

TerraLib as an Open Source Platform for Public Health Applications

Karine Reis Ferreira

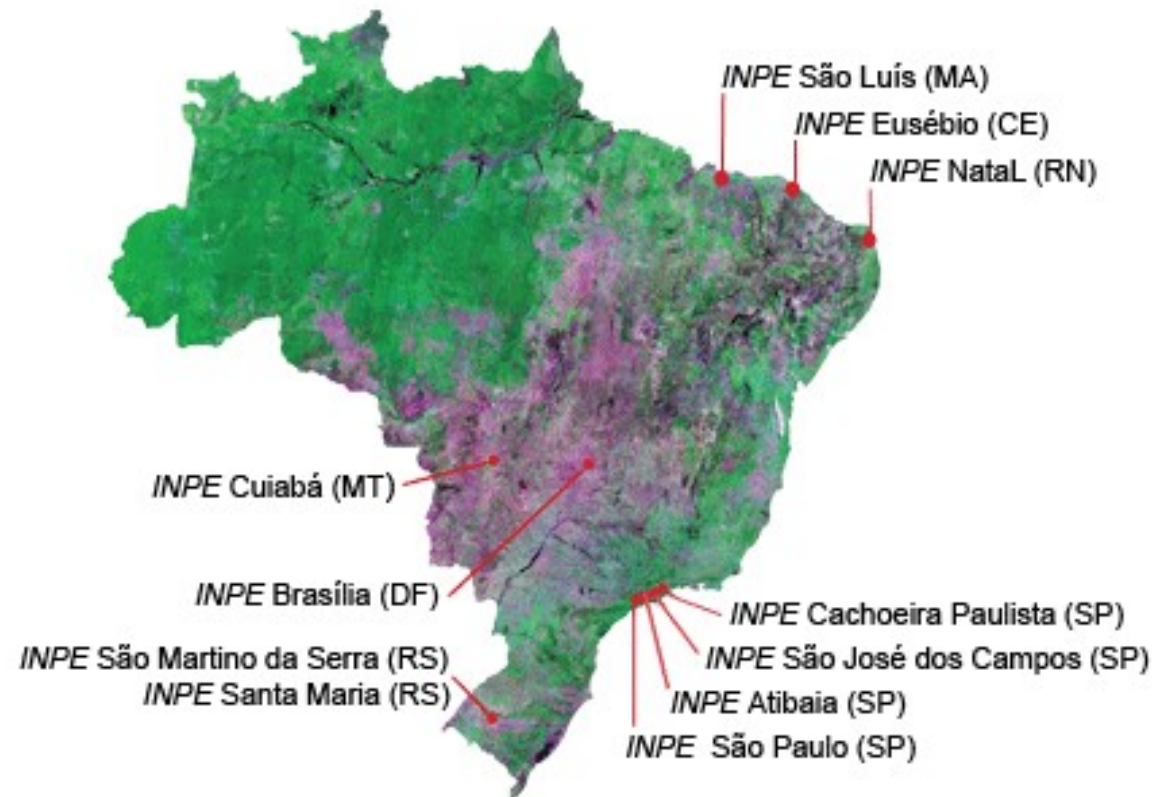


2008 FREE AND OPEN SOURCE
SOFTWARE FOR GEOSPATIAL CONFERENCE

September 2008

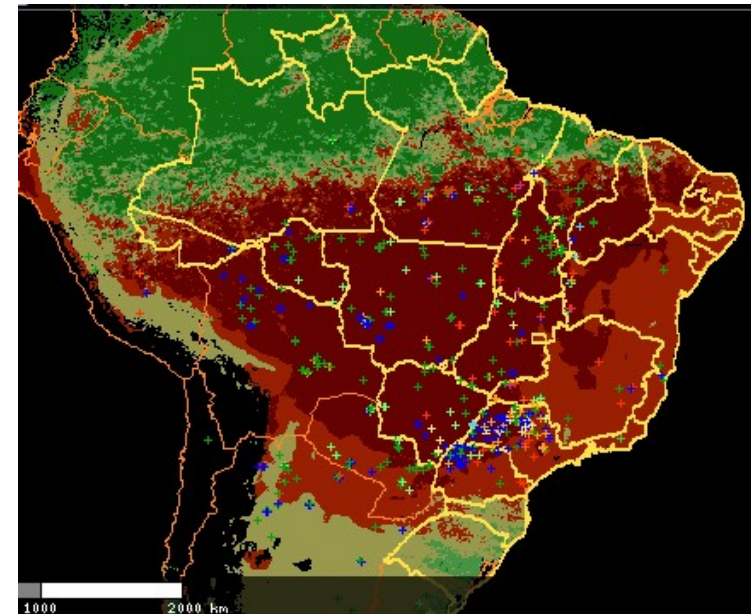
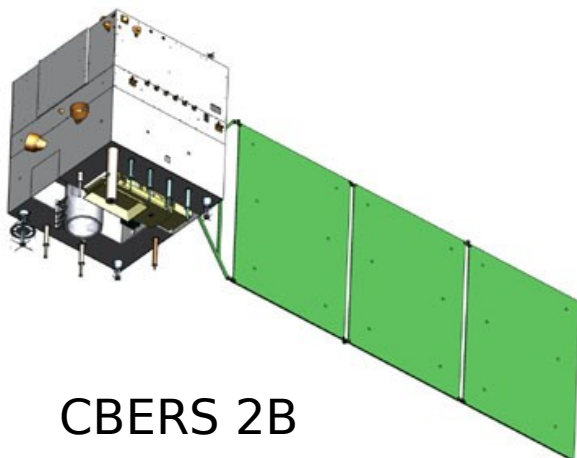
INPE – National Institute for Space Research

- Brazilian research institute
- Main campus is located in São José dos Campos in São Paulo state
- 1,600 employees
- 6 graduate courses



INPE – National Institute for Space Research

- Some researches and services:
 - CBERS – China-Brazil Earth Resources Satellite
 - Weather Forecast and Climate Studies
 - PRODES: Monitoring of Amazon Deforestation
 - PROARCO: Fire Monitoring
 - Free geo softwares



DPI – Image Processing Division

History developing geographical softwares



Free GIS

Geographical files and DBMS

Desktop and Multiplatform

Image Processing, Spatial Analysis, Edition, ...

100.000
downloads



Free and **Open Source** Geographical
Software **Library** (TerraLib) and
Geographical **Application** (TerraView)

Spatial DBMS

Client-Server and Multiplatform



1991

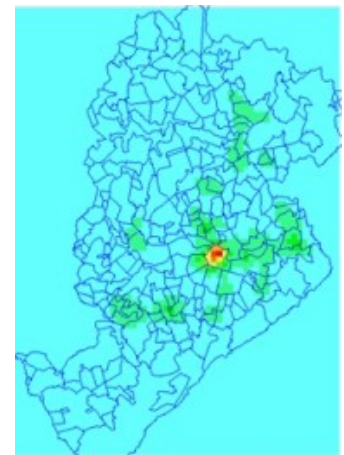
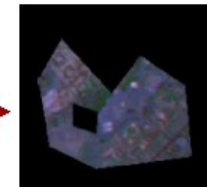
2001

now

TerraLib




- Library to develop geographical applications
- C++ language
- Free and Open Source – LGPL
- Extensive use DBMS
 - MySQL, PostGIS
 - Oracle, Oracle Spatial, SQLServer
- Spatial operations, image processing, spatial analysis, ...




TerraLib web site (www.terralib.org)

[INPE](#)[DPI](#)


**TerraLib**

- DOCUMENTATION
- DOWNLOAD
- CHANGELOG
- EXTENSIONS
- FORUM
- LIST OF PROJECTS


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 **WHAT IS TERRALIB?**

TerraLib is a GIS classes and functions library, available from the Internet as open source, allowing a collaborative environment and its use for the development of multiple GIS tools. Its main aim is to enable the development of a new generation of GIS applications, based on the technological advances on spatial databases.[more]

 **NEWS**

[2008-02-19] **TerraLib 3.2.0 is available**

 TerraLib 3.2.0 is launched. It fixes the bugs founded in the third release candidate and is now considered as the latest stable release of TerraLib.

