Background

- **RAMONA is a 2 year (2022-2023)** ESA funded project quantifying African Rangelands using SENTINEL-1-2-3 data

- **Steering committee** (JRC,GEOGLAM RAPP, ILRI,WFP,GMES,FAO)

- **Key users** (UNCCD,IFAD,ARC-LNR,NRF,SAEN,CSE,ARC,CLISS AGRHYMET,South African National Parks,IGAD,iCPAC,KWT,Maasai Mara WC,SSO, ZIEM)

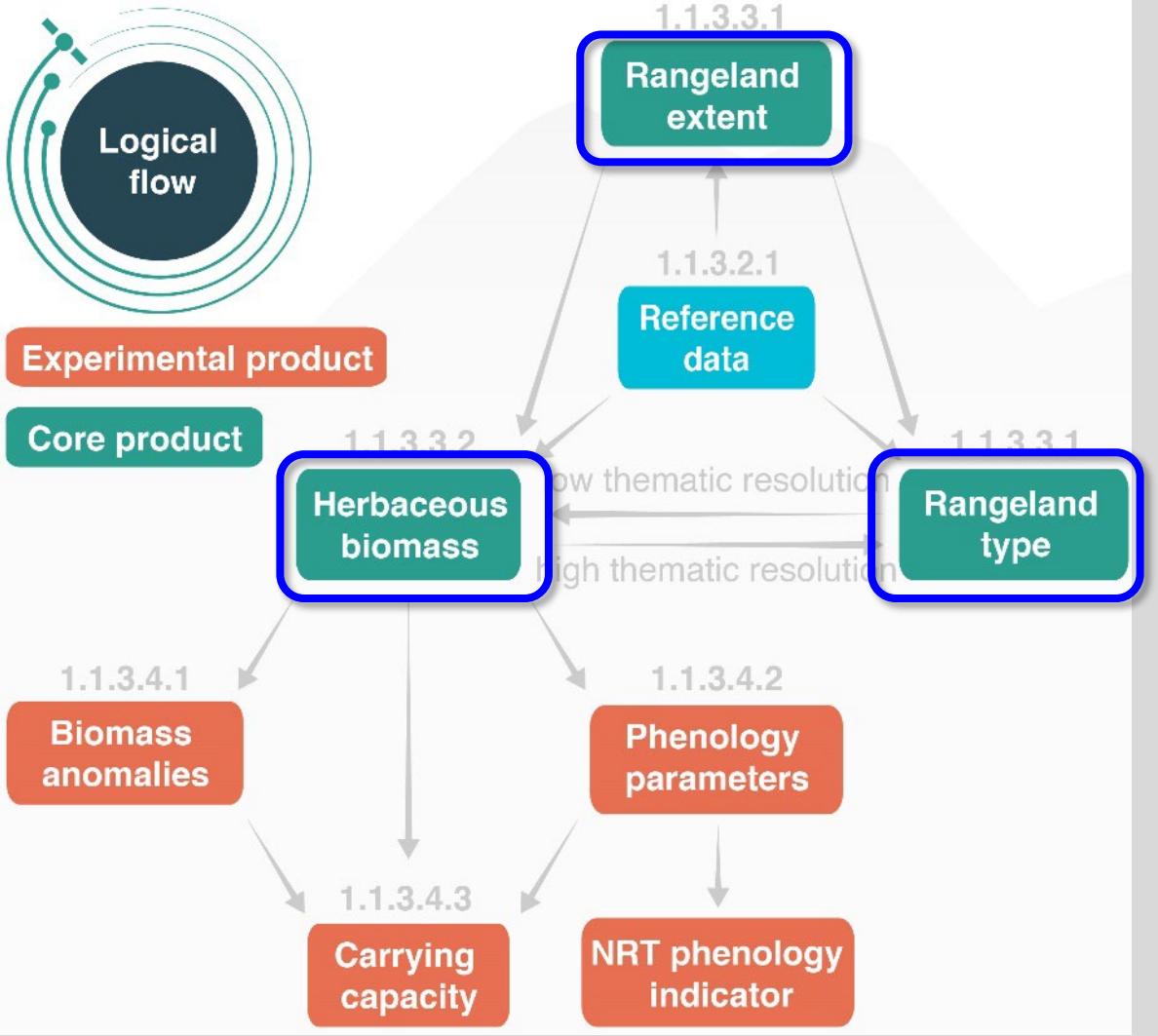
- **Collaborators** (a range of field sites, flux sites, data providers and so on, in Africa and elsewhere), and **more are welcome!**

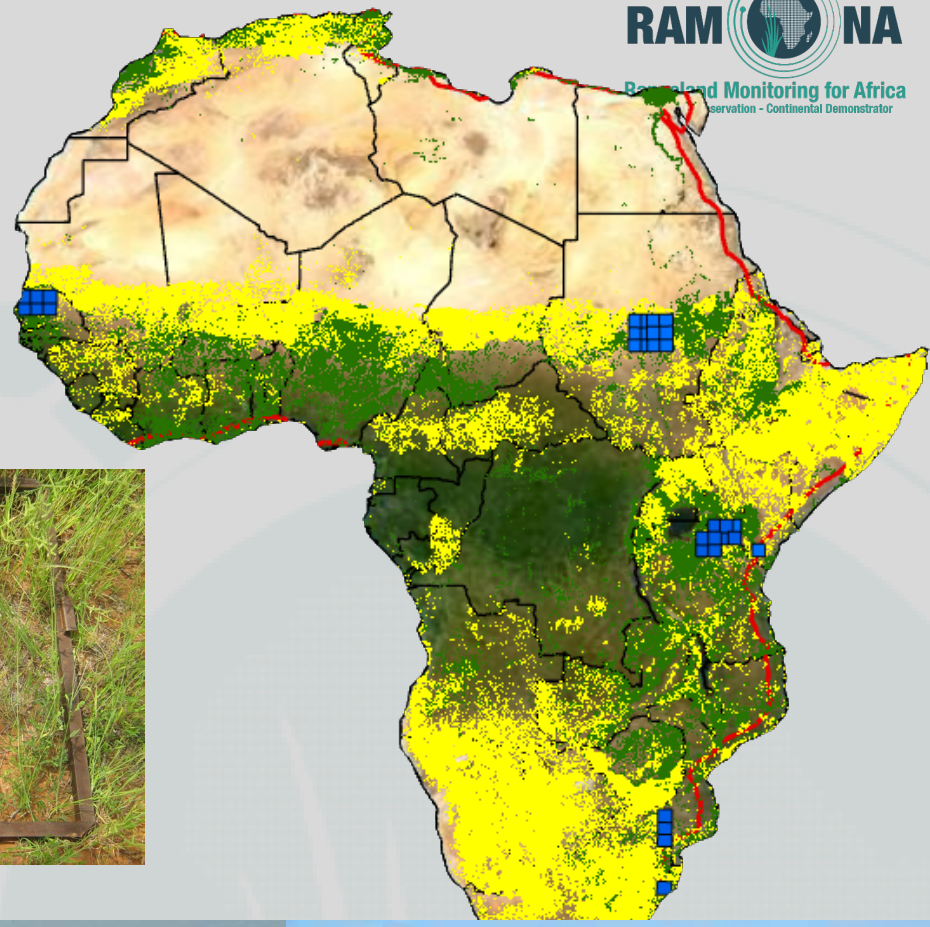
Motivation

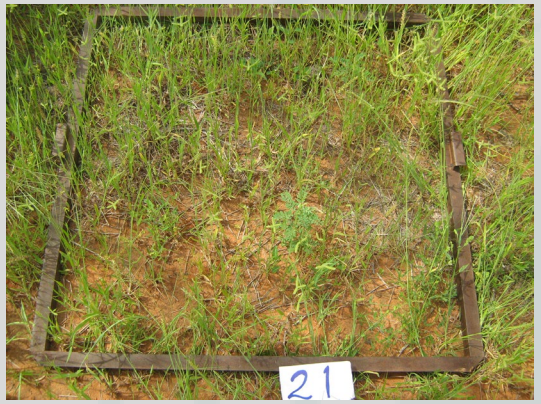
- **Rangeland biomass contribute** proteins (milk, meat) to about 350 million people
- Provide **habitat** for **wildlife**.

The primary objective of the RAMONA project is to develop and implement a prototype EO based rangeland monitoring system at **continental** scale for Africa. A functional and effective monitoring system should provide timely and reliable information on key rangeland variables, in a form that is accessible and interpretable to users.

