Assessing Ecosystem Health and Carbon Capture of Coastal Restoration Using Drones, Remote Sensing, and Machine Learning

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Background/Objectives. Assessing the progression and success of coastal restoration projects in the face of climate change and sea level rise is vitally important. For restoration projects in tidal estuarine environments, this can include estimating carbon capture, monitoring site erosion and topography, and evaluating the effects of sea level change on vegetation. Drones and machine learning are revolutionary technologies that can help answer questions at image resolutions not possible with satellite data and at scales not feasible with field data (Alvarez-Vanhard et al., 2020). Traditional field data collection can be labor-intensive, requiring multi-team field crews with specialized skills and equipment working long days. Satellite data have limitations in spectral, spatial, and temporal resolution (Alvarez-Vanhard et al., 2020). Drone-derived data can be collected more cost effectively than traditional approaches, with the added benefit of limiting disturbance to the sensitive ecosystems being monitored.

Approach/Activities. CDM Smith used drone-mounted optical and 10-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 data with traditional field sampling techniques, for training and testing, to model site-wide above ground biomass of saltmarsh cordgrass (*Spartina alterniflora*). The team then combined above ground biomass information and drone-derived topographic data to analyze the relationship between elevation and carbon capture.

Results/Lessons Learned. The use of drone data and machine learning can assess ecosystem health and carbon capture provides insights of site characteristics at resolutions that are not possible using satellites. It also allows for data collection on a much greater scale than traditional field work. The project team was able to assess restoration metrics across the site at the square inch resolution. Multiple drone-mounted sensors provided high resolution data on vegetation coverage, elevation, soil characteristics, and biomass. This allows for rapid identification of potential issues and implementation of corrective restoration actions or adaptive management. The high resolution and spatially explicit estimates of carbon capture 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.