

SECFT

SPANISH SOCIETY
FOR CARTOGRAPHY,
PHOTOGRAMMETRY
AND REMOTE SENSING

Presented to the 18th General Assembly 2019 Tokyo, Japan,
of the International Cartographic Association



2015 National Report Spain 2019

XXIX International Cartographic Conference
International Cartographic Association. ICA

15th - 20th July 2019, Tokyo, JAPAN

Board of the Spanish Society for Cartography, Photogrammetry and Remote Sensing (Sociedad Española de Cartografía, Fotogrametría y Teledetección, SECFT)

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This Board was renewed at the Ordinary General Assembly of the Spanish Society for Cartography, Photogrammetry and Remote Sensing held in Madrid on the 14th of June 2018

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MR. ADOLFO DALDA MOURÓN and MR. MILAN KONECNY, all of them due to their dedication and
commitment to the Spanish Society for Cartography, Photogrammetry and Remote
Sensing



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Opening Remarks

D. FRANCISCO JAVIER GONZÁLEZ MATESANZ
President of SECFT

The 29th International Cartographic Conference, 18th General Assembly of the International Cartographic Association, to be held in July 2019 in Tokyo, will not only be a great opportunity of knowledge exchange between different mapping organisations around the World, but also a real challenge to redesign the World as cartographers have been doing since the beginning of time. This time the title of the event is «Mapping Everything for Everyone», which is something that has been done by cartographers for a long time, and that is absolutely mandatory nowadays since the whole World is connected as all events that happen on it are also connected.

Nowadays it is not common to have a map without a spatial database that not only provides a more efficient way to produce up-to-date maps, but also gives specialised users a geographical tool where the database may receive manifold queries from all types of points of view and retrieve the desired information. From the general user's point of view, the database has to be accessible, up to date, easy to use and all geographic objects contained shall keep a coherence among them.

The challenge without any doubt is to have the most sensitive objects updated in the database since the classic production workflows turns unaffordable as far as objects are maintained as a whole. A strategy change arises, keeping the core information updated, through quality assurance environments with territory listeners to evidence changes on the territory. This strategy not only allows competitive geographical information compared with other commercial services but it also keeps cartographic products and any other GIS services updated continuously with fresh information.

The Spanish Society for Cartography, Photogrammetry and Remote Sensing (SECFT) provides a great interest on this strategic approach because some members of the Executive Board are involved in this transformation. On this occasion in Tokyo we want to present this Spanish National Report as a good example of that interest. With it, we want to present the most important achievements of the Spanish activity both in geographical information and in cartography.

Furthermore, within the framework of the International Cartographic Conferences, Spain through SECFT presented four years ago a candidature to a Vice-Presidency of the Executive Committee of ICA. Pilar Sánchez-Ortiz was elected in the year 2015 and has been Vice-President of the Executive Committee of ICA these last four years with outstanding results. Now SECFT is presenting Andrés Arístegui as the new Spanish candidate to a Vice-Presidency of the Executive Committee of ICA for the 2019-2023 period. His election would guarantee that Spain, Member state of ICA since its foundation in 1959, may continue working hard for ICA over the next four years both in the Executive Committee and in the various existing Commissions.



Members of SECFT Executive Committee, Vice-President of EC-ICA (2015-2019) and the new Spanish candidate to Vice-President of EC-ICA for the 2019-2023 period. Madrid 2019



Introduction

The Spanish Society for Cartography, Photogrammetry and Remote Sensing (SECFT) is the representative in Spain for both the International Cartographic Association (ICA) and the International Society for Photogrammetry and Remote Sensing (ISPRS). Hence Spain has been present over the last fifty years in all biannual international conferences organised by ICA (*ICC1962.1, Frankfurt, Germany - ICC2017 Washington D.C., USA*), and in all nine quadrennial conferences organised by ISPRS (*XIV ISPRS Congress 1980, Hamburg, Germany – XXIII ISPRS 2016, Prague, Czech Republic*). Moreover SECFT has also been the representative for both the Spanish cartographic sector in all general assemblies of ICA, and the Spanish photogrammetric and remote sensing sector in all general meetings of ISPRS.

The International Cartographic Exhibition 2019 can be joined using the SECFT webpage



The work carried out by SECFT is noteworthy in terms of organising the Spanish contribution to the international map exhibitions held at ICA Cartographic Conferences over the last 24 years. Spanish cartography has been awarded 27 times altogether over the last years, i.e. Barcelona (Spain) 1995, Ottawa (Canada) 1999, Durban (South Africa) 2003, Corunna (Spain) 2005, Moscow (Russia) 2007, Santiago (Chile) 2009 and Washington DC (USA) 2017.

On the occasion of the 29th International Cartographic Conference to be held in Tokyo (Japan), SECFT has included a link on its webpage so that everybody may join ICC2019 and Barbara Petchenik 2019 International Competition (to be observed at www.secft.es). As a result, a vast representation of the Spanish cartography including all main institutions will be present in Tokyo.

SECFT has received the support of all main cartographic institutions in Spain, i.e.

- National Geographic Institute of Spain/National Center for Geographic Information (IGN-CNIG)
- Spanish Army Geographic Center (CEGET)
- Spanish Hydrographic Office (IHM)
- Cartographic and Photographic Center. Spanish Air Force (CECAF)

- Geological and Mining Institute of Spain (IGME)
- Spanish Institute for Oceanography (IEO)

One of the main targets of these International Cartographic Conferences is to enable knowledge and experience exchange among professionals who develop their work in the academic world, in the official cartographic agencies or in companies specialised in these sectors. In this respect, the various reports of activities presented at the different International Cartographic Conferences play an important role as they are an essential tool

International Cartographic Exhibition, Tokyo (Japan) ICC2019

ICA National Member

Spain-Sociedad Española de Cartografía, Fotogrametría y Teledetección (SECFT)

Proposal of maps distribution on panels



Proposal of map
distribution on panels at the
International Cartographic
Exhibition ICC2019 Tokyo

for knowing and becoming acquainted with cartographic knowledge, trends and working methods in the manifold countries of the world. The *SECFT* Board has been paying special attention to preparing reports on the different activities since they are very useful for promoting and showing the goals achieved between meetings, as well a great source of historical information on the achievements of the cartographic development along time.

Nowadays all reports submitted since 1999 (1999-2003, 2003-2007, 2007-2009, 2007-2011, 2011-2013 and 2011-2015) may be consulted online on the SECFT webpage www.secft.es (see its [Publications - National Reports](#) section) as well as on the ICA webpage www.icaci.org (see the [Members-National Reports](#) section) and on the Archive.

The role of the Spanish participation in international conferences has been growing steadily. We hope this contribution will continue developing during the present Conference held in July 2019 in Tokyo (Japan).

Undoubtedly Spain is a country closely linked to ICA and it is one of the countries that has most contributed to the international cartographic community. Spain is the only country in the World that has hosted three international cartographic conferences apart from Germany, i.e. Madrid 1975, Barcelona 1995 and Corunna 2005. Spain has been actively contributing to the development of ICA for over 50 years, since its very foundation in 1959.

SECFT has taken part continuously in various projects of ICA, especially in developing projects and programs of maps and geographic information dissemination, as well as promoting study meetings and forums on matters of common interest.



SECFT Board presented during the International Conference ICC2015, held in Rio de Janeiro (Brazil), the candidature of its Secretary General, Pilar Sánchez-Ortiz, to become Vice-President of ICA for the period 2015-2019. She was elected for four years. During this period SECFT has promoted and sponsored international projects carried out following the Spanish duties on EC-ICA-VP.

El mundo de los mapas



The first project made by the SECFT in the period 2015-2019 was the translation into Spanish of the book «The World of Maps», known in Spanish as «El Mundo de los Mapas». This project was included in the ICA International Project known as IMY 2015-2016, what stands for International Map Year 2015-2016. This translation is one of the most important cooperation works carried out between ICA and SECFT and seeks to ease the access to this document of geographical interest to

the international Spanish speaking cartographic community. The proposal to carry out this task was offered to SECFT by the managers and coordinators of ICA Bengt Rystedt and Ferjan Ormeling. Furthermore SECFT helped translating the logo «We love maps» into Spanish, what came to be the two logos «Nosotros amamos los mapas» and «Yo amo los mapas».

<https://mapyear.icaci.org/el-mundo-de-los-mapas/>

This project is published in different websites, i.e.



ECFT website www.secft.es



ICA website <https://icaci.org/publications/the-world-of-maps/el-mundo-de-los-mapas-spanish/>



National Geographic Institute of Spain (IGN) website <http://www.ign.es/web/ign/portal/publicaciones-boletines-y-libros-digitales#DA-libro-elmundomapas>

Pilar Sánchez-Ortiz, Vice-President of ICA Executive Committee during the period 2015-2019 and Secretary General of SECFT, has promoted several activities related to the tasks linked to this Vice-Presidency <http://icaci.org/executive-committee/pilar-sanchez-ortiz-rodriguez/>

These activities may be assigned to three ICA Commissions, i.e.

- ❖ Commission on Cartographic Heritage into the Digital

The 13th Conference on Cartography and Heritage was held in Madrid (Spain) from the 18th to the 20th of April 2018. This event was extremely successful and was appointed by the Chair and the ICA team as the best event ever held within this Commission <http://cartography.web.auth.gr/ICA-Heritage/Madrid2018/>



Picture of the website and the official poster to the 13th Conference on Cartography and Cartographic Heritage of the International Cartographic Association (ICA) including the official logos for ICA, ICA Commission on Cartographic Heritage into the Digital, SECFT, National Geographic Institute of Spain, Spanish Army, Spanish Royal Navy and National Library of Spain

SECFT, together with the Map Library of the National Geographic Institute of Spain (IGN), organised the event and succeeded in including in the conference the most important Spanish institutions storing ancient maps, such as the Spanish Army, the Spanish Royal Navy and the National Library of Spain. All participants in the conference were invited by these three institutions, together with the National Geographic Institute of Spain, to visit their Map Libraries where a vast quantity of ancient maps of great interest is held.



Participants at the
Conference in Madrid in
the year 2018



From left to right: F. Javier González Matesanz, President of SECFT and Deputy Head for Cartography at the National Geographic Institute of Spain; László Zentai, Secretary General of ICA; Amador Elena Córdoba, Head of the National Geographic Institute of Spain; Pilar Sánchez-Ortiz, Vice-President of ICA and Secretary General of SECFT; Evangelos Livieratos, Chair of the ICA Commission on Cartographic Heritage into the Digital. Madrid, April 2018

These international events are of great interest to professionals as they offer the opportunity to promote techniques and processes that ease an access to cartographic resources and treasures that are otherwise invisible.



Professor Evangelos Livieratos gives the Recognition to Pilar Sánchez-Ortiz Rodríguez (EC-ICA VP). Thessaloniki, (Greece) 2019



In the context of the 14th International Conference on Digital Resources for Cartographic Heritage held in Thessaloniki (Greece) from the 8th to the 10th of May 2019, the President of the Commission on Cartographic Heritage into the Digital, Prof. Evangelos Livieratos, gave a Recognition to Pilar Sánchez-Ortiz (EC-ICA VP) in appreciation to her dedication and commitment to the Commission. This was carried out in the presence of Prof A. Stogiannidou, Vice Rector of Aristotle University of Thessaloniki (AUTH); M. P. Ray, Consul general of France in Thessaloniki; Georg Gartner, Past-President of the Executive Committee of ICA and professor at Vienna University; Javier G. Matesanz, Deputy Head for Geodesy and Cartography at the National Geographic Institute of Spain and President of SECFT; Marcos Pavo López, Head of the Central Cartographic Registry; and the rest of participants at the 14th International Conference. In response, Pilar Sánchez-Ortiz, Head of Thematic Mapping and National Atlas, gave a copy of the new National Atlas of Spain to the Library of Aristotle University of Thessaloniki.

❖ Commission on Cartography and Children

Spain plays an important role in Barbara Petchenik International Map Competition. This event was created in the year 1993 in honour of Barbara Petchenik, an American cartographer who promoted mapping among children. The main target of this competition is to encourage children to share their vision of the World by drawing creative maps. SECFT has helped organising this competition since 2015 by publishing the rules of the competition on its website and encouraging children to take part in it. This enables many Spanish children to take part in the international competition as they will in Tokyo in July 2019 during the 29th International Cartographic Conference.

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BARBARA PETCHENIK CHILDREN'S WORLD MAP DRAWING COMPETITION-2019
ICA MEMBER-SOCIEDAD ESPAÑOLA DE CARTOGRAFÍA, FOTOGRAMETRÍA Y
TELEDETECCIÓN-SECFT-SPANISH SOCIETY OF CARTOGRAPHY

CONCURSO DE DIBUJO BARBARA PETCHENIK 2017

CONCURSO BARBARA PETCHENIK CHILDREN MAP COMPETITION 2015.

Para esta convocatoria se seleccionaron seis obras que representaron a España y compitieron en agosto de 2015 en Río de Janeiro (Brasil), coincidiendo con la celebración de la 27ª Conferencia Internacional de Cartografía y que mostramos a continuación.

CONCURSO BARBARA PETCHENIK CHILDREN MAP COMPETITION 2013.

Para esta convocatoria se seleccionaron seis obras que representaron a España y compitieron en agosto de 2013 en Dresden (Alemania), coincidiendo con la celebración de la 25ª Conferencia Internacional de Cartografía y que mostramos a continuación.

ES-1: "THE WISE TURTLE"
PAULA PEÑA- 12 AÑOS

ES-2: "THE SAVING MAGNET"
BLANCA SÁNCHEZ- 12 AÑOS

ES-3: "ALWAYS LOVING DISCOVERING"
ALBA SERRANO- 13 AÑOS

ES-4: "GOOD MORNING WORLD"
NOEMI SÁNCHEZ- 14 AÑOS

ES-5: "THOUSAND DIRECTIONS"
ÁNGELA NUÑEZ - 14 AÑOS

ES-6: "THE TREE"
LUCÍA REJÓN - 14 AÑOS

TERMINACIÓN DEL CONCURSO DE DIBUJOS BARBARA PETCHENIK 1993-

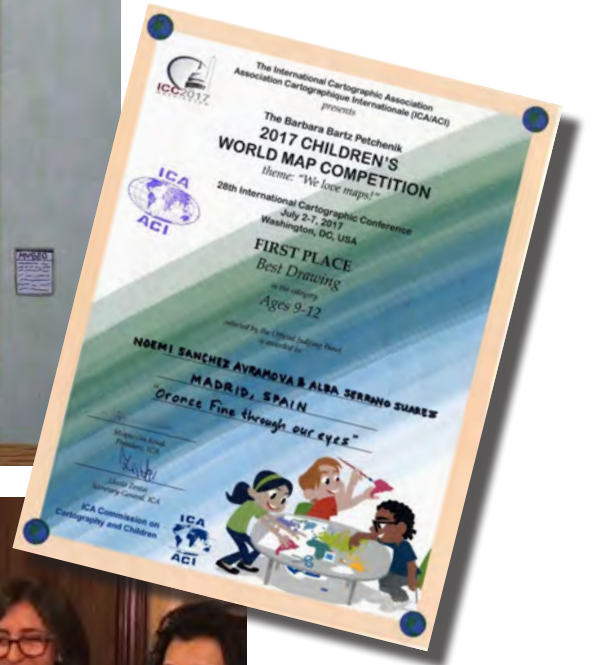
<http://www.ica.org/>

<http://icc2019.org/>

Spanish contribution to Barbara Petchenik Children's World Map Drawing Competition International Competition 2019



«Oronce Fine through our eyes», completed by 12 year old Noemí Sánchez Avramova and Alba Serrano Suárez, first award in the 9-12 year old category



Prize delivery to the children Noemí Sánchez and Alba Serrano by Javier G. Matesanz, President of SECFT, and Pilar Sánchez-Ortiz, Secretary General of SECFT. Madrid, October 2017



Pilar Sánchez-Ortiz Rodríguez (Spain) has been a member of the Jury of Barbara Petchenik Map Competition in the years 2015, 2017 and 2019.

On the occasion of the 28th International Cartographic Conference in Washington D.C. (USA)-ICC2017, Spain received the First Award in the 9 to 12 year old category. A map called «Oronce Fine through our eyes», completed by Noemí Sánchez Avramova and Alba Serrano Suárez, pupils at Arturo Soria School in Madrid, was elected among 193 maps coming from 34 different countries.

SECFT newsletter

The Spanish Society for Cartography, Photogrammetry and Remote Sensing (SECFT) was created in 1977. Throughout this long period of time, SECFT has devoted its efforts to the dissemination of national and international initiatives related to cartography, photogrammetry and remote sensing. Hence a SECFT Newsletter was founded and is published every six months. It is dedicated to promote the knowledge of what is cutting-

BOLETÍN INFORMATIVO DE LA

SECFT

SOCIEDAD ESPAÑOLA DE CARTOGRAFÍA, FOTOGRAMETRÍA Y TELEDETECCIÓN

N.º 20 • JULIO 2018

Favorecer el progreso científico
Promover el conocimiento
Impulsar la unión entre profesionales

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Madrid sede de la 13ª Conferencia Internacional «Digital Approaches to Cartographic Heritage» - ICA Commission on Cartographic Heritage into the Digital

La Sociedad Española de Cartografía, Fotogrametría y Teledetección (SECFT), como representante nacional de la Asociación Cartográfica Internacional (ICA), ha promovido la celebración en España de la 13ª Conferencia Internacional de la ICA sobre Recursos Digitales para el Patrimonio Cartográfico, durante los días 18, 19 y 20 de abril, en la sede central del Instituto Geográfico Nacional (IGN-CNIG) en Madrid, esta conferencia ha sido organizada por la SECFT y la Comisión de Cartografía y Patrimonio de la ICA, con el patrocinio del IGN-CNIG, y ha contado con la valiosa e imprescindible colaboración de tres importantes instituciones oficiales de Madrid, todas ellas con vasto Patrimonio Cartográfico Histórico de enorme valor: la Biblioteca Nacional de España, el Museo Naval de la Armada Española (Ministerio de Defensa) y el Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército de Tierra (CEGET), (Ministerio de Defensa). Estas tres generosas instituciones han ofrecido a los profesionales que participaron en el evento enriquecedoras visitas guiadas para conocer su importante patrimonio cartográfico que evidencia el verdadero activo atesorado en España.

Canal de la Conferencia Madrid 2018 con los logos oficiales de las instituciones participantes.

La conferencia fue inaugurada por F. Javier González Matesanz, Presidente de la SECFT y Subdirector General de Geodesia y Cartografía del IGN junto con Mónica Grobo López, Secretaria General del IGN-CNIG representando ambos al Comité Organizador Local, y en representación del Comité Organizador Internacional por Lisako Zentil, Secretario General de la ICA y Evangelos Livieratos, Chair de la Comisión de Cartografía y Patrimonio de la ICA.

La ceremonia de apertura fue llevada a cabo por Marcos Pavo López, Jefe de Área del Registro Central de Cartografía (Archivo Histórico Cartográfico, Biblioteca Cartográfica) del IGN y Pilar Sánchez-Oña Rodríguez, Vice-Presidenta del Comité Ejecutivo de la ICA, enlace entre la Comisión de Cartografía y Patrimonio y el Comité Ejecutivo de la ICA (EC-ICA) y Jefa de Servicio del Atlas Nacional de España (ANE) del Área de Cartografía Temática y Atlas Nacional de la Subdirección General de Geodesia y Cartografía del Instituto Geográfico Nacional (IGN).

En esta conferencia se ha podido apreciar el valor y el protagonismo que tienen las cartotecas, los museos y los archivos cartográficos como autoridades que son garantes en términos de compromiso y ejecución de las políticas públicas necesarias a la hora de

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BOLETÍN INFORMATIVO DE LA

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SOCIEDAD ESPAÑOLA DE CARTOGRAFÍA, FOTOGRAMETRÍA Y TELEDETECCIÓN

N.º 21 • DICIEMBRE 2018

Favorecer el progreso científico
Promover el conocimiento
Impulsar la unión entre profesionales

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España en mapas. Una síntesis geográfica, nueva publicación del Atlas Nacional de España del siglo XXI

España en mapas. Una síntesis geográfica es la nueva publicación de la serie Compendios del proyecto Atlas Nacional de España, en la etapa actual que se ha denominado ANE del siglo XXI (ANE001), obra singular en la producción científica, técnica y gráfica del Instituto Geográfico Nacional, elaborada por el equipo multidisciplinar del Área de Cartografía Temática y Atlas Nacional.

COMPENDIOS ATLAS NACIONAL DE ESPAÑA

ESPAÑA EN MAPAS

Una síntesis geográfica

Se trata de un compendio de la geografía y la historia de España a través de mapas, gráficos, tablas, textos e imágenes interrelacionados y con el objetivo de transmitir lo fundamental del medio natural y humano del país.

La publicación, elaborada por el Instituto Geográfico Nacional, pertenece a la serie Compendios del Atlas Nacional de España.

Con la colaboración de:

La presentación oficial de esta magna obra, fue presidida por el ministro de Fomento D. José Luis Abalos Meco, el 12 de diciembre de 2018, en el Real Observatorio de Madrid, este Atlas fue calificado como sobresaliente y de referencia fundamental. En el acto de presentación también intervinieron el Director General del Instituto Geográfico Nacional (IGN) y Presidente del Centro Nacional de Información Geográfica (CNIG), D. Lorenzo García Asensio, el catedrático D. José Sancho Comín como presidente de la red ANE001 de organizaciones científicas y académicas que participa en la dirección y colaboración científica y el Jefe del Área de Cartografía Temática y Atlas Nacional, D. Alfredo del Campo García.

Esta obra, con una nueva estructura temática y actualizada, presenta de una manera sintética, integrada y razonada la geografía e historia de nuestro país, a través de mapas, gráficos, ilustraciones, imágenes, tablas y textos.

Para contactar

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Pictures of the front pages of Newsletters 20 and 21

edge in these fields of activity. The Newsletter supplements the information provided on the website www.secft.es, enabling its access to professionals of these sectors who work either in the Public Sector, at Universities and/or in private companies. In the year 2019, volumes 20 and 21 of the Newsletter have been completed with a total of 21 articles.

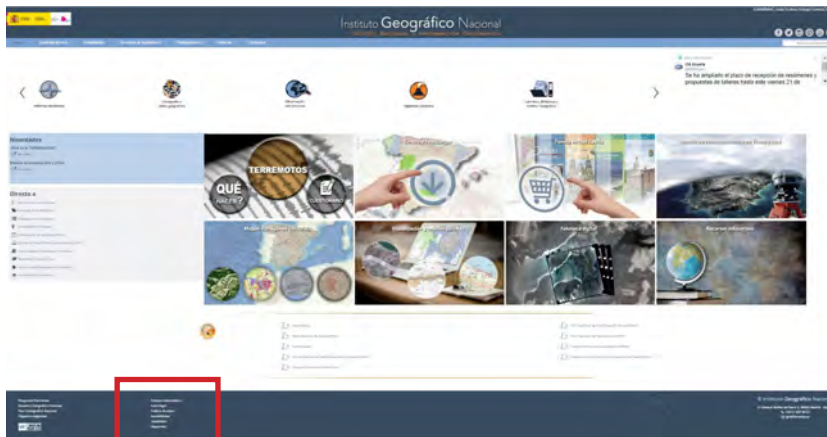
SECFT webpage and social networks

Information related to cartography and geographic information systems both in Spain and abroad has continued being updated and disseminated on SECFT webpage www.secft.es. According to SEO evaluation, SECFT webpage gets a mark of 61%, what provides it with a conspicuous report.

The presence of SECFT on social networks is continuously being improved, especially on Twitter and Facebook.

Cooperation agreements between SECFT and other Societies and Institutions

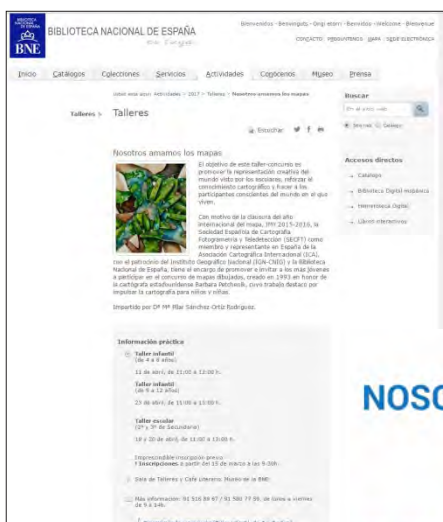
SECFT has been working together with the National Geographic Institute of Spain (IGN) over the last four years on several projects, among others on the translation of the book "[The World of Maps](#)" from English into Spanish.



The National Geographic Institute of Spain includes a link to SECFT website on its homepage <https://www.ign.es/web/ign/portal/info-enlaces-relacionados>



Furthermore SECFT has signed cooperation agreements with some other national and international initiatives related to mapping and satellite images, in particular for developing projects and programs of diffusion and dissemination of cartography and geographic information, promoting study meetings and forums on matters of common interest.



In April 2017 several workshops were completed under the slogan «We Love Maps. Draw your World on a map». The National Library of Spain hosted the workshops in Madrid (Spain) which were organised by SECFT in order to promote the logo of the international year of the map IMY 2015-2016. These events were sponsored by the National Library of Spain www.bne.es and the National Geographic Institute of Spain www.ign.es. These workshops were led by Pilar Sánchez-Ortiz Rodríguez, Vice-President of ICA



National Library of Spain webpage comprising all information related to the workshops carried out by SECFT with the sponsor of the National Library of Spain and the National Geographic Institute of Spain. Logos of the various institutions can be seen



Picture of the poster for promoting Barbara Petchenik Children Map Competition 2019 with a selection of pictures drawn by children which were awarded from 1993 to 2017. Official logos of the organising and sponsoring institutions of the workshops are to be observed on the poster.

Participants at the workshop



Multipurpose room of the National Library of Spain where the workshops were carried out. Cartographic material may be observed on the picture.



Some of the professionals who took part in the workshops can be observed on the picture, from left to right: Mario López Ruiz (National Library of Spain), Montserrat Pérez Botet (National Geographic Institute of Spain), Marisa Corral Magro (National Library of Spain), Pilar Sánchez-Ortiz Rodríguez (ICA-SECFT- National Geographic Institute of Spain), Lola Abad (SECFT), Belén Ramírez Pérez (National Library of Spain), and Cecilia M. González Martín (SECFT).

Executive Committee (2015-2019), Secretary General of SECFT and Head of the «Thematic Mapping and National Atlas» Department at the National Geographic Institute of Spain. Nevertheless she counted on the cooperation of many professionals whose enthusiasm and excellent performance helped carrying out the project successfully. During the workshops good experiences with children of different ages were tested in the way they approached and discovered maps, read them, learned and showed their ability to draw them.

Similar events were carried out in 2018

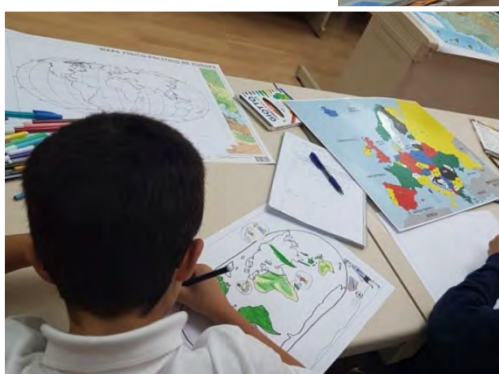
Similar workshops for children aged 9-12 called «We love maps. Draw a map of your World» were carried out in Madrid (Spain) from the 14th to the 18th of November 2018 under the scope of the 18th Science & Innovation Week. These workshops were hosted by the National Geographic Institute of Spain and were sponsored by the Geographic Information National Centre.



Pictures of the maps drawn by participants at the workshop



Room at the National Geographic Institute of Spain comprising cartographic material used for the 2018 workshop



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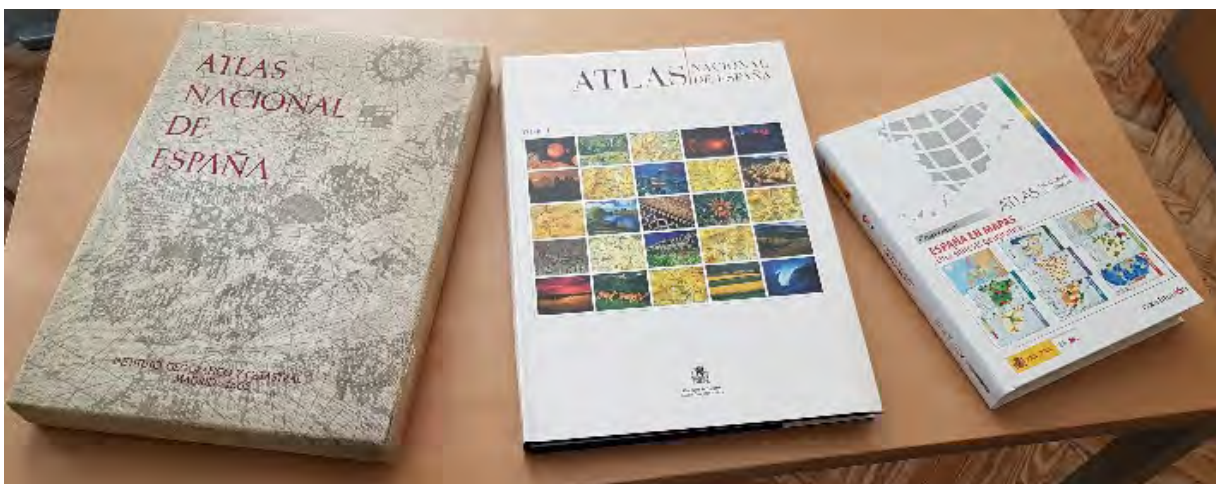
Since its foundation in 1870, the National Geographic Institute of Spain (IGN) has been engaged in scientific researches and production activities in the field of mapping. IGN is also involved in projects related to astronomy, geodesy, geophysics, photogrammetry, remote sensing, geographic information systems, spatial data infrastructures and administrative boundary lines.

National Atlas of Spain

The National Atlas of Spain is a compendium of maps, charts, reports, tables and photographs that aims to depict the detailed human and physical geography and history of this Member State of the European Union. Several phases along the History of the National Atlas of Spain can be drawn since the mid 19th Century. The current stage started towards 2010 and is called *National Atlas of Spain of the 21st Century (ANE XXI)*.