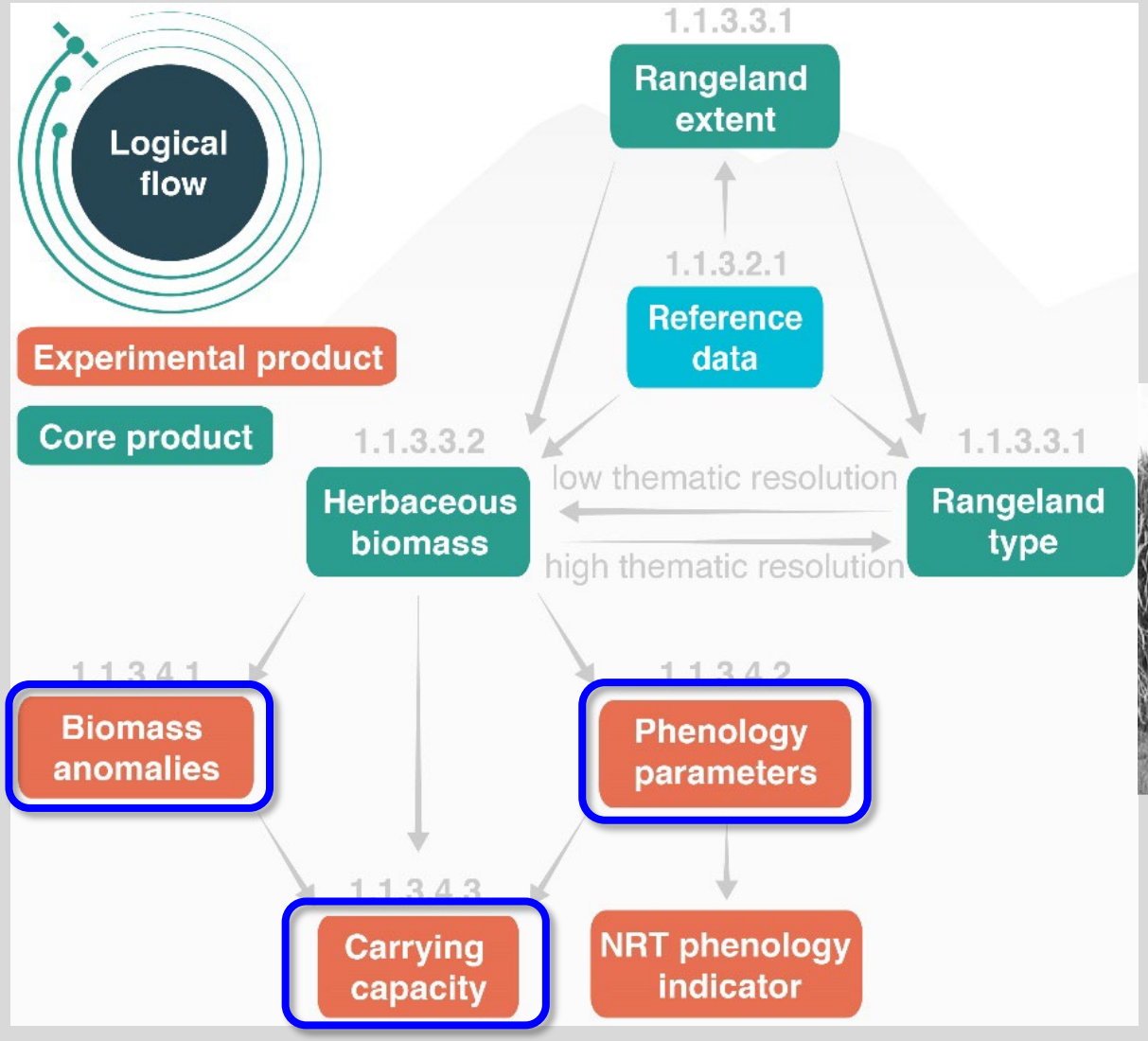
Core products

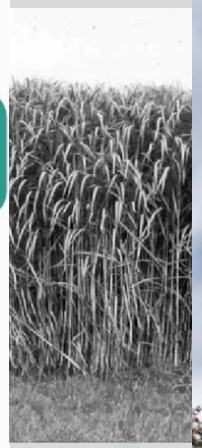


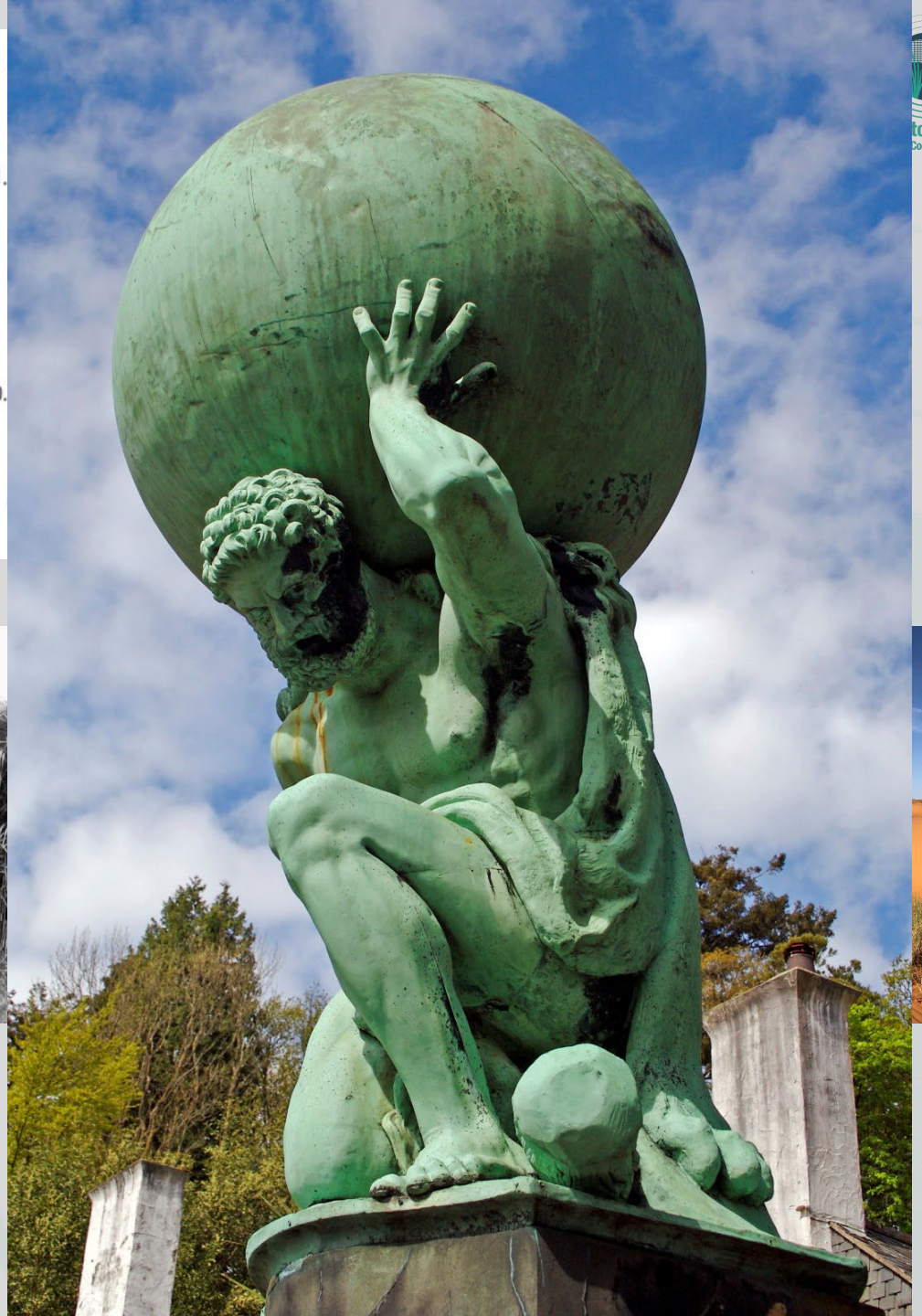


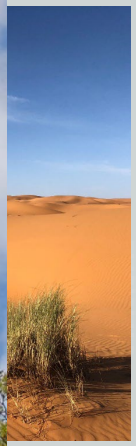


Experimental products

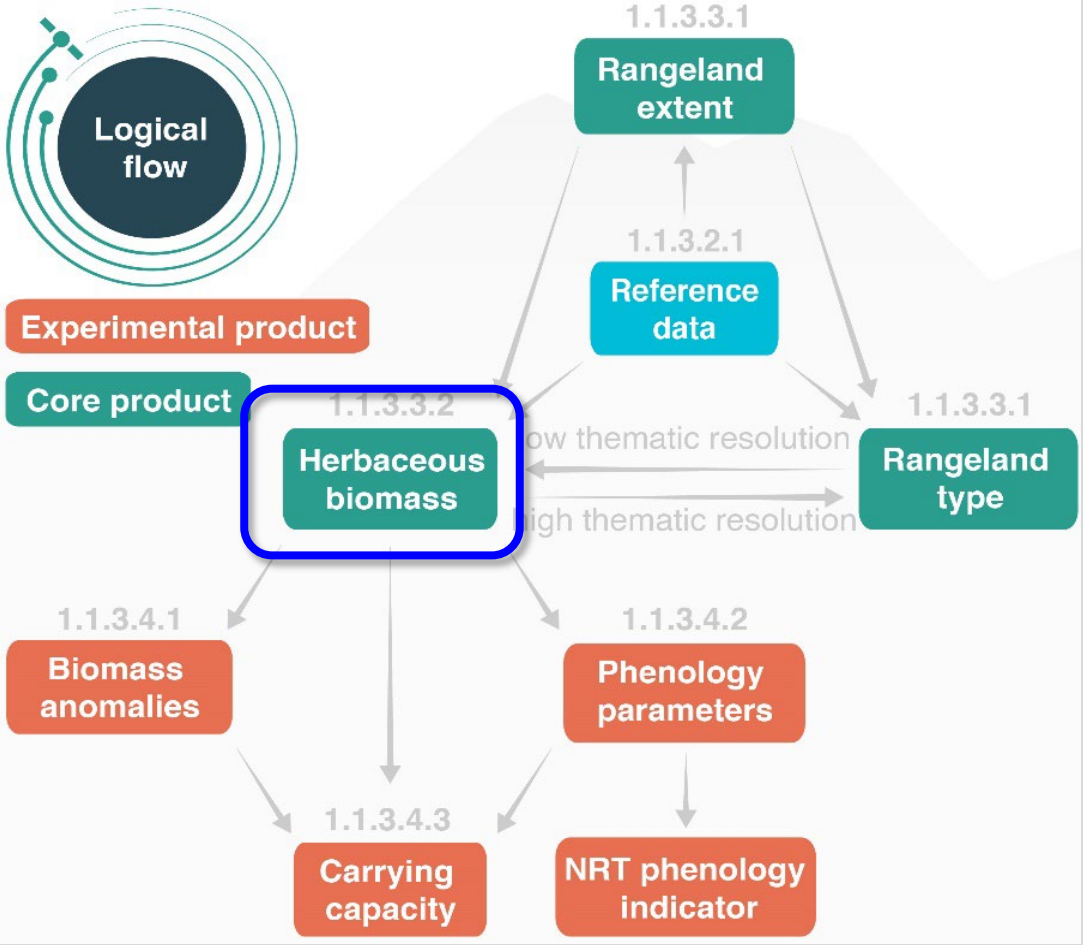








Rangeland Herbaceous Biomass



Rangeland Herbaceous Biomass - estimated monthly at 10 m spatial resolution for African Rangelands

Herbaceous rangeland biomass [t DM ha^{-1}] is the net accumulation of the photosynthetic gain of carbohydrates (gross primary productivity, GPP, [g C m^{-2} day^{-1}]), and losses through autotrophic respiration (Ra).

