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Tropical forests and climate change: advancing wood biomass and carbon estimation through dendrochronology and X-ray densitometry

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Abstract

The increase in carbon dioxide concentration in the atmosphere during the Anthropocene has significant impacts on the climate, affecting the balance of forest ecosystems and global food security. Tropical forests play a crucial role in carbon storage and sequestration but are adversely affected by frequent drought events and rising temperatures, leading to negative impacts on the growth and, in some cases, the plant species mortality. In this context, it is crucial to improve methodologies for quantifying wood biomass and carbon assimilation by tree species. Traditionally, allometric equations and wood basic density data from the literature are used, which can result in imprecise estimates. Additionally, the assessment of the climate change effects often relies on periodic forest inventories, many of which began only in the last few decades in tropical forests. To overcome these challenges, we propose the adoption of dendrochronology, involving the tree-rings analysis combined with X-ray densitometry. This approach allows the tree growth rates determination from planting or recruitment, providing high precision in determining wood density. These variables are essential for model development and offer a temporal perspective on tree growth, contributing to the climate change impacts evaluation and the improvement of adopted management practices. The resulting data, including annual growth and wood microdensity determination, can be applied for more accurate biomass and carbon estimative in various contexts, such as primary forests, reforested areas, and forest restoration sites.

Key words: Tropical Ecosystems; Tree Rings; Carbon Dynamics; Climate Resilience; Forest Management.