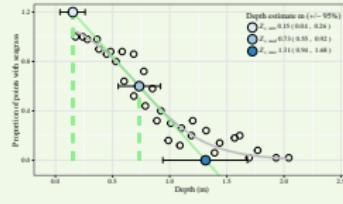


Quantifying seagrass light requirements using an algorithm to spatially resolve depth of colonization

Marcus W. Beck, James D. Hagy III, Chengfeng Le

USEPA National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, beck.marcus@epa.gov, Phone: 8509342480

Nov. 4, 2016





Seagrasses and water quality

Seagrasses are beneficial - healthy seagrass, healthy estuary

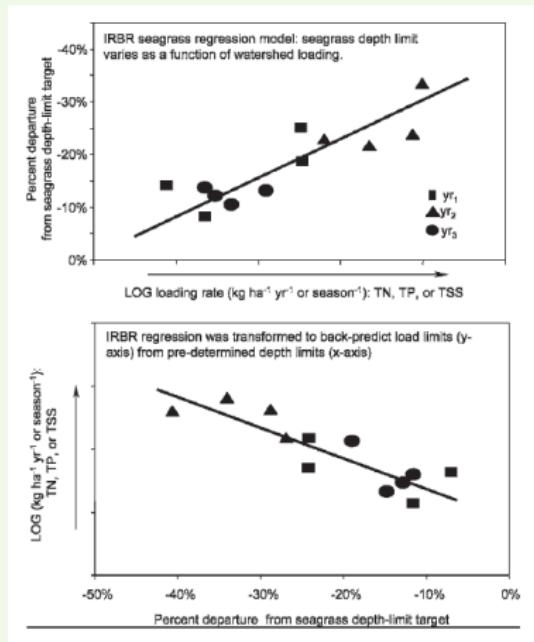
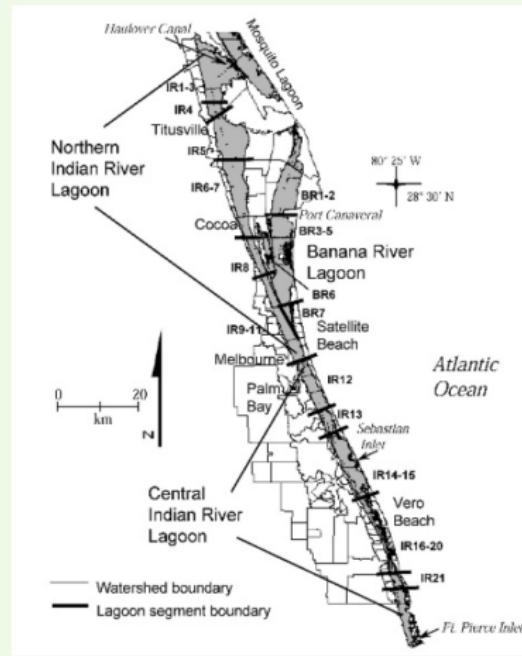


Seagrasses are sentinels of water quality [Short and Wyllie-Echeverria, 1996]

flickr.com/photos/swimvixen2

Seagrasses and water quality

Nutrient limits using seagrass depth-limit targets [Steward and Green, 2007]





Seagrasses and water quality

The maximum depth of colonization is a useful proxy of eutrophication

Often used as a basis for establishing nutrient criteria



Seagrasses and water quality

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Often used as a basis for establishing nutrient criteria

Problem 1: No consensus on the best way to measure depth of colonization

Problem 2: Plenty of data are available but standardized techniques have not been developed



Seagrasses and water quality

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Problem 2: Plenty of data are available but standardized techniques have not been developed

