Assessing Hurricane Sandy Impacts on Benthic Habitats in Barnegat Bay with New Topographic-Bathymetric Lidar Technology

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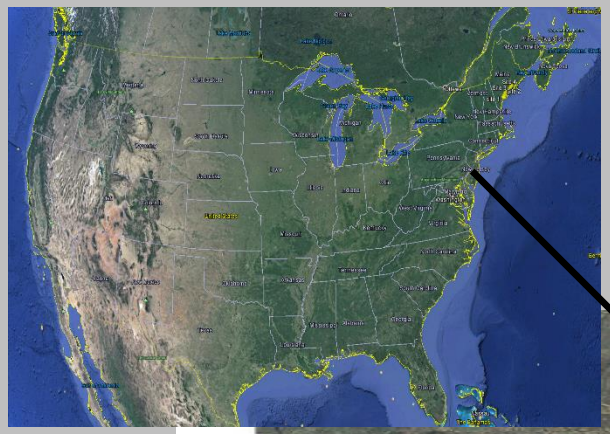
Hurricane Sandy

- Landfall- October 29, 2012
- Cost: 50 billion dollars in damages
- Most of the damage was focused the coastal zones of New York, New Jersey and Connecticut

Project Goal

- Investigate the effects of Hurricane Sandy on benthic habitats using topo-bathy lidar

Barnegat Bay, NJ



- Shallow, sandy, poorly flushed and bordered by much development
- 2 meters of storm surge
- Barrier island breach
- Overwash

Seagrass

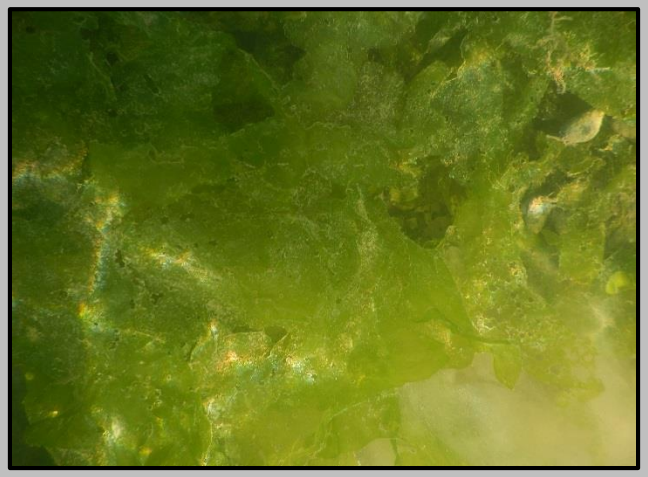
KEY INDICATORS

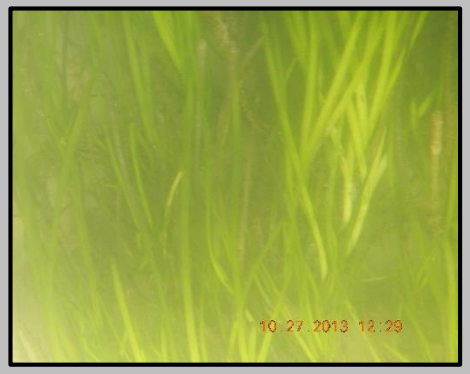
- Water quality
- Ecosystem health
- Essential fish and shellfish habitat

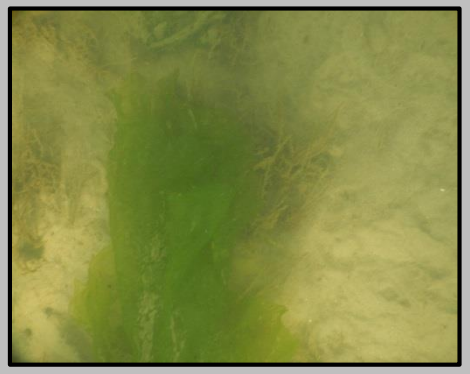
Eelgrass, *Zostera marina; Photo credit:* Cornell Cooperative Extension of Suffolk County.

