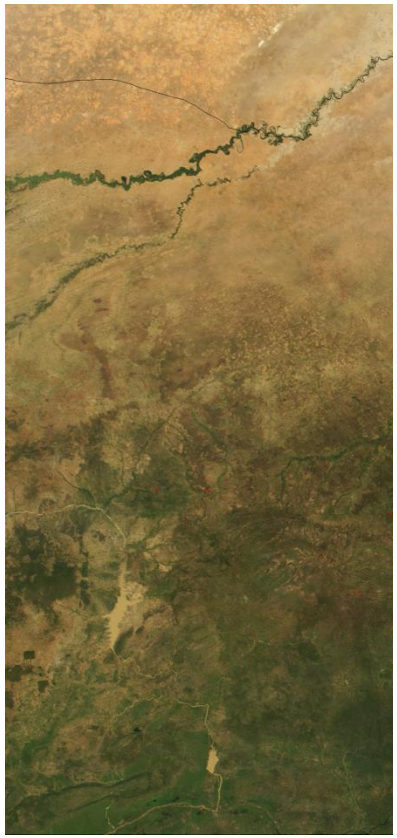
BEODAY

Beersel, 30th January 2018

U-TURN

Understanding Turning Points in Dryland Ecosystem Functioning



Research programme for earth observation "STEREO III"
(Support to the exploitation and Research in Earth Observation)

belspo

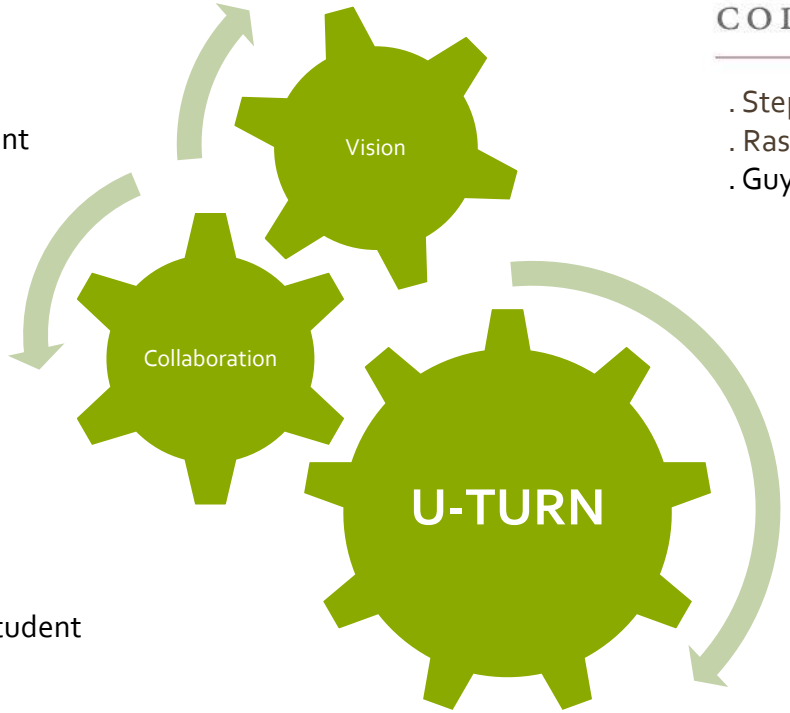
Our consortium

KU LEUVEN

. Ben Somers
. Wanda de Keersmaecker
. Paulo Bernardino, PhD student

UNIVERSITY OF COPENHAGEN

. Stephanie Horion
. Rasmus Fensholt
. Guy Schurgers



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. Hans Verbeeck
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WAGENINGEN UR
For quality of life

. Jan Verbesselt

vito
vision on technology

. Anne Gobin
. Ruben Van De Kerchove

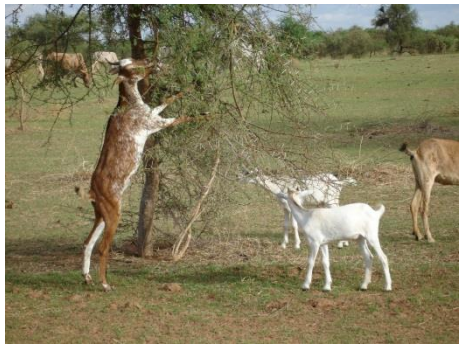
TU Delft

. Stef Lhermitte

Research topic & Project relevance

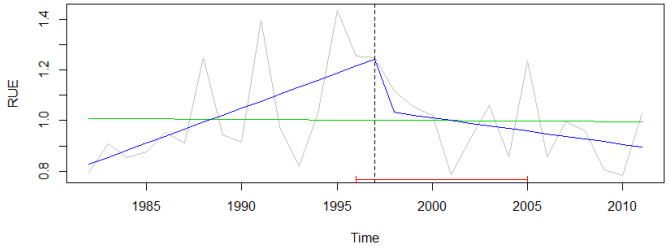
DRYLANDS

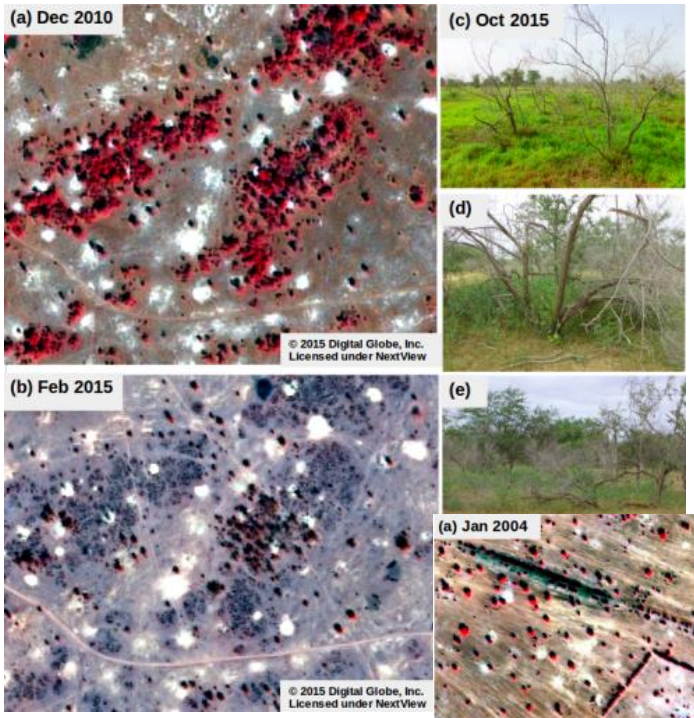
40% Earth's land surface - 40% Global Net Primary productivity - 30% population



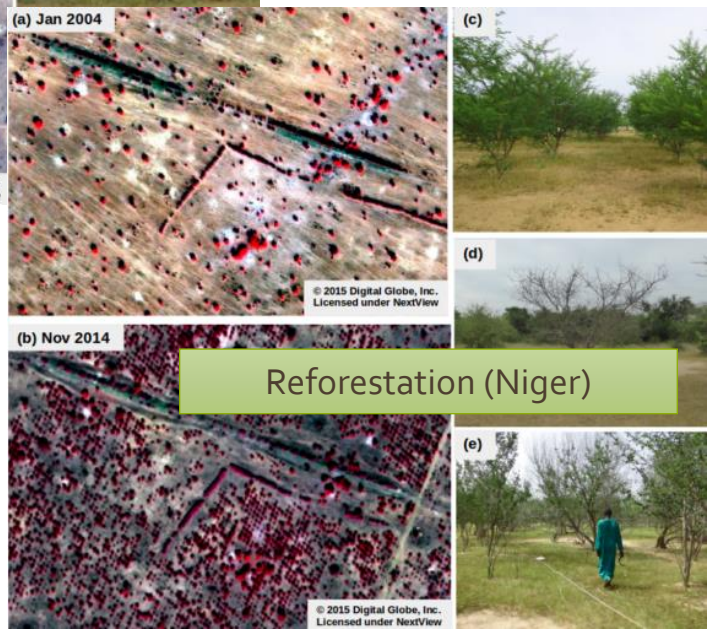
Research topic & Project relevance

Turning points in ecosystem functioning





Large scale drought-induced tree dying (Senegal, 2015)