Study objective

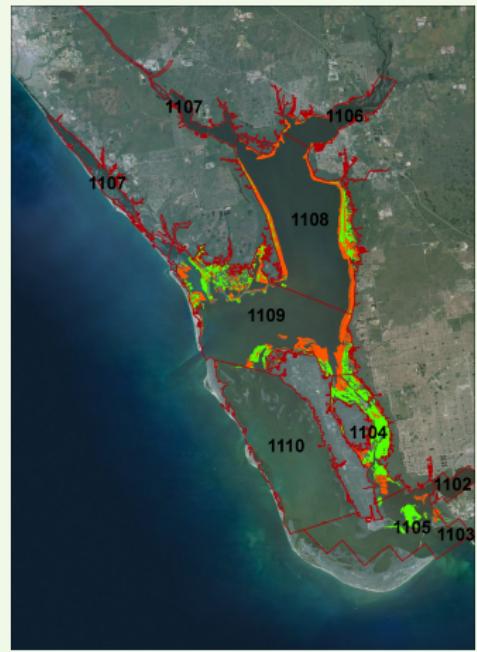
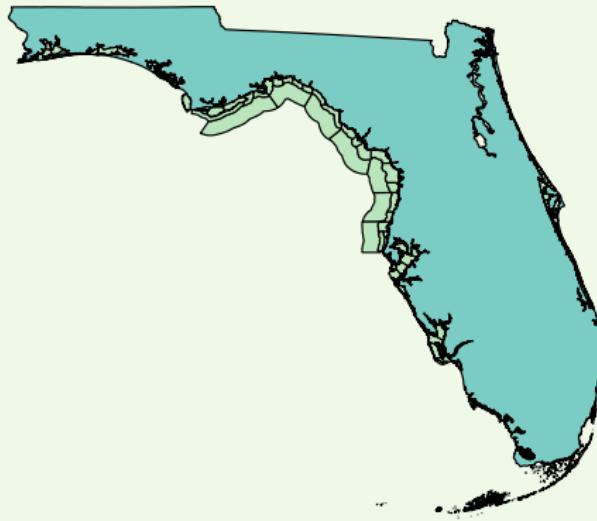
Develop and apply an algorithm that uses geospatial data to describe relationships between seagrass depth limits, water clarity, and light requirements [Beck, Hagy, Le, in review]



Seagrasses and water quality

Existing geospatial datasets - coastal segments, seagrass areal coverage, bathymetry

Segment-based approach





Seagrasses and water quality

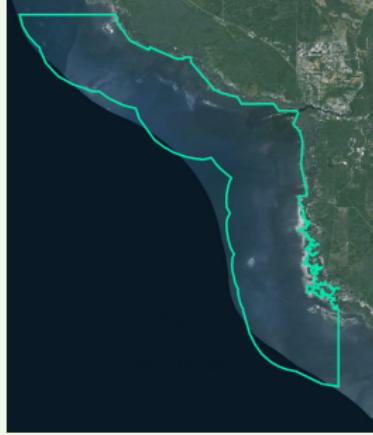
How can we estimate depth of colonization?



Seagrasses and water quality

How can we estimate depth of colonization?

1. Pick a segment

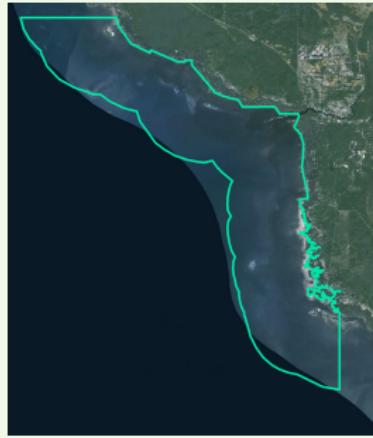




Seagrasses and water quality

How can we estimate depth of colonization?

1. Pick a segment



2. Get seagrass area

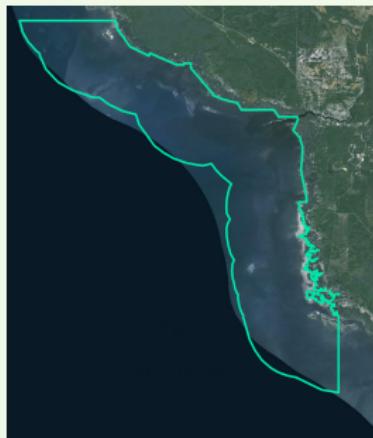




Seagrasses and water quality

How can we estimate depth of colonization?

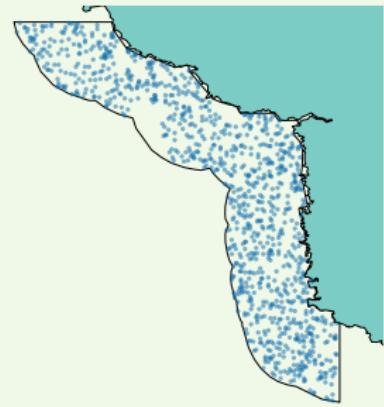
1. Pick a segment



2. Get seagrass area



3. Get depth points

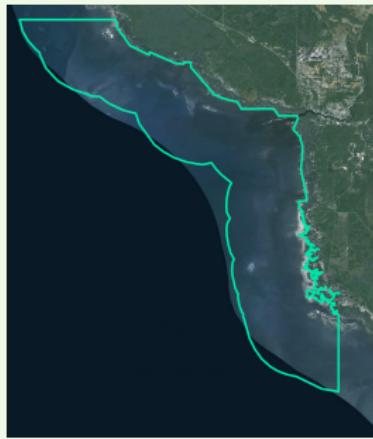




Seagrasses and water quality

How can we estimate depth of colonization?