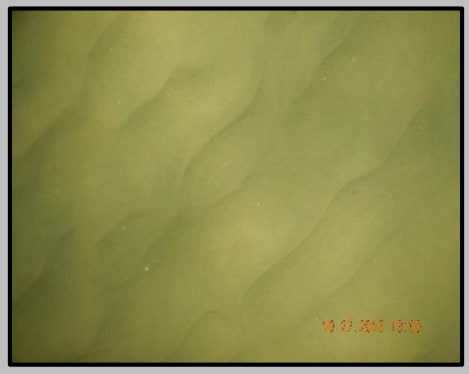
Bay scallop, *Argiopecten irradians;* photo credit: Cornell Cooperative Extension Eelgrass Program

Benthic Habitats

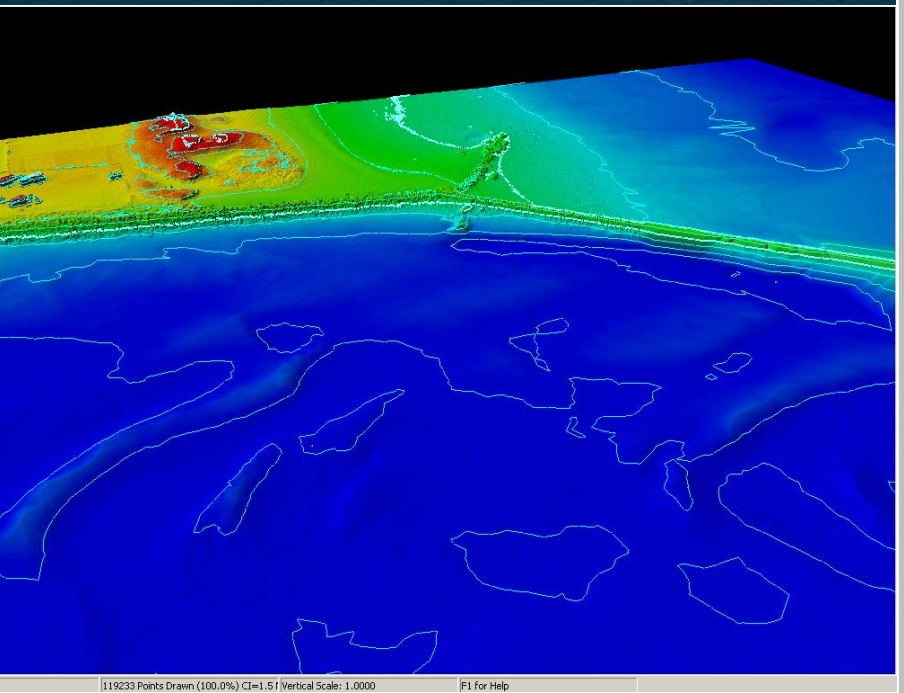






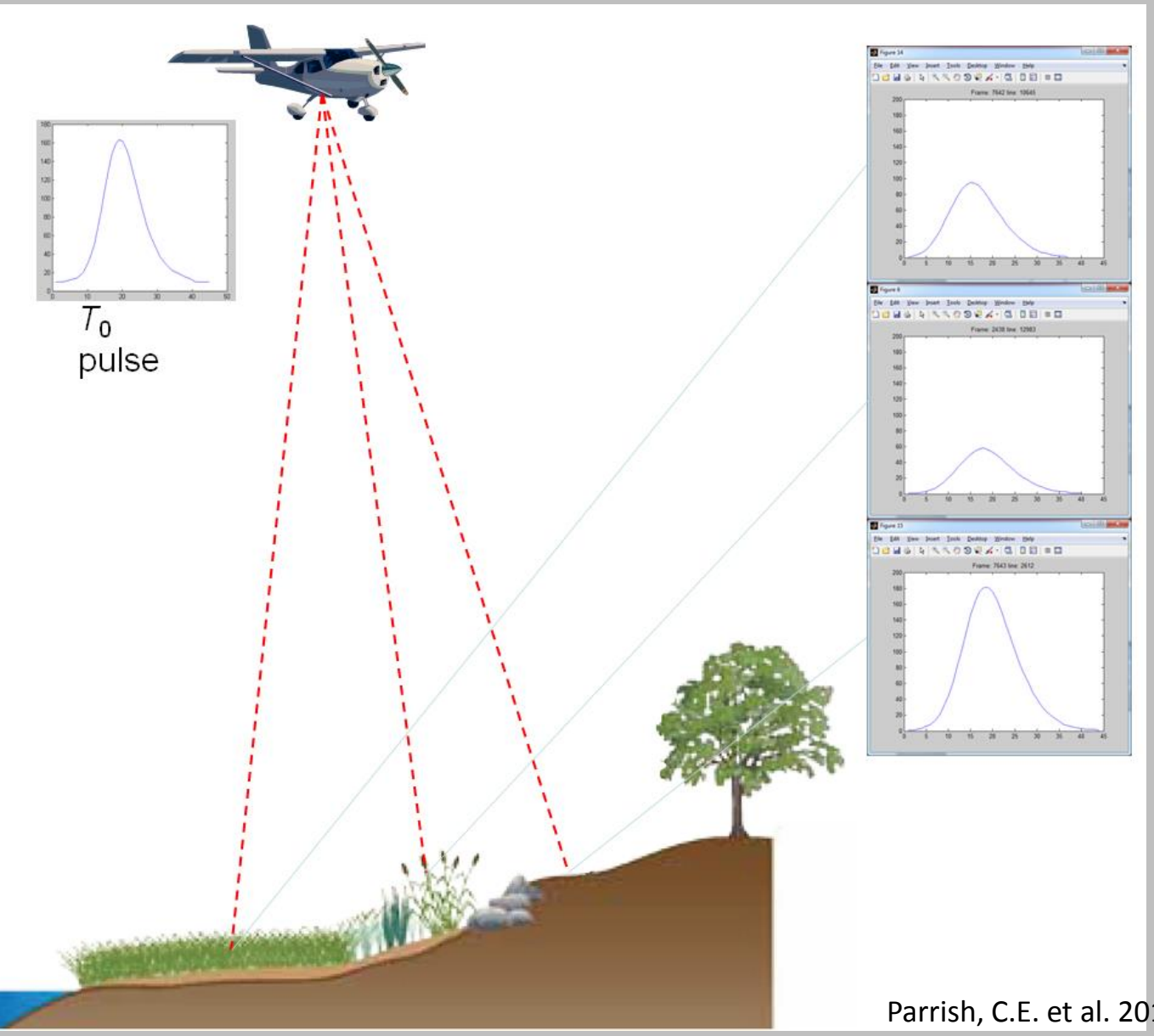


Topo-Bathy Lidar



- **Emerging class of topo-bathy lidar system**
  - Occupies middle ground between conventional topographic and bathymetric systems:
    - Narrow beam, low power, small FOV, very high sampling rates
    - Focus is on shallow water and environmental applications
- Why of interest to NOAA & partners?
  - Uniquely suited for shoreline mapping
    - Seamless, high-resolution data across backshore, intertidal, and nearshore marine zones
  - Fill in shallow water gap (shoreward of NALL line)
  - SLR analysis, inundation modeling
  - Habitat mapping
