SANBI
Biodiversity for Life
South African National Biodiversity Institute

Considerations when developing national capital accounts for biological carbon

7 – August 2024
Graham von Maltitz – SANBI
Patrick O'Farrell University of the Western Cape

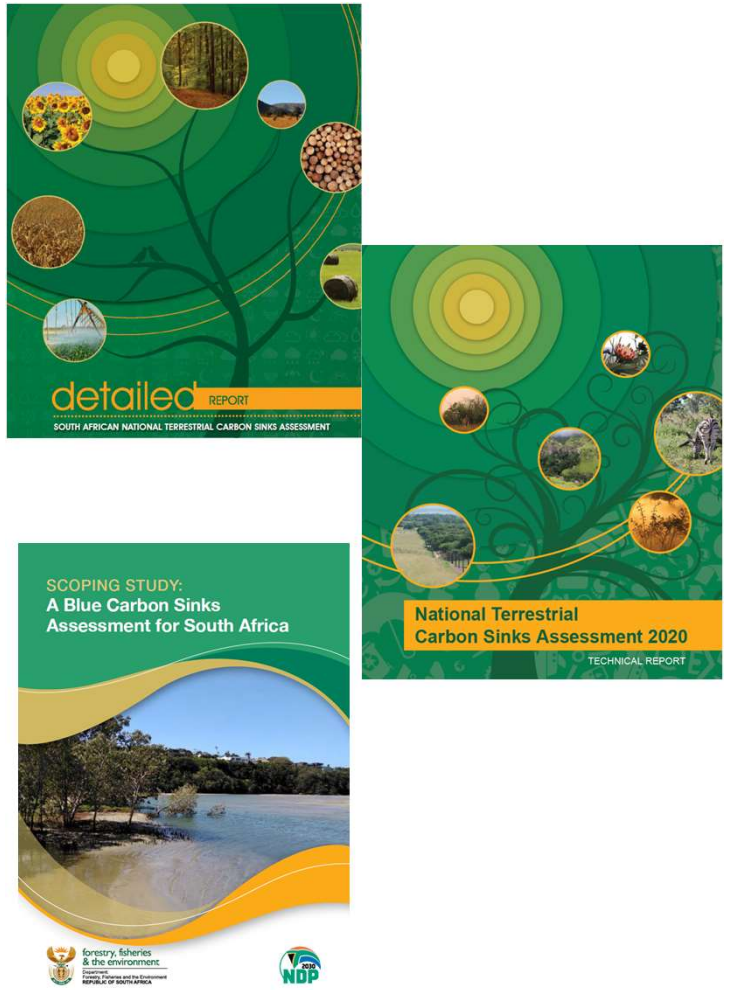
Where did we get our data?

2014 and 2020 National terrestrial carbon sinks assessment

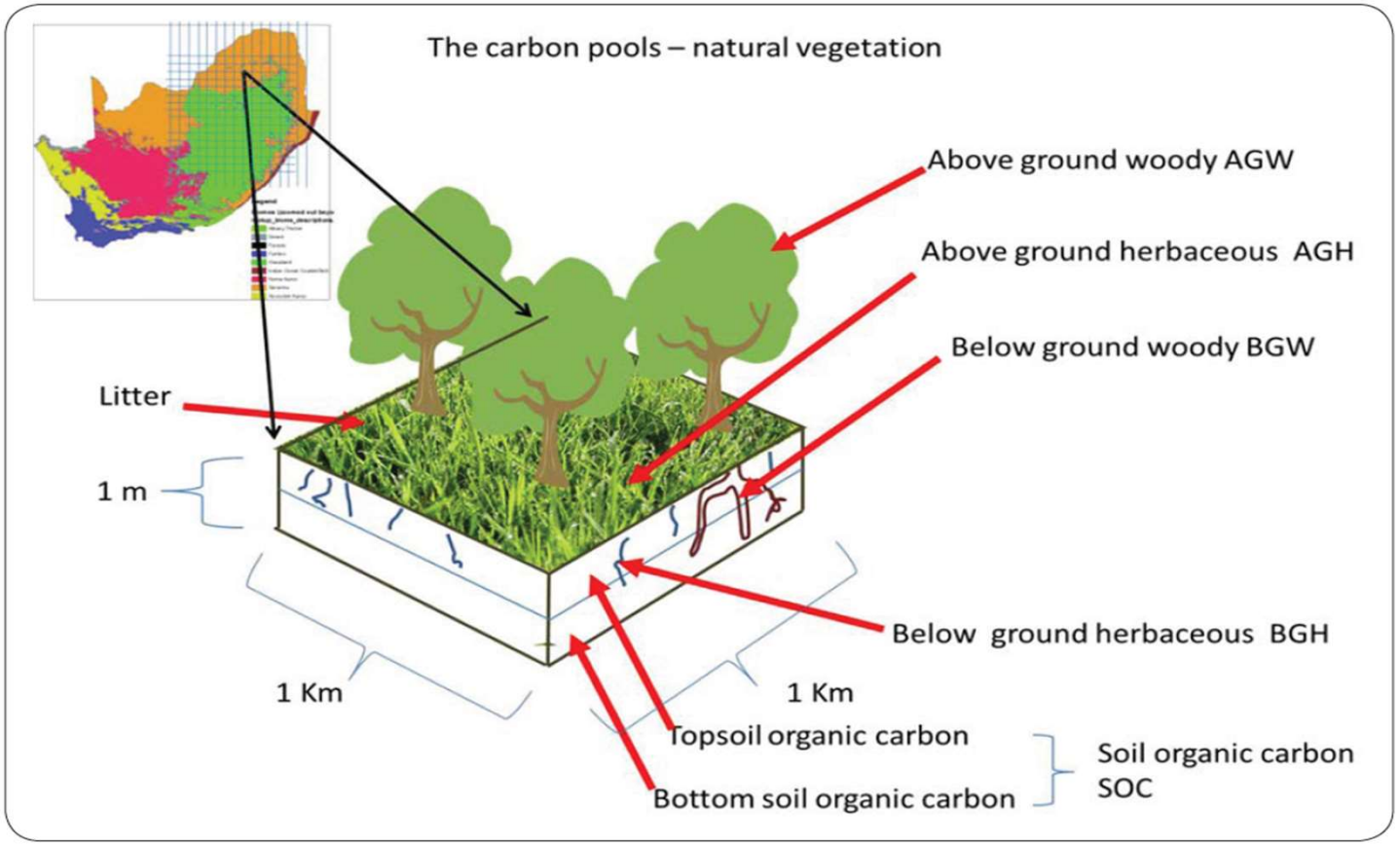
2021 A Blue carbon sinks assessment for South Africa

