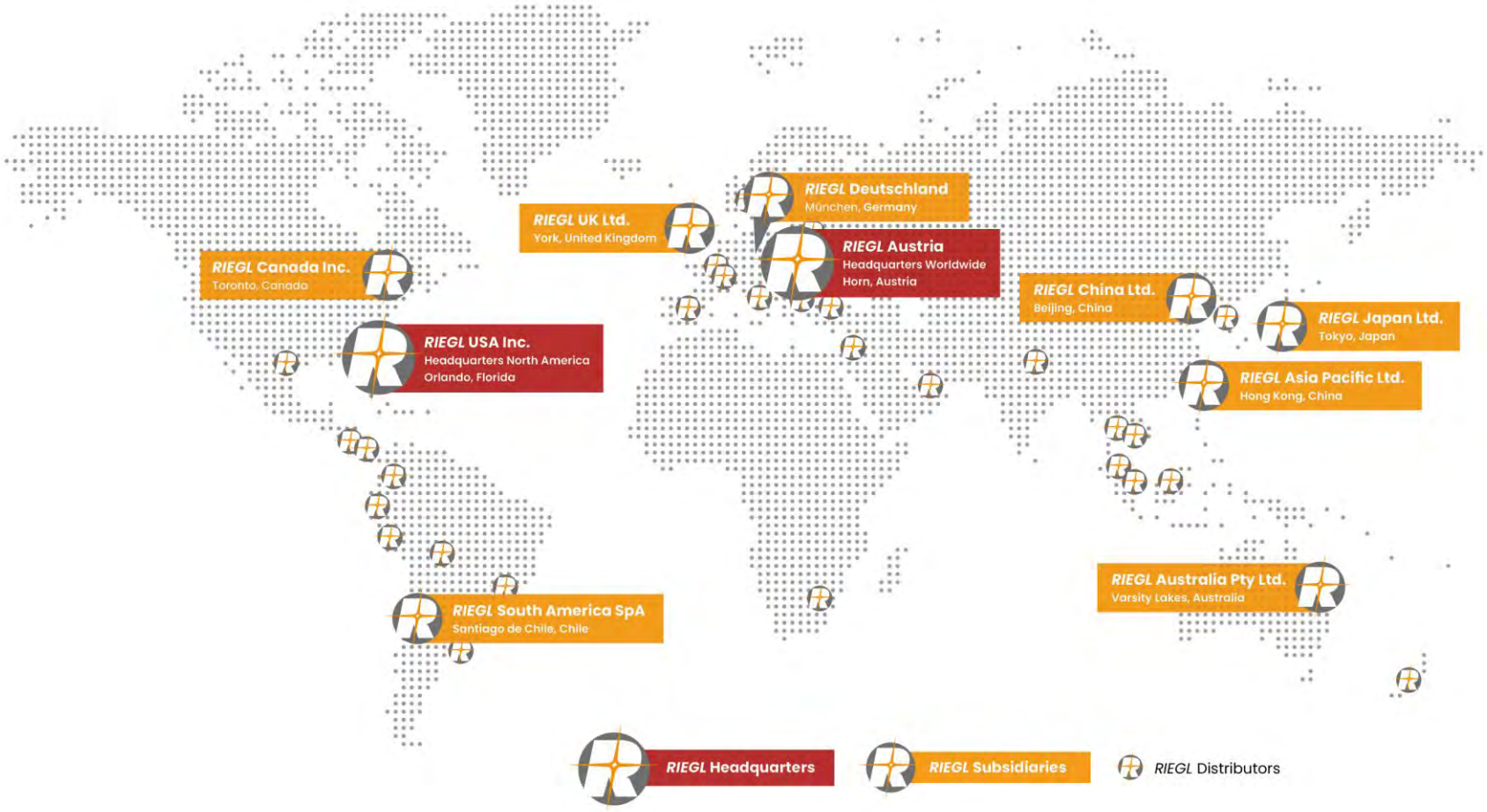
UAV-basiertes 3D Laserscanning

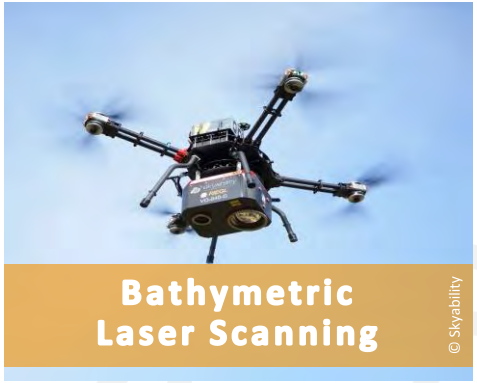
Philipp Amon

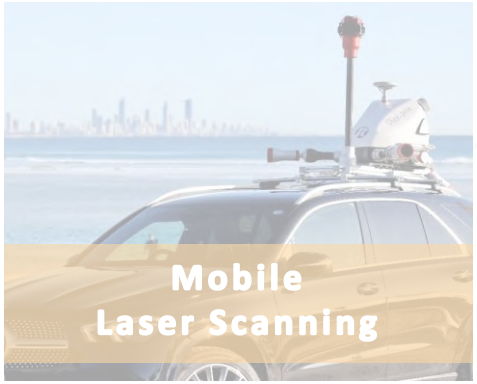
Manager ULS Business Division,
RIEGL LMS GmbH

23.01.2025, Drohnenforum 2025


RIEGL Deutschland
München, Germany
RIEGL UK Ltd.
York, United Kingdom
RIEGL Austria
Headquarters Worldwide
Horn, Austria
RIEGL Canada Inc.
Toronto, Canada
RIEGL China Ltd.
Beijing, China
RIEGL Japan Ltd.
Tokyo, Japan
RIEGL USA Inc.
Headquarters North America
Orlando, Florida
RIEGL Asia Pacific Ltd.
Hong Kong, China
RIEGL Australia Pty Ltd.
Varsity Lakes, Australia
RIEGL South America SpA
Santiago de Chile, Chile
RIEGL Headquarters
RIEGL Subsidiaries
RIEGL Distributors

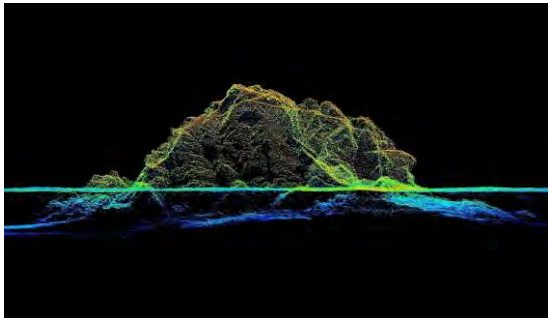
UAV-based Laser Scanning | *UAV-basiertes Laserscanning*

