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ABSTRACT

Forests worldwide are facing increasingly frequent climate extremes due to global warming. The negative effects of climate change on tropical forests have been extensively reported by both permanent plots and tree-ring studies that targeted forest's responses to climate. While they focus mostly on community and population levels, the effects of landscape heterogeneity on trees' sensitivity to climate is often not accounted for, overlooking the diverse responses of individual trees to climate variation. We tested the hypotheses that trees may differ in sensitivity to climate and that some microenvironmental conditions may exert the role of climate-change refugia. We built the first tree-ring chronology of Amburana cearensis trees sampled across a Seasonally Dry Tropical Forest (SDTF) in Brazil. We ensure a robust tree-ring dating using dendrochronological methods and 14C dating of trees inhabiting various conditions characterized here through the seasonality of the local Normalized Difference Vegetation Index. At the population level, the standard tree-ring chronology suggests that tree growth depends on rainfall and temperature, leading to a common conclusion that drier and warmer conditions would impact interannual tree growth in the tropics. However, the cluster analyses revealed groups of individual trees with distinct growth sensitivities to climate. The most sensitive trees were the individuals located in the highly seasonal vegetation of the epikarst, in contrast to the complacent trees (non-sensitive to regular interannual climate variability) inhabiting the less-seasonal vegetation in the deep soil epikarst and valley. Based on these groups of trees, we built two mean chronologies and assessed their climate-growth relationships. In accordance with the individual analysis, the tree-ring chronology of complacent trees showed no association with wet season precipitation and only moderate association with temperature. The areas supporting these complacent trees of A. cearensis in the less seasonal vegetation correspond to a quarter of the entire sampling site. The climate buffering capacity of these refugia may only be compromised in years of climate extremes when all sampled trees share low growth rates during years with anomalous low rainfall and high temperature. Assessing individual's climate sensitivity is therefore paramount for a comprehensive understanding of the heterogeneous responses of tropical forests to climate change. The hidden individual tree responses in the population can help identify priority areas of management in a rapidly changing environment.