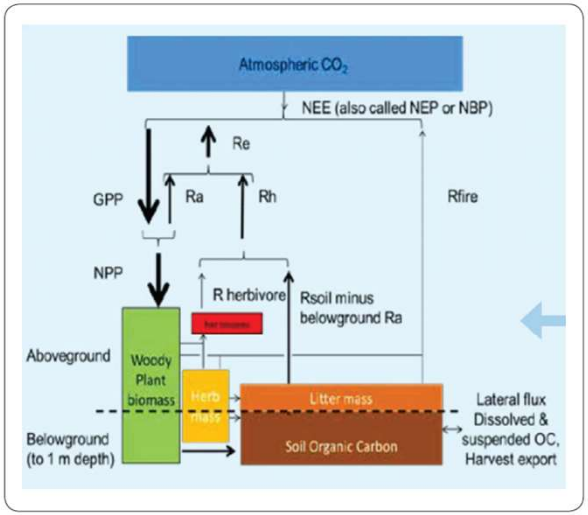
- Tree cover – Satellite imagery and models i.e. is actual tree cover
- Below ground tree cover – bases as % of above ground tree cover
- Grass cover – based on plot data
- Soil organic carbon. Soil plot data, extrapolated to country based on topography and other variables. Loss based on land cover changes

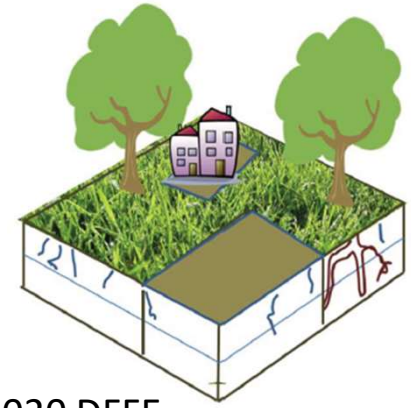
- All represented at 1 km grid, but often based on far finer resolution data



What do we mean by biological carbon?



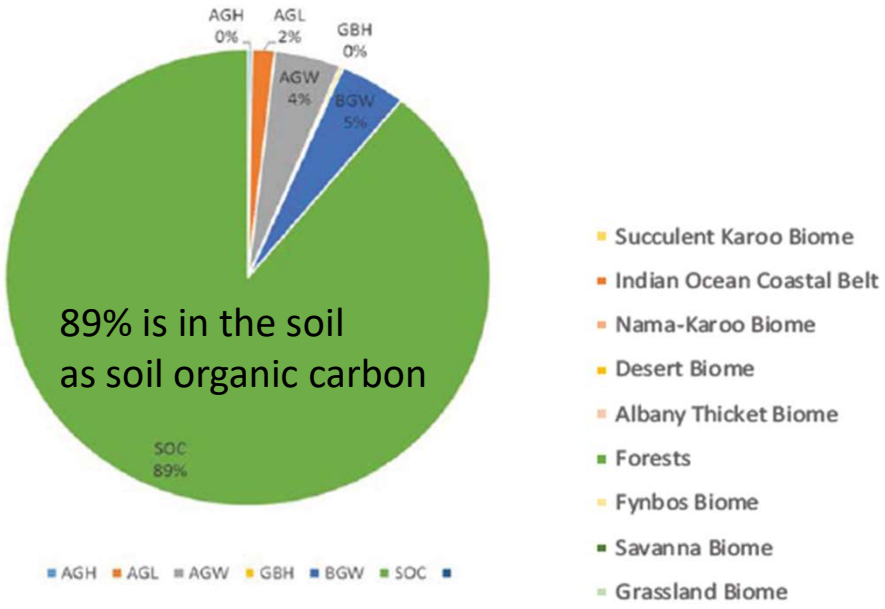




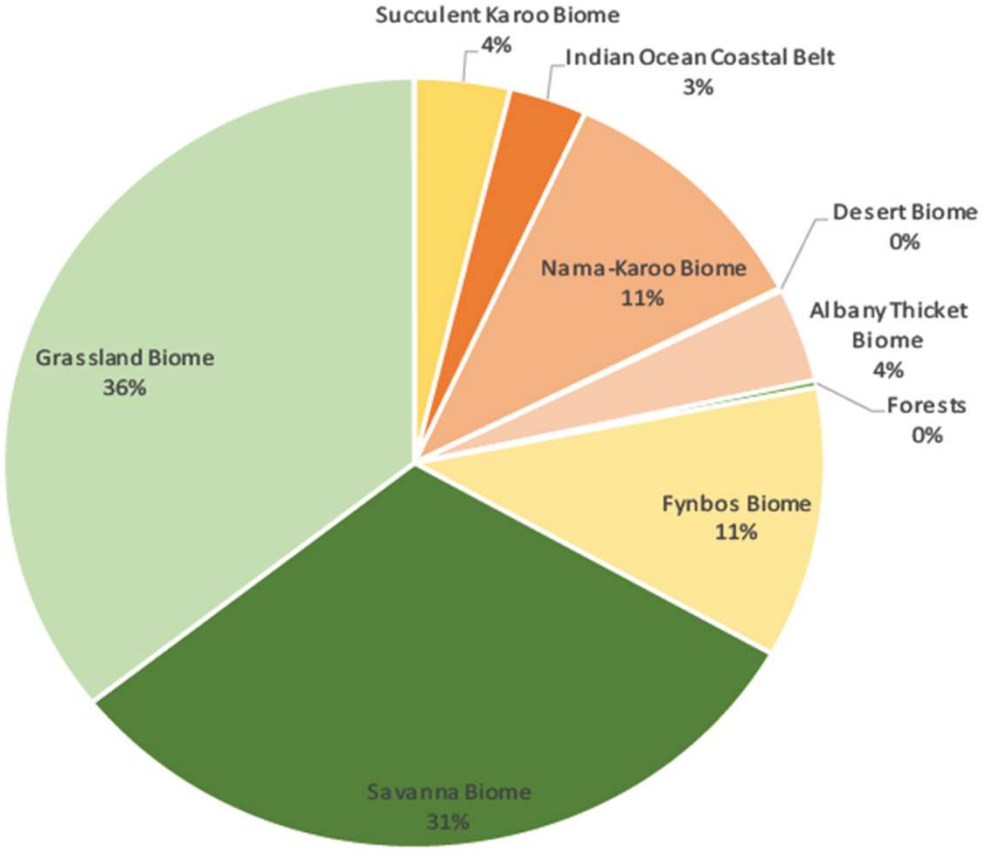
Includes peat
Excludes coal

Reference- National Terrestrial Carbon Sinks Assessmsmnt 2014 and 2020 DFFE

Where is the biocarbon stored?



