Modeling Sea Level Rise Driven Coastal Forest Loss and the Aboveground Carbon Impacts With Remote Sensing and Machine Learning

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Coastal forests are among the world's most important carbon (C) stores, sequestering C faster than terrestrial forests per unit area. However, these essential C sinks are increasingly threatened by land development and sea level rise. Land cover maps for the Croatan National Forest in North Carolina were generated using Landsat satellite imagery and common image classification methods including maximum likelihood (ML), random forests (RF), and support vector machines (SVM), with the SVM and RF classifiers achieving the best performances with overall accuracy up to 94%. The classifier was then used to classify land cover in 1985, 2011, and 2021. To estimate the C stocks, ordinary least squares (OLS) regression analysis was conducted with Landsat-derived normalized difference vegetation index (NDVI) and aboveground biomass data with an R2 value of 0.65. Aboveground biomass C was estimated using the regression analysis results to evaluate the changes over the 30-year period. To estimate future impacts, data overlaid with sea level rise scenarios from NOAA Sea Level Rise maps were assessed. Under the highest emissions scenario, about 340,000 tonnes of aboveground carbon in the study area is expected to be impacted by sea level rise by 2100. This study demonstrates the efficacy of machine learning image classification for the identification of coastal ecosystems and monitoring of their aboveground C stocks over time using satellite imagery.

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