Plot data in SECO

John L. Godlee & SECO Team

john.godlee@ed.ac.uk

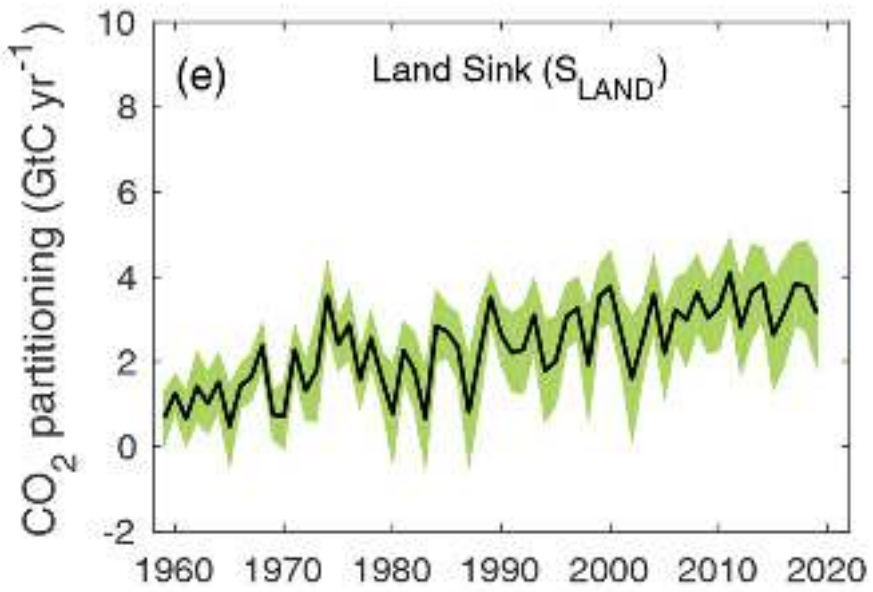
THE UNIVERSITY of EDINBURGH
School of GeoSciences

Goals of SECO

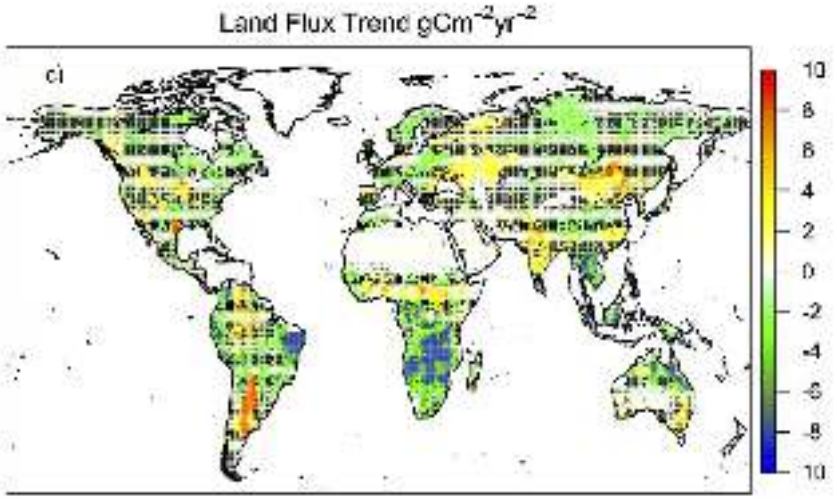
Estimate carbon flux in the dry tropics.

Understand the drivers of variation in carbon fluxes across dry tropical biomes.

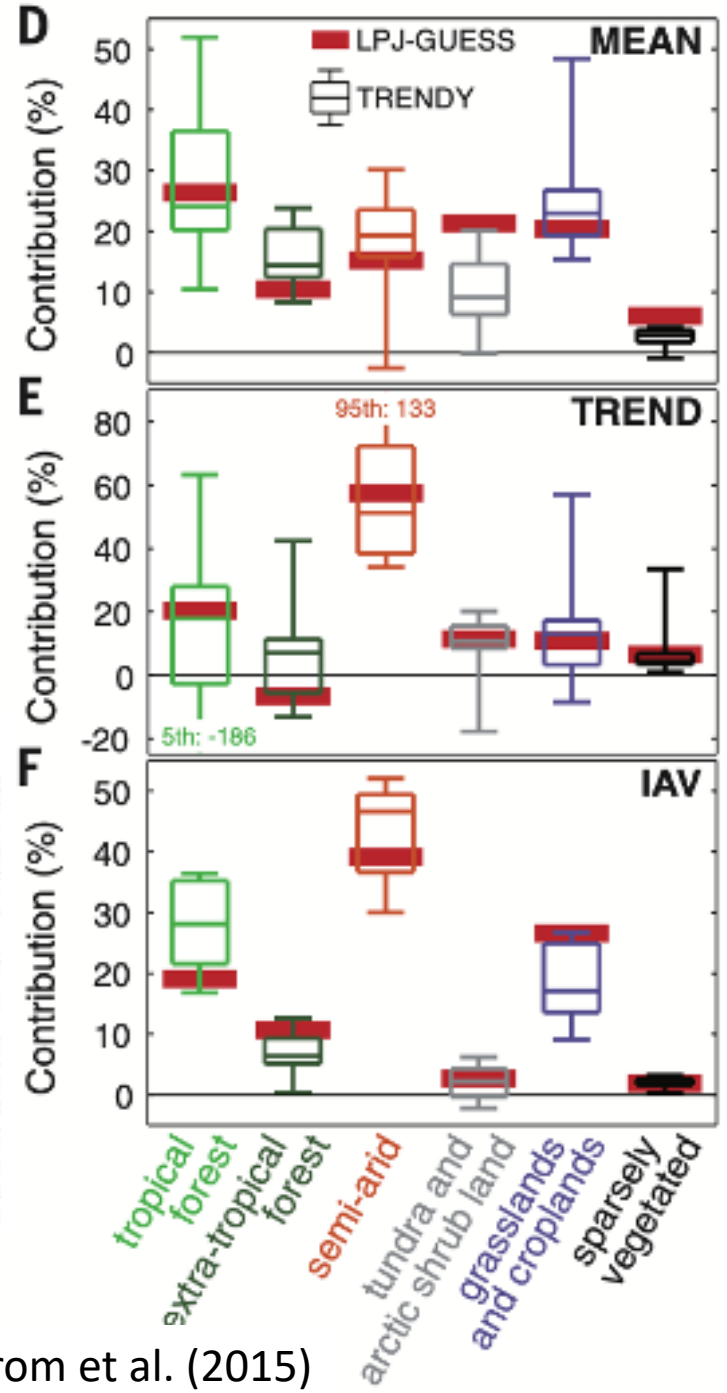
Make predictions of how and why carbon fluxes will change in the future.



