

# Surveying of Coastal Zones: Airborne and Marine-Mobile Laser Scanning Solutions

Martin Pfennigbauer<sup>1)</sup>, Alexander Haring<sup>\*1)</sup>, Vladimir Kadatskiy<sup>2)</sup>, Peter Rieger<sup>1)</sup>, Andreas Ullrich<sup>1)</sup>

1) RIEGL Laser Measurement Systems GmbH, Horn, Austria, [www.riegl.com](http://www.riegl.com) 2) Riegl USA, Inc., Orlando, Florida, USA, [www.rieglusa.com](http://www.rieglusa.com)

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## Introduction

The demand for up-to-date, accurate, and high resolution topographic data of coastal zones is increasing, since spatial information of harbor structures, river estuaries, and littoral zones above and below water is required for construction projects, hydrographic analysis, traffic safety, and environmental concerns. For these fields of applications, RIEGL offers airborne and ship-borne mobile laser scanners and laser scanning systems. Due to their high measurement rates, they deliver dense point clouds of land, buildings, vegetation, sea surface, and seafloor. Specially developed for marine purposes, the mobile laser scanning system VMY-250-MARINE is the ideal instrument for surveying harbor facilities, bridges, and coastlines from survey vessels. This contribution will give insight into the technical principle, the practical workflow, and present results of various projects done with these instruments.



