The Lone Star UAS Test Site

An update
Scientific Committee for Oceanographic Aircraft Research
June 27, 2016

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LSUASC Test Site
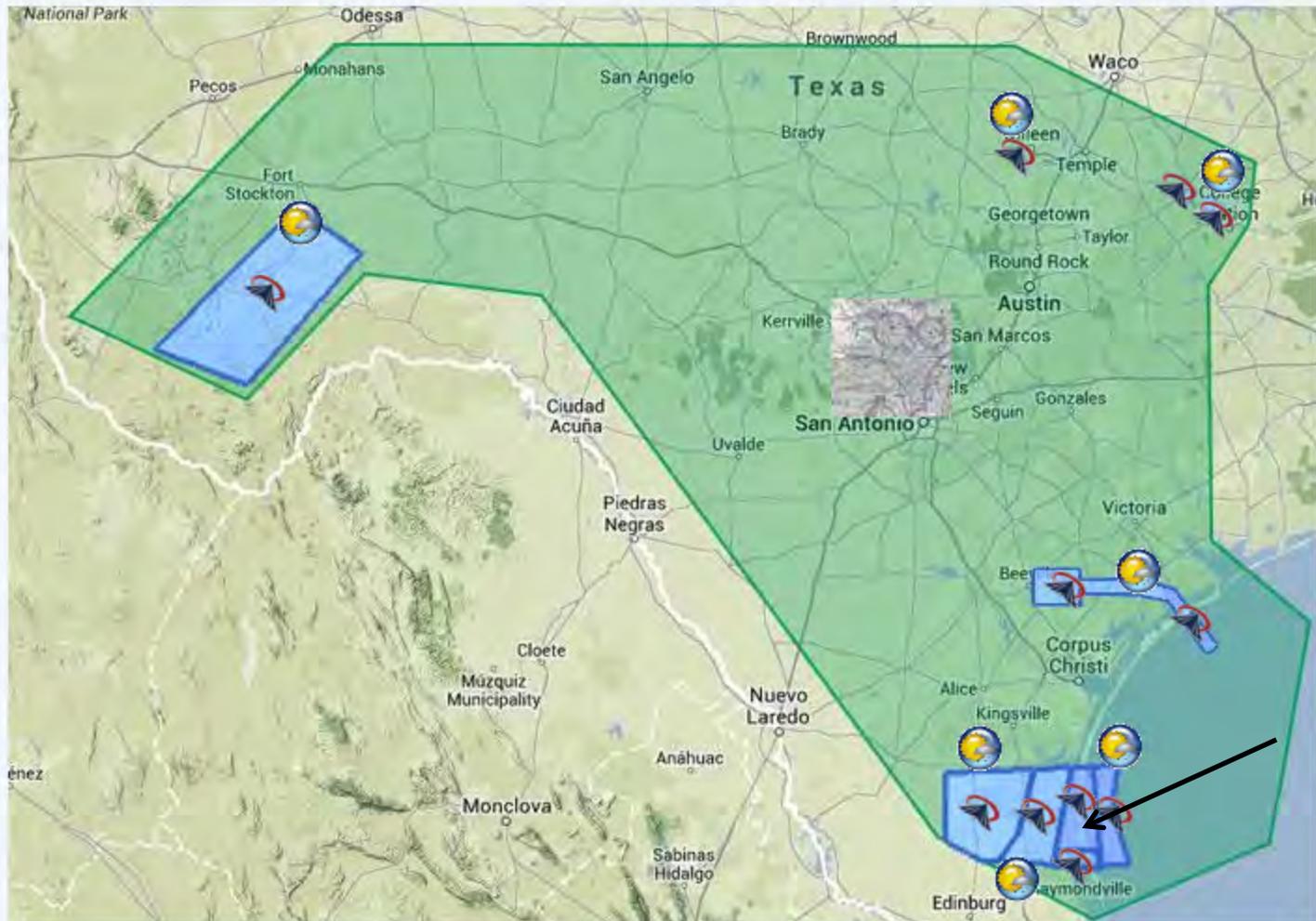
6100 mi², 11 geographically diverse ranges, sparsely populated coastlines

LSUASC Recent Highlights
(since June 2015)

Multi-vehicle sUAS operations during national demonstration of NASA Unmanned Traffic Management (UTM)	**2016-04**
First National UAS Credentialing Program certificates awarded	**2016-03**
First Annual Texas UAS Summit in Austin, Texas	**2016-03**
Assessment of propeller scarring in Redfish Bay for TPWD	**2016-01**
Testing of sUAS technologies for DHS with MTSI	**2016-01**
FAA Public Meeting at Texas A&M-Corpus Christi	**2015-09**
Award of IDIQ contract and two tasks with NASA Armstrong	**2015-08**
One of eight flight partners for NASA UTM Build 1 Demo	**2015-08**
First Test Site to fly under 400' Broad Area COA	**2015-08**

Bringing UAS to America's Skies

NASA UTM Mission Manager Display, April 2016 Test

LSUASC Research Accomplishments

- Established procedures for operating multiple UAS

- Developed a 3D common operational picture for display of multiple vehicles (SAGE)

- Refined and updated LSUASC UTM Client for NASA UTM Technical Capability Level 2

- Submitted the Interconnection Security Agreement (ISA) to NASA to create a secure data connection between LSUASC's Mission Control and the NASA Live Virtual Constructive

