Socioeconomic and environmental dynamics of land-cover and land-use change in the Cerrado frontier

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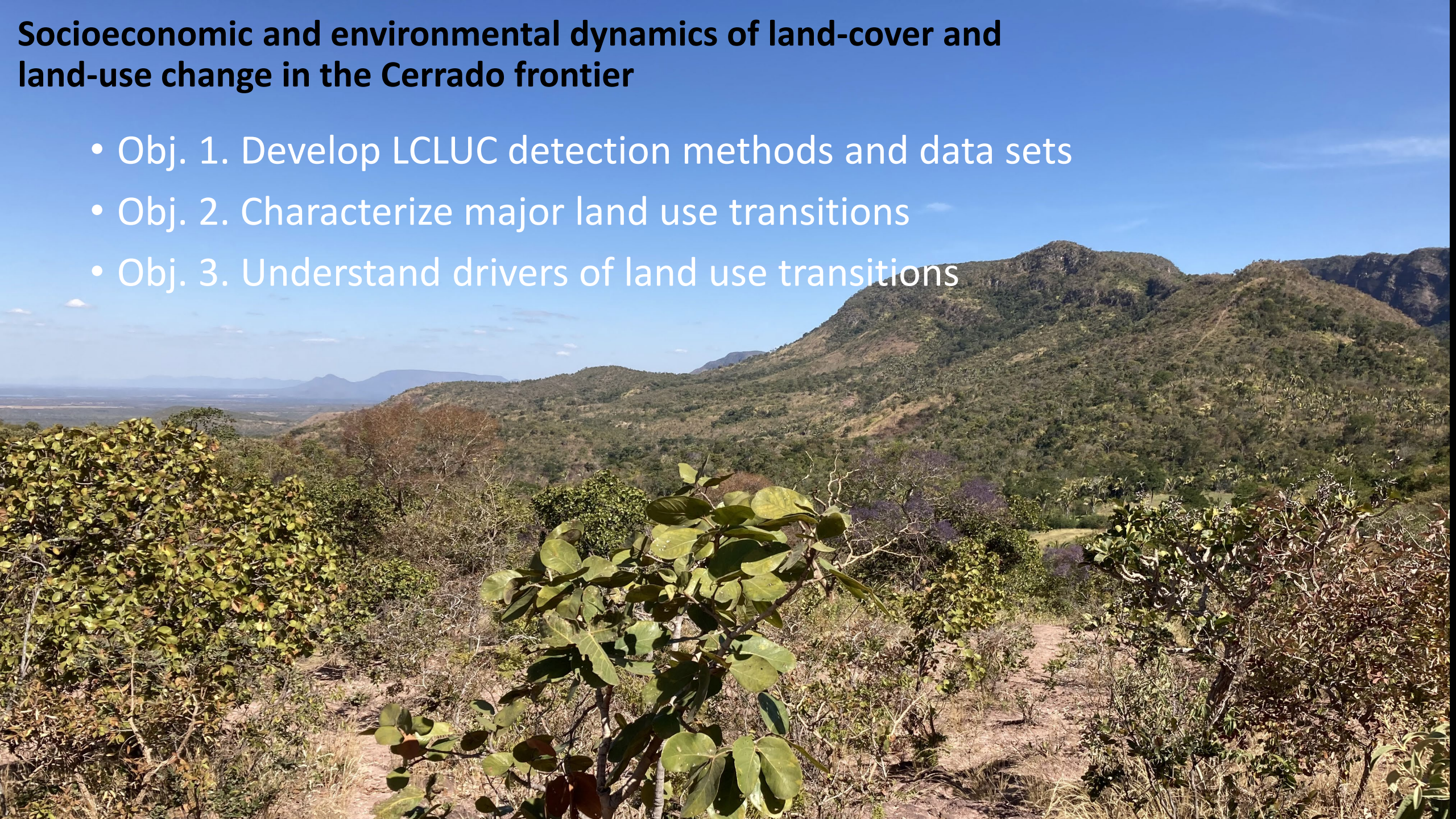
02 April 2024, NASA LCLUC Science Team Meeting

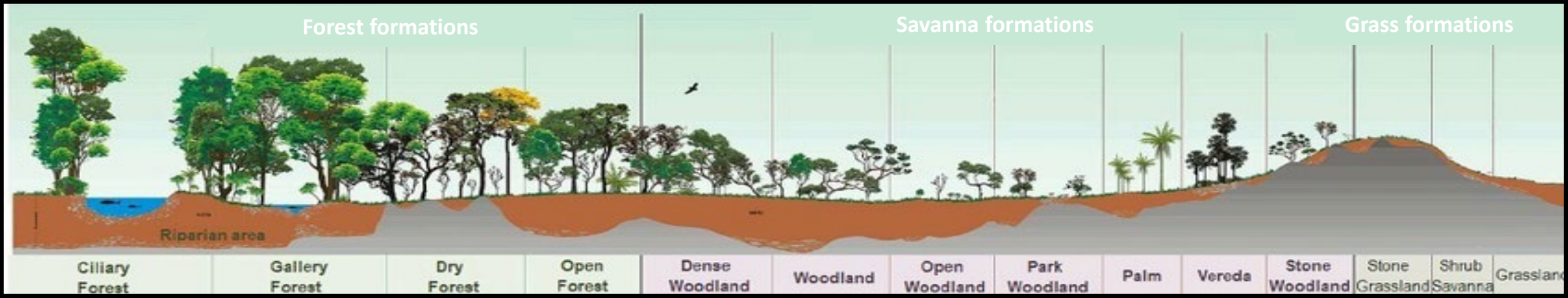
Institutions and collaborations

Socioeconomic and environmental dynamics of land-cover and land-use change in the Cerrado frontier

- Obj. 1. Develop LCLUC detection methods and data sets
- Obj. 2. Characterize major land use transitions
- Obj. 3. Understand drivers of land use transitions



Cerrado physiognomies



Ribeiro & Walter 2008

Cerrado

- 2 million km^2
- 43% of plant species are endemic
- Most unprotected savanna in the world

THREATS: expansion of croplands, deforestation

Photos: S. Spera, Tanguro Research Site

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JANUARY 19 2008: 5:31 PM EST

