Improving spatial resolution in estimates of seagrass depth of colonization

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1 Outline

- Needs
  - Seagrass related to habitat quality and strongly affected by water clarity
  - Extensive datasets describing historical and current seagrass growth patterns and distribution in Florida estuaries
  - No consistent approach for estimating depth of colonization (DoC) to establish restoration targets
  - WBID has been considered appropriate management unit although considerable spatial heterogeneity in seagrass growth
  - Reproducible and empirical approaches can be developed that leverage multiple types of information to provide more consistent estimates for restoration targets or nutrient criteria
- Objectives
  - Use information-rich datasets to estimate seagrass DoC by incorporating spatially referenced information
  - Provide a basis for using these estimates to inform nutrient criteria development using empirical relationships with water clarity
- Approach
  - Describe Hagy method and/or WBID approach, emphasis on situations where seagrass growth is spatially variable or when restoration target is misinformed
  - Describe spatially-referenced method, case studies
  - Compare/contrast the two, with emphasis on relation to secchi data

  - Implications for criteria development and/or restoration targets

- To do
  - Rectify seagrass depth bin procedures
  - Tidal datum correction
  - Segment specific relationship of seagrass depth of col w/ Secchi
  - Compare cumulative sum approach with binning
  - Quantitative evaluation of grid spacing, grid location, and radius

2 Methods

The following describes methods used to estimate seagrass DoC that incorporate spatial information to improve resolution. Methods build extensively on those in Hagy et al. (in prep).

2.1 Within-segment variation in seagrass depth of colonization estimates

First, an example is provided that illustrates spatial heterogeneity within an individual estuary segment to highlight a need for improved resolution. Segments are commonly used as a basis for quantifying nutrient criteria and it is shown that these spatial scales may not be sufficient for characterizing variation in seagrass growth. Hagy et al. (in prep) describe methods for estimating seagrass DoC by segments using historical and current records of seagrass coverage combined with bathymetric data. The approach begins by combining bathymetric sounding data with coverage data to create a Geographic Information System (GIS) layer containing both sets of information. The points are grouped into depth bins and the proportion of points within each depth bin that contain seagrass are quantified. The maximum DoC for each segment is estimated using a plot of proportion of points occupied against depth bin. In general, the plot is characterized by a decreasing trend such that the proportion of occupied points by depth bin decreases and flattens with increasing depth. A regression is fit on this descending portion of the curve such that the intercept point on the x-axis is considered the maximum depth of colonization. The median portion of this curve is considered the median depth of the deepwater edge of seagrass. Estimates are obtained for seagrass coverage layers that describe continuous and continuous with patchy (all) seagrass.

Figure 1 illustrates spatial variation in seagrass distribution on a latitudinal gradient in Old Tampa Bay, Florida. Using methods in Hagy et al. (in prep), the estimate for median seagrass DoC for the segment is an over- and under-estimate for northern and southern portions, respectively. Figure 2 provides a similar example for the a segment in the Big Bend region of Florida. Again, seagrass depth of colonization is over- and under-estimated for different areas of the segment. In particular, DoC is greatly over-estimated at the outflow of the Steinhatchee where high concentrations of dissolved organic matter naturally limit seagrass growth. These examples suggest that estimates of DoC are needed at finer spatial scales to provide a more robust determination of restoration targets and nutrient criteria.

2.2 Estimating seagrass depth of colonization using spatial information

An alternative approach for estimating seagrass DoC was developed that incorporates spatial information for improved resolution. The new approach has a similar theoretical foundation as the original, although the methods for estimation are slightly different. The first difference is that the maximum DoC is estimated using a cumulative distribution curve. The second and more important difference is that the estimates are specific to locations using a grid-based approach. These main differences are described below using an example from the Big Bend region of Florida.

Input data for estimating spatially-referenced depth of colonization require only two shapefiles: a segment polygon and a point layer of bathymetric soundings and seagrass presence/absence. The latter shapefile was created using methods in described in Hagy et al. (in prep). In general, the point layer contains coordinates of bathymetric sounding pounts that were within 1 km of a seagrass coverage layer. The sounding points were merged with the coverage layer to identify points occurring within seagrass beds.