  - Riverine mapping
  - Coastal zone management, coastal science => ***IOCM!***

Use of Waveform Features for Habitat Mapping



- Compute (ideally in real-time) features related to return waveform shape (amplitude, width, etc.)
- For V-line systems, Riegl computes 2 features and stores them in LAS Extra Bytes: “reflectance” and “pulse deviation”
- Grid these features and use resultant raster layers in habitat classification

Parrish, C.E. et al. 2014. *Geoscience and Remote Sensing Letters*, Vol. 11, No. 2, pp. 569-573.

June 2013 Airborne Data Acquisition

NOAA Hawker Beechcraft King Air 350ER

Furthest aft: Riegl VQ-820-G topo bathy lidar.
Foreground: Applanix DSS DualCam digital aerial camera

Sept 2013 Airborne Data Acquisition

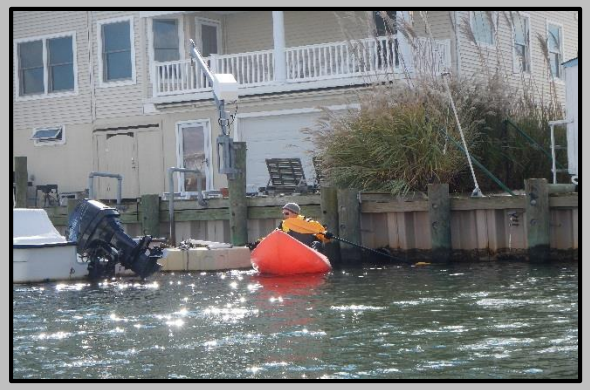
NOAA DeHavilland Twin Otter (DHC-6)

