RIEGL Government and Industry Market Development:

Mapping the Globe

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(Represented by Lingxiao Zhu)
11/19/2018

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- *RIEGL* Intro
- LiDAR as a Critical Geospatial Technology
- Inherent Advantages of *RIEGL*
- Country Statistics (UN)
- UN-GGIM
- National Mapping:
  - Topo, Boundary, Shoreline
- National Mapping Critical Elements:
  - Requirements, Political and Economic Drivers, Multiple Silos, 'Map it once, not many times', Refresh Rates, Standards and Capacity planning
- Tools:
  - LiDAR, IFSAR, Photogrammetry, Surveying GCP, Satellites
- Data formats:
  - LAS ,LAZ, OPEN Source
- Software:
  - ESRI and Open Source
- Data Storage Options
- Website for Product Distribution
- ASPRS, ISPRS, THOSA, IFHS, IHO
- MAPPS and WGIC: How they Work
- Examples:
  - USA, Netherlands, Norway, 3DEP Website, NOAA National Shoreline Mapping and Charting
- Data Examples
- Point cloud Visualizations

Remote Sensing and LiDAR

- ***Light detection and ranging (LiDAR) has evolved as an essential remote sensing technology needed to support high-value applications, such as flood risk management, water supply and quality, infrastructure and construction management, natural resources conservation, geologic resource assessment, and hazard mitigation. LiDAR is one of the primary technologies used to support mapping of elevation and other Earth surface characteristics.***

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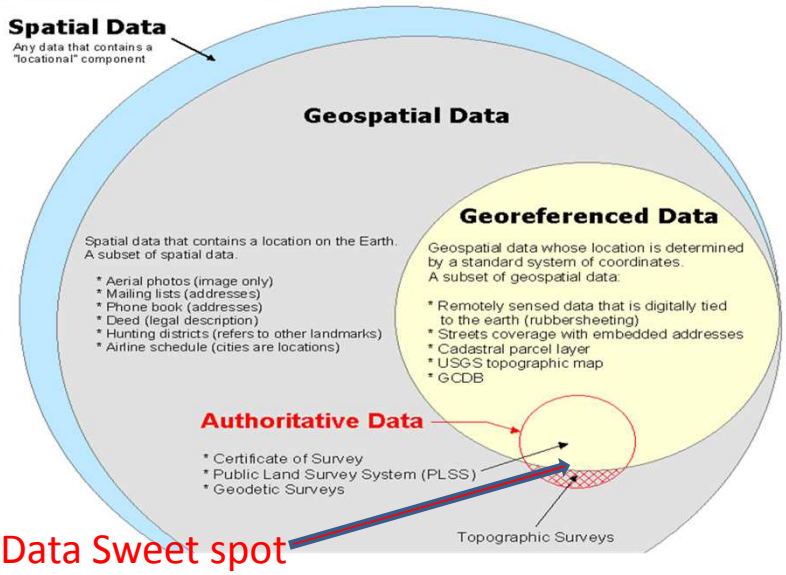
Authoritative Data



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National Mapping Remote Sensing Tools

- Satellite,
- Photogrammetry
- LiDAR
- Geodesy
- Check point surveys and ground control
- Photo interpretation
- Field reconnaissance
- Orthophotography
- Hyperspectral and multispectral imagery analysis

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Country Statistics (UN)

Geospatial Impact on Statistics

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UN-GGIM (United Nations Global Geospatial Information Management)

ECOSOC established the Committee of Experts as the apex intergovernmental mechanism for making joint decisions and setting directions with regard to the production, availability and use of geospatial information within national, regional and global policy frameworks. Led by United Nations Member States, UN-GGIM aims to address global challenges regarding the use of geospatial information, including in the development agendas, and to serve as a body for global policymaking in the field of geospatial information management

Sustainable Development Goals – Examples:

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UN-GGIM – Linking Data, Policy, People

SDG ISSUES

- Climate change
- Desertification, land degradation and drought
- Disaster risk reduction
- Forests
- Oceans & Seas

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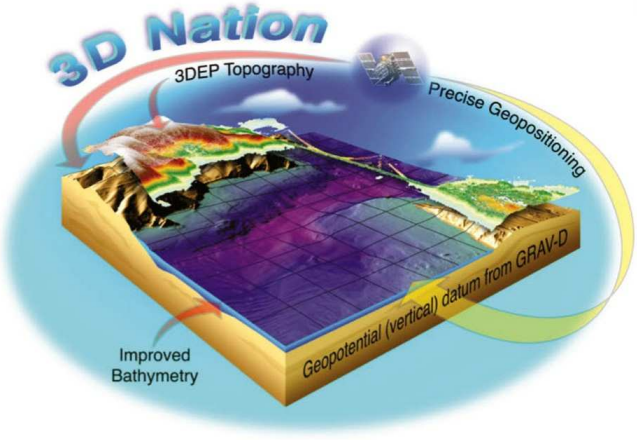
The 3D Nation



Elements of the 3D Nation concept.

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Smart Cities and Countries

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COUNTRY MAPPPING ACTIVITIES

National topographic mapping of Land
Infrastructure
Forestry
Vegetation
Port and Shoreline Mapping

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National Mapping Policy Formation

neea_final-report_revised-3-29-12.pdf

1. Executive Summary
National Enhanced Elevation Assessment (NEEA)
The U.S. Geological Survey (USGS) and other members of the National Digital Elevation Program (NDEP) sponsored the first-ever national assessment to document business use requirements for and benefits of national enhanced elevation data that would significantly expand national elevation data availability, quality and usability. The goal of the assessment was to develop and refine requirements for a national program and to identify program implementation alternatives, costs and benefits for meeting priority national elevation data needs. The assessment quantifies answers to three key questions.

1. Is it more cost effective for the government to manage these activities within the context of a national program?
2. Are there additional national or agency benefits derived from such a strategy?
3. What does the optimized program look like?

The assessment results provide significant evidence that an enhanced national elevation program could provide conservatively-estimated net benefits between $116M/year and $620M/year and Benefit/Cost Ratios between 4.3 to 1 and 4.9 to 1, depending upon options implemented.

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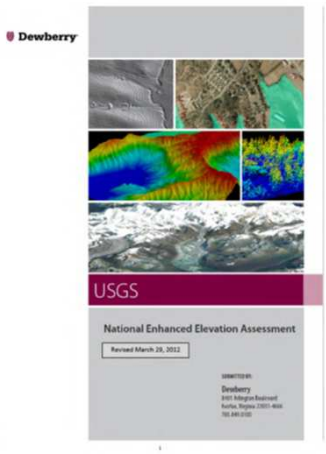
USA National Topo Map – 3DEP



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Critical Elements for Success: 3DEP

- Establish the requirements
- Determine the political and economic drivers
- Remove organizational silos,
- Remove redundancy -map it once, not many times
- Determine the cycle and refresh rates
- Establish relevant standards
- Conduct capacity planning

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UN-GIM Efforts for National Mapping: Shoreline

Oceans, seas and marine resources are increasingly threatened, degraded or destroyed by human activities, reducing their ability to provide crucial ecosystem services. Important classes of threats are, among others, climate change, marine pollution, unsustainable extraction of marine resources and physical alterations and destruction of marine and coastal habitats and landscapes. The deterioration of coastal and marine ecosystems and habitats is negatively affecting human well-being worldwide.

