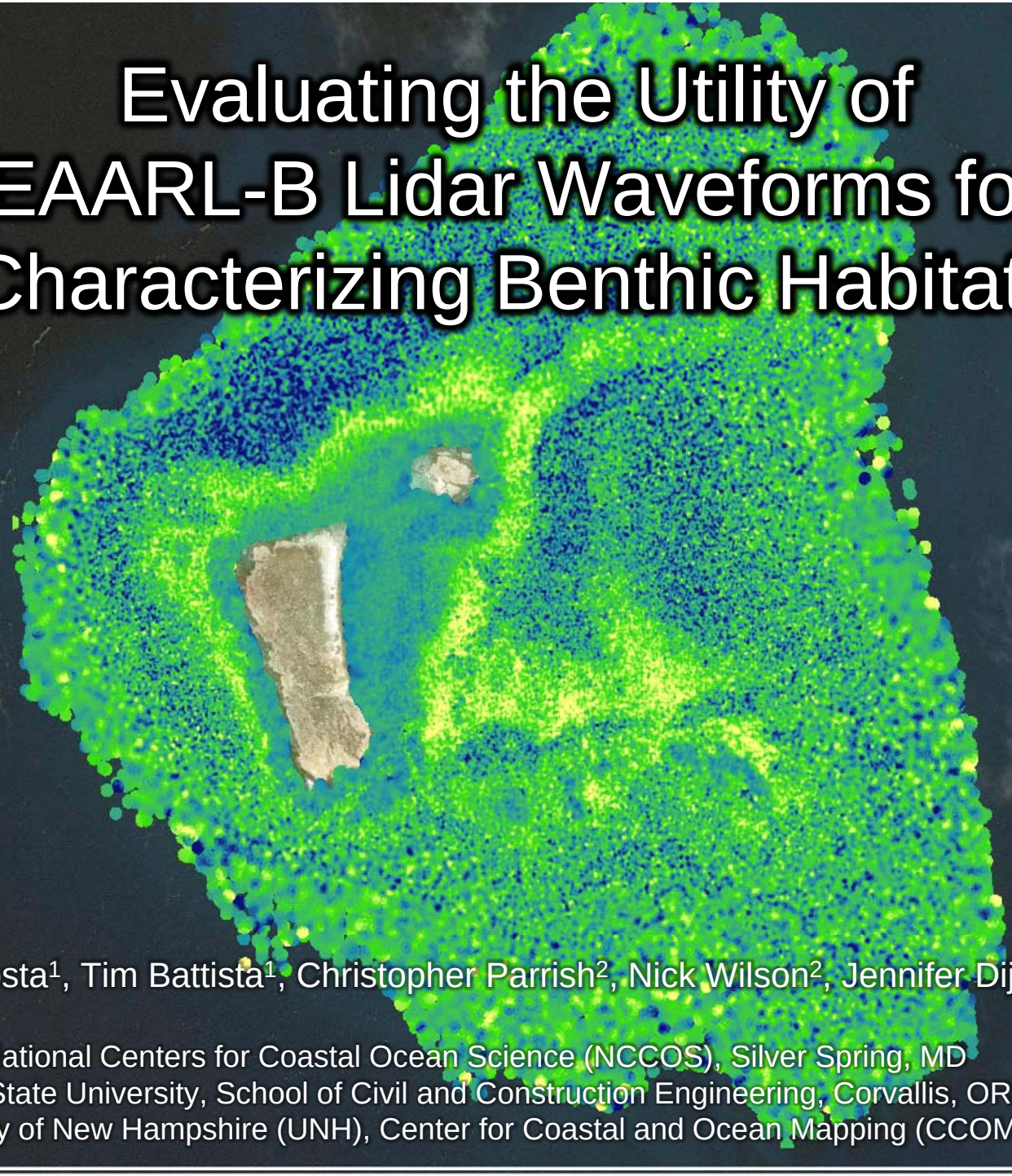
Evaluating the Utility of EAARL-B Lidar Waveforms for Characterizing Benthic Habitats



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Agenda

1. Project Background

2. Project Objective & Questions

3. Methods:
- Project Area
- Lidar Waveform Processing

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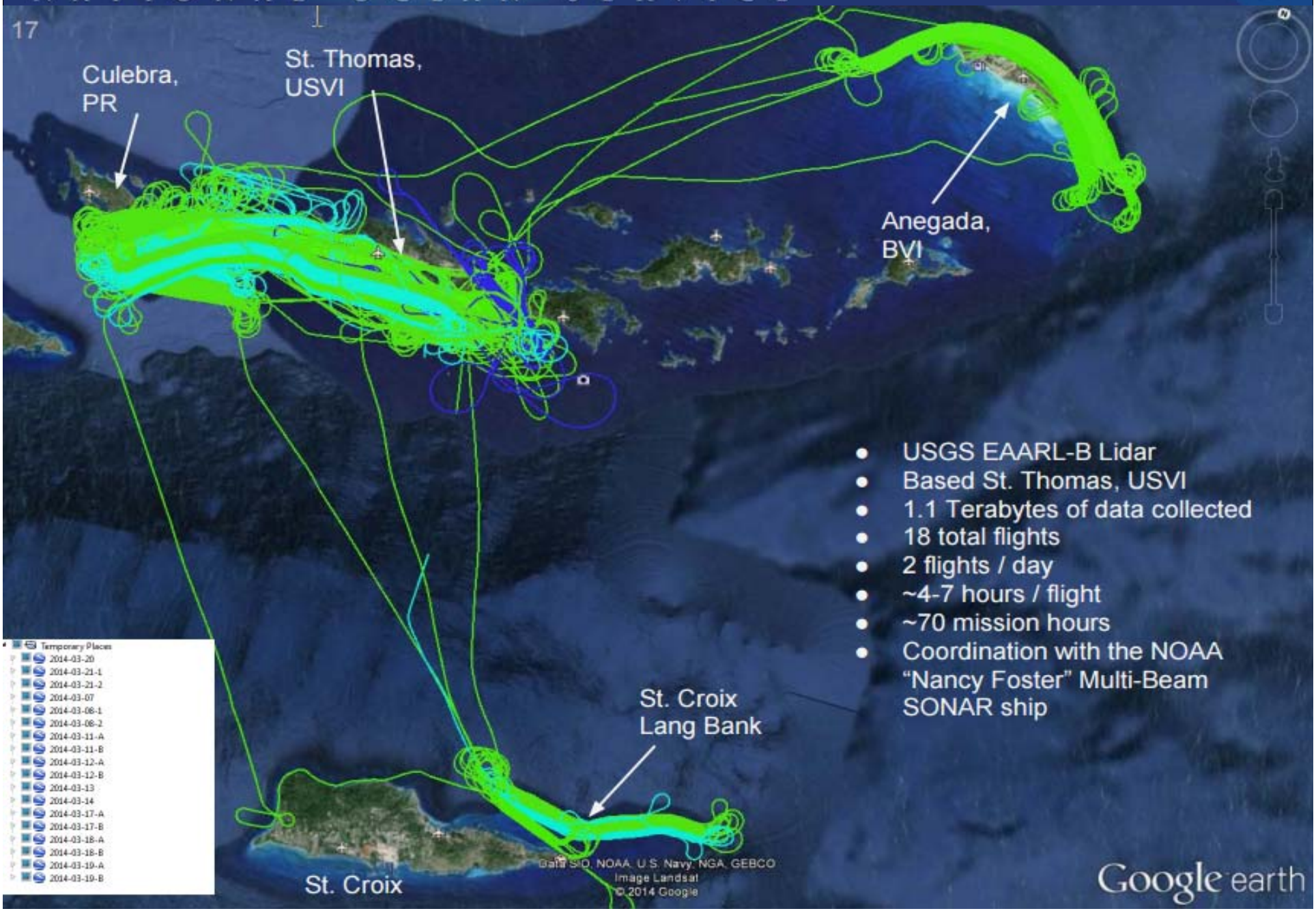
4. Methods (Next Steps):
- *Field work*
- *Data mining*