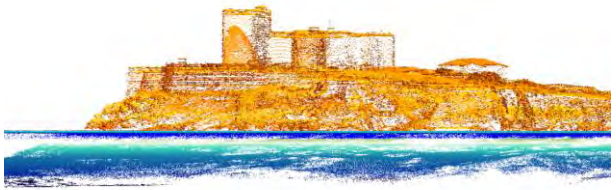




RIEGL®

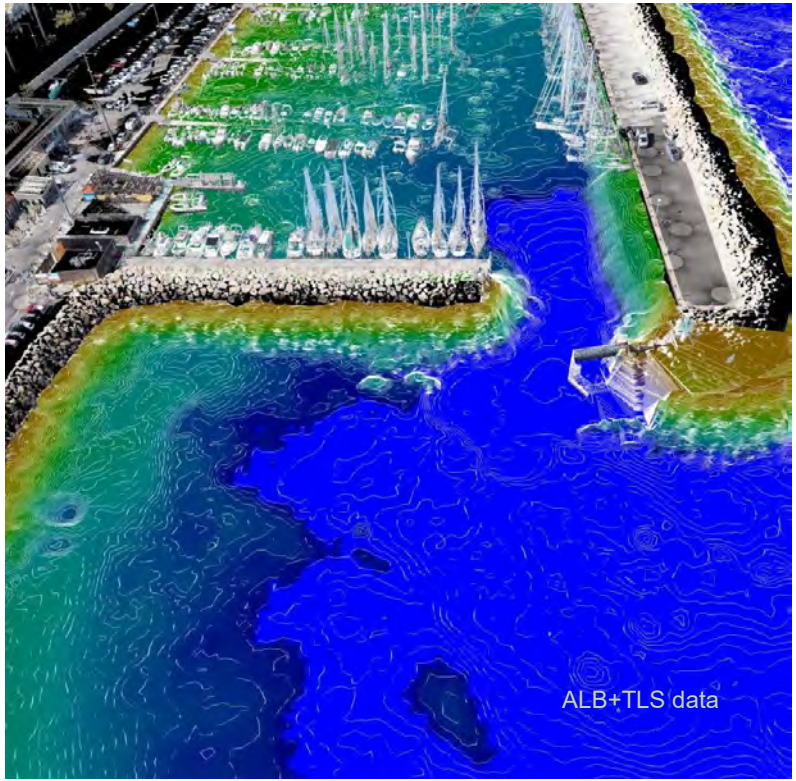
Bathymetric Laser Scanning | *Bathymetrisches Laserscanning*





RIEGL®

Complementary data acquisition



Smooth fusion of LiDAR datasets
from static (TLS) and airborne (ALB) acquisition campains

RIEGL®

RIEGL UAV-based Laser Scanning | *UAV-basiertes Laserscanning*

miniVUX-1UAV, /-3UAV

1.6 kg
360° FOV
100 /200 kHz
eff. pulse rate

extremely lightweight

VUX-1UAV[22] /-LR[22]

3.5 kg
360° FOV
1.2/ 1.5 MHz
eff. pulse rate

powerful sensor for various applications in wide area UAV surveying

NEW VUX-100[25]

2.3 kg
160° FOV
1.33 MHz
eff. pulse rate
scan speed
up to 200 lines/sec

large FOV and lightweight; suited for complex areas and flexible use

VUX-120[23]

2.3 kg
100° FOV
2 MHz
eff. pulse rate

NFB (Nadir/Forward/ Backward) Scanning for an optimal coverage of complex and vertical targets

VUX-160[23] / VUX-180[24]

2.6 kg
100° FOV
2 MHz
eff. pulse rate

fully integrated IMU/GNSS system

NFB (Nadir/Forward/ Backward) Scanning for an optimal coverage of complex and vertical targets

2.7 kg
75° FOV
2 MHz
eff. pulse rate

fully integrated IMU/GNSS system

scan speed up to 800 lines/sec, resulting in an optimal line and point distribution; perfectly suited for use on high-speed UAVs

VUX-240[24]

4.3 kg
75° FOV
2 MHz
eff. pulse rate

operating flight altitude up to 1,430 m (4,700 ft) @ 60% target reflectivity

versatile scanner for use on high-speed UAVs, helicopters or small manned aeroplanes

for applications using low-flying small or mid-sized multi-rotor UAVs
e.g. mining, topography, forestry, landslide and avalanche monitoring

for applications using fixed-wing UAVs
e.g. corridor mapping, city modeling

for applications using higher-flying large UAVs or helicopters
e.g. mapping with the need of detailed high-resolution data

Which UAVs for which scanner? | *Welche UAVs für welchen Scanner?*

- compact design
- small to medium sized areas
- low flight speed
- visibility to the pilot

miniVUX Series
VUX-1 Series
VUX-100[25] / VUX-120[23] / VUX-160[23]

- aerodynamic design
- large areas or corridors
- high flight speed
- usually no visibility to the pilot

VUX-120[23]
VUX-160[23]
VUX-180[24]

- large payload
- medium to large areas
- moderate to high flight speeds
- usually no visibility to the pilot

