

South African Carbon Stocks, Sources and Sinks

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Knowles

National Climate Change Response Dialogue
Gallagher Estate





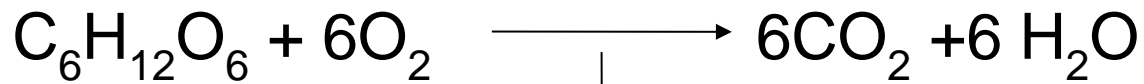
energy from sunlight



Glucose

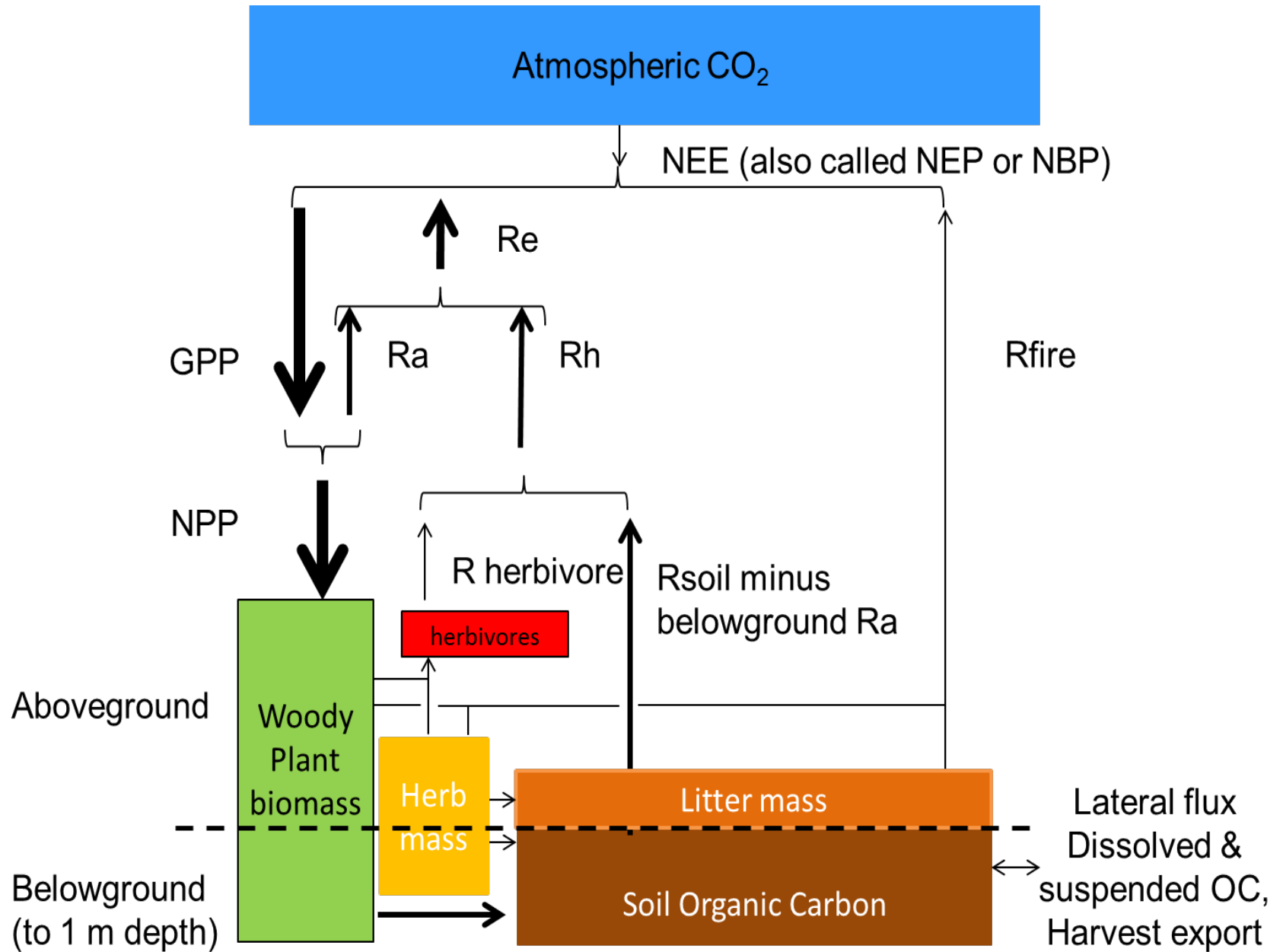


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ENERGY
RELEASED





National Carbon Sink Assessment for South Africa

- Quantify current carbon stocks and fluxes nationally
 - Spatially-explicit
 - Repeatable
 - Error analysis
 - Validation
- ... for the purpose of assessing the mitigation potential and restoration options for different land covers and land use types

Standard approach: Stratified-random sampling

Our approach: Continuous-variable 'mapping'

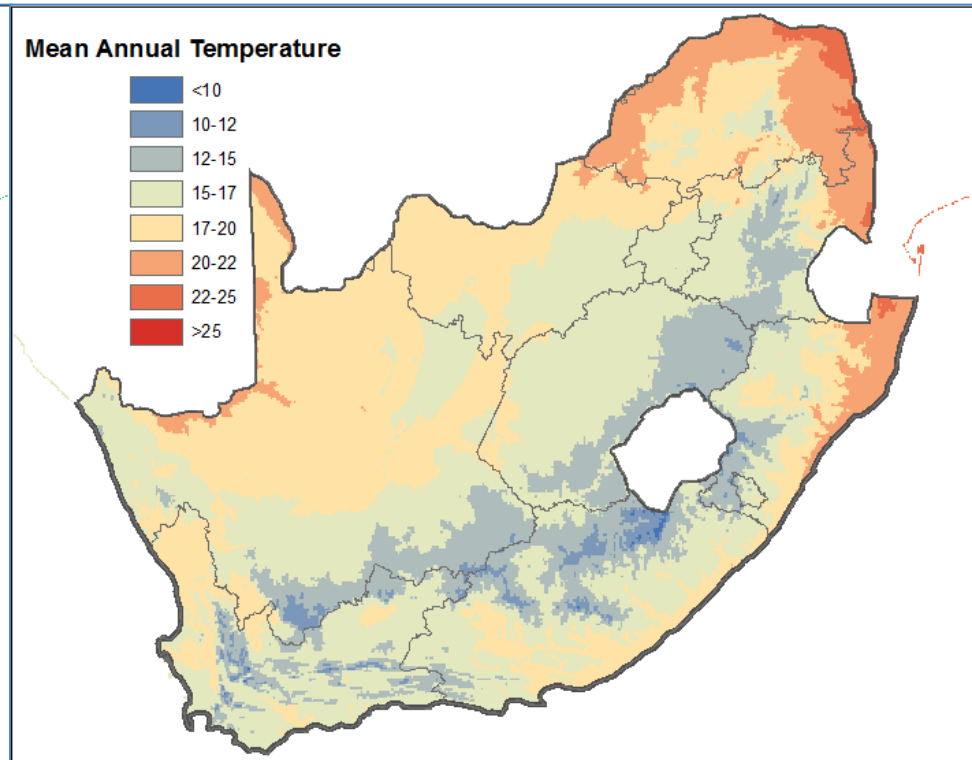
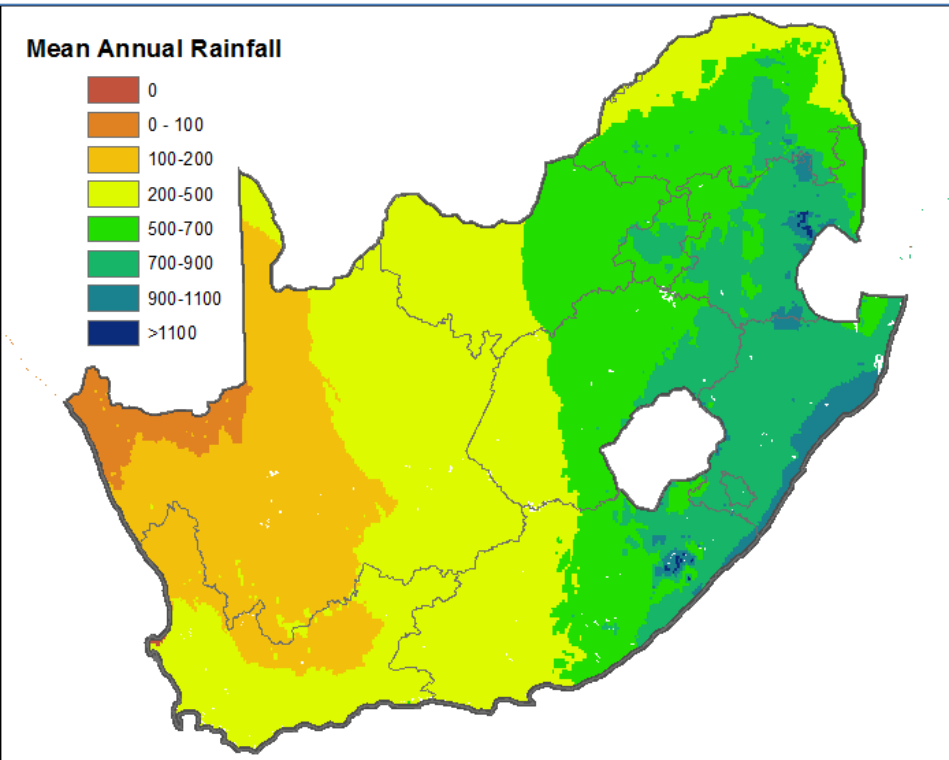