- USGS EAARL-B Lidar
- Based St. Thomas, USVI
- 1.1 Terabytes of data collected
- 18 total flights
- 2 flights / day
- ~4-7 hours / flight
- ~70 mission hours
- Coordination with the NOAA "Nancy Foster" Multi-Beam SONAR ship

Project Background:

- Benthic habitat maps depict structure & cover of seafloor
- Habitat maps support marine planning and management
- Habitat maps created from Lidar depth & relative reflectance data (Figs.1, 2)
- Few studies have developed habitat maps from Lidar waveforms

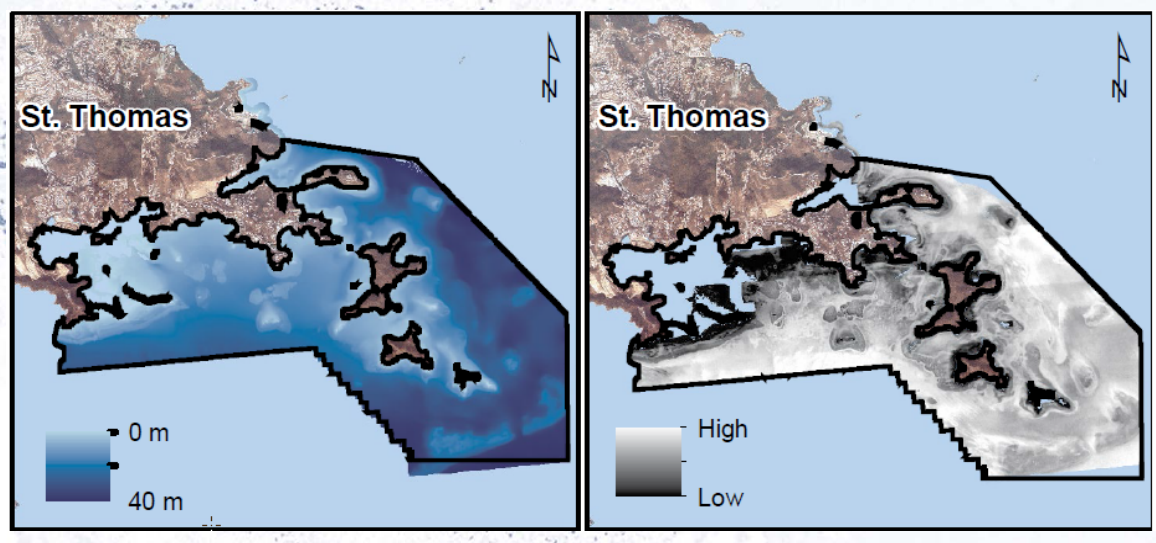


Fig. 1. Example of Lidar data used to for habitat mapping in USVI.

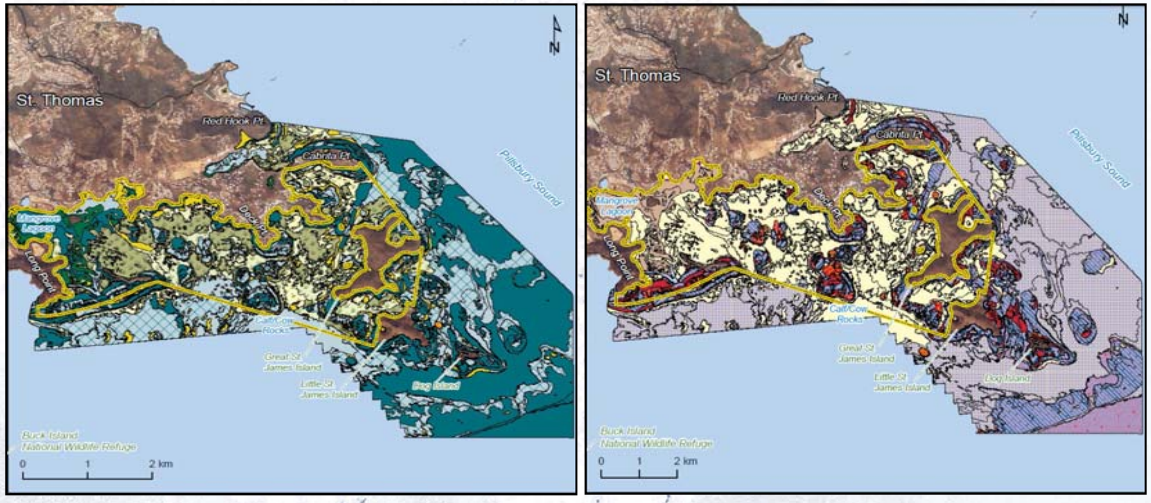


Fig. 2. Benthic habitat maps developed from above Lidar data.

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Project Objective:

Mine additional information from EAARL-B Lidar data to develop more resolved benthic habitat maps.