Light Use Efficiency

In short, gross primary productivity, (**GPP**), [g C m^{-2} day^{-1}] will be estimated based on EO data and climatic data via the light use efficiency concept

$$GPP = \varepsilon_{max} \times fAPAR \times PAR_{in} \times scalars$$

Where

GPP = Gross primary production [g C m^{-2} day^{-1}]

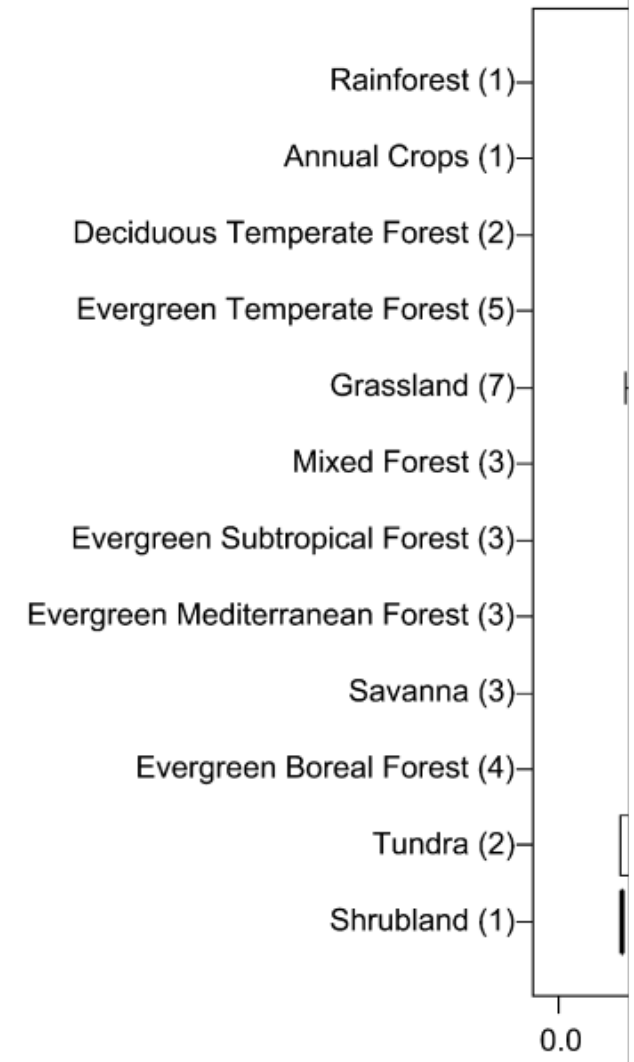
ε_{max} = is the light use efficiency [g C MJ^{-1}]

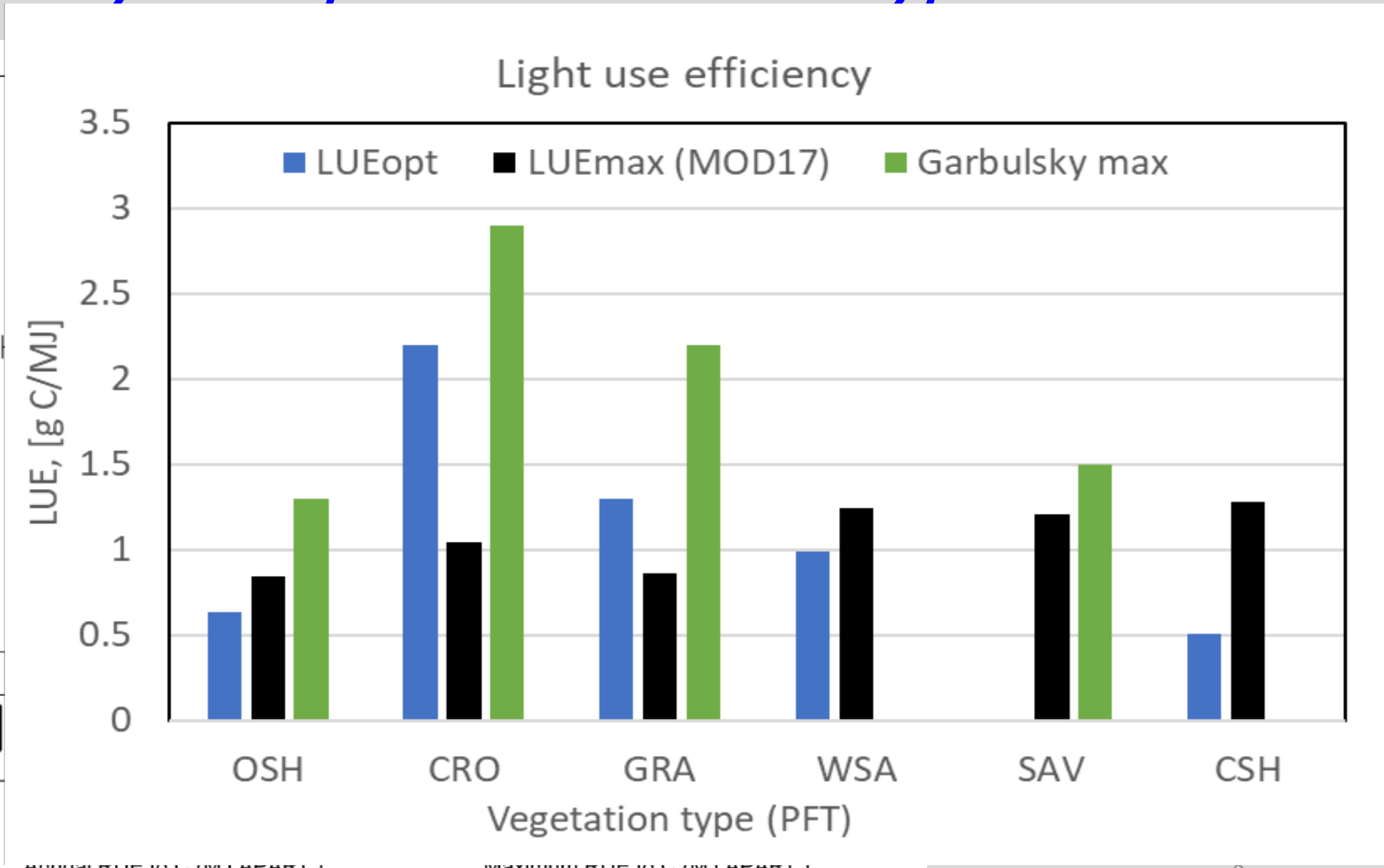
fAPAR = fraction of PAR absorbed by the canopy [0-1]

