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The role of rainfall intermittency for tropical vegetation

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The distribution of tropical grassland, savanna and forest biomes, and the transition between them, are determined by complex and dynamic interactions among abiotic and biotic factors, which include climate, soil, herbivory and fire. Precipitation is one of the primary drivers of the distribution of tropical vegetation. While mean annual rainfall is recognized to have an important role as a predictor of biome boundaries at coarse scale in tropical areas, rainfall seasonality has also been recognised as a key predictor. In particular, seasonality of rainfall affects the temporal distribution of soil water and the fire probability, which in turn influences the relative dominance of trees and grasses.

Predicted increases in global temperatures are expected to alter the hydrological cycle over the coming decades. Future projections of global climate models generally indicate a larger probability of intense rainfall events and a higher prevalence of dry periods, although these changes are not always accompanied by associated changes in the total annual rainfall. In these areas, adjustments in rainfall intensity and frequency, two of the characteristics of rainfall intermittency, can induce shifts in the relative distribution of tree and grass cover in tropical ecosystems. However, how rainfall intermittency influences those ecosystems is unclear. The effect has been studied either in small-scale ecological studies, with simple eco-hydrological models, or in broad-scale analysis of observed woody cover from field sites, with sometimes contrasting results. Also, despite their widely recognized importance, a continental analysis including grass cover is still missing.

Building upon recent work that highlights the existence of three ranges of mean annual rainfall (MAR) where tropical biome dynamics is determined by the relative influence of other factors, this study investigates the role of rainfall intermittency, assessing satellite data on tree and grass cover (from MODIS), rainfall (from TRMM) and fire intervals (from MODIS) at a continental scale in sub-Saharan Africa.

The results show that intermittency has a role to play in determining vegetation cover, with that role dependent on MAR range. Overall, accounting for the differing impacts of rainfall intermittency by MAR range goes some way towards explaining the contrasting findings on the role of intermittency for relative tree / grass dominance in tropical ecosystems reported in other research.