



# Radiografia das Pastagens do Brasil Resultados, Desdobramentos & Perspectivas



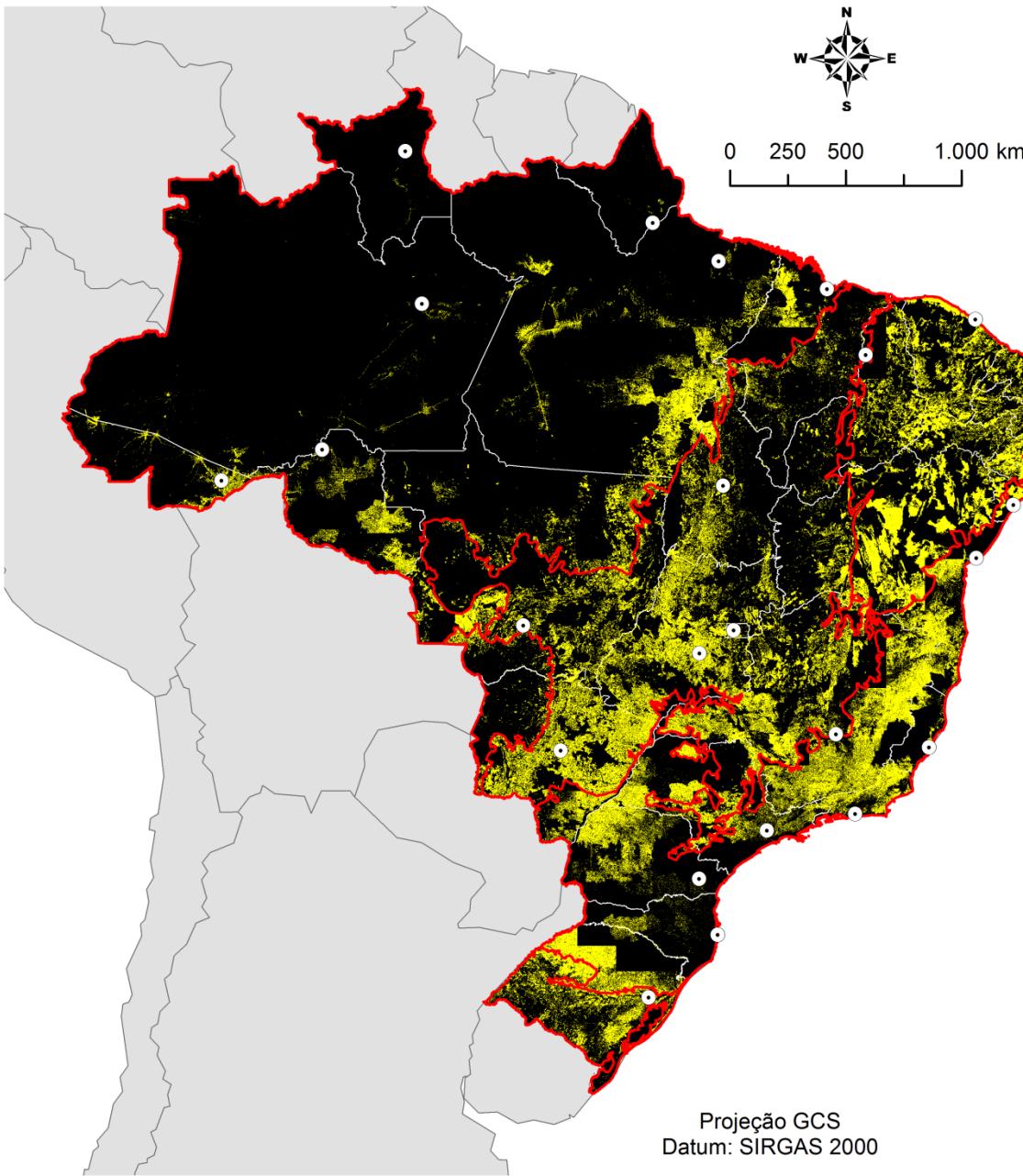
**UFG**

Laerte Guimarães Ferreira *et al.*  
Universidade Federal de Goiás (UFG)  
Instituto de Estudos Sócio-Ambientais (IESA)  
[www.lapig.iesa.ufg.br](http://www.lapig.iesa.ufg.br)

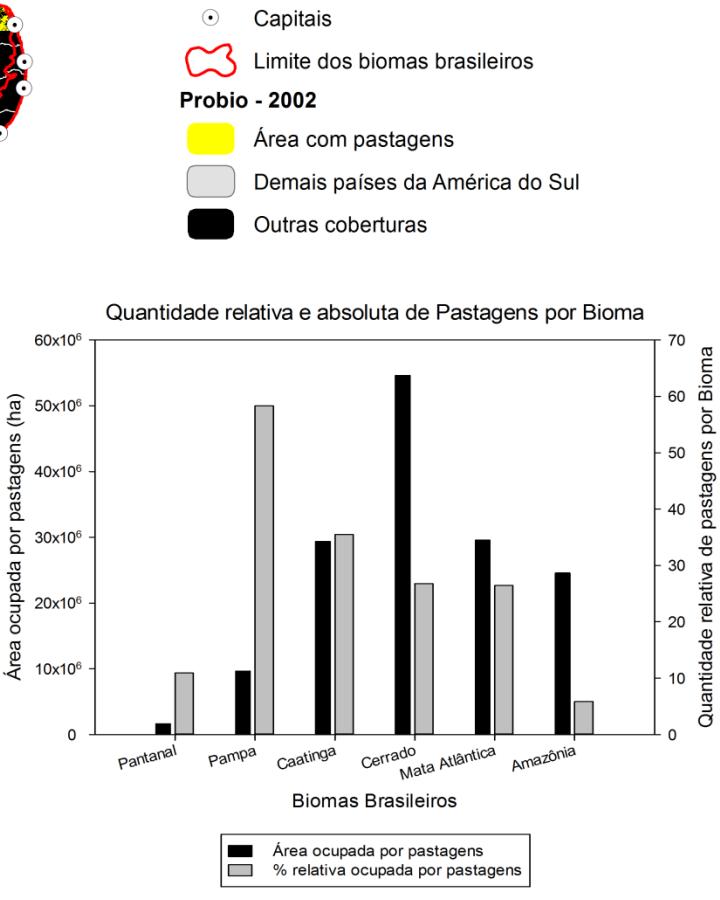
# Motivação & Contexto

Faz. Glória (Uberlândia, MG), Abril 2014

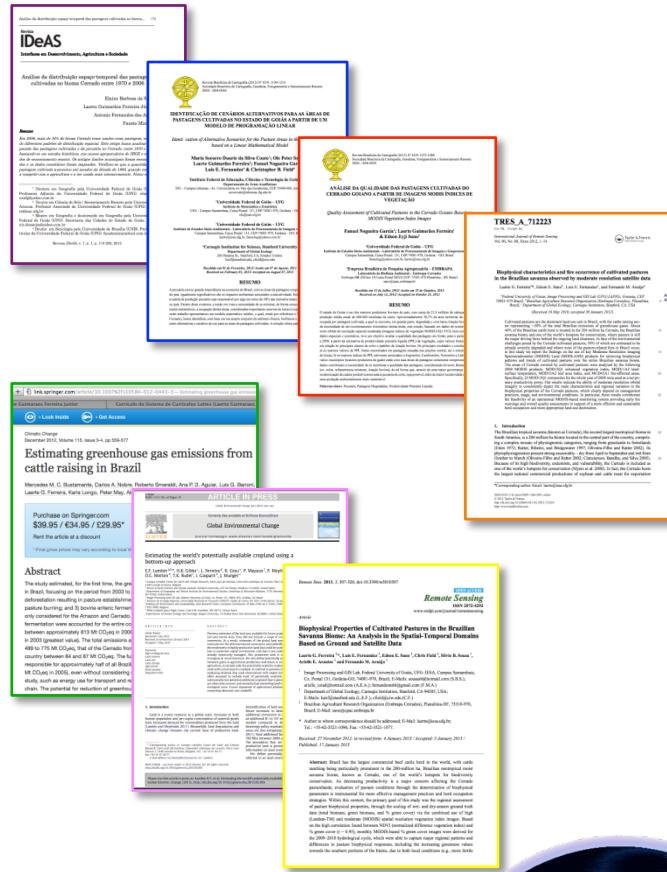
# Motivação



**Paisagens Produtivas & Sustentáveis**  
**“Commodities ambientais”**



# Contexto

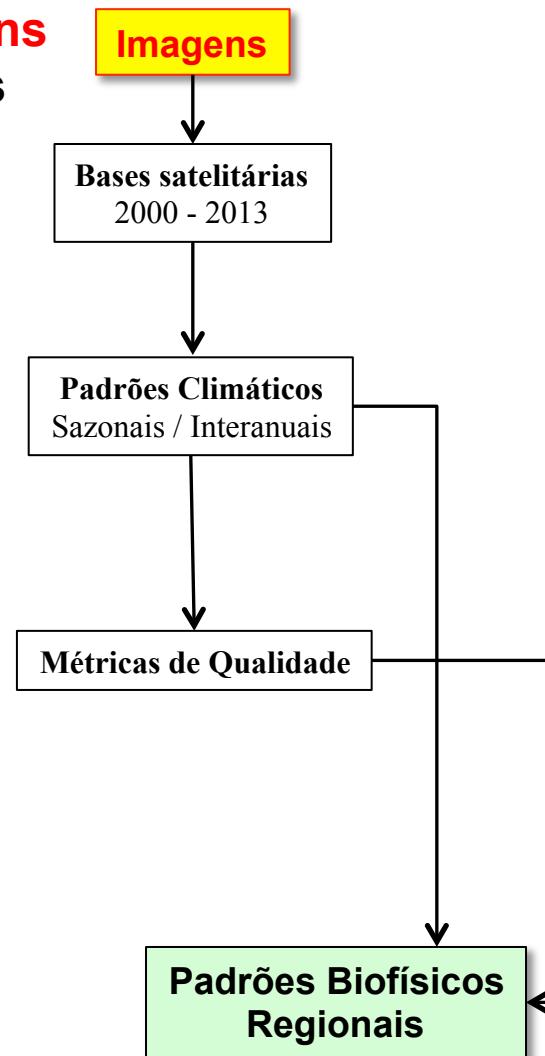


# Caracterização biofísica & *upscaling* **Land reserve**

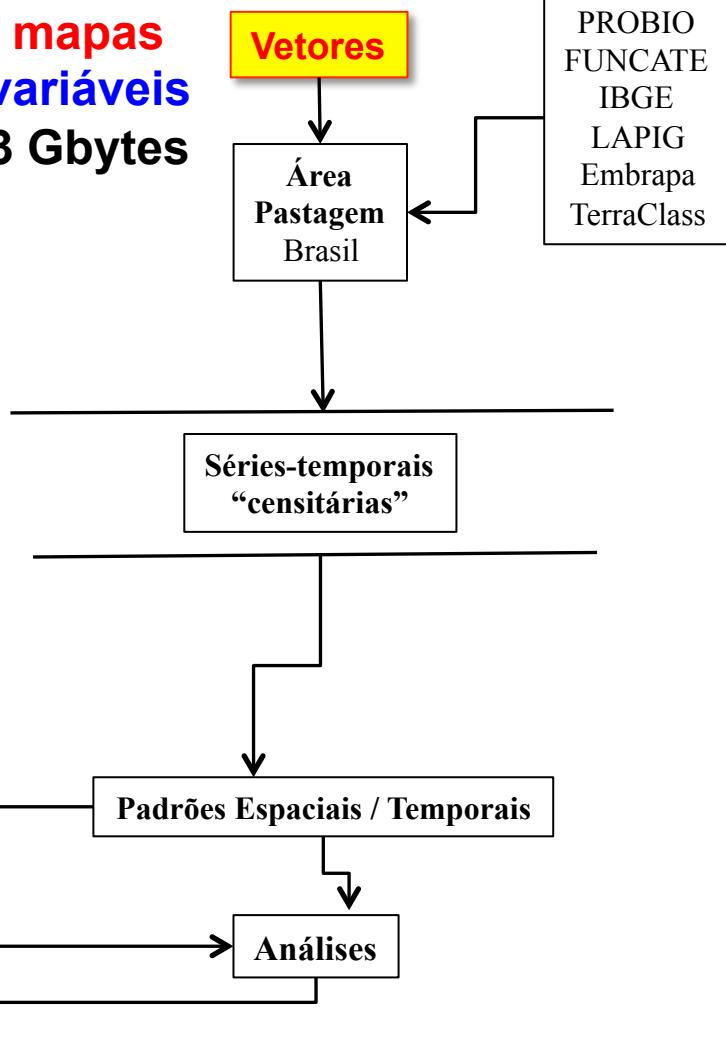


# Radiografia das Pastagens do Brasil: dados & abordagens

**1792 imagens**  
~ 3 Tbytes



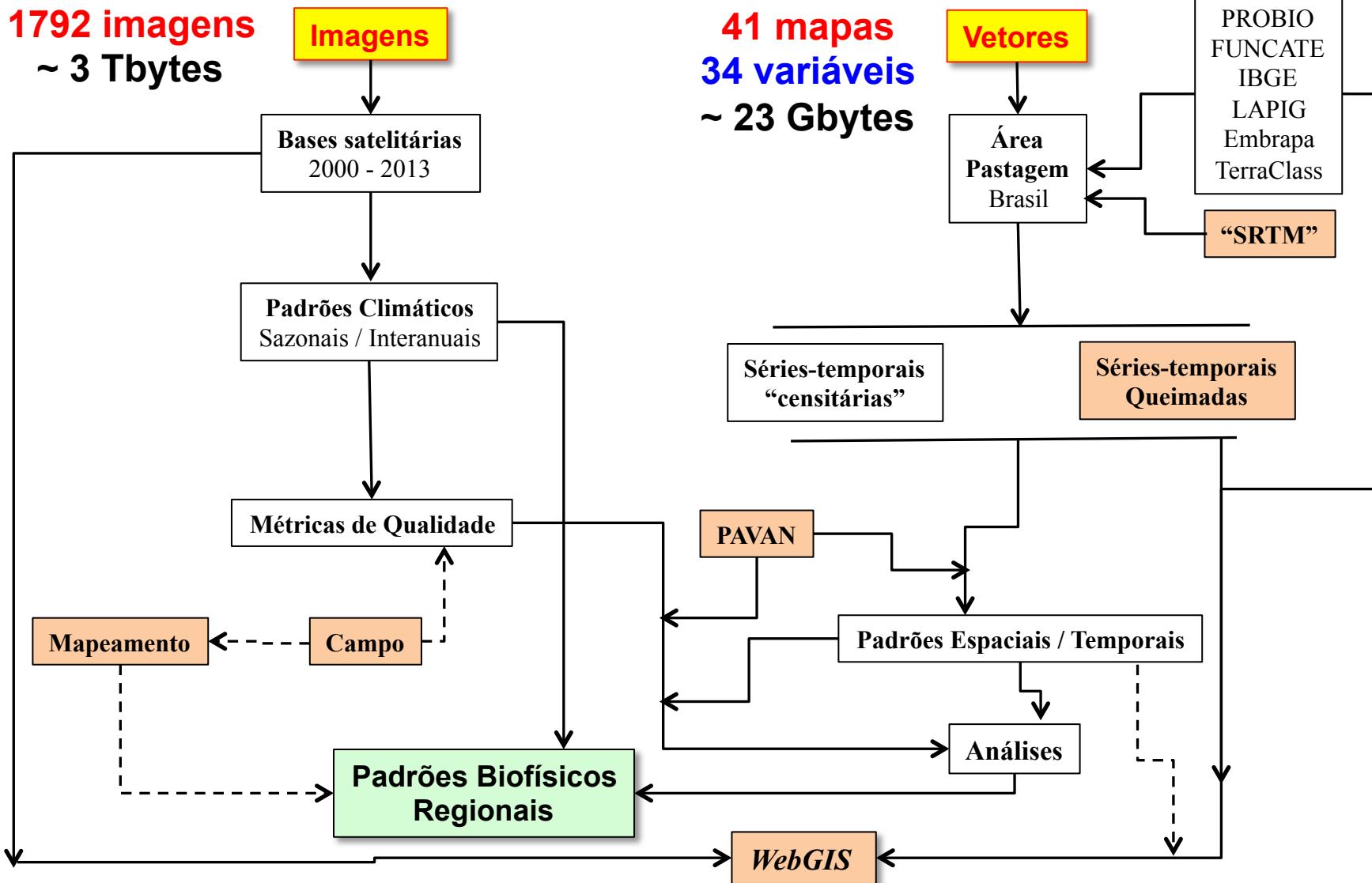
**41 mapas**  
**34 variáveis**  
~ 23 Gbytes



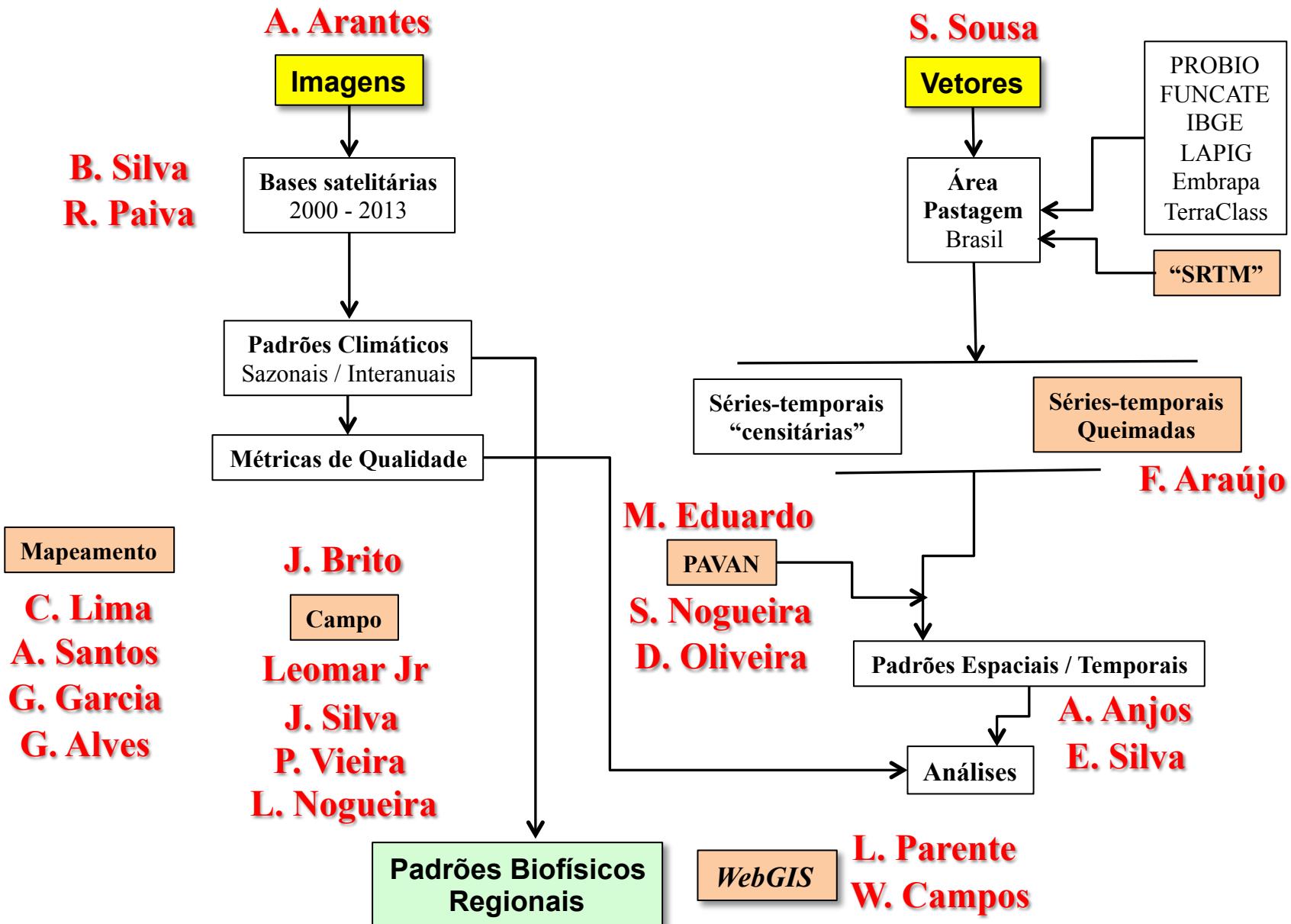
PROBIO  
FUNCATE  
IBGE  
LAPIG  
Embrapa  
TerraClass