- Remote sensing data and models
- Spatial maps of all key variables (1km resolution)

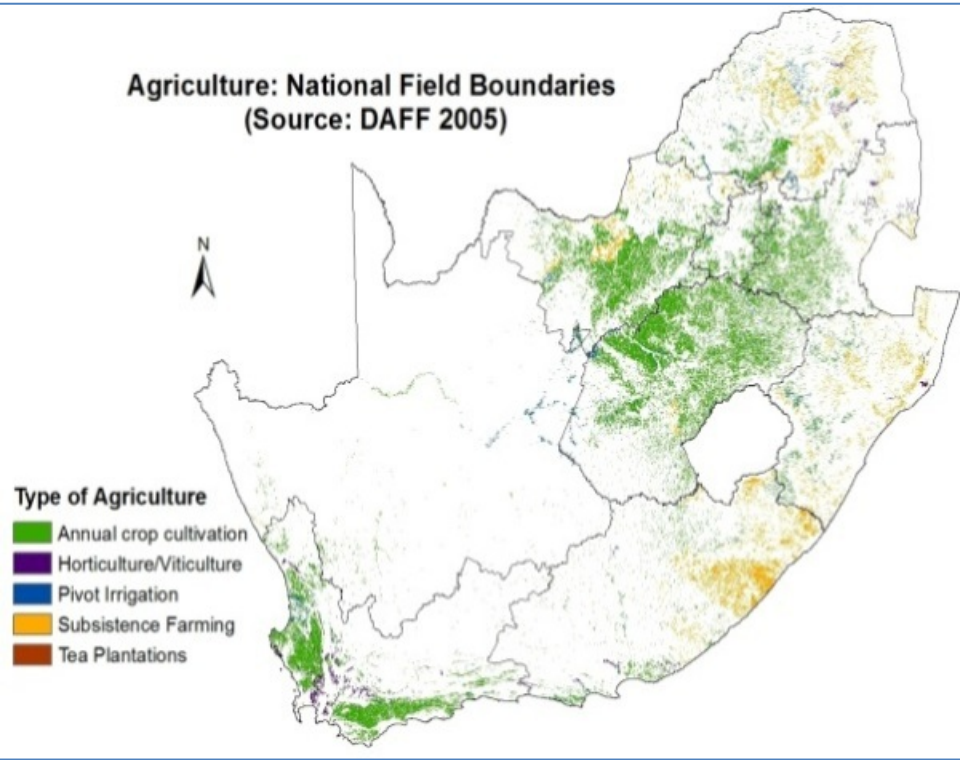
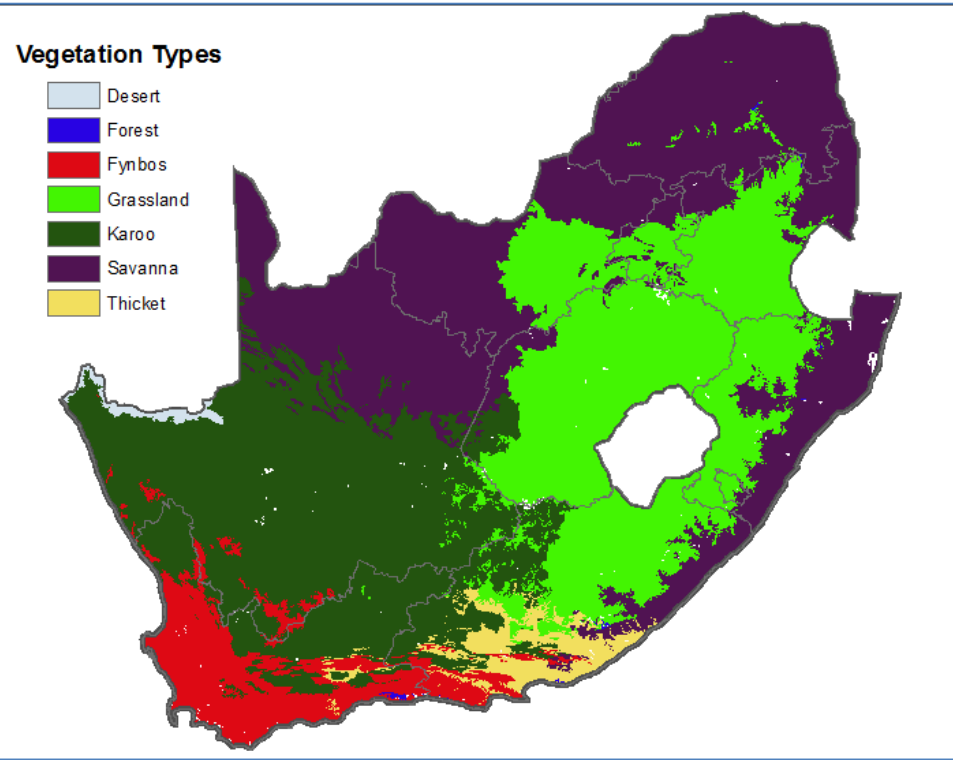
Advantages:

1. Repeatable
2. Cheaper
3. Summarise by different categories

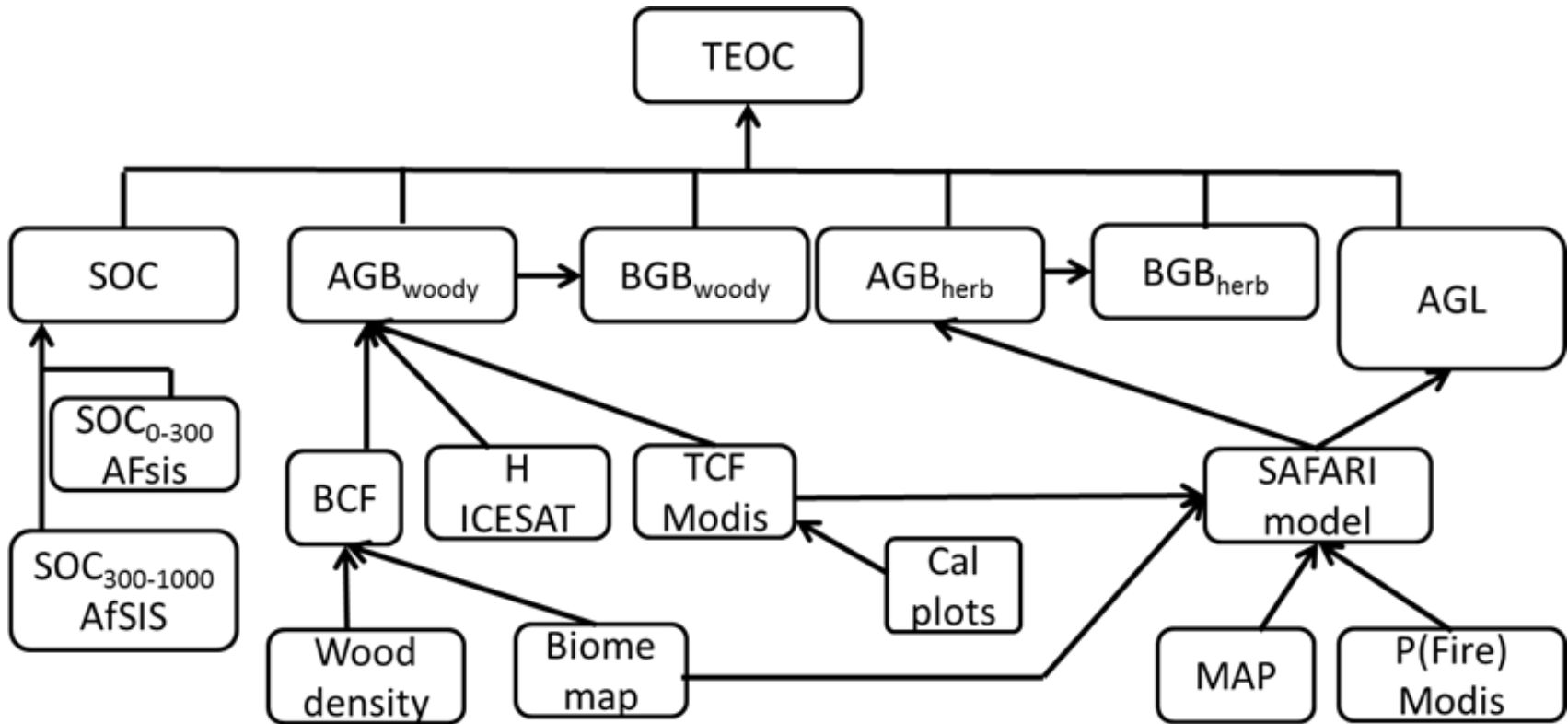
Input data - bioclimatic



Input data – land cover



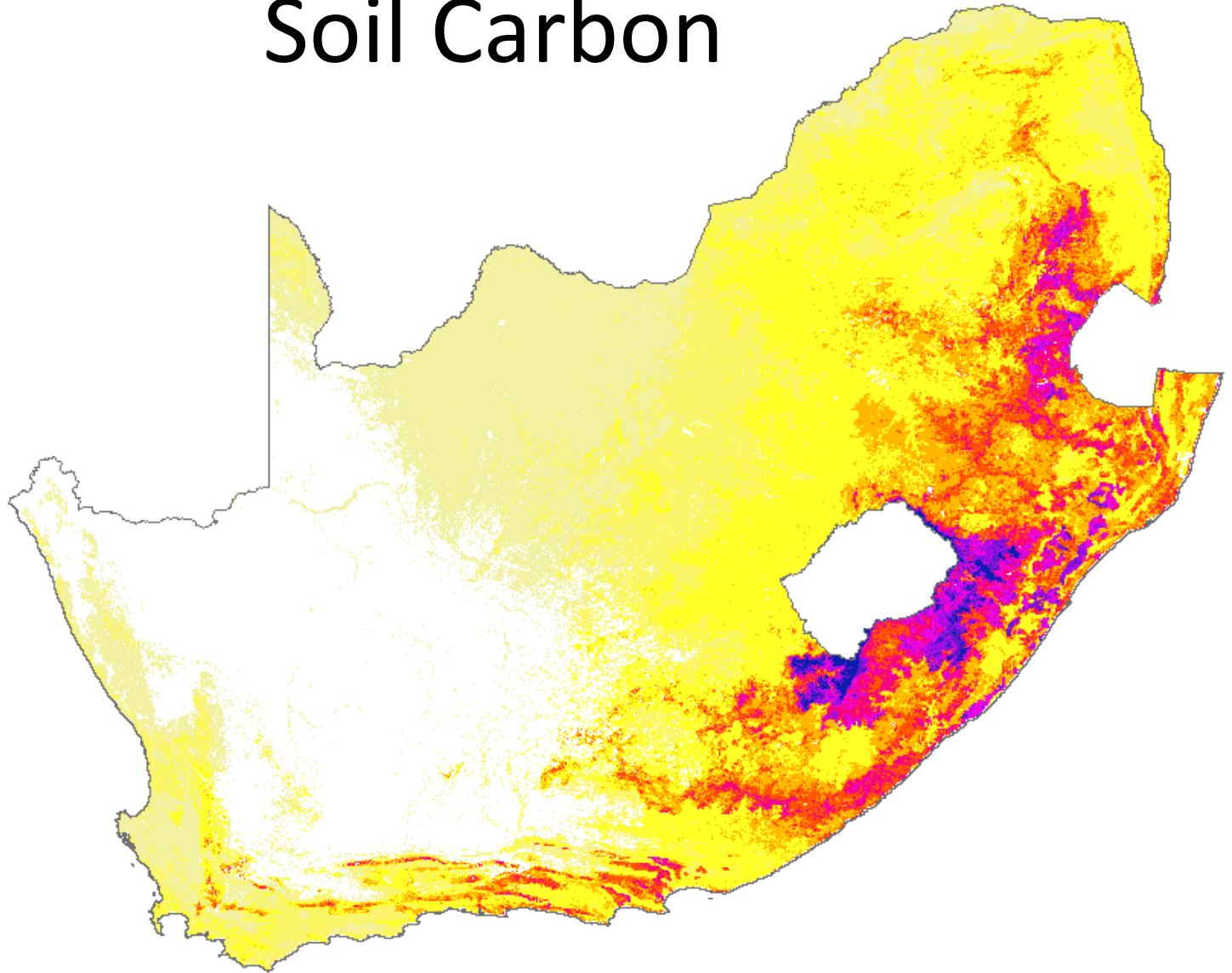
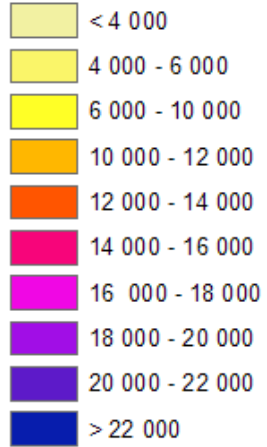
Modelling carbon stocks