- Acquired/integrated new UAS platforms and sensors

LSUASC SAGE Common Operational Picture
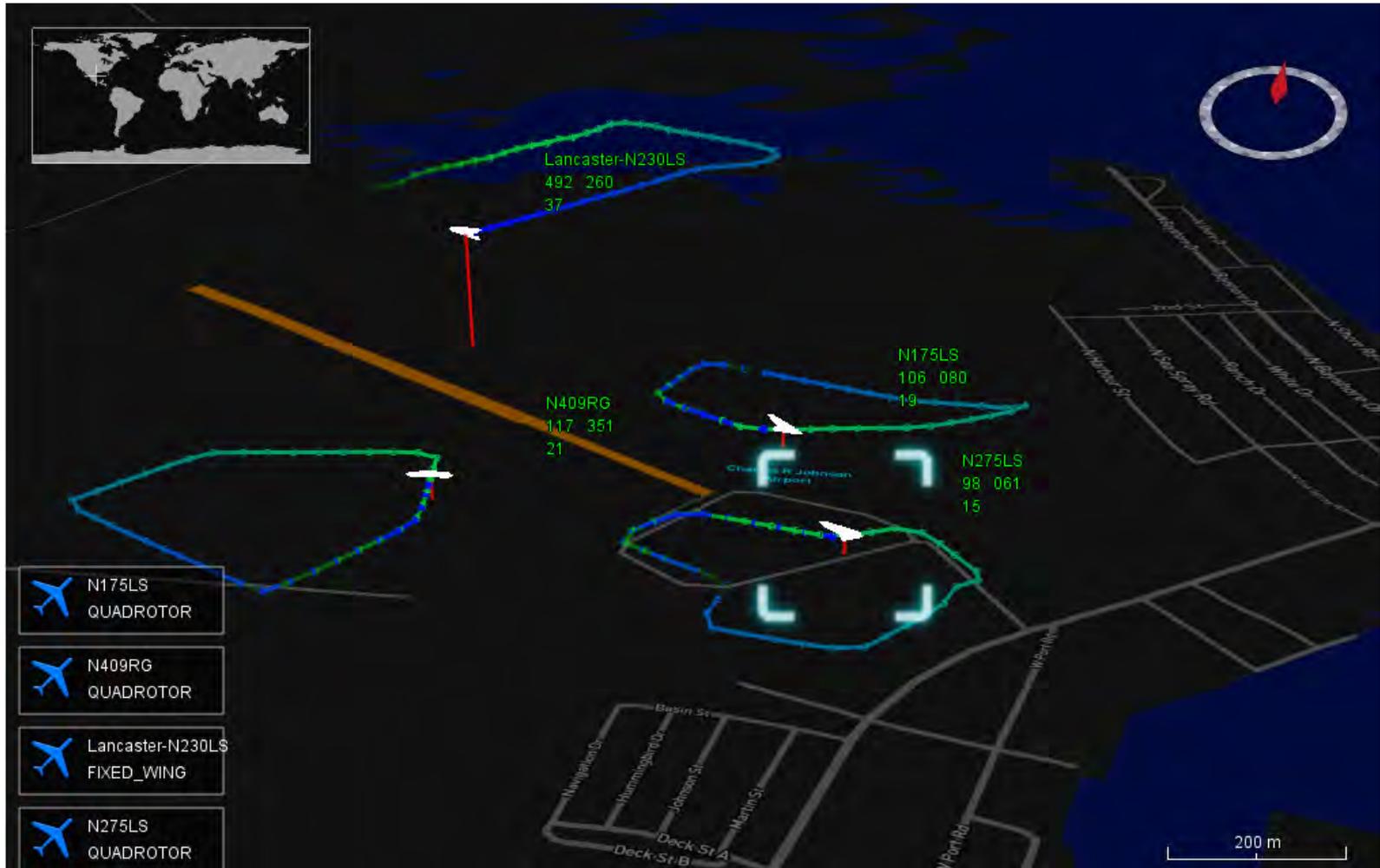
LSUASC Path Forward

- Secure ISA and authority to operate (ATO) with NASA

- Expand and refine the National UAS Credentialing Program with TEEX

- Develop ability to conduct Beyond Visual Line of Sight (BVLOS) testing

- Conduct vehicle-to-vehicle UAS operations (swarming)

- Expand and develop software information architecture in Mission Control Center

Bringing UAS to America's Skies

TAMU-CC / Lone Star
Coastal Aerial Surveying Program

2015-16 example projects

TPWD Seagrass Survey of Redfish Bay
(Dec 2015)

< 2 cm GSD
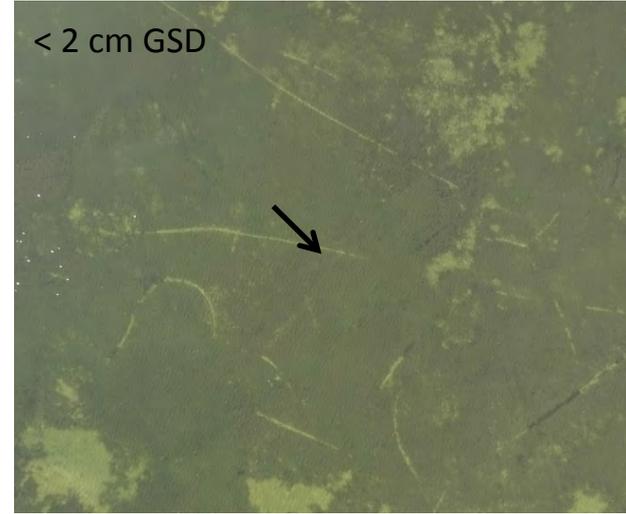
Study Area: sites ~50 acres

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Bringing UAS to America's Skies

UAS Structure from Motion (SfM) Photogrammetry (Pix4D, Photoscan,etc.)