Left: Riegl LMS Q-680, Right: Riegl VQ-820-G

Study Locations

- ❑ Bathymetry
- ❑ Waveform Features
  - ❖ Pulse Shape Deviation
  - ❖ Reflectance
- ❑ Aerial Imagery

Ground Truth

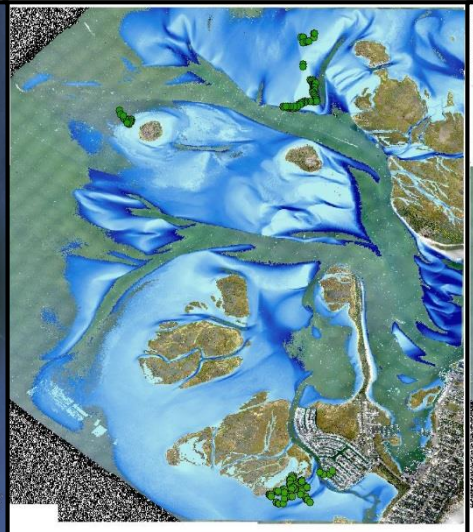


Recorded:

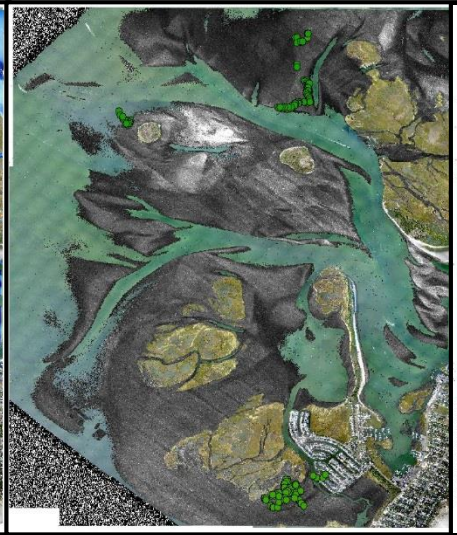
- ❑ Site
- ❑ GPS points using a hand held GPS
- ❑ Image of recorded point