# Radiografia das Pastagens do Brasil: dados & abordagens

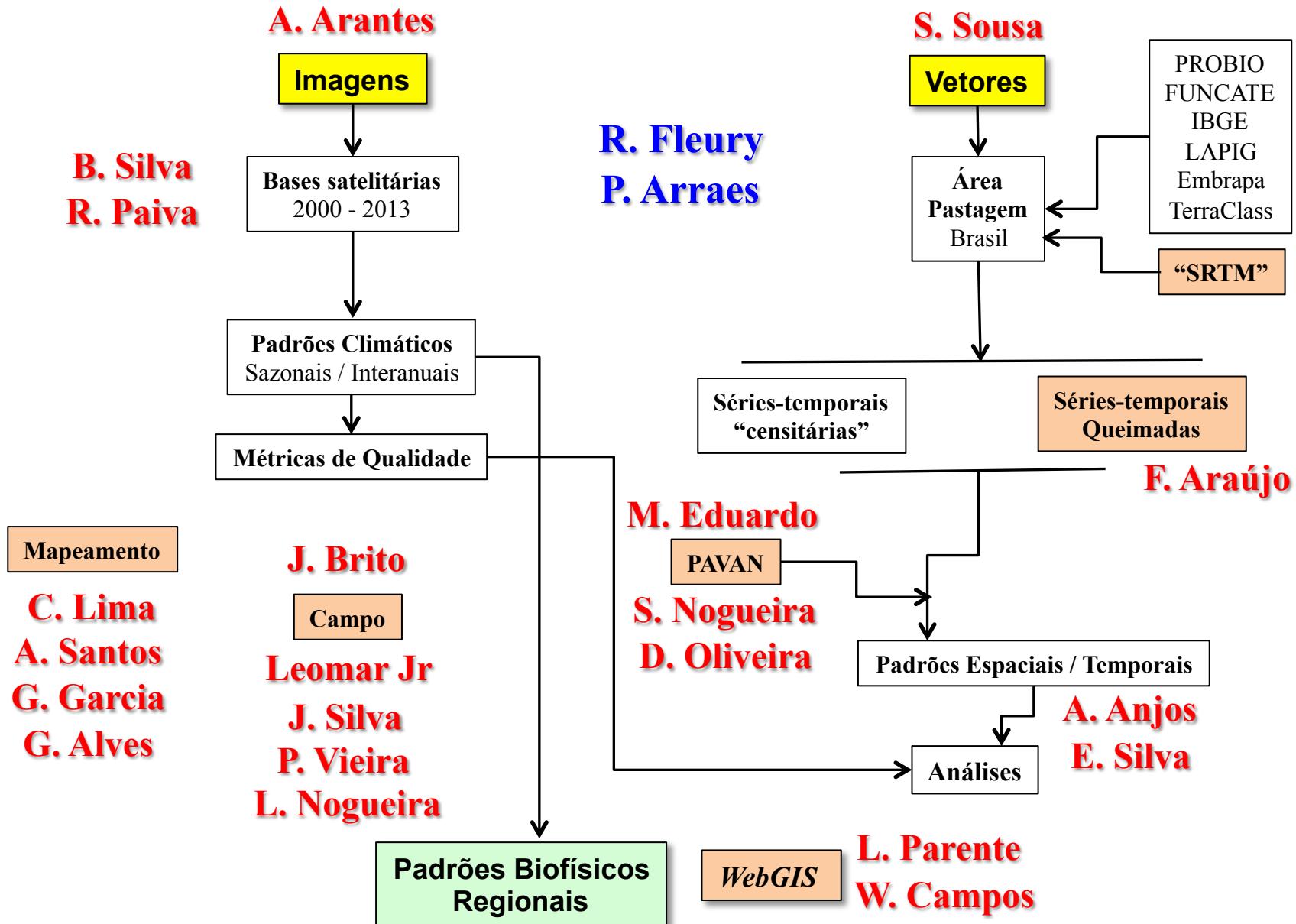
**1792 imagens**  
~ 3 Tbytes



# Radiografia das Pastagens do Brasil: metas & equipe



# Radiografia das Pastagens do Brasil: metas & equipe



# Áreas de Pastos no Brasil Bases Existentes & Lacunas

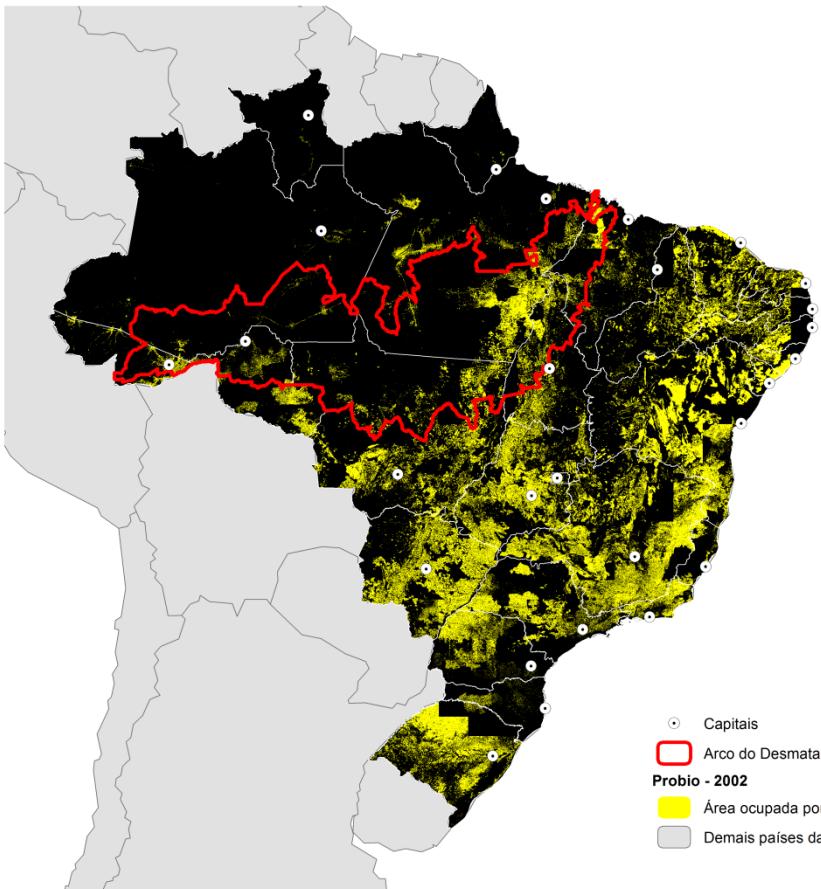


Faz. Jatobá (BHRV, Goiás), novembro 2014

# Pastagens no Brasil: dados disponíveis...

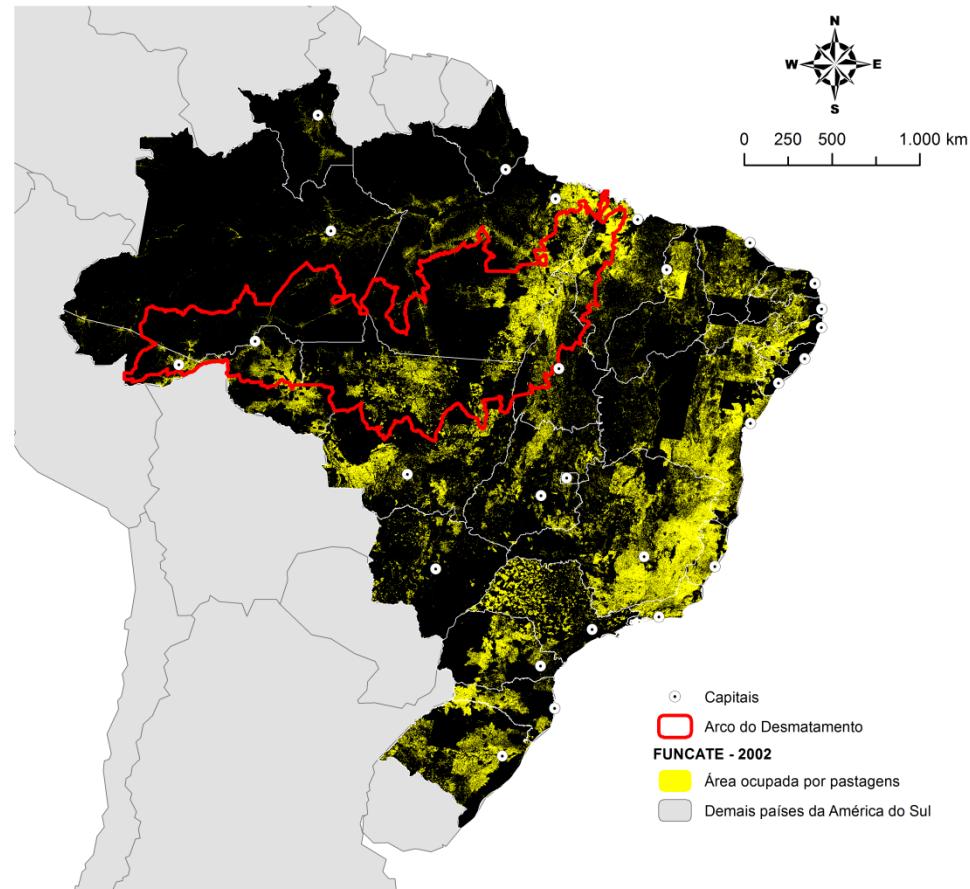
**PROBIO 2002**

**~ 150 Mha**



**Funcate 2002**

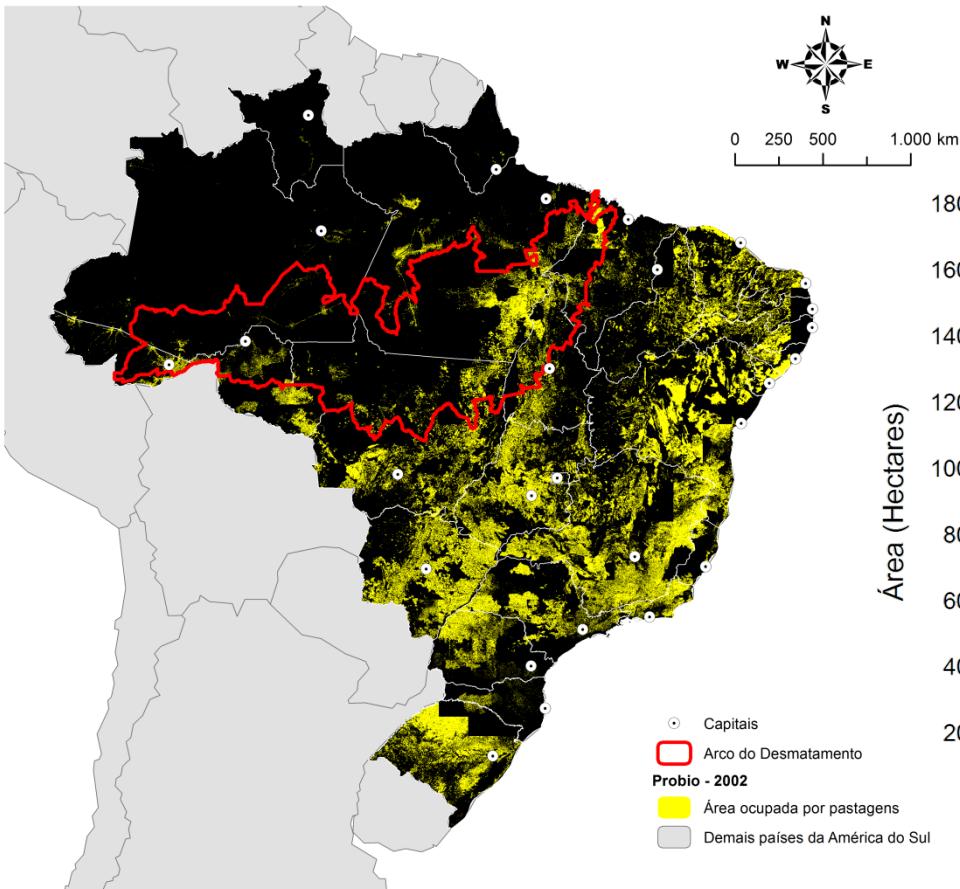
**~ 136 Mha**



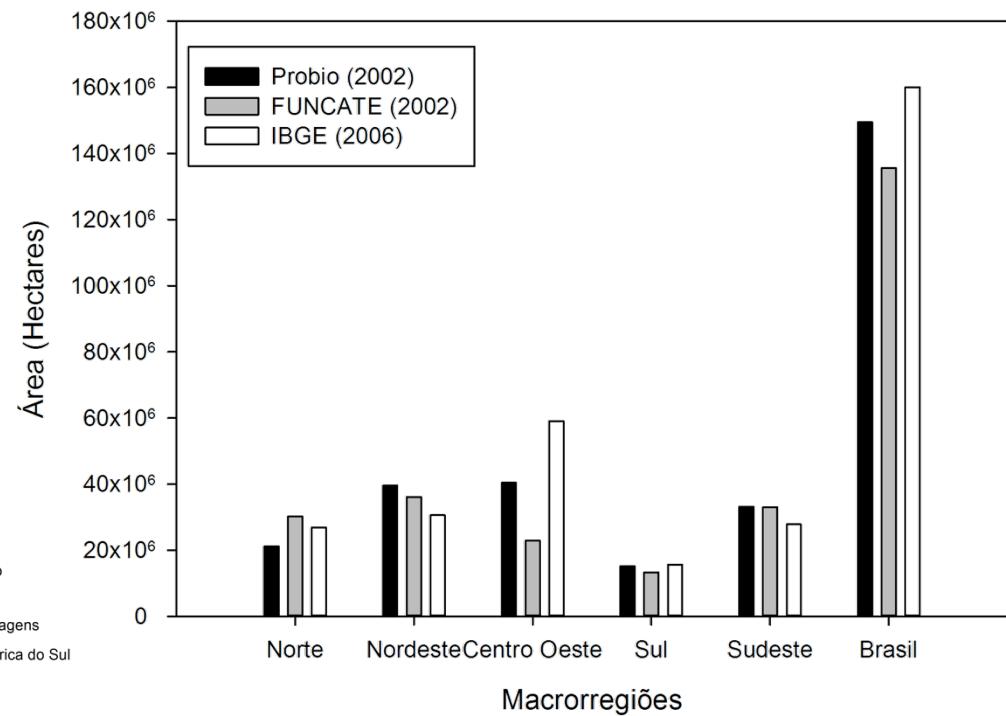
# Pastagens no Brasil: dados disponíveis...

**PROBIO 2002**

**~ 150 Mha**



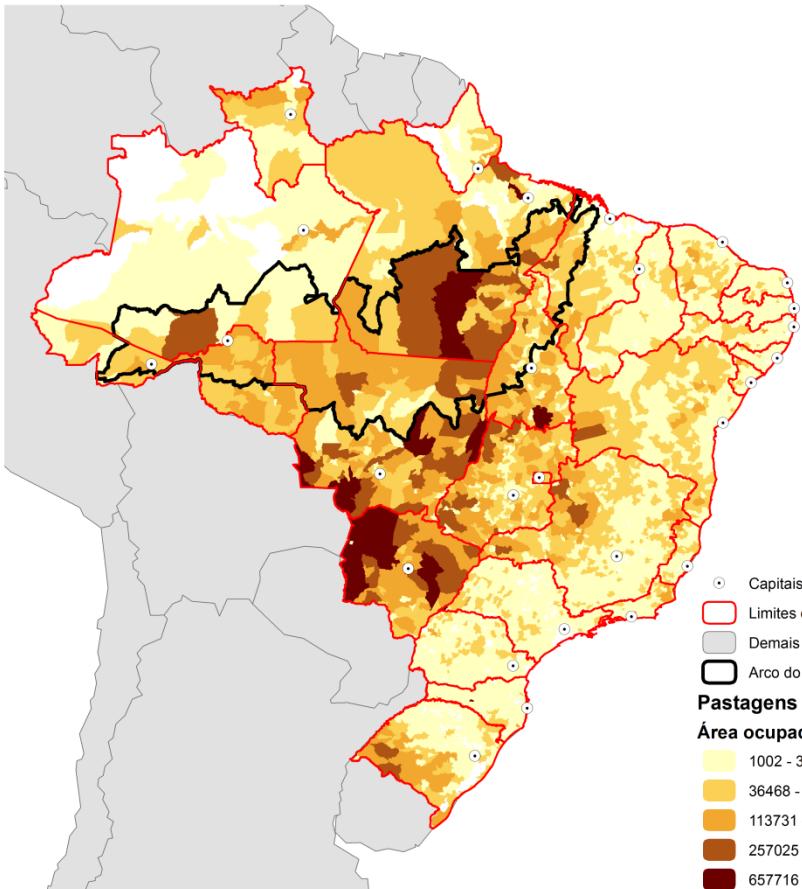
Área Ocupada por Pastagens nas Macrorregiões Brasileiras



# Pastagens no Brasil: dados disponíveis...

IBGE 2006

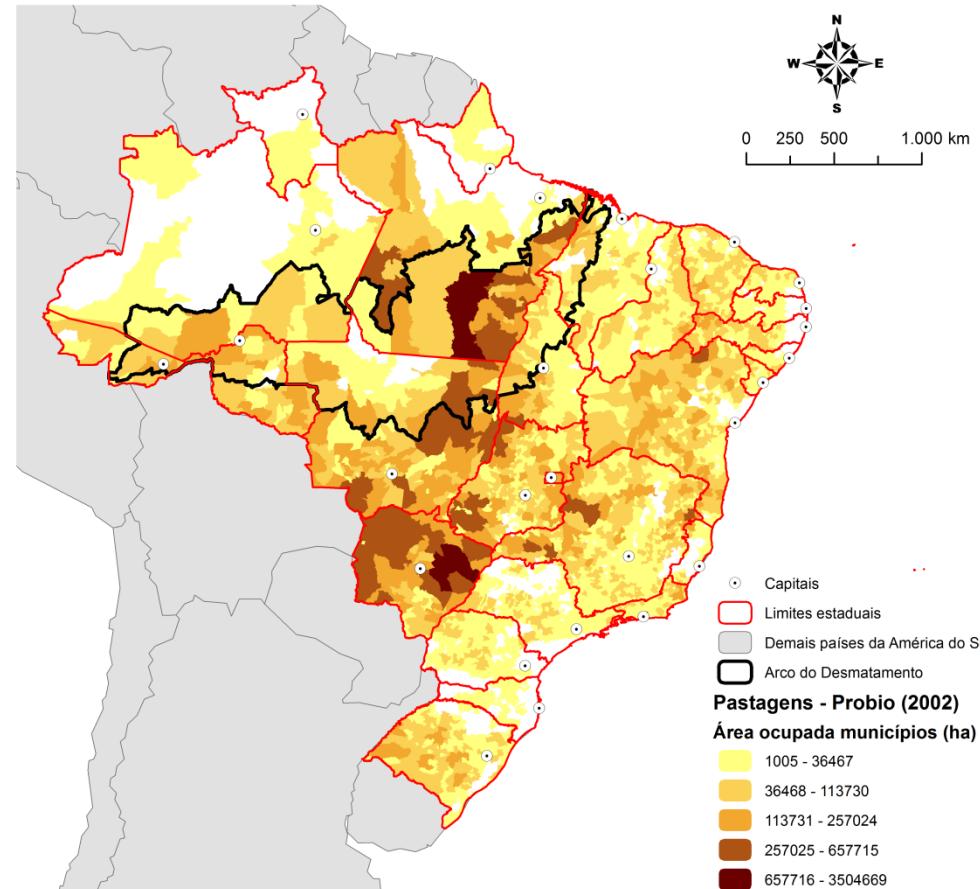
~ 160 Mha



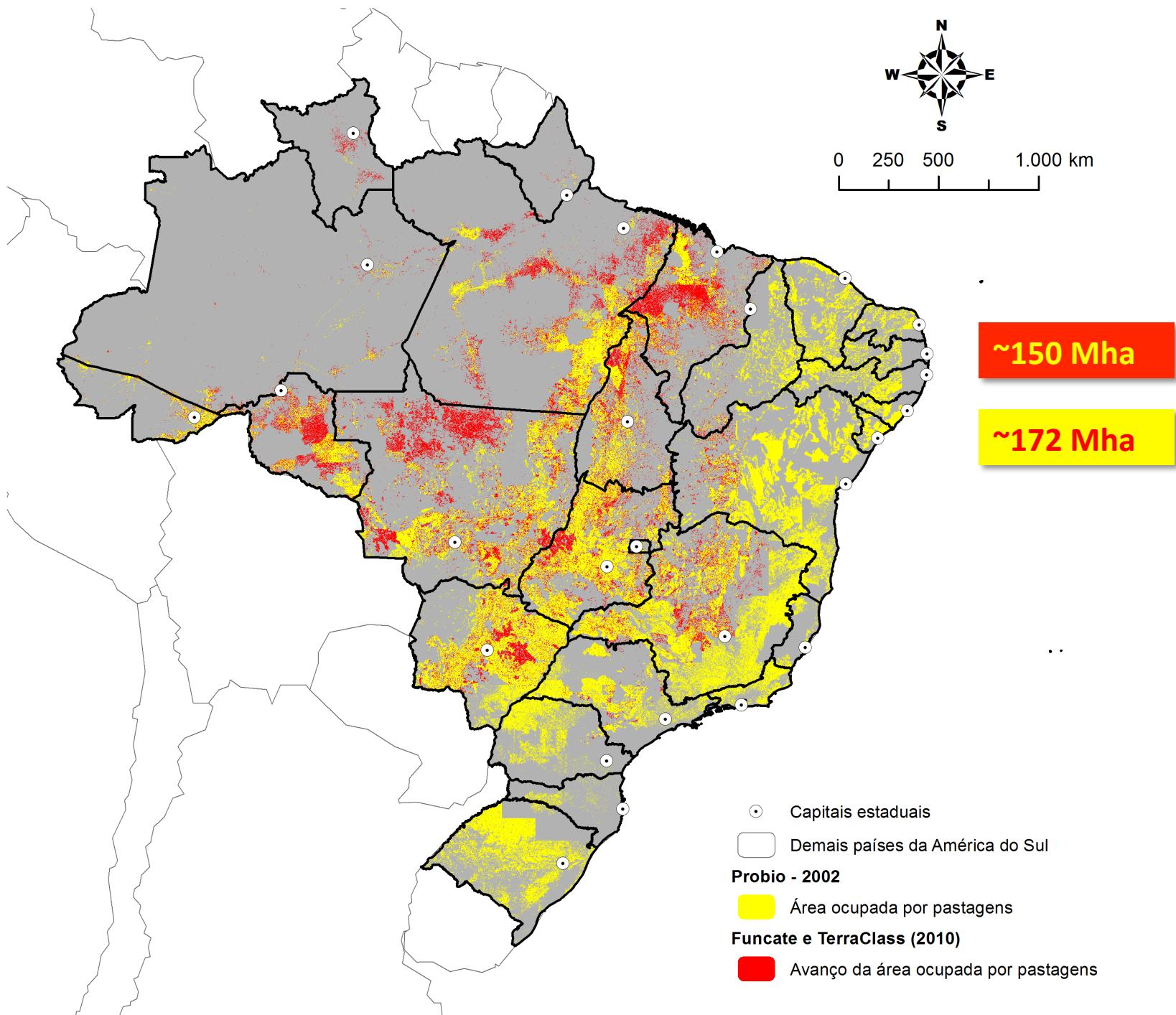
censitários

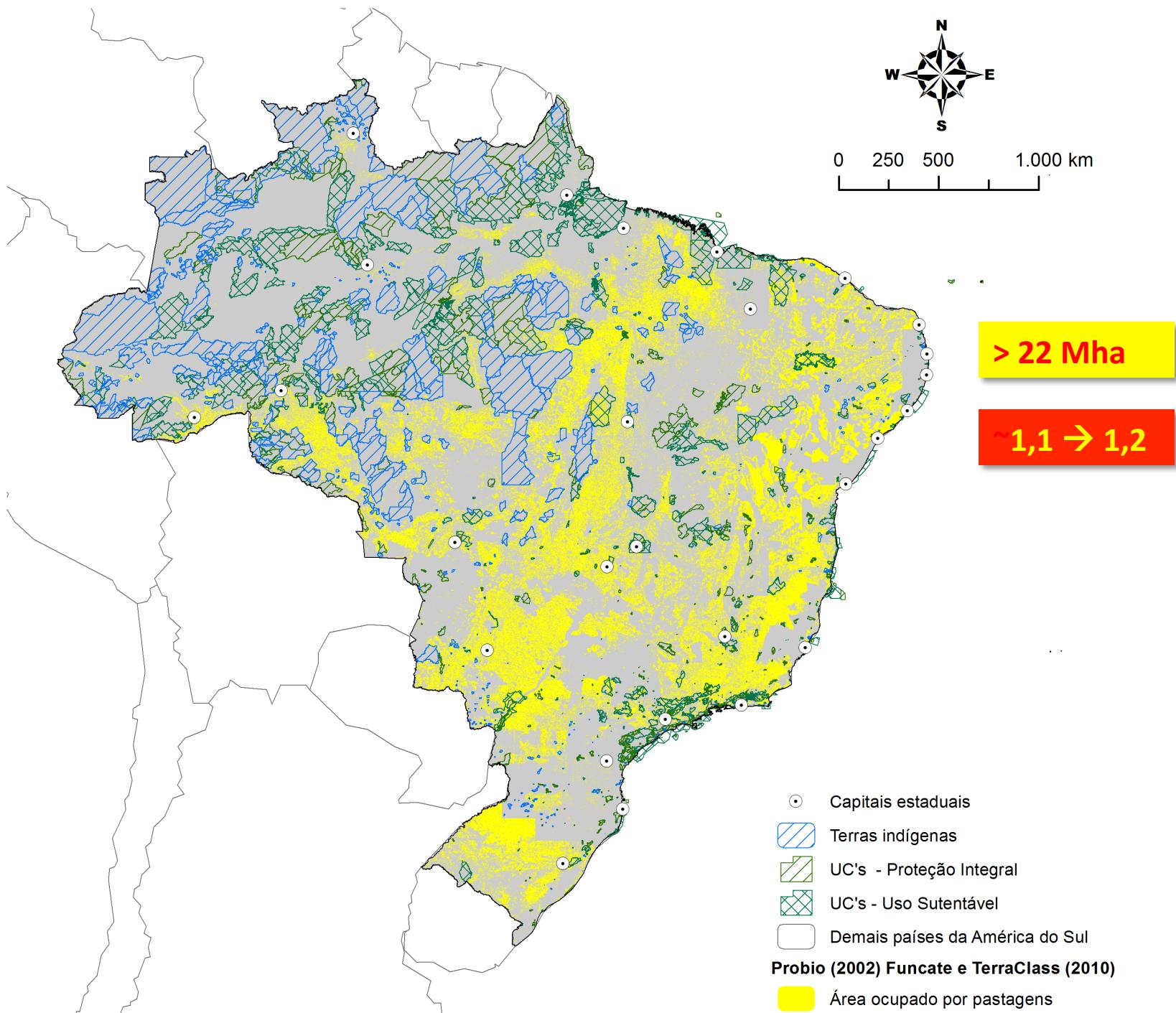
PROBIO 2002

~ 150 Mha



raster





# Considerações: dados & área de pasto no Brasil

- Levantamentos existentes (satelitários e IBGE) desatualizados e distintos...
  - Padrões regionais consistentes e próximos
  - Análise integrada: 163 a 172 Mha
- Pastagens interiorizadas e concentradas ao longo de um eixo (Cerrado – Amazônia)
  - Sudeste PA, leste MT, norte e leste MS
  - BR-153, BR-163, BR-365, BR-230, BR-364
- Correlação entre valores absolutos e relativos
  - Sul PA, noroeste GO, nordeste MS
  - Leste MG e norte RS
- Expansão (2002 → 2010) consistente
  - localização de matadouros e frigoríficos
  - Limites de terras indígenas e unidades de conservação



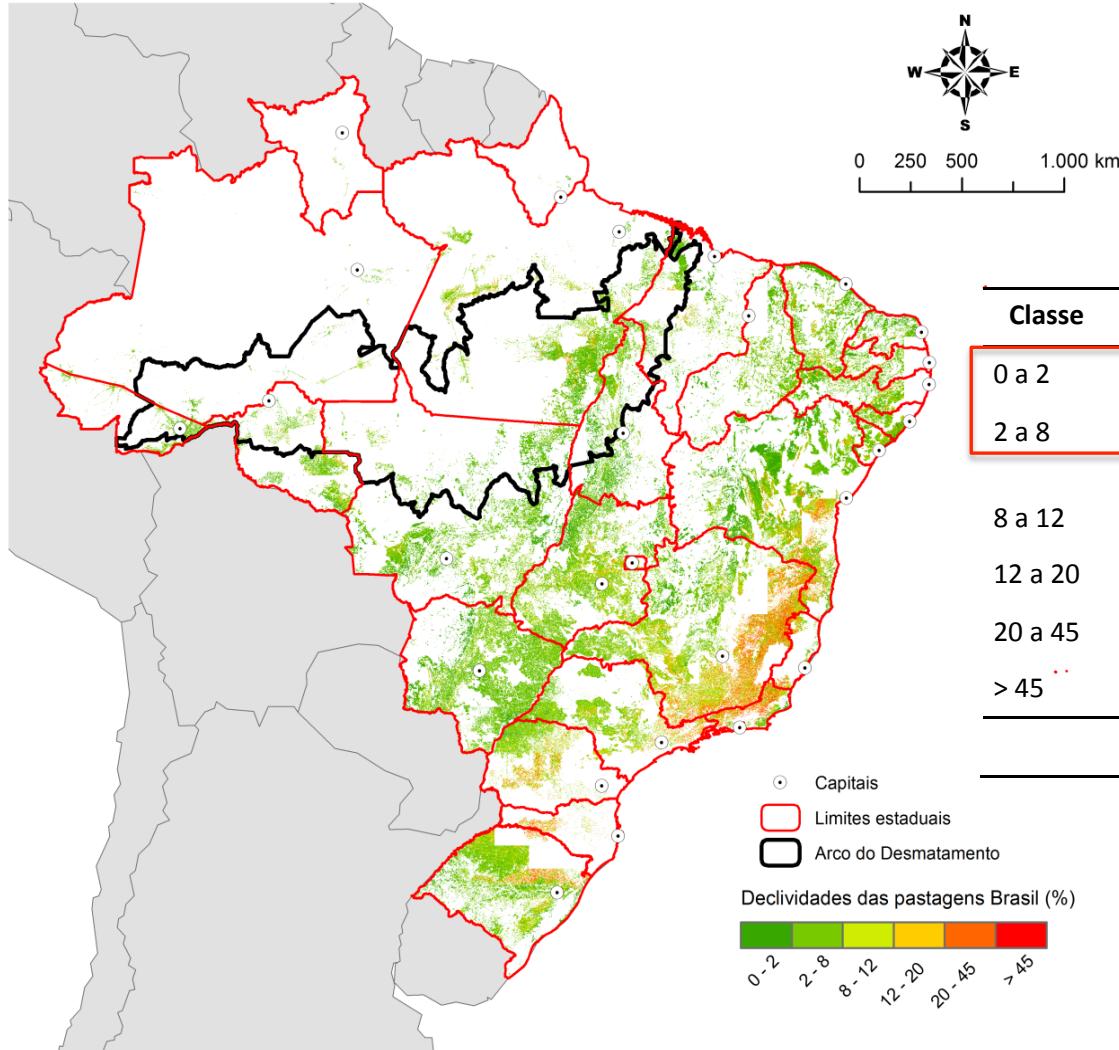
# **Áreas de Pastos no Brasil**

## **Padrões de Distribuição & Contextos**

### **Histórico, Sócio-Econômico & Ambiental**

**Faz. Glória (Uberlândia, MG), Agosto 2014**

# Pastagens & declividade



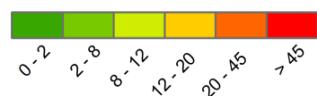
Classe	Tipo	Área (km <sup>2</sup> )	%
0 a 2	Plano	332087,7	22,1
2 a 8	Suave Ondulado	801252,6	53,4
8 a 12	Moderadamente Ondulado	138092,2	9,2
12 a 20	Ondulado	114193,5	7,6
20 a 45	Fortemente Ondulado	87722,9	5,8
> 45	Montanhoso	28373,7	1,9
Total		1501722,7	100

Capitais

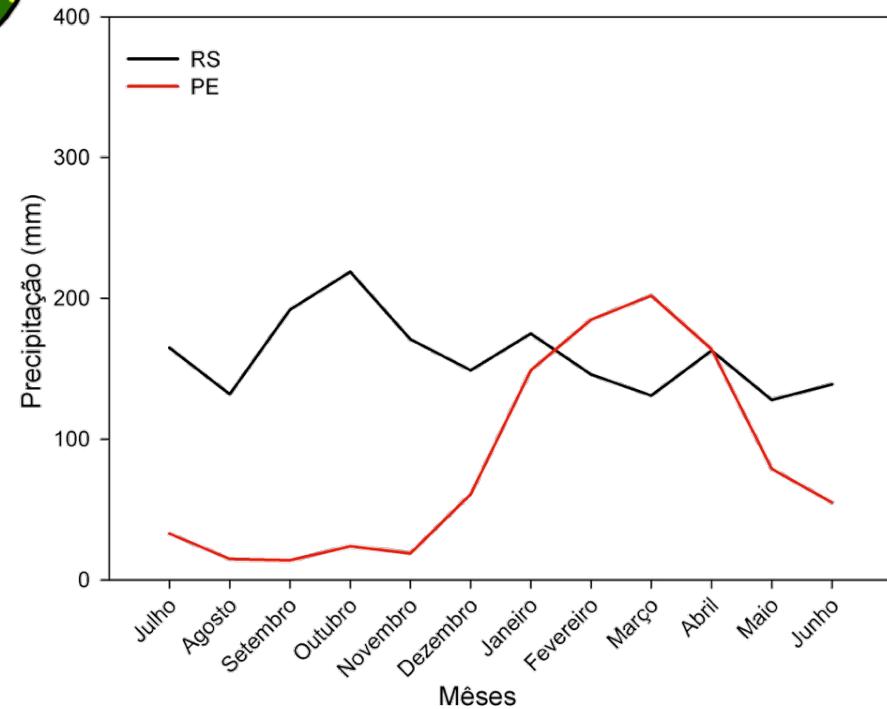
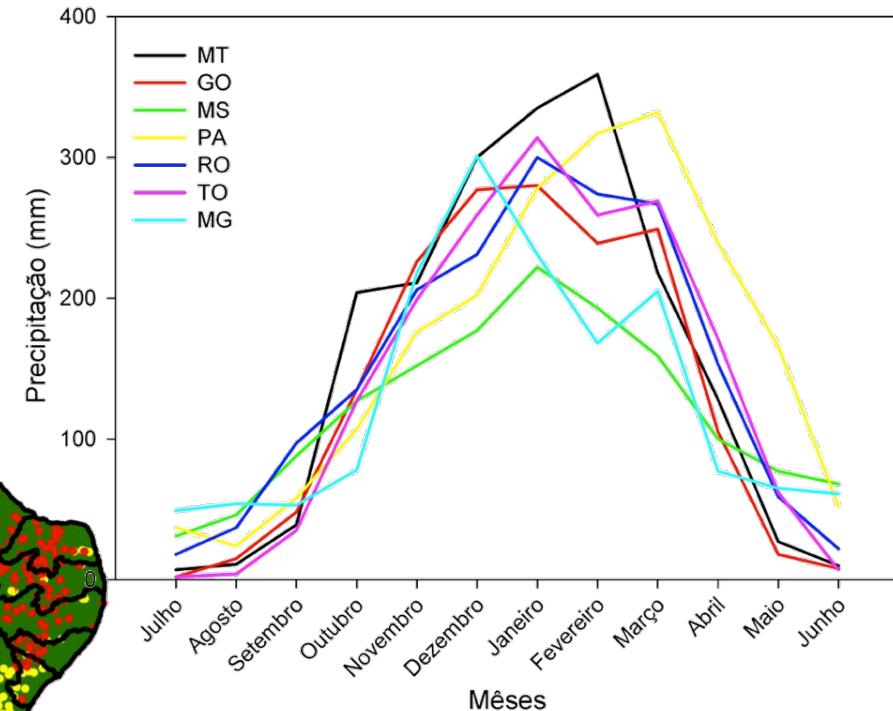
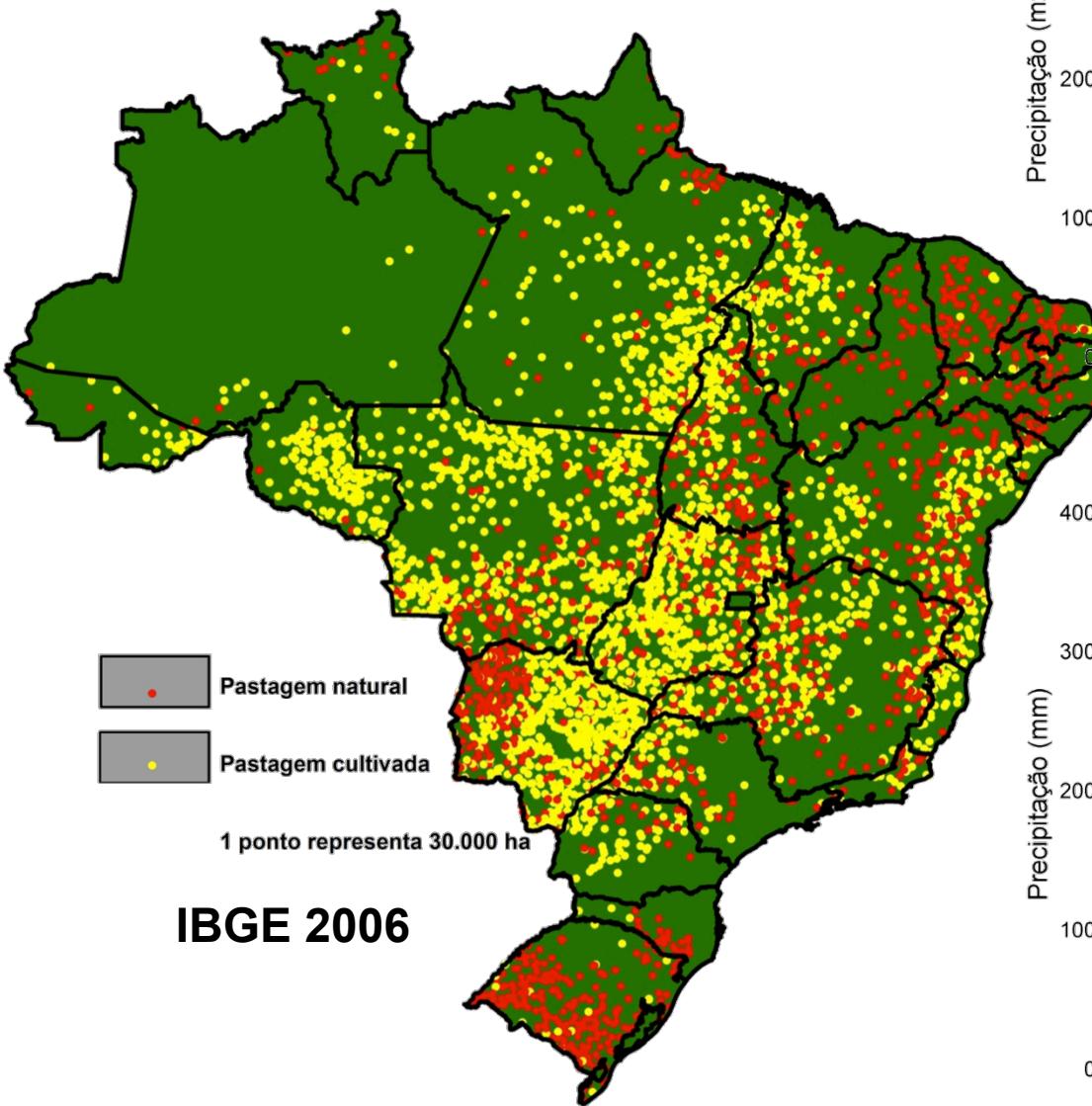
Limites estaduais

