

# The Road Not Taken

“The Future of GIS” - GeoBrasil 2000

Gilberto Câmara

INPE

[www.dpi.inpe.br/geobr](http://www.dpi.inpe.br/geobr)



Licença de Uso: Creative Commons Atribuição-Use Não-Comercial-Compartilhamento  
<http://creativecommons.org/licenses/by-nc-sa/2.5/br/>



# **Por Mares Dunca Antes Navegados**

**As Armas e os Barões Assinalados  
Que Da Ocidental Praia Lusitana  
Passaram Por Além da Tapobrana  
Por Mares Nunca Dantes Navegados**



# What's The Future of GIS ?

## Current Generation

- Maps as Support for Representation of Spatial Information

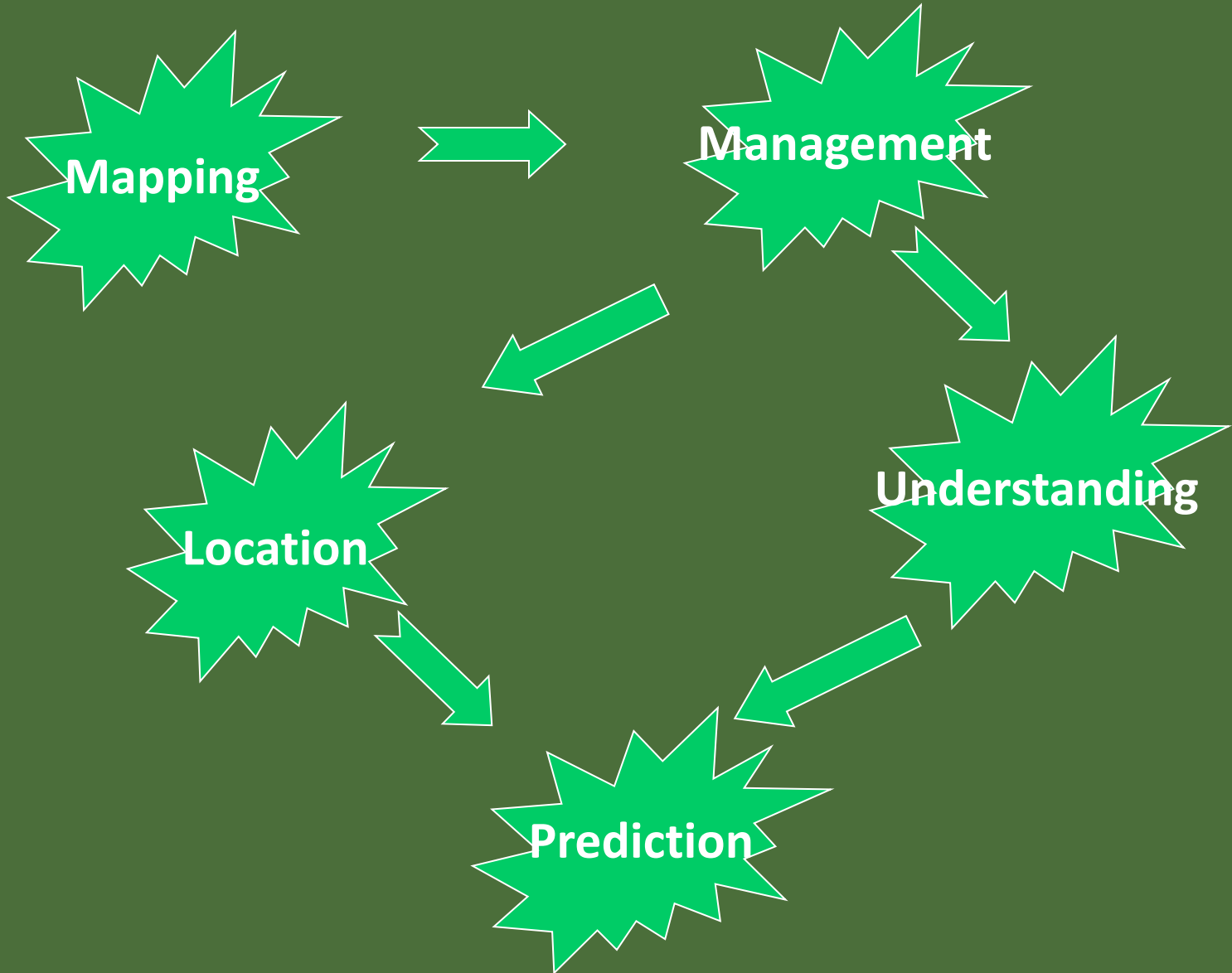
## What's Needed ?

- Extending the concept of space
- Concepts: Location, Spatio-Temporal Evolution, Action

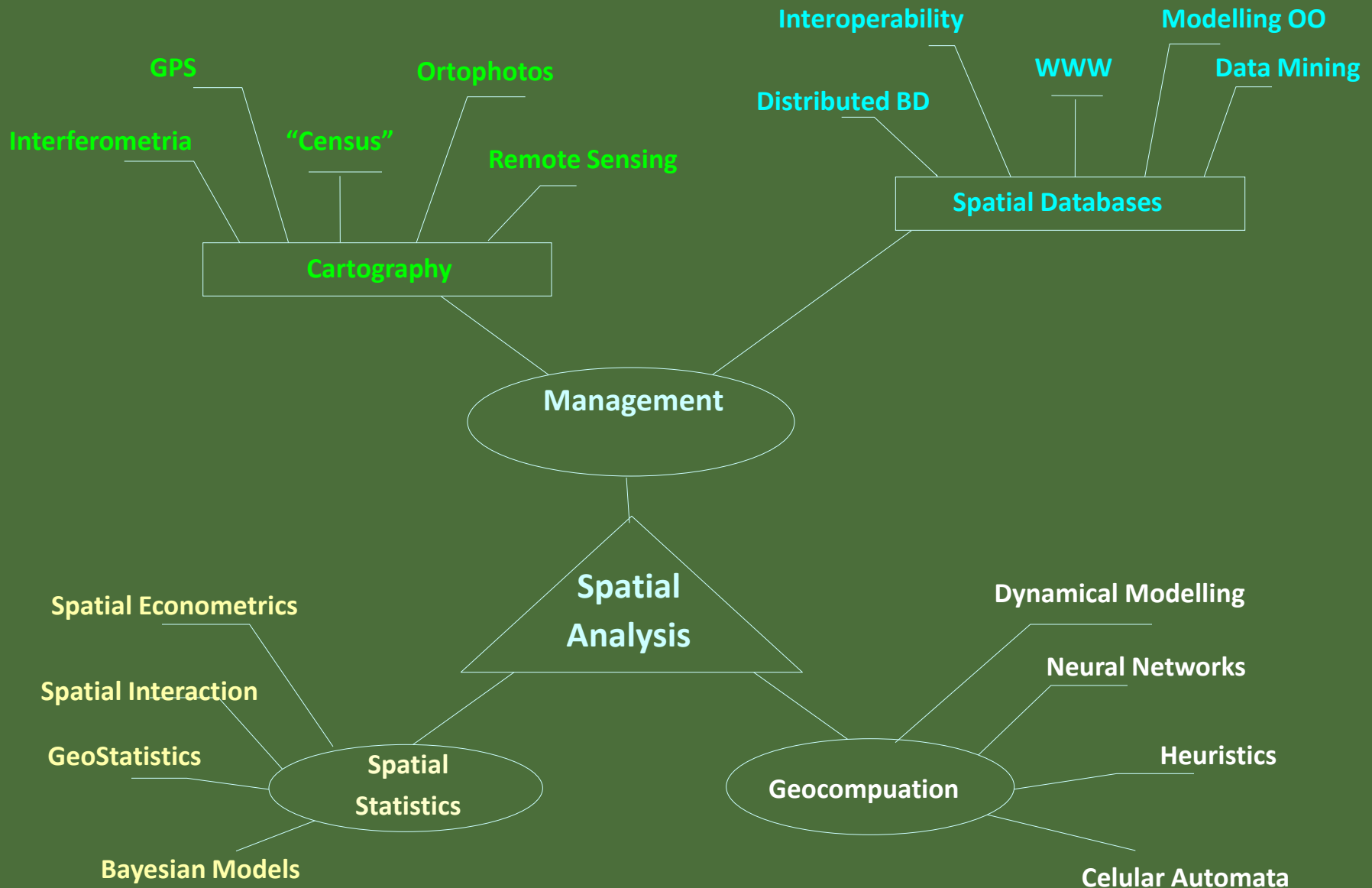
**“Space as a system of entities and a system of actions”**



