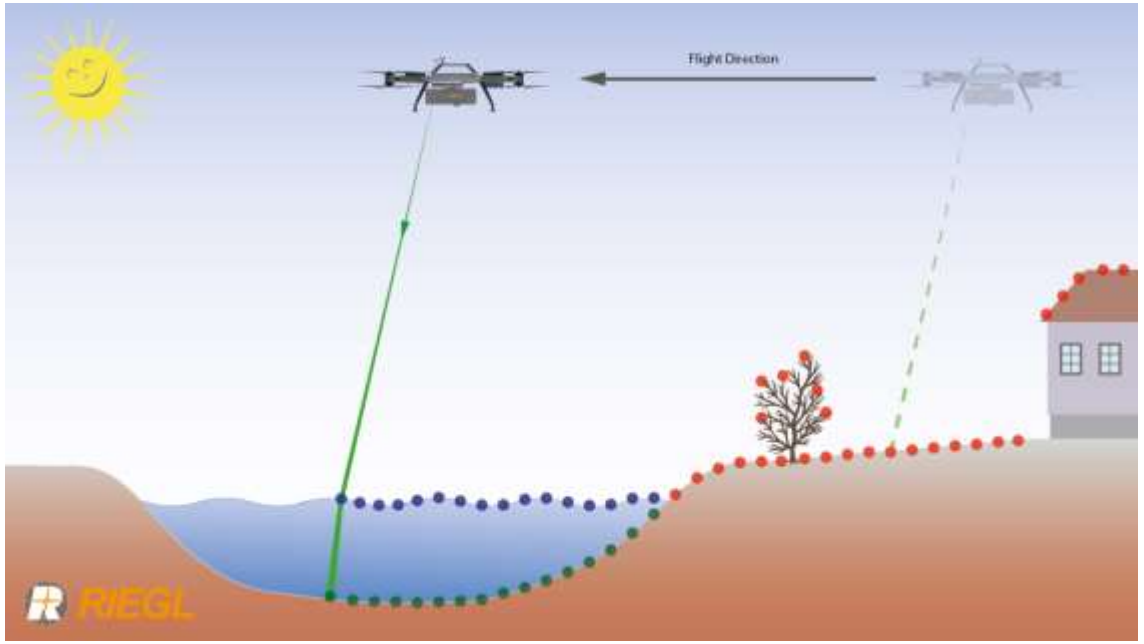
Weight: 16 kg

RIEGL BDF-1 Profiling the Waterbody

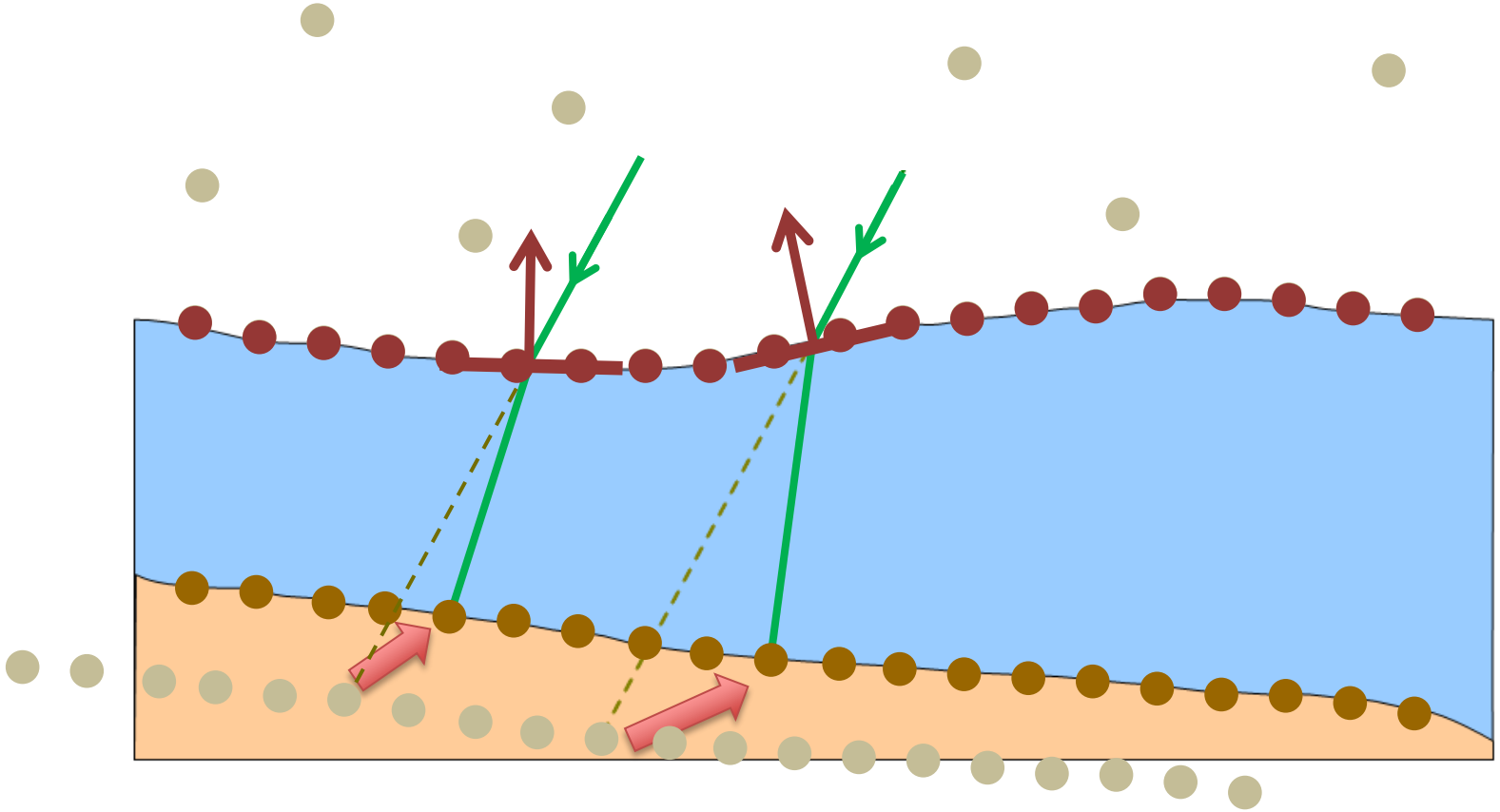
- Generation of river profiles
- Repeated survey of water reservoirs
- Surveying of canals
- Landscaping
- Support of construction works
- Surveys for planning and carrying out hydraulic engineering work