## Airborne topographic-bathymetric laser scanning

### VQ-820-G

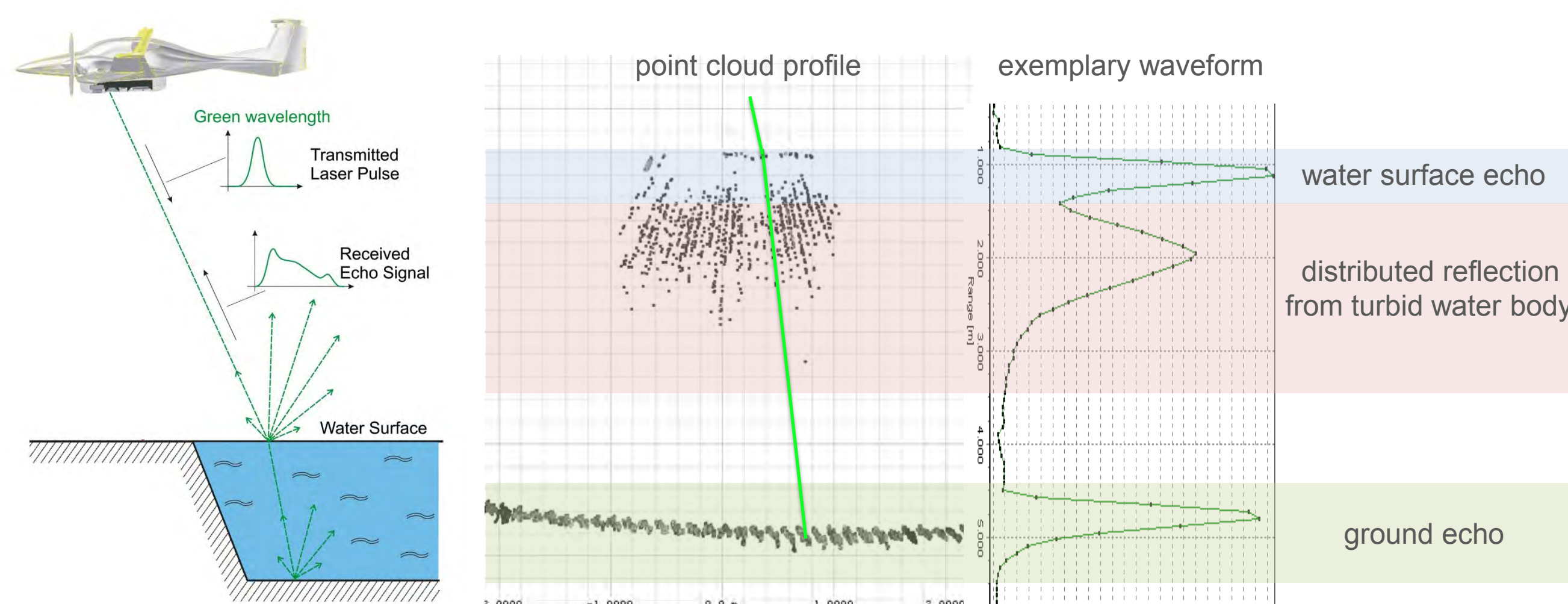
#### Concept and parameters

The VQ-820-G is a hydrographic laser scanner designed for high-resolution mapping of shallow waters with low turbidity.



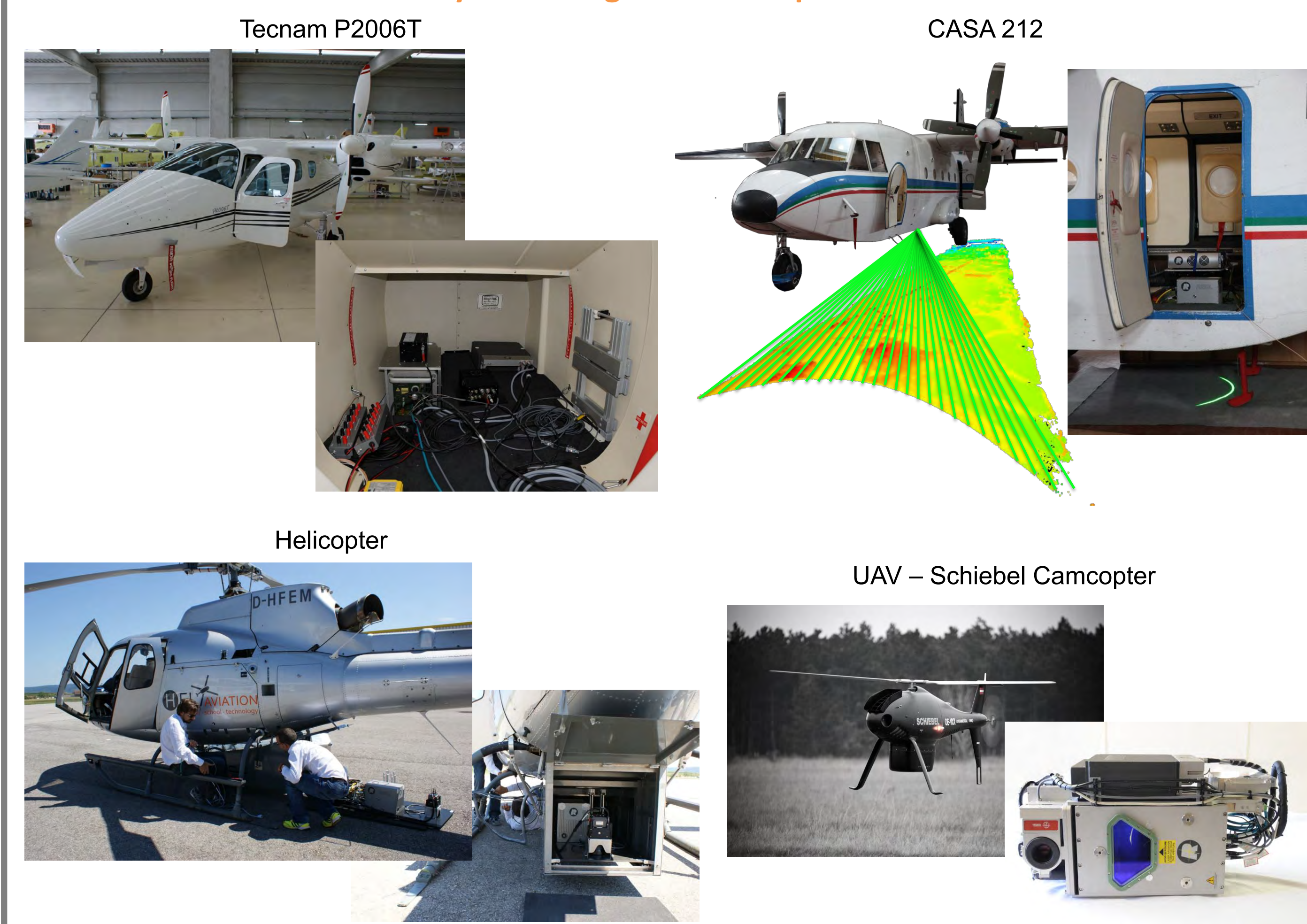
Wavelength	532 nm (visible green light)
Measurement range Topography	1500 m at $\rho \geq 20\%$ 2500 m at $\rho \geq 60\%$
Measurement range Hydrography	1 Secchi depth bright ground
Ranging accuracy	25 mm
FOV	42°
Beam divergence	1 mrad
Measurement rate	up to 195 kHz
Scan speed	50 – 200 lines/s
Laser Safety	Laser Class 3B
Multiple time around	Yes, up to 4 pulses in the air