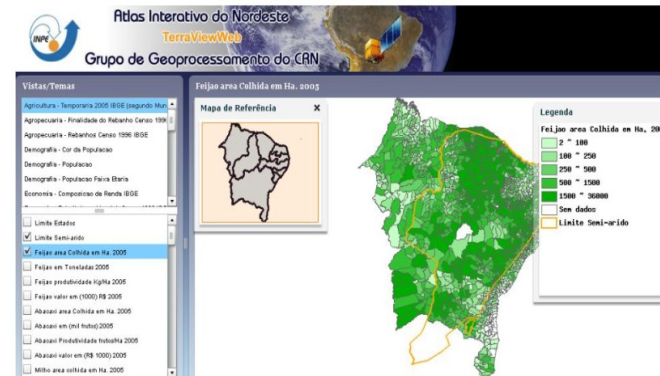
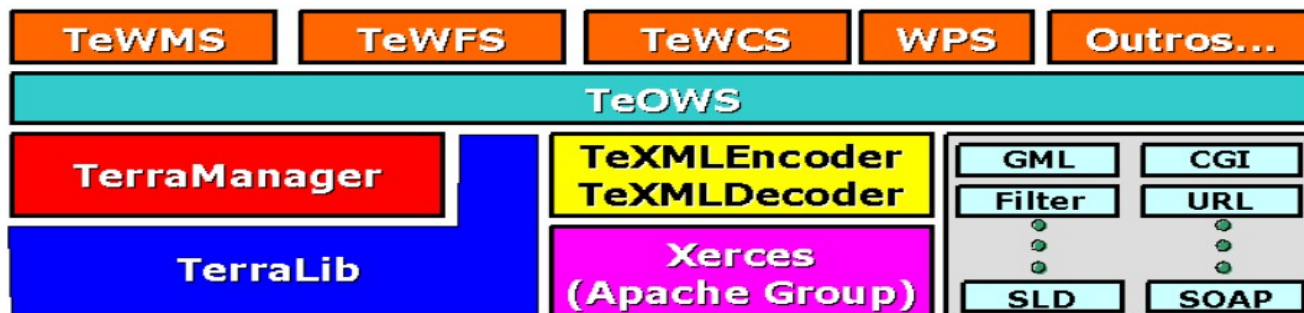
[2007-12-21] **TerraLib 3.2.0 RC3 is available** The last stable version of **TerraLib** is the 3.1.4. We are now preparing the new stable version that will be the 3.2.0. **TerraLib** 3.2.0 RC3 is the third candidate to **TerraLib** release 3.2.0. It fixes the bugs founded in the second release candidate. If you are interested in use **TerraLib** 3.0.2 RC3 go to the download area.

[2007-12-12] **TerraLib 3.2.0 RC2 is available** The last stable version of **TerraLib** is the 3.1.4. We are now preparing the new stable version that will be the 3.2.0. **TerraLib** 3.2.0 RC2 is the second candidate to **TerraLib** release 3.2.0. It fixes the bugs founded in the first release candidate. If you are interested in use **TerraLib** 3.0.2 RC2 go to the download area.

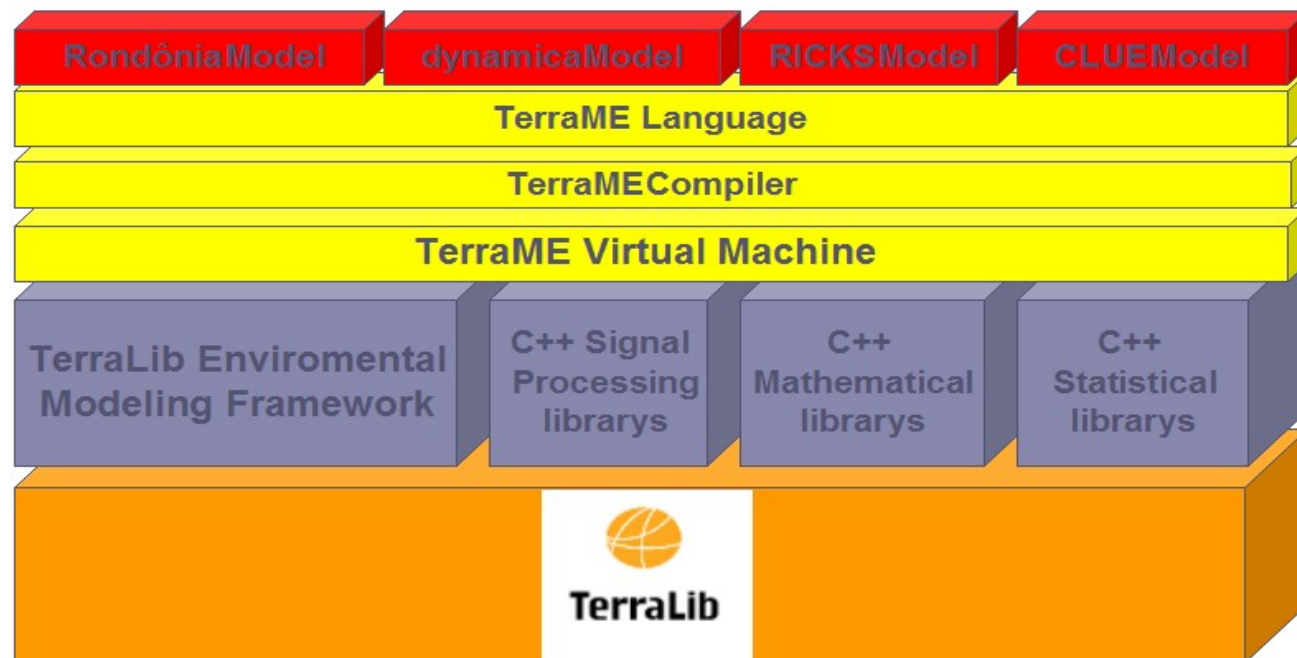
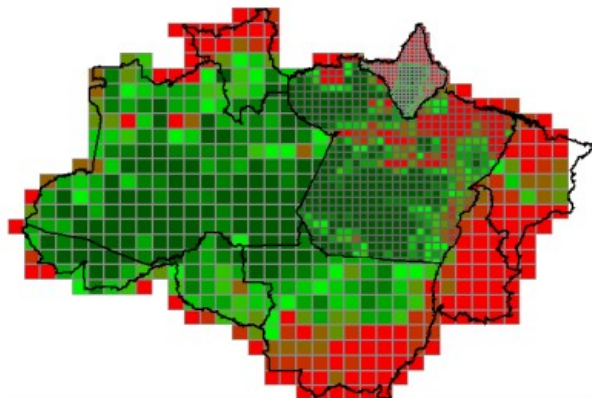
[2007-08-12] **TerraLib 3.2.0 RC1 is available** The last stable version of **TerraLib** is the 3.1.4. We are now preparing the new stable version that will be the 3.2.0. **TerraLib** 3.2.0 RC1 is the first candidate to **TerraLib** release 3.2.0. It contains modifications and enhancements that have been tested internally and have the potencial to be part of the next stable release, unless fatal bugs emerge. We are now making it available so that users get the chance to try it and help us to remove any remaining

TerraLib

OGC Web Service support



Environmental Modeling support



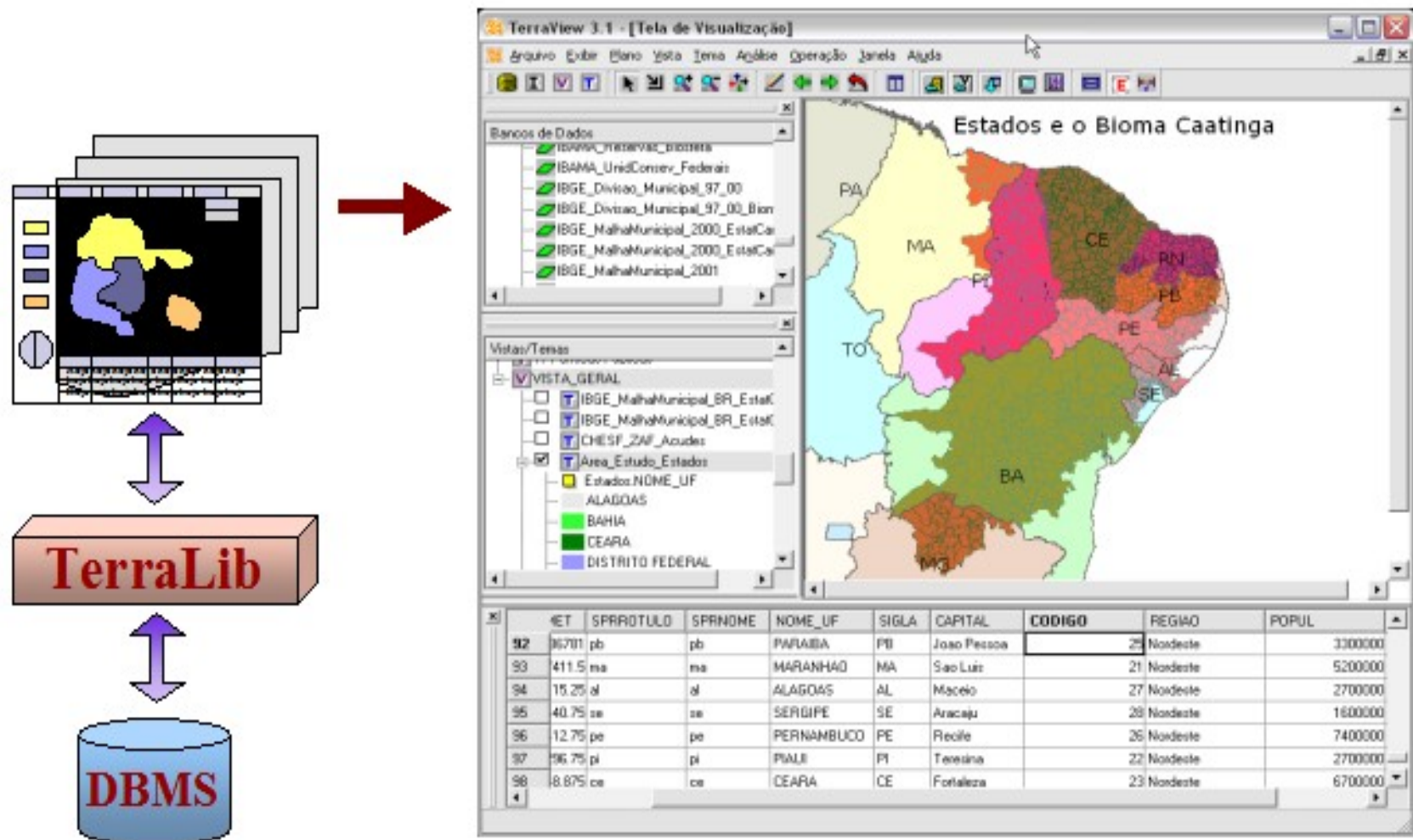
TerraView



- Geographical application built using TerraLib
- Is an example of:
 - how to build a geographical application using TerraLib
 - what you can do using this library
- Free and Open Source – LGPL

TerraView


Set of graphical interfaces (QT toolkit) that use the TerraLib functionalities.