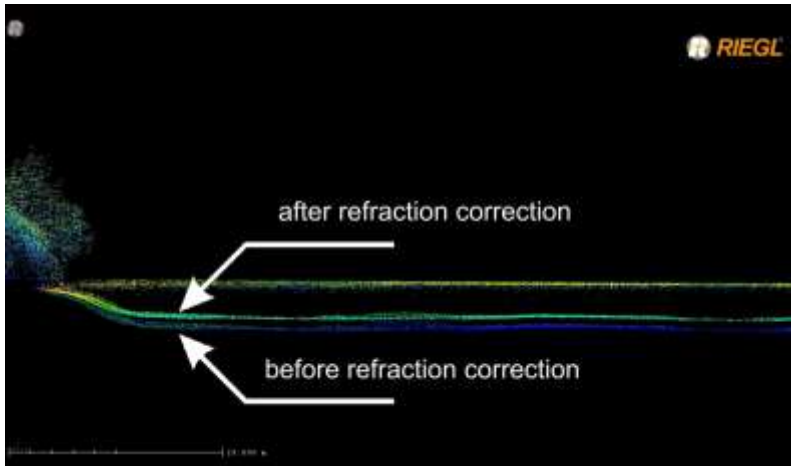
RIEGL BDF-1 Mode of Operation



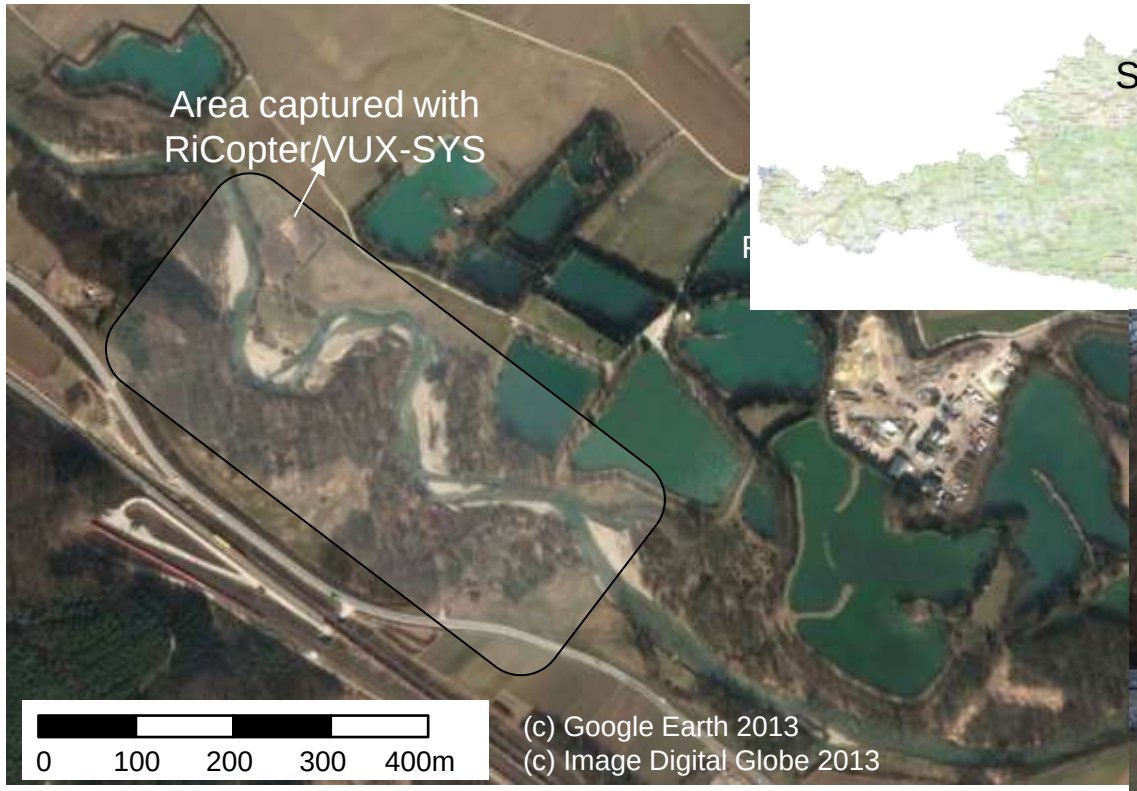


Principle of Refraction Correction





Application Example – Complex Topography