#### Echo waveform



Echo digitization with online waveform processing with multiple target capability provides high-accuracy ranging. Optionally, the waveform data may be stored for post-processing.

#### System integration examples



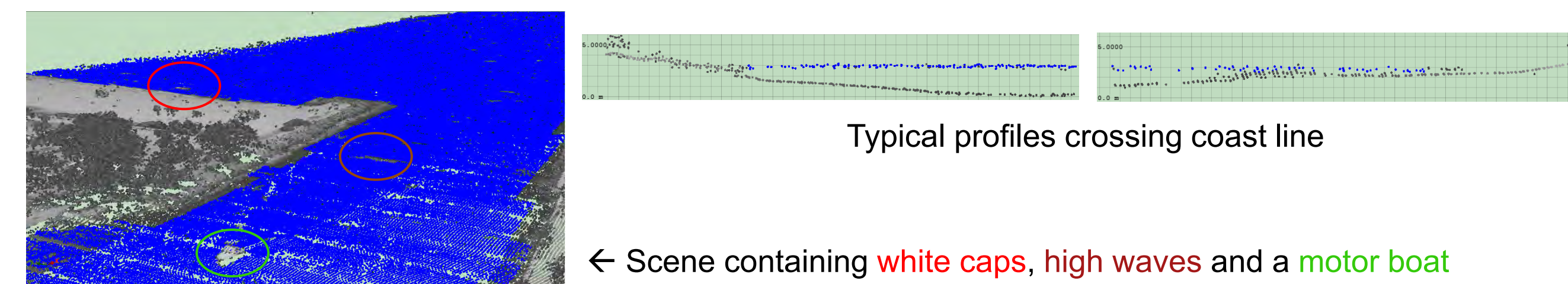
## Refraction correction

### Workflow

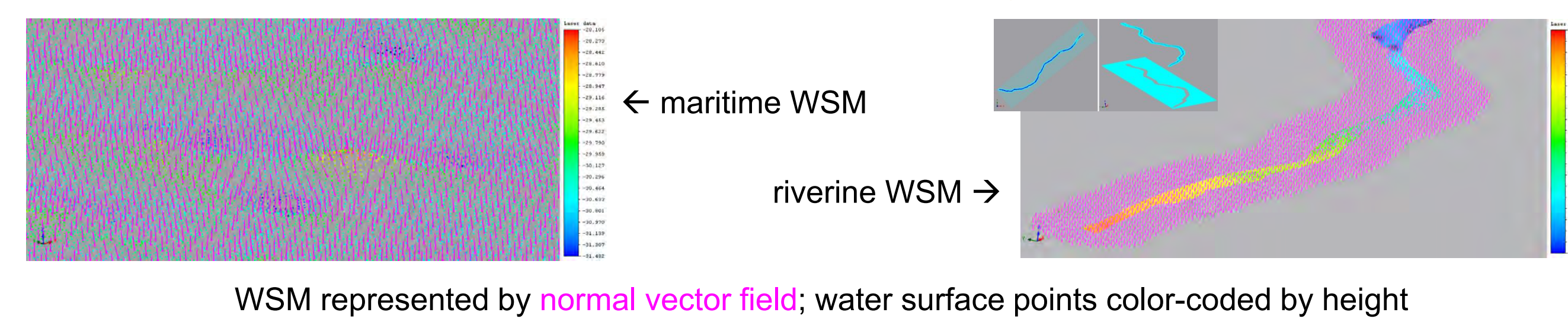
- Step 1: Classification of water surface points** Classification of water surface points may be done automatically or manually.
- Step 2: Generation of a water surface model** Based on the classified points, a water surface model (WSM) is generated.
- Step 3: Refraction correction using Snell's law** Finally, refraction correction is applied to points below the WSM using Snell's law.

