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Future changes in South American biomass distributions, biome distributions and plant trait spectra is dependent on applied atmospheric forcings.

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It remains poorly understood why the position of the forest-savanna biome boundary, in a domain defined by precipitation and temperature, differs in South America, Africa and Australia. Process based Dynamic Global Vegetation Models (DGVMs) are a valuable tool to investigate the determinants of vegetation distributions, however, many DGVMs fail to predict the spatial distribution or indeed presence of the South American savanna biome. Evidence suggests fire plays a significant role in mediating forest-savanna biome boundaries, however, fire alone appear to be insufficient to predict these boundaries in South America. We hypothesize that interactions between precipitation, constraints on tree rooting depth and fire, affect the probability of savanna occurrence and the position of the savanna-forest boundary.

We tested our hypotheses at tropical forest and savanna sites in Brazil and Venezuela using a novel DGVM, aDGVM2, which allows plant trait spectra, constrained by trade-offs between traits, to evolve in response to abiotic and biotic conditions. Plant hydraulics is represented by the cohesion-tension theory, this allowed us to explore how soil and plant hydraulics control biome distributions and plant traits. The resulting community trait distributions are emergent properties of model dynamics.

We showed that across much of South America the biome state is not determined by climate alone. Interactions between tree rooting depth, fire and precipitation affected the probability of observing a given biome state and the emergent traits of plant communities. Simulations where plant rooting depth varied in space provided the best match to satellite derived biomass estimates and generated biome distributions that reproduced contemporary biome maps well. Future projections showed that biomass distributions, biome distributions and plant trait spectra will change, however, the magnitude of these changes are highly dependent on the applied atmospheric forcings.