VUX-120[23] / VUX-160[23] / VUX-180[24]
VUX-240[24]
VQ-840-G(E)/GL
VQ-860-G

RIEGL®

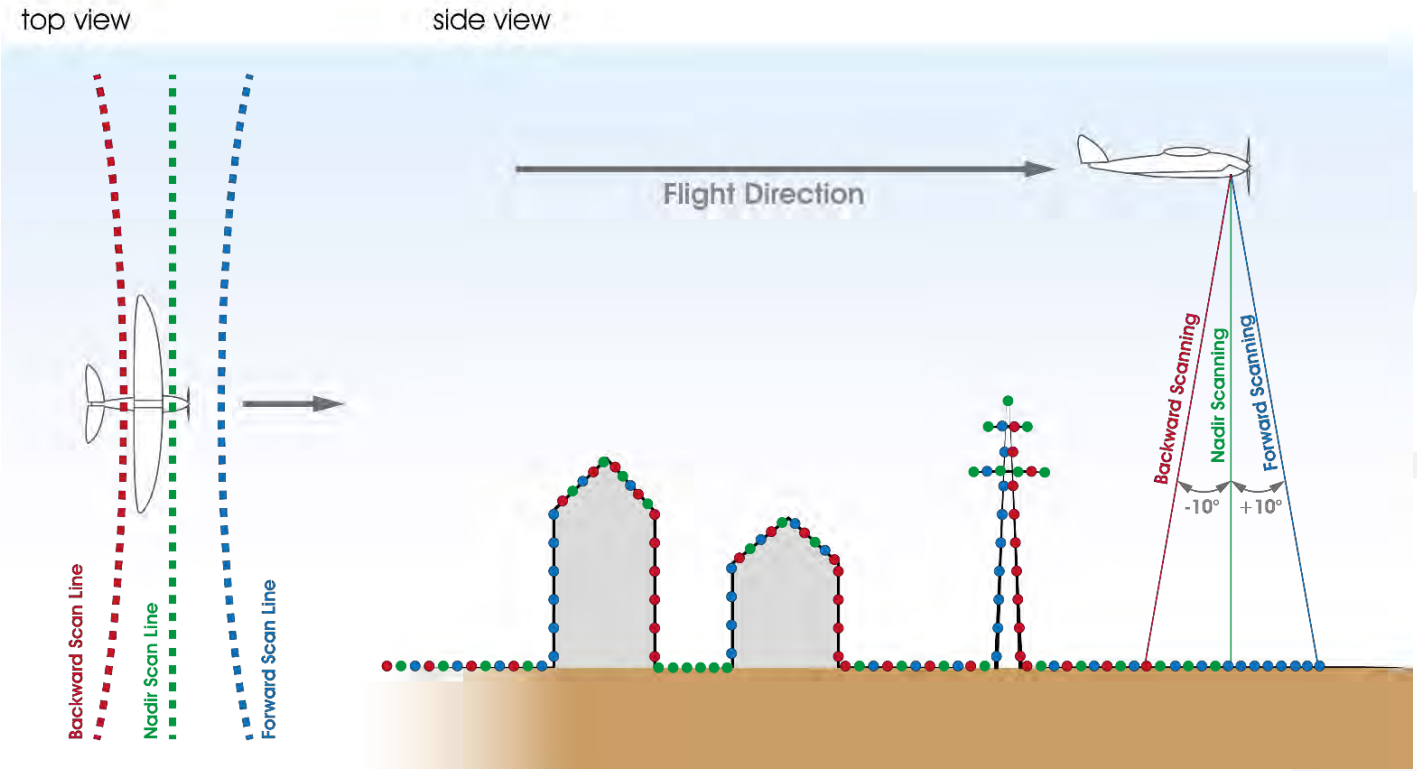
UAV Integration Examples| *UAV Integrationsbeispiele*

RIEGL®

VTOL Integration Examples | *VTOL Integrationsbeispiele*

RIEGL

RIEGL VUX-120²³ / VUX-160²³ NFB Scanning for Complete Coverage



Nadir

Forward (+ 10°)

Backward (- 10°)

RIEGL

NEW

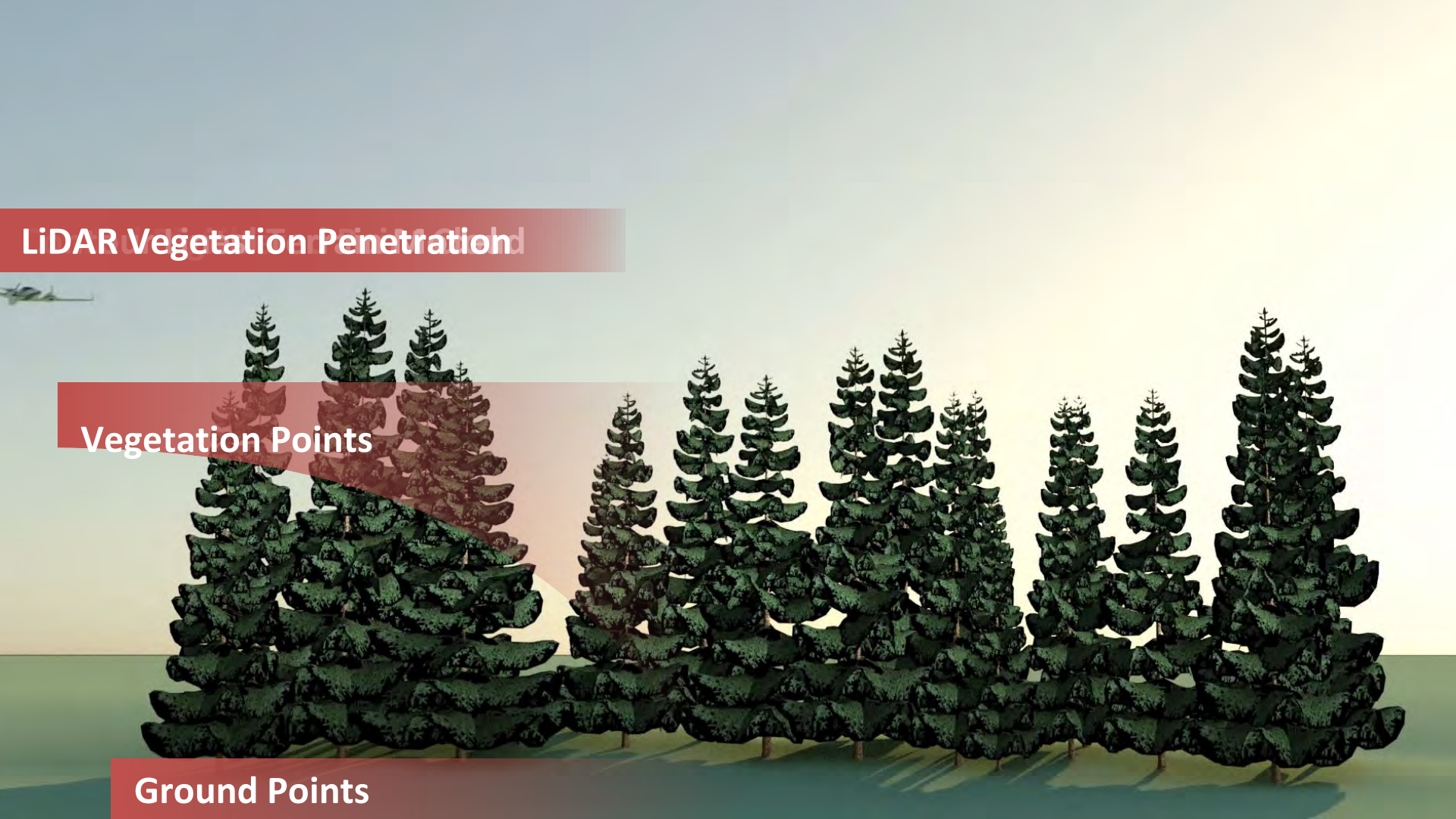
RIEGL RiLOC-E^{25} / RiLOC-F
Location and Orientation Component

