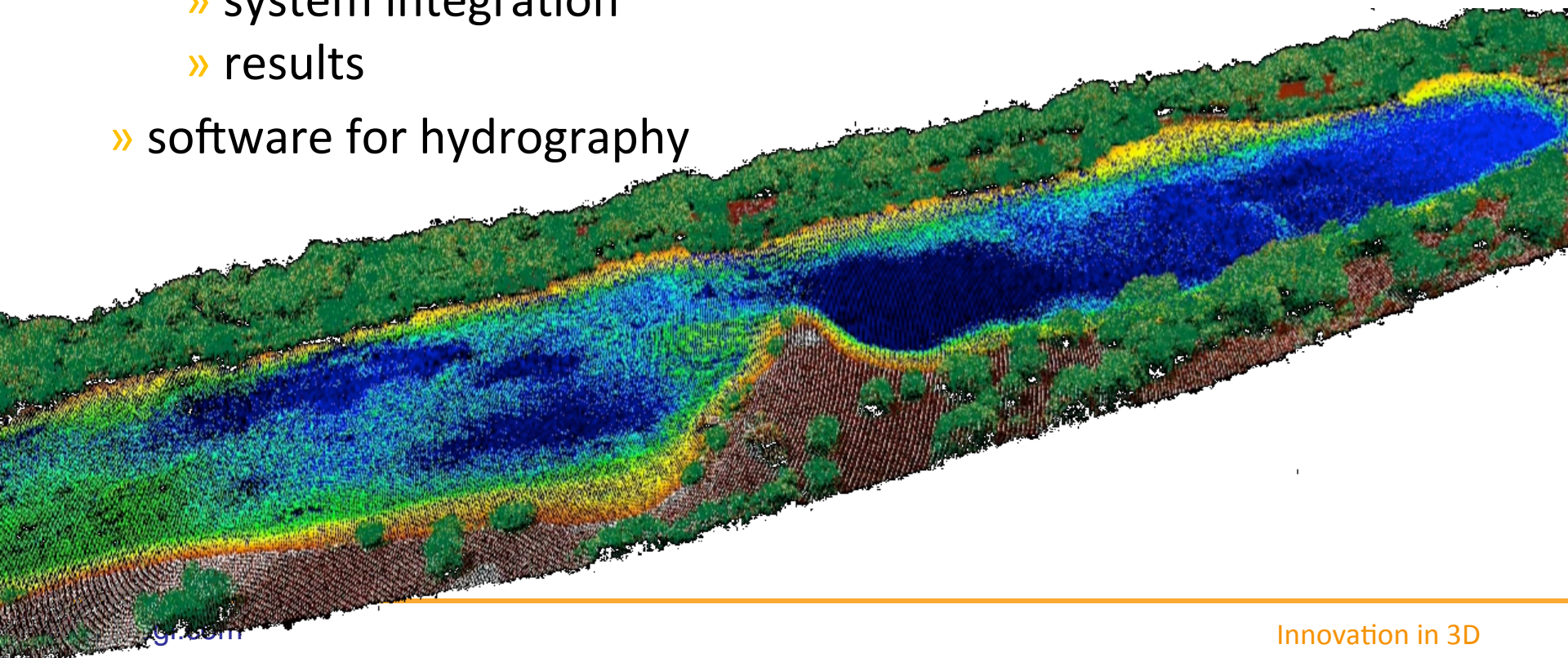
Hydrographisches Airborne Laserscanning für die präzise und hochauflösende Vermessung von Flussläufen und Ufergebieten

Martin Pfennigbauer
Alexander Haring

RIEGL Research

AGENDA

- Introduction ALS
- *RIEGL* topo-bathy laser scannerVQ-820-G & VQ-880-G
  - product specifications
  - system integration
  - results
- software for hydrography