La Quere et al. (2020)



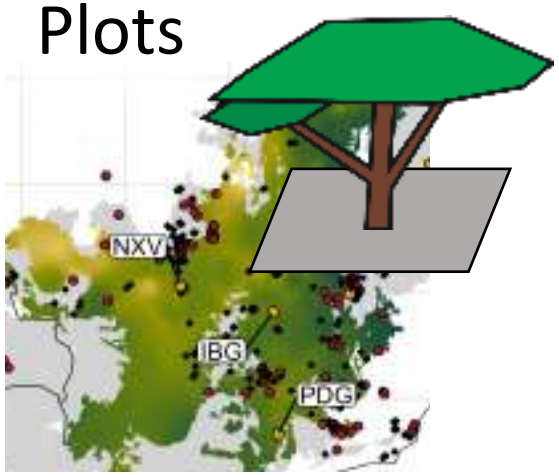
Sitch et al. (2015)



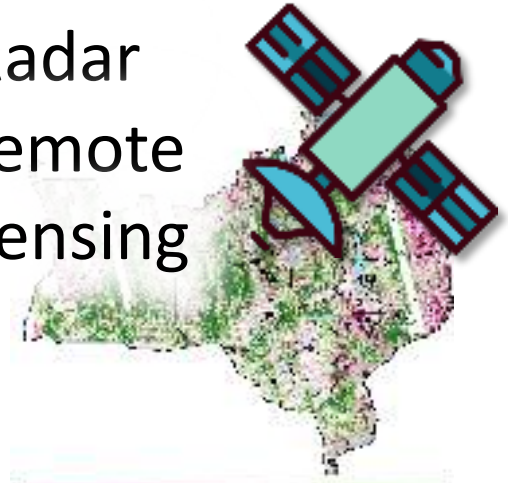
Ahlstrom et al. (2015)

