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Eelgrass remote sensing **triple-threat** – assessment of simultaneously collected satellite, LiDAR, and sonar data

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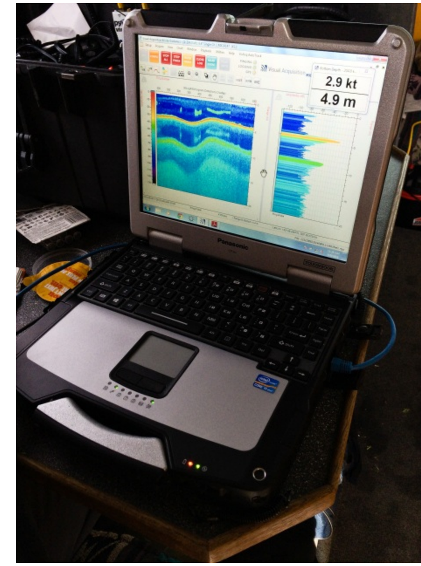
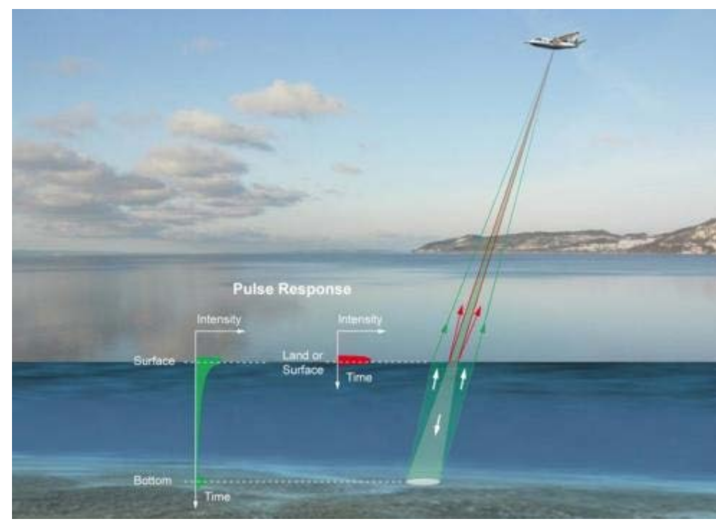
Agenda

1. Overview / Study Area
2. Field Data
3. Methodology
4. Results
5. Conclusion and Questions





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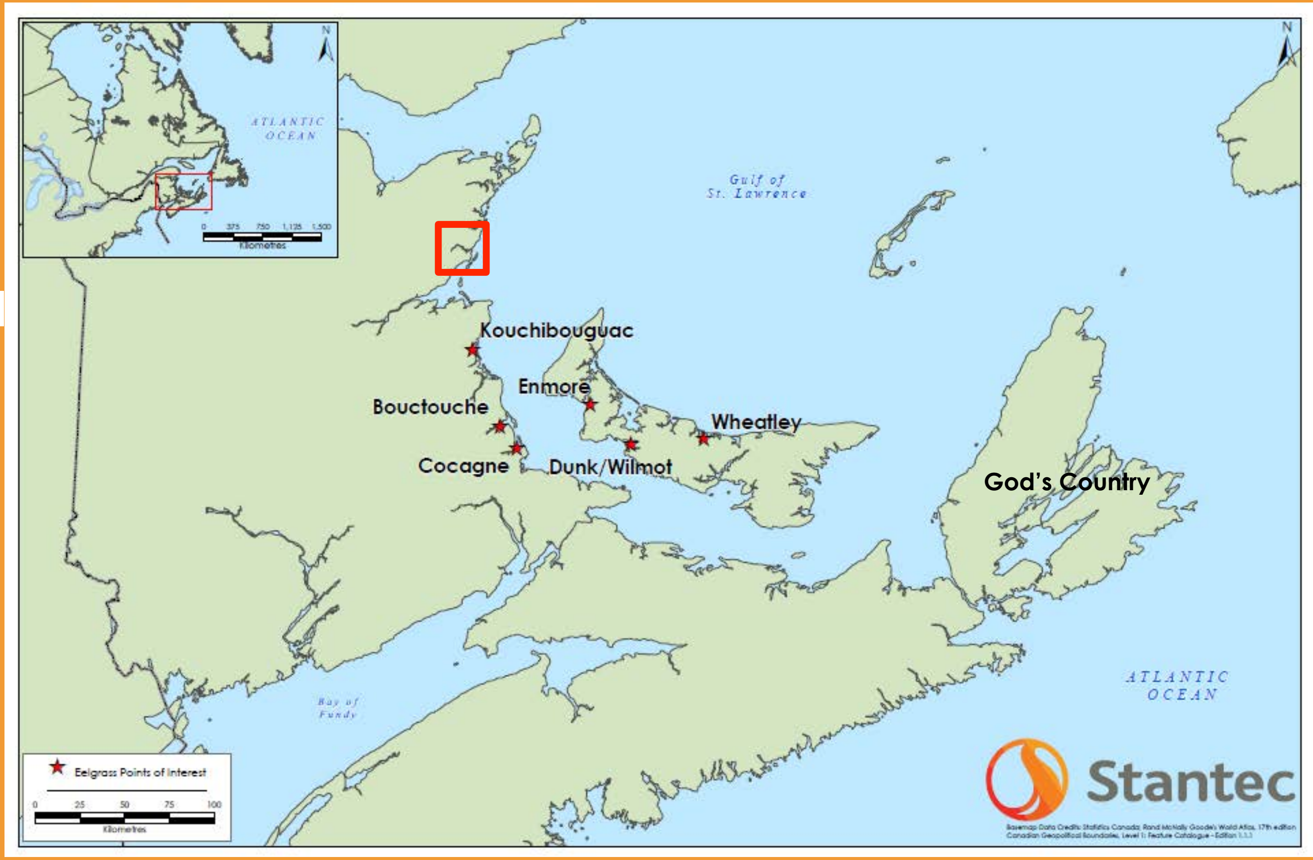
1 Overview / Study Area

- Three types of remote sensing data were collected from Tabusintac, NB over a three day period between September 24th and 26th, 2014
- Assess the accuracy/cost-effectiveness of these three eelgrass mapping approaches to inform resource management

- Single Beam Sonar (BioSonics)
- 8-band multispectral satellite imagery (Worldview-2)
- Topo-Bathy Lidar (Chiroptera II)



2 Methods - Groundtruth Data

- Ground-truthing 24-26 Sept 2014
  - 70 stations sampled
    - Stratified, random sampling
    - 4 x georef drop camera video quadrats per station
      - Presence/Absence
      - Percent cover
      - Algae
    - Depth sounding
  - RTK GPS checkpoints (n = 24)
  - Secchi disk
  - Underwater light measurements (n = 10)
    - Diffuse attenuation coefficients