Arco do Desmatamento

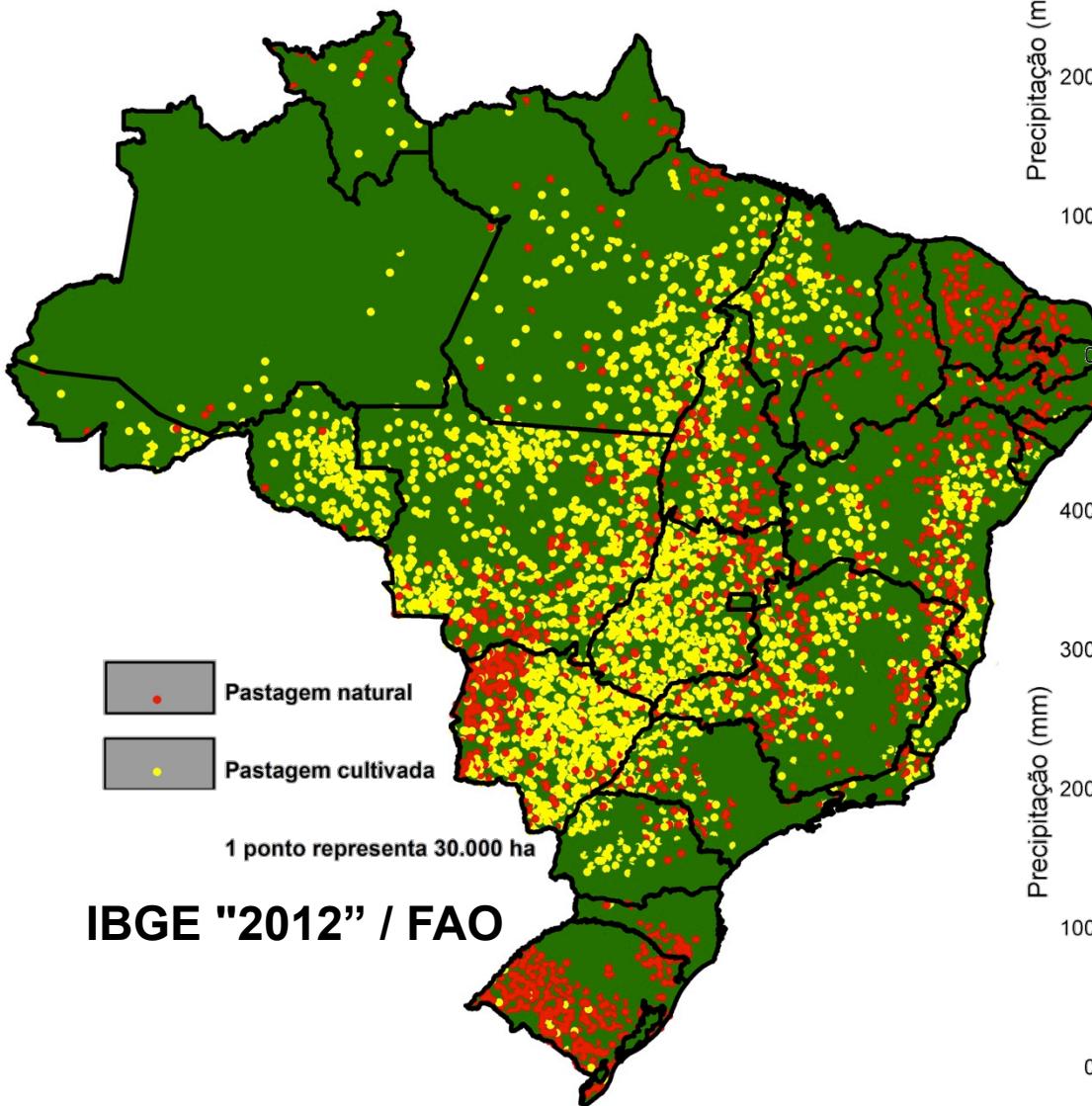
Declividades das pastagens Brasil (%)



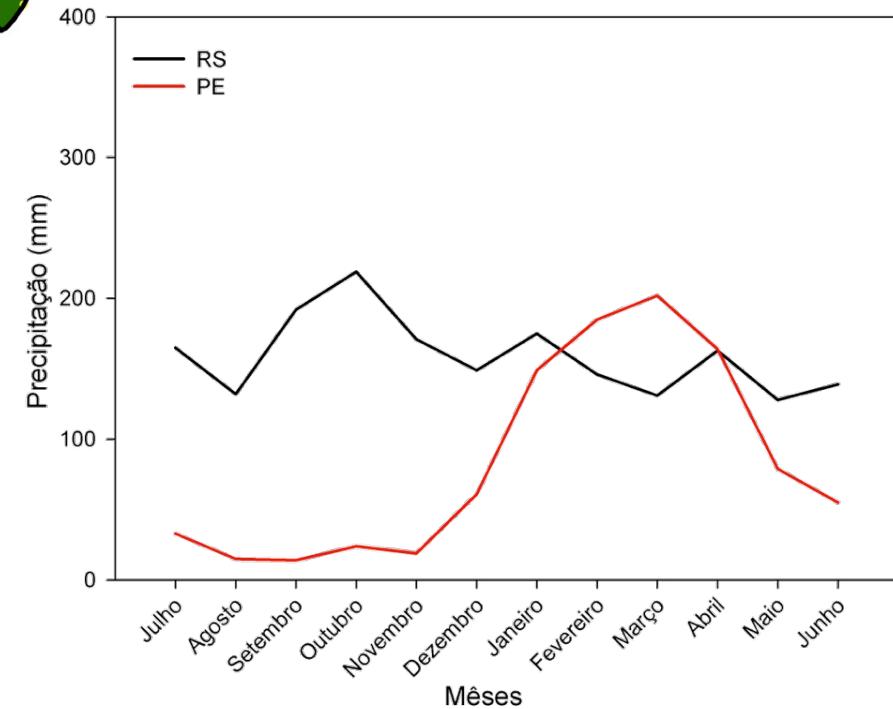
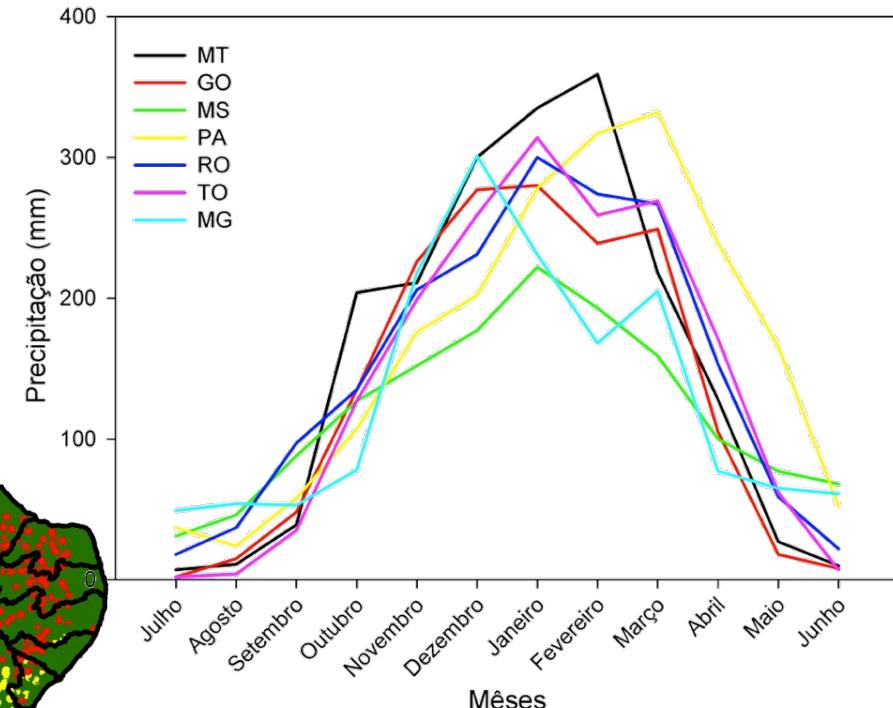
# ... & regime climático



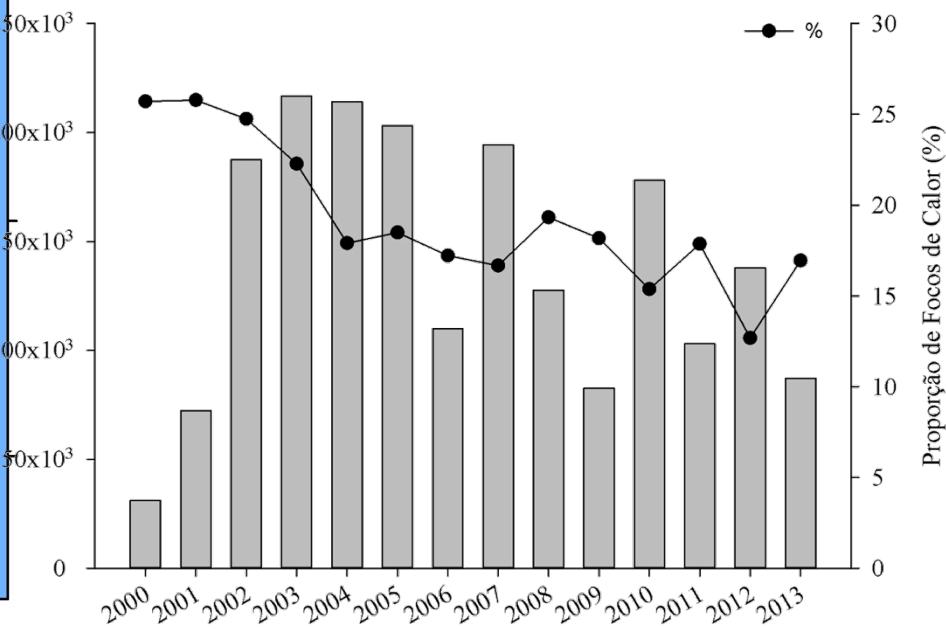
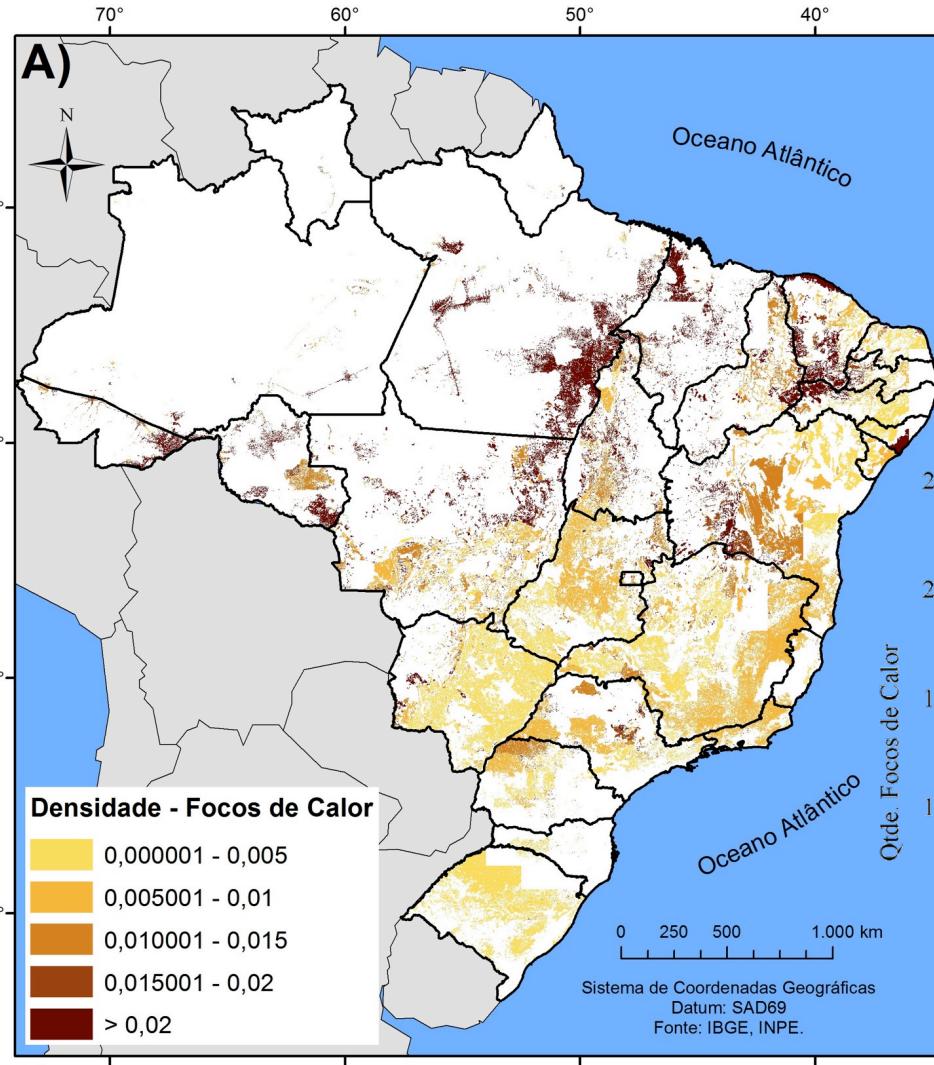
# ... & regime climático



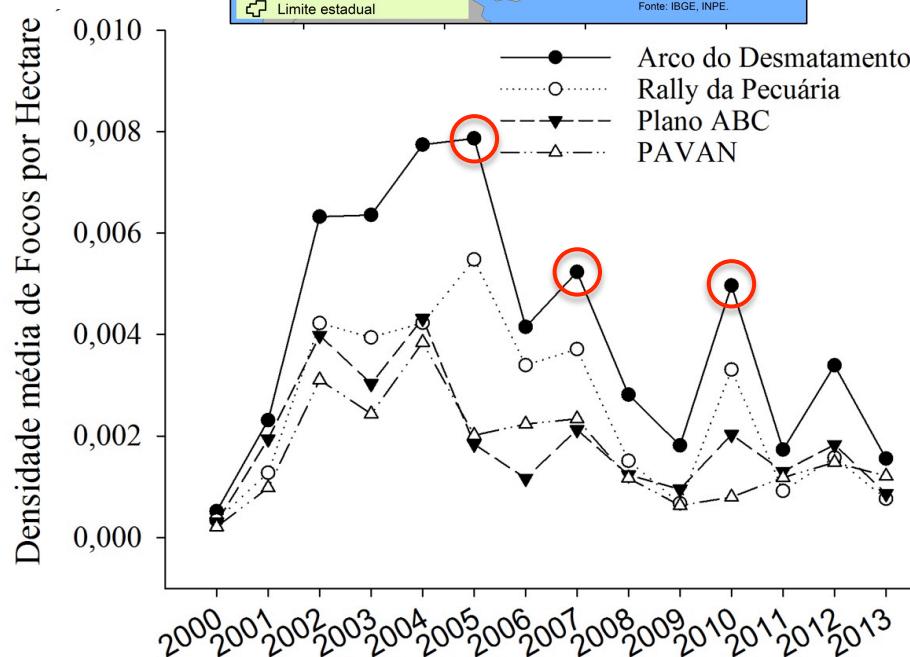
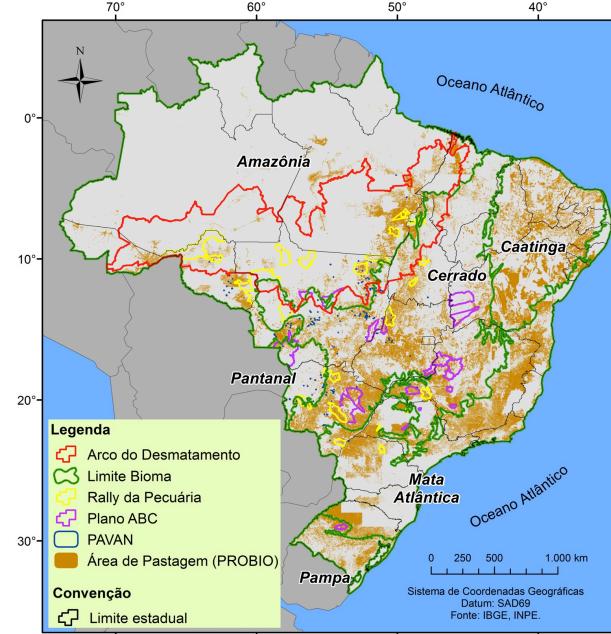
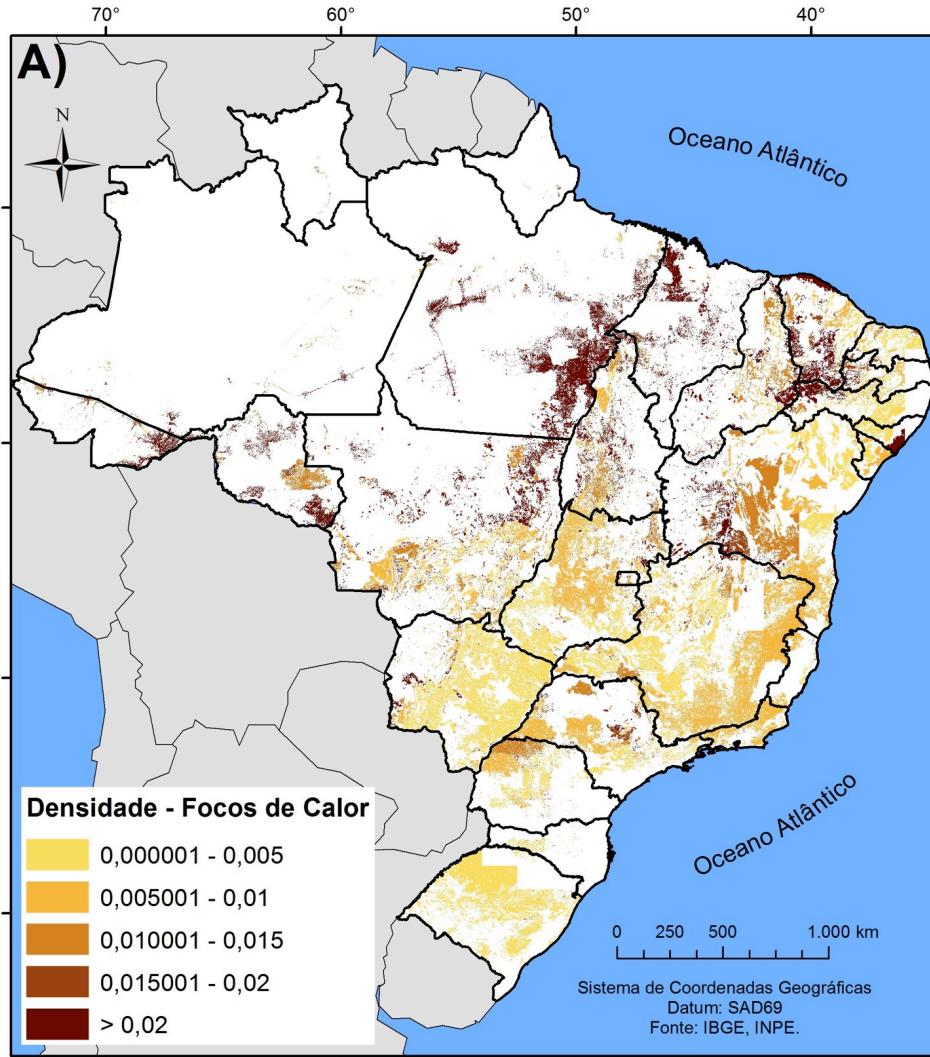
Anjos, A.; Silva, E., Ferreira, L. XVII SBSR (submetido)



