



PERFORMANCE OF THE RIEGL VQ-880-G LIDAR SENSOR IN MAPPING COASTAL NEAR-SHORE BATHYMETRY

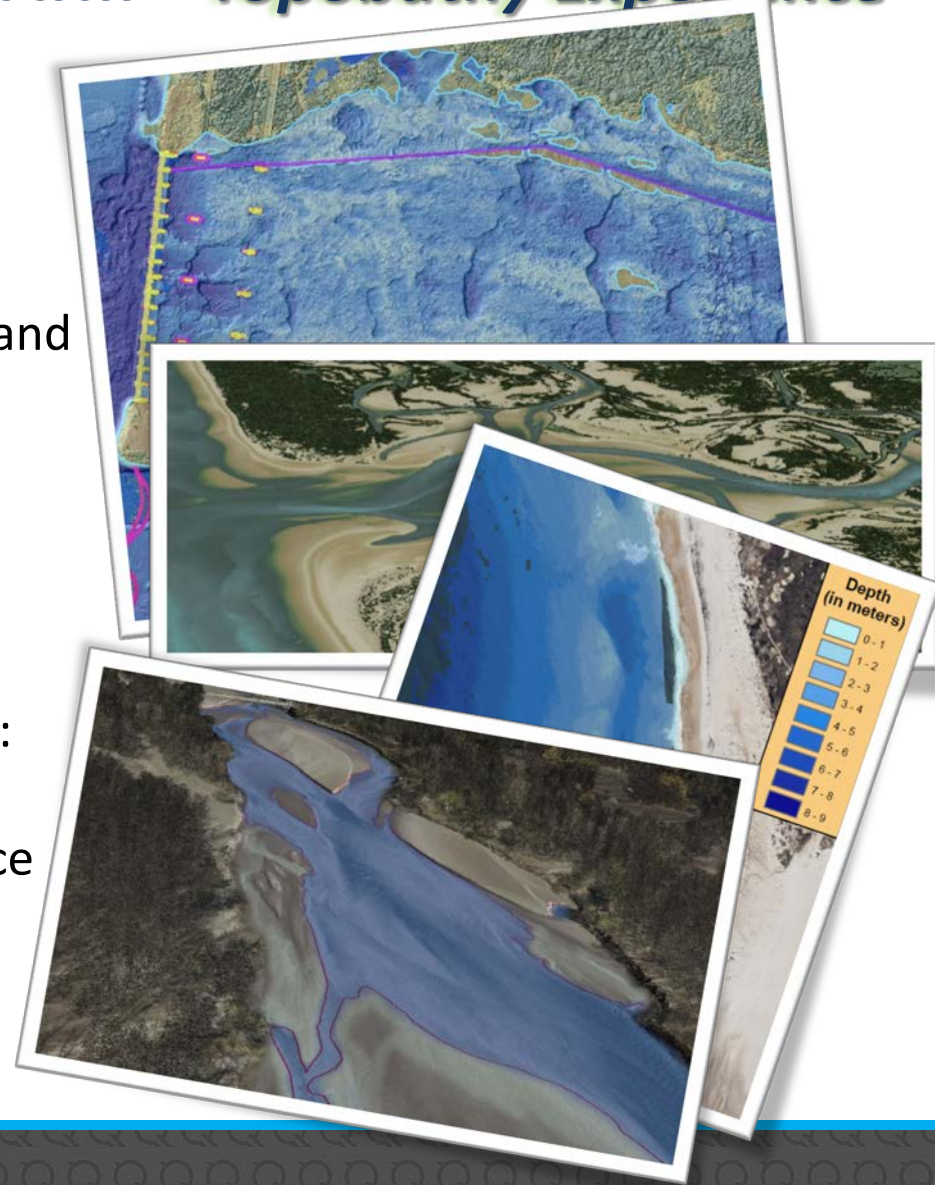


Coastal GeoTools 2017
Wednesday, February 7
Colin Cooper, Russ Faux, Nick Kules



QSI – Full Service GeoSpatial Firm – Topobathy Experience

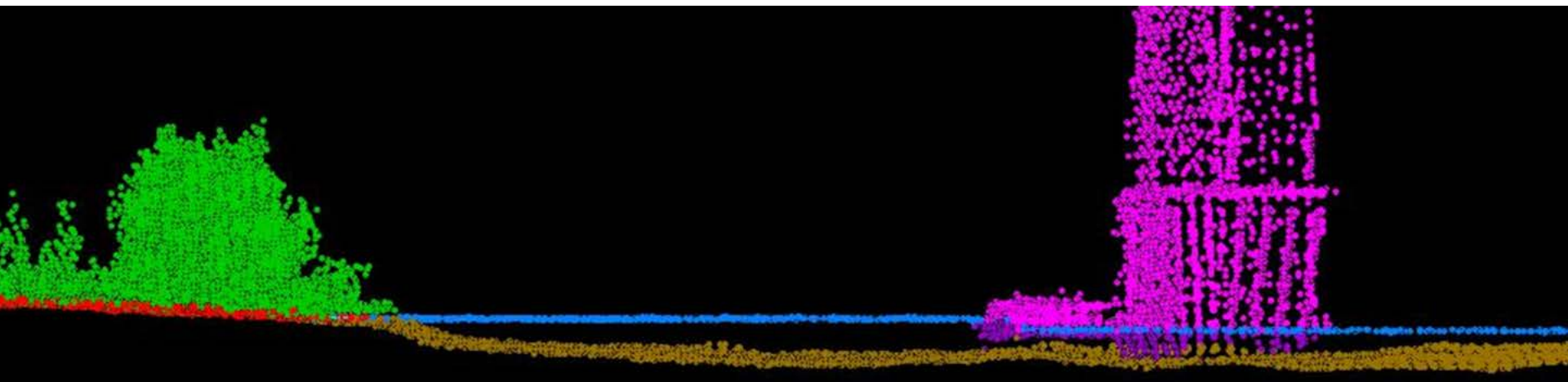
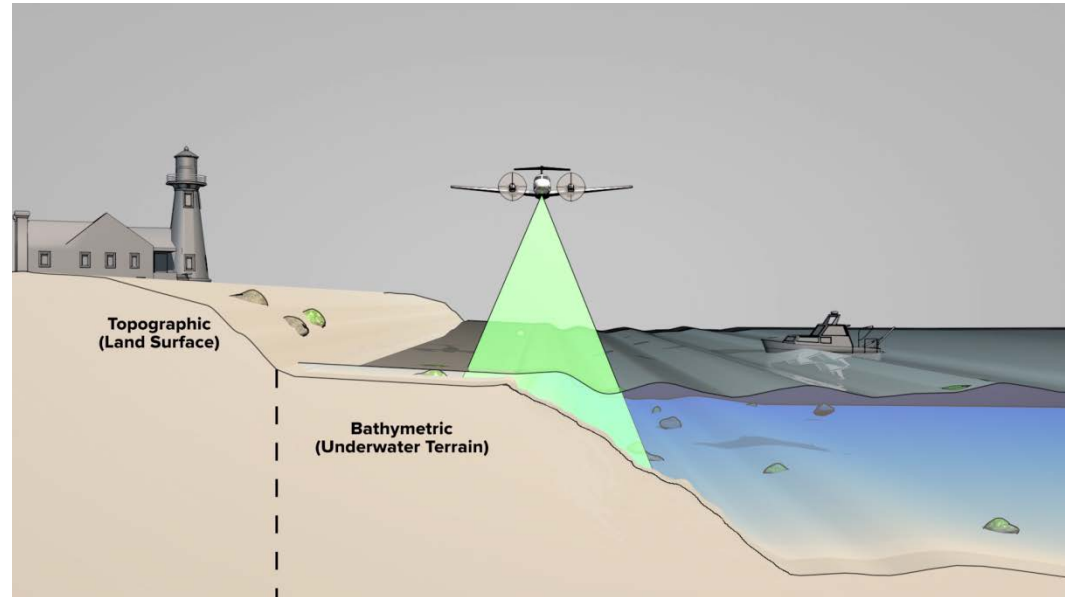
- Started in 2012 with the Sandy River in Oregon
- Over 4,325 square miles surveyed
- 25 states plus New Brunswick, Ontario, and British Columbia
- Over 42 projects
- Growing client base (29+)
- QSI provides remote sensing services nationally under the following contracts:
 - ✓ NOAA NGS Shoreline Mapping
 - ✓ USGS Geospatial Product and Service Contract(GPSC) III
 - ✓ USACOE JALBTCX (AE) Survey and Mapping Support Services





Topobathy: extending the survey under water

- Using green wavelength lidar to create a seamless survey



Shallow Water – Airborne Hydrographic LiDAR Systems

2002

	USGS EAARL
Pulse Length	1.3 ns
Beam Divergence	1.5 mrad
Max PRF	3KHz
Hydrography	1.5 SD



2011 - 2012

Riegl VQ-820-G	AHAB Chiroptera I	Optech Aquarius
1.0 ns	2.5 ns	NA
1.0 mrad	3.0 mrad	1.0 mrad
285kHz	18 kHz	70KHz
1.0 SD	10 m (for Kd=0.15)	10 m (for Kd < 0.1/m)