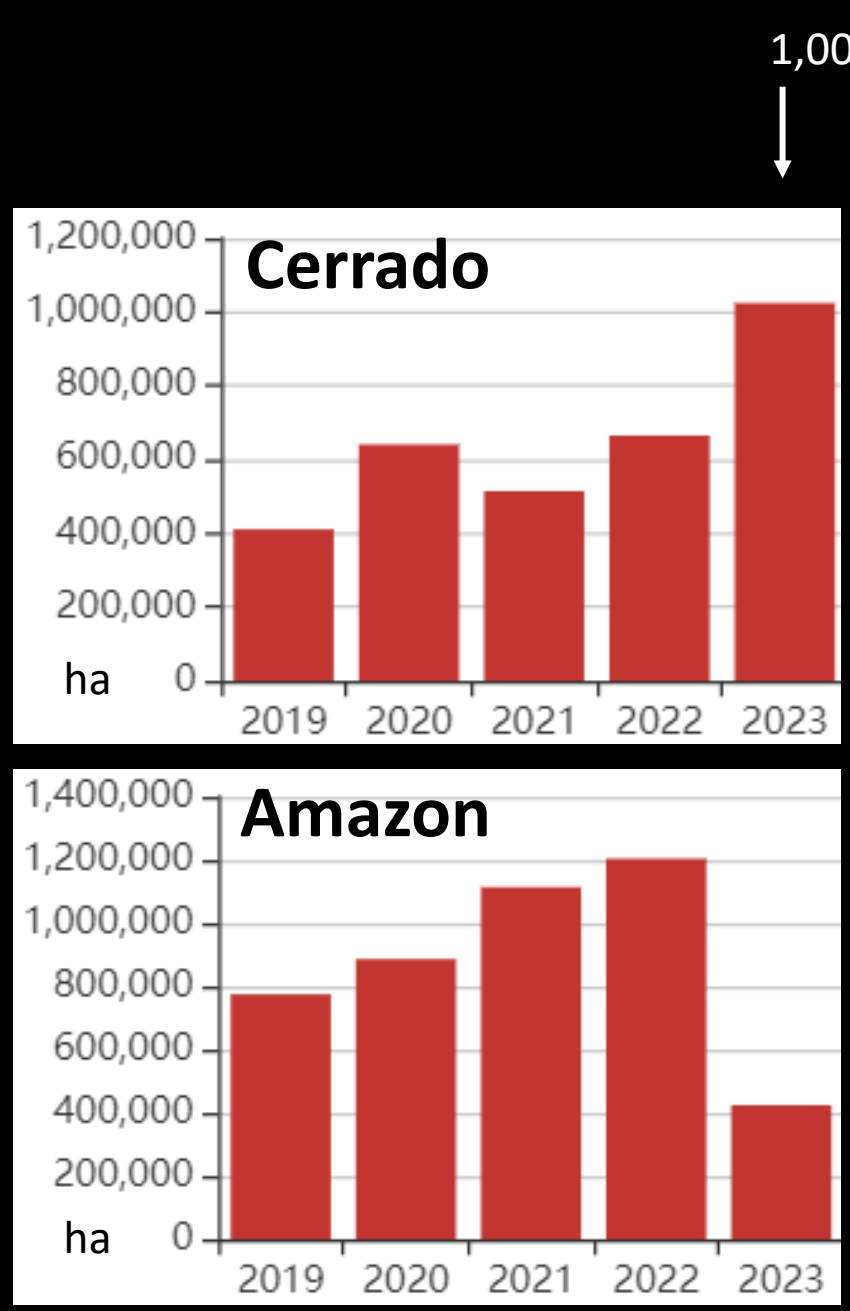
Soylandia (pg. 2)

By Susanna B. Hecht and Charles C. Mann

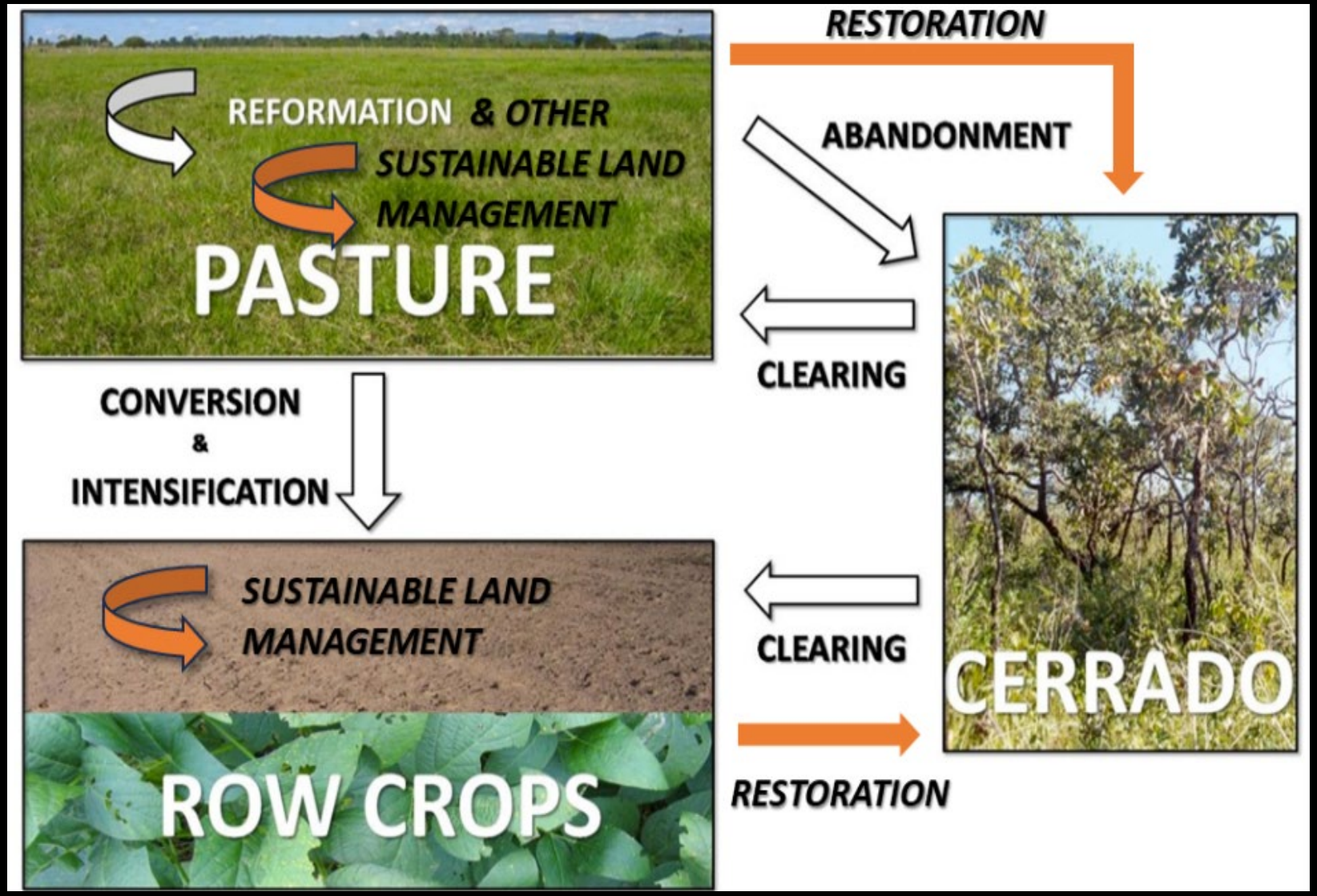
"It was a much bigger assault on an ecosystem than