# Evolution of Spatial Information



# Tecnologias de Geoprocessamento





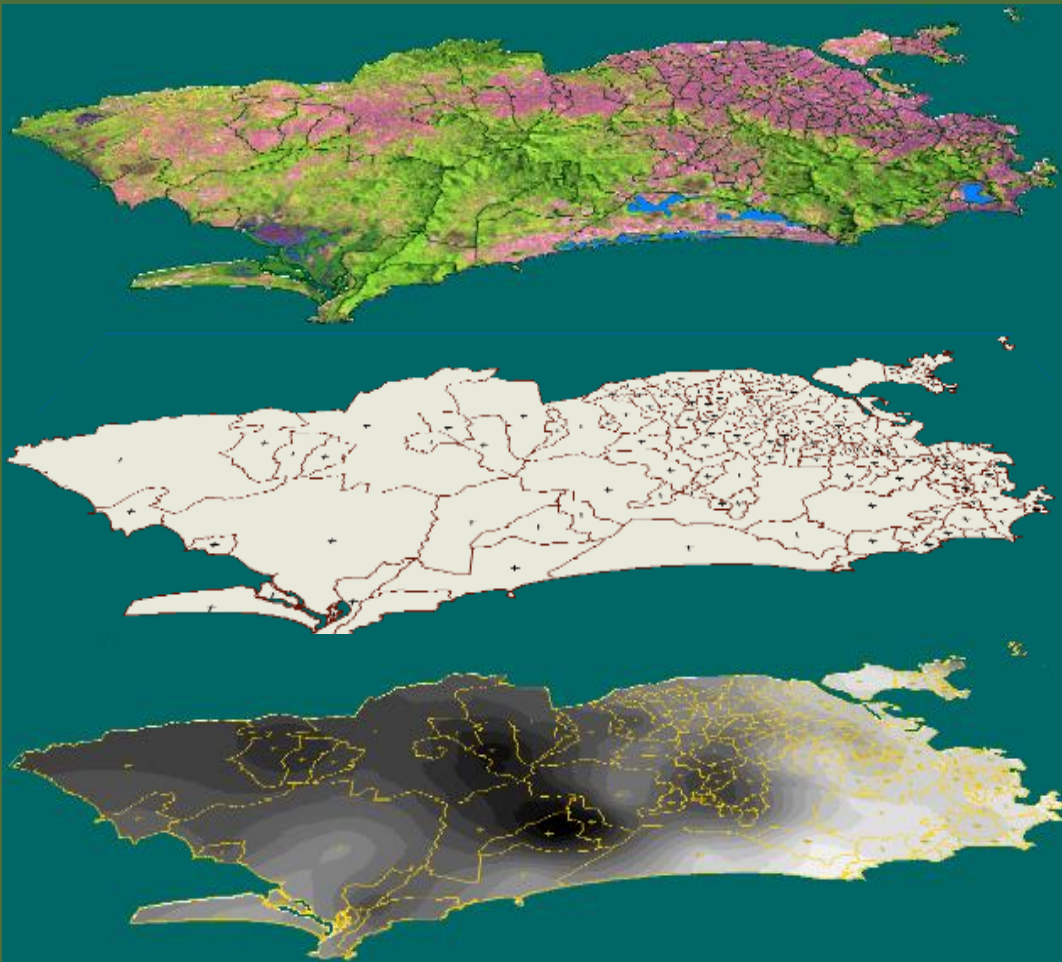
# Understanding Space: What's Needed?

What's special about spatial data ?

Typical Issues on Spatial Understanding

- Spatial Variability
- Uncertainty
- Topological Relations
- Temporal Variability
- User-domain Ontologies