Three methodological approaches

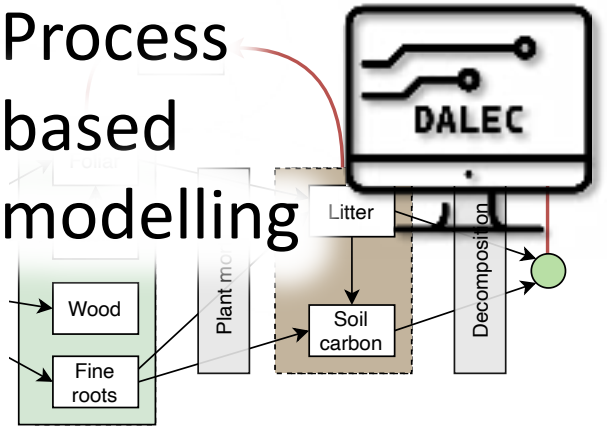
Plots



Radar remote sensing



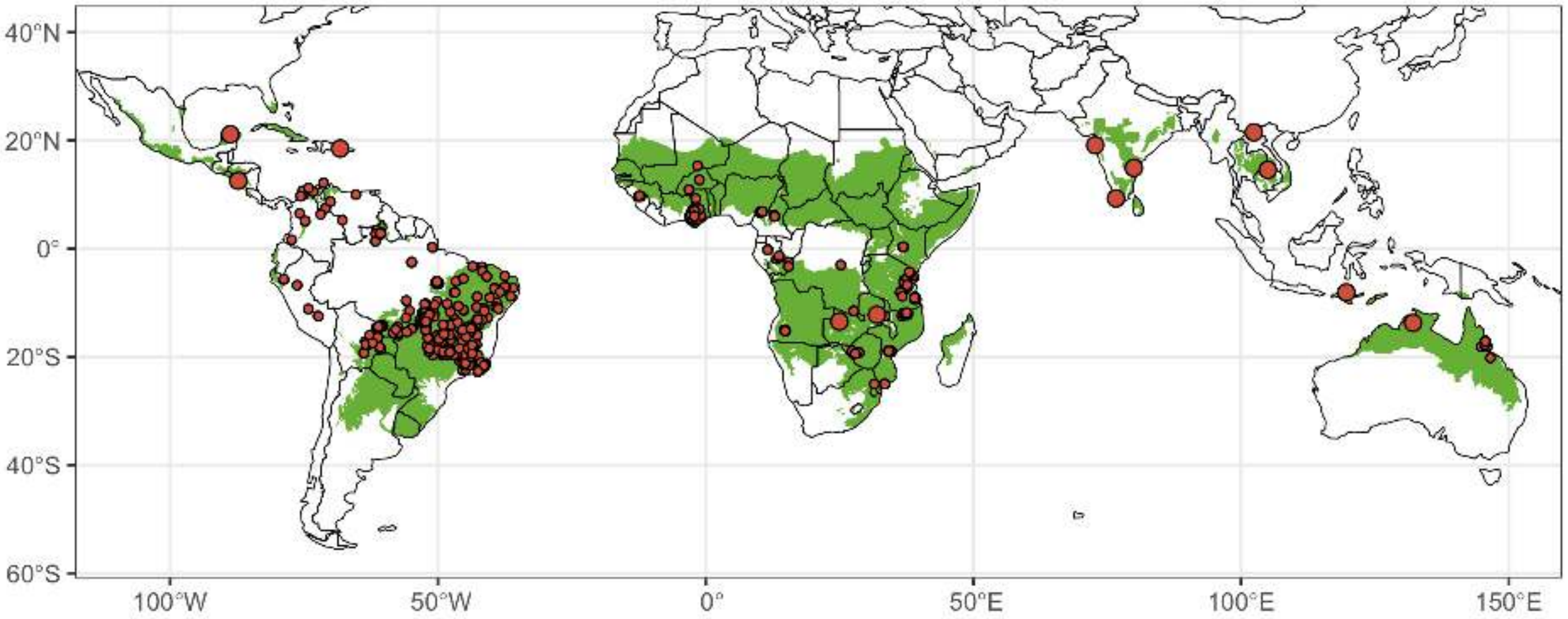
Process based modelling



Plots provide:

- Individual-level rates of growth and mortality
- Species composition and community structure
- Auxiliary data to constrain modelling - traits, phenology, soil, woody debris, herbaceous biomass etc.
- Woody biomass stocks and canopy structure to calibrate remote sensing