Study Sites

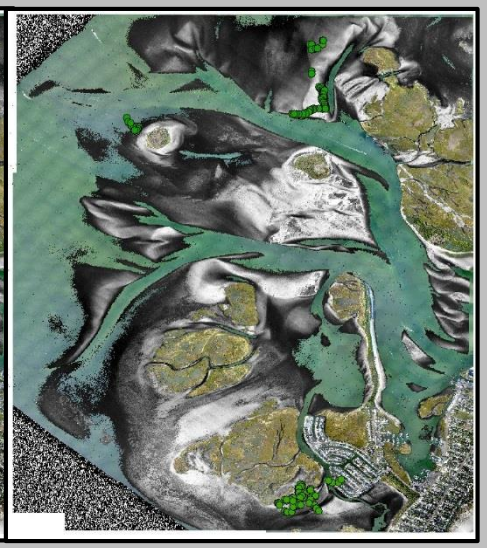
Aerial RGB Image



Bathymetry



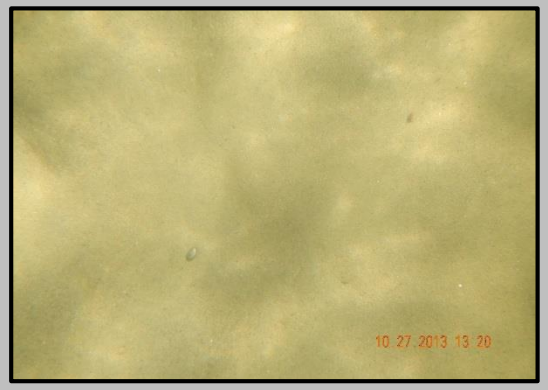
Pulse Shape Deviation



Reflectance Image

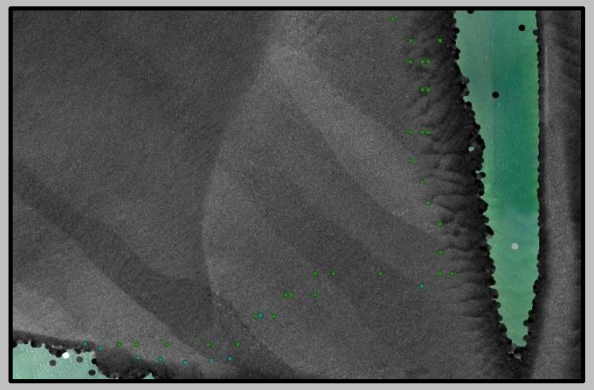
Sand

Camera Photo

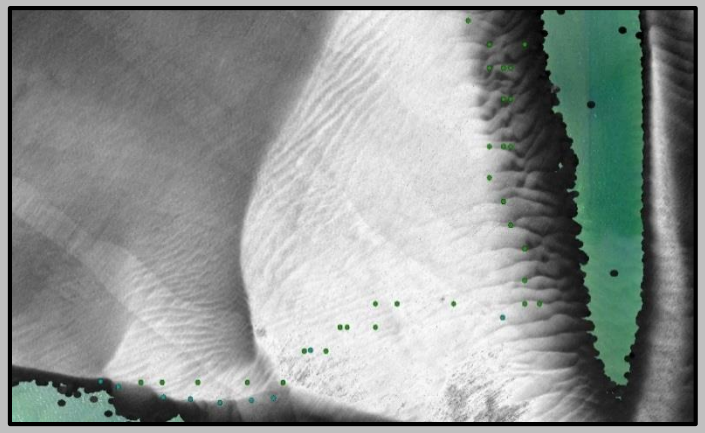


Aerial RGB Image

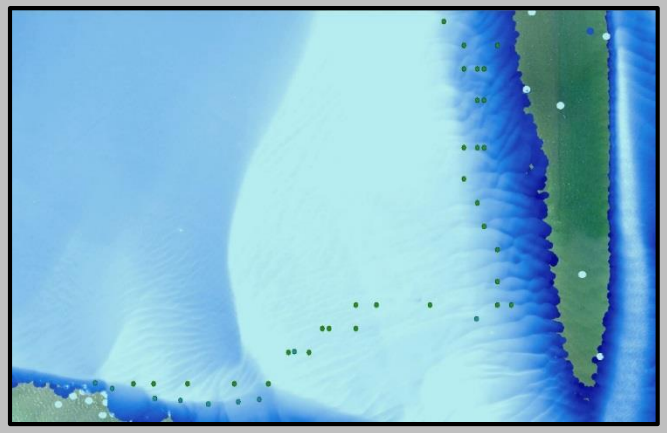
