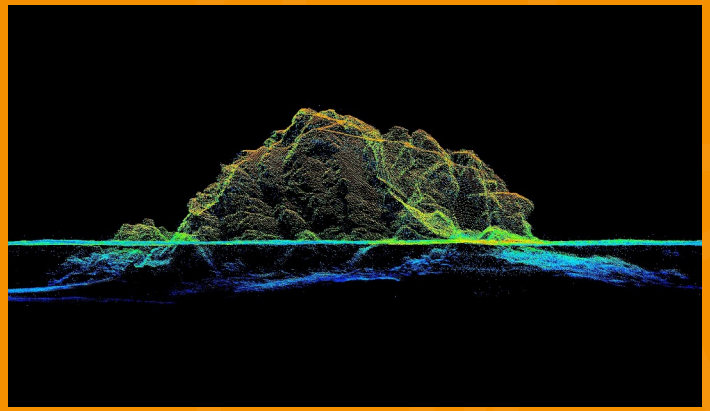
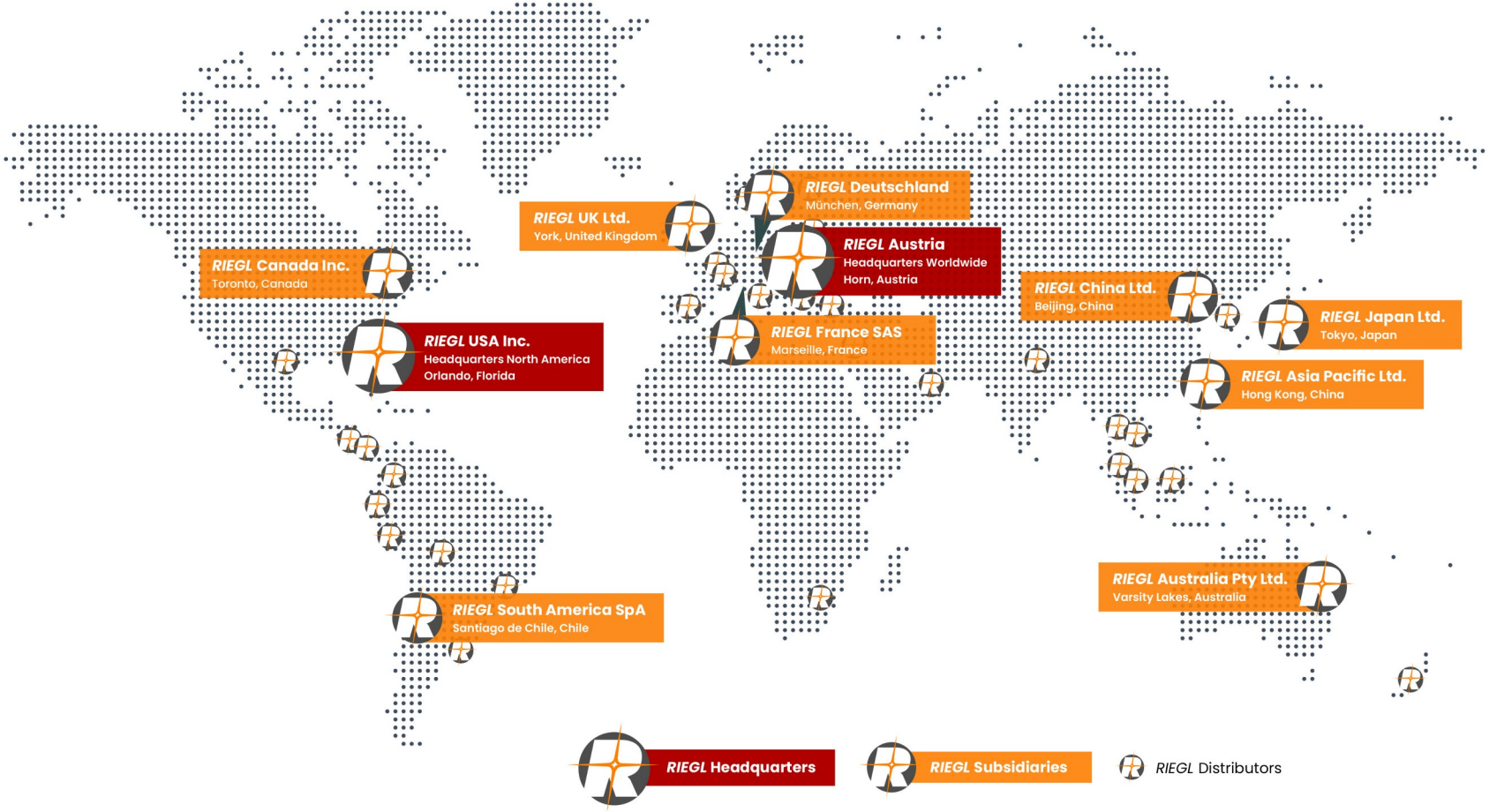
Where water meets land:
The challenges in coastal mapping and river surveying

Markus Handl
International Partner Management
RIEGL International GmbH



Geospatial World Forum 2026 : 27 April - 01 May, Amsterdam, Netherlands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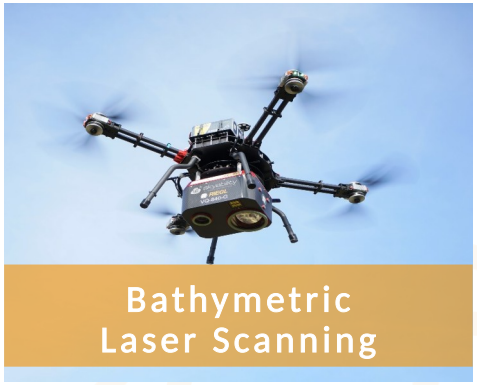
Product Branches



