REPORT ON CARTOGRAPHY IN THE REPUBLIC OF CHILE
2011 - 2015

PRESENTED BY THE CHILEAN NATIONAL COMMITTEE OF THE
INTERNATIONAL CARTOGRAPHIC ASSOCIATION

AT THE SIXTEENTH GENERAL ASSEMBLY
OF THE INTERNATIONAL CARTOGRAPHIC ASSOCIATION

AUGUST 2015
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PART ONE: CHILEAN NATIONAL COMMITTEE OF THE ICA

1.1: Introduction

1.1.1. Preface from the ICA National Committee

In the Latin American region, Chile has, over recent decades, made notable progress, continuously, towards better levels of socioeconomic development. There is still a lot of work to be done in terms of protection for natural resources and planning for territorial development, this situation being common to all of the countries of this region.

The Military Geographic Institute of Chile (IGM) has been closest to these concerns and has been obliged to permanently update its cartographic procedures along with the tools used both in office-base tasks and in the field, also to improve the technical capabilities of its staff, which has meant a greater precision and quality in the cartography with which it faces and takes on the growing needs of the population.

The IGM, through this report submitted to the 16th General Assembly of the International Cartographic Association, not only presents in concise form its recent tasks among its cartographic and geodesic activities, but also summarizes briefly the current state of cartography in the spheres of public institutions, universities and the private sector.

Yours most sincerely,
1.1.2 The ICA National Committee of Chile

The Military Geographic Institute of Chile (IGM) sustains the National Committee of the ICA in Chile because it is the official authority representing the Chilean State in matters involving geography, mapping, surveying and the representation of Chilean territory in official cartography. The IGM represents the State in international organizations related to geography and geo-spatial information\(^1\), including the ICA. This representation is assigned specifically to the Director of the IGM, who leads the ICA National Committee. The IGM acts as secretariat for this National Committee, coordinating ICA-related activities in Chile, which can involve other local organizations.

1.1.3 National Reports from Chile to the ICA

This report complements previous reports from this National Committee covering earlier periods. Images of cartographic products are not included because most of the institutions named in this report provide these at their own websites and geportals, for which the URL addresses are stated. The contact details are valid at the date of this report; but no guarantee can be given that these will remain valid for the remainder of the period 2015 – 2019. This report will be submitted to the Executive Committee and to the 16th General Assembly of the ICA.

1.1.4. Contact Details for ICA National Committee in Chile

<table>
<thead>
<tr>
<th>Director of IGM &amp; National Committee President</th>
<th><a href="mailto:direccion@igm.cl">direccion@igm.cl</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>IGM Geographic Division (includes the following contacts)</td>
<td><a href="mailto:sdgeo@igm.cl">sdgeo@igm.cl</a></td>
</tr>
<tr>
<td>IGM National &amp; International Relations Section (contact for this report)</td>
<td><a href="mailto:rrii@igm.cl">rrii@igm.cl</a></td>
</tr>
</tbody>
</table>

Contact for children’s maps competitions: concursos@igm.cl

Telephone: (56) – 2 – 24109314. Other contact details are those given for the IGM in 3.1.

1.1.5. Presidents of the ICA National Committee in Chile

The Chilean National Committee of the ICA has been led by successive Directors of the IGM; in this period these have been:

- March 2011 to December 2012: Colonel Rodrigo Maturana Nadal
- December 2012 to December 2013: Colonel Leonardo Perez Alvarez
- December 2013 to date: Colonel Rony Jara Lecanda

1.2. Chilean ICA National Committee during 2007 - 2011

1.2.1 Outline of National Committee Activities

During the current period (since 2011), the Chilean National Committee has continued to support the ICA through the annual fee payments, attendance at ICC conferences and correspondence.

In November 2011, the Regional Geographic Conference (UGI 2011) was held, organized by the IGM in conjunction with the International Geographic Union (IGU). On the basis of the mutual recognition between ICA and the IGU as scientific societies dedicated to the geo-sciences, also on the success in running ICC 2009, has earned in hosting this type of event, the ICA Executive Committee had previously agreed to the proposal from the Chilean ICA National Committee to back UGI 2011 as a conference Patron. Vice-President Paolo Menezes (Brazil) represented the ICA E.C. at UGI 2011.

1.2.2 Chilean Commission Chair

In early 2011 the Chilean National Committee responded to the call for nominations (to be voted on at the 15th General Assembly) with one nomination for the chair of the Commission for Maps and Graphics for the Blind and Visually Handicapped. At the General Assembly this nomination was successfully adopted, and Prof. Alejandra Coll took over the chair of this Commission from previous chair Dan Jacobson (Canada).

Alejandra Coll, a cartographer based at the “Universidad Tecnológica Metropolitana” (UTEM) has for many years been actively involved in the “Centro de Cartografía Tactil” (CECAT), a research and special project unit of the UTEM for developing tactile maps and educational materials for the blind. The experience gained by Alejandra Coll in the work of CECAT, in coordinating many of the international projects of the PAIGH (see 2.2), and in contributing to ICC 2009 as chair of the conference Scientific Sub-Committee were suitable qualifications for taking on this responsibility.

Since 2011, Alejandra Coll has led the Commission in a range of activities. Of necessity, a lot of the organisation work has been performed by the Chair and some close contributors based in Chile, but the Vice-Chair is Brazilian and efforts have been made to contact and reach potential contributors and participants in other ICA member countries.

In April 2015, responding to a request from Alejandra Coll, the Chilean National Committee agreed to nominate her as candidate for the same Commission, in effect applying for re-election to lead the Commission over a second period up to 2019.

1.2.3 International Map Year in Chile

In late 2014 the IGM and the Chilean N.C. assessed the “International Map Year” (IMY) initiative of the ICA, and decided to participate. So far, the main actions have been:

- Declare the National “Barbara Petchenik” competition for Children’s maps as part of IMY; the IMY logo was included in the announcement of the competition and in the guidelines for participants.
- Distribution of a letter to entities outside the IGM;
  - Armed Forces; SHOA, SAF
  - State agencies; SERNAGEOMIN, CIREN, IDE-Chile, CONAF, National Library
  - Universities: Univ. of Chile, Univ. of Santiago, Catholic Univ., Univ. of Talca, UTEM, Univ. of Concepción, Univ.B.O’Higgins, Chilean Society for Geographers (SOCHIGEO)
  - Municipal/Borough: Santiago, Las Condes, Maipú
  - Private enterprises: ESRI-Chile, SIIGSA, Geosoluciones
  This letter briefly summarized the IMY, encouraged them to see the IMY web site for further information and recommended that they participate.
- Between the 27th of April and the 12th of June 2015, an exhibition was set up with the title “Cartografía, una Forma de Conocer el Mundo” (cartography, a means of understanding the world); the IMY logo was included in public announcements of the exhibition. Organized by the IGM and set up at the Chilean “Biblioteca Nacional” (national library), 42 panels presented a representative sample of cartography through the ages, focusing mainly on those historical maps where any part of Chilean territory appears, from earliest times up to the 19th century, together with some maps made by the IGM or its precursors since the 19th century. Surveying and cartographic instruments were displayed in three glass exhibition cases.
- On August 12th, the IGM hosted a seminar open to the public, titled “Jornada Académica de Ciencias de la Tierra”; declared an IMY event with the IMY logo included in publicity materials, at which a series of presentations was made by leading local experts in their field from various institutions on topics of the earth sciences, including historical cartography, current geomatics applications, geographic education, spatial analysis and tactile maps.
1.2.4 Children’s Map Competitions in Chile

For the Barbara Petchenik competition in 2011, a national competition was initiated in late 2010. Due to a combination of factors outside the control of the N.C., the number of competition entries was far smaller than it had been in the previous competition (2009); nevertheless, six Chilean designs were sent in April 2011 to the Commission for inclusion in the international competition and for display at the ICC in Paris that year.

For the competition of 2013, it was not possible for Chile to participate.

In October 2014, the IGM and Chilean National Committee of the ICA announced a National Competition on the web site, providing for download a document with the guidelines for participants. In March several schools were contacted directly and encouraged to participate, so that finally in April a small number of paintings and drawings were received.

1.3. Chile and the ICA Conferences

1.3.1. ICC 2011

At the XXVI ICC and General Assembly, held in Paris, France, in July 2011 the Chilean National Committee participated through the official Chilean delegation of two members of IGM staff. From Chilean authors, one full paper (from an author at the SAF) and two abstracts (from authors at the University of Concepción and at the IGM) were published in the ICC 2011 Proceedings.

1.3.2. ICC 2013

At the XXVII ICC held in Dresden, Germany, in August 2013, one member of the IGM staff attended, along with Chilean attendees from the SHOA, CENEGEO (University of Talca) and the UTEM among others. The National Committee sent, for inclusion in the “International Cartographic Exhibition” and competition, maps from the following Chilean organisations:

- Military Geographic Institute of Chile – IGM: 4 maps
- Hydrographic and Oceanographic Service of the Navy - SHOA: 2 maps (including one map displayed as part of the IHO sector of the Exhibition)
- Center for Natural Resources Information - CIREN: 2 maps
- Aero-Photogrammetric Service of the Air Force – SAF: 1 map
- National Geology and Mining Service – SERNAGEOMIN: 1 map

Papers presented at ICC 2013 included those submitted by Chilean authors from the CENEGEO (Talca), from the UTEM (Santiago) and from the “Playa Ancha “ University (Valparaíso).

1.3.3. ICC 2015

The Chilean National Committee has aided the preparation of ICC 2015 by providing edited copies of its main databases compiled at ICC 2009 (registered attendees and authors of submissions). Currently the National Committee is preparing to attend ICC 2015 and the General Assembly with a delegation.

PART TWO: MULTI-INSTITUTIONAL AND INTERNATIONAL ACTIVITIES

2.1. National Spatial Data Infrastructure of Chile

Secretaría Ejecutiva,
INFRAESTRUCTURA DE DATOS ESPACIALES,
MINISTERIO DE BIENES NACIONALES
Alameda Bernardo O’Higgins 720 piso 8
Santiago
Región Metropolitana

www.ide.cl

Telephone (56) – 2 – 29375896
2.1.1. Introduction

The Chilean SDI has been described in outline in previous National Reports. Since 2011, a major change has been the new name; now it is the "Infraestructura de Datos Espaciales de Chile" or simply IDE-Chile (Chilean spatial data infrastructure). Previously it was known as the “National Territorial Information Coordination System” or S.N.I.T.