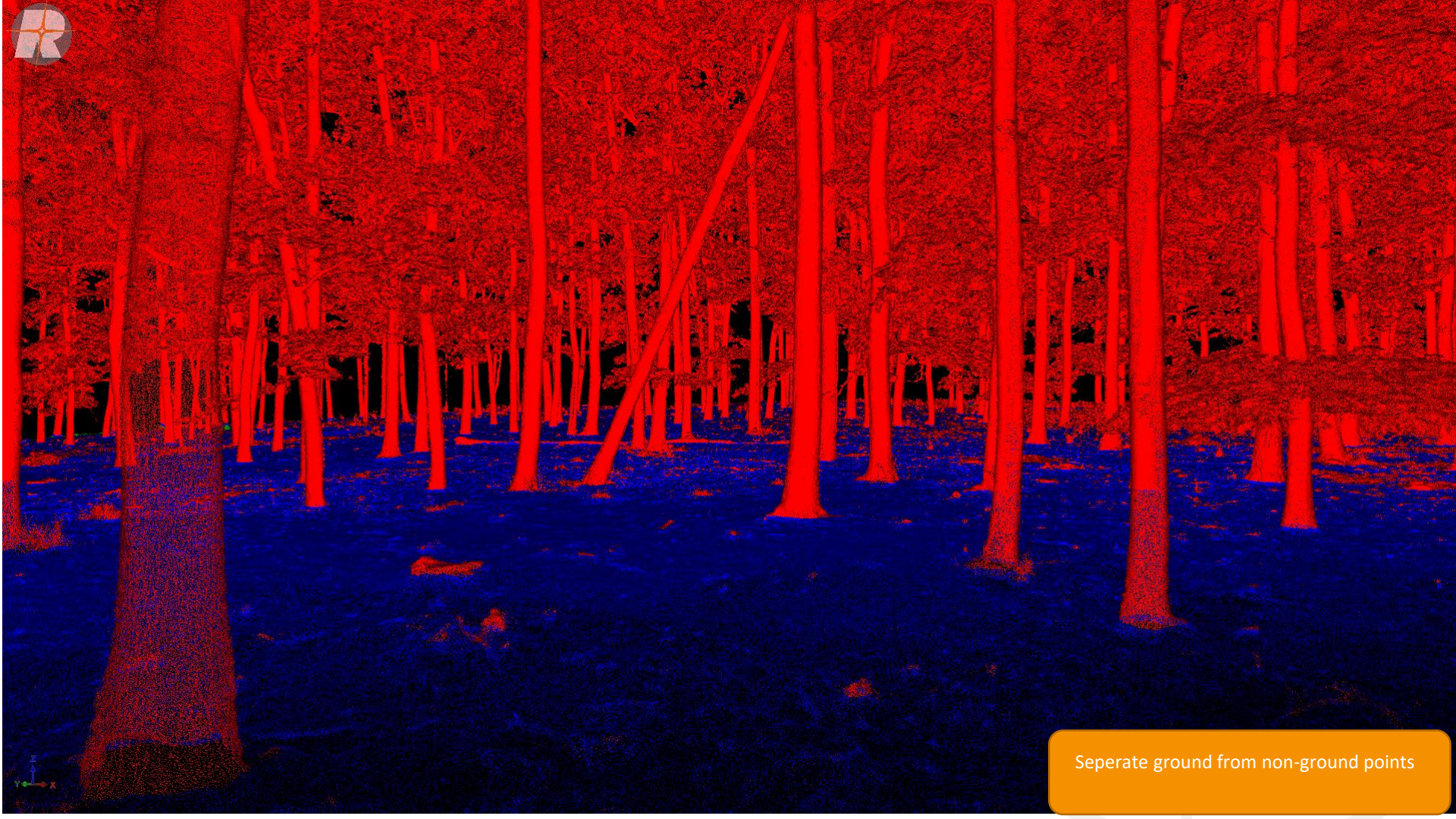
RIEGL's IMU/GNSS solution for VUX-series laser scanners