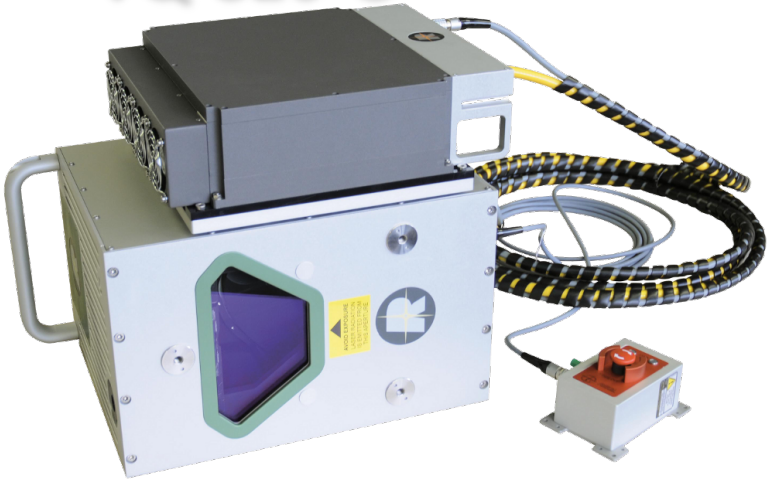
RIEGL Airborne Laser Scanners

VQ-480

LMS-Q680i

DR680

VQ-820-G



VQ-580

Dedicated software

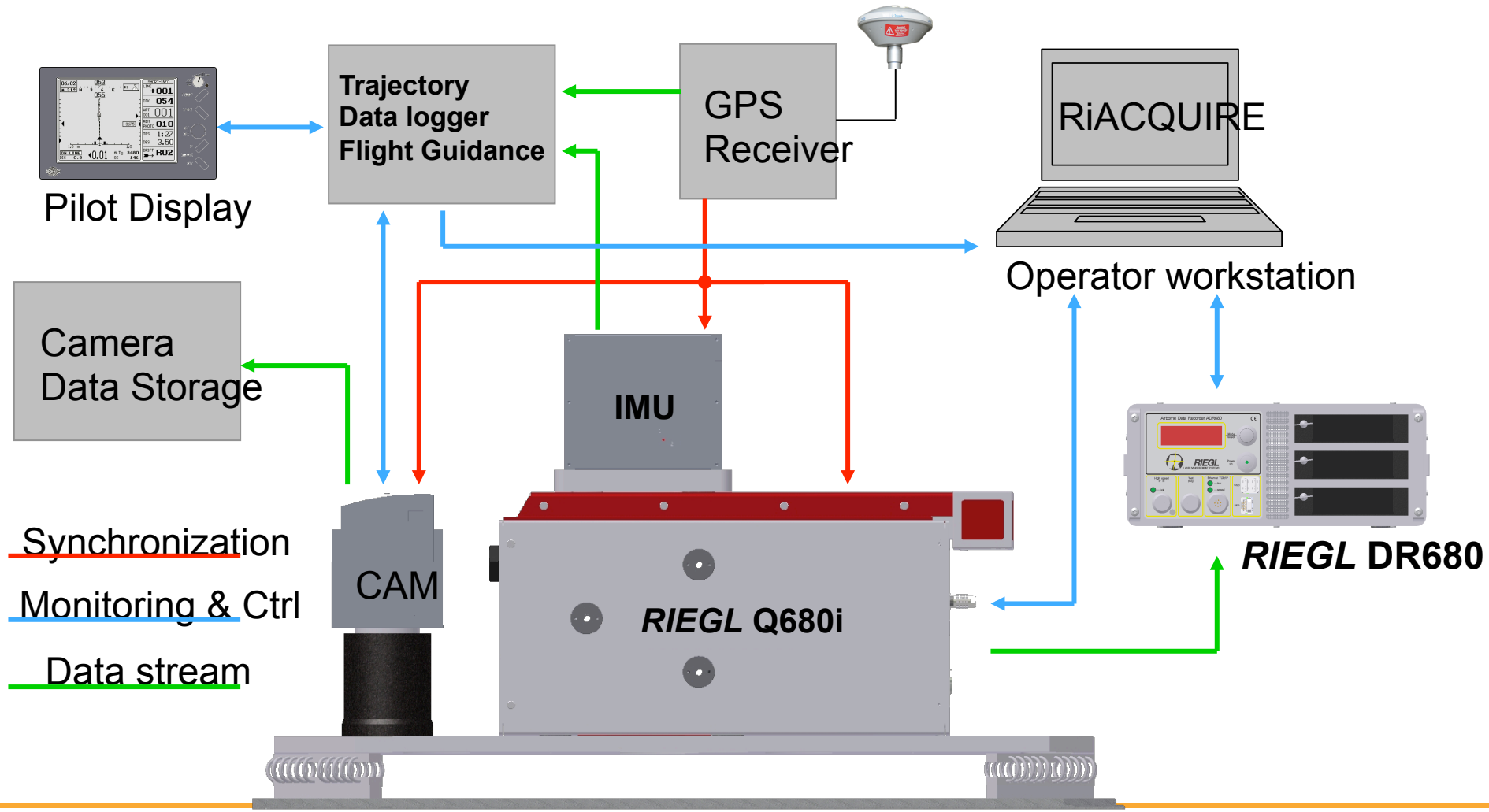
3rd party sensors

APPLANIX POS AV

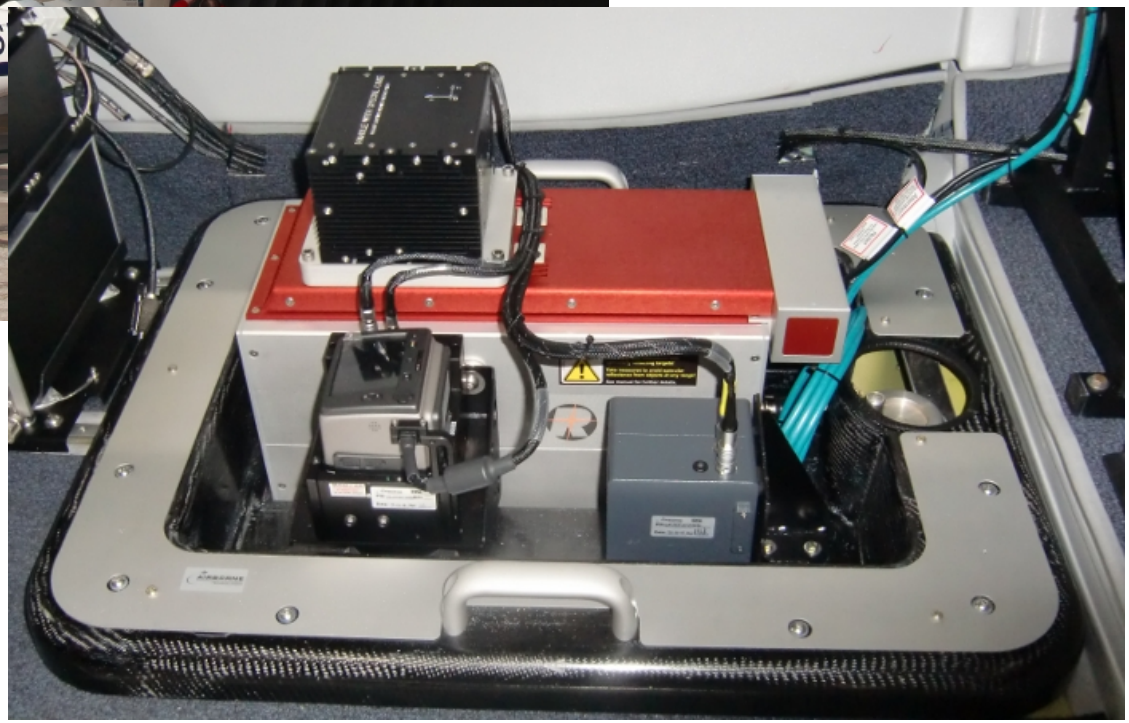
IXSEA AIRINS

IGI AEROControl & IGI CCNS

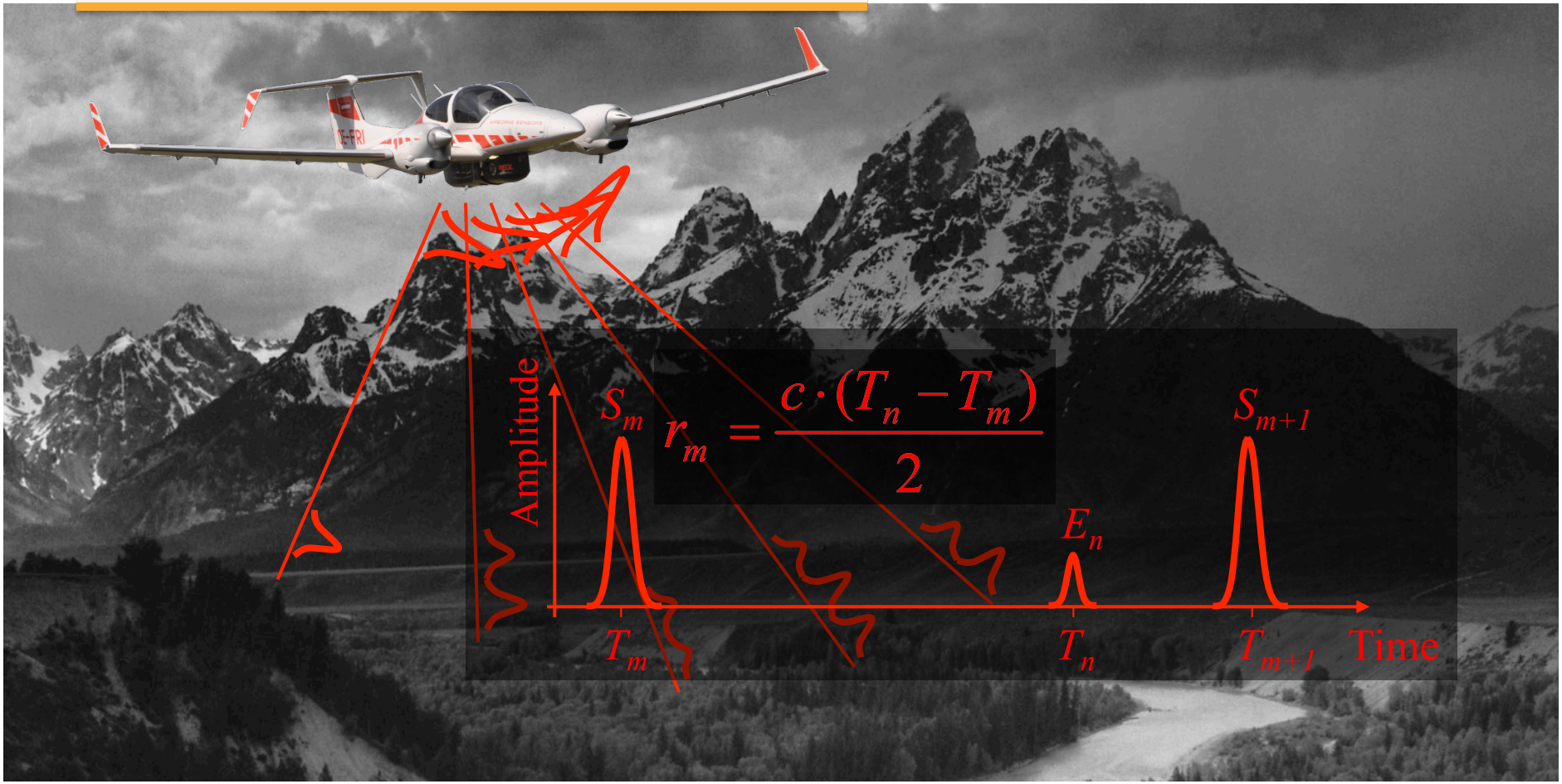
Block diagram of ALS system



ALS system integration

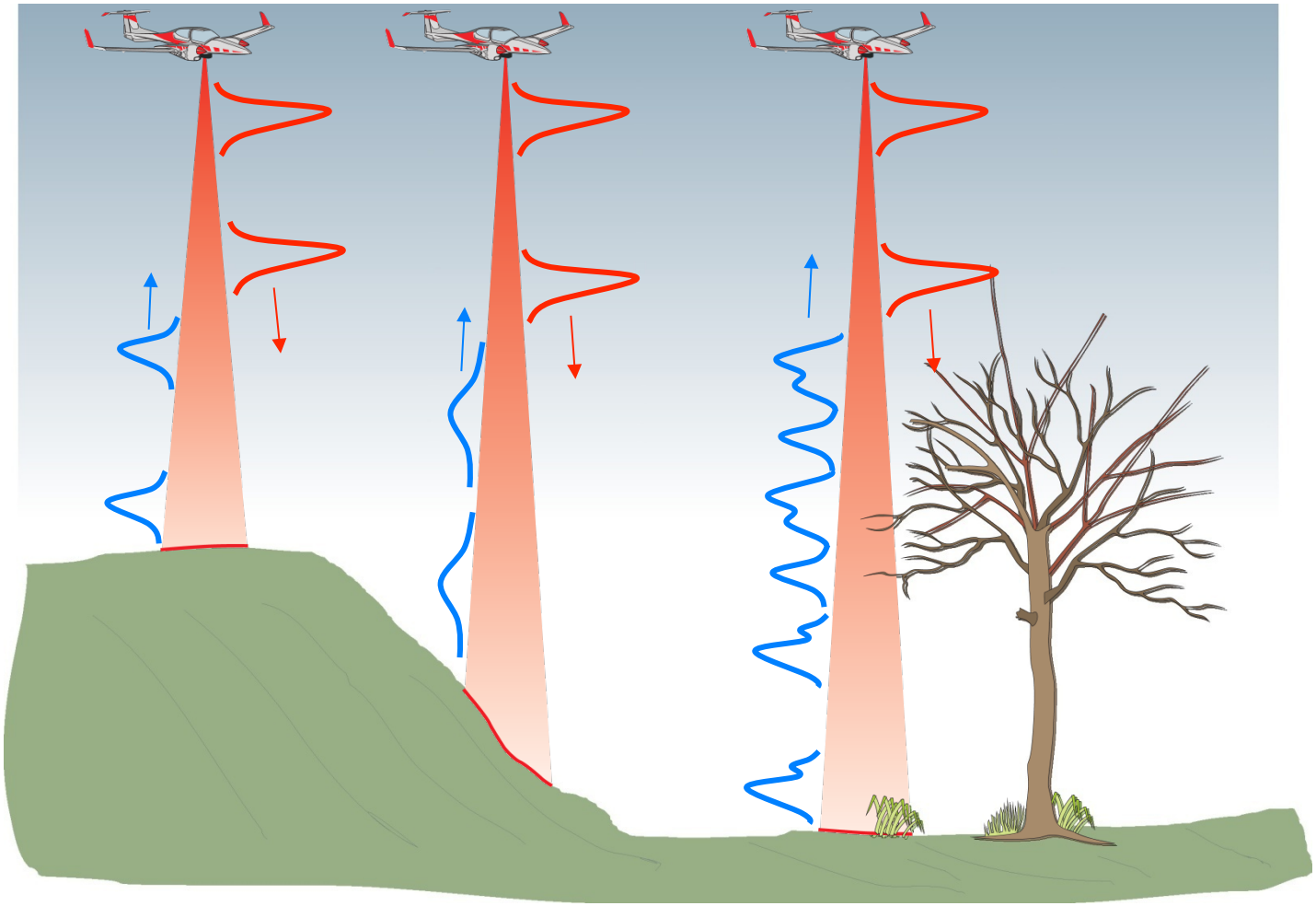


Principle of time-of-flight measurements

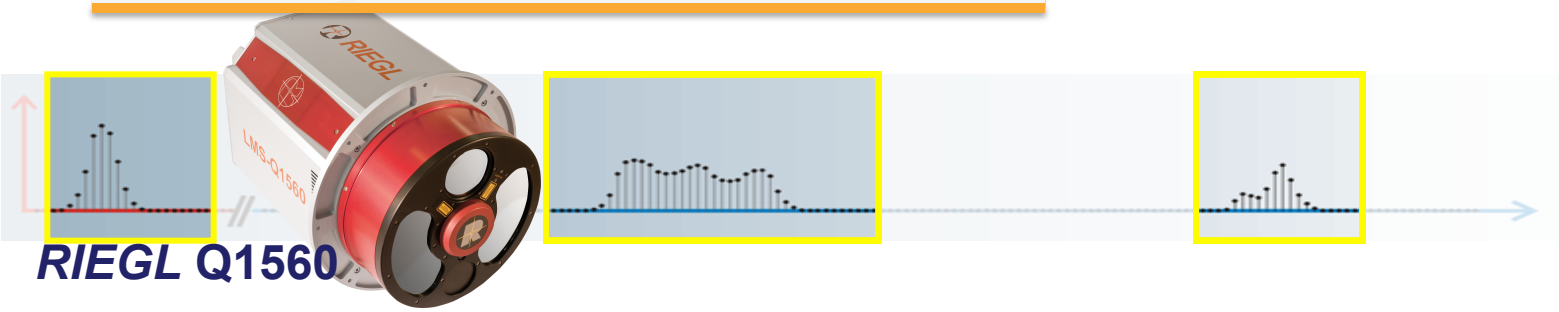


$$r_m = \frac{c \cdot (T_n - T_m)}{2}$$

Full Waveform Data Acquisition



Categories of waveform data



RIEGL Q1560

full waveform data

Data acquisition

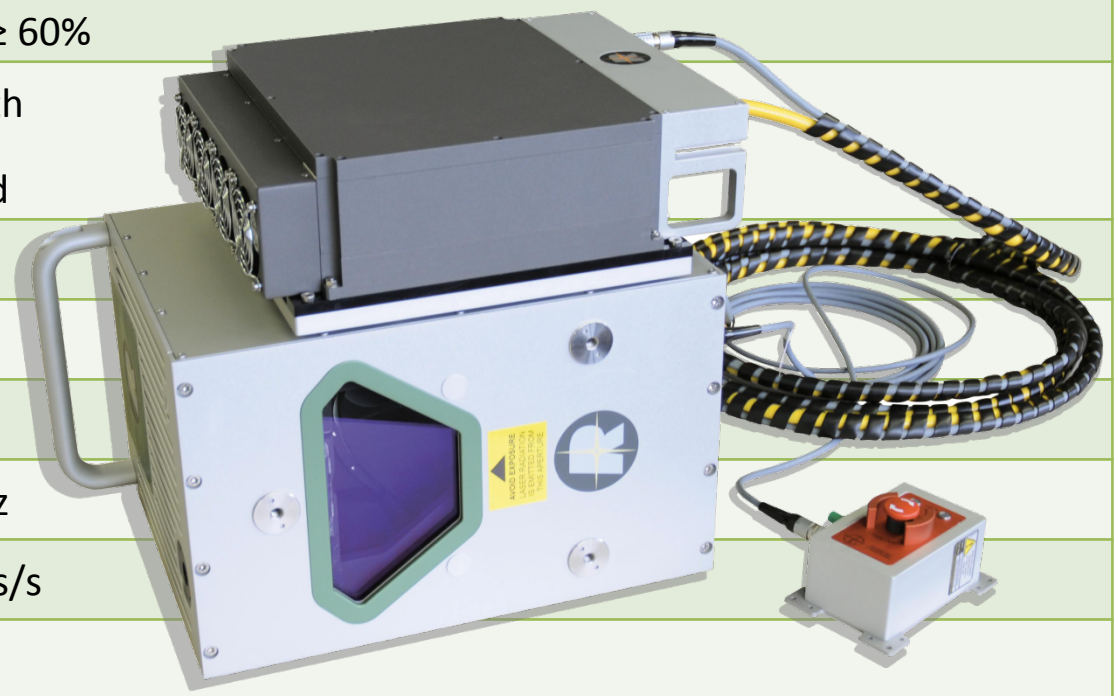
Colored point cloud

RIEGL®

RIEGL VQ-820-G

VQ-820-G product specifications

wavelength	532 nm (visible green light)
measurment range topography	1500 m at ρ ≥ 20% 2500 m at ρ ≥ 60%
water penetration	1 Secchi depth bright ground
ranging accuracy	25 mm
FOV	42°
beam divergence	1 mrad
net measurement rate	up to 195 kHz
scan speed	50 – 200 lines/s
laser Safety	laser class 3B
multiple time around	yes, up to 4 pulses in the air



VQ-820-G features

- excellently suited for combined hydrographic and topographic airborne survey
- high-accuracy ranging based on **echo digitization** and **online waveform processing** with multiple target capability
- high spatial resolution due to narrow laser beam and high pulse repetition rate up to 520 kHz, high scanning speed up to 200 scanlines/second and a wide field of view 42°
- compact, rugged and light-weight modular configuration, compatible with standard airborne platforms.
- **waveform data output**, data accessible via RiWAVELiB
- seamless integration with other *RIEGL* ALS Systems and software packages