# Pastagens & queimadas



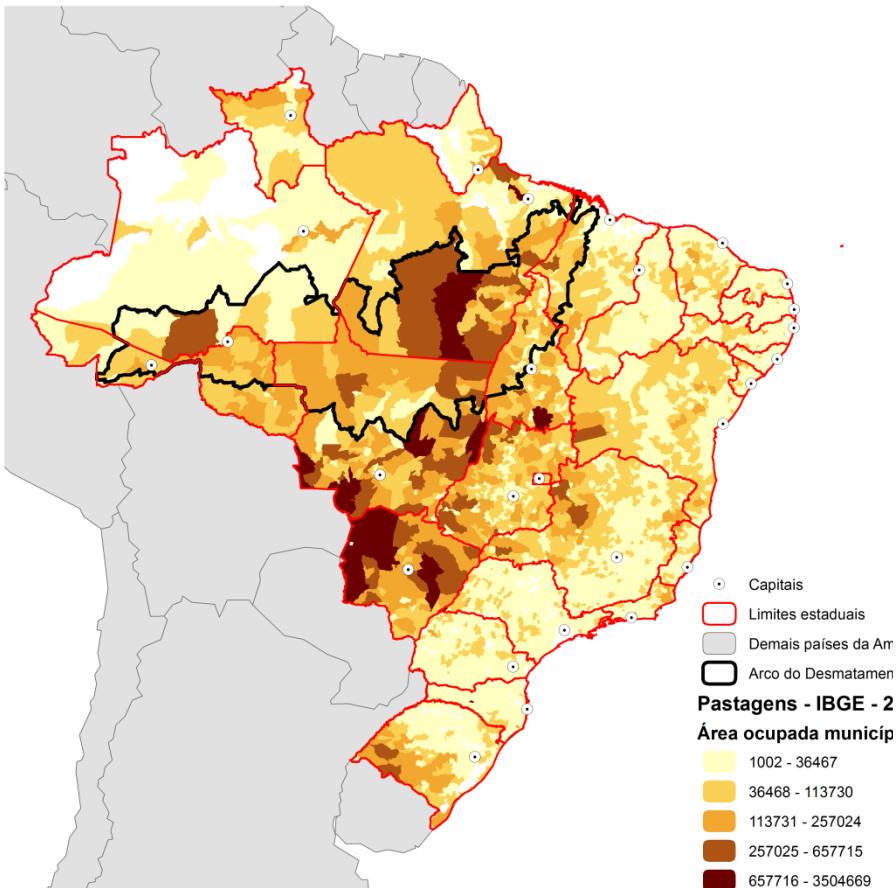
# Pastagens & queimadas



# Área Pastagens & Socioeconomia...

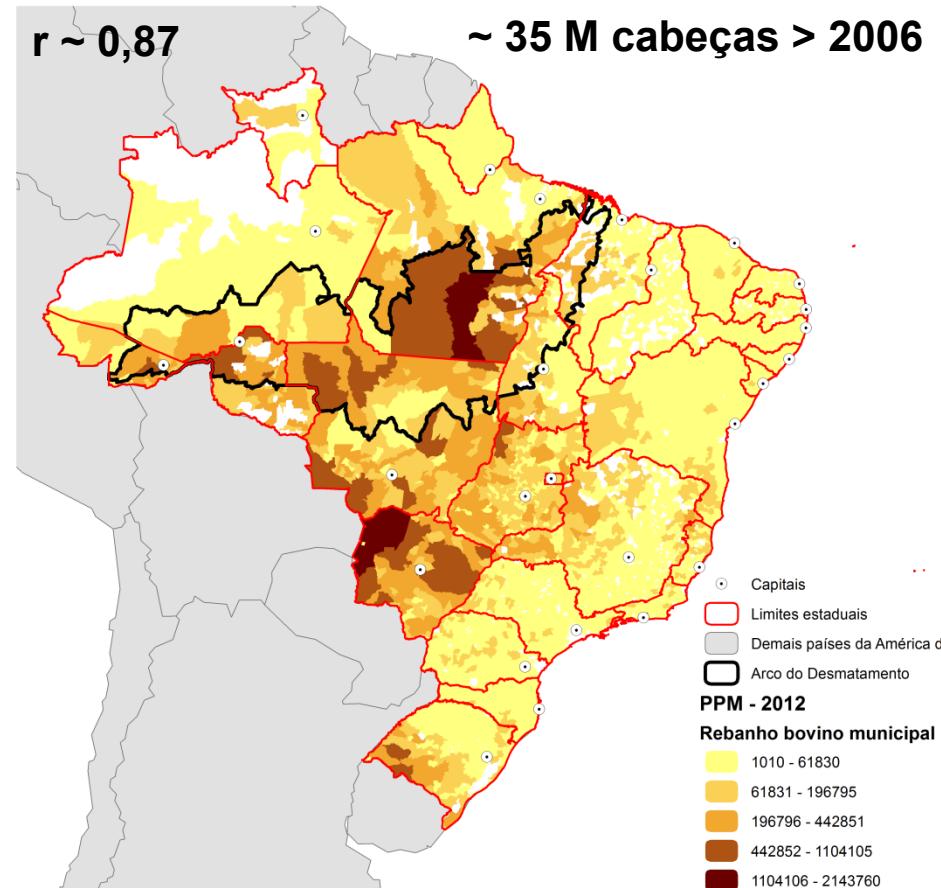
IBGE 2006

~ 160 Mha

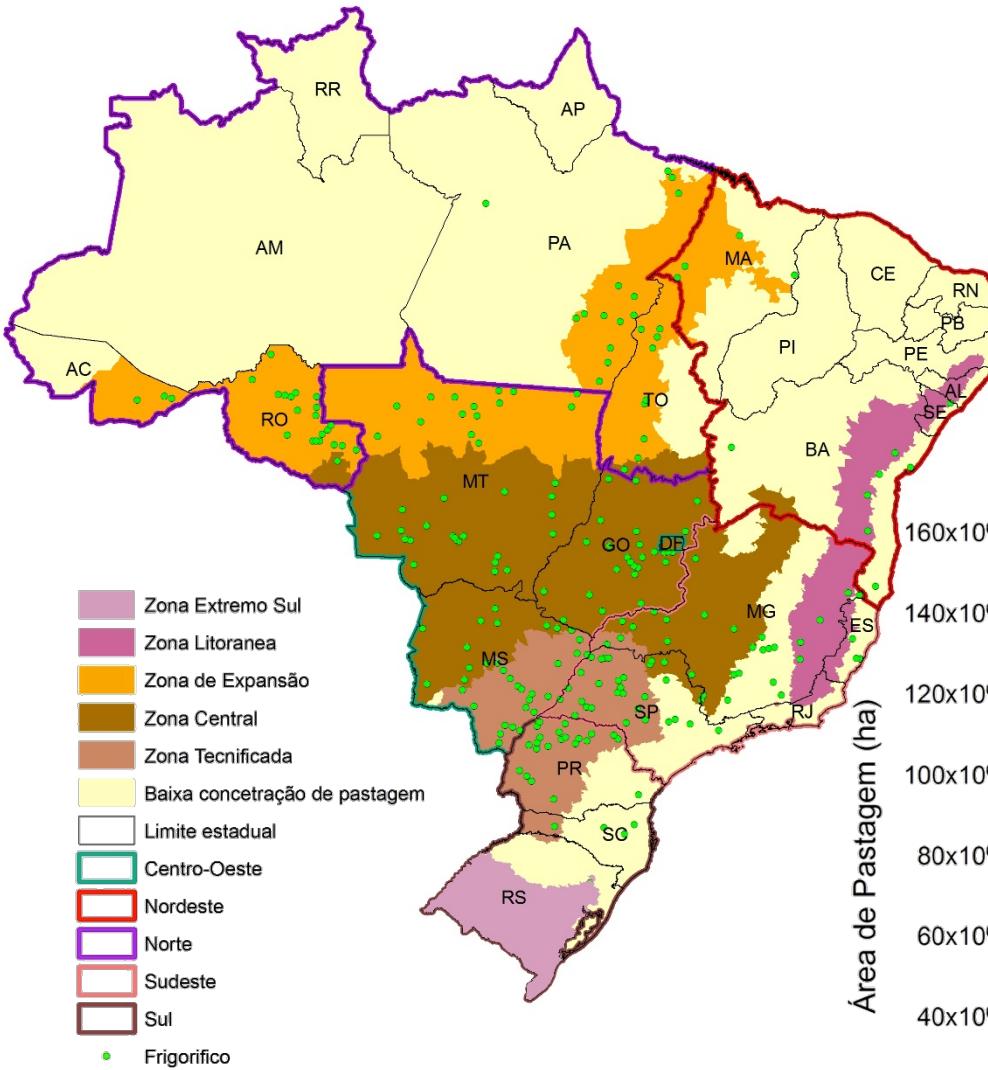


IBGE PPM 2012

~ 211 M cabeças

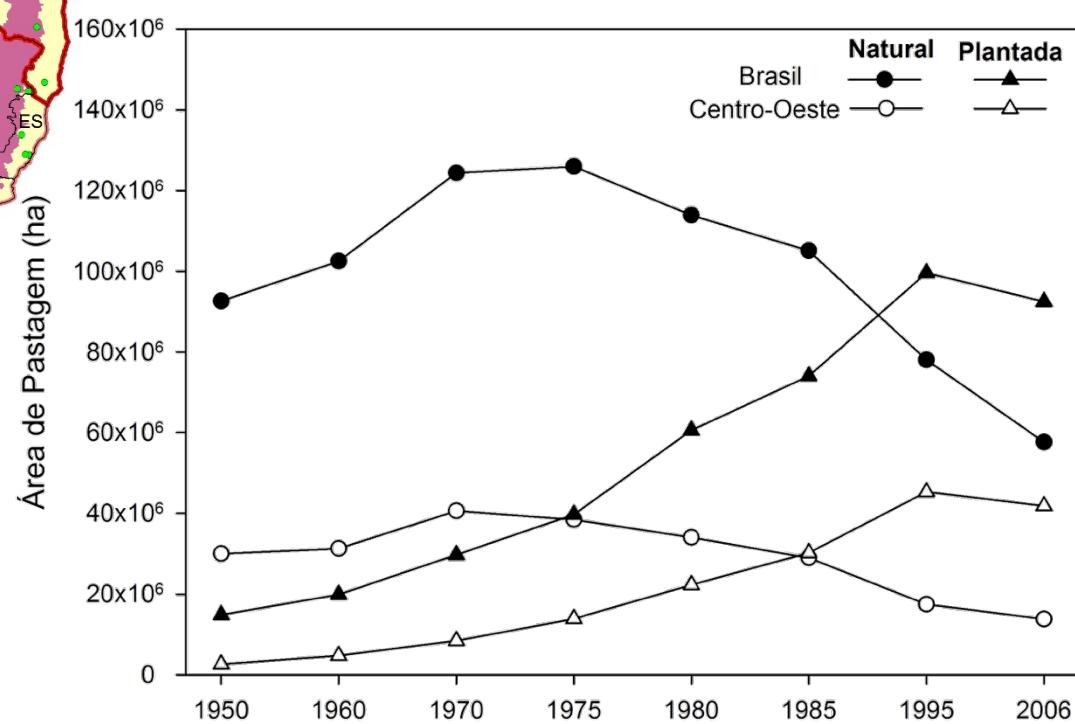


# Zonas de concentração das pastagens no Brasil



**80% Brachiaria (1960)**  
ciclo mais longo e espacialmente expansivo

**Andropogon (1980)**  
Solos de baixa a média fertilidade

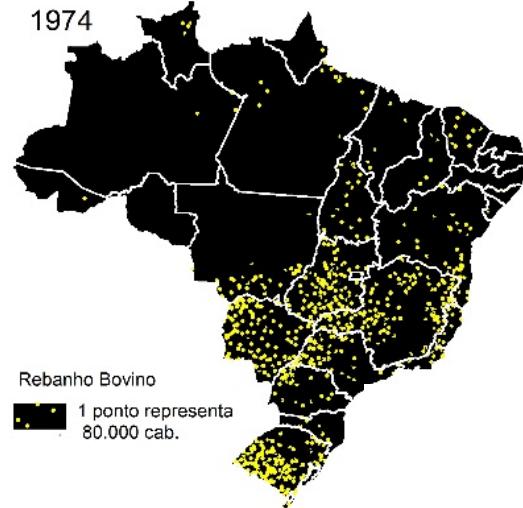


# Zonas de concentração do rebanho bovino...

Embrapa

Gado de Corte

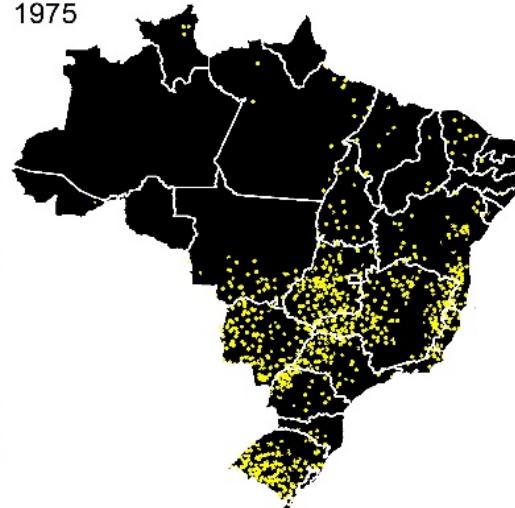
1974



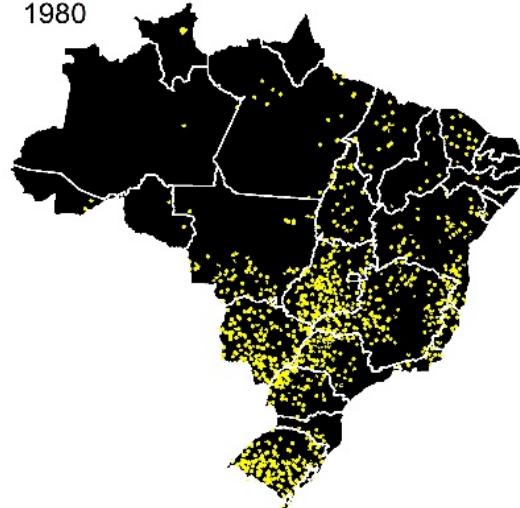
Polamazônia (MT, PA, "TO")

Polo Centro

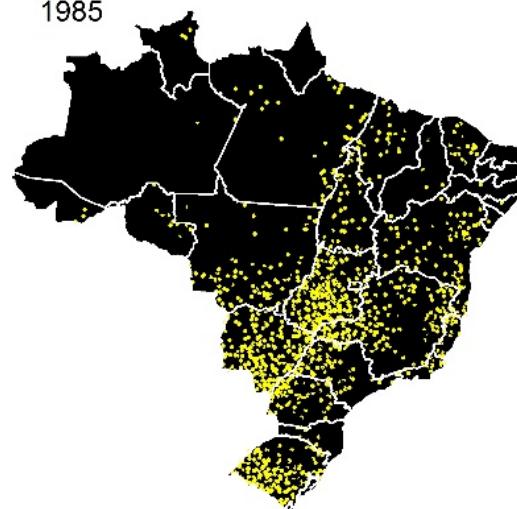
1975



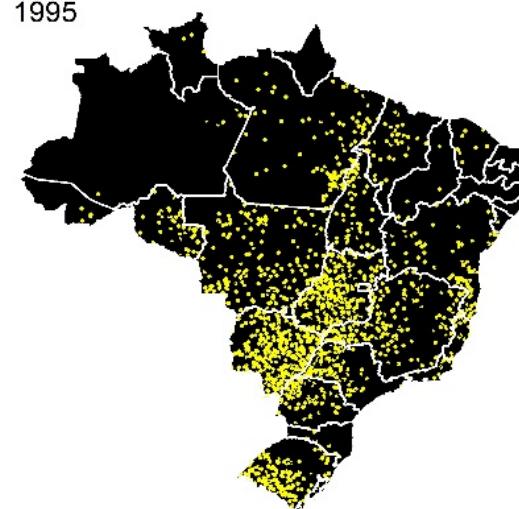
1980



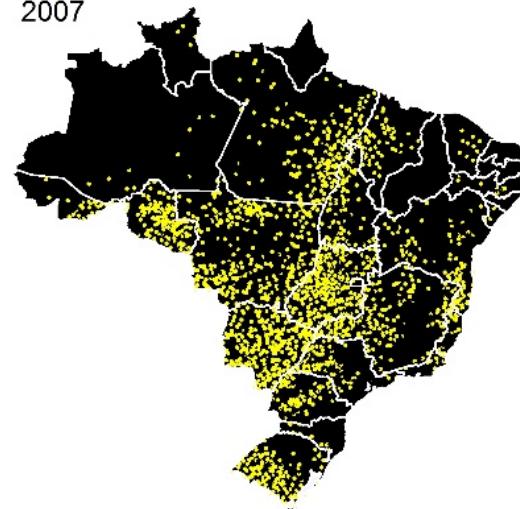
1985



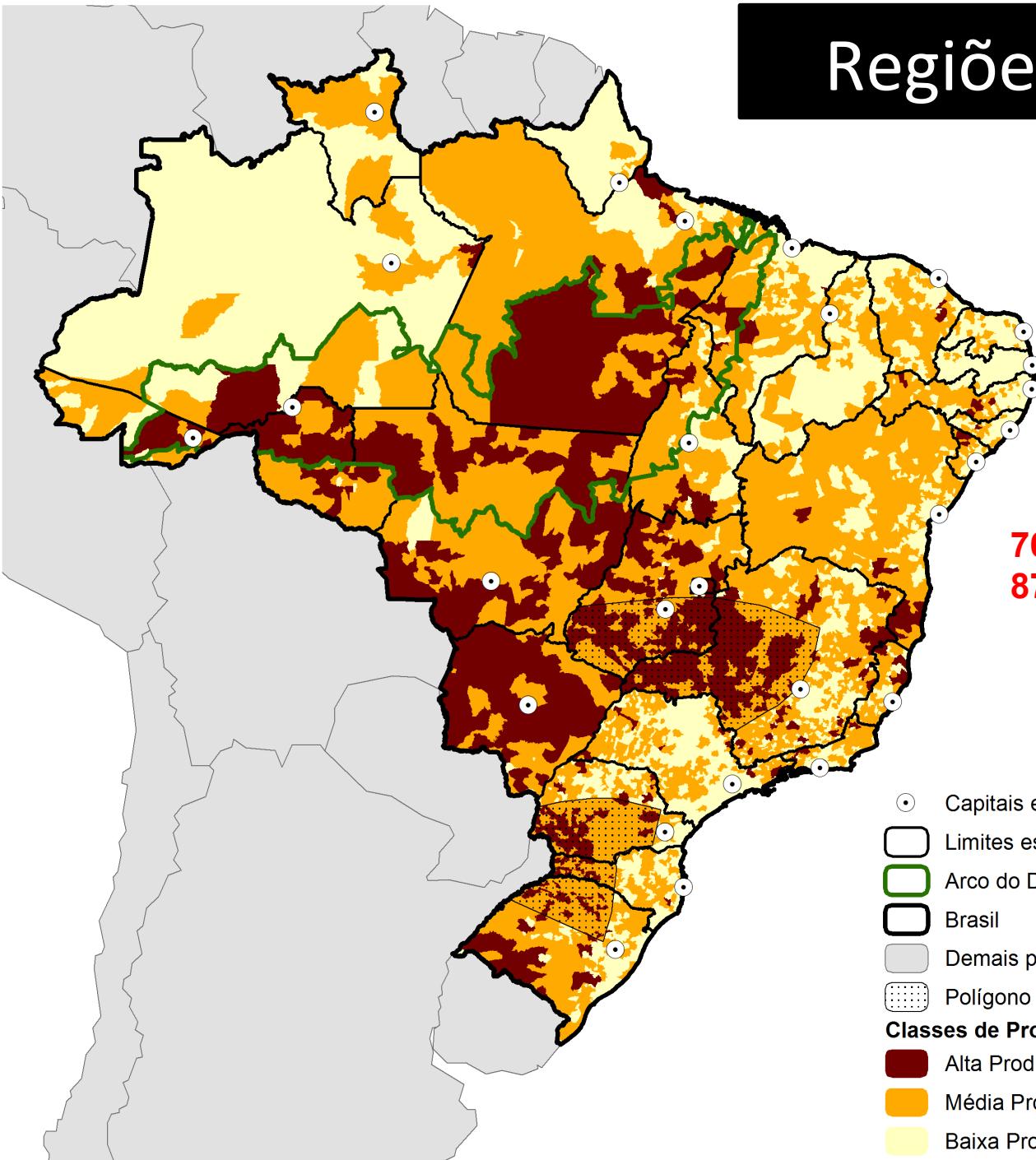
1995



2007



# Regiões “pecuárias”



- Pastagens
- Rebanho
- Produção leiteira
- Vacas ordenhadas
- Abates

76% investimentos Plano ABC  
87% matadouros & frigoríficos

- Capitais estaduais
  - Limites estaduais
  - Arco do Desmatamento
  - Brasil
  - Demais países da América do Sul
  - Polígono Leiteiro
- Classes de Produtividade Pecuária**
- Alta Produtividade Pecuária
  - Média Produtividade Pecuária
  - Baixa Produtividade Pecuária

# Considerações: padrões e contextos

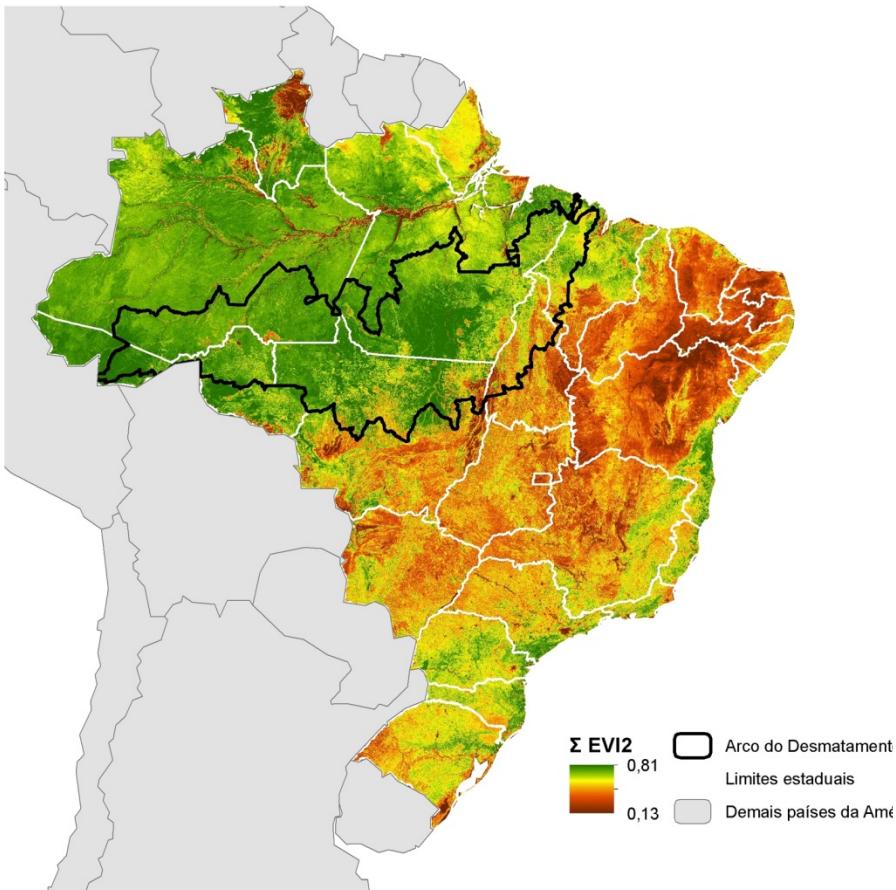
- ~ 75% das pastagens em declividades < 8%
  - Municípios “pecuários”: ~ 90% < 8%
  - Áreas compatíveis com a produção de grãos
- Pastagens nativas (sul, Caatinga, Pantanal)
  - Precipitação (e/ou solos úmidos)
  - Clima semi-árido (desfavorável às espécies exóticas)
- Cinco zonas de concentração das pastagens
  - Zonas de expansão, central e de tecnificação
    - ~ 90% dos matadouros e frigoríficos
- Fogo em pastagens: eventos climáticos & manejo
  - 2002 – 2007 (~ 25%), expansão e/ou consolidação?
    - Pastagens em zonas de expansão, central e tecnificação
- Plano ABC / Recuperação: 1404 municípios (2013)
  - Alta (305) e média (768) produtividade

# **Padrões Biofísicos & Métricas de Qualidade**

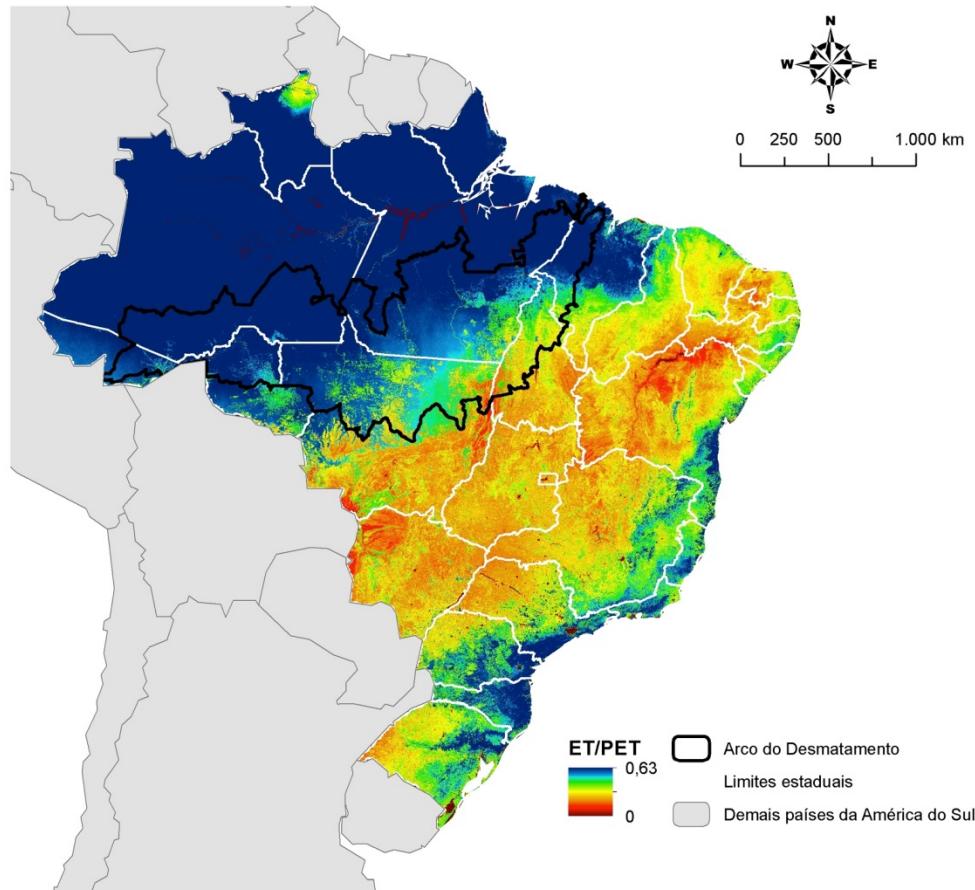
**Faz. Douradinho (Prata, MG), Abril 2014**

# Imagens Brasil: 2000 - 2013

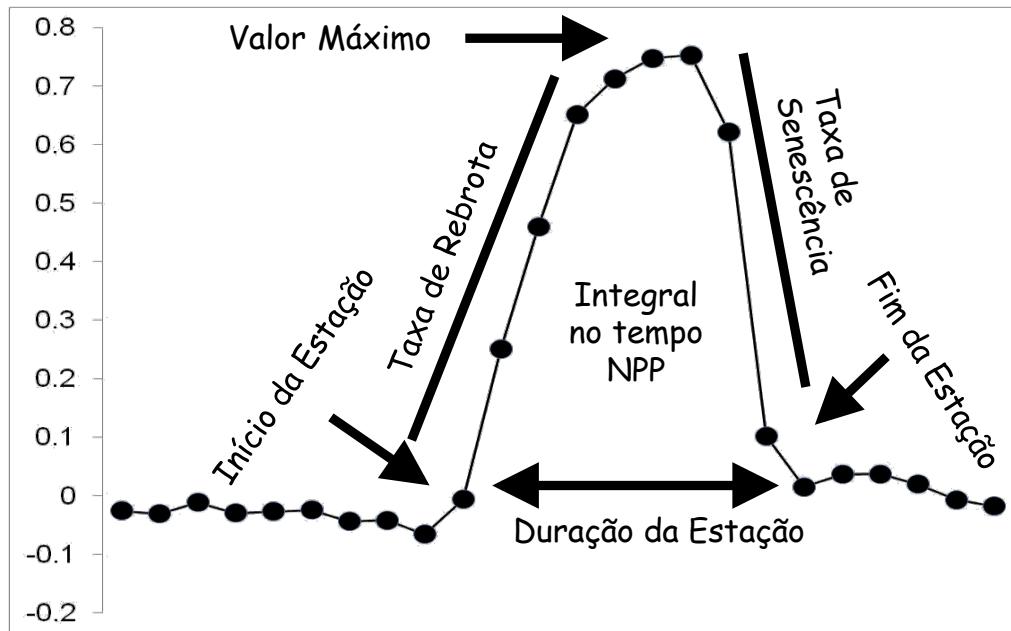
**MOD13Q1**  
**2000 - 2013**



**MOD16A1**  
**2000 - 2013**



# Obtenção de parâmetros sazonais

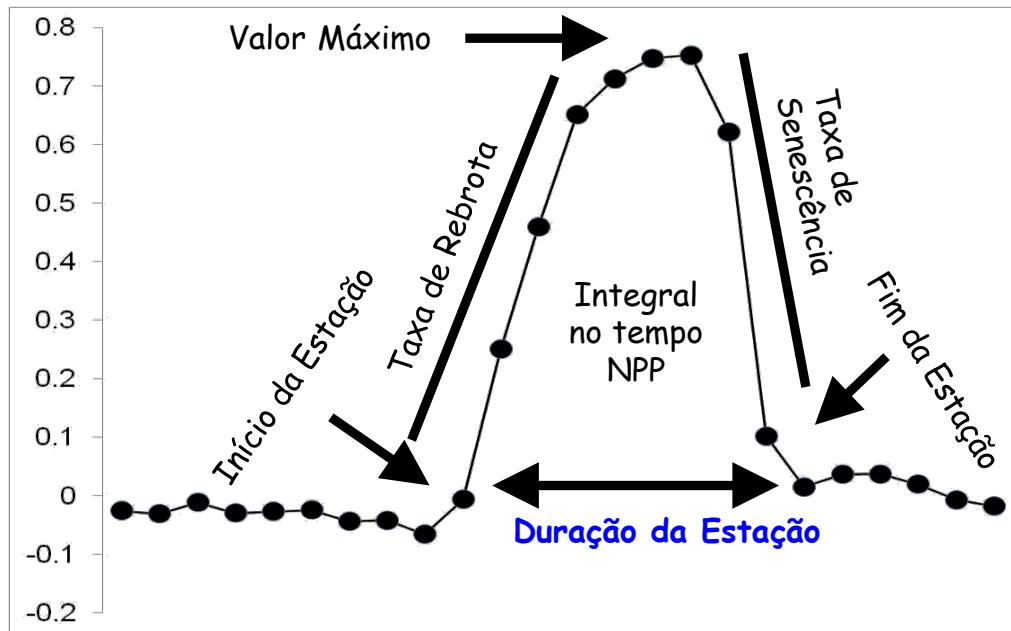


Imagens	Mosaicos	Espaço em Disco
MOD13Q1 – EVI2	322	390 GB
MOD16A2 – ET e PET	312	24 GB
TRMM – PPT	156	17 MB