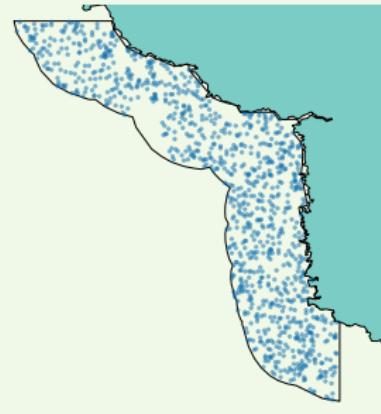
1. Pick a segment



2. Get seagrass area



3. Get depth points

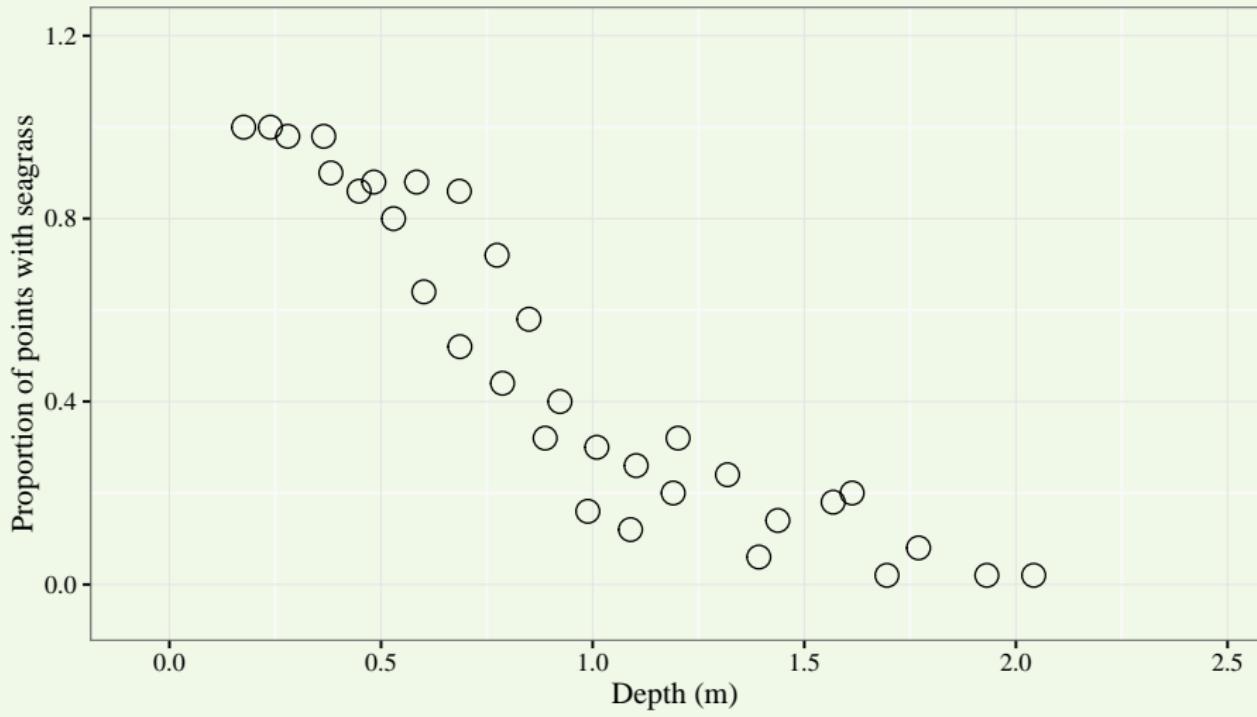


