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Urgent need for warming experiments in tropical forests

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Tropical forests represent one of the planet's most active biogeochemical engines. Although only 15 % of the planet's terrestrial surface is comprised of tropical forests, they account for over 2/3 of live terrestrial plant biomass, nearly 1/3 of all soil carbon (C), and exchange more carbon dioxide (CO_2) with the atmosphere than any other biome. In the coming decades, the tropics will experience unprecedented changes in temperature, rapid increases in atmospheric CO_2 concentrations, and significant alterations in the timing and amount of rainfall. Given the disproportionate role tropical forests play in the global climate, combined with the high uncertainty surrounding their responses to change, funding agencies are increasingly interested in how these ecosystems will respond to future climatic conditions. Thus, it is imperative that the scientific community identify key research priorities to resolve major uncertainties about the functioning of tropical forests and to improve predictive capacity of earth system models. With these goals in mind, we ask (1) can we quantify the uncertainty in C balance response to climate change in the tropics? (2) why should we implement large-scale manipulation experiments in tropical forests? (3) how many environmental factors should be manipulated? (4) which environmental factor(s) to manipulate? and (5) at what spatial and temporal scales should these manipulations occur? We investigate overall model uncertainty of tropical latitudes with a Coupled Model Intercomparison Project Phase 5 (CMIP5) analysis and review current literature to discuss the scientific benefits and inevitable trade-offs inherent in large-scale manipulative field experiments. We discuss how to prioritize research approaches given both funding and logistical constraints in order to optimize the knowledge gained from the limited resources available for such research.