## Parâmetros Sazonais Utilizados

- Produtividade Primária Líquida - NPP
- Taxa de Rebrota
- Taxa de Senescência

# Obtenção de parâmetros sazonais



## Imagens

## Mosaicos

## Espaço em Disco

MOD13Q1 – EVI2

322

390 GB

MOD16A2 – ET e PET

312

24 GB

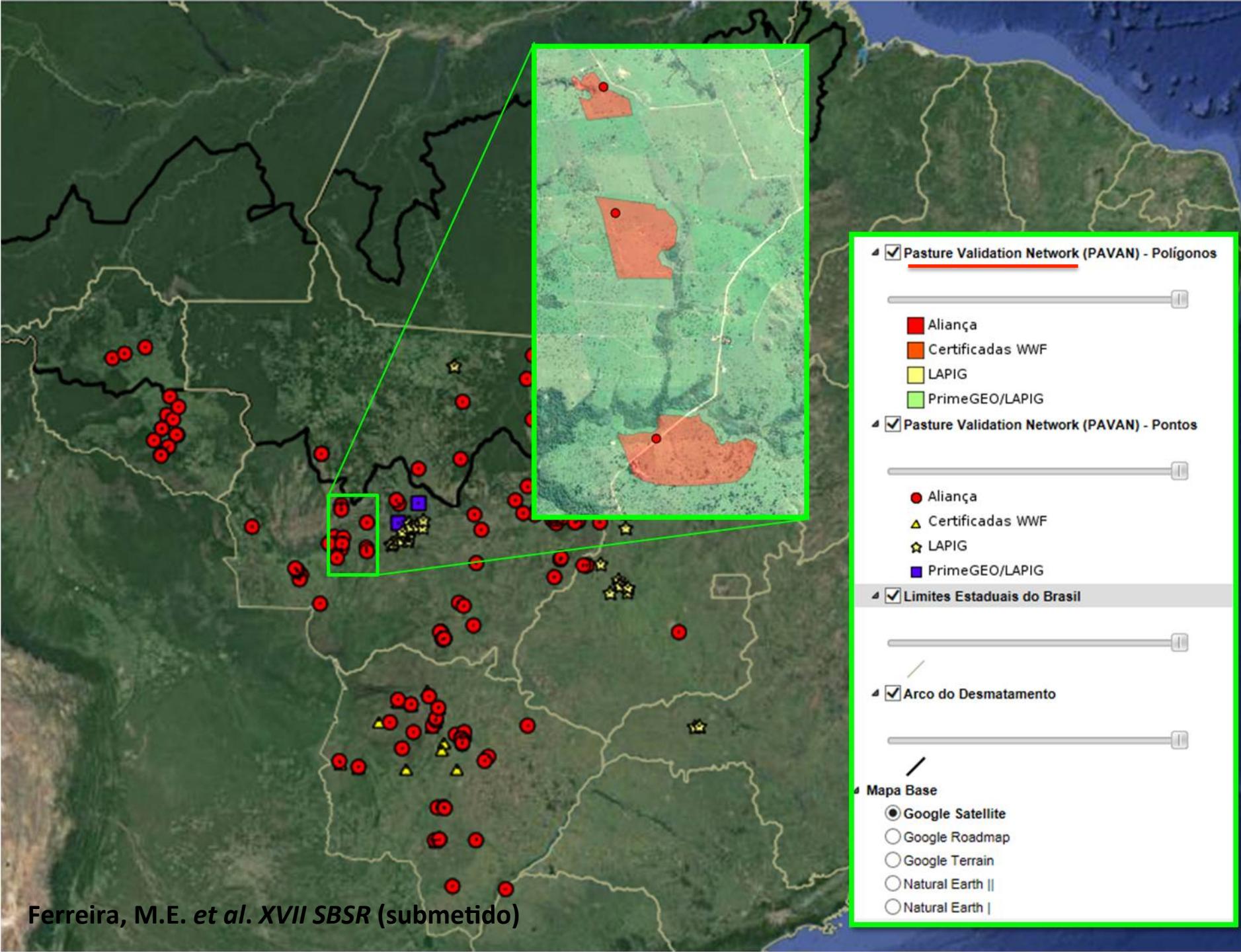
TRMM – PPT

156

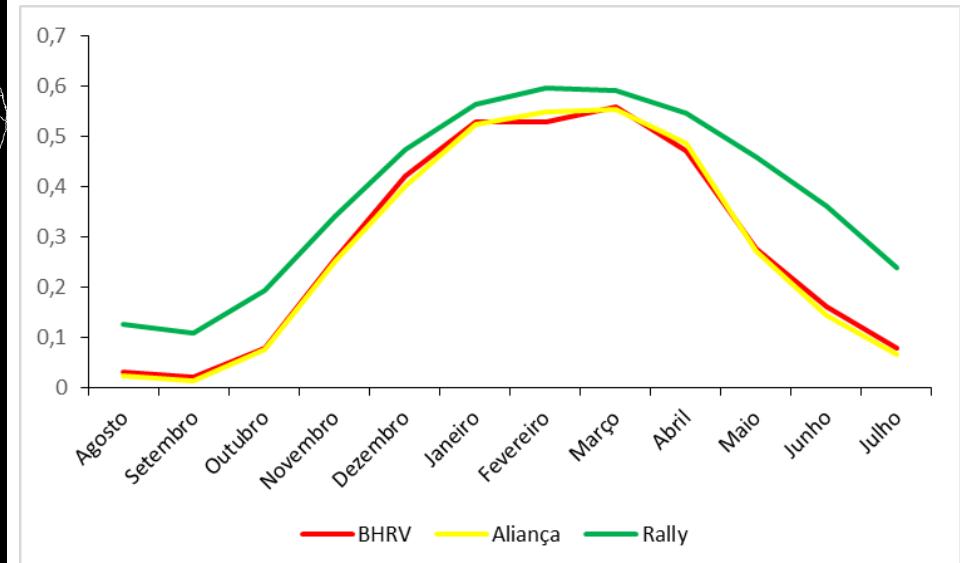
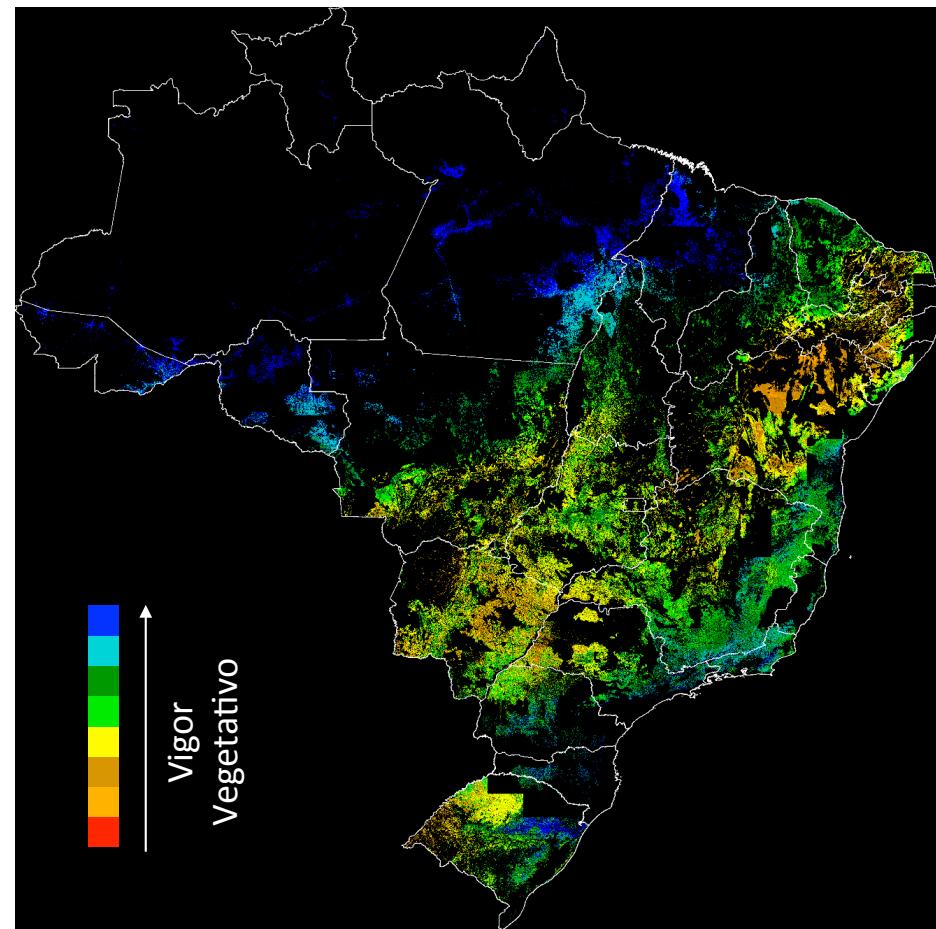
17 MB

## Parâmetros Sazonais Utilizados

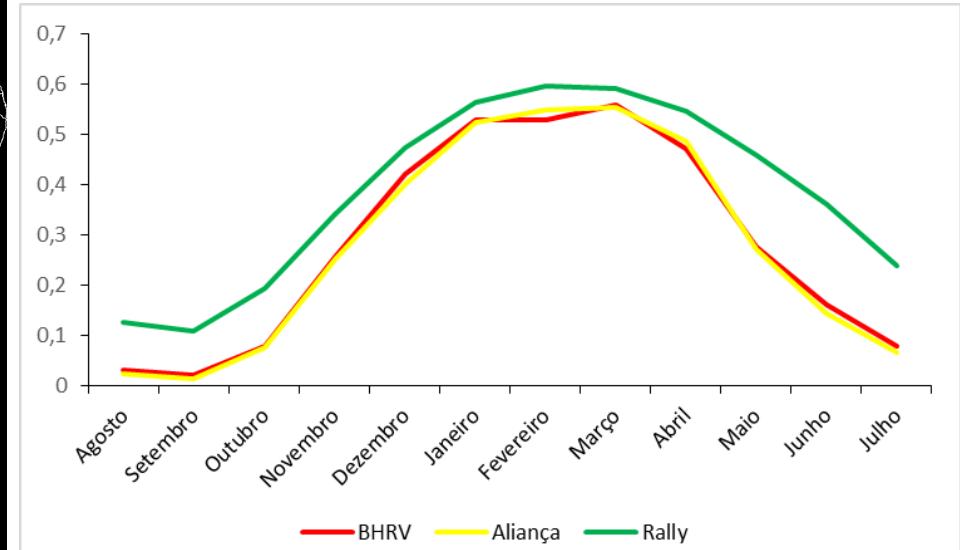
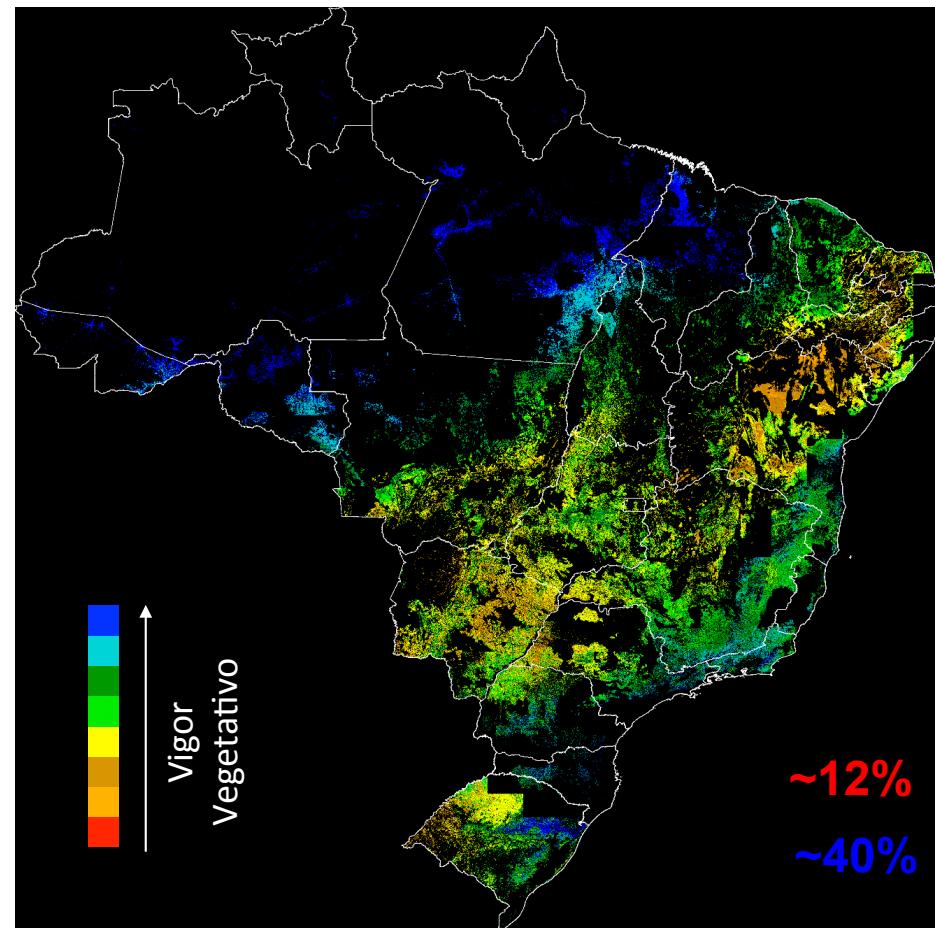
- Produtividade Primária Líquida - NPP
- Taxa de Rebrota
- Taxa de Senescência



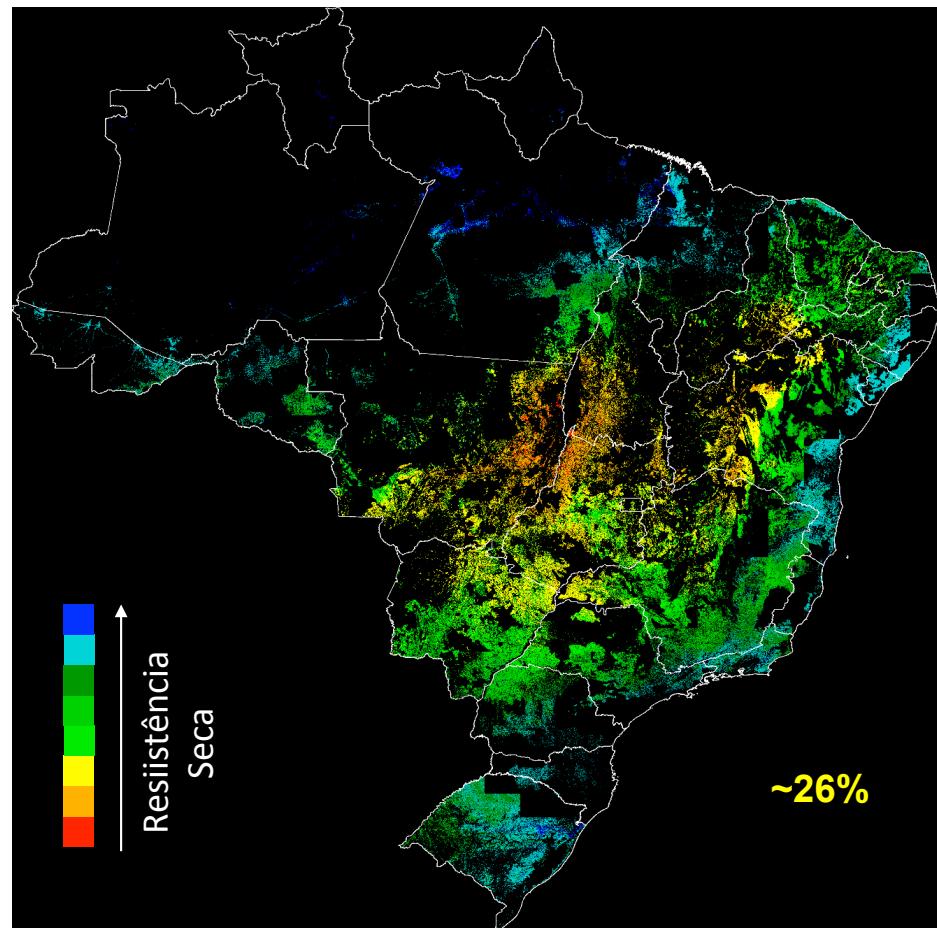
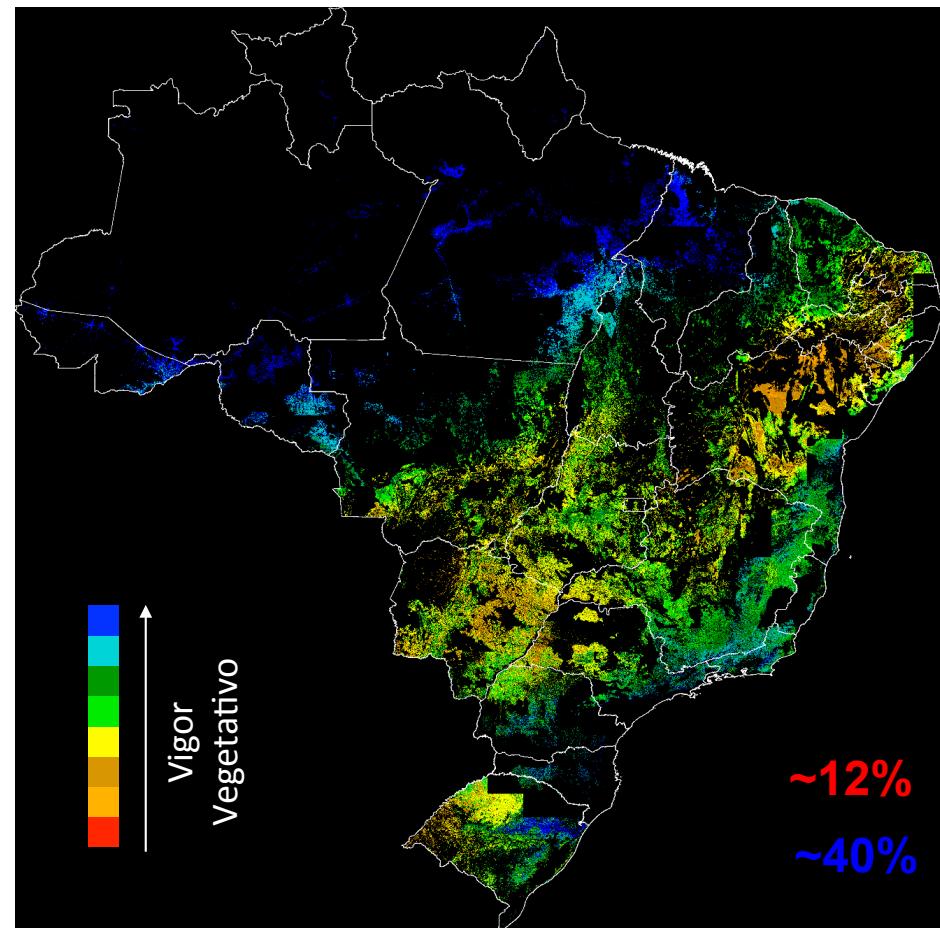
# ETn Acumulado: *Vigor Vegetativo*



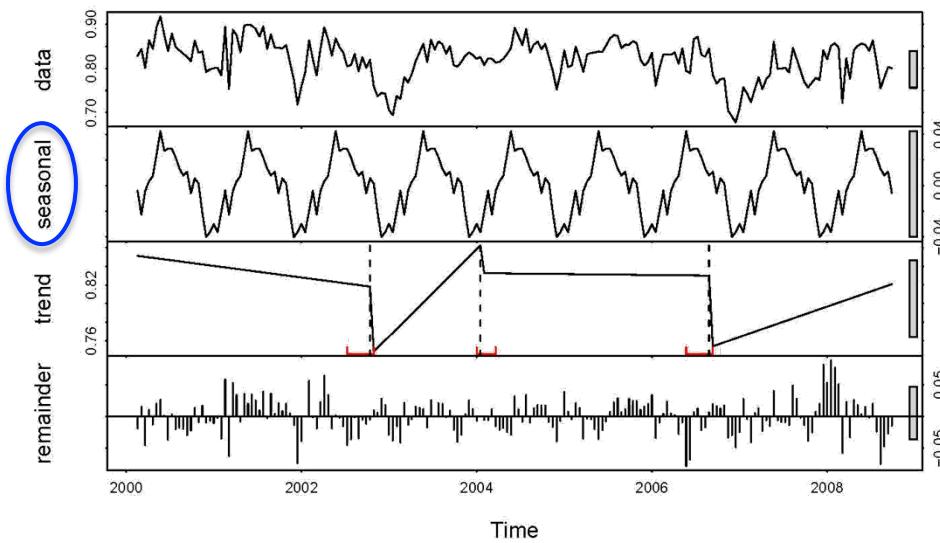
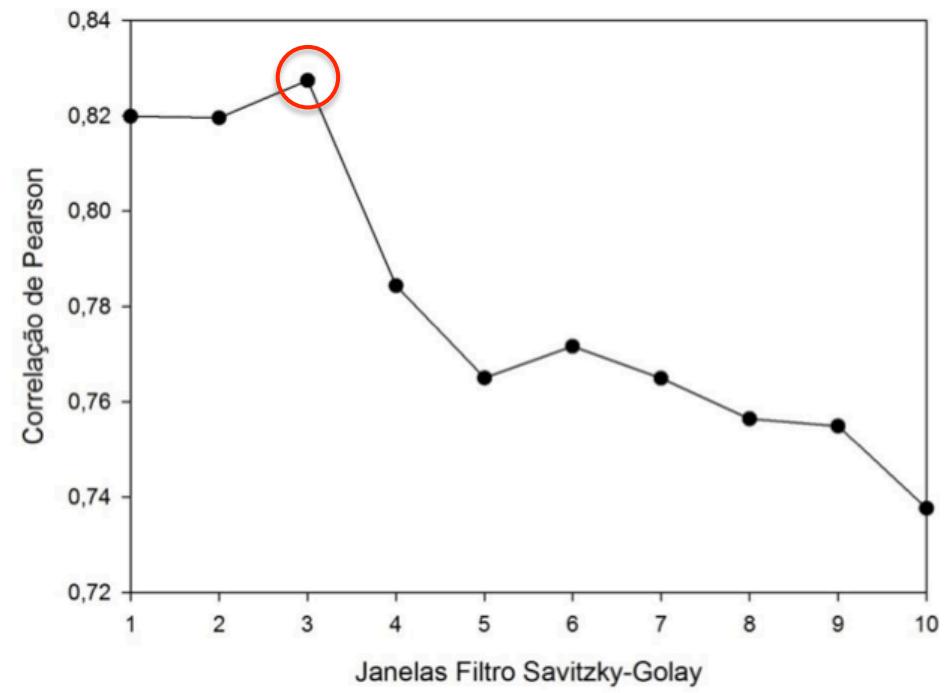
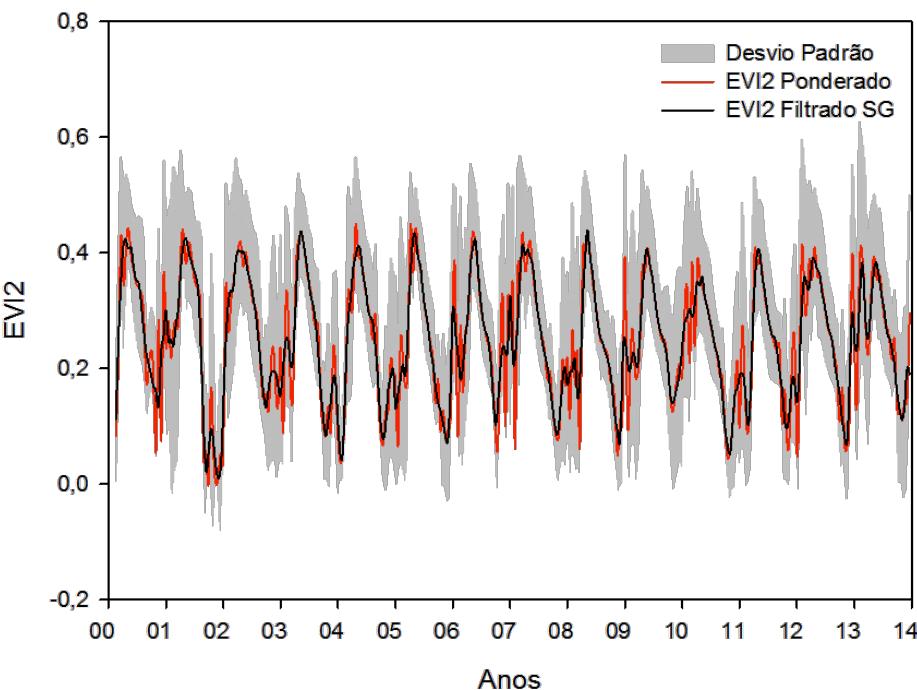
# ETn Acumulado: *Vigor Vegetativo*



# ETn Acumulado: *Vigor Vegetativo*



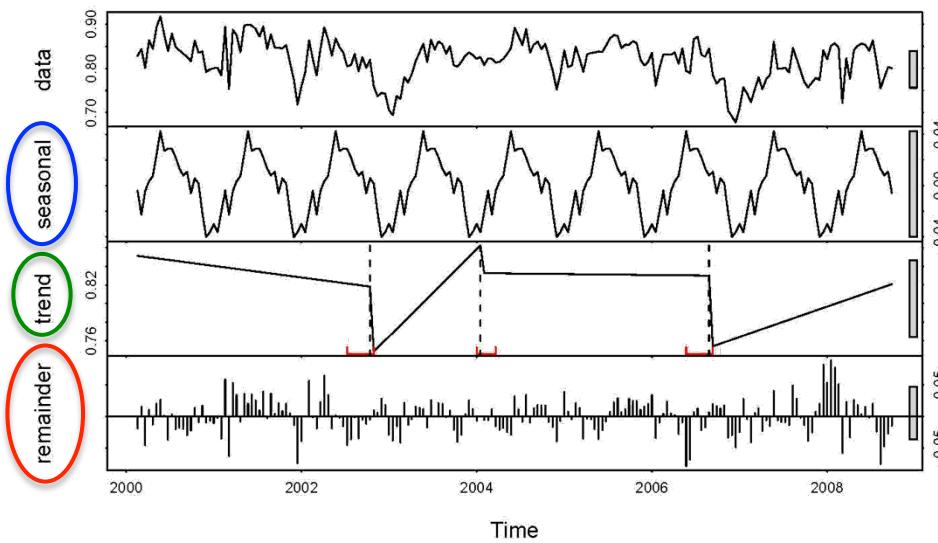
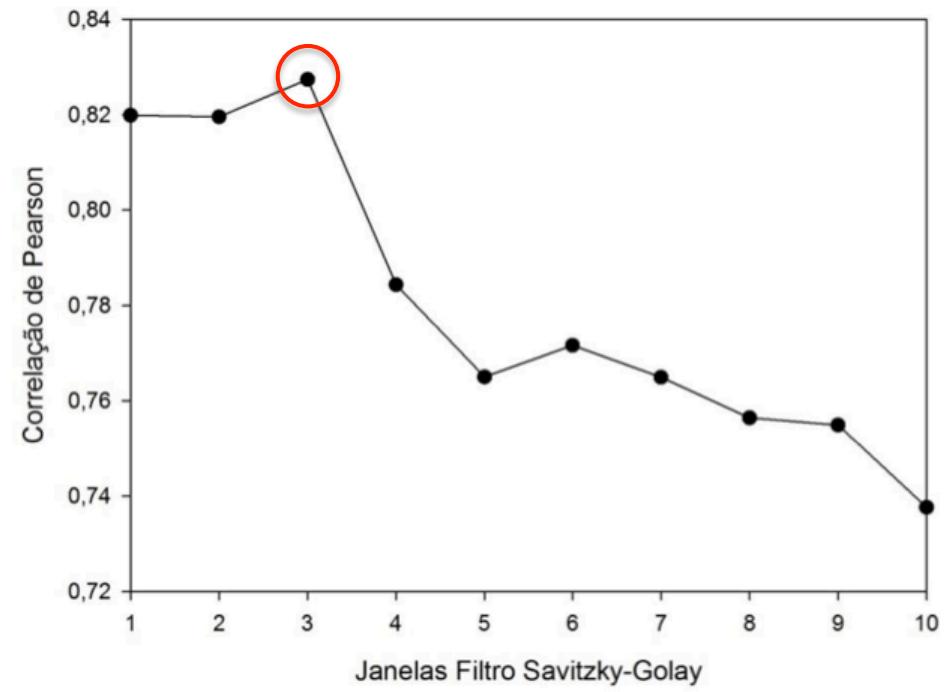
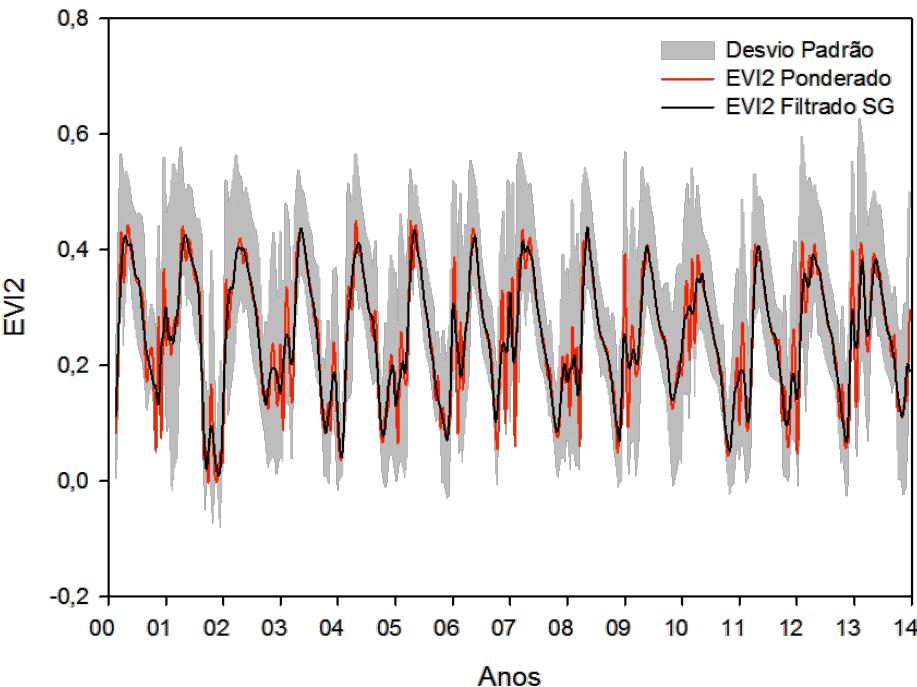
# Características das séries temporais EVI



