



What is realistic and feasible?

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Carbon Dynamics in the Anthropocene Workshop

April 2021

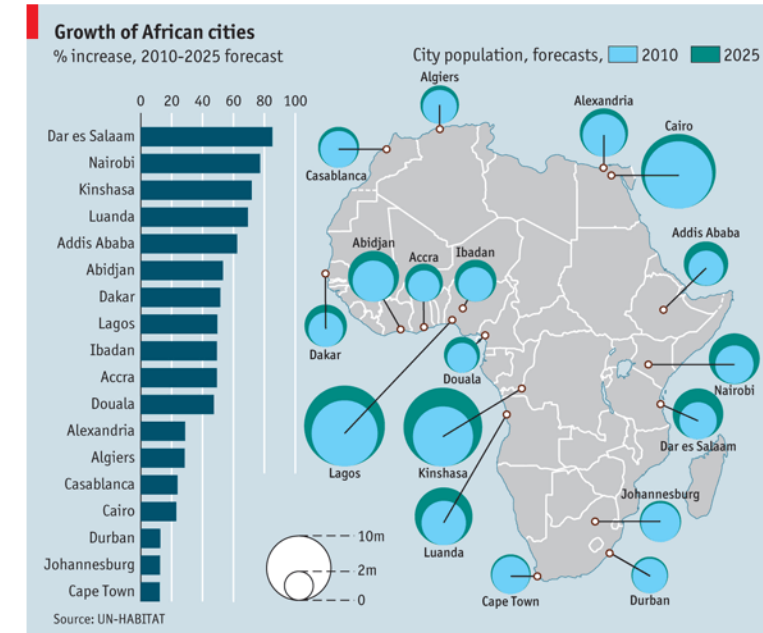


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UNIVERSITY

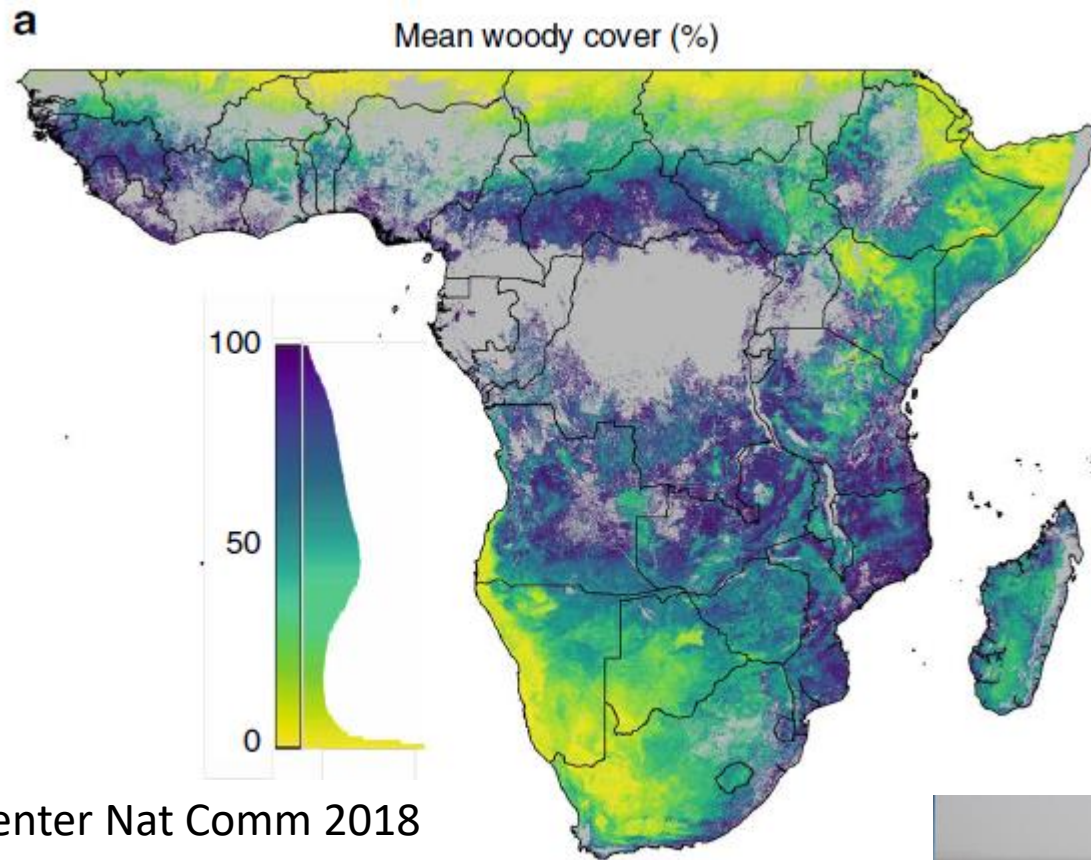


Context of Africa

- Populations growing but expected to stabilize in coming decades
- Rapidly urbanizing, but currently the livelihoods of millions of people are dependent on natural ecosystems.
- African landscapes are a 'resource' for Natural Climate Solution projects and countries have committed millions of km to afforestation projects BUT have also committed to increasing agricultural production.
 - The numbers don't always add up.
- Unlike South America, large-scale agriculture is not yet extensive
 - potential to identify better development pathways