LCLUC Hot Spot

- Historically, Cerrado deforestation increases when Amazon deforestation decreases (happening again now)
- Highest observed rates= ~8,000km^2/yr (2011, 2012)
- Agricultural development is likely the largest driver but poorly constrained in terms of underlying environmental and socioeconomic factors
- Indirect drivers also at play

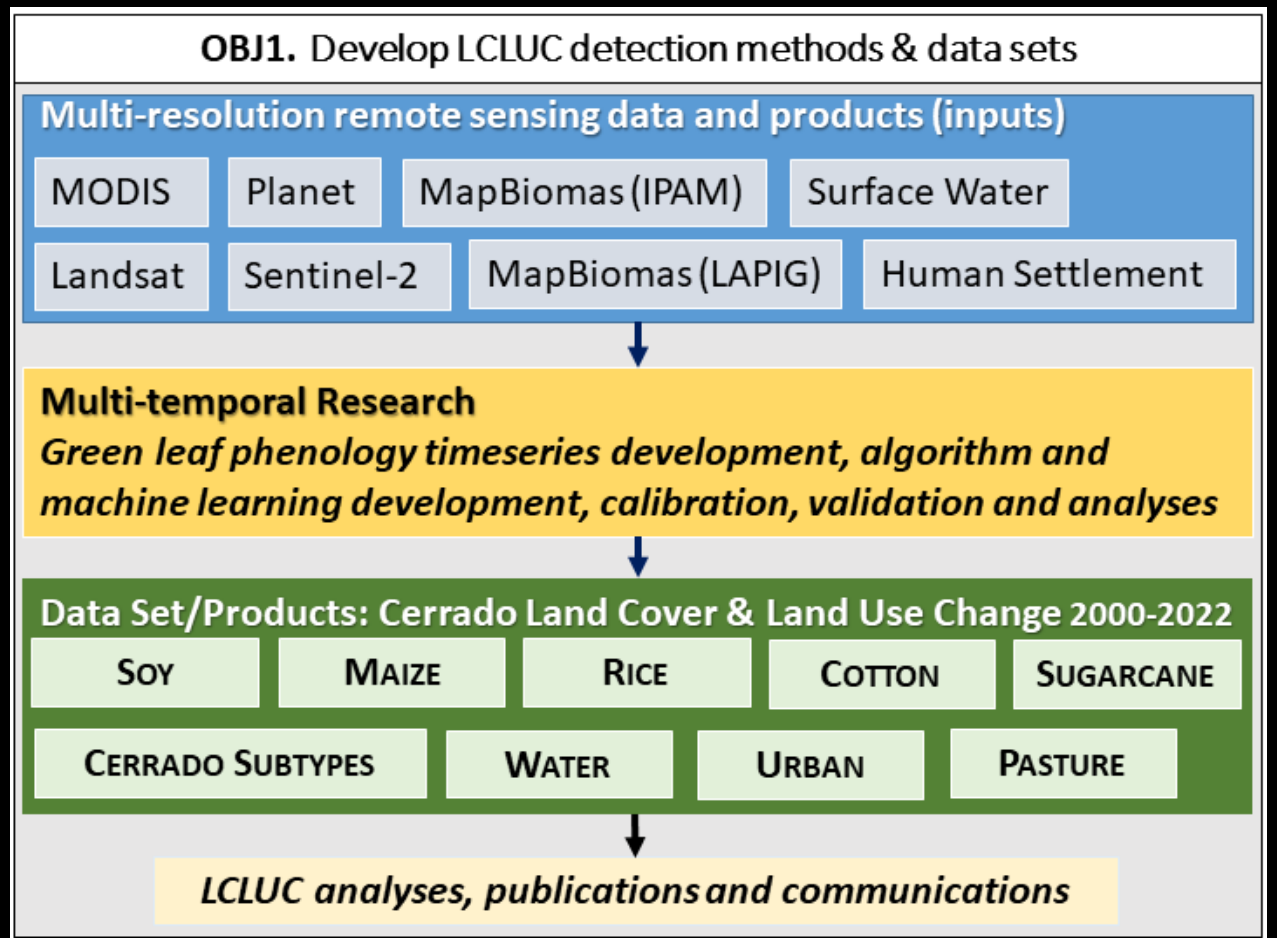


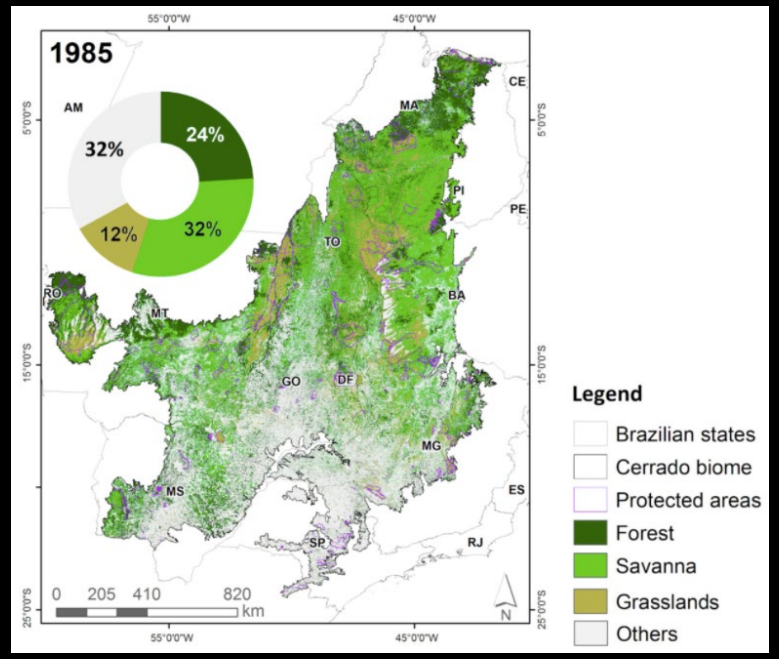
Cerrado LCLUC today



1. Develop LCLUC detection methods and data sets