Project Research Questions:

1. How do we produce corrected, gridded Lidar waveform products from EAARL-B data? (*Chris Parrish & Nick Wilson, OSU*)

2. Which benthic habitats are correlated with the corrected, gridded Lidar waveform products?

3. How does the spatial resolution of the Lidar waveform products (and the *in situ* habitat data) affect the direction and strength of these correlations?

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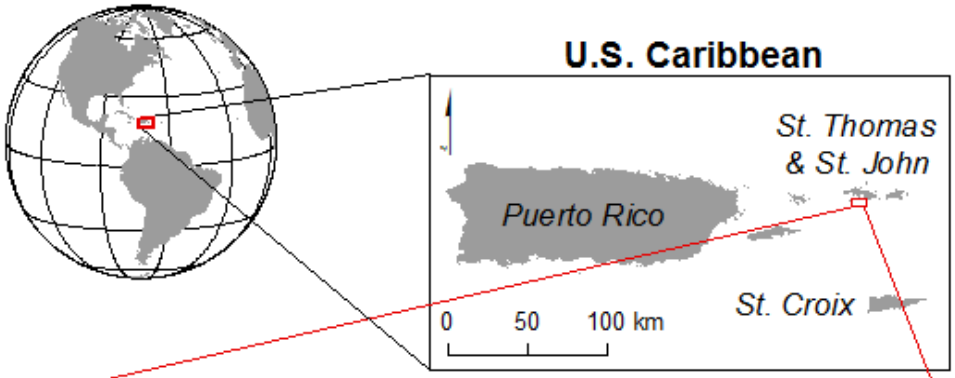
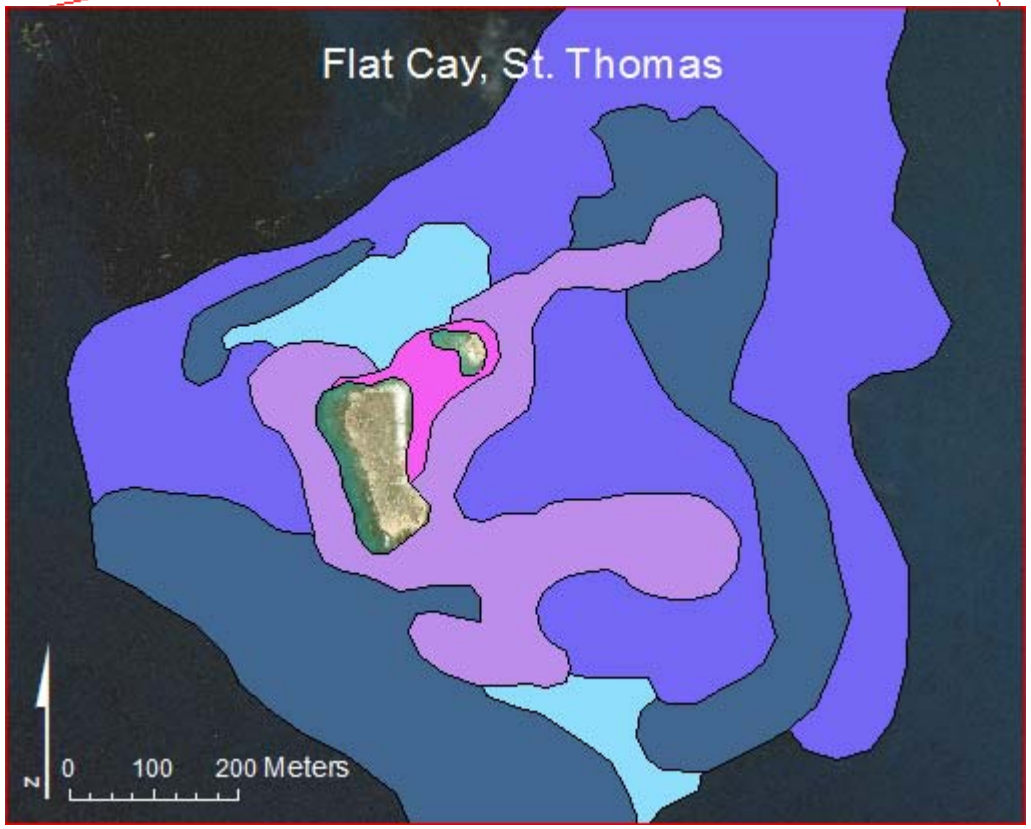
Methods: Project Area

- *Location*: Flat Cay, St. Thomas

- *Depths*: 0 – 28 m
- *Data Density*: 1 - 4 pts/m^2
- *Dominant Benthic Habitats*:

Hardbottom/Uncolonized Bedrock
Reef/Colonized Bedrock
Reef/Colonized Pavement
Reef/Linear Reef
Reef/Scattered Coral-Rock

