Integration of Statistics and Geographic Information Systems: the R/TerraLib case

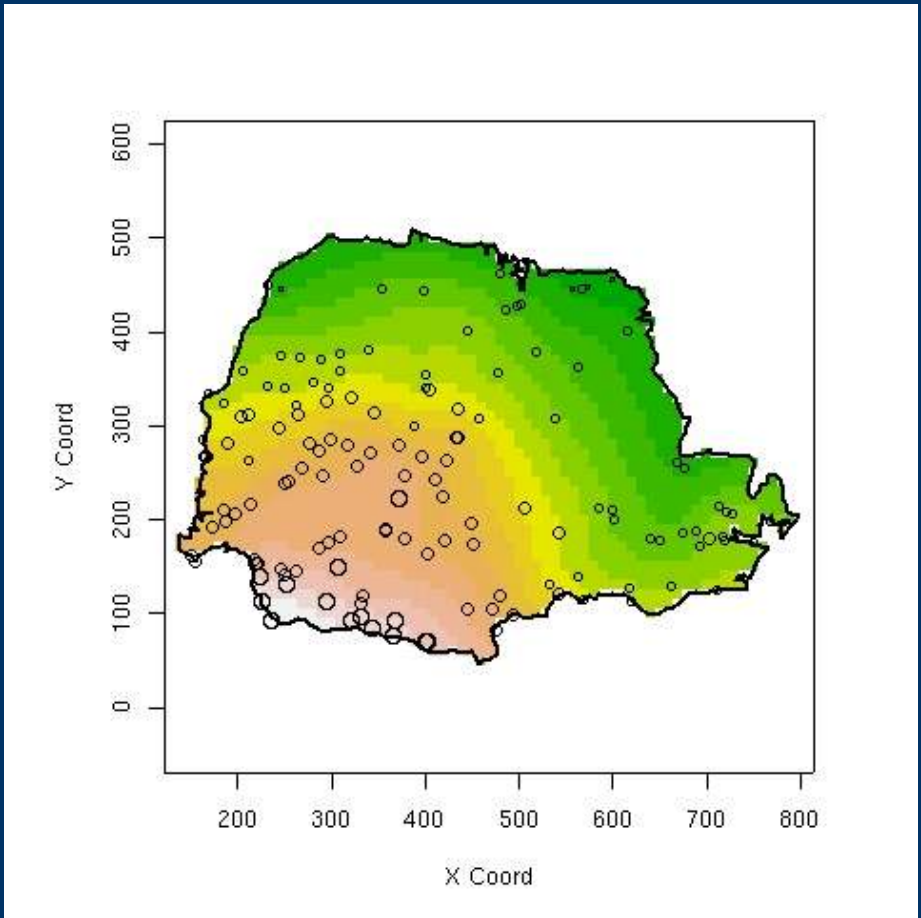
Pedro Ribeiro de Andrade Neto
Paulo Justiniano Ribeiro Junior
Karla Donato Fook

GeoInfo 2005

Introduction

- Constantly evolving software technology
- Spatial statistics in statistical softwares
  - Point pattern analysis
  - Geostatistics
  - Areal data analysis

- Statistical softwares lack:
  - Neighborhood
  - Multiple geometry
  - etc.



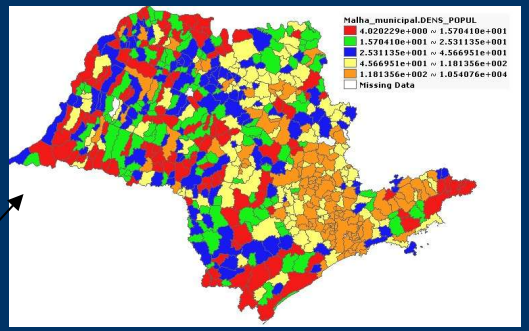
Introduction

Geographic Information Systems (GIS)

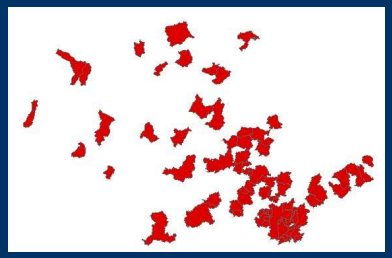
- Manipulate several georeferenced data
- Geoprocessing algorithms
- GIS lack complex statistical analysis

MUNICIPIO	CODIGO	ESTADO	AREA_KM2	POPULACAO	DENS_POPUL
ILHABELA	3520400	SP	347	13100	37.70777
ILHA COMPRIDA	3520426	SP	189	3434	18.21377
ILHA SOLTEIRA	3520442	SP	659	22145	33.5847
INDAIATUBA	3520509	SP	311	121906	392.54542
INDIANA	3520608	SP	128	4733	37.10068
INDIAPORA	3520707	SP	279	4431	15.85582