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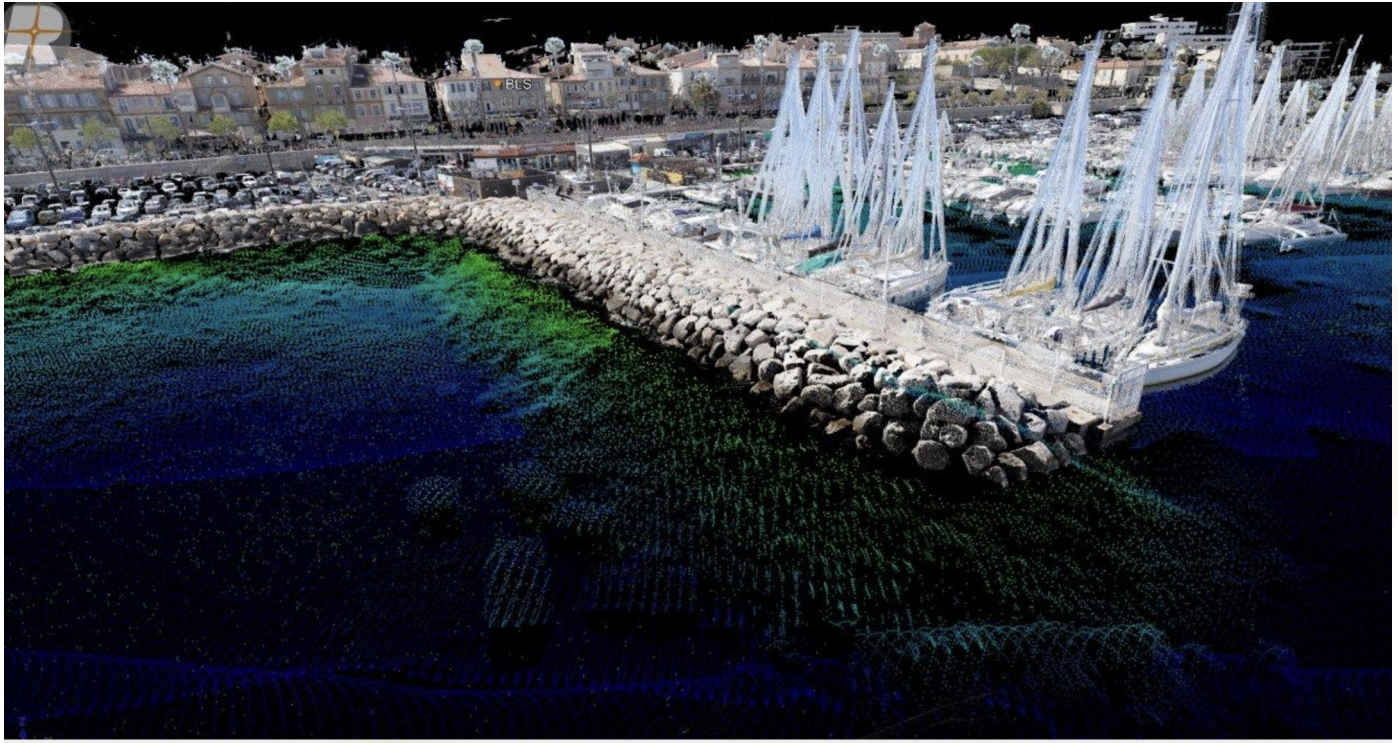
RIEGL Products for Hydrographic Applications

Survey of infrastructure and vegetation close to the shore by means of terrestrial, airborne, and mobile – boat-based systems.

Survey of underwater topography by topo-bathymetric airborne systems



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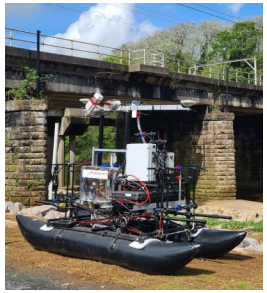
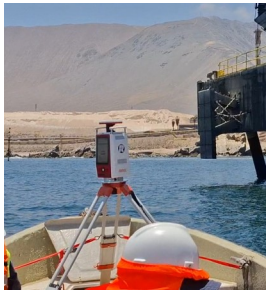
RIEGL Products Hydrographic Applications

Terrestrial

Vessel based





[un] Crewed Aircraft

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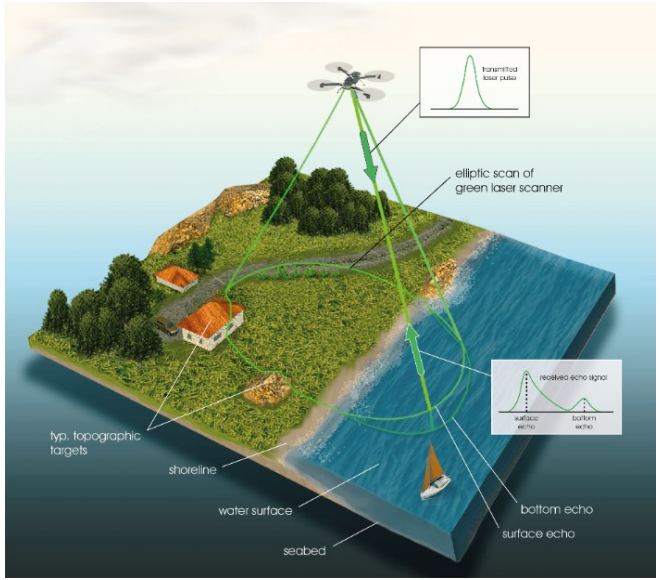
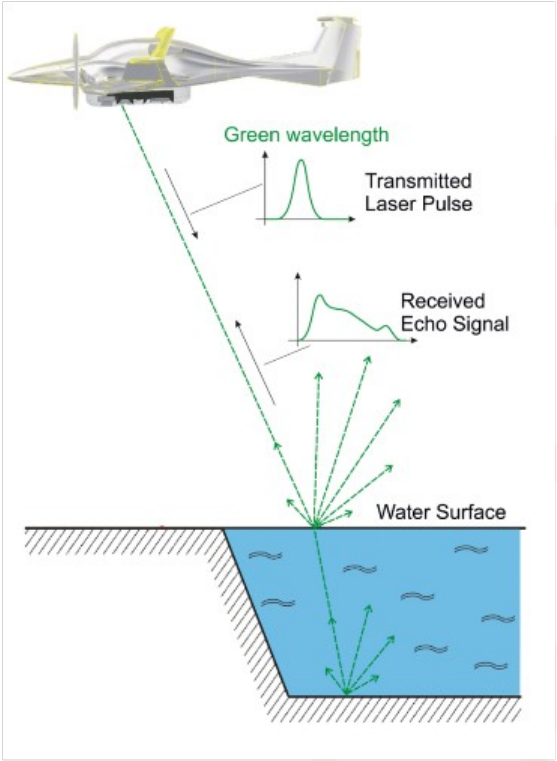
Hydrographic Survey + Topographic Survey : the bridging role of a combined Topo-Bathymetric Method

Example Harbor Infrastructure.
Orthophoto + ALB Data, Lago Maggiore, Italy

Principle of Bathymetric Lidar





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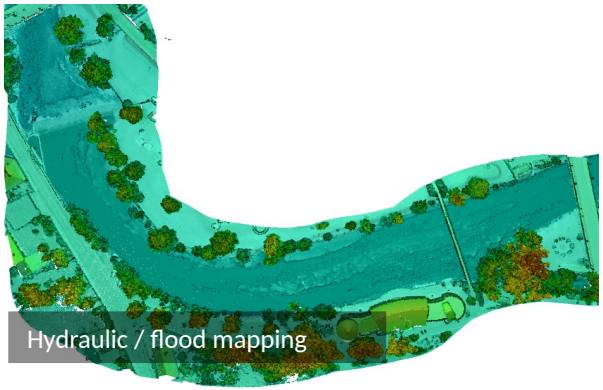
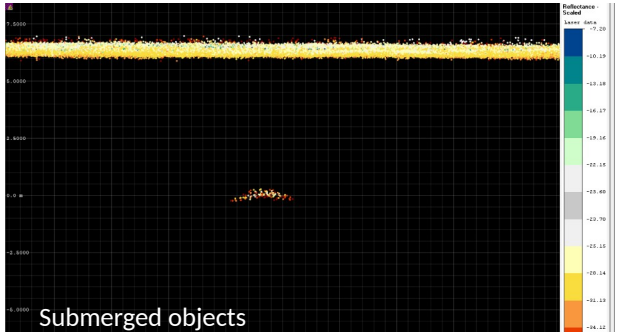
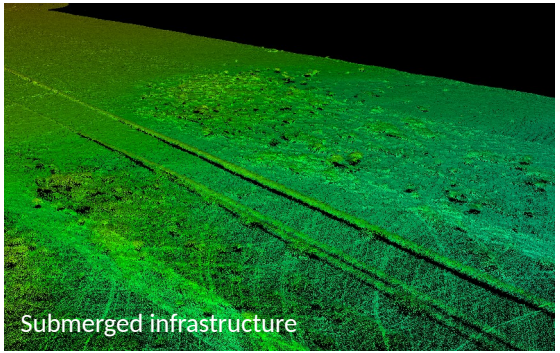
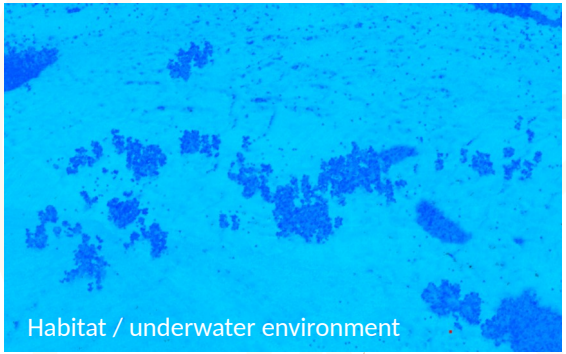
Example Hydrographic Applications