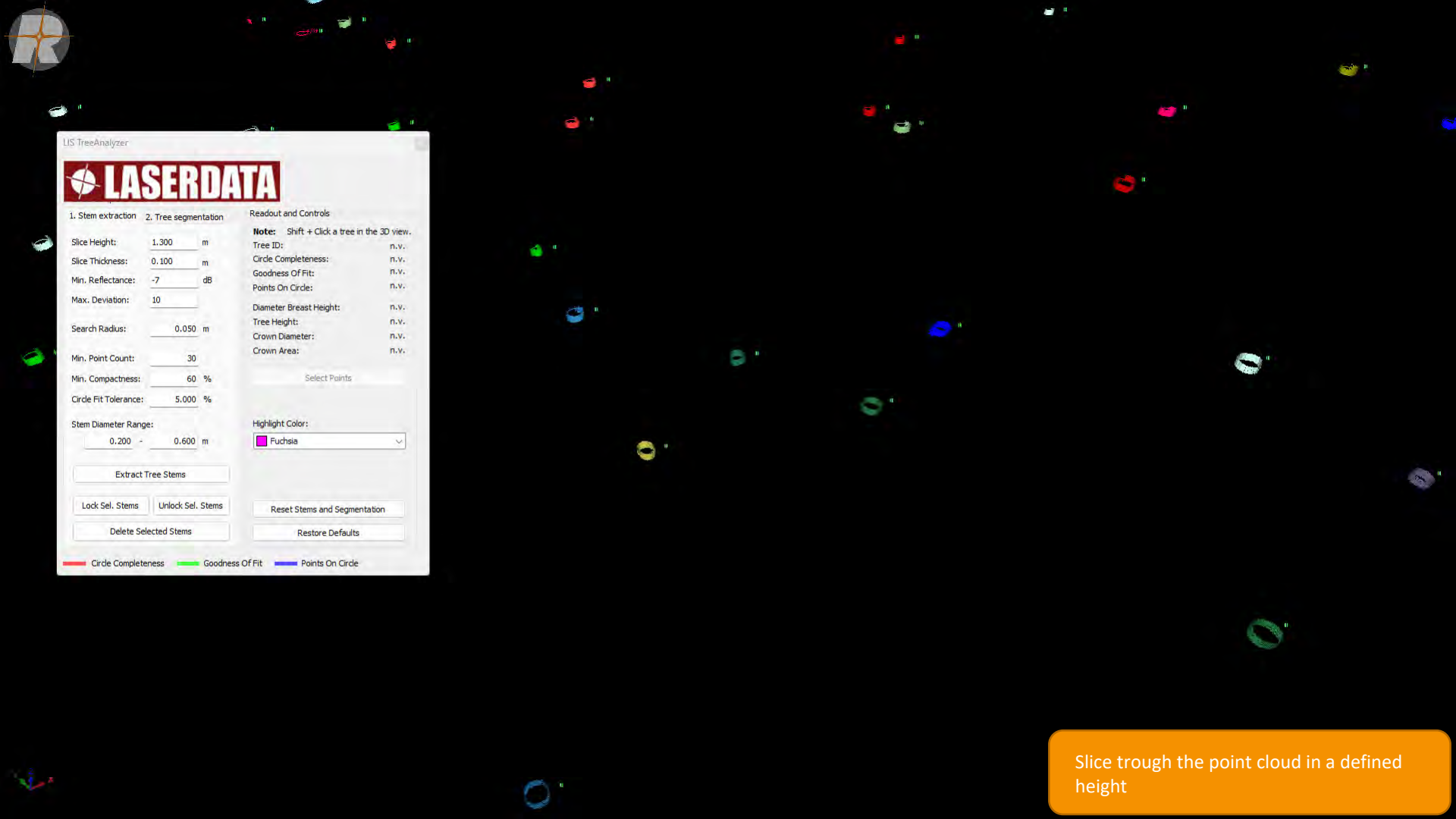
	RiLOC-E^{25}	RiLOC-F
Roll/Pitch [deg] (GPS, IMU post processed accuracies)	**0.010 °**	**0.008 °**
Yaw [deg] (GPS, IMU post processed accuracies)	**0.020 °**	**0.015 °**
Performance specifications [m] (position, post-processed)	**0.02 - 0.04 m**	**0.02 - 0.03 m**
IMU sampling rates	up to more than **700 Hz**	up to more than **700 Hz**
IMU acceleration range	±8 g, full scale	±8 g, full scale
IMU angular range	± 300°/sec	± 300°/sec
GNSS system	L1/L2, GPS, GLONASS, Galileo and BeiDou	**multi-constellations** (GPS, GLONASS, Galileo and BeiDou) up to triple-frequency