helicopter

Tecnam P2006T

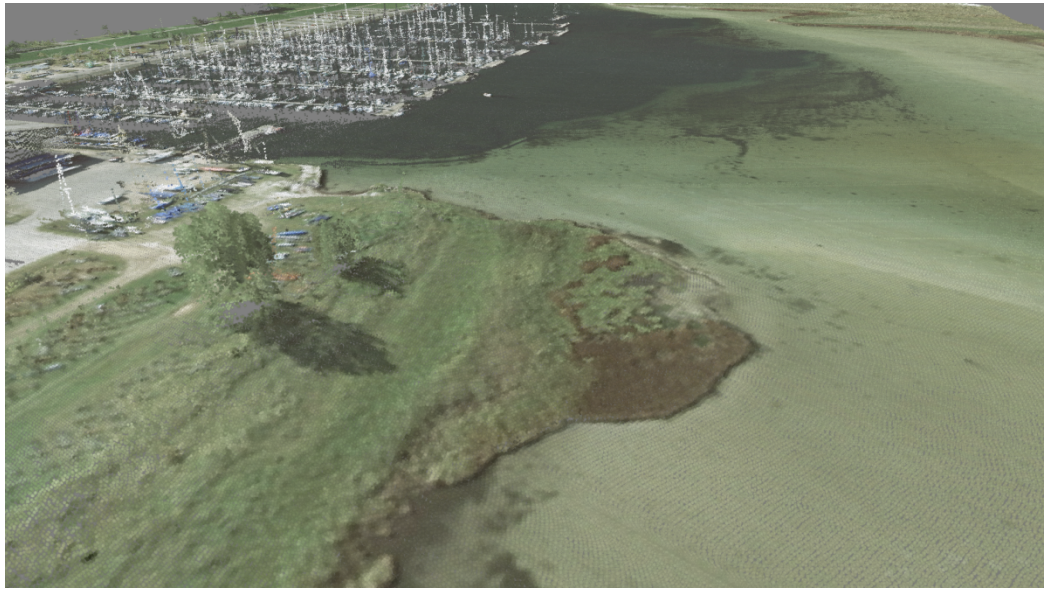
RIEGL®

CASA 212

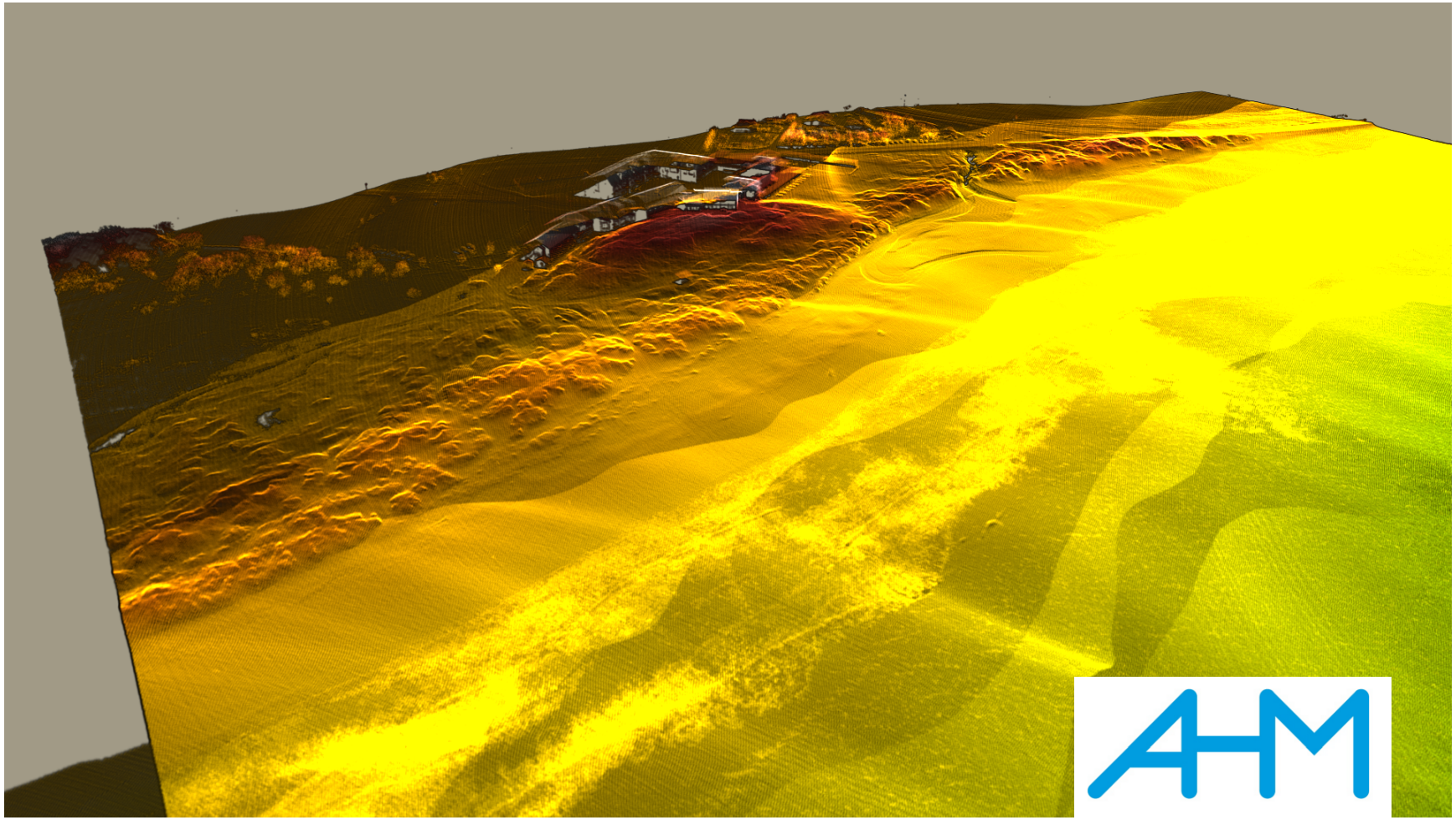
costal survey example data – Baltic Sea

surf zone and beach

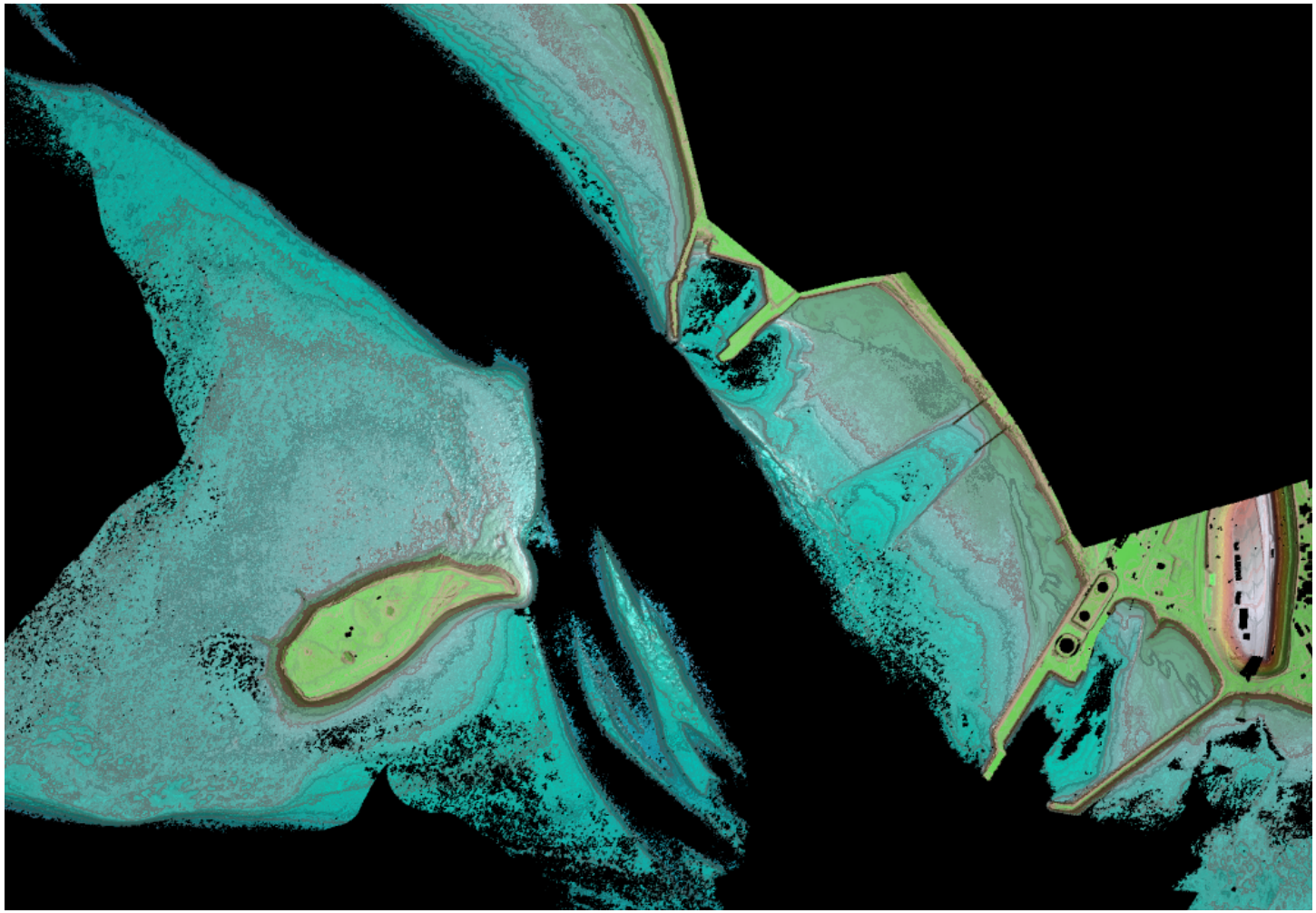
near Rostock/Germany



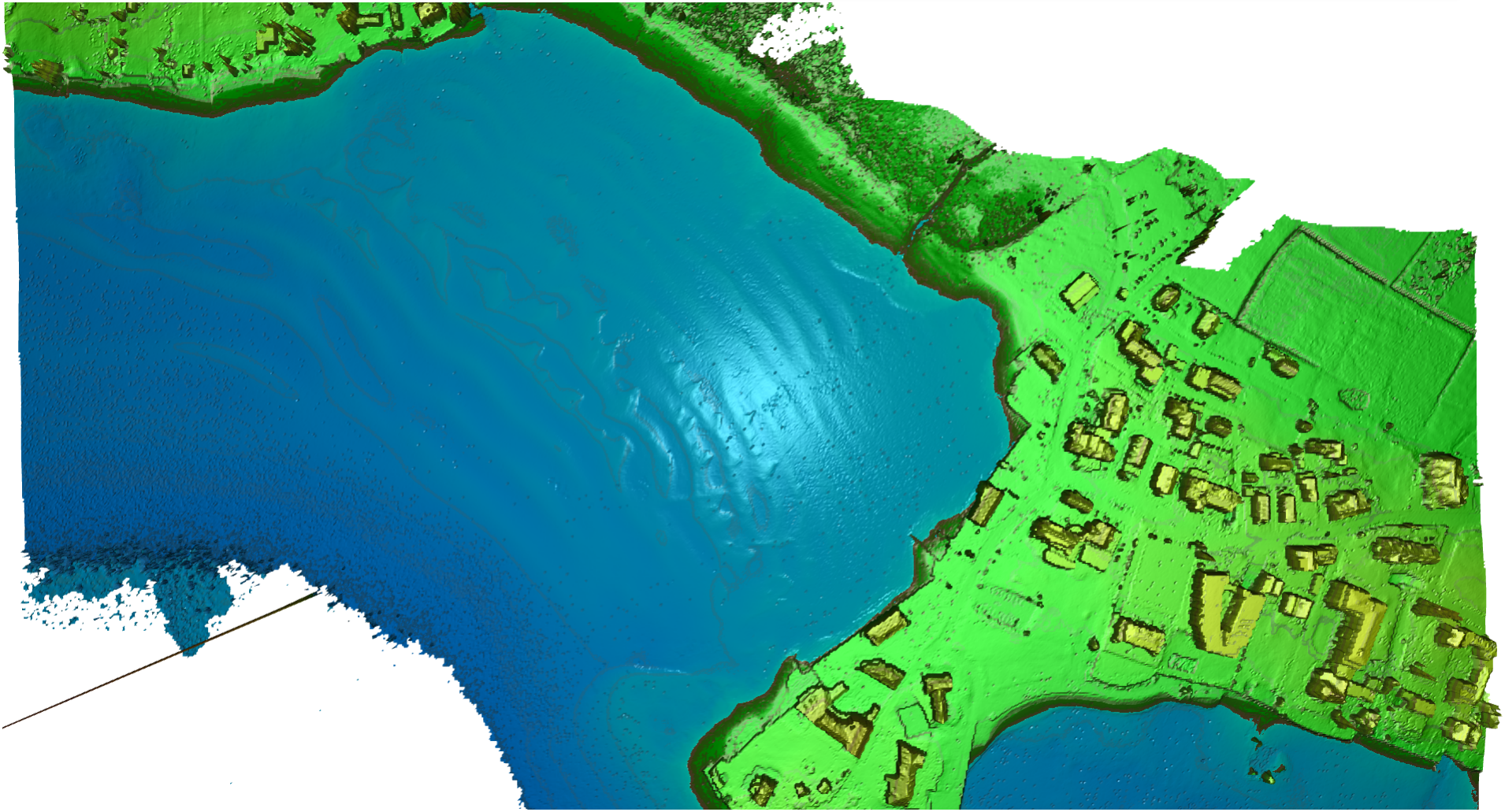
Fjord Mapping – near Stavanger