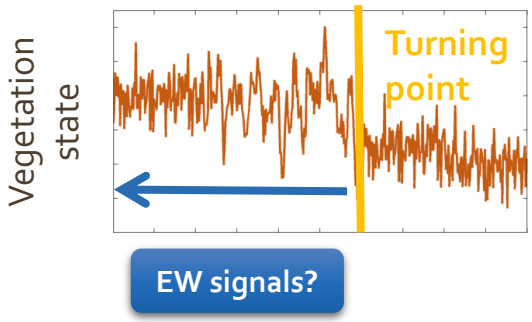
Reforestation (Niger)

- Traditional assumptions about linear changes in vegetation dynamic
- No method for large-scale assessement
- Low understanding of drivers and processes leading to turning point
- Needs for monitoring, modelling and early warning of turning point

Research questions

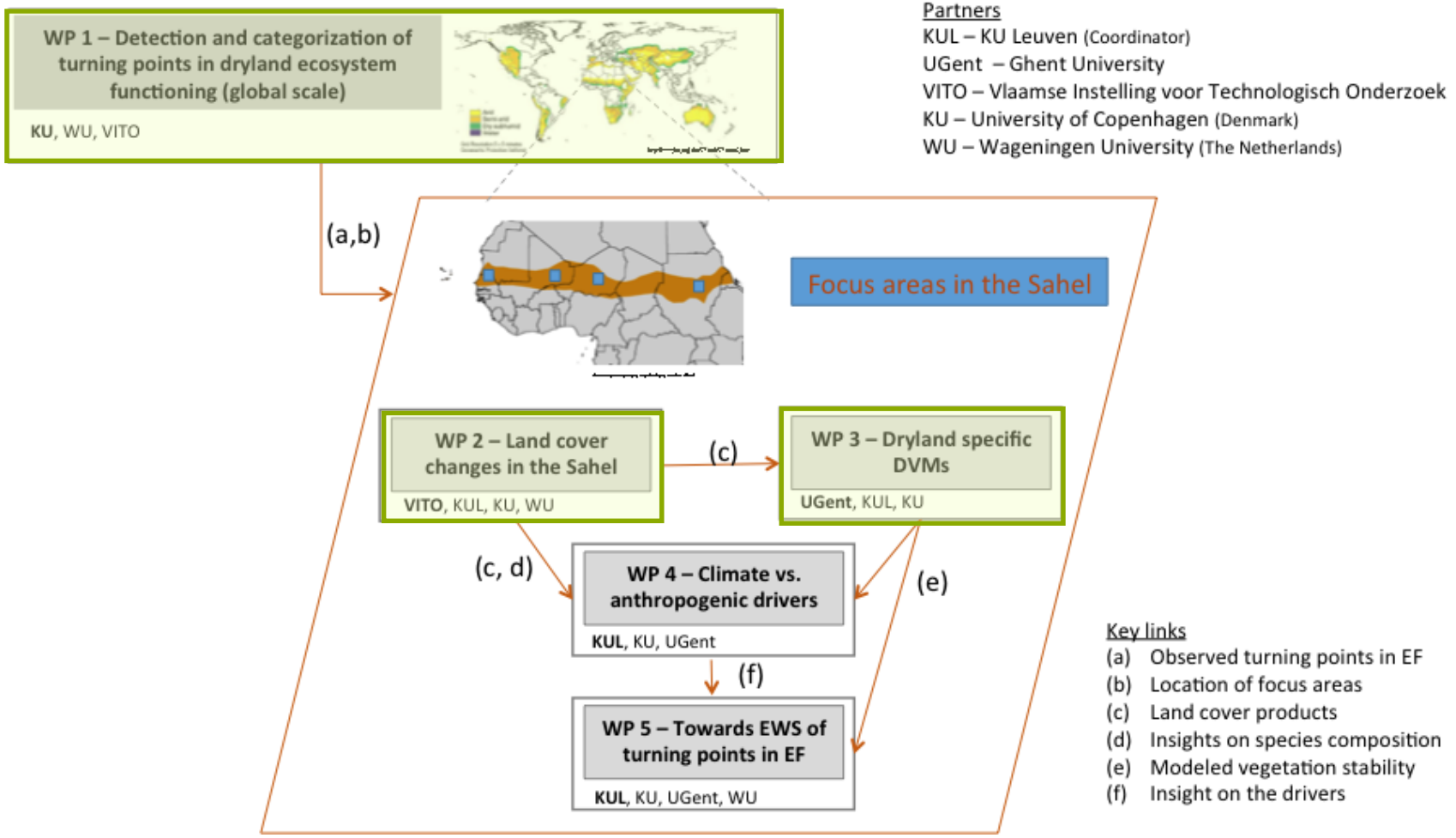
1. What is the **overall importance** of turning points in ecosystem funtioning in global dryland?

2. How sensitive is dryland vegetation response to anthropogenic and climatic **drivers**?



3. Can combined EO-DVMs analysis provide relevant information for **early warning** of TP?

Partners
KUL – KU Leuven (Coordinator)
UGent – Ghent University
VITO – Vlaamse Instelling voor Technologisch Onderzoek
KU – University of Copenhagen (Denmark)
WU – Wageningen University (The Netherlands)



Key links
(a) Observed turning points in EF
(b) Location of focus areas
(c) Land cover products
(d) Insights on species composition
(e) Modeled vegetation stability
(f) Insight on the drivers

[1] **Mapping and characterizing turning points** in EF in global drylands

[2] Reconstructing the **history of land use/cover change** (Focus areas)

[3] **Parametrizing Dynamical Vegetation Models** (DVMs) to dryland specific conditions (Focus areas)

[4] **Disentangling climatic and anthropogenic drivers** of turning points (Focus areas)

[5] Assessing **proxies for early warning** of turning points in EF (Focus areas)