PAR_{in} = incoming photosynthetic active radiation [MJ day^{-1}]

scalars = different types of environmental controls [0-1]

^{E}max, may vary with plant functional type





Annual RUE [g C (MJ APAR)$^{-1}$]

Maximum RUE [g C (MJ APAR)$^{-1}$]

Spatial domain

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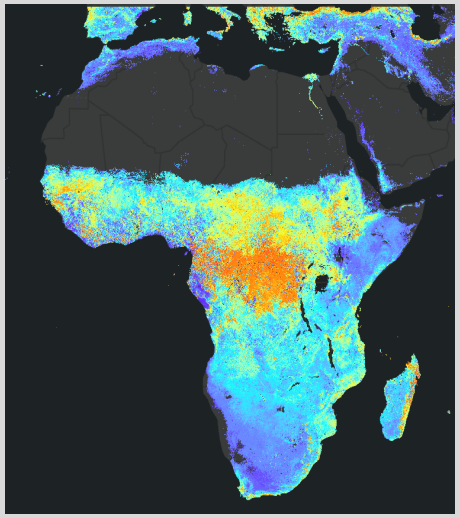
GPP = ε_{max} X

fAPAR		Incoming PAR		Moisture scalar		Temp-scalar



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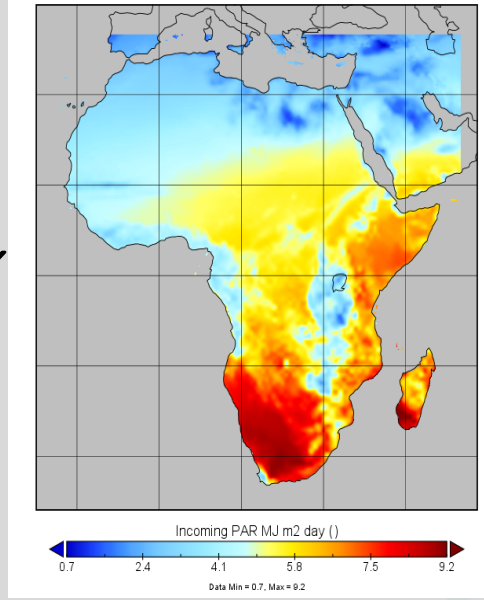

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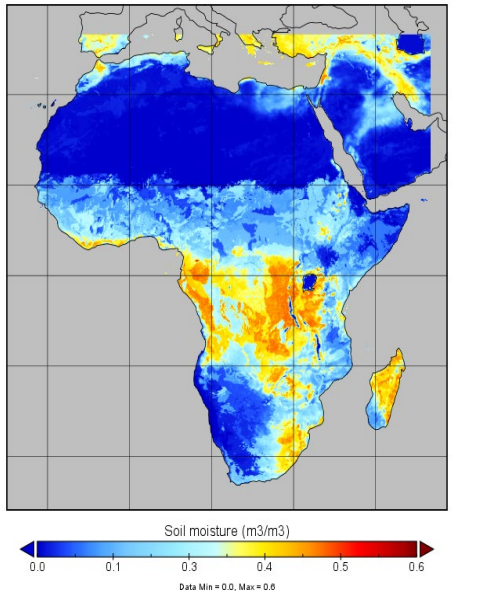

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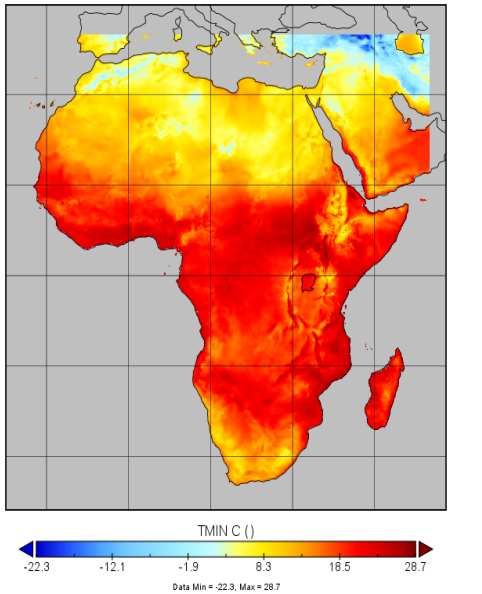

fAPAR from Sentinel 2,3, **PAR** and **Climate data** from ERA5-land (+)

ε_{max} (Light use efficiency) from Flux data and from literature

Sentinels 1,2,3

S1 – derive woody fraction

S2- time series of FAPAR at 10 m resolution

S3-OLCI high temporal resolution, used for gap filling of S2 data

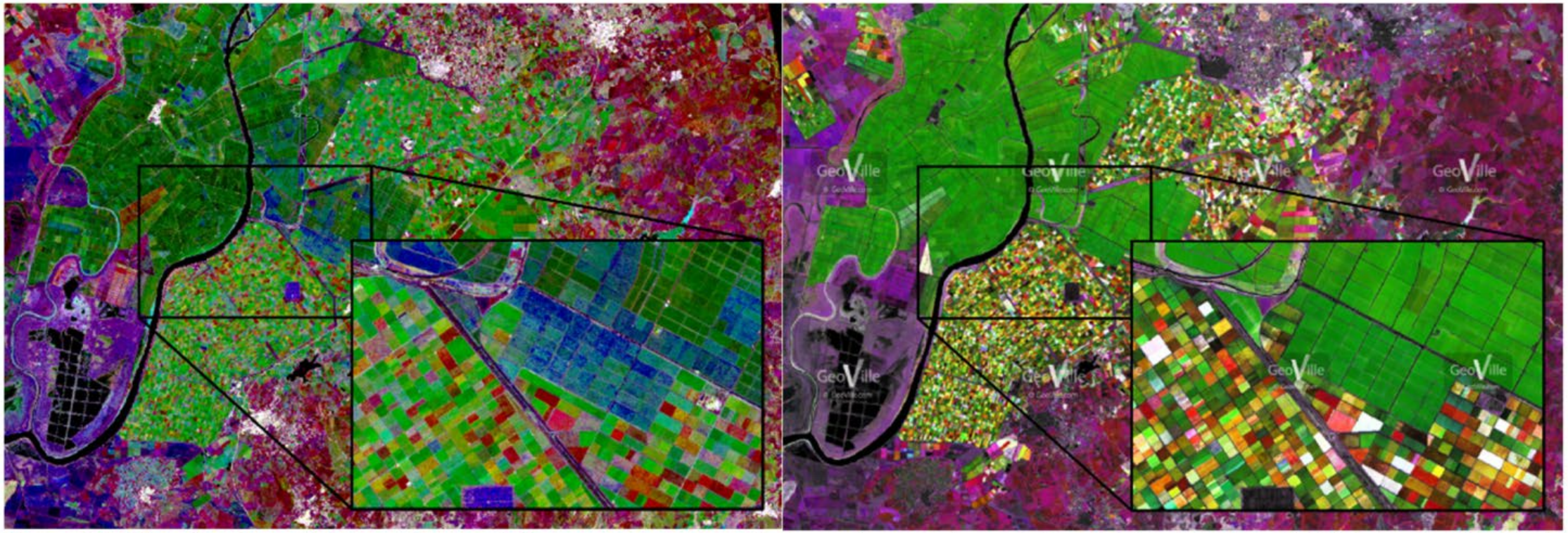

Figure 19: Visualisation of time-series model parameters when fitting a harmonic model to S-1 backscatter (left) in comparison with optically achieved parameters based on S-2 greenness (right). Both images include all satellite data for a two-year data period.