Grouping



Population > 70000



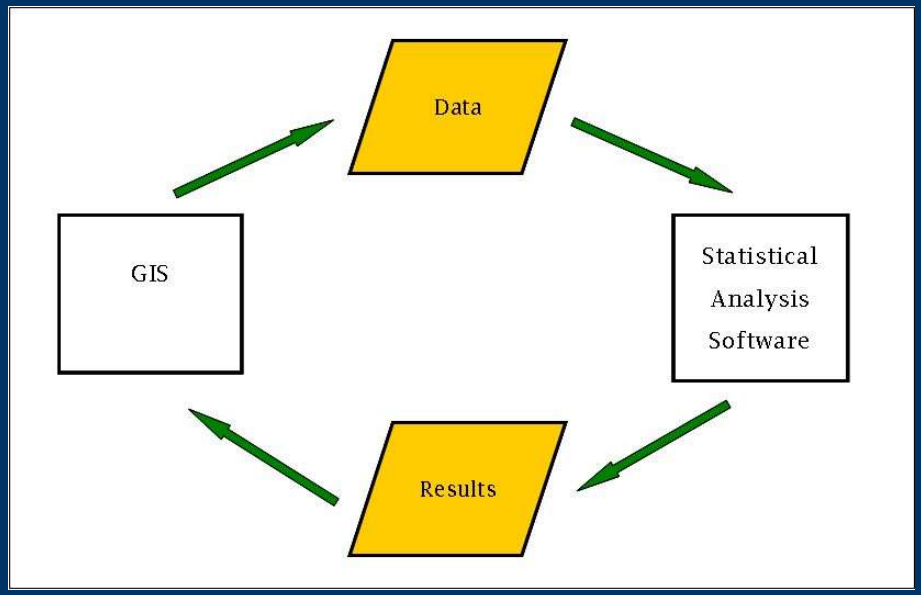
São Paulo neighbors

Motivation

Integration

- Technique that combines software components in order to generate more complex systems
- Saves time and resources
- Can increase individual effectiveness of both GIS and statistical softwares

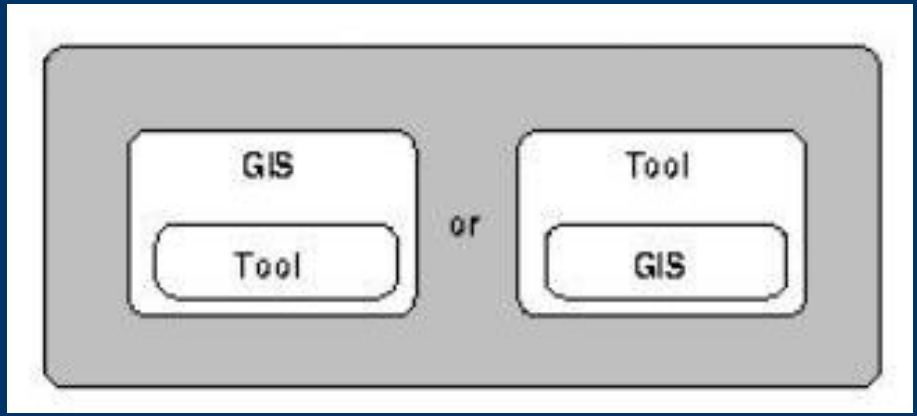
Integration: loose coupling



- Two different softwares
- Data exported using files

- SPRING + SpaceStat (Anselin 92)
- ArcInfo + R (Gomes-Rubio 2005)

Integration: close coupling



- Calls direct from the GIS, and vice versa (Bivand and Neteler 2000)

- ArcInfo + S (Bao et al 2000)
- GRASS + R (Bivand and Netler 2000)

Integration: databases

(Fischer et al 96) propose to use *geographic* databases for information exchange:

- share a common database
- preserves object identity and metadata

None of the works fits in this description

Goal

- Provide access to a geoprocessing library in a close coupling way using a spatial database
- From an statistical program: R
- To a geoprocessing library: TerraLib
- aRT: R-TerraLib API

