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Non-destructive, in-field determination of wood density in tropical forests

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Tropical forests are a significant store of terrestrial carbon[1,2,3], and quantification of the above-ground carbon stocks provides a way to improve understanding of vegetation dynamics in the face of climate change. The determination of carbon stocks in tropical forests usually relies on a combination of remote sensing data and allometric models that predict tree biomass[4], with extensive requirements for the collection of field data. Tropical forests usually contain a high diversity of tree species, with a wide range of wood densities and the wood density of tropical trees may vary considerably across their diameter[5,6]. In addition, field core extraction and laboratory processing for wood density determination are time consuming and costly.

In this study, wood density has been indirectly determined by a novel ultrasonic, field-based method across different tropical forests types and climates through Australia, Vanuatu and Papua New Guinea and compared against laboratory wood density determinations on the same samples. The data set comprises 1500 measurements on living trees to study the intraspecific and interspecific variation of wood density across tree species ranging from soft to hardwoods and also along the stem of standing trees.

Regression analysis suggests a positive relationship between ultrasonic velocity and intraspecific and interspecific variation of wood density indicating a potential use for this technique for carbon inventory development in tropical forests The technique may be particularly valuable for directly measuring the wood density of large trees, which can contain one third of the total proportion of above ground carbon biomass in tropical forests[7] and are particularly onerous to core to the pith to measure average wood density across the whole stem by traditional techniques. This study will in the development of predictive relationships between wood density and environmental variables to infer carbon stocks at local and global scale through the validation of an accurate field-based, non-destructive measurement of wood density.

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