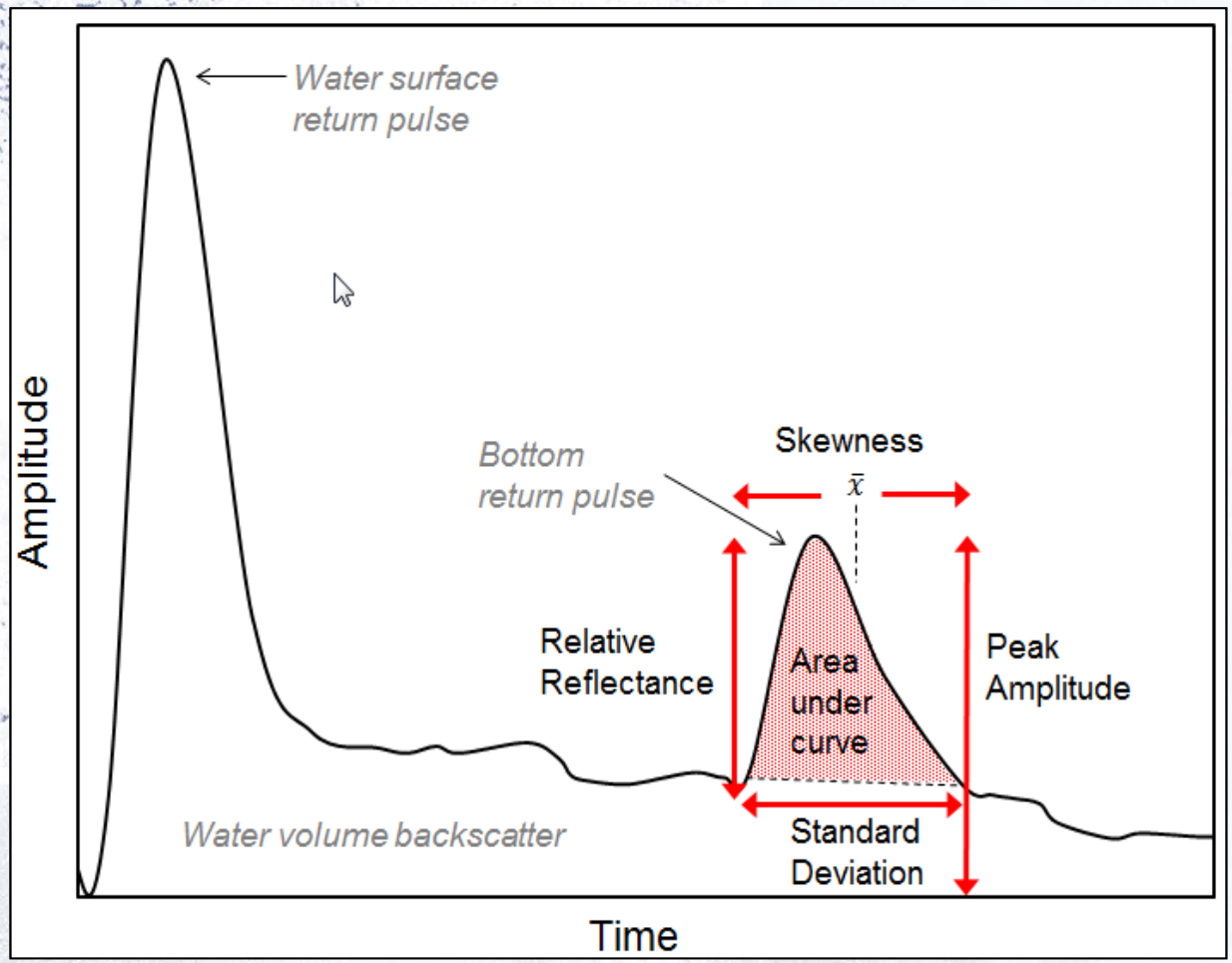




Methods: Lidar Processing

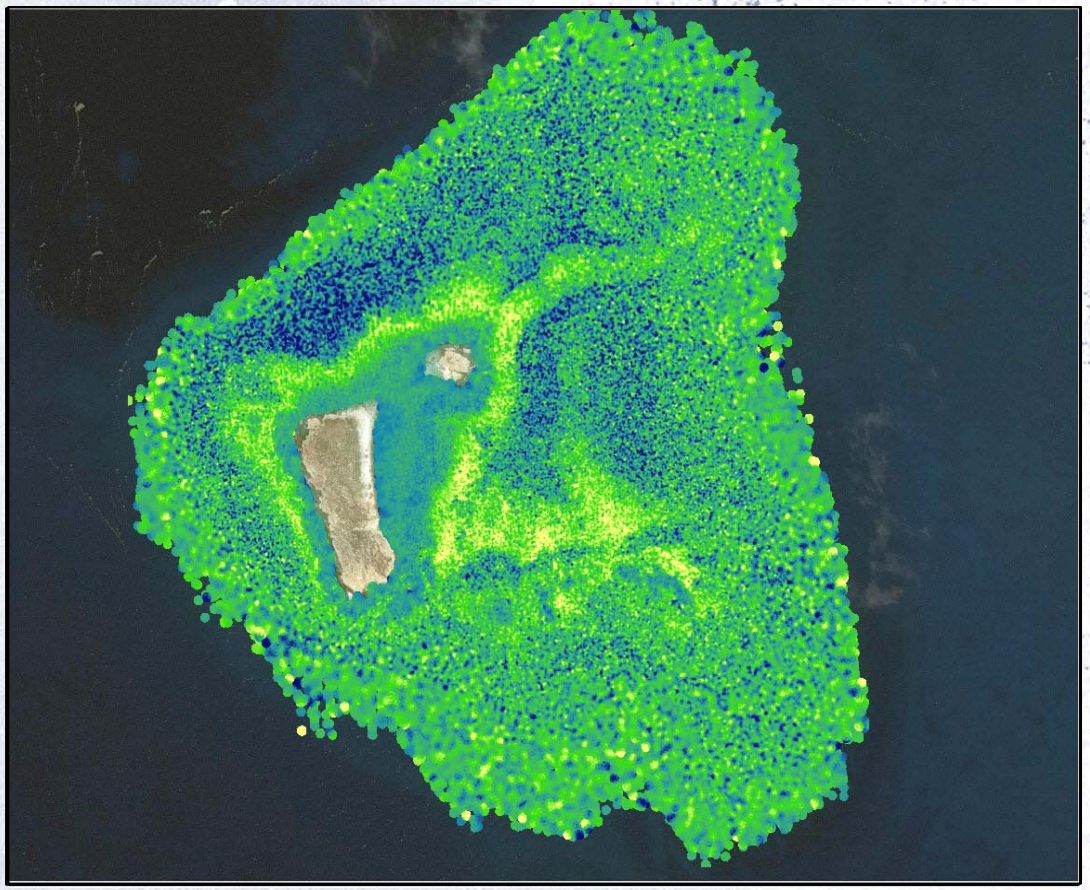
- Corrected Lidar waveforms in USGS's ALPS software

1. **Relative reflectance –** max value of bottom return pulse corrected for depth & incidence angle
2. **Area under the curve –** amount of energy returned from bottom
3. **Peak amplitude –** uncorrected max value of bottom return pulse
4. **Std. deviation** – width of the bottom return pulse
5. **Skewness –** asymmetry of bottom return pulse