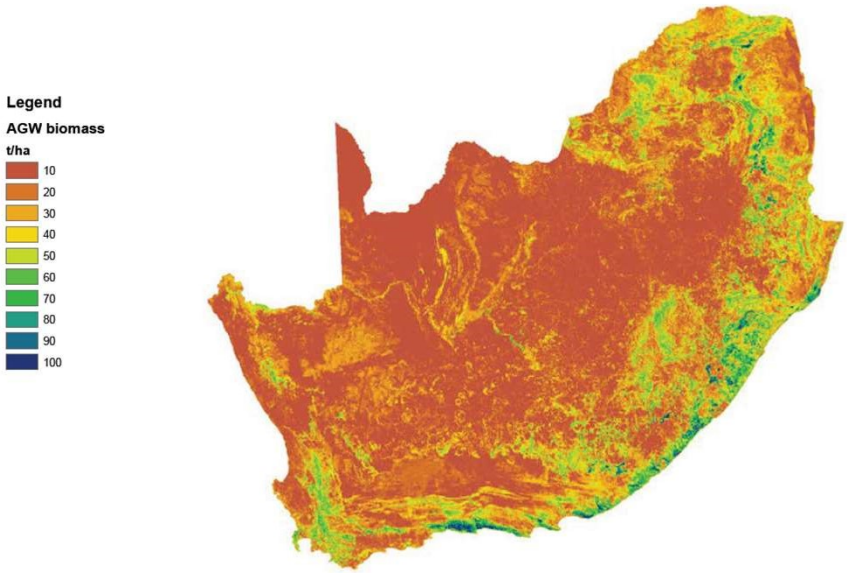
Trees biomass is only about 9% of the total biocarbon



The largest amount of carbon is in the grasslands – as soil carbon

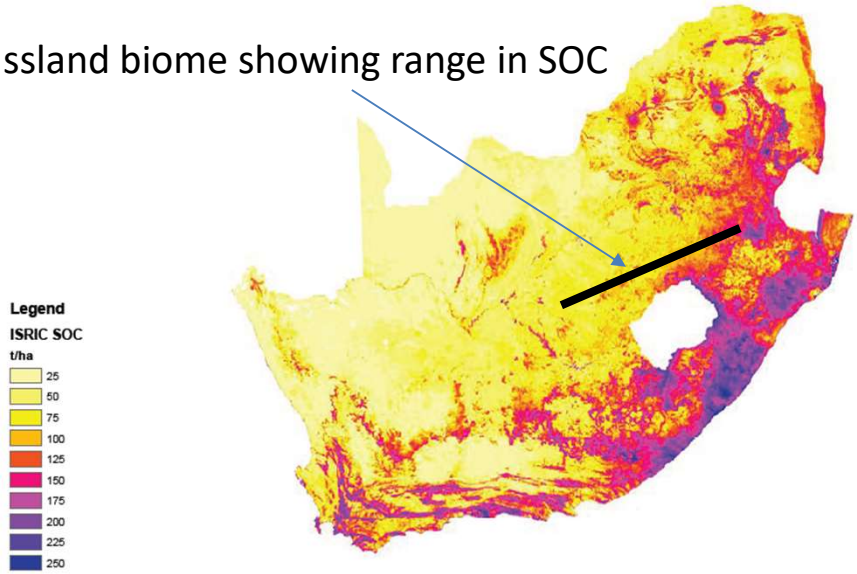
Reference- National Terrestrial Carbon Sinks Assessmsmnt 2020 DFFE

Where is our carbon stored?

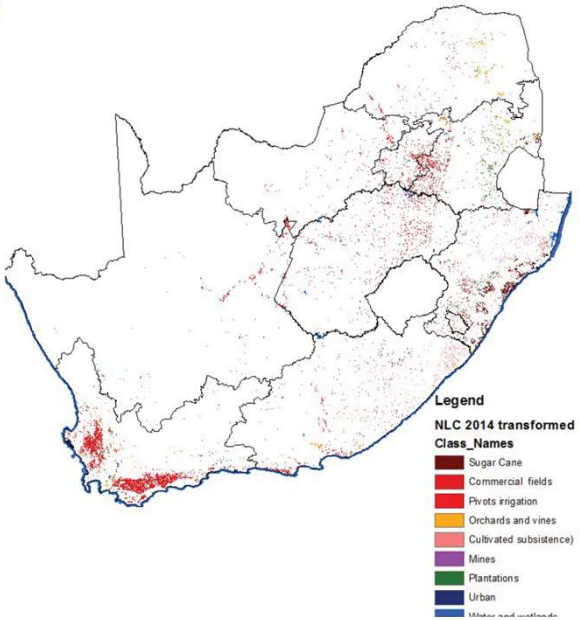


Above ground woody biomass
carbon distribution in South Africa
Based on satellite derived models

Transect through grassland biome showing range in SOC



Soil Organic Carbon distribution in
South Africa
Based on soil pit data and models



Land transformation in South Africa
From National Land Cover Map
Used to model SOC loss

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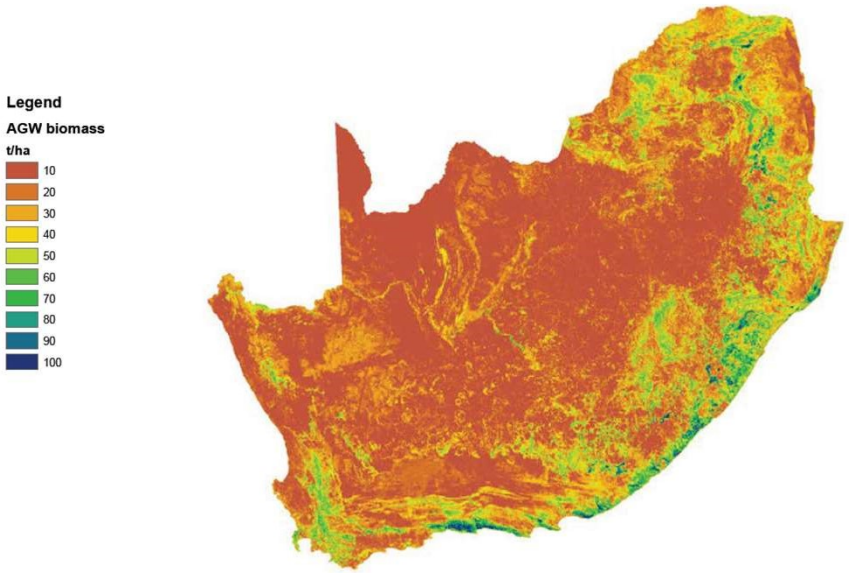
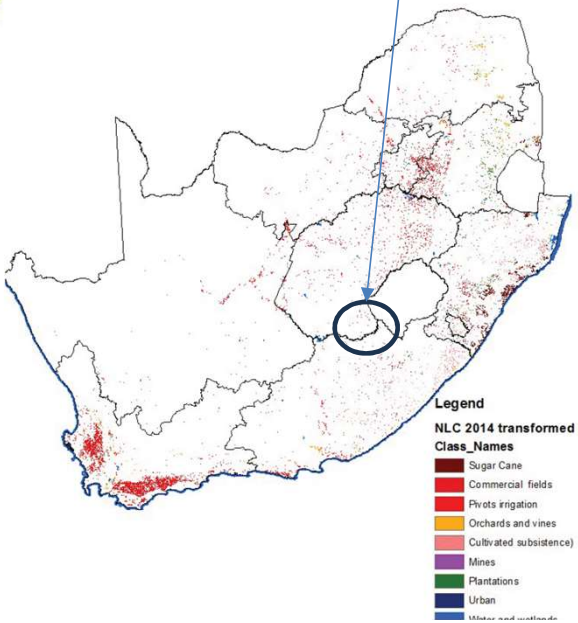


