Quantifying Ecosystem Health and Carbon Capture of Coastal Restoration Using Drones and Machine Learning

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Assessing the progression and success of coastal restoration in the face of climate change and sea level rise is vitally important. This can include estimating carbon capture, monitoring site erosion, and evaluating the effects of sea level change on vegetation. Drones and machine learning are revolutionary technologies that allow us to answer questions at resolutions not possible using satellite data and scales not feasible using field data. Drone-derived data can be collected more cost effectively than traditional approaches, with the added benefit of limiting disturbance to sensitive ecosystems.

CDM Smith used drone-mounted optical and 5-band multispectral cameras to collect multiple data sets at a tidal salt marsh restoration site and an adjacent reference marsh in Savannah, Georgia. These data sets were used to assess site topography, erosion, vegetative health, and biomass. The team combined drone-derived surface elevations and multispectral data with traditional field sampling techniques into a machine learning model to quantify site-wide above ground biomass of saltmarsh cordgrass (*Spartina alterniflora*) at a quarter meter resolution. The machine learning model results ($R^2 = 0.78$) were more accurate than biomass estimates using simple linear regressions of multispectral drone data.

The high resolution and spatially explicit estimates of above ground biomass in relation to elevation can provide land managers with valuable site-specific data on the potential effects of sea level change and coastal erosion on restoration sites. The combination drone-derived 3D structural data and multispectral data to estimate biomass could be applied to non-wetland restoration sites as well to track biomass in native versus invasive species. Additionally, this approach can be scaled to a range of restoration sizes (1 to >1,000 acres). This information helps land managers improve restoration efforts and is a key component to quantifying carbon capture and providing a more detailed picture of site-wide sequestration.

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