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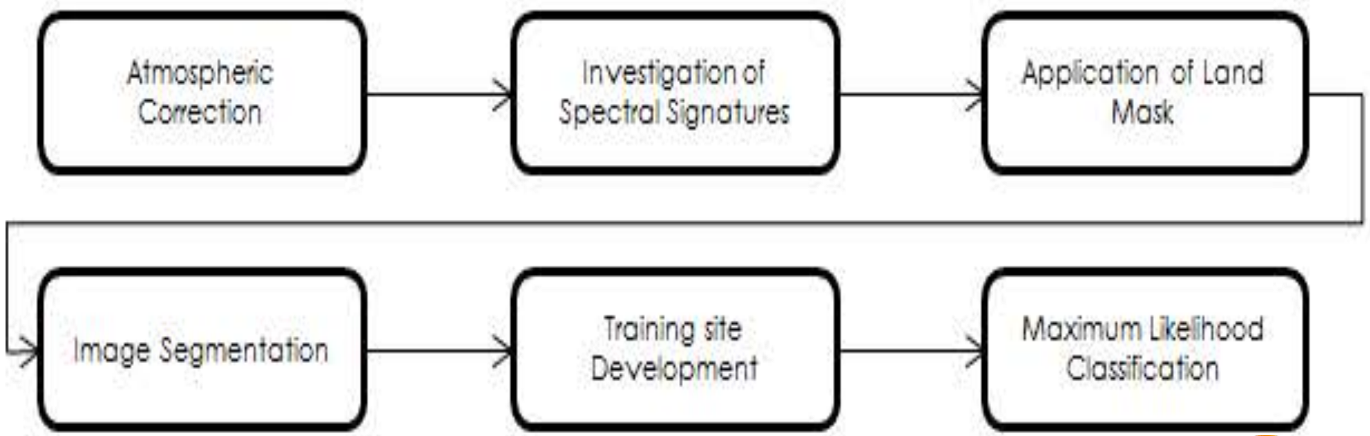
2 Methods - WorldView-2

- 8-band image set collected on September 24th, 2014
  - Coastal Blue, Blue, Green, Yellow, Red, Red edge, NIR1, NIR2
- Spatial resolution of 0.46m (pan-sharpened)
- Combination of image segmentation and supervised classification



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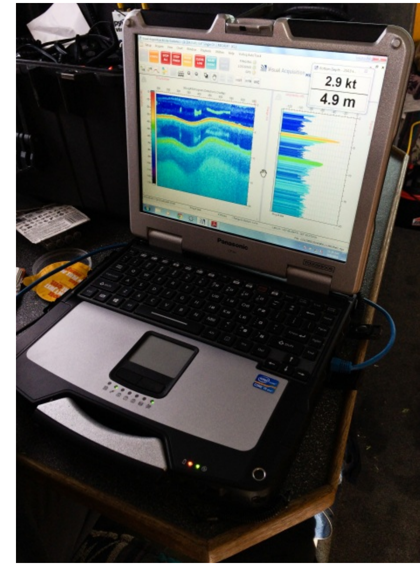
2 Methods - Single Beam Sonar



- BioSonics accuracy
  - Range: 1.7 cm ± 0.2% of depth
  - Positional: <3 m, 95% typical
- \>8,500 data points
  - Bathymetry
  - Percent cover
  - Canopy height
  - Sediment classifications
- Transects oriented east-west spaced approximately 350 m apart in a north-south direction
  - total linear distance = 30.4 km
  - area of 5.45 km^2

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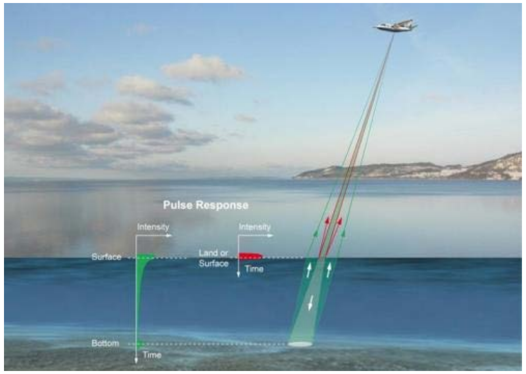
2 Methods -Lidar

Topo-Bathy Lidar (Chiroptera II)

- 1064 nm near infrared (NIR) topo laser for ground returns and a green 515 nm bathy laser for seabed returns.

3 products produced, including:

- Lidar elevation (bathymetry)
- Lidar only eelgrass map
- Lidar-Aerial Photo Eelgrass map supplemented with Single Beam Sonar
- Full details in Webster et al. (*in press*)