Above ground woody biomass carbon distribution in South Africa
Based on satellite derived models

Areas of high degradation, but not mapped a transformation.
Loss of SOC to degradation a key unknown



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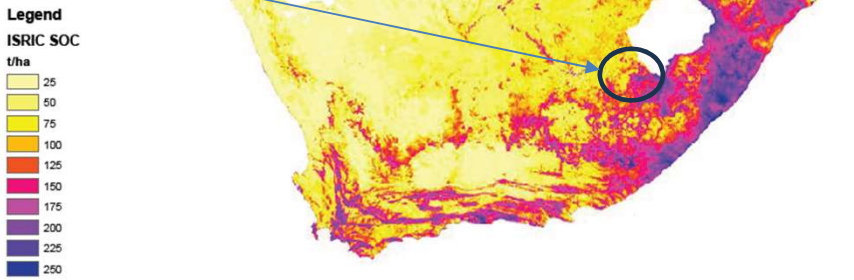


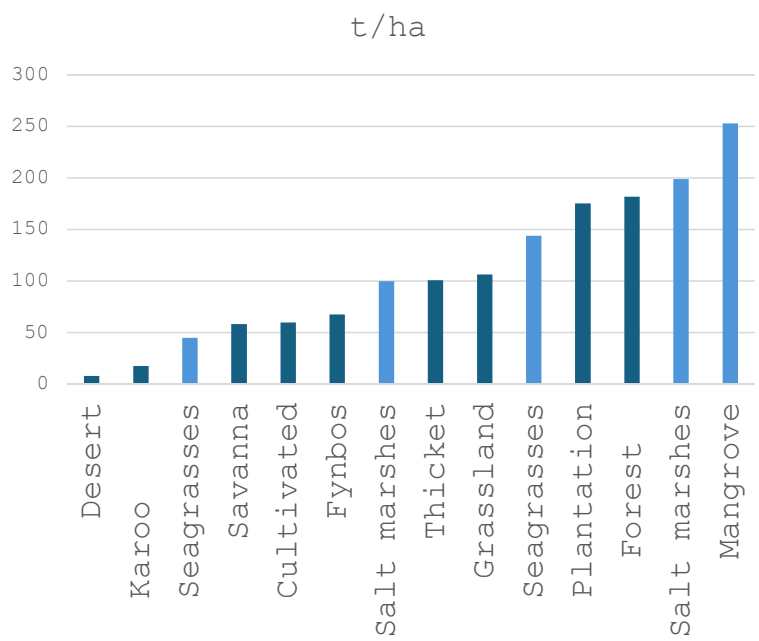
Soil Organic Carbon distribution in South Africa
Based on soil pit data and models

Primary production and standing biomass

GPP Gross Primary Production

GPP	Mean tonne/ha	SD
Desert	1	0
Fynbos	1.42	1.34
Thicket	3.81	2.64
Savanna	4.15	3.2
Karoo	4.4	4.6
Grassland	6.45	3.04
Forests	9.77	2.81

Total C/ha



Above ground biomass C/ha

Vegetation type	Mean rainfall	t/ha C
Sub-tropical thicket	413	**41**
Woodland - Mopane	506	**12**
Dry grassland	560	**0.3**
Savanna - Combretum	572	**10**
Coastal Lowland Forest	800	**75**
Coastal Scarp Forest	800	**65**
Moist temperate grassland	1324	**2**

NPP net primary production = ~1/2 GPP
Sugar cane under ideal conditions ~ 40 t/ha/y

From NCSA 2014 – DFFE and Green Carbon Assessmsmnt 2022 DFFE

For their rainfall, thicket is highly productive and has high carbon

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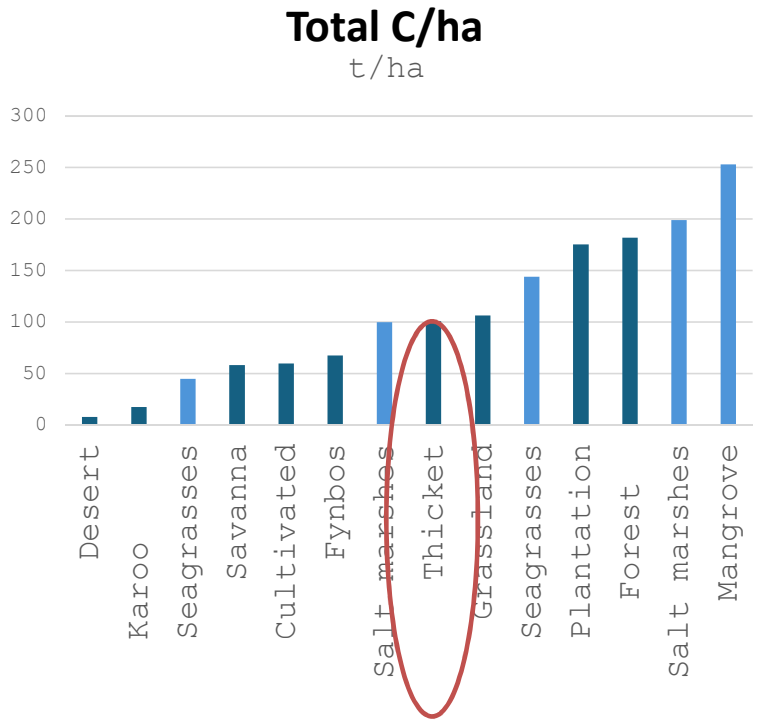