The National Geographic Institute of Spain noticed that a new era ought to be launched at the *Department of Thematic Mapping and National Atlas* towards the beginning of the 2010's. New interests by potential users were perceived, several new contents were to be introduced, new technologies offered unique possibilities, cooperation with Universities and other scientific institutions could flourish and the new Atlas could benefit from the vast experience held at the technical working group gathered at the *Department of Thematic Mapping and National Atlas* within the National Geographic Institute of Spain. Therefore deploying a new strategy became crucial.

On the one hand, the technical direction and the coordination of this new Atlas was kept at the *Department of Thematic Mapping and National Atlas* within the National Geographic



Members of Red ANEXXI

This publication *Spain on Maps. A Geographic Synopsis* has been accomplished by the National Geographic Institute of Spain in cooperation with a working group called red ANEXXI that includes a wide range of scientific and academic organisations, i.e.

Asociación de Geógrafos Españoles / Association of Spanish Geographers
Biblioteca Nacional de España / National Library of Spain
Instituto de Economía, Geografía y Demografía del Consejo Superior de Investigaciones Científicas CSIC / Spanish High Council for Scientific Research – Committee for Economy, Geography & Demography at the Social Sciences Office
Real Academia de la Historia / History Royal Academy of Spain
Universidad Autónoma de Madrid / Autonomous University of Madrid
Universidad Carlos III de Madrid / King Charles III University of Madrid
Universidad Complutense de Madrid / Complutense University of Madrid
Universidad de Alcalá / University of Alcalá
Universidad de Alicante / Universitat d'Alacant / University of Alicante
Universidad de Burgos / University of Burgos
Universidad de Cádiz / University of Cádiz
Universidad de Cantabria / University of Cantabria
Universidad de Castilla-La Mancha / University of Southern Castile
Universidad de Córdoba / University of Córdoba
Universidad de Extremadura / University of Extremadura
Universidad de La Laguna / University of La Laguna
Universidad de La Rioja / University of Rioja
Universidad de Las Palmas de Gran Canaria / University of Las Palmas de Gran Canaria
Universidad de León / University of León

Universidad de Málaga / University of Málaga
Universidad de Murcia / University of Murcia
Universidad de Navarra / University of Navarra
Universidad de Oviedo / University of Oviedo
Universidad de Salamanca / University of Salamanca
Universidad de Sevilla / University of Seville
Universidad de Valladolid / University of Valladolid
Universidad de Zaragoza / University of Saragossa
Universidad del País Vasco / Euskal Herriko Unibertsitatea / University of the Basque Country
Universidade de Santiago de Compostela / University of Santiago de Compostela
Universidad Isabel I / Queen Elizabeth I of Castile University
Universidad Nacional de Educación a Distancia / Spanish Distance Course National University
Universidad Pública de Navarra / State University of Navarra
Universitat Autònoma de Barcelona / Autonomous University of Barcelona
Universitat de Barcelona / University of Barcelona
Universitat de les Illes Balears / University of the Balearic Islands
Universitat de Lleida / University of Lleida
Universitat de València / University of Valencia
Universitat Jaume I / Jaume I University of Castellón

Red ANEXXI has been sponsored by



Institute of Spain. This included gathering texts, drawing maps, printing, publishing, disseminating and giving a legal support to the new Atlas. On the other hand, arranging a new thematic structure and developing the scientific contents was approved to be led by a scientific network called *Red ANEXXI* which includes 140 researchers and professors who work at 34 Spanish Universities as well as at the National Library of Spain, the History Royal Academy of Spain, the Association of Spanish Geographers and the Institute for Applied Economy, Geography & Demography at the Spanish High Council for Scientific Research.

SECTION I CARTOGRAPHY IN GEOGRAPHY

- Chapter 1 Mapping Geographic Knowledge
- Chapter 2 General Cartography and Toponymy

SECTION II PHYSICAL GEOGRAPHY

- Chapter 3 Earth Structure and Landforms
- Chapter 4 Climate and Hydrosphere
- Chapter 5 Biogeography and Soils

SECTION III HISTORY

- Chapter 6 Historical overview

SECTION IV POPULATION, SETTLEMENTS AND SOCIETY

- Chapter 7 Population
- Chapter 8 Urban Settlements
- Chapter 9 Society

SECTION V ECONOMY

- Chapter 10 Farming, Forestry and Fishing
- Chapter 11 Manufacturing, Construction, Energy, Mining and Quarrying
- Chapter 12 Tourism
- Chapter 13 Sales, Services and Trade

SECTION VI SOCIAL FACILITIES

- Chapter 14 Education, Science, Culture and Sports
- Chapter 15 Health and Social Care
- Chapter 16 Justice and Home Affairs

SECTION VII TRANSPORT AND DIGITAL SECTOR

- Chapter 17 Transport
- Chapter 18 Digital sector

SECTION VIII INTERNAL TERRITORIAL STRUCTURES

- Chapter 19 Treasury, Business and Labour Market
- Chapter 20 Landscape
- Chapter 21 Environment
- Chapter 22 Regions and Local Government

SECTION IX SPAIN IN THE WORLD

- Chapter 23 Spain and the Global Context
- Chapter 24 Spanish presence in the World



His Majesty King Felipe VI giving the «Communication Award SGE 2018» from the Spanish Geographic Society to the Head of the National Geographic Institute of Spain in relation to the National Atlas of Spain. Madrid, April 2019

Funding for this scientific cooperation was obtained from Santander Bank. Also 200 experts not included in *Red ANExxi* were consulted.

As a result of this stage, a new Atlas called «*Spain on Maps. A Geographic Synopsis*» was published. It is included in the *Synopsis Series* of the National Atlas of Spain. This new Atlas was unveiled in Autumn 2018 by the Minister of Development of Spain. Only four months later it received an award from the Spanish Geographic Society given by His Majesty King Felipe VI.

This new Atlas is divided in 24 chapters. The first chapter is devoted to the art of mapping, the image of Spain along History and the role the National Geographic Institute plays in Spanish cartography. Thematic structure continues then with physical geography and the natural environment where the human being settles, what includes geophysics, geology, geomorphology, climate, water resources, coasts, flora, fauna and soils. It then moves on to human geography and how the human being settles nowadays on the Iberian Peninsula as a result of many centuries of human evolution in Southern Europe. This includes history, demography, urban settlements, society, economy, social facilities and transports. Finally, this new Atlas is completed with two chapters devoted to the territorial structures, political divisions and institutional organisations within Spain as well as how Spain as a whole is included in the European Union, is linked to Latin America and is integrated in the global context.

Nearly 1200 graphic contents have been included along its 620 pages, 827 of which are maps. Data have been provided by over 125 national and international official organisations, primarily by the different departments, agencies and public bodies of the National Government of Spain. It comprises different types of maps, i.e. thematic maps considering various aspects of life and nature, maps showing how those aspects have changed over time, maps comprising various geographic areas, etc.

This publication is available at:

- A paper hardback version of this publication is available at the **Online Shop** under <https://www.cnig.es>
- The whole book may be downloaded on a digital format at the National Geographic Institute **website** under the digital book section at <http://www.ign.es/web/publicaciones-boletines-y-libros-digitales>
- Whole chapters and graphic contents may be displayed and downloaded at the National Geographic Institute of Spain **website** <http://www.ign.es/web/ign/portal/espana-en-mapas>
- Data, metadata and shape files may be obtained (if licences allow so) at the **Download Center** under *Thematic Maps of the National Atlas of Spain* at <http://centrodedescargas.cnig.es/CentroDescargas/catalogo.do?Serie=RTANE#selectedSerie>
- Maps and graphic contents may be accessed by means of a thematic search at **El Buscón** (which stands for *The Searcher*), based on the Atlas Thesaurus at <http://www.ign.es/ane/bane/>
- Base maps may be downloaded under *CartoBaseANE* (which stands for Base Cartography for the National Atlas of Spain) at the **Download Center** at <http://centrodedescargas.cnig.es/CentroDescargas/catalogo.do?Serie=RTANE#>

Furthermore a new Geoportal of the National Atlas of Spain has been developed from January to March 2019 in order to improve internet dissemination. This new Geoportal is now available under <http://atlasnacional.ign.es/wane/>. MediaWiki technology has been used for developing this new Geoportal.

In March 2019 Chapter I.1.1. of the National Atlas of Spain called *The image of Spain along History* has started being extended so that it may become a monograph. Its current 12 pages that include a text and 20 maps shall be developed and expanded into a full book of about 400 pages including 200 maps. This work ought to be carried out along the year 2019 so that it may be printed and published on the internet early next year. This work will be part of the *Monograph Series* that intends to extend all contents included briefly in this *General Series* of the National Atlas and delve into specific fields of inquiry. Also, cross curricular subjects such as social policies may also be expanded and deepened in this monographs over the coming years.

In April 2019 a new Interactive Atlas has started being developed. It will hopefully be available by Autumn 2019. Graphic contents on the internet shall become interactive or animated and shall be subject to further edition. Two different technologies, i.e. ArcGISOnline and Geoclip, are being used to make maps become interactive.

Another major target for the coming months is keeping all resources updated on all conduits for information. Chapters related to Human Geography such as economic indicators, social facilities, transports, etc. tend to get quickly out-of-date. Therefore, gathering the latest existing information from other official institutions and depicting it on maps that may help understanding trends, strengths and weaknesses of the country is a major task. In June 2019, the Atlas published in 2018 has started being updated.

Land Observation

Land Observation constitutes a fundamental activity in the proper management of policies that are based on a detailed and precise knowledge of the spatial environment. Continuous changes on the territory must be updated from time to time in order to ease an efficient and sustainable economic development. Technological progress has improved land observation methods by providing the necessary mechanisms for acquiring precise and quality information in a shorter period and at a lower cost.

The responsibility of providing useful datasets, services and knowledge to Spanish users rests on the National Geographic Institute of Spain (IGN), as it is the competent authority for geographic information at a national level.

IGN defined in the year 2014 a set of institutional strategic principles aligned with European INSPIRE Directive, United Nations Perspective and users' needs to generate Geospatial Reference Information (GRI). GRI is defined as the basic geospatial information able to organise any subsequent actions that may take place on the territory. GRI acts as a skeleton of geo-infrastructures where other geospatial information may be located or mapped. GRI in IGN brings and fulfills the principles assumed in international initiatives such as:

- GRI is organised following essential themes considered in the European INSPIRE Directive annexes I and II and in its transposition to the Spanish law LISIGE, as well as according to UN GGIM Fundamental Data Themes.
- Adopt new data models for ensuring interoperability and new production systems that this type of information demands.
- Adapt the processes and updating time of GRI to the current users' needs.
- Identify and prioritise users' communities, i.e. National Public Administration, rest of the Spanish Public Administration, European programs and initiatives, Global requirements, academic and business sectors and the rest of stakeholders.
- GRI grows from the reengineering production processes at IGN, which is able to create the core and essential subset information. This core information is completed afterwards by the closely related geospatial information supplied by other Public Administrations. Altogether there is a broad GRI that is suitable for all users.
- Technical aspects of GRI should be described by the objectivity, accuracy, automatic and timeliness, coming from users' needs.

Accordingly, IGN considers Land Observation and GRI as key activities in leading the cartographic activities it is assigned with. From the Land Observation Unit, which is part of the General Division for Geodesy and Cartography, IGN carries out the following tasks:

- The management and development of national plans for territory observation for geographic and cartographic applications aligned with relevant initiatives and programs, such as UN GGIM, Copernicus, Inspire, etc.
- The use of photogrammetry and remote sensing systems.

- The production, updating and use of digital terrain models obtained from airborne sensors.
- The production, updating and use of geospatial reference information of Land Cover & Land Use, Hydrography and Settlements, according to national, European and international requirements, and also in line with other international initiatives such as UN GGIM, Copernicus, Inspire, etc.

Since 2004 this activity revolves around the National Plan for Land Observation (PNOT), led by the National Administration via various Ministries and Regional Administrations. It is thus a cooperative plan that pools technical, logistical and economic efforts through complex mechanisms of inter-administrative coordination led by the National Geographic Institute of Spain / National Center for Geographic Information (IGN / CNIG).

PNOA Image

The National Plan for Aerial Orthophotography (PNOA) provides regular coverage (each 3 years) of the whole national territory via very high resolution aerial orthophotographs: PNOA25/50 (25/50 cm) and PNOA10 (10 cm).

<http://pnoa.ign.es/presentacion-y-objetivo>



Orthoimagery from PNOA

PNOA Lidar and DEMs

PNOA also provides regular coverage of digital elevation models for the whole Spanish territory based on different grid values (25m, 5m and 2m). These DEMs have been obtained

from LIDAR datasets with a density of 0.5p/m² among other derived altimetric products such as land classification, contour lines, etc.

<http://pnoa.ign.es/presentacion>



Headquarters of the National Geographic Institute of Spain in Madrid, Color Point Cloud, PNOA Lidar

PNT

The National Remote Sensing Plan (PNT) provides regular coverage (annual, monthly and weekly) of the whole Spanish territory via medium and low resolution satellite images (2.5 to 100 m).

<http://pnt.ign.es/>



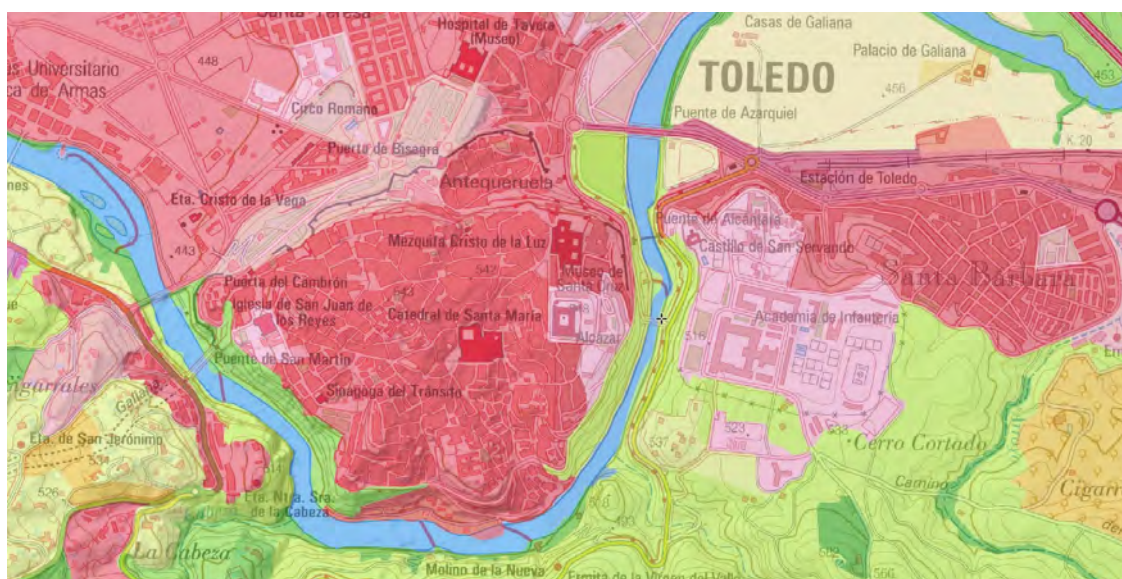
Different colour composition of a PNT image

Basic and thematic geographic information is produced using the coverages provided by PNOA and PNT in a wide range of scales, from a local to a national level, by all cartographic institutions in the country.

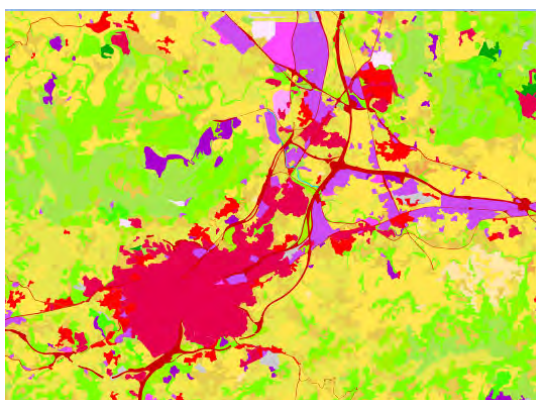
Land Cover and Use: SIOSE

The generation of GRI on Land Cover & Land Use is driven by the Project Information System on Land Cover & Use in Spain (SIOSE) which is based on a common object oriented data model for land cover and land use information. This data model was the reference for land cover information production at a 1:25,000 scale until 2014, and it is currently being new redesigned with improved spatial and thematic resolution for a second generation SIOSE called *SIOSE de Alta Resolución* (High Resolution SIOSE). Semantic and geometric generalisation of high resolution Land Cover data produced by SIOSE project, used for Corine Land Cover 2012 and 2018 production, is a successful example of a bottom-up approach for European land cover & use generation, within the Copernicus Land Services, and it is led in Spain by IGN.

<http://www.siose.es/>



SIOSE dataset



Example of SIOSE generalisation for CLC production

Cartography

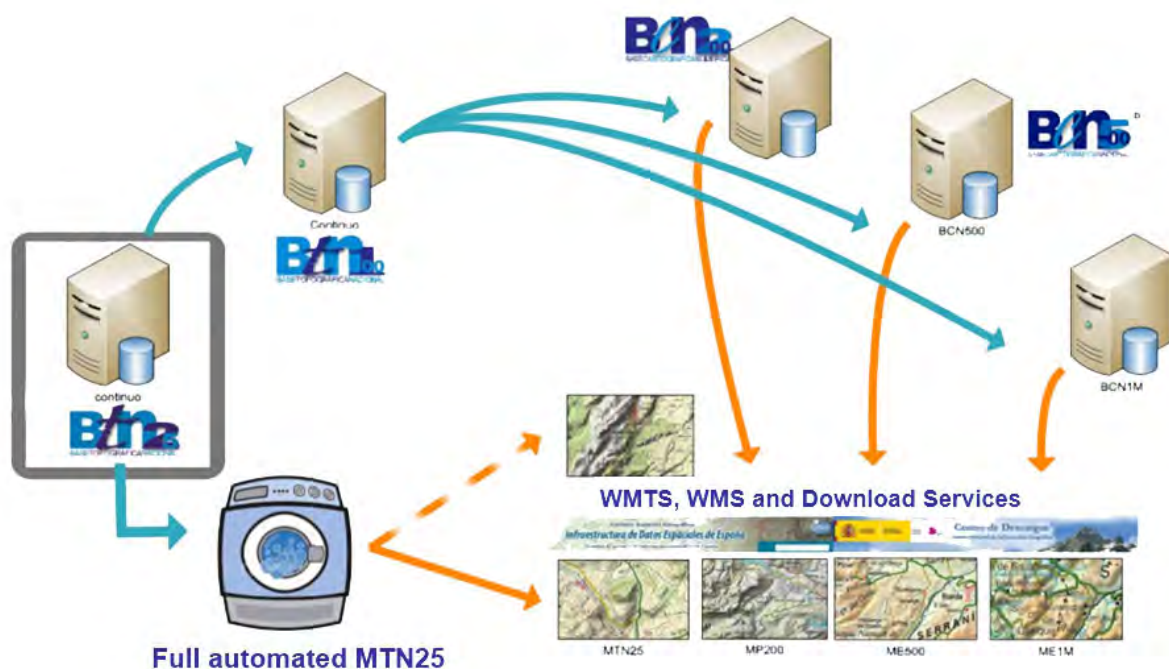
Cartography provides people with knowledge of a territory by interpreting and representing it with maps. Nowadays ancient maps have evolved to many modern versions such as digital maps, cartographic databases and other geospatial information used in geographic information systems to analyse and model phenomena that take place on the territory.

From data acquired by territory observation and other different information sources, cartography thereby constitutes a practical platform that shall be managed from a multidisciplinary outlook (through topographic cartography or as a geometric description of the territory) and from a specific approach (through thematic mapping that emphasizes, develops or includes specific aspects linked to an industrial, cultural, social and/or environmental activity).

A basic need is therefore detected. This requirement is fulfilled by configuring a knowledge and management infrastructure for the territory. Its availability is guaranteed by the Public Administration that promotes its production and updating in order to boost a development that may be economically efficient, environmentally sustainable and useful to society.

Thus, the National Geographic Institute of Spain considers cartographic production, among other duties entrusted to this institution, as a high priority activity that is performed by the General Division for Geodesy and Cartography via:

- Producing and updating of both the Topographical Maps of Spain at 1:25,000 and 1:50,000 scales and the derived maps (provincial maps, regional maps, etc.)



Full production workflow for viewer and download service

- Producing, updating and using nationwide topographic and cartographic bases in order to integrate them into geographic information systems, as well as for shaping the national topographic map and other basic and derived maps.
- Managing mapping laboratories and workshops.
- Creating and updating the National Atlas of Spain and all thematic mapping in support of the National Administration Specific Action Programs.
- Providing technical assistance to public bodies on mapping issues.

Integrated production process

IGN changed its production process in the year 2014. Nowadays, our workflows are based on specialised bases of Geographic Reference Information (GRI).

All mapping series and spatial databases are produced in one global project. This ensures consistency between all products and takes advantage of synergies between the different departments among IGN and between IGN and other public bodies of the National and Regional Administration.

IGN has designed a large and medium scale production workflow, taking into account the growing significance of distributing digital maps and geographic information viewer services that require very quick actions for supplying changes from the real-world to our users.

The efficiency of this workflow is based, on the one hand, on knowing as soon as possible which elements of the real world have changed and loading them into the geospatial information databases immediately. On the other hand, on developing processes for obtaining cartographic products automatically based on information collected in our databases.

That is, the goal is to minimize the gap time between changes in the real world and the updating on our geospatial databases, from where the information is made available to the end user by different means, eg. GIS layers, maps for web services or «hardcopy National Topographic Map editions».

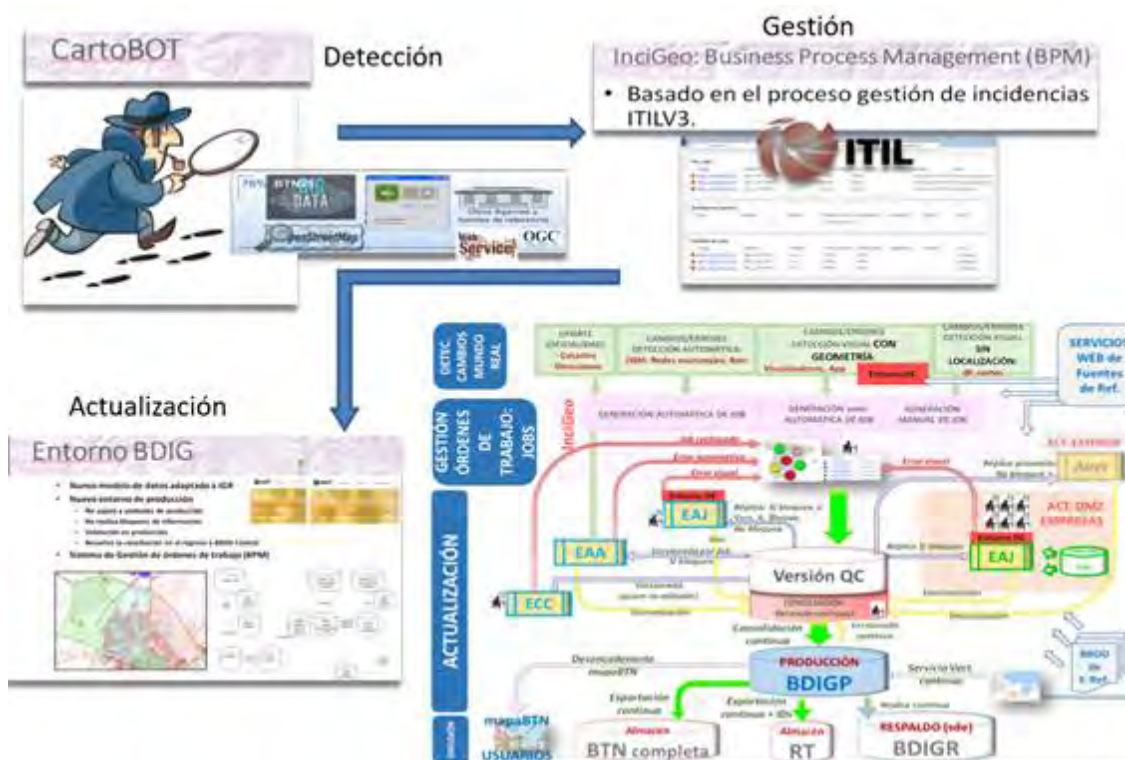
The Program for The Productive Change for Geospatial Information Databases (BDIG): continuous updating for geographic information

In order to improve the efficiency in the continuous updating of spatial features compiled in the geospatial information databases, IGN has launched The Program for the Productive Change for Geospatial Information Databases in 2017 that includes three connected and complementary projects, i.e.

- CartoBot: its aim is to obtain changes from the real world using innovative methods, such as harvesting through web services, Big Data, Artificial Intelligence (AI), etc. without having to abandon completely other classical methodologies.
- InciGeo: this is an application to manage work orders derived from the detected changes. It is based on Business Process Management.

- **BDIG production environment:** its main target is to develop a working environment that allows executing work orders for the joint update of geospatial databases of different themes, thus ensuring consistency.

In addition, this new methodology has got another difference compared to the traditional procedure, since instead of updating large geographical areas (provinces, municipalities or sheets in full), it acts on tiny areas. This means that the areas affected by the real change are managed as an individual job. And these jobs are located only where the real world has changed. In this way, we change from a planned updating system (Predictive) to a more efficient system oriented to where the territory has really changed (Adaptive).



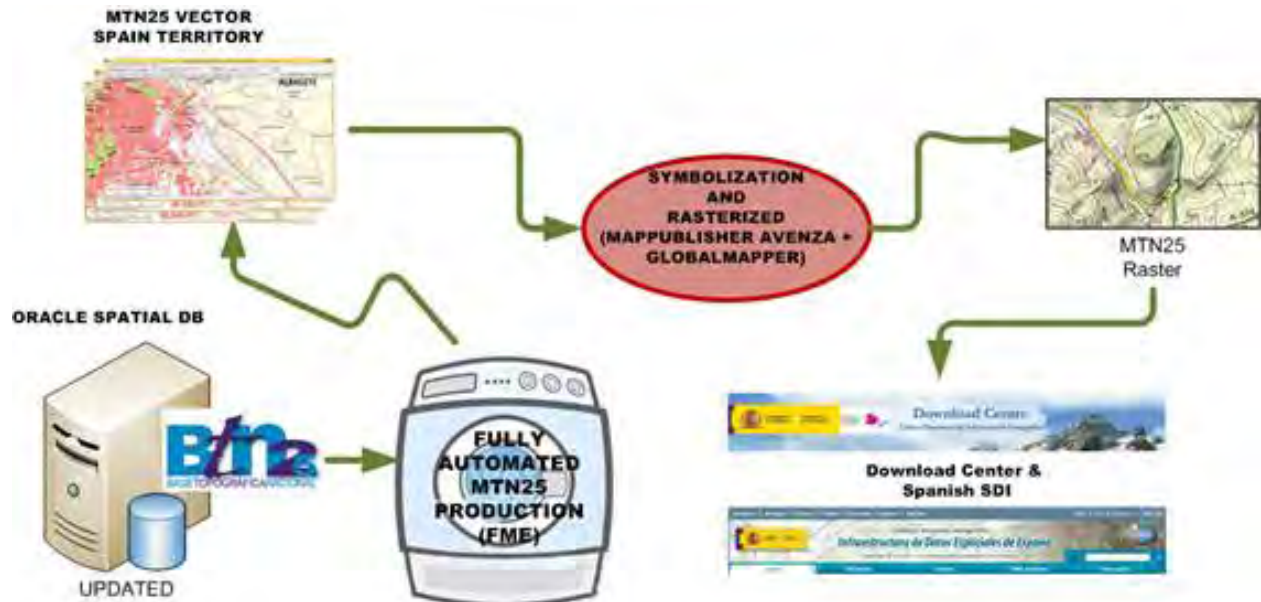
BDIG Program, composed by CartoBot, InciGeo and BDIG production environment projects

Automated production of the National Topographical Map

The need to speed up production to keep our cartographic products updated and reduce time to market has forced IGN to develop an automated tool. This development replaces the set of manual, semi-automated and automated techniques previously used when producing the National Map of Spain at 1:25,000 scale, according to the technological changes carried out in the cartographic production workflows of this institution in recent years.

A vector file is obtained using this new tool which includes a unique FME process that is divided into different sequential threads for the different topics. This file is conceived to be the final product (downloads Web Map viewers and Web services) or to be a hard copy map through a manual simplified edition. A complete description of an automated production workflow is shown on the figure below.

In this way, it is possible to reduce the production time, sacrificing the aesthetic quality of the current map. This goal fulfils the users' requirements since they rather have a more updated product albeit at the expense of a small loss of the final aesthetic quality.



Automated production workflow of the National Topographic Map

Obtaining automated maps means a breakthrough due to two different reasons. First, because it accelerates the process of obtaining the map from the Topographic Database BTN25, and it provides recently updated mapping information. And second, because it allows the institution to redirect employers who are now devoted to editing processes, to BTN25 continuous updating and automation processes.