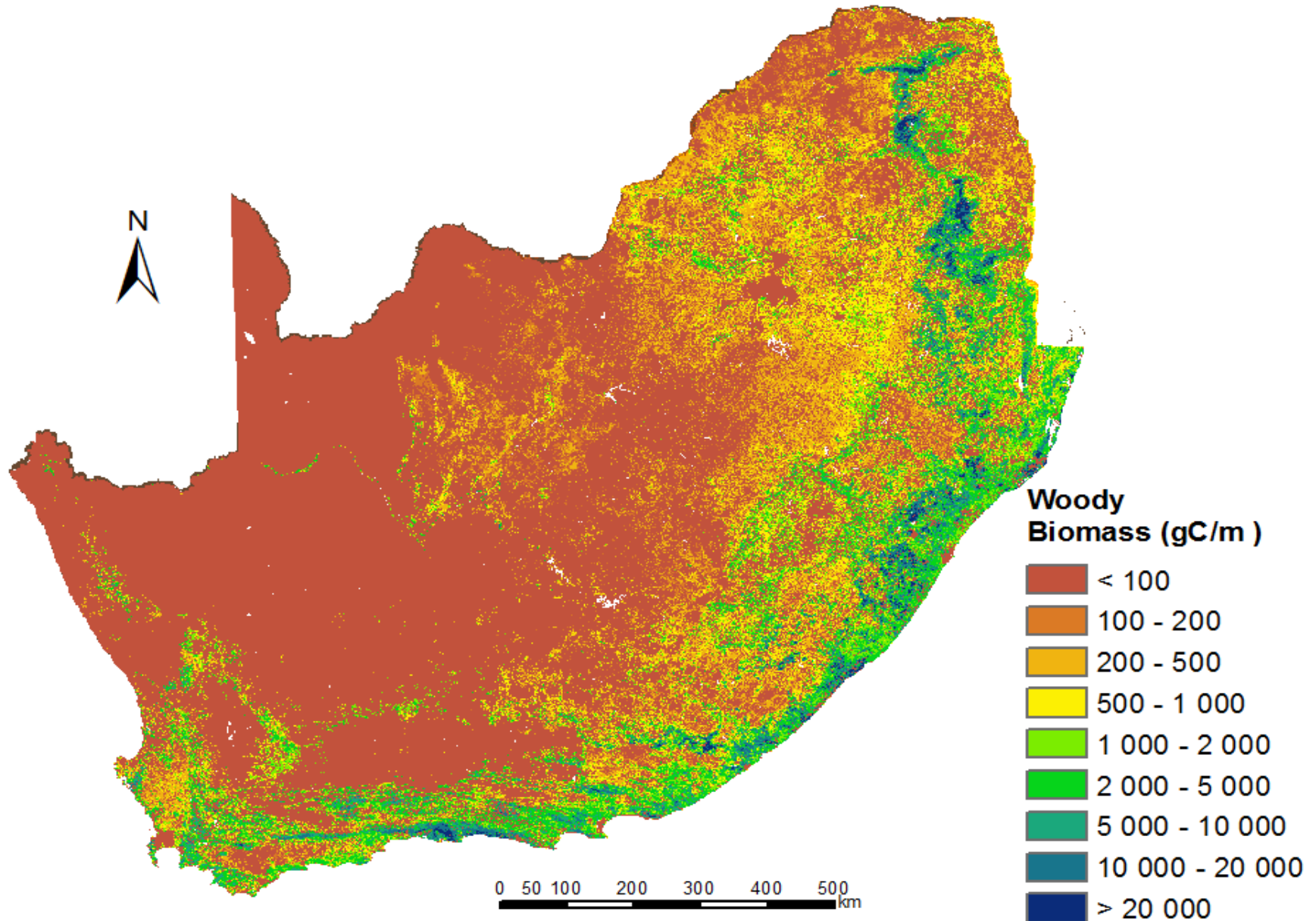
Soil Carbon

Soil C from AfSIS

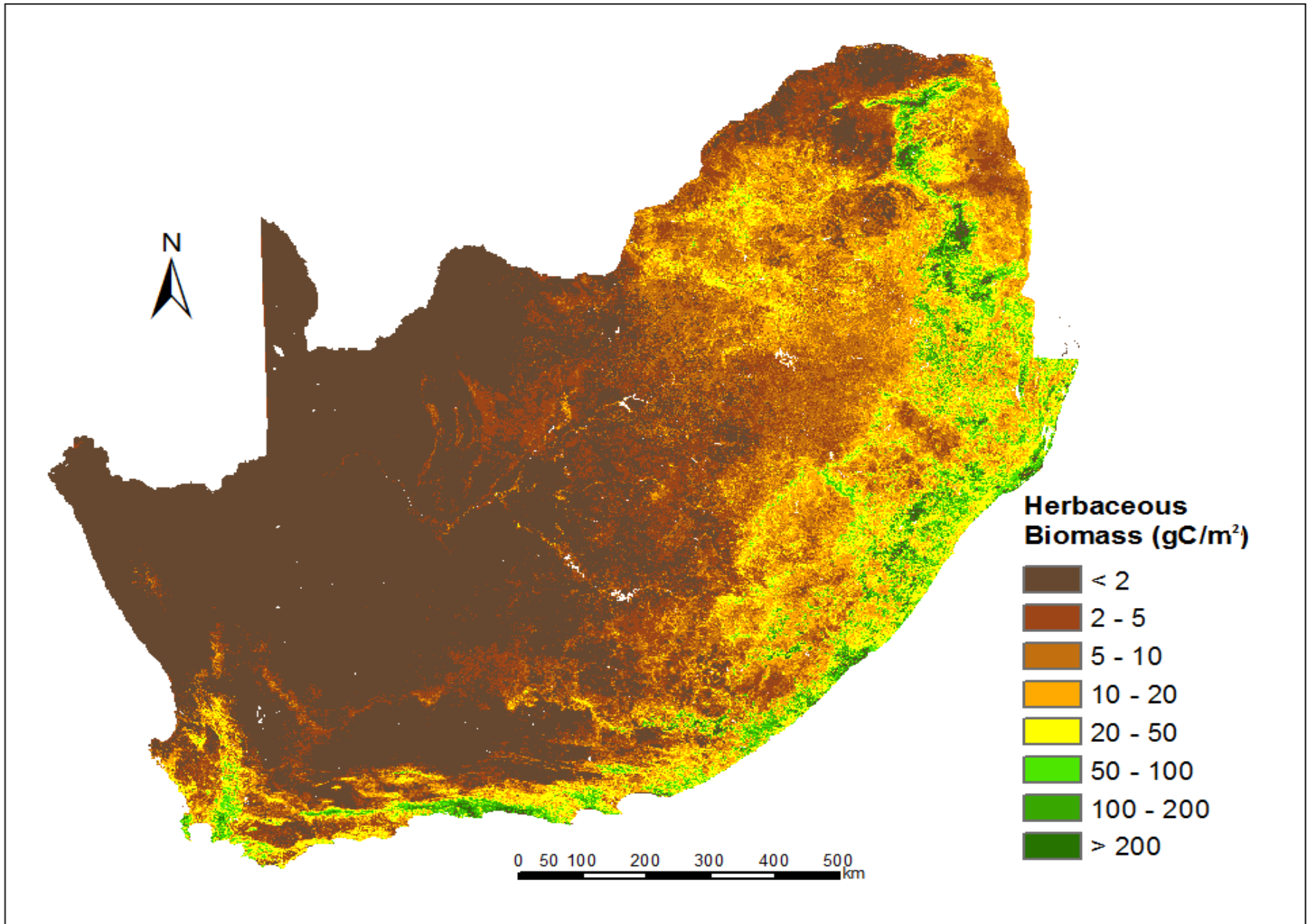
g/m²



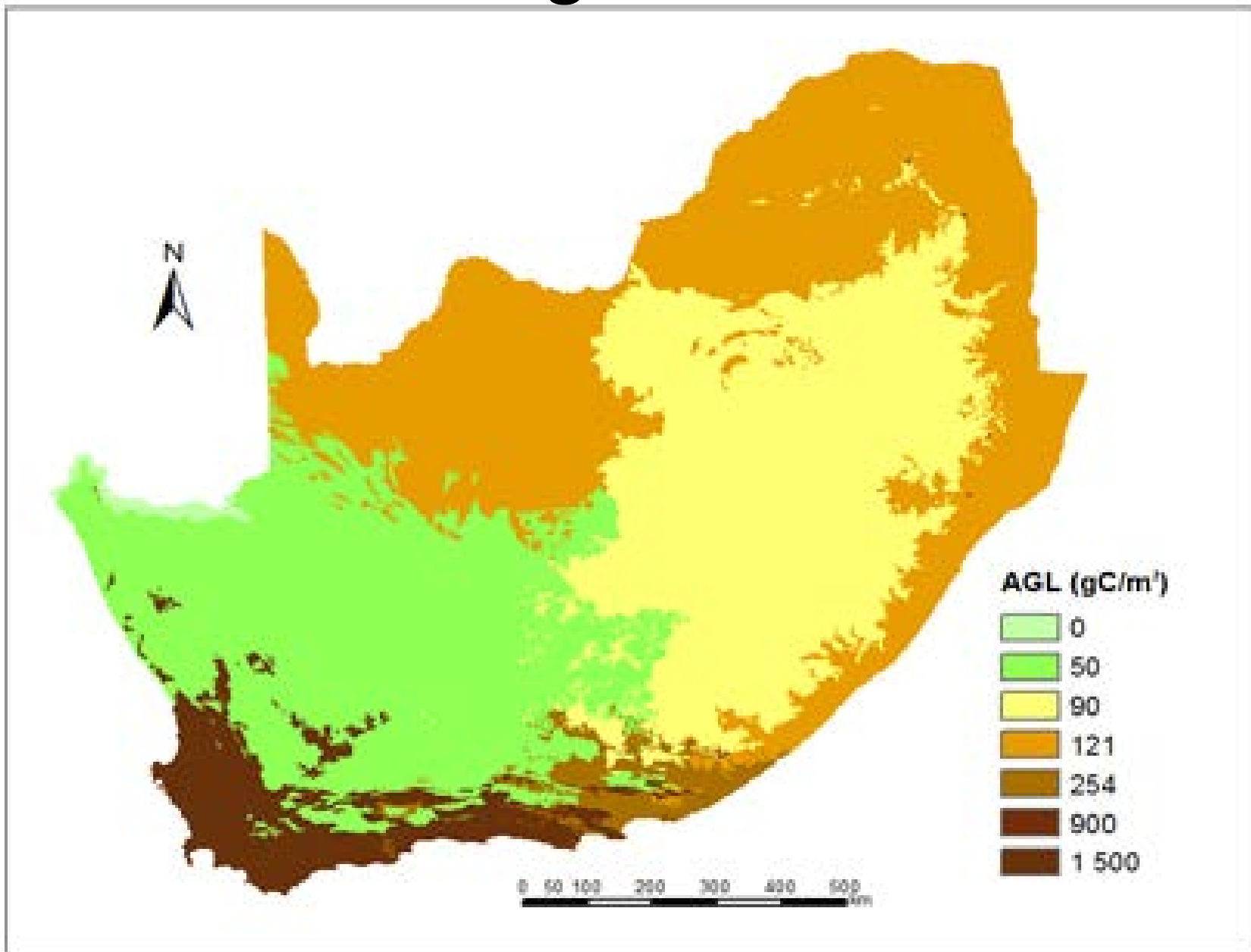
Above-ground woody biomass



Above-ground herbaceous biomass



Aboveground litter



Terrestrial Biomass Stocks

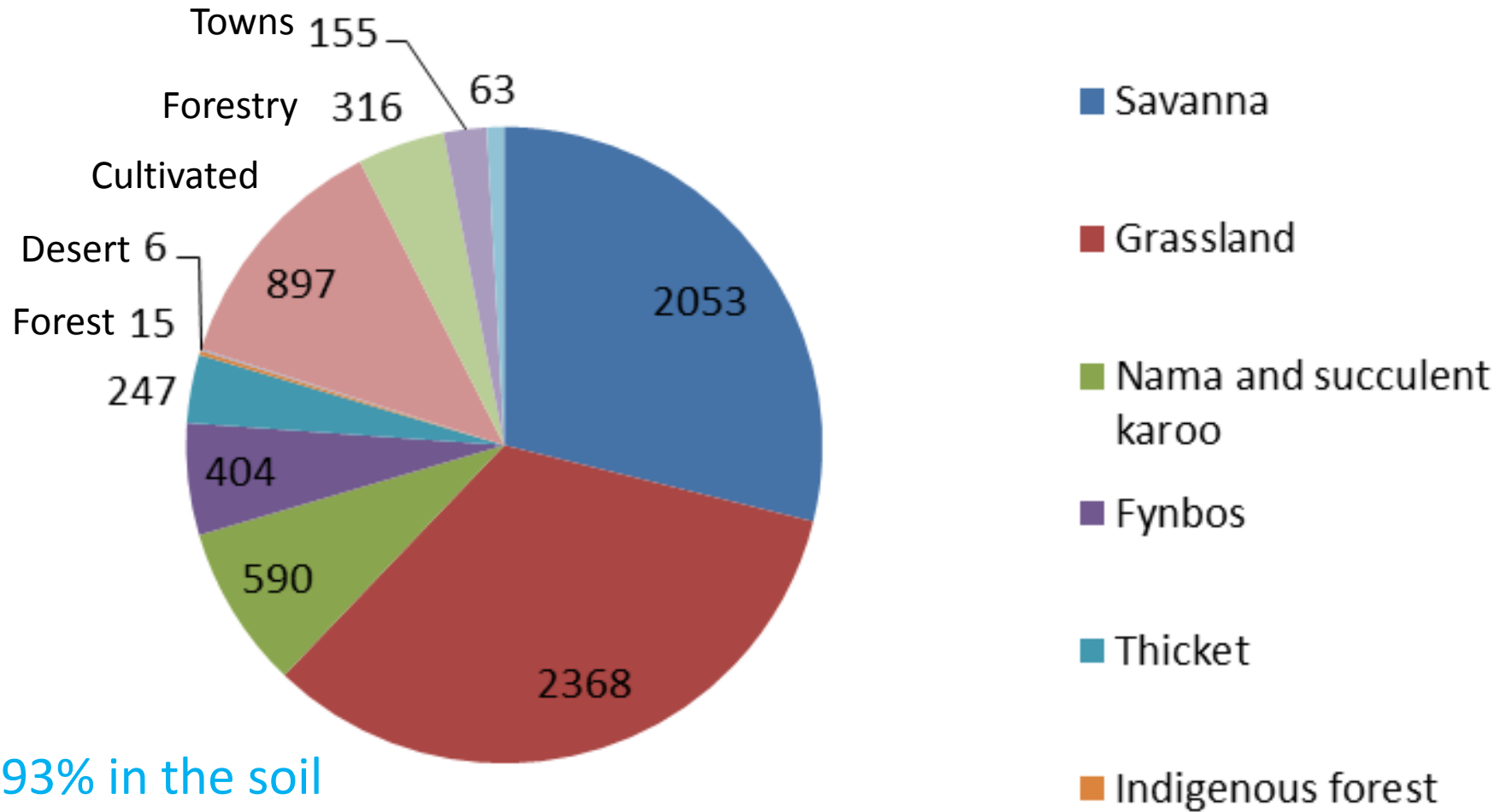
above– and belowground, plus litter

Land cover class	Mean	SD (spatial)	Area	Best estimate	Lower confidence limit	Upper confidence limit
	gC/m ²		km ²		Tg C	
Savanna	418	756	358473	150	123	342
Grassland	532	748	224377	119	109	279
Nama and succulent karoo	70	159	334812	24	30	54
Fynbos	1119	626	61490	69	51	140
Thicket	2370	3159	27402	65	41	152
Indigenous forest	7186	3423	857	6	3	13
Desert	1	17	7017	0	0	0
Cultivated	186	50	138269	26	41	56
Plantation forestry	4603	969	16952	78	56	148
Settlement, mines, industry	421	345	28798	12	12	19
Total South Africa			1169649	548	466	1203

Total Ecosystem organic C

Land cover class	Mean	SD (spatial)	Area	Best estimate	Lower confidence limit	Upper confidence limit
	gC/m ²		km ²		Tg C	
Savanna	5834	3513	358473	2091	1961	5214
Grassland	10660	4725	224377	2392	2213	5736
Nama and succulent karoo	1769	1799	334812	593	587	862
Fynbos	6773	4100	61490	416	372	1140
Thicket	10101	5347	27402	277	236	785
Indigenous forest	18198	6172	857	16	12	42
Desert	799	113	7017	6	6	6
Cultivated	5980	1731	143948	860	840	1788
Plantation forestry	17559	4320	16952	298	252	769
Settlement, mines, industry	6793	2448	23119	157	152	276
Other, waterbodies etc	3167	1536	19967	64	62	97
Total South Africa			1218414	7170	6693	16715