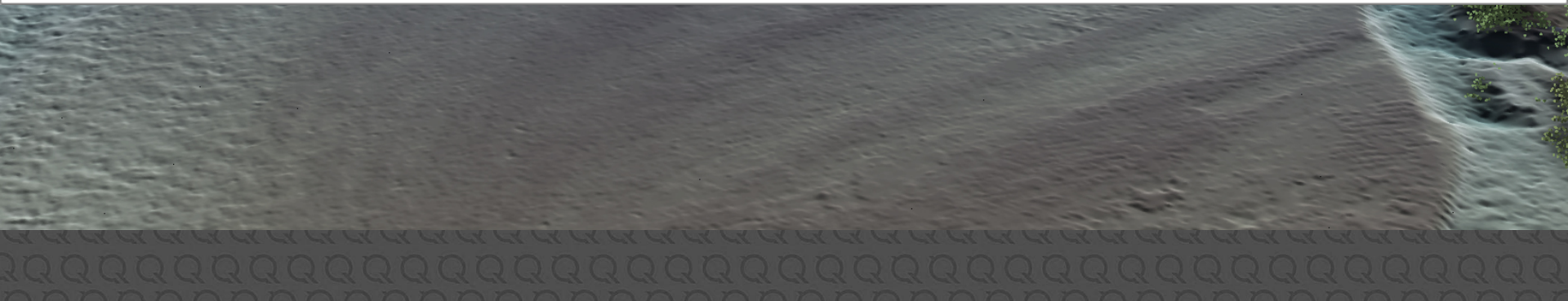
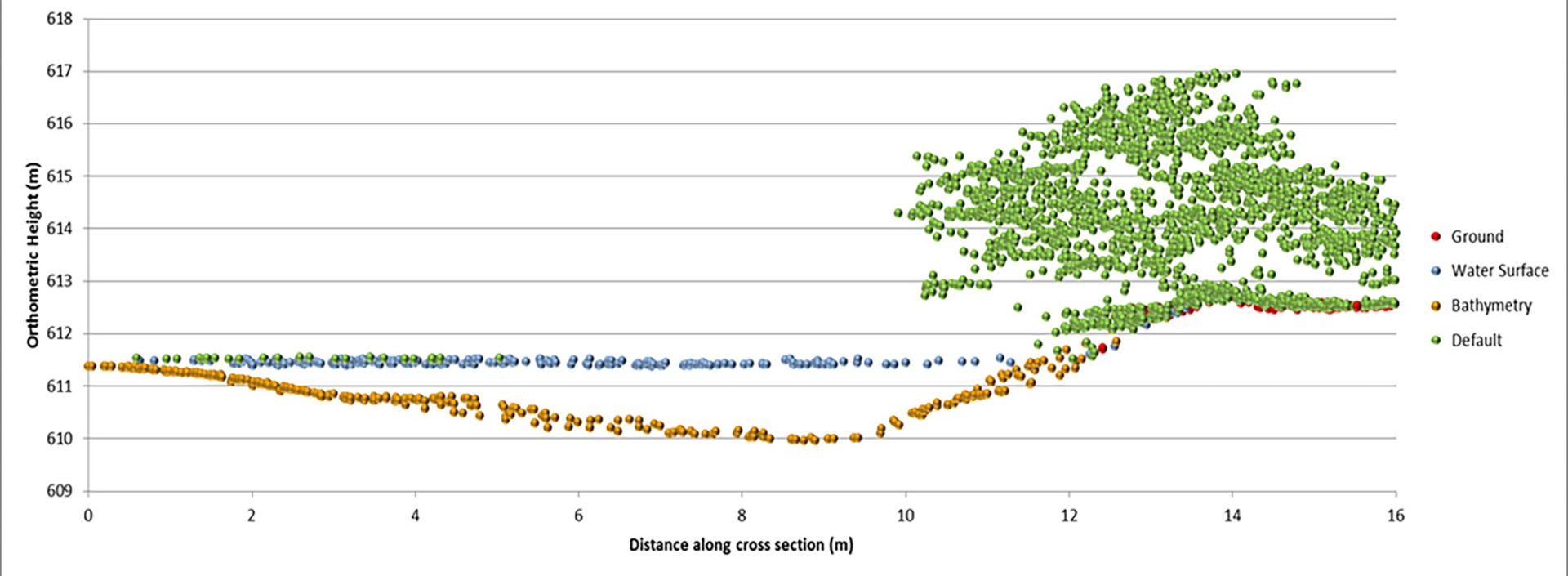
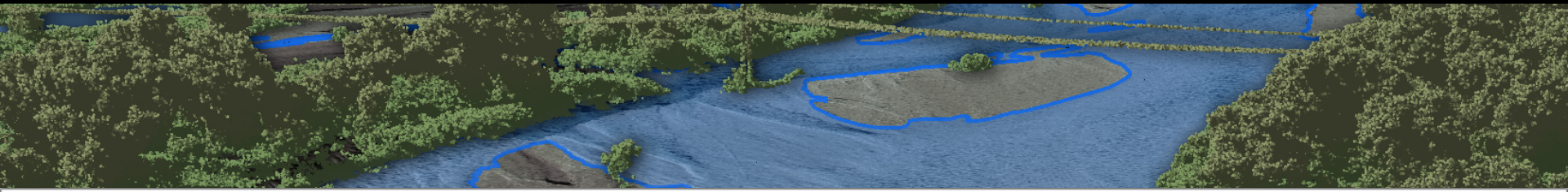


2014 - 2015

Riegl VQ-880-G	AHAB Chiroptera II	Optech Titan
500kHz Green 500k Hz NIR	35 kHz Green 500k Hz NIR	300KHz Green IR, NIR
1.5 SD	1.5 SD 3.0 SD (Option)	NA



Topobathy DEM with above ground lidar returns





How it helps

Lay the foundation for sound decision making



Riverine Flood Inundation Maps

View riverine flood forecasts in a visual format

Contributing Partners

FEMA, NOAA NWS, NOAA OCM, USACE, USGS



Sea Level Rise Viewer

View potential impacts of sea level rise along the coast

Contributing Partners

NOAA OCM



Digital Shoreline Analysis System

Computes the rate of shoreline change using multiple historical shoreline positions

Contributing Partners

USGS

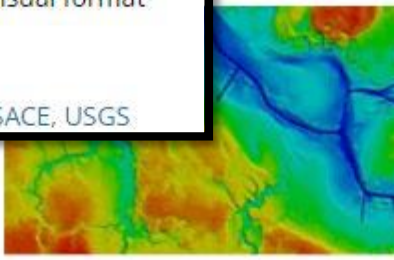


Sea Level Affecting Marshes Model

Simulates potential impacts on wetlands and shorelines from long-term sea level rise

Contributing Partners

EPA, Warren Pinnacle Consulting



VDatum

Vertically transforms geospatial data between a variety of tidal, orthometric, and ellipsoidal datums

Contributing Partners

NOAA CO-OPS, NOAA NGS, NOAA OCS





Stories right here in SC using elevation data



Office for Coastal Management
DIGITALCOAST

- ABOUT
- DATA
- TOOLS
- TRAINING
- TOPICS
- STORIES**

Displaying 51 Stories

Elevation ×

VIEW FILTERS

SEARCH LIST BY KEYWORD

Rise in Southeast Florida



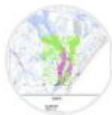
Understanding the Present by Studying the Past through Lidar in American...



Using Coastal Inundation Scenarios to Advance Community Resilience



Using Geospatial Techniques to Plan for Climate Change Impacts on Coasta...



Using Lidar to Determine Bluff Recession Rates for Lake Erie



Using Lidar to Plan for Sea



The map displays South Carolina with major cities like Columbia, Charleston, and Greenville. A popup window titled "Using Geospatial Techniques to Plan for Climate Change Impacts on Coastal Habitats in South Carolina" is overlaid on the map. The popup text reads: "Partners used the Sea Level Affecting Marshes Model and Habitat Priority Planner to identify priority lands to conserve as sea level rises." Below the text is a "View Full Story" link. The map also shows various national forests and state routes.

Zoom to State/Territory ▾





Stories right here in SC using elevation data

The screenshot shows the NOAA Office for Coastal Management Digital Coast website. The header includes the NOAA logo, the text "Office for Coastal Management DIGITALCOAST", and navigation links for "ABOUT", "DATA", "TOOLS", "TRAINING", and "TOPICS". Below the header, it states "Displaying 51 Stories" and has a filter for "Elevation" with a close button. A "VIEW" button and a "SEARCH LIST" input field are also present.

The main content area features a list of five story cards on the left, each with a circular thumbnail image:

- Transportation Infrastructure on the East...
- Building Resilient Communities Using a Beachfront Vulnerability Index in...
- Building Storm Ready and Resilient Communities in New Jersey
- Capturing Traditional Knowledge to Inform Restoration Planning in Hawai'i
- Consolidating Data Sets to Simplify Climate Risk Communication

The right side of the page displays a map of South Carolina. A pop-up window is overlaid on the map, titled "Visualizing Sea Level Rise to Engage Municipal Government Officials in Coastal South Carolina". The pop-up text reads: "Maps created using lidar-derived elevation data engage stakeholders and illustrate future impacts of tidal flooding caused by sea level rise." Below the text is a "View Full Story" link. The map shows major cities like Anderson, Greenwood, Columbia, Florence, Myrtle Beach, Long Bay, August, Port Gordon, Statesboro, Mt Pleasant, Charleston, and North Charleston, along with highways and geographical features like Sumter National Forest.

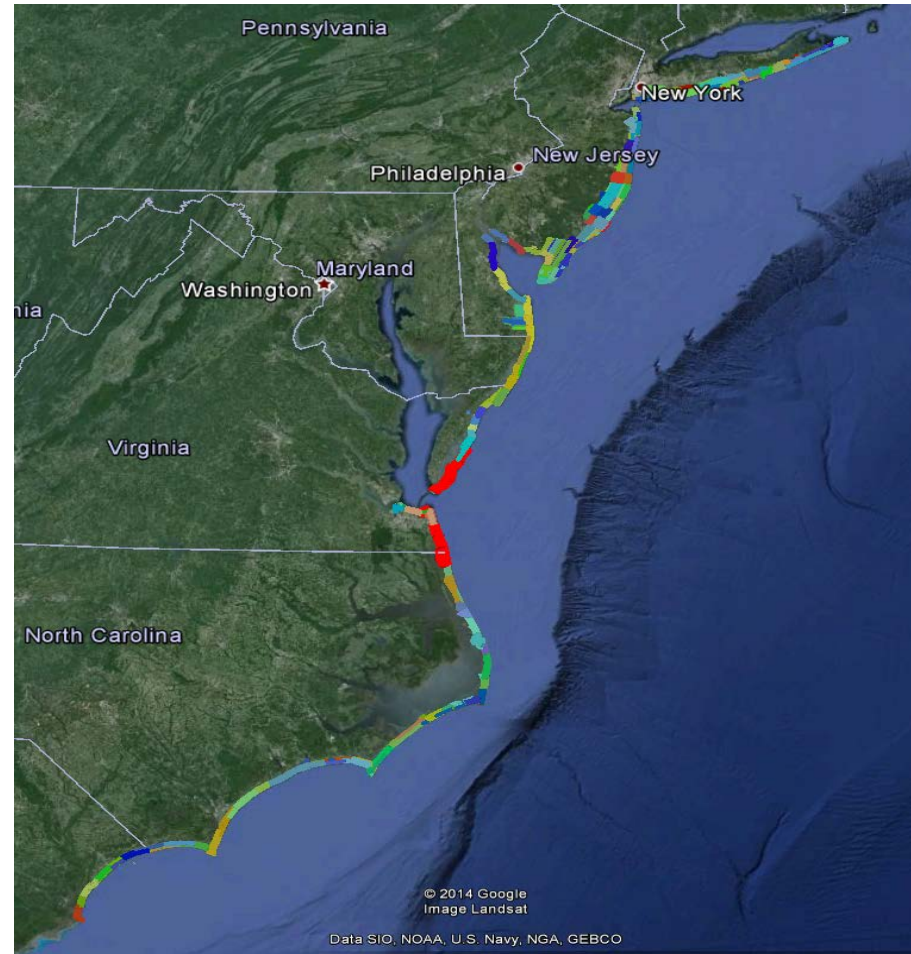


Sandy Topo-Bathymetric Project (2013/14)