Feature detection "SIFT"

Feature correspondence

Projective reconstruction / image orientation

Sparse 3D Reconstruction

Epipolar rectification / Dense matching
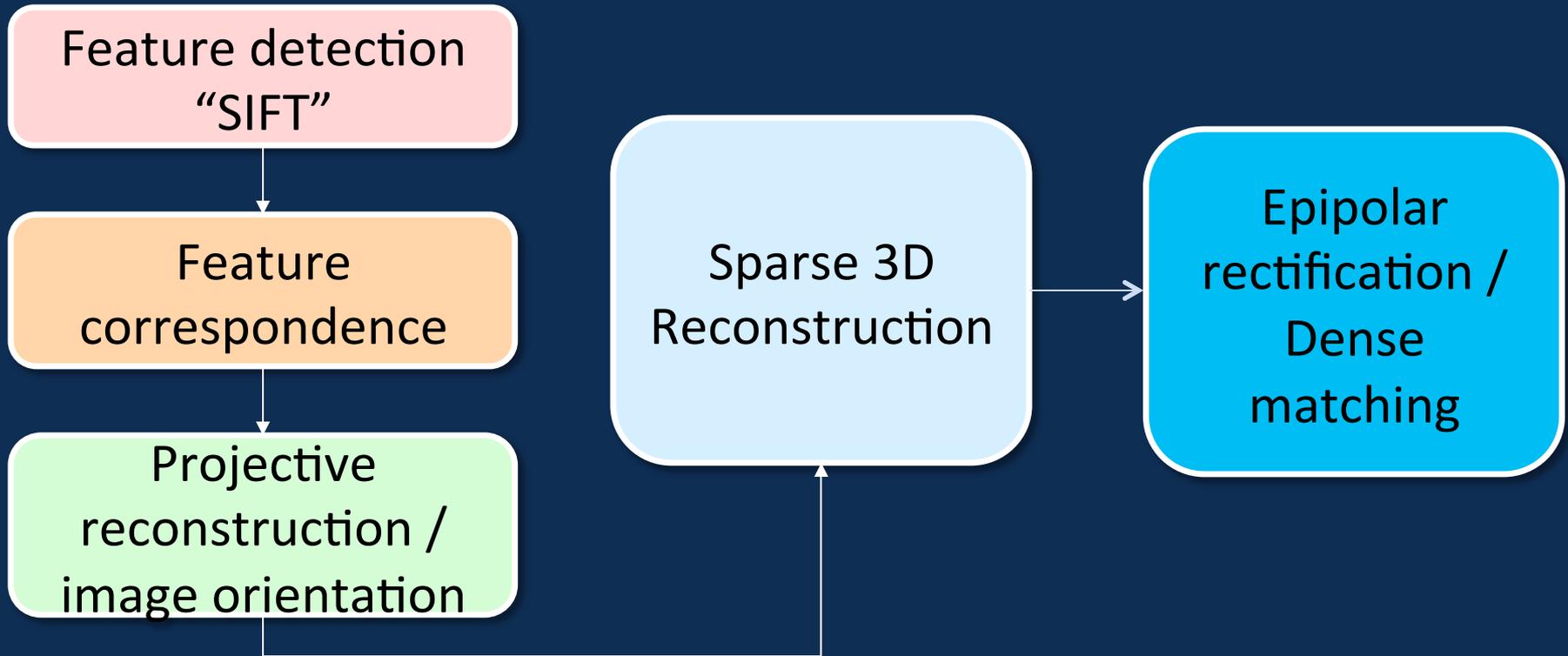
Outputs→ *3D point cloud, DSM, Orthomosaic*