Good governance, an enabling environment, sustainable land- and marine- based human activities, and adequate measures will be required to reduce the negative anthropogenic impacts on the marine environment, for example due to a more sustainable use of resources, changes in production and consumption patterns and improved management and control of human activities. Projects and measures should ideally be designed and implemented in an integrated, cross-sectoral and cross-scale manner, in line with the ecosystem approach and involving all stakeholders.

Managing the Future of the Coasts

- The world has 356,000 KM of coastline – World Factbook
- 40% of the worlds population lives in the Coastal Zone – United Nations Data
- Most of the world's Mega Cities are in the Coastal Zone
- Shoreline morphology is constantly changing
- The Benthic Zone management is critical to human survival
- Aggradation zone and flood mapping for rivers and coasts impacts humans worldwide

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National Shoreline Mapping

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Topo Bathy Lidar is critical for

Confirms storm surge models

Determine Coastal Resilience

Coastal flooding predicitions

GIS analysis

Benthic habitat assessment

Ports assessment(key economic engines)

Sea level rise impact zones

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Coastal Mapping Challenges

Wind and Wave Loads
Tide
Weak Geodetics
Resources
Anthropogenic Influences
Operational Issues
GPS Information
Water clarity
Flight restrictions

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Coastal Mapping Purposes

Charts for safety in navigation

Maps for Coastal Intelligence and resiliency

Emergency response

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Example of the populations use of the data

It is critical to make data and information available to the authorities and also the population

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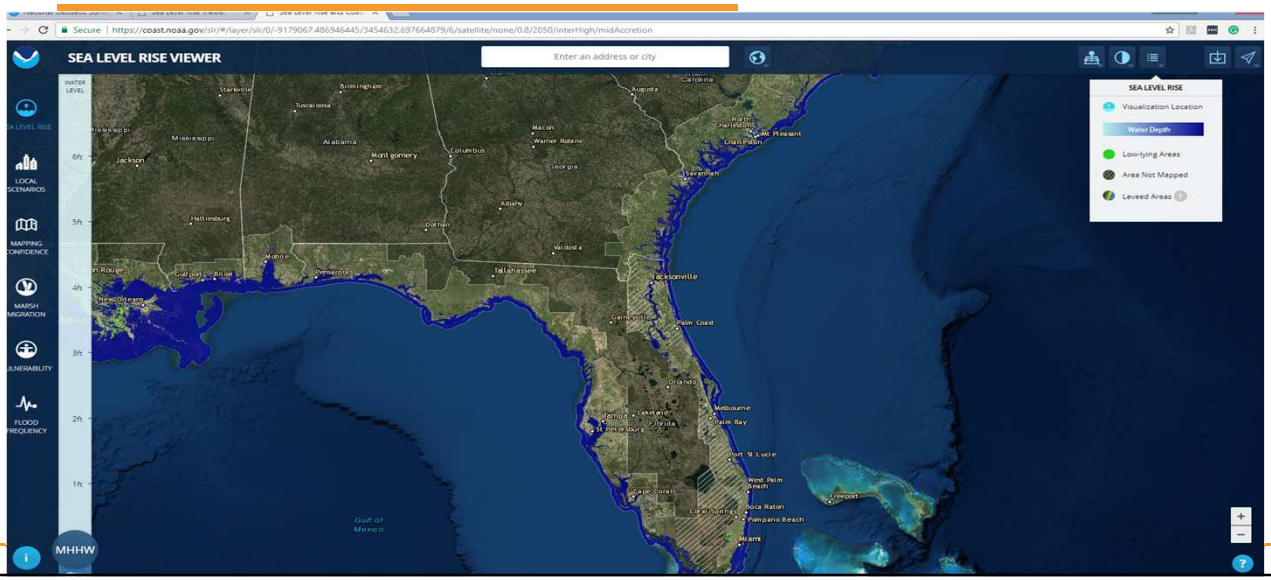
NOAA Sea Level Rise Viewer



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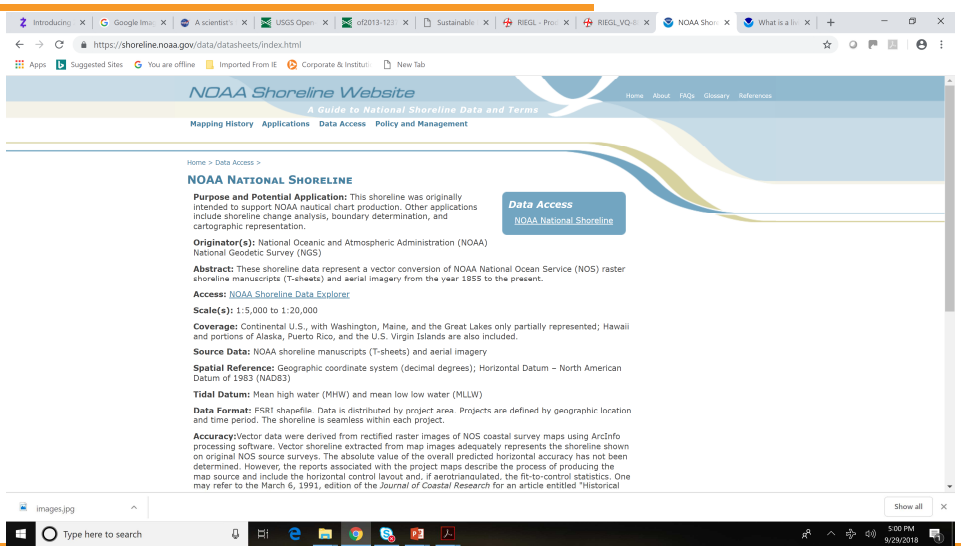
NOAA Data Distribution Portal



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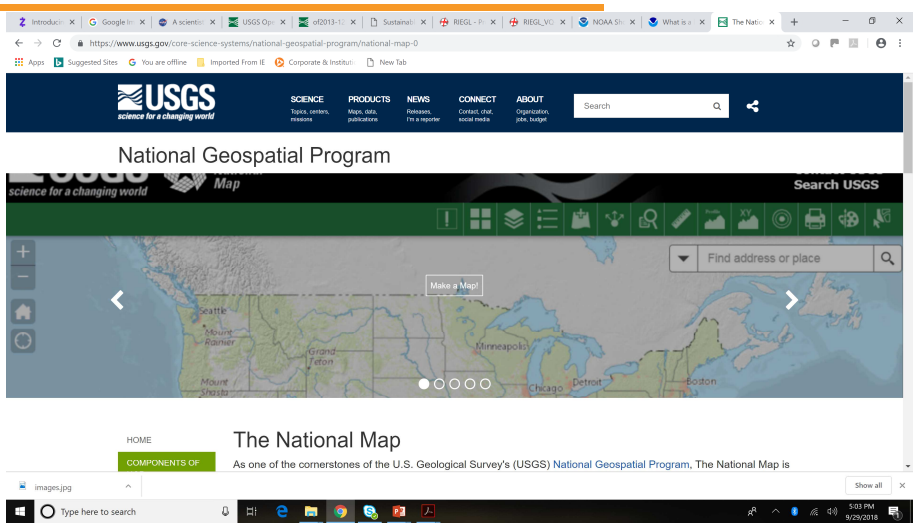
USGS DATA DISTRIBUTION PORTAL



