

# Paradigm change in Land Cover information: from Classifications to Object Oriented Data Models (OODM)

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IGN  
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❖ Outline

1. Preface: Database of “people”
2. Problems of Land Cover classifications
3. New solution: Parametric Object Oriented Land Cover databases
4. Can OO-LU/LC DB help the Bottom-Up approach?
5. Adequacy to Inspire and GMES needs



Suppose we need to build a database of “people”,  
and we decide to **use a classification**

# ❖ 3 characteristics considered for “people”:

Characteristic	Possible values	Number of possible values
1. gender	- man - woman	2
2. height	- tall - medium height - small	3
3. weight	- fat - medium weigh - thin	3



Characteristic	Possible values	Number of possible values
1. gender	- man - woman	2
2. height	- tall - medium height - small	3
3. weight	- fat - medium weigh - thin	3

Classification



Number of classes =  $2 * 3 * 3 = 18$

# ❖ “Classification” of people

Nomenclature with:  $2 * 3 * 3 = 18$  classes

## 1. Men

### 1.1. Tall men

- 1.1.1. Tall and **fat** men
- 1.1.2. Tall and **medium-weight** men
- 1.1.3. Tall and **thin** men

### 1.2. Medium height men

- 1.2.1. Medium height and **fat** men
- 1.2.2. Medium height and **medium-weight** men
- 1.2.3. Medium height and **thin** men

### 1.3. Small men

- 1.3.1. Small and **fat** men
- 1.3.2. Small and **medium-weight** men
- 1.3.3. Small and **thin** men

## 2. Women

### 2.1. Tall women

- 2.1.1. Tall and **fat** women
- 2.1.2. Tall and **medium-weight** women
- 2.1.3. Tall and **thin** women

### 2.2. Medium height women

- 2.2.1. Medium height and **fat** women
- 2.2.2. Medium height and **medium-weight** women
- 2.2.3. Medium height and **thin** women

### 2.3. Small women

- 2.3.1. Small and **fat** women
- 2.3.2. Small and **medium-weight** women
- 2.3.3. Small and **thin** women





But there are many other possible characteristics to be considered:

- nationality
- age
- study level
- work
- residence
- eyes color
- hair color
- diseases
- marital status
- number of sons
- hobbies
- religion
- etc, etc, etc.....

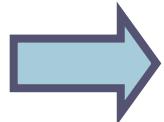




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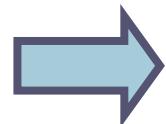
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What would be the **number of classes** needed to store all this information ?



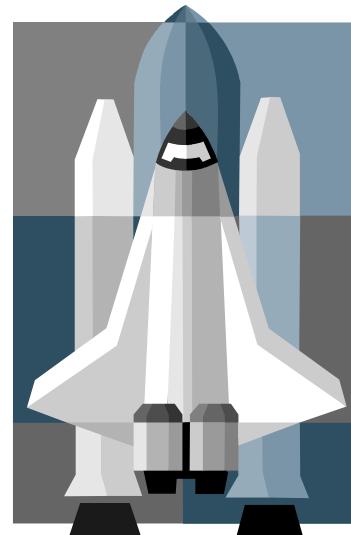
$$250 * 100 * 4 * 100 * 250 * 5 * 4 * 20 * 4 * 10 * 20 * 10 =$$

$$250 * 100 * 4 * 100 * 250 * 5 * 4 * 20 * 4 * 10 * 20 * 10 =$$



$$= 8,000,000,000,000,000$$

$$= 8 * 10^{15} \text{ classes !!}$$



- Would these classes be **useful** in practice?
- Would it be possible to **implement** them in an information system?

⇒ NO !

- ❖ This is called by computer engineers the 'class explosion' problem



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# ❖ “Classification” of people

Nomenclature with:  $2 * 3 * 3 = 18$  classes

## 1. Men

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### 1.3. Small men

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- 2.3.1. Small and **fat** women
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# Land Cover Classifications

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1. ARTIFICIAL AREAS	1.1. Urban fabric:	1.1.1. Continuous urban fabric: Most of the land is covered by structures and transport network. Buildings, roads and artificially surface areas cover more than 80% of the total surface. Non-linear areas of vegetation and bare soil are exceptional	1.1.1.1 Residential continuous dense urban fabric. Residential structures cover more than 80% of the total surface. More than 50% of the buildings have three or more stories. 1.1.1.2 Residential continuous medium dense urban fabric. Residential structures cover more than 80% of the total surface. Less than 50% of the buildings have three or more stories. 1.1.1.3 Informal settlements
		1.1.2 Discontinuous urban fabric Most of the land is covered by structures. Buildings, roads and artificially surface areas are associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces. Between 10% and 80% of the land is covered by residential structures.	1.1.2.1 Residential discontinuous dense urban fabric. Buildings, roads and artificially surface areas cover between 50% and 80% of the total surface area of the unit. 1.1.2.2 Residential discontinuous sparse urban fabric. Buildings, roads and artificially surface areas cover between 10% and 50% of the total surface area of the unit. The vegetated areas are predominant but is not land dedicated to forestry or agriculture. 1.1.2.3 Residential urban blocks 1.1.2.4 Informal discontinuous residential structures

This is the same methodology used in Land Cover Classification databases. E.g: Corine LC, Moland, Anderson,...

## ❖ Problem 1: Information lost

Information stored in the database is **much less** than information acquired by the photointerpreter:

*E.g.: The photointerpreter evaluates a certain polygon's trees percentage as 75 %, and in consequence he labels it as Corine 3.1.1. "Broad-leaved forest".*

*... But the user only receives the information that trees are "more than 30 %"*



## ❖ Problem 2: Spatial variations not registered

Important **spatial variations** in certain parameters values **do not appear** in the database if this variations do not “cross” the “threshold line”

- *E.g.: Urban areas with very different levels of building densities (as 10 % and 50 %) have to be assigned to the same Moland class (1.1.2.2. Residential discontinuous sparse urban fabric.)*



## ❖ Problem 3: Temporal changes not registered

- If these changes do not “cross” the “**definition rule**” threshold.

*E.g.: If the building density of a polygon has increased from 11% to 79 % this polygon is labeled as Corine’s 1.1.2. “Discontinuous urban fabric”, in both databases, and so*

***no change is registered.***

and/or:

- These changes are “hidden” in polygons assigned to **dominant classes** or to **mixed classes**.



**Change not registered !!**

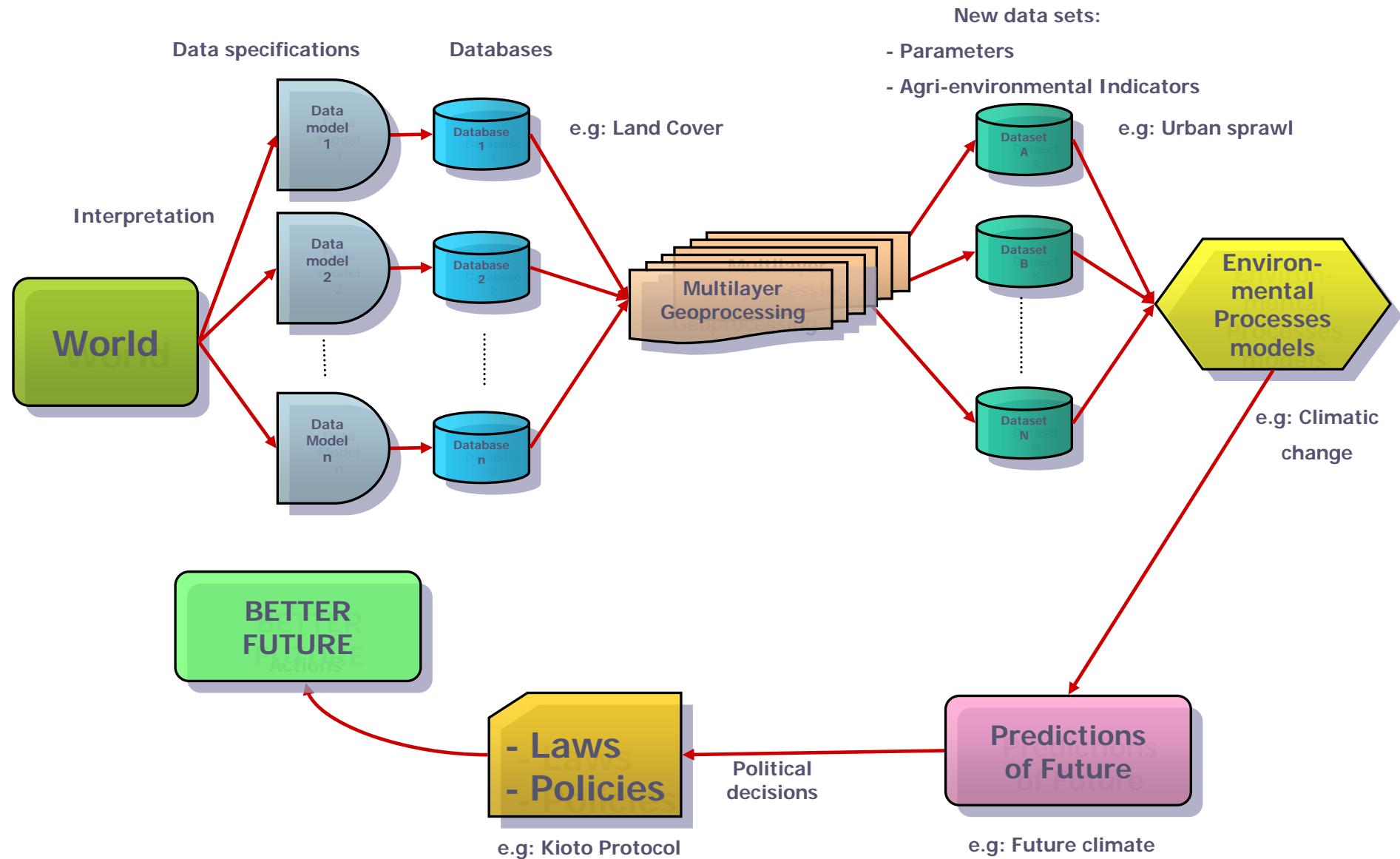
## ❖ Problem 4: Parameters and Indicators calculations not possible

Many **parameters** and “**Indicators**” could be **calculated from the values** of the parameters appearing in class definitions (sometimes “crossing” them with exogenous information such as population, etc...). *Eg:*

- *building density ( $m^3/m^2$ ) in an area*
- *$m^2$  of building per person in an area*
- *average height of buildings in a town*
- *% of impervious surface in an area*
- *% of trees in a forest*
- *$m^2$  of green areas per person in an area*
- *land take by transport infrastructures in a city*
- *etc...*

Land Cover Classifications do not allow calculating these indicators, because de **real values** of the different parameters are **not stored in the database (only “intervals”)**:

# ❖ Need for calculation of parameters and Indicators



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# ❖ Parametric database of “people”

## People

- **Gender:** controlled list (man, women)
- **Height (m):** real
- **Weigh (Kg):** real
- **Nationality:** controlled list (country table)
- **Age (years):** integer
- **Study level:** controlled list
- **Work:** controlled list
- **Residence:** text
- **Eyes color:** controlled list
- **Hair color:** controlled list
- **Diseases:** controlled list
- **Married:** boolean
- **Number of sons:** integer
- **Hobbies:** controlled list
- **Religion:** controlled list



# ❖ One instance of “people”

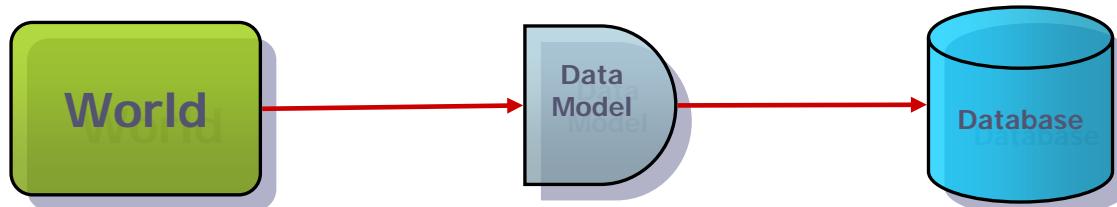
## John Smith

- Gender: man
- Height (m): 1.77
- Weigh (Kg): 82.6
- Nationality: USA
- Age (years): 52
- Study level: University
- Work: Engineer
- Residence: San Diego, CA
- Eyes color: brown
- Hair color: blond
- Diseases: none
- Married: yes
- Number of sons: 2
- Hobbies: golf, sailing
- Religion: protestant



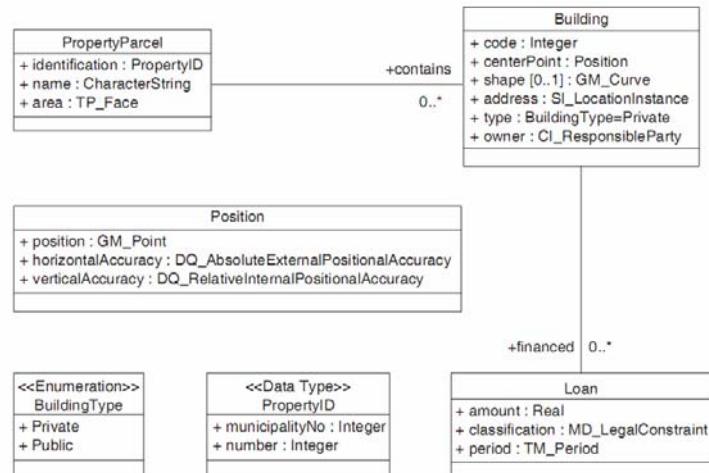
## ❖What is a Data Model ?

- A **data model** is the description of what we are storing in a database and how.
- It is the “**link**” between reality and the Database



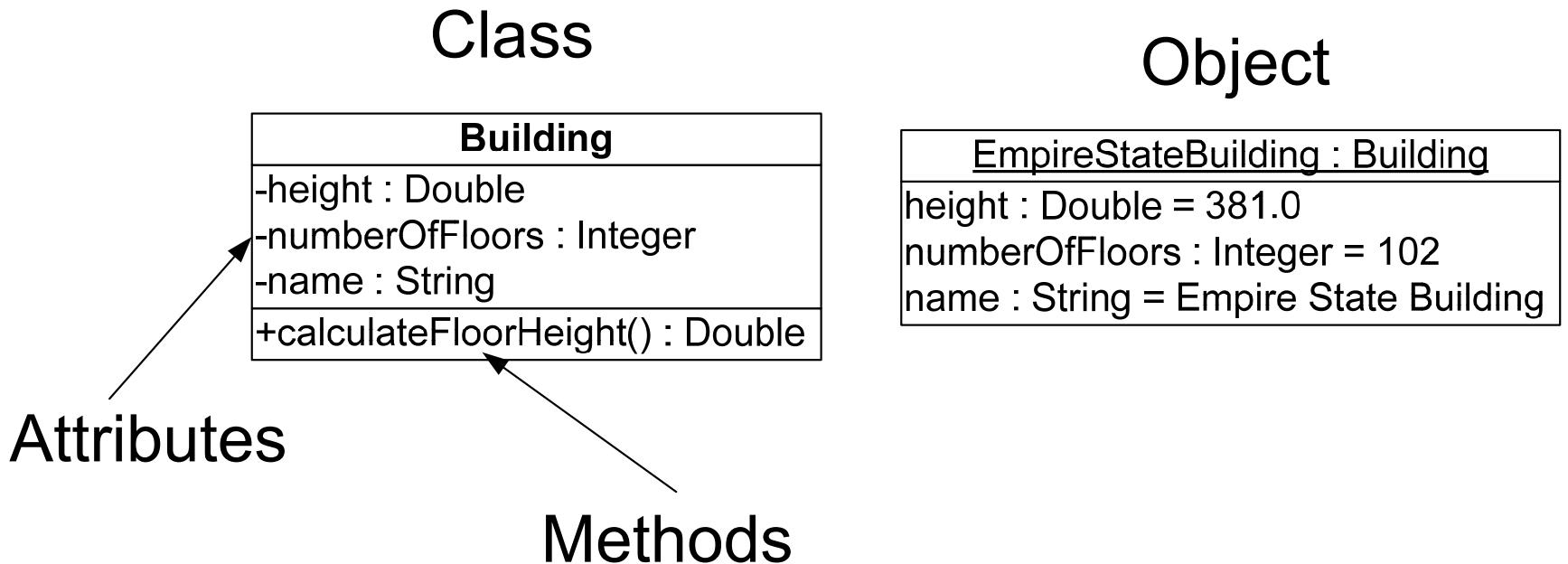
# What is a Object Orientation ?

- “Object Orientation” is the standard in Computer Science today
- **Parametric Object Oriented Data Models (POODM)** are used extensively in every type of databases and **Information Systems** (airports, hospitals, production facilities,...)....  
....including “some” **GIS** databases



# ❖ UML (Unified Modeling Language)

- ❑ The standard for Object Oriented Models
- ❑ Used by ISO in its standards



□ Principal relationships between classes:

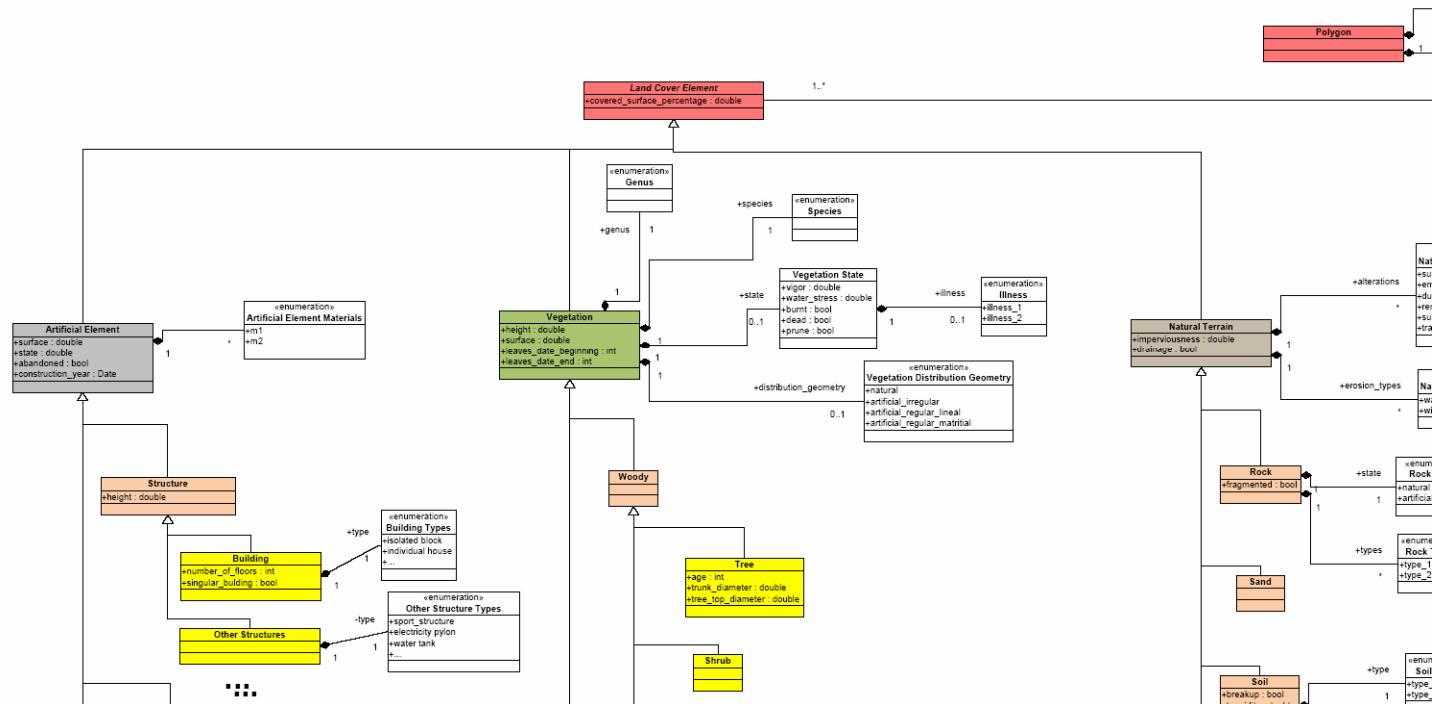
- **Inheritance** (Generalization / Specialization): A class **inherits** (or specializes) the **state** and **behavior** of another class
- **Aggregation**: allows to capture the **structural relationships** among entities in the real world (part-of)
- **Association**: allows to capture other kinds of relationships among entities in the real world

## ❖ International Geographic Standards:



- ❑ Object-Oriented, Feature Data Models are mandatory in ISO 19109 (called “Application Schemas”)
  
- ❑ They are also mandatory in Inspire INSPIRE “Generic Conceptual Model” (Document 2.5 v3.1)





- ✓ **UML (Universal Modeling Language)** lets us express, store, modify, extend,... this structure easily and make it understandable by anybody

## ❖ Object Orientation for Land Cover Information

- Land Cover has been **traditionally** modeled (**Corine, Moland** Andersons,...) using classifications, legends, nomenclatures....
- Up to now OODM **have not been used** for Land Cover Information

# Land Cover Classifications (Moland legend)



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LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1. ARTIFICIAL AREAS	1.1. Urban fabric:	<p>1.1.1 Continuous urban fabric: Most of the land is covered by structures and transport network. Buildings, roads and artificially surface areas cover more than 180% of the total surface. Non-linear areas of vegetation and bare soil are exceptional.</p>	<p>1.1.1.1 Residential continuous dense urban fabric. Residential structures cover more than 80% of the total surface. More than 50% of the buildings have three or more stories.</p> <p>1.1.1.2 Residential continuous medium dense urban fabric. Residential structures cover more than 80% of the total surface. Less than 50% of the buildings have three or more stories.</p> <p>1.1.1.3 Informal settlements</p>
		<p>1.1.2 Discontinuous urban fabric Most of the land is covered by structures. Buildings, roads and artificially surface areas are associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces. Between 10% and 80% of the land is covered by residential structures.</p>	<p>1.1.2.1 Residential discontinuous dense urban fabric. Buildings, roads and artificially surface areas cover between 50% and 80% of the total surface area of the unit.</p> <p>1.1.2.2 Residential discontinuous sparse urban fabric. Buildings, roads and artificially surface areas cover between 10% and 50% of the total surface area of the unit. The vegetated areas are predominant but is not land dedicated to forestry or agriculture.</p> <p>1.1.2.3 Residential urban blocks</p> <p>1.1.2.4 Informal discontinuous residential structures</p>



Density thresholds



Land Cover Elements

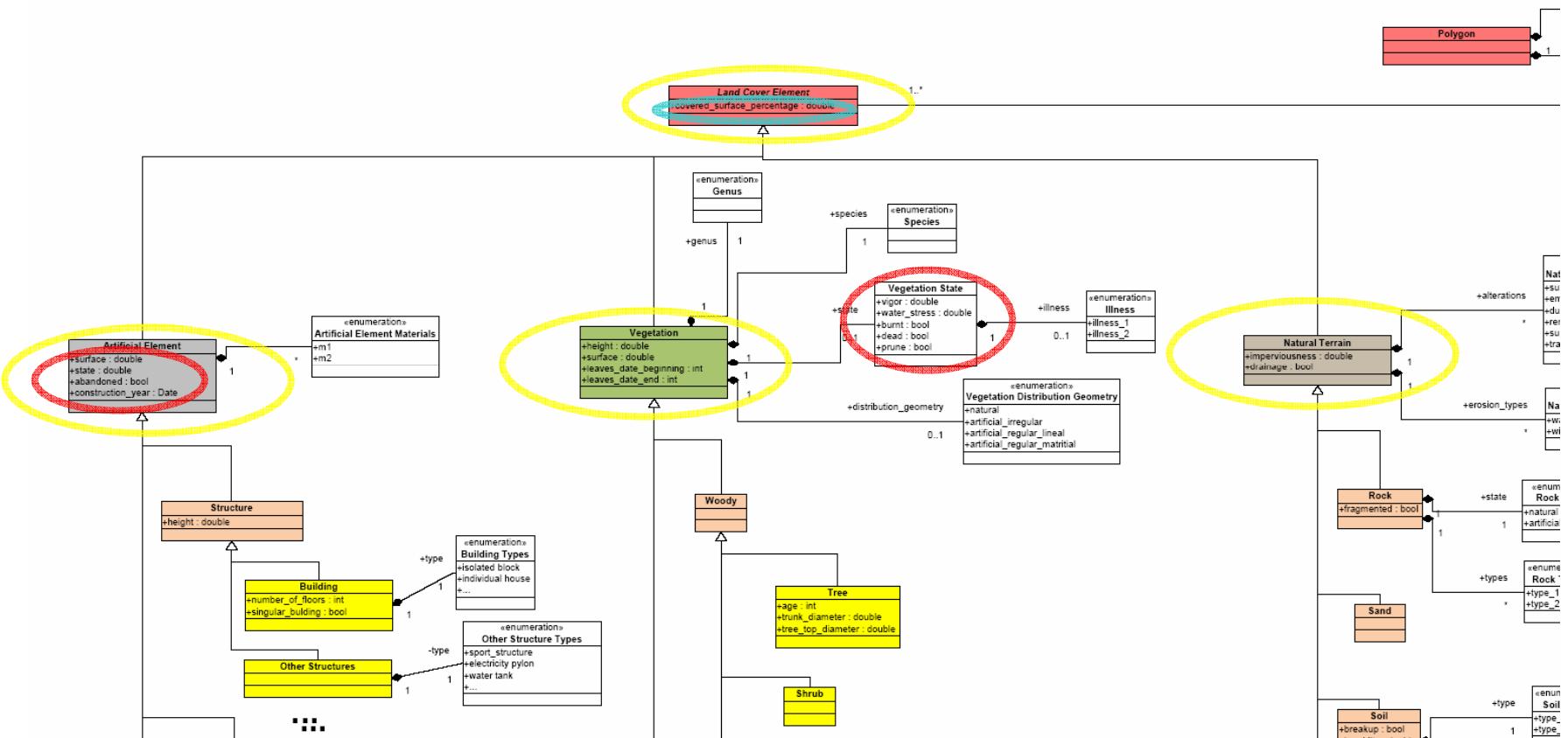


Attributes



Percentage of polygon occupation

# Parametric object oriented data model



## Land Cover elements:

- complete
- structured
- explicit
- extensible
- complete
- structured
- explicit
- exact values measured and stored in database
- extensible

## Attributes:

- complete
- structured
- explicit
- exact values measured and stored in database
- extensible

## Percentage of polygon occupation:

- explicit
- expressed rigorously:  
(type: real, integer, boolean, list,...)
- exact values measured and stored in database

## ❖ Basic principles of Object Oriented Land Cover Databases:



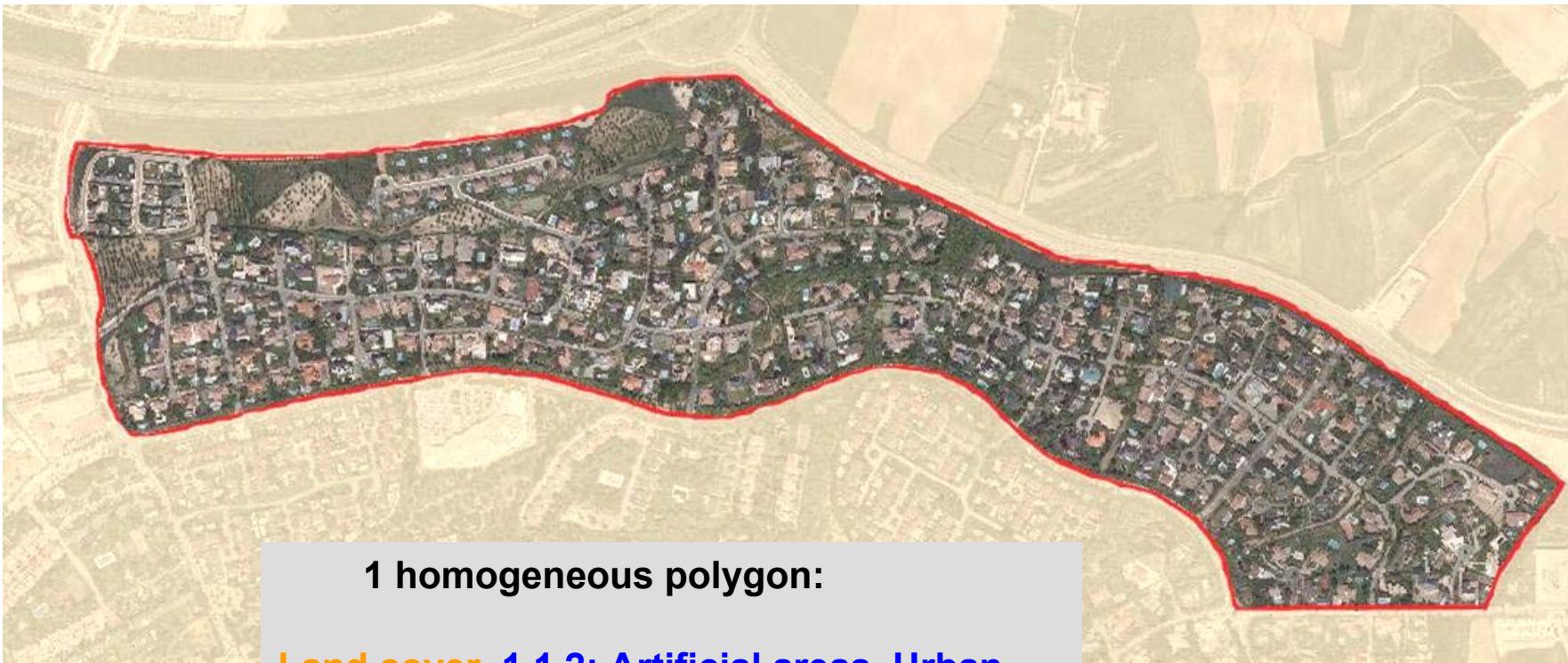
- ❑ We do not “**classify**” polygons. We **describe** polygons
- ❑ Each polygon has one or more “**Land covers**” (LC)
- ❑ We store in the database the **% of the polygon occupied** by each “Land cover”

## ❖ Examples



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**1 homogeneous polygon:**

**Land cover 1.1.2: Artificial areas. Urban fabric.**

**Discontinuous urban fabric**  
(100 % of polygon's surface)

**Land Cover Elements in it:**

- Buildings (50 %)
- Roads (15 %)
- Trees (deciduous) (20 %)
- Herbaceous vegetation (10 %)
- Swimming pools (5 %)

❖ Ejemplo de Determinación de los “LC Elements”



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## Airborne Laserscanning data - DSM

**LISA**  
Laser Information System Austria



© ALS Daten zur Verfügung gestellt vom Amt der Kärntner Landesregierung. Ausschnitt Klagenfurt

13/15

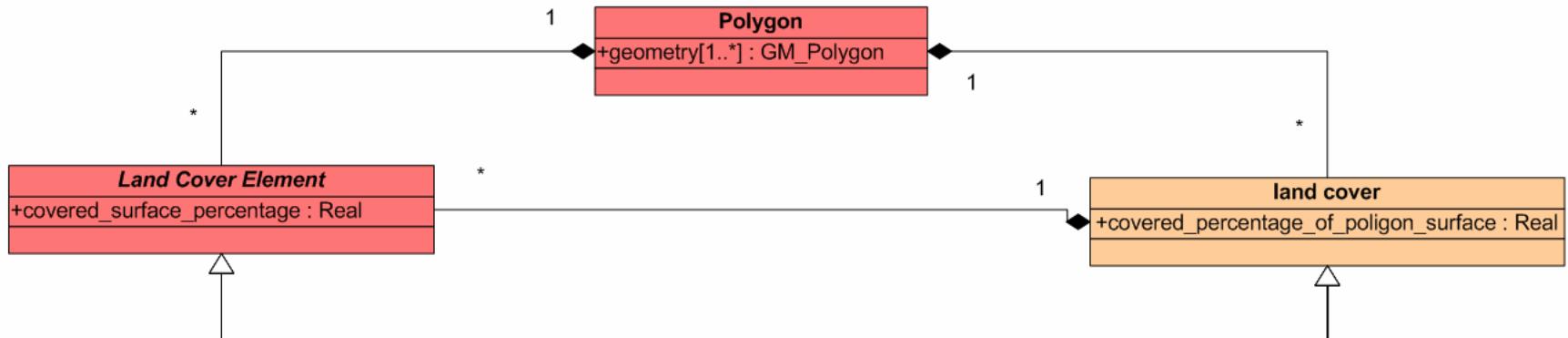


❖ Ejemplo de Determinación de los “LC Elements”

## Building and vegetation layer



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- ❑ Land Covers are made up of “**Land Cover Elements**” (**LCE**)
- ❑ We store in the database the **% of each land cover** occupied by each LCE.
- ❑ Each LC and LCE can have “**attributes**”
- ❑ The **actual values** of all attributes for each LC and LCE are **stored** in the database

- The use of POODM for Land Cover Information **has been developed**, tested and **is working in the Spanish SIOSE Project**, which is in advanced production phase (finishing by end of 2009)



- **ENRÓ DE AGUA (4.4.8.1.1)**
- **URBANO MIXTO / CASCO (4.5.2.5.1.1)**
- **URBANO MIXTO / ENGANCHE (4.5.2.5.1.2)**

#### RICA DESCRIPCIÓN COBERTURA SIMPLE:

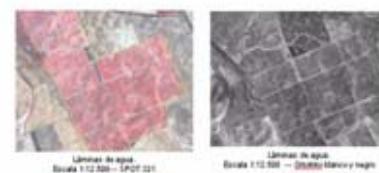
Cultivos intensivos, VILLEDO, Regadio

• **DEFINICIÓN**  
Áreas de cultivo intensivo ocupadas por el cultivo de la vid, independientemente del destino de la producción y del sistema de cultivo.

Se distingue en cultivos intensivos dedicados a la explotación mixta intensiva, en cultivos intensivos dedicados a la explotación mixta intensiva para el abastecimiento de la villa y el control de la erosión y se incluye un grupo dedicado a los plantaciones. Se producen cultivos de cultivo en vides con disposición a mano realizada y cosechados en botes con envasado.

• **Características**

- frutos de plantaciones de vides,
- viñedo e intensivo dedicado,
- cultivos con baja producción, por lo que en el número de plantas o densidades de vides.

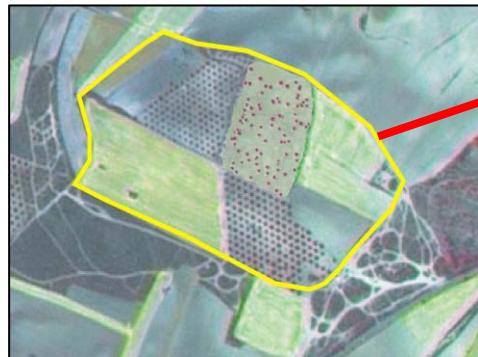


• **DESCRIPCIÓN**

Cultivo mixto. Presenta alta actividad en la banda infrarroja para el cultivo destinado existente entre las riegas. Destacan las irregularidades.

Se observa una estructura regular de los parcelas y dentro de estas se puede diferenciar mediante la textura los dos sistemas de cultivo de vides (mixta y establecida).

Se confunde con cultivos herbáceos o herbáceos de baja medida en verano.

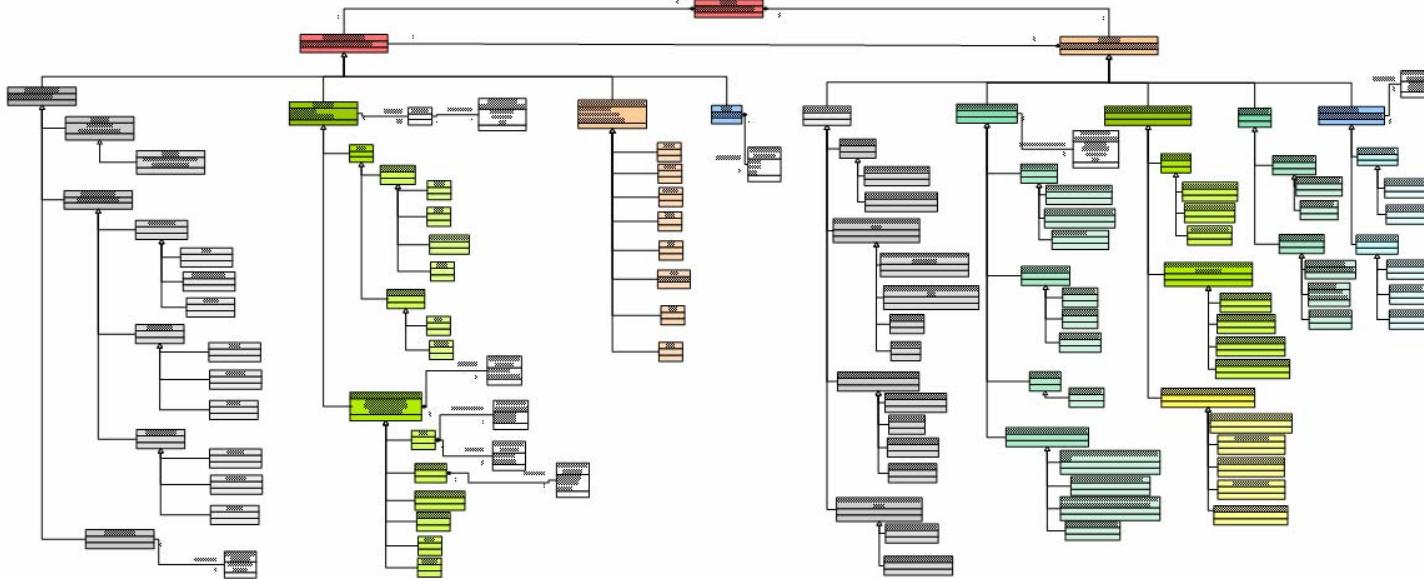


A screenshot of a GIS application interface for digitizing land cover polygons. A red arrow points from the yellow polygon in the image on the left to the 'Guardar' (Save) button at the top right of the dialog box.

The dialog box contains the following fields:

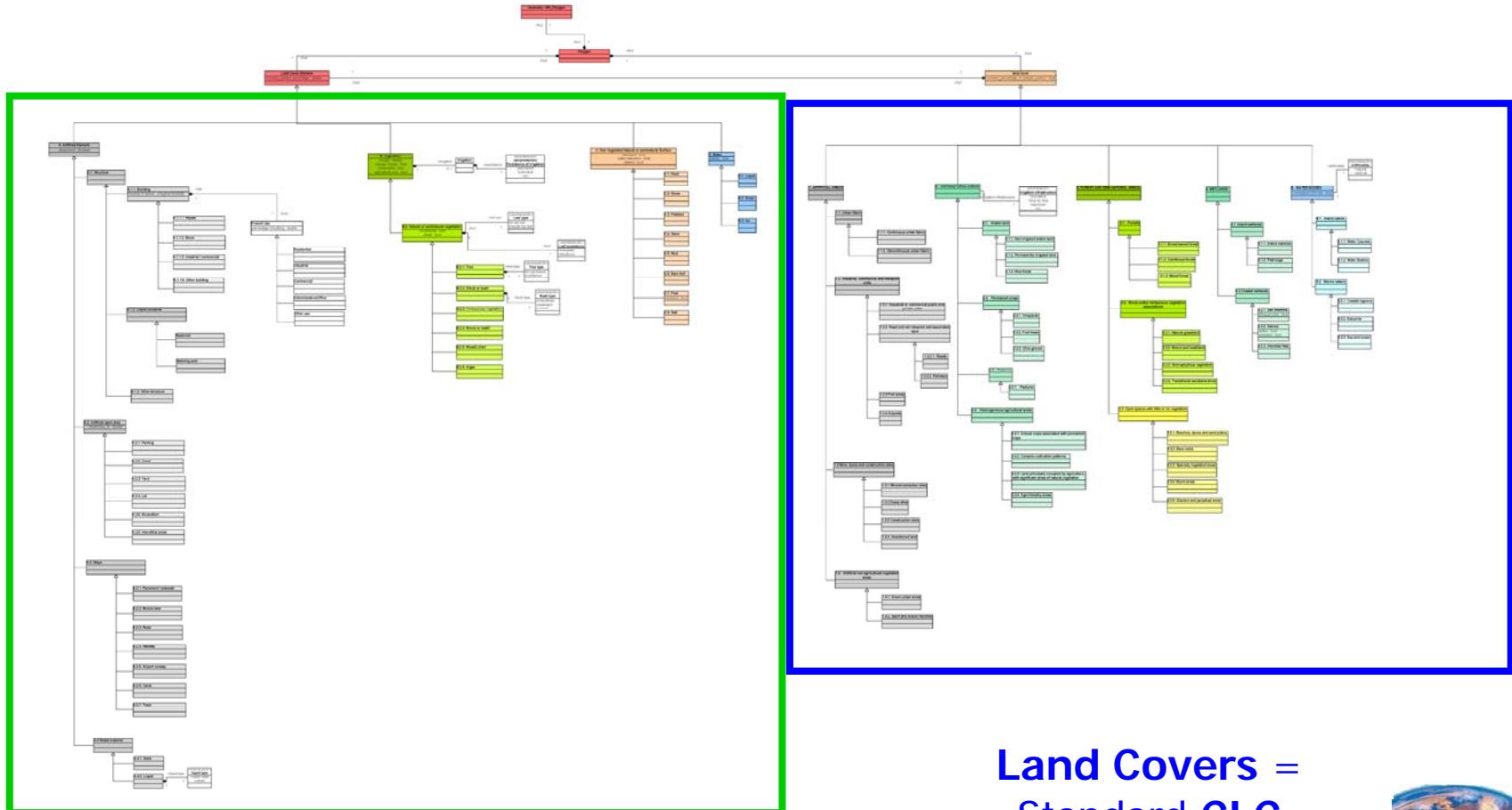
- Guardado:** Buttons for 'Añadir' (Add), 'Modificar' (Modify), 'Eliminar' (Delete), and 'Guardar' (Save).
- Tipo de cobertura:** Radio buttons for 'Simple', 'Compuesta predefinida', and 'Compuesta'. 'Simple' is selected.
- Mosaico Regular:** A dropdown menu showing 'Mosaico Regular'.
- Tipo de cobertura:** Radio buttons for 'Simple', 'Compuesta predefinida', and 'Asociación'. 'Simple' is selected.
- PASTIZAL:** A dropdown menu listing categories: ARBOLADO FORESTAL, COBERTURA DE AGUA, COBERTURAS ARTIFICIALES, COBERTURAS HÚMEDAS, CULTIVOS, MATORRAL, PASTIZAL, and TERRENOS SIN VEGETACIÓN. 'CULTIVOS' is highlighted with a blue selection bar.
- Polígono:** A hierarchical tree view showing a 'Mosaico regular [100%]' polygon containing sub-polygons: 'Pastizal [50%]', 'Olivar/viñedo [25%]' (which further contains 'Viñedo [50%]' and 'Olivar [50%]'), and 'Olivar [50%]'.
- Atributos:**
  - Superficie cubierta (en %): 25
  - Atributos:
    - Cortas
    - Procede de cultivo
    - Función de cortafuegos
- Buttons:** 'Aceptar' (Accept) and 'Cancelar' (Cancel).

A physical implementation (**Relational Database** and an **Application to fill it**) according with data model specifications have been developed and are in use in SIOSE production



We are presenting here an “evolution” of SIOSE Data Model,  
“Corine Land Cover Object Oriented Data Model” CLC-OODM  
designed to allow for:

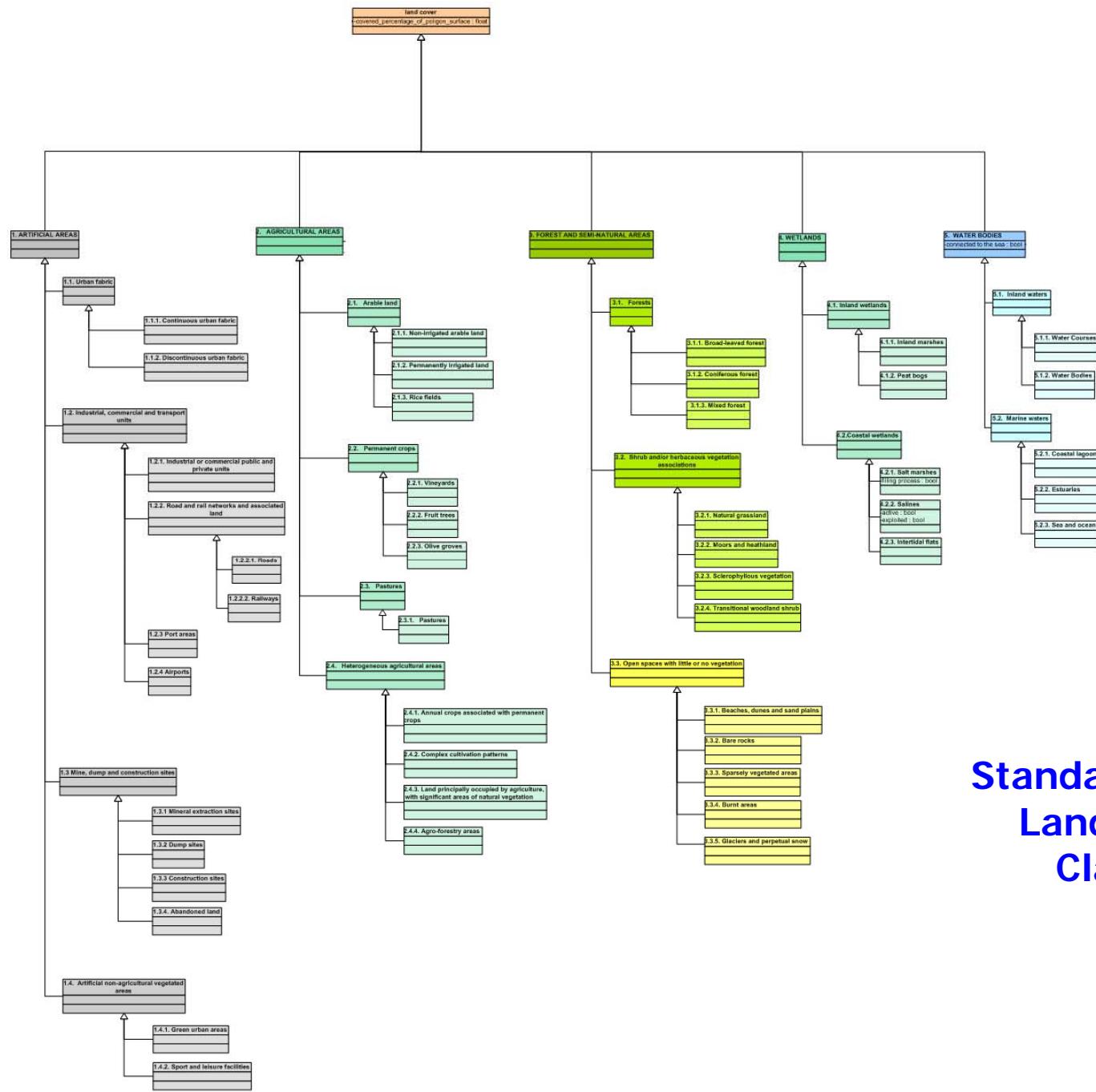
- Maximum compatibility with standard Corine Land Cover Databases
- Maximum reuse of existing information
- Easy migration path from CLC classifications to Parametric databases



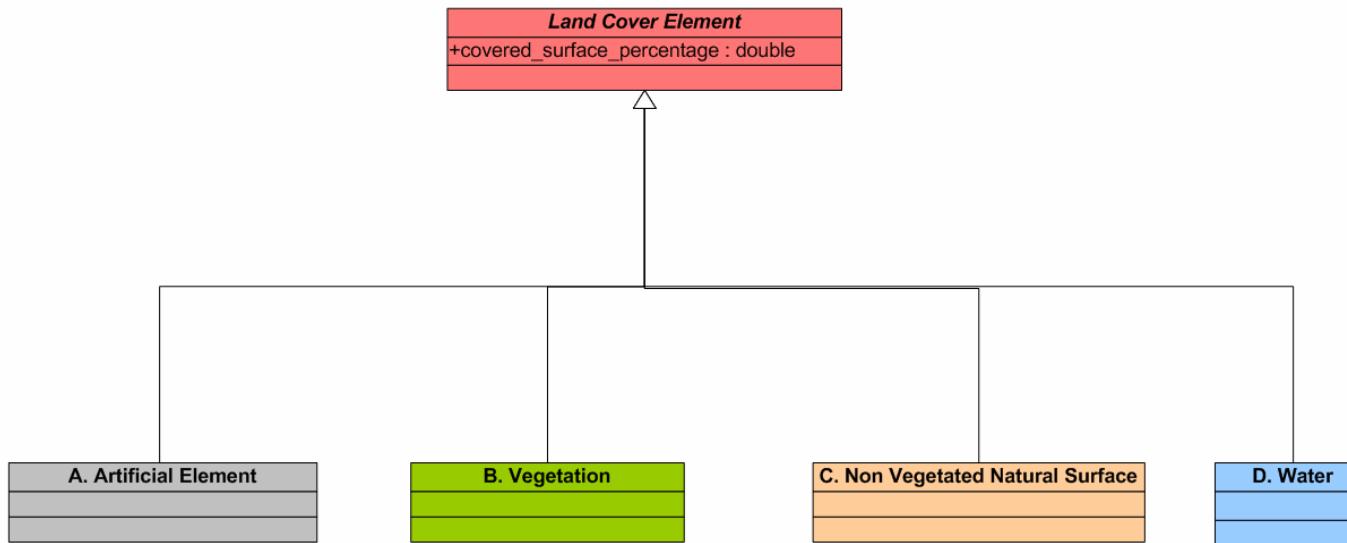
**Land Cover Elements: features of other Inspire theme (with reduced semantic level of detail)**

**Land Covers =  
Standard CLC  
Nomenclature, in  
UML**





**Standard Corine  
Land Cover  
Classes**

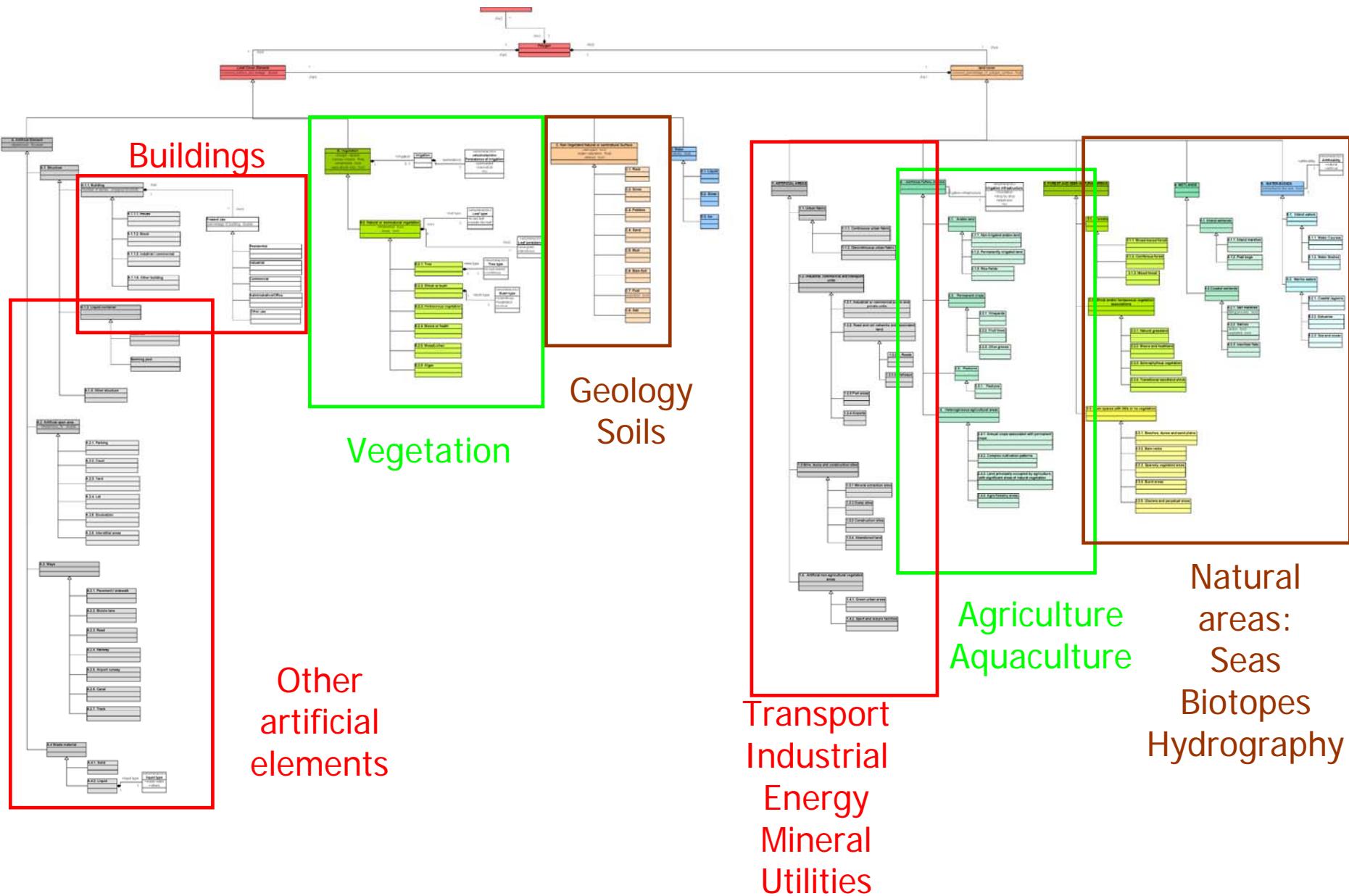


**Land Cover  
Elements  
(only 1st level  
presented)**

# Land Cover overlaps with most other GI Themes

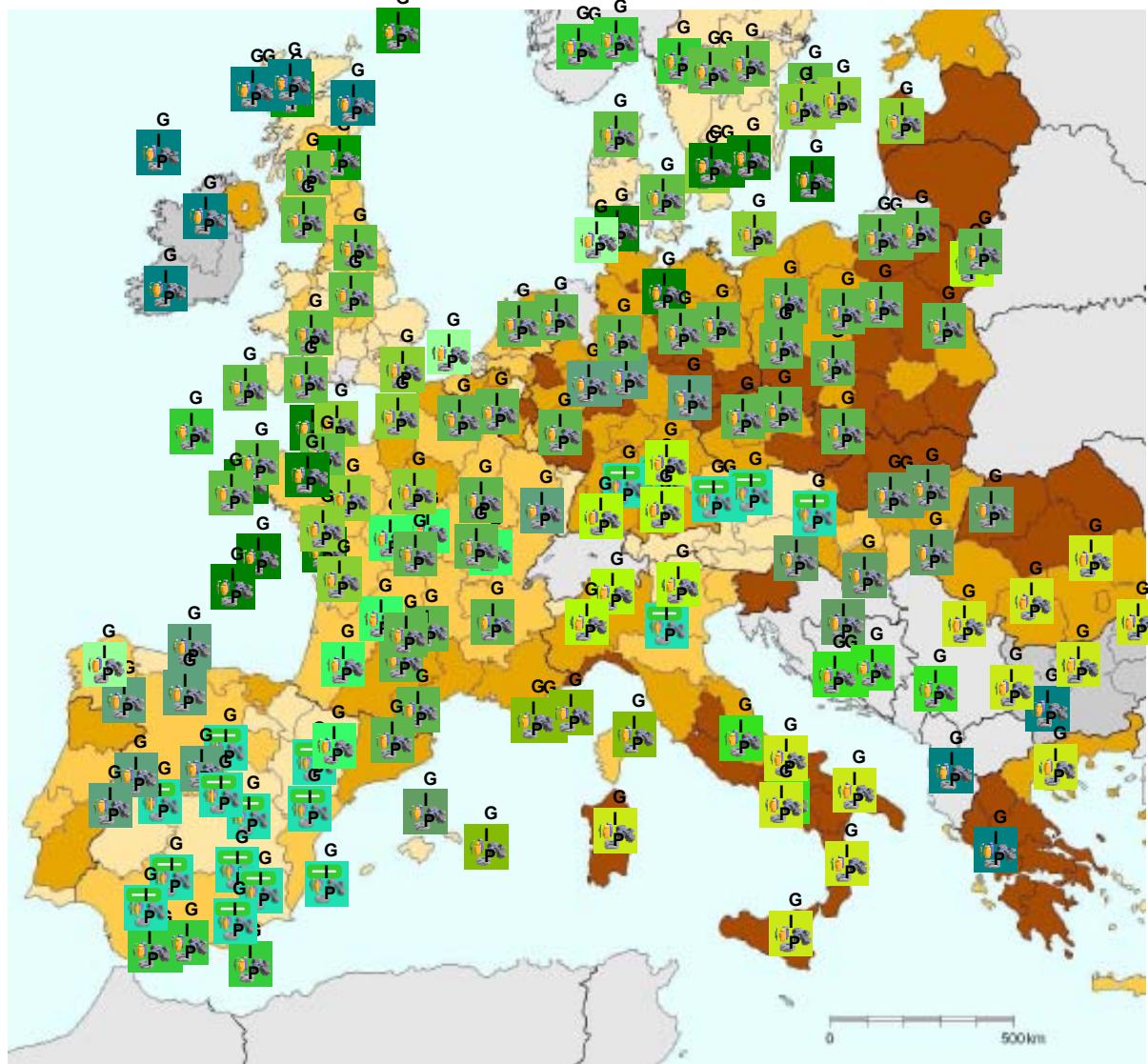
RIO

DIRECCIÓN GENERAL  
DEL INSTITUTO



## ❖ Outline

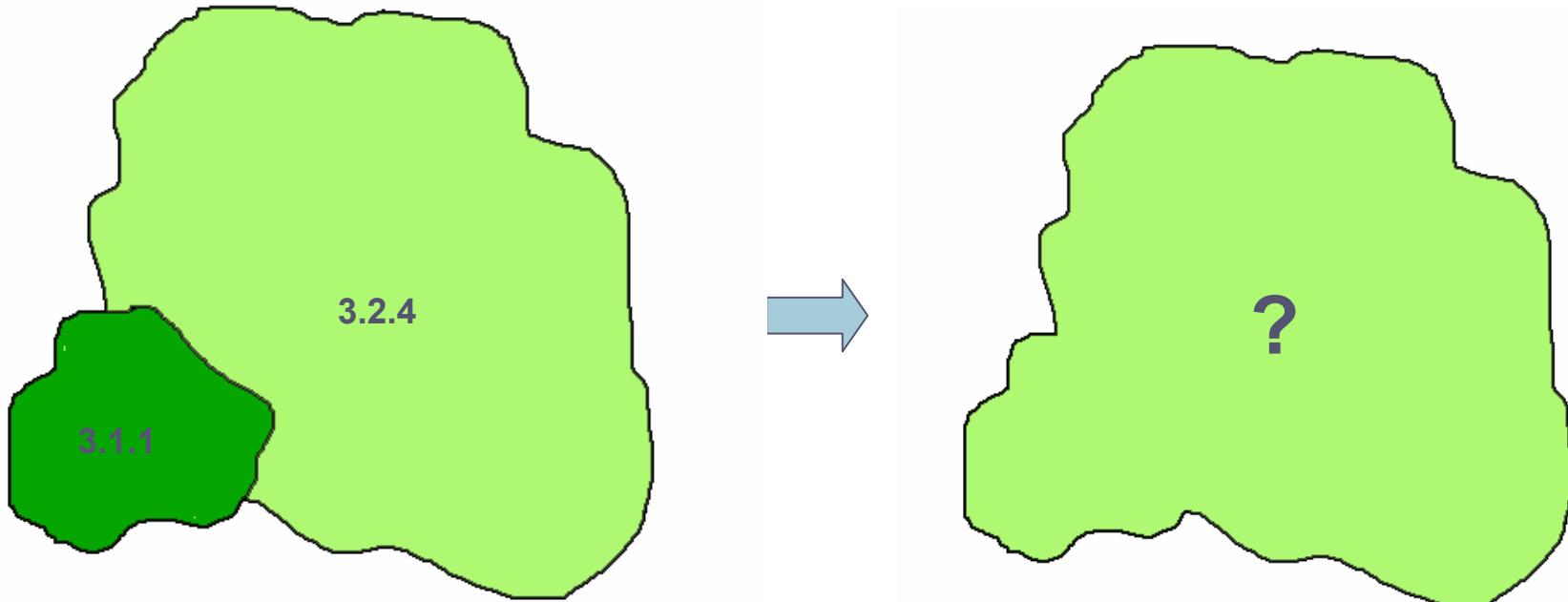
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$19 * 39 \approx 741$  Regional LU/LC Databases in Europe

## LU/LC Classifications

### Generalization problem:



**3.1.1.** Broad leaved forest (**Trees  $\geq 30\%$** )

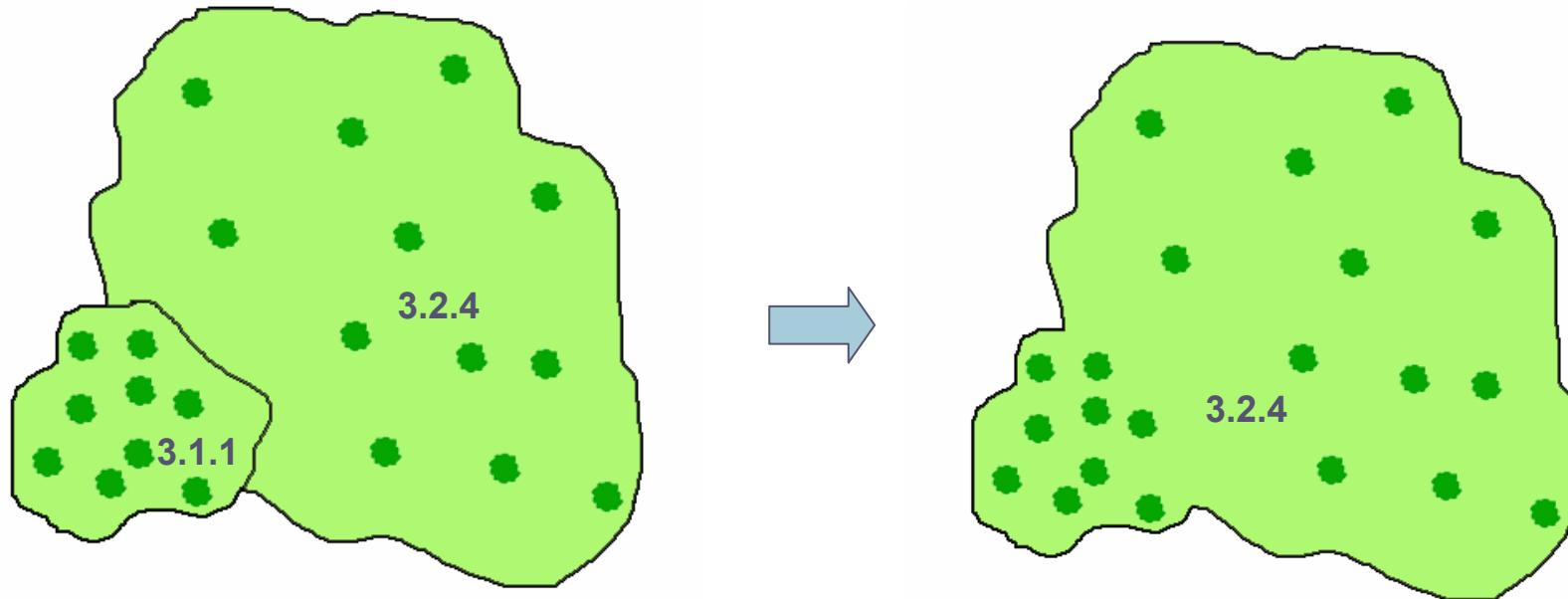
**3.2.4.** Transitional woodland (**Trees  $< 30\%$** )

The merged polygon is of  
**unknown class.**

We have to **repeat the Photo  
interpretation**

## Object-Oriented LU/LC Databases

Generalization possible: e.g: CLC-OO Databases



3.1.1. Broad leaved forest (**Trees = 48 %**)

Polygon surface = 15 Ha

Merged Polygon surface =  $15 + 60 = 75$  Ha

% Trees =  $(15*48 + 60*14)/75 = 20.8\%$

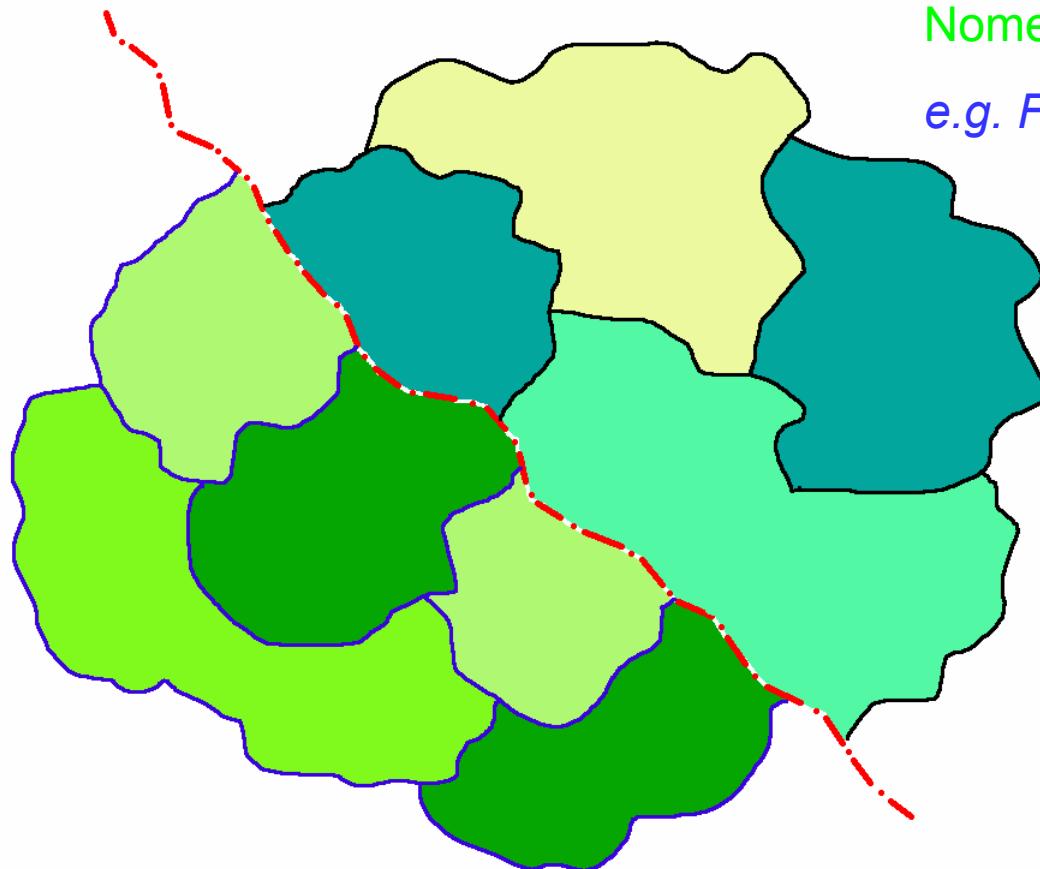
3.2.4. Transitional woodland (**Trees = 14 %**)

(Polygon surface = 60 Ha)

→ 3.2.4. Transitional woodland  
with Trees = 20.8 %

## LU/LC Classifications

### Mosaicking problems:



Region 1:

Land Cover Nomenclature 1

e.g. Forest = trees  $\geq 30\%$

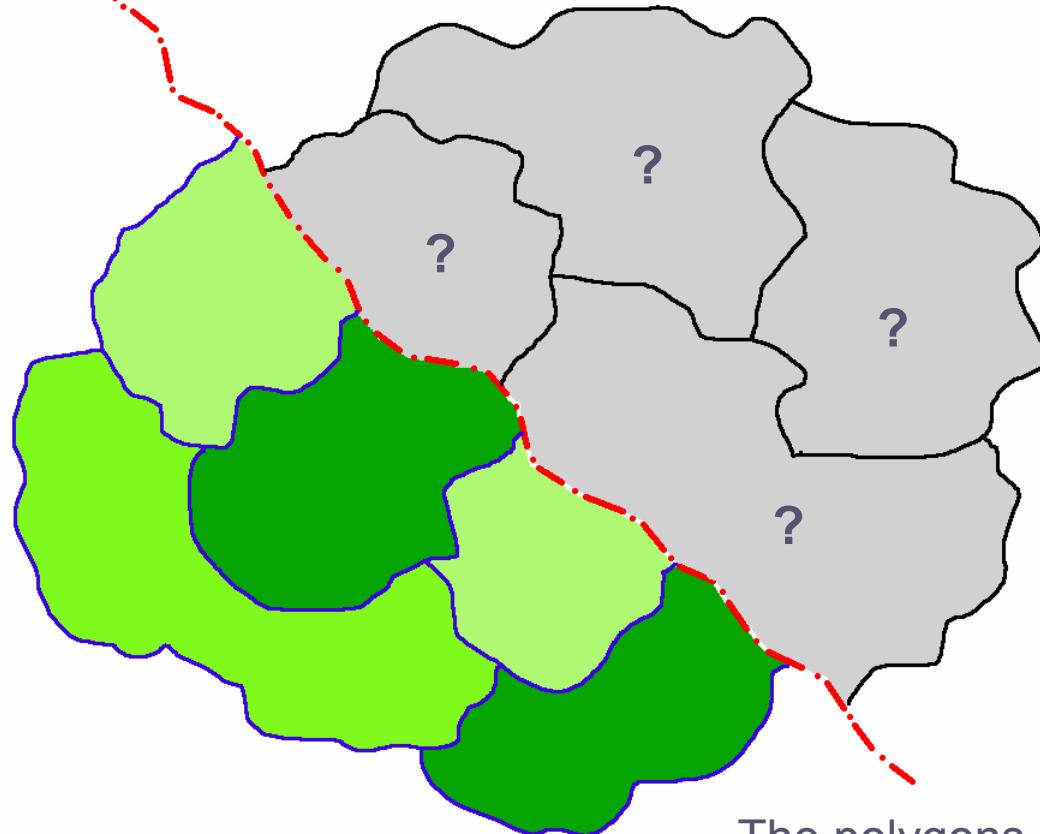
Region 2:

Nomenclature 2

e.g. Forest = trees  $\geq 50\%$

# LU/LC Classifications

## Mosaicking problems:

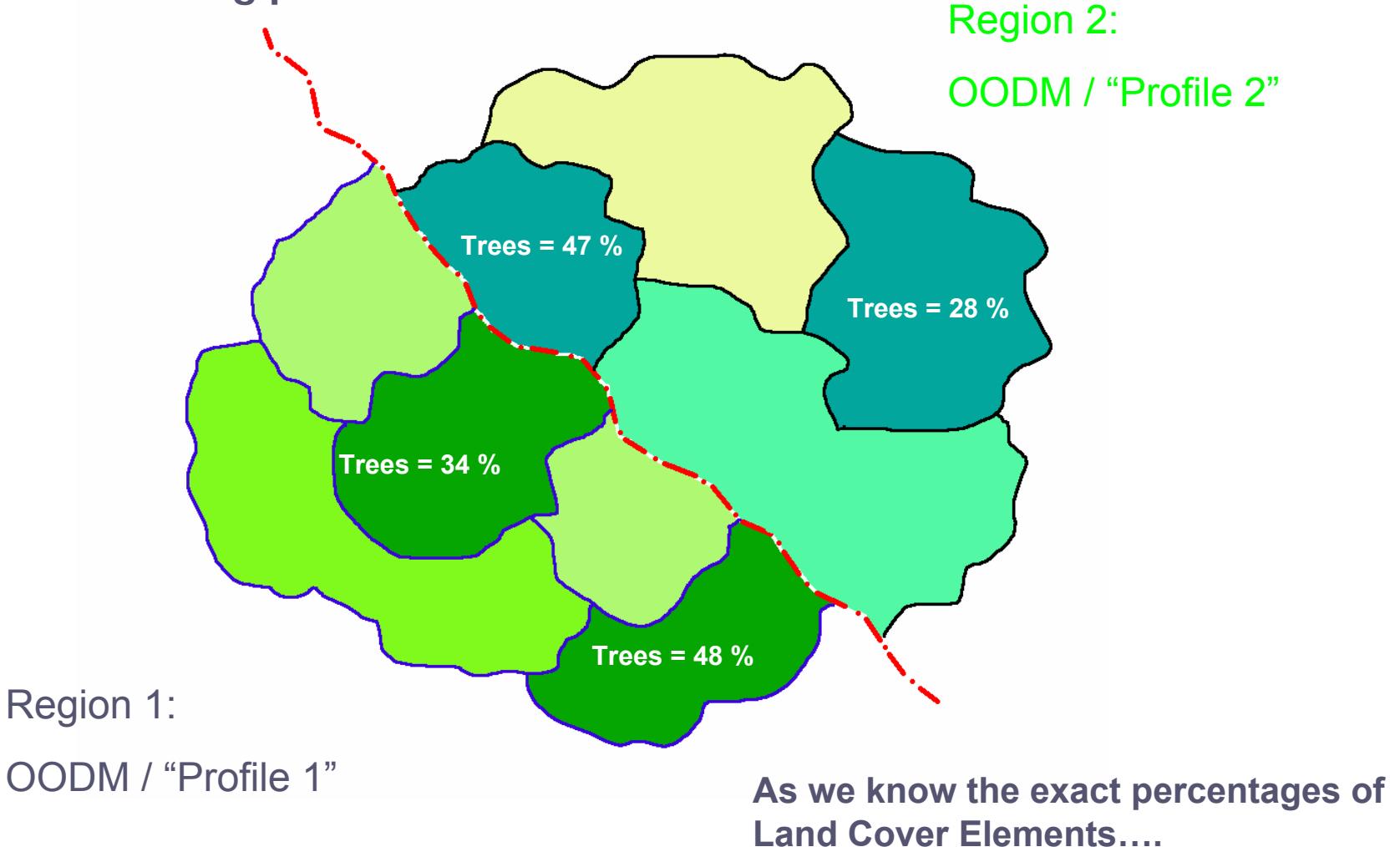


The polygons of the database with a different nomenclature are of unknown class

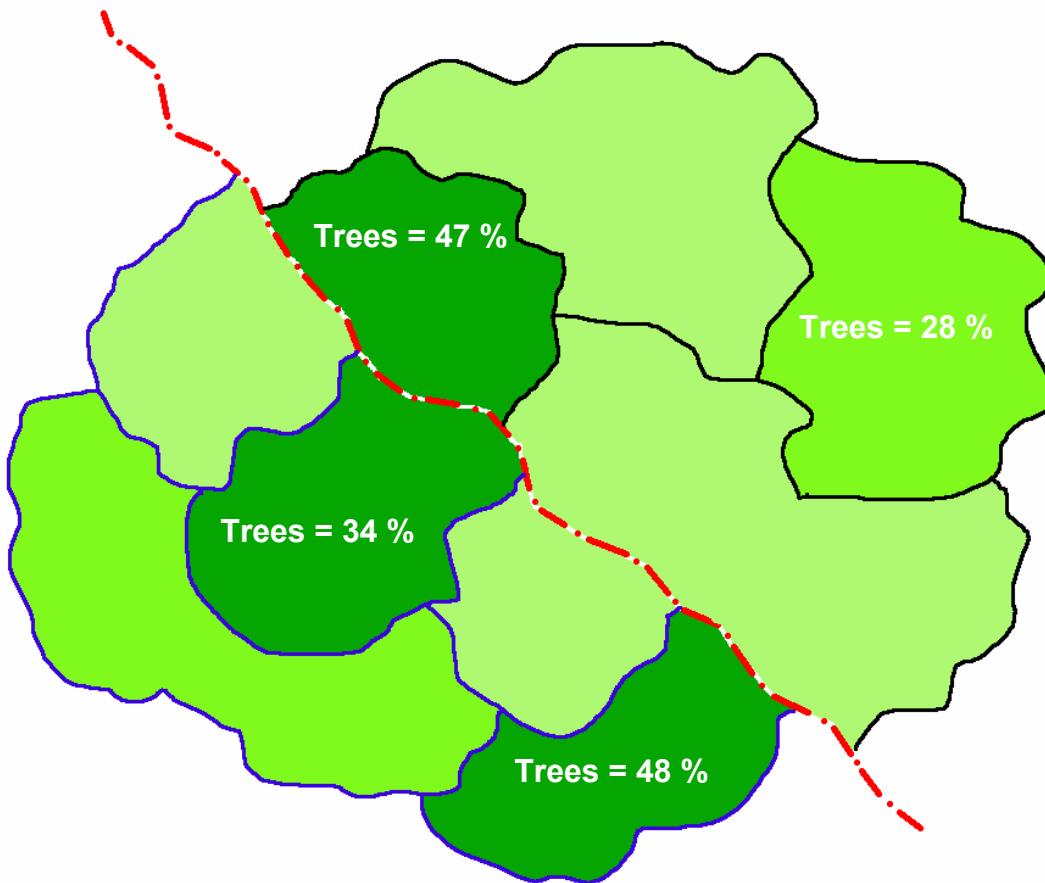
We have to **repeat the Photo interpretation**

## Object-Oriented LU/LC Databases

Mosaicking possible:



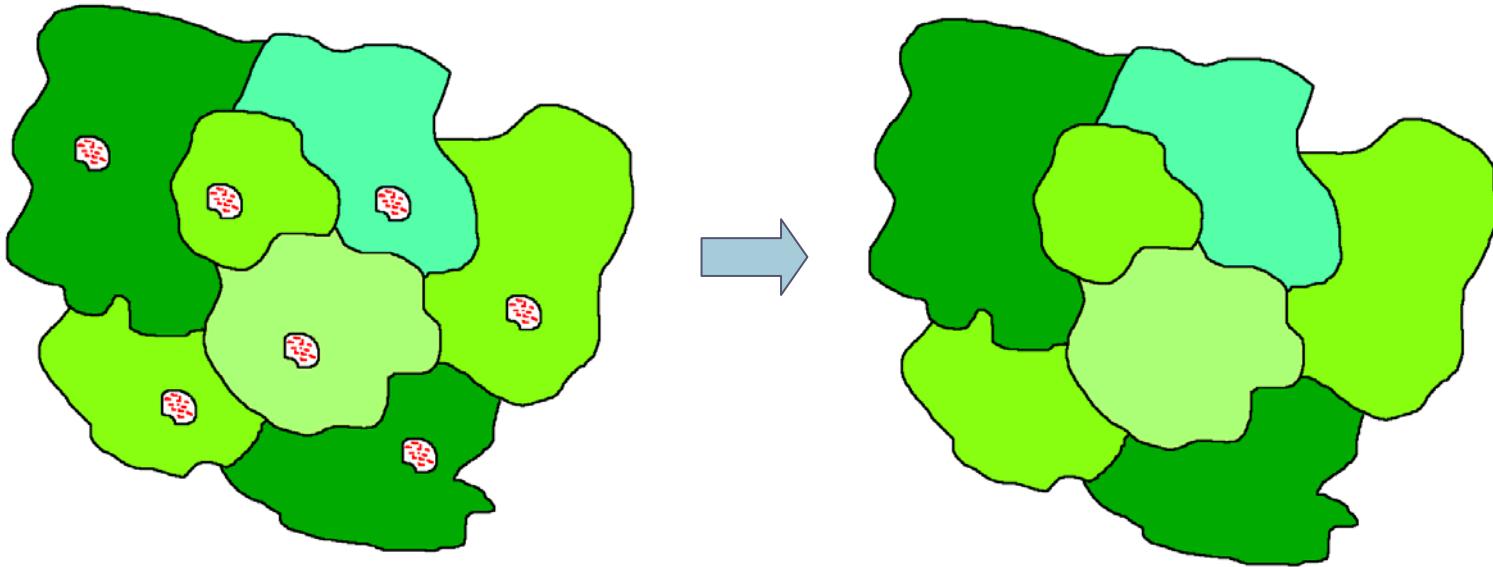
We can merge the common part of both  
“Profiles”



And assign the correct Land Covers

## LU/LC Classifications:

Statistical Inconsistencies between  
high resolution and low resolution databases



High resolution (**national**)  
classification database:

**10 %** of region is 1.1.1. "Continuous  
urban fabric"

But **all** polygons (< 25 Ha: LR MMU)

Low resolution (**European**)  
classification database:

**0 %** of region is 1.1.1. "Continuous  
urban fabric")

Because Polygons have been  
assigned to dominant classes

## ❖ Outline

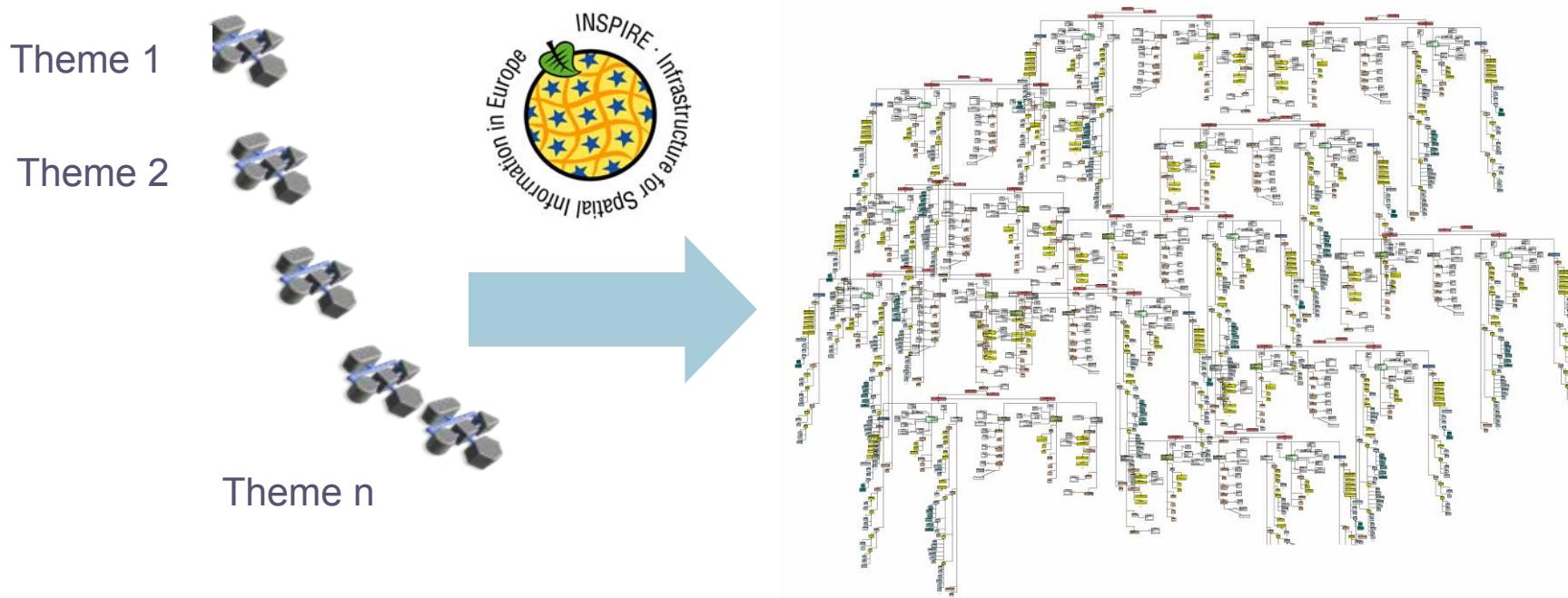
1. Preface: Database of “people”
2. Problems of Land Cover classifications
3. New solution: Parametric Object Oriented Land Cover databases
4. Can OO-LU/LC DB help the Bottom-Up approach?
- 5. Adequacy to Inspire and GMES needs**

Needs	Land Cover/Use classifications	Object Oriented Data Models
1. Spatial generalization	NO <i>When we aggregate polygons into bigger ones, there is no way to automatically derive the class of the resultant polygon</i>	YES
2. Multiresolution coherence	NO <i>Classes in polygons smaller than MMU disappear during generalization</i>	YES
3. Mosaicking of different existing Land Cover databases possible	NO <i>There is no way to know de label of a polygon in a DB with a different Nomenclature</i>	YES <i>One can merge existing OOLCDB to a common POODB</i>

Needs	Land Cover/Use classifications	Object Oriented Data Models
4. Integration with remote sensing automatically derived parameters ( <b>Top-Down approach</b> )	<p>NO</p> <p><i>Each polygon has a single attribute: the class label</i></p>	<p>YES</p> <p><i>The mean of continuous value variables for each polygon's area can then be input and stored in the OODM database as a parameter that qualifies each polygon</i></p>
5. Indefinite Extensibility	<p>NO</p> <ul style="list-style-type: none"> <li>- <i>Proliferation of unusable classes, due to the multiple "crossings" of several classification criteria</i></li> <li>- <i>It is impossible to add external information from a specialized field to a HC database</i></li> </ul>	<p>YES</p> <p><i>One can add new features and attributes as needed</i></p>
6. Allow for different update periods	<p>NO</p> <p><i>Each polygon has a single attribute: the class label. It has to be updated at once</i></p>	<p>YES</p> <p><i>One can update certain "Land covers", Land Cover Elements or Attributes of an Object Oriented database more frequently. E.g:</i></p> <ul style="list-style-type: none"> <li>- urban fabric: 1 year</li> <li>- forest trees: 5 years</li> </ul>

Needs	Land Cover/Use classifications	Object Oriented Data Models
7. Perfect change detection	NO <i>Changes in polygons <b>not registered</b> unless they cross the “Class limit” values</i>	YES <i>Any variation in the composition or attributes of a polygon can be registered</i>
8. ISO 19109 compliance	NO <i>They are not <b>Feature Data Models (Application Schemas)</b> (<b>The same for FAO's LCCS</b>)</i>	YES <i>An OO-LCDM can easily be an ISO19109 FDM (Application Schema)</i>
9. INSPIRE “Generic Conceptual Model” (Document 2.5 v3.1) compliance	NO <i>They are not ISO 19109 compliant (<b>The same for FAO's LCCS</b>)</i>	YES <i>An OO-LCDM can easily be ISO19xxx compliant (Application Schema). You need to use UML 2.1</i>

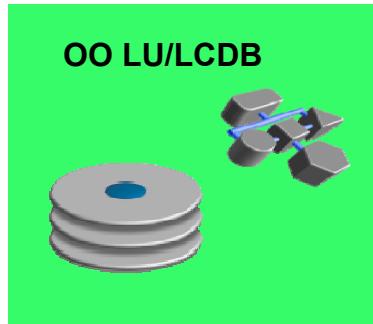
- The use of FDM to model every geospatial theme is the **only way** to assure compatibility between them, and **to make it possible** to develop a “**Consolidated Data Model**” (CDM) of all Geospatial Information (GI) themes



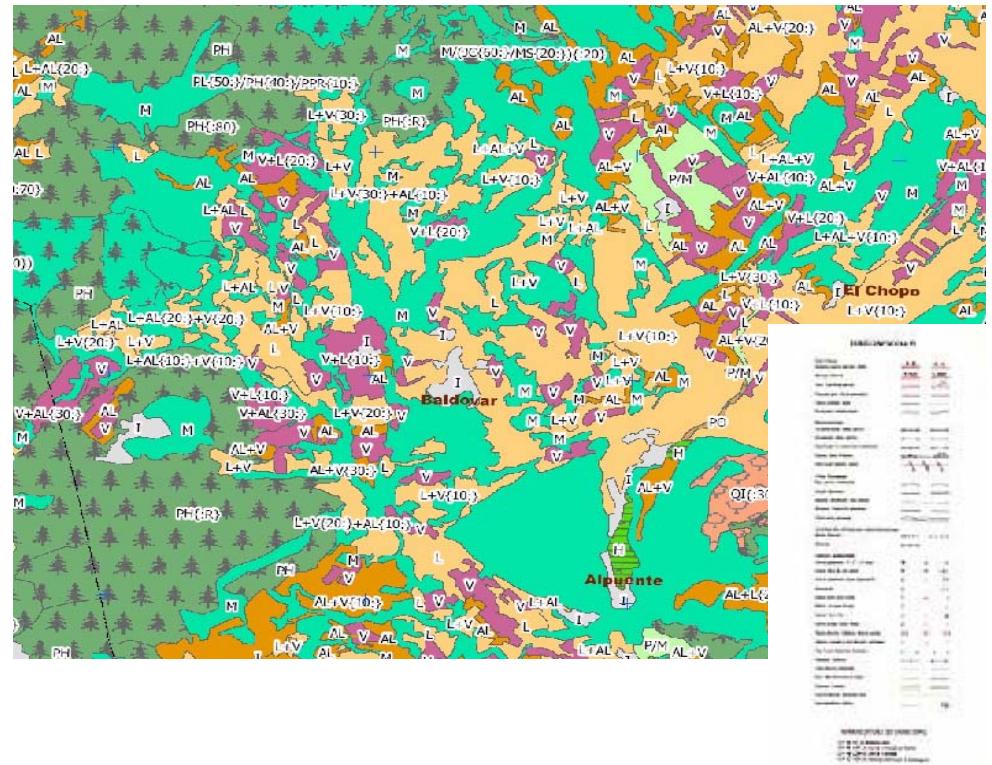
- INSPIRE is going to develop a CDM to integrate the different GI themes (in Annexes 1 to 3)**

## ❖ “Backward” compatibility

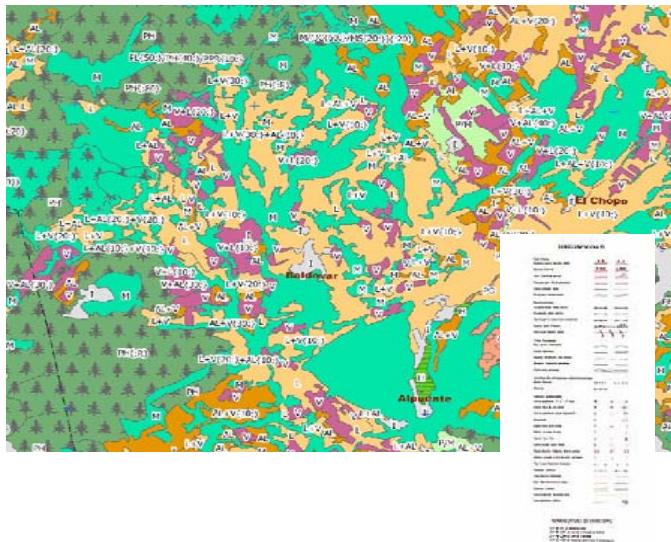
- From an Object Oriented LU / LC Database, **standard classifications** can be **derived** by making appropriate **SQL queries** to the database



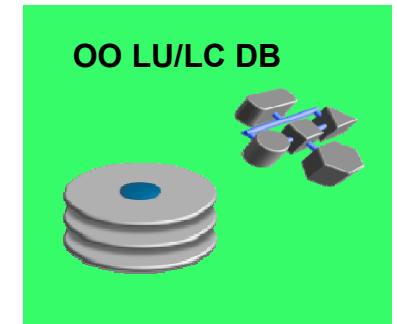
SQL Queries



- ❖ “Forward” compatibility:  
Migration Path for **existing data**
- The information in **existing LU/LC classifications** datasets can be input in an adequately designed OO-LU/LC database:



Data processing



## ❖ Migration Path:

### A) Automatic data processing:

- The **polygon lines** of an existing Classification Database **are valid** for the new Object Oriented database
- % of LCE and attribute values:

**Option 1:** store min and max of class interval:

*attribute\_max*  
*attribute\_min*

**Option 2:**

*mean of interval = attribute value*

## Migration Path:

### ❖ B) Manually adding extra information (optional):

- Homogeneous polygons:
  - “Land Covers” are **valid**
  - You only need to **add**:
    - LC Elements %
    - attribute values for LC and LCE
- Non-Homogeneous polygons:
  - Dominant “Land Covers” are **valid**
  - You only need to **add**:
    - Additional Land Covers present in the polygon
    - LC Elements %
    - attribute values for LC and LCE

So then...

- Cost for producing an Object Oriented LU/LC database is estimated compared to traditional Classification Databases:  
only 15 – 20 % more
- Great increase in usefulness and reusability of information
- Migration path for existing classification databases possible
- Object Oriented approach make less critical to improve MMU, because statistics will be correct even with coarse MMU

Production and Verification / Validation of the database is easier:

Photointerpreters do not need to keep in mind all the time complex definitions and “interpretation rules” of the Nomenclature.



**Generalisation:**

How to map vines associated with fruit trees within a single parcel?

- In this case, the dominance of each permanent crop should be considered. In general, priority will be given to vineyard if dominances are approximately the same. Otherwise the dominating permanent crop will be represented.

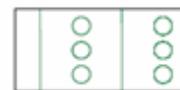


fruit trees



vines

vine cover = 50 %



221

vine cover < 50 %



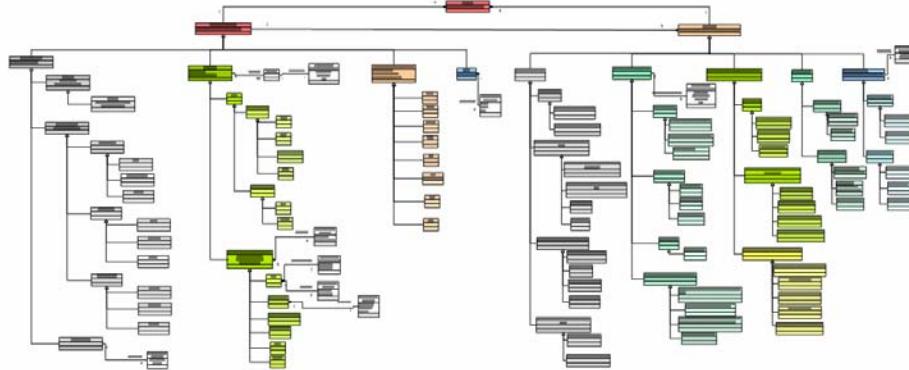
222

vine cover > 50 %



221

- In case of vines associated to olive trees within a single parcel, priority will be given to class 221.



- ❑ LU/LC, as any other G.I. theme **can and should be modeled in UML** using an ISO 19109 “Application Schema” (Feature Data Model)
- ❑ LCCS (FAO’s Land Cover Classification System) is not an acceptable solution
- ❑ The ideas and problems presented here are applicable to the development of many **other Inspire Themes Data Models**



- Spain is proposing international institutions with responsibility in LU/LC information (EEA, Inspire, GMES, ISO, FAO...) to adopt a similar philosophy for future LU/LC databases and offers its collaboration for building a standard LC Feature Data Model.
  
- In the last EIONET meeting in Copenhagen (23-24 April 2009) there was consensus between member States to create a Working Group for exploring the Object Oriented Land Cover Data Modeling approach for future Corine Land Cover.



**SIOSE**  
**Sistema de Información de**  
**Ocupación del Suelo de España**  
**(Land Cover/Land Use Information System**  
**of Spain)**

Nuria Valcarcel  
Guillermo Villa  
Instituto Geográfico Nacional  
España

- Multiples iniciativas en cobertura /uso de suelo a nivel:
  - Global (GlobCover/ESA, JRC, FAO..)
  - Europeo (Corine, GMES, LUCAS, European LC Data Centre..)
  - Nacional y regional
- La ocupación de suelo tiene aplicación en un amplio rango de dominios ( G. forestal, agrícola, biodiversidad, planeamiento territorial, gestión hídrica, etc).

# ❖Comparación nomenclaturas

IPCC categories	IGBP	GlobCorine
Forest land	1 Evergreen Needleleaf Forests 2 Evergreen Broadleaf Forests 3 Deciduous Needleleaf Forests 4 Deciduous Broadleaf Forests 5 Mixed Forests 6 Woody Savannas <b>14 Cropland / Natural Vegetation Mosaic (3)</b> <b>15 Savannas (2)</b>	<b>2.3 Permanent crops and associations (3)</b> <b>3.2 Mosaic farmland (3)</b> 4.1 Standing forest <b>4.2 Transitional woodland and shrub (2)</b> 7.1 Forested wetlands
Cropland	<b>'Bosque':</b> <b>IGBP: FCC &gt;60%; altura &gt; 2m</b> <b>GlobCORINE: FCC &gt; 30%</b>	2.1 Non-irrigated arable land 2.2 Irrigated or post-flooded agriculture <b>2.3 Permanent crops and associations (3)</b> <b>3.2 Mosaic farmland (3)</b>
Settlements	13 Urban and Built-up	1 Artificial areas

DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 14 March 2007

establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

## Información capturada una vez, compartida por muchos

The infrastructures for spatial information in the Member States should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level; that it is possible to combine spatial data from different sources across the Community in a consistent way and share them between several users and applications; that it is possible for spatial data collected at one level of public authority to be shared between other public authorities; that spatial data are made available under conditions which do not unduly restrict their extensive use; that it is easy to discover available spatial data, to evaluate their suitability for the purpose and to know the conditions applicable to their use.



## DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 14 March 2007

establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

### INTEROPERABILITY OF SPATIAL DATA SETS AND SERVICES

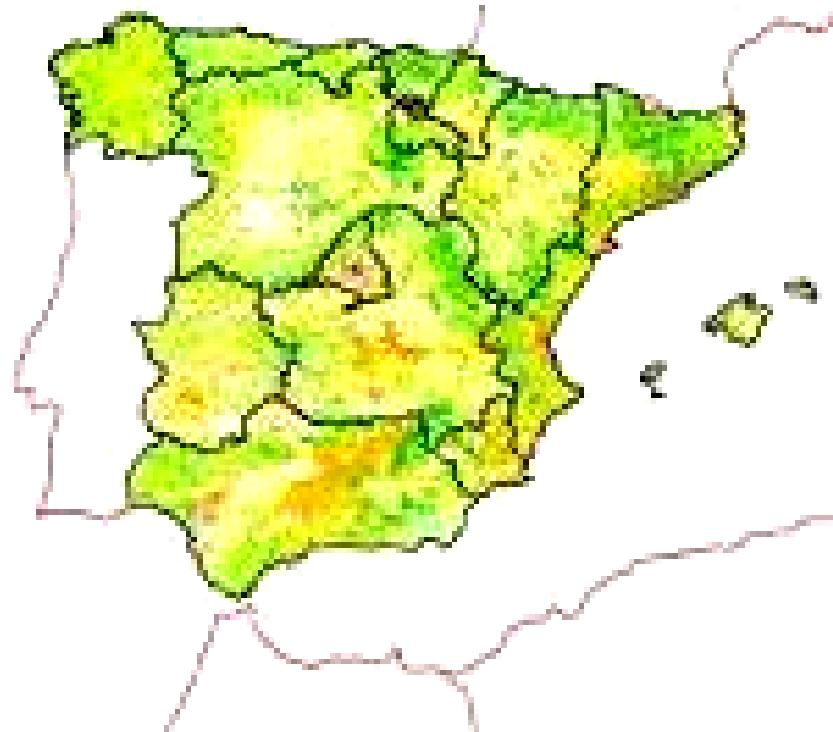
Article 7

## Armonización e interoperabilidad de las LC/LU DBs existentes en España

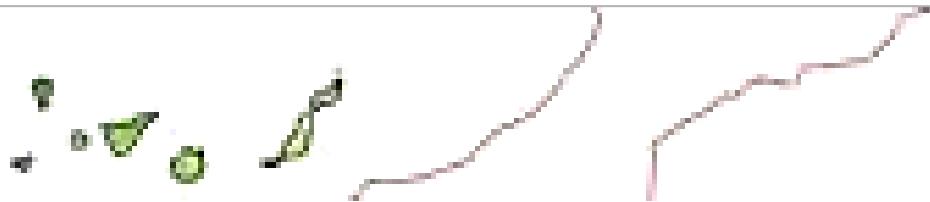


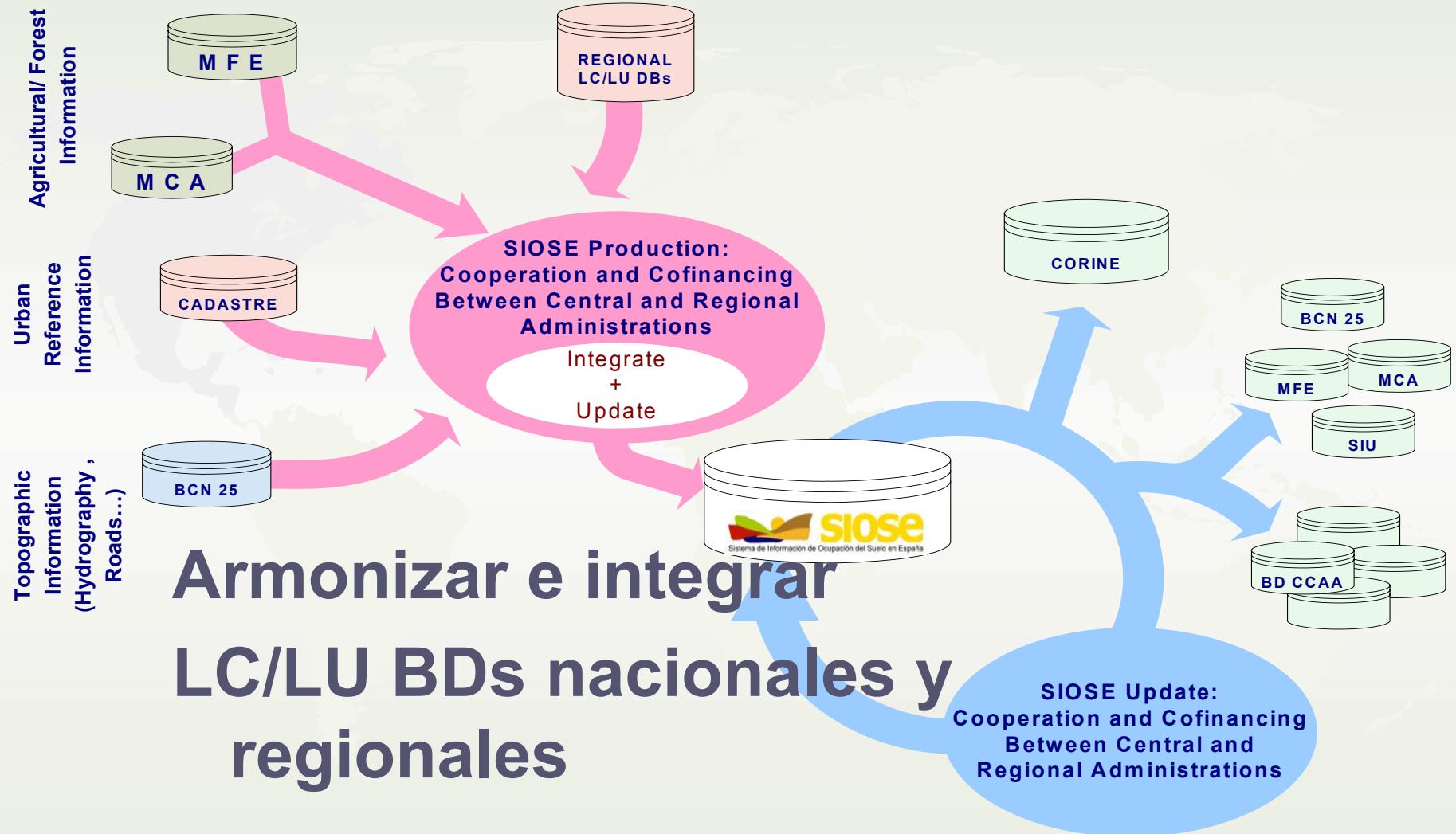
1. Implementing rules laying down technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and services, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 22(3). Relevant user requirements, existing initiatives and international standards for the harmonisation of spatial data sets, as well as feasibility and cost-benefit considerations shall be taken into account in the development of the implementing rules. Where organisations established under international law have adopted relevant standards to ensure interoperability or harmonisation of spatial data sets and services, these standards shall be integrated, and the existing technical means shall be referred to, if appropriate, in the implementing rules mentioned in this paragraph.

## Mejorar CLC2000: necesidad de información más detallada de LC/LU

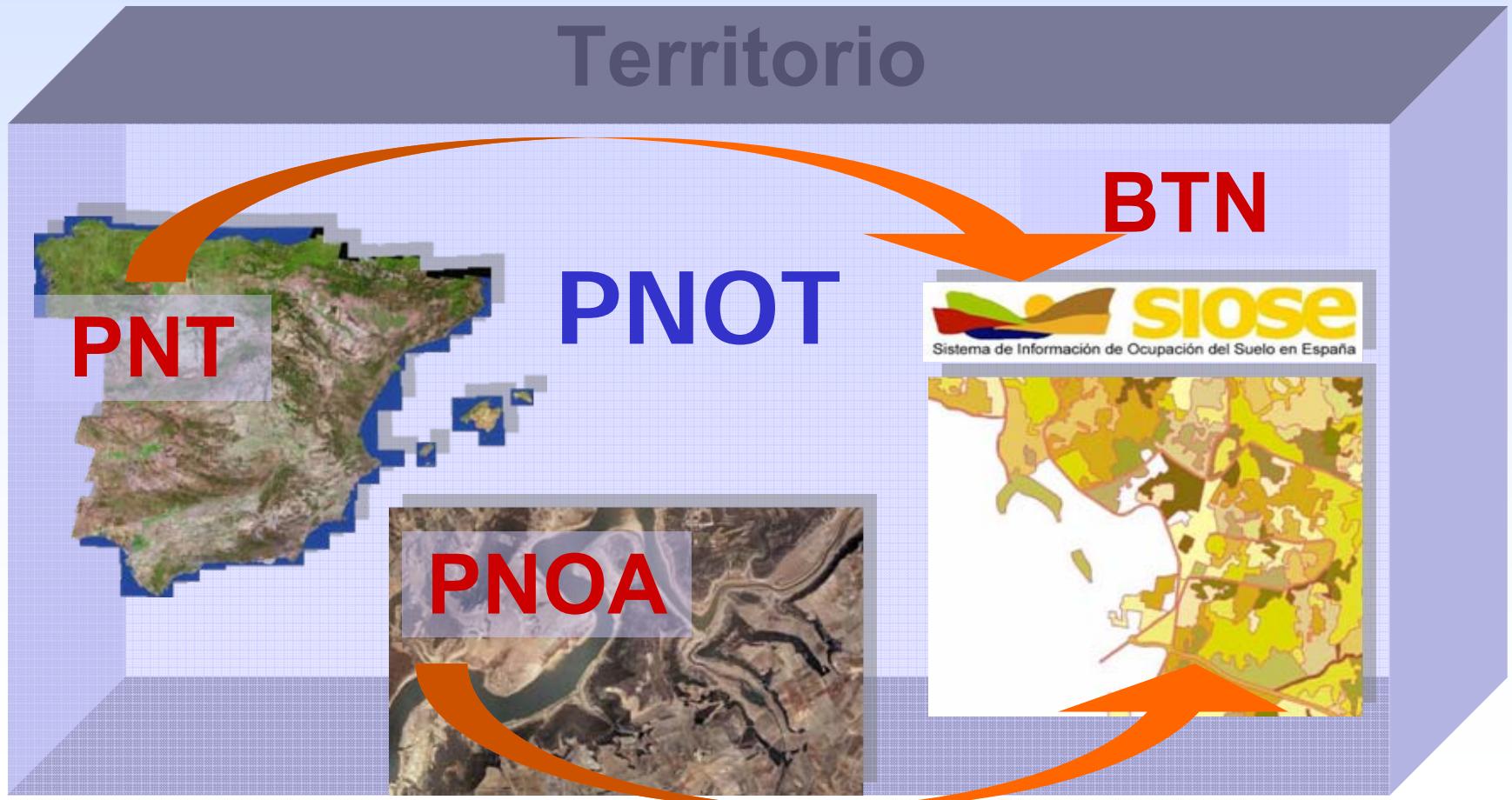


- Algunas instituciones nacionales y regionales producían land use/cover GIS de más detalle que CLC2000 :
  - geométrica → mayor escala
  - Semantica → parámetros temáticos (propósito)

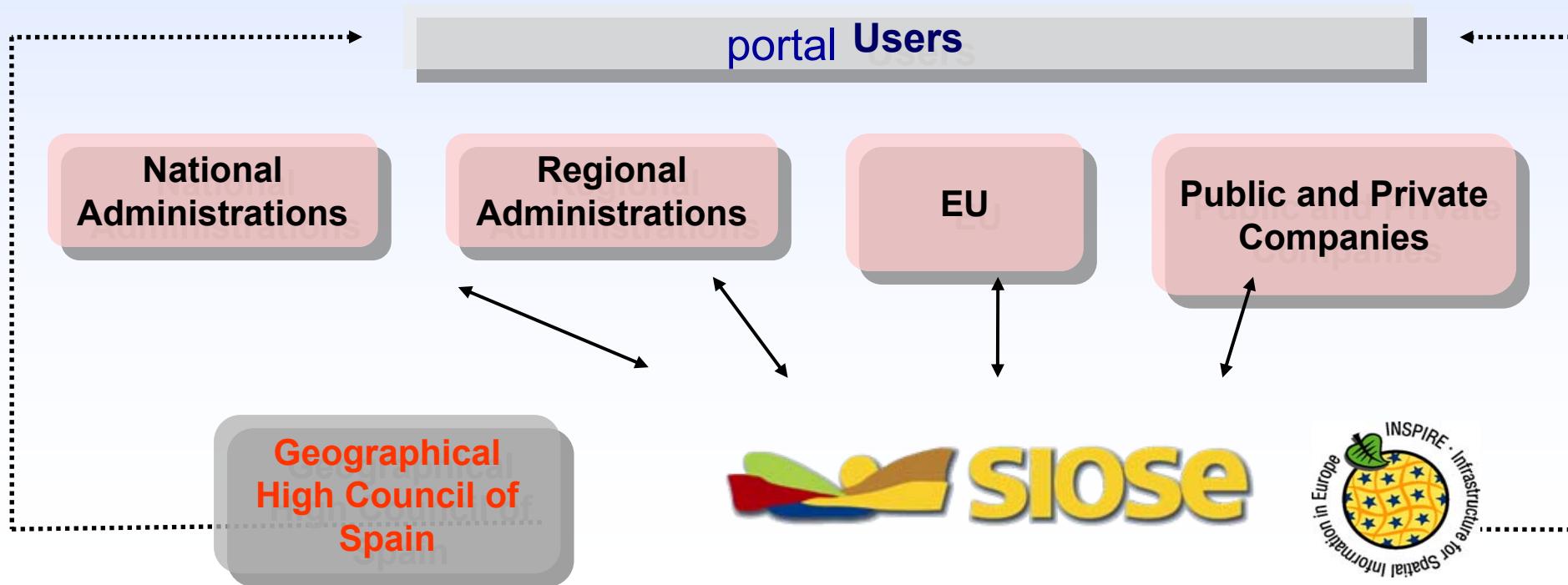




# Producción coordinada en el Plan Nacional de Observación del Territorio

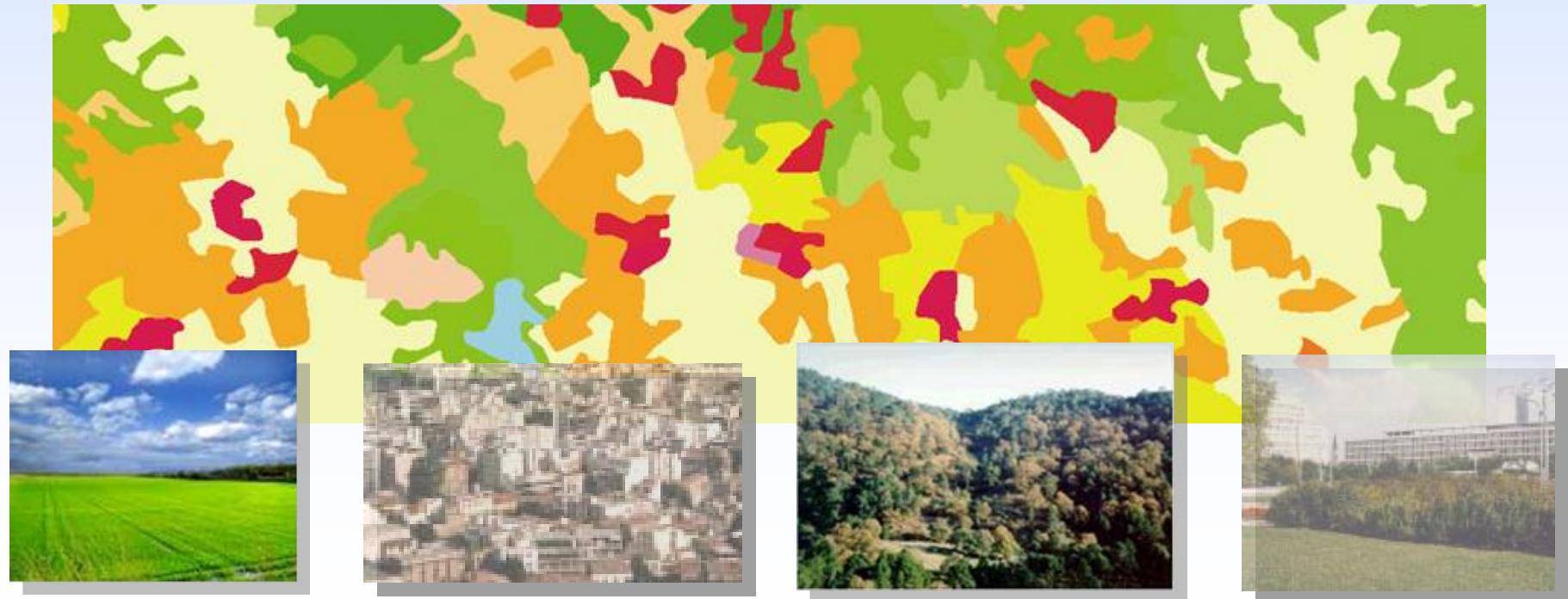


- ❖ **Producción descentralizada (inc. presupuesto) (19 Adm. Regionales + Adm. Central)**
- ❖ **Modelo de producción eficiente:** Actualización **2 años.**
- ❖ **Modelo de datos alcanzado por consenso**



## Base de datos de Ocupación de Suelo de España 1:25.000.

❖BD LC/LU Nacional: **homogénea, multi-parametro, multi-propósito, multi-escala**, basada en **requerimientos comunes de nuestros usuarios**



# Modelo de datos conceptual, normalizado e interoperable de la ocupación del suelo

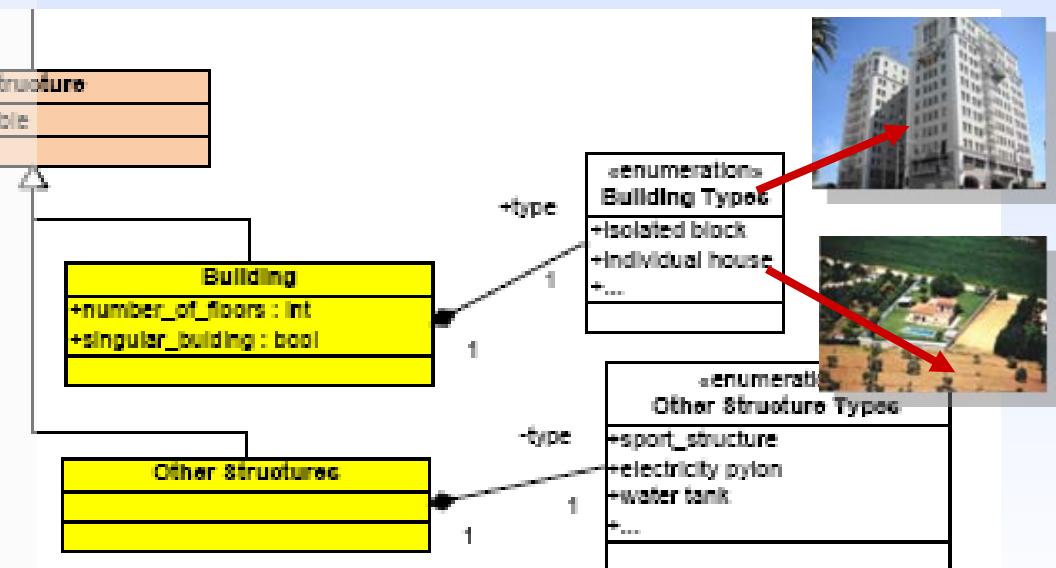
**Multi-criterio:** distingue cobertura v uso del suelo

**Multi-parametro:** varios atributos para un único polígono

**Orientado a objetos:** MD entidad relación usando UML

**Facilmente extensible en el futuro**

**Elaborado en consenso**



ISO TC211 + OGC

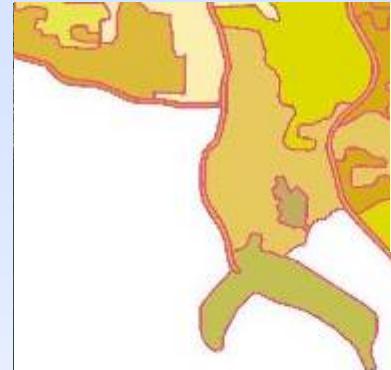
## Coordinado con los Planes Nacionales de Teledetección y Ortofotografía Aérea





- Unidad mínima cartografiable variable, *según las clases.*
  - ✓ - *Tejido urbano y Agua:* 1 ha.
  - ✓ - *Zonas agrícolas:* 2 ha.
  - ✓ - *Zonas forestales y naturales:* 2 ha.
  - ✓ - *Humedales, playas, invernaderos, Vegetación de ribera:* 0,5 ha.

## Proceso de Obtención



Edificaciones: 50%  
Zonas Verdes Artificiales: 15%  
Láminas de Agua Artificiales: 5%  
Viales: 15%  
Otras construcciones: 5%  
Suelo no Edificado: 0%



Cultivos leñosos (frutales): 2 %  
Cultivos herbáceos (distinto de arroz): 70%  
Cultivos herbáceos (arroz): 20%  
Láminas de agua: 8%



# ❖Qué tenemos (2009)?

## Productos adicionales:

- ❖ Proyectos de investigación y desarrollo asociados
- ❖ WMS services & portal Web
- ❖ Herramientas SW
- ❖ Base de datos de campo

Web portal: [www.siose.es](http://www.siose.es).

Digital photograph album of LC/LU + SIOSErama



## Inspire SDIC LC/LU: Productores, expertos y usuarios

Call for SDICs and LMOs - Microsoft Internet Explorer proporcionado por M.Fomento proxy\_pac

Archivo Edición Ver Favoritos Herramientas Ayuda

Búsqueda Favoritos Búsquedas

Dirección [http://inspire.jrc.ec.europa.eu/sdic\\_call/sdclmоГoDetails.cfm](http://inspire.jrc.ec.europa.eu/sdic_call/sdclmоГoDetails.cfm) Ir Vínculos

**Spatial Data Interest Community Description**

Description	
<b>SDIC Title</b> <sup>1</sup>	National Assembly of the Land Cover and Use Information System of Spain (SIOSE)
<b>Acronym</b> <sup>2</sup>	SIOSE National Assembly
<b>Mission and Objectives</b> <sup>3</sup>	IGN Spain (EIONET's National Reference Center for Soil) is coordinating SIOSE Project (Spanish Land Use and Land Cover Information System) at 1:25.000 nominal scale. This project is being developed by more than 25 institutions and interest groups. Decisions will be taken by a steering committee, organization aspects will be managed by a secretariat, and representatives of the Spanish Ministry of Environment will be part of the community of producers. Membership as a producer is open to any organization willing to take part in the initiative.
<b>Mandate</b> <sup>4</sup>	Discuss issues to the Spanish Land Cover and Use Information System of Spain - Land use modeling, reference systems, etc.



INSPIRE site  
Your Details

All Registered SDIC/LMOs



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# Explotación de datos de Siose



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Proyecto SIOSE en la Región de Murcia - Microsoft Internet Explorer

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Búsqueda Favoritos Autocompletar

Dirección http://localhost/siose/consulta\_siose.php Buscar Marcadores Buscar Corrector ortográfico Traducir Autocompletar Acceder

Google

Región de Murcia SIOSE Sistema de Información de Ocupación del Suelo en España GOBIERNO DE ESPAÑA MINISTERIO DE FOMENTO DIRECCIÓN GENERAL DEL INSTITUTO GEOGRÁFICO NACIONAL CENTRO NACIONAL DE DOCUMENTACIÓN GEOGRÁFICA

## Consultar base de datos

Base de datos a consultar: G:\MapasSigt\Siose\bd\siose.mdb

Seleccionar coberturas:

- CULTIVOS.CULTIVOS LEÑOSOS.FRUTALES CÍTRICOS
- CULTIVOS.CULTIVOS LEÑOSOS.FRUTALES NO CÍTRICOS
- CULTIVOS.CULTIVOS LEÑOSOS.OLIVAR
- CULTIVOS.CULTIVOS LEÑOSOS.OTROS
- CULTIVOS.CULTIVOS LEÑOSOS.VINEDO
- CULTIVOS.PRADOS
- MATORRAL
- PASTIZAL
- TERRENOS SIN VEGETACIÓN
- TERRENOS SIN VEGETACIÓN.GLACIARES Y NIEVES PERMANENTES
- TERRENOS SIN VEGETACIÓN.PLAYAS, DUNAS Y ARENALES
- TERRENOS SIN VEGETACIÓN.RAMBLAS
- TERRENOS SIN VEGETACIÓN.ROQUEDO
- TERRENOS SIN VEGETACIÓN.ROQUEDO.ACANTILADOS MARINOS
- TERRENOS SIN VEGETACIÓN.ROQUEDO.AFLORAMIENTOS ROCOSOS Y ROQUEDO
- TERRENOS SIN VEGETACIÓN.ROQUEDO.CANCHALES
- TERRENOS SIN VEGETACIÓN.ROQUEDO.COLADAS LÁVICAS CUATERNARIAS
- TERRENOS SIN VEGETACIÓN.SUELLO DESNUDO
- TERRENOS SIN VEGETACIÓN.ZONAS QUEMADAS

**Coberturas compuestas**

- ASOCIACION
- ASOCIAACION ARTIFICIAL COMPUESTO
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL ADMINISTRATIVO INSTITUCIONAL
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL CAMPO DE GOLF
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL CEMENTERIO
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL CULTURAL
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL DEPORTIVO
- ASOCIAACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL EDUCACIÓN

Filtro (Opcional):

- SECANO
- REGADIO
- REGADIO.REGADO
- REGADIO.NO REGADO
- FUNCIÓN DE CORTAFUEGOS
- NO FUNCIÓN DE CORTAFUEGOS
- CORTAS
- NO CORTAS
- FORMACIÓN DE RIBERA
- SIN FORMACIÓN DE RIBERA
- PLANTACIÓN
- NO PLANTACIÓN
- PROCEDA DE CULTIVO
- NO PROCEDA DE CULTIVO
- FORZADO
- NO FORZADO
- ABANCALADO
- NO ABANCALADO
- EDIFICIO ENTRE MEDIANERAS
- EDIFICIO AISLADO
- VIVIENDA UNIFAMILIAR AISLADA
- VIVIENDA UNIFAMILIAR ADOSADA
- NAVE
- ROTURADO NO AGRÍCOLA
- NO ROTURADO NO AGRÍCOLA
- ZONAS EROSIONADAS
- ZONAS NO EROSIONADAS
- VIVIENDA UNIFAMILIAR
- EN CONSTRUCCIÓN

Realizar Consulta Borrar selección

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Listo Intranet local

# Explotación de datos de Siose



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Atrás Último Búsqueda Favoritos Imprimir Vínculos

Dirección http://localhost/siose/consulta\_bc\_siose.php

Google Buscar Autocompletar Acelerar

Región de Murcia SIOSE Sistema de Información de Ocupación del Suelo en España GOBIERNO DE ESPAÑA MINISTERIO DE FOMENTO DIRECCIÓN GENERAL DEL INSTITUTO GEOGRÁFICO NACIONAL INSTITUTO DE INVESTIGACIONES GEODÓMICAS

Informe obtenido de la base de datos: G:\MapasSigyt\Siose\bd\siose.mdb

COBERTURA	SUPERFICIE (HECTAREAS)	%SUPERFICIE
CULTIVOS.CULTIVOS LEÑOSOS.FRUTALES.CÍTRICOS	13.597,05	5,14
CULTIVOS.CULTIVOS LEÑOSOS.OLIVAR	1.020,98	0,69
CULTIVOS.CULTIVOS LEÑOSOS.MIÑEDO	997,94	0,13
<b>TOTAL COBERTURAS SIMPLES</b>	<b>15.756,77</b>	<b>5,95</b>
ASOCIACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL.ADMINISTRATIVO INSTITUCIONAL	179,37	0,07
ASOCIACION ARTIFICIAL COMPUESTO EQUIPAMIENTO / DOTACIONAL.CEMENTERIO	99,10	0,01
<b>TOTAL COBERTURAS COMPUSTAS</b>	<b>212,47</b>	<b>0,08</b>
<b>TOTAL COBERTURAS SELECCIONADAS</b>	<b>15.969,24</b>	<b>6,03</b>
<b>TOTAL DE LA BASE DE DATOS</b>	<b>264.640,16</b>	<b>100,00</b>

Generar fichero para capa

Atrás

Último Intranet local

# Explotación de datos de Siose

Proyecto SIOSE en la Región de Murcia - Microsoft Internet Explorer

Archivo Edición Ver Favoritos Herramientas Ayuda

Atrás Último Buscador Favoritos Marcadores Buscar Corrector ortográfico Traducir Autocompletar Ir Vínculos

Dirección http://localhost/siose/consulta\_bd\_siose.php

Google Buscar Marcadores Buscar Corrector ortográfico Traducir Autocompletar Ir Vínculos Acceder

Región de Murcia SIOSE Sistema de Información de Ocupación del Suelo en España GOBIERNO DE ESPAÑA MINISTERIO DE FOMENTO DIRECCIÓN GENERAL DEL INSTITUTO GEOGRÁFICO NACIONAL INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

Informe obtenido de la base de datos: G:\MapasSigt\Siose\bd\siose.mdb

COBERTURA	SUPERFICIE (HECTAREAS)	%SUPERFICIE
CULTIVOS.CULTIVOS LEÑOSOS.FRUTALES.CÍTRICOS	13.597,85	5,14
CULTIVOS.CULTIVOS LEÑOSOS.OLIVAR	1.820,98	0,69
CULTIVOS.CULTIVOS LEÑOSOS.VIÑEDO	337,94	0,13
<b>TOTAL COBERTURAS SIMPLES</b>	<b>15.756,77</b>	<b>5,95</b>
ASOCIACION.ARTIFICIAL COMPUESTO.EQUIPAMIENTO / DOTACIONAL.ADMINISTRATIVO INSTITUCIONAL	179,37	0,07
ASOCIACION.ARTIFICIAL COMPUESTO.EQUIPAMIENTO / DOTACIONAL.CEMENTERIO	33,10	0,01
<b>TOTAL COBERTURAS COMPUSTAS</b>	<b>212,47</b>	<b>0,08</b>
<b>TOTAL COBERTURAS SELECCIONADAS</b>	<b>15.969,24</b>	<b>6,03</b>
<b>TOTAL DE LA BASE DE DATOS</b>	<b>264.648,16</b>	<b>100,00</b>

Generar fichero para capa

Atrás

Descarga de archivo

¿Desea abrir o guardar este archivo?

Nombre: Capa\_consulta\_siose.xls  
Tipo: Hoja de cálculo de Microsoft Excel  
De: localhost

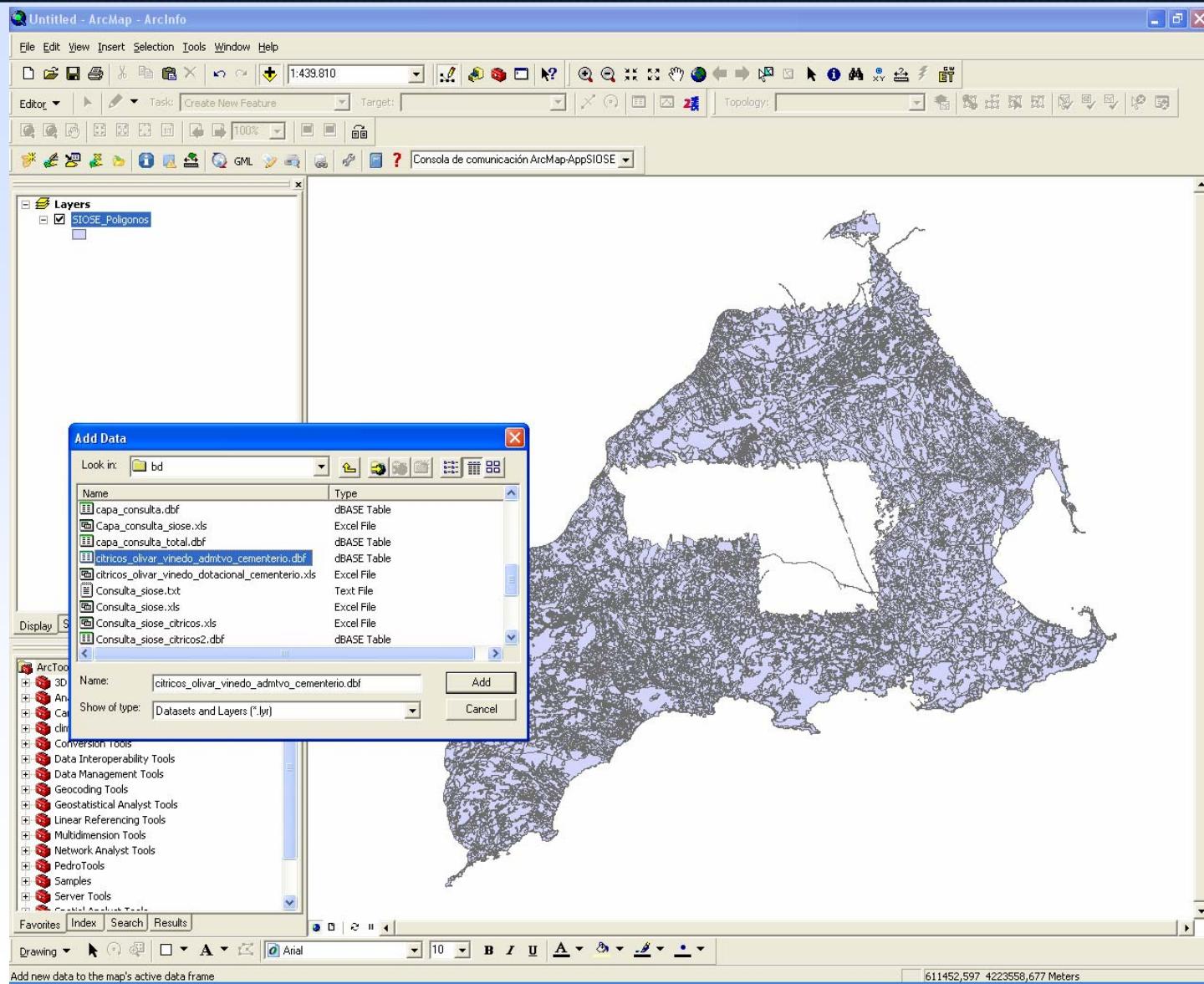
Abrir Guardar Cancelar

Los archivos procedentes de Internet pueden ser útiles, pero algunos archivos pueden dañar potencialmente su equipo. Si no confía en el origen, no abra ni guarde este archivo. ¿Cuáles son los riesgos?

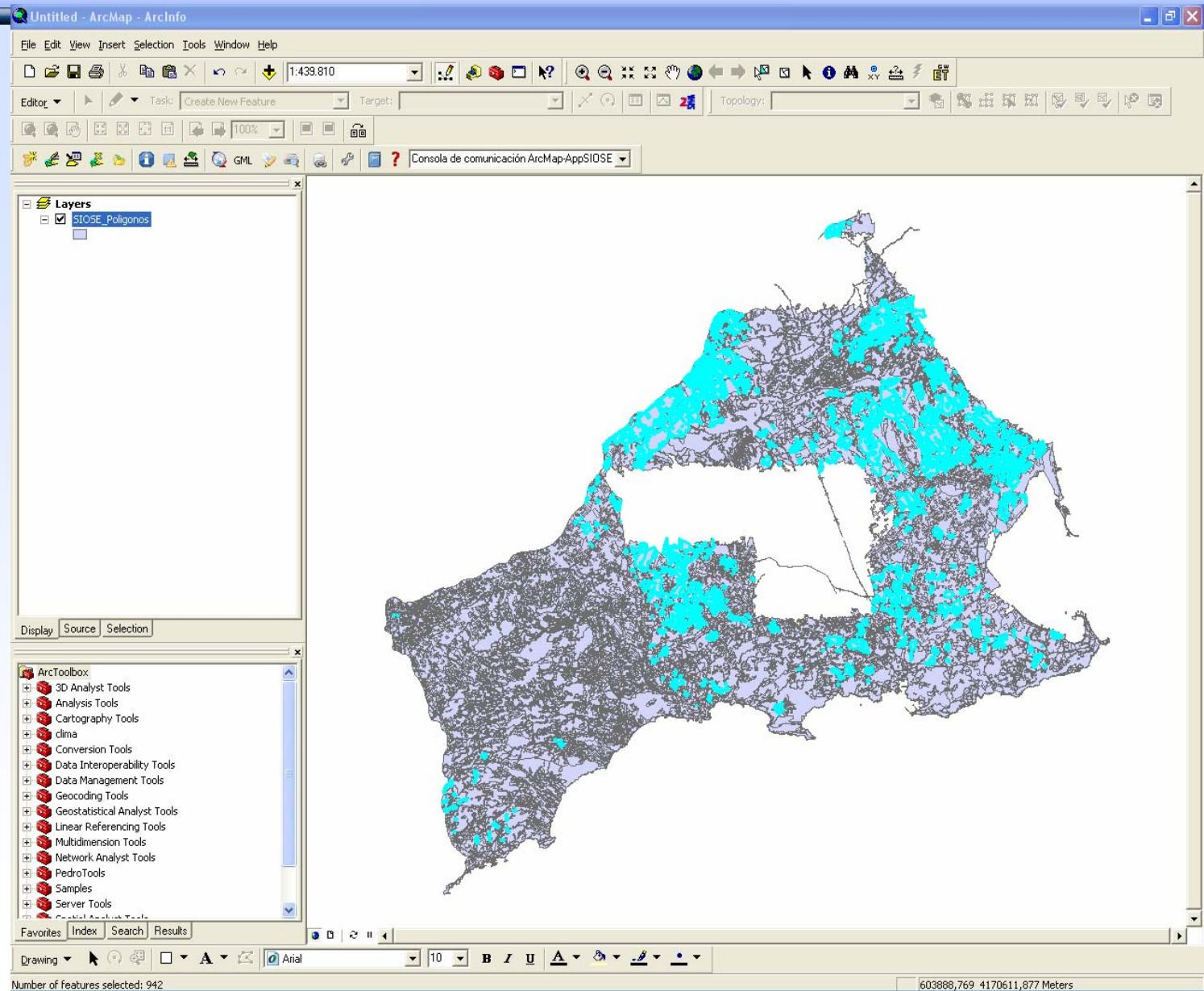
Iniciando descarga desde el sitio: http://localhost/siose/genera\_capa.php

Intranet local

# Explotación de datos de Siose



# Explotación de datos de Siose



# ❖SIOSE multipurpose use: Corine Land Cover Thematic Map

Corine Land Cover Object Oriented Application

Principal map

Auxiliary map Table of content CORINE

CLC

- 112
- 0
- 142
- 131
- 123
- 121
- 141
- 133
- 231
- 241
- 331
- 111
- 122
- 332
- 321
- 243
- 132
- 134
- 324
- 322
- 421
- 311
- 512
- 242
- 211

Auxiliary map 264.567,25 4.831.195,5 Map scale 1:35.170 © IGN 2009



# ❖SIOSE multipurpose use: Corine Land Cover Thematic Map

Corine Land Cover Object Oriented Application

Principal map      Auxiliary map      Table of content      CORINE

Principal map 262.121,20 4.826.293,1 Map scale 1:35.170

© IGN 2009

**Corine Land Cover Object Oriented Application**

Principal map



Auxiliary map KYOTO

- KYOTO
  - KYOTO\_FC
    - Forest <= 20%
    - Forest > 20%
- UN\_FCC
  - UN\_FCC
    - Forest <= 10%
    - Forest > 10%
- CLC\_FCC
  - CLC\_FCC
    - Forest 1 - 9%
    - Forest 10 - 19%
    - Forest 20 - 49%
    - Forest 50 - 69%
    - Forest > 70%
- SOIL\_SEALING
  - SOIL\_SEA
    - Build-up 1 - 29%
    - Build-up 30 - 59%
    - Build-up 60 - 79%
    - Build-up 80 - 99%
    - Build-up 100%
- CORINE
- CLC\_OO
- Sianpar2\_ETB\_S89\_ecw

Auxiliary map 262.187,01 4.830.988,4 Map scale 1:35.170 © IGN 2009

# ❖SIOSE multipurpose use: Soil Sealing Thematic View

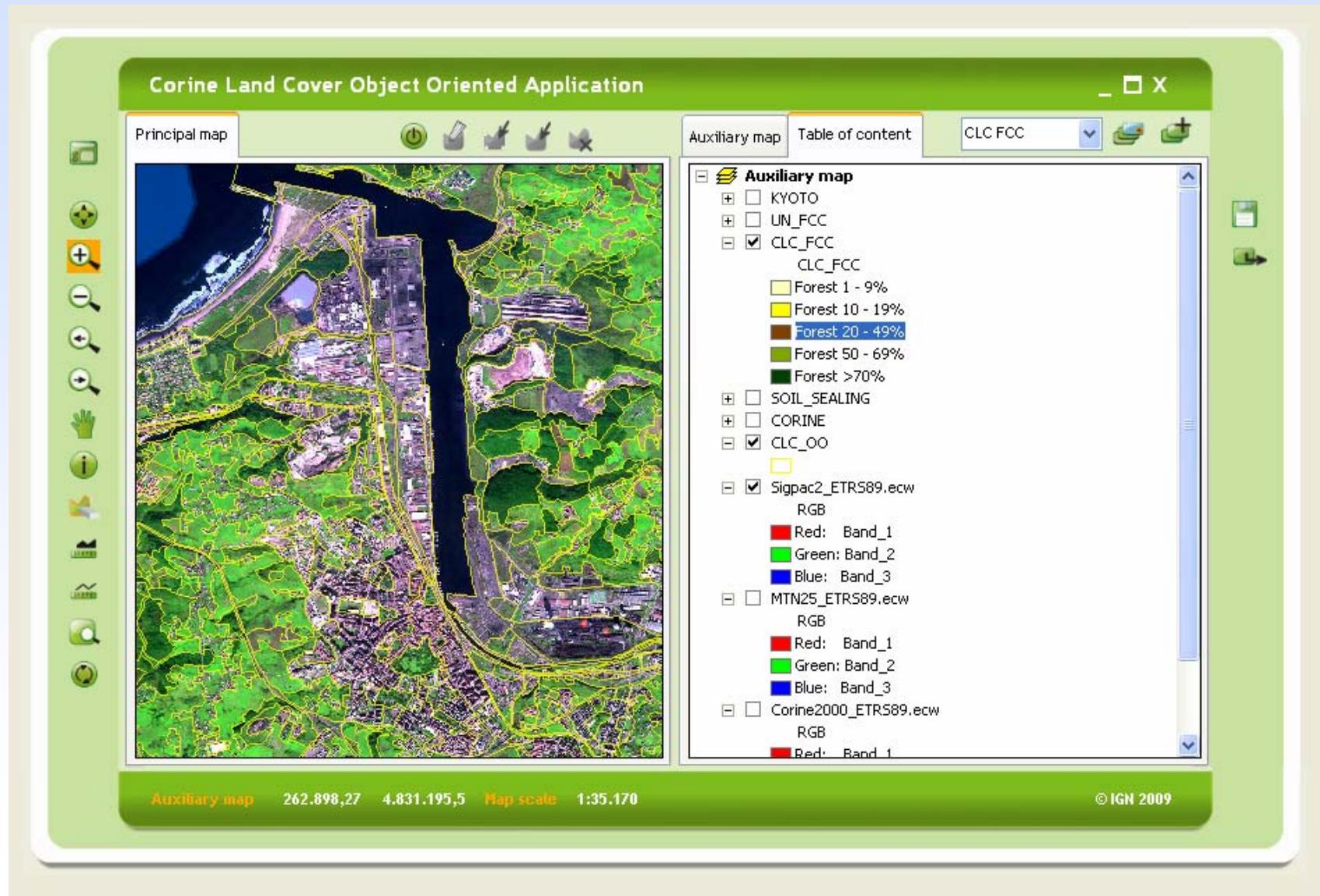
Corine Land Cover Object Oriented Application

Principal map

Auxiliary map Table of content SOIL SEALING

Auxiliary map 264.801,73 4.831.195,5 Map scale 1:35.170 © IGN 2009

# ❖SIOSE multipurpose use: % Tree Coverage View



# ❖SIOSE multipurpose use: % Tree Coverage View



INSTITUTO  
GEGRÁFICO  
NACIONAL



Corine Land Cover Object Oriented Application

Principal map      Auxiliary map      Table of content      CLC FCC

Principal map      264.308,30      4.825.481,1      Map scale      1:35.170      © IGN 2009

# ❖SIOSE multipurpose use: UNFCCC Tree Coverage View

Corine Land Cover Object Oriented Application

Principal map



Auxiliary map Table of content UN FCC

Auxiliary map

- KYOTO
- UN\_FCC
  - UN\_FCC
    - Forest <= 10%
    - Forest > 10%
  - CLC\_FCC
  - SOIL\_SEALING
  - CORINE
  - CLC\_OO
    - Sigpac2\_ETRS89.ecw
    - MTN25\_ETRS89.ecw
    - Corine2000\_ETRS89.ecw

Principal map 265.683,43 4.829.161,2 Map scale 1:35.170 © IGN 2009

# ❖SIOSE multipurpose use: UNFCCC Tree Coverage View

Corine Land Cover Object Oriented Application

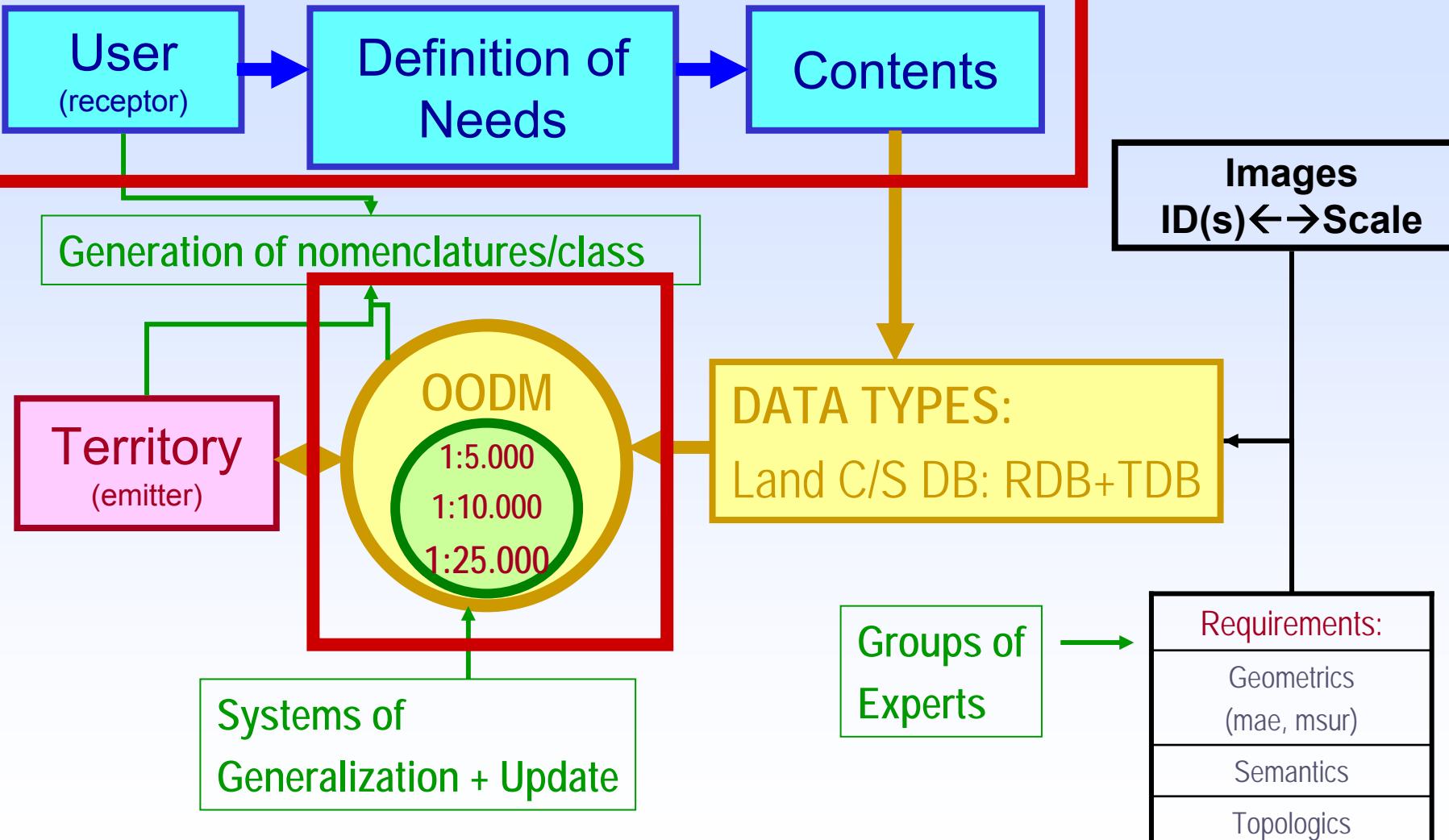
Principal map      Auxiliary map      Table of content      UN FCC



Auxiliary map      264.401,73    4.825.816,1    Map scale    1:35.170      © IGN 2009

❖ How? →

# Object Oriented Conceptual DM





Thank you for your kind attention