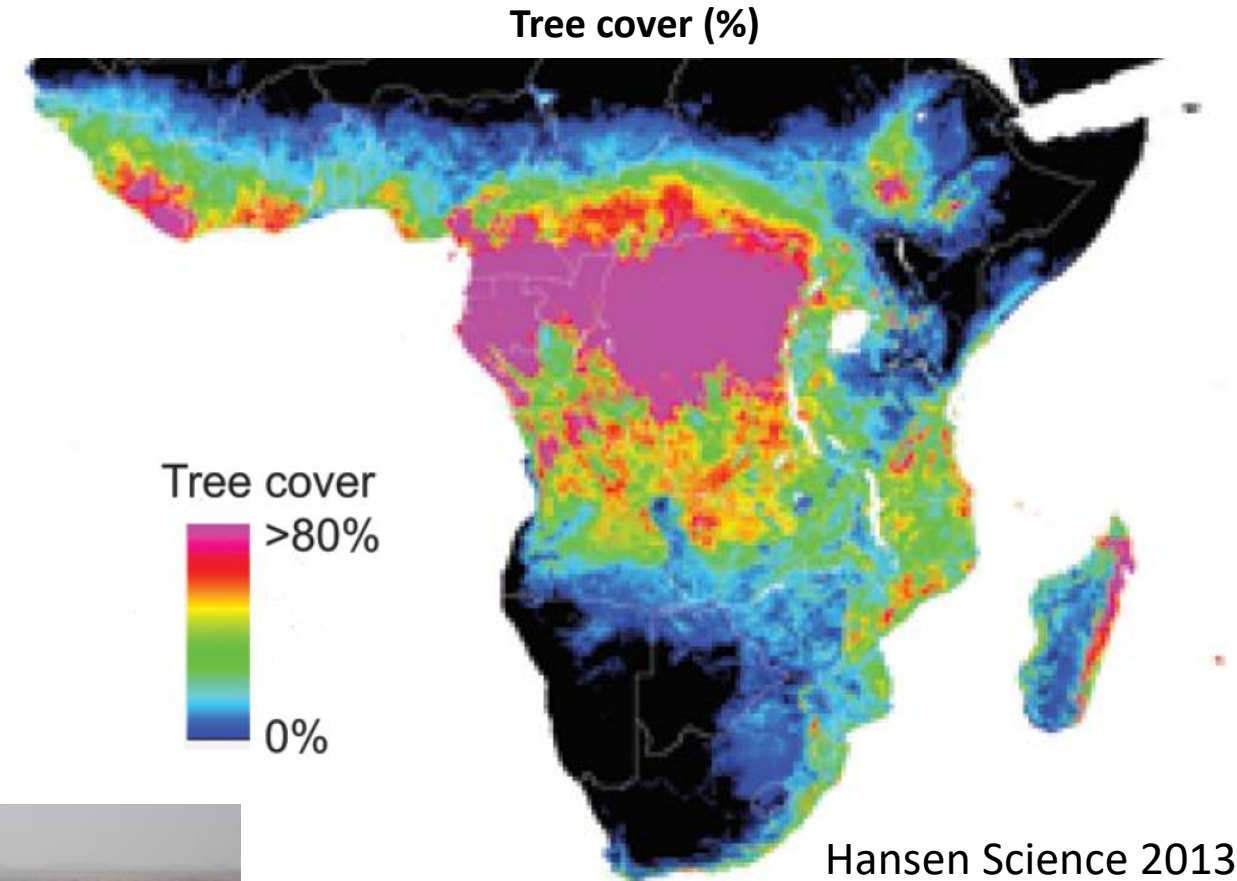


Point 1: Remotely sensed data are also models



Venter Nat Comm 2018

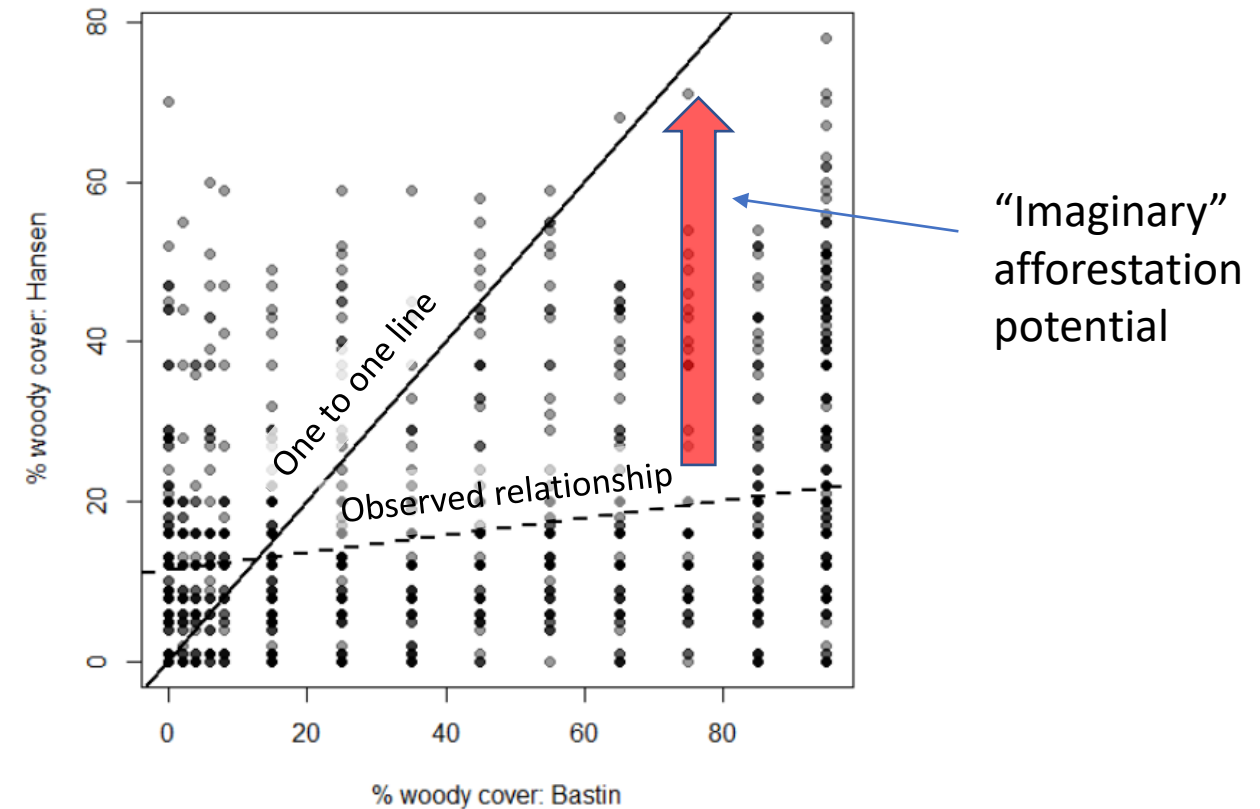
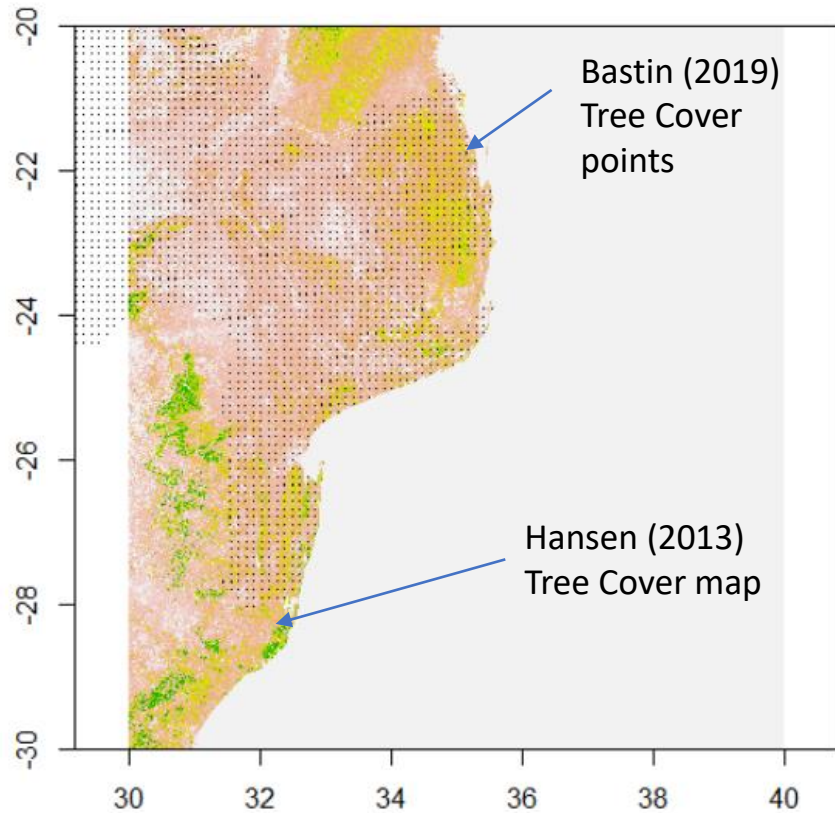
Decision tree using Landsat:
“We identified woody plant canopies using texture, colour and canopy shadows as identification cues”