The entire workflow is supported by the Hydrography Tools available in the software RIPROCESS.

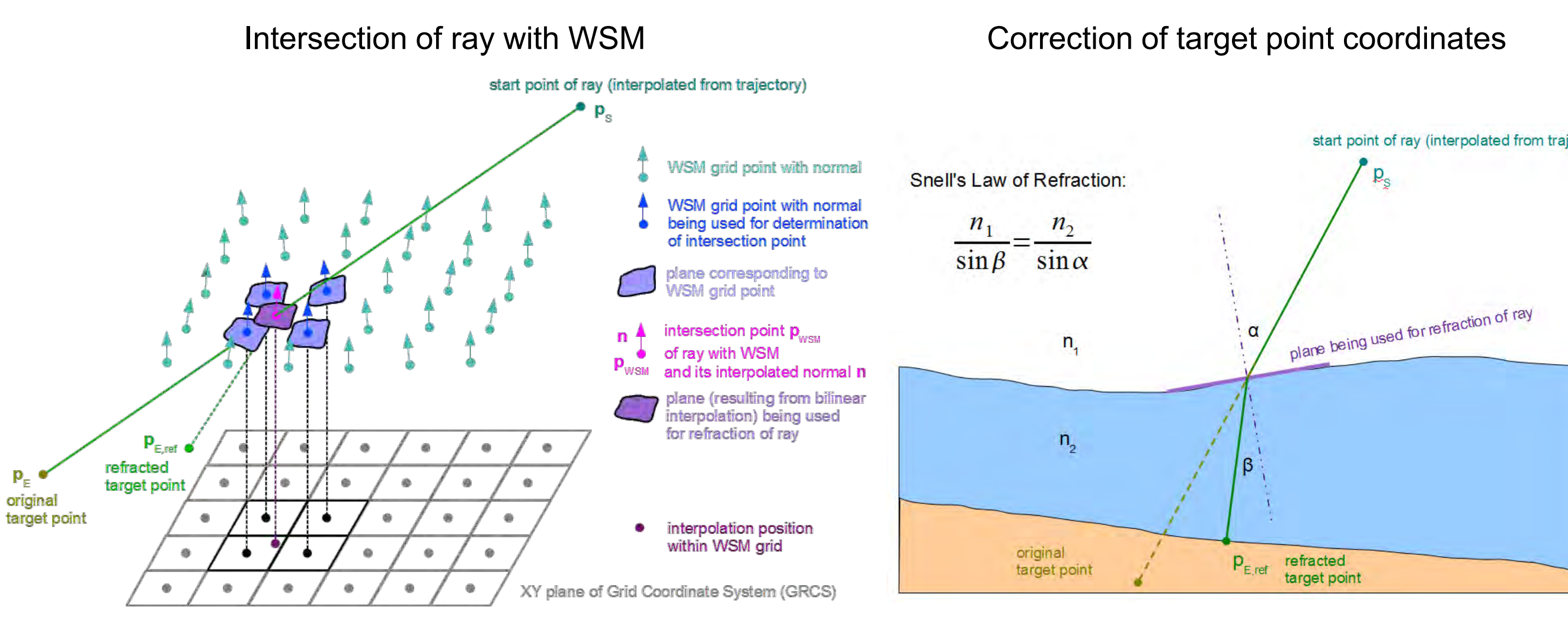
#### Automatically classified water surface points – examples