SA carbon stocks GtC

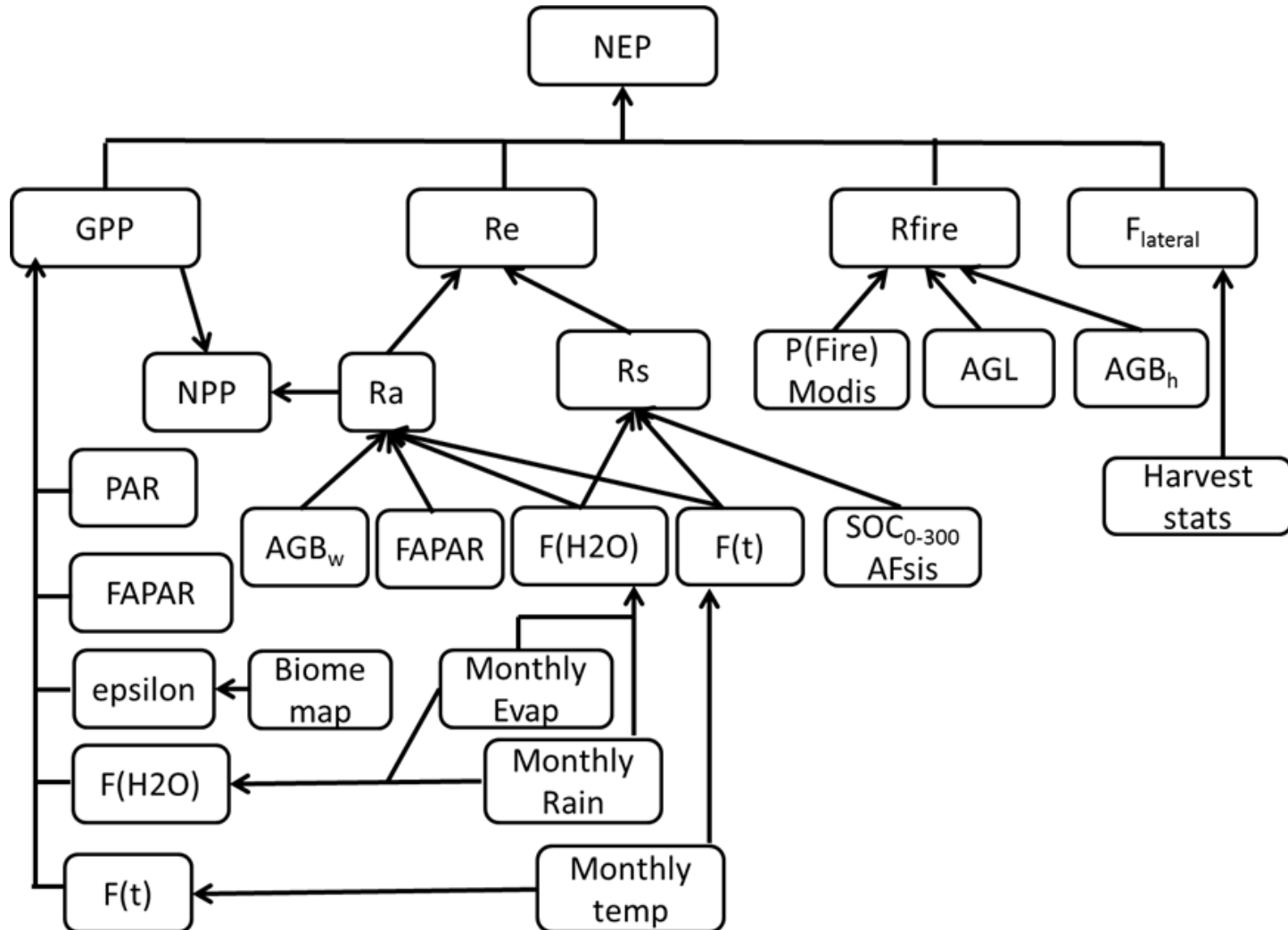


93% in the soil

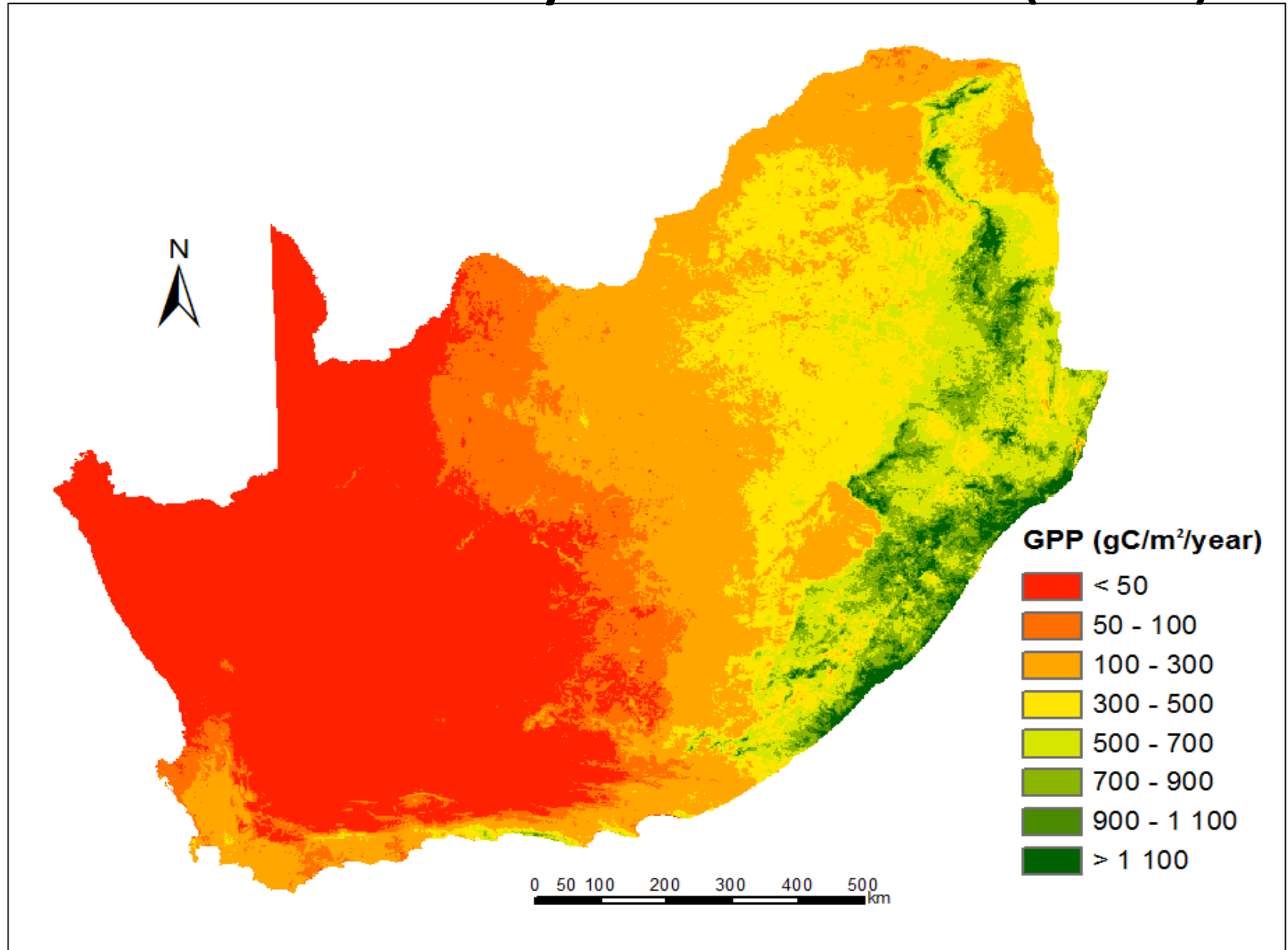
Transformed
Systems 20%

Natural systems 80%

Components of flux



Gross Primary Production (GPP)