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Grassland has almost as much carbon as forests, but it is below ground

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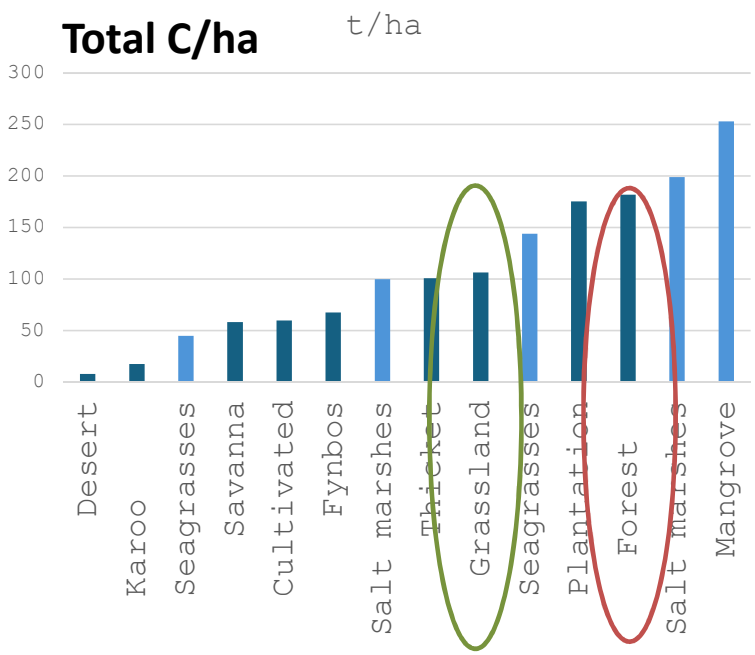

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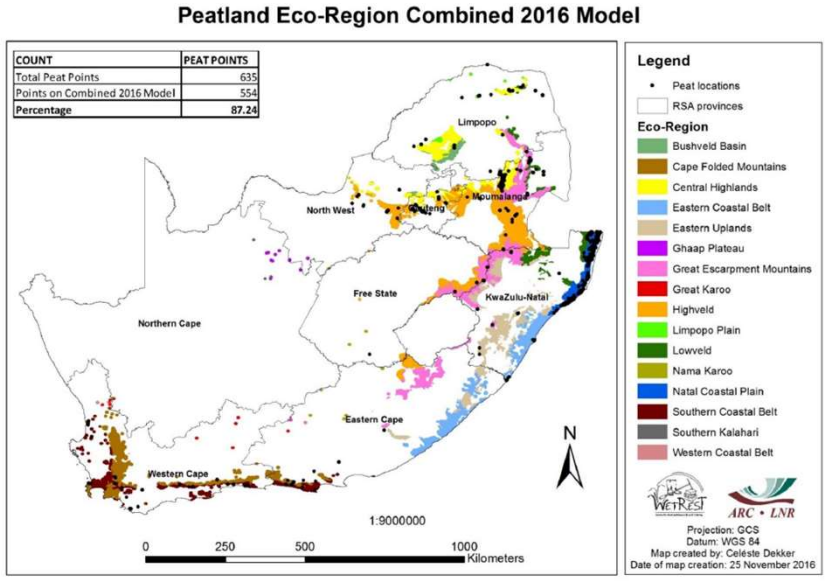
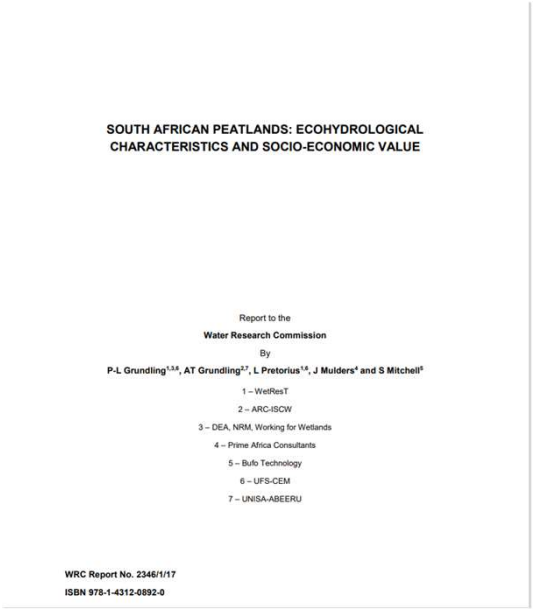
From NCSA 2014 – DFFE and Green Carbon Assessmsmnt 2022 DFFE

Peatlands, a unique carbon store

- Build up over 50 000 years, can be lost in days
- Est 4.2 to 431.5 Mt C
- R13 – R191 Billion R (2017)
- Confirmed area 30716 ha





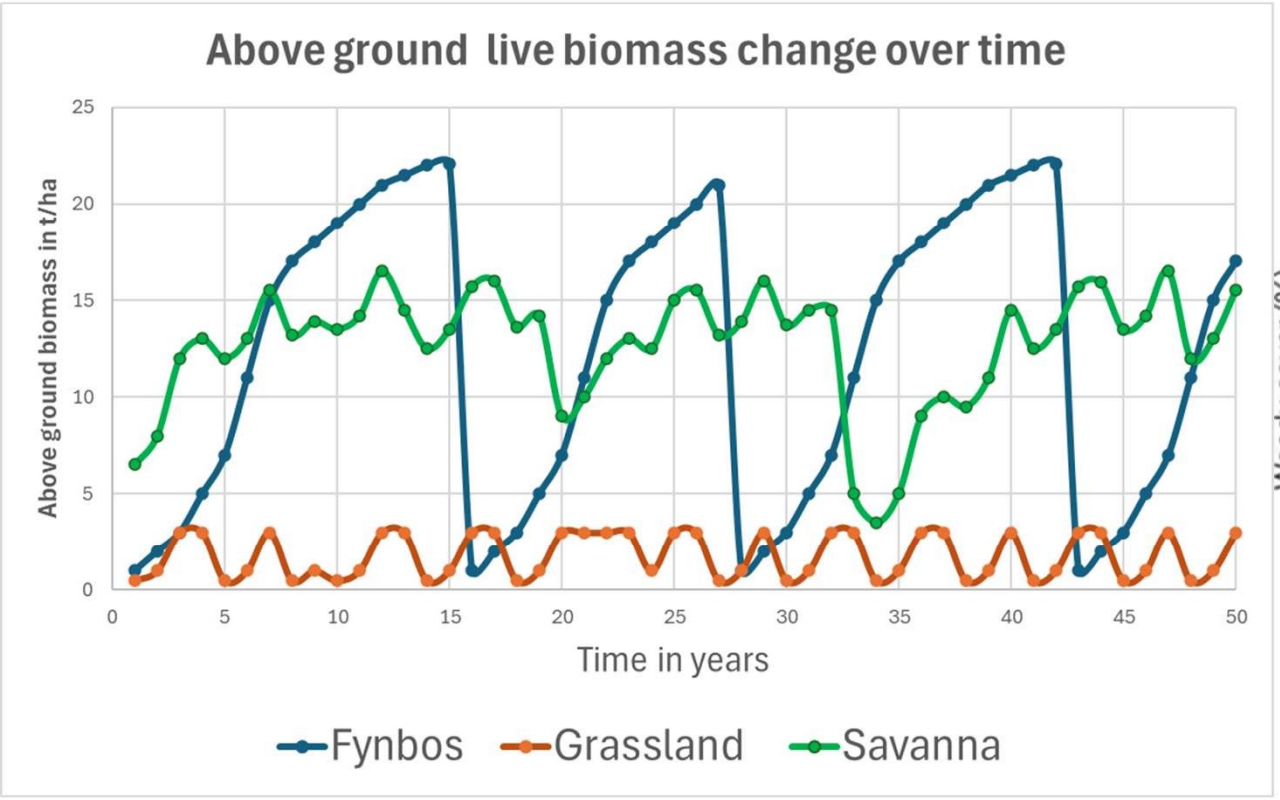
SOUTH AFRICAN PEATLANDS: ECOHYDROLOGICAL CHARACTERISTICS AND SOCIO-ECONOMIC VALUE