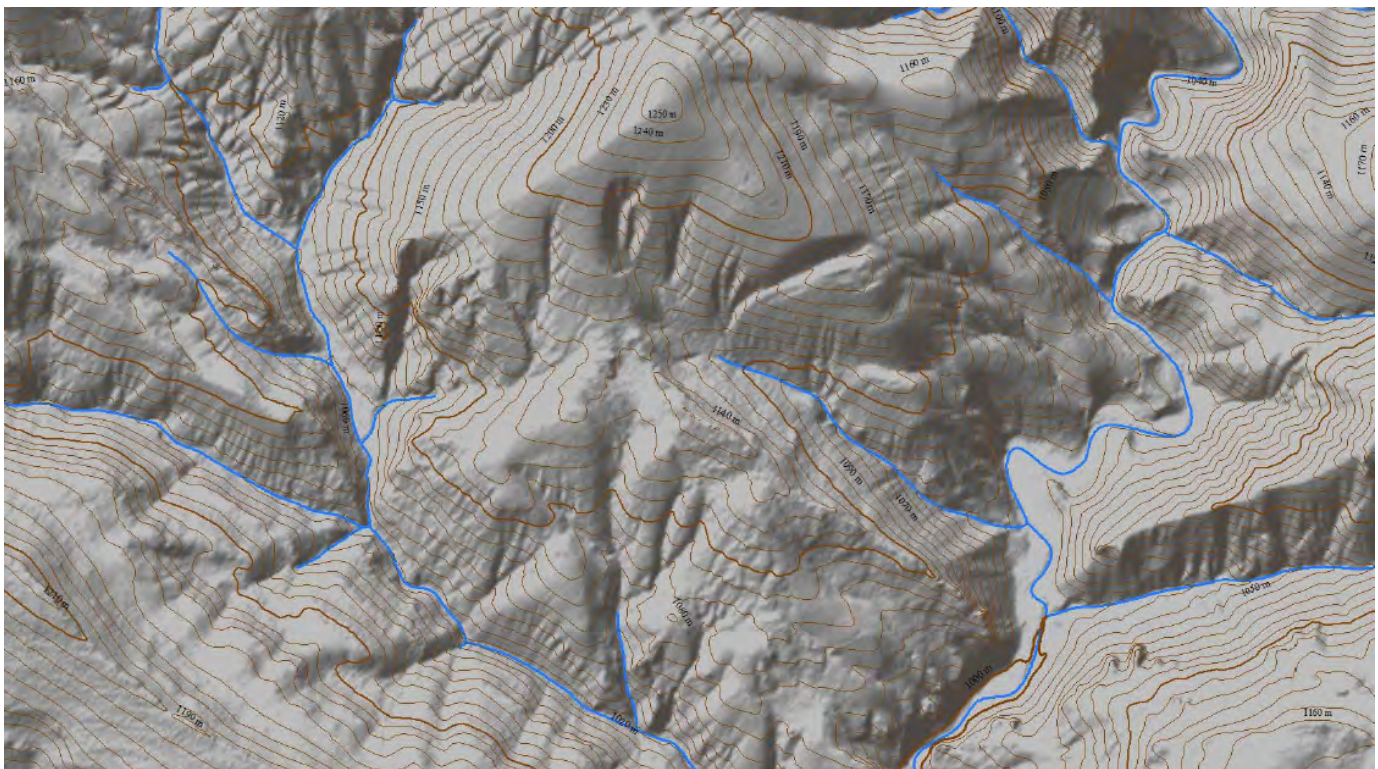
Results of automated mapping process in the town of Cartagena (left: Database raw data; right: automated process output)

Production of Geographic Reference Information

According both to the European Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Union (INSPIRE) and to the Spanish Law transposing this Directive, which is Law 14/2010 of Spatial Data Infrastructures and Services (LISIGE) that encourages data re-use, the National Geographic Institute of Spain (IGN) started in the year 2014 to rethink its data production processes in order to become more efficient and to achieve that all cartographic products sharing a common INSPIRE theme could be derived from a single source, the so-called «Geospatial Reference Information Data Base (GRI)».

GRI Hydrography

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

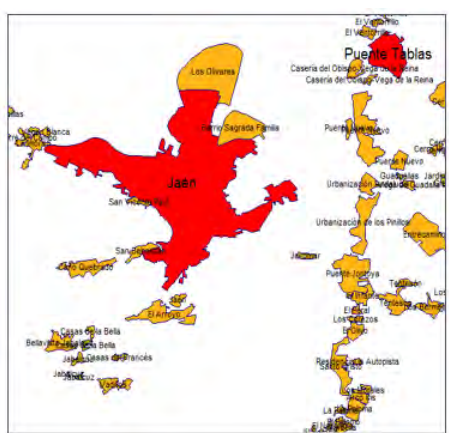


SIOSE dataset

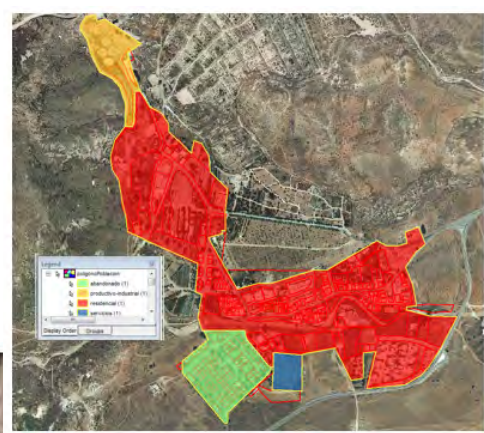
Key points of this work have been managing a big data environment with over 160,000 Lidar data files, as well as creating within six months the infrastructure for storing 40 Tb and their automatic processes. The result of this production is an accurate automatic hydrographic network extracted for the whole country with a significant improvement for the altimetric component of the 3D linear vector as well as coherent with elevation datasets.

GRI Settlements

GRI Settlement production is supported primarily on two criteria, i.e. it is based on cadastral parcels and it is developed by automatic processes. This project aims to provide a high-resolution, nationwide homogeneous spatial information that may satisfy the users' requirements in relation to spatial management of settlements (spatial planning, urban development, environmental protection, statistics, addresses, demography, mapping, etc.). To carry out this work, a methodology was first developed in order to assign automatically the settlement code to the cadastral data. Secondly a manual revision was necessary in order to solve the remaining data. Besides, an automatic method was developed to extract settlement boundaries according to cadastral data, based on the parametrisation of urban development (dispersion degree) and spatial analysis of cadastral data aggregation.



Settlement identification



land use subdivision



boundary extraction

GRI Transport Networks

Since the Transport Networks is one of the most relevant themes of GRI included in INSPIRE Annex I, IGN started working on this dataset so that it could become INSPIRE compliant.

Preliminary works: Data model definition and document delivering

IGN started working in March 2014 on its data model definition, facing a double challenge: the definition of a «Transport Network» (TN) data model compliant with the legal framework and with the cartographic products requirements.

An extension of the INSPIRE data model adding particular feature types and values to some code lists and specifying the INSPIRE values that are applicable to TN contents was needed to fulfil the Spanish requirements. The full process was carried out from INSPIRE data model [.eap](#) files and it is documented on the TN specifications, which are ISO 19131 compliant.

Finally, the data model defined composed of five **3D-linear transport networks (road, rail, air, water and cable)**, where, according to the INSPIRE TN data specifications, the **infrastructures** of every transport mode are **linked to the** corresponding **network**, being all of them connected by means of **multimodal relationships**.



GRI-TN Documentation

First version of the Transport Network Dataset (GRI-TN)

IGN started producing the Transport Network (TN) dataset in the year 2015 as a seamless Geographical Reference Information Database on the whole Spanish territory with a double target:

Creating a seamless, homogeneous and coherent geospatial database of TN data, being both a data product itself and the data source for other cartographic products published by this institution.

Ensuring the INSPIRE compliant answer on TN data from Spain to the European Commission by providing the existing transport geospatial datasets and fulfilling the INSPIRE Implementing Rules before November 2017.

After a three year production process, IGN overcame in March 2017 the challenge of completing its first version of the INSPIRE compliant Transport Network database and providing it through INSPIRE compliant services [discovery (<http://www.idee.es/csw-codsi-idee/srv/spa/csw>), view (<http://www.ign.es/wms-inspire/ign-base>), and download (<http://www.ign.es/wfs-inspire/transportes>).

This TN dataset first version is a seamless Geographical Reference Information Database that covers the whole Spanish territory and which has been created by gathering, homogenising and validating official data (data from IGN and moreover data provided by the main stakeholders in the TN field), in cooperation with some Regional Mapping Institutions.

Right from the beginning, this project has been recognised as a best-practice of INSPIRE implementation on TN data by many Regional Mapping Institutions. Moreover the Cartographic Institute of the Region of Valencia has directly carried out the data production in this region.



Image of the Geographical Reference Information on Transport Network in the urban area of Santander

The maintenance and update of the national INSPIRE compliant Transport Network database

Although the production process has been an arduous work, the next challenge to face seems to be even more complex. It is related to its maintenance according to the update frequency demanded by data transport users. This implies the urge to change the traditional methodology, speeding up and automatising processes to the widest possible extent, in order to shorten both the production and quality validation processes and, simultaneously, fulfil the quality requirements demanded to products published by the National Mapping Agencies.

So far, since the database first version was concluded in March 2017, IGN has been tackling this def by developing processes based on the change automatic detection between GRI-TN and vector and raster information sources. Regards vector data, automatic processes to ease the integration of the updated data provided by the official stakeholders (mainly by the Regional Cartographic Institutions and by the National Ministry of Transports) have been implemented. The objective is to define triggers to locate potential areas to be reviewed with high frequency instead of reviewing the whole reference dataset everytime. Regards raster sources, a pilot project based on Matching Learning (ML) techniques has been undertaken. In this case, comparing images of the same area taken on different dates allows detecting variations on the transport elements to be considered in the data update. Likewise, efforts are being made in order to use ML in data validation and semantic attributes improvement.

In any case, the management of the updating process based on change detection has been implemented according to the INSPIRE identifiers and lifecycle attributes.

Just as GRI-TN big dataset, its maintenance is also structured by transport modes. Thus, the railway, air and water network datasets are updated separately from the road network dataset with a once-twice a year frequency; the whole review of the road and street network conclude every four years although the main roads are updated every year.

Users

Global users may download these open dataset from the IGN [Download website](#) and since January 2019 they can also access data by means of its [viewer](#):

The IGN experience during these years has shown that the TN model is suitable for the Mapping Agencies and it has awakened the general interest among other public bodies of the Spanish Administrations.

Many of the original data stakeholders become GRI-TN users due to the value added on the data after the data source integration procedures carried out during the updating process. Some Regional Mapping Agencies are examples of this kind of users.



GRI_Transport Network viewer

One of the most relevant use case is the **HERMES project**, led by the Ministry of Transports. It is currently under development and aims to be the technological platform to support the information model of the whole Ministry of Transports, which is multimodal and transversal in relation to the Trans-European Transport Network (TEN-T), and within the framework of the General Transport Network within Spain.

In this case, IGN works to provide the geographic reference information of all modes of transport required by this Information System, in accordance with its specific requirements for each mode of transport, such as lightening and simplifying routes of the road network or the redefining the geometric limits of harbours. Thus, HERMES will become the Information System of the Ministry of Transports generated by the contribution of

information from the different stakeholders and, specifically, IGN will be the supplier of the geographic data component.



In blue the original GRI-TN data, in red customized data according to HERMES project requirements

Summary of IGN cartographic products and geographic information databases

❖ National Basic Cartography

- National Topographic Database 25K (BTN25) is the most accurate official seamless topographic spatial data of the whole Spanish Territory that keeps the consistence between different feature classes and the homogeneity in the whole territory. This database is structured in more than 100 feature types; it is important to highlight that it includes hydrographic and transport networks. On the other hand, it is the heart of our joint geospatial production system, so it is the main information source of the National Topographic Map and the rest of Topographic and Cartographic databases.
- National Topographic Map at 1:25,000 (MTN25) scale. Available in paper and digital format (vector and raster), in continuous updating.
- National Topographic Map at 1:50,000 (MTN50) scale. Available in paper and digital format (vector and raster), in continuous updating.

❖ **Derived and Thematic Maps**

- National Topographic Database at 1:100,000 (BTN100) scale. It is a multipurpose geographic information system with 20 m resolution, and it is the main data source of derived cartographic products.
- National Cartographic Database at 1:200,000 (BCN200) scale. It is another multipurpose geographic information system, aimed to provide an easy way to develop cartographic products. BCN200 has a numerical link to BTN100.
- Provincial Maps Series. It is a set of 48 independent maps of Spanish provinces at 1:200,000 scale.
- Regional Map Series. It is a map series of ten Regions that include several provinces from 1:200,000 to 1:400,000 scales.
- National Cartographic Database at 1:500,000 (BCN500) scale. It is a multipurpose geographic information, linked to the Map of Spain at 1:500,000 scale.
- Map of Spain at 1:500,000 scale. Available in paper and digital format (vector and raster)
- Map of Spain at 1:1,250,000 and 1:2,000,000 scale. Available in paper and digital format (vector and raster)
- Raised Relief maps. They are a set of printed over the raised relief plastic maps.

❖ **Geographic Reference Information for Transport Network (GRI-TN)** is a Geographical Reference Information INSPIRE compliant Database, seamless all over the Spanish territory, created by gathering official data provided by the main stakeholders in the TN field in cooperation with some Regional Mapping Agencies. It is composed of five 3D-linear transport networks (road, rail, air, water and cable), and their infrastructures, being all of them connected by means of a multimodal relationship.❖ **CartoCiudad.** The Spanish official address database to be used in location-based services.❖ **SIOSE.** The Spanish Land Cover/Use Information System with a precision equivalent to a scale of 1:25,000.❖ **Aerial Photos and Remote Sensing Image Collections**

- Aerial Photos, available at 0.22 m or 0.45 m resolution of the whole Spanish territory.
- Orthophotos available at 25/50 cm resolution for the whole of Spain in a regular coverage from two to four years and 10 cm resolution for special areas.

❖ **Digital Terrain Model:**

- MDT5 of 5 x 5 m grid
- MDT25 of 25 x 25 m grid
- MDT200 of 200 x 200 m grid.
- MDT LiDAR. Obtained by Lidar

Library, Map Library & Topographical Archive

IGN is responsible by Law for protecting and updating bibliographic collections, historical cartography and technical documents, archiving georeferenced legal information and enabling their access to users.

These tasks are entrusted to the Service for Geographical Documents which is a department included in the General Secretariat of IGN. This department manages the cartographic and bibliographic collections as well as the Topographical Archive, which is of great value for the development of the cartographic powers entrusted to IGN.

All these documents shall be catalogued, classified, managed and preserved according to the possibilities offered by new technologies, in order to guarantee a suitable service for the different projects within IGN, for the rest of the Public Administration and to society in general.

Due to the diversity of the funds that are preserved and managed at the Service for Geographical Documents, there are three different offices, i.e. library, map library and topographical archive.

The **library** was founded in 1870, when the Geographic Institute of Spain was first established. During its 150 years of existence, it has specialised and endowed with bibliographic collections on those subjects related to the activities carried out by IGN. All



Main page of our online catalog

funds are scanned and they may be managed by computer software. These collections are available on various means, i.e. [library catalog](#) on the IGN website, email, telephone or in person at the library itself.

The **map library** was also founded together with the Institution itself, back in the year 1870. It was born with the main task of preserving the different cartographic products used to draw the National Topographic Map at a 1: 50,000 scale.

Over time, the map library has become the deposit of all cartographic products within the National Geographic Institute, as well as other public and private organisations. Their funds are enriched every year by donations or acquiring cartographic collections which are of interest in the antique market. Among our cartographic funds, users may find a collection of maps of Spain and the rest of the world accomplished from the 15th to the 20th centuries, as well as several atlases and globes. Most of them are original pieces, yet some of them are very good facsimiles of unique pieces in the World.

The Map library also stores all editions of the National Topographical Map series at 1: 50,000 and 1:25,000 scales, as well as all editions of Provincial and Regional map series.

The Map Library offers a customer service, both in person and by email. Much of their cartographic funds are digitized and some can be viewed and downloaded on the [map library catalog](#) that is located on the IGN website. Users may also find on this Catalog various applications such as virtual globes, geographical finder, interactive maps and virtual exhibitions.

The **Topographical Archive** keeps many of the documents accomplished in the cartographic production processes carried out by the National Geographic Institute from its foundation until approximately the use of aerial photogrammetric methods back in the 1950's. In addition, it preserves numerous documents accomplished by other organisations that existed prior to IGN, such as the General Board of Statistics and the Statistical Commission back in the 19th century.

The Topographical Archive has got a vast amount of documents, most of which are original manuscripts, of both literal and cartographic information. The oldest documents date from the second half of the 19th century, yet some technical documents completed by the National Geographic Institute continued to be stored until the first half of the 20th century. Among these funds, the Kilometrical Sheets and the Cadastral Certificates of the General Board of Statistics shall be remarked, as well as some planimetric maps, altimetric maps, urban settlement maps, field notebooks and boundary line statement notebooks that were used for completing the National Topographical Map of Spain at a 1:50,000 scale.

The most demanded documents are currently digitised and georeferenced and can be downloaded using the [Download Center](#) on the IGN website. The Topographical Archive also handles requests from users by email, telephone or in person at the IGN headquarters in Madrid.

In addition to these tasks, annual exhibitions are prepared and arranged in order to show the cartographic collections to the general public. These exhibitions are open to the public and may be visited for free during the morning opening hours or by request guided tours by email.



Picture of our current exhibition

Since 2015, five exhibitions have been developed, which are the following:

2015: «**Cartography in the 19th century**»

2016: «**Maps in the time of Cervantes**»

2017: «**Oikoumene, the evolution of the world's image**»

2018: «**From Iberia to Spain through maps**»

2019, current exhibition: «**The maps and the first circumnavigation of the world:
Magalhaes-Elcano**»

Furthermore virtual visits have been created for most exhibitions, so that they can continue being [consulted online](#).

Astronomy, Geophysics and Space Applications

Earthquakes, ground surface deformation, gas emissions at volcanic areas, gravity measurements, geomagnetic datasets... All these observations carried out at IGN in the fields of seismicity, volcanology, gravimetry and geomagnetism are represented with detailed cartography and digital elevation models to provide accurate geophysical maps. IGN is the legal institution responsible for both the National Seismic Network and the Volcano Monitoring Network in Spain. In addition, IGN is also a Tsunami Warning Center of UNESCO and detects, assesses, and informs about phenomena that could induce a tsunami on the Spanish coasts.

These geophysical observations provide information about the physical processes that occur at the Earth's interior and are noted and measured on the ground surface. The information is georeferenced and combined with detailed cartography to give alerts to Spanish Civil Protection and to draw Spanish Hazard Maps. It also allows developing the Spanish Earthquake Resistance Code.

Furthermore, IGN owns instruments and infrastructures for radio astronomy, spatial geodesy and geodynamics that enable studying not only the Universe but also the geodesy of the Earth. Multiple space geodetic techniques and networks provide precise observations needed to monitor, map, and understand changes in the Earth's shape, rotation, and mass distribution, determining the celestial and terrestrial reference frames and giving information about precise positioning, Earth's Global Change, plate tectonics, etc.



National Center of Geographic Information

The National Centre of Geographic information (CNIG) is an independent agency depending on the Ministry of Infrastructures and Transport, throughout the Spanish National Geographic Institute (IGN). CNIG is responsible for producing, developing and distributing the geographic work and publications demanded by society. In particular and according to the CNIG statute, approved by Royal Decree 663/2007, dated May 25, it is tasked with the following functions:

- To commercialise and disseminate the products and services of IGN Spain.
- To guarantee the quality and distribution of official geographic data.
- To support the development and use of national mapping.
- To develop products and services on demand.
- To maintain a territorialized system of public information and manage the operations of the regional services of the IGN and, if needed, of its territorial dependencies, as well as the organizational and functional management of the network of «Casas del Mapa» (sites that provide IGN data products and maps).
- To provide specialized technical assistance in the field of geographic techniques and sciences, and for the operations established in the Statute and those committed by the High Geographic Council for government departments integrated into the National Cartographic System.

In accordance with article 15.1.i) and 15.1.j) of Royal Decree 953/2018 and within the strategic framework defined by the Spanish National Geographic Institute, CNIG is likewise tasked with the planning and management of the National Spatial Data Infrastructure of Spain, as well as the harmonization and standardization of data and services within the framework of the National Cartographic System. Likewise, the planning and developing value-added services and new systems and applications in terms of geographic information, especially for the use in the sector of Public Administrations, are also responsibility of CNIG Spain.

In 2015 was published the Ministerial Order FOM/2807/2015, that establishes the data policy of the geographic data products of Instituto Geográfico Nacional (IGN Spain). The article 4 states *«The use of the digital geographic information products mentioned in Article 2 will be open and free of charge, provided that the origin and ownership of the data is mentioned, within the scope and in the way authorized by the corresponding license»*.

Therefore, the use of the IGN's geographic data products and services defined within the scope of Order FOM/2807/2015 implies the user's acceptance of a [CC-BY 4.0](#) license.

The licensing conditions for the use of geographic data products and services produced by the IGN and for those co-produced by the Autonomous Regions and other public bodies within the framework of the National Cartographic System are available in: http://www.ign.es/web/resources/docs/IGNCnig/FOOT-Condicion Uso_eng.pdf.

The National Centre of Geographic information has published on paper the following data products between 2016 and 2019:

❖ **National Parks**

- National Park of Ordesa and Monte Perdido
- National Park of TEIDE

❖ **National Topographic Map 1:25,000**❖ **National Topographic Map 1:50,000**❖ **Provincial Maps 1:200,000**

- Araba/Álava, Gipuzkoa, Bizkaia
- Cáceres
- Cádiz
- Córdoba
- Madrid
- Navarra
- Salamanca
- Segovia
- Valladolid

❖ **Autonomic maps**

- Andalucía-1:400,000
- Castilla-La Mancha- 1:400,000
- Castilla and León-1:400,000
- Comunitat Valenciana-1:300,000
- Madrid-1:200,000
- Murcia- 1:200,000

❖ **Relief map**

- Cantabria 1:200,000. ed. 2018
- Castilla and León 1:400,000 .ed. 2018
- Castilla-La Mancha 1:500,000. ed. 2018
- Cataluña 1:325,000 .ed. 2015



National Park of Picos of Europa 1:50,000. ed. 2018

- Madrid 1:200,000. ed. 2018
- National Park of Picos of Europa 1:50,000. ed. 2018
- Península Ibérica, Baleares and Canarias 1:1, 250,000. ed. 2016
- Región of Murcia 1:200,000. ed. 2018

❖ **General map of Spain, Europe and world: physical and physical and political maps**

❖ **Map of Camino of Santiago (Way of St. James)**

❖ **Natural spaces**

❖ **National Atlas of Spain**

- Spain on maps. A geographical synthesis

❖ **Books**

Institutional website

This website represents the IGN and the CNIG, whose main objective is to bring more and better the geographic information to the society so that the National Geographic Institute and the National Geographic Information Centre become reference organizations in their areas of activity.

In March of 2017, a new version of site www.ign.es was opened.



Home of web IGN

The principal components of this site are:

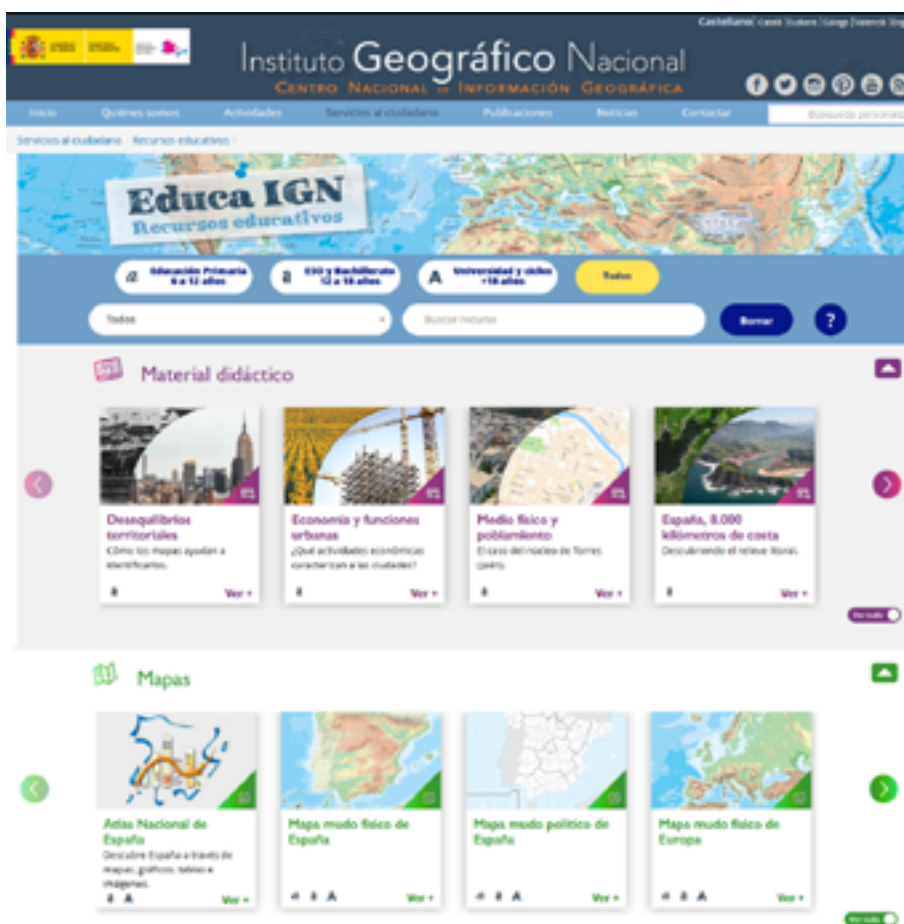
- **Horizontal menu:** It includes access to legal, historical and institutional information, access to the description of the main activities and services offered to the user and the professional publications. Also, the social Networks and a web browser.
- **Gallery of activities:** where to access the application, resources, data and documentation of each principal area of activity of IGN

- **Central web content:** section that allows access to the resources and website that the users visit more frequently: viewer, download centre, online shop, etc.
- **Direct links:** It includes the direct links to several applications and resources
- **Bottom:** links to thematic geoportal as well as information of Data policy, legal notice, frequently asked questions, etc.

During these years, the section of «[Seismic Information](#)» and «[Cartography and Geographic data](#)» has had a high number of visits: more than 5 million per year.

The «[Digital books section](#)» has increased during last year, offering 35 books on various topics. It must be highlighted that «Spain on maps. A geographical synthesis» has reached a number of 16,719 downloads in three months.

Finally, it should be noted that [educational resources](#), [Geodesy](#) and the [Map Library Catalogue](#) and the [IBERPIX viewer](#) are resources of high interest among our users.



Page of educational resources

Access to the IGN website: <http://www.ign.es>

Download Center

Opening a new version in April of 2017, the [Download Center](#) (CdD) is a web site created by the National Centre of Geographic Information, aimed at serving users as a free tool for downloading geographic digital files generated by the Directorate General for the National Geographic Institute (IGN).

The free and open use of the downloaded information is allowed for any purpose, including commercial and publication purposes, provided that recognition and acknowledgment of the IGN as source and owner of such licensed geographic information products and services is made (CC BY 4.0 ign.es), as indicated in [User license](#) document.

The section of «Products» shows the descriptions of all the products available for download. These products are grouped by type of data offered and their possible use for example, images of aerial photographs and orthophotos, map images, vector files, databases for spatial analysis, files containing 3D information, route map files, etc.

Some examples of products to download:

- Images of aerial photographs and orthophotos of several years and with different pixel sizes, besides.
- Satellite imagery.

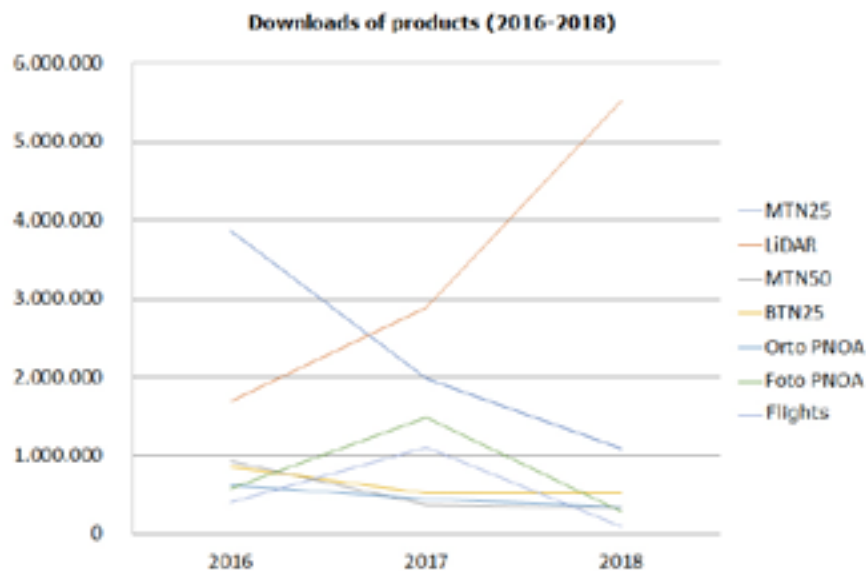


Home of Download Center

- Basic topographical data necessary for the representation of the territory, such as transport network, gazetteer, boundary lines and geodetic points.
- Cartographic and Topographic Bases for exploitation by means of Geographic Information Systems (GIS).

- Altimetry information that represents the landform of the national territory and, in the case of LiDAR data, of the elements that are found on it as well (LiDAR 0.5points/m² covering the whole Spain).
- Route files, including routes of the Camino of Santiago (St. James' Way), routes in National Parks and Greenways, designed for display on computer or mobile devices.
- Digital files resulting from the scanning all printed editions of the National Topographic Maps and other maps at different scales. They include a framework of coordinates and marginal information.
- Digital files from the scanning of documents of great cartographic and historical value, which include plans and manuscript maps, as well as minutes, and limit line records.

The number of products and downloads has increased the last year. In 2018, 730 TB of Geographic Information was downloaded; the LiDAR product was the most demanded by our clients the last year.



Graphic of downloads of products since 2016

Thanks to these changes, the IGN and CNIG continue to advance in the openness and re-use of geospatial information in Spain, development of new products and the implementation of application web, and to its positive impact in the socio-economic sphere.

Access to the Download center: <http://centrodedescargas.cnig.es/CentroDescargas/index.jsp>

SignA – The National Geographic Information System of Spain

The National Geographic Information System (SIGNA) of Spain is the on-line GIS of the National Geographic Institute (IGN), whose purpose is to integrate geographic data and services in a single geoportal for its analysis and consultation through internet <http://signa.ign.es/signa>

SilGNA was open to the public in December 2010 and nowadays it has reached the fourth version. The geoportal has been increasing the demand and today is a tool for daily use for many users and for very different applications.

It has been developed according client/server architecture, based on a thin client. This means that the processing is done in IGN's servers and it does not require installing any software, just to have a common browser. It is also implemented according to standards so it is fully interoperable with OGC services.

The main functionalities are:

- Search: to look for population entities, geographic names and addresses, and locate them in the map.
- Measure of distances, areas and topographic profiles based on the points introduced by the user.



Home of Download Center

- Report of errors found in the data to improve the cartography
- Connection to standard OGC services: WMS, WMTS, WFS, CWS, etc.
- Loading of user data in different formats: GML, KML, Shapefile and GPX.
- Tailor-made printing.
- Query of data using the SignA database containing more than 100 feature types about: administrative boundaries, hydrography, transport network, buildings, facilities, utilities, protected sites, etc. The queries can be:
 - ✓ Semantic: filtering by attributes. For example, consult the municipalities of the province of Cáceres with a population less than 500.

- ✓ Spatial: considering spatial relations among different entities. For example, obtain the campsites contained in the Region of Murcia.
- ✓ Buffer: obtain entities in a distance to an entity. For example, obtain the population in 10 km around the Gregorio Marañón Hospital.

The result of the queries can be downloaded in different formats: GML, KML, DGN and DXF.

