



# Brazilian cartography 522 years of mapping

This work was supported from Operational Programme Research, Development and Education - Project „Postdoc2MUNI“ (No. CZ.02.2.69/0.0/0.0/18\_053/0016952).

03.11.2022



EUROPEAN UNION  
European Structural and Investment Funds  
Operational Programme Research,  
Development and Education



**Ítalo Sousa de Sena**  
*Postdoctoral researcher*  
*Virtual Geographic Environments*

# Summary



- **Colony and Empire**
  - First maps
    - Exploring the coast
    - Exploring the continental lands
  - Institutionalization of mapping efforts
- **Republic**
  - First Republic
  - New State
  - Military governments
  - 1988 constitution
- **Brazilian Space Program**
  - Brazilian satellites
  - Monitoring system

Can you guess the distances?

## Brazil's extremes

From north to south:

From west to east:

Coastline perimeter:



Can you guess the distances?

## Brazil's extremes

From north to south:

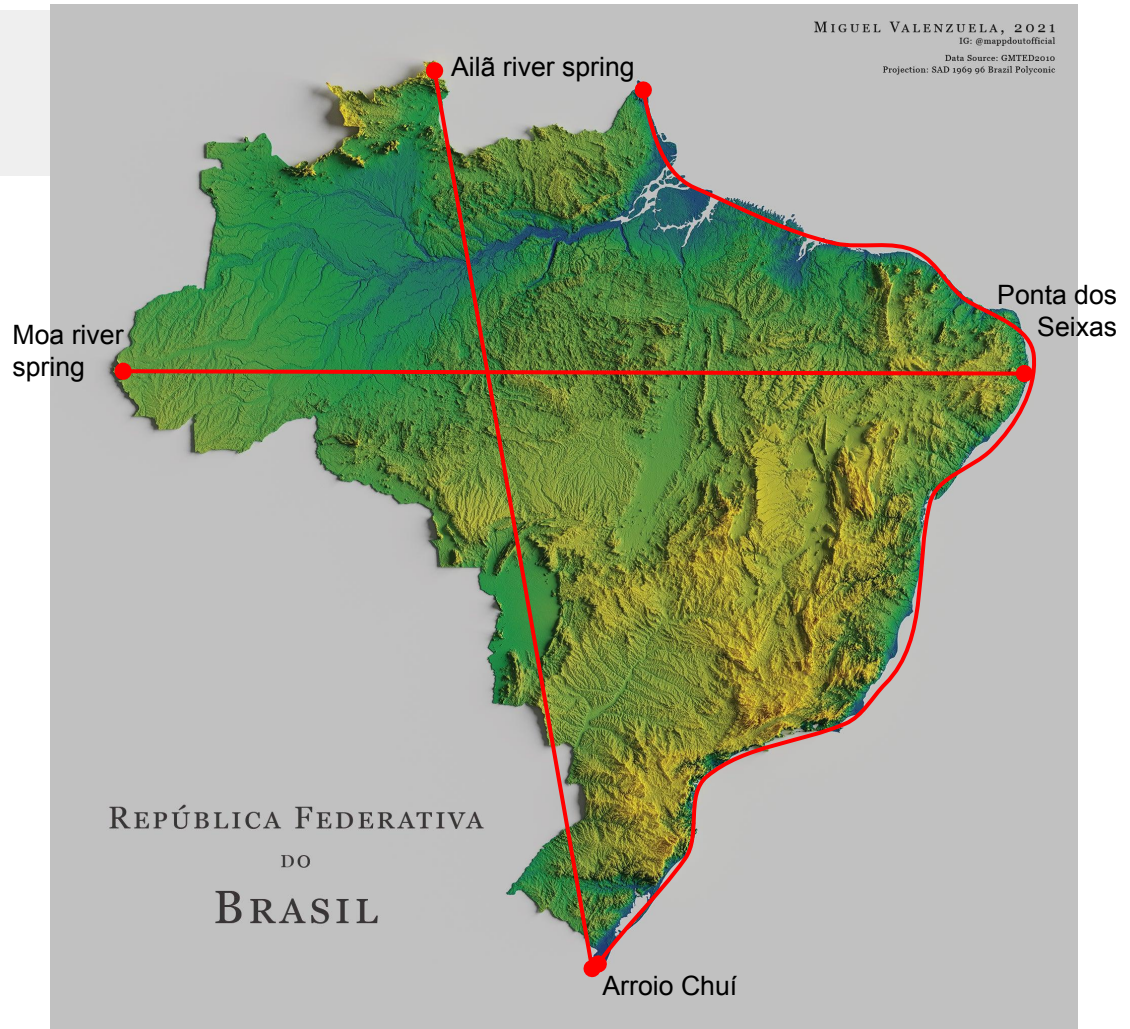
**4.365 km**

From west to east:

**4.319 km**

Coastline perimeter:

**7.357 km**





# In comparison to the Czech Republic

## Brazil

??? km<sup>2</sup>

Population: ??? million inhabitants

## Czech Republic

78,864 km<sup>2</sup>

Population: 10,7 million inhabitants



# In comparison to the Czech Republic

## Brazil

8.516.000 km<sup>2</sup>

Population: 212,6 million inhabitants

## Czech Republic

78,864 km<sup>2</sup>

Population: 10,7 million inhabitants



# Why this comparison?



# Why this comparison?



- 522 years of mapping history
- Large areas to be mapped
- Lack of road infrastructure
- Elevated costs to perform mapping
- Wild lands and “empty spaces”
- State institutions concentrated in urban centers



# Population

## Densidade demográfica

2010

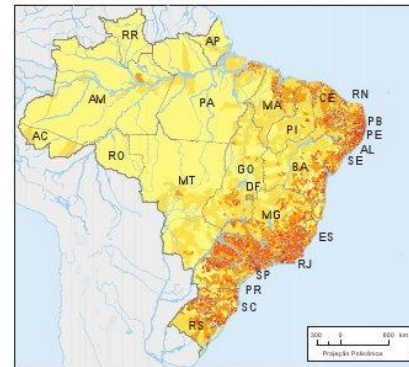


Demográfico 1940/2000; e Síntese do Censo Demográfico 2010. In: IBGE. Sítio: sistema IBGE de ocupação automática. Rio de Janeiro, 2011. <http://www.sidra.ibge.gov.br/bda/tabela/listatmp?l=cd10=301&P=C&1296>. Acesso em: mar 2012.

