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A high-resolution monitoring network investigating stem growth of tropical forest trees

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Background

The proportion of carbon (C) allocated to tree stems is an important determinant of the C sink-strength of global forest ecosystems. Understanding the mechanisms controlling stem growth is essential for parameterization of global vegetation models and to accurately predict C sequestration of forest ecosystems. However, we still lack a thorough understanding of temporal variations in stem growth of tropical forest ecosystems, which will be key in determining potential climate feedbacks under projected global changes.

Conclusions

Our results indicate that fluctuations in stem diameter were related to seasonal variations in temperature and water availability, such that tropical stem growth rates were positively related to temperature and precipitation during the wet season but showed a negative trend during the onset of the dry season. Our findings indicate that high-resolution monitoring of stem growth of tropical trees is crucial to determine the response of tropical C storage to intra-annual climate variation and therefore will be key to accurately predict future responses of tropical aboveground carbon storage, and should be of special interest for ecosystem research and earth system science.

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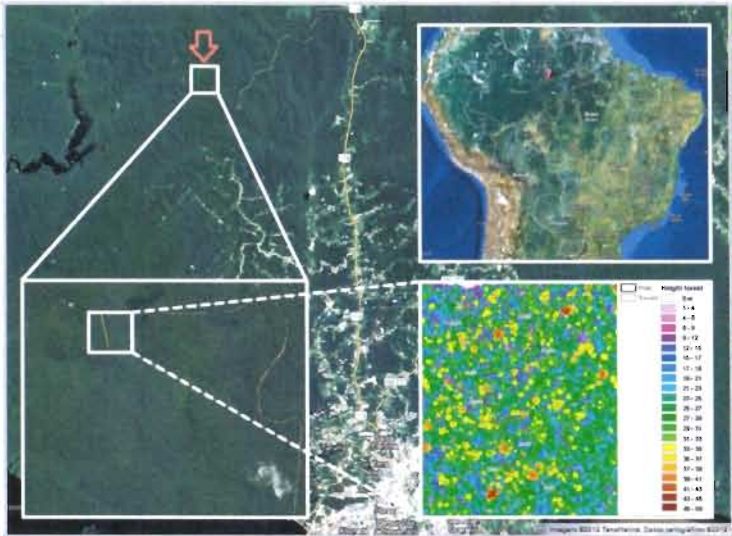

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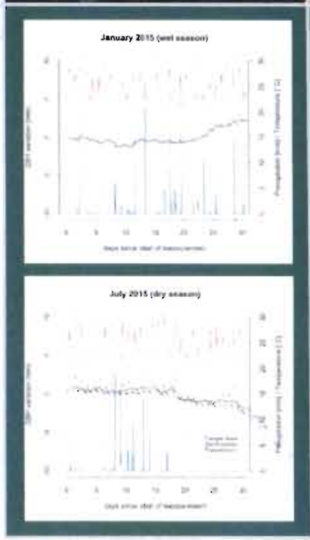

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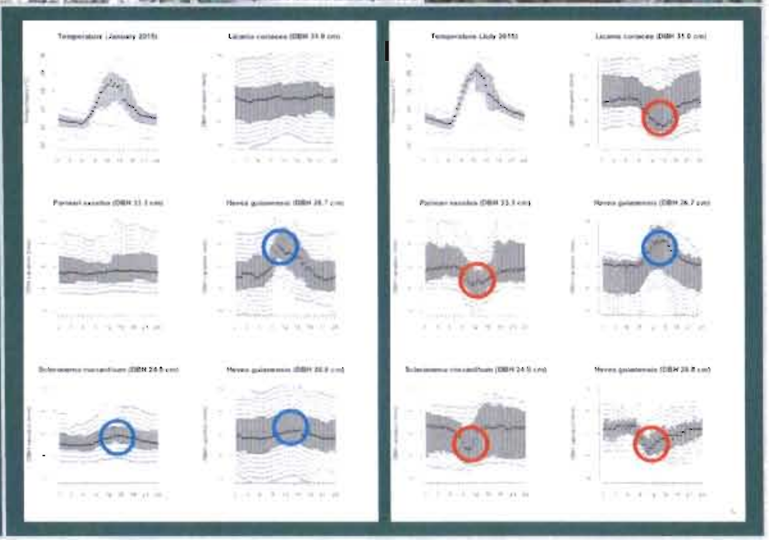

Methodology

We here present data from a novel monitoring network of automated dendrometer devices installed in the first free air CO_2 enrichment (FACE) experiment conducted in the central Amazon (**Fig. 1**).

The so-called *TreeHugger* dendrometers (http://globalchangesolutionsllc.com/products/treeHugger.html) feature a membrane potentiometer to analyze diurnal changes in stem growth and thus can be used to monitor the expansion and contraction in tree diameter at low cost in high temporal resolution (**Fig. 2**).

Results

We found a pattern of increased stem growth during the wet season but a reduction in stem growth during the onset of the dry season (**Fig. 3**). We further identified a changing pattern of diurnal growth signals in response to climate seasonality, i.e. a positive response of diurnal stem growth patterns during the wet season (blue symbols) but a negative diurnal stem growth response, i.e. midday depression, during the dry season (red symbols). This could further indicate that a positive growth response is related to the loading of photosynthates under non-limiting conditions; while vice versa a negative growth response could indicate a growth reduction due to water limitation during the dry season (**Fig. 4**).

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