

The Global Extent and Determinants of Savanna and Forest as Alternative Biome States

1. A. Carla Staver^{1,*},
2. Sally Archibald²,
3. Simon A. Levin¹

+ Author Affiliations

1. ¹*Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA.*
2. ²*Natural Resources and Environment, Council for Scientific and Industrial Research, Pretoria 0001, South Africa.*

1. ↩ To whom correspondence should be addressed. E-mail: astaver@princeton.edu

Abstract

Theoretically, fire–tree cover feedbacks can maintain savanna and forest as alternative stable states. However, the global extent of fire-driven discontinuities in tree cover is unknown, especially accounting for seasonality and soils. We use tree cover, climate, fire, and soils data sets to show that tree cover is globally discontinuous. Climate influences tree cover globally but, at intermediate rainfall (1000 to 2500 millimeters) with mild seasonality (less than 7 months), tree cover is bimodal, and only fire differentiates between savanna and forest. These may be alternative states over large areas, including parts of Amazonia and the Congo. Changes in biome distributions, whether at the cost of savanna (due to fragmentation) or forest (due to climate), will be neither smooth nor easily reversible.