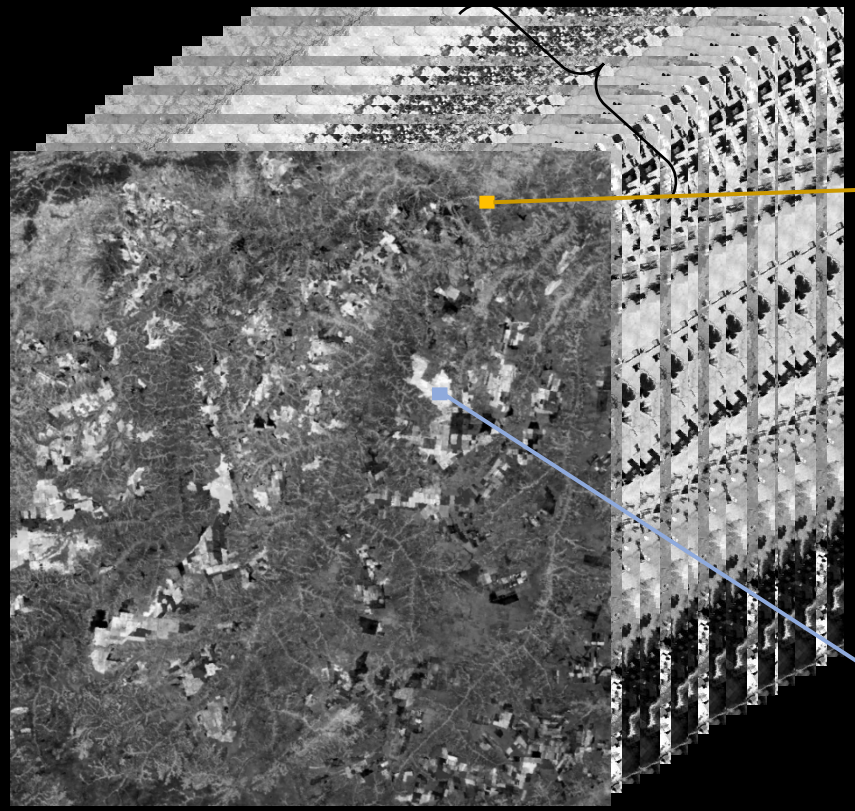
- Remote sensing analysis for specific crop types and rotations, irrigated agriculture, and pastoral and agricultural abandonment within MapBiomas “cropland” category. New: full Cerrado extent, 2000-2023



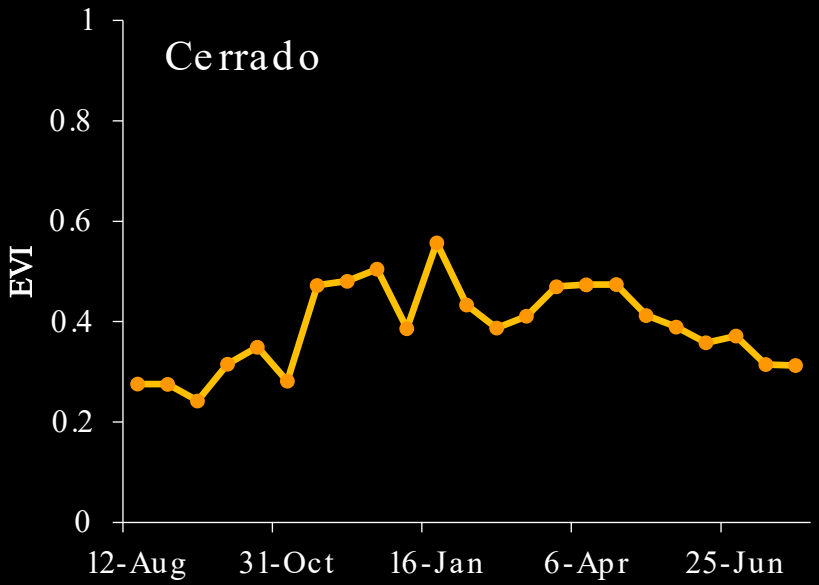


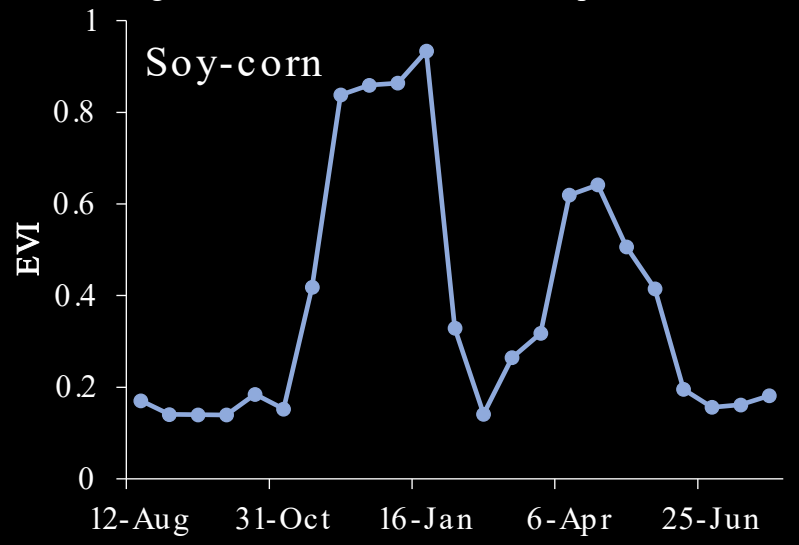
Cerrado land use circa 1985, provided by IPAM and MapBiomas. “Others” refers primarily to pasture lands (Alencar et al. 2020).