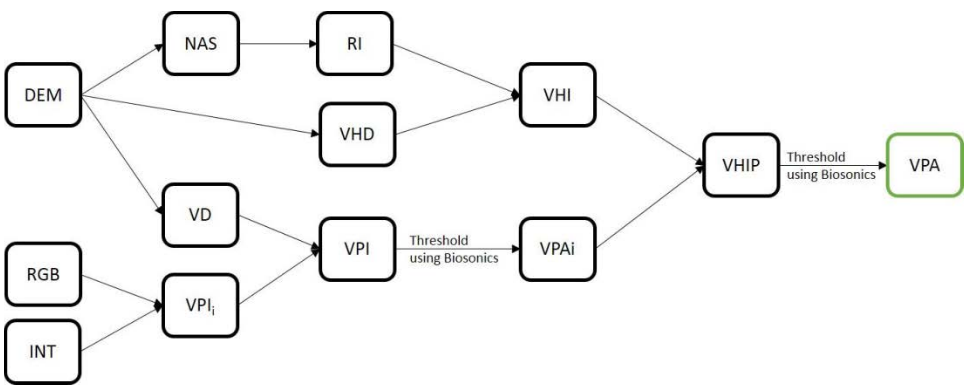
2 Integrated Assessment

BioSonics filled data gaps from WV-2/Lidar

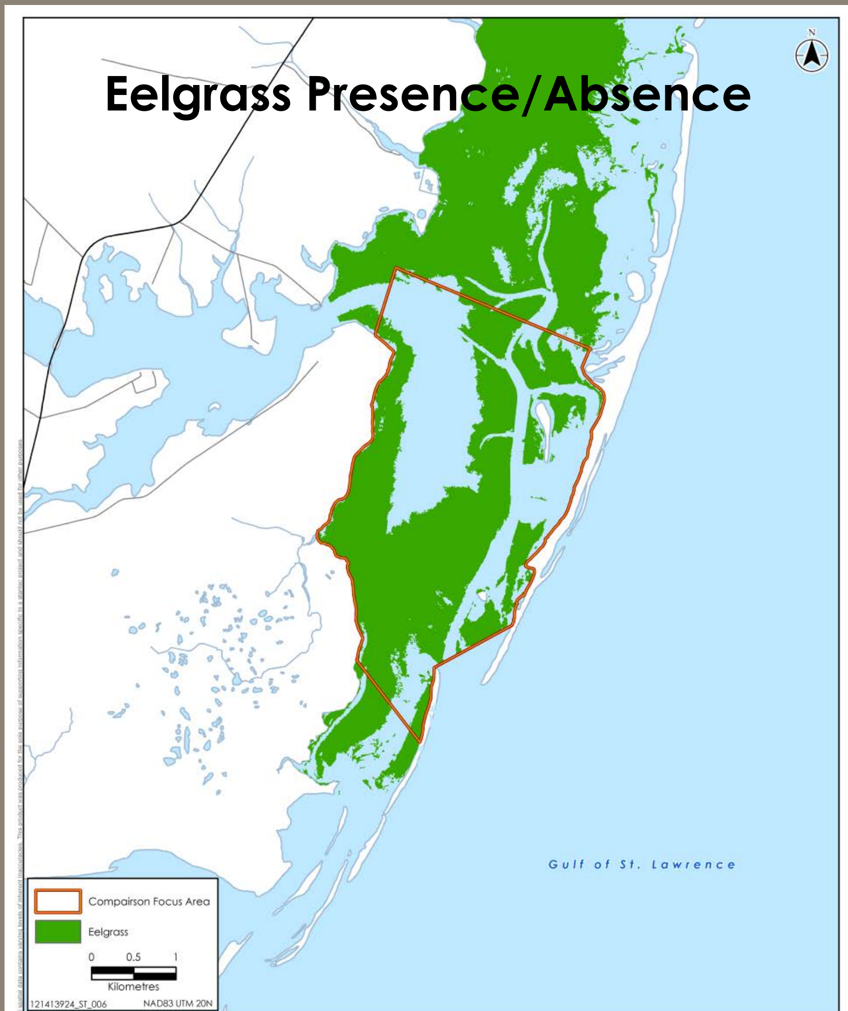
- **depth-signal attenuation**

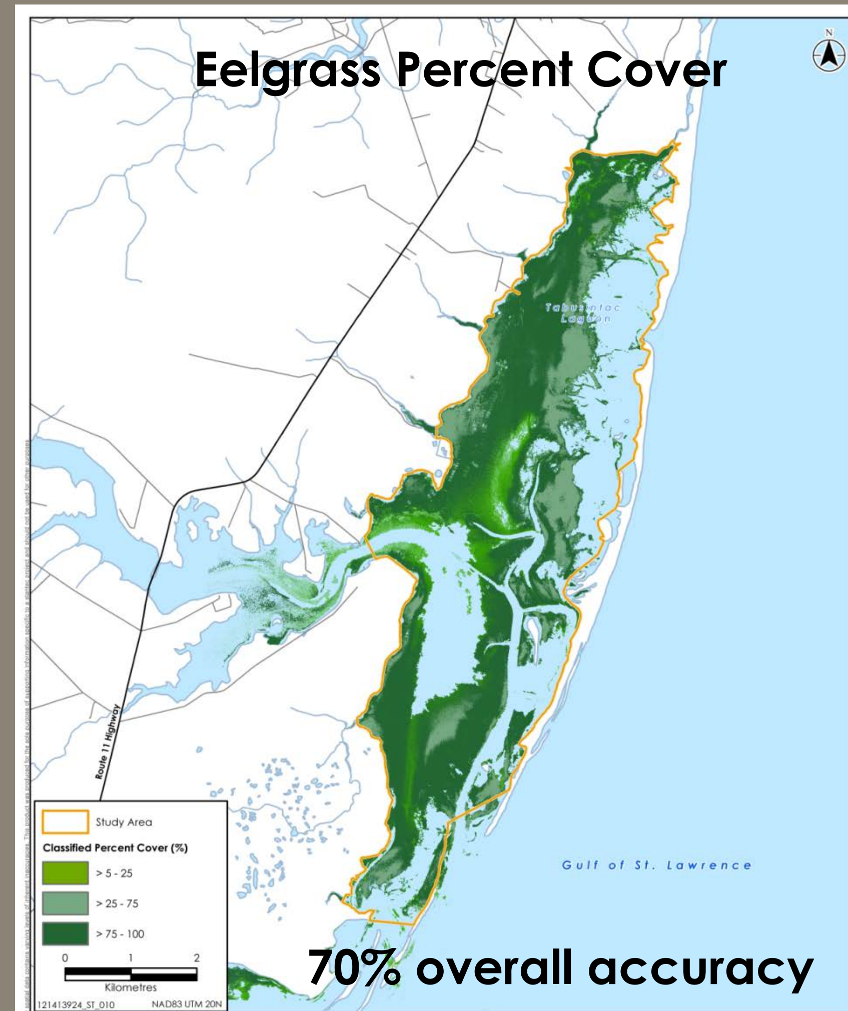
BioSonics supplemented to gauge overall accuracy effect

- **Super Maps!**



3 Results – WorldView-2





- Mostly medium-high density
- 15.8 km^2 of eelgrass
- E of O (false neg) greatest @ low PC
- Swath of "0% cover"

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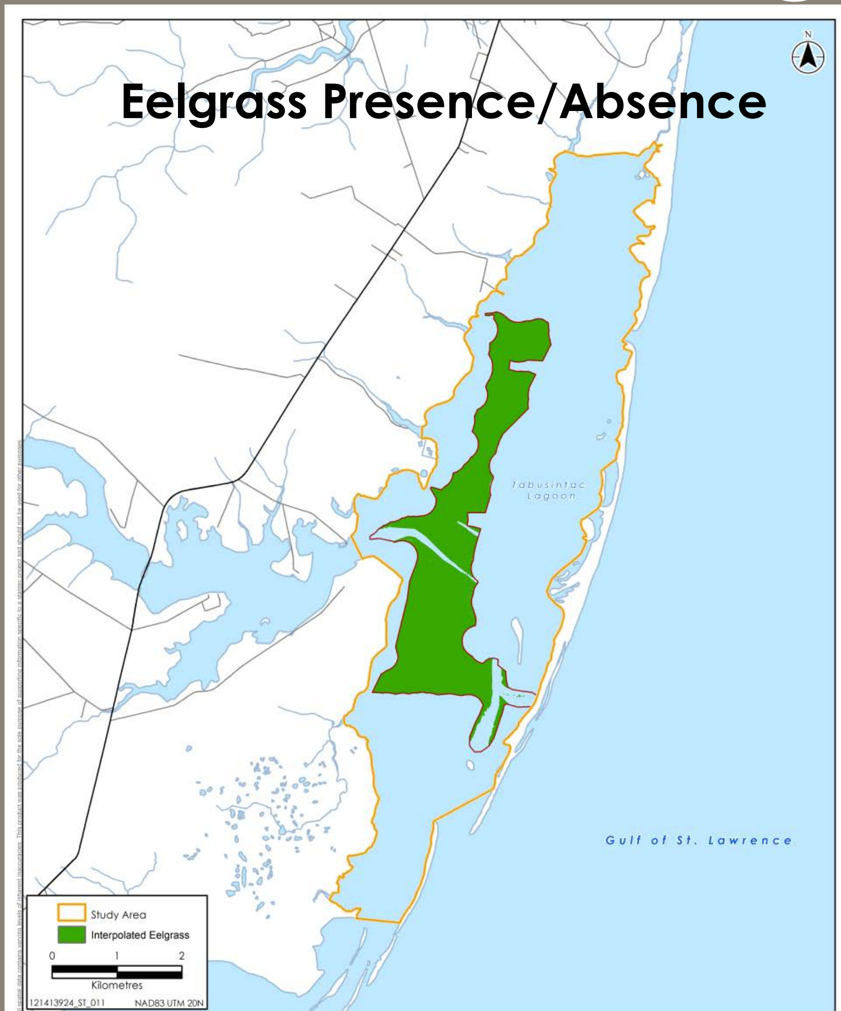
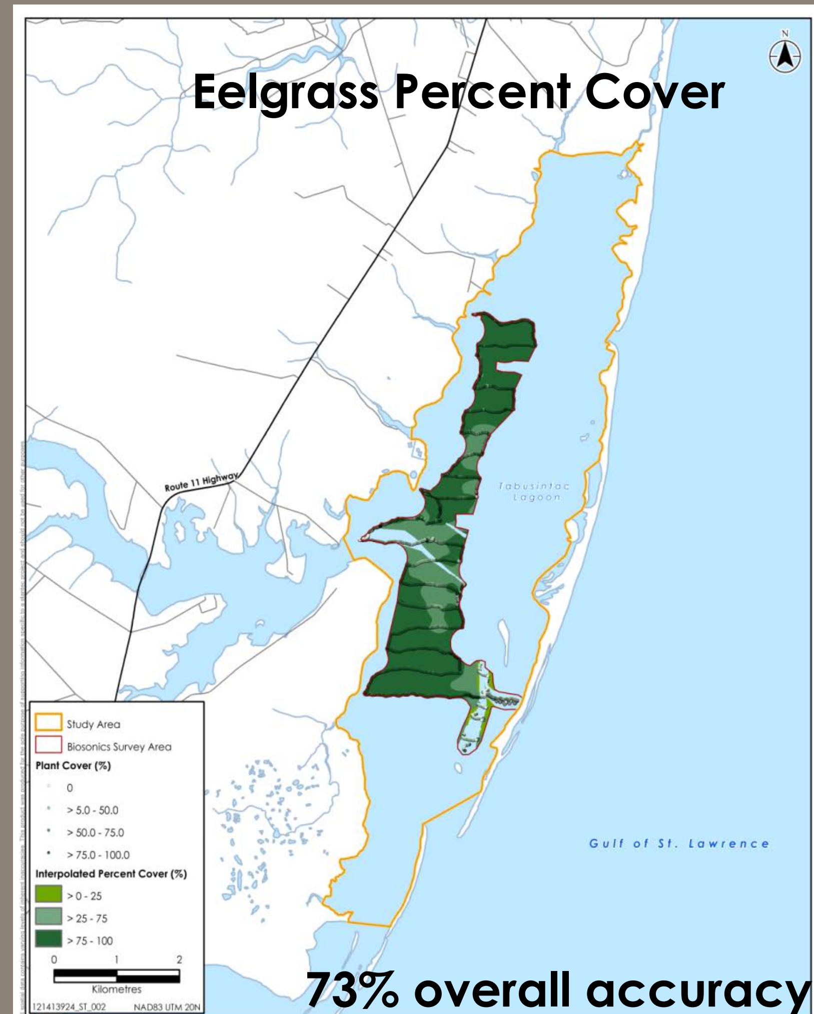
3 Results – Single Beam Sonar