Report to the
Water Research Commission
By
P-L Grundling[1,3,6], AT Grundling[2,7], L Pretorius[1,6], J Mulders[4] and S Mitchell[5]
1 – WetResT
2 – ARC-ISCW
3 – DEA, NRM, Working for Wetlands
4 – Prime Africa Consultants
5 – Bufo Technology
6 – UFS-CEM
7 – UNISA-ABEERU

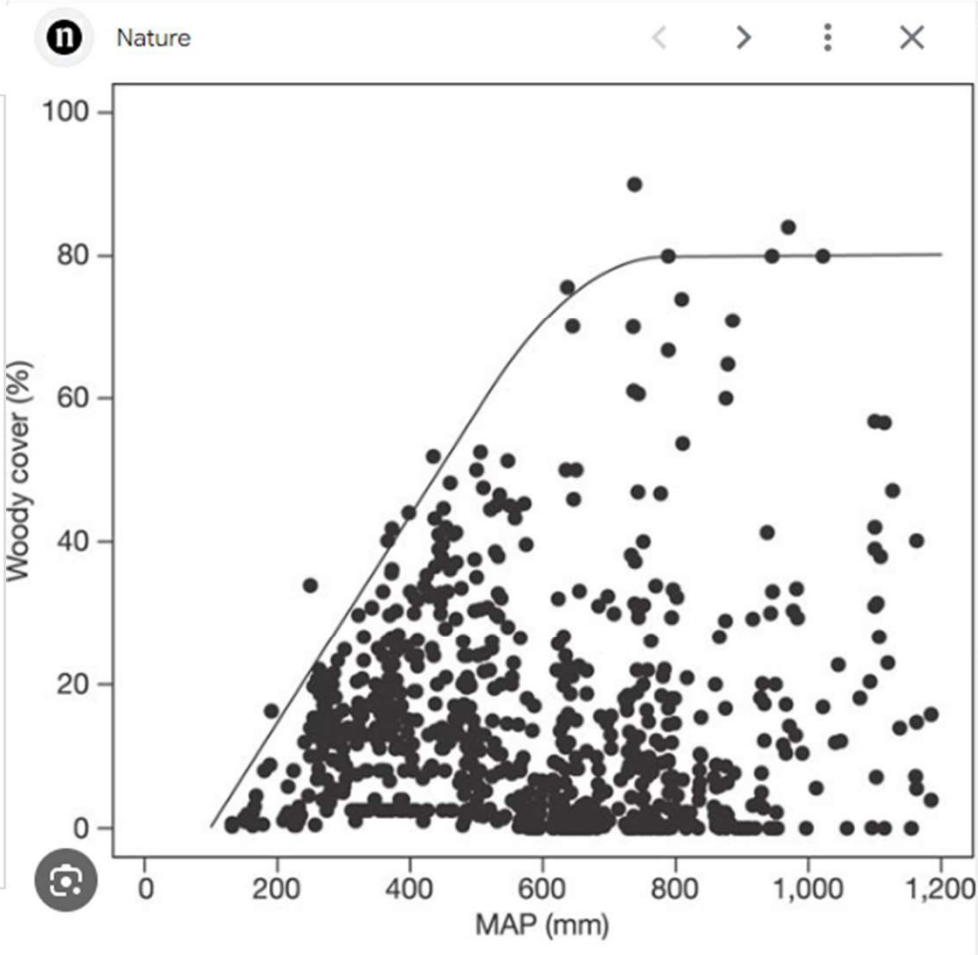
WRC Report No. 2346/1/17
ISBN 978-1-4312-0892-0