Remotely-sensed (EVI) phenology is very distinct for different land uses



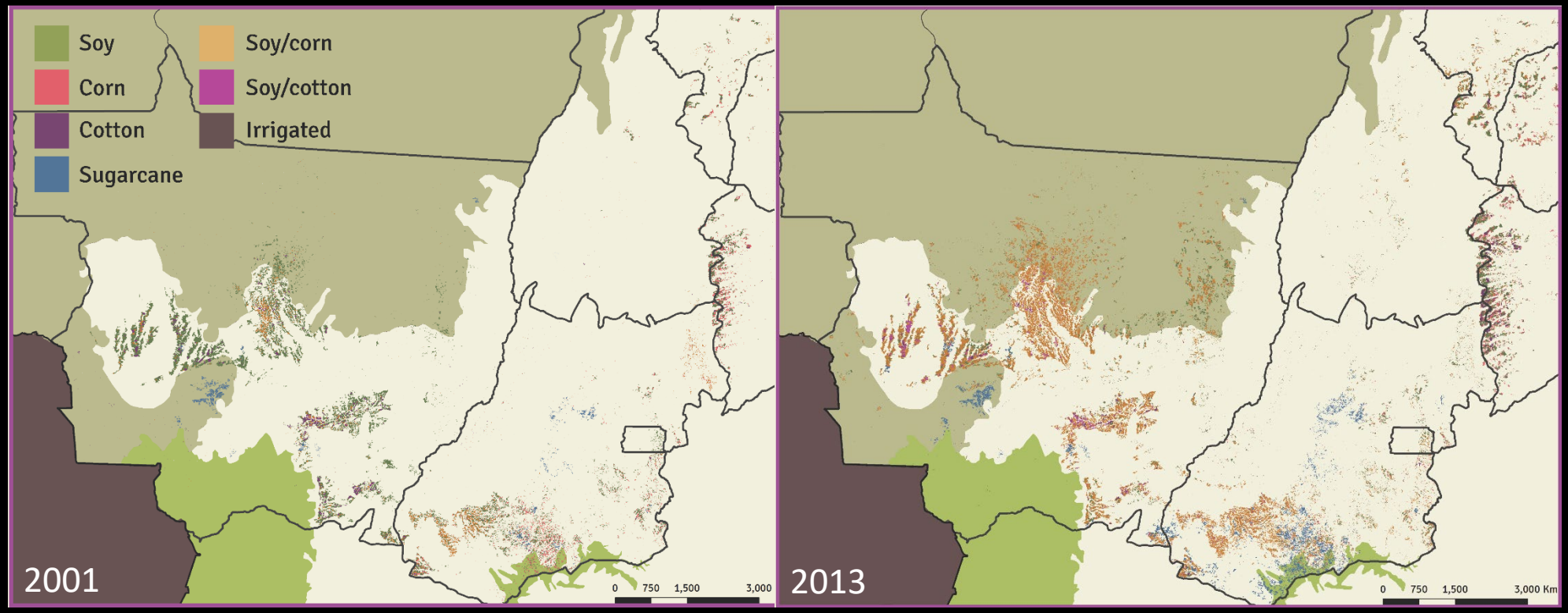
16-day, 250 m resolution MODIS Enhanced Vegetation Index (EVI) data





Galford et al. 2008 RSE, Spera et al. 2016 ERL

Example map outputs



Total land in agriculture 8,000,000 → 15,200,000 ha

6-fold increase in soy/corn double cropping

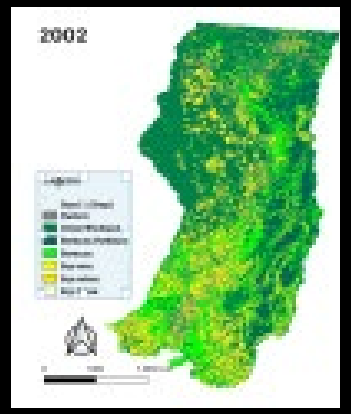
(833,000 ha → 5,200,000 ha)

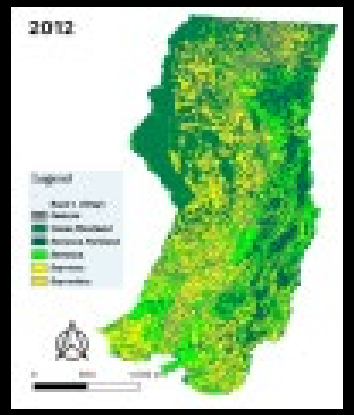
Spera et al. 2014

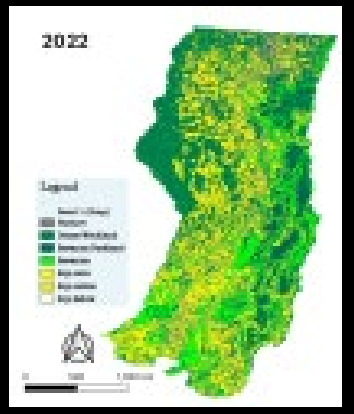
Remote sensing progress

- Moving workflow to cloud-based computing and Python
- Testing different machine learning algorithms
- ✓ Preliminary results look strong
- ■ Updating ground-truth (cal/val) data for crop types or rotations

Work by Uyoyo Adeyemo,
PhD Student/UVM







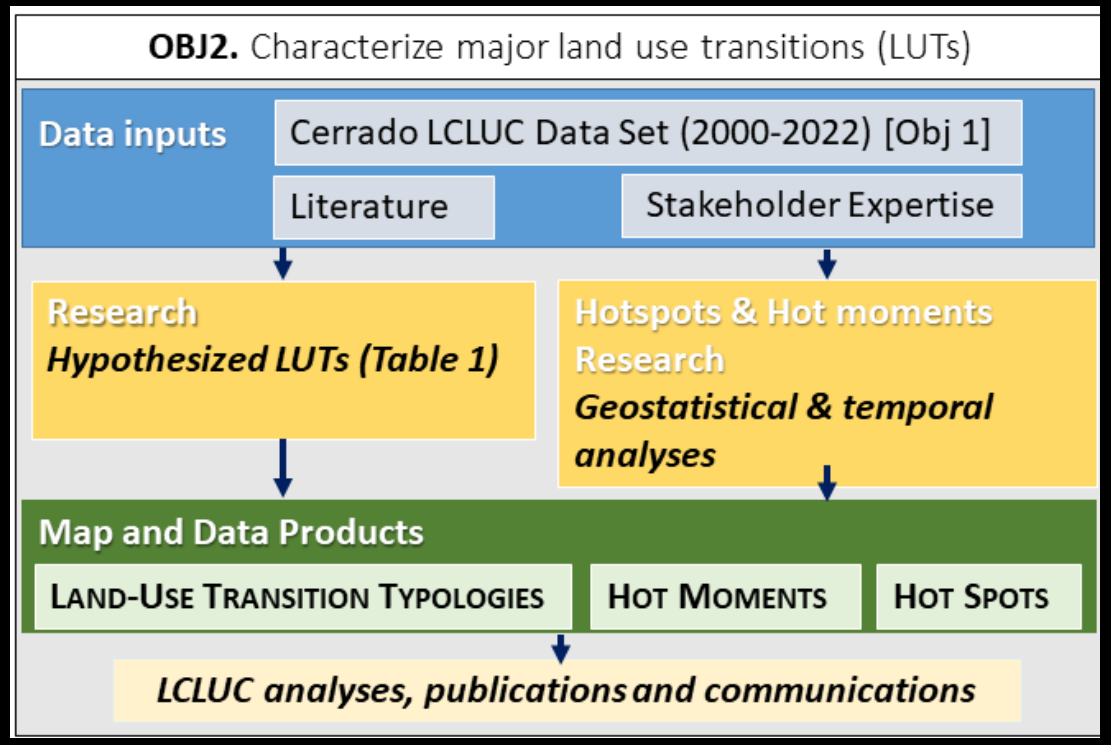
1. Develop LCLUC detection methods and data sets