Componentes da Série Temporal

- **Sazonal**
- Tendência
- Ruído

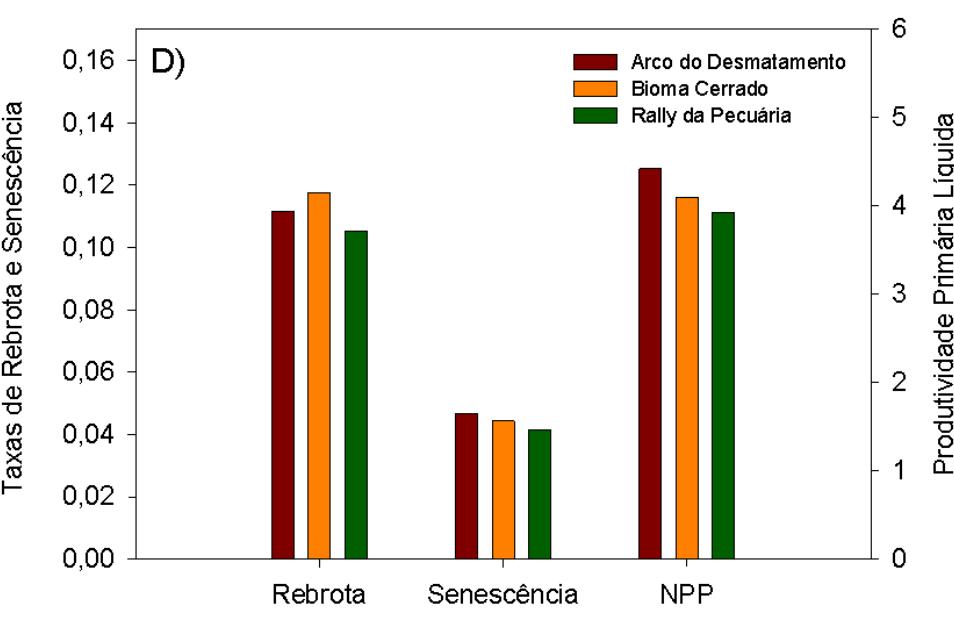
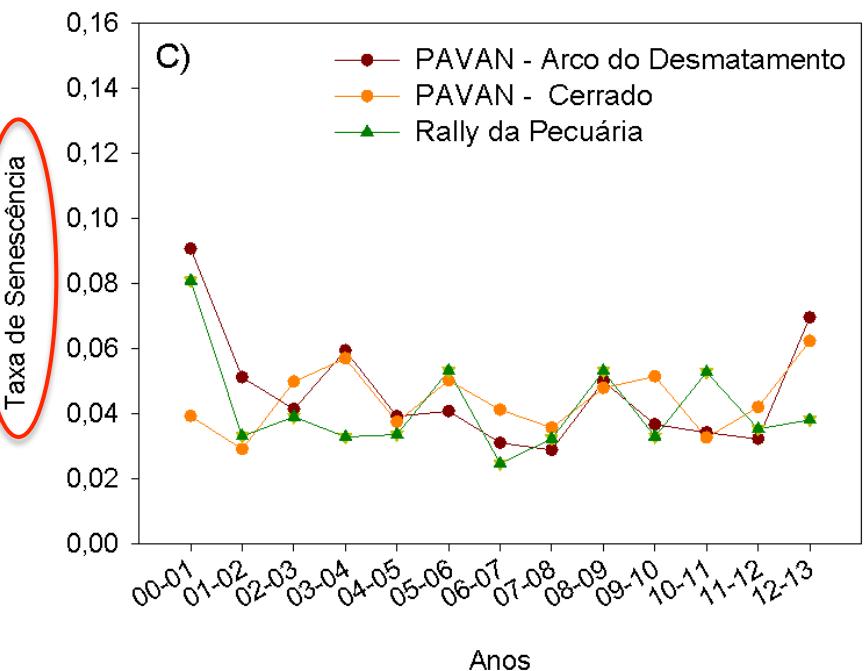
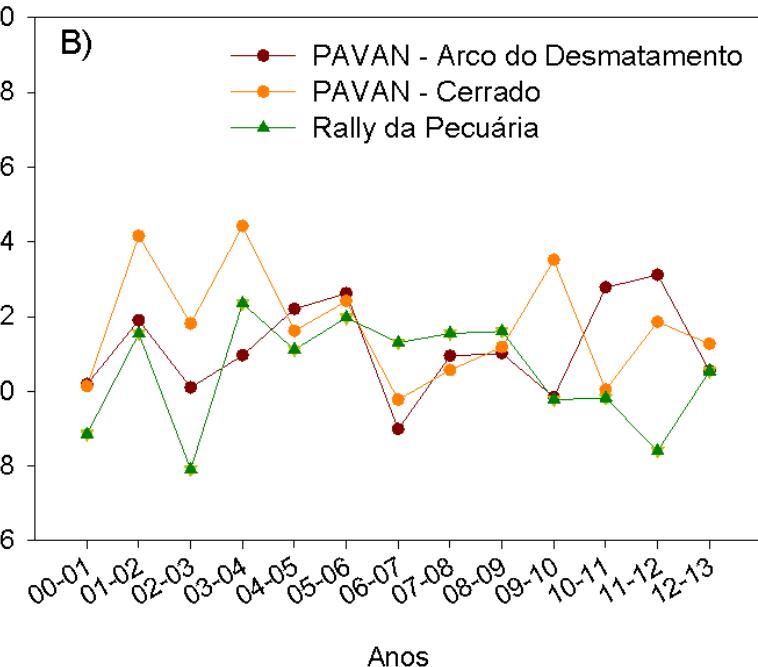
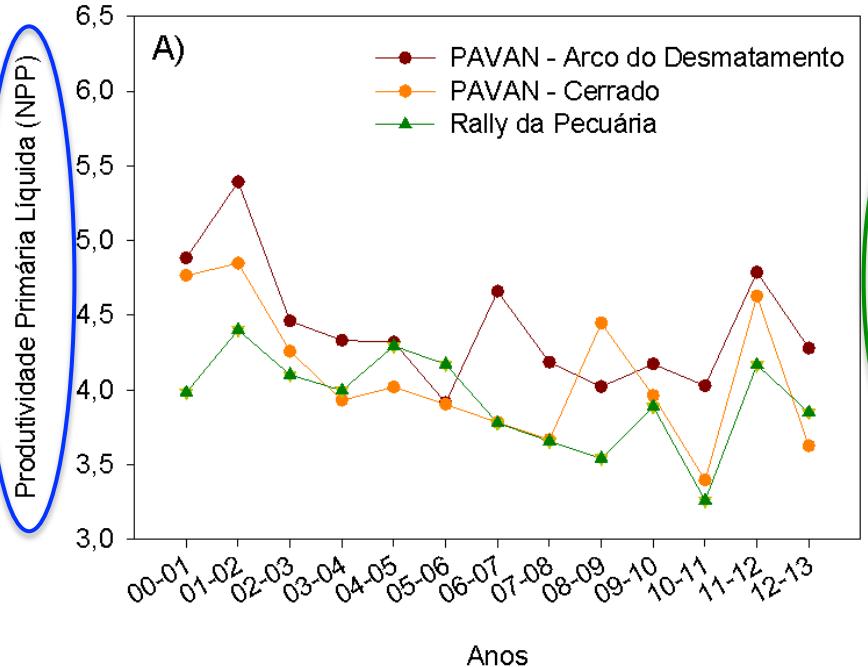
# Características das séries temporais EVI



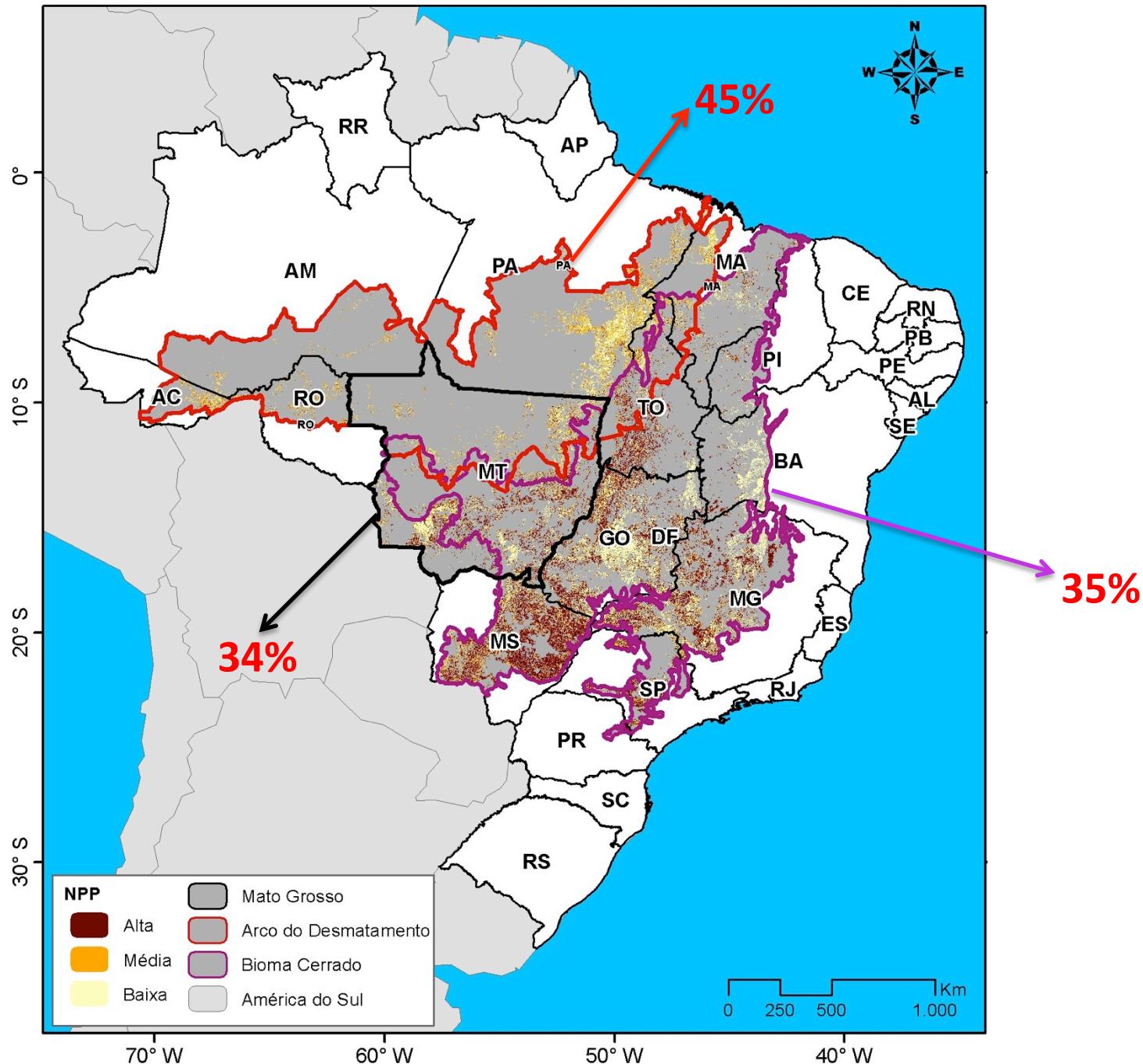
Componentes da Série Temporal

- **Sazonal**
- Tendência
- Ruído

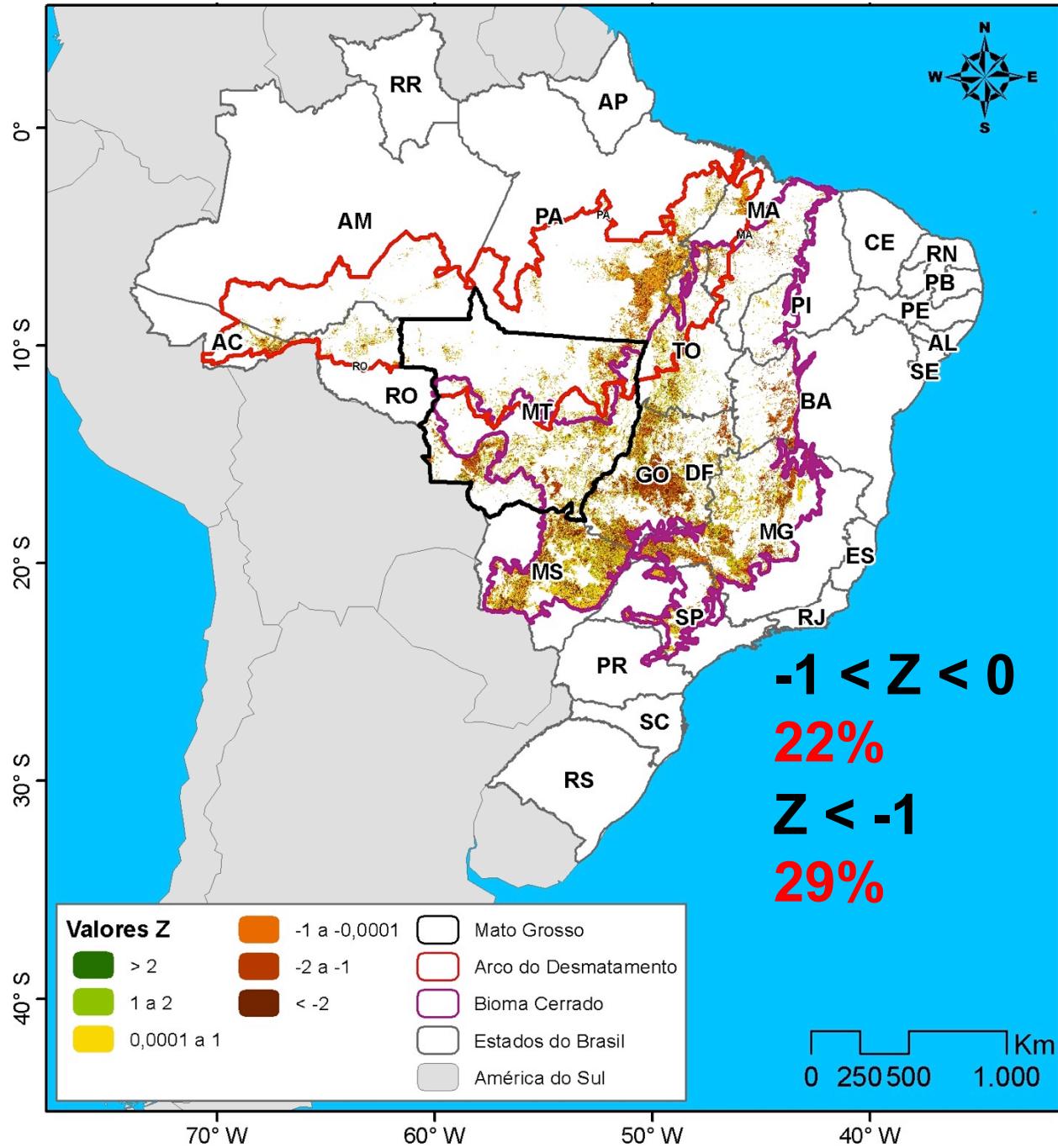
# Métricas sazonais (“qualidade”)



# Produtividade Primária Líquida



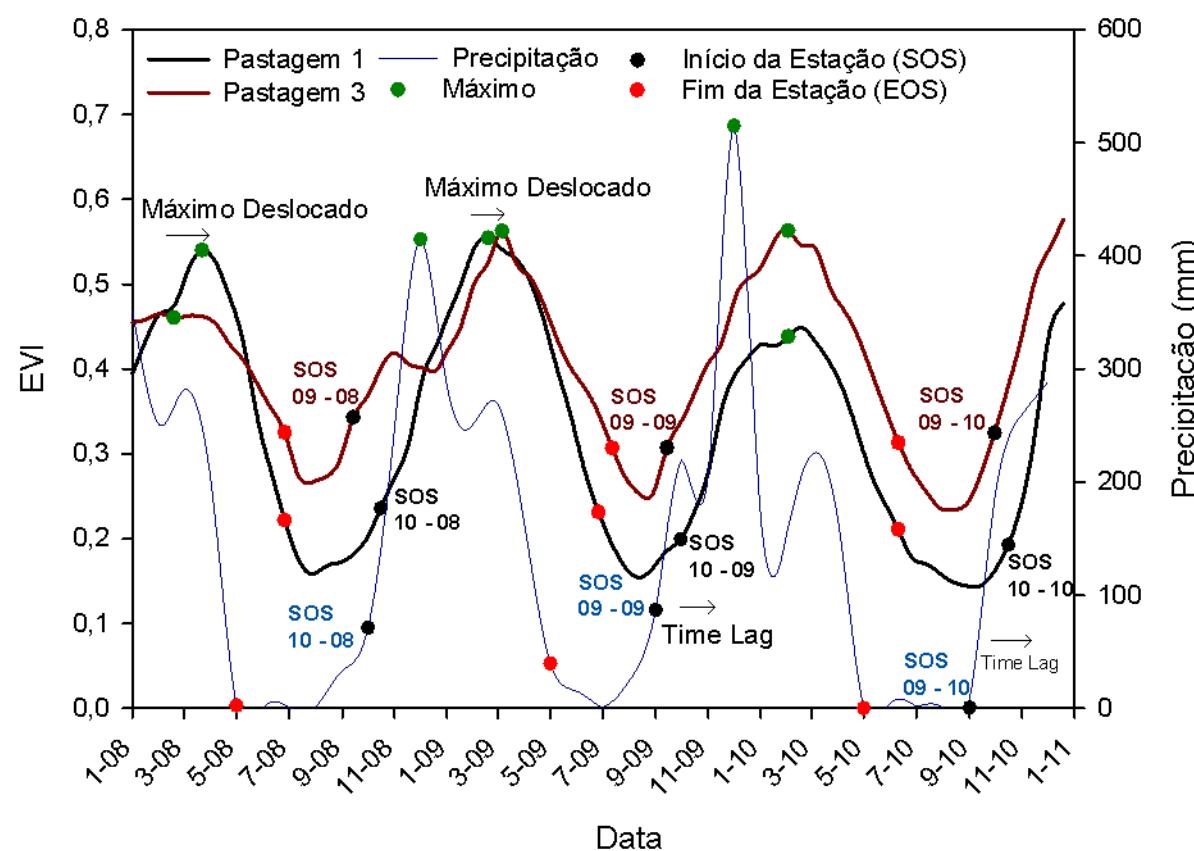
# NPP + Taxa de Rebrota



# Considerações: padrões biofísicos e métricas

- Vigor das pastagens (atividade fotossintética e ET) em função do regime climático

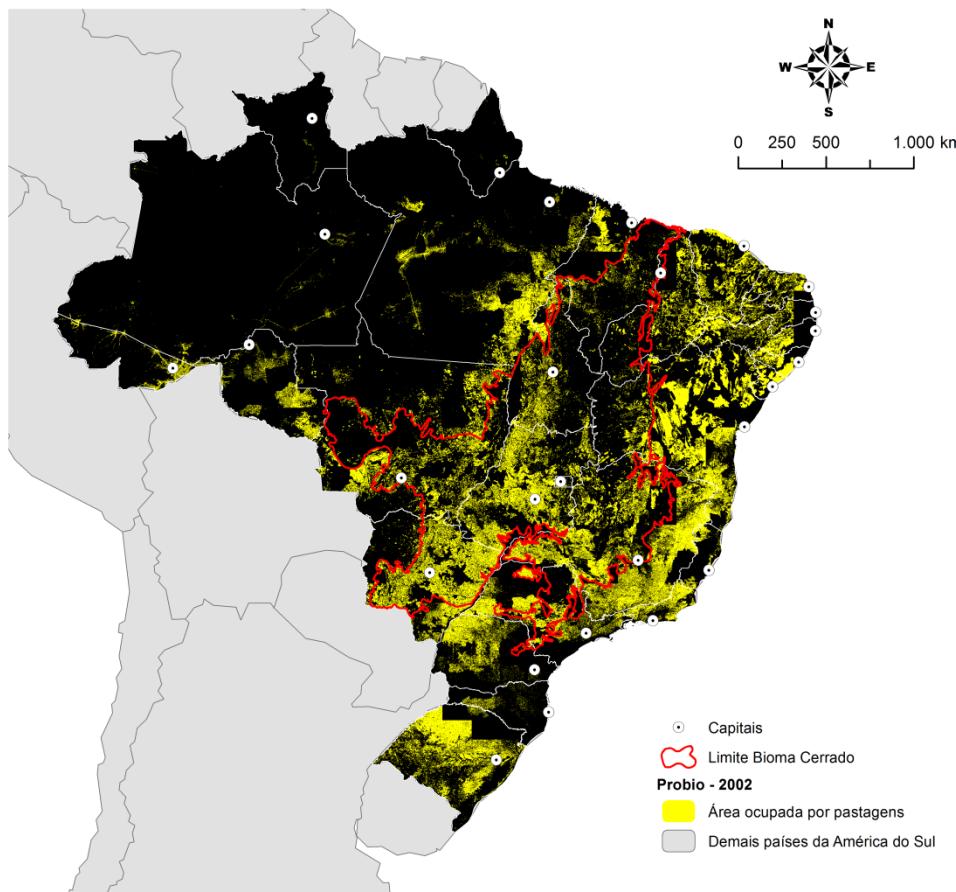
- Desafio: separação componentes climático e ambiental
  - Tendências
  - Fenologia vs. manejo



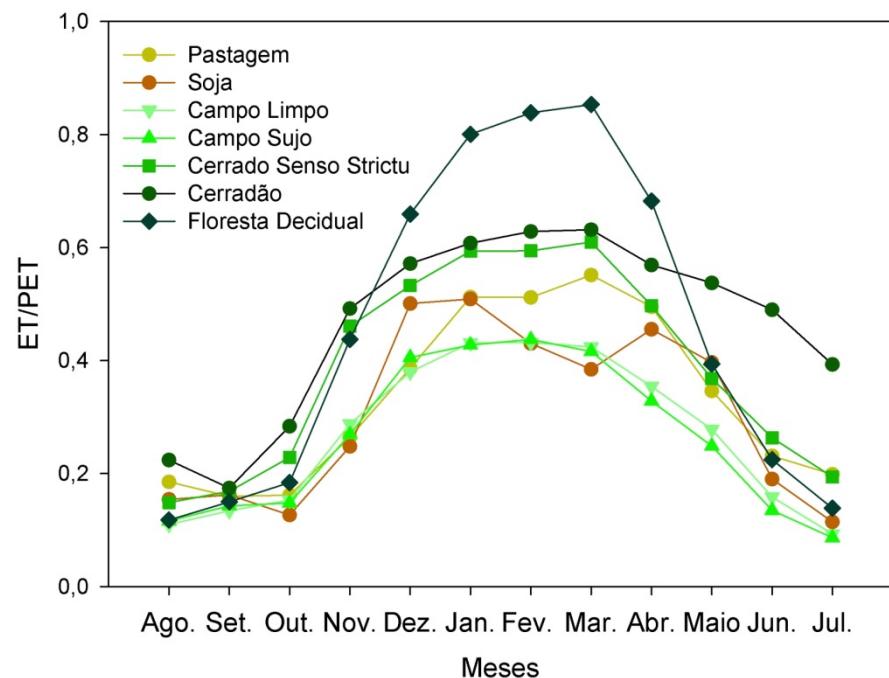
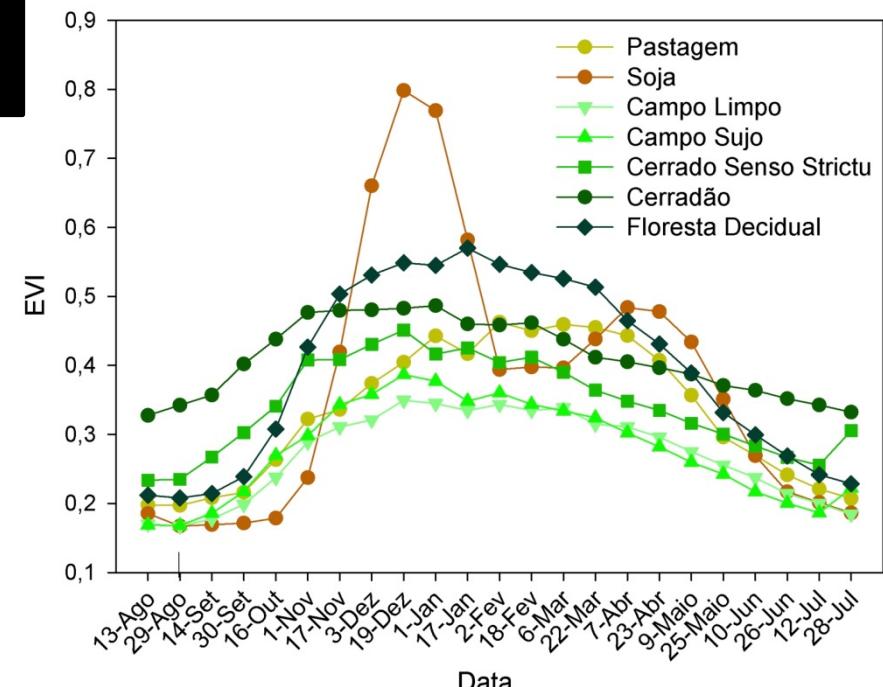
# Pastagens & Serviços Ecossistêmicos

Bacia do Rio Vermelho (Goiás), Março 2013

# Ecossistema emergente...

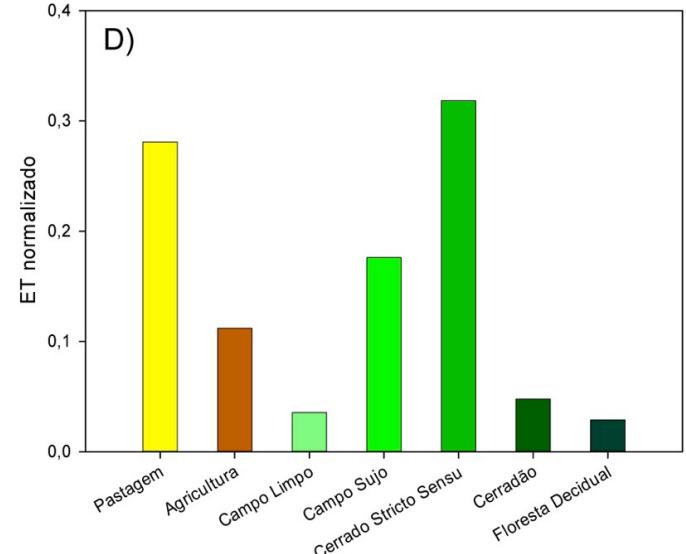
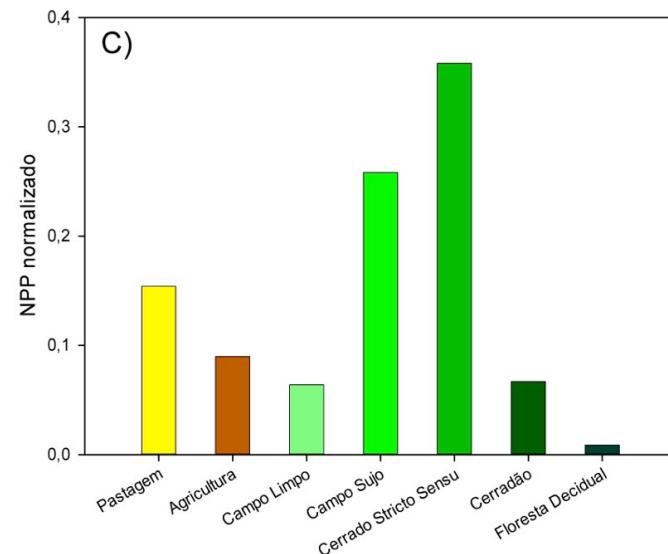
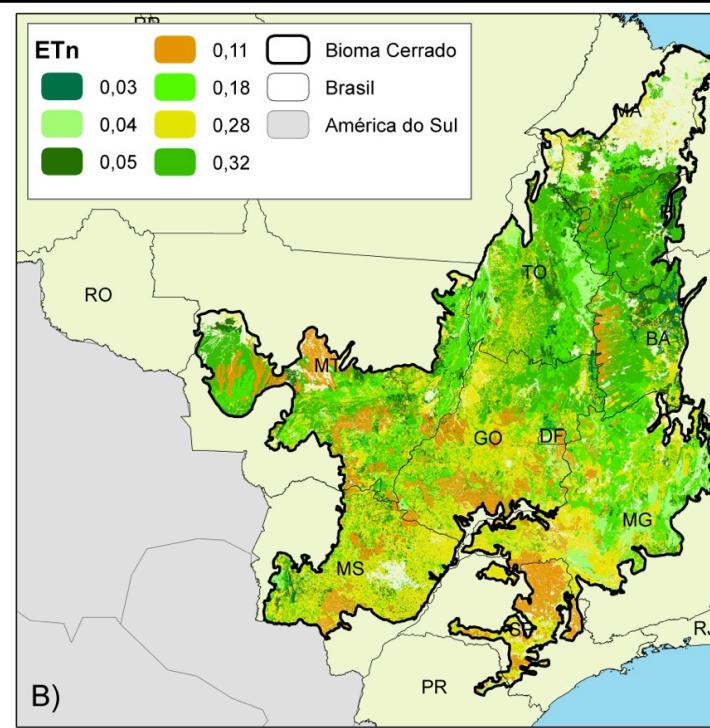
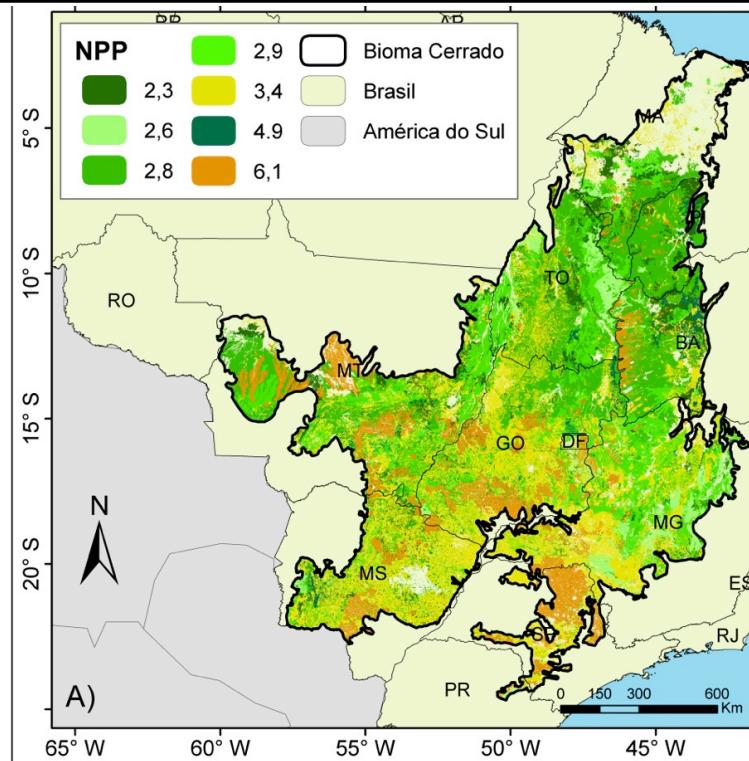


Reducing  
Emissions from  
Pasture degradation  
**REPD**



# Pastagens – fluxos carbono & água

Arantes, A.; Ferreira, L.; Coe, M. *Remote Sens. of Environment* (em revisão)



# Considerações: fluxos carbono e água

- Pastagens bem manejadas
  - Interação superfície – atmosfera
  - Elevadas taxas de produtividade primária e ET;
    - Mitigação de GEE e regeneração de chuvas;

Cobertura e Use da Terra	ET 2002 (Gt)	Biomassa 2002 (Gt)
Pastagem	419	9
Agricultura	156	3
Campo Limpo	57	1
Campo Sujo	278	5
Cerrado Stricto Sensu	332	7
Cerradão	71	2
Floresta Estacional Decidual	22	0.4
<b>Vegetação Remanescente</b>	<b>760</b>	<b>16</b>
<b>Agropecuária</b>	<b>576</b>	<b>12</b>
<b>Total</b>	<b>1336</b>	<b>28</b>

An aerial photograph showing a green, hilly landscape. Several distinct red, winding paths or tracks are visible, particularly on the left side and running diagonally across the frame. Small clusters of green trees are scattered throughout the terrain.

