Projecting the Future of African Rangelands under Climate Change using the Af-Range Ecosystem Model

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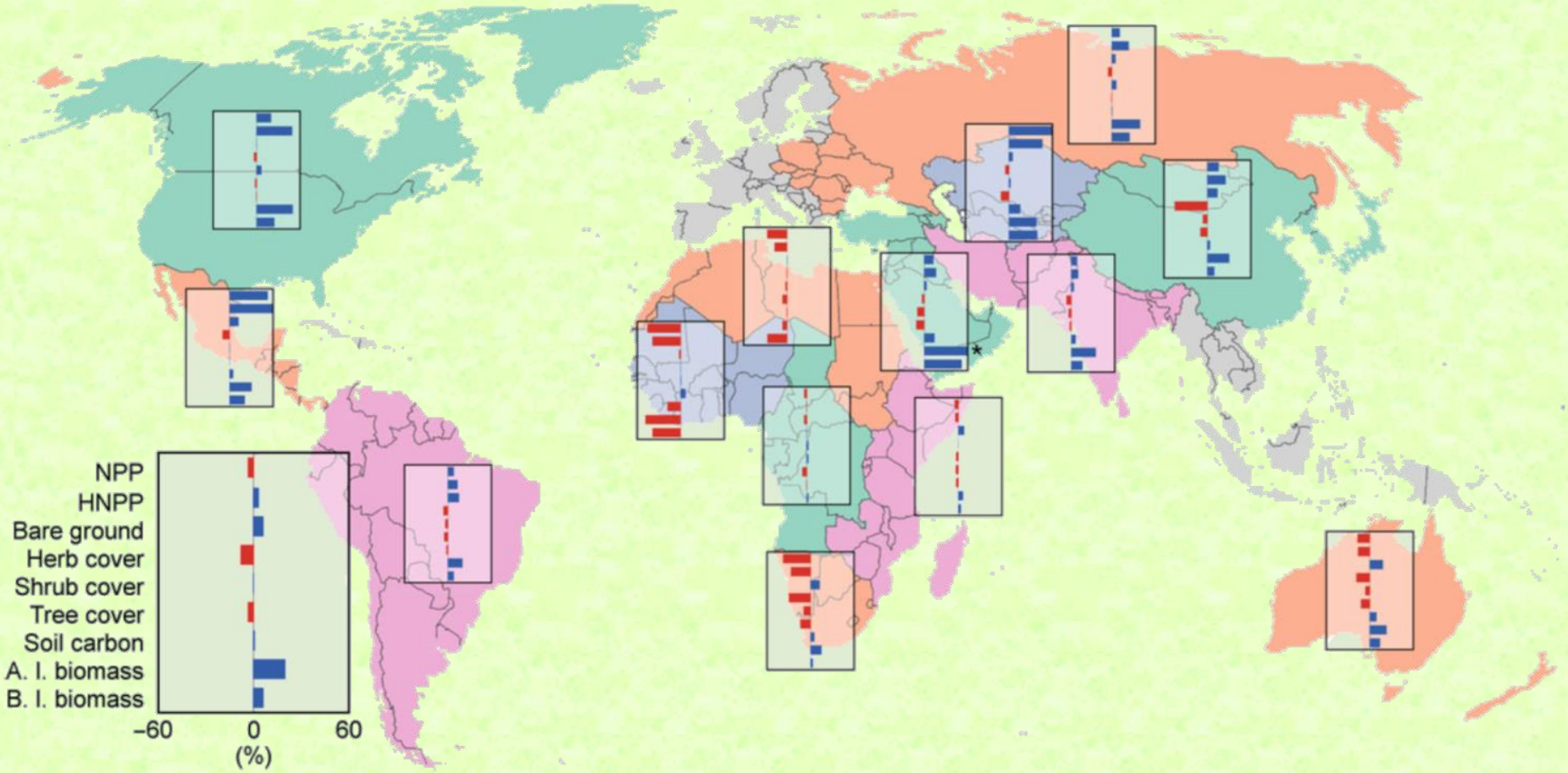