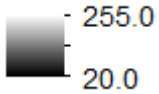
Methods: Lidar Processing

- Draft, corrected EAARL-B waveforms for Flat Cay

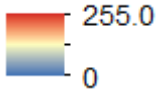


Flight Lines

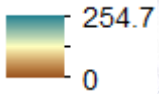
1. Relative reflectance



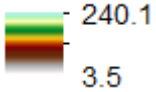
2. Area under the curve



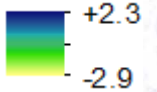
3. Peak amplitude



4. Standard Deviation

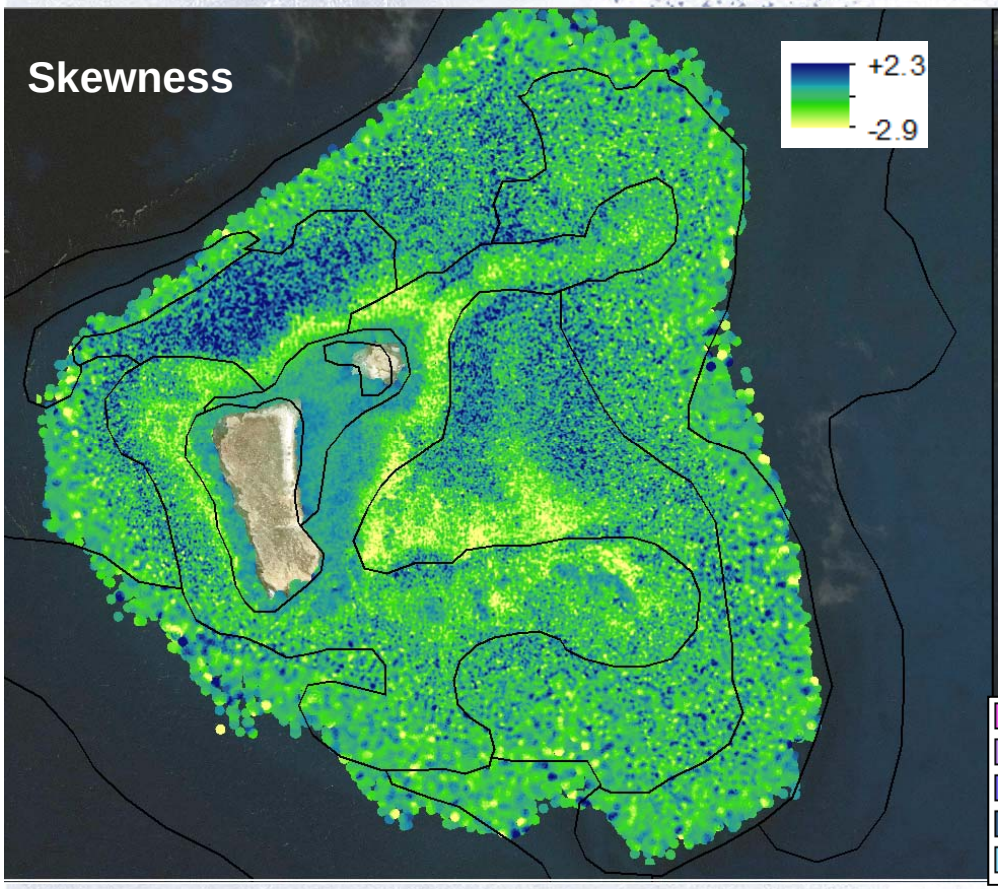


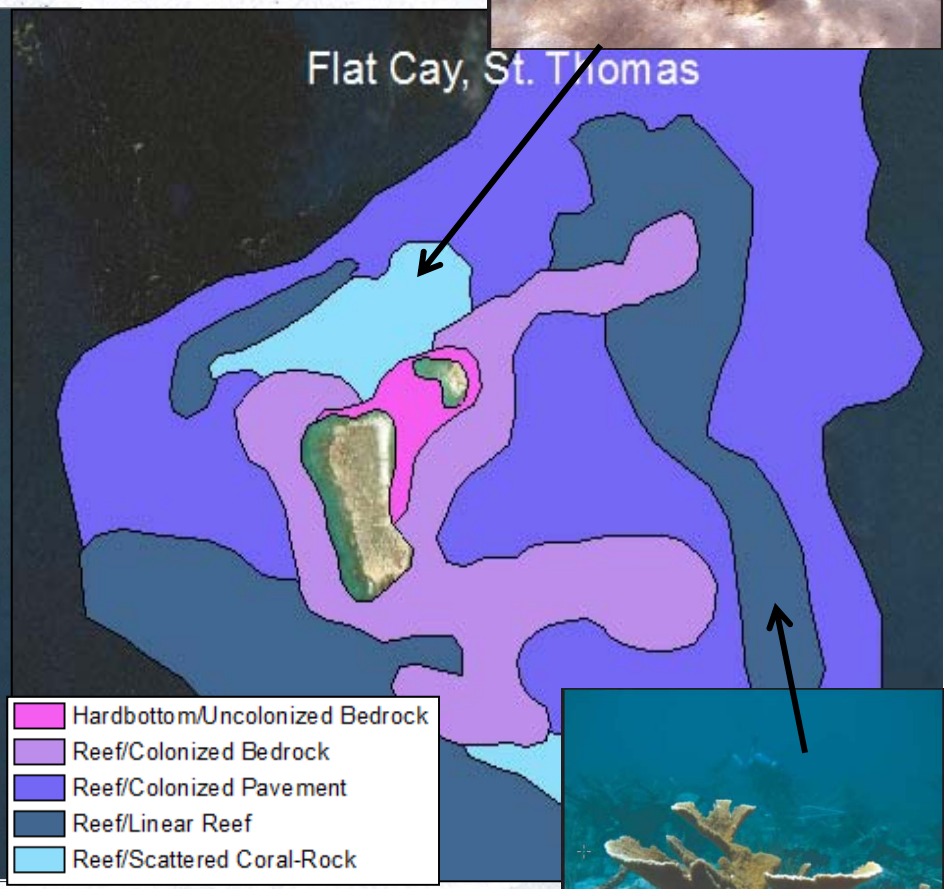
5. Skewness

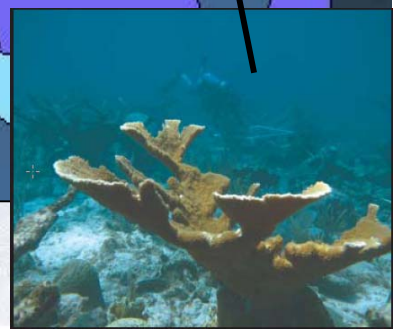


Methods: Lidar Processing

- Qualitative comparison of draft, corrected waveforms with benthic habitats







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Methods: Field Work

(around Flat Cay)