Dense Matching
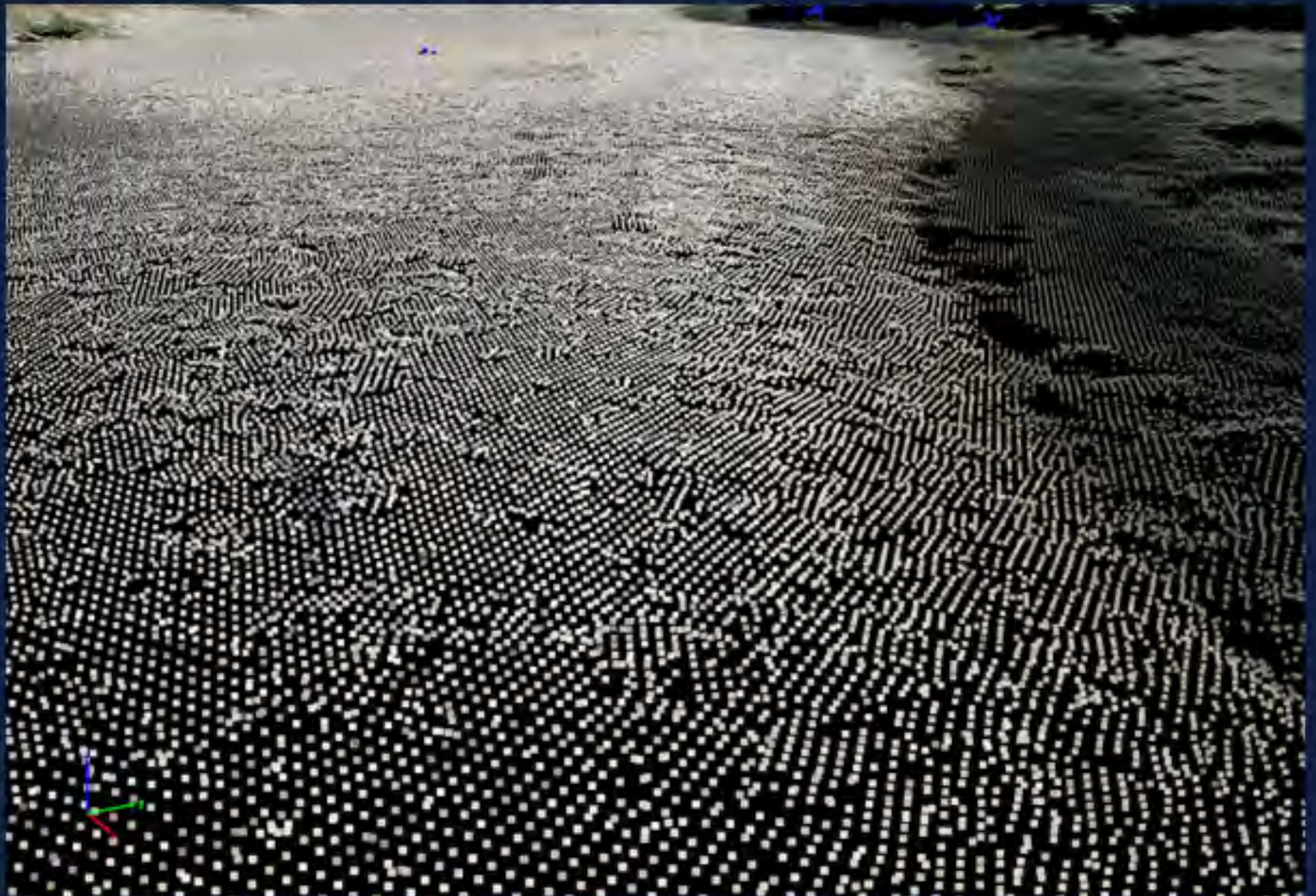
Example: Densification = ¼ image scale (¼ resolution); Point density = 4*GSD

Challenges with SfM in Submerged Zone

- Specular reflection / glint leads to false matching / large error
- Sand ripples / low texture
- Water is dynamic
- Poor water clarity (< 1m)

Flight at 90 m, 2.9 cm GSD

RGB

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Typical "Noisy" SfM point cloud over water
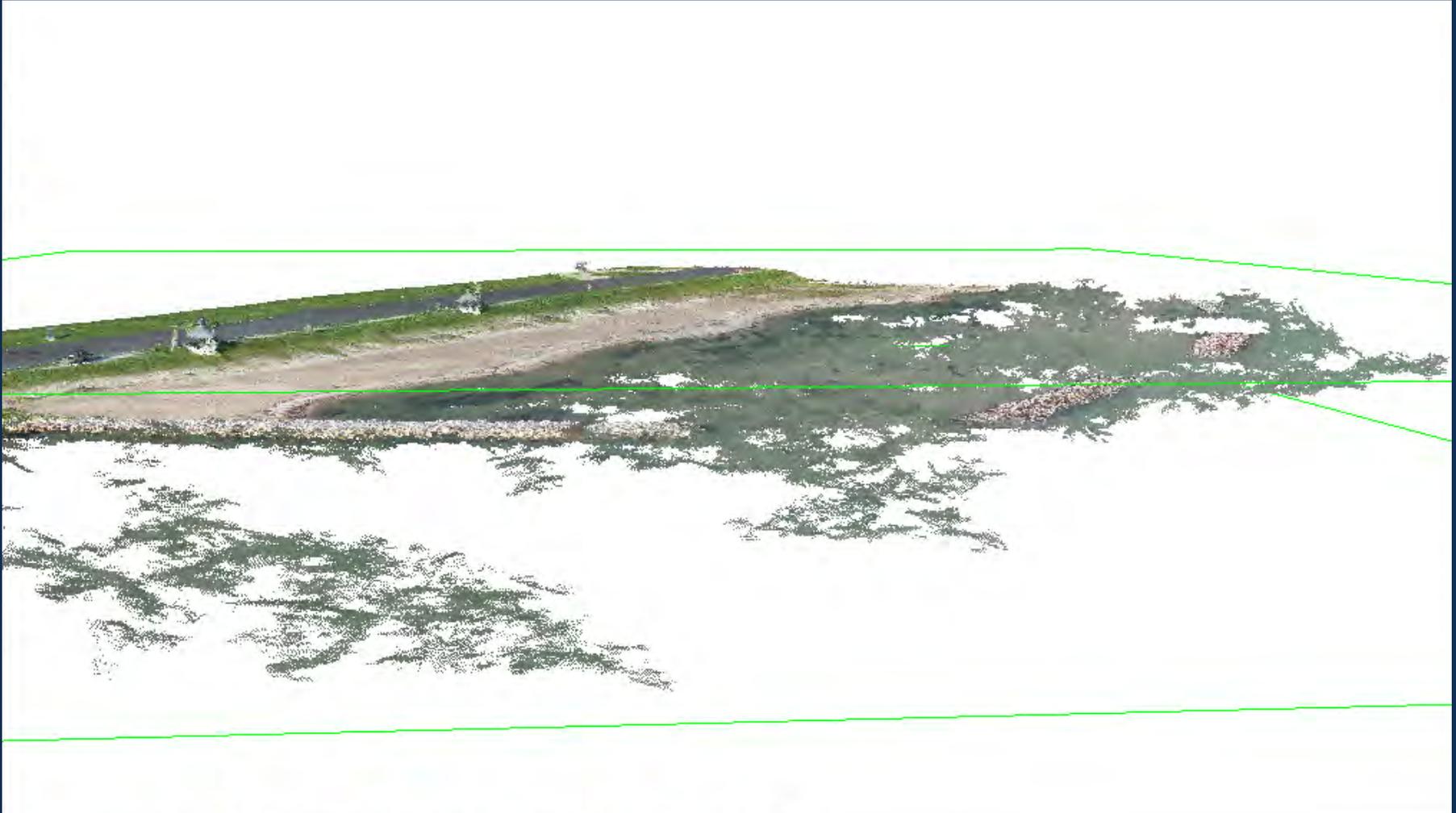
Different SfM Processing Examples