Temporal domain (Dahra, Senegal, 2020, daily)

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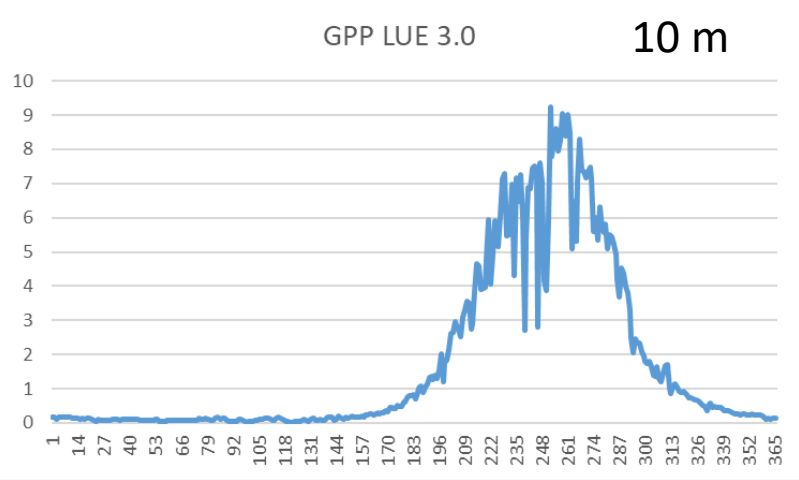

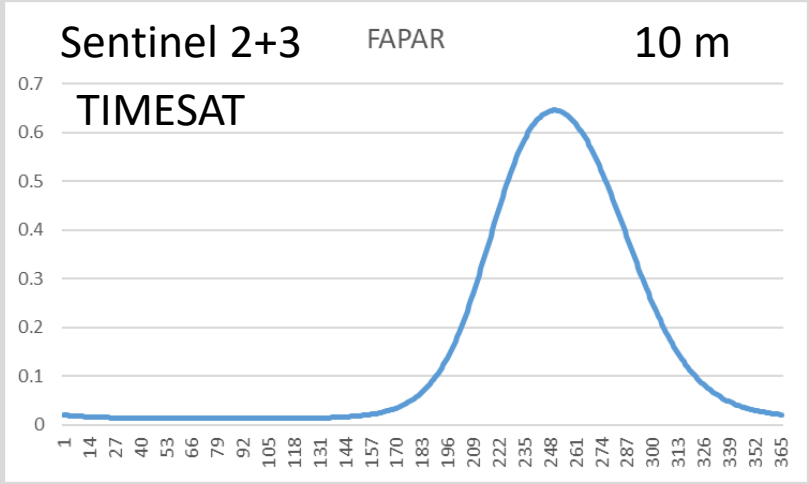

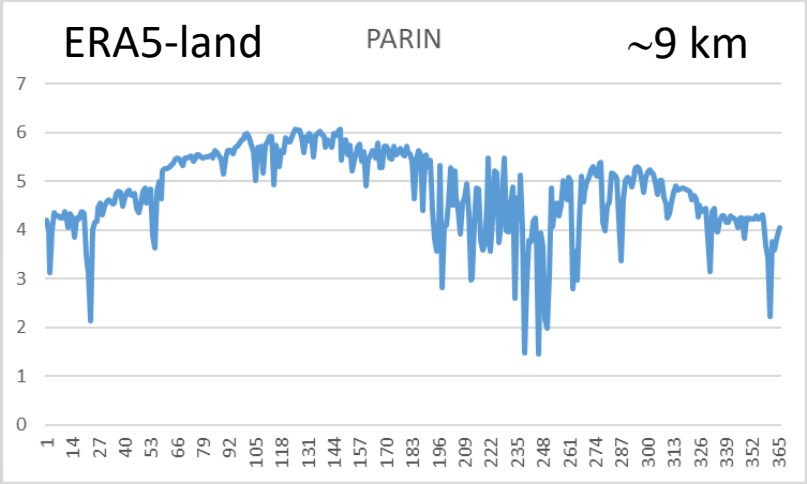

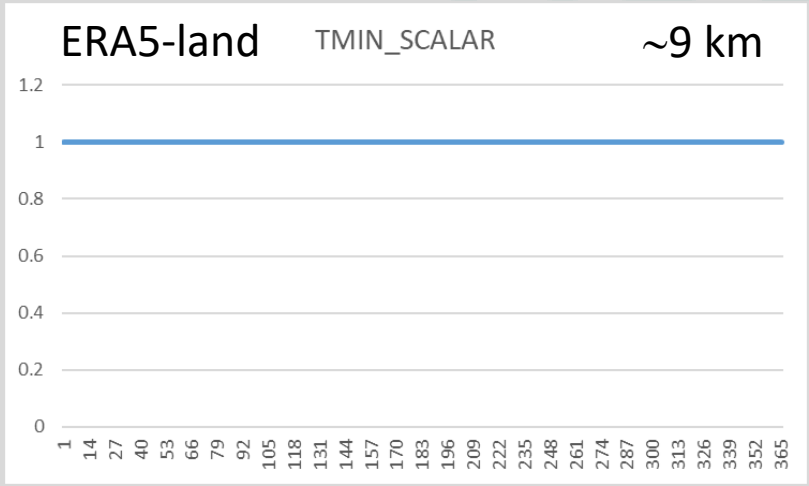

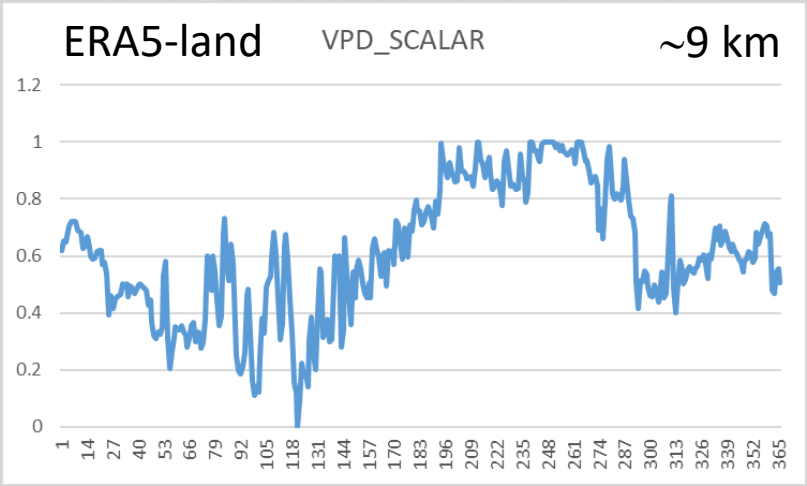

Enviro

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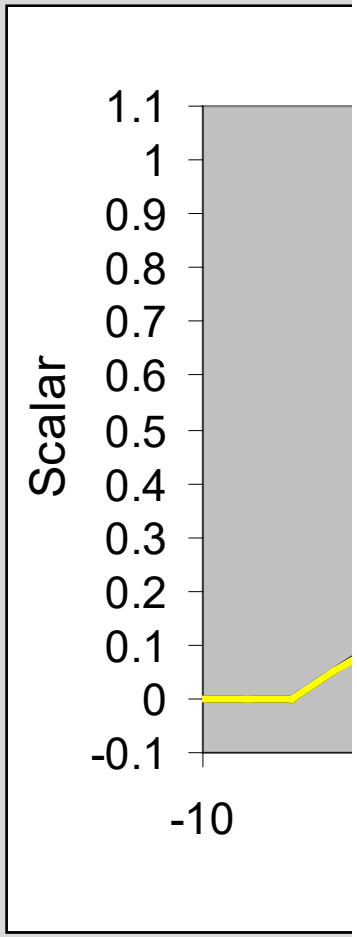
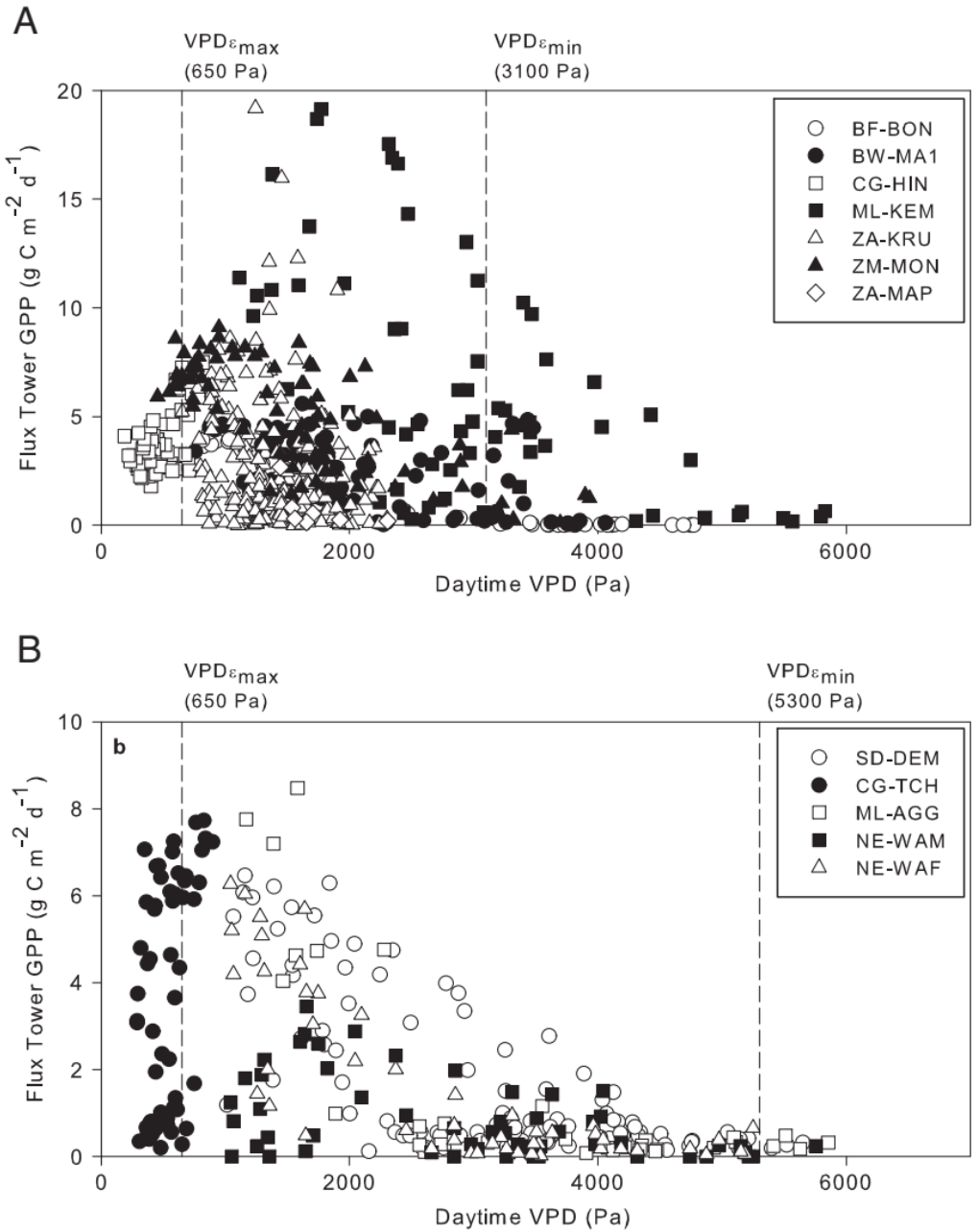