- NOAA - National Geodetic Survey (NGS) Shoreline Mapping Program

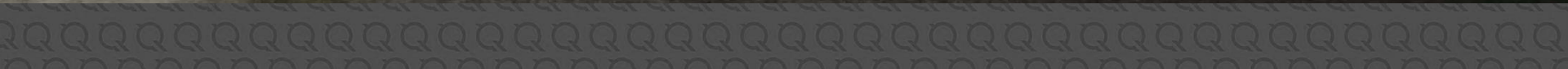
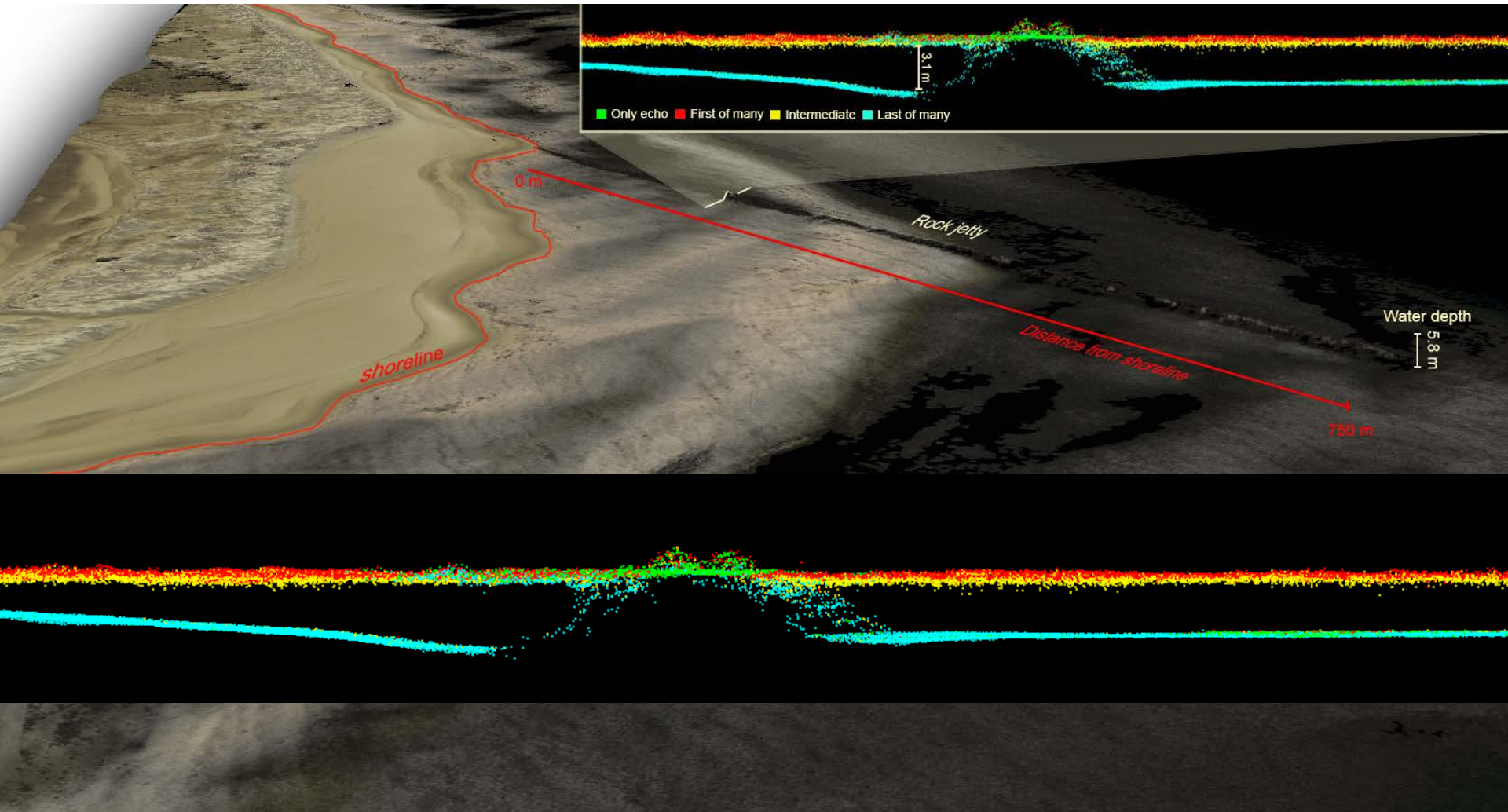


- Foundational data needed for:
 - ✓ Coastal Zone Management
 - ✓ Inundation Modeling
 - ✓ Habitat Mapping
- Deployed three Riegl VQ-820-G topo-bathymetric sensors

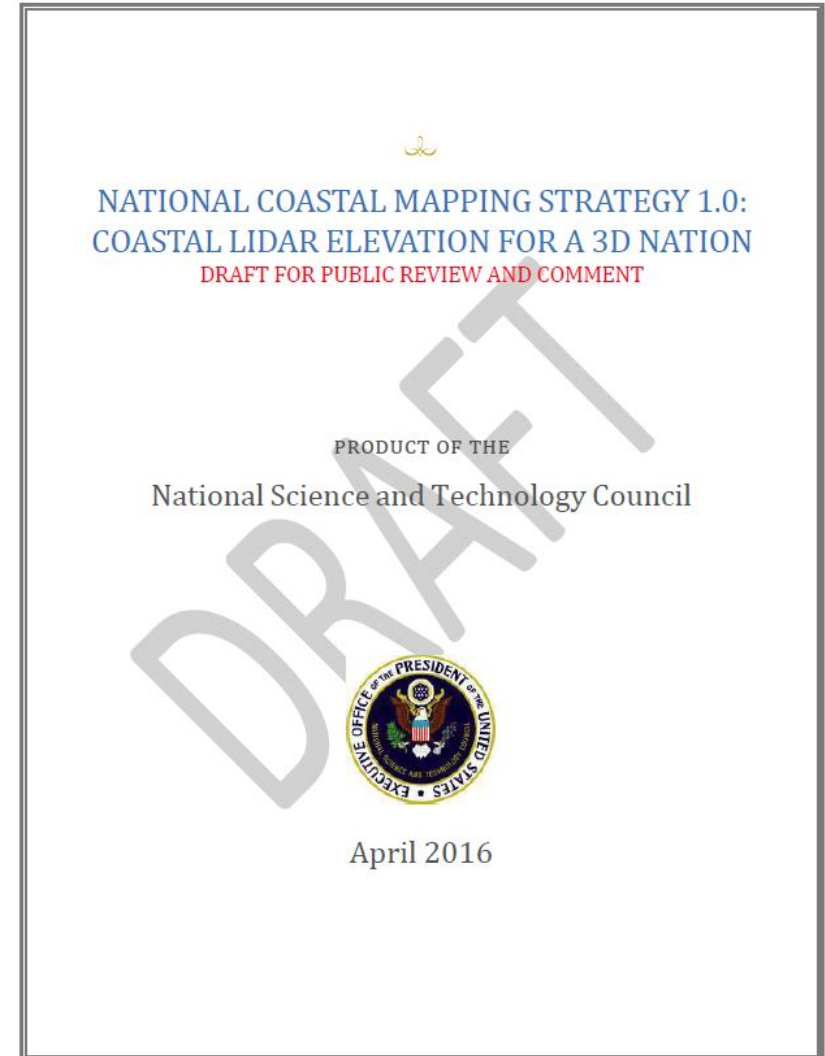
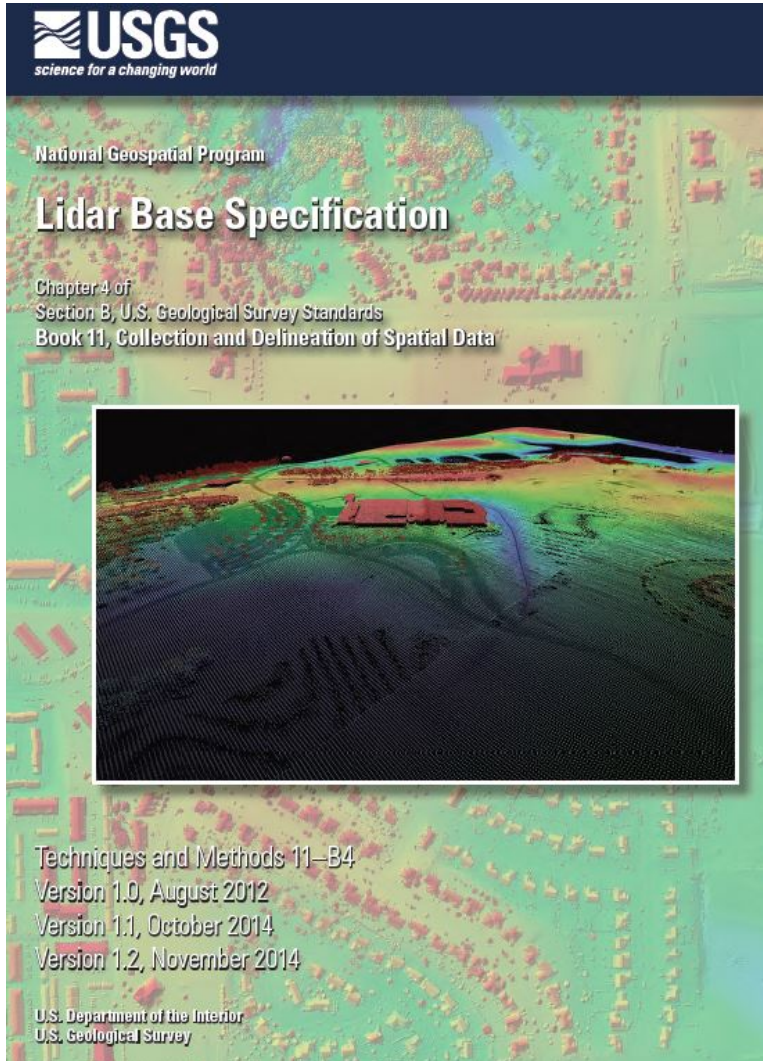