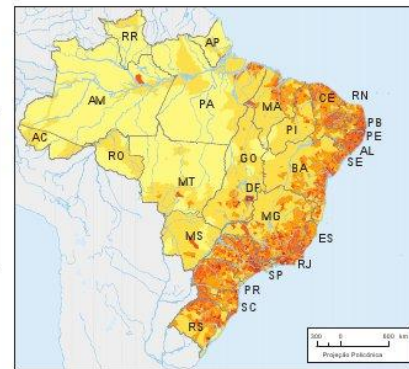
.gov.br

0800 721 8181

1960



1980

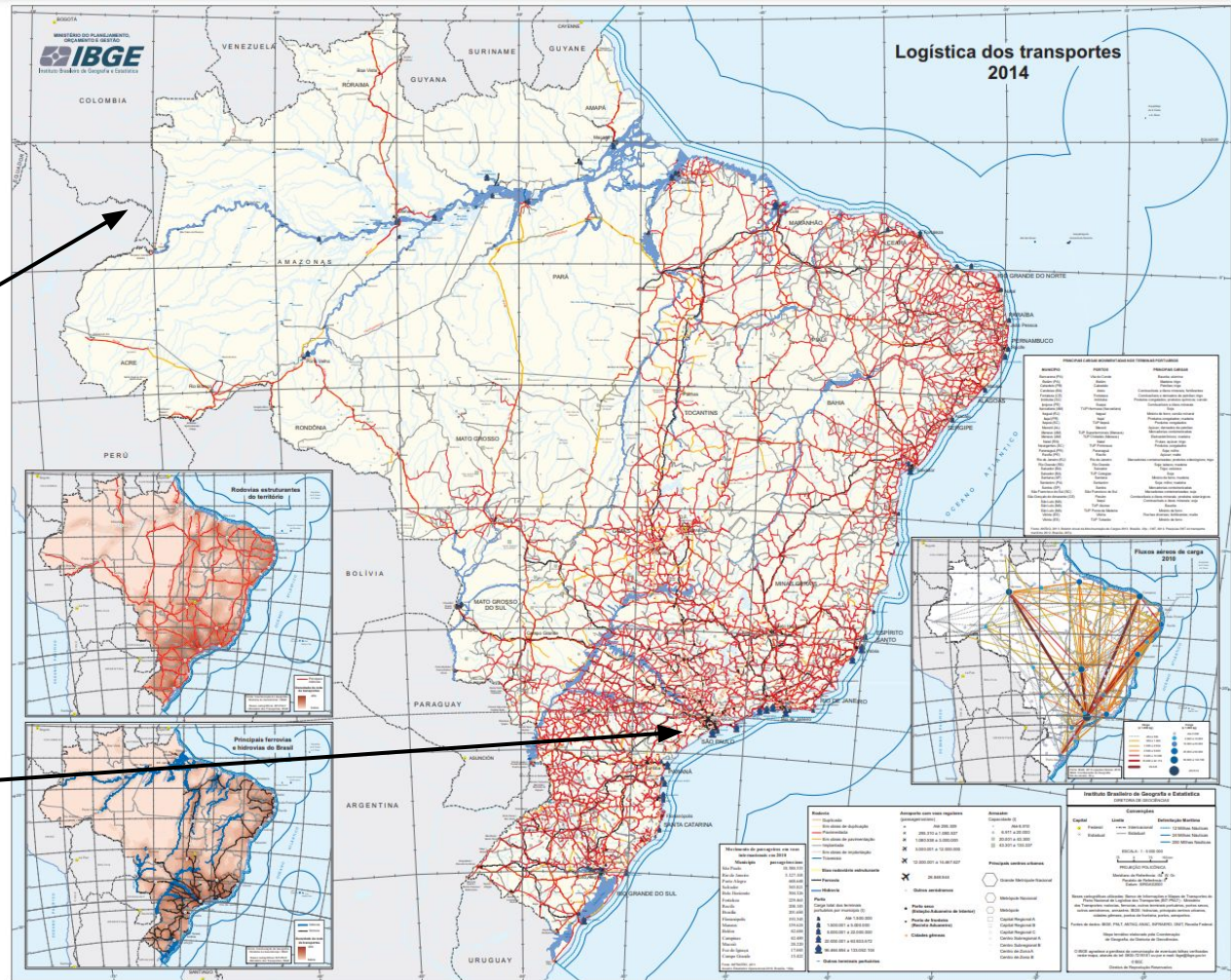


População residente, segundo o sexo e os grupos de idade (%)





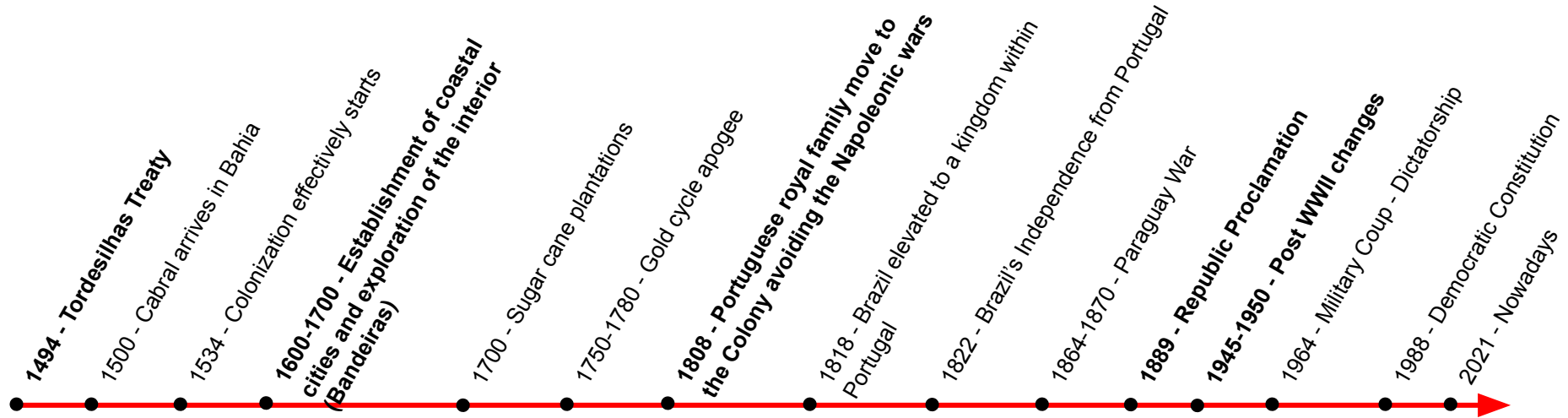
# Roads



# Brief Brazilian History Timeline

Events that changed the power, reflecting on changes in territories and borders.

Maps register those changes, keeping track of former power relations in the geographical space.

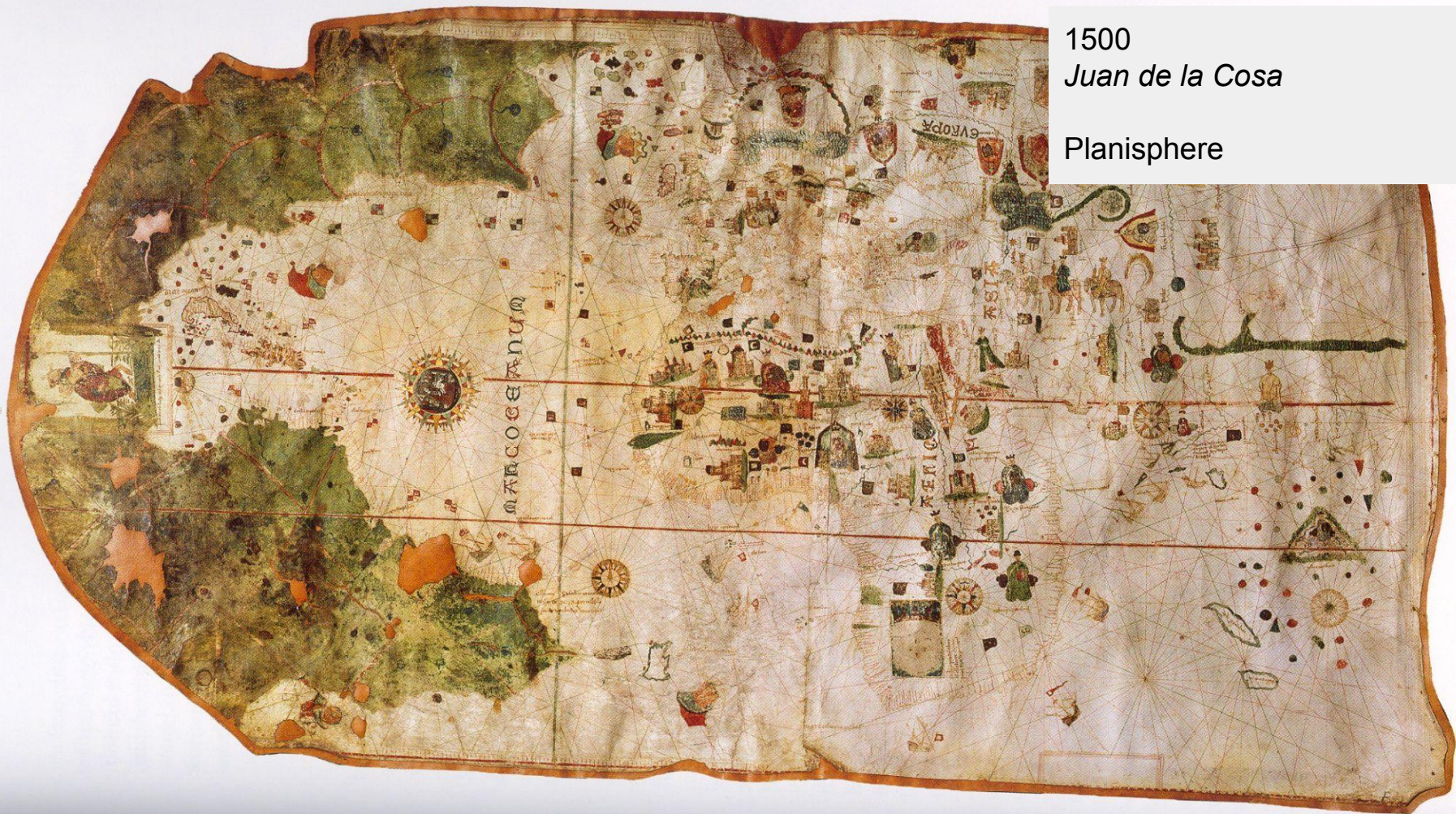


# Colony and Empire



1500  
*Juan de la Cosa*

Planisphere



Does anyone know  
the origin of the  
country's name?



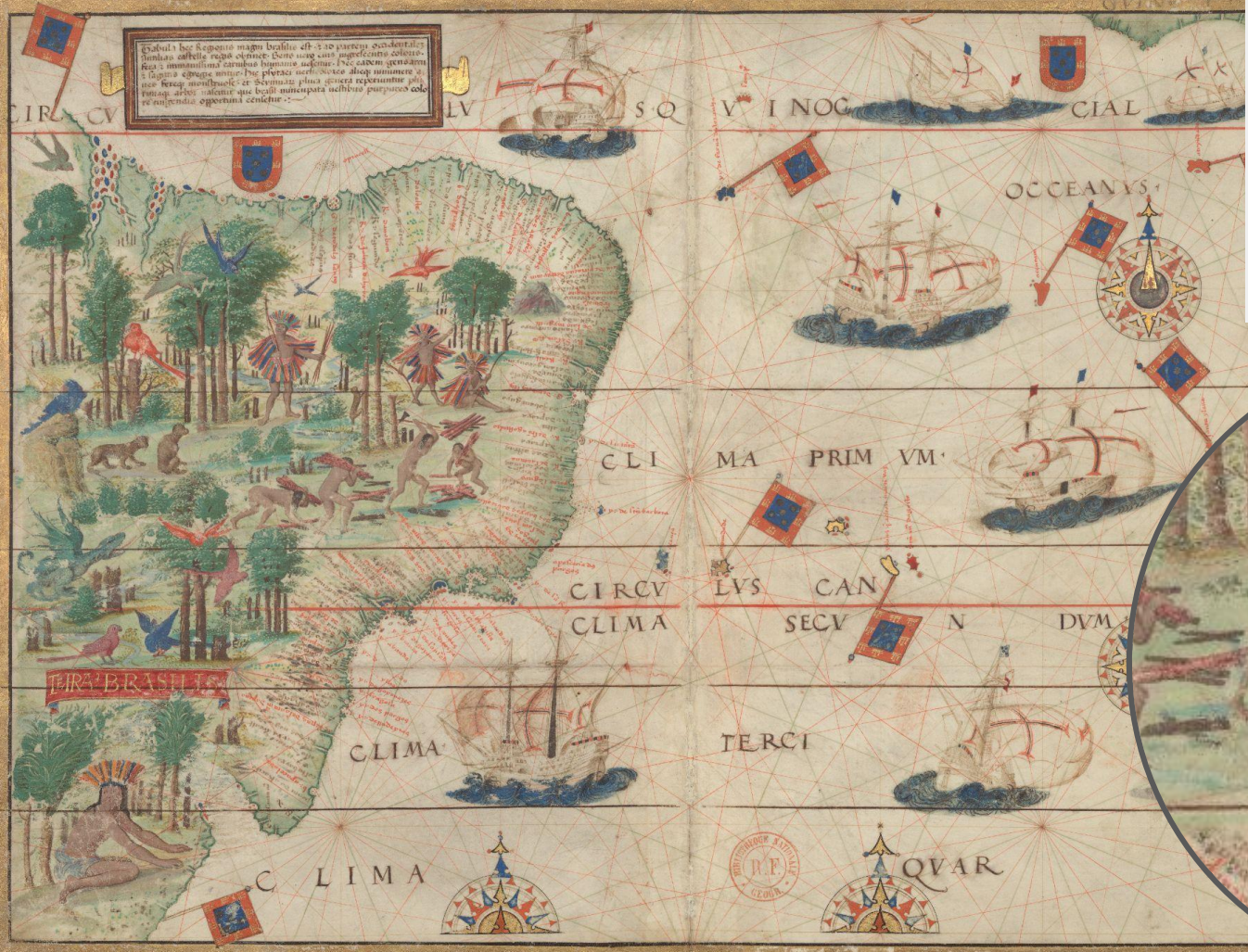
# *Paubrasilia echinata*



Ember/Ash (English)  
Brasa (Portuguese)

žhavé uhlíky





Exempli gratia hoc regnum magnum Brasilis est in partem occidentalem  
Americae ab illis regio omnino. Dicitur esse casus imperatoris catholici  
regis et immensum dicitur habere lignum rubrum. In eo habentur gemmarum  
et lapidum etiam aurum. Hoc pivatae sunt. Quae alioquin nuncupantur  
in usum ferreus munditiae et sicut in plura genera reputantur pro  
ferreus aliter. Sicut in quibusdam munitur sublimi purpura color  
reperitur opportuna cunctis.

1519  
*Terra Brasilis*  
*Lopo Homem*

Brasil tree (pau-brasil)  
exploration for red ink  
production



## Many changes over the centuries

Despite its brief history in comparison to Czech Republic and Europe, in general, Brazil's borders changed a lot over time.

The dynamic was quite different though. The country's borders changed due to the discovery of lands and also by territorial disputes among Spain and Portuguese crowns.

War is something uncommon in the Brazilian territory, but many local and regional conflicts and insurrections/revolutions happened within the country's territory.







# Remarkable historical maps of Brazil









Cantino Planisphere (1502)  
Brazil represented with its still undiscovered territory









OLINDA DE PHARNAMBUCO

Verloren door de E. Oost-Indische Compagnie

1630



Bref recit  
Deer que a ruy pado a la pinto  
de A. P. E. E. S.  
Olinda de Fernambuco

OLINDA DE PHARNAMBUCO  
Verloren door de E. Oost-Indische Compagnie  
1630



OLINDA DE PHARNAMBUCO  
Verloren door de E. Oost-Indische Compagnie  
1630

Cort verhael  
Der Stadt Olinda/  
PHARNAMBUCO.

OLINDA DE PHARNAMBUCO  
Verloren door de E. Oost-Indische Compagnie  
1630

OLINDA DE PHARNAMBUCO  
Verloren door de E. Oost-Indische Compagnie  
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1630

OLINDA DE PHARNAMBUCO  
Verloren door de E. Oost-Indische Compagnie  
1630

1630  
*Olinda and Recife, Pernambuco*

### **Dutch Portuguese War (1602-1663)**

Hendrick Corneliszoon Lonck (1568-10 October 1634), with a fleet of 52 ships of the Dutch West India Company, captured the Portuguese port of Olinda on the coast of Brazil on 14 February 1630.

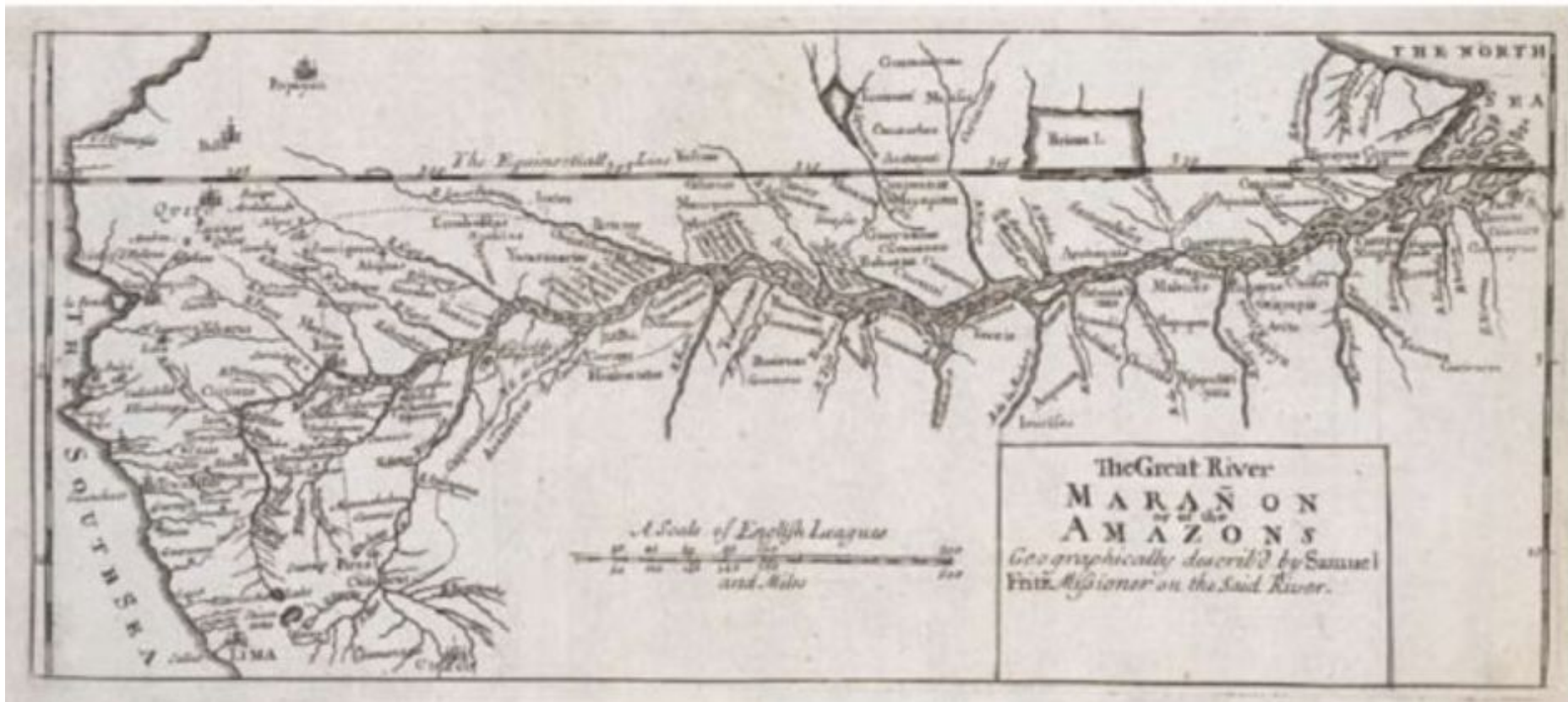
This action, which was followed by the capture of the state of Pernambuco, was a part of the Dutch-Portuguese War called the Sugar War whereby the Dutch acquired the sugar trade from the Portuguese in this region. The Dutch-Portuguese war was itself an extension of the Eighty Years War (1568-1648) since the Portuguese were joined to Spain in a dynastic union between 1580 and 1640.



João Teixeira Albernaz II (1666)

Maps of the Portuguese Kingdom  
Rich in toponyms and topographic details referring to the  
Brazilian coastline





The great river Marañon or of the Amazon.  
Based on map produced by father Samuel Fritz in 1690.  
One of the first representations of the Amazon river as a whole.



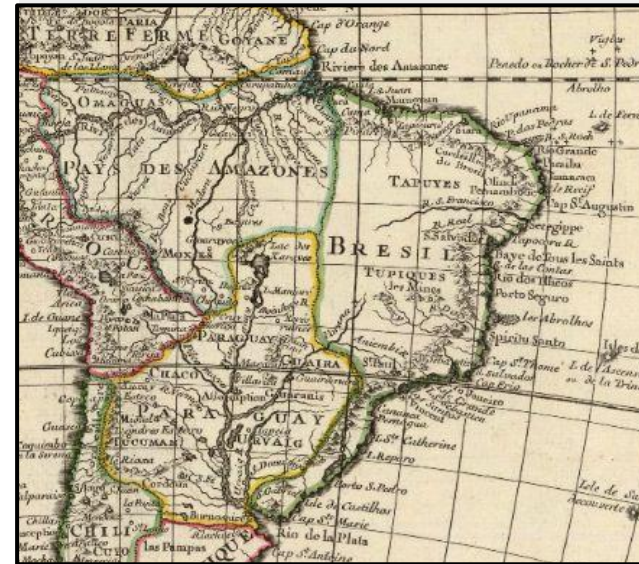


1722

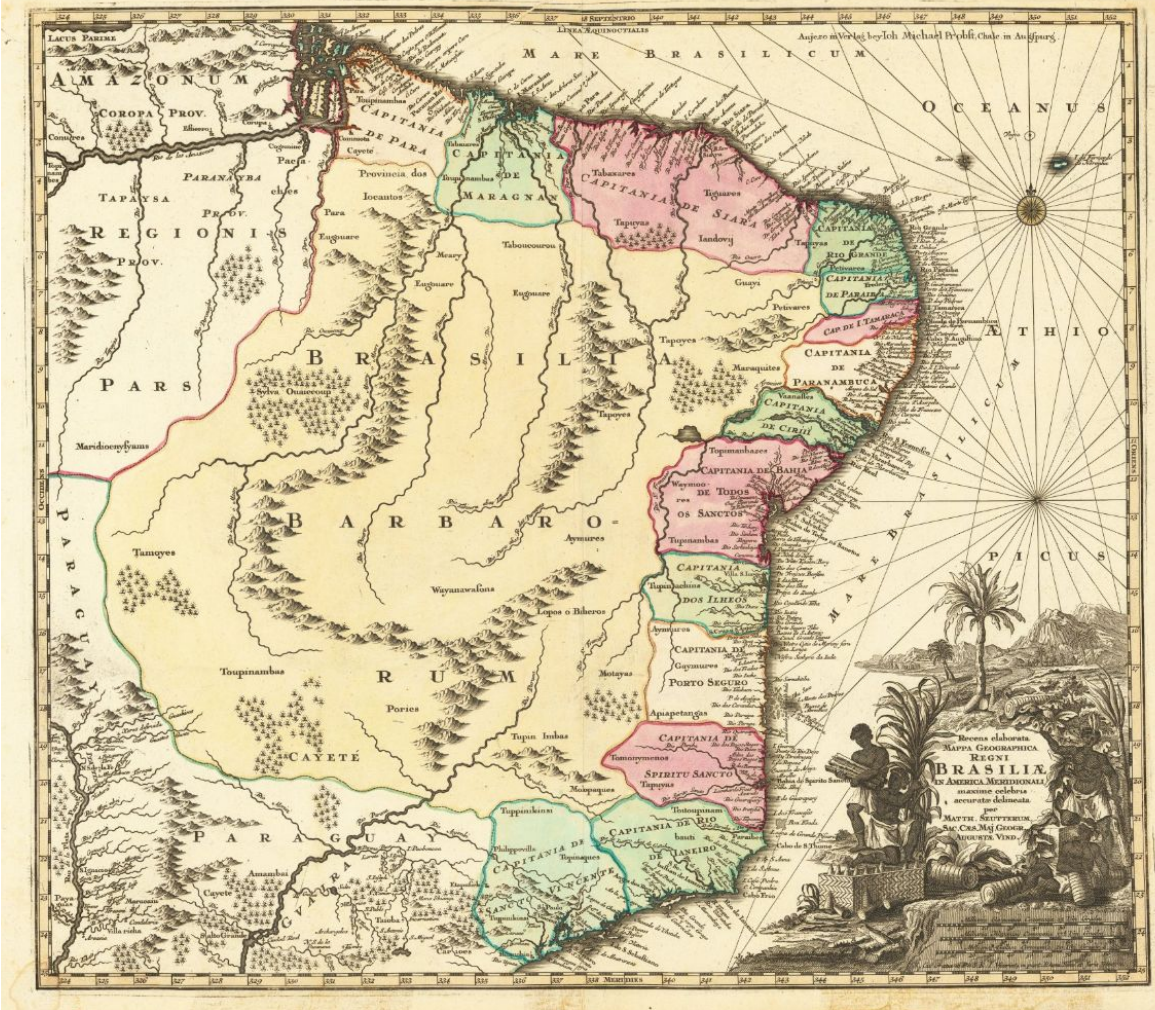
*L'Amérique meridionale*

Guillaume de Delisle

**What can you spot in this representation of Brazil that remains almost the same nowadays?**







Recens elaborata mappa geographica regni Brasiliae in America Meridionali (1728)

Matthaeus Seutter (1678-1756)

Redesigned borders of hereditary captaincies of the Portuguese colony.



# Continental lands exploration and mapping



L'Amerique meridionale  
Daniel de La Feuille (1708)



# Shoreline and continental lands mapping

- Bandeirantes - Mercenaries
- Native people hunting
- Brazilian gold rush (1st cycle)
  - First urban network
- Trespassing Tordesilhas Treaty





## Brazilian gold cycle (XVIII and XIX centuries)

Two main waves of explorers going towards the continental lands

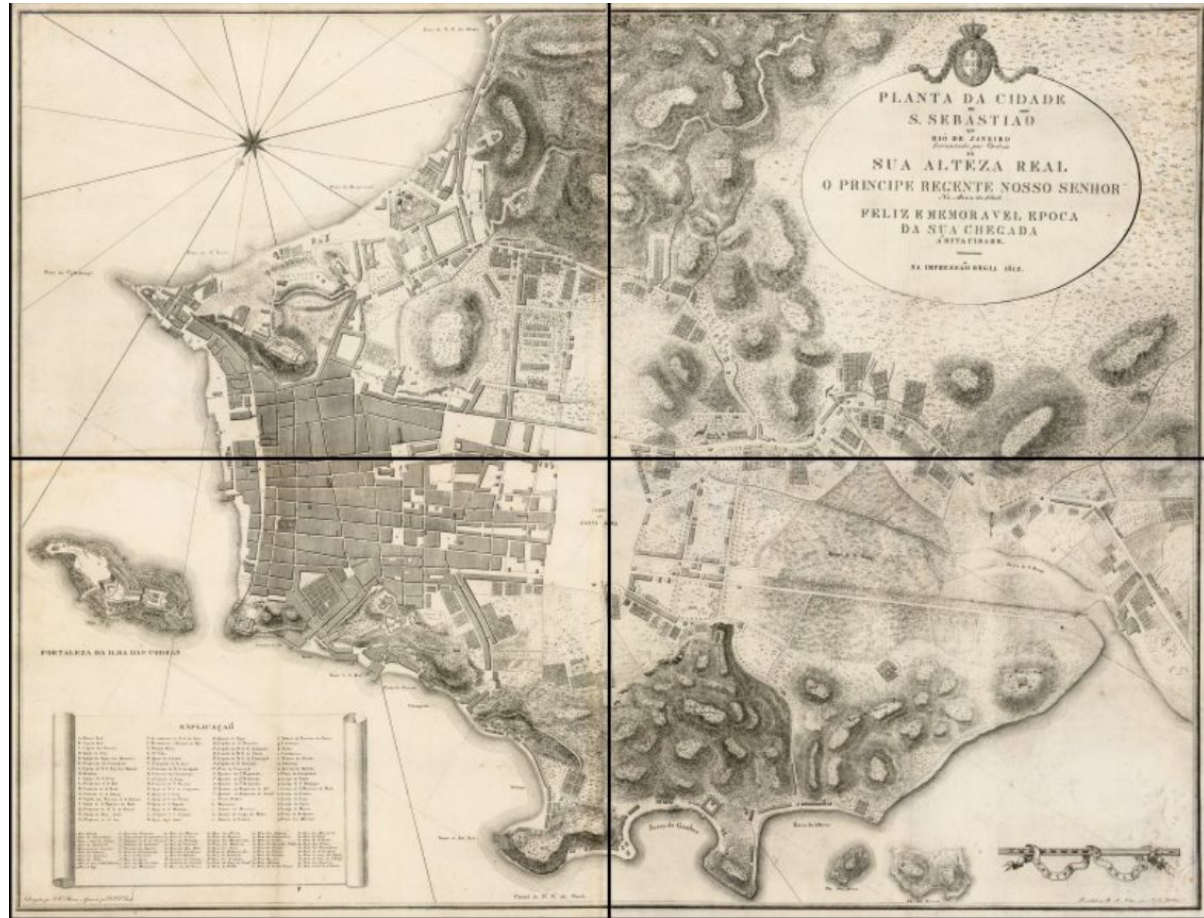
Gold was first found in the last decade of the XVII century.

Importance of mapping the mines in order to collect taxes ( $\frac{1}{5}$  of all explored gold must be paid to the Portuguese crown)

Establishing a network of villages connected by trails, rivers and mountain ridges as landmarks for orienteering.

# Portuguese crown move to Brazil (1808)

Plan of St. Sebastian of Rio de Janeiro city. This map was produced to celebrate the year when the Portuguese royal family moved to the colony. It was printed on 1812.





# Republic Proclamation

Institutionalization of mapping activities  
by the Military



# 1810 - First school for Military Geographers Engineers in the Royal Military Academy

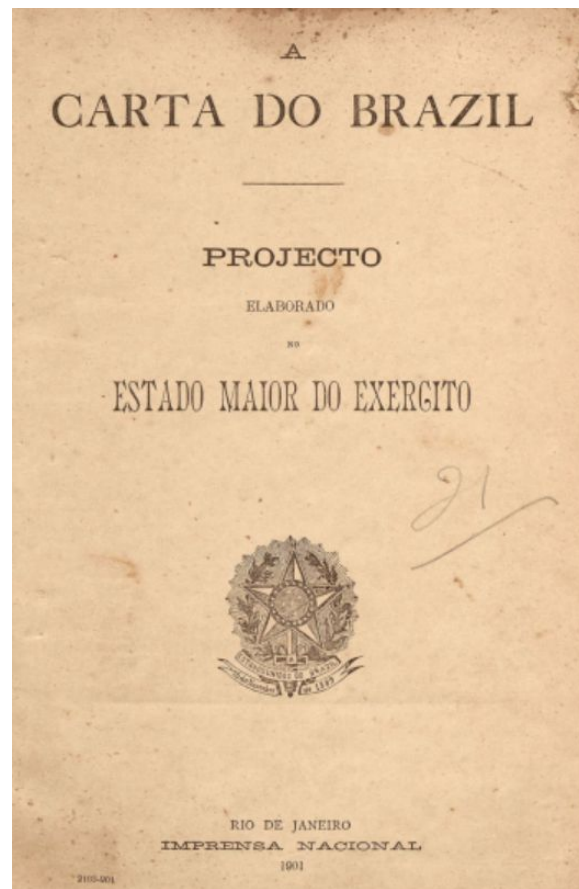
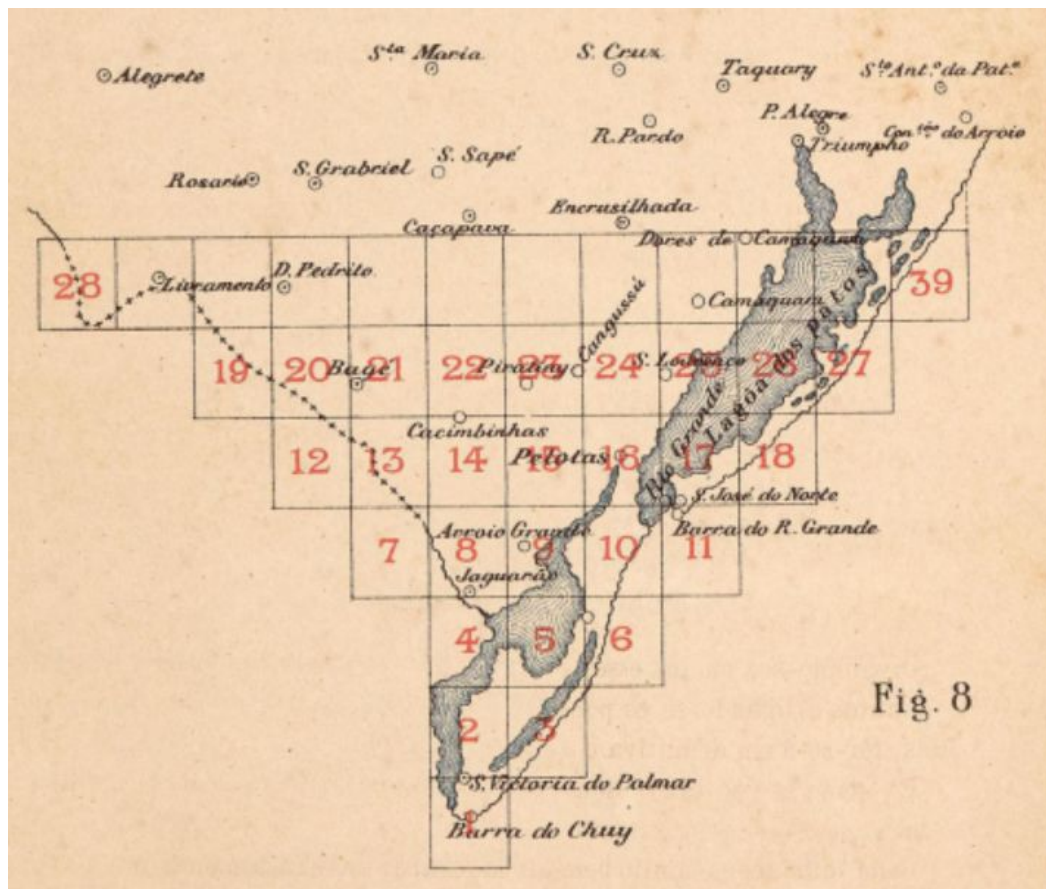


In 1875, the general map of the empire was presented in the international exposition in Philadelphia, U.S., in order to show how the Brazilian Empire was arranged in that time, as well as to show how established was the mapping efforts by the national military.

1882 - opening of the official litographic workshop, giving autonomy for the country to publish its own maps.



# Militar systematic mapping project (1901)



# 1900-1945

Alfredo Vidal, founder of the Military Geographic Service

1914 - 1st stereophotogrammetric survey in Brazil

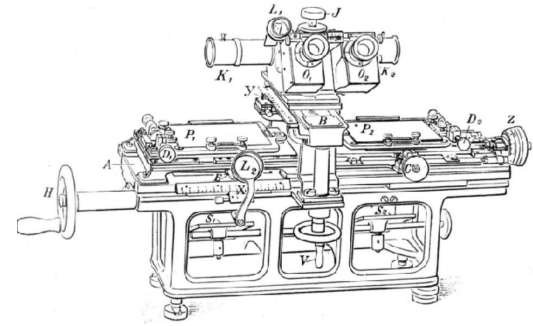
After WWI - Austriac Cartographic Mission

- Map of Brazil 1:1 000 000

**1922** - 100 years of independence celebration

- **Carta Geographica do Brasil**

1928 - Creation of the Border Mapping Commission





# Vargas Era (1930-1945) and post WWII

1932 - Army Geographic Service

1938 - Establishment of the **Brazilian Institute of Geography and Statistics (IBGE)**

1942 - First aerophotogrametry survey by the USAF (United States Air Force)

1954 - 1st Brazilian Geographers Congress

1956 - Army Geographic Service starts using UTM system

1957 - Foundation of the **Brazilian Cartographic Society**



An aerial photograph of a lush green landscape. In the upper right, a waterfall cascades down a rocky cliff. Below it, a large body of water, possibly a reservoir or a wide river, is visible. The surrounding area is covered in dense green vegetation, with some brownish patches indicating cleared land or different types of terrain. The overall scene is vibrant and natural.

# Brazilian Space Program



# Brazilian Space Agency



Alcântara Launching Centre (CLA) - Maranhão

Barreira do Inferno Launching Centre - Rio Grande do Norte



INPE (National Institute of Space Research)

- Responsible for:
  - meteorological monitoring and reports
  - satellite technology development
  - land use assessment and monitoring
  - satellite imagery processing and publishing

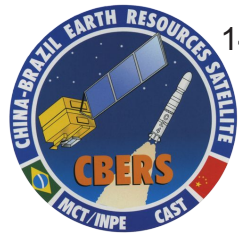
Brazilian Air Force

- ITA (Aeronautics Technological Institute)
- IAE (Aeronautics and Space Institute)



# Brazilian satellites - CBERS (China-Brazil Earth Resources Satellite)

Partnership with China Academy Space Technology (CAST)



14/10/1999  
disabled



21/10/2003  
disabled



19/09/2007  
disabled



09/12/2013  
problems to reach operational orbit



07/12/2014  
operating



20/12/2019  
operating



**Imagem WFI – composição em cores reais, 55 m de resolução espacial, recorte de 330 km por 200 km (Cuiabá, MT, abaixo à esquerda; Reservatório do Manso acima no centro).**



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**Imagem MUX –  
composição em cores  
reais, 16 m de resolução  
espacial, recorte de 30  
km por 20 km (cidades  
de Jardim e Guia Lopes  
da Laguna, MS).**



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**Imagem WPM – banda pancromática, 2 m de resolução espacial, recorte de 5 km por 3 km (cidade de Primavera do Leste, MT).**

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# Brazilian satellites - AMAZÔNIA 1

- Launched on 28.02.2021
- Partnership with India Space Agency
- Illegal deforestation
- Shoreline monitoring
- Operates along with CBERS-4 and CBERS-4A satellites (constellation)





# Legal Amazon region Deforestation Satellite Monitoring Project PRODES (TerraBrasilis)

**TerraBrasilis** | PRODES (Deforestation) Maps ▾ Graphs ▾ About Contact Help 🇧🇷 🇺🇸

**TerraBrasilis**  
PRODES (Deforestation)

8 Amazon

Deforestation Mask - 2007  
prodes-amz

Amazon Biome  
prodes-amz

Cloud - 2016/2020  
prodes-amz

Forest - 2016/2020

500 km  
500 mi

Search: Lng: -88.417969 Lat: 5.460847

TerraBrasilis <http://terrabilis.dpi.inpe.br/app/map/deforestation?hl=pt-br>

# Deforestation Detection Alert System



IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING, VOL. 8, NO. 7, JULY 2015

3619

## DETER-B: The New Amazon Near Real-Time Deforestation Detection System

Cesar Guerreiro Diniz, Arleson Antonio de Almeida Souza, Diogo Corrêa Santos, Mirian Correa Dias, Nelton Cavalcante da Luz, Douglas Rafael Vidal de Moraes, Janaina Sant'Ana Maia, Alessandra Rodrigues Gomes, Igor da Silva Narvaes, Dalton M. Valeriano, Luis Eduardo Pinheiro Maurano, and Marcos Adams

**Abstract**—The Brazilian Legal Amazon (BLA), the largest global rainforest on earth, contains nearly 30% of the rainforest on earth. Given the regional complexity and dynamics, there are large government investments focused on controlling and preventing deforestation. The National Institute for Space Research (INPE) is currently developing five complementary BLA monitoring systems, among which the near real-time deforestation detection system (DETER) excels. DETER employs MODIS 250 m imagery and almost daily revisit, enabling an early warning system to support surveillance and control of deforestation. The aim of this paper is to present the methodology and results of the DETER based on AWIFS data, called DETER-B. Supported by 56 m images, the new system is effective in detecting deforestation smaller than 25 ha, concentrating 80% of its total detections and 45% of the total mapped area in this range. It also presents higher detection capability in identifying areas between 25 and 100 ha. The area estimation per municipality is statistically equal to those of the official deforestation data (PRODES) and allows the identification of degradation and logging patterns not observed with the traditional DETER system.

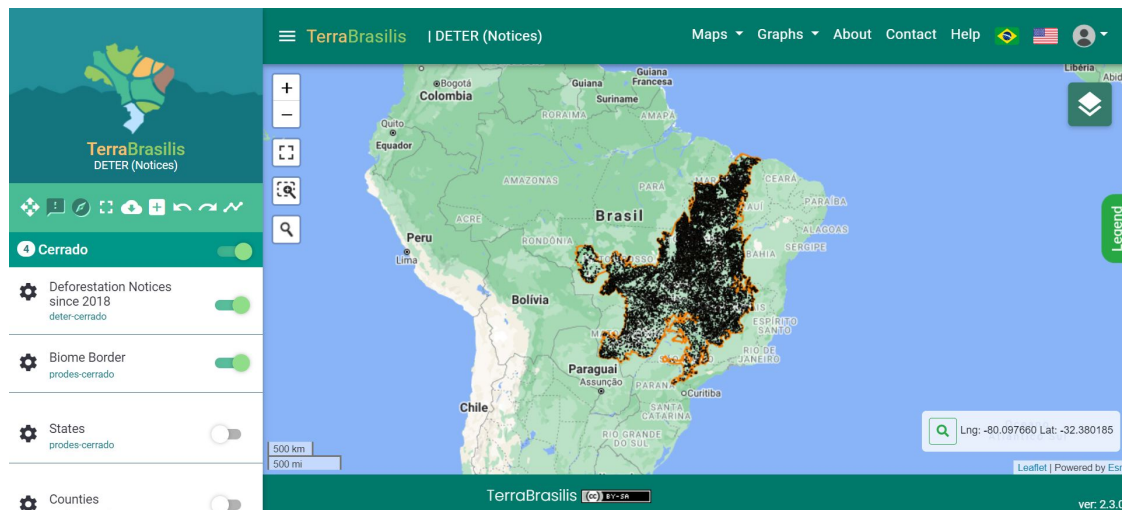
and land cover histories [3], [5] and its deforestation is a major environmental problem [3].

Given the region complexity and dynamics, there are large government investments focused on the control and prevention of deforestation. The National Institute for Space Research (INPE) is currently developing five complementary systems for BLA forest monitoring: 1) the Amazon Deforestation Monitoring Project (PRODES); 2) the Selective Logging Detection Project (DETEX); 3) the Brazilian Amazon Forest Degradation Project (DEGRAD); 4) the near real-time deforestation detection (DETER) [6]; and 5) the land use and land cover mapping of Amazon Deforested Areas (TerraClass) [7].

The PRODES system, created in 1988, is designed to provide annual rates of gross deforestation in BLA providing detailed information on deforestation dynamics [6], [8]. Despite PRODES importance for forest monitoring and the establishment of public policies, the time required for the production

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7128317>

General Coordination of Earth Observation  
Amazon Region Centre  
Ministry of Science, Technology, Innovations and Communications



<http://terrabilis.dpi.inpe.br/app/map/alerts?hl=pt-br>



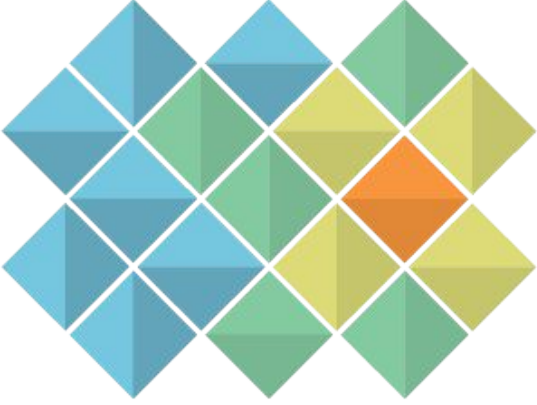
## O PORTAL BRASILEIRO DE DADOS GEOESPACIAIS - SIG BRASIL

A INDE ▾ DADOS GEOESPACIAIS ▾ ESTATÍSTICAS ▾ SUPORTE ▾ NOTÍCIAS CONTATO



Todos os dados geoespaciais produzidos pelas instituições governamentais brasileiras reunidos em um só lugar.

<https://visualizador.inde.gov.br/>



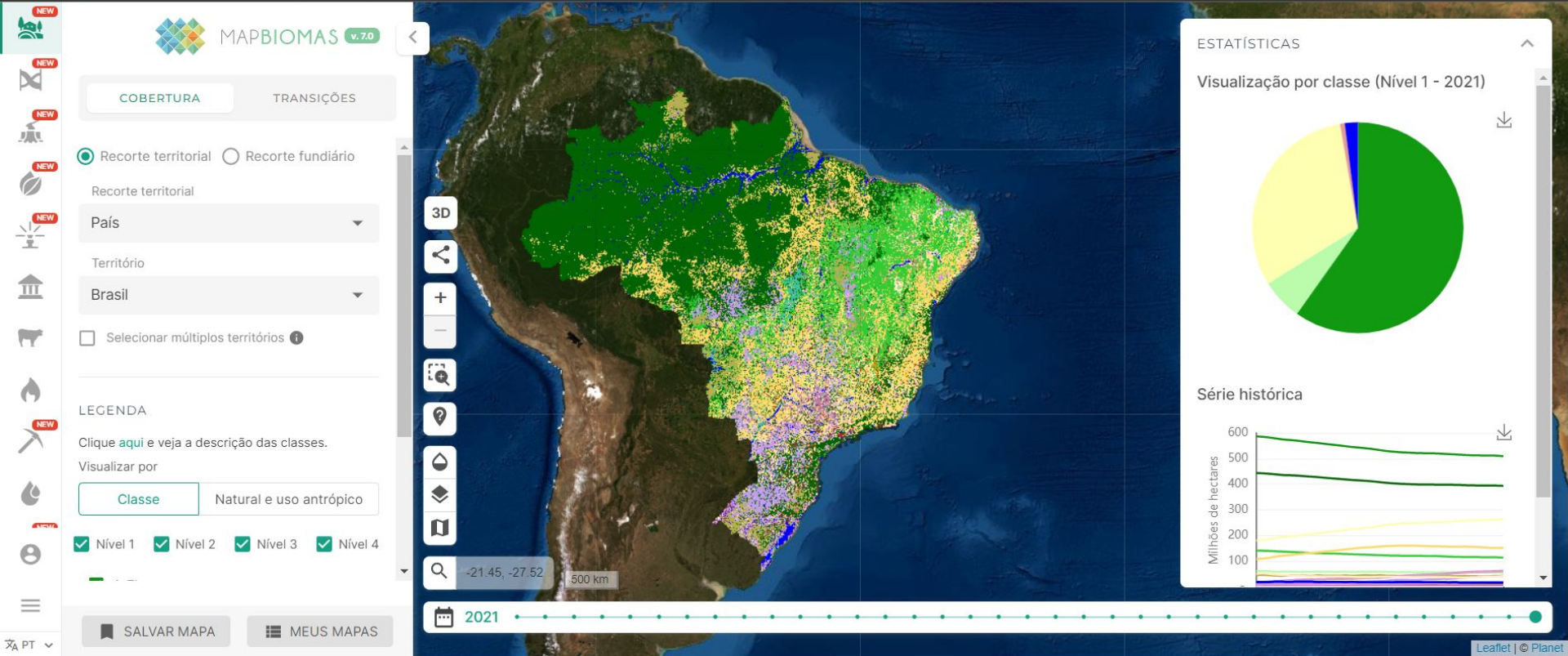
# MAPBIOMAS

[BRASIL]

MapBiomas is a collaborative network formed by NGOs, universities, and technology startups, which reveals the transformations in the Brazilian territory through science, making knowledge about land use accessible to seek conservation and combat changes in climate.

It has produced annual land cover and land use mapping and **monitors surface water and fire scars monthly with data from 1985**. The project also validates and produces reports for each deforestation event detected in Brazil since January 2019 with the product [MapBiomas Alerta](#).





<https://plataforma.brasil.mapbiomas.org/>



# STAY UP TO DATE

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MapBiomos' Fire Monitor: September numbers

[Read more](#)



91.6% of the area mined in Brazil is located in the Amazon biome

[Read more](#)



Soy occupies 10% of the Cerrado

[Read more](#)



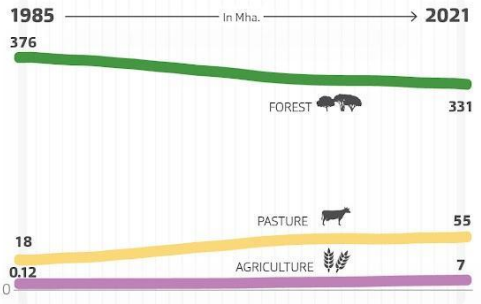
In 37 years, the Amazon has lost 12% of its forest

[Read more](#)

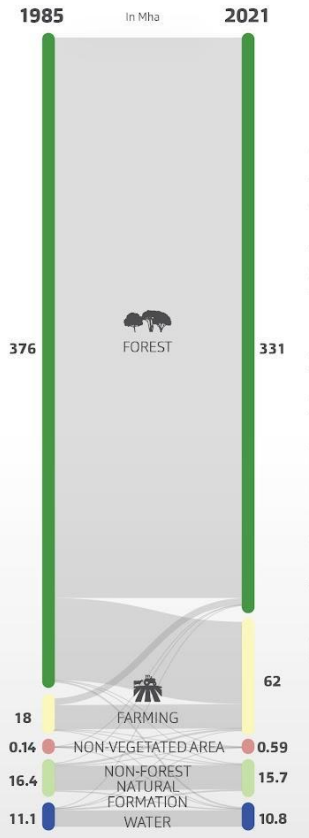
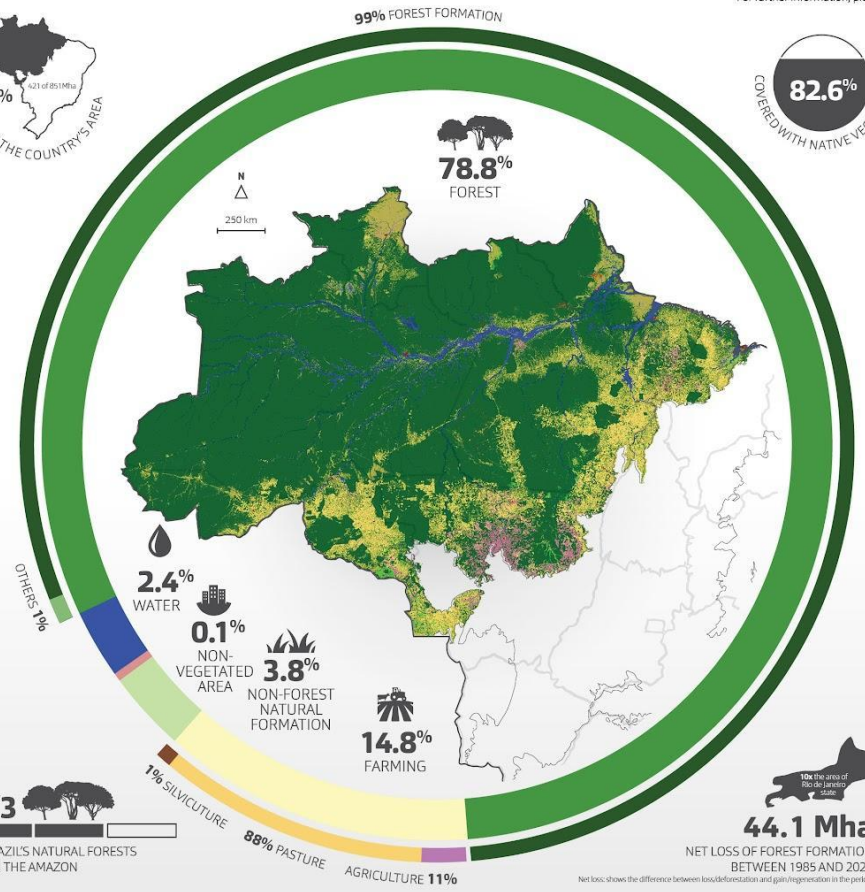
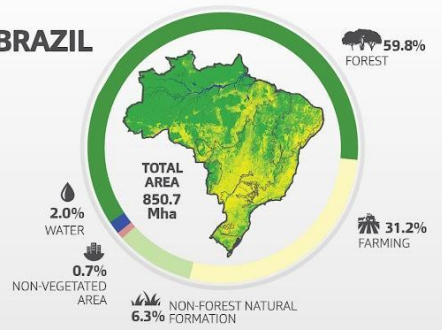


# Amazon

Land use and land cover annual evolution (1985-2021)



## BRAZIL



SOURCE: MapBiomas, Collection 3.0. The MapBiomas Project provides annual land use and land cover maps, as well as land use change maps during the period from 1985 to 2021. All datasets, as well as the methodology and accuracy assessment of MapBiomas Collections are available at the project website [www.mapbiomas.org](http://www.mapbiomas.org).



# Questions? Comments?

This work was supported from Operational Programme Research, Development and Education - Project „Postdoc2MUNI“ (No. CZ.02.2.69/0.0/0.0/18\_053/0016952).



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