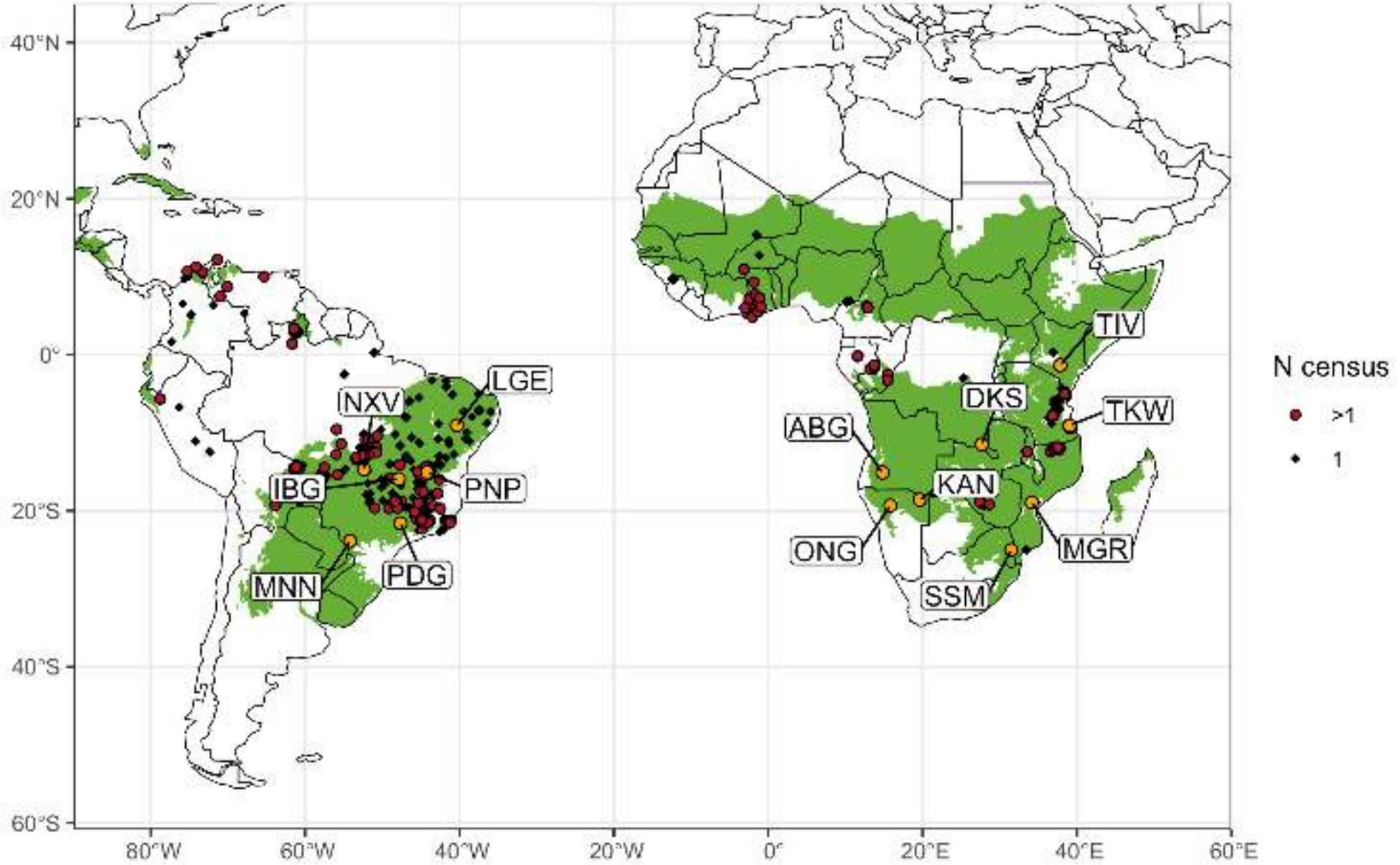
SECO plot data – Global



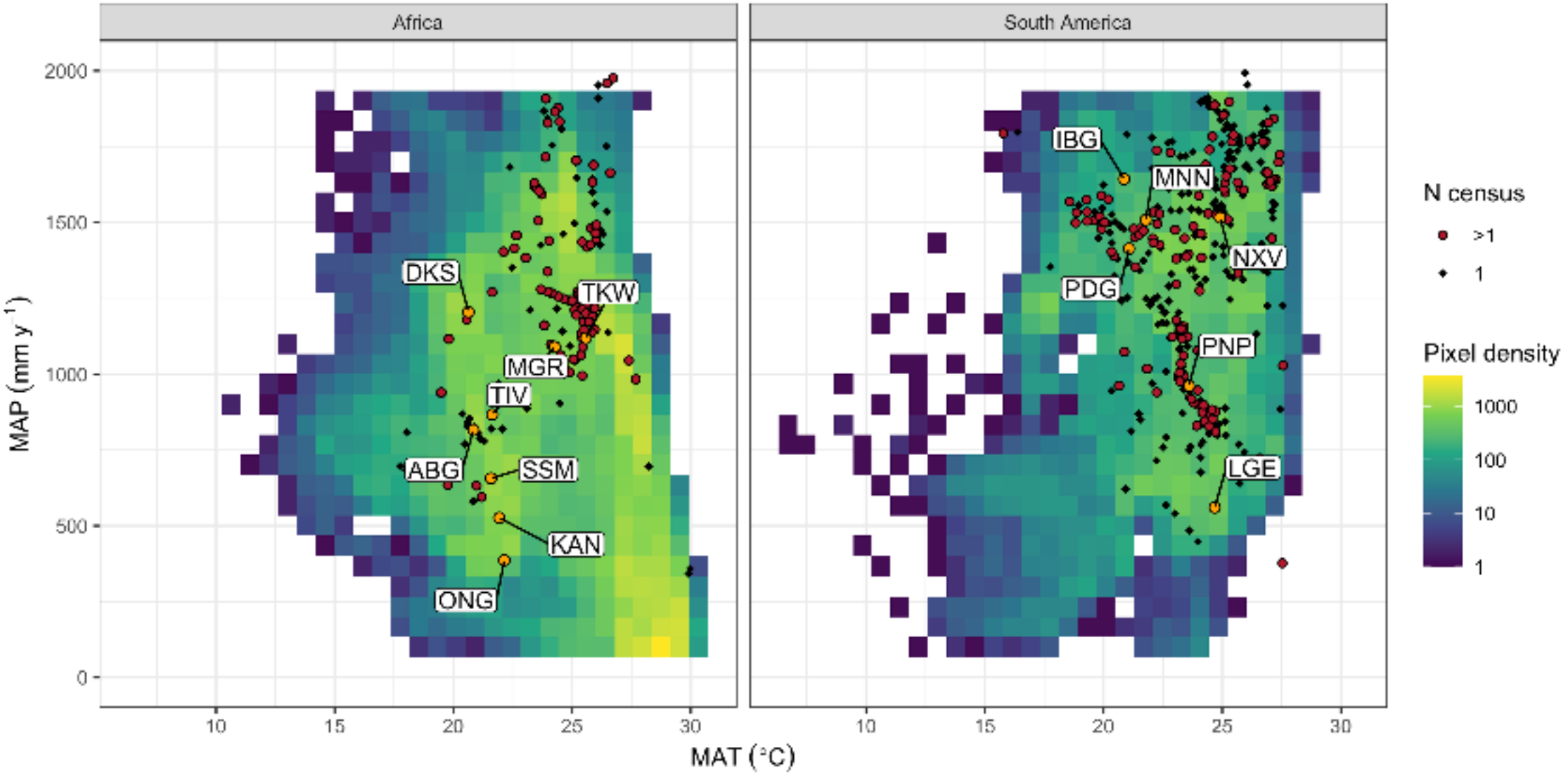
FORESTPLOTS.NET

SEOSAW

SECO plot data – Africa and South America



SECO plot data – climate space

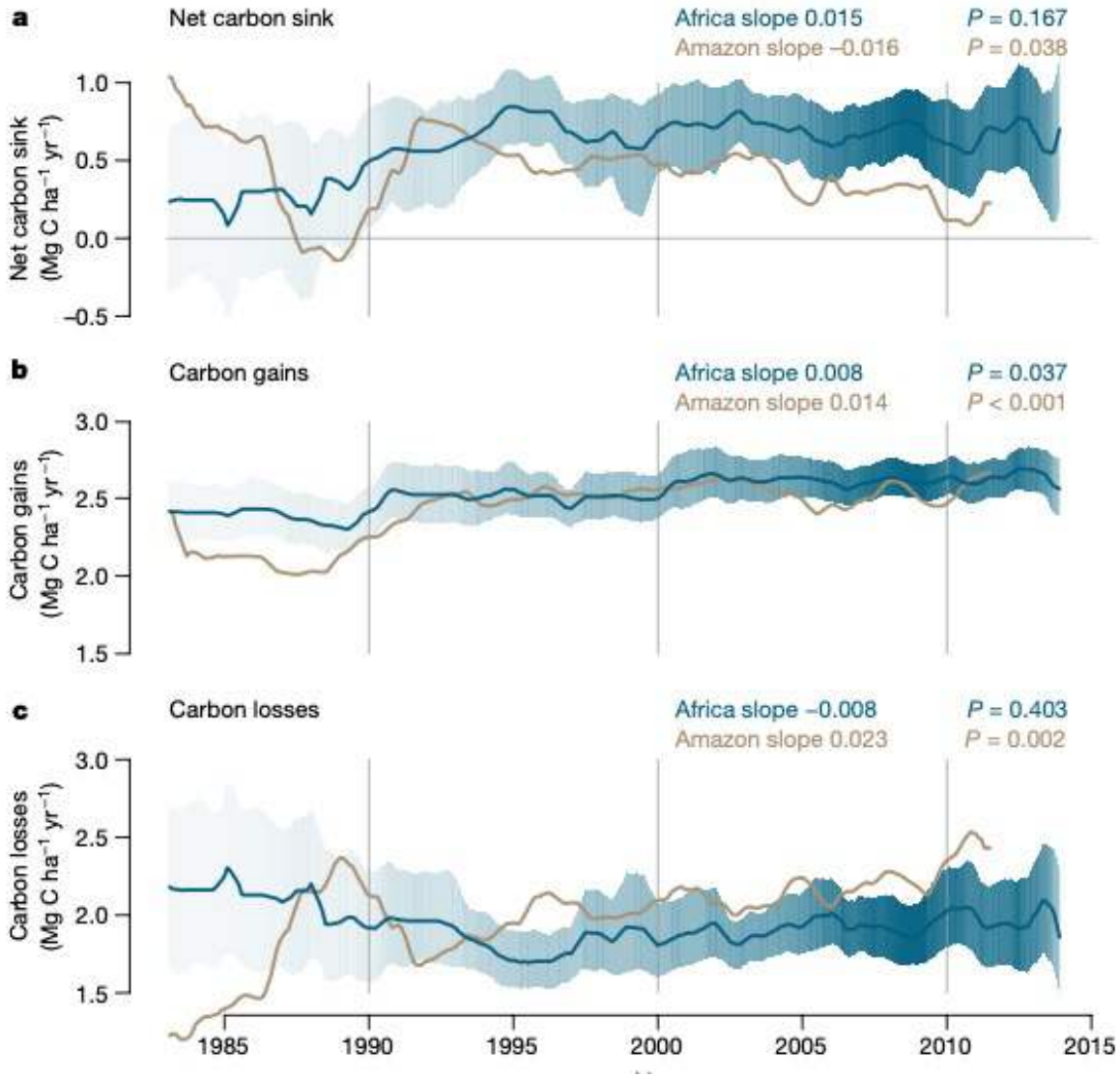


Separating growth and mortality

- In Amazonian rainforests, the carbon sink is declining due to increased mortality and decreasing growth (Brienen et al. 2015).
- But in African rainforests, mortality is steady (Hubau et al. 2020).