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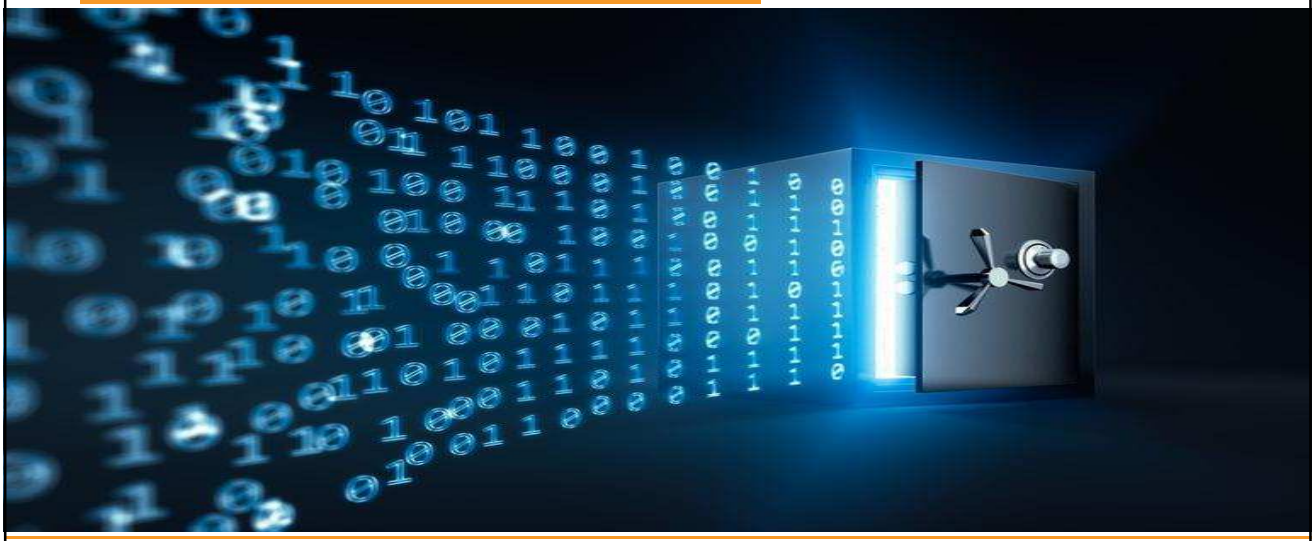
The Data Management Structure

- Data Strategy and Architecture
- Data Integration
- Organizational Alignment
- Security and Privacy
- Governance
- Master Data Policy
- Data Quality
- Solution Management
- Metadata Management
- Analytics
- Dashboards, Scorecards and Reporting

Data Storage Options



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The Cloud

aws

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Important Associations

isprs
information from imagery

INTERNATIONAL HYDROGRAPHIC ORGANIZATION
1921
IHB MONACO BHI
IHO

THSOA

OGC®
Making location count.

asprs
THE IMAGING & GEOSPATIAL INFORMATION SOCIETY

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Industry Associations

VISION: To be a collaborative platform to advance role of geospatial industry and strengthen its contribution in world economy and society

Mission: To be a catalyst for intra and inter industry knowledge exchange and co-creation of larger business opportunities for geospatial industry enhancing its value impact through policy advocacy, business development and collaborative programs.

WGIC

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U.S. Geospatial Association for Commercial Firms

MAPPS is the only national association of geospatial, mapping and photogrammetry firms with the following objectives:

- **Advocate o**n Capitol Hill for sound geospatial policy and legislation
- **Expand** the geospatial market and create growth opportunities
- **Provide** professional recognition for innovation and projects
- **Increase** private sector use by government entities
- **Serve** as the voice of the private geospatial firms
- **Enhance** ability to participate in the free enterprise market
- **Promote** business interests and contest unfair competition
- **Offer** engaging business networking, professional knowledge exchange, and educational programs

MAPPS
An Association of Photogrammetry, Mapping, and Geospatial Firms

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Riegl and ESRI – LMAP Inititative

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esri

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LMAP Initiative

Store, Manage, & Organize

LiDAR collections within the ArcGIS Platform using best practices

Search, Filter, quickly Find & Acquire

Individual LiDAR tiles or entire collections utilizing a map based web application

Cloud Based

Requires no additional user software

Scalable

Manage all your LiDAR collections in an efficient, cost effective manner

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Quantum Spatial Inc.

- Largest geospatial solutions provider in North America including imaging, remote sensing, modelling, visualisation and GIS.
- RIEGL Topo-Bathy LiDAR for 6 years and have scanned over 3.5 million acres.
- Inspired by LMAP Initiative to help **organise projects** and **promote customer feedback loops** while utilising licenses and products already at their disposal.

quantum SPATIAL

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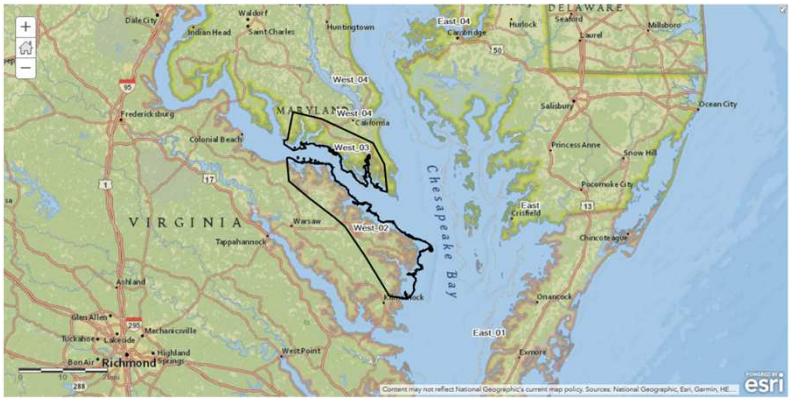
Quantum Spatial Inc. – Task

- Contracted by NOAA (National Oceanic and Atmospheric Administration) to collect topo-bathymetric LiDAR and areal photography over river delta regions of Chesapeake Bay in Virginia and Maryland
- Dates: Jan 2017 and early 2020
- Project data will enable:
  - Shoreline characterization
  - Nautical charting
  - Geodesy
  - Marine resource management



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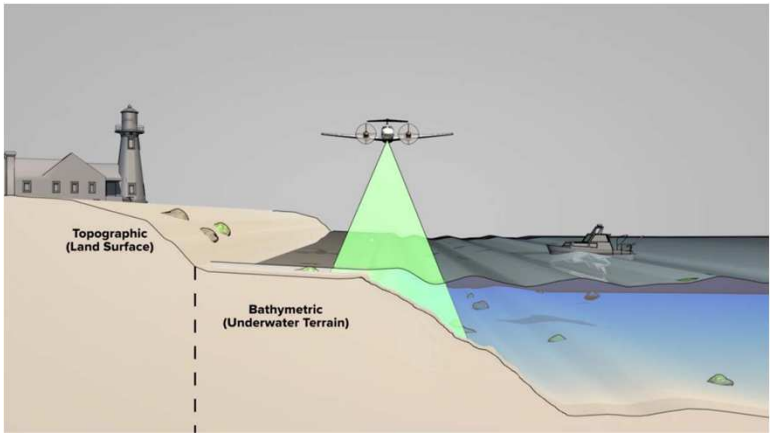
Quantum Spatial Inc. – Bathymetric LiDAR



Images in this slide courtesy of Quantum Spatial Inc.