- Mostly medium-high density
- 15.8 km^2 of eelgrass

- E of O (false neg) greatest @ low PC
- Swath of "0% cover" reduced

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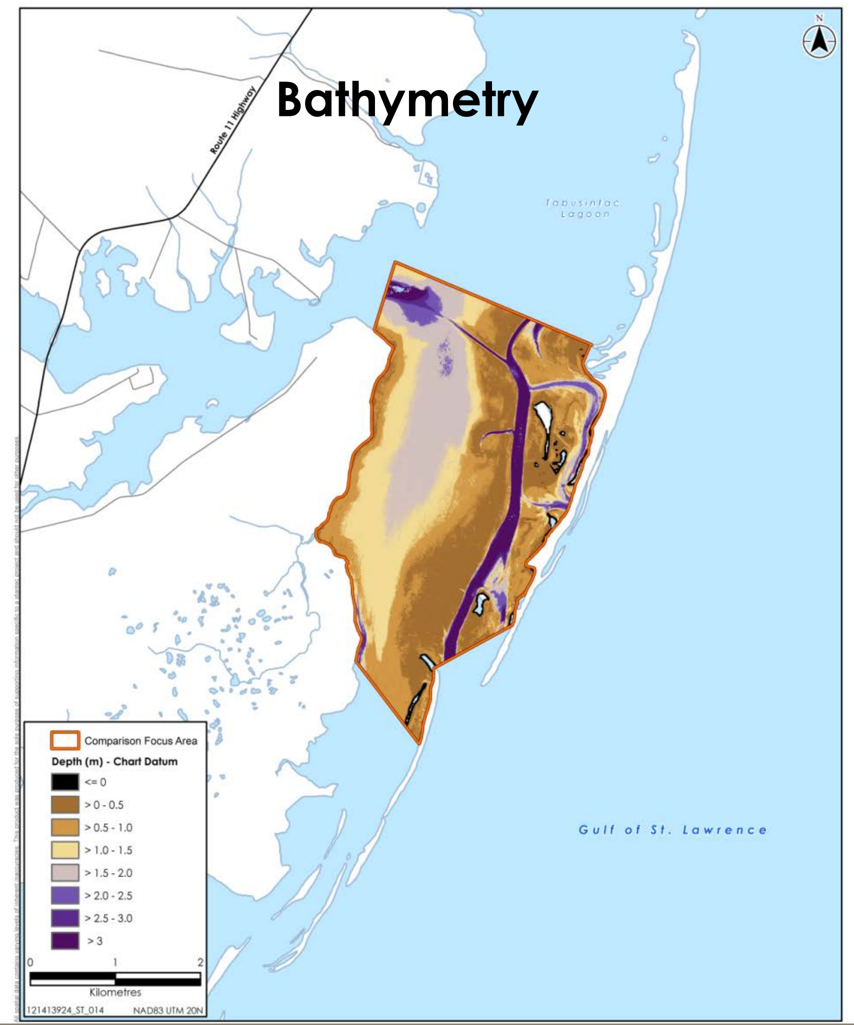
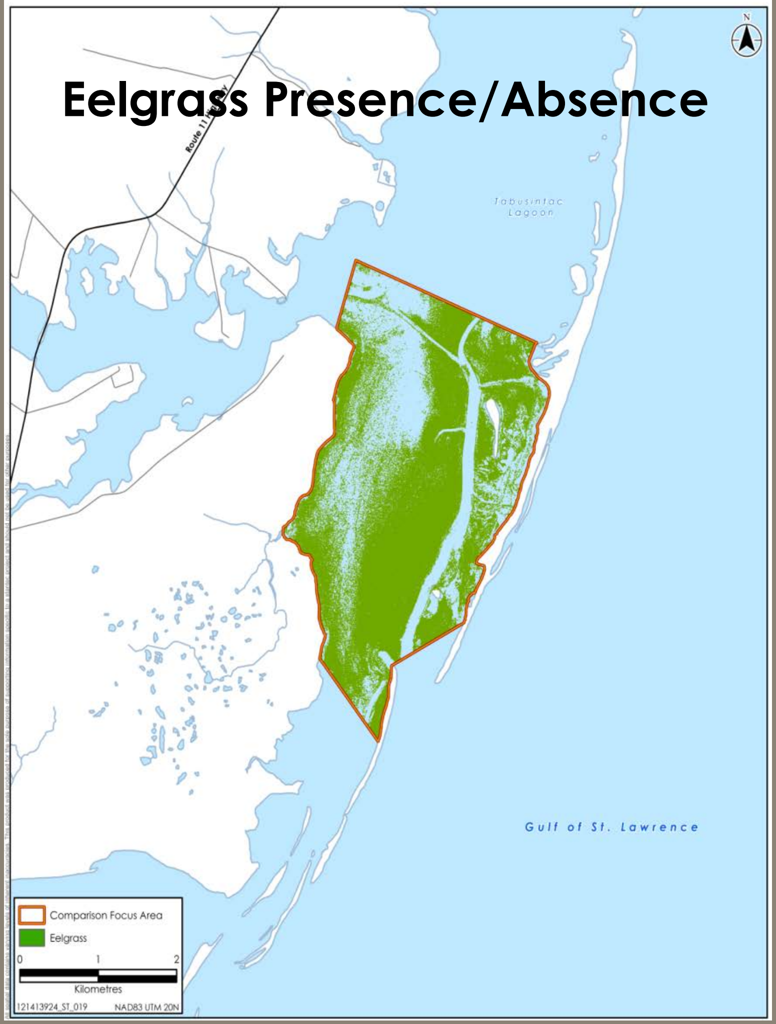
3 Results – LiDAR