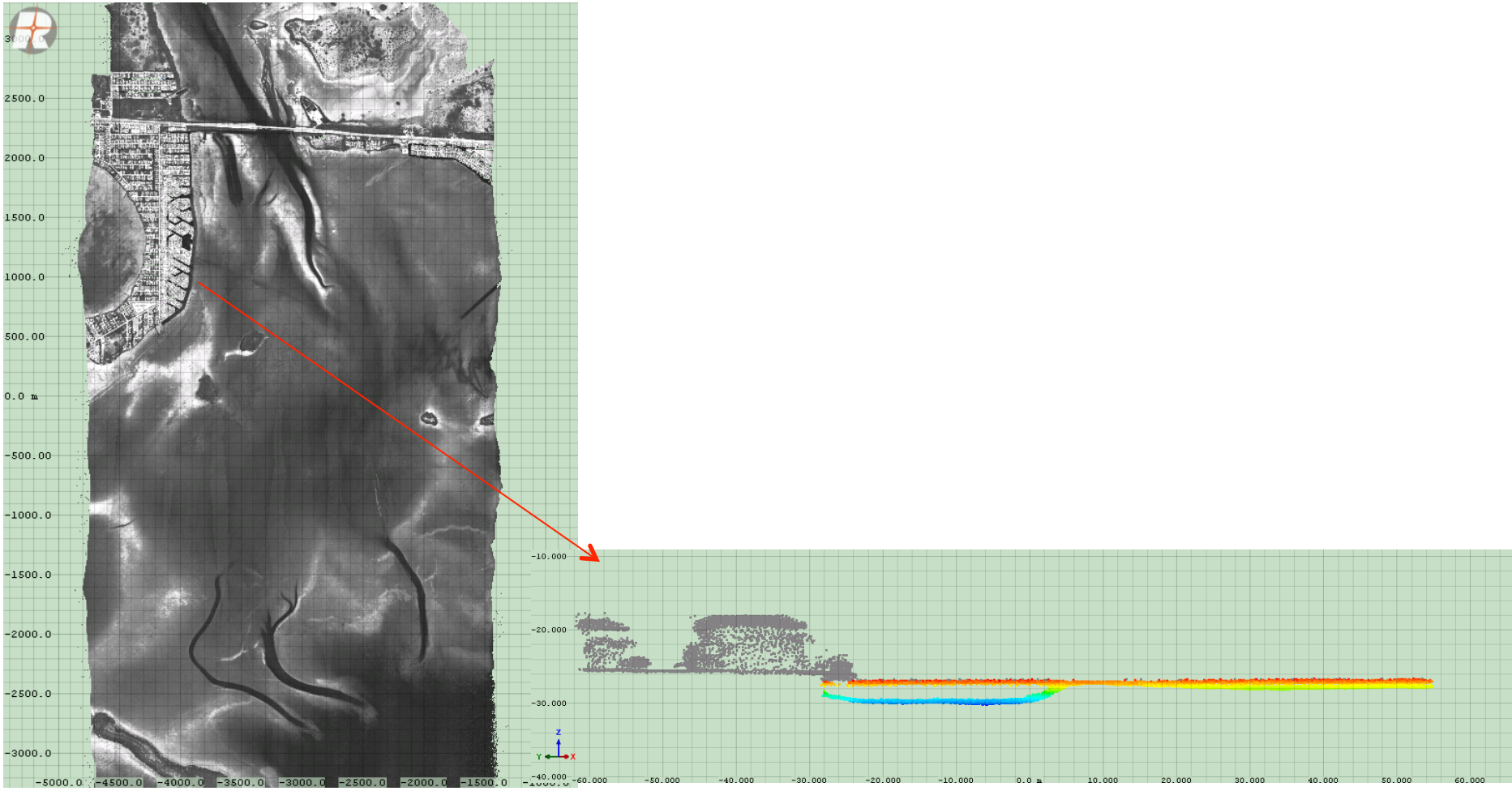
Denmark



Lake Constance

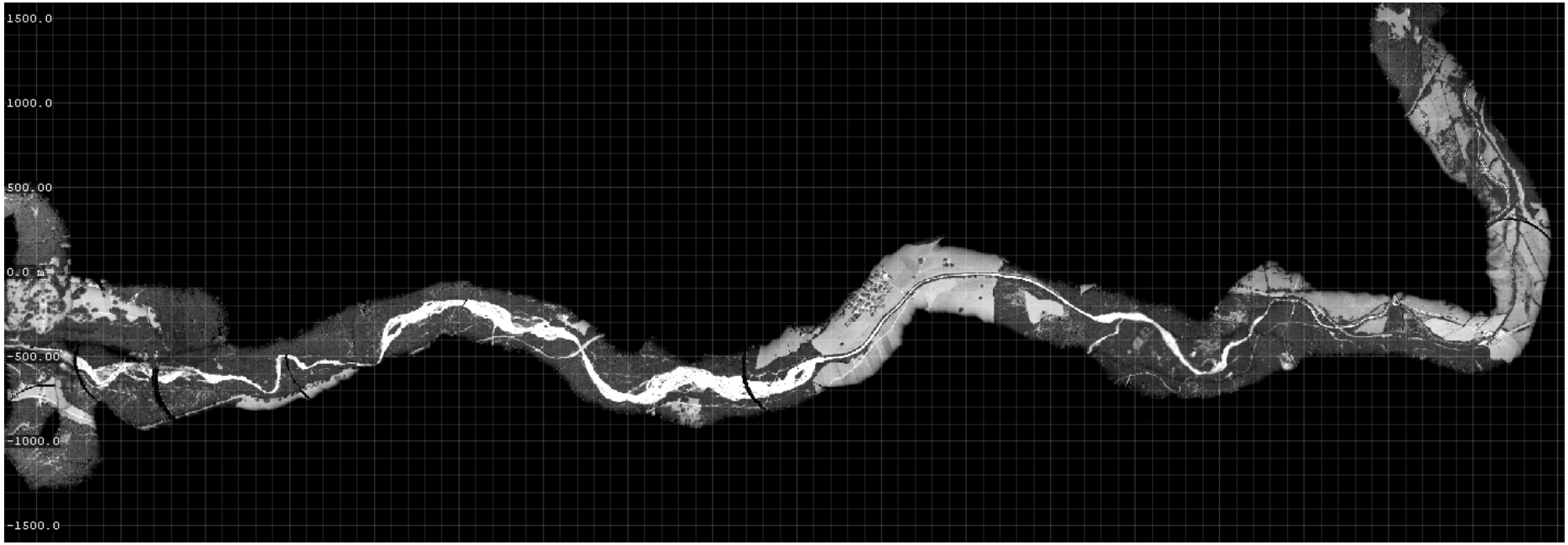


Florida Keys



Adriatic Sea

large-scale surveying of rivers



- full coverage of riverbed, riverbank, and surrounding area
- requires careful planning concerning precipitation, snowmelt etc.