- How has Cerrado land use evolved? (2000-2023)
- Focus: crop types, including rotations, irrigated agriculture, and abandonment
- **Opportunity**: Integration of results into existing platforms as new additional resources (MapBiomas, LAPIG)
- **Opportunity**: cover crop mapping with IPAM

2. Characterize major land use transitions (LUTs)

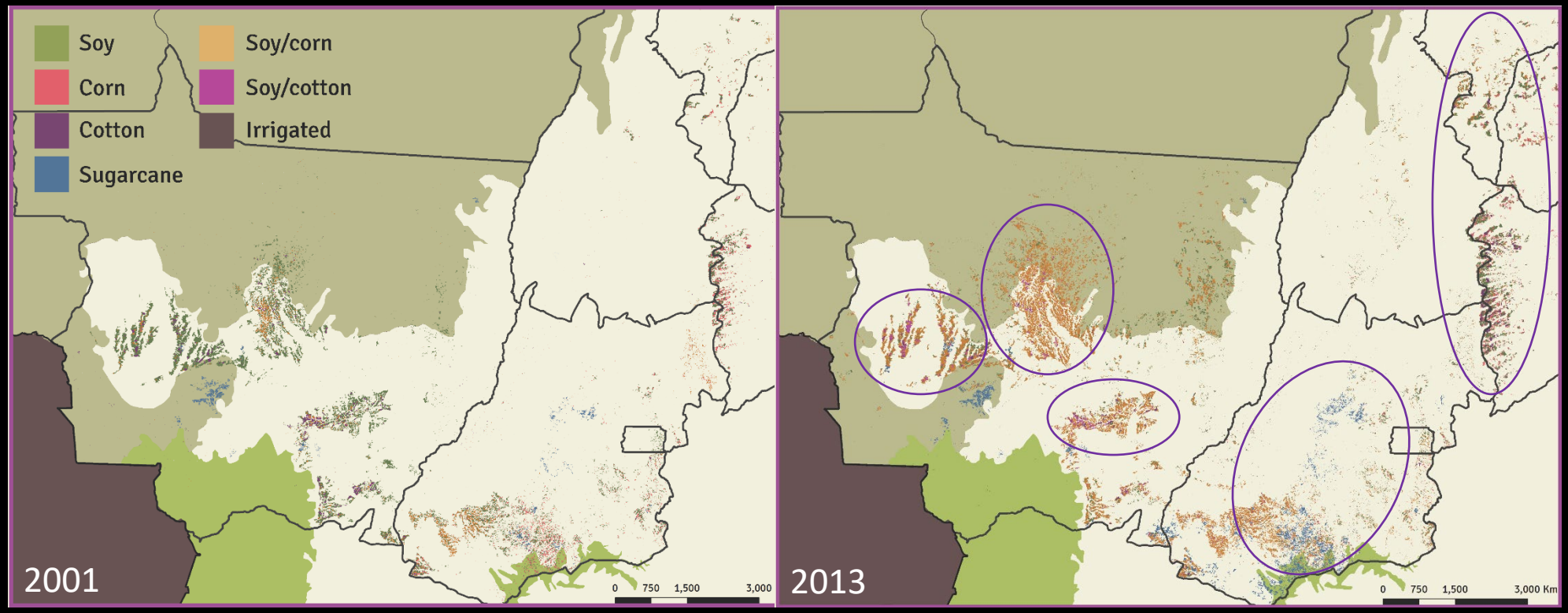
- Where and when do hot spots and hot moments occur?
- Methods: LUT typologies, classes, geostatistical methods

Dr. Ariane Rodrigues, Postdoc (June 2024)



Hypothesized LUTs	Example
Deforestation	Cerrado → Pasture or Crops
Regrowth	Pasture or Crops→ Cerrado
Ag. Expansion	Fallow → Pasture or Crops Pasture → Crops
Ag. Intensification	Pasture → Crops Single Cropping → Double Cropping Single or Double Cropping → Irrigated Ag.