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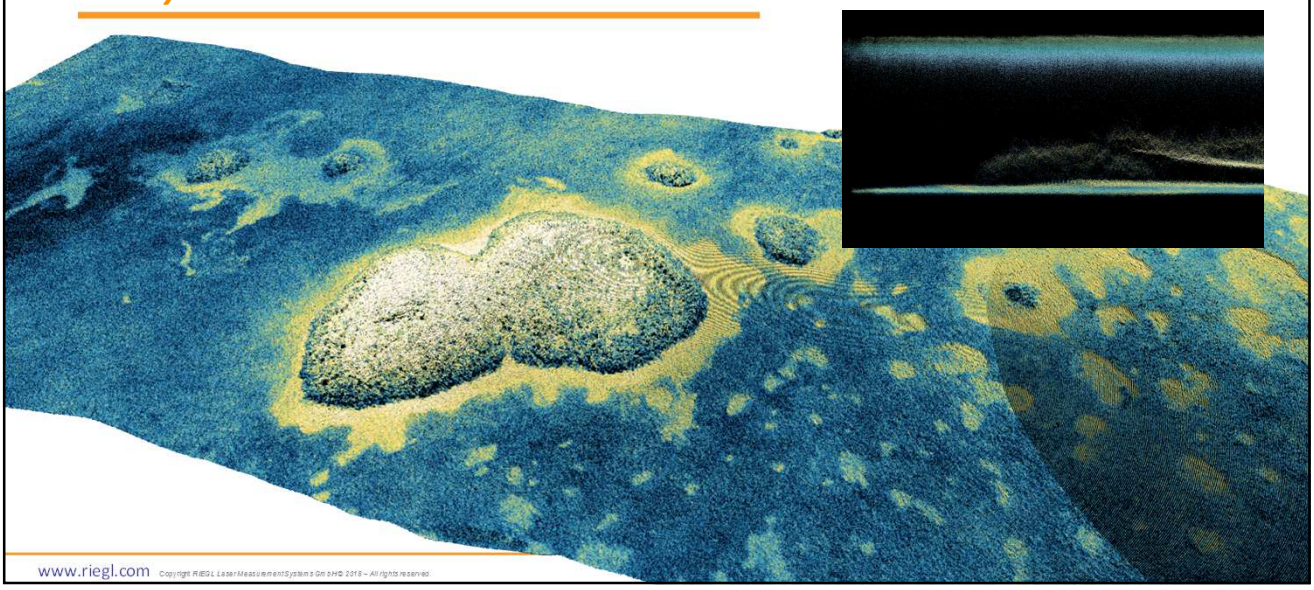
Bathymetric LiDAR



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Quantum Spatial Inc. – Data Sources

Primary Data Source

- RIEGL VQ-880-G Bathymetric LiDAR

Additional Data

- LiDAR derivatives
- Project Flightlines
- Water Quality
- Turbidity Measurements
- Survey Points
- Acquisition Photos

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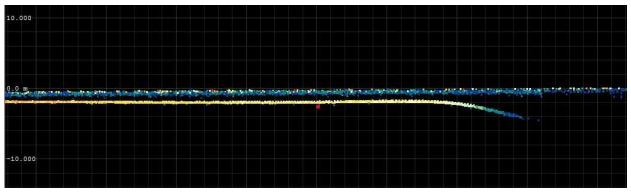
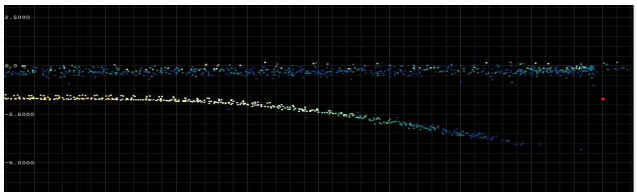
NOAA Chesapeake Bay CROSS-SECTION MAP
2/15/2018 MISSION





Tide Station: Lewisetta, VA (8635750) Mean range 1.24 ft.				
	Start Time	Tide Level (ft)	End Time	Tide Level (ft)
Predicted 20% Tide Window	17:11	0.248	21:49	0.248
Observed 20% Tide Window	17:30	0.248	21:30	0.248
Time of Flight	17:56	0.057	21:13	0.142

Images in this slide courtesy of Quantum Spatial Inc.

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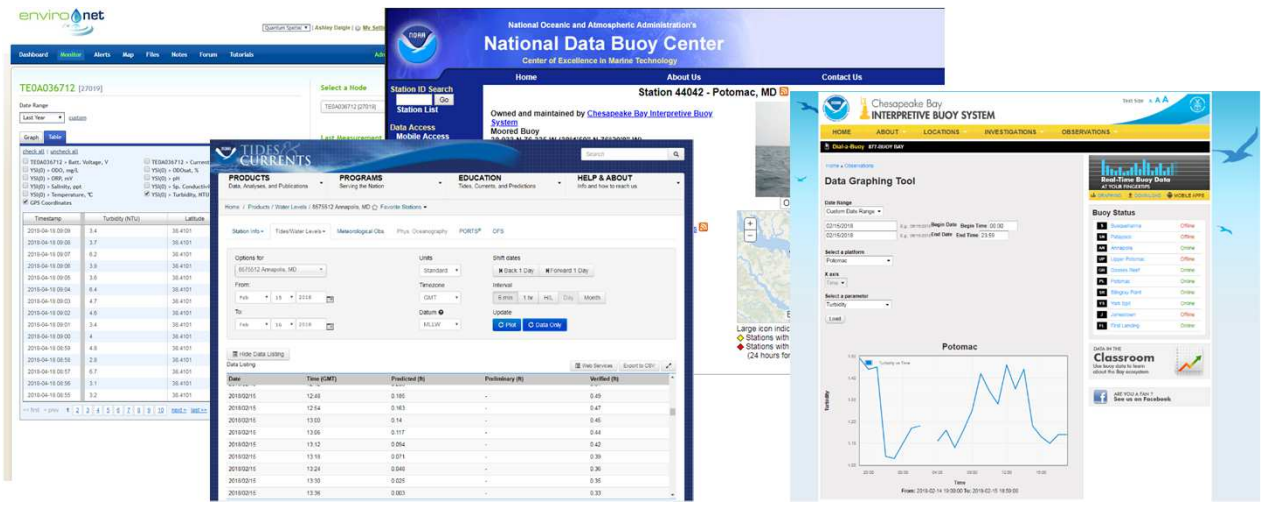
Quantum Spatial Inc. – Implementation



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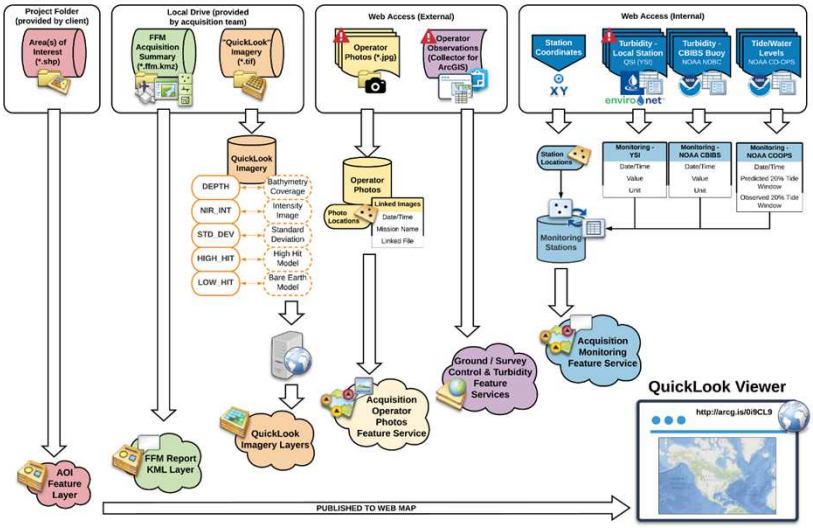