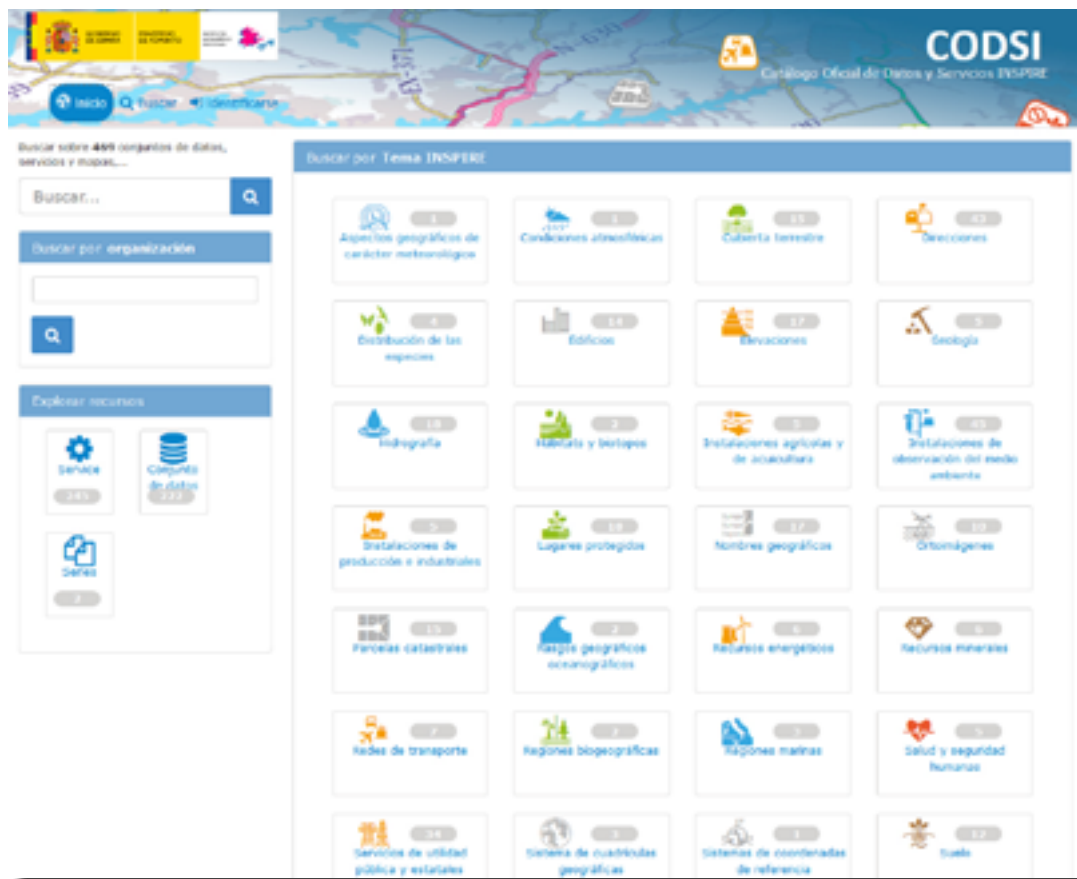
As a conclusion, SIGNA geoportal integrates the best of GIS and SDI worlds in a common environment accessible in a free and open manner for experts and non-experts users.

Access to SiGNA: <http://signa.ign.es/signa>

INSPIRE Services and Datasets Official Catalogue (CODSI)

The Consejo Superior Geográfico (CSG), or national Geographic High Council, is the executive body of the National Cartographic System (SCN), having consultation and planning role for the official geographic information and cartography. CSG is the National Contact Point for INSPIRE and the body responsible for the coordination and direction of the National SDI of Spain (IIEG).

CSG created the «Consejo Directivo de la Infraestructura de Información Geográfica of España (CODIIGE)» (Executive Board of the Spanish SDI) for managing and controlling IIEG. One of the tasks carried out in the 2016 by CODIIGE was the creation of the «Action Plan»



CODSI interface

to ensure the implementation of Directive of INSPIRE in Spain and by defining the creation of «National official Catalogue of Dataset and Services INSPIRE (CODSI)».

CNIG is responsible for the implementation and coordination of Catalogue CODSI. This catalogue included 469 INSPIRE metadata files of dataset and services according INSPIRE regulation 1205/2008 regarding metadata. It is connected via harvesting or files interchange with the catalogues of national and regional SDI nodes.

To ensure the access to CODSI's resources, CNIG has implemented the National discovery service (following OGC CSW standard) to publish the collection of metadata that allows users searching and finding official geographic information and resources through a catalogue client.

The [INSPIRE Geoportal](#) is the central European access point to the data provided by EU Member States and several EFTA countries under the INSPIRE Directive. For Spain, the service CSW of CODSI is regularly harvested from the INSPIRE Geoportal to include the Spanish metadata in the [Inspire Thematic Viewer](#).

The Geoportal of the Spanish Spatial Data Infrastructure, IDEE, include the point of access to this CODSI and since 2016 the CODSI is the base of the INSPIRE monitoring process.

Access to CODSI: <http://www.idee.es/csw-codsi-idee/>

Access to information of Monitoring Information: <https://www.idee.es/web/guest/seguimiento-e-informes>

Web Services and mobile Applications

One of the works carried out by the IGN, through the CNIG, is the publication of web services to be used as cartographic map, development of applications for computer and mobile platform.

Web Visualization Services

Taking into account the principles of INSPIRE Directive about services and looking or compliance with Implementing Rules, CNIG publish Inspire Network Services.

From 2015 to present the number and the type of visualization and download web service has been increasing. And the requests of services have increased appreciably in the last few years. In 2018 would close with a record of more than 220 TB request to visualization services.

Some of examples of web services most used:

WMS and WMTS of Base Map

Cartography from different geographic databases of Spain (ordered from smaller to larger scale) produced by several organizations (National Geographic Institute,) CEGET,

CODSI interface



Army Geographic Center, General Directorate of Cadastre. The access or connection to this service to obtain their intended functionalities is free of charge in any case if the authorship of IGN as proprietary of the service and its contents.

- WMS: <http://www.ign.es/wms-inspire/ign-base?>
- WMTS: <http://www.ign.es/wmts/ign-base?>

WMS and WMTS of IGN Cartography

Raster Cartography official of IGN at different scales. The access or connection to this service to obtain their intended functionalities is free of charge in any case if the authorship of IGN as proprietary of the service and its contents.

- WMS: <http://www.ign.es/wms-inspire/mapa-raster?>
- WMTS: <http://www.ign.es/wmts/mapa-raster>



WMTS of Cartography

WMS and WMTS orthophotos of the PNOA

These services lets view the most updated orthophotos of the PNOA (National Aerial Orthophotography Plan) from an approximate scale 1:70 000. For smaller scales (less detailed) Spot5 satellite images are shown. PNOA's coverage is built on different acquisition date and geometric resolution (50 or 25 cm) mosaics. The service shows these mosaics according with the default Inspire style. Allowed picture pixel sizes are between: width (10-2 000) and high (10-2 000). The access or connection to this service to obtain their intended functionalities is free of charge in any case if the authorship of IGN as proprietary of the service and its contents (which can be stored for private use) is mentioned as follows: «PNOA provided by © National Geographic Institute of Spain»



WMTS of Orthophotos

- WMS: <http://www.ign.es/wms-inspire/pnoa-ma>
- WMTS: <http://www.ign.es/wmts/pnoa-ma>

It's also possible to see Orthorectified images of different photographic flights of national coverage (SIGPAC, OLISTAT, American flight, Series B flight, PNOA) promoted by different Public Administrations in the «Historical service».

- WMS: <http://www.ign.es/wms/pnoa-historico?>

On this page, you may consult the list of available web services of IGN: <https://www.ign.es/web/ign/portal/ide-area-nodo-ide-ign>

Mobile Applications (App)

Mobile device users prefer to use applications installed on their smartphones. For the last several years, CNIG has developed several App Mobile:

- **Maps of Spain:** Free visualizer ideal for hiking, cycling, running, skiing, etc. which uses the services of the National Geographical Institute as background cartography and other sets of services from other Ministries
- **Seismology pro:** App that allows the reception and visualization of all the seismic events of Spain and surroundings in an Android OS device.
- **National Parks:** Application that allows you to consult information on the history, wildlife, vegetation and routes of the National Parks of Spain as additional information, such as information centers, accommodation, lookouts, shelters, etc.
- **Santiago Way:** Application to facilitate the realization of the different stages of the Ways of Santiago (French way, North way, etc.) and their points of interest using the mapping services of the National Geographical Institute as a cartographic background and all the information on the stages provided by the Spanish Federation of Friends of the Camino of Santiago Associations.

On this page, you may consult the list of Apps available:

<https://www.ign.es/web/ign/portal/dir-aplicaciones-moviles>



App Santiago Way

Spanish Army Geographic Center

Darío Gazapo 8. Acuartelamiento Alfonso X

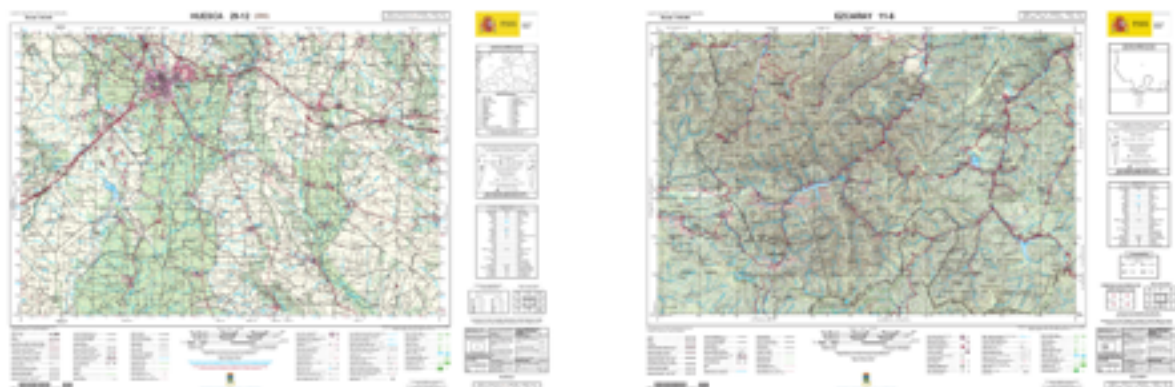
E-28024 Madrid - Spain

Phone number: +34 91 512 66 00

Fax number: +34 91 512 69 43

The aim of the Spanish Army Geographic Centre is to provide the Armed Forces the required geospatial information for planning and conducting military operations. To this end, and in accordance with the four-year Cartographical Plan of the Armed Forces, it produces geospatial information both national territory and those abroad interest areas to be determined.

National territory geospatial information production is based on cartographical standardised series. Spain Military Map M7815 series (scale 1:50,000) is kept on working through updating the former M7814 series from photogrammetrical flight and field review, all in European Terrestrial Reference System ETRS89. At the same time, «MGCP Framework» has been successfully implemented both in new data capture and database outline, modifying the final appearance and going forward the future M7816 series work flow development. At the moment, MGCP data scheme is fully implemented in data acquisition, field review, quality assurance and map edition, being the pilot sheet in the map edition phase with MGCP Topographic Map (MTM) format and simbology.



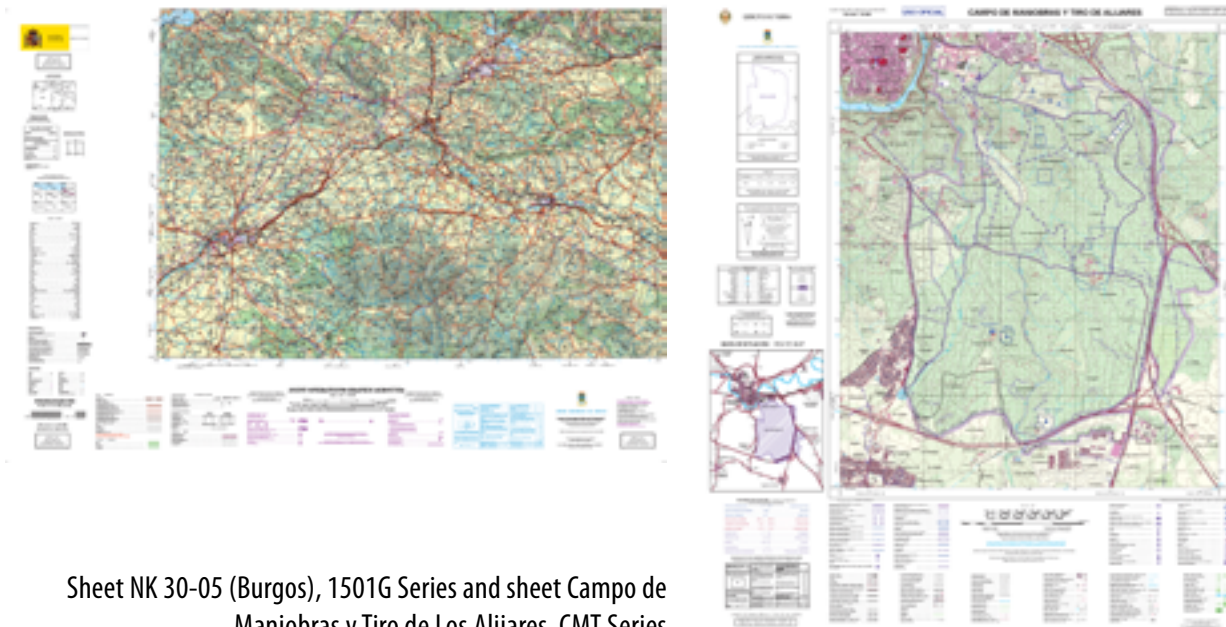
Sheet 29-12 Huesca, M7815 Series and sheet 11-06 Ezcaray, M682 Series

Scale 1:100,000 M682 series, also in ETRS89, is develop from BTN100 vector data. BTN100, a database that gathers the INSPIRE European directive requirements, is the result of the collaboration between the National Geographic Institute of Spain and the Spanish Army Geographic Centre in order to produce in an harmonized way 1:100,000 cartographical series and lowers. This project has been a milestone in the collaboration among directorates and agencies producers of geospatial information in Spain.

Small scale series such as Joint Operations Graphic 1501 Ground (1:250,000), 1404 series (1:500,000), Military Map of Spain (1:1,000,000 and 1:1,500,000) as well as a Military

Road Guide (scale 1:40,000) that besides the general information, it shows the access to military facilities, all of them with updates every four years, complete the requirements of geospatial information for conducting and planning military operations in national territory. These series workflow are in phase of study in order to gradually adapt, during the next 4-6 years, the database schemes and outputs to the Defense Geospatial Interchange Working Group (DGIF) framework and specifications.

The CMT series (Firing Ranges & Training Areas) complete the needed geospatial information in order to develop the military units training. This series, of heterogeneous nature, is composed of different scales maps and orthophotomaps of firing ranges, training areas and military facilities. Besides topographic information, provides a military information layout with a new symbology in accordance with the STANAG 3833 Ed4 (AGeoP-15), implemented in 2016. As in M7815 series, CMT series workflow is being adapted to MGCP database schemes and work spaces, that will output the future M8815 series.



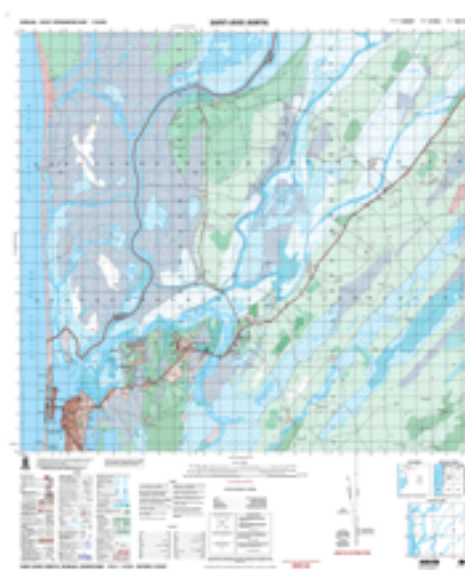
The production of geospatial information abroad is mainly based on spatial orthoimages and information provided by the Multinational Geospatial Co-Production Program (MGCP). Spain, through the Spanish Army Geographic Centre, joined the program as «leader nation» by means of high-resolution satellite images orthorectification, collecting vector data information (HRV) and ensuring the quality control of data produced by Spain and other MGCP member nations.

As a complement to this, Spain has joined a new multinational co-production program named TREx, where the Spanish Army Geospatial Centre actively participates. TREx is a multinational co-production program with the aim of setting up a high resolution digital terrain model by means of radar imagines from TERRASAR and TANDEM-X satellites. The TREx bureau at the Spanish Army Geospatial Centre has reached the FOC after get certification, train the personnel and install the needed systems.

Beginning with MGCP and TREx data, scale 1:50.000 standardized maps of different parts of the world, where Spanish military units are deployed, are produced, completing this geospatial information with higher scales products based on orthoimagery with the corresponding vector data. After a period of one year, approximately, the needed changes has been implemented in order to turn the MGCP Derived Graphic (MDG) into MGCP Topographic Map (MTM).

The Spanish Army Geographic Unit (UGET) is able to deploy in the areas that are determined and is provided by all the means to dispose accurate and on-time geospatial information to the deployed forces. This support include, in addition to cartographic production tasks, field survey, on-ground cartographic review and data collection, support to Intelligence Preparation of the Battlefield (IPB) process, production of thematic maps, map printing and dissemination, natural disasters simulation, virtual and 3D scenarios modelling, participating in both multinational and national environment. Among international collaborations, the UGET takes part in the Eurocorps Combined Geo-support Unit, the NATO Response Force and the Multinational Geographic Support Group, responsible for providing geospatial information for NATO and EU missions, and the European Union Battle Group. At national stage, the collaborations with the Military Emergency Unit (UME) are highlighted. In order to perform its duties, the UGET is provided with the most modern equipment and material, standing out a cartographical RPAS Geodrone made in Spain and a Trimble SX10 Total Station.

The Spanish Army Geographic Centre also attends different national and international working groups. Personnel of the Centre participates as technical member in the Multinational Geospatial Co-Production Program (MGCP), MGCP Urban Vector Data



Sheet 13573 (Saint-Louis North), G725G Series of Senegal, MTM produced and edited from MGCP vector data



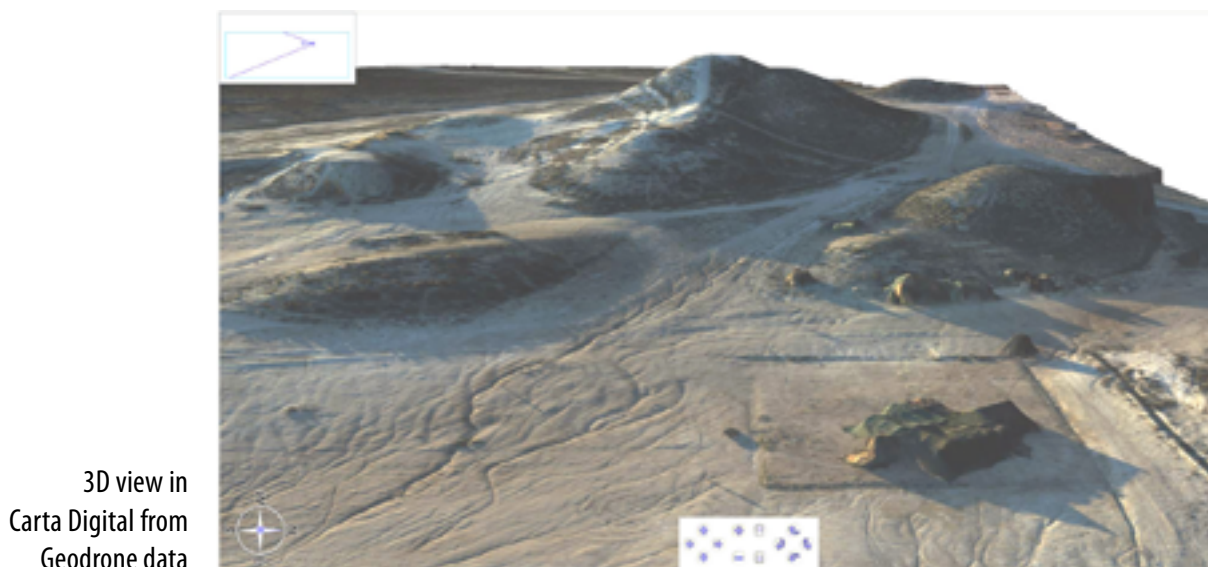
RPAS Geodrone and SX10 Total Station. Spanish Army Geographic Unit (UGET)



(MUVD), TanDEM-X High Resolution Elevation Data Exchange Program (TREx), Defence Geospatial Information Working Group (DGIWG), NATO Interservice Geospatial Working Group (IGeoWG), NATO Geospatial Information Framework (NGIF), Spanish Spatial Data Infrastructure (GT-IDEE), Reference Geodetic System Group, Spanish Geographic Names Group, etc.

The Spanish Army Geographic holds the technical direction of Carta Digital program. Carta Digital is a geographic information system that allows the visualization, analysis and exploitation of geospatial information in different raster and vector format, with advance symbology and 3D data analysis capability, including APP-6C military symbology. Nowadays, it's been implementing the evolution to a 64 bits architecture.

One more task is the maintenance and demarcation of the boundary lines with France and Portugal. Bilateral meetings with responsible staff of both countries are holding annually as well as a field campaign in order to improve the demarcation, overhauling and cleaning both borders.





GNSS survey. Spanish-French border

In order to provide the Spanish Armed Forces with printed maps and publishing, the Centre has a graphic arts workshop. Among its capacities highlights a digital design department, a lithography workshop with offset presses, a digital printing workshop with high performance reprography capacities and a binding workshop.

Finally, the Army Geographic Centre holds in its Cartographic and Geographic Studies Archive a historical collection of 290 atlas in 354 volumes, and 25770 maps and charts dated from XVI to XX centuries. Even though the worldwide geographical scope, most of the pieces belong to Spain, America, North of Africa and Philippines. The Archive has its permanent exhibition in the «Alfonso X» barracks, and annually, celebrates a temporary exhibition in different cities of Spain.



Offset press



Permanent exhibition hall. Cartographic Archive

Spanish Hydrographic Office

Plaza San Severiano, 3

E-11007 Cádiz - Spain

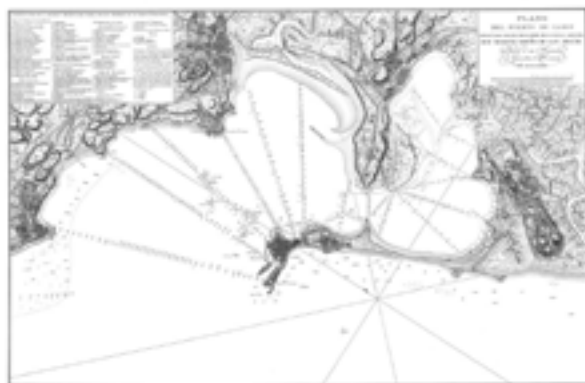
Phone number: +34 956 59 94 05

Fax number: +34 95 6599396

E-mail: ihmesp@retemail.es

The Spanish Hydrographic Office (Instituto Hidrográfico de la Marina (IHM)) is a Spanish Navy organization of public and international interest, tasked with the safety of navigation and the capture and dissemination of maritime and coastal information to further nautical sciences. One of its main missions is the production, publication and updating of nautical charts considered of interest for mariners, as well as military cartography. Also, production of military cartography developed in different Additional Military Layers (AML) to be used in WECDIS consoles is carried out.

The «*Instituto Hidrográfico de la Marina*» (IHM) as we currently know it did not operate under such a name from the start, and it was not even based in Cádiz as it is now. To find the roots of the activities carried out by the *Instituto* we should go back to the *Casa de Contratación*, established in the *Atarazanas* at Seville in the early 16th C, specifically in 1503, by the Catholic King and Queen. The *Casa de Contratación*, despite being subordinated to the *Consejo Real y Supremo de Indias* in 1524, directed for a long time the discovery, colonization and commerce with the New World. When the *Casa de Contratación* was officially ended in 1790, it was evident the need for some body to fill the gap that this disappearance had left. Although there was a Hydrographic Deposit since 1770, the edition of the «*Atlas Marítimo de España*» (Maritime Atlas of Spain) by Vicente Tofiño –the most important cartographic work in Spanish History–, prompted the creation of some organization for the co-ordination and standardization of the cartographic production. So, by the R.O. dated 17 December 1797 it was established



Tofiño Chart. Plano del Puerto de Cádiz



75th anniversary of the IHM in Cádiz

the *Dirección de Trabajos Hidrográficos* or *Dirección de Hidrografía* (Directorate of Hydrographic Works or Directorate of Hydrography). In 1921, Spain became a Founding Member of the International Hydrographic Bureau, an organization established to foster cooperation and standardization among Hydrographic Offices of their Member States. In 1927 the *Observatorio de Marina de San Fernando* (ROA), established its Section IV, *Servicio Hidrográfico de la Armada* (Navy Hydrographic Office). In 1943,

considering the need to further hydrography, the hydrographic service was detached from the ROA and so the IHM was born by law dated 30 December, sited in Cádiz and as an organization under the Navy Staff to promote cartography and achieve wider action in all functions related to hydrography and navigation.

The Law on the Organization of Cartography (7/1986) states that the production and maintenance of basic Nautical Cartography belongs to the State Administration, through the IHM. On 1 December 2007, Royal Decree 1545/2007 dated 23 November entered into force, regulating the National Cartographic System. Basically it reiterates the same principles, and it specifically states: «It belongs to the *IHM* all planning, production scheduling, creation and maintenance of nautical cartography».

Honorary mentions

In 2018, was celebrated the 75th anniversary of the IHM in Cádiz.

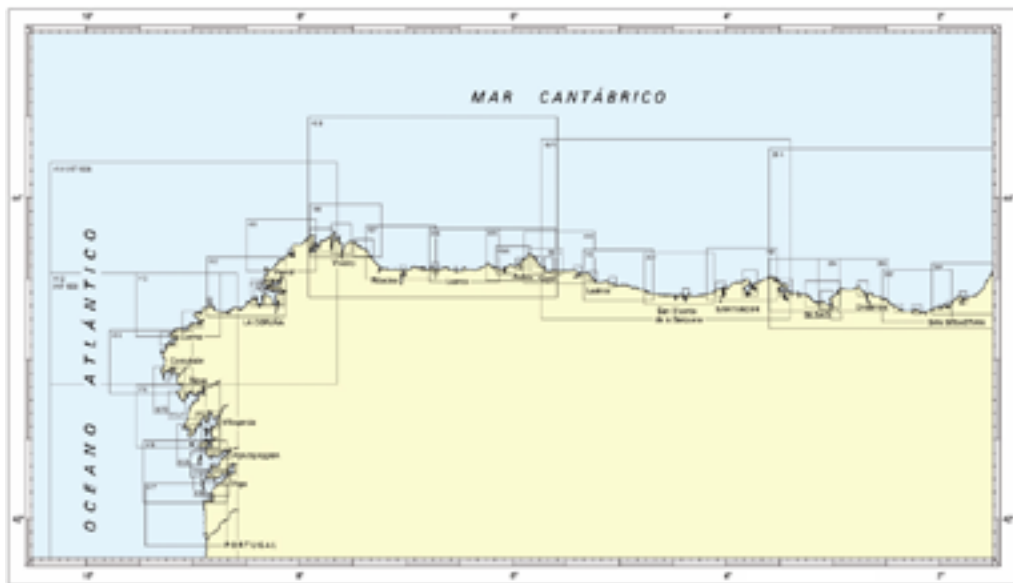
Competencies:

Collection of data and news on alterations in the environment, aids to navigation or dangers to the same, which will be disseminated as Notices to Mariners, for the updating of nautical charts. In special:

- Hydrographic surveys and studies on submarine relief in Spanish coasts and maritime areas. As well as, systematic observation and study



Coverage area of Spanish nautical charts



Spanish NW
paper nautical
charts

of tides and currents, temperatures and acoustic and electromagnetic propagation in seawater.

- Development of Nautical Charts, books and documents as aids to navigation, and their printing and distribution.

During the last two years the production of New Charts and Editions on paper is considered as adequate, as the average age of published cartography is 10,4 years, which compares favourably with neighbouring Hydrographic Offices.

Also, as a part of the Cartographic Project, production of ENC Electronic Cartography is continued, having achieved full coverage for Purpose 2 «General 1:1,000,000», Purpose 3 «Coastal 1:100,000», Purpose 4 «Approaches 1:50,000», Purpose 5 «Harbour 1:8,000». Purpose 6 «Berthing 1:4,000» is at 10% coverage and it is expected to achieve complete coverage at the end of 2022, covering all main ports and harbours.

From 2015 to 2019 this IHM provided the Central Registry for Cartography under the National Geographic Institution with the updated coastline for Spain, derived from the base chart series at scale 1:50000.

Cartographic Production

Cartographic production during the relevant time period is as follows, both for paper charts and ENC.

Paper Charts

192 nautical charts were published, as follows:

- 71 New Charts and New Editions.
- 121 Re-printings.