2.1.2. Structure of the IDE-Chile

The IDE-Chile Executive Secretariat (based at the Ministry for National Assets and Resources), continues in its labours as the central node of a cooperative alliance of the Ministries, public agencies, institutions and local governments that develop and use territorial information. The Secretariat reports to an inter-ministerial committee made up of the Ministers and representatives of eleven major government ministries, while receiving technical advice from an inter-ministerial technical committee.

The work of the IDE is distributed across several thematic areas, each of which groups together several institutions active in a specific area or sector. The area most closely involved in cartographic production is the “Basic Territorial Information” group, all of whose members are organizations covered by this report to the ICA.

There are also organisations active in IDE issues at a local or regional level which are grouped by geographic region; these include many municipal and regional bodies. In each of Chile’s fifteen regions, there is a regional coordinator of these activities, associated with the Regional superintendency and liaising with the IDE national secretariat.

2.1.3. International Activities of the IDE-Chile in this period

From the earlier periods of the work of the SNIT, there was an active involvement at international level, especially with links to Technical Committee 211 of the ISO and also the Global Spatial Data Infrastructure Association (GSDI). In recent years there has been an increasing involvement in the network and initiative led by the United Nations and known as the “Global Geospatial Information Management” (GGIM), in which Chile is represented by the IDE-Chile Secretariat. For a period recently, the Vice-President of the UN-GGIM regional entity for the Americas, was the Executive Secretary of the IDE-Chile Secretariat (see http://www.un-ggim-americas.org/).

2.1.4. On-Line Resources of SNIT

Associated with the web site (www.snit.cl), the Secretariat provides on-line access to:

- The IDE-Chile Metadata Catalogue at http://www.geoportal.cl/geoportal/, with records now covering a very large proportion of cartographic holdings managed by the state, governmental and public entities of Chile.
- The Map Viewer at http://www.geoportal.cl/Visor/, where a user can select sets of objects from a wide variety of thematic sources, drawn from the institutions and bodies that cooperate with the IDE-Chile and its catalogue, to display over a single georeferenced base map image of Chilean territory. The base map too can be changed between a few alternative types of image.
- Datasets provided remotely through the “Geonode” system from some participating institutions for viewing in the Geoportal.
- At the http://www.geonodo.cl/ web pages, oriented to organisations wishing to set up their own geonode linked to the IDE-Chile Geoportal.

Through the IDE-Chile web site, the most recent of the “SNIT” journals² can be accessed and downloaded; this provides updates on how geospatial technologies and SDI techniques are being applied in various sectors throughout Chile.

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2.2 Pan-American Institute for Geography and History - PAIGH

<table>
<thead>
<tr>
<th>Sección Nacional del IPGH de Chile</th>
</tr>
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<tbody>
<tr>
<td>INSTITUTO PAN-AMERICANO DE GEOGRAFIA E HISTORIA – IPGH</td>
</tr>
</tbody>
</table>

www.ipgh.org

Chilean National Section: rrmn@igm.cl
National Section web page: http://www.igm.cl/IPGH/

2.2.1. Introduction

The Pan-American Institute for Geography and History (PAIGH) is an international agency supervised by the Organization of American States (OAS). It promotes activities in the fields of Geography, Cartography, Geophysics and History that are organized by four Commissions, one for each of these fields. PAIGH coordinates a network of 21 National Sections, one in each of the PAIGH member states. The Chilean National Section has its headquarters at the IGM and is supported by several local institutions.

2.2.2. Chilean Support for the PAIGH at International Level

A major contribution to the central functions of PAIGH came towards the end of the period in which Dr. Santiago Borrero had exercised the fundamental, critical role of PAIGH General Secretary, leading the PAIGH permanent secretariat based in Mexico City. Among the candidates for the successor to Dr. Borrero during 2013 was the Chilean, Eng. Rodrigo Barriga, former army colonel who, as a member of the staff of the IGM and finally as Director there, had previously made substantial contributions to the ICA, including his role as chair of the ICA National Committee and as President of the ICC 2009 Local Organising Committee. Rodrigo Barriga was elected at the PAIGH General Assembly in November 2013 and has since then worked as General Secretary.

In 2014, Santiago, Chile, was the venue for the annual meeting of the PAIGH Council, the most important event in the sequence of PAIGH events that year. Besides the meeting itself on November 11th – 13th 2014, many of the visiting PAIGH leaders, among them the heads of the Argentine and Ecuadorean ICA National Committees, visited the IGM and the Tactile Cartography Centre of the UTEM (see 4.1) on November 14th.

2.2.3. PAIGH Cartography Commissions

In Chile, support is especially strong for the PAIGH Cartography Commission; in fact the headquarters of the international PAIGH Cartography Commission was located in Chile itself up until the year 2013, so Chilean institutions have been making a contribution to Cartography throughout the region of the Americas. The President of the PAIGH Cartography Commission in that period was Alejandra Coll Escanilla, the same cartographer and academic who is currently the chair of an ICA Commission (see above, at 1.2.2). At the PAIGH General Assembly held in November 2013, Alejandra Coll handed over the position to Carlos López Vázquez, a leading Uruguayan cartographer based in Montevideo.

The PAIGH National Section of Chile coordinates the four local Commissions that are the Chilean counterparts to the four international commissions. The Chilean Cartography Commission, sustained by several of the institutions covered in this report, has been active in supporting the technical projects and technical committees coordinated by the international PAIGH Cartography Commission. It is chaired by the Director of the CENGEO (see 4.2.7.).

2.2.4. PAIGH Cartography Commission Technical Committees in Chile

A large part of the PAIGH Cartography Commission’s technical work is sustained by permanent technical committees; two of these have their headquarters in Chile:
- The ‘Tactile Cartography’ Committee relates to a long-standing program of the PAIGH to support the development of tactile and 3D maps and representations of space; the headquarters of this Committee is at the Tactile Cartography Center (see 4.1.3.) of the
UITEM. Note that this is also the location of the Chair of the ICA Commission on Maps & Graphics for the Blind.

The ‘Aeronautical Charts’ Committee is sustained by the SAF (see 3.3) together with other bodies within PAIGH member states that are involved in aeronautical navigation.

Chilean organizations have been active in other technical committees. It should be noted that in November 2013, the responsibility of the editorship of the “Revista Cartográfica”, the journal of the PAIGH in the cartographic field, changed hands; previously a member of the staff at the IGM in Chile had been editor; a contributor to the PAIGH in Brazil took over.

2.2.5. PAIGH Cartography Commission Projects in Chile

The ‘Technical Cooperation Projects’ differ from the Technical Committees in that they receive partial funding (the Committees do not) but at the same time they are not permanent. The projects are international in scope while having a center of operations or coordination in one country. A significant number of these projects are run from Chile; the projects of this period associated specifically with the Cartography Commission (excluding those linked to the other Commissions) have been:

- 2012; “Application of a primary methodological stage to an atlas of environmental hazards, at the level of a basic territorial planning unit”. Marcela Salinas, UTEM
- 2013; Course/workshop: “Teaching geography through tactile maps and teaching materials to the instructors of pupils and students with special educational needs in Latin America” Enrique Pérez, UTEM
- 2014; “Proposal for standardizing tactile symbology for Latin America: application to cartography for tourism (2014-2016)” Enrique Pérez, UTEM

2.3. SSOT: Chilean Satellite

The “Satellite System for Terrestrial Observation” – SSOT - is the first remote sensing system to be commissioned, operated and owned by the Chilean state. A summary description was given in point II.3 of the National Report to the ICA for the 2007 – 2011 period; since then, the Satellite has been successfully launched and placed into orbit (December 2011). Its telescope and sensor can capture multi-spectral images at a resolution of 5.8 meters and panchromatic images at a resolution of 1.4 meters.\(^3\)

This satellite has begun to provide images for use in remote sensing applications, including various types of thematic mapping. The Chilean Air force operates the “FASAT-Charlie” satellite while the SAF (see 3.3) handles the requests from user-clients from various sectors in Chile, allowing the whole Chilean community to benefit. See http://www.ssot.cl/ for further information and sample images.

\(^3\)See full technical specifications at http://www.saf.cl/images/Material%20PDF/FASAT-C_Specs_v1.4.pdf
3.1. Military Geographic Institute of Chile - IGM

INSTITUTO GEOGRAFICO MILITAR DE CHILE
Nueva Santa Isabel 1640
Santiago
Región Metropolitana

www.igm.cl

<table>
<thead>
<tr>
<th>Telephone</th>
<th>(56) – 2 – 24109300 / (56) – 2 – 24109400</th>
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<tbody>
<tr>
<td>Sales Department</td>
<td><a href="mailto:ventas@igm.cl">ventas@igm.cl</a></td>
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<td><a href="mailto:compras@igm.cl">compras@igm.cl</a></td>
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<td><a href="http://200.27.184.149/IGMChile/">http://200.27.184.149/IGMChile/</a></td>
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3.1.1. Introduction

The Military Geographic Institute (IGM) is the principal cartographic agency of Chile, being the official authority representing the state in matters involving geography, surveying and maps of Chilean territory. Its mission is to maintain the fundamental base cartography of Chilean terrestrial territory, together with other tasks involving the geo-sciences. The IGM is attached to the Army of Chile and staffed by a mix of uniformed and civilian personnel.

3.1.2. Reference Systems and Geodesy up to May 2015

The standard reference framework for accurate horizontal positioning in Chile is the “National Geodesic Network” (RGN in Spanish initials). By May 2015 the RGN consisted of 616 passive reference stations and 49 fixed active stations (25 of these with Internet connection). The RGN is integrated with the international geodesic program covering the whole of the American continents called “Geocentric Reference System for the Americas” or SIRGAS in Spanish initials; for this reason the RGN is now known as “RGN SIRGAS-Chile”. The IGM uses SIRGAS-Chile as a framework for survey information and cartography.