Savannas

Grasslands



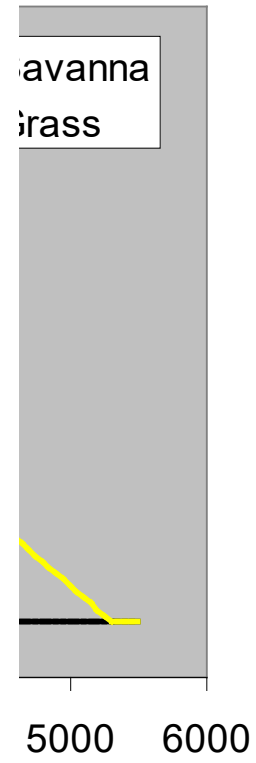


Fig. 6. 8-day eddy covariance estimated GPP (g Cm^{-2} day^{-1}) against 8-day average daytime tower VPD (Pa) for savannas (A) and grasslands (B). The dashed vertical lines mark the thresholds at which VPD inhibits photosynthesis in MOD17A2. $VPD_{\varepsilon max}$ is the daily average VPD at which ε is maximum (VPD scalar = 1) whereas $VPD_{\varepsilon min}$ is the daily average VPD at which ε is minimum (VPD scalar = 0).

GPP to bi

Net primary pro
or CUE.

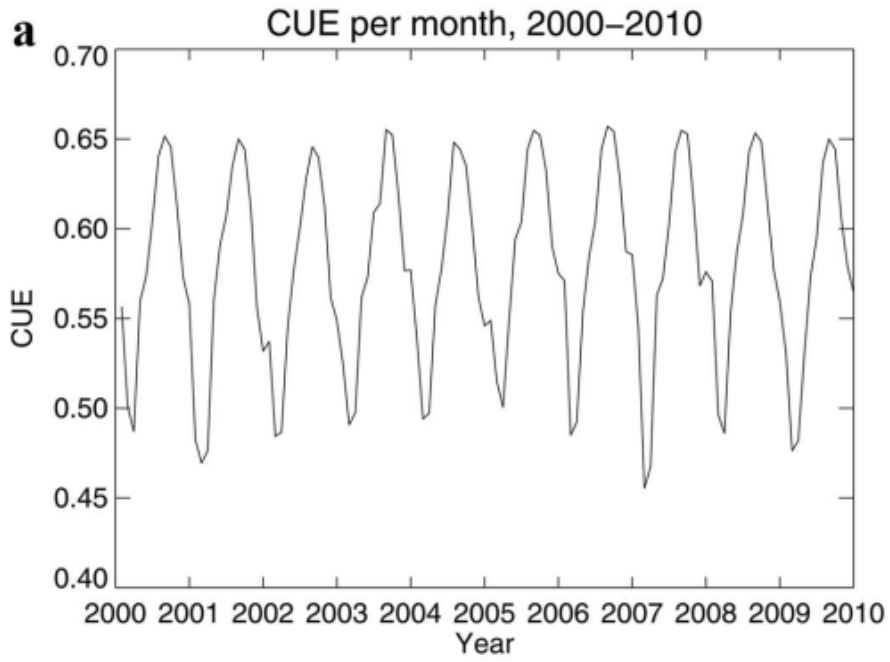
NPP = GPP – R

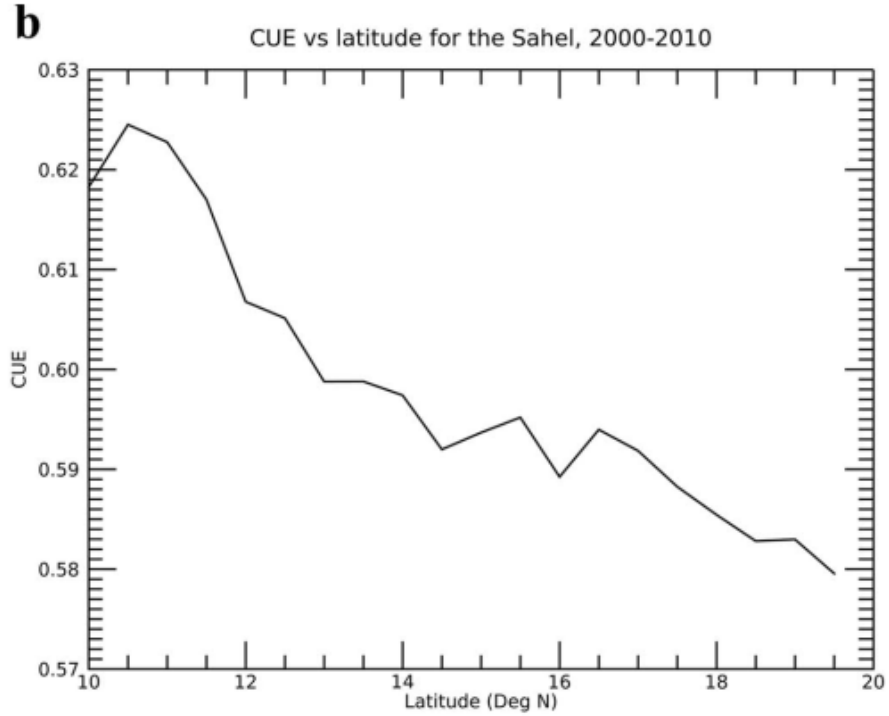
CUE = NPP/G

NPP = GPP x

Biomass [g DM
turnover and

NPP will be deri
NPP/GPP) derive





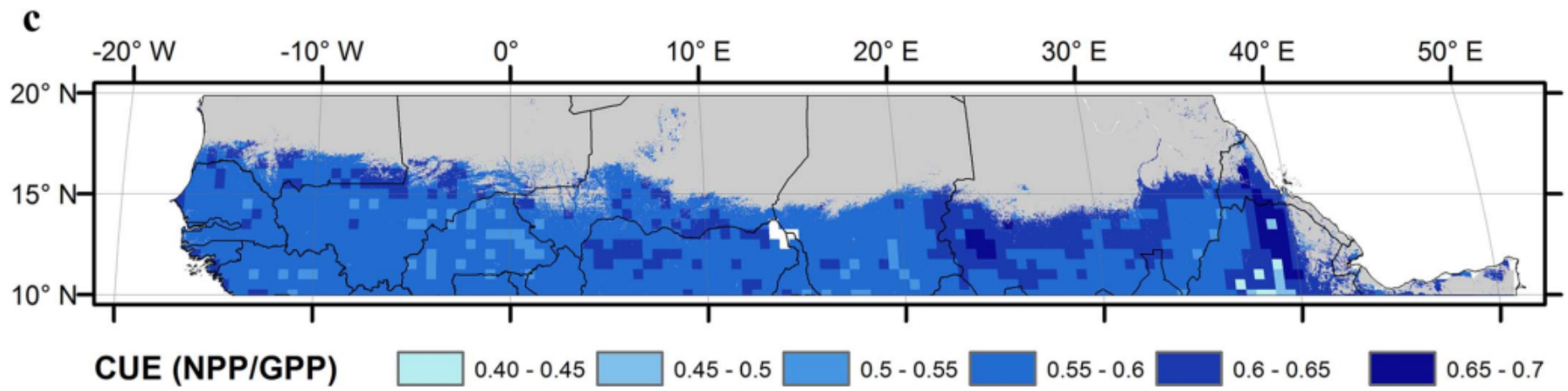


Fig. 3. Temporal (a) and spatial (b) variability (average for 2000–2010) in carbon use efficiency (CUE) in Sahel, originating from the dynamic vegetation model LPJ-GUESS. Mean (2000–2010) LPJ-GUESS CUE per grid cell, grey indicates no data (c). Overall mean CUE = 0.597.