Underwater SfM Church
Delta Sensagram
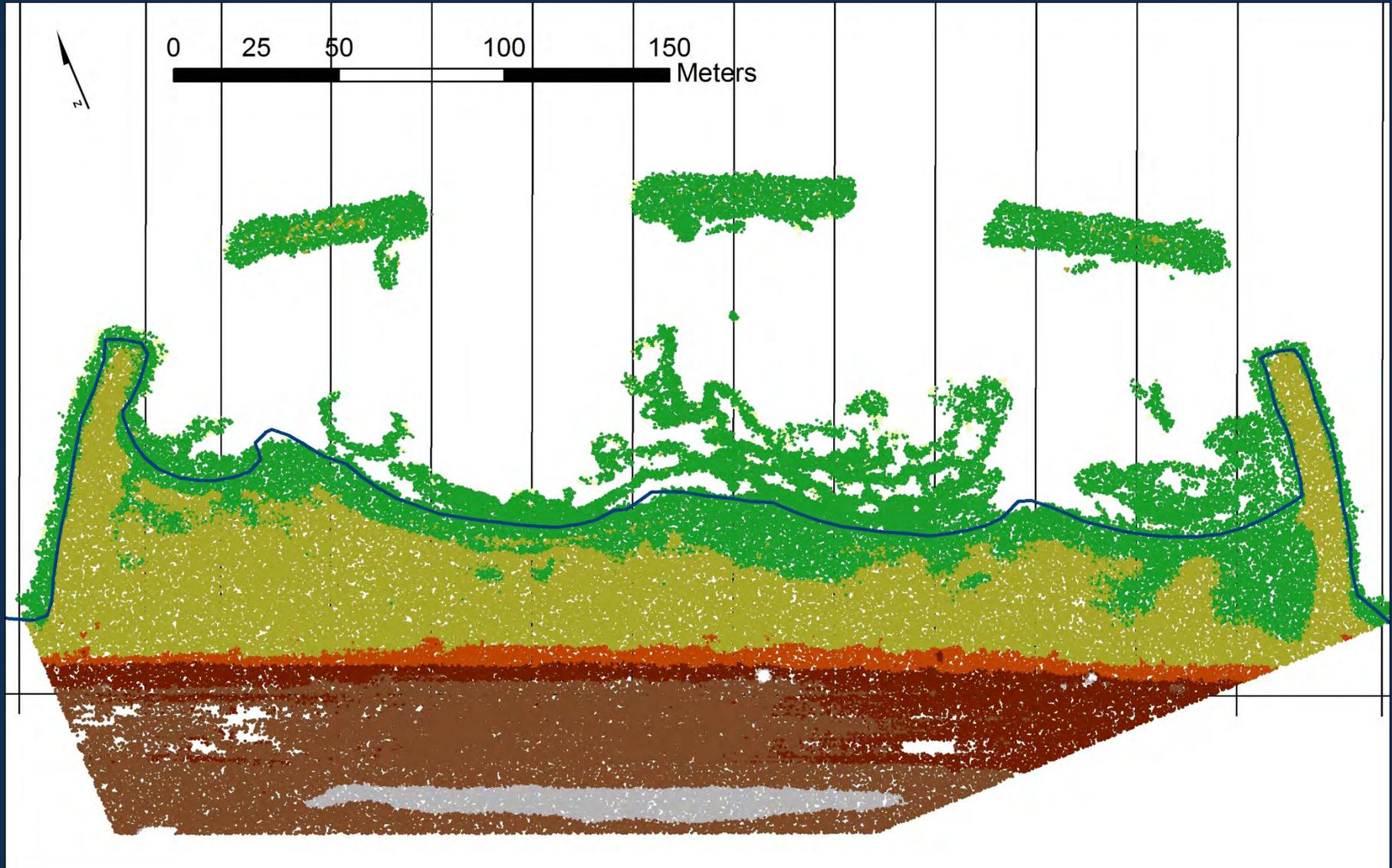
Alternative to SfM: Optical Inversion

- Derive a depth map through calibration of band reflectance ratios to ground truth (RTK GPS)

Bathymetric Algorithm: Normalized Ln(Blue)/Ln(Green)