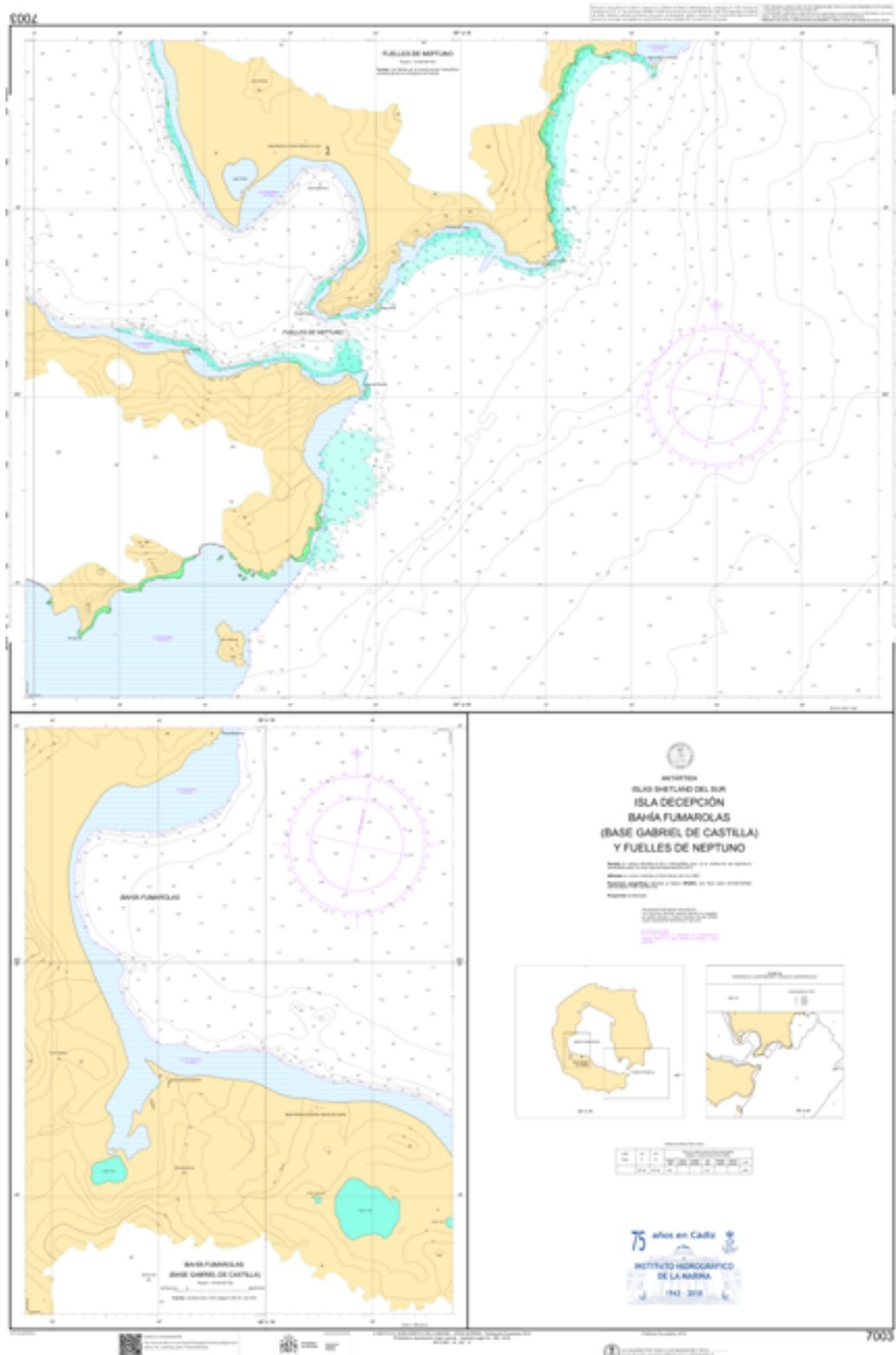


Chart for 75th anniversary of the IHM in Cádiz

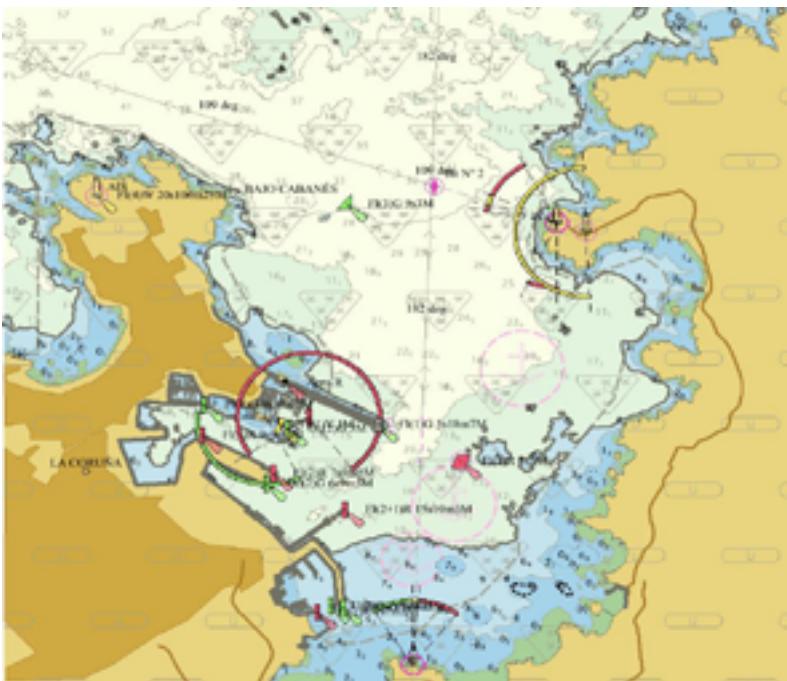
Electronic Nautical Charts (ENC)

103 ENCs have been produced, as follows:

- 70 New Charts.
- 106 New Editions.

Currently the overall amount of available ENCs is 296, which can be classified by their navigational purposes as follows:

- | | |
|------------|-----|
| • General | 4 |
| • Coastal | 21 |
| • Approach | 82 |
| • Harbour | 187 |
| • Berthing | 2 |



Spanish Electronic Nautical
Chart ES504126 (La Coruña
Harbour)

Updates

Our chart portfolio is updated using information received mainly from Port Authorities, Hydrographic Commission, Harbour Master and Naval Offices. They are distributed as follows:

- 1441 Notice updating paper charts, 98 of which included a block correction, published in the Weekly Edition of our Notices to Mariners Bulletin.
- Also, the corresponding corrections were applied to the stocks of paper charts at this IHM.
- 1580 updates for ENCs.
- 5455 Print on Demand paper charts.
- 12159 Total overturned notices to mariners.

Other Nautical Publications

- A new edition of IHO INT1 publication «*Símbolos, abreviaturas y términos usados en las cartas náuticas*» (Symbols and Abbreviations Used on Nautical Charts) was published in October 2018 as 6th edition. This is the Spanish version of the official IHO INT1 publication.
- A new edition of «*Catálogo de Cartas Náuticas y Otras Publicaciones*» (Nautical Chart and Publication Catalogue) was published in February 2017 and 2018.
- IHO S4 publication «Regulations for International (INT) Charts and Chart Specifications of the IHO (Spanish: Edition 4.8.0, October 2018) was translated into Spanish.
- IHO S65 publication «ENCs: Production, Maintenance and Distribution Guidance» (**Edition 2.1.0 - May 2017**) was **translated into Spanish**.
- IHO Document «Facts about Electronic Charts and Carriage Requirements» was translated into Spanish.
- A new edition of «*Catálogo de Cartografía Náutica Militar*» was published in March 2018.
- 5 Leisure charts, D46, D47, D48, D48N & D60B were published in A3 booklet format.
- New printings of the Training Chart and Plotting Sheet (0B).
- Publication V Century first circumnavigation of the Earth by Juan Sebastian Elcano (1519-2019)



Catalogue of Nautical Charts and other publications



Chart V Century first circumnavigation of the Earth by Juan Sebastian Elcano (1519-1601)

Historical Nautical Cartographic

Historical Nautical Cartographic production during the relevant time period has been a total of 54 new charts. One example of this historical cartography is the SETO-UCHI chart in the Sea of Japan published in 1871.



SETO-UCHI chart in the Sea of Japan published (1871)

Military Cartography

AML Project

Once NATO has implemented [STANAG 4564](#) (Warship Electronic Chart Display Information System (WECDIS)), covering the considerations from all participating countries in the development of the so-called Warship Electronic Chart Display and Information System (WECDIS), which is a customization of ECDIS performance standards for warships, a CD was produced with several demonstrations following with the stages of a project for AML development [STANAG 7170](#) (Additional Military Layers (AML) – Digital Geospatial Data Products). These involve a number of digital geospatial data products in a joint presentation to satisfy the requirements of NATO naval defence beyond simple navigational use. AML production follows S-57 specifications, supplemented by some special Product Specifications to cover their specific needs.

A production scheme for 138 products has been designed, prioritizing such layers with updated data available and considering the geographic areas where the Navy carries out major exercises.

Developments

IDE Infrastructure

IDEIHM <http://ideihm.covam.es/index1.html>, Infrastructure Within the framework of Spatial Data Infrastructure, and building on developments during the previous four years, we have established nautical chart display services (Web Map Service, WMS) based on the display of electronic nautical charts complying with the S52 display standard, as well as a download service (Web Feature Service, WFS) of the Spanish coastline at scale 1:50000, and a catalog service for nautical cartography metadata (Catalog Service for Web, CSW). All these services have been developed using open source tools and based on OGC (Open Geospatial Consortium) standards, following the guidelines in the INSPIRE European Directive and the Spanish Law LISIGE.



IDE infrastructure Web

There is also a IHM Web catalogue services including information on available IHM data and services, with a simple browser to display different WMS services.

International and National participation

IHM as cartography institution, Represents the Spanish State in the International Hydrographic Organization (IHO), and it is involved in several international forums and working groups. For instance:

- Part of the Council Geographic Superior (CSG) and its Specialized Commissions.
- Spanish Geospatial Data Infrastructure (IDEE).
- IHO in the Mediterranean and Black Sea Hydrographic Commission (MBSHC)
- IHO in the East Atlantic Hydrographic Commission. (CHATO)
- IHO in the Hydrographic Commission on Antarctica (HCA)
- IHO in the Long-range Radio-Notices for the Mediterranean and the Black Sea (NA-VAREA III).
- IHO in the Hydrographic Services and Standards Committee (HSSC).
- IHO in the S-100 Working Group (S100WG)
- IHO in the ENC Standards Maintenance Working GROUP (ENCWG)
- IHO in the Nautical Cartography Working Group (NCWG), (Formerly CSPCWG)
- IHO in the Nautical Information Provision Working Group (NIPWG)
- IHO in the Tides, Water Level And Currents Working Group (TWCWG)
Represents the Navy in the following Bodies and Commissions
- International Maritime Organization (IMO).
- International Commission on Lights (IALA).
- NATO Committees and Working Groups that are determined.
- Geospatial Maritime Working Group (GMWG).
- Geospatial Maritime Working Group Technical Panel (GMWGTP).
- NATO AML Co-Production Programme Technical Panel (NACPP).
- Part of the International Boundary Commissions with Portugal and France.
- Any work groups or committees of said Organization that are of interest for the development of their duties.



Cartographic and Photographic Center. Spanish Air Force (CECAF)

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E-28054 – Madrid - Spain
Telephone number: + 34 91 649 32 33
Fax number: +34 91 518 04 00
cecaf@ea.mde.es

From 1920, when the aerial photographic and reconnaissance activities firstly began to nowadays, the Spanish Air Force has been producing many cartographic and photographic series, mainly for the aircrews for the aeronautical cartographic production.

A little of history. In 1930 the Cartographic and Photographic School was created to train the aircrews in the photographic techniques. Later, in 1950, the Cartographic and Photographic Service produced the first aeronautical charts for fighters. Meanwhile the School continued to train personnel in photogrammetric and cartographic sciences. In 1979 the Cartographic and Photographic Centre adopted the current denomination, CECAF.

CECAF main activities spans from aeronautical cartography production, photointerpretation, aerial photography, flight inspection for nav aids calibration, aircraft navigation procedures design and aerial validation, topography, photogrammetry, offset printing, historical photography archive and photo-video production.

CECAF main geospatial productions are instrumental and visual aeronautical charts, both paper and digital formats. Geospatial Aeronautical information are mainly collected from two sources:

- Aeronautical Information Publication (AIP) from Spain, Portugal, France, Morocco and Algeria.
- Topographic equipments and aerial images from the digital sensor on board of CECAF aircrafts.

The aeronautical coordinates published in CECAF maps refer to the WGS84 geodetic system, in accordance with the ICAO Annex 15. The altimetry reference system is the mean sea level marks in Alicante as the altitude reference for the peninsula and the local mareographic references for each of the islands. CECAF aeronautical information is managed under the structure of AIXM.

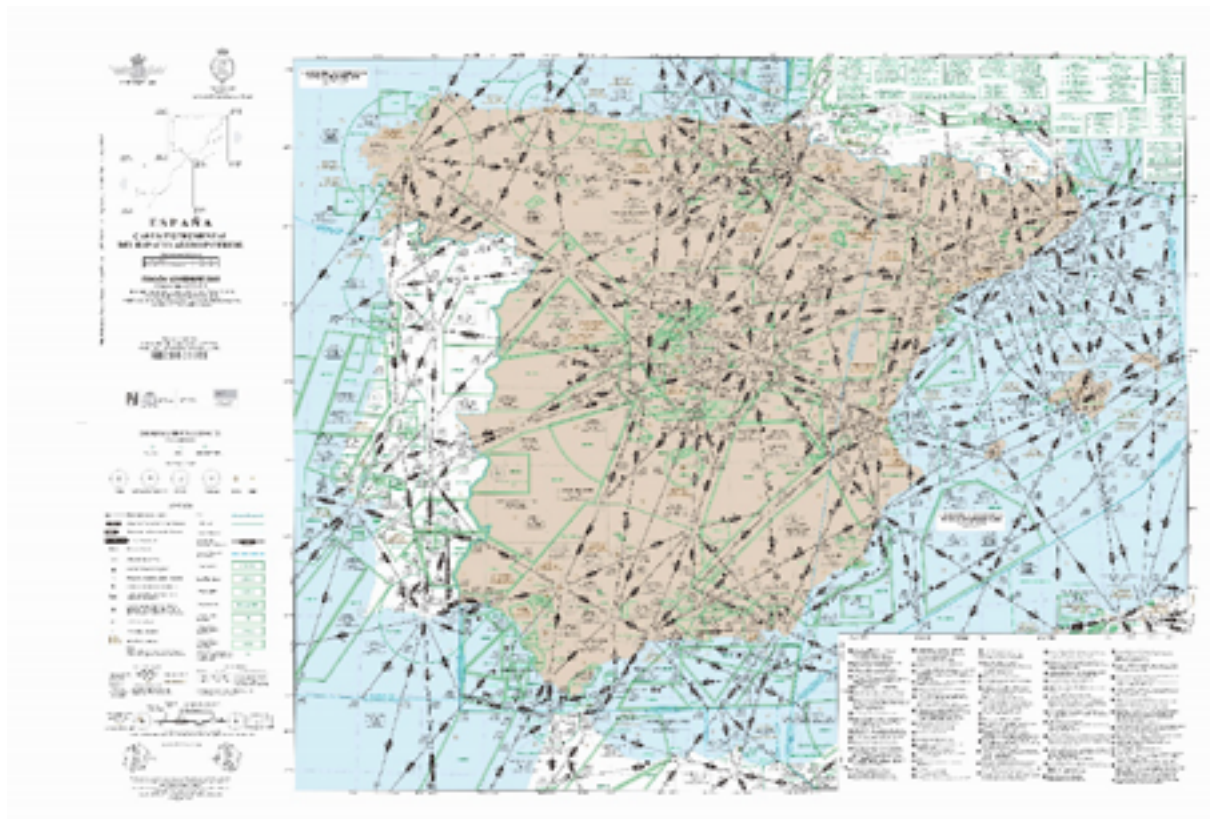
Charts for Instrument Flight Rules (IFR). Scale 1:2,000,000

The usefulness of these charts is the instrumental navigation through airways, following IFR regulations. IFR are flights referenced to instruments in cockpit. Navigation (course and distance) is accomplished by reference to electromagnetic signals.

There are two instrumental charts, Lower Airspace Chart which contains aeronautical information up to flight level FL245 (24,500 feet), and Upper Airspace Chart with aeronautical information from FL245 and above. Both charts have Lambert conformal conic projection.

Geographic information is considerably simplified because in aeronautical charts only aeronautical information is required for flight procedures.

The following information is depicted: airways, nav aids, aerodromes, waypoints and airspaces. Significant airspaces are Prohibited Area (P), Restricted Area (R), Dangerous Area (D), Wildlife Sensitive Area (F), Flight Information Region (FIR) and Terminal Maneuvering Area (TMA). It is depicted also magnetic course, distances (measure in feet) and another information that may be used for IFR purpose.



Lower Airspace Chart of Spanish Peninsula

Airways are routes followed by airplanes and are the most significant features depicted in instrumental charts. Airways can be one-way or two-ways. Course and elevation are depicted for every airway. Different elevations within the airway determine level flight of the aircraft. The airways are composed of sections between two points. These points are nav aids or waypoints.

Nav aids are electronic equipment facilities used to provide course, range and/or altitude to aircrafts so that they can determine their position and in some cases the distance to them. There are several types of nav aids, TACAN, VOR, DME, NDB, etc.

Terminal Maneuvering Area (TMA)

These charts provide information for airplane operating with IFR in the TMA airspaces established in the Spanish territory. The aim is to provide information to move from the en route phase of flight to the initial approach. The scale may vary according to the area to cover and the projection is Lambert conformal conic.



TMA of Galicia, Zaragoza, Valencia and Madrid

Airports affected by terminal routings and airways are represented on TMA charts. Also is depicted nav aids, radio frequencies, waypoints, distances, magnetic declination, holding patterns, magnetic bearings, airspaces, altimetry data, etc.

This chart is edited on a single sheet, using the front and back. It is selected the eight most important TMAs: Madrid, Galicia, Valencia, Zaragoza on the front and Barcelona, Seville, Palma, and the Canary Islands on the back. That provision has not been arbitrary; it has taken into account the folding of the sheet.

Aeronautical Visual Chart. Scale 1:1,000,000

Airfields, nav aids, airspaces, obstacles are depicted on Aeronautical Visual Chart. An important subject is altimetry. Altimetry information in feet on each grid is presented to ensure flight safety over physical obstacles. Place names and hypsometric tints are of particular interest in aeronautical visual charts.

This mapping is published in three separate sheets that completely cover the entire national territory (East, West of the Iberian Peninsula and Canary Islands). On the back of each of them is depicted airspace restrictions, communications, graphic scales and conventional signs. According to NATO standards, obstacles from 200 ft and above are depicted. The chart is published annually and is projected in Lambert conformal conic.

Low Flying Chart (LFC). Scale 1:500,000

LFC is designed primarily for visual flight. Aeronautical and topographical information is used to navigate with reference to landforms as unique elements. This aeronautical chart is used for mission planning as well.

The aeronautical features depicted in LFC are airports, heliports, runways, nav aids, waypoints, obstacles, airspaces and provisional landing runways.

In the center of each grid of the map, there is a number representing the elevation in hundreds of feet or Maximum Elevation Figure (MEF). Above MEF, the flight is considered safe from the point of view of obstacle clearance.



Sheet number 6 corresponding to LFC Valencia area

Moreover, elements that can be dangerous for low altitude navigation, obstacles higher than 62 meters high (200 feet), wind farms or power lines are highlighted.

LFC is represented by a Lambert conformal conic projection and Spain territory is divided into nine sheets. The chart is published annually.

Joint Operation Graphic Air (JOG-A). Scale 1:250,000

Joint Operations Graphics Air is designed primarily for visual flight. It uses UTM projection with four different zones: 28, 29, 30 and 31. It is published every five years with 44 sheets covering the national territory.

JOG-A is made using the topographic layer from Spanish Army Geographic Center to which the aeronautical information layer necessary for air navigation has been added. Aeronautical information comes from both CECAF and AIP-Spain.

This chart matches the Join Operations Graphic (Ground) published by the Army. Using the later as template. Several elements needed for navigation has been added, including airports, provisional landing runways, nav aids and obstacles over 60 meters. Aeronautical and topographical information allows instrumental and visual navigation. In the centre of each map grid there is a figure called MEF.

Geographic features, as lakes, rivers, villages and mountains are taken as visual reference. The chart is also used for mission planning. Altimetry shadows are also included to give a sense of relief to the chart.

Transit Flying Chart (TFC). Scale 1:250,000

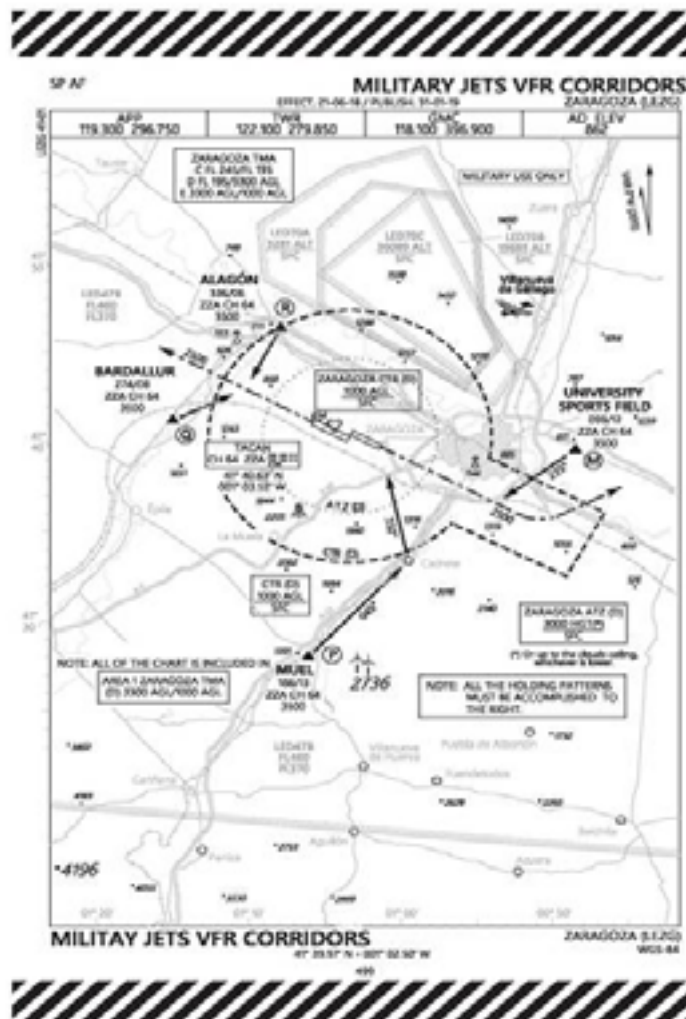
TFC is an aeronautical chart quite similar to JOG-A where a layer of airspaces has been added. TFC is designed primarily for visual flight, and is published in digital format once every year.



TFC Sheet corresponding to Madrid area

Pilot's Manual Charts

The Pilot's Manual are produced for Spanish military airports and civil and military airports under the Defense Ministry authority. Pilot's Manual provides to air crews the following information: Instrumental Approach Charts (IAC), Standard Instrument Departure Procedures (SID), Standard Arrivals (STAR), Visual Approach Procedures (VAC) and Airport Diagrams (AD).



LEZG Military Jets VFR Corridor

► Instrumental Approach Charts (IAC):

For aircraft operating under instrument flight rules (IFR), an instrument approach is a predetermined maneuvers for the orderly transfer of an aircraft under Instrument Meteorological Conditions (IMC) from the beginning of the initial approach to a landing, or to a point from which a landing may be made visually.

There are two main classifications for IAC: precision and non-precision. Precision approached utilizes both lateral (localizer) and vertical (glide slope) information. Non precision approaches provide lateral course information only.

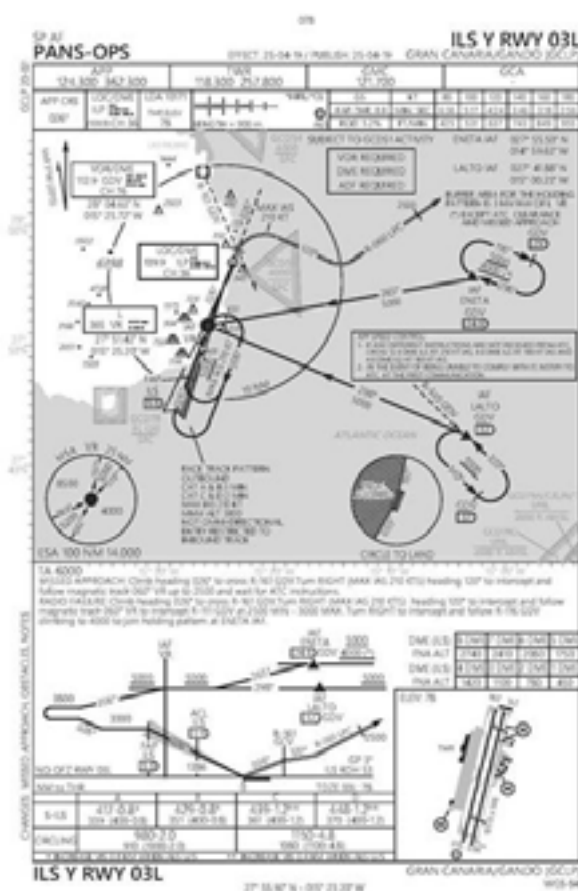
Publications depicting instrument approach procedures are called Terminal Procedures, but are commonly referred by pilots as approach plates. These documents depict the specific procedure to be followed by a pilot for a particular type of approach to an airport.

They depict prescribed altitudes and courses to be flown, as well as obstacles, terrain, and potentially conflicting airspace. They list missed approach procedures and commonly used radio frequencies.

CECAF uses NATO military standards to design these aeronautical charts, which is an extension of ICAO 8168 Vol II document. The projection is UTM and the scale is between 1:500,000 and 1:1,000,000. The aeronautical information is update every 28 days (AIRAC cycle).

► Standard Instrument Departures (SID) and Arrivals (STAR)

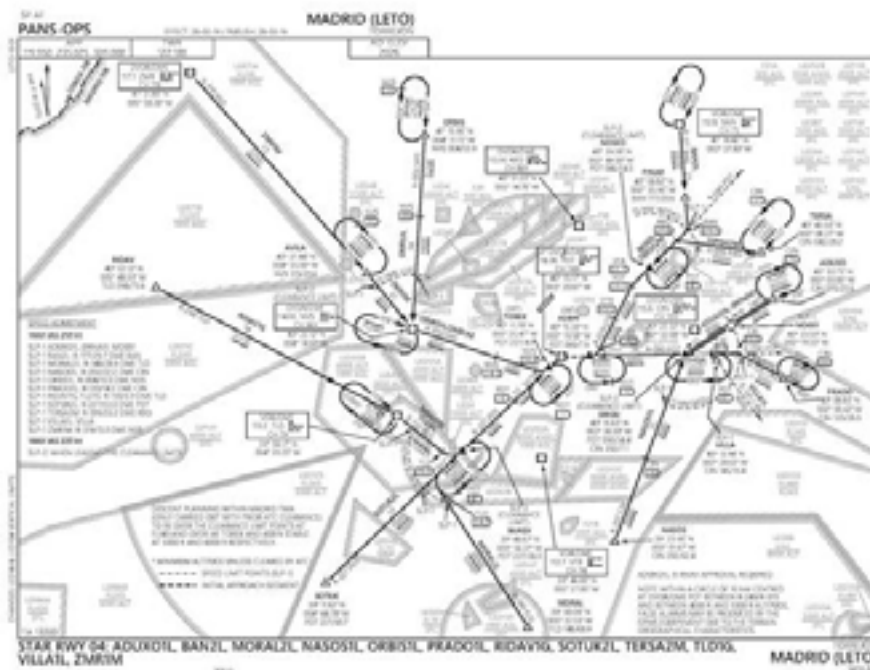
SID and STAR describe the routes followed by the aircraft according to their destination, from the airport to the assigned airway and from route to the starting point of the approximation, respectively. The function of these procedures is to allow simultaneous departures and arrivals at the airport control area without risk of collision.



Gran Canaria/Gando Airbase ILS procedure

Geospatial information depicted in these charts are:

- Identification of each of the departures or arrivals represented in the letter.
- Identification of airport runways.
- Radio frequency contact with different ATC services.
- Date of entry into force.
- Transition altitude.



STAR corresponding to Torrejón Air Base

- VOR, NDB or GNSS locations are used as reference in the chart and have the following information: name of item, type and frequency (only nav aids), which identifies Morse sequence (nav aids only), latitude and longitude.

Maps for Mission Planning Systems

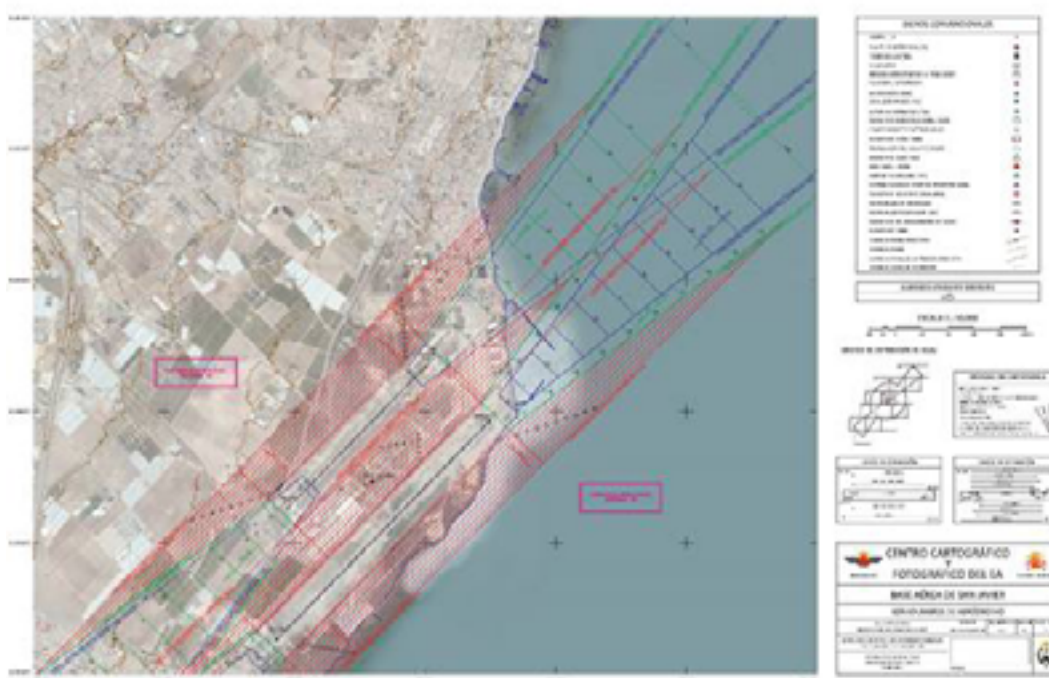
CECAF provides different types of mapping utility for aeronautics in different standard formats of digital maps for use in the various weapons system and cockpit. The types of charts supplied in digital format are:

- Global Navigation Chart (GNC) (1:5,000,000).
- Operational Navigation Chart (ONC) (1:1,000,000).

- Tactical Pilotage Chart (TPC) (1:500,000).
- Joint Operational Graphics Air (JOG-A) (1:250,000).
- Charts for Instrument Flight Rules (1:2,000,000).
- Chart of Visual Navigation (1:1,000,000).
- Low Flying Chart (LFC) (1:500,000).
- Topographic maps (1:50,000).
- Orthoimages.

Charts for Aeronautical Easements

Aeronautical easements established in air bases, military airfields and heliports respond to the need expressed by Spanish Air Navigation Law. An Aeronautical easement defines the airspace that should be kept without obstacles around the aerodrome in order to carry out safely aircraft operations.



San Javier airport aeronautical easements

There are three types of maps produced in connection with easements:

- Aerodrome easements: space used to protect the runway.
- Radiofrequency easements: space which protects the issuance of aeronautical nav aids.

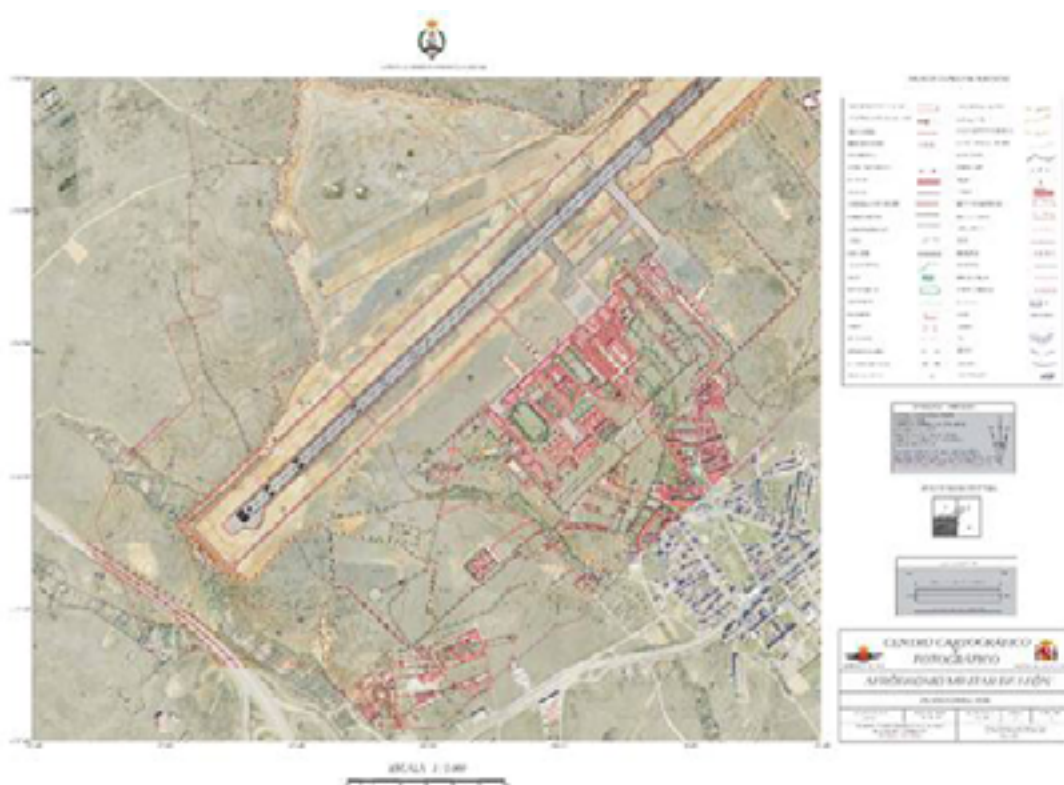
- Operations easements: space which protects instrumental procedures established around an airport.

The maps used for this type of easements meet the requirements of the Law and is entirely drawn up by the CECAF. Cartographic characteristics are:

- 1:10,000 scale for aerodrome and radio electric easements. 1:50,000 scale for operations easements
- UTM projection, Reference Systems ETRS89.
- Contours with 5 or 20 meters equidistance.
- Graphical representation of any element greater or equal to 2 meters, except those of special interest for such cartography, which would be represented by conventional symbols.

Infrastructure Cartography Maps

Another CECAF mission is the production of topographic maps at different scales, from the photogrammetric flight to the cartographic product. These maps are obtained by photogrammetric triangulation and restitution processes and vector files are generated. 1:1,000, 1: 5,000 and 1:10,000 scales are produced. These maps are used to identify boundaries, buffer zones, infrastructure works, etc.

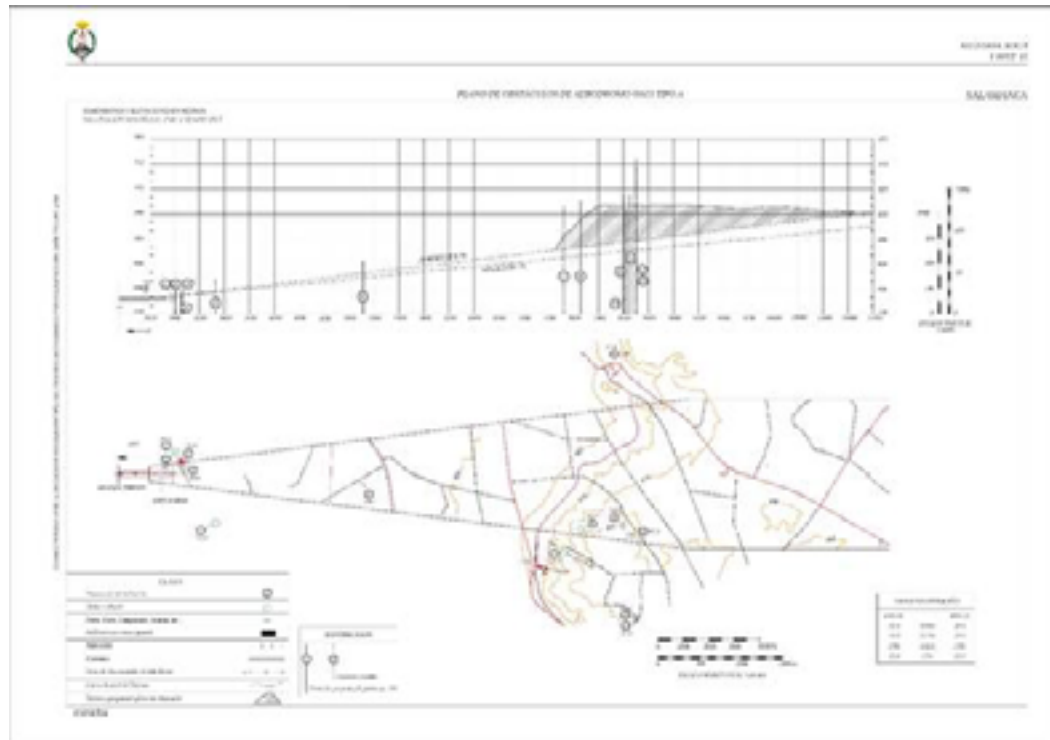


León military aerodrome 1:5,000

Aerodrome Obstacle Charts - ICAO Type A

This chart, in combination with the relevant information published in the AIP, shall provide the data necessary to comply with the operating limitations of the aircraft during take-off.

Aerodrome Obstacle Charts are made in order to provide necessary data to ensure that the aircraft, in case of engine failure during take-off maneuver, can interrupt or start the flight rising to a specified height, with a given security margin over all obstacles located in the flight path area.



Salamanca Aerodrome Obstacle Charts - ICAO Type A

Nav aids Calibration and Flight Procedures Validation

Nav aids calibration was assigned as a mission to CECAF on December, 9th 2008. The aircraft (Cessna Citation 560) incorporates a calibration console UNIFIS 3000, which obtains and records the data necessary to perform the inspection of nav aids.

CECAF also conducts flight validation and data verification of flight procedures design (FPD). Several steps are mandatory:

- Verify for accuracy of terrain, obstacles, aerodrome and nav aids data.
- Validate «intended use» of FPD as defined by stakeholders.
- Validate flight capacity.
- Validate flight safety.

International participation

CECAF, as aeronautical cartography institution, is involved in several international forums and working groups. For instance:

- NATO Geospatial Board (NGB)
- NATO Joint Geospatial Standardization Working Group (JGSWG)
- NATO Geospatial Aeronautical Working Group (GAWG)
- Airfield Services and Procedures Panel (ASPP)
- Military Instrument Procedures Standardization Team (MIPST)
- Spanish Spatial Data Infrastructure (IDEE)
- OPEN SKIES Treaty

CECAF also organizes the Spanish Air Force Photointerpretation International Trophy (TROFEA)

PROGRAMA:

- 08:30 - 09:00: Recepción de participantes.
- 09:00 - 09:20: Bienvenida, presentación y fotografía de grupo.
- 09:20 - 09:45: Primeros temas del trabajo: "CA (CIBERDEFENSA)".
- 09:45 - 10:10: Segundo tema del trabajo: "SIGINT".
- 10:10 - 10:25: Pausa / Café.
- 10:25 - 10:55: Tercera parte del trabajo: "CECAF 2018".
- 11:00 - 11:20: Visita al Museo del Aire.
- 11:20 - 11:40: Visita al Museo del Aire.
- 11:40 - 12:25: Desplazamiento al Pabellón Histórico.
- 12:30 - 14:00: Recepción de autoridades, clausura y entrega de premios.
- 14:00: Copia de fotointerpretación.

FOTINTERPRETACIÓN:
La rapidez y la seguridad en la interpretación dependen principalmente de que se efectúe de modo sistemático y por personal bien entrenado.

LUGAR DE DESARROLLO:
Edificio de Aeronave - Salas de actos,
Centro Cartográfico y Fotográfico del E.A.
Base Aérea de Cuatro Vientos (Madrid).

PREPARACIÓN Y ORGANIZACIÓN:
Servicio de Fotointerpretación del CECAF.

DURACIÓN: 3 días.

PARTEICIPACIÓN: Personal de las Fuerzas Armadas y la Armada, y personal militar de otros países de nuestra entera gratificación.

FECHA: 27 de septiembre de 2018.

OBJETIVOS:

- Adquirir entrenamiento específico en el área de la fotointerpretación junto a profesionales de las FAE españolas y de países amigos.
- Punto de encuentro de personal experto e intercambio de experiencias a nivel nacional e internacional.
- Mayor comprensión de la labor del fotointerprete y su repercusión en el planeamiento y toma de decisiones.

Para más información: cecaf_ciberdefen@ma.es

CENTRO CARTOGRAFICO Y FOTOGRAFICO DEL EJERCITO DEL AIRE

TROFEA 2018

VI Trofeo de Fotointerpretación del Ejército del Aire

CECAF Photointerpretation International Trophy

Geological and Mining Institute of Spain

Ríos Rosas, 23

E-28003 Madrid-Spain

Phone number: +34 91 3495700

Fax number: +34 91 4426216

The Geological and Mining Institute of Spain (IGME) is a public research department which has the elaboration and maintaining the geological cartography of the nation among his main commitments. That was the reason of his creation in 1849 under the name "Madrid and Kingdom General Geological Map Commission". IGME is an institution with a wide experience on Earth Sciences. Thus, not only maintain geological mapping in several scales since then, but grows his selection across other related and derived products. These are the so-called "Geotematic Maps" devoted to a research, practice or didactic function or to solve specific problems.

Since its very beginnings, IGME develops systematic geological map series. First, as a set of provincial maps developed until 1914. The first attempt to produce a complete coverage of the Geological Map of Spain at 1:50,000 scale was developed from 1927 to 1970) (1st Series) but ends unfinished. A new and more ambitious project: Geological Map of Spain 1:50,000 scale (2nd Series, MAGNA) was completed between 1970 and 2004. Associated with this program a new series of geological maps at 1:200,000 scale and a geological mapping of the Spanish continental platform and adjacent margins (FOMAR) were started. From 1863 on wards, together with those middle scale cartographies, broad or mural geological maps of the whole country have been published at 1:1,000,000 and 1:2,000,000 scales.

Starting about the middle of the 20th century, thematic geological cartography has been developed, paying special attention to surficial geology: geomorphologic and quaternary deposits maps, as a useful tool for land use planning. Aiming to integrate these cartographies into the systematic 1:50,000 geological mapping and update them, a 3rd Series MAGNA of Geotematic Maps was developed. Special attention towards the social and economic impact of natural disasters promotes definitely the making of geological risk and/or geological danger cartographic databases and maps. Geological resources are also considered, including hidrogeological, geotechnical, metalogenetic and industrial and mineral rocks resources maps.

Spatial information and digital maps in particular, like almost any other type of information, is mainly demanded in digital format. The digital transformation is shown in the amount of digital information available on IGME's website. In order to allow easy and intuitive access to this huge amount of information, the InfoIGME portal <http://info.igme.es> has been developed. Thus, this portal lets users to search, query, display and download of all the digital geoscientific information available at IGME. To get directly to the maps, a specific website has been created <http://info.igme.es/cartografiadigital>, where maps are grouped by type, series and availability.

The main cartographic series developed at present by the IGME are:

Geological Cartography 1:50,000 scale (MAGNA series)

Constituting the main geological database of Spain, the MAGNA program includes a total of 1143 geological maps represented at 1:50,000 scale in the mainland areas and a more detailed 1:25,000 scale in the island territories except Mallorca. The published information of each sheet includes a geological map, a geomorphological one (from 1991 onwards) and an explanatory report. A complete set of related information including paleontological, petrological and sedimentological reports, photographs, rock preparations and samples, inventory of geological sites, etc. for each sheet are also available for free consultation and are freely accessible through the web site:

<http://info.igme.es/cartografiadigital/geologica/Magna50.aspx?language=en>

This huge task was developed after 35 years of work, from 1970 until 2004.

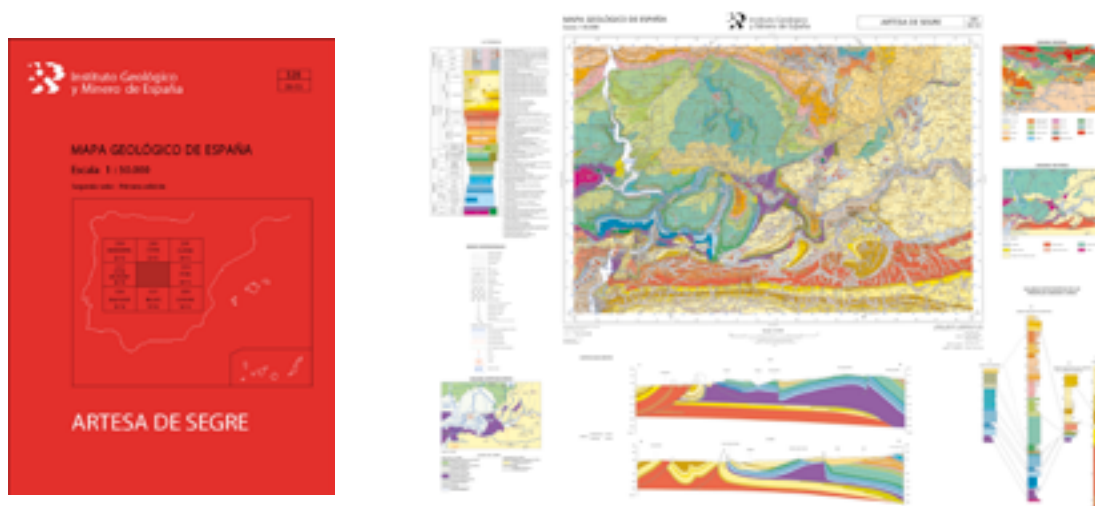


Fig.1.- Image of one of the last published geological maps of MAGNA series: Sheet 328 Artesa de Segre, and its notice

Continuous Geological digital map 1:50.000 scale. GEODE project

After the completion of MAGNA program, a new activity of geological harmonisation of geological maps at 1:50,000 scale was developed. The aim of this project is to create a new, seamless 1:50,000 geological map avoiding discontinuities between sheets and to deliver information in a quick, modern and efficient way to the user.

This endeavour, named as GEODE project, aimed to ensure a geological continuity between the different geological sheets produced after the MAGNA program and to improve the dissemination and the usefulness of the geological mapping. For this purpose the territory of Spain was divided in 30 geological homogeneous provinces. This product,

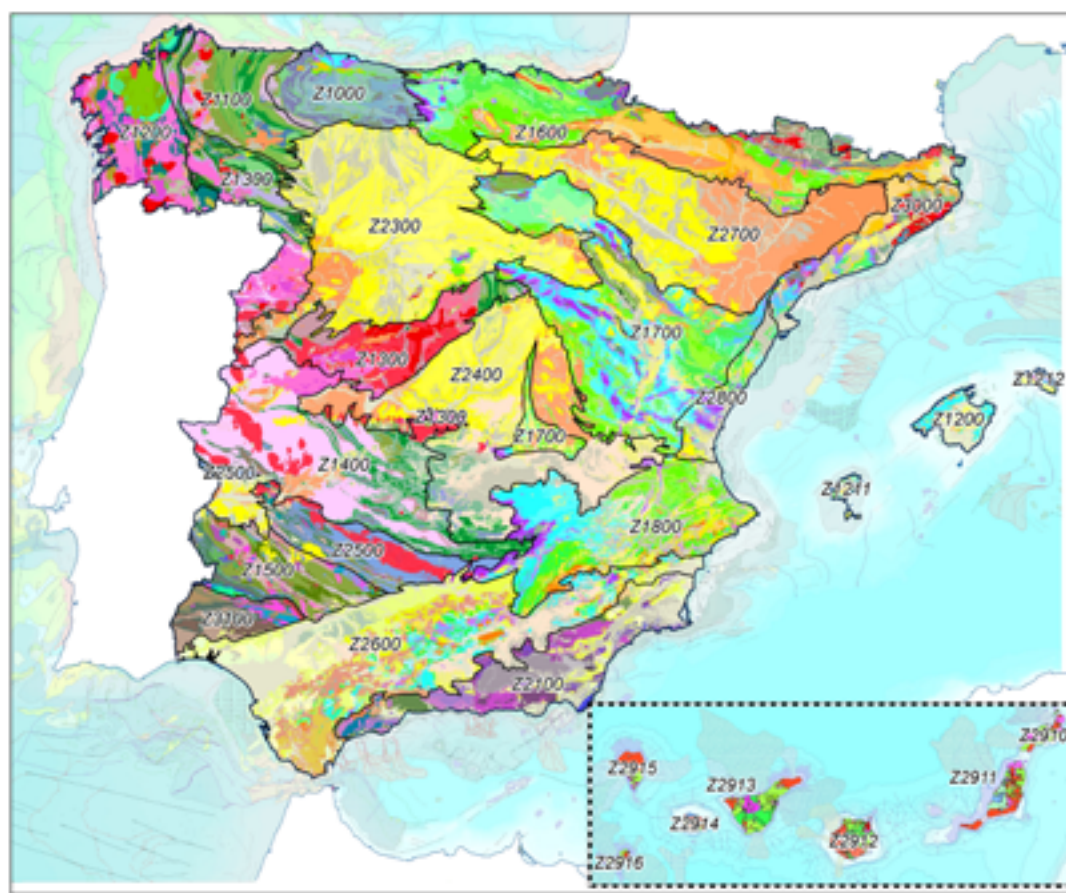


Fig. 2.- Distribution of GEODE geological provinces

entirely digital, and accessible only by web browsers, includes a series of geological information layers (shapefiles) and a legend for each of the regional units. The program is expected to be completed in 2019, but a regular update of their geological information layers is planned.

<http://info.igme.es/cartografiadigital/geologica/Geode.aspx?language=en>

3th Series MAGNA of Geological Maps 1:50,000 scale

Combining the main commitment of the update the detailed geological cartography with the purpose of complete the geomorphological map series, a new mapping program was designed. This project constitutes the 3rd series of the geological map at 1:50,000 scale and is so-called MAGNA 3rd Series.

His objectives are to update MAGNA series maps and complete them with surface geology and underground information. Every sheet of the new Geological Map of Spain at 1:50,000 3rd Series, includes a Geological, Geomorphological and Active Process map and a complete descriptive memoir.

For a while this new digital series was distributed in interactive DVD format, which includes a GIS client accessing maps, reports and auxiliary information. In this media, all the information obtained during the elaboration of the map is included and fully consultable.

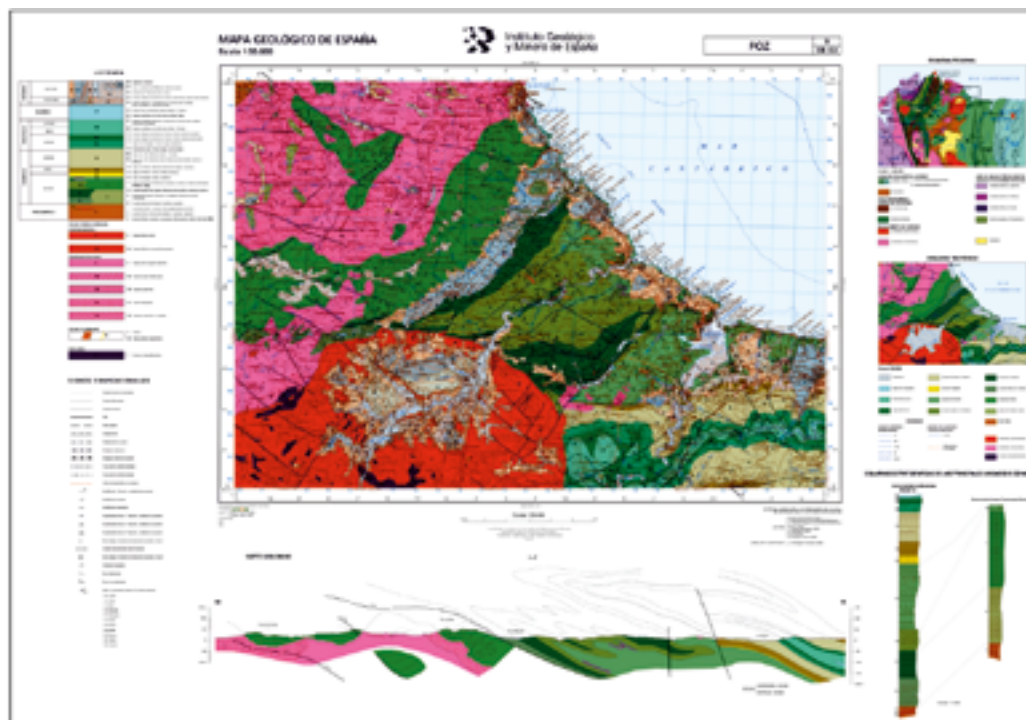


Fig. 3.- Example of a geological sheet (Foz, number 9) of the 3rd series MAGNA maps

Three interactive CD of the new Digital Edition of Geological Map of Spain at 1:50,000 scales were published between 2013 and 2015

Nowadays, as the DVD format becomes obsolete the new cartography produced in this project is available on a specific website.



Fig. 4a.- Geomorphological map 1:50,000 scale of the sheet 999 Huelva-Los Caños published in 2019



Fig. 4b.- Active processes map 1:50,000 scale of the sheet 999 Huelva-Los Caños published in 2019

Geomorphology, Active Processes and Geomorphological Units Maps

Included in the MAGNA 3rd Series Plan, the Geomorphological Map of Spain series at 1:50.000 scale is a set of thematic maps derived from the geological map, but focusing in surficial geology and landscape interpretation. It is composed by three related individual maps: *Geomorphological map* that delivers information about landforms. *Active processes*, a geodynamic activity inventory (seismic, geotectonic, volcanic, landslides, erosion, floods, antropic activities and sedimentary processes associated with some lithologies) drawn by the forms that they generate. The third map, *Geomorphological Units map*, divided the territory in homogenous areas from a geomorphologic point of view, as a summary of previous cartographies.

Geomorphological Map coverage starts in 1991 as a part of 1:50.000 MAGNA cartographic series as a full colour and at 1:50.000 scale map. After three decades of development the Geomorphological Map has experienced several changes and improvements. Nowadays the 40% of the Spanish territory is covered by this series.

Regional synthesis, mural and popular maps

Small scale geological maps published by the IGME include the systematic series of Geological Maps at 1:200,000 scale. Benefiting from the great improvement of scientific geological knowledge obtained during the geological mapping at 1:50.000 scale, these maps aim to face regional geological controversies. The notice of the maps is structured as scientific monographies using the cartographic information to resolve regional geological problems. As in the MAGNA series, the scale varies, being 1:200,000 in the mainland and

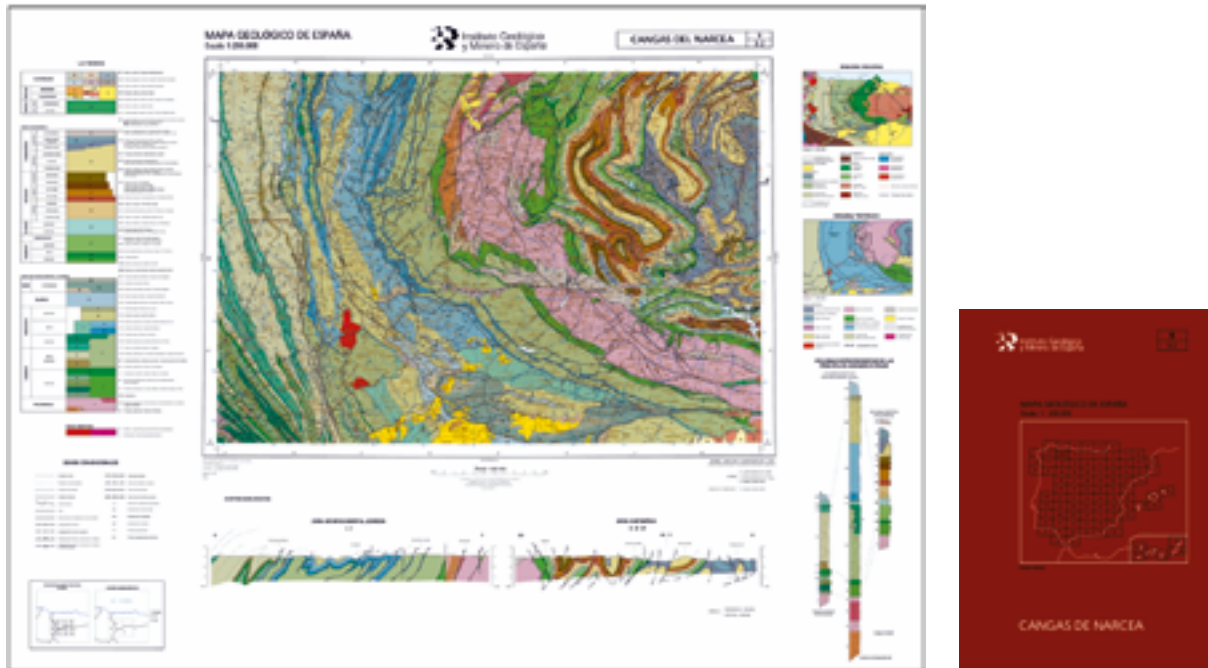


Fig. 5.- Geological Map of Spain at 200,000 series. Cangas de Narcea sheet (number 9), to be published in 2019

becoming 1:100,000 for the maps of the islands. At this moment the coverage of this series attains 50% of the territory of Spain.

Periodic preparation of mural maps showing the whole of Iberian Peninsula is a traditional activity and a way to show "the state of the art" of broad Spanish geological knowledge.

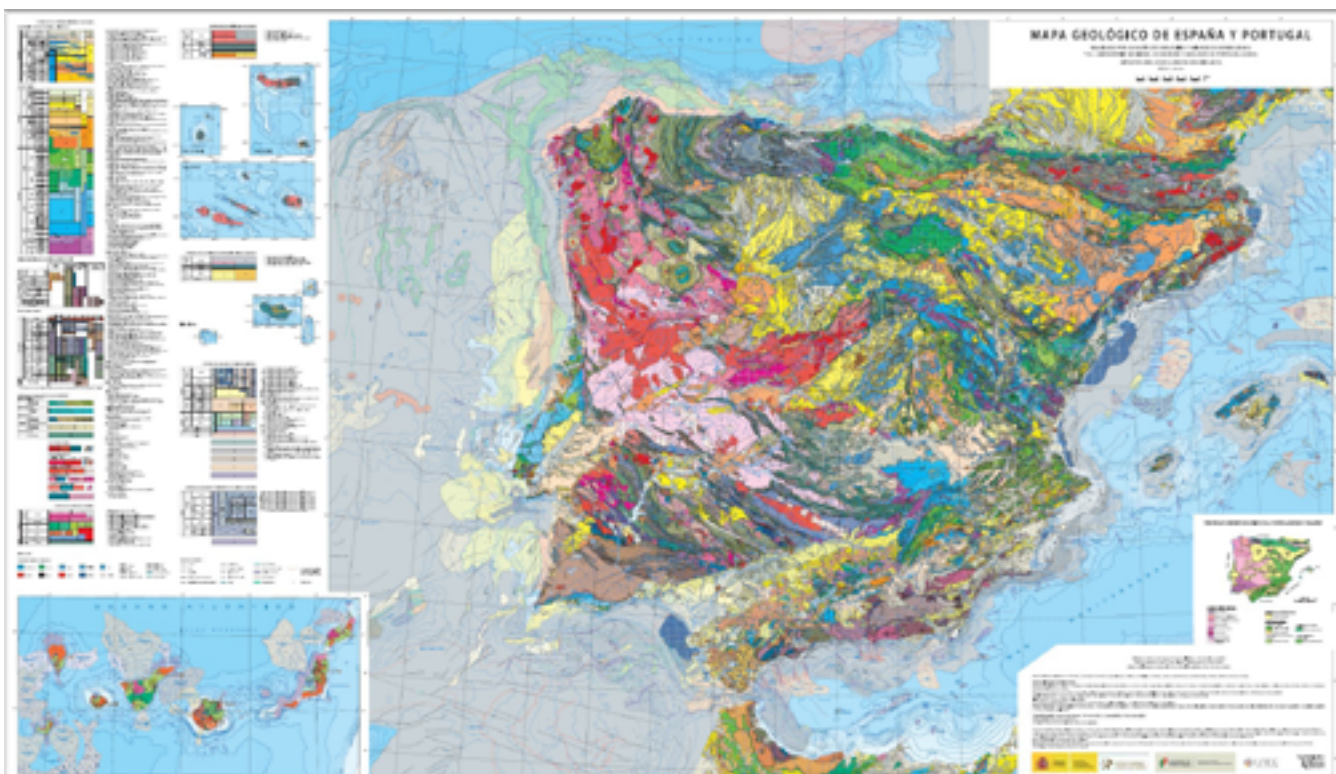


Fig. 6.- The new geological map 1:1,000,000 scale of Spain and Portugal published in 2015

In 2015, a new version of the geological map of Spain and Portugal at 1:1,000,000 scale was published. Made in collaboration with the Portuguese geological Survey (LNEG), as a novelty this map includes the geological delineation of the continental shelf.

Geological Maps of National Parks: GEONATUR Series

In 2018 the IGME starts a new cartographic series devoted to geological and geomorphological maps of National Parks and other protected natural areas. The first publication is the Geological Map of the Ordesa and Monte Perdido National Park at 1:25,000 scale. This series, printed over a new support: ecologic stone (limestone) paper, include a basic explanation of the main geological features of the Park in its back.

Simplified geological and geomorphological maps constitute also a key element of the **Geological Guides of National Parks**. It shows relationships between geology, relief and vegetation. Also includes some itineraries of interest. All this series deals with nature tourism demand of information.



Fig. 7.- The new Geological Map of the Ordesa and Monte Perdido National Park at 1:25,000 scale

Marine Geological Mapping

A major activity of IGME is the geological study of the marine environment and its resources. With this aim, IGME is participating in the EMODnet-Geology project, launched by the European Commission as part of its Marine Knowledge 2020 strategy. Under this project, IGME has provided harmonized and standardized marine data and new multi-resolution digital maps including sea-floor geology, seabed substrate, geomorphology, coastal behavior, geological events (earthquakes, tsunamis, submarine landslides, active faults, volcanic centers, fluid emissions), mineral occurrences (aggregates and metallic

minerals) and hydrocarbons and submerged landscapes. The outputs (maps, documents and additional data) are open and freely delivered through an Internet portal (<http://www.emodnet-geology.eu>). In addition, new digital bathymetric maps have been developed on

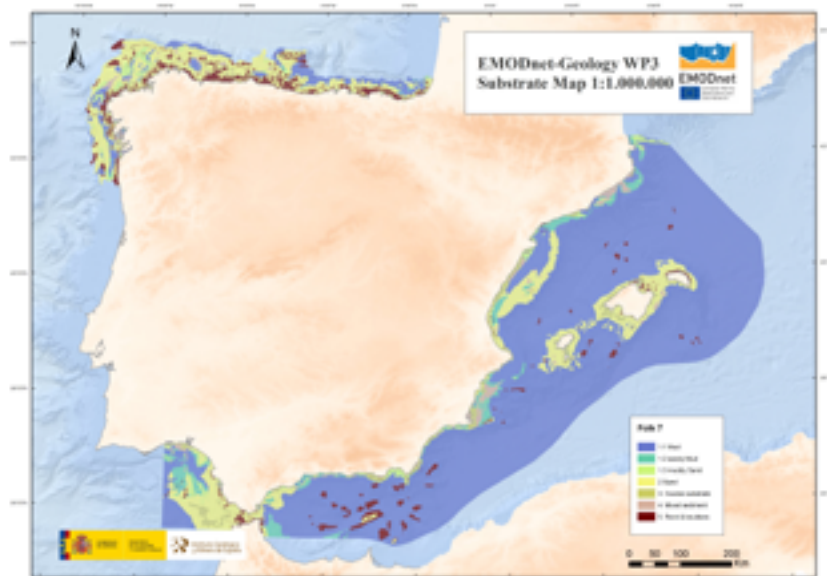


Fig. 8.- Seabed substrate map of Spain at 1.1.000.000 scale (EMODnet-Geology)

the basis of datasets originated from hydrographic and research organizations in the «High Resolution Seabed Mapping» European project (<http://www.emodnet-bathymetry.eu>).

Considering that the economic potential of marine minerals is growing, as a consequence of the pressure on terrestrial resources, an additional effort is being devoted to map different types of mineral occurrences. In this sense, IGME coordinates the project «Seabed Mineral Deposits in European Seas: Metallogeny and Geological Potential for Strategic and

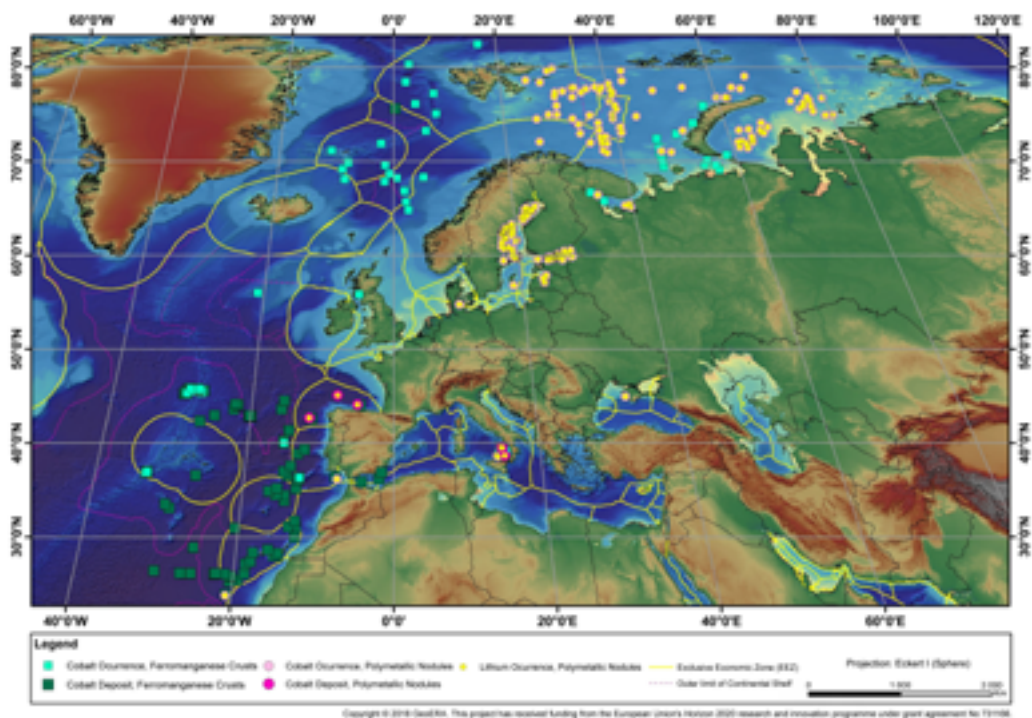


Fig. 9.- Distribution of Cobalt and Lithium occurrences in European seas (MINDeSEA)

Critical Raw Materials» (GeoERA- MINDeSEA), also funded by the European Commission. In the framework of this project, mineral maps and datasets of seabed deposits and mineral-potential and prospectivity maps (massive sulphide deposits, Fe-Mn crusts, placer deposits, polymetallic nodules, phosphorites and critical raw materials) are being developed (<http://geoera.eu/projects/mindesea>).

These mapping activities complement the brand new program devoted to digital marine cartography (GEODEMAR). This program is aimed to develop new digital harmonized thematic maps of the Spanish Continental Shelf. Maps will also cover the claimed extended continental shelf according to the United Nations Convention on the Law of the Sea and will also benefit from the great improvement of scientific geological knowledge derived from scientific projects carried out by IGME.

Geological Hazards

Research, forecast, prevention and mitigation of hazards generated by natural processes of geological origin are an IGME commitment. They deal with earthquakes, tsunamis, volcanism, floods, landslides (subsidence and slope), avalanches and those related with coastal processes.

The activities of the IGME in this topic include field works, in situ investigations, digital elevation models and a qualitative and quantitative zoning as a result of the multifactorial analysis using GIS.

Scale varies from regional to 1:5,000/1:25,000 when the study areas are high populated.

Earthquake Hazards: QAFI and ZESIS databases

In 2012 IGME implemented a new web service hosting a database of Quaternary-active faults in Iberia (QAFI). This database contains a compilation of faults showing geological evidence of activity during the Quaternary period (last 2.6 million years). Its two main



Fig. 10.- Screenshot of the QAFI web service (<http://info.igme.es/qafi/>)



Fig. 11.- Screenshot of the ZESIS web service (<http://info.igme.es/zesis/>)

purposes are a) to become an official repository of scientific data in relation to Quaternary tectonics, and b) to facilitate transfer of knowledge to the earthquake risk community in Spain and Portugal (engineers, decision makers, seismic hazard analysts). The database is hosted and maintained by the IGME in cooperation with the Portuguese LNEG. It is freely accessible to the research and technical community at <http://info.igme.es/qafi/>.

In 2015 a new web application was launched with the name ZESIS (Zonas Sismogénicas de la Península Ibérica - Seismogenic Zones of the Iberian Peninsula). The database documents the criteria and data used to define and characterize a total of 55 different zones that were included in a comprehensive probabilistic seismic hazard analysis at a national scale directed by the Spanish Instituto Geográfico Nacional (IGN) in 2012. The main purposes of the database are a) to inform the earthquake hazard community about the main seismogenic model used in the calculations of the Spanish seismic hazard map and, b) serve as a basis for future improvements and updates of the national hazard map.

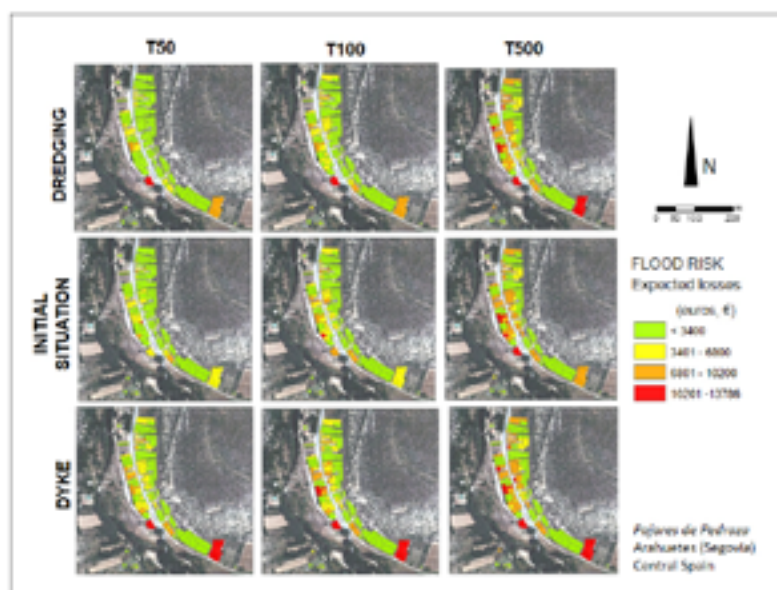


Fig. 12.- Flood risk maps for different return periods (T) and mitigation measures, Pajares de Pedraza (Segovia)

Flood hazard and risk mapping

From 2013 onwards, the collaboration of the scientific and technical staff of the IGME has led to the publication of the first Spanish maps of true flood risk and its components (integrated hazard, social and economic vulnerability and exposure). As a result of this initiative a series of true integrated vulnerability maps, including both economic and social affectations originated by flood hazards, are available for the whole Castilla and León region. Very detailed maps (1:500 to 1:2,000 scale) of economic flood risk have been also delineated for several Spanish municipalities (Navaluenga, Pajares de Pedraza, Segovia's Old Royal Mint, Toro-Zamora, Taburiente National Park), including cartographies and cost-benefit analyses of mitigation measures. With this analysis also flood risk perception maps, using geostatistical techniques have been made.

Ground movements mapping and monitoring

In 2016, IGME implemented a new web service that shows cartographic representation of ground movements (landslides and subsidence) in Spain (BD-MOVES). The database BD-MOVES meets European and international standards and data specifications of the European Directive INSPIRE. For this purpose, it includes alphanumeric and cartographic fields (shapes) for the spatial and temporal description of ground motion (location, name, typological classification, morphometry, hillside situation regarding the date of the main event, reactivations, etc.), characterization of the medium in which occur (geology, hydrogeology, land use, slope orientation, etc.) and evaluation of its current state of activity. It also contains information on the intrinsic physical, geomorphological and anthropic causes that condition and trigger movements on the warning signs and the damage they cause (costs, losses, type of affected items, degree of damage, number of people affected, etc.). Finally, it records costs of interventions to mitigate risk, techniques and methods used for data collection and all references and links to documentation references available on IGME and internet.

IGME combined BD-MOVES information with landslide databases of 17 Geological Surveys of Europe to elaborate the first European Landslide density map. The 849,543 landslides reveal 210,544 km² landslide prone areas in 23,681 administrative areas where



Fig. 13.- Ground movement database from the Geological Survey of Spain: http://mapas.igme.es/gis/services/Cartografia_Tematica/IGME_BDMoves_ES/MapServer/WMSServer

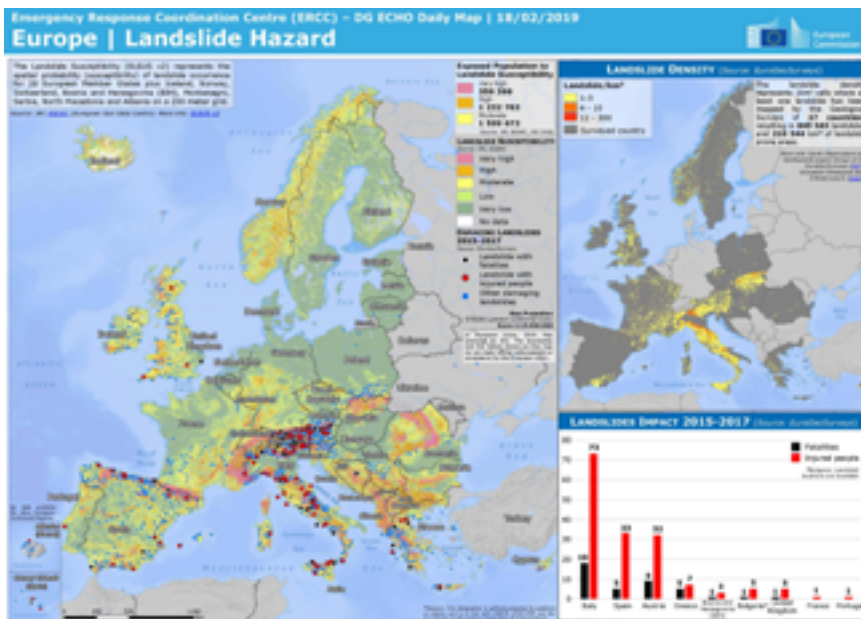


Fig. 14.- Landslide hazard map elaborated by DG ECHO based on the review of landslide hazard of the Geological Surveys of Europe: <http://www.europe-geology.eu/map-viewer/>

the Geological Surveys recorded at least one landslide. However, we estimated that the completeness of the databases from the Geological Surveys is on average 17%, varying between 1% and 55% among analysed countries. Moreover, since 2015 the Geological Surveys deliver an annual report on damaging landslides producing an impact in Europe. According to this work, 194 landslides produced fatalities or injuries, and 3710 produced an impact in urban structures and infrastructures. The Emergency Response Coordination Centre (ERCC) from DG ECHO has recently published this information of interest for the European Commission.

Geological hazard and risk mapping for insurance purposes

The IGME provides assessment to the Spanish insurance system of natural disasters (Consorcio de Compensación de Seguros) which has lately included flood, earthquake and volcano risk mapping for the Canary Archipelago at a postal code scale. Such mapping and the concluding remarks were published in 2014 as a book and a free online ebook called GEOMEPE, Modelo de Evaluación de Pérdidas por Peligros Geológicos (Loss evaluation method for geologic hazards). This mapping effort provides a clear view of the insurance needs and increases public awareness related to such natural phenomenon, their possible consequences and the different strategies to mitigate unwanted outcomes. A forthcoming agreement with the CCS will soon allow mapping tsunami hazards and tsunami risks.

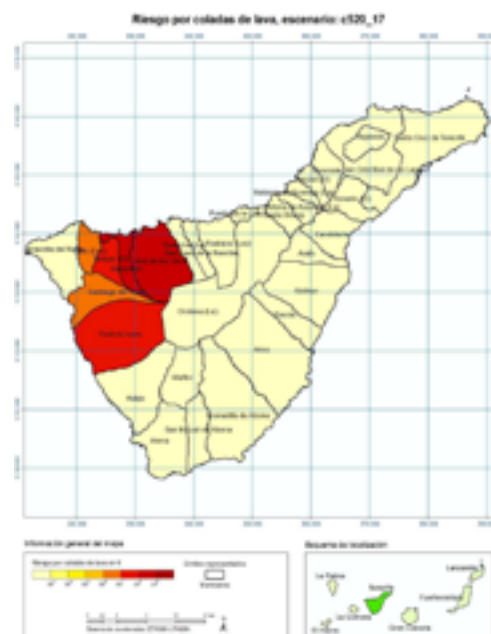


Fig. 15.- Lava flows risk, scenario: c520_17 of Tenerife (Canary) island

At an EU level, the IGME has actively contributed to the development of several data specs within Annex III of the INSPIRE Directive, their implementation and follow-up.

Geophysics

Geophysical Maps (gravimetric, magnetic and radiometric maps) are a main tool to obtain important information about the internal structure of the interior of the Earth. For this kind of information the IGME has developed a specific Geophysical Information System (SIGEOF) (<http://info.igme.es/SIGEOF/>) where it stores and publishes gravimetric, magnetic and radiometric data obtained during its geological and mining field exploration duties during the last 50 years.

Research subsurface activities include the realization of gravimetric and aeromagnetic maps in digital format at a scale of 1: 200,000. At this moment the methodological bases to carry out the gravimetric map, combining coloured anomalies with a recent vectorial geological base (GEODE) have been established. These maps could also include 2D and 3D models derived from interpretation of the subsurface geological structures.

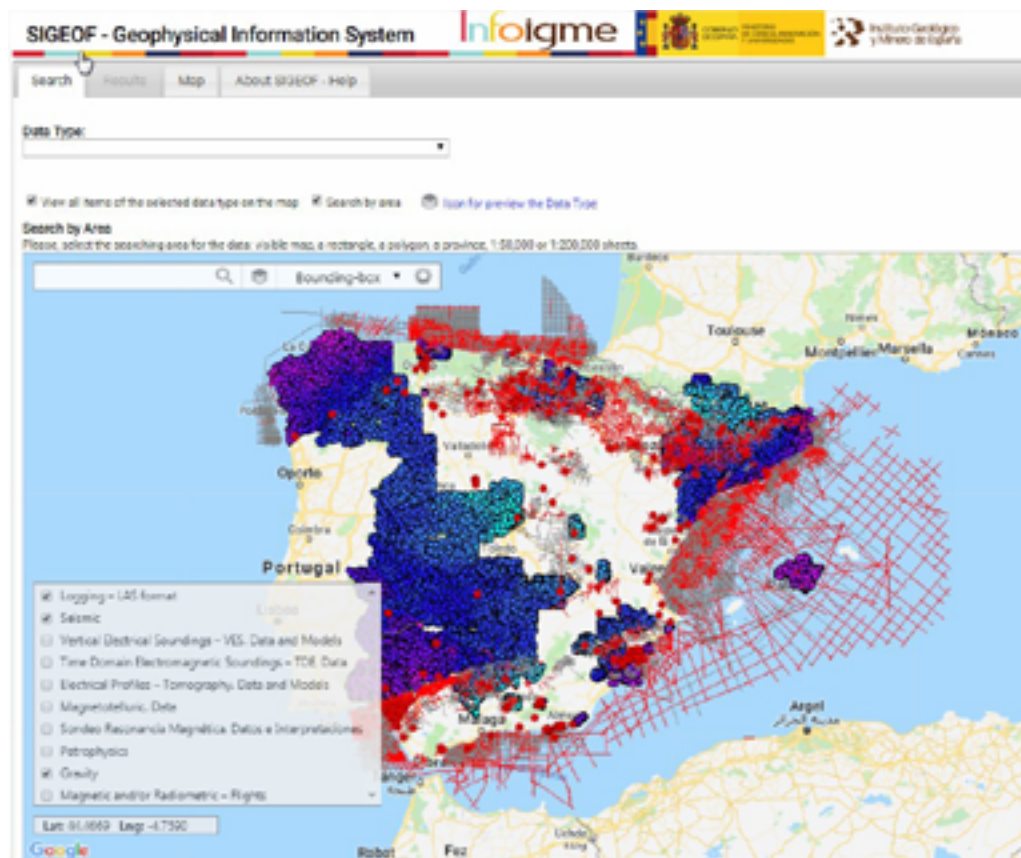


Fig. 16.- Screenshot of SIGEOF website (<http://info.igme.es/sigeof/>)

Hydrogeology

IGME's hidrogeological maps show regional aquifer features as well as exploitation aspects as basic information for further detail works.

The Hidrogeological Map of Spain at 1:1,000,000 (1972) is previous to a systematic series at 1:200,000 carried out between 1982 and 1990. Since then hydrogeology is included as a complementary information in the Geological Map at 1:50,000 (MAGNA). Hidrogeological and Hidroenvironmental Atlas are made in collaboration with regional and provincial institutions.

Metallogenic Geology, Geochemistry and Industrial rocks and minerals

Metallogenical Maps are essential tools to know potential mining of an area. They display metal, non-metal and energy mineralization evidences on a geological base. Publishing scale is usually 1:200,000 or regional and provincial layouts (1:100,000/1:400,000).

Geochemistry cartographies contribute to the knowledge of a wide set of chemistry elements geographical distribution related with superficial formation such as alluvium and soils. 1:100,000 and 1:600,000 are common regional scales. Association or anomalies maps have a more straightforward application with concrete objectives such as mining exploration, land planning or health issues.

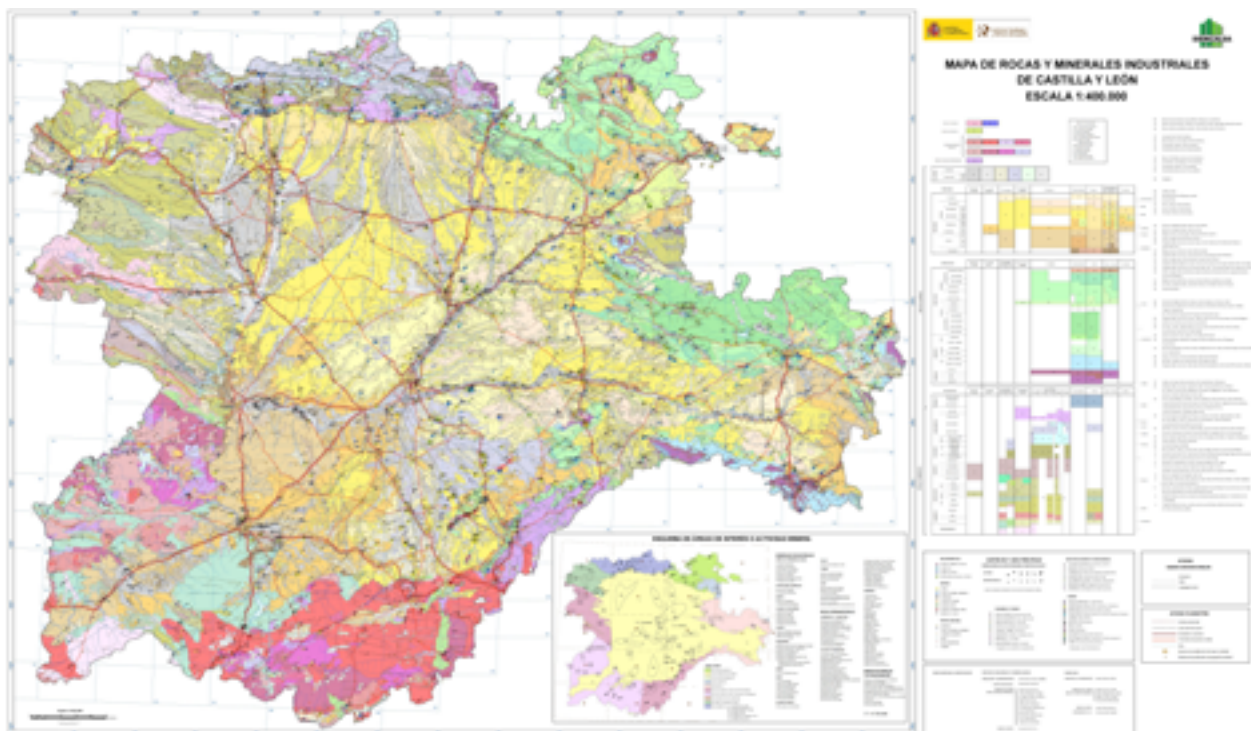


Fig. 17.- Industrial Rocks and Minerals Map at 1:400,000 of Castilla y León published in 2016

The Industrial Rocks Map at 1:200,000 scale had an old development based on deposits with an associated inventory card. Current proposal, the Industrial Rocks and Minerals Map (MANARMIN) is a geological-mining map that summarizes current knowledge of industrial rocks and minerals mining and its potential use. Regional maps, issued from collaboration with regional authorities are also published as the new "Industrial rocks and minerals map of Castilla y León" published in 2016.

Geological Heritage

The map of main geological domains of Spain is crucial for geological heritage research. Geosites selection was done specifically for each geological domain through a systematic geoheritage inventory. Scientific, didactic and touristic values have been assessed for each geosite. On a second phase we carried out vulnerability and risk of degradation evaluation on geosites including geoindicators. Since 2008, the Spanish Inventory of Geosites -IELIG

acronym in Spanish- (<http://info.igme.es/ielig/>) web service is a new tool which hosts the database of IELIG.

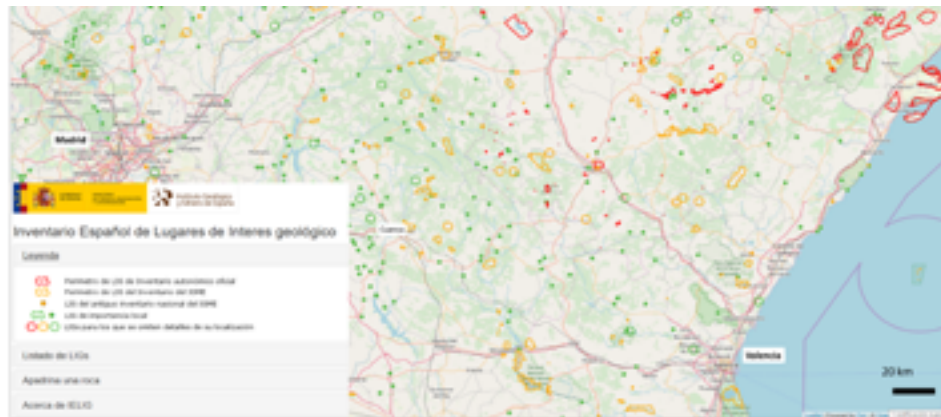


Fig. 18.- Image of the IELIG (<http://info.igme.es/ielig/>) web service which hosts the inventory of Sites of Geological Interest of Spain

Dissemination of cartographic information

IGME website

In 2003, IGME started the compilation and organization of digital maps in a shared repository. A unique access point to get the digital maps available was opened in order to improve dissemination and use of maps in digital format. Nowadays, InfoIGME is the website to gain the Geoscientific information generated by the IGME. It integrates the digital maps portal, a dataset catalog, an advanced search system, several specific applications to display and query different databases, a map viewer and a large number of web map services.



Fig. 19.- Screenshot of Geoportal of IGME's digital maps

- The digital maps portal (<http://info.igme.es/cartografiadigital/>), having internet and intranet versions, makes available geological and thematic maps to users. Maps in different formats are available, but also dossiers, metadata and any other additional information of interest. Most of the information available in the internet version can be downloaded in jpg and/or pdf format. Vector maps are supplied in ESRI shapefile on request to the Digital Maps Service.
- IGME offers several web map services (<http://mapas.igme.es>) complying with the interoperability standards developed by the Open Geospatial Consortium (OGC). These standards make it easier to display and get information from vast amount of permanently up-to-date spatial information ready to use in any desktop or web GIS application. In addition, KML and ArcGIS Server services are provided.
- A new map viewer (<http://info.igme.es/visorweb/>) was recently developed by IGME. It allows users to display and query, through standard tools, all the spatial datasets from IGME, and other organization, using WMS, WMTS or ArcGIS Server services. There is a list of predefined map services that can be overlapped on the layers loaded by default. It is possible to load services through its URL. It also let users the management of this information, changing the layer visibility, their order and transparency. Additional information can be displayed for layers (legends, metadata, etc.) and for identified features (reports, pictures, etc.)

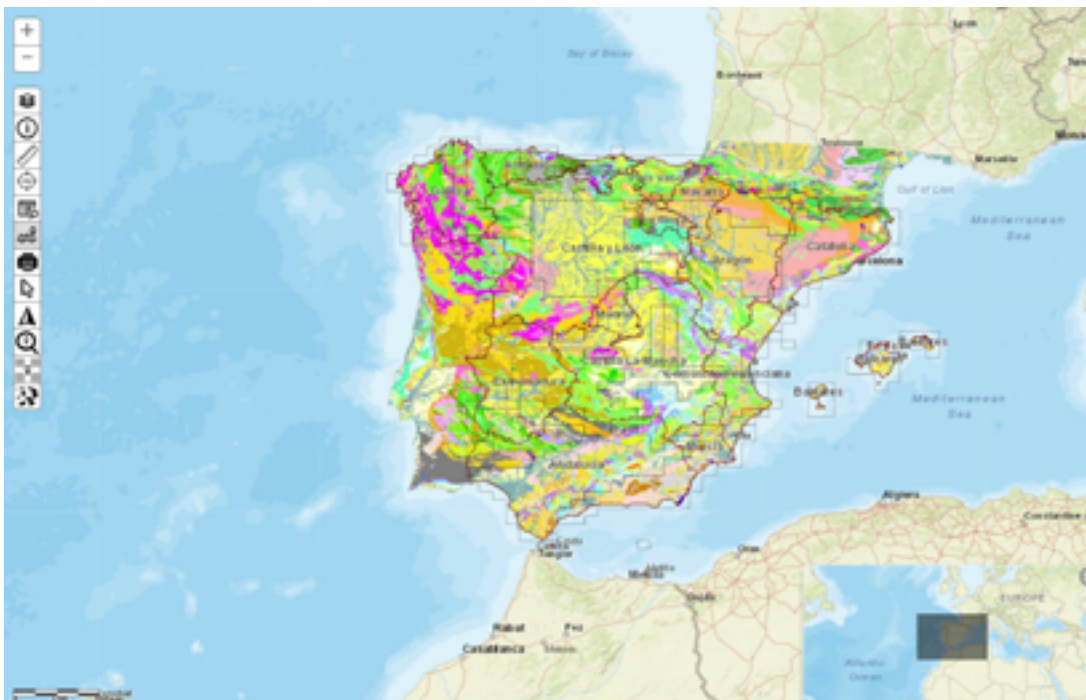


Fig. 20.- Screenshot of IGME map viewer

In 2018, a dataset catalog (<http://info.igme.es/datacatalog/>) was incorporated into InfoIGME, which extends the previous digital maps inventory and adds new functionalities and the possibility of discovering IGME's databases. That year was also launched an advanced search system (commonly known as ISE: <http://info.igme.es/ise/>), a tool that allows selecting, by alphanumeric and spatial criteria, features from different IGME's geoscientific information datasets, as well as displaying the main attributes of the selected

features and its location on a map. It is also possible to access the dataset to which the features belong to in different formats or open applications to query or display those features.

Technological support

Aerial Works Service (STA in Spanish) was established in 2017 to support IGME's technical and scientific projects, facilitating the collection of all types of georeferenced ground data using low cost air platforms, with high spatial and temporal resolution.

Among the products generated by the STA are ortho-rectified photo mosaics, digital elevation models (DEMs), 3D models with real textured high resolution, oblique and zenithal aerial photographs, 3D point clouds, documentary aerial videos and other research activities.

As a support for all Earth science professionals, and especially geologists, who need to obtain georeferenced data in the field, IGME has developed an application for mobile devices (Android tablets). INGEOTAB is a simple and user friendly tool which allows create customizable forms for data entry, draw sketches on maps or photos or record data in custom fields with pre-defined drop-down lists, among other facilities. INGEOTAB

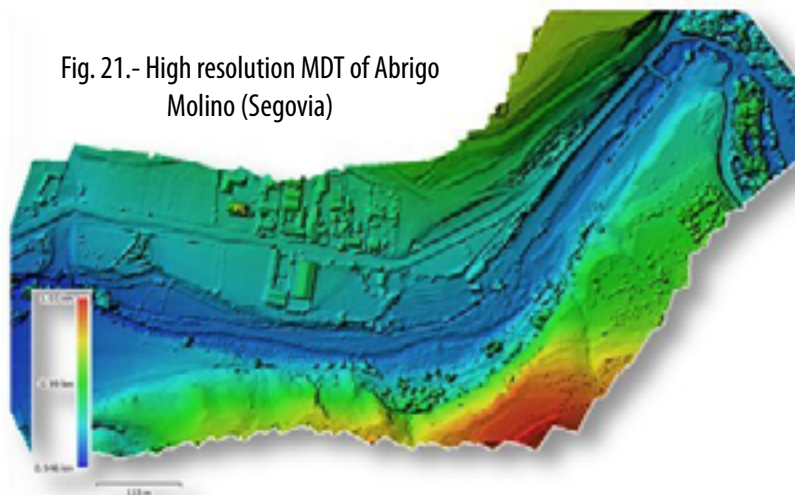


Fig. 21.- High resolution MDT of Abrigo Molino (Segovia)



Fig. 22.- INGEOTAB app

integrates multiple tools that facilitate the capture and display of information on a single device: maps, GPS position and track recording, compass, clinometer, georeferenced photographs, and so on.

International Activity

IGME spreads his activities abroad through developing countries, and in the last years has participated in geological mapping programs in Argentina and Dominican Republic.

In 2014, the Minister of Geology and Mines of the Angola Republic, through the Geological Institute of Angola (IGEO), launched the National Plan of Geology (PLANAGEO), for a period of 6 years. PLANAGEO has as a main objective to improve the geological knowledge and the mineral resources potential of the country of Angola in order to re-activate the national mining sector and guarantee the sustainable development of the nation.

The IGME participates in the PLANGEO Program as a part of one Temporary Union of Companies (UTE), jointly with the National Laboratory of Energy and Geology of Portugal (LNEG) and IMPULSO, a private Spanish company. Within this project, the UTE is responsible for the execution of the regional geophysical and geological surveys and the elaboration of geological maps of 480.000 km², out of 1.280.000 km² of the whole country (Fig. 23).

Currently, the main results of the PLANAGEO have been the realization of 44 geological maps at scale 1:250,000 (as the shown in Fig. 22), synthetic and mineral resources maps at scale 1:500,000, and tectonic-structural, hydrogeological and metallogenetic maps at

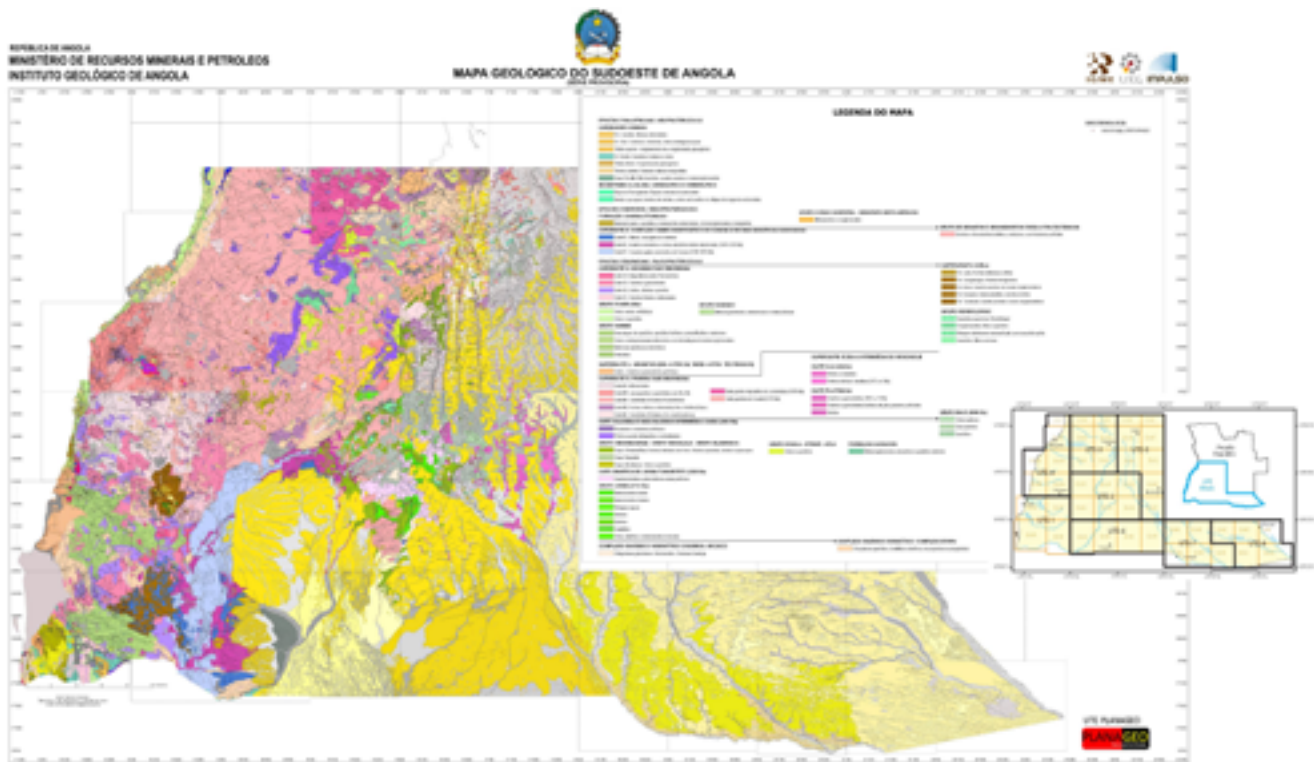


Fig. 23.- Synthetic geological map at scale 1: 1,000,000 of the UTE cartographic block (legend for of the igneous and metamorphic rocks of the Angola Shield). Schema showing UTE block location in the Republic of Angola, grids represent the sub-blocks divisions and map sheets at a scale of 1: 250,000.

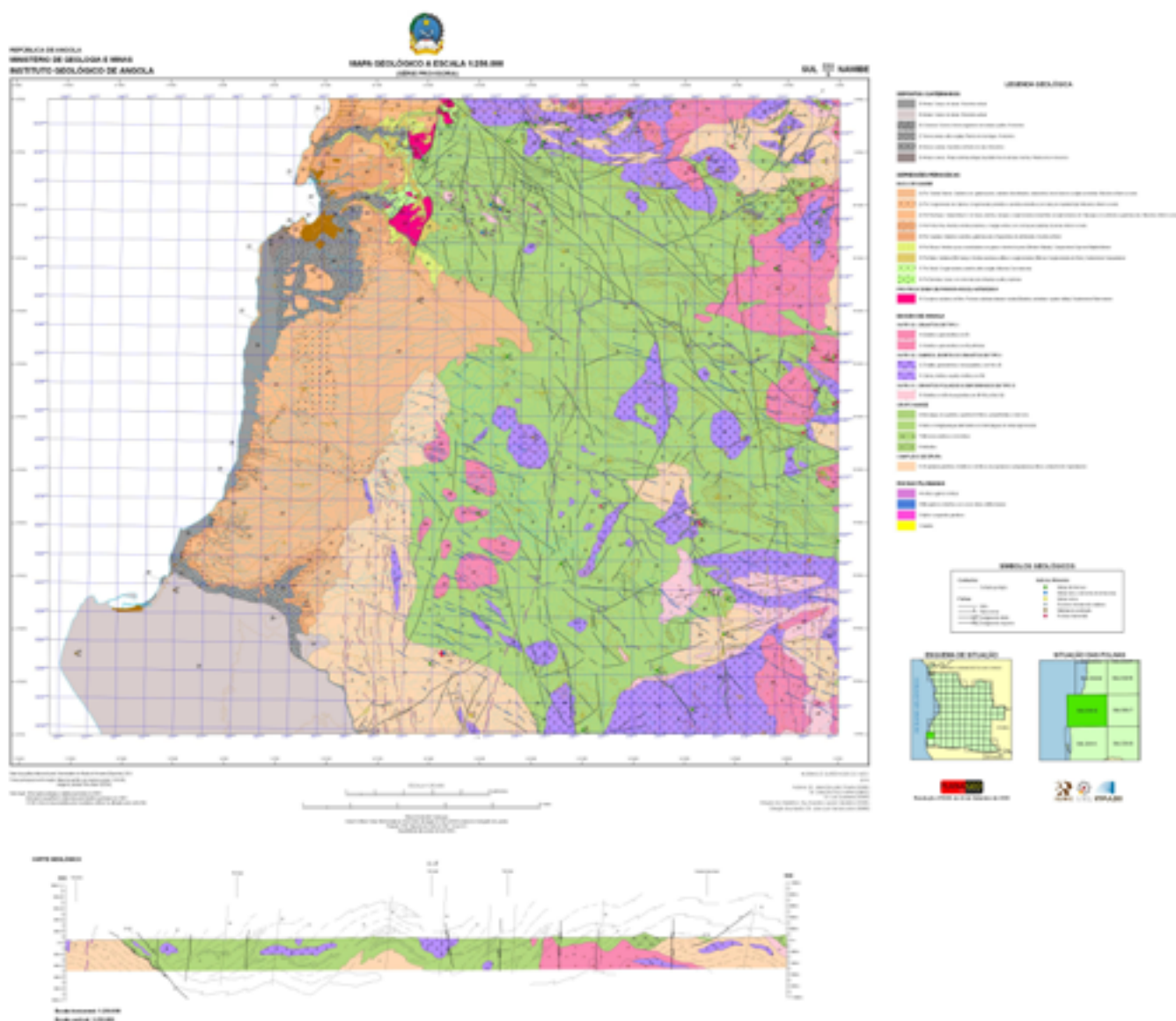


Fig. 24.-Geological map of Namibe at scale 1: 250,000

scale 1: 1,000,000 (Fig. 24), as well as thematic spatial databases and other geo-referenced information. These results constitute a basic infrastructure for the exploration and location of areas of mineral resources, the evaluation of geological hazards and the prevention of disasters, the management of land uses and the planning of the territory, among other objectives.

This objective was attained despite the extreme geological complexity of the territory of Angola, which includes very old rocks of the Angola Shield affected by Eburnean Orogeny: ortho and para-derived metamorphic rocks of Neoproterozoic to Paleoproterozoic age, and Paleoproterozoic granitoids; sedimentary and volcanic rocks of Cretaceous to Quaternary age, belonging to the coastal Namibe Basin; and siliciclastic sedimentary rocks of Cenozoic age of the intracratonic Kalahari Basin.

Dissemination and exhibition activities

As a part of their divulgation activities, in 2015 the IGME presented an exhibition about historical geological mapping: «Hispaniae Geologica Chartographia: The geological representation of Spain through History». This demonstration was on display in the historic site of the Alcázar de Segovia from December 2105 to March 2016 attaining a total of 35.000 visitants and in the National Center for the Research of the Human Evolution (CENIEH) in the city of Burgos from October to December 2016.

This exhibition gathers together a selection of maps showing the evolution of geological mapping in Spain as it responds to scientific and cultural advances in the country, as well as to the concerns and needs of society. Each of the 40 maps chosen represents an important milestone at the time of its making, due to the techniques involved, the subject matter, or the way in which the information was obtained.



Fig. 25.- Image of the exhibition «Hispaniae Geologica Chartographia» located in the Leonor de Plantagenet room of the Alcázar de Segovia

Awards and honorary mentions

The video production of the IGME «The Geological Map: Drawing the Earth's skin»

<https://www.youtube.com/watch?v=qdz9DN74ukY>

which explains what a geological map is and how it is made, has won two awards:

First price *Ex aequo* in the short scientific videos section of the Ciencia en Acción Spanish program (2016).

Price to the best production as a Teaching Resource of the XXVIII International Contest of Audiovisual Works BICC Ronda-Madrid-Mexico Biennial of Scientific Media (2016).

Spanish Institute for Oceanography

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The Spanish Institute of Oceanography (IEO) is a public research organization dedicated to research in marine science, especially in relation to scientific knowledge of the oceans, fishing resources sustainability and the marine environment. The IEO was created in 1914 and depends on the Ministry of Science, Innovation and Universities.

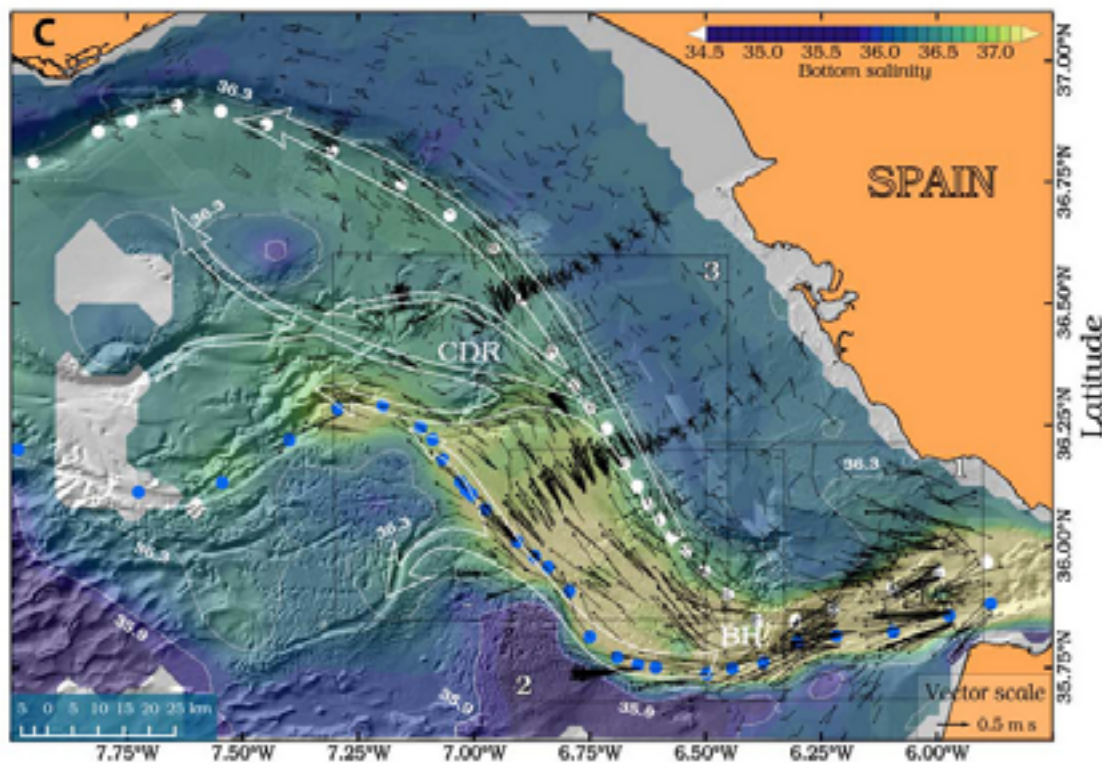
The IEO is the investigative and advisory body for the fisheries sector policy of the Government. Furthermore, it is the scientific and technological representative of Spain in most of the forums and international organizations related to the sea and its resources, as well as it performs other services for scientific-technological development and maintenance of industrial, social and business activities, with the aim of increasing of the oceans scientific knowledge and so to make a sustainable use of them. It is organized in 3 main areas: Environment, Fisheries and Aquaculture.

From the beginning the IEO has developed multidisciplinary cartography for the purpose of disseminate the results of its research. Since all areas and working groups numerous maps are being developed representing the distribution of all variables of marine environment: fisheries resources, species, habitats, bathymetry, geomorphology, physical and chemical properties, pollution, mineral resources, uses and activities carry out by human in marine environment. To check some examples of cartography developed from IEO (spanish continental shelf, 3D models, etc.) you can visit <http://www.ieo.es/es/web/ieo/cartografia>.

In addition to this, the IEO develops a Spatial Data Infrastructure (IDEO) with the goal of providing access to marine information, which includes as primary tool the IEO Geoportal (<http://www.geo-ideo.ieo.es/geoportalideo/catalog/main/home.page>), with a Web Map Service (WMS) and others implements to search and consult the metadata of data and services.

Map of shaded relief map of the GoC seafloor bathymetry with near-bottom instantaneous velocity vectors (black arrows) over salinity (color shades)

Authors: Ricardo F. Sánchez-Leal, María Jesús Bellanco, Luis Miguel Fernández-Salas, Jesús García-Lafuente, Marc Gasser-Rubinat, César González-Pola, Francisco J. Hernández-Molina, Josep L. Pelegrí, Alvaro Peliz, Paulo Relvas, David Roque, Manuel Ruiz-Villarreal, Simone Sammartino, José Carlos Sánchez-Garrido.

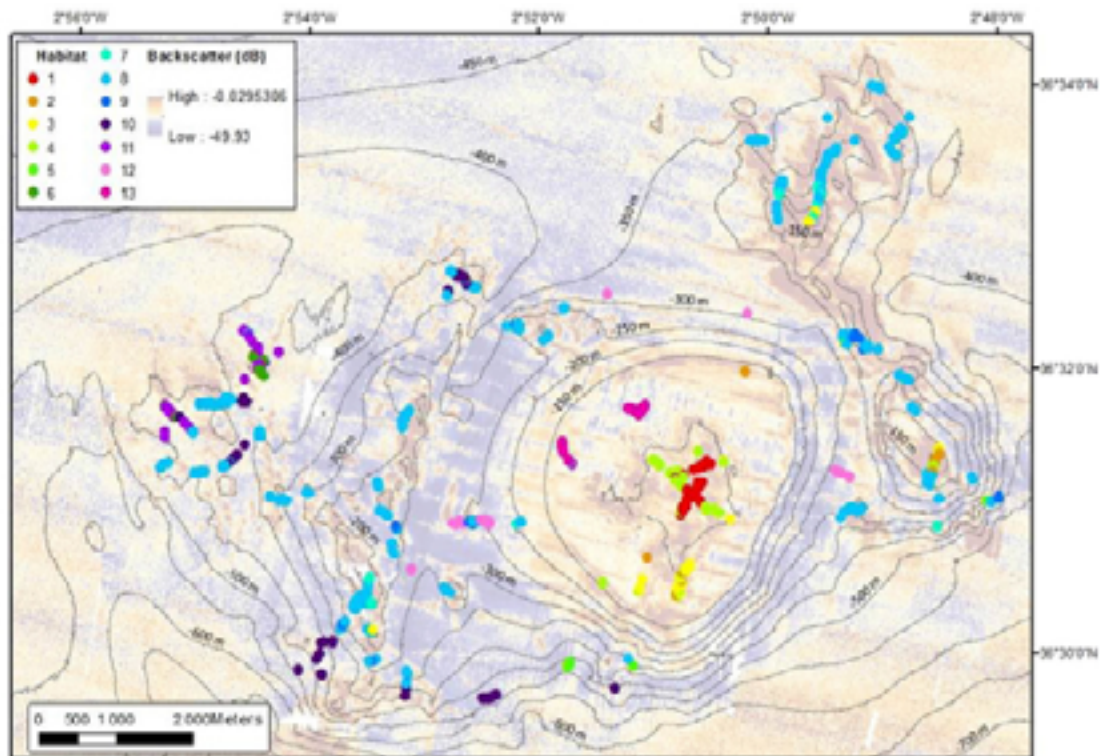


The pathways and transformations of dense water overflows, which depend on small-scale interactions between flow dynamics and erosional-depositional processes, are a central piece in the ocean's large-scale circulation. A novel, high resolution current and hydrographic data set highlights the intricate pathway travelled by the saline Mediterranean Overflow as it enters the Atlantic. Interaction with the topography constraints its spreading. Over the initial 200 km west of the Gibraltar gateway, distinct channels separate the initial gravity current into several plunging branches depth-sorted by density. Shallow branches follow the upper slope and eventually detach as buoyant plumes. Deeper branches occupy mid slope channels and coalesce upon reaching a diapiric ridge. A still deeper branch, guided by a lower channel wallmarked by transverse furrows, experiences small-scale overflows which travel downslope to settle

at mid-depths. The Mediterranean salt flux into the Atlantic has implications for the buoyancy balance in the North Atlantic. Observations on how this flux enters at different depth levels are key to accurately measuring and understanding the role of Mediterranean Outflow in future climate scenarios.

Map of distribution of the habitats identified in the Seco de los Olivos Seamount superimposed on the backscatter map

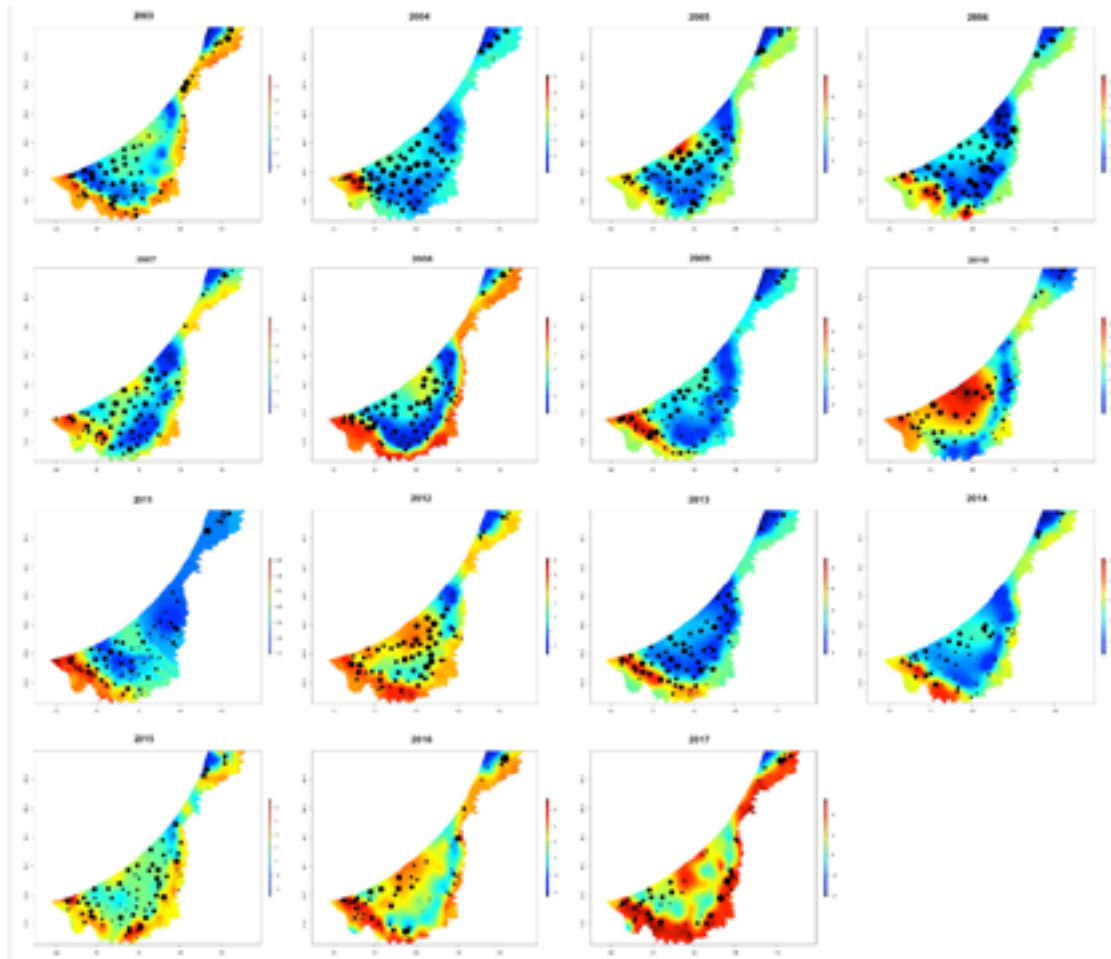
Authors: A. De la Torriente, A. Serrano, L.M. Fernández-Salas, M. García, R. Aguilar.



High habitat diversity was observed on the Seco de los Olivos Seamount (SW Mediterranean Sea), a Site of Community Importance belonging to the Spanish marine Natura 2000 Network. The habitat Bathyal mud with pennatulids (*Kophobelemnon stelliferum*) was scattered across the ridge, habitat Bathyal mud with *Isidella elongata* was only found in muddy sediments of the north-western area. Habitat Bathyal detritic sand with solitary escleractinians *Caryophyllia smithii*, determined by the solitary coral *Caryophyllia smithii* var. *clavus*, also appeared on soft bottoms although at intermediate depths and BPI ranges and higher backscatter values. These bottoms, which are characterized by a flat seafloor covered with sandy sediments, are dispersed in the western, northern and eastern areas surrounding the central seamount, between the guyot and the surrounding ridges. The high diversity and patchiness of habitats found on the Seco de los Olivos Seamount can be explained by the high environmental variability resulting from its wide geomorphologic diversity, where flat summits, steep flanks, rocky outcrops and sedimentary moats are combined. The distribution of benthic habitats at this seamount is likely a combination of suitable ecological conditions, local recruitment, feeding strategies and attachment mechanisms. Knowledge on the occurrence of habitats in areas of natural importance is crucial to species and habitats conservation and to develop proper monitoring and management programs aimed at fulfilling European regulation requirements.

Maps of predicted probability of occurrence of thorny skate (*Amblyraja radiata*) from 2003 to 2017 in the tail of the Grand Banks of Newfoundland

Authors: Maria Grazia Pennino, Elena Guijarro-Garcia, Raul Vilela, Jose Luis del Río, Jose María Bellido (IEO). February 2019



Globally, commercial fisheries have had a strong impact on elasmobranch populations directly through high catch rates and indirectly through by-catch. Consequently, the abundance of many species is declining and some of them are considered to be under threat of extinction. On a regional scale, this negative trend has also been evidenced in international waters of the Southern Grand Banks area (off Newfoundland, Canada), where the occurrence of the thorny skate (*Amblyraja radiata*, Donovan 1808) has declined by nearly 70% in the last decades. This study used Bayesian Species Distribution Models to investigate the habitat preference and biomass trends of the thorny skate during a 14-year period (2003-2017), linking five environmental predictors (i.e., bathymetry, sea bottom temperature, seabed aspect, slope and rugosity) and prey distribution with fishery independent data. Our findings identify some of the sensitive habitats for this species and the ecological factors that may drive its population dynamics in the area.

The maps shown here are based on the environmental predictors and thorny skate catches registered annually during the EU-Spain 3NO groundfish survey.

Habitats Maps Series (according to Marine Report Unit)

Habitats maps series based on EUNIS Classification, depending on EUNIS's levels (1-3 or 4-6). The zonal distribution has been structured in terms of the five spanish marine areas named «Demarcaciones Marinas»; these are the marine region subdivisions which are the administrative territory for the Spanish Marine Strategy. We use these demarcations like Marine Report Unit (MRU) according to the Directive 2008/56/CE Marine Strategy Framework Directive (MSFD).

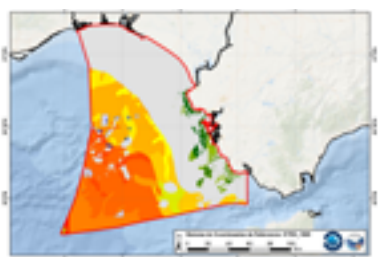
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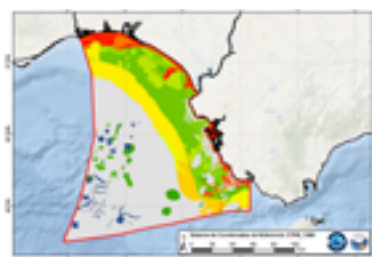
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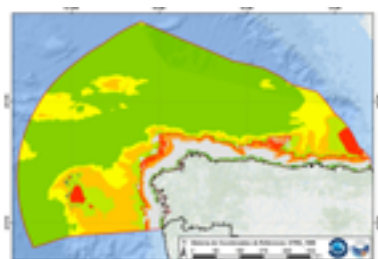
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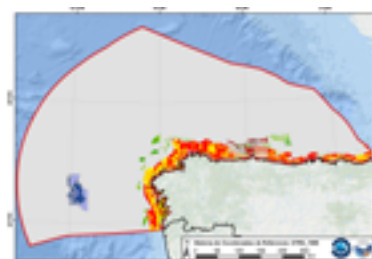
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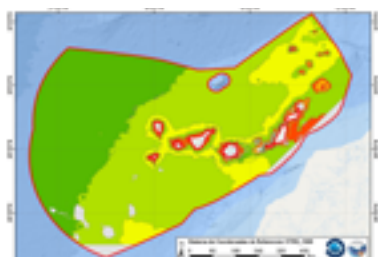
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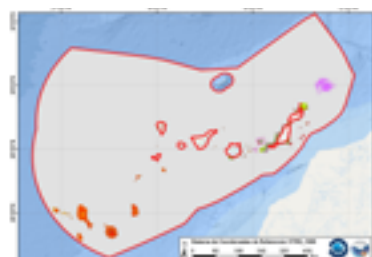
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09_Mapa_
EEMM_Nivel3_
EUNIS Canaria



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Canaria



IEO geoportal

All IEO web map services are accesible from IEO geoportal (<http://www.geo-ideo.ieo.es/geoportalideo/catalog/main/home.page>). This geoportal allow to consult the metadata of the services and the different viewers generated using these WMS services are availables. In addition to the viewer with general information available from the IEO Geoportal, other viewers for specific areas, as the Hierro and Cabrera islands, Namibia or CCLME region, have been generated.