4. Match depth points with p/a of seagrass...



Seagrasses and water quality

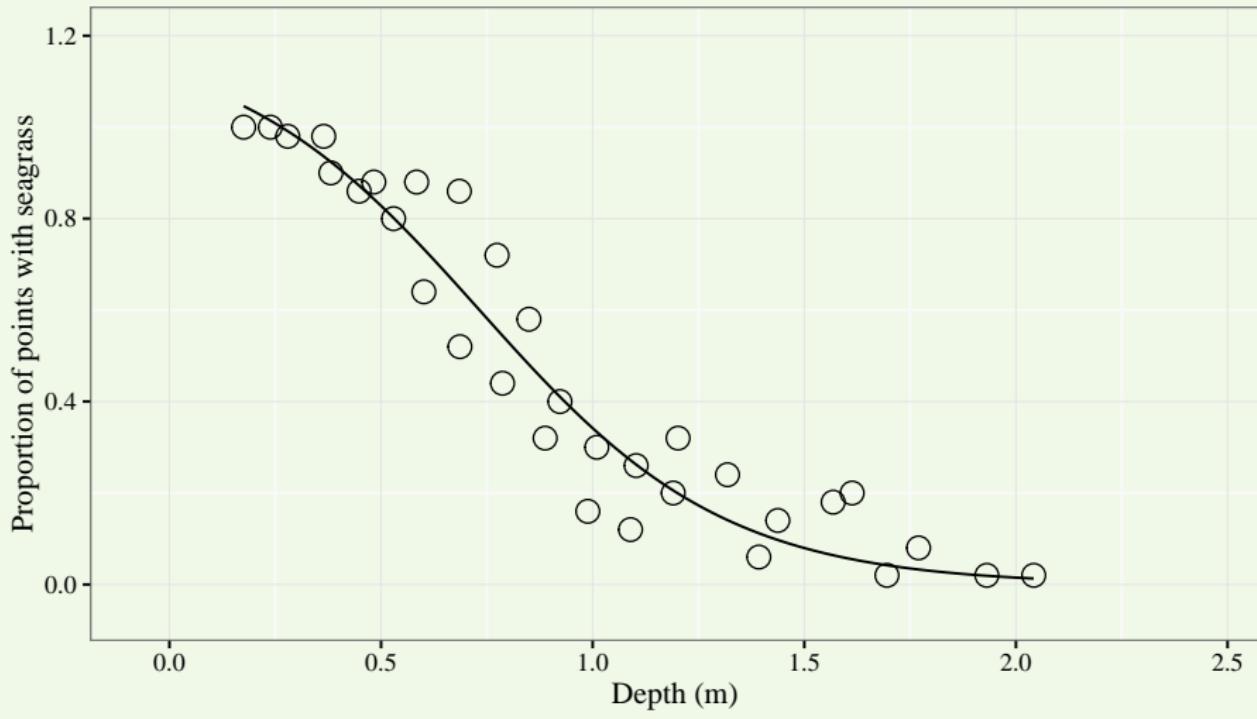
Plot the distribution of seagrass by increasing depth





