SECO: Resolving uncertainties in the carbon cycle of the dry tropics

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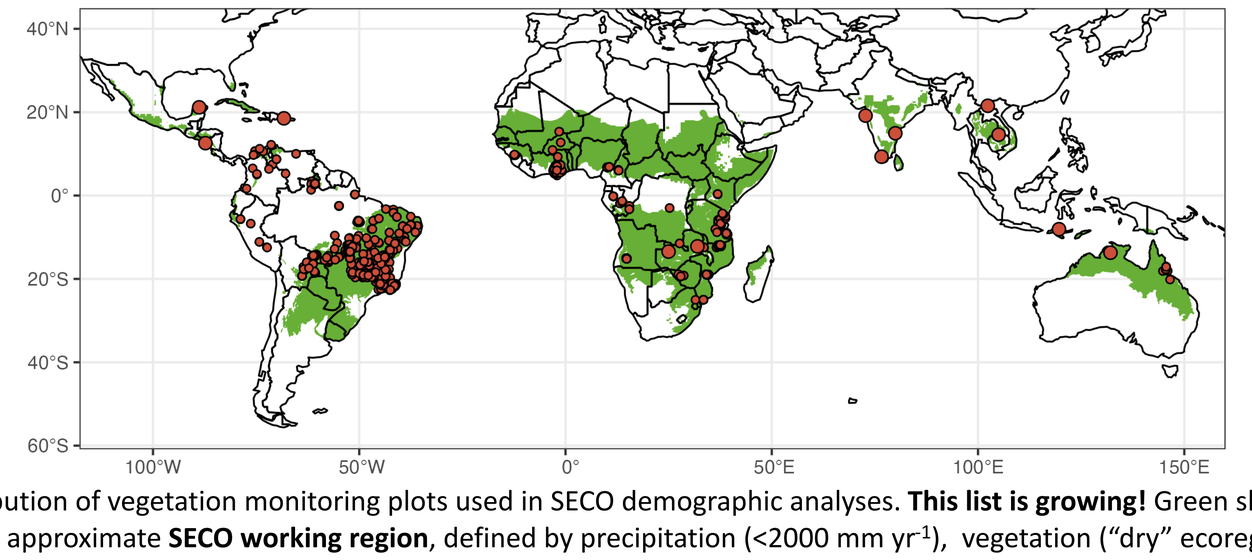
Background

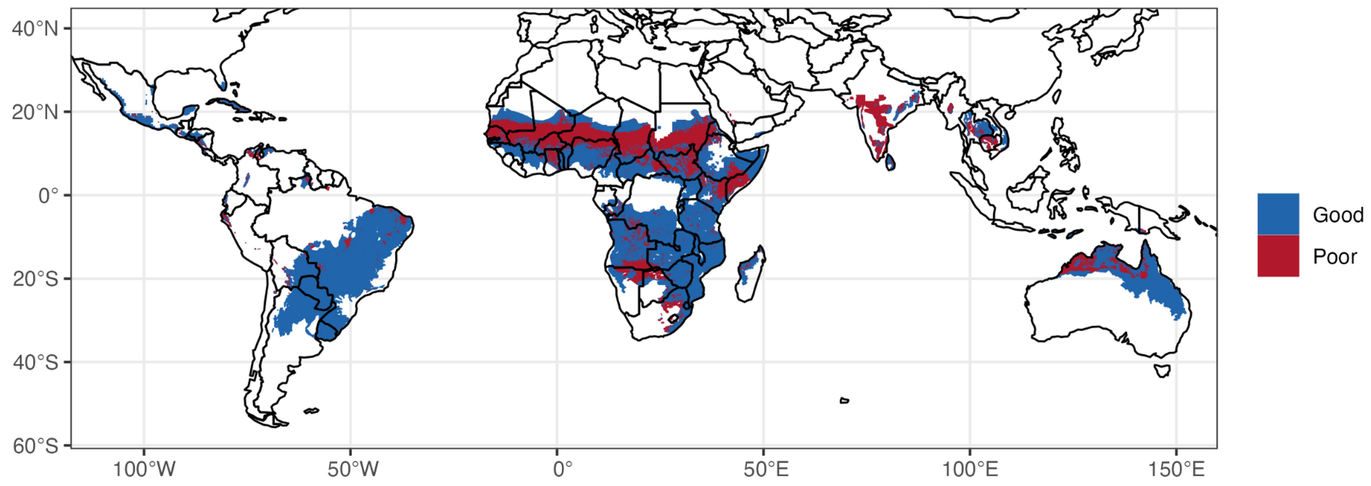
DGVMs estimate seasonally dry tropical woodlands to be the **largest**, **most sensitive** and **fastest growing** component of the **terrestrial carbon sink**.[1]
But, these estimates are highly **uncertain**, arising from a **lack of empirical understanding** of their internal **carbon dynamics**.