Typische ULS-Anwendungsbeispiele

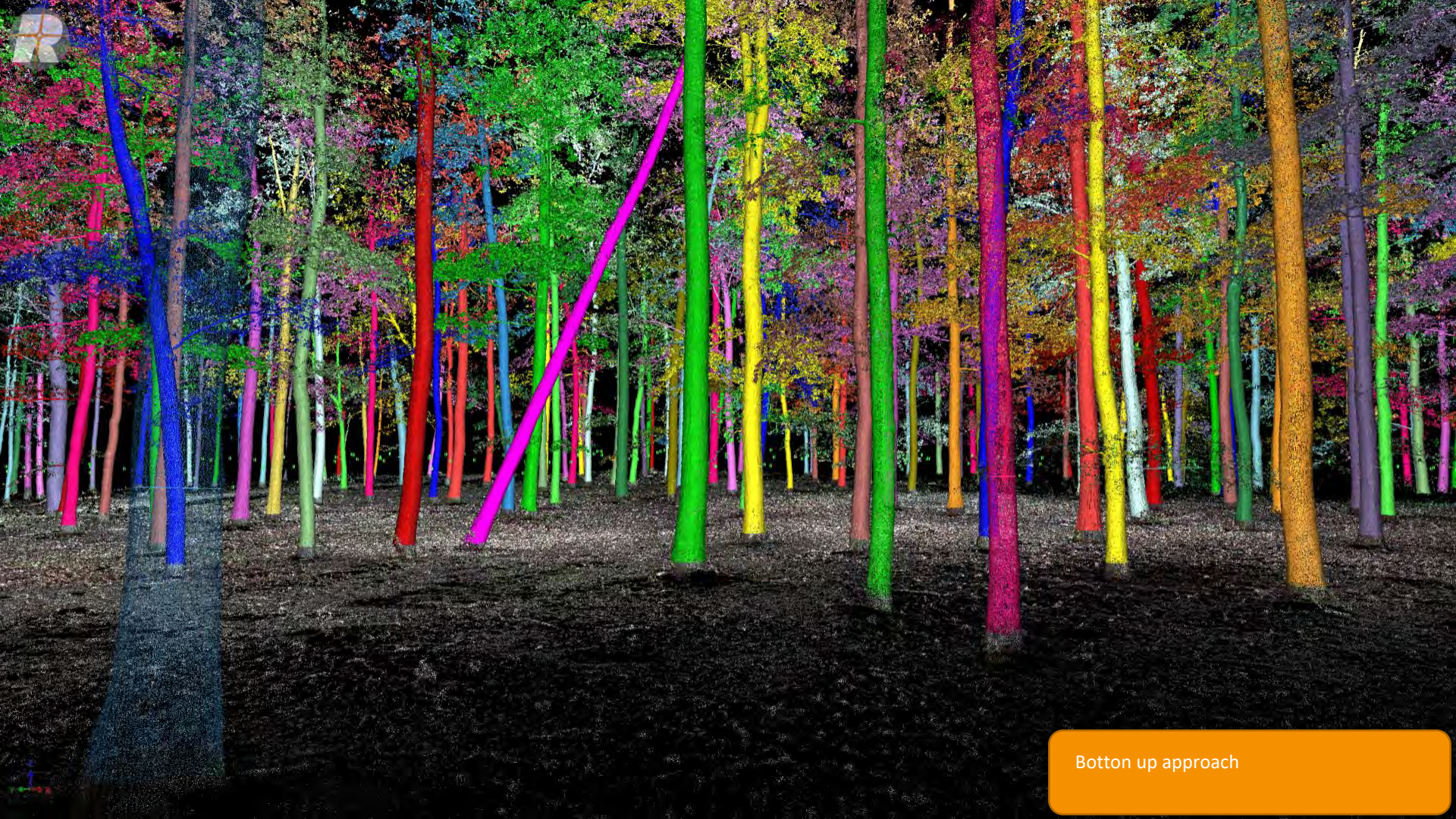
LiDAR Vegetation Penetration




Seperate ground from non-ground points

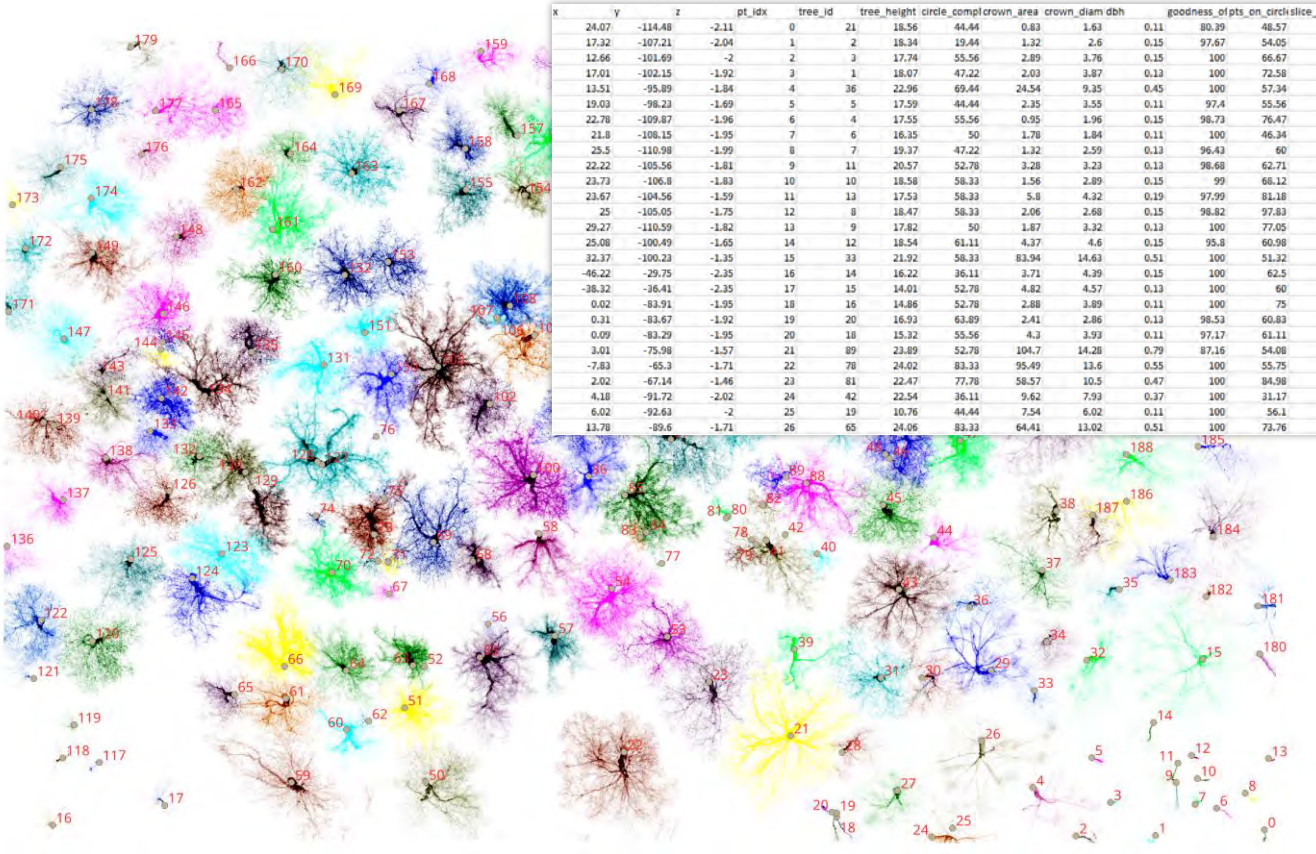


Slice trough the point cloud in a defined height



Botton up approach

Results



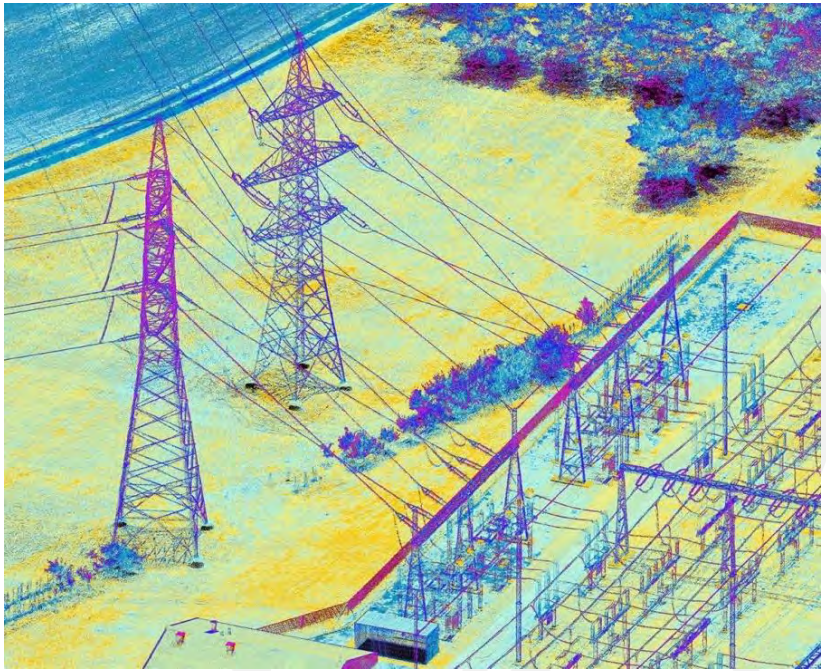
x	y	z	pt_idx	tree_id	tree_height	circle_compl	crown_area	crown_diam	dbh	goodness_of	pts_on_circl	slice_height
24.07	-114.48	-2.11	0	21	18.56	44.44	0.83	1.63	0.11	80.39	48.57	1.3
17.32	-107.21	-2.04	1	2	18.34	19.44	1.32	2.6	0.15	97.67	54.05	1.3
12.66	-101.69	-2	2	3	17.74	55.56	2.89	3.76	0.15	100	66.67	1.3
17.01	-102.15	-1.92	3	1	18.07	47.22	2.03	3.87	0.13	100	72.58	1.3
13.51	-95.89	-1.84	4	36	22.96	69.44	24.54	9.35	0.45	100	57.34	1.3
19.03	-98.23	-1.69	5	5	17.59	44.44	2.35	3.55	0.11	97.4	55.56	1.3
22.78	-109.87	-1.96	6	4	17.55	55.56	0.95	1.96	0.15	98.73	76.47	1.3
21.8	-108.15	-1.95	7	6	16.35	50	1.78	1.84	0.11	100	46.34	1.3
25.5	-110.98	-1.99	8	7	19.37	47.22	1.32	2.59	0.13	96.43	60	1.3
22.22	-105.56	-1.81	9	11	20.57	52.78	3.28	3.23	0.13	98.68	62.71	1.3
23.73	-106.8	-1.83	10	10	18.58	58.33	1.56	2.89	0.15	99	68.12	1.3
23.67	-104.56	-1.59	11	13	17.53	58.33	5.8	4.32	0.19	97.99	81.18	1.3