TerraView web site


(www.dpi.inpe.br/terraview)

[INPE](#) [DPI](#)



[equipe](#) [parceiros](#) [licença](#) [procurar por](#) [no](#) [Site](#) 


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 **PROJETO TERRAVIEW**


O **TerraView** é um aplicativo construído sobre a biblioteca de geoprocessamento **TerraLib**, tendo como principais objetivos:

- Apresentar à comunidade um fácil visualizador de dados geográficos com recursos de consulta e análise destes dados.
- Exemplificar a utilização da biblioteca **TerraLib**.

O **TerraView** manipula dados vetoriais (pontos, linhas e polígonos) e matriciais (grades e imagens), ambos armazenados em SGBD relacionais ou geo-relacionais de mercado, incluindo ACCESS, PostgreSQL, MySQL e Oracle.

 **NOTÍCIAS**

|19/02/2008| **Disponível o TerraView 3.2.0**

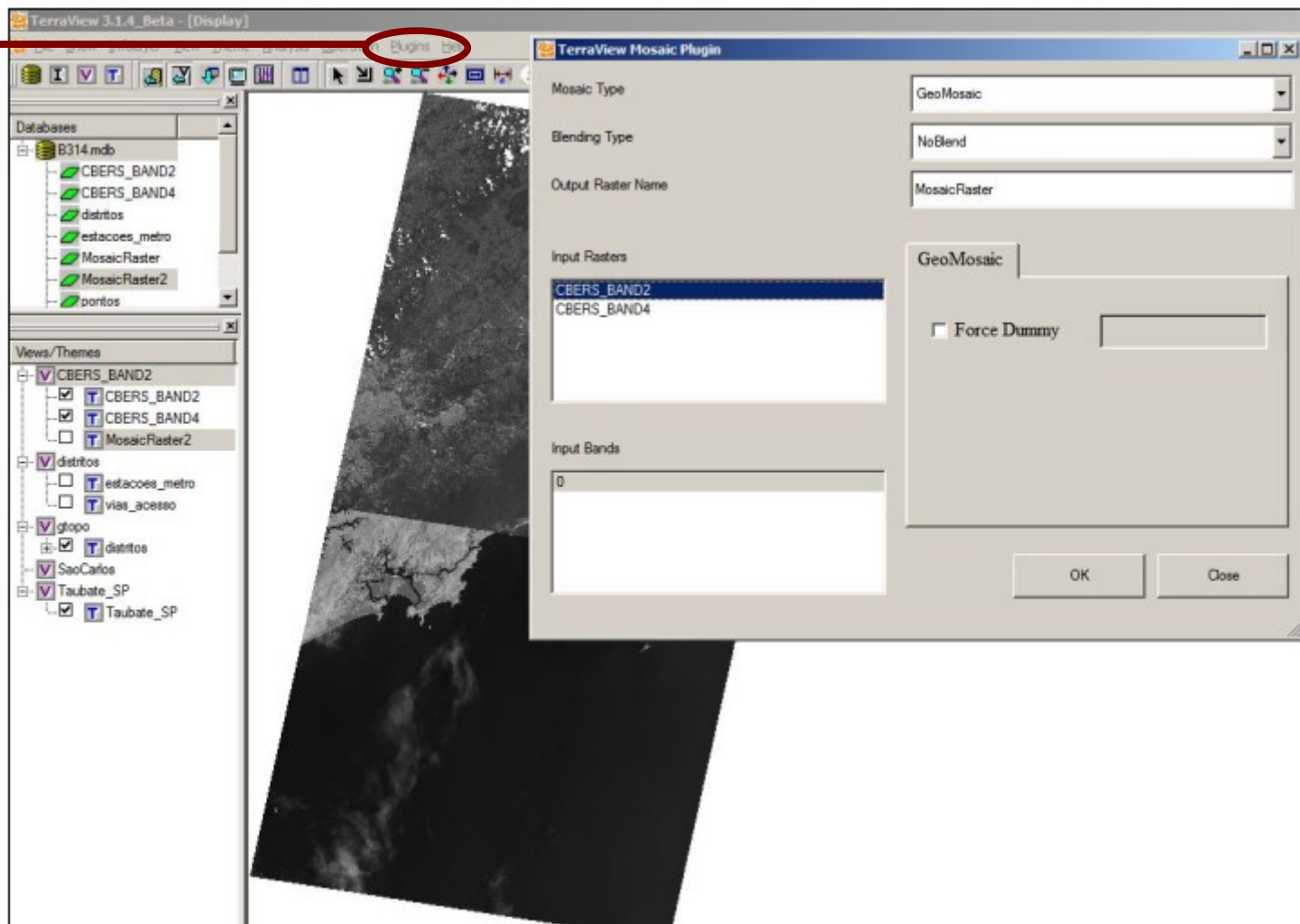
 Está disponível a Versão 3.2.0 do TerraView. Juntamente com essa versão podem ser obtidos Plugins que permitem a visualização de camadas de informação a partir de servidores WMS (Web Map Service) ou arquivos Shapefile em disco e para o acesso a Temas criados em bancos TerraView remotos.

|21/12/2007| **Disponível o TerraView 3.2.0 RC 3** Está disponível a terceira Candidata a Versão 3.2.0 do **TerraView**. Ela contém correções de erros encontrados na segunda candidata a versão. Juntamente com essa versão podem ser obtidos Plugins que permitem a visualização de camadas de informação a partir de servidores WMS (Web Map Service) ou arquivos Shapefile em disco e para o acesso a Temas criados em bancos **TerraView** remotos.

TerraView Plug-ins

Add new graphical interfaces and functionalities to TerraView and customize it through plug-ins

Plug-ins
menu



Ex.:
Mosaic
Images
Plug-in

Brazilian Public Health Problems

- Endemic Diseases

- Dengue Fever
- Malaria
- Leptospirosis

Aedes aegypti mosquito



Anopheles mosquito



Cases in Brazil

	Infected	Died	year
Dengue Fever	559,954	158	2007
Malaria	457,659	59	2007
Leptospirosis	2,698	301	2005



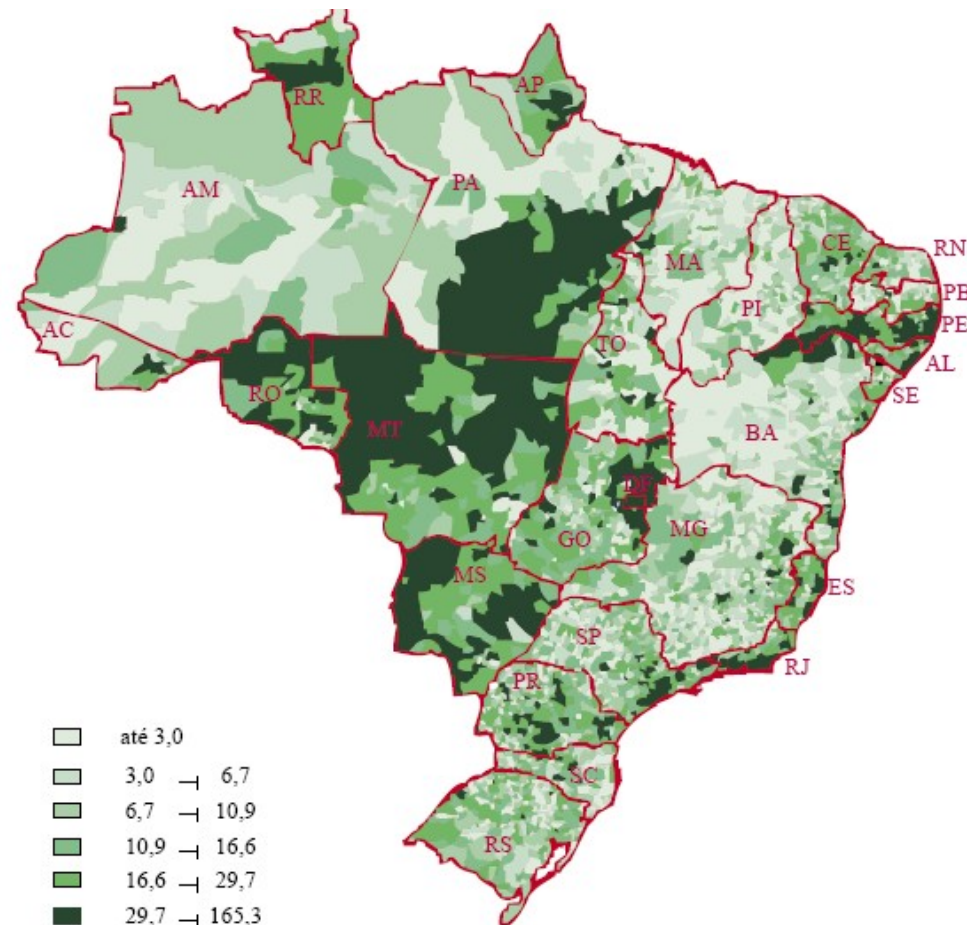
[Source: Ministry of Health, 2008]