Concept and Method

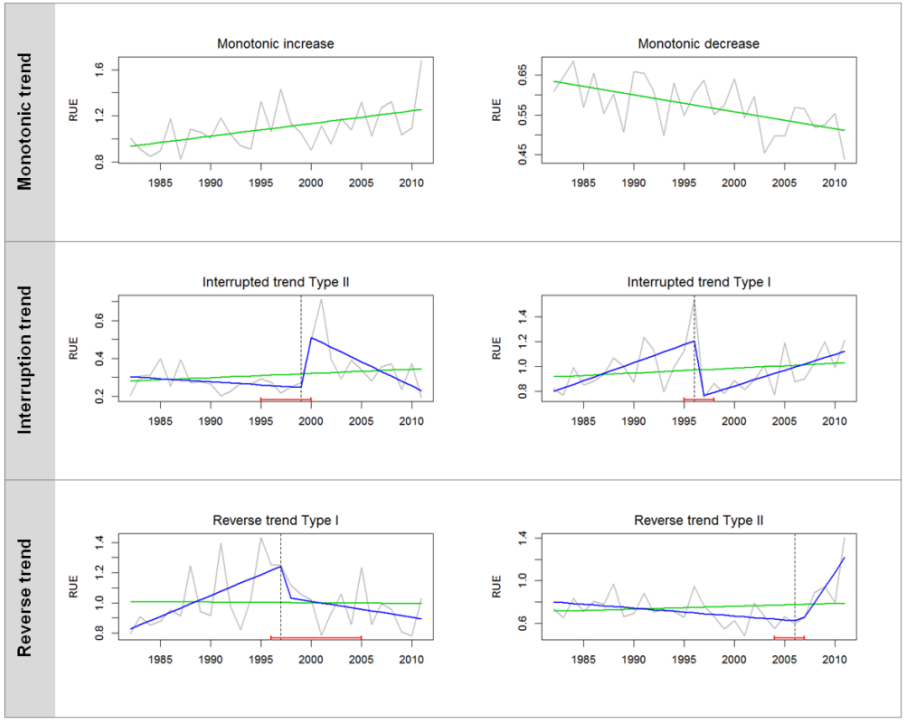
Turning point detection

Mapping and characterizing turning points in ecosystem functioning in global drylands :

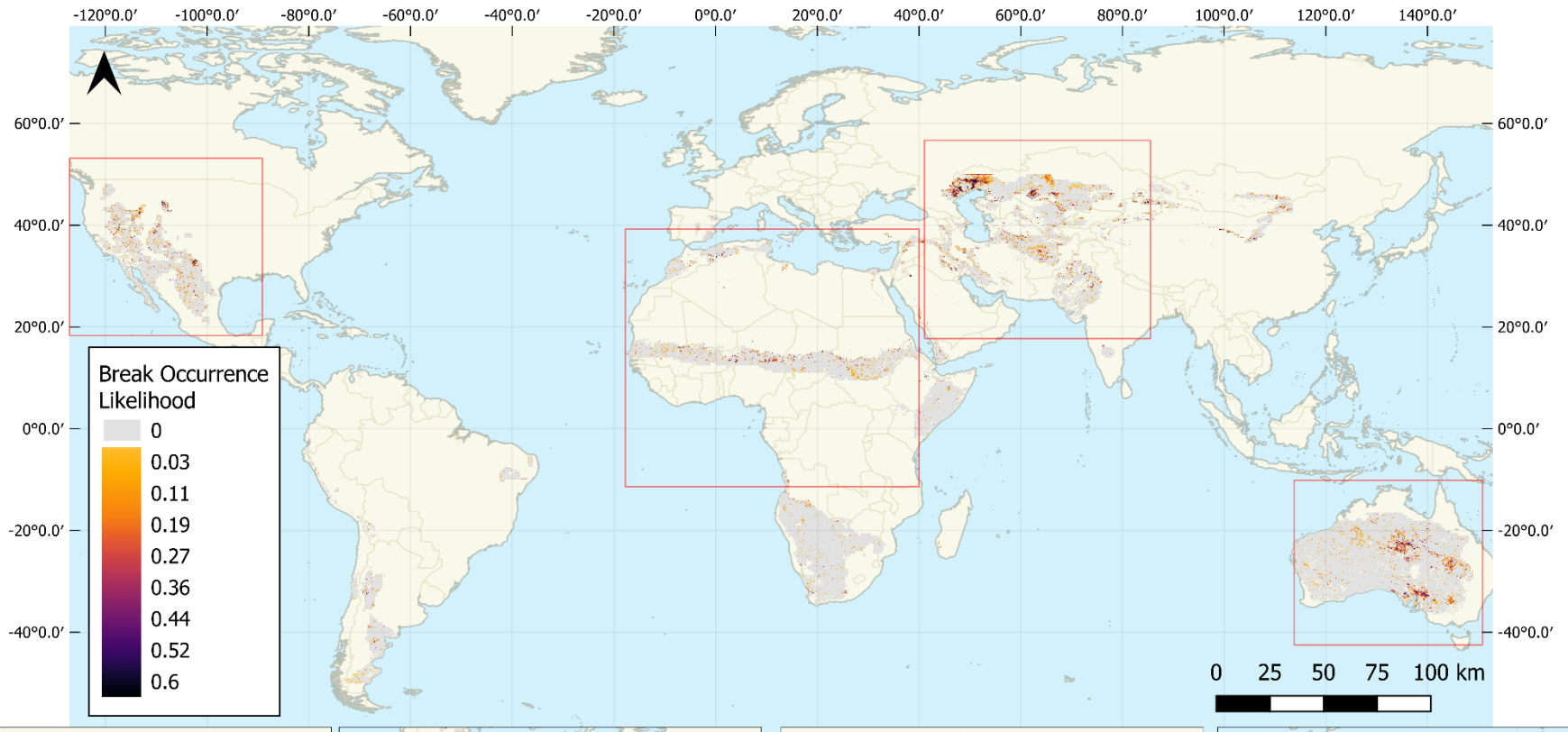
- Use of segmented trend analysis (BFAST) on time series of Rain-Use Efficiency (based on AVHRR derived NDVI and rainfall)

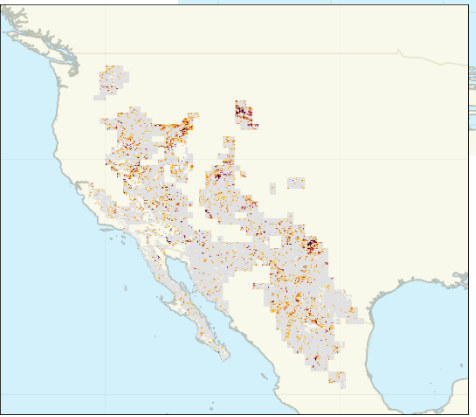
- Key research steps:
  - **Improvement** of the breakpoint detection and categorization techniques

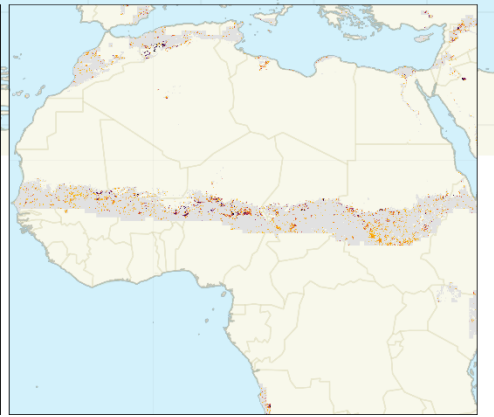
  - **First global assessment** of turning points in ecosystem functioning