- **How are mortality rates changing in the dry tropics?**

- **Which species, or taxonomic groups are contributing most to growth, biomass turnover?**

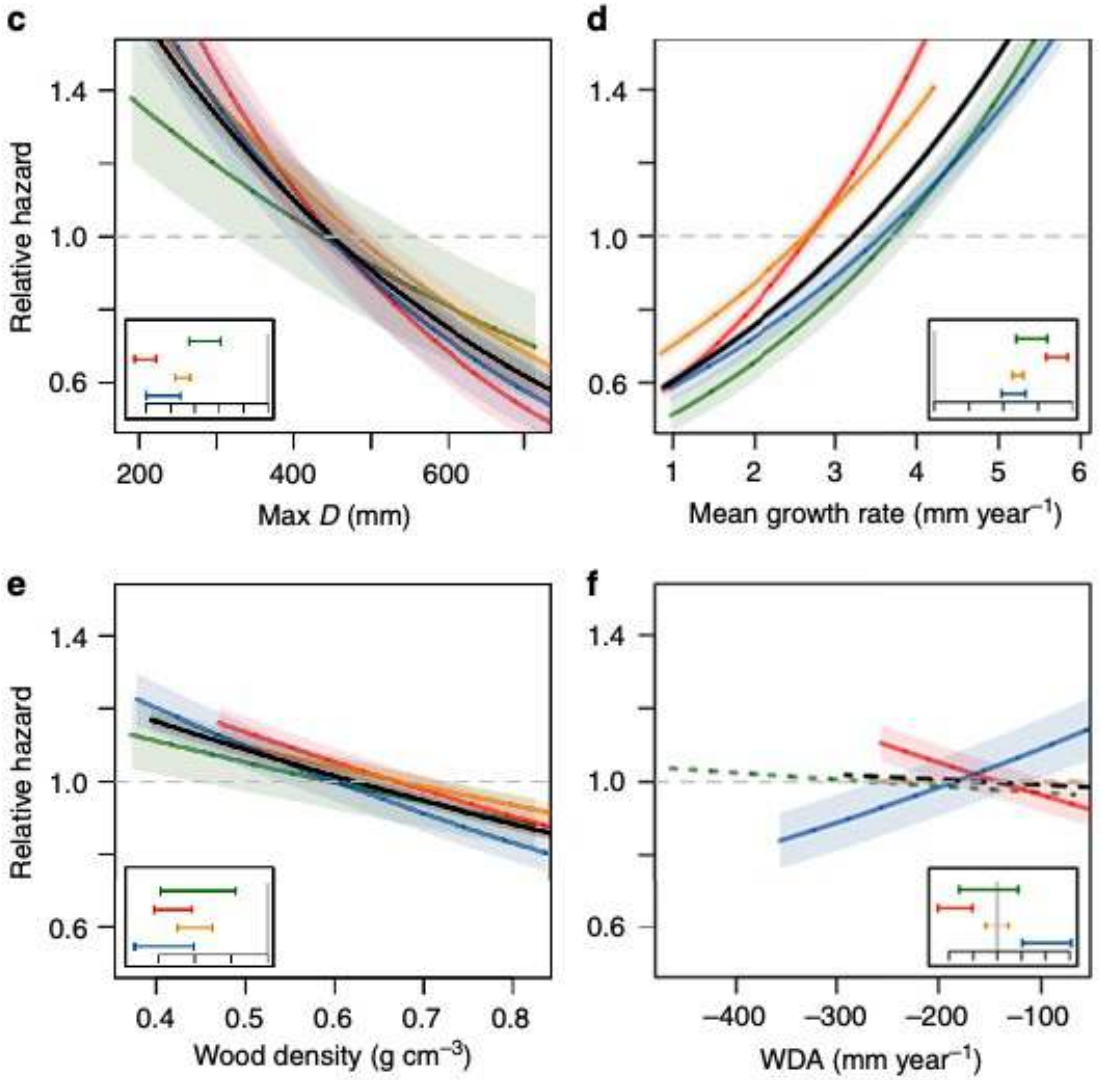


Hubau et al. (2020)

Mortality risk factors

- CO_2 fertilization is predicted to increase growth rates in the dry tropics.
- Wet forest:
  - ↑growth rates = ↑mortality risk
  - ↑wood density = ↓mortality risk
  - regional variation in mortality rates
- ↑growth rates could reduce fire mortality

- **Will climate change and CO_2 fertilization change community composition through variable mortality?**