Brazilian Public Health Problems

- Violence

- Total rate: 27 homicides per 100.000 inhabitants per year
- 30 or 40 times higher than that of England, France, Austria and Japan

Homicide rates 2002/2004



[Source: Julio Jacobo Waiselfisz, 2007]

Applications for Public Health

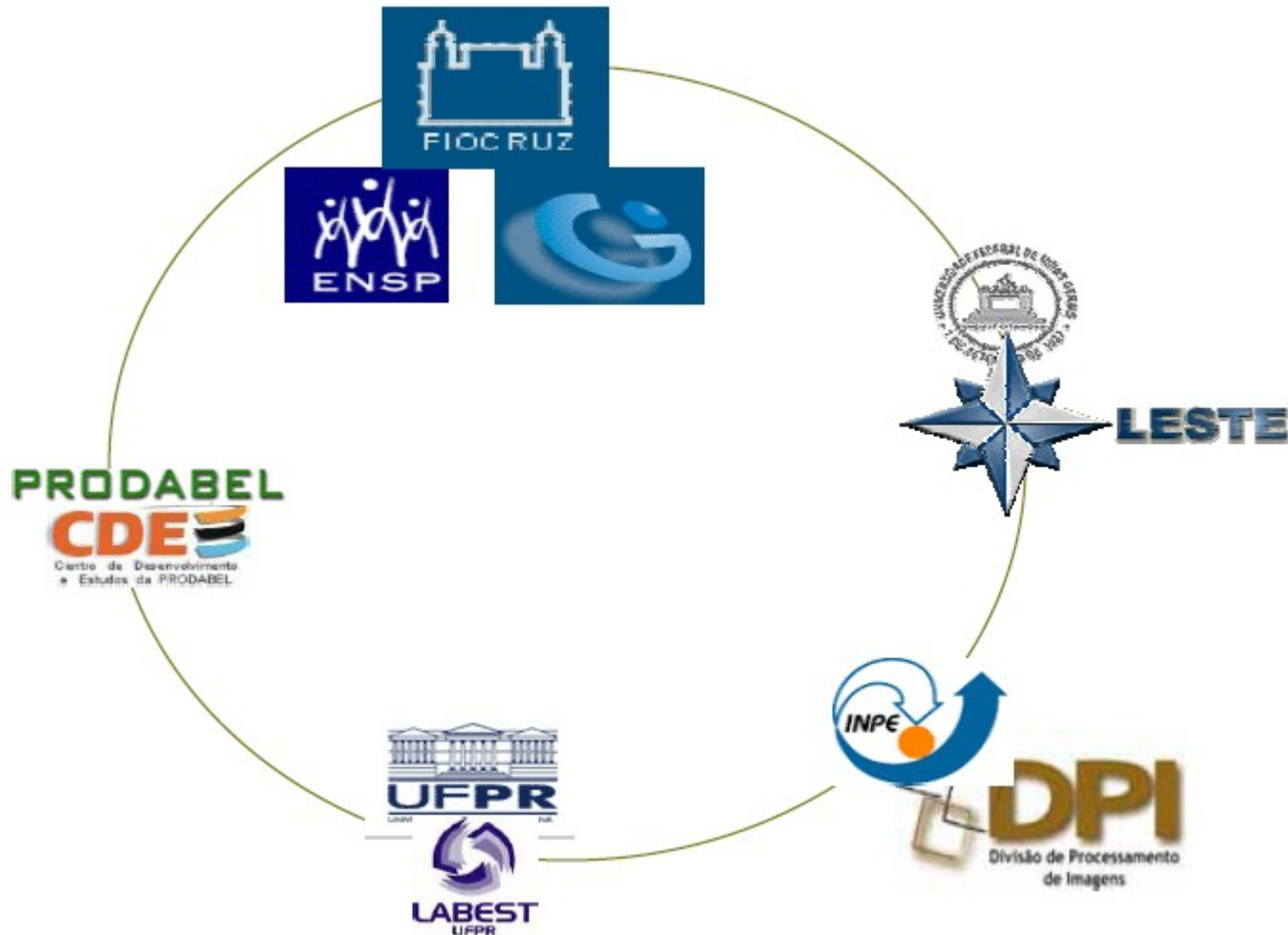
- Software tools able to:
 - detect epidemic outbreaks and spatio-temporal clusters
 - model and identify risk and protection factors in endemic and epidemic moments
 - integrate environmental information, risk factor detection, and warning methods

TerraLib Solutions for Public Health

- Projects networking health institutes, universities and government department:
 - Join specialists from different areas
 - Examples: SAUDAVEL and EUREQA
- Free and open source tools
 - Built using TerraLib library
 - Examples: TerraStat, TerraCrime, aRT and TerraCluster plug-ins

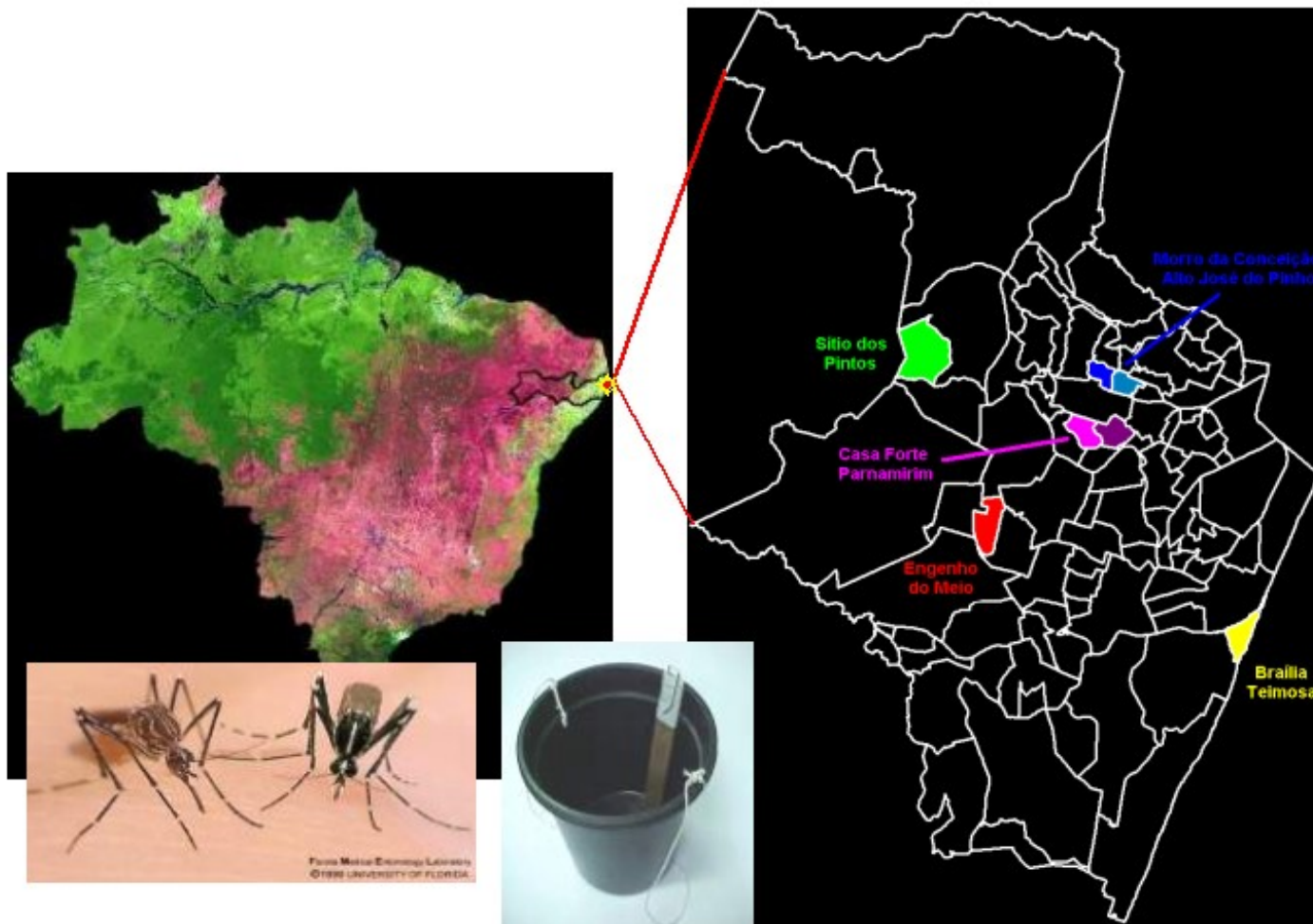
SAUDAVEL Project

A Surveillance System to control, alert and intervene epidemic and endemic diseases, like Dengue Fever and Leptospirosis.