Bathy Algorithm Elevation (NAVD88)
- <-5
- -4-(-5)
- -3-(-4)
- -2-(-3)
- -1-(-2)
- >-1

$$\frac{\ln(Blue - 450nm)}{\ln(Green - 520nm)}$$

8 cm residual
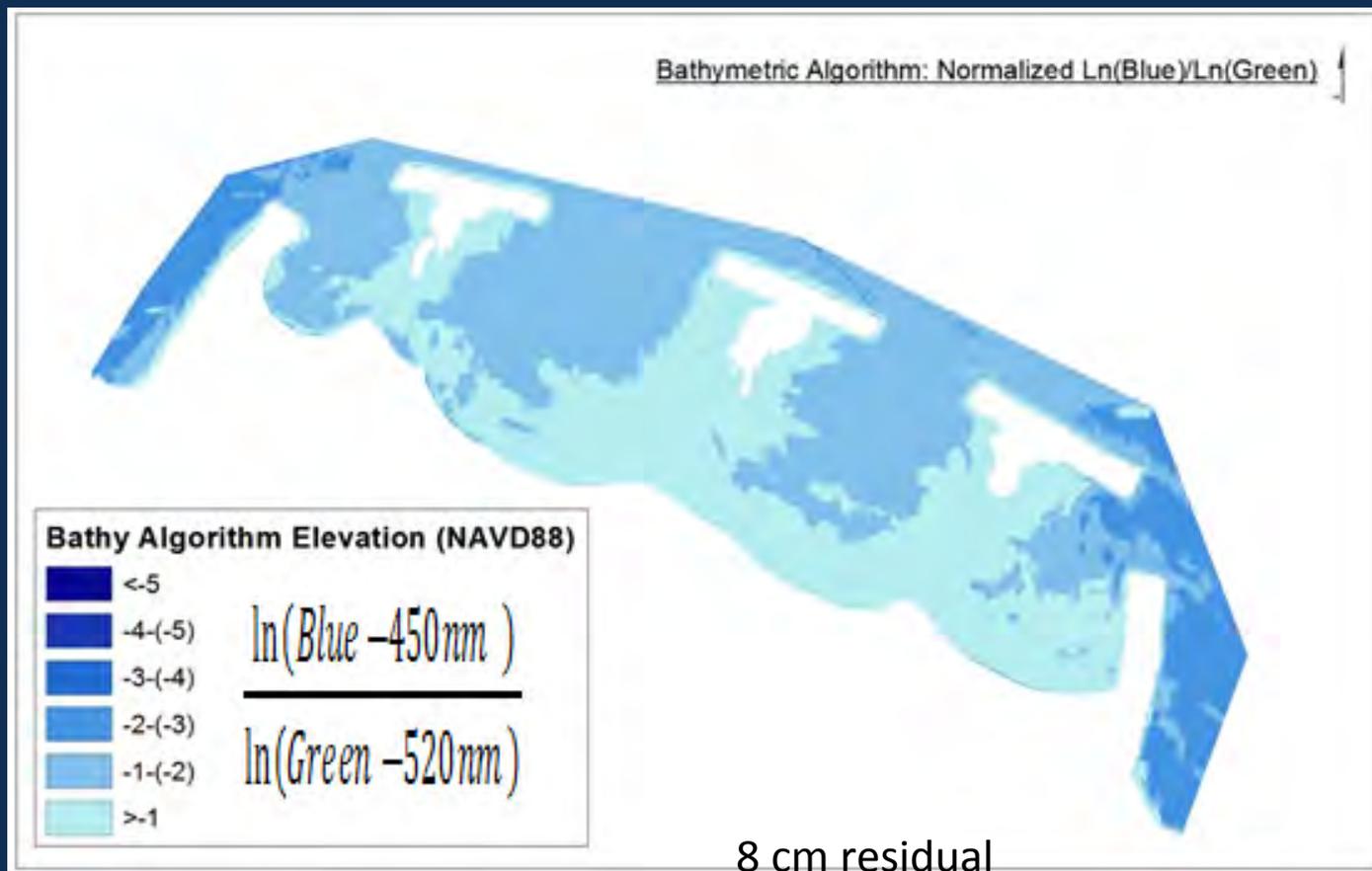
Seamless Topo-bathymetric DEM
optical inversion depth + denoised SfM points
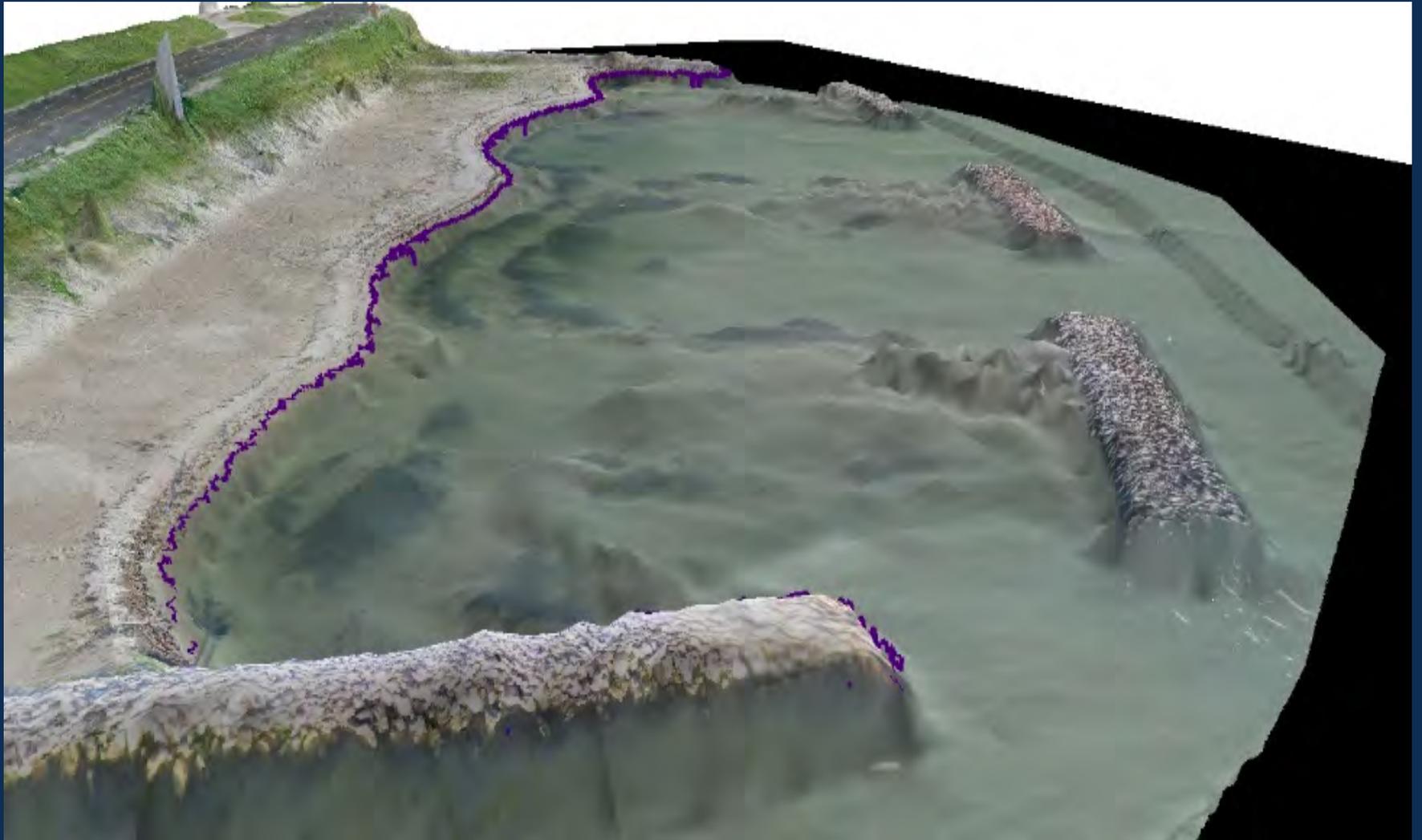
NOAA/GLO CMP: Submerged Pipeline Detection with Bathymetric Lidar