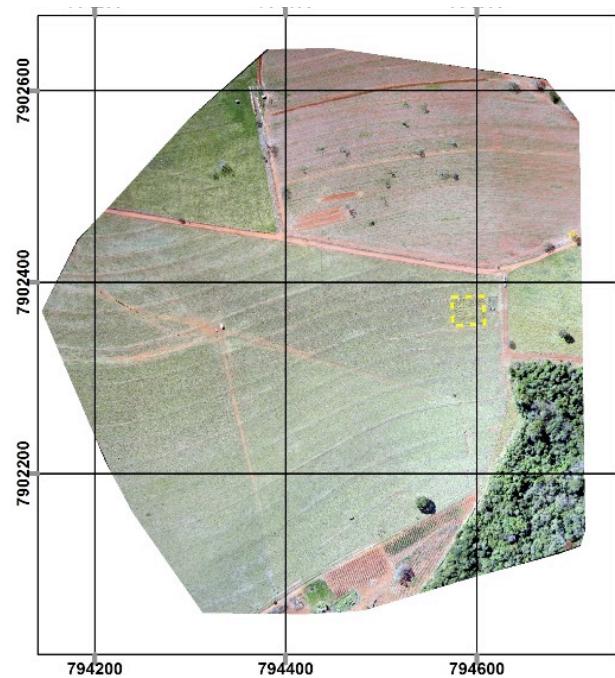
*Desdobramentos...*

**Bacia do Rio Vermelho (Goiás), Março 2013**

# Validação & scaling...

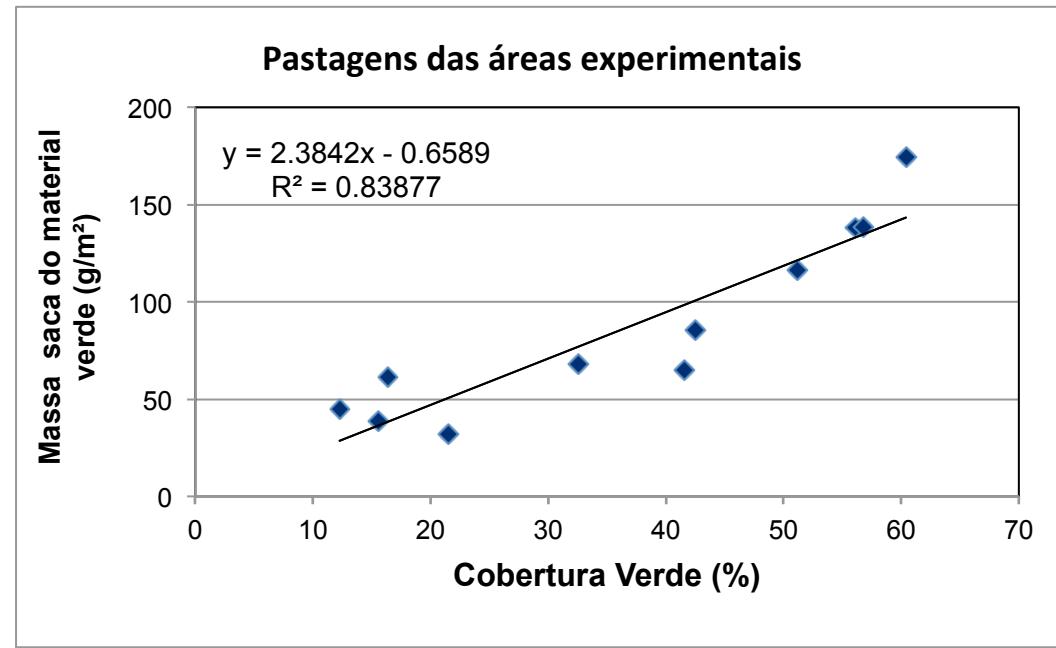
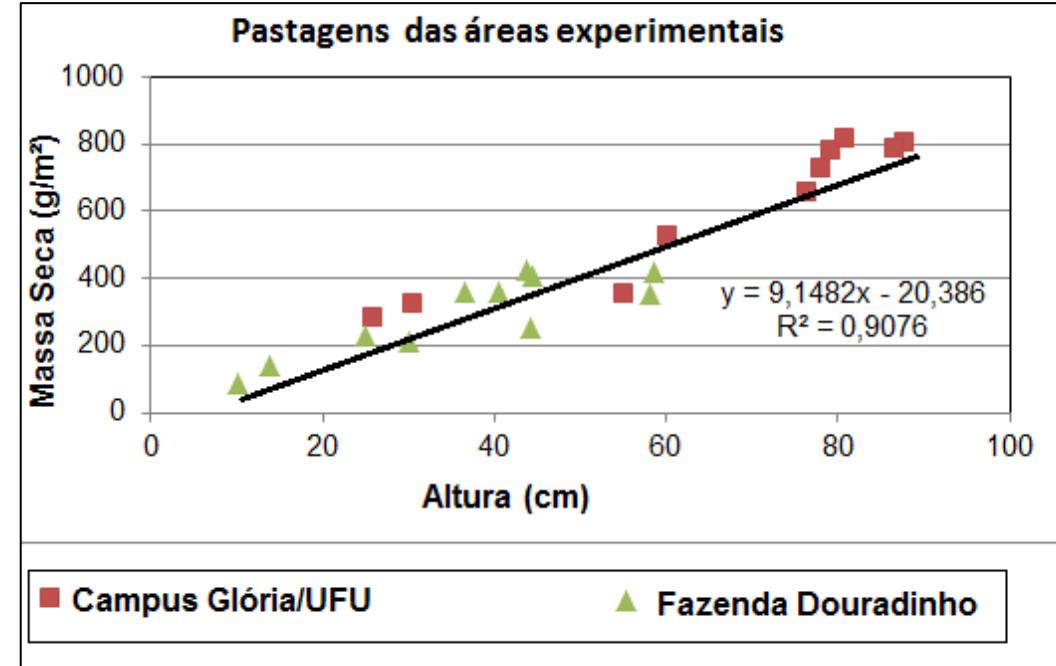
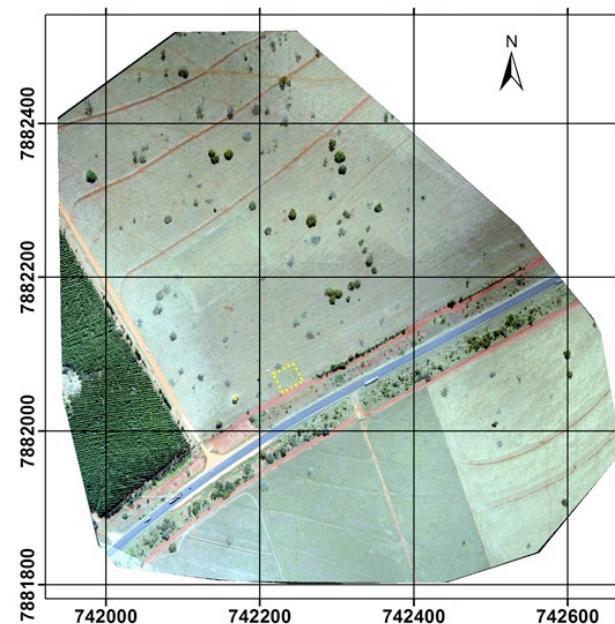
Faz. Glória

5216 kg / ha

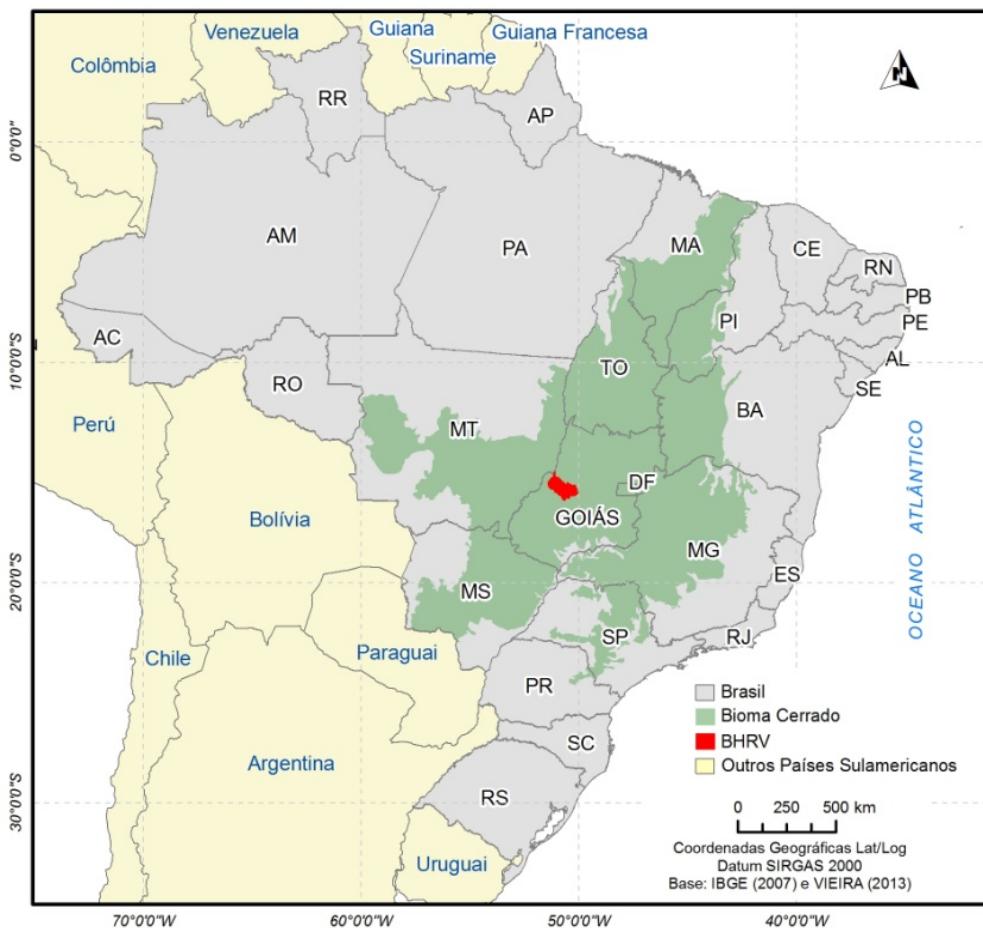


Faz. Douradinho

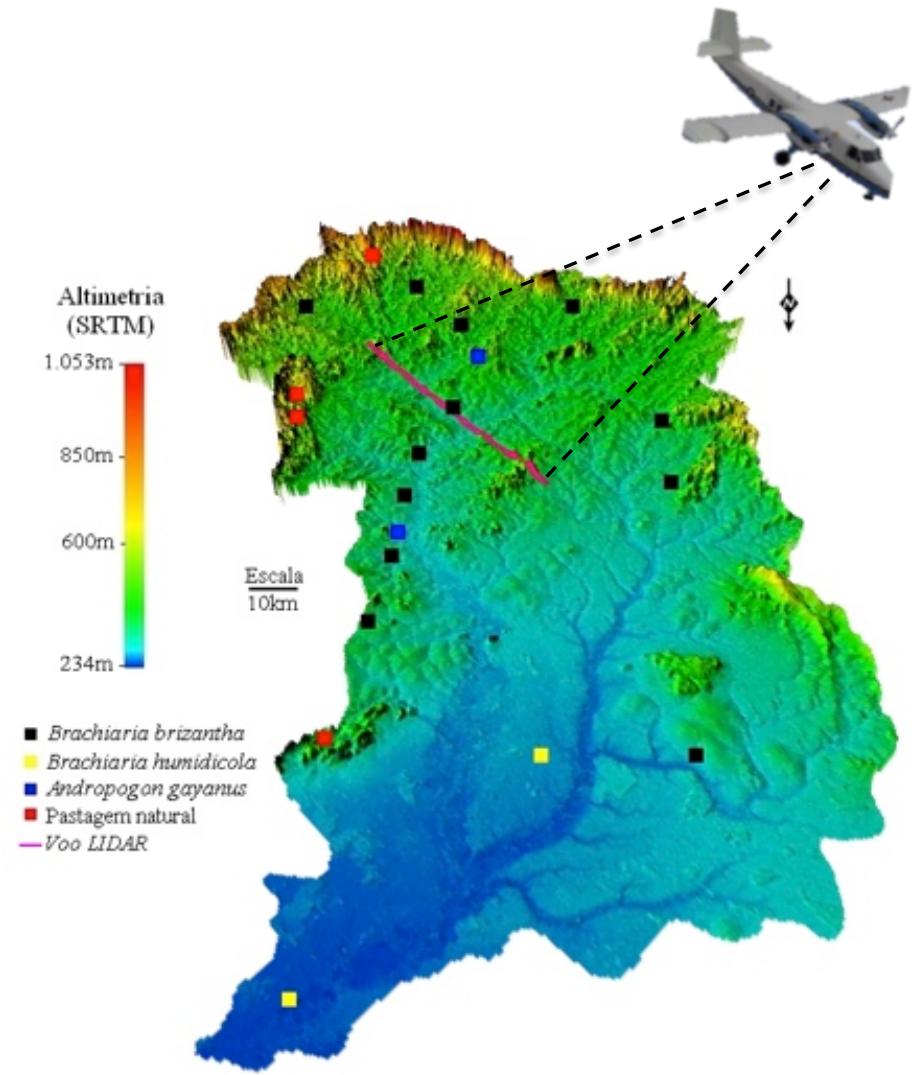
2670 kg / ha



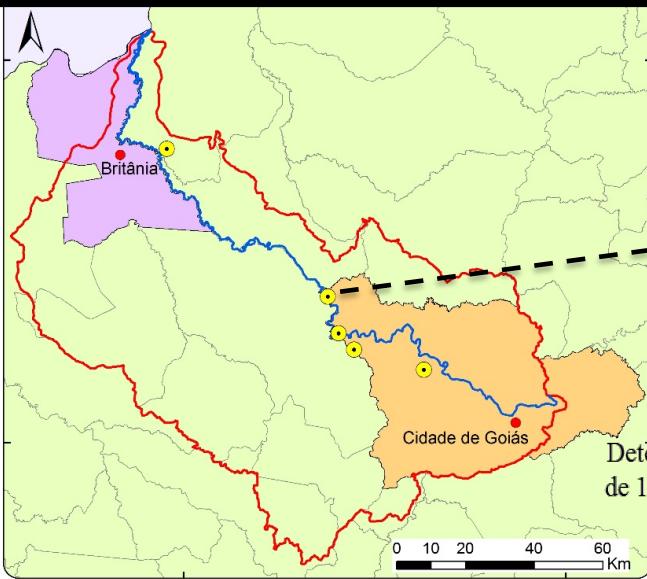
# Validação & scaling...



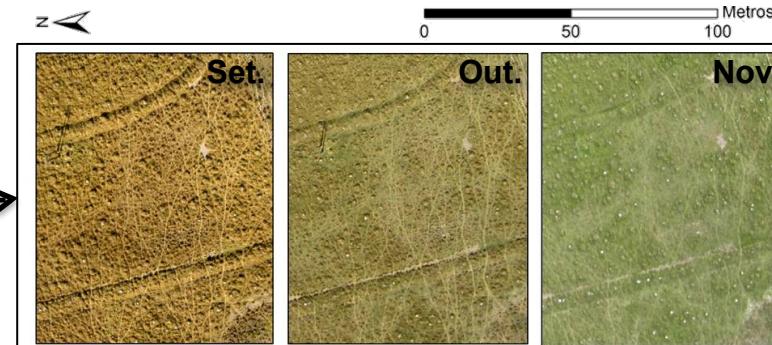
**Bacia Hidrográfica do Rio Vermelho**  
“Laboratório BHRV”



# Validação & scaling...



Determinação da direção  
de 180° e implantação do  
transepto (50 m)

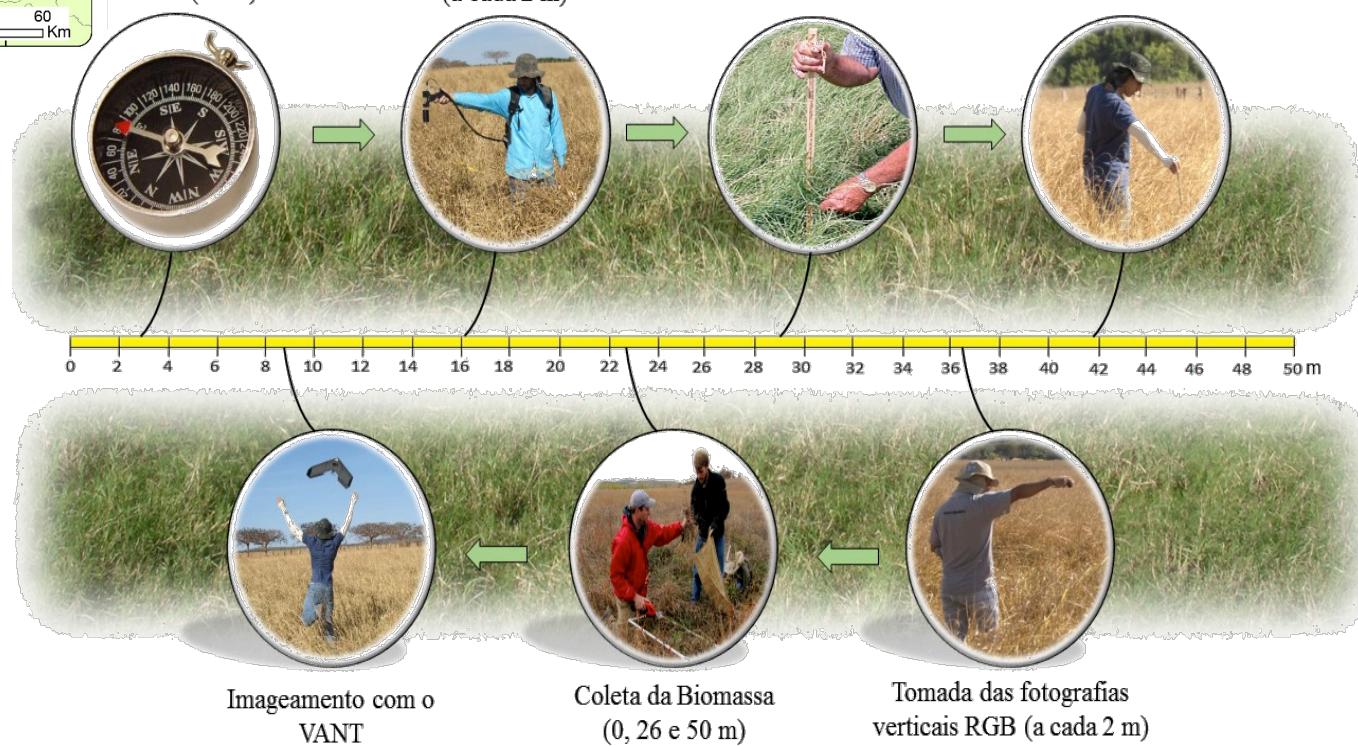


Faz. Jatobá

Coleta de dados com o  
espectrorradiômetro  
(a cada 2 m)

Medição da altura da  
pastagem (a cada 2 m)

Amostragem dos alvos  
com pinpoint (a cada 2 m)



## Pastagem.org



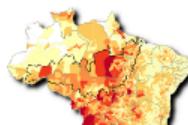
### Apresentação

Entenda a importância das pastagens para o país



### Equipe

Conheça os pesquisadores envolvidos nessa iniciativa



### Mapa Interativo

Acesse os dados espaciais

### Notícias



16 Outubro 2014

#### [Seca castiga pastagens e causa morte de animais em Bonópolis, GO](#)

A falta de chuva provoca prejuízos aos pequenos produtores rurais de Bonópolis, no norte de Goiás. A seca, que atinge a região há mais de três meses, castiga as pastagens e plantações. Na ú...



14 Outubro 2014

#### [Disponibilidade de bovinos segue limitada no Brasil](#)

Nesta segunda semana de outubro, o mercado físico do boi gordo registrou novos movimentos de alta de preços num cenário onde a disponibilidade de animais segue limitada. Muitas indústrias frigor...



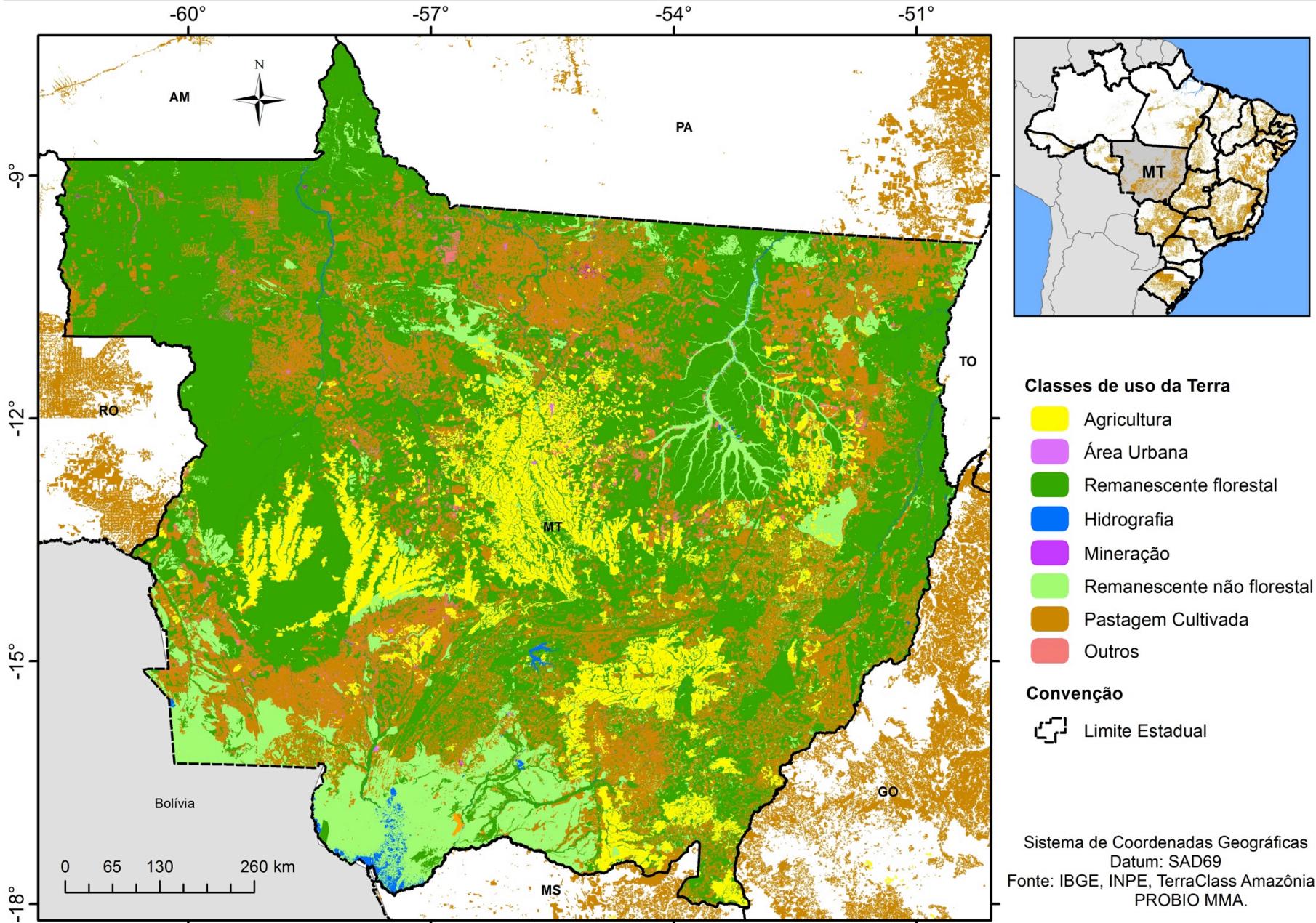
08 Outubro 2014

#### [Revista Nature Genetics destaca pesquisa brasileira](#)

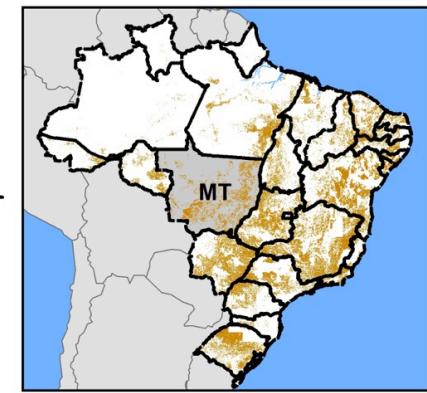
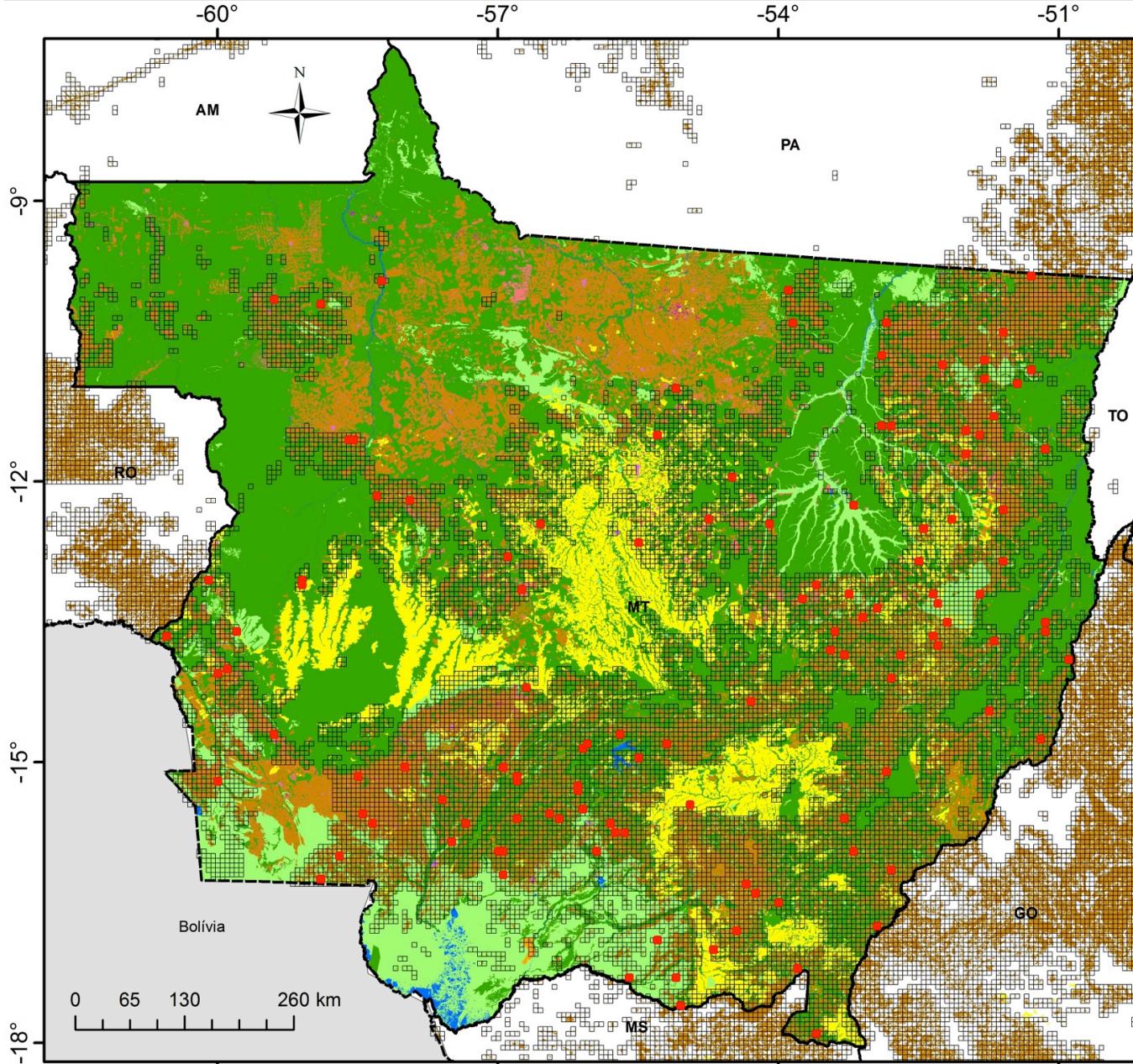
A mais recente edição da revista Nature Genetics, publicada em setembro, destaca o crescimento da pesquisa genômica brasileira aplicada à agricultura e chama a atenção para a necessidade de se...