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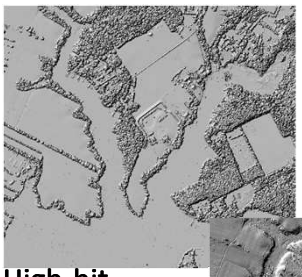
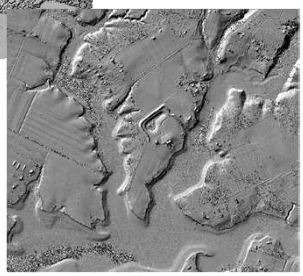
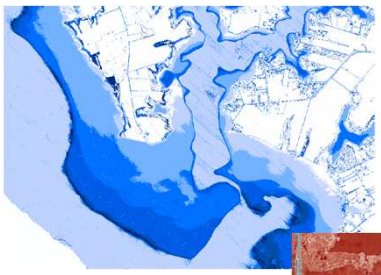


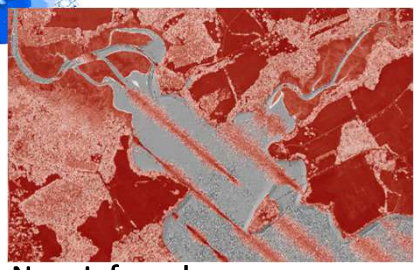
High-hit



Low-hit



Bathymetric Cover



Near Infrared

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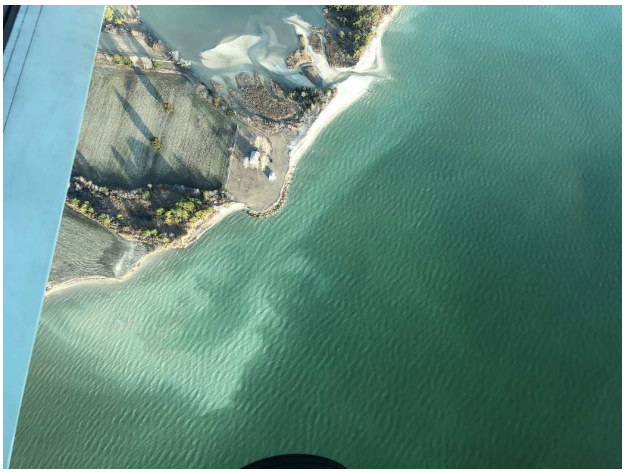

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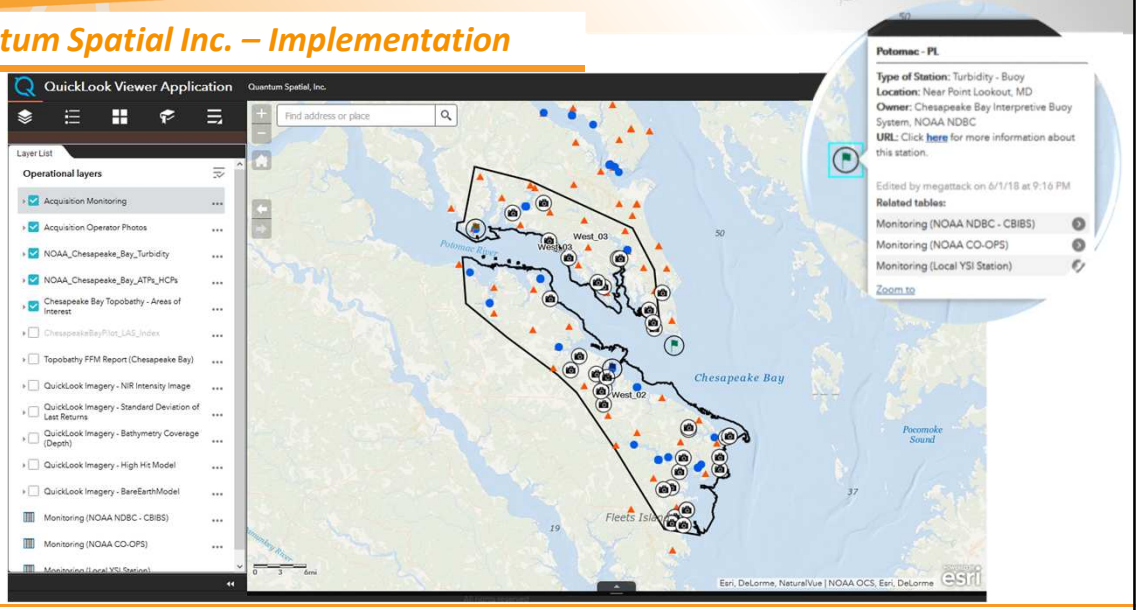

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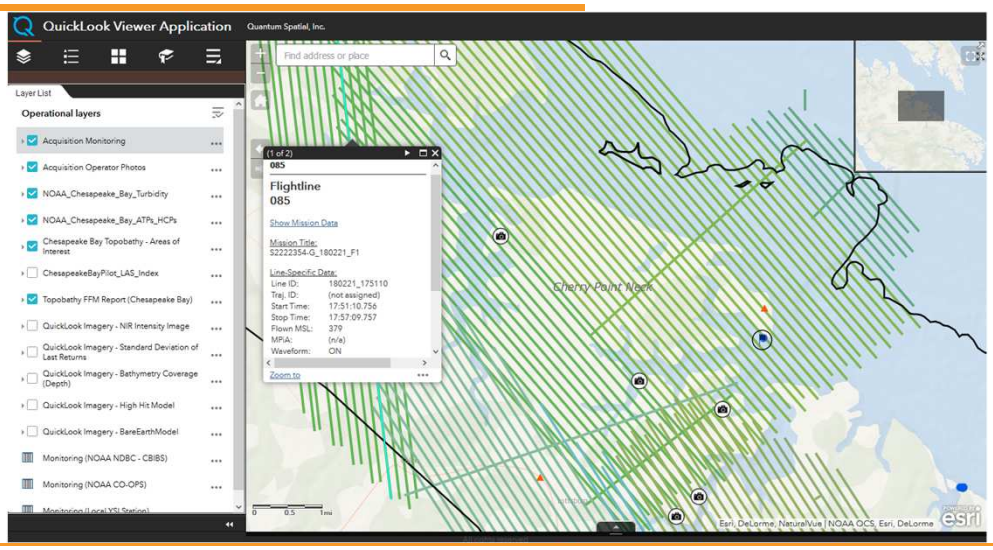

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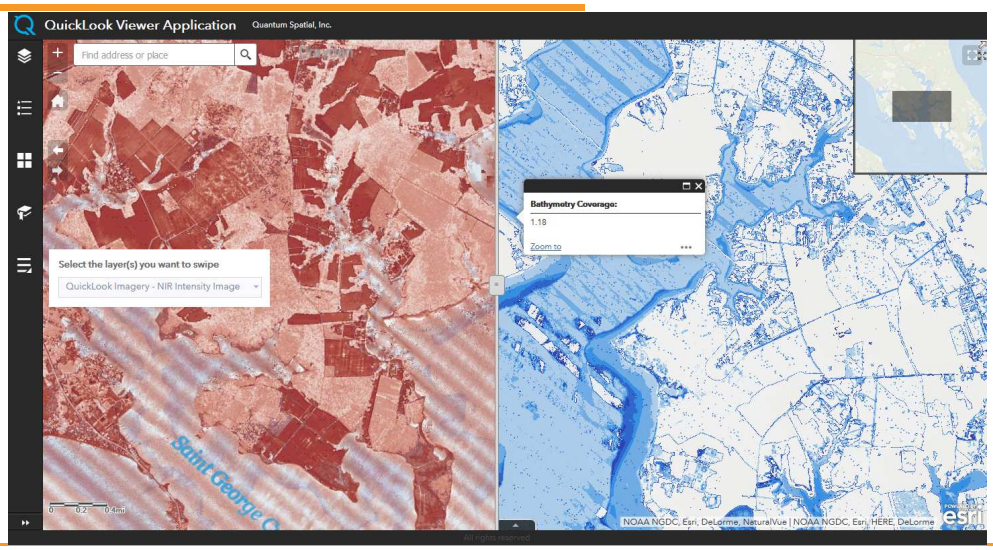