NPP – Annual net primary production

HNPP – Herbaceous annual net primary production

A. l. biomass – Aboveground live biomass

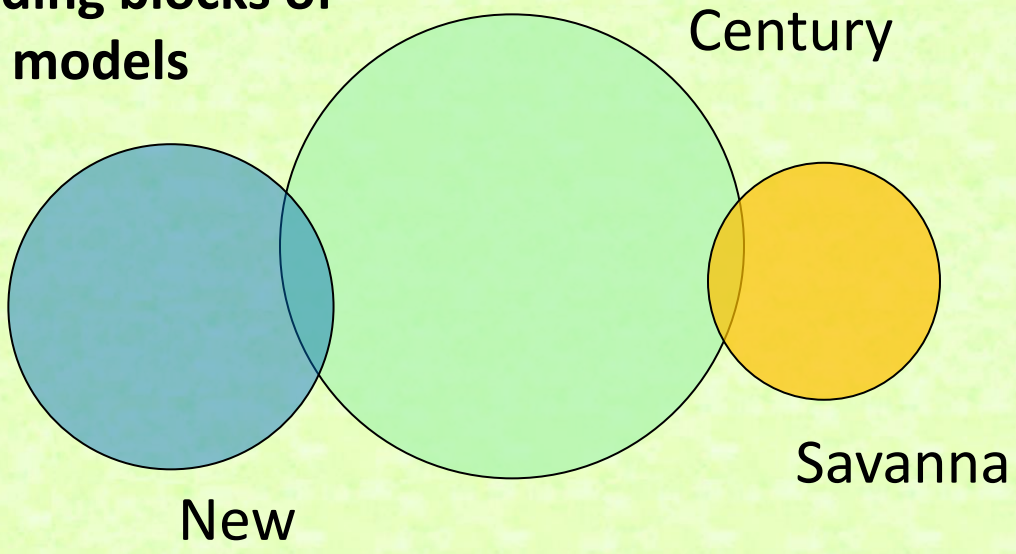
B. l. biomass – Belowground live biomass

Boone et al. (2018)

We created the **L-Range** suite of models to:

- Represent rangelands, although used more broadly now
- Respond to main climate variables
- Represent main functional biomass groups
- Responsive to fire, grazing intensity, and other management practices