Hydraulic / flood mapping

- Coastline and shallow water mapping
- Acquiring base data for flood prevention
- Habitat mapping
- Measurement of aggradation zones
- Surveying for hydraulic engineering
- Hydro-archeological surveying
- Survey of Riverine Systems
- Detection of submerged objects /structures


Submerged objects


Submerged infrastructure


Habitat / underwater environment

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Expressing Measurement Performance in Secchi Depths

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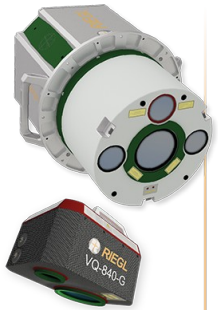
TIMELINE RIEGL TOPO-BATHYMETRY

2011	2014	2016	2017	2018	2022	2024	2025
							
VQ-820-G	VQ-880-G	BDF-1	VQ-880-GH	VQ-880-GII / VQ-840-G	VQ-840-GL	VQ-840-GE / VQ-860-G	VUX-820-G

MILESTONES

In system design:	compact, high performance, high resolution ALB	first miniaturization for UAV	wide model portfolio for integration into various aircraft types
In data processing:	unconditional full waveform recording	exponential decomposition & waveform averaging	deep learning enhanced waveform processing

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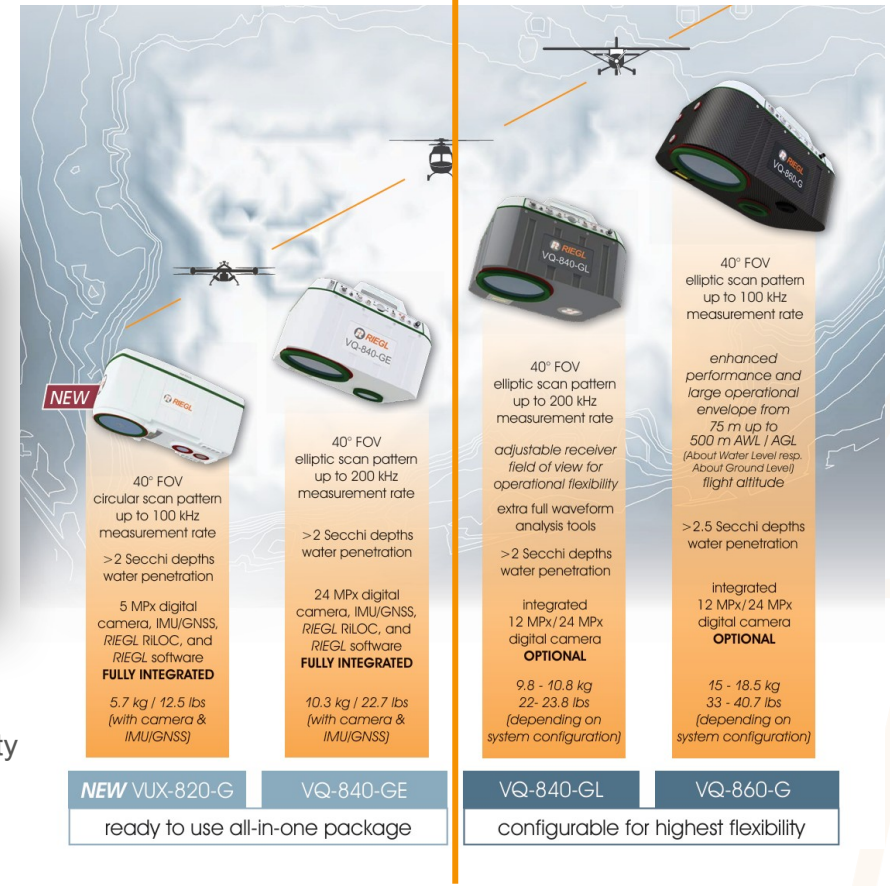
Current product portfolio

- Rapid and frequent deployment
- Lower altitude / high density
- Ease of use
- Pre-configured



- Wider area mapping / Greater planning
- Use with external sensors
- Higher altitude / mid density
- Fast flight speed

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.. some specs and key facts for system comparison..

VUX-820-G

- Lightweight 5.7Kg
- Compact drone deployable sensor
- Integrated INS system and RGB Camera
- GUI for visual ease of config

VQ-860-G

- Typical Operation~ 900ft AGL
- Typically, crewed-aircraft deployment
- May use external sensors i.e. camera INS