Preliminary Results, first test (MOD17, ε_{max}=1.0,1.5,3.0)

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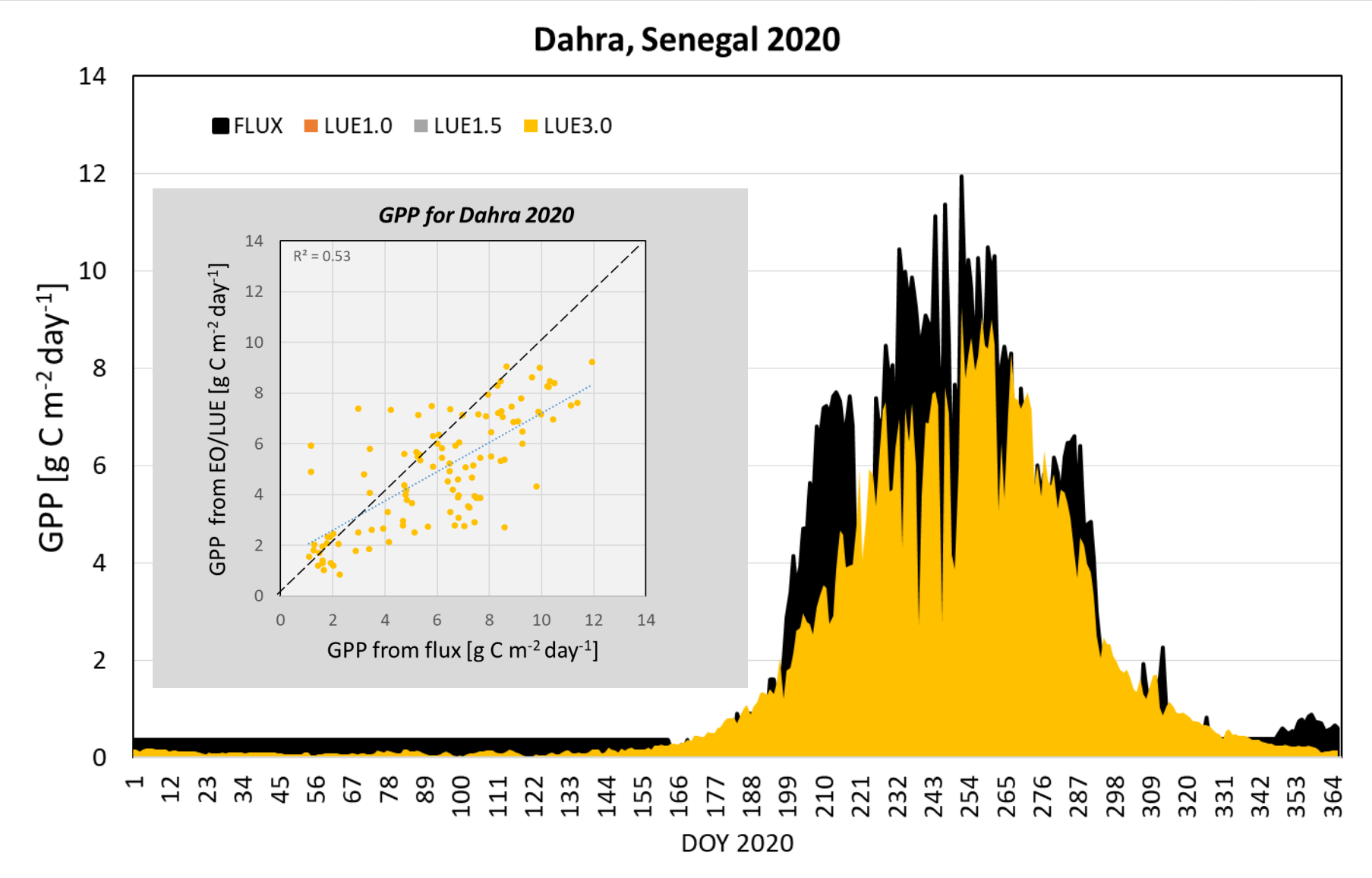

Flux Data (calibration)

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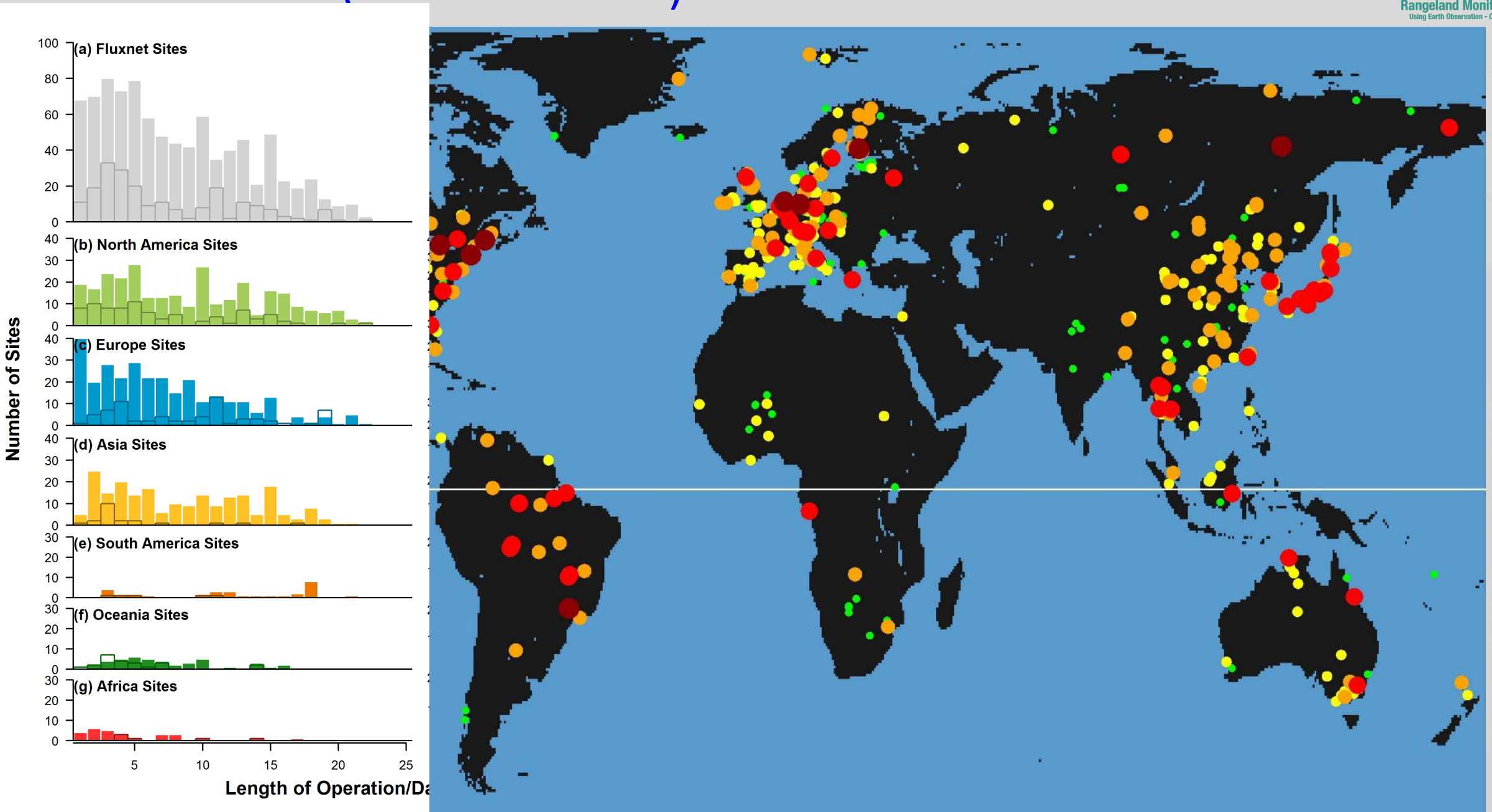