SAUDAVEL Project

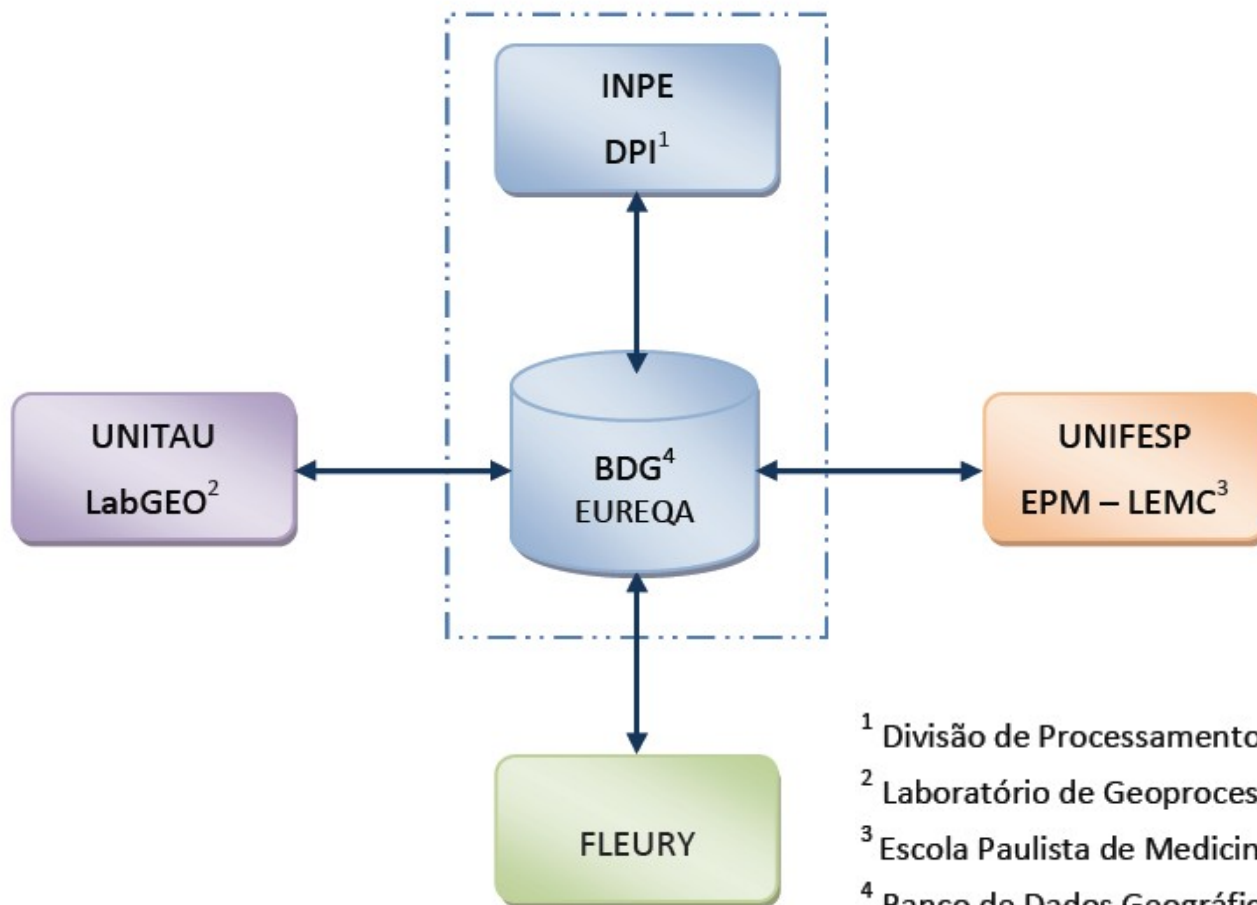
Central experiment: Monitoring Dengue Fever in Recife city, based on egg traps for *Aedes aegypti* and *Aedes albopictus* mosquito.



100 geo-referenced egg traps in each site.

EUREQA Project

Goal: Explore bacterial infections and resistance dynamics and their spatio-temporal correlations with antimicrobial usage density.



¹ Divisão de Processamento de Imagens

² Laboratório de Geoprocessamento

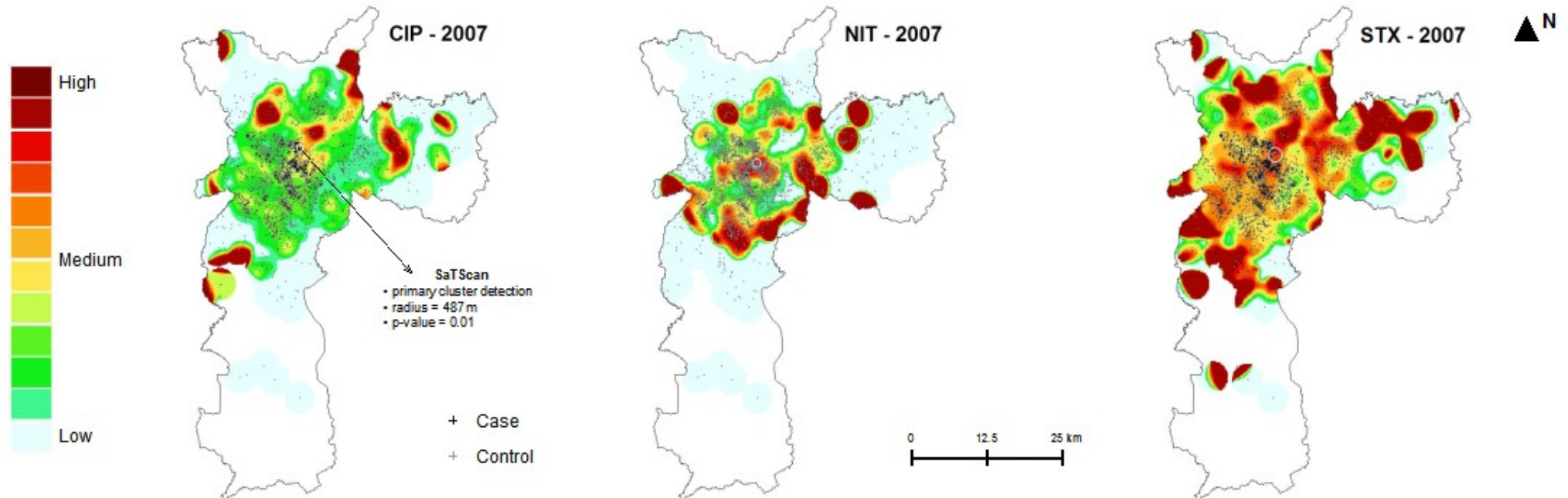
³ Escola Paulista de Medicina – Laboratório Especial de Microbiologia Clínica

⁴ Banco de Dados Geográfico EUREQA

EUREQA Project

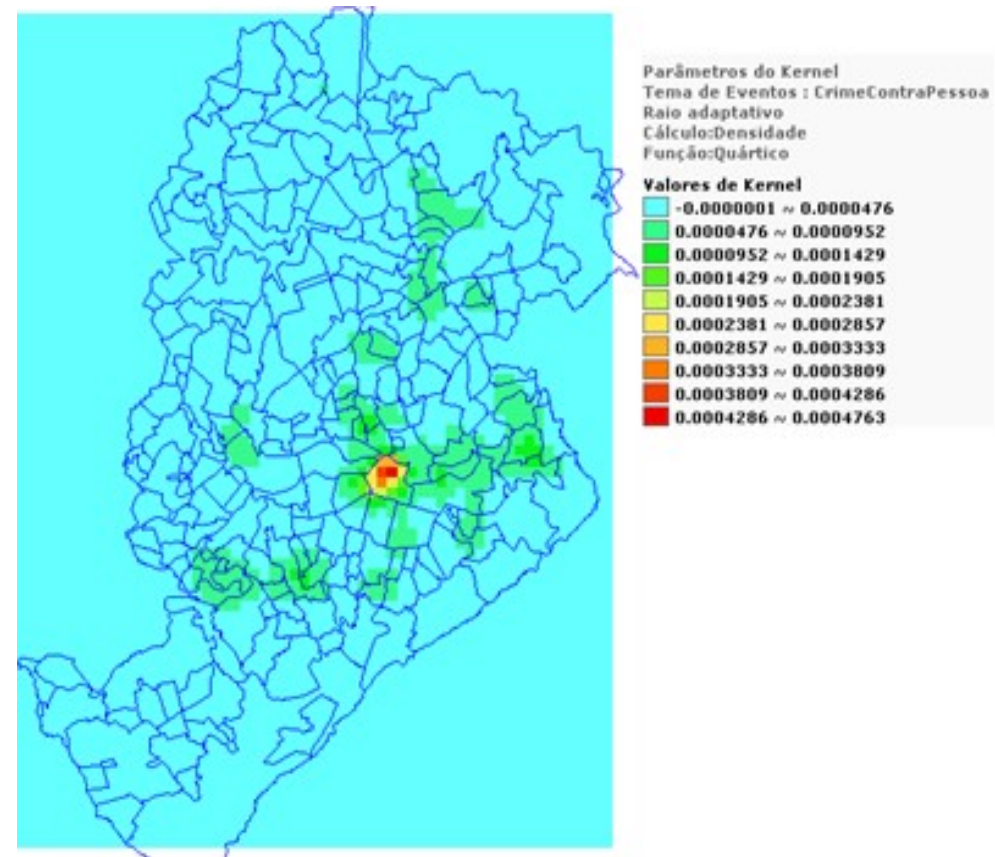
Case study: community urinary tract infections (cUTIs) caused by *Escherichia coli* bacteria in São Paulo city.