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Integration Examples UAV

RiCOPTER® ... A RIEGL® COMPANY

SCHIEBEL

ACECORE

dji

VELOS ROTORS®

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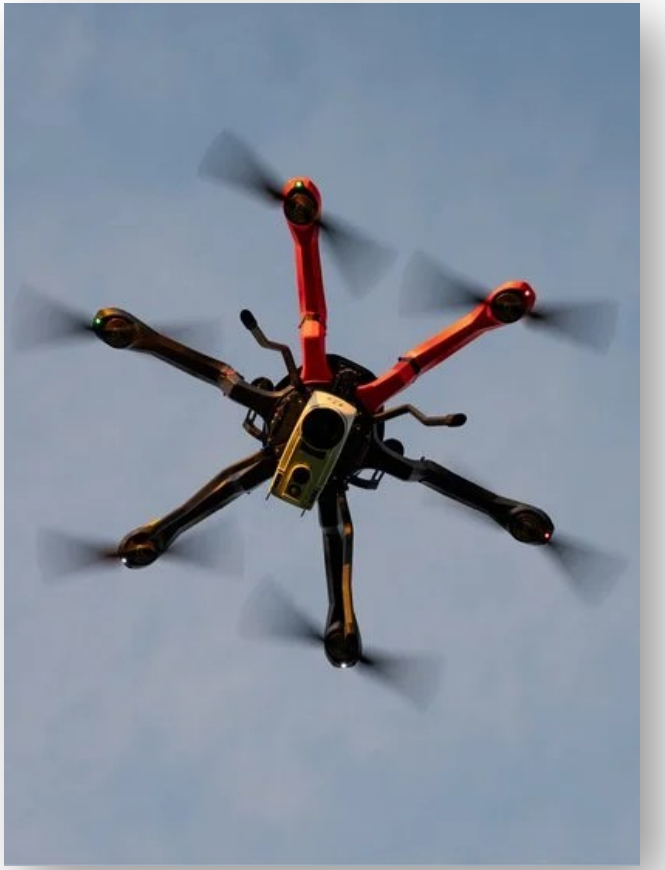
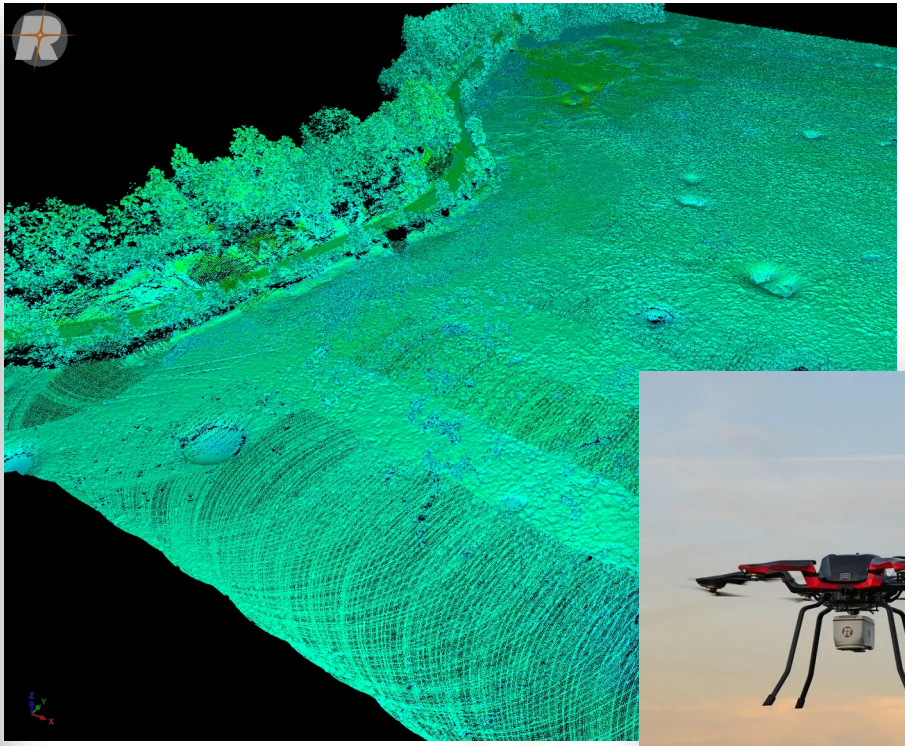
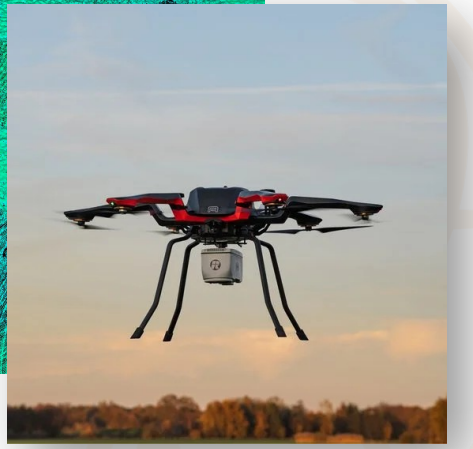
Integration examples VUX-820-G on Acecore NOA







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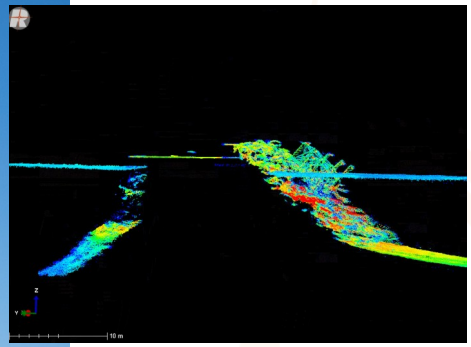
Integration Examples VQ-840-GE on Acecore NOA



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Integration Examples VQ-840-GE Installation in Cessna 206

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Integration Examples VQ-860-G Installation in DA-62

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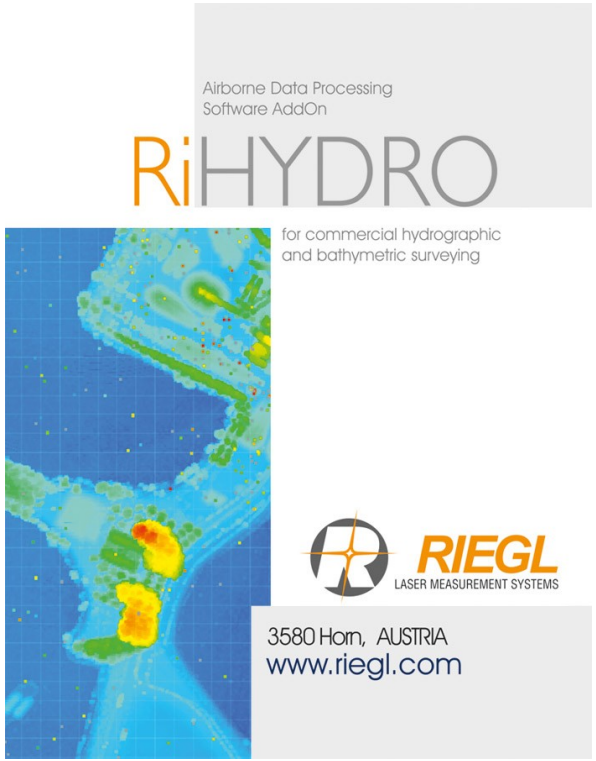
Integration Examples VQ-860 Installation on the wingstrut and on a helicopter payload arm

Processing Tools for Hydrographic Data



RIEGL Software, Add-on to RiPROCESS

- Automatic **classification** of water surface points
- Generation of a **water surface model** (WSM)
- **Refraction correction** of points below the water surface

