

Urban vegetation : data acquisition and management in OrbisGIS

**Institut de Recherche en Sciences et
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The vegetation in the city

Context

To cope to the global change and to respond to the social request , the vegetation appears like a solution to the urban problems and to a sustainable development of the city



The vegetation in the city

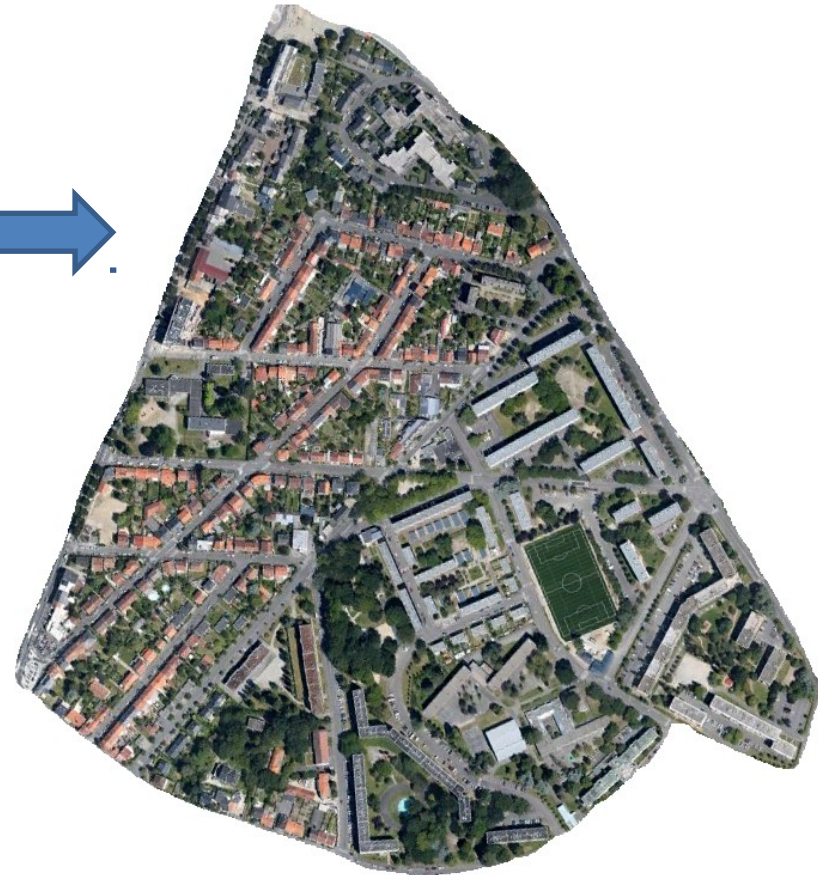
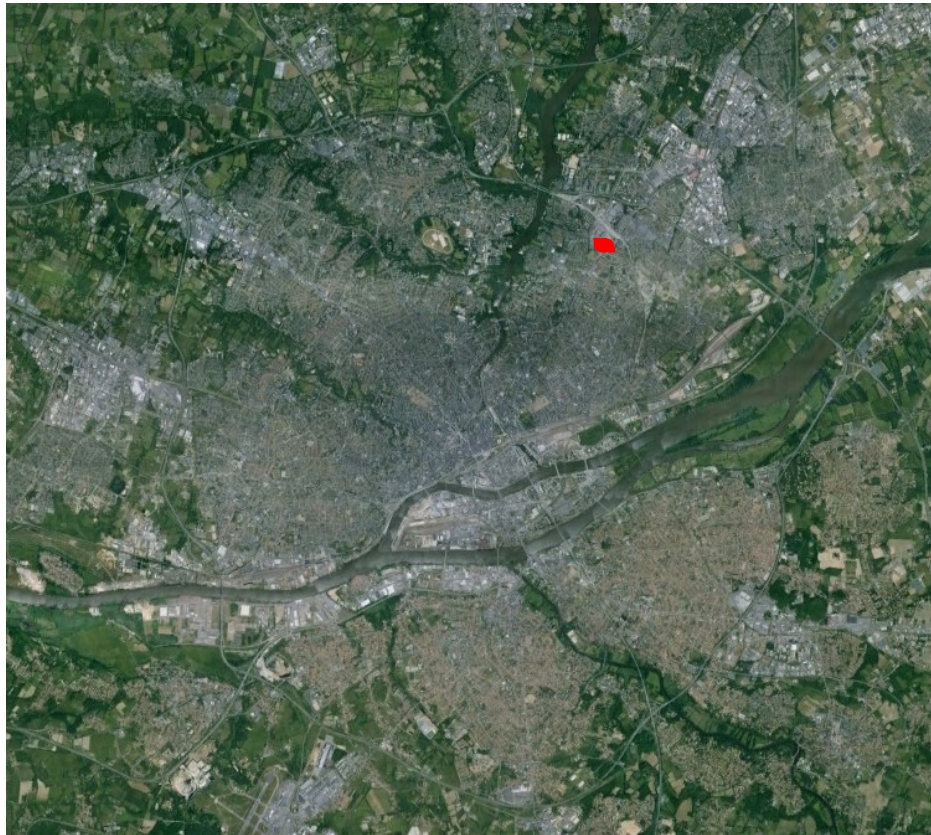
To analyze the effects of the vegetation on the different components of the urban system, we need spatial data base of the surface vegetation

- which sources of information?
- which spatial resolution ?
- which precision of the vegetation description?