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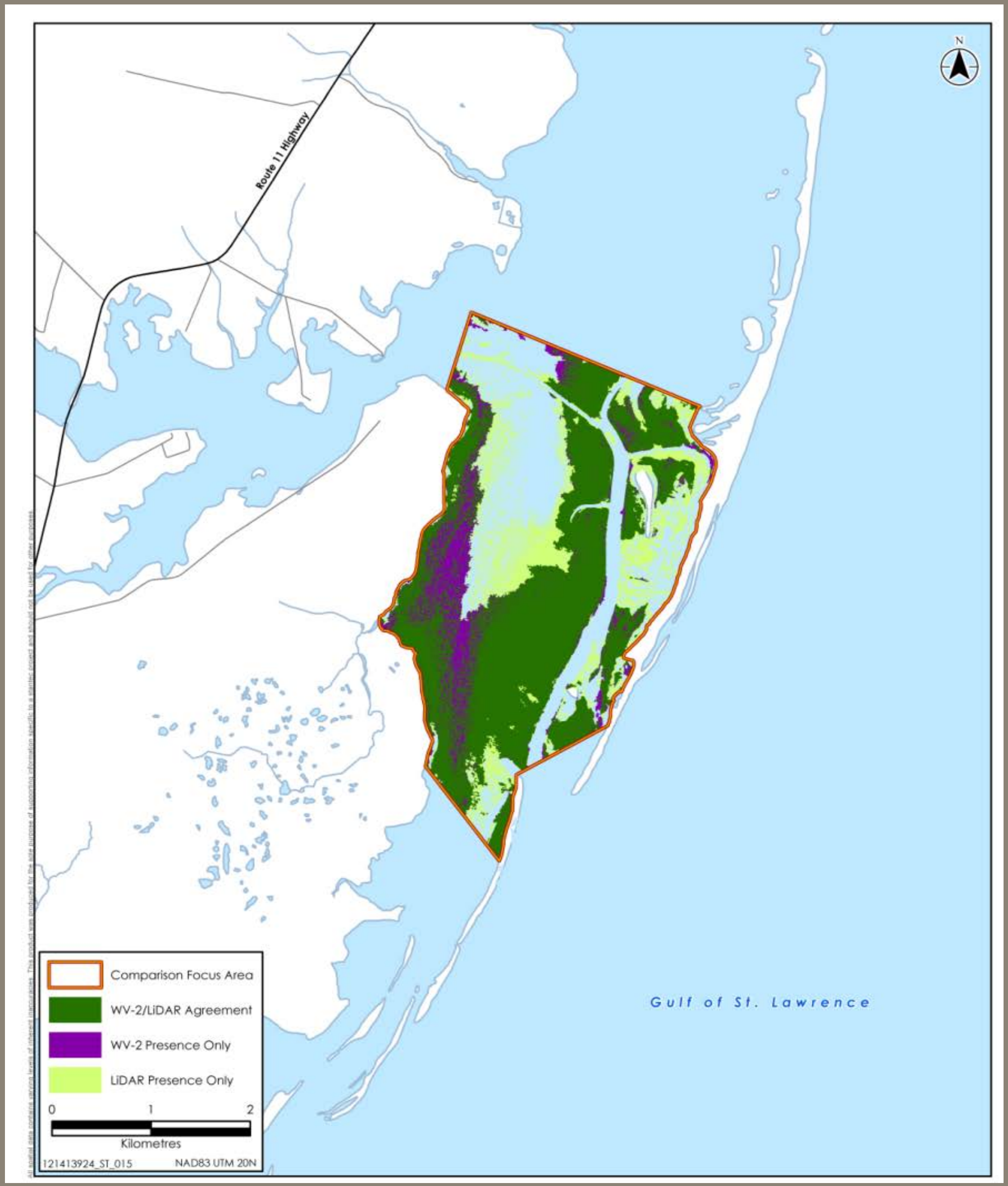
3 Results – LiDAR



- Comparable to WV-2, with slight disagreements
- 75% joint presence/ absence for lidar and WV-2

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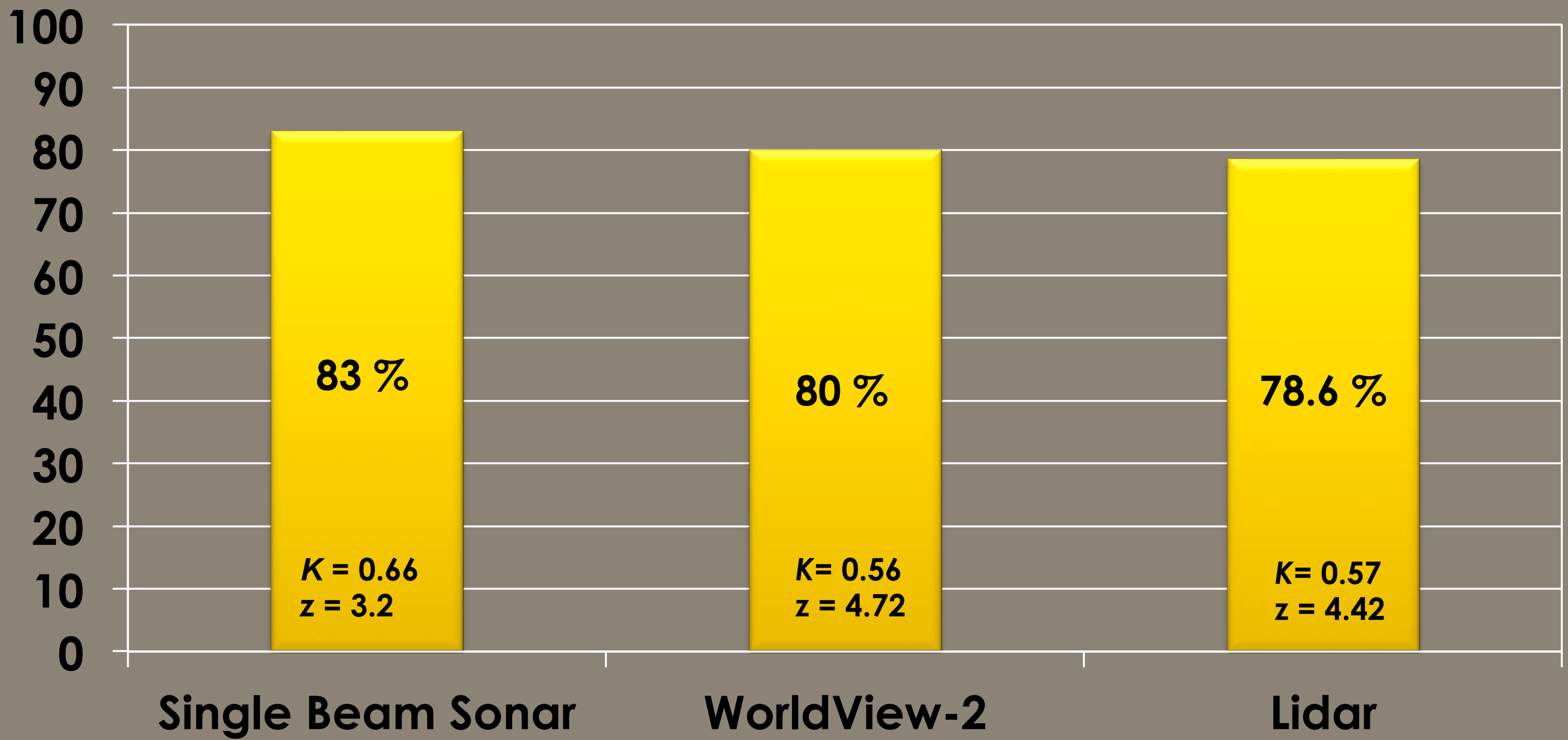
Overall Accuracy (%) P/A



For eelgrass presence/absence, all methods are statistically indistinguishable from ground-truth data, as indicated by the Kappa Statistic ($p < 0.001$).

