Title: Pantropical Patterns of Tropical Tree Damage and Death

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Project Abstract: Tropical forests are of utmost importance for the global carbon cycle and the world's biodiversity. Yet, our understanding of the likely response of tropical forests to the changing climatic conditions is very limited. This is partially attributed to the lack of a mechanistic inclusion of tree mortality in vegetation demographic models. Tree death not only has implications on the species demographic rates but on the biomass turnover times. Advancing in the understanding of the causes and consequences of tropical tree mortality is, therefore, a research priority to obtain more accurate predictions of the future of tropical forests and the carbon cycle-climate feedbacks. In order to expand the data available for developing and testing mechanistic models of tree mortality, we designed a protocol to perform annual tree damage and death assessments in large ForestGEO plots, as part of Phase I of the Next-Generation Ecosystems Experiments – Tropics (NGEE-Tropics) project. Here, we present results from 20 surveys, comprising over 100,000 (stem x time) observations made on 40,000 stems in seven sites across the tropics. The proportion of dead and damaged trees found standing, broken, and uprooted were significantly different among sites. These differences are likely related to patterns of forest disturbance and, thus, mortality drivers (e.g., winds, droughts) operating at regional and continental scales. Within forests, tree size and small-scale habitat differences emerged as important factors explaining the intra-plot variability in the probability of tree death and damage. The collateral damage of understory trees following crown loss and death of canopy trees was a conspicuous process across the tropics. In general, mortality linked to other variables such as loss of leaf area, leaf damage, lianas, wounds, or tumors was variable and site-specific. Long-term collection of tree death data will enable more robust annual climate-related tree mortality assessments, as well as the possibility to obtain more accurate estimates of woody residence times, and a better parametrization of stress-related damage associated with elevated mortality risks at the individual level.