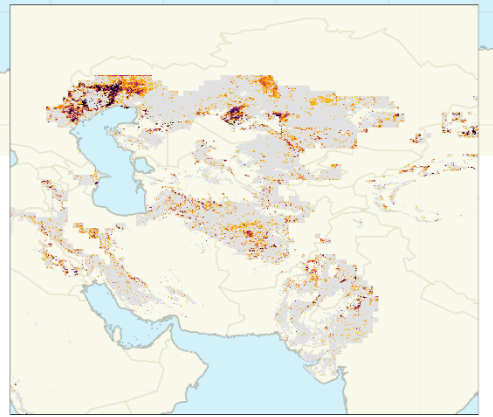


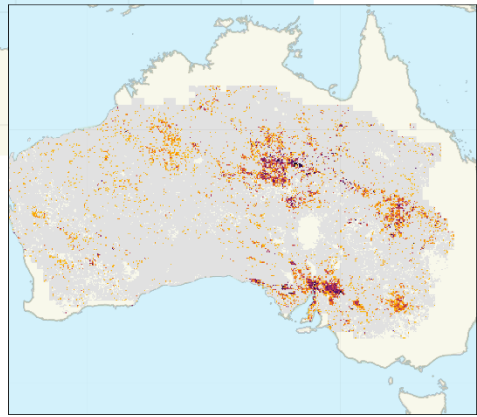
Turning point detection







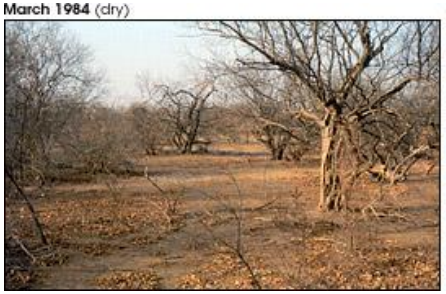




Concept and Method

History of land use-land cover change

March 1984 (dry)



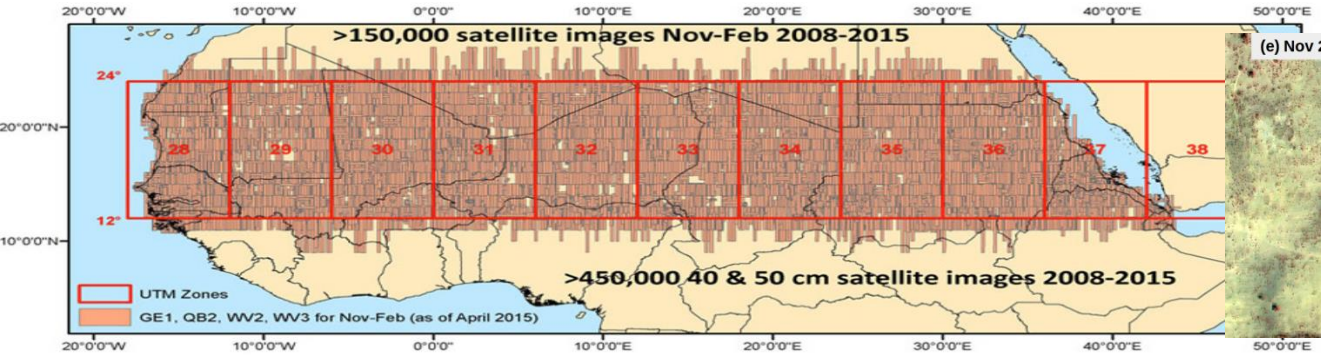
September 1982 (wet)

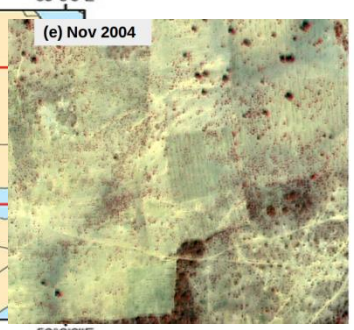
Rationale

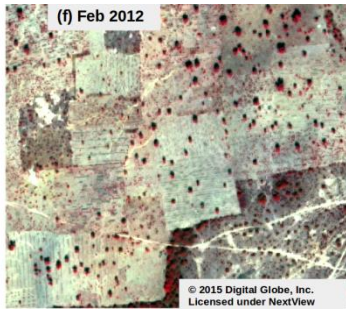
- Gain insights in the contribution of LULCC to dryland vegetation dynamics (WP 3 and 4)
- Establish a LULC mapping methodology designed for the Sahel
- Construct approx. 5 year epochs products using dense HR images stack (Landsat/SPOT)
- VHR data for training and validating (NASA)

Challenges of LU/LC mapping in the Sahel

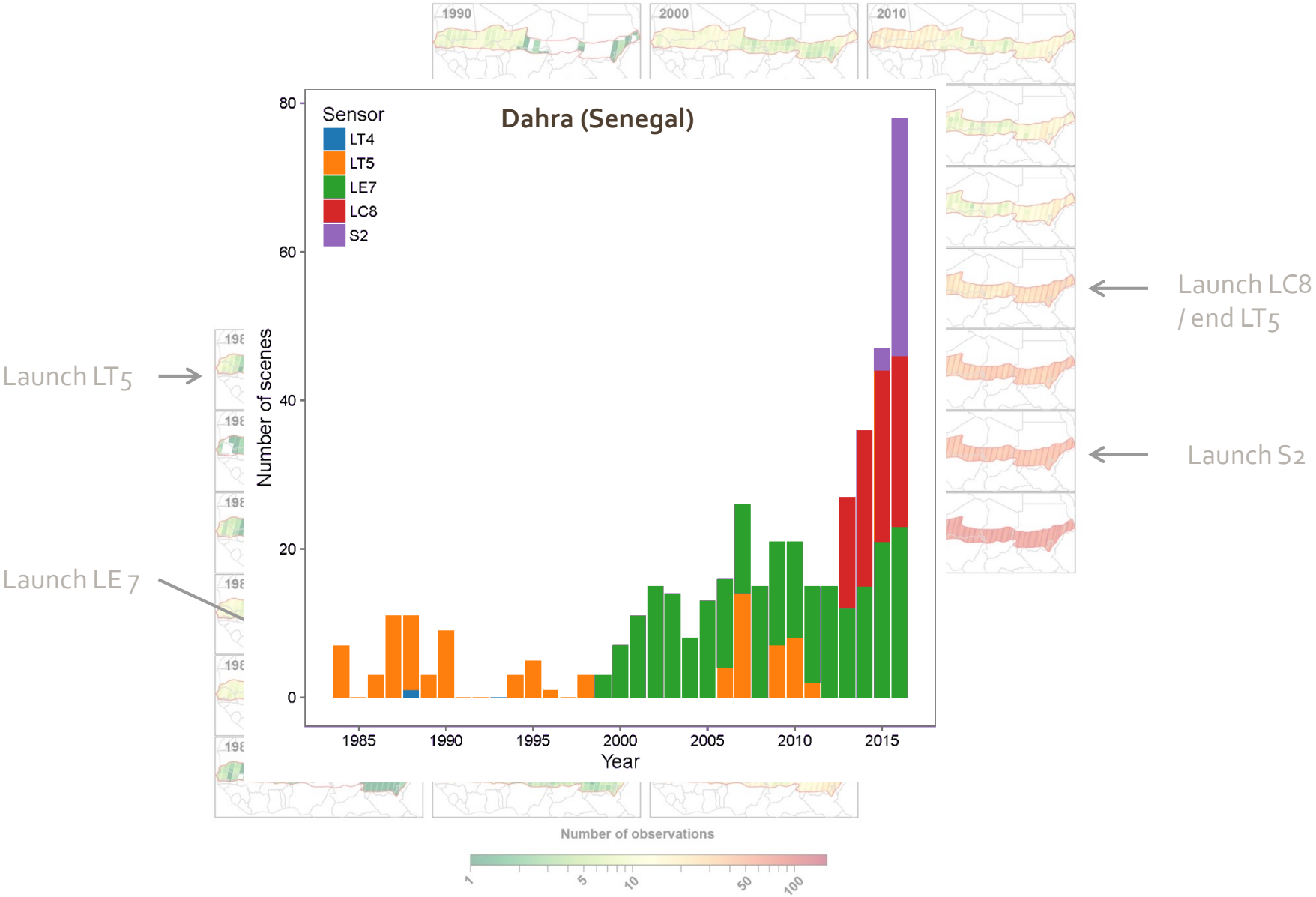
- Small agricultural plot size and fragmentation of agricultural landscape
- Mosaic of cropland, fallow and natural grassland
- Dry *versus* wet season