1. Choose sample sites using waveform products

- Field work planned for 9/2016

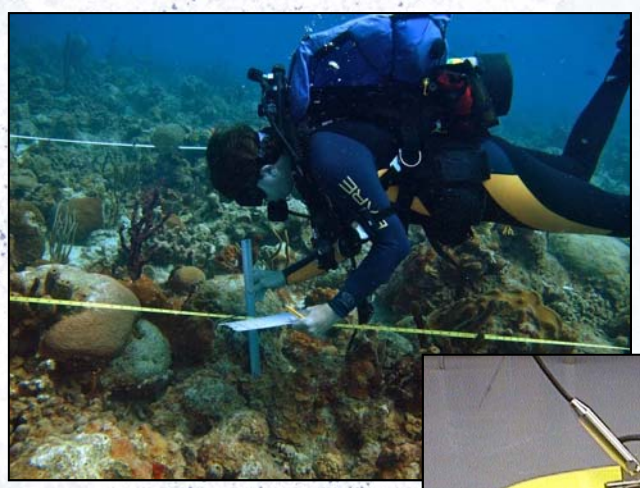
2. Collect data at these sample sites, including:

Habitats

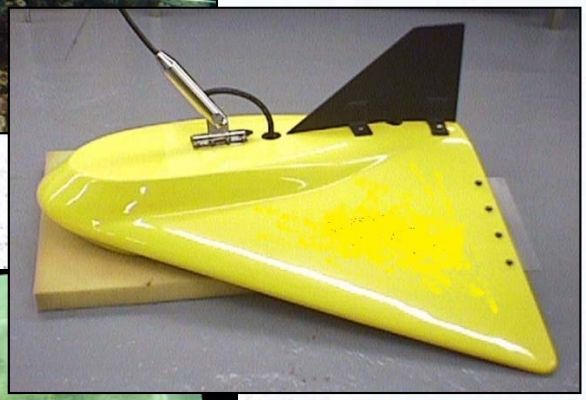
- Coral reef, bedrock, pavement, sand, live coral, seagrass, algae

Habitat metrics

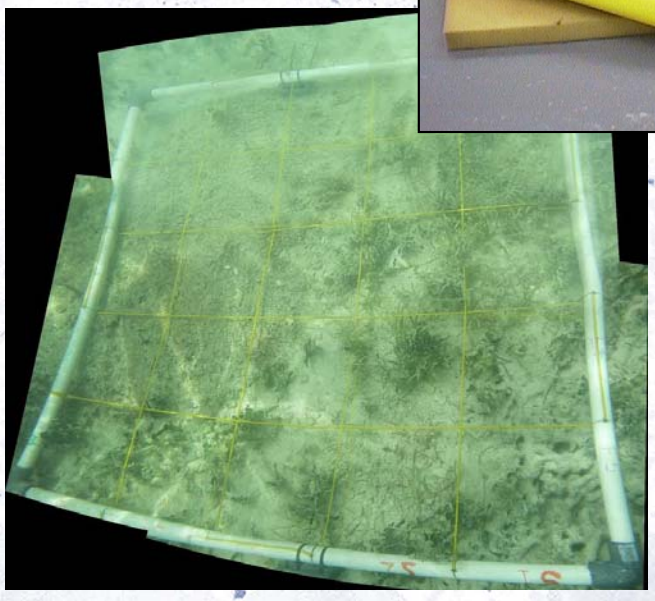
- Species richness/diversity, canopy heights, rugosity, others?



SCUBA



V-Wing Towed Depressor



Photos mosaics

Methods: Data Mining

3. Mathematically link habitats & habitat metrics to gridded, LiDAR waveforms

- Use machine learning to develop mathematical relationships among habitats & waveforms
- Apply mathematical relationships to develop more resolved (?) habitat maps

Pavement, Turf Algae

Coral Reef, Live Coral

Sand with Scattered Cora/Rock

Bedrock, Macroalgae

Summary:

To Date:

1. Developed workflow to produce corrected, gridded waveform products (Chris Parrish & Nick Wilson)

2. Qualitative analysis suggest correlations among habitats & waveform products

To Do:

1. Quantify these relationships to develop more resolved habitat maps

Questions?

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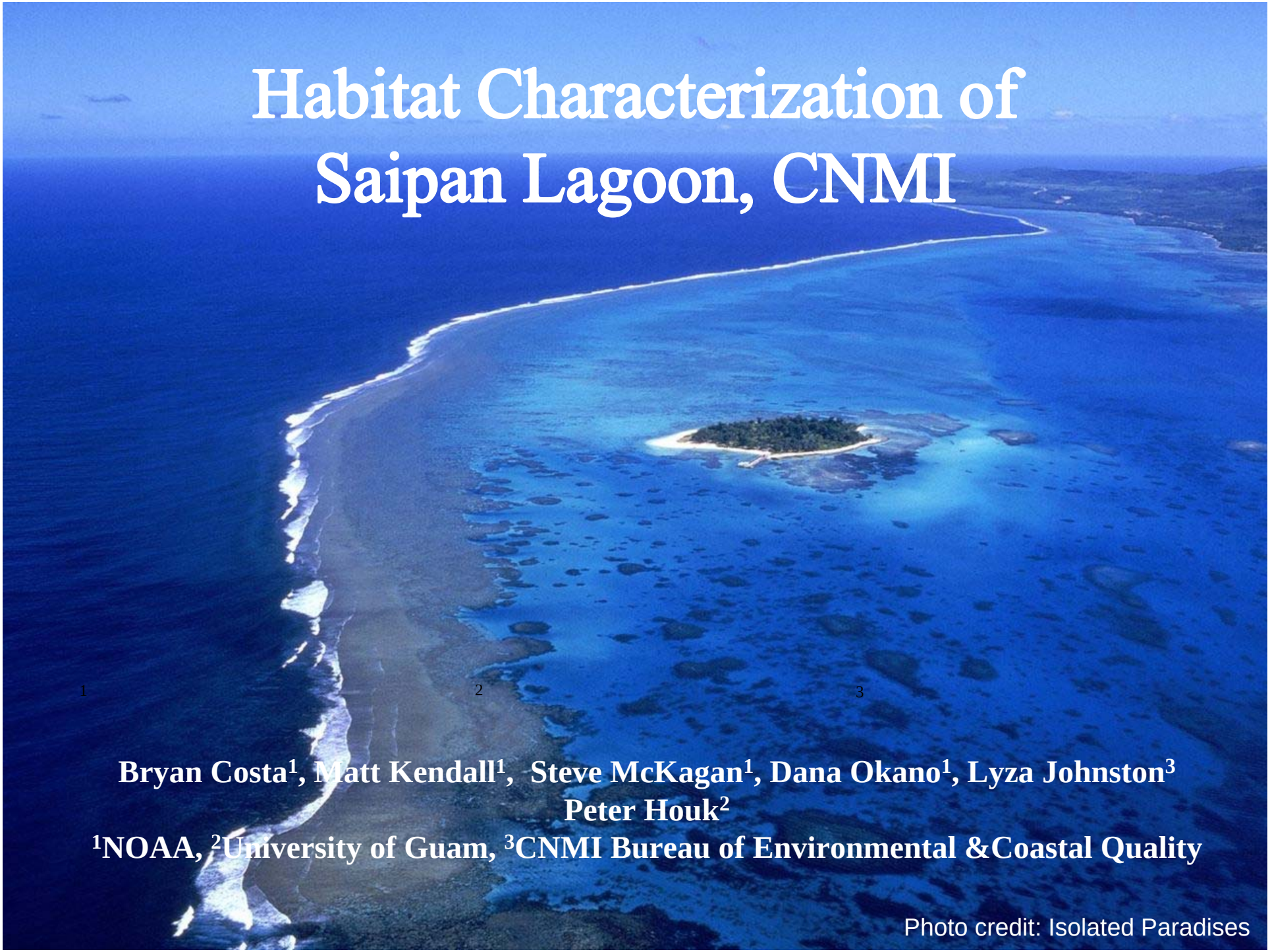
Joint Hydrographic Center