# Sharing Visions of Space

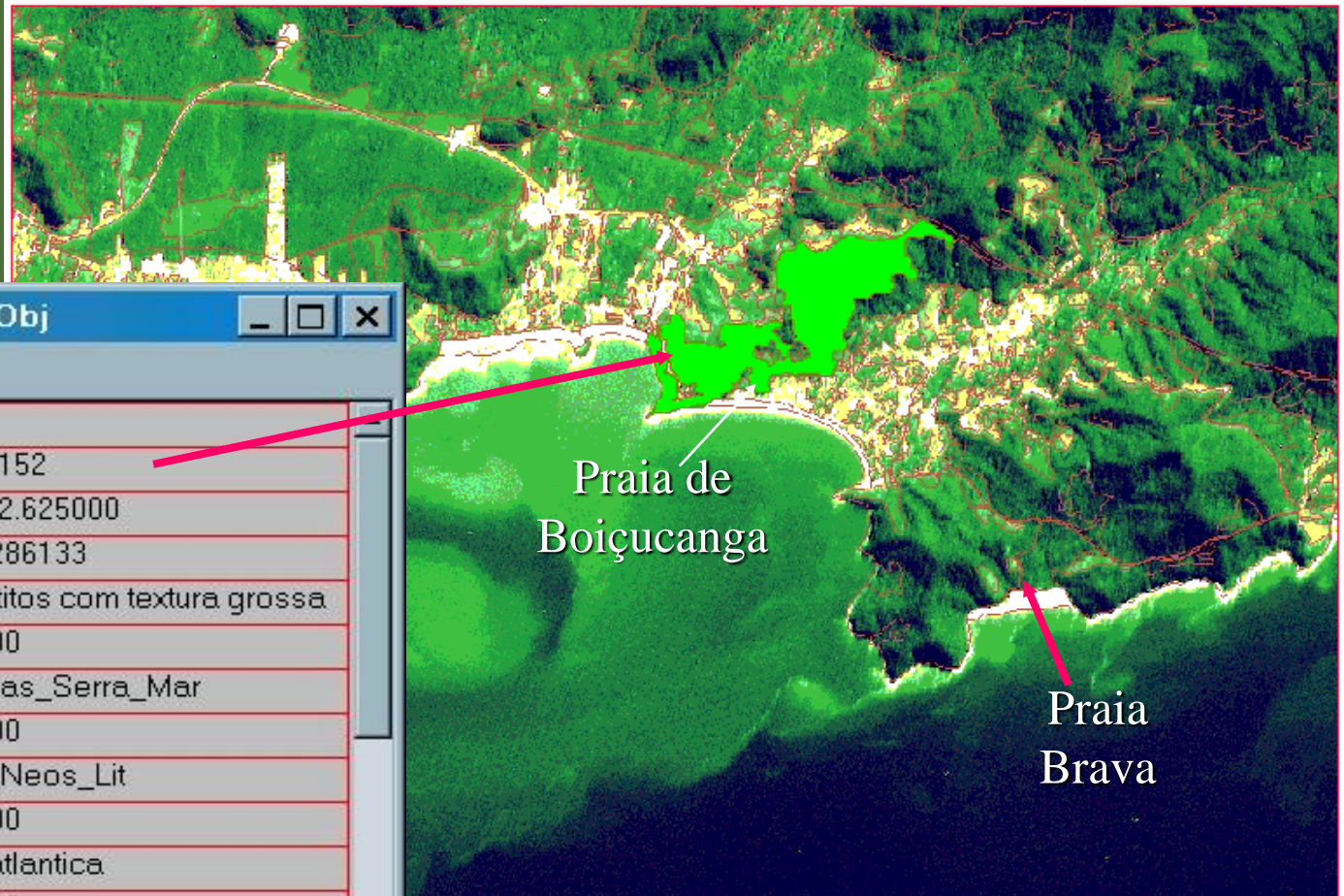


## Modelos de Dados

- Representations of Geographical Reality
- Imagens
- Superfícies
- Feições



# Neither Surfaces, nor Features...Land Units!



Atributos: UnTerrBas\_Obj

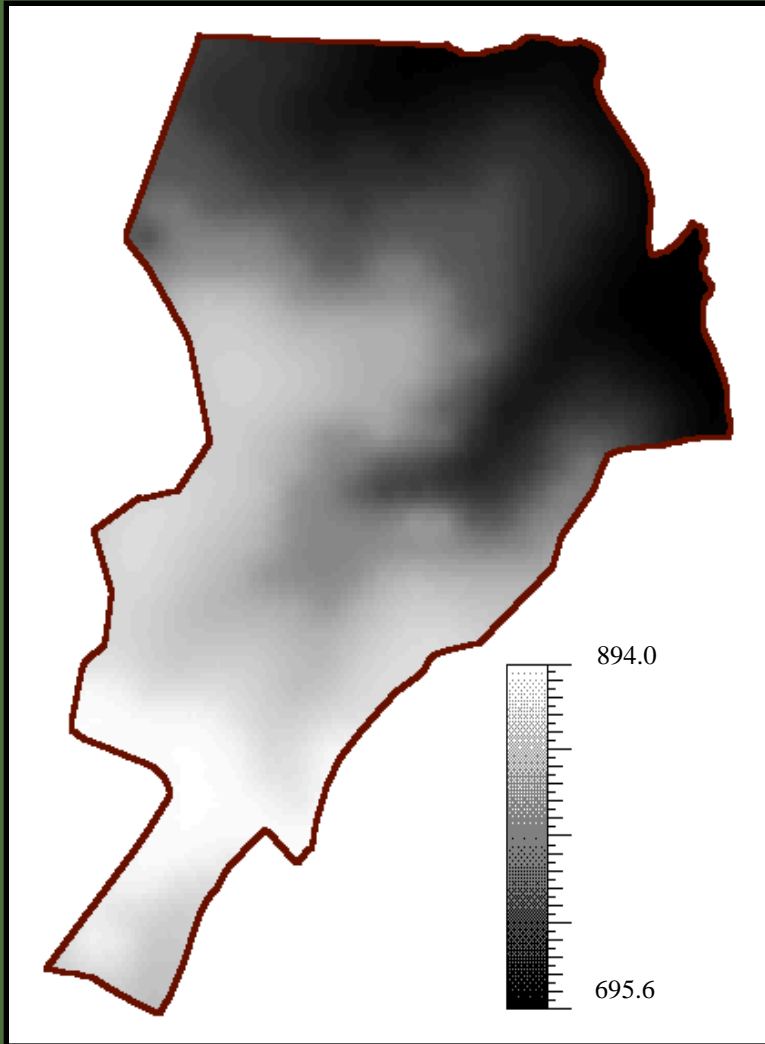
Ajuda

ID	43433
NOME	UTB_0152
AREA	1331122.625000
PERIMETRO	12710.286133
GEOL_CLS	Migmatitos com textura grossa
GEOL_VUL	1.300000
RELEVO_CLS	Escarpas_Serra_Mar
RELEVO_VUL	3.000000
SOLO_CLS	Camb_Neos_Lit
SOLO_VUL	2.700000
VGUSO_CLS	mata_atlantica
VGUSO_VUL	1.000000
VULN_MEDIA	2.000000
DECLIV_MEDIA	55.171955
ALTITUDE_MEDIA	139.339515