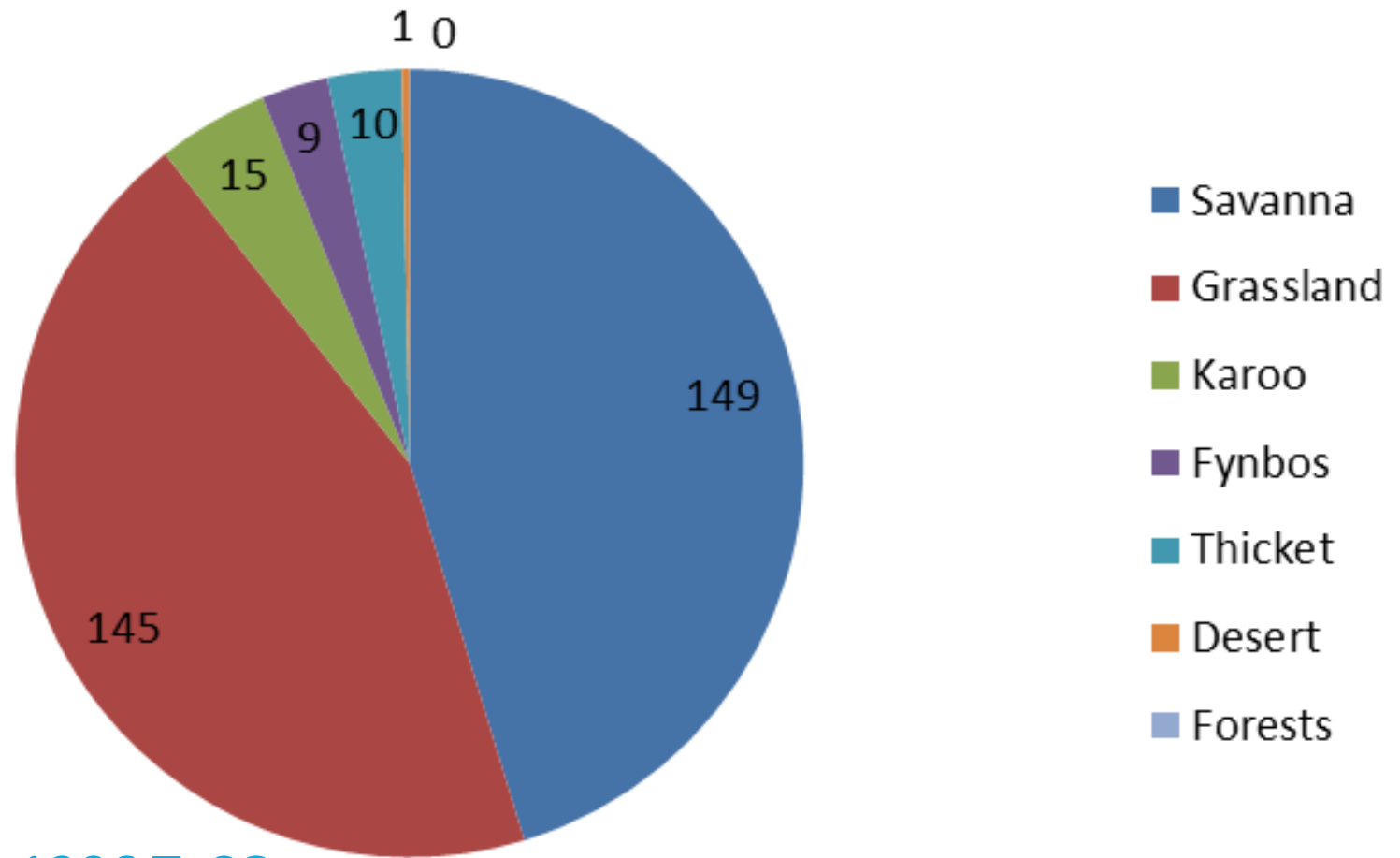


Gross Primary Production

Natural systems

Land cover class	Mean	SD spatial	Area	Best estimate	Lower confidence limit	Upper confidence limit
	gC/m ² /y		km ²		TgC/y	
Savanna	415	320	358473	149	54	351
Grassland	645	304	224377	145	72	361
Karoo	44	46	334812	15	5	34
Fynbos	142	134	61490	9	2	19
Thicket	381	264	27402	10	2	23
Desert	977	281	857	1	0	2
Forests	1	0	7017	0	0	0
Total, natural ecosystems			1014428	329	135	790

Fluxes from natural systems, TgC/y



National GPP 1206 TgCO₂

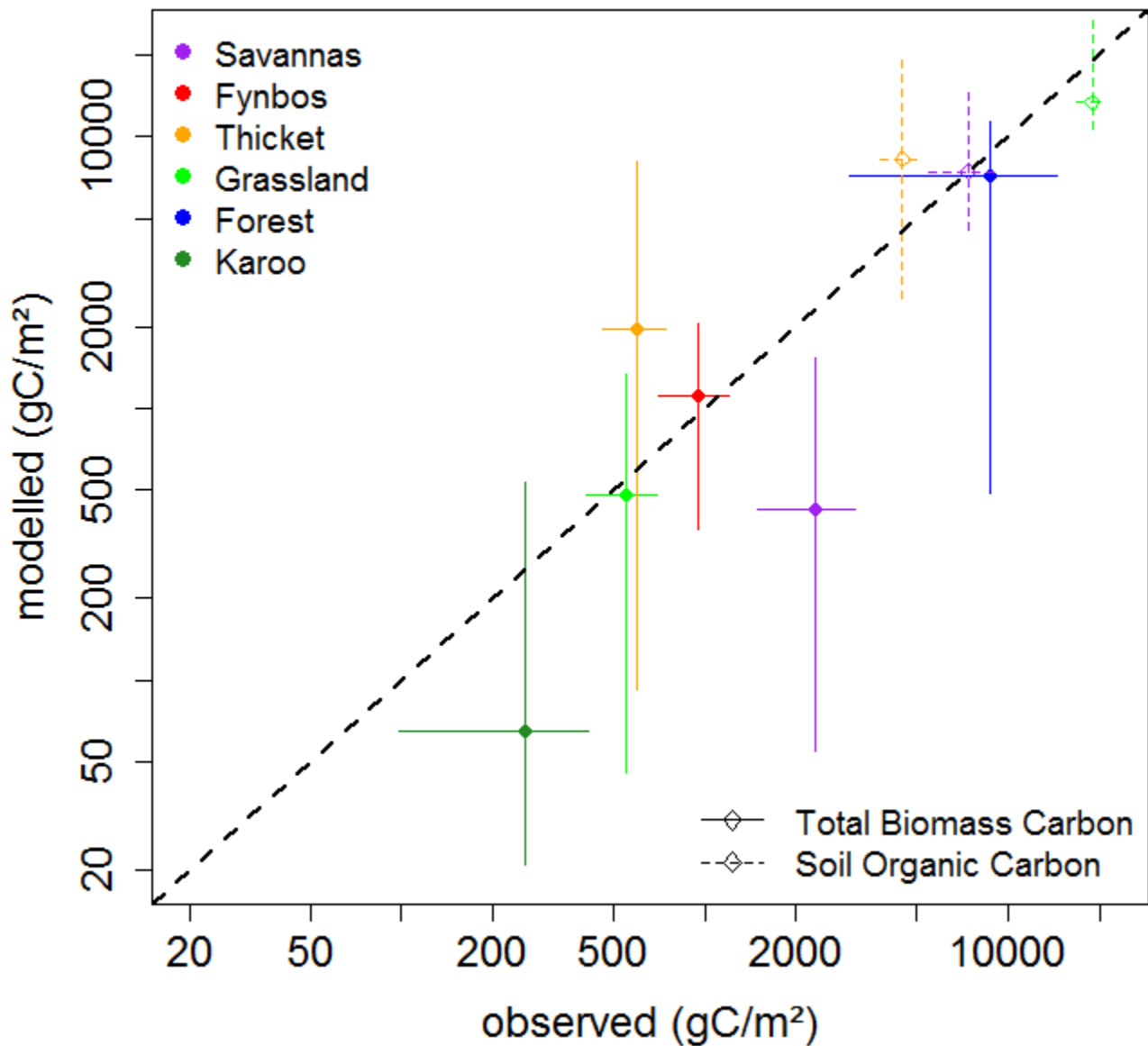
Net Ecosystem Production ~ 20 TgCO₂/y = national sink

For comparison: SA National inventory 2000 was 335 TgCO₂/y

Validation datasets

- Soil organic C: demanding requirements and cant use SA soil survey profiles n=200
 - Lesogo Khomo, 62 profiles in KNP
 - Mills & Cowling (Powell?), 119 profiles in thicket (intact, degraded, old fields)
 - Von Maltitz 19 profiles, Drakensberg
- Vegetation n=358
 - Savanna Shackleton 51 sites, Shea 12 sites (herbaceous and litter)
 - Fynbos 34 1980's studies; Kruger, van Wilgen, Rutherford
 - Karoo 10 Middelberg, Tierberg, (others may be available)
 - Forest 41 Glenday eThekweni, Durheim S Cape, others pending
 - Grassland 72 Drakensberg, Bloemfontein, Kalahari
 - Thicket 150, Powell (used 1/3 for cal, 2/3 for val)

Validation



Conclusions

STOCKS

- 93% of all carbon is in the SOIL
 - slow to accumulate (centuries to millennia)
 - can get lost quickly through poor soil management
- 80% in natural, 20% in transformed systems

FLUXES

- SA is a net sink for carbon of $\sim 20 \text{ TgCO}_2/\text{y}$
- Our national emissions are $\sim 15\text{x}$ larger than this

Set the context for mitigation discussions around AFOLU

Conclusions- methods

- Spatially-explicit: can encompass variance within biomes/land uses.
- Accuracy: 10% Confidence intervals are within 5% of the mean
- To do this with stratified sampling requires 1000-2000 samples nationwide (costs 3 times higher)
- Ideally – integrate methods:
 - use sample-based approach to validate and improve models
 - use the continuous variable approach for actual calculations

An aerial photograph of a rural landscape. The terrain is a mix of green and brown, suggesting different types of vegetation or soil. There are several rectangular plots, possibly agricultural fields, separated by thin lines. A small, light-colored building with a dark roof is visible in the lower right quadrant. The overall scene is a typical rural or agricultural setting.

Contributors:

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