25	-105.05	-1.75	12	8	18.47	58.33	2.06	2.68	0.15	98.82	97.83	1.3
29.27	-110.59	-1.82	13	9	17.82	50	1.87	3.32	0.13	100	77.05	1.3
25.08	-100.49	-1.65	14	12	18.54	61.11	4.37	4.6	0.15	95.8	60.98	1.3
32.37	-100.23	-1.35	15	33	21.92	58.33	83.94	14.63	0.51	100	51.32	1.3
-46.22	-29.75	-2.35	16	14	16.22	36.11	3.71	4.39	0.15	100	62.5	1.3
-38.32	-36.41	-2.35	17	15	14.01	52.78	4.82	4.57	0.13	100	60	1.3
0.02	-83.91	-1.95	18	16	14.86	52.78	2.88	3.89	0.11	100	75	1.3
0.31	-83.67	-1.92	19	20	16.93	63.89	2.41	2.86	0.13	98.53	60.83	1.3
0.09	-83.29	-1.95	20	18	15.32	55.56	4.3	3.93	0.11	97.17	61.11	1.3
3.01	-75.98	-1.57	21	89	23.89	52.78	104.7	14.28	0.79	87.16	54.08	1.3
-7.83	-65.3	-1.71	22	78	24.02	83.33	95.49	13.6	0.55	100	55.75	1.3
2.02	-67.14	-1.46	23	81	22.47	77.78	58.57	10.5	0.47	100	84.98	1.3
4.18	-91.72	-2.02	24	42	22.54	36.11	9.62	7.93	0.37	100	31.17	1.3
6.02	-92.63	-2	25	19	10.76	44.44	7.54	6.02	0.11	100	56.1	1.3
13.78	-89.6	-1.71	26	65	24.06	83.33	64.41	13.02	0.51	100	72.76	1.3

- Exact georeferenced location of each individual tree
- Unique tree ID
- Tree height
- Crown area
- Crown diameter
- DBH

Addititional:

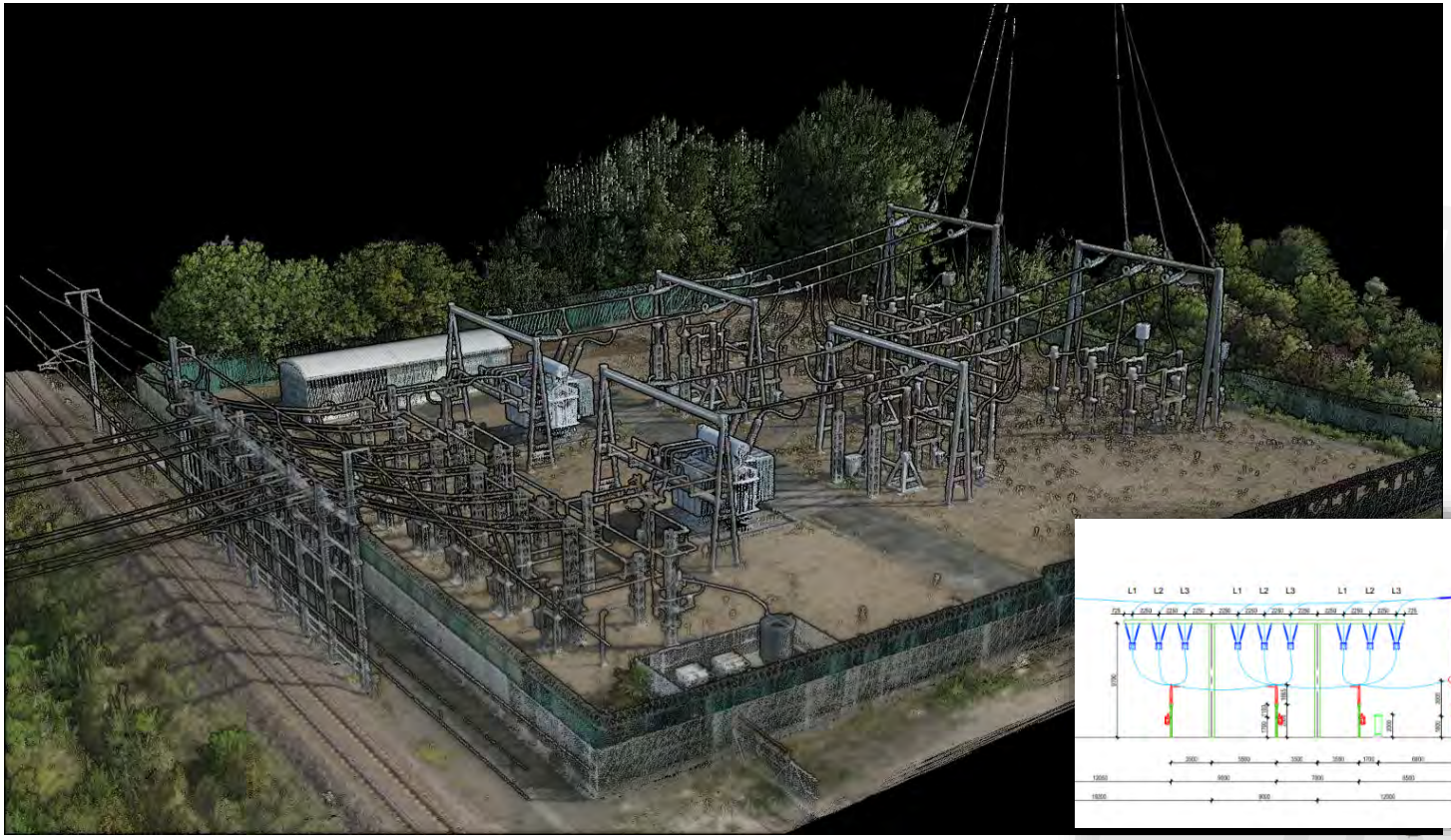
Each individual tree can be exported as a seperate pointcloud for further analysis