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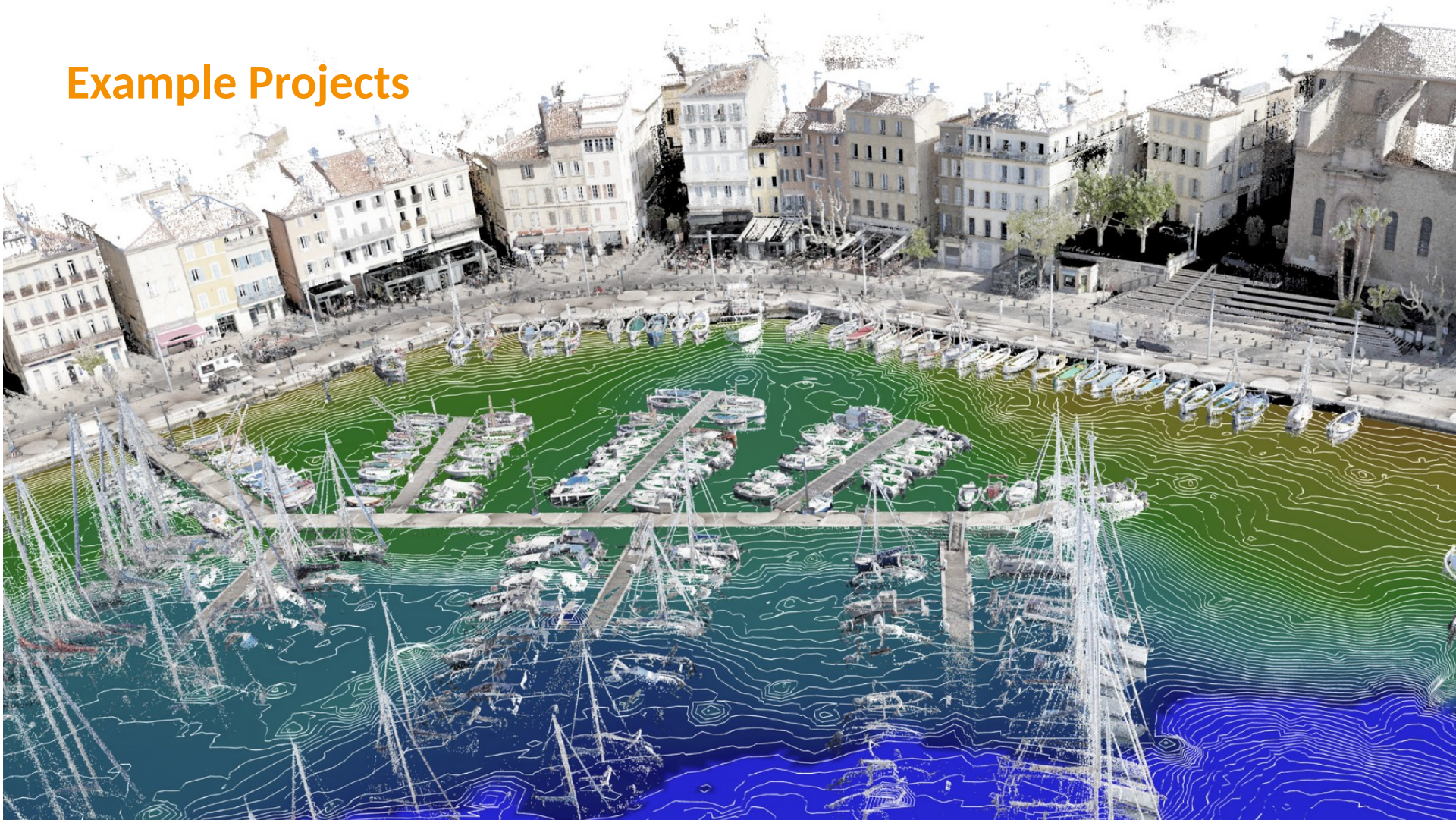
Example Projects



VQ-860-G Samer Island, Coatia

Fig 1. Geographic situation: Adriatic Sea- Croatian Coast.

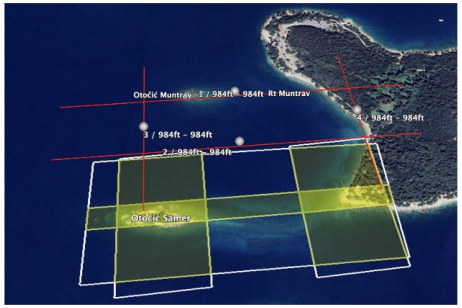


Fig 2. Overview of the study area nearby Rovinj.

Acquisition Platform	Diamond DA62 MPP
Acquisition Software	RiACQUIRE-ALS
Acquisition speed	approx. **110** kts (~ 204 km/h)
PRR	**50 kHz – 100 KHz** (Record008_Line1, Record014_Line1)
Field of view	**40°**
Flight altitude AGL	approx. **300** meters (~ 984 feet)
Laser beam divergence	**6.0** mrad

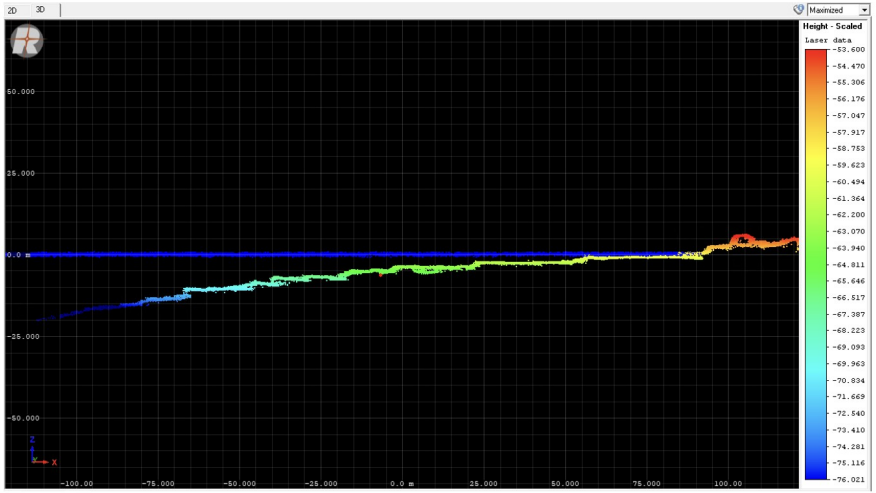


Fig 10. Example detailed profile encoded by heights & water surface points (blue)

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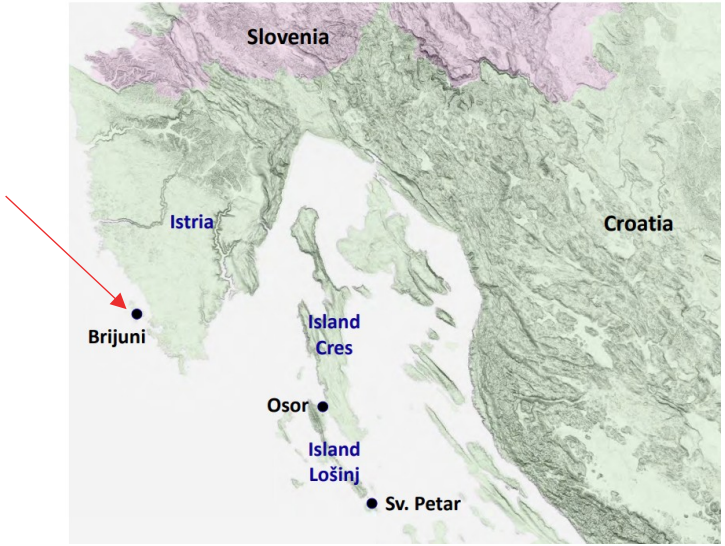
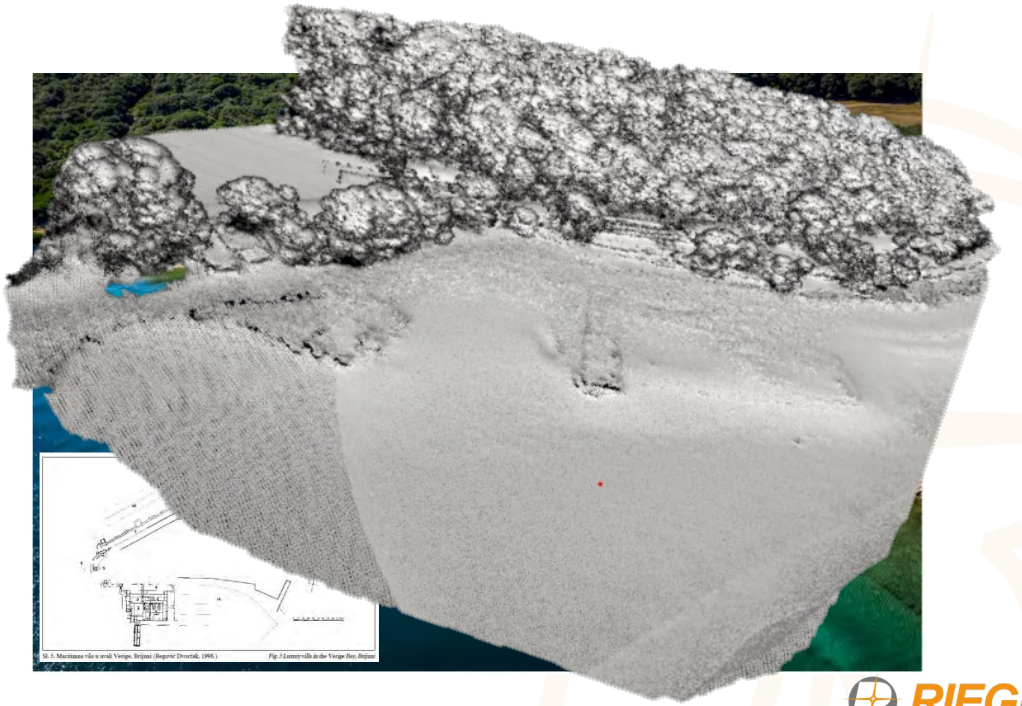
VQ-860-G Brijuni Island, Croatia