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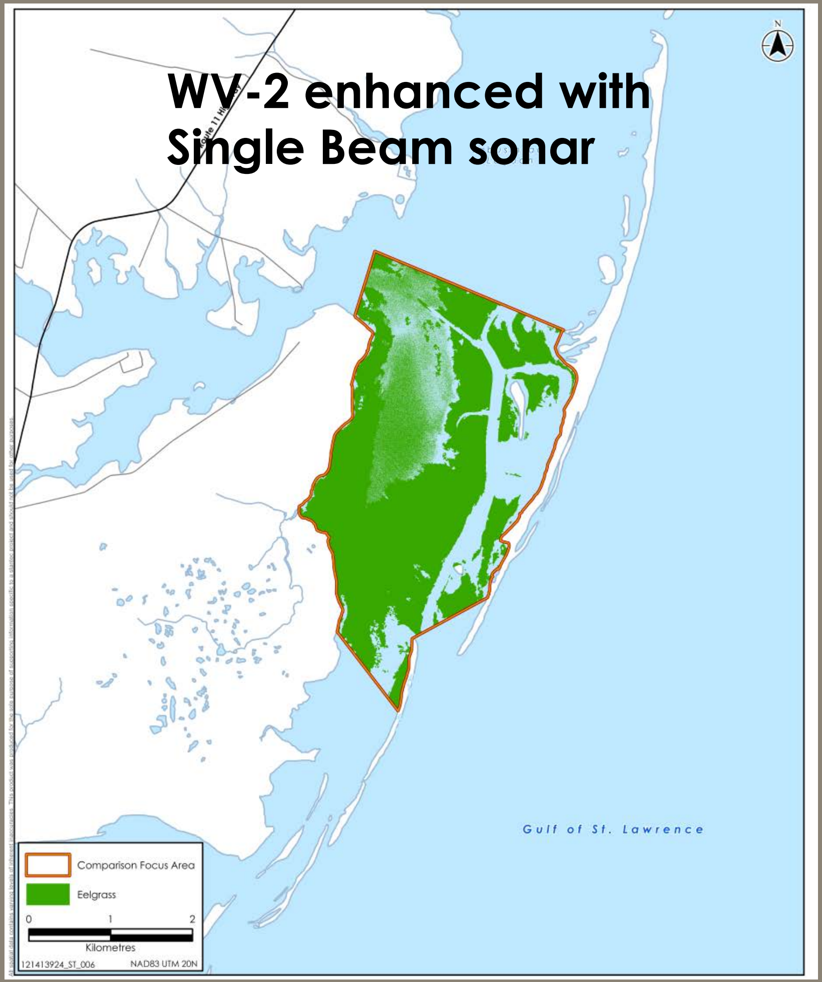
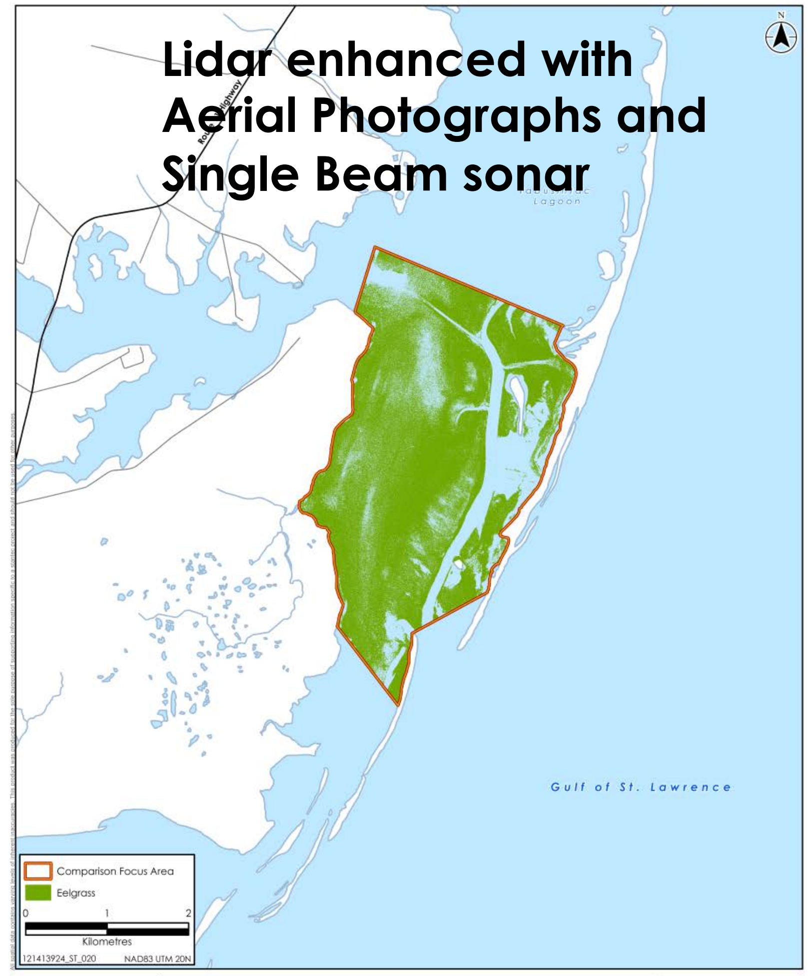
3 Results – Integrated Assessment