Sample Results/Profiles



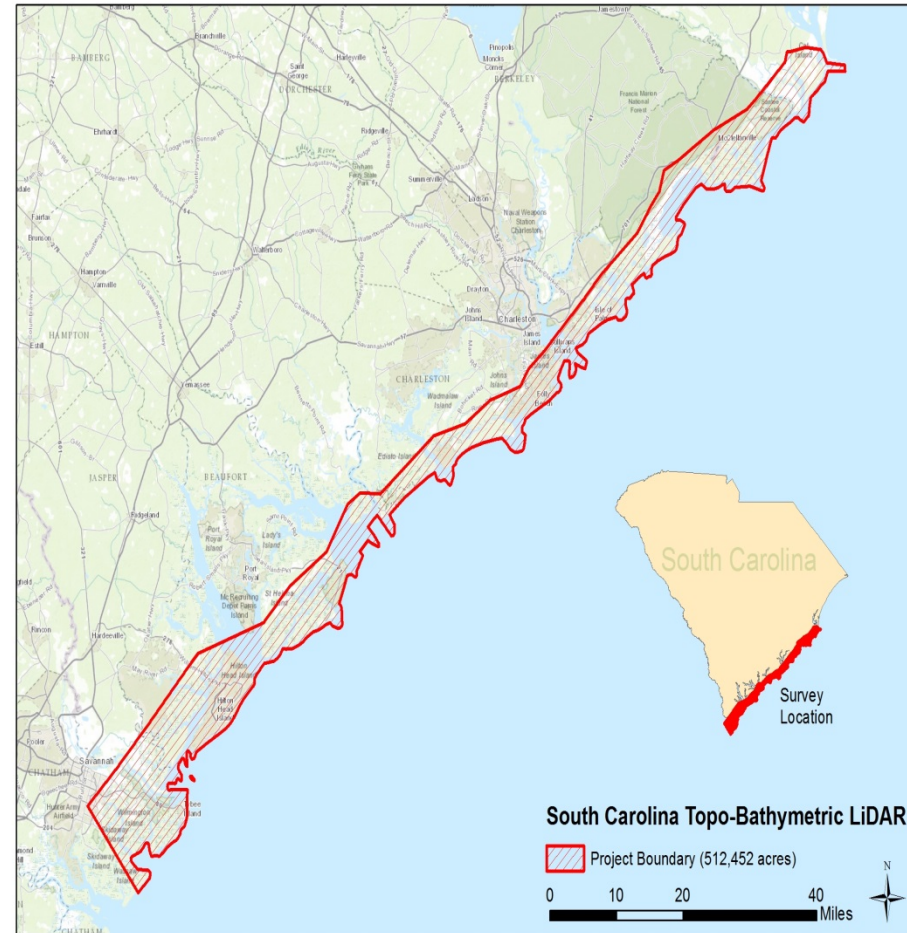
USGS spec & National Coastal Mapping Strategy





South Carolina Topo-bathy Project

Topo-Bathymetric LiDAR Settings and Spec.	
Aircraft	Cessna Caravan
Sensors	Riegl VQ-880-G
Survey Altitude (AGL)	400 m
Swath Overlap	30% side-lap
Field-of -View	40° (20° off-NADIR)
Single Swath Density	≥ 15 pulses/m ²
No. of Flight Lines	1,289
Flight Line Length	8,454 nautical miles
GPS Baselines	≤ 13 nm
Primary Control Monuments	16 Existing, 8 New
Collection Conditions	Clarity-dependent, within 20% of Mean Range around MLLW



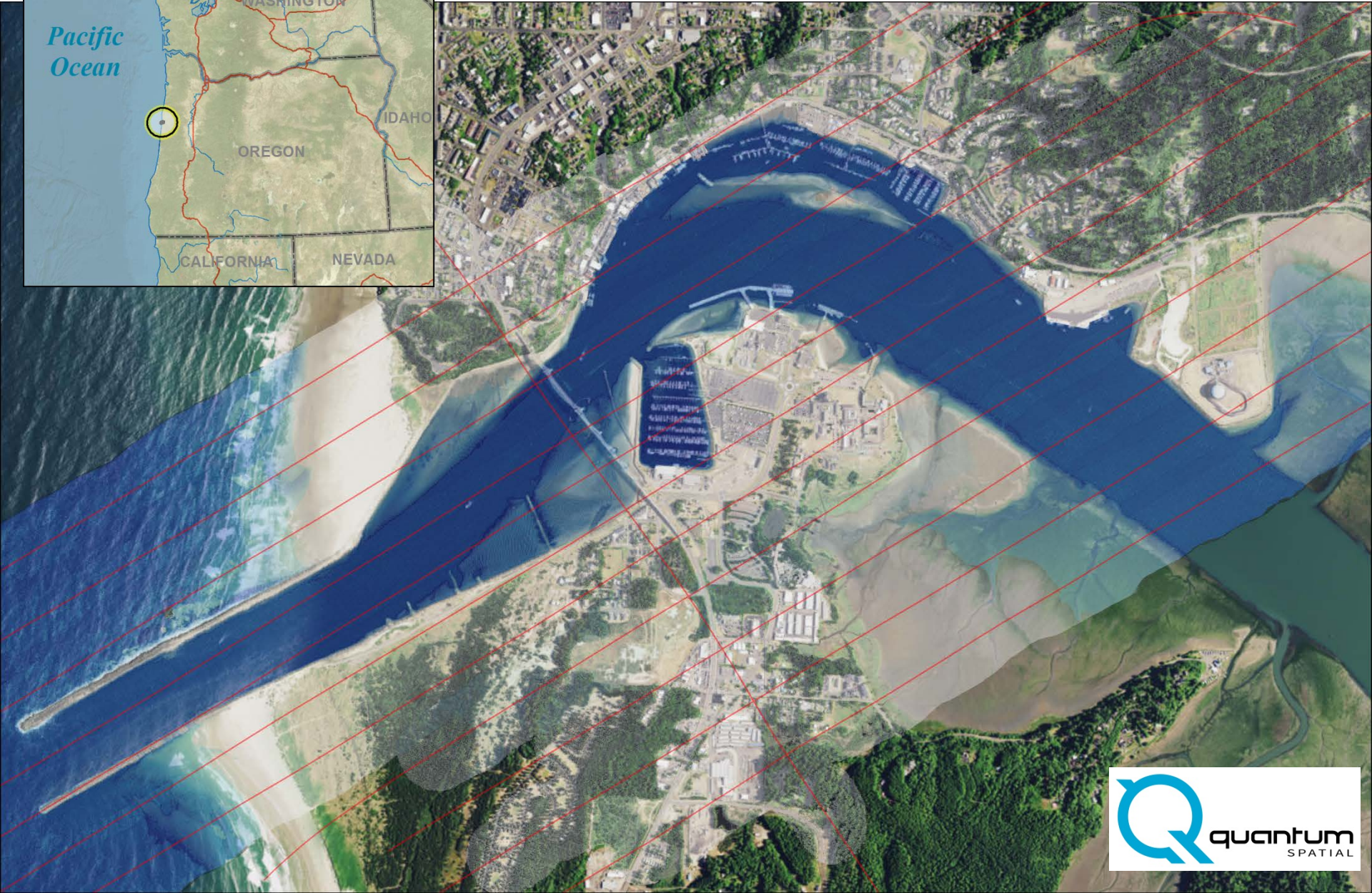
Riegl VQ-880-G



circular and linear
scan pattern

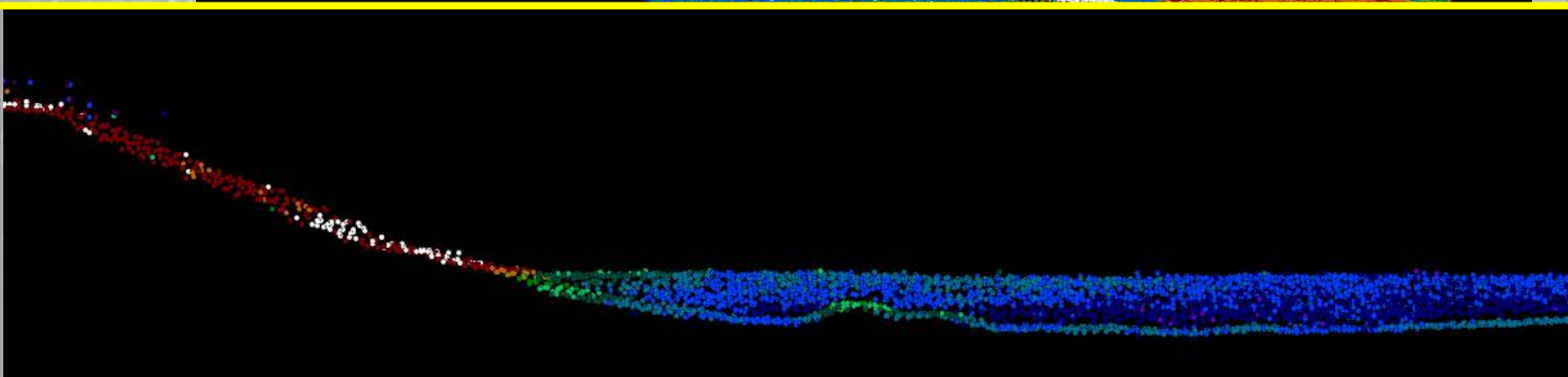
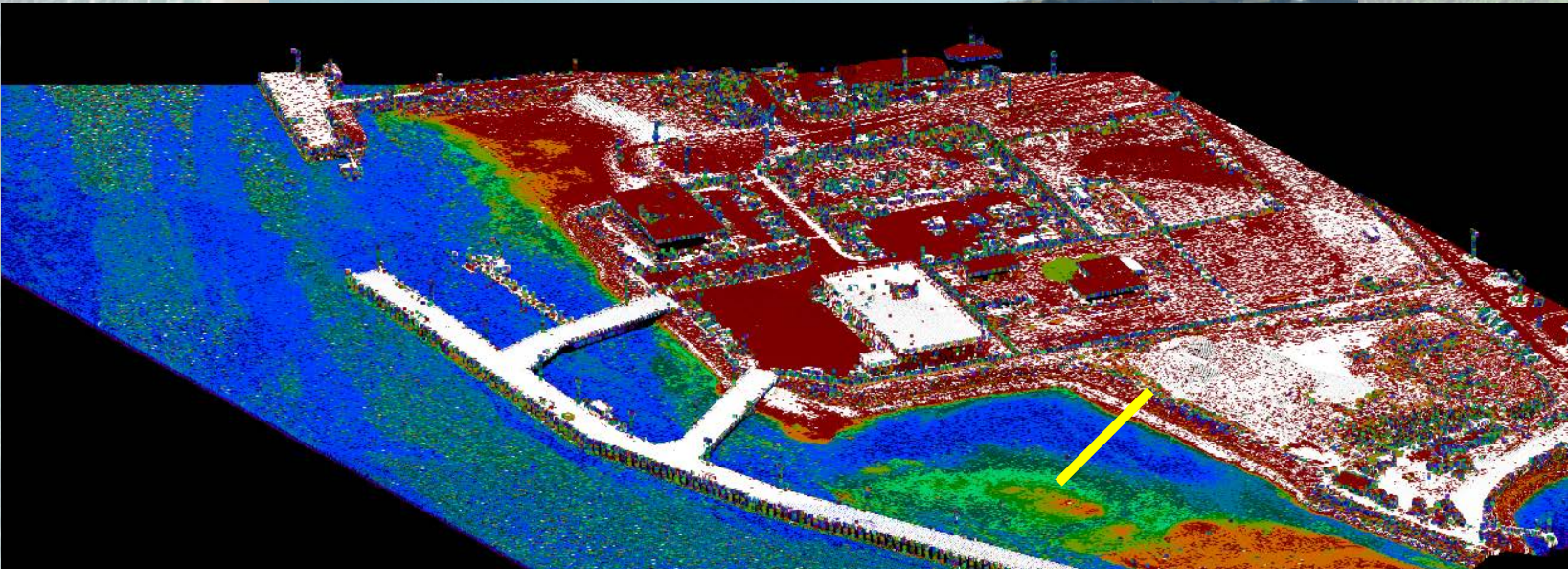
- High Pulse Rate (284 kHz for SC)
- Online waveform digitizing
- Integrated IMU
- 1.5 Secchi Depth “depth rating”

