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TITLE: Terrestrial laser scanning to quantify above-ground biomass of structurally complex coastal wetland vegetation

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ABSTRACT:

Above-ground biomass represents a small yet significant contributor to carbon storage in coastal wetlands. Despite this, above-ground biomass is often poorly quantified, particularly in areas where vegetation structure is complex. Traditional methods for providing accurate estimates involve harvesting vegetation to develop mangrove allometric equations and quantify saltmarsh biomass in quadrats. However broad scale application of these methods may not capture structural variability in vegetation resulting in a loss of detail and estimates with considerable uncertainty. Terrestrial laser scanning (TLS) collects high resolution three-dimensional point clouds capable of providing detailed structural morphology of vegetation. This study demonstrates that TLS is a suitable non-destructive method for estimating biomass of structurally complex coastal wetland vegetation. We compare volumetric models, 3-D surface reconstruction and rasterised volume, and point cloud elevation histogram modelling techniques to estimate biomass. Our results show that current volumetric modelling approaches for estimating TLS-derived biomass are comparable to traditional mangrove allometrics and saltmarsh harvesting. However, volumetric modelling approaches oversimplify vegetation structure by under-utilising the large amount of structural information provided by the point cloud. The point cloud elevation histogram model presented in this study, as an alternative to volumetric modelling, utilises all of the information within the point cloud, as opposed to sub-sampling based on specific criteria. This method is simple but highly effective for both mangrove ($r^2 = 0.95$) and saltmarsh ($r^2 > 0.92$) vegetation. Our results provide evidence that application of TLS in coastal wetlands is an effective non-destructive method to accurately quantify biomass for structurally complex vegetation.

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