UN-GGIM National Report - Spain

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1. UN-GGIM PARTICIPATION

IGN-CNIG participated in the UN-GGIM initiative from the beginning promoting the committee's objectives inside Spain and along international communities. Particularly IGN-CNIG collaborates actively in the Working Group on Trend in National Institutional Arrangements in Geospatial Information Management (NIA), through Antonio Arozarena (IGN-CNIG) as chairman of the group. The overall objective of the NIA is the identification of best practices, sets of institutional models and legal frameworks for national geospatial information management and interoperability between different systems and institutions responsible for its management, while ensuring uniformity and standardization.

It is also important to remark the IGN-CNIG expert participation by Nuria Valcárcel in the UN-GGIM Working Group on Fundamental Data, for defining and establishing a core themes set of fundamental datasets at global level; and Javier González in the UN-GGIM Working Group on Global Geodetic Reference Frame for the sustainable development.

At continental level, Antonio Arozarena (IGN-CNIG) also plays the role of Vice Chair in the Executive Body in UN-GGIM Europe. Nuria Valcárcel (IGN-CNIG) participates as expert on the Working Group 1, with the purpose of determining the scope, contents and technical recommendations for UN-GGIM Europe's Core Reference Data, through the revision and selection of priority UE INSPIRE Directive themes, based on the identification of basic user needs according to the United Nations Sustainable Development Goals, from a bottom-up and top-down approach. Paloma Abad (IGN-CNIG) participates as expert on the Working Group 2, with the tasks of prioritize the needs of users for combining data, establish recommendations to implement the priorities of data combinations, and recommend effective methods of public management, quality management, data interoperability, access control and security measures for the integration of data from multiple sources, identifying legal and other barriers to the integration.

2. EUROPEAN REGULATION AND NATIONAL CONNECTIONS

INSPIRE Directive 2007/2/CE aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure enables the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries. INSPIRE is based on the infrastructures for spatial information established and operated by the Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications.

According to Art. 19(1) of the INSPIRE Directive, each Member State must designate a National Contact Point (NCP), to be responsible for contacts with the Commission in relation to INSPIRE. The High Geographic Council and the IGN-CNIG as Secretary is the NCP in Spain and guide the participation of more than 40 Spanish stakeholders along the country.

IGN-CNIG also collaborated directly during 2008-2012 in the definition of INSPIRE specifications by the participation in the INSPIRE Thematic Working Groups on Geographical Names, Addresses, Orthoimagery, Elevations, Land Cover and Land Use. Since the creation of INSPIRE Thematic Clusters platform IGN-CNIG has an actively compromise in the collaboration for disseminating all advances and experiences in the Directive implementation with the rest of INSPIRE community.

In 2013, a Commission expert group called INSPIRE Maintenance and Implementation Group (MIG) was set up by the more interested and representatives NCPs where IGN-CNIG represented Spain. MIG coordinates the joint activities between the European Commission, the

European Environment Agency and the EU Member States to support the maintenance and implementation of the INSPIRE Directive.

In 2010 in order to fulfil the INSPIRE principles in Spain was promulgate the nation law 14/2010 on infrastructure and services of geographical information (LISIGE) that incorporates the European Directive into Spanish law ensuring compliance. LISIGE includes the establishment of the geographic Information Infrastructure, which integrates the set of geographic information infrastructures and interoperable geographic information services under the responsibility of the Spanish public administrations. LISIGE defines a themes set in direct connection with INSPIRE and its specifications, and with objective to reach the INSPIRE requirements and coordinate actions, LISIGE also promoted the creation of national thematic groups composed with experts coming from public administrations national, regional or local, universities, research centres, and stakeholders. IGN-CNIG performed the driving guidance in the LISIGE definition and participated in most of the national expert groups.

Also remarkable is the IGN-CNIG data policy regulation aligned with the INSPIRE data-sharing principles, Directives 2003/4/CE, 2003/35/CE for the public access to environment information and Directive 2003/98/CE for the re-use of public sector information. IGN-CNIG data policy is regulated by Ministerial Orders FOM/956/2008 and FOM/2807/2015 where all IGN-CNIG geospatial information is accessible for the users free of charge, including also to the private sector for commercial purposes.

The legal framework in Spain is completed by the law(RD) 1545/2007, that regulates the *Sistema Cartográfico Nacional* (SCN) is a model of action that seeks the effective exercise of public functions in the area of geographic information. The Government, with respect to the current competence distribution and previous report of the *Consejo Superior Geográfico* - High Geographic Council, regulates the SCN in order to achieve the following objectives: guarantee the homogeneity of the information produced by the public bodies, facilitate the efficiency in public expenditure for mapping and geographic information systems, ensuring public availability and updating of reference geographic data, and optimizing the quality of official cartographic production and its usefulness as a service to the public. The CSG is closely linked with UE INSPIRE Directive principles and national LISIGE law.

3. ISO PARTICIPATION

ISO/TC 211 Geographic information/Geomatics aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management, acquiring, processing, analysing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations.

Asociación Española de Normalización y Certificación (AENOR), established in 1986 as a non-profit private association undertook the responsibility formerly held by official authorities for the development, publication and promotion of Spanish standards, for which it has been granted recognition by law as the only body responsible. Being an active member of the main European and international standardization, for an AENOR's mission is to contribute, through the development of standardization and certification. AENOR facilitates the promoting and implementation of geographic information standards by the creation of the National Technical Committee on this matter AEN/CTN 148 *Información Geográfica Digital*, linked with ISO/TC 211. On the IGN-CNIG lays the presidency and secretary on this national committee.

AEN/CTN 148 structures set of rules that specify a methodology for defining, describing and transferring representations of the real world. This facilitates the understanding and use of the real world information referred to in the field by means of coordinates, textual descriptions or codified names. The committee objective is to facilitate the standards' use on: capture, storage, verification, integration, manipulation, transfer, analysis, prevention, management and updating of digital geographic information, referring to real world.

4. INSTITUTO GEOGRÁFICO NACIONAL

The *Instituto Geográfico Nacional* (IGN) was created in 1870 as a respond to governmental administration of cartography activities. Nowadays IGN-CNIG plays the role of National Mapping Agency with competences also in other fields in geo-information such as Earth observation, spatial data infrastructures, astronomy, geodesy or geophysics.

Geospatial information is seen, for management purposes, as a comprehensive system including the complete cycle of the information, from capturing data to publishing and disseminating final geospatial products and services. Inside this whole process IGN-CNIG has all the transformation, analysis and cartographic production tasks.

http://www.ign.es/

4.1 GEOSPATIAL REFERENCE INFORMATION

As authoritative body on geospatial information at national level, on the IGN lays the public responsibility for providing useful datasets, services and knowledge for the Spanish users. There for IGN is established as the steering national public institution that, by means policies arrangements with rest of public administrations and high technology and sector leadership, directs, plans, coordinates and manages at national level, official geospatial information in fields on Cartography, SDI, Astronomy, Geodesy and Geophysics.

To proceed with this leadership the IGN since 2014 defined a set of institutional strategic principles aligned with INSPIRE Directive, United Nations perspective and coming users' needs, to generate Geospatial Reference Information (GRI).

GRI is defined as the basic geospatial information able to organize any subsequent actions over the land. GRI means the skeleton geo-infrastructure to locate or map rest of geospatial information. GRI in the IGN brings and fulfil the principles assumed in international initiatives:

- GRI is organized and produced following essential themes considered in INSPIRE Directive annex I and Spanish law LISIGE.
- Adopt new data models for ensuring interoperability and new production systems of that type of information demands.
- Adapt the processes and updating time of GRI to the current users' needs.
- Identification and prioritization of users' communities: national public administration, remaining Spanish public administration, European programs and institution, Global requirements, academic and business sectors and rest of stakeholders.
- GRI rises from the reengineering production processes at the IGN, able to create the core and essential subset information that afterwards is completed by the closely related geospatial information coming from rest of national public administration to set up the broad GRI suitable for all users.
- Technical aspects of GRI overcome the traditional characteristics of IGN information, and should be described by the objectivity, accuracy, automatic and time closing from users' needs.

To plan the actions at the IGN, several themes were prioritized: hydrography, transports networks, settlements, orthoimagery, elevations, land cover and land use. Meanwhile for the hydrography, transport networks and settlement, it was necessary to develop a new production framework, for the rest of themes were just included since 2004 in the *Plan Nacional de Observation del Territorio* (PNOT), the GRI initiative of land observation.

Mayor benefits have been identified in production system based on GRI:

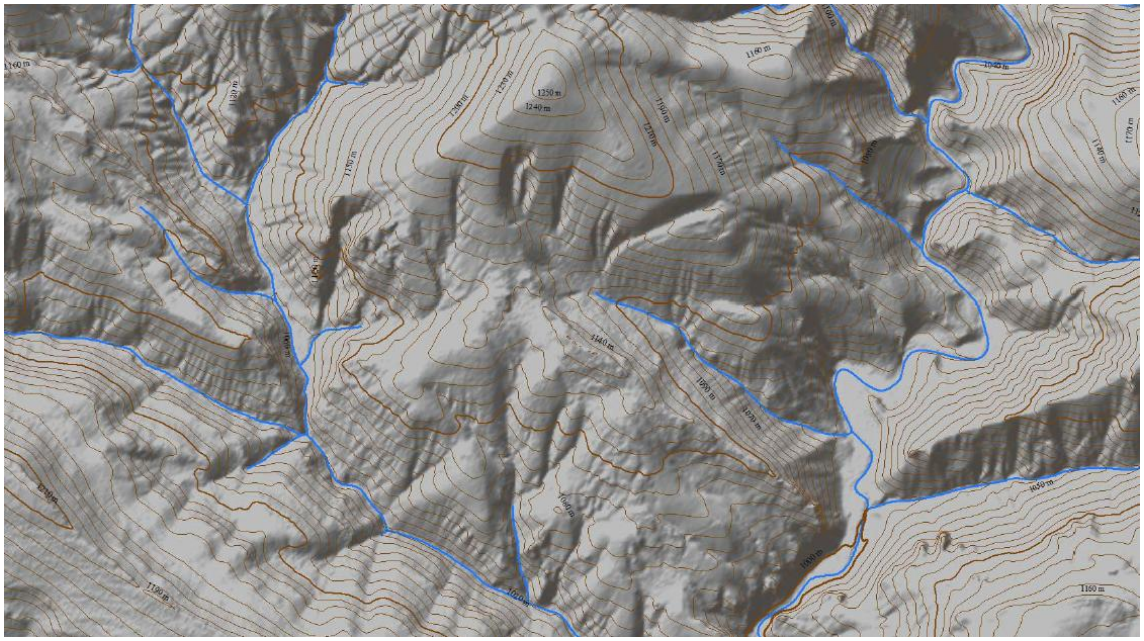
- GRI becomes the same data source for multiple applications and users
- Facilitate avoiding duplicities and cost savings

- More efficient to fulfil Geospatial Information Management
- Involves authoritative and reliable information, guaranteed information for responsible institutions

4.1.1 Hydrography

The goal is to get an accurate and updated river network, automatically extracted as possible. IGN has full LiDAR coverage for the whole Spanish territory with a density of 0.5 points per square meter. Hydrological terrain models were generated with 2m of resolution, from which the network were extracted combining hydrographic criteria (topographic network) and hydrological criteria (flow accumulation river network).

Key points of this work had been the managing a big data environment, more than 160,000 Lidar data files, the infrastructure to store 40 Tb and their automatic processed in 6 months. The results of this production is an accurate automatic hydrography network extracted for the whole country with a significant improvement for the altimetric component of the 3D linear vector and coherent with elevation datasets.



Hydrographic network obtained automatically from LIDAR DEM.

4.1.2 Transport Networks

The objective in relation with transport was defined as getting a network as much accurate and updated as it was feasible. By integration and depuration of present IGN datasets, rest of Spanish cartographic agencies, cadastre, post office and National and Regional transport agencies.

First step was to define a data model and specifications, INSPIRE compliant, identifying the candidate features and attributes to work on them, reached by consensus among IGN, regional cartographic agencies and official data providers (i.e. Roads Ministry, Traffic Department, Railway Manger, etc.). The next step was the data production by updating, integration and improving the initial IGN datasets with official information from responsible sources. Road transports and streets was prioritized in the dataset production.

Integrated transport network in urban area.

4.1.3 Settlements

GRI Settlement production is supported primarily on two criteria: it is based on cadastral parcels and developed by automatic processes. With the aim to provide a high-resolution spatial information, homogeneous nationwide and satisfy the users' requirements in relation to the spatial management of settlements (spatial planning, urban development, environment protection, statistics, addresses, demography, mapping, etc.). To carry out this work firstly it is developed a methodology to assign automatically the settlement code to the cadastral data. Secondly a manual revision is necessary in order to solve the remaining data. In parallel, an automatic method was developed for settlement boundaries extraction according to cadastral data, based on the parameterization of urban development (dispersion degree) and spatial analysis of cadastral data aggregation.

Settlements identification (left), boundary extraction (centre) and land use subdivision (right).

4.2 PNOT

Apart from the raised GRI information systems in the last decade accomplished within UN and INSPIRE guidelines and recommendations previously described, since 2004 IGN-CNIG leads the institutionalised master program for Earth observation, National Plan for Land Observation (PNOT). PNOT involves the consolidated projects on orthoimagery, elevations and land cover

and land use, considered afterwards the IGR systems on their respective thematic areas offering reference and authoritative data along more than one decade.

This integrated production system of PNOT includes all the public stakeholders with authority in geographic information in a decentralized and collaborative production model in which take part all levels for administration: local, regional and national. Through a co-funded economic model this cooperative way of producing information is a powerful tool for sustainability, even in crisis times, as we reach the objective of gathering data only once and by the most appropriate agent or group of agents.

The definition of the user´s needs, base of the design of the system, is reached by consensus and translated to technical requirements taking in regard the standardization process that is currently taking place in geospatial information at, both, European and global levels (INSPIRE Directive, ISO TC211). This initial orientation allows to successfully integrate projects at regional, national and international levels and improves the technical sustainability of these projects in time.

The system is based on the use of common shared data sources, mostly digital images obtained through a variety of airborne and space sensors, and on working with agreed data models. This contributes to the harmonization of the geospatial information used by all the stakeholders and improves compatibility and interoperability among their projects.

This basis and this approach build up a solid bottom-up national model of producing and managing geospatial information that converges with international top-down approach at the European level, fitting perfectly with current initiatives like the development of INSPIRE Directive or Copernicus.

These methods of production, management and approaching among administrations coordinated by Instituto Geográfico Nacional &l Centro Nacional de Información Geográfica (IGN-CNIG) were awarding with the United Nations Public Service, Cat.4, Promoting Whole-of-Government Approaches in the Information Age.

In the first phase, the objective of the PNOT is to obtain aerial image coverage and digital elevation models for multidisciplinary applications, with economically optimized resolution and updating periods, as well as to develop applications in which these images are going to be used. This coverage is organized into various levels of spatial resolution and time frequencies, which are materialized into specific sub-plans described in the following paragraphs.

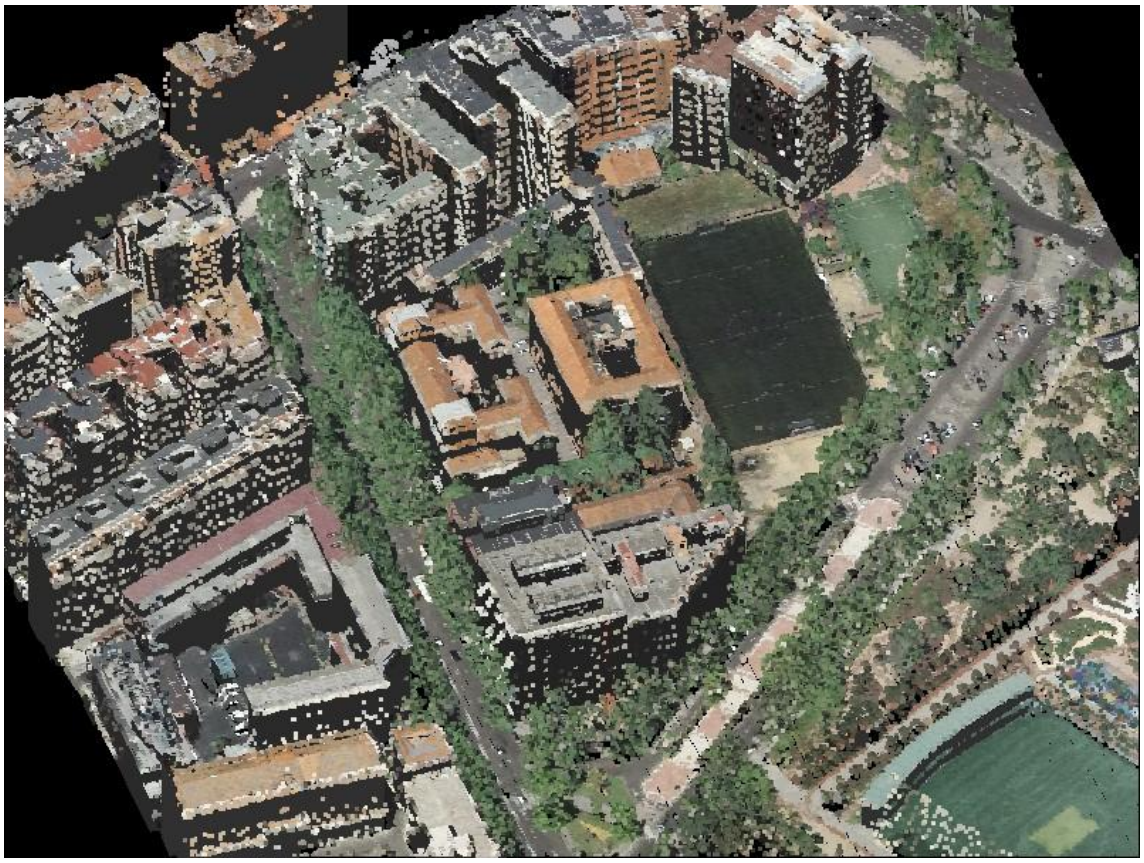
4.2.1 PNOA Image

National Plan for Aerial Orthophotography (PNOA), which provides periodic coverage (each 3 years) of the entire national territory via very high resolution aerial orthophotography: PNOA25/50 (25/50 cm) and PNOA10 (10 cm).
http://pnoa.ign.es/presentacion-y-objetivo

Orthoimagery from PNOA

4.2.2 PNOA Lidar and DEMs

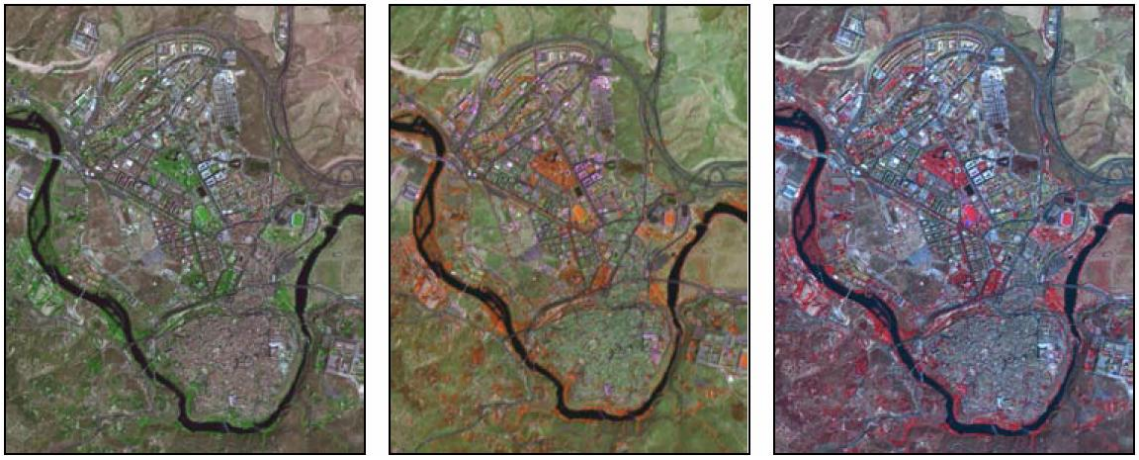
PNOA also provides periodic coverage of digital elevation models for entire national territory based in different resolution values (25m, 5m and 2m). These DEMs have been obtained from LIDAR datasets with a resolution of 0.5p/m2 among others derived altimetric products such as land classification, contour lines, etc.
http://pnoa.ign.es/presentacion



Headquarters National Geographic Institute, Color Point Cloud, PNOA Lidar

4.2.3 PNT

National Remote Sensing Plan (PNT), which provides periodic coverage (annual, monthly and weekly) of the entire national territory via medium and low resolution satellite images (2.5 to 100 m).
http://pnt.ign.es/

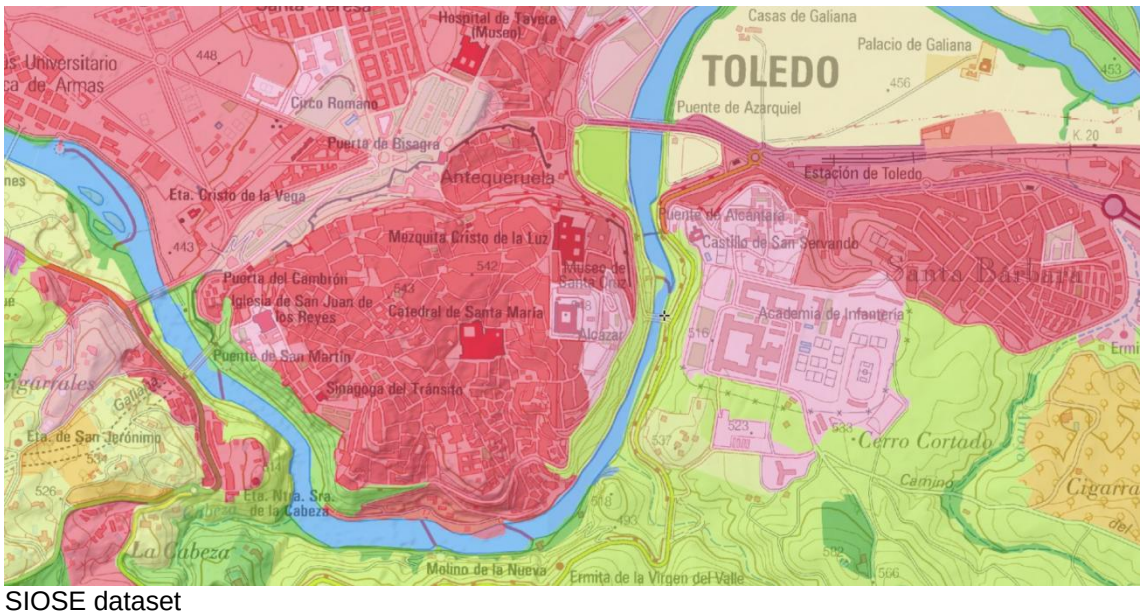


Different colour composition of a PNT image

From the coverage of PNOA and PNT basic and thematic geographic information is produced in a wide range of scales, from local to national level, by all the cartography producer agents of the country.

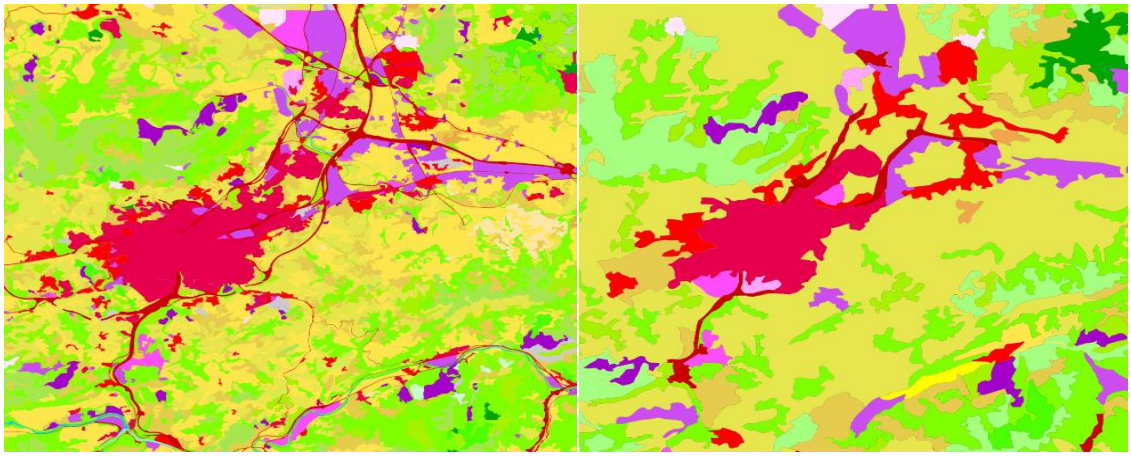
4.2.4 SIOSE

Information System on Land Cover in Spain (SIOSE) is based on a common object oriented data model for land cover and land use information. This data model is the reference for land cover information production at 1:25.000 scale and higher. Semantic and geometric generalization of high resolution Land Cover data produced by SIOSE project is an example of a bottom-up approaching for land cover.
http://www.siose.es/



SIOSE dataset

SIOSE is extremely connected with the European initiative of land observation, Copernicus that involves traditional European Environment Agency datasets. The high resolution information of SIOSE is the base for production by generalization of Copernicus CORINE Land Cover and validation of Copernicus High Resolution Layers, Urban Atlas or Riparian Zones.



Example of SIOSE generalization

4.3 OTHERS IGN-CNIG INITIATIVES

4.3.1 Topographic data bases and maps series

About topographic data bases Spain have the Harmonized Topographic Base (BTA) with 1:5.000–1:10.000 reference scale. BTA was built and agreed by Regional Cartographic Agencies and the IGN-CNIG and delivered as a recommendation by the Geographic High Council (CSG) of Spain. BTA allows to share and exchange information between Regional and State Administrations at these scales and so, the subsequent and coherent production of the National Topographic Base 1:25.000 (BTN25), the national topographic database by the IGN-CNIG.

These projects together with GRI datasets make up the reference information set for derived the final cartographic products at 1:25.000 and 1:50.000 scales: National Topographic Map 1:25.000 (MTN25) and National Topographic Map 1:50.000 (MTN50); National Cartographic Base 1:100.000 (BCN100), the Province Map 1:200.000 (MP200), Spanish Map 1:500.000 (ME500) and the National Map 1:1.250.000 (M1000).

Detail of MTN50 (left), M1000 (right)

4.3.2 CartoCiudad

Collaboration and coordination between different administrations is continuous as, for instance, in CartoCiudad project. CartoCiudad is the result of merging together and harmonising

information provided by several national public bodies, mainly General Directorate of Cadastre, National Statistics Institute, Post Office and IGN-CNIG, and also regional organisations in some Autonomous Regions. The outcome of this integration process is a Geographic Information System of a national and seamless streets, ways and roads network, topologically structured and complemented with urban cartography, census-based and postal information, covering all the Spanish municipalities, line with the INSPIRE Directive.
http://www.cartociudad.es/

4.3.3 Spanish SDI

The Spatial Data Infrastructure (IDE) is a system composed of a set of resources (catalogues, servers, programs, applications, web pages, etc.) from different Spanish public administrations that allows the access and management of datasets and geographic services (described throughout its metadata), available on the Internet, which complies with a series of ~~standards,~~ standards and specifications that regulate and guarantee the interoperability of geographic information along Spain. IGN-CNIG plays the role of driving coordinator of the Spanish SDI community and participate actively in different initiatives on the matter.

http://www.idee.es/

4.3.4 Download Centre

The Download Centre is a website that allows free downloads of geography-related digital files, generated by IGN-CNIG, provided that such files are accessible and re-usable, as set out in Ministerial Order FOM/2807/2015, on the policies for public dissemination of geographic information generated by the IGN-CNIG. This Download Centre, as per the relevant agreements, also makes available geographic information owned by other agencies of the Public Administration for users. http://centrodedescargas.cnig.es/

4.4 IGN-CNIG PARTICIPATION IN CONTINETAL AND GLOBAL INITIATIVES

At continental level it is important to list the main European initiatives where the IGN-CNIG works in partnership, provides service, interchanges knowledge and plays the role national representative.

- UN-GGIM Europe. Role of Vice Chairman in the Executive Body, and participation on Working Groups A and B.
- Copernicus Programme, European Union programme aimed at developing European information services based on satellite Earth Observation and in situ (non-space) data. IGN-CNIG is part of Copernicus User Forum to contribute in the definition of the program, coordinates the Land Service at national level, and collaborate in the definition of Geospatial Reference Data in the in-situ component.
- INSPIRE Directive. IGN-CNIG experts participated in the INSPIRE data specifications redaction and in past years represent one of the most actively national community of Directive implementation and compliant datasets and web-services generation. IGN-CNIG also participate in the INSPIRE implementation groups MIG and its technical subgroup MIG-T.
- IGN-CNIG plays the role of National Reference Centre on Land Cover, Land Use and Spatial Planning for the European Network (EIONET) for the European Environment Information and Observation.
- EuroGeographcis. European consortium to represents the European National Mapping, Cadastral and Land Registry Authorities, where IGN-CNIG participate in the production of datasets and web-services, and collaborate in the Knowledge Exchange Networks (KEN) groups of experts addressed for the most pressing aspects of European geospatial information.

- EuroSDR. Not-for-profit organisation linking with National Mapping and Cadastral Agencies with Research Institutes and Universities in Europe for the purpose of applied research in spatial data provision, management and delivery. IGN-CNIG represents Spain, transmitting and exchanging the developments in geospatial information.

Globally it is remarkable the participation in international organizations and consortiums through global land cover observation programs:

- UN-GGIM. Chairman of National Institutional Arrangements in Geospatial Information Management and participation on Working Group for Fundamental Data and Global Geodetic Reference Frame
- GEO SB-02 Global Land Cover (GEO/GEOSS): Contribution to the GEO Task on Global Land Cover, including Data Model, optical and radar images at different resolutions, and surface parameters, as Essential Climate Variables (ECV) datasets, for the understanding of Climate Change.
- ESA global Land Cover map/Global Land Cover Network (GLCN): The GlobCover project is part of ESA's Earth Observation Data User Element (DUE)
- Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD): is an international coordinated effort to provide land cover data (vegetation mainly) for sustainable management of natural resources.
- NASA Land-Cover and Land-Use Change Program (LCLUC) is a scientific interdisciplinary program.
- Global Land Cover Facility (GLCF) is an investigation centre for studying the land cover change dynamics and the causes of these changes.
- Global Land Project program for terrestrial ecosystem financed by International Geosphere-Biosphere Programme (IGBP) and International Human Dimensions Programme (IHDP).

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