COMITÉ NATIONAL ESPAGNOL DE GÉODÉSIE ET GÉOPHYSIQUE

SPANISH NATIONAL COMMITTEE OF GEODESY AND GEOPHYSICS

NATIONAL REPORT ON GEODESY

FOR

1995 - 1998

IUGG XXII GENERAL ASSEMBLY

PREFACE

This report outlines Spanish activities in Geodesy for the period 1995 to 1998. It has been prepared for submission to the International Association of Geodesy (IAG) on the occasion of the XXII General Assembly of the International Union of Geodesy and Geophysics in Birmingham, U.K., 18-30 July 1999. It is issued on behalf of the Spanish National Committee of Geodesy and Geophysics

In the report the main activities in Geodesy developed in Spain in the period 1995-1998 by different Institutions are presented. This Institutions in alphabetic order are.

1.- Geographic Service of the Army (Servicio Geográfico del Ejército). MADRID.

2.- Institute of Astronomy and Geodesy (Instituto de Astronomía y Geodesia), MADRID.

3.- Institute Cartographic of Catalonia (Instituto Cartográfico de Cataluña). BARCELONA.

4.- National Geographic Institute (Instituto Geográfico Nacional). MADRID.

5.- Royal Institute and Observatory of the Navy. (Real Instituto y Observatorio de la Armada). San Fernando. CÁDIZ.

6.- Valencian Cartographic Institute (Instituto Cartográfico Valenciano). VALENCIA

The information provided by the Institutions has been incorporate in the Report, and due to the quantity and diversity of works done these has been resumed, giving for each Institution a list of the works followed by the list of papers published in the period.

Madrid, May, 1999

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2. INSTITUTE OF ASTRONOMY AND GEODESY. MADRID

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SOME RESEARCH PROJECTS

"Airborne laser altimetric monitoring of the rapid evolution of topography in long valley, ca caldera". National aeronautic and space administration, USA. (October 1995 October 1998). J. B. Rundle, j. Fernández

"Analytical modelling of the three-dimensional deformation field due to magmatic intrusions". EU. Env4-ct96-0259; csic-0325/ff. (June 1996- June 1998). L. García Cacho, j. Fernández.

"Analysis of time dependent fault interactions and stress transfer in southern California using viscoelastic coulomb failure functions: application to data from the southern California integrated GPS array". National aeronautics and space administration (nasa). Usa. (January 1997-December 1999). J. B. Rundle, j. Fernández,

"Desarrollo de instrumentos y programas de análisis para aplicaciones geodinámicas y de ingeniería. Nuevas técnicas y métodos en el laboratorio geodinámico de Lanzarote". i+d (amb97-0706). 1997-99.: R. Vieira, J. Arnoso, F. González Montesinos, M. J. Sevilla, C. de Toro.

"*Determinación óptima de los ciclos de station-keeping para el sistema Hispasat*". Cicyt. I+d esp 96-0636. J. Mª gambí, p. Romero.

"*Estudio do risco/sismica do grupo central do archipiélago dos Azores*".Praxis xxi: 1º concurso de financiamiento de proyectos de idt em engenharia. 1997-99. V. H. Forjaz, a. J. González camacho, f. Gonzalez montesinos, e. Vélez, r. Vieira.

"*European mobile early warning system*". EU environment and climate research and technological program. Env4-ct98-0728. J.l. cheminée. Paris. Partner nº 3: instituto de astronomía y geodesia. R. Vieira, j. Arnoso, e. Vélez.

"*Investigaciones geodésicas y geodinámicas en zonas oceánicas. Estudios en el mar mediterraneo y en el océano atlántico nororiental*.". Join commission hispano-greek (maae), 1997-1998. M. J. Sevilla. C. De toro, r. Vieira.

"*Modelización matemática de procesos volcánicos de alta peligrosidad y vigilancia geodésica de avalanchas*". Cicyt. Amb96-0498-c04-04). 1996-999. J. Fernández, j. Arnoso, f. Gonzalez montesinos

"*Problemas no lineales elípticos y parabólicos en ecuaciones en derivadas parciales*". Pb96-0583 dges. J. I. Díaz, j. Otero.

"*Determinación del geoide ibérico*". Join commission hispano-portuguese csic-jnict. (1998-1999). M. J. Sevilla, r. Vieira

"*Técnicas de observación de deformaciones de la corteza terrestre*". (aeci). 96-cn001. 1996-1999. R. Vieira, cai weixin.

SUMMARY OF Results description

Optimal determination of the station-keeping cycles for the hispasat system (P. Romero)

Since by the international legislation our country is assigned only the geoestationary window located 30° W with the limits +/- 0° 05 NS and +/- 0° 07 EW (where there already collocated two satellites) and, necessarily, if other satellite were kunched it should be placed in the same window, a collocation strategy for the station keeping of three satellites is being developed.

Deformation Modeling (J. Fernández)

The research in deformation modeling has been developed by this group associated to two of the main natural hazards: modeling of geodetic effects (deformation and gravitational potential and gravity changes produced by volcanic and seismic activity. We have work on the solution of direct problem and also inverse problem.

For volcanic loading problem different Earth models have been considered in the modeling (homogenous, layered, elastic, elastic-gravitational, anelastic, plane surface, with topography), and different kind of intrusions (point source, tridimensional source, mass, overpressure, spherical intrusion, ellipsoidal...). We have found it is very important the consideration of vertical structure when calculating deformation, and the ambient gravitation field when studying gravity and gravitational potential changes. The changes in the medium's properties with depth may result in considerable changes to the magnitude and pattern of the effects caused by a magmatic intrusion with regard to those calculated for a homogenous half-space. Different FORTRAN 77 codes have been developed to do the computations of the deformation models. These codes allow us to calculate displacements (horizontal and vertical), tilt, vertical strain and potential and gravity changes on the surface of an

elastic-gravitational layered Earth model, due to a magmatic intrusion. The intrusion is treated as a point source and the medium can consist of up to four layers overlying a homogeneous half space. A top most water layer can be included to calculate sea level changes. The codes are named GRAVW1, GRAVW2, GRAVW3 and GRAVW4. They can be obtained by FTP to the servers of CIRES, University of Colorado at Boulder and Computers & Geosciences journal.