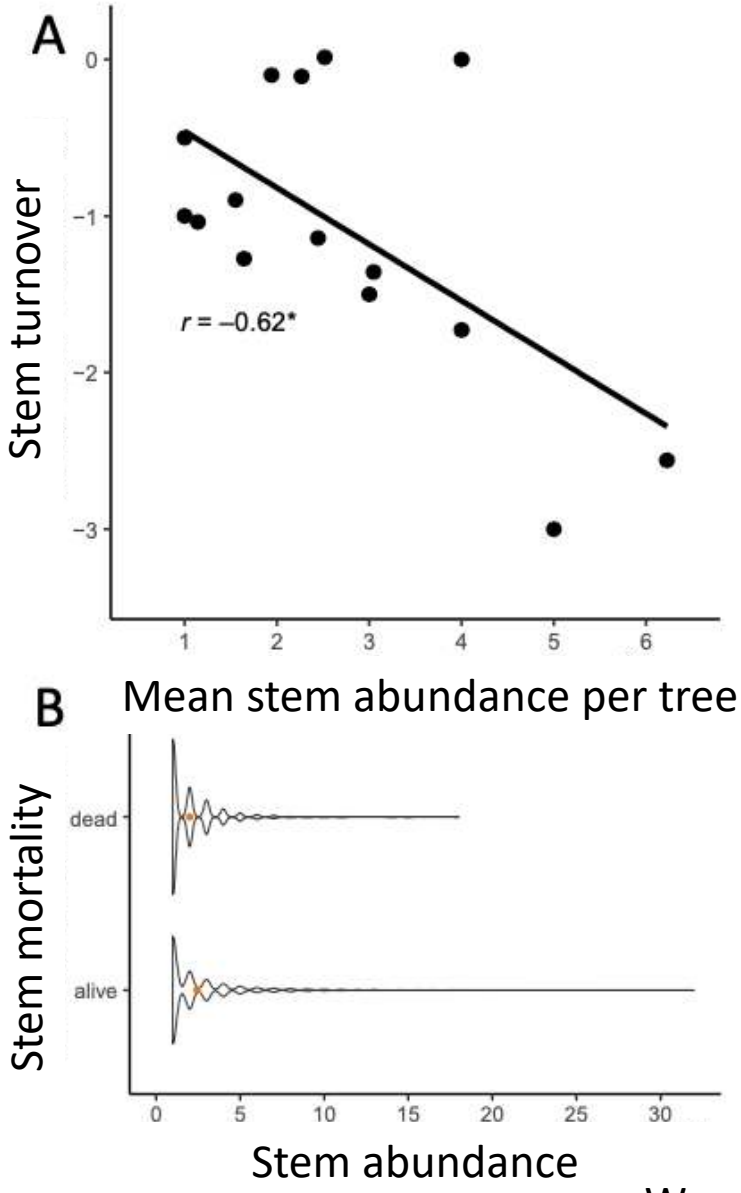
Esquivel-Muelbert et al. (2020)

Multi-stemmed trees

- Rare in wet forests, abundant in the dry tropics.
- Resilient to disturbance, climate extremes.
- Higher biomass turnover.
- Not as tall, but large below-ground reserves.

- **How does the presence and abundance of multi-stemmed trees alter biomass dynamics?**

- **Will multi-stemmedness increase in the dry tropics?**



Ware et al. (2022)

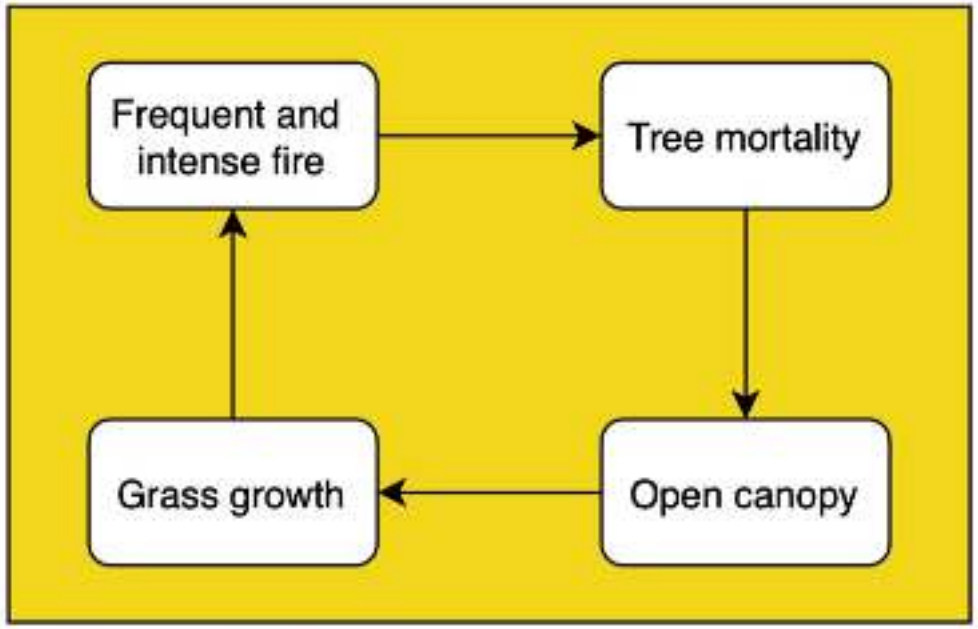
Disturbance, size class distribution, competition

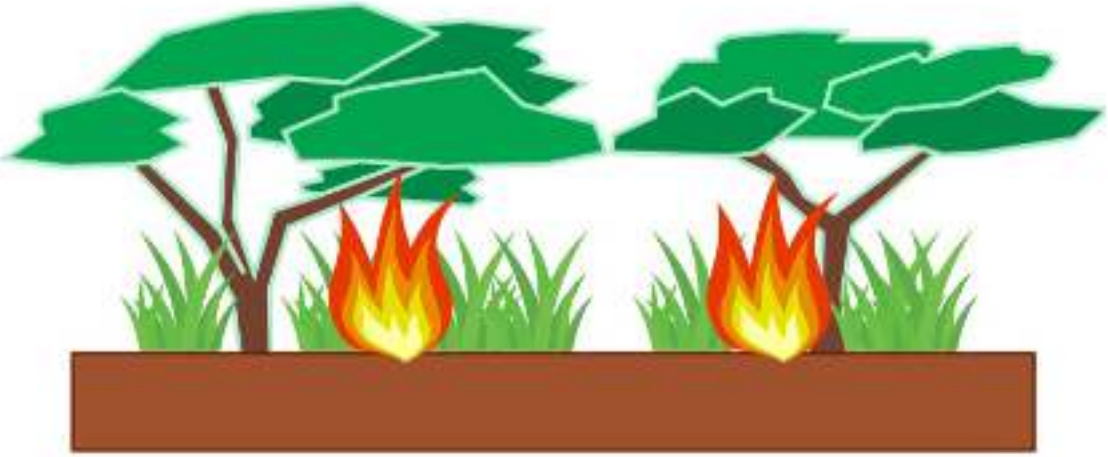
- Savannas are structured by a combination of disturbance and resource limitation.
- Stem size structure and spatial distribution of stems affect competitive interactions.