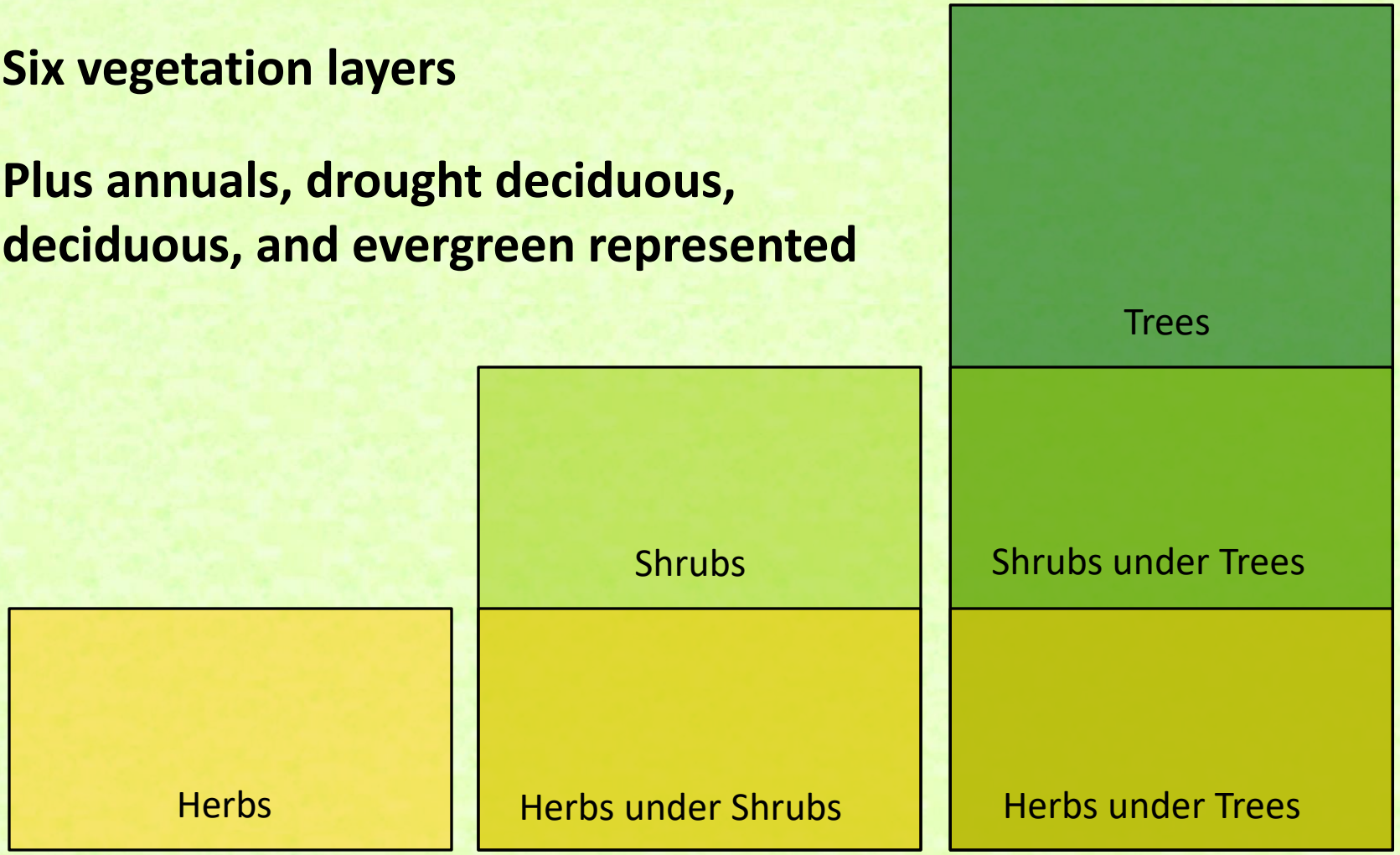
The building blocks of L-Range models

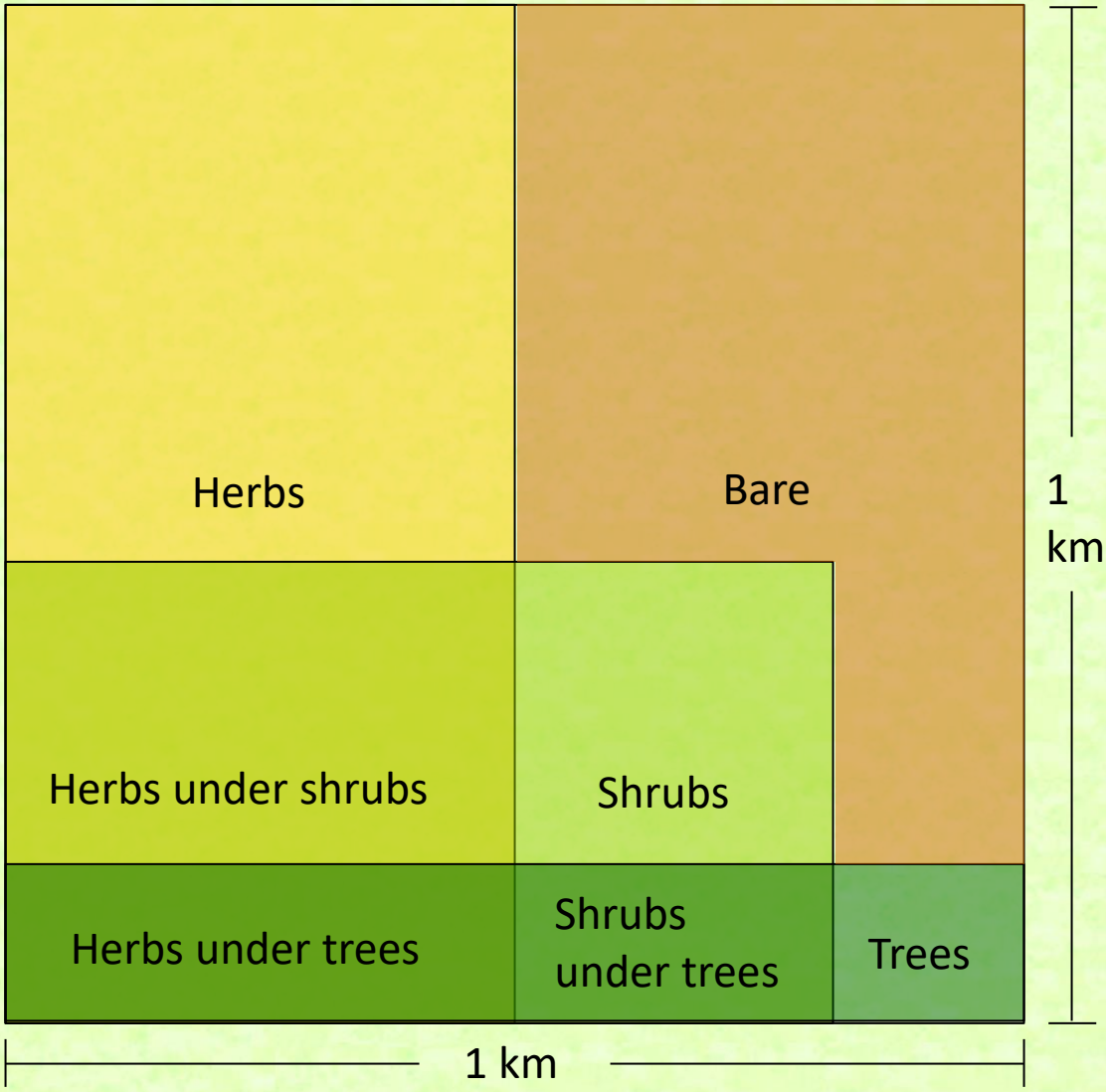


Three vegetation facets

Six vegetation layers

Plus annuals, drought deciduous, deciduous, and evergreen represented





Populations on a 1 km^2 area per land unit are simulated

Establishment influenced by:
Relative seed production
Water:PET
Surface litter
Herbaceous roots
Woody cover