Spatial data exploratory analysis: Kernel³ ratio maps



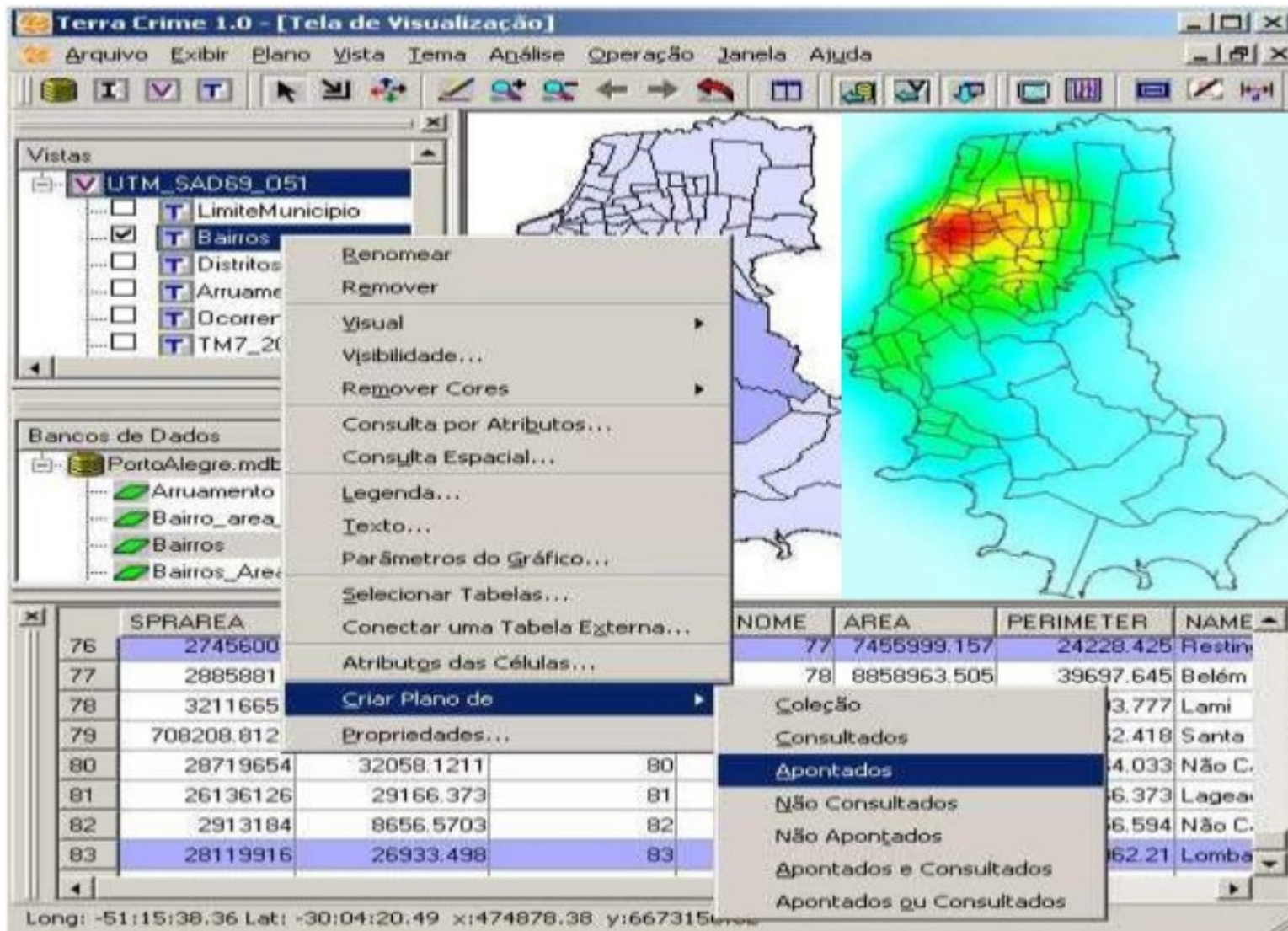
TerraStat

- A library with spatial statistic functions:
 - Moran Index, Local Mean, ...
 - Kernel Map and Kernel Ratio Map
 - Skater
 - Semivariogram
 - Empirical Bayes
- Developed by LESTE and INPE
- Distributed with TerraLib



TerraCrime

A surveillance system to control and alert crime occurrences.



CRISP
+
LESTE
+
INPE

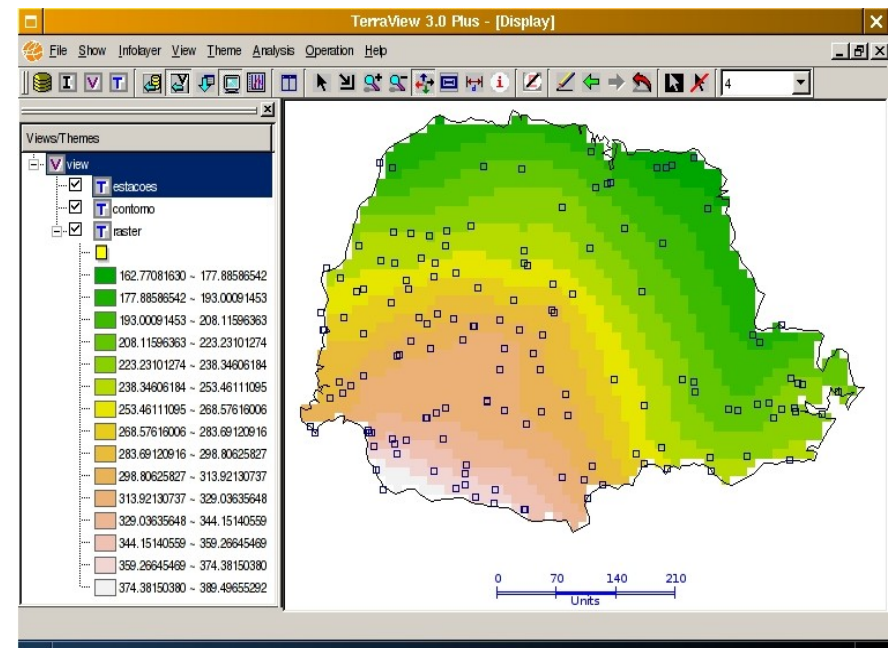
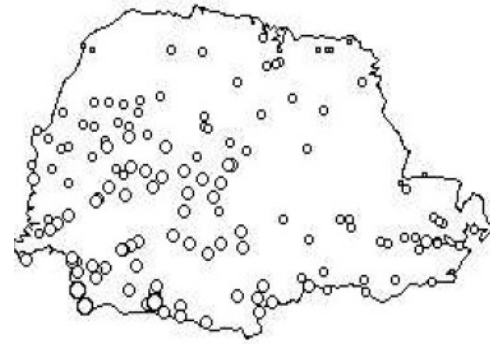


aRT = R-TerraLib API



- Interface between the statistic software **R** and the geographical library **TerraLib**.
 - **R**: language and environment for graphics and statistical analysis (<http://www.r-project.org/>)
- Developed by Laboratory of Statistics and GeoInformation (LEG) at Federal University of Paraná.
- Available at <http://www.est.ufpr.br/aRT>

aRT

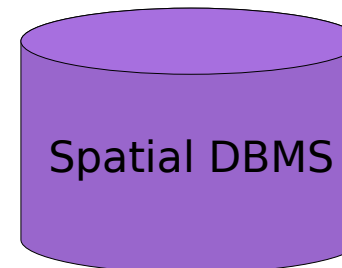
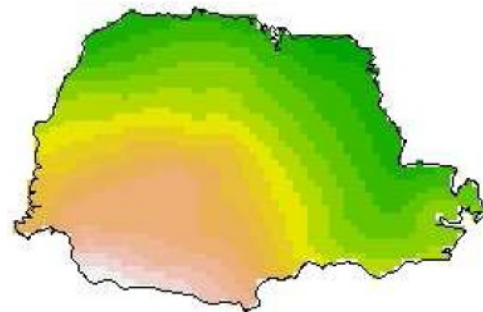


data



TerraLib

statistics



- Handle raster and vector data
- Store and retrieve them from spatial DBMS
- Geoprocessing algorithms, such as neighborhood construction