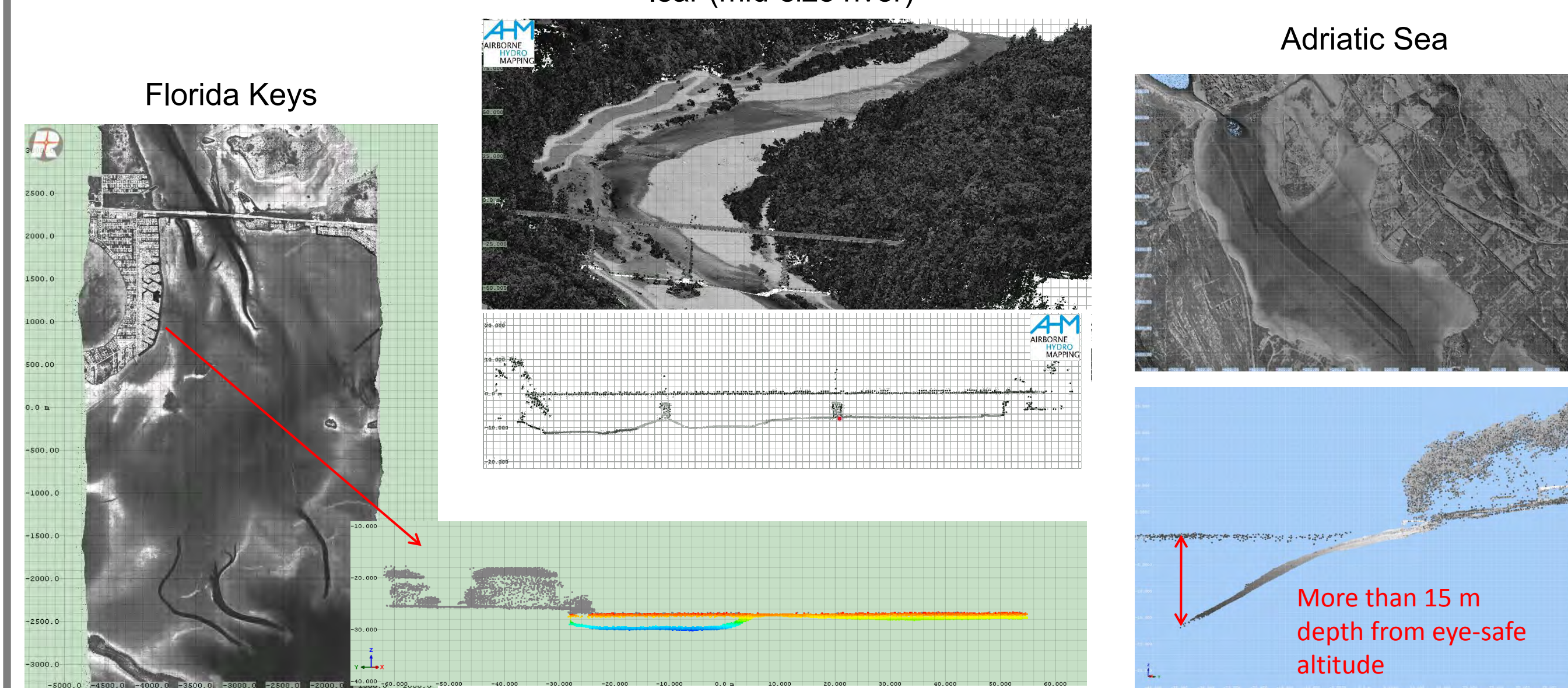
#### Water surface models – examples



#### Refraction correction

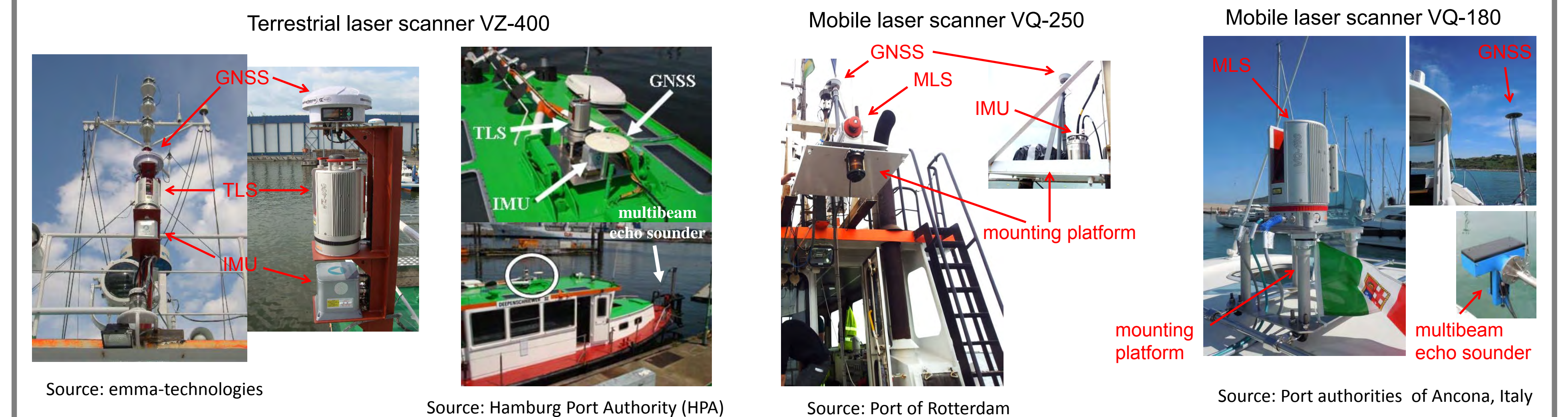


## Results



## Ship-borne mobile laser scanning

### System integration of terrestrial and mobile laser scanners

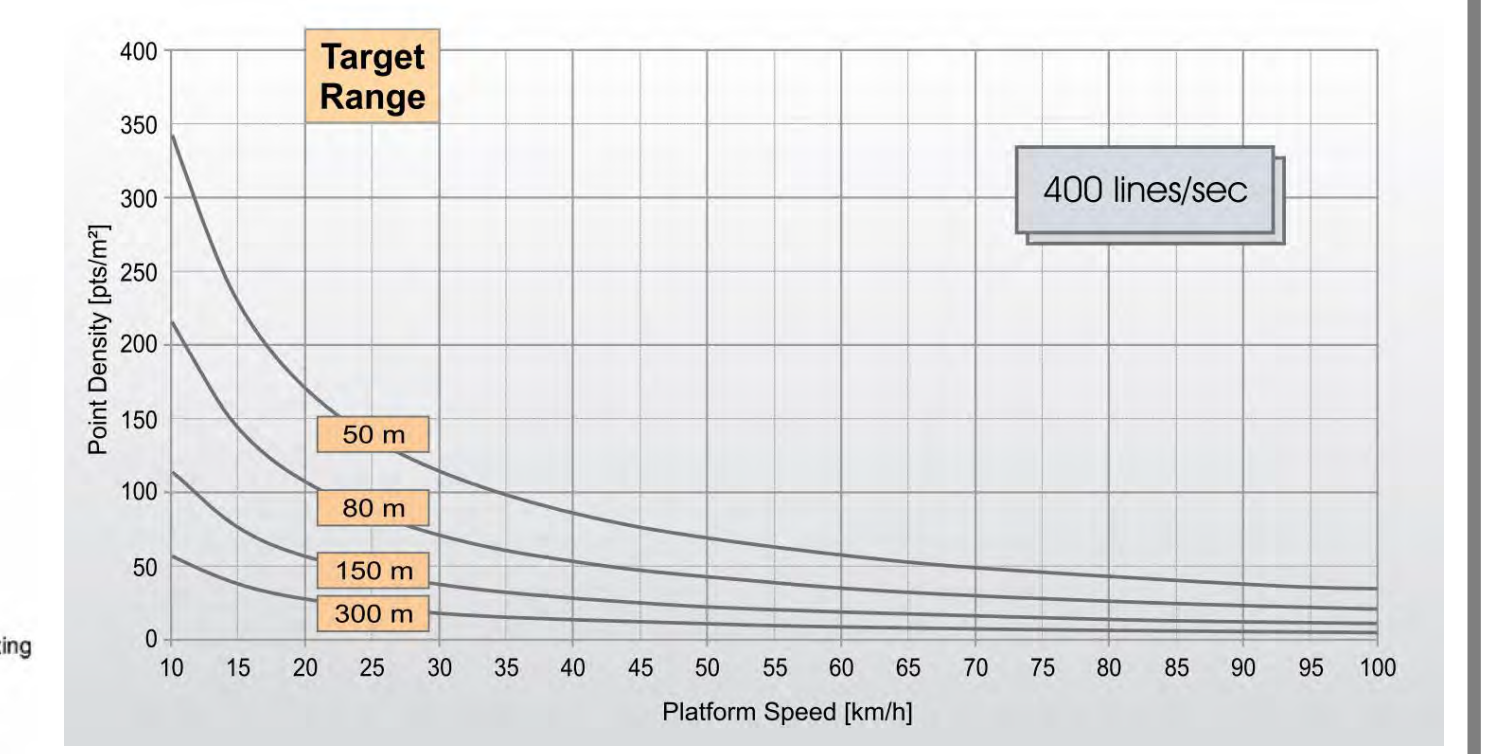


