Fostering Mangrove Sustainability: Blue Carbon Estimation by Integrating Allometric Equations With Machine Learning and Remote Sensing

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Global discussions on environmental conservation are in the spotlight, mainly due to the 2023 United Nations Climate Change Conference, where a significant amount of US$ 186.6 million was allocated to conservation initiatives, focusing particularly on mangroves. The critical importance of tropical ecosystems in the fight against climate change is recognized, with special emphasis on their high capacity of storing carbon., This study addresses the need to assess environmentally sensitive areas, by directly quantifying carbon stocks in mangroves, considering both the target audience that is indirectly affected and the populations whose livelihoods rely on this ecosystem. This research devises a supervised classification algorithm on Google Earth Engine API for processing and mapping land use. It has a library of images provided by the European Space Agency (ESA) from the COPERNICUS satellite and its Harmonised Sentinel-2 MultiSpectral Instrument Level-2A variant. After generating the theme map and extracting the spatial variables, an index of the dominance of species influencing carbon sequestration in mangrove forests is applied to the visual vegetation classes. Then, variables specific to mangrove species, such as Avicennia schaueriana, Laguncularia racemosa, and Rhizophora mangle, are inserted based on a database that refers to allometric equations for estimating biomass in the region of interest. Finally, the study uses a correction factor to approximate the calculation of carbon stocks compared to manual samples in the field, identifying a difference between automated systems with satellite monitoring and manual collection systems. The idea is publicly accessible, with initial filing with the Brazilian IP registration office and information licensed on GitHub.