Available data - HR



Concept and Method

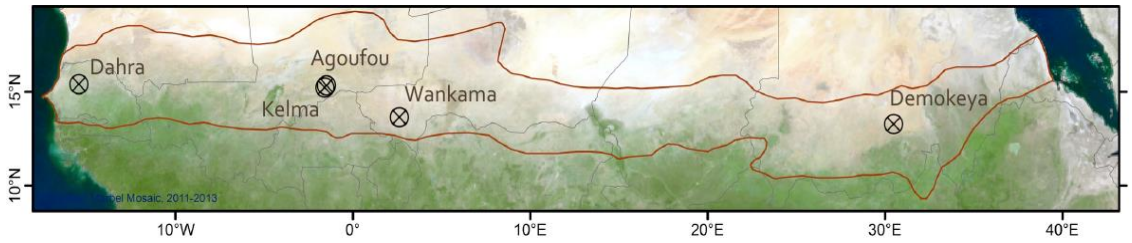
Dryland specific DVMs

Dynamic global vegetation models

- Simulate vegetation ecology and its associated biogeochemical and hydrological cycles
- Two state-of-the-art 2nd generation models: *ED2* and *LPJ-GUESS*

Parametrizing Dynamical Vegetation Models (DVMs) to dryland specific conditions through EO data assimilation to enable accurate simulation of drylands vegetation dynamics

Preliminary results

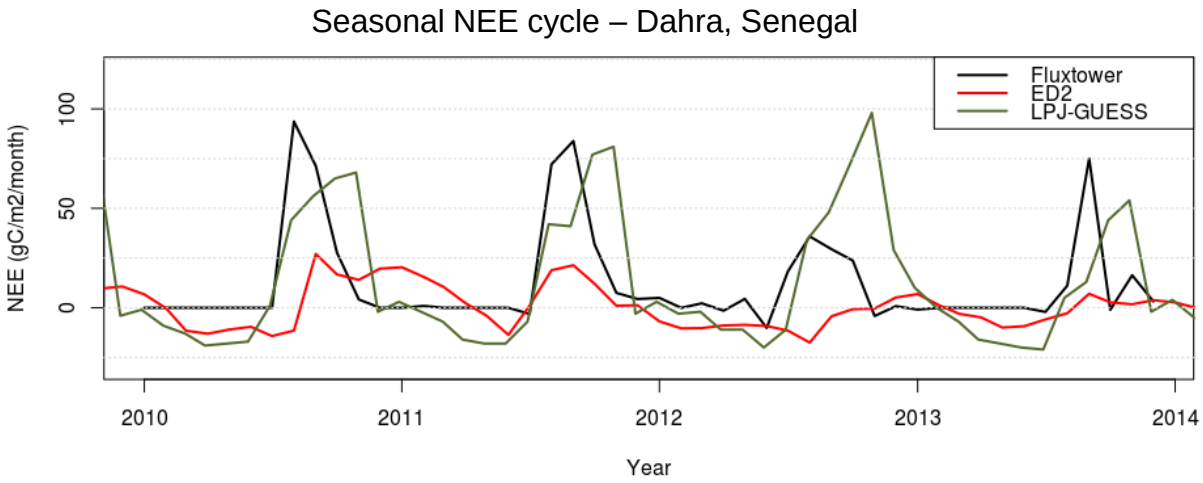


Flux tower sites across the Sahel

- drivers (meteorology)
- validation (carbon flux)

PFT

- Drought-deciduous tropical trees
- C_4 grasses



LPJ-GUESS

- fair representation of carbon exchange captures seasonal cycle relatively well

ED2

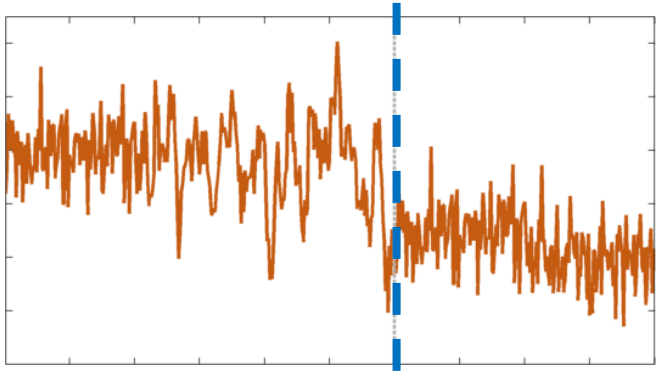
- underestimates carbon exchange significantly
- possible reason: trees die off in model
- originally developed for tropical forests: further parameter tuning necessary