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Open Source

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Open Source Video Created by…

hobu

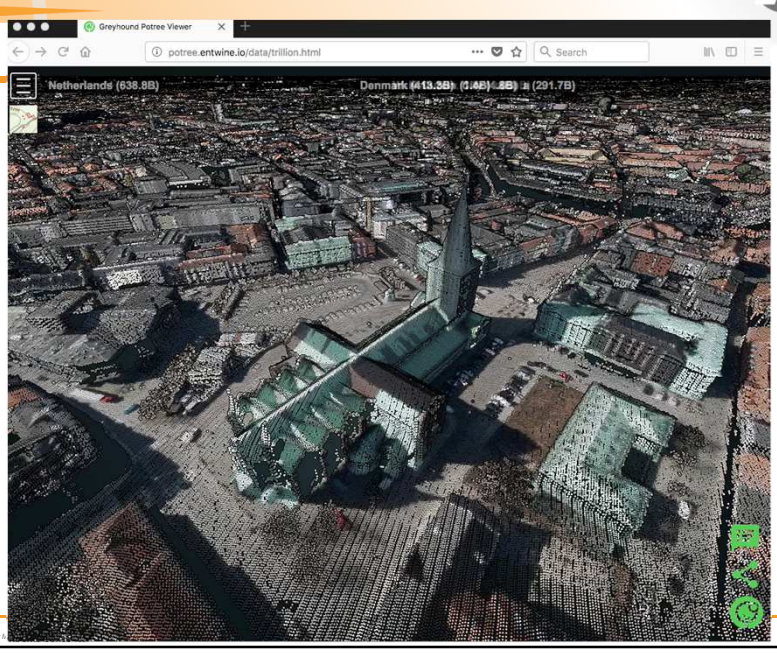
pdal.io

entwine.io

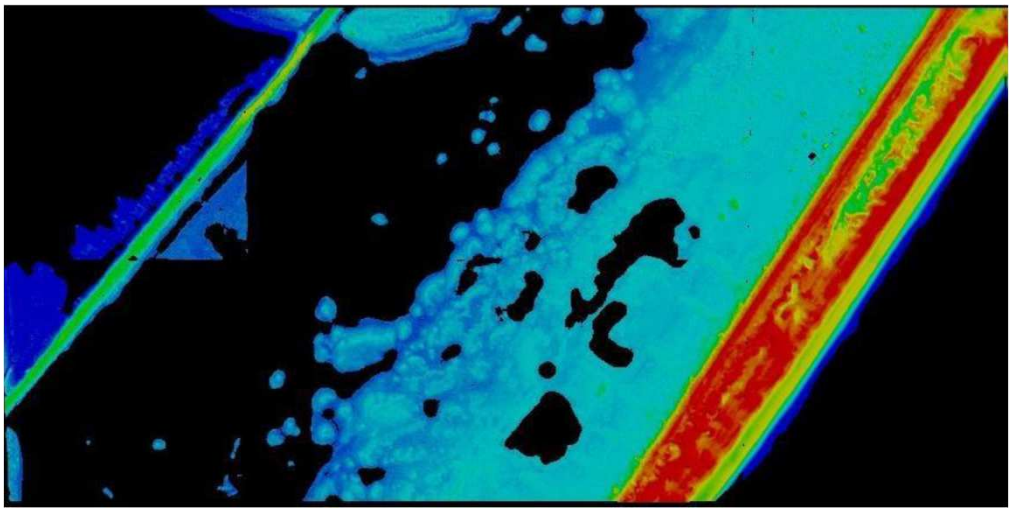
libLAS

greyhound.io

Examples: Around the Globe



Project Example of Coastal Island – Topo LiDAR Only



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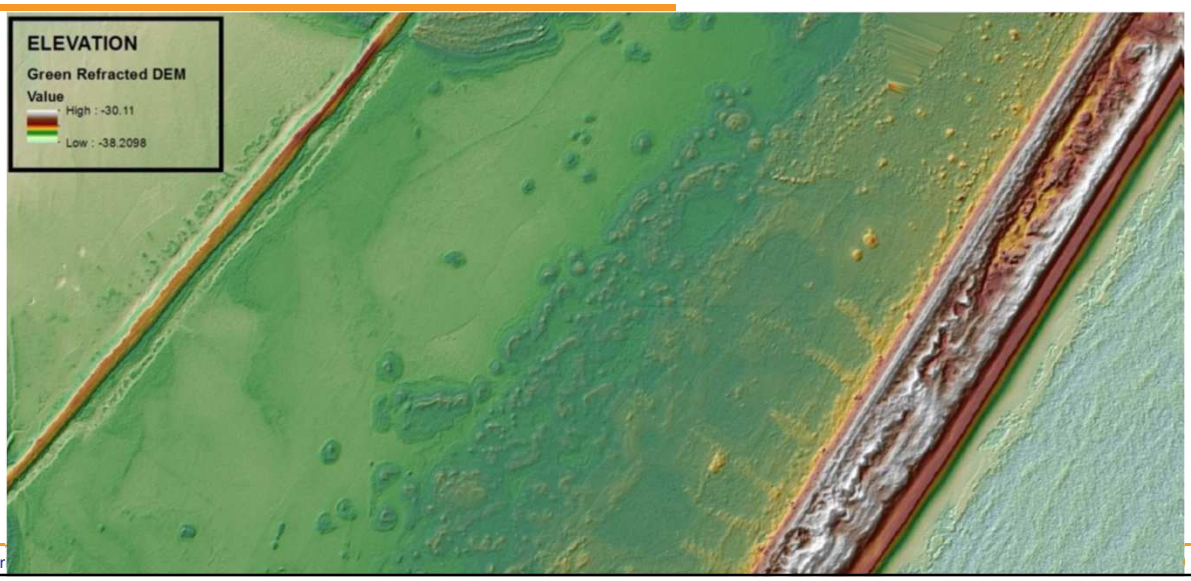
Project Example – Seamless Topo-Hydro



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Example – Overlayed with Imagery; 7 m resolution RGB