Stromleitungsbefliegung / Trassenmonitoring



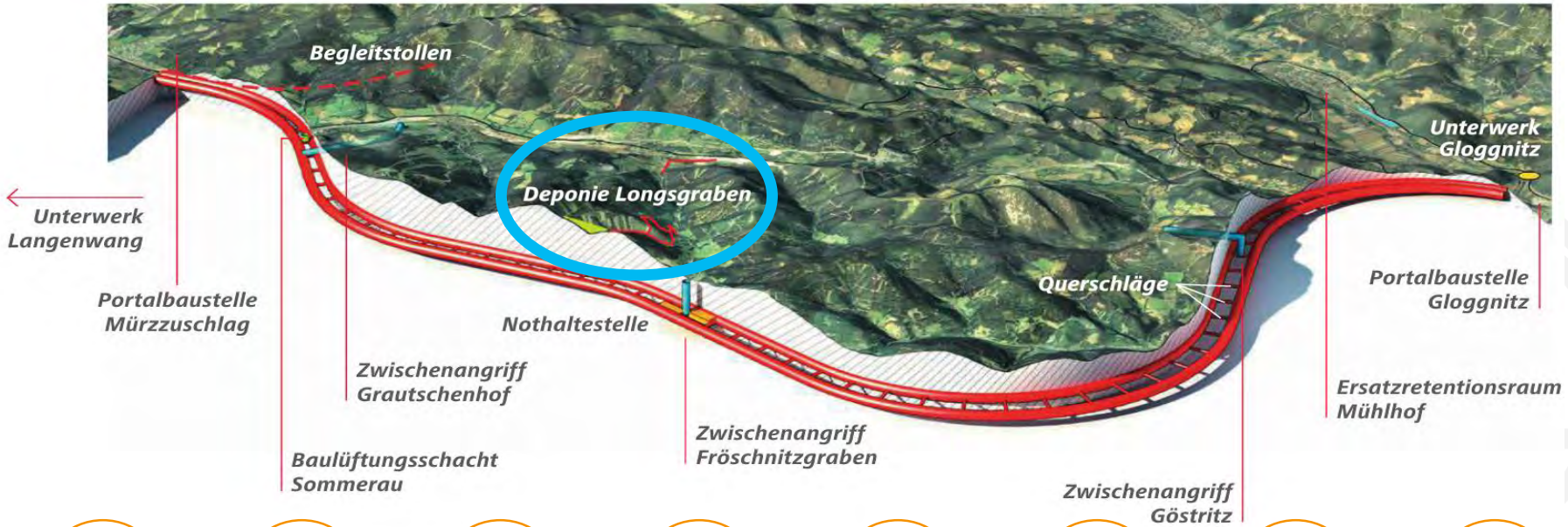
RIEGL®

Umspannwerke



Change Detection

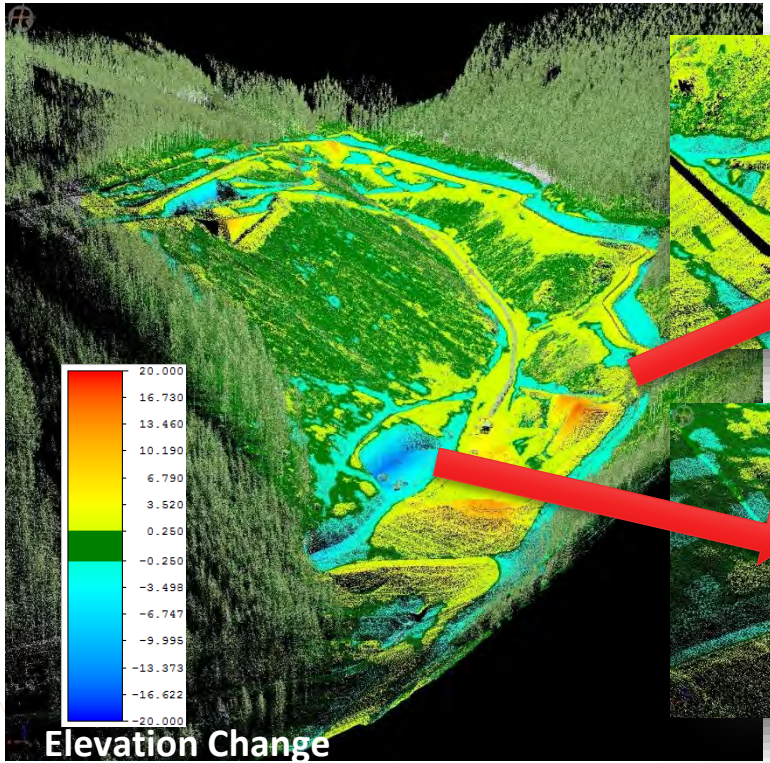
Graphics: OEBB

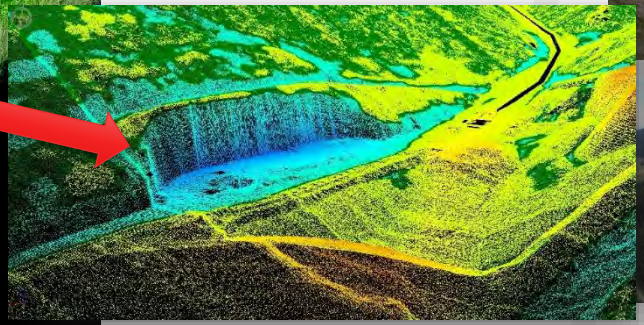


27,3 km | 8,4 ‰ | 230 km/h | -30 min | NAT& TBM | 12 years | 2025 | 11Bn €

RIEGL

Change Detection





RIEGL

Danke für Ihre Aufmerksamkeit!

Philipp Amon, RIEGL | pamon@riegl.com





Innovation in 3D