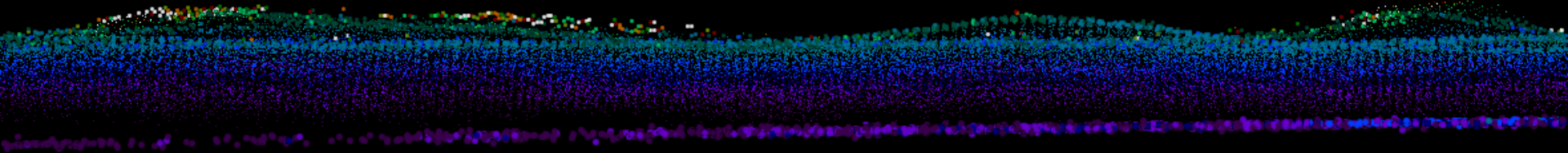
Yaquina Bay, Oregon (Port of Newport)

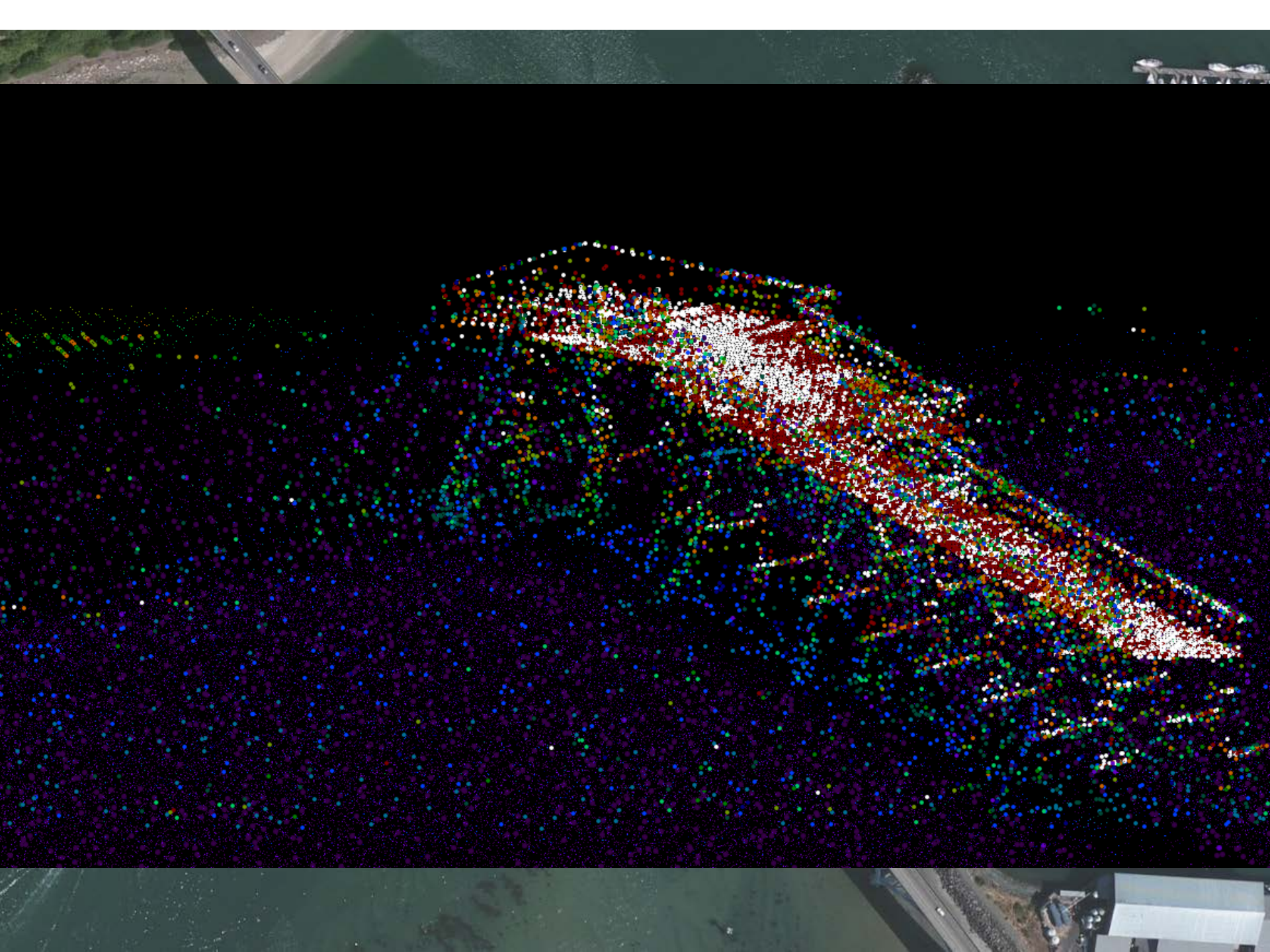


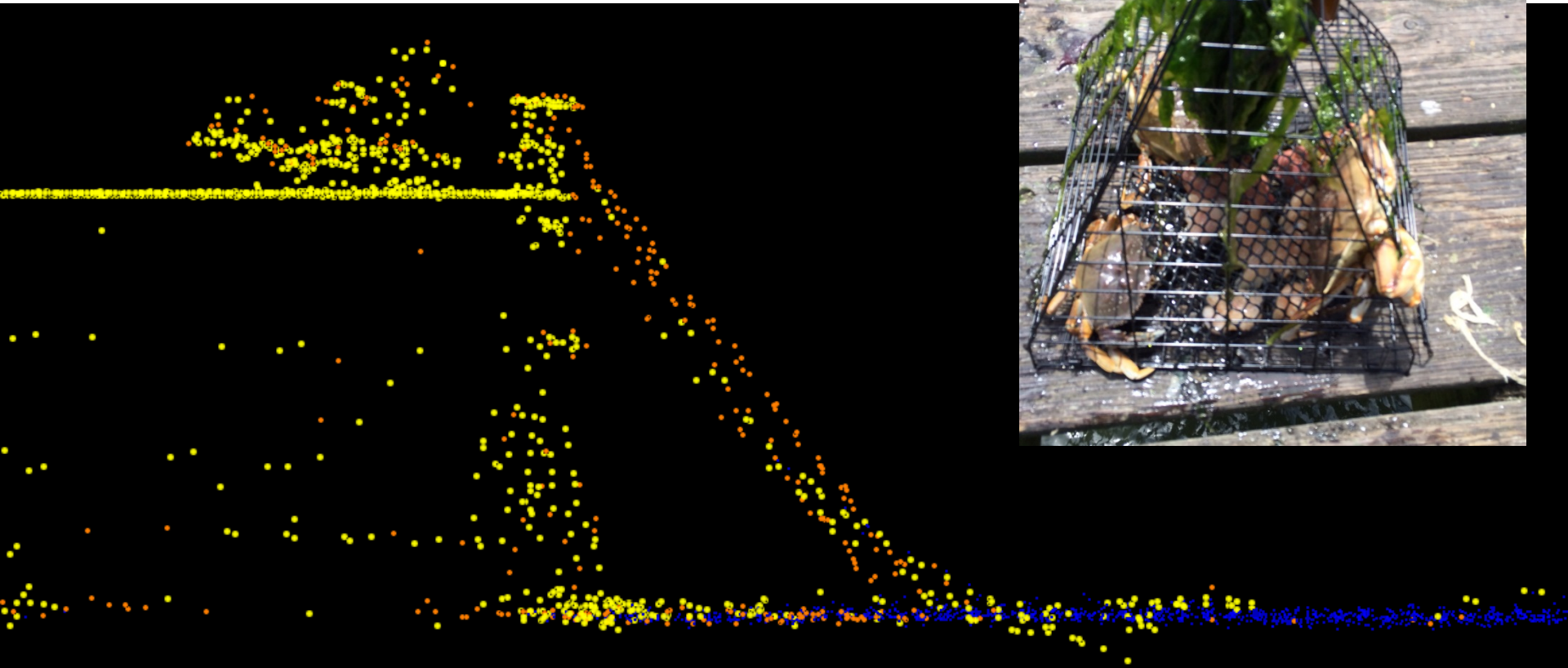
Hard at work!

