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UAV-based Wetland Monitoring: Mapping Coastal Habitats and Changes in Vegetation Height with Digital Terrain Models

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Monitoring coastal wetlands, particularly mangroves, is increasingly important as the impacts of climate change increase. As sea levels rise and temperature increase, vegetation communities traditionally associated with tropical and sub-tropical coastlines will migrate northward and also inland, along waterways. The transition from coastal marshes and subshrubs to woody mangroves is a fundamental change to coastal community structure and species composition, requiring monitoring. However, this transition is likely to be episodic, complicating monitoring efforts, as mangrove advances are countered by dieback resulting from increasingly impactful storms. Coastal habitat monitoring has traditionally been done through satellite and ground-based surveys. This project investigates the use of UAV lidar and multispectral photogrammetry which can be obtained routinely at higher resolution than satellite derived data, and cheaper and faster than ground-surveys. Using UAV-based methods we monitor and classify coastal habitats, including mangroves, using simple machine learning methods. Between 2020 and 2022 we investigated the use of remote sensing to monitor a multiple use Florida coastal ecosystem. Using UAV lidar we mapped vegetation communities and detected sections of significant canopy loss. Ground truthing verified the occurrence of recent canopy loss at the scale of individual snag remnants of woody mangrove associates, i.e., buttonwood trees (Conocarpus erectus). Using UAV lidar and multispectral photogrammetry data as inputs into a random forest model, we created several models of habitat classification. Training inputs included 2000-pixel and 5000-pixel data subsets. Initial results were resampled to match the size of tree crown in the field area creating four classification schemes. All classifications were validated using standard metrics. Mangrove habitat identification using the resampled 2000-pixel model has 85% producer's accuracy and 80% user's accuracy. UAV surveys combined with machine-learning streamline coastal habitat monitoring and facilitate repeat surveys to assess the effects of climate change.