Hansen Science 2013

Decision tree using Landsat:
“For this study, trees were defined as all vegetation taller than 5m in height”

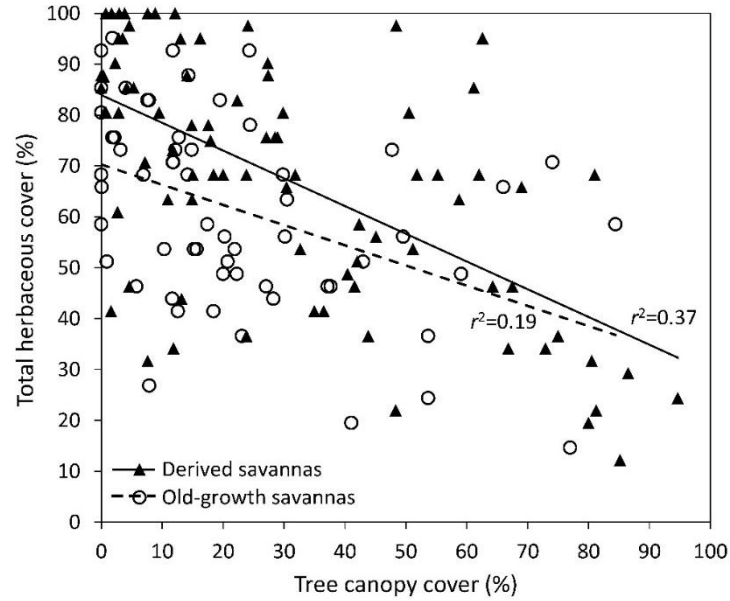
.... designed for particular purposes, can be misused



Using Hansen (trees > 5m) to derive current woody cover, and Collect Earth (all woody plants) to derive potential woody cover....

results in gross over-estimates of the potential for woody expansion “afforestation” globally.

...can quantify structure, but not function or diversity (yet)