Death influenced by:
Nominal death rate
Water:PET
Grazing
Annuals
Shading

Boone et al. (2020)

Differences in landscapes are addressed with different landscape units

Herbivores are Represented

Each 20 x 20 km landscape cell includes 10 herbivore populations

They can be set up to represent anything a user wishes

In the draft application seven are used and they are:

- Cattle
- Goats
- Sheep
- Camels
- Donkeys
- Wild grazers
- Wild mixed grazer-browsers

L-Range:

130+ (selectable) spatial surfaces produced each month

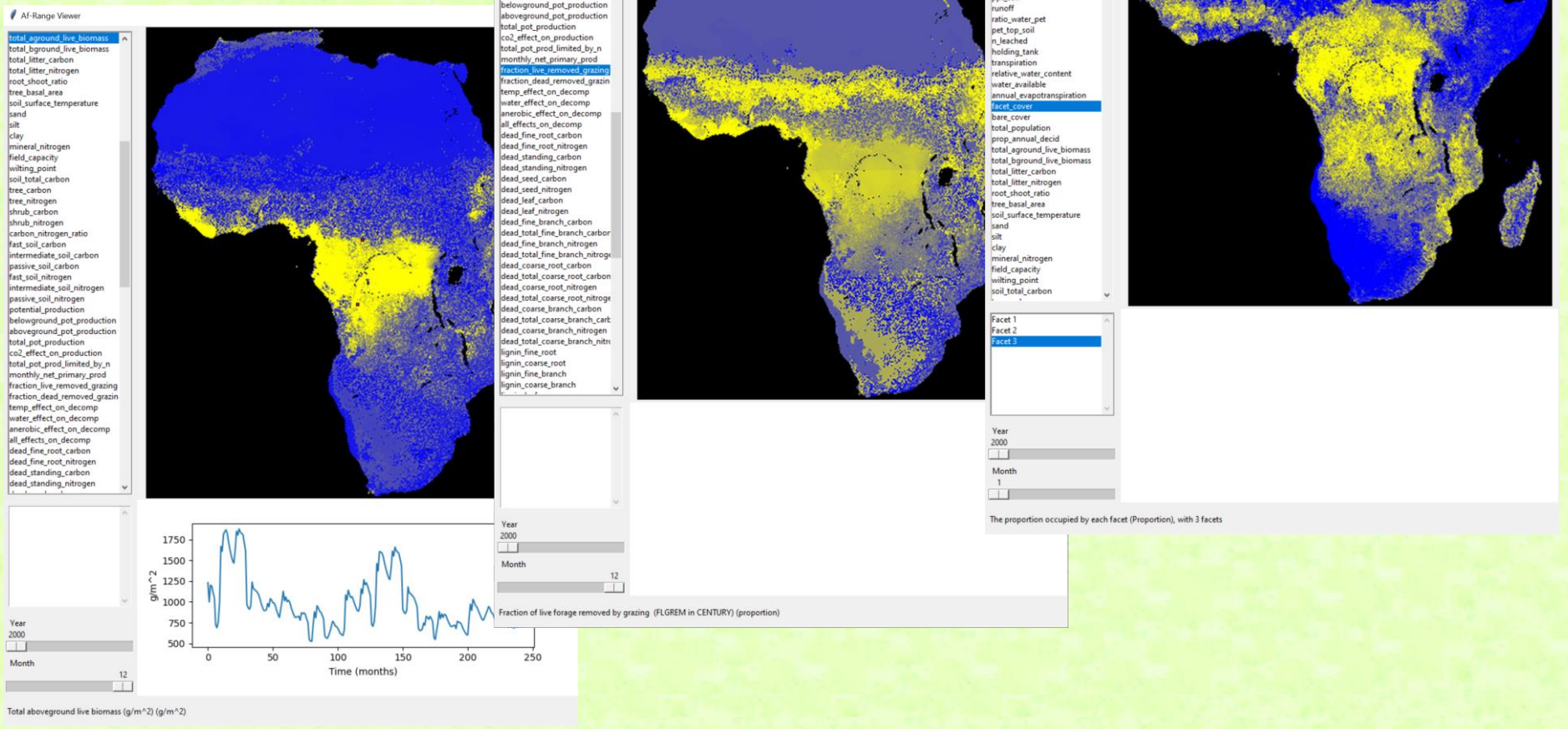
Such as:

- Heat accumulation and Plant phenology
- Facet cover (herbs, shrubs, trees); Bare cover
- Total above- and belowground biomass
- Shrub and tree carbon and nitrogen
- Fast, Intermediate, and Passive soil carbon and nitrogen
- Monthly net primary production
- Litter structural and metabolic carbon and nitrogen
- Leaf, Seed, Fine and Coarse branch and root carbon, nitrogen
- Leaf area index
- Fire severity and Burned carbon and nitrogen