Pulse Shape Deviation



Reflectance Image

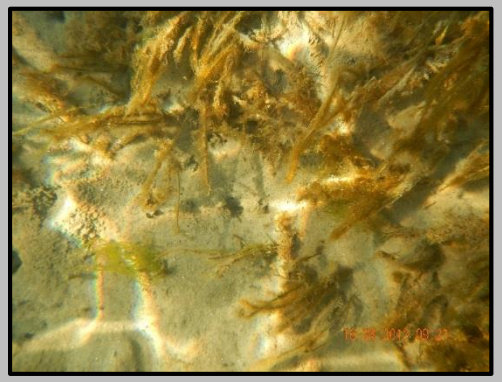


Bathymetry



Sand and Macroalgae

Camera Photo



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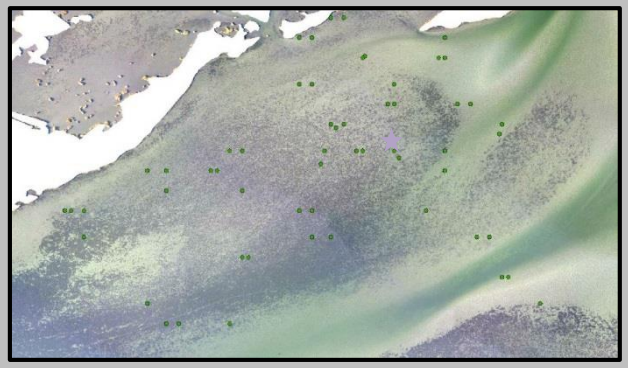
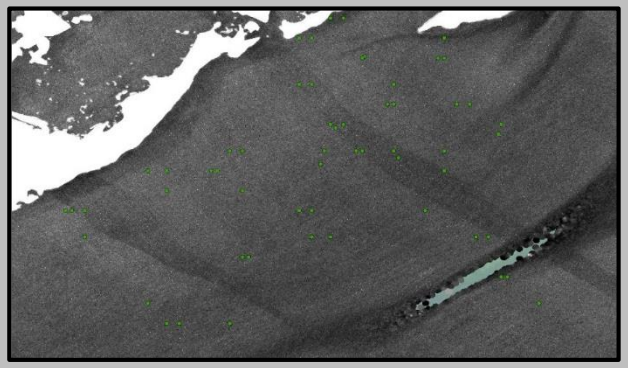
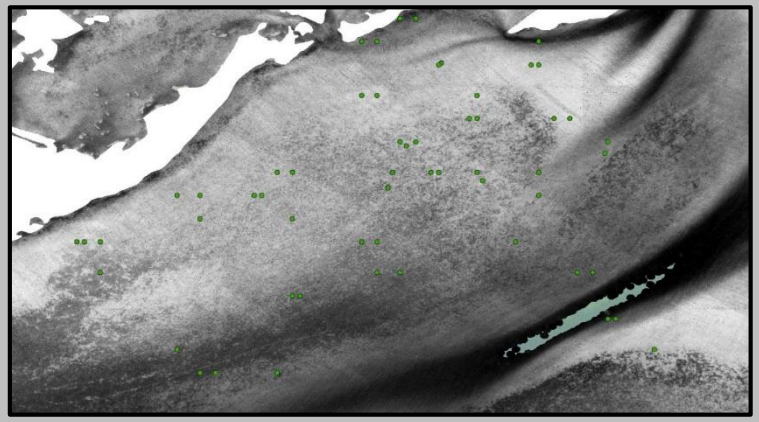