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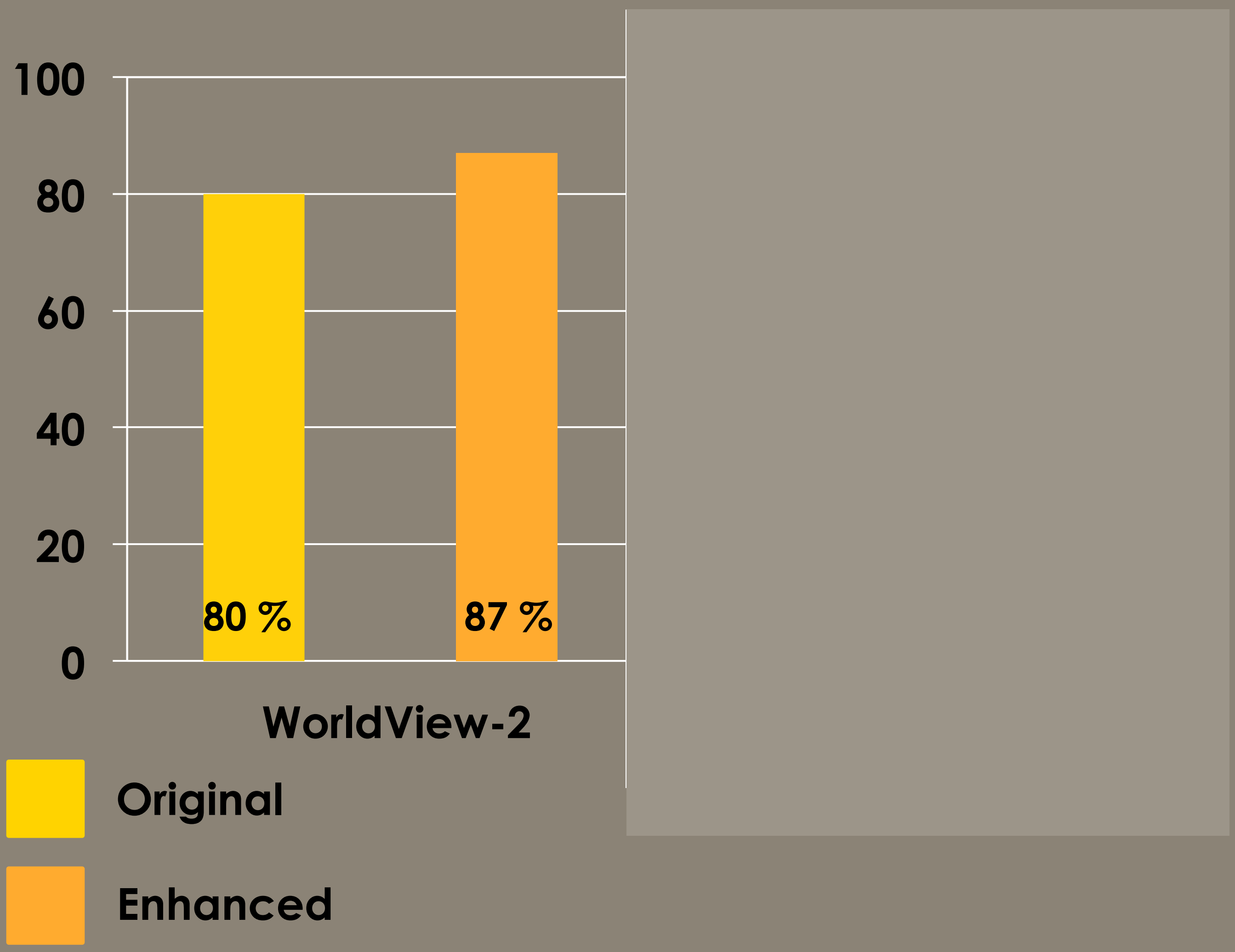
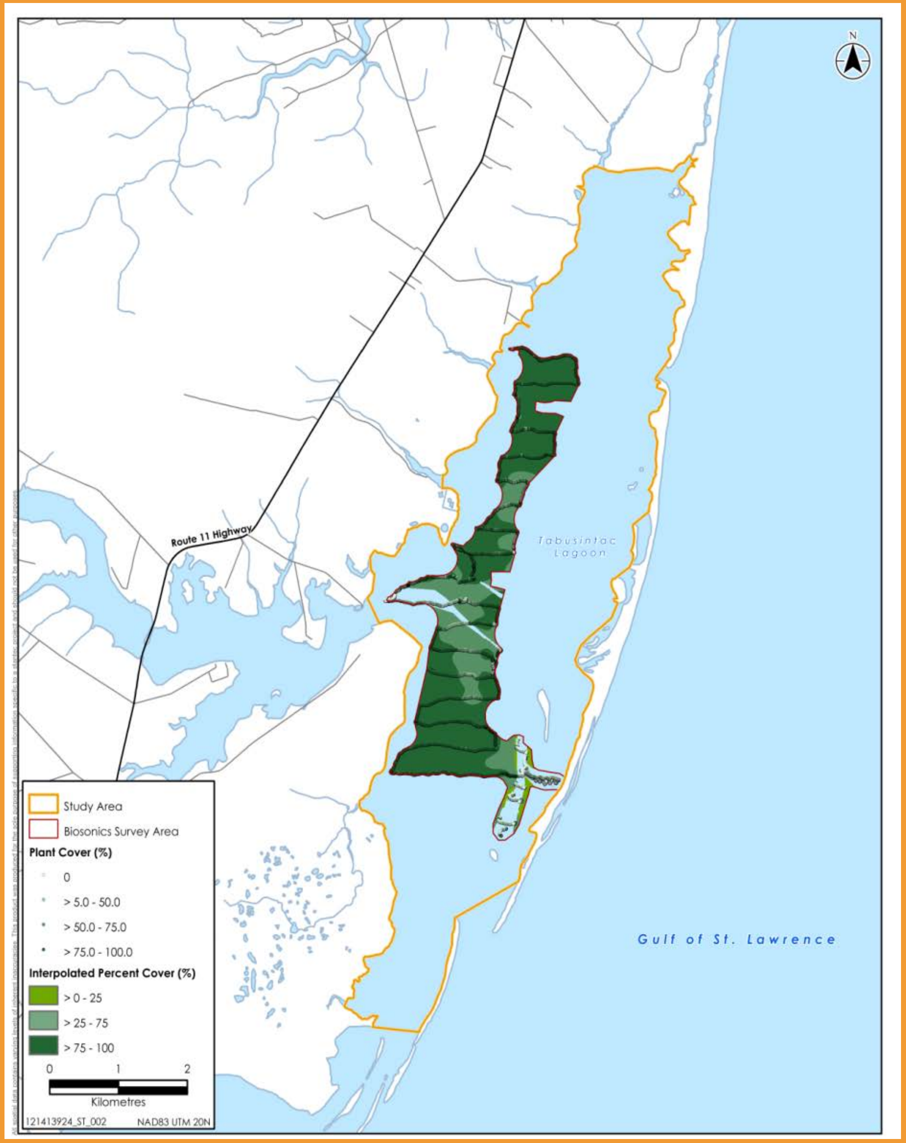
3 Results – Integrated Assessment