RIEGL®

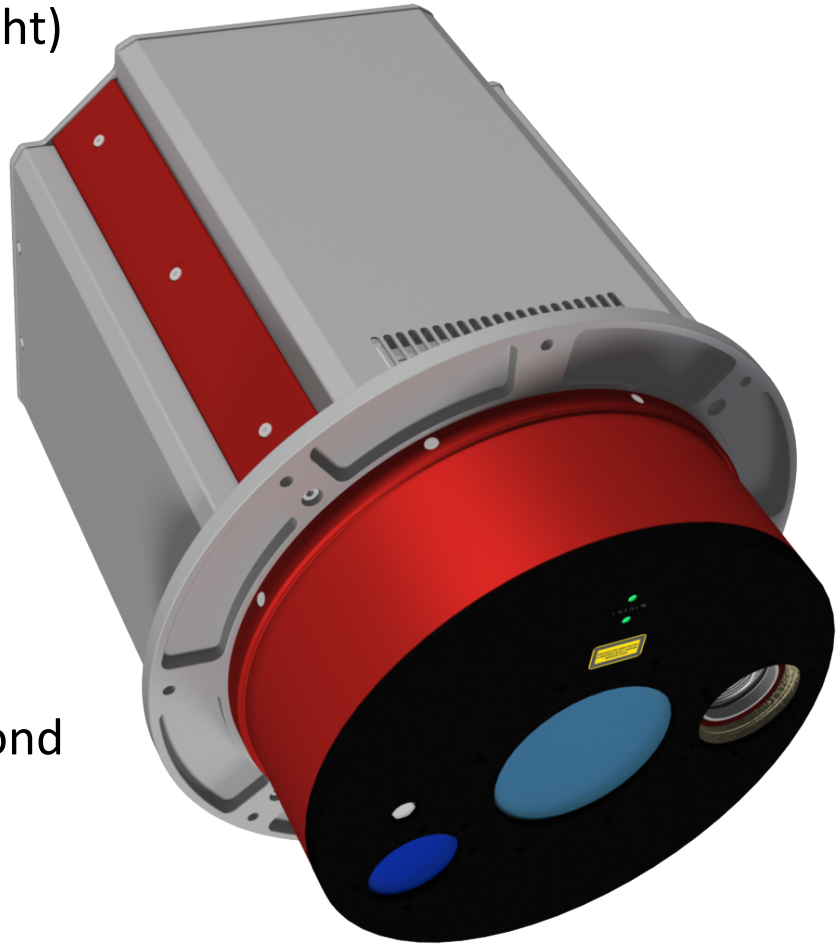
RIEGL VQ-880-G

In a nutshell…

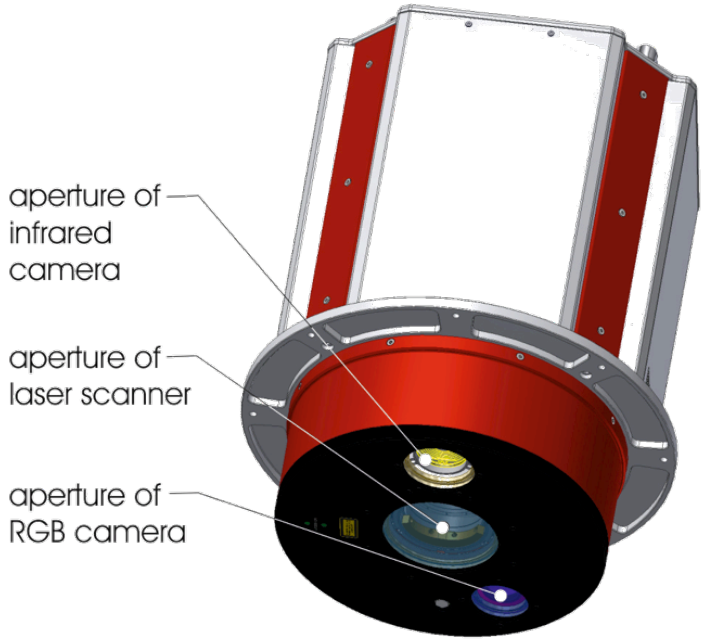
- based on *RIEGL* LMS-Q1560 platform
- fully integrated turn-key solution
- new scan mechanism
- improved measurement rate
- improved penetration
- full waveform recording for every laser shot

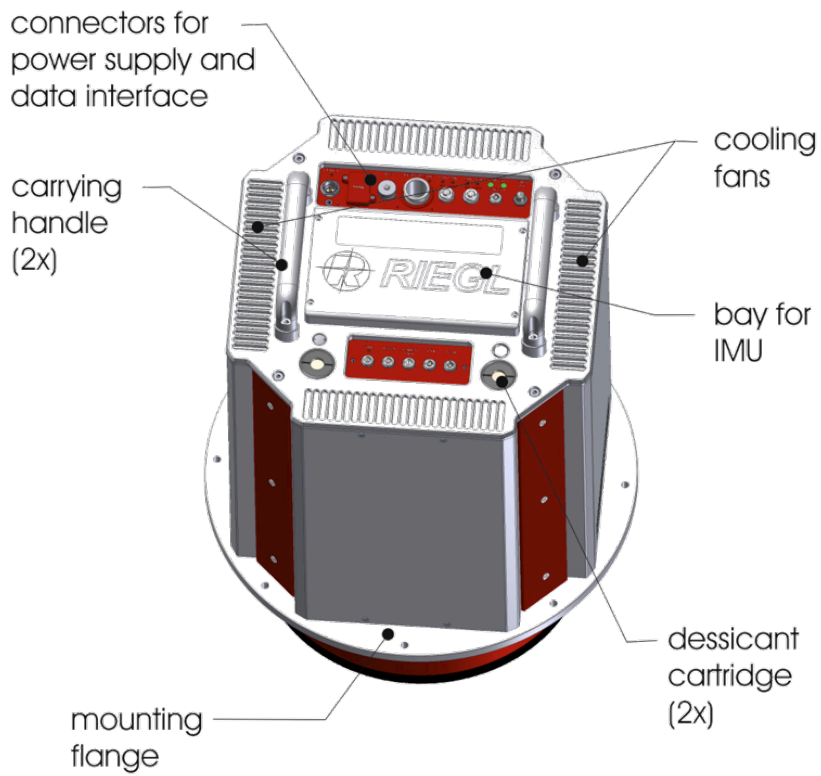
Key specifications

wavelength	532 nm (visible green light)
measurment range topography	2500 m at ρ ≥ 20% 3600 m at ρ ≥ 60%
measurment range hydrography	>1 Secchi depth bright ground
ranging accuracy	25 mm
FOV	+/- 20°
beam divergence	selectable, 0.7-2 mrad
measurement rate	520 kHz
scan speed	10 – 80 revolutions/second
laser safety	Laser Class 3B
multiple time around	yes



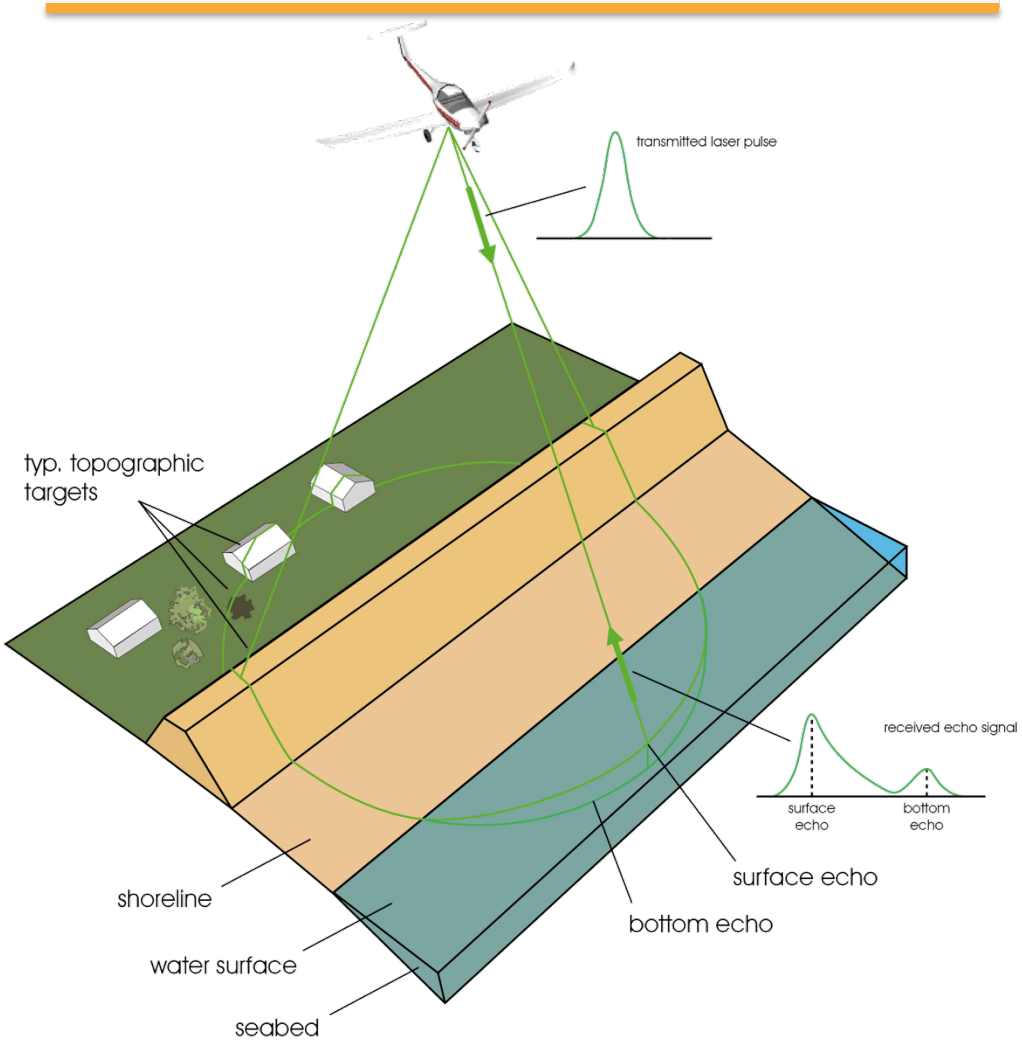
VQ-880-G features

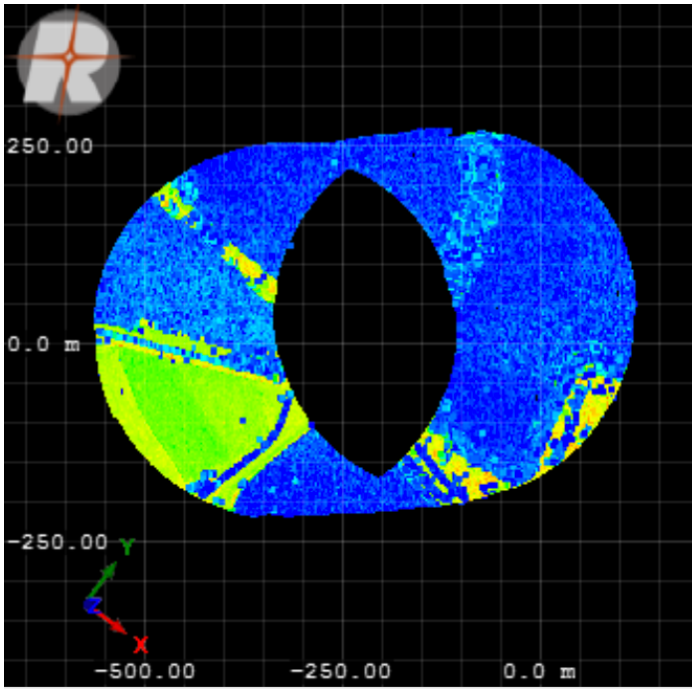




- power consumption: 550W
- weight: 60 kg
- dimensions: 444 x 444 x 615 mm³

Scan pattern





Interfaces and system components

- Gbit Ethernet
- High-speed fiber link to RIEGL DR1560 data recorder
- 18-32 V DC power supply