### Mobile laser scanning systems VMX-250 and VMX-450

- Fully calibrated measuring head with 2 VQ "full-circle" profile scanners (2x VQ-250, 2x VQ-450 resp.)
- Flexible mounting on various vehicles (car, railway, vessel,...)
- Resulting point clouds in survey accuracy
- Suitable for both close-range and long-range applications (open land, coasts, harbors,...)



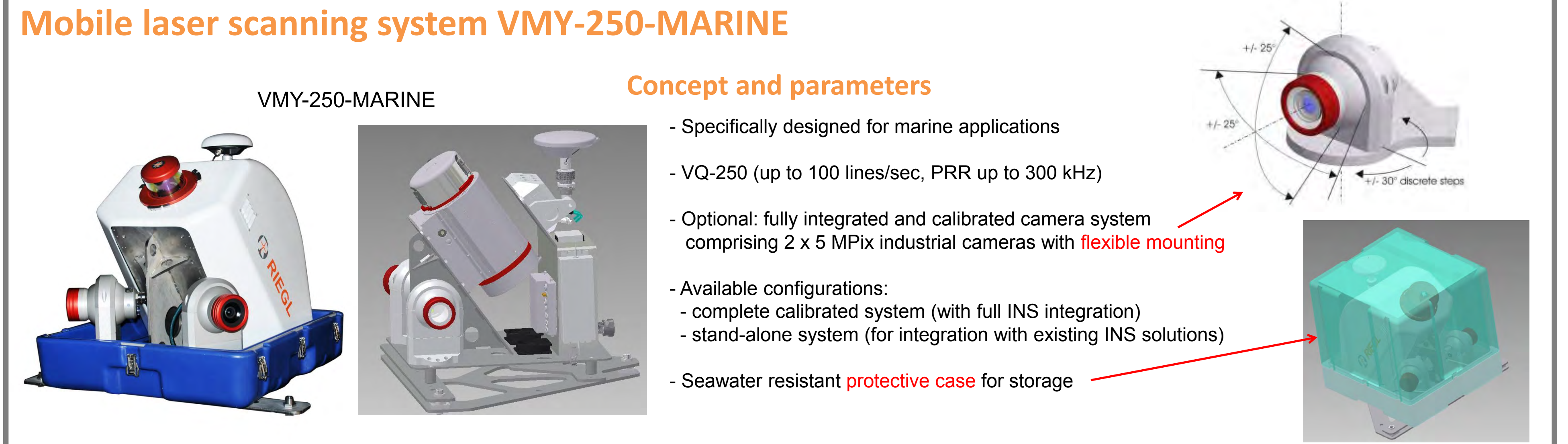
Point density diagram (in case of long-range applications using a pulse repetition rate of 300 kHz)