application example hydro archaeology

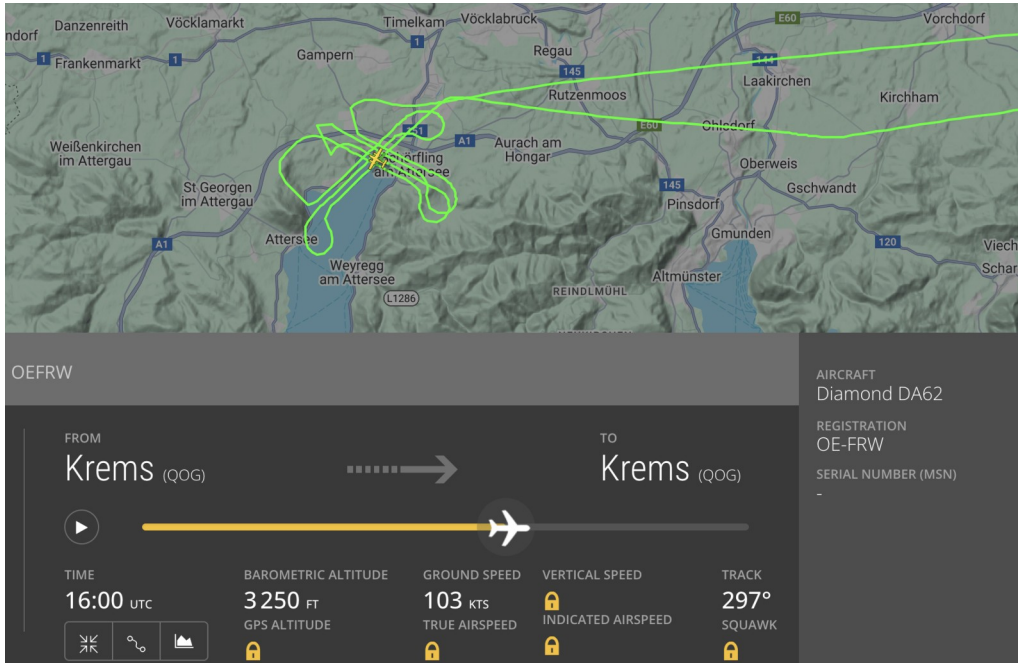
	Flight altitude: 820 ft
VQ-860-G	PRR = 50 kHz and 100 kHz
DA-62	Laser beam divergence = 6 mrad

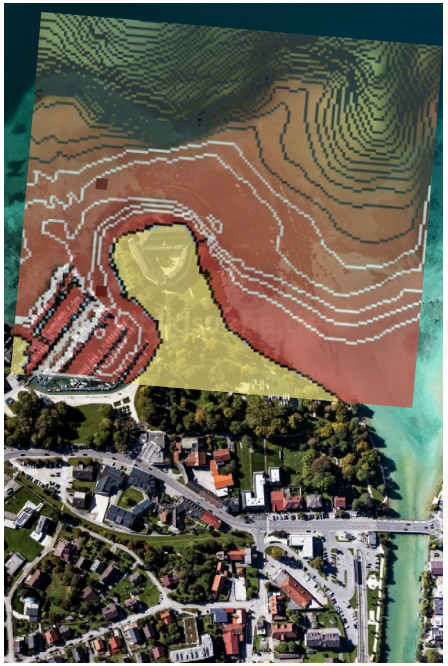




VQ-860-G - Enhancing Productivity

VQ-860-G excells with a wide operational envelope: typically flown at 900 ft, it is also possible to carry out flights at lower altitude, for high level of detail, or even higher for maximum efficiency in covering large survey areas. A recent test project flown over lake Attersee in Austria, proves the excellent depth penetration performance at 1700 ft AGL





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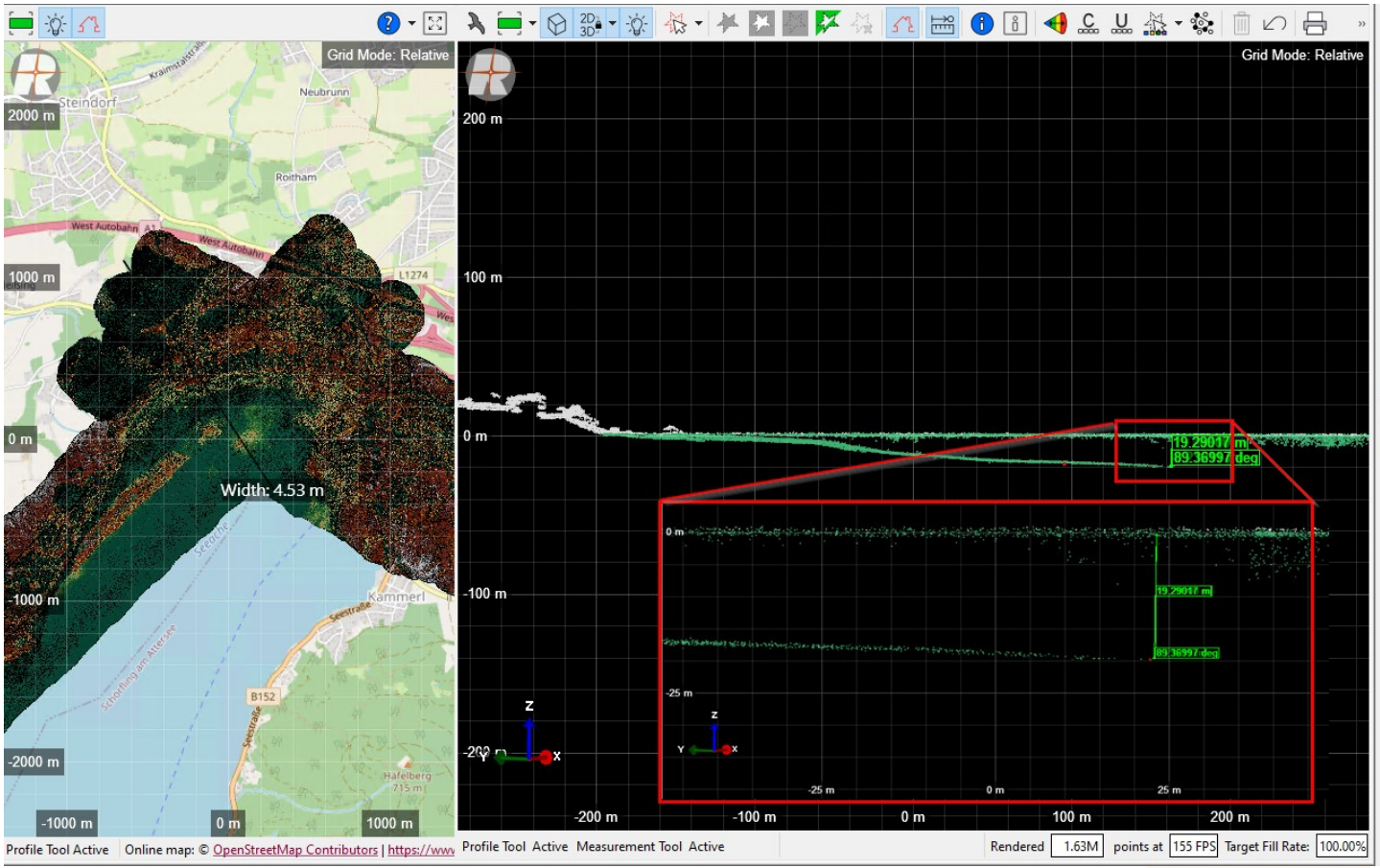
VQ-860-G - Results from High Altitude Testflight