- integrated digital camera (29 Mpixel RGB)
- integrated IMU/GNSS
- *RIEGL* DR1560 for data storage

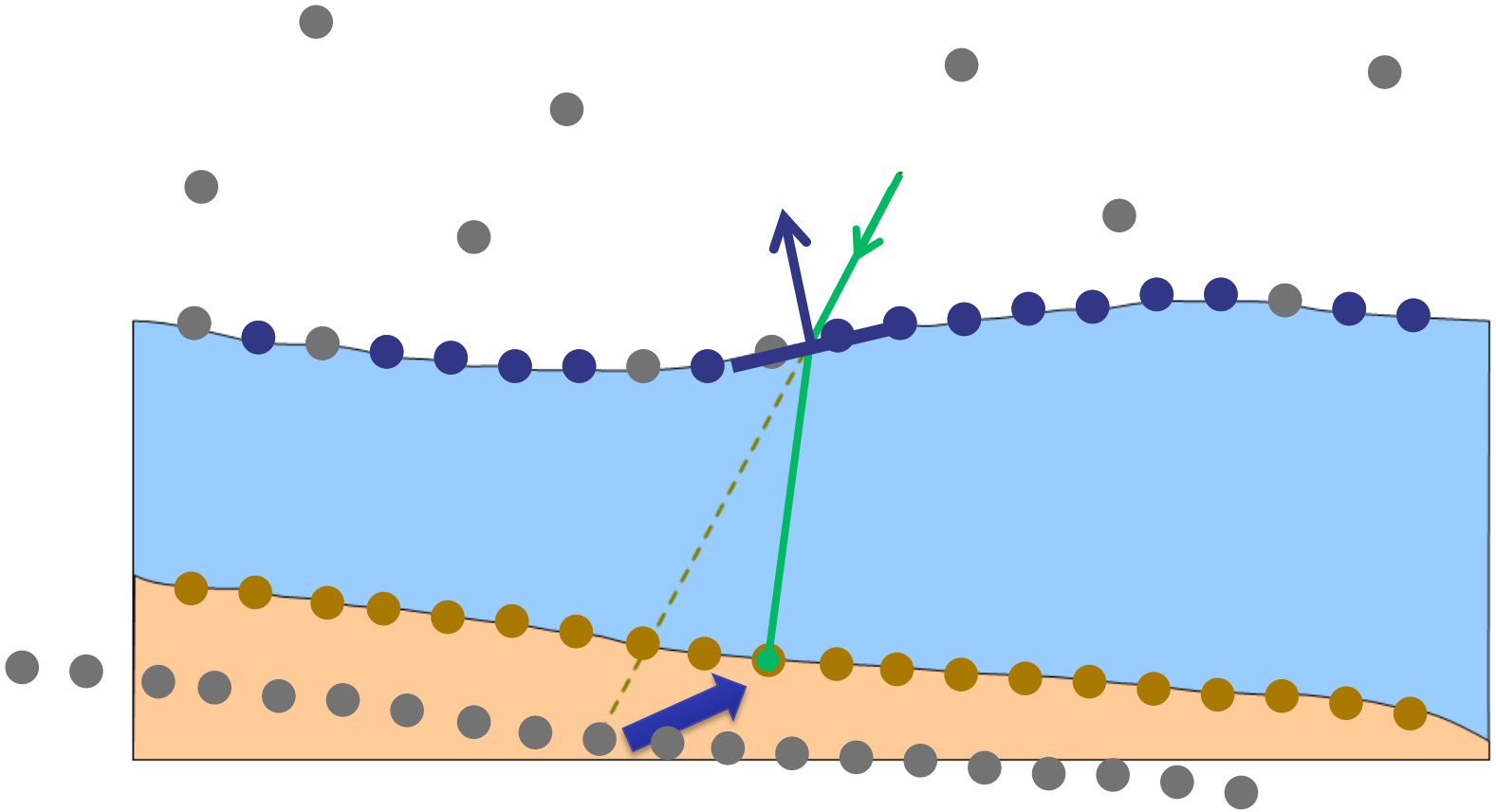
Results

RIEGL®

RIEGL Software Hydrography Addons

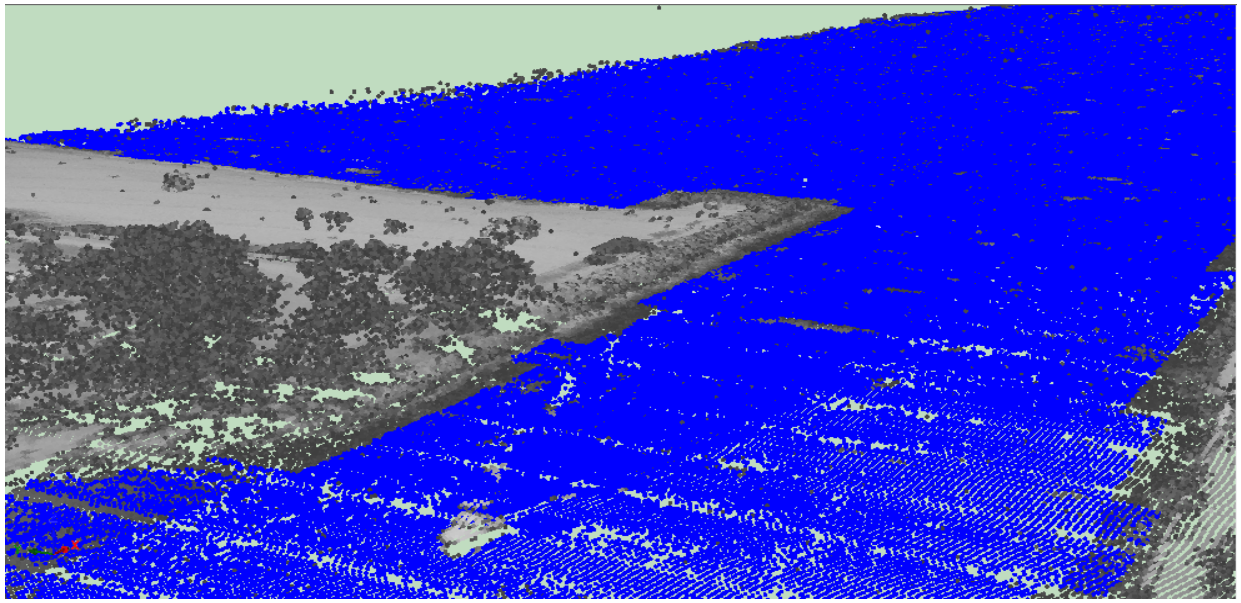
point cloud classification
refraction correction