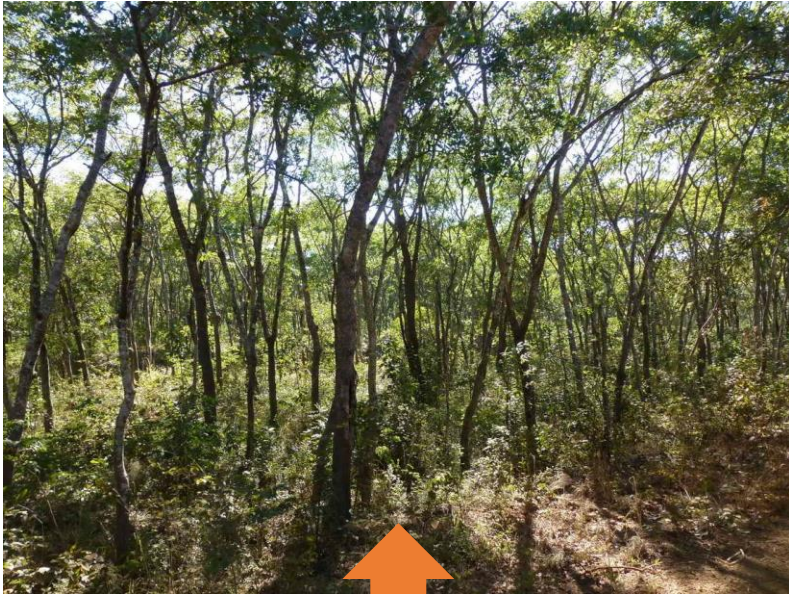
Veldman, Phil Trans 2016



Photos: Tony Sinclair - Serengeti



Point 2: Tropical woodlands are dynamic



*Brachystegia
spiciformis*:
Dominant tree in
all photographs



Photos: John Mendelsohn:
Southern Angola

.....evolved with, and adapted to frequent disturbances



*Millettia
stuhlmannii*



*Afzelia
quanzensis*

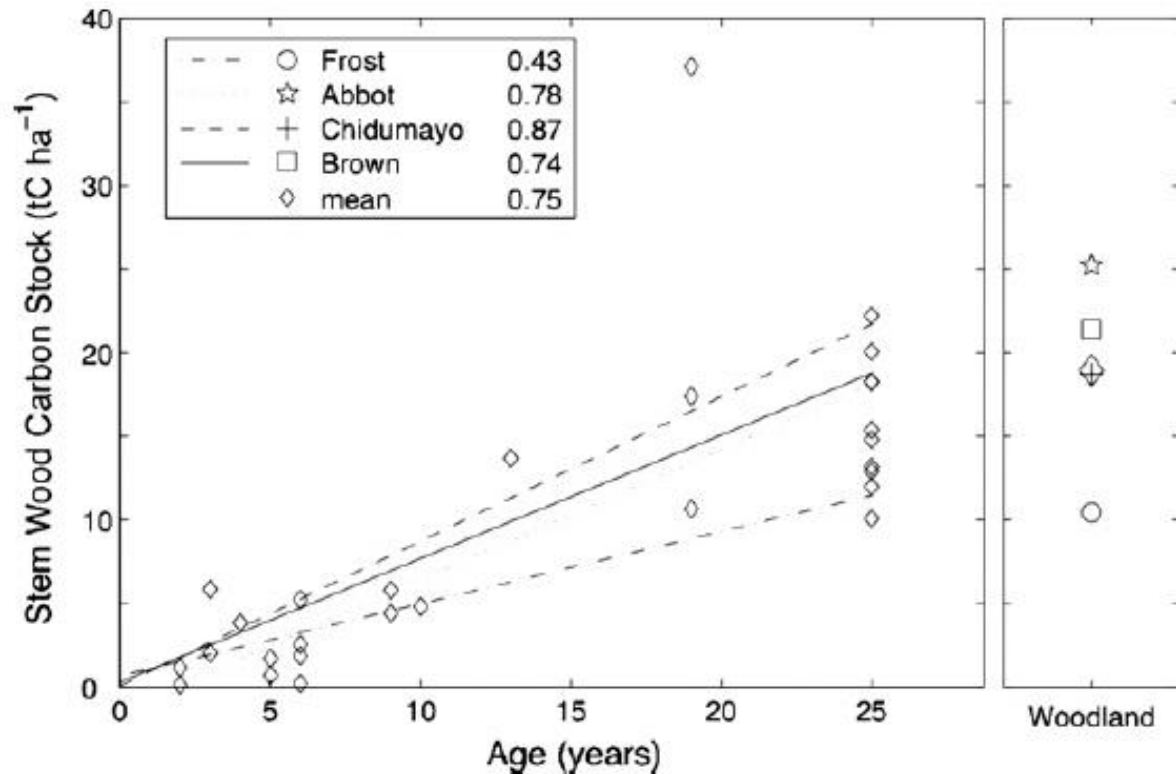


*Brachystegi
spiciformis*



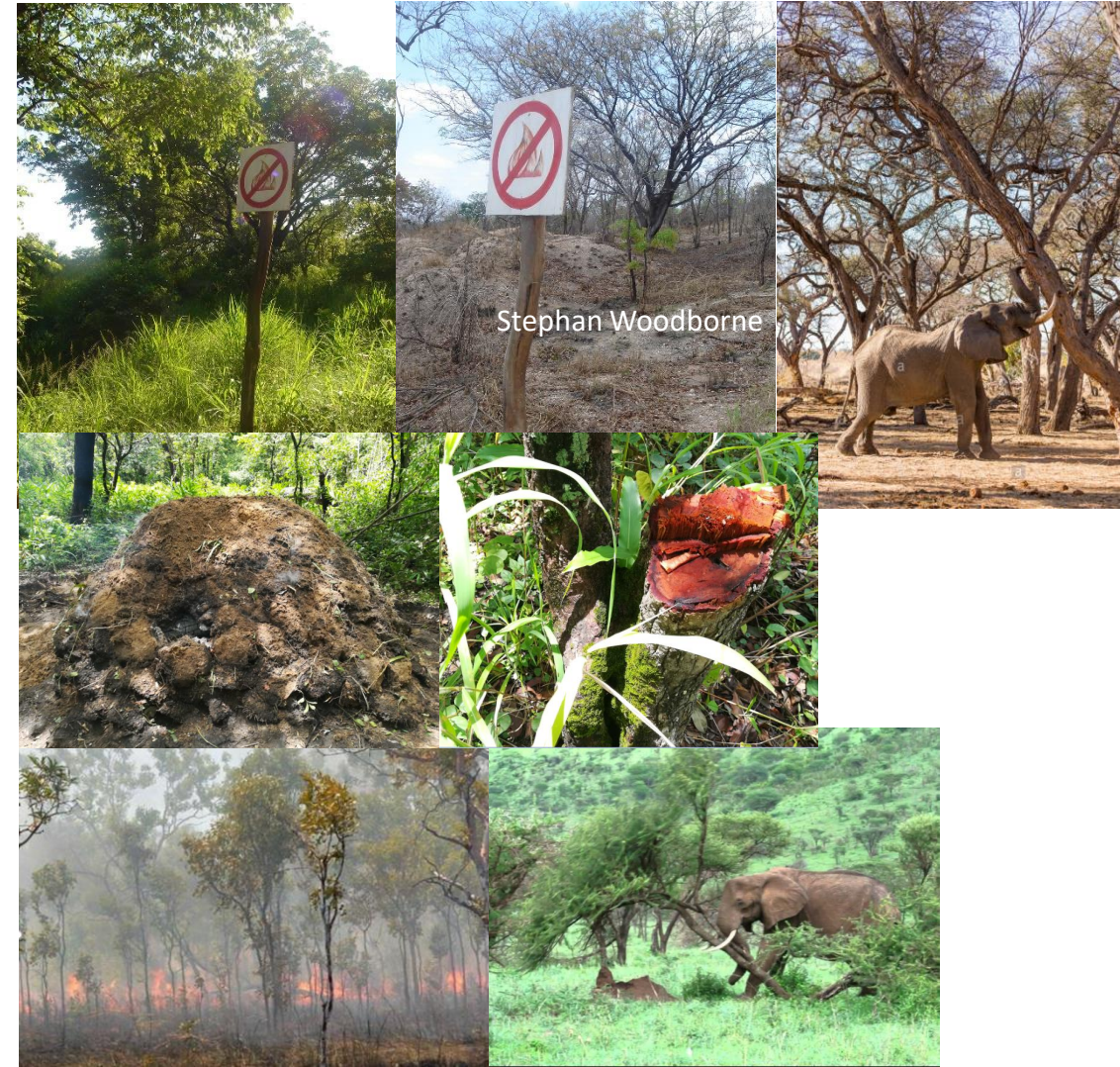
.....poor places to store above-ground carbon

Models predict rapid above-ground carbon storage potential

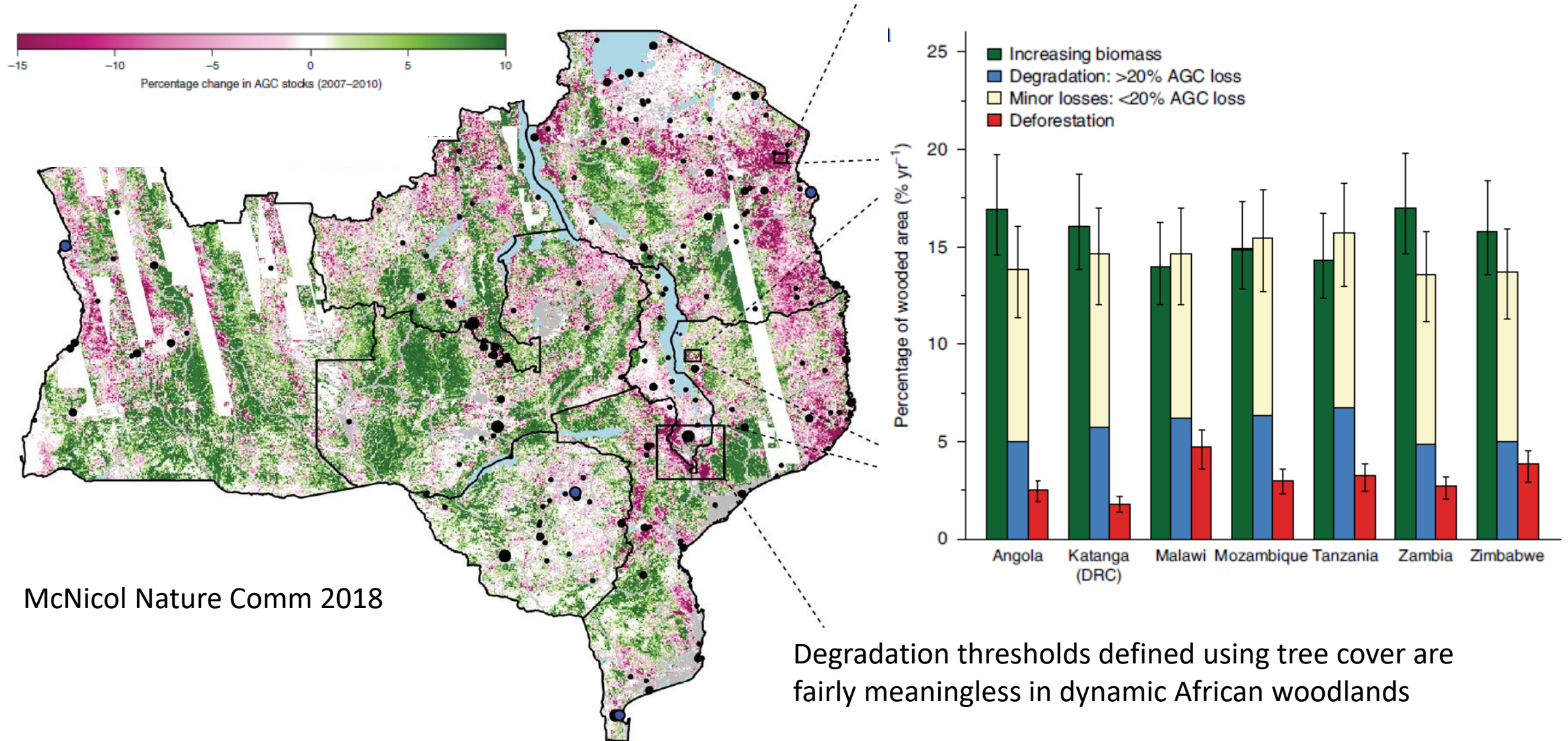


Williams ForEcolMan 2007

Reality shows equally rapid above-ground carbon losses



.....poor places to store above-ground carbon



McNicol Nature Comm 2018

Degradation thresholds defined using tree cover are fairly meaningless in dynamic African woodlands

Consequences of incorrectly identifying land as degraded.