Data and maps, Grundling et al 2017

Natural Fluctuations

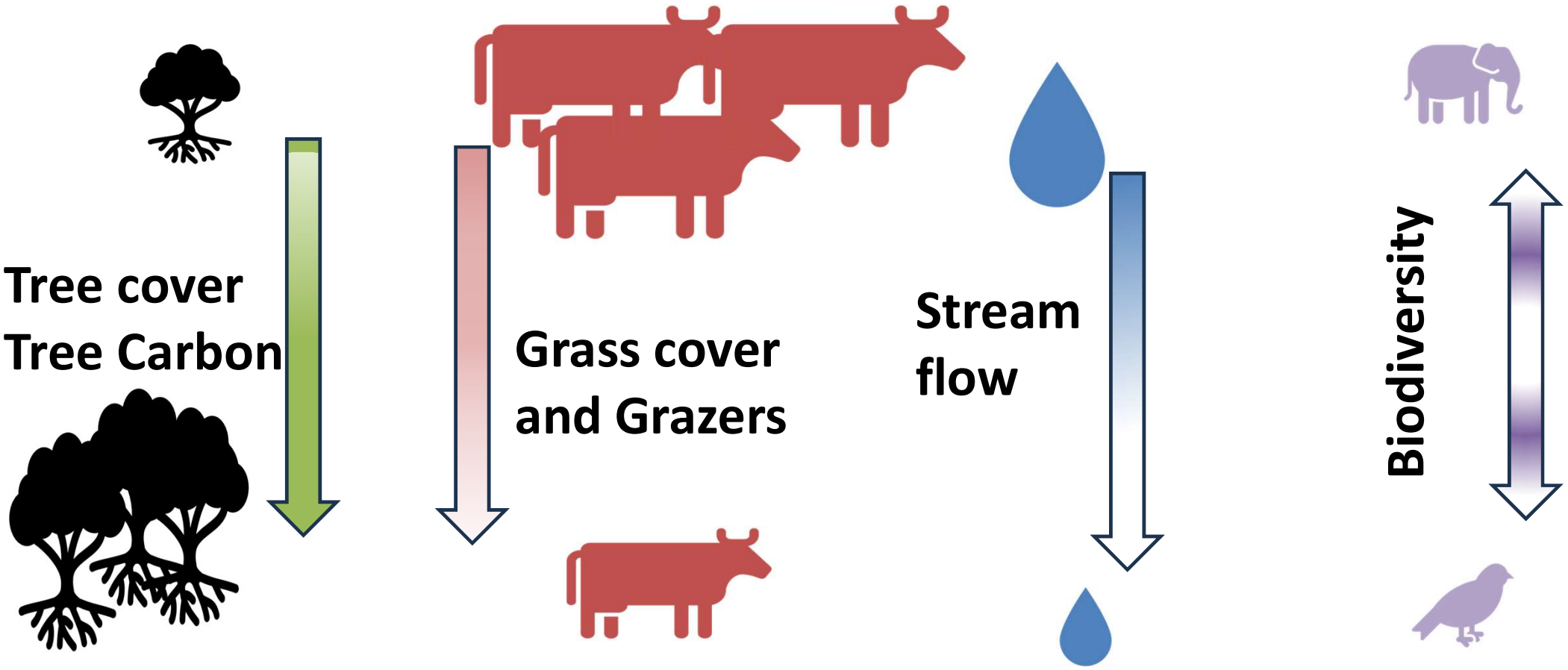


Conceptual diagram of natural biomass fluctuate in different biomes



Savanna tree cover vs rainfall – Sankaran et al 2005

Is more biological carbon always good?
Some critical tradeoffs



Is some biocarbon “bad carbon”?

- Plantation forestry
- Alien invasive trees
- Bush encroachment

Photo https://youthleadermagazine.com/south-africa-working-for-water/

- Replace natural biodiversity
- Reduce available water in streamflow
- Potentially cause erosion
- Change albedo (stored carbon may be offset through reduced reflection of heat)

If some biocarbon is bad carbon, what is good biocarbon? i.e. the win-win solutions

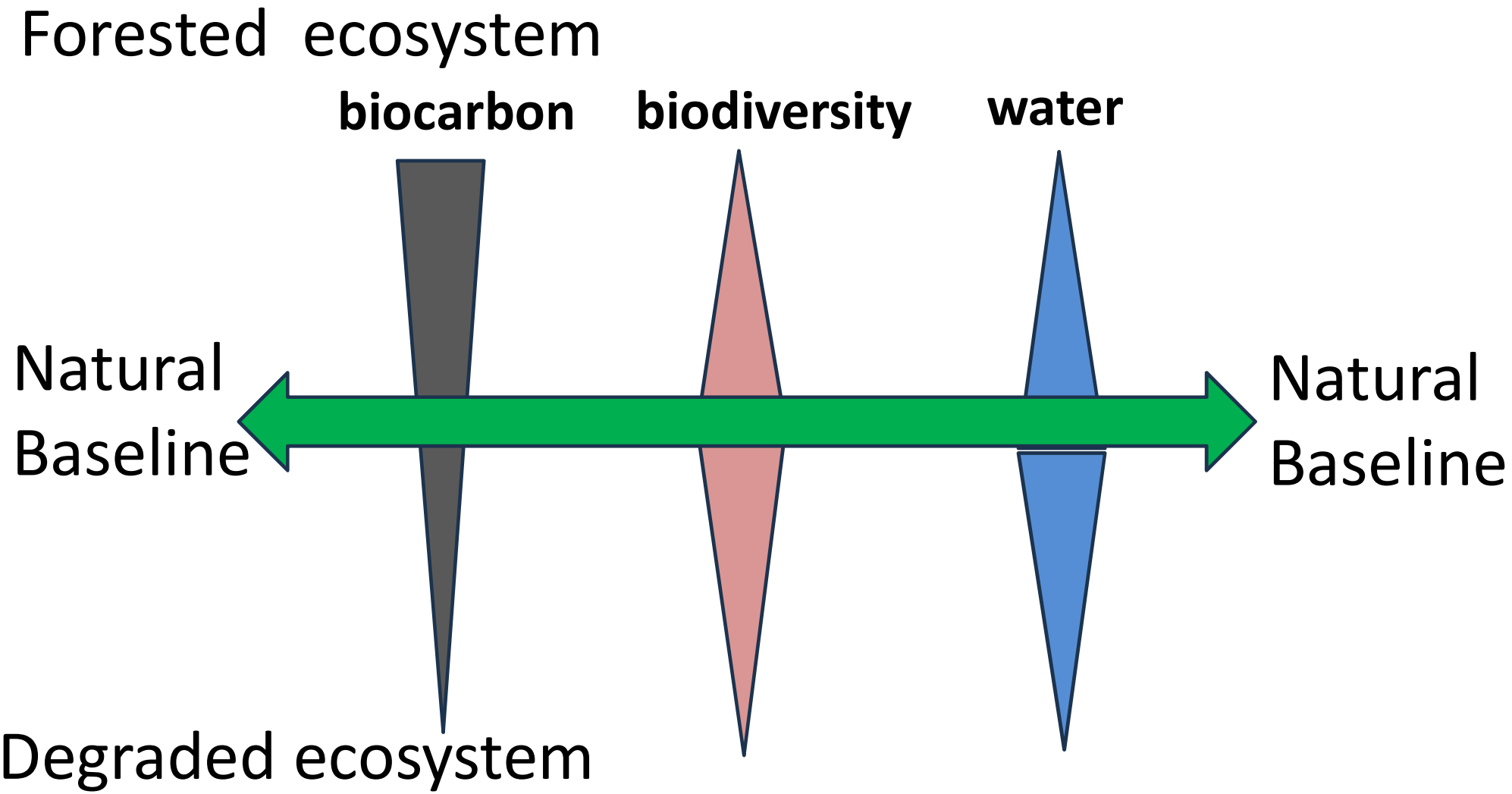
Restoration of degraded land

- Increased SOC
- Improved biodiversity
- Improved chance for biodiversity adaptation to climate change
- Improved hydrology and groundwater recharge