Shamrock Cove

Initial Laser Pulse

Surface Return

Bottom Return
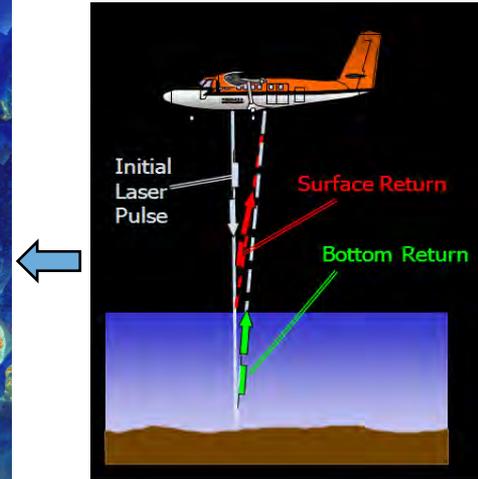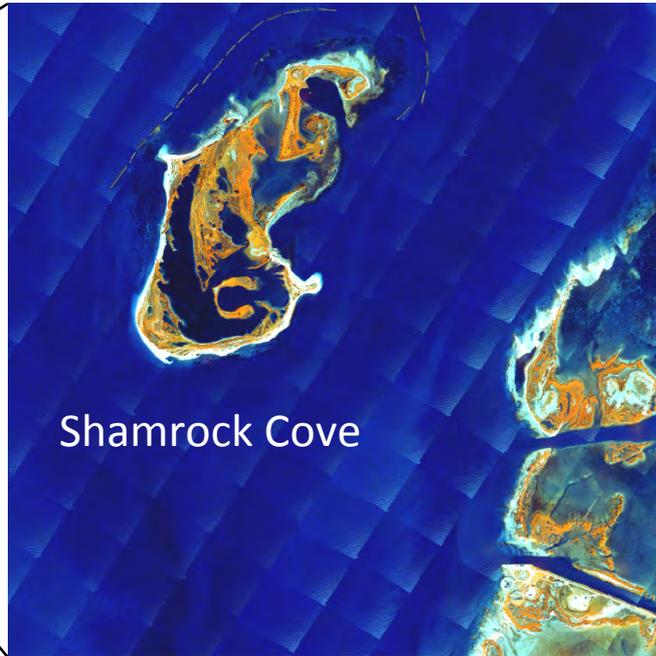
UT BEG Chiroptera Bathy LiDAR: green laser, 35 kHz, < 10 m depth (~1.5 Secchi)
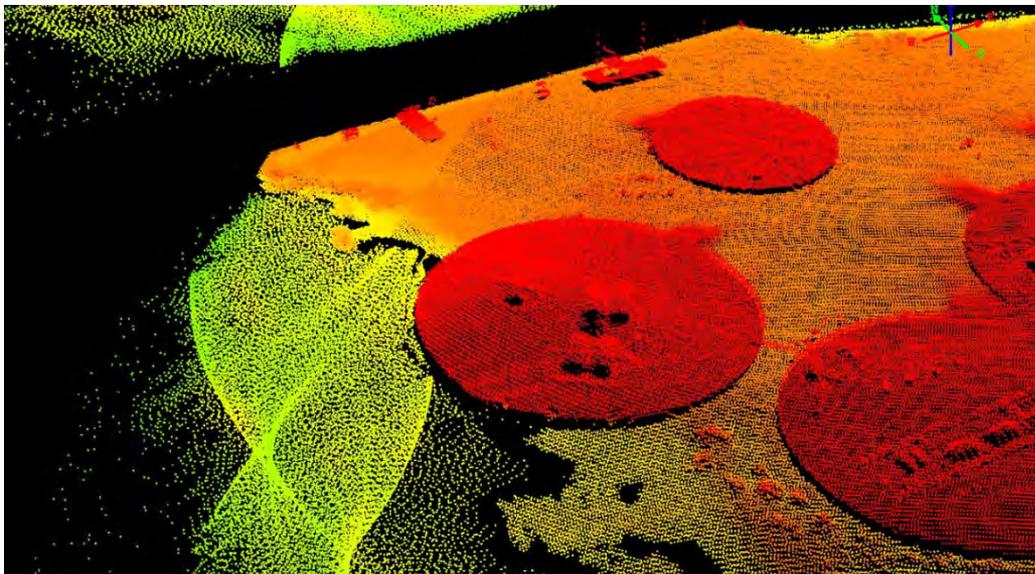
Bathymetric LiDAR DEMs showing submerged pipeline
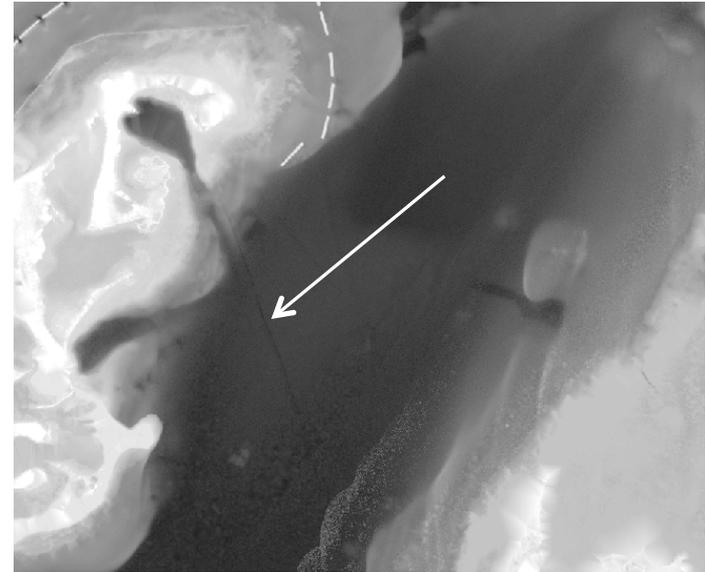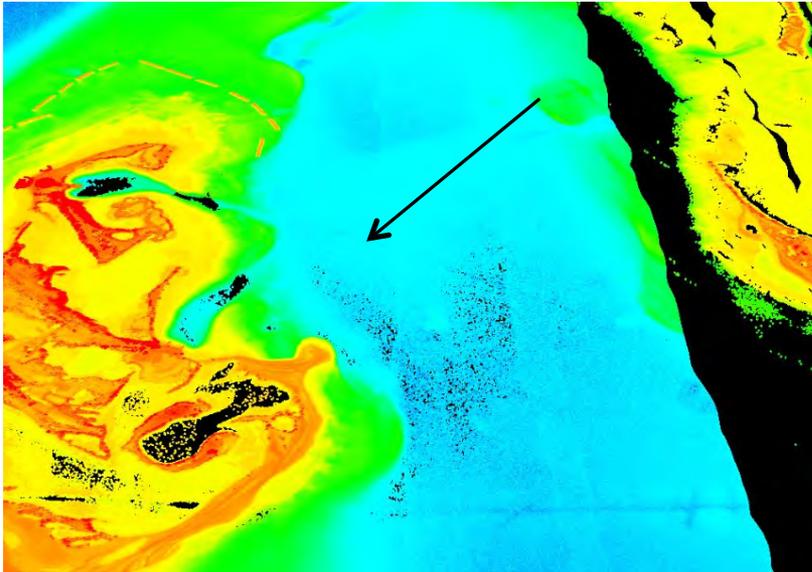