Chris Parrish
Nick Wilson
Oregon State University

Habitat Characterization of Saipan Lagoon, CNMI



1 2 3

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Photo credit: Isolated Paradises

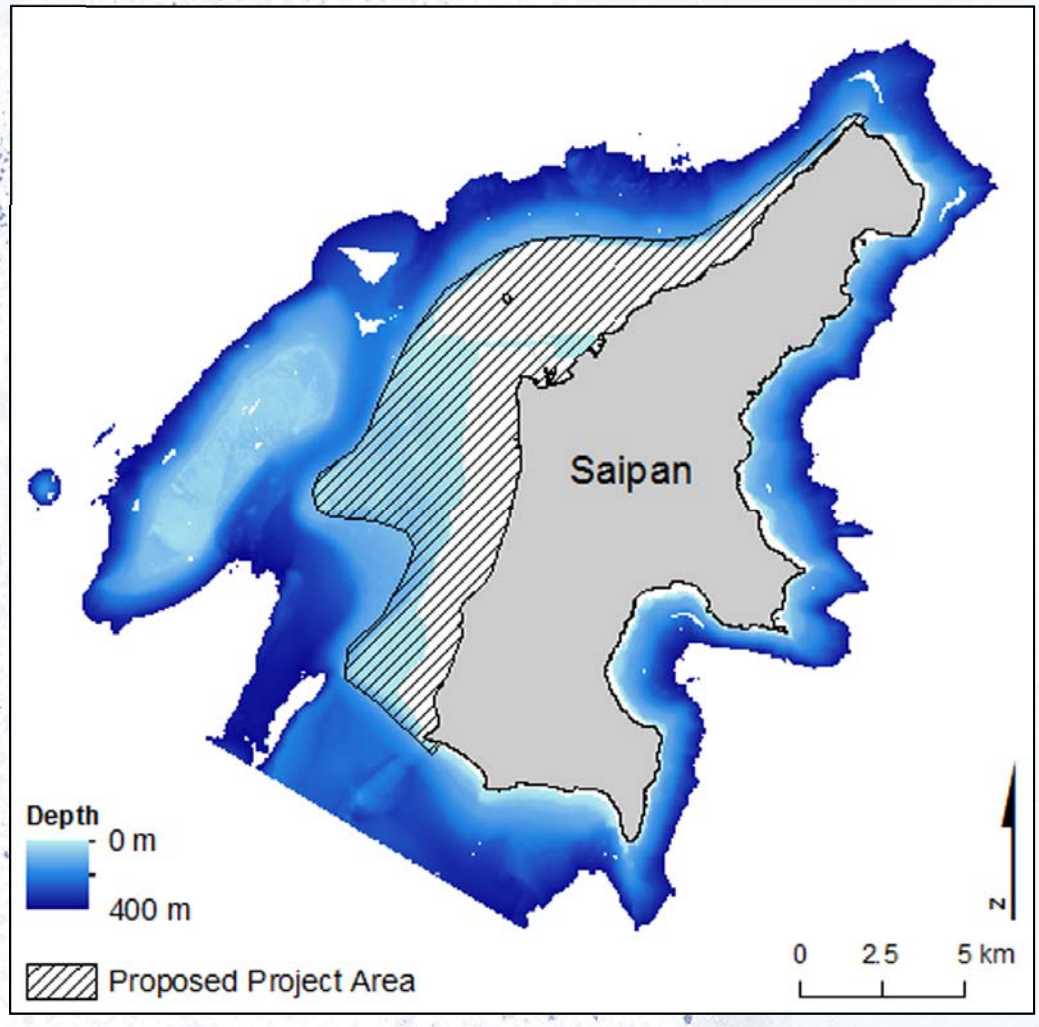
Mapping Habitat Changes in Saipan Lagoon