R Project for Statistical Computing

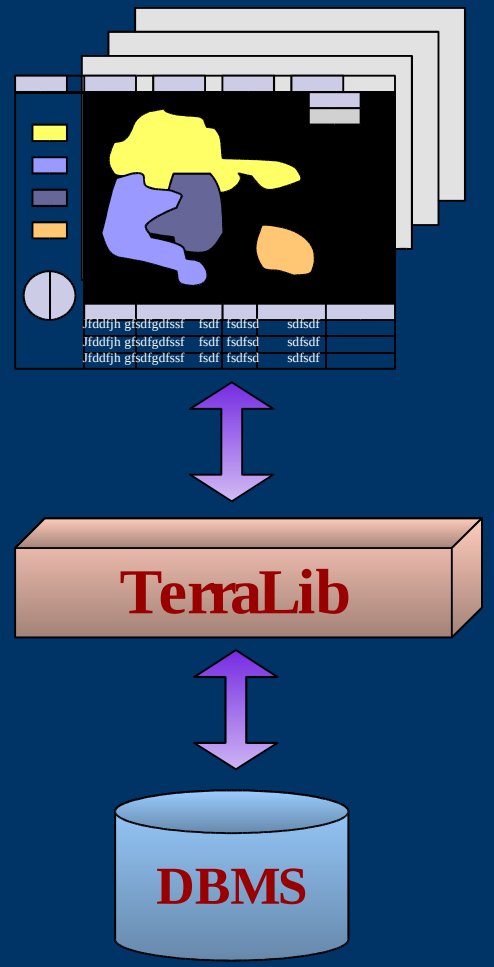
- Free software

- Point pattern analysis: spatstat, splancs
- Geostatistics: gstat, geoR, geoRglm
- Areal data analysis: DCluster, spdep

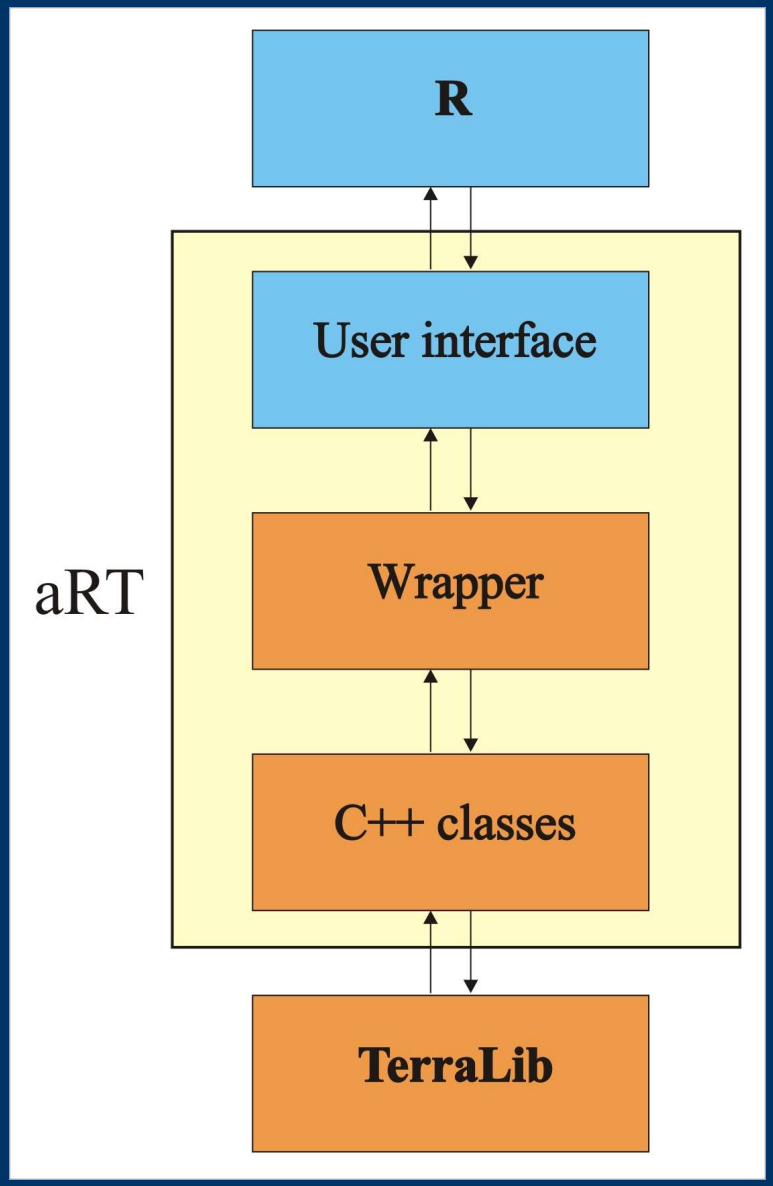
- 32 packages currently available in the *Spatial Task View* on the CRAN repository

TerraLib

- Free software
- Database interfaces
- Spatial-temporal structures
- Geoprocessing algorithms