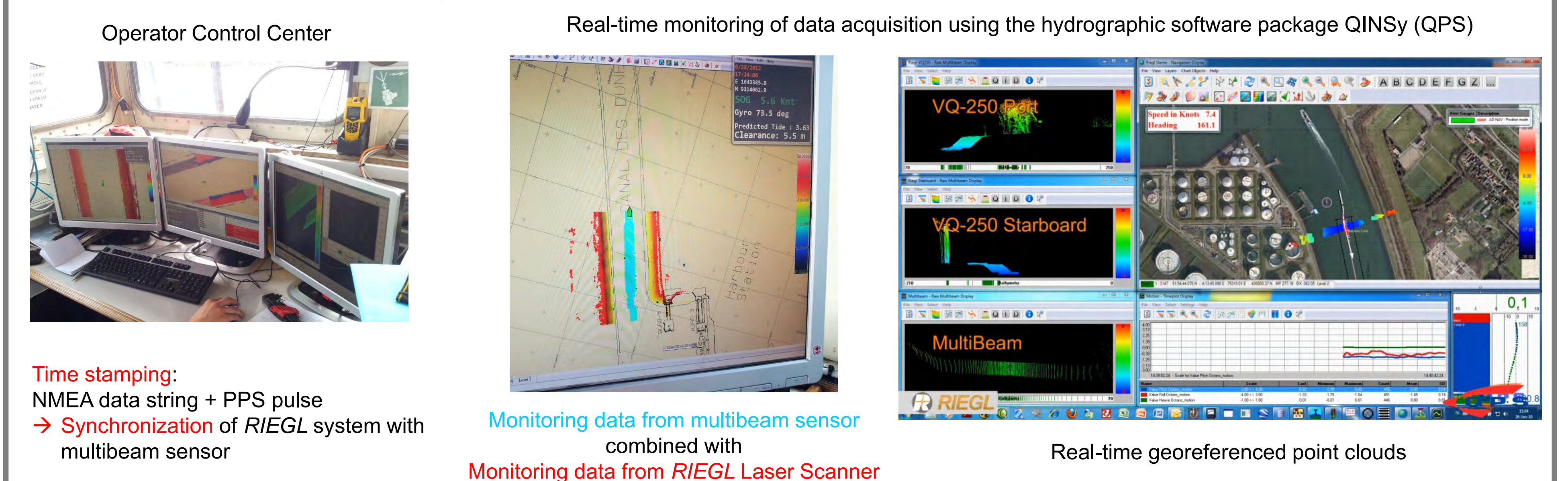
### Mobile laser scanning system VMY-250-MARINE

#### Concept and parameters

- Specifically designed for marine applications
- VQ-250 (up to 100 lines/sec, PRR up to 300 kHz)
- Optional: fully integrated and calibrated camera system comprising 2 x 5 MPix industrial cameras with flexible mounting
- Available configurations:
  - complete calibrated system (with full INS integration)
  - stand-alone system (for integration with existing INS solutions)
- Seawater resistant protective case for storage



#### Integration example: VMY-250-MARINE with multibeam sensor



## Conclusion and outlook

The airborne topo-bathymetric laser scanner VQ-820-G and the mobile mapping system VMY-250-MARINE are RIEGL's first laser scanning solutions dedicated to hydrographic surveying, both yielding highly dense and accurate 3D point clouds. The VQ-820-G allows the efficient survey of shallow waters (both riverine and maritime areas) including the adjacent land surface. The VMY-250-MARINE mobile laser scanning system is specifically developed for marine applications. It may be easily integrated into a given hydrographic survey system in order to acquire spatial data both above (laser scanner) and below (multibeam echo sounder) the water surface, which is important for a seamless survey of objects within the water-land transition area (e.g. bridge pillars or quay walls). Due to the growing demand for spatial data in coastal areas and encouraged by the enthusiastic feedback obtained from its customers, RIEGL will further advance technology development in this field.