Proposed Timeline:
FY2016 – FY2017

Proposed geographic focus:
Saipan Lagoon

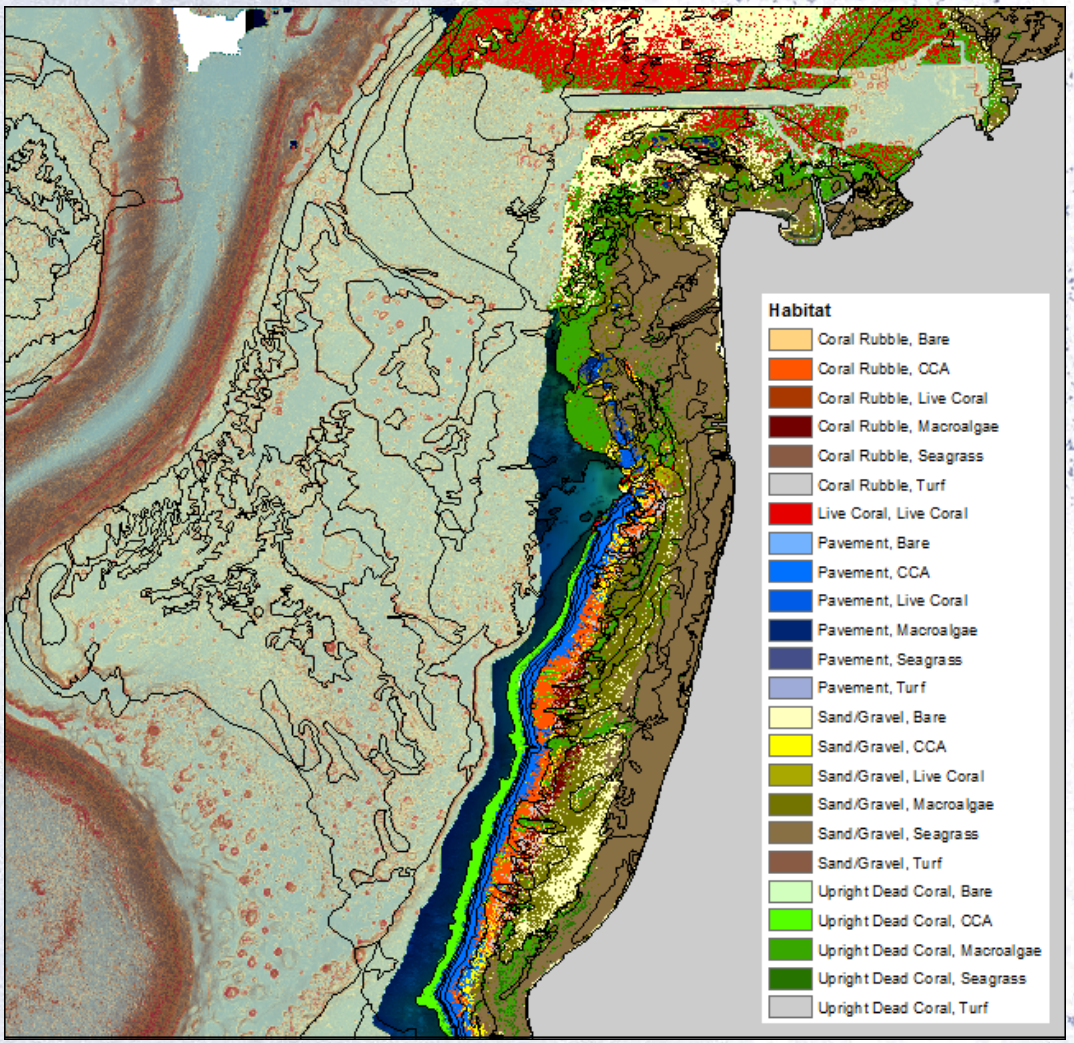
Proposed Research

1. Create an updated benthic map for Saipan Lagoon
2. Managers requested an updated map to assess habitat changes

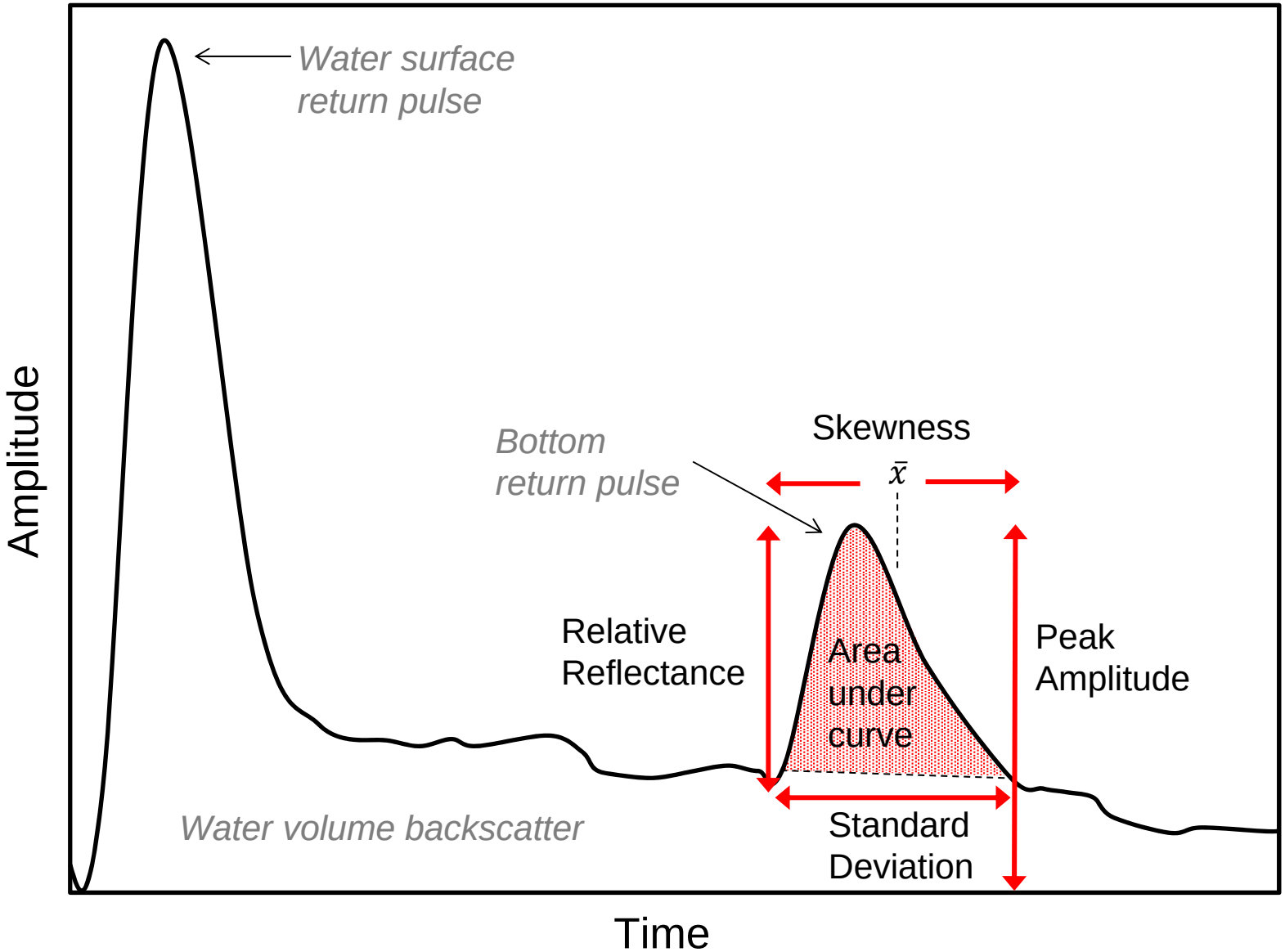


Proposed Objectives
1. Support permitting & update of Saipan Lagoon Use Management Plan

How is SDB supporting this effort?



1. Depth data critical for habitat mapping

2. Allows analyst or computer to classify distinct habitats on seafloor

Lidar Waveform