The vegetation in the city

The case study : Pin sec District, Nantes

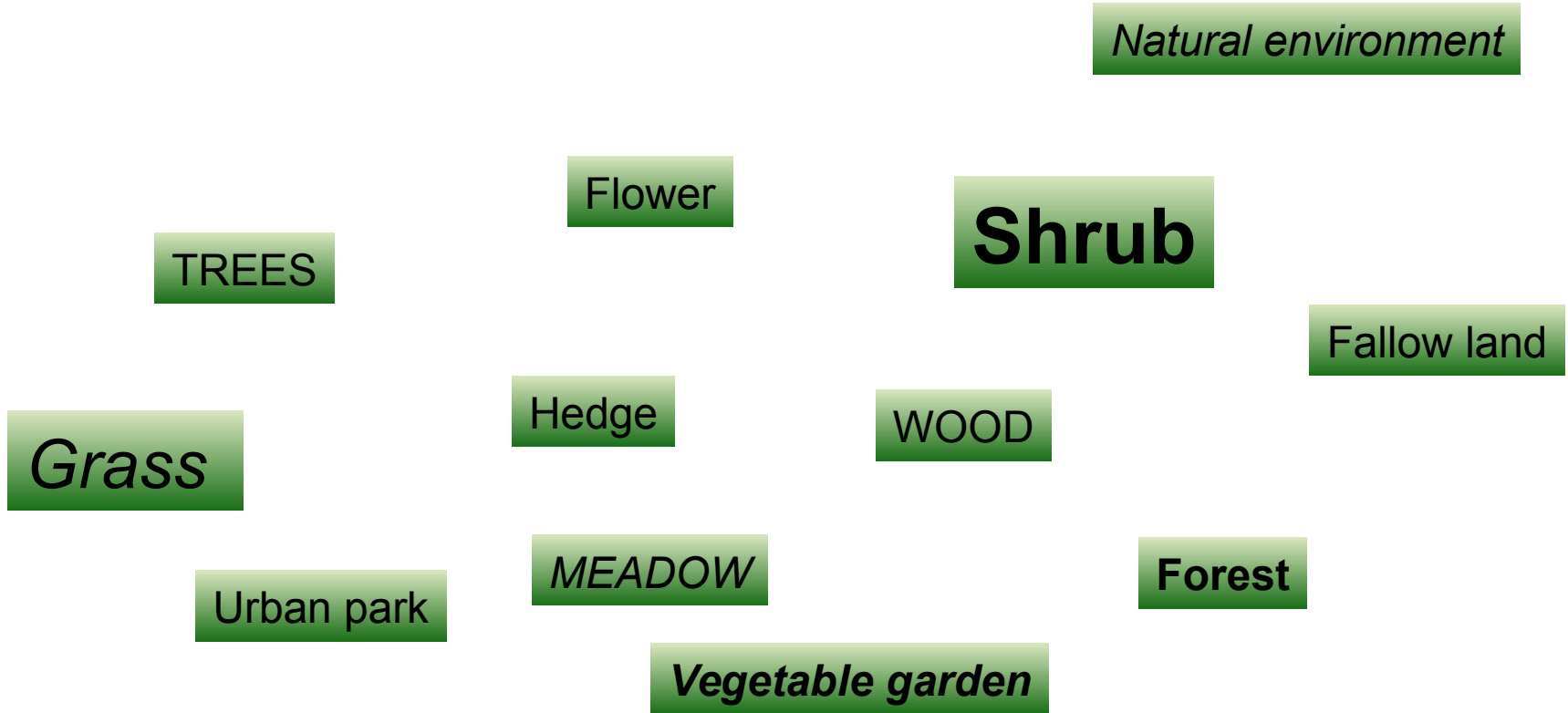


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2. Sources of information : geographical reference and satellite images
3. Resolution :
 1. Spatial resolution: from low to high resolution
 2. Spectral resolution : from multispectral to hyperspectral resolution
4. Data management

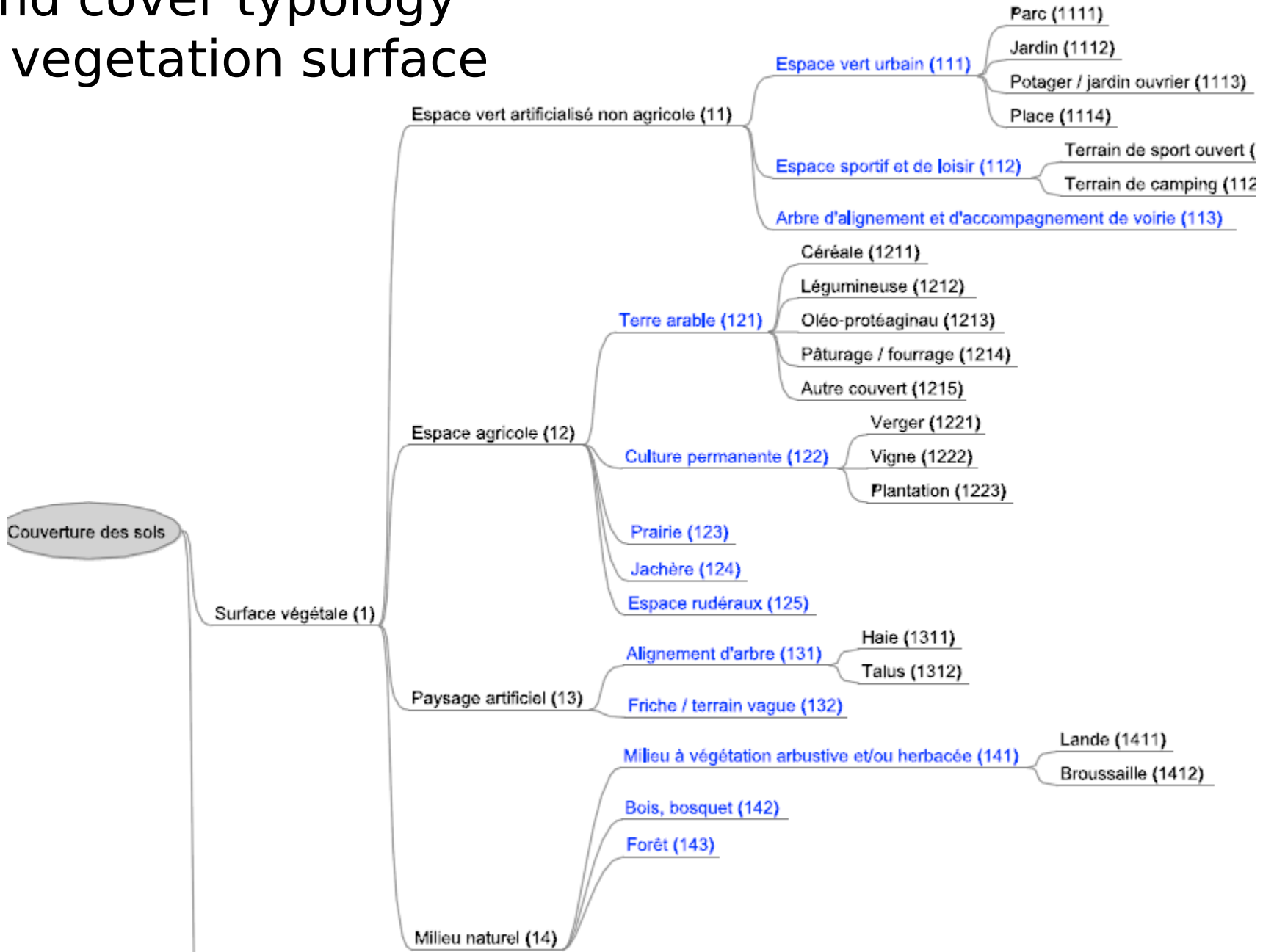
Semantic question

What is *vegetation*?



A land cover typology

ex : vegetation surface



Thesaurus : concept definition

Example : GEMET thesaurus

green space


Definition:

A plot of vegetated land separating or surrounding areas of intensive residential or industrial use and devoted to recreation or park uses.
(Source: LANDY)

broader terms


 land setup

narrower terms


 garden

 public park

 recreational area

 urban green

related terms

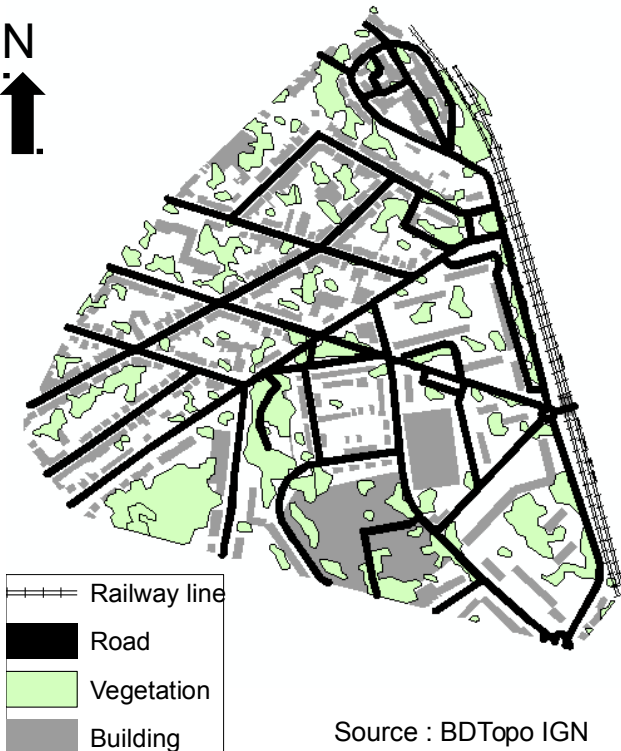
 recreation

Concept URL: <<http://www.eionet.europa.eu/gemet/concept/3770>>

Sources of information

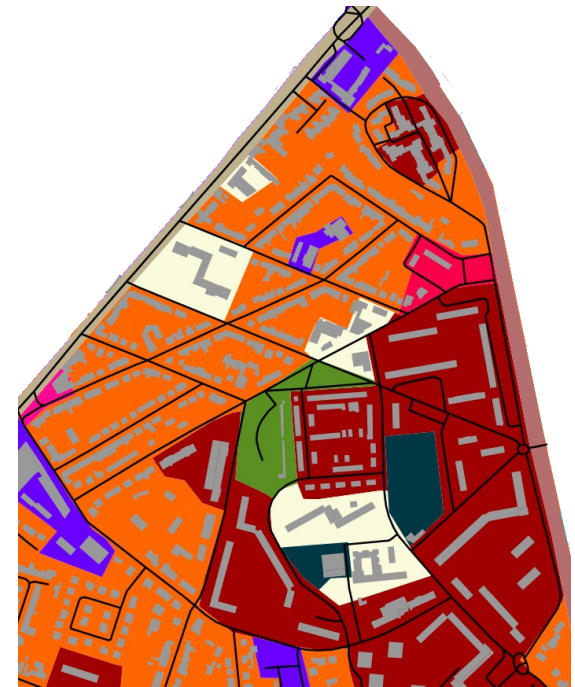
Geographical reference : vectorial data

BDTopo (IGN)



Source : BDTopo IGN

BDMOS (Conseil général)



Sources of information

Satellite images

Multispectral



Hyperspectral (VNIR)



Spatial and spectral resolution

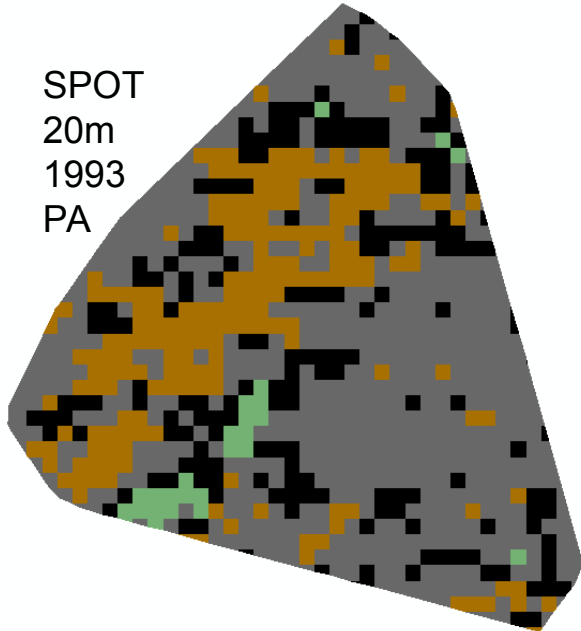
Data acquisition :

Satellite / sensor	Spatial resolution	Bands number	Date of acquisition
SPOT	20m	4	1993
SPOT	20m	4	2000
SPOT	10m	4	2004
Rapideye	5m	3	2010
SPOT	2.5m	3	2009
Quickbird	2.4m (0.6m panshaperning)	4	2009
HYMAP	4m	126	2008

Image analysis :
- pixel-approach (PA)
- object-approach (OA)

Results

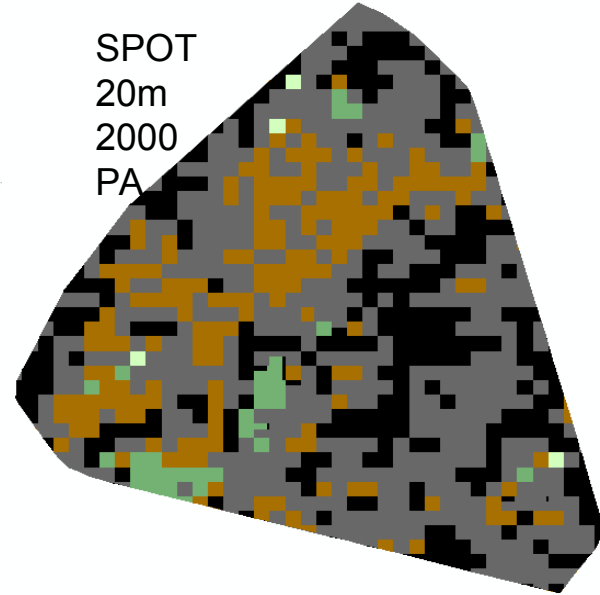
SPOT
20m
1993
PA



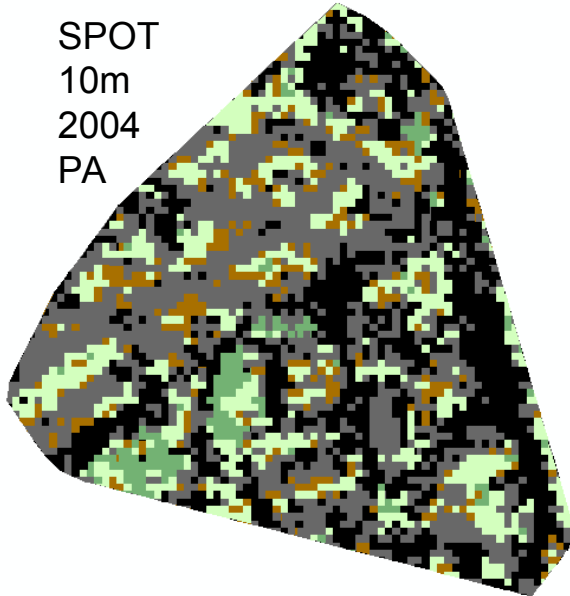
Ground truth
2012



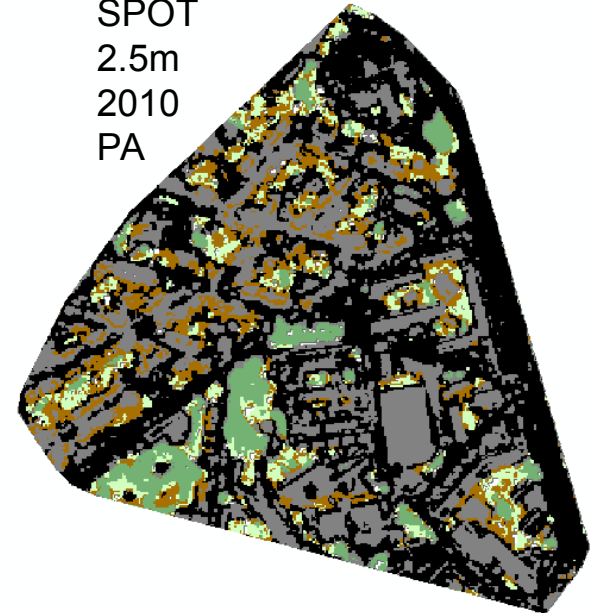
SPOT
20m
2000
PA







SPOT
10m
2004
PA

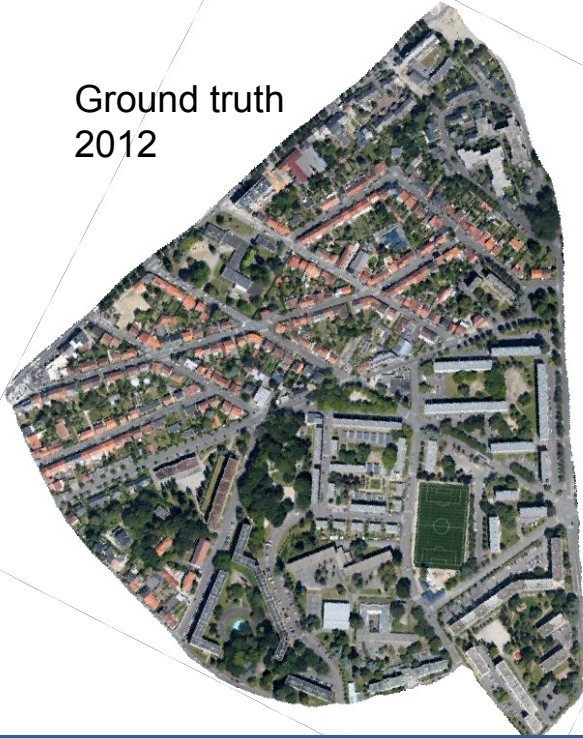


SPOT
2.5m
2010
PA



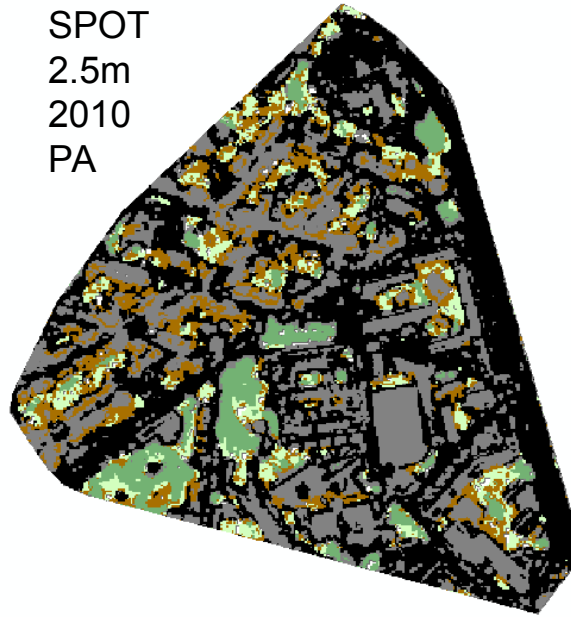
-  Built surface
-  No classified
-  Asphalt surface
-  Bare soil
-  Trees surface
-  Grass surface

Ground truth
2012



Results

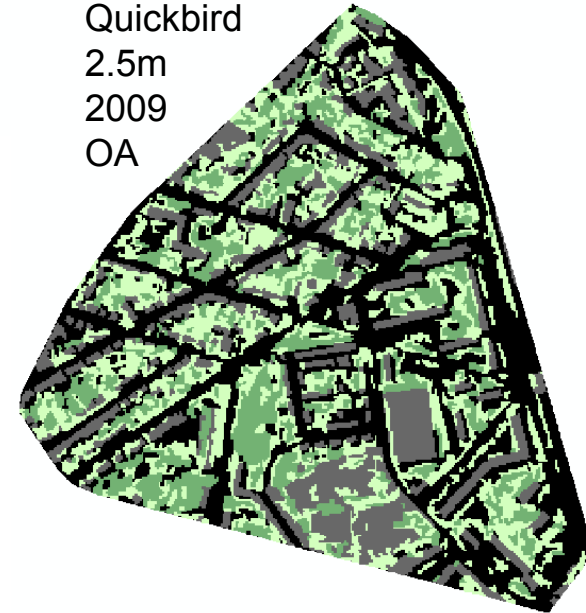
SPOT
2.5m
2010
PA



SPOT
2.5m
2010
OA



Quickbird
2.5m
2009
OA



Results

Surface of vegetation

Satellite / sensor	Spatial resolution	Bands number	Date of acquisition	Vegetation surface
SPOT	20m	4	1993	17 782
SPOT	20m	4	2000	14 001
SPOT	10m	4	2004	45 201
SPOT	2.5m	3	2009	179 631
Quickbird	2.4m	4	2009	164 541
HYMAP	4m	126	2008	108 403

Compare to hyperspectral data :

- Quickbird and SPOT - 2.5m : over estimation of 15% and 19%
- SPOT - 10m : under estimation of 17%

Data management

A lot of data, especially in geography:

- many ways to produce,
- many ways to model (*i.e a road can be depicted as a line or a polygon, ...*),
- many levels of quality (geometric and semantic)

→ How to be sure that the data correspond to our needs and follow them on the long term (→ ensure the continuity of a database)?

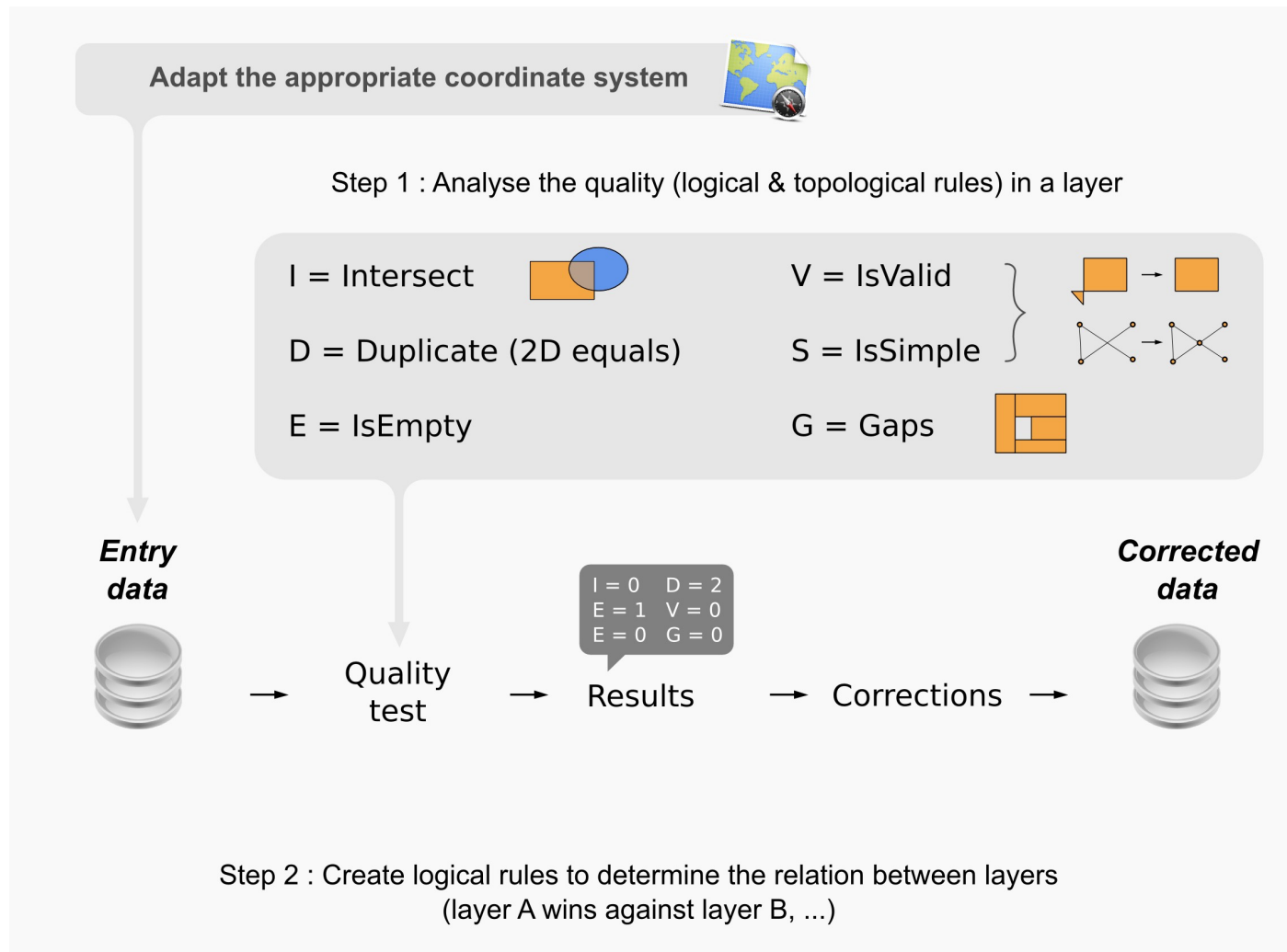
For instance, how can one follow the evolution of vegetation between two years?

→ we propose a three step methodology

- 1- a control of the data quality
- 2- a semantic qualification
- 3- a versioning model

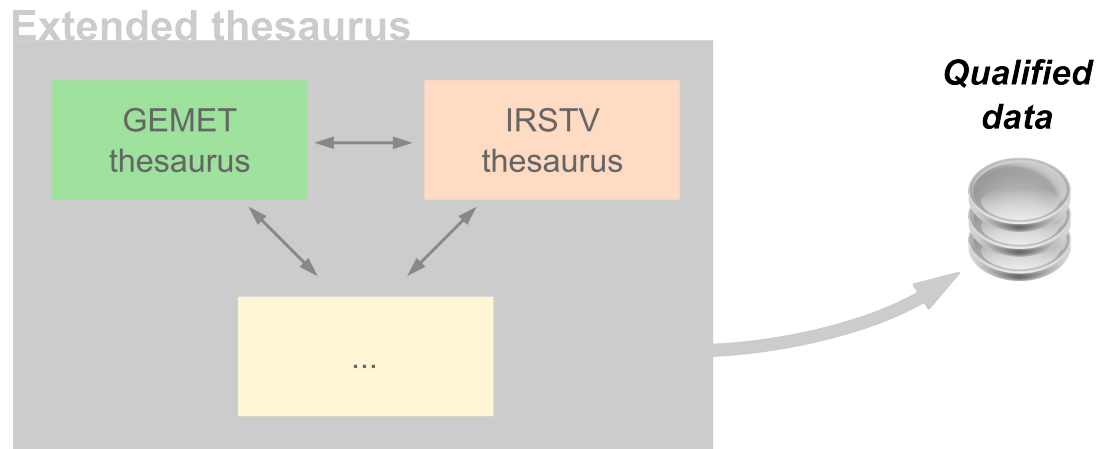
Data management – Quality process

Identify geometric inconsistencies before they are added to the database.
For example two objects representing gardens cannot overlap.



Data management – Semantic qualification

How can one know and perfectly use one's data if they are qualified by various terms (*i.e* : a river is called « hydrographic network » in the BD Topo from IGN and is called « water area » in a classification which comes from a remote sensing image)?



→ Based on different thesauruses (GEMET, AgroVOX, ...) we create a **UNIFIED** thesaurus.

→ This thesaurus is used to **qualify information** stored in a spatial database and to **offer a single entry point**.

For example if the term garden is qualified in GEMET, we can use it. Otherwise, we add it to the IRSTV's thesaurus.

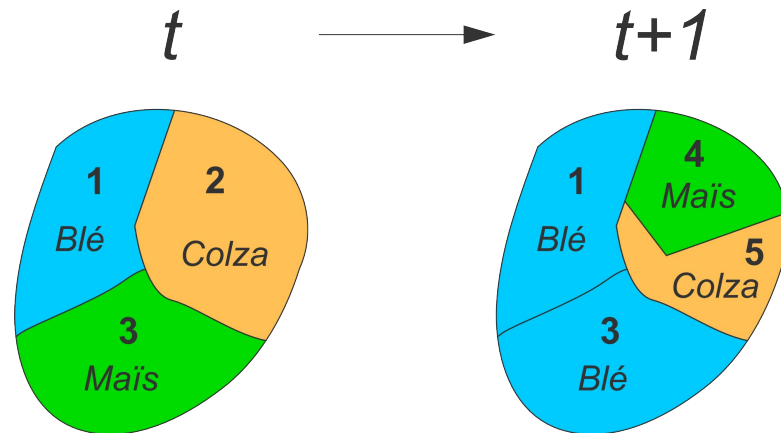
Data management – Versioning model

Geographic information (*GI*) describes features that are in constant evolution (buildings and roads change regularly)

GI providers can deliver each year (or month) an updated release of their data.

→ But how to determine the relationship between features (vegetation area, ...) over different periods? How to detect modifications?

Here is visual example. Geometrical and semantical characteristics of parcels can evolve from t to $t+1$ → we have to know this.



Data management – Versioning model

After comparing different existing models (*snapshot model*, *space-time composite*, ...) we decided to develop a new one :

- data are followed over a long period of time,
- data are not duplicated each time there is a modification → only the modification history is stored,
- via specific functions, the user can rebuild the past / travel in time,

This model is implemented in a RDBMS (PostgreSQL with spatial extension PostGIS).

And OrbisGIS (Opensource GIS) allows one to populate and query this model, using its graphical user interface and its own spatial language.

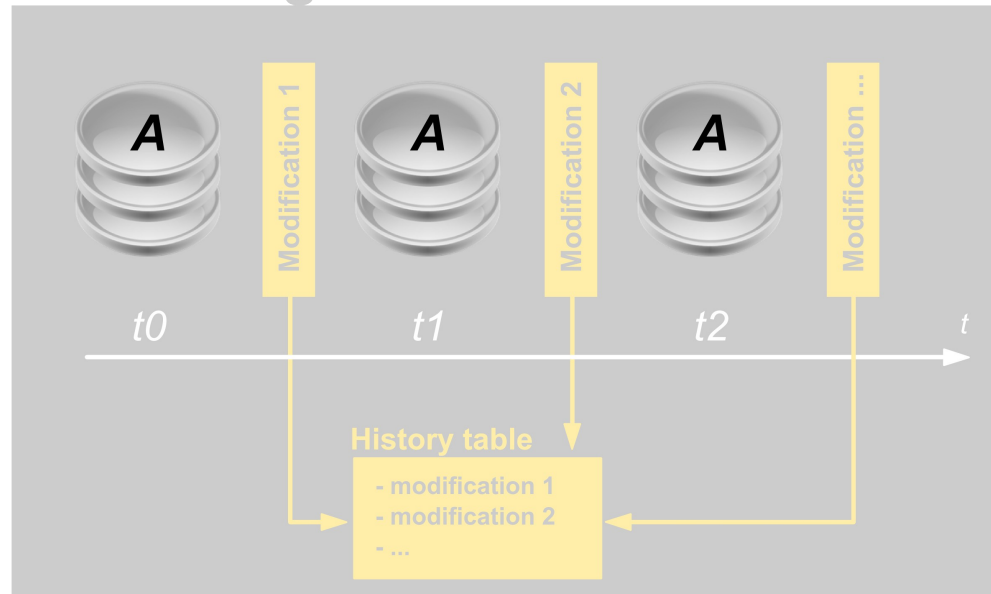


Data management – Versioning model

Data A



Versioning model



- The versioned layer is still the same

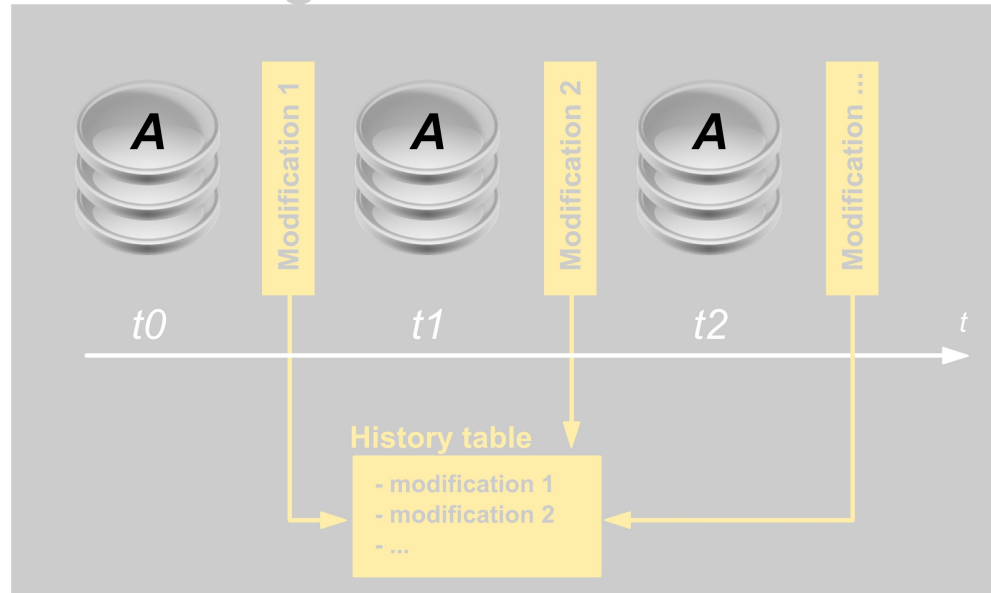
- Each modification is stored in a dedicated journal of logs

Data management – Versioning model

Data A



Versioning model



- The versioned layer is still the same

- Each modification is stored in a dedicated journal of logs

We are in t_2 and we want to consult Data A in t_0

→ *rollback system*

Versioning model



Data management – Versioning model

- Create a link between two identical tables (same referential, same scale, ...), but for two different dates (i.e Corinne Land Cover (CLC) 1999 and 2004),
- Then continue to follow CLC over time via the versioning model.

Data A



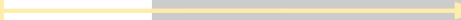
Data A'



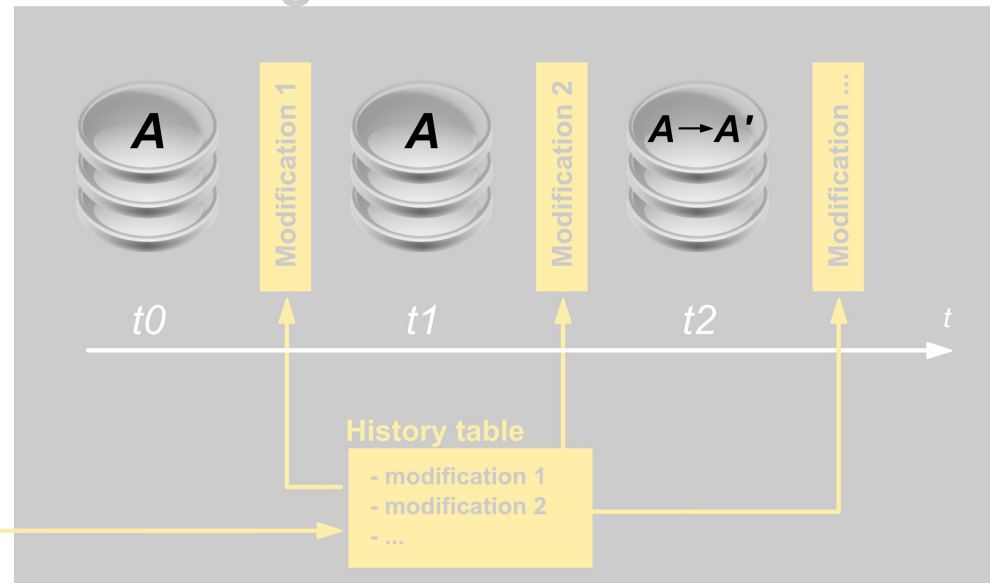
Process to determine modifications between A en A'



Convert & insert modifications into history table



Versioning model

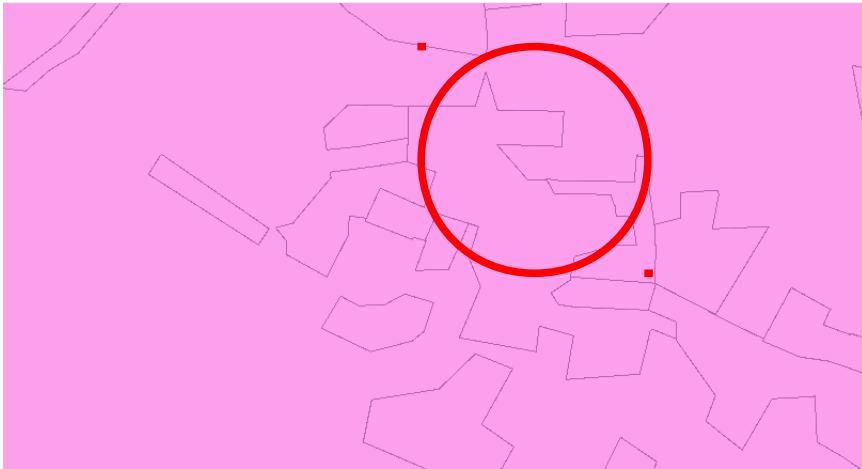


Data management – Versioning model

Case study with a BD MOS layer from CG 44 (department of Loire-Atlantique)

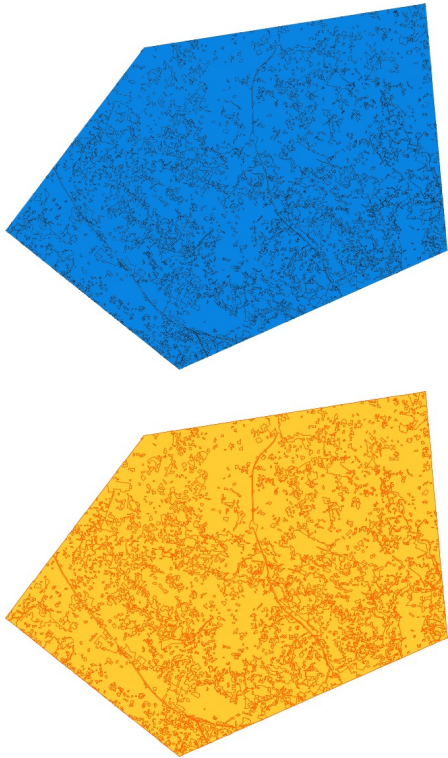
- BD MOS is the equivalent of CLC but at a finer resolution,
- Public data (free to download) for 1999, 2004 and 2009

Detection of localised changes between 1999 (pink) and 2004 (green)

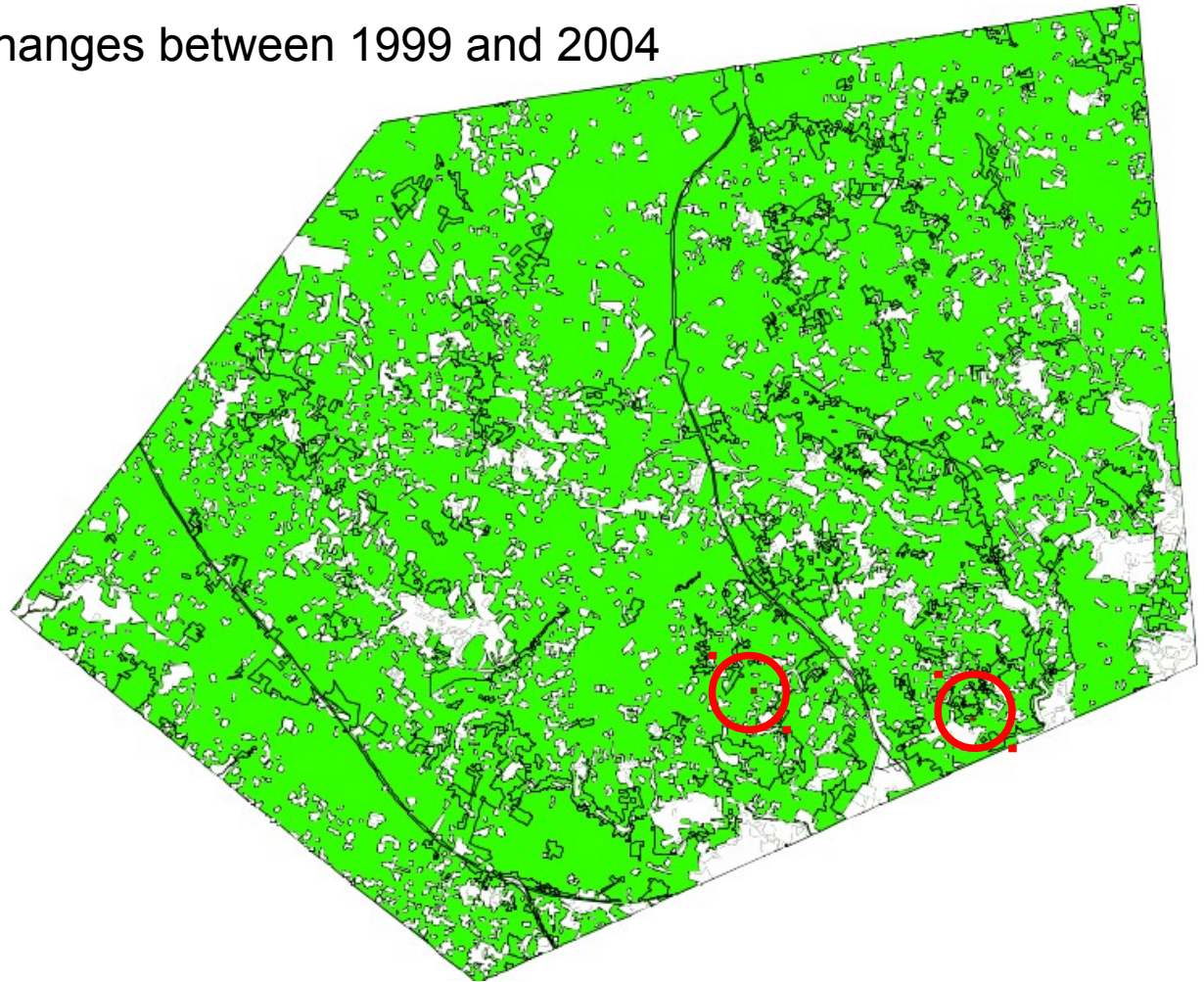


Data management – Versioning model

Detection of full scale changes between 1999 and 2004



*Landcover in 1999 (blue)
and 2004 (orange)*



*Changes in green.
Static features (same geometry and same attributes) in white
Semi-static features (same geometry but different attributes) in red circles*

Data management – Conclusion

This methodology of data management allows to

- fix constraints to collect and organize data (i.e geometric errors, definition of attributes),
- give a temporal organization to data,
- query data at various spatial-temporal scales
- do statistics on the changes (i.e the green zones expanded by 5 % between 2000 and 2010)

This model is available under open-source licence (GPL3)

Results of this work will be available via WMS (Web Map Service) at <http://webcarto.orbisgis.org/>