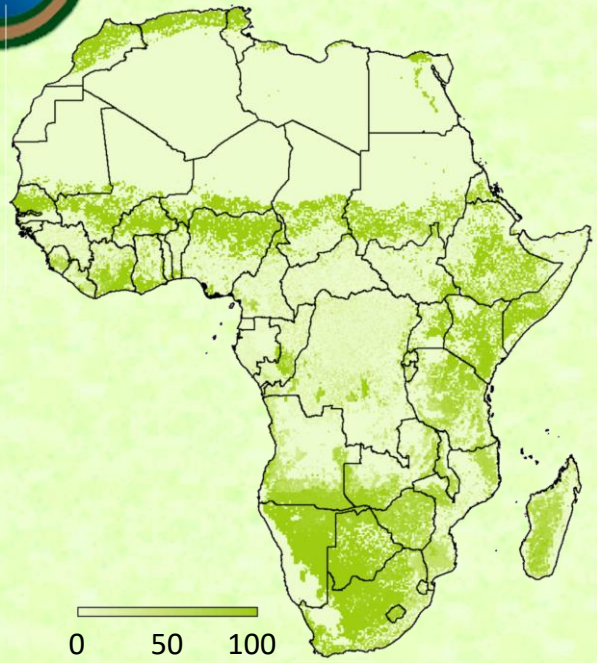
Tree cover (%)

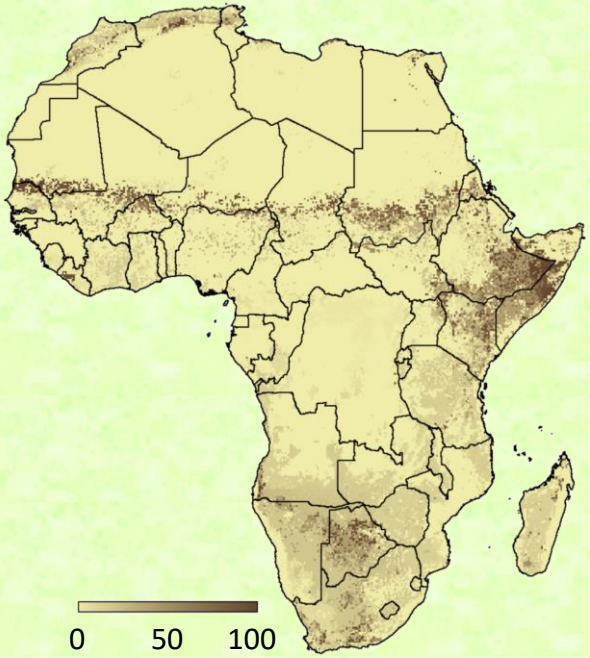
Fraction live biomass removed by grazing (prop.)

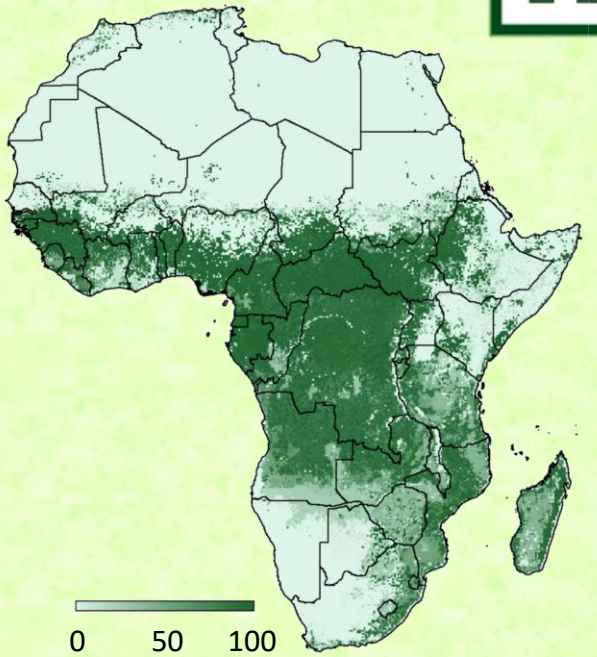
Total aboveground live biomass (g m^{-2})



2022



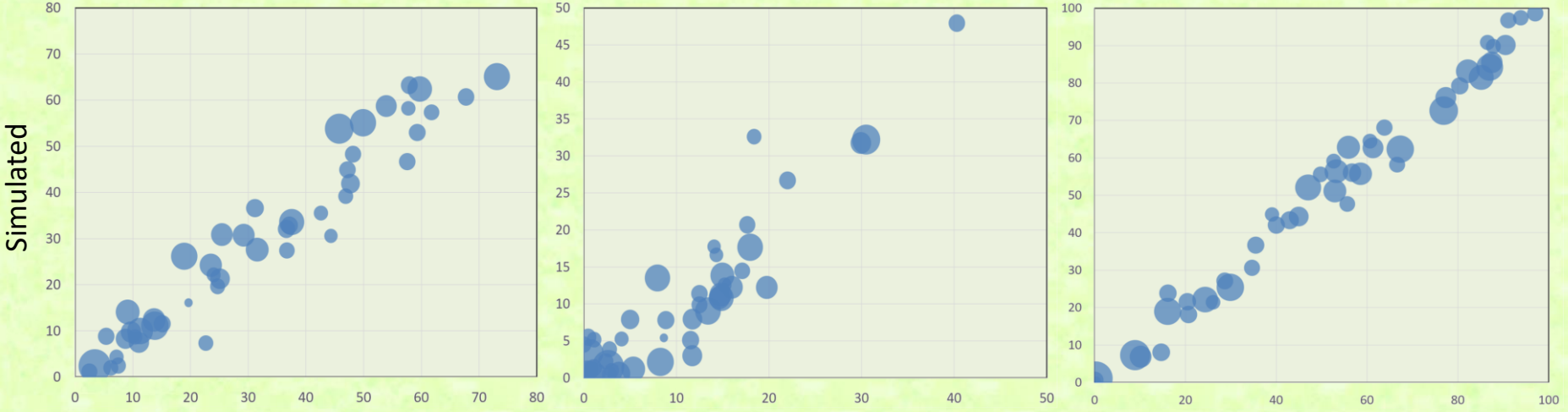




Herbaceous Cover (%)

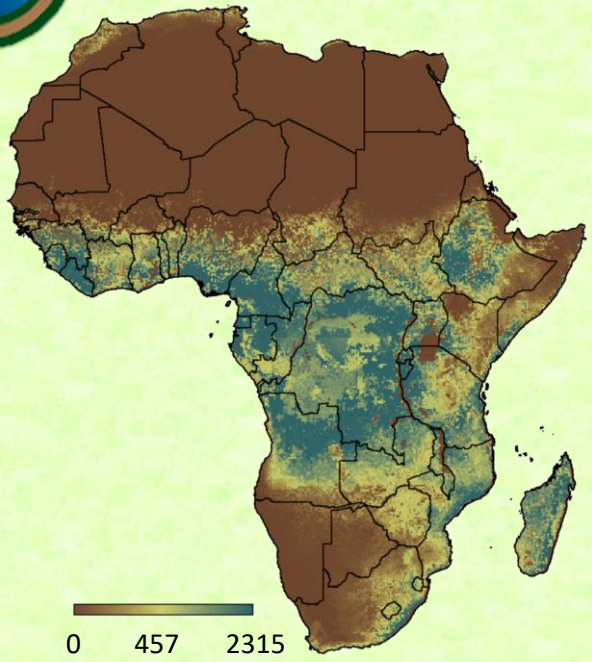
Shrub Cover (%)

Tree Cover (%)

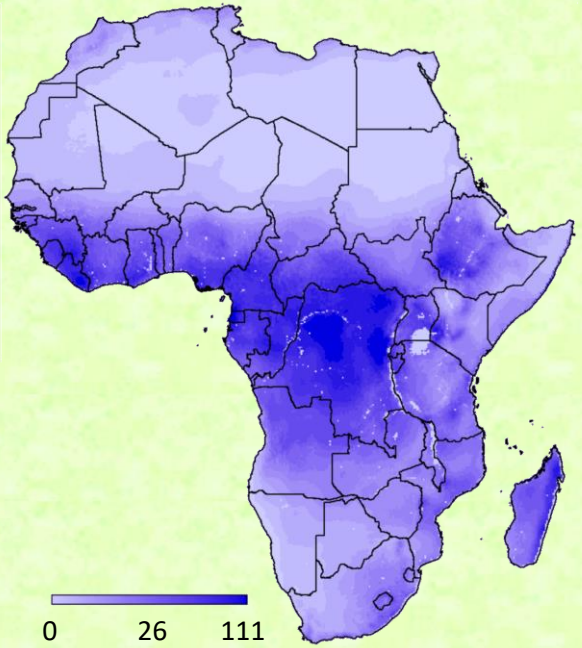


* Herbivores held constant

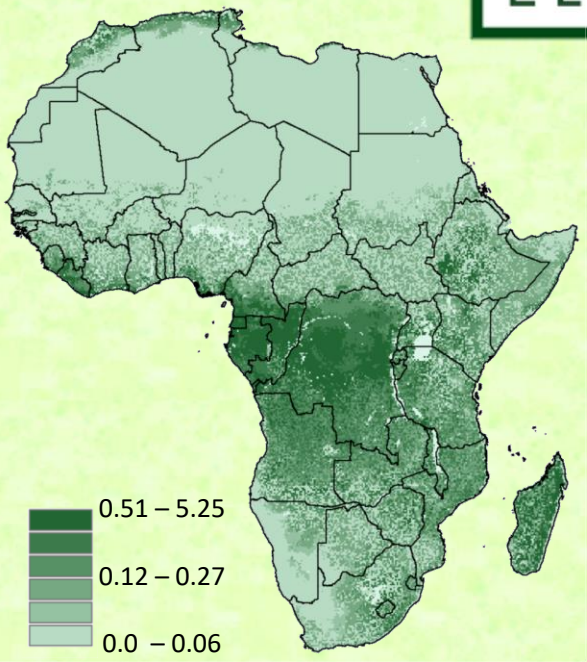
2022



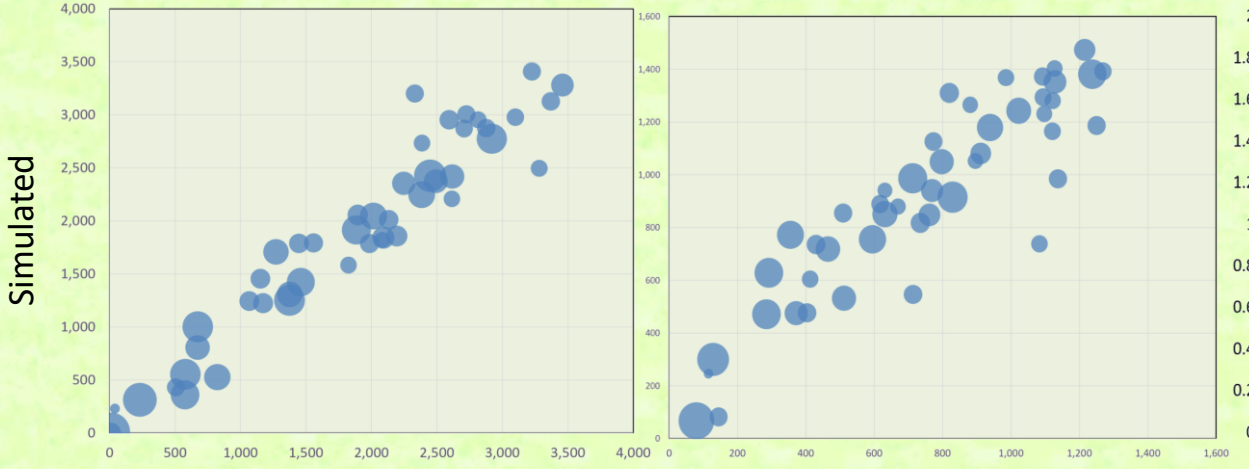
Annual Net Primary Production (g m^{-2} yr^{-1})

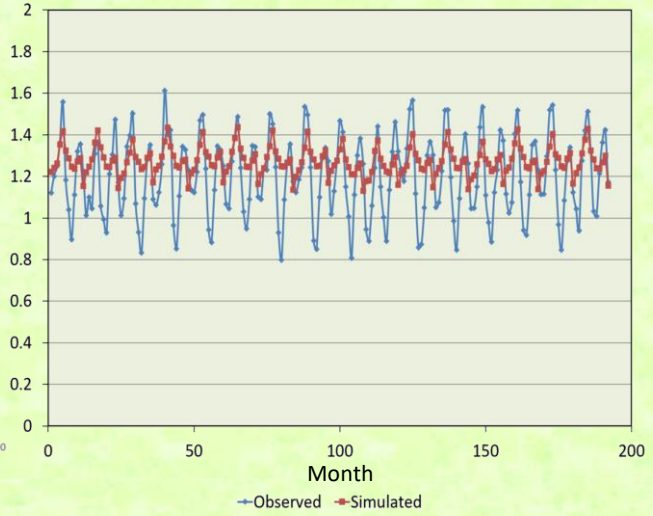


Evapotranspiration (cm yr^{-1})



Leaf Area Index





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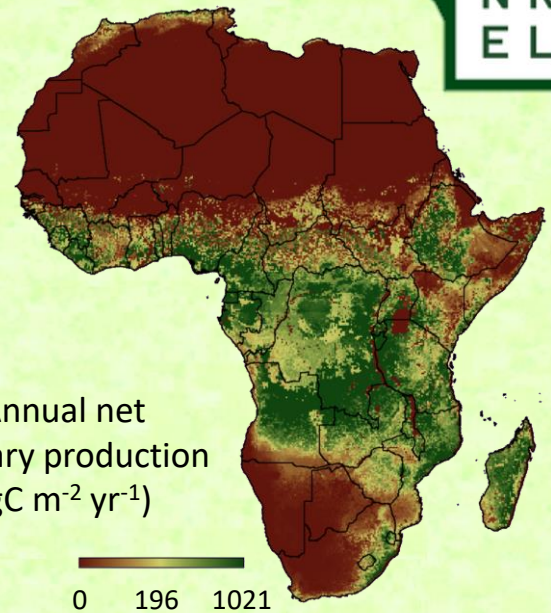
Discovery through Scenario Analyses