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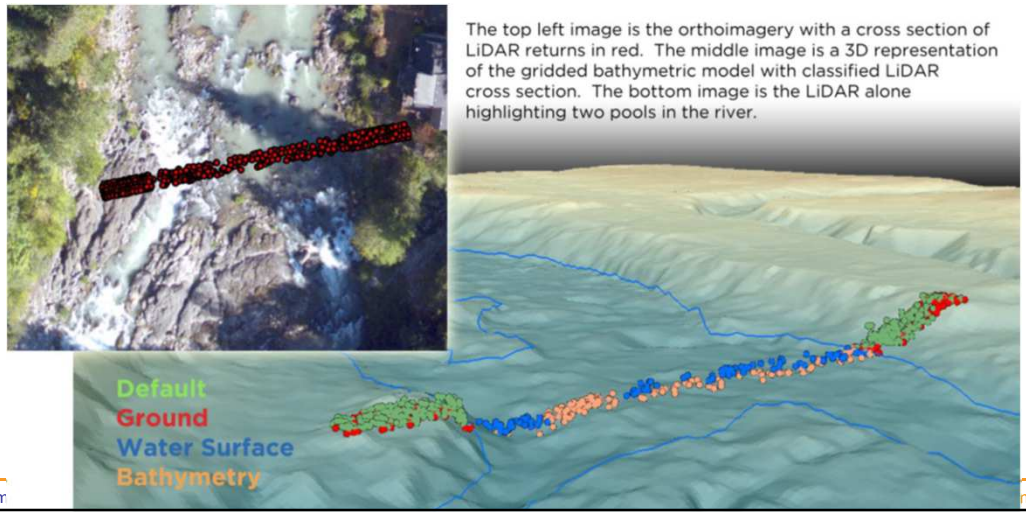
River Mapping



The top left image is the orthoimagery with a cross section of LiDAR returns in red. The middle image is a 3D representation of the gridded bathymetric model with classified LiDAR cross section. The bottom image is the LiDAR alone highlighting two pools in the river.

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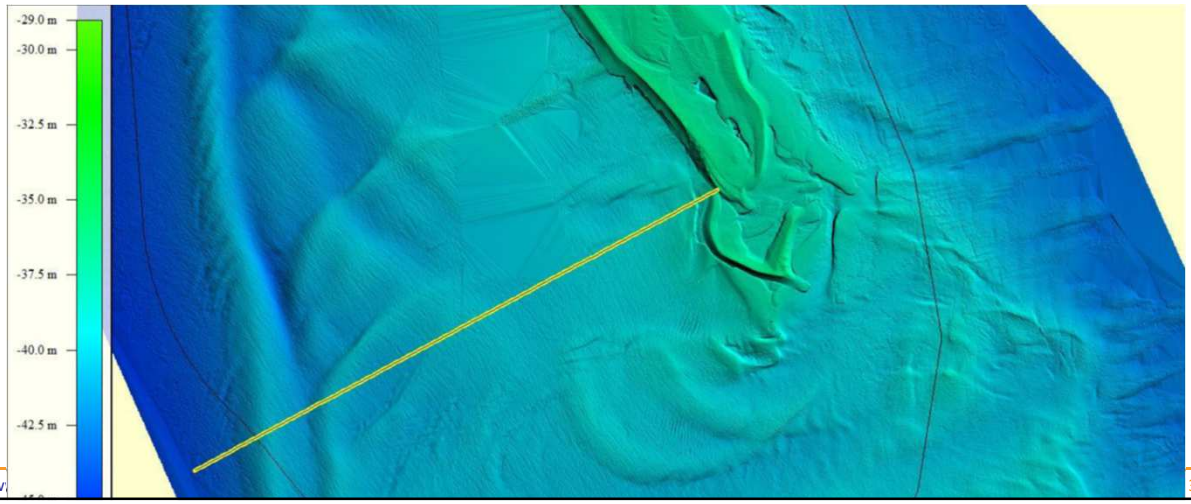
Ocean Performance



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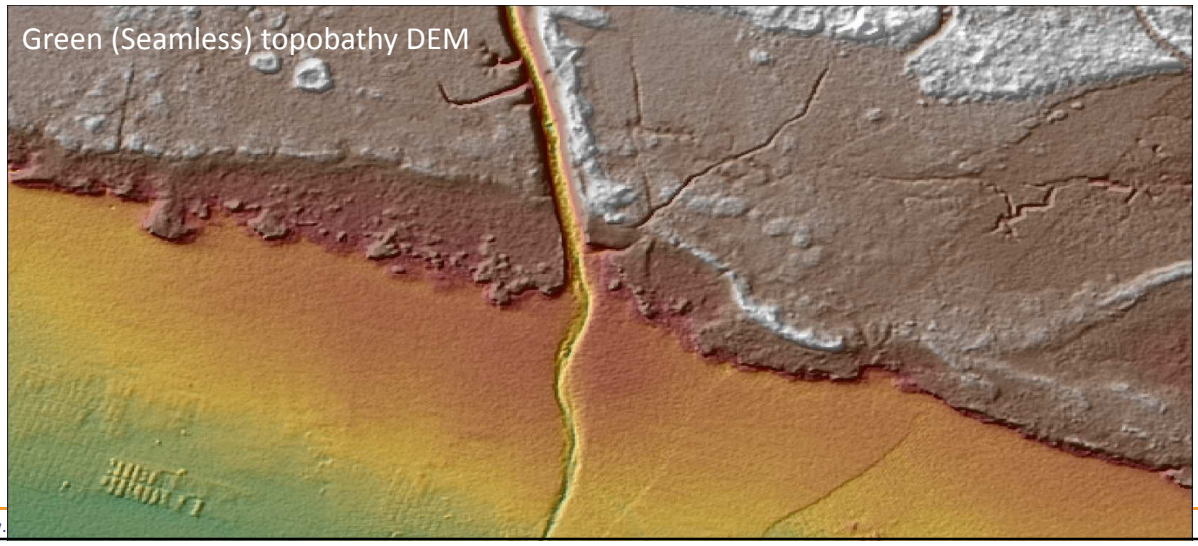
Underwater Features



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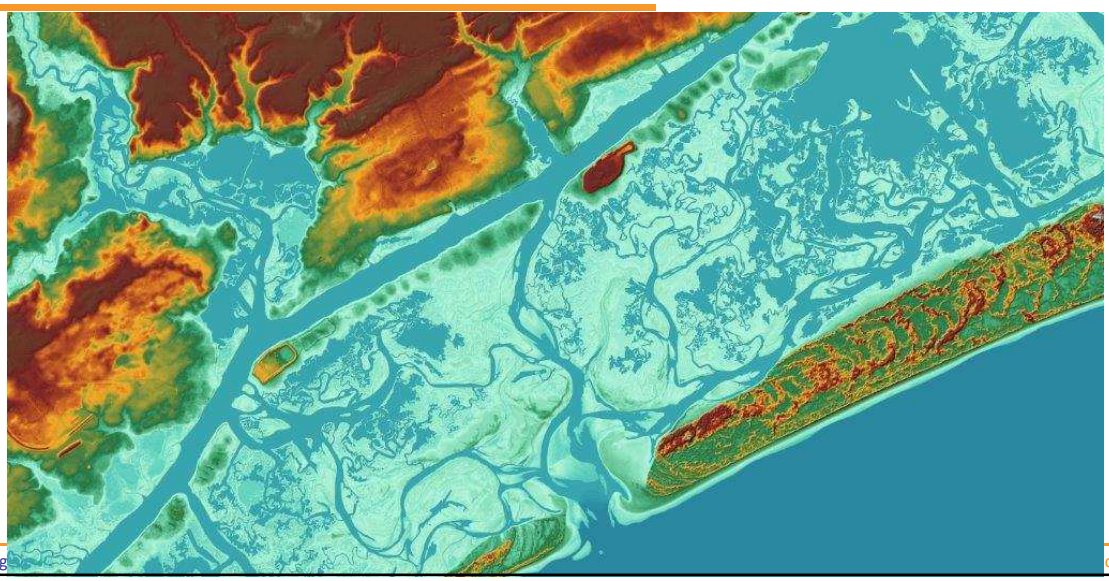
Incredible Detail