Concept and Method

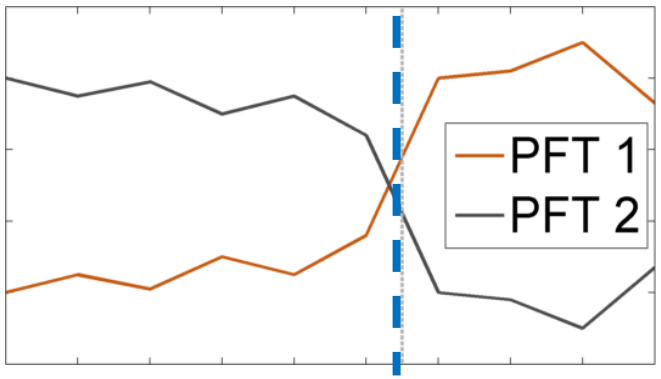
WP4

Human vs. climatic drivers

Turning point



Vegetation state

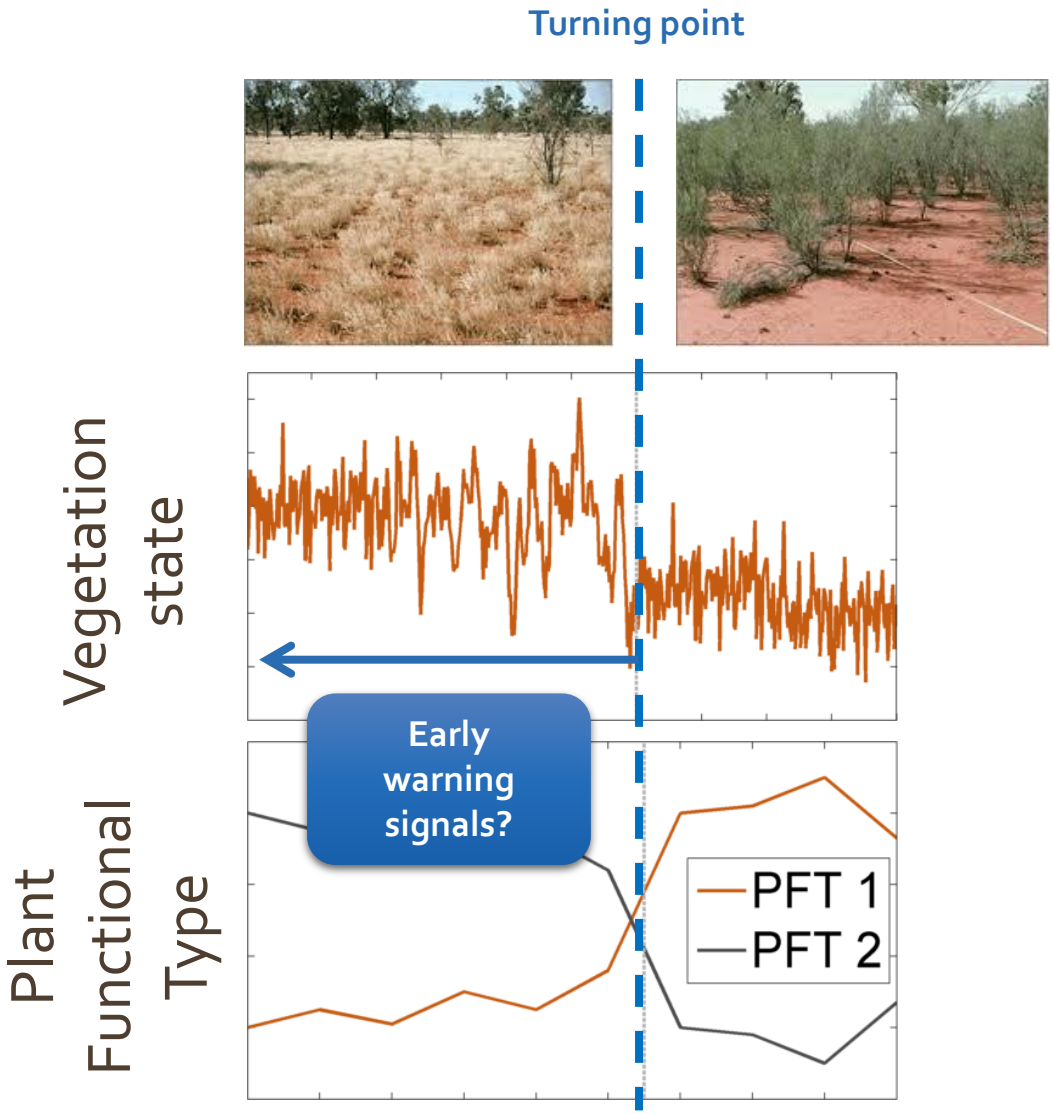


Plant Functional Type

Climatic or anthropogenic turning point?

Concept and Method

WP5
Early-warning proxies for turning points



- Proxy type 1: Short-term vegetation stability indicators
- Proxy type 2: Critical eco-climatic thresholds

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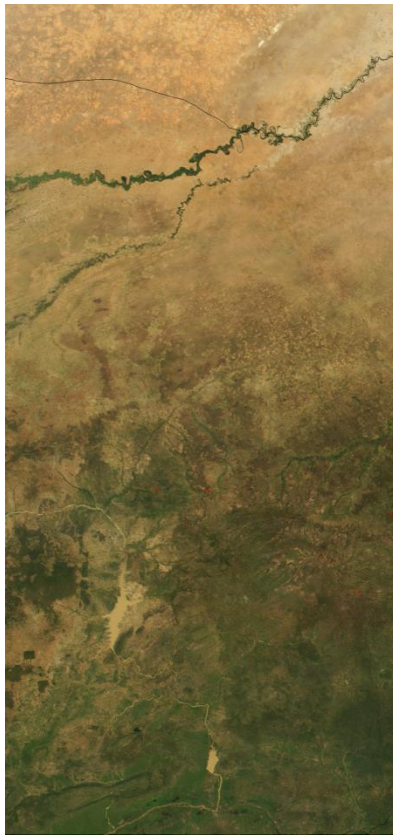


Research programme for earth observation "STEREO III"
(Support to the exploitation and Research in Earth Observation)

belspo

Research questions

Global turning points in ecosystem functioning ?

What is the overall importance of turning points in ecosystem funtioning in global dryland ?

Research questions

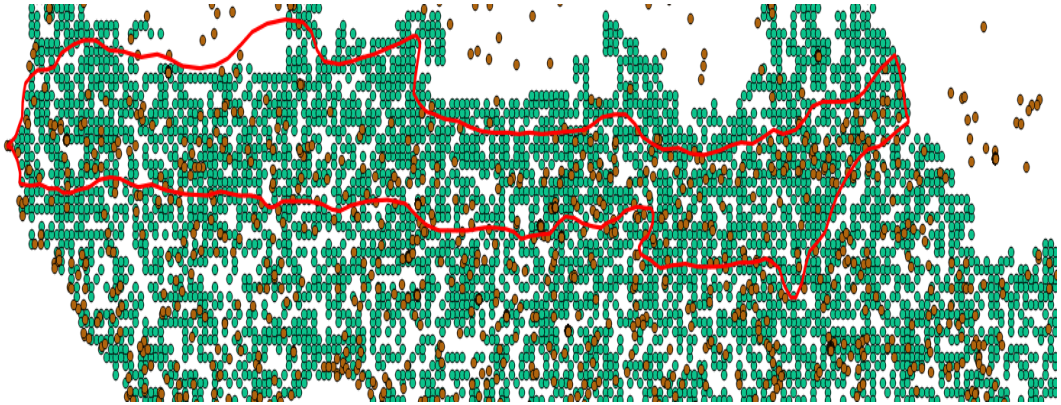
What are the driving forces for these abrupt changes in ecosystem funcioning?

How sensitive is dryland vegetation response to each of the anthropogenic and climatic drivers?

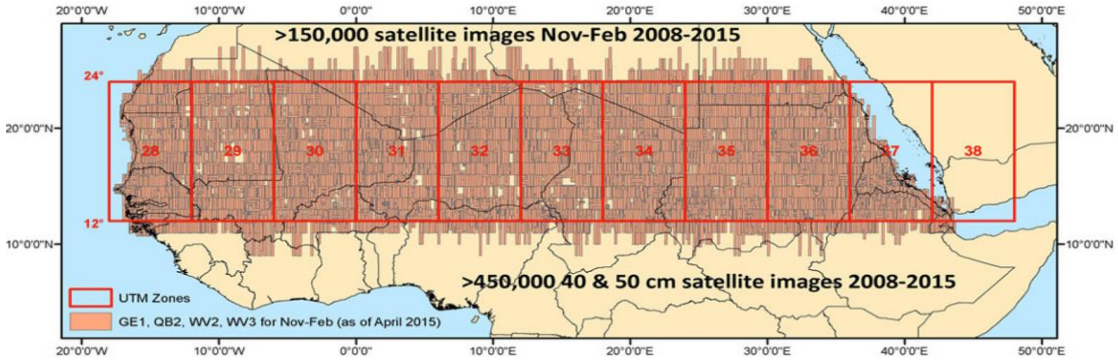
How important is the anthropogenic footprint on the drylands?