Example hotspots

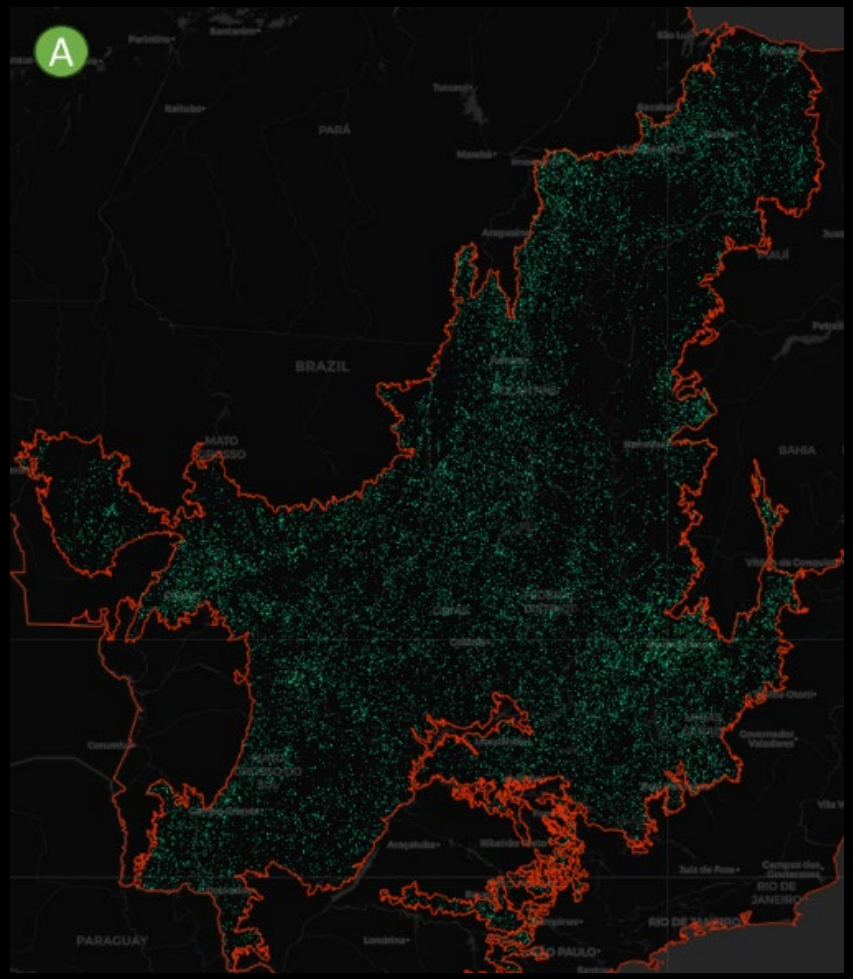


Goal: apply geostatistical approaches to identify hot spots and hot moments and their distinguishing characteristics (environmental & socioeconomic)

Maps from Spera et al. 2014

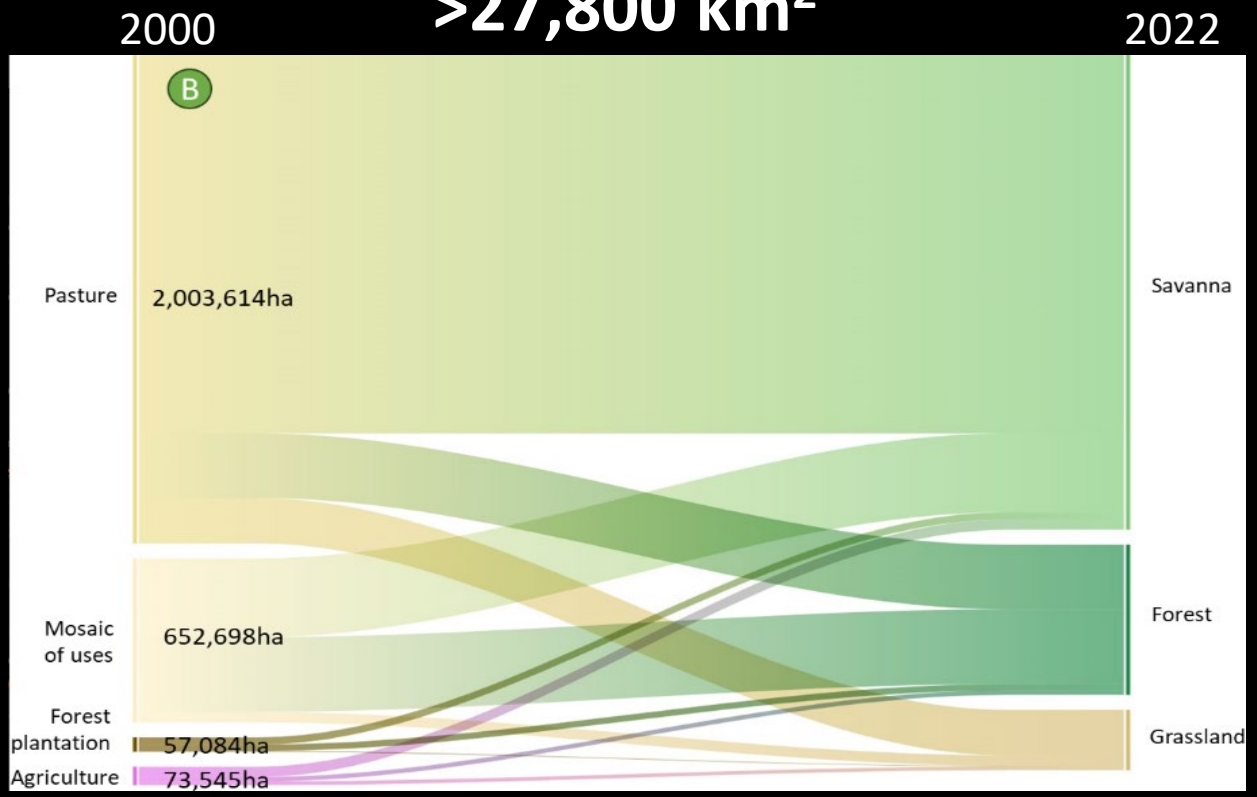
Regrowth (restoration?) a noteworthy LUT