The spatially-referenced approach for estimating depth of colonization begins by creating a systematic grid of sampling points at a set distance within the segment polygon. Points in the seagrass/bathymetric sounding layer that occur within a set radius from each grid point are selected. An estimate of seagrass DoC is obtained for each group of selected points and assigned as a spatially-referenced value for each grid point. The seagrass DoC estimate for each point is based on the cumulative distribution curve for two sets of information in the data. The first cumulative distribution describes the cumulative number of all sample points by depth and the second describes the cummulative number of sample points with seagrass by depth. The DoC estimate is based on differences in slope between these two curves. Thus, a second plot is created that compares the slopes by depth for each cumulative distribution curve. The maximum depth of colonization is estimated from these slope curves when the slope of the seagrass curve is less than 5% of the slope of the curve for all points. Likewise, the median depth of colonization is estimated when the slope of the seagrass curve is less than 50% of the slope of the curve for all points. Values are not estimated when the seagrass slope curve

2.3 Sensitivity analysis and comparison with segment-based approach

2.4 Developing a spatially coherent relationship of water clarity with depth of colonization

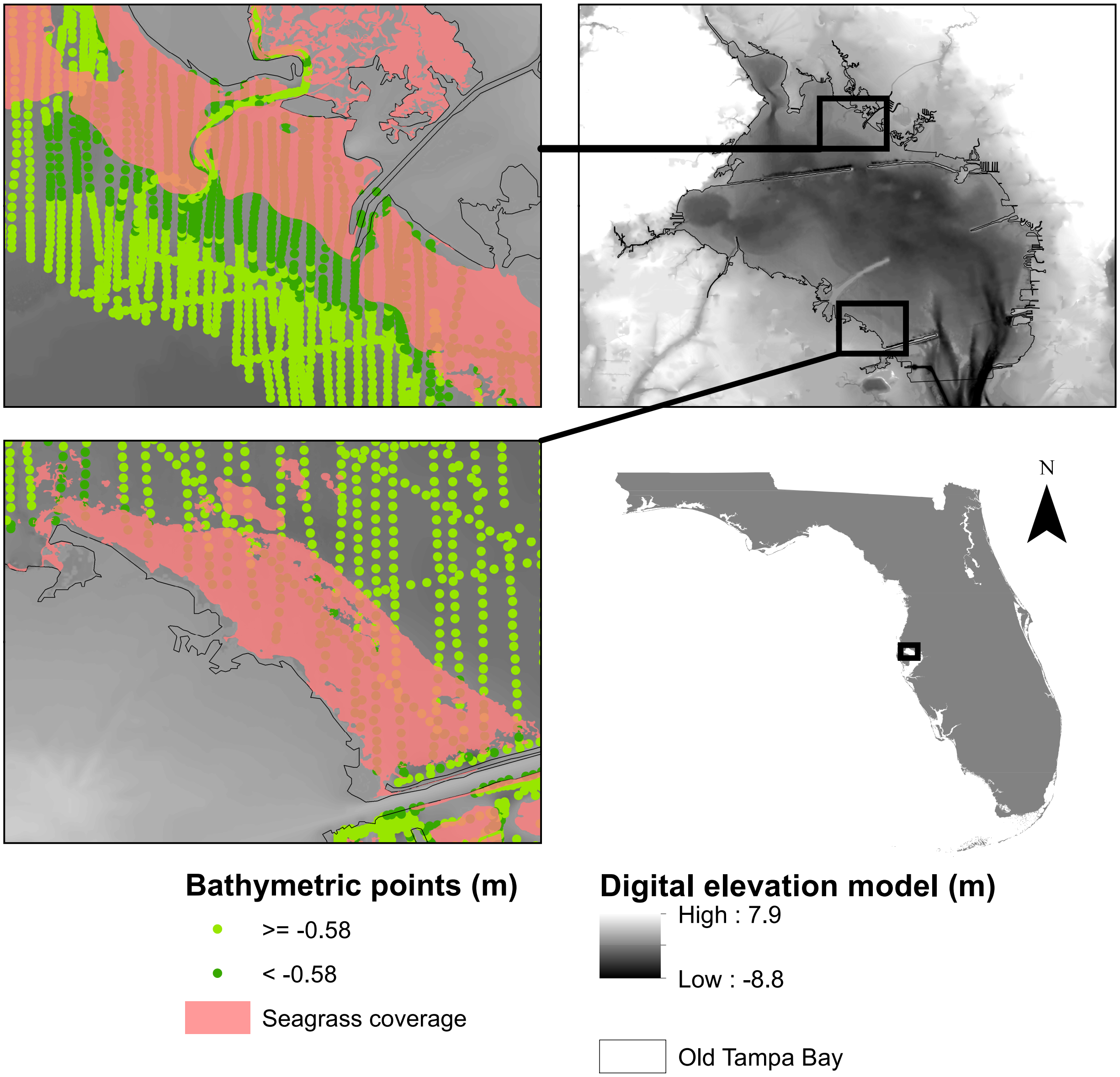

Figure 1: Example of over- and under-estimates for seagrass depth of colonization in Old Tampa Bay, Florida. The top-left figure indicates over-estimation and the bottom-left indicates under-estimation. Bathymetric points are color-coded by the median depth of colonization estimate for all seagrass (patchy and continuous) in the segment.