NOAA Marine Operations Center





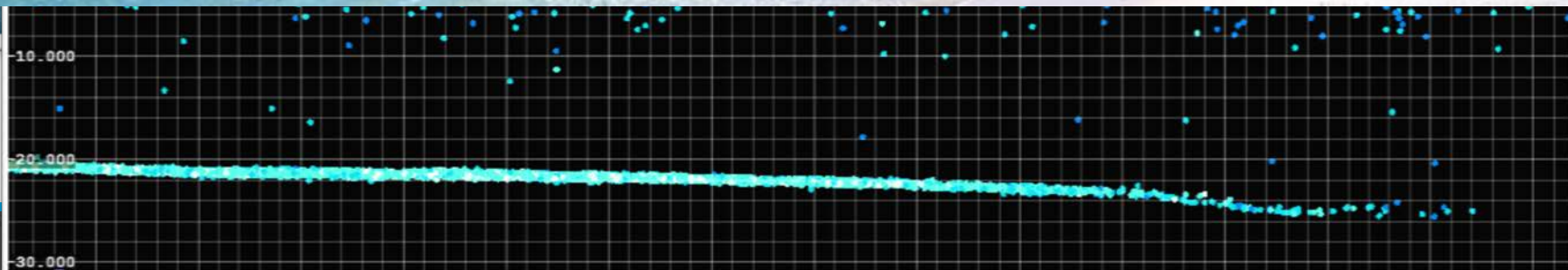




Crab line?



Coast of Florida – Test Data



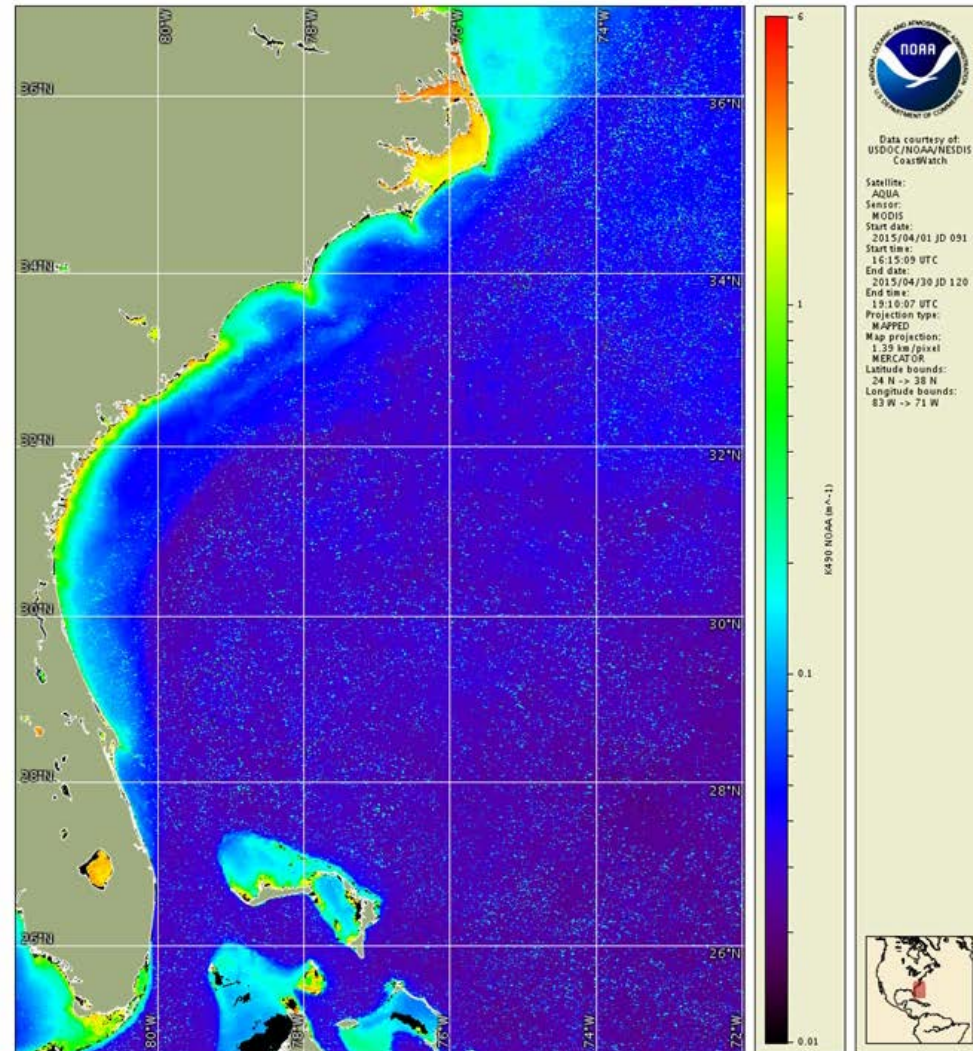
Back to South Carolina





Predicting Water Clarity

- Qualitative water clarity assessments based on existing imagery and satellite data.
- Site observations of local conditions and trends.
- Quick look analysis of topobathymetric data as it is collected.





South Carolina Water Clarity

- High local spatial and temporal variability
- How to quantify trends and “optimal” conditions?
- How many “optimal” flight days do we get a in a month, in a year?





Wind Speed & Direction

South Carolina 1/29/2017

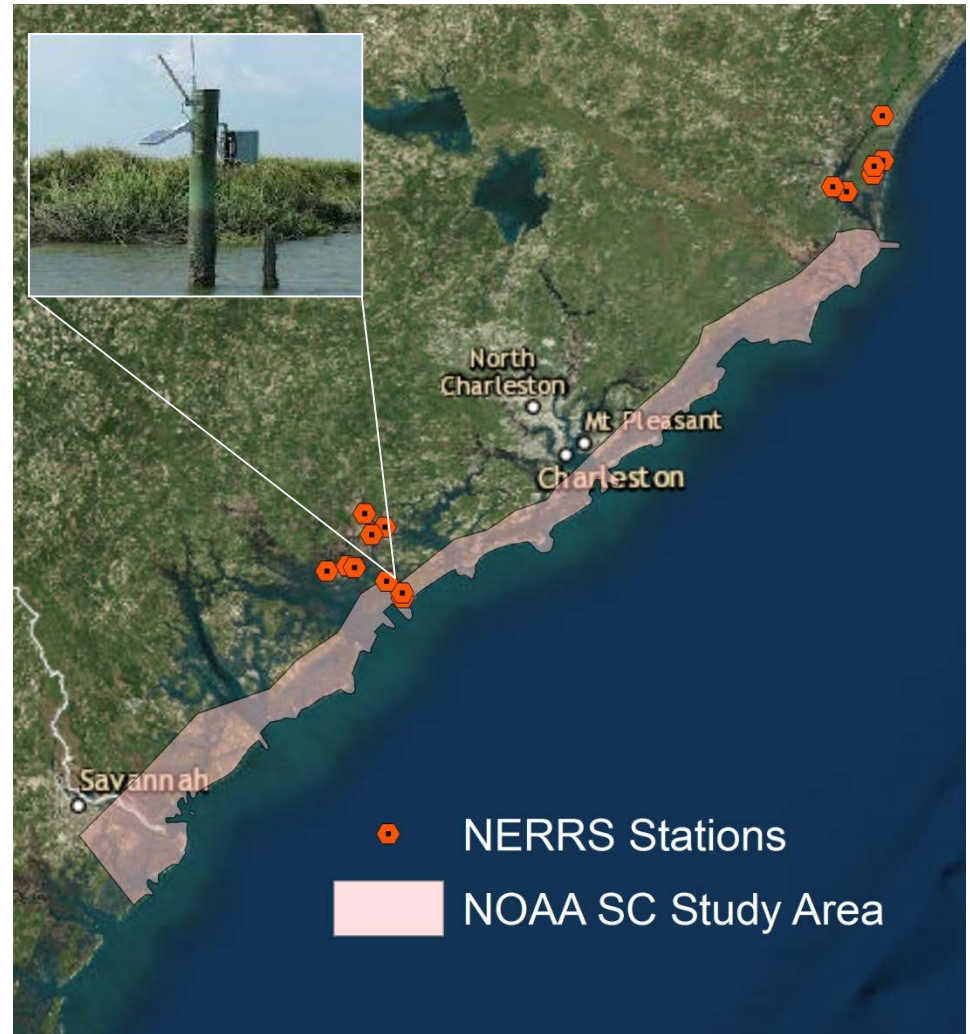


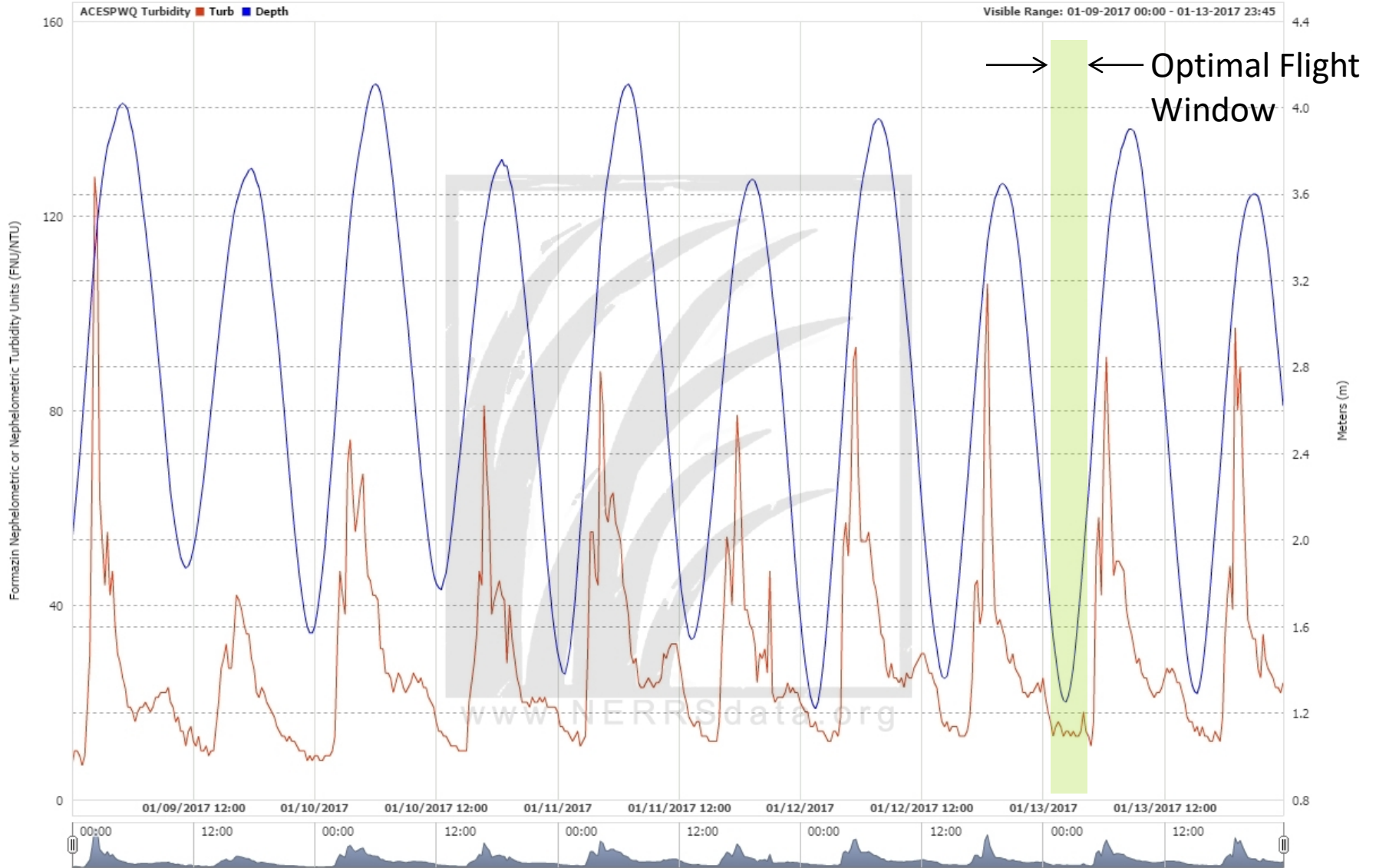


Predicting Water Quality

National Estuarine Research Reserve System (NERRS)