- spatial statistics
- geostatistics
- global and local spatial patterns
- analysis of point patterns

aRT = R-TerraLib API

- R package for information exchange
 - GRASS, RarcInfo and aRT
- **aRT**: R package that encapsulates TerraLib concepts

```
conn      = openConn()
db        = openDb(conn, "dbname")
thpoints  = openTheme(db, "themepoints")
thcontour = openTheme(db, "themecontour")

points    = getPoints(thpoints)
contour   = getPolygons(thcontour)
data      = getData(thpoints)

raster = krige(points, contour, data)

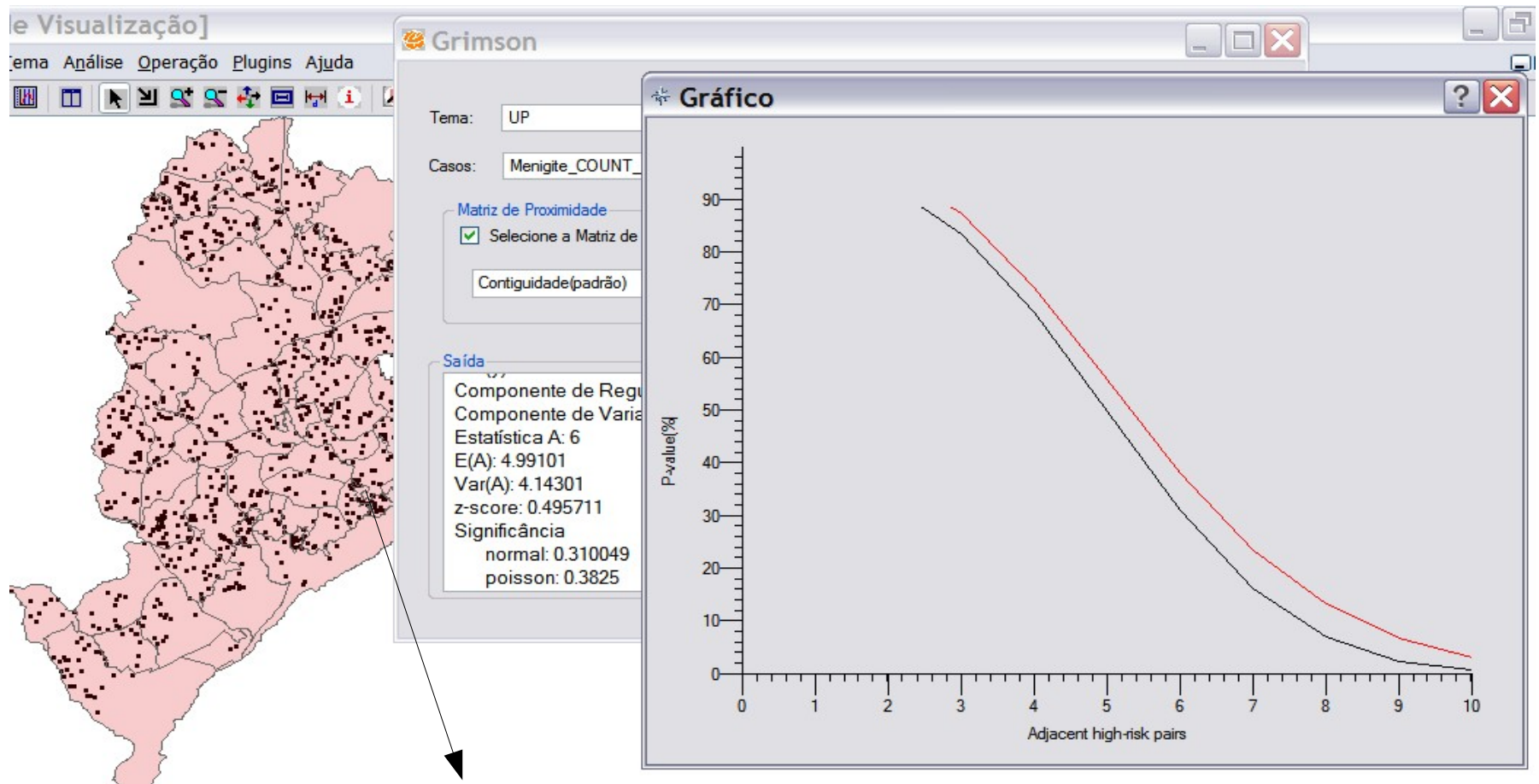
l = createLayer(db, "lraster")
addRaster(l, raster)
thraster = createTheme(l, "themeraster")
```

TerraCluster

- An ongoing collaborative project
 - INPE (National Institute for Space Research)
 - LESTE (Spatial Statistics Laboratory at Federal University of Minas Gerais)
 - SVC (Secretary of Health Surveillance)
- 25 TerraView plug-ins for:
 - Spatial temporal cluster detection
 - Analyses of point patterns
 - Rate estimation

TerraCluster: Grimson plug-in

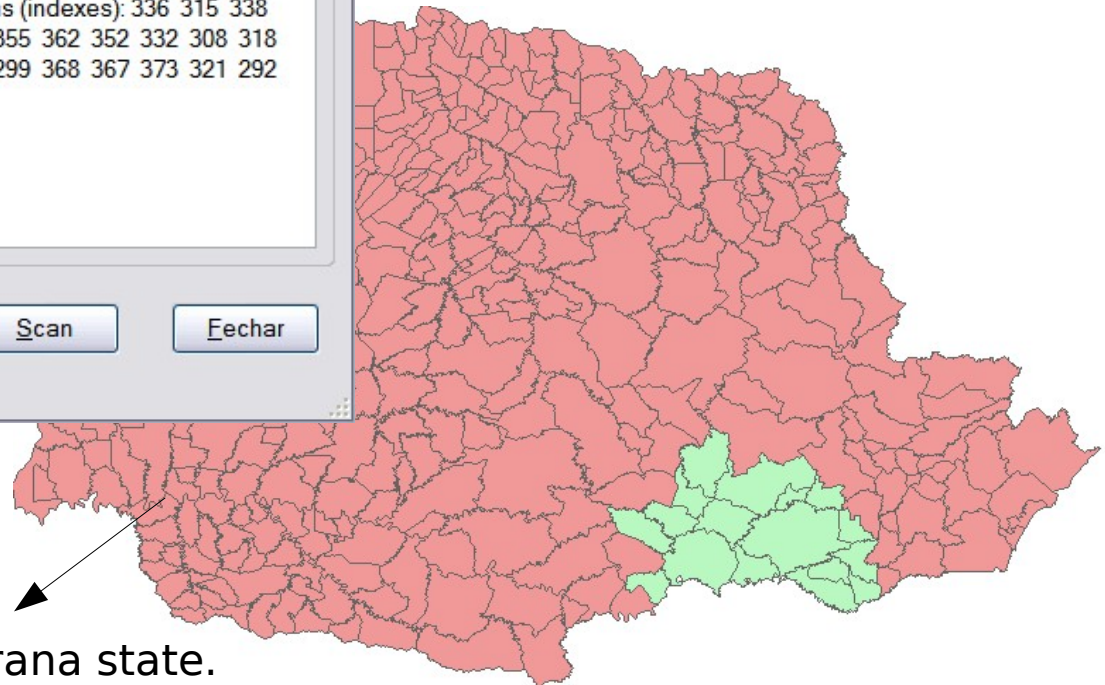
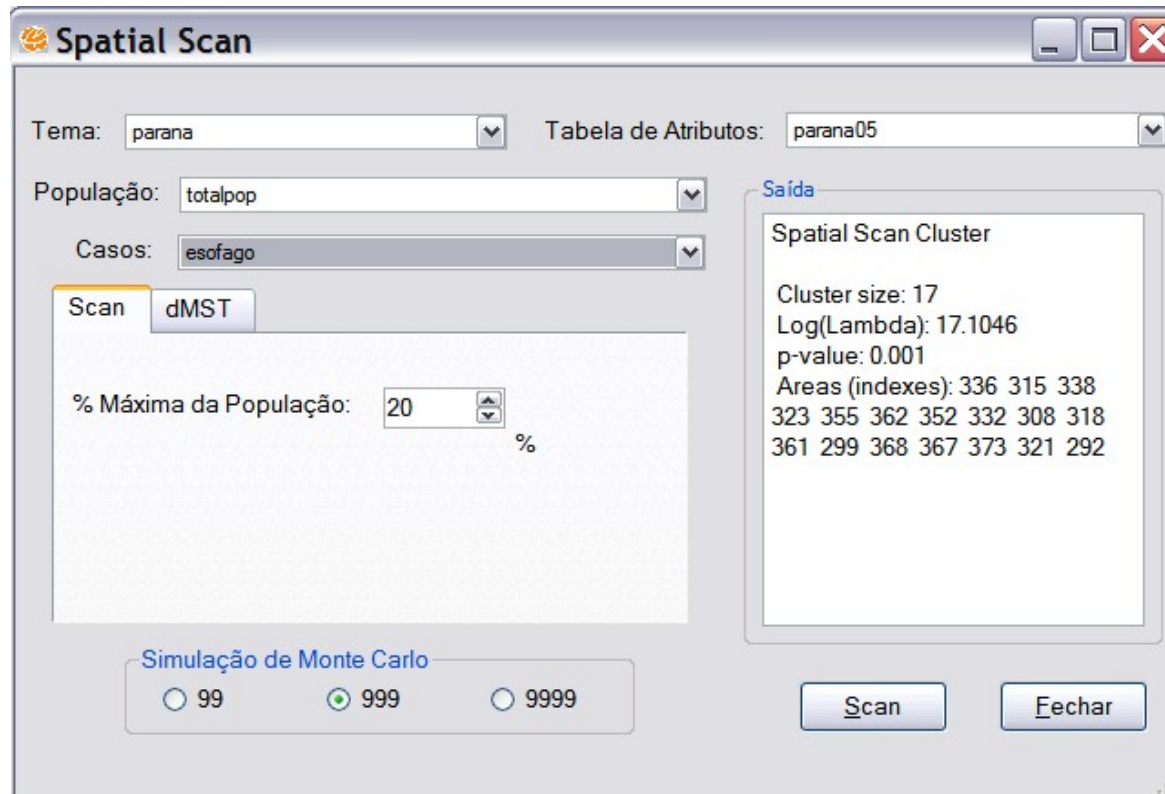
A method to detect if objects with high risk are randomly distributed in space



Cases of meningitis in Belo Horizonte city.