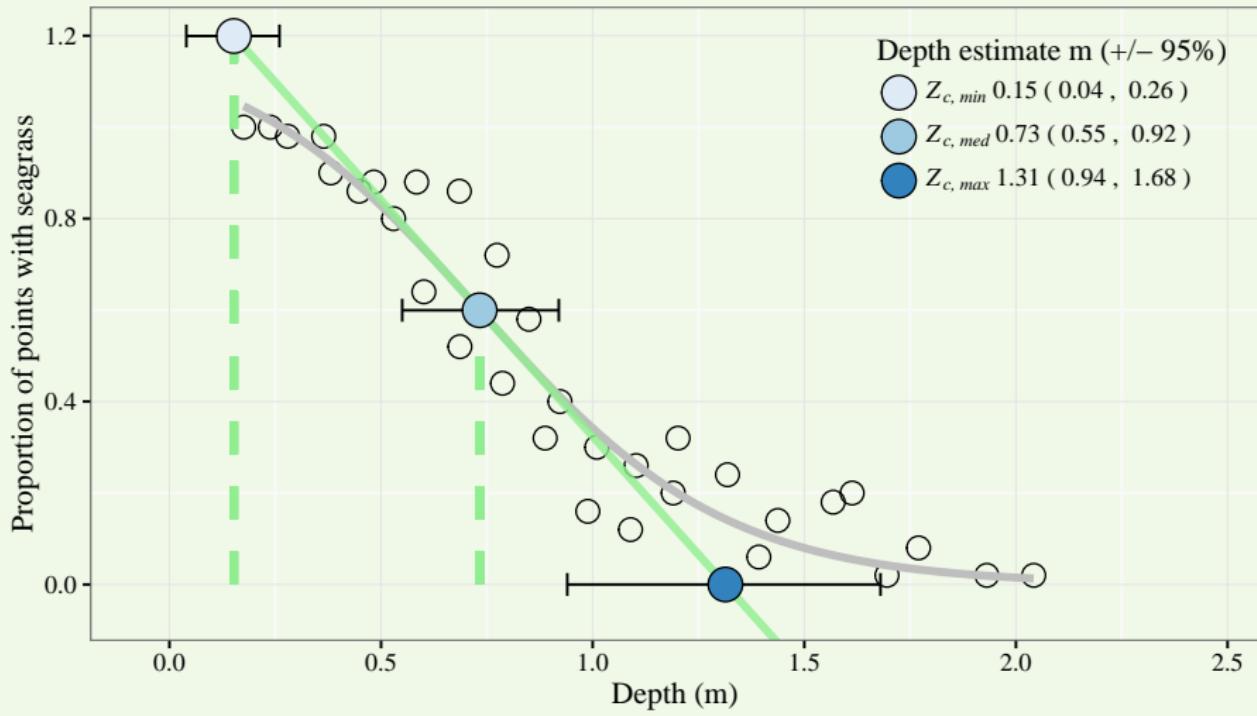
Seagrasses and water quality

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Seagrasses and water quality

Plot the distribution of seagrass by increasing depth





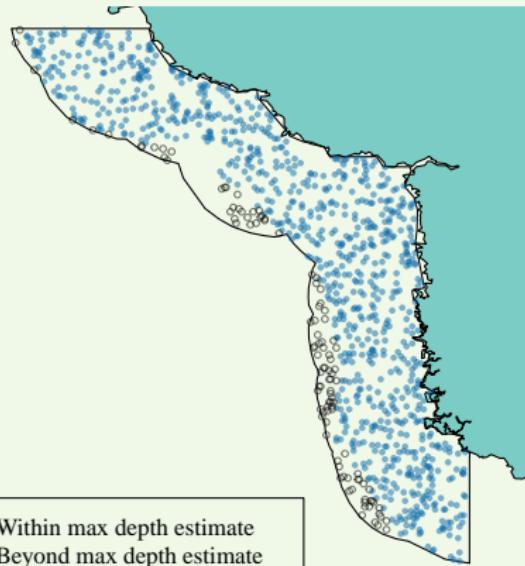
Seagrasses and water quality

The estimate depends on the spatial context...



Seagrasses and water quality

The estimate depends on the spatial context...

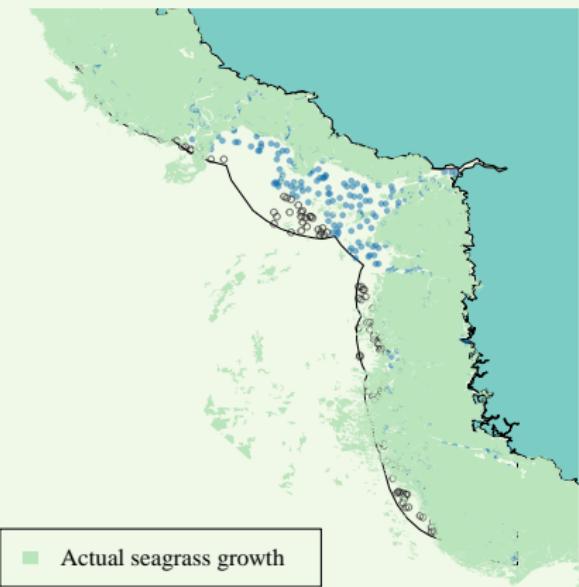
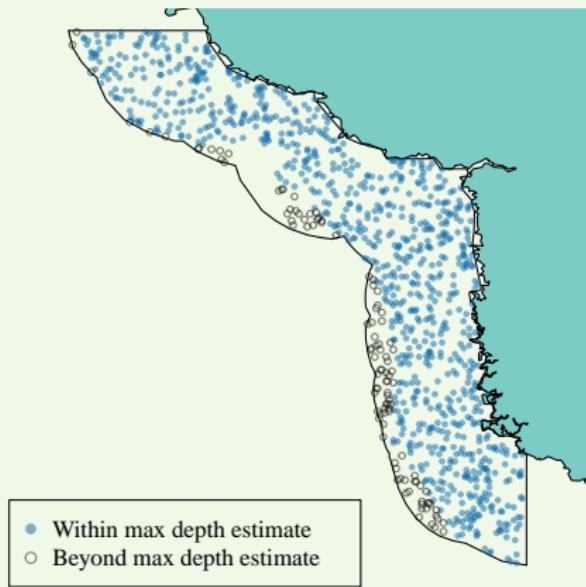


- Within max depth estimate
- Beyond max depth estimate



Seagrasses and water quality

The estimate depends on the spatial context...