**Silva, W. et al. XVII SBSR (submetido)**

# Novo mapa de pastagens para o Brasil...



# Novo mapa de pastagens para o Brasil...



## Legenda

- Amostras MT 5 x 5km
- Grid 5 x 5km

## Classes de uso da Terra

- Agricultura
- Área Urbana
- Remanescente florestal
- Hidrografia
- Mineração
- Remanescente não florestal
- Pastagem Cultivada
- Outros

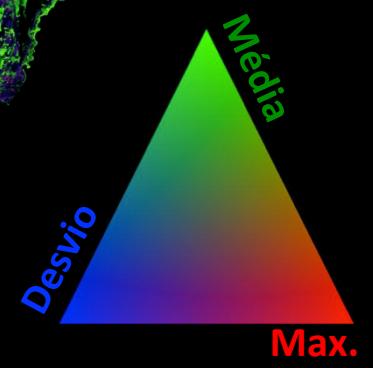
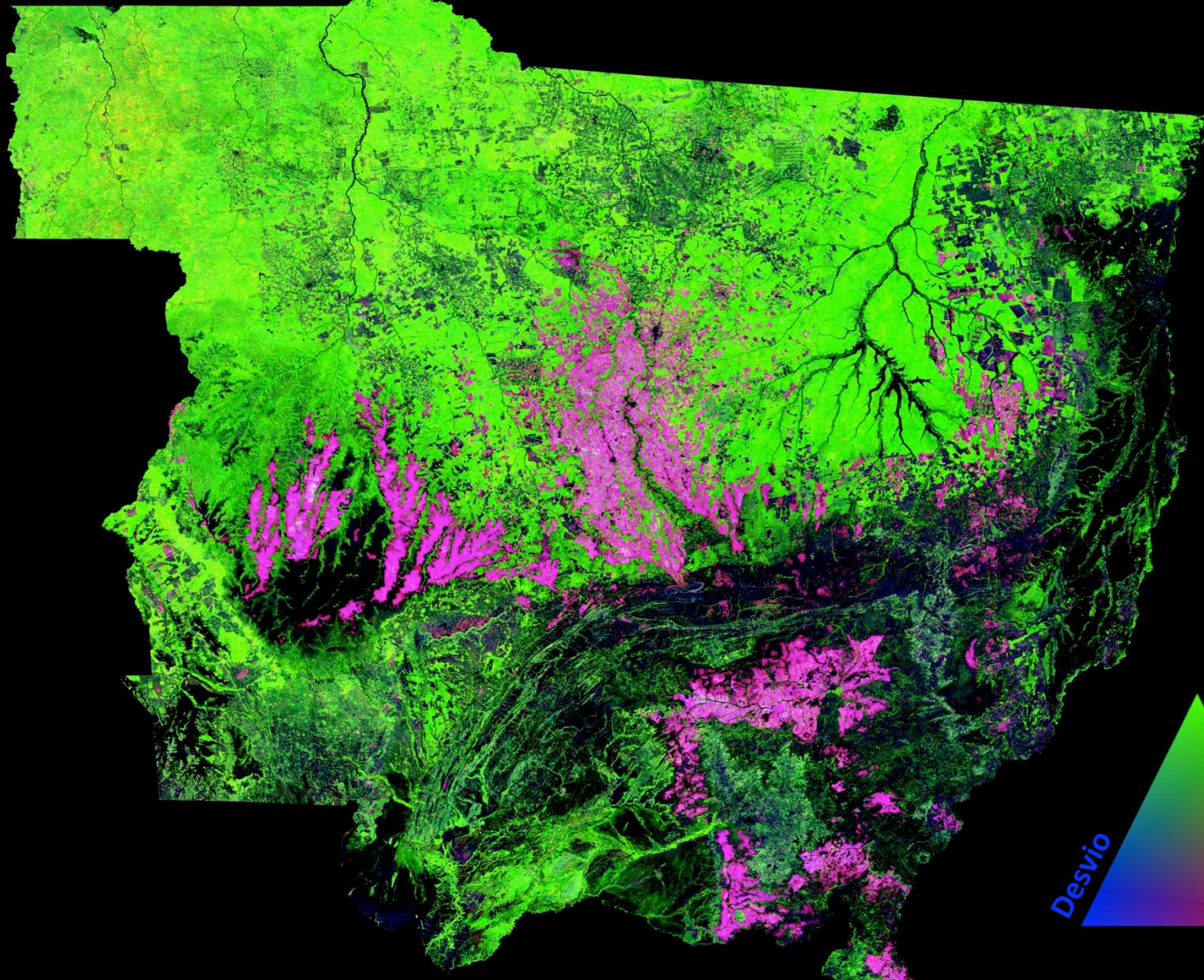
## Convenção

- Limite Estadual

Sistema de Coordenadas Geográficas  
Datum: SAD69

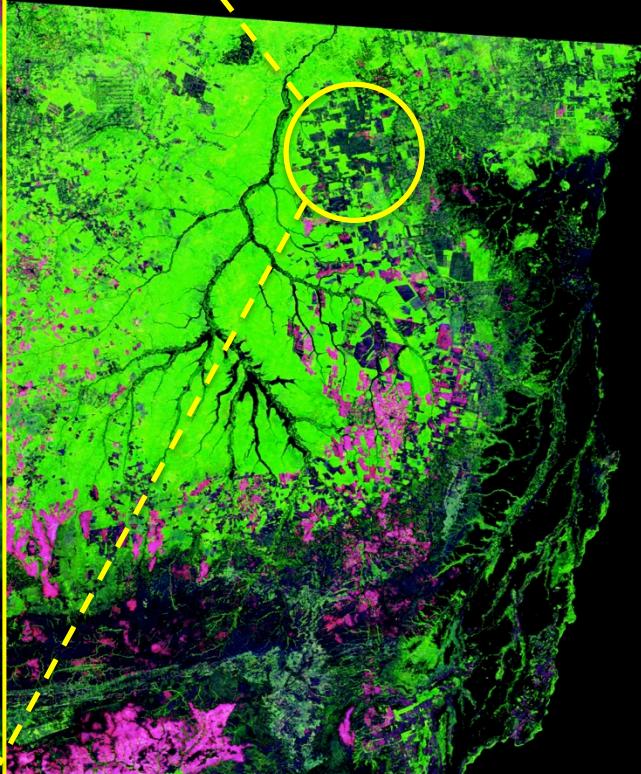
Fonte: IBGE, INPE, TerraClass Amazônia,  
PROBIO MMA.

276 imagens MODIS EVI2

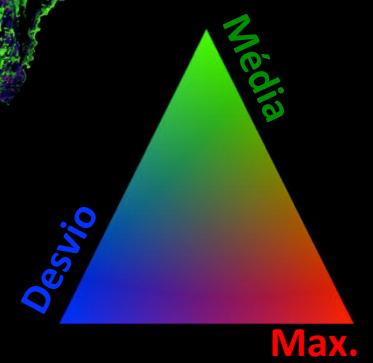
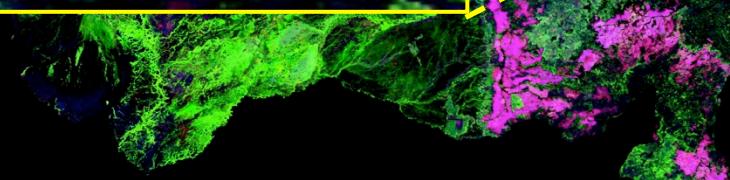
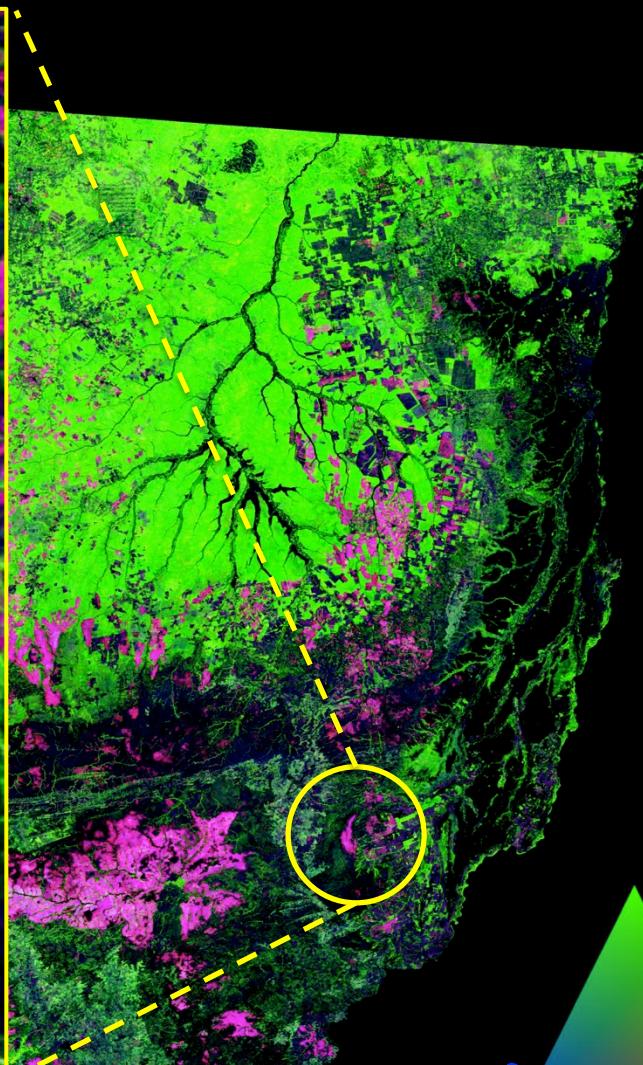
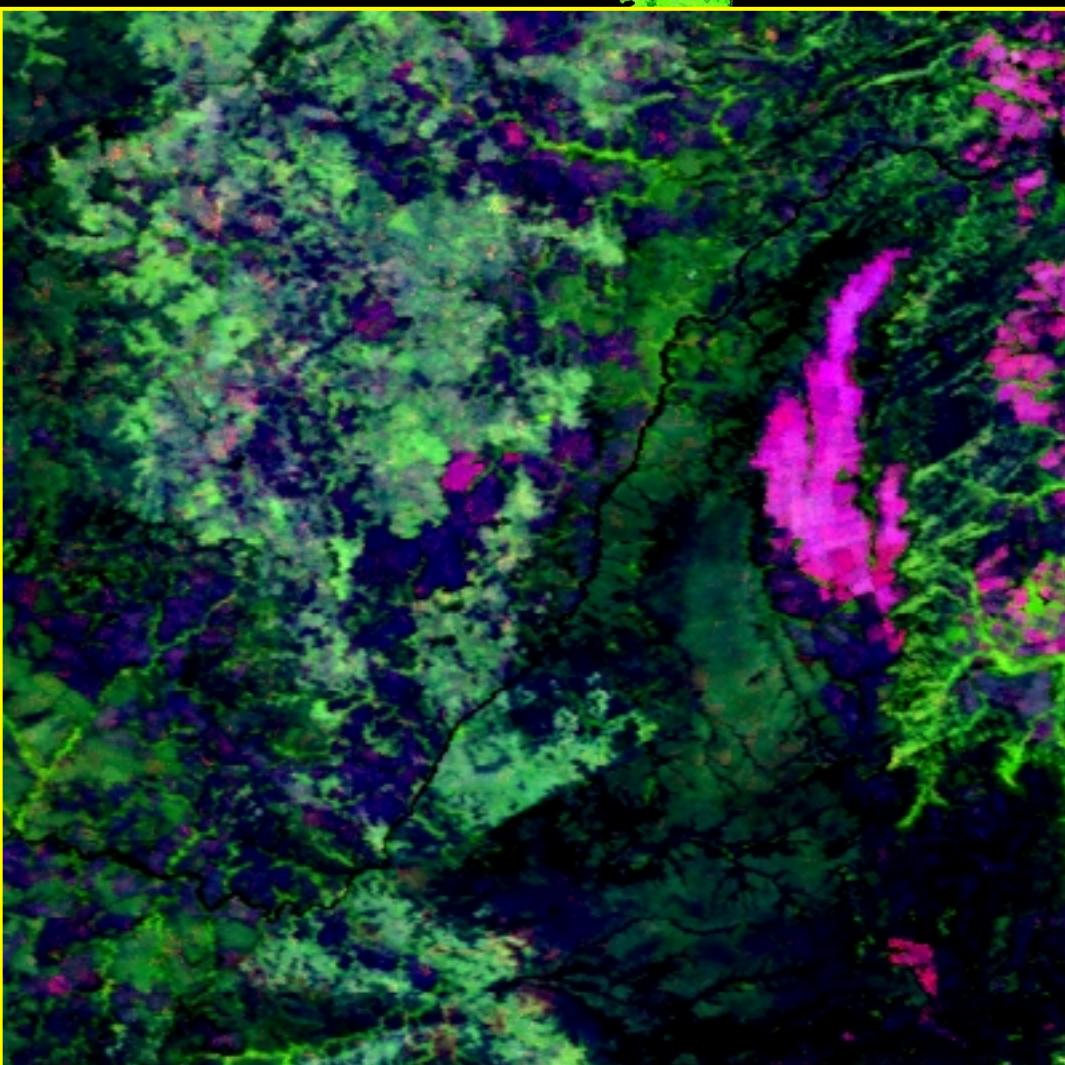




276 imagens MODIS EVI2



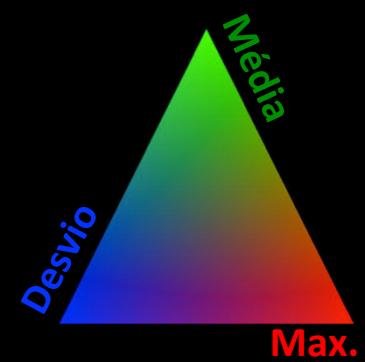
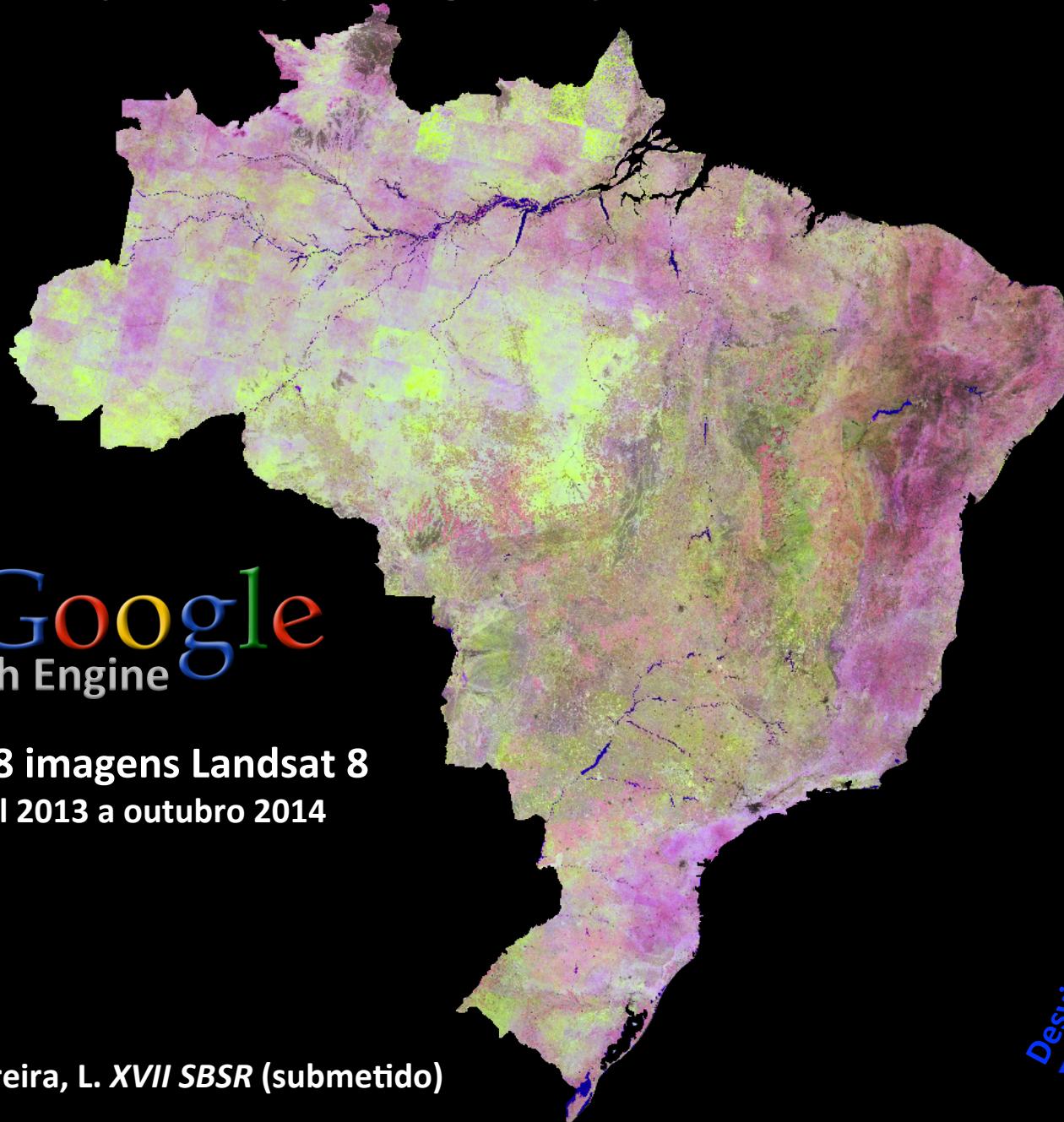
276 imagens MODIS EVI2



# Novo mapa de pastagens para o Brasil...

Google  
Earth Engine

16758 imagens Landsat 8  
abril 2013 a outubro 2014



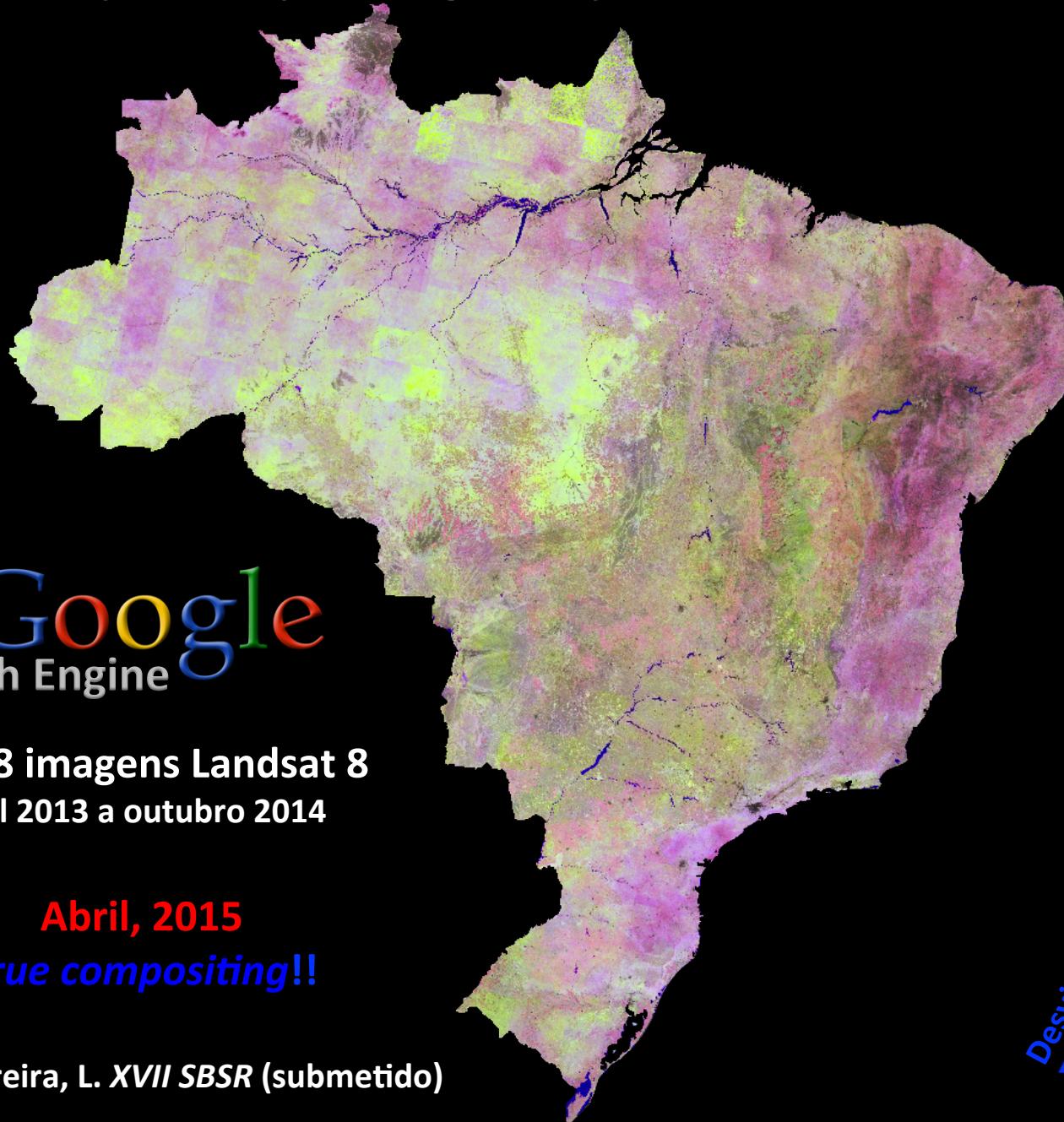
# Novo mapa de pastagens para o Brasil...

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16758 imagens Landsat 8  
abril 2013 a outubro 2014

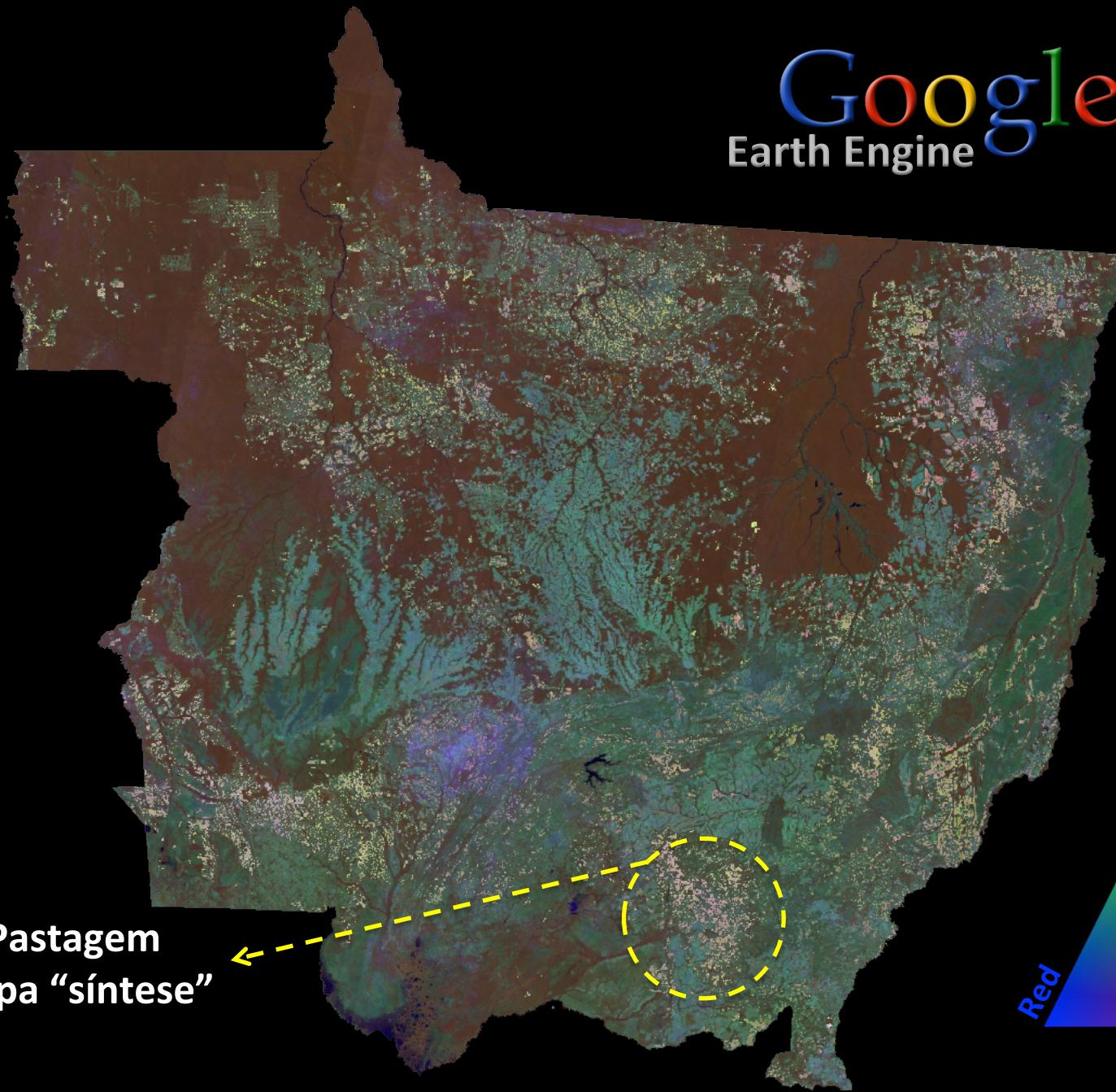
Abril, 2015  
*True compositing!!*

Parente, L.; Ferreira, L. XVII SBSR (submetido)

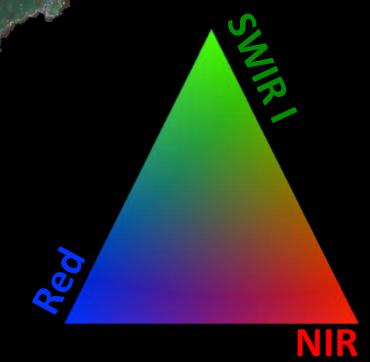


# Novo mapa de pastagens para o Brasil...

Google  
Earth Engine



Pastagem  
Mapa “síntese”



# Perspectivas...

LABORATÓRIO DE  
PROCESSAMENTO DE  
IMAGENS E  
GEOPROCESSAMENTO  
LAPIG



UNIVERSIDADE FEDERAL DE GOIÁS

# *Spatial metrics and baselines of degradation patterns and provision of ecosystem services by pastures in Brazil*

GORDON AND BETTY  
**MOORE**  
FOUNDATION



		Baseline Conditions	
Output		Current	Projected
<i>Spatially explicit pasture information</i>			
Updated and refined pasture map for Brazil		Brazil: PROBIO 2002 / 1:250.000 Amazon Forest TerraClass 2010 / 1:250.000 Cerrado TerraClass 2013 / 1:250.000	2014 integrated, updated, and refined pasture map for the entire Brazilian territory (> 1:250.000)
<i>Pasture degradation trends</i>			
Pasture degradation map		Indirect pasture degradation estimations based on the 2006 IBGE census data (cattle occupation rates at municipality level)	2015 satellite-based degradation estimations (@ 250m spatial resolution) calibrated to ground biophysical / management information
<i>Pasture carbon and water fluxes</i>			
Estimation of pasture environmental impacts and ecosystem services	None		Estimation of carbon and water fluxes variations as a function of pasture conditions and management practices
<i>long-term pasture responses to grazing and management</i>			
Pasture degradation and productivity trends	None		Identification, on a per-pixel basis, of pasture response to investments, intensification, etc. Improved strategies regarding cattle and resources allocation





**Obrigado**  
**laerte@ufg.br**