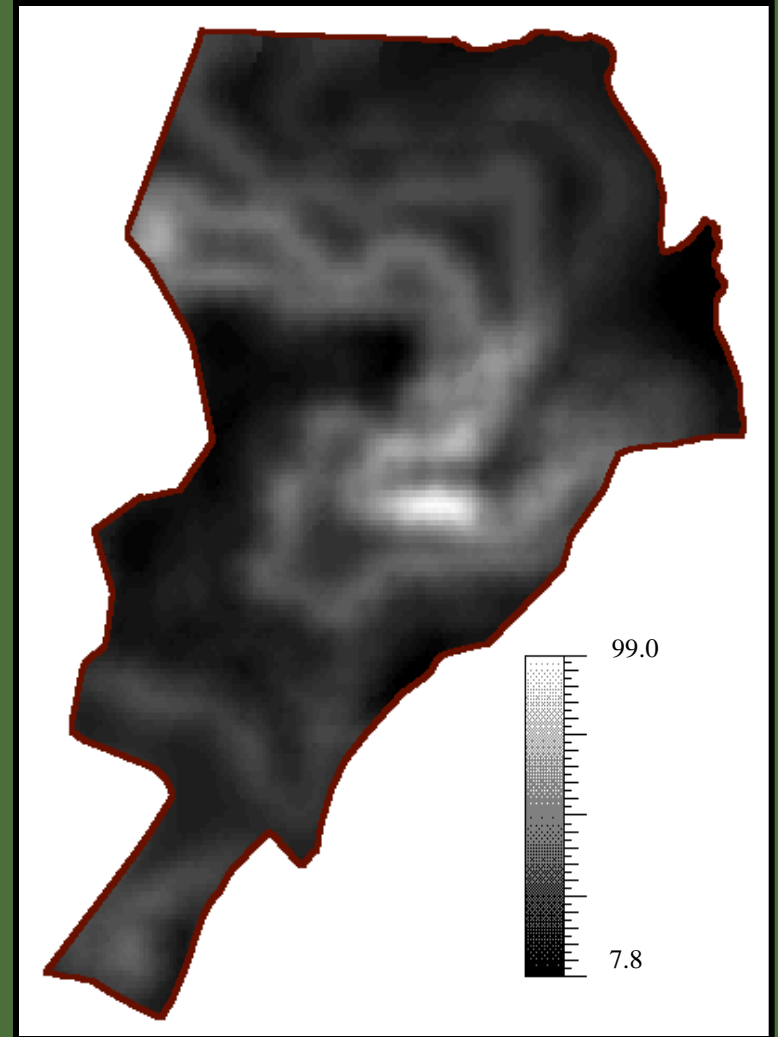
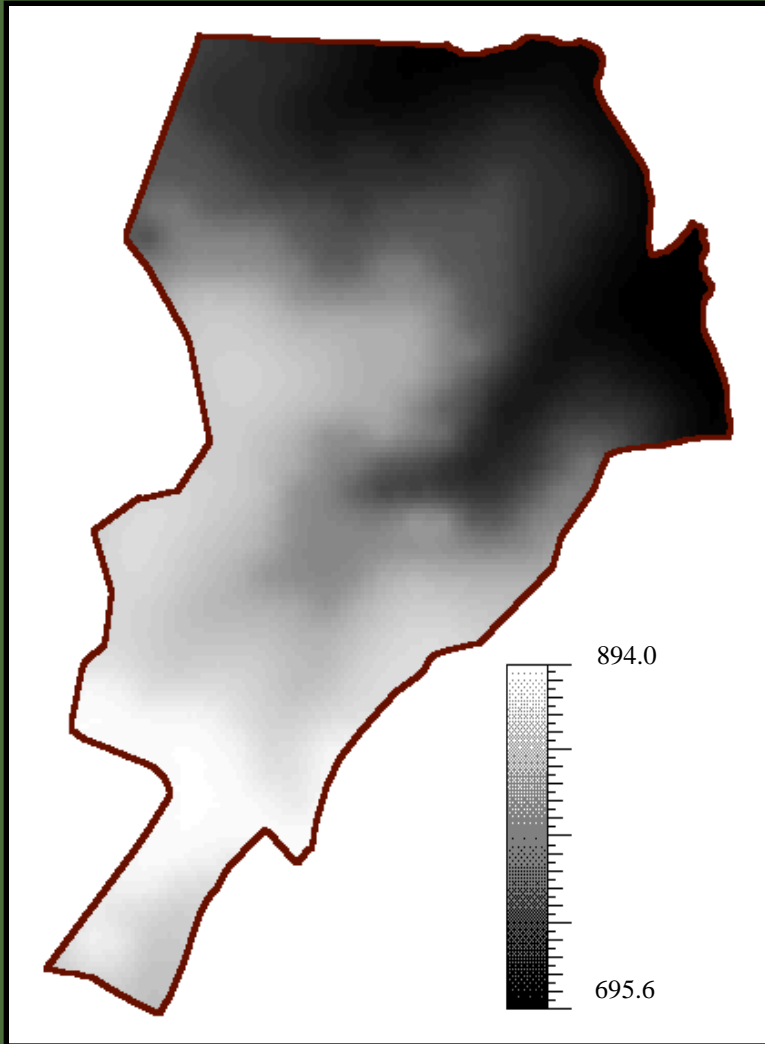
Exemplo de Unidade Territorial Básica - UTB



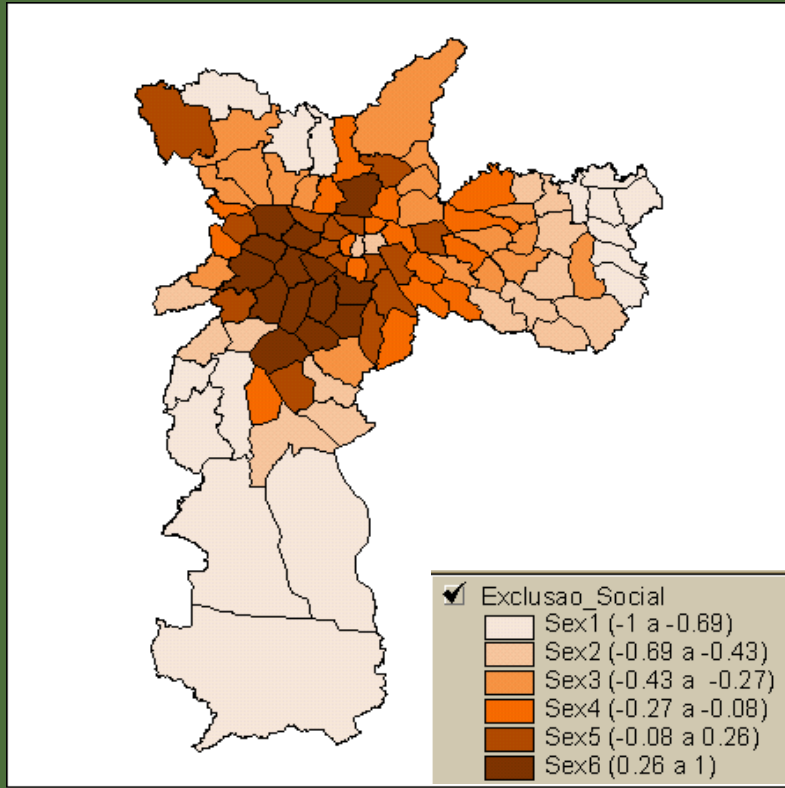
# We Lie with Maps...