Also theoretical and computational methods has been developed by this group of research in the last years for the calculation of displacement resulting from different types of faults in viscoelastic-gravitational layered media. The Earth model considered consists of a single elastic-gravitational layer overlying a viscoelastic-gravitational half-space. The fault extends along the layer. One of the most important applications of the model presented here is the detailed examination of the time-dependent deformation of many earthquake cycles on the same fault plane. For models with a short recurrence time interval, the plate motion dominates the displacement field during the entire cycle, and major effects of the viscoelastic displacement only occur near the edge of the fault plane. However, for very long recurrence times, the accumulated viscoelastic displacement dominates the deformation field following the earthquake at large distances from the fault. These displacement patterns can serve as an indicator for the various stages of a long reoccurrence interval earthquake cycle.

We have developed FORTRAN 77 programs to compute vertical and horizontal displacements due to thrust faulting (FLTGRV and FLTGRH codes respectively), and produced by strike slip faulting (STRGRV and STRGRH). The codes for computing displacements due to faulting can be obtain via anonymous FTP from the servers iamg.org (of the journal *Computers & Geosciences*) and fractal.colorado.edu (*Cooperative Institute for Research in Environmental Sciences*, University of Colorado at Boulder). In the last computer the codes can be found in the directory /fractal/users/ftp/pub/Viscocodes.

The results of this research have been obtained in the framework of 11 research projects and contract (three of them supported by Spain, three by the European Union, two by NASA and other two supported by Spain and other countries not included in the European Union). Prof. Dr. José Fernández, of this group has been member of the Special Study Group 4.176 (Models of temporal variations of the gravity field) of the Section IV of International Association of Geodesy.

GEOID DETERMINATION.

Geoid determination is a major problem of Physical Geodesy. Today the whole international geodetic and geophysical community is interested in this task and a great number of international workshops and symposiums on this topic are held. Recently into the International Association of Geodesy, the International Geoid Service has been created. The use of geoid related data, in particular its undulation, is widespread in all branches of the Geodesy and it is natural to find it in other Earth Sciences as in Geophysics, Oceanography etc., as well as in Civil Engineering.

1.- The Iberian Geoid IBERGEO95 (m.j. sevilla).-The computation of the geoid over large areas is possible in the framework of international collaboration. In the Iberian Peninsula the collaboration between the "Instituto de Astronomía y Geodesia (UCM-CSIC)" at Madrid, the Spanish "Instituto Geográfico Nacional" and the "Instituto Portugues de Cartografia e Cadastro", in the frame of the IBERGEO Project, has made possible the accomplishment of the Iberian geoid. This collaboration has provided the most recent and precise gravimetric data and a modern digital terrain model.

The first determination of a preliminary geoid in a small zone in the center of Spain was made in 1991, using the least squares collocation (LSC) method and the first gravimetric geoid of Portugal, also with LSC, was computed in 1992. The geoid of the center of Spain was refined in 1993 taking into account terrain effects. The first determination of a gravimetric geoid in the whole Iberian Peninsula was made in 1994.

Now, a new and detailed geoid has been computed in the Iberian Peninsula and surrounding regions, between the limits 35<?<45 for latitudes and -10.5<?<5.5 for longitudes, in a grid with mesh sides of 2.17 and 2.67 kilometres in latitudes and longitudes direction, respectively. The geoid solution was computed based on the following data types: A) the geopotential model OSU91A spherical harmonic coefficients set complete to degree and order 360, B) a set of 186813 point free-air gravity anomalies covering the Iberian Peninsula and the surrounding regions, the gravity data being corrected for atmospheric and terrain effects, and C) a 1000x1000 meters digital terrain model for Spain and the ETOPO5U revised for the rest of the area.

All data has been tested and validated. The LSC method has been applied systematically to predict free air gravity anomalies with validation purposes, using the spherical harmonic coefficient set OSU91A to reduce anomalies. Gross errors have been detected in 2% of the marine data and in 1% of the land data. The terrain effects have been taken into account by means of the remove-restore technique, and the Helmert’s second condensation reduction has been used to reduce gravity anomalies. The indirect effect on the geoid has been considered in consequence.

The method used in the computations of the contribution of the local gravity data to the geoid was Stokes' integral in convolution form. The input data were fully reduced gridded gravity anomalies. To evaluate the Stokes’ formula, three techniques were used: the first is the planar Fast Hartley Transform (FHT); the second is the spherical miltiband Fast Fourier Transform technique with 2D discrete FFT and the third is the spherical 1D-FFT technique, which allows the evaluation of the discrete spherical Stokes’ integral without any approximation, parallel by parallel. In all computations discrete spectra of the kernel function is used. 100 % zero-padding was appended around the signal matrix in order to avoid circular convolution effects.

The final geoid was obtained by adding the contribution of the model and the contribution of the reduced gravity anomalies as well as the indirect effect. The various results have been analysed and compared. The definitive results, referred to the GRS80 system, are presented in a map covering the region contoured at 50 cm intervals. This map is constructed from the 262144 predicted geoid undulations. The geoidal height mean square error obtained by comparison with GPS undulations is almost everywhere less than 1 ppm.

2. The Canarian Geoid (M.J. Sevilla).- A high precision gravimetric determination of the geoid of the Canarian archipelago has been made, using the following data types: a) a global geopotential model, namely the OSU91A spherical harmonic coefficients set, b) a set of 37290 point free air gravity anomalies covering the islands and surrounding ocean, including recent new data, and c) a 200x200 meters digital terrain model for the islands and the ETOPO5U for the rest of the area.

The method used in the computations was the Stokes' integral in convolution form. The input data were gridded gravity anomalies. To evaluate the integral, the Fast Fourier Transform techniques were applied. Discrete spectra of the kernel function is used. 100 % zero padding was appended around the signal matrix to avoid circular convolution effects. The terrain correction was applied to the data and the corresponding indirect effect was taken into account. Comparison with GPS undulations is everywhere less than 1 ppm.

3. The Moroccan Geoid (e.h., benaïm, A.M., Swassi, M.J. Sevilla).- A local gravimetric geoid is computed on the Northern Moroccan area using 60448 gravimetric data points. The available statistical methods have been used to describe the gravimetric data and to estimate the experimental covariance function. The spherical form of the Stokes integral in its discrete form and the approximated spherical kernel in the multi-band spherical FFT approach as well as the Stokes integral have been used. Both methods have been combined with the remove-restore technique. These methods have been applied to the same gridded gravimetric residual anomalies with respect to the global geopotential model OSU91A. Because of the lack of topographic data, the terrain effect is not considered. The comparison of the results between the two methods and each one with GPS/levelling determinations showed an encouraging agreement, waiting the completion of the Moroccan DTM.

4. North-East Atlantic Geoid (J. Catalao, M.J. Sevilla).- A new high resolution gravimetric geoid in the north-east Atlantic is obtained. Sea gravity data properly validated and covering the area $35^{o}<\phi<45^{o}$, $344^{o}<\lambda<352^{o}$ are merged with satellite altimetry derived gravity anomalies in order to evaluate a 3'x3' gravity anomaly grid. The effect of the topography/bathymetry is taken into account through the RTM method and according to a remove-restore technique using as reference a high degree and order geopotential model. Geoid heights are computed in the 3'x3' grid using the efficient 1D FFT procedure. In order to assess the quality of our computations in land, from the gridded gravimetric heights corresponding heights are interpolated onto GPS stations located in the mainland and along the west coastal part of the Iberian peninsula as well. Mean sea level data available in several of the above mentioned stations are used to obtain a better control between the land-sea interface. Considering the oceanic area the gravimetric geoid heights are compared with corresponding heights from the TOPEX/Poseidon altimetry mission. Additional comparisons with previous detailed geoid solutions available in the area are carried out.

A new geopotential model tailored to gravity data in the North-East Atlantic was developed. The new geopotential model (FCUL96B), completed to degree and order 360, has been calculated using a new set of 30' x 30' mean free-air gravity anomalies properly validated, obtained from several ocean gravimetric missions since 1975 to 1990. The calculation of the tailored model was based on the OSU91A coefficient set, that was used as a start model. Several comparisons were made in order to access to the quality of the model: a) the coefficients of FCUL96B, tailored model, were compared with OSU91A model; b) derived gravity anomalies were compared with point free air anomalies; c) derived geoid height were compared with geoid height obtained from TOPEX/POSSEIDON and ERS1 satellites. The RMS value of the difference between mean free air anomalies and derived mean anomalies decrease from 12.67 mGal to 6.56 mGals with respect to OSU91A. Reduced anomalies obtained from EGM96 and FCUL96B has a s.d. of 23 mGal and 18 mGal, respectively. The comparison of EGM96, OSU91A and FCUL96B, with altimetric data obtained from ERS1 and TOPEX, reveals a better accuracy of the FCUL96B model. The standard deviation of the differences between geoid height derived from OSU91A with ERS1 was 0.38 m with an amplitude of 3.8 m and decreases to 0.30 and 2.8m for FCUL96B. The residuals obtained from EGM96 has the same rms of the tailored model, but more than 70 cm on the amplitude. In this area EGM96 geopotential model reveals a better fit to the gravity field than OSU91A but not as good as the tailored model FCUL96B. From the results we obtained, we verify that a tailored model can provide a superior reference surface for local and regional solutions, if the gravity data used in the tailoring process was improved in quality or in density.

5. Altimetric Geoid in the Canary-Azores region from ers-1 data (M.J. Sevilla, J. Calvao, G. Rodriguez Velasco) ERS-1 satellite Altimetry data corresponding to the second multidisciplinary phase of the satellite, have been used over a zone in the North Atlantic during fifteen months of mission. They have been corrected of all modelled effects. A data validation has been done using criteria related with the observed and average statistical values. Mean arcs are obtained from a year to take out the seasonal effects. After getting them, crossover points between ascending and descending arcs are determined. Residual differences are adjusted by least-squares. Two parameters are obtained for every arc. The mean sea surface obtained with the adjusted residuals is tested over Canary Islands region with a gravimetric geoid.

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1. SPGIC: *Sistema de Posicionament Geodèsic Integrat de Catalunya*

Since 1991, the *Institut Cartogràfic de Catalunya* (ICC) is working on the project SPGIC, based on sparse geodetic networks, the knowledge of the geoid and GPS. So one can define SPGIC as a set of geodetic permanent stations, networks, procedures, regulations, data, communications, software, hardware and technical advice that allows for high precision local positioning in Catalonia.

1.1 XU: *Xarxa Utilitària de Catalunya*

During that period (1995-1998), XU (forth order geodetic network) is composed of 1267 points (631 control points from the Spanish national geodetic network) measured by GPS, that allows the determination of a datum transformation from ED50 into ETRS89. To evaluate all these data it has been used: 5128 GPS baselines, 661 vertical control points (22 of them measured by levelling), 631 horizontal control points and 4 points with ETRS89 coordinates (corresponding to the GPS permanent stations EBRE, CREU, ESCO and BELL).

1.2 XdA: *Xarxa d'Anivellació*

In1996, the ICC bought hardware and software to automate and optimise the data acquisition with the digital level Leica NA3000.

Small levelling lines has been observed to include in the XU control points some IGN National Levelling Network (NAP) and to determine some vertical movements in some areas near working mines . The GPS permanent station EBRE has been levelled in order to be included on the European Vertical Reference Network (EUVN). The future levelling lines of the XdA network have been planed.

1.3 Tidal gauge stations

Since 1990, the ICC has been storing data from the tidal gauge station l'Estartit and has been collaborating with other institutions in Spain.

1.4 GPS permanent stations

During this period a big effort has been made in this area. Currently, there are 5 GPS permanent stations running and 3 more under construction. The stored data are used for the ICC (computation of aerial control support) and for the geodetic community, who disposes of these data daily via GeoFons (see 1.6) and IGS/EUREF data centres. Five of them – EBRE, CREU, BELL, ESCO, LLIV – send the data daily to IGS and EUREF networks.

The list of the current GPS permanent stations is:

- EBRE (DOME n. 13410M001). *Observatori de l'Ebre*. SW of Catalonia. Operational since June 1992.
- CREU (DOME n.13432M001). *Far de Cap de Creus*. NE of Catalonia. Operational since August 1996.
- BELL (DOME n. 13431M001). *Bellmunt de Segarra*. Operational since May 1997.
- ESCO.(DOME n. 13435M001) *Escòrnacrabes*. NW of Catalonia. Operational since December 1996.
- LLIV (DOME n. 13436M001) *Llívia*. Operational since beginning 1999.
- AVEL. *les Avellanes*. Under construction.
- PLAN. *les Planes*. Under construction.
- MONT. *Montcada i Reixach*. Under construction.

During 1996, a new system has been introduced which allows, via Internet, to send daily the GPS data to the IGS. The naming convention of the files available via GeoFons (see 1.6) has been adapted to the IGS standards.

ICC is studying the operation of the GPS permanent stations with the same communications platform VSAT (Very Small Aperture Telemetry) via satellite that will be used by the new seismic network of ICC. That will make available 1Hz GPS data from the GPS permanent network at the ICC headquarters in real time. The goal is to promote real time GPS applications.

ICC is currently working on the broadcasting of GPS phase corrections (RTK) through DAB (Digital Radio Broadcasting). The goal is to provide a service that allows subdecimetric GPS positioning all over Catalonia.

1.5 RASANT

The ICC, the *Direcció General de Transports* (DGT) and the *Centre de Telecomunicacions de la Generalitat de Catalunya* (CTGC) have started the RASANT system of broadcasting GPS differential corrections. Combining GPS with RASANT signals, one can locate with a relative precision up to ±1 m. This system has a great number of applications. In particular, allows of precise determination of terrestrial vehicles. The RASANT system has been developed by the *Landesvermessungsamt Rheinland-Westfalen* (Germany) and it has been adopted by the other German Länder and by the ICC. All these institutions promote RASANT to be the European system of broadcasting GPS corrections via RDS (Radio Data System).

RASANT is a system of broadcasting GPS differential corrections computed by the ICC in some GPS permanent stations. The code corrections, smoothed with phase, are in RTCM SC-104 format and are broadcasted using RDS system of *Catalunya Música*. The conditions of reception of RDS signals are identical to the radio signals. The used cover is the same as the stereo-signal of *Catalunya Música* in normal conditions. It is understood, approximately, over a 90% of the territory and a 95% of the inhabitants of Catalonia.

The unfolding of the RASANT system has been split into three phases: demonstration, experimental and operative. The demonstration phase started on December 11th, 1995 in the area of FM cover of Collserola tower. During this phase some tests about the quality reception, accuracy and precision in the coordinate determination have been made. The experimental phase started during 1997, setting up the GPS permanent station in its definitive place, Bellmunt de Segarra, which is broadcasting continuously differential corrections. In mid 1999 an integrity monitoring of the RASANT system will be set up based on RSIM (Reference Station Integrity Monitoring) standards.

1.6 GeoFons

On April 1995, during the *II Setmana Geomàtica de Barcelona*, the ICC presented the GeoFons BBS service, a free of charge service for consulting the geodetic information from ICC.

The user, once connected, can consult files, download it or deliver questions or messages. Geodetic data: geoid models, datum transformations, coordinates and technical reports are available in the file area. In the GPS data area, daily GPS data from permanent stations can be found.

In 1996, GeoFons was implemented as an Internet service (http://www.icc.es) and in 1998, the BBS service was disconnected as it was technically obsolete.

2. GeoCat: *Geoide de Catalunya*

Geoid determination is still one of the main activities of the geodetic research. Since 1995 the ICC is studying the combination of its inertial Litton LTN-101 flagship with GPS to do airborne gravimetry. Litton LTN-101 flagship of ICC has participated, with other inertial sensors, in a gravimetric flight test in Rocky Mountains (Canada).

In autumn 1998, the first gravimetric flight over Catalonia has been done using the Cessna Citation-I aeroplane and the inertial sensor Litton LTN-101 flagship combined with a high precision GPS receiver. This technique will provide a homogeneous set of gravity anomalies that will help in improving the geoid of Catalonia UB91.

Furthermore, it has to be remarked that during May 1995, the first absolute gravity point in Catalonia had been observed in Barcelona, by Prof. Iginio Marson (DINMA, Trieste) .

3. High precision positioning

The PotSis (Potencialitat Sísmica del Pirineu Oriental) campaign, PotSis'94, has been processed using the Bernese software and the point coordinates have been computed and, later, compared with PotSis'92 campaign using GeoTeX system. Within that project the paper "Practical lessons from analysis of a GPS network designed to detect movements of 1 mm/y in the Eastern Pyrenees" has been written and presented in the XXIII General Assembly of the European Geophysical Society (EGS).

The ICC has collaborated with the *Departament de Geologia Dinàmica, Geofísica i Paleontologia* of the *Universitat de Barcelona* in the project CuaTeNeo: *Cuantificación de la Tectónica y la Neotectónica en la parte oriental de la Península Ibérica*, which is similar to PotSis. This project (PB93-0743-C02-02) has been financed by DGICYT. A GPS network has been set up in order to quantify the present deformation rates in the south-eastern border of the Iberian Peninsula. In 1997 the first GPS campaign has been carried out with the collaboration of Escola d'Enginyeria Tècnica Topogràfica de la UPC and Escuela de Ingeniería en Geodesia y Cartografía de la Universidad de Jaén.

The ICC is currently working in two research projects: IGUANA (TIC97-0993-C02-02) and MAGIC (ENV4-CT98-0745) that deal with atmosphere modelling for precision in navigation, kinematics positioning and GPS baselines, as well as obtaining water vapour contents of the atmosphere for improving meteorological predictions.

4. NOSA: Sensor Orientation

During that period a SISA (airborne integrated sensors system) has been defined and developed. The main goal of this study is the integration of different airborne sensors (image, position and attitude) necessary for the correct orientation of the images collected by the image sensor. This system integrates the GPS data acquisition

(necessary to determine positions), inertial system data (to determine angular parameters) and the components for time synchronisation.

For determining angular parameters the ICC acquired the inertial system Litton LTN-101 flagship. The INS (Inertial Navigation System) was financed by the CUR-CIRIT (*Comissionat per a Universitats i Recerca – Comissió Interdepartamental de Recerca i Innovació Tecnològica*), PIR94-9915, and the DGICYT (*Dirección General de Investigación Científica y Tecnológica*), IN94-0210.

In 1997, a first prototype of SISA has been made and was used to orient the CASI sensor. A test flight was made to validate this concept and, the first production flight was made in 1998 with a quasi-final version of the prototype.

In the framework of the use of inertial systems to determine directly angular parameters, in 1997, the ICC and Applanix made the test flights *Guissona* and *Linyola*, confirming its great potential in applications where angular precision of 15''-30'' are required.

5. GeoTeX: *Geodèsia, Teledetecció i Xarxes*

The GeoTeX system is a general geodetic and photogrammetric point determination system which is able to deal with any type of geometric functional model.

GeoTeX has reached version 1998.2.1 (version 2.1, year 1998) where many improvements have been added: implementation of the generalised photogrammetrist's algorithm, which reduces the run time in big networks; initial approximation generation for CASI sensor models; assignation of dynamic memory with Fortran90, that allows of computations without any kind of limitations; introduction of a new version of the AdIL formats; introduction of robust estimation for the automated detection of blunder errors.

During this period, GeoTeX has been moved from VAX/VMS system to Windows NT. It has been done to reach, mainly, two goals: to adjust to the new ICC development environment and to get new platforms and utilities. Moreover, the portability of GeoTeX has allow to move it to other platforms: VAX/VMS, DOS, Windows NT, OpenVMS de Alpha, UNIX and Sun/Solaris.

Since February 1998, there are available in the Web of ICC (http://www.icc.es), a basic subset of GeoTeX utilities, named geodetic calculators, which allow anybody to do some geodetic transformations, such as transformation from WGS84 coordinates into UTM coordinates in ED50 system.

6 Public service

The ICC is collaborating with l'Escola d'Enginyeria Tècnica Topogràfica de la Universitat Politècnica de Barcelona (UPC) and Departament d'Enginyeria de

Geodèsia, Cartografia i Fotogrametria, Universitat Politècnica de Valencia on several student diploma projects.

Since 1995, la Xarxa Temàtica de Geodèsia (XTG), a team of professionals and researchers interested on geodesy, financed by Direcció General de Rercerca-CIRIT, tries to promote the dissemination of geodetic knowledge, and strength the relation between the members of the XTG. It has to be remarked the cycle of 11 lectures promoted by XTG.

The Col·legi Oficial d'Enginyers Tècnics en Topografia de Catalunya i Balears and ICC organized theIII Setmana Geomàtica de Barcelona: Cartografía y Sistemas de Información (Barcelona, 8-11 April, 1997).

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I. POSITIONING

1. IBERIA95

Once observed in May 1995 IBERIA95 GPS Network, consisting of 27 spanish stations and 9 portuguese ones, after pre-processing, processing and adjustment of observations with *Bernese GPS Software, UNIX Version 4.0,* these results were submitted to Subcommission EUREF Technical Working Group, which stated in Bad Neuenahr Ahrweiler EUREF Symposium (10^{th}-13^{th} June 1998) Resolution nr. 1:

" The IAG Subcommission for Europe (EUREF) recognising that in May 1995 the Iberia95 campaign was observed and all the results were submitted to the EUREF Technical Working Group where they were accepted as class B standard (about 1 cm at the epoch of observation) endorses these results as improvements and extensions to EUREF89".

Thus established the peninsular zero order network, the whole REGENTE Network is being processed leaned to IBERIA95 station coordinates.

2. BALEAR98

Due to IBERIA95 only covered peninsular territory except Balearic Archipelago where only 3 EUREF89 stations existed, the IGNE decided, in co-operation with Servicio Geográfico del Ejército (SGE), the establishment of a balearic network similar to IBERIA95. Consisting of 6 stations, it was observed from April 21^{st} to 26^{th} 1998, occupying 3 stations SGE and the other three IGNE. The observation fulfilled the same requirements employed in IBERIA95 and its following processing and adjustment was made with Bernese Software, holding SAN FERNANDO, VILLAFRANCA, and EBRO (Spain), GRASSE (France) and CAGLIARI (Italy) as reference stations. The final results, in ITRS96 epoch 1998.3 and ETRF89 epoch 1989.0 has been submitted to Subcommission EUREF Technical Working Group to be studied and possibly approved. It has in this way been set up a zero order balearic network, absolutely homogeneous with the peninsular one.

3. REGENTE

During 1995, 1996, 1998 kept on monumentation, observation and processing of the National Geodetic Network by Spatial Techniques (Red Geodésica Nacional por Técnicas Espaciales, REGENTE), being covered at this moment balearic and canarian archipelagos and two thirds of Peninsular Spain, including the link to France (16 french RGBF stations occupied). Adding 1999 and 2000 campaigns, REGENTE network will be finished, and consisting of 1100 GPS stations that coincide with National Geodetic Network points and NAP stations, will imply a precision of 3 cm in each coordinate, once it will have been adjusted to IBERIA95 and BALEAR98.

4. EUVN97

From May 21st to 29th 1997, IGNE contributed to the *European Vertical GPS Reference Network (EUVN)* campaign occupying the following stations:

- ALICANTE, tide gauge belonging to IGNE and origin of NAP peninsular Spanish Network.
- ALMERÍA, in IGNE Geophysical Observatory, linked to the tide gauge.
- BARCELONA, around tide gauge station.
- CASETAS, next to UELN node.
- LA CORUÑA, tide gauge belonging to IGNE.
- PALMA DE MALLORCA, tide gauge belonging to IEO.
- PUERTOLLANO, next to UELN node.
- SANTANDER, linked to tide gauge belonging to IEO.

GPS observations and information required from BKG were correctly delivered to that institution. The Analysis Centre of Czech Republic processed these observations together with the 5 portuguese stations.

EUVN coordinates (ITRF96 epoch 1997.4) from all stations are available in the *Report of the European Vertical Reference Network GPS Campaign 97.*

1. HIGH PRECISION LEVELLING NETWORK

1. New adjustment of NAP of Peninsular Spain

The IGNE has made a new adjustment of the spanish NAP. First, a main network has been adjusted by least squares which consists of 81 levelling lines inside 59 nodes, being 10555 km the total length and 130 km the mean line length. From this adjustment, new geopotencial adjusted numbers of the 59 nodes have been obtained, referred to the height origin point of peninsular Spain (mean sea level in Alicante), and from which geopotential numbers and orthometric heights for lines of NAP network have been processed, those belonging to the set of adjustment as well as the others. The final result is named *Height Reference System RNAP98*.

2. NAP Network of Canary Islands

In 1997, with financial support of "Gobierno Autonómico de Canarias", the IGNE carried out the reconnaissance and monumentation of a High Precision Levelling Network, NAP, in the main seven islands of Canary Archipelago. This network, with an approximate length of 1000 km, was partly observed and processed by IGNE that year. Lanzarote´s island network was completed, the main ring of Fuerteventura´s island (only Punta de Sable´s branch to be observed) and the main ring and part of transversal line of Gran Canaria Island. Simultaneously to the gravimetric observation of all NAP lines, a GPS observation (rapid static) in 92% of nails was carried out.

The work was interrupted at the end of the year and, due to administrative reasons, it is not yet been resumed, thus the establishment of NAP net in the archipelago could not be finished.

3. INTERREG II PROJECT

At the end of 1998 was accepted IGNE project (proposal in 1994) in order to make the monumentation and NAP levelling of about 1500 km in the Pyrenean Region (from Behovia to Port Bou and linking branches), everything under auspices of *INTERREG II Operative Program of Boundary Regions of Spain and France.*

In March of current year the IGNE begun with its own technical staff the tasks of monumentation of lines and branches that will be observed geometrically by private enterprises to which, after the formal public sale, will be assigned any of four working regions. By its own, the IGNE has begun in July the gravimetric observation (Lacoste& Romberg) of all nails set up, as well as GPS observation (rapid static leaned to REGENTE) where it could be done.

Due to the special climatology of the region, the tasks will be divided into two campaigns, 1999 and 2000, so that they will totally be finished in Spring 2001.

2. GEODETIC WORKS IN NATIONAL AIRPORTS

In order to fulfil EUROCONTROL requirements to precisions in WGS84 coordinates and orthometric heights assigned to special points of all national airports, the IGNE, by request of "Ente Público Aeropuertos Españoles y Navegación Aérea (AENA)", has accomplished several campaigns to check results obtained by private enterprises in different airports, with precise GPS observations, rested on points of IBERIA95 or REGENTE, in those places where important mistakes could have been detected.

In the current year, the IGNE is determining orthometric height of all airports, assuring a precision better than 0.200 m, making use of GPS data registered simultaneously in two IBERIA95 or REGENTE stations, in two NAP stations and two special points of each airport, removing precise differences of ellipsoidal heights between NAP and airport points with differences between geoid undulations of IBERGEO95. Thus we have reached to transport of orthometric heights from NAP lines to the airports with precisions better than 0.05 m.

1.7 BROADCASTING OF DIFFERENTIAL GPS CORRECTIONS

Since middle of 1997, the IGNE in cooperation with "Radio Nacional de España (RNE)" has made several tests to broadcast differential GPS corrections, as requested by quite a lot users, to manage fleets, to control special public services (burning forests, ambulances, public transport, traffic, and so on.). To do that, the IGNE uses software licenced by LVA of NordRhein-Westfallen, under agreement of exclusive use by IGNE and RNE as free official public service.

The main objective of setting up DGPS/RASANT system is establishing and implementing a public service to terrestrial positioning available to spanish community of GPS users with usual criteria of precision, integrity and availability in this kind of systems.

The given service by DGPS/RASANT system will be based upon broadcasting RTCM differential corrections in RASANT format through sub-carrier not audible RDS of RNE broadcasting stations.

The attainment of the objective establishes on a basis of formalization of technical cooperation agreement between IGNE and RNE suscribed to that motive, thus differencial corrections will be broadcasted by FM broadcasting stations of the "Red Técnica de Difusión" of RNE. This corrections will be delivered following international accepted formats (RTCM and UIT´s Recomendation nr. 823), compressed in RASANT format, with free access to all users who have a FM/RDS/RASANT receiver.

Precision given by this system will be better than 5 m 2dRMS (95% of probability). In more restrictive conditions concerning to distance to correction generating point and data availability, the system will reached about 1 m precisions.

The DGPS/RASANT system will be a network that consists of stations DGPS/RASANT and a Control Centre.

The DGPS stations that will work in redundant mode by double reference receiver will have the tasks:

- RTCM differential correction generation, evaluation and compression to RASANT format.
- Data deliver to RDS net server of RNE through phone line point to point, optical fibre link or equivalent.
- Working Integrate Monitoring in each station DGPS by decoding RASANT format to RTCM by a FM/RDS/RASANT receiver.
- Observable store setting up a GPS Database.

On its own, the control centre placed in the IGNE facilities in Madrid, will have the following tasks:

- To assure intercomunication with DGPS stations.
- To monitor and control DGPS parameter, assuring system homogeinity.
- To integrate metric precision controls in future peripherical stations.
- To download dayly, or by request, of GPS information towards the Net of permanent GPS station Database.

The fact of being in the peninsular periphery inside a radius of 500 km and positions obtained during the period 1997/98 guarantees that the first part of the network set up will be deal with one control centre and two reference stations, one in Madrid (IGNE) and the other in Sta. Cruz de Tenerife (Geophysical Centre of Canary Islands of the IGNE).

1. GEODETIC CONTROL OF VLBI DSS65 (INTA/NASA) ANTENNA

In December 1998, by request of "Estación Espacial de Robledo de Chavela (Madrid)" belonging to INTA/NASA was accomplished the first observation to the DSS65 antenna, used in Very Long Base Interferometry (VLBI) campaigns, in order to determine the theoretical position of the centre of the antenna (inmaterial point in the confluence of main and secondary axes).

For this reason, the IGN established previously a Very High Precision Geodetic Network, with very short baselines, named as Inner Net (RI), six of which points encircle the DSS65 antenna. From them an angle (azimuthal and zenithal) observation was completed of a mark placed in the middle of each trunnion (*yellow* mark and *red* mark) that materialize the secondary axis of the antenna. That observation was made in twelve different azimuths (previously placed in vertical position), at 30 degree intervals. In each position, each trunnion is visible from at least 3 net points.

The adequate treatment of observations, reiterated in two different days, allowed processing, from each trunnion, the three coordinates (x,y,H) of theoretical centre of the antenna, as centre of yellow circle and red circle.

Later on, the "Centro de Estudios Matemáticos avanzados de Blanes (CESIC)" asked in 1997 two new observations, previous and after upward movement (and later settlement) of DSS65 antenna, as a result of a new concrete founding estimated as necessary because of doubts about its stability, specially vertical. Following the same method described before, in May and June 1997 were completed observations, processing and adjustments.

In order to keep on controlling the stability of the antenna, and by request of the same institution, were carried out new observations, April 1998 and March 1999, showing the results the enclosed TABLE:

COORDINATES OF CENTRE OF DSS65 ANTENNA

OBSERVACIÓN	MARCA		ROJA	MARCA		AMARILLA
AÑO	x (m)	y (m)	H (m)	x (m)	y (m)	H (m)
1988	55.927	31.005	781.254	55.929	31.003	781.261
1997	55.928	31.009	781.272	55.930	31.005	781.281
1997 (2)	55.933	31.005	781.281	55.933	30.995	781.289
1998	55.926	31.000	781.270	55.930	30.999	781.282
1999	55.925	30.998	781.277	55.928	30.998	781.289

It can be observed that after an appreciable elevation of about 2 cm in 10 year´s time (1988 to 1997), the antenna lifted about 8 mm after concrete foundation (97-1 to 97-2), and then went down almost 1 cm at settling (97-2 to 98) and again lifted about 7 mm the following year (98 to 99), and no clear cosequences could be derived of the phenomen in subsoil of the antenna, thus needing the annual measurements.

V. MEAN SEA LEVEL

5.1 SPANISH TIDE GAUGE INTEGRATED NETWORK (RIMA)

Following international recommendations about coordination and systematization of tide- gauge data, the spanish institutions "Instituto Geográfico Nacional IGNE", "Instituto Español de Oceanografía IEO", "Puertos del Estado PE" and "Instituto Hidrográfico de la Marina IHM" have carried out the *Tide Gauge Integrated Network Project*, RIMA, with the objectives:

- Fitness to instrument and facilities to GLOSS requirements.
- Agreements about quality control and data processing.
- Measurements referencing to local and global reference systems.
- National Tide-Gauge Data Bank design.
- Study of mean sea level evolution.

The RIMA net consists of 33 tide gauges, delivered between 17 harbours in Peninsular Spain, 2 in the Balearic Islands, 4 in the Canary Islands and 1 in Ceuta.

Recently, the IGNE has set up a new tide gauge station in Fuerteventura Island, thus there are only without tide gauge station left La Gomera and El Hierro islands.

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The Iberia95 project. **E.Rodríguez et al**. Paper presented in the EUREF Symposium 1998. IGNE 1998.

The BALEAR98 project. **E. Rodríguez et al**. Paper presented EUREF Symposium 1999. SGE-IGNE, 1999.

Difusión de correcciones diferenciales GPS para navegación terrestre. **F.J. González et al**. Paper presented in I Asamblea hispano-portuguesa de Geodesia y Geofísica. Almería, 1998.

Red Española de Nivelación. Trabajos actuales del IGNE. **A. Barbadillo**. Paper presented in I Asamblea hispano-portuguesa de Geodesia y Geofísica. Almería, 1998.

La Red Geodésica de España en el siglo XXI. **E. Rodríguez et al.** GEOCONVERGENCIA. 1999.

DGPS y RTDGPS topográficos en el IGNE. **F. J. González et al**. GEOCONVERGENCIA. 1999.

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The "Real Instituto y Observatorio de la Armada en San Fernando" (ROA), is a Navy Institution working on geodesy since its foundation on the mid XVIII century. Nowadays, the work on this area is mainly concentrated in Satellites Laser Ranging (SLR) and Global Positioning System (GPS) applications.

1. Satellites Laser Ranging (SLR).

Installed on the top of the main building, under a dome, ROA has a SLR station successively improved since 1968. During the period 1995-1998, the station has been upgraded in the following items:

- New tracking system based on microprocessors.
- Modification of the focal tube and replacing the focal lens.
- New reception system, modifying the position of the photomultiplier.
- Develope an advanced predictions software.
- Firts steps to change the external calibration by an internal one.
- General adjust of the laser bench and associated electronic equipment.
- Replacement of the elevation tracking motor.
- First steps for the implementation of a "Single Photon Avalanche Diode" (SPAD) to replace the photomultiplier.
- Diferent tracking tests in active-active and active-passive laser modes.
- Replacement of the dome by a new astronomical one, which has implied to modify the telescope position by increasing its elevation about 30 cm.
- Substitution of the all electrical power lines by new ones.
- Redesign and implement new electronic circuit boards.
- Main and secondary mirrors periodical repairs.

The above mentioned modifications have been partially funded by the following research projects:

- "Automatic Geophysical Station" (MN-8302), Spanish Defence Minestry Research Programns.
- "An optimization of the precision for the laser obervations on artificial satellites" (ESP97-1816-C04-01), from the National Programn for Space Research, Comision Interministerial de Ciencia y Tecnología (CICYT), I+D Spanish National Plan.
- "Blind tracking on artificial satellites by laser telemetry" (ESP93-0879-C02-01), from the National Programn for Space Research, Comision Interministerial de Ciencia y Tecnología (CICYT), I+D Spanish National Plan.

A brief tracking statistics for the 1995-98 period are:

- 1995:

SATELITE	N.ECOS	N.PASOS
AJISAI	364519	240
STELLA	8627	53
ERS-1	22490	81
LAGEOS-1	695	3
LAGEOS-2	0	0
METEOR3	41279	68
STARLETTE	18101	57
ERS-2	21867	72
TOPEX	167980	124
TOTALES:	645558	698

- 1996:

SATELITE	N.ECOS	N.PASOS
AJISAI	178200	206
STELLA	6237	46
ERS-1	7319	34
ERS-2	12121	61
LAGEOS-1	0	0
LAGEOS-2	98	2

ADEOS	1178	5
RESURS	555	14
FIZEAU	1881	25
STARLETTE	11101	62
GFZ-1	326	4
TIP	153	4
TOPEX	90777	88
TOTALES:	309946	551

- 1997:

SATELITE	N.ECOS	N.PASOS
AJISAI	310740	148
STELLA	38835	105
ERS-1	0	0
ERS-2	49537	98
LAGEOS-1	19451	53
LAGEOS-2	28963	70
ADEOS	12701	41
RESURS	4334	44
FIZEAU	11448	52
STARLETTE	60101	133
GFZ-1	2207	12
TIP	1650	24
DIADEM-1C	186686	167
DIADEM-1D	138979	81
TOPEX	256239	150
TOTALES:	1121871	1178

1998:

SATELITE	N.ECOS	N.PASOS
AJISAI	424563	288
STELLA	55466	159
ERS-1	9487	30
ERS-2	52480	149
LAGEOS-1	37840	124
LAGEOS-2	24643	91
GFO-1	18224	61
RESURS	3979	47
FIZEAU	9702	55
STARLETTE	110467	188
GFZ-1	3357	17
GEOS3	6186	14
WESTPAC	250	9
TOPEX	244860	217
TOTALES:	998721	1449

The exceptional bad weather conditions during 1996 and several fails in the mirrors repair process oblied to stop the tracking activity during several months on that year. On the other hand, the station dome substitution implied to stop the station activity in 1998, from november 15th on. Those stops on activity are close related to the final statistics for every year.

1. **GPS geodetic activity.**

The ROA GPS geodetic activity came from the middle 80's. During that period ROA has participated in several field campaings, among which highlihgts the Spanish Antartic research campaings (1987, 88, and so on). It's worth to be mentioned the GPS geodynamic net deployed by ROA in 1994, monumenting several sites south Spain-north Africa, and having a first observation field campaing during that year. This net has been mainly stablished in order to study the geodynamic evolution of the Ibero-Maghrebian region, that is south Spain, Gulf of Cadiz, Alboran sea and north Morocco, region crossed by the Eurasia-Africa plate boundary. During 1994 a Cadiz Bay GPS net was also stablished to study mean sea level variations and oceanographic circulations in that bay.

During the period 1995-98, the main GPS geodetic activities carried out by ROA have been:

GPS field campaings:

- "Iberia-95" field campaing. Organized by Spanish IGN covering the Iberia Peninsula, in order to establish an Iberian GPS net linked to EUREF'89. ROA was responsible for field observations in the VN9 (Tarifa), Cordoba and San Fernando sites.
- "Antartic campaing 1995/96". The ROA GPS Antartic net deployed in Deception Island, was reobserved during the Antartic summer. Simultaneous observations were carried out in "Tierra de Fuego, Argentina" by "La Plata" University. A new site was monumented, in the vicinities of the Spanish base, and first observed during this campaing.
- "Cadiz Bay'96" field campaing. Reobservation of seven sites from the above mentioned net, deployed surrounding the Cadiz bay. This campaing was carried out in collaboration with the University of Cadiz.
- "SELF II project field campaing". ROA has participated in this EU project as a part of the Spanish group. Regarding to GPS, during november'96, a field campaing was carried out in collaboration with IfAG (BKG) German group. Eight sites were observed to reference five tide gauges located South and East Spain and to link them to ITRF. Three Water Vapour Radiometers were deployed by the Swiss ETH group, colocated with GPS. This field campaing is linked to the MAGIES'93 carried out during the SELF I project.
- During february-march 1997, was developed a campaing in order to provide a geodetic GPS reference to a group of nine Spanish laboratories of electronics linked with ROA Electronics Department.
- A field campaing was carried out during february'98 covering the above mentioned ROA Ibero-Maghrebian GPS Geodynamic net. Five sites located South Spain-North Africa have been reobserved.
- A field camping covering the SouthWest of the Iberian Peninsula has been carried out as a colaboration among ROA and the Universities of Porto and Lisboa (Portugal). This campaing has allowed to expand the ROA GPS geodynamic net to the west.

GPS permanent net:

During the period 1995-98, ROA has deployed a GPS permanent net, with four GPS station located South Spain-North Africa, controlled from ROA by modem phone line.

- SFER: San Fernando station (SW Spain): Located on the top of an old ROA tower, is integrated in the IGS since the beginnig of 1996, nevertheless the first observations come from 1993.
- CART: Cartagena station (SE Spain): Colocated in the vicinities of a VBB seismic station deployed by ROA at a navy base in Cartagena. The first continuous observations come from march 1998.
- MELI: Melilla station (North Africa): Installed in a Spanish village located North

Arica. The first continuous observations come from may 1998.

- MAHO: Mahon station (Minorca, Balearic Islands).): Colocated in the vicinities of a VBB seismic station ROA will deploy in 1999 at a navy base in Mahon (Minorca Is.). Several interference problems delayed the continuous observations till october 1998.

The equipment deployed at those stations is:

- TRIMBLE 4000 ssi or sse receivers.
- Choke ring or geodetical antenna.
- Computer + modem.
- UPS + electrical and phone line protection.
- Phone line.

All the GPS data coming both the field campaings and permanent stations, are processed by using the GIPSY-OASIS II software (Jet Propulsion Lab.).

The above mentioned GPS activities have been funded by the following research projects:

- "Automatic Geophysical Station" (MN-8302), Spanish Defence Minestry Research programns.
- "Focal mechanism, crustal deformations, seismotectonics and seismic risk in southern Spain" (AMB97-0975-C02-02), from the National Programn for Environment Research, Comision Interministerial de Ciencia y Tecnología (CICYT), I+D Spanish National Plan.
- "Sea level fluctuations in the Mediterranean: interactions with climate processes and vertical crustal movements (SELF II)". (ENV4-CT95-0087). European Comission Programme on Environment and Climate.
- "Meteorological Applications of Global Positioning System Integrated Column water vapor measurements in the western Mediterranean (PL972065). European Comission DGXII/D Fourth Framework Programme. Theme 3, Area 3.3.1.
- "GPS geodetic receiver" (IN94-0117), from the National Programn for Antartic Research, Comision Interministerial de Ciencia y Tecnología (CICYT), I+D Spanish National Plan.
- "Geodynamics of South Shetland Islands and Tierra de Fuego (Argentina): Geodetic and Geodynamic techniques" (ANT96-1463), from the National Programn for Antartic Research, Comision Interministerial de Ciencia y Tecnología (CICYT), I+D Spanish National Plan.
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Introduction

The Valencian Cartographic Institut is a recent Institution, created according to the law 9/1999, of December 9th, by the Generalitat Valenciana (Valencian Govern). The Valencian Cartographic Institut is an Autonomous Institution ascribed to the Consellería de Presidencia (Department of Valencian Presidency), with the aim of promoting, coordinating and developing cartographic, photogrammetric, geodetic, geophysical, topographic tasks, as well as any geographic technology for the Generalitat Valenciana. The Valencian Cartographic Institut has its own legal status, administrative and economic autonomy and has full capacity of action in the execution of their objectives in accordance with the guidelines of the Consellería de Presidencia.

The most important duties of the Valencian Cartographic Institut, without dismissing that the scientific and technological development may advise new ones, are the followings:

- Setting strategic aims for Valencian geodesy, photogrammetry and cartography, as well as preparation of geodetic and cartografic long-term plans.
- Gathering, clasification, filtering administration of the existent cartography in Valencia and, possibly, in other organizations of private status to create a cartographic data bank.
- Realization, reproduction and distribution of basic cartographic works.
- Coordination and supervision of cartographic work of the Valencian Administration.
- Promoting of the cartographic and geographycal information systems of the Valencian Administration.
- Training of the Valencian Administration Staff ascribed to cartographic tasks, with special interest in the Generalitat Valenciana Staff.
- Investigation and development of new techniques in geodetic, cartographic and topographic engineering.
- Publication and diffusion of the carried out works.
- Relationship with organizations of similar nature from other Spanish Autonomies or international ones.
- Establishing collaboration agreements with other organizations of the Valencian Administration, particularly the local ones.

The laboratories of the Polytechnic University of Valencia and the Valencian Cartographic Institute are working in collaboration for improving their research, development, educational system and production tasks.

Aims and Objectives in 1999/2000 period

The Valencian Cartographic Institute has begun the edition of the cartography 1:10.000 scale. Its aims and objetives for 1999/2000 period are the following:

- Effective management, diffusion and advice to all the Departments of the Generalitat and local Administrations on cartographic tasks.
- Geodesy: analysis and evaluation of 4th order Geodetic Net, levelling and establishment of GPS permanent stations.
- Geophysics: planning of the Digital Sismic Net and the Comunidad Valenciana Geoid pre-project.
- Realization of the Cartography 1:10.000 scale, update of cartographic elements (highways, roads), metric analysis, thematic cartography, GIS applications.
- Creation of GIS for local Administrations, user training and maintenance of the information data.
- Creation of a Photogrammetric Data Bank.
- Programme of activities on Photogrammetry applied Cultural Hereditage.

Collaborations

The following collaboration agreements will be signed with other Institutions during this year:

- Instituto Geográfico Nacional.
- Polytechnic University of Valencia.
- Centro de Gestión Catastral y Cooperación Tributaria.
- Excmo. Ayuntamiento de Valencia (City Council of Valencia).
- Local Organizations/Institutions.

1.- Geographic Service of the Army. MADRID.

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