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Coastal Wetlands Restoration

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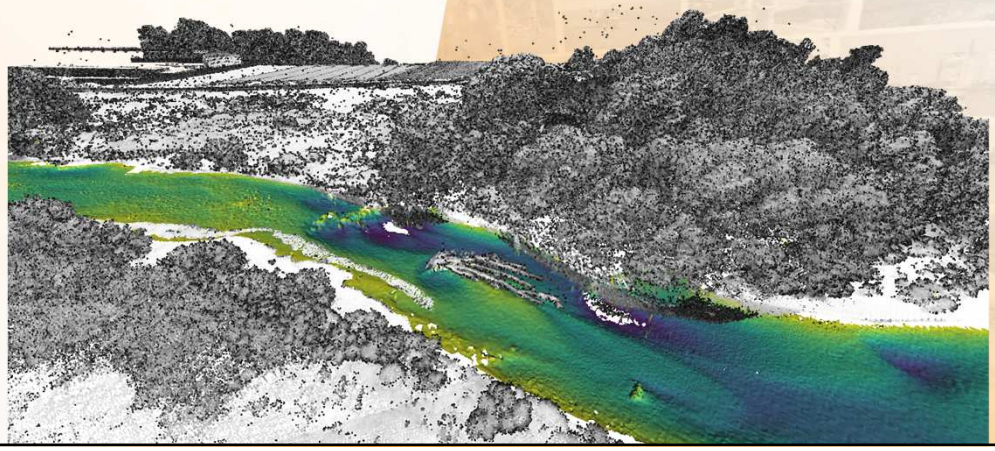
Airborne Laser Bathymetry – Hardware and Software Updates



VQ-880-GH and VQ-880-G II

Airborne Laser Scanning system for combined hydrographic and topographic surveying

Camera configuration:

- 2 PhaseOne cameras (RBG and NIR)
- up to 100 MPixel CMOS without FMC or
- up to 80 MPixel CCD with FMC
- dedicated data recorder enables high image rate

IR channel

- significantly improved ranging performance
- higher rep rate (up to 900 kHz)

Green channel

- improved waveform storage capability (longer sample blocks)
- higher rep rate (up to 700 kHz)

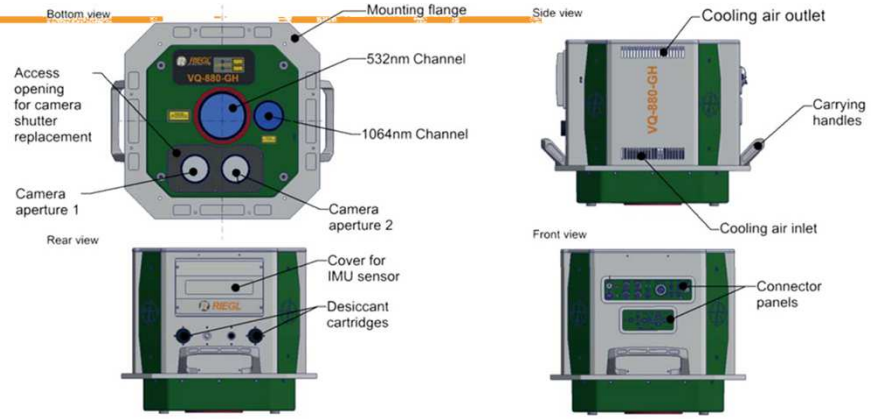
VQ-880-GH, VQ-880-G II key specifications

wavelength	532 nm (visible green light)
measurement range *topography*	2500 m at ρ ≥ 20% 3600 m at ρ ≥ 60%
measurement range *hydrography*	1.5 Secchi depth bright ground
ranging accuracy	25 mm
Scanner field of view	40°
Laser beam divergence	selectable, 0.7-1.7 mrad
measurement rate	up to 700 kHz
scan speed	up to 80 revolutions/second
laser safety	Laser Class 3B
multiple time around processing	yes

VQ-880-GH, VQ-880-G II key specifications

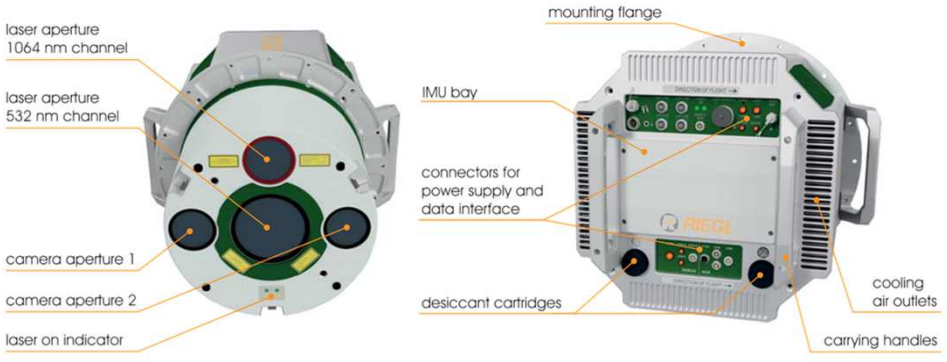
wavelength	1064 nm (IR)	
measurement range topography	**1800 m** at ρ ≥ 20% **2800 m** at ρ ≥ 60%	@ 150 kHz laser PRR
ranging accuracy	25 mm	
Scanner field of view	40°	
measurement rate	up to **279 kHz** @ **900 kHz** laser PRR	
scan speed	up to 200 revolutions/second	
laser safety	Laser Class 3B	
multiple time around processing	yes	

VQ-880-GH
System configuration & interfaces



- weight: 70 kg (depending on cofiguration)
- dimensions: 490 x 660 x 580 mm³, mounting flange 580 mm x 580 mm

VQ-880-G II
System configuration & interfaces



- weight: 70 kg (depending on cofiguration)
- dimensions: Ø524 mm x 780 mm

VQ-880-GH, VQ-880-G II
System configuration & interfaces

- Gbit Ethernet
- high-speed fiber link to *RIEGL* DR1560 data recorder
- 18-32 V DC supply, 400 W power consumption
- integrated IMU/GNSS
- *RIEGL* DR1560 for data storage
- IX controller for imagery storage

VQ-880-GH

VQ-880-G II

Software updates

Refraction correction
- **Depth bias correction**
- **Depth as an attribute**
- **More user-selectable parameters**

Total Propagation Uncertainty
- **Determination of point-specific TPU values (dry land and subsea)**
- **Include TPU values in LAS export**

Full waveform analysis
- **Point-wise classification (surface, volume, bottom)**
- **Bias-free determination of sea surface location**
- **Turbidity estimation**
- **Improved resolution of water surface and ground for shallow water**

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Inherent Advantages of RIEGL

- High laser repetition rates
- Superb signal processing
- Excellent system design & integration
- Short pulse laser shots
- Complete software package

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RIEGL

Why RIEGL?

- Excellently suited for combined land and hydrographic airborne survey
- High-accuracy ranging based on echo digitization and online waveform processing with multiple target capability
- High spatial resolution due to ultra high laser repetition rates
- Compact, rugged and light-weight modular configuration, compatible with standard airborne platforms
- Optional waveform data output, data accessible with RiWAVELib
- RiHYDRO and RiProcess Processing Software

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Thank you for your kind attention!





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