Lara Monteiro, PhD Student



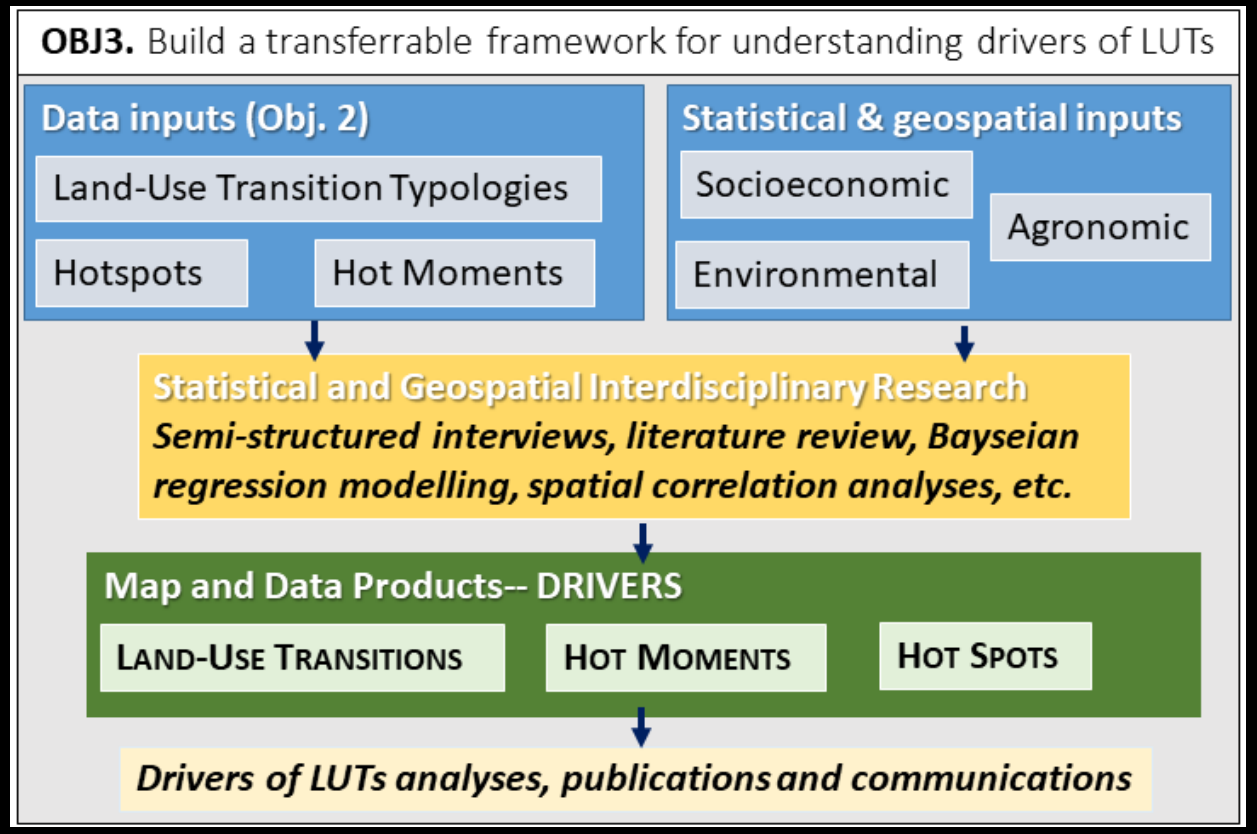
- Diffuse, but large cumulative impact
- Great interest from regional partners

>27,800 km²



3. Understanding drivers of LUTs

- What factors influence a LUTs?
- Approach: LUT classes; socioeconomic data/surveys



Targeting incentives to scale up restoration in the Brazilian Cerrado

Lara Monteiro, PhD Student UVM/ Gund Fellow

- Literature review of the incentives to promote the restoration of grasslands and savanna ecosystems worldwide
- Understanding the socioeconomic reality of restorers at the Cerrado – WHO
- Understanding the drivers & motivations behind restoration – WHY
- Matching incentives to different profiles of restorers to scale up restoration – HOW

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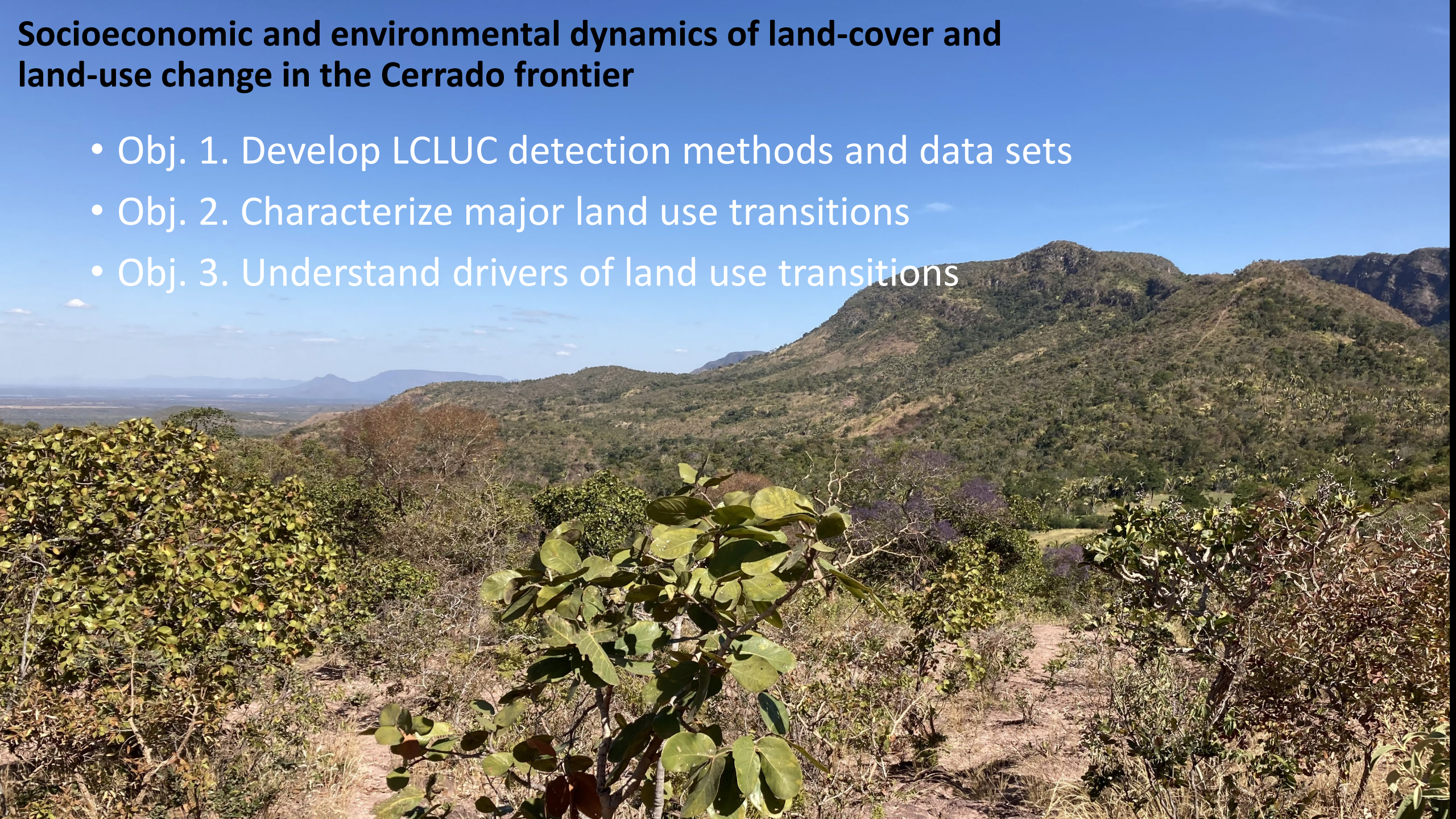
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