...it makes more sense to focus on sustainable utilisation



“Woodlands provide 76% of total energy use in the region in the form of **potentially renewable** biomass.”

Ryan Phil Trans 2016:

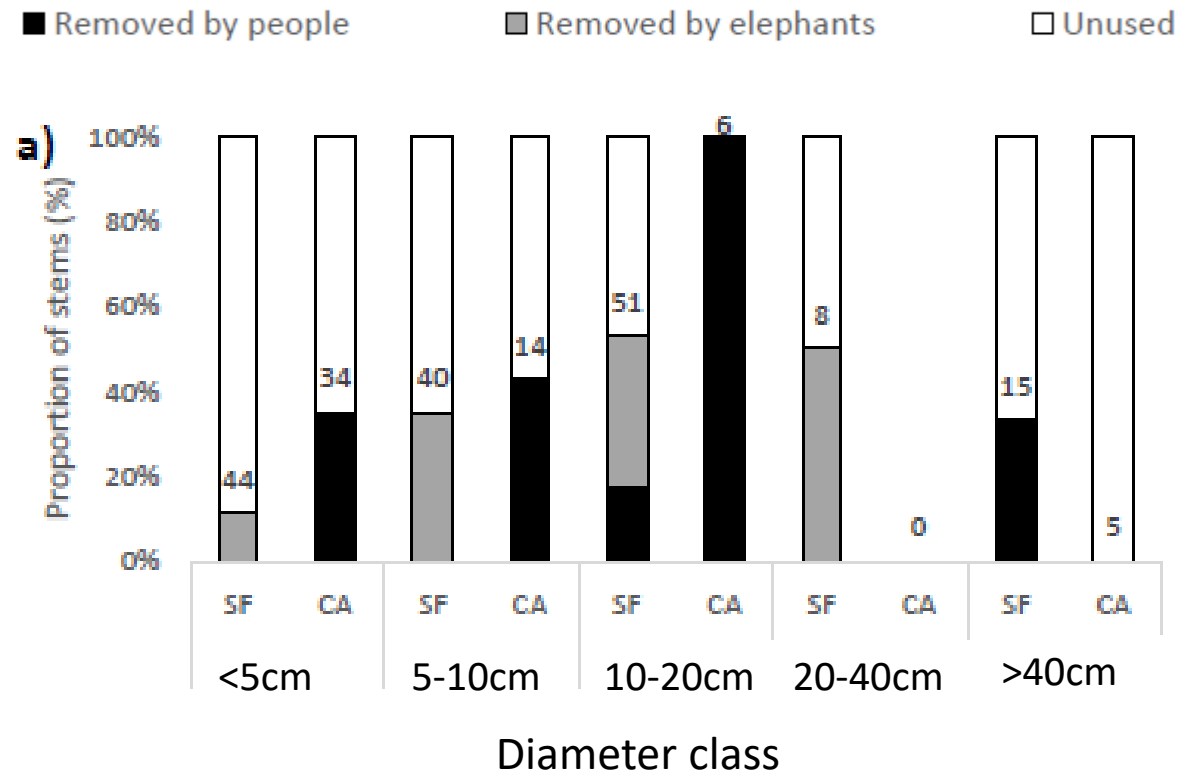
Help us to manage this resource sustainably, rather than tying it up in a **small, risky above ground** stock for ever.

The alternative is even MORE fossil fuel use!

Current fuel wood usage in southern Africa:

93 Mtonnes yr⁻¹ which @ 15 J/kg ~ **45 000 MW (~10 large power stations)**

...defining “sustainable” utilisation in dynamic African woodlands

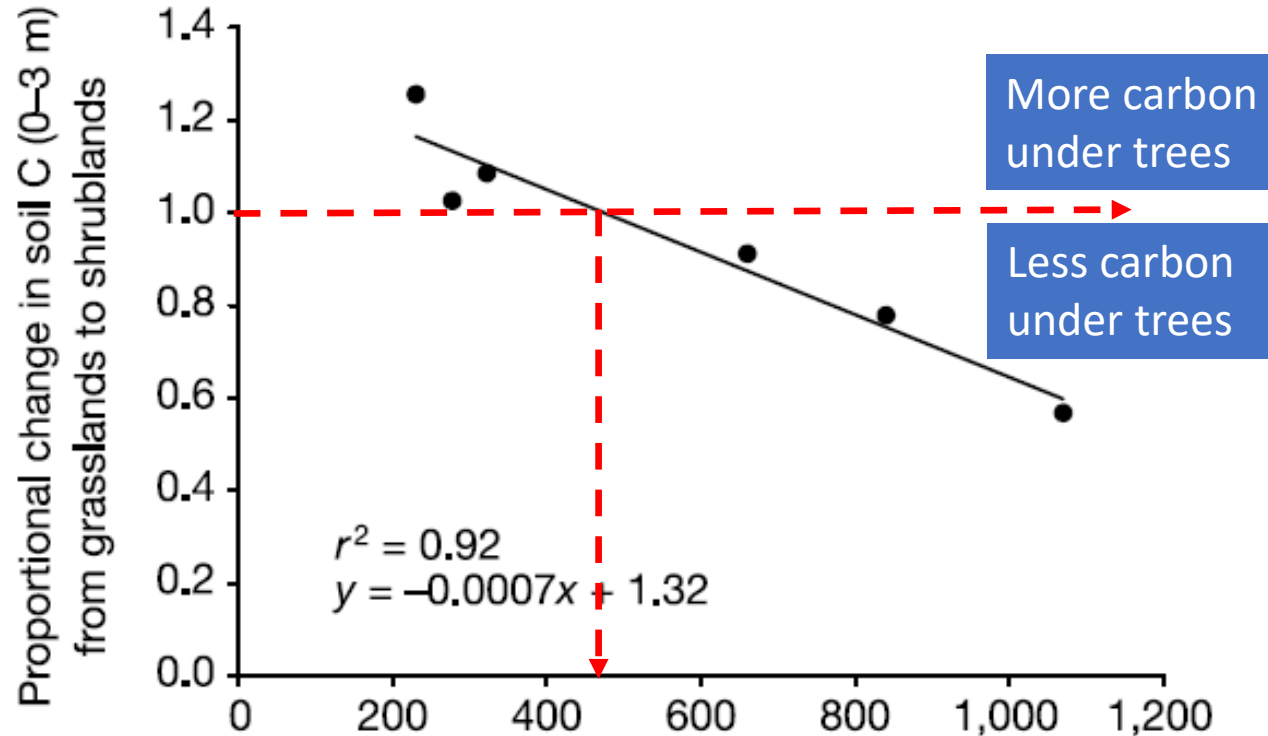


Point 3: Think carefully about soil carbon stocks



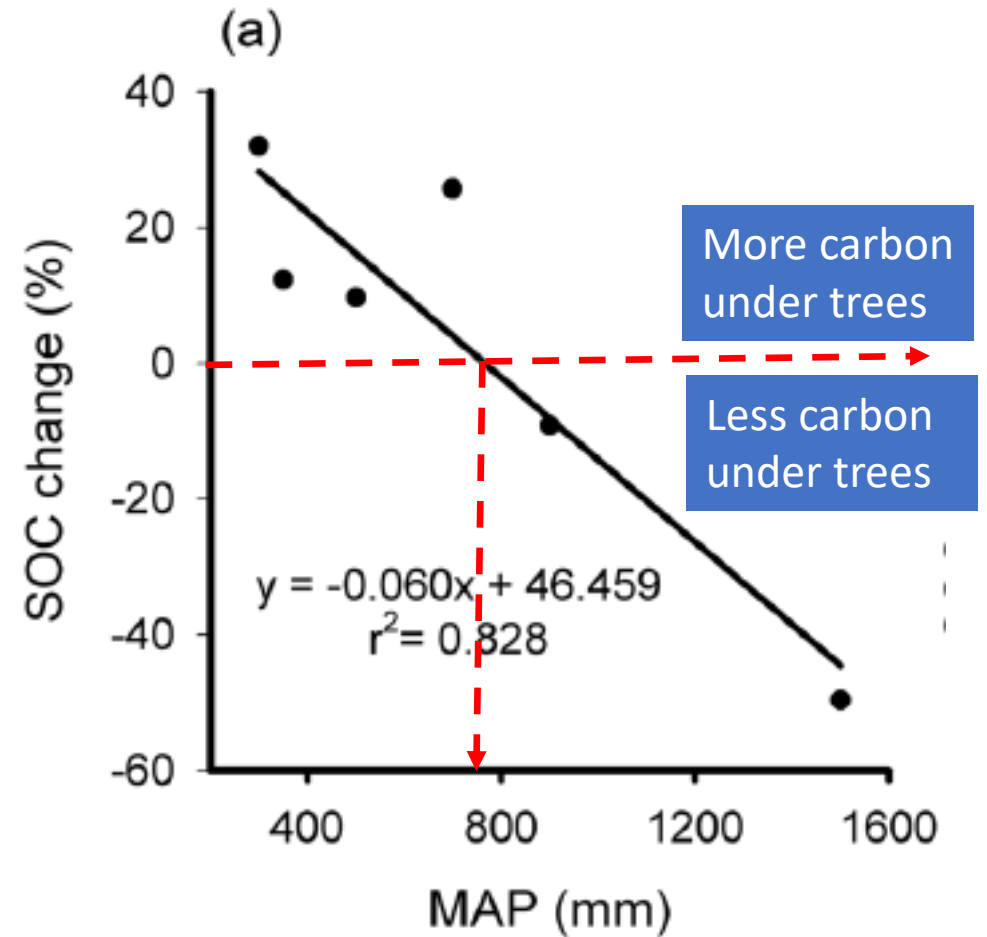
Zambia land use patterns (Google earth)

....SOC can show opposite trends to above ground carbon



Jackson et al Nature 2002 (N. America)

Less soil carbon in “afforested” areas than grasslands above
~450mm MAR

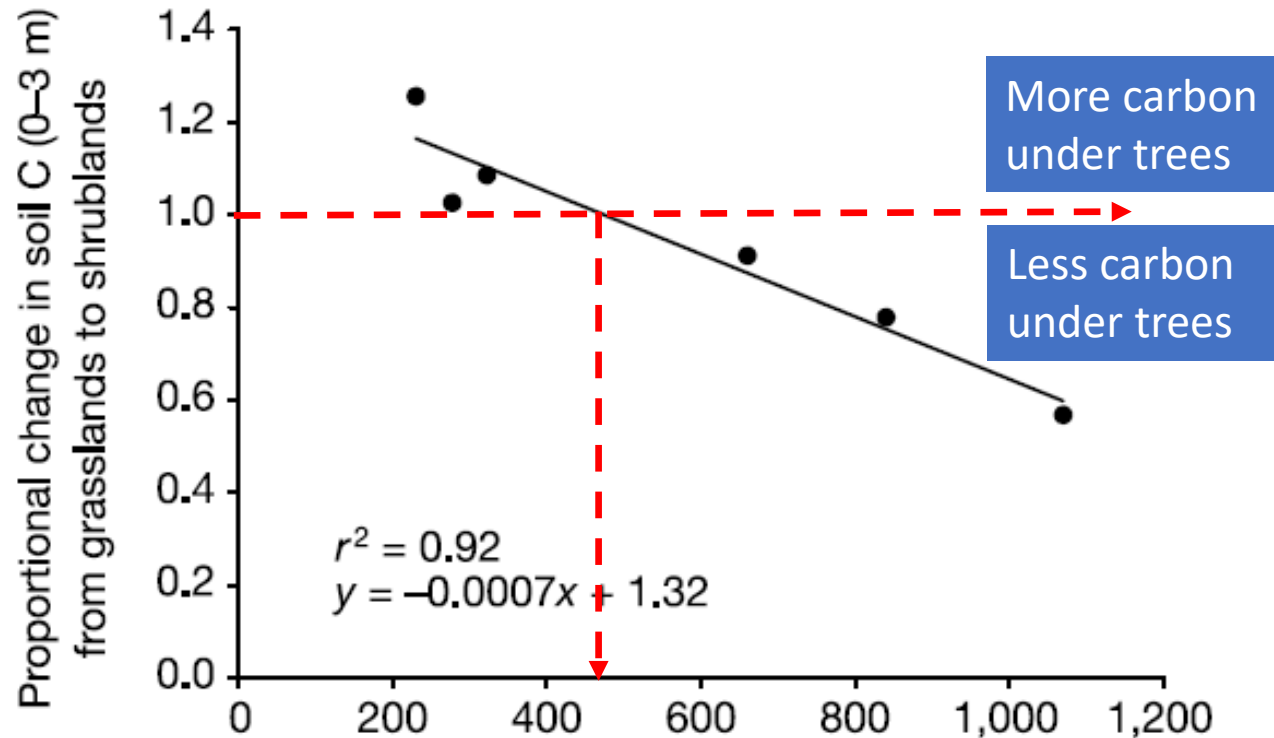


Mureva et al, Sci Reports, 2018 (S.Africa)