what it's all about…

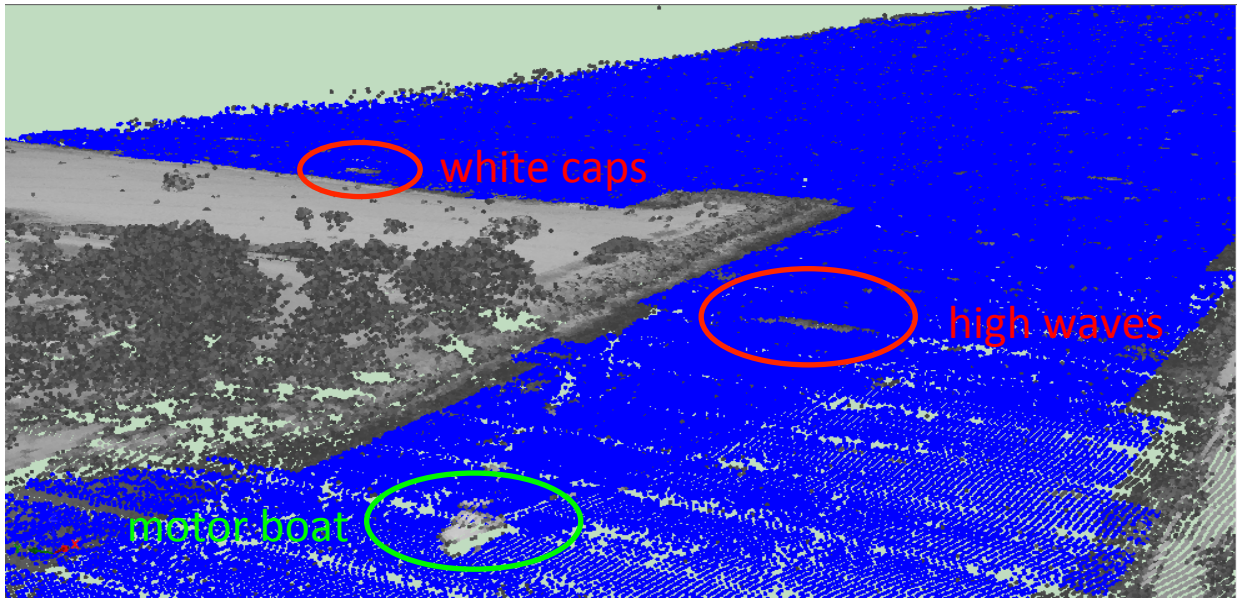


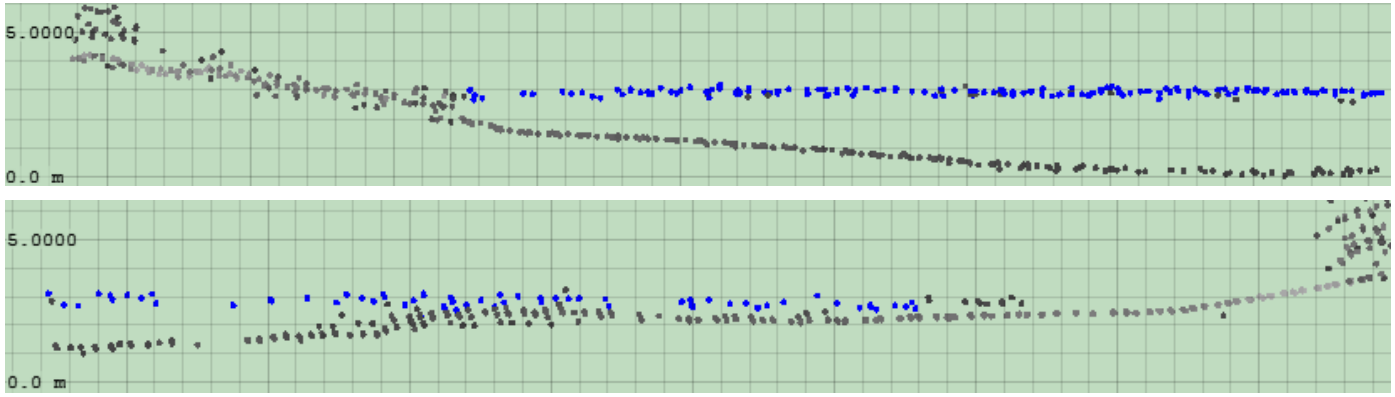
classification of water surface points

- each scan line (strip) is processed independently
- input:
  - geo-referenced scan line from VQ-820-G with sufficient density of surface returns
  - optionally: scan data from additional laser scanner



classification of water surface points – examples

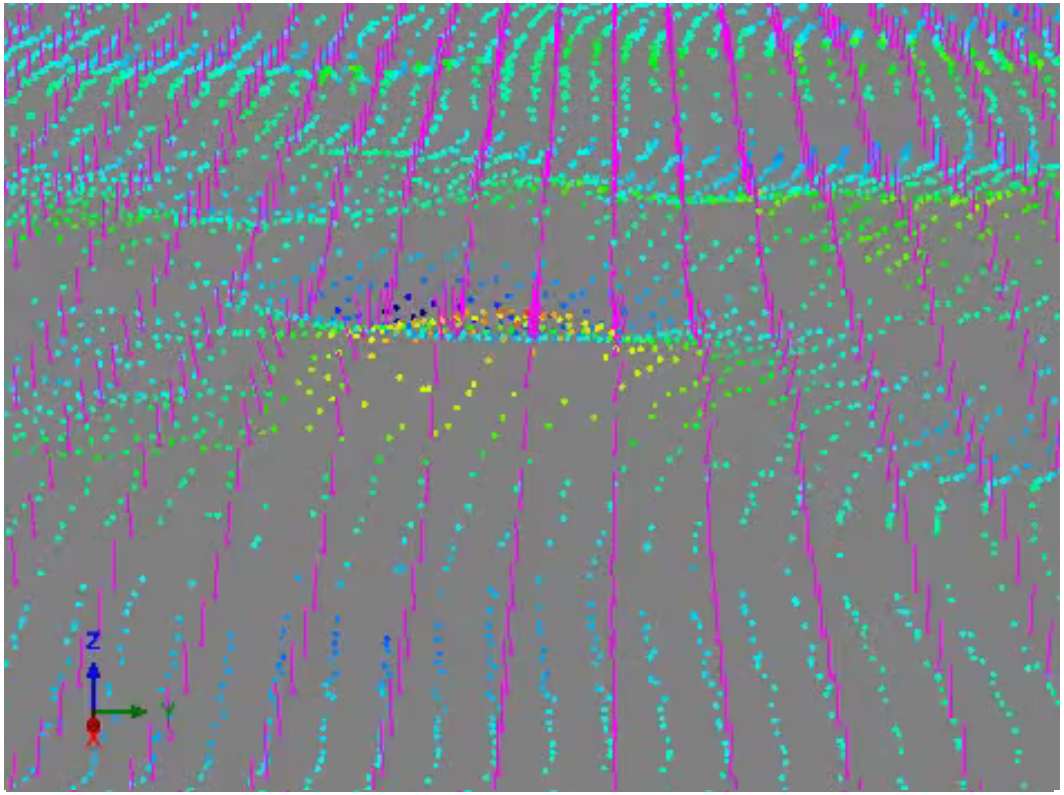




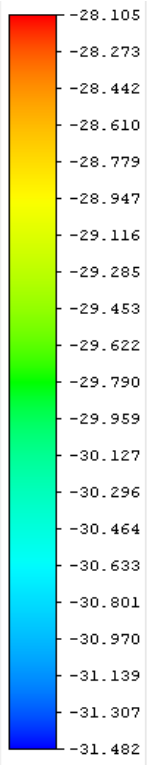
typical profiles crossing coast line

generation of WSM – results (1)

WSM in case of high waves (ocean mode):



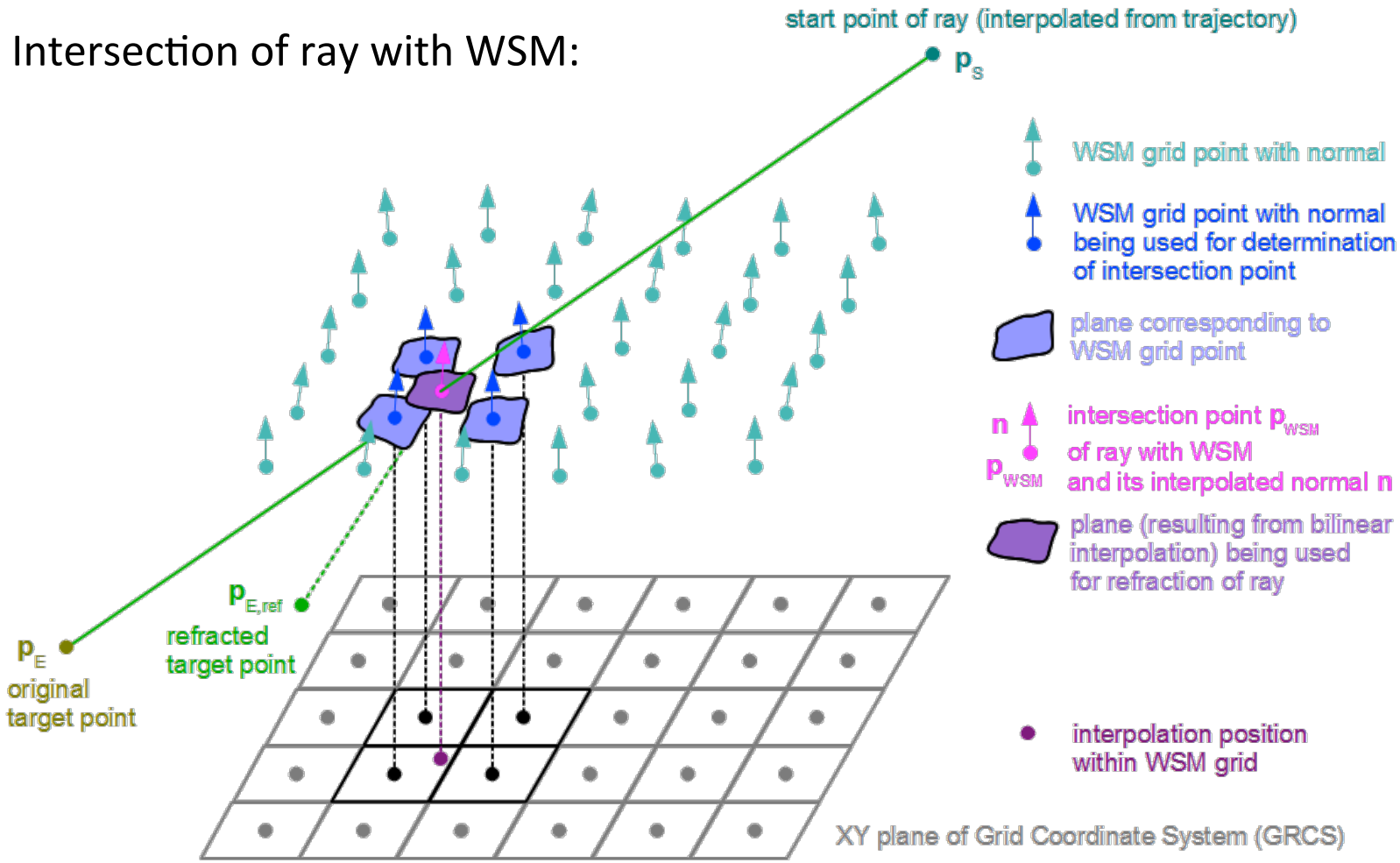
elevation



WSM (displayed as normal vector field) and water surface points (z-color-coded)

refraction correction (1)

Intersection of ray with WSM:



Thank you for your kind attention!

Martin Pfennigbauer
mpfennigbauer@riegl.com

Alexander Haring
aharing@riegl.com

Innovation in 3D