Water Quality Monitoring Stations

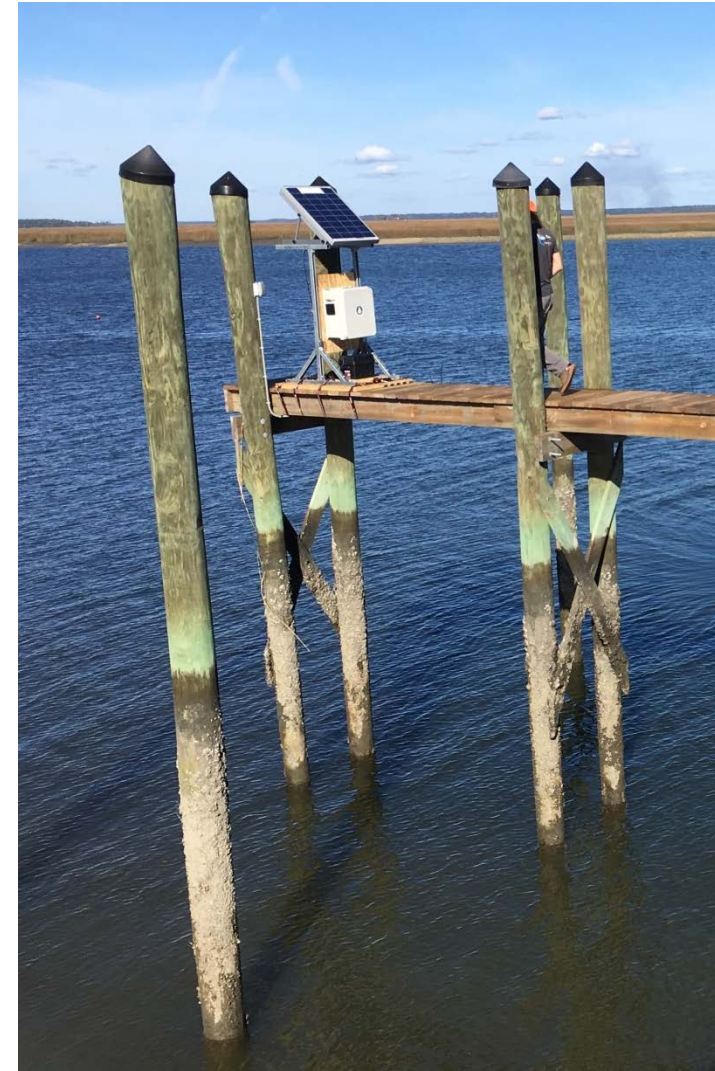






Expanded Monitoring

- NERRS Stations
 - Primarily inland of LiDAR Area-of-Interest
 - Valuable temporal insights, but spatially limited
- QSI Expanded Water Clarity Monitoring
 - Deployment of semi-portable real-time station - more proximate to flight areas
 - Secchi disc and handheld turbidimeter measurements in the flight area
- Improved predictability and bathymetric coverage

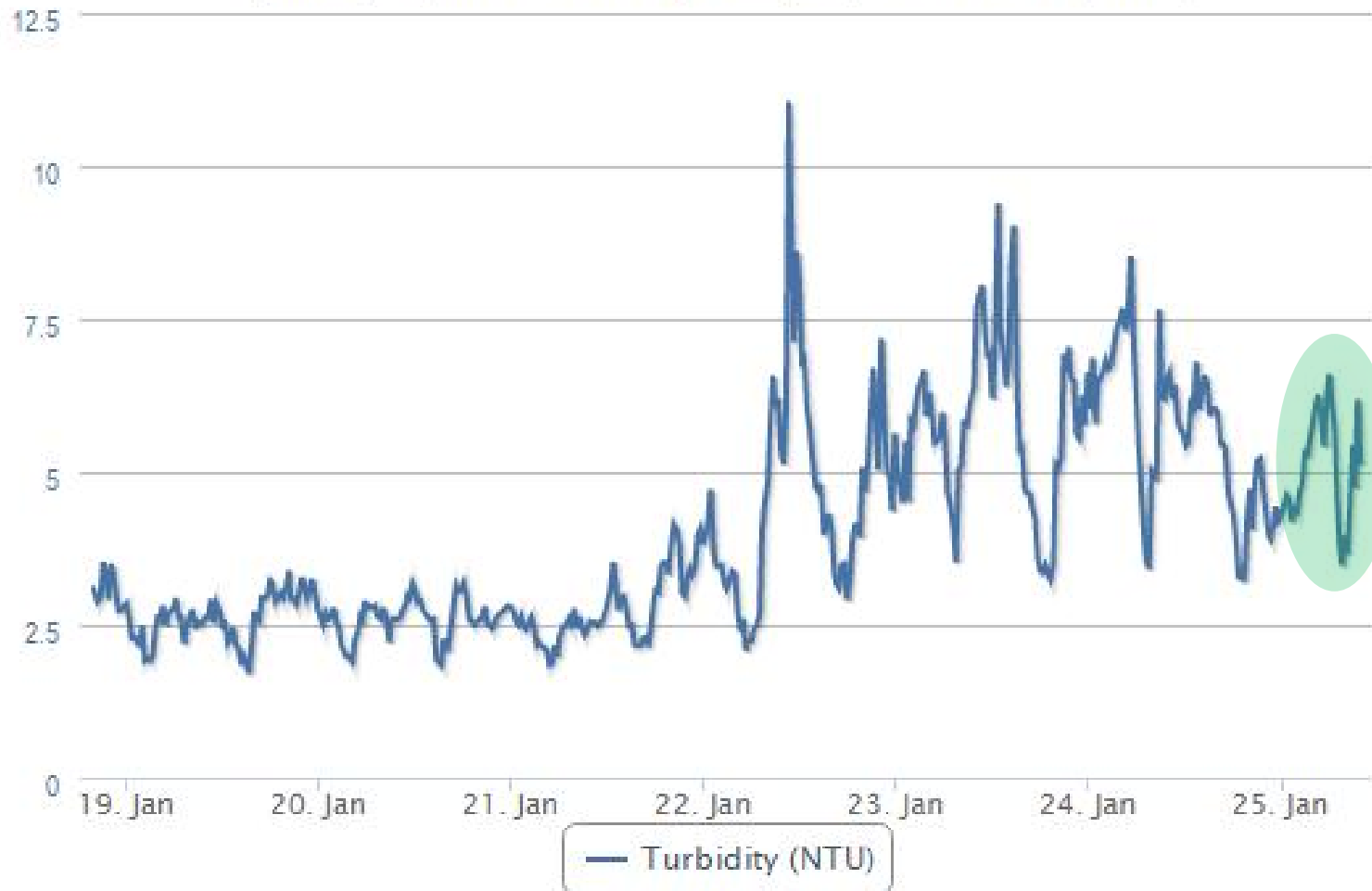




Go/No Go(?)

TD00760040

January 18, 2017 19:45 to January 25, 2017 19:45 (GMT-5)