Less soil carbon in “afforested” areas than grasslands above
~750mm MAR

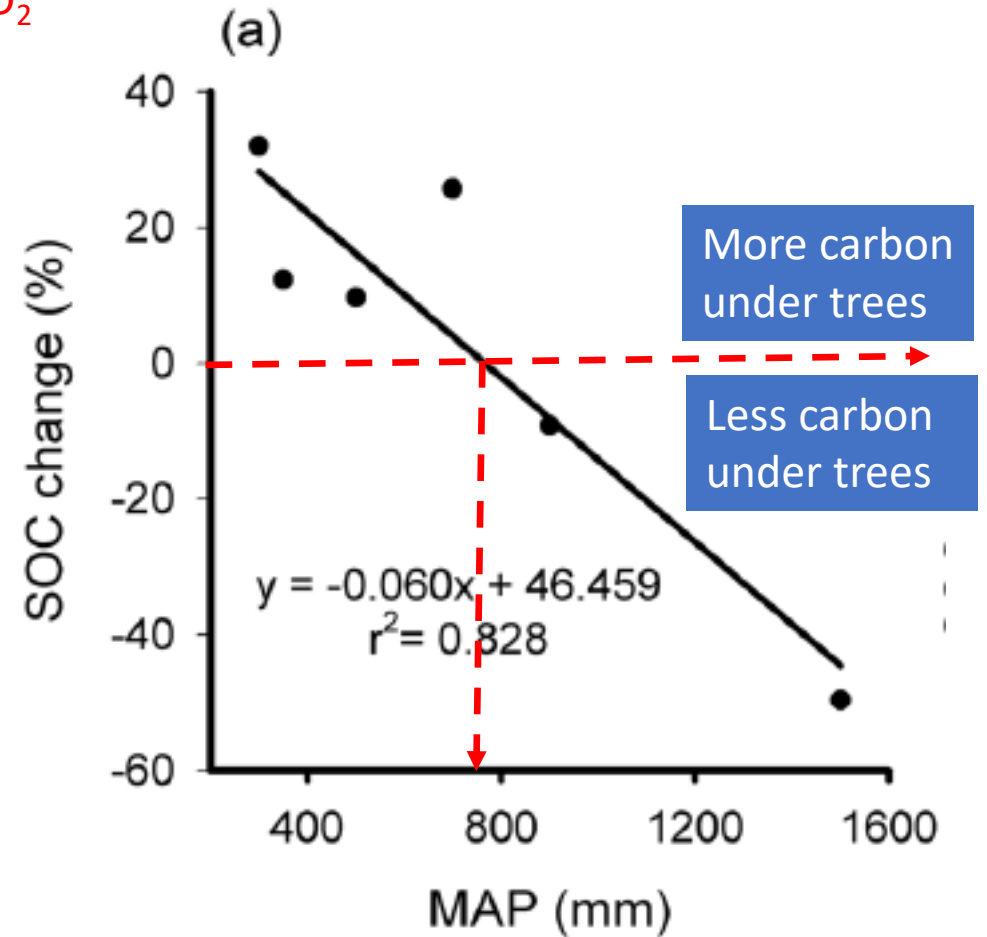
....SOC can show opposite trends to above ground carbon

See also Terrier Nature 2021 for trends with elevated CO₂



Jackson et al Nature 2002 (N. America)