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VUX-820-G - Lake Almsee: vegetation mapping

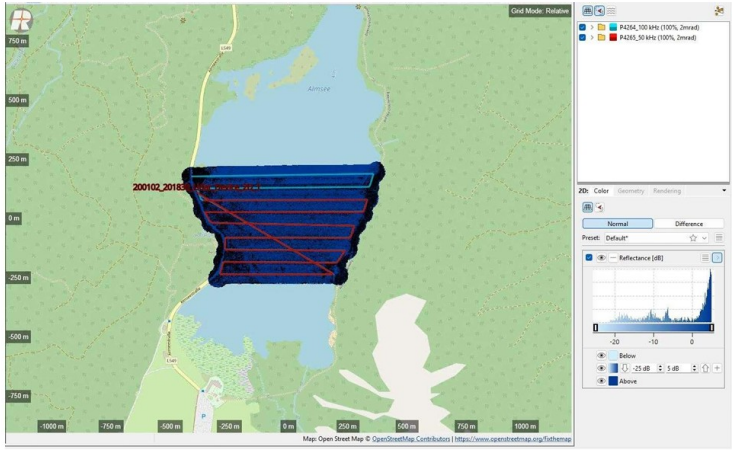
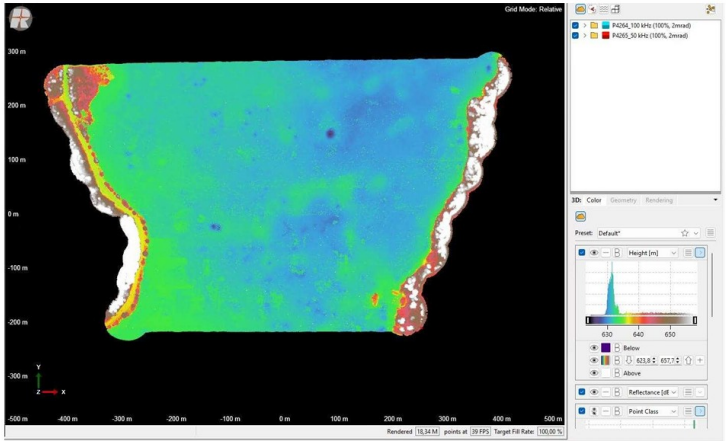
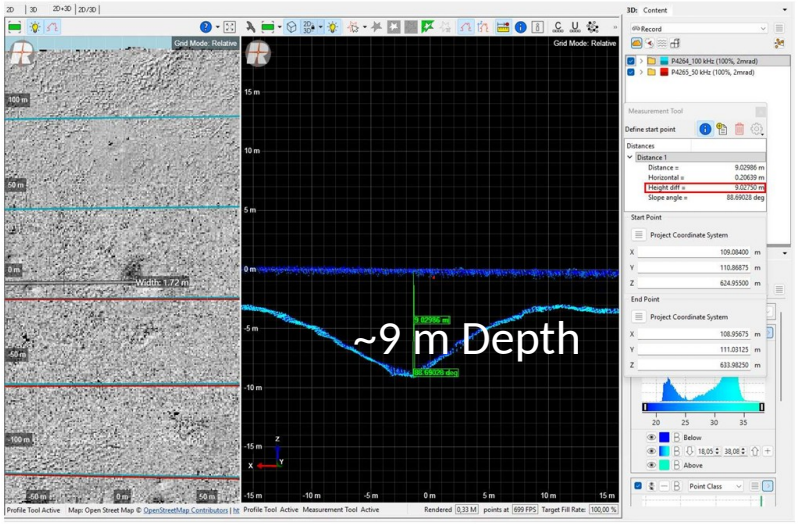


Fig 6. Example point cloud colorized according to the target reflectance





Demo data processing – Georeferenced Point Cloud	
Section processed	approx. 24 ha
Software used	RiPROCESS version 1.9.8
Processed data volume	processed scan data **43** GB (*RIEGL* point cloud format, RDBX)
Points in total	approx. **220** Mio. Points (all records are used)
Point density	approx. **221** points / m² (water surface + underwater), of a single strip in nadir direction - 100 kHz approx. **90** points / m² (water surface + underwater), of a single strip in nadir direction - 50 kHz
Maximum water penetration	approx. **9** meters

Target detection capability
test flight at REPMUS trial in Troia, Portugal, 2024
RIEGL VQ-860-G – bathymetric scanner
mounted on SCHIEBEL Camcopter S-100

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SCHIEBEL PRESS

Target detection capability

SCHIEBEL CAMCOPTER® S-100 UAS IMPRESSES WITH ITS MULTI-MISSION CAPABILITIES AT REPMUS 2024

Vienna, 16 October 2024 – Schiebel participated in the large-scale NATO supported exercise REPMUS 2024 (Robotic Experimentation and Prototyping using Maritime Uncrewed Systems) hosted by the Portuguese Navy. For the third year in a row, the CAMCOPTER® S-100 presented its unrivalled multi-mission capabilities in the maritime domain.

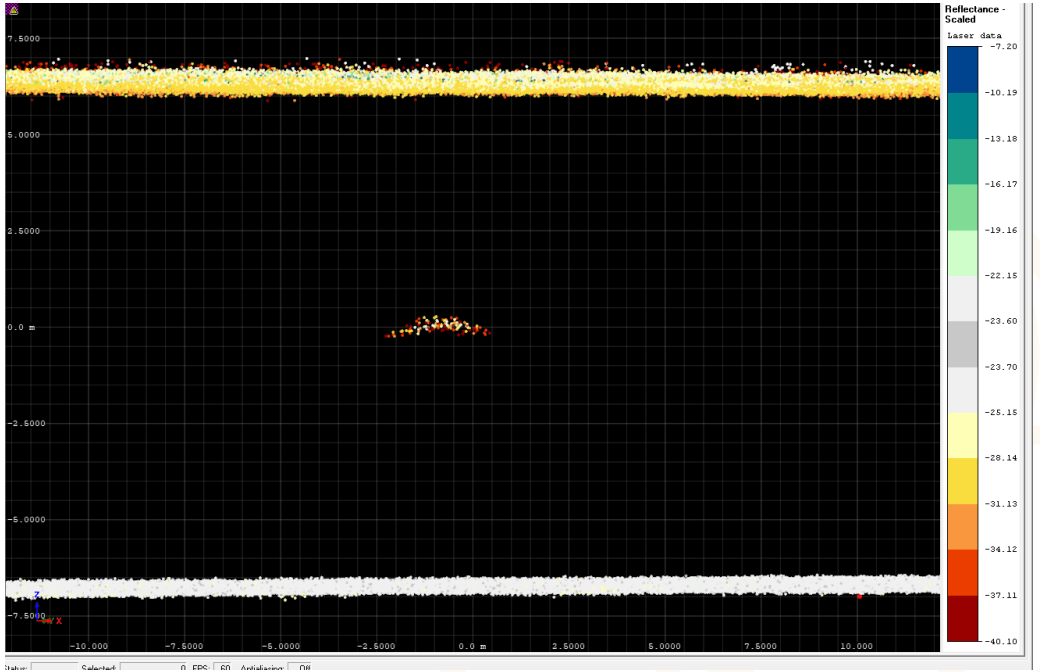
Sponsored by the UK Royal Navy and in partnership with Thales, the S-100 flew multiple missions over the three weeks of the exercise and impressed with its Intelligence, Surveillance and Reconnaissance (ISR) capabilities as well as its Anti-Submarine Warfare (ASW), Mine Counter Measures (MCM) and Rapid Environmental Assessment (REA) solutions:

Sonobuoy deployment and data relay (ASW)

At last year's REPMUS, the CAMCOPTER® S-100 demonstrated its sonobuoy dispenser, successfully deploying four G-size sonobuoys from the air to form a small ASW barrier. This year, the UAS additionally dropped and deployed the more capable A-size sonobuoys alongside the four G-size sonobuoys. A second S-100, configured with the Thales BlueTracker communications payload, then relayed the sonobuoy signals back to the ground station in real time providing critical range extension. The mission was planned and monitored using the Thales M-Cube Mission Management System, with BlueTracker acoustic processing of the received signals and subsequent dissemination of underwater targets to the Combat Management System. An end-to-end, integrated capability for ASW operations.

Bathymetric and topographic mapping (MCM and REA)

Schiebel fitted the CAMCOPTER® S-100 with the VQ-860-G and the VUX-120 LiDARs from the Austrian company Riegl, enabling the S-100 to scan the exercise waters for both drifting and moored mines. The laser scanners provide simultaneous bathymetric and topographic mapping under water, on surface and along coastlines, making the S-100 the perfect asset for detecting sea mines (for MCM) as well as for supporting amphibious operations (for REA). The mission was planned and monitored using Thales M-Cube Mission Management System, a task order was then placed on the mine clearance divers to complete the identification of the mines detected by the UAS. An end-to-end, integrated capability for MCM and REA operations.



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System Setup

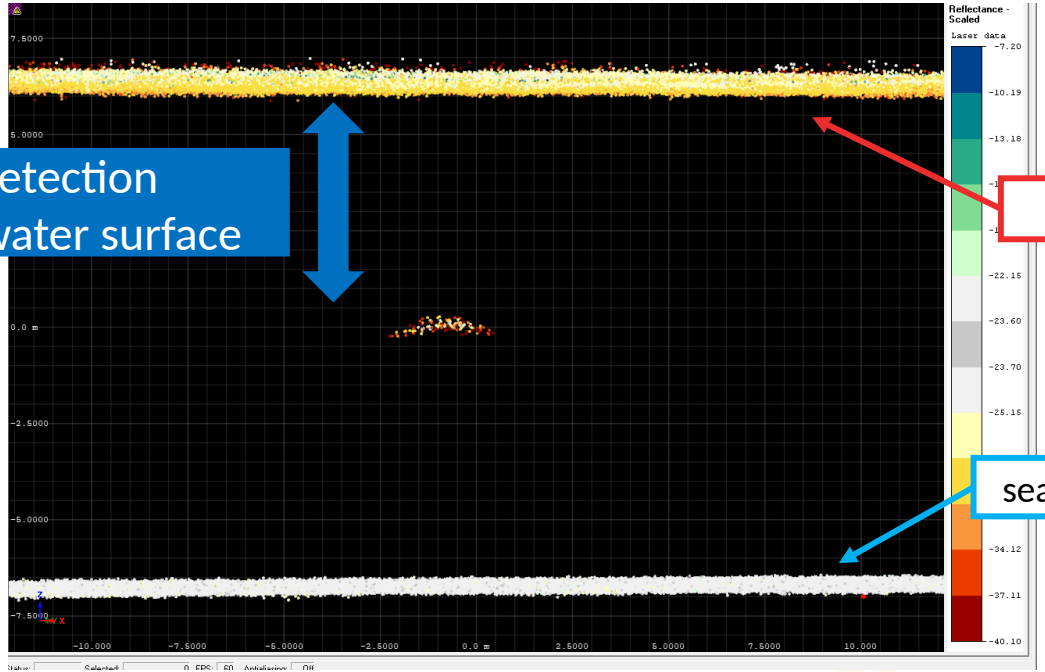
VQ-860-G
Bathymetric
LiDAR
(green laser)

VUX-120
Topographic
LiDAR
(near
infrared)

RIEGL

Target detection capability

target detection
6 m below water surface



water surface

sea bottom (20m)

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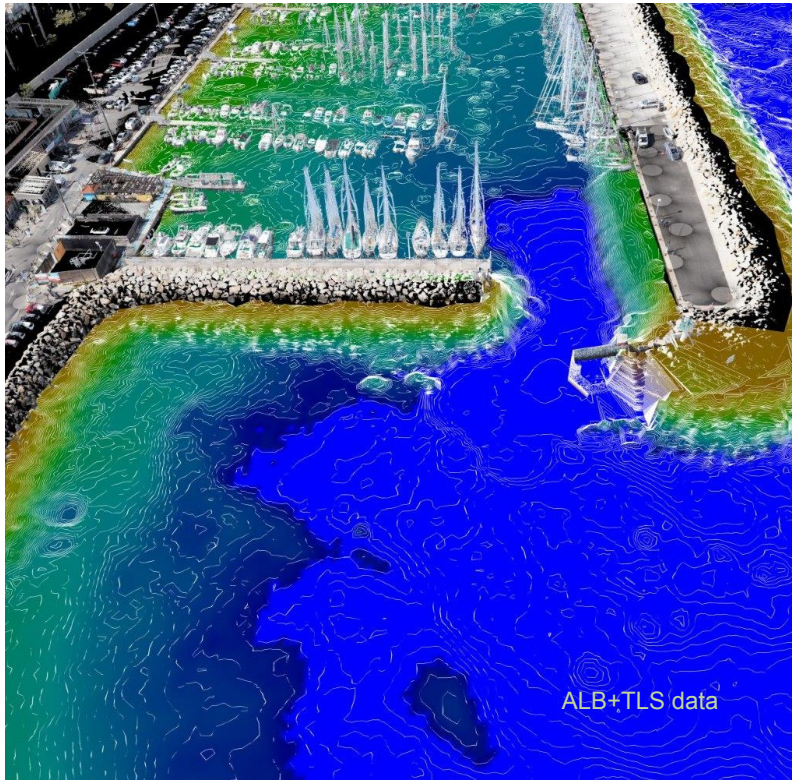
Fusion of LiDAR datasets



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

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Thank you for your kind attention.

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GWF GEOSPATIAL WORLD FORUM

Geospatial World Forum 2026 : 27 April - 01 May, Amsterdam, Netherlands