In **SECO**, with an inter-continental meta-network of 40+ researchers and >500 repeat-census plots across the **Neotropics**, **Africa, South East Asia**, and **Australia**, we will derive the first pan-tropical estimates of tree **demographic rates** and **net woody biomass change** to improve our understanding of dry tropical carbon dynamics.

Here, we present preliminary results from an analysis of **woody stem growth and mortality factors, highlighting continental variation in woody carbon dynamics**.

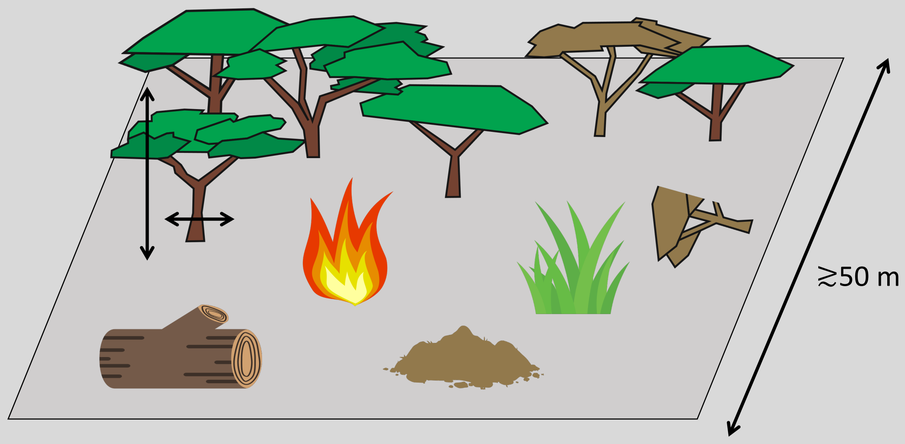


Distribution of vegetation monitoring plots used in SECO demographic analyses. **This list is growing!** Green shading shows approximate **SECO working region**, defined by precipitation (<2000 mm yr^{-1}), vegetation ("dry" ecoregions)[2], temperature (no frost), and estimated woody biomass (10-150 tAGB ha^{-1})[3].



The **climatic and disturbance representivity** of SECO plots across the wider SECO working region. Blue shading indicates the area is well represented by the plots (**95th percentile of plot environmental space**), red indicates the area is not well represented. Credit: Samuel Bowers. *N.B. work in progress.*

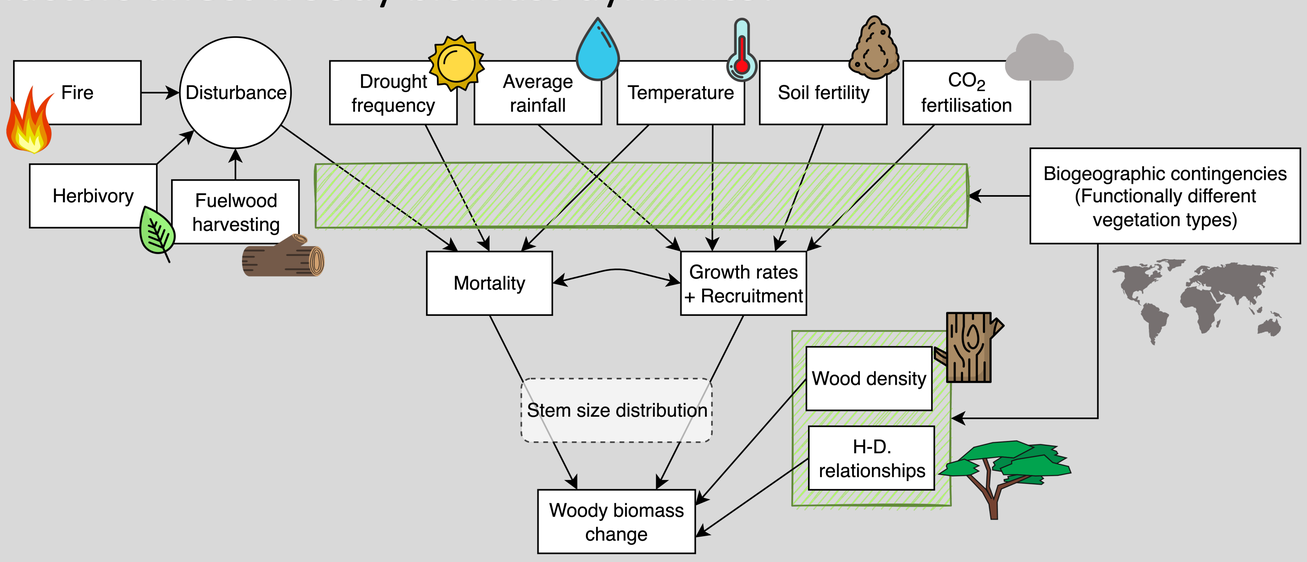
What's in a plot?