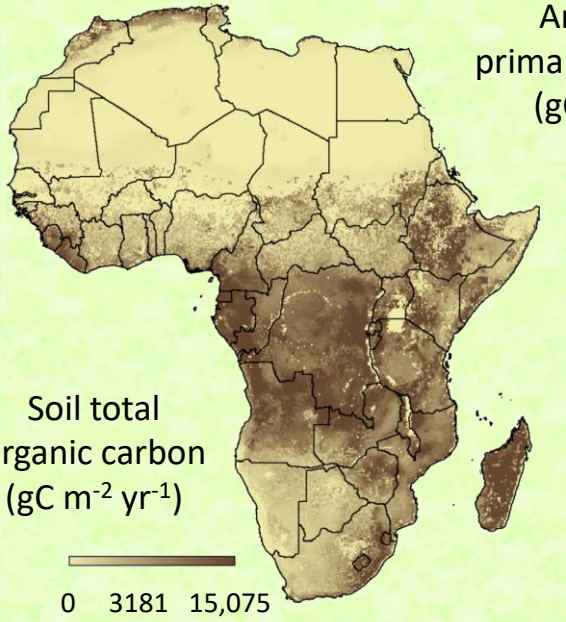
- Climate change
- Cover change
- Stocking rates
- Herbivore dynamics
- Herbivore mobility
- Soil carbon dynamics
- Soil nitrogen dynamics
- Fire, fertilization
- More frequent droughts
- Coupled systems modeling

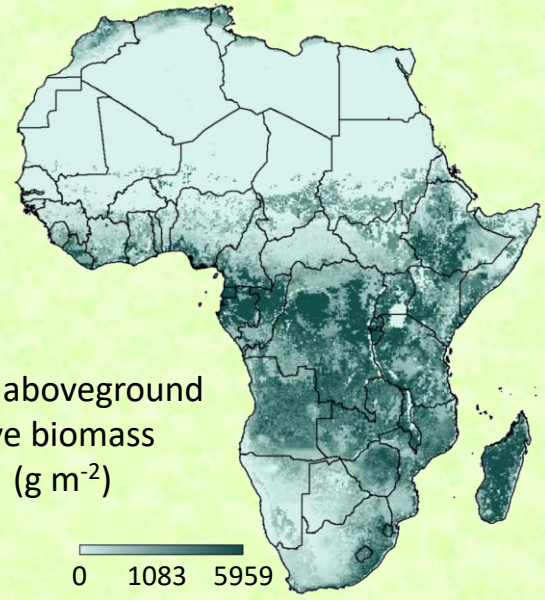
2070

ACCESS RCP 8.5

Draft: Do not cite







The L-Range Model Family

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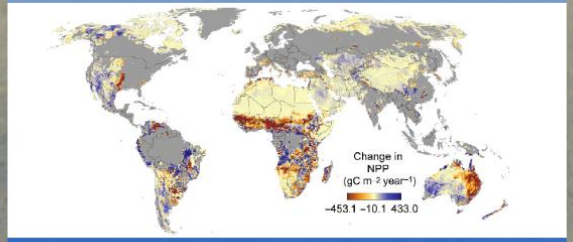
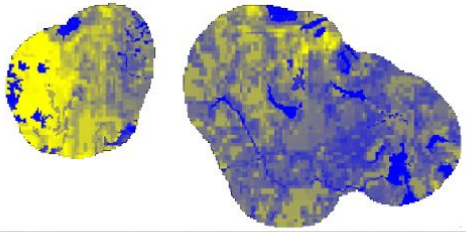
G-Range

G-Range is an ecosystem model that simulates dynamics in biogeochemistry, plant cover, and plant production for rangelands at a **global** scale.



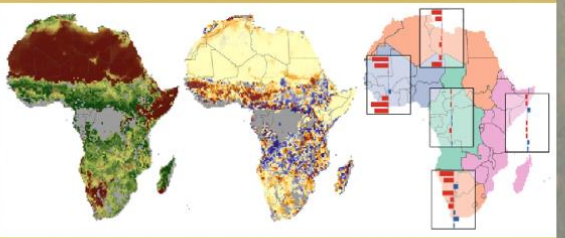
L-Range

L-Range is an ecosystem model that simulations dynamics in biogeochemistry, plant cover, and plant productivity for landscapes at a **local** scale. The tool can be applied to very large or very small areas, and versions can join with models representing human decision in a coupled-systems approach.



Af-Range

Af-Range is an application of L-Range to the **African continent** that may be used in analyses. Af-Range can represent the dynamics of domestic and wild herbivores across the continent.



L-Range.com


The End
Questions?
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