TerraCluster: Spatial Scan plug-in

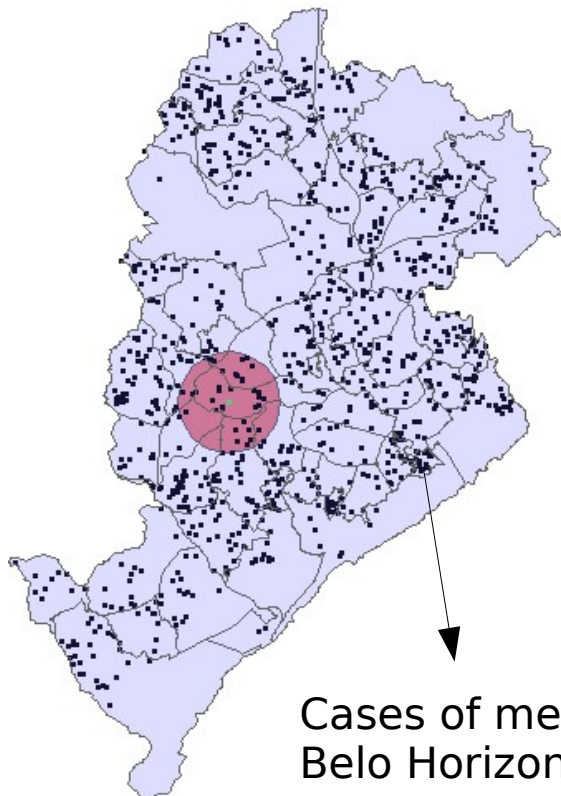
A method to detect to detect spatial cluster



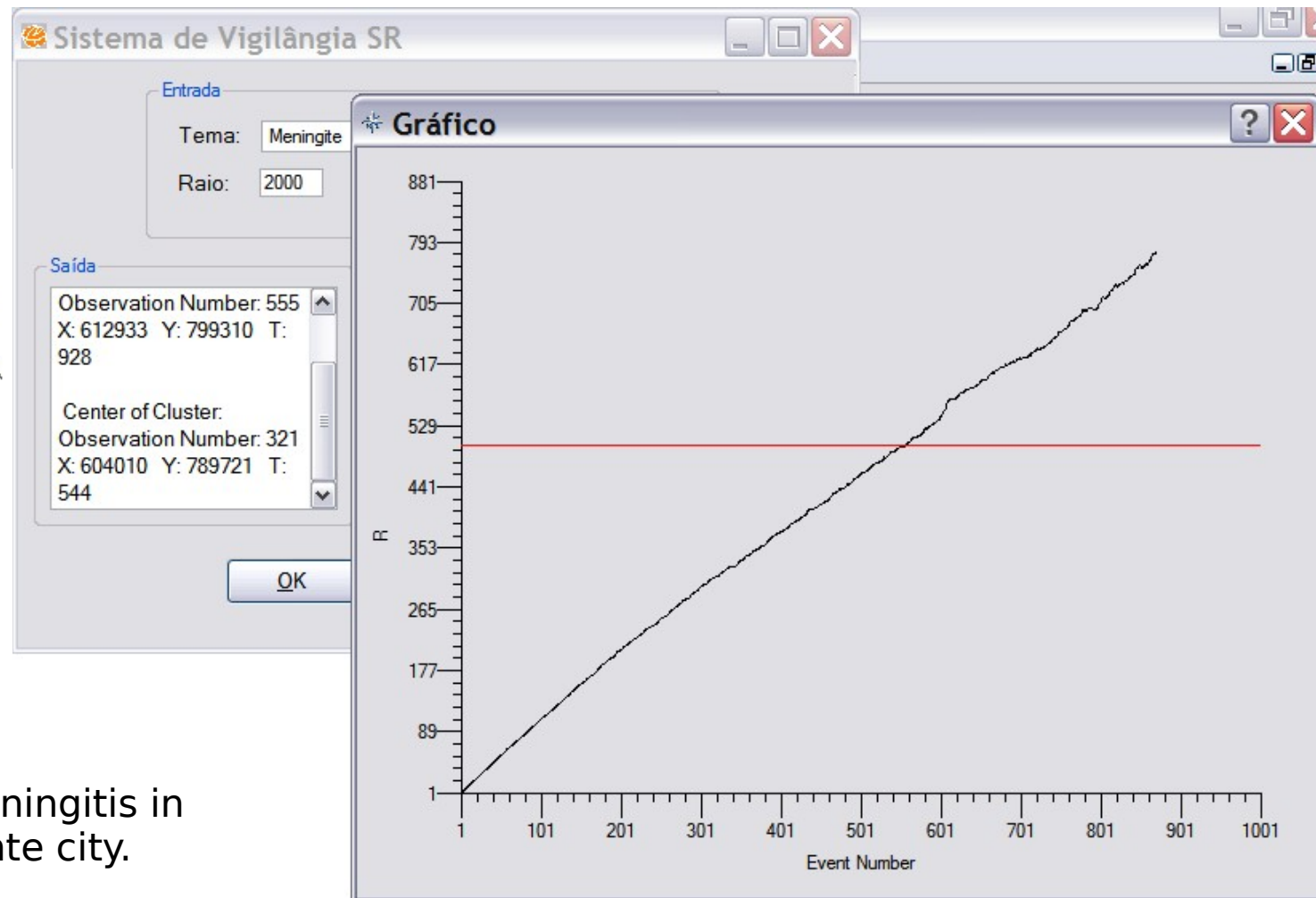
Deaths caused by esophagus cancer in Parana state.

TerraCluster: Shiryayev-Roberts Surveillance System plug-in

A method to detect and alert spatio-temporal clusters based on events



Cases of meningitis in
Belo Horizonte city.



TerraCluster

Download plug-ins at:

www.est.ufmg.br/leste/terracluster

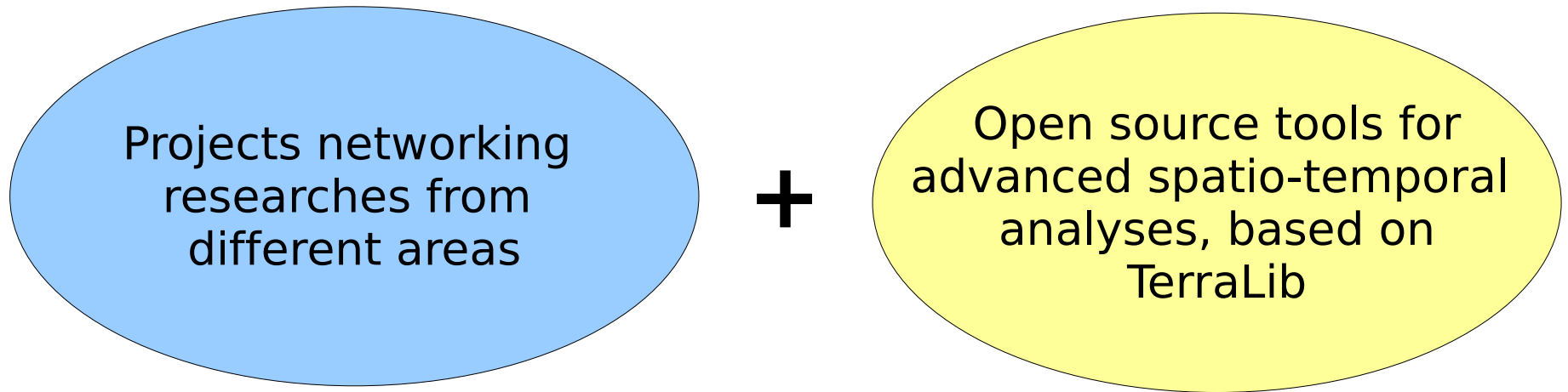
Some references about implemented methods:

Grimson, R.C. (1989) Assessing patterns of epidemiological events in space-time. In *Proceedings of the 1989 Public Health Conference on Records and Statistics*. Hyattsville, MD: National Center for Health Statistics.

Assunção, R., Costa, M., Tavares, A. and Ferreira, S. (2006) Fast detection of arbitrarily shaped disease clusters. *Statistics in Medicine*, 25, 723–742.

Correa, T.R. and Assunção, R.M. (2007) Shiryayev-Roberts Method to Detect Space-Time Emerging Clusters. In: Davis, C.A Jr. and Monteiro, A.M.V. (eds.) *Advances in GeoInformatics*, Heidelberg: Springer, 283–291.

Conclusion



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Paulo Justiniano Ribeiro Junior and Renato Martins Assunção

Thank you!

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