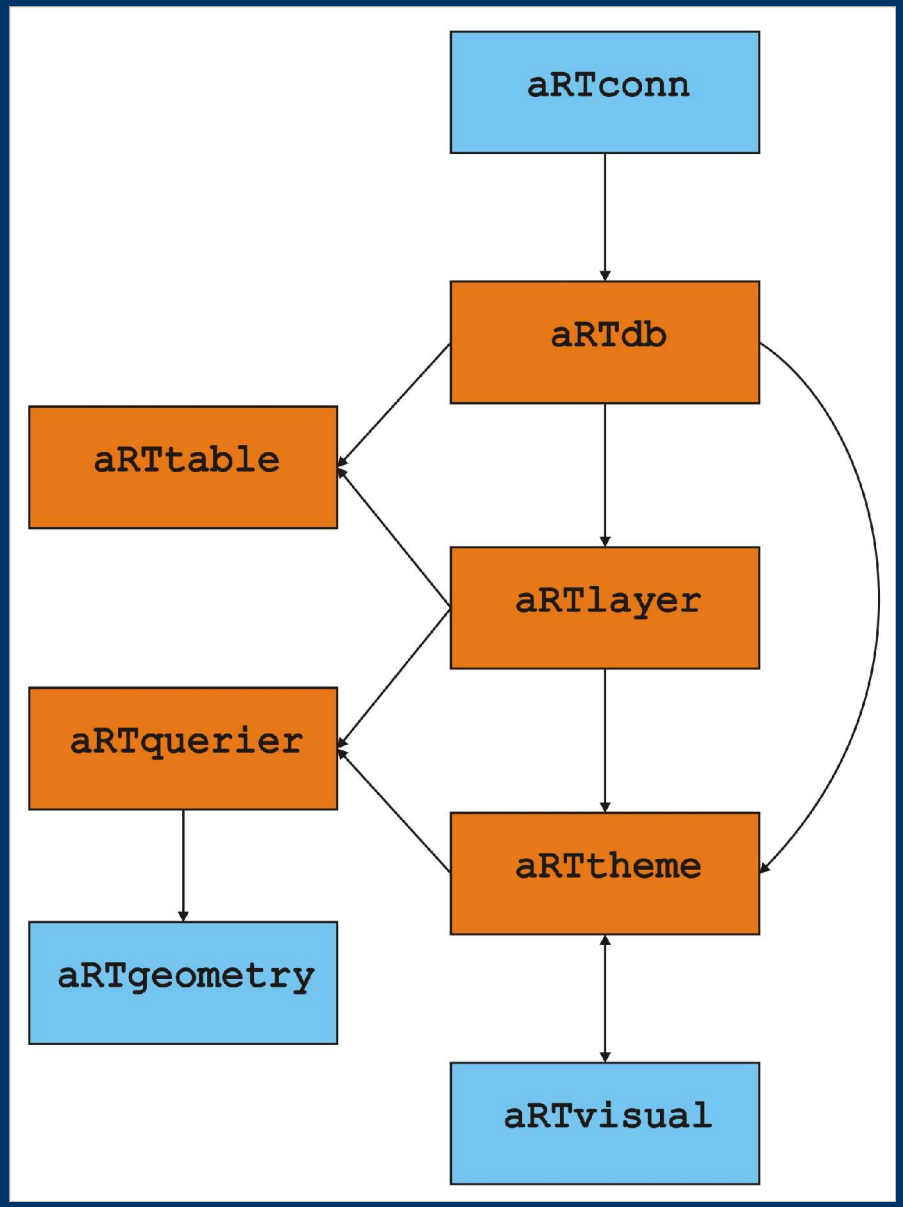


aRT: R-TerraLib API



aRT conceptual model

- TerraLib concepts within R objects



Other functionalities

- Database management functions
- Spatial relations
- Set operations
- Metrics
- Queries

Conclusions

- TerraLib inside R
- Close coupling using databases
- aRT encapsulates TerraLib components

Current status of the project

- Version 0.4-11(2005-11-17)
- Already adheres to the sp classes
- Documentation – vignettes
- Source code and windows binary version
- Available at http://www.est.ufpr.br/aRT

Future work

- Additional interfaces to Terralib algorithms
- Option on compiling for geoprocessing functions without database dependency (via *configure* tool)
- Expanded functionality for temporal tables and queries
- Further drivers
- etc...

Integration of Statistics and Geographic Information Systems: the R/TerraLib case

Pedro Ribeiro de Andrade Neto
Paulo Justiniano Ribeiro Junior
Karla Donato Fook