For vertical positioning, see point III.1.2 in the report of 2007 – 2011. There is also a gravity network made up of 68 absolute gravity stations and 60 relative gravity stations.

3.1.3. Main Map Series

The central production process of the IGM concerns the coverages of Chilean territory in map series portraying the relief and major physical terrain features. See point III.1.3 in the report of 2007 – 2011 about the requirements that shape these map series.

The primary map series is the 1:50,000 series, which covers all of continental (i.e. South American) Chile with a total of 1439 map sheets. Of these, the great majority, 1376 maps, are available for purchase in both printed and digital media. Of the remaining 63 sheets, more than half of those are available to the general public but in digital media only.

The 1:250,000 scale series is now complete for continental Chile with 80 sheets, available in printed format. Since the last report (2007 – 2011), these have been converted from the previous Datum, PSAD-56 to the newer SIRGAS-Chile Datum, which constitutes a significant change to this coverage.

There are also older map coverages at 1:25,000, 1:100,000, and 1:500,000 scales; only the last of these covers the whole of continental Chile (see report of 2007 – 2011 for further details).

3.1.4. Current Cartographic Projects

The central cartographic production process of the IGM used for the 1:50,000 and 1:250,000 map series was outlined in the report of 2003 – 2007. That process has undergone substantial change as a result of a new map coverage of Chilean territory at 1:25,000 scale, which uses remote sensing data as the main source data. Chapter III.1.5 of the report for the
2007 – 2011 period outlined the initial stages of the program for this new coverage; currently this program has entered the production phase. A full description is available in a paper presented at the FIG conference in 2014.

In the report for 2007 – 2011, chapter III.1.6 described the development, in conjunction with the ONEMI, of the Integrated Information System for Emergencies (SIIE). Currently work on this system is ongoing, to improve its functions, capability and performance.

### 3.1.5. Other IGM Projects, Products, Services and Activities

Chapter III.1.7 of the Report of 2007 – 2011 summarised the other products of the IGM (separate from the main map coverages), the services and the participation of the IGM in other organizations, both within Chile and internationally. These have continued in recent years; a significant new tendency has been an increase in the obligations of the IGM towards compliance with local laws and regulations.

### 3.1.6. Publications in this Period

The new maps published recently include:

<table>
<thead>
<tr>
<th>Title</th>
<th>Date of Edition</th>
<th>Scale</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Maps of Chile Collection</td>
<td>April 2009</td>
<td>1:5,100,000</td>
<td>The “Maps of Chile Collection” is a series of 5 educational maps, each with an identical map base showing all of Chile, each with a different, specific theme. The maps displayed at ICC 2013 were N°1 “Political-Administrative Divisions”, N°2 Relief and N°4 “Climates”. Projection: modified Polyconic projection of Lallemand.</td>
</tr>
<tr>
<td>“Puerto Eden”</td>
<td>January 2013</td>
<td>1:250,000</td>
<td>The entire pre-existing 1:250,000 scale map coverage of the whole of Chilean territory had been converted to the SIRGAS (WGS 84) Datum during previous years; this map was one of the last to be published in its new version. Catalogue n° 64, width 750 mm, height 622 mm.</td>
</tr>
<tr>
<td>“Archipelago Juan Fernández”</td>
<td>June 2013</td>
<td>1:19,000</td>
<td>Map of the Juan Fernandez islands in the Pacific Ocean. Projection: UTM. Datum: SIRGAS (WGS 84). Intended for education in schools, tourists, map collectors. width 1,520 mm, height 1,040 mm.</td>
</tr>
<tr>
<td>Easter Island – Chile</td>
<td>August 2013</td>
<td>1:16,500</td>
<td>Displayed at ICC 2013. Map of Easter Island in the Pacific Ocean. Projection: UTM. Based on a photogrammetric flight of 1981 and a field survey in 2004. Portrays relief by terrain modeling. Intended for education in schools, tourists, map collectors. width 1,520 mm, height 1,040 mm.</td>
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</table>

The atlases published in this period are the following:

- “Atlas Geográfico para la Educación” (geographic atlas for education), Edition of 2013, 216 pages, ISBN 978-956-202-100-5. At intervals, new versions of this atlas are published with substantial updates and improvements; this is the latest version.

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3.2. Hydrographic and Oceanographic Service of the Chilean Navy – SHOA

The Hydrographic and Oceanographic Service of the Navy (SHOA), among other duties, performs hydrographic surveys and produces the official nautical cartography of Chile. Further details, including outline descriptions of the cartographic production process, the nature of the main products, cooperation with other local organisations in Chile and with international organisations were all provided in the previous report of 2007 – 2011.

According to the “Anuario” (see below), the production processes have continued to undergo modernization in recent years; all-digital processes have been introduced to the photogrammetric restitution tasks. For the cartographic editing, a system called “Hydrographic Production Database” (HPD) has been integrated with the production line.

During this period operations have continued to obtain data from the field by surveys on land along the coast and by bathymetric surveys. Aerophotogrammetric and bathymetric survey data has been processed to update a range of maps and produce a range of nautical cartography on paper and as electronic charts. At sea, naval vessels carry SHOA echo sounding equipment to survey and map the ocean floor in Chilean territorial waters.

3.2.2 Report from the SHOA and list of Maps Published in this Period

The Director of the SHOA, Admiral Patricio Carrasco Hellwig, sent a special report for inclusion in this report; this consists mainly of the following list of recent publications.

**Nautical Maps on Paper**

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<td>1331</td>
<td>Bahía Mejillones del Sur – Puerto Mejillones</td>
<td>1:25.000</td>
<td>2011</td>
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<tr>
<td>12750</td>
<td>Acceso Oceánico a Bahía Cook</td>
<td>1:100.000</td>
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<tr>
<td>6226</td>
<td>Lago Caburgua, Playa Negra Norte</td>
<td>1:15.000</td>
<td></td>
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<td>6226</td>
<td>Lago Caburgua, Playa Blanca y Caburgua</td>
<td>1:15.000</td>
<td></td>
</tr>
<tr>
<td>2251</td>
<td>Caleta Zenteno</td>
<td>1:5.000</td>
<td>2013</td>
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<td>2250</td>
<td>Aproximación a Caleta Zenteno (to be displayed at ICC 2015)</td>
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**Tsunami Flooding Hazard Maps**

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3.2.3 Books Published in this Period

- “Miradas al Territorio Submarino de Chile” (view of the underwater territory of Chile), 2014.
  SHOA was patron. The “Andres Bello” University prepared the book as a joint publication.

3.2.6 International Cooperation

The SHOA represents Chile in the International Hydrographic Organisation (IHO). In November 2014, the SHOA hosted, at a venue in Viña del Mar, an international meeting of the IHO Committee on “Hydrographic Services and Standards”.

For the ICA, until 2011 a key member of the SHOA management chaired the ICA Commission on Marine Cartography. A map from the SHOA was displayed at ICC 2013 (Germany)5. Recently, the SHOA has expressed interest in participating in the International Map Year6 with an emphasis on promoting nautical cartography.

5 “Tsunami Inundation Chart, Valparaíso – Viña del Mar” at 1:15,000 scale, published in March 2012, portraying the sectors of the port and city of Valparaíso vulnerable in the case of a serious Tsunami.
6 Letter with id. “SHOA ORDINARIO N° 13000/7/101/IGM” signed by the Director of the SHOA, addressed to the IGM Director, dated 22nd May 2015.
3.3.1 Introduction

The Aerophotogrammetric Service is the state agency, attached to the Chilean Air Force, responsible for creating and standardizing official aeronautical navigation cartography covering Chilean territory, also for providing the photogrammetric or satellite image coverages used in the creation of the official cartography of Chile.

3.3.2 Production and Products of the SAF

The cartographic process has been summarized in previous reports to the ICA. The SAF has, in recent years, fully incorporated a LiDAR system into its production processes for Digital Terrain Models and Surfaces (DTM, DSM) and cartography.

The main cartographic products of the SAF are:

- Processed satellite images, panchromatic or multi-spectral
- Images of aerial photography, which may be georeferenced, ortho-rectified, or combined into mosaics
- Ortho-images
- Image-based cartography (vector map objects overlaid on a georeferenced base of images from aerial photography)
- Aeronautical maps oriented to flight planning and in-flight navigation at 1:1,000,000, 1:500,000 and 1:250,000 scales
- Digital vector cartography, oriented to various user sectors
- Digital Elevation Models

The SAF has already begun to share with other state institutions the products obtained from the SSOT program and the Chilean satellite (see point 2.3 above). For the general public, the SAF has implemented a geoportal ("Geosaf") for clients to gain access to and purchase images captured from the sensor mounted on the FASat-Charlie Chilean satellite.

3.3.3 Events and international cooperation

In 2013, over the period 23\textsuperscript{rd} to 25\textsuperscript{th} of October, the SAF hosted the second “Latin American Remote Sensing Week” – LARS – organized in conjunction with the International Society for Photogrammetry and Remote Sensing – ISPRS. LARS featured presentations from local and international speakers, mainly focused on remote sensing, also covering cartography, GIS, SDI, and image processing. The third LARS event is scheduled for the period 29\textsuperscript{th} March – 1\textsuperscript{st} of April in 2016; see www.lars.cl.

For the Map Exhibition at ICC 2013, the SAF provided a 1:2,000,000 scale map of a large part of Chilean Antarctic Territory. Titled “Bahía Fildes – Teniente Parodi”, it was based on data captured via aircraft in October 2011 and is in polar stereographic projection.
3.4. Agriculture Ministry and Dependant Agencies

3.4.1 Natural Resources Information Center - CIREN

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<td>Avenida Manuel Montt 1164</td>
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</tr>
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<td>Telephone</td>
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<td>Fax</td>
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<td>E-mail – general information</td>
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</table>

### 3.4.1.1 Introduction

CIREN is a state institution attached to the Agriculture Ministry dedicated to creating, gathering, maintaining and updating information related to natural resources and agriculture. Further details on the mission of CIREN and its main cartographic holdings were given in the previous report to ICA (2007 – 2011).

### 3.4.1.2 Recent Projects of CIREN

The projects performed recently or currently with a substantial cartographic content have included:

- Maps of zones throughout Chile defined in terms of the plant species suitable for potential biofuel production (in conjunction with ODEPA).
- Maps of vulnerability of agricultural and forestry zones in relation to natural hazards (SPPIRA project and SIMVA system) in the « Araucania » (IX Region).
- Thematic maps, component of a survey and study of sclerophyllous plant woodlands of central Chile (in conjunction with CONAF).
- Cooperation with the Borough of Coquimbo (III Region) in the implementation of a system based on GIS and a map coverage at 1 :10,000 scale for planning and decision-making in relation to agricultural development and natural resources.
- Update of existing thematic maps of the Tenth Region (southern Chile) using colour orthoimages at 1 :10,000 scale as the main source and overlaying these with information obtained from a GIS database with a spatial classification by soil and aptitude for agricultural use.
- Set up thematic digital maps (in ArcView, with final output for users in .pdf) classifying the greater part of central-northern, central and central-southern Chilean terrain by its hydrogeology. The source material is CIREN's holdings of older orthophotos, some at 1 :20,000 scale, others at 1 :10,000, overlaid with thematic hydrological information, all in analogue media.
- Thematic maps, part of a project to classify into zones the « Maule » (7th) Region of Chile by suitability for production of fruit, berries and similar agricultural land uses.
- Update the maps covering a large part of central Chile, originally part of the national vegetation survey carried out in the late 1990's (described in the report to ICA for the 1999-2003 period), including a geometric correction with the result being georeferenced to Datum WGS 84, inclusion of land use changes up to 2012 as observed with the aid of SPOT 5 satellite images and linking to a relational geographic database structured in accordance with a pre-existing land use mapping methodology.
- Creation of a Territorial Information System focused on cadastral classification (mostly agricultural) of the Ninth "Araucania" Region using colour Spotmap orthoimages overlaid with thematic data, including data from the Chilean Internal Taxation Service (SII).
In the previous report to the ICA the survey by CIREN of agricultural areas dedicated to fruit production was mentioned; the results that can be displayed in cartographic media have now been made available on-line through the « ICET » system of the Agriculture Ministry (see 3.4.3).

CIREN has participated in conjunction with the CENGEO (of the University of Talca) in the "Georandanos " project (see Annex 2).

Some projects have led to the creation of on-line resources making spatial datasets available to the general public with viewer mechanisms giving access to « Territorial Information Systems » ; these include :

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<th>Summary</th>
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<td><a href="http://www.sitrural.cl">www.sitrural.cl</a></td>
<td>Sistema de Información Territorial Rural – SITR</td>
<td>Rural Territorial Information System</td>
<td>Intended primarily for facilitating decision-making by borough and local community organisations.</td>
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<tr>
<td>sitha.ciren.cl</td>
<td>Sistema de Información Territorial de Humedales Altoandinos</td>
<td>Territorial Information System for Andean Highland Wetlands</td>
<td>Focused on hydrous resources, salt pans and marshes in the Andean upland and desert areas of the far north of Chilean territory.</td>
</tr>
<tr>
<td>rapanui.ciren.cl</td>
<td>Sistema de Información Territorial Rapa Nui</td>
<td>Easter Island Territorial Information System</td>
<td>Provides thematic data about soils, erosion and agricultural potential on this Pacific Island.</td>
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3.4.1.3 Some Recent Publications of CIREN

The CIREN presented two maps at the Map Exhibition of the ICC in 2013, both published earlier in that same year:

- “Basic Soil Map of Easter Island, Chile”, at 1:30,000 scale. Part of the Easter Island project mentioned above, for the purposes of agricultural development, this map provides information about soil types, using QuickBird satellite orthoimages of the year 2003 at 1:20,000 scale. The thematic data involves an agricultural study and the zoning of soils by themes such as phosphorous present and acidity.

- “Land uses of Coastal Non-Irrigated Areas of Central-Southern Chile”, at 1:70,000 scale. This presents the coastal non-irrigated areas in central-southern Chile, obtained from the visual analysis of Landsat 5 TM satellite images and processing them through digital classification algorithms and multicriteria analysis of vegetational indexes, topography, climate and soil, allowing current land use to be characterized and the boundaries of vegetated coverages to be defined. Tree cover, annual grasslands, crops, orchards, vineyards and other classes were differentiated, with a legend set up based on the CORINE LAND COVER classification system.

An important atlas was published in January 2015 with the title "Proyecto Kairos, Identificación de localidades agrícolas afectadas por eventos climáticos adversos, Región de los Ríos” (Kairos Project: identification of agricultural sites affected by adverse weather events in the "Los Ríos" region). The maps included are referenced to the Datum WGS 84 and use UTM projection. It is printed on bond paper with a page size of 800 x 600 mm and hard covers. The “Kairos” project has been aimed at identifying those agricultural sites and zones most adversely affected over the last five years by adverse weather and climatic conditions, including drought, floods, heavy snowfall, frosts and extreme low temperatures. This has led to the production of fifteen regional atlases, intended as an aid to preparation for future adverse events.
### 3.4.2. National Forestry Corporation – CONAF

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<td>Región Metropolitana</td>
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www.conaf.cl

| Telephone – general information        | (56) - 2 – 26630000 |
| E-mail – general information           | consulta.oirs@conaf.cl; sit@conaf.cl |
| Geoportal                              | sit.conaf.cl |

In the previous national report to the ICA, the work of the “Corporacion Nacional Forestal” (National Forestry Corporation – CONAF) was summarized and a report specially drafted by CONAF staff was included which stated: “The National Forestry Corporation is the institution dependent on the Agriculture Ministry, responsible for contributing to the development of the country through the sustainable management of forest ecosystems and the mitigation of the effects of climate change, by encouraging the development of and monitoring compliance with legislation on forest and environmental issues, the protection of vegetation resources and the management of the protected woodland areas of the State”.

Chief among the geospatial holdings of CONAF is the national vegetation survey, first created in the 1990’s and reported in the report to the ICA for 1999 – 2003. Since then CONAF has continued to update the maps presenting the land use and vegetation classifications of this valuable dataset gradually over various locations. Staff at the Santiago headquarters continue to use GIS tools in their continual update of the vegetation survey and development of other geospatial datasets used for management of natural woodland reserves, information on the industrial forestry sector, surveys of biodiversity resources, and the handling of forest fires.

A very large part of these holdings is available to the public through the Territorial Information System ‘SIT-CONAF’, which, since it was mentioned in the report to the ICA of 2011, has been further developed, being accessible to the public as a web map server.

### 3.4.3. Office of Agrarian Studies and Policies – ODEPA

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The Office of Agrarian Studies and Policies – ODEPA - is part of the Ministry of Agriculture and is responsible for researching, preparing and distributing the technical and scientific information required for the formulation of policies in the fields of agriculture, forestry and fisheries. The DEPA has published a very large part of the documentation and cartography that it handles through a portal at http://icet.odepa.cl/ and the “ICET” (sistema de Consulta Estadístico Territorial) system; this includes a map viewer for certain datasets and also access to catalogues of maps (.pdf, .shp and text .pdf files with maps included) for download.

The material available here includes the results of the “Catastro Fruticola” (fruit production survey) developed largely by CIREN (see 3.4.1), including the location and characterization of fruit plantations and related agricultural infrastructure.

A member of the ODEPA played a key role in the scientific sub-committee that was part of the local organizing committee for ICC 2009, held in Santiago.
### 3.4.4. Forestry Institute – INFOR

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The Forestry Institute, attached to the Agriculture Ministry, is responsible for research, development, and transfer of sciences, techniques and technology related to forestry resources and ecosystems, in collaboration with forestry and wood products industries and with the scientific community. It maintains an inventory of forest and woodland ecosystems which is continuously updated on the basis of ongoing monitoring. A large part of this material can be accessed online in a geoportal with map viewer, web map and file download services, collectively titled “Mapa Forestal Inventario Continuo” (continual inventory forest map).

### 3.5 National Geological and Mining Service – SERNAGEOMIN

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</tr>
</tbody>
</table>

The National Geology Division of SERNAGEOMIN, is responsible for developing geological knowledge and the production of thematic cartography at governmental level, mainly in basic geology, geological hazards, mineral resources, geophysics, geothermal aspects, hydrogeology and territorial planning.

In the period 2011-2014, this institution has produced about 180 maps, corresponding to 70% of the program called ‘National Geology Plan’, started in the year 2011, with the aim of a geological survey of the country (1:100,000 scale), together with creating aeromagnetic and geochemical information intended for aiding the start-up of mining exploration. A list of titles of maps is attached; these are available to the public through these web sites:

<table>
<thead>
<tr>
<th>Geoportal</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://geoportal.sernageomin.cl/geoportal/">http://geoportal.sernageomin.cl/geoportal/</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>On-line catalogue</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://tienda.sernageomin.cl/tiendavirtual/">http://tienda.sernageomin.cl/tiendavirtual/</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>On-line library index</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://biblioserver.sernageomin.cl/opac/index.asp">http://biblioserver.sernageomin.cl/opac/index.asp</a></td>
</tr>
</tbody>
</table>

Sernageomin has strengthened its processes for making cartography and the quality of its products, through projects that incorporate technology, new procedures in the production flow...
and the application of standards. Specifically, the ‘Digital Cartography Production System’ (2011-2013) has made it possible to have a distributed system in which the GIS technology (ESRI) participates from the data capture in the field up to the products for the web, using standardized models for data and graphic portrayal. Together with this, there are catalogue services for satellite images that support field surveys (GeoImage project, 2012-2013) and map services for distributing and commercial sale of products (projects called ‘Actualización de Portal GeoMIN’ (updating GeoMIN site) and ‘Mejoras a tienda Virtual’ (improvements to virtual shop), 2014-2015).

In this period, this institution has made a substantial investment in training its human resources, both in scientific matters for enriching the information content and in technological matters involving the development and operation of the systems that support cartographic production.”

3.5.3 Recently published cartography

The complete list of maps and cartography created since 2011 is given as a bibliographical list in Annex II. The provision of this list is a valuable contribution to this report.

A large part of the cartographic material listed is available to the public through the geoportal of SERNAGEOMIN, called the “Portal Geomin”. Separately from the geoportal, the SERNAGEOMIN web site also gives access to an on-line library of documentation; the .pdf files at http://www.sernageomin.cl/presentaciones-geologia.php includes samples of mapping under development and a set of slides summarising the geophysics mapping techniques used in Chile7.

3.6. Other Government Ministries and Specialized Agencies

3.6.1. National Statistics Institute - INE

<table>
<thead>
<tr>
<th>INSTITUTO NACIONAL DE ESTADÍSTICAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. Presidente Bulnes 418</td>
</tr>
<tr>
<td>Santiago</td>
</tr>
<tr>
<td>Región Metropolitana</td>
</tr>
<tr>
<td><a href="http://www.ine.cl">www.ine.cl</a></td>
</tr>
</tbody>
</table>

Telephone: (56) – 2 - 2892 4000
E-mail – general information: ine@ine.cl

The National Statistics Institute – INE – is the governmental agency that provides official statistics and manages the official census. INE organises a large part of its statistical research and publications using maps of Chile’s local political-administrative divisions, urban plans identifying individual blocks between streets, and other sources adapted for census tasks by a small in-house unit with capability for geospatial information handling.

The INE has made available through its web site its “Atlas INE” (at http://www.ine.cl/aplicaciones/20_03_12/atlas_ine.swf), an on-line system presenting in very simplified and accessible form a series of thematic maps of Chilean territory based on census data, in essence a web atlas.

3.6.2. Ministry of Public Works - MOP

<table>
<thead>
<tr>
<th>Official Name:</th>
<th>Ministerio de Obras Públicas - MOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>Morandé 59, Santiago, Región Metropolitana</td>
</tr>
<tr>
<td>Telephone:</td>
<td>(56) – 2 - 2449 3000 / (56) – 2 - 2449 4000</td>
</tr>
</tbody>
</table>

The Ministry of Public Works (MOP) uses geo-spatial data for engineering and surveying purposes involving the country’s transport networks, water resources, and public works in

---

7 “Cartografía Geofísica”, slides for presentation, March 2014. Authors: Daniel Morales (Expositor), Jorge Vivallos, David Cáceres y Cecilia Donoso, published by SERNAGEOMIN.
general. The Division responsible for the roads and highways (“Dirección de Vialidad”) manages the map server at www.mapas.mop.cl. The atlas of the whole of Chile’s road and highway network, the “Cartas Camineras 2013” is available for viewing at this site or for download as image files.

The Division responsible for supervising water resources (extraction, collection, measuring tasks, distribution, and removal networks for all kinds of water) has published spatial data showing the water networks (natural and artificial), local rights to and restrictions on water extraction, and glacier locations through the web page http://www.dga.cl/productosyservicios/mapas/Paginas/default.aspx, linked to an external “ARCGIS Online” map server.

3.6.3. National Office for Frontiers and Limits of the State - DIFROL

<table>
<thead>
<tr>
<th>Official Name:</th>
<th>Dirección Nacional de Fronteras y Limites del Estado – DIFROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>Teatinos 180 piso 7, Santiago, Región Metropolitana</td>
</tr>
<tr>
<td>Web site:</td>
<td><a href="http://www.difrol.gob.cl">www.difrol.gob.cl</a></td>
</tr>
<tr>
<td>Telephone:</td>
<td>(56) – 2 - 2827 5900 / 3810179 (fax)</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:infodifrol@minrel.gov.cl">infodifrol@minrel.gov.cl</a></td>
</tr>
</tbody>
</table>

The National Office for Frontiers and Boundaries of the State (DIFROL) is where maps, charts and geo-spatial products are checked to ensure that they comply with Chilean laws8, 9, before they are authorized for distribution or sale in Chile.

According to their web site, substantial progress has been made recently in cooperation between DIFROL and its counterparts in Argentina on developing shared topographic mapping of the Chile – Argentina boundary, in the framework of the joint initiative “Comisión Mixta de Limites Chile – Argentina”.

3.6.4 Environment Ministry

<table>
<thead>
<tr>
<th>Official Name:</th>
<th>Ministerio del Medio Ambiente</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addresses:</td>
<td>San Martín 73, Santiago, Región Metropolitana</td>
</tr>
<tr>
<td>Web site:</td>
<td><a href="http://portal.mma.gob.cl/">http://portal.mma.gob.cl/</a></td>
</tr>
<tr>
<td>SINIA Geoportal:</td>
<td><a href="http://ide.mma.gob.cl/produccion/">http://ide.mma.gob.cl/produccion/</a></td>
</tr>
<tr>
<td>Telephone:</td>
<td>(56) – 2 - 25735600</td>
</tr>
</tbody>
</table>

The Environment Ministry manages thematic data involving environmental impact studies and runs the system known as the National Environmental Information System – SINIA - a collection of documents and information services about environmental issues, resources, nature reserves and protected biodiversity areas. The spatially referenced information can be accessed through the public map server called the ‘Geographic Environmental Information System’; this provides coverages in aerial photos and thematic maps. The same Ministry also manages a resource available to the public as the “Sistema Nacional de Calidad de Aguas” (national water quality system), which includes a map viewer.

3.6.5. National Emergency Office – ONEMI

<table>
<thead>
<tr>
<th>Official Name:</th>
<th>Oficina Nacional de Emergencia – ONEMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>Beaucheff 1671, Santiago, Región Metropolitana</td>
</tr>
<tr>
<td>Web site:</td>
<td><a href="http://www.onemi.cl">www.onemi.cl</a></td>
</tr>
<tr>
<td>Telephone:</td>
<td>(56) – 600 586700</td>
</tr>
</tbody>
</table>

The National Emergency Office, attached to the Interior Ministry, is the agency responsible for coordinating the actions of the state in relation to natural disasters; it advises on preparations that mitigate the effects of natural hazards, coordinates the immediate response to a crisis,

and advises on recovery from disasters. Natural hazards considered here include earthquakes, tsunamis, volcanic eruptions, large-scale fires across both forested and urban areas, mudslides, and floods.

Within the ONEMI, there are specialists handling geographic information and providing public access, through the web page www.onemi.cl/mapas/, to a collection titled “Mapas zonas seguras” (safe zone maps); these show for each urban conurbation and settlement along the coast the evacuation routes and safe zones in case of Tsunamis. The ONEMI has integrated the Integrated Information System for Emergencies (SIIE - see 3.1.4 above) into its system of operations management.

3.7 Regional and Local Government Bodies

3.7.1. Regional and local bodies, and the influence of the Chilean NSDI

Chile has three levels of local government; firstly the 15 Regions, then 54 Provinces, and 346 Borough or Municipal units at the lowest level. At these levels there has been significant consolidation of earlier achievements guided mainly by the “IDE-Chile” (Chilean NSDI) network, making progress in capabilities and resources for handling spatial data. Some of the spatial data from these regional and local bodies, through Geonodes, reaches the public through the IDE-Chile Geoportal.

3.7.2. On-line resources

Several local government administrative units have set up map servers, portals or web sites that provide access to digital cartography, much of the data being derived from the planning and other administrative tasks of these bodies. Some of these are:

Regions:
- Metropolitan Region: http://observatorio.gorerm.cl/
- Fourteenth “Los Rios” Region: http://www.idelosrios.cl/

Municipal boroughs:
- Las Condes: http://www.lascondesonline.cl/Archivos Generales/asp/portalsit.asp
- Maipú: http://portal.maipu.cl/sitma/

PART FOUR: ACADEMIC, EDUCATIONAL AND TRAINING SECTOR

4.1 Metropolitan Technological University – UTEM

4.1.1. Introduction

The Metropolitan Technological University (UTEM) contains the leading center in Chile for cartography in the academic sector. The School for Cartography runs the five-year course in cartography and geomatics leading to a degree as professional cartographer. The Cartography Department staff manage activities aimed at research and development, including a considerable contribution to the programs of the PAIGH.
4.1.2 International Cooperation

At international level one of the leading academics of the School and Department for Cartography was President of the PAIGH Cartography Commission from 2006 up to November 2013. The same person, Alejandra Coll, was elected to be Chair of the ICA Commission on Maps and Graphics for the Blind in the General Assembly of 2011.

A cartographer attached to the UTEM Cartography School, Pablo Azócar Fernández, presented a paper\(^\text{10}\) at the 27\(^{\text{th}}\) ICC conference held in 2013, in Dresden, Germany. At the same conference, a new book\(^\text{11}\) was announced, co-authored by Pablo Azocar with one of the key figures of cartography in Germany and of the organization of the 27\(^{\text{th}}\) ICC.

4.1.3. Center for Tactile Cartography of the UTEM

The Center for Tactile Cartography (CECAT) is a research center attached to the Metropolitan Technological University and its Faculty for Humanities and Social Communications Technologies, with links to the Cartography Department. It performs research and training in the area of tactile cartography, multi-sensorial communication and educational techniques in these areas for persons with special needs. The CECAT produces tactile maps and materials oriented to the blind and the visually handicapped. A catalogue has been published on-line\(^\text{12}\).

It is the only academic center in Chile dedicated to this area, and has become a leader in its field at regional level through its contacts in Latin America.

The Pan American Institute for Geography and History (PAIGH, see 2.2) has for many years supported several joint projects involving tactile cartography, so the CECAT has worked in collaboration with other centers in Latin America. Since 2011, the Director of the CECAT, Prof. Alejandra Coll, has been the Chair of the ICA Commission on Maps & Graphics for Blind and Partially Sighted People, so the CECAT has been the location for meetings of this Commission. Several of the activities described in the annual bulletins of this Commission of the ICA have involved the CECAT; these include the preparation of the book “Guía Metodológica: Enseñanza y Aprendizaje del Espacio Mediante el Tacto” (methodological guide: teaching and learning about space by touch), which has been a major project of the CECAT and is to be published by the UTEM with the patronage of the ICA.

In November 2014, immediately following the meeting of the PAIGH (mentioned in 2.2.2), many of the persons present in Santiago for the PAIGH event visited the CECAT as a group, these included the Secretary General of the PAIGH, the Chair of the PAIGH Cartography Commission, and the Chairs of the ICA National Committees of Argentina and Ecuador.

A recent project at the CECAT has been the creation of a set of 3D tactile maps titled as a whole “Physical map of geographic concepts of coastal, plains and mountainous landscapes”. Intended as an aid for teaching concepts of physical geography, there is a main map at 1:1,300,000 scale, several larger scale maps of enlarged sectors of the main map, and a manual intended for the teacher using the set of maps.

\(^{10}\)“Paradigmatic tendencies in Cartography and mapping during the scientific and postmodern periods\(^\text{\textdagger}\)”. Pablo Azocar Fernández, August 2013, published as paper N° 361 / 1069 in the proceedings of the 26\(^{\text{th}}\) ICC of 2013 in Germany.


\(^{12}\)“Catálogo 2013\(^\text{\textdagger\textdagger}\)”, published as a .pdf file by the UTEM and CECAT, registered in the Chilean Intellectual Property Records as N° 153816
4.2. Universities with Geosciences Courses

4.2.1. Bernardo O'Higgins University

This University, through the Engineering and Management Faculty, runs a five-year course for students to qualify at Engineering level in Surveying and Cartography ("Ingeniería en Geomensura y Cartografía"). Further details have been given in previous reports to the ICA.

4.2.2 Catholic University of Chile – PUC

The Geography Institute, within the Faculty for History, Geography and Political Sciences, runs a five-year full-time first degree course in geography, also a two-year part-time postgraduate course in Geography and Geomatics; these courses contain substantial cartographic content. The Geography Institute also continues to sustain a range of academic, scientific and applied research activities and to publish its findings and activities; further details have been provided in the report of 2011 to the ICA.

One of the current projects of the University is the preparation of an atlas about the internal administrative boundaries of Chile during the nineteenth and early twentieth centuries, covering the history and spatial location of units such as provinces, to be published in the near future.

4.2.3. University of Chile

The Geography Department, within the Faculty for Architecture and Urban Development, continues runs first degree and post-graduate courses in geography, with a substantial cartographic content. Further information about the courses and research activities of this University is in the previous National reports to the ICA.
4.2.4. University of Santiago

The University of Santiago Engineering Faculty includes the Department of Geographic Engineering. The courses it runs include:

- Civil engineering in Geography – six years, for a first engineer-level degree
- Engineering in Surveying - four years, for a first degree as surveyor
- Geomatics – two years, for a post-graduate degree or “magister”

The Department of Geographic Engineering staff manage research projects; those named in the previous report to the ICA (2011) have continued. This Department has facilities and equipment for both learning and research activities in the fields of GIS, remote sensing photogrammetry, geodesy, surveying and data processing.

4.2.5. University of Concepción

Several courses at this university include components covering cartographic and geospatial information handling techniques; the courses include a first degree course for professional Geographers at the Concepción campus, a degree course in Geomatics Engineering at the Los Angeles campus, and a postgraduate degree course in Geographic Analysis.

Among the research centers attached to the University of Concepción, the “Territorial Planning & Urban Systems” research unit, part of the “EULA-Chile” Environmental Sciences Center, and the GIS laboratory within the “Patagonia Ecosystems Research Center” (CIEP) have advanced capabilities for managing spatial data and thematic mapping. Another research unit, the “Transportable Integrated Geodesic Observatory” (TIGO), described in previous reports to the ICA as a joint project also involving the IGM of Chile and an institution in Germany, has recently ceased operations and been closed down.

4.2.6. Catholic University of Valparaíso

At the Catholic University of Valparaiso (PUCV) and within its Faculty for Ocean Sciences and Geography, the Geography Institute runs a four-year first degree course in geography, with a substantial cartographic content. Research projects have included the processing and application of remote sensing images obtained through the Chilean satellite (see 2.3).
4.2.7 Center for Geomatics at the University of Talca

**CENTRO GEOMÁTICA – CENGEO, UNIVERSIDAD DE TALCA**

Avda. Lircay s/n
Talca
VII Region

Telephone: (56) – 71 – 2201580
E-mail – contact for this report mrodrig@utalca.cl
Web mapping application www.cartografiadelvinedo.utalca.cl

The Geomatics Center - CENGEO - is attached to the University of Talca, focused on the practical applications in specific business, administrative and industrial sectors of data derived from aerial photography, satellites and geodesic/GPS surveying, using digital cartography, GIS, DEM, and spatial data modelling. CENGEO provides support to several of the University's courses by teaching the geomatics course components and by providing study facilities. It also provides specialized advice, consultancy and training services to entities outside the University of Talca and performs research projects with them.

In 2013, the director of the CENGEO, Carlos Mena, took over as chair of the Cartography Commission attached to the Chilean National Section of the Pan American Institute for Geography and History (PAIGH); see the PAIGH National Section Web site http://www.igm.cl/IPGH/, menu option “Comisiones” – “Cartografía” for further information.

Major projects undertaken recently at CENGEO include the implementation of a system for management in the vineyard and wine-producing of the Seventh “Maule” Region of Chile; this was described in a paper 13 submitted to the 27th ICC (Dresden, Germany, in 2013), where the CENGEO Director presented the paper. For the beneficiaries of the project, the access to thematic maps of the results can be seen on-line at www.cartografiadelvinedo.utalca.cl. CENGEO has provided a report detailing these projects; this report (with some editing and translation to English) is reproduced in Annex III.

4.3 Military Polytechnic Academy

**ACADEMIA POLITÉCNICA MILITAR – ACAPOMIL**

Avenida Valenzuela Llanos 623
La Reina
Región Metropolitana

Telephone: (56) – 2 – 226683638 / (56) – 2 – 226683608

The Chilean armed forces provide, to its officers, training and education at university level at the ‘Military Polytechnic Academy’ (ACAPOMIL), which runs five-year full-time courses equivalent to University engineering courses. These start with a grounding in basic engineering subjects common to all the engineering courses, then starting to specialize; one of these specializations is titled ‘Information and Communications Technological Systems’, within which the options for final specialization includes ‘Geography’. Those who complete the course including the geography specialization graduate as Military Polytechnic Engineers with skills in surveying, geography, cartography, remote-sensing, geo-informatics and allied disciplines in the geo-sciences.

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5: THE PRIVATE SECTOR

5.1 The Private Sector: Overview

Cartography as a business and trade continues to evolve in the private sector as outlined in previous reports. An article in “GIM International” describing the mapping of volume changes for a mining operation, gives an idea of the level of expertise applied by surveyors in the private sector.

Inclusion in this listing is intended only as reference information and does not constitute an endorsement or recommendation of those organisations. As follows, two lists of those private organizations known to the National Committee (there may be others).

5.2. Cartographic Services

The following list is of those firms mainly focused on providing, to specific clients, technical services involving cartography and related geosciences, in a few cases also publishing materials intended for the general public.

<table>
<thead>
<tr>
<th>Address</th>
<th>Telephone</th>
<th>E-mail</th>
<th>Web site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Research</strong> (Asesorias Alicia Norambuena Belloni y Compania Ltda.)</td>
<td>(56)-2-26651730 Fax: (56)-2-26659201</td>
<td><a href="mailto:empresa@dataresearch.cl">empresa@dataresearch.cl</a></td>
<td><a href="http://www.dataresearch.cl">www.dataresearch.cl</a></td>
</tr>
<tr>
<td><strong>Digimapas Chile Ltda.</strong></td>
<td>(56) – 2 - 26657811, (56) – 2 - 23359041</td>
<td><a href="mailto:info@digimapas.cl">info@digimapas.cl</a></td>
<td><a href="http://www.digimapas.cl">www.digimapas.cl</a></td>
</tr>
<tr>
<td><strong>Eagle Mapping Sudamerica S.A.</strong></td>
<td>(56) - 2-23436726</td>
<td><a href="mailto:ems@eaglemapping.cl">ems@eaglemapping.cl</a></td>
<td><a href="http://www.eaglemapping.cl">www.eaglemapping.cl</a></td>
</tr>
<tr>
<td><strong>ESRI Chile S.A.</strong></td>
<td>(56) - 2-24819000 Fax: (56)-2-24819099</td>
<td><a href="mailto:info@esri.cl">info@esri.cl</a></td>
<td><a href="http://www.esri-chile.com">www.esri-chile.com</a></td>
</tr>
<tr>
<td><strong>Fotogrametría – Blanco Garda Sergio</strong></td>
<td>(56) 9 9888 4963</td>
<td><a href="mailto:sergioblanco@fotogrametria.cl">sergioblanco@fotogrametria.cl</a></td>
<td><a href="http://www.fotogrametria.cl">www.fotogrametria.cl</a></td>
</tr>
<tr>
<td><strong>Fotosig</strong></td>
<td>(56)–2– 696 56 78 (56)–2– 698 00 44</td>
<td><a href="mailto:fotosig@adsl.tie.cl">fotosig@adsl.tie.cl</a> <a href="mailto:fotosig@gmail.com">fotosig@gmail.com</a></td>
<td><a href="http://www.fotosig.cl">www.fotosig.cl</a></td>
</tr>
<tr>
<td><strong>Geocen</strong></td>
<td>(56)-2-22946 0703 (56)-2-22946 0727</td>
<td><a href="mailto:infor@geocen.cl">infor@geocen.cl</a></td>
<td><a href="http://www.geocen.cl">www.geocen.cl</a></td>
</tr>
<tr>
<td><strong>Geocom</strong></td>
<td>(56) - 2 - 24803600</td>
<td><a href="mailto:ventas@geocom.cl">ventas@geocom.cl</a>; <a href="mailto:serviciotecnico@geocom.cl">serviciotecnico@geocom.cl</a>; <a href="mailto:soporte@geocom.cl">soporte@geocom.cl</a></td>
<td><a href="http://www.geocom.cl">www.geocom.cl</a></td>
</tr>
<tr>
<td><strong>Geogestión Ltda.</strong></td>
<td>56 2) 2848 8711 - Form on web site</td>
<td><a href="http://www.geogestion.cl/">www.geogestion.cl/</a></td>
<td></td>
</tr>
<tr>
<td><strong>Geoinfo</strong></td>
<td>(56) – 2 -24317900 Fax: (56)-2-24317910</td>
<td><a href="mailto:geoinfo@geoinfo.cl">geoinfo@geoinfo.cl</a></td>
<td><a href="http://www.geoinfo.cl">www.geoinfo.cl</a></td>
</tr>
<tr>
<td><strong>Geoingeniería Digital</strong></td>
<td>(56) – 2 – 23785269</td>
<td><a href="mailto:geoing@vtr.net">geoing@vtr.net</a></td>
<td><a href="http://www.geoingenieriadigital.cl">www.geoingenieriadigital.cl</a></td>
</tr>
</tbody>
</table>

### 5.3 Publications for the general public

These firms focus on maps and atlases intended for the tourism and road travel markets:

<table>
<thead>
<tr>
<th>Address</th>
<th>Telephone</th>
<th>E-mail</th>
<th>Web site</th>
</tr>
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<tbody>
<tr>
<td>Chiletur Copec</td>
<td>(56) – 2 – 26907000</td>
<td>Form on web site</td>
<td><a href="http://ww2.copec.cl/chiletur/">http://ww2.copec.cl/chiletur/</a></td>
</tr>
<tr>
<td>Editorial Compass</td>
<td></td>
<td></td>
<td>//mapascompass.cl/</td>
</tr>
<tr>
<td>TrekkingChile</td>
<td>(56)-71-1970096 /</td>
<td><a href="mailto:casachueca@trekkingchile.com">casachueca@trekkingchile.com</a>;</td>
<td><a href="http://www.trekkingchile.com">www.trekkingchile.com</a></td>
</tr>
<tr>
<td></td>
<td>(56)-71-1970097</td>
<td>turismocaminante@trekkingchile.</td>
<td>com</td>
</tr>
<tr>
<td>Tourmaps – Mapas Turísticos</td>
<td></td>
<td></td>
<td><a href="http://www.tourmaps.cl">www.tourmaps.cl</a></td>
</tr>
</tbody>
</table>
6. ACKNOWLEDGEMENTS AND ACRONYMS

6.1. Acknowledgements

The National Committee of the ICA in Chile gives special thanks for the assistance received in the preparation of this report. Special thanks are due to the Military Geographic Institute of Chile for the coordination, drafting and delivery of this report, together with contributions of information from members of staff. The other institutions which contributed information for this report are:

- SERVICIO HIDROGRÁFICO Y OCEANOGRÁFICO DE LA ARMADA – SHOA
- CENTRO DE INFORMACIÓN DE RECURSOS NATURALES - CIREN
- SERVICIO NACIONAL DE GEOLOGIA Y MINERIA - SERNAGEOMIN
- UNIVERSIDAD TECNOLOGICA METROPOLITANA – UTEM
- CENTRO GEOMATICA – CENEGEO (TALCA UNIVERSITY)

6.2 List of Acronyms Used

6.1.1. Spanish language acronyms

- CECAT – Centro de Cartografía Tactil
- CENEGEO - Centro Tecnológico de Geomática
- CIREN - Centro de Información de Recursos Naturales
- CONAF – Corporación Nacional Forestal
- DIFROL – Departamento de Fronteras y Límites
- IGM – Instituto Geográfico Militar
- INE - Instituto Nacional de Estadística
- IPGH – Instituto Panamericano de Geografía e Historia
- MOP - Ministerio de Obras Públicas
- PUC - Pontificia Universidad Católica de Chile
- PUCV - Pontificia Universidad Católica de Valparaíso
- RGN – Red Geodésico Nacional
- SAF - Servicio Aerofotogramétrico de la Fuerza Aérea
- SERNAGEOMIN - Servicio Nacional de Geología y Minería
- SHOA - Servicio Hidrográfico y Oceanográfico de la Armada
- SIIE - Sistema Integrado de Información para Emergencias
- SNIT - Sistema Nacional de Información Territorial
- SOCHIGEO - Chilean Society for Geographic Sciences
- USACH - Universidad de Santiago de Chile
- UTEM - Universidad Tecnológica Metropolitana

6.1.2 English language acronyms

- GSDI - Global Spatial Data Infrastructure
- ICC – International Cartographic Conference
- IMY – International Map Year
- ISPRS – International Society for Photogrammetry and Remote Sensing
- LARS - Latin American Remote Sensing
- PAIGH - Pan-American Institute for Geography and History
- TIGO - Transportable Integrated Geodesic Observatory
Annex 1.: List of SERNAGEOMIN Maps

2011

1. Geology of Calbuco Volcano, Tenth “Los Lagos” Region. Scale 1:50,000. Authors: Sellés, D.; Moreno, H. Map series: Basic Geology n.130

2. Volcanic hazards of Chile. Scale 1:2,000,000. Authors: Lara, L.E.; Orozco, G.; Amigo, A.; Silva, C. Map series: Environmental Geology n.13.


5. Geology of Lascar Volcano, Second “Antofagasta” Region. Scale 1:50,000. Authors: Gardeweg, M.C.; Amigo, A.; Matthews, S.J.; Sparks, R.S.J., Clavero, J. Map series: Basic Geology n.131.

6. Geology of the eastern area of the Puerto Cisnes map sheet, Eleventh “Aysén” Region. Scale 1:250,000. Authors: De la Cruz, R.; Cortés, J. Map series: Geological Map of Chile, Basic Geology No. 127.


11. Preliminary assessment of geological hazards in the Tirúa area, Eighth “BioBío” Region. Scale 1:10,000. Authors: Jara, C.; Moreno, H.; Marín, M. Map of hazard from tsunami flooding.

12. Preliminary assessment of geological hazards in the Tirúa area, Eighth “BioBío” Region. Scale 1:10,000. Authors: Jara, C.; Moreno, H.; Marín, M. Map of hazards from flooding by overflowing watercourses and ground saturation.

13. Preliminary assessment of geological hazards: Punta Laviapië bay area, Eighth “BioBío” Region. Scale 1:10,000. Authors: Marín, M.; Ortiz, M. Map 8-1: Hazards from removals of large volumes, geology for rebuilding and hazard management - Volume 2.


20. Preliminary assessment of geological hazards: Town of Penco area, Eighth “BioBío” Region, Scale 1:10,000. Authors: Ramírez, P.; Falcón, M.F.; Marín, M.; Crexell, C. Map 10-2: Hazard from tsunami flooding, geology for rebuilding and hazard management. Volume 2

21. Preliminary assessment of geological hazards: Cocholgú bays area, Eighth “BioBío” Region, Scale 1:10,000. Authors: Fernández, J.; Falcón, M.F.; Venegas, C.; Arenas, M. – Key words clave: seismicity, geological hazard and danger, prevention of hazards, disasters, geological assistance, Cocholgú, Biobío hazards from removals of large volumes.

22. Preliminary assessment of geological hazards: Cocholgú bays area, Eighth “BioBío” Region.. Scale 1:10,000. Authors: Falcón, M.F.; Marín, M. Map of hazards from flooding by overflowing watercourses and ground saturation. Key Words: Cocholgue, flooding, seismicity, geological hazard and danger, prevention, disasters, geological assistance, Biobío, hazard from tsunami flooding.


52. Potassium, Thorium and Uranium gamma ray spectrometry for the map of Chaca, Fifteenth “Arica & Parinacota” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 44, 3 Maps.


56. Geology of the Caritzalillo-El Tofo area, Third “Arica” and Fourth “Coquimbo” Regions. Scale 1:100,000. Authors: Creixell, C.; Ortiz, M.; Arevalo, C. Geological Map of Chile, Map series: Basic Geology nos. 133 and 134.

57. Geology of the Wheelwright lake and San Francisco pass areas, Third “Arica’’ Region. Scale 1:100,000. Authors: Clavero, J.; Mpodozis, C.; Gardeweg, M.; Valenzuela, M. Geological Map of Chile, Map series: Basic Geology 139-140.


60. Dense, large-scale seismic zoning of the city of San Pedro, Eighth Biobío Region. Scale 1:20,000. Authors: Ramírez, P.; Vivallos, J.; Cáceres, D.; Forseca, A. Geological Map of Chile, Map series: Environmental Geology 16.3 maps.


67. Geological map of Iquique, Third “Tarapacá” Region. Scale 1:100,000. Authors: Sepúlveda, F.; Vásquez, P. Special Report coded as IR-12-50.

68. Geological map of Mamiña, Third “Tarapacá” Region. Scale 1:100,000. Authors: Blanco, N.; Ladino, M.; Tomlinson, A. Special Report coded as IR-12-50.

69. Geological map of Paltllos, Third “Tarapacá” Region. Scale 1:100,000. Authors: Vásquez, P.; Sepúlveda, F. Special Report coded as IR-12-50.

70. Geological map of Pozo Almonte, Third “Tarapacá” Region. Scale 1:100,000. Authors: Vásquez, P.; Sepúlveda, F. Special Report coded as IR-12-50.

71. Geological map of Oficina Victoria, Third “Tarapacá” Region. Scale 1:100,000. Authors: Sepúlveda, F.; Vásquez, P.; Quezada, A. Special Report coded as IR-12-50.


78. Map of Cerro Químal, Second “Antofagasta” Region. Scale 1:100,000. Authors: Bassó, M.; Mpodozis, C. Geological Map of Chile, Map series: Basic Geology 143.

2013


92. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Surire, Fifteenth “Arica and Parinacota” Region. Scale 1:100,000. Authors: Vivallós, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 48, 3 maps.


94. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Camiña, First “Tarapacá” Region. Scale 1:100,000. Authors: Vivallós, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 50, 3 maps.


96. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Pisagua, First “Tarapacá” Region. Scale 1:100,000. Authors: Vivallós, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 54, 3 maps.


98. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Zapiga, First “Tarapacá” Region. Scale 1:100,000. Authors: Vivallós, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 56, 3 maps.

100. Spectrometry of gamma rays for potassium, thorium and uranium for the map of Guaymilla, First “Tarapacá” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 52, 3 maps.


103. Potassium, Thorium and Uranium gamma ray spectrometry for the map of Chacritas, First “Tarapacá” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 60, 3 maps.


105. Magnetometry of the Vallena-Domeyko area, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 63.


111. Geology of the ‘Salar de Aguila’ and ‘Portezuelo del León Muerto’ areas, Third “Atacama” Region. Scale 1:100,000. Authors: Narango, J.A.; Villa, V.; Venegas, C. Geological Map of Chile, Map series: Basic Geology 151-152.


113. Maps of Iquique and Pozo Almonte, Third “Tarapacá” Region. Scale 1:100,000

114. PDF. Map - Authors: Vásquez, P.; Sepúlveda, F.A. Geological Map of Chile, Map series: Basic Geology 162-163.

115. Map of El Salvador, Antofagasta Region. Scale 1:100,000., in PDF. Authors: Cornejo, P.; Matthews, S.; Moodoiz, C.; Rivero, O.; Riquelme, R. Geological Map of Chile, Map series: Basic Geology 158.


117. Geology of the ‘El Tránsito-Lagunillas’ area, Third “Atacama” Region. Scale 1:100,000. Authors: Salazar, E.; Coloma, F.; Creixell, C. Geological Map of Chile, Map series: Basic Geology 149.


119. Geology of the Cerro Lila-Peine area, Second “Antofagasta” region. Scale 1:100,000. Authors: Niemeyer, H. Geological Map of Chile, Map series: Basic Geology 147.

120. Magnetic Map (cm, mtp y rts) of ‘Los Vientos’ area, Second “Antofagasta” Region. Scale 1:100,000. Author: SERNAGEOMIN.

121. Spectrometry map of gamma rays and of ternary elements (K, Th y U) for ‘Sierra de Varas’ area, Second “Antofagasta” Region. Scale 1:100,000. Author: SERNAGEOMIN.

122. Spectrometry map of gamma rays and of ternary elements (K, Th y U) for ‘Punta Possalaves’ and ‘Vicuña Mackenna’ ridge areas, Second “Antofagasta” Region. Scale 1:100,000. Author: SERNAGEOMIN.

123. Spectrometry map of gamma rays and of ternary elements (K, Th y U) for ‘Los Vientos’ area, Second “Antofagasta” Region. Scale 1:100,000. Author: SERNAGEOMIN.


127. Map of Aguas Blancas area, Second “Antofagasta” Region. Scale 1:100,000. Authors: Ferrando, R; Espinoza, F; Matthews, S; Cornejo, P; Arriagada, C. Geological Map of Chile, Map series: Basic Geology 160.

129. Spectrometry of gamma rays for potassium, thorium and uranium of the map of “Isla Blanca” Island and Talata, Second “Antofagasta” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 75-76, 3 maps.

130. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Caldera, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 102, 3 maps.

131. Spectrometry of gamma rays for potassium, thorium and uranium of the map of the “Antofagasta” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 106, 3 maps.

132. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Catalina, Second “Antofagasta” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 78, 3 maps.

133. Spectrometry of gamma rays for potassium, thorium and uranium of the map of the “Cerro del Pingo” (Pingo hill), Second “Antofagasta” and Third “Atacama” Regions. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 94, 3 maps.

134. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Chañaral, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 90, 3 maps.

135. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Cifuncho, Second “Antofagasta” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 82, 3 maps.

136. Spectrometry of gamma rays for potassium, thorium and uranium of the map of Copiapó, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 104, 3 maps.

137. Spectrometry of gamma rays for potassium, thorium and uranium of the map of “Diego de Almagro”, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 92, 3 maps.


139. Spectrometry of gamma rays for potassium, thorium and uranium of the map of the “Exploradora” area, Second “Antofagasta” and Third “Atacama” Regions. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 88, 3 maps.

140. Spectrometry of gamma rays for potassium, thorium and uranium of the “Inca de Oro” area, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 100, 3 maps.

141. Spectrometry of gamma rays for potassium, thorium and uranium of the map of “Los Loros” area, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 112, 3 maps.

142. Spectrometry of gamma rays for potassium, thorium, and uranium of the map of “Puerto Flamenco” area, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 96, 3 maps.

143. Spectrometry of gamma rays for potassium, thorium, and uranium in the “Quebrada Salltrosa” area map, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 98, 3 maps.

144. Gamma spectrometry for potassium, thorium, and uranium of the “Castilla” and “Totoral Bajo” areas, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 109-110, 3 maps.

145. Gamma ray spectrometry for potassium, thorium, and uranium of the “Sierra Vaquillas Altas” area map, Second “Antofagasta” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 80, 3 maps.

146. Magnetic Map of “Punta Posalaves” and “Sierra Vicuña Mackenna” areas, Second “Antofagasta” Region. Scale 1:100,000. Author: SERNAGEOMIN. Magnetic map (cmt, rtp y rte).
156. Magnetic Map of Chañaral, Third “Atacama” Region. Scale 1:100,000. Authors: Vivallos, J.; Donoso, C. Geological Map of Chile, Map series: Geophysics 89.
169. Geology of the Isluga and Hualla range areas, First “Tarapacá” Region. Scale 1:100,000. Authors: Cortés, J.; Cascante, M.; Zavala, V. Geological Map of Chile, Map series: Basic Geology 172-173.
174. Hazards at Sollipulli Volcano, Ninth “Araucanía” Region. Scale 1:50,000. Authors: Jara, C.; Moreno, H. Geological Map of Chile, Map series: Environmental Geology 18.


185. Geochemistry of sediments of the Pisagua map sheet, Fifteenth & First Regions of Chile. Scale 1:250,000. Interactive map and text in PDF. Authors: Astudillo, F.; Lacassie, J.P.; Baeza, L.; Barrera, J.; Carrasco, F.; Castillo, P.; Espinoza, F.; Figueroa, M.; Miralles, C.; Muñoz, N.; Ramírez, C.; Salinas, P. Map series: Geochemistry No. 2

186. Geochemistry of sediments of the Arica map sheet, Fifteenth Region of Chile. Scale 1:250,000. Interactive map and text in PDF. Authors: Baeza, L.; Lacassie, J.P.; Astudillo, F.; Barrera, J.; Carrasco, F.; Castillo, P.; Espinoza, F.; Figueroa, M.; Miralles, C.; Muñoz, N.; Ramírez, C.; Salinas, P. Map series: Geochemistry No. 3
Annex 2.: Report from the “CENTRO DE GEOMÁTICA” (geomatics centre) of the University of Talca

Annex 2.1 Digital Databases Created by CENGE

APINOVA Database:
The GIS “APINOVA” database has been created on the basis of the project in the Maule Region of Chile titled “Design of a Digital Apibotanic Cartography for the Development of Organic Apiculture in the Maule Region (2013-2016)”. The digital layers in raster and vector formats of cover the base cartography (roads, water courses, bodies of water, settlements, urban zones), vegetation (CONAF Woodland survey, vegetation valued for its importance to apiculture, CIREN fruit cultivation survey, cultivation at genetically modified seedbeds), apiculture zones (beehives and apibotanic agricultural ground), satellite images (Landsat 8, Quickbird) and Digital Elevation Digital (SRTM 1arcsec). The work scale established is 1:20,000.

The project is for setting up a Digital Apibotanic cartography (web mapping), intended for de development of organic beekeeping in 19 boroughs of the Maule Region. The areas with potential for organic beekeeping are identified, moreover with a model for predicting the flowering of six forest species important for apiculture being designed. With these, organic beekeeping production can be managed in accordance with the relevant European Union regulations. The web site provides an online querying service in real time to beekeeping specialists concerning production zoning (apibotanic maps), with simulation of the state of the six species of interest.

GEOARANDANOS Database:
The GIS “GEOARANDANOS” database was created on the basis of the project in the Maule Region titled “Creation and application of tools for decision-making, based on digital aids, enabling improvements to the current competitiveness of blueberries in the Maule Region(2011-2014)”. This contains raster and vector layers of the variables of the base map (roads, watercourses, bodies of water, settlements, urban zones), environment (average temperatures and precipitation, soils), production (orchards, packing and cold storage), satellite images (Landsat 7, WorldView2) and DEM (SRTM 3arcsec). The working scale was set at 1:10,000.

The project involves creating and applying tools for decision-making on the basis of digital aids that enable blueberry production in the Maule Region to be improved by integrating eco-physiology, agronomy and technologies involving geomatics. The project involved gathering and putting into a systematic order the base information, choosing the source of satellite information, creating spatial and thematic information, and setting up a GIS.

VINEYARDS OF MAULE Database:
The “VINEYARDS OF MAULE” (vineyards of the Maule region) GIS database was set up on the basis of a project for digital Cartography of vineyards in the Maule Region carried out in 2009-2011. This contains raster and vector layers of the variables of the base map (roads, watercourses, bodies of water, settlements), production (wine-producing areas, vineyards, and wine storage facilities) satellite images (Landsat 7, Spot 5, MODIS, SPOTMAP) and DEM (SRTM 3arcsec) and satellite products (NDVI, combining infrared and false colour). The working scale was set at 1:20,000. A digital application was developed using mainly a database including all the wine producers of the region, with information obtained from satellite images and surveys carried in the field of the producers. A web mapping platform was set up, providing a detailed and current view of the surface, variety and condition of the various producing zones in the Maule Region.

Annex 2.2: Training activities performed by CENGE at the Univ. of Talca

Training workshops for wine producers (2011-2012)

The training workshops were held at the CENGE laboratories where the wine producers got to know the basic techniques for using the Viewer giving access to vineyard survey of the Maule region (http://www.cartografialdelvino.de.utaclla.cl/). This viewer is user-friendly, allowing any producer linked to the Internet to manage his land without needing complex programmes for handling spatial information. The data used is suitably geo-referenced, allowing it to be sued with a high level of precision.

Seminars held by the Geomatics Centre

- “Territorial Information Systems; geo-information for the development of Chile”: in conjunction with CIREN, 2012.
- International seminar “Geomatics Technologies Applied to Vineyards and Wine-growing”, Agrarian Innovation Foundation (FIA), Regional Government in “Maule” (GORE) and CENGEN of Talca University, 2011.