UAS-SfM for shallow-water structure imaging
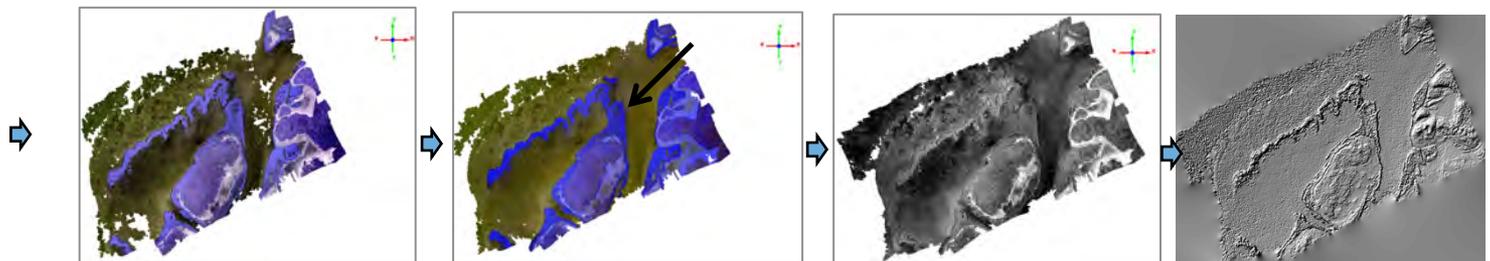
3-band SfM 3D point cloud (PC)

Lyzenga 2006 glint corrected PC

Green single-band PC

Green single-band DEM

North Padre Island Beach Survey for City of CC
(Feb. 2015)

6 miles

4 miles

Gulf of Mexico

3D Fly Through

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Thank You SCOAR

Questions?

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