Seagrasses and water quality

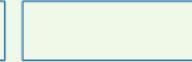
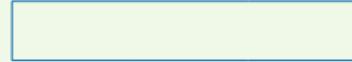
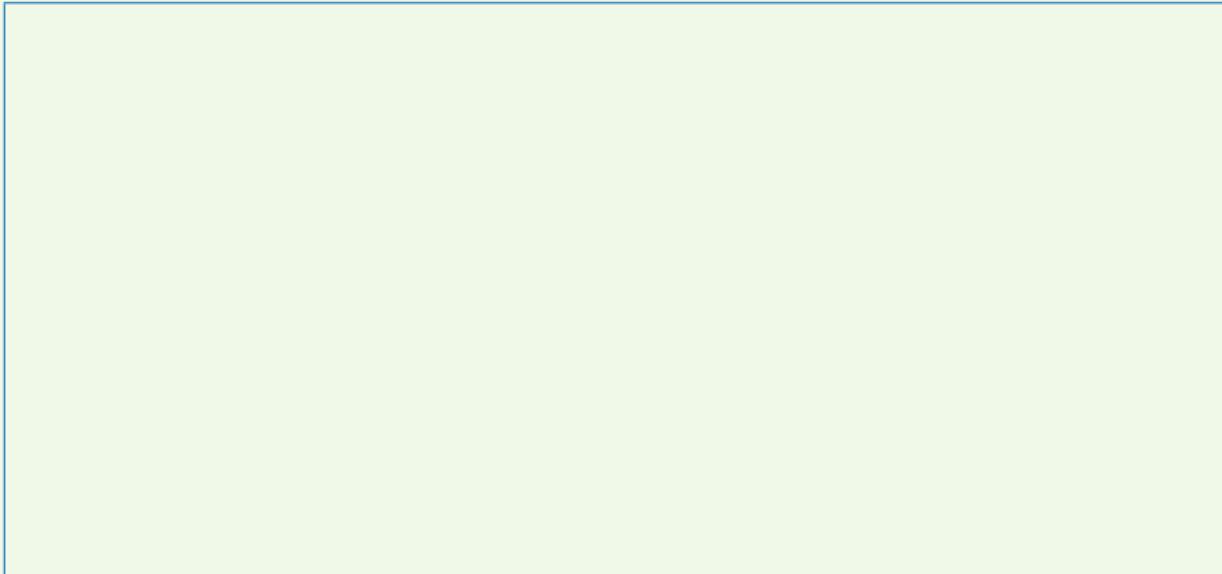
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Seagrasses and water quality

The estimate depends on the spatial context...





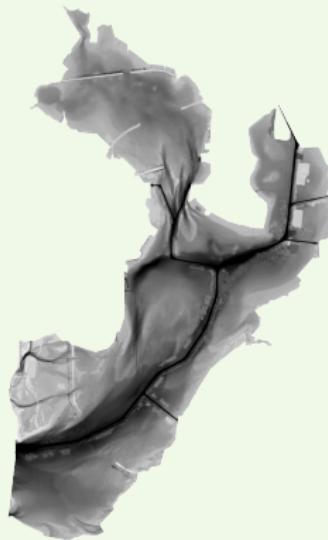
Seagrasses and water quality

The algorithm was applied to entire estuaries with relevant data

Boundaries



Depth



Seagrass



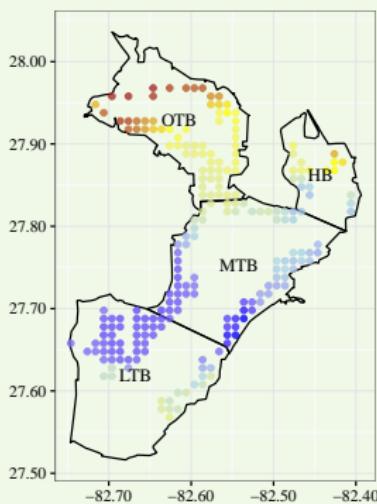
Seagrasses and water quality

Can we link depth estimates with water clarity to understand light requirements?