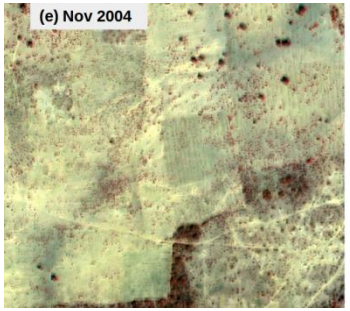
Ground truth data

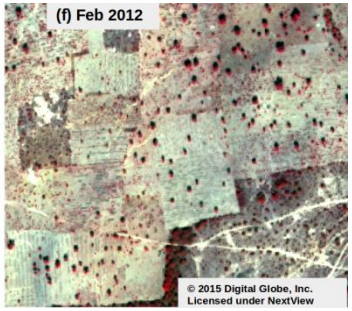
- Use of existing datasets as much as possible
  - Open data: GOFC-GOLD(+- 400 training points available)
  - (Copernicus Global Land Cover Mapping: >1500 training points available and counting)
  - KU datasets



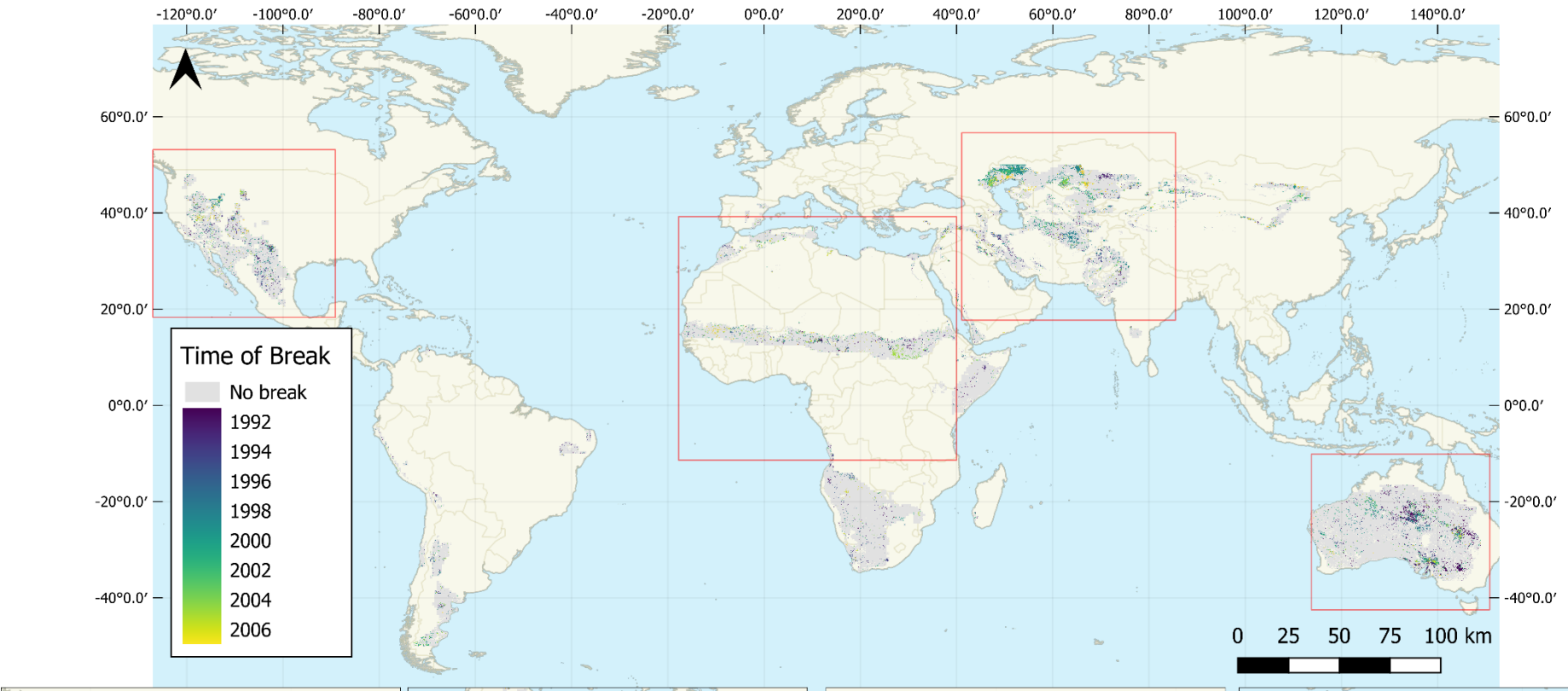
- Gather new training validation data based on VHR imagery