- Tree species
- Multi-stemmed trees
- Stem diameter+height
- Tree mortality
- Disturbance regime
- Soil carbon and nutrients
- Coarse woody debris
- Non-woody biomass.

A diversity of seasonally dry tropical vegetation. Left: Baikiaea woodlands in Bicuar National Park, southern Angola (Photo: John Godlee). Right: Caatinga arbórea in northern Minas Gerais, Brazil (Photo: Kyle Dexter). **Not pictured: thickets, savannas, forests, grasslands, shrublands etc.**

What factors affect woody biomass dynamics?

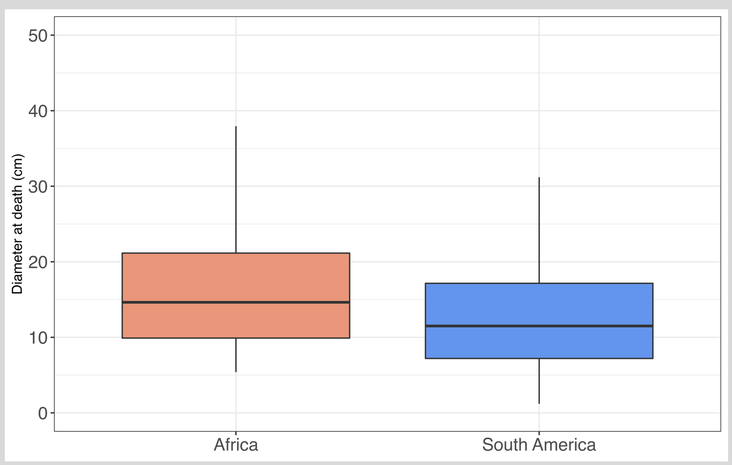


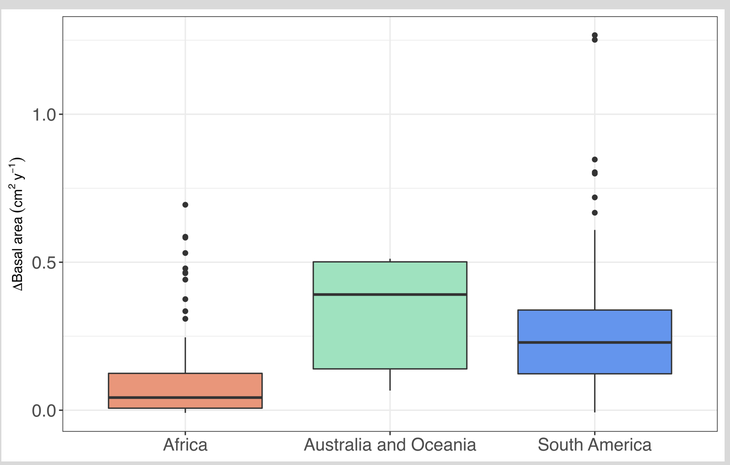
Continental variation in woody stem demographic rates

- Fastest growing individuals in Australia.
- High growth rates in Africa mostly in West Africa.
- Trees in Africa die at larger sizes.

What causes these continental differences:

- Disturbance?
- Climate?
- Biogeography?





Next steps

- Net biomass change:
  - are the dry tropics a sink or a source?
  - do patterns differ by continent, vegetation type?
- How does community composition influence demographic rates?

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References:
[1]Ahlstrom et al. (2015). The dominant role of semi-arid ecosystems in the trend and variability of the land CO2 sink. Science 348.6237, 895–899.
[2]Avitabile et al. (2016). An integrated pan-tropical biomass map using multiple reference datasets. Global Change Biology 22.4,1406–1420
[3]Dinerstein et al. (2017). An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm. BioScience 67.6, 534–545

More on SECO here: