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Newsletter
OF THE INSTITUT CARTOGRÀFIC DE CATALUNYA

Generalitat de Catalunya
Institut Cartogràfic de Catalunya

Information about the production, development and research projects of the Institut Cartogràfic de Catalunya

Constitution of the Institut de Geomàtica consortium

On 30 September 1997 the constitution of the Institut de Geomàtica (Institute of Geomatics) consortium was approved by decree of the Generalitat de Catalunya (Catalan Autonomous Government, Decree 256/1997), published in the *Diari Oficial de la Generalitat de Catalunya* (Official Gazette, no. 2492 of 9 October 1997). This consortium was established by the Generalitat de Catalunya, through the Departament de Política Territorial i Obres Públiques (Regional Planning and Public Works, DPTOP) and the Comissionat per a Universitats i Recerca (Commission for Universities and Research), and the Universitat Politècnica de Catalunya (Polytechnical University of Catalonia, UPC). Since Catalonia has an important cartographic tradition and the various public and private cartographic institutions have a long history, the Generalitat de Catalunya, on the one hand, wishes to promote the development of geomatic sciences, and the UPC, on the other hand, considers it of interest to develop research and teaching related to these sciences, and its intention is to award the geodetic and cartographic engineering degree (established by Royal Decree 290/1992 of 17 July). The participation of the Generalitat de Catalunya in the Institut de Geomàtica is provided for by the DPTOP through the Institut Cartogràfic de Catalunya (Cartographic Institute of Catalonia, ICC).

Thus, the main objective of the Institut de Geomàtica is to promote and develop geomatic sciences, both in the fields of scientific and technological research and in teaching. Geomatics may be defined as a multidisciplinary group of sciences and technologies concerned with the study, acquisition, storage, organization, analysis, diffusion, management and use of geographically referenced spatial information. Geomatic disciplines include cartography, photogrammetry, remote sensing, geodesy, topography and geographical information systems, and their main areas of application are the management and planning of territorial infrastructure, management of the environment and natural resources, and recently, satellite navigation in general and navigation of land vehicles in particular.

Developments in the field of geomatics have been clearly influenced by the evolution of technology itself and by certain trends in the market and in society. These technological developments may be summarized as follows:

1. The rapid development of information technology and the impact of this on the cost, scale, capacity and speed of data processing and acquisition.
2. The availability of inexpensive and accurate GPS (Global Positioning System) equipment.
3. The development of digital primary data capture technologies.
4. The possibility of integrating heterogeneous data from different sensors and databases.
5. The increased facility with which aircraft and space images may be obtained.
6. The development of information management systems, particularly geographical information systems.

Developing trends in the market and in society reveal:

1. The growing use of geographical information in a large number of management systems.
2. The importance of the government sector as the main client requiring geomatic services.
3. New opportunities as a result of environmental applications and navigation.
4. The impact of the high cost of cartographic bases, with respect to the acquisition and maintenance of information.
5. The rapid growth of geomatic requirements in certain areas (Eastern Europe, Asia and Latin America).

The potential of geomatics is enormous, and for this potential to be realized, balanced growth in all its areas of influence is required: administration, industry and services, teaching and research. In the field of research, geomatics and the disciplines that it encompasses are widely represented and prioritized in the various research and development (R+D) programmes of the most developed countries, and it is in this sector that the Institut de Geomàtica is in a position to aspire to obtain projects from the institutions that finance these, based on the experience and the contacts that the ICC and the UPC currently have. The main lines of research will cover the areas of geodesy, cartographic modelling and representation, remote sensing and photogrammetry, navigation, and the industrial applications of all these.

In the field of teaching, emphasis should be made of the strong link between geomatics and technological innovation, and this makes the constant retraining of geomatics professionals necessary. Thus, the requirements of society in this field lead the Institut de Geomàtica to plan its teaching approaches from various perspectives:

1. Undergraduate studies. Leading to the geodetic and cartographic engineering degree.
2. Graduate studies. Leading to the doctorate programmes (Ph. D.), master of science (M. Sc.) and postgraduate courses, to education innovative researchers and professionals in the sector, and to provide specific education for professionals from other special fields of study.
3. Continuing education. Short courses and seminars, designed to train on highly specific methodologies or technologies.

It is foreseen that during 1998 work will begin on the construction of the main office of the Institut de Geomàtica on the Castelldefels campus of the UPC, very close to the city of Barcelona, and that both research and teaching activities will commence at the main office or the provisional offices at the Institute's disposal. We wish the Institut de Geomàtica a successful start to its activities and excellent results in the short, medium and long term.

Mapa topogràfic del territori metropolità de Barcelona 1:2 000

The *Mapa topogràfic del territori metropolità de Barcelona 1:2 000* (Topographic map of the metropolitan area of Barcelona) is a series of basic digital cartography, formed by 554 sheets, completed to a large extent by the ICC for the Mancomunitat de municipis de l'Àrea metropolitana de Barcelona (Association of town councils of the Metropolitan area of Barcelona, MMAMB), following an agreement with this body. The series is highly complex, given the technical characteristics and the territory that it covers. It is based on photogrammetric stereoplotting, with contour lines every 1 m, and structured into six initiatives undertaken in the following years: 1986, 1989, 1991, 1993, 1994 and 1996-97. The total number of hectares stereoplotted is 46 669.

The MMAMB is composed of 33 municipalities, and all of them are wholly covered in this cartographic project: Badalona, Badia del Vallès, Barberà del Vallès, Barcelona, Begues, Castellbisbal, Cerdanyola del Vallès, Cornellà de Llobregat, Castelldefels, Esplugues de Llobregat, Gavà, l'Hospitalet de Llobregat, Molins de Rei, Montcada i Reixac, Montgat, Pallejà, el Papiol, el Prat de Llobregat, Ripollet, Santa Coloma de Cervelló, Santa Coloma de Gramenet, Sant Adrià de Besòs, Sant Andreu de la Barca, Sant Boi de Llobregat, Sant Climent de Llobregat, Sant Cugat del Vallès, Sant Feliu de Llobregat, Sant Joan Despí, Sant Just Desvern, Sant Vicenç dels Horts, Tiana, Torrelles de Llobregat and Viladecans.

The project has been completed in four consecutive stages: flight and support; photogrammetric stereoplotting; digital edition, revision of field data and database, and finally, publication of the sheets.

All the flights have been aerial triangulated from the support obtained from the MMAMB's own network geodetic points, which gives a topographic coherence to the whole area mapped; furthermore, this network has been integrated and adjusted with the geodetic network of Catalonia. Approximately 9 100 points on the terrain have been obtained by the method of aerial triangulation.

The stereopairs stereoplotted (in DGN format) go to the editing and quality control stations, where the sheets are created at 1:2 000 scale. Immediately after this, field checking is done, when experienced teams will add information (urban fixtures, toponymy, etc.) and correct defects caused by the limitations of the method of photogrammetric capture itself (projectures, lack of stereoplotting due to occlusions, etc.). Once the field revision has been incorporated and the cartographic formatting has been finalized, the sheets are incorporated into a geographical information system based on Arc/Info tools. At the same time, the sheets are filmed and published.

Completion	Stereoplotting (ha)	Sheets stereoplotted	Sheets printed
1986	8 873	77	77
1989	4 895	38	38
1991	7 605	59	59
1993	9 306	86	86
1994	7 605	59	–
1996-97	8 385	65	–
Total	**46 669**	**384**	**260**

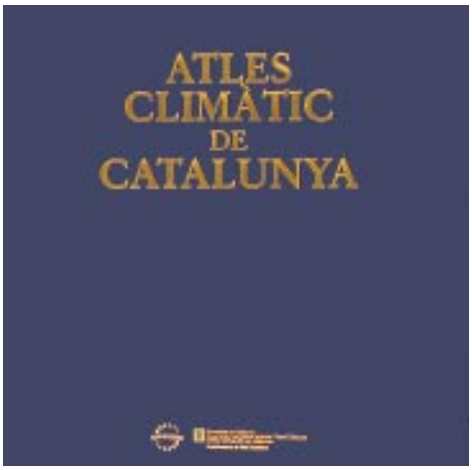
Completion	Flight/year	Scale	Stereopairs with ground control points	Field control points
1986	ICC / 1985	1:5 000 b/w	386	170
1989	ICC / 1987	1:5 000 b/w	133	68
1991	AZIMUT SA / 1990	1:8 000 b/w	191	105
1993	ICC / 1992	1:5 000 colour	572	217
1994	ICC / 1992	1:5 000 colour	452	151
1996-97	ICC / 1996	1:5 000 colour	539	135
Total			**2 273**	**846**

Atles climàtic de Catalunya

The ICC and the Departament de Medi Ambient (Environment) of the Generalitat de Catalunya have jointly promoted the publication of the *Atles climàtic de Catalunya* (Climatic atlas), which consists of three distinct parts: thermopluviometric data, wind data and solar radiation data in the territory of Catalonia. The ICC is responsible for the cartographic management, the production and the cartographic design of this work.

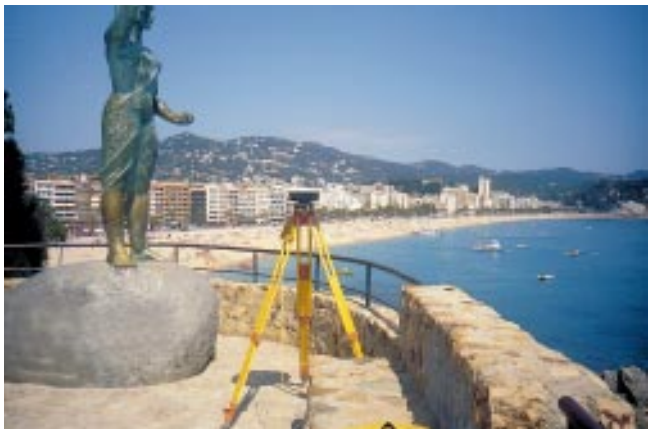
The first section, concerned with thermopluviometric data (average monthly and annual temperature and precipitation, potential evapotranspiration, annual hydric deficit, characteristic synoptic situations, etc.) was published in December 1996 and was officially presented in March 1997. The information shown was compiled and prepared by the Professors of Climatology Pedro Clavero Paricio, Javier Martín Vide and Josep M. Raso Nadal, of the Departament de Geografia Física i Anàlisi Regional (Physical Geography and Regional Analysis) of the University of Barcelona.

Since its publication, this detailed cartographic work about the climate of Catalonia has established itself as an essential reference work for any partial or comprehensive study or analysis concerned with climatology or the environment.



Densification of the geodetic network of Catalonia

It is of extreme importance to have the benefit of a utilitarian geodetic network in the territory of Catalonia, based on national networks, these, in turn, being based on continental networks, in order to ensure the highest accuracy of the cartography on which the various planning initiatives undertaken in the territory are prepared.



The utilitarian geodetic network of Catalonia is a three-dimensional network geodetic points, in which the horizontal and vertical components are not separated. The coordinates of its geodetic points are determined by global calculations that cover the whole of the territory of Catalonia and include support data to link them with the national networks and new observations for the effective determination of the utilitarian network points. The support data consists of the coordinates of the horizontal national networks - first and low order - and the spot heights of the vertical national network - levelling - and also the estimations of their accuracy. The new observations, the specific observations of the utilitarian network, are made between its geodetic points and the geodetic points of the national networks. The observations are largely based on satellites (Navstar GPS - Global Positioning System) and are complemented by levelling observations and knowledge of the geoid of Catalonia, calculated by the ICC.

The distribution of geodetic points of the utilitarian geodetic network is adapted to the needs of its users and to the special conditions of the territory and the technology, with respect to both the implantation and observation of the network and its subsequent use. Bearing in mind the growing use of geodetic artificial satellites, the distance between vertices of the network ranges from approximately 800 m in urban areas with a high density of buildings and where the subsequent use of satellites for topographic work is difficult, to approximately 7 km in non-urban areas, where the use of these satellites enables coordinates to be obtained quickly and at a low cost.

At December 1997, the utilitarian network consisted of 1 092 points. The establishment and distribution of this network guarantees the high precision required in cartographic and topographic works on any scale and homogeneity and continuity in different cartographic initiatives, which will result in an increase in the geometric quality of any type of project undertaken in the territory and, in turn, a reduction in the referencing costs.

Automation of mosaics in the generation of orthoimages

The digital mosaic of images is one of the key tasks in the image cartography production process. A large number of the orthoimages that are produced require the mosaic of two or more images.

The process followed to complete the mosaic starts from the hypothesis that the different images are corrected geometrically, which makes a perfect overlap of the different components possible. The first step consists in the calculation of the two histograms of the areas common to the two or more images to be joined and the selection of one of these as a reference (image A) and the transfer of the histogram of the image to be modified (image B) onto the reference image. This function varies the digital values of image B, bringing them close to the values existing in image A. Once the function is applied to image B, the radiometrically corrected image B1 is obtained and an image of differences between A and B1 - image C - will be calculated. This image C is a synthetic image, on which it will be possible to manually and interactively define a cut-off line or a borderline between the two images. Finally, image B1 is cut along the defined line and the mosaic is made with the reference image A. The same procedure is used for replacement of the areas of images with clouds by others that do not have clouds.

Currently, the definition of the mosaic line is made by means of automatic drawing algorithms of the best cut-off line, looking for the areas that minimize the differences between the images that will form the mosaic, that is to say, the places where the differences in colour are minimal. This automatic process leads to a substantial saving in time compared with the manual process, and it may even become an unattended process. On the other hand, the mosaic requires that the images are cut in such a way that radiometric incompatibilities are avoided as far as possible, thereby avoiding their identification on the resultant mosaic.

In the case of particularly difficult mosaics (differences between the dates of the images or appearance of mist on these), a method has been developed which facilitates the smooth transition between the different images. This method has produced results of sufficient quality so as to permit its use in the production of mosaics between aerial photography and Earth observation satellite image.

Training and technological transfer course for technicians from the Republic of Venezuela

During the period from March to May 1997, the ICC organized and coordinated the Training and technological transfer course for technicians from the Republic of Venezuela, which formed part of the contract DGSC-PORTO-03-96 signed between the ICC and the Dirección General Sectorial del Catastro (Land Registry Regional Office) of the Ministerio de Agricultura y Cría (Ministry of Agriculture and Stockraising, MAC) of the Republic of Venezuela for the capture and production of digital orthorectified images, within the framework of the *Plan de Inversiones para la Transformación del Sector Agropecuario* (Investment Plan for the Transformation of the Agricultural Sector, PITSA) (see Newsletter of the ICC, no. 4 of September 1997).

The advanced technology provided by the ICC in this project and its subsequent transfer to the management authorities of the Republic of Venezuela, with special use of technologies that lead to optimum productivity and quality, involved the training of specialists in each of the fields for the future development and management of the data obtained by the Venezuelan professionals themselves. The course was structured in two stages:

1. National stage. Completed over a period of 2 weeks in March in the city of Caracas, with teaching provided by staff from the ICC. 87 persons attended, and the main objective was to train working groups for their incorporation into a production process. Of these 87 persons, 33 were selected and this selection process was managed by an assessment team composed of the ICC, the MAC, the Servicio Autónomo de Geografía y Cartografía Nacional (Autonomous National Geography and Cartography Service, SAGECAN) and the Fundación de Geografía y Cartografía Militar (Military Geography and Cartography Foundation, FUNGECAMIL), of the Republic of Venezuela.
2. International stage. Completed over a period of 6 weeks between April and May in the city of Barcelona for the 33 persons selected during the previous phase. Two weeks of the course were taught by staff of the ICC with specific training in the fields of digital aerial triangulation, stereoplotting, obtaining digital terrain models by correlation, automated orthorectification, filming of images, and design and cartographic production. Furthermore, a 3-week training course about geographical information systems was given by specialists from the Universitat Autònoma de Barcelona (Autonomous University of Barcelona), and during the last week visits were made to various cartography and land registry production centres.

The principal medium and long-term objectives are encapsulated in the theoretical training in the techniques to be used; the use of specialized instruments; completion of all the steps in the production chain; use of geographical information systems for the management of land registries and the capacity to reproduce and develop projects of this kind in the Republic of Venezuela.

4th Applied Statistics Week

The Institut d'Educació Contínua (Continuing Education Institute, IDEC) of the Pompeu Fabra University (UPF) is organizing the 4th Applied Statistics Week, to be held from 26 June to 2 July 1998 and devoted on this occasion to Statistics in the Environmental Sciences. The programme includes three courses:

Course 1. Sampling principles and methods for environmental studies (26-27 June), given by Prof. Vic Barnett, of the University of Nottingham.

Course 2. Multivariate analysis in environmental ecological and ecotoxological research (29-30 June), given by Prof. Cajo J. F. Ter Braak, of the Centre for Biometry Wageningen.

Course 3. Model-based Geostatistics, with environmental applications (1-2 July), given by Prof. Peter Diggle, of the Lancaster University.

Professors Michael Greenacre and Albert Satorra (UPF) are responsible for the coordination of these courses.

For more information and/or inscription, contact:
IDEC
Carrer de Balmes, 132 – 08008 Barcelona
Tel. 34-3-542 18 06 – Fax 34-3-542 18 08
http://www.upf.es/idec – E-mail: idec@upf.es

Honorary mention

On 9 December 1997, in the course of the annual meeting, the President of the Hungarian Society of Surveying, Mapping and Remote Sensing and Rector of the Polytechnical University of Budapest, Prof. D. Átros Detreköi, presented the General Director of the Institut Cartogràfic de Catalunya and Vice-president of the International Cartographic Association (ICA/ACI), Jaume Miranda Canals, with the certificate declaring him to be an Honorary Member of this Society.

The Hungarian Society, which represents the cartographic community of Hungary, conferred this honour in recognition of the efforts made by the ICC in the field of international cooperation and in fostering closer relations with this Society on the occasion of the 10th General Assembly and the 17th International Cartographic Conference of the ICA/ACI, held in Barcelona in September 1995.

Congratulations!

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Parc de Montjuïc – E-08038 Barcelona – Telephone 34-3-425 29 00 – Telefax 426 74 42 – http://www.icc.es – E-mail: aguell@icc.es

Balmes, 209-211 – E-08006 Barcelona – Telephone 34-3-218 87 58 – Telefax 218 89 59
Emili Grahit, 10 A – E-17002 Girona – Telephone 34-72-20 04 93 – Telefax 20 04 93
Doctor Fleming, 19 – E-25006 Lleida – Telephone 34-73-27 47 76 – Telefax 27 47 76
Anselm Clavé, 1 – E-43004 Tarragona – Telephone 34-77-23 01 56 – Telefax 23 01 56

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