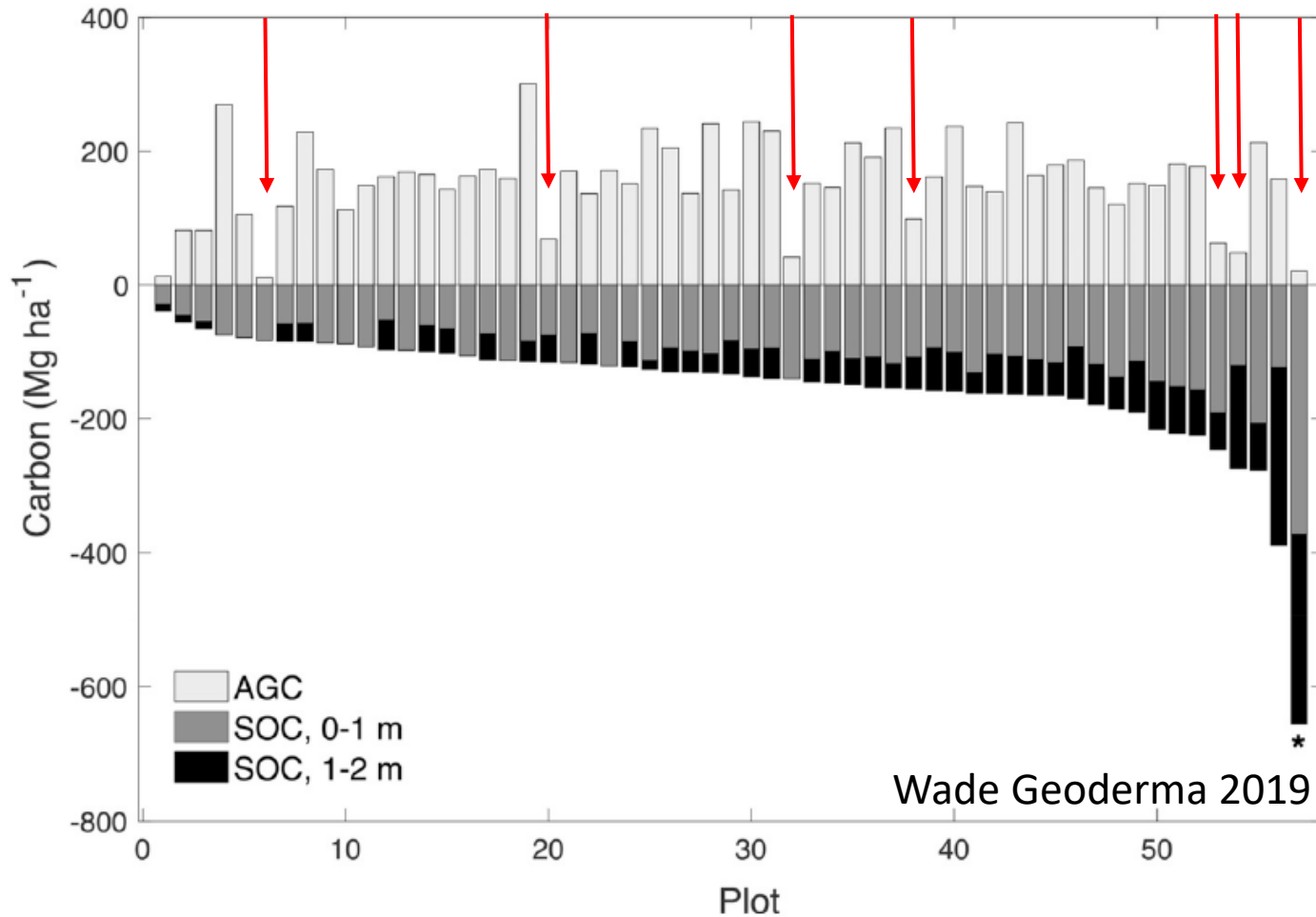
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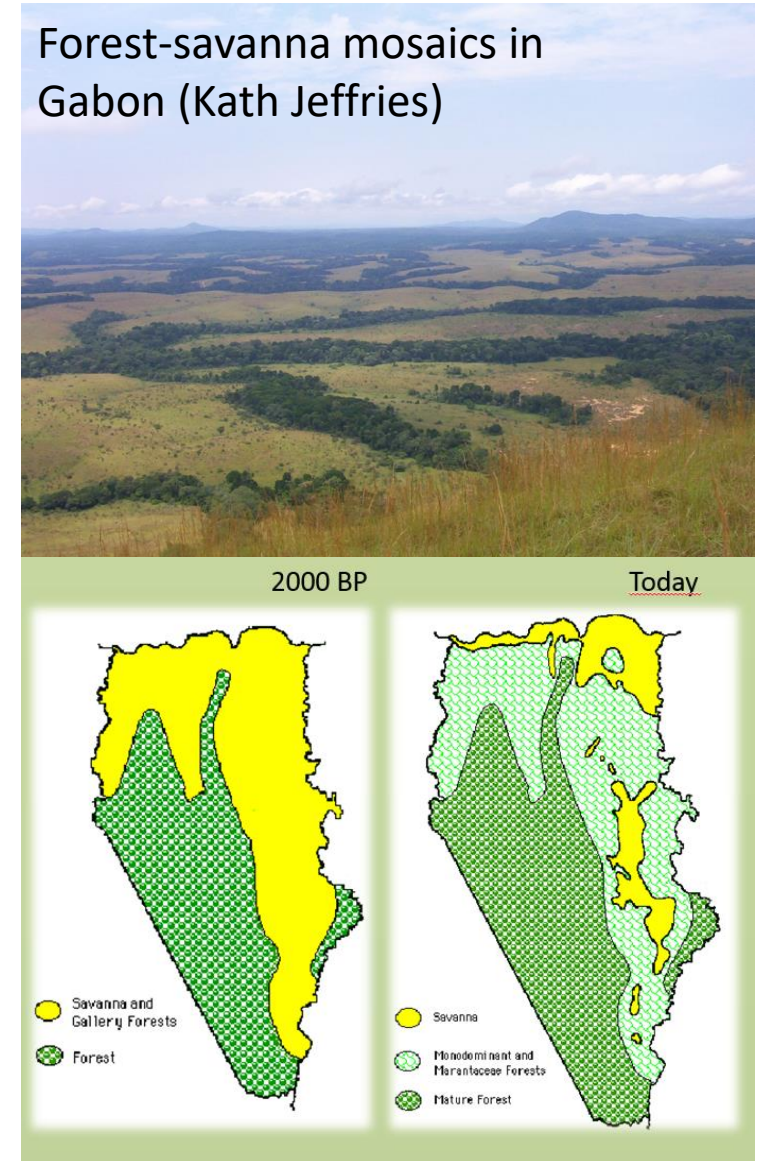
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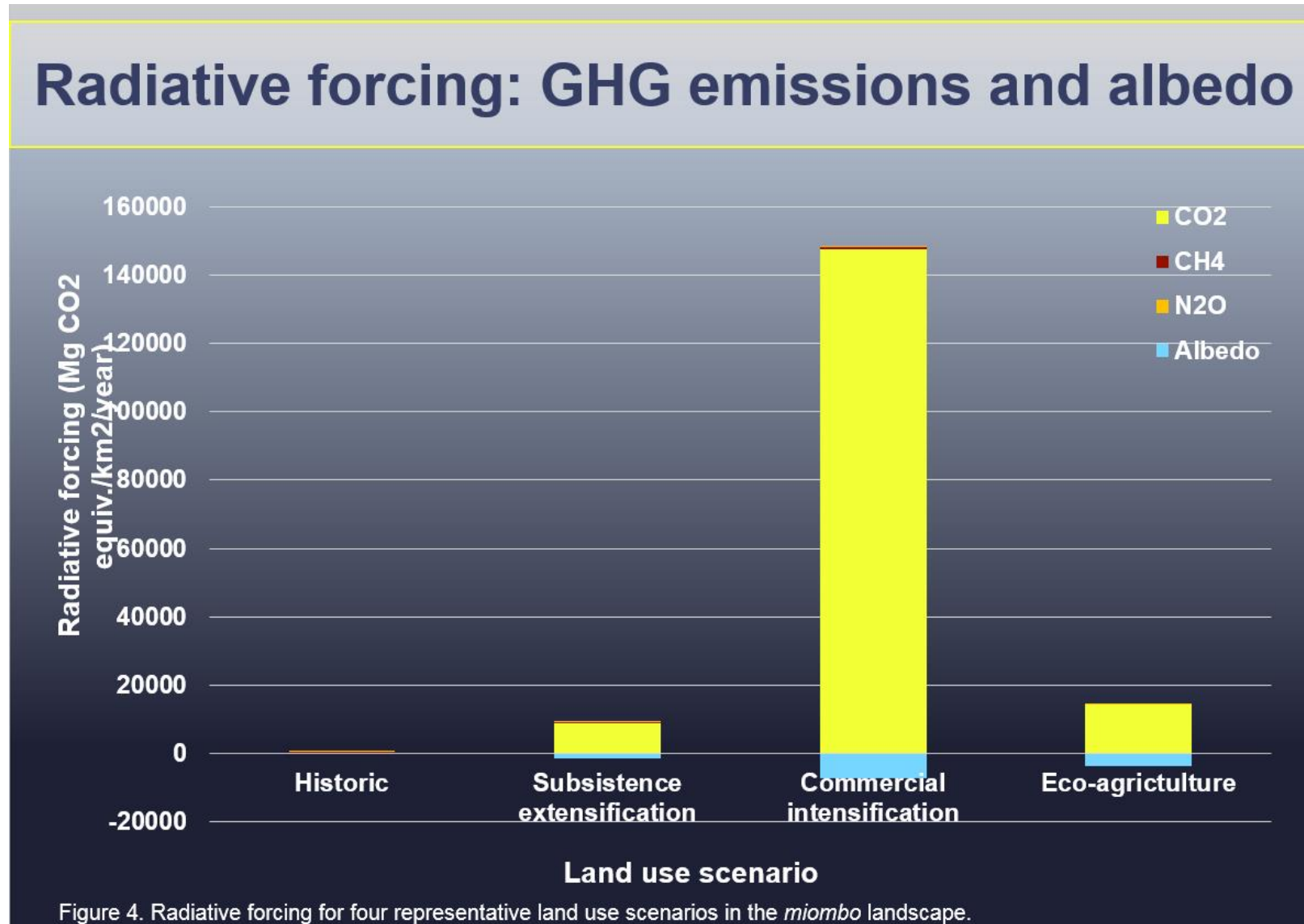
....SOC stocks do not mirror above ground carbon



Are these really afforestation opportunities to help solve the climate crisis, or economic opportunities for certain sectors of society to make money?



....SOC stocks are threatened by land transformation more than forest loss



Sally Wilson, MSc,
Wits University, 2018

Summary

1. Remotely sensed data are also models
 - Designed for particular purposes, can be misused
 - Can quantify structure, but not function
2. Tropical woodlands are dynamic
 - Poor places to store above-ground carbon
 - Currently, in Africa it makes more sense to focus on sustainable utilisation than afforestation
3. Think carefully about soil carbon stocks
 - SOC can show opposite trends to above ground carbon (more trees = less SOC)
 - Can result in very different carbon management solutions
4. Encouraging regeneration instead of active planting.
 - Active planting creates jobs and economic opportunities – more dependent on uncertain scientific analyses!
 - Encouraging regeneration takes away economic opportunities - less dependent on the models being perfect!

What are the proactive things we can do?

- Be careful to compare the right things
- Continue the fantastic job of quantifying the above-ground dynamics of African ecosystems
- Work to provide data that tells us about function, not only structure
 - i.e. can we use remote sensing to distinguish secondary grassland from old-growth grasslands? ('Purpleveld' grasses)
 - OR can the more detailed structural RS products coming online better represent function?
- Help make sense of soil organic carbon fluxes and stocks – linking observations to process-based models



Thank you