Depth of colonization

$Z_{c, med}$ (m)

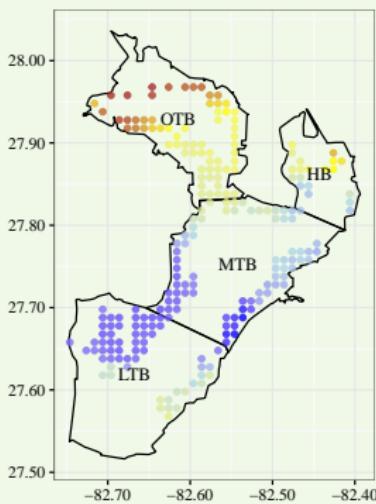
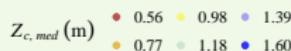
- 0.56
- 0.77
- 0.98
- 1.18
- 1.39
- 1.60



Seagrasses and water quality

Can we link depth estimates with water clarity to understand light requirements?

Depth of colonization



$$\%SI = 100 \cdot \frac{I_z}{I_o} = \exp(-K_d \cdot Z_{c,med})$$

I_z : irradiance at depth

I_o : irradiance at surface

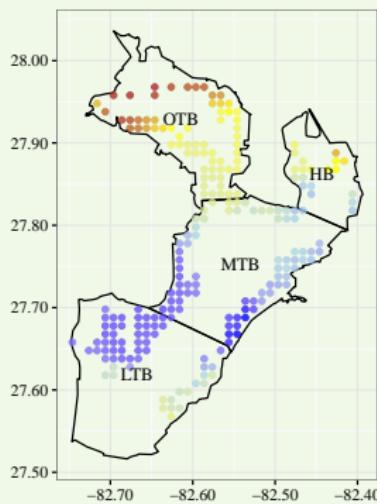
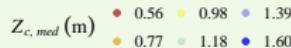
K_d : light extinction coefficient

- Percent surface irradiance at depth as a measure of seagrass light requirements
- Can be used to characterize light regimes that maintain seagrass habitat

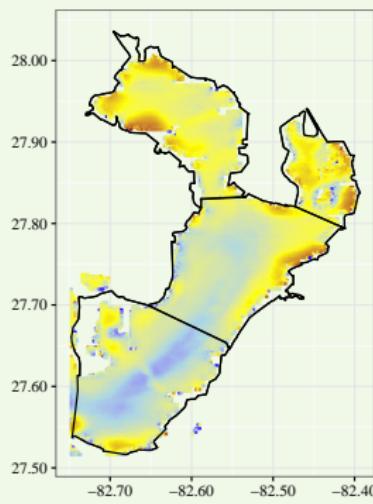
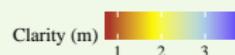
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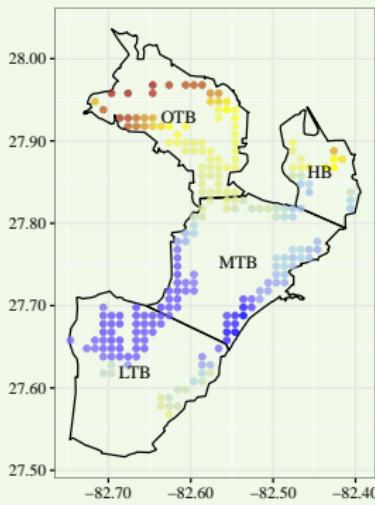
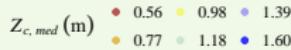
Water clarity



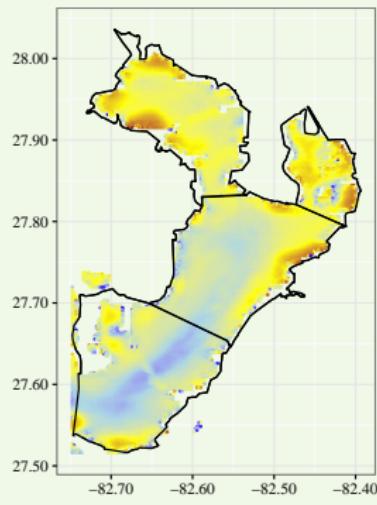
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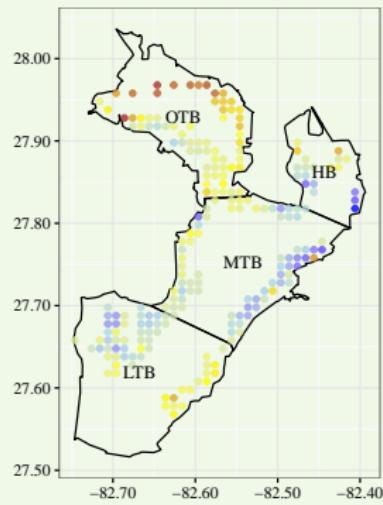
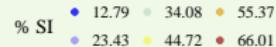
Depth of colonization



Water clarity



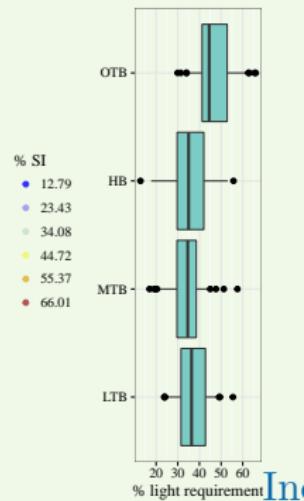
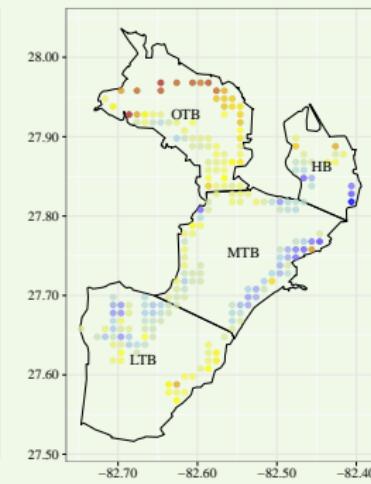
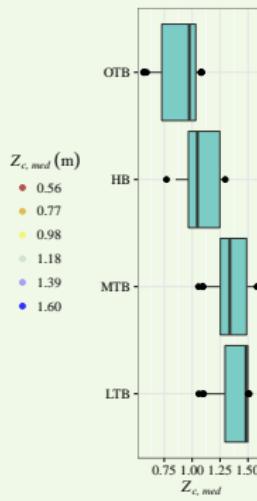
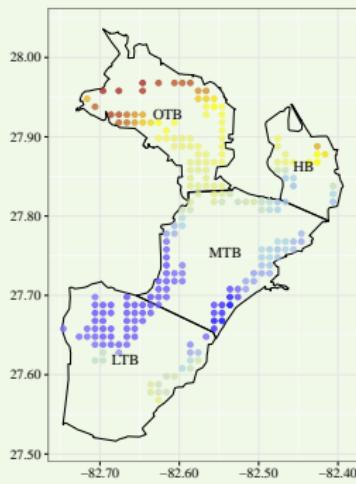
Light requirements



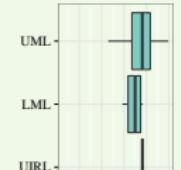
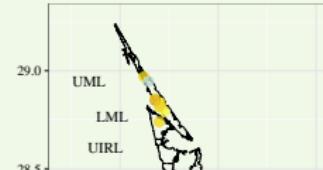
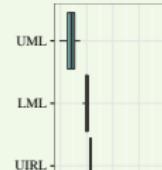
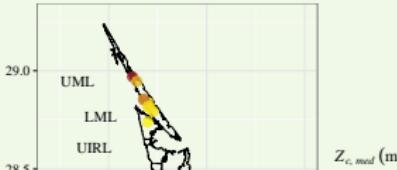


Seagrasses and water quality

Tampa Bay summary:



River Lagoon summary:





Seagrasses and water quality

Benefits of the approach:

- The spatial unit for any estimate of seagrass growth limit is problem-specific
- Allows for a ‘compliance-point’ approach (saves time/money)
- Increased understanding of seagrass growth patterns - natural and anthropogenic drivers



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Lots to be done...

References

- Short FT, Wyllie-Echeverria S. 1996.
Natural and human-induced disturbance of seagrasses.
Environmental Conservation, 23(1):17–27.
- Steward JS, Green WC. 2007.
Setting load limits for nutrients and suspended solids based upon seagrass depth-limit targets.
Estuaries and Coasts, 30(4):657–670.