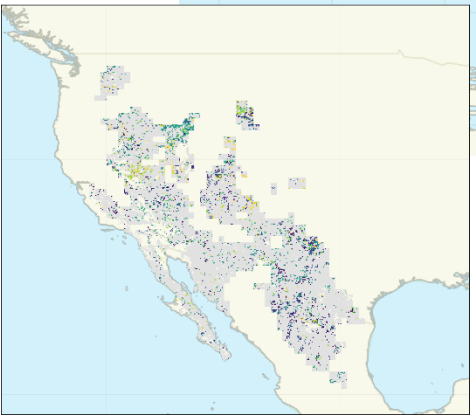


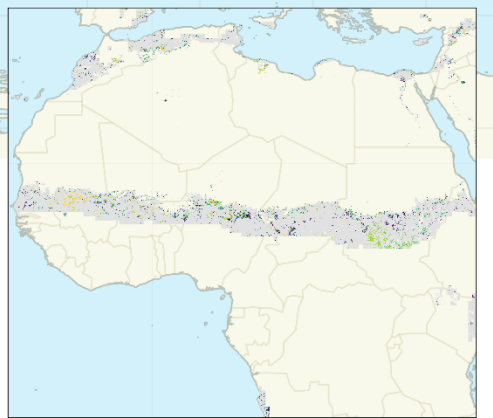


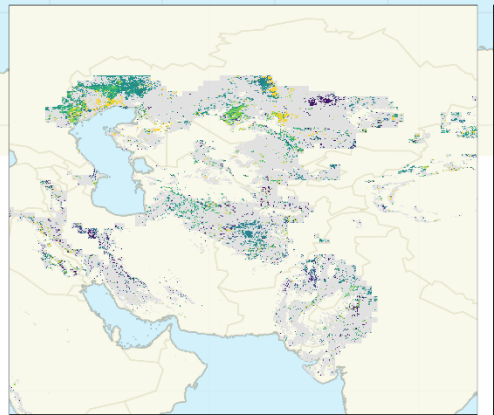


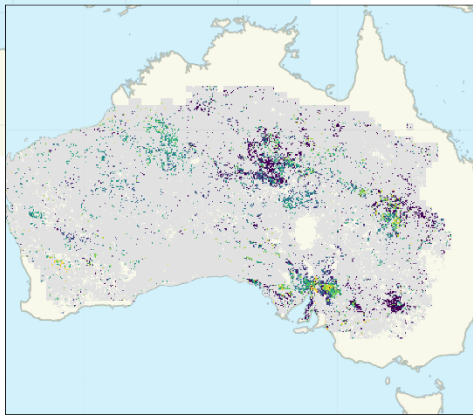
Turning point detection











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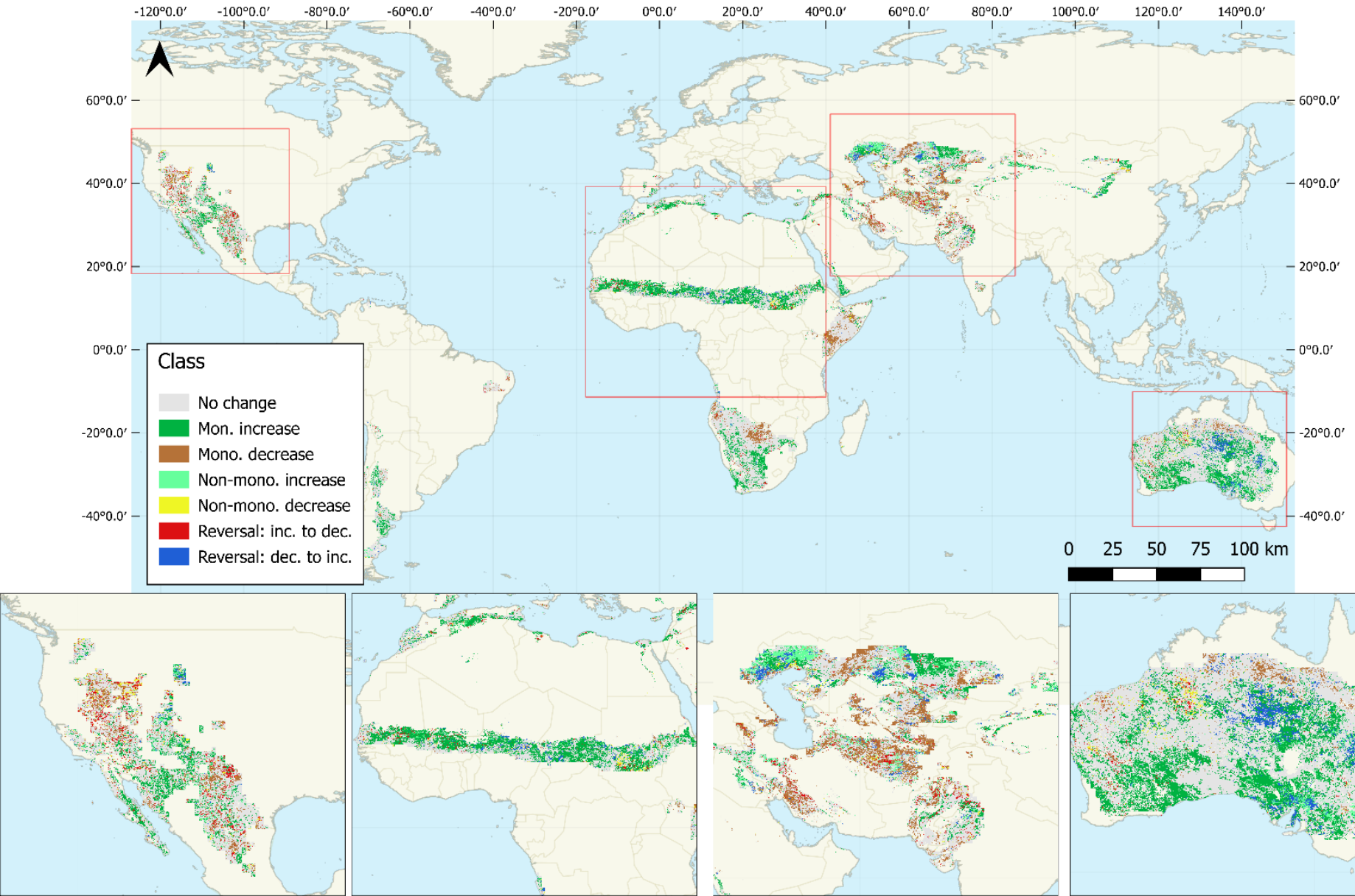

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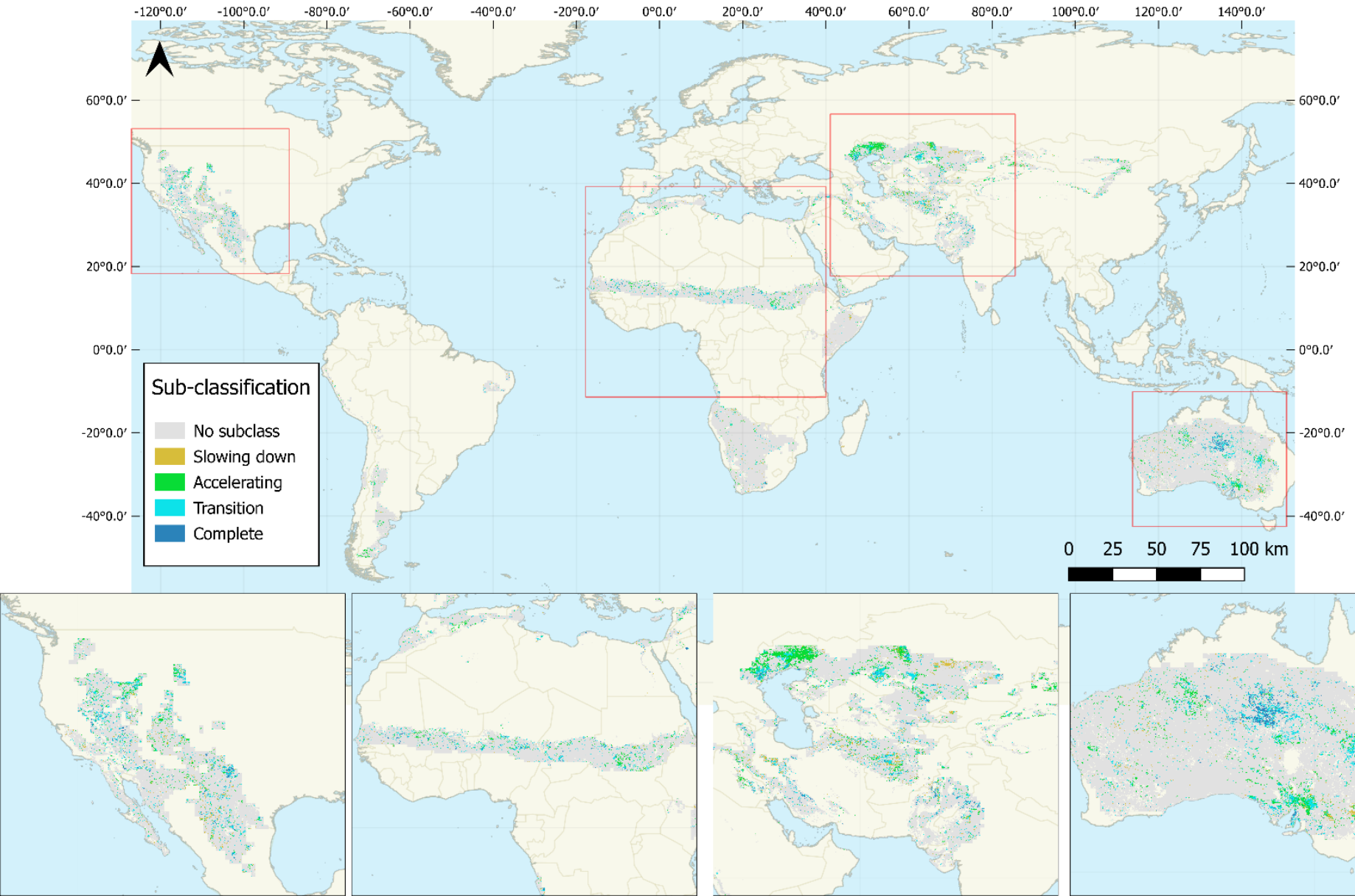
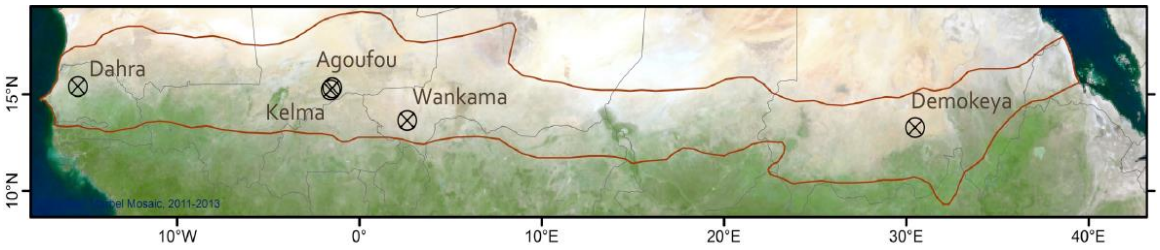


Preliminary study



Flux tower sites across the Sahel

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Savannah biome

Plant Functional Types