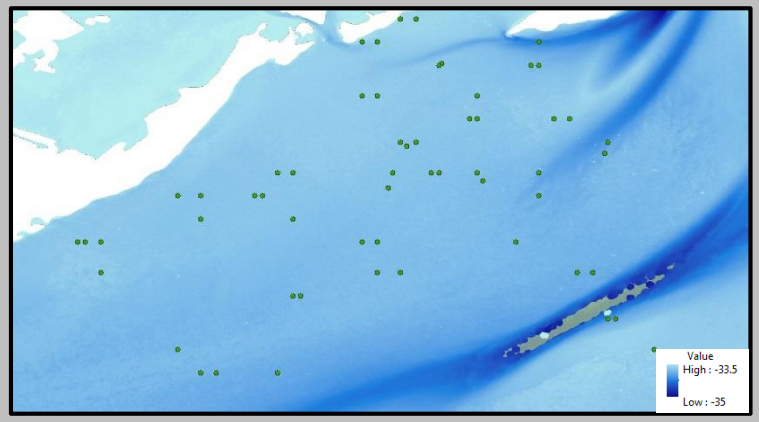
Pulse Shape Deviation



Reflectance Image

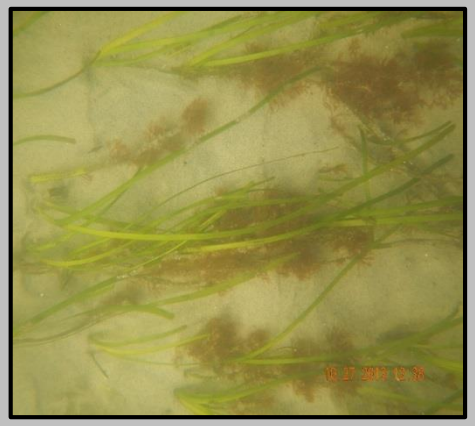


Bathymetry

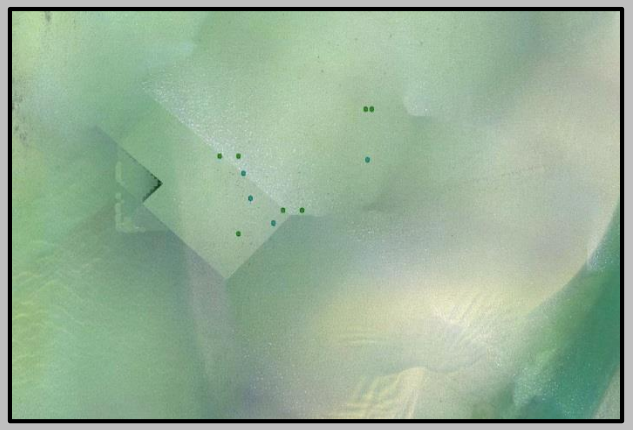


Sand and Eelgrass

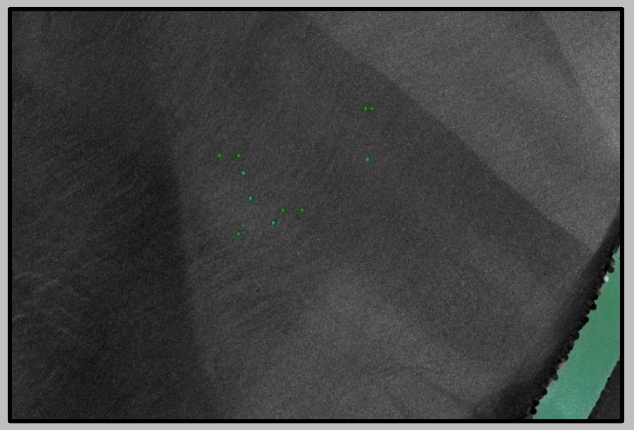
Camera Photo



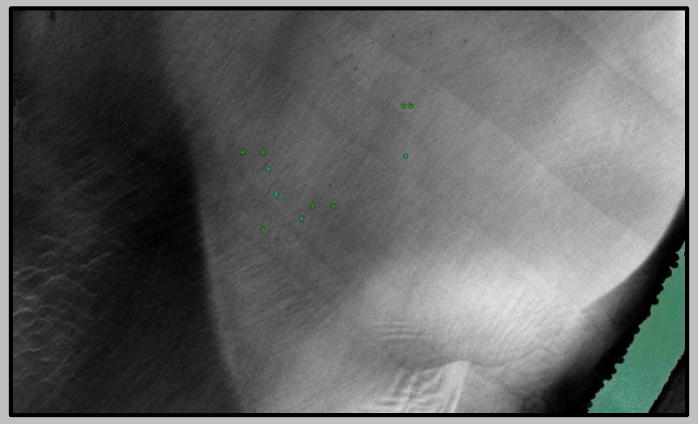
Aerial RGB Image



Pulse Shape Deviation



Reflectance Image



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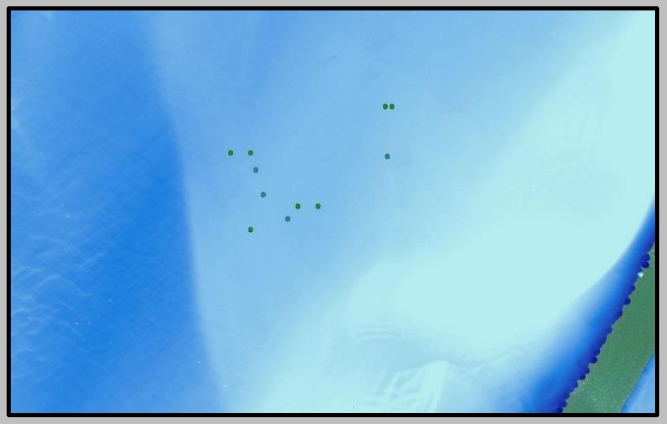
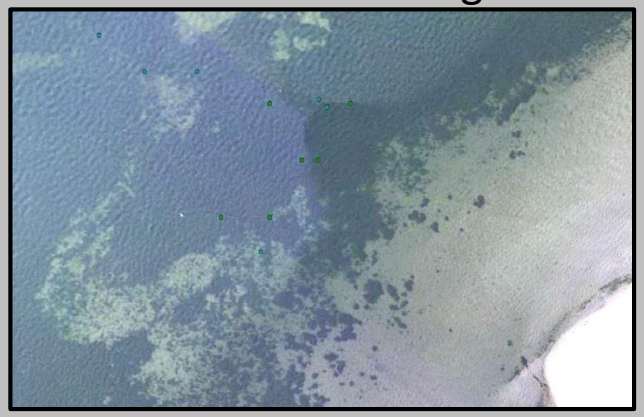