- **How do fire and resource limitation affect stem size distribution?**

- **How do competitive interactions vary with stem size distribution?**

- **Does composition or diversity influence size structure and spatial distribution? How does this affect potential woody biomass?**





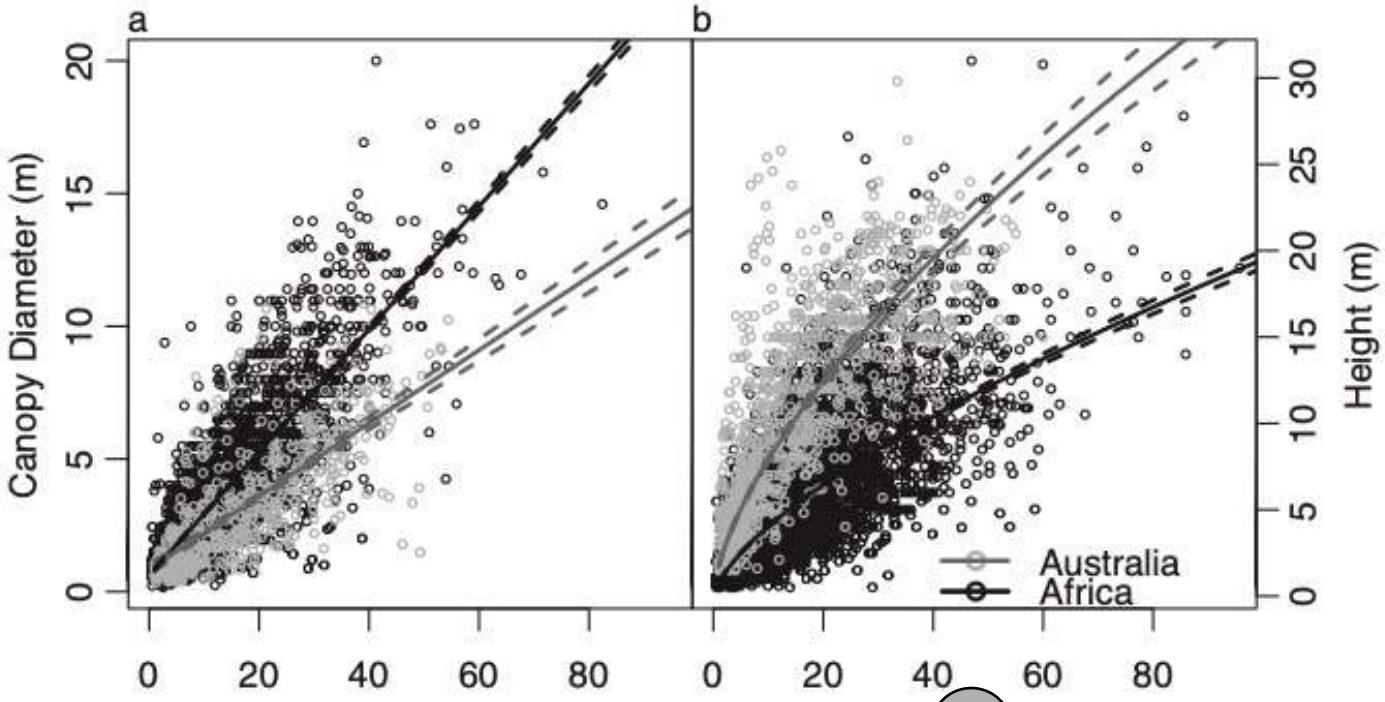
Staver et al. (2011)

Biogeography, continent effects

- Wide crown miombo vs. tall and skinny eucalypt savanna (Moncrieff et al. 2014).
- Productive dipterocarps allocate more to wood than in neotropics (Banin et al. 2014).
- Life-history strategy, mortality rates, growth rates
- Nitrogen fixers

- **How does life history strategy affect biomass turnover?**

- **Which evolutionary lineages are driving productivity?**



Moncrieff et al. (2014)

Summary

- Plot data can answer questions on internal dynamics of dry tropical ecosystems.
- Plots also support other SECO research approaches.
- We don’t understand how mortality rates vary across the dry tropics, or what drives that variation.
- CO2 fertilization could have multiple contradictory effects on biomass dynamics.
- Multi-stemmed trees are peculiar and deserve more attention.
- There is a complex interaction between stem size class distribution, competition, and disturbance.
- Life history strategy and continental differences in evolutionary history could alter responses to global change.