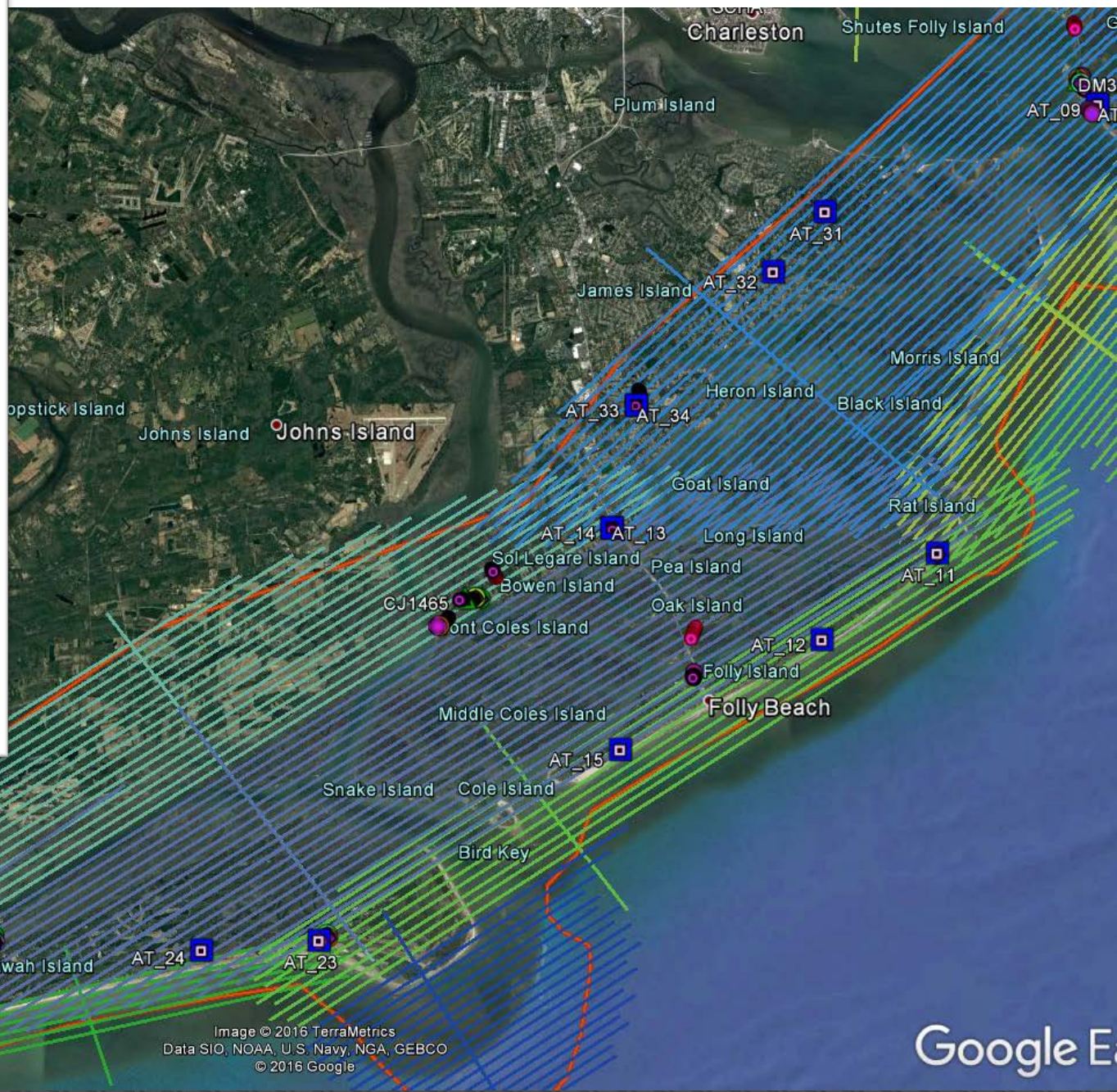
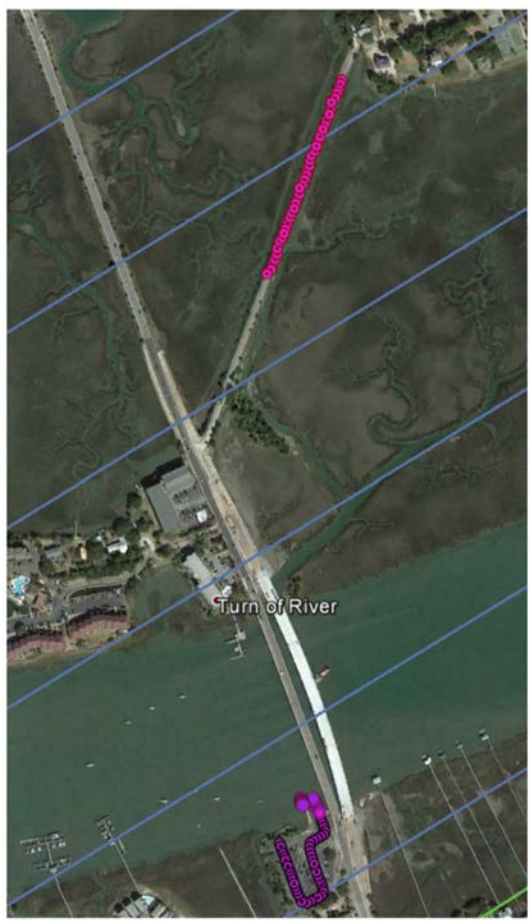


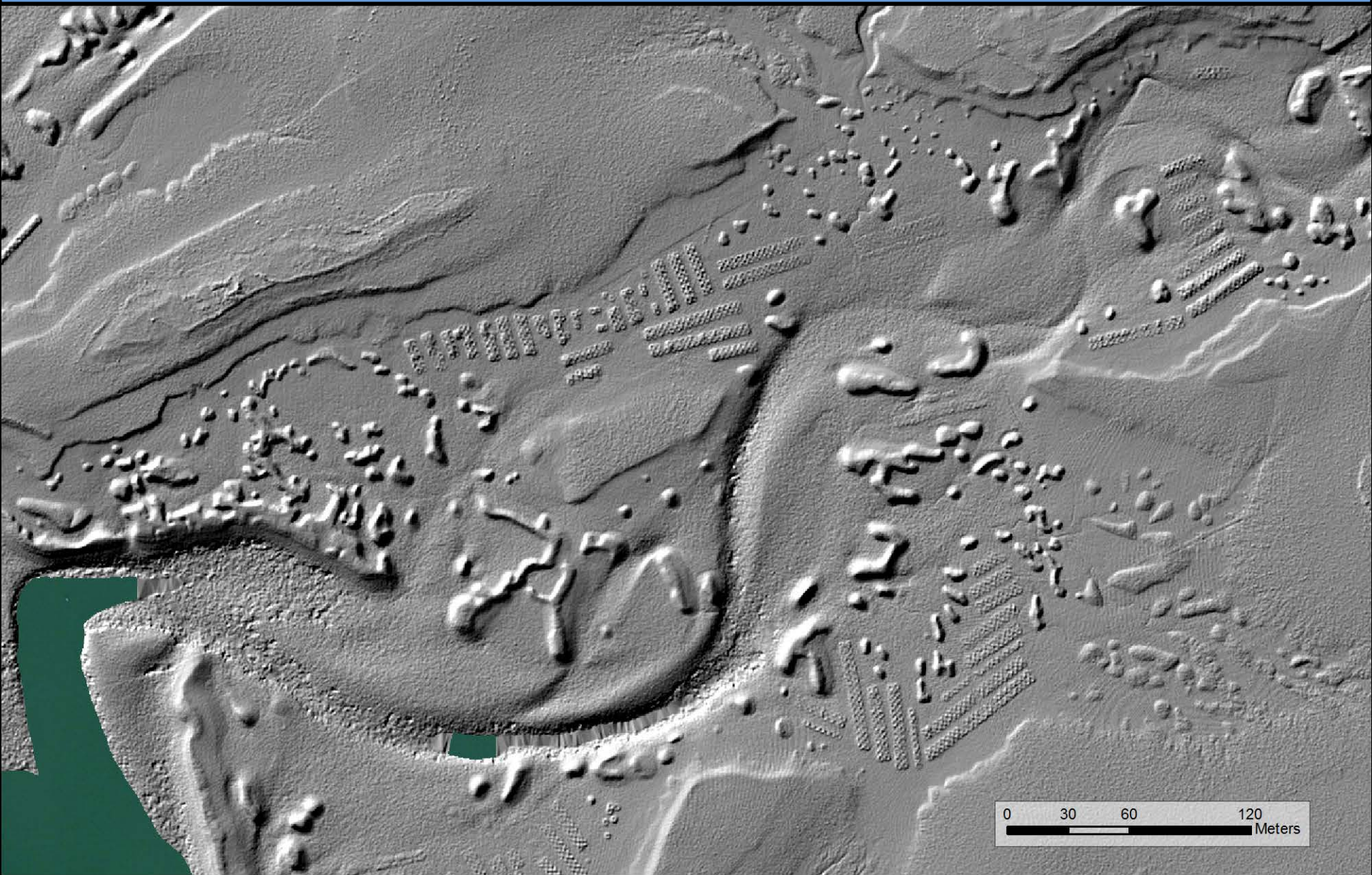
Image © 2016 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2016 Google

Google E

Back bay marshes and mudflats behind Kiawah Island, SC : 2016 NOAA NGS topobathy lidar



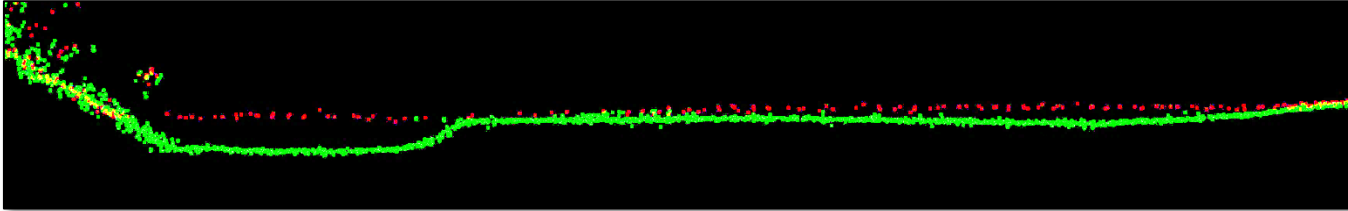
Back bay marshes and mudflats behind Kiawah Island, SC : 2016 NOAA NGS topobathy lidar



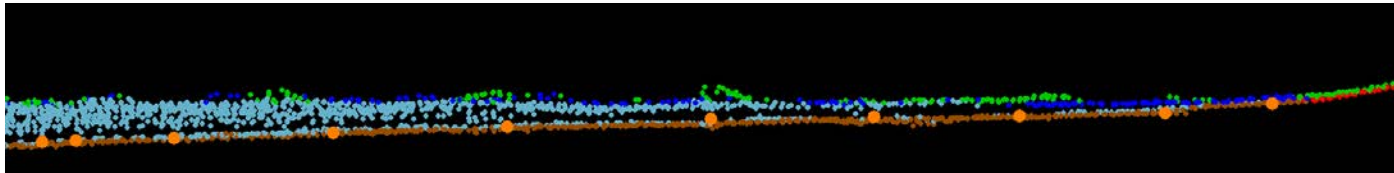
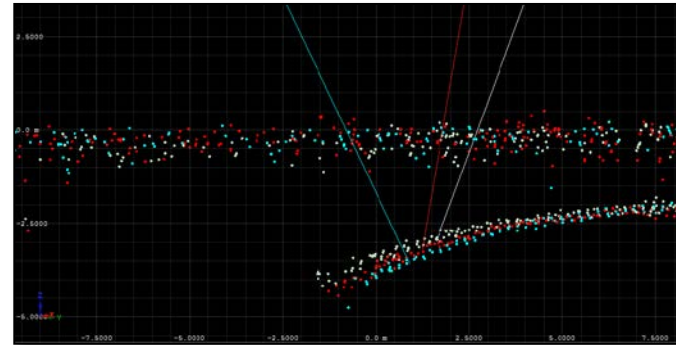


Refraction

- Water surface classification
 - Classify waters surface from NIR points (in static environments) or green surface points in ocean environments



- Refraction
 - Refract points based on distance from waters surface and angle of incidence



- QAQC
 - Verify refracted point alignment between swaths, and against ground control points



Summary

- Topo-bathymetric LiDAR is providing foundational data to support coastal resilience and coastal intelligence.
- QSI has deployed next generation LiDAR technology (Riegl VQ-880-G) in a range of riverine and coastal environments.
 - Increased depth performance, resolution, and collection/processing efficiency.
- QSI is actively acquiring data along the South Carolina Coast.
 - Water clarity is highly variable – field monitoring has helped increase precision of LiDAR collections
 - Terrain models will vastly improve the currency and resolution of existing data.



An aerial photograph of a river system. The river is overlaid with a semi-transparent blue layer, and its banks are outlined with a thin red line. The surrounding landscape is a mix of green trees and brownish, sandy or silty areas.

Thanks! ... questions?

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