Combining data from
RIEGL VUX-Sys and BDF-1

RIEGL RiCOPTER with *RIEGL* VUX-Sys

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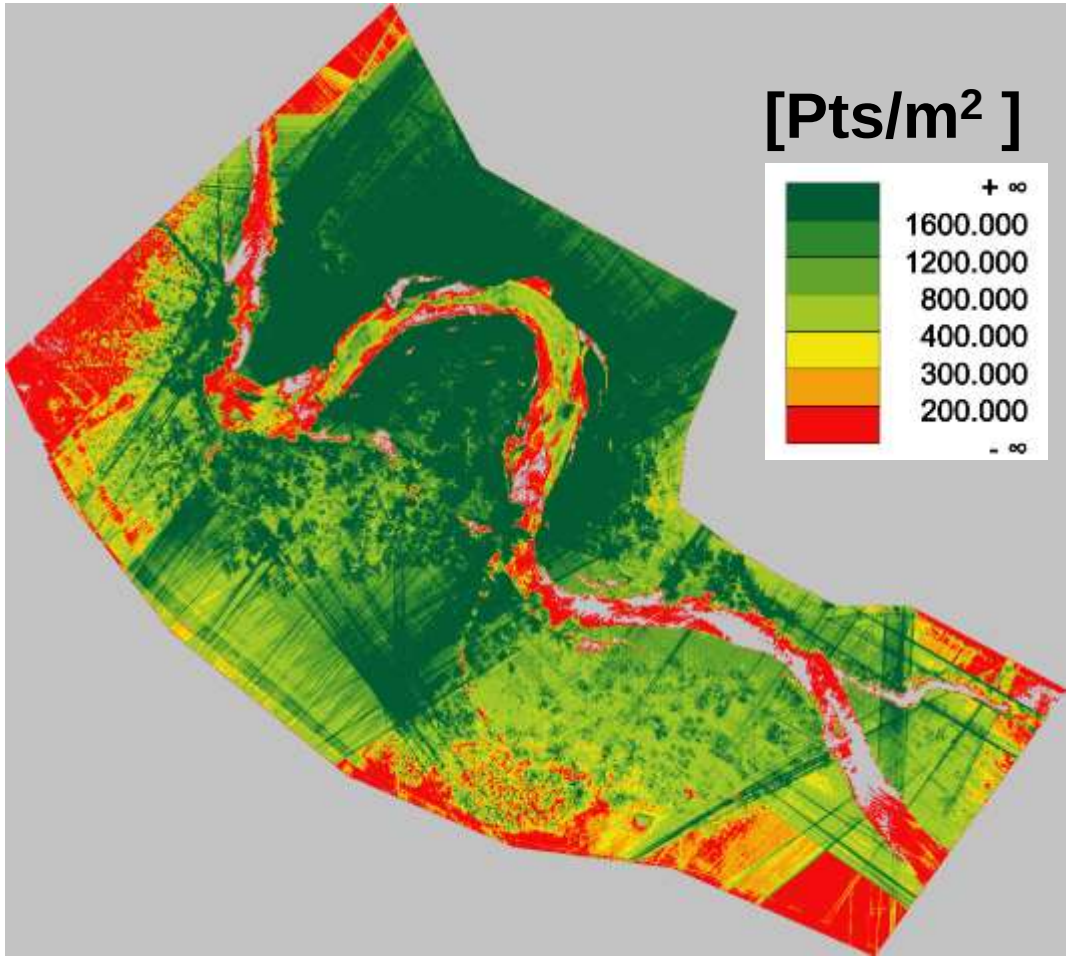