4 Discussion

BioSonics

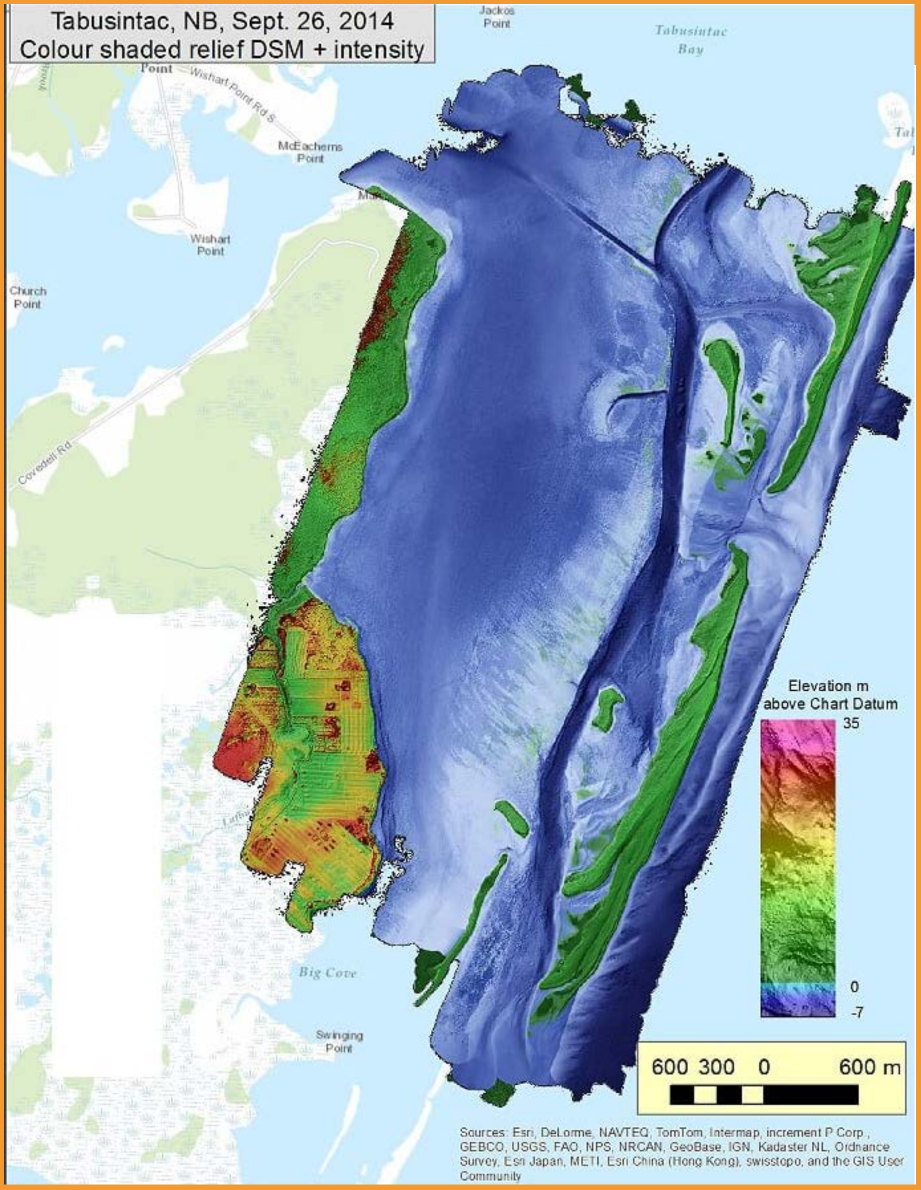
- Transect spacing not ideal (usually 50 m cells)
- If interpolated map acceptable, sonar is powerful
- High res PC, feature delineation, canopy height, bathymetric, and sediment composition maps not affected by water depth or water clarity
- $ - Cheapest option



4 Discussion

Lidar

- Accurate
- Anomaly-spectral signature of affected by water depth and water clarity
- benefits from the number of data products that are collected simultaneously: water depth, water surface, intensity, and orthophotos
- Depth normalization
- $$$ - most expensive option



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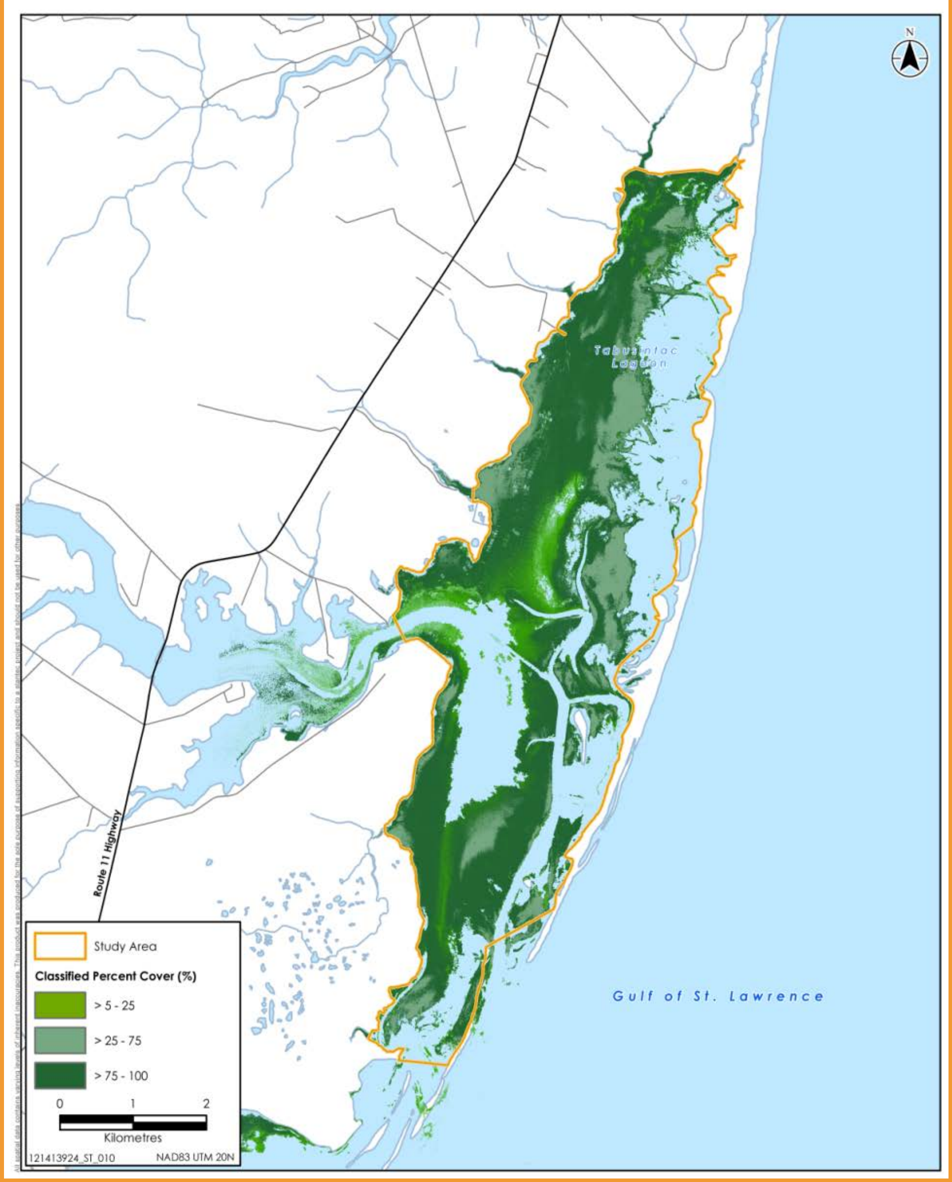
4 Discussion

WV-2

- Accurate
- Also provides PC
- Anomaly-spectral signature of affected by water depth and water clarity
- ongoing sGSL research and Barrell et al. (2015) produced eelgrass maps at greater depths
- $$ - 2nd cheapest option



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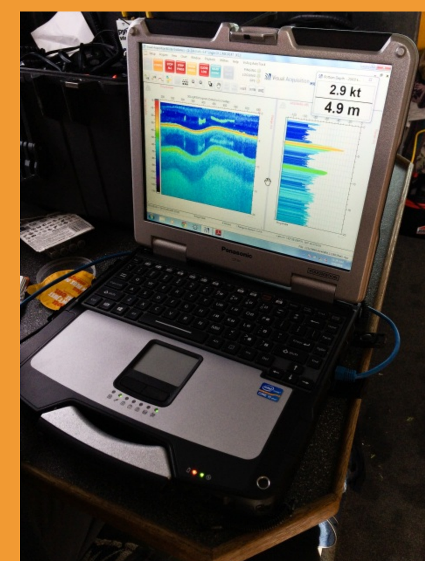
4 Discussion

- Each technique accurate yet each methodology had its own strengths and limitations.
- Depending on study goals, any one or a combination of these methods could produce reliable maps



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Questions?