# EUROPEAN FORUM FOR GEOSTATISTICS 2012

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*„If you cannot describe it, you cannot manage it"*

CZECH STATISTICAL OFFICE

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CAGI

# Urban Morphological Zones for Spain:

## *Urban indicators from and Object Oriented Land Cover data base and a population grid*

(in progress…)

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# Definition

- **Urban Morphological Zones** (**UMZ**): *"A set of urban areas laying less than 200m apart*".
- Those urban areas are defined from land cover classes contributing to urban tissue and function.
- They have been created by the EEA for Europe from CORINE Land Cover (CLC) classes for 1990, 2000 and 2006:

http://www.eea.europa.eu/data-and-maps/data/urban-morphological-zones-2006-umz2006-f3v0

# Objective

- **Create UMZ** from high resolution land cover information (no reference to LAU2 boundaries).
- Use the **EEA methodology**, conveniently adapted to the structure of our data.
- **Assign to each UMZ population** figures from a population grid.
- Eventually, explore the possibility of developing **urban indicators** from the land cover dataset.

# Information

1. **High resolution and complex land cover dataset**: Information System on Land Cover in Spain (SIOSE). An object oriented database developed by our *National Geographical Institute* (IGN).
2. **A 1 $Km^2$ population grid:** constructed by top-down methods from SIOSE and census track population data for 2006 (presented at the EFGS 2012 Lisbon meeting).

# SIOSE *versus* CLC

- **Cartographic scale**:
  1:25.000 SIOSE *versus* 1:100.000 CLC
- **Minimum Mapping Unit**:
  1ha. Urban zones, SIOSE *versus* 25ha. CLC
- **Minimum width lineal elements:**
  15 m. SIOSE *versus* 100 m. CLC
- **Data Model**:
  Object oriented, SIOSE *versus* hierarchical (44 classes) CLC

# SIOSE *versus* CLC

- **Spatial resolution**:

| | |
|---|---|
| CLC2006 | 155.801 polygons |
| SIOSE2005 | 2.477.593 polygons |

- **Average polygon size**:

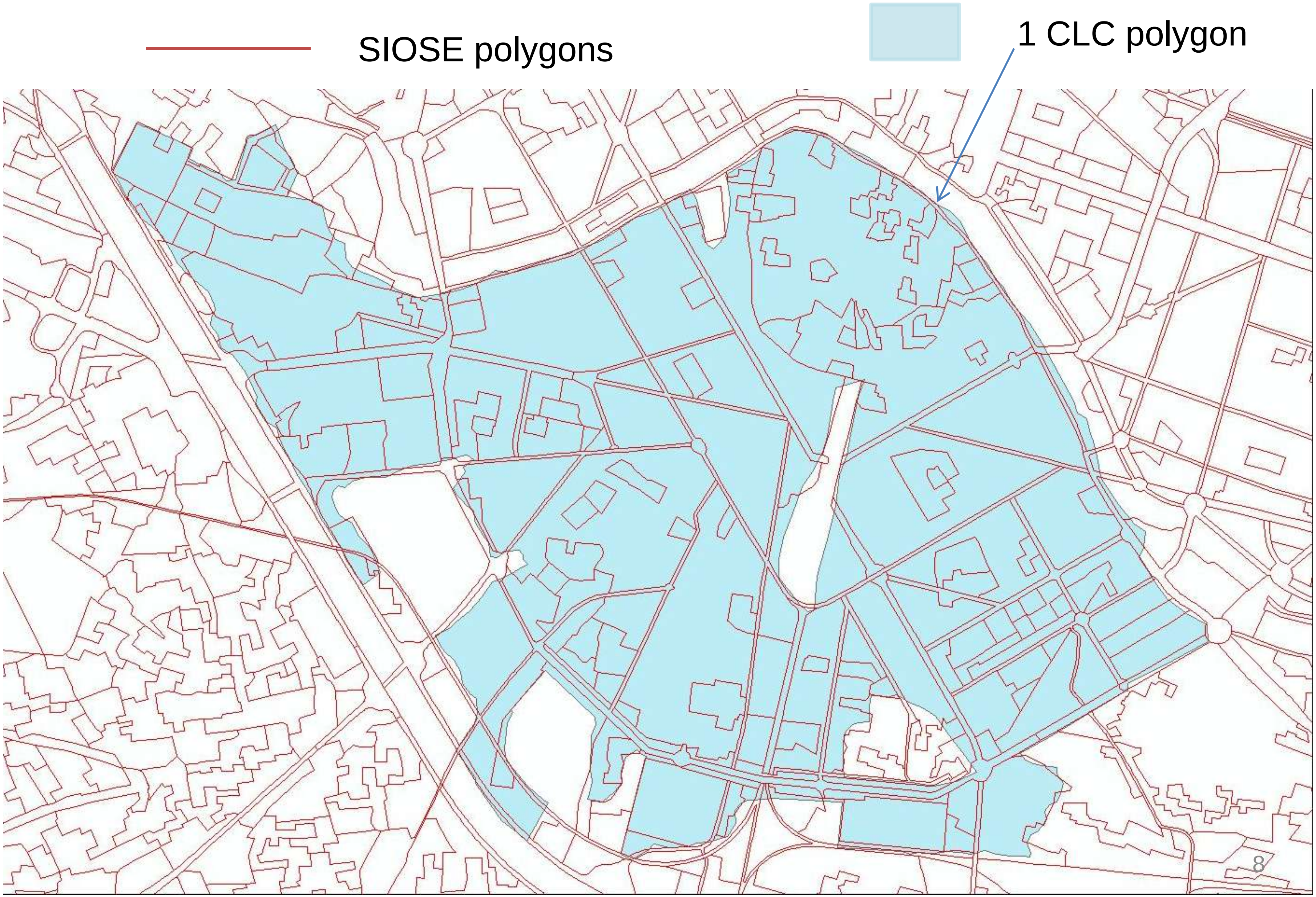
| | |
|---|---|
| CLC2006 | 3,24 $Km^2$ |
| SIOSE2005 | 0,20 $Km^2$ |

- **Thematic resolution**:

CLC2006: 44 covers (= 44 classes)

SIOSE2005: 820.632 covers (different combination of classes)

# SIOSE *versus* CLC



# CLC: Data Model

- In CLC only one cover is assigned to each polygon:

**Table 3.1 -CORINE land cover nomenclature**

| Level 1 | Level 2 | Level 3 |
|---|---|---|
| 1. Artificial surfaces | 1.1. Urban fabric | 1.1.1. Continuous urban fabric |
| | | 1.1.2. Discontinuous urban fabric |
| | 1.2. Industrial, commercial and transport units | 1.2.1. Industrial or commercial units |
| | | 1.2.2. Road and rail networks and associated land |
| | | 1.2.3. Port areas |
| | | 1.2.4. Airports |
| | 1.3. Mine, dump and construction sites | 1.3.1. Mineral extraction sites |
| | | 1.3.2. Dump sites |
| | | 1.3.3. Construction sites |
| | 1.4. Artificial non-agricultural vegetated areas | 1.4.1. Green urban areas |
| | | 1.4.2. Sport and leisures facilities |
| 2. Agricultural areas | 2.1. Arable land | 2.1.1. Non-irrigated arable land |
| | | 2.1.2. Permanently irrigated land |
| | | 2.1.3. Rice fields |
| | 2.2. Permanent crops | 2.2.1. Vineyards |
| | | 2.2.2. Fruit trees and berry plantations |
| | | 2.2.3. Olive groves |
| | 2.3. Pastures | 2.3.1. Pastures |
| | 2.4. Heterogeneous agricultural areas | 2.4.1. Annual crops associated with permanent crops |
| | | 2.4.2. Complex cultivation patterns |
| | | 2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation |
| | | 2.4.4. Agro-forestry areas |
| 3. Forests and semi-natural areas | 3.1. Forests | 3.1.1. Broad-leaved forest |
| | | 3.1.2. Coniferous forest |
| | | 3.1.3. Mixed forest |
| | 3.2. Shrub and/or herbaceous vegetation associations | 3.2.1. Natural grassland |
| | | 3.2.2. Moors and heathland |
| | | 3.2.3. Sclerophyllous vegetation |
| | | 3.2.4. Transitional woodland shrub |
| | 3.3. Open spaces with little or no vegetation | 3.3.1. Beaches, dunes and sand plains |
| | | 3.3.2. Bare rock |
| | | 3.3.3. Sparsely vegetated areas |
| | | 3.3.4. Burnt areas |
| | | 3.3.5. Glaciers and perpetual snow |
| 4. Wetlands | 4.1. Inland wetlands | 4.1.1. Inland marshes |
| | | 4.1.2. Peatbogs |
| | 4.2. Coastal wetlands | 4.2.1. Salt marshes |
| | | 4.2.2. Salines |
| | | 4.2.3. Intertidal flats |
| 5. Water bodies | 5.1. Inland waters | 5.1.1. Water courses |
| | | 5.1.2. Water bodies |
| | 5.2. Marine waters | 5.2.1. Coastal lagoons |
| | | 5.2.2. Estuaries |
| | | 5.2.3. Sea and oceans |

# SIOSE: Data Model

- In SIOSE a polygon is characterized by many classes, with different spatial structures:

| NOMBRE | ETIQUETA | ID |
|---|---|---|
| COBERTURA ARTIFICIAL | | 100 |
| Edificación | EDF | 101 |
| Zona verde artificial y arbolado urbano | ZAU | 102 |
| Lamina de agua artificial | LAA | 103 |
| Vial, aparcamiento o zona peatonal sin vegetación | VAP | 104 |
| Otras construcciones | OCT | 111 |
| Suelo no edificado | SNE | 121 |
| Zonas de extracción o vertido | ZEV | 131 |
| CULTIVOS | | 200 |
| Cultivos Herbáceos | | 210 |
| Arroz | CHA | 211 |
| Cultivos Herbáceos distintos de Arroz | CHL | 212 |
| Cultivos Leñosos | | 220 |
| Frutales | | 221 |
| Frutales Cítricos | LFC | 222 |
| Frutales no Cítricos | LFN | 223 |
| Viñedo | LVI | 231 |
| Olivar | LOL | 232 |
| Otros cultivos leñosos | LOC | 241 |
| Prados | PRD | 290 |
| PASTIZAL | PST | 300 |
| ARBOLADO FORESTAL | | 310 |
| Frondosas | | 311 |
| Frondosas Caducifolias | FDC | 312 |
| Frondosas Perennifolias | FDP | 313 |
| Coníferas | CNF | 316 |
| MATORRAL | MTR | 320 |
| TERRENOS SIN VEGETACIÓN | | 330 |
| Playas, dunas y arenales | PDA | 331 |
| Suelo desnudo | SDN | 333 |
| Zonas quemadas | ZQM | 334 |
| Glaciares y nieves permanentes | GNP | 335 |
| Ramblas | RMB | 336 |
| Roquedo | | 350 |
| Acantilados marinos | ACM | 351 |
| Afloramientos rocosos y roquedos | ARR | 352 |
| Canchales | CCH | 353 |
| Coladas lavicas cuaternarias | CLC | 354 |

# SIOSE *versus* CLC

- SIOSE does not classify a given **polygon** within a fixed hierarchical nomenclature, but it allows to assign **one or more covers** to the same polygon, using shares of occupation, that eventually add to 100%.
- The **aim** is **not to classify each polygon**, but **to describe each polygon as accurate as possible**.
- In addition, (simple) covers have **attributes**, providing additional information on the spatial distribution of covers, or signaling its potential use.
- Much more complex information than the usual thematic maps, but it is also much more versatile and adaptable to the researcher needs.

# SIOSE: Simple covers

- The data model begins with a basic list of 40 **simple covers**

| CODIGO | NOMBRE | ETIQUETA | Km$^2$ | % |
|---|---|---|---|---|
| **100** | **COBERTURA ARTIFICIAL** | | **18,702** | **3.70%** |
| 101 | Edificación | EDF | 5,651 | 1.12% |
| 102 | Zona verde artificial y arbolado urbano | ZAU | 1,633 | 0.32% |
| 103 | Lamina de agua artificial | LAA | 731 | 0.14% |
| 104 | Vial, aparcamiento o zona peatonal sin vegetación | VAP | 4,626 | 0.91% |
| 111 | Otras construcciones | OCT | 817 | 0.16% |
| 121 | Suelo no edificado | SNE | 3,921 | 0.77% |
| 131 | Zonas de extracción o vertido | ZEV | 1,323 | 0.26% |
| **200** | **CULTIVOS** | | **190,622** | **37.67%** |
| 210 | Cultivos Herbáceos | | *133,998* | *26.48%* |
| 211 | Arroz | CHA | 1,338 | 0.26% |
| 212 | Cultivos Herbáceos distintos de Arroz | CHL | 132,660 | 26.22% |
| 220 | Cultivos Leñosos | | *49,720* | *9.83%* |
| 221 | Frutales | | *13,458* | *2.66%* |
| 222 | Frutales Cítricos | LFC | 3,404 | 0.67% |
| 223 | Frutales no Cítricos | LFN | 10,054 | 1.99% |
| 231 | Viñedo | LVI | 10,771 | 2.13% |
| 232 | Olivar | LOL | 24,330 | 4.81% |
| 241 | Otros cultivos leñosos | LOC | 1,161 | 0.23% |
| 290 | Prados | PRD | 6,904 | 1.36% |
| **300** | **PASTIZAL** | **PST** | **89,716** | **17.73%** |
| **310** | **ARBOLADO FORESTAL** | | **91,779** | **18.14%** |
| 311 | Frondosas | | *50,872* | *10.05%* |
| 312 | Frondosas Caducifolias | FDC | 23,012 | 4.55% |
| 313 | Frondosas Perennifolias | FDP | 27,860 | 5.51% |
| 316 | Coníferas | CNF | 40,907 | 8.08% |
| **320** | **MATORRAL** | **MTR** | **85,455** | **16.89%** |
| **330** | **TERRENOS SIN VEGETACIÓN** | | **25,302** | **5.00%** |
| 331 | Playas, dunas y arenales | PDA | 354 | 0.07% |
| 333 | Suelo desnudo | SDN | 15,764 | 3.12% |
| 334 | Zonas quemadas | ZQM | 873 | 0.17% |
| 335 | Glaciares y nieves permanentes | GNP | 5 | 0.00% |
| 336 | Ramblas | RMB | 378 | 0.07% |
| 350 | Roquedo | | *7,928* | *1.57%* |
| 351 | Acantilados marinos | ACM | 162 | 0.03% |
| 352 | Afloramientos rocosos y roquedos | ARR | 6,706 | 1.33% |
| 353 | Canchales | CCH | 698 | 0.14% |
| 354 | Coladas lavicas cuaternarias | CLC | 362 | 0.07% |
| **400** | **COBERTURAS HÚMEDAS** | | **994** | **0.20%** |
| 410 | Humedales continentales | | *110* | *0.02%* |
| 411 | Zonas pantanosas | HPA | 74 | 0.01% |
| 412 | Turberas | HTU | 25 | 0.00% |
| 413 | Salinas continentales | HSA | 11 | 0.00% |
| 420 | Humedales marinos | | *884* | *0.17%* |
| 421 | Marismas | HMA | 740 | 0.15% |
| 422 | Salinas marinas | HSM | 144 | 0.03% |
| **500** | **COBERTURA DE AGUA** | | **3,470** | **0.69%** |
| 510 | Aguas continentales | | *3,312* | *0.65%* |
| 511 | Cursos de agua | ACU | 874 | 0.17% |
| 512 | Láminas de agua | | *2,438* | *0.48%* |
| 513 | Lagos y lagunas | ALG | 217 | 0.04% |
| 514 | Embalses | AEM | 2,221 | 0.44% |
| 520 | Aguas marinas | | *158* | *0.03%* |
| 521 | Lagunas costeras | ALC | 85 | 0.02% |
| 522 | Estuarios | AES | 73 | 0.01% |
| 523 | Mares y océanos | AMO | 0 | 0.00% |
| | **Superficie Total de España** | | **506,040** | **100.00%** |

# SIOSE: Composite covers

- **Simple covers are aggregated into composite covers** to describe fully the composition and structure of a polygon.
- Each simple cover is assigned its share of the surface of the polygon.
- Complex covers can be nested.
- A set of **consistency rules** are build into the database.

# SIOSE: Composite covers

| CODIGO | NOMBRE | ETIQUETA | Km$^2$ | % |
|---|---|---|---|---|
| 701 | **DEHESA** | DHS | 24,373 | 58.97% |
| 702 | **OLIVAR VIÑEDO** | OVD | 247 | 0.60% |
| 703 | **ASENTAMIENTO AGRÍCOLA RESIDENCIAL** | AAR | 1,765 | 4.27% |
| 704 | **HUERTA FAMILIAR** | UER | 393 | 0.95% |
| 800 | **ARTIFICIAL COMPUESTO** | | 14,556 | 35.22% |
| 810 | Urbano mixto | | *6,323* | *15.30%* |
| 811 | Casco | UCS | 1,629 | 3.94% |
| 812 | Ensanche | UEN | 2,643 | 6.39% |
| 813 | Discontinuo | UDS | 2,051 | 4.96% |
| 820 | Industrial | | *1,799* | *4.35%* |
| 821 | Polígono industrial ordenado | IPO | 949 | 2.30% |
| 822 | Polígono industrial sin ordenar | IPS | 330 | 0.80% |
| 823 | Industria aislada | IAS | 520 | 1.26% |
| 830 | Primario | | *1,617* | *3.91%* |
| 831 | Agrícola/Ganadero | PAG | 727 | 1.76% |
| 832 | Forestal | PFT | 22 | 0.05% |
| 833 | Minero extractivo | PMX | 859 | 2.08% |
| 834 | Piscifactoría | PPS | 9 | 0.02% |
| 840 | Terciario | | *266* | *0.64%* |
| 841 | Comercial y oficinas | TCO | 144 | 0.35% |
| 842 | Complejo hotelero | TCH | 51 | 0.12% |
| 843 | Parque recreativo | TPR | 27 | 0.07% |
| 844 | Camping | TCG | 44 | 0.11% |
| 850 | Equipamiento/Dotacional | | *1,238* | *3.00%* |
| 851 | Administrativo institucional | EAI | 128 | 0.31% |
| 852 | Sanitario | ESN | 43 | 0.10% |
| 853 | Cementerio | ECM | 54 | 0.13% |
| 854 | Educación | EDU | 174 | 0.42% |
| 855 | Penitenciario | EPN | 11 | 0.03% |
| 856 | Religioso | ERG | 37 | 0.09% |
| 857 | Cultural | ECL | 47 | 0.11% |
| 858 | Deportivo | EDP | 280 | 0.68% |
| 859 | Campo de golf | ECG | 230 | 0.56% |
| 860 | Parque urbano | EPU | 234 | 0.57% |
| 870 | Infraestructuras | | 3,313 | 8.02% |
| 880 | Transporte | | *2,815* | *6.81%* |
| 881 | Red viaria | NRV | 2,256 | 5.46% |
| 882 | Red ferroviaria | NRF | 337 | 0.82% |
| 883 | Portuario | NPO | 68 | 0.16% |
| 884 | Aeroportuario | NAP | 154 | 0.37% |
| 890 | Energía | | *137* | *0.33%* |
| 891 | Eólica | NEO | 69 | 0.17% |
| 892 | Solar | NSL | 7 | 0.02% |
| 893 | Nuclear | NCL | 8 | 0.02% |
| 894 | Eléctrica | NEL | 21 | 0.05% |
| 895 | Térmica | NTM | 18 | 0.04% |
| 896 | Hidroeléctrica | NHD | 7 | 0.02% |
| 897 | Gaseoducto/Oleoducto | NGO | 7 | 0.02% |
| 900 | Telecomunicaciones | NTC | 5 | 0.01% |
| 910 | Suministro de agua | | *280* | *0.68%* |
| 911 | Depuradoras y potabilizadoras | NDP | 35 | 0.08% |
| 913 | Desalinizadoras | NDS | 242 | 0.59% |
| 912 | Conducciones y canales | NCC | 3 | 0.01% |
| 920 | Residuos | | *76* | *0.18%* |
| 921 | Vertederos y escombreras | NVE | 63 | 0.15% |
| 922 | Plantas de tratamiento | NPT | 13 | 0.03% |
| | **Superficie Total** | | 41,334 | 100.00% |

- Some composite covers are predefined, and have a particular structure.
- This is not an exhaustive list and can be adapted to particular needs.

# SIOSE: Attributes

- In addition, covers can be assigned an attribute, that provides additional information on the particular cover.

| CODIGO | Tipo | NOMBRE | ETIQUETA |
|---|---|---|---|
| 10 | **Distribucion Espacial** | | |
| 11 | | ASOCIACION | A |
| 12 | | MOSAICO REGULAR | M |
| 13 | | MOSAICO REGULAR | I |
| 20 | **Tipo Edificacion** | | |
| 21 | | EDIFICIO AISLADO | ea |
| 22 | | EDIFICIO ENTRE MEDIANERAS | em |
| 23 | | VIVIENDA UNIFAMILIAR. AISLADA | va |
| 24 | | VIVIENDA UNIFAMILIAR. ADOSADA | vd |
| 25 | | NAVE | nv |
| 28 | **En Construccion** | EN CONSTRUCCIÓN | ec |
| 30 | **Irrigacion** | | |
| 31 | | SECANO | sc |
| 32 | | REGADÍO REGADO | rr |
| 33 | | REGADÍO NO REGADO | rn |
| 35 | **Abancalado** | ABANCALADO | ab |
| 36 | **Es Forzado** | FORZADO | fz |
| 40 | **Plantacion** | PLANTACIÓN | pl |
| 41 | **Formación de Ribera** | FORMACIÓN DE RIBERA | fr |
| 44 | **Función de Cortafuegos** | FUNCIÓN DE CORTAFUEGOS | fc |
| 45 | **Cortas** | CORTAS | ct |
| 46 | **Procedencia de Cultivo** | PROCEDENCIA DE CULTIVOS | pc |
| 47 | **Alta Montaña** | ALTA MONTAÑA | am |
| 48 | **Es Roturado no Agricola** | ROTURADO NO AGRÍCOLA | ra |
| 49 | **Es Zona Erosionada** | ZONAS EROSIONADAS | ze |
| 50 | **Es Cuaternaria** | CUATERNARIAS | cu |

# SIOSE: Polygon labels

- Each polygon has a code label.

1. Polygon with a simple cover:

   100FDCfr = **FDCfr**

2. Polygon with a composite cover:

   **R(50LFNfzrr_40CNFpl_10SDNfc)**

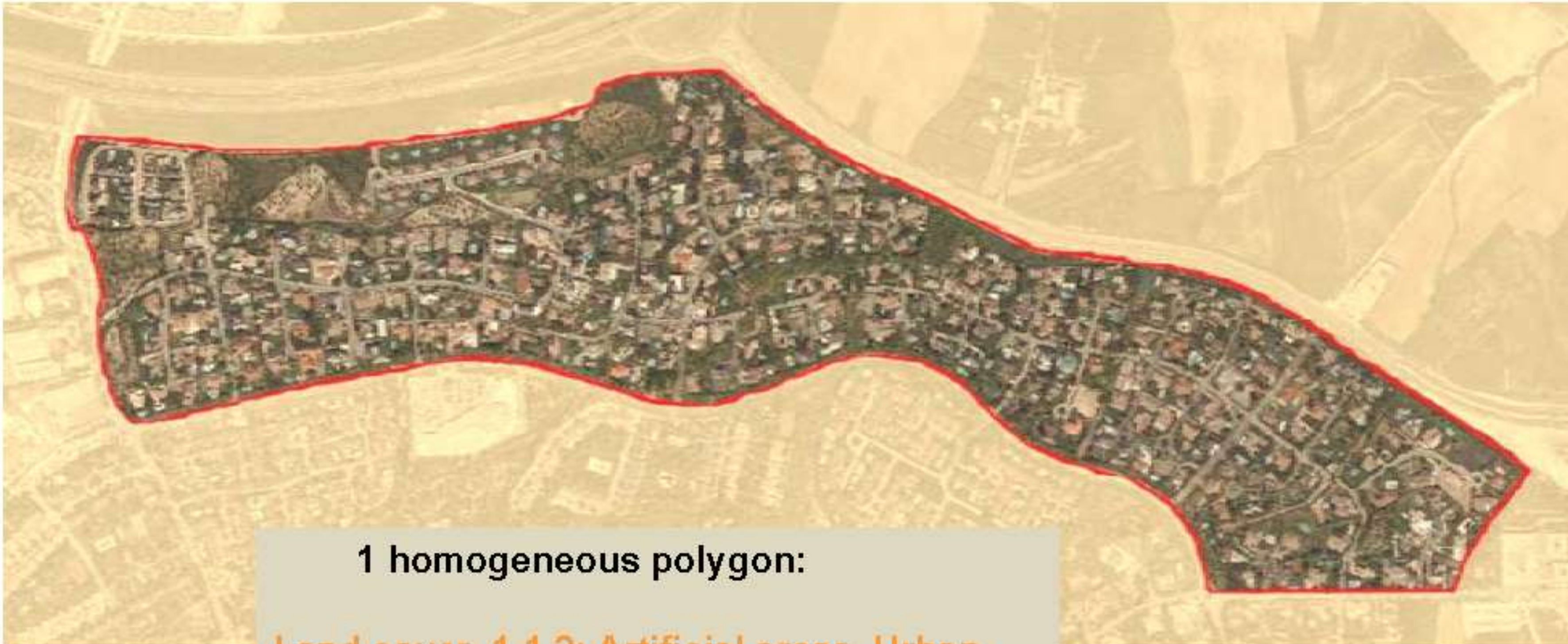
3. Polygon with a composite predefined cover:

   **UER(30LFCfzsc_25EDFva_20CHLfzrr_20FDPpl_5LAA)**

4. Polygon with a nested composite cover:

   **R(80A(70MTRfr_30ZQM)_20OVD(90LVIfzsc_10LOLfzsc))**

# ❖ Example 1: Artificial area



**1 homogeneous polygon:**

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

(100 % of polygon's surface)

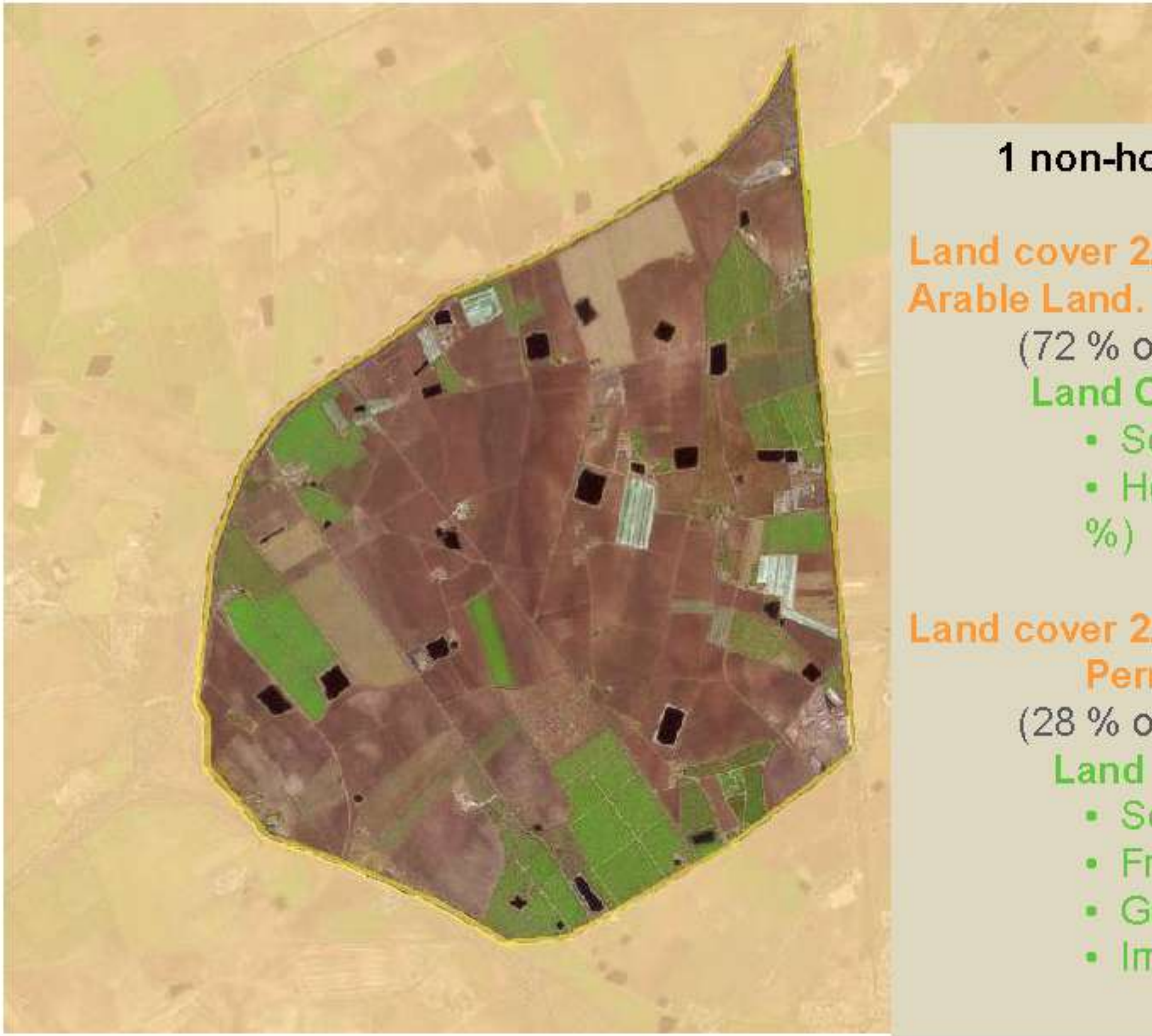
**Land Cover Elements in it:**

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



Source: Guillermo Villa. IGN. EIONET OODMWG Meeting. Madrid 10-11 December 2009

# ❖ Example 2: Agricultural area



**1 non-homogeneous polygon:**

**Land cover 2.1.1: Agricultural Areas. Arable Land. Non-irrigated arable land**
(72 % of polygon's surface)
**Land Cover Elements in it:**
- Soil (60 %)
- Herbaceous Vegetation (crop) (40 %)

**Land cover 2.2.2: Agricultural Areas. Permanent crops. Fruit trees**
(28 % of polygon's surface)
**Land Cover Elements in it:**
- Soil (12 %)
- Fruit Trees (80 %)
- Greenhouses (2 %)
- Irrigation reservoirs (6 %)



Source: Guillermo Villa. IGN. EIONET OODMWG Meeting. Madrid 10-11 December 2009

# ❖ Example 3: Natural area

**1 non-homogeneous polygon:**

**Land cover 3.1.1: Forest and seminatural Areas. Forest. Broad-leaved forest**

(55 % of polygon's surface)

**Land Cover Elements in it**:

- Soil (10 %)
- Trees (deciduous) (90 %)

**Land cover 3.1.2: Forest and seminatural Areas. Forest. Coniferous forest**

(45 % of polygon's surface)

**Land Cover Elements in it**:

- Soil (5 %)
- Trees (coniferous) (95 %)



Source: Guillermo Villa. IGN. EIONET OODMWG Meeting. Madrid 10-11 December 2009

# A nomenclature for SIOSE

- The power of SIOSE is also its weakness.
- For creating UMZ we need rules to determine the land cover classes to be considered as “urban areas”, so they can be included in the UMZ.
- **Step 1**: Create a nomenclature (hierarchical model) from SIOSE. Similar to CLC, but much more detailed: *SIOSE´s Hierarchical Model* (SHM).
- We devised **an automatic algorithm that classifies each SIOSE polygon into a given set of classes**, and **all polygons are classified**.

# SHM classes
## (*level 3*)

- At level 4 SHM has 83 classes and at level 3 (comparable with CLC) it has 49 classes.

**1. SUPERFICIES ARTIFICIALES**
- 1.1. *Zonas urbanas*
  - 1.1.1. Tejido urbano continuo: casco
  - 1.1.2. Tejido urbano discontinuo.
- 1.2. *Zonas de actividad.*
  - 1.2.1. Actividad primaria.
  - 1.2.2. Actividad industrial: polígonos, industrias aisladas
  - 1.2.3. Servicios: comercial, oficinas, complejos hoteleros
  - 1.2.4. Equipamiento diverso/Dotacional
  - 1.2.5 Equipamiento deportivo/recreativo/cultural
- 1.3. *Infraestructuras*
  - 1.3.1. Transporte
  - 1.3.2. Energía
  - 1.3.3. Telecomunicaciones
  - 1.3.4. Suministro de agua
  - 1.3.5. Residuos, vertederos y escombreras
- 1.4. *En construcción*
  - 1.4.1 Zonas urbanas
  - 1.4.2. Estructuras de tipo público o industrial
  - 1.4.3. Infraestructuras en construcción

**2. ZONAS AGRÍCOLAS**
- 2.1. *Tierras de labor*
  - 2.1.1. Tierras de labor en secano
  - 2.1.2. Terrenos regados permanentemente
  - 2.1.3. Arrozales
- 2.2. *Cultivos permanentes*
  - 2.2.1. Frutales cítricos
  - 2.2.2. Frutales no cítricos
  - 2.2.3. Olivares.
  - 2.2.4. Viñedos.
  - 2.2.5. Otros cultivos leñosos
- 2.3. *Prados y praderas*
  - 2.3.1. Prados y praderas
- 2.4. *Zonas agrícolas heterogéneas*
  - 2.4.1. Asociación de cultivos anuales con permanentes
  - 2.4.2. Mosaico de cultivos anuales/permanentes/pastos
  - 2.4.3. Terrenos agrícolas con vegetación natural
  - 2.4.4. Sistemas agroforestales (dehesas).

**3. ZONAS FORESTALES CON VEGETACIÓN NATURAL Y ESPACIOS ABIERTOS**
- 3.1. *Bosques*
  - 3.1.1. Bosques de frondosas.
  - 3.1.2. Bosques de coníferas.
  - 3.1.3. Bosque mixto
- 3.2. *Espacios de vegetación arbustiva y/o herbácea*
  - 3.2.1. Pastizales naturales.
  - 3.2.2. Matorrales.
- 3.3. *Espacios abiertos con poca o sin vegetación*
  - 3.3.1. Playas, dunas y arenales.
  - 3.3.2. Suelo desnudo
  - 3.3.3. Zonas quemadas
  - 3.3.4. Glaciares y nieves permanentes
  - 3.3.5. Ramblas
  - 3.3.6. Roquedo

**4. ZONAS HÚMEDAS**
- 4.1. *Zonas húmedas continentales*
  - 4.1.1. Humedales y zonas pantanosas
  - 4.1.2. Turberas y prados turbosos
  - 4.1.3. Salinas continentales?
- 4.2. *Zonas húmedas litorales*
  - 4.2.1. Marismas
  - 4.2.2. Salinas marinas

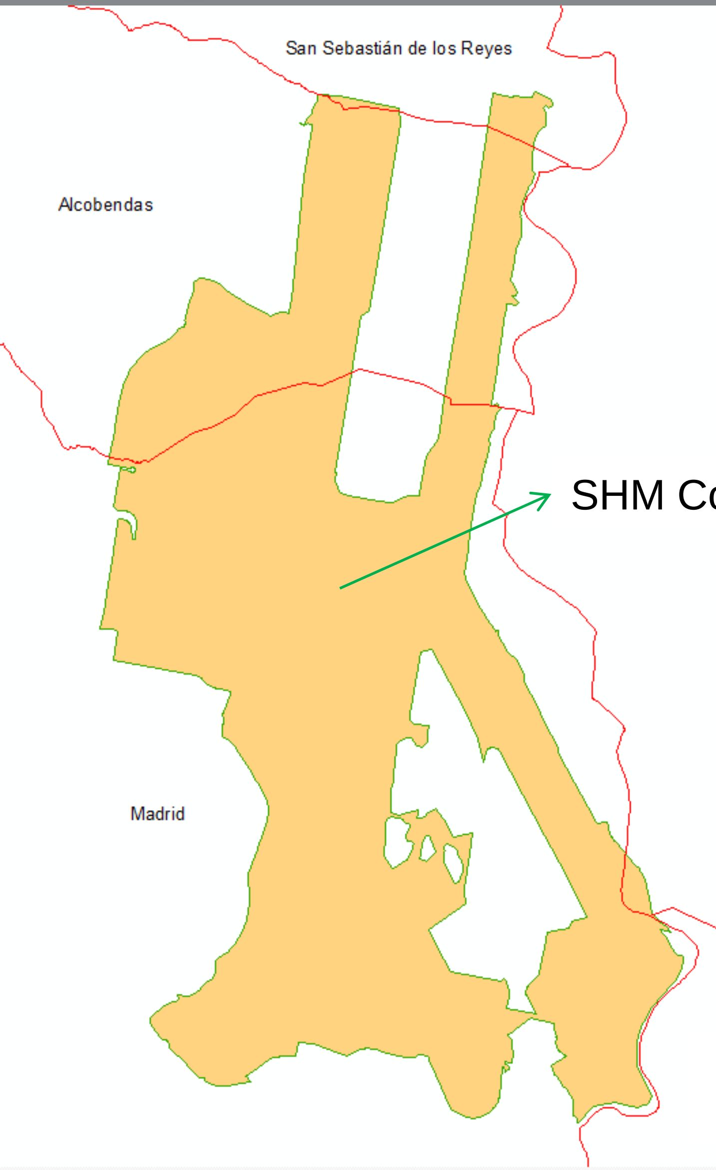
**5. SUPERFICIES DE AGUA**
- 5.1. *Aguas continentales*
  - 5.1.1. Cursos de agua.
  - 5.1.2. Láminas de agua.
- 5.2. *Aguas marinas*
  - 5.2.1. Lagunas costeras
  - 5.2.2. Estuarios
  - 5.2.3. Mares y océanos

# A nomenclature for SIOSE

- The **algorithm** implements the following steps:

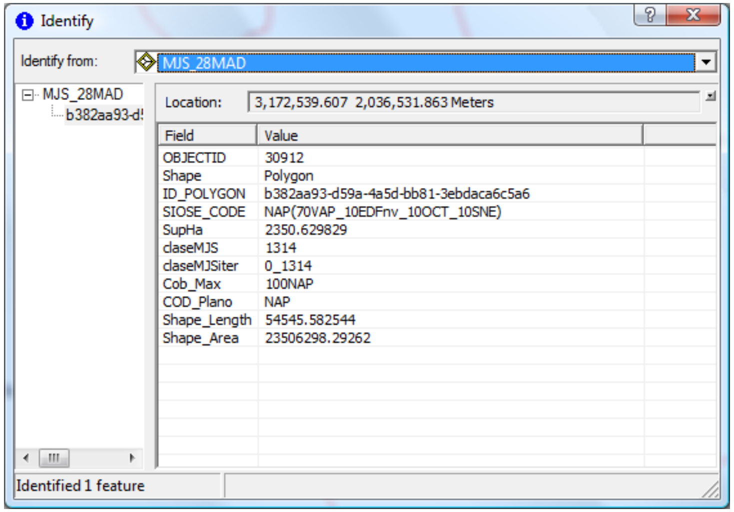
1. Create a correspondence table between SIOSE covers and the new SHM nomenclature.
2. Simplify SIOSE´s label into a “plain code” (simple/predefined composite cover and its associated share of surface, no nesting!)
3. Define **assignment rules**: majority and hierarchical simple rules and preference composite rules for polygons without a clear dominance structure.

# A nomenclature for SIOSE




Assignment rules does not alter SIOSE´s original polygons, so we can track the original information on each polygon.

SHM Code: 1314 - Airports




SIOSE´s ID_POLYGON: b382aa93-d59a-4a5d-bb81-3ebdaca6c5a6

SIOSE´s Label: NAP(70VAP_10EDFnv_10OCT_10SNE)

SIOSE´s dominant cover: 100NAP

SIOSE´s plain code: NAP

# A nomenclature for SIOSE

- These rules mimics the technical information (photointerpretation manual) in developing CLC and SIOSE and are designed to minimize “heterogeneous covers”.
- A validation exercise against CLC gave more satisfactory results for our nomenclature (SHM) than for the nomenclature implemented in the Web Map Service (WMS) of IGN (IberPix).

# UMZ

- **Step 2**: Given SHM create UMZ following a modified EEA´s methodology.

1. **Core classes** (CC): Urban fabric, Industrial and commercial units and Green urban areas.
2. **Enlarged core classes** (ECC): Port areas, Airports and Sport and leisure facilities if they are close (proximity rule) or neighbours (contiguity rule) to the CC. Iterative process.
3. **Gaps**: Forest, scrub, natural grassland, water treatment and desalination plants, dumps,… when they are completely within ECC.

# UMZ

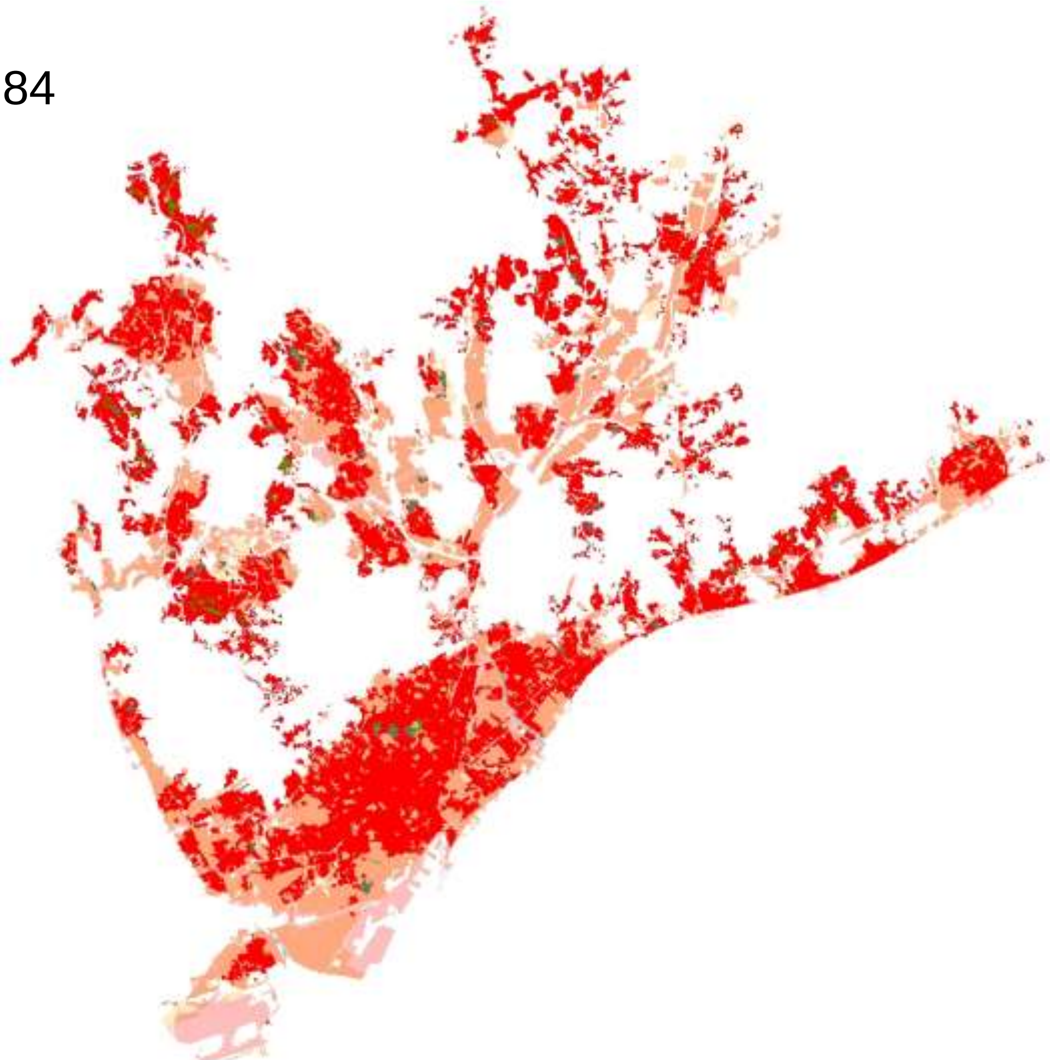
4. **Linear features** (LF): Road and rail networks and Water courses if they are neighbours (contiguity rule) to the ECC, then clipped by a 100m buffer.
5. **Contiguity core classes**: Go back to look for additional contiguity core classes not previously included. Iterative process.
6. **Merge**: Polygons lying less than 200m apart are merged under a unique identifier.

# UMZ

- Eventually, UMZs less than a minimum threshold (20 ha) are dropped.
- In this way we generate about 5.000 UMZ.
- We work in vector format, the original geometry of polygons is not altered and we always keep the contents of each UMZ in terms of its composition: SHM polygons and the original SIOSE information.
- This implies than we can always recover the shares of simple SIOSE land covers for each UMZ.
- After population has been assigned a minimum threshold of population will be established.

# UMZ: Barcelona

SIOSE polygons: 4,538
Area: 377.55 Km²
Population: 3,802,184



# UMZ: Barcelona

SIOSE polygons: 4,538
Area: 377.55 Km²
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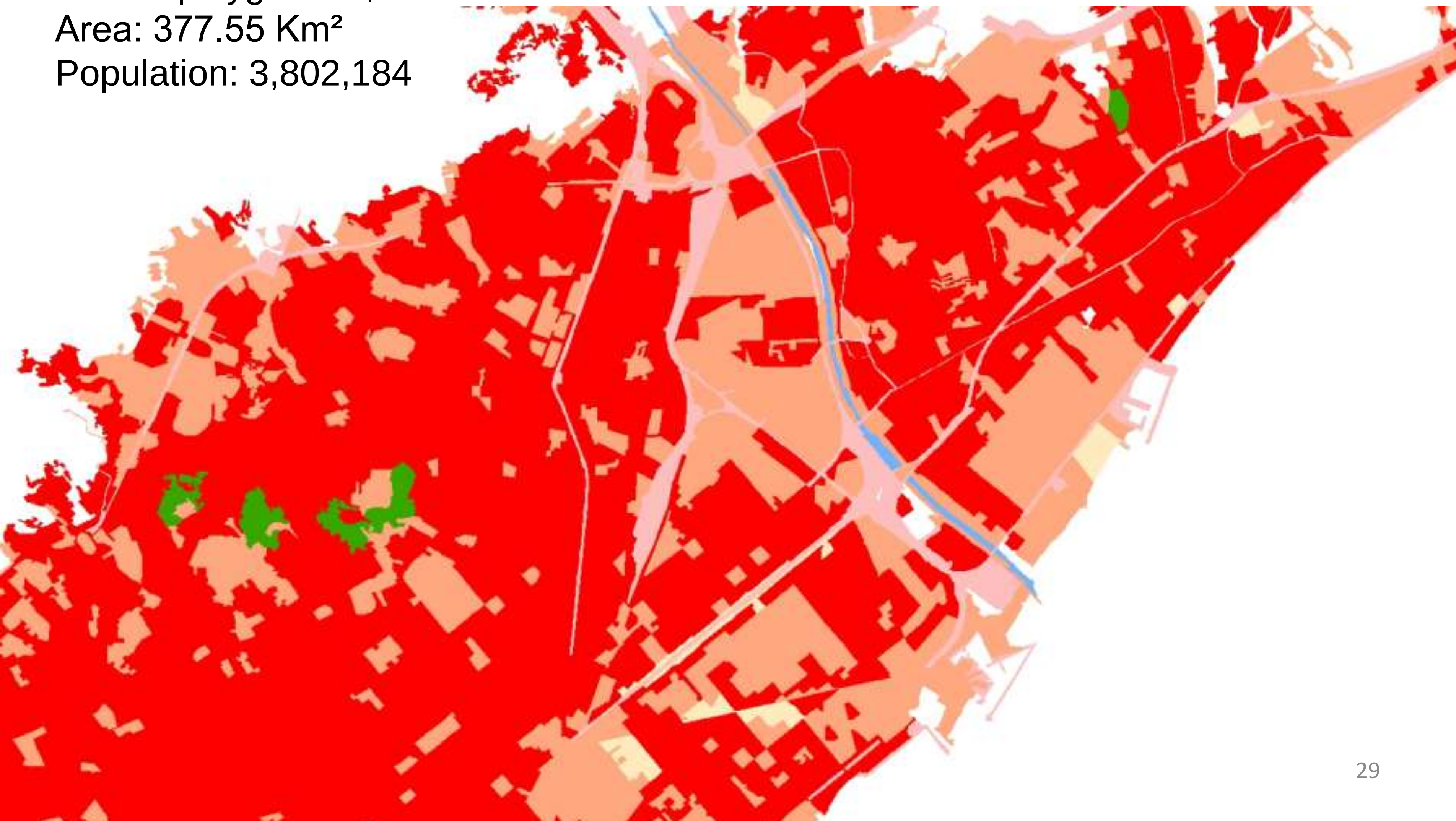
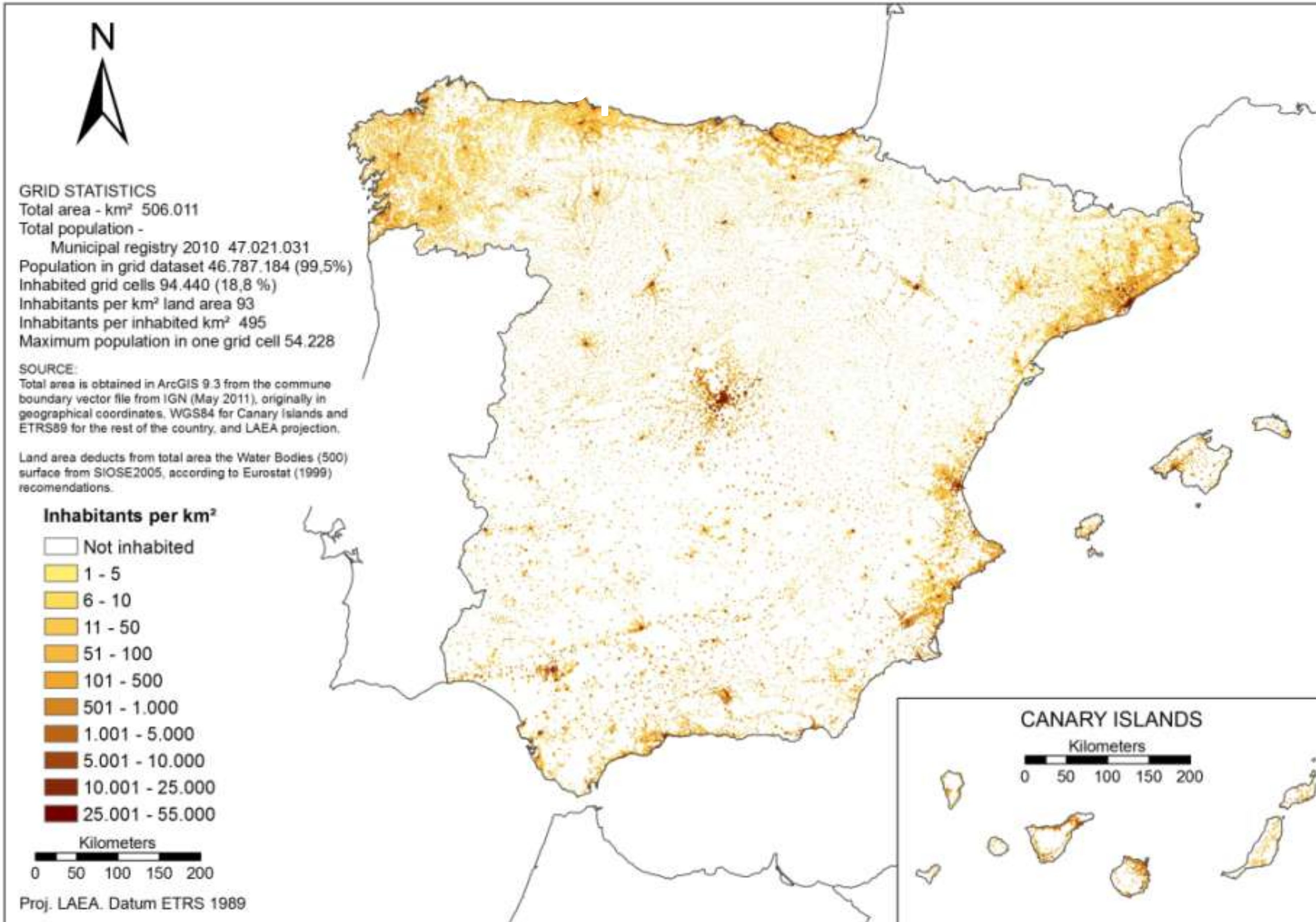


# Population

- **Step 3**: The UMZ vector layer is overlaid with a population grid, so a population figure is assigned to each UMZ.
- We used a top-down grid build from census tracks (ED) population data and SIOSE as auxiliary information.


N
GRID STATISTICS
Total area - km² 506.011
Total population -
Municipal registry 2010 47.021.031
Population in grid dataset 46.787.184 (99,5%)
Inhabited grid cells 94.440 (18,8 %)
Inhabitants per km² land area 93
Inhabitants per inhabited km² 495
Maximum population in one grid cell 54.228
SOURCE:
Total area is obtained in ArcGIS 9.3 from the commune boundary vector file from IGN (May 2011), originally in geographical coordinates, WGS84 for Canary Islands and ETRS89 for the rest of the country, and LAEA projection.
Land area deducts from total area the Water Bodies (500) surface from SIOSE2005, according to Eurostat (1999) recomendations.
Inhabitants per km²
Not inhabited
1 - 5
6 - 10
11 - 50
51 - 100
101 - 500
501 - 1.000
1.001 - 5.000
5.001 - 10.000
10.001 - 25.000
25.001 - 55.000
Kilometers
0 50 100 150 200
Proj. LAEA. Datum ETRS 1989
CANARY ISLANDS
Kilometers
0 50 100 150 200

# Population

- We are in the process of disaggregating population characteristics; like sex, age or nationality, but this information has not yet been exploited.

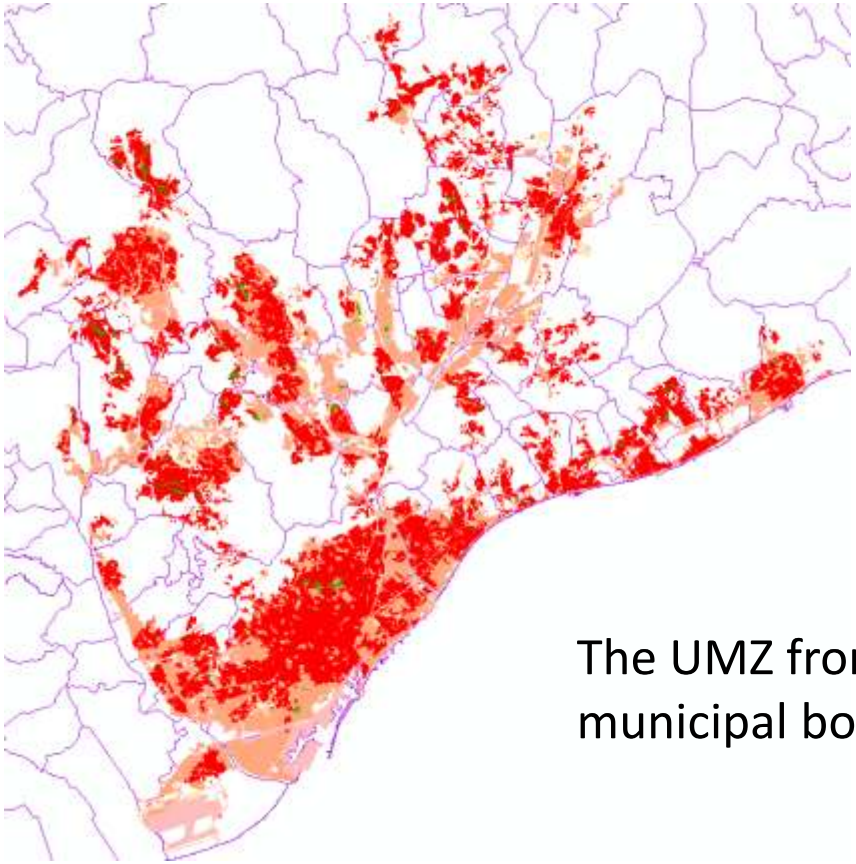
| | A | B | C | D |
|---|---|---|---|---|
| 1 | GRD_NEWID | Total | Males | Females |
| 2 | 1KmN0942E1916 | 1,246 | 673 | 573 |
| 3 | 1KmN0942E1917 | 422 | 222 | 200 |
| 4 | 1KmN0942E1918 | 547 | 299 | 248 |
| 5 | 1KmN0942E1919 | 11 | 6 | 5 |
| 6 | 1KmN0942E1920 | 304 | 166 | 138 |
| 7 | 1KmN0943E1916 | 2,284 | 1,245 | 1,039 |
| 8 | 1KmN0943E1917 | 1,984 | 1,054 | 930 |
| 9 | 1KmN0943E1918 | 269 | 145 | 124 |
| 10 | 1KmN0943E1919 | 120 | 66 | 54 |
| 11 | 1KmN0943E1920 | 477 | 261 | 216 |
| 12 | 1KmN0944E1916 | 952 | 497 | 455 |

# Urban Population

- We find 735 UMZ of at least 5,000 inhabitants that accounts for 35,348,163 inhabitants. Very similar to the population living in Urban Clusters (35,579,555), using Eurostat definition.
- We find 415 UMZ of at least 10.000 inhabitants and 101 UMZ of at least 50.000 inhabitants, that accounts for 26,702,656 inhabitants. A bit higher that the population living in Urban Centers (22,258,510), using Eurostat definition.
- We find 56 UMZ of at least 100.000 inhabitants and 3 UMZ with more than a million of population.

# UMZ and LAU2

- Intersecting UMZ with LAU2 boundaries we can relate urbanization to political boundaries.

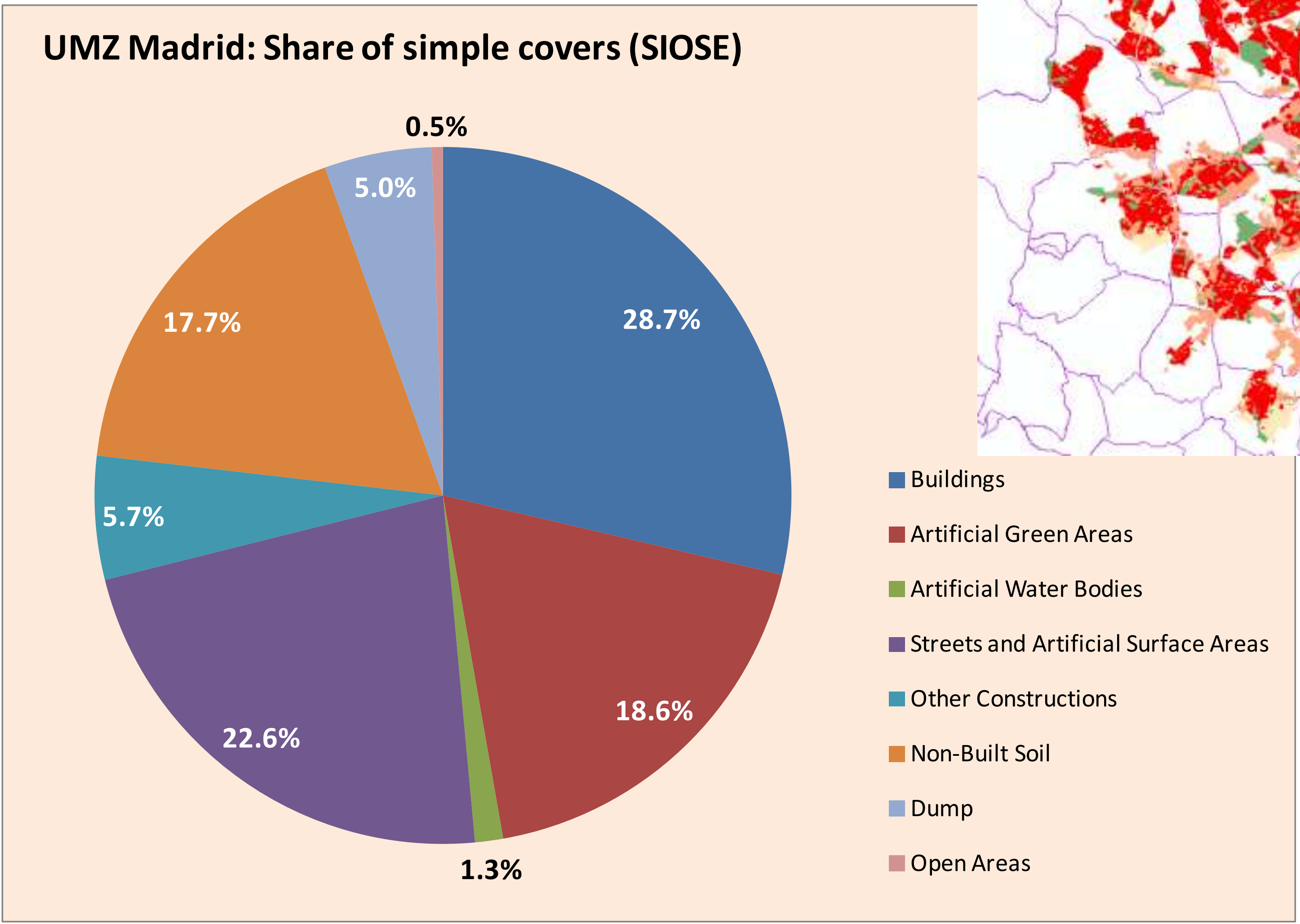


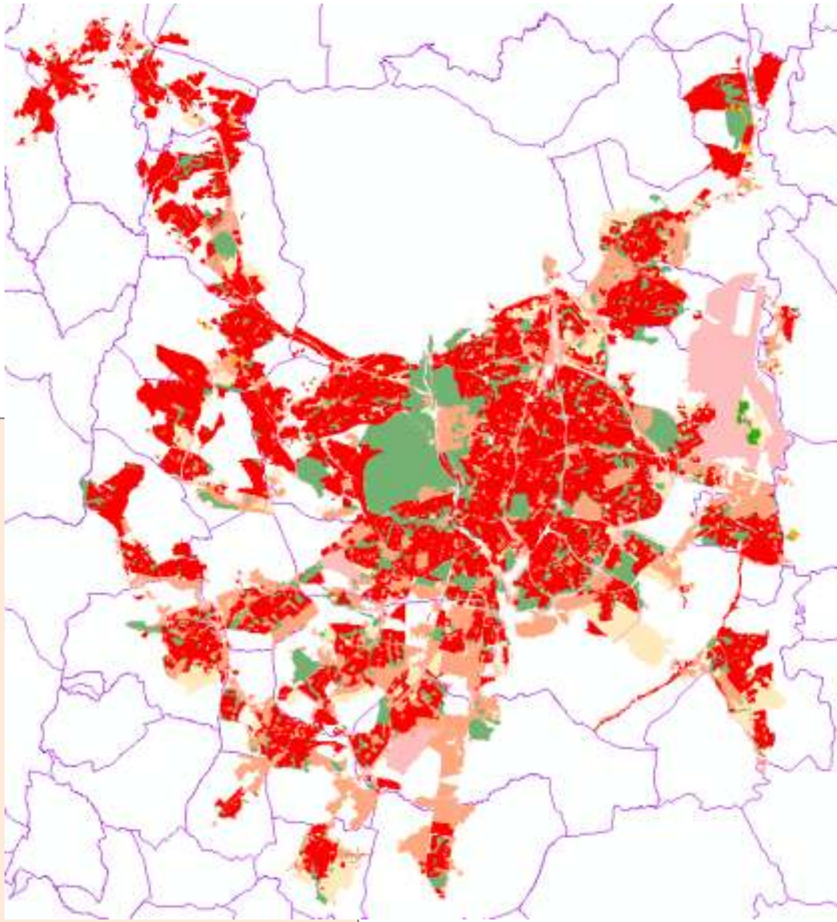
- 22 UMZ spread over more than 10 LAU2, but most of the UMZ (4,339) are confined within the limits of only one LAU2.

The UMZ from Barcelona is the more dispersed across municipal boundaries. It is present in 67 LAU2.

# UMZ: Madrid

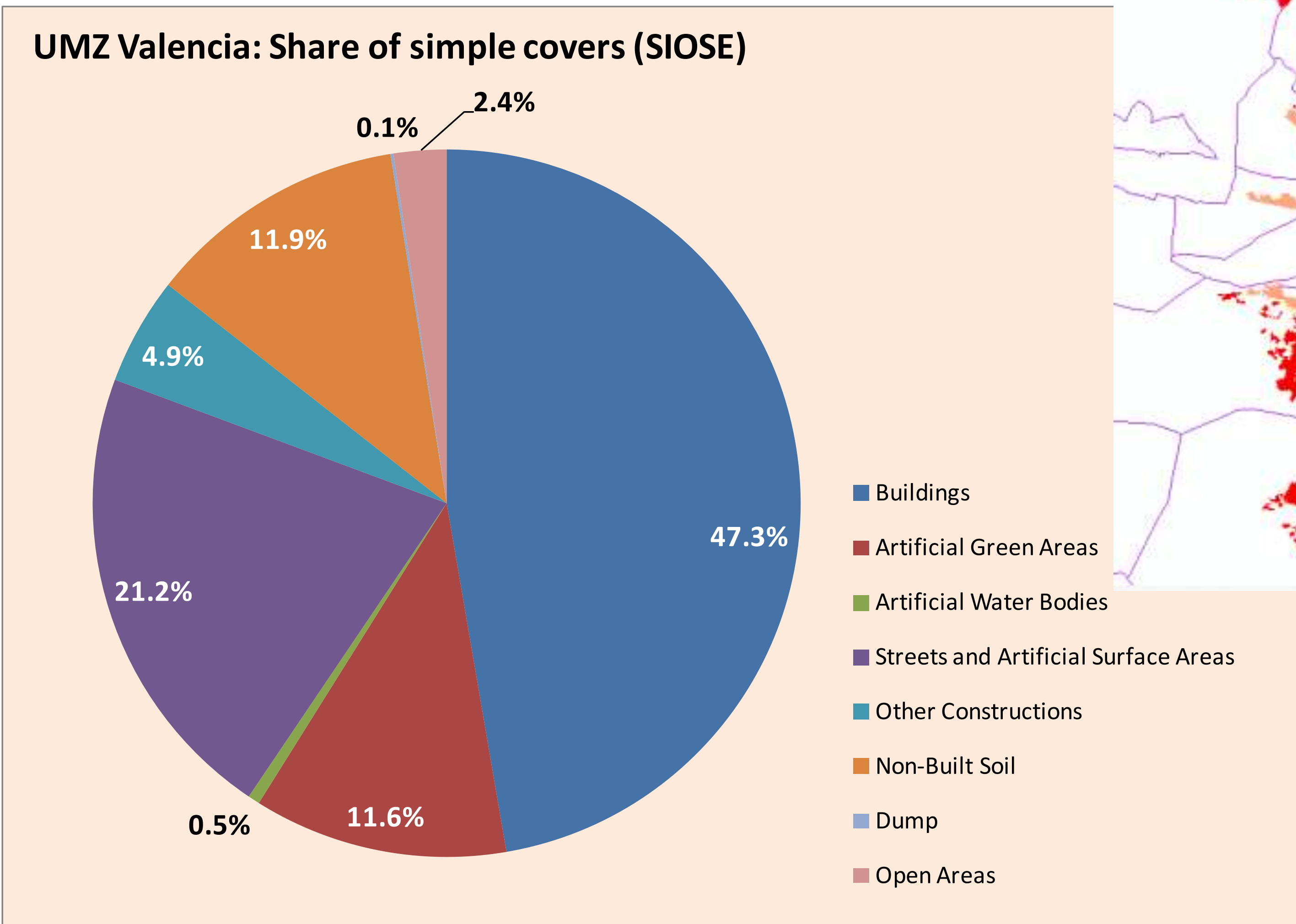
Area: 605.90 Km²
Population: 4,833,124

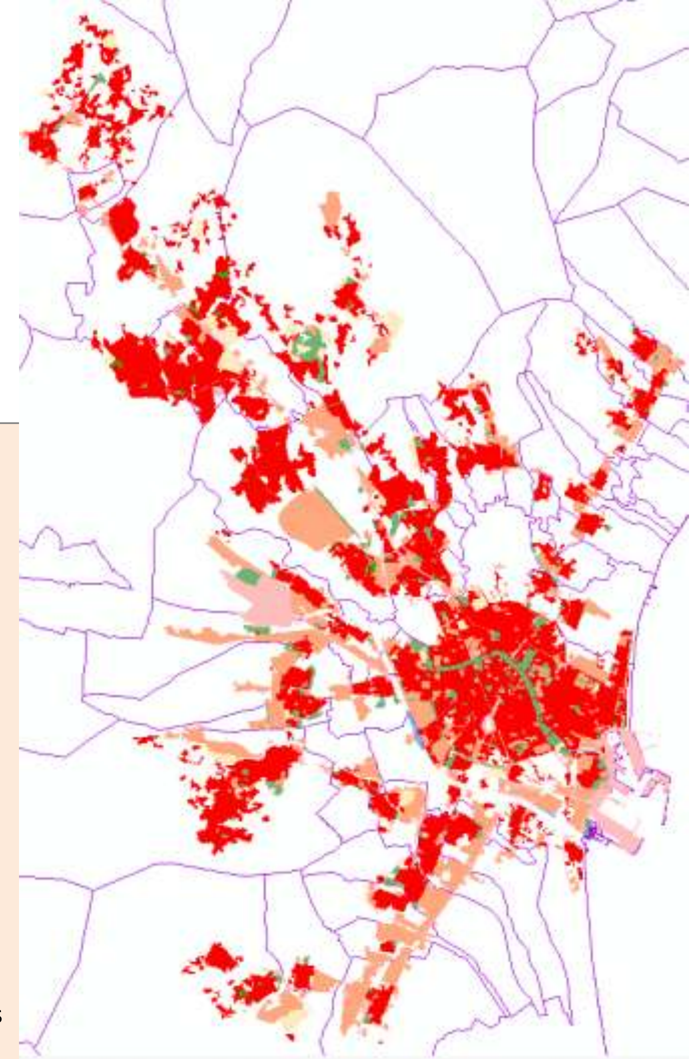


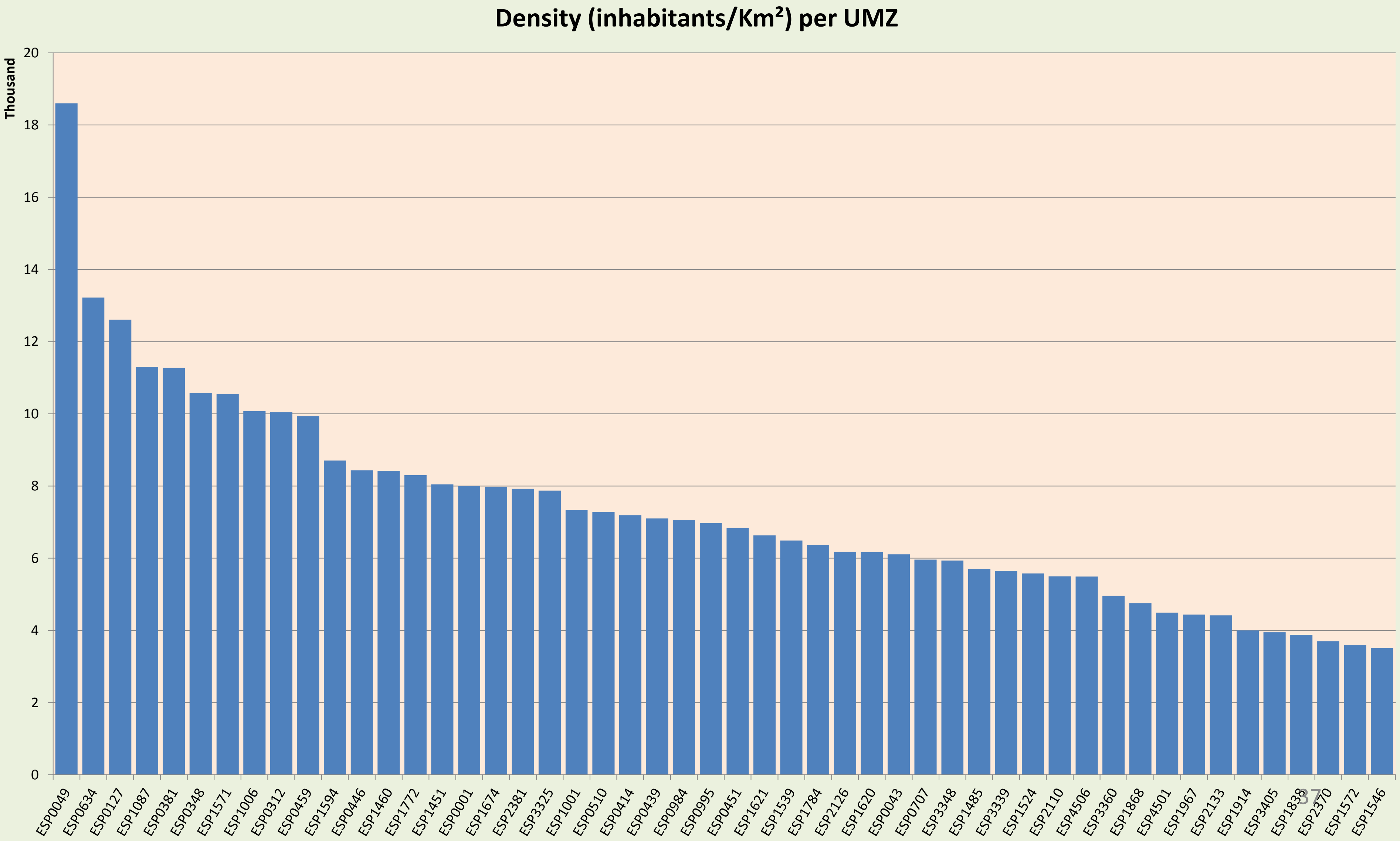
# UMZ: Valencia

Area: 180.02 Km²
Population: 1,515,755



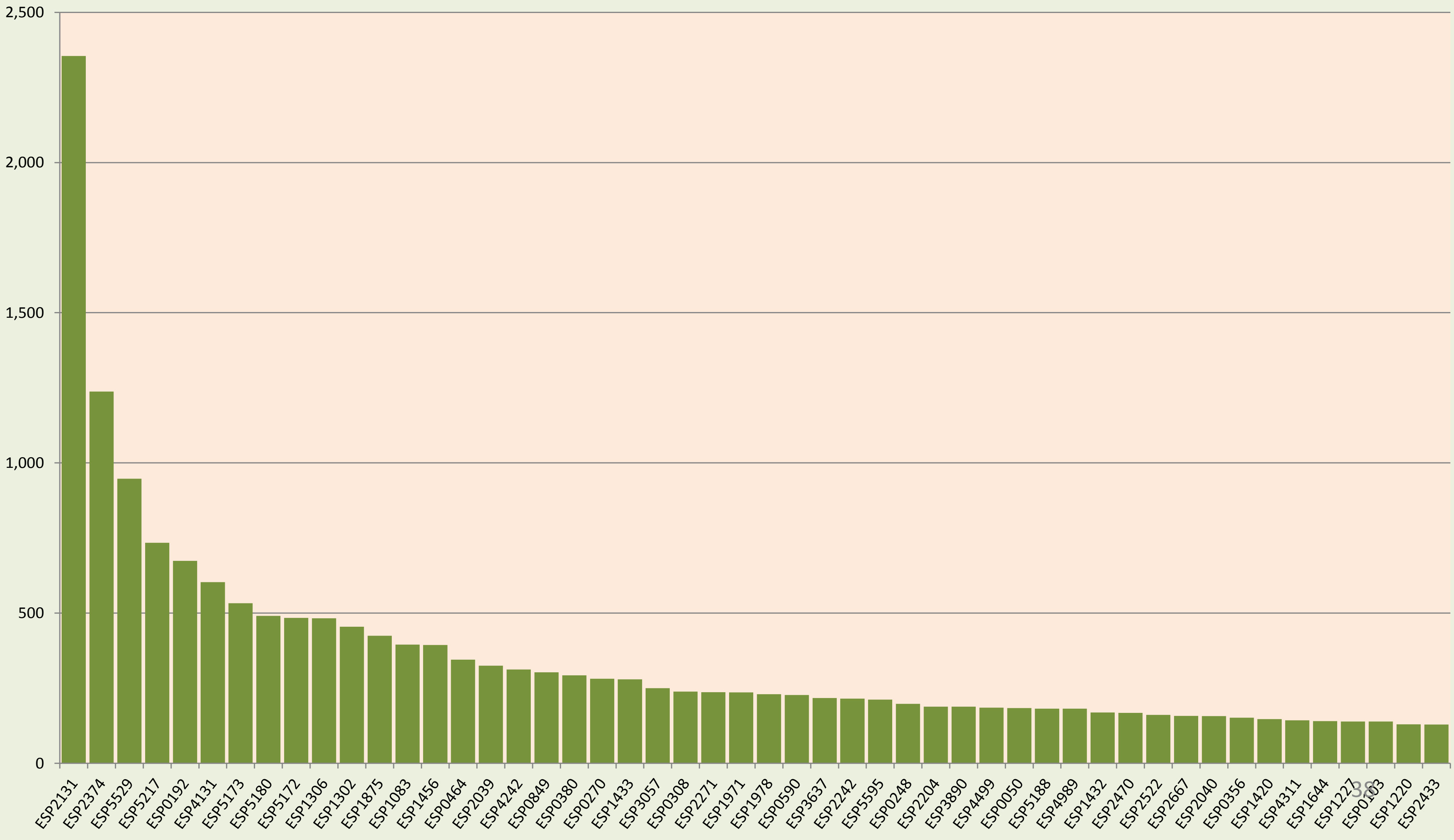



# Densities


Density (inhabitants/Km²) per UMZ
Thousand
20
18
16
14
12
10
8
6
4
2
0
ESP0049
ESP0634
ESP0127
ESP1087
ESP0381
ESP0348
ESP1571
ESP1006
ESP0312
ESP0459
ESP1594
ESP0446
ESP1460
ESP1772
ESP1451
ESP0001
ESP1674
ESP2381
ESP3325
ESP1001
ESP0510
ESP0414
ESP0439
ESP0984
ESP0995
ESP0451
ESP1621
ESP1539
ESP1784
ESP2126
ESP1620
ESP0043
ESP0707
ESP3348
ESP1485
ESP3339
ESP1524
ESP2110
ESP4506
ESP3360
ESP1868
ESP4501
ESP1967
ESP2133
ESP1914
ESP3405
ESP1838
ESP2370
ESP1572
ESP1546

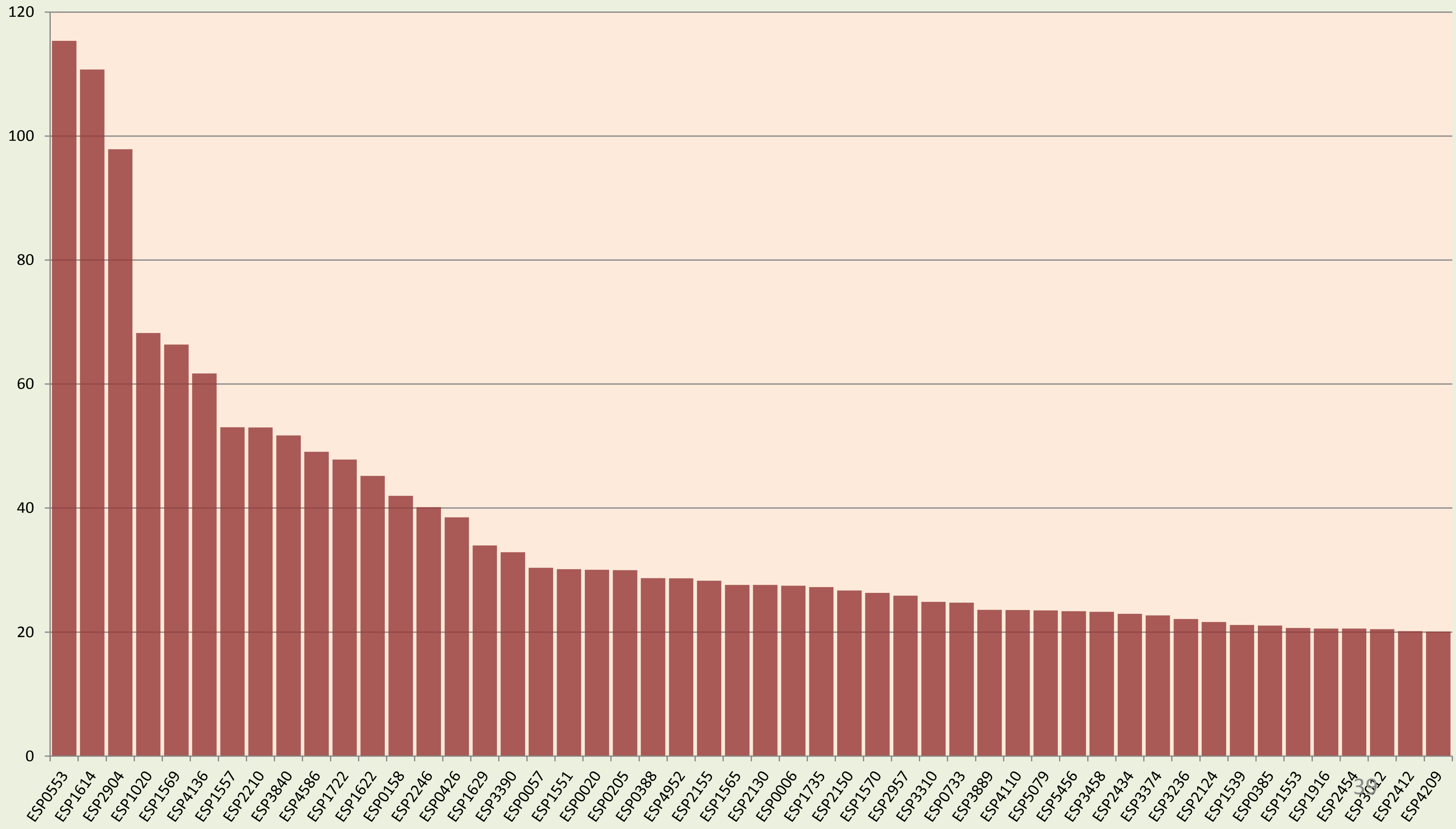
# Urban Indicators

**Green Areas (m²) per person**



# Urban Indicators

**Sports, leisure and cultural facilities (m² - class 125) per person**



# Urban Morphological Zones for Spain:

## *Urban indicators from and Object Oriented Land Cover data base and a population grid*

***Many thanks for your attention***

*Francisco J. Goerlich,* University of Valencia and Ivie
*Isidro Cantarino,* Polytechnic University of Valencia