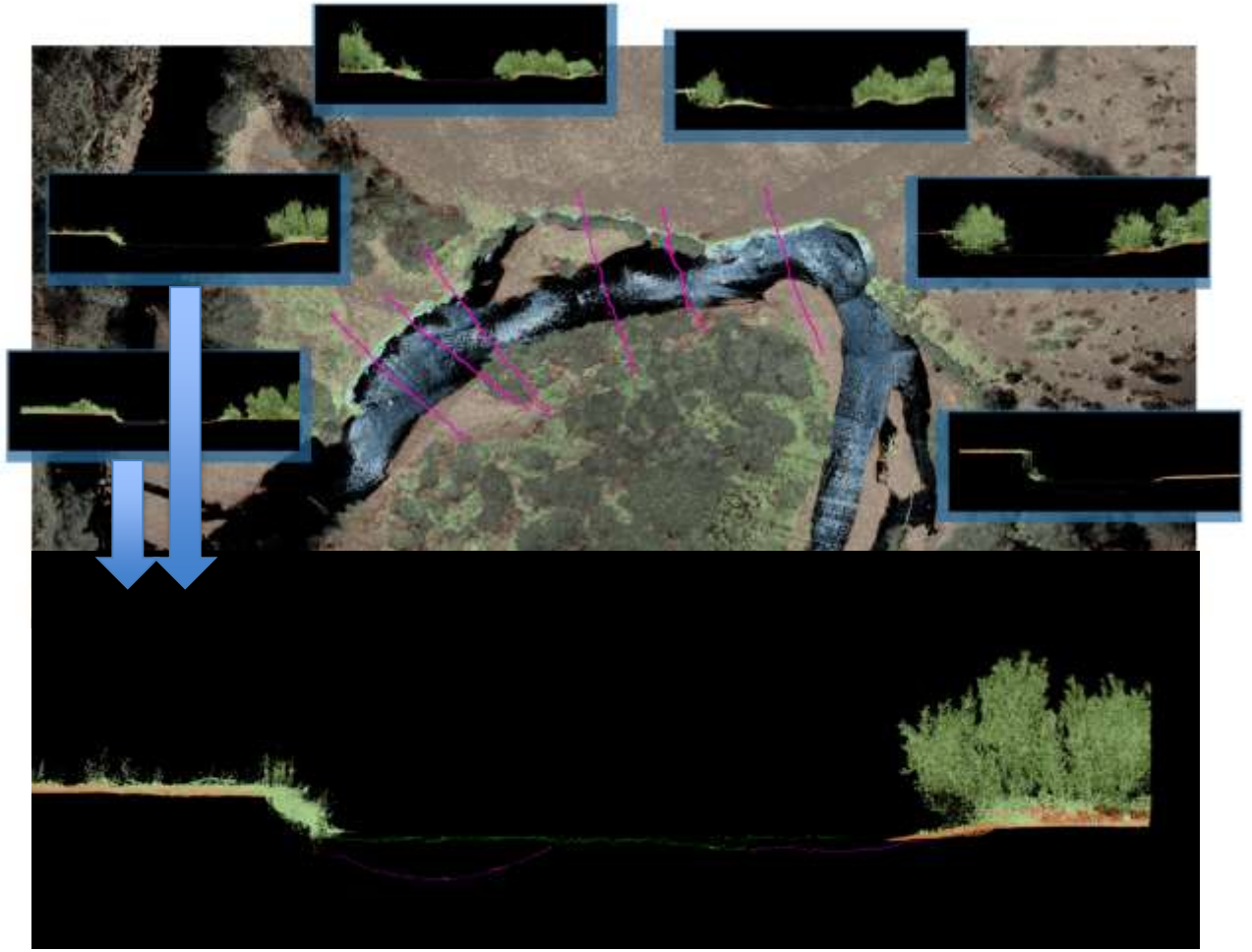

Application Example – Architecture

- TLS Data RIEGL VZ-400i
- ULS Data RIEGL VUX-Sys
- TLS/ULS Combined
- TLS/ULS Highlighted

Summary

- RIEGL ULS solution, a powerful ready to fly UAV-based Airborne Laser Scanning System
- *Usability for many different application*