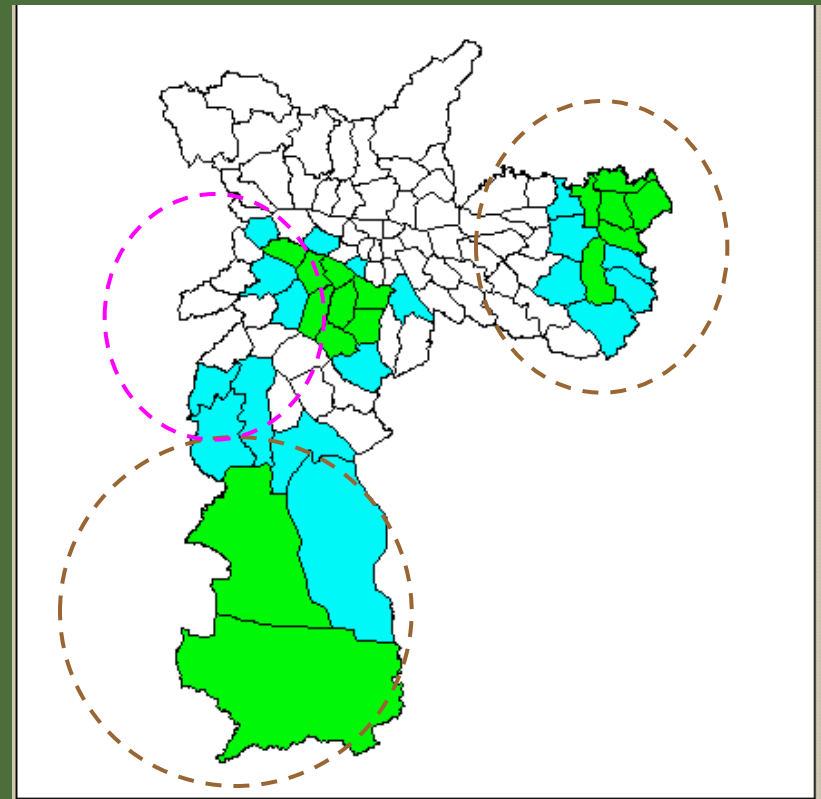
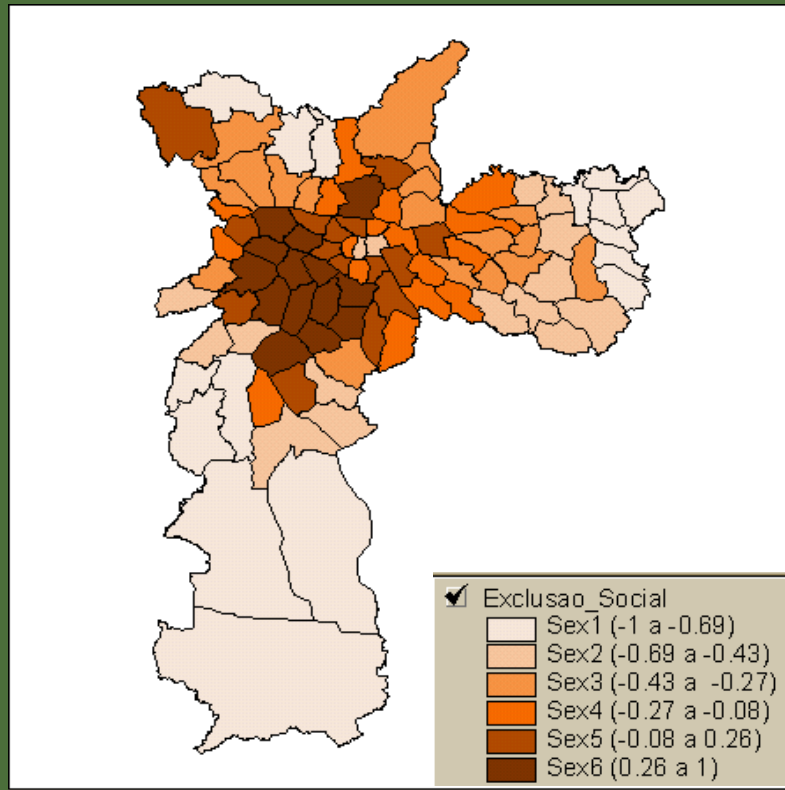
# We Lie with Maps... How Much ?



# We See Maps...



# We See Maps...Do We See the Patterns ?

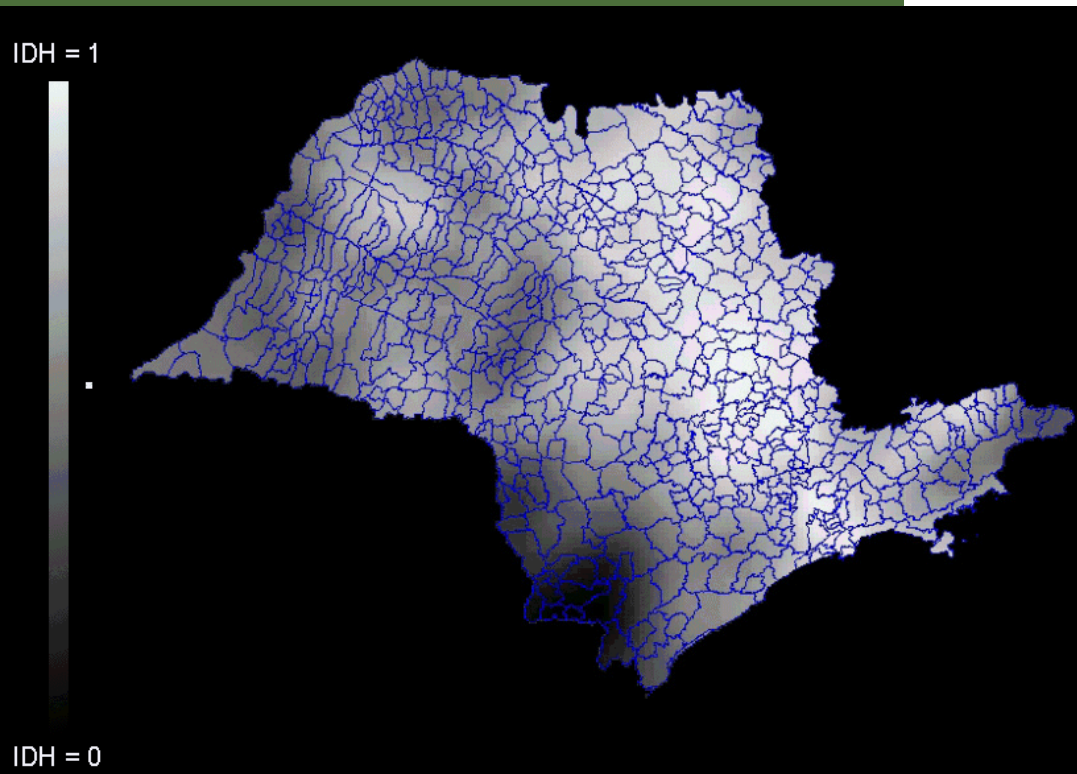
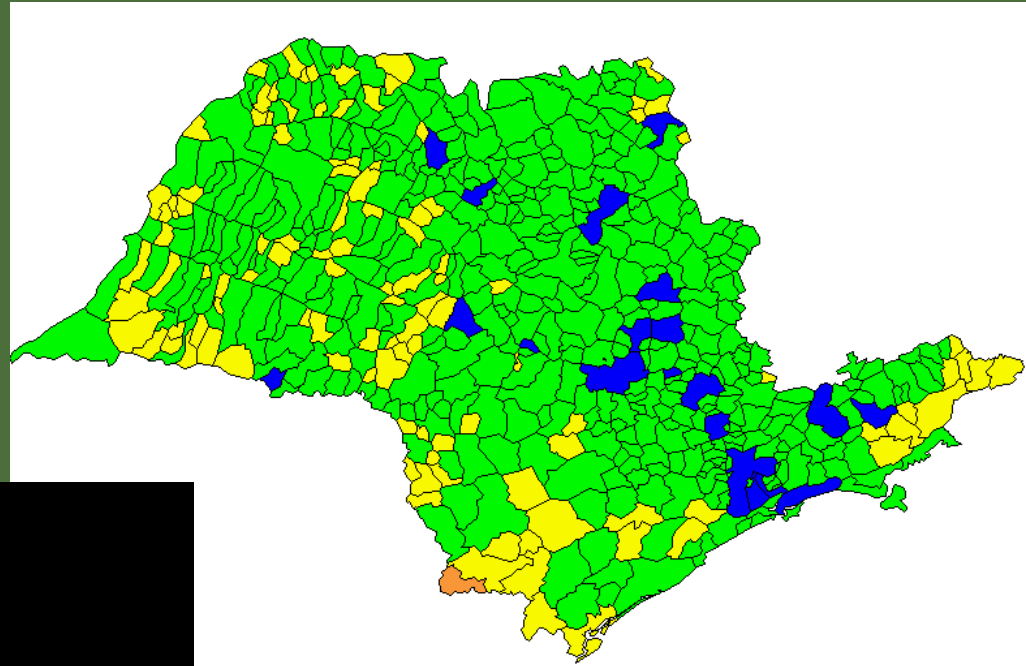