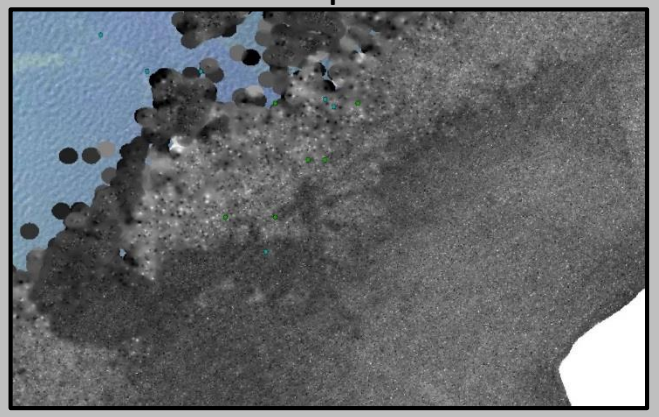
Eelgrass

Camera Photo

Aerial RGB Image



Pulse Shape Deviation



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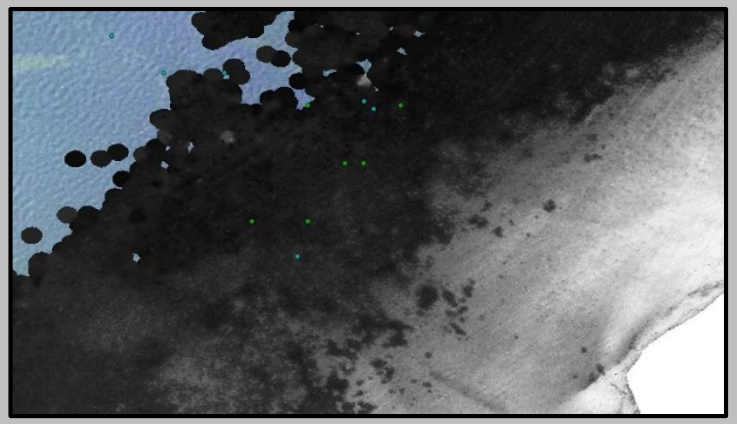

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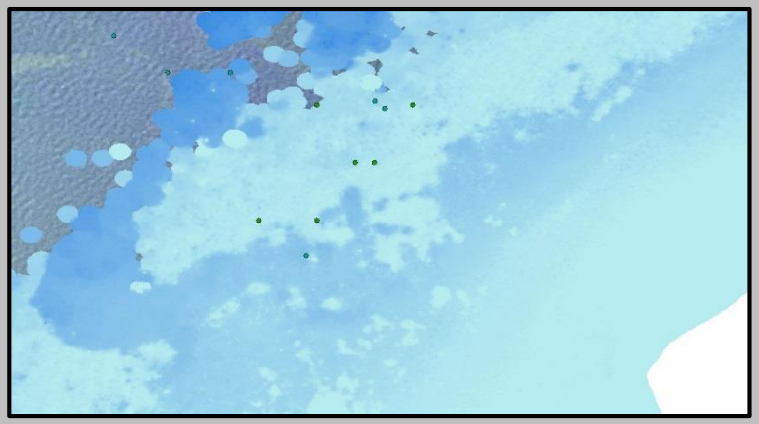

Future Directions

- Object-based classification
- Investigate the impacts of Hurricane Sandy on eelgrass beds:
  - Waveform metrics, specifically reflectance to pre- and post Hurricane Sandy lidar
  - Pre- and post-Images (satellite, airborne) of Barnegat Bay

Acknowledgements

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