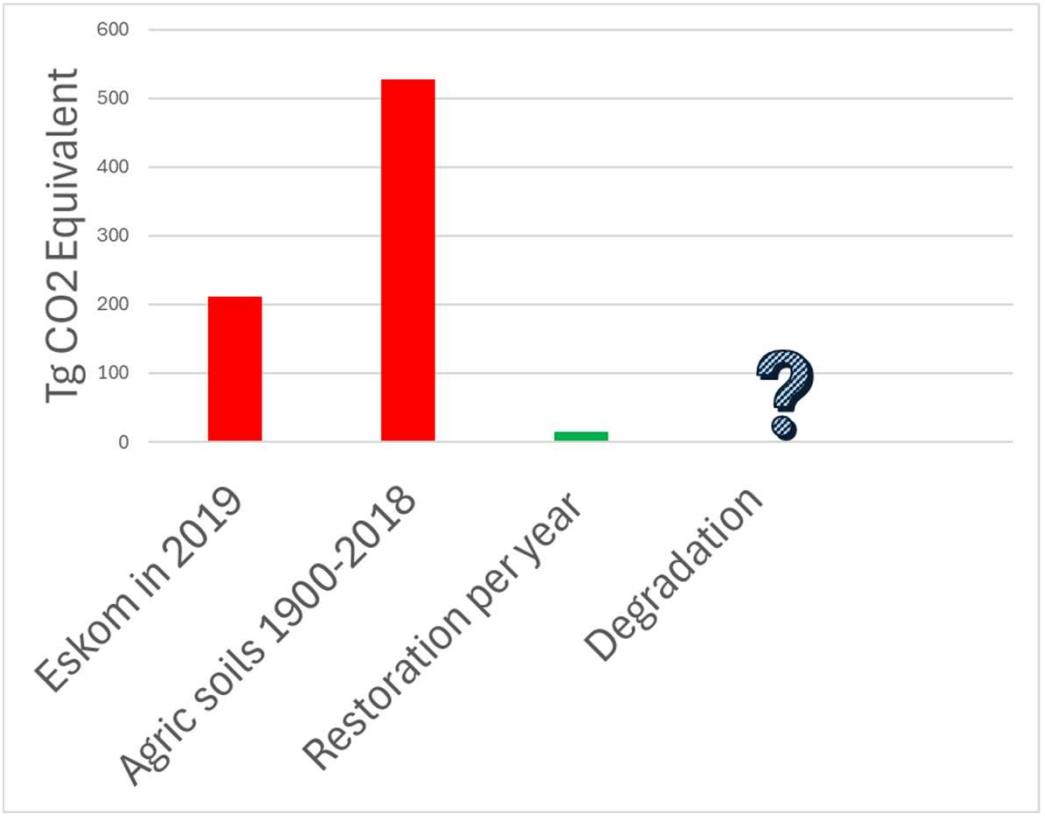
Sustainable crop agricultural practices

- Increased SOC
- Improver water use
- Improved nutrient use
- Greater climate resilience
- Improved soil biodiversity

Finding the balance



Comparing Eskom emissions to land use emissions



- Each year Eskom emits about 1/3 of the total historic loss of SOC carbon from crop agriculture.
- The change in SOC due to land degradation outside of croplands is poorly understood.

To put this into perspective:

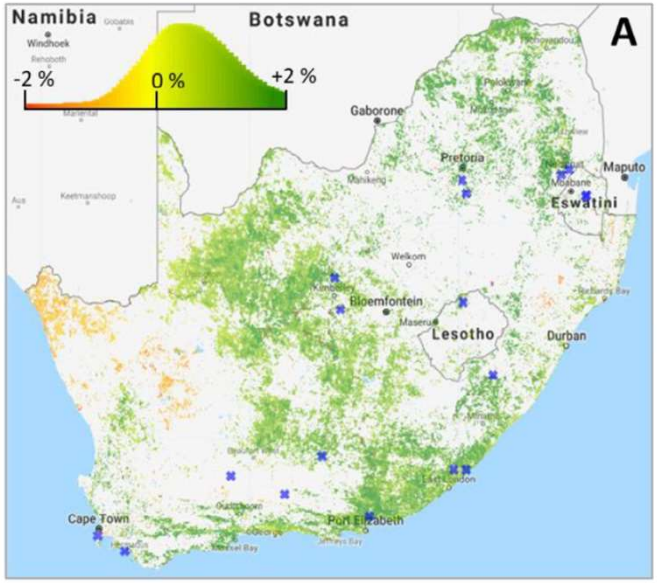
The total estimated biocarbon stock is about the same as 126 years of Eskom emissions

Degradation – the big unknown impact

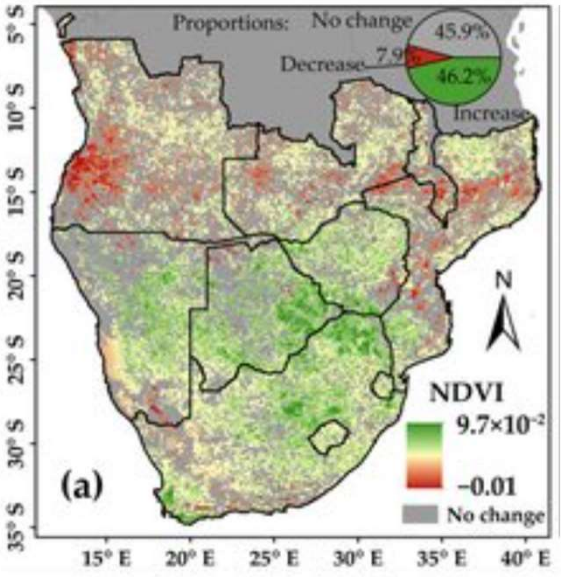
- We struggle to map the extent of land degradation
- We have a poor knowledge of the link between the state of degradation and the loss of soil carbon
- We have very limited data on the rates of soil carbon increase during restoration
- Some degradation, such as alien plant invasion, has a positive impact on above ground carbon, impacts on total carbon is complex and poorly studied

The impact of Climate change on biocarbon

- CO2 fertilization effect. Plants become more water efficient
- CO2 promotes tress over C4 grass
- The effect probably peaks
- A move to being more arid results in less SOC and above ground biomass. All of South Africa is becoming effectively dryer.



EVI change. Venter et al. 2020 1884 to 2018 landstat



Li et al 2023. NDVI

Conclusion

- We have a relatively good understanding of the national carbon stock and can map it spatially
- Most carbon is in the soil as SOC
- Restoring grassland is more important than restoring forest
- Some biomes such as the Albany thicket have great potential for restoration
- Restoration can only compensate for a small fraction of national emissions,