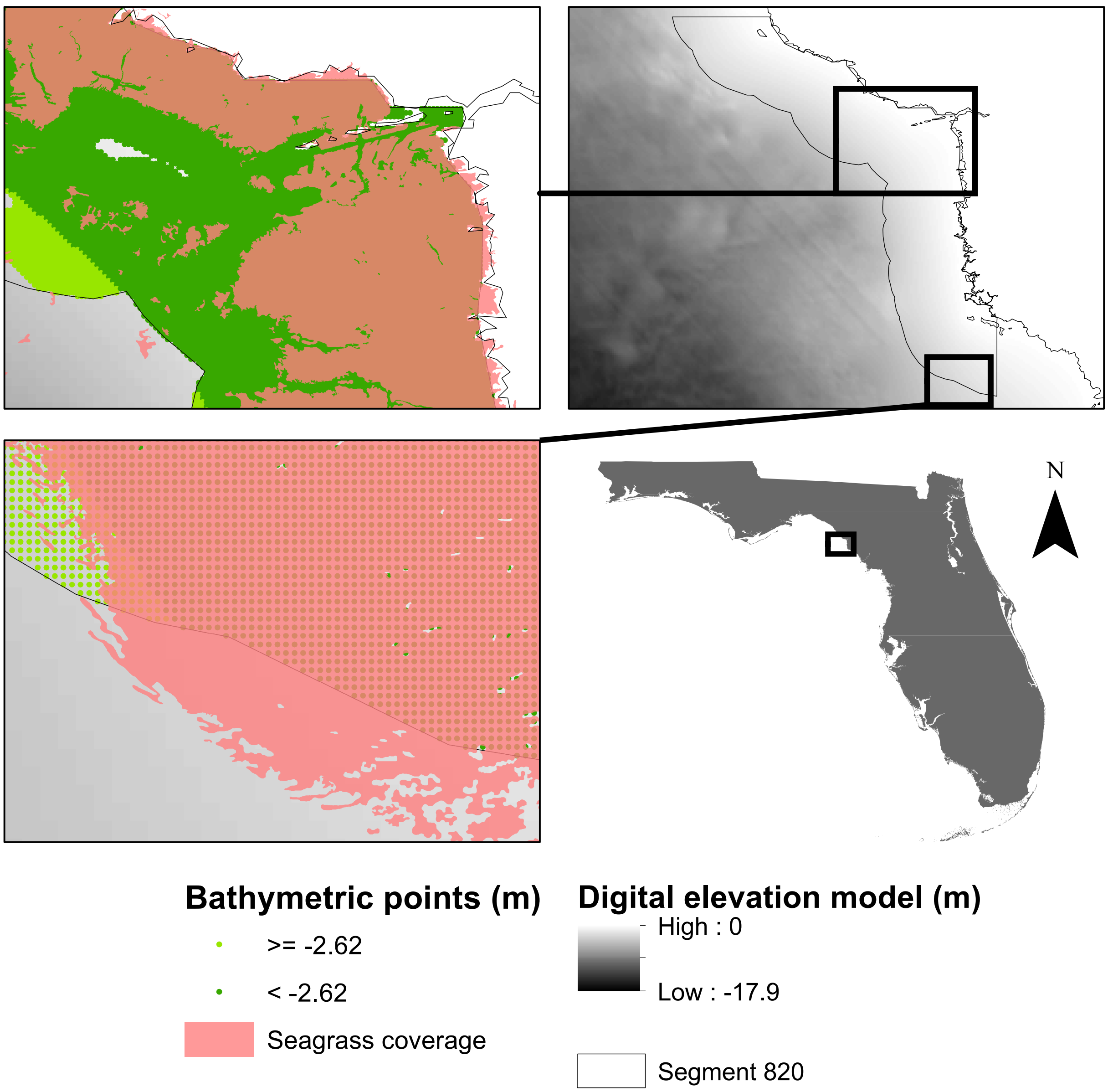

Figure 2: Example of over- and under-estimates for seagrass depth of colonization for a segment in the Big Bend region, Florida. The top-left figure indicates over-estimation and the bottom-left indicates under-estimation. Bathymetric points are color-coded by the median depth of colonization estimate for continuous seagrass in the segment.