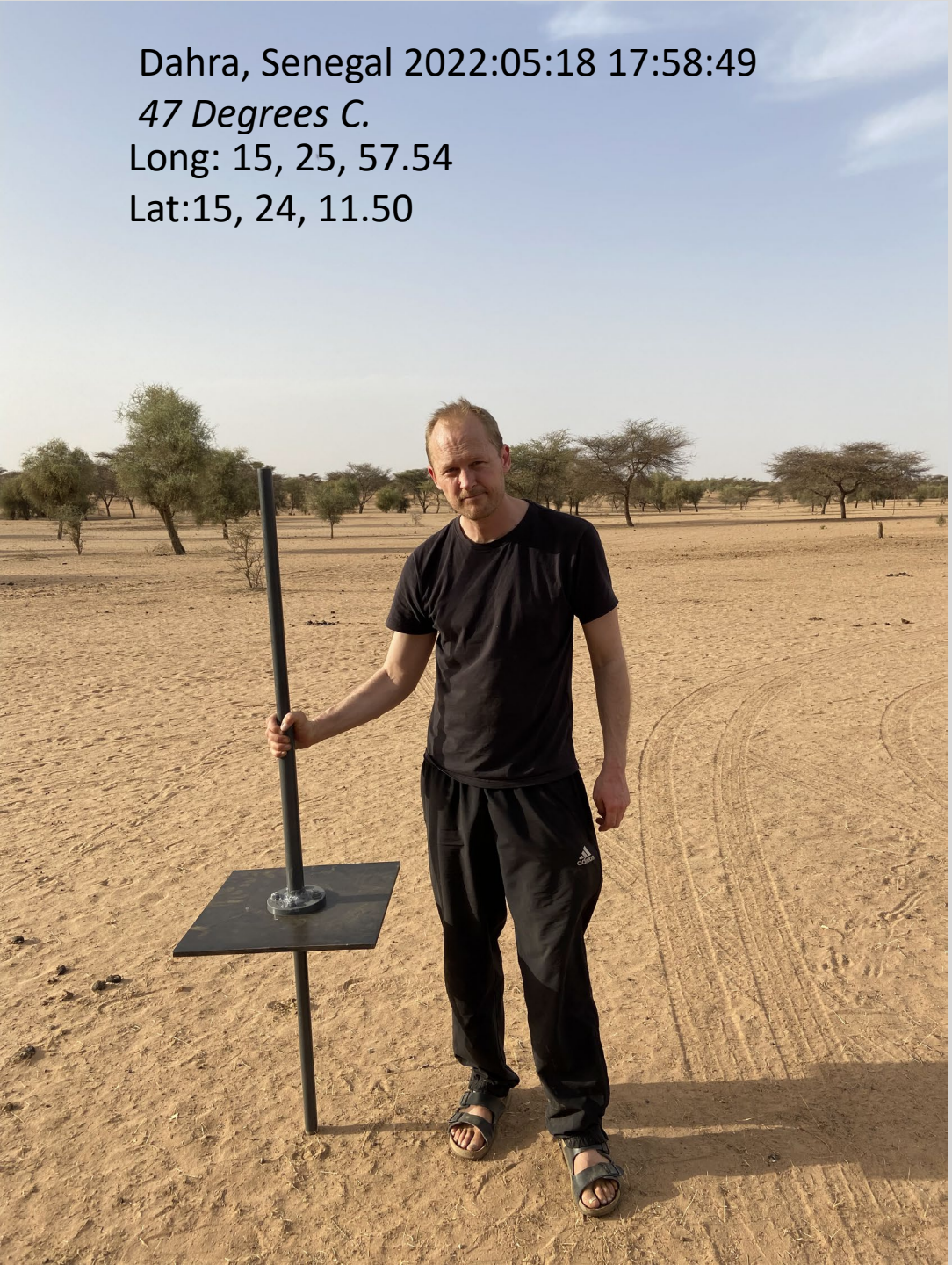

Validation data

Disc Pasture Meter

Collection of validation data in progress thanks to Torbern *et al* in Senegal.

Similar sampling initiated in Kenya (2 sites) Sudan and is already in progress in SA.

Future African population and per capita biomass

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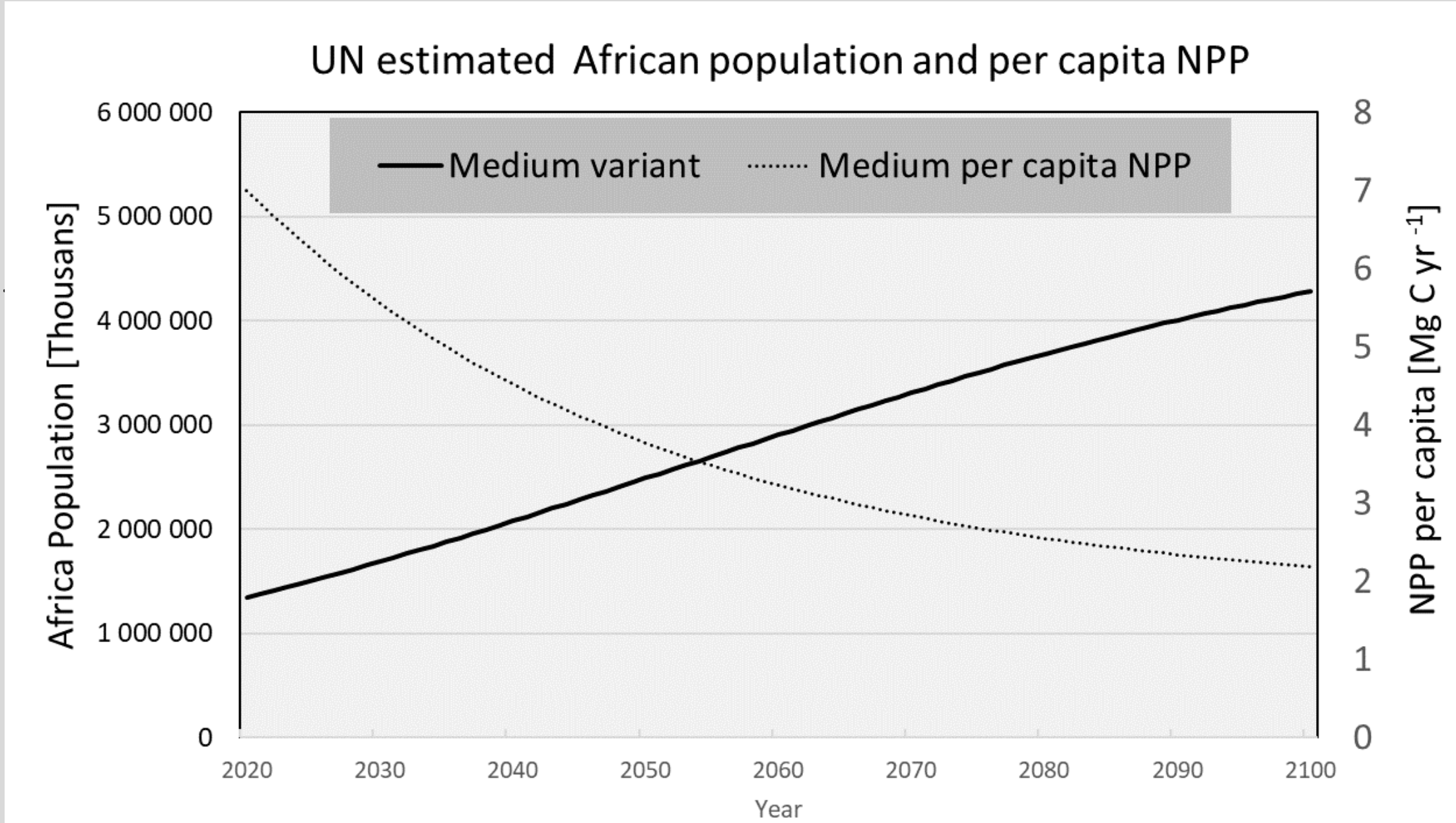

Closing words

- Project still in an early phase.
- Quantifying African **herbaceous rangeland biomass** (at 10x10 m) in large and diverse regions is challenging due spatial/temporal heterogeneity.
- Limited **availability** of (standardized) calibration/validation data (flux, biomass etc)
- (Sustainable) Rangeland resource management require monitoring!
- Follow RAMONA progress at https://www.ramona.earth/

Thanks