“Clusters” of social exclusion/inclusion in São Paulo



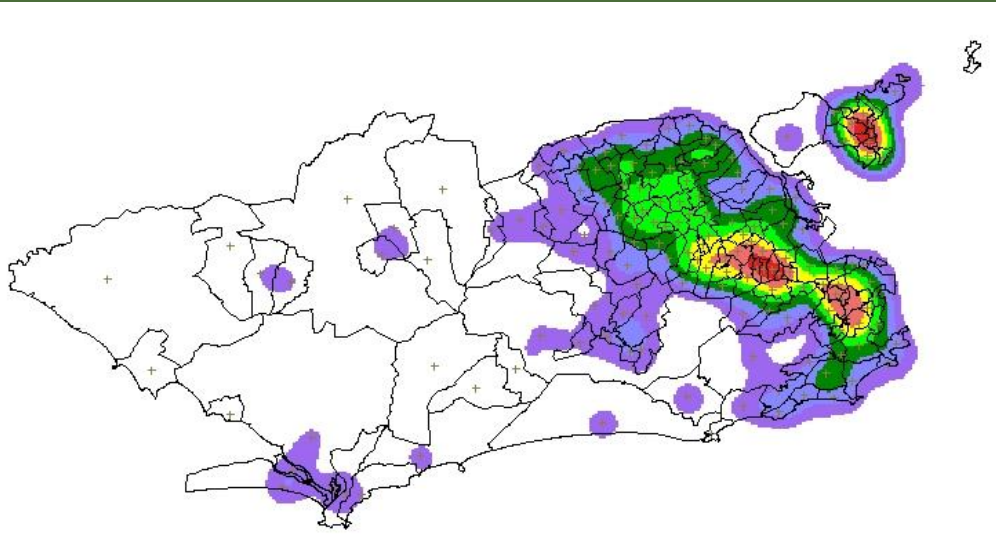
# Extending Perceptions of Space

Space as a planar subdivision

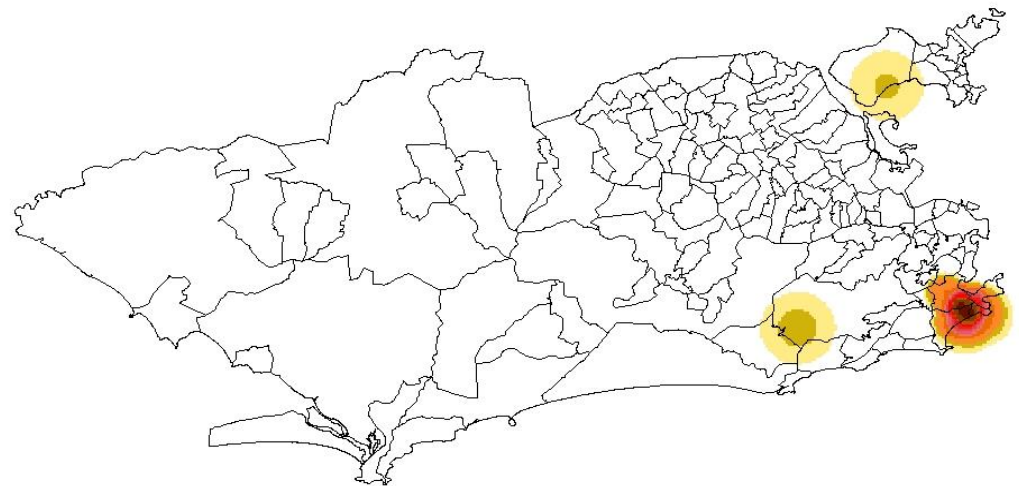


Space as a continuous surface

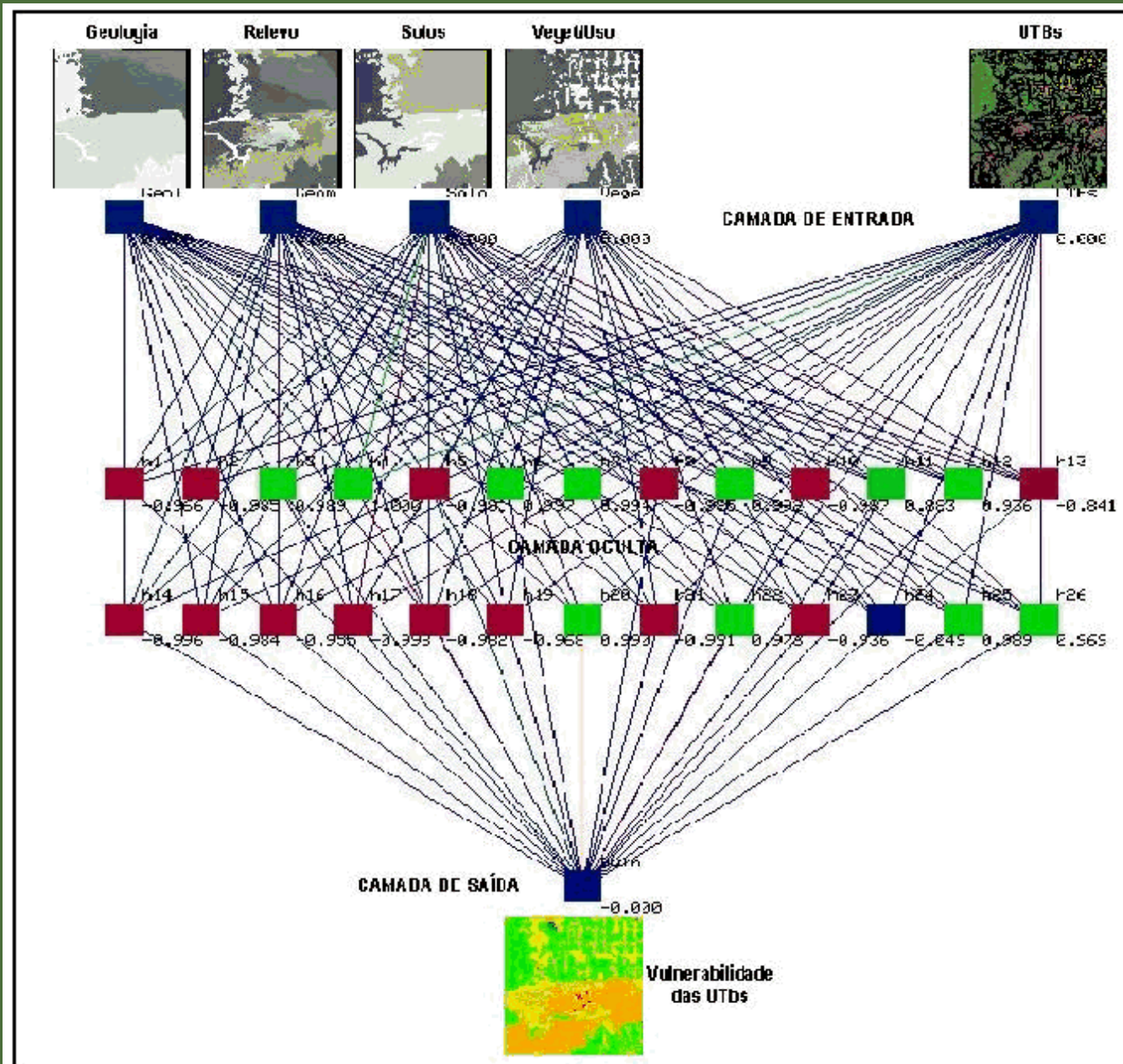
# Understanding Space



Space as Clusters of Events



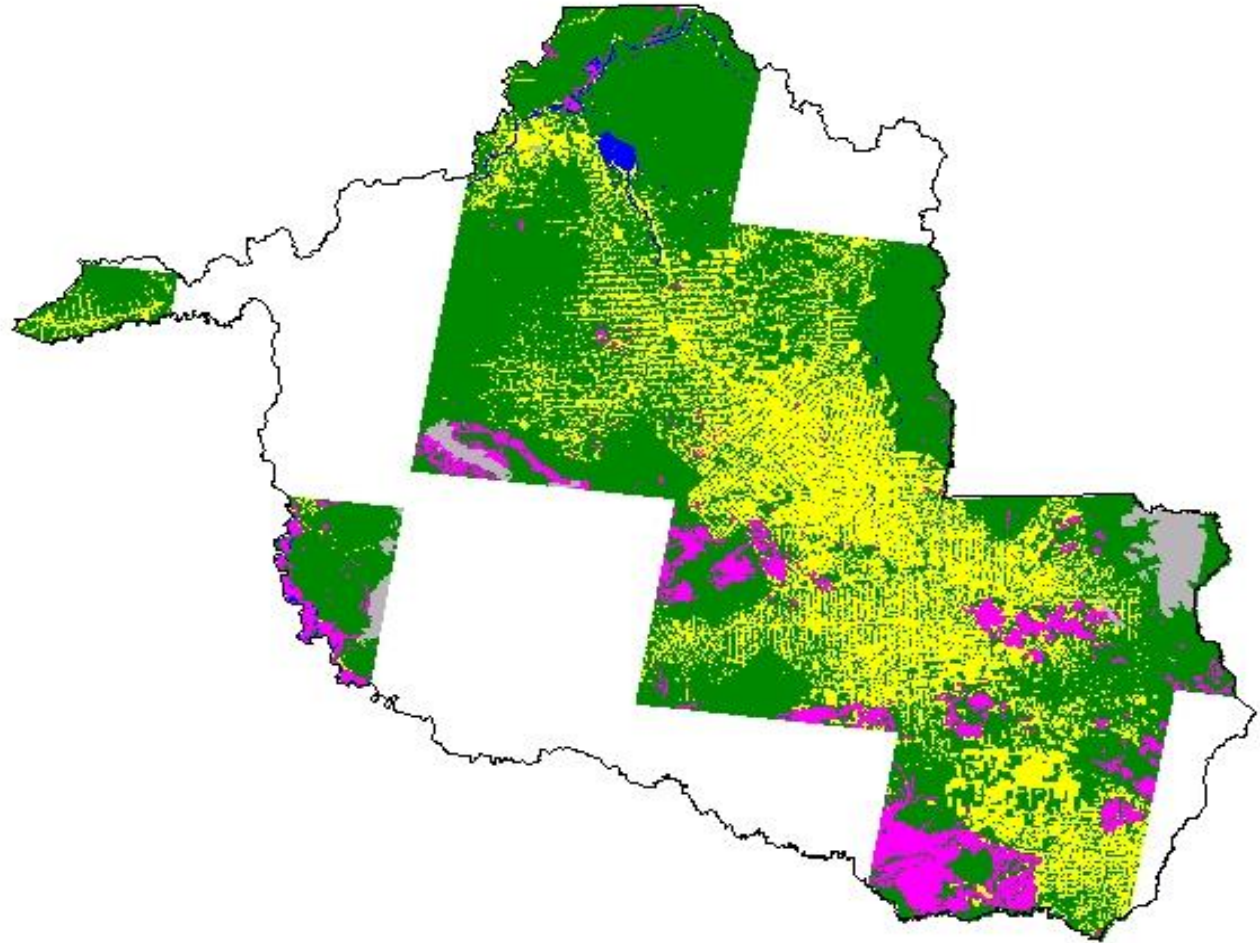
# Treinamento em Redes Neurais





# We Can Map the Past

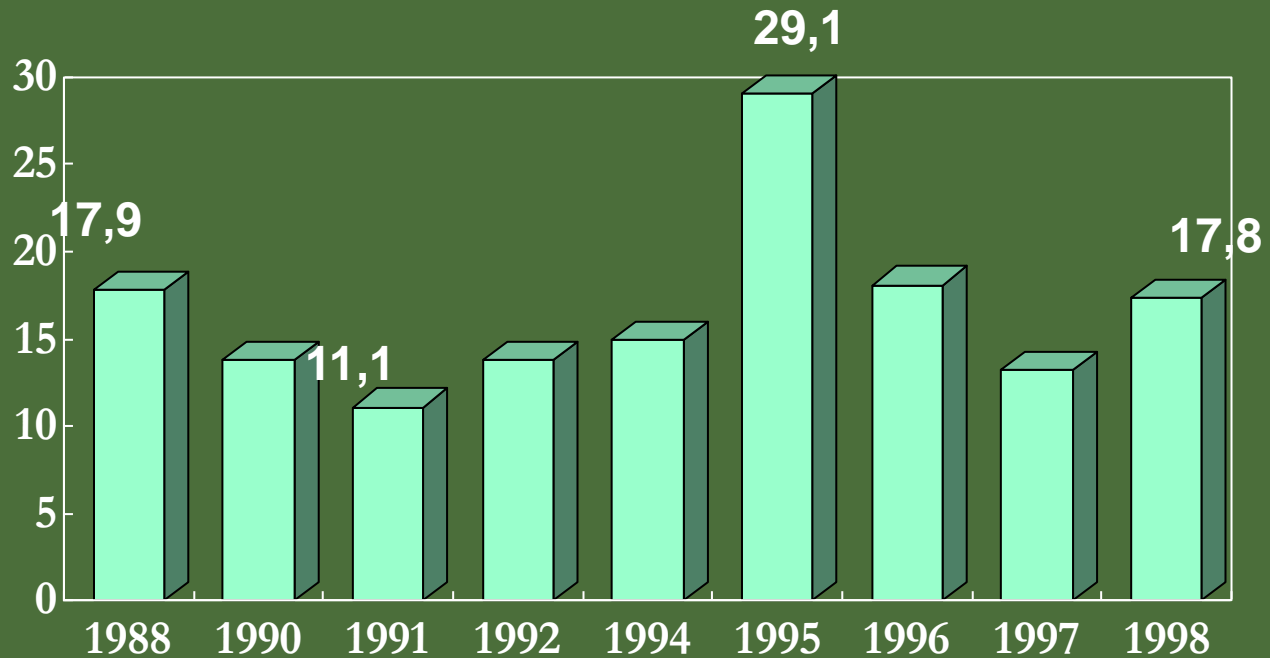
RONDÔNIA  
STATE: Critical  
Areas





# Can We Predict the Future ?

1.000km<sup>2</sup>/  
year



Annual rate of deforestation in Amazonia  
(228 LANDSAT TM images )



# **Geotechnology at INPE: Motivation**

**Empowering policy makers, scientists and NGOs in the Third World to adequately use sophisticated technology such as Geographical Information Systems (GIS) to better manage their natural and human resources.**



# Geotechnology development at INPE

## Motivation

- provide innovative and user-friendly system
- strongly linked to research and education

## Long-term investment

- 1st. Generation (1982-1992): DOS system
- 2nd. Generation (1992-present): SPRING (Windows/Linux)

## Cooperative Development

- INPE: team of 40 people (R&D)
- Brazilian institutions: EMBRAPA, PUC/RJ
- 150 man-years, 500,000 LOC in C++



# INPE: SPRING Technology

## Support for Environmental Projects

- Data Integration (images, surfaces, socio-economical data, thematic maps)
- Data Modelling (Map Algebra, Spatial Statistics)

## Education

- Support for 100 graduate students in 5 years
- 700 users trained in Brazil and S. America (3 years)
- 4 books produced (available on-line)





# **SPRING Technology: Empowering People**

## **SPRING - emphasis on innovation**

- **new image classification algorithms**
- **strong analytical capability**
- **use of Geostatistics and Spatial Statistics**

## **Available on the Internet**

- **8,000 downloads in 2 years (3,000 outside Brazil)**
- **mirror sites: Spain, Portugal**

**Free Technology need not be worse !**





# Technological Development in Third World - The Challenges

How to empower people with advanced technology ?

Is there a place for Third-World technology in a global market ?



# Empowering People with Geotechnology in Brazil

## Environment

- Largest rain-forest (4.000.000 km<sup>2</sup>)
  - what is causing a 15,000 km<sup>2</sup> annual deforestation in Amazonia ?

## Economy

- 10th in GNP, 85st in HDI
  - where are the excluded citizens of Brazil ?

## Health

- modern private hospitals x public health system
  - where should we allocate resources ?

# Empowering People with Geotechnology: the “White-Box”

*results = people + methods + software*

## People

- “learning by doing” x “learning by using”

## Methods

- translate concepts into working procedures

## Software

- provide adequate support for data analysis and integration





# Third-World technology in a global market : The Challenges

## Competitive IT solutions

- require qualified personnel
- long-term investment (10+ years)

## Lots of qualified IT personnel in Third World

- dispersed em many institutions (no critical mass)
- how to share resources and knowledge ?

## “Act locally, think globally”

- local solutions can be applied elsewhere
- sucessful IT products should have a global perspective



# Third-World technology in a global market: Towards an Alternative

## Building an alternative to technological domination

- Internet supporting a network of co-operation

## Co-operative IT solutions

- requires re-thinking of how IT works
- Open Source: Linux as a paradigm
- SPRING is an example of what can be achieved

## Towards a “new utopia”

- “turning globalization upside down”
- IT should bring solutions, not software monopolies

# The Road Not Taken

Two roads diverged in a yellow wood,  
And sorry I could not travel both  
And be one traveler, long I stood  
And looked down one as far as I could  
To where it bent in the undergrowth;

Then took the other, as just as fair,  
And having perhaps the better claim,  
Because it was grassy and wanted wear;  
Though as for that, the passing there  
Had worn them really about the same,

And both that morning equally lay  
In leaves no step had trodden black.  
Oh, I kept the first for another day!  
Yet knowing how way leads on to way,  
I doubted if I should ever come back.

I shall be telling this with a sigh  
Somewhere ages and ages hence:  